Appendix F
Remedy-produced Water Management Technical Memorandum

Management of Water Produced from Operation and Maintenance of Groundwater Remedy, PG&E Topock Compressor Station, Needles, California

TO: Pacific Gas and Electric Company

FROM: CH2M HILL

DATE: August 15, 2011 (Draft); November 18, 2011 (Rev. 0, Preliminary [30%] Design); April 5, 2013 (Rev. 1, Intermediate [60%] Design); September 8, 2014 (Rev. 2, Pre-Final [90%] Design)

This technical memorandum summarizes the plan for managing water produced during the operation and maintenance (O&M) of the Topock groundwater remedy (referred to herein as "remedy-produced water") at the Pacific Gas and Electric Company (PG&E) Topock Compressor Station (TCS) in Needles, California. This water primarily consists of water generated from maintenance activities of remediation wells such as backwashing and rehabilitation. Other types of water generated from remedy O&M (smaller volume) will also need to be managed such as monitoring well sampling purge water, equipment decontamination wastewater, and rainfall that collects in secondary containment areas of remedy facilities. For clarity, remedy-produced water does not include freshwater extracted from the ground. The remedy is reliant on the dozens of wells used for the in-situ reactive zone (IRZ), freshwater and carbon-amended injection, and groundwater extraction. For all wells, especially for the injection and IRZ wells, regular maintenance is vital to keep efficient and effective operations during the 30-year projected life of the remedy. Well maintenance will also prevent or reduce the need for drilling new replacement wells. The management strategy for remedy-produced water must be sensible and flexible to meet the needs of the system and the regulatory requirements, be cost-effective, and must not constrain remedy operations.

This memorandum discusses the evaluation of remedy-produced water management options, the preferred management plan, and the design basis/design criteria. The design basis covers three parts of the management system: transport, conditioning, and reuse/disposal. The approach described herein is for the operation phase of the final remedy. It is assumed that water produced during remedy construction will be managed at the Interim Measure Number 3 (IM-3) treatment system or by trucking off-site, or by the remedy-produced water management system (if it is available). This assumption will be revisited throughout the design and construction process.

The information presented here has been developed from PG&E's experience maintaining the IM-3 injection wells and operation of the IRZ system at the Hinkley site. This experience includes both routine well cleaning and backwashing and rehabilitation work. Since the submittal of the preliminary (30%) Basis of Design (BOD) report in November 2011, the Hinkley testing of backwashing frequency was completed in June 2012 and the IM-3 injection wells underwent a mechanical rehabilitation event in May 2012 using Aqua Gard™. The information gained from these operations has been incorporated into this pre-final design and Section 4 (Well Maintenance and Decommissioning) of the Operations and Maintenance Plan (Volume 1 of the O&M Manual which is included as Appendix L of this 90% BOD report). The design and the well maintenance procedures will be updated as additional operational data become available.

This memorandum was originally transmitted to the California Department of Toxic Substances Control (DTSC) and the U.S. Department of the Interior (DOI) on August 15, 2011. DTSC and DOI comments on the original memorandum were incorporated, and an updated memorandum was included in the Draft BOD Report/Preliminary (30%) Design along with responses to agencies' comments. Comments were received on the updated memorandum from DOI, DTSC, and the Hualapai Indian Tribe; responses to those comments were provided in Appendix I of the 60% BOD report.

Transport

Within the project area, water generated from well maintenance activities can be either trucked or conveyed via pipelines, or both. The preferred approach is to use both methods. Conveyance piping will be constructed to remediation wells requiring frequent maintenance such as the IRZ, carbon amendment, and freshwater injection wells. For wells requiring less frequent maintenance such as extraction and monitoring wells, trucking is the preferred option for conveying the remedy-produced water. Trucking is also the preferred option for wells where installing pipelines would be difficult.

The advantages of piping over trucking are that piping has a lower visual impact, lower safety risk during operation, lower risk of spills, lower carbon dioxide emissions, and will require less cleared space at the wellhead for maintenance activities. Using piping to convey remedy-produced water also allows automation of the backwashing for the injection and IRZ wells. This would entail installing dedicated backwashing pumps, valves, and controls, to enable the backwashing to occur on a regular schedule (all equipment can be installed in the well vault to reduce visual impacts). The backwashing sequencing would be planned such that one (or more) well is being backwashed at a time to optimize the system hydraulics. Automated backwashing could be done on a cyclic basis with 3 on-off cycles of 10 minutes on and 5 minutes off for a total of 30 minutes of pumping time. The duration and number of on-off cycles will be further evaluated during the design and refined during operation. Automated backwashing offers several benefits, including reducing the number of vehicles and crews traveling across the site and minimizing disturbance as well as the visual impacts from operations.

The piping for remedy-produced water may also serve as a backup for the main pipes carrying water to or from the wells. For example, if a pipe carrying freshwater to a freshwater injection well became unusable, the remedy-produced water pipe (after appropriate flushing) can be used to carry freshwater while the primary pipe is repaired. Having this backup minimizes such unplanned downtime.

Figure F-1 shows a layout of the remedy-produced water conveyance piping network. Piping will primarily be installed underground, but may also be installed aboveground in certain locations. To minimize disturbance from construction, all piping will be installed in common trenches, to the extent practicable, with other pipes and utilities serving the wells. The design basis and criteria for remedy-produced water piping are described in Section 3.4 (Remedy-produced Water Management) and Appendix C (Design Criteria) of the Basis of Design Report.

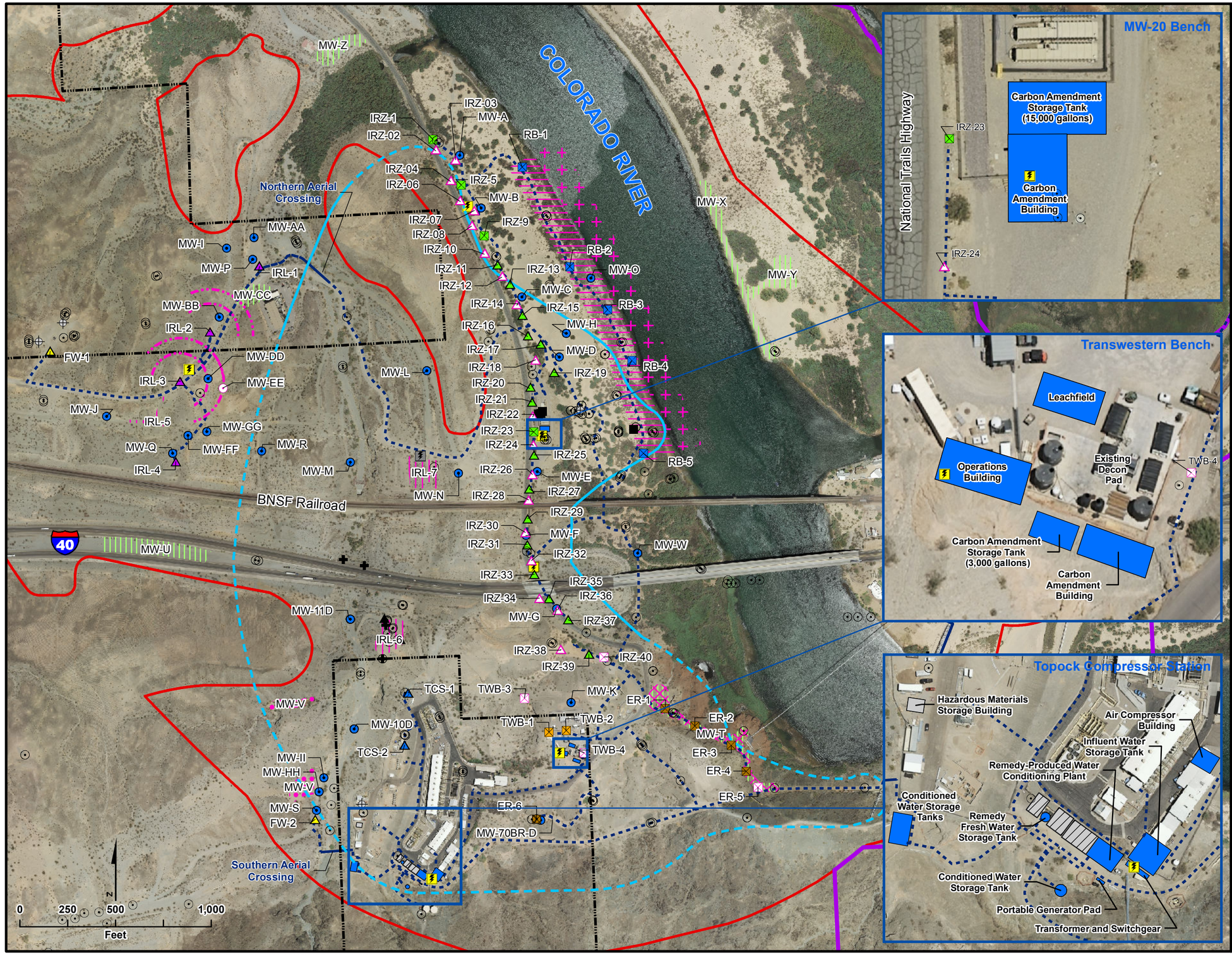
Remedy-produced Water Conditioning and Reuse/Disposal

The remedy-produced water conditioning aspect is divided into the three components that are used to evaluate and design the system: quantity of remedy-produced water, quality of remedy-produced water, and the degree of conditioning required.

Estimate of Remedy-produced Water Quantity

The initial quantity of remedy-produced water was estimated to range from 3 to 16 million gallons (MG) per year in the revised Corrective Measures Implementation/Remedial Design Work Plan (CH2M HILL 2011), and was refined to 7.3 MG per year in the 30% design. Subsequent evaluation/modeling has resulted in further design refinement, and the current estimate is approximately 7.6 MG per year, as shown in Table F-1. Backwash operation continues to be the largest contributor to the annual volume, with over 61 percent of the total amount, with rehabilitation operation as the second largest contributor at 2.56 MG per year, or about 34 percent. The remaining remedy-produced water (< 5 percent) includes rainwater that falls within remedy facility containment and monitoring well purge and sampling equipment decontamination water.

These estimates will be further refined through the design and the operational experience to be gained from injection wells at both PG&E's Hinkley and Topock sites. A variable that will have a significant impact on the volumes produced is the frequency of backwash events. Backwashes will be more frequent than rehabilitations, and will result in a large cumulative volume of remedy-produced water. But the backwashing process requires less



LEGEND

- Property Boundaries
- Area of Potential Effects (APE)
- EIR Project Area

Existing Wells:

- Extraction Well
- Injection Well
- Monitoring Well
- Water Supply Well

Provisional Wells:

(Items in Pink are Provisional)

- Extraction Well
- Injection Well
- Monitoring Well (MW-EE is a pending/future provisional monitoring well)
- Arc for IRL-2 and IRL-3 Arsenic Monitoring Wells [3]
- Area for East Ravine (ER) Wells (ER-7 to ER-11 and MW-T)
- Area for Potential Slant Well Screens
- Area for Inner Recirculation Loop (IRL) Wells
- Area for River Bank Extraction Wells (RB-6 to RB-9)
- Area for Monitoring Well (MW-V)

Planned Wells:

- Extraction, East Ravine
- Extraction, National Trails Highway (NTH) In-situ Reactive Zone (IRZ)
- Extraction, Riverbank
- Extraction, Transwestern Bench
- Injection, Freshwater
- Injection, Inner Recirculation Loop
- Injection, NTH IRZ
- Injection, Topock Compressor Station
- Remedy Monitoring Well
- Recirculation Well
- Area for Monitoring Well (Applies to MW-CC, MW-T, MW-U, MW-X, MW-Y, and MW-Z)

Pipeline Corridor for Remedy

- Aboveground Pipe
- Underground Pipe/Conduit

Remedy Facilities

- Planned Transformer
- Future Provisional Transformer
- Proposed Remedy Structure
- Contingent Freshwater Pre-injection Treatment System
- Approximate extent of hexavalent chromium [Cr(VI)] concentrations exceeding 32 micrograms per liter (µg/L) at any depth ingroundwater based on fourth quarter 2013 sampling events. Dashed where based on limited data.

Note:

1. Note that in compliance with EIR mitigation measure CUL-1a-9, as well as PA and CHPMP mitigation measures, the pipeline along the dirt road west of National Trails Hwy is located in an existing, previously disturbed, access road. In addition, the location of the road and pipeline was field verified and does not create any direct physical impact or effect on the Topock Maze, as it is manifested archaeologically, in compliance with EIR mitigation measure CUL-1a-10, PA, and CHPMP mitigation measures.
2. All well and structure locations are approximate.
3. Arcs for IRL-2 and IRL-3 arsenic monitoring wells represent a range of potential well locations. Portions of the arcs are not suitable for well installation due to technical and/or cultural resources constraints.

FIGURE F-1
GENERAL REMEDY SYSTEM LAYOUT - CALIFORNIA

REMEDY-PRODUCED WATER MANAGEMENT
TECHNICAL MEMORANDUM
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL

Path: \\Zinfandel\proj\PacificGasElectricCo\TopockProgram\GIS\MapFiles\2014\CMS\FIGF1_90pct_CAdetails.mxd

TABLE F-1

Current Estimate of Remedy-produced Water Quantity During Groundwater Remedy Implementation

Management of Water Produced from Operation and Maintenance of Groundwater Remedy
PG&E Topock Compressor Station, Needles, California

Source	Proposed Well Count	Events/ Year/ Well	Average Volume/ Event/ Well (gal)	Annual Volume (MG)	Anticipated Quality of Remedy-produced Water [a]
Backwash [b]					
Freshwater Injection Wells	2	51	9,000	0.92	Similar to water from Arizona aquifer, plus sediment
Inner Recirculation Loop (IRL) Injection Wells – receiving fresh water and/or water from river bank extraction wells	4	51	13,500	2.8	The wells receiving fresh water will have water quality similar to water from the Arizona aquifer, plus sediment and rehabilitation chemicals. The wells receiving river bank well water will have water quality similar to water from the riverbank extraction wells, plus sediment, IRZ byproducts[c], and rehabilitation chemicals [g]
TCS Injection Wells	2	51	2,250	0.23	Similar to water from the East Ravine and extraction wells northeast of the TCS plus sediment and IRZ byproducts [c]
IRZ Injection Wells	24	30	1,000	0.72	Similar to water in the aquifer at well, plus sediment and IRZ byproducts [c]
Well Rehabilitation [f]					
Freshwater Injection Wells	2	1	175,000	0.35	Similar to water from the Arizona aquifer, plus sediment and rehabilitation chemicals [g]
IRL Injection Wells – receiving fresh water and/or water from river bank extraction wells	4	1	175,000	0.70 [e]	The wells receiving fresh water will have water quality similar to water from the Arizona aquifer, plus sediment and rehabilitation chemicals. The wells receiving river bank well water will have water quality similar to water from the riverbank extraction wells, plus sediment, IRZ byproducts[c], and rehabilitation chemicals [g]
TCS Injection Wells	2	1	36,000	0.07 [e]	Similar to water from the East Ravine and the extraction wells northeast of the TCS plus sediment and IRZ byproducts[c], and rehabilitation chemicals [g]
IRZ Injection and Extraction Wells	28	1 [d]	48,000	1.3	Similar to water from the aquifer at well, plus sediment, IRZ byproducts[c], and rehabilitation chemicals [g]
Extraction – Floodplain (Riverbank Extraction Wells)	5	0.2	75,000	0.08	Similar to water from the aquifer at well, plus sediment, IRZ byproducts[c], and rehabilitation chemicals [g]
Freshwater Supply Well (Extraction)	1	0.2	75,000	0.02	Similar to water from Arizona aquifer, plus sediment and rehabilitation chemicals [g]
Extraction – East Ravine/ Transwestern Bench	7	0.2	30,000	0.04	Similar to water from the aquifer at well, plus sediment, IRZ byproducts[c], and rehabilitation chemicals [g]

TABLE F-1

Current Estimate of Remedy-produced Water Quantity During Groundwater Remedy Implementation

Management of Water Produced from Operation and Maintenance of Groundwater Remedy
PG&E Topock Compressor Station, Needles, California

Source	Annual Volume (MG)	Anticipated Quality of Remedy-produced Water
Other Water		
Rainwater from containment areas	0.3	Anticipated to contain trace amounts of chemicals stored in remedy facility containment areas
Sampling well purge water and equipment decontamination	0.1	Similar to water from aquifer at wells; may include chromium, IRZ byproducts, hydrocarbons[c]
Wastewater from construction of wells in the future	Variable [h]	Similar to drilling water, water from aquifer at well, could contain residues from drilling such as hydrocarbons or organic carbon
Total	**7.6[d,e]**	

Notes:

gal = gallons; IRZ = In-situ Reactive Zone; MG = million gallons; TCS = Topock Compressor Station.

[a] Water removed from wells during well backwash and rehabilitations will be primarily the water in the surrounding aquifer. For injection wells, the water quality will essentially be determined by the injection source and other components as listed in this column.

[b] Volumes are calculated by assuming the backwash rate is twice the injection rate and backwashing will last for 30 minutes per event. Total volumes are calculated by using the aggregate injection flow for each well type or using the individually specified injection rates. Injection rates are calculated by dividing the total design flow for a well type by the number of wells of that type (based on Tables 3.2-1 through 3.2-3 and Table 3.3-1 in this BOD Report). For example, there are 4 IRL injection wells pumping 900 gpm resulting in an average of 225 gpm per well. The backwash rate is then 2 times 225 gpm or 450 gpm. The average design flow rate for freshwater injection wells is 150 gpm (300 gpm divided by two wells), and for the TCS injection wells it is 37.5 gpm. IRZ wells are assumed to be in service 6 months every 2 years, so 30 backwashes are assumed per well, but only IRZ injection wells will be backwashed. The aggregate IRZ injection flow rate is 400 gpm divided by 24 wells for an average of 16.7 gpm. The backwash flow rate will be twice that, or 33.3 gpm, which results in 1,000 gallons per backwash.

[c] IRZ byproducts = iron, arsenic, manganese, organic carbon.

[d] The Hinkley IRZ pilot test was completed and confirmed the selection of weekly backwashing frequency and annual rehabilitation.

[e] Well count is based on flow and fate and transport modeling (see Basis of Design Report). The number of wells could increase or decrease based on scenarios evaluated during the ongoing groundwater modeling efforts.

[f] Well rehabilitation volumes are estimated based on experience at Topock or other sites with similar wells. IRZ and injection wells are assumed to require annual rehabilitations, while extraction wells are assumed to need rehabilitation every 5 years.

[g] The potential well maintenance reagents include acids (some with dispersants) to dissolve mineral deposits and break up biofilms (muriatic acid, phosphoric acid, glycolic acid, etc.); oxidizing agents to disinfect and degrade microbial biofilms (hydrogen peroxide, chlorine); biocides to inhibit microbial growth (Tolcide®); carbon dioxide, and chelating agents to aid acid and disinfectant penetration, remove mineral deposits, and break down and disperse biofilms (e.g., citric acid).See Section 4 of Volume 1 of the O&M Manual for additional details on well maintenance.

[h] Future well construction will produce water roughly comparable to the volumes produced during a rehabilitation of that type of well. It is assumed that large well rehabilitations and development of new wells will not both need to be managed simultaneously by the remedy-produced water management system.

time and effort than rehabilitations, and can reduce the frequency of more labor-intensive and obtrusive well maintenance activities. The IM-3 injection wells have been backwashed about twice monthly or more frequently based on well performance since early 2008. Backwashing frequency has been based on the measured injection well performance to maintain injection well capacity. The current assumption is that backwashing will be performed weekly for 30 minutes at a rate of twice the injection rate. Injection rates were assumed to be the average of the type of well. For example, there are four inner recirculation loop (IRL) injection wells with a total flow of 900 gallons per minute (gpm). This is an average of 225 gpm per well injection rate, and at a rate of twice the injection rate gives a backwashing rate of 450 gpm for the injection wells. Pumping or backwashing at this rate for 30 minutes results in 13,500 gallons of remedy-produced water.

For rehabilitation, it is assumed that the injection and IRZ wells will undergo one rehabilitation event per year and the extraction wells will undergo one rehabilitation event every 5 years.[1] The estimated quantity of water produced from rehabilitation was derived from operational experience of injection wells associated with the interim measure at Topock and other sites. Since early 2008, the IM-3 injection wells have undergone rehabilitation every one to two years (mostly mechanical rehabilitation events with one chemical rehabilitation event in 2010). In May 2012, the IM-3 injection wells underwent a mechanical rehabilitation event in which carbon dioxide was injected into the wells (Aqua Gard™) to agitate and loosen any plugging material that may have precipitated in the filter pack and surrounding formation since the last rehabilitation event. Test results are currently being evaluated; if determined to be effective, this rehab technique could extend the period between backwash/rehab events, and could result in less produced water. This technique was approved in the IM-3 Injection Well O&M Plan (CH2M HILL 2006); the mechanical means to deliver carbon dioxide into the well have been incorporated into the fresh water injection well design.

Actual well maintenance requirements of the remediation wells at Topock will not be known until actual operation begins. An important performance metric, specific injectivity (height of water column during injection versus static water levels divided by the injection rate), will be used to gauge well performance.

As part of PG&E's chromium remediation using an IRZ at Hinkley, the optimization of backwashing frequency of IRZ wells was studied. Backwashing frequency was adjusted to learn the effects on well fouling rates and well performance, as measured by specific capacity. This evaluation was intended to determine whether the use of routine backwashing will extend the time period of satisfactory well performance before rehabilitating the well becomes necessary. Test results confirmed the weekly backwashing frequency presented in Table F-1.

Estimate of Remedy-produced Water Quality

Water quality varies depending upon whether the stream is from backwashing or rehabilitation, the type of well, and the water source, as indicated by the information shown in Table F-1. Another way to evaluate water quality is shown in Table F-2, which presents a summary of the constituents likely to be found in the waste streams of the various types of wells. Water quality will be used to determine the appropriate conditioning process and also match the waste streams with possible disposal/reuse options. In keeping with the objective to have a flexible approach to managing the remedy-produced water, it is helpful to discuss the cleaning activities in a broader way and the effects on water quality.

The backwash stream will contain sediment that either is carried in injected water or in aquifer materials drawn into the well during backwashing. This is a result of vigorous pumping and surging similar to what occurs during well development. High pumping rates can draw accumulated solids from inside the filter pack or aquifer material surrounding the filter pack to recover some of the well capacity. Dissolved constituents present in the aquifer around the remediation well or in the injected water stream could be found in the backwash stream. The backwash stream from the IRZ and IRL injection wells is anticipated to contain carbon and in-situ byproducts (iron, manganese, and arsenic).

[1] The IM-3 extraction wells underwent mechanical rehabilitation in March/April 2013, approximately 8 years after startup.

The rehabilitation streams can be thought of as having two distinct water quality characteristics – one at the beginning and the other at the end of the rehabilitation process. Based on experience with the chemical rehabilitation of injection wells at Topock in October-November 2010, the initial step used acid to lower the pH so that mineral deposits can be dissolved, and as a result, the first flush will be at very low pH (pH 2.0 – 3.0) and will contain high concentrations of solid ionic materials (e.g., part per million levels of total chromium, manganese, iron, and nickel) and rehabilitation chemicals. No hazardous waste (pH < 2.0) is expected to be generated. The next steps involve pumping and cleaning the well using mechanical methods such as swabbing and jetting. As remedy-produced water continues to be pumped from the well, the water quality becomes more similar to that of the aquifer water. Eventually, this water quality will be more similar to backwash water and can be managed in a similar manner.

TABLE F-2
Summary of Constituents Expected in Water Streams of Various Well Types
Management of Water Produced from Operation and Maintenance of Groundwater Remedy
PG&E Topock Compressor Station, Needles, California

Wells	Sediment	Chromium	Iron	Manganese	Arsenic	Organic Carbon	Acid	Other Rehabilitation Chemicals
Fresh water injection	B, R	-	-	-	-	-	R	R
Carbon-amended injection	B, R	?	B, R	B, R	B, R	B, R	R	R
In-situ reactive zone (IRZ)	B, R	?	B, R	B, R	B, R	B, R	R	R
Extraction - floodplain	B, R	B, R	B, R*	B, R*	B, R*	B, R*	R	R
Extraction - freshwater	B, R	B, R	-	-	B, R	-	R	R
Extraction - bedrock	B, R	B, R	B, R	?	B, R	-	R	R
Monitoring well purge	-	Some	Some	Some	Some	-	-	-

Notes:
B = Well backwash
R = Well rehabilitation
? = uncertain
* Initially but may decrease over the period of operation.

In October 2011, samples were collected from tanks used to haul IM-3 injection well backwash water. These samples were collected to characterize the backwash water and the results are shown on Table F-3.

A pilot test was conducted at Hinkley to evaluate backwashing frequency at the IRZ well SA-RW-19 and to characterize the quality of backwash water. Based on the results collected from June 2011 through June 2012, an initial backwashing frequency of once a week is planned for Topock. Operational data will be collected to evaluate this frequency and make adjustments, as discussed in Section 4 of Volume 1 of the Operations and Maintenance Manual. It is also anticipated that IRZ injection wells will also require mechanical and chemical rehabilitation, and for the purpose of this design, a frequency of once a year has been used. Table F-4 shows the analytical results of the backwash water samples collected from the wellhead during backwashing. One notable observation is that frequent backwashing appears to reduce the buildup of solids and organic carbon in the tested well. The solids are attributed to buildup of biomass, which uses the carbon for growth and absorbs particulate matter. It was observed that the biomass settles quickly in the settling tanks. The operation of the backwashing at Hinkley for development of a design basis at Topock is complete. However, backwashing at Hinkley is ongoing at IRZ well SA-RW-19 for remediation purposes.

TABLE F-3

IM-3 Injection Well Backwash Water Characterization – IW-2 and IW-3

Management of Water Produced from Operation and Maintenance of Groundwater Remedy
PG&E Topock Compressor Station, Needles, California

Analyte	Units [a]	Result [b]
Nitrate as N	mg/L	2.7
Sulfate	mg/L	490
Alkalinity	mg/L	32
Alkalinity, Bicarbonate (As $CaCO_3$)	mg/L	32-41
Alkalinity, Carbonate (As $CaCO_3$)	mg/L	<5
Alkalinity, Hydroxide (As $CaCO_3$)	mg/L	<5
Suspended Solids (Residue, Non-Filterable)	mg/L	<10 - 11
pH	pH Units	7.4 – 7.68
Antimony, dissolved	µg/L	<10
Barium, dissolved	µg/L	13 - 14
Beryllium, dissolved	µg/L	<1
Cadmium, dissolved	µg/L	<3
Calcium, dissolved	µg/L	140,000
Cobalt, dissolved	µg/L	<3
Copper, dissolved	µg/L	7.8 - 10
Iron, dissolved	µg/L	47 - 84
Lead, dissolved	µg/L	<10
Magnesium, dissolved	µg/L	29,000
Manganese, dissolved	µg/L	<10
Molybdenum, dissolved	µg/L	16
Nickel, dissolved	µg/L	<5
Silver, dissolved	µg/L	<3
Sodium, dissolved	µg/L	1,400,000-1,900,000
Vanadium, dissolved	µg/L	<3
Zinc, dissolved	µg/L	<10 – 110
Arsenic, dissolved	µg/L	0.16 - 0.31
Chromium, dissolved	µg/L	0.96 – 4.7
Selenium, dissolved	µg/L	3.2
Thallium, dissolved	µg/L	<2.5
Mercury, dissolved	µg/L	<0.2

Notes:

[a] µg/L = micrograms per liter; mg/L = milligrams per liter

[b] <n = less than the reporting limit value shown

TABLE F-4

Summary of Backwash Sample Analytical Results – Hinkley IRZ SA-RW-19

Management of Water Produced from Operation and Maintenance of Groundwater Remedy
PG&E Topock Compressor Station, Needles, California

Analyte	Sample Date (2011/2012)									
	6/29	7/12	7/19	7/26	8/2	8/9	8/18	9/1	11/22	4/4/12
Alkalinity Hydroxide, mg/L[a]	<5[b]	<5	<5	<5	-[c]	-	-	-	210	250
Alkalinity, Bicarb. as $CaCO_3$, mg/L	170	170	200	170	180	210	220	210	<5	<5
Alkalinity, Carb. as $CaCO_3$, mg/L	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Alkalinity, Total as $CaCO_3$, mg/L	170	170	200	170	180	210	220	210	210	250
Chloride, mg/L	39	37	38	37	-	-	-	-	1.6	1.8
Nitrate as Nitrogen, mg/L	<0.5	<0.05	<0.05	<0.05	-	-	-	-	2.7	7.1
Nitrite as Nitrogen, mg/L	<0.5	<0.05	<0.05	<0.05	-	-	-	-	74	80
Sulfate, mg/L	46	42	27	53	-	-	-	-	72	78
Orthophosphate, Dissolved, mg/L	<0.1	<0.02	<0.02	<0.02	-	-	-	-	---	---
Calcium, mg/L	51	44	46	43	45	55	62	67	9.4	0.65
Calcium (Dissolved), mg/L	50	50	50	52	44	54	64	65	24	17
Iron, mg/L	8.2	6.6	6.7	4.5	2.2	2.1	1.1	1.3	110	360
Iron (Dissolved), mg/L	3	1.6	0.97	1.5	0.03	0.026	0.041	0.17	23	34
Iron, 0.1µ Filter[d], Dissolved, mg/L	1.7	1.5	1	1.5	-	-	-	-	---	---
Magnesium, mg/L	9.3	9.6	10	8.6	9.2	11	11	11	0.11	0.16
Magnesium (Dissolved), mg/L	8.8	9.6	8.8	9.3	8.6	10	11	11	0.97	5.6
Sodium, mg/L	56	-	-	-	-	-	-	-	12	13
Sodium (Dissolved), mg/L	56	-	-	-	-	-	-	-	12	14
Arsenic, µg/L[e]	4.6	3.4	2.7	11	6	4.7	2.4	3.5	0.25	0.26
Arsenic (Dissolved), µg/L	1.9	1.6	0.57	0.98	1.9	1.6	1.6	1.8	0.24	0.72
Manganese, mg/L	1.1	1	0.82	2.3	1.5	1.1	0.33	0.5	---	---
Manganese (Dissolved), mg/L	0.47	0.46	0.66	0.3	0.062	0.13	0.11	0.22	---	---
Hexavalent Chromium, µg/L	-	-	-	-	-	-	47	36	---	---
Total Chromium (Recoverable), µg/L	130	130	130	490	220	160	88	120	8	7.6
Total Dissolved Chromium, µg/L	14	30	10	47	55	52	58	39	---	---
Total Dissolved Solids (TDS), mg/L	580	410	410	400	380	420	470	480	---	---
Total Suspended Solids (TSS), mg/L	540	210	130	510	56	120	24	44	---	---
pH, pH Units	-	-	-	-	7	7.3	7.2	7.2	500	540
Dissolved Organic Carbon, mg/L	100	130	120	200	15	16	3	1.1	53	26
Total Organic Carbon, mg/L	110	94	140	170	52	66	9.6	12	34	130

Notes:

[a] mg/L = milligrams per liter
[b] <n = less than the reporting limit value shown
[c] "-" = no sample collected
[d] 0.1 micron (µ)
[e] µg/L = micrograms per liter

Degree of Conditioning Required

The degree of conditioning needed is a function of how the remedy-produced water will be reused or disposed of, and the discharge requirements that are imposed. The options evaluated were as follows:

1. Trucking off-site
2. Discharge to TCS evaporation ponds
3. Reuse by blending with freshwater and use in TCS cooling towers
4. Reuse by blending with carbon-amended water and injection into the IRZ injection wells

Three options previously considered and subsequently eliminated from further consideration are blending conditioned produced water with freshwater for freshwater injection, discharge to ground surface, and use of designated well(s) for disposal. Blending conditioned produced water with freshwater for freshwater injection was eliminated because the water quality may not suitable for re-injection outside the plume or may cause operational (well fouling) issues.

Ground surface discharge was eliminated due to concerns over high visual impact, stakeholder and regulatory acceptance, and permitting challenges. The use of a designated well or wells for disposal of remedy-produced water, while technically viable, could negatively affect the number of wells available for use in the groundwater remediation and therefore constrain the remedy.

Table F-5 summarizes the options evaluated and provides information available to date. Given the constraints and uncertainties discussed above, the design approach is to use a combination of multiple reuse/disposal options to provide operational flexibility and to ensure that the remedy-produced water management system does not prevent proper maintenance of the groundwater remedy system.

The conditioning of produced water can be accomplished with fixed and/or mobile units. Mobile conditioning equipment may be used during well maintenance periodically for filtration, but not for conditioning of dissolved metals. The primary reason is that the amount of equipment required for such conditioning would exceed the available space in the areas where wells are likely to be installed. Furthermore, using mobile equipment for full conditioning could increase the potential for leaks and spills. For the above reasons, the conditioning system will be fixed units and has been designed to be housed in a building at the Compressor Station. The conditioning system has been designed for continuous and intermittent operation to allow for operational flexibility.

TABLE F-5
Summary of Disposal/Reuse Options Evaluated
Management of Water Produced from Operation and Maintenance of Groundwater Remedy
PG&E Topock Compressor Station, Needles, California

Disposal/Reuse Options	Description	Infrastructure Required Prior to Use
Trucking off-site	Transport unconditioned produced water to a permitted facility off-site.	Trucking off-site will require constructing a loading station at TCS or the MW-20 bench. This would be equipped with pumps, hoses, secondary containment, and controls, located inside a secured facility.
Discharge to TCS evaporation ponds	The Compressor Station's lined evaporation ponds receive cooling tower blowdown water and evaporate it as part of normal Compressor Station operations. Solids are removed from the ponds periodically. The ponds operate under Waste Discharge Requirements (WDRs) issued by the California Regional Water Quality Control Board (Water Board). Excess capacity of the ponds is estimated to be between 500,000 and 1,000,000 gallons per year. PG&E plans to coordinate with the RWQCB regarding substantive requirements applicable to the use of the evaporation ponds at PG&E Topock Compressor Station for disposal of certain remedy-produced water streams (e.g., first flush well rehabilitation water, other minor wastewater streams) and potentially wastewater from the contingent freshwater pre-injection treatment system)	Conveying remedy-produced water to the TCS evaporation ponds will be accomplished by installing a pipeline on TCS property that connects to the existing cooling tower blowdown pipeline that discharges to the ponds. Provisions to enhance evaporation, thereby increasing the ponds' capacity, are included in the 90% design.
Reuse by blending with freshwater and use in TCS cooling towers	The cooling towers use fresh water to cool compressed natural gas. The water is re-circulated in the tower and the volume is reduced through evaporation. Make-up water is added so the cooling demand is met. Water is blown down (discharged) from the system to control concentration of dissolved salts or other impurities in the circulating water. The blowdown discharges to the existing evaporation ponds through an existing pipeline. Conditioned remedy-produced water with low dissolved and suspended solids concentrations is likely to be suitable for use in the cooling towers, and may be beneficial to cooling tower operation. In addition, as the circulating water is currently treated to prevent fouling and corrosion in the cooling towers, this reuse option will be evaluated/ designed to ensure a similar level of protectiveness. The cooling tower water usage between January 2009 and March 2011 ranged from 11 to 110 gpm (using monthly water volumes converted to instantaneous rates).TCS cooling towers cannot accept remedy-produced water with high levels of dissolved iron and manganese.	Conveying remedy-produced water to the TCS cooling towers could be accomplished by installing a connection to the existing cooling tower makeup pipe that feeds freshwater to the cooling towers.
Reuse by blending carbon-amended water and injection into IRZ injection wells	The IRZ injection wells could take remedy-produced water with minimal conditioning, except for solids removal. This may benefit the remedy in further accelerating the plume movement toward the IRZ line on National Trails Highway (NTH). However, it is not known how much excess capacity the wells could take without affecting the plume movement. The groundwater modeling being performed will be used as a tool to understand the relative difference in the allowable fresh water and carbon-amended injection rates so that flow ranges can be defined for effective operation.	Re-injecting remedy-produced water with carbon-amended water will require a connection to the carbon-amended and IRZ injection pipelines. Remedy-produced water flow will be metered in, so as to not disrupt the remedy system hydraulics. Modeling confirmed that the additional flow to the IRZ injection wells will not negatively affect system hydraulics.

TABLE F-5

Summary of Disposal/Reuse Options Evaluated

Management of Water Produced from Operation and Maintenance of Groundwater Remedy
PG&E Topock Compressor Station, Needles, California

Disposal/Reuse Options	Description	Infrastructure Required Prior to Use

Note:

Two reuse/disposal options for remedy-produced water that were previously being considered are not being further evaluated in the remedy design. These options include the Infiltration Gallery in Bat Cave Wash and the Moabi Regional Park sewage ponds. If PG&E proposes to evaluate this option further in the future, PG&E will discuss the option with agencies and Tribes at that time.

In summary, the degree of conditioning required for the remaining options carries forward into the design is described below.

- Trucking off-site to permitted disposal facility – Prior to trucking offsite, field neutralization and/or field filtered with a transportable treatment unit may occur. All remedy-produced water sources are assumed to be acceptable to one or more offsite facilities.
- Discharge to TCS evaporation ponds – Remedy-produced water discharged to the evaporation ponds must not be hazardous. The only anticipated parameter with the potential to be hazardous is pH (acidic conditions); water with pH less than or equal to 2.0 (characteristic waste level) cannot be directly discharged to the ponds. In such case, prior to the disposal at the TCS ponds, field neutralization and/or field filtered with a transportable treatment unit may occur
- Reuse by blending with freshwater and use in TCS cooling towers – The cooling towers need relatively clean water to keep the cooling towers operating effectively. Therefore near-neutral pH, low concentrations of dissolved iron, silica, and manganese, similar water quality to the current supply which has low total dissolved solids, and low solids concentrations are preferred to prevent fouling. The plan is to achieve low dissolved iron, silica, and manganese by only sending remedy-produced water low in these constituents (such as freshwater injection well backwash) to the tower. Therefore, no conditioning for removal of dissolved iron, silica, and manganese is anticipated.
- Reuse by blending with carbon amended water nd injection into IRZ wells – These wells will have elevated levels of IRZ byproducts, carbon, and possibly chromium because they will be located within the chromium plume. Injection wells need similar water to the formation water (i.e., near-neutral water [pH 6.5 to 8.5]) to not cause adverse geochemical reactions that might precipitate or dissolve minerals. Therefore, pH adjustment is required if the pH is acidic (such as from a well rehabilitation). Elevated levels of IRZ byproducts and low chromium levels are acceptable since they will be taken care of in the reducing zone. Therefore no conditioning for removal of organic carbon or dissolved iron and manganese is anticipated. Solids need to be filtered to prevent clogging.

Remedy-produced Water Management Plan

The reuse/disposal plans for the various types of remedy-produced water differ. Multiple options are maintained where possible to provide operational flexibility. Table F-6 describes the management plan. The plan is subject to change if underlying assumptions prove incorrect. This plan is intended to be flexible and to evolve with operational experience during the groundwater remedy implementation.

This analysis indicates that the following minimal options need to be available for onsite disposal/re-use:

- For disposal, TCS ponds are made available, or some of the remedy-produced water will have to be transported offsite.
- Re-use will occur by injection into IRZ injection wells.

The rationale as embodied in Table F-6 is based in large part on diverting the most impacted water to the TCS evaporation ponds (provided its pH is greater than 2.0, as noted above) or trucking it offsite for disposal. Cleaner water is pumped to the following options, listed in order of preference:

1. IRZ injection wells – Flow limits to maintain system hydraulics, iron, and manganese could also foul wells and increase frequency of maintenance.
2. TCS cooling towers – Will not affect the remedy wells directly and will reduce TCS water usage. However, the remedy-produced water will be blended with cooling tower make-up water and the total must not exceed the cooling requirements of the compressors. Any excess water has to be diverted elsewhere.

TABLE F-6

Reuse/Disposal Management Plan for Water Produced During Groundwater Remedy

Management of Water Produced from Operation and Maintenance of Groundwater Remedy
PG&E Topock Compressor Station, Needles, California

Source	Estimate (MG/year)	Management Plan – Listed in Order of Preference
Backwash of freshwater injection wells/IRL injection wells receiving fresh water	2.32	Process through B-side of Remedy-produced Water Conditioning Plant, then to: 1. IRZ injection wells 2. Compressor station cooling towers
Backwash of IRZ injection wells, TCS injection wells, IRL injection wells receiving water from river bank extraction wells, and IRZ CIP[c]	2.35 [a, b]	Process through A-side of Remedy-produced Water Conditioning Plant, then to IRZ injection wells
Well rehabilitation (all wells) - first flush	0.77 [a, b]	1. TCS ponds [d] 2. Trucked offsite [d] 3 Field neutralization and/or field filtered with a transportable treatment unit, and then convey water to Remedy-produced water conditioning plant (A-side) for processing and re-inject into IRZ injection wells.
Well rehabilitation (all wells) – second flush	1.8 [a, b]	Same as backwash from corresponding well
Other water – cleaner streams	0.3	Relatively clean water, such as rainwater in containment and some decontamination water, will be managed by the same means as the backwash water from freshwater injection wells. Process through B-side of Remedy-produced Water Conditioning Plant, then to: 1. IRZ injection wells 2. Compressor station cooling towers
Other water – some purge and decontamination water	0.1	1. Process through A-side of Remedy-produced Water Conditioning Plant, then to IRZ injection wells 2. TCS ponds 3. Trucked offsite
Other water – produced water from construction of wells in the future	Variable	High-solids water: TCS ponds or truck offsite Low-solids water: Process through A-side of Remedy-produced Water Conditioning Plant, then to IRZ injection wells

Notes:

MG = million gallons

If the contingent FWPTS were to be implemented, backwash water generated from the treatment system would be a potential additional source of remedy-produced water. The majority (approx. 95%) of the backwash water generated will be recycled in the FWPTS leaving only about 5% of the backwash stream needing to be managed (this stream is not expected to have elevated arsenic concentrations). The management options for backwash water include reuse in the cooling towers, discharge to the evaporation ponds, and/or trucking to off-site permitted disposal facilities.

[a.] Testing of IRZ well maintenance schemes at Hinkley is complete and confirmed the weekly backwashing and annual rehabilitation frequency. Assumed that roughly 30% of rehabilitation water will be high-solids or low-pH “first flush” water. Remainder assumed to be similar in nature to backwash water.

[b] Assumes half of the flow to the IRL injection wells is fresh water with the remainder amended with carbon.

[c] Prior to transferring the spent solution from the Clean-in-Place (CIP) System to the remedy-produced water conditioning plant, the solution will be allowed to settle and precipitate solids prior to pumping to the conditioning plant. Spent solutions from Clean-in-Place System could also be shipped off-site for disposal.

[d] Note that prior to the disposal at the TCS ponds or trucking offsite, field neutralization and/or field filtered with a transportable treatment unit may occur.

Possible Future Changes

As the Topock groundwater remedy operation progresses over its expected multi-decade life, PG&E may find the need to optimize or otherwise change the system. Possible examples of changing conditions include new sources or characteristics of remedy-produced water; the need for additional wells; the need to further condition the water produced; new disposal or reuse options; or new waste discharge restrictions. These changing conditions may necessitate a change to the remedy-produced water management system, such as different, larger conditioning processes, which will in turn trigger the need for agencies' approval and stakeholders' involvement.

Remedy-Produced Water Management System Design

Design Criteria

Water produced during the remedy implementation will require some conditioning for most of the reuse/disposal options. Three possible water conditioning systems, representing the range required by the varying options, are:

- **Solids removal.** Solids must be removed if water is to be re-injected into the aquifer to minimize impact on well injectivity loss due to plugging. In this case, if low-pH water needed to be neutralized, it would be conditioning at the well head and would be transported to the centralized management facility for solids removal.
- **Solids removal and neutralization.** If low-pH water from well rehabilitation is to be re-injected into the aquifer, it must be neutralized to prevent mobilization of minerals and/or precipitation of solids in the aquifer, which would cause a loss of well injectivity. Neutralization will also be performed to meet waste discharge requirements.
- **Solids removal, neutralization, and dissolved constituent removal.** If strict water quality requirements are mandated for re-injection options, removal of dissolved constituents (such as arsenic, manganese, iron, calcium, and selenium) may be required.

The preferred system is **solids removal with neutralization.** Figure F-2 shows the currently planned conceptual process schematic for this system. This is based on the following assumptions:

- Remedy-produced water that has significantly higher concentrations of solids or dissolved constituents (e.g., byproducts) than what exists in the aquifer water will be sent to the TCS evaporation ponds, or transported offsite for disposal. The preferred approach is to send the water produced at the beginning of rehabilitation events to the TCS ponds (or truck offsite) and to manage the water produced later in the rehabilitation process by the same means as for backwash water. The cutover from first flush to second flush rehab water is proposed to be defined through easily measured onsite water quality tests such as pH, turbidity, and conductivity. In general, during well rehab events, turbid and/or discolored water (first flush) will be removed from the well until the water becomes clear and the well is relatively clean. All first flush water will be contained in temporary, portable tanks, tested, and managed.
- Flexibility for neutralizing non-hazardous low-pH water (pH less than about 6.5 but greater than 2.0) from well rehabilitations will be provided either through the remedy-produced water management system by caustic addition to the equalization tanks or by an alternative approach such as sending the water to the TCS evaporation ponds, transporting to offsite disposal, or neutralizing with temporary portable systems at the well head.

Under the management plan presented in Table F-6, removal of dissolved constituents will not be required because the injected water quality will be similar to the aquifer water quality in/near the IRZ injection wells[1]. Temporary fluctuations in water quality will occur during remedy implementation prior to achieving Remedial Action Objectives. Institutional controls will prevent use of affected groundwater while the remedy is being implemented. There are currently no municipal or private wells in the chromium plume area, to PG&E's knowledge. Furthermore, contaminant migration to the river that could potentially affect water quality goals or beneficial uses will not occur during remedy implementation through in-situ remediation and groundwater

extraction along the river bank. PG&E believes that this interpretation is consistent with the requirements of the anti-degradation provisions of 40 CFR 131.12 and State Water Resources Control Board Resolution No. 68-16.

[1] In response to comments on the 60% design (RTCs #341 and #757), a contingency plan to remove scaling ions from remedy-produced water was developed. The contingent system, referred to as the dissolved metals removal system (DMRS), would be located entirely in the planned Remedy-produced Water Conditioning Building inside the TCS. No additional footprint is required for installation of this contingency system. The DMRS would be designed to be fully integrated into the currently planned conditioning process for remedy-produced water, thereby allowing for easy installation if required in the future. See Appendix L of this BOD, O&M Manual Volume 3, Appendix A, for more details.

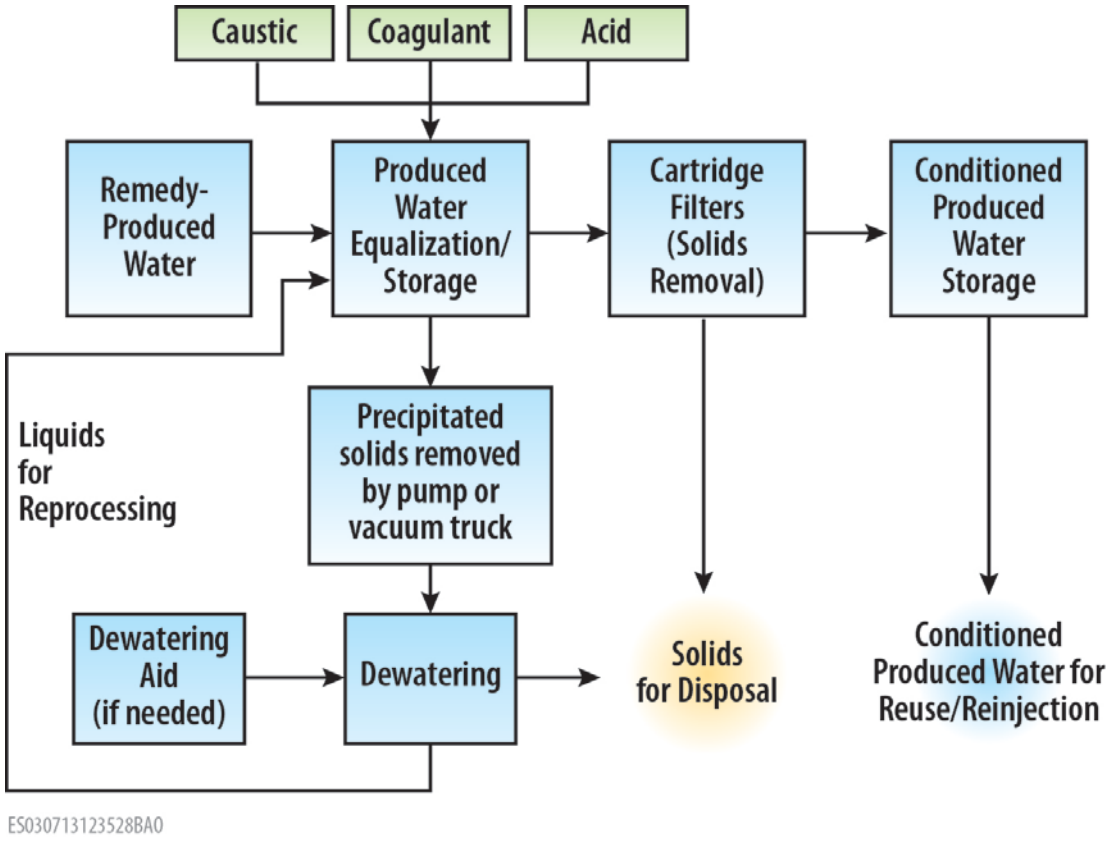


FIGURE F-2
Conditioning Process Schematic
Management of Water Produced During Groundwater Remedy
PG&E Topock Compressor Station, Needles, California

Table F-7 at the end of this memo summarizes the preliminary design criteria for the remedy-produced water management system.

System Sizing

The remedy-produced water conditioning system was sized for solids-removal and neutralization equipment (pumps, filters, and caustic and acid storage) to meet the design criteria shown on Table F-7. Space will be reserved within the system's building for equipment that may be needed in the future. This includes additional cartridge filters to remove smaller particles (1 micron) if this proves necessary to protect remediation wells, and portable granular activated carbon units if needed to remove trace hydrocarbons from rainwater or decontamination water. Space for other supporting functions such as an onsite laboratory, operators' control room, and limited equipment storage have also been provided. Due to space constraints within the TCS, the critical functions such SCADA, controls, and telecom have been consolidated and housed in the Operations Building in the Transwestern Bench, and the rest of the maintenance functions and storage will be consolidated at a long-term remedy support area located at Moabi Regional Park.

The conditioning equipment will be housed in a building inside TCS. It should be noted that the total footprint of the system is larger than the building itself, due to the water equalization requirements and the supporting functions (e.g., operator's office and on-site laboratory, equipment storage). Due to space constraints at the TCS, the remedy-produced water tanks and buildings cannot be fit into a single area but have instead been placed at locations inside the station so as not to interfere with existing compressor station facilities.

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TABLE F-7
Remedy-produced water Management System Design Criteria
Management of Water Produced from Operation and Maintenance of Groundwater Remedy
PG&E Topock Compressor Station, Needles, California

Design Criteria	Value	Notes
Flow – Average	20 gpm	Best current estimate is 7.6 million gallons per year. If 80% uptime, system would process 18 gallons per minute while running.
Flow – Peak	35 gpm	To manage 50,000 gallons per day.
Equalization volume	>50,000 gal 4 tanks	Largest projected daily production of water is 50,000 gallons per day (during rehabilitation of largest injection well). Provide multiple tanks to allow segregation of varying types of remedy-produced water. At least one of the tanks will be fitted with pumps and venturi eductors to aid in pH adjustment or coagulation. To allow for operational flexibility to segregate/manage various produced water streams and to optimize processes in the future, the conditioning system will be configured with two parallel trains: 1) Remedy A-side and 2) Freshwater B-side. Both trains will be equipped initially with identical processes/units as illustrated in Figure F-2.
Effluent water quality requirements	Total suspended solids (TSS) - < 5 microns pH – 6.5-8.5	Effluent TSS will be < 5 microns to limit injectivity loss in wells used for re-injection. Based on experience at Interim Measure No. 3 (IM-3), Hinkley, and other re-injection sites. Effluent pH will be 6.5 to 8.5 to achieve near neutral pH and not cause adverse geochemical reactions
Solids dewatering	One dewatering system available at all times	Use phase separators (such as at IM-3) for dewatering solids precipitated in pH adjustment steps. Could also be used for the disposal of spent filter cartridges and solid wastes from future sampling.
Influent solids loading	Typical: 60 mg/L TSS	Estimated value consistent with Hinkley results.
Degree of automation	Full	System is to be able to run un-manned (such as nights, weekends, and holidays). Automated to detect non-compliant effluent and shut down system.
Uptime	80%	System can be down for extended periods (~1 week) without jeopardizing well injectivity. Therefore, full system redundancy is not provided. Parallel process streams (A-side Remedy and B-Side Freshwater) equipped with two pairs of duplex filters
Operating time	24 hours per day	Using automation, the system will be able to run full time while unattended. The system will be designed for continuous and intermittent operation based on levels in the influent tanks.
Effluent discharge	Ability to convey water to all reuse/disposal options	Include connections to allow for trucking of conditioned water from system effluent tanks.

Notes:
gpm = gallons per minute; mg/L = milligrams per liter

Appendix G
Evaluation of Arched Bridge Integrity and Space Availability to Support Freshwater Supply Pipeline

TOPOCK BRIDGE (Old Trails Bridge) ASSESSMENT

TO

ASSESS SUITABILITY OF TOPOCK BRIDGE TO SUPPORT A NEW 12" WATERLINE TO BE OWNED BY PACIFIC GAS & ELECTRIC COMPANY

AT

Topock, Arizona

Old Route 66 Arch Bridge Crossing Rio Colorado
Between Arizona and California



October 3, 2011

PREPARED BY:

Danielle Martin, El Paso Corporation Engineering Intern
Juan C. McLane, P.E., El Paso Corporation

INTRODUCTION

The purpose of this report is to assess the structural capacity of the Topock Bridge (Old Trails Bridge) to support a proposed 12-inch waterline supported by the bridge. The bridge is owned by El Paso Natural Gas Company (EPNG) and it currently carries two (2) 30-inch pipelines transporting natural gas. Pacific Gas and Electric Company (PG&E) plans on installing a 12-inch waterline on the Topock Bridge that would be owned and maintained by PG&E. PG&E has asked EPNG to conduct this assessment of the Topock Bridge prior to PG&E installing the proposed new waterline. The report contains that assessment and is separated into the following sections:

a) A background narrative.
b) Pipe materials data.
c) Results and Discussion.
d) A conclusion and recommendation.
e) References.

BACKGROUND

The Topock Bridge (Old Trails Bridge) was constructed in 1914 and is located in Topock which is an unincorporated community in Mohave County, Arizona. The bridge was part of the Transcontinental National Old Trails Road, and by 1926, was part of Route 66 that crossed the Colorado River. The bridge carried vehicle traffic up until 1947. The bridge was only one lane and was rated at 11 Tons. Then, in 1948, the deck was removed so the bridge could accommodate a natural gas pipeline. [(1)]

The bridge currently carries two such 30-inch natural gas transmission pipelines. EPNG transports natural gas on its interstate transmission pipeline system on Line 1104 to the middle of the bridge where custody of the gas and ownership of the pipeline transfers to PG&E. The second natural gas pipeline on the bridge, which is known as Line 1900, is owned by Mojave Pipeline Company, L.L.C. which is an affiliate of EPNG.

DATA

1. SEPTEMBER 1914 BRIDGE DESIGN LOADS

   Truck load 10-Ton [(2)] (See Exhibit 1)

   *Note: "Lane Load" concept did not develop until 1923 and the "Truck Train Loading" and equivalent load was developed in 1929[(2)].

2. HISTORICAL INSPECTIONS

   On June 28, 2010, EPNG hired Acuren Inspection, from Denver, Colorado to inspect the bridge. The Acuren inspection consisted of a visual inspection that included: inspection of the pipelines coatings, inspection of pipeline supports and supporting structures, and insertion of horizontal and vertical alignments. A few pipe supports were found to be have some corroded areas but with sufficient integrity to support the bridge as well as the current and anticipated loads. The inspection report evaluates the bridge as in "good condition." As of the date of this report, EPNG is evaluating bids to have the entire bridge painted and the corrosion spots repaired.

3. EXISTING AND PROPOSED BRIDGE LOADS

   a. Existing 30-inch pipeline, 194 lbs/ft pipeline Number 1104.
   b. Existing 30-inch pipeline, 194 lbs/ft pipeline Number 1900.
   c. Proposed 12" waterline, 88 lbs/ft. (pipe and fluid for testing)
   d. Assume 1000 lbs point load for pipe supports and fittings.

4. ASSUMPTIONS AND CLARIFICATIONS

For purposes of this report, the following assumptions and clarifications apply:

   a. Although the bridge was rated at 11-Ton at the time, a 10-Ton vehicle was used for the design. This assumption is a bit more conservative in the sense that the calculations are comparing the proposed loading to lower bridge design stresses produced by the 10-Ton vehicular load.

   b. The bridge loading concept developed in 1929 was a calculated determination. (See Exhibit A, 3 of 3). This concept involves placing concentrated loads and an equivalent load such that they produce the largest moment or shear on the structure. Although the concentrated and equivalent loads application produced the largest moment, the single truck load was used to evaluate the bridge (See Results and Discussion section). Again, this is conservative approach.

   c. No wind or earthquake evaluation was done. It is assumed that the original Topock bridge design did not include any seismic loading. In 1933, however, it became mandatory to include 8 percent of the weight for seismic design [(4)]. Similarly, it was not until 1927 when the Uniform Building Code was published that wind load was included. There is no record that the bridge was ever analyzed for wind and earthquake loads [(5)] to bring the bridge to Code compliance.

   d. Vehicular impact loading was not added to the vehicle loads. The calculation is more conservative without applying the vehicular impact loads in the sense that the calculations are comparing the proposed loading to lower bridge design stresses.

   e. The deck span of the bridge is 592 ft. long (See attached drawing PB3-EB6-6). It is supported by cables within the arch portion of the bridge and supported by columns on the cantilever portion of the bridge at every 18.5 ft. It is assumed that the supports are the critical element in the bridge. Thus an 18.5 ft section of the bridge was used to compare the original design capacity of the bridge with the proposed loading (pipelines).

   f. Assume 1000 lbs. point load for pipe supports and fittings.

RESULTS AND DISCUSSION

The bridge is an arched three hinged structure. As stated in the assumptions, the deck is supported at 18.5 ft. intervals; the bridge was analyzed: (1) by loading one 18.5 ft section of the bridge with the 10-Ton design vehicle used in 1914, (2) by loading the same 18.5 ft section with the proposed pipeline loads, and (3) by loading the 18.5 ft section with the concentrated and distributed load concept. The results were compared to assess the bridge structural capacity.

1. PROPOSED BRIDGE LOADING CALCULATIONS – (2) 30” gas pipelines and (1) 12” waterline full with water.

   The calculations show that the design moment is equal to 25.1 ft-k, and the design shear is equal to 4.9 kips (See Exhibit A, 1 of 3)

2. ORIGINAL BRIDGE DESIGN CALCULATIONS – 10-Ton Design Truck

   The calculations show that the design moment is equal to 45.2 ft-k, and the design shear is equal to 13.9 kips (See Exhibit A, 3 of 3)

3. CONCENTRATED AND DISBRIBUUTED LOAD CONCERPT (from 1929)

   The calculations show that the design moment is equal to 110.6 ft-k, and the design shear is equal to 18.9 kips (See Exhibit A, 3 of 3)

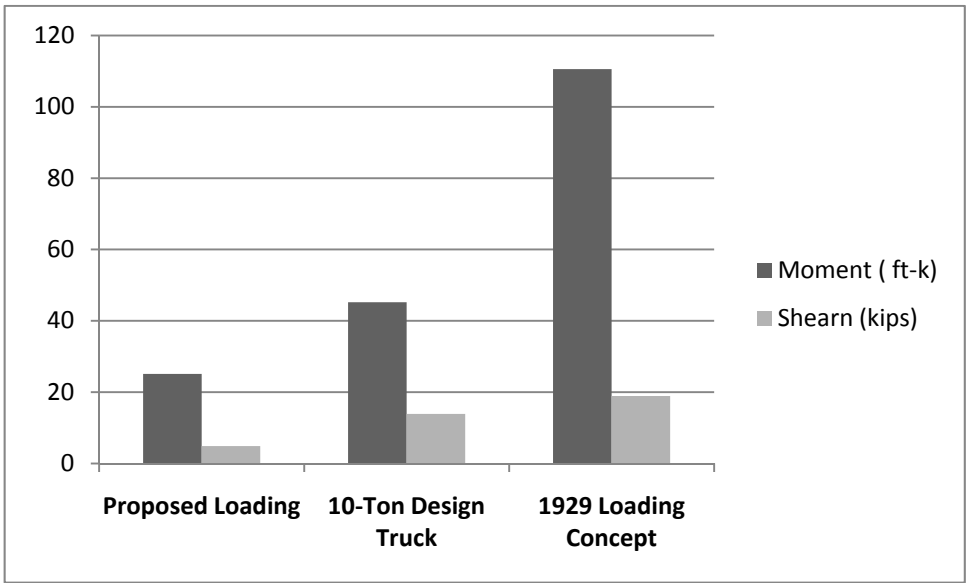


TABLE 1

Table 1 shows the stress comparison among the proposed loading, the original 10-Ton bridge design, and the 1929 loading concept. The stress comparison between the proposed loading of (12” waterline and two 30” pipelines) and the 10-Ton truck loading produces a moment that is 55% percent of the original 10-Ton truck bridge design moment capacity and a shear that is 36% of the original 10-Ton truck bridge design shear capacity. The 1929 loading concept is shown for reference. The latter is not used in the recommendation.

CONCLUSIONS

The proposed 12-inch waterline load on the bridge will be within acceptable design loads for the Topock Bridge. The proposed loading produces a moment that is 55 percent of the design moment and produces a shear that is 36 percent of the design shear. The structural analysis results for the bridge are conservative since the design truck impact loads and the lane loading pattern were not included in the calculation.

RECOMMENDATIONS

It is recommended that during construction, equipment larger than 16 kips not be used in any 18.5 ft. long deck section. Additionally, the bridge deck supports shall be visually inspected prior to construction.

REFERENCES

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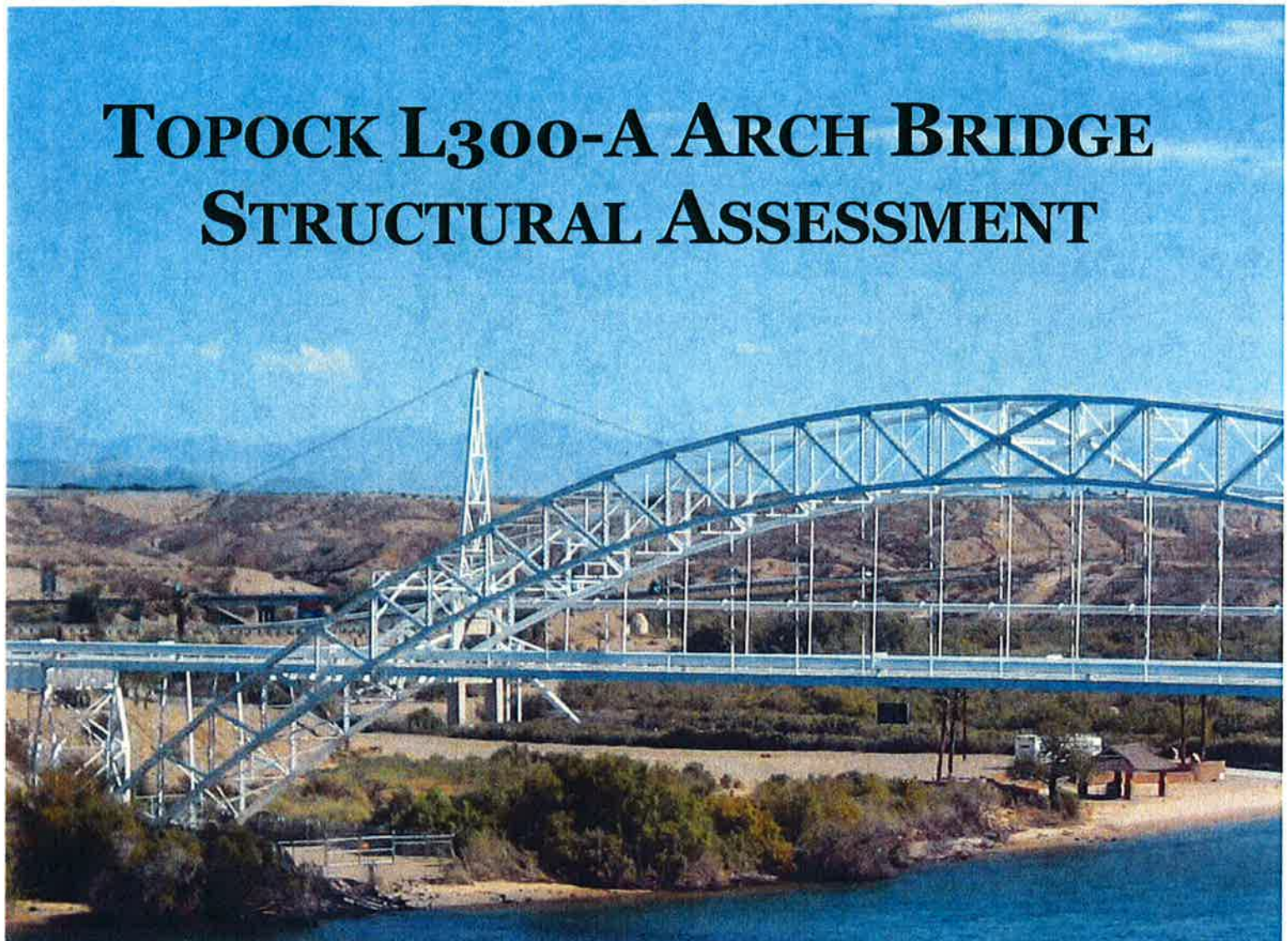
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TOPOCK L300-A ARCH BRIDGE STRUCTURAL ASSESSMENT



FINAL REPORT

December 13, 2011

AECOM
2101 Webster Street, Suite 1000
Oakland, CA 94612

TOPOCK L300-A ARCH BRIDGE STRUCTURAL ASSESSMENT FINAL REPORT

PREPARED FOR PG&E

December 13, 2011



Report By:

Kathleen Graham, P.E.

Savas Kolankaya. S.E.

Simon Luo, P.E.

AECOM

2101 Webster Street, Suite 1000
Oakland, CA 94612

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1.0 INTRODUCTION

The Topock (Old Rivers) Bridge is an arched steel structure constructed in 1914 as part of the Transcontinental National Old Trails Road and was used as a means of transportation for vehicles traveling along Route 66 between California and Arizona until 1947. In 1948 the bridge deck was removed in order to accommodate the natural gas pipeline which it continues to carry today.

Currently the existing structure supports two 30-inch gas pipelines and one 6-inch waterline. Located in Topock, an unincorporated area of Arizona, the bridge spans 608 feet across the Colorado River and is supported at 18½ foot intervals. The following report assesses the capability of the Topock Bridge to support an additional 12-inch waterline as proposed by Pacific Gas & Electric Company (PG&E). It also considers the effect of adding water to the existing gas lines in order to pressure test the pipes.

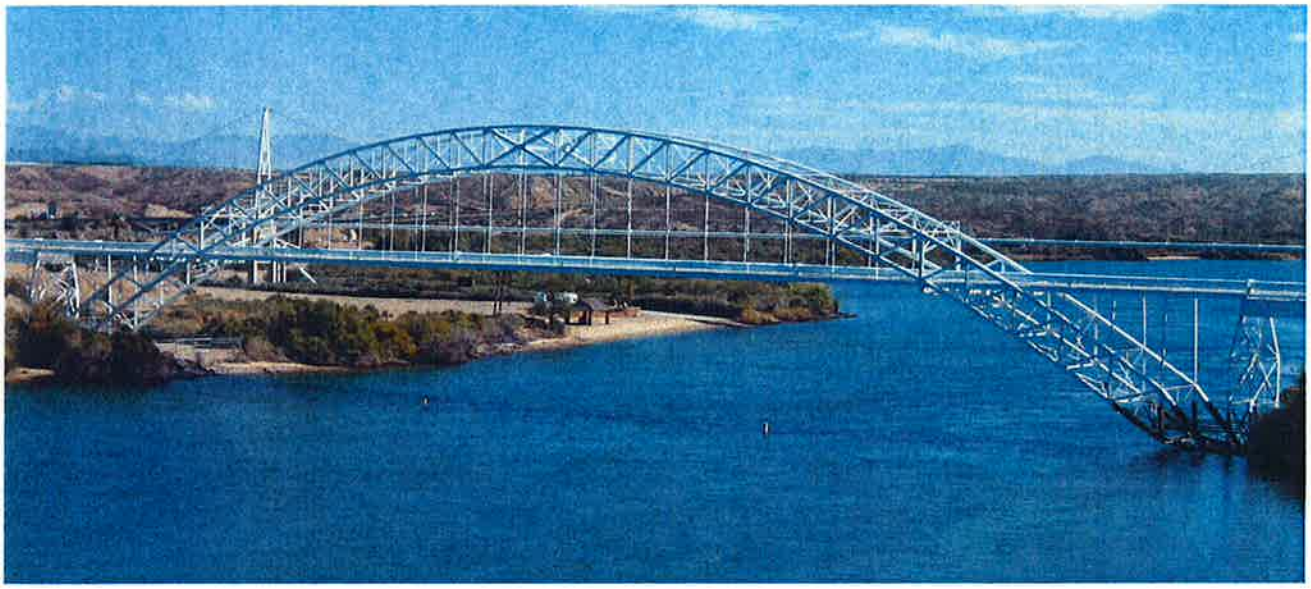


Figure 1.1: Topock L300-A Arch Bridge

2.0 DESIGN INPUT

2.1 Geometry and Section Properties

Due to the age of the bridge, very little of the original design information was available. It was assumed that all steel members were made from 36 ksi steel based upon investigations of material properties used in the early 20th century.

As one of the owners, the El Paso Corporation was able to provide an erection plan drawing indicating the overall geometry of the bridge but lacking any member sizes. Hand measurements were taken of any easily accessible members but it was necessary to scan the bridge using CYRAX scanning equipment in order to estimate the remaining dimensions and member properties.

A large portion of the bridge is composed of built-up sections which had to be individually defined for the analysis. Both the top and bottom chords of the truss consist of back-to-back channels connected with flat bars in a crisscrossed pattern. Similarly, the diagonal truss members contain a series of flat tie bars that run between pairs of double angles. Any additional strength due to such tie bracing was conservatively ignored in the structural analysis. Appendix B shows the cross-sections that were used for such built-up members in the bridge model.

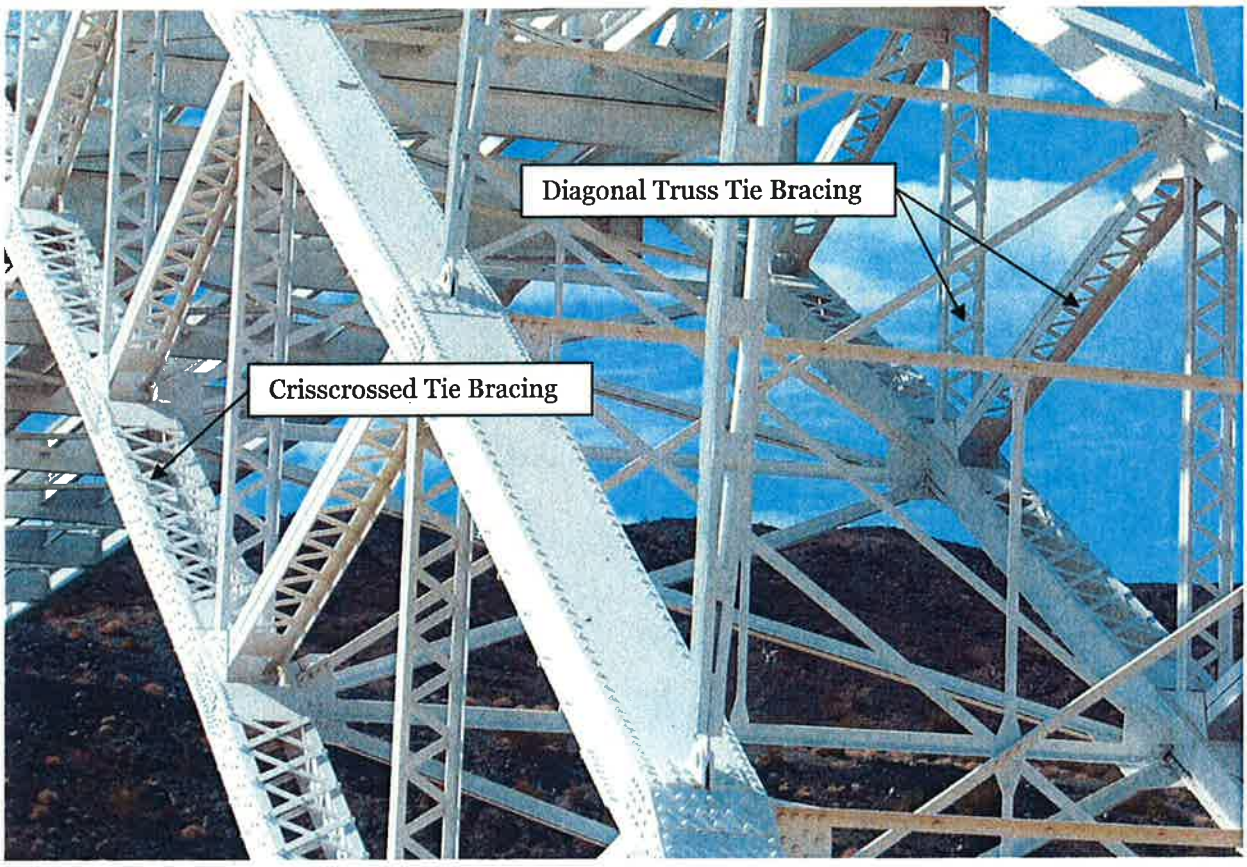


Figure 2.1: Tie Bracing

2.2 Design Codes

Analysis of the bridge was performed in accordance with the following design codes.

- California Building Code (CBC-2010)
- International Building Code (IBC-2009)
- Minimum Design Loads for Buildings and Other Structures (ASCE 7-05)
- AISC Manual of Steel Construction, 13th Edition (AISC 360-05)

2.3 Wind Parameters

The following parameters were used to calculate the wind forces according to the provisions of ASCE 7-05.

- Basic Wind Speed: V = 90 mph under normal operating conditions
  V = 30 mph during pressure testing
- Exposure Category C
- Importance Factor, $I_W = 1.15$

2.4 Seismic Parameters

Seismic forces were calculated using the following seismic parameters in accordance with the provisions of ASCE 7-05.

- Site Location: Latitude = 34.714225; Longitude = -114.493332
- Mapped Spectral Response Acceleration: $S_S = 0.216$; $S_1 = 0.133$
- Site Class D
- Site Coefficients: $F_a = 1.6$; $F_v = 2.268$
- Design Spectral Response Acceleration: $S_{DS} = 0.231$; $S_{D1} = 0.201$
- Seismic Occupancy Category IV
- Importance Factor, $I_E = 1.5$
- Seismic Design Category D

3.0 DESIGN LOADS

3.1 Load Cases

Loads were applied to the structure as outlined in the following load cases. Longitudinal wind and seismic forces do not govern the design so they were not included in the analysis. Detailed load calculations can be found in Appendix C.

- DEAD: Dead load on the structure includes the self weight of all steel members as well as the weight of each of the two gas pipelines and two waterlines (including weight of the water). Pipe loads were applied to the transverse deck beams at vertical pipe support locations based upon tributary lengths.

- TEST WT: Similarly to the pipe dead loads, the additional weight of water present during testing was applied to transverse deck beams at vertical pipe support locations. Testing loads were applied to each gas line separately in load case TEST WT 1 and TEST WT 2.

- WIND: Wind loads were applied to the structure based upon the surface area of members. Loads were applied at the joints along the top and bottom chords of the truss as well as the outermost deck beam. Wind loads on the deck were reduced based upon the assumption that a certain amount of shielding would occur.

- TEST WIND: Test wind loads are the same as wind loads except with reduced magnitudes based on 30 mph basic wind speeds instead of 90 mph winds.

- PIPE WIND: Wind pressure on the surface area of each of the pipes was applied as point loads in the positive y-direction at horizontal pipe support locations.

- TEST PIPE WIND: Reduced wind pressures acting on the surface area of each of the pipes were used during pressure testing.

- SEISMIC: Seismic loads on the structure were applied to all steel members in the positive y-direction as a fraction of their weight.

- PIPE EQ: Seismic forces acting on the pipes were input by applying a fraction of the weight of each pipe at the location of horizontal pipe supports.

3.2 Load Combinations

The following table summarizes how the load cases were combined and input into SAP2000. It was assumed that wind speeds would not exceed 30 mph during testing of the pipes, therefore reduced wind loads were used in combinations that include test weight loads. Additionally, it was considered unlikely for an earthquake to occur concurrently with testing, thus test weight loads were not included in any load cases containing seismic forces.

Load Combination	Load Factor	Load Case
1.4D (Test 1)	1.4	DEAD
		TEST WT 1
1.4D (Test 2)	1.4	DEAD
		TEST WT 2
1.2D + 1.6W	1.2	DEAD
	1.6	WIND
		TEST WIND
1.2D + 1.6W (Test 1)	1.2	DEAD
		TEST WT 1
	1.6	TEST WIND
		TEST PIPE WIND
1.2D + 1.6W (Test 2)	1.2	DEAD
		TEST WT 2
	1.6	TEST WIND
		TEST PIPE WIND
$(1.2+0.2S_{DS})D + 1.0E$	1.25	DEAD
	1.0	SEISMIC
		PIPE EQ

4.0 METHOD OF DESIGN

4.1 SAP2000

The bridge was modeled using SAP2000 which is a proprietary structural analysis software produced by Computers and Structures Inc. (CSI). SAP2000 uses a graphical user interface to create 3D structural models with a variety of loading and analysis options. Such models may be checked against the provisions of both U.S. and international design standards. SAP2000 will also automatically calculate the properties of user-defined sections and include them within the design code check. A verification of the software can be found in Appendix E.

4.2 Truss Structures

In the analysis of the bridge structure, the top and bottom chord of the arch were assumed to be continuous members with a hinge connection at the center. All remaining vertical and horizontal elements were modeled as truss members with pin connections at each end and free of bending moments.

4.3 Tension-Only Members

Bracing members with long unbraced lengths and high slenderness ratios were assumed to act as tension-only members. It was assumed that any compression forces in these members would be redistributed as tension in adjacent members.

5.0 RESULTS

5.1 Normal Operating Conditions

Normal operating conditions were used to assess the capability of the bridge to support an additional 12-inch waterline. Members with loads exceeding their capacity by more than 5% were considered to be overstressed. Compressive forces in tension-only members were combined with the tension in adjacent braces and then checked against their tensile capacity. The governing load combination for all members was 1.2D + 1.6W.

5.1.1 Horizontal Deck Braces

Horizontal braces along the bridge deck were considered to be tension-only members. After combining tension and compression forces, three pairs of braces were found to be overstressed on each side of the bridge.

5.1.2 Longitudinal Deck Beams

Large axial forces produced in intermediate longitudinal deck beams by the computer analysis were disregarded due to the fact that these beams do not participate in the shear transfer of the horizontal truss system. With the absence of axial force, none of the beams are overstressed.

5.1.3 Transverse Deck Beams

Several transverse deck beams are indicated as being overstressed due to large minor-axis moments caused by high axial forces in the longitudinal deck beams. Since the longitudinal beams don't actually carry such forces, minor moments were disregarded and none of the transverse beams were found to be overstressed.

5.1.4 Top Chord Horizontal Truss Braces

Steel rods bracing the top of the truss were considered to be tension-only members. When the compressive forces are redistributed, none of the rods are overstressed.

5.1.5 Bottom Chord Horizontal Truss Braces

The capacity of double angle braces along the bottom of the truss were found to be insufficient to withstand the applied loads even after considering them as tension-only members.

5.1.6 Vertical Truss Members

Vertical members of the truss are shown as overstressed where they connect to the bridge deck at a location 222 feet from the center. Minor-axis moments are created within the truss due to an eccentricity in the model between the transverse deck beam and the vertical truss member. A closer look at this connection shows that such an eccentricity will not occur and thus minor moments may be disregarded.



Figure 5.1: Connection of Truss to Bridge Deck

5.1.7 Vertical Truss Braces

After checking the tensile capacity of vertical truss members against their combined total force, it was found that only the braces located 222 feet from the center were overstressed.

5.1.8 Bridge Support Braces

Vertical braces on the face of the tower support at 304 feet and those of the support at 360 feet were both indicated as being overstressed. When analyzed as tension-only members, all braces were found sufficient to carry the applied loads.

5.2 Dead Loads Only

Results generated from the computer analysis indicated that some vertical braces were failing in compression due to dead loads. When these braces are considered to be tension-only, the capacity of such members is taken as zero and the compressive forces are redistributed to the adjacent columns. A second model was therefore created to make sure that such adjacent members would have sufficient capacity to withstand any additional forces caused by the removal of tension-only members. The analysis does not consider seismic and wind forces, however the additional dead loads experienced during testing of the 30-inch gas lines were included. Results show that none of the members will be overstressed when subjected to dead loads only.

5.3 Pressure Test Conditions

During testing of the 30-inch gas lines additional dead loads due to water were applied in conjunction with reduced wind loads. Seismic forces were not included due to the unlikelihood of an earthquake and pressure testing occurring simultaneously. Results from this analysis show some bracing members not being able to withstand the applied loads, however when they are taken as tension-only members none are overstressed.

6.0 CONCLUSIONS

The capacity of Topock L300-A Arch Bridge was investigated with a new 12-inch diameter waterline and checked for conformance to current design codes. Members which exceeded allowable stress levels are identified in Section 5.0 and their recommended modifications are detailed in Section 7.0. The bridge foundations are not shown on any design drawings so it was not possible to investigate their capacity. Since the additional weight added to the bridge is only 10% of the total weight it is assumed that existing foundations will continue to sufficiently support the structure under the new loads.

7.0 RECOMMENDATIONS

The following drawings were added in response to 60% RTC #471

HALF UPPER-CHORD LATERAL SYSTEM.

HALF LOWER-CHORD LATERAL SYSTEM.

DET 2 SK-2 TYP. EA. SIDE

SECTION B-B.

SECTION M-M.

ARIZONA

CALIFORNIA

FLOOR LEVEL=503.5'

FLOOR LEVEL=503.5'

HINGE ELEV.=450.5

HINGE ELEV.=450.5

EXTREME HIGH WATER MARK (1857?) ELEV 456.0

HIGH WATER MARK 1914 ELEV. 449.0 (HIGHEST SINCE 1857)

WATER LEVEL FEBRUARY 1915 ELEV. 433.0

BED ROCK

SAND BAR

SAND AND GRAVEL

LOOSE ROCK & DENSE GRAVEL

HARD GRAVEL, SAND & GRAVEL

SIDE ELEVATION MAIN SPAN.

SCALE: 1"=20'-0".

32 SPA. @ 18'-6", 592'-0" C-C PINS.

56'-0" 56'-0" 608'-0" 56'-0" 56'-0"

DET. 1 TYP. SK-1

J_2 (15 BENTS THUS EACH SIDE OF ℄)

832'-0"

EXPANSION JOINT

EXPANSION JOINT

GIRD B_3 GIRD C_3 GIRD A_3 GIRD D_3 GIRD D_3 GIRD C_3 GIRD B_3

FLOOR SYSTEM

SECTION A-A.

SECTION D-D.

SECTION E-E.

SECTION F-F.

SECTION G-G.

SECTION H-H.

SECTION K-K

SECTION L-L.

DET 3 TYP. 2 PLA. SK-3

SECTION C-C

SIDE VIEW

HALF PLAN OF FLOOR SYSTEM

(SECTION THROUGH FLOOR BEAMS)

HALF LONGITUDINAL FLOOR SECTION

EXPANSION JOINT

¾" HOOK BOLT

JOINT

3"x8"x1'-0" RIVET

8"x8" CURB

TYPICAL CURB DETAIL

REGISTERED PROFESSIONAL ENGINEER SAVAS KOLANKOWSKI S 3563 EXP. 12/31/2012 STRUCTURAL STATE OF CALIFORNIA

← Modifications Only.

NOTE:
RETRACED FROM KANSAS-CITY STRUCTURAL STEEL CO'S DWG.
ORDER 7744-7745-7746

REFERENCES
SHOP DETAILS DWG: # F 1589.

CANCELED

NO	DATE	DESCRIPTION	APPRD
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TABLE OF CHANGES

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BY Dept. of E.O.
DIV. V.C. Peasley
CH. Floor
DR.
DATE 1-6-50

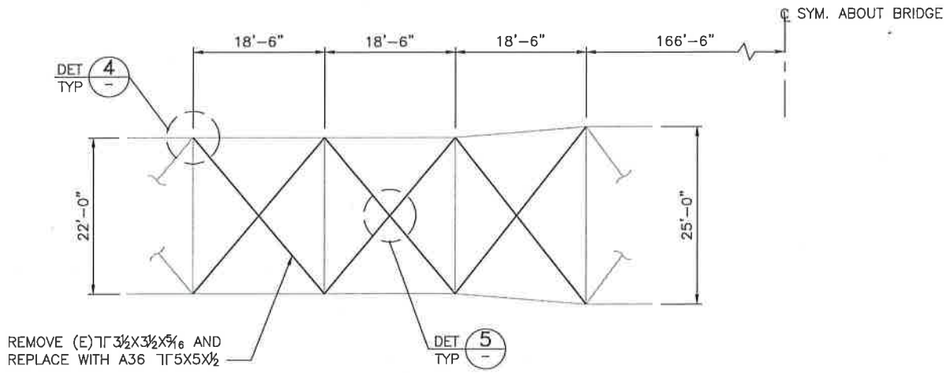
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ERECTION PLAN
COLORADO RIVER HIGHWAY BRIDGE
TOPOCK-MILPITAS, MAIN 300
DEPARTMENT OF GAS OPERATION
PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO CALIFORNIA

BILL OF MATERIAL

SUPERSEDES
SUPERSEDED BY
SHEET NO. SHEETS

DRAWING NUMBER 481620 CHANGE 1



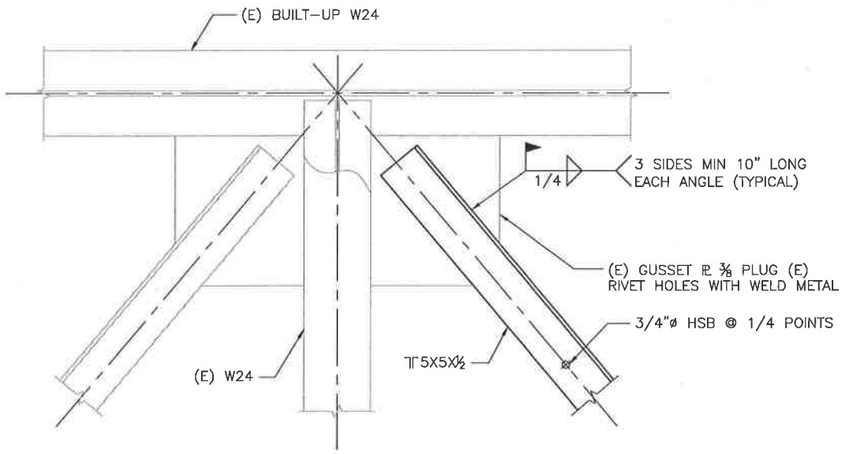
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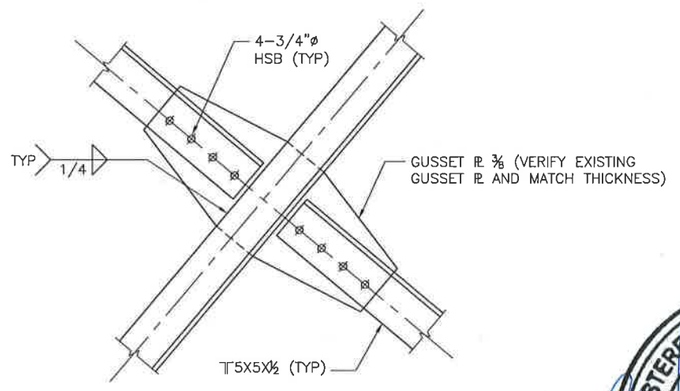
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2. CODES AND SPECIFICATIONS
   - A. INTERNATIONAL BUILDING CODE IBC–2009.
   - B. MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES, ASCE 7–05
   - C. AISC MANUAL OF STEEL CONSTRUCTION, 13TH EDITION.
   - D. AISC SPECIFICATION FOR STRUCTURAL STEEL BUILDINGS, MARCH 9,2005 (ANSI/AISC 360–05)
   - E. AISC SEISMIC PROVISIONS FOR STRUCTURAL STEEL BUILDINGS (ANSI/AISC 341)
   - F. AWS D1.5, BRIDGE WELDING CODE – AMERICAN WELDING SOCIETY.
   - G. AWS D1.8, STRUCTURAL WELDING CODE – SEISMIC SUPPLEMENT, AMERICAN WELDING SOCIETY.
   - H. SPECIFICATION FOR STRUCTURAL JOINTS USING ASTM A325 OR A490 BOLTS, JUNE 30, 2004. HEREIN REFERRED TO AS THE RCSC SPECIFICATION.
   - I. AISC CODE OF STANDARD PRACTICE FOR STEEL BUILDINGS, MARCH 18, 2005.
3. MATERIALS

   UNLESS OTHERWISE NOTED ON THE DESIGN DRAWINGS, MATERIALS SHALL CONFORM TO THE FOLLOWING SPECIFICATIONS:

   - A. STRUCTURAL STEEL W–SHAPES ——— ASTM A992, Fy=50 ksi
   - B. OTHER STRUCTURAL STEEL SHAPES, PLATES AND BARS ——— ASTM A36 , Fy=36 ksi
   - C. STRUCTURAL STEEL TUBING ——— ASTM A500 GRADE B; Fy=46 ksi
   - D. HIGH STRENGTH BOLTS, NUTS AND WASHERS ——— ASTM A325
   - E. WELDING ELECTRODES ——— AWS A5.1 SERIES E70
4. PAINTING SHALL MATCH THE EXISTING STRUCTURE.
5. FIELD MEASURE AND VERIFY ALL DIMENSIONS AND CONDITIONS BEFORE FABRICATING STEEL.
6. FOR CONNECTION PROBLEMS REPORT TO THE ENGINEER FOR APPROVAL.



DETAIL 4
SCALE: 1 1/2" = 1'–0"



DETAIL 5
SCALE: 1 1/2" = 1'–0"



AECOM
2101 WEBSTER STREET SUITE 1000
OAKLAND, CA 94612-3060

PROJECT NO.
60229232

REFERENCE DRAWINGS

NOTES

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PROFESSIONAL SEAL

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DRAWN BY	K. GRAHAM	1/10/12
CHECKED BY	S. KOLANKAYA	1/10/12
APPROVED BY		
APPROVED BY		

STRUCTURAL DETAILS
HORIZONTAL DECK BRACES

TOPOCK L300–A ARCH BRIDGE

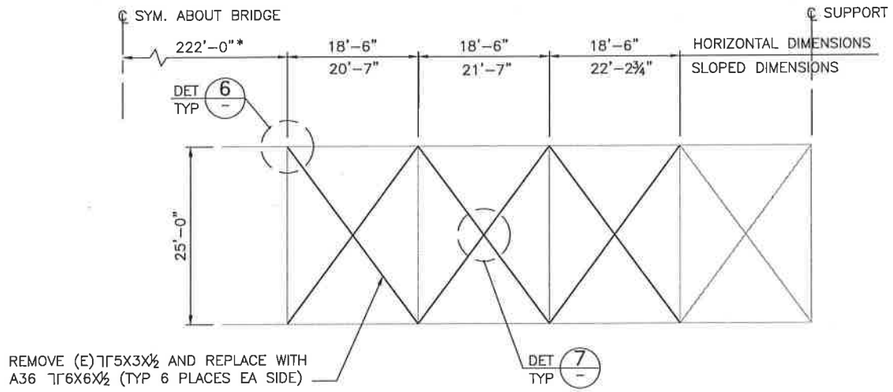
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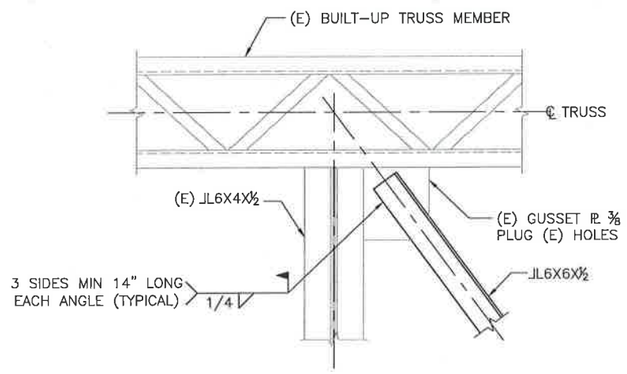
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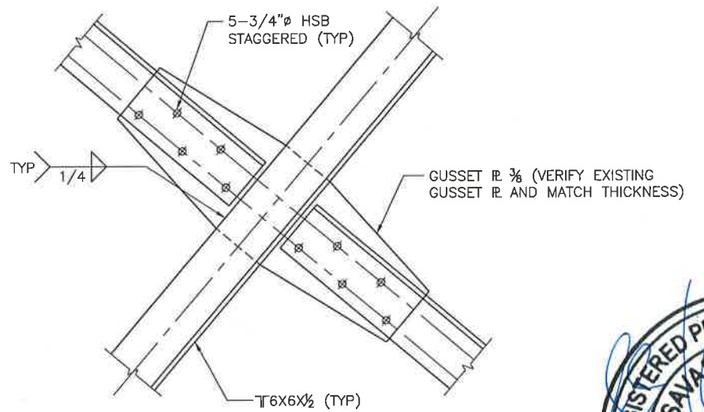
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DETAIL 6 — SCALE: 3/4" = 1'–0"



DETAIL 7 — SCALE: 1 1/2" = 1'–0"

REGISTERED PROFESSIONAL ENGINEER — SAVAS KOLANKAYA — S 3563 — EXP. 12/31/2012 — STRUCTURAL — STATE OF CALIFORNIA

AECOM
2101 WEBSTER STREET SUITE 1900
OAKLAND, CA 94612-3060

PROJECT NO. 60229232

REFERENCE DRAWINGS

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DRAWN BY	K. GRAHAM	1/10/12
CHECKED BY	S. KOLANKAYA	1/10/12
APPROVED BY		
APPROVED BY		

STRUCTURAL DETAILS
BOTTOM CHORD HORIZONTAL BRACES

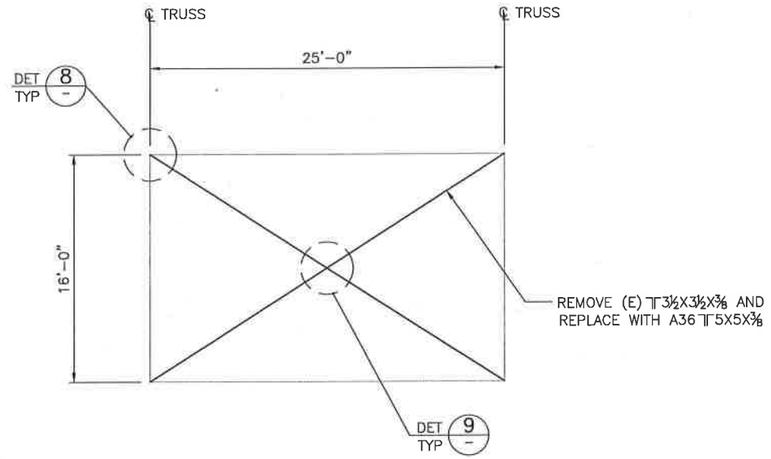
TOPOCK L300–A ARCH BRIDGE

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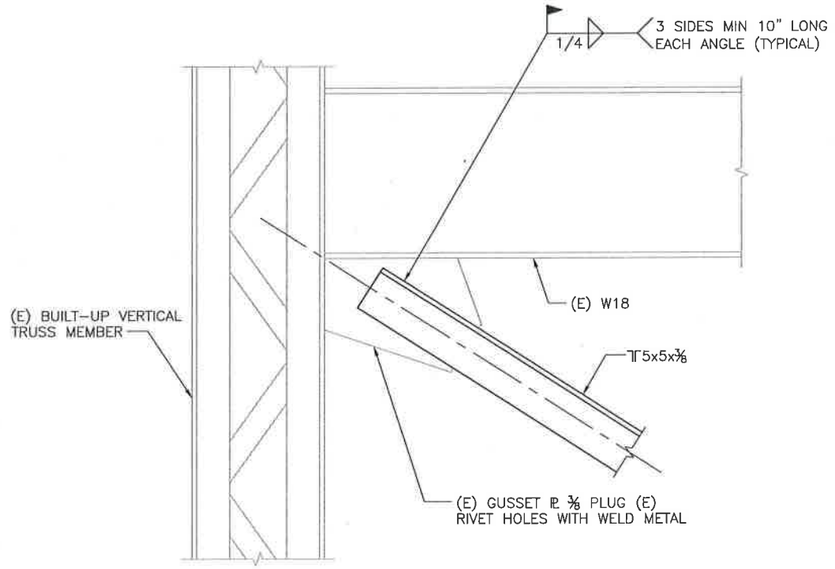
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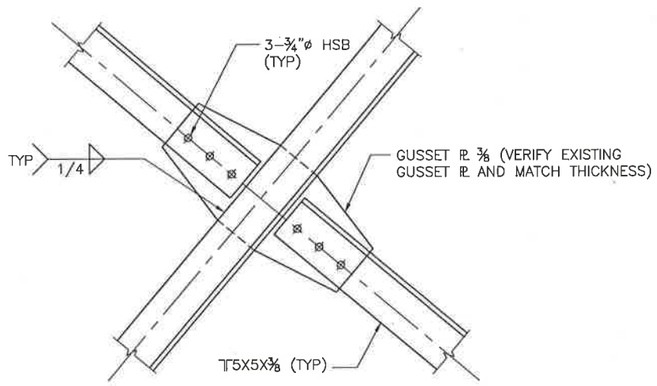
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DETAIL 8
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DETAIL 9
SCALE: 1 1/2" = 1'–0"

REGISTERED PROFESSIONAL ENGINEER
SAVAS KOLANKAYA
S 3563
EXP. 12/31/2012
STRUCTURAL
STATE OF CALIFORNIA

AECOM
2101 WEBSTER STREET SUITE 1000
OAKLAND, CA 94612-3060

PROJECT NO.
60229232

REFERENCE DRAWINGS

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DESIGNED BY	S. KOLANKAYA	1/10/12
DRAWN BY	K. GRAHAM	1/10/12
CHECKED BY	S. KOLANKAYA	1/10/12
APPROVED BY		
APPROVED BY		

STRUCTURAL DETAILS
VERTICAL TRUSS BRACES @ 222'

TOPOCK L300–A ARCH BRIDGE

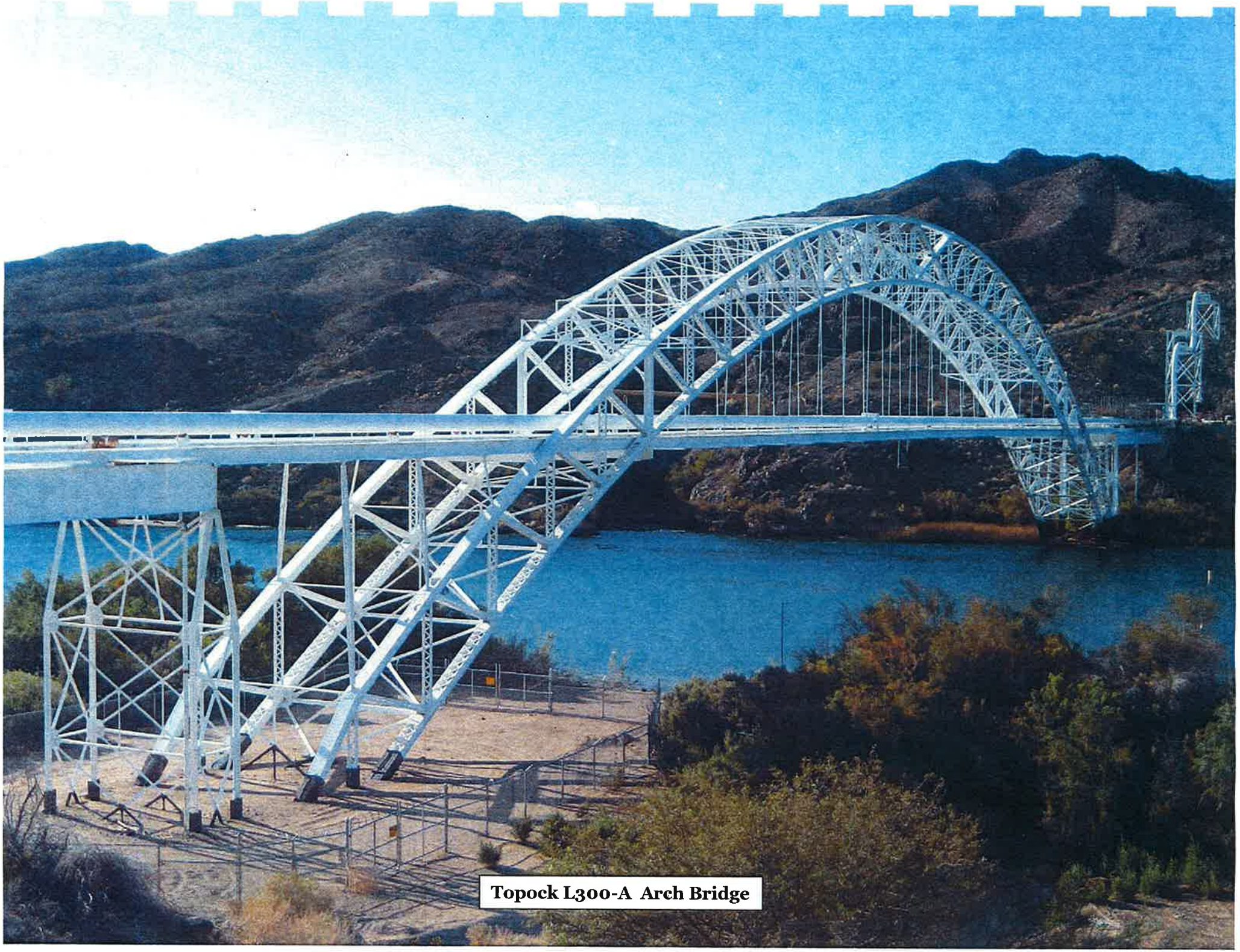
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APPENDIX A

BRIDGE PHOTOS



Topock L300-A Arch Bridge

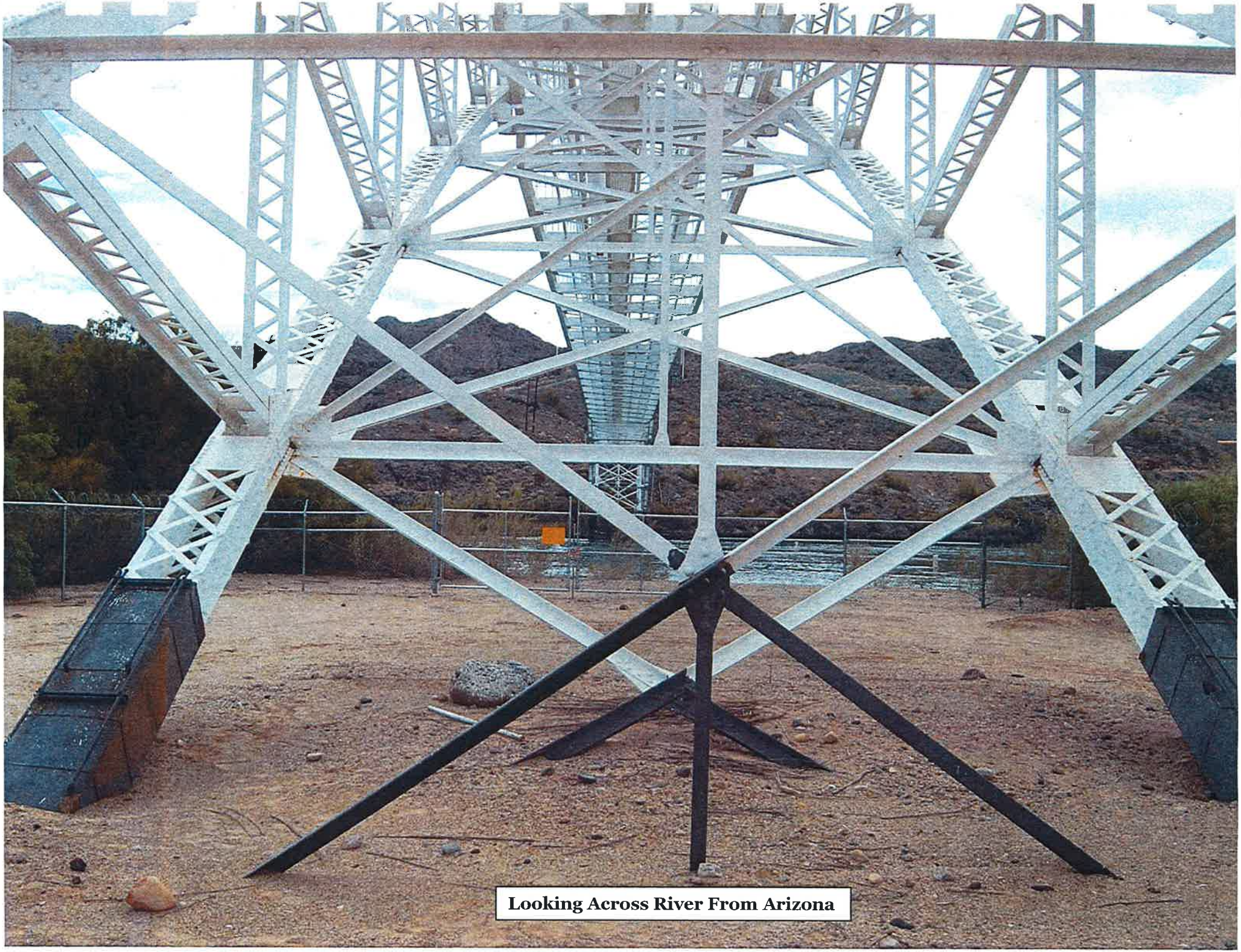


Looking Across River From California



Looking Across the Bridge Deck

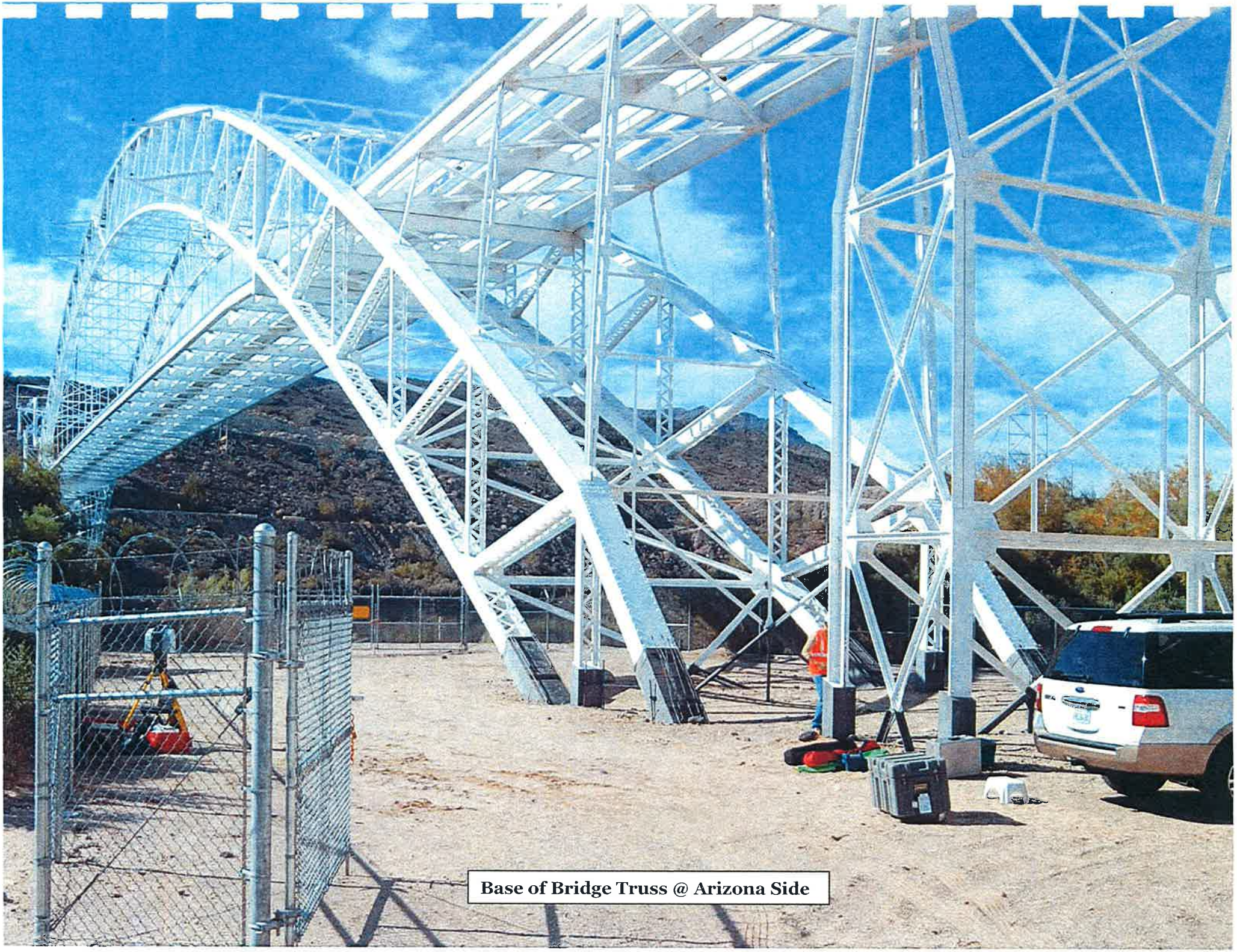

Top Hinge Connection @ Center



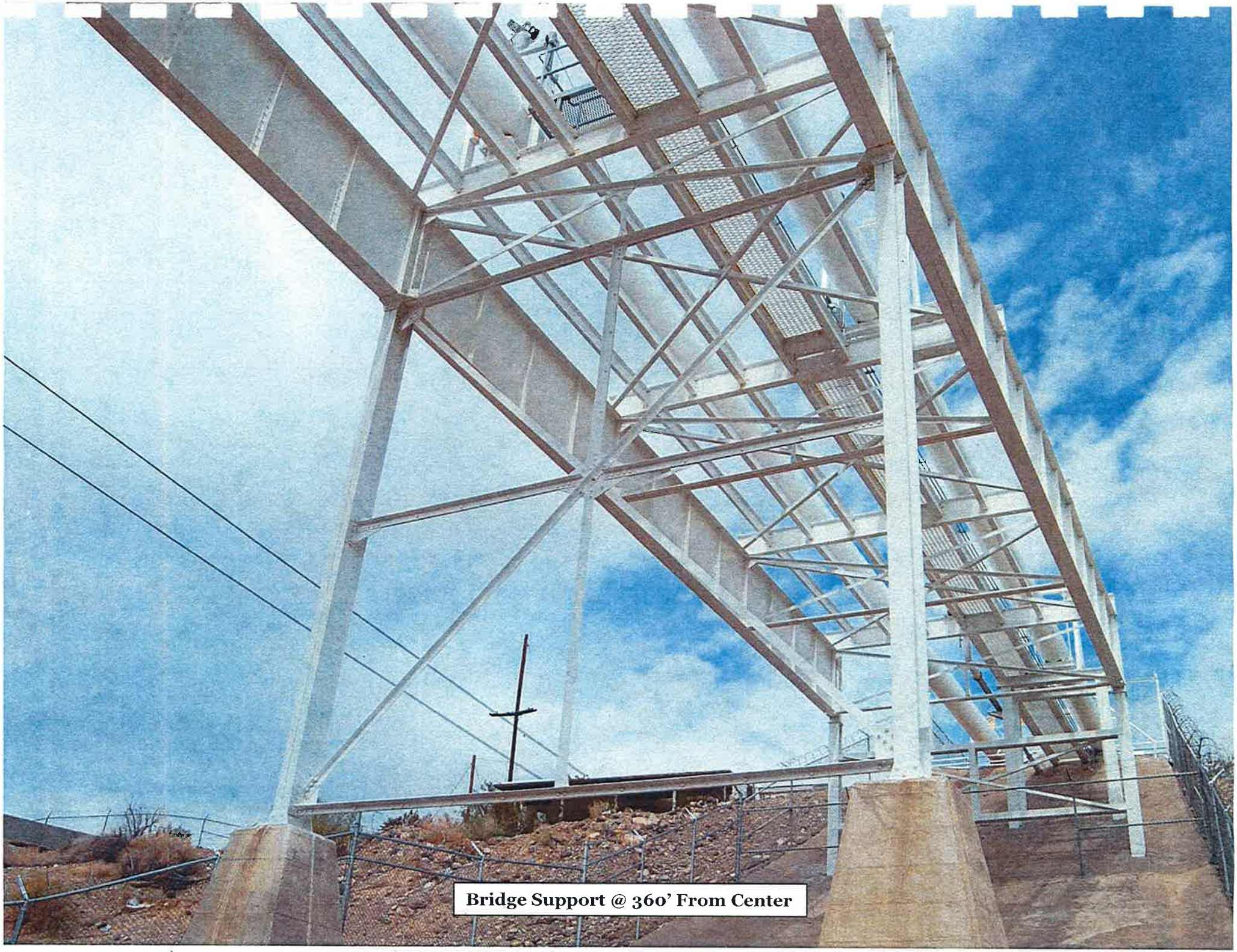
Looking Across River From Arizona



Underside View



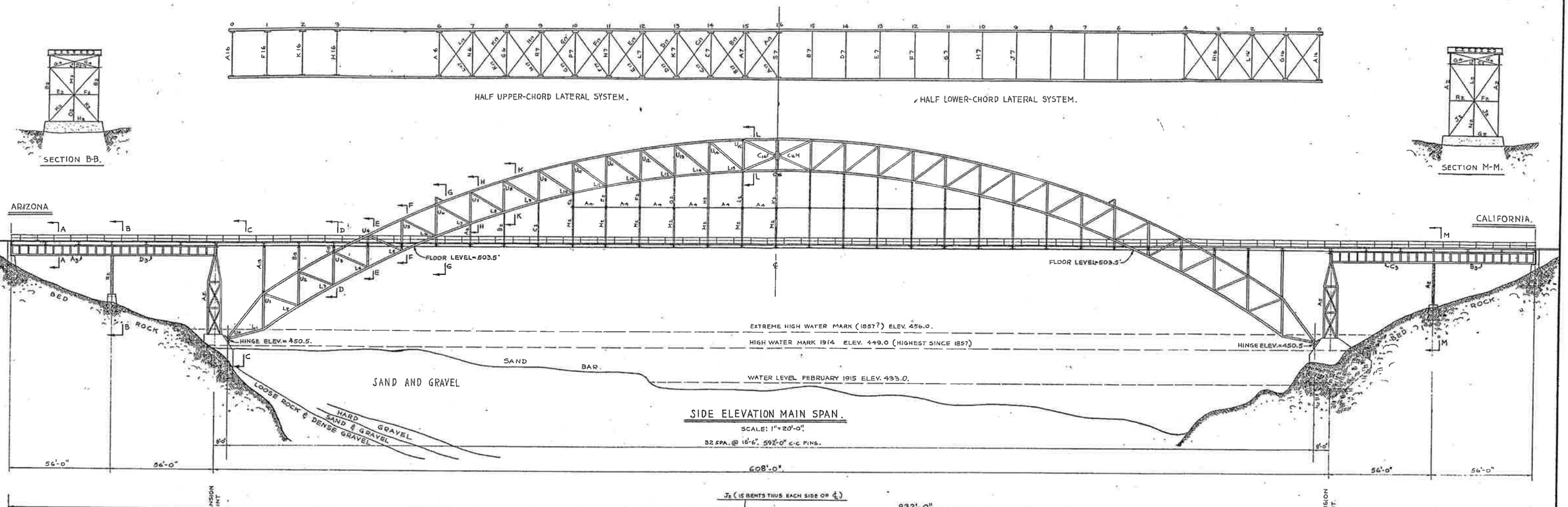
Base of Bridge Truss @ Arizona Side



Bridge Support @ 360' From Center

APPENDIX B

DESIGN INPUT



NOTE:
RETRACED FROM KANSAS-CITY STRUCTURAL STEEL CO'S DWG.
ORDER 7744-7745-7746.

REFERENCES
SHOP DETAILS DWG: # F-1589.

SCANNED

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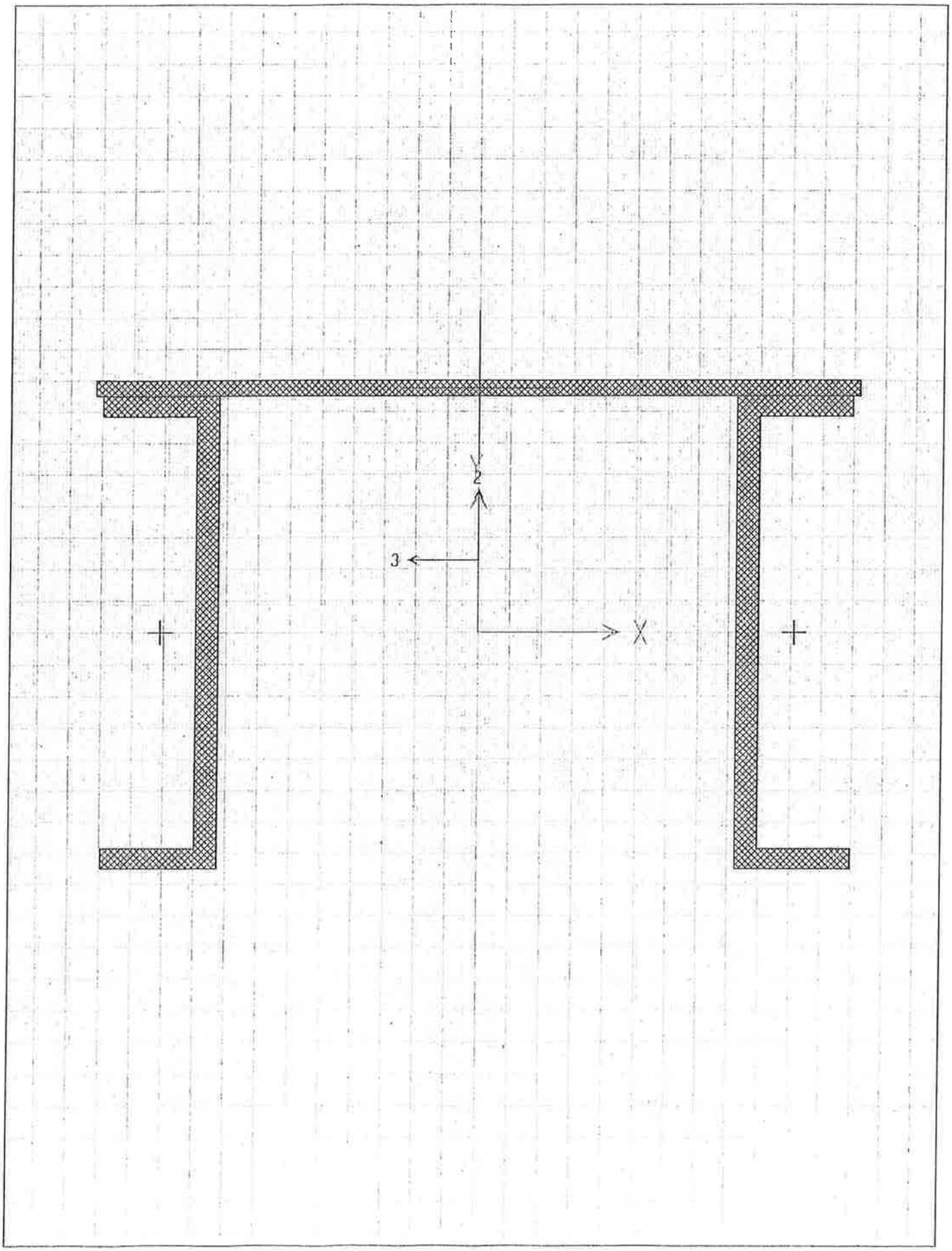
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GM 707-688. DRAWING LIST
BY Dept of G.O. DR. W.F. Peckhoff CH. Stone
CK.
DATE 6-16-50
SCALES As Shown.

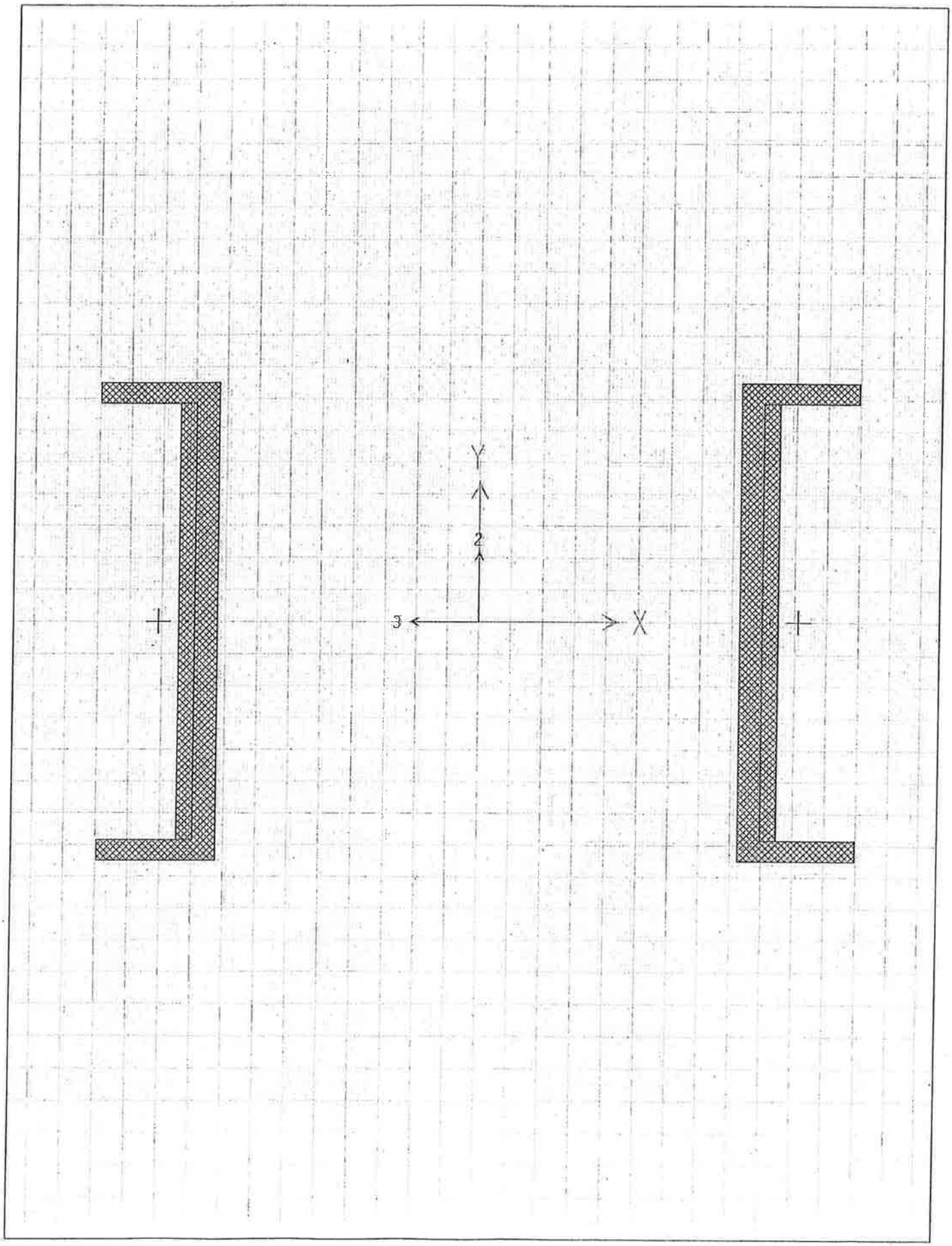
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COLORADO RIVER HIGHWAY BRIDGE
TOPOCK-MILPITAS, MAIN 300

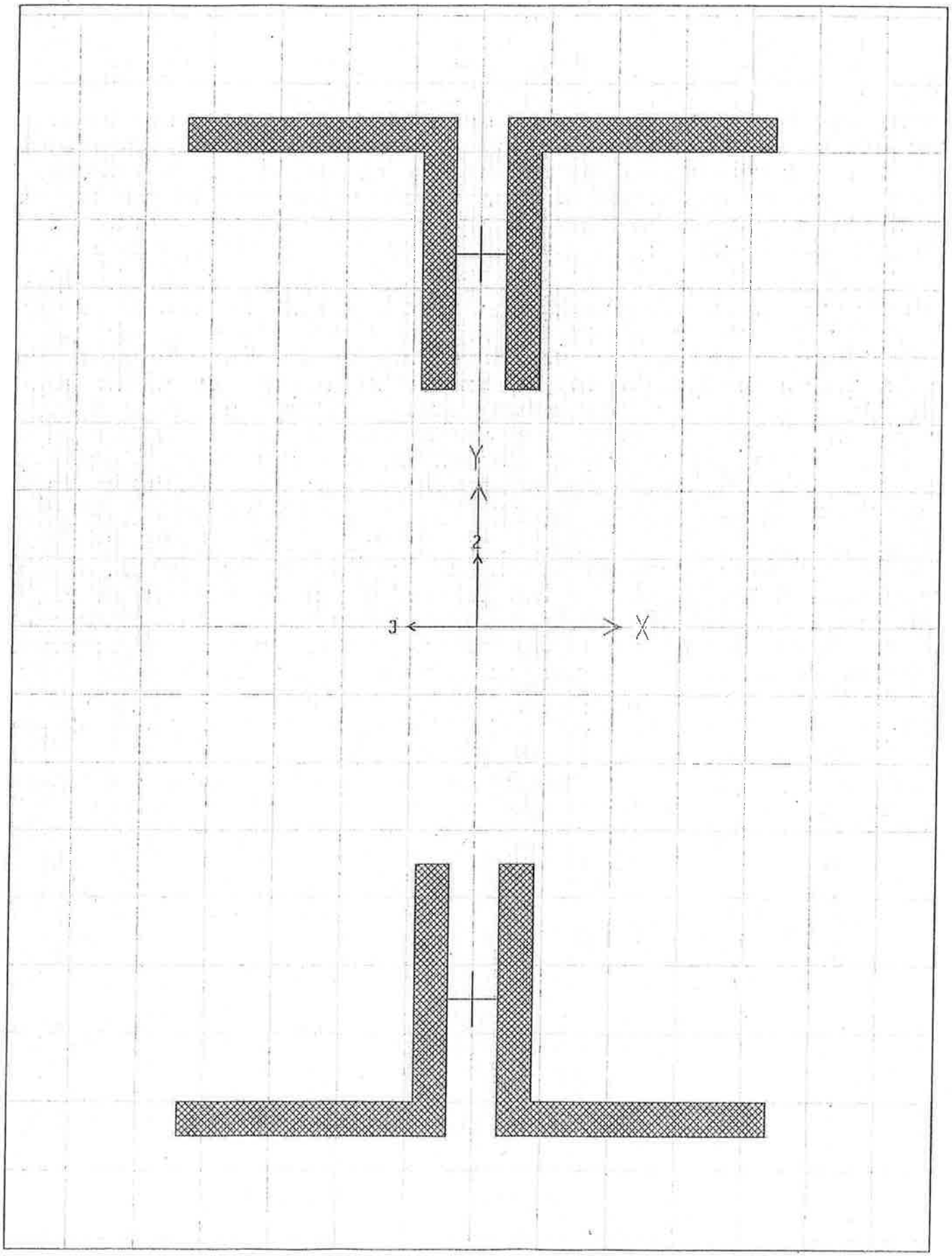
DEPARTMENT OF GAS OPERATION
PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO CALIFORNIA

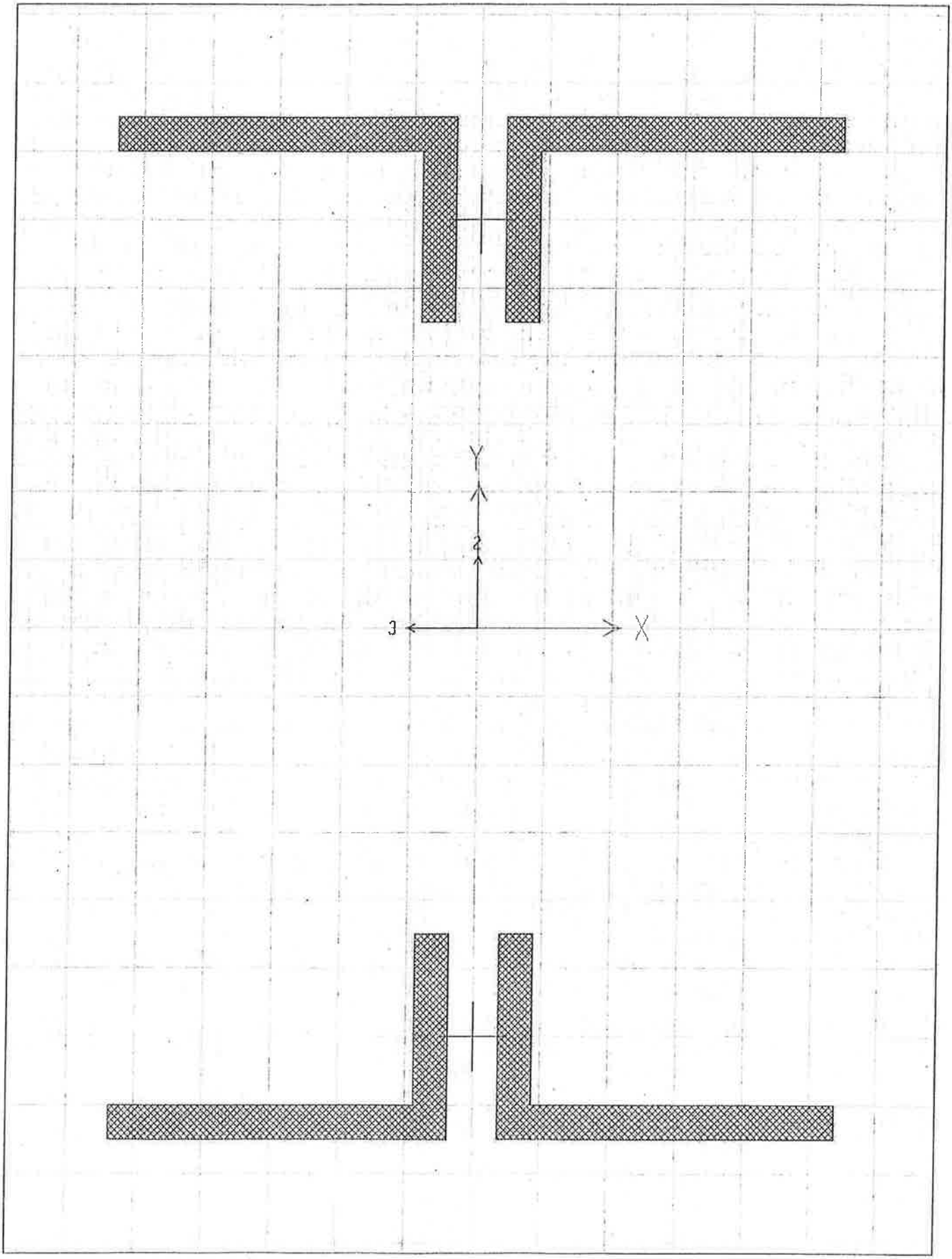
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SUPERSEDES
SUPERSEDED BY
SHEET NO. SHEETS
DRAWING NUMBER CHANGE
481620

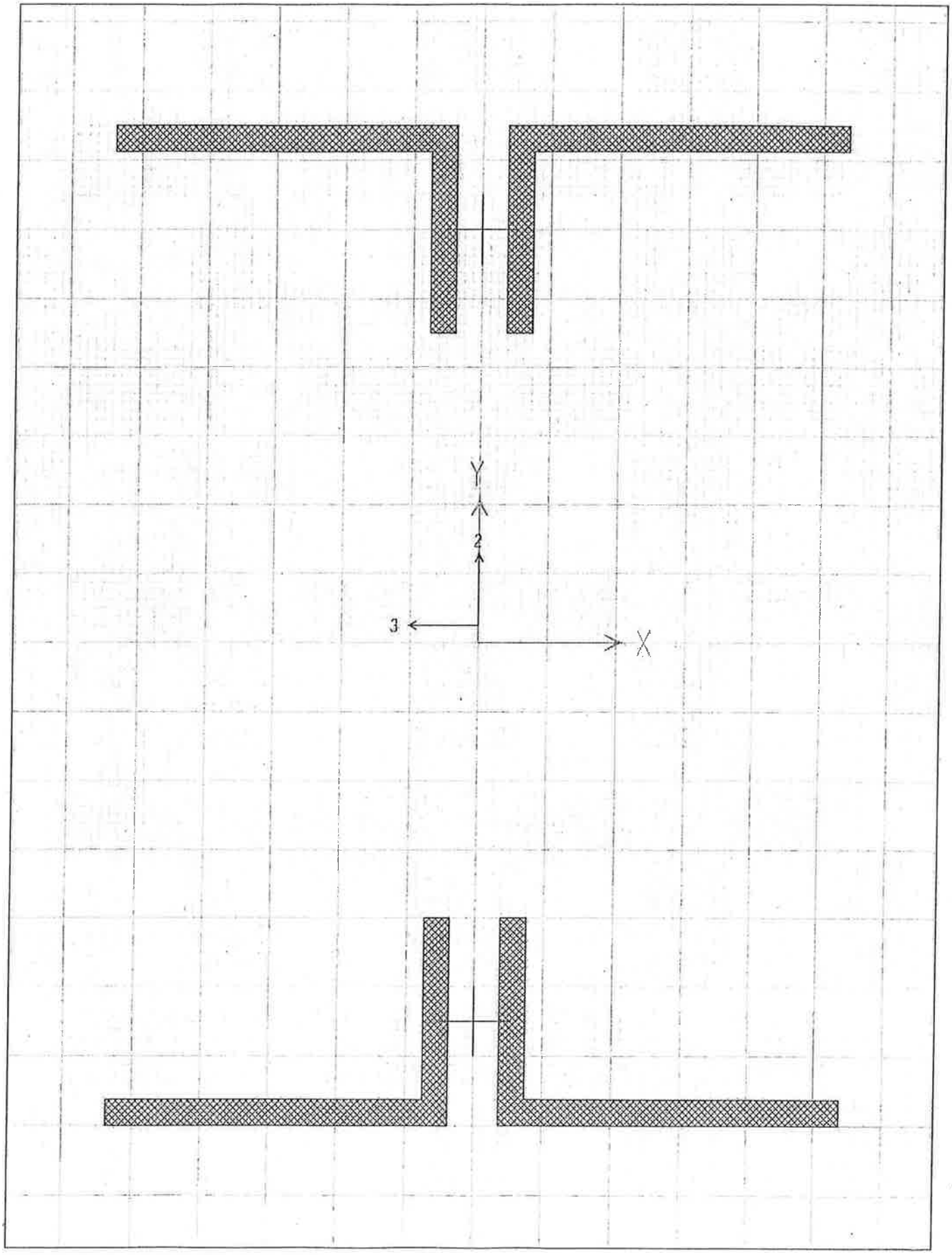
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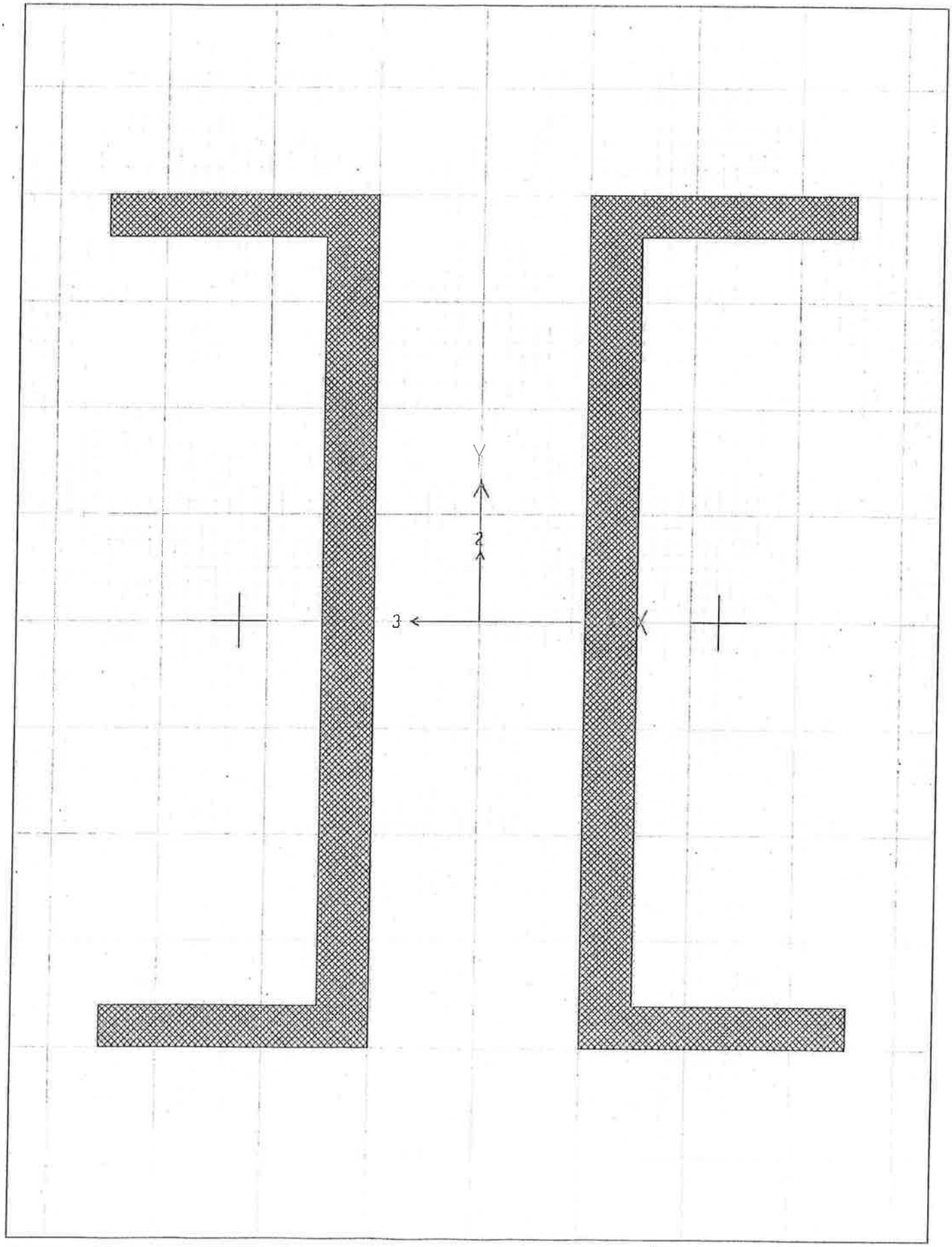

2
3
X

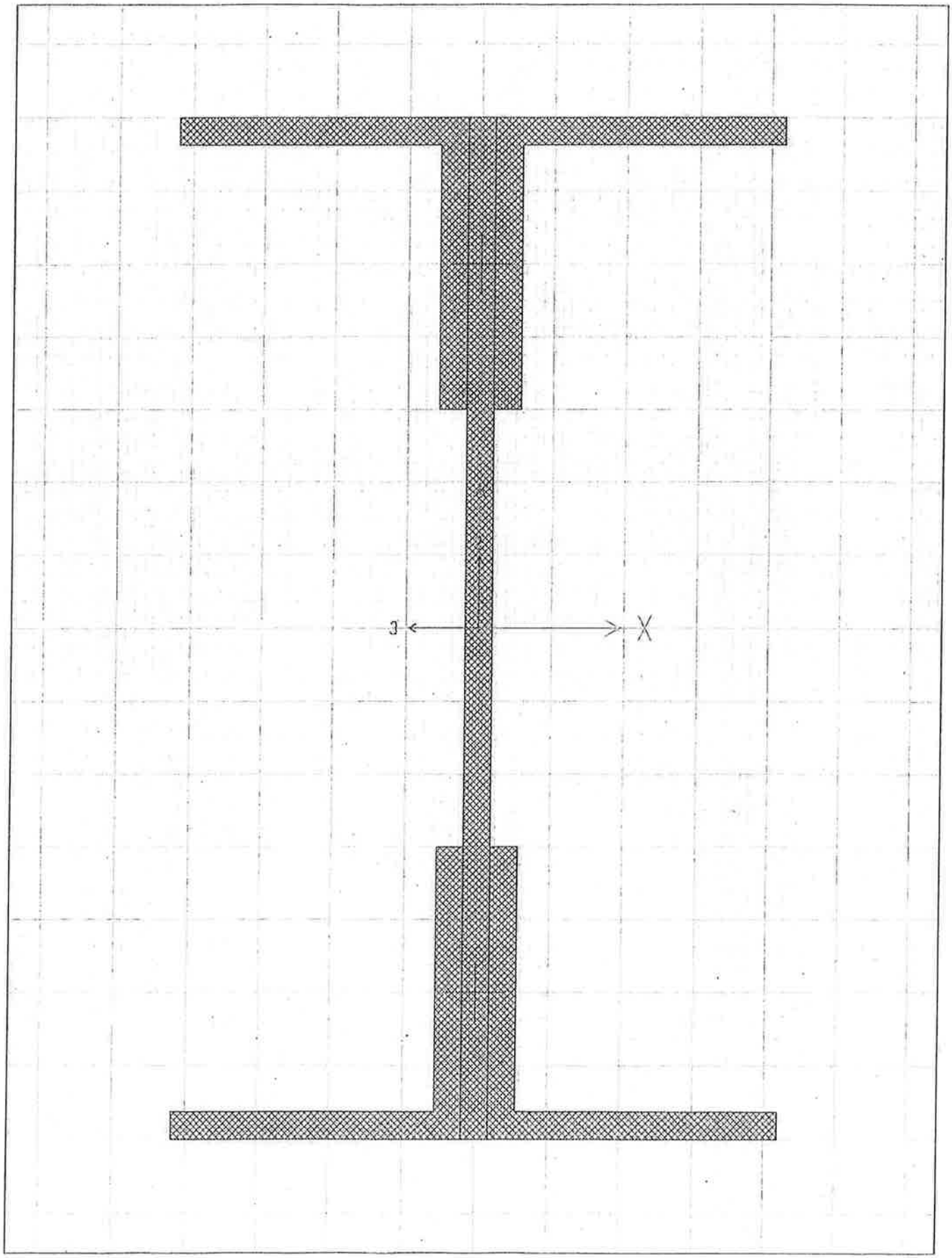

Y
2
X


Y
2
3
X


Y
2
3
X


Y
2
3
X


Y
2
3
X


2
3
X

APPENDIX C

DESIGN LOADS

AECOM

PROJECT: Topock Compressor Station | PAGE:
CLIENT: PG&E | DESIGN BY:
JOB NO.: | DATE: | REVIEW BY:

ASCE 7-05 Wind Load Calculation for Non-building Equipment Supported at Grade

Basic Wind Speed, V = 90 (mph) (Figure 6-1)

Exposure Category = C (Section 6.5.6.3)

Important Factor, Iw = 1.15 (Section 6.5.5 & table 6-1 for category IV structure)

Topographic Factor, Kzt = 1 (Section 6.5.7.2) -- Flat

Wind directional Factor, Kd = 0.95 (Table 6-4, consevatively use the Max. value)

Velocity Pressure Coefficient, Kz (Table 6-3)

Exposure C

Elevation (ft)	Kz
0 - 15	0.85
20	0.9
25	0.94
30	0.98
40	1.04
50	1.09
60	1.13
70	1.17

Velocity Pressure, qz = 0.00256 * Kz * Kzt * Kd * Iw * V^2 (section 6.5.10)

Elevation (ft)	qz (psf)
0 - 15	19.26
20	20.39
25	21.29
30	22.20
40	23.56
50	24.69
60	25.60
70	26.51

Net Force Coefficient, Cf = 1.4 (Figure 6-21, h/D < or = 7 for various cross section)

Gust Factor, G = 0.85 (Section 6.5.8.1)

Desing Wind Pressure, P = qz * G * Cf

Elevation (ft)	P (psf)
0 - 15	22.91
20	24.26
25	25.34
30	26.42
40	28.04
50	29.38
60	30.46
70	31.54

AECOM	Job Title:	Topock L300-A Arch Bridge			Subject:	Seismic Loads
	Job No:					
	Prepared By:		Date:			
	Checked By:		Date:			

SEISMIC LOADS

Seismic Parameters:

Site Location: Latitude = 34.714225 Longitude = -114.493332

Mapped Spectral Response Acceleration: $S_S := 0.216$ $S_1 := 0.133$

Site Class D

Site Coefficients: $F_a := 1.6$ $F_v := 2.268$

Design Spectral Response Acceleration: $S_{DS} := 0.231$ $S_{D1} := 0.201$

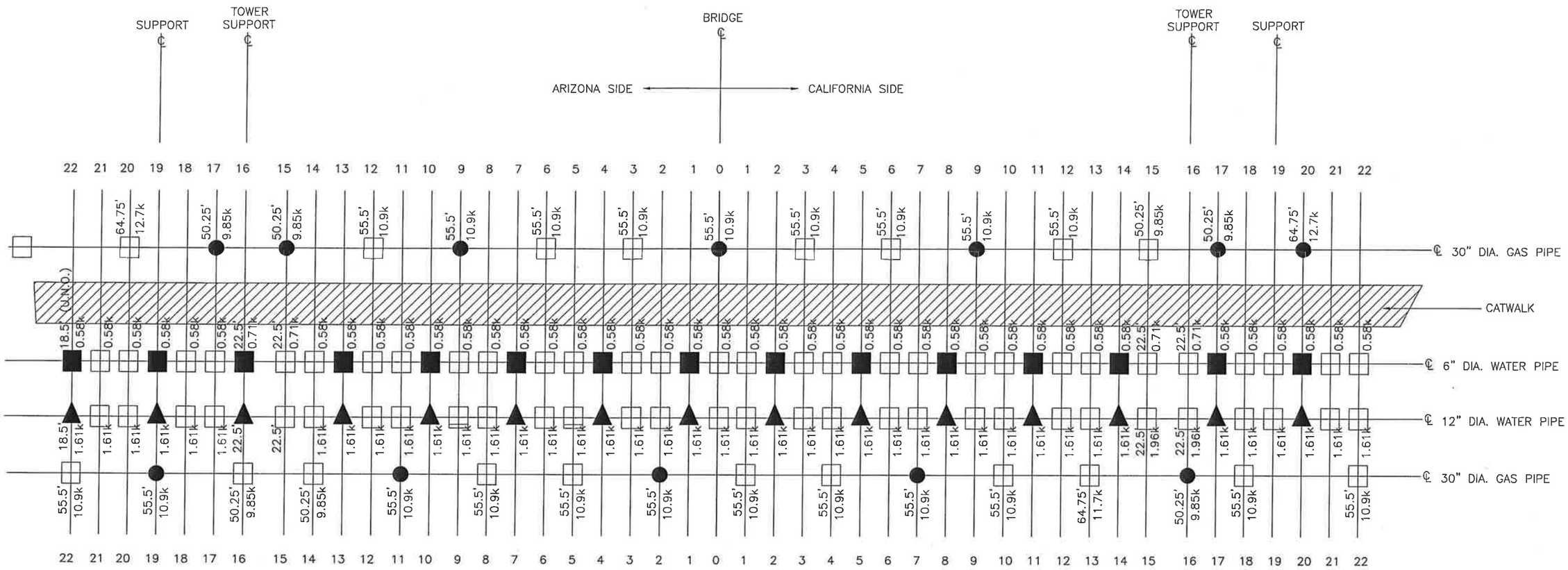
Seismic Occupancy Category IV

Importance Factor: $I_E := 1.5$

Seismic Response Coefficient:

Response Modification Coefficient: $R := 3$

$$C_S := \frac{S_{DS}}{\left(\frac{R}{I_E}\right)} \qquad C_S = 0.116$$



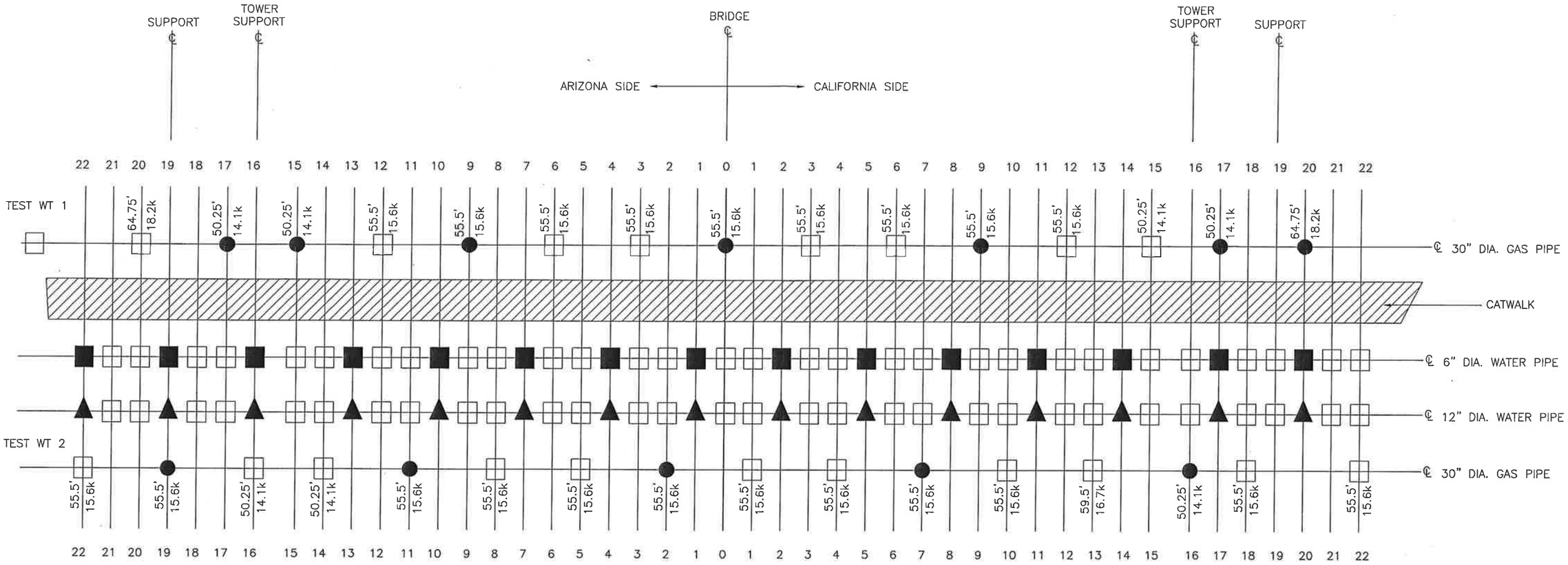
DEAD LOADS

30"ø GAS PIPE = 196 #/FT (EMPTY)

6"ø WATER PIPE = 31.5 #/FT (INCL. WATER)

12"ø WATER PIPE = 87 #/FT (INCL. WATER)

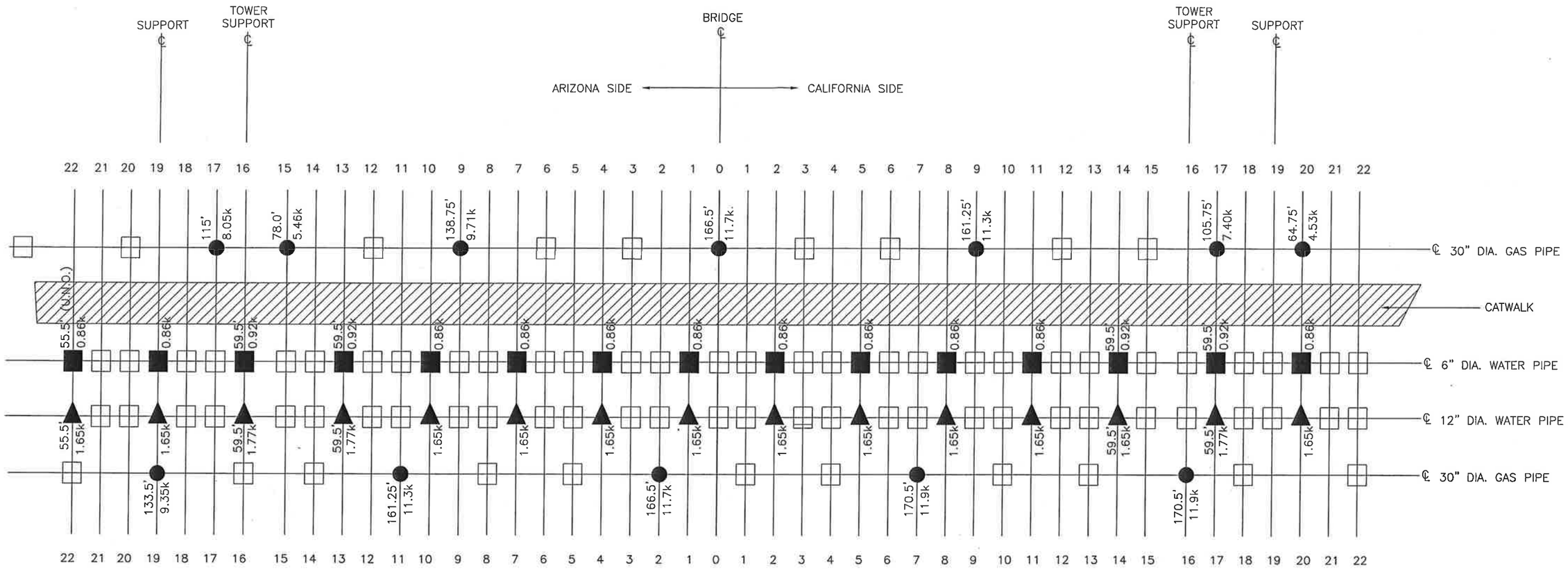
- VERTICAL SUPPORT ONLY FOR (6" 12" & 30" PIPES)
- VERTICAL & HORIZONTAL SUPPORT FOR 30" PIPE
- VERTICAL & HORIZONTAL SUPPORT FOR 6" PIPE
- VERTICAL & HORIZONTAL SUPPORT FOR 12" PIPE



TEST LOADS

30"ø GAS PIPE = 281 #/FT (WT OF WATER ONLY)

- □ VERTICAL SUPPORT ONLY FOR (6" 12" & 30" PIPES)
- ● VERTICAL & HORIZONTAL SUPPORT FOR 30" PIPE
- ■ VERTICAL & HORIZONTAL SUPPORT FOR 6" PIPE
- ▲ VERTICAL & HORIZONTAL SUPPORT FOR 12" PIPE



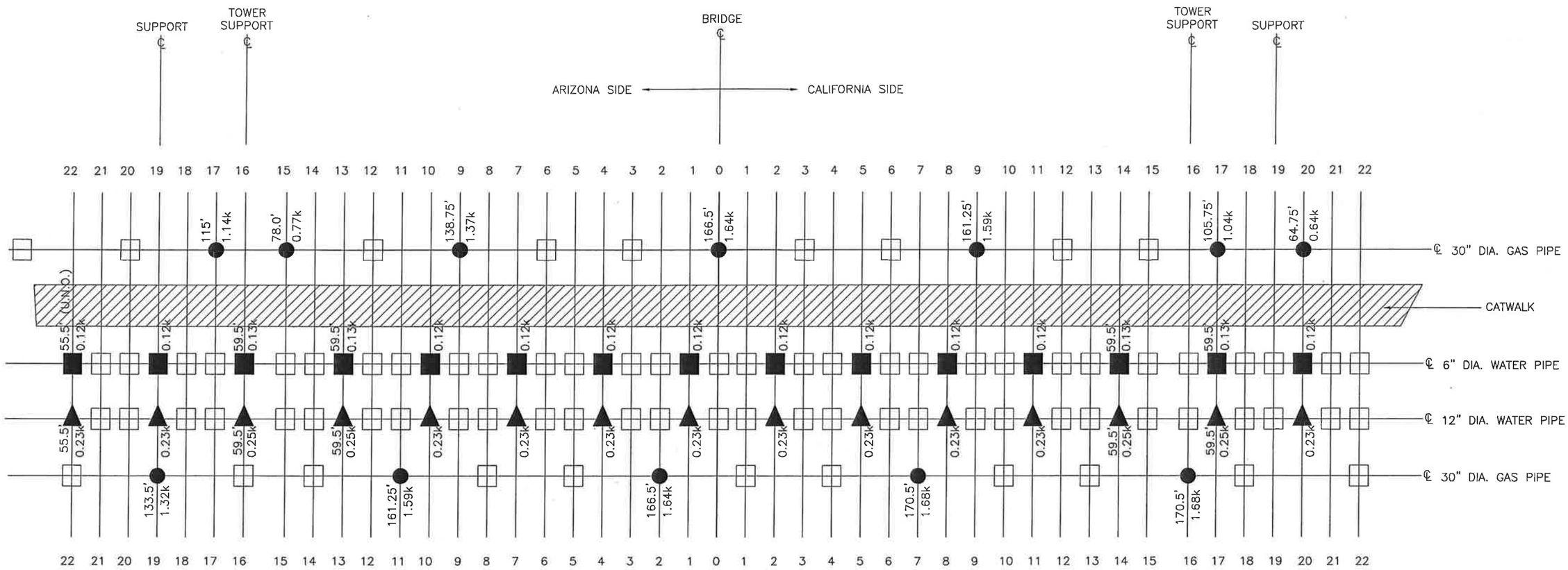
PIPE WIND LOADS

30"ø GAS PIPE = 28 PSF*(30"/12) = 70 #/FT

6"ø WATER PIPE = 28 PSF*(6.625"/12) = 15.5 #/FT

12"ø WATER PIPE = 28 PSF*(12.75"/12) = 29.75 #/FT

- VERTICAL SUPPORT ONLY FOR (6" 12" & 30" PIPES)
- VERTICAL & HORIZONTAL SUPPORT FOR 30" PIPE
- VERTICAL & HORIZONTAL SUPPORT FOR 6" PIPE
- VERTICAL & HORIZONTAL SUPPORT FOR 12" PIPE



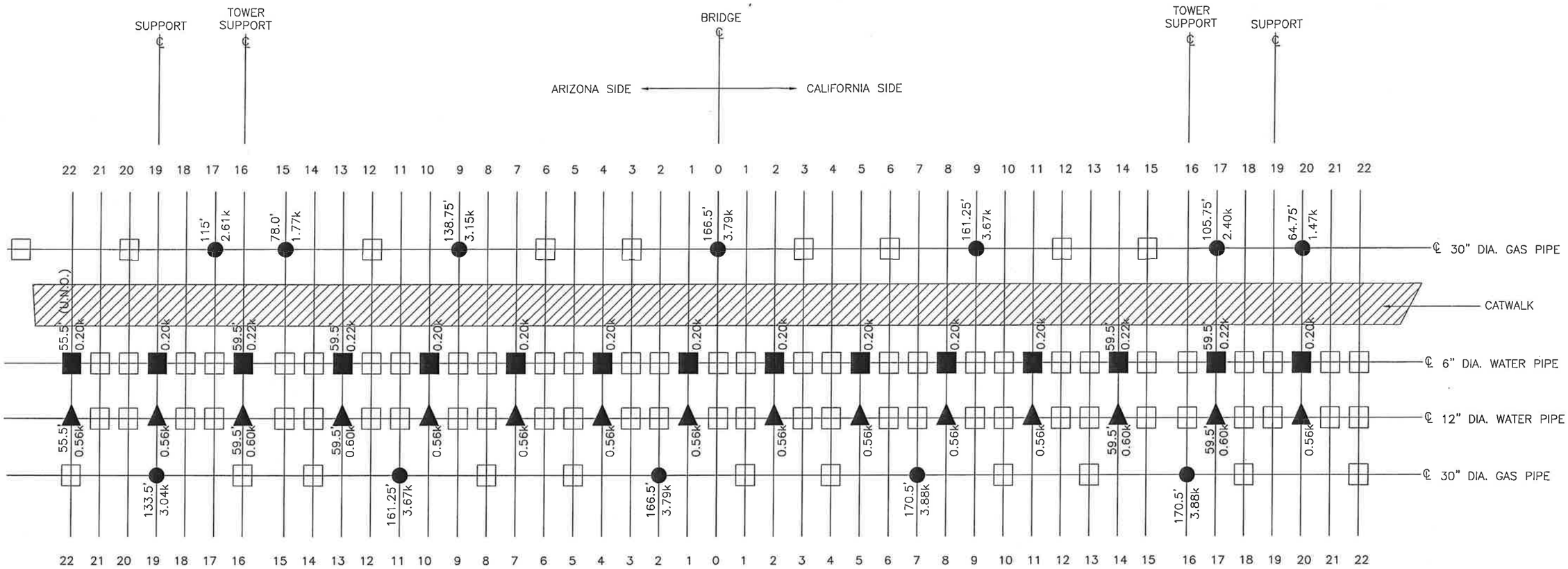
TEST PIPE WIND LOADS

30"ø GAS PIPE = 3.95 PSF*(30"/12) = 9.875 #/FT

6"ø WATER PIPE = 3.95 PSF*(6.625"/12) = 2.18 #/FT

12"ø WATER PIPE = 3.95 PSF*(12.75"/12) = 4.20 #/FT

- VERTICAL SUPPORT ONLY FOR (6" 12" & 30" PIPES)
- VERTICAL & HORIZONTAL SUPPORT FOR 30" PIPE
- VERTICAL & HORIZONTAL SUPPORT FOR 6" PIPE
- VERTICAL & HORIZONTAL SUPPORT FOR 12" PIPE



PIPE EQ LOADS

V = 0.116*DEAD LOAD

- VERTICAL SUPPORT ONLY FOR (6" 12" & 30" PIPES)
- VERTICAL & HORIZONTAL SUPPORT FOR 30" PIPE
- VERTICAL & HORIZONTAL SUPPORT FOR 6" PIPE
- VERTICAL & HORIZONTAL SUPPORT FOR 12" PIPE

APPENDIX D

CONSTRUCTION DRAWINGS

HALF UPPER-CHORD LATERAL SYSTEM.

HALF LOWER-CHORD LATERAL SYSTEM.

DETAIL (2) TYP. EACH SIDE 48(620-SH2

SECTION B-B.

SECTION M-M.

ARIZONA

CALIFORNIA

FLOOR LEVEL=503.5'

FLOOR LEVEL=503.5'

BED ROCK

BED ROCK

HINGE ELEV.=450.5.

HINGE ELEV.=450.5

EXTREME HIGH WATER MARK (1857?) ELEV. 456.0.

HIGH WATER MARK 1914 ELEV. 449.0 (HIGHEST SINCE 1857)

WATER LEVEL FEBRUARY 1915 ELEV. 433.0.

SAND BAR.

SAND AND GRAVEL

LOOSE ROCK & DENSE GRAVEL

HARD SAND & GRAVEL

GRAVEL

SIDE ELEVATION MAIN SPAN.

SCALE: 1"=20'-0".

32 SPA. @ 18'-6", 592'-0" C-C PINS.

56'-0" 56'-0" 608'-0" 56'-0" 56'-0"

DETAIL (1) TYP. EACH SIDE 48(620-SH1

EXPANSION JOINT

GIRD B3 GIRD C3 GIRD A3 GIRD D3

J_2 (15 BENTS THUS EACH SIDE OF ℄)

832'-0"

EXPANSION JOINT

GIRD A3 GIRD D3 GIRD C3 GIRD B3

DETAIL (3) TYP. 2 PLACES 48(620-SH3

FLOOR SYSTEM

SECTION A-A.

SECTION D-D.

SECTION E-E.

SECTION F-F.

SECTION G-G.

SECTION H-H.

SECTION K-K.

SECTION L-L.

SECTION C-C.

SIDE VIEW

HALF FLOOR SECTION THRU TRUSSES.

HALF TYPICAL FLOOR SECTION.

(SECTION THROUGH TRUSSES)

HALF LONGITUDINAL FLOOR SECTION.

EXPANSION

TYPICAL CURB SPLICE

REGISTERED PROFESSIONAL ENGINEER SAVAS KOLIMBATA S 3563 EXP. 12/31/2012 STRUCTURAL STATE OF CALIFORNIA

MODIFICATIONS ONLY

NOTE:
RETRACED FROM KANSAS-CITY STRUCTURAL STEEL CO.'S DWG.
ORDER 7744-7745-7746.

REFERENCES
SHOP DETAILS DWG: # F-1589.

SCANNED

NO	DATE	DESCRIPTION	APPRD
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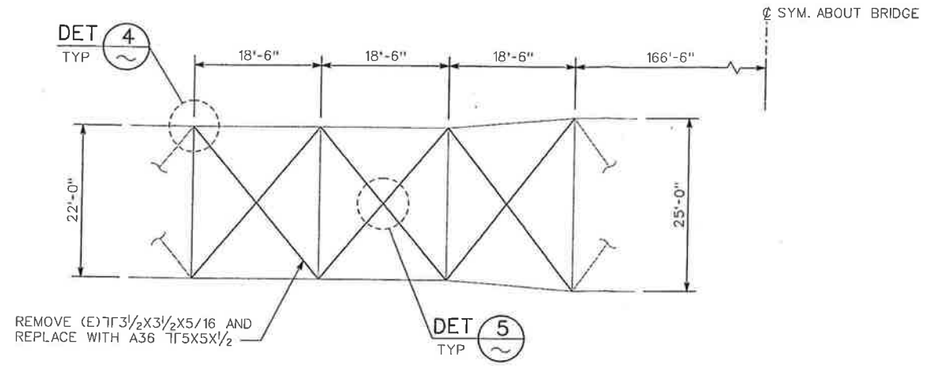
TABLE OF CHANGES

APPROVED BY GM 10/6/88.
DRAWING LIST
BY Dept. of G.O.
DR. W. Frankhoff
CH. Asst.
DA.
DATE 6-10-88
SCALES As Shown.

ERECTION PLAN
COLORADO RIVER HIGHWAY BRIDGE
TOPOCK-MILPITAS, MAIN 300
DEPARTMENT OF GAS OPERATION
PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO CALIFORNIA

BILL OF MATERIAL
SUPERSEDES
SUPERSEDED BY
SHEET NO. SHEETS
DRAWING NUMBER CHANGE
481620 1

481620-1-1-88

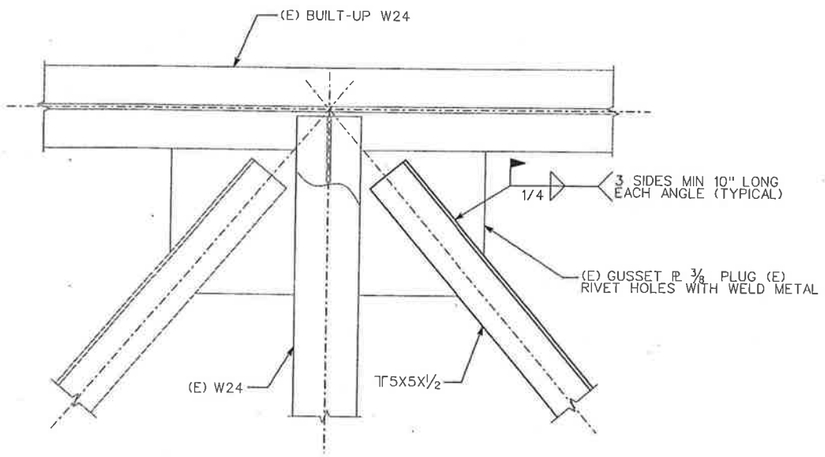


HORIZONTAL DECK BRACES

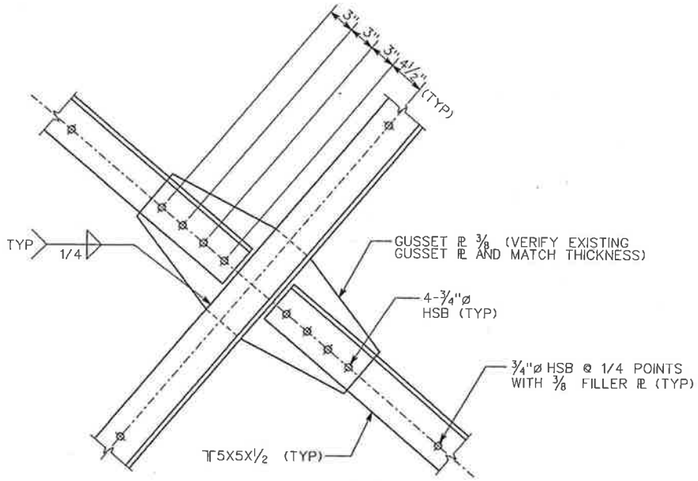
DETAIL 1 — SCALE: 3/32"=1'-0" — 481620 / 481620-SH1

NOTES

1. FOR LOCATION SEE DWG 481620.
2. CODES AND SPECIFICATIONS
   - A. INTERNATIONAL BUILDING CODE IBC-2009
   - B. MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES, ASCE 7-05
   - C. AISC MANUAL OF STEEL CONSTRUCTION, 13TH EDITION
   - D. AISC SPECIFICATION FOR STRUCTURAL STEEL BUILDINGS, MARCH 9, 2005 (ANSI/AISC 360-05)
   - E. AISC SEISMIC PROVISIONS FOR STRUCTURAL STEEL BUILDINGS (ANSI/AISC 341)
   - F. AWS D1.5, BRIDGE WELDING CODE - AMERICAN WELDING SOCIETY.
   - G. AWS D1.8, STRUCTURAL WELDING CODE - SEISMIC SUPPLEMENT, AMERICAN WELDING SOCIETY
   - H. SPECIFICATIONS FOR STRUCTURAL JOINTS USING ASTM A325 OR A490 BOLTS, JUNE 30, 2004 HEREIN REFERRED TO AS THE RCSC SPECIFICATION
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   - B. OTHER STRUCTURAL STEEL SHAPES, PLATES AND BARS — ASTM A36, Fy=36 KSI
   - C. STRUCTURAL STEEL TUBING — ASTM A500 GRADE B, Fy=46 KSI
   - D. HIGH STRENGTH BOLTS, NUTS AND WASHERS — ASTM 325
   - E. HIGH STRENGTH STRUCTURAL STEEL RIVETS — ASTM A588, GRADE 3
   - F. WELDING ELECTRODES — AWS A5.1, SERIES E70
4. PAINTING SHALL MATCH THE EXISTING STRUCTURE.
5. FIELD MEASURE AND VERIFY ALL DIMENSIONS AND CONDITIONS BEFORE FABRICATING STEEL.
6. FOR CONNECTION PROBLEMS REPORT TO THE ENGINEER FOR APPROVAL.
7. CONTRACTOR SHALL CHECK WELDABILITY OF EXISTING STEEL PLATES BEFORE WELDING STEEL BRACES.
8. CONTRACTOR SHALL NOT REMOVE BRACING IN MORE THAN ONE BAY AT A TIME BEFORE INSTALLATION OF NEW BRACES.



DETAIL 4 — SCALE: 1½"=1'-0"



DETAIL 5 — SCALE: 1½"=1'-0"

DRAWING REFERENCES:

481620 —— ERECTION PLAN

REGISTERED PROFESSIONAL ENGINEER SAVAS KOLANKAYA S 3563 EXP. 12/31/2012 STRUCTURAL STATE OF CALIFORNIA

AECOM
2101 WEBSTER STREET SUITE 1000
OAKLAND, CA 94612-3060
PROJECT NO. 60229232

NO.	DATE	DESCRIPTION	GM/SPEC	DWN	CHKD	SUPV	APVD BY
0	02-03-12	ISSUED FOR CONSTRUCTION		KG	SK		

REVISIONS

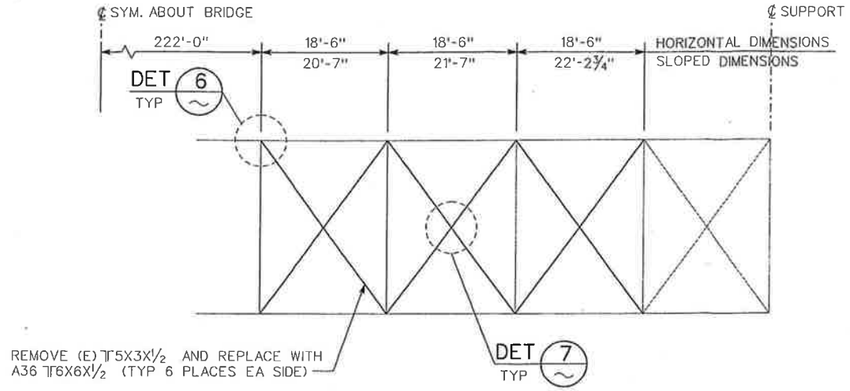
APPROVED BY: SO, SUPV, DSGNS. KOLANKAYA, DWN K. GRAHAM, CHKDS. KOLANKAYA, OK, DATE 02-03-12, SCALES AS NOTED

STRUCTURE - DETAILS
ARCH BRIDGE MODIFICATIONS
300A TRANSMISSION LINE

GAS TRANSMISSION & DISTRIBUTION
PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

MICROFILM
BILL OF MATL
DWG LIST
SUPSDS
SUPSD BY
SHEET NO. 481620-SH1 OF SHEETS
REV 0

FILENAME: 481620-SH1.DGN 02-03-12

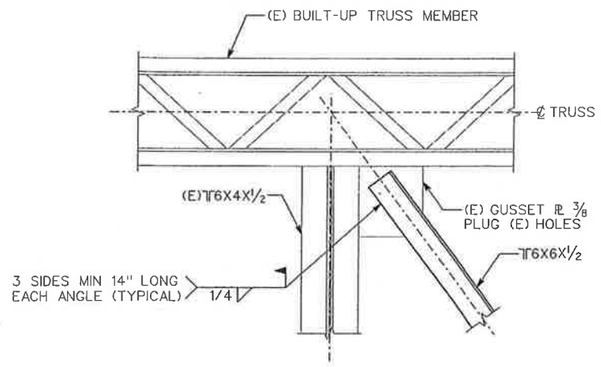


BOTTOM CHORD HORIZONTAL BRACES

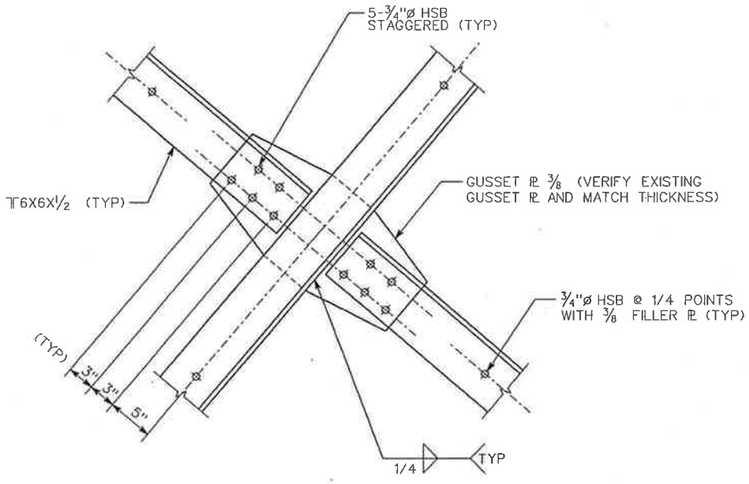
DETAIL 2 — 481620
SCALE: 3/32"=1'-0" — 481620-SH2

NOTES

1. FOR LOCATION SEE DWG 481620.
2. CODES AND SPECIFICATIONS
   - A. INTERNATIONAL BUILDING CODE IBC-2009
   - B. MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES, ASCE 7-05
   - C. AISC MANUAL OF STEEL CONSTRUCTION, 13TH EDITION
   - D. AISC SPECIFICATION FOR STRUCTURAL STEEL BUILDINGS, MARCH 9, 2005 (ANSI/AISC 360-05)
   - E. AISC SEISMIC PROVISIONS FOR STRUCTURAL STEEL BUILDINGS (ANSI/AISC 341)
   - F. AWS D1.5, BRIDGE WELDING CODE - AMERICAN WELDING SOCIETY.
   - G. AWS D1.8, STRUCTURAL WELDING CODE - SEISMIC SUPPLEMENT, AMERICAN WELDING SOCIETY
   - H. SPECIFICATIONS FOR STRUCTURAL JOINTS USING ASTM A325 OR A490 BOLTS, JUNE 30, 2004 HEREIN REFERRED TO AS THE RCSC SPECIFICATION
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   - C. STRUCTURAL STEEL TUBING — ASTM A500 GRADE B, Fy=46 KSI
   - D. HIGH STRENGTH BOLTS, NUTS AND WASHERS — ASTM 325
   - E. HIGH STRENGTH STRUCTURAL STEEL RIVETS — ASTM A588, GRADE 3
   - F. WELDING ELECTRODES — AWS A5.1, SERIES E70
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5. FIELD MEASURE AND VERIFY ALL DIMENSIONS AND CONDITIONS BEFORE FABRICATING STEEL.
6. FOR CONNECTION PROBLEMS REPORT TO THE ENGINEER FOR APPROVAL.
7. CONTRACTOR SHALL CHECK WELDABILITY OF EXISTING STEEL PLATES BEFORE WELDING STEEL BRACES.
8. CONTRACTOR SHALL NOT REMOVE BRACING IN MORE THAN ONE BAY AT A TIME BEFORE INSTALLATION OF NEW BRACES.



DETAIL 6
SCALE: ¾"=1'-0"



DETAIL 7
SCALE: 1½"=1'-0"

DRAWING REFERENCES:

481620 —— ERECTION PLAN

REGISTERED PROFESSIONAL ENGINEER
SAVAS KOLANKAYA
S 3563
EXP. 12/31/2012
STRUCTURAL
STATE OF CALIFORNIA

MICROFILM

AECOM
2101 WEBSTER STREET SUITE 1000
OAKLAND, CA 94612-3060
PROJECT NO. 60229232

NO.	DATE	DESCRIPTION	GM/SPEC	DWN	CHKD	SUPV	APVD BY
0	02-03-12	ISSUED FOR CONSTRUCTION	KG	SK			

REVISIONS

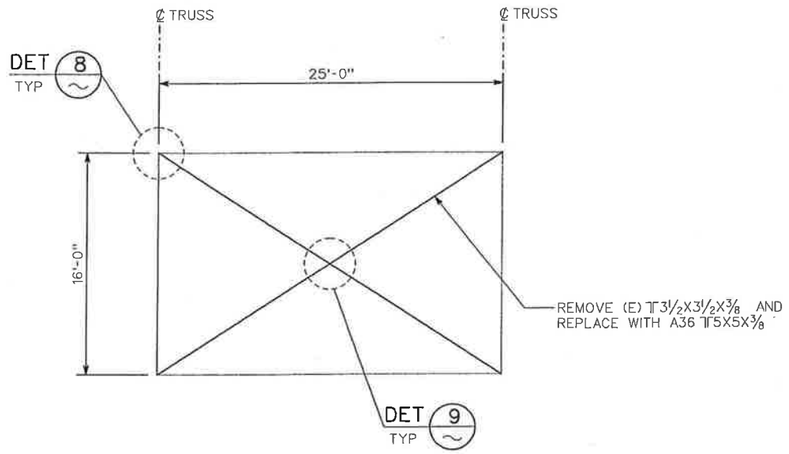
APPROVED BY	
	SO
	SUPV
	DSGNS.KOLANKAYA
	DWN K. GRAHAM
	CHKDS.KOLANKAYA
	OK
	DATE 02-03-12
	SCALES AS NOTED

STRUCTURE - DETAILS
ARCH BRIDGE MODIFICATIONS
300A TRANSMISSION LINE

GAS TRANSMISSION & DISTRIBUTION
PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

BILL OF MATL	
DWG LIST	
SUPSDS	
SUPSD BY	
SHEET NO. OF SHEETS	
481620-SH2	REV 0

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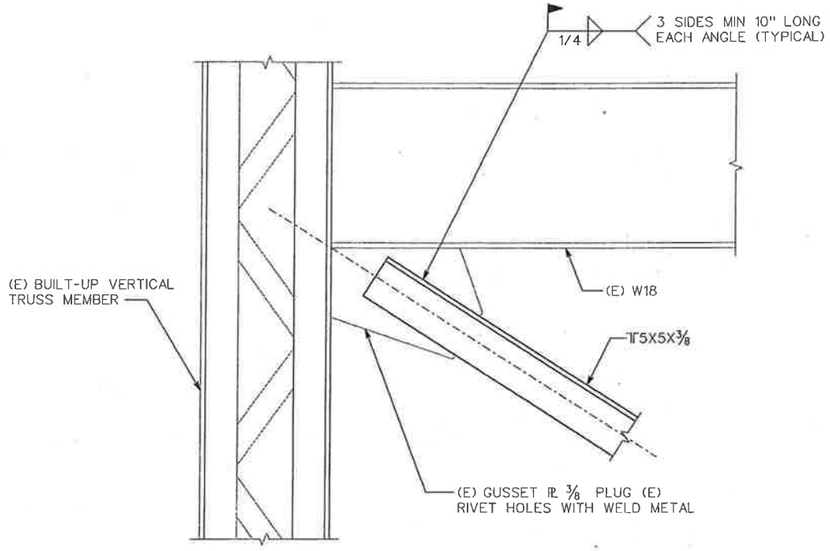


VERTICAL TRUSS BRACES @ 222'

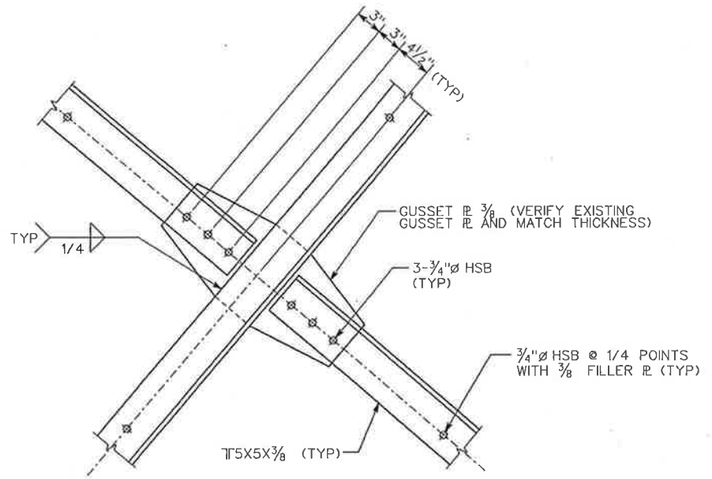
DETAIL 3 (481620)
SCALE: 3/32"=1'-0" 481620-SH3

NOTES

1. FOR LOCATION SEE DWG 481620.
2. CODES AND SPECIFICATIONS
   - A. INTERNATIONAL BUILDING CODE IBC-2009
   - B. MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES, ASCE 7-05
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   - E. AISC SEISMIC PROVISIONS FOR STRUCTURAL STEEL BUILDINGS (ANSI/AISC 341)
   - F. AWS D1.5, BRIDGE WELDING CODE - AMERICAN WELDING SOCIETY.
   - G. AWS D1.8, STRUCTURAL WELDING CODE - SEISMIC SUPPLEMENT, AMERICAN WELDING SOCIETY
   - H. SPECIFICATIONS FOR STRUCTURAL JOINTS USING ASTM A325 OR A490 BOLTS, JUNE 30, 2004 HEREIN REFERRED TO AS THE RCSC SPECIFICATION
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   - C. STRUCTURAL STEEL TUBING — ASTM A500 GRADE B, Fy=46 KSI
   - D. HIGH STRENGTH BOLTS, NUTS AND WASHERS — ASTM 325
   - E. HIGH STRENGTH STRUCTURAL STEEL RIVETS — ASTM A588, GRADE 3
   - F. WELDING ELECTRODES — AWS A5.1, SERIES E70
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DETAIL 8
SCALE: 1½"=1'-0"



DETAIL 9
SCALE: 1½"=1'-0"

DRAWING REFERENCES:

481620 —— ERECTION PLAN

REGISTERED PROFESSIONAL ENGINEER
SAVAS KOLANKAYA
S 3563
EXP. 12/31/2012
STRUCTURAL
STATE OF CALIFORNIA

AECOM
2101 WEBSTER STREET SUITE 1900
OAKLAND, CA 94612-3060
PROJECT NO. 60229232

NO.	DATE	DESCRIPTION	GM/SPEC	DWN	CHKD	SUPV	APVD BY

REVISIONS

NO.	DATE	DESCRIPTION	GM/SPEC	DWN	CHKD	SUPV	APVD BY
0	02-03-12	ISSUED FOR CONSTRUCTION		KG	SK		

REVISIONS

APPROVED BY	SO
	SUPV
	DSGNS.KOLANKAYA
	DWN K. GRAHAM
	CHKDS.KOLANKAYA
	QK
	DATE 02-03-12
	SCALES AS NOTED

STRUCTURE - DETAILS
ARCH BRIDGE MODIFICATIONS
300A TRANSMISSION LINE

GAS TRANSMISSION & DISTRIBUTION
PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

MICROFILM	
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DWG LIST	
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Appendix H
Updated Cost Estimate

APPENDIX H

Updated Cost Estimate

This appendix will not be completed in time for the publication of the 90% BOD Report on September 8, 2014. It will be completed on September 15, 2014 and at that time will be sent to all recipients of the 90% BOD Report hardcopies for insertion into their binders. Other readers will be able to download a PDF of Appendix H from the project SharePoint site.

Appendix I
Responses to Comments on the Basis of Design Report/Intermediate (60%) Design Submittal

TABLE I-1

Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
General Comments										
1	DOI-1	General		A final decision is necessary regarding above ground versus below ground piping in the uplands area and for the fresh water pipeline. In order to adequately evaluate the differences between the options, DOI, in consultation with interested Tribes, is submitting a matrix of evaluation factors to use in comparing the current design and three above ground pipeline options. Proposed evaluation criteria are also included. Please complete the pipeline matrix evaluation for use during comment resolution and final consideration of the pipeline layout. When completing the evaluation of alternatives, for each criterion consider all aspects of the project in the evaluation, including handling and storage of residual soils. Please see Attachment A – Above ground/below ground pipeline evaluation matrix.	See information included in DOI's pipeline evaluation matrix and associated visualizations (included in **Attachment A**, at the end of this table).			The FMIT, the Hualapai Tribe, and the Cocopah Indian Tribe each provided the tribe's assessment and comments on the alternative pipeline routings. The CRIT also provided feedback via email on this subject. The Tribes' letters and email are included in **Attachment A**, at the end of this table.	Information presented in DOI's pipeline evaluation matrix and associated visualizations were discussed with the agencies, Tribes, and stakeholders at the November 19-20, 2013 TWG meeting. Tribes' response was presented at the December 17-18, 2013 TWG meeting and subsequently provided in a draft technical memorandum from TRC (Charlie Schlinger) to PG&E, DTSC and DOI/BLM dated Dec 17, 2013 (also included in **Attachment A**, at the end of this table). A site walk was held on Dec 27, 2013 to further discuss the piping options. Representatives from DOI, FMIT, Hualapai Tribe, Chemehuevi Tribe, TRC, and PG&E participated in the site walk. A presentation was made by TRC (Charlie Schlinger) at the January 23, 2014 TWG meeting (presentation materials are included in **Attachment A**, at the end of this table). Additional analysis was performed by PG&E on Segments 1 and 2 of Pipeline A, and presented at the February 11, 2014 TWG meeting. Presentation materials are also included in **Attachment A**, at the end of this table.	The 90% design complies with the Agencies' directive on aboveground/belowground pipeline infrastructure in the April 4, 2014 letter titled *"Directives on Outstanding Issues of the Response to Basis of Design Report/ Intermediate (60%) Design Comments for PG&E Topock Compressor Station Remediation Site"*.
2	DOI-2	General		In correspondence dated October 23, 2008 from DOI to PG&E (Attachment B) regarding the National Wildlife Refuge System Administration Act and the corresponding Appropriate Use Analysis and Compatibility Determination, FWS identified key elements that need to be evaluated during the remedial alternative analysis. These elements must also be addressed during the design. While much of the necessary information is contained within the 60% design document, it is difficult to locate. In order to memorialize that these	See attached table titled *Supplemental Information for ARAR #7_AUA_CD* (included in **Attachment B**, at the end of this table).		Comment resolved pending review of the 90% design.		Comment resolved.	Updated information is included in Table 6.2-1A of the 90% BOD, titled "*Information for the Havasu National Wildlife Refuge's Appropriate Use Analysis and Compatibility Determination (AUA/CD)*".

TABLE I-1

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Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

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				elements have been addressed, please include them in the "Action Section" of the ARAR tables, Item 7, and identify or reference the actions specified in the current design. Additionally, for the remaining elements, please identify proposed actions to be included within the 90% design submittal.						
3	DOI-3	General		When referring reader back to an Appendix, it is recommended that the exact location, (e.g., page number or Section number), be provided to enable readers to easily search for the referenced information.	Comment noted.		Comment resolved.		Comment resolved.	Section numbers have been added to Appendix references throughout the 90% documents.
4	DOI-4	General	Time to remediate plume	With regards to the timeline for remediating the plume, a 30-year period is discussed; however, the number of pore volume flushes is not. The number of pore volumes provides the reader with a more tangible sense of the hydrodynamics of the system. Please provide a discussion regarding the number of pore volume flushes in the text.	The following sentence will be added to the text: "Based on an average groundwater flow velocity of 1 ft/d, a total of approximately 6 pore volumes flushes are projected to occur over the 30 year period of remediation." Because the remedy involves active remediation of the hexavalent chromium through carbon amendment, the performance of the remedy is not solely dependent on groundwater pore flushes, but rather the active geochemical reactions in conjunction with groundwater flushing.		Comment resolved pending review of 90% design.		Comment resolved.	90% BOD Apdx B Section 6.4.
5	DOI-5	General		Some in-text citations have commas and others do not. A single format should be chosen, and then review and modify the document for consistency.	Comment noted. The current convention is in-text citation without commas in the 60% BOD and this will continue into the 90% BOD. Citations will be reviewed and any with stray commas will be corrected. Editing/modification of a previously published report (published prior to the BOD but included as an appendix), for the sole purpose of updating its citation convention is not warranted.		Comment resolved.		Comment resolved.	Corrections have been made as indicated in the response.
6	FMIT-1 Hualapai-1 Chemehuevi-1 Cocopah-1 CRIT-1	General		A conceptual narrative for the anticipated steps in the decommissioning of this proposed remedy should be included to assist in both evaluating the design elements and how they would impact removal of the remedy infrastructure, and in evaluating the total, cumulative impacts of this project.	A narrative for the approach of the steps to decommissioning of the proposed remedy will be provided in the 90% design.			Comment resolved pending review of the 90% design. Tribes request that, if possible, this information be provided prior to submittal of the 90% design.	Comment resolved.	A narrative was developed in response to this comment. See **Attachments T** at the end of this table.

TABLE I-1

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PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
7	FMIT-2 Hualapai-2 Chemehuevi-2 Cocopah-2 CRIT-2	General		The Response to Comment process (for the 60% Basis of Design report) and the following development of the 90% Basis of Design report needs to include face-to-face consultation with tribes to document/demonstrate that tribal issues/criteria are being addressed.	Comment noted. As discussed at the July 18, 2013 TWG meeting, face-to-face meetings will be held to discuss and resolve comments on the 60% design. PG&E defers to DOI on Tribes' request for consultation.		As noted by PG&E, face-to-face comment resolution meetings have been scheduled for the 60% design. In addition, DOI and BLM have scheduled a face-to-face meeting to discuss the RTCs with the Tribes coinciding with the October 29, 2013 CHPMP meeting. We also anticipate Technical Working Group (TWG) meeting in between comment resolution and the 90% design deliverable.	Okay.	Comment resolved.	Not applicable ***Note to BOD Reviewers - As indicated in RTC #485 FMIT-148, when the "Final Comment Resolution" indicates "Comment resolved" and this column indicates "Not applicable", it means that the comment has been resolved and there is no need for modify the cited text/ tables/ figures in the next iteration of the BOD. For brevity, this note will not be repeated throughout this RTC table.***
8a	FMIT-3	General		It is apparent from a comparison of comments the Tribe issued for the 30% BOD and the 60% BOD document that the alternative designs of certain project components certain that the Tribe expressed preferences because they related to tribal religious and cultural issues were not factored or substantively considered in engineering designs. At a minimum, equal scientific/engineering rigor should be given to these legitimate alternate design constraints. For example, the Tribes expressed strong preferences for above-ground utility routings, however, the utility routings in the 60% BOD are almost exclusively routed below ground. Additionally, at one of the TWG meetings, PG&E provided a screening matrix for alternative routings in the East Ravine area. While this type of decision information is quite helpful in understanding the underlying decision rationale, it does not factor in tribal preferences.	The preference stated by the FMIT and by other tribes for aboveground facilities was substantively considered in formulating the 60% design. PG&E believes that the proposed 60% design represents the most practical design in the Topock site setting, which incorporates the Tribes' preferences to the extent practicable, is most protective of remedy infrastructure, most O&M friendly for the decades-long life of this remedy, and most consistent with the certified EIR. As documented in the 30% RTC table (60% BOD Appendix I), PG&E has incorporated Tribal preferences to eliminate the BCW trenching (an area that is in close proximity to the Topock Maze), to relocate wells in the upland (one of these well relocations requires building a new access road into a wash) (RTC #185 HA-36), as well as to reduce the number of transformers and site all transformers aboveground (RTC #183 HA-34). Regarding the topic of aboveground vs. belowground, this was discussed with Agencies and Tribes during the 3/20/2012 meeting and the 30% design comment resolution meetings. PG&E's rationale for below-ground construction is well documented in 30% RTC #159 HA-21, #182 HA-33.			Comment resolved.	Comment resolved.	The 90% design complies with the Agencies' directive on aboveground/ belowground pipeline infrastructure in the April 4, 2014 letter titled *"Directives on Outstanding Issues of the Response to Basis of Design Report/ Intermediate (60%) Design Comments for PG&E Topock Compressor Station Remediation Site"*.

TABLE I-1

Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
					PG&E has and will continue to collaborate with Tribes and Agencies towards a satisfactory resolution of Tribal concerns. More specific evaluation of aboveground piping alternatives is provided in the response to comment #1 DOI-1.					
8b	Hualapai-3 Chemehuevi-3 Cocopah-3 CRIT-3	General		It is apparent from the 30% to the 60% designs that certain tribal preferences relating to tribal religious and cultural issues were not factored or substantively considered in engineering designs. At a minimum, equal scientific/ engineering rigor should be given to these legitimate alternate design constraints. For example, the Tribes expressed strong preferences for above-ground utility routings, however, the utility routings in the 60% BOD are almost exclusively routed below ground. Additionally, at one of the TWG meetings, PG&E provided a screening matrix for alternative routings in the East Ravine area. While this type of decision information is quite helpful in understanding the underlying decision rationale, it does not factor in tribal preferences.	See response to comment #8a FMIT-3.			Comment resolved.	Comment resolved.	The 90% design complies with the Agencies' directive on aboveground/ belowground pipeline infrastructure in the April 4, 2014 letter titled *"Directives on Outstanding Issues of the Response to Basis of Design Report/ Intermediate (60%) Design Comments for PG&E Topock Compressor Station Remediation Site"*.
9	FMIT-4 Hualapai-4 Chemehuevi-4 Cocopah-4 CRIT-4	General		The Tribes expect that both short-term and long- term disturbances to the ground surface and below ground be avoided and minimized. Subsurface disturbances permanently change the natural order of the land and require disruptive removal of these utilities once the remedy is complete. Invasive subsurface disturbances need to be avoided to the extent practicable. Installation of remedial infrastructure on the ground surface itself needs to be minimized in terms of its footprint. The Tribes have provided input on their preferences for installation methods in comments on the 30% BOD that call for minimization of subsurface disturbances.	PG&E understands the importance of and appreciates the Tribes' position on avoidance and minimization of subsurface disturbance. To this end, PG&E notes that while there is short-term disturbance associated with the construction/removal of belowground utilities, there is less disturbance in the long-term associated with O&M. Aboveground utilities will inherently require more maintenance than belowground utilities, especially in an environment like Topock (e.g., heat, vandalism). It should also be noted that for an above ground configuration, thermal design considerations may require substantial additional footprint to allow for expansion/contraction loops as well as a potentially large support structures (e.g., pipe racks, conduits or cable tray, shade assemblies).				This comment and response are being discussed as part of the evaluation of aboveground piping alternatives (#1 DOI-1, #8a FMIT-3, and #8b Hualapai-3/ Chemehuevi-3/Cocopah-3/CRIT-3).	The 90% design complies with the Agencies' directive on aboveground/ belowground pipeline infrastructure in the April 4, 2014 letter titled *"Directives on Outstanding Issues of the Response to Basis of Design Report/ Intermediate (60%) Design Comments for PG&E Topock Compressor Station Remediation Site"*.

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Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

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					See also response to comments #1, DOI-1, #8a FMIT-3, and #8b Hualapai-3/ Chemehuevi-3/Cocopah-3/CRIT-3.					
10a	FMIT-5	General		Since the basic operational methods of the proposed remedy and IM-3 are fundamentally incompatible, and therefore, once the proposed remedy begins, IM-3 cannot be used. The start- up strategy for the final remedy needs to be efficient, thereby assuring the earliest possible demonstration that the remedy is "operating properly and successfully" (OPS) so that the IM3 plant can be decommissioned.	It is agreed that the transition between IM-3 and implementation of the proposed remedy is an important step, and this transition phase was considered and simulated with the solute transport model. The key criteria considered during this transition were to: 1) minimize duration of IM operation; 2) control and reduce the mass of chromium in the floodplain as quickly as possible; 3) minimize the migration of the chromium plume in the floodplain during remedy start-up; and 4) maximize control of implementation risks during initial implementation of the NTH IRZ. The simulated transition between IM-3 and the proposed remedy is presented in Section 7.3 of the 60% BOD. In this section, four potential start-up scenarios for the proposed remedy were evaluated with varying durations and remedial component order. The criteria for decommissioning IM-3 as well as the definition of "operating properly and successfully" for the purposes of the overall groundwater remedy are specified in the 2012 Settlement Agreement between DTSC and the FMIT.			Comment resolved.	Comment resolved.	Not applicable
10b	Hualapai-5 Chemehuevi-5 Cocopah-5 CRIT-5	General		The basic operational methods of the proposed remedy and IM-3 are fundamentally incompatible, and therefore, once the proposed remedy begins, IM-3 cannot be used. The start-up strategy for the final remedy needs to be efficient, thereby assuring the earliest possible demonstration that the remedy is "operating properly and successfully" (OPS) so that the IM3 facility can be decommissioned.	See response to comment #10a FMIT-5.			Comment resolved.	Comment resolved.	Not applicable
11a	FMIT-6	General		The 90% Design stage is one of the last opportunities for the Tribes to address the project design. Review of schedule projections presented in the 60% BOD report indicates that the current schedule for the 90% design review may not allow be sufficient	Comment noted. As discussed at the July 18, 2013 TWG meeting, face-to-face meetings will be held to discuss and resolve comments on the 60% design. PG&E defers decision on extension of	DTSC is committed to working with the Tribes to afford reasonable review time frames for large documents such as the BOD reports. DTSC has and will continue to maintain an open dialogue with the Tribes	DOI and BLM acknowledge the complexity of design documents and suggest an extension to the review period as well. As per the schedule	Okay with DOI's response.	Responses noted.	Not applicable

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				time for Tribal review and consultation. The BOD documents are voluminous, with many detailed appendices which the Tribes need to review. In addition, at each stage of the design review process, sections are introduced that have not been previously seen by the reviewers. There needs to be sufficient time for the Tribal representatives, and the Tribes' technical consultants to review these documents, for the Tribes to consult both with the technical consultants, Tribal governments and elders, and with the other Tribes prior to being able to provide comments and to allow sufficient time to exercise their rights to government-to-government consultations with the agencies in regard to project impacts. An ongoing dialogue with the Tribes during the interim period between the 60% and 90% documents would be helpful as PG&E's consultants respond to comments on the 60% design. Also, the Tribe requests consultation with the agencies regarding the potential impacts of the proposed final design against the design presented in the FEIR so that there is sufficient time to discuss those impacts and treatment measures.	90% design review and FMIT's request for consultation to DOI and DTSC.	regarding the proposed project and to discuss Tribal concerns associated with the potential impacts during the remedy design. However, to effectively consider Tribal issues, DTSC encourages early communication from the Tribes on concrete concerns for consideration in advance of the project approval.	provided in the July TWG, DOI agrees that the suggested 60-day review period for the Tribes and stakeholders with an additional 15 calendar days for the agencies to review those comments prior to our comment submittal is appropriate. DOI/BLM will work with the Tribes in scheduling face-to-face consultation meetings on the 90% design documents.			
11b	Hualapai-6 Chemehuevi-6 Cocopah-6 CRIT-6	General		The 90% Design stage is one of the last opportunities for the Tribes to address the project design. Review of the 60% BOD report indicates that the current schedule for the 90% design review may not allow sufficient time for Tribal review and consultation. The BOD documents are voluminous, with many detailed appendices which the Tribes need to review. In addition, at each stage of the design review process, sections are introduced that have not been previously seen by the reviewers. There needs to be sufficient time for the Tribal representatives and the Tribes' technical consultants to review these documents, for the Tribes to consult with the technical consultants, Tribal governments and elders, and with the other Tribes prior to being able to provide	Comment noted. As discussed at the July 18, 2013 TWG meeting, face-to-face meetings will be held to discuss and resolve comments on the 60% design. PG&E defers decision on extension of 90% design review and FMIT's request for consultation to DOI and DTSC.	See response to comment #11a FMIT-6.	See response to comment #11a FMIT-6.	See response to comment #11a FMIT-6.	Responses noted.	Not applicable

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				comments and to allow sufficient time to exercise their rights to government-to-government consultations with the agencies in regard to project impacts. An ongoing dialogue with the Tribes during the interim period between the 60% and 90% documents would be helpful as PG&E's consultants deal with the issues raised in these comments to the 60% design. Also, the Tribes request consultation with the agencies regarding the potential impacts of the proposed final design against the design presented in the FEIR so that there is sufficient time to discuss those impacts and the sufficiency of mitigation.					
12	FMIT-7 Hualapai-7 Chemehuevi-7 Cocopah-7 CRIT-7	General		The current "project boundary" limits as depicted in various project maps have been shown to be incomplete and/or inconsistent with sensitive areas that should be avoided. This conflict needs to be resolved such that all sensitive areas are excluded from any project activity prior to completion of the 90% design document.	The project boundaries as shown in various project maps are not incomplete. With respect to avoiding sensitive areas, the design is consistent with the EIR's requirement in Mitigation Measure CUL-1a-10 to avoid "any direct physical impact on the Topock Maze, as it is manifested archaeologically." The design complies with that requirement by avoiding placement of any infrastructure in the Topock Maze as it is manifested archeologically. Additionally, in compliance with Mitigation Measure CUL-1a-10, PG&E is designing the remedy to prevent all indirect (e.g. noise, aesthetics) impacts on the Topock Maze to the maximum extent feasible as determined by DTSC.	DTSC would like to clarify that the map of the project area in the certified EIR is not meant to depict or define archaeologically sensitive areas. In compliance with the CEQA Guidelines (California Code of Regulations, Title 14, Division 6, Chapter 3), Section 15124(a), the programmatic EIR described the location and boundaries of the proposed project for evaluation and review of the potential environmental impacts associated with the proposed project. Please note that as a result of our review, DTSC adopted mitigation measures, including CUL-1a-10, to ensure project activities would avoid direct physical impact on the Topock Maze as it is manifested archaeologically.				Not applicable
13a	FMIT-8	General		Chemicals that are foreign to the natural environment are a concern to the Tribes. Additionally, some chemicals may be more offensive for use in a sacred area than others. It is necessary to fully disclose the types, volumes, and frequencies of chemical usage associated with the project. The Tribe requests consultation prior to any changes in chemical additives.	PG&E shares the Tribes' concern about chemicals and their usage in the remedy, including the sustainability perspective. At the 60% design stage, the types, volumes, and frequencies of potential chemicals anticipated for use in remedy operations are included in Section 3 and Appendix D of the 60% BOD report, as well as Volume 1 of the O&M Manual. Specifically, the O&M Manual			FMIT clarified that its reference to consultation in its original comment was to notification and discussion.	Comment resolved.	Exhibit 4.2-5 of O&M Plan (Volume 1 of the O&M Manual). Exhibit L2.2-1 of the main text of the O&M Manual.

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Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

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					Volume 1 Exhibit 4.2-5 provides a summary of potential chemicals for well rehab, and Section 7.2 lists the potential chemicals to be used in well rehab, the remedy produced water condition plant, the freshwater pre-injection treatment system, and the in-situ remediation system. Anticipated volumes of chemical usage in the remedy produced water conditioning system, the freshwater pre-injection treatment system are also provided in Appendix D (drawings G-12-02 and 12-04, respectively). PG&E requests input from Tribes during the design process as to any chemicals that may be more offensive for use in Tribes' view, as referred to in Tribes' comment, so that PG&E may consider that input now. For further clarification, the title of Exhibit 4.2-5 will be changed to: "Summary of <u>Proposed</u> ~~Available~~ Chemicals for Well Rehabilitation Applications." PG&E agrees to provide the requested notification and discuss with Tribes if requested.					
13b	Hualapai-8 Chemehuevi-8 Cocopah-8 CRIT-8	General		Chemicals that are foreign to the natural environment are a concern to the Tribes. Additionally, some chemicals may be more offensive for use in a sacred area than others. It is necessary to fully disclose the types, volumes, and frequencies of chemical usage associated with the project.	See response to comment #13a FMIT-8.				Comment resolved.	Exhibit 4.2-5 of O&M Plan (Volume 1 of the O&M Manual). Exhibit L2.2-1 of the main text of the O&M Manual.
14	FMIT-9 Hualapai-9 Chemehuevi-9 Cocopah-9 CRIT-9	General		There are very specific requirements for the handling and storage of soils displaced and/or stored during the Topock project. Therefore, any "boiler plate" General Notes related to the storage and handling of excavated materials typically included in engineering drawings and specifications are not appropriate for the Topock site. Special care should be taken during the preparation of any and all engineering plans to ensure the appropriate soil handling and storage procedures are properly described and are consistent with Topock soil handling documents.	Comment noted. As stated in response to comment #435 FMIT-127, the following wordings will be included in the General Notes: "Management of displaced soils shall be in accordance with the Soil Management Plan (Volume 4 of the O&M Manual) and the Management Protocol for the Handling and Disposition of Displaced Site Materials (Appendix B of the Soil Management Plan)."			Comment resolved.	Comment resolved.	90% BOD, Appendix D, Drawing C-00-02.

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15	MWD-1	General	Communication	A communication action plan should be developed to ensure ongoing coordination with agencies and stakeholders throughout the life of the project. Plan should identify key agency stakeholder contacts (to be updated as needed) and identify proposed notifications (i.e., monitoring, project updates, river threat notifications). In addition, the CWG communication structure, which has worked effectively, could continue to meet on a less frequent basis, such as annually. A new section should be included in the BOO report to discuss proposed communication with project stakeholders.	In compliance with requirements in the CD and the CACA, the Draft O&M Manual, Section L2.2 (page L2-1) and Exhibit L2.2-3 (pages L2-5 through L2-7) present a preliminary framework for communication, and is intended to be used by PG&E to inform, seek inputs, seek approval from agencies, resolve issues, and/or comply with requirements. Specifically, Exhibit L2.2-3 lists the types of communications, the triggering events (e.g., progress update, compliance reporting, discovery, releases, etc.), the regulations/ plans/ agreements that require such communications, the parties initiating and receiving the communications, and general communication procedures and protocols. PG&E welcomes inputs from agencies, Tribes, and stakeholders on this preliminary framework, and is open to repeating this or similar information in another section of the design report. Note that as required by the CD and CACA, this or similar info will also be included in the forthcoming Remedial Action Work Plan. PG&E defers to DTSC on the CWG communication structure and meeting frequency.	DTSC intends to continue the CWG meetings on a frequency that best serves the project stakeholders and the Tribal nations. DTSC conducts a routine meeting survey at the last scheduled CWG meeting of the calendar year to seek input and feedback on meeting frequencies, and locations. Furthermore, DTSC also welcomes feedback of meetings throughout the year and will strive to ensure that the meetings are purposeful and relevant to the project.			Comment resolved.	Exhibit L2.2-1 of the main text of the O&M Manual. Table 2.3-1 of the Construction/Remedial Action Work Plan.
Specific Comments – Executive Summary										
16	FMIT-10	Executive Summary		The Executive Summary states that a pretreatment system to polish Arizona groundwater to California standards is part of the BOD. This item was not included in the project description for the groundwater remedy as outlined in the FEIR. What will be the process for comparing the final design against the FEIR project description? How will the Tribe be included in those discussions?	PG&E defers to DTSC on FEIR content and process related the FEIR.	The January 2011 Certified EIR was prepared as a programmatic EIR with as much information known to us at the time. As the project design evolves, all concerned parties should take note of changes from the conceptual design of the remedy. DTSC will conduct a final CEQA analysis to compare the potential impacts from the existing design with the concepts evaluated in the Certified EIR. DTSC will release all findings in accordance with CEQA guidelines. DTSC, however, encourages the Tribes to present any concerns during the design evaluation				Not applicable

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						for agency consideration to be incorporated into our CEQA impacts analysis.				
17	DTSC-1	Executive Summary	The freshwater source details will be included in an addendum to the 60% BOD	Depending on timing in completion of the FWIP, PG&E may not be preparing an addendum, but instead prepare a technical memorandum of the investigation result. PG&E will incorporate the information gathered into the 90% design. Make changes to Figure ES-2 also.	Comment noted. Revision to Figure ES-2 as well as Exhibits 1.0-1/ 7.2-1 and report text will be made to reflect a technical memorandum of the FWIP investigation results as discussed at the July 17, 2013 CWG.	Okay.			Comment resolved.	90% BOD Section 3.3.1 (2nd paragraph).
18	FMIT-11	ES-1		The Overview has been revised in such a manner to highlight the modern built environment by adding references to modern intrusions into the same paragraph and context with the Maze. This is inappropriate, disrespectful and hurtful. It seems that this is an effort to try and undercut the traditional tribal use of the area. We also caution that such statements should not be used to try and question the cultural integrity of the area or the Tribe's traditional beliefs.	PG&E will include the discussion of the historic-era features and archaeological resources in a separate paragraph from the discussion of the Topock Maze.			Comment resolved.	Comment resolved.	90% BOD Section ES.1, 3rd and 4th paragraphs.
19a	FMIT-12	ES-1, etc.	The Area of Critical Environmental Concern (ACEC)	The Area of Critical Environmental Concern (ACEC) is mentioned within the 60% BOD and contributed to the exclusion of one of the potential freshwater sources, however, no map is provided within the document depicting this area. It is anticipated that the Freshwater Implementation Plan (FWIP) contains further details on this area.	The ACEC will be added to Figure 1.2-1 in Section 1 of the 90% BOD. The figure will be referenced in the text of the Executive Summary.			Comment resolved.	Comment resolved.	90% BOD Figure 1.2-1. 90% BOD Section ES.1 (5th paragraph).
19b	Hualapai-10 Chemehuevi-10 Cocopah-10 CRIT-10	ES-1, etc.	The Area of Critical Environmental Concern (ACEC)	The Area of Critical Environmental Concern (ACEC) is mentioned within the 60% BOD and contributed to the exclusion of one of the potential freshwater sources, however, no map is provided within the document depicting this area. It is anticipated that the Freshwater Implementation Plan (FWIP) is forthcoming and should provide further details on this area.	See response to comment #19a FMIT-12.			Comment resolved.	Comment resolved.	90% BOD Figure 1.2-1
20	DOI-6	Page v	"In addition, PG&E and the United States executed a Remedial Design/Remedial Action …"	Insert "on behalf of the Department of the Interior" after "Consent Decree (CD)".	Text will be inserted as requested.		Comment resolved.		Comment resolved.	90% BOD Executive Summary (1st paragraph). O&M Manual Section L1. 90% BOD Apdx B Executive Summary. 90% BOD Apdx B Section 1.1.

TABLE I-1

Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
21	DTSC-2	Executive Summary, Page v, Third Paragraph.	…PG&E has made the conservative assumption for freshwater pre-injection treatment goals, specifically that the arsenic treatment goal will be to reduce concentrations below the federal/state Maximum Contaminant Level (MCL) of 10 micrograms per liter (µg/L) and that the fluoride treatment goal will be concentrations below the state MCL of 2 milligrams per liter (mg/L).	DTSC and PG&E have independently concluded that although fluoride concentration from Arizona source well might be above MCL, that the receiving water body in California is similar in concentration and treatment of fluoride is presently optional and at PG&E's discretion. Therefore, designing a goal to attain 2 mg/L for fluoride is futile as higher concentrations already exist in the area where fresh water will be injected. Please revise. It is recommended that the text (here and throughout the entire document) be revised to indicate that fluoride treatment is not likely, based on existing data, due to elevated background values already above the MCL where water will be injected. Suggest supporting the issue by calculating a fluoride background number for the injection area. Show all fluoride data and calculations so that the background number and method can be verified. An arsenic background specific for the injection area should also be calculated. Clarify that arsenic treatment will be fully developed, regardless, in the 90% and final designs. If arsenic treatment is not required by the State Board now, it should be ready as a contingency should arsenic levels rise over the course of the remedy.	In response to this comment, PG&E will calculate a fluoride background concentration for the injection area, and will submit to DTSC when it is available. As for an arsenic background concentration, PG&E does not feel that this is necessary because the State Board letter allows for, under specified conditions, the injection of freshwater with naturally occurring arsenic at levels above the levels in the receiving groundwater basin. As directed by DTSC, PG&E will include a freshwater pre-injection treatment for arsenic only in the 90% and final designs as a contingency. The cited text will be revised to reflect this response throughout the 90% BOD.	Comment resolved pending review of the 90%. Include the fluoride and background in the 90%.			Comment resolved.	90% BOD Section 2.3.4. 90% BOD Section 3.3.3.4. O&M Contingency Plan (Volume 3 of the O&M Manual), Appendix B.
22	MWD-2	ES.1 /vi	At top of page "...Southern California Metropolitan Water District..."	This should read "...Metropolitan Water District of Southern California..."	Text will be revised as requested.				Comment resolved.	90% BOD Section ES.1 (1st paragraph).
23	DOI-7	Section ES.2, Page vii	Remedial Action Objectives	Information in the section should identify the expected time it will take to achieve remedial goals. Provide discussion of the modeling, as well as a short summary of operation and maintenance in this section. Key parameters, such as capture zone results and the sensitivity of TOC concentrations and injection/ extraction rates should be included. Also, include a short discussion of the SCADA system, a key operational element.	Comment noted. PG&E will include a high level summary of the projected remedial timeframe, the modeling, and elements of the operation and maintenance plan in the Executive Summary for the 90% design document. Key parameters related to operational success will be highlighted along with the role of SCADA in the operation and maintenance of the system.		Comment resolved pending review of the 90% design.		Comment resolved.	90% BOD Section ES.3, Section ES.5, and Table ES-1.

TABLE I-1

Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
24	DTSC-3	ES.2 Remedial Action Objectives, Page vii, Item 2	Prevent or minimize migration of total chromium (Cr[T]) and Cr(VI) in groundwater to ensure concentrations in surface water do not exceed water quality standards that support the designated beneficial uses of the Colorado River (11 µg/L Cr[VI]).	Need to add clarifying language that since river concentrations are generally not detected for chromium, remedial system operations would be modified should chromium start to be detected in the river.	Comment noted. This section of the Executive Summary is intended to merely restate the established RAOs for the reader's convenience, and not to discuss system operations/ adjustments. Please see response to a similar comment, #637 DTSC-193. No changes to text will be made.	Okay.			Comment resolved.	Not applicable
25	FMIT-13 Hualapai-11 Chemehuevi-11 Cocopah-11 CRIT-11	Executive Summary p. vii	*Ensure that the geographic location of the target remediation area does not permanently expand following completion of the remedial action.*	Shouldn't this say that the geographic "area" should not permanently expand, rather than "location"?	The reference text is accurate and consistent with the wording of RAO #4 in the CMS/FS (CH2M HILL 2009), the ROD (DOI 2011), and the Statement of Basis (DTSC 2011). The intention of this RAO is to ensure that the plume boundary (32 ug/L) does not permanently expand after completion of the remedial action.			Comment resolved.	Comment resolved.	Not applicable
26	DTSC-4	Executive Summary, page viii	central maintenance/ storage facility that will house site operation and field staff, remote control and monitoring equipment, an on-site laboratory, a document repository center, a training/conference room, equipment storage, etc.	To minimize the groundwater remedy footprint at the site, PG&E should only consider infrastructures that are critical to the operation and maintenance of the remedy. PG&E should provide specifications for minimum footprint of all required infrastructure with design basis. Allocation of space for training, conference room, library, and patio uses should not be conjoined with the remedy as required infrastructure.	Conducting meetings with stakeholders/ Tribes/ Agencies, providing trainings to project workers/ contractors, and record keeping are amongst the essential elements of the Topock remediation project and are required to comply with agencies' processes (EIR mitigation measures, ARARs, CD, CACA, etc.). The "library" is intended as a repository of essential project documents at the site for purposes of referencing, training, and record keeping. Allocation of space to ensure that these functions can be accommodated at the Topock site in the long-term is necessary. The current practice of borrowing the sole existing TCS conference room for remediation meetings/trainings is not a long-term solution, as this conference room is often needed for meetings/trainings by PG&E Gas	DTSC agrees that meetings and record keeping are essential functions of the project, however, most of these activities are currently outsourced to off-site venues. Continuation of this practice is encouraged in order to minimize infrastructures at the site. Since PG&E is now possibly proposing a change in the suggested design, DTSC will defer comments on this matter pending submission of modified infrastructure layout and design. DTSC awaits PG&E's evaluation/ proposal.			Comment resolved.	90% BOD Table ES-1 and Section 3.5.3.

TABLE I-1

Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
					Operations and may at times, not be available for remediation project. The "patio use" referenced in this comment, takes advantage of a natural plateau at the TWB Bench to provide additional outdoor meeting space for the project. In order to reduce the infrastructure on the Transwestern Bench, PG&E is currently evaluating the option of moving the following functions originally intended to occur at the Transwestern Bench - training, conference room, library, laboratories, maintenance, and storage – to a location at Park Moabi. The functions anticipated to remain at the bench include carbon amendment facilities, remedy wells, and a smaller building to house programmable logic controllers (PLCs), uninterrupted power supply, communications, etc. The existing equipment decon pad will still be retained for use as a decon pad. PG&E will continue to evaluate this option and will keep the agencies, Tribes, and other stakeholders informed of PG&E's proposal prior to the 90% design submittal.					
27	DOI-8	Table ES-1 Page xi	Remedy Feature – Carbon amendment and carbon storage facilities	Please identify the anticipated initial dosage of ethanol/TOC to be delivered during system start-up.	The following text will be added as a bullet to Table ES-1 under a new section "Organic Carbon Dosing and Delivery Strategy": "<u>The system will be initiated with an anticipated initial total organic carbon amendment concentration of 100 mg/L</u>."		Comment resolved.		Comment resolved.	90% BOD Table ES-1.
28	DOI-9	Table ES-1, Page xii	Remedy Feature – Access pathways and roadways	Can a figure be used to reference the roads and pathways?	Figure 3.5-9 shows proposed access routes for remedy features. Text will be added to reference this figure in Table ES-1.		Comment resolved.		Comment resolved.	90% BOD Figures 3.5-9A and 3.5-9B.
29	MWD-3	Figure ES-1	none	Interim reviews such as the 5-year review should be included during remedy implementation for the Site Cleanup Process.	A note will be added to Figure ES-1 as requested.				Comment resolved.	90% BOD Figure ES-1 (footnote).
30	DOI-10	Figure ES-2		The figure title is misleading. Modify the title block of this figure by deleting "Initial Start-Up" <u>or</u> extend the timeline on the figure itself to include the start-up timeline.	Figure ES-2 will be modified by extending the timeline to include Initial Start-up.		Comment resolved.		Comment resolved.	90% BOD Figure ES-2.
31a	FMIT-14	Fig. ES-3 Surrounding	General Remedy	The legend in the map does not indicate what the red outlines on the	The FMIT is correct; the red outline is the EIR project area. The legend of	FMIT is correct that the red outline on the map is the			See #12 FMIT-7/Hualapai-7/ Chemehuevi-7/Cocopah-	90% BOD Figures ES-3 and ES-4A.

TABLE I-1
Response to Comments on Basis of Design Report/Intermediate (60%) Design
Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design
PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
		Property Map	System Layout	map represent. It is assumed that the red outline represents the project EIR boundary. It is anticipated that this boundary will be updated based on recent archeological surveys for the 90% BOD report.	this figure will be updated to explain the red line. PG&E defers to DTSC for response to project EIR boundary update.	project area based on PG&E's conceptual design at the time of the EIR in 2011. It is not DTSC's intention to conform the outline to specific archeological sites. Instead the outline is a delineation of the entire area within which project activities may or may not occur. As the project design is refined, the final project boundaries will be updated and appropriate CEQA process will be followed.			7/CRIT-7.	
31b	Hualapai-12 Chemehuevi-12 Cocopah-12 CRIT-12	Fig. ES-3 Surrounding Property Map	General Remedy System Layout	The legend in the map does not indicate what the red outlines on the map represent. It is assumed that the red outline represents the project EIR boundary. It is anticipated that this boundary will be updated based on recent archeological surveys for the 90% BOD.	See response to comment #31a FMIT-14.	See response to comment #31a FMIT-14.			See #12 FMIT-7/Hualapai-7/ Chemehuevi-7/Cocopah-7/CRIT-7	90% BOD Figures ES-3 and ES-4A.
32	FMIT-15	ES-3 and Section 2.4.1		Please explain Note 1 stating that PG&E has "a possessory interest" on two parcels (650-161-11 and 650-161-12) owned by the Havasu National Wildlife Refuge. Please provide more detail including the nature of this possessory interest and when this interest was granted, its duration and whether any consideration was paid.	PG&E's easement interest in parcels 650-161-11 and 650-161-12 was granted by the U.S. Bureau of Land Management in 1955, for the operation of a compressor station and associated pipelines. Per San Bernardino County Assessor's Office parcel map 0650-16, the total area for parcel 0650-161-12 is 25.72 acres. No acreage information is provided for parcel 0650-161-11 on the County map. Consideration was paid for the interest. The term of the easement is perpetual.			Comment resolved.	Comment resolved.	Not applicable
33	DOI-11	Figure ES-4	General Remedy System Layout	The red boundary line (EIR project boundary) is not identified in the legend but should be.	The red outline is the EIR project area; the legend of this figure will be updated to explain the red line.		Comment resolved.		Comment resolved.	90% BOD Figure ES-4A.
34	MWD-4	Figure ES-4, Figure 3.0.1		An explanation for the red line should be included in the legend.	The red outline is the EIR project area; the legend of this figure will be updated to explain the red line.				Comment resolved.	90% BOD Figure ES-4A.
35	DOI-12	Figure ES-10	60% Design Illustration	The 30% Design Illustration identified the Hazardous Waste Storage Building; however, the 60% Design Illustration does not identify any hazardous waste storage location.	PG&E currently plans to utilize a joint-use hazardous waste storage facility within the fence line of the Topock Compressor Station. The compressor station staff is conducting a project to construct a new hazardous waste storage building on site. All this information will be included in the Hazardous Material Business Plan, which will be included in the 90% design submittal.		Comment resolved.		Comment resolved.	90% BOD Figure ES-10.

TABLE I-1

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Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

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36	DTSC-5	Executive Summary	Figure ES-11	According to Appendix L, Operation and Maintenance Plan, IRZ-40 should be depicted as an IRZ extraction well, not an injection well. Please revise.	Figure ES-11 will be revised as requested (IRZ-40 is a provisional extraction well).	Okay.			Comment resolved.	90% BOD Figure ES-11.
37	FMIT-16	Figure ES-11		Figure ES-11: Please explain in narrative form (in one section) what infrastructure has been proposed to be subtracted from and added to the FMIT parcel. It would assist the Tribe's understanding of the design if a section of the 90 % BOD could describe the design in detail relative to that Parcel, the Maze and other especially culturally-sensitive locations.	Comment noted. Text will be added to the Executive Summary in the 90% BOD to describe remedy infrastructure proposed to be subtracted from 60% design and added at 90% design to the FMIT parcel. In addition, a description of the design relative to that Parcel, the Maze and other especially culturally-sensitive locations will also be provided at 90% design. Information will be provided to the FMIT for preview prior to 90% submittal.			Comment resolved.	Comment resolved.	90% BOD Section ES.3 of the 90% BOD describes remedy proposed on the FMIT parce, and changes from 60% to 90%l. Figure ES-12 illustrates the changes graphically. Tables 6.1-1 and 6.2-2 provide further information on steps taken in the design of the groundwater remedy to avoid any direct physical impact on the Topock Maze, as it is manifested archaeologically, prevent indirect impacts on the Topock Maze, to the maximum extent feasible, and avoid, minimize, or mitigate impacts on other historical and archaeological resources to the maximum extent feasible.
38	DTSC-6			Summarize/tabulate short term criteria/goals that will be the basis to assess if the remedy is operating adequately and potential contingency actions for not meeting those short term criteria/goals.	Short term goals and timeframes have implicitly been established in the Transition Plans evaluated in Section 7.3 and the Sampling and Monitoring Plan (Appendix L, Volume 2). These short term goals and a reference to the adaptive operations activities specified in the Sampling and Monitoring Plan will be summarized in the Introduction of the 90% BOD. The short-term goals summary is being developed in coordination with the agencies.	DTSC has been requesting the development of measurable short term remediation goals since the Corrective Measure Study. Although the goals stated in the response are appropriate, they lack specificity for measurement and decision making. PG&E will need to develop explicit, discrete, measurable goals/metrics in the 90%. These may be in addition to less quantifiable goals. DTSC will work with PG&E on the short term goal summary for the 90% BOD.	DOI will work with PG&E on the short term goal summary for the 90% BOD.		This topic will be carried forward. Resolution of this comment will be included in the 90% design.	PG&E is working on the short-term goals in coordination with DTSC and DOI.
39	DTSC-7			East Ravine pipeline. DTSC prefers that pipelines not be run through an active AOC that The might require characterization or remediation in the future provided that alternative access ways exist. Therefore, DTSC requests that an alternative pipeline path leading to extraction well ER-6 be selected.	PG&E is evaluating alternative pipe routing for ER-6 extraction piping, power and control conduits (see **Attachment C**, at the end of this table). It should be noted that, while any work around ER-6 will cause disturbance to the AOC, an effort will be made to minimize the amount of soil disturbed.	DTSC understands that PG&E is contemplating different approaches for the East Ravine pipeline alignment and looks forward to its presentation to agencies and stakeholders as part of the 90% design process.			PG&E and DTSC have discussed this comment and the alternative pipe routings shown in **Attachment C**, at the end of this table on December 19, 2013. As directed by DTSC, PG&E presented the alternative pipe routings to the agencies, Tribes, and stakeholders at the TWG meeting held on February 11, 2014. The ER-6 pipeline route was addressed in the letter	90% BOD Figure ES-4 and Appendix D, Drawing C-07-59.

TABLE I-1

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									received from DTSC and DOI on April 4, 2014, which provided directives on the remaining 60% issues. The agencies' directives regarding the ER-6 pipeline route will be incorporated into the 90% design.	
Specific Comments – Section 1										
40	DTSC-8	Introduction, p.1-2, 2nd paragraph, last sentence	As directed by DOI, a comment resolution meeting will be held prior to finalizing responses to comments and the Implementation Plan.	Is this correct and outstanding? DTSC assumes that this meant to say two comment resolution meetings were held in response to the comments received?	At the time of the 60% design submittal (April 5, 2013), responses to comments received on the revised FWIP (January 2013) were in progress, and one meeting had been planned to discuss responses with stakeholders, Tribes, and agencies. On May 14, 2013, the planned meeting was held. At the end of that meeting, it was decided that a second meeting was needed to complete discussions of the responses. The second meeting was held on May 21, 2013. The cited text will be deleted and replaced with: "Two comment resolution meetings were held on May 14 and May 21, 2013. The Final Implementation Plan was issued on July 19, 2013 (redline version) and August 2, 2013 (clean version). Additional comments were received from one Tribe on the Final Plan. These comments were considered by DTSC and DOI prior to approving the Final Plan on September 4, 2013."	Comment resolved.			Comment resolved.	90% BOD Section 3.3.1.
41	DOI-13	Section 1.1.1, Page 1-5	"Thin layers of white powdery materials …"	It should be noted that this material will be sampled as part of the ongoing Soil RFI/RI.	Comment noted. The following text will be added (shown in underline typeface): "Thin layers of white powdery materials have also been identified. DTSC had previously sampled some of the identified white powder materials. Additional white powder material that is located on the northern slope of East Ravine below the station access road will be sampled as part of the upcoming supplemental Soil RFI/RI."		Comment resolved.		Comment resolved.	90% BOD Section 1.1.1.
42	DTSC-9	1.1.1 Description and History of SWMU 1/AOC 1 and AOC 10, Page 1-5,		Update the history to incorporate the recently discovered information regarding the 1964 waste water injection well apparently utilized for waste disposal.	Per DTSC's direction on the draft RFI/RI Volume 1 Addendum Report (Site History and Background), PG&E will provide a detailed discussion of the history of the 1964 well in that report. The following sentence will	Comment resolved.			Comment resolved.	90% BOD Section 1.1.1.

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		Paragraphs 2 and 3.			be added to this section of the 90% BOD: "A recent (2013) discovery of a 1964 site record shows a steel pipe extending from a "water treatment chamber" at the former sludge drying bed area on the TCS to an "abandoned water well" in the bottom of Bat Cave Wash, detailed information will be provided in the RFI/RI Volume 1 Addendum."					
43	DOI-14	Section 1.1, Pages 1-5 and 1-6	All paragraphs	There are numerous features cited in the text but no map for the reader to identify the locations. These features include but are not limited to: AOC 4, AOC 10, PGE-08, ACEC, the Topock Maze, and HNWR. Please include a map with the features, or cross reference to Section 2 figures as appropriate.	Features referenced in the text will be added to Figure 1.2-1, with the exception of the Topock Maze due to confidentiality reason.		Comment resolved.		Comment resolved.	90% BOD Figure 1.2-1.
44	DOI-15	Section 1.1.3, Page 1-6		The second paragraph was added in response to a DOI comment, (RTC-28, DOI 14), regarding mitigation measures developed in accordance with the BLM PA and the CHPMP. Since this section pertains to ecological resources, the recommend text in the RTCs would be more appropriate for the new Section 1.1.2. A reference to and short discussion of the PBA should be included in this section. The MMRPs address both and should be shown as such.	The second paragraph of Section 1.1.3 will be moved to the end of Section 1.1.2. The following text will be added at the end of Section 1.1.3: "Remedial and investigative activities conducted to date at the Topock site are in conformance with the requirements of the 2007 Programmatic Biological Agreement (PBA) and its 2012 Addendum. Activities associated with implementation of the groundwater remedy will be under a new PBA, in conformance with the requirements of the federal Endangered Species Act (ESA), the Fish and Wildlife Coordination Act, and the Migratory Bird Treaty Act, as well as the EIR mitigation measure BIO-2b. PG&E, USFWS, and DOI are coordinating on the PBA for the final remedy. The goal is to complete the PBA in time for completion of ESA Section 7 consultation prior to the approval of the Remedial Action Work Plan."		Modify the 2nd to the last sentence in the response to the following: *PG&E, USFWS, **BLM** and DOI are coordinating on the PBA for the final remedy.* BLM is currently responsible for Section 7 consultation with FWS.		The following text will be added at the end of Section 1.1.3: "Remedial and investigative activities conducted to date at the Topock site are in conformance with the requirements of the 2007 Programmatic Biological Agreement (PBA) and its 2012 Addendum. Activities associated with implementation of the groundwater remedy will be under a new PBA, in conformance with the requirements of the federal Endangered Species Act (ESA), the Fish and Wildlife Coordination Act, and the Migratory Bird Treaty Act, as well as the EIR mitigation measure BIO-2b. PG&E, USFWS, BLM, and DOI are coordinating on the PBA for the final remedy. The goal is to complete the PBA in time for completion of ESA Section 7 consultation prior to the approval of the Remedial Action Work Plan."	90% BOD Sections 1.1.2 and 1.1.3.
45	DOI-16	Section 1.1.3, Page 1-6		The in-text citation for BOR 2010 is not listed in the Reference section.	The in-text citation for BOR 2010 will be revised to BLM 2010.		Comment resolved.		Comment resolved.	90% BOD Section 1.1.2.
46	FMIT-17	Section 1.2		Should reference, and not downplay, the significant and unmitigated	PG&E proposes the following change in the third paragraph of Section			Comment resolved.	Comment resolved.	90% BOD Section 1.2.2.

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				impacts of the project as stated in the groundwater FEIR.	1.2.2 (inserted verbiage shown in underline typeface: "The EIR concluded that implementation of the groundwater remedy would generate significant adverse environmental impacts, and for most potential impacts, the EIR prescribes mitigation measures capable of reducing these impacts to less-than-significant levels. For impacts to cultural resources within the Topock Cultural Area and noise impacts in the Topock Cultural Area, the prescribed mitigation measures are not capable of reducing these impacts to less-than-significant, and the EIR concluded that those impacts would be significant and unavoidable. The EIR includes an MMRP (DTSC 2011c) for the groundwater remedy. The mitigation measures were identified for impacts associated with various resources, including aesthetic, air quality, cultural, biological, geology and soils, hazardous materials, hydrology and water quality, noise, and water supply resources (DTSC 2011c)."					
47	DTSC-10	Introduction, p1-8, continuation from previous page.	EIR prescribes mitigation measures capable of reducing these impacts to less-than significant levels.	Please add "where possible" after "significant levels"	The text will be added as requested.	Okay.			Comment resolved.	90% BOD Section 1.2.2.
48	DOI-17	Figure 1.2-1		Please identify the location of the Topock Maze on Figure 1.2-1, or provide further explanation in the Notes, since it is discussed in Note 2.	The Topock Maze is described in the 60% BOD, specifically the Executive Summary (page vi, 2nd paragraph) and Section 1.1.2 (page 1-6, 1st full paragraph). For confidentiality reasons, the Maze has not been identified on maps in public documents such as the 60% design. No changes will be made to Figure 1.2-1.		Comment resolved.		Comment resolved.	Not applicable
49	FMIT-18 Hualapai-13 Chemehuevi-13 Cocopah-13 CRIT-13	Fig. 1.2-1 Groundwater Remedy Project Area And System Layout	Groundwater Remedy Project Area And System Layout	It is not clear why the Cr(VI) plume boundary, which is based on Q4 2011 sampling has not been updated. The plume boundary could be refined with more recent sampling and additional data collected during the East Ravine characterization efforts	As discussed in Section 2.2 of the 60% BOD, the Cr(VI) plume boundary included data through February 2012 for the East Ravine wells. An updated Cr(VI) plume boundary will be included in the 90% BOD with additional data collected from the East Ravine groundwater investigation effort which was			Comment resolved.	Comment resolved.	Figures throughout the 90% documents. 90% BOD Section 2.2. 90% BOD Apdx B Section 6.2.5

TABLE I-1

Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
					completed in July 2012.					
Specific Comments – Section 2										
50	DTSC-11	Section 2 Baseline Site Conditions and Pre-Design Work		Add a section (text, tables and figures) describing baseline site conditions for the freshwater injection areas. Also see DTSC comment on Executive Summary, Page v, Third Paragraph.	A section will be added as requested in the 90% BOD.	Ok pending review of 90% report.			Comment resolved.	90% BOD Section 2.3.4.
51	DOI-18	Section 2.1.1, Page 2-1	"The Topock site is situated in a basin-and-range geologic environment in the Mohave Valley."	The Chemehuevi detachment fault should be shown in Figure 2.1-1. The text should include some discussion of the significance of the fault to the hydrogeology of the Topock site.	The surface expression of the Chemehuevi detachment fault will be shown on Figure 2.1-1. The following text will be added to Section 2.1.1, as a footnote at the end of page 2-1: "[1]The following discussion focuses on the influence of the Chemehuevi detachment fault on groundwater flow in the vicinity of the compressor station. The 2006 Bedrock Tech Memo (*Information Review of Groundwater Conditions in Bedrock Formations at PG&E's Topock Compressor Station, Needles, California. March 15, 2006*) provides additional information on the detachment fault and the influence of faults on groundwater flow in nearby basins. The footwall of the Chemehuevi detachment fault is the exposed metadiorite bedrock on the slopes south of the compressor station. In most locations near the compressor station, alluvium lies in contact with the metadiorite, so the tectonic features associated with faulting are less apparent, although distinct tectonic features are observable in some outcrops nearby and in rocks in the mountains south of the compressor station. In some locations in East Ravine and the compressor station, Miocene conglomerate overlies the metadiorite and evidence of faulting has been observed in rock cores across this contact.. Evidence of faulting within the metadiorite has not been identified in site core. The contact between the conglomerate and the metadiorite has only been encountered at depth during the installation of three wells; MW-57, MW-67, and MW-68. At MW-67 only	Comment resolved.	Comment resolved.		Comment resolved.	90% BOD Section 2.1.1. 90% BOD Figure 2.1-1.

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					7 feet of conglomerate were encountered, which may have been a boulder laying on the metadiorite rather than an intact part of the conglomerate formation. In MW-57, the conglomerate near the contact was dry when drilled but once saturated began to collapse into the hole. The conglomerate at the contact had been altered and exhibited mylonitic texture and very weak cementation. In the three wells where the contact between the conglomerate and the metadiorite was encountered. The conglomerate at the contact was completely dry. The lack of cementation in the conglomerate would tend to heal fractures that formed at the contact. Thus, the most obvious feature of the detachment fault, the contact between the conglomerate and the metadiorite does not represent a conduit for groundwater flow. Hydraulic testing from two wells that are screened across this contact also shows that it does not produce water. In MW-57, depth specific flow measurements were conducted that did not identify any flow at the contact. Depth specific flow data were not collected from MW-68BR-280, but this well is open across the contact and produces very little water. It will pump dry at a rate of 0.5 gpm. The contact was encountered in the very bottom of MW-67 but the no depth specific flow testing was done and the well is not screened across the contact. It should be noted that the fault is a zone of fracturing, not just a single break in the rock. Slickensides (evidence of rock movement along a fracture) have been observed on fracture surfaces within the metadiorite. Given the regional nature and advanced age of the detachment fault, it is likely that all the bedrock wells at the site are technically within the fault zone, so the fault itself is not an important feature in the groundwater flow at the site. The fault does not affect the chromium plume in the alluvial aquifer, all of which lies above the					

TABLE I-1

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					fault."					
52	DOI-19	Section 2.1.1, Page 2-1	"The site is located at the southern (downstream) end of the Mohave Valley groundwater basin."	The Topock Marsh should be identified in Figure 2.1-1 since it is specifically addressed in the paragraph.	The Topock Marsh will be added to Figure 2.1-1.		Comment resolved.		Comment resolved.	90% BOD Section 2.1. 90% BOD Figure 2.1-1.
53	DOI-20	Section 2.1.2, Page 2-2	"Groundwater occurs in the Tertiary and younger alluvial fan and fluvial deposits."	Please reference the appropriate figure where the wells cited in this paragraph can be located.	These wells are shown on Figure 2.2-1. In addition, these wells will be added to Figure 2.1-2. The following text will be added at the end of the 2nd sentence of 1st full paragraph: "… (see Figures 2.1-2 and 2.2-1 for well locations)."		Comment resolved.		Comment resolved.	90% BOD Section 2.1.2,
54	DOI-21	Section 2.1.2, Page 2-2	"During the test at MW-57-185 (pumped at approximately 3 gallons per minute [gpm] for 7 hours) … ."	Was steady state achieved during drawdown?	During the constant rate pumping test in MW-57-185, steady state was achieved for approximately the last two hours of the test. Please see the 2009 East Ravine report, Attachment A4-2, MW-57BR Constant Rate Test (page 387 of 1003 of the PDF file) for additional details of the drawdown in the pumping well during the test.		Comment resolved.		Comment resolved.	90% BOD Section 2.1.2,
55	DOI-22	Section 2.1.2, Page 2-2	"During the test at MW-70BR-225 (pumped at approximately 9 gallons per minute [gpm] for 12 hours) … ."	Was steady state achieved during drawdown?	During the constant rate pumping test in MW-70BR-225, steady state was achieved early in the test, and remained at steady state during the majority of the test. Please see the 2013 Addendum to the East Ravine Report Attachment D, Site H Constant Rate Test. The first graph shows the drawdown for the constant rate test performed in MW-70BR-225; page 873 of 958 of the PDF for additional details of the drawdown in the pumping well during the test.		Comment resolved.		Comment resolved.	90% BOD Section 2.1.2.
56	DOI-23	Section 2.1.2, Page 2-2	"Groundwater occurs in the Tertiary and younger alluvial fan and fluvial deposits."	Footnote 1 addresses pumping well MW-70-105, which is not one of the wells discussed in the first paragraph of Section 2.1.2 regarding performance of bedrock pump tests. Also, Footnote 1 seemingly conflicts with the statement in the first paragraph of Section 2.1.2 that yield from the bedrock wells was insufficient to cause drawdown in the higher permeability alluvium.	MW-70-105 is the water table well that is referred to in Footnote 1 (not the pumping well). The footnote will be edited to clarify this. In addition, well MW-70-105 is a shallow bedrock well, not installed in the alluvium.		Comment resolved.		Comment resolved.	90% BOD Section 2.1.2.
57	DOI-24	Section 2.1.2, Page 2-3	"… fractured bedrock is in hydraulic	Are upward gradient conditions consistently present at the site? Do seasonal fluctuations of groundwater	Available data shows that upward gradients are dominant but sufficient data are not available for all seasons		Comment resolved.		Comment resolved.	Not applicable

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			communication with the Alluvial Aquifer and equilibrates to an approximate elevation similar to the water table in the Alluvial Aquifer."	elevations ever present a downward gradient condition?	and all wells to determine whether seasonal fluctuations may sometimes result in a reversal of gradients in some locations.					
58	DTSC-12	2.2 Chromium Plume Dimensions, First Quarter 2012, P.2-3		Minor Edits: Table 2.2-1 footnotes are not numbered properly and do not correlate with the Notes section under the table. Table 2.2-2 should indicate why the maximum concentration for mercury is "0".	The footnotes in Table 2.2-1 will be corrected, and the numbered notes will be numbered accordingly to include information for the following table items: 1. Results Summary for RFI/RI Wells. 2. Background Comparison 3. Chemical-Specific ARARs 4. Number of Wells with Average Exceeding UTL. The maximum concentration for mercury is 0.4 µg/L. This table will be updated in the 90% BOD.	Comment resolved pending review of the 90% BOD.			Comment resolved.	90% BOD Tables 2.2-1 and 2.2-1.
59	DTSC-13	2.2 Chromium Plume Dimensions, First Quarter 2012, P.2-4	The volume of the plume within the East Ravine bedrock formation is believed to represent less than 2 percent of the total plume.	Calculations supporting the 2 percent value should be included in the document. If this calculation is located elsewhere in the design document, please reference.	This estimate derives from the groundwater transport model. The model is initialized with the February 2012 chromium plume. The porosity values in the model are as follows: a) alluvial aquifer porosity is 12% mobile and 23% immobile; b) bedrock aquifer porosity is 2% mobile and 0.1% immobile. Assuming these porosity values with equal concentrations in mobile and immobile phases, the volume of the chromium plume in bedrock is less than 1% of the total. The figure of <2% was used to account for the uncertainty in the bedrock porosity value. The above explanation will be added to the 90% BOD.	Comment resolved pending review of the 90% BOD.			Comment resolved.	90% BOD Section 2.2.
60	DTSC-14	2.3.1 Constituents of Potential Concern (COPCs), P.2-4	It should be noted that the COPCs (selenium, molybdenum, and nitrate) are not expected to impact remedy performance	The statement is a little confusing. The remedy design must account for monitoring of these parameters. Action levels or goals should be developed to ensure elevated concentrations do not adversely affect the environment or the remedy (e.g., reduce nitrate to below MCL; contain elevated COPCs within the	For consistency with response to comment #61 DTSC-15, the first sentence of the cited text will be revised to: "It should be noted that the COPCs (selenium, molybdenum, and nitrate) are not expected to ~~impact remedy performance and, therefore, do not~~	DTSC conceptually agrees that the COPCs should not have significant effects of the performance of the in-situ remedy. However, PG&E should develop, as part of O&M, action levels and procedures for dealing with the COPCs in the unlikely event			Comment resolved.	90% BOD Section 2.3.1. O&M Manual Volume 2 Section 5.1.2.

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			and, therefore, do not impact the remedy design. Further, the 2009 Groundwater Risk Assessment (ARCADIS 2009) concluded that selenium, molybdenum, and nitrate do not represent a significant health risk to future hypothetical users of the groundwater. The 2009 risk assessment is not up to date with current data, especially new data collected at the TCS and East Ravine. For instance, new nitrate data collected were higher than that utilized in the 2009 risk assessment. Therefore, modifying risk assessment conclusions is requested.	boundary of the chromium plume). PG&E has indicated that the remedy should only help to reduce the concentrations of these particular constituents. Modification of the sentence is required.	~~impact the remedy design~~ have any significant effect on the performance of the in-situ reduction. However, the COPCs will be monitored throughout the remedy. Remedy pumping and injection will be operated so that the extent of elevated concentrations of COPCs at the completion of the remedy does not extend beyond the current extent of the chromium plume. The COPCs can be removed from groundwater within the IRZs. During operation, the areas of elevated COPCs are not expected to expand beyond the current boundaries of chromium plume or the floodplain down gradient from the IRZ. COPC concentration trends in wells on either side of the IRZ will be monitored to evaluate the degree to which COPCs are being attenuated by the IRZ." Threshold concentrations and a decision tree for assessment of elevated COPCs will be included in the 90% design. As agreed in the Human Health and Ecological Risk Assessment Work Plan Addendum 2 memorandum (RAWP Addendum 2 – Scope; ARCADIS 2013), an outline of the approach to evaluate the new groundwater data collected since the 2009 Groundwater Risk Assessment (GWRA; ARCADIS 2010) will be presented in the upcoming RAWP Addendum 2, and the results of the evaluation presented either as a technical memorandum or an addendum to the GWRA. Note, however, that the new groundwater data collected in the TCS and East Ravine have been evaluated and the results of the evaluations presented in the "Addendum to the Summary and Findings Associated with the East Ravine Groundwater Investigation" dated November 15, 2012 (CH2MHILL 2012). As stated in the November 2012 document, the new data do not suggest any previously unknown hotspots or contaminant source areas.	that the COPCs are more prominent than expected. Comment resolved pending review of the 90% design.				

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61	DTSC-15	2.3.1.1 Selenium, P. 2-4	Selenium is not expected to impact remedy performance and therefore does not impact remedy design.	Please delete the cited sentence as it is redundant and not entirely accurate. Also delete the equivalent sentences in the molybdenum and nitrate sections.	This sentence and equivalent sentences about molybdenum and nitrate will be revised as follows (inserted verbiage shown in underline typeface, deleted verbiage shown in ~~strikethrough~~ typeface): "~~[COPC name] is not expected to impact remedy performance and therefore does not impact remedy design.~~ [COPC name] will be monitored throughout the remedy. It is not expected to have any significant effect on the performance of the in-situ reduction, however remedy pumping and injection will need to be operated so that the extent of elevated concentrations of [COPC name] at the completion of the remedy does not extend beyond the current extent of the chromium plume." See also discussion about selenium and nitrate in the response to comment #62a FMIT-19.	Comment resolved.			Comment resolved.	90% BOD Section 2.3.1.
62a	FMIT-19	Section 2.3.1p. 2-4	*It should be noted that the COPCs (selenium, molybdenum, and nitrate) are not expected to impact remedy performance and, therefore, do not impact the remedy design.*	Elevated concentrations of nitrate in groundwater were caused by repeated evaporation of naturally occurring nitrate (see PG&E Technical and Ecological Services, Bat Cave Wash, 1995; and RFI-RI, Volume 2, 2008). Elevated selenium concentrations in water from wells in the study area appear to correlate with nitrate concentrations (See Exhibit VI); therefore, it might be that selenium concentrations are a reaction product of the high nitrate concentrations (possibly the solid-phase selenium in aquifer sediments is being oxidized by nitrate). Carbon amendments to the aquifer will treat and remove both nitrate and selenium; however, as the nitrate plume is hydraulically pushed into the IRZ line, nitrate will inhibit the reduction of chromate? Can the model be used to forecast arrival of the nitrate plume and reactions at the IRZ line?	The agency approved Final RFI/RI Volume 2 Report discusses several potential sources of nitrate in site groundwater besides the evaporative concentration in original blowdown water. Section 5.3.1.6 on page 5-19 of the RFI/RI Volume 2 states: "The nitrate in these wells may be associated with mountain front recharge, as the wells lay at the base of an alluvial fan within or near incised drainage channels running northward. Numerous studies have documented nitrate generation through lightning discharges in thunderstorms.. Recent research has shown that a significant reservoir of nitrate can accumulate in the soil beneath areas of desert pavement in the Mohave Desert (Graham, 2008 [*Large near-surface nitrate pools in soils capped by desert pavement in the Mojave Desert*. California Geology. Volume 36, No. 3. R.C. Graham, et al.])… Another potential source of nitrate is historical blasting associated with railroad, freeway, compressor station, and pipeline construction, and with the quarry behind the Old Evaporation Ponds. Other potential nitrate sources include animal grazing, which historically took place on portions of			Comment resolved.	Comment resolved.	O&M Manual Volume 2 Section 4.2.1. O&M Manual Volume 2 Table 2.1-2.

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					the site, and evaporative concentration of natural nitrate in blowdown water at the facility." It is possible that nitrate (and other oxyanions) may compete with the reduction of chromate by organic carbon. However, compared to the mass of chromate in the plume, the mass of nitrate is relatively small. Therefore, PG&E will closely monitor the concentrations and movement of nitrate and other nitrogen compounds (nitrite and ammonium), and operate the remediation system as efficiently as possible, and to anticipate and prepare for the effects of competing oxyanions on the efficacy of carbon amendments. Monitoring of nitrate has been included in Table 2.1-2 of the Draft O&M Manual, Volume 2 (Sampling and Monitoring Plan). This table will be revised in the 90% BOD to include monitoring of other nitrogen compounds.					
62b	Hualapai-14 Chemehuevi-14 Cocopah-14 CRIT-14	Section 2.3.1p. 2-4	*It should be noted that the COPCs (selenium, molybdenum, and nitrate) are not expected to impact remedy performance and, therefore, do not impact the remedy design.*	Elevated concentrations of nitrate in groundwater were caused by repeated evaporation of naturally occurring nitrate (see PG&E Technical and Ecological Services, Bat Cave Wash, 1995; and RFI-RI, Volume 2, 2008). Elevated selenium concentrations in water from wells in the study area appear to correlate with nitrate concentrations (See Exhibit V; R2=0.78); therefore, it might be that selenium concentrations are a reaction product of the high nitrate concentrations (possibly the solid-phase selenium in aquifer sediments is being oxidized by nitrate). Carbon amendments to the aquifer will treat and remove both nitrate and selenium; however, as the nitrate plume is hydraulically pushed into the IRZ line, is it possible that nitrate will inhibit the reduction of chromate? Can the model be used to forecast arrival of the nitrate plume and reactions at the IRZ line?	See response to comment #62a FMIT-19. Also note response to comment #61 DTSC-15.			Comment resolved.	Comment resolved.	O&M Manual Volume 2 Section 4.2.1. O&M Manual Volume 2 Table 2.1-2.
63	DTSC-16	2.3.1.3 Nitrate, P. 2-5	Concentrations elevated above the UTL and in some cases above the	Revise the sentence as follows, "Concentrations elevated above the UTL and in some cases above the ARAR of 10 mg/L are found in the alluvial zone of the aquifer ~~along the~~	PG&E disagrees with the proposed text changes. Inspection of the historical nitrate data in the agency approved RFI/RI Volume 2 Addendum (Figure 2-16, page 66 of	Comment resolved. See response to comment #65 DTSC-18.			Comment resolved.	Not applicable

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			ARAR of 10 mg/L are found in the alluvial zone of the aquifer along the mountain front recharge areas (i.e., southern Bat Cave Wash and the New Evaporation Ponds).	~~mountain front recharge areas (i.e., southern Bat Cave Wash and the New Evaporation Ponds).~~ almost exclusively within the boundary of the chromium plume.“	the report PDF) demonstrate that the locations in the New Ponds area are consistently high and not insignificant in number compared to the locations found within the plume. In addition, the majority of plume monitoring locations have low concentrations of nitrate, without counting the naturally-reducing portions of the floodplain. No changes are proposed to the text.					
64	DTSC-17	2.3.1.3 Nitrate, P.2-5	…there are several potential sources of nitrate, including concentration by lightning in rainfall, disruption of desert pavement, blasting materials from nearby quarries and roadway construction, animal grazing, and evaporative concentration in industrial wastewater.	The discussion on nitrate contamination does not mention a potential source on the station: waste releases from various septic systems. Please revise text to acknowledge this issue.	The following sentence is proposed to be added at the end of the cited sentence: “<u>The septic systems at the Topock Compressor Station may be a potential source of nitrate.</u>”	Comment resolved.			Comment resolved.	90% BOD Section 2.3.1.
65	DTSC-18	2.3.1.3 Nitrate, P.2-5	Although multiple potential sources exist for elevated nitrate in groundwater, DTSC maintains it cannot be eliminated as a COPC.	Revise the sentence as follows, “Although multiple potential sources exist for elevated nitrate in groundwater, DTSC maintains it cannot be eliminated as a COPC<u>, especially in light of recent elevated nitrate data that clusters near the compressor station suggesting it as a source.</u>	Elevated nitrate near the Compressor Station have been known for some time (see Figure 2-16 of RFI/RI Volume 2 Addendum). It was agreed at that time that Compressor Station sources were a potential source, among the others described. PG&E suggests the additional text be revised to read “…, <u>given the highest nitrate concentrations occur in groundwater wells near the Compressor Station.</u>”	Comment resolved.			Comment resolved.	90% BOD Section 2.3.1.
66	DTSC-19	2.3.3.1 Total Dissolved Solids, P.2-8	The greater TDS in these wells is not believed to be due to their association with the plume	Please delete the cited sentence because the cited wells would have obviously been affected by TDS releases associated with PG&E’s discharges to Bat Cave Wash.	The following text will be added following the cited text: ““….10,000 mg/L. <u>Because well MW-9, MW-10, and MW-11 are chromium contaminated wells, the TDS associated with them cannot be attributed to only natural TDS, but</u>	Comment resolved.			Comment resolved.	90% BOD Section 2.3.3

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			footprint, since historical samples collected outside the RFI/RI from the Old Evaporation Ponds wells ranged between 500 and 10,000 mg/L.		must represent a mixture including TDS associated with waste discharge from the compressor station.“					
67	DTSC-20	2.3.3.1 Total Dissolved Solids, P.2-9 && 2.3.3.2 Sulfate, P.2-9	TDS is not expected to impact remedy performance nor impact the remedy design. In particular, Cr(VI) reduction was observed in the presence of elevated TDS concentrations, as presented at the January 19, 2012 TWG meeting. Additional discussions are included in Appendix B (Groundwater Modeling) of this BOD Report. Similar to TDS and the COPCs (selenium, molybdenum, and nitrate), sulfate is not expected to impact remedy performance nor impact the design.	Please delete the cited paragraph/sentence as they are redundant with language on page 2-8, section 2.3.3. See DTSC comments on 2.3.1 Constituents of Potential Concern (COPCs), P.2-4 and 2.3.1.1 Selenium, P.2-4 above. What are the TDS limits for injection? Waste discharge limits issued from the Regional Water Quality Control Board for IM-3 were specified and PG&E complied with them. It seems there should be some general minerals limit for waters injected into the aquifer that are not eventually captured by the proposed remedy. Start with IM3 WDR limits and discuss rationale for any excursions from those limits. Need to establish discharge limits for large suite of parameters: Title 22 metals, general minerals, etc.,	The cited sentences will be removed in the 90% BOD. It is unclear as to how the second part of this comment is related to these sections of the BOD, which are intended to describe the baseline conditions for TDS and sulfate. Nonetheless, as discussed in the response to comment #145 DTSC-50, PG&E believes that TDS limits for injection is not required for the remedy. It is important to note that the purpose for injection with respect to the remedy is different from the purpose of discharge with respect to IM3. The selected remedy relies on the ability to inject water in order to mix water throughout the treatment zone, therefore, setting discharge limits is inconsistent with the selected remedy. The purpose of IM3 discharge is a sustainable way to retain water in the groundwater basin and to minimize the amount of trucking needed for off-site disposal. Setting discharge limits for IM3 is appropriate to ensure the quality of water being returning to the basin.	Ok DTSC agrees that discharge limits should not be described in the referenced section of the design report. However, DTSC disagrees with PG&E that discharge limits are not warranted for the remedy because the purpose of remedy is different from IM3. Although the reasons for water injection might be different, the goal of both actions is to ensure the quality of the water returning to the basin and to ensure that the beneficial use designation of the basin plan is maintained outside of the plume area. DTSC disagrees that setting discharge limits are inconsistent with the selected remedy. Also see response to comment #145.			Discussion between DTSC, DOI, RWQCB, and PG&E is ongoing to resolve this comment. This topic will be carried forward. Resolution of this comment will be included in the 90% design. PG&E will also work on items related to this comment as directed in the Agencies’ direction letter dated April 4, 2014.	90% BOD Section 2.3.3.
68	DOI-25	Section 2.4.1, Page 2-10	“Kinder Morgan, the co-owner (along with PG&E) of the arched bridge	There are no recommendations to address the brace members because Appendix G, Section 7 (Recommendations) is missing. Please provide Section 7.	See Drawing #481620, Change #1 (Erection Plan, Colorado River Highway Bridge Topock-Milpitas Main 300) for recommended modifications for compliance with current wind/horizontal loading		Comment resolved.		Comment resolved.	90% BOD Appendix G.

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			over the Colorado River, … ."		requirements (included in **Attachment K**, at the end of this table). This drawing will be added to the report as Section 7. PG&E Gas Transmission, as the entity responsible for the pipe bridge within PG&E organization, is leading the discussion with Kinder Morgan regarding modifications to the arched bridge. Any follow-on pipeline bridge improvement project will be a Gas Transmission project. Consistent with current practice, PG&E will keep the agencies, stakeholders, and Tribes informed of Gas Transmission projects in the Topock area.					
69	DTSC-21	Section 2.4.1, 1st bullet, p. 2-11	To maximize reuse of the existing electrical infrastructure, the final groundwater remedy will use power from the Compressor Station and/or the City of Needles Electric system.	Please note as a condition for the approval of the selected remedy, DTSC required, in the January 31, 2011 remedy approval letter, that " (2) PG&E shall rent or otherwise obtain a single new primary 320 kW generator, of similar make and model of the existing generator (Isuzu Model 6WG1X), for purposes of providing backup electricity when needed at the site for implementation of the approved project."	Comment noted. PG&E will obtain a generator that meets the condition of approval in DTSC's January 31, 2011 remedy approval letter. The generator will be located on PG&E parcel.	Resolved. DTSC will review the complete electrical system as part of the 90% design.			Comment resolved.	90% BOD Sections 2.4.1 and 3.5.1. O&M Manual Volume 1 Section 2.4.
70	FMIT-20	Section 2.4.1		References that an inventory of existing infrastructure related to the project area is ongoing. The Tribe looks forward to seeing this inventory. A schedule for publishing this inventory should be provided.	A draft of the inventory will be available at 90% design.			Comment resolved pending review of 90% design.	Comment resolved.	90% BOD Section 2.4.1 and Figure 2.4-1A.
71	MWD-5	2.4.1/ 2-9	First paragraph, fourth sentence "...Southern California Metropolitan Water District."	This should read "...Metropolitan Water District of Southern California."	Text will be revised as requested.				Comment resolved.	90% BOD Section 2.4.1.
72a	FMIT-21	Section 2.4.3.1, p. 2-12 Coordination of RFI/RI Soil Investigation with Remedy Design and Construction	*As discussed during the resolution of comments on the 30% BOD (PG&E 2011a), the additional soil investigations will incorporate*	It is not clear why a discussion regarding an infiltration gallery is included within the 60% BOD. The Tribe is opposed to this option.	Management of remedy wastewater including transport, treatment potential and disposal/reuse was first discussed in Section 2.2.3 of the November 2011 CMI/RD Work Plan, and again in Section 3.4 of the 30% BOD. In each report, the rationale for an infiltration gallery in Bat Cave Wash was presented (e.g., Item #5 on page 2-25 of the CMI/RD, 1st		Revise the last sentence of the first paragraph as follows: there **were** no other comments from Tribes on this subject. Also include a note in the response that the infiltration gallery was included as an	Tribe considers this issue open pending future proposal by PG&E.	PG&E's revised response is as follows: Management of remedy wastewater including transport, treatment potential and disposal/reuse was first discussed in Section 2.2.3 of the November 2011 CMI/RD Work Plan, and again in Section 3.4 of the 30% BOD. In	90% BOD Exhibit 3.4-2 (see note at end of Exhibit).

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Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
			the possible use of an infiltration gallery in Bat Cave Wash for disposal of treated remedy produced water, and will include collection of relevant and adequate data to support the CMS/FS design.		paragraph of Section 3.4.2 on page 3-27 of the 30% BOD). While there was a comment from one Tribe in favor of surface water infiltration in Bat Cave Wash, there was no other comments from Tribes on this subject. The Tribe's concern is however, noted. This option is not being further evaluated at this time. If PG&E proposes to evaluate this option further in the future, PG&E will discuss the option and the Tribe's concern at that time.		alternative for wastewater disposal in the EIR and that further input from the Tribes will be considered during the soil CMS/FS development and review.		each report, the rationale for an infiltration gallery in Bat Cave Wash was presented (e.g., Item #5 on page 2-25 of the CMI/RD, 1st paragraph of Section 3.4.2 on page 3-27 of the 30% BOD). While there was a comment from one Tribe in favor of surface water infiltration in Bat Cave Wash, there <u>were</u> no other comments from Tribes on this subject. <u>The EIR considered both onsite management and off-site disposal of remedy-produced water - the infiltration gallery was one of the potential onsite management options.</u> The Tribe's concern is however, noted. This option is not being further evaluated at this time. If PG&E proposes to evaluate this option further in the future, PG&E will discuss the option and the Tribe's concern at that time, and <u>will seek further input from the Tribe during the Soil CMS/FS development and review</u>.	
72b	Hualapai-15 Chemehuevi-15 Cocopah-15 CRIT-15	Section 2.4.3.1, p. 2-12 Coordination of RFI/RI Soil Investigation with Remedy Design and Construction	*As discussed during the resolution of comments on the 30% BOD (PG&E 2011a), the additional soil investigations will incorporate the possible use of an infiltration gallery in Bat Cave Wash for disposal of treated remedy produced water, and will include collection of relevant and adequate data to support the CMS/FS design.*	It is not clear why a discussion regarding an infiltration gallery is included within the 60% BOD. The Tribes are opposed to this option.	See response to comment #72a FMIT-21.			Tribes consider this issue open pending future proposal by PG&E.	See above.	90% BOD Exhibit 3.4-2 (see note at end of Exhibit).

TABLE I-1

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Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

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73	DTSC-22	2.4.4 Surface Water and Wetlands, Page 2-13, Table 2.4-1	Table 2.4-1 and Starting with the annual event in December 2010, in-situ byproducts (arsenic, manganese, and iron) were added to the list of analytes for the surface water monitoring program to assist with establishing baseline levels upgradient and downgradient of the site.	Surface water monitoring should include, at a minimum, monitoring for COPCs nitrate, selenium, and molybdenum. Table 2.4-1 indicates that minimal data has been collected for nitrate, selenium, and molybdenum to date and, therefore, collection for these constituents should be implemented immediately. Appropriate detection limits are not being used for selenium according to the table (detection limits are greater than chemical specific ARAR levels). This should be rectified during future sampling events.	The three COPCs (selenium, molybdenum, and nitrate) were added to the Topock surface water monitoring program in June 2011. Table 2.4-1 of the 60% BOD includes data through December 2011. As of September 2013, the number of surface water samples collected for selenium is 288, for molybdenum is 288, and for nitrate is 276. The detection limit for selenium in surface water samples has been reduced from 10 to 5 parts per billion since August 2012. Table 2.4-1 will be updated in the 90% BOD.	Comment resolved.			Comment resolved.	90% BOD Table 2.4-1.
74	DTSC-23	Section 2.4.4, p. 2-13, 3rd paragraph	Starting with the annual event in December 2010, in-situ byproducts (arsenic, manganese, and iron) were added to the list of analytes for the surface water monitoring program to assist with establishing baseline levels upgradient and downgradient of the site.	In the 60% design, Section 2.3.2, PG&E also identified iron and barium as potential by-product of remedy. PG&E should immediately incorporate these constituents into the sampling program for baseline purposes as well.	As indicated in the 60% BOD, iron was added (along with arsenic and manganese) to the Topock surface water monitoring program in December 2010. Barium will be added to the surface water monitoring program starting with the next surface water sampling event in November 2013.	Comment resolved.			Comment resolved. Note that Barium was added to the surface water monitoring program in November 2013.	90% BOD Section 2.4.5 and Table 2.4-1.

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Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

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75	DOI-26	Section 2.4.6, Page 2-14		In-text citations for 2008 California Diversity Database (CNDDB) and 2010 CNPS are inconsistent. A consistent format should be used.	The in-text citations for the subject references are consistent with the citation convention in the 60% BOD, and that is to spell out the exact wording of an abbreviation the first time it appears in the report. Thus, in the last paragraph of Section 2.4.6 (page 2-14), CNDDB is spelled out because this is the first time this abbreviation appears in the report; whereas CNPS is not spelled out because this is its second appearance in the report (the first appearance is in the 4th bullet of Section 2.4.6 where its exact wording is spelled out, consistent with the convention).		Comment resolved.		Comment resolved.	Not applicable.
76	DOI-27	Section 2.4.6, Page 2-16	Special-Status Plants	In-text citations for USFWS (1996a) and CNPS (2001) are inconsistent. A consistent format should be used.	The in-text citations for the subject references are consistent with the citation convention in the 60% BOD, and that is, for authors of multiple publications in a single calendar year (e.g., USFWS in 1996), to assign a letter after the year in alphabetical order. When there is only one publication in a single year, no letter is needed after the year (e.g., CNPS in 2001).		Comment resolved.		Comment resolved.	Not applicable.
77s	DOI-28	Section 2.4.7, Page 2-17	"The EIR mitigation measure CUL-1b/c2 requires that a cultural resources study be conducted …."	It is stated that a geoarchaeological investigation was completed in June 2012, and that a report is forthcoming. It is unclear if information contained within the report will influence the design. If so, it is important to have this report available and an analysis complete before final direction is given on changes to the 60% Design.	PG&E provided a draft geoarchaeological investigation report to Tribes for review in July 2013, and recently discussed with Tribes at the August 20, 2013 TMU meeting. The investigation results inform the design. Although the report is not due to agencies until the 90% design, in response to this comment, PG&E will provide a draft report to DOI for its preview.		Comment resolved.		Comment resolved.	Not applicable.
78	DOI-29	Table 2.2-1	Notes	The in-text citation for CH2M HILL 2009 is not listed in the Reference section.	The letter "a" will be added after 2009.		Comment resolved.		Comment resolved.	90% BOD Table 2.2-1.
79	DOI-30	Table 2.3-1	Notes	The in-text citation for CH2M HILL 2008 is not listed in the Reference section.	The information for CH2M HILL 2008 is in the References section; please see the 5th reference listed under CH2M HILL.		Comment resolved.		Comment resolved.	90% BOD Table 2.3-1.
80	DOI-31	Figure 2.1-2		Please modify the legend to identify and define two map features – the black dashed line and the gray dotted line.	The gray dotted line demarcates the Bat Cave Wash channel. The black dashed line is an approximation of the extent of saturated alluvium. The legend will be modified to include both map features.		Comment resolved.		Comment resolved.	90% BOD Section 2.1 and Figure 2.1-1.

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Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
81	DOI-32	Figure 2.4-3	Notes	The in-text citation for CH2M HILL 2009 is not listed in the Reference section.	The 2009 East Ravine Investigation Report is Appendix A to the CMS/FS (CH2M HILL 2009d), which is listed in the Reference section. The letter "d" will be added after 2009 on Figure 2.4-3.		Comment resolved.		Comment resolved.	90% BOD Figure 2.4-3. The letter "e" instead of "d" was added after 2009 to reflect updated reference section in the 90% BOD.
82	DOI-33	Figure 2.4-4		The font in the legend and figure are very small and difficult to read. At the minimum, it would be helpful to show a larger label and arrow identifying the locations of AOCs 11 and 12 since they are called out in the text (first paragraph of Section 2.4.3).	Figure 2.4-4 will be revised to show larger labels and arrows.		Comment resolved.		Comment resolved.	90% BOD Figure 2.4-4.
83	DOI-34	Figure 2.4-11		Indigenous plants of traditional cultural significance within the EIR project area in compliance with mitigation measure CUL-1a-5: Arrowweed is not included on the map but should be as it has been identified as a plant of cultural significance.	Culturally significant plants shown in Figure 2.4-11 included only those species that were included in Appendix PLA of the Final EIR. The list in Appendix PLA is based on a list of Colorado River Indian Ethnobotany. Arrow weed is not included on that list. Arrow weed however will be protected during construction as a mature plant under AES-1a. Populations of arrow weed were mapped in the Mature Plants Survey Report included in Appendix A7 of the 60% BOD (see Figure 3, page 509 of the PDF).		Add a footnote to Figure 2.4-11 noting that the Tribes have stated that Arrow weed is an ethnobotanical sensitive plant (June 2011).		The following note will be added to Figure 2.4-9 in the 90% BOD: "Tribes have stated that Arrow weed is an ethnobotanical sensitive plant (June 2011). Arrow weed however is not on the Appendix PLA of the FEIR. Arrow weed will be protected during construction as a mature plant under AES-1a."	90% BOD Sections 2.4.6 and 2.4.7, and Figrue 2.4-11.
84a	FMIT-22	Figure 2.4-11 Indigenous Plants Of Traditional Cultural Significance Within The EIR Project Area In Compliance With Mitigation Measure Cul-1a-5	Note on map reads: *"Note that in compliance with EIR mitigation measure CUL-1a-9 as well as PA and CHPMP mitigation measures, the pipeline along the dirt road west of National Trails Highway is located in an existing, previously disturbed, access road. In addition, the location of the road and the pipeline was field verified and does not*	The statement that "the location of the road and the pipeline does not create any direct effect on the Topock Maze," which is made based on alleged compliance with EIR mitigation measure CUL-1a-10, PA and CHPMP should be removed from the text. It is overstated and misleading. Compliance with these measures does not ensure that the cultural and spiritual integrity of the site is unaffected. It should be emphasized that the Tribe was not sufficiently made part of the groundwater EIR process. Tribes have the singular capacity to evaluate whether there are impacts on the Maze. Additionally, some of the recent archaeological surveys performed by the Tribes in cooperation with PG&E and DTSC contractors indicate there may indeed be direct effects on the Maze. Would it be possible to place all of the infrastructure on the east side of National Trails Highway to	PG&E understands and the EIR acknowledges that the mitigation measures do not ensure the spiritual integrity of the site is unaffected. The note does not state that compliance with mitigation measures would ensure that the cultural and spiritual integrity of the site is unaffected. As disclosed in the EIR, even with implementation of CUL-1a-9 and CUL-1a-10, the impact on the Topock Cultural Area as a historic resource would be significant and unavoidable. (Final EIR at p. 4.4-61.) As the note on Figure 2.4-11 states, however, compliance with the requirements of the PA, CHPMP mitigation measures, and EIR mitigation measures CUL-1a-9 and CUL-1a-10 will prevent direct impacts on the Topock Maze as archeologically manifested. Through discussions with the Tribe, PG&E understands that the Tribe's comment that the "Tribe was not sufficiently made part of the EIR				PG&E's response was discussed with the FMIT, and revised in response to that discussion. In addition, PG&E evaluated moving all NTH IRZ wells to the east side of National Trails Highway and the results of the evaluation was presented at the February 11, 2014 TWG meeting (map is included in **Attachment D**, at the end of this table). PG&E understand that this comment is resolved.	Several figures in the 90% BOD show all NTH IRZ wells on the east side of National Trails Highway (e.g., Figures ES-4A, ES-10, etc.)

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PG&E Topock Compressor Station, Needles, California

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			create any direct physical impact or effect on the Topock Maze, as it is manifested archaeologically, in compliance with EIR mitigation measure CUL-1a-10 and PA and CHPMP mitigation measures."	better avoid cultural resources that may be eroding from the mesas?	process" does not refer to the overall EIR process, but is specific to the initial archeological surveys of the Maze. In addition, PG&E understands that the comment is not intended to be a claim against the EIR process. PG&E notes for the record that DTSC provided all stakeholders with the opportunity to comment on the Draft and Final EIR pursuant to CEQA, and made a special effort to consult with the Tribe. The Tribe availed itself of those opportunities, submitting numerous comments. (See, e.g., Final EIR, Vol. 1, at pp. 4-2-112, 4-170-78.) The Final EIR responds to the Tribe's comments and numerous changes to the EIR were made based on the Tribe's input. (*Id.* at pp. 4-113-69, 4-179-84.) See response to comment #12 FMIT-7. PG&E is committed to complying with the state and federal mitigation measures to ensure that the Project will not have a direct impact on the Maze as it is archeologically manifested. PG&E understands that the Tribes have conducted a Tribal Cultural Values Assessment, which is currently under review by the agencies and PG&E. The issue of the Maze boundaries and the Project's compliance with applicable state and federal mitigation measures will thus be a subject of further discussion between PG&E, the Tribes, and the agencies. In response to the question about the possibility of placing the infrastructure on the east side (instead of the west side of NTH), and based on the comment clarification discussion with the Tribes on 9/5/13 and subsequent discussions at the December 2013 TWG meeting, PG&E reviewed the locations of all provisional IRZ wells below the mesas and determined that these provisional wells could be moved to the east side of NTH. Specifically, the proposed new locations for four provisional wells (IRZ-12, IRZ-14, IRZ-22, and IRZ-24) were included on a map that was made available to stakeholders,					

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Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design
PG&E Topock Compressor Station, Needles, California

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					Tribes, and the agency representatives who participated in the October 28, 2013 site walk (map is included in **Attachment D**, at the end of this table).					
84b	Hualapai-16 Chemehuevi-16 Cocopah-16 CRIT-16	Figure 2.4-11 Indigenous Plants Of Traditional Cultural Significance Within The EIR Project Area In Compliance With Mitigation Measure Cul-1a-5	Note on map reads: *"Note that in compliance with EIR mitigation measure CUL-1a-9 as well as PA and CHPMP mitigation measures, the pipeline along the dirt road west of National Trails Highway is located in an existing, previously disturbed, access road. In addition, the location of the road and the pipeline was field verified and does not create any direct physical impact or effect on the Topock Maze, as it is manifested archaeologically, in compliance with EIR mitigation measure CUL-1a-10 and PA and CHPMP mitigation measures."*	The statement that "the location of the road and the pipeline does not create any direct effect on the Topock Maze", which is made based on alleged compliance with EIR mitigation measure CUL-1a-10, PA and CHPMP, should be removed from the text. This statement is overstated and misleading. Compliance with these measures does not ensure that the cultural and spiritual integrity of the site is unaffected. It should be emphasized that the Tribes were not sufficiently made part of the groundwater EIR process. The Tribes have the singular capacity to evaluate whether there are impacts on the Maze. Additionally, some of the recent archaeological surveys performed by the Tribes in cooperation with PG&E and DTSC contractors indicate information to the contrary. Would it be possible to place all of the infrastructure on the east side of National Trails Highway?	PG&E understands and the EIR acknowledges that the mitigation measures do not ensure the spiritual integrity of the site is unaffected. The note does not state that compliance with mitigation measures would ensure that the cultural and spiritual integrity of the site is unaffected. As disclosed in the EIR, even with implementation of CUL-1a-9 and CUL-1a-10, the impact on the Topock Cultural Area as a historic resource would be significant and unavoidable. (Final EIR at p. 4.4-61.) As the note on Figure 2.4-11 states, however, compliance with the requirements of the PA, CHPMP mitigation measures, and EIR mitigation measures CUL-1a-9 and CUL-1a-10 will prevent direct impacts on the Topock Maze as archeologically manifested. With respect to the claim about tribal participation in the EIR process, PG&E notes for the record that DTSC provided all stakeholders, including Tribes, with the opportunity to comment on the Draft and Final EIR pursuant to CEQA, and made a special effort to consult with interested Tribes. This effort to communicate with interested Tribes is summarized in the Final EIR at Volume 1, page 4-201, and Volume 2, pages 4.4-14, 4.4-26 to 4.4-37. Interested tribes availed themselves of the opportunities to comment, for example by submitting numerous comments on the Draft EIR. (See Final EIR, Vol. 1, at pp. 4-185, 4-191–96, 4-200, 4-202, 4-204–9, 4-218–19.) The Final EIR responds to the comments from interested Tribes and numerous changes to the EIR were made based on input from the interested Tribes. (Id. at pp. 4-186–90, 4-197–99, 4-201, 4-203, 4-210–17, 4-220–21.) With respect to impacts on the Maze, PG&E is committed to complying with the state and federal				PG&E evaluated moving all NTH IRZ wells to the east side of National Trails Highway and the results of the evaluation was presented at the February 11, 2014 TWG meeting (map is included in **Attachment D**, at the end of this table). PG&E understand that this comment is resolved.	Several figures in the 90% BOD show all NTH IRZ wells on the east side of National Trails Highway (e.g., Figures ES-4A, ES-10, etc.)

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PG&E Topock Compressor Station, Needles, California

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					mitigation measures to ensure that the Project will not have a direct impact on the Maze as it is archeologically manifested. PG&E understands that the Tribes have conducted a Tribal Cultural Values Assessment, which is currently under review by the agencies and PG&E. The issue of the Maze boundaries and the Project's compliance with applicable state and federal mitigation measures will thus be a subject of further discussion between PG&E, the Tribes, and the agencies. In response to the question about the possibility of placing the infrastructure on the east side (instead of the west side of NTH), and based on the comment clarification discussion with the Tribes on 9/5/13 and subsequent discussions at the December 2013 TWG meeting, PG&E reviewed the locations of all provisional IRZ wells below the mesas and determined that these provisional wells could be moved to the east side of NTH. Specifically, the proposed new locations for four wells (IRZ-12, IRZ-14, IRZ-22, and IRZ-24) were included on a map that was made available to stakeholders, Tribes, and the agency representatives who participated in the October 28, 2013 site walk (map is included in **Attachment D**, at the end of this table).					
Specific Comments – Sections 3.1 and 3.2 (Additional comments on Sections 3.1 and 3.2 are included with Appendix B Modeling)										
85	DOI-35	Section 3.1.1, Page 3-1	"… (3) short-term responses to pump testing events; … ."	Are there any long-term pump test data available within the alluvial aquifer within the site boundaries from earlier site operations (supply wells) or investigations?	There were no pump test data, either long or short term, available from the former alluvial supply wells at the compressor station site. All of the pump test data pertinent to the alluvial aquifer at the compressor station has been developed during the remedial investigations and interim measures activities at the site.		Comment resolved.		Comment resolved.	Not applicable
86	DOI-36	Section 3.1.2, Page 3-2		The in-text citation for Zheng (1990) is inconsistent with formatting. A consistent format should be used.	The in-text citation will be changed to "(Zheng 1990)".					90% BOD Section 3.1.2.

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87	MWD-6	3.1, Appendix B, Section 4	Constant flux boundary for wells.	The text does not describe how groundwater extraction/injection is assigned to respective wells in the model. The flux can be explicitly assigned to each well node (i.e. layer) or can be assigned passively using MODFLOW's Multi Node Well Package. The latter approach would be preferred based on the planned screens crossing multiple aquifer/model layers that would produce/receive flow dependent on the layer's hydraulic conductivity. Explicitly assigning the flux for extraction/injection well layers could erroneously estimate the amount of plume or reactant capture and/or movement.	The multi node well package was utilized to automatically distribute the extraction/injection rates across multiple layers at a single well based upon the simulated transmissivity. In the instances where discrete screen intervals were anticipated, layer-specific rates were assigned directly.				Comment resolved.	Not applicable
88	DTSC-24	Section 3.2.1.1, Well Maintenance and Rehabilitation Reagents		Please provide the MSDS for NuWell 120 and NuWell 310 as part of the project H&SP.	Material safety data sheets for NuWell 120 and NuWell 310 will be provided as part of the project H&SP.	Okay.			Comment resolved.	O&M Manual Volume 5.
89	DOI-37	Section 3.2.1, Pages 3-4 and 3-5	"● Up to 24 injection wells (i.e., NTH IRZ Injection Wells) situated … ." "● One provisional extraction well (IRZ-40) and up to 30 … ."	The 16 locations and 19 locations of the more numerous injection wells referenced in these bullets are not evident from the map. Suggest deleting the term "locations".	Note that the map (Figure 3.0-1) depicts the 16 NTH IRZ Injection Well locations and 19 provisional NTH IRZ Injection Well locations and not individual wells. In some cases, multiple wells will be installed at a single location, hence the distinction between "wells" and "locations". The legend of Figure 3.0-1 will be updated as follows: 1) green triangular marker will represent "Injection Well Location (NTH IRZ)" instead of "Injection Well (NTH IRZ)"; and 2) gray triangular marker will represent "Future Provisional Injection Well Location" instead of "Future Provisional Injection Well". No changes to the text are proposed.		Comment resolved.		Comment resolved.	90% BOD Figure 3.1-1.
90	DTSC-25	3.2.1.1/3-7	In-well components include pneumatic packers	Please consider using self-sealing threaded packers for ease of use and longevity in lieu of the pneumatic packers.	PG&E proposes to use fixed head packers that may be pneumatically or hydraulically inflated to isolate zones within a well. These packers are capable of higher inflation pressures, which are required due to the anticipated pressure differentials during operation of the remediation wells. Further, the seal can be monitored to confirm packer functionality. K-packers are typically only used for low-pressure differential applications. K-packer	Comment resolved. See response to comment #232 DTSC-103.			Comment resolved.	Not applicable

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					seal integrity is not capable of being monitored and may allow for injected carbon amended water to be forced past the packer and into a screen interval that was not targeted for the solution. Please see response to comment #132 DTSC-40 and #232 DTSC-103 for discussion on the application of packers for long-term zone isolation for groundwater monitoring purposes versus short-term isolation for remediation purposes.					
91	FMIT-24 Hualapai-17 Chemehuevi-17 Cocopah-17 CRIT-17	Section 3.2.1.1 p. 3-5 to 3-10	General comment regarding subheading "Description," which describes the recirculation system design and components	Much information is presented in this section. Could the section be subdivided and explained in greater detail by subcategories or subheadings?	Section 3.2.1.1 (p. 3-5 to 3-10) is currently subdivided with subheadings. Exhibit 3.2-1 was added to the 60% Design Submittal to supplement the text based on comments on the 30% Design Submittal. Additional detail regarding the recirculation system design and components are included elsewhere in the 60% Design Submittal, as referenced in Section 3.2.1.1. PG&E will evaluate how to further subdivide Section 3.2.1.1 in the 90% Design Submittal to provide greater clarity for the reader.			Comment resolved pending review of 90% BOD.	Comment resolved.	90% BOD Sections 3.2.1, 3.2.2, and 3.2.3.
92	DOI-38	Section 3.2.1.1, Page 3-5		The text indicates the presence of 24 NTH IRZ injection wells. Figure 3.1-1 shows 21 NTH IRZ well locations. Please review and revise as necessary.	Figure 3.1-1 depicts "NTH IRZ Well Locations" and not individual NTH IRZ Injection/Extraction Wells. There are 16 total NTH IRZ Injection Well locations and four total NTH IRZ Extraction Well locations, i.e., 20 total NTH IRZ well locations. NTH IRZ well location IRZ-18 is a provisional location and should correlate to the adjacent, un-numbered pink "provisional" dot on Figure 3.1-1. The purple dot currently labeled as IRZ-18 is an error, and this extra purple dot will be removed from Figure 3.1-1 and Figure 6.4-2 (same figure in Appendix B of the 60% BOD).		Comment resolved.		Comment resolved.	90% BOD Figure 3.1-1.
93	DOI-39	Section 3.2.1.1, Page 3-6	"The identification of separate, laterally-continuous litho-stratigraphic or hydrostrati-graphic zones … ."	It is suggested that the word "supported" be used instead of "facilitated" when describing the lack of laterally continuous units. Use of the term "facilitated" makes it sound like the borehole log lacks sufficient detail to perform the analysis. Note – this paragraph is used numerous times in the text and figures of the BOD and appendices and should be	The referenced sentence will be revised to read as follows (added text shown in <u>underline</u> typeface and deleted text shown in ~~strikethrough~~ typeface): "The identification of separate, laterally-continuous lithostratigraphic or hydrostratigraphic zones by means of correlation from borehole to borehole is not ~~facilitated~~ <u>supported</u> by the information given on the		Comment resolved.		Comment resolved.	90% BOD Sections 3.2.1, 3.2.2, 3.2.3, and 3.2.5.

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				changed throughout.	borehole logs." This sentence will be modified in all places throughout the report.					
94	DOI-40	Section 3.2.1.1, Exhibit 3.2-1 And Section 3.2.1.1, Page 3-9	Exhibit 3.2-1 Carbon substrate dosing and flow rate 3.2.1.1 Organic Carbon Dosing and Delivery Strategy	PG&E learned from its work at the Hinkley Compressor Station site that arsenic had a two fold increase and manganese had a 249 to 2186 fold increase in concentrations with the introduction of ethanol into the aquifer system. Similar results were observed during the Topock site pilot tests. PG&E plans on making field adjustments to chemical infusion/amendment concentrations to find the right dose to minimize the generation of byproducts. What is the basis for the 100 mg/L nominal concentration for carbon substrate dosing and the nominal flow? To what extent is the dosing value based on experiences at Hinkley?	The 100 mg/L nominal concentration for carbon dosing is based on the results of pilot testing and solute transport modeling. Specifically, pilot test results indicated that Cr(VI) reduction could be achieved with TOC dosing of between 10 and 50 mg/L carbon (Appendix B, Section 3.4-1). The injection concentration of 100 mg/L carbon is based on the results of solute transport modeling, which indicate that the injection of 100 mg/L carbon achieves the distribution of 10-15 mg/L of TOC in the zones between injection wells that is necessary to achieve a complete IRZ (see Appendix B, Section 6.4.1). The following text describing the use of pilot test results and solute transport model predictions to inform TOC injection concentrations will be added to Section 3.2.1.1 in the 90% Design Submittal: "Based on ISPT results summarized in Section 3 of Appendix B, a sustained TOC concentration between 10 and 50 mg/L is sufficient to establish chromium reducing conditions. The injection concentration of 100 mg/L carbon is based on the results of solute transport modeling, which indicate that the injection of 100 mg/L carbon achieves the distribution of 10 to 15 mg/L of TOC in the zones between injection wells that is necessary to achieve a complete IRZ (see Appendix B, Section 6.4.1)" The dosing value was based on pilot test data and solute transport modeling specific to the Topock site, rather than the Hinkley site. However, the concentrations proposed for Topock are consistent with the range of concentrations applied at Hinkley, i.e., 5 to 400 mg/L TOC.		Comment resolved pending review of 90% design.		Comment resolved.	90% BOD Section 3.2.1.

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95	DOI-41	Section 3.2.1.1, Page 3-9, Portable Tanks		It should be noted that portable tanks may be used with provisional wells in the future for treatment of recalcitrant zones.	The following text will be added to Section 3.2.1.1 – Portable Tanks: "In addition, portable tanks may be used with provisional wells in the future for treatment of recalcitrant zones." See also response to comment #96a FMIT-25 for information regarding the anticipated footprint for portable tank use.		Comment resolved.		Comment resolved.	90% BOD Section 3.2.1.
96a	FMIT-25		Section 3.2.1.1 p. 3-9	A topic at the 6/18/2013 TWG meeting in Henderson included a discussion of individual well footprints. The added footprint of portable tanks at the wellhead was not discussed. Furthermore the visual and cultural impacts associated with presence of portable tanks have not been evaluated within the groundwater EIR. In addition the Tribe has not been asked which wellheads would be an acceptable location for a portable tank. The impacts associated with use of portable tanks should be evaluated with input from the Tribes, and the added footprint at the wellhead should be clearly documented and presented to the Tribes for input.	The intention of the section of the text in question was to describe the flexibility of the design that allows for the injection of carbon substrate directly to a well through connections in the well vault in the NTH IRZ. The 90% Design Submittal will be clarified to also include this flexibility for the TCS and IRL injection wells. Portable tanks are not anticipated to be "installed" at wellheads for semi-permanent use. Rather, it may be necessary at times during the remedy to complete those injections by pulling a portable tank to the well on a trailer or in a smaller vehicle carried by an operator during work hours. The anticipated footprint of these operations will be similar to that for sampling or maintenance. See Draft O&M Manual, Volume 2, Appendix A, SOP-A13 for spill prevention, containment, and control measures for well development, sampling, and purging.	The potential use of portable tanks was fully disclosed as part of Chapter 3, "Project Description" in the Groundwater Final EIR. As a program-level analysis, the visual and cultural impacts associated with all potential types of infrastructure were described in the Final EIR to the extent practicable given the level of design detail available at the time. The impact analysis presented in the Final EIR was provided for the "proposed project" which includes the construction of wells, pipelines, access roads, and other project facilities including tanks (which could include portable tanks based on the Project Description provided in the Final EIR). See supporting text from the Final EIR in Project Description - pp 3-14 Reductant Storage and Associated Facilities, pp. 3-22 Construction of Wells, pp 3-27 Operation and Maintenance of Proposed Project; Aesthetics – pp 4.1-25, pp 4.1-28 Table 4.1-2.			This comment and PG&E's response were discussed with the Tribes at the October 16-17, 2013 TWG meeting.	90% BOD Sections 3.2.2 and 3.2.3 O&M Manual Volume 1 Section 2.1.
96b	Hualapai-18 Chemehuevi-18 Cocopah-18 CRIT-18	Section 3.2.1.1 p. 3-9	*"Portable Tanks. The NTH IRZ Injection Well design will include manual addition ports to accommodate the potential use of portable tanks (5- to 1,000-gallon capacity) for the direct*	A topic at the 6/18/2013 TWG meeting in Henderson included a discussion of individual well footprints. The added footprint of portable tanks at the well head was not discussed. Furthermore the visual and cultural impacts associated with presence of portable tanks have not been evaluated within the groundwater EIR. In addition the Tribes have not been asked which well heads would be an acceptable location for a portable tank. The impacts associated with use of	See response to comment #96a FMIT-25.	See response to comment #96a FMIT-25.			See #96a FMIT-25.	90% BOD Sections 3.2.2 and 3.2.3 O&M Manual Volume 1 Section 2.1.

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			injection of dilute carbon substrate solution at the wellheads. This alternative means of reagent delivery allows for added flexibility in long-term system operation, and portable tanks can be used for specific, targeted injections on an as-needed basis. Portable tanks may be preferred over pipelines at locations where the carbon injection volume is low, injections occur with long rest periods, or long pipelines are expected to pose health and safety and/or long-term O&M challenges. Portable tanks may also be used in conjunction with substrates that are perishable (e.g., whey) and/or exhibit a long biodegradation half-life to facilitate a low volumetric dose."	portable tanks should be evaluated within the EIR with input from the Tribes and the added footprint at the well head should be clearly documented and presented to the Tribes for input.						
97	DOI-42	Section 3.2.1.1, Page 3-10, Well	"The dissolved Cr(III) will either be	Rather than state "… or will re-precipitate as pH is buffered …", which sounds counterproductive,	The sentence will be modified as follows (added text shown in underline typeface and deleted text		Comment resolved.		Comment resolved.	90% BOD Section 3.2.1.

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		Maintenance and Rehabilitation Reagents, 3rd paragraph	removed … ."	suggest the following language: " ... and any residual Cr(III) not removed will re-precipitate …".	shown in ~~strikethrough~~ typeface): "The dissolved Cr(III) will ~~either~~ be removed from the well during rehabilitation, ~~or will~~ and any residual Cr(III) not removed will re-precipitate as pH is buffered following rehabilitation."					
98	DOI-43	Section 3.2.1.2, Page 3-11, In-Situ Pilot Tests, 3rd paragraph		The "short-circuiting" is not well explained, nor is there a discussion of how this "short-circuiting" will be adequately addressed by the design. Please provide clarification.	The following text will be inserted in this section to explain "short circuiting": "The Upland ISPT was designed with two recirculation wells. Each well was screened in two depth intervals (shallow and deep). Pilot test injections were performed by injecting into one of the two screened intervals at each well and extracting from the other interval—i.e., each dual-screened well was used for both injection and extraction. By injecting and extracting at different depths, the goal was to create a depth-dependent forced gradient laterally between the two wells. However, the result was that a substantial portion of the injected solution was re-extracted by the same well (from the opposing depth interval)—i.e., it "short-circuited" vertically, limiting lateral (horizontal) distribution of carbon away from the wells. This point is discussed in detail in Section 3 of Appendix B." A figure will also be included. This short-circuiting is addressed in the design by not using dual-recirculation wells. Each IRZ well will be used exclusively for either injection or extraction of groundwater at any given time, eliminating the possibility of vertical short-circuiting.	Suggest adding a figure to illustrate short-circuiting if not already included.	Comment resolved.		Comment resolved.	90% BOD Section 3.2.1.
99	DTSC-26	3.2.2 Inner Recirculation Loop. P.3-12 Also see Exhibit 3.2-2	…and (3) provide secondary protection for the Colorado River by controlling the migration of potential byproducts generated by the NTH IRZ in	This suggests that the shallow portion of the aquifer and river may not be protected by byproduct migration. Contingency measures may be necessary. Ensure shallow well monitoring is enhanced in this area (including evaluation of particle flow paths in the area).	An extensive monitoring program has been designed to evaluate byproduct migration downgradient of the NTH IRZ and in the vicinity of River Bank Extraction Wells in both the shallow and deep portions of the aquifer. This monitoring program (specifically, the IRZ downgradient monitoring and riverbank extraction/northern NTH extraction monitoring elements of the performance monitoring program,	What would be PG&E's contingencies if the actual concentrations of by-products are higher than solute transport model predictions? What are the action levels and triggered response? If the model is correct, then all is fine, but if model is incorrect, PG&E must have response in place. There is concern that a contingency does not exist to			Comment resolved. Per DTSC request, particle track figures for Layers 1-4 were submitted to DTSC on March 11, 2014 (see **Attachment R** at the end of this table). Particle tracking figures will continue to be included in the 90% Design document.	90% BOD Section 3.2.2. 90% BOD Apdx B Section 6.5. O&M Manual Volume 3.

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			the deeper portion of the aquifer.		described in detail in Appendix L, Volume 2, Section 4.2) includes a combination of existing wells and proposed wells (wells H and O) which will provide adequate coverage for byproduct monitoring in the shallow zone. Cross sections along the NTH IRZ and the shoreline will be produced to show monitoring well screens and chromium plume delineations (included in **Attachment Q**, at the end of this table); these cross sections will help to illustrate monitoring well coverage in the shallow zone. Placement of the shallow monitoring wells was guided by the solute transport modeling results. Consideration of byproduct migration was an important element of monitoring well location, analyte selection, and sampling frequency. Simulated solute transport results indicate byproduct concentrations (Mn and As) generated from the NTH IRZ are within the range of the naturally occurring shallow Mn and As concentrations in the floodplain. Solute transport modeling is a superior tool for assessing remedy performance and designing the monitoring program; and PG&E recommends continued use of the solute transport model, rather than particle tracking, for monitoring well network design. Simulated flow fields will be provided to illustrate the simulated groundwater flow directions (included in **Attachment E**, at the end of this table). The flow fields will be generated with the same hydraulic parameters as the simulated hydraulic capture zones presented in Appendix B Section 6.5 and Figures 6.5-9 to 6.5-12. Contingency measures will be evaluated and presented in the 90% design.	capture/ mitigate potential eastbound byproducts or chromium in the floodplain south of RB-5 towards bedrock (e.g., MW-23). DTSC awaits proposed cross sections to aid in assessing monitoring programs. Comment resolved pending review of the 90% design.				
100	DTSC-27	3.2.2.1 Description. River Bank Extraction Wells, P.3-12		No provisional river bank extractions well locations are identified. As the river is a significant receptor important to all stake holders, it is requested that at least six provisional well locations be included as a contingency measure should additional extraction be needed to	Although no provisional River Bank Extraction Wells are identified, significant capacity and system flexibility have been built into the design of the river bank extraction system should additional extraction be needed. Modeling indicates that hydraulic capture of the deeper	A site walk was conducted on October 28, 2013. PG&E, tribes, stakeholders, and agencies attended. PG&E illustrated four potential provisional river bank extraction locations that were located in the field			Comment resolved.	90% BOD Section 3.2.2. 90% BOD Apdx B Section 6.4.2. O&M Manual Volume 1 Section 2.1.

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				control contaminants, byproducts, or enhance hydraulic control.	portion of the alluvial aquifer is achieved at a total average extraction flow rate of 150 gpm with operation of four of the River Bank Extraction Wells (see Table 3.2-2 of the BOD/60% Design Submittal). However, flexibility has been provided (1) with an additional well [RB-2], and (2) to increase the total flow rate to as much as 500 gpm should additional extraction capacity be needed. Additionally, all of the River Bank Extraction Wells have been designed with two screened intervals: a lower screened interval to target the deeper portions of the unconsolidated alluvial sediments and an upper screened interval to allow for shallow groundwater capture, if necessary. The shallow screens will be isolated from the well pump unless the need to pump in the shallow unit proves necessary. In addition to the operational flexibility measures summarized above, up to four future provisional River Bank Extraction Wells will be added (see map included in **Attachment D**, at the end of this table). The four proposed future provisional River Bank Extraction Well locations are located roughly midway between the five current River Bank Extraction Well locations (RB-1 to RB-5). Future provisional wells could potentially be installed at these locations to supplement extraction wells RB-1 through RB-5 if needed to provide the intended Cr(VI) migration control. Additional future provisional extraction well locations north of RB-1 or south of RB-5 were also considered. However, it is unlikely that installing a well further south of RB-5 would provide significant benefit because the saturated thickness decreases as the bedrock contact is approached in this direction. Additionally, the reducing rind extends down into model Layers 3 and 4 south of RB-5. Installing a well north of RB-1 would also provide minimal benefit because the diffuse Cr(VI) upgradient of the NTH IRZ will be contained by the northern NTH IRZ Extraction Wells. Potential	approximately half way between proposed RB wells. Locations were described as general areas that could be shifted as needed based on data gathered during implementation of the remedy. Attendees should be well informed regarding this matter and PG&E should proceed with its proposed modifications cited in the response to the left. Comment resolved pending review of the 90% design.				

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					locations for the additional provisional River Bank Extraction Wells will be selected during a later stage of the 60% BOD response-to-comment process considering both technical criteria and knowledge of sensitive areas. The precise locations of the provisional wells, including areas south of RB-5 and the need for additional extraction wells will be evaluated and considered as operational data is collected and system performance evaluated.					
101	DOI-44	Section 3.2.2.1, Page 3-13	"A packer will be installed in the well to separate the upper and lower screened intervals."	Will a dual packer system be used to isolate the zones?	A single fixed-head packer will be used to isolate the two well screens. This installation is detailed on Drawing M-05-01 in Appendix D.		Comment resolved.		Comment resolved.	90% BOD Appendix D Drawing M-05-01.
102	DOI-45	Section 3.2.2.1, Page 3-13	"The purpose of the upper screen is to allow . . . ."	The text states that the upper screen will be installed on the River Bank Extraction Wells to allow for additional groundwater capture if monitoring data indicate this is needed. This indicates groundwater is not pumped from the upper screen unless it is necessary. Please provide additional details on what the monitoring data would show that would trigger additional groundwater capture, and clarify that groundwater is indeed not continuously pumped from the upper screen. If the upper screens were to be pumped, what impact would they have on the capture zone?	The Sampling and Monitoring Plan provides extensive detail on what monitoring observations would trigger the need for shallow riverbank extraction, as addressed by NTH IRZ DQO-3 (Section 2.2.1, Appendix L, Volume 2). Specifically, shallow riverbank extraction would be implemented only if other measures to control byproduct generation and migration (e.g., adjustment of reagent type, dosing concentrations, injection rates, etc.) were ineffective (see Figures 2.2-2 and 2.2-5, Appendix L, Volume 2). A reference to the Sampling and Monitoring Plan (Appendix L, Volume 2) will be added to this paragraph in the 90% Design Submittal. Figures 6.5-10 and 6.5-11 of Appendix B show the estimated hydraulic capture in the shallow zone when the River Bank Extraction Wells are operated without shallow intervals on. As shallow screens are opened and riverbank extraction rates are increased, the capture zone in the shallow depths would expand, while maintaining the capture zone at deeper depths.		Resolved pending review of the 90% design.		Comment resolved.	90% BOD Section 3.2.2.
103	DTSC-28	Section 3.2.2.1, p. 3-14, 1st sentence and	Final determination of the screened	PG&E should describe how and when input on the screen intervals will take place. The decision process should be	Field procedures and a decision-making plan will be included in the Construction/Remedial Action Work	Comment resolved.			Comment resolved.	90% BOD Sections 3.2.1, 3.2.2, and 3.2.3.

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		subsequent well installation	intervals will be made based on information collected in the field associated with drilling boreholes for the River Bank extraction wells.	described.	Plan. General field construction communication procedures/protocols are included in Exhibit L2.2-3 of the Draft O&M Manual (p. L2-5).					
104	DOI-46	Section 3.2.2.1, Page 3-14, Inner Recirculation Loop Injection Wells, 1st paragraph		Supplement the discussion on the disposition of river bank extracted groundwater if freshwater is injected in to all four IRL wells.	The text will be modified as follows (added text shown in underline typeface and deleted text shown in ~~strikethrough~~ typeface): "However, the final ~~layout~~ design of the Inner Recirculation Loop Injection Wells will be flexible enough to accommodate either injection water source (i.e., extracted water from the River Bank Extraction Wells or fresh water from the freshwater supply system) at each well to minimize potential byproduct impacts. All groundwater extracted from the River Bank Extraction Wells will be re-injected into one or more of the Inner Recirculation Loop Injection Wells. Total flow to the Inner Recirculation Loop Injection Wells will be supplemented with flow from the freshwater supply system, as needed."		Comment resolved.		Comment resolved.	90% BOD Section 3.2.2.
105	DOI-47	Section 3.2.3.1, Page 3-18, East Ravine Extraction Wells, 1st paragraph	" . . . this design has since been revised to five extraction wells operating at a total nominal flow rate of 5 gpm . . . "	This estimated long term flow rate (5 gpm) is half the previous estimate (10 gpm) based on the results of the short term pump tests identified in Section 2.1.2. Further, it is anticipated at this lower rate that the pumps may run "dry" and thus need to be operated on a cyclical basis. Should the combined flow rates over a long period of time result in more than one well being cycled on-off, what impact could this have on the estimated time to clean-up the site? Is it possible should more than one pump need to be cycled on-off that the capture zone may be disrupted and fragmented? If so, how would this be addressed?	East Ravine wells ER-1 to ER-4 are proposed to be operated at rates of 0.5 gpm each due to the low anticipated yield in the fractured bedrock. ER-6 located at Site H is proposed at 3 gpm due to the identification of a higher attainable yield at the MW-70BR-225 well. Given the variable nature of the fractured bedrock and the interconnectivity of these fractures, the actual yield of these wells will be evaluated during remedy operation and adjusted accordingly to obtain a maximum sustainable rate. Additional provisional east ravine wells will be considered in the event of poor performance of the proposed east ravine extraction wells (See response to comment #109 DTSC-30). It is not anticipated that cycling the east ravine bedrock extraction wells would have a		Comment resolved.		Comment resolved.	90% BOD Section 3.2.3.

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					significant impact on the capture zone because as the area in the vicinity of bedrock wells dewater, minimal hydraulic capture will occur. As the bedrock rebounds during an off-cycle, the groundwater will collect in the well(s). Once the well is turned back on the water will be captured due to the slow groundwater velocities in this area.					
106	DOI-48	Section 3.2.3.1, Page 3-18, East Ravine Extraction Wells, 4th paragraph	"The East Ravine Extraction Wells will be constructed using up to 12-inch nominal diameter well casing with one or two screened intervals . . . "	This text is inconsistent with the text found in Section 3.2.5.1 which calls for borehole design without a well screen with potential diameter of four inches.	The inconsistencies will be corrected in the 90% Design Submittal. It is anticipated that the extraction wells within the bedrock will be installed with one continuous open interval so that groundwater is extracted from all permeable fractures. If the wells penetrate intervals of poor rock quality, the borehole will be "sleeved" with well casing and/or screen to maintain borehole integrity during operation. If rock quality is so poor that fine-grained materials must be managed in the subsurface, then a conventional filter-packed screen might need to be installed.		Comment resolved pending review of the 90% design.		Comment resolved.	90% BOD Section 3.2.3.
107	DOI-49	Section 3.2.3.1, Page 3-18, East Ravine Extraction Wells, 4th paragraph	"Therefore, the screened intervals of the extraction wells as shown on Table 3.2-3 are preliminary, . . . "	A review of Table 3.2-3 identifies screen length but not the interval, nor does it mention multiple screens to target specific bedrock intervals. Is the word "interval" being used in the text to describe model layer? Also, in what model layers (screen intervals) will each of the East Ravine Extraction wells be set? Please provide some discussion on the hydrogeologic conditions that would merit multiple screens versus a single screen or open borehole.	The word "interval" does not specifically relate to model layers and is simply intended to identify the entire saturated thickness at a given location. Based on the specific capacity of existing wells constructed in the East Ravine area, it is anticipated that the East Ravine extraction wells will be installed to depths that happen to penetrate all model layers such that there is sufficient available drawdown during operation. See response to comment #106 DOI-48 regarding anticipated well construction.		Comment resolved.		Comment resolved.	90% BOD Section 3.2.3.
108	DTSC-29	3.2.3.1/3-18	The groundwater production and radius of influence of the East Ravine Extraction Wells is expected to be small.	Please utilize geophysical logging tools including an acoustic borehole televiewer, heat pulse flow meter, and video log. Conduct evaluation/interpretation of cores (fracture orientation, aperture, density, etc.) and packer testing in the exploratory boreholes to characterize fractures, hydraulic conditions (whether and at what depth fracture flow is occurring), and water quality. In addition, to determine transmissivity with depth, consider drop tests using blank	The design goal for the East Ravine Extraction Wells is to construct wells that will produce adequate flow with sufficient drawdown to maximize hydraulic control. Therefore, the key design criterion will be to have a borehole of sufficient depth to allow for the requisite available drawdown with a pump set in the open borehole. Well design and construction will be an iterative process of drilling and well testing as part of adaptive design. The use of geophysical methods and other kinds	Better understanding flow dynamics in bedrock is desirable and the design document needs to have provisions to utilize advanced techniques to assess fracture flow systems. Comment resolved.			Comment resolved.	Not applicable

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				borehole liners such as FLUTe.	of testing is not necessary to accomplish the design goals. A variety of tools, as listed, will be available to evaluate high production zones if determined necessary.					
109	DTSC-30	3.2.3.1 Description. East Ravine Extraction Wells, Page 3-18, and Exhibit 3.2-3	Initial estimates, presented in the 2009 CMS/FS, held that approximately 15 wells, pumping a combined total of up to 10 gpm, would be required to provide hydraulic capture of the area of Cr(VI) in the East Ravine bedrock. However, this design has since been revised to five extraction wells operating at a total nominal flow rate of 5 gpm (maximum of 9 gpm) based on data obtained from the more recent East Ravine groundwater investigations (see Section 2.1.2).	What aspects of the East Ravine investigation provided the basis to conclude that the five East Ravine Extraction Wells will be adequate to "provide hydraulic capture of the Cr(VI) impacted groundwater … in the East Ravine bedrock"? What about the plume to the southern portion of the site which have not been fully characterized? It is not clear why the original estimate of 15 wells at 10 gpm has been revised to 5 at 5 gpm. Clarifying text should be added in this section. Additional East Ravine provisional extraction wells seem appropriate based on the original estimate, inherently difficult remedial clean up posed by bedrock fractures, and difficulty accurately modeling bedrock.	As stated in Section 2.1.2 of the BOD/60% Design Submittal, the East Ravine groundwater investigations have shown that "there is no evidence to indicate any sizable potential for development of groundwater in the bedrock, although locally, small yields may be developed from fractures". In an effort to balance the objectives of maximizing mass capture while minimizing the footprint of the remedial system, four extraction wells were proposed in the East Ravine area. An additional well, ER-6, was proposed at Site H, utilizing existing monitoring well MW-70BR-225, because elevated Cr(VI) groundwater concentrations were detected at this location and a relatively high groundwater extraction rate could be obtained. One provisional well (ER-5) has been identified to accommodate data to be collected in the southern portion of the site (Site K, near MW-72BR). Clarifying text to this effect will be added to Section 3.2.3.1. Up to six future provisional East Ravine Extraction Wells will be added as a contingency measure should additional extraction capacity be needed (see map included in **Attachment D**, at the end of this table). Potential locations for these wells will be selected during a later stage of the 60% BOD response-to-comment process considering both technical criteria and knowledge of sensitive areas.	Resolution dependent upon clarifying text to be added in the 90%. A site walk was conducted on October 28, 2013. PG&E, tribes, stakeholders, and agencies were invited to attend. Potential provisional well locations/ areas were described as areas along the general length of the old trails highway. The length of the road at interest was walked. PG&E should now proceed with its proposed modifications cited in the response to the left.			Comment resolved.	90% BOD Section 3.2.3. O&M Manual Volume 1 Section 2.1.

TABLE I-1

Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

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110	DOI-50	Section 3.2.3.1, Page 3-18, TCS Injection Wells, 1st paragraph	"The two TCS Injection Wells will each receive . . . "	The combined nominal **injection** flow is 27 gpm. Please change and modify the statement accordingly.	The text will be revised as follows to clarify (inserted text shown in underline typeface and deleted text shown in ~~strikethrough~~ typeface): "Each of ~~T~~the two TCS Injection Wells will ~~each~~ receive approximately 13.5gpm of carbon-amended groundwater for a combined nominal injection flow rate of 27gpm..."		Comment resolved.		Comment resolved.	90% BOD Section 3.2.3.
111	DTSC-31	3.2.3.1 Description. TCS Injection Wells, P.3-18	….and injections will be timed to allow for adequate dispersion of the injectate away from the well.	Clarify the meaning of "dispersion" in this section.	The sentence will be modified as follows (added text shown in underline typeface and deleted text shown in ~~strikethrough~~ typeface): "…and injections will be timed to allow for adequate lateral distribution ~~dispersion~~ of organic carbon ~~away from the well~~."	Okay.			Comment resolved.	90% BOD Sections 3.2.1 and 3.2.3. 90% BOD Exhibit 3.2-3.
112	DTSC-32	3.2.3.1 Description. TCS Injection Wells, P.3-18	Results of the modeling effort indicate that the potential for westward flow from the TCS Injection Wells, and the resulting westward expansion of the plume, is sufficiently mitigated by the natural eastward flow gradient and the injection of fresh water at FW-2…	Actual monitoring will need to be conducted to the west to verify the modeling effort. This section should discuss or reference the monitoring that will be conducted to assess anticipated hydraulics and aquifer chemistry. PG&E should consider how best to monitor for potential westward expansion/ containment of the plume. Well installation west of the TCS injectors should be evaluated to ensure an adequate monitoring program is in place.	Agreed that monitoring should be conducted to ensure that the Cr plume is adequately controlled to the west of the TCS injections. Several lines of evidence will be used to evaluate groundwater flow and plume control in this area. First, groundwater elevations will be measured and the hydraulic gradients will be evaluated to see if the model predicted gradients and hydraulic control are realized. Second, analytical data will be collected from monitoring wells to the west of the TCS injections. Monitoring wells MW-10 and MW-38S/D have been specified to the west of the TCS as inner plume compliance wells (Table 2.1-2 of the Sampling and Monitoring Plan, Volume 2 of Appendix L) which are used to ensure that Cr(VI) concentration trends behave within expectations per Compliance DQO-2 (RAO 3) in Section 2.1 of the Sampling and Monitoring Plan. In addition, MW-9, located south of MW-10 and to the west of the TCS, will be added to the monitoring program network as an additional inner plume compliance well. Chromium concentration trends will serve as an indicator of whether the high concentration (several milligram per liter) plume in the vicinity of the	DTSC is considering the use of conservative tracers be added to TCS-1 and TCS-2 injection wells and monitored in western Bat Cave Wash monitoring wells. The 90% design should allow for tracers if other lines of evidence are inconclusive.			Comment resolved.	90% BOD Section 3.2.3. O&M Manual Volume 2 Sections 2.1 and 2.2.3.

TABLE I-1

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Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

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					TCS injection wells is migrating beyond expectations to the west. TOC and byproduct concentration trends can also serve as indicators for whether TCS injected water is migrating further to the west than predicted by solute transport modeling. TCS tracer injections and monitoring in Bat Cave Wash would verify that injection fluid is not migrating westward, but would not be as conclusive as chromium concentration trends to confirm that the plume is not being pushed by TCS injections. A TCS tracer study is therefore not recommended.					
113	DOI-51	Section 3.2.3.1, Page 3-19, Organic Carbon Substrate Amendment System (Transwestern Bench)	"Groundwater extracted from the Transwestern Bench carbon amendment system will include . . . "	Please discuss the conditions that would require the TWB extraction well flow to be directed to the IRZ, and the impact to remediation of the Cr(VI) plume under the TCS.	The primary destination for the TWB extracted groundwater is still the TCS Injection Wells for remediation of the Cr(VI) plume under the TCS, although flexibility is included in the design to re-direct to the NTH IRZ if needed or warranted. Such conditions may include, but are not limited to: 1) if TCS Injection Wells need to be slowed or turned off, re-direction to the NTH IRZ would allow TWB and East Ravine extraction to continue; 2) if at later times in the remedy operation the TCS carbon injections are sufficiently successful that the need for additional injection is reduced; and 3) to supplement the carbon-amended NTH IRZ injection if additional injection is needed to sustain a continuous injected carbon front to prevent Cr(VI) breakthrough and TCS injection needs can be met at the same time. Text will be included in the 90% BOD to reflect this response.		Comment resolved pending review of the 90% design.		Comment resolved.	90% BOD Section 3.2.3.
114	DOI-52	Section 3.2.3.2, Page 3-20, 2nd paragraph	"Furthermore, although the borehole drilled at MW-70BR-225 during the second phase of investigation yielded enough groundwater to sustain pumping for hydraulic	Does this statement indicate a low specific yield resulting in a sharp drawdown near the pump test well, combined with a low aquifer storage, causing negligible impacts on drawdown in nearby monitoring wells? If so, will current proposed well spacing establish a capture zone that will be maintained and provide an unbroken hydraulic barrier stopping eastward migration of contaminants to the river?	The performance of extraction wells screened in bedrock is dependent on secondary porosity features such as fracture density, fracture aperture, and the interconnectivity of the fractures. Due to the variability of these features in the subsurface, the performance of these wells will be best evaluated by the monitoring well network and the total groundwater volume extracted from each well after remedy implementation. East ravine		Comment resolved.		Comment resolved.	90% BOD Section 3.2.3.

TABLE I-1
Response to Comments on Basis of Design Report/Intermediate (60%) Design
Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design
PG&E Topock Compressor Station, Needles, California

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			testing, the drawdown measured in the observation wells was negligible."		provisional wells were identified (see comment response #109 DTSC-30) in the event that additional extraction/hydraulic control is needed in the vicinity of the proposed bedrock extraction wells.					
115	DTSC-33	3.2.3.3 Uncertainties and Assumptions, Page 3-20	The TCS Recirculation Loop will be implemented and operated using an adaptive approach, similar to operation of the NTH IRZ system—data will be collected from select monitoring wells, and operations will be modified to optimize the remedy performance.	Due to the adaptive approach described, it would appear that additional provisional wells should be called out in the event they are needed.	Two provisional TWB Extraction Wells (TWB-3 and 4) were identified, along with additional provisional East Ravine Extraction Wells (see response to comment #109 DTSC-30). Provisional TCS Injection Wells were not identified as these wells are designed to accelerate the remedial timeframe by injecting carbon amended water into areas with elevated Cr(VI) concentrations. Operational rates of the TCS recirculation loop need to be controlled in order to prevent western migration of the plume. Additional language will be added to the 90% design discussing the need for flexibility to locate wells in the future as the remedial program evolves. Any modifications would be discussed with stakeholders prior to implementation.	During the Oct 2013 field visit, it was noted that additional/ alternate well locations might be possible north of TWB-3 (provided old roads were repaired and regarded). Also note comment #543 DTSC-152 discussing IRL-6 that might be used as an extractor and noting its location could be adjusted if necessary. Please note the above in the section and note that it provides some flexibility in adapting to uncertainties. Comment resolved pending review of 90% design.			Comment resolved.	90% BOD Sections 3.2.1, 3.2.2, and 3.2.3.
116	DOI-53	Section 3.2.4.1, Page 3-21	"The NTH IRZ contains significant lengths of extracted groundwater, carbon-amended water, and remedy-produced water conveyance pipelines."	It does not appear the CIP would address remedy-produced water conveyance pipelines. Please clarify.	The CIP system is also capable of operating in a closed loop through the main IRZ well backwash headers as depicted on Drawings I-04-02 and I-04-03 in Appendix D. The text of Section 3.2.4.1 will be amended to reflect this operational scenario.		Comment resolved pending review of 90% design.		Comment resolved.	90% BOD Section 3.2.4.
117	DOI-54	Section 3.2.4.1, Page 3-21	"Within the pipe alignment will be a network of electrical ducts to route electrical power, control, and instrumentation conductors to the NTH IRZ extraction and	This sentence seems out of place and should be deleted.	The sentence will be deleted.		Comment resolved		Comment resolved.	90% BOD Section 3.2.4.

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			injection wells."							
118	DOI-55	Section 3.2.4.1, Page 3-21, 7th sentence	"The reagents used will be those categories of water treatment chemicals . . . "	The text specifies that the CIP reagents will be determined in bench-scale testing. When and how will this testing be performed?	See response to comment #121 FMIT-26 and Hualapai/Chemehuevi/ Cocopah/CRIT-19. An SOP and further description will be provided in the 90% Design Submittal.		Comment resolved pending review of 90% design.		Comment resolved.	90% BOD Section 3.2.4. O&M Manual Volume 1, Appendix B IRZ-SOP-10.
119	DTSC-34	Exhibit 3.2-4	Maintenance reagent – to be determined	The reagents to be considered should be listed no later than 90% design. Since the reagents are selected based on those approved for drinking water systems, they should be readily available and listed.	The anticipated chemicals would be similar to those used for well rehabilitation and listed in Exhibit 4.2-5 of the O&M Plan, Volume 1 of the O&M Manual. Sodium hydroxide is the only chemical of note that is not listed on Exhibit 4.2-5. A separate exhibit specific to the CIP system will be included in the 90% Design Submittal.	Okay			Comment resolved.	O&M Volume 1 Exhibit 5.1-1.
120	DTSC-35	Section 3.2.4.1, CIP system description. p. 3-21	Ultimate selection of an effective reagent(s) will require bench-scale testing of actual scale deposits.	When and how will this be done? PG&E should provide details in O&M manual.	See response to comment #121 FMIT-26 and Hualapai/ Chemehuevi/Cocopah/ CRIT-19. An SOP and further description will be provided in the 90% Design Submittal.	Okay			Comment resolved.	90% BOD Section 3.2.4.
121	FMIT-26 Hualapai-19 Chemehuevi-19 Cocopah-19 CRIT-19	Clean-In-Place System Exhibit 3.2.4 p. 3-21	*Ultimate selection of an effective reagent(s) will require bench-scale testing of actual scale deposits.*	What are "actual scale deposits?" When will the SOP for the bench scale testing be developed? This testing procedure should be reviewed in a TWG forum.	In order to optimize the CIP cleaning solution we will need to wait for the scale to potentially develop within the pipe network and then test different solutions on samples of the scale (i.e., the "actual scale deposits"). A general SOP for the bench scale testing can be included in the 90% Design Submittal, although if implemented the bench-testing procedures will likely be refined based on the observed scaling issues. Reference Exhibit 4.2-5 from the O&M plan for a list of potential cleaning chemicals. Any supplemental chemicals such as sodium hydroxide will be included in the 90% design documents.			Comment resolved pending review of 90% design documents.	Comment resolved.	90% BOD Section 3.2.4.
122	DOI-56	Section 3.2.5.1, Page 3-22, Screened Interval	"Final determination of the screened intervals will be made based on information collected in the field associated with drilling	What tools and methodologies will be used to determine screen intervals in the field? Who will make the determinations? Since Appendix C is large, please reference where in Appendix C one can find the proposed tools and methodologies.	The 90% Design Submittal will clarify that the reference refers to Attachment D of Appendix C (Design Bulletin: Remediation Well Design and Field Construction Approach). Field procedures and a decision-making plan will be included in the Construction/Remedial Action Work Plan. General field construction		Comment resolved pending review of 90% design.		Comment resolved.	90% BOD Section 3.2.5.

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			boreholes for the injection wells. Appendix C provides a summary of potential field data collection tools and methodologies . . . "		communication procedures/ protocols are included in Exhibit L2.2-3 of the Draft O&M Manual (p. L2-5).					
123	DOI-57	Section 3.2.5.1, Page 3-22, Screened Interval		Is it PG&E's intention to install well casing into bedrock to finish the well? If so, how deep will the casing be set into bedrock and how will this be accomplished?	See responses to comments #106 DOI-48 and #107 DOI-49.		Comment resolved pending review of 90% design.		Comment resolved.	90% BOD Section 3.2.3.
124	DOI-58	Section 3.2.5.1, Page 3-23, Screen Diameter	"The East Ravine Extraction Wells which will be installed in bedrock may be of open hole design without a well screen and may be of smaller diameter . . . "	The text should indicate that surface casing will be installed in the East Ravine Extraction Wells.	Comment noted. The text will be modified as follows (inserted text shown in <u>underline</u> type face, deleted text shown in ~~strikethrough~~ type face): "The East Ravine Extraction Wells which will be installed in bedrock may be of open hole design ~~without a well screen~~ and may be of smaller diameter (potentially 4-inch diameter in the open borehole portion of the well) than the remediation wells installed in the unconsolidated aquifer. <u>If an open borehole completion is used, a cemented surface casing will be installed in compliance with California well standards.</u>"		Comment resolved.		Comment resolved.	90% BOD Section 3.2.5.
125	DOI-59	Section 3.2.5.1, Page 3-23, Screen Diameter	" . . . (potentially 4-inch diameter in the open borehole portion of the well) . . . "	What criteria will be used to determine the diameter of the boring and consequently the open borehole portion of the well?	Previous wells in the East Ravine area that are of open hole completion design have been drilled to a 4-inch boring diameter. This is the basis for the 4-inch diameter design. However, if field testing indicates that a larger borehole diameter could allow for a more effective well, then a larger boring diameter will be considered.		Comment resolved.		Comment resolved.	Not applicable
126	DOI-60	Section 3.2.5.1, Page 3-23, Casing and screen material and type		During the May TWG meeting, it was stated that replacement wells will be installed in the same hole by overdrilling. Please mention how replacement wells will be installed when the well is constructed of stainless steel and/or carbon steel.	Installation of a replacement well in the same hole by overdrilling is one option available and discussed in the FEIR. In addition, well replacement may be completed within a new borehole located in the area of the original well when the well is constructed of stainless steel or carbon steel. A reference to Section 4.2.2.5 "Well Replacement" of the O&M Plan will be included in a new		Resolved pending review of the 90% design.		Comment resolved.	90% BOD Section 3.2.5.

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					bullet that will be added to this section of the 90% Design Submittal.					
127	DOI-61	Section 3.2.5.2, Page 3-23	"In general, pipe materials are selected . . . "	Please explain when pre-cast concrete trenches will be used versus a standard construction trench.	Pre-cast concrete trenches will be used for segments of the pipelines where an active roadway or access driveway is located over the pipeline that is expected to need periodic access for maintenance purposes or where extended periods of maintenance would affect use of the road. These areas include, but are not limited to, the driveways accessing the MW-20 bench from NTH, the portion of NTH in front of the Transwestern Bench, segments of the pipeline inside the compressor station, and segments of the pipelines in the Uplands area.		Comment resolved.		Comment resolved.	Not applicable
128	DTSC-36	3.2.4.1/3-23	Screen diameter	Please use a screen for the East Ravine Wells to allow for longevity and avoid long-term well rehabilitation issues or well replacement.	See response to comment #106 DOI-48 regarding anticipated well construction for extraction wells in the East Ravine area.	Okay.			Comment resolved.	90% BOD Section 3.2.3.
129	DTSC-37	3.2.4.1/3-23	Casing and screen material type	Please include louvered screened as depicted in Appendix D with a final determination based on field parameters.	Material in Appendix D (M-02-02) will be changed to "stainless steel well screen" in place of "stainless steel louver well screen". Stainless steel, wire-wrapped screen will be used for the IRZ wells.	Comment resolved.			Comment resolved.	90% BOD Apdx D Drawing M-02-02.
130	DTSC-38	3.2.4.1/3-23	Wells seals	Please provide the installation method to provide the neat cement seal between screen intervals for the wells.	Comment noted. The following text will be added: "Neat cement will be installed via tremie grout method."	Okay.			Comment resolved.	90% BOD Section 3.2.5.
131	DTSC-39		Figure 3.1-1	One extra well appears to have been added near IRZ-18. Please revise.	This error will be corrected in both Figure 3.1-1 and Figure 6.4-2 (same figure in Appendix B of the 60% BOD). NTH IRZ well location IRZ-18 is a provisional location and should correlate to the adjacent, un-numbered pink "provisional" dot on Figure 3.1-1. The purple dot currently labeled as IRZ-18 is an error, and this extra purple dot will be removed.	Okay.			Comment resolved.	90% BOD Figures 3.1-1 and 6.4-2.
132	DTSC-40	3.1.4 Remediation System Design and Analysis, P.3-4	Figures 3.1-2 to 3.1-6	Footnotes to the cross sections indicate that numerous packers will be used as part of the remedy. PG&E has recently argued that well packers are only a short term solution for well monitoring and are prone to maintenance issues. Therefore, a contingency should be developed should packer maintenance be	While the packers proposed to be used in the remediation wells may be similar to those used in the East Ravine investigation, the method of use is different. Packers used for groundwater monitoring must remain inflated and functional for long periods of time (i.e., years) to maintain monitoring zone isolation,	Response noted. See response to comment #232 DTSC-103.			Comment resolved.	90% BOD Appendix B Figure 6.4-2.

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				problematic over the years that the remedy will operate.	while those used as integral components of a remediation system may be removed and re-installed periodically for well or packer maintenance. Packers used in remediation wells serve to isolate screened intervals and facilitate the distribution of varying quantities of carbon amended water to each screened interval individually, but long-term isolation is not a requirement. Therefore packers are ideal for use in remediation wells because there are opportunities to remove and maintain them, as necessary. During use, packer inflation pressures will be monitored by pressure instruments to ensure an adequate seal is maintained during injection operations. See response to comment #232 DTSC-103 for clarification on the use of packers in monitoring wells during the East Ravine investigation.					
133	DTSC-41	Figure 3.1-1	Conceptual Final Groundwater Remedy Cross-Section Locations	Please include iso-concentrations of the plume on the figure.	Plume iso-concentrations can be added to Figure 3.1-1 (and Appendix B Figure 6.4-2) with the consideration that there are variations in concentration vertically. Show the cumulative four-layer plume outline or to just generate four versions of this figure to display the plume distribution in each layer.	Please use the cumulative view on one figure and then use the cross-sections to show vertical distribution. Comment resolved pending review of 90% design.			Comment resolved.	90% BOD Figure 3.1-1 and Appendix B Figure 6.4-2.
134	DTSC-42	Figure 3.1-3	Conceptual Final Groundwater Remedy Cross-Section B-B’	Please provide additional wells north of IRZ-1 to fully address the lateral extent of the plume.	A review of historical data collected at MW-35-060 and MW-35-135, northernmost monitoring wells located adjacent to the proposed location of IRZ-1, indicates that Cr(VI) concentrations have oscillated at these wells but are generally below 32 ppb. The maximum Cr(VI) concentration observed at MW-35-060 was 35.8 ppb in March 2008, and the maximum Cr(VI) concentration observed at MW-35-135 was 37.8 ppb in December 2010. The concentration trends observed at MW-35-060 and MW-35-135 suggest that these wells define the edge of the Cr(VI) plume, and additional remediation wells installed to the north of IRZ-1 will provide negligible value for treatment. In addition, the simulated	The MW-35 cluster does not monitor the deep portion of the aquifer where PG&E’s cross-section B-B’ shows contamination to extend. It is requested that a deep well (e.g., greater than 300 feet bgs.) be installed in the vicinity of MW-35. An additional provisional well location to the north should be cited if this deep well encounters significant contamination. Comment resolved pending review of 90% design.			Comment resolved.	90% BOD Figure 3.1-3.

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					hydraulic capture zone of the northern NTH IRZ wells extends more than 100 feet to the north past IRZ-1 in Layer 2 (see Figure 6.5-10 of Appendix B) and more than 300 feet to the north past IRZ-1 in Layers 3 and 4 (see Figures 6.5-11 and 6.5-12 of Appendix B, respectively). As noted by the DTSC, the MW-35 cluster does not monitor the deep portion of the aquifer. The northern extent of the Cr(VI) plume in the deep portion of the aquifer along the NTH is currently defined by TW-4. Cr(VI) concentrations at this well have consistently been below 32 ppb since 2007. Additional Cr(VI) concentration data, including data from the deep portion of the aquifer, will be collected during installation of IRZ-1 and monitoring wells A and B to further delineate the extent of the plume to the north. Based on the additional information, an additional well to the north of MW-35 may be determined to be necessary. In addition, PG&E proposes to install an additional monitoring well northwest of MW-35 for remedy compliance monitoring (see also response to comment #651 DTSC-199).					
135	FMIT-23	Figure 3.1.3		This conceptual final groundwater remedy cross section depicts the extent of the infrastructure that could be intruding into this culturally sensitive area during the remedy and possibly permanently depending on the well decommissioning processes used. This visually describes a major part of the significant impact to the TCP caused by the proposed remedy.	PG&E has reviewed the locations of four provisional NTH IRZ wells (IRZ-12, IRZ-14, IRZ-22, and IRZ-24) located below the mesas and has determined that these provisional wells could be moved to the east side of National Trails Highway. The proposed new locations/areas for these four wells were included on a map that was made available to the stakeholders, Tribes, and agency representatives who attended the October 28, 2013 site walk, and were also discussed during the November 5 TWG meeting (map is included in **Attachment D**, at the end of this table). In response to clarifications from the Tribes during the December 12, 2013 TWG meeting, PG&E evaluated moving all NTH IRZ wells to the east side of National Trails Highway. The results of the evaluation was presented during the February 11, 2014 TWG meeting prior to the 90%				PG&E evaluated moving all NTH IRZ wells to the east side of National Trails Highway, the results of the evaluation was presented at the February 11, 2014 TWG meeting (map is included in **Attachment D**, at the end of this table). PG&E understand that this comment is resolved.	90% BOD Figure 3.1-3

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					design (map is included in **Attachment D**, at the end of this table).					
136	DTSC-43	Figure 3.1-4	Conceptual Final Groundwater Remedy Cross-Section C-C'	Please provide additional wells north of TWB-3 to fully address the lateral extent of the plume.	Originally, in the 30% Design Submittal, a well (MID-EX-1) was proposed to the north of TWB-3. However, this well was removed from the 60% Design Submittal due to constructability issues observed in the field: i.e., presence of multiple major gas pipelines, limitations on heavy equipment access, and evidence of significant erosion. In addition, although the intent of the TWB Extraction Wells is to accelerate capture/treatment of the portion of the Cr(VI) plume located immediately downgradient of the TCS, these wells are not intended to provide full capture/treatment. The portions of the Cr(VI) plume that are not within the simulated capture zone (e.g., to the north of TWB-3) are anticipated to pass through the NTH IRZ where they will be treated. The need and location of additional injection and/or extraction wells will be evaluated and considered as operational data is collected and system performance evaluated. This concept will be incorporated into the 90% design.	DTSC is concerned that, based on existing data, the highest chromium contaminant concentrations would be located between the compressor station and the MW-20 bench. Trying to attack the highest contaminant concentrations with this particular loop system seems beneficial. Keep note that IRZ well installation may better suggest where to locate these wells. Therefore a provisional well location/ alternative well location(s) should be based off the results of the IRZ installation and data collection. Can IRL-6 and/or IRL-7 also be utilized as extractors early on to focus on high chromium concentrations? PG&E and DTSC conducted a site walk on October 28, 2013. After viewing the area north of TWB-3, it was decided a well might be able to be cited in that area provided that dirt moving activities be conducted (e.g., repair former road from erosion, flatten/prep. site for drill rig). Therefore, DTSC requests that an additional provisional well be added to this area. Comment resolved pending review of the 90% design.			Comment resolved.	90% BOD Sections 3.2.1, 3.2.2, and 3.2.3.
137	DTSC-44	Figure 3.1-6	Conceptual Final Groundwater Remedy Cross-Section E-E'	Please provide additional wells north of IRL-6 to fully address the lateral extent of the plume.	Future provisional well IRL-7 is proposed to the north of IRL-6. Note that future provisional wells IRL-6 and IRL-7 were proposed as a contingency should monitoring indicate that cleanup is not progressing at the anticipated rate. These wells, located in the current central portion of the Cr(VI) plume, are designated as "late time" remedial wells that are intended to accelerate the remediation process once eastward migration of the Cr(VI) plume has occurred.	PG&E should consider the inclusion of some flexibility in the design document to allow IRL-6 to be moved a couple hundred feet to optimize remedy design based on data to be collected during remedy implementation. Also modify the design document to allow early startup of provisional wells IRL-6 and/or IRL-7 if determined necessary based on monitoring and operational data.			Comment resolved.	90% BOD Section 3.2.2.

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PG&E Topock Compressor Station, Needles, California

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					Additional remediation wells were not proposed to the north of IRL-6 due to constructability issues and access/right-of-way limitations associated with construction in the area between I-40 and the BNSF Railroad. The accessibility issues in this area were previously discussed during the January 9, 2012 briefing and project area site walk that was led by representatives of PG&E and attended by members and representatives of the Fort Mojave Indian Tribe and the Hualapai Tribe.	Comment resolved, see also comment #136 DTSC-43.				
Specific Comments – Sections 3.3 through 3.6										
138	DTSC-45	3.3.1 Freshwater Supply Sources, Pages 3-24 and 3-25	Use of an existing well avoids the disturbance and the uncertainty about quantity and quality of supply that would be associated with drilling a new well.	This sentence should be revised as PG&E indicates that additional characterization (and disturbance) of the HNWR-1 area is needed as there is uncertainty regarding the hydrogeology of the area and even some concern with the construction of the well. Additional characterization is to be collected through implementation of the freshwater work plan.	The cited sentence will be deleted as requested.	In light of PG&E's recent Arizona supply well findings expressed on November 4, 2013, DTSC requests that the cited sentence simply be deleted. PG&E now contends that the HNWR-1 well has questionable construction that would affect its operation and maintenance and the location does not appear as desirable geohydrologically when compared to Site B. PG&E has proposed to drill a new well at Site B. Potential disturbances for a California well would likely be similar to those for Arizona wells.			Comment resolved.	90% BOD Section 3.3.1.
139	DTSC-46	3.3.1 Freshwater Supply Sources, Page 3-25	Although geochemical modeling indicates that this arsenic will not migrate far from the injection points and will dissipate within a reasonable period of time after the completion of the remedy, the RWQCB, subject to its invitation for PG&E to seek review by the SWRCB, indicated that	The use of the term "within a reasonable period of time" is subjective. As the RWQCB and, therefore, DTSC did not find this to provide sufficient merit for injection above the MCL, this statement is therefore moot and may or may not be reasonable. It should be replaced with the estimated number of years that it will take for the arsenic to return to pre-injection conditions.	The State Board letter dated November 20, 2013 provides the Board's rationale and conditions for allowing injection of naturally occurring arsenic above MCL without pre-treatment. The letter also states that the arsenic water quality objective must be met within the earlier of 20 years after achieving the RAO for Cr or 20 years after ceasing injection of water containing naturally occurring arsenic above MCL. On this basis, the term "within a reasonable period of time" could be interpreted as "within approximately 20 years".	Comment resolved based on interpretation by the State Board's November 20, 2013 letter. PG&E should, however, revise the sentence to specify "approximately 20 years after injection ceases for the remedy."			Comment resolved.	90% BOD Section 3.3.1.

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			the HNWR-1 water would likely need treatment to remove naturally occurring arsenic prior to injection.							
140	DTSC-47	3.3.1 Freshwater Supply Sources, Page 3-25	In addition, pumping fresh water from this area would have an adverse effect on the performance of the remedy.	Please delete the cited sentence. Recollection has it that the California pumping scenario had little, if any, effect on the remedy.	Model simulations presented in Attachment C of the Freshwater Source Evaluation Technical Memorandum suggest pumping from Park Moabi has a slight adverse effect on the cleanup time, however it is probably within the margin of error of the model, so the sentence will be deleted as requested.	Okay.			Comment resolved.	90% BOD Section 3.3.1.
141	FMIT-27 Hualapai-20 Chemehuevi-20 Cocopah-20 CRIT-20	Section 3.3.1 p. 3-25	*"The third option included in the CMS/FS was to obtain water from the Colorado River."*	This section does not mention that the Colorado River has high TOC concentrations (7 to 8 mg/L), and it is difficult to remove TOC using water treatment methods.	The following sentence will be added to this section: "<u>It is possible that the organic carbon might also need to be removed from the river water prior to injection, which is difficult to remove using conventional water treatment methods.</u>"			Comment resolved.	Comment resolved.	90% BOD Section 3.3.1. 90% BOD Exhibit 3.3-1.
142	DOI-62	Section 3.3.2, Page 3-26	"The primary drawback is that the aquifer at Moabi Regional Park does not appear to be capable of delivering a sufficient quantity of water for the remedial action . . . "	Please explain the basis of this statement. Is this statement based on well production history of an existing well?	The basis for this statement is found in a discussion of the performance of several previous and existing wells at Park Moabi, provided in the a tech memo titled *Freshwater Source Evaluation, PG&E Topock Compressor Station, Needles, California* , April 27 2012.		Comment resolved.		Comment resolved.	Not applicable
143	DTSC-48	3.3.2 Evaluation of Freshwater Supply Sources/ Selection of Preferred Source, Page 3-26	The fact that it is an existing well means that there would be less disturbance associated with use of HNWR-1 than with construction of a new well or river intake.	Please delete the cited sentence as PG&E has stated concern with the geologic characterization at HNWR-1 and with the well itself and has proposed to disturb the area with borehole installation up to 400 feet and possibly with installation of a replacement well.	See response to comment #138 DTSC-45.	See response to comment #138 DTSC-45.			Comment resolved.	90% BOD Section 3.3.2.
144	DTSC-49	3.3.2 Evaluation of Freshwater Supply Sources/	Water quality data at the area of	Note: For consistency with the previous sentence in the document, please modify the sentence as	The sentence will be revised as requested.	Okay.			Comment resolved.	90% BOD Section 3.3.2.

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		Selection of Preferred Source, Page 3-26	injection exhibits high levels of naturally occurring fluoride.	indicated, "Water quality data at the area of injection exhibits elevated high levels of naturally occurring fluoride."						
145	DTSC-50	3.3.2 Evaluation of Freshwater Supply Sources/ Selection of Preferred Source, Page 3-26	It is also likely that the TDS of the water from a high capacity well would be greater than 3,000 mg/L, making it undesirable for injection into the less saline, upper portions of the aquifer at the Topock site.	What are the TDS limits for freshwater injection at the Topock site. Language contained here suggests that discharge limits should be below at least 3,000 mg/L for the upper portion of the aquifer. Discharge limits for all analytes injected into the aquifer are needed.	The cited text refers to possible water quality from a hypothetical well at Moabi Regional Park. It should be noted that HNWR-1 water has a fairly low TDS level of approximately 500 mg/L. As discussed in response to comment #67 DTSC-20, setting discharge limits is not appropriate for the remedy due to the mixing that is necessary in the treatment zone. It is anticipated that as the lower TDS freshwater is injected and mixed with the higher TDS water (greater than 3000 mg/L) from the middle and deeper portions of the receiving water, the resulting TDS in the receiving water will be lower after injection than that before injection of freshwater. Water quality including electrical conductivity (related to TDS) will be monitored in sentinel wells at the injection areas and elsewhere throughout the site during the remedial action.	See response to #67 above. Discharge limits for all analytes injected into the aquifer are needed. DTSC is referring to FW and IRL wells outside the plume boundary and not the IRZ line. Please refer to the existing discharge requirements for IM-3 injections as starting point. PG&E should attempt to protect the low TDS shallow zone during FW and IRL injections. Perhaps high TDS waters can be preferentially injected into lower zones via packer systems or dedicated injection wells.			Discussion between DTSC, DOI, RWQCB, and PG&E is ongoing to resolve this comment. This topic will be carried forward. Resolution of this comment will be included in the 90% design. PG&E will also work on items related to this comment as directed in the Agencies' direction letter dated April 4, 2014.	90% BOD Sections 3.2.2 and 3.3.3 O&M Manual Volume 1 Sections 2.1 and 3.1
146	DOI-63	Exhibit 3.3-1, Page 3-27, 2. Quantity of Water Available	"At the time of this writing, PG&E has conducted a longer-term constant rate extraction test at HNWR-1 . . . "	How long was the extraction pump test run?	This test was planned to be a 96-hour test but it was cancelled at the last minute because Southwest Water needed to postpone the shut down and monitoring of water levels in Topock-2/3, until a later time. PG&E plans to conduct this test as part of the FWIP.		Comment resolved pending review of the 90% design.		Comment resolved.	Not applicable

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147	DTSC-51	3.3.2 Evaluation of Freshwater Supply Sources/ Selection of Preferred Source, Exhibit 3.3-1, Page 3-27	While this has negligible effects on the rate of Cr(VI) removal, it could be important if there were some objectionable characteristic in the injected water because it is likely that some of the injected water would be drawn back close to or possibly within Park Moabi by the end of the active remedial action.	The cited sentence is speculative and confusing and should probably be deleted or clarified. It would seem that water sourced from Park Moabi could not be "objectionable" to a well in Park Moabi. What is the basis for this comment? Was fate and transport modeling conducted to form a basis?	The sentence in question will be revised to read: "Although pumping freshwater from Park Moabi would have negligible effects on the rate of Cr(VI) remediation, there are two potential problems: 1) pumping more than about 60 gpm from a well or wells at Park Moabi poses a risk of upconing of high TDS water from depth and degrading water quality in the existing wells and 2) if high TDS water were pumped from Park Moabi and injected into the freshwater wells, it could be drawn back to the park over the course of the remedial action and degrade the water quality in the existing wells. (see Appendix J for further details)"	Comment resolved.			Comment resolved.	90% BOD Exhibit 3.3-1.
148	DTSC-52	3.3.2 Evaluation of Freshwater Supply Sources/ Selection of Preferred Source, Exhibit 3.3-1, Page 3-27	At the time of this writing, PG&E has conducted a longer-term constant-rate extraction test at HNWR-1 well to confirm the well capacity to meet the need of the remedy and other needs; results from this test will be presented when available.	Please include the date of the long term extraction test.	The long term extraction test was cancelled on short notice shortly after the 60% BOD was submitted because Southwest Water needed to postpone the shut down and monitoring of water levels in Topock-2/3, until a later time. PG&E plans to conduct this test as part of the FWIP, and summarized/ referenced in the 90% BOD.	DTSC concurs that the results from this test will need to be presented or summarized and referenced in the 90% BOD.			Comment resolved.	90% BOD Exhibit 3.3-1.
149	DOI-64	Exhibit 3.3-1, Page 3-29, 4. Implement-ability Considerations	"All new conditioning facilities or an arsenic treatment facility will require electricity and strong chemicals . . . "	What chemicals would be used that are classified as "strong"?	Strong chemicals would include oxidizing agent (e.g., calcium hypochlorite) and acids (e.g., sulfuric or hydrochloric acid). For arsenic/fluoride removal, a caustic (e.g., sodium hydroxide) would also be used. Text will be included in the 90% BOD to reflect this response.		Comment resolved pending review of 90% design.		Comment resolved.	90% BOD Exhibit 3.3-1.
150	DOI-65	Exhibit 3.3-2,	Possible Operational	The table indicates that well replacement may be a possible	In general, over drilling or replacement are both possibilities for		Comment resolved.		Comment resolved.	Not applicable

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		Page 3-31	Actions for Potential Problem – Well yield declines below the minimum required for optimal remedy operation	action. It is presumed that either over-drilling of the current HNWR-1 well site or re-drilling adjacent to the current site are both possible considerations for well replacement?	replacing wells that are no longer performing as design. In the case of HNWR-1, the screen is set inside the well casing and not welded or otherwise attached, so it could not be easily removed for over-drilling. If the screen couldn't be removed, it would likely be necessary to abandon HNWR-1 and drill a replacement well nearby.					
151	DTSC-53	3.3.2 Evaluation of Freshwater Supply Sources/ Selection of Preferred Source, Exhibit 3.3-2, Page 3-31		Suggest adding increasing river bank extraction to the Possible Operational Actions column on this table.	Increasing river bank extraction results in increased velocity across the IRZ line and across the floodplain. Increased groundwater flow velocity can potentially result in incomplete treatment of chromium in the IRZ and insufficient time for byproducts to dissipate between the IRZ and the river bank wells. This option will be added to the table, with the caveat that it could only be used to offset a marginal reduction in freshwater supply. The nominal aggregate riverbank well extraction rate of 150 gpm was the ideal rate for the remedial system design based on the groundwater flow and solute transport modeling. Sensitivity analyses conducted at a rate of 300 gpm riverbank extraction (Appendix B Section 10.3) indicates that small fingers of Cr(VI) progress past the NTH IRZ during the 18 month NTH IRZ off-cycle, although they are attenuated during the next 6-month NTH IRZ on-cycle. Additional steps such as increase NTH IRZ operational rates, activation of provisional NTH IRZ wells, reduction in the NTH IRZ off-cycle duration, or an increase in TOC injection concentrations can also be used to address potential Cr(VI) breakthrough along the NTH IRZ. Due to the limited amount of hydrogeologic data in the northern part of the floodplain where the aquifer thickens, flexibility was added into the riverbank extraction well design to allow for greater total extraction rates than the model currently projects would be optimal. An aggregate riverbank extraction rate of 500 gpm was estimated as a	Table 3.2-2 indicates that nominal river back extraction rates are 150 gpm. Maximum rates are stated to be a combined 500 gpm. This also relates to comment #839 DTSC-252. Is 500 gpm an excessive groundwater flow velocity? Is 500 gpm a realistic rate? If not, what is realistic? DTSC agrees with PG&E with respect to the risk associated with high extraction rates. This is one of the reasons that DTSC has requested additional contingency river bank extraction wells to manage possible breakthroughs or excess by-product generation. DTSC also agrees that extraction velocity adjustments would be an essential contingency measure for the remedy as well. Comment resolved.			Comment resolved.	90% BOD Exhibit 3.3-2. O&M Manual Volume 3 Table 2.3-1.

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					reasonable maximum for the riverbank extraction wells in order to accommodate the potential for higher than expected transmissivity along the river bank. A model run was not conducted at a 500 gpm riverbank extraction rate. If the transmissivity along the river bank is higher than expected, the hydraulic influence of the river bank wells on the IRZ would be lessened and pumping rates from the river bank wells would need to be increased above the rates currently projected by the model to maintain hydraulic control. The groundwater flow and solute transport model will be updated based on data obtained during well installation and operation which will allow for the riverbank extraction well pumping rates to be refined.					
152	DTSC-54	Exhibit 3.3-2, Contingency Matrix for potential problems with HNWR-1	Well yield declines below the minimum required for optimal remedy operation Third bullet: Establish institutional control to prevent excessive drawdown from competing water users.	Possible contingency measures did not include the tie in of Topock 2 and 3 for added quantity of known quality water. Instead of seeking new well immediately, PG&E should design the system to allow Topock 2 and 3 water to be blended with HNWR-1. DTSC would not have jurisdiction in Arizona to limit or restrict water usage from users outside of PG&E's area of contamination. Restrictions may be within the jurisdiction of the Federal land owner or under jurisdiction of the Arizona state agencies. Furthermore, as a condition of approval, DTSC specified in the certified EIR that PG&E's remedy cannot interfere with existing water usage.	As discussed in response to comment #168 DTSC-63, PG&E will separate the freshwater supply and storage for the remedy and the Compressor Station. Topock-2/3 wells will continue to supply water for Compressor Station use via the existing 6-inch pipeline. Because of this separation of freshwater storage, the tie-in of Topock-2 and 3 wells will be eliminated in the 90% design. A tee and a valve will be added to the new 10,000-gallon freshwater storage tank for the remedy to allow for the flexibility of adding water from the TCS storage tanks as needed. Comment noted. As directed, PG&E fully intends to demonstrate compliance with EIR mitigation measure WATER-1, which is to proactively identify and mitigate potentially significant effects on local groundwater levels associated with proposed freshwater extraction wells. In addition, as directed, PG&E will also implement institutional controls (ICs) to protect the integrity and the effectiveness of the remedy in the short-term and long-term. To this end, PG&E is evaluating the need for and/or the scope of an IC at or near the HNWR-1 well to ensure adequate quantity of fresh water for	Okay.			Comment resolved.	90% BOD Figures 3.3-1, 3.5-1, and 3.5-3.

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					remedy effectiveness (see Note 3 on Figure 5.1-1, page 211 of the PDF). In the event an IC is determined to be needed, PG&E will work with the appropriate agencies, land manager, and land owner to obtain the necessary IC.					
153	DTSC-55	Exhibit 3.3-2, Quality of water in freshwater well declines over time		DTSC has required PG&E to design the water treatment system so that it would be a contingency in event water quality would impact PG&E's ability to continue operation of the remedy. Construct and operate the water treatment system should be listed as a contingency.	PG&E complied with DTSC's direction in its December 31, 2012 letter and included a freshwater pre-injection treatment system in the 60% design. Therefore, the water treatment system was not a contingency in the 60% BOD. As discussed in response to comment #21 DTSC-2, PG&E will include a freshwater pre-injection treatment for arsenic only in the 90% and final designs as a contingency.	Comment resolved pending review of the 90%. Please ensure freshwater pre-injection treatment for arsenic is listed in Exhibit 3.3-2.			Comment resolved.	O&M Manual Volume 3.
154	DOI-66	Section 3.3.2, Page 3-32	"Most of the water produced by HNWR-1 is expected to come from the Colorado River . . . "	Several concerns were identified in Exhibit 3.3-1 regarding use of the Colorado River as a source of fresh water. These included susceptibility to future contamination, and the possibility of the presence and potential need to address emerging contaminants. Further describe how these concerns do not carry over to the use of wells located near Sacramento Wash/Topock Marsh.	Wells near the river do not pump river water directly. Groundwater travel time from the river to a well located at the distance of HNWR-1 well is likely many months to a few years. Depending on the transport properties some contaminants move much slower than the water. All contaminants are subject to dispersion and dilution between the river and a well. So if a contaminant is found in the river, there is ample time to stop pumping or institute additional monitoring before it shows up in a well near the river, and the concentration of the contaminant in the well is likely to be considerably less than in the river. Discussion of this will be made clearer in the text.		Comment resolved pending review of text addition.		Comment resolved.	90% BOD Section 3.3.2. O&M Manual Volume 2 Section 5.2.2.
155	DOI-67	Section 3.3.2, Page 3-32	"Most of the water produced by HNWR-1 is expected to come from the Colorado River . . . "	The in-text citation for ADEQ 2001 is not listed in the Reference section.	The following item will be listed in the Reference under ADEQ -- *"ADEQ. 2001. Ambient Groundwater Quality of the Sacramento Valley Basis: A 1999 Baseline Study."*		Comment resolved.		Comment resolved.	90% BOD Section 9.
156	DTSC-56	3.3.2 Evaluation of Freshwater Supply Sources/ Selection of Preferred Source, Source Water	This radius extends to within 500 feet of the EPNG Mojave Topock Compressor Station in	The text and Exhibit 3.3-3 should disclose the locations of existing water wells in the vicinity of HNWR-1. Based on the radius of influence pictured in Exhibit 3.3-3, this should include, at a minimum, the following wells: Old Southwest Gas, MTS-1,	The Old Southwest Gas well is likely one of the former wells at the site where Topock 2 and 3 currently exist. At least three wells have been drilled at this location and only two exist today. Southwest Gas was the owner when these wells were drilled.	Comment resolved.			Comment resolved.	90% BOD Section 3.3.2. O&M Manual Volume 2 Section 5.2.2. O&M Manual Volume 2 Exhibit 5.2-1.

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		Assessment, Page 3-32, Paragraph 1 and Exhibit 3.3-3	Arizona and encompasses the Topock Marina area (see Exhibit 3.3-3). As shown in Exhibit 3.3-3, the majority of the property in this radius is undeveloped…	MTS-2, Sanders, Smith, PGE-9N, PGE-9S, New Topock Marina well, and monitoring wells MW-54 cluster, MW-55 cluster, and MW-56 cluster. Please also consider including Serrano and GSRV-2 especially if Site B were to be utilized instead of HNWR-1. Please clarify if any of these wells have been appropriately decommissioned and no longer exist at the surface. The source water assessment should focus on the developed areas that may have water impacts associated with them. Some research into the various waste ponds at the EPNG Mohave Compressor Station should be conducted and summarized in this section. Groundwater monitoring parameters should be selected and included in remedy monitoring that would be related to or unique to EPNG operations. Installation of monitoring wells associated with the waste ponds may be prudent. Summary of the monitoring well data related to former USTs at Topock Marina should be cited. Former Topock shops/gas stations (e.g., old garages) should be considered and appropriate monitoring parameters and monitoring wells should be selected and incorporated into the remedy.	Hand drawn sketches on some of the well records show an abandoned well between Topock 2 and 3. As far as PG&E knows, all of the other wells listed are still in existence and the figure will be modified to show them. Based on information in the ADEQ Topock Groundwater Study report, the ponds at the Mohave Topock Station were constructed in 2005 and are permitted units with leak detection systems. The ponds receive non-contact cooling water that was formerly directly discharged to the river. There is no reason to suspect that these recently constructed, RCRA permitted facilities receiving non-hazardous cooling water should represent a threat to water quality or require additional monitoring to be installed by PG&E. PG&E will request information from ADEQ regarding the former USTs at the Topock Marina. The UST site was closed by ADEQ, so it is not anticipated that it would continue to be a threat to groundwater quality in the HNWR well, which is over 2,000 feet away. The MW-55 cluster is located less than 100 feet from the former UST and directly between the UST and HNWR-1, so it should provide an adequate monitoring location to address this concern, or the concern about unknown historic sources in the Topock area. Additional information obtained will be summarized in the 90% design.					
157	DOI-68	Section 3.3.2, Page 3-32	"This dump consists of small area of rusty cans and other metal debris scattered on the land surface. . . . It is located adjacent to a flat area that may have housed a military or work crew	Is there any information about the dump area? Has any testing been done? Could this site represent a potential source for the elevated arsenic found in HNWR-1?	There is no information about the dump area and it does not appear to PG&E or DTSC to be a threat to groundwater. The text will be revised as follows (inserted verbiage shown in underline typeface, deleted verbiage shown in ~~strikethrough~~ typeface): "This <u>area</u> ~~dump~~ consists of ~~small area of~~ rusty cans and other metal debris scattered on the land surface…"		Comment resolved.		Comment resolved.	90% BOD Section 3.3.2. O&M Manual Volume 2 Section 5.2.2.

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Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
			encampment."							
158	DTSC-57	3.3.2 Evaluation of Freshwater Supply Sources/ Selection of Preferred Source, Source Water Assessment, Page 3-32	Also within this radius is a former dump area which DTSC expressed concern about.	As existing DTSC representatives had no knowledge of the former dump site cited, the reference to DTSC should be deleted. After reviewing this item, DTSC visited the cited area in Arizona and it did not appear to be a significant threat to groundwater resources (Does PG&E believe it is a threat?). It is uncertain why it is being discussed in the document. DTSC is interested in any historical knowledge PG&E may have of this area. Please clarify.	The cited text and the rest of the paragraph will be deleted. The following text will be inserted in its place: "A question was raised in a public meeting about a rumored former "Topock Dump" that reportedly contained trash from local residents. PG&E was not aware of any such former dump. A member of the FMIT who has lived in the area for many years indicated that the area of debris and can scatter was the only "dump" that he knew of in the area and speculated that it might have been trash left from a railroad work camp. PG&E agrees that this debris does not appear to represent a threat to groundwater." Because this area does not appear to be a dump, Exhibit 3.3-3 will be revised to describe it as a "debris area" rather than a dump. In addition, the word "dump" at the end of the next paragraph will be replaced with "EPNG Mojave Topock Compressor Station".	Comment resolved pending review of replacement language in 90% BOD.			Comment resolved.	90% BOD Section 3.3.2; original text retained (but revised) to reconcile with RTC#157 DOI-68
159	DTSC-58	3.3.2 Evaluation of Freshwater Supply Sources/ Selection of Preferred Source, Source Water Assessment, Page 3-32, Paragraph 2 and 3.	Most of the water produced by HNWR-1 is expected to come from the Colorado River (via its partial diversion into Topock Marsh), although some will be derived from groundwater flowing down from the Sacramento Valley to the east (CH2M HILL 2012d). There are currently no monitoring wells in Sacramento Wash. The property	Include the basis for this statement regarding most of the groundwater coming from the river. What do stable isotope data from HNWR-1 tell us? Was modeling utilized to arrive at this conclusion? Is there enough (any) hydraulic conductivity data to make this statement? A simple assessment of the pictured 5-year radius of influence in Exhibit 3.3-3 suggests that half to a third of the groundwater might come from the east/northeast and not be sourced from the river (especially if you consider three dimensional flow). Geologic channels in the Sacramento Wash could alter this simple assessment. Please revise the statement to best relate to site conditions. Please also revise the monitoring well installation conclusion (See DTSC comment on 3.3.2 Evaluation of Freshwater Supply Sources/Selection of Preferred Source, Source Water Assessment, Page 3-32 Paragraph 1	The first sentence will be revised to read "Water produced by HNWR-1 is expected to be a mix of water recharged from the Colorado River and groundwater flowing down from the Sacramento Valley to the east (CH2M HILL 2012d)." Considering the close proximity of the well to the river and the larger volume of water available from river recharge, it is reasonable to assume that a large fraction of the water would come from the river, but there is currently insufficient data about the aquifer in the vicinity of HNWR-1 to quantify the relative fractions of water that would come from the river vs. from Sacramento Wash recharge. To be consistent, the first sentence in the next paragraph will also be revised as follows: "...~~the majority a~~ component of the water produced from HNWR-1 should originate from the Colorado River …". Based on three available samples of	Comment resolved.			Comment resolved.	90% BOD Section 3.3.2. O&M Manual Volume 2 Section 5.2.2.

TABLE I-1
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Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design
PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
			upstream in Sacramento Wash is undeveloped for miles… Considering the lack of existing contaminant sources in the Sacramento Valley (Exhibit 3.3-3), the installation of monitoring wells in Sacramento Wash upstream of HNWR-1 for source water protection is not considered warranted…..	and Exhibit 3.3-3 above).	stable isotopes, the average concentrations of oxygen18 and deuterium in HNWR-1 are -10.2 per mil and -75.4 per mil respectively. This water plots in near the center of the "Isotopic Non-Industrial Signature" group shown on Figure 5-24a in Volume 2 of the RFI, and indicates an intermediate signature between the river and another signature represented by the ground water coming down Sacramento Wash. If HNWR-1 is pumped continuously, the isotopic signature could begin to shift as more river water is drawn into the well. This effect has been noted in response to IM-3 pumping, which has resulted in an increasing percentage of river water with time in wells near PE-1 (see Figure 6-21 in RFI Volume 2). See response to comment #160 DTSC-59 regarding the need for monitoring wells around the freshwater well.					
160	DTSC-59	Section 3.3.2, p.3-32, 2nd paragraph	Considering the lack of existing contaminant sources in the Sacramento Valley (Exhibit 3.3-3), the installation of monitoring wells in Sacramento Wash upstream of HNWR-1 for source water protection is not considered warranted.	DTSC disagrees with PG&E's conclusion. DTSC believes that it would be prudent to understand the incoming water quality up gradient of the freshwater well over time to ensure that quality will meet the injection objective prior to detection at the production well. Advance knowledge will allow proper planning before issue arises at the well. Furthermore, because the area of draw down encompasses many potential users, it is also necessary to monitor possible changes in water quality conditions prior to impacts of nearby wells. DTSC requests that PG&E provide a robust monitoring system up gradient and down gradient of the fresh water well.	Even in areas where groundwater is a primary source of drinking water and potential contaminant sources are numerous (such as Phoenix, Tucson, and the San Fernando Valley) installation of monitor wells for an early warning system around a new production well is not a typical requirement. CH2M HILL is unaware of any municipality that is required to provide this level of monitoring for wells that are remote from any known sources of contaminants and directly serve water to their customers. In addition, the predictive value of data from a monitoring well at a distance from a pumping well is limited. In a radial converging flow field around a pumping well, any single monitor well represents only a small fraction of the total circle from which the flow converge at the pumping well. The concentration in a continuously pumped well represents an integrated sample of water coming inward to the well from all directions. Due to dilution in the radial flow field, the concentration in the pumped well could be much less than in a	In an effort to minimize additional well installations, it is proposed that existing wells be utilized to provide groundwater data that may provide value for source water protection. As the only known potential source of anthropogenic contamination in the vicinity would be from the Mohave Topock Station waste ponds, periodic analysis of Topock 2/3 well data should be included in the remedy operation and added to the 90% design. Wells Topock 2/3 are located between HNWR-1 and the Mohave Topock Station and capture water from a significant distance as compared to a dedicated monitoring well.			Comment resolved. PG&E will include periodic sampling of Topock-2/3 wells in the 90% assuming that the well owner will allow sampling of the wells.	90% BOD Section 3.3.2 (3rd paragraph from the bottom, last sentence). O&M Manual Volume 2, Section 5.2.2 (5th full paragraph, last sentence) PG&E will provide Topock-2 and 3 water quality data collected for water supply purposes as PG&E receives the information from Southwest Water.

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Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
					monitoring well located even a few hundred feet away. For a monitoring network to be able to accurately predict future concentrations in a pumped well, monitoring wells would need to be spaced sufficiently close so that they could begin to represent the average water quality coming into the pumped well from all directions. The number of wells required to accomplish this goes up geometrically with the distance from the pumped well. Using the equations provided for travel time to the well in Section 3.3.2, a robust monitoring network located far enough from the pumped well to provide reasonable early warning, (say a years' travel time), would need to monitor a circumference of about 7,500 feet. So even with relatively wide spacing of 1,000 feet between wells, this would require 7 new monitor wells. To dedicate this many monitoring wells for the purpose of monitoring a supply well that does not serve customers directly and is located in a relatively undeveloped area seems excessive and unwarranted, particularly in light of the need to control the total well count at the Topock site.					
161	DTSC-60	3.3.2 Evaluation of Freshwater Supply Sources/ Selection of Preferred Source, Source Water Assessment, Page 3-32, Paragraph 3.	The travel time of constituents in river water to a nearby well may take many years, depending on their mobility (CH2M HILL 2012d); therefore, river water quality is a good indicator and should be used for source water protection of HNWR-1.	It is requested that existing well locations (e.g., MW-54/55/56) be considered for periodic monitoring of river constituents/ source protection. Also clarify that the freshwater supply well will be periodically monitored for potential river contaminants.	The primary monitoring strategy for detecting contaminants in the river is to rely on samples of river water. Samples of wells near the river provide at best a diluted sample of what is in the river. Recharge to HNWR-1 is much more likely to come from the nearby Topock Marsh than from the main river channel, where MW-54 and MW-56 wells are located. There is continuous interchange of water in the marsh with the river, so there is no reason to expect a contaminant in the river would not be present in the marsh, or vice-versa. The MW-54 and 56 well clusters are outside the projected 5 year travel time from HNWR-1, so monitoring at these locations is of questionable value to predicting water quality changes in HNWR-1. The MW-55 cluster is between the Topock Marina and HNWR-1, PG&E agrees that	Comment resolved.			Comment resolved.	O&M Manual Volume 2 Section 5.2.2 (last paragraph) and Table 5.2-5.

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Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

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					monitoring at this location could have some value in detecting contaminants originating from any sources in the small developed area around the marina and it will be included in the monitoring program. The proposed monitoring program for freshwater supply well(s) is provided in Exhibit 5.2-2 of the O&M Manual, Volume 2 (page 5-4) and includes constituents such as pesticides and herbicides that are more commonly found in surface water than in groundwater and may be present in the river.					
162	DTSC-61	3.3.2 Evaluation of Freshwater Supply Sources/ Selection of Preferred Source, Source Water Assessment, Page 3-32, Paragraph 3.	The river in the immediate vicinity of the site and downstream is monitored by the Metropolitan Water District of Southern California (MWD).	Please include the MWD monitoring stations on a figure so all will know where sampling is conducted with respect to the PG&E site and that it is appropriate.	PG&E received permission from MWD to include its monitoring stations on a figure in the Topock design report. Therefore, PG&E will include MWD monitoring stations in Figure 2.4-7 (Surface Water Monitoring Locations) in the 90% BOD.	Okay			Comment resolved.	90% BOD Figure 2.4-7.
163	CRB-1	Section 3.3.2, p. 3-37	*"most of the water produced by HNWR-1 is expected to come from the Colorado River (via its partial diversion into Topock Marsh), although some will be derived from groundwater flowing down from the Sacramento Valley to the east"*	The Board expects any new well to be drilled in compliance with state and federal laws. Although the draft BOD report indicates PG&E's intention to maximize re-injection of treated remedy-produced water to the groundwater basin and minimize consumptive use for the remediation project, any consumptive use at the project should be documented. The Board requests that PG&E document water usage information that includes the amount of water diverted and re-injected to groundwater at the remediation project site.	PG&E plans to document groundwater usage and has equipped extraction and injection wells with flowmeters and totalizers as shown on the P&ID drawings. Under the terms of its water right, PG&E will continue to report quantities of water pumped and injected during the operation of the remedy to the City of Needles, as administering agency for the Lower Colorado River Water Supply Project (LCWSP) water for non-federal entities (FEIR at page 4.12-1).					90% BOD Appendix D Drawings (e.g., E-02-01, I-01-01, M-01-01, etc.)
164	DOI-69	Exhibit 3.3-4, Page 3-34		At what depth would each well be set in order to achieve the design gpm flow rate? Does PG&E have specific capacity information for each location?	Tables 3.2-1 and 3.2-2 provide additional information on well depths and screen lengths. The exact depths and design of each well will be determined based on geology encountered at the time of drilling. Specific capacity data is only available at a few existing wells at the site. A footnote will be added to indicate that the well will be tested	What is PG&E's process that would hopefully minimize additional drilling? Comment resolved pending review of the 90% design.	Comment resolved pending review of the 90% design.		Comment resolved.	90% BOD Table 3.3-1 (Footnote b). Construction/Remedial Action Work Plan Sections 3.1 and 3.2 for well construction approach and sequencing.

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					to ascertain specific capacity for injectivity. Text will be added to reference the O&M plan discussion on the well construction process.					
165	DTSC-62	3.3.3 Design Basis for Freshwater Supply System, Page 3-34.	Extraction well or well(s) in Arizona (HNWR-1 well is the primary freshwater supply well, freshwater can be augmented with water from current TCS supply wells [Topock-2/3] if needed)	DTSC concurs that the remedy freshwater supply should not be unnecessarily burdened by Compressor Station needs unrelated to the project. Potentially utilizing Topock 2/3 wells is necessary and appropriate.	Comment noted.	Response noted.			Comment resolved.	Not applicable
166	DOI-70	Exhibit 3.3-4, Page 3-35, Supply Pump	"A separate flow meter and connection for the Refuge to use."	The sentence is incomplete.	The sentence will be revised as follows: "A separate flow meter and connection <u>will be provided</u> for the Refuge to use."		Comment resolved.		Comment resolved.	90% BOD Exhibit 3.3-4.
167	DOI-71	Exhibit 3.3-4, Page 3-35	Footnote b	The information in Footnote b regarding the freshwater injection wells seems inappropriate. Suggest deleting the footnote.	Footnote b is useful because it provides a cross-reference to the well design parameter tables in Section 3. Therefore, it is suggested that footnote b be retained and revised as follows: "See Table 3.3-1 for design flows related to Freshwater Injection Wells (FWs) and Table 3.2-2 for design flows related to Inner Recirculation Wells (IRLs)."		Comment resolved.		Comment resolved.	90% BOD Exhibit 3.3-4.
168	DTSC-63	Section 3.3.3, Design Basis for Freshwater Supply System, p.3-35	To accommodate potential future operational changes associated with the remedy while maximizing the use of existing facilities, the design incorporates the current freshwater supply system for the Compressor Station. The	Project demand should be first priority for the design and future operation of the freshwater source. PG&E should separate station operational needs from remedy. It is DTSC's expectation that the use of all infrastructure designed and constructed under DTSC's approval would be prioritized for remedy first and not PG&E's operational needs. Furthermore, DTSC has not evaluated, in the Certified EIR, the economic impacts to water purveyor by allowing PG&E to use the same fresh water source for operational needs.	The first priority for the freshwater stored in or flow from the existing storage tanks is fire protection for the Compressor Station and current water need at the Station, and that priority cannot be changed. To ensure first priority for remedy use and after further evaluation of the additional controls, instrumentation, and tank upgrades needed to be installed in the existing tanks in order to harmonize various demand for freshwater, PG&E will separate the freshwater supply storage for the remedy and the Compressor Station. A separate and smaller tank (10,000 gallons) will be installed inside the Compressor Station for remedy use only and will be supplied by the new freshwater	Comment resolved pending review of 90% design. Since this is a new change from the 60% BOD, PG&E should keep the agencies, Tribes, and other stakeholders informed of this proposal before the 90% BOD submittal.			Comment resolved.	90% BOD Figures 3.3-1, 3.5-1, and 3.5-3. PG&E discussed the design change related to the separation of freshwater storage and the location of the new 10,000-gallon remedy freshwater water storage tank, at the June 18, 2014 TWG meeting and the July 16, 2014 CWG meeting.

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			compressor Station's current water need (approximately 110 gpm) is served by Topock-2 and -3 supply wells in Arizona; the fresh water is conveyed via a pipe crossing the Colorado River on the arch bridge.		supply source from Arizona (pending completion of the Alternative Freshwater Source Evaluation). Note that Topock-2/3 wells will continue to supply water for Compressor Station use via the existing 6-inch pipeline. The new 10,000-gallon tank is different from the proposed conditioned water storage tank and will be located near the planned Remedy-produced water conditioning plant (see proposed layout and tank specification in the technical memorandum titled "Addendum to the Freshwater Pre-injection Treatment System Design Basis", included in **Attachment F** at the end of this table). As for freshwater supply piping, PG&E will retain the existing 6-inch line to supply the Compressor Station.					
169	DOI-72	Section 3.3.3.2, Page 3-36	"Storage of fresh water is required to meet the flow demands to injection wells during extended supply well(s) shutdown and outage . . . "	How long of a shutdown can the system endure and meet flow demands before storage capacity is exhausted?	The existing freshwater storage capacity is 420,000 gallons. Per Exhibit 3.3-4, the injection flow for IRZ/FW wells ranges from 150 to 900 gpm, and the Compressor Station flow is 110 gpm, for a combined total of 260 to 1,010 gpm. At this combined flow range, the supply well(s) could be shut down for 7 hours to almost 27 hours before the storage capacity is exhausted. Note that if needed, injection flows can also be temporarily reduced to allow injection to continue for a longer time.		Comment resolved pending review of SOPs in 90% design.		Comment resolved.	This RTC is no longer applicable with the separation of freshwater storage between TCS and groundwater remedy. This essentially decouple the fire protection supply from freshwater injection. TCS will continue to supply fire protection water for groundwater remedy facilities. The new 10,000 gallon Remedy freshwater storage tank will supply the freshwater injection well FW-2. At the nominal and maximum flowrates of 50 and 100 gpm, FW-2 can be operated for 2-3 hrs with the freshwater supply well down. Note that if needed, injection flows can also be temporarily reduced to allow injection to continue for a longer time. Since the upland wells (FW-1 and certain IRL wells) receive freshwater directly from the supply well, they will not be operated if the supply well is down.
170	DOI-73	Section 3.3.3.1, Page 3-36	"After crossing the Colorado	A figure showing the water pipeline route would be useful to support the	A figure will be added in this section as requested.		Comment resolved.		Comment resolved.	90% BOD Figure 3.3-1.

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			River into California, the water pipeline . . . “	text.						
171	DOI-74	Section 3.3.3.2, Page 3-36	“An analysis of the fire protection system hydraulic performed at the 60% design stage suggested that there is adequate storage capacity to meet fire flow storage requirements that can be shared with the remedy, as long as there is sufficient supply . . . “	How long can injection wells operate during a shutdown before they are required to be shutdown to ensure ample water for fire protection?	The existing freshwater storage capacity is 420,000 gallons. Per PG&E’s insurance company, the required fire flow for TCS is 900 gpm and duration is 60 minutes, which results in a total of 54,000 gallons. See also response to comment #428 FMIT-124 below for fire flow requirements for remedy facilities. If the storage tanks are completely full and the freshwater supply well(s) are down, the injection wells can be operated for 6 to 11 hours and still ensure ample water for fire protection for both TCS and remedy facilities. If a certain minimum level must be maintained in the storage tanks, the duration could be less (the control strategy will be included in 90% design). Note that if needed, injection flows can also be temporarily reduced to allow injection to continue for a longer time.		Comment resolved pending review of SOPs in 90% design.		Comment resolved.	This RTC is no longer applicable with the separation of freshwater storage between TCS and groundwater remedy. This essentially decouple the fire protection supply from freshwater injection. TCS will continue to supply fire protection water for groundwater remedy facilities. The new 10,000 gallon Remedy freshwater storage tank will supply the freshwater injection well FW-2. At the nominal and maximum flowrates of 50 and 100 gpm, FW-2 can be operated for 2-3 hrs with the freshwater supply well down. Note that if needed, injection flows can also be temporarily reduced to allow injection to continue for a longer time. Since the upland wells (FW-1 and certain IRL wells) receive freshwater directly from the supply well, they will not be operated if the supply well is down.
172	DTSC-64	3.3.3.1 Freshwater Supply Piping Network, Page 3-36, Paragraph 2 and 3.		For clarity, please indicate if the existing pipeline from Topock 2-3 will be removed along any of its existing length.	The entire length of the existing pipeline carrying water from Topock-2/3 is included in the 60% design. Final configuration of the pipeline including any modifications for remedy use will be included in the 90% design submittal.	Comment resolved pending review of the 90% BOD.			Comment resolved.	At this 90% design stage, the existing 6-inch freshwater pipeline from Topock-2 and 3 to TCS storage tanks will remain. See 90% BOD Exhibit 3.3-1, Evaluation Criteria #2, 3rd paragraph for additional details.
173	DTSC-65	3.3.3.1 Freshwater Supply Piping Network, Page 3-36, Paragraph 4.		Indicate if the freshwater piping, other buried piping, or other remedy components will require cathodic protection for protection against corrosive soils. Is so, please discuss and include the design. Suggest indicating the composition of the piping in these sections (believe it’s all plastic underground after review of Appendix L, Volume 1, Section 5).	At the 60% design stage, the material of construction for belowground water pipes is plastic (HDPE), and for aboveground water pipes is steel (Schedule 40 steel with AWWA C205 cement mortar lining) or plastic (HDPE or CPVC). Steel pipe will have an exterior coating to prevent external corrosion. Based upon this design approach, no cathodic protection is required.	Okay, pending final material specification, including the composition of the exterior coating for the pipes.			Comment resolved.	90% BOD Exhibit 3.3-4 (Item: Water Pipe).
174	DTSC-66	3.3.3.2 Freshwater	…sharing of existing	It is not clear why this statement is needed. From a supply standpoint,	This statement will be deleted as requested.	Okay.			Comment resolved.	90% BOD Section 3.3.3.

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		Supply Storage, Page 3-36	Compressor Station facilities dictates that the needs of the Compressor Station will supersede freshwater injection requirements.	the Compressor Station can always utilize existing Topock 2-3 supply wells. It is requested that this statement be deleted as supply for the station can be augmented with proven, exiting resources.						
175	DOI-75	Section 3.3.3.3, Page 3-37, Technology Selection/Ongoing Bench Scale Testing	"The initial list of technologies evaluated for freshwater pre-injection treatment . . . "	To state that the initial screening was based on the experience of the engineering team with the technologies downplays what was actually performed – an analysis of cost, waste generation quantities, and performance uncertainty. Suggest the insertion of different language here and in Appendix M.	The reference text is accurate. The technology screening was done in two steps – the first step was to brainstorm the technologies based on the engineering team's experience, and the second step was to evaluate the technologies based on treatment effectiveness, reliability and flexibility, operational complexity, waste generation, footprint, and cost-effectiveness. PG&E welcomes suggestions on text to make this point clearer.		Resolved.		Comment resolved.	Not applicable.
176	DTSC-67	3.3.3.3 Freshwater Pre-Injection Treatment System (FWPTS), Page 3-37	…this design includes a FWPTS for the removal of arsenic and fluoride to conservative treatment goals—specifically, the arsenic treatment goal is to achieve concentrations below the federal/state MCL of 10 µg/L, and the fluoride treatment goal is concentrations below the state MCL of 2 mg/L.	A separate "arsenic only" treatment design should also be included as it is more likely that arsenic treatment would be needed as per State/Water Board directive or as a contingency in the future. Attaining a goal of 2 mg/L for fluoride is futile as higher concentrations already exist in the area where fresh water will be injected. Please revise.	Section 3.3.3.3 text in the 90% BOD will be revised to reflect an arsenic only treatment system as a contingency per the State Board letter. Reference to fluoride treatment will be removed in the 90% BOD.	Comment resolved pending review of the 90%.			Comment resolved.	90% BOD Section 3.3.3.4. O&M Manual Volume 3.
177	DTSC-68	3.3.3.3 Freshwater Pre-Injection Treatment System (FWPTS),	As a result of this evaluation and screening process, AA was selected for bench scale	Would the same treatment technology be proposed if arsenic, and not fluoride, were to be treated? In other location within the 60% design, PG&E appear to suggest that a different technology would be	DTSC is correct that a different technology would be proposed for arsenic treatment only. Based on bench scale testing, PG&E proposes granular ferric hydroxide (GFH) as the adsorption media. PG&E will	Comment resolved pending review of the 90%.			Comment resolved.	90% BOD Section 3.3.3.4. O&M Manual Volume 3.

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		Technology Selection/Ongoing Bench Scale Testing, Page 3-37	testing; AA works similarly to ion exchange by exchanging hydroxide ions with arsenic and fluoride on the surface of an adsorptive media.	utilized for treat arsenic alone. This important issue must be addressed as it is less likely that fluoride treatment will be needed. Other reasonable methods for treating arsenic only should be considered and, if appropriate, additional detailed designs should be prepared. Minimizing building footprint and waste volumes are logical criteria to assess the treatment technologies for this site. At a minimum, an arsenic only treatment system should be carried forward into final design as a contingency measure even if the State Board does not require treatment. This will minimize lengthy delay to the cleanup should treatment become necessary in the future.	include a freshwater pre-injection treatment for arsenic only in the 90% and final designs as a contingency.					
178	DTSC-69	Section 3.3.3.3, Ongoing bench scale testing, p.3-37 to 38	As discussed at the January 16, 2013 CWG and January 17, 2013 TWG meetings, the bench scale test is being conducted using HNWR-1 water at an offsite laboratory, CH2M HILL's Applied Science Laboratory… The bench scale testing is currently ongoing to verify the effectiveness of various optimization techniques to better under [stand] waste quantity/ quality, reduce waste generation, and chemical use (see below for additional details).	When will these bench scale tests be complete and results shared with stakeholders? What parameters and testing methods are being employed as part of these tests? Where is the test proposal or work plan? PG&E should disclose these tests being conducted as part of the remedy evaluation.	A summary of the test plan was included in the 60% design, Section 4 of Appendix M (Freshwater Pre-Injection Treatment System Design Basis Tech Memo). The bench scale tests are now complete. See attached technical memorandum that summarizes the bench scale test results for arsenic only treatment and the design basis for a corresponding FWPTS. For clarity in the 90% BOD, the attached memo (see **Attachment F** at the end of this table) will replace the As-F memo previously presented in Appendix M of the 60% BOD.	Comment resolved pending review of the new Appendix M submittal/90% design.			Comment resolved.	90% BOD Appendix M.

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179	DOI-76	Section 3.3.3.3, Page 3-38, Process Description		Please add a discussion of solids management (expected quantities, characteristics, handling, and disposition) to the section. Also, add information regarding solids management to Exhibits 3.3-5 and 3.3-6.	A discussion of solids management will be added to this section in the 90% BOD. As stated in response to comment #176 DTSC-67, Section 3.3.3.3 text in the 90% BOD will be revised to reflect an arsenic only treatment design as a contingency.		Resolved pending review of the 90% design.		Comment resolved.	90% BOD Section 3.3.3.4, last paragraph, last sentence. O&M Manual Volume 3, Appendix B, Section 5.2 (page 5, Wastewater and Solid Waste Generation).
180	DOI-77	Section 3.3.3.3, Page 3-38, Process Description	"This information will provide further clarification on the waste quantities and qualities . . . "	The chance of using the option to reinject regeneration wastewater into the IRZ seems remote, since it will contain elevated arsenic, fluoride, and salts relative to the untreated freshwater. Suggest deleting this option.	As directed by DTSC, PG&E will design an arsenic only freshwater pre-injection treatment system and this will be included in the 90% design as a contingency. Based on bench scale testing, PG&E proposes granular ferric hydroxide (GFH) as the adsorption media. This media is disposable and does not require regeneration. The cited text will be revised as follows in the 90% BOD: "<u>The majority (approx. 95%) of the backwash water generated will be recycled in the freshwater pre-injection treatment system leaving only about five percent of the backwash stream needing to be managed (this stream is not expected to have elevated As concentrations). The management options for backwash water include reuse in the cooling towers, discharge to the evaporation ponds, and/or truck to off-site permitted disposal facilities.</u>"		Comment resolved.		Comment resolved.	90% BOD Exhibit 3.4-3 (Footnote).
181	DTSC-70	3.3.3.3/3-38	Process Description	The proposed use of wastewater in the cooling tower or reinjection in the in situ reactive zone wells may present challenges in obtaining the quantity and quality diverted. Please provide specific water quality parameters required and viability for the proposed reuse of each said reuse.	Regarding water quality parameters required for reuse of wastewater in the cooling towers, NALCO (PG&E's current contractor for cooling tower chemistry) will review and sign off on any influent water prior to its use in the cooling towers. The Topock remediation team has and will continue to engage NALCO in the proposed reuse of conditioned remedy-produced water in the TCS cooling towers. At this time, this reuse option remains viable and will be carried forward into the 90% design. Regarding water quality parameters required for reinjection into the IRZ wells, PG&E understands that the comment pertains to requirements for protection of the IRZ wells from fouling. To that end, PG&E prepared a technical memorandum titled "Summary of IRZ Well Fouling at	DTSC understands that the water quality acceptable for use at the cooling towers rests solely upon PG&E and to some extent the RWQCB for the discharge water to the existing ponds. DTSC's objective is to ensure the protection of the water basin receiving the reused wastewater and that PG&E is operating in a manner that would safeguard the future use of the beneficial use aquifer. Although DTSC remains cautious due to injection well fouling issues experienced at Hinkley. DTSC will, however, withhold any further comments based on PG&E's assurance that they have thorough understanding of the chemistry associated with injection well design as			Comment resolved.	Not applicable

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					Hinkley as it Relates to Re-Injection of Remedy Produced Water into IRZ Injection Wells at Topock" (included in **Attachment P** at the end of this RTC table). This technical memorandum summarizes IRZ well fouling experience at Hinkley and confirms that based on operational information collected to date at Hinkley, the effluent water quality requirements specified for conditioned remedy produced water at Topock are adequate and are protective against fouling of IRZ wells (see Exhibit 3.4-5 of the 60% BOD). This will be confirmed during remedy operation by the proposed sampling program for the influent and effluent of the conditioning system (see Exhibit 5.3-2 of O&M Manual Volume 2, Sampling and Monitoring Program). With the proposed protections, reinjection of conditioned remedy-produced water into the IRZ wells continues to remain viable and will be carried forward into the 90% design.	well as pending complete review of the compliance monitoring plan to be submitted with the 90% design.				
182	DOI-78	Exhibit 3.3-5, Page 3-39		From the Compressor Station Freshwater Storage Tanks, what percent of the water will be used for Compressor Station Use and what percent of the water will be directed to the pre-treatment system?	See response to comment #168 DTSC-63. Exhibit 3.3-5 will be revised to separate the freshwater supply storage for the remedy and the Compressor Station.		Resolved pending review of the 90% design.		Comment resolved.	90% BOD Exhibit 3.3-4 (see Freshwater Storage Capacity).
183	DTSC-71	Exhibit 3.3-5	To IRZ Wells from Backwash Tanks	Under what circumstance and chemical conditions can the backwash water be used in the IRZ wells? Although the remedy is operating under the CERCLA exemption from Waste Discharge Requirements, DOI as the administrating agency of the exemption must understand the substantive requirements for injecting the waste water stream into the ground. DTSC recommends PG&E and DOI to consult with the RWQCB to identify and include in the report. Alternatively, PG&E should consider removing injection of backwash water into the IRZ as a waste water management option.	Exhibit 3.3-5 will be revised to reflect an arsenic only pre-injection treatment system. The arsenic removal process is highly efficient enabling a high recycling rate (about 95%) of the backwash water, therefore, the volume of wastewater needing to be managed will be minimal. This volume of wastewater can be accommodated using management options such as cooling towers, TCS evaporation ponds and/or offsite permitted facilities. Therefore, the option of injecting backwash water (from freshwater pre-injection treatment) into the IRZ will not be necessary and therefore, will be removed.	Comment resolved pending review of the 90%.			Comment resolved.	90% BOD Exhibit 3.4-3 (see Footnote).
184	DTSC-72	Exhibit 3.3-5/3-39	Pre-injection Treatment Process Schematic	Please introduce pre-treatment chemical after the filters to save on overall dosage quantity as well as filter longevity.	Injecting pre-treatment chemicals such as hypochlorite upstream of the filters offers two benefits – first, any solids formed during the	Okay.			Comment resolved.	Not applicable.

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					hypochlorite mixing will be captured by the filters and second, any bacterial growth on the filter cartridges will be prevented.					
185	DTSC-73	Exhibit 3.3-5/3-39	Pre-injection Treatment Process Schematic	Please introduce pre-treatment chemical after the filters to save on overall dosage quantity as well as filter longevity.	The comment appears to be identical to comment #184 DTSC-72. See response to comment #184 DTSC-72.	Okay.			Comment resolved.	Not applicable.
186	DTSC-74	Exhibit 3.3-6/3-40	Freshwater Pre-Injection Treatment Design Criteria	Please use the operation pH range from 6 as mentioned in Section 3.3.3.3 page 3-38 in the process description for consistency.	The freshwater pre-injection treatment design criteria will be revised to reflect an arsenic only treatment system. The proposed use of disposable granular ferric hydroxide (GFH) as the adsorption media for arsenic removal does not require media regeneration, therefore, it will not need a neutralization step. As stated in response to comment #176 DTSC-67, Section 3.3.3.3 text in the 90% BOD will be revised to reflect an arsenic only treatment design as a contingency.	Comment resolved pending review of the 90%.			Comment resolved.	90% BOD Section 3.3.3.4.
187	DOI-79	Section 3.3.3.4, Page 3-41		This section does not contain a discussion of the rationale for well placement and the absence of provisional wells. Please add this discussion.	A sentence will be added to indicate that the injection wells were located based on groundwater model results and site surveys to locate suitable sites for drilling.		Resolved pending review of the 90% design.		Comment resolved.	90% BOD Section 3.3.3.3, 2nd paragraph, 1st sentence.
188	DOI-80	Section 3.3.3.4, Page 3-41	"Injection wells invariably lose capacity over time."	Please mention the likelihood of adding additional injection wells to increase capacity based on the IM-3 experience.	After the most recent (June 2013) well rehabilitation work, the IM-3 injection wells have been operating near their original capacity. At this time, after almost 7 years of operation, the IM-3 injection wells have not required replacement. The water from IM-3 passes through a micro-filter and is almost completely free from suspended solids. Water to be injected into the FW and IRL wells during the final remedy will not be filtered. In addition, it is likely that bio-fouling will be a factor in the IRL wells where carbon may be added. Since the final remedy injection wells will be receiving water from a different source than the IM-3 injection wells, it is not appropriate to make projections based on IM-3 experience alone.	Okay. DTSC, however, understands that currently there are injection well fouling issues at Hinkley and would like PG&E to consider the lessons learned from similar operations and ensure appropriate responses are in place during O&M at Topock.	Comment resolved.		Comment resolved.	Not applicable
189	DTSC-75	3.3.3.4 Freshwater Injection Wells, Page 3-41	Injection of fresh water extracted from Arizona into	Revise the sentence to also indicate that fresh water injection is required to ensure hydraulic control so that the chromium plume will not migrate	The sentence will be revised to read "Injection of fresh water extracted from Arizona into the wells is planned to be continuous to aid in	Okay.			Comment resolved.	90% BOD Section 3.3.3.3, 1st paragraph, 1st sentence. 90% BOD Apdx B Section 6.4.7

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			the wells is planned to be continuous to aid in reducing the time to cleanup.	beyond identified plume boundaries.	reducing the time to cleanup and provide hydraulic control to prevent migration of the chromium plume beyond identified plume boundaries."					
190	DTSC-76	3.3.3.4 Freshwater Injection Wells, Page 3-41	The anticipated nominal injection flow rate per well ranges from 50 to 100 gpm, and the anticipated maximum flow rate is 100 to 200 gpm per well.	The section should clarify that freshwater is also being proposed to be injected at wells IRL-3 and 4 at a total of nominal flow rate of 300gpm.	PG&E suggests adding a reference to Exhibit 3.3-4 (pages 3-34 and 3-35) at the end of this sentence, rather than spelling out information for IRL-3 and IRL-4 only.	Okay.			Comment resolved.	90% BOD Exhibit 3.3-4 (Footnote a).
191	DTSC-77	3.3.3.4 Freshwater Injection Wells, Page 3-41	If the step testing indicates that the capacity of any injection well is less than three times the design flow rate, consideration will be given to installation of an additional well to ensure that sufficient injection capacity is available for the life of the remedy.	Consideration must also be given to installation of a new well should unexpected contamination be discovered. The potential for this to occur increases where characterization efforts are minimal. For instance, the FW-2 area is not as well characterized as the FW-1 area and might intersect the chromium plume. This issue also applies to other areas and the remedy document must account for these contingent wells. Conversely, wells targeting contamination may come up clean or low yield and need to be drilled in a new location to more efficiently extract contaminants.	Concur. There are numerous factors that will only become known after drilling and testing could affect the need for additional wells or the design of a well. The 90% design will contain a section describing an adaptive approach to well installation which will take into account the various factors that could cause a change in the number of design of wells as they are being installed and provide a process for decision making during the well installation phase.	PG&E should not be waiting to the 90% design to describe such an integral part of the evaluation for remedy design. DTSC will reserve our review of the adaptive approach when it is presented.			Noted.	Construction/ Remedial Action Work Plan, Section 3.1. 90% BOD, Section 3.6.3.
192	DTSC-78	3.3.3.4/3-41	Freshwater Injection wells	Please provide the rationale and basis for the requirement of one third the design flow for injection well replacement. It is recommended that empirical data as well as modeling may help to adequately ascertain the full hydraulic control of each well and the need for replacement.	PG&E suggested that, as a rule of thumb, new injection locations should have a sufficient number of wells to provide about 3 times the design capacity to provide adequate contingency for future decreases in injection flow (see response to comment #164 DOI-69). Because it is not known how much capacity will be lost over time, particularly in the IRL wells that may be subject to bio-fouling or fouling by iron and manganese from the floodplain, modeling would not be useful in establishing a threshold for excess capacity. The trade-off for not providing sufficient excess injection	What if the replacement well also does not exhibit 3 times the proposed capacity, will PG&E move to another well location? When will this stop? Comment resolved.			Comment resolved.	Not applicable.

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					capacity during initial construction is the need for future downtime and intrusion to install new injection wells when existing wells are no longer able to provide sufficient capacity. PG&E believes a factor of three times the design flow is a comfortable margin of safety, however a smaller margin could probably be tolerated so long as there is recognition that it entails more likelihood of remedy down time and well installation in the future.					
193	DOI-81	Section 3.3.3.4, Page 3-42	"Well vaults will be equipped with removable covers . . . "	How many workers are required to remove a cover? Does it make since to use spring-loaded doors on the well vaults?	PG&E plans to have spring-assist lids on well and valve vaults. This feature will be shown in the 90% design.		Comment resolved pending review of 90% design.		Comment resolved.	90% BOD Appendix E, Specification Section 05 50 00 - Metal Fabrications, Part 2.15, Vault Access Doors and Hatches.
194a	FMIT-28	Section 3.3.3.4	*Freshwater injection wells "During flow rate and capacity testing, injection wells need significantly greater actual capacity than design capacity. If well has low capacity, another well will be drilled to obtain greater capacity."*	What is the limit on this iterative approach? Could the result be too many large boreholes and greater destruction of	Please note that the reference text is incorrectly quoted in this comment. Section 3.3.3.4 states: "Injection wells invariably lose capacity over time. In order to last for the life of the remedial action, it will be necessary for the injection wells to have initial capacity significant greater than their design flow rates. If the step testing indicates that the capacity of any injection well is less than three times the design flow rate, consideration will be given to installation of an additional well to ensure that sufficient injection capacity is available for the life of the remedy." PG&E proposes that as a rule of thumb, initial injection capacity at each FW or IRL location should be approximately three times the design flow rate for that location. Any additional wells needed to achieve this capacity would be installed in the same area as the primary well. Well drilling at any one area would only continue until this target of three times the design capacity was reached. There is also a possibility that the design flow rates for individual well locations could be adjusted to allow for somewhat more injection in the higher permeability locations and somewhat less injection in the lower permeability locations.			Comment resolved pending review of 90% design.	Comment resolved.	Not applicable.

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				the sacred landscape?	PG&E's consideration of installation of additional wells will be conducted consistent with the PA, CHPMP, CIMP, and the cultural resource mitigation measures in the EIR, including but not limited to the requirements that new facilities be placed in areas already disturbed by previous grading and other mechanized activities to the extent practicable (PA, § III(B)(2)(c), EIR Mitigation Measure CUL-1a-9), that existing monitoring wells and related facilities shall be used to the maximum extent practicable (PA, § III(B)(2)(a)) and that PG&E shall, to the extent practicable, restore the areas affected by the Topock Remediation Project. (PA, §§ III(B)(3)(c),V, EIR Mitigation Measure CUL-1a-8(e)).					
194b	Hualapai-21 Chemehuevi-21 Cocopah-21 CRIT-21	Section 3.3.3.4	*Freshwater injection wells "During flow rate and capacity testing, injection wells need significantly greater actual capacity than design capacity. If well has low capacity, another well will be drilled to obtain greater capacity."*	What is the limit on this iterative approach? Could the result be too many large boreholes and greater destruction of the sacred landscape? Please explain the relevance of the cap on the number of wells and how that relates to abandonment of such underperforming wells under this scenario.	See response to comment #194a FMIT-28. The cap on number of wells was established in the EIR, in recognition of tribal sensitivity to activities that involved drilling or digging in the earth. If a well can be replaced in the original borehole, it does not increase the well count. Unless the new well encountered different geologic conditions and/or has significantly smaller capacity than the well it replaced, there would be no net change in the number of wells. If the new well has significantly smaller capacity, it may be necessary to replace an existing well with two wells under. In this case, each of these additional wells at each location would add to the well count. Clarify in the BOD text and indicate in the figure legend that there may be more than one well installed at the FW or IRL well locations initially to ensure sufficient capacity.			Comment resolved pending review of 90% design.	Comment resolved.	Not applicable.

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195	FMIT-29 Hualapai-22 Chemehuevi-22 Cocopah-22 CRIT-22	Section 3.4 p. 3-42 to 3-49	Remedy produced water management	This section does not discuss how well development water will be handled.	Section 3.4.2.1/Exhibit 3.4-3 (page 3-45) and Figure 3.4-1 discuss management options for well development water (wastewater from construction of wells). The identified options included IRZ injection wells, TCS ponds, and trucking offsite. For construction of the initial wells (prior to having the IRZ wells and the remedy produced water condition plant in place), the management options will also include re-injection into the aquifer where the well is drilled and processing at the IM3 treatment plant (after characterization). Text will be added to the 90% BOD.			Comment resolved pending review of the 90% design.	Comment resolved.	90% BOD Exhibit 3.4-3 (last row, Other water – wastewater from construction of wells in the future). O&M Manual Volume 1 Section 6.1.
196	DOI-82	Exhibit 3.4-1, Page 3-42		Regeneration and media bed rinse water from freshwater treatment should be included in the table, and throughout this section.	Comment noted. Since the arsenic treatment system is only intended as a contingency in the 90% design, PG&E proposes to add the requested info (i.e., potential additional volume of remedy-produced water if the contingency were to be implemented) in a footnote rather than in the body of Exhibit 3.4-1. Text will also be updated to reflect the arsenic treatment system only.		Comment resolved.		Comment resolved.	90% BOD Exhibit 3.4-1 (Footnote).
197	DTSC-79	3.4 Remedy-produced Water Management, Page 3-42	These maintenance activities will produce an ongoing water stream that must be managed as part of the remedial action.	For clarity, change “water” in the cited sentence to “waste” (a few other occurrences were noted in the document as well). It is recognized that some waste streams may be reutilized. The usage would be consistent with other sections.	The text will be changed as requested.	Okay.			Comment resolved.	90% BOD Section 3.4.
198	DOI-83	Section 3.4.1, Page 3-43	“Because the characteristics of the rehabilitation wastewater may not be known until it is pumped back out of the well, . . . “	What are the water quality criteria for pumping rehabilitation water to the Water Conditioning Plant?	The following text will be added to this section: “If pumped through the pipelines over long distance, solids could cause obstructions to form in the pipe or accumulate at low points. For this reason, it is better to remove solids closer to the point of generation.”		Comment resolved.		Comment resolved.	90% BOD Section 3.4.1 (3rd paragraph).
199	DOI-84	Section 3.4.2, Page 3-43	“The most efficient way to return the remedy-produced	Delete Carbon-amended Injection Wells for consistency with Exhibit 3.4-2, Item 4 – Reuse by blending with carbon-amended water and injection into the IRZ wells.	Suggested change to text will be made.		Comment resolved.		Comment resolved.	90% BOD Section 3.4.2 (Item #4).

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			water to the aquifer is through the network of NTH IRZ and Carbon-amended Injection Wells associated with the remedial action."							
200	DOI-85	Section 3.4.2, Page 3-43	"The following four reuse/disposal options are carried forward in the design: . . . "	Instead of trucking water off- site, is it possible to re-use the water for vegetation watering?	There is very little vegetation at the compressor station site that needs watering and there are no other irrigation needs nearby. PG&E does not consider it to be practical to use a periodically-generated water source (such as the water designated for off-site disposal) to meet the site irrigation needs.		Resolved.		Comment resolved.	Not applicable
201	DOI-86	Section 3.4.2, Page 3-43, 4th bullet	"Reuse by blending with other water . . . "	Bullet 4 should read like Exhibit 3.4-2 Item 4 – Reuse by blending with carbon-amended water and injection into the IRZ wells. Blending with (unconditioned?) backwash water or second flush well rehab water seems incorrect.	Suggested changes to the text will be made.		Comment resolved.		Comment resolved.	90% BOD Section 3.4.2.
202	DTSC-80	3.4.1 Transportation, Page 3-43	The wastewater pipelines will be installed in the same utility corridors for other remedy piping to service the wells as shown on Figure 3.0-1.	Indicate and reference sections describing the type of pipelines that will be utilized (e.g., double lined) to transfer the waste streams within the utility corridors.	A reference to Appendix C (Design Criteria), Section C.5.1 (Piping) will be added to the text. Section C.5.1 describes the type of pipelines included in the design (e.g., piping materials, single-walled/ double-walled pipes, leak detection methods).	Okay			Comment resolved.	90% BOD Section 3.4.1 (2nd paragraph).
203	DTSC-81	3.4.2/3-43	Reuse/Disposal Options	The proposed use of wastewater in the cooling tower or reinjection in the in situ reactive zone wells may present challenges in obtaining the quantity and quality diverted. Please provide specific water quality parameters required and viability for the proposed reuse of each said reuse.	See response to comment #181 DTSC-70.	Noted, see response to #181.			Comment resolved.	Not applicable
204	DOI-87	Exhibit 3.4-2, Page 3-44	Discharge to TCS evaporation ponds	Given the potential for higher concentrations of some constituents from the regeneration and bed-rinsing, including arsenic and fluoride, consideration should be given to examining discharge levels yielding	PG&E understands DOI's comment to ask about the wastewater stream from the freshwater pre-injection treatment system included in the 60% BOD, in compliance with DTSC's prior directive to include a pre-		Comment resolved pending review of the 90% design.		Comment resolved.	90% BOD Exhibit 3.4-2 (Item #2).

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				potential harmful effects to migratory birds accessing the ponds. Concerns could be reduced through the installation of netting over the ponds, sonic bird repellents or other deterrent. Please discuss the preferred alternative with the agencies prior to choosing a design.	treatment system to polish Arizona groundwater to California standards prior to injection. Since the 60% BOD, the State Board has issued a decision letter and DTSC has provided direction based on that letter that the design criteria for potential future pre-treatment of freshwater at Topock will be limited to arsenic removal only and will be included only as a contingency. The arsenic-only removal process is less complex than arsenic and fluoride removal process, and thus discharge of wastewater containing elevated levels of arsenic and fluoride to the evaporation ponds will not be necessary. Once the remedy is operational, evaluation of concentrations of constituents discharged to the ponds from other remedy wastewater streams and appropriate measures to protect migratory birds, if needed, will be conducted, in cooperation with the agencies. Text will be added to the 90% design to summarize the evaluation of discharge to the ponds.					
205	DTSC-82	Exhibit 3.4-2/3-44	Reuse/Disposal Options and Associated Degree of Conditioning Required	Please use the operation pH range from 6 as mentioned in Section 3.3.3.3 page 3-38 in the process description for consistency. Revise all occurrences of pH range discussion in document.	The text on page 3-38 will be revised to have a pH value of 6.5 in the neutralization step in order to meet the effluent water quality requirements listed on Exhibit 3.3-6 (including pH of 6.5-8.5). No other changes are proposed.	Okay.			Comment resolved.	90% BOD Section 3.3.3.4, Process Description, 2nd sentence.
206	DTSC-83	3.4.2 Reuse/ Disposal Options and Conditioning, Page 3-44	The degree of conditioning needed is a function of how the remedy-produced water will be reused or disposed of, and the discharge requirements that are imposed.	This section should briefly discuss and reference the location of various inject for the remedy.	The following text will be added at the end of the cited text in the 90% BOD: "(see Exhibit 3.4-2, the column titled Conditioning Requirements)". Text on page 3-46, first bullet section 3.4.2.2, will be clarified to make the separation between first flush rehab water and second flush rehab water clearer,	Response sufficient. However, the comment was referring to measureable discharge limits (parameters/acceptance criteria) in general. See comment #181 on water quality limits.			Comment resolved pending review of the 90% Design. See comment #181.	90% BOD Section 3.4.2, 4th paragraph, 1st sentence. 90% BOD Section 3.4.2.2, Conditioning, 2nd paragraph, 1st bullet.

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207	DTSC-84	3.4.2 Reuse/Disposal Options and Conditioning, Page 3-44	Exhibit 3.4-2 2. Discharge to TCS evaporation ponds Produced water must not be hazardous, If the pH is less than or equal to 2.0 (characteristic waste level), the water could not be disposed of in the TCS ponds.	Are there any other limitations related to discharge to the evaporation ponds (e.g., Are existing pond liners and pipelines compatible with all potential waste streams)? Shouldn't the existing design/as-built of this option, and discharge specifications of this and any other existing options, be provided in the document?	Yes, the design criteria (Appendix C) for the groundwater remedy also applies here (e.g., piping compatibility with conveying fluids in Section C.5.1). The regulatory framework for the disposal of remedy-produced water in the TCS evaporation ponds will be included in the 90% design (see also response to comment #623 DTSC-187).	Okay pending review of 90%.			Comment resolved.	90% BOD Exhibit 3.4-2 (Item #2).
208	DTSC-85	3.4.2 Reuse/Disposal Options and Conditioning, Page 3-44.	These options include the Infiltration Gallery in Bat Cave Wash which is retained until the completion of the Soil RFI/RI and CMS/FS and the Moabi Regional Park sewage ponds which is under evaluation.	If not dropped from the design, it would seem that both proposals would need to be fully developed immediately - not after the 90% design.	As stated in response to comment #72a FMIT-21, the infiltration gallery in Bat Cave Wash is not being further evaluated at this time. If PG&E proposes to evaluate this option further in the future, PG&E will discuss the option with agencies and Tribes at that time. This also applies to the Moabi Regional Park sewage ponds option. The referenced text will be revised as follows (inserted verbiage is shown in underline typeface, deleted verbiage is shown in ~~strikethrough~~ typeface): "Two reuse/disposal options for remedy-produced water previously considered are not being further evaluated in the remedy design. ~~retained for further evaluation and are not dropped from consideration as part of the remedy design,~~ These options include the Infiltration Gallery in Bat Cave Wash ~~which is retained until the completion of the Soil RFI/RI and CMS/FS~~ and the Moabi Regional Park sewage ponds ~~which is under evaluation~~. If PG&E proposes to evaluate this option further in the future, PG&E will discuss the option with agencies and Tribes at that time."	Comment resolved. DTSC has not considered these options as part of CEQA assessment. Should PG&E consider them in the future, additional assessment will be required.			Comment resolved.	90% BOD Exhibit 3.4-2 (Footnote).
209	DOI-88	Exhibit 3.4-3, Page 3-45		Discharge from media regeneration/ back wash tanks identified in Section 3.3.3.3 of the freshwater treatment system should be included as a potential source of remedy-produced	Comment noted. Since the arsenic treatment system is only intended as a contingency in the 90% design, PG&E proposes to add the requested info (i.e., potential source of remedy-		Comment resolved.		Comment resolved.	90% BOD Exhibit 3.4-3 (Footnote). O&M Manual Volume 1 Section 6.1.

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				water and produced water management considerations in this section.	produced water if the contingency were to be implemented and associated management options) in a footnote to, rather than in the body of Exhibit 3.4-3.					
210	DOI-89	Exhibit 3.4-3, Page 3-45	Well rehabilitation (all wells) – first flush	Why would this water need to be neutralized and/or filtered to send to the conditioning plant when these are two functions of the conditioning plant? If it is corrosion of the cement mortar-lined pipe, are there alternative pipe materials that can be used so that trucking is used only as a backup?	If pumped through the pipelines over long distance, solids could cause obstructions to form in the pipe or accumulate at low points. For this reason, it is better to remove solids closer to the point of generation.		Comment resolved.		Comment resolved.	Not applicable
211	DTSC-86	3.4.2.1 Management Plan Page 3-45.	Exhibit 3.4-3 3. If first flush water is neutralized in the field and/or filtered with a transportable treatment unit, send water to Remedy-produced Water Conditioning Plant for processing and re-inject into IRZ injection wells.	It is unclear if first flush water <u>will or might be</u> neutralized in the field. Will it always be field neutralized if pH is less than 2 as indicted in Figure 3.4-2. Please clarify in the text and revise Figure 3.4-2 as necessary.	First flush water will be neutralized in the field as shown in Figure 3.4-2. The reference text in Exhibit 3.4-3 will be revised to state: "~~If first flush water is~~ <u>Field neutralization</u> ~~ed in the field~~ and/or <u>field</u> filtered with a transportable treatment unit and then <u>convey</u> ~~send~~ water to the Remedy-produced Water Conditioning Plant for processing and re-inject into IRZ injection wells".	Comment resolved.			Comment resolved.	90% BOD Exhibit 3.4-3 (Item #3). O&M Manual Volume 1 Section 6.1
212	DOI-90	Section 3.4.2.2, Page 3-46, 1st bullet	"If first flush water is neutralized in the field and/or filtered with a transportable treatment unit at the well head, the water may be sent to the Remedy-produced Water Conditioning Plant for processing prior to reinjection into the IRZ injection wells."	Further treatment of first flush rehabilitation water, whether filtered or pH-adjusted, in the Water Conditioning Plant and eventual reuse is not recommended because of the potential presence of high concentrations of dissolved chromate, byproducts and oxidants.	This method is appropriate because some arsenic will be removed through filtration/ neutralization and any remaining dissolved arsenic will be similar in concentration to the reduced environment within the IRZ. Any soluble Cr(VI) that remains will be immobilized by the IRZ.		Comment resolved.		Comment resolved.	Not applicable

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213	DTSC-87	3.4.2.2 Conditioning Page 3-46.	Under the management plan presented above, removal of dissolved constituents will not be required because the injected water quality will be similar to the aquifer water quality in/near the IRZ Injection Wells.	Treated injection water quality must be monitored at some level to ensure appropriate water quality is being injected into the aquifer. This paragraph should briefly discuss monitoring of the treated water and refer the reader to an appropriate monitoring section.	As discussed in Section 1.3 of the BOD (Organization and Content of BOD), this section of the BOD is intended to discuss the design basis and assumptions/ considerations (e.g., number/locations of wells, design flow rates), while Volume 2 of the O&M Manual is intended to address proposed sampling and monitoring during implementation (e.g., sampling frequency/ analytes). For clarity, it is recommended that a sentence be added at the very beginning of Section 3 to refer the reader to Volume 2 of the O&M Manual for sampling/monitoring details, instead of in the subsections.	Comment resolved.			Comment resolved.	90% BOD Section 3, Intro, 3rd paragraph.
214	DTSC-88	Section 3.4.2.2, p.3-46	In the event that the produced water is hazardous, permitted transportable treatment units could be used.	Since PG&E asserts that the proposed cleanup is conducted under the CERCLA permit exemption, this may not apply. However, substantive requirements for such operation would be required, such as record keeping, maximum air quality emission limitations, secondary containment, etc. PG&E should specify these applicable requirements.	Treatment could potentially be performed using a treatment unit operated exclusively at the Topock site, in which case the substantive requirements for a fixed treatment unit (FTU) operating under the Conditional Authorization (CA) permit tier would apply, or a transportable treatment unit (TTU) authorized to operate at multiple sites, in which case the substantive requirements for a transportable treatment unit (TTU) operating under the Permit By Rule (PBR) tier would apply. FTUs operating under CA must comply with all applicable requirements for hazardous waste generators. If treatment occurs in containers, all containers must have secondary containment, be in good condition, managed to prevent leaks, remain closed except when adding or removing waste, and meet hazardous waste labeling requirements. Hazardous waste containers must be inspected weekly. If treatment occurs in tanks the tanks must be equipped with secondary containment and overfill protection and must be labeled as containing hazardous waste. Hazardous waste tanks must be inspected daily and must undergo an integrity assessment by a California-licensed professional engineer (PE). The treatment unit must have written operating instructions and maintain a record of the dates,	Comment resolved pending review of SOPs in the 90% design.			Comment resolved.	Not applicable.

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					concentrations, amounts, and types of waste treated, as well as a written inspection schedule and inspection log. FTUs operating under CA must also maintain a written closure cost estimate and must maintain a financial assurance mechanism if the closure cost estimate exceeds $10,000. Adequate security must be provided. A TTU operating under PBR must meet the following additional requirements in addition to those applicable to the CA tier. Additional records must be maintained, including a written waste analysis plan. Closure must occur pursuant to a written closure plan, and completion of closure must be certified by a California-registered PE.					
215	DTSC-89	Section 3.4.2.2, p.3-46, 1st bullet	The cutover from “early” stage to “later” stage is proposed to be defined through easily measured onsite water quality tests such as pH, turbidity, and conductivity.	This set of identified analysts is too limiting to ensure that it complies with substantive requirements for waste water injection. DTSC is unsure of the regulatory constraints associated with reinjection of waste, even if it is into the same contaminated zone. PG&E should conduct this analysis In the design and specify to reader and agencies for clarity and implementation.	This set of parameters is only intended for use in the field to differentiate between the dirtier (first flush) and the cleaner (second flush) water during well rehab events. As described in Section 4.2.2.3.5 of the O&M Manual Volume 1 (page 4-19), during well rehab events, turbid and/or discolored water (first flush) will be removed from the well until the water becomes clear and the well is relatively clean. All first flush water will be contained in temporary, portable tanks, tested, and managed in accordance the updated Figure 3.4-2 of the 60% BOD and Figure 6.1-2 of the O&M Manual Volume 1 (in response to comment #619 DOI-250). As for reinjection of remedy-produced water back into treatment zone, please see response to comment #181 DTSC-70.	Comment resolved pending review of the 90%. See response to comment #181			Comment resolved.	O&M Manual Volume 1 Section 4.2.2.3.5 (page 4-18) and Figure 6.1-2. 90% BOD Figure 3.4-2.

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216	DTSC-90	Section, 3.4.2.2, p.3-46, last paragraph	Furthermore, contaminant migration to the river that could potentially affect water quality goals or beneficial uses does not occur during remedy implementatio n through groundwater extraction along the river bank.	This would only be true if there is full hydraulic capture of the water flow towards Arizona and the river, and that the remedy as proposed will not send mobilized by products through the IRZ. DTSC requests PG&E to include particle tracking for evaluation as part of the remedy design. Much of the conceptual remedy has changed since the CMS/FS, including elimination of the northern freshwater injection point, and changes in well locations. PG&E should use the particle tracking model to visually demonstrate the resulting flow lines for evaluation of the remedy's ability for hydraulic capture and verify the model through actual sampling during operation.	See response and resolution to comment #646 DTSC-197 regarding particle tracking. Figures for each layer were prepared and submitted to DTSC for review.	DTSC may still consider the evaluation of particle tracking for the future..			Flow field figures for Layers 1-4 were submitted to DTSC and DOI on December 30, 2013 (see **Attachment E**, at the end of this table). Per DTSC request, particle track figures for Layers 1-4 were submitted to DTSC on March 11, 2014 (see **Attachment R** at the end of this table). Particle tracking figures will continue to be included in the 90% Design document. Comment resolved.	90% BOD Section 3.1, Figures 3.1-1 through 3.1-7 90% BOD Appendix B, Figures 6.5-13 through 6.5-20
217	DTSC-91	Exhibit 3.4-4/3-47	Remedy-Produced Water Conditioning Process Schematic	Please provide the disposition of the water obtained as the result of the dewatering process.	The exhibit will be updated to show the water will be returned to the influent tanks for re-processing.	Okay.			Comment resolved.	90% BOD Exhibit 3.4-4. O&M Manual Volume 1 Section 2.3.
218	DTSC-92	3.4.2.2 Conditioning Page 3-48.	Exhibit 3.4-5 Influent solids loading Typical: 60 mg/L total suspended solids Estimated value consistent with Hinkley results.	With the higher TDS encountered at Topock, is it appropriate to always utilize Hinkley results? Should the suspended solids estimate be modified?	It is assumed that this comment addresses TSS, and not TDS. As discussed in Appendix F (pages F-7 to F-10), PG&E conducted a test at Hinkley to evaluate the effectiveness of regular backwashing on an IRZ well. At Topock, the IM-3 injection wells also undergo regular backwash. From a design standpoint, although Hinkley data does not reflect Topock specific conditions, it does show how the IRZ well performs with regular backwashing. Using IRZ backwash data for a design basis is more conservative and appropriate as it contains more suspended solids than IM-3 backwash. In addition, the IRZ backwash water also contains biomass.	Okay.			Comment resolved.	Not applicable
219	DOI-91	Section 3.5.1, Pages 3-49 and 3-50	"Secondary power supply will be power generated from small photovoltaic solar panels . . . "	The text refers to the placement of small photovoltaic solar panels at selected remote sites. Are these sites identified in the 60% Design or will they be identified in the 90% Design? Will solar panels encourage vandalism? Consider appropriate theft-prevention devices (locks, etc.) as necessary to ensure continued function of the secondary power supply.	These small solar panels will be identified in the 90% design. Theft-prevention devices and techniques commonly employed for remote sites will be considered and included as appropriate.		Comment resolved pending review of 90% design.		Comment resolved.	90% BOD Appendix D, Drawing E-16-01.

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220	DOI-92	Section 3.5.2, Page 3-50		What safety operational alarms will be incorporated into the SCADA that will automatically notify personnel and shut down equipment/systems/operations as required?	At the 60% design stage, precise alarms and control logic have not been fully defined. Examples of safety alarm conditions that would shut down equipment/systems include, but not limited to the following: a) A high level condition in the ethanol storage tank causes an alarm that notifies the operator and tanker to discontinue filling the tank. As a precautionary safety measure, this condition will shutdown the carbon substrate hose pumps and close the downstream flow control valves. b) A high level alarm in the secondary containment pipe downstream of the ethanol tank would shut down the ethanol hose pumps and valves if a leak is detected, indicating a loss of ethanol from the primary pipe. c) A high level in an influent storage tank at the remedy-produced water tank farm causes an alarm that closes the upstream control valve to prevent overfilling. d) A level switch being triggered in any secondary containment (e.g., well or meter vault) would shut down any pumps and close valves associated with that pipeline in an attempt to isolate that portion of piping. An exhibit or table will be added to the O&M Manual, Volume 1 to list the alarm conditions.		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Volume 1, Table 3.1-1 (Control Set Points and Approaches).
221	DTSC-95	Section 3.5.1, Electrical Power Supply and Distribution, p.3-50		Please note that the December 31, 2011 remedy decision letter from DTSC to PG&E states in condition 2 that PG&E shall obtain a 320 kW generator for the purpose of providing backup electricity at the site for remedy implementation. PG&E should include this condition into the design document.	PG&E will include a generator that meets the condition of approval in DTSC's January 31, 2011 remedy approval letter, in the 90% BOD. The generator will be located on PG&E parcel. The generator will be described in text and shown on maps.	Resolved. DTSC will review the complete electrical system as part of the 90% design.			Comment resolved.	90% BOD Section 3.5.1 and Figure 3.5-1.
222	DTSC-96	Section 3.5.3, p.3-52, rationale 3.	To accommodate the shared use of this bench by the Topock remediation project and Transwestern,	Please reference 3.5-9 in text for this new access road.	A reference to Figure 3.5-9 will be added as requested.	Okay.			Comment resolved.	90% BOD Section 3.5.3.

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			a new access road will be built east of the bench to allow for access to Transwestern's gas transmission equipment.							
223	DTSC-97	3.5.5 Access Roads and Pathways, Page 3-54	Figure 3.5-9	Access routes to every monitoring device (e.g., monitoring wells) will need to be identified. At a minimum, these devices will need to be decommissioned as part of the project.	Comment noted. Figure 3.5-9 presents the access routes to remedy features proposed in the 60% design. This figure will be updated to reflect changes between the 60% and 90% design.	Okay pending review of 90%.			Comment resolved.	90% BOD Section 3.5.5 90% BOD Figures 3.5-9A and 3.5-9B
224	DOI-93	Section 3.6.1, Page 3-55	Borehole Quality Constraints	The in-text citation for DTSC 2011d is not listed in the Reference section.	The in-text citation for DTSC 2011d is listed in the Reference section, please see the 6th reference under California Department of Toxic Substances Control (DTSC).		Comment resolved.		Comment resolved.	Not applicable
225	DTSC-98	3.6 Monitoring Well Design, Page 3-55	However, the details included in this table are estimated and will likely change as additional data are collected during construction.	Due to acknowledged uncertainties when installing new wells, contingencies should be made for additional monitoring wells. It is just too difficult to forecast future needs without the data in hand. Additional DTSC comments regarding the number of monitoring wells are identified in Appendix L.	PG&E recognizes the uncertainty associated with installing new wells. Information will be gathered throughout the remedy lifetime as new wells are installed and the remedy is optimized. This information will be used further refine understanding of the hydrogeology and contaminant distribution. PG&E acknowledges that additional monitoring wells may be necessary based on new information as it becomes available. Buffer has been built into the monitoring network design to allow for this contingency, while respecting cultural sensitivities and the EIR 60 borehole limit.	Comment resolved pending review of the 90% design. See also response to comment #632 DTSC-190.			Comment resolved.	Not applicable
226	DTSC-99	3.6 Monitoring Well Design, Paragraph 2, Page 3-55		In addition to a table, this section should include a figure illustrating where the monitoring wells are located in map view. Suggest easy read format similar to Figure 3.1-1.	A figure will be added as requested in the 90% BOD.	Comment resolved pending review of the 90%.			Comment resolved.	90% BOD Section 3.6.
227	DTSC-100	3.6.1 Key Variables and Well Design Considerations, Page 3-55	Depth-specific samples and continuous core collected during drilling have been useful at the Topock site when designing monitoring	The underlined last sentence will need to be modified as utilizing depth specific data as well as continuous core can also be mandatory for establishing remedial wells. Please revise to capture both aspects of this issue.	The two referenced sentences will be deleted from the text. The 90% design report will present a comprehensive strategy for data gathering during well design and installation. This approach will make use of all available data at the time each well is drilled to determine what additional data needs to be collected during drilling.	Comment resolved pending review of the 90% design.			Comment resolved.	90% BOD Section 3.6.1. Construction/Remedial Action Work Plan Section 3.2.

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			wells intended to characterize the plume. However, the effort to obtain this data to determine screened intervals of remediation monitoring wells, which may be located in a plume undergoing active remediation, may not be warranted at all locations.							
228	DTSC-101	3.6.1 Key Variables and Well Design Considerations, Page 3-55	However, the number of available boreholes is limited (DTSC 2011d). No more than 60 boreholes can be installed for the construction of monitoring wells.	DTSC based the number of wells on estimates provided by PG&E at a stage when the remedy was quite conceptual. While every effort should be made to minimize the total number of wells, if necessary, wells should be installed for an identified purpose and not be artificially bound by the specific well counts for the design. Please evaluate this section based on need and possible contingencies and not well count.	The EIR was developed to balance potential impacts of the remedy implementation, including impacts to cultural resources. As such, limitations were placed on the number of boreholes for remedial wells and monitoring wells. PG&E maintains that it is important to stay within these limitations that were specified in the EIR to preserve an appropriate balance between remedy implementation and minimizing impacts. With regards to the design of the monitoring program, the locations and number of monitoring wells were decided upon to provide the necessary density of data to meet the data quality objectives detailed in the Sampling and Monitoring Plan (Appendix L, Volume 2). The referenced text in Section 3.6.1 is specific to how monitoring well design influences the number of boreholes that will be needed. Section 3.6.2 provided an evaluation of several monitoring well design options and factors to consider in selecting a design, including the number of boreholes that will be required, well utility, and constructability and longevity. Use of monitoring wells that place multiple well screens within a single borehole will allow greater data density and vertical coverage while minimizing	Comment resolved pending review of the 90% design. See response to comment #632 DTSC-190.				Comment resolved.	Not applicable

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					the number of boreholes. In summary, the monitoring well cap specified in the EIR is achievable while providing the appropriate data density to meet data quality objectives. One potential exception that may lead to exceedance of the EIR cap is any potential State Water Board requirement to include monitoring wells in specific directions and at specific distances around the freshwater injection wells. See also response to comment #225 DTSC-98 and #632 DTSC-190.					
229	DTSC-102	3.6.1 Key Variables and Well Design Considerations, Page 3-55		The section should add anticipated decommissioning technique as a variable, as some of the more exotic designs may require overdrilling as the preferred decommissioning method. For this site, the decommissioning approach should be considered up front.	An additional design detail bullet (Well Decommissioning) will be added to the discussion of each well design detailed in Section 3.6.2.	Okay pending review of the proposed additions.			Comment resolved.	90% BOD Section 3.6.2. Construction/Remedial Action Work Plan Section 3.2. O&M Manual Volume 1 Appendix B, Well Decommissioning SOP.
230	DOI-94	Section 3.6.2, Page 3-56		Please provide graphic design details on how wells will be constructed, and QA/QC procedures to be employed.	Conceptual drawings for each of the well designs detailed in Section 3.6.2 will be included in the 90% BOD.		Resolved pending review of the 90% design.		Comment resolved.	90% BOD Appendix D, Drawings C-16-01 through 03.
231	FMIT-31 Hualapai-23 Chemehuevi-23 Cocopah-23 CRIT-23	Section 3.6.2 p. 3-56 to 3-58	Well design options	Where the water table is within about 18 feet of land surface, a peristaltic or centrifugal pump might be used to collect water samples. With borehole size limitations, numerous zones could be sampled using tubes for sampling access, rather than submersible pumps in nested wells.	PG&E agrees that the use of small diameter pumping systems are beneficial when there are limitations on borehole diameter, multiple zones within one borehole must be monitored, and the depth to water is shallow. However, as detailed in Section 3.6.1 there are several other design variables that must be considered for the Topock site when determining the appropriate diameter of a monitoring well casing.			Comment resolved pending review of 90% design documents.	Comment resolved.	Not applicable
232	DTSC-103	3.6.2 Well Design Options, Page 3-57	Dual-screen Wells. This design has been used in two bedrock boreholes in the East Ravine area, and is also planned for many of the IRZ wells associated with the final groundwater remedy.	The section must discuss the failings of the packers in both of the two East Ravine wells and how PG&E plans to overcome those failure modes in the final design.	A specific reference to the failings of inflatable packers when used in East Ravine wells will be added to the "Constructability and Longevity" bullet for dual-screen wells. The failure mode observed in these wells is inherent in the design of inflatable packers. As detailed in this section, inflatable packers can be maintenance intensive and may require periodic replacement, which is not desirable for monitoring wells because the isolation of the two monitoring intervals is lost. This is a different operating condition than that of the remediation wells. Packers used in remediation wells	Response noted. However, DTSC may request that packers be utilized in monitoring wells, to be evaluated on a case by case basis.			Comment resolved.	90% BOD Section 3.6.2.

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					serve to isolate screened intervals and facilitate the distribution of varying quantities of carbon amended water to each screened interval individually, but long-term isolation is not a requirement. Therefore, packers are ideal for use in remediation wells because there are opportunities to remove and maintain them, as necessary. See responses to comment #132 DTSC-40 for clarification on the use of packers in monitoring wells during the East Ravine investigation and #90 DTSC-25 regarding the types of packers included in the remediation well design.					
233	DTSC-104	3.6.2 Well Design Options, Page 3-57 and 58		Please add a section discussing the ability of the different well designs to accommodate pressure transducers. The flat gradients and continuously changing river stage make this a very important consideration for well design.	The need for monitoring wells to be able to accommodate water level transducers is identified in Section 3.6.1 as a design consideration (well utility). The text in Section 3.6.2 already speaks to the ability of each design to be scaled to accommodate required sample equipment. However, as requested, pressure transducers will be specifically identified in these sections (note that pressure transducers are already specifically mentioned for multi-level wells).	Okay.			Comment resolved.	90% BOD Section 3.6.2.
234	DTSC-105	3.6.2 Well Design Options, Page 3-58	Multi-level Wells. Multi-level well designs vary significantly by manufacturer, but many of them include elastomeric materials in the sealed intervals which may not be stable in the subsurface environment at the Topock site.	Please elaborate on the elastomeric materials used in some multilevel wells as it is not certain how this can affect Topock data collection efforts.	This statement was meant to highlight the fact, that based on site experience with the FLUTe liners, there may be a problem with some materials in the reduced environment of the bedrock or IRZ. PG&E does not have information on the specific properties of all the elastomeric materials used in the different multilevel samplers and many of these are likely proprietary. The statement will be expanded to read: “Multi-level well designs vary significantly by manufacturer, but some of them include elastomeric materials in the sealed intervals which may not be stable in the subsurface environment at the Topock site. <u>Based on experience with FLUTe liners in the East Ravine, it is recommended that testing be conducted prior to deployment of any multilevel system that contains</u>	Okay.			Comment resolved.	90% BOD Section 3.6.2.

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					elastomeric materials to insure the stability of those materials in a geochemically reduced environment.”					
235	DTSC-106	Table 3.6-2	Well ID	Although PG&E specified the type of monitoring by well IDs, it would be good to reference the accompanying map or figure that has the Well ID labeled (i.e. footnote to see Figure 3.0-1). Furthermore, PG&E should color code the types of monitoring on a figure. This will provide easier visual reference of information contained in this table.	Reference to monitoring well location figure(s) and color coding will be added as requested in the 90% BOD.	Okay pending review of the 90%.			Comment resolved.	90% BOD Figure 3.6-1.
236	DTSC-107	Table 3.6-2	Type of Monitoring	The selected wells for extraction well monitoring, Freshwater injection well monitoring and plume monitoring seem limited. Also, little rationale is provided on why only the selected wells identified are chosen. Would prefer to identify type of monitoring based on particle tracking.	A footnote will be added to Table 3.6-2 in the 90% BOD, to state the basis for identification of type of monitoring. Please refer to response and resolution to comment #646 DTSC-197 regarding particle tracking.	Comment resolved pending review of the 90%. Also see response to comment #216 DTSC-90.			Comment resolved.	90% BOD Table 3.6-2.
237	DTSC-108	3.3.3.1 Freshwater Supply Piping Network, Page 3-35.	Figure 3.0-1	Include the pipeline and connection from the Topock 2-3 wells that will be used for this remedy of figure 3.0-1. Also include or reference an existing drawing that only shows the freshwater piping.	As discussed in RTC #168 DTSC-63, PG&E will separate the freshwater supply and storage for the remedy and the Compressor Station. Topock-2/3 wells will continue to supply water for Compressor Station use via the existing 6-inch pipeline. Because of this separation of freshwater storage, the connection for Topock-2 and 3 wells will be eliminated in the 90% design. Figure 3.0-1 will be updated to reflect this separation and show the new freshwater storage tank for the remedy. Reference will be made to a new figure that only shows the freshwater piping.	Comment resolved pending review of the 90%.			Comment resolved.	90% BOD Exhibits 3.3-1, 3.3-4.
238	DTSC-109	Figure 3.4-1	A Side Remedy	According to text, PG&E will consider final disposition of remedy generated water to TCS cooling tower, evaporation pond and off-site disposal. These options are not depicted in figure from A Side.	Note “**” on Figure 3.4-1 enumerates the referenced options.	Okay, but prefer options to be considered be depicted beyond a footnote.			Comment resolved.	Not applicable
239	DTSC-110	Figure 3.5-2	Conceptual Visualization	Will the new proposed new access road for Transwestern be paved or native dirt road as depicted? PG&E should label the new road as well.	The new single-lane access road to the north side of the Transwestern bench will have a compacted commercial road base surface. This road will be labeled “Transwestern North Access Road”.	Okay.			Comment resolved.	90% BOD Figure 3.5-2.
240	FMIT-30	Figure 3.5-6		Can anything be done to remove the existing and proposed tanks from the	The existing tanks cannot be removed as they are essential to the operation of the Compressor Station.			The Tribe requests evaluation of relocating the proposed new tank. The Tribe prefers	PG&E will evaluate the Tribe’s request as part of the 90%	The proposed conditioned water tank was relocated to a lower

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				mountain side?	The proposed conditioned water tank is located on an existing bench on the hill to take advantage of the gravity flow to minimize energy usage. No changes are proposed for these tanks.			that the foothills remain without infrastructure. Hualapai concurs with the FMIT.	design.	elevation. See 90% BOD Figures ES-5 and ES-6.
Specific Comments – Section 4										
241	DOI-95		General Comment Regarding Building Construction	Please see the attached memorandum entitled *Federal Leadership in High Performance and Sustainable Buildings Memorandum of Understanding* (Attachment C), and integrate construction principles as appropriate.	PG&E will review the attached memorandum and integrate construction principles into the groundwater remediation project as appropriate.		Resolved pending review of the 90% design.		Comment resolved.	90% BOD Table 4.0-1.
242	DOI-96	Page 4-1		During the implementation phase of the groundwater treatment program, will PG&E look into the following green remediation factors? • Operation of energy-efficient equipment at peak performance • Periodic evaluation and optimization of equipment with high energy demand • Management of demand to leverage low peak capacity and rates • Minimization of particulates/dust during construction	Yes. Performance of the system and individual pumps will be monitored with process measurement devices such as flowmeters, pressure transmitters, and electrical metering. The plant control system will be utilized to minimize the peak electrical demand. Data will be tracked over time and alarmed if it falls outside of an acceptable range. At that time, the equipment or process can be further analyzed for issues that have caused it to loose efficiency or require more power. The following text will be added as an additional bullet in Table 4.0-1 in Energy Use: "O&M activities will minimize energy use by optimizing equipment via routine maintenance and minimizing energy consumption during peak energy use periods." As for minimization of particles/dust during construction, primary dust control measures such as surface wetting and/or stabilization will be implemented. Vacuum methods are also available as a secondary measure for dust control, if needed.		Comment resolved.		Comment resolved.	90% BOD Table 4.0-1.
243	FMIT-32	Section 4		This section describes PG&E's Sustainability Practices. This policy was adopted in 2011 and updated in 2012. PG&E has been applying it to Topock. The Tribe believes that this policy should have been developed in consultation with the Tribe pursuant to the 2006 FMIT-PG&E settlement agreement. This policy should be informed by consultation with the Tribe. When will PG&E engage the	<u>Proposed revision to the RTC is below in bold/underlined:</u> PG&E initially developed its Programmatic Sustainable Remediation Guidance in 2011 in close collaboration with DTSC. PG&E has applied the Guidance to over 75 remediation projects, and specifically to the Topock Remediation Project since last year. The Guidance provides for the application of				PG&E's response was discussed with the FMIT, and revised in response to that discussion.	Not applicable.

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				Tribe in this effort?	sustainability at any point during the remediation project life cycle, from project planning through site closure and post-remediation site conditions, where applicable, and provides a standardized process for the integration of sustainable practices across PG&E remediation projects. ~~PG&E does not believe that the 2006 Settlement Agreement is implicated by the Programmatic Sustainable Remediation Guidance. PG&E is always open to comments on its practices, including from the FMIT.~~ PG&E does not believe that the 2006 Settlement Agreement is implicated by the Programmatic Sustainable Remediation Guidance. PG&E understands that the FMIT disagree with this conclusion and that the Tribe believes that it should have been consulted by PG&E on the development of the Programmatic Sustainable Remediation Guidance. While PG&E and the FMIT continue to have different views on the requirements of the Settlement Agreement with respect to the Programmatic Sustainable Remediation Guidance, PG&E is open to any comments on the Programmatic Sustainable Remediation Guidance from the FMIT. If the FMIT offers such comments on the Programmatic Sustainable Remediation Guidance itself, PG&E and the FMIT will follow up on this issue outside the remedy response-to-comment process. If the FMIT has any specific comments on the application of the Programmatic Sustainable Remediation Guidance to the groundwater remedy at 90% Design, PG&E will respond to such comments during the 90% Design RTC process.					

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Specific Comments – Section 5										
244	DOI-97	Page 5-1	"The SOB (DTSC 2011) stated that due to the incomplete evaluation of soil contamination . . . "	The in-text citation for DTSC 2011 is not listed in the Reference list section.	The letter "a" will be added after 2011.		Comment resolved.		Comment resolved.	90% BOD Section 5, 3rd paragraph.
245	DOI-98	Page 5-1, 1st bullet	Category 1 ICs	Based on current hydrogeologic understandings, should groundwater withdrawal usage by the private sector in the vicinity of the freshwater supply well(s) require an IC to protect quantity supply issues to the treatment program?	As indicated in Figure 5.1-1 (page 211 of the PDF), PG&E is still evaluating the need for and/or scope of an institutional control at and around HNWR-1 well, for the purpose of ensuring the quantity of freshwater needed for the remedy over its decades long operation. PG&E notes that policies for the management of surface uses and the use of groundwater on the HNWR are included in the 1994 Lower Colorado River National Wildlife Refuges Comprehensive Management Plan.		Comment resolved.		Comment resolved.	90% BOD Figure 5.1-1.
246	DOI-99	Section 5.1, Page 5-2		This subsection defines areas for future restrictions. If groundwater quality may be an issue in the future, does PG&E plan on performing a Wellhead Protection Study to ascertain where spills, leaks, chemical storage areas, etc., may impact the water quality upgradient of the freshwater supply well during operation in order to apply/seek any development restrictions?	The section titled "Source Water Assessment" on page 3-30 describes the approach taken to identify the wellhead protection zone around HNWR-1 based on Arizona guidance. Exhibit 3.3-3 shows the estimated radius of the wellhead protection zone There are no major sources of groundwater contaminants in this zone. PG&E does not propose to seek development restrictions for the purposes of wellhead protection. However, as indicated in Figure 5.1-1 (page 211 of the PDF), PG&E is still evaluating the need for and/or scope of an institutional control at and around HNWR-1 well, for the purpose of ensuring the quantity of freshwater needed for the remedy over its decades long operation. PG&E notes that policies for the management of surface uses and the use of groundwater on the HNWR are included in the 1994 Lower Colorado River National Wildlife Refuges Comprehensive Management Plan.		Comment resolved.		Comment resolved.	90% BOD Figure 5.1-1.

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247	DTSC-111	5.1 Define Areas for Future Restrictions, Page 5-2.	Information obtained from the Topock Marina on Historic Route 66 during the first quarter 2013 indicates that they are planning to conduct exploratory drilling on their property in hope of locating a groundwater supply well that can produce about 2000 gallons per minute for use as fire protection water at their future facility. Target timing is 2013.	Update this item as the Topock Marina well has already been installed. Include any future plans the marina owners may be considering for water sources for existing and planned future development.	The Topock Marina has completed a 4-inch test well, but has not yet completed a production well. The text in this section will be updated to reflect what is known about Topock Marina water supply at the time the 90% design is submitted.	Okay pending review of the 90% BOD.			Comment resolved.	90% BOD Section 5.1, 2nd paragraph, 2nd bullet.
248	FMIT-33	Section 5.3.2		This summary does not appear to fully track the 2006 settlement between FMIT-PG&E. This section should be revised in consultation with the Tribe for accuracy regarding the nature of the easement and provisions for the Tribe's consent.	This comment was discussed at Sept TWG meeting, and PG&E and FMIT counsel further discussed it following up on that meeting. PG&E invites the FMIT to provide further clarification as to the specific text in section 5.3.2 that is of concern.				Comment resolved, pending any further clarification from the FMIT.	Not applicable.
249	DTSC-112	5.3.2 Access to Non-Federal Lands, Page 5-4	Access agreements with private property owners for remedial structures on their lands, where such agreements do not otherwise exist It should be noted that under the Settlement Agreement between PG&E…	The first sentence is incomplete and requires revision.	The subject sentence is complete and was intended as the 7th (last) bullet in Section 5.3.2. The text will be revised to add a bullet before the sentence.	Okay.			Comment resolved.	90% BOD Section 5.3.2.

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250	DOI-100	Table 5.1-1A (Page 5-5) and Figure 5.1-1		The text in the table indicates that the Caltrans ROW, parcel number is 650-161-09 is under HNWR/USFWS management and BLM ownership. The property is BOR withdrawn land, not BLM, managed by USFWS. Consider including soil storage/staging areas in the Potential Remedial and Investigative Activities column, (parcel 650-161-02 et al.).	Text and figure will be revised as requested.		Comment resolved.		Comment resolved.	90% BOD Table 5.1-1A.
Specific Comments – Section 6										
251	DOI-101	Section 6.2, Page 6-1	"There are 57 RARs that address several resource areas . . . "	The in-text citation for BLM 2012 is not listed in the Reference section.	The in-text citation for BLM 2012 is listed in the Reference section; please see the 5th reference under U.S. Bureau of Land Management (BLM).		Comment resolved.		Comment resolved.	Not applicable
252a	FMIT-34	Table 6.1-1		There are several references to the Corrective Measure Construction/ Remedial Action Work Plan, the Plan for Decommissioning and Removal of IM-3 Facility and Site Restoration (part of CIMP), and, the Closure Plan for Decommissioning of Remedy Facilities and Restoration. However, none of these plans yet exist, and thus compliance with a number of the relevant EIR Mitigation Measures is impossible to assess at this time and therefore should not be concluded as such in the BOD.	The column that lists these documents is titled "Which document(s) will contain or satisfy this measure?" The intent of this column is to identify what current or future document(s) are intended to satisfy this measure and be transparent on future forthcoming documentation. This column is not intended to document compliance with the mitigation measure. A footnote will be added to this effect.			Comment resolved.	Comment resolved.	90% BOD Tables 6.1-1 and 6.2-1.
252b	Hualapai-24 Chemehuevi-24 Cocopah-24 CRIT-24	Table 6.1-1		There are several references to the Corrective Measure Construction/ Remedial Action Work Plan, the Plan for Decommissioning and Removal of IM-3 Facility and Site Restoration (part of CIMP) and the Closure Plan for Decommissioning of Remedy Facilities and Restoration. However, none of these plans yet exist, and thus compliance with a number of the relevant EIR Mitigation Measures is impossible to assess at this time.	See response to comment #252a FMIT-34.			Comment resolved.	Comment resolved.	90% BOD Tables 6.1-1 and 6.2-1.
253	DOI-102	Table 6.1-1, Mitigation Number AIR-1c, Page 6-6	"c) Stabilize (using soil binders or establish vegetative cover) . . . "	In the event PG&E selects vegetative cover for stabilization, there is an expectation that indigenous species will be used. Please provide references regarding revegetation protocols. How long will the plant cover be maintained and watered to assure establishment/germination? Also, please propose criteria that will be used to determine successful	AIR-1c addresses control of air pollutants and precursors during construction and requires soil stabilization in the form of soil binders or vegetative cover. As presented in Table 6.1-1, if soil stabilization will be accomplished through vegetative cover, native fast-growing plants will be used. Plant cover will be maintained only to establish soil stabilization with the		Comment resolved pending review of 90% design.		Comment resolved.	Section 2.1 of the Habitat Restoration Plan for Riparian Vegetation and Other Sensitive Habilitats (Appendix to the Construction/Remedial Action Work Plan) states that the use of herbaceous vegetation covers as a soil stabilization technique is not being proposed for this project because this approach was not considered appropriate

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				vegetation/stabilization.	assumption that the surrounding native vegetation will eventually naturally re-establish at the site. The RAWP will include a list of potential plants to be used as vegetative covers, stabilization agents and methodologies to be used.					for this environment. Soil stabilization techniques will be an integral part of stormwater pollution prevention because these measures minimize dust and protect desert topsoil, particularly in areas of contamination or with minimal surface soil.
254	DOI-103	Table 6.1-1, Mitigation Number BIO-1, Page 6-7	"During the preliminary (30%) design, it has been determined that complete avoidance of habitats under USACE jurisdiction (e.g., Bat Cave Wash) is not feasible . . . "	Will the 90% Design identify the area where wetland rehabilitation will occur in order to achieve "no net loss"?	At the 60% design stage, no net loss of wetlands are anticipated with implementation of the remedy (see Section 2.4 and Figure 2.4-5 of the BOD). This expectation will be verified at 90% design. Note that Bat Cave Wash is a Jurisdictional Waters of the U.S. but is not a wetland. Bat Cave Wash is characterized by very short, infrequent flows in response to rain events. Any flows or accumulation of water infiltrate quickly following rain events. Minor impacts to this drainage would not result in the loss of hydrologic function and mitigation measures including replacement of any impacted trees would ensure no loss of habitat value.		Comment resolved.		Comment resolved.	90% BOD Table 6.1-1 (mitigation measure BIO-1) and Figure 2.4-5.
255	DOI-104	Table 6.1-1, Mitigation Number BIO-1, Page 6-8		References to the CDFW 2013 source do not include the year.	The year 2013 will be added to the CDFW reference in the Reference section.		Comment resolved.		Comment resolved.	90% BOD Section 9.
256	DOI-105	Table 6.1-1, Mitigation Number CUL-1a-8a, Page 6-16		The in-text citation for Q4 2011 is not listed in the Reference section.	In this instance, the wording "(Q4 2011)" is not intended as in-text citation, but rather to note for the reader that the first published quarterly report is the Fourth Quarter 2011 report.		Comment resolved.		Comment resolved.	Not applicable
257	FMIT-35	Table 6.1-1	BIO-1	There has been no outreach from the tribe on this 404 permit as it was assumed that waterways or pumping directly from the river would not occur. However, now that this is occurring, the Tribe requests a meeting with PG&E for the purpose of explaining exactly the context of a request for exemption. Additionally, the Tribe believes the USACE consult with the Tribe.	The 60% design does not include a river intake structure or pumping directly from the river. The context of a request for exemption and the role of USACE was discussed with Tribes at the August 21, 2013 meeting in FMIT's office in Needles (the MMRP meeting between DTSC and Tribes).			Review in progress. The Tribe seeks a direct consultative relationship with all agencies involved with the project.		Not applicable
258	DOI-106	Table 6.1-1, Mitigation Number GEO-1a-a,	"A grading and erosion control plan will be prepared . . . "	Will the plan address segregating and stockpiling top soil so it can be reused in an effective manner?	The grading and erosion control plan will be prepared to meet the substantive requirements per San Bernardino County. The plan will		Resolved pending review of the 90% design.		Comment resolved.	90% BOD Appendix E Specification Sections 31 10 00 (removal and segregation) and 31 23 23 (Fill and Backfill).

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		Page 6-27			address management of top soil consistent with the response to comment #774 FMIT-193.					
259	DOI-107	Table 6.1-1, Mitigation Number HAZ-2c, Page 6-32	"c. Should evidence of contaminated soil be identified during ground disturbing activities (e.g., noxious odors, discolored soil), work in this area will immediately cease until soil samples can be collected and analyzed . . . "	What mitigative measures, such as stabilization and wetting, will be implemented to minimize dust generation, and thereby prevent/minimize the spread of any contamination, until test results are known? Where will specific soil removal protocols be identified (i.e., monitoring, removal methods, additional sampling requirements, runon/runoff and dust control measures, etc.)?	Primary dust control measures will be surface wetting and stabilization. Vacuum methods are also available as secondary measures, if needed. Potentially contaminated soils encountered in situ will be covered/ isolated to minimize the potential for migration until laboratory results are received. Details on soil removal protocols will be included in the Remedial Action Work Plan.		Comment resolved.		Comment resolved.	Construction/Remedial Action Work Plan Sections 3.1 and 4.
260	FMIT-36 Hualapai-25 Chemehuevi-25 Cocopah-25 CRIT-25	Table 6.1-1 p. 6-17	Noise-1a	Vibration-sensitive land uses are assumed to consist only of residential and mobile home parks. Based on this assumption Tribal land uses are neglected. Tribal land use must be considered.	The stated assumption is consistent with the certified EIR (see page 4.9-20), and was expressly mentioned in both the 30% and 60% designs. No comments were received on this topic in the 30% design.	Noise and vibration- sensitive receptors are discussed in the Noise and Vibration-Sensitive Land Uses in section 4.9.1.5 which did identify the Topock Cultural Area as a sensitive land use.		The DTSC response indicates that noise and vibration sensitive land uses in section 4.9.1.5 did identify the Topock Cultural Area as a sensitive land use. We note that, apparently, no impacts to this use were analyzed. The development of the 90% Basis of Design Report should include a consultation with the Tribes to consider and identify vibration and noise sensitive Tribal uses and users. Comment closed. The Tribes would request that as sound monitoring details are resolved, the usage of the Topock area as a location of deep spiritual meaning and associated usage would be taken into account to the fullest extent possible.	This comment and the responses were discussed at the December 12, 2013 TWG telecon. The TRC (Charlie Schlinger) presented draft proposed language for Tribes' response at the February 11, 2014 TWG meeting. The Hualapai Tribe provided a letter with language to close out the unresolved noise and vibration-related comments (see **Attachment H**, at the end of this table).	90% BOD Table 6.1-1.
261	FMIT-37 Hualapai-26 Chemehuevi-26 Cocopah-26 CRIT-26	Table 6.1-1 p. 6-17	Noise 1-b	It is not sufficient to manage communication with vibration-sensitive receptors concerning vibration issues and complaints. There needs to be a meaningful and functional set of protocols for both communicating and resolving issues and complaints. Further, applicable vibration standards need to be spelled out and the basis for their	The certified EIR specifies the requirements for mitigation measure Noise-1b. PG&E defers to DTSC on response to comment regarding the sufficiency of the requirements and applicable standards.	Potential noise and vibration impacts were fully evaluated and circulated for comments in the June 2010 Draft EIR prior to finalization and certification in January 2011. The applicable standards, threshold of significance and impact analysis can be found in Sections 4.9, and 6.4.9 of the FEIR. The identification of a		Comment stands. Tribal concerns regarding noise may be different than applied regulatory standards. The Tribes would like to continue a dialogue with the agencies to further clarify the nature of noise and vibration impacts.	This comment and the responses were discussed at the December 17-18, 2013 TWG meeting.	Not applicable

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				selection provided.		disturbance coordinator by PG&E is to ensure an open channel of communication between the project proponent and anyone who might have concerns over the proposed activities. Furthermore, mitigation measure CUL-1a-8h provides for a protocol to be developed in partnership with the Tribes to address issues associated TWG teklewith noise and vibration.				
262a	FMIT-38	Table 6.1-1 p. 6-17	Noise-2a	While the Mitigation Measure calls for utilization of the "best-available noise suppression devices", the 60% Action calls for "available noise suppression devices"; if no devices are available, then conceivably, no devices would be utilized. No explanation is provided for the deviation from the adopted mitigation measure. Proposed deviations from any mitigation measure should be done in an open manner with an opportunity for the Tribe to comment.	There is no proposed deviation to the EIR mitigation measure. The word "best" will be inserted before "available" in the future 90% Action column.			Comment resolved.	Comment resolved.	90% BOD Table 6.1-1 (Noise-2a).
262b	Hualapai-27 Chemehuevi-27 Cocopah-27 CRIT-27	Table 6.1-1 p. 6-17	Noise-2a	While the Mitigation Measure calls for utilization of the "best-available noise suppression devices", the 60% Action calls for "available noise suppression devices"; if no devices are available, then conceivably, no devices would be utilized. No explanation is provided for the deviation from the adopted mitigation measure.	See response to comment #262a FMIT-38.			Comment resolved.	Comment resolved.	90% BOD Table 6.1-1 (Noise-2a).
263	FMIT-39 Hualapai-28 Chemehuevi-28 Cocopah-28 CRIT-28	Table 6.1-1 p. 6-18	Noise-2c	While vibration-sensitive receptors are discussed and identified as part of Noise-1, there is no similar discussion and identification of noise- sensitive receptors.	The certified EIR defined noise sensitive receptors in Chapter 4.9.1.5 (Existing Noise Environment, page 4.9-5).	Noise and vibration- sensitive receptors are discussed in the Noise and Vibration-Sensitive Land Uses section 4.9.1.5 which did identify the Topock Cultural Area as a sensitive land use.		The DTSC response indicates that noise and vibration sensitive land uses in section 4.9.1.5 did identify the Topock Cultural Area as a sensitive land use. We note that, apparently, no impacts to this use were analyzed. The development of the 90% Basis of Design Report should include a consultation with the Tribes to consider and identify vibration and noise sensitive Tribal uses and users. Comment closed. The Tribes would request that as sound	This comment and the responses were discussed at the December 12, 2013 TWG telecon. The TRC (Charlie Schlinger) presented draft proposed language for Tribes' response at the February 11, 2014 TWG meeting. The Hualapai Tribe provided a letter with language to close out the unresolved noise and vibration-related comments (see **Attachment H**, at the end of this table).	90% BOD Table 6.1-1 (Noise-2c).

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								monitoring details are resolved, the usage of the Topock area as a location of deep spiritual meaning and associated usage would be taken into account to the fullest extent possible.		
264	FMIT-40 Hualapai-29 Chemehuevi-29 Cocopah-29 CRIT-29	Table 6.1-1 p. 6-18	Noise-2d	It is not sufficient to manage communication with noise-sensitive receptors and concerning noise issues and complaints. There needs to be a meaningful and functional set of protocols for both communicating and resolving issues and complaints. Further, applicable noise standards need to be spelled out and the basis for their selection provided.	In conformance with requirements in the EIR MMRP, mitigation measure CUL-1a-8h (Protocols for the appropriate methods, consistent with mitigation measure Noise-3, to reduce auditory impacts) was developed as part of the draft CIMP with inputs from Tribes. The draft CIMP was submitted to the Tribes for review on July 8, 2013, and comments were received from Tribes on October 22, 2013. PG&E will review and discuss these comments with Tribes prior to submitting the draft CIMP to DTSC at 90% design. PG&E defers to DTSC on response to comment regarding the sufficiency of the requirements and applicable standards. The certified EIR lists the applicable noise standards for the remedy. Section C.11 of Appendix C contains the noise design criteria for the remedy.	See response to comment #261 FMIT-37.		Comment stands. Tribal concerns regarding noise may be different than applied regulatory standards. The tribes would like to continue a dialogue with the agencies to further clarify the nature of noise and vibration impacts. The FMIT requests to review the CIMP prior to the 90% design submittal.	This comment and the responses were discussed at the December 17-18, 2013 TWG meeting.	CIMP Noise Protocol CUL-1a-8h (the CIMP Is included as an appendix to the Construction/ Remedial Action Work Plan).
265a	FMIT-41	Table 6.1-1 p. 6-21	CUL-1a-10	Regarding certain (e.g., noise, aesthetics, etc.) impacts on the Topock Maze and the associated sacred area, the 60% BOD report states, as did the 30% BOD report, that "prevention of indirect impacts to the Maze will be incorporated into the design to the maximum extent feasible as determined by DTSC". Where is the process spelled out for such a determination by DTSC? Additionally, the Tribe does not consider such impact "indirect." They are direct impacts.	PG&E defers to DTSC as the language cited in the comment is copied verbatim from the certified EIR.	DTSC makes such a determination through oversight of PG&E's implementation of mitigation measure to avoid any identified archaeological sites. PG&E will also conduct pre-construction survey and if necessary follow CHPMP requirements for treatment if avoidance is impossible. Tribes will also be invited to the pre-construction survey.		The response only mentions archeological value and not cultural value. In addition, the response does not address the indirect vs. direct portion of the comment.	This comment and the responses were discussed at the December 17-18, 2013 TWG meeting.	Not applicable
265b	Hualapai-30 Chemehuevi-30 Cocopah-30 CRIT-30	Table 6.1-1 p. 6-21	CUL-1a-10	Regarding certain impacts on the Topock Maze (e.g., noise, aesthetics, etc.) and the associated sacred area, the 60% BOD report states, as did the 30% BOD report, that "prevention of indirect impacts to the Maze will be incorporated into the design to the maximum extent feasible as determined by DTSC". Where is the process spelled out for such a	See response to comment #265a FMIT-41.	See response to comment #265a FMIT-41.				Not applicable

TABLE I-1

Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
				determination by DTSC?						
266	DOI-108	Table 6.2-1, Chemical-Specific (Item Numbers 1, 2, 3, 52, 53, and 55), Pages 6-45 through 6-48	Which existing/future document(s) will document continued compliance with this ARAR?	The column is empty for these ARARs. It is likely that the following documents will fulfill this action: 1) routine groundwater monitoring data; 2) influent-effluent data; 3) groundwater elevation monitoring data within extraction, injection, and monitoring wells; 4) contaminant mass balance removal calculations; 5) percent system is operational on a monthly basis; 6) annual system operational and effectiveness report; and 7) annual capture zone analysis report. Other data/reports may also be generated that would likely fulfill this requirement.	Exhibit L2.2-4 of the O&M Manual (Section L3.3) includes a proposed template and outline for quarterly progress reports during remedy O&M, as required by the 2013 CD (Section X and Appendix C) and the 1996 CACA (Attachment 7). The proposed outline includes all elements listed in this comment. PG&E assumes that, for efficiency, the monthly operational information listed under Item #5 will be reported on a quarterly basis in the quarterly reports, i.e., not in separate reports. Text will be added to this column to indicate the future documents for compliance with the ARARs.		Comment resolved pending review of 90% design.		Comment resolved.	90% BOD Table 6.2-1, Chemical-specific ARARs (Item #s 1, 2, 3, 52, 53, and 55).
267	MWD-7	6.2-1, Table 6.2-1, Item No. 3	The remedy is designed to prevent migration of contaminants to the Colorado River that would result in an exceedance of applicable water quality standards."	This should read "The remedy is designed to prevent migration of contaminants to the Colorado River that would result in an exceedance of applicable water quality standards, including federal, California, and Arizona standards."	Comment noted. Text will be revised as suggested.				Comment resolved.	90% BOD Table 6.2-1, Item #3.
268	DOI-109	Table 6.2-1, Item Number 32, Page 6-48	Action (60% Design Report Compliance Status) column – ". . . the results will be summarized in a forthcoming report for DTSC review."	The federal agencies should be included in the review as well.	Comment noted. The draft Wetlands Delineation Report was submitted to DTSC and DOI on August 22, 2013.		Comment resolved.		Comment resolved.	Not applicable
269	DOI-110	Table 6.2-1, Item Number 40, Page 6-50	Triggering Event column – "Expiration of existing PBA (end of 2012) . . . "	The Triggering Event column should be updated.	The triggering event column will be revised to state (underline typeface is added text, ~~strikethrough~~ typeface is deleted text): "Extension of existing PBA ~~(end of 2012)~~ through December 31, 2017 or construction of the remedy, whichever is sooner."		Comment resolved.		Comment resolved.	90% BOD Table 6.2-1, Item #40.
270	DOI-111	Table 6.2-1, Item Number 45, Page 6-51		The Triggering Event should also consider construction of any future replacement wells in Arizona, if necessary.	The triggering event column will be revised to state (underline typeface is added text, ~~strikethrough~~ typeface is deleted text): "During project design and ~~before~~ construction of wells in Arizona".		Comment resolved.		Comment resolved.	90% BOD Table 6.2-1, Item #45.

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Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

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271	DOI-112	Table 6.2-1, Item 13, Page 6-66		References to the CDFW 2013 source do not include the year.	See response to comment #255 DOI-104.		Comment resolved.		Comment resolved.	90% BOD Section 9.
272	DOI-113	Table 6.2-1, Item Number 14, Page 6-67	Action (60% Design Report Compliance Status) Column	It should be noted in the last column that the action to be taken by PG&E involves the implementation of measures identified in the PA and CHPMP, and through ongoing consultation activities with the Tribes that will avoid, mitigate, or otherwise minimize adverse effects from the undertaking.	The following text will be added to the last column of Table 6.2-1 for Item 14 after "Requirements in the PA and the CHPMP will be adhered to": "<u>These requirements include implementation of mitigation measures identified in the PA and the CHPMP and through ongoing consultation activities with the Tribes that will avoid, mitigate, or otherwise minimize adverse effects from the undertaking.</u>"		Comment resolved.		Comment resolved.	90% BOD Table 6.2-1 Item 17.
273	FMIT-42	Table 6.2-1		The Tribe disagrees with the conclusions regarding Item No. 39 (RFRA) and Item No 22 (AIRFA). There is no question in the Tribe's mind that the project burdens the traditional religious practices of the Tribe. The issue is not merely defined by physical access concerns. The Actions should more fully reflect the breadth of the statutes and the projects impacts on the Tribe. The Tribe is also concerned about Item No. 14 (NHPA). The Action described appears to be mostly about producing documents. Action should also focus on process inclusion of the Tribe. It should also reflect that Treatment Measures may evolve as the design evolves.	PG&E defers to DOI.		In specific reference to Item 39 (RFRA), the federal courts have held that the requirement not to impose a substantial burden on the exercise of traditional religious practices is violated "only when individuals are forced to choose between following the tenets of their religion and receiving a governmental benefit or coerced to act contrary to their religious beliefs by the threat of civil or criminal sanctions." Based on this judicial interpretation of the law, DOI has concluded that the groundwater remedy does not present a substantial burden on the exercise of traditional religious practices. However, DOI and BLM acknowledge that many of the Tribes feel that the remediation project does impact religious and cultural practices in the Topock area. One effort made to address this concern was DOI and BLM's development of the Tribal Access Plan to assure the Tribes of	Under further tribal review.	This comment and response were discussed at the February 11, 2014 TWG meeting.	Not applicable

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Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

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							continued access to federal lands contained within the boundary of the APE. The provision of tribal access to property for religious, spiritual or other cultural purposes is consistent with both RFRA and AIRFA. DOI and BLM will continue to consult with the Tribes in an effort to identify and implement mitigation measures that will prevent or mitigate impacts on the ability of Tribal members to exercise traditional cultural and religious activities associated with the Topock area. The documents referenced under “Action”, including the PA and the CHPMP, are the result of the ongoing consultation efforts with the Tribes and serve to memorialize the collaborative decisions made during these meetings.			
274	MWD-8	6.2-1, Table 6.2-1, Item No. 52	"There is no state MCL for Cr(VI)..."	This should read 'There is currently no state MCL for Cr(VI), although the California Department of Public Health has been ordered to propose an MCL for Cr(VI) by August 31, 2013. When the final MCL for Cr(VI) has been set, this item will be revised as necessary. In the meantime, the RAO has been established..."	Text will be revised as follows: “There is currently no state MCL for Cr(VI), although the California Department of Public Health has proposed a draft MCL of 0.010-milligram per liter for Cr(VI). This statement regarding the state MCL for Cr(VI) will be revised as necessary when a final MCL is issued. The RAO has been established based on the regional background concentration of 32 µg/L at the conclusion of remedy implementation.”				Comment resolved.	90% BOD Table 6.2-1 Item #52.
275	MWD-9	6.2-1, Table 6.2-1, Item No. 99	"There are no MCLs or MCLGs for Cr(VI)..."	This should read "There are currently no MCLs or MCLGs for Cr(Vl), although the California Department of Public Health has been ordered to propose an MCL for Cr(VI) by August 31, 2013. When the final MCL for Cr(Vl) has been set, this item will be revised as necessary. In the meantime, the RAO of 32 ug/L..."	See response to comment #274 MWD-8.				Comment resolved.	90% BOD Table 6.2-1 Item #99.

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276	DOI-114	Table 6.2-2, Item Number 4, Stipulation I(D) Page 6-72 And Table 6.2-3, Page 6-77		The compliance status addresses the stipulation in part. The language contained within this section specifies that "If adverse effects to such properties are unavoidable, PG&E, under the direction of BLM, will develop and follow procedures that reduce the possibility of inadvertent damage." It is our expectation that proactive measures will be included in the Remedial Action Work Plan to reduce the potential for inadvertent damage, including those listed in Section 6.6.3 of the CHPMP.	Comment noted, although PG&E notes that it appears that this comment applies to Item No. 4 of Table 6.2-3 only and not Item No. 4 of Table 6.2-2, which relates specifically to restoration. PG&E will describe steps to prevent or reduce the potential for inadvertent damage in the Remedial Action Work Plan.		Comment resolved pending review of 90% design.		Comment resolved.	90% BOD Table 6.2-3 Item #4.
277	FMIT-43	Table 6.2-2		Stipulation 18. The Tribe believes that a solid draft plan and not merely an outline of the IM3 decommissioning and restoration plan should be produced prior to the groundwater remedy.	PG&E understands that the FMIT's comment is focused on Section 8 of the Draft IM-3 Decommissioning, Removal, and Restoration Work Plan ("Draft Plan"), which sets forth a general approach for IM-3 Site restoration. In brief, Section 8 of the Draft Plan includes restoration guidelines (steps to be followed during restoration), elements of the restoration of habitat and revegetation and demobilization, and a draft annotated outline of a future more detailed, site specific IM-3 Restoration Plan. In coordination with the FMIT and other tribes, PG&E will develop a schedule for developing the more detailed Restoration Plan The schedule will be tailored to provide a timely plan with additional detail on the restoration process, and avoid delay so that restoration will commence shortly after decommissioning is completed. PG&E anticipates that some details of the restoration plan, in particular the amount of earthwork and earth movement involved in the restoration, will be deferred to the completion of decommissioning, so that PG&E and the Tribes can evaluate which approach may minimize further disturbance (and may minimize the amount of earth movement) while achieving the required restoration. PG&E believes that specific determination can best be made when the condition of ground surface is known, following the removal of the IM3 facilities.				In addition to discussions at the TWG, PG&E's response was discussed with the FMIT, and revised in response to that discussion.	Draft IM-3 Decommissioning, Removal, and Restoration Work Plan, Section 1.1, last paragraph.

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PG&E Topock Compressor Station, Needles, California

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278	DOI-115	Table 6.2-3, Page 6-77, Item Number 6		The CHPMP supersedes the CRMP. A description of the proposal describing a program of periodic site monitoring and condition assessment shall be provided by PG&E.	Comment noted. A program for periodic site monitoring and condition assessment will be proposed concurrent with the 90% design.		Comment resolved pending review of 90% design.		Comment resolved.	90% BOD Table 6.2-3 Item #6.
Specific Comments – Section 7										
279	DTSC-113	Section 7.3.1, p.7-5, 3b	Establish IRZ cut-off as quickly as possible	Please clarify what is meant by this evaluation criterion.	The evaluation criteria of establishing an IRZ cut-off is to establish a continuous front of carbon distribution along the NTH IRZ to develop reducing conditions in order to actively reduce Cr(VI) in groundwater. Text will be clarified for better description.	Okay pending review of the additional text.			Comment resolved.	90% BOD Section 7.3.1 Item #3b.
280	DOI-116	Section 7.3.2, Page 7-6, 1st bullet (Scenario 1A)		It is not clear whether FW-1 and FW-2 are operational with “Freshwater Injection ON”; please clarify.	For the "Freshwater Injection ON" steps, FW-1 and FW-2 are both operational. Footnote "4" will be updated to clarify that these two wells are active.		Comment resolved.		Comment resolved.	90% BOD Section 7.3.2, Footnote 9.
281	DOI-117	Section 7.3.2, Page 7-6	“Simulate Cr(VI) transport for Scenarios 1A and 2A are shown in Figure 7.3-1 . . . “	Please clarify why only Model Layers 2 and 4 were modeled and not all layers.	All model layers were simulated in all groundwater flow and solute transport model runs. In many cases only Model Layers 2 and 4 were presented in an effort to condense the number of figures presented. Model Layers 1 and 2 represent the shallow portion of the aquifer and have similar plume footprints, so Model Layer 2 was utilized as a representative of the shallow aquifer as the simulated results in Model Layers 1 and 2 were similar. Model Layers 3 and 4 represent the deep portion of the aquifer and have similar plume footprints so Model Layer 4 was utilized as a representative of the deep aquifer as the simulated results in Model Layers 3 and 4 were similar. Text will be included in the 90% BOD to reflect this response.	Include/ summarize the provided response in the 90% BOD report.	Comment resolved.		Comment resolved.	90% BOD Section 7.3.2. 90% BOD Apdx B Section 7.4,
282	DOI-118	Section 7.3.2, Page 7-7	“Based on these results, a shorter, 1-year start-up is preferred . . . .”	The text in this section discusses the options of either the 1 year start-up schedule or the 2 year start-up schedule. DOI supports the implementation of the 1 year start-up process based on the assumption that the sooner the system is fully operational the sooner PG&E and the agencies/ stakeholders will gain an understanding of how the system operates under current conditions.	DOI’s preference is noted.		Comment resolved pending review of the 90% design.		Comment resolved.	Not applicable

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Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

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283	DTSC-114	Section 7.3.3, p.7-7, last paragraph	The downside of complete shutdown of the IM system upon final groundwater remedy start-up is that the hydraulic control exerted by the IM pumping would end. From a hydrogeologic perspective, this is not a significant concern due to the slow migration rate and the presence of the reducing rind.	Although the hydraulic gradient is flat, depending on the time of year, if the implementation is during the low river stages, the hydraulic movement would be significantly higher toward Arizona. Also, would PG&E's conclusion still be true with nine months of reductant injection at IRZ and minimum three months of freshwater injection? DTSC is concerned that this approach would allow a slug of Cr(VI) to be pushed towards Arizona, even if it is protective of river water.	Seasonal variations in river stage will result in localized variations in flow velocity but the long term trends will still be consistent with average flow velocities. PG&E's conclusion is still true with nine months of NTH IRZ operation and 3 months freshwater injection as Scenarios 1A (6 month NTH IRZ and 3 month freshwater injection) and 1B (12 month NTH IRZ and 6 month freshwater injection) bracket this timeframe. Even with the longer transitional operation times described in Scenario 1B, simulation results indicate that a slug of Cr(VI) will not be pushed towards Arizona and will still be within the simulated hydraulic capture zone of the River Bank Extraction Wells when they are activated.	Comment resolved.			Comment resolved.	Not applicable
284	DOI-119	Section 7.4, Page 7-8	"In response to the FMIT's comment on the 30% design . . . "	The IM-3 Decommissioning Plan and the Remedial Action Work Plan are included as part of the DOI/PG&E Consent Decree and therefore subject to review and approval by DOI. DOI concurrence on the shutdown of IM-3 is also expected. The text in the paragraph should reflect this.	Text in this paragraph will be revised as follows (inserted verbiage shown in <u>underline</u> typeface): "In response to the FMIT's comment on the 30% design (HA-GC2 and HA-29) and as directed by DTSC, the following procedures and criteria for DTSC's <u>and DOI's</u> determination that the remedy is maintaining plume control and that IM-3 decommissioning can be approved are presented below for review by project stakeholders and Tribes during the design phases and approval by DTSC <u>and DOI</u> as part of the Construction/ Remedial Action Work Plan."		Comment resolved.		Comment resolved.	90% BOD Section 7.4, 1st paragraph.
285	DOI-120	Section 7.4, Page 7-8, Plume Control Criteria	" . . . within the EIR project area, as defined in the EIR and as shown in EIR Exhibit 3-2, . . . "	It is unclear why the text specific to the EIR is included.	The Plume Control Criteria set forth in the 60% BOD are the same as those in the settlement agreement between the Fort Mojave Indian Tribe and DTSC.		Comment resolved.		Comment resolved.	Not applicable
286	DOI-121	Section 7.4, Page 7-9	"The IM-3 system shall be turned off when the groundwater remedy	The IM-3 Decommissioning Plan is included as part of the DOI/PG&E Consent Decree and the Programmatic Agreement and is subject to DOI review and approval. We do, however, acknowledge that	The text referenced by this comment reflects the terms of the settlement agreement between the FMIT and DTSC. The text will be revised by adding the following sentence to Section 7.4 to clarify this (before		Comment resolved.		Comment resolved.	90% BOD Section 7.4, 1st paragraph.

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			equipment and facilities are in place and ready to start-up. The remedy equipment and facilities may include the NTH IRZ wells, the River Bank Extraction Wells, the freshwater wells, monitoring wells, the East Ravine/TCS wells, and the pipelines, controls, and electrical and mechanical systems needed to operate these wells. DTSC will issue to PG&E a written approval of the decommissioning of IM-3 directing PG&E to implement the DTSC and DOI-approved IM-3 decommissioning plan no later than 30 days after the following three items have occurred: a) DTSC determines that the groundwater remedy is achieving plume control; b) DTSC determines that the groundwater remedy is Operating	only DOI concurrence on DTSC's decision for the timing of IM-3 decommissioning is necessary. The text in this paragraph and subsequent items is confusing concerning authority with respect to acceptance of the remedy, acceptance of shutdown of IM-3, and the approval of the IM-3 Decommissioning Plan. Specific to item b in this section, the remedy must be determined concurrently by DOI, (as the CERCLA lead), and DTSC to be functioning properly and performing as designed for DOI to consider the remedy "operational and functional" in accordance with the NCP 300.435(f)(2) and DTSC to determine that the remedy is "Operating Properly and Successfully".	"Plume Control Criteria"): "<u>These procedures and criteria are set forth in the 2012 Settlement Agreement between the FMIT and DTSC.</u>" Additionally, PG&E understands that DOI must determine that the remedy is functioning properly and performing as designed for DOI to consider the remedy "operational and functional" in accordance with NCP 300.435(f)(2). The text will be revised to acknowledge this by adding the following sentence before the last sentence of Section 7.4: "<u>Additionally, with respect to step (b) above, DOI must concurrently determine the remedy to be functioning properly and performing as designed for DOI to consider the remedy "operational and functional" in accordance with the NCP 300.435(f)(2).</u>"					

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			Properly and Successfully (OPS) (unless DTSC determines, at its lawful discretion, that such decommission-ing can occur prior to DTSC's OPS determination); and C) After DOI concurs with the decommission-ing of IM-3, DTSC shall issue to PG&E a written approval of the decommissioni ng of IM-3 directing PG&E to implement the DTSC- and DOI-approved IM-3 Decommission-ing Work Plan."							
287	MWD-10	7.4/ 7-8 to 7-9	Phasing Alternatives/ Transition from Interim Measure to Final Remedy	Text indicates DTSC will approve decommissioning of IM-3 facilities based on, among other thing, the groundwater remedy Operating Properly and Successfully (OPS), unless DTSC determines decommissioning can occur prior to OPS. Is this discretionary disclaimer necessary? The decommissioning plan, to be submitted at the 90% Design, should not recommend decommissioning the IM-3 facilities until established metrics for the remedy criteria are met.	The text referenced by this comment reflects the terms of the settlement agreement between the FMIT and DTSC. In accordance with the agreement, the decommissioning plan will not recommend decommissioning of the IM-3 facilities until the Plume Control Criteria are met and DTSC determines that the groundwater remedy is achieving plume control, DOI determines that the remedy is operational and functional, and DOI concurs with DTSC's determination to decommission IM-3. The settlement agreement also provides, however that "DTSC' s determination of Plume Control . . . must be made concurrent with or after DTSC's OPS determination, ***unless DTSC in its lawful discretion, decides that decommissioning of IM-3 can occur prior to DTSC's OPS Determination;*** and DOI must concur with DTSC's	Because of the Tribal sensitivity of the IM-3 treatment plant location, DTSC may consider timing of the decommissioning activities in advance of OPS determination when the remedy demonstrates reasonable success but with clear evidence of protection of the Colorado River. However, DTSC will provide notice to all stakeholders of the intent to decommission the IM-3 plant prior to approval to implement the IM-3 decommissioning plan defined in the final remedy design (to be submitted with 90% design).			Comment resolved.	Not applicable

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					decision to decommission IM-3." (emphasis added).					
288	DOI-122	Section 7.6, Page 7-10	"Figure 7.6-1 shows a preliminary map of all temporary equipment staging areas and the yard, . . . "	According to the text, only a subset of the areas shown in Figure 7.6-1 would be used as staging areas. Recommend including a rectangle under the Notes for this figure depicting the area actually needed for staging, and identify the acreage. This information will be useful in evaluating selection of areas for staging.	Figure 7.6-1 has been revised to show acreage for the potential equipment staging and soil storage areas (see **Attachment G**, at the end of this table).		Comment resolved.		Comment resolved.	At this 90% stage, the full content of Section 7.6 (including Figure 7.6-1) has been incorporated into the Construction/Remedial Action Work Plan, where constructed related elements are presented in detail. See Section 4 and Figure 4-5 of the Construction/Remedial Action Work Plan for details.
289	DOI-123	Figure 7.6-1		Based on input from the Hualapai, Cocopah, Chemehuevi, Quechan, CRIT and Fort Mojave Indian Tribes, and considering the additional activity in the Refuge and adjacent to the Topock Maze, DOI requests that the BOR Quarry and former evaporation pond area no longer be considered as options for staging or soil storage during the groundwater remedy implementation. Additionally, BLM and San Bernardino County have discussed the potential use the OHV staging area within Park Moabi as a potential storage location for excess soil. PG&E has engaged with the County regarding the remedy and the use of similar areas around Park Moabi and should include this area as an option.	Figure 7.6-1 has been updated to remove the BOR Quarry and former evaporation pond area as options for staging or soil storage, and to add the OHV staging area within Park Moabi as a potential storage location for excess soil (see **Attachment G**, at the end of this table). In addition, the Old Gravel Pit/Current Paint Ball area was added as a potential soil storage area for evaluation.		Comment resolved pending review of 90% design.		Comment resolved.	At this 90% stage, the full content of Section 7.6 (including Figure 7.6-1) has been incorporated into the Construction/Remedial Action Work Plan, where constructed related elements are presented in detail. See Section 4 and Figure 4-5 of the Construction/Remedial Action Work Plan for details.
290	DTSC-115	Figure 7.6-1	Proposed staging areas, construction yard and access routes	Please note that environmental impacts have not been fully evaluated for the use of any staging areas outside of the final EIR project boundary.	The proposed staging areas are all located within the APE, and as noted in the EIR, the entire area of the APE was studied for impacts such as impacts to biological resources (see Final EIR exhibit 4.3-1 showing entire APE as biological study area) and impacts to cultural resources (see Final EIR exhibit 4.4-1 showing entire APE as cultural resources study area). The EIR states in the project description that staging areas would typically be located in areas that are already developed or disturbed, and that staging areas could be anywhere within the project area as shown in the EIR. (Final EIR, p. 3-21). All but three of the proposed staging areas are within the EIR project area. With respect to these three proposed staging areas, they are all located within the APE which was evaluated for impacts to biological	The proposed CEQA impact conclusion by PG&E may very well be appropriate; however, this formal analysis within the CEQA context for the three areas outside of the current project boundaries has not been conducted. PG&E's response is noted.		The Tribes request to be involved in any future cultural studies.	Comment and responses noted.	Not applicable.

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PG&E Topock Compressor Station, Needles, California

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					and cultural resources, and they consist of areas that have been previously developed or disturbed, consistent with the statement in the EIR project description. PG&E understands and anticipates that the use of these areas for staging would be evaluated as part of DTSC's CEQA evaluation of the final design. PG&E also anticipates that this review will demonstrate that the use of these areas does not involve new or substantially more severe environmental impacts compared to the evaluation in the Final EIR, given that the areas are previously developed or disturbed and have already been evaluated for impacts to cultural and biological resources.					
291	FMIT-44	Figure 7.6-1		The Tribe and PG&E appear to disagree about the timing of the DTSC-required restoration of the prior IM3 parking area. The Tribe believes that the directive from former DTSC Director Blevins remains in place, requiring the immediate restoration of that area. The settlement agreement between FMIT and PG&E could not override DTSC's direction. The Tribe objects to that area being proposed as a staging area in the design.	PG&E agrees with DTSC's interpretation that B.B. Blevins' March 8, 2005 letter regarding restoration of the staging area has been superseded by the settlement agreement between DTSC and the FMIT. In addition, the 2006 settlement agreement between PG&E and the FMIT, which addresses restoration of the IM-3 Site, also supersedes the prior direction in the 2005 letter. That settlement agreement states "upon decommissioning of the IM-3 treatment plant, PG&E will work in consultation with the Tribe to restore the IM-3 Site to pre-existing conditions to the maximum extent practicable, subject to the continued use of remedial facilities" and requires PG&E to consult with the FMIT regarding a plan for restoration of the IM-3 Site. (2006 Settlement Agreement § VII(A)(1).) The 2006 settlement agreement's provisions regarding restoration encompass the entire IM-3 Site, including the staging area. Section XII(H) of the 2006 settlement agreement expresses its intent to supersede other documents concerning the same subject matter: "This agreement supersedes all prior or written agreements, negotiations, discussions, understandings and representations between the Settlement Parties hereto and/or their respective counsel with respect	Comment noted regarding Tribe's objection to that area being proposed as a staging area in the design. See RTC #776 for related discussions of construction staging areas. DTSC wants to clarify its position regarding the March 8, 2005 Director Blevins' letter directing PG&E to meet certain timing deadlines for restoration of the IM3 staging area. DTSC believes that the 2006 Settlement Agreement between FMIT and DTSC supersedes Director Blevins' 2005 letter. Various sections of the Agreement, including paragraph V.M., that states that this "Agreement supersedes all prior oral or written agreements...between the parties hereto…." supports this position.			PG&E and the FMIT have discussed this comment and its response to the Tribe's comment.	Not applicable

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					to the subject matters covered hereby.”. . .					
Specific Comments – Section 8 (Cost Estimate)										
292	DTSC-116	Section 8		As stated, PG&E is required to update the financial assurance annually for the life of the project. DTSC is unaware of any financial assurance update since the April 5, 2011 approval by DTSC.	PG&E agrees that annual updates to financial assurance are required. PGE has provided a copy of the most recent financial assurance submittal dated March 28, 2013 to DTSC Topock project staff.	Okay. DTSC has accepted the 2013 FA filing.			Comment resolved.	Not applicable
293	DOI-124	Exhibit 8-1		No back-up is provided.	Appendix H (Updated Cost Estimate) contains the detailed cost estimates including basis of estimate, assumptions, etc.		Comment resolved.		Comment resolved.	90% BOD Appendix H.
294a	FMIT-45	Exhibit 8-1 p. 8-1	*“Post-Remediation Deconstruction, Year 41”*	The updated cost estimate for this project includes estimated costs for “deconstruction”. We understood that the timing of the remedy decommissioning plan would be near the end of the remediation time period. If so, then what assumptions were used to estimate these “deconstruction” costs?	Attachment E of Appendix H (pages 3419-3426 of the 60% BOD PDF) presents the assumptions used to estimate the deconstruction costs.			Comment resolved.	Comment resolved.	90% BOD Appendix H.
294b	Hualapai-31 Chemehuevi-31 Cocopah-31 CRIT-31	Exhibit 8-1 p. 8-1	*“Post-Remediation Deconstruction, Year 41”*	The updated cost estimate for this project includes estimated costs for “deconstruction”. We understood that the timing of any decommissioning plan would be near the end of the remediation time period. If so, then what assumptions were used to estimate these “deconstruction” costs?	See response to comment #294a FMIT-45.			Comment resolved.	Comment resolved.	90% BOD Appendix H.
Specific Comments – Appendix A4-A7 (Plants Survey Methodology Technical Memoranda and Plant Survey Reports)										
295	DOI-126	Appendix A4, Mature Plants Survey Report Page 6:		Salt cedar and Athel tamarisk are both described. There is no mention of Athel as an upland species, as found in the FWIP. These reports should be consistent. In describing salt cedar remove the following text, “DeLoach et al. (2000) have characterized the invasion of salt cedar as “one of the worst ecological disasters to impact riparian ecosystems of the United States displacing native plants, degrading wildlife habitat, and causing the decline of the threatened and endangered species””. Sher and Quigley (2013) challenge this representation and provide research to support it. Sher, Anna &Martin F. Quigley (ed). 2013. Tamarix: A case study of	The Mature Plants Survey Report is currently being revised. There was an attempt by the botanists to differentiate species of tamarisk found at the site (Tamarix ramosissima and T. aphylla). T. aphylla can be found in floodplains - text in the Mature Plants Survey Report will be revised to reflect that it is not entirely confined to uplands.		Comment resolved.		Comment resolved.	See the May 19, 2014 *Addendum to Mature Plant Survey Report for the PG&E Topock Compressor Station* included in Appendix A4 of the 90% BOD.

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				ecological change in the American West. Oxford University Press. New York, NY.						
296	DOI-127	Appendix A4, Mature Plants Survey Methodology, Page 7 of 7	References	The second and sixth references on the list are the same citation. Please revise.	Comment noted. Revising previously published documents for the sole purpose of revising reference list is however not warranted and not recommended. No changes are proposed.		Comment resolved.		Comment resolved.	Not applicable
297	DOI-128	Appendix A4, Mature Plants Survey Methodology, Page 7 of 7	References	The following items are included on the Reference list but are not referenced in the text: CH2M HILL 2005, Holland R. F. 1976, and Jepson Flora Project, 2010.	Comment noted. Revising previously published documents for the sole purpose of updating in-text citation is however not warranted and not recommended. No changes are proposed.		Comment resolved.		Comment resolved.	Not applicable
298	DOI-129	Appendix A4, Floristic Survey Methodology, Page 19 of 22	Field Surveys	CNPS (2001) was referenced in text. This reference format does not match that shown in the reference list. Please correct.	The reference format will be corrected.		Comment resolved.		Comment resolved.	Revising Appendix A4 for the sole purpose of revising reference format is not warranted. Therefore, no changes were made.
299	DOI-130	Appendix A4, Floristic Survey Methodology, Page 20 of 22	References	The following items are included in the Reference list but are not referenced in the text: CDNPA, 1981; CH2M HILL 2005; CH2M HILL 2007; Jepson Online Interchange (2011); SEINet, 2011; and USFWS 2000.	Comment noted. Revising previously published documents for the sole purpose of updating in-text citation is however not warranted and not recommended. No changes are proposed.		Comment resolved.		Comment resolved.	Not applicable
300	DOI-131	Appendix A4, Mature Plants Survey Report, Page 7	Hillside palo verde	The in-text citation reads “California Consortium of Herbaria” while in the reference section it is listed as “Consortium of California Herbaria”.	Comment noted.		Comment resolved.		Comment resolved.	Not applicable
301	FMIT-46 Hualapai-32 Chemehuevi-32 Cocopah-32 CRIT-32	Append A4	Technical Memoranda on Methodologies of Mature Plant Survey and Floristic Survey and the Mature Plants Survey Report	The Tribes requested that plant survey include the entire EIR project area. Now that this project area has been expanded based on a recent archeological survey conducted in the Spring 2013 is an addendum needed for the plant surveys to ensure that all of the plants within the new EIR project boundary have been properly accounted?	PG&E is updating the Mature Plants Survey report to include results from the Spring 2013 survey that covered the freshwater source implementation area, target for submittal is Q4 2013.			Comment resolved pending submittal of the Mature Plants Survey report.	Comment resolved. The revised Floristic Survey Report was submitted to DTSC and DOI on December 30, 2013, and included the Spring 2013 survey results of the freshwater evaluation areas in Arizona. In addition, the Ethnobotany Survey Report was also updated to include Spring 2013 survey results of the freshwater evaluation areas in Arizona, and submitted to DTSC and DOI on January 17, 2014.	See the May 19, 2014 *Addendum to Mature Plant Survey Report for the PG&E Topock Compressor Station* included in Appendix A4 of the 90% BOD.
302	FMIT-47 Hualapai-33 Chemehuevi-33 Cocopah-33 CRIT-33	Append A4 Memo p. 2 of 7	*The survey area encompasses the Project Area, totals approximately 780 acres, and varies in*	Does the plant survey cover the areas that will be included in the expanded APE due to the pending decision on freshwater source implementation?	PG&E is updating the Mature Plants Survey report to include the Spring 2013 survey that covered the freshwater source implementation area, target for submittal is Q4 2013.			Comment resolved pending submittal of the Mature Plants Survey report.	Comment resolved. The revised Floristic Survey Report was submitted to DTSC and DOI on December 30, 2013, and included the Spring 2013 survey results of the freshwater evaluation areas in	See the May 19, 2014 *Addendum to Mature Plant Survey Report for the PG&E Topock Compressor Station* included in Appendix A4 of the 90% BOD.

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			elevation from approximately 400 to 700 feet above sea level.						Arizona. In addition, the Ethnobotany Survey Report was also updated to include Spring 2013 survey results of the freshwater evaluation areas in Arizona, and submitted to DTSC and DOI on January 17, 2014.	
303	DOI-132	Appendix A5, Section 1, Page 1-1		The in-text citation for DTSC, 2011 is not listed in the Reference section.	Comment noted. The missing reference will be added.		Comment resolved.		Comment resolved.	See the December 30, 2013 *Topock Groundwater Remediation Project Revised Floristic Survey Report* included in Appendix A5 of the 90% BOD.
304	DOI-133	Appendix A5, Section 4.3, Page 4-3	"The surveys were floristic and comprehensive in nature…".	The in-text citation for Jepson Online Interchange, 2011 in this section is different than the in-text citation found on Page 5-2.	Comment noted. The in-text citation will be revised.		Comment resolved.		Comment resolved.	See the December 30, 2013 *Topock Groundwater Remediation Project Revised Floristic Survey Report* included in Appendix A5 of the 90% BOD.
305	DOI-134	Appendix A5, Section 5.4, Page 5-3		The in-text citation for DTSC, 2011 is not listed in the Reference section.	Comment noted. The missing reference will be added.		Comment resolved.		Comment resolved.	See the December 30, 2013 *Topock Groundwater Remediation Project Revised Floristic Survey Report* included in Appendix A5 of the 90% BOD.
306	DOI-135	Appendix A5, Section 6, Page 6-1		The following items are included in the Reference list but are not referenced in the text: Calflora, 2012; and USFWS 2000.	Comment noted. The references will be deleted.		Comment resolved.		Comment resolved.	The subject items are retained on the Reference list because: 1) USFWS 2000 was referenced in Section 4.5, 1st sentence. 2) Calflora 2012 was referenced in Appendix A (page 45 of the PDF).
307	DOI-136	Appendix A5, Section 6, Page 6-1		The citation for "Southwest Environmental Information Network, SEINet. 2011." should be revised to "Southwest Environmental Information Network (SEINet). 2011."	Comment noted. The citation text will be revised.		Comment resolved.		Comment resolved.	See the December 30, 2013 *Topock Groundwater Remediation Project Revised Floristic Survey Report* included in Appendix A5 of the 90% BOD.
308	DOI-137	Appendix A5, Appendix F, Page F-1	"Under Mitigation Number CUL-1a-5 in the mitigation monitoring and reporting program . . . "	The in-text citation for DTSC, 2011 is not listed in the Reference section.	Comment noted. The missing reference will be added.		Comment resolved.		Comment resolved.	See the December 30, 2013 *Topock Groundwater Remediation Project Revised Floristic Survey Report* included in Appendix A5 of the 90% BOD.
309	DOI-138	Appendix A5, Appendix F, Page F-1	Mitigation for Special-status plants	The in-text citation for Baldwin et al. 2012 is not listed in the Reference section.	Comment noted. The missing reference will be added.		Comment resolved.		Comment resolved.	See the December 30, 2013 *Topock Groundwater Remediation Project Revised Floristic Survey Report* included in Appendix A5 of the 90% BOD.
310	DOI-139	Appendix A6, Page 6	References	The following item is included in the Reference list but is not referenced in the text: CDFG 2012.	Comment noted. Revising previously published documents for the sole purpose of updating in-text citation		Comment resolved.		Comment resolved.	Not applicable

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					is however not warranted and not recommended. No changes are proposed.					
311	DOI-140	Appendix A-7, Ethnobotany Survey Report.	General Comment	Is Lycium considered an ethnobotanical or culturally significant? Anderson's desert thorn (Lycium andersonii) is only mentioned on page 2-1 as a component of the Blue palo verde woodland community, but is not listed as a plant in the EIR Appendix PLA. It produces edible berries and may have been used as a food source.	Culturally significant plants for the survey of culturally significant plants were those species that were included in Appendix PLA of the Final EIR. PG&E will survey for Lycium and include the survey results in the 90% BOD.		Comment resolved pending review of 90% design.		Comment resolved.	See the February 28, 2014 *Supplemental Ethnobotanical Plant Surveys for the PG&E Topock Compressor Station* included in Appendix A7 of the 90% BOD.
312	DOI-141	Appendix A-7, Appendix A: Target List of Culturally Significant Plant Species from Appendix PLA of the EIR with the Potential to Occur in the Project Area		Arrowweed is not identified as a plant of cultural significance in this report but it should be.	Comment noted. Surveys for culturally significant plants included only those species that were included in Appendix PLA of the Final EIR; Arrowweed was not included on this list. See response to comment #83 DOI-34. PG&E will survey for Arrowweed and include the survey results in the 90% BOD.		Add a footnote to Figure 2.4-11 noting that the tribes have recently (June 2011) stated that Arrow weed is an ethnobotanical plant. Comment resolved pending review of 90% design.		The following note will be added to Figure 2.4-9 and similar maps in the 90% BOD: "Tribes have stated that Arrow weed is an ethnobotanical sensitive plant (June 2011). Arrow weed however is not on the Appendix PLA of the FEIR. Arrow weed will be protected during construction as a mature plant under AES-1a".	See the February 28, 2014 *Supplemental Ethnobotanical Plant Surveys for the PG&E Topock Compressor Station* included in Appendix A7 of the 90% BOD.
313	DOI-142	Appendix A-7, Ethnobotany Survey Report. Section 2.1.2, Page 2-1	Tamarisk thicket is primarily found on the low sandy terraces adjacent to the Colorado River and Park Moabi Slough. This vegetation type is also found near the terminus of the larger ephemeral washes associated with the dissected terraces south of the Colorado River'. (Same text appears in the Final Floristic Survey Report, Section 2.1.2, page 2-1)	Athel tamarisk is described. There is no mention of Athel as an upland species, as found in the FWIP. These reports should be consistent.	The Ethnobotany Survey Report is currently being revised. There was an attempt by the botanists to differentiate species of tamarisk found at the site (Tamarix ramosissima and T. aphylla). T. aphylla can be found in floodplains - text in the report will be adjusted to reflect that it is not entirely confined to uplands.		Comment resolved.		Comment resolved.	See the January 15, 2014 *Topock Groundwater Remediation Revised Ethnobotany Survey Report i*ncluded in the Appendix A7 of the 90% BOD.
314	DOI-143	Appendix A7, Section 4.2, Page 4-1		The in-text citation for USFWS 2011 is not listed in the Reference section.	Comment noted. The in-text citation will be added to the reference list.		Comment resolved.		Comment resolved.	The January 15, 2014 *Topock Groundwater Remediation Revised Ethnobotany Survey Report* did not cite USFWS 2011;

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										therefore, that citation is not included in the Reference list.
315	FMIT-48 Hualapai-34 Chemehuevi-34 Cocopah-34 CRIT-34	Append A7 Section 5.3 p. A7-5-3	*Additional floristic surveys will be completed in the spring of 2013 to focus on areas where culturally significant herbaceous plant species are most likely to be present within the Project Area.*	When will the results of the 2013 survey be incorporated into the previous plant surveys?	See response to comment #302 FMIT-47.			Comment resolved pending submittal of the Mature Plants Survey report.	Comment resolved. The revised Floristic Survey Report was submitted to DTSC and DOI on December 30, 2013. The revised report expanded on the previous plant survey report (which covers the 2011/2012 surveys), and included the Spring 2013 survey results of the freshwater evaluation areas in Arizona.	See the May 19, 2014 *Addendum to Mature Plant Survey Report for the PG&E Topock Compressor Station* included in Appendix A4 of the 90% BOD.
316	FMIT-49 Hualapai-35 Chemehuevi-35 Cocopah-35 CRIT-35	Append A7 Append-E of A7 (Avoidance and Restoration Plan for Significant Plant Species") P. A7-E-2	*Topsoil salvaged from short-term disturbance areas should be piled to no more than 4 feet high and stabilized to prevent loss during storage.*	It is not clear however how the 4-foot maximum depth was determined. Will surface soils stored at the bottom of a 4 foot stock pile be able to preserve the biological integrity of the soils for extended durations? It is requested that PG&E provide a technical memorandum outlining options for how the biological integrity will be ensured during short- and long-term soil storage.	The height of the stockpile was determined based on the ability of the stockpiled soil to maintain viable seeds and nutrients. The American Association of State Highway and Transportation Officials (AASHTO) developed The Compendium of Environmental Stewardship Practices in Construction and Maintenance <http://environment.transportation.org/environmental_issues/construct_maint_prac/compendium/ best practices/> which includes thousands of individual practices used by DOTs across the country. Through a peer review vetting process, a number of practices in the Compendium have been identified as Best Practices. In Chapter 4 Section 4.11.1 under Soil Management Practices, the maximum depth of soil stockpiles is recommended to be no more than 4 feet: "When stockpiling topsoil, mound soil no higher than 1.3 m (4 feet) high for less than 1 year. Cover to prevent soil erosion and contamination by weeds." (See attached PDF). However, a literature review of soil stock piling (Strohmeyer 1999) suggest that adverse effects may occur in soil stockpiles greater than one meter (3 feet) deep. Therefore the cited text will be revised to indicate the temporary topsoil stockpiles will not exceed a depth of 3 feet. This new specification for top soil			Comment resolved.	Comment resolved.	CIMP Appendix A (Mitigation and Monitoring Plan for Culturally Significant Plants), Section 2.3.1 2nd paragraph.

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					storage will be incorporated into the 90% BOD. Based on the insignificant amount of top-soil anticipated to be stored, PGE does not believe that a technical memorandum is warranted.					
Specific Comments – Appendix A8 (Supplemental Baseline Sound Level Measurement Technical Memorandum)										
317	FMIT-50 Hualapai-36 Chemehuevi-36 Cocopah-36 CRIT-36	Append A8		There needs to be a narrative that explains how these baseline data will be used in any decision-making process(es), and as a part of Mitigation Measures NOISE-1, NOISE-2 or NOISE-3.	The purpose of the supplemental sound data (collected in 2012 and 2013) was to augment the then existing noise data set (collected during the EIR development period) which is comprised of data collected over a single 15-minute period in December 2008 at the short-term measurement locations in the FEIR (shown in Exhibit 4.9-2 as ST-1, ST-2, and ST-3). As with other existing environmental conditions (e.g., water quality, site topography, vegetation communities, etc.), the purpose of the data is to document site conditions prior to remedy implementation. In compliance with mitigation measure NOISE-1 and NOISE-2, PG&E has designated disturbance coordinators who will manage any project-related complaints. In addition, PG&E will comply with mitigation measure CUL-1a-8h, protocols to reduce auditory impacts as part of the future CIMP. The above noise data is available for use, if needed and as appropriate. See also response to TRC's (Charlie Schlinger) memorandum dated December 10, 2013, included in **Attachment H**, at the end of this table.	The noise data collected for the EIR was used to determine the threshold sound energy for the project. No additional decisions will be made based on the long term or short term survey results.		Comment resolved. Tribal concerns regarding noise may be different than applied regulatory standards.	Comment resolved. PG&E will insert the Appendix A8 RTCs at the end of Appendix A8.	Appendix A8 RTCs at the end of Appendix A8.
318	FMIT-51 Hualapai-37 Chemehuevi-37 Cocopah-37 CRIT-37	Append A8		A tabular inventory and map of noise source locations (inclusive of sound power levels, with time dependencies noted) is needed in order to assess the noise impact(s) of this project. There should be an inventory and map for each of the construction and operational periods.	Comment noted. This information will be provided at 90% BOD once the infrastructure locations/ alignment are settled. See also response to TRC's (Charlie Schlinger) memorandum dated December 10, 2013, included in **Attachment H**, at the end of this table.			Comment resolved pending review of the 90% design.	Comment resolved.	90% BOD Appendix D, Table D1-13.
319	FMIT-52 Hualapai-38 Chemehuevi-38 Cocopah-38 CRIT-38	Append A8		It is not clear whether and how the selection and specification of noise-generating equipment, such as transformers, above-ground pumps, and motors, etc., will utilize noise-restrictive criteria.	The majority of pumps and motors will be located either underground, inside a well, or inside an enclosure (e.g., building). Power supply equipment/backup generator also will be located inside enclosures or buildings. Placing pumps, motors,			Comment resolved pending review of the 90% design.	Comment resolved.	Not applicable

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					and power supply/ backup generators in these locations effectively minimizes the sound emissions. The remaining non-emergency above ground equipment is limited to transformers which are similar in size to the one already operating at IM-3, and communication/control panels. Selection of this equipment will be reviewed by the Noise Engineer for conformance with the noise design criteria (see Section C.11). See also response to TRC's (Charlie Schlinger) memorandum dated December 10, 2013, included in **Attachment H**, at the end of this table.					
320	FMIT-53 Hualapai-39 Chemehuevi-39 Cocopah-39 CRIT-39	Append A8		The important effect(s) of meteorological conditions on the long-range propagation of sound should be addressed.	Meteorological effects are most pronounced for elevated sources or very loud sources, particularly those with strong low frequency content (such as a train). The operational sources of noise associated with this project are primarily located within buildings or underground, therefore their sound emissions are minimized and are not elevated. This project does not utilize equipment which is known to emit high levels of low frequency noise (such as train engines or unsilenced simple-cycle combustion exhaust stacks). See also response to TRC's (Charlie Schlinger) memorandum dated December 10, 2013, included in **Attachment H**, at the end of this table. Below is PG&E's response to the suggested language to close this comment: 1. The methodology for noise measurement in Topock Project Sound Level Measurements Protocol complies San Bernardino County Code 83.01.080(a) – Noise Measurement, and the EIR. The County requirements include the use of a sound level meter that meets ANSI standard, Type 1 or 2, and use the "A" weighted sound pressure level with unit of measurement as dB(A). The dB(A) is the sound pressure level as measured on a meter using the A-weighting filter	DTSC recognizes that meteorological conditions generally have the potential to result in increased, or decreased, noise exposure at known sensitive receptors. CEQA requires lead agencies to consider whether a project would have a substantial permanent increase in ambient noise levels above levels existing without the project, or a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project. Here, construction noise for the project was appropriately identified as a potentially significant impact and mitigation measures were imposed in "Mitigation Measure NOISE-2: Project Generated Construction-Related Noise Levels". This issue will be considered further if needed based on the final design.		. See the following language in the Hualapai Tribe's letter (3/10/14) – Use the following language for closure of this comment: 1. Revise the noise measurement protocol in consultation with the Tribes. Specifically, the protocol needs to include the collection and archiving of noise measurements that include spectral content (noise level as a function of frequency, which consists of unfiltered and un-weighted, or un-averaged, raw data, aka band spectra), and noise recordings accompanied by a spoken or written narrative addressing what noise and sounds are being heard. 2. Following the above revised protocol, collect additional noise data during the summer and early winter of 2014. 3. Adopt the protocol for use on the project, going forward.	Written comments on the responses to this comment were received from the TRC (Charlie Schlinger) on November 15, 2013. PG&E provided a response to the written comment on December 10, 2013 (see memo included in **Attachment H**, at the end of this table). The TRC (Charlie Schlinger) presented draft proposed language to this comment at the February 11, 2014 TWG meeting. On March 10, 2014, the Hualapai Tribe provided a letter with language to close out the unresolved noise and vibration-related comments (see **Attachment H**, at the end of this table).	CIMP Noise Protocol CUL-1a-8h.

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					network. Noise standards are expressed as Leq which is the equivalent energy level of a time varying signal over a given period of time, typically, 1, 8, or 24 hrs. Further, the EIR identified the applicable criteria as A-weighted. There is no technical or regulatory basis to revise the measurement protocol or to further clarify the existing sources. For the above reasons, PG&E believes that it is not necessary to collect additional measurements or noise recordings to be consistent with the EIR. However, PGE recognizes the importance of the area to the Tribes, and should a concern about the actual noise generated by remedy operations arise, PG&E will work with the Tribes, agencies, and stakeholders to thoroughly investigate and resolve the issue appropriately . 2 & 3. See response to #1 above.					
321	FMIT-54 Hualapai-40 Chemehuevi-40 Cocopah-40 CRIT-40	Append A8 p. 1 and Figure 1	*The sound measurement locations were selected near the short term measurement locations in the Final Environmental Impact Report (FEIR) (DTSC,2011).*(shown in Exhibit 4.9-2 as ST-1, ST-2, and ST-3) (see Figure 1)	The three sites, ST-1, ST-2 & ST-3, have quite different levels of background sound levels and time—distributions, but this is not discussed. The report as it stands provides practically no quantitative evidence about the nearby noise sources and their (expected/measured) spatial contribution to the background noise. Such information is crucial to properly analyze and understand the highly variable background noise which was measured across the three sites. Further, it is unclear as to why these sites were chosen. *"PGE asked for clarification of this comment prior to response. The following clarification of comment was obtained from TRC on October 17, 2013. Response addresses the clarified comment.* *It is unclear what the data entries included in Appendix A8 Tables (1 & 2) represent? It is assumed that these data represent averages of other numbers presumably numbers in the Appendices (C-H) of Appendix A8. Please confirm if this assumption is*	American National Standards Institute (ANSI) S1.4 Type 1 (precision) sound level meters were used to monitor ambient sound levels. The sound level meters were programmed to report the average (L_{eq}) and statistical sound level metrics (Leq, L50, and L90) at hourly intervals. The sound level meters continuously monitor the sound levels during each hourly interval and automatically calculate and report the average and statistical levels at the conclusion of the hourly interval. This process repeats continuously until the meters are manually turned off or the batteries are depleted and	A specific rationale for the selection of individual sites for noise measurements was not provided in the Groundwater Final EIR. Based on the locations of the monitoring locations, the following can be inferred: ST 1 was chosen for its proximity to Maze Loci A; ST 2 was chosen for its proximity to Maze Loci C; ST 3 was chosen for its proximity to residences and traffic intersection at Park Moabi; LT A was chosen to provide ambient noise data from I-40; and LT B was chosen to provide ambient noise data from the BNSF rail line. It can also be inferred from the text in the Final EIR that the five locations were identified in recognition of the existing noise environment associated with the site (i.e., the diversity of background sound levels that exist on the site) and the existing noise-sensitive land uses. Further, because		The Tribe was not involved in the selection of the sites in the FEIR and the 2012-2013 study. The Tribe also note that there is no noise monitoring plan. See the following language in the Hualapai Tribe's letter (3/10/14) – Use the following language for closure of this comment: 1. Revise the noise measurement protocol in consultation with the Tribes. Specifically, the protocol needs to include the collection and archiving of noise measurements that include spectral content (noise level as a function of frequency, which consists of unfiltered and un-weighted, or un-averaged, raw data, aka band spectra), and noise recordings accompanied by a spoken or written narrative addressing what noise and sounds are being heard. 2. Following the above	Written comments on the responses to this comment were received from the TRC (Charlie Schlinger) on November 15, 2013. PG&E provided a response to the written comment on December 10, 2013 (see memo included in **Attachment H**, at the end of this table). The TRC (Charlie Schlinger) presented draft proposed language to this comment at the February 11, 2014 TWG meeting. On March 10, 2014, the Hualapai Tribe provided a letter with language to close out the unresolved noise and vibration-related comments (see **Attachment H**, at the end of this table).	Not applicable

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				correct. In addition it is not clear what the numbers in Appendices C-H represent? Presumably, they too are "averages" of other numbers - these latter numbers probably being what was actually measured. Please provide additional detail that allows the reader to understand what was actually measured and for what duration(s). That is, what are the basic measurements for this baseline sound characterization, and what "averaging" methods were used to develop the tabular summary information?	the meter automatically turns off. Appendices C through H present the data reported by the sound level meters in tabular and graphical format. The data in Table 1 is a summary of the data presented in Appendices C through H. Table 1 presents the maximum and minimum hourly Leq sound pressure level and corresponding wind speed for each monitoring location during both the daytime (7 a.m. to 10 p.m.) and nighttime (10 p.m. to 7 a.m.) periods for both the summer and winter monitoring events. For example, the data presented in Appendix C (ST-1, August 2012) was reviewed to identify the maximum and minimum L_{eq} during the daytime and nighttime periods. These maximum and minimum levels were summarized for in Table 1 along with the wind speed that occurred during those maximum and minimum periods for ST-1 during August 2012. Table 2 presents the same sound pressure level data that is in Table 1 alongside the data collected from the 2008 EIR (the wind speed which was reported in Table 1 was omitted from Table 2 to enhance readability of Table 2). Table 2 shows that the short-term data collected for the 2008 EIR is within the range of the longer-term data collected over both a summer and winter period. Had the 2008 EIR sound level data fallen substantially outside the range of that recorded during this longer term monitoring event, its reproducibility could have been questioned. This did not occur. That is, there was nothing anomalous or spurious occurring during the time the sound level data reported in the 2008 EIR was collected.	intervening topography exists between the compressor station and other portions of the project areas in the form of mesas that generally shield noise-sensitive receptors from full exposure of current on-site operations, multiple representative sites for ambient noise measurements were necessary. To accurately describe potential noise related impacts, the Final EIR used the ambient noise survey data from the individual locations to determine impacts to nearest sensitive receptors from the proposed project (i.e., the data collected for the three sites was not averaged). The normalization of the data described above, was conducted for individual sites only.		revised protocol, collect additional noise data during the summer and early winter of 2014. 3. Adopt the protocol for use on the project, going forward.		
				Site selection is a critical matter when it comes to developing a baseline. In the case of noise on this project, 3 sites were selected, with very little basis/justification provided in the FEIR. (The initial response to comments for this comment goes a long way in providing some explanation, but it is not complete, as	These sites were chosen by the EIR preparer for noise measurements because mesas that generally shield noise sensitive receptors from full exposure of operations that were occurring when the EIR was prepared, exist between the compressor station and other portions of the project areas (see FEIR, page 4.9-5). Additional data					

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				ST-1 and ST-2 are indeed located on "mesa" tops (upland areas) and one, ST-3, is located down off of the "mesa", at a street intersection.) Please provide additional detail regarding what is it about these sites that is representative and meaningful when it comes to baseline noise measurements? Why are these locations appropriate for developing the baseline sound characterization? *The reporting in Appendix A8 is too clinical and terse; there are no more than a half-dozen sentences given to the discussion of results, mainly with an eye toward wind effects on noise measurements. While there are essential footnotes related to measured wind speed, which is highly relevant to noise measurements, there is no interpretation and discussion of the numerical values in Tables 1-2, or in the Tables in Appendices C-H in terms of individual site location and proximity to known noise sources, time of day, actual noise from these sources, season, atmospheric conditions, topographic conditions, or any other factor known to influence the measurements.* *There needs to be clear communication, in the design documents, of how these most recent noise data, together with the FEIR noise data collected in 2008, will be used as part of the project design.*	was collected in proximity to these sites in 2012 – 2013. Agencies, Tribes, and Stakeholders were informed of this selection as documented in the *Sound Level Measurements Protocol Technical Memorandum* (Appendix B to the 60% BOD Appendix A8). See also response to comment #322 FMIT-55/Hualapai-41. The *Sound Level Measurements Technical Memorandum* in Appendix A8 is intended to report the supplemental data collected during the 2012-2013 event. Since the existing site conditions (e.g., noise environment, topographic condition) are well documented in the FEIR, that body of information is intentionally not repeated in this technical memorandum. If helpful, additional references to the FEIR can be added to this technical memorandum. See responses to comment #317 FMIT-50/Hualapai-36 and #319 FMIT-52/ Hualapai-38, as well as TRC's (Charlie Schlinger) memorandum dated December 10, 2013, included in **Attachment H**, at the end of this table. For PG&E's response to suggested language to close this comment, see RTC #320.					
322	FMIT-55 Hualapai-41 Chemehuevi-41 Cocopah-41 CRIT-41	Append A8 p.1 and Photo 1 & 2		The 60% BOD Report Appendix A-8 noise measurement locations are reported to be "near" and "in proximity to" the certified EIR noise measurement locations. The meanings of these terms are ambiguous and need clarification. Why were the certified EIR noise measurement locations not used?	Precise GPS locations were not available for the locations used in the certified EIR. The 2012 – 2013 noise measurement locations were selected based on their suitability for a longer term noise measurement. All of these locations are within approximately 100 feet of the EIR noise measurement locations and are well within the same acoustical environment.			The Tribes were not involved in the selection of the sites in the FEIR and the 2012-2013 study. The Tribes also note that there is no noise monitoring plan.	This comment and response were discussed at the October 16-17, 2013 TWG meeting. Comment resolved.	Not applicable
Specific Comments – Appendix B (Development of Groundwater Flow, Geochemical, and Solute Transport Models) and Sections 3.1 and 3.2										
323	DOI-144	Appendix B	General Comment	It is recommended that an executive summary be prepared that discusses and summarizes the main points of the modeling. Findings and recommendations should be	An executive summary will be prepared to summarize the main points in the modeling and will serve as an introduction to Appendix B in the 90% Design Submittal.		Comment resolved pending review of 90% design.		Comment resolved.	90% BOD Apdx B, Executive Summary

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				highlighted so the reader is aware of what will be implemented and how the findings will be incorporated into the remedial program design.						
324	DOI-145	Section 2.4, Page 7	"Specifically, this involves the simulation of native microorganisms through the delivery of a degradable source of organic carbon, . . . "	What types/species of microorganisms are present at the Topock site?	The pilot tests conducted at the Topock site demonstrated that the bacteria capable of generating the reducing conditions required for chromium reduction are present. The data generated in the pilot studies indicated that aerobic bacteria, denitrifiers, manganese reducers, iron reducers, sulfate reducers, and methanogens are present and were stimulated by the addition of lactate and ethanol at the site. Further analysis of which species of bacteria are present was not conducted and is not necessary to design or implement the remedy. A reference to where the pilot tests are discussed in Section 3 will be added to this section.		Comment resolved pending review of 90% design.		Comment resolved.	90% BOD Apdx B Section 2.4
325	DOI-146	Section 2.4, Page 8	"Note that the reduction of chromate is thermodynamically more favorable than the reduction of Mn(III/IV), Fe(III), and $SO4^{2-}$[S(VI)]; therefore, it is not theoretically necessary to achieve manganese-, iron-, or sulfate-reducing conditions in order to reduce Cr(VI)."	It has been reported that Cr(III) will oxidize to Cr(VI) in the presence of Mn(IV) oxides. Could this possibly occur at the Topock site? Please discuss.	The issue of re-oxidation of Cr(III) precipitated during in-situ remediation to Cr(VI) by manganese oxides was evaluated extensively as part of the Corrective Measures Study/Feasibility Study in conjunction with the Technical Working Group and members of the United States Geological Survey. The oxidation of naturally occurring Cr(III) to Cr(VI) is responsible for the natural background concentration of Cr(VI) in groundwater. This oxidation process is anticipated to convert Cr(III) precipitated by in-situ remediation. However, the rate and extent of oxidation is anticipated to be limited to background levels by two key factors: the limited solubility of Cr(III) and the lack of reactivity of the manganese oxides in an IRZ area. Thus, the conclusion of the analysis of the CMS/FS was that "The degree of reversibility of the Cr(VI) reduction reaction is expected to ultimately result in Cr(VI) concentrations at levels similar to ambient Cr(VI)" (Table 5.5 of the CMS/FS). A detailed analysis of this topic was presented in Appendix G, Section 7 of the CMS/FS. Text will be included in the 90% BOD		Comment resolved pending review of 90% design.		Comment resolved.	90% BOD Apdx B Section 2.4

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					to reflect this response.					
326	DOI-147	Section 2.4, Page 8	"The goal within the IRZ is to make the reducing environment strong enough that the desired reduction reactions are achieved, without making it so strong as to drive unnecessary or undesirable reduction reactions that may generate byproducts (discussed below)."	What monitoring program will be established to ensure this occurs? Please reference the appropriate sections in the Sampling and Analysis Plan for details on monitoring.	The following text will be added to this paragraph in the 90% Design Submittal: "An extensive monitoring program will be implemented to ensure that this is accomplished; namely, that Cr(VI) reduction is complete, while byproduct generation is minimal and controlled (see NTH IRZ data quality objectives in Appendix L, Volume 2, Section 2.2.1 and monitoring program details in Appendix L, Volume 2, Section 4)."		Comment resolved.		Comment resolved.	90% BOD Apdx B Section 2.4
327	DOI-148	Section 3.2, Page 12	"These results demonstrate that byproduct generation is directly related to the strength of the reducing environment created. The reducing environment can be adjusted to minimize byproduct liberation without negatively impacting Cr(VI) reduction by properly controlling organic carbon dosing and distribution."	How will the reducing environment and byproduct liberation be monitored and adjusted? Please reference the appropriate sections in the Sampling and Analysis Plan for details on byproducts.	The following text will be added to this bullet in the 90% Design Submittal: "These relationships between TOC dosing and byproduct generation will be verified during remedy implementation. Specifically, an extensive monitoring program will be implemented to assess Cr(VI) treatment, TOC consumption, and byproduct generation as the remedy proceeds (see NTH IRZ data quality objectives in Appendix L, Volume 2, Section 2.2.1 for the NTH IRZ, and monitoring program details in Section 4, Appendix L, Volume 2)."		Comment resolved.		Comment resolved.	90% BOD Apdx B Section 3.2
328	DOI-149	Section 3.4.1, Page 13	"These results also highlight the importance of a sustained TOC concentration to achieve	With river deposits, it is anticipated that varves of differing grain sizes may be present. The occurrence of varves may cause fingering of TOC injections. How does PG&E plan on addressing this potential issue?	Injected fluids will migrate within the unconsolidated aquifer materials according to natural preferential pathways defined by permeability heterogeneity. These pathways will be the same for Cr(VI) migration. The river deposits (fluvial deposits) have		Comment resolved.		Comment resolved.	90% BOD Apdx B Section 3.4.1

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			Cr(VI) treatment, . . . “		a lesser degree of such heterogeneity than the alluvial deposits based on descriptions of cuttings from boreholes drilled for monitoring wells. In addition, variability in transport and reagent distribution will be assessed in the monitoring program through monitoring of TOC dose-response (see Appendix L, Volume 2: NTH IRZ data quality objectives, Section 2.2.1 and monitoring program details in Section 4). Specifically, if aquifer heterogeneity results in incomplete Cr(VI) treatment with TOC amendments, operational adjustments will be made to improve performance.					
329	DOI-150	Section 3.4.1, Page 14	“Cases where high ORP was observed in the presence of TOC, particularly in the upland ISPT (e.g., PT-7S), were likely due to the mixing of treated and untreated water, as well as the time required for initial establishment of a reducing environment with an active microbial community.”	What is the anticipated time period for establishment of an active microbial community?	Upon initial introduction of organic carbon into a new area, the stimulation of microbial activity of the indigenous population of microorganisms present will be almost immediate. The growth of that initial population into the mature microbial community takes several weeks.		Comment resolved.		Comment resolved.	Not applicable
330	FMIT-56 Hualapai-42 Chemehuevi-42 Cocopah-42 CRIT-42	Append B Section 3.4.2 p. 15	TOC Degradation Half- Life	TOC half-life will be affected by the presence of dissolved nitrate. When the nitrate plume is hydraulically pushed through the IRZ line, the system could perform differently than predicted by the TOC degradation half-life of 20 days. When will the nitrate plume arrive at the IRZ line? Can the model provide such a forecast?	See response to #62a FMIT-19.			See response to #62a FMIT-19.	Comment resolved (see also #62a FMIT-19.)	O&M Manual Volume 2 Section 4.2.1 O&M Manual Volume 2 Table 2.1-2
331	DOI-151	Section 3.4.2, Page 15	“This is a reasonable assumption based on data developed	The discussion focuses on the expected half-life of TOC. The information in this paragraph maintains that research conducted at	Similar to the Topock site pilot tests, injection of lactate and ethanol stimulated the activity of aerobic bacteria, denitrifiers, manganese reducers, iron reducers and sulfate		Comment resolved pending review of the 90% design.		Comment resolved.	90% BOD Apdx B Section 3.4.2

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			from the Hinkley site, . . . "	the Hinkley site is applicable to the Topock site. Are the microorganisms found at the Hinkley site similar to or the same as the microorganisms present at the Topock site?	reducers at Hinkley. At Hinkley, the degradation rates of lactate and ethanol were similar, supporting the assumption made in the modeling at Topock that the degradation rates of lactate and ethanol are similar. Microbial activity at both sites were able to develop sufficient reducing conditions to successfully reduce Cr(VI). Additional detail on the use of lactate and ethanol at the Hinkley site will be added to the text.					
332	DOI-152	Section 3.4.4, Page 16	" . . . indicate a mobile porosity of 12%."	How will precipitation of chemicals in response to geochemical reactions impact mobile and immobile porosity?	Precipitation of minerals will not have a noticeable impact on porosity or permeability within the aquifer. This issue was investigated in the Corrective Measures Study/Feasibility Study Report for Chromium in Groundwater (December 2009), with permeability reduction calculation results provided in Appendix G, Section 4.4 of that report. Specifically: "The amount of additional total Cr that will be added by the in-situ treatment is very small compared to the naturally-occurring concentration of total Cr in the soil... [which would] result in a porosity reduction of 1.3E-5 (absolute), a level that will have a negligible effect on aquifer permeability for any of the mobile porosities noted..."		Comment resolved.		Comment resolved.	Not applicable
333	DOI-153	Section 4, Page 18, 1st paragraph		During use of the PEST program, how was each parameter designated (e.g., adjustable, fixed, or linked)?	The horizontal hydraulic conductivity, the ratio between horizontal and vertical hydraulic conductivity, and the river bed conductance were adjusted within reasonable ranges, and final values were accepted based on both PEST output and professional judgment. The remainder of the model parameters were fixed to values from site characterization or determined during manual calibration.		Comment resolved.		Comment resolved.	Not applicable
334	DOI-154	Section 4, Page 18, 1st paragraph		The PEST program allows optimum parameter values to be constrained between individually-specified upper and lower bounds. How were specific upper and lower bounds chosen, and on what data were they based?	The bounds were chosen based on professional judgment, given previous non-PEST analyses of aquifer test data, observed drilling cores and well logs, and general hydrogeologic knowledge of parameter ranges. These bounds started as broad values and were		Comment resolved.		Comment resolved.	Not applicable

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					constrained as deemed necessary in subsequent PEST runs.					
335	DOI-155	Section 4, Page 18, 1st paragraph	"Groundwater budget was developed from regional river gradient and estimates of precipitation recharge, subsurface inflow beneath major and minor washes, evapotranspiration, and subsurface outflow."	What data was used to calculate evapotranspiration? Was the data site-specific?	Presented in 2005 Groundwater Flow Model Update Report (Section 2.5.2). The evapotranspiration (ET) rate was not designed to correspond to published plant ET rates, but as a value averaged over nodal areas which consist of both bare soil along with plant growth. The value of 9.59e-04 ft/d was assigned to areas where plant growth is obvious from field conditions and aerial photographs. This value assumes a roughly 10-20% ground cover for each nodal area and average ET values published for several species typical to this region including Fourwing Saltbrush, Salt Cedar, Arrowweed, and Quailbrush (Mc Donald, Charles C., and Gilbert H. Hughes. 1968. *Studies of Consumptive Use of Water by Phreatophytes and Hydophytes Near Yuma, Arizona*. Water Resources on Lower Colorado River Salton Sea Area. USGS Paper 486-F, Washington, DC.; Gay, Lloyd W. 1986. Water Use by Saltcedar in an Arid Environment. p.855-862. In Karamouz, Mohammad., George R. Baumli, and William J, Brick. Water Forum '86: World Water Issues in Evolution. Volume 1. American Society of Civil Engineers, New York, NY.). An extinction depth of 10 feet was assigned, corresponding with the assumed average root depth. In active ET areas of the model domain (i.e., the southern floodplain, Bat Cave Wash mouth, Topock Marsh area) the plants are predominantly small and the water table is within several feet of land surface, so the 10-foot extinction depth is considered appropriate. In this model package, the maximum ET rate is applied only when the water table coincides with the ground surface. The rate decreases linearly to zero at the extinction depth. Therefore, all areas of the model in which the depth to water is greater than 10 feet have zero ET applied.		Comment resolved.		Comment resolved.	Not applicable
336	FMIT-57	Append B | Figure 5.3-1	Mn Oxide Reductive	Please present these rate constant calibrations and values. How do these	Additional detail on the equations, assumptions, and calibrated rate			Comment resolved pending review of the 90% design.	Comment resolved.	90% BOD Apdx B Section 5.3.1

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	Hualapai-43 Chemehuevi-43 Cocopah-43 CRIT-43	5.3.1 p. 24	Dissolution, Figure 5.3-1, calibration of the rate constant for manganese and arsenic reduction.	constants compare with literature sources?	constant for manganese oxide dissolution will be included in Appendix B in the 90% design. Specifically, the half-reactions included in the PHREEQC database that link manganese oxide reduction to organic carbon (ethanol) oxidation are as follows: MnO_2: $H_2O + 4\ H^+ + 2\ e^- = Mn^{+2} + 3\ H_2O$ $2\ CO_3^{-2} + 16\ H^+ + 12\ e^- = C_2H_6O + 5\ H_2O$ This yields: $6(MnO_2{:}H_2O) + 10\ H^+ + C_2H_6O = 6\ Mn^{+2} + 13\ H_2O + 2\ HCO_3^-$ Far from equilibrium, the kinetic rate will be independent of the concentrations of the products (right side of the equation), and assuming that the manganese oxide concentration and pH does not change appreciably within the IRZ, the kinetic rate becomes first order with respect to organic matter concentration: $d[MnO_2]/dt = -k*C$ where k is the rate constant and C is the organic carbon concentration. The rate constant value after calibration was determined to be 2.48e-4 inverse days. Importantly, this rate constant is highly site-specific, as the manganese oxidation rate will vary according to the properties of manganese phases within the aquifer (including the exposed surface area, mineralogy, purity, and crystallinity of manganese oxides and oxyhydroxides at the site) as well as the organic carbon microbial oxidation rate, as based on site-specific observations from pilot testing. Accordingly, literature values of manganese oxidation rates will not be directly comparable; regardless, a discussion of literature studies of microbial manganese oxidation will be included in the 90% design.					
337	FMIT-58 Hualapai-44 Chemehuevi-44	Append B 5.3.1 p. 24	*The solute transport model, therefore, links*	Would it be reasonable/helpful during the first cycle of TOC injections in the IRZ to monitor TOC and Mn at short time intervals at one or two	During startup, monthly monitoring at IRZ dose response wells is specified in the Sampling and Monitoring Program (Appendix L,			Comment resolved pending review of 90% design.	Comment resolved.	90% BOD Apdx B Section 5.3.1 O&M Manual Volume 2 Section 4.2.1

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	Cocopah-44 CRIT-44		*the generation of manganese directly to the concentration of TOC through a proportionality constant…*	selected points to confirm this relationship?	Volume 2, Section 4). The monthly monitoring frequency was specified, given the timescales required for transport of reagents from injection wells to dose response wells on the order of 1-2 months and establishment of a microbial population within the IRZ are on the order of weeks. As initial monthly samples are collected, the changes will be assessed and more frequent sampling will be conducted if necessary. This language will be added to Appendix L, Volume 2 for this portion of the sampling program.					
338	DOI-156	Section 6.2.1, Page 33	"The simulated mobile porosity of the aquifer is 12% of the total volume, with immobile porosity to be 28% of the total volume."	Was a sensitivity analysis conducted to deduce the effect of major model parameters on contaminant transport and, if so, how sensitive was the model to changes in the mobile porosity and immobile porosity values?	Sensitivity analyses were conducted during the calibration of the regional groundwater flow model (CH2M HILL 2005) and numerous sensitivity analyses were conducted and presented in the 60% BOD Appendix B (Section 10). Mobile and immobile porosity values were not addressed in the sensitivity analyses as these porosity values were determined during tracer injection tests conducted at the Site. With no changes in hydraulic conductivity or hydraulic gradient, the reduction in mobile porosity and an increase in immobile porosity would result in faster transport velocities, and slower velocities would occur with an inverse adjustment. Flexibility in components of the remedial design (well flow rates, provisional well locations, etc.) was integrated into the design to account for any variability encountered in the field.		Comment resolved.		Comment resolved.	Not applicable
339	MWD-11	Appendix B, 6.2.1, 3rd paragraph	"...with the immobile porosity to be 28% of the total volume."	The immobile porosity should be 23% given the mobile porosity is 12% and the total porosity is 35%.	Agreed, this was a typographical error in the text and will be corrected. All of the solute transport model runs utilized an immobile porosity of 23% and a mobile porosity of 12%.				Comment resolved.	90% BOD Apdx B Section 6.2.1
340	MWD-12	Appendix B, Section 6	PHREEQC modeling	Providing the PHREEQC model inputs and outputs as an attachment would be informative for the various geochemical assessments and would provide further supporting data for the reviewers.	Select example model PHREEQC input files will be provided in Appendix B of the 90% Design Submittal.				Comment resolved.	90% BOD Apdx B Sections 5.2, 5.3.1, 5.3.2, and 5.4.1
341	FMIT-59 Hualapai-45 Chemehuevi-	Append B 6.2.7 p. 36	*Dissolved iron … will also precipitate*	Carbon concentrations will remove dissolved oxygen, and the anoxic water (possibly a low-DO plume) will	Oxygen will be introduced through the natural flux of dissolved oxygen in groundwater flowing from areas			The Tribes request a contingency plan to address high manganese and low pH	Comment resolved.	90% BOD Section 3.4.2 90% BOD Apdx B Section 6.2.7

TABLE I-1

Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
	45 Cocopah-45 CRIT-45		*through reaction with dissolved oxygen in the aquifer. Manganese concentrations will attenuate via… reoxidation.*	migrate downgradient from the IRZ line towards the IRZ or riverbank extraction wells. How will dissolved oxygen be reintroduced into the aquifer for these reactions to take place?	outside of the IRZ and from the river. In more oxic portions of the aquifer, Fe(II) uptake will occur both through reaction with dissolved oxygen and by adsorption to/oxidation by Fe(III) minerals, forming mixed Fe(II)/ (III)-oxides. Dissolved oxygen and iron minerals in the deeper aquifer will mix and come into contact with groundwater coming in from upgradient. As iron minerals accumulate downgradient of the IRZ, this will continue to provide additional sorption capacity for manganese and arsenic. This process of attenuation of iron by sorption, rather than re-oxidation, is similar to the attenuation mechanism that is anticipated and that was modeled for manganese.			in groundwater. Comment resolved pending review of the 90% design.		
				What will be the resulting pHs of the aquifer water?	Changes in pH and production of dissolved gases are not anticipated to be a concern based on the in-situ pilot test (ISPT) results as well as results observed at Hinkley and other sites. During pilot testing, no significant changes in pH were observed in monitoring wells, indicating that any pH changes caused by carbon consumption and subsequent redox/precipitation/dissolution reactions were adequately buffered by the aquifer solids.					
				What will happen to all of the dissolved gases (CO2, H2(g), H2S, N2) that will be produced as part of the remediation?	Dissolved gas concentrations generated within the IRZ are anticipated to be sufficiently low as to minimize formation of a gas phase within the aquifer. Given the relatively low carbon concentration used in pilot testing and specified in the design, any CO_2 generated will be at a low enough concentration that it will remain dissolved and be flushed through the IRZ over time. Further, pH buffering to circumneutral values will ensure that most of the inorganic carbon generated will be present as bicarbonate rather than dissolved CO_2. Formation of H_2(g) and H_2S will be limited by controlling TOC concentrations to limit byproduct generation. Formation of these gases (as well as N_2 formation) was not an					

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					issue during the pilot testing conducted in the floodplain. Gas generation was higher during the upland ISPT in locations where organic carbon was distributed at concentrations in the 5,000 to 10,000 mg/L TOC range. The upland ISPT results indicate that lower concentrations of organic carbon, which have been proven effective, should be used to prevent excess gas generation; and lower concentrations have been specified in the design. The changes associated with the in-situ system are not expected to affect the reducing rind enveloping the river; if anything they will reinforce the effects.					
				Can these affect the reducing rind enveloping the Colorado River?						
342	DTSC-117	Appendix B 6.2.8 Naturally Occurring Manganese, Page 37	To account for the naturally occurring manganese in the floodplain, the average observed manganese concentrations in the floodplain were delineated based on well data correlated to model layer elevations. Figures 6.2-5 and 6.2-6 display the delineated naturally occurring average floodplain manganese in model layers 1 through 4.	Please prepare a table of the average observed manganese concentrations, or reference the location of the dataset that were used in preparing each figure/model development. DTSC remains concerned with the depiction of the prevalence of manganese in the modeling figures.	The average observed manganese concentrations used to delineate the naturally occurring manganese are presented in Figure 2.3-5 of the 60% BOD, and the complete data set is provided in Appendix A1 of the 60% BOD.	Okay.			Comment resolved.	Not applicable
343	DTSC-118	Appendix A 6.4/page 37	Basis for Recirculation Design	Please provide an additional run of the model evaluating the potential of commencing the remedy by injecting into the Riverbank and East Ravine injection wells to confine the plume hydraulically away from the Colorado River before employing the proposed recirculation.	Based on the current remedy design the River Bank and East Ravine wells are specifically designed as extraction wells not injection wells. The scenario presented in the comment is not considered viable.	Comment resolved.			Comment resolved.	Not applicable

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344	FMIT-60 Hualapai-46 Chemehuevi-46 Cocopah-46 CRIT-46	Append B 6.4.1p. 39	*"This system component is designed to be a recirculating system where all the water extracted along the NTH IRZ will be amended with carbon and injected into the NTH IRZ, resulting in a net flow of 0 gpm along the NTH IRZ line."*	If the injection capacity along the NTH IRZ is not sufficient to handle the proposed volume, can it be assumed that the river bank extraction volume would be reduced to match the actual injection capacity?	Water extracted from the NTH IRZ Extraction Wells will be used for injection along the NTH IRZ line. Water from the River Bank Extraction Wells will be injected into the IRL wells in the Uplands. If the NTH IRZ Injection Wells cannot handle the volume generated by the NTH IRZ Extraction Wells, the extraction rate will be reduced and the need for additional NTH IRZ Injection Wells will be considered.			Comment resolved.	Comment resolved.	Not applicable
345a	FMIT-61	Append B 6.4.1 Figure 6.4-2	Figure 6.4-2	In this figure, the IRZ-18 is shown as a planned well, with an un-numbered pink provisional dot adjacent to it. Was IRZ-18 changed from provisional to planned based on results of model runs that suggested potential fingering of Cr(VI) between wells IRZ-17 & -19? IRZ-18 was not on the list of wells in the BOD section 3.2.1 but it seems it was included in some figures showing the IRZ system layout.	This error will be corrected in Figures 3.1-1 (60% BOD) and 6.4-2 (Appendix B of the 60% BOD). IRZ-18 is a provisional well and should correlate to the adjacent un-numbered pink provisional dot. The purple proposed IRZ-18 dot and label will be removed. All of the solute transport model runs correctly have IRZ-18 as a provisional well, and this error is limited to the posting figure.			Comment resolved.	Comment resolved.	90% BOD Apdx B Figure 6.4-2
345b	Hualapai-47 Chemehuevi-47 Cocopah-47 CRIT-47	Append B 6.4.1 Figure 6.4-2	Figure 6.4-2	In this figure, the IRZ-18 is shown as a planned well, with an un-numbered pink provisional dot adjacent to it. Was IRZ-18 changed from provisional to planned based on results of model runs that suggested potential fingering of CrVI between wells IRZ-17 & -19? IRZ-18 was not on the list of wells in the BOD section 3.2.1 but it seems it was included in some figures showing the NTH IRZ system layout.	See response to comment #345a FMIT-61.			Comment resolved.	Comment resolved.	90% BOD Apdx B Figure 6.4-2
346	FMIT-62 Hualapai-48 Chemehuevi-48 Cocopah-48 CRIT-48	Append B – 6.4.7 p. 43	*It is assumed that HNWR-1…will be treated for naturally occurring arsenic…therefore the simulated Freshwater Injection Wells did not contain arsenic.*	If the State Board allows injection of untreated water from HNWR-1 (or other freshwater source), will these runs be repeated using the initial, natural arsenic concentrations?	Yes, if the injection of untreated HNWR-1 water is allowed, these runs can be updated to reflect the natural arsenic concentrations associated with the freshwater injection.			Comment resolved pending review of the 90% design and pending State Board decision.	Comment resolved.	90% BOD Apdx B Section 6.4.7
347	FMIT-63	Append B 6.5	Figures 6.5-5	Current monitoring of river bank	Yes. Although there are seasonal			Comment resolved.	Comment resolved.	90% BOD Apdx B Section 7.4

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Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

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	Hualapai-49 Chemehuevi-49 Cocopah-49 CRIT-49	Figures 6.5-5 thru 6.5-8	thru 6.5-8	wells indicates that those wells closest to the river are influenced by the strong seasonal river level changes. These figures appear to suggest that these strong seasonal variations will have a nominal effect on the overall GW gradients/river bank extraction during the remedial operation. Is that accurate?	changes in river stage that result in local variations in groundwater flow, the overall performance of the long term remedy operation will reflect that of average conditions. As discussed in Appendix B Section 7.4, river stage fluctuations were considered using model simulation as well as a comparative analysis of transient and steady state results. The overall conclusion of these two analyses was that the steady state model is appropriate to use for the long term simulation of the remedial design. This will be clarified in Section 7.4 of Appendix B.					
348	DOI-157	Section 7.1, Page 45	"The solute transport model was run for a period of 50 years utilizing the transport parameters and flow conditions described in Section 6 for the simulated Cr(VI)."	Given the complexity of site stratigraphy and the required amendment injection balancing needed to minimize byproduct generation of Mn and As, it may take over 18 months to establish a balance in O&M operations. As such, please provide model results for 3 and 5 years so comparisons with model runs to actual observations can be made at later dates.	Simulated transport model results for 3 and 5 years will be provided.		Comment resolved.		Comment resolved.	90% BOD Apdx B Section 7.1
349	DTSC-119	Appendix A Figure 7.1-x	Simulated Maximum IRZ Generated Hexavalent Chromium Transport Results	The modeling results shows residual concentrations remain at year 30 whereby the remedy needs to be extended. Please provide additional years modeling to predict the actual anticipated remedy completion. In addition, the first 20 years of extraction does not demonstrate adequate contaminant plume control hydraulically as evidenced by the migration and release past the zone of capture of the Riverbank injection wells beyond the banks of the Colorado River.	Additional simulation times beyond year 30 can be generated. Although the simulated results in Model Layer 4 indicate a portion of the low concentration plume migrates under the river in the vicinity of RB-4 and RB-5, this portion of the plume is still within the hydraulic capture zone of the River Bank Extraction Wells (see Appendix B Figure 6.5-12; the hydraulic capture zone of the River Bank Extraction Wells extends to the east of these wells and under the river). Groundwater flow velocities between RB-4 and RB-5 are relatively slow in this area, but the area is still hydraulically controlled.	Okay.			Comment resolved.	90% BOD Apdx B Section 7.1
350	FMIT-64 Hualapai-50 Chemehuevi-50 Cocopah-50 CRIT-50	Append B 9.1.2 p. 56	First paragraph	The chemical interplay of TOC, Mn, Cr(VI), As etc. seems well described in the modeling, however, it may be advantageous during the first cycle of TOC injection, to monitor key elements (Mn, As) in the field at weekly intervals at selected wells to confirm that the natural system is	PG&E strongly agrees that collection of time-resolved information is critical to adequately understanding the biogeochemical processes affecting remedy performance and byproduct dynamics. However, given that the timescales required for transport of reagents from injection			Comment resolved pending review of 90% design.	Comment resolved.	O&M Manual Volume 2 Section 4.2.1

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Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

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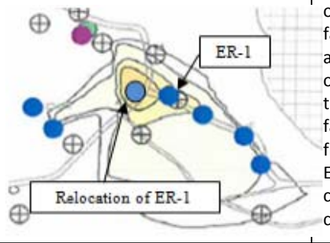
Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
				responding generally as predicted.	wells to dose response wells are on the order of one to two months and establishment of microbial population equilibria within the IRZ are on the order of weeks, the monthly monitoring of dose response wells specified in the Sampling and Monitoring Program (Appendix L, Volume 2, Section 4) will provide adequate time-scale resolution for determining system performance. As initial monthly samples are collected, the changes will be assessed and more frequent sampling will be conducted if necessary. This language will be added to Appendix L, Volume 2 for this portion of the sampling program.					
351	DOI-158	Section 10.1, Page 60	"Figures 10.1-3 and 10.1-4 depict the model layers 2 and 4 Cr(VI) results for the 75-foot and 150-foot NTH IRZ well spacing after 30 years of simulated transport."	Based on the model runs and sensitivity analysis (as shown in Figures 10.1-3 and 10.1-4), residual Cr(VI) remains within the East Ravine in higher concentration due west of ER-1 after 30 years of operation. Would relocating ER-1 to the center of the remaining Cr(VI) "hot spot" area mitigate this area of higher concentration? 	As per technical discussions held after submittal of the 60% BOD, modifications will be made to the simulated bedrock in order better simulate fracture flow in the groundwater flow and transport model. Adjustments will include the reduction of mobile and immobile porosities to reflect secondary porosity features and the adjustment of the associated Cr(VI) retardation factor in the bedrock. These adjustments will not have an impact on hydraulic flow patterns but the transport modeling will demonstrate faster velocities associated with fracture flow. Additional provisional East Ravine Extraction Wells will be considered as per response to comment #109 DTSC-30.		Comment resolved.		Comment resolved.	90% BOD Apdx B Sections 6.2.1 and 6.2.3
352a	FMIT-65	Append B 10.4 Figures 10.4-1, 4-3, etc.	Figures 10.4-1, 4-3, etc.	For example, in Figure 10.4-1 & -3 which simulates Mn transport in Layer 2 of the model, for the lower sorption rate(s), the figure gives the impression that Mn generated will migrate to within the footprint of the river. Although cross- sections A-A' to F-F' in figures 6.4-3 to -8 appear to suggest that Layer 2 is actually representative of sediments beneath the river, and not at or above the river bed, these cross-sections are all N/S and do not show an E/W transect which crosses the river. Please confirm that the 2-D perspective shown in these figures does not represent migration into the river	The 2-D perspective represents migration of manganese in the aquifer under the river. Clarification will be added to the text and individual figures.			Comment resolved pending review of 90% design.	Comment resolved.	90% BOD Apdx B Section 10.4

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Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

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				itself.						
352b	Hualapai-51 Chemehuevi-51 Cocopah-51 CRIT-51	Append B 10.4 Figures 10.4-1, 4-3, etc.	Figures 10.4-1, 4-3, etc.	In Figure 10.4-1 & -3 which simulates Mn transport in Layer 2 of the model, for the lower sorption rate(s), the figure gives the impression that Mn generated will migrate to within the footprint of the river. Although cross-sections A-A' to F-F' in figures 6.4-3 to -8 appear to suggest that Layer 2 is actually representative of sediments beneath the river, and not at or above the river bed. These cross-sections are all north/south and do not show an east/west transect which crosses the river. Please confirm that the 2-D perspective shown in these figures does not represent migration into the river itself.	See response to comment #352a FMIT-65.			Comment resolved pending review of 90% design.	Comment resolved.	90% BOD Apdx B Section 10.4
353	FMIT-66 Hualapai-52 Chemehuevi-52 Cocopah-52 CRIT-52	Append B 10.5 p. 63		Section 6.4.7 stated that it was assumed that the freshwater source would be pre-treated to remove any naturally occurring arsenic to ND. 1) Please confirm that these model runs were done assuming an As concentration of ND for injected fresh water. 2) If the State Board allows the use of the freshwater source without pre-treatment, will these runs be repeated using the background As concentration in the freshwater source?	1) Arsenic associated with the freshwater injection was not included in the modeling evaluation based on the assumption that it would be treated to meet State Board requirements or lower. 2) Yes, if the State Board allows for use of the freshwater source without pre-treatment, these runs will be repeated using the background arsenic concentration in the freshwater source.			Comment resolved pending review of the 90% design and pending State Board decision.	Comment resolved.	90% BOD Apdx B Section 10.5
354	DOI-159	Section 10.14, Page 71		Based on the sensitivity analysis, what recommendation is offered with regards to amending riverbank extracted water with TOC to address elevated Cr(VI) concentrations?	If elevated Cr(VI) concentrations are present in the riverbank extracted water, the minimum amount of carbon should be added in order to effectively reduce the Cr(VI) and produce minimal byproducts. If byproducts are observed to be a greater risk upon implementation, there is flexibility in the design to oscillate the IRL wells receiving riverbank water with those receiving freshwater in order to mitigate the byproduct impact. IRL DQO-2 in the Sampling and Monitoring Plan (Appendix L, Volume 2) provides details on monitoring for Cr(VI) concentrations in riverbank extraction water and adjusting TOC amendments.		Comment resolved.		Comment resolved.	90% BOD Apdx B Section 10.14

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355	DOI-160	Figures 10.13-1 through 10.13-6		Recommend that the additional wells, IRL-6 and IRL-7, be identified in these graphics.	IRL-6 and IRL-7 will be labeled in these figures for clarification.		Comment resolved.		Comment resolved.	90% BOD Apdx B Figures 10.13-1 through 10.13-6
356	DOI-161	Section 10, Figures 10.1-1 through 10.15-4		Typically, the figures display the results of three sensitivity analyses for both Model Layer 2 and Model Layer 4. Variations in concentrations and flow rates are utilized to ascertain potential impacts to the remedial program (e.g., how sensitive is the model to changes). A review of the 109 drawings determined that there were minimal changes between the runs. For example, variations in TOC concentrations and groundwater withdrawal had little to no impact on the results. Please explain why there were minimal changes among nearly all the runs.	The fact that there were minimal changes between the simulated results in nearly all of the runs indicates that the majority of the parameters adjusted in the sensitivity runs had a low degree of sensitivity. However, a few of the runs indicated parameters of higher sensitivity (i.e., TOC concentrations, TOC/Cr(VI) trigger, manganese sorption/generation). Recognizing the difficulty in comparing the 109 drawings, a table summarizing the relative sensitivities of the 15 different sensitivity runs will be provided for the 90% Design Submittal. This will better illustrate the sensitivity of the various sensitivity runs to Cr(VI), manganese, and arsenic simulation.		Comment resolved pending review of 90% design.		Comment resolved.	90% BOD Apdx B Section 10
357a	FMIT-67	Append B Section 2.3 Page 6,		The effect of this high range of TDS should be evaluated in the context of remedial system efficiency/performance. Was the dismissal of variable-density influence because of earlier evaluations that suggested it was not so important in affecting the plume migration? While this may be the case, current ASR technology suggests the anisotropy/layering and heterogeneity combined with density differences may strongly affect injection of freshwater of low TDS into a stratified density distribution based on reported orders of magnitude difference. The lower Cr(VI)-rich denser water may not be remediated with the assumption of uniform water density. The implication is that when the system starts up, and efforts are made to monitor, then adjust system performance, improvements to the system operating factors (i.e., flow rates, TOC injections, on/off durations etc.) may not be able to improve cleanup as predicted by the uniform density model predictions. Wells at this time will have been installed with little chance to improve spacing (which might need to be	Given the aquifer heterogeneity and vertical anisotropy, and the relatively high expected flow velocities within the system, advection-driven flows are expected to allow adequate horizontal flows to develop and be maintained at all depths between freshwater injection wells and riverbank extraction wells. See response to comment 384a. While it is acknowledged that effects of density-driven flow may occur, they are not expected. If however, effects of density are observed during remedy implementation (i.e. slower, or 'short-circuiting' of flushing within the deeper, more saline portions of the aquifer in areas some distance away from the injection wells), steps can be taken to mitigate these impacts. Potential steps include varying well flow rates over the entire screened zone, or packing off sections of upper screened intervals to increase flushing in deeper zones, effectively countering buoyant effects caused by density contrasts between injected freshwater and in-situ denser water. The 90% design will include a section describing in more detail how density effects will be			The FMIT transmitted a letter to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7, 2014. The letter is included in **Attachment S** at the end of this table.	PG&E's response has been revised to reflect ongoing discussions between PG&E and TRC (Bob Prucha). On April 7, 2014, the FMIT transmitted a letter regarding comments on modeling issues. PG&E will work with the Tribe and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Apdx B Section 2.3

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Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

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				closer...even with the remaining contingent wells). The Tribe is not advocating for additional wells, just that wells be placed in the most efficient locations from the outset (while respecting sensitive areas) thereby potentially reducing the need for additional future wells. Either way, it is recommended that this factor be evaluated by the model.	mitigated, should they occur.					
357b	Hualapai-53 Chemehuevi-53 Cocopah-53 CRIT-53	Append B Section 2.3 Page 6,		The effect of this high range of TDS should be evaluated in the context of remedial system efficiency/performance. Was the dismissal of variable-density influence because of earlier evaluations that suggested it was not so important in affecting the plume migration? While this may be the case, current ASR technology suggests the anisotropy/layering and heterogeneity combined with density differences may strongly affect injection of freshwater of low TDS into a stratified density distribution based on reported orders of magnitude difference. The lower CrVI rich denser water may not be remediated with the assumption of uniform water density. The implication is that when the system starts up - and efforts are made to monitor, then adjust system performance - improvements to the system operating factors (i.e. flow rates, TOC injections, on/off durations etc.) may not be able to improve cleanup as predicted by the uniform density model predictions. Wells at this time will have been installed with little chance to improve spacing (which might need to be closer, even with the remaining contingent wells). Either way, it is recommended that this factor be evaluated by the model.	See response to comment #357a FMIT-67.			The Cocopah Indian Tribe transmitted a letter to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 9, 2014. The letter is included in **Attachment S** at the end of this table.	See comment #357a FMIT-67. On April 9, 2014, the Cocopah Indian Tribe transmitted a letter regarding comments on modeling issues. PG&E will work with the Tribe and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Apdx B Section 2.3

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358	FMIT-68 Hualapai-54 Chemehuevi-54 Cocopah-54 CRIT-54	Section 3.0 p. 3-1	*Central to the design process is the groundwater modeling effort which was used to refine/ optimize the key remedy features.*	Where are specific optimization/refinement criteria used to guide development of the remedy design and operational strategy?	The specific optimization/ refinement criteria to guide the development of the remedy design and operational strategy are: 1) reduce the anticipated remedial timeframe for effective capture and treatment of the Cr[VI] plume; 2) minimize the necessary remediation infrastructure [i.e., total number of new well locations] or "footprint" of the remedial system; and 3) minimize the impact of potential byproducts [i.e., arsenic and manganese]. Specific design elements of the individual remedial design components are presented in Appendix B and Section 3.2 of the 60% BOD. In addition, a table of optimization criteria will be developed reflecting the remedial design specifications and parameters encountered during well installation and operation.			Comment resolved pending review of the 90% design. The FMIT and the Cocopah Indian Tribe transmitted letters to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7 and April 9, 2014, respectively. The letters are included in **Attachment S** at the end of this table.	Comment resolved. On April 7 and April 9, 2014, the FMIT and the Cocopah Indian Tribe transmitted letters regarding comments on modeling issues, respectively. PG&E will work with the Tribes and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Section 3.1.4 90% BOD Apdx B Section 6.4
359	FMIT-69 Hualapai-55 Chemehuevi-55 Cocopah-55 CRIT-55	Section 3.1.1p. 3-1	*In addition, the auto-calibration program PEST was employed torefine the calibration and to reduce the effects of uncertainty in each calibration target.*	How did PEST reduce uncertainty in each calibration target? How exactly did PEST refine the model calibration? A concern exists about how well the hydraulic aquifer parameters have been calibrated and how well-tested the distribution is, as implied by the complex distribution presented for each layer (i.e., Layers 2, 3 and 4 in Figures 4.5-2 through 4.5-4, respectively). Clearly no data points exist beneath the River, but the hydraulic property distribution is complex. The concern arises because the system is calibrated to existing "unstressed" conditions relative to what will happen when the operating remediation system stresses the system well outside of calibration, both in terms of changes to heads, but also in terms of flows into/out of the remedial area from external boundaries including the river and lateral boundaries, where little characterization (or conceptualization) has occurred. PEST was utilized to develop complex parameter distributions for hydraulic conductivity (as outlined in Section 3.2, in the Report "Groundwater Model Update Report, July 2005"). It	Text will be modified as follows: "*In addition, the auto-calibration program PEST was employed to refine the calibration~~ and to reduce the effects of uncertainty in each calibration target~~*". PEST refined the model calibration because the first stage of the calibration was manual through a trial-and-error approach until an approximate match was achieved. The second stage then involved PEST where it was run numerous times with incremental parameter adjustments to reduce error variance (CH2M HILL, 2005). Based on the available data the groundwater flow model was calibrated against (a) long term average groundwater levels, (b) average monthly floodplain levels responding to fluctuating river levels, (c) short-term responses to pump testing events, and (d) plume development over time) the groundwater flow model was finalized and approved by DTSC for use in the CMS. The Kh:Kv ratios were refined with PEST as described in Section 3.2 of the Groundwater Model Update Report (CH2M HILL, 2005). PEST was only allowed to adjust parameters			The FMIT and the Cocopah Indian Tribe transmitted letters to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7 and April 9, 2014, respectively. The letters are included in **Attachment S** at the end of this table.	PG&E's response has been revised to reflect ongoing discussions between PG&E and TRC (Bob Prucha). On April 7 and April 9, 2014, the FMIT and the Cocopah Indian Tribe transmitted letters regarding comments on modeling issues, respectively. PG&E will work with the Tribes and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Sections 3.1.1 and 3.1.5

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PG&E Topock Compressor Station, Needles, California

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				is unclear whether the complex Kh:Kv ratios presented in Figures B-6 were determined through PEST. Given the importance and high uncertainty associated with the hydraulic conductivity values, both horizontally and vertically, it is surprising that a sensitivity analysis was not conducted to assess the full range of possible remedial system performance. Remedial systems are typically designed conservatively to allow for unexpected variances in field conditions during remedy implementation.	(including Kv) in the area of the floodplain, which shows up in Figure 8-6 as the oval shaped area of earth tone color. Outside the floodplain area, Kv was calculated as a thickness weighted geometric mean of the stratigraphic units assigned to each model cell. The complex pattern of geometric triangles in the areas of the model north and east of the Topock Site is an artifact of rounding of the Kv values to fit the color scheme of the figure. The values in the model actually vary just slightly above and below 10, causing the color scale to “flicker” between the lighter green for values less than 10 and the darker green for values greater than 10.. Adjustments in the riverbed conductance and evapotranspiration parameters led to little variation in calibration results indicating the low degree of sensitivity to these parameters in the calibration scenarios. As a result, these parameters were not adjusted during the PEST analysis. By contrast, the model was found to be much more sensitive to K and Kh/Kv, especially in the floodplain transient data calibration (matching changes in monthly average water levels over the course of the year and water level response during short-term aquifer tests). It is acknowledged that there is not a single unique solution for the calibration of the groundwater flow model, and variations in parameter values could produce similar calibration results. The hydraulic stress on the aquifer will be different when the final remedy is in operation than it was during the model calibration. The groundwater flow and solute transport model will be updated and recalibrated if significant differences from the current model construction are encountered with respect to hydrogeologic characterization or remedy performance. This will allow the model to be used as a tool to evaluate the performance and guide the operation of the remedial design					

TABLE I-1
Response to Comments on Basis of Design Report/Intermediate (60%) Design
Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design
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					after including the adjusted data. See response to comment 653 DOI-658. A section will be added to the 90% BOD report to describe model update procedures.					
360	FMIT-70 Hualapai-56 Chemehuevi-56 Cocopah-56 CRIT-56	Section 3.1.1 p. 3-1	*This calibration procedure yielded a highly variable distribution of hydraulic conductivities to better reflect the local-scale geologic heterogeneities that characterize the natural system.*	Is this realistic considering the highly variable K configuration beneath the river with no supporting data? What should be done is to test a range of hydraulic properties beneath the river to see how much calibration and predictions change.	It is recognized that the complexity of K array beneath the river is not supported by data, however this array did result in some improvement of the match to calibration targets and the overall range of K is consistent with what has been measured. Despite the lack of hydraulic data beneath the river, the simulated K distributions represent an estimated interpolation of K values based on data collected in the vicinity of the river. Hydrogeologic interpretation is important in simulating areas where limited data are available. It is acknowledged that there is not a single unique solution for the calibration of the groundwater flow model, and variations in parameter values could produce similar calibration results. The hydraulic stress on the aquifer will be different when the final remedy is in operation than it was during the model calibration. The groundwater flow and solute transport model will be updated and recalibrated if significant differences from the conceptual site model are encountered with respect to hydrogeologic characterization or remedy performance. This will allow the model to be used as a tool to evaluate the performance and guide the operation of the remedial design after including the adjusted data. See response to comment 653 DOI-268. A section will be added to the 90% BOD report to describe model update procedures.			The FMIT and the Cocopah Indian Tribe transmitted letters to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7 and April 9, 2014, respectively. The letters are included in **Attachment S** at the end of this table.	PG&E's response has been revised to reflect ongoing discussions between PG&E and TRC (Bob Prucha). On April 7 and April 9, 2014, the FMIT and the Cocopah Indian Tribe transmitted letters regarding comments on modeling issues, respectively. PG&E will work with the Tribes and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Section 3.1.5
361	FMIT-71 Hualapai-57 Chemehuevi-57 Cocopah-57 CRIT-57	Section 3.1.1 p 3-1 to 3-2	*In general, the groundwater flow submodel honors the hydraulic conductivity distribution and boundary conditions.*	In general? Where doesn't it, and why? Also, were recent changes in bedrock included in either the regional re-calibration or latest sub- scale Modflow model? What was done to confirm flow conditions in the regional model are	The text will be edited as follows (deleted text shown in ~~strikethrough~~ typeface): "~~In general, t~~The groundwater flow submodel honors the hydraulic conductivity distribution and boundary conditions... ~~established by the original regional model~~ extracted from the regional flow model."			Comment resolved pending review of the 90% design. The FMIT and the Cocopah Indian Tribe transmitted letters to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7 and April 9, 2014, respectively. The	Comment resolved. On April 7 and April 9, 2014, the FMIT and the Cocopah Indian Tribe transmitted letters regarding comments on modeling issues, respectively. PG&E will work with the Tribes and the TRC to resolve these comments and incorporate the	90% BOD Section 3.1.1

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				consistent w/those in the submodel?	Structural changes due to the east ravine investigation were integrated into both the regional flow model and the submodel for the 60% BOD. Additional edits to the bedrock simulation in the solute transport model will be integrated into the 90% Design Submittal to better account for flow in bedrock fractures. These edits will include reductions in the mobile and immobile porosity values and the Cr(VI) retardation factor in bedrock that were discussed following the submittal of the 60% BOD. Consistency between the flow conditions in the regional model and those in the submodel were confirmed by directly comparing the simulated groundwater flow results between the two models. A well construction evaluation strategy will be presented in the 90% design. The discussion of use of the model during that period will be included in the strategy.			letters are included in **Attachment S** at the end of this table.	resolution in the 90% design.	
362	FMIT-72 Hualapai-58 Chemehuevi-58 Cocopah-58 CRIT-58	Section 3.1.2p. 3-2	*In addition, a sensitivity analysis was conducted in which various parameters (e.g., Cr[VI] partition coefficient, manganese generation/ attenuation rate, and arsenicgeneration/attenuation rate) were adjusted until a reasonable qualitative and quantitative fit to the observed data was obtained.*	Is this really a “sensitivity” analysis, or a model calibration?	Text will be modified for clarification of the sensitivity analysis: "In addition, a sensitivity analysis was conducted in which various parameters (e.g., Cr[VI] partition coefficient, manganese generation/ attenuation rate, and arsenic generation/ attenuation rate) were adjusted <u>to evaluate the relative impact on the simulated solute transport model results with respect to Cr(VI), manganese, and arsenic</u> ~~until a reasonable qualitative and quantitative fit to the observed data was obtained~~." Relative sensitivities of each of the selected parameters/ conditions evaluated with the model will be tabulated to further illustrate the results of the sensitivity analyses and will be included in the 90% design submittal.			Comment resolved pending review of the 90% design. The FMIT and the Cocopah Indian Tribe transmitted letters to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7 and April 9, 2014, respectively. The letters are included in **Attachment S** at the end of this table.	Comment resolved. On April 7 and April 9, 2014, the FMIT and the Cocopah Indian Tribe transmitted letters regarding comments on modeling issues, respectively. PG&E will work with the Tribes and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Sections 3.1.2 and 3.1.4
363	FMIT-73 Hualapai-59 Chemehuevi-59	Section 3.2.1.1 p. 3-5	*Wells will be amended with carbon substrate and injected into*	Is it really net flow of zero if carbon is added? What about imported fresh water injected into IRL1 and IRL2. Isn’t this a net increase in flow?	The net flow of 0 gpm for the NTH IRZ refers to the balance of 300 gpm NTH IRZ extraction and 300 gpm NTH IRZ injection. Carbon amendment is not anticipated to have a significant			Comment resolved pending review of 90% design.	Comment resolved.	90% BOD Section 3.2.1 90% BOD Apdx B Section 6.4-1

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	Cocopah-59 CRIT-59		*the NTH IRZ line via the 24 NTH IRZ Injection Wells, resulting in a net flow of 0 gpm.*		impact on the cumulative injection rate. The NTH IRZ statement does not refer to elements of the Inner Recirculation Loop or freshwater injection. Text will be added to the 90% design to reflect this clarification.					
364a	FMIT-74	Section 3.2.1.1 p. 3-5	*Based on the results of groundwater flow and solute transport modeling, the current recirculation system configuration—injection wells spaced along the NTH IRZ line with extraction wells located at the ends and in minimal places along the line—will allow for adequate lateral dispersion of organic carbon while minimizing the potential for the extraction of carbon substrate or treated water.*	Were ”adequate” lateral dispersion of OC and minimizing potential extraction of OC or treated water the only constraints? How were different optimization constraints considered or weighted to come up with the final configuration? For example, how were constraints (i.e., minimizing generation of secondary geochemical species or minimizing overall cleanup time) incorporated into the final remedy configuration? What are details related to defining the constraint for minimizing cleanup? Was it minimum time to minimize Cr(VI) conversion to Cr(III) within 30 years, for the entire plume, or was it total reduction in overall plume volume of Cr(VI) or Cr(III)? It is important to distinguish between them. What is meant by "in minimal places"?	The three optimization criteria are to minimize the remedial clean-up time of the Cr(VI) plume, minimize infrastructure, and minimize byproduct generation. These three optimization criteria were considered concurrently in the design of the remedy. A table of optimization criteria will be developed reflecting the remedial design specifications and parameters encountered during well installation and operation. In order to minimize the remedial clean-up time of the Cr(VI) plume (first optimization criterion listed above), the NTH IRZ should provide adequate lateral dispersion of carbon and minimize the potential extraction of carbon. The text "in minimal places" will be revised to "in the central portion of the NTH IRZ".			Comment resolved pending review of the 90% design. The FMIT transmitted a letter to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7, 2014. The letter is included in **Attachment S** at the end of this table.	Comment resolved. On April 7, 2014, the FMIT transmitted a letter regarding comments on modeling issues. PG&E will work with the Tribe and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Sections 3.1.4 and 3.2.1 90% BOD Apdx B Table 6.4-1
364b	Hualapai-60 Chemehuevi-60 Cocopah-60 CRIT-60	Section 3.2.1.1 p. 3-5	*Based on the results of groundwater flow and solute transport modeling, the current recirculation system configuration—injection wells spaced along the NTH IRZ line with extraction wells located at the ends and in minimal places along the line—will allow for adequate lateral dispersion of*	Were ”adequate” lateral dispersion of OC and minimizing potential extraction of OC or treated water the only constraints? How were different optimization constraints considered or weighted to come up with the final configuration? For example, how were constraints (i.e., minimizing generation of secondary geochemical species or minimizing overall cleanup time) incorporated into the final remedy configuration? What are details related to defining the constraint for minimizing cleanup? Was it minimum time to minimize CrVI conversion to CrIII within 30 years, for the entire plume, or was it total reduction in overall plume volume of CrVI or CrIII? It is important to distinguish between them.	See response to comment #364a FMIT 74.			Comment resolved pending review of the 90% design. The Cocopah Indian Tribe transmitted a letter to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 9, 2014. The letter is included in **Attachment S** at the end of this table.	Comment resolved. On April 9, 2014, the Cocopah Indian Tribe transmitted a letter regarding comments on modeling issues. PG&E will work with the Tribe and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Sections 3.1.4 and 3.2.1 90% BOD Apdx B Table 6.4-1

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			organic carbon while minimizing the potential for the extraction of carbon substrate or treated water.	What is meant by "in minimal places"?						
365	FMIT-75 Hualapai-61 Chemehuevi-61 Cocopah-61 CRIT-61	Section 3.2.1.1 p. 3-5	*In general, the purpose of the NTH IRZ Extraction Wells is to preserve the natural west to east flow gradient,….*	Is this really the main purpose? Would this be another optimization constraint on remedial design alternatives involving changes in flow rate, locations, depths etc.?	Well locations, well spacing, and well rates were all considerations during the remedial design process. The text will be edited as follows (inserted text shown in <u>underline</u> typeface and deleted text shown in ~~strikethrough~~ typeface): "~~In general, t~~ <u>T</u>he ~~purpose of the~~ NTH IRZ Extraction Wells <u>were designed to generate sufficient flow rate to support the NTH IRZ Injection Wells</u> ~~is to preserve the natural west to east flow gradient and, thus, encourage flow through the IRZ~~. The three northern NTH IRZ Extraction Wells (IRZ-1, IRZ-5, and IRZ-9) were positioned to minimize the number of NTH IRZ wells while offering hydraulic control of the northern, low concentration end of the Cr(VI) plume and minimizing the extraction of reduced water containing organic carbon or dissolved minerals. The NTH IRZ Extraction Well location situated near the center of the NTH IRZ line (IRZ-23) was positioned to maintain and accentuate the eastern flow component of the groundwater, and adjustments will be made to the injection flow rates and carbon dosing in the vicinity of this well location in order to alleviate potential well fouling (see Appendix L, the Draft O&M Manual)…" A table of optimization criteria will be developed reflecting the remedial design specifications and parameters encountered during well installation and operation.			Comment resolved pending review of 90% design. The FMIT and the Cocopah Indian Tribe transmitted letters to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7 and April 9, 2014, respectively. The letters are included in **Attachment S** at the end of this table.	Comment resolved. On April 7 and April 9, 2014, the FMIT and the Cocopah Indian Tribe transmitted letters regarding comments on modeling issues, respectively. PG&E will work with the Tribes and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Sections 3.1.4 and 3.2.1 90% BOD Apdx B Section 6.4.1
366	FMIT-76 Hualapai-62 Chemehuevi-62 Cocopah-62 CRIT-62	Section 3.2.1.1p. 3-5	*The three northern NTHIRZ Extraction Wells (IRZ-1, IRZ-5, and IRZ-9) were positioned to minimize the number of NTH IRZ wells while*	This sounds like another optimization criterion. How is this weighted along with all the other criteria?It is recommended that a table of all optimization criteria be prepared and relative weights shown. Which was most important, which the least?A table showing all prioritized constraints should actually help going forward to find the best optimization into 90% design and during/post-	Well locations, well spacing, and well rates were all considerations in designing the NTH IRZ in order to prevent the migration of Cr(VI) towards the floodplain. All criteria were important and interrelated in the design of the NTH IRZ. The exhibits/tables will be expanded in the 90% Design Submittal to better illustrate the considerations taken into account for the design of each			Comment resolved pending review of 90% design. The FMIT and the Cocopah Indian Tribe transmitted letters to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7 and April 9, 2014, respectively. The letters are included in **Attachment S** at the end of	Comment resolved. On April 7 and April 9, 2014, the FMIT and the Cocopah Indian Tribe transmitted letters regarding comments on modeling issues, respectively. PG&E will work with the Tribes and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Section 3.1.4

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			offering hydraulic controlof the northern, low concentration end of the Cr(VI) plume and minimizing the extractionof reduced water containing organic carbon or dissolvedminer als.	startup.There are many considerations and they should be clearly tracked.	remedial component. A table of optimization criteria will be developed reflecting the remedial design specifications and parameters encountered during well installation and operation.			this table.		
367a	FMIT-77	Section 3.2.1.1 p. 3-5	*However, given the limited unconsolidated aquifer thickness at the southern end of the NTH IRZ (approximately 10 feet as compared to 300 feet at the northern end) and the injection volumes necessary to maintain an effective NTH IRZ, locating the NTH IRZ Extraction Wells to the north provided greater advantage in the model simulations.*	This brings up the issue of whether there should have been another optimization objective that relates, not so much to reducing areal footprint or volume of Cr(VI) in the shortest time possible, but that attempts to reduce overall source-path- receptor risk. Which areas pose the highest risk to potential receptor(s).	The primary potential receptor at the Site is the Colorado River. While optimization objectives are to minimize the Cr(VI) remedial timeframe, minimize infrastructure, and minimize byproduct generation, the overall remedy is designed to prevent migration of Cr(VI) to the river. The NTH IRZ is designed to remediate and/or provide hydraulic capture of the Cr(VI) plume as it migrates towards the floodplain (to effectively "cut-off" the plume). The River Bank Extraction Wells were designed to hydraulically control the deep portions of the floodplain currently impacted with Cr(VI); and the East Ravine Extraction Wells were designed to provide hydraulic capture of the Cr(VI) groundwater impacts in the bedrock to prevent migration to the river. A table of optimization criteria will be developed reflecting the remedial design specifications and parameters measured or observed during well installation and operation.			Comment resolved pending review of 90% design. The FMIT transmitted a letter to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7, 2014. The letter is included in **Attachment S** at the end of this table.	Comment resolved. On April 7, 2014, the FMIT transmitted a letter regarding comments on modeling issues. PG&E will work with the Tribe and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Section 3.1.4
367b	Hualapai-63 Chemehuevi-63 Cocopah-63 CRIT-63	Section 3.2.1.1 p. 3-5	*However, given the limited unconsolidated aquifer thickness at the southern end of the NTH IRZ (approximately 10 feet as compared to 300 feet at the northern end)*	This brings up the issue of whether there should have been another optimization objective that relates, not so much to reducing areal footprint or volume of CrVI in the shortest time possible, but that attempts to reduce overall source-path-receptor risk. Which areas pose the highest risk to receptor(s)?	See response to comment #367a FMIT-77.			Comment resolved pending review of 90% design. The Cocopah Indian Tribe transmitted a letter to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 9, 2014. The letter is included in **Attachment S** at the end of this table.	Comment resolved. On April 9, 2014, the Cocopah Indian Tribe transmitted a letter regarding comments on modeling issues. PG&E will work with the Tribe and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Section 3.1.4

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			and the injection volumes necessary to maintain an effective NTH IRZ, locating the NTH IRZ Extraction Wells to the north provided greater advantage in the model simulations.							
368	FMIT-78 Hualapai-64 Chemehuevi-64 Cocopah-64 CRIT-64	Section 3.2.2.1 p. 3-12	*It is anticipated that three to five of the River Bank Extraction Wells (shown on Figure 3.0-1) will be operated at any given time based on the need to control potential migration of Cr(VI) located downgradient of the NTH IRZ, control byproduct migration in the deeper portion of the aquifer, and enhance hydraulic gradients to accelerate the remediation timeframe, while simultaneously minimizing the effects of the river bank extraction on development and maintenance of the NTH IRZ and/or maintenance of the natural*	Is this another optimization constraint not listed among the 3 major constraints? How would the natural reducing rind be ”maintained”?	Yes, while the three major constraints governing the remedial design (minimize remedial timeframe, minimize infrastructure, and minimize byproduct generation) are still the most critical, the consideration of preserving the existing reducing rind to the extent possible was still important in the design of the River Bank Extraction Wells. For clarification, the text will be edited to replace "minimizing the effects of the river bank extraction on development and maintenance of the NTH IRZ and/or maintenance of the natural reducing rind located along the Colorado River" with "minimizing the effects of the river bank extraction on development and distribution of the NTH IRZ reducing zone and minimizing the impact to the natural reducing rind located along the Colorado River". A table of optimization criteria will be developed reflecting the remedial design specifications and parameters encountered during well installation and operation.			Comment resolved pending review of 90% design. The FMIT and the Cocopah Indian Tribe transmitted letters to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7 and April 9, 2014, respectively. The letters are included in **Attachment S** at the end of this table.	Comment resolved. On April 7 and April 9, 2014, the FMIT and the Cocopah Indian Tribe transmitted letters regarding comments on modeling issues, respectively. PG&E will work with the Tribes and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Sections 3.1.4 and 3.2.2

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			reducing rind located along the Colorado River.							
369	FMIT-79 Hualapai-65 Chemehuevi-65 Cocopah-65 CRIT-65	Section 3.2.2.1 p. 3-12	*Monitoring wells will be used to monitor the effectiveness of the NTH IRZ, and to help determine the ideal pattern of River Bank Extraction Well operations to maintainan appropriate balance of these operational goals.*	So in effect, there are non-modeling optimization constraints too. Can these be added to the growing matrix of optimization constraints to clearly show what is shaping decisions now on rates, locations, on/off durations, screen-zones etc.... and then future changes to the system?	Well locations, well spacing, and well rates were all considered in the remedial design to address the three major constraints (minimize remedial timeframe, minimize infrastructure, and minimize byproduct generation). These will be added to the matrix in the 90% BOD to describe the remedial design criteria. This table of optimization criteria will reflect the remedial design specifications and parameters encountered during well installation and operation. A well construction evaluation strategy will be presented in the 90% design. The discussion of use of the model during that period will be included in the strategy.			Comment resolved pending review of the 90% design. The FMIT and the Cocopah Indian Tribe transmitted letters to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7 and April 9, 2014, respectively. The letters are included in **Attachment S** at the end of this table.	Comment resolved. On April 7 and April 9, 2014, the FMIT and the Cocopah Indian Tribe transmitted letters regarding comments on modeling issues, respectively. PG&E will work with the Tribes and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Sections 3.1.4 and 3.1.5
370	FMIT-80 Hualapai-66 Chemehuevi-66 Cocopah-66 CRIT-66	Section 3.2.2.1 p. 3-12	*The expected total average extraction flow rate of these wells is 150 gpm, although flexibility will be provided to increase this flow rate to 500 gpm (see Table 3.2-2).*	How was 500 gpm determined? Is this enough to account for the cumulative effects of uncertainty in flows, transport, geochemical reactions etc?	The 500 gpm maximum was determined by increasing the nominal flow rate by more than a factor of three to provide hydraulic capture in the event that the regional volumetric flow rates are up to three times higher than anticipated. While this is unlikely, the flexibility was incorporated into the model for conservativeness. The 500 gpm maximum is more than adequate to account for uncertainty in flows. An additional model run at 500 gpm will be used to assess the implications of this maximum flow rate and the results will be accounted for in the O&M plan presented in the 90% design.			Comment resolved pending review of the 90% design. The FMIT and the Cocopah Indian Tribe transmitted letters to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7 and April 9, 2014, respectively. The letters are included in **Attachment S** at the end of this table.	Comment resolved. On April 7 and April 9, 2014, the FMIT and the Cocopah Indian Tribe transmitted letters regarding comments on modeling issues, respectively. PG&E will work with the Tribes and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Section 3.2.2 90% BOD Apdx B Section 10.3
371	FMIT-81 Hualapai-67 Chemehuevi-67 Cocopah-67 CRIT-67	Section 3.2.2.1 p. 3-14	*…. (3) accommodation of uncertainties in field implementation.*	Can this be explained in more detail? What about uncertainties in all the various flow, transport and geochemical model inputs so far? How does one really show this uncertainty as it relates to TOC upper range?	Uncertainties in field implementation could potentially include variations in local geochemistry (i.e., dissolved oxygen, nitrate) or microbial ecology (e.g., carbon consumption by sulfate reducers or methanogens) that would require additional TOC injection to develop the appropriate reducing conditions. This uncertainty will be mitigated through monitoring at IRL dose response wells and making TOC dosing adjustments accordingly, as specified in the O&M Manual (Appendix L), Volume 2,			Comment resolved pending review of 90% design. The FMIT and the Cocopah Indian Tribe transmitted letters to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7 and April 9, 2014, respectively. The letters are included in **Attachment S** at the end of this table.	Comment resolved. On April 7 and April 9, 2014, the FMIT and the Cocopah Indian Tribe transmitted letters regarding comments on modeling issues, respectively. PG&E will work with the Tribes and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Section 3.2.2.1, Organic Carbon Dosing and Delivery Strategy

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					Section 2.2.2, IRL DQO-2. The text will be updated to include these details and a reference to the O&M Manual. Similar text will be added to Table 3.2-1.					
372	FMIT-82 Hualapai-68 Chemehuevi-68 Cocopah-68 CRIT-68	Section 3.2.2.1 p. 3-14	*Injections will be timed to allow for adequate dispersion of the injectate away from the well.*	What is the qualitative and quantitative definition of ”adequate dispersion” away from a well?	Adequate dispersion is demonstrated by the development of reducing conditions between the injection wells thus establishing a complete barrier to ensure that Cr(VI) in groundwater is effectively reduced (below 32 ppb). This will be evaluated by monitoring TOC concentrations, Cr(VI) concentrations, and reducing conditions within and downgradient of the IRL wells.			Comment resolved.	Comment resolved.	90% BOD Section 3.2.2
373	FMIT-83 Hualapai-69 Chemehuevi-69 Cocopah-69 CRIT-69	Section 3.2.2.3 p. 3-16	*The Inner Recirculation Loop will be implemented and operated using an adaptive approach, similar to operation of the NTH IRZ system— data will be collected from monitoring wells within the Inner Recirculation Loop, and operations will be modified to optimize the remedy performance.*	How does modeling fit into this ”adaptive” approach, if at all?	Modeling will be used in conjunction with the observed field data. By comparing the model predictions to new field data collected during installation of the remedial system, the predictive accuracy of the model can be assessed. If there are significant variations in the actual remedy performance as compared to the simulated solute transport model, the flow and/or solute transport models can be updated to better reflect site conditions. The updated model can then be used to evaluate the system performance and guide adjustments in the operation of the remedial system. See response to comment #653 DOI-268. A section will be added to the 90% BOD report to describe model update procedures.				The comment was resolved verbally at the February 12, 2014 CWG. Comment resolved.	90% BOD Section 3.1.5
374	FMIT-84 Hualapai-70 Chemehuevi-70 Cocopah-70 CRIT-70	Figure 3.1-1	*Conceptual Final Groundwater Remedy Cross-Section Locations*	South of indicated rind, is there a greater weighting of Cr(VI) removal from the system due to lack of natural reducing conditions?	For the cross-section, the reducing zone delineations were terminated at the bedrock contact for the purpose of the figure; this does not reflect lack of reducing conditions. , The East Ravine Extraction Wells are designed to hydraulically control Cr(VI) concentrations associated with groundwater in bedrock. See also response to comment #377 FMIT-87/Hualapai-73.			Comment resolved pending review of the 90% design.	Comment resolved.	90% BOD Figure 3.1-1
375	FMIT-85 Hualapai-71	Figure 3.1-3	*Conceptual Final*	Does the fact that the plume occupies the lower part of the unconsolidated	See response to comments #357a FMIT-67 and #384a FMIT-94.				PG&E’s cited responses have been revised to reflect	90% BOD Apdx B Section 2.3

TABLE I-1

Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
	Chemehuevi-71 Cocopah-71 CRIT-71		*Groundwater Remedy Cross-Section B-B'*	material, probably along with more dense, higher TDS water suggest it will also be more difficult or complicated to remediate with current plan unless density dependent flow conditions are evaluated?					discussions between PG&E and TRC (Bob Prucha). Comment resolution is pending review/okay by the Tribes.	
376	FMIT-86 Hualapai-72 Chemehuevi-72 Cocopah-72 CRIT-72	Append B Section 2.0p. 3	*For the Site, the conceptual model forms the single most important guide for the design and operation of the proposed remediation system, as it is the basis for the numeric modeling, comprised of groundwater flow and contaminant fate and transport that simulate the operation of the remediation system.*	This sentence (1st paragraph) says, the conceptual model represents the most important guide for design and operation of the proposed remediation system. As such, presenting a more detailed discussion of the conceptual flow, fate/transport and geochemical models, for the existing system AND for proposed remediation system (complete with injection/extraction, TOC etc) and how they relate to each other is critical for reviewers to appreciate all of the factors (and assumptions) that go into development of the complex models used as the primary tool to support design of the remediation system, and determine how it will be operated. Simple flow arrows typically included are not included (and should be included) on a diagram that depicts current/proposed conditions. A simple narrative here without supporting graphics is of only limited value. Previous documents have shown this information, but it is difficult to track down and see everything together in one piece that reflects current understanding and knowledge of how the system works.	Flow arrows/flow fields can be added to Figures 6.5-1 to 6.5-12 to better illustrate groundwater flow directions with respect to ambient flow conditions, active remedy flow conditions, and hydraulic capture of active extraction wells. A conceptual operational diagram will also be prepared and included in the 90% design to illustrate the source of extracted water and where it will be injected for each remedial element.			Comment resolved pending review the 90% design documents.	Comment resolved.	90% BOD Apdx B Sections 4 and 6.4
377	FMIT-87 Hualapai-73 Chemehuevi-73 Cocopah-73 CRIT-73	Append B Section 2.2 p. 5	*The saturated thickness of the alluvial aquifer is approximately 100 feet in the floodplain and thins to the south, pinching out along locations where the Miocene Conglomerate and igneous/ metamorphic rocks outcrop.*	Can the location of this point be indicated on a map? Isn't this where the rind also disappears and as such represents an important factor in the conceptual flow and fate/transport model?	Yes, this contact can be identified in a figure. The bedrock contact is evident with the abrupt change in hydraulic conductivity values in Figures 4.5-1 to 4.5-4 of Appendix B (60% BOD) but this contact can be clearly labeled in the 90% BOD.			Comment resolved pending review of 90% design.	Comment resolved.	90% BOD Apdx B Section 4.2

TABLE I-1

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Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

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378	FMIT-88 Hualapai-74 Chemehuevi-74 Cocopah-74 CRIT-74	Append B Section 3.4.3 p. 15	*The relationship between TOC and manganese concentration is shown in Figure G13 of Appendix G of the CMS/FS, while Figure G14 of the CMS/FS shows the relationship for TOC and arsenic. In the solute transport model, these correlations are used as the basis for manganese and arsenic generation. Manganese and arsenic generation rates were calculated based on the average amount of byproduct observed in solution for TOC concentrations greater than 10 mg/L and less than 100 mg/L within the upland and floodplain ISPT datasets.*	Rather than use the Mn factor of 0.016, which appears to represent an average or best-case scenario, the range of concentrations of Mn vs. TOC should be considered in the design? Also, Figures G13 and G14 in the CMS/FS are derived from sites other than Topock (i.e., from page 33/45 in App G in CMS/FS it states *"Empirical data demonstrates this as shown in Figures G12, G13, and G14 which depict relative trends of iron, manganese, and arsenic versus total organic carbon (TOC) observed at several sites where large-scale, long-term IRZ remedies are currently being applied."*). Are these applicable to the particular geochemical conditions at Topock?	The basis for the relationship between organic carbon concentration and generation of dissolved manganese and arsenic is from the results of the in-situ pilot tests (ISPTs) conducted at the Topock site, both in the upland and floodplain. In the case of manganese, the base case was developed using the average concentration generated at organic carbon concentrations between 10 and 100 mg/L (as described in Section 3.4.3). Manganese is naturally present in Topock soil at higher concentrations than arsenic and therefore was detected at higher concentrations in the dissolved phase, as compared to arsenic, as a result of the application of organic carbon. Because of this, the arsenic generation rate is lower than that for manganese, and this rate is also based on the Topock ISPTs. Section 3.4.3 refers to Figures G13 and G14 in the CMS/FS because these show the relatively predictable trend in manganese and arsenic generation as related to organic carbon concentration. This predictable trend forms the technical basis for the development of generation rates for the Topock design; however the rates themselves are based on the Topock ISPT data and are therefore appropriate for the geochemical conditions at the Topock site. The sensitivity analysis captures a wide range of generation rates, and covers the range of manganese, arsenic, and TOC concentrations relevant to operation of the remedy. These points will be made clearer in Section 3.4.3 of Appendix B in the 90% Design Submittal. Text will be included in the 90% design directing the reader to the details of the manganese sensitivity analysis and summarizing the results of that analysis.			Comment resolved pending review of 90% design.	Comment resolved.	90% BOD Apdx B Section 3.4.3
379	FMIT-89 Hualapai-75 Chemehuevi-	Append B Section 4.5 p. 20	*The hydraulic conductivity distribution of the upper four*	This indicates 'highly heterogeneous' but what is vertical to horizontal anisotropy if any? This does not appear on the associated figures, but	Figures displaying the distribution of the Kh:Kv zonation will be generated and presented in the 90% design. These figures will be consistent with				The comment was resolved verbally at the February 12, 2014 CWG. Comment resolved.	90% BOD Apdx B Section 4.5 90% BOD Apdx B Figures 4.5-6, 4.5-7, and 4.5-8

TABLE I-1
Response to Comments on Basis of Design Report/Intermediate (60%) Design
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PG&E Topock Compressor Station, Needles, California

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	75 Cocopah-75 CRIT-75		*layers representing the alluvial aquifer were simulated as highly heterogeneous layers as depicted on Figures 4.5-1 to 4.5-5. All hydraulic conductivity values in the submodel were assigned on the basis of the original regional groundwater flow model properties.*	is important in the overall performance of the remedial system, especially if density effects are relevant.	the Kh:Kv figures previously presented in the 2005 Groundwater Flow Model Report but will reflect the adjustments made to the groundwater flow model after the East Ravine investigation.					
380	FMIT-90 Hualapai-76 Chemehuevi-76 Cocopah-76 CRIT-76	Append B Section 6.3 p.37	*A sensitivity analysis quantifies the impact that variations on model parameter values have on differences between Site observations and model predictions.*	This is not the standard definition of sensitivity analysis. ASTM standards for conducting a sensitivity analysis show there are there are two types: a) calibration sensitivity and b) predictive sensitivity. The Tribe recommends that both types of sensitivity analyses be performed.	The groundwater flow model was calibrated against (a) long term average groundwater levels, (b) average monthly floodplain levels responding to fluctuating river levels, (c) short-term responses to pump testing events, and (d) plume development over time. A solute transport model was adopted following the choice of remedy in the CMS, with the approved hydraulic model forming the basis of this model. Predictive sensitivity was applied to the solute transport model, since prediction of remedy success was made on the basis of concentration of Cr(VI) and COPCs A predictive sensitivity analysis was conducted using the solute transport model by varying multiple solute transport model parameters and observing the impact on Cr(VI), TOC, Mn, and As. A calibration sensitivity analysis is not applicable for the solute transport model as the full scale remedial design has not been implemented and therefore no data exists to calibrate the solute transport model against for future pumping conditions. Text will be added to clarify the basis for selecting the specific subset of possible parameters and remedial system operational rates evaluated				The comment was resolved verbally at the February 12, 2014 CWG. Comment resolved.	90% BOD Apdx B Section 6.3

TABLE I-1
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PG&E Topock Compressor Station, Needles, California

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					during this sensitivity analysis. The relative sensitivities of variables will be organized and summarized in a sensitivity table to better illustrate the degree of sensitivity, in addition to presenting the simulated solute transport modeling results at 10 and 30 years for Cr(VI), TOC, Mn, and As.					
381a	FMIT-91	Append B Section 6.3 p. 37	*However, various aspects of the Cr(VI) plume and behavior of manganese and arsenic were analyzed in detail with the solute transport model to determine an appropriate range of solute transport parameters to use for the predictive modeling.*	Is it possible to explain why there was no sensitivity analysis of flow conditions and their influence on the remedy? The sensitivity of flow conditions on the overall remedial system performance likely dominates the sensitivity of system response to other factors. It is important to know how to rank these factors, especially when the system is started up and future changes are needed. There are many factors that can be adjusted, or that may explain why the system might not perform as expected. Unexpected conditions of performance might be likely, given the relatively high number of factors and assumptions associated with model predictions (flows, fate/transport, geochemical processes etc). What is the sensitivity of screen depth, well placement, flow rates, especially when key parameters are adjusted? What is the sensitivity of K distributions (especially under river and surrounding known data areas - where it is assumed)? What about the riverbed conductance? Was local scaled-sensitivity analysis to determine and rank which parameters the flow, transport and geochemical reactions are most sensitive to ever performed or considered?	See comments 359 FMIT-69 and 360 FMIT-70. Variations in hydraulic conductivity would impact the volumetric flow through the aquifer which was evaluated by varying the remedial design flow rates (riverbank extraction well rates, freshwater injection well rates, and NTH IRZ well spacing and rates) in the solute transport model sensitivity analysis (Appendix B Section 10). Utilizing the data collected during installation and implementation of the remedial design would be more beneficial than basing the design operation on a theoretical sensitivity analysis. The remedial design components were designed through interpretation of the flow and hydraulic conditions from observed data. These remedial components were then simulated using the groundwater flow and solute transport model. With respect to the remedial design, the proposed remedial design layout would not change, but the implementation of provisional wells or variations in well injection/extraction rates can be adjusted. Variations in encountered hydraulic properties or overall system performance will be integrated back into the groundwater flow and solute transport model to determine the impact on the proposed remedial timeline. It is acknowledged that there is not a single unique solution for the calibration of the groundwater flow model, and variations in parameter values could produce similar calibration results. The hydraulic stress on the aquifer will be different when the final remedy is in operation than it was during the model calibration. The groundwater flow and solute				The comment was resolved verbally at the February 12, 2014 CWG. Comment resolved.	90% BOD Apdx B Section 6.3

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					transport model will be updated and recalibrated if significant differences from the conceptual site model are encountered with respect to hydrogeologic characterization or remedy performance. This will allow the model to be used as a tool to evaluate the performance and guide the operation of the remedial design after including the adjusted data. See response to comment 653 DOI-268. A section will be added to the 90% BOD report to describe model update procedures.					
381b	Hualapai-77 Chemehuevi-77 Cocopah-77 CRIT-77	Append B Section 6.3 p. 37	*However, various aspects of the Cr(VI) plume and behavior of manganese and arsenic were analyzed in detail with the solute transport model to determine an appropriate range of solute transport parameters to use for the predictive modeling.*	Is it possible to explain why there was no sensitivity analysis of flow conditions and their influence on the remedy? The sensitivity of flow conditions on the overall remedial system performance likely dominates the sensitivity of system response to other factors. It is important to know how to rank these factors, especially when the system is started up and future changes are needed. There are many factors that can be adjusted, or that may explain why the system might not perform as expected. Unexpected conditions of performance might be likely, given the relatively high number of factors and assumptions associated with model predictions (flows, fate/transport, geochemical processes etc.) What is the sensitivity of screen depth, well placement, flow rates, especially when key parameters are adjusted. What is the sensitivity of K distributions (especially under river and surrounding known data areas - where it is assumed). What about the riverbed conductance? Was local scaled-sensitivity analysis to determine and rank which parameters the flow, transport and geochemical reactions are most sensitive to ever performed or considered?	See response to comment #381a FMIT-91.				See comment #381a FMIT-91.	90% BOD Apdx B Section 6.3
382	FMIT-92 Hualapai-78 Chemehuevi-	Append B Section 6.3 p. 37	*By adjusting parameters, such as chromium*	What is the basis for choosing to adjust only these, and by what range? Selecting the range is always subjective and uncertain.	The parameters listed in this section were not the only ones adjusted in the sensitivity analysis; these were only listed here as examples. All of			The FMIT and the Cocopah Indian Tribe transmitted letters to DTSC/DOI regarding comments on modeling	PG&E's response has been revised to reflect discussions between PG&E and TRC (Bob Prucha).	90% BOD Apdx B Section 6.3

TABLE I-1

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	78 Cocopah-78 CRIT-78		*partition coefficient, manganese Freundlich constants, arsenic precipitation rate, manganese liberation rate, and arsenic liberation rate, a reasonable qualitative and quantitative fit to the observed data and flow conditions was obtained. In addition to varying the parameters for the constituents of concern, additional analyses were conducted to evaluate additional parameter impacts on the solute transport model. These parameters include the TOC injection concentration, the riverbank extraction well rate, and the NTH IRZ well spacing. The solute transport modeling sensitivity analysis is presented in Section 10.*		the parameters describing the generation/ attenuation of solutes included in the solute transport model (including TOC, Cr[VI], manganese, and arsenic) were included in the sensitivity analysis, and, therefore, this aspect of the sensitivity analysis is comprehensive. It is agreed that there is a degree of subjectivity and uncertainty associated with selecting sensitivity ranges. A more detailed discussion of the parameters adjusted and justification of the ranges will be presented in Section 10. For clarity, the text in Section 6.3 will be modified to include all adjusted parameters in the 90% Design Submittal. Specifically, the following text will replace the second and third paragraphs of Section 6.3: "Each of the solute transport parameters affecting the transport and dynamics of dissolved solutes was adjusted in the sensitivity analysis, including the chromium partition coefficient, manganese Freundlich constants, arsenic precipitation rate, manganese and arsenic liberation rates, TOC half-life, and TOC-based chromium precipitation trigger. Each of these parameters was adjusted within a range encompassing anticipated values. For some parameters, the ranges were informed by a geochemical assessment of how site-specific variations in water quality affect the parameter of interest (see the geochemical sensitivity analysis described in Section 9.2), while for other parameters, sensitivity ranges were harder to constrain. In these cases, the ranges were chosen to be sufficiently wide (from at least +/- 50% to over an order of magnitude in some cases) to more than encompass any reasonably-anticipated values, given that the values chosen are site-specific and based on pilot test observations. Parameter ranges and results are described in more detail in Section 10. In addition to solute transport parameters, engineering design			issues related to the 60% BOD on April 7 and April 9, 2014, respectively. The letters are included in **Attachment S** at the end of this table.	On April 7 and April 9, 2014, the FMIT and the Cocopah Indian Tribe transmitted letters regarding comments on modeling issues, respectively. PG&E will work with the Tribes and the TRC to resolve these comments and incorporate the resolution in the 90% design.	

TABLE I-1

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					parameters were also adjusted in the sensitivity analysis to evaluate potential design modification scenarios. Adjusted parameters included the TOC injection concentration, extraction rate at riverbank extraction wells, NTH IRZ well spacing, off-cycle NTH IRZ extraction, total NTH IRZ injection/extraction rates, freshwater injection rates, TOC injection in the IRL, and addition of intermediate recirculation wells. As with the solute transport parameters, parameter ranges were chosen to fully encompass reasonably-anticipated possibilities under a broad range of scenarios. Although numerous scenarios were considered in this analysis, additional design modification scenarios not considered here may become evident as the remedy proceeds. The results of these analyses are presented in Section 10." An additional paragraph will be added to list the parameters that were not adjusted during this solute transport model sensitivity analysis.					
383a	FMIT-93	Append B Section 6.4 p. 38	*Potential well locations were carefully selected by first avoiding culturally or otherwise sensitive areas to minimize impact…*	Given the many apparent design constraints identified throughout the document, it is strongly suggested that a full list be presented, showing how each is weighted in the effort to ”optimize” the remedial system (i.e., well locations, extraction/injection rates, on/off durations, etc.). It would be helpful for the Tribe to review this list prior to the 90 % BOD being issued.	Well locations, well spacing, and well rates were all considered in the remedial design to address the three major constraints (minimize remedial timeframe, minimize infrastructure to avoid culturally sensitive areas, and minimize byproduct generation). A full list/matrix of design considerations will be provided in the 90% design.			Comment resolved pending review of 90% design.	Comment resolved.	90% BOD Apdx B Table 6.4-1
383b	Hualapai-79 Chemehuevi-79 Cocopah-79 CRIT-79	Append B Section 6.4 p. 38	*Potential well locations were carefully selected by first avoiding culturally or otherwise sensitive areas to minimize impact…*	This is another design constraint. Given the many apparent design constraints identified throughout the document, it is strongly suggested that a full list be presented showing how each is weighted in the effort to “optimize” the remedial system (i.e., well locations, extraction/injection rates, on/off durations, etc.)	See response to comment #383a FMIT-93.			Comment resolved pending review of 90% design.	Comment resolved.	90% BOD Apdx B Table 6.4-1
384a	FMIT-94	Append B Section 11.0p. 73	*Note that density dependent flows (resulting from potential*	Investigation/Remedial Investigation (RFI/RI), PG&E Topock Compressor Station, Needles,California Volume 2 - Hydrogeologic Characterization and Results of Groundwaterand Surface	See comment 357a FMIT-67. In addition, the journal reference cited in the comment (Ward, et. al, 2008. *Variable density modeling of*			The FMIT transmitted a letter to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7, 2014. The	PG&E’s response has been revised to reflect discussions between PG&E and TRC (Bob Prucha).	90% BOD Apdx B Section 11

TABLE I-1

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			deviations intemperature and salinity) were not simulated because these will have a negligible impact onsystem flows and the remedy design when compared to the natural heterogeneity of the aquifer.	Water Investigation, Feb 11, 2009, pages 6-33 to 6-37) This evaluation ONLY considered effects of density on plumemovement, not on effectiveness, efficiency or potential problems with the remediationsystem. Page 107 to 108 in Groundwater Modeling in Arid and Semi-Arid Areas edited by Howard S. Wheater, Simon A. Mathias, Xin Li discusses density effects on injection for ASR.The report should present an analysis supporting dismissal of density/temperature effects.What are the temperature effects on piped in freshwater injected over entire screened zone/aquifer? (see Revised Final RCRA Facility See also http://www.deepdyve.com/lp/elsevier/variable- density-modelling-of-multiple-cycle-aquifer- storage-and-NSsvy8c4T2 for variable density effects on cyclic ASR effects of heterogeneity and anisotropy (vert:horz). Review of 2009 CH2M HILL report suggests complex lateral heterogeneities and variable vertical anisotropy complicate this picture but WERE NOT considered in evaluating density effects on remediation system simulations. Available literature (and FEFLOW) suggest this should be considered, even if it is conceptual. This alone could cause considerable variation in predicted flow, transport, and geochemical predictions.	*multiple cycle aquifer storage and recovery (ASR): Importance of anisotropy and layered heterogeneity in brackish aquifers*) supports the conclusion that advective flow will likely be dominant over density driven flow in the vicinity of the Topock freshwater injection wells in most instances, though it is still possible. The paper presents a formula for calculating the Mixed Convection Ratio, M (M = $\frac{2\pi rB}{Q} Kv \left(\frac{\rho-\rho 0}{\rho 0}\right)$). When M is much less than one, advective flow is dominant. When M is greater than 1, density driven flow has more influence. The value of M varies with distance from the well and several other parameters. Using the formula provided in the paper, the mixed convection ratio M was calculated for the two freshwater wells, FW-1 and FW-2. For this calculation, it was assumed that the water temperature was 85 degrees F and that the TDS of the injected freshwater would be 450 mg/L. The nominal injection rates from the 60% design were 100 gpm at FW-1 and 50 gpm at FW-2. The TDS of the water in the aquifer at the injection wells was estimated based on highest TDS values from nearby deep zone wells. The values of M calculated at the distance of the next nearest injection well to the freshwater well in question. The parameters used in the calculations are shown in the tables included in **Attachment I**, at the end of this table. For both FW-1 and FW-2, M is less than 1 out to the radius of the nearest other injection well, indicating that advective flow will dominate over density driven flow within this radius. At greater distances from the freshwater wells, density-driven flow starts to have more influence in the deep aquifer, but at these greater radii the flow will be influenced more by the IRL wells than by the freshwater wells. Density difference is one of several factors that could adversely affect the flushing efficiency in some areas of the site. Low permeability zones and preferential groundwater flow			letter is included in **Attachment S** at the end of this table.	On April 7, 2014, the FMIT transmitted a letter regarding comments on modeling issues. PG&E will work with the Tribe and the TRC to resolve these comments and incorporate the resolution in the 90% design.	

TABLE I-1

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Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

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					paths are other factors. It is anticipated that there will be areas where flushing occurs faster than projected, and other areas where it occurs slower than projected. After several years of operations, areas where flushing efficiency is lacking will start to become apparent. One of the reasons for designing injection and extraction wells with excess capacity above the design flows is to have flexibility to adjust pumping and injection rates to optimize flushing of the plume to the IRZ. If density-driven flow impacts are observed to occur during remedy implementation (i.e. slower flushing of deeper, more saline portions of the aquifer in areas some distance away from the injection wells), steps can be taken to help mitigate these impacts. Potential steps include varying well flow rates or packering off sections of the screened intervals to manage density effects. The 90% design will include a section describing how density effects could be mitigated, should they occur.					
384b	Hualapai-80 Chemehuevi-80 Cocopah-80 CRIT-80	Append B Section 11.0p. 73	*Note that density dependent flows (resulting from potential deviations intemperature and salinity) were not simulated because these will have a negligible impact onsystem flows and the remedy design when compared to the natural heterogeneity of the aquifer.*	The report should present an analysis supporting dismissal of density/temperature effects. What are the temperature effects on piped in freshwater injected over entire screened zone/aquifer? (see Revised Final RCRA Facility Investigation/Remedial Investigation (RFI/RI), PG&E Topock Compressor Station, Needles, California Volume 2 - Hydrogeologic Characterization and Results of Groundwater and Surface Water Investigation, Feb 11, 2009, pages 6-33 to 6-37) This evaluation ONLY considered effects of density on plume movement, NOT on effectiveness, efficiency or potential problems with the remediation system. Page 107 to 108 in Groundwater Modeling in Arid and Semi-Arid Areas edited by Howard S. Wheater, Simon A. Mathias, Xin Li – discusses density effects on injection for ASR. See also: http://www.deepdyve.com/lp/elsevier/variable-density-modelling-of-	See response to comment #384a FMIT-94.			The Cocopah Indian Tribe transmitted a letter to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 9, 2014. The letter is included in **Attachment S** at the end of this table.	See comment #384a FMIT-94. On April 9, 2014, the Cocopah Indian Tribe transmitted a letter regarding comments on modeling issues. PG&E will work with the Tribe and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Apdx B Section 11

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Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
				multiple-cycle-aquifer-storage-and-NSsvy8c4T2 for variable density effects on cyclic ASR - effects of heterogeneity and anisotropy (vert:horz). Review of 2009 CH2M HILL report suggests complex lateral heterogeneities and variable vertical anisotropy complicate this picture but WERE NOT considered in evaluating density effects on remediation system simulations. Available literature (and FEFLOW) suggest this should be considered - even if it is conceptual. This alone could cause considerable variation in predicted flow, transport and geochemical predictions.						
385	FMIT-95 Hualapai-81 Chemehuevi-81 Cocopah-81 CRIT-81	Text is from "Groundwater Model UpdateReport, July 2005",page 2-8	*The model requires three parameters for each river node: water surface elevation, riverbed elevation, and riverbed resistance (the inverse of permeability). Riversurface elevations were assigned throughout the model domain using average elevation of themain Topock site measuring point (I-3) and historical average river gradients between I-3 and the USGS gauging station in Topock Gorge, between I-3 and the RRB station at theupstream end of the site, and average gradient north*	What are effects of these assumptions (or associated uncertainty), especially the "riverbed resistance", on remedial system performance?Were these ever tested? The resistance as calculated here does not seem to correlate well with the thickness of the rind. Does it need to?	The simulated water surface elevation was based on average site measuring point data and historical average gradients and is therefore directly correlated with observed river stages. The riverbed elevation is an approximate representation of the river profile and would not have a significant impact on the remedial system performance as it remains in model layer 1. Riverbed resistance was evaluated during the calibration of the groundwater flow model and through the implementation of PEST it was observed that riverbed resistance was a relatively insensitive parameter. Riverbed resistance is dependent on the riverbed thickness and the model layer structure. By contrast, the rind is defined by geochemical properties, specifically reducing conditions prevalent in shallow-medium depth groundwater wells surrounding the river and the porewater of the river itself and the rind extends beyond the riverbed into the floodplain. Therefore the riverbed resistance does not necessarily correlate with the rind. The effects of changing riverbed conductance on the projected performance of the river bank wells has not been tested in the model. It should be noted that the river bank wells are not intended to be screened in the shallow zone, so they won't be drawing water directly from the area immediately adjacent to and below the river. The amount of			The FMIT and the Cocopah Indian Tribe transmitted letters to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7 and April 9, 2014, respectively. The letters are included in **Attachment S** at the end of this table.	PG&E's response has been revised to reflect discussions between PG&E and TRC (Bob Prucha). On April 7 and April 9, 2014, the FMIT and the Cocopah Indian Tribe transmitted letters regarding comments on modeling issues, respectively. PG&E will work with the Tribes and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Apdx B Section 12

TABLE I-1

Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
			of the site from USGS maps. The riverbed elevation wascalculated by assuming a triangular bed profile with a maximum depth of 20 feet decreasing to zero at the banks. Riverbed resistance is defined as the sum of:(1) riverbed thicknessdivided by its vertical hydraulic conductivity and (2) half of Layer 1 thickness divided by its vertical hydraulic conductivity.		water the wells draw from the river will be affected by both the river bed conductance and the Kh/Kv ratio of the sediments between the well screen depth and the river bottom, and Kh/Kv ratios surrounding the wells. Additional data to evaluate these parameters will be generated as the river bank extraction wells are installed and tested. The model will be updated, re-calibrated if necessary, and new long-term predictions made as these new data become available. A section will be added to the 90% BOD report to describe model update procedures.					
386	FMIT-96 Hualapai-82 Chemehuevi-82 Cocopah-82 CRIT-82	Section 3.1.4 p. 3-3	*Numerous iterations of the remedial system layout and operational strategy were then considered and simulated in order to arrive at an optimized remedial approach and to account for uncertainties in the model predictions.*	The document should present a summary of layouts and operational strategies and how were these used to 'optimize' the remedial approach. How were these used to account for uncertainties in model predictions specifically?	Considerable flexibility was incorporated into the remedial design by including provisional well locations and ranges in well rates in order to account for uncertainties in the model predictions. A table of optimization criteria will be developed reflecting the remedial design specifications and parameters encountered during well installation and operation.			Comment resolved pending review of 90% design. The FMIT and the Cocopah Indian Tribe transmitted letters to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7 and April 9, 2014, respectively. The letters are included in **Attachment S** at the end of this table.	Comment resolved. On April 7 and April 9, 2014, the FMIT and the Cocopah Indian Tribe transmitted letters regarding comments on modeling issues, respectively. PG&E will work with the Tribes and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Section 3.1.4
387	FMIT-97 Hualapai-83 Chemehuevi-83 Cocopah-83 CRIT-83	Section 3.1.4 p. 3-3	*Parameters that were adjusted between model runs included well locations, well extraction or injection rates, well*	It would be better to not confuse model “parameters” (i.e., hydraulic conductivity, storage, riverbed conductance etc.) with model boundary conditions (i.e., well extraction/injection rates, cycling of wells etc.). It appears most of these are the latter.	The text will be modified to better differentiate between model parameters and model boundary conditions. The revised text is as follows "~~Parameters~~ Boundary conditions that were adjusted between model runs included well locations, well extraction or injection rates, well cycling patterns (i.e.,			Comment resolved pending review of the 90% design.	Comment resolved.	90% BOD Section 3.1.4

TABLE I-1

Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
			cycling patterns (i.e., duration of active operation versus shutdown), carbon substrate amendment injection concentrations, and reinjection destinations…		duration of active operation versus shutdown), ~~carbon substrate amendment injection concentrations,~~ and reinjection destinations. Solute transport model parameters were also adjusted including carbon amendment injection concentrations, carbon decay rates, Cr(VI) partition coefficient, manganese generation/ attenuation rates, and arsenic generation/ attenuation rates." Relative sensitivities of each of the parameters/ conditions evaluated with the model will be tabulated to further illustrate the results of the sensitivity analyses and will be included in the 90% design submittal.					
388a	FMIT-98	Section 3.1.4p. 3-3	• *Reduce the anticipated remedial time frame for effective capture and treatment of the Cr(VI) plume;* • *Minimize the necessary remediation infrastructure (i.e., total number of new well locations) or "footprint" of the remedial system; and* • *Minimize the impact of potential byproducts (i.e., arsenic and manganese.)*	After reviewing the document, it appears these are only three of other important optimization criteria. It is highly recommended that all of these be compare within a table where their relative priorities (importance) can be shown in deriving the final "layout" and "operational strategy" for the remedial system. What are the specific "performance metrics" for optimization? For example, what does the model suggest is the optimum time to reduce the plume volume (or Cavg for Cr(VI)) to some small remaining percentage of existing mass? Were the optimization (or sensitivity) runs designed to only qualitatively determine things like well locations, rates, cycling etc? It does not seem very quantitative. Is this because the overall modeling objectives are somewhat vague? Review of Appendix B - does not show a very clear optimization strategy. In fact, it appears to be confused with a limited sensitivity analysis that only assesses remedial design performance by adjusting remediation system-specific boundary conditions individually (and not in combination). It would be more useful to conduct a sensitivity analysis to evaluate remedial system performance due to the combined effects of remediation system BCs with uncertain model parameters, or model BC unrelated to	These are still the three core criteria for the remedial design. All three are directly related and need to be balanced during remedy design and implementation A table of optimization criteria will be developed reflecting the remedial design and operation specifications and parameters encountered during well installation and operation. Performance metrics will be developed as part of this table. A subset of possible boundary conditions and solute transport model parameters were varied individually to assess their direct impact on the simulation results. Relative impacts of individual parameters could be masked by simulating combinations of flow and solute transport parameters (and boundary conditions). Conclusions can still be drawn on combined impacts based on sensitivity simulation results where only individual parameter/boundary conditions are adjusted. The relative sensitivities of adjusted inputs will be summarized in a sensitivity table to better illustrate the degree of sensitivity, in addition to presenting the simulated solute transport modeling results at 10 and 30 years for Cr(VI), TOC, Mn, and As. The adjusted inputs will be arranged by type (i.e, flow parameter, transport parameter, boundary condition,			The FMIT transmitted a letter to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7, 2014. The letter is included in **Attachment S** at the end of this table.	PG&E's response has been revised to reflect discussions between PG&E and TRC (Bob Prucha). On April 7, 2014, the FMIT transmitted a letter regarding comments on modeling issues. PG&E will work with the Tribe and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Section 3.1.4 90% BOD Apdx B Sections 6.6 and 10

TABLE I-1

Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
				the remediation system (i.e., recharge, ET, lateral inflows). This would have been useful towards evaluating effects of model parameter uncertainty on predictions, though other sources of uncertainty would have to also be considered as well for a complete picture (i.e., conceptual and model input uncertainty).	operational factor etc) for clarity.					
388b	Hualapai-84 Chemehuevi-84 Cocopah-84 CRIT-84	Section 3.1.4p. 3-3	• *Reduce the anticipated remedial time frame for effective capture and treatment of the Cr(VI) plume;* • *Minimize the necessary remediation infrastructure (i.e., total number of new well locations) or "footprint" of the remedial system; and* • *Minimize the impact of potential byproducts (i.e., arsenic and manganese.)*	After reviewing the document, it appears these are only three of other important optimization criteria. It is highly recommend that all of these be compiled within a table where their relative priorities (importance) can be shown in deriving the final "layout" and "operational strategy"' for the remedial system. What are the specific "performance metrics" for optimization? For example, what does the model suggest is the optimum time to reduce the plume volume (or Cavg for CrVI) to some small remaining % of existing mass? Were the optimization (or sensitivity) runs designed to only qualitatively determine things like well locations, rates, cycling etc.? It does not seem very quantitative. Is this because the overall modeling objectives are somewhat vague? Review of Appendix B does not show a very clear optimization strategy. In fact, it appears to be confused with a limited sensitivity analysis that only assesses remedial design performance by adjusting Remediation System-specific Boundary Conditions (BCs) individually (and not in combination). It would be more useful to conduct a sensitivity analysis to evaluate remedial system performance due to the combined effects of remediation system BCs with uncertain model parameters, or model BCs unrelated to the remediation system (i.e. recharge, ET, lateral inflows). This actually would have been useful towards evaluating effects of model parameter uncertainty on predictions, though other sources of uncertainty would have to also be considered as well for a complete	See response to comment #388a FMIT-98.			The Cocopah Indian Tribe transmitted a letter to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7, 2014. The letter is included in **Attachment S** at the end of this table.	See comment #388a FMIT-98. On April 9, 2014, the Cocopah Indian Tribe transmitted a letter regarding comments on modeling issues. PG&E will work with the Tribe and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Section 3.1.4 90% BOD Apdx B Sections 6.6 and 10

TABLE I-1

Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
				picture (i.e., conceptual and model input uncertainty.)						
389	FMIT-99 Hualapai-85 Chemehuevi-85 Cocopah-85 CRIT-85	Section 3.2 p. 3-4	*….represent a level of detail appropriate for the 60 percent design phase…*	What is ”appropriate”? As opposed to the 30% or 90%?	"Appropriate" level of detail for the 60% is a near final design to provide a clear approximation of the remedy performance.			Comment resolved.	Comment resolved.	Not applicable
390	FMIT-100 Hualapai-86 Chemehuevi-86 Cocopah-86 CRIT-86	Section 3.2.1.1 p. 3-7	*….at the 16 NTH IRZ Injection Well locations/clusters resulted in effective remediation (i.e., produced an adequate reducing zone while limiting byproduct formation)…*	Can this be defined more clearly/accurately - it seems important as a remediation system performance target. But stating that it ”produced an adequate reducing zone while limiting byproduct formation” is vague. The model results are quantitative, though uncertain, and should be used as such to evaluate overall performance.	The text will be modified as follows (added text shown in <u>underline</u> typeface and deleted text shown in ~~strikethrough~~ typeface): "...the 16 NTH IRZ Injection Well locations/clusters resulted in effective remediation (i.e., ~~produced an adequate reducing zone some of the Cr[VI] simulations indicated that~~ Cr[VI] treatment through the NTH IRZ was complete without breakthrough, while predicted byproduct generation, migration, and attenuation were limited to levels consistent with the current conditions of the reducing rind ~~limiting byproduct formation~~)...”.			Comment resolved pending review of the 90% design.	Comment resolved.	90% BOD Section 3.2.1
391	FMIT-101 Hualapai-87 Chemehuevi-87 Cocopah-87 CRIT-87	Append B Section 1.2p. 1	*The objectives of this modeling study were to develop a groundwater flow and solute transport model for useas follows:* • *Evaluate subsurface flow conditions* • *Evaluate the fate and transport of Cr(VI)* • *evaluate fate and Transport of manganese and arsenic* • *Evaluate potential remedial system*	These objectives seem inconsistent with those conveyed in the project RAOs. For example, isn’t the key objective of the modeling to develop aremedial design layout and operation that meet RAOs? Why aren’t objectives of the RAOs stated here as key guides to how the model was developed and applied towards developing the design and operation of the remedial system? As written here, the modeling appears to be used only to ”evaluate” conditions. The subsequent text clearly indicates the modeling tool(s) are used to support many critical steps of the proposed design/operation, for example: well locations, pumping rates, TOC injection rates, cycling of injection/extraction etc). As such, shouldn't the objectives been restated to better convey how the modeling tool(s) are used here and how they will be used in the future? Objectives are crucial to defining the purpose and approach for the modeling and should be clearly	The objectives of the groundwater flow and transport model will be refined to more clearly reflect the RAOs. The process used and the role of the model in the design will be more clearly described in the 90% design document.			Comment resolved pending review of the 90% design. The FMIT and the Cocopah Indian Tribe transmitted letters to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7 and April 9, 2014, respectively. The letters are included in **Attachment S** at the end of this table.	Comment resolved. On April 7 and April 9, 2014, the FMIT and the Cocopah Indian Tribe transmitted letters regarding comments on modeling issues, respectively. PG&E will work with the Tribes and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Apdx B Section 1.2

TABLE I-1

Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
			configurations	established.						
392	FMIT-102 Hualapai-88 Chemehuevi-88 Cocopah-88 CRIT-88	Append B Section 1.2 p. 1	This appendix describes the results of six major components of the modeling study at the Site:	The flow, solute transport and fate associated with the natural and remedial operation flow systems is complex. The conceptual and numerical modeling of these processes is equally complex. It is standard practice to include flow charts of showing how previous regional modeling fit in with local-scale models, how the flow model feeds into the transport and the geochemical models, and then how sensitivity and uncertainty analyses/ model validation are conducted. This is recommended to help technical reviewers convey these concepts to other less technical people. It will also be useful for conveying how future updates would be conducted (i.e., what aspects of modeling). Much of the fate/transport modeling for example, depends on flow modeling. Ultimately the modeling should support complex decisions.	A flow chart will be developed and included in the 90% design submittal to show the relationship of the regional groundwater flow model, the geochemical model, and the solute transport model, and the associated uncertainties and sensitivities.			Comment resolved pending review of the 90% design documents. The FMIT and the Cocopah Indian Tribe transmitted letters to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7 and April 9, 2014, respectively. The letters are included in **Attachment S** at the end of this table.	Comment resolved. On April 7 and April 9, 2014, the FMIT and the Cocopah Indian Tribe transmitted letters regarding comments on modeling issues, respectively. PG&E will work with the Tribes and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Apdx B Section 1.2
393	FMIT-103 Hualapai-89 Chemehuevi-89 Cocopah-89 CRIT-89	Append B, Section 3.2 p. 12	*The reducing environment can be adjusted to minimize byproduct liberation without negatively impacting Cr(VI) reduction by properly controlling organic carbon dosing and distribution.*	This section should discuss the optimization strategy to minimize byproduct liberation?	The optimization strategy to minimize byproduct generation is to introduce the minimum amount of carbon necessary to establish sufficient reducing conditions for Cr(VI). This information will be added to the text.			Comment resolved pending review of 90% design. The FMIT and the Cocopah Indian Tribe transmitted letters to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7 and April 9, 2014, respectively. The letters are included in **Attachment S** at the end of this table.	Comment resolved. On April 7 and April 9, 2014, the FMIT and the Cocopah Indian Tribe transmitted letters regarding comments on modeling issues, respectively. PG&E will work with the Tribes and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Apdx B Section 3.2
394	FMIT-104 Hualapai-90 Chemehuevi-90 Cocopah-90 CRIT-90	Append B Section 4.0p. 18	*The auto-calibrationprogram PEST was employed to refine thecalibration and to reduce effects of uncertainty in each calibration target. The PEST programaddresses*	How was this done specifically? Simple application of PEST does not assure validity of the distributions. In fact, the very complex hydraulic conductivity beneath the Colorado River seems unsupported by data and somewhat contrived. The concern is how this affects predicted aquifer response to the long- term remedial system operations. The sensitivity of these parameter distributions on model predictions should be evaluated.	Text will be modified as follows: "*The auto-calibration program PEST was employed to refine the calibration <u>by minimizing the difference between observed and simulated calibration targets</u> ~~and to reduce effects of uncertainty in each calibration target~~.*" Despite the lack of hydraulic data beneath the river, the simulated hydraulic conductivity (K) distributions minimizes the objective function(s) based on data that was available in the vicinity of the Colorado River. Hydrogeologic			The FMIT and the Cocopah Indian Tribe transmitted letters to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7 and April 9, 2014, respectively. The letters are included in **Attachment S** at the end of this table.	PG&E's response has been revised to reflect discussions between PG&E and TRC (Bob Prucha). On April 7 and April 9, 2014, the FMIT and the Cocopah Indian Tribe transmitted letters regarding comments on modeling issues, respectively. PG&E will work with the Tribes and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Apdx B Section 4

TABLE I-1

Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
			heterogeneity in the aquifer by establishing a variable hydraulic conductivitydistribution across the groundwater flow model domain during thecalibration process.		interpretation is important in simulating areas where limited data is available. Given that the simulated K value distribution agreed with the hydrogeologic interpretation and resulted in a well calibrated groundwater flow model, this is the best baseline to conduct the solute transport modeling. While varying the K distribution may impact the calibration and predictions, the baseline run would still be the ideal version to utilize minimizing the need for a detailed sensitivity analysis.					
395	FMIT-105 Hualapai-91 Chemehuevi-91 Cocopah-91 CRIT-91	Append B Section 4.4 p. 20	Boundary Conditions	Typically recharge and evapotranspiration are discussed in this section. In the CH2M HILL document titled "Groundwater Model Update Report, July 2005", Maximum ET rates appear to have been set at 0.42 in/yr. This seems exceptionally low for max ET rate. Statewide estimates in this area likely exceed this by at least 2 orders of magnitude. The implication of underestimating this rate is that under the non-stressed calibration conditions more groundwater likely discharges into the river nodes rather than ET nodes adjacent to the river. The problem with this is that during remedial system operation, when the system gets stressed beyond the "calibration state", the predicted dynamics and water balance associated with aquifer-river interactions and aquifer-ET interactions will be wrong. See http://www.twdb.texas.gov/publications/reports/contracted_reports/doc/2004483535_UT_BEG.pdf for published examples of annual maximum ET rates and a review of ET simulations in MODFLOW. Time-varying Cr data presented at the TWG meeting, July 18, 2013, showed annual cyclicity of shallow Cr concentrations. Is it the variation in ET rates that concentrates Cr during warmer months? If so, is this accounted for in the models? The calibration of the transient groundwater flow model (MICROFEM) appears to be based on varying river stage and ET rates based	During the calibration process, it was observed that evapotranspiration was not a sensitive parameter in the groundwater flow model. The MODFLOW/MT3D flow model utilized the average ET rate directly from the regional groundwater flow model and it was held constant to represent long-term steady state conditions. Because of the depth of the water table throughout most of the model domain, the ET rate is specified as zero at the extinction depth specified to be 10 feet. The active areas are predominantly in the flood plain and to the south near the bedrock where the aquifer pinches out and are consistent with the narrow bands of observed vegetation. During remedy operation ET would likely remain the same or decrease due to hydraulic stresses in the floodplain. From a volumetric approach, implications for an ET value that is too low would mean that more water would discharge to the river to achieve flow balance in the system. This may require increased flows at river bank extraction wells than anticipated. During installation/testing and model updates, this will be further evaluated to see if the ET module parameters in the groundwater flow model need to also be updated under this new state of stress.				The comment was resolved verbally at the February 12, 2014 CWG. Comment resolved.	Not applicable

TABLE I-1

Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

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				on the Consumptive Use Program 2005 data - but it is unclear how 0.42 in/yr was scaled to match this data. What did the long-term transient MODFLOW/ MT3D flow and fate/transport simulations with the new remedial system design and operation presented here assume for maximum ET rate and its variation in time? What are implications if it is too low?						
396a	FMIT-106	Append B Section 5.1p. 21	Geochemical and Reactive Transport Code Selection *Batch simulations were performed with the geochemical modeling software PHREEQC…"*	How sensitive are the PHREEQC geochemical reactions to seasonal variations in injected water temperatures? Would external air temperature variations affect above the extracted groundwater temperatures associated with piping from the freshwater source?	All of the geochemical reactions considered are sensitive to temperature to a minor extent. The average temperature of groundwater at the Site is approximately 25°C, which is the temperature at which the geochemical calculations were run. While water temperatures are expected to change slightly during travel through the pipelines and tanks, the temperature changes will be readily buffered as the water is injected back into the aquifer so that the actual temperature change within the aquifer will be so small that the effects on geochemical reaction rates and equilibria will be negligible. Any variations in solute transport parameters as a result of temperature fluctuation are well-bracketed by the sensitivity parameter ranges already considered in Section 10. With respect to the freshwater injection, modeling will be updated in the 90% design to account for differences in temperature between the source water and the injection sites.			Comment resolved pending review of the 90% design.	Comment resolved.	90% BOD Apdx B Sections 5.2 and 5.4.3
396b	Hualapai-92 Chemehuevi-92 Cocopah-92 CRIT-92	Append B Section 5.1p. 21	Geochemical and Reactive Transport Code Selection *Batch simulations were performed with the geochemical modeling software PHREEQC…"*	How sensitive are the PHREEQC geochemical reactions to seasonal variations in injected water temperatures? Would external air temperature variations affect the extracted groundwater temperatures associated with piping from the freshwater source?	See response to comment #396a FMIT-106.			Comment resolved pending review of the 90% design.	Comment resolved.	90% BOD Apdx B Sections 5.2 and 5.4.3
397	FMIT-107	Append B	*In addition to*	These are not really model	The text will be edited from			Comment resolved pending	Comment resolved.	90% BOD Apdx B Section 6.3

TABLE I-1

Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

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	Hualapai-93 Chemehuevi-93 Cocopah-93 CRIT-93	Section 6.3 p. 37	*varying the parameters for the constituents of concern, additional analyses were conducted to evaluate additional parameter impacts on the solute transport model. These parameters include the TOC injection concentration, the riverbank extraction well rate, and the NTH IRZ well spacing. The solute transport modeling sensitivity analysis is presented in Section 10.*	"parameters" but rather remedial system factors associated with external boundary conditions imposed on the flow system. Mixing model parameters that affect flow, fate/transport, geochemical reactions with those associated with the design/operation of the remedial system is confusing. During start-up, model testing/verification, it will become essential to distinguish between the many inputs to the model(s) to understand the reason(s) why any deviations between what has been predicted by the model(s) and what is observed under the new system stresses so that the proper adjustments can be made to improve overall performance (i.e., reducing Cr at the fastest rate possible).	"parameter impacts" to "remedial system design" for clarification. Geochemical parameters / solute transport parameters / hydrogeologic parameters / remedial system layout and operation will all be considered while comparing the performance of the remedial design in relation to the simulated results.			review of the 90% design.		
398	FMIT-108 Hualapai-94 Chemehuevi-94 Cocopah-94 CRIT-94	Append B Section 6.4 p. 37	Remediation Design	What are performance metrics developed for the design and operation? These should have been developed at key locations/areas to allow quantitative comparisons between sensitivity runs that appear to be used to assess different adjustments to the well locations and operations? Many results of the sensitivity runs are evaluated "qualitatively", so it is difficult to assess true performance at key areas.	Relative sensitivities of each of the parameters/conditions evaluated related to Cr(VI) reduction, Mn generation/attenuation, and As generation/ attenuation will be tabulated to further illustrate the results of the sensitivity analyses and will be included in the 90% design submittal. Exact performance metrics were not generated for specific locations, but rather the spatial distribution of TOC, Cr(VI), Mn, and As were used to develop the remedial system design and operation. In addition, a table of optimization criteria will be developed reflecting the remedial design specifications and parameters encountered during well installation and operation.			Comment resolved pending review of the 90% design documents. The FMIT and the Cocopah Indian Tribe transmitted letters to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7 and April 9, 2014, respectively. The letters are included in **Attachment S** at the end of this table.	Comment resolved. On April 7 and April 9, 2014, the FMIT and the Cocopah Indian Tribe transmitted letters regarding comments on modeling issues, respectively. PG&E will work with the Tribes and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Apdx B Tables 10.1 and 6.4-1

TABLE I-1

Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
399	FMIT-109 Hualapai-95 Chemehuevi-95 Cocopah-95 CRIT-95	Append B Section 8.1.2 p. 51	Geochemical Model Parameters	This may have been presented in previous reports, but it is difficult to understand these complex flow, transport and chemical reactions without a conceptual diagram that shows fundamental components and processes that are then modeled.	An illustrative conceptual diagram highlighting all of the major geochemical processes considered in evaluating the remedy will be prepared for the 90% Design Submittal. This conceptual diagram will primarily serve to illustrate the processes outlined in Section 5.2, which includes all of the reactions considered in the geochemical and reactive transport modeling.			Comment resolved pending review of the 90% design.	Comment resolved.	90% BOD Apdx B Section 2.4
400	FMIT-110 Hualapai-96 Chemehuevi-96 Cocopah-96 CRIT-96	Append B Section 8.2 p. 53	*Incremental manganesecon centration increases in the river werecalculated based on the average river flow rate past the Site, estimated at 6.8 million gpm (CH2M HILL 2011). Based on model estimated river interface concentrations and thecalculated river dilution factors, the incrementalcon centration increase isless than 2.5 ng/L (less than 0.0025 µg/L) underall scenarios modeled,down from between 6 and 60 ng/L without oxidation. It is, therefore, predicted that any increase in Mn(II) concentration in the river will be orders of magnitude below detection,*	Isn't this also true for Cr and As? Does this address the RAO regarding prevention of impacts on the Colorado River water?	The simulated results indicate that Cr(VI) is reduced and hydraulically captured and will not impact the Colorado River. Similarly, simulated byproduct arsenic generation in the floodplain remains below 5 ppb and will not impact the Colorado River. This addresses the RAO regarding the prevention of impacts to the Colorado River.			Comment resolved.	Comment resolved.	90% BOD Apdx B Section 8.2

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			particularly after oxidation within the hyporheic zone.							
401	FMIT-111 Hualapai-97 Chemehuevi-97 Cocopah-97 CRIT-97	Append B Section 9.2 p. 58	*The sensitivity range considered in the solute transport model sensitivity analysis, therefore, adequately accounts for uncertainty and variability in groundwater chemistry, as well as additional uncertainty/ variability in sorption site concentration.*	All model parameters, boundary condition assumptions, and conceptualization uncertainties need to be assessed along with uncertainties in groundwater chemistry.	Uncertainty is inherent in any mathematical representation of a natural system. It is acknowledged in the groundwater flow and solute transport models that a more detailed uncertainty analysis would confirm this uncertainty. The proposed design and range of operation were based on the calibrated groundwater flow model, the predictive solute transport modeling and sensitivity analysis, available characterizations, and professional judgment.			The FMIT and the Cocopah Indian Tribe transmitted letters to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7 and April 9, 2014, respectively. The letters are included in **Attachment S** at the end of this table.	PG&E's response has been revised to reflect discussions between PG&E and TRC (Bob Prucha). On April 7 and April 9, 2014, the FMIT and the Cocopah Indian Tribe transmitted letters regarding comments on modeling issues, respectively. PG&E will work with the Tribes and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Apdx B Section 11
402	FMIT-112 Hualapai-98 Chemehuevi-98 Cocopah-98 CRIT-98	Append B Section 10.0 p. 59	Solute Transport Model Sensitivity Analysis	The sensitivity of model transport results performed here does not consider effects of the many complex flow parameter/boundaryconditions. Can the same conclusions about adjustments to design/operation factors (i.e., well spacing, TOC injection concentrations, etc.) be made given the uncertainties associated withflows? Is it always possible to conclude the design is conservative and operations can always be 'tweaked' to meet objectives? If multiple factors/parameters/boundary conditions had been adjusted within reasonable ranges simultaneously, rather than individually, would the conclusions be the same? There are many parameters and factors influencing the overall remedial system performance. Because the modeling tools are the primary tools used to define the design and operation of the system, it is recommended that all flow, transport, and geochemical parameters and boundary conditions, and all design and operation factors	The groundwater flow model utilized to conduct the solute transport modeling represents a reasonable calibration to the available data. It is admittedly not the only possible combination of parameters that could result in an acceptable calibration. The uncertainty in model predictions is accounted for by providing flexibility in the design flow rates and well locations. This design flexibility is based on the solute transport modeling and sensitivity analysis, professional experience, and the hydrogeologic characterization of the site. Adjustment to groundwater flow model parameters will change flows through hydrogeologic units differently, but adjusting individual remedial design injection/extraction well flow rates within stated ranges is expected to allow the system to meet stated objectives. A section will be added to the 90% BOD report to describe model update procedures.			Suggest it is better to use a range of calibrated model inputs (flow) and transport inputs (possible range) to simulate a range of possible outcomes. The FMIT and the Cocopah Indian Tribe transmitted letters to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7 and April 9, 2014, respectively. The letters are included in **Attachment S** at the end of this table.	PG&E's response has been revised to reflect discussions between PG&E and TRC (Bob Prucha). On April 7 and April 9, 2014, the FMIT and the Cocopah Indian Tribe transmitted letters regarding comments on modeling issues, respectively. PG&E will work with the Tribes and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Apdx B Section 12

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				be compiled and kept separate. Given the complexities of the flow/transport system, when initial observed system performance starts to deviate from what was simulated, knowing which parameters, or factors to adjust will be essential. The impression here is that they are not distinguished, nor fully tested. It is difficult to see how the model(s) won't be required to be updated frequently, at least early on, especially with any adjustments to the design or operation. Every adjustment would require long-term projections to make sure that none of the modeling objectives (or metrics) are problematic. This doesn't seem possible using just field observations.						
403a	FMIT-113	Append B Section 10.13 p. 71	Intermediate Recirculation Well Sensitivity *In order to optimize the performance of the remedial design….*	How many simulations were conducted and what were the performance metrics, or optimization criteria/targets?	Numerous simulations were conducted with changes in well locations, well rates, well operations, and TOC concentrations. The optimization criteria were to accelerate the remedial timeframe while preventing Cr(VI) migration past the NTH IRZ, hydraulically capturing the existing floodplain Cr(VI) impacts, and minimizing byproduct generation. A table of optimization criteria will be developed reflecting the remedial design specifications and parameters encountered during well installation and operation. Performance metrics will be developed as part of this table.			Comment resolved pending review of 90% design. The FMIT transmitted a letter to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7, 2014. The letter is included in **Attachment S** at the end of this table.	Comment resolved. On April 7, 2014, the FMIT transmitted letters regarding comments on modeling issues. PG&E will work with the Tribe and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Apdx B Section 10.13
403b	Hualapai-99 Chemehuevi-99 Cocopah-99 CRIT-99	Append B Section 10.13 p. 71	Intermediate Recirculation Well Sensitivity *In order to optimize the performance of the remedial design….*	Is it really optimized? How many simulations were conducted and what were the performance metrics, or optimization criteria/targets?	See response to comment #403a FMIT-113.			Comment resolved pending review of 90% design. The Cocopah Indian Tribe transmitted a letter to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7, 2014. The letter is included in **Attachment S** at the end of this table.	Comment resolved. On April 9, 2014, the Cocopah Indian Tribe transmitted a letter regarding comments on modeling issues. PG&E will work with the Tribe and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Apdx B Section 10.13
404	FMIT-114 Hualapai-100 Chemehuevi-100 Cocopah-100 CRIT-100	Append B Section 11.0p. 73	*As with all mathematical models of natural systems, the groundwater flow and solute*	There is a lack of discussion on anisotropy within the remediation zone. K values are shown on plots, but nothing on Kv distribution. What effect does the increased uncertainty in model input parameters (outside of the localized	Horizontal to vertical K (Kh/Kv) ratios are discussed in the Groundwater Model Update Report (CH2M HILL, 2005) and the final calibrated distribution is utilized in the MODFLOW model / solute transport model.			Predictive uncertainty can be assessed, even if it means looking at the extremes of key parameter ranges.	The comment was resolved verbally at the February 12, 2014 CWG. Comment resolved.	Not applicable

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			transport model is limited by factors, such as scale, accuracy of the estimated hydraulic properties and/or boundary conditions, and the underlying simplifications and assumptions incorporated into the model. These factors result in limitations to the model's appropriate uses and to the interpretations that may be made of the simulation results."	remedial system area where there is anabundance of data) have on the remedial system performance towards achieving model objectives or RAOs? A key outcome of the uncertainty analysis for the Tribes is an estimate of how long it will take for the system to operate. Can it be less than 30 years, or could it be greater than 50? It would have been useful if the uncertainty analysis here considered all parameter/boundary condition uncertainties in addition to "sensitivities" of various remedial design or operation factors. Figures D4-1 through D4-8 in the Jan 2009 CH2M HILL Report titled "Corrective Measures Study/Feasibility Study Report for Chromium in Groundwater" nicely show a range of uncertainty for cleanup times vs. amount, but these aren't to be applied to the current design or operation.	See response to comment 401 FMIT-111.					
405	FMIT-115 Hualapai-101 Chemehuevi-101 Cocopah-101 CRIT-101	Append B Section 11.0 p. 73	*With respect to the solute transport model, uncertainty associated with subsurface heterogeneity was addressed by simulating the system as a dual-domain model….*	How was "uncertainty" with heterogeneity addressed by assuming a dual-domain model? Is this assumed to be the largest source of uncertainty in the solute model?	Text will be modified as follows: *A dual-domain mass-transfer approach was used to model solute transport in the heterogeneous aquifer system as the small-scale preferential flow pathways cannot be fully and explicitly represented by the spatial discretization in a numerical model for practical reasons.*			The FMIT and the Cocopah Indian Tribe transmitted letters to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7 and April 9, 2014, respectively. The letters are included in **Attachment S** at the end of this table.	PG&E's response has been revised to reflect discussions between PG&E and TRC (Bob Prucha). On April 7 and April 9, 2014, the FMIT and the Cocopah Indian Tribe transmitted letters regarding comments on modeling issues, respectively. PG&E will work with the Tribes and the TRC to resolve these comments and incorporate the resolution in the 90% design.	90% BOD Apdx B Section 11
406	FMIT-116 Hualapai-102 Chemehuevi-102 Cocopah-102 CRIT-102	Append B Section 11.0p. 73	*This sensitivity analysis can be utilized to address the uncertainty in the model by providing a range of remedial impacts and relative impacts of*	Concerns include: a) Uncertainty - parameter adjustments only partly contribute to overall prediction uncertainty. Conceptual uncertainty is typically the largest. There is no discussion on the latter, or on an actual uncertainty analysis vs. a sensitivity analysis. A sensitivity analysis should not be confused with an uncertainty analysis that	a) Uncertainty is inherent in any mathematical representation of a natural system. It is acknowledged in the groundwater flow and solute transport models, and a detailed uncertainty analysis would confirm such uncertainty. Typical Monte Carlo analyses require hundreds to thousands of runs to produce uncertainty plots. Given the size and complexity of the flow and solute transport model, this is not a			The FMIT and the Cocopah Indian Tribe transmitted letters to DTSC/DOI regarding comments on modeling issues related to the 60% BOD on April 7 and April 9, 2014, respectively. The letters are included in **Attachment S** at the end of this table.	PG&E's response has been revised to reflect discussions between PG&E and TRC (Bob Prucha). On April 7 and April 9, 2014, the FMIT and the Cocopah Indian Tribe transmitted letters regarding comments on modeling issues, respectively. PG&E will work with the Tribes and the TRC to resolve these comments and incorporate the	90% BOD Apdx B Table 10.1

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			byproducts.	simultaneously varies parameters an amount that preserves calibration and provides a probability associated with predictions. Typical methods are Monte Carlo, GLUE, Linear, etc.). See http://www.nrc.gov/reading-rm/doc-collections/nuregs/contract/cr6805/cr6805.pdf b) Only a select number of parameters were evaluated in the sensitivity analysis. It is unclear whether those parameters adjusted in the analysis represent ones the system response is most sensitive to. A complete table showing which parameters were adjusted, by how much, the basis for the adjustments and quantifiable results is needed. c) Were model results from each sensitivity run evaluated to ensure that specified parameter adjustments still produced results within calibration? Calibration was performed against several datasets (page 18, p. 1, AppB) including short-term pumping tests and monthly water level response to river-levelfluctuations. Were these re-evaluated with parameter adjustments in the sensitivity analysis to ensure sensitivity results are still valid within the calibration solution space? d) It is unclear what basis is used for specification of parameter adjustment amounts. This can be very subjective and can lead to meaningless output if results lie outside of calibration target values. Can specific calibration target values/tolerance be provided? It is not uncommon to vary hydraulic conductivity by an order of magnitude (a factor of 10), but each parameter should only be adjusted by an amount commensurate with its likely range. e) Parameter adjustments appear to have been only varied individually vs. in combination. The concern here is that although the system	practical exercise. b) The parameters varied for the solute transport model represented the major parameters utilized in the solute transport model as well as the remedial components. The sensitivity analysis details were presented in Section 10 of Appendix B, but they will be tabulated and organized by type for clarity. c) The calibration was conducted for the groundwater flow model prior to the integration into the solute transport submodel. Subsequent sensitivity analyses conducted using the solute transport model involved ranges in solute transport parameters and remedial component operation. d) Parameter variation was described in Section 10 of Appendix B, but they can be tabulated for clarity. e) Solute transport model parameters were varied individually to assess their direct impact on the simulation results. Relative impacts of individual parameters could be masked by combining sensitivity				resolution in the 90% design.	

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				might have responded one way with one input adjustment (i.e., IRZ well location spacing), with an adjustment of another input such as injection/extraction well flow rates, or hydraulic conductivity values, results would likely be different.	runs. However, conclusions can still be drawn on combined impacts based on the individual sensitivity analyses.					
407	FMIT-117 Hualapai-103 Chemehuevi-103 Cocopah-103 CRIT-103	Append B Section 12.0p. 74	*During installation and implementation of the remedial design, the additional hydrogeologic and groundwater quality data can be utilized to update the groundwater flow and transport models to improve their effectiveness as evaluation tools.*	The details of how this will be done should be included. It is highly recommended that the flow model be updated and verified as new wells are completed and hydraulically tested. This way, it would be possible to revise any remaining well locations if needed.	See response to comment #653 DOI-268. There are several checkpoints during remedy implementation when the groundwater flow and solute transport model update will be evaluated, including during installation, after system start-up, and during remedy operation. During the installation phase the model will be updated, if the data collected during construction significantly contradict the current model construction. For example, if large variations in saturated aquifer thickness, bedrock extent, permeability, chromium distribution, etc. are measured compared to what has been modeled to date, the model would be updated and re-run. The regional model would be updated first, then imported into the fate and transport submodel before transport runs are conducted. During remedy well testing and system start-up, information will be gathered about achievable flow rates for the remedy wells and system as installed and actual hydraulic gradients. That information will be fed back into the model and additional predictions will be made. As remedy operation progresses, the observed data will be used to better calibrate the model and generate updated predictions of future performance. In particular if actual data collected contradicts geochemical or solute transport results, the model will be updated and predictive scenarios will be re-run. A section will be added to the 90% BOD report to describe model update procedures.				The comment was resolved verbally at the February 12, 2014 CWG. Comment resolved.	90% BOD Apdx B Section 12
Specific Comments – Appendix C (Design Criteria), Attachment C (Geotechnical Analysis) and Attachment E (Fire System Analyses)										

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408	FMIT-118	Appendix C		Section C.2.2 Earthwork: This section states that access roads with two way traffic must be at least 20 ft wide. Adding utility trenching of at least three feet and proper drainage to the required 20 feet increases the possibility of maze disturbance. Will design alternatives to minimize width including variances be sought?	All new access roads included in 60% design (e.g., for IRL-2/IRL-4 and the access road north of the Transwestern Bench) have been designed for the smaller, one-way traffic width. The larger two-way traffic width access road applies to new fire access road and was included in Appendix C for completeness. San Bernardino County Code Chapter 5 allows a variance for narrower fire access roads if turnouts [6 feet wide by 50 feet long] are provided about every 600 feet (County Standard 503.1). Language will be added to this section to recognize the county variance.			In general, FMIT wants to reduce infrastructure footprint and takes advantage of variances. Tribe would also like to walk the alignment around the time of 90% design.	Comment resolved.	90% BOD Appendix C Section C.2.2. Regarding Tribe's request to walk the alignment around the time of the 90% design, there were two scheduled walks at TCS – the first walk was held on June 19, 2014 (also a TWG meeting) to view remedy facility locations including wells, and the second walk was held on July 24, 2014.
409	DTSC-120	Appendix C, Section C.2.2, p.c-5, 1st bullet	If drilling fluids are used, continuous monitoring for frac-out conditions will be performed to prevent harm to human health and the environment caused by the release of such fluids.	Please list the potential type of drilling fluids to be used. Since there are concerns with health and safety from the release of such fluids, PG&E should cover this subject specifically in the site Health and Safety Plan and attached the MSDS for the fluids.	Potential type of drilling fluids will be listed in the Construction/Remedial Action Work Plan.	Okay pending review of the 90%.			Comment resolved.	Construction/Remedial Action Work Plan Section 3.2.1.1 and Exhibit 3.2-1
410	DTSC-121	Appendix C, Section C.2.3 Storm Drainage, p.c-6	List of erosion control measures	Will PG&E provide storm drainage control plan along with pre-final and final design so that the locations of such items as silt fences, sediment basins, and check dams be identified?	This information will be included as part of the Construction/Remedial Action Work Plan that will be part of the 90% submittal.	Okay.			Comment resolved.	Construction/Remedial Action Work Plan
411	DTSC-122	Appendix C, Section C.2.6, Construction in 100-year Floodplain	In this 60%, certain infrastructure (piping) cannot be located outside of the 100-year floodplain as defined by the above baseline flood elevation.	PG&E should provide a figure showing where these infrastructures are located and continue to report back to the agencies and stakeholder groups on the progress of discussion with Counties. DTSC requests that all variances from County standards be properly documented for administrative record.	Figure 2.4-5 shows the remedy project components that are located in the 100-year floodplain. PG&E will keep the stakeholders informed of discussion with the Counties and document any variance from Country requirements.	PG&E should document all variances being sought and its status throughout the design and construction process. Suggest tabulating the specific variance in the design document with on-going status.			Comment resolved.	Not applicable
412	DTSC-123	Appendix C, Section C.4, Geotechnical	It is important to note that PG&E continues to engage in discussions	PG&E should be mindful that any activities conducted for the purpose of the remedy must be in conformance of the final EIR evaluation. All intrusive activities undertaken for the purpose of the	PG&E appreciates the comment; we are fully aware of and have been complying with this requirement. We will continue to discuss with agencies and keep Tribes and stakeholders informed of all ground disturbance	Okay.			Comment resolved.	Not applicable

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			with transportation agencies, counties, and other property owners/land managers… additional geotechnical data may be required to meet specific requirements of agencies and/or property owners/land managers.	remedy must be discussed with agencies to determine approval process. Furthermore, such activities may be subject to requirements and/or compliance with the adopted mitigation measures for the project, including, but not limited to, stakeholder notification and Tribal monitoring.	activities for the purpose of the remedy, as required by the mitigation measures in the EIR.					
413	DTSC-124	Appendix C, Section C.5.1 piping	Designation of pipelines (e.g. pipeline A, Pipeline H)	Please include or reference a figure that shows the locations of the pipeline segments.	Drawing C-07-02 shows the pipeline segments and this will be called out in the text.	Okay.			Comment resolved.	90% BOD Appendix C Section C.5.1 referenced drawing C-07-01 (Pipeline Key Map)
414	DTSC-125	Appendix C, Section C.5.5.1		Three specific areas are identified in this section, Area 1, 2 and 3. However, there are no diagram or figure referenced to visually discern these areas. Please provide a reference figure of the areas.	A new exhibit showing these three areas will be added in the 90% BOD.	Comment resolved pending review of the new exhibit.			Comment resolved.	90% BOD Figure 3.5-1
415	DTSC-126	Appendix C, Section C.6.9	All existing utilities will be potholed for actual depth prior to construction following Compressor Station or utility owner methods and requirements	PG&E should be mindful that any activities conducted for the purpose of the remedy must be in conformance of the final EIR evaluation. All intrusive activities undertaken for the purpose of the remedy must be discussed with agencies to determine approval process. Furthermore, such activities may be subject to requirements and/or compliance with the adopted mitigation measures for the project, including, but not limited to, stakeholder notification and Tribal monitoring.	See response to comment #412 DTSC-123.	Response noted.			Comment resolved.	Not aplicable
416	DTSC-127	Appendix C, Section 9, PG&E Personnel Requirements		All personnel associated with the project should review and comply with the requirements of the project specific Health and Safety Plan to be submitted (as stated in Section C.10). Furthermore, PG&E must maintain Health and Safety Plan on site and accessible to all personnel engaged in this project.	Comment noted. The following text will be added to the last sentence of the second paragraph in Section C.10 to reflect this comment (inserted text shown in <u>underline</u> typeface): "These health and safety plans <u>will be available onsite and</u> will describe…"	Okay			Comment resolved.	90% BOD Apdx C Section C.10
417	DOI-162	Section C.12,		The following items are included in the Reference list but are not	The Jepson Flora Project is not listed as a reference in Section C. 12. The		Comment resolved.		Comment resolved.	90% BOD Apdx C Text in various

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		Page C-32		referenced in the text: Caltrans 2008; CH2M HILL 2004; CH2M HILL 2009; Freilich, Leitner & Carlisle, and Jepson Flora Project, 2010.	remaining four items (Caltrans 2008; CH2M HILL 2004; CH2M HILL 2009; Freilich, Leitner & Carlisle) will be added as references to the text.					sections
418	DTSC-128	Attachment B, Calculations, Remedy-produced Water Conditioning Process Caustic Usage, RAW data, page 6 of 6		Where did PG&E extract these concentrations from? What are the rationales for their use and how are they used in the calculations? This really is not explained.	These concentrations are based on laboratory analysis of samples of the backwash water from injection well IW-3 collected on October 5, 2011 (See page 1273 of the 60% BOD PDF, Item #4 under Givens/ Assumptions).	Okay.			Comment resolved.	Not applicable
419	FMIT-119 Hualapai-104 Chemehuevi-104 Cocopah-104 CRIT-104	Attach C		A friction angle of 38 degrees, used for fill and alluvial materials in the slope stability analyses, seems high in comparison to friction angle values presented in Exhibit C.1-1. The Modified Proctor maximum dry densities are at the high end of what could be expected (but they are not impossibly high, given that the material is well- graded (poorly-sorted) and contains minimal clay). Some consideration needs to be given to the friction angle of in-situ material versus the friction angle of compacted laboratory specimens tested in direct shear, assuming that we are concerned with slope stability of natural slopes vs. the stability of constructed slopes compacted to 90% of Modified Proctor maximum dry density.	The friction angle of 38 degrees used in the slope stability analysis should not be compared to the friction angles in Exhibit C.1-1 because the values are for different soils in different locations. The friction angles used for slope stability analysis are based upon a geotechnical investigation conducted in 2009 at AOC 4 on the southwest side of the station. The friction angles shown in Exhibit C.1-1 are based upon a geotechnical investigation conducted in 2004 for the Interim Measures No. 3 site on the north side of I-40 and approximately 3,000 feet from AOC 4. The design considered the difference in friction angle for in-situ soil versus remolded soils. This is demonstrated in Exhibit C.4-1 where different design friction angles are presented for compacted fill and native soil (App. C).			Comment resolved.	Comment resolved.	Not applicable
420	FMIT-120 Hualapai-105 Chemehuevi-105 Cocopah-105 CRIT-105	Attach C	Geotechnical Summary	It may be appropriate to consider the effect of partial saturation on apparent (ephemeral) cohesion in the granular site soils, especially as it relates to slopes maintainable during construction. Site soils may appear to be capable of greater slope stability when partially-saturated, versus their stability when dry.	PG&E does not consider the effects of partial soil saturation on soil strength to be important for this site for the conditions anticipated during construction or for the life of project.			Comment resolved.	Comment resolved.	Not applicable
421	FMIT-121 Hualapai-106 Chemehuevi-106 Cocopah-106 CRIT-106	Attach C	Geotechnical Summary	The slope stability analysis results do not appear to be presented in the report documentation.	Please see Appendix C, Attachment C, *Geotechnical Investigation, Topock AOC4 Remediation, Pre-Work Plan Data Collection Activities Technical Memorandum* (pages 5 and 6 of the TM or pages 1757 and 1758 of the 60% BOD PDF).			Comment resolved.	Comment resolved.	Not applicable

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422	DOI-163	Attachment C, Section C.1, Page C-1		This section references two different CH2M HILL 2009 documents, one from February and one from October. The in-text citations should correspond with the References section; therefore, the in-text citations need to be modified to CH2M HILL 2009a and CH2M HILL 2009b.	Section C.1 merely provides information on two reports, (e.g., their full titles and when they were published in 2009), and did not cite or extract any information from these reports, therefore, it is not necessary to cite them as references in this section.		Comment resolved.		Comment resolved.	Not applicable
423	DOI-164	Attachment C, Exhibit C.1-4, Page C-4	Notes	Should the citation for CH2M HILL 2009 be revised to CH2M HILL 2009b?	The letter "b" will be added after the year 2009.		Comment resolved.		Comment resolved.	90% BOD Appendix C Attachment C
424	DOI-165	Attachment C, Section C.3, Page C-8		The International Code Council 2001 is included in the Reference list but are not referenced in the text.	The title of this reference is the *2001 California Building Code (CBC)* by the International Code Council and the California Building Standards Commission (see the last reference in Section C.12). The *2001 CBC* is referenced in the text on page C-2, 2nd bullet (2nd sentence) and 4th bullet (last sentence).		Comment resolved.		Comment resolved.	Not applicable
425	DOI-166	Attachment C, Section 6.0, Page 16		The following items are included in the Reference list but are not referenced in the text: ASTM 1994; International Code Council 2000; International Conference of Building 1997; and United States Geologic Service 2003.	See page 4 for reference to ASTM. No changes to the 2004 report are proposed.		Comment resolved.		Comment resolved.	Not applicable
426	FMIT-122 Hualapai-107 Chemehuevi-107 Cocopah-107 CRIT-107	Attach E	Fire System Analyses	This technical memo has no stated source or date.	Source and date will be added to Attachment E in the 90% design submittal.			Comment resolved pending review of the 90% design documents.	Comment resolved.	90% BOD Appendix C Attachment E
427	FMIT-123 Hualapai-108 Chemehuevi-108 Cocopah-108 CRIT-108	Attach E	Fire System Analyses	The analysis doesn't explicitly consider NPSH requirements for either fire pump. NPSH criteria for the Allis Chalmers electric-motor-driven fire pump are provided but are illegible, and no criteria are presented for the ITT A-C diesel- motor-driven fire pump.	The net positive suction head (NPSH) available for the fire service pumps is 96.4 feet at design flows. The required NPSH for either of the pumps is not readily available from the manufacturers. However, cavitation is not expected to be a problem. Required NPSH values can vary from 2 to 30 feet. Even allowing for a 30% buffer and assuming required NPSH is 30 feet, the available NPSH should not be higher than 39 feet (30 * 1.30), which is significantly less than the 96.4 feet available. If cavitation was a problem, it should have been evident from annual pump testing.			Comment resolved.	Comment resolved.	Not applicable

TABLE I-1

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Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

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428	FMIT-124 Hualapai-109 Chemehuevi-109 Cocopah-109 CRIT-109	Attach E	Fire System Analyses	For an industrial facility mixing flammable liquids, the required fire flow seems low.	Please note that the volume of ethanol within a building during normal operations is less than 4 gallons (Including the pumps and piping). The following fire flow required was provided to the design team by PG&E's insurance company: a) MW-20 bench: 363 gpm sprinkler flow (1210 sq ft of 0.3 gpm/sq ft) plus a 500 gpm hose allowance for a fire hydrant. b) TW bench - 144 gpm sprinkler flow (480 sq ft of 0.3 gpm/sq ft) plus a 500 gpm hose allowance for a fire hydrant. It should be noted that extinguishing a fire in a sprinklered building requires on the average approx. 8% of the volume of water to extinguish a similar blaze in a similar, unsprinklered building. This is because the fire is quenched with water before it can accelerate out of control.			Comment resolved.	Comment resolved.	Not applicable
Specific Comments – Appendix D (Engineering Plans/Drawings)										
429	FMIT-125	General		There is no notation on the plans (i.e., in "General Notes" or elsewhere) indicating that the area is listed on the National Register of Historic Places, eligible for listing on the National Register as a Traditional Cultural Property and/or a sacred place and that all workers are subject to sensitivity training before working in the field. Such notations should appear on all plans to underscore the nature of the project area and demonstrate a commitment to cultural sensitivity. The plans may be the only project document some workers have contact with.	Workers will participate in site orientation and training on cultural/ historical resources sensitivity that will be provided at the project initiation meeting, to be held at the Topock Compressor Station. Site orientation will stress that all site activities will be conducted in a respectful manner. PG&E believes that this training should address the FMIT's concerns in this comment. However, the following text will also be added to the General Notes: "The project area is eligible for listing on the National Register as a Traditional Cultural Property and/or considered a sacred place by area American Indian Tribes; all workers are subject to sensitivity training before working in the field."			Comment resolved.	Comment resolved.	90% BOD Appendix D Drawing C-00-01.
430	DOI-167	G-10-01		The schematic includes a discharge line from pump PMP-205 going to the "Influent Tank Farm". This discharge line should be going to "Influent Tanks", since the location is already in the Influent Tank Farm.	This call out will be changed to show the pump returning fluids to the Influent Tanks.		Comment resolved.		Comment resolved.	90% BOD Appendix D Drawing I-11-04.
431	DTSC-129	Appendix D Page G-12-02	Mass Balance Remedy	Please use the operation pH range from 6 as mentioned in Section	This comment does not apply to this drawing. The text here will be	Okay.			Comment resolved.	90% BOD Appendix D Drawing G-12-02.

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			Produced Water	3.3.3.3 page 3-38 in the process description for consistency.	revised to be pH 6.5 in accordance with the Drawing G-12-04.					
432	DTSC-130	Appendix D Page G-12-03	Process Schematic for Freshwater Pre-Injection Treatment System	Please introduce pre-treatment chemical after the filters to save on overall dosage quantity as well as filter longevity. In addition, please consider the possible use of hydrochloric acid to save in amount used and efficiency.	See responses to comment #184 DTSC-72 and #185 DTSC-73. Hydrochloric acid was considered. However, since sulfuric acid is currently used for conditioning cooling makeup water, it is proposed to be used in the freshwater pre-injection treatment system to take advantage of the economy of scale.	Okay.			Comment resolved.	90% BOD Exhibit 3.3-6.
433	DTSC-131	Appendix D Page G-12-03	Process Schematic for Freshwater Pre-Injection Treatment System	The proposed use of wastewater in the cooling tower or reinjection in the in situ reactive zone wells may present challenges in obtaining the quantity and quality diverted. Please provide specific water quality parameters required and viability for the proposed reuse of each said reuse.	See RTC #181 DTSC-70.	Noted. See RTC #181 DTSC-70.			Comment resolved.	Not applicable
434a	FMIT-126	Append D1 "C"-Drawings		Based on the information presented in Appendix D-2 (C-Drawings), in deciding to place nearly all utility (water, electrical, fiber-optic, etc.) services below ground, the designers apparently gave no consideration to Tribal preferences or to an earlier-stated tribal preference to have that infrastructure placed above-ground, thereby minimizing earth disturbance. Above ground piping also appears supported in at least certain areas by the draft GeoArchaeological Report	See response to comment #8a FMIT-3. The Tribe's comments expressing a preference for aboveground facilities were noted and considered. While PG&E recognizes the Tribe's expressed preference, the facilities are proposed below ground because that is consistent with the analysis in the EIR. (See, e.g., EIR, Vol. 2, at 1-6.) Placing facilities aboveground creates potentially significant aesthetic, O&M, and safety impacts. Further, while aboveground utilities may reduce earth disturbance to some extent, aboveground facilities would still require earth disturbance for foundations, vaults, and other supporting equipment. PG&E believes that the proposed 60% design represents the most appropriate design in the Topock site setting while incorporating the Tribes' preferences to the extent practicable, is most protective of remedy infrastructure, most O&M friendly for the decades-long life of this remedy, and most consistent with the certified EIR. The draft geoarchaeological report (July 2013) presents results from the geoarchaelogical assessment of the Project Area, and ranks locations where sediments have the highest,				This comment and response are being discussed as part of the evaluation of aboveground piping alternatives (#1 DOI-1, #8a FMIT-3, and #8b Hualapai-3/ Chemehuevi-3/Cocopah-3/CRIT-3).	The 90% design complies with the Agencies' directive on aboveground/ belowground pipeline infrastructure in the April 4, 2014 letter titled *"Directives on Outstanding Issues of the Response to Basis of Design Report/ Intermediate (60%) Design Comments for PG&E Topock Compressor Station Remediation Site"*.

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				(July 2013).	intermediate, lowest, or no potential to contain buried archaeological resources. As discussed at the August 20, 2013 TMU meeting, this ranking is relative rather than absolute – higher potential does not mean that archaeological materials are likely to be encountered, but rather the stratigraphic unit with this designation is more capable of containing buried archaeological materials than other units. Therefore, the potential ranking only represents relative probability and does not predict actual locations of buried archaeological materials or suggest preferred locations for aboveground vs. belowground piping and utilities.					
434b	Hualapai-110 Chemehuevi-110 Cocopah-110 CRIT-110	Append D1 "C"-Drawings		Based on the information presented in Appendix D-2 (C-Drawings), in deciding to place nearly all utility (water, electrical, fiber-optic, etc.) services below ground, the designers apparently gave no consideration to Tribal preferences or to an earlier-stated tribal preference to have that infrastructure placed above-ground, thereby minimizing earth disturbance.	See response to comments #8a FMIT-3 and #434a FMIT-126.				This comment and response are being discussed as part of the evaluation of aboveground piping alternatives (#1 DOI-1, #8a FMIT-3, and #8b Hualapai-3/ Chemehuevi-3/Cocopah-3/CRIT-3).	The 90% design complies with the Agencies' directive on aboveground/ belowground pipeline infrastructure in the April 4, 2014 letter titled *"Directives on Outstanding Issues of the Response to Basis of Design Report/ Intermediate (60%) Design Comments for PG&E Topock Compressor Station Remediation Site"*.
435	FMIT-127 Hualapai-111 Chemehuevi-111 Cocopah-111 CRIT-111	Append D1 Sheet C-00-01 "General Notes"	*"3. No excavated material shall be stored on site except as approved by owner"* *4. Dispose of unusable excavated materials at no additional cost to the owner"*	This project has very specific requirements regarding all soil excavated at the site. These "general notes" while typical of most construction projects are inappropriate for this project. The contractor should be referred to the specific documents detailing soil handling for this project. Additionally, the procedure under development for handling displaced soils needs to be referenced.	Comment noted. These notes will be revised to state: "Management of displaced soils shall be in accordance with the Soil Management Plan (Volume 4 of the O&M Manual) and the Management Protocol for the Handling and Disposition of Displaced Site Materials (Appendix B of the Soil Management Plan)."			Comment resolved.	Comment resolved.	90% BOD Appendix D Drawing C-00-02.
436a	FMIT-128	Append D1 Design Drawings ("C"-drawings)		**SEE EXHIBITS I to IV submitted with these comments:** Construction of pipe sections A & H, as presented in the 60% BOD report (see Exhibit I) will involve considerable soil excavation, surface disturbance, soil testing, soil transport, soil processing and, possibly, soil storage in an extremely culturally sensitive area. An alternative approach, with much less excavation and surface disturbance,	See response to comment #1 DOI-1 and pipeline evaluation matrix (see **Attachment A**, at the end of this table).			The FMIT provided the tribe's assessment and comments on the alternative pipeline routings. The Tribe's comment letter is included in **Attachment A**, at the end of this table.	Information presented in DOI's pipeline evaluation matrix and associated visualizations were discussed with the agencies, Tribes, and stakeholders at the November 19-20, 2013 TWG meeting. Tribes' response was presented at the December 17-18, 2013 TWG meeting and subsequently provided in a draft technical memorandum from TRC (Charlie Schlinger) to	The 90% design complies with the Agencies' directive on aboveground/ belowground pipeline infrastructure in the April 4, 2014 letter titled *"Directives on Outstanding Issues of the Response to Basis of Design Report/ Intermediate (60%) Design Comments for PG&E Topock Compressor Station Remediation Site"*.

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				and consistent with already-stated Tribal preferences, is as follows: Obtain 12 kV power from the City of Needles and step it down to 480 V near IM-3 using a dedicated transformer. This would require coordination and possible partnership, with the City of Needles, as they are planning an upgrade of the line capacity, at least as far as the Pirate's Cove development. Distribute the 480-V power to the planned (and possible contingency) IRL & FW wells using conventional above-ground power lines and poles, with a nominal spacing of100-150 feet. See Exhibit II. This approach to the electrical supply would possibly eliminate the need for step-down transformers at each major point of use. Alternatively, if line losses at 480 Vare too high, or if other constraints dictate, distribute the 12 kV power on above-ground power lines and poles, and step down the voltage at each major point of use. Also, pole mounts of transformers could be considered. Use wireless SCADA (Supervisory Control and Data Acquisition) communication technology (which is highly developed) instead of fiber optic technology for monitoring and control, or hang fiber optic cables using the electrical power poles. The wireless approach would require aerial antennas for communication with the project control center. Construct water lines in a manner similar to existing above-ground IM water lines or the existing above-ground freshwater water Topock Compressor Station supply line (exposed pipe). See Exhibits III & IV for two possible above- ground waterline location alternatives (Alternatives I & II) for pipe sections A & H. This differs from the design in the 60% BOD report in that almost all utility infrastructure would be above-ground. Along limited portions of pipe sections A & H, as needed, the above-ground water lines could/may need to be placed in an above-ground concrete box. Along limited portions of the pipe section A, aerial bridge crossings (such as the one presently					PG&E, DTSC, and DOI/ BLM dated Dec 17, 2013 (also included in **Attachment A**, at the end of this table). A site walk was held on Dec 27, 2013 to further discuss the piping options. Representatives from DOI, FMIT, Hualapai Tribe, Chemehuevi Tribe, TRC, and PG&E participated in the site walk. A presentation was made by TRC (Charlie Schlinger) at the January 23, 2014 TWG meeting (presentation materials are included in **Attachment A**, at the end of this table). Additional analysis was performed by PG&E on Segments 1 and 2 of Pipeline A, and presented at the February 11, 2014 TWG meeting. Presentation materials are also included in **Attachment A**, at the end of this table.	

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				planned for the Bat Cave Wash) crossing, would be used or underground installations would be utilized. In addition to reduced excavation costs (at the time of construction, possibly during the project life- cycle, and at decommissioning) and ground disturbance. This overall approach would greatly reduce the excavation volume required, though the electrical, water and SCADA/communication infrastructure would be visible and subject to vandalism. As part of the communication system, cameras could be installed for monitoring. The Tribes request that this Utility Alternative be studied and presented as part of the CEQA process. NOTE: Exhibits I-IV show approximate locations only.						
436b	Hualapai-112 Chemehuevi-112 Cocopah-112 CRIT-112	Append D1 Design Drawings ("C"-drawings)		**SEE EXHIBITS I to IV submitted with these comments:** Construction of pipe sections A & H, as presented in the 60% BOD report (see Exhibit I) will involve considerable soil excavation, surface disturbance, soil testing, soil transport, soil processing and, possibly, soil storage. An alternative approach, with much less excavation and surface disturbance, and consistent with already-stated Tribal preferences, is as follows: Obtain 12 kV power from the City of Needles and step it down to 480 V near IM-3 using a dedicated transformer. This would require coordination and possible partnership, with the City of Needles, as they are planning an upgrade of the line capacity, at least as far as the Pirate's Cove development. Distribute the 480-V power to the planned (and possible contingency) IRL & FW wells using conventional above-ground power lines and poles, with a nominal spacing of 100-150 feet. See Exhibit II. This approach to the electrical supply would possibly eliminate the need for step-down transformers at each major point of use. Alternatively, if	See response to comment #436a, FMIT-128.			The Hualapai Tribe and the Cocopah Indian Tribe each provided the tribe's assessment and comments on the alternative pipeline routings. The CRIT also provided feedback via email on this subject. The Tribes' letters and email are included in **Attachment A**, at the end of this table.	Information presented in DOI's pipeline evaluation matrix and associated visualizations were discussed with the agencies, Tribes, and stakeholders at the November 19-20, 2013 TWG meeting. Tribes' response was presented at the December 17-18, 2013 TWG meeting and subsequently provided in a draft technical memorandum from TRC (Charlie Schlinger) to PG&E, DTSC, and DOI/ BLM dated Dec 17, 2013 (also included in **Attachment A**, at the end of this table). A site walk was held on Dec 27, 2013 to further discuss the piping options. Representatives from DOI, FMIT, Hualapai Tribe, Chemehuevi Tribe, TRC, and PG&E participated in the site walk. A presentation was made by TRC (Charlie Schlinger) at the January 23, 2014 TWG meeting (presentation materials are included in **Attachment A**, at the end of this table). Additional analysis was	The 90% design complies with the Agencies' directive on aboveground/ belowground pipeline infrastructure in the April 4, 2014 letter titled *"Directives on Outstanding Issues of the Response to Basis of Design Report/ Intermediate (60%) Design Comments for PG&E Topock Compressor Station Remediation Site"*.

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				line losses at 480 V are too high, or if other constraints dictate, distribute the 12 kV power on above-ground power lines and poles, and step down the voltage at each major point of use. The use of pole-mounted transformers should be strongly considered to avoid additional ground disturbance. Use wireless SCADA (Supervisory Control and Data Acquisition) communication technology (which is highly developed) instead of fiber optic technology for monitoring and control, or hang fiber optic cables using the electrical power poles. The wireless approach would require aerial antennas for communication with the project control center. The use of fiber optic technology would require that fiber optic service be brought in to the IM3 area, parallel to the proposed above-ground water lines, or along the existing City of Needles 12kV service infrastructure, possibly originating near the Transwestern bench area. Construct water lines in a manner similar to existing above-ground IM water lines or the existing above-ground freshwater water Topock Compressor Station supply line (exposed pipe). See Exhibits III & IV for two possible above-ground waterline location alternatives (Alternatives I & II) for pipe sections A & H. This differs from the design in the 60% BOD report in that almost all utility infrastructure would be above-ground. Along limited portions of pipe sections A & H, as needed, the above-ground water lines could may need to be placed in an above-ground concrete box. Along limited portions of the pipe section A, aerial bridge crossings (such as the one presently planned for the Bat Cave Wash) crossing, would be used or underground installations would be utilized. In addition to reduced excavation costs at the time of construction, possibly during the project life-cycle, and at decommissioning) and ground disturbance, this approach could possibly eliminate the need for some					performed by PG&E on Segments 1 and 2 of Pipeline A, and presented at the February 11, 2014 TWG meeting. Presentation materials are also included in **Attachment A**, at the end of this table.	

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				sections of dual-wall pipe. This overall approach would greatly reduce the excavation volume required, though the electrical, water and SCADA / communication infrastructure would be visible and subject to vandalism or other physical damage. In addition, limitations on vehicular access to the little-used portion of old Route 66, between Park Moabi Road on the west side and National Trails Highway on the east, could be explored, e.g., with gated access on each end and with pedestrian access allowed, for the period of remedy operation. We believe that the east and west ends of Route 66 have apparently been signed for several years to discourage access by the public. This action, which would require agency buy-in, would reduce objections associated with the use of above-ground infrastructure. As part of the communication system, cameras could be installed for monitoring. The Tribes request that this Utility Alternative be studied and presented as part of the CEQA process. NOTE: Exhibits I-IV show approximate locations only.						
437	FMIT-129 Hualapai-113 Chemehuevi-113 Cocopah-113 CRIT-113	Append D1 Design Drawings ("C"-drawings)		Construction of pipe sections B1 & B2 as presented in the 60% BOD report, will require considerable excavation and corresponding surface disturbance. An alternative design is as follows. Utilize above-ground water piping (as is presently done). The 12 kV service along pipe section B1 could be done using above-ground (aerial) distribution on conventional poles, or, per the design, with a minimal trench.	See response to comment #1 DOI-1 and evaluation matrix (see **Attachment A**, at the end of this table).				Information presented in DOI's pipeline evaluation matrix and associated visualizations were discussed with the agencies, Tribes, and stakeholders at the November 19-20, 2013 TWG meeting. Tribes' response was presented at the December 17-18, 2013 TWG meeting and subsequently provided in a draft technical memorandum from TRC (Charlie Schlinger) to PG&E, DTSC, and DOI/ BLM dated Dec 17, 2013 (also included in **Attachment A**, at the end of this table). A site walk was held on Dec 27, 2013 to further discuss the piping options. Representatives from DOI, FMIT, Hualapai Tribe, Chemehuevi Tribe, TRC, and	The 90% design complies with the Agencies' directive on aboveground/ belowground pipeline infrastructure in the April 4, 2014 letter titled *"Directives on Outstanding Issues of the Response to Basis of Design Report/ Intermediate (60%) Design Comments for PG&E Topock Compressor Station Remediation Site"*.

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									PG&E participated in the site walk.	
438	FMIT-130	C-05-06 C-07-10		Power and communication Node 5 is currently designed to be constructed due north of IRL-3's well and meter vault. The node is approximately ~15'-20' north of the vaults and on top of a crest (~12'-15') above the well vaults. Construction of this Node will cause a great disturbance to the surrounding land, and its current construction location will create a visual eye sore with the surrounding area. Redesign to reduce impacts should be sought.	In response to this comment, Node 5 will be relocated down the slope on a flat spot to be created by earthwork. As a result, all equipment will be spread out laterally along the road (about 100 feet) to ensure adequate space for O&M (see figure in **Attachment J**, at the end of this table). Drawing C-05-06 will be revised to reflect this detail. The proposed relocation will remain the same if the aboveground option is selected for piping. Under either proposal piping between the relocated equipment and IRL-3 will be underground.			Comment resolved pending review of the 90% design.	Comment resolved.	90% BOD Appendix D Drawing C-05-06.
439	FMIT-131	C-05-06		Pull Boxes PBX-D5C and PBX-T5C sizes do not match between C-05-06 and E-00-08. Also the pull boxes are very large, in respects to the amount of fiber optics running through them. What can be done to reduce size?	Size of the pull boxes will be updated in the 90% drawings.			The issue will be revisited pending the decision of aboveground vs. belowground piping.	PG&E will update the size of pull boxes in the 90% design and submit for review and comment.	90% BOD Appendix D Drawings C-05-06 and E-00-08. As noted, PG&E is evaluating options to optimize Node 5 footprint.
440	FMIT-132	C-02-01		Pull Boxes E and C are on the North side of the existing dirt road, while the FW-1 vaults are on the south side. Is it necessary to split the pull boxes from the well vaults, disturbing both sides of the road?	The pull boxes were located on the north side because of space constraint on the south side of the road and to avoid having to shutdown IM-3 injection during construction. Further, future maintenance and repair would be more difficult and less safe due to a lack of space if the pull boxes and well vaults were both located on the same side of the road (see figure in **Attachment J**, at the end of this table). Drawing C—02-01 will be revised to reflect this detail.			Comment resolved pending review of the 90% design.	Comment resolved.	90% BOD Appendix D Drawing C-02-01.
441	DTSC-132	Appendix D Page C-05-01 and C-05-02	IRL-4 Access Road Site Plan	Please combine the plan and profile if possible for ease of use in design and construction.	Comment noted. PG&E will evaluate the possibility of combining the cited plan and profile drawings as requested, and will include in the 90% design.	Response noted. Comment deferred to 90%.			Noted.	90% BOD Appendix D Drawings C-05-01 and C-05-02. The possibility of combining these drawings was evaluated. For clarity and ease of use in construction, these drawings will remain as two separate drawings.
442	FMIT-133	C-05-03 C-05-05 C-07-10		Currently IRL-2 location is of great concern. The disturbance to the local area during construction and after during monitoring will have heavy impact to the Maze both physically and visually. As previously mentioned in meetings between FMIT and PG&E, FMIT recommends further rigorous evaluation of an alternative locations	In response to this comment, PG&E evaluated what would be required to relocate IRL-2 closer to the road. Taking into consideration the Southwest gas ROW, the remedy piping corridor, and the space required for drilling and O&M of this well, PG&E will need to cut into the bank of the road on the north side			The Tribe would like to see visualizations of both options and further discussion prior to the 90% design.	This comment and response were discussed with Tribes at the December 12, 2013 TWG meeting, and the December 27, 2013 site walk. The requested visualization of IRL-2 was provided on December 17, 2013 and included in **Attachment J** at the end of this	90% BOD Appendix D Drawings C-05-03 and C-05-05.

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				closer to the road adjacent to the main pipeline.	and install a retaining wall to prevent slough off or caving (see figure and visualization in **Attachment J**, at the end of this table). PG&E does not recommend IRL-2 be relocated due to the required amount of earthwork and associated disturbance, as well as the construction challenges on a slope.				table. In response to the Tribes' preference for no additional cuts would be made into the banks on either side of the roadway, IRL-2 location will remain as proposed in the 60% design.	
443	DTSC-133	Appendix D Page C-07-17 and C-07-18	Pipeline Plan and Profile	Please provide a reference and detail for the above ground supports.	Please see drawing C-07-67 for aboveground supports. PG&E will evaluate the aboveground supports in the 90% design.	PG&E's proposal for above ground support appears excessive for non-hazardous water.			PG&E will evaluate the aboveground supports in the 90% design.	Not applicable because this portion of Pipeline B (formerly Segment B4) was brought underground. See Appendix D Drawings C-07-28, -29, and -103 (Segment B2).
444	FMIT-134	C-07-02 C-07-54		Pipeline J - Purpose of this Line? It is taking water from the RAW line before it is treated. (Two lines from raw water line with isolation valves).	Pipeline J is the main trunk connecting Pipeline B, the freshwater supply pipeline from the Arizona wells, to the FW and IRL wells in the uplands. This allows for direct pumping from the supply well(s) to the injection wells, and reduces electricity use. See also drawing G-00-06 (blue line). In the event that pre-injection treatment of freshwater supply is needed, all freshwater would first be pumped to the treatment system at the Compressor Station via Pipeline B. The treated freshwater would then flow to the uplands injection wells, along the Station access road following Pipeline F (see drawing C-07-01 for key map). The pipes will be installed if the contingency action is required. At the time the construction is complete, isolation valves will be closed on Pipeline J to prevent untreated freshwater from flowing to the injection wells.			Comment resolved pending review of 90% design documents.	Comment resolved.	Not applicable
445	DTSC-134	Appendix D Page C-07-74, Detail C12	Trench Sections	Please provide the footing design for the pipe support.	The pipe support referenced was designed to be anchored into the rock surface that was expected to be located directly under the road bed. Subsequent investigation has revealed that it may be possible to place the pipe in a more traditional trench. This will be evaluated during the 90% design process and presented in the 90% Design Submittal.	Ok pending review of 90%. However, PG&E should consider minimizing footprint and infrastructure in respect for the Tribal sensitivity of the area.			Comment resolved.	90% BOD Appendix D Drawing C-07-109
446	FMIT-135	C-08-01 S-06-06		Currently there are four new structures planned for the Transwestern Bench area. The carbon	PG&E disagrees with the assertion regarding the level of ground disturbance. Field inspection and			Comment resolved. The Tribe requests that details be presented prior to submittal	Comment resolved.	90% BOD Appendix D Transwestern Bench 08 Drawings

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Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

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				amendment building and carbon storage tanks will be built on the south side of the decon pad, 25-30 ft of undisturbed ground will have to be leveled for construction. Construction of the new storage building, on the west side of the decon pad, will require cutting into a ~15'-20' undisturbed hillside, and the construction of a retaining wall. Lastly, the new two story maintenance facility is extremely large, and will also require that undisturbed areas are disturbed for construction purposes. What can be done to reduce this level of landform disturbance?	historical account of excess fill materials from TCS construction used at the TW Bench indicate that the footprint of the carbon amendment building and carbon storage tanks is located in primarily fill materials. The maintenance facility would require a cut of about 5 feet into the hillside. However, as discussed in response to comment #26 DTSC-4, in order to reduce the infrastructure on the TW Bench, PG&E is evaluating an option of moving some functions originally intended to occur at the TW Bench - training, conference room, library, laboratories, maintenance, and storage – to a location at Park Moabi. Concurrently, PG&E is evaluating a revised layout of the potential remaining functions at the bench. PG&E will keep the agencies, Tribes, and stakeholders informed of PG&E's proposal regarding location and layout prior to the 90% design submittal.			of the 90% design. The Tribe further requests that PG&E verify that the excavation will be limited to actual fill materials.		(i.e., Function Code 08 Drawings)
447	FMIT-136	C-02-01 C-05-03 C-05-05 C-05-06 C-07-09 C-07-10 C-07-11 C-07-12 C-07-13 C-07-14		With IM-3 remaining potentially operational until after the final groundwater remedy is up and running, is it possible to construct and install the groundwater remedy's wells, injection pipeline, trenching, and conduit (See Referenced Sheets) while the IM-3 components are still in place? The proposed locations for the new remediation components are in the exact same locations as the old IM-3 system. Is there enough room to construct and install the new system around the old, without being forced to disturb an even greater area? Can any of the existing IM-3 components at these locations be decommissioned consistent with whatever need has been identified for maintaining the IM-3 treatment plant?	Yes, it is possible. Construction approaches will be included in the forthcoming Construction/Remedial Action Work Plan. All efforts will be made to minimize the amount of disturbance during construction. PG&E understood that the second question in the comment to ask if partial decommissioning of the IM-3 infrastructure can be done as part of construction of the full-scale remedy. The response to this question is partial decommissioning of the IM-3 infrastructure cannot be done. Additionally, note that the criteria for decommissioning IM-3 are specified in the 2012 Settlement Agreement between DTSC and the FMIT. In accordance with the agreement, the decommissioning plan will not recommend decommissioning of the IM-3 facilities until the Plume Control Criteria are met and DTSC determines that the groundwater remedy is achieving plume control, DOI determines that the remedy is operational and functional, and DOI concurs with DTSC's determination to decommission IM-3. The settlement agreement also provides,				PG&E and the Tribe discussed this comment and response at the December 17-18, 2013 TWG meeting.	Construction/Remedial Action Work Plan Section 3.

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					however, that "DTSC' s determination of Plume Control . . . must be made concurrent with or after DTSC's OPS determination, unless DTSC in its lawful discretion, decides that decommissioning of IM-3 can occur prior to DTSC's OPS Determination; and DOI must concur with DTSC's decision to decommission IM-3."					
448	FMIT-137	C-07-69 C-07-70 C-07-71 C-07-72		With pipelines being placed in open air concrete trenches, has pipeline expansion and contraction been taken into account for the total length of trenching required?	Pipeline expansion/ contraction has been accounted for. Two different methods will be shown in the 90% design – expansion joints or pipeline anchors (provided at 200 foot spacing or at each joint whichever is closer).			Comment resolved.	Comment resolved.	90% BOD Appendix D.
449	DTSC-135	Appendix D Page M-02-02	Freshwater Injection Well Construction Details	Please note that the text prescribes stainless steel continuous wrapped well screens as opposed to the provided louvered screens in the notes section. Please correct accordingly based on the final proposed well screen chosen.	The details of the wells design are still being developed. The text in Section 3.3.3 will be expanded to more fully describe the well design for each type of well and the drawings will be made consistent with the text at the 90% design.	Okay			Comment resolved.	90% BOD Section 3.3.3.
450	DTSC-136	Appendix D Page M-02-02	Freshwater Injection Well Construction Details	Please provide a neat cement seal between the annular space of the inner and outer well casings.	The space between the conductor casing and the inner casing will be sealed by the wellhead flange. Not clearly shown on the drawings included in the 60% BOD is the sanitary seal at the top of the inner casing. This type of construction provided for in California State Well Standards Bulletin 74-81 (see Figure 5b in the attachment to the RTCs). Drawings on Sheets M-02-01 and M-02-02 will be revised to more clearly show the seal on the inner casing. The FW Injection wells are being constructed in this way to allow for the possibility of reconstructing the wells by pulling the inner casing, removing the clogged gravel pack and the inner few inches of the borehole wall, and reconstructing the well in the original borehole. If successful, this could allow for reconstruction of an injection well without the need to drill another borehole. The ability to successfully pull the inner casing in an old well where the gravel pack may be cemented by mineral precipitates is uncertain, however this method of well construction is proposed to allow for that possibility. If neat	Comment resolved pending review of the 90%. Also consider bentonite seals for saturated zones.			Comment resolved.	90% BOD Appendix D Drawing M-02-02.

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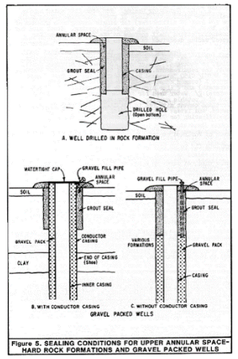
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					cement were installed between the conductor and the inner casing, it would not be possible to pull the inner casing and reconstruction of the well in the original borehole will be significantly more complicated. However, based on data collected during construction, it might be determined that installation of grout between the casings is advantageous. For this reason additional design drawings for an alternative well construction, which includes a neat cement seal between the casings (provided a permanent conductor casing is installed) will also be included in the 90% BOD. The application of a cement seal will be assessed during the 90% design and potentially during construction.  Figure 5. SEALING CONDITIONS FOR UPPER ANNULAR SPACE-HARD ROCK FORMATIONS AND GRAVEL PACKED WELLS					
451	DTSC-137	Appendix D Page M-02-02	Freshwater Injection Well Construction Details	Please define the ¼" ASR hydraulic oil line in the well more clearly.	The drawing will be revised to show the hydraulic line connected to the downhole flow control valve and indicate that only food grade mineral oil will be used in the hydraulic system controlling the downhole valve.	Okay			Comment resolved.	90% BOD Appendix D Drawing M-02-02 (revised to more clearly show the hydraulic line).
452	FMIT-138	M-03-05		Injection meter and well vaults inside diameter = 5'x8'-6" and 4'x5' respectively. Vaults appear large for the 2-inch and 3-inch pipelines. Can these be reduced? Also, flow arrow for backwash line reversed.	Injection and extraction well vault sizes in the 60% design were included as "typical" sizes and were not specifically designed or sized for each specific location. Each well vault will be evaluated and the size adjusted, as needed, during the 90% design process. Comment is noted regarding the flow arrow and will be addressed in the 90% design.			Tribe prefers smaller footprint, smaller vault.	Comment resolved.	90% BOD Appendix D Drawing M-03-05.
453	FMIT-139	M-02-01		Large vaults result in greater disturbance of land for FW-series,	M-02-01 only details the FW and not the IRL injection wells. The IRL well			Comment resolved pending review of the 90% design	Comment resolved.	90% BOD Appendix D Drawing M-02-01. The comment was

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				IRL-series wells. Can butterfly valve in injection line between FCV and FCA be eliminated, seems like extra component given butterfly valves at entrance and exit of vault. Also consider swapping FCV and flow meter to minimize potential for FCV to introduce flow disturbance prior to flow meter.	vault dimensions are identified on M-05-05. As part of the 90% design, PG&E will review this to evaluate whether the vault length can be reduced by taking out one valve. Since this change will occur on the smaller FW pipe, it is unlikely to change the required length for the larger RW pipe.			documents.		considered and an evaluation was conducted as indicated in the response. Results from the evaluation indicate that all valves are needed and need to kept for maintenance purposes.
454	FMIT-140	E-00-21		Node 5 communication panel located near IRL- 3 is 90"x36". Can the panel size be reduced?	PG&E will evaluate a smaller panel size (up to 18” shorter in height) and propose a final panel size in the 90% design, after important design details such as aboveground vs. belowground piping and conduits have been settled.			The issue will be revisited pending the decision of aboveground vs. belowground piping.	PG&E will evaluate a smaller panel size and propose a final panel size in the 90% design for review and comment.	90% BOD Appendix D E-00-21. At this 90% stage, Node 5 communication panel is designed to support all remedy communications in the uplands related to planned wells FW-1, IRL-1 to 4, and future provisional wells IRL-5 to 7. This eliminates the need for additional equipment for future provisional wells and the associated disturbance with installation of the equipment. The panel size is appropriate for this type of installation and intended use at Topock. PG&E will continue to seek ways to reduce the panel size while balancing the need for and the ability to properly maintain the equipment over multiple decades.
Specific Comments – Appendix E (Draft Specifications)										
455	DOI-168	Part 3, Division 1, Section 01 11 00, Part 1, 1.01, B, 1		The Summary of Work includes installation of 51 new remedy wells. Section 3 of the main text identifies installation of the following remedy wells; 24 NTH injection, four NTH extraction, five river bank extraction, four IRL injection, two TWB extraction, five ER extraction, two TCS injection, and two FW. This accounts for a total of 48 wells (not including provisional wells). Please review and clarify.	Comment noted. The Summary of Work will be revised at 90% stage to reflect the well count at 90% design.		Comment resolved pending review of 90% design.		Comment resolved.	A summary of borehole count is provided in Tables ES-2A and 2B of the 90% BOD. The Summary of Work will be prepared after the design is finalized.
456	DOI-169	Part 3, Division 1, Section 01 11 00, Part 1, 1.01, B		Suggest revising the Summary of Work to include more specific language regarding facilities and design components to be constructed. It is not clear that all design elements are incorporated as currently written (i.e., see Exhibit 3.5-1, truck loading/unloading stations, central maintenance and storage buildings are not discussed in the work summary).	Comment noted. The Summary of Work will be updated at 90% stage.		Comment resolved pending review of 90% design.		Comment resolved.	The Summary of Work will be prepared after the design is finalized.
457a	FMIT-141	Appendix E Sect	Section 2.01	The 60% BOD report indicates that	The subject specification section, 03			Comment resolved pending	Comment resolved.	Not applicable

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		03 30 00 Page 15-16	Materials C. Admixtures	underground concrete vaults carrying high voltage conduits are to be marked with red-dyed concrete. However no specific product is provided for technical review. General information available for underground concrete dyes indicate that electrical concrete envelope shall contain red dye at 8 lbs. per cubic yard of concrete. Based on this standard concentration it is concluded that significant amounts of this dye will be used as part of the remediation system design and could be potentially released into the subsurface. The 60% BOD report provides no recommendations on the specific product that will be used or environmental safety requirements for this dye. It is requested that PG&E provide information on the specific dyes that will be used and ensure that the selected dyes have been adequately characterized for environmental hazards (i.e. aquatic toxicity, persistence and bioaccumulation) and for use in this sensitive area.	33 00 (Cast-In-Place Concrete), contains information about the pigments that may be used to color the electrical duct banks. General pigment characteristics are specified in Article 2.01.C.1. More detailed pigment characteristics are specified in Article 2.01.C.9. That Article also specifies requirements by referencing reputable widely-used nationally-recognized product standards. PG&E believes that the specified properties in the subject specification align our goals with the Tribes' goals in terms of using sustainable products to meet the objectives of the project. It is not standard practice to specify a specific pigment product during design because the engineer cannot know all of the other products that will be in the concrete mix. As a result, the designer cannot determine compatibility and may accidentally specify a product that reacts with other materials in the mix and adversely affects concrete performance. It is standard practice to specify material requirements for the pigments as done in the subject specification section. This allows the construction contractor to propose and submit a concrete mix with compatible products. It also allows the construction contractor to propose more innovative products that may not have been available or known at the time of design. The contractor's proposed products will be submitted for review and approval before use per Article 1.04.A.1.c.5. Although Article 2.01.C.9 does mention electrical duct banks, the subject specification section does not appear to mention underground concrete electrical vaults. It is an industry best practice to color underground concrete electrical duct banks to improve safety; however, PG&E is not aware of colored concrete being used for underground vaults. PG&E agrees to provide pigment information to the tribe, if requested when it becomes available.			review of 90% design documents.		

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457b	Hualapai-114 Chemehuevi-114 Cocopah-114 CRIT-114	Appendix E Sect 03 30 00 Page 15-16	Section 2.01 Materials C. Admixtures	The 60% BOD report indicates that underground concrete vaults carrying high voltage conduits are to be marked with red-dyed concrete. However no specific product is provided for technical review. General information available for underground concrete dyes indicate that electrical concrete envelope shall contain red dye at 8 lbs. per cubic yard of concrete. Based on this standard concentration it is concluded that significant amounts of this dye will be used as part of the remediation system design and could be potentially released into the subsurface. The 60% BOD report provides no recommendations on the specific product that will be used or environmental safety requirements for this dye. It is requested that PG&E provide information on the specific dyes that will be used and ensure that the selected dyes have been adequately characterized for environmental hazards (i.e. aquatic toxicity, persistence and bioaccumulation)	See response to comment #457a FMIT-141 above.			Comment resolved pending review of 90% design documents.	Comment resolved.	Not applicable
458	MWD-13	Appendix E/ 31 10 00-6	Site Clearing	Due to sensitivities, please clarify whether onsite debris burning will be prohibited. Section 3.13 A.3 indicates that "Burning of debris onsite will not be allowed"; however, the following sections include provisions for when debris may be burned onsite.	This section will be revised to indicate no burning is allowed.				Comment resolved.	90% BOD Appendix E Specification 31 10 00.
Specific Comments – Appendix F (Remedy-produced Water Management Technical Memorandum)										
459	MWD-14	Appendix F/ F-12	Table F-5 Summary of Disposal/ Reuse Options Under Evaluation	Text indicates trucking-offsite will require constructing a loading station at TCS or the MW-20 bench location. Would the loading station design consider storage of anticipated 7.6 MG of wastewater? The TCS site should be preferred over the MW-20 bench location, since the remedy-produced water conditioning building is located at the TCS site.	To maintain operational flexibility, there will be two loading stations – a new station inside the compressor station and a modified station at the MW-20 Bench. There will not be any additional water storage due to space limitations at both locations.				Comment resolved.	Not applicable
460	DTSC-138	Appendix F Page F-14	Remedy-Produced Water Management Plan	Please expand upon the effluent limits for the cooling Tower and IRZ well options.	See response to comment on #181 DTSC-70.	Response noted. See response to comment on #181 DTSC-70.			Comment resolved.	Not applicable
461	DTSC-139	Appendix F Page F-14	Remedy-Produced	Please provide a contingency to address the fact that actual dissolved	The primary line of defense against well fouling is proper well	DTSC is mainly concern with well fouling if dissimilar water			Comment resolved.	O&M Contingency Plan (Volume 3 of the O&M Manual), Appendix

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			Water Management System Design – Design Criteria – 6th Bullet	constituents for the remedy prove dissimilar to the existing or future aquifer water quality.	maintenance. The following text will be added to the end of the 4th bullet on page F-14. "Wells will be maintained following procedures described in Section 4.2 of the O&M Manual Volume 1. These procedures are designed to be applied flexibly based on observation and measurement during well monitoring, maintenance, and rehabilitation. Rehabilitation can include the use of mechanical methods, application of different chemicals, and more frequent rehabilitation events. As the rehabilitation effort increases, PG&E may ultimately decide to reconstruct or replace a well." In the event that poor water quality is encountered in water generated from well maintenance (e.g., presence of scaling ions, low or high pH, high suspended solids), Table 2.2-1 of the Contingency Plan (O&M Manual Volume 3) has identified mitigation measures for these contingencies in design and operations.	quality would be returned to the formation. Describe PG&E's contingency if well maintenance is not successful. Comment resolved.				A.
462	MWD-15	Appendix F/ F-14	Trucking off-site to permitted disposal facility	If remedy-produced water (plus misc. flows) can't be reused onsite, the project proposes to dispose of the water offsite. Identify the proposed permitted disposal facilities which would accept this water.	Potential disposal facilities will be identified and included in the 90% design.				Comment resolved.	O&M Manual Volume Section 6.1.5.

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463	DTSC-140	Appendix F Page F-16	Remedy-Produced Water Management System Design – Design Criteria – 3rd Bullet	Please provide the possible future options for the solids removal, neutralization, and dissolved constituent removal for the strict water quality requirements.	The primary line of defense against well fouling is proper well maintenance. The following text will be added to the end of the 4th bullet on page F-14. "Wells will be maintained following procedures described in Section 4.2 of the O&M Manual Volume 1. These procedures are designed to be applied flexibly based on observation and measurement during well monitoring, maintenance, and rehabilitation. Rehabilitation can include the use of mechanical methods, application of different chemicals, and more frequent rehabilitation events. As the rehabilitation effort increases, PG&E may ultimately decide to reconstruct or replace a well." In the event that poor water quality is encountered in water generated from well maintenance (e.g., presence of scaling ions, low or high pH, high suspended solids), Table 2.2-1 of the Contingency Plan (O&M Manual Volume 3) has identified mitigation measures for these contingencies in design and operations. See also response to comment #757 DTSC-239.	Okay pending review of the 90% design.			Comment resolved.	O&M Contingency Plan (Volume 3 of the O&M Manual), Appendix A.
464	DTSC-141	Appendix F Figure F-2 Page F-17	Conditioning Process Schematic	Please provide the disposition of the waste stream for the water from the dewatering phase.	See response to comment #217 DTSC-91, and drawing G-12-01 (Appendix D-2).	Okay.			Comment resolved.	90% BOD Appendix F Figure F-2.
465	DOI-170	Appendix F, Page F-17	References	The following item is included in the Reference list but is not referenced in the text: CH2M HILL 2009.	DOI is correct. However, revising a previously published document for the sole purpose of updating a reference list is not warranted, therefore, no changes are proposed to Appendix F.		Comment resolved.		Comment resolved.	Not applicable
Specific Comments – Appendix G (Evaluation of Arched Bridge Integrity and Space Availability to Support Freshwater Supply Pipeline)										
466a	FMIT-142	Append G		This appendix consists of 2 separate evaluations, one by EPNG and one by AECOM. A comparison of the two reports may be warranted. The former does not consider wind or seismic loading, whereas the latter does. The former doesn't consider loading due to gas pipe hydrostatic pressure testing, whereas the latter does. Does PG&E still consider the EPNG report relevant?	PG&E conducted its own evaluation and recommended modifications of select structural members for compliance with current wind/horizontal loading requirements. PG&E Gas Transmission, as the entity responsible for the pipe bridge within PG&E organization, is leading the discussion with Kinder Morgan regarding modifications to the arched bridge. Any follow-on pipeline bridge improvement project			Comment resolved pending review of the 90% design.	Comment resolved.	Not applicable

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					will be a Gas Transmission project. Consistent with current practice, PG&E will keep the agencies, stakeholders, and Tribes informed of Gas Transmission projects in the Topock area.					
466b	Hualapai-115 Chemehuevi-115 Cocopah-115 CRIT-115	Append G		This appendix consists of 2 separate evaluations, one by EPNG and one by AECOM. A comparison of the two reports may be warranted. The former doesn't consider wind or seismic loading, whereas the latter does. The former doesn't consider loading due to gas pipe hydrostatic pressure testing, whereas the latter does. We are not sure if the EPNG report is even relevant.	See response to comment #466a FMIT-142.			Comment resolved pending review of the 90% design.	Comment resolved.	Not applicable
467	DOI-171	Appendix G, Topock Bridge (Old Trails Bridge) Assessment, Page 5 of 5	References	The following items are included in the Reference list but are not referenced in the text: National Park Service; Kulicki, John; El Paso Gas Company; Elnashai, Amr; and Structural Engineers Associates.	Comment noted.		Comment resolved.		Comment resolved.	Not applicable
468	FMIT-143 Hualapai-116 Chemehuevi-116 Cocopah-116 CRIT-116	Append G AECOM report		Rather than assuming a steel strength of 36,000 lb/square inch (AECOM report), it would be best to establish steel strength based on field measurements (stress-strain microprobe, or another method) or lab measurements.	PG&E Gas Transmission, as the entity responsible for the pipe bridge within PG&E organization, is leading the discussion with Kinder Morgan regarding modifications to the arched bridge. Any follow-on pipeline bridge improvement project will be a Gas Transmission project. PG&E appreciates the Tribes' inputs.			Comment resolved pending review of the 90% design.	Comment resolved.	Not applicable
469a	FMIT-144	Append G		Is scour at all a concern for the abutment on the ~~Arizona~~ California side? Please discuss why or why not.	The Arched bridge has been in service for almost 100 years. There has not been any problem with scour in that time. There is insufficient evidence that a problem exists to warrant study of this issue.			Comment resolved pending review of the 90% design.	Comment resolved.	Not applicable
469b	Hualapai-117 Chemehuevi-117 Cocopah-117 CRIT-117	Append G		Is scour at all a concern for the abutment on the Arizona side?	See response to comment #469a FMIT-144.			Comment resolved pending review of the 90% design.	Comment resolved.	Not applicable
470	FMIT-145 Hualapai-118 Chemehuevi-118 Cocopah-118 CRIT-118	Append G AECOM report Sect. 5.3		In section 5.3 of the AECOM report, there is discussion of analysis of bridge response under the condition when a single (presumably) gas pipe is being hydrostatically pressure tested with water. For that test, wind loads were reduced. By how much and why? Does a water-filled 30-inch-diameter gas pipe really not	During the hydrotesting, the wind velocity should not exceed 30mph per page 3, paragraph 2.3. Pressure testing procedure takes about 8 hours and weather forecast will be consulted for wind. Higher wind will cause overstress in some members. AECOM did not perform an existing			The Tribes strike the first question of the second part of the comment "Does a water-filled 30- inch-diameter gas pipe really not place significant load on the bridge compared to a water-filled 12- inch-diameter water line?"	Comment resolved.	Not applicable

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				place significant load on the bridge compared to a water-filled 12- inch-diameter water line? Also, why is there no reference analysis provided for the bridge in its existing condition?	conditions as a reference analysis.			Comment resolved.		
471	FMIT-146 Hualapai-119 Chemehuevi-119 Cocopah-119 CRIT-119	Append G AECOM report Sect. 6.0		In section 6.0 (Conclusions) of the AECOM report, reference is made to a section 7.0, said to contain recommended modifications. There appears to be no section 7.0.	See attached Drawing #481620, Change #1 (Erection Plan, Colorado River Highway Bridge Topock-Milpitas Main 300) for recommended modifications for compliance with current wind/horizontal loading requirements (included in **Attachment K**, at the end of this table). This drawing will be added to the report as Section 7. PG&E Gas Transmission, as the entity responsible for the pipe bridge within PG&E organization, is leading the discussion with Kinder Morgan regarding modifications to the arched bridge. Any follow-on pipeline bridge improvement project will be a Gas Transmission project. Consistent with current practice, PG&E will keep the agencies, stakeholders, and Tribes informed of Gas Transmission projects in the Topock area.			Comment resolved pending review of the 90% design.	Comment resolved.	90% BOD Appendix G.
Specific Comments – Appendix H (Updated Cost Estimate)										
472	FMIT-147	General		The first paragraph is unclear about whether PG&E is asserting that the remedy cost increase is attributable to addressing stakeholder comments. Please clarify and explain the relevance of this assertion if the cost increase was otherwise required to comply with ARARs or other statutory requirements. Also, please explain on page 10 of the estimate why certain mitigation measures are excluded from the estimates.	Cost increase is primarily attributable to more engineering detail and changes between the 30% and the 60% designs. Some of the changes are in response to stakeholder (including agency) comments, for example the addition of As/F pre-treatment facility. Specific cost increases (or decreases) can be found in Table H-1, with text explanations in Table H-2. As detailed in those tables some of the larger cost increases include: • Monitoring wells: The monitoring well network was modified which resulted in larger and deeper wells. A pre-drilling field program and expanded testing was added. In addition, well construction materials changed to more expensive material. • Arsenic/fluoride treatment plant: Construction and			Comment resolved pending review of the 90% design.	Comment resolved.	90% BOD Appendix H.

TABLE I-1

Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

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					operation/maintenance were added due to concerns about water quality in the HNWR-1 well. An alternative to treatment is still under consideration, but DTSC directed that treatment of parameters above CA MCLs be included in the 60% design. • Power source: Specifics were added regarding the source and distribution of power for the operation of the remedy as information became available. • Certain mitigation measures (listed in Appendix H) were excluded from the 60% design cost estimate for various reasons, including judgment that the costs were minimal relative to overall project costs (disturbance coordinator, tribal access plan), or because these items were not estimable at the time (TRC), or because the costs are embedded within design and operation (noise mitigation). Certain costs that were not estimable at the time of the 60% design, may be estimable at 90% design, and, if so, will then be included in the cost estimate. Text will be added to the 90% design to clarify that the changes in cost estimates are based on various factors including technical, stakeholder, and agency inputs.					
473	MWD-16	Appendix H/ Table H-1	Construction Cost Estimate	Construction cost of As/F Freshwater treatment is estimated at $9.5 million (nearly 9% of overall construction cost). Does the estimated O&M cost ($6.8 million per year) in Attachment C Table 1 include O&M costs for the pre-injection treatment system, including chemical costs?	The estimated annual O&M cost for the pre-injection treatment system for arsenic and fluoride in Attachment C Table 1 (page 3397 of the 60% BOD) is $1.16M. The estimated cost included chemicals as well as labor, maintenance, and materials.				Comment resolved.	90% BOD Appendix H.
474	DOI-172	Appendix H, Attachment A, Page 2	General Project Description	The in-text citation for DTSC 1996 is not listed in the Reference section.	Noted. Will include in the 90% design submittal.		Comment resolved.		Comment resolved.	90% BOD Appendix H.
475	DOI-173	Appendix H, Attachment A, Page 2	General Project Description	The in-text citation for DOI, 2005 is not listed in the Reference section.	Noted. Will include in the 90% design submittal.		Comment resolved.		Comment resolved.	90% BOD Appendix H.
476	DOI-174	Appendix H, Attachment A,	Estimate Classification	Please change the in-text citation for “2009 CH2M HILL” to “CH2M HILL 2009”.	Noted. Will include in the 90% design submittal.		Comment resolved.		Comment resolved.	90% BOD Appendix H.

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		Page 4								
477	DTSC-142	Appendix H, Cost Resources, 5th bullet	National Electrical Contractors Association – Labor Unit Manual and published list pricing discounted 30% for electrical materials	Please provide rationale on the 30% discount applied.	The 30% discount for electrical materials is based upon professional experience and conversations with vendors regarding discount for bulk purchase. Note that the 30% discount did not apply to any of the generation equipment.	DTSC discourages use of discount rates unless it is backed up by vendor estimates. Pursuant to EPA's guide for cost estimate (EPA 540-R-00-002 OSWER 9355.0-75), "If possible, more than one vendor quote should be obtained. Quotes from multiple sources can be averaged, or the highest quote can be used in the cost estimate if the collected quotes seem to be at the low end of the industry range."			DTSC's input are noted for the 90% cost estimate.	90% BOD Appendix H.
478	DTSC-143	Appendix H, Major Assumptions, p.6	HDPE pipe installation and fusing will be done at night for the next day of work.	This is contrary to PG&E's design statements that night work is not anticipated. Please explain.	Pipe installation will be done during daytime hours. Pipe fusing can be done at night and to do so could significantly reduce the construction schedule. If such work is proposed for the night time, PG&E will take all possible steps to reduce lighting (shrouding and shielding temporary lights) and duration. All night time work will be performed in compliance with the approved mitigation measures.	If this is PG&E's plan, it is recommended that all statements associated with night work are consistent within the design document.			Comment resolved.	90% BOD Appendix H.
479	DTSC-144	Appendix H, Major Assumptions, p.7	Startup is 6 weeks.	Please define start up and how this effects costs.	The startup task entails pre-commissioning and commissioning tasks for the Remedy system. Pre-commissioning includes confirming all electrical, mechanical, and controls equipment are installed properly so that the system is accepted as complete following construction and startup can be begin. Equipment testing during this phase includes such things as motor rotation tests, control loop checks, and valve actuation. Any defects found during this phase will be corrected and checked prior to accepting the system. Commissioning includes testing the entire system on both a subsystem level (e.g., individual well or carbon dosing system) and the entire system to verify operational sequences and alarms work properly using clean water to the maximum extent possible. Any system defects are repaired and checked prior to accepting the commissioning phase. A testing phase using contaminated	Comment resolved pending review of the 90% design.			Comment resolved.	90% BOD Appendix H.

TABLE I-1

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					groundwater, known as groundwater commissioning, would normally be the next step, but this step was not included in the estimate as the procedures had not been defined for the 60 percent design. Once a groundwater commissioning procedure is prepared (start-up procedures will be included in the 90% design) this step can be estimated. The time of six weeks is based upon the best estimate of time at the 60% design stage. The quality of the engineering/ specifications with input from the owner with incorporation of the owner input and design requirements into a comprehensive QA program will determine the true time and cost of startup. Price impacts are based upon how the risk is contractually distributed among the various vendors and subcontractors. For instance, if startup and testing is a time and materials/expense activity, cost will increase if the startup time exceeds six weeks. If startup time is based upon a lump sum performance based scope of work, the cost may remain the same. The time and pricing implications can be better examined when the class 1 estimate is priced because the design plan set and specifications will be more definitive (i.e., complete design, functional description, schedule).					
480	DTSC-145	Appendix H, Description of Construction Work	Process trench spoil, assuming 100% will be used as bedding/backfil l	Did estimate take into consideration the large volume of soil that may require storage, care and maintenance for an extended period of time? What cost assumptions were used for the soil?	Not enough information regarding the anticipated volumes, storage locations, and details regarding maintenance protocols for excess soil was available at the time of the 60% design cost estimate. Therefore, it was assumed that all of the soil generated would be re-used on-site. This information will be updated in the 90% design cost estimate. DTSC's input are noted for 90% cost estimate.	PG&E is currently considering specific locations for soil storage from the construction phase of the project. Cost estimate should be consistent with PG&E's proposal for the quantity of soil estimated for storage.			Comment resolved.	90% BOD Appendix H.
481	DTSC-146	Appendix H, Excluded Costs		Why did PG&E exclude these costs, especially mitigation measures that will be required for the life of the project?	See response to comment #472 FMIT-147. DTSC's input are noted for 90% cost estimate.	DTSC would like to see a rationale for each item that is excluded from the cost estimate in the 90% design. Please note that all costs, even			Comment resolved.	90% BOD Appendix H.

TABLE I-1
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Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
						minimal costs should be included.				
482	DOI-175	Appendix H, Attachment C, Page 2	References	The following item is included in the Reference list but is not referenced in the text: CH2M Hill 2011.	Noted. Will include in the 90% design submittal.		Comment resolved.		Comment resolved.	90% BOD Appendix H.
483	DTSC-147	Appendix H, Attachment C, Table 1	Arsenic and Fluoride Treatment Plant – Comment: Facility O&M and assumes minimal waste need to be transported off-site	According to PG&E's Sustainability Summary Metrics of 3/29/2013, PG&E estimated Liquid Waste Truck Trips to range from low of 500 truck trips to high of 1,833 trips for AA technology. See also comment on Appendix M, 4.0 Summary of Ongoing Bench-scale Testing Results, Wastewater Generation, Page 4 below. Please explain why this assumption is used for cost estimate.	The reference text assumes the wastewater could be managed using a range of management options similar to those identified for remedy produced water. The assumption was made based on preliminary bench testing results. Note that PG&E will remove the arsenic and fluoride treatment system, and include an arsenic only freshwater pre-injection treatment system, in the 90% design as a contingency.	PG&E's response suggests that the Sustainability Summary Metrics as published is misleading since the design document considered another set of management options. The cost estimate must consider the higher of the range of options that are consistent with the design. PG&E cannot publish in a summary metric of needing up to 1833 truck trips and yet not consider it for cost estimate. DTSC understands that the 90% design will contain different technology and that the cost estimate will be updated.			Comment and response noted.	90% BOD Appendix H.
Specific Comments – Appendix I (Response to Comments on Draft 30% BOD Report)										
484	DOI-176	Appendix I	General Comment	The references in this Appendix need to be reviewed, as there seems to be some in-text citations missing, as well as some discrepancies with the corresponding References list.	Comment noted. Cross references will be verified.		Comment resolved.		Comment resolved.	This Appendix.
485	FMIT-148	General		Where the final two columns (final comment resolution and where responses are reflected in the BOD report) are blank, how is the reader to interpret the status of the comment? For example, is it being carried forward to the final design document for resolution? Is there any schedule for resolution, either by date or program event? Also, some of the Final Comment Resolution Boxes do not appear to "match" the DTSC or DOI responses to the 30 % design comment (i.e., Item 303). This makes the tracking of comments difficult and the matrix of limited utility. How will this be resolved in the final design documents?	In that case, it means that the comment has been resolved and there is no need for modify the cited text/tables/ figures in the next iteration of the BOD. For the 90% BOD, in such case, PG&E proposes to put "Comment Resolved" under the Final Comment Resolution column and "Not Applicable" under the "Where responses are reflected in the BOD report" column. PG&E welcome suggestions from the Tribe to assist with its tracking of the comments and use of the matrix.			Comment resolved.	Comment resolved.	90% BOD Appendix I.
486	FMIT-149	Items 25 & 183		By letter dated March 15, 2012, to DTSC and DOI, the Tribe communicated that its legal counsel had not provided any non-confidential communications to PG&E	PG&E fully responded to all of the Tribe's comments on the 30% BOD (See Appendix I in the Intermediate Basis of Design Document.) When responding to the Tribe's comments,				PG&E and the FMIT have discussed this comment and the response.	Not applicable

TABLE I-1
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PG&E Topock Compressor Station, Needles, California

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				on the 30% BOD and did not authorize PG&E to communicate or represent the Tribe's position in any regard. This should be noted in respect to PG&E's responses on these and other items in the 30% BOD. Please refer to and incorporate the Tribe's position on Items 25 and 183 as they are set forth in that letter.	PG&E did not in any way indicate that its response to the Tribe represented the Tribe's position. PG&E's responses to comments represent PG&E's understanding and good faith effort to answer comments. PG&E continues to understand based on the Tribe's May 15, 2012 letter to DTSC and DOI (the comment appears to have the wrong date) that the Tribe's comments regarding the East Ravine area and electrical transformers were not intended "to criticize the completeness of the FEIR nor to request additional mitigation measures." (Letter from the Tribe to DTSC and DOI (May 15, 2012) at p. 5). Accordingly, PG&E's response that the Tribe's comments on items 25 and 183 references to mitigation measures refers to measures from the EIR and does not need to be amended.					
487	FMIT-150	Item 27		PG&E's response/the intermediate BOD narrative does not respond to DOI's comment. Also, the Tribe believes it is disrespectful for PG&E to try and place modern development in the same paragraph and same context as the Tribe's religious and cultural history/values. These should be separated in the final BOD. Also, please strike statement that Tribe "considers" the area sacred; the area IS sacred to the Tribe. Finally, did the language that was struck at the end (what appear to be general project protocols to minimize impacts) get moved elsewhere and if so where?	**Proposed revision to the RTC is below in bold/underlined:** DOI's comment recommended that Section 1.1 "be revised to discuss project history and a new section or subsection be added to address the cultural significance, cultural and historic resources and ecological resources, including the ACEC and the HNWR." PG&E's response to this comment and its revisions reflected in the 60% BOD directly address DOI's comment by adding further information regarding project history to Section 1.1. "Background" and by adding subsections further addressing Cultural and Historic Resources and Ecological Resources. In response to the FMIT's request that discussion of modern development be separated from the Tribe's religious and cultural history/ values. PG&E will include the discussion of the historic-era features and archaeological resources in a separate paragraph from the discussion of the Topock Maze. Text will be changed as follows: "[t]he Topock site and adjacent lands are contained within a larger			The FMIT requests that the stricken language be inserted into the 90% BOD.	PG&E and the FMIT have discussed this comment and the response. PG&E is awaiting a response from the FMIT on the text options that PG&E presented.	90% BOD Executive Summary. 90% BOD Section 1.1.1.

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					geographic area that is ~~considered~~ sacred to ~~by~~ the Fort Mojave Indian Tribe and to ~~by~~ other Native American Tribes." **PG&E proposes either of the following sentences in lieu of the above revision:** **"The APE for the Topock site is contained within what the FMIT and other Native American Tribes have identified as a larger area of traditional and cultural importance."** **OR** **"The Tribes have stated that the APE is contained within a larger geographic area that is sacred to the FMIT and other Native American Tribes."** Finally, the language that was stricken at the end of Section 1.1 (in response to 30% design comments #27 DOI-13 and #30 HA-3c) was not moved elsewhere, instead it was replaced with language stating that impacts to cultural resources will be minimized by implementing mitigation measures in the EIR, PA and CHPMP, and in consultation with the Tribes throughout the design process.					
488	FMIT-151	Item 27		PG&E's response/the intermediate BOD narrative does not respond to DOI's comment. Also, the Tribe believes it is disrespectful for PG&E to try and place modern development in the same paragraph and same context as the Tribe's religious and cultural history/values. These should be separated in the final BOD. Also, please strike statement that Tribe "considers" the area sacred; the area IS sacred to the Tribe. Finally, did the language that was struck at the end (what appear to be general project protocols to minimize impacts) get moved elsewhere and if so where?	The FMIT has confirmed that comment FMIT-151 is duplicative of comment FMIT-150. See response to comment #487 FMIT-150.				Comment resolved.	Not applicable
489	FMIT-152	Item 53		The Tribe is concerned about DTSC's statement that it "continues to be concerned with the efficacy of the remedy." It seems to the Tribe that DTSC has approved this particular remedy and would be surprised if DTSC would approve a remedy it did	PG&E defers to DTSC.	DTSC's statement is in regards to the acknowledgement of the complexity of the proposed remedy in context to the sensitivity of the surrounding landscape. The technology presented is sound,		Review in progress.	This comment and responses were discussed at the December 17-18, 2013 TWG meeting.	Not applicable

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				not think would work or be effective. What does this statement mean to DTSC?		however, there are constraints that would limit PG&E's ability to refine the remedy, or respond as they would in a typical remedial enhancement; for example, installing additional injection wells in response to recalcitrant areas. Nevertheless, as included in the original statement, "PG&E has been able to provide reasonable logic to all concerns raised. DTSC will continue to carefully evaluate and monitor PG&E's proposal throughout the design, construction and implementation process."				
490	FMIT-153	Item 63		Is PG&E's proposal to incorporate possible use of an infiltration gallery in Bat Cave Wash into the soil RFI/RI Work Plan mean that potential aspects of the groundwater remedy are now being proposed to be combined with the soil remedy? What are the potential CEQA ramifications of this? Please note that the Tribe objects to such an infiltration gallery in this especially culturally sensitive area.	As stated in the response to comment #72a FMIT-21, the concept of an infiltration gallery in Bat Cave Wash was included in the design documents as an option to manage remedy-produced water. This option is not being further evaluated in the design at this time. If PG&E proposes to evaluate this option further in the future, PG&E will discuss the option at that time, and will seek further input from the Tribes during the Soil CMS/FS development and review. Text will be added to the 90% BOD to reflect this response.			Comment resolved.	Comment resolved.	90% BOD, Footnote to Exhibit 3.4-2 90% BOD, Appendix F, Footnote to Table F-5
491	FMIT-154	Item 65		Why would the 20-foot setback requirement not apply to the Arizona remedy infrastructure? Why would the rationale for such requirements differ on each side of the River?	PG&E defers to DTSC as the 20-foot setback requirement is set forth in the EIR mitigation measure AES-2a.	DTSC's understanding of PG&E's response to the referenced comment is that there will not be any substantial vegetation removal along the riverbank for any infrastructure proposed in the Arizona side of the river. Therefore, set back in Arizona side of the river is not applicable based on current design.		Response noted.	Noted.	Not applicable
492	FMIT-155	Item 71		The Tribe appreciates DOI's response that additional consultation "provides the framework needed to address cultural values of religious and spiritual significance." The Tribe would like DOI to provide it with a timeframe for that consultation that	PG&E defers to DOI.		BLM has conducted formal Section 106 consultation with the Tribes early in the remedial design process on both the 30% and 60% design documents	Response noted.	Noted.	Not applicable

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				will be adequate to the need and not push that important and long-awaited consultation to the very end of remedy design or when insufficient time will remain for those necessary discussions.			and will consult on the 90% design documents when they become available. DOI and BLM have had several formal, face-to-face consultation meetings with the Tribes on the CHPMP (bi-monthly), the 30% design documents (March 8, 2012) and 60% design documents (May 23rd 2013 & July 9, 2013) as well informal discussions at the TWG meetings. We will continue to engage in consultation on the design throughout the remainder of the resolution and review of the 90% design package. DOI will continue to coordinate as much as possible with the tribes to allow for sufficient time for consultation.			
493	FMIT-156	Item 119		The Tribe feels that PG&E's generalized comment is not fully responsive. The Tribe would like to understand the specifics of where cultural resource constraints may affect design and operation. As noted elsewhere, the Tribe also would like to understand the different design options relative to tribal cultural resources.	Section 6 of the 60% BOD (Table 6.1-1) presents a summary of actions taken or being performed under each EIR mitigation measure, which includes specific examples of how the 60% design incorporated cultural considerations and Tribal inputs, e.g., the use of field reviews in siting infrastructures, eliminating the BCW trenching, relocating wells in the upland, and reducing the number of transformers/ siting transformers aboveground. More recent examples of how cultural resources consideration was incorporated into the design are: 1) the relocation of monitoring well I in the uplands to a location further away from cultural resources, 2) the proposed relocation of certain provisional IRZ wells and associated infrastructure from the west side to the east side of NTH at the request of the Tribes, and 3) the current evaluation of relocating well IRL-2 closer to the road. Regarding alternative design options, please see response to comment #1 DOI-1 for aboveground vs.			Comment resolved. Please provide similar examples moving forward.	Comment resolved.	Table 6.1-1 of the 90% BOD includes specific examples of how the 90% design incorporated cultural considerations and Tribal inputs, e.g., CUL-1a-10. 90% BOD Executive Sumamry Section ES.3, last paragraph, contains examples of actions taken to avoid new remedy infrastructure on the FMIT parcel.

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					belowground piping design.					
494	FMIT-157	Item 125		The statement that PG&E will adhere to any “agreements” made regarding well and system decommissioning appears to ignore that DTSC has the power to direct and require action by PG&E.	Noted. PG&E recognizes that DTSC and DOI are primary approval authorities for the project and can direct/ require action by PG&E.			Comment resolved.	Comment resolved.	Not applicable
495	FMIT-158	Item 205		The Tribe appreciates DOI’s response that the federal agencies are evaluating potential options for use restrictions for property under its jurisdiction. The Tribe requests DOI to consult with it on such options.	PG&E defers to DOI.		The Tribal Access Plan will remain in place to assure the Tribes of continued access to federal lands contained within the boundary of the APE. If necessary, development of further land use restrictions would be implemented by the bureaus within their specific management plans, and these planning processes typically include tribal consultation. The language from the Record of Decision for the groundwater remedy clearly states that "Institutional controls are measures undertaken to limit or prohibit activities that may interfere with the integrity of a cleanup action or result in unacceptable human exposure to hazardous substances remaining at a site. Such measures are adopted to assure the continued protection of human health. The institutional controls adopted by the Selected Remedy for the Site are specified in the *BLM Lake Havasu Field Office Resource Management Plan* issued in May 2007 and in the *1994 Lower Colorado River National Wildlife Refuges Comprehensive Management Plan.* These plans restrict surface uses and use of			Not applicable

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							the groundwater. Institutional controls will remain in place for the duration of the remedy until RAOs are achieved."			
Specific Comments – Appendix J (Freshwater Supply Technical Memorandum and Response to Comments)										
496	FMIT-159	General Comment		The Tribe submitted comments on earlier versions of the FWIP. These should be addressed along with DTSC's and DOI's comments.	PG&E had provided responses to all comments received on the FWIP (2013) prior to finalizing the work plan. These responses are documented in Attachment A of the FWIP. Additional comments were received from FMIT on the Final FWIP, and those were reviewed by DTSC/DOI prior to FWIP implementation. In addition, PG&E also provided responses to all comments received on the Freshwater Supply Technical Memo (2012), these are documented in Appendix J of the 60% BOD.			Comment resolved.	Comment resolved.	Not applicable
497	FMIT-160	DTSC Comment 10		PG&E states that it purchased water from the owners of the Topock 2 and 3 wells. Were there any other users or purchasers of water from these wells during the time period referenced in the comment? Does PG&E still buy water from this source and if so, for what purpose?	These wells are currently owned by the Southwest Water Company. The wells were previously owned by the City of Needles and by Burlington Northern Santa Fe Railroad. PG&E continues to purchase water from these wells for industrial uses at the Topock Compressor Station. PG&E is aware that the Topock Marina facility used water from these wells prior to its demolition a few years ago, but does not have any further information about other users or purchasers.			Comment resolved.	Comment resolved.	Not applicable
498	DOI-177	Appendix J, Section 2.2.2, Page 4	Total Dissolved Solids	The in-text citation for RWQCB 2006 is not listed in the Reference section.	The in-text citation for RWQCB 2006 is the *"Water Quality Control Plan, Colorado River Basin Region 7 (includes Amendments Adopted by the Regional Board through June 2006)"*.		Comment resolved.		Comment resolved.	Not applicable
499	DOI-178	Appendix J, Section 3.2.2, Pages 9 and 10		The in-text citations to the LeRoy Crandall and Associates source are "Crandall". Should the citations be revised to "Crandall & Associates"?	This is an editorial preference. Editing/ modification of a previously published report (outside of the BOD) to solely update a citation convention is not warranted.		Comment resolved.		Comment resolved.	Not applicable
500	DOI-179	Appendix J, Section 3.2.2, Pages 10		The in-text citation for Metzger and Loeltz 1973 is not listed in the Reference section.	This in-text citation is listed in the Reference section (Section 9) of the 60% BOD, please see page 9-4, it is the 8th reference from the top.		Comment resolved.		Comment resolved.	Not applicable
501	DOI-180	Appendix J,		The in-text citations to the LeRoy Crandall and Associates source are	See response to comment #495 DOI-178.		Comment resolved.		Comment resolved.	Not applicable

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		Section 3.3.2, Pages 19 through 21		"Crandall". Should the citations be revised to "Crandall & Associates"?						
502	DOI-181	Appendix J, Table 3-1, Page 2 of 3	Notes	The in-text citations to the LeRoy Crandall and Associates source are "Crandall". Should the citations be revised to "Crandall & Associates"?	See response to comment #495 DOI-178.		Comment resolved.		Comment resolved.	Not applicable
503	DOI-182	Appendix J, Response to Comments, Page J-16	Comment Number 12	In-text citations for CH2M HILL 2012g and CH2M HILL 2013a are not listed in the Reference section.	These in-text citations are listed in the Reference section (Section 9) of the 60% BOD, please see page 9-3, they are the 14th and 15th references from the top, respectively.		Comment resolved.		Comment resolved.	Not applicable
504	DOI-183	Appendix J, Response to Comments, Page J-18	Comment Number 15	The in-text citation for CH2M HILL 2013a is not listed in the Reference section.	See response to comment #499 DOI-182.		Comment resolved.		Comment resolved.	Not applicable
505	DOI-184	Appendix J, Response to Comments, Page J-23	Comment Number 33	The in-text citation for CH2M HILL 2012f is not listed in the Reference section.	This in-text citation is listed in the Reference section (Section 9) of the 60% BOD, please see page 9-3, it is the 13th reference from the top.		Comment resolved.		Comment resolved.	Not applicable
Specific Comments – Appendix K (Revised East Ravine Groundwater Investigation Addendum)										
506	DOI-185	Appendix K, Executive Summary, Summary of Key Findings, Refined understanding of hydrogeology, Page 1	"The depth to bedrock beneath the TCS was found to be deeper than previously estimated, which indicates a larger area of saturated alluvium in this area than previously estimated."	Since aquifer thickness has increased, how does this impact the current groundwater remedial program (e.g., well screening zones, water volumes, capture zone, pumping rates, etc.)?			At the time of the 60% design, DOI had not completed their review of the ER-TCS Addendum. DOI recommends that ER-TCS addendum comments in the 60% design be deferred to comment resolution on the ER-TCS Addendum.		Comment deferred to comment resolution on the ER-TCS addendum.	See Table F-1 of the *Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation*
507	DOI-186	Appendix K, Section 2.5, Page 9	"The depth-specific samples were collected using a wireline straddle packer tool to isolate fractures in the interval of interest."	Please identify the intervals of interest.			See DOI's note in row above.		Comment deferred to comment resolution on the ER-TCS addendum.	See Table F-1 of the *Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation*

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508	DOI-187	Appendix K, Section 3.2, Page 12	"Depth-specific grab samples were collected from the two primary flow zones using packers."	Are the two primary flow zones found at 148-168 feet and 195 feet? If so, this information should be stated parenthetically at the end of the sentence.			See DOI's note in row above.		Comment deferred to comment resolution on the ER-TCS addendum.	See Table F-1 of the *Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation*
509	DOI-188	Appendix K, Section 3.6.1, Page 19	"The drawdown caused by pumping was too small to observe directly in any but the closet well, MW-70-105 9 shallower well pair to the pumping well), where the well exhibited a consistent dewatering trend and a total of 1.6 feet of drawdown . . . "	What is the distance from the pumping well to well MWE-70-105?			See DOI's note in row above.		Comment deferred to comment resolution on the ER-TCS addendum.	See Table F-1 of the *Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation*
510	DOI-189	Appendix K, Section 3.6.2, Page 19		Please identify the range of specific capacity measurements so readers can better understand the specific capacity estimates without having to refer to data located elsewhere in the document.			See DOI's note in row above.		Comment deferred to comment resolution on the ER-TCS addendum.	See Table F-1 of the *Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation*
Specific Comments – Appendix L (Draft Operations and Maintenance Manual)										
511	DOI-190	Section L1.1.2, Page L1-2	"In addition, a summary of compliance with applicable Programmatic Agreement (PA) stipulations and Cultural and Historic Properties Management Plan (CHPMP) provisions are included in Tables L1.1-3 and L1.1-4, respectively."	It should be noted that additional CHPMP measures may be identified during ongoing consultation meetings with the Tribes, and the CHPMP will be modified accordingly.	Comment noted.		Comment resolved.		Comment resolved.	Not applicable
512	DOI-191	Table L1.1-1,	"Plans and	When will these specifications be	The specifications will be made		Comment resolved		Comment resolved.	See the *Habitat Restoration Plan*

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		Mitigation Number AES-1b, Page L1-5	specifications for revegetation shall be developed by a qualified plant ecologist or biologist before any riparian vegetation is disturbed and shall be implemented consistent with CUL1a-5."	made available for review?	available for review with submittal of a revegetation plan for impacts to riparian vegetation, at 90% design.		pending review of 90% design.			*for Riparian Vegetation and Other Sensitive Habitats*, which is included in an appendix to the Construction/Remedial Action Work Plan.
513	DOI-192	Table L1.1-1, Mitigation Number AES-1e, Page L1-5	"e) The final revegetation plans and specifications shall be reviewed and approved by an architect, landscape architect, or allied design professional licensed in the State of California . . ."	It is important to ensure that the qualified person is familiar with native desert flora, with experience (and success) in desert restoration. The selected professional should have qualifications and experience with desert landscape and revegetation needs, as well as an associated maintenance background, in order to ensure success of the program. Additionally, the plan must be reviewed and approved by FWS biologist or botanist and the PG&E biologist.	Comment noted. A botanist with expertise in desert flora and experience designing revegetation plans in arid areas will prepare the revegetation plan which will be approved by the PG&E biologist. A Certified Landscape Architect professionally licensed in the State of California with experienced in desert landscape and revegetation requirements will also review the revegetation plans. Draft plans will be submitted for USFWS review at 90% design.		Comment resolved pending review of 90% design.		Comment resolved.	The *Habitat Restoration Plan for Riparian Vegetation and Other Sensitive Habitats* (included as an appendix to the Construction/ Remedial Action Work Plan) was prepared by CH2M HILL biologist Steve Long and E2 botanist Russ Huddleston, and reviewed and approved by PG&E biologist Virginia Strohl and CH2M HILL Landscape Architect Linda Cyra-Korsgaard (licensed in California). All of these named individuals have expertise in desert flora and experience designing revergetation plans in arid areas.
514	DOI-193	Table L1.1-1, AES-1a, Page L1-5		The citation for this section is CH2M HILL 2012a; however, the reference section includes two CH2M HILL references – CH2M HILL 2012 and CH2M HILL 2012f.	The citation 2012b will be revised to 2012.		Comment resolved.		Comment resolved.	Not applicable as this reference is no longer in the O&M Manual Section L5
515	DOI-194	Table L1.1-1, AES-2a, Page L1-6		The in-text reference is CH2M HILL 2011d; however, the reference page has 2011a, b, c, and k. CH2M HILL 2011k should be CH2M HILL d in the Reference list.	The citation 2011k will be revised to 2011d on the Reference List.		Comment resolved.		Comment resolved.	Not applicable as this reference is no longer in the O&M Manual Section L5
516	DOI-195	Table L1.1-1, Mitigation Number AES-2b, Page L1-6	"b) Existing mature plant specimens shall be protected in place during construction, operation, and decommissioni ng phases. The identification of plant specimens that are determined	As the project will take place over several decades, how frequently will the Mature Plant Survey be performed in order to update data and protect future mature plant species?	Mature plants will be surveyed as part of the pre-construction biological survey prior to any ground disturbance and prior to ground disturbing activities during operations and decommissioning and avoided as much as possible throughout implementation of the remedy.		Comment resolved.		Comment resolved.	Not applicable

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			to be mature and retained shall occur as part of the design phase and mapped/identified by a qualified plant ecologist . . . “							
517	DOI-196	Table L1.1-1, AES-2b, Page L1-6		The in-text reference is CH2M HILL 2012b; however, in the Reference list there is only 2012 and 2012f. Which should be designated as “a” and which as “b”?	See response to comment #514 DOI-193.		Comment resolved.		Comment resolved.	Not applicable as this reference is no longer in the O&M Manual Section L5
518	DOI-197	Table L1.1-1, BIO-3b, Page L1-12		The in-text reference is CH2M HILL 2012a; however, in the Reference list there is only 2012 and 2012f. Which should be designated as “a” and which as “b”?	Item 2012f on the Reference List will be revised to 2012a. No changes are needed to BIO-3b.		Comment resolved.		Comment resolved.	Not applicable as this reference is no longer in the O&M Manual Section L5
519	DOI-198	Table L1.1-1, Mitigation Number GEO-1a-a, Page L1-28	“a) A DTSC-approved grading and erosion control plan, prepared by a California Registered Civil Engineer, shall be completed . . . “	How often will the engineered control measures be inspected in the field to ensure that they are fully operational?	This information will be included in the plan for review.		Comment resolved pending review of 90% design.		Comment resolved.	Discussions regarding BMPs in the Construction/Remedial Action Work Plan Section 4 and appendix.
520	DOI-199	Table L1.1-4, Section 6.9, Page L1-73		The in-text reference is BLM et al. 2010; however, the reference list says 2011.	The subject in-text reference is actually part of the excerpt text lifted from the CHPMP. Therefore, it is not include in the reference list of this volume (Section L5).		Comment resolved.		Comment resolved.	Not applicable.
521	MWD-17	Appendix L, Draft O&M Manual, Section 2	Communication	Metropolitan/downstream users of the Colorado River should be included in receiving any communication that involves a potential threat to the river.	The following text will be added to Exhibit L2.2-3 (Preliminary Communication Framework), Party Receiving Communications column, for triggering events listed on page L2-6 only (other trigger events are not expected to pose a threat to the river): “<u>If there is a potential threat to the river, notify MWD and immediate downstream users such as the Chemehuevi Indian Tribe as soon as possible</u>.”				Comment resolved.	O&M Manual Main Text Table L2.2-1.

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522	DOI-200	Exhibit L2.2-4, Page L2-9	2. Operations Summary	The report section should also include percentage of time treatment systems were operational on a monthly basis, quantity of water recovered for treatment, as well as cumulative total, quantity of ethanol injected, etc.	Comment noted. These parameters have been anticipated as operational and process monitoring data.		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Main Text Exhibit L2.2-2. O&M Manual Volume 2 Exhibit 6.5-1.
523	DOI-201	Exhibit L2.2-4, Page L2-9	3. Performance Summary	The report section should also include volume of water collected and treated, Cr(VI) mass treated, influent-effluent data, etc.	Comment noted. The information listed in this comment will be included in Section 3 (Performance Summary) of the quarterly progress reports.		Comment resolved.		Comment resolved.	O&M Manual Exhibit L2.2-2. O&M Manual Volume 2 Exhibit 6.5-1.
524	DOI-202	Section L2.3, Page L2-12		Suggest adding OSHA training to this section.	The following text will be added at the end of the first paragraph under Section L2.3: "In addition, all workers will be required to comply with the training requirements specified in the overall Project Health and Safety Plan *[available at 90% design]* and their own site-specific Health and Safety Plan specific to their operations on the project."		Comment resolved.		Comment resolved.	O&M Manual L2.3.
525	FMIT-161	Workers Training (L2.3)		Please confirm that cultural sensitivity training is required of PG&E's consultants before field work and report submittal.	This is confirmed.					Not applicable
526	FMIT-162	Work Variance Request Form: Exhibit L2.2.5		How will the Tribe be notified of variances to the project during project implementation?	As operation of the project proceeds, PG&E will continue to implement the adopted mitigation measures, which include multiple requirements for Tribe monitoring and outreach/ coordination with Tribes during project implementation, including the protocols for continued communication and tribal communication to be set forth in the CIMP that is required pursuant to Mitigation Measure CUL-1a-8.					O&M Manual Main Text Table L2.2-1.
527	DOI-203	Section L3.1, Offsite Laboratory Data, Page L3-1	"At a minimum, the laboratory will maintain the following records: . . . "	How long will the laboratory be required to maintain such records?	Laboratory records are normally retained for five years after the data are reported. However, in compliance with Section XXV of the CD (DOI 2013), PG&E will maintain such records for 10 years following receipt of certification of completion. At the conclusion of the record retention period, PG&E will notify DOI and DTSC in writing at least 90 days prior to the destruction of any records and will provide DOI and DTSC with the opportunity to take possession of any records. Text will be revised to add the		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Main Text Section L3.1.

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					duration of retention of records.					
528	DOI-204	Section L3.1, Maintenance/Calibration Records, Page L3-1	"Computerized maintenance management programs could be implemented at the facility, as appropriate, to keep track of maintenance requirements."	Will the "computerized maintenance management programs" have the capacity to send out reminders via email when a maintenance activity should be performed?	The maintenance management program will have the capacity to issue work orders for routine maintenance activities.		Comment resolved.		Comment resolved.	O&M Manual Main Text Section L3.1.
529	DTSC-148	Appendix L L3.1 Data Management Onsite Laboratory Data, Page L3-1	Certain testing for process control monitoring will be performed at an onsite laboratory in accordance with site specific SOPs.	Where are/will these SOPs be located (90%)? Please identify the location of SOPs as they are introduced so that they may be easily referenced and reviewed. A "hyperlink" is suggested in the electronic versions.	Available SOPs for onsite lab measurements have been provided for review in the 60% design submittal, please see Draft O&M Manual Volume 2 (Sampling and Monitoring Plan), Appendix A (SOPs). Additional SOPs may be available at the 90% design, the use of hyperlink will be explored for the 90% BOD.	Comment resolved pending review of the 90%.			Comment resolved.	O&M Manual Volume 2 Appendix A (SOPs). References to the appendix were added. The use of hyperlink was considered for the 90% BOD, and will need to be tested. Due to time constraint, PG&E will continue to test for potential implementation in the final design documents.
530	DTSC-149	Appendix L L3.1 Data Management, Page L3-2	Exhibit L3.1-1	Minor edit: It appears that "Offsite lab data was repeated twice in the figure balloons and omitted "Onsite lab data".	Comment noted. The second balloon will be revised to state "Onsite lab data".	Okay.			Comment resolved.	O&M Manual MainText Section L3.1.
531	DOI-205	Section L3.3, Page L3-3	"…progress reports will be submitted monthly during RA construction and quarterly after the remedy has been implemented and demonstrated to be operating as intended."	As start-up may require two years before the RA is operating as intended, will monthly progress reports be provide during this time period?	PG&E believes that quarterly progress reporting is adequate during remedy start-up because the amount of new information will not be generated at the same frequency or speed as during construction. In addition, PG&E will provide notifications of planned O&M activities (including sampling activities) via monthly emails, as indicated in Exhibit L2.2-3. In addition, PG&E will hold a regular monthly technical call during startup activities to include agencies and stakeholders.		Comment resolved.		Comment resolved.	Not applicable
532	DTSC-150	Appendix L L3.3 Reporting Page L3-3		Add to this section to indicate that agencies may require additional reporting requirements as the remedy progresses.	The following text will be added to Section L3.3: "It is noted that the agencies may request additional information, or reports as the remedy progresses."	Okay.			Comment resolved.	O&M Manual Main Text Section L3.3.
533	DOI-206	Section 5, Pages L5-1 and L5-2		The following are on the Reference list but are not referenced in the text: CH2M HILL 2011k, CH2M HILL 2012f, and CH2M HILL 2012. Should these items be removed from the Reference list?	See response to comments #515 DOI-194 and #519 DOI-197: Item 2011k will be revised to 2011d and Item 2012f will be revised to 2012a. No changes are proposed for Item 2012.		Resolved.		Comment resolved.	O&M Manual Main Text Section L5.

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Specific Comments – Appendix L – Volume 1: Operations and Maintenance Manual										
534	DOI-207	Volume 1	General Comment	Without detailed SOPs and equipment O&M Manuals, the O&M Plan is more of an overview of operations. It is understood that these documents will be provided in the 90% Design.	Comment noted. PG&E looks forward to inputs from and discussions with the agencies, Tribes, and stakeholders on the information presented in the Draft O&M Plan, as that will inform and shape the details that are forthcoming in the 90% design.		Comment resolved.		Comment resolved.	Detailed SOPs are included in Appendix B of O&M Manual Volume 1 and Appendix A of O&M Manual Volume 2. Select equipment manuals are included in Appendix A of O&M Manual Volume 1.
535	DOI-208	Volume 1	General Comment	Will all pumps and valves be labeled with ID numbers in the field, thereby allowing operators to cross reference information and drawings within the O&M manual to equipment in the field?	Yes. The following text will be added to the second paragraph in Section 2.0: "All pumps and valves will have steel identification tags attached to the device to enable operations personnel to identify equipment and cross-reference information within the O&M manual and drawings."		Comment resolved.		Comment resolved.	O&M Manual Volume 1 Section 2.
536	FMIT-163	Section 1		The plan should set out how CEQA requirements will be met when changes occur during the decades-long operation of the remedy, and how the Tribe will participate in that review.	As operation of the project proceeds, PG&E will continue to implement the adopted mitigation measures, which include multiple requirements for Tribe monitoring, outreach, and coordination during operation of the remedy, including the protocols for continued communication and tribal communication to be set forth in the CIMP that is required pursuant to Mitigation Measure CUL-1a-8. It is PG&E's understanding that changes generally will not require a further CEQA review process unless there is a discretionary project approval that triggers such a review. Absent such a new future project approval, the CEQA review process will have been completed, and tribal participation will be pursuant to the Mitigation Measures including the CIMP. If there is a new discretionary approval based on some change in the remedy, however, it is PG&E's understanding that DTSC would evaluate the proper CEQA document for any such required new approval, and the form of that document will depend on the nature of the new approval. PG&E understands that DTSC as lead agency would follow the required CEQA procedures according to the type of document to be prepared.	In addition to CEQA requirements for public involvement, DTSC will continue to work collaboratively with the Tribes through established Consultative Work Group meetings as well as early communication with the Tribes pursuant to the 2006 settlement agreement. DTSC will work with the Tribes and the CTF, a subgroup of the CWG, to clarify the relationship between CEQA and the environmental investigation and cleanup process for the public, stakeholders, and the Tribes.		This is an open issue that will be carried forward to the 90% design.	This is an open issue that will be carried forward to the 90% design.	Not applicable

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537	DOI-209	Section 2.1.1.1, Page 2-2	"Dual screen extraction wells will be constructed with a dedicated pump for each well screen with the intervals separated using a pneumatic packer."	Will the dual screen extraction wells share the same riser pipe? If not, the text should specify that each screen will have a dedicated riser pipe.	It is anticipated that the dual screen extraction well pumps will have dedicated riser pipes. Section 2.1.1.1 will be revised to reflect this.		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Volume 1 Section 2.1
538	DOI-210	Section 2.1.1.1, Page 2-2	"Conveyance piping from extraction well IRZ-23 to the main groundwater conveyance header will be double-contained and include leak detection instrumentation at low points."	The significance of well IRZ-23 should be for clarification purposes. Leak detection should also be considered for the connection between conveyance pipeline and the main header.	The concrete trench containing piping for IRZ-23 will slope to the low points and, therefore, to the leak detection instruments. The IRZ-23 conveyance line exits double-containment in the carbon amendment room at the MW-20 bench, a room that already includes leak detection equipment.		Comment resolved.		Comment resolved.	Not applicable
539	DOI-211	Section 2.1.1.1, Page 2-2		What casing material will be used for the extraction wells? Will cathodic protection be required?	Well construction details, including casing material and corrosion protection measures, are included in the 60% BOD Report, Section 3.2.5.1. Text will be included in the 90% BOD to reflect this response.		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Volume 1 Section 2.1
540	DTSC-151	Appendix L O&M Plan Volume 1 2.1.1.1 NTH IRZ Extraction Wells Page 2-2	Conveyance piping from extraction well IRZ-23 to the main groundwater conveyance header will be double-contained and include leak detection instrumentation at low points.	Include the rationale for double containment and leak detection in this pipe segment and not others.	As described in Appendix C, Section C.5.1, conveyance pipelines will be single-walled unless the pipe is used to convey: 1) groundwater or remedy-produced water that exhibits the hazardous waste characteristic; or 2) concentrated carbon substrate. In these cases, double-walled piping will be used. Based on these criteria and anticipated remedy operations and groundwater concentrations, double-walled piping is included for conveyance associated with extraction wells IRZ-23, TWB-1, TWB-2, future provisional extraction well IRZ-40, IRL-4 remedy-produced water, and certain piping at the MW-20 Bench and Transwestern Bench Carbon Amendment Facilities.	Okay	Comment resolved.		Comment resolved.	Not applicable

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541	DOI-212	Section 2.1.1.3, Primary Carbon Amendment, Metering, and Control Equipment, Page 2-3	"A sample port and pressure gauge located downstream of the static mixer will be used for monitoring purposes."	Will a sample port be made available before carbon amendment is applied for sampling purposes?	Sample ports are located at each individual well for sampling purposes but are not included in the carbon amendment room prior to the static mixers. A sample port upstream of the static mixer will be included for collecting TOC samples for diagnostic purposes.		Comment resolved.		Comment resolved.	O&M Manual Volume 1 Section 2.1
542	DOI-213	Section 2.1.1.3, Primary Carbon Substrate Storage, Page 2-3	". . . , with secondary containment around the nozzles and connections as required by regulation and/or best practices."	If ethanol is the substrate of choice, it is presumed that the requirements for storage in fire rated, impact-resistant tanks with secondary containment would be instituted at the site. Please clarify the notation for containment around "nozzles and connections".	Ethanol storage tanks are specified as both fire-rated and impact-resistant with integral secondary containment. "Nozzles and connections" refers to portions of the ethanol filling and withdrawal system that are not immediately adjacent to the tank. This may include tanker hose connections at the tanker offload bays and piping connections inside the carbon amendment buildings.		Comment resolved.		Comment resolved.	Not applicable
543	DTSC-152	Appendix L O&M Plan Volume 1 2.1.2 Inner Recirculation Loop, Page 2-4	Three provisional Inner Recirculation Loop Injection Wells (IRL-5 through IRL-7,[1] see Figure 2.1-1). [1] IRL-6 may alternatively be considered as an extraction well with extracted groundwater re-injected into the other IRL injection wells.	Discuss or reference the section describing the basis for these provisional wells and criteria that would be used to trigger installation. Same issue for all provisional wells.	The basis for adding provisional wells is provided in the Sampling and Monitoring Program, Appendix L, Volume 2, Section 2. In particular, the basis for adding IRL provisional wells and the criteria used to trigger installation are discussed in Volume 2: Sampling and Monitoring Plan (Section 2.2.2; see also Figure 2.2-4). References to the appropriate sections of the Sampling and Monitoring Program (Volume 2) will be added throughout this section of Volume 1 in the 90% Design Submittal. Additional language will be added to the 90% design discussing the need for flexibility to locate wells in the future as the remedial program evolves. Any modifications would be discussed with stakeholders prior to implementation.	As suggested after the October 2013 site walk, DTSC would prefer PG&E to propose a wider area for contingency wells instead of specific dots on a map. Please include text that conveys this message as well. Comment resolved pending review of the 90% design.			Comment resolved.	O&M Manual Volume 1 Section 2.1
544	DOI-214	Section 2.1.2.1, Page 2-4	"The River Bank Extraction Wells are currently anticipated to be constructed with 8-inch diameter well casing, . . . "	Provide the anticipated type of well casing material. Is cathodic protection required?	Well construction details, including casing material and corrosion protection measures, are included in the 60% BOD Report, Section 3.2.5.1. Text will be included in the 90% BOD to reflect this response.		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Volume 1 Section 2.1

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545	DTSC-153	Appendix L O&M Plan Volume 1 2.1.2.2 Inner Recirculation Loop Injection Wells, Page 2-5	Water captured by the River Bank Extraction Wells will be amended with carbon substrate if the Cr(VI) concentrations are greater than 32 micrograms per liter (µg/L). The Sampling and Monitoring Plan in Volume 2 of this O&M Manual presents the monitoring plan for collecting and evaluating analytical data to determine whether or not carbon amendment will be required according to this criterion.	Injection criteria should be developed for constituents other than just chromium. What if the riverbank water contains elevated constituents (e.g., nitrate, selenium, molybdenum, etc.). What is the desired TDS level sought for injection and what is the TDS discharge limit? How much TDS will be added via addition of amendments (ethanol/lactate) or via conditioned water?	Remedy pumping and injection will be operated so that the extent of elevated concentrations of COPCs at the completion of the remedy does not extend beyond the current extent of the chromium plume. Management of the COPCs will not necessarily require carbon addition to the IRL, and setting discharge limits for injection could impede the efficient operation of the remedy. Therefore, COPC-based criteria for carbon addition have not been developed at this time. TDS limits for IRL injection are not necessary. This is because the selected remedy relies on the ability to inject water in order to mix water throughout the treatment zone, therefore, setting discharge limits is inconsistent with the selected remedy. The influent TDS and constituents of TDS will be monitored and addressed if found to be affecting well performance. Lactate and ethanol will be converted to biomass and bicarbonate alkalinity, a constituent of TDS. Sodium, the counter ion to lactate, would also contribute to TDS. However, other processes, such as precipitation of carbonate minerals, will reduce TDS within the IRZs. TDS concentrations over time were measured during the floodplain pilot test, and concentrations declined over the course of the study.	See response to comments 38, 145, and 181. Please explain the highlighted statement.			Discussion between DTSC, DOI, RWQCB, and PG&E is ongoing to resolve this comment. This topic will be carried forward. Resolution of this comment will be included in the 90% design. PG&E will also work on items related to this comment as directed in the Agencies' direction letter dated April 4, 2014.	Not applicable
546	DTSC-154	Appendix L O&M Plan Volume 1 2.1.2.2 Inner Recirculation Loop Injection Wells, Page 2-5	Below-grade piping between the IRL-4 valve and well vaults will be installed in double-contained piping with leak detection instrumentation at low points.	Briefly include the rationale for double containment and leak detection in this pipe segment and not others (or is the sentence a little unclear). Please clarify.	The following text will be added: "Due to the steepness of the access road, secondary containment is included between the valve/ meter vault and the well vault. A sump pump and concrete containment vault is included near the well vault to capture and recover fluids emanating from a release. This approach also improves safety during operations and maintenance. For example during well maintenance, fluids can be pumped from the well directly into a temporary portable tank located near the meter vault located outside the ravine. This approach eliminates the need to haul a tank into the ravine."	Okay.			Comment resolved.	O&M Manual Volume 1 Section 2.1

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547	DOI-215	Section 2.1.3.1, Page 2-6	"The Transwestern Bench Extraction Wells will be operated at any given time . . . "	The combined nominal flow rate for the extraction wells should be 26 gpm, not 22 gpm.	The combined nominal flow rate for the Transwestern Bench Extraction Wells (TWB-1 and TWB-2) was correctly stated as 22 gpm.		Comment resolved.		Comment resolved.	Not applicable
548	DOI-216	Section 2.1.3.2, Page 2-6	"Similar to the Transwestern Bench Extraction Wells, an electric motor-operated submersible pump will be installed . . . "	If well ER-6 has potential for flooding, why has it not been decided at the 60% design stage to simply build an above ground vault? Are there other factors yet to be considered?	ER-6 was added to the 60% Design Submittal at a late stage as a result of stakeholder feedback, and the potential for flooding in the area had not been fully evaluated necessitating the inclusion of "may". The 90% Design Submittal will include the design of an elevated vault for the well.		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Volume 1 Section 2.1.3.2
549	DOI-217	Section 2.1.3.4, Page 2-6	"The TW Bench carbon amendment system P&ID is shown on Drawing I-08-01 in Appendix A."	Will a sample port be provided for sampling at the TransWestern Bench, East Ravine, and Supplemental Flow extraction wells before carbon mixing occurs?	Each individual extraction well includes a sample port prior to groundwater from that well exiting the vault. Text will be included in the 90% BOD to reflect this response.		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Volume 1 Section 2.1
550	DOI-218	2.1.3.4-Carbon Amendment System (TW Bench) pg. 2-7	Carbon Substrate Storage Instrumentation	Will instrumentation be installed to signal a high level alarm during tank filling operations?	Yes, a visual and audible alarm beacon near the ethanol offload stations will be included to notify the operators and tanker drivers of a high level in the ethanol storage tank as described on Page 2-7. In addition, both ethanol storage tanks include an internal fixed mechanical shut-off valve that prevents overfilling of the tank, also described on Page 2-7.		Comment resolved.		Comment resolved.	O&M Manual Volume 1 Sections 2.1.1.3 and 2.1.3.4.
551	DOI-219	Section 2.1.3.4, Carbon Substrate Storage Instrumentation Page 2-7		It is understood that there will be sample ports pre- and post-treatment, and that high level alarms will be installed. Please confirm.	Sample ports are located at each individual extraction well, within the carbon amendment buildings, and in the injection well vaults. High level alarms will be installed. See response to comment #550 DOI-218 for high level alarm discussion.		Comment resolved.		Comment resolved.	Not applicable
552	FMIT-164	Section 2.2.1.2		What is the expected height of the chain link fence for the primary freshwater supply well (HNWR-1). Have the visual impacts of the fencing been evaluated with tribal input? The Tribe prefers to minimize the presence of any necessary infrastructure.	The height of the chain link fence is anticipated to be 6 feet high (similar to the current fence for HNWR-1). A fence is necessary to protect the well and associated piping/ electrical and controls. As for evaluation of visual impacts, PG&E understands that per comment DTSC-237 (#750), DTSC will conduct additional CEQA review			Comment resolved pending review of the 90% design.	Comment resolved.	90% BOD Appendix D Drawing C-01-01, Note 4. Total height of fence is about 6 feet plus 1 foot of barbed wire.

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					based on information in the final design.					
553	DTSC-155	Appendix L O&M Plan Volume 1 2.2.1.2 Components, Page 2-9	To allow for these wells to supplement the HNWR-1 well, if needed, the existing 6-inch diameter pipeline from Topock-2 and -3 wells will be retrofitted for connection to the new 12-inch pipeline in Arizona.	It is recommended that the existing 6-inch line be connected to the new 12-inch line during construction of the new line. A valve can also be installed to open the 6-inch line if the Topock 2-3 water source is needed for compressor station operations.	Comment noted. PG&E will take the suggestion into consideration in the 90% design. Topock-2 and -3 wells will be connected to the new 12 inch pipeline in Arizona.	Comment resolved.			Comment resolved.	This RTC is no longer applicable as the freshwater storage for remedy and TCS is now separate. Topock-2 and -3 wells will not be connected to the 12-inch freshwater pipeline.
554	DOI-220	Section 2.2.1.3, Page 2-9		Please provide additional explanation of the operation of Topock-2/-3 based on line pressure. Are the Topock-2/-3 wells expected to be operational on an intermittent basis or only when flow rates drop below required levels at the HNWR-1 well?	The operation scheme for freshwater supply will be determined at the 90% design, after further information is learned on the primary well from implementation of FWIP. Barring this forthcoming information and the final design details, it is more likely that the Topock-2/3 wells would be operated when flow rates drop below required rates in the primary supply well.		Comment resolved pending review of 90% design.		Comment resolved.	This RTC is no longer applicable as the freshwater storage for remedy and TCS is now separate. Operation of Topock-2 and -3 wells will not be tied to operation of the remedy freshwater supply well (HNWR-1A).
555	DOI-221	Section 2.2.2, Page 2-9		The in-text citation for DTSC 2012 is not in the Reference list, and needs to be added.	The in-text citation will be added to the Reference list.		Comment resolved.		Comment resolved.	O&M Manual Volume 1 Section 8
556	DOI-222	Exhibit 2.2-2, Page 2-11		The notes indicate the wastewater could be blended with conditioned remedy produced water. This is not mentioned in Appendix M. There are four types of wastewater generated by pre-injection treatment; backwash, regeneration, rinse, and neutralization. Appendix M indicates only the neutralization waste stream has been considered as a candidate for the cooling towers and IRZ wells. Are all these streams candidates for blending, or just the neutralization stream?	No, not all cited waste streams are candidates for blending. Exhibit 2.2-2 will be revised to reflect an arsenic only treatment system.		Comment resolved.		Comment resolved.	O&M Manual Volume 1 Exhibit 2.2-2.
557	DTSC-156	Appendix L O&M Plan Volume 1 2.3 Remedy-produced Water Management, Page 2-13		It is requested that this introduction section include brief discussion of the estimated volume of waste water generated. Perhaps the volumes can be included in Exhibit 2.3-1.	The volumes from Table F-1 (Appendix F) will be shown on Exhibit 2.3-1.	Okay. Please note that the O&M Plan should be a standalone document to be used on site after design and construction are complete.			Comment resolved.	O&M Manual Volume 1 Section 2.3, 1st paragraph.

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558	DOI-223	Section 2.3.2.4, Page 2-15	"Alarm conditions include the following: . . . "	There is no mention of high level alarms on the frac tank.	This section refers to the control system for the piping system, not tanks. Alarm conditions associated with the frac tank is in Section 2.3.1.4 (page 2-14, 3rd paragraph).		Comment resolved.		Comment resolved.	Not applicable
559	DTSC-157	Appendix L O&M Plan Volume 1 2.3.2.4 Control System, Page 2-15	For direct buried pipe segments, potential leaks will be monitored by measuring backwash pump discharge pressure and flow rates.	This method of leak detection seems less desirable, especially for slower leaks. What other alternatives exist? Please also remind the reader how often direct burial is proposed.	The following text will be added: "In addition, annual pressure testing of these segments will be performed as routine operation. This will apply to over 60% of the 13,400 feet of piping sections with remedy produced water pipes."	Based on current proposal, it is possible that slow leaks would not be detected for up to one year? Perhaps the use of double wall piping and moisture sensors would be more effective.			Response noted and will be considered in the 90% design.	O&M Manual Volume 1 Section 2.3.2.4.
560	DTSC-158	Appendix L O&M Plan Volume 1 2.3.3.2 Components, Page 2-16	• Future coagulant feed tank and pump system • Future dewatering aid supply system	Please discuss (or reference the appropriate section) the reference to "future" unconditioned water storage components.	PG&E is evaluating the feed systems for coagulants and dewatering aids (e.g., metering pumps, piping, and small storage containers), and will provide additional information at the 90% design. These systems are anticipated to fit in the current footprint of the remedy-produced water conditioning plant and the influent water tank farm.	All systems anticipated must be specified and fully designed for construction if PG&E anticipate their use. Anything not fully designed cannot be supplemented into the remedy without a separate decision process. Comment resolved.			Comment resolved.	O&M Manual Volume 1 Section 2.3.3.2.
561	DOI-224	Section 2.3.3.2, Page 2-17	"The Conditioned Water Storage system includes the following major components: • Remedy A-side conditioned water tank farm • Conditioned water tank.. "	For clarity, indicate that the 2nd bullet – Conditioned water tank refers to the Remedy B-side conditioned water tank.	The suggested change in text will be made.		Comment resolved.		Comment resolved.	O&M Manual Volume 1 Section 2.3.3.2.
562	DOI-225	Section 2.3.4.3, Page 2-18	"The Remedy A-side conditioned water tanks supply conditioned water to the IRZ wells . . . "	The text indicates the Remedy A-side conditioned water will be pumped across the Station. Does this refer to the TCS? Also, why would it need to be pumped considering the amount of elevation head between the conditioned water tanks and the MW-20 bench frac tank? Discuss the management of Remedy B-side conditioned water.	Correct, "Station" refers to the TCS. The Remedy A-side conditioned water tank farm is located at a ground elevation of about 609 feet and must move the water up to the main part of the Station located at about 626 feet elevation. Management of the Remedy B-side conditioned water is described in the last paragraph of Section 2.3.4.3 (page 2-19). Primary use for the		Comment resolved.		Comment resolved.	Not applicable

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					conditioned water is cooling tower makeup, and secondary use is re-injection to IRZ wells.					
563	DOI-226	Section 2.4, Page 2-19	"The power system will be transmitted at 480 VAC to 12K VAC along the pipeline corridors . . . "	It is stated in the text that power cables can be buried in accordance with National Electrical Safety Code 30 to 36 inches below grade, or as deep as 48 inches. Indicate what is proposed for the remedy electrical power.	In general, the 60% design proposes a minimum depth of 18 inches for buried low voltage power (up to 480volts) and 36 inches for buried medium voltage power. If required to avoid conflict(s) with other utilities, power conduits may have to go deeper -- typical vertical separations from pipes could be 6-12 inches. The field effort to resolve conflicts where remedy utilities cross foreign utilities will help determine the precise depths of buried utilities, and this information will be incorporated into the 90% design. In some cases, options exist to bury power conduits at a shallower depth, e.g., through the use of concrete encasement.		Comment resolved pending review of 90% design.		Comment resolved.	90% BOD Section 3.5.1 O&M Manual Volume 1 Section 2.4
564	DTSC-159	Appendix L O&M Plan Volume 1 2.4 Power Supply and Distribution, Page 2-19	Secondary power supply will be power generated from small photovoltaic solar panels at various locations such as the Central Maintenance Facility at the Transwestern Bench and at select remote well locations.	Why not put solar panels on most/all new remedy buildings? Why only select structures?	The reference text does not preclude solar panels from being considered for other remedy structures. PG&E is evaluating solar panels for all remedy buildings, and will include in 90% design as appropriate. Text will be included in the 90% BOD to reflect this response.	Okay.			Comment resolved.	90% BOD Section 3.5.1 O&M Manual Volume 1 Section 2.4
565	FMIT-165	Section 2.4		The burial depths for voltage vary. What is the proposed depth? How much of this system is in areas classified as sensitive in the geoarchaeological report?	In general, the 60% design proposes a minimum depth of 18 inches for buried low voltage power (up to 480volts) and 36 inches for buried medium voltage power. If required to avoid conflict(s) with other utilities, power conduits may have to go deeper. See also response to comment #563 DOI-226. Text will be added to the 90% BOD. See attached map showing an overlay of the 60% design on the layer showing sediment ranks from the geoarch report (see **Attachment L**, at the end of this table). As discussed in the response to			Comment resolved pending review of the 90% design. The Tribe notes that the CIMP is not yet completed as of 12/17/13.	Comment resolved.	90% BOD Section 2.4.

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				How can potential impacts to buried cultural resources be avoided?	comment #434a FMIT-126, the potential ranking only represents relative probability and does not predict actual locations of buried archaeological materials or suggest preferred locations for aboveground vs. belowground infrastructure. Reference the geoarch potential map in the 90% BOD. Section 3.2 of the Draft Geoarchaelogical Assessment presents recommendations to avoid potential impacts to buried archaeological or historical sites during design/construction. These call for excavations in higher or moderate potential sediments to be avoided to the extent feasible, and if necessary, to be monitored by an archaeologist and a tribal representative. If archaeological or historical resources are discovered, they would be treated according to the requirements of the CIMP, PA, and CHPMP. In accordance with the monitoring protocol of the PA, the Tribes will be provided the opportunity to monitor excavations and all ground disturbing activities.					
566	DOI-227	Section 2.5, Page 2-19	"A SCADA system will be installed for controlling and monitoring the remedy."	Will selected operators be able to remotely check on system operation status from home computers? Will operators be able to make changes to operations remotely?	The control scheme is being developed and will be included in the 90% design. It is envisioned that authorized personnel will be able to check on the system status remotely and provide the necessary responses. Security considerations are factored in the design to maintain system security.		Comment resolved pending review of 90% design.		Comment resolved.	90% BOD Table ES-1 90% BOD Section 3.5.2 O&M Manual Volume 1 Section 2.5
567	DOI-228	Section 3, Page 3-1	"For the reader's convenience, select process and instrumentatio n diagrams have been included in Appendix A of this Volume."	P&IDs are provided for convenience, but rarely does the text reference specific P&IDs to facilitate understanding of the operation. This is rather inconvenient. Please provide the appropriate references to the drawings.	Comment noted. References to drawings will be added to the text.		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Volume 1 Sectiosn 3, 3.1, and 3.2.
568	DTSC-160	Appendix L O&M Plan Volume 1 3.1.1.1 NTH IRZ Extraction and	Initially, the NTH IRZ Injection and Extraction Wells will be operated to	The time for estimated cleanup (among other things) should be recalculated after actual flow rates for all remedy components are established and new hydraulic data	See response to comment #653 DOI-268.	Okay.			Comment resolved.	Not applicable

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		Recirculation, Page 3-1	target flow rates as specified in Table 2.1-1. However, actual flow rates may vary in the field.	become available. A schedule to conduct this update(s) should be included in the design document. A schedule to assess the accuracy of the groundwater flow and transport model over time should also be prepared.						
569	DOI-229	Section 3.1.3, Page 3-3		Because there is a single header feeding all of the north (or south) NTH IRZ injection wells, adjustments to the flow of any one well to add additional carbon reduces the flow at some or all of the other wells, as the extraction well flow rate is fixed. Although it is not proposed that there be individual lines from the carbon amendment system at the MW-20 Bench to all the injection wells, it seem that system adjustments, including carbon injection rates, to achieve optimum carbon dosing will be tricky at best.	PG&E does not anticipate the need to routinely implement the dosing of specific quantities of carbon substrate to wells on an individual basis. However, if certain wells within the north or south branches of the NTH IRZ require supplemental substrate injections, provisions have been included for dosing immediately at the well vaults. An SOP for this operation will be included in the 90% Design Submittal. Text will be included in the 90% BOD to reflect this response.		Comment resolved.		Comment resolved.	O&M Manual Volume 1 Section 3.1
570	DOI-230	Section 3.1.3, Page 3-3	"The target carbon load will be based on the extracted groundwater flow rate of each individual well and the target in-situ carbon concentration. As summarized in Section 2.1.1.4 and detailed in the Sampling and Monitoring Plan in Volume 2 of this O&M Manual, carbon substrate amendment concentrations, frequency, and duration will be adjusted based on analytical groundwater data and injection well performance data."	Will carbon concentration analyses be performed at the site or off-site at a laboratory?	All analyses associated with sampling events identified in the Sampling and Monitoring Plan (Appendix L, Volume 2) will be performed by an off-site analytical laboratory. However, additional supplemental sampling may be performed that will include on-site field analyses, including total organic carbon (TOC) analysis. PG&E is currently in the process of testing bench procedures for on-site TOC analysis with site groundwater. If these procedures are to be implemented, details will be added to Appendix L in the 90% Design Submittal, including analysis SOPs and references at appropriate locations in the document.		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Volume 2, Section 7.1

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571	DTSC-161	Appendix L O&M Plan Volume 1 3.1.3.2 NTH IRZ Carbon Substrate Amendment, Page 3-7	Three separate injection well location designs exist for the NTH IRZ injection system: a single-screen injection well design, a dual-screen well design, and a dual-screen injection well clusters design.	Due to the size of the design document, the location of the well design section should be cited here. Detailed drawings and associated text will need to be prepared for review.	A reference to Appendix D, Design Drawings, which describes the IRZ well designs, will be provided in this section.	The O&M Plan should be developed as a separate stand-alone document for the O&M phase of the remedy. References to BOD is not appropriate and should be appended to the O&M plan. Comment resolved.			Comment resolved.	O&M Manual Volume 1 Section 3.1
572	DTSC-162	Appendix L O&M Plan Volume 1 3.1.3.2 NTH IRZ Carbon Substrate Amendment, Page 3-7	The appropriate injection sequence will be selected based on chemistry results.	Please prepare a flow chart to assist the reader in understanding how the chemistry will influence operations.	This flow chart has already been prepared and is included as Figures 2.2-2, 2.2-4, and 2.2-6 in the O&M Manual Volume 2: Sampling and Monitoring Plan. The details on how chemistry results will be collected and used to determine operations is also described in Sections 2.2 and 4.2 of Volume 2. References to Volume 2 will be included in this section in the 90% design.	Okay.			Comment resolved.	Figures 2.2-2, 2.2-4, and 2.2-6 in the O&M Manual Volume 2.
573	DTSC-163	Appendix L O&M Plan Volume 1 3.1.3.4 Carbon Amendment Procedure (Transwestern Bench), Page 3-9	Continuous or intermittent injection or dosing of the selected carbon substrate, carbon substrate target TOC concentrations, and injection frequency and duration will be adjusted based on groundwater analytical data and injection well performance, as summarized in Section 2.1.3.5 and presented in Volume 2 of this O&M Manual.	It does not appear that a section 2.1.3.5 exists (probably should be 2.1.3.4). Please revise. Please include the section(s) to Volume 2 for quick reference.	The reviewer is correct. The reference will be updated in the 90% Design Submittal to refer to Section 2.2.3. A reference to Section 4 of Volume 2 will also be included in the 90% Design Submittal.	Okay.			Comment resolved.	O&M Manual Volume 1 Section 3.1

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574	DTSC-164	Appendix L O&M Plan Volume 1 3.1.5 Regularly Scheduled Equipment O&M, Page 3-11 to 3-13	Maintenance Requirements	Please include a schedule for conducting inspections in the maintenance requirement sections.	Inspection schedules will be included in the 90% Design Submittal.	Okay pending review of the 90% BOD.			Comment resolved.	O&M Manual Volume 1 Section 3.1
575	DTSC-165	Appendix L O&M Plan Volume 1 3.1.6 Standard Operating Procedures and Equipment O&M Manuals, Page 3-13		It is requested that all SOPs be released (in batches?) as soon as possible for review by interested parties. This is suggested to minimize the burden of reviewing numerous SOPs with the 90% design.	PG&E will take this under advisement, but cannot commit to releasing SOPs in batches prior to the final 90% Design Submittal.	Response noted. Significant time may be necessary for stakeholders, Tribes and agencies to review all SOPs.			Comment resolved.	Not applicable
576	DTSC-166	Appendix L O&M Plan Volume 1 3.1.6 Standard Operating Procedures and Equipment O&M Manuals, Page 3-13	Conveyance system maintenance	Modify the SOP to include "Conveyance system maintenance and inspection" so that any concerns with underground leakage are addressed.	The text will be modified as suggested for the 90% Design Submittal.	Okay.			Comment resolved.	O&M Manual Volume 1, Section 3.1.6 and PIPE-SOP-01
577	DTSC-167	Appendix L O&M Plan Volume 1 3.5 Power Supply and Distribution, Page 3-19		This section should address solar O&M on some level.	An SOP will be prepared to address solar O&M and included in the 90% design.	See comment to #575 DTSC-165. Comment resolved.			Comment resolved.	O&M Manual Volume 1 Section 3.4, Section 7.6
578	DTSC-168	Appendix L O&M Plan Volume 1 Well Maintenance and Decommissioning, Page 4-1	This section will include the general approach for decommissioning wells related to the Final Remedy at Topock and will be a guide to determining the appropriate methods for a given well.	This sentence must be modified to indicate that all PG&E Topock Compressor Station Wells utilized as part of site characterization activities will also be decommissioned according to applicable laws and the forth coming SOP. The section must contain a comprehensive list of all wells to date that will eventually need to be decommissioned. This list should also include those wells already decommissioned.	The referenced sentence will be revised as follows (<u>underline</u> typeface is added text): "This section will include the general approach for decommissioning wells related to the Final Remedy at Topock, <u>and wells utilized as part of site characterization activities,</u> and will be a guide to determining the appropriate methods for a given well. Section 4.3 (Well Decommissioning) states that the SOP for well decommissioning will be presented in Appendix C of the O&M Plan at the 90% stage. Section 4.3 will also include a reference to the master well inventory for the Topock	Okay pending review of the 90% BOD. Clearly specify in this section where the comprehensive list of all wells is kept. It can be repeated within the large 90% BOD.			Comment resolved.	O&M Manual Volume 1 Section 4, Section 4.3

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					project. This SOP includes a list of all wells that have been utilized as part of site characterization activities and those wells already decommissioned.					
579	DOI-231	Section 4.1.1.1, Page 4-2	"Water level logging with the level probes should begin 1 to 2 weeks prior to startup so that background water level trends can be evaluated."	It is recommended that the river stage should also be monitored during this time period.	The referenced sentence will be revised as follows (underline typeface is added text, ~~strikethrough~~ typeface is used for deleted text): "Water level logging (with level probes) in all wells associated with the given test as well as in the Colorado River ~~with the level probes~~ should begin 1 to 2 weeks prior to startup so that background water level trends can be evaluated."		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Volume 1 Section 4.1
580	DOI-232	Section 4.1.1.2, Page 4-2	"Following installation and development, a key freshwater or amended water injection well . . . "	It is stated in the text that extracted groundwater will be tested to confirm that is suitable prior to reinjection. What are the analytes to be tested and what are the criteria for suitability?	The referenced text will be revised to be consistent with the requirements of both California State Water Resources Control Board Water Quality Order No. 2003-0003-DWQ, and the State Board letter as follows: "Following installation and development, a key freshwater or amended water injection well will be tested to evaluate its maximum injection flow rate. This testing will involve extracting water from the well, storing the water in portable tanks, then injecting the water back into the well through a filter to remove particulate matter. Chemical additives will not be used during well testing activities, and therefore, the water will not be tested prior to re-injection."		Comment resolved.		Comment resolved.	90% BOD Section 3.3.3 O&M Manual Volume 1 Section 4.1
581	DTSC-169	Appendix L O&M Plan Volume 1 4.1.1.1 Well Capacity, Page 4-2	Water level logging with the level probes should begin 1 to 2 weeks prior to startup so that background water level trends can be evaluated.	This section should make reference to deconvolution methods that will be utilized to evaluate water level data at the site. The remedy design document will need a section dedicated to discussion of the deconvolution technique. Don't recall seeing discussion of it elsewhere.	It is not anticipated that deconvolution would normally be used to evaluate water levels or well performance. Water level evaluations will rely on averaging over a period of time to damp out river fluctuations, similar to what is done now to monitor water levels in response to IM-3 pumping. Specific capacity or injectivity can be measured without the need for deconvolution because the water level change in the pumping or injection well is large compared to the river influence. Deconvolution has only been used in the past to analyze results of short term aquifer tests, which are not planned in conjunction with routine well maintenance discussed in this	Consider the need for assessment of hydraulic influence at the margins of pumping/injection (e.g., where it may be desirable to show containment or hydraulic effect. While this does not seem the appropriate section, it does seem that it might be used for the project and must be included in the project tool box. Comment resolved pending review of 90% design.			Comment resolved.	See Section 3.1.1.5 (Well Testing) of the Construction/Remedial Action Work Plan.

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PG&E Topock Compressor Station, Needles, California

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					section. A reference to the deconvolution tool will be added to the O&M Manual, Volume 1, Section 4.					
582	DTSC-170	Appendix L O&M Plan Volume 1 4.1.1.2 Flow Logging and Aquifer Testing, Page 4-2	Flow logging can be a useful element of the baseline evaluation for wells that are constructed screen intervals greater than 75 feet in length.	Why 75 feet? Certainly flow logging can be done in wells with shorter screens. Please clarify and revise text.	75 feet is a somewhat arbitrary number based on the thickness of the alluvial aquifer at the site. While flow logging can be done on wells with shorter screens, the data are less useful. The sentence will be revised to read "Flow logging can be a useful element of baseline evaluation, particularly in longer screened wells. In shorter screened wells (less than about 75 feet of screen length) there is typically less need to understand the variations in flow along the screen and therefore flow logging is less useful."	Okay.			Comment resolved.	O&M Manual Volume 1 Section 4.1
583	DTSC-171	Appendix L O&M Plan Volume 1 4.1.1.2 Flow Logging and Aquifer Testing, Page 4-2	This testing will involve extracting water from the well, storing the water in portable tanks, testing the extracted water to confirm that it is suitable for injection back into the aquifer, then injecting the water back into the well through a filter to remove particulate matter.	Specify what testing of the extracted water will be conducted to confirm that it is suitable for injection back into the aquifer.	See RTC #580 DOI-232.	See RTC #580 DOI-232.			Comment resolved.	90% BOD Section 3.3.3 O&M Manual Volume 1 Section 4.1
584	DTSC-172	Appendix L O&M Plan Volume 1 4.1.1.2 Flow Logging and Aquifer Testing, Page 4-2	Once the system is online and operational, the well capacity baselines will be re-evaluated over a much longer period to confirm that steady state conditions are	Specify/clarify what the anticipated frequency for aquifer testing (well capacity/injectivity testing) will be over the duration of the project. This section should probably reference Exhibit 4.1-3.	The title of this section is not correct. Aquifer tests which typically involve pumping a single well at a controlled rate for a long period of time and monitoring water levels in a number of monitor wells are not planned. The title will be revised to read "Flow Logging and Well Performance Testing". Section 4.1.1.2 describes the baseline evaluation planned to evaluate if the newly installed wells are performing at their design flow rates during and shortly after the	Okay.			Comment resolved.	O&M Manual Volume 1 Section 4.1

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			met and the capacity is not fluctuating. It is expected that this will be done during the first month to few months of the system being commenced.		startup of the system. Frequency of well performance evaluation over the duration of the remedial action will be monthly, as shown in Exhibit 4.1-3.					
585	DTSC-173	Appendix L O&M Plan Volume 1 4.1.1.3 Video Survey, Page 4-2	Once testing is complete, and all equipment is removed from the well, a baseline video survey will be conducted on select wells to support diagnosis of future well problems.	List the wells that will definitely be surveyed by video. Also include a list of wells that might be surveyed and those that are not planned on being surveyed.	The second sentence of Section 4.1.1.3 will be revised as follows (<u>underline</u> typeface is added text, ~~strikethrough~~ typeface is used for deleted text): "Once testing is complete, and all equipment is removed from the well, a baseline video survey will be conducted on ~~select wells~~ <u>all remediation wells</u> to support diagnosis of future well problems.	Okay.			Comment resolved.	O&M Manual Volume 1 Section 4.1
586	DTSC-174	Appendix L O&M Plan Volume 1 4.1.1.4 Water Quality Sampling, Page 4-3	Exhibit 4.1-1 a Parameters will be collected during baseline monitoring, and may not be collected at later sampling dates.	It is requested that the analytes with footnote "a" be samples two or three times to establish an early, more, representative baseline. This section should clarify that the sampling pertains to maintenance issues and that conventional plume and remedy effectiveness monitoring are detailed in other volumes. Similar revision should be applied to section 4.1.2.3 Water Quality Monitoring on page 4-6.	Footnote "a" applies to analytes scheduled for baseline assessment of IRZ injection wells. All IRZ injection wells will be installed in areas of similar hydrogeologic condition, and the baseline analytical results for all IRZ wells will be evaluated together to determine if any of the data points appear to be anomalous or representative of a condition not observed at other IRZ locations. The text will be revised to state that two baseline samples will be collected to establish the baseline condition. A third baseline sample will be collected if it is necessary to confirm the baseline condition should a given data point appear anomalous. It is assumed that the two baseline samples will be collected approximately one month apart; however, the time between samples might be shortened if determined necessary to ensure that the collection of these samples doesn't delay startup of the system. Changes to the duration between samples will be discussed with the agencies prior to implementation. The following statement will be added to the beginning of Sections	The table needs revision. It is not clear that footnote "a" applies to IRZ injection wells. Sampling the IRZ injection wells two or three times is requested for establishing a representative baseline. Hydrogeochemical conditions should be understood prior to start up. PG&E must ensure this does not delay system start up. Please revise. Put this in a more appropriate water quality sampling section if necessary. Comment resolved.			Comment resolved.	O&M Manual Volume 1 Section 4.1

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					4.1.2.3: "Water quality monitoring in this section pertains specifically to the assessment and tracking of well performance. Water quality monitoring for the purposes of plume monitoring or remedy performance are detailed in other volumes."					
587	FMIT-166 Hualapai-120 Chemehuevi-120 Cocopah-120 CRIT-120	Append L-Vol 1 Section 4.1.1.4 p. 4-3	Exhibit 4.1-1	Please specify what sampling frequencies and statistics will be used to establish baseline conditions for the Biological and Geochemical Analytical Monitoring Parameters indicated in the notes to this table.	Sampling frequencies are detailed on Exhibit 4.1-3. A single sampling round is proposed for establishing baseline conditions. Biological and geochemical data will be collected to evaluate potential agents causing well fouling as water is being injected. In general, baseline data, collected before continuous extraction and re-injection begins, are not as useful for understanding well performance issues as trends in water quality (extracted and re-injected) over time. Trends in water quality can be correlated with changes in well performance. Therefore, no statistical analysis is planned for evaluation of well performance.			Comment resolved pending review of 90% design documents.	Comment resolved.	Not applicable
588	DOI-233	Exhibit 4.1-3, Page 4-5		Please explain why many of the monitoring parameters in this exhibit are not recommended for the IRZ injection wells.	Biological and Geochemical sampling, biological activity tests, and MFI: The changes in chemistry and bacteria in the IRZs will be dominated by the reducing conditions generated by the addition of ethanol and is well understood (i.e. biomass, reduced metals, sulfide, and alkalinity concentrations will increase). Measuring these changes will not provide insight into the causes of fouling, which are known to be due to biological growth and precipitation of iron sulfide and carbonate minerals and therefore these measurements are not specified. Sand Content: sand may cause well clogging. The source of sand would be extraction wells where the water for re-injection is sourced, not the from the injection wells themselves. Therefore, sand content measurements were specified for extraction wells rather than IRZ injection wells.		Comment resolved pending review of the 90% design.		Comment resolved.	Not applicable

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589	DOI-234	Exhibit 4.1-3, Page 4-5	Note a	Why would the SCADA system not be capable of calculating a daily average well capacity?	Failure of the downhole water level transducers is likely the most common reason that well performance data might not be available from the SCADA system. The provision for manual measurement is included in the event the SCADA system is inoperable, regardless of the reason for failure. Note that there is a typographic error in Note A. Quarterly will be changed to Monthly.		Resolved.		Comment resolved.	O&M Manual Volume 1 Section 4.1
590	DOI-235	Exhibit 4.1-3, Page 4-5	Note b	Suggest modifying the sampling schedule so that extraction wells are sampled semiannually between years 1 and 2 of operation, and then sampled annually after year 2.	Concur. The note b will be revised as follows (<u>underline</u> typeface is added text, ~~strikethrough~~ typeface is used for deleted text): "Extraction wells will be sampled monthly for the first quarter, quarterly for the next three quarters, <u>semiannually between years 1 and 2 of operation</u>, then annually after the <u>second</u> ~~first~~ year of operation."		Comment resolved.		Comment resolved.	O&M Manual Volume 1 Section 4.1
591	DTSC-175	Appendix L O&M Plan Volume 1 4.1.2 Long-Term Performance Tracking, Page 4-5	Exhibit 4.1-3 [b] Extraction wells will be sampled monthly for the first quarter, quarterly for the next three quarters, then annually after the first year of operation.	Footnote b. Depending on results, DTSC may request more frequent sampling, especially if effects of operations have not stabilized or are not anticipated. This applies to all monitoring, not just maintenance monitoring. Why are the Field Screening methods listed as annually? It would seem that they would lend themselves to more frequent monitoring. It would seem the IRZ column should be more populated. Why wouldn't you periodically evaluate field parameters (e.g., turbidity), sand content, or even geochemical sampling. Also note that footnote C is missing.	Footnote b comment is noted. The field screening data are listed for annual monitoring based on the frequency of groundwater sampling events. Additional field screening data can be collected as needed, but each sampling event is increased field presence and associated impacts. See response to comment #588 DOI-233 regarding the scheduled analysis of samples collected from IRZ injection wells. The reference to footnote c has been removed from the table. Please note that the frequency for "Field Screening Sampling and Testing" has been revised to be "Annually, or as needed".	Okay, however, as commented, DTSC may request more frequent sampling if effects of operations have not stabilized.			Comment resolved.	O&M Manual Volume 1 Section 4.1
592	DOI-236	Section 4.1.2.1, Page 4-5	"To evaluate the level-indicating transmitter (LIT) accuracy and as a backup in case of level transmitter failure, water levels should be measured	Will water level measurements in injection wells be made through the 1-inch sounding pipe identified in drawing I-02-03? Will a 1-inch sounding pipe be present in extraction wells?	See drawing M-02-02 for a better representation of the sounding tube in the freshwater injection wells. This tube will be installed in the gravel pack outside the well casing. It is intended to provide a measurement of the water level outside the well screen when the well is in operation. This water level will be compared with the water level inside the well to evaluate the degree of plugging in the screen and gravel pack. Sounding		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Volume 1 Section 4.1

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			manually as part of the performance evaluation and documented for reporting purposes."		tubes in extractions wells will be considered for the 90% Design Submittal.					
593	FMIT-167 Hualapai-121 Chemehuevi-121 Cocopah-121 CRIT-121	Append L-Vol 1 Section 4.1.2.1 p. 4-6	*The demotion/ promotion of the performance color code will result in consideration for routine maintenance frequency changes (see Exhibit 4.2-1 in Section 4.2.1, Routine Maintenance). For example, if the capacity of a given well drops below 85 percent, the well will be coded as yellow and potentially undergo more frequent maintenance or rehabilitation until the capacity is improved.*	Please provide additional detail on how well capacity will be determined. For example is capacity based on one time measurements or statistical averages? Also how will reduced efficiencies be determined? This is of importance as it will be used to drive the possible decision for increases in well rehabilitation frequencies or determine the need for well replacements, both activities which will lead to increased field presence and associated impacts.	Well performance will be tracked in the same way it has been tracked for the IM-3 injection wells. The specific capacity or injectivity will be estimated based on measurements of flow and water level when the well is first put into service. These measurements are made after the well has been pumping or injecting for a sufficient time to allow water levels to stabilize. The flow rate divided by the drawdown (or "drawup" in an injection well) provides a measure of the specific capacity or specific injectivity in the well. The specific capacity/injectivity values will be plotted on a graph. If the line on the graph shows the average specific capacity or injectivity has decreased to 85% of the original value, the well will be coded as yellow.			Comment resolved pending review of the 90% design.	Comment resolved.	Not applicable
594	DOI-237	Section 4.1.2.2, Page 4-6	"1. Visual Inspection. The aboveground discharge/ supply pipe, . . . "	The applicability of ARAR 47, (Exemption of Superfund remedial action activities; use requirements; definition), to visual inspections is unclear. ARAR 48, (well construction standards; remedial measures), specifies that "all well construction, replacement, deepening and abandonment operations shall comply with the rules adopted pursuant to this section". Please provide specific citation of the applicable rules regarding well inspections.	The comment is correct that ARAR #47 does not apply to well inspections. ARARs #48 and #98 pertain to well construction standards but not with inspections per se. The intent for including these two ARARs is to recognize the well standards and that the wells will be inspected to meet the requirements of these standards. If helpful, the cited text can be revised to remove the reference to ARARs as follows: "The aboveground discharge/supply pipe, valves, gauges, meters, well seals, well pads, vaults, and flanges should be inspected for visible leaks and damage ~~per the following~~		Comment resolved.		Comment resolved.	O&M Manual Volume 1 Section 4.1

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					~~applicable, relevant, and appropriate requirements (ARARs) for California (ARAR 98) and Arizona (ARAR 47 and 48) (DOI 2010).~~"					
595	DTSC-176	Appendix L O&M Plan Volume 1 4.1.2.2 Wellhead Inspection and Field Parameter Testing, Page 4-6		An SOP needs to be prepared and referenced in this section for visual inspections of well heads. DTSC has been working with PG&E recently on this item and expects similar procedures to persist throughout the remedy.	An SOP for inspection of wells associated with the groundwater remedy will be included in the 90% design. This SOP will be based on the one currently used for wells associated with the groundwater monitoring program, which DTSC has worked with PG&E to develop.	Okay. As stated earlier, the O&M plan should be a standalone document to be followed during the 30+ years of remedy operation. This SOP should be part of the O&M Plan.			Comment resolved.	O&M Manual Volume 1 Well-SOP-08
596	FMIT-168	Section 4.2.2		It appears a consequence of failure to maintain the wells can result in additional intrusion. The Tribe requests that regular maintenance occur to minimize the need for non-routine maintenance.	Comment noted. Regular maintenance schedules are outlined in Section 4.2.1.			Comment resolved pending review of 90% design documents.	Comment resolved.	Not applicable
597	DOI-238	Section 4.2.2.3.1, Page 4-12	"2. The video survey should be conducted using a color camera capable of side-scanning and photography plus video recording of the survey so that it can be viewed later."	Will depth be recorded with the video, allowing the viewer to determine the depth that corresponds with specific video segments?	Yes. The commercial well video cameras record the depth on each frame of video. The following sentence will be added: "The video survey will also be encoded with depth."		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Volume 1 Section 4.2
598	DTSC-177	Appendix L O&M Plan Volume 1 Flow Logging and Aquifer Testing, Page 4-12	Spinner logging and aquifer testing will be completed before and after rehabilitation to assess the success of the rehabilitation program.	Replace "Spinner" with "Borehole flow meter" of "Borehole flow" to acknowledge that other types of flow logging might be utilized.	The text will be revised as requested.	Okay.			Comment resolved.	O&M Manual Volume 1 Section 4.2
599	DTSC-178	Appendix L O&M Plan Volume 1 *Air Impact Gun*, Page 4-13	Air impact gun methods are available through the following licensed dealers:	Suggest the following edit to add flexibility overtime, "Air impact gun methods are <u>known to be currently</u> available through the following licensed dealers:" A similar edit is requested on Page 4-21 for wire charge device dealers.	The text will be revised as requested.	Okay.			Comment resolved.	O&M Manual Volume 1 Section 4.2
600	DOI-239	Section 4.2.2.3.3,	"4. Injection. . . . The volume of each batch	Will the isolated zones be isolated via a packer and/or dual packers?	Yes.		Comment resolved.		Comment resolved.	Not applicable

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		Page 4-14	injected into an isolated zone should be calculated . . . “							
601	DTSC-179	Appendix L O&M Plan Volume 1 Injection, Page 4-14	Chemicals may be added from the well head for wells with short screens.	If reagents are going to be poured down the well from the top of casing, clarify if it will be necessary to remove the concentrated reagent from the sides of the well (e.g., prior to collecting a representative sample from the rehabilitated well). DTSC recommends that a tremie pipe always be used.	Agreed. The text will be revised to say (inserted text shown in underline typeface, deleted text shown in ~~strikethrough~~ typeface): “Chemicals should be added through a tremie pipe from the well head in ~~for~~ wells with short screens”	Okay. Change may to will or should.			Comment resolved.	O&M Manual Volume 1 Section 4.2
602	DOI-240	Section 4.2.2.3.4, Page 4-15	“● Phosphoric acid has no particular advantage over other acids except for sulfate salt removal (Smith 2007) except the ability to dissolve iron and manganese compounds.”	This sentence appears incomplete. Please consider that the Smith article further recommends that the shock method of treatment be used to remove sulfate minerals instead of using phosphorus-containing chemicals, noting that residual phosphorus can act as a nutrient and actually boost regrowth. Phosphorus-containing material also promotes algal and cyanobacterial growth in surface waters.	The first sentence will be revised as follows (inserted text shown in underline typeface, deleted text shown in ~~strikethrough~~ typeface): “Phosphoric acid has no particular advantage over other acids in the ability to dissolve iron and manganese compounds except for sulfate salt removal (Smith 2007) ~~except the ability to dissolve iron and manganese compounds~~.” It is agreed that phosphoric acid appears to have several drawbacks, as noted in the discussion, but it may still be useful in some specific situations so it should be included as an option.		Comment resolved.		Comment resolved.	O&M Manual Volume 1 Section 4.2
603	DOI-241	Section 4.2.2.3.4, Page 4-15	General comment	This section is very generic. Please include a discussion of chemicals used for well rehabilitation at the Hinkley site, including information on what worked, what did not work, and any unforeseen complications. Also, please include text explaining that addition of hypochlorite can result in formation of trihalomethanes via reaction with soluble organics. Use of hypochlorite solutions should be avoided at Topock because of the high TOC content in the injection wells.	Lessons learned from the Hinkley operations have been incorporated into the O&M plan for Topock. The following details will be added to the text in the 90% design, “At Hinkley, hydrochloric acid was initially used for IRZ well cleaning and resulted in well screen corrosion. To date a phosphoric acid (NuWell 120 and a biodispersant (NuWell 310) have been used with success on IRZ, clean water injection and extraction wells. A variety of materials comprise the various well screens at the Hinkley site and include low carbon steel, copper bearing mild steel and stainless steel. No corrosion has been detected during post chemical cleaning video logging.” Text will also be included in the 90% BOD regarding the use of chlorine based products and the formation of trihalomethanes.		Comment resolved pending review of the 90% design.		Comment resolved.	O&M Manual Volume 1 Section 4.2

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604	DOI-242	Section 4.2.2.3.6, Page 4-21	"While the original capacity may never be restored, reasonable rehabilitation results are roughly 75 percent of the baseline value."	What is the source of the 75 percent value, experience or scientific literature?	The 75% is a rough estimate based on experience with well rehabilitation at multiple sites. The sentence will be revised as follows: "While the original capacity may never be restored, <u>experience with multiple wells at other sites suggests that successful</u> ~~reasonable~~ rehabilitation ~~results are~~ <u>can often restore</u> roughly 75 percent of the baseline value."		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Volume 1 Section 4.2
605	DTSC-180	Appendix L O&M Plan Volume 1 4.2.2.5 Well Replacement, Page 4-22	If it is determined after further evaluation and discussions with agencies that a replacement well is warranted and that the most suitable location to achieve the well objective is within 200 feet of the original well location, well replacement will proceed under the scope of this O&M Plan.	The 200 foot criteria appears arbitrary and should be deleted. Suggest replacing "200 feet" with "the area" in the cited sentence. This is requested since the well in question is being removed since rehabilitation will not allow it to function properly any further. If moving the replacement well 245 feet, for example, makes the best technical sense, then DTSC requests that the well and the associated disturbance be situated so that it will provide valuable data for the longest amount of time. Of course, this is assuming the new area poses the same level of disturbance and concerned tribes have the opportunity for input.	Agree. Text changes will be made as suggested. PG&E notes that if the new well is in the same geologic conditions as the well it replaced, there would be no net change in the number of wells (see FEIR, Page 3-26).	Okay.			Comment resolved.	O&M Manual Volume 1 Section 4.2
606	FMIT-169	Section 4.2.2.5.		The Tribe appreciates the comment that well replacement is the least desirable option to achieve the given objective of the well. New wells cause impacts to this cultural area. Exhibit 4.2.7 indicates that over 50 years, each well can expect to be replaced. This means twice as many wells intruding into the landscape. Did the groundwater FEIR analyze that impact? If so, please cite to the pages. If not, please identify what process will be applied to evaluate the impacts of ongoing replacement.	The impacts of well replacement have been evaluated in the FEIR - Note 2 in Table 1-1 (page 1-4) states "Replacement wells were estimated to be 10% of the wells per year". This means up to 11 replacement wells per year (10% of 110 new remediation wells [excludes replacement wells]) were factored in the CEQA analysis over a 30-year life of the remedy, a total of 330 replacement wells. The assumptions in the O&M Plan (Exhibit 4.2-7) are environmentally more conservative than the FEIR when it comes to well replacement (up to 110 replacement wells), so the level of replacement set forth in the O&M plan is within what was			Comment resolved.	Comment resolved.	Not applicable

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					evaluated in the FEIR. See also FEIR pages 4.1-42 and 4.4-59.					
607	DOI-243	Exhibit 4.2-6, Page 4-23		Provide a footnote detailing the absence of well reconstruction for extraction wells and monitoring wells. Such an explanation of this issue would be appropriate in Exhibit 4.2-8 as well.	Footnotes will be added to Exhibit 4.2-6 and 4.2-8 to indicate that extraction wells are not considered to be good candidates for reconstruction due to their smaller borehole diameter and that monitor wells are generally not anticipated to need replacement or reconstruction (unless damaged).		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Volume 1 Section 4.2
608	DTSC-181	Appendix L O&M Plan Volume 1 4.2.3 Well Maintenance Frequency, Page 4-23/4	Exhibits 4.2-6 vs 4.2-8	Clarify in the reconstruction section why extraction wells (and monitoring wells) are not called out for reconstruction, yet injection wells are identified.	See response to comment #607 DOI-243.	Okay			Comment resolved.	O&M Manual Volume 1 Section 4.2
609	DOI-244	Section 4.2.4, Page 4-25	"The well performance tracking data will be evaluated and reported internally on a quarterly basis."	Clarify if "reported internally" refers to PG&E only. If so, justify why the data would not be disseminated to the agencies/stakeholders in operational reports.	The sentence will be revised to remove the word "internally" The well performance data will be included in the quarterly performance reports.		Comment resolved.		Comment resolved.	O&M Manual Volume 1 Section 4.2
610	DTSC-182	Appendix L O&M Plan Volume 1 4.2.4 Reporting, Page 4-25	The well performance tracking data will be evaluated and reported internally on a quarterly basis. The frequency of data evaluation and reporting may change as well performance trends evolve during system operation. A suggested Well Performance Report outline, which includes the reporting of maintenance activities, is shown in Exhibit 4.2-9.	Clarify that an initial quarterly reporting frequency for the Well Performance Report will be utilized.	See response to comment #609 DOI-244.	Okay			Comment resolved.	O&M Manual Volume 1 Section 4.2

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PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
611	DOI-245	Section 5.1, Page 5-1	"During operation of the CIP loop, all of the groundwater extraction pumps will be de-energized . . . "	Obviously an acid is being used to dissolve scale if pH stabilization is the criterion for maintenance completion. Because it is dependent on the strength of the acid and amount of scale, pH stabilization may or may not be an indicator that all scale has been dissolved. Therefore, pH stabilization would likely not be a good criterion for removal of biological growth. Please provide additional discussion to clarify the maintenance process.	Depending on the nature of any biological films or mineral scale that may develop in the pipelines, as well as the final reagent solution selection, there may be multiple potential criteria for assessing pipeline flushing completion. Additional discussion, including an SOP for this process, will be included in the 90% Design Submittal.		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Volume 1 Section 5.1
612	DTSC-183	Appendix L O&M Plan Volume 1 5.1 Clean-In-Place (CIP) System, Page 5-1	The CIP solution will then be mixed in the reagent day tanks and pumped through the pipelines and into the receiving tank.	The section should be expanded to discuss what a "CIP solution" might contain similar to the section on well maintenance chemicals. Section 3.2.4 briefly discusses this, yet one would expect this section to contain more detail.	An exhibit listing potential CIP chemicals will be included in the 90% Design Submittal. An SOP for this process will be included in the 90% Design Submittal. See also response to comment #119 DTSC-34.	Okay.			Comment resolved.	O&M Manual Volume 1 Exhibit 5.1-1.
613	DTSC-184	Appendix L O&M Plan Volume 1 5.2 Maintenance and Repair of Plastic Pipe (HDPE), Page 5-2		As Section 2.3.2 (Conveyance of Unconditioned Remedy-produced Water) identifies conveyance pipeline pigging stations and cleanouts, these pipeline maintenance components should be described in detail in this section.	These elements will be included in the 90% design and added to the O&M Plan.	Okay.			Comment resolved.	O&M Manual Volume 1 Section 5.4
614	FMIT-170 Hualapai-122 Chemehuevi-122 Cocopah-122 CRIT-122	Append L-Volume 1 Sect. 6.1.1 p. 6-1	Expected Waste Streams	Please indicate where backwash and well rehabilitation waste water will be stored during the characterization step prior to the final disposal of this water.	It may be necessary at times during the remedy to hold wastewater for characterization prior to final disposal. Temporary portable tanks will be used to hold the water for this purpose. As discussed in response to comment #96a FMIT-25, portable tanks are not anticipated to be "installed" at wellheads for semi-permanent use. Clarification will be included in the 90% design documents.			Comment resolved.	Comment resolved.	O&M Manual Volume 1 Section 6.1
615	DOI-246	Section 6.1.3.1, Pages 6-3 and 6-4	General comment	This section needs to clearly state that the remedy-produced water conditioning plant is not designed for the treatment of RCRA and non-RCRA hazardous waste due to the presence of chromium and arsenic, and/or as a result of low pH (<2).	The following text will be added to the end of the 1st paragraph: "<u>The conditioning plant is not designed for treatment of RCRA and non-RCRA hazardous waste.</u>"		Comment resolved.		Comment resolved.	O&M Manual Volume 1 Section 6.1

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616	DOI-247	Exhibit 6.1-2, Page 6-4		For completeness, include Remedy A-side or Remedy B-side conditioning (or no conditioning) under the Management Plan column.	Text will be added as suggested.		Comment resolved.		Comment resolved.	90% BOD Exhibit 3.4-3 O&M Manual Volume 1 Section 6.1 Exhibit 6.1-2.
617	DOI-248	Exhibit 6.1-2, Page 6-4	Exhibit 6.1-2 and Figure 6.1-1	It seems that the chemicals used in the CIP may be similar to the chemicals used in well rehabilitation. Explain why CIP wastewater is not handled similarly to first flush well rehabilitation water.	The following text will be added at the beginning of footnote a: "Prior to transferring the spent solution to the remedy-produced water conditioning plant, the solution will be allowed to settle and precipitate solids prior to pumping to the conditioning plant."		Comment resolved.		Comment resolved.	90% BOD Exhibit 3.4-3 O&M Manual Volume 1 Section 6.1 Exhibit 6.1-2.
618	DOI-249	Exhibit 6.1-2, Page 6-4	Exhibit 6.1-2 and Figure 6.1-2	The third waste management option for first flush well rehabilitation water needs clarifying information to address the following points: • Why does the water need to be filtered before sending it to the conditioning plant, since the main purpose of the conditioning plant is the removal of solids? Based on Figure 6.1-2, it appears the concern focuses on whether the wastewater is a hazardous waste due to the presence of chromium and arsenic. Are pre- and post-filtration testing for chromium and arsenic to be performed at the TWB lab? • Because first flush rehabilitation water may be high in soluble chromium and arsenic even after filtration, and could also contain residual oxidants, it does not seem prudent to process this water through the conditioning plant and reinject it at the IRZ. Perhaps this method should not be an option.	If pumped through the pipelines could cause obstructions to form or accumulate solids at low points. It is better to remove the solids near the point of generation. If testing is needed, it would be performed at the onsite lab located in the Central Maintenance Facility. (see also response to comment #210 DOI-89). This method is appropriate because some arsenic will be removed through filtration/ neutralization and any remaining dissolved arsenic will be similar in concentration to the reduced environment within the IRZ. Any soluble Cr(VI) that remains will be immobilized by the IRZ.		Comment resolved.		Comment resolved.	Not applicable
619	DOI-250	Section 6.1.3.1, Page 6-4	Figure 6.1-2	Suggest including the following revisions for clarification: • Top Row – After "To Off-Site Disposal or Treatment Facility" add the phrase "as a RCRA or non-RCRA hazardous waste" • Rows 2 and 3 – Add As < 5mg/L to the boxes showing Cr < 5 mg/L • Indicate the effluent from the conditioning plant goes to the IRZ injection wells (if this concept is still viable)	See updated Figure 6.1-2 (**Attachment M**, at the end of this table).		Comment resolved.		Comment resolved.	O&M Manual Volume 1 Section 6.1 Figure 6.1-2.

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				• Last Row – After "To Off-Site Treatment Facility add the phrase "as a non-hazardous waste" • TU note – Add a discussion of filtering (which may require additional revisions to the figure)						
620	DTSC-185	Appendix L O&M Plan Volume 1 6.1.5 Disposal Facilities, Page 6-5	Wastes designated as RCRA or Non-RCRA hazardous wastes will be transported to and disposed of in a Class I hazardous waste land disposal facility that is approved by the appropriate state environmental official in the receiving facility's state as well as the DOI Project Manager.	Please list the actual disposal facilities that may be used so that DTSC can ensure they are properly permitted or are appropriate for the specified waste stream.	Potential disposal facilities will be identified and included in the 90% design.	Okay pending verification of permit status.			Comment resolved.	O&M Manual Volume 1 Section 6.1.5.
621	DTSC-186	Appendix L O&M Plan Volume 1 6.2 Recoverable Materials, Page 6-6	Exhibit 6.2-1 Concrete – Processed Deliver to onsite crushing plant for processing and staging for future us as road base	Provide details regarding an onsite concrete crushing plant. Where is it to be located? Does one already exist? What is the anticipated operational duration during final remedy construction and implementation?	This option is listed as typical recycling option in the industry for onsite processing of concrete. There is no existing crushing plant onsite. Until the remedy features and locations are settled, it is not possible to evaluate the viability of this option at Topock. If determined viable, PG&E will provide additional information at 90%.	As a design document, if PG&E has not concluded on the viability of this option, the statement should not be included. PG&E should flag this as addition to infrastructure from EIR remedy concept if determined to be viable at 90% design.			Comment resolved.	O&M Manual Volume 1 Section 6.2. The option of onsite concrete crushing was removed after further evaluation.
622	DOI-251	Section 7.1, Page 7-1	"In compliance with the EIR mitigation measures HYDRO-1, HYDRO-2, and HYDRO-3 (DTSC 2011), . . . "	It is important to reference ARAR 34 (Federal Water Pollution Control Act) with respect to the SWPPP, BMP Plans, and monitoring plans (the actions taken to comply with this ARAR).	The following text will be added to Section 7.1 (page 7-1): "In compliance with the EIR mitigation measures HYDRO-1, HYDRO-2, and HYDRO-3 (DTSC 2011) and Federal Action-Specific ARAR #34 (DOI 2010), …" The following text will be added to Appendix E, Section 1.0 (page E-1): "In addition, mitigation measures (HYDRO-1, HYDRO-2, and HYDRO-3) set forth in the certified EIR (DTSC		Comment resolved.		Comments resolved.	O&M Manual Volume 1 Section 7.1

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					2011) and Federal Action-Specific ARAR #34 included in DOI's ROD (DOI 2010) requires…"					
623	DTSC-187	Appendix L O&M Plan Volume 1 7.1 Storm Water Pollution Prevention, Page 7-1	Please note that the remedy design has and will continue to incorporate engineering elements to reduce or prevent pollutants from being released in storm water discharges (e.g., install overhead protection for areas where hazardous materials are stored/ handled, collect and route all stormwater discharges to the TCS evaporation ponds).	As the TCS evaporation ponds are being utilized as part of the remedy, Regional Water Quality Control permits/WDRs/monitoring program, etc., and any other related permit/requirements associated with the ponds should be included in the design document.	Comment noted. The regulatory framework for the disposal of remedy-produced water in the TCS evaporation ponds will be included in the 90% design. PG&E has and will continue to coordinate with the RWQCB on the permitting/requirements associated with the use of the TCS evaporation ponds as part of the remedy. The substantive requirements for use of the ponds will be summarized in the 90% design documents. Any permitting requirements will also be included.	DTSC is unclear of the meaning "regulatory framework." This could imply a simple statement of the oversight agency and the regulatory sections that covers the discharge. DTSC is more interested in the specific discharge limits and the compliance constraints. Comment resolved.			Comment resolved.	PG&E is coordinating with the RWQCB regarding substantive requirements applicable to the use of the evaporation ponds at PG&E Topock Compressor Station for disposal of certain remedy-produced water streams
624	DTSC-188	Appendix L O&M Plan Volume 1 7.2 Hazardous Material Management, Page 7-2		Clarify where hazardous waste will be stored, especially since the current Hazardous Waste Storage Building is planned to be removed for placement on Influent Water Storage Tanks? A replacement Hazardous Waste Storage Building for existing compressor station waste is no longer in the 60% as it was in the 30%. A figure illustrating where hazardous waste will be stored on and offsite should be included in this section.	See response to comment #35 DOI-12.	Okay pending review of the HW storage location on site.			Comment resolved.	O&M Manual Volume 1 Section 7.2. O&M Volume 4 Section 2.4.
625	DOI-252	Exhibit 7.4-1, Page 7-4		One of the Effective BMPs included in the exhibit describes the stabilization of disturbed areas with approved soil stabilizing agents. Please provide the list of "approved agents" for consideration in the remedy design package.	Comment noted. This information will be included in the 90% design and Construction/ Remedial Action Work Plan.		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Volume 1 Exhibit 7.4-1 Footnote 2.

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626	DOI-253	Section 8, Page 8-1		Although present in the Reference list, the CH2M HILL 2012 citation is not found in the text. Should the item be removed from the Reference list?	This item will be removed from the Reference list.		Comment resolved.		Comment resolved.	O&M Manual Volume 1 Section 8
627	DOI-254	Appendix F, Page F-1	"The handling and management of hazardous materials within the remedy facilities . . . "	Please indicate when the Compressor Station HMBP and the separate HMBP for management of hazardous materials outside of the TCS will be provided.	As reported in the Action column of Table L1.1-2 (Summary of Compliance with ARARs) for ARARs #90 and 91, an outline of the HMBP is included in the 60% design submittal. Drafts of the complete documents will be provided in the 90% design.		Comment resolved.		Comment resolved.	See Appendix E of O&M Manual Volume 1 for existing HMBPs.
628	DOI-255	Appendix F, Pages F-1 and F-2		The section does not include reference to recordkeeping. Will recordkeeping be required?	The following text will be added to Appendix F: "**5.0 Record Keeping** The following San Bernardino County CUPA HMBP guidelines for record keeping will be adopted for the project: • A copy of the HMBP Plans will be kept on site. • The Cover Sheet, Business Activities Form, Business Owner/Operator Identification Form, and any other information that has changed is required to be updated by March 1 of every year. • The entire Business Plan will be reviewed and re-certified every 3 years. • The Plan will be revised within 30 days of change of: owner, business address, business name, emergency contact information, inventory, or other site conditions which may significantly impact emergency response (such as additional hazardous materials, increased quantities exceeding 50% of previously reported maximum quantity, and/or increased container sizes). PG&E will provide the revised Plan to the Agencies. In addition, in compliance with		Comment resolved.		Comment resolved.	Appendix F.

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					Section XXV of the CD (DOI 2013), PG&E will maintain records for 10 years following receipt of certification of completion. At the conclusion of the record retention period, PG&E will notify DOI and DTSC in writing at least 90 days prior to the destruction of any records and will provide DOI and DTSC with the opportunity to take possession of any records."					
Specific Comments – Appendix L – Volume 2: Sampling and Monitoring Plan										
629	DOI-256	Section 1.0, Page 1-1	" . . . selected the final groundwater remedy to address chromium in groundwater at Solid Waste Management Unit (SWMU) 1/Area of Concern (AOC) 1 . . . "	For clarity, change "chromium in groundwater at" to "chromium in groundwater resulting from discharges to".	The text will be revised as follows (inserted text shown in underline typeface and deleted text shown in ~~strikethrough~~ typeface): "to address chromium in groundwater resulting from discharges to ~~at~~ Solid Waste Management Unit (SWMU) 1/Area of Concern (AOC) 1 and within AOC 10 (DOI 2010 and DTSC 2011)".		Comment resolved.		Comment resolved.	O&M Manual Volume 2 Section 1
630	DTSC-189	Appendix L O&M Plan Volume 2 1.0 Introduction, Page 1-1	The monitoring program will have several components: compliance monitoring, process control monitoring, and constituents of potential concern (COPCs) monitoring.	It's important that the introduction provide a straight forward reason(s) for conducting monitoring. Therefore it is suggested that the cited sentence be followed with the following sentence or similar language: "These different programs will monitor the effectiveness of the remedy and track the groundwater contaminant plume over time. Monitoring will also be used to make sure that the neighboring ground and river water are not adversely affected by the remedy."	The following will be added after the cited sentence: "These different monitoring program components will be used to evaluate remedy effectiveness and implementation, and to monitor contaminants in groundwater over time. Monitoring will also be used to ensure that the groundwater contaminant plume does not permanently expand or adversely impact potential receptors."	The highlighted statement is a short and long term remediation goal that DTSC considers to be important prior to compliance with the RAOs for the remedy. Comment resolved.			Comment resolved.	O&M Manual Volume 2 Section 1
631	DOI-257	Section 1.1, Page 1-1	"The RAOs for the groundwater remedy are: . . . "	Recommend adding the following RAO: "Monitor on-going operations in order to improve and enhance treatment programs, expediting remediation in an environmentally, cultural, and cost-effective manner."			DOI withdraws this comment		Comment resolved.	Not applicable
632	DTSC-190	Appendix L O&M Plan Volume 2 1.2.2 Adaptive Operations Approach, Page 1-2	In the field, variations in Cr(VI) concentration distributions, lithology and hydrogeology	The adaptive approach clearly and understandably includes design uncertainty including well locations. For this reason, DTSC requests that the potential need for additional provisional wells be acknowledged in the design document beyond what is	See also response to comment #225 DTSC-98. The potential need for additional provisional wells (beyond those that have currently been identified) will be acknowledged in the design document. The borehole count will be updated in the 90%	DTSC agrees that maintaining the total well count as originally conceived is desirable. However, to realistically account for the unknowns and uncertainties, DTSC believes a larger set of			Comment resolved.	O&M Manual Volume 2 Section 1.2.2

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			will be encountered. To deal with the uncertainty in these parameters in implementation, the remedial system was designed to be flexible and the remedy will be implemented with an adaptive operational strategy. During system installation and baseline sampling, additional data will be collected that will refine the current conceptual model. Where appropriate, the data may be used to refine the design, for example of remedial well screens and perhaps locations. The data will also be used to update the solute transport model and refine remedy projections. During remedy implementation, monitoring data will be collected and used to guide the operations of the system, including changes in operational	currently identified. Perhaps a percentage of the total number of new wells can be used for this additional provisional well count for the anticipated 30 to 40 years of remedy operation and monitoring. DTSC fully understands the need to minimize the number of wells on this site to address tribal concerns, but the ability to properly develop and monitor the remedy when dealing with unknowns/ uncertainties must also be realistically addressed.	design.	contingency wells need to be specified to minimize future delays associated with additional environmental assessments. It would be preferable to include this concept in the 90% design. These wells may not be needed at all, but can be used to account also for difficulties that may be encountered while installing multiple screens per borehole. Comment resolved pending review of the 90% design.				

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			flow rates, injection parameters, and potentially well locations. This monitoring program provides a plan for data collection, interpretation, and guidance for adapting operations as the remedy is implemented.							
633	FMIT-171 Hualapai-123 Chemehuevi-123 Cocopah-123 CRIT-123	Append L2- V2 1.2.2 p.1-2		The adaptive management concept is useful as it allows data to continually benefit and refine the operation of the system as the data is collected. Is there also a concept of modifying the monitoring program based on knowledge gained as the remedy is operated? If so, what would be the means of communicating possible changes in the monitoring program?	Yes, it is anticipated that the monitoring program may need to be refined as information is gained during remedy construction, start-up, and routine operation. As indicated in Section 2, including footnotes to Tables 2.1-2 and 2.1-3, the sampling program will be re-evaluated after two years of operation. However, modifications to the sampling program may be recommended sooner based on the results of monitoring within the first two years. Changes to the monitoring program will either be included within the quarterly monitoring report as recommendations for future monitoring ("Section 6: Recommendations" section; see Exhibit L2.2-4 in Appendix L), or included within a separate proposal submitted to the agencies. This section will be updated with a reference to Section 6.5 (Reporting). Section 6.5 will be expanded in the 90% Design Submittal to discuss how proposed changes to the monitoring plan and proposed operational adjustments will be communicated.			Comment resolved pending review of 90% design.	Comment resolved.	O&M Manual Volume 2 Section 2
634	DOI-258	Section 2.0, Page 2-1	"For the remedy, the decision rules are effectively an adaptive operations framework that outlines . . ."	The text in Section 2.0 does not indicate the frequency of data interpretation and determining the need for operational adjustments. Please add a statement addressing this in the second paragraph.	The following text will be added to Section 2.0: "Data from the monitoring programs will be received on a schedule indicated by the monitoring frequency outlined in Table 2.1-2. These data will be interpreted as they are received to inform any potential modifications to system operations."		Comment resolved.		Comment resolved.	O&M Manual Volume 2 Section 2

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					As detailed in Section 6.5 and Section L3.3 and Exhibit L2.2-4 of the Main Body of Appendix L, quarterly reports will be submitted with sampling results, interpretation of the results and an interpretation of progress toward RAOs.					
635	DTSC-191	Appendix L O&M Plan Volume 2 2.0 Monitoring Goals and Data Quality Objectives, Page 2-1	• Problem statements and decision statements (Section 2) • Inputs to the decisions and study area boundaries (Sections 3 and 4) • Decision rules (Section 2) • Limits of decision errors and optimization of design for data collection (Sections 3 and 4)	It is not clear what sections (in parentheses) are being referenced in the cited text. This is an issue in other sections of this volume. Please clarify/revise throughout the entire volume if appropriate. For example, Section 3.0 discusses Remedy Compliance Monitoring and does not mention decision error or study area boundaries.	In the 90% design, the text throughout the volume will be revised to use the DQO language (problem statement, study area, etc.) to clarify how each of these are defined in the referenced sections.	Okay.			Comment resolved.	O&M Manual Volume 2 Sections 2.1, 3.1, and 4.2
636	DTSC-192	Appendix L O&M Plan Volume 2, Compliance DQO-1 (RAO 2) Page 2-1	RAO 2 will be satisfied during remedy operation by the in-situ treatment of Cr(VI) in groundwater; the treatment will minimize and prevent Cr(VI) and Cr(T) from reaching the Colorado River.	This section should acknowledge that in-situ will not be able to clean up the downgradient chromium contamination in the floodplain during startup of the remedy and that enhanced floodplain and river monitoring should be conducted during startup until river bank extractors are turned on and running and properly affecting hydraulics in the area.	The following text will be added to this section: "During initial start-up of the NTH IRZ prior to operation of the River Bank Extraction Wells, Cr(VI) in the floodplain downgradient of the NTH IRZ will not be treated. Modeling results indicate that operations of the NTH IRZ during this period are protective of the Colorado River—i.e., the Cr(VI) plume does not migrate a significant distance in the floodplain during start-up, and the portion of the plume located downgradient of the NTH IRZ does not migrate past the capture zone of the River Bank Extraction Wells. To verify these predictions, quarterly sampling of the NTH IRZ downgradient monitoring well network and the river sampling locations will be conducted, as indicated on Table 2.1-2."	Comment resolved.			Comment resolved.	O&M Manual Volume 2 Section 2.1
637	DTSC-193	Appendix L O&M Plan Volume 2, Compliance	Although RAO 2 is specifically intended to address Cr(VI),	First, it should be clarified in the text that since river chromium concentrations are generally not detected, remedial system operations	The underlined text will be added to the first sentence of the second paragraph under this DQO: "If Cr(VI), arsenic, or manganese	Okay.			Comment resolved.	O&M Manual Volume 2 Section 2.1

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		DQO-1 (RAO 2), Page 2-1	the IRZ by-products arsenic and manganese will also be monitored. The surface water quality criteria for Cr(VI) is 11 µg/L and 150 µg/L for arsenic (Source: Table 2 of the Record of Decision [ROD], ARAR #3, Federal Water Pollution Control Act. 33 USC 1251-1387, 40 CFR 131.38).	would be modified should any chromium (or byproduct or COPC) start to be detected in the river that was attributable to remedy operations. It appears the DQO in Table 2.1-1 captures this issue for chromium, arsenic and manganese. Recommend adding the chromium plume co-constituents nitrate, selenium, and molybdenum to this DQO as, like arsenic and manganese, will be monitored as part of river protection.	concentrations increase in surface water samples, or are detected at locations that were previously non-detect, and are attributable to the Topock site, operational changes will be implemented per the process control decision rules outlined in Section 3." Surface water sampling for COPCs is specified in Section 5.1 of the Sampling and Monitoring Plan (Volume 2 of the O&M Manual).					
638	FMIT-172 Hualapai-124 Chemehuevi-124 Cocopah-124 CRIT-124	Append L2- V2 2.1 p. 2-1, last para	*If Cr(VI), arsenic or manganese concentrations increase in surface water samples and are attributable to the Topock site…*	Pilot test data indicate that the potential for increases in byproducts is greater with the concentration of the carbon amendment applied. If successful treatment of Cr(VI) in the IRZ requires significantly higher amendment concentrations than originally anticipated, would there be an increase in the frequency of monitoring for possible byproducts?	The monitoring frequencies proposed in the Sampling and Monitoring Plan are not dependent on the concentrations of carbon used. Rather, they were designed to adequately monitor the response to carbon amendments regardless of what the response may be based on time for changes to occur due to reaction and transport. Although byproduct concentrations may increase with higher amendment concentrations, byproduct generation rates and transport times will still be adequately assessed with the proposed monitoring schedule.			Comment resolved pending review of 90% design documents.	Comment resolved.	Not applicable
639	DOI-259	Section 2.1, Page 2-2	Tables 2.1-2 and 2.1-3	Recommend adding a column providing the model layers that are monitored for each well. This would be useful in evaluating the vertical as well as the horizontal monitoring coverage provided by the wells.	Columns indicating screen intervals and model layers intersected by screened intervals for each monitoring well will be added to Table 2.1-2 in the 90% Design Submittal. This information will likely not be added to Table 2.1-3 in order to avoid redundancy and complexity in the table.		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Volume 2 Section 2.1 O&M Manual Volume 2 Table 2.1-2
640	DOI-260	Section 2.2, Page 2-2	General comment	The text and Figure 2.2-2 make reference to Table 2.2-1 for anticipated time frames for Cr (VI) attenuation to assist in evaluating the need for operational changes. Many of these ranges are relatively wide so they do not have much utility as a decision criterion. Please clarify.	The timeframe ranges for Cr(VI) attenuation will be re-assessed based on model results and tighter timeframes provided in the 90% Design Submittal. The narrower ranges will provide a more meaningful basis for assessment of operational changes.		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Volume 2 Section 2.2.1 O&M Manual Volume 2 Tables 2.1-4 and 2.1-5

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641	DTSC-194	Appendix L O&M Plan Volume 2, Compliance DQO-2 (RAO 3), Page 2-2	…and concentration trends will be reviewed to assess progress toward this RAO. Cr(VI) concentration trends will be evaluated and model projections compared to baseline estimates.	Provide details of how this assessment is to be conducted. Reference specific sections if necessary. Same for the other DQO/RAOs	The underlined text will be added: "…and concentration trends will be reviewed to assess progress toward this RAO, per the process outlined in IRL DQO-1 in Section 2.2.2 and Freshwater DQO-1 in Section 2.2.3. Cr(VI) concentration trends will be evaluated and model projections compared to baseline estimates, as summarized in Table 2.1-3." As noted in response to comment #673 DTSC-213, the estimated timeframes in Table 2.1-3 will be updated in the 90% design. The DQO/RAO section will be reviewed and similar references added throughout the section to clarify where evaluation processes are specified in the 90% design.	Highlighted DQOs reference Table 2.2-1, but now there is also Table 2.1-3. See also response to comment #673 DTSC-213. Comment resolved.			Comment resolved.	O&M Manual Volume 2 Section 2.1
642	DTSC-195	Appendix L O&M Plan Volume 2, Compliance DQO-3 (RAO 4), Page 2-2	The data collected will be analyzed to ensure that the concentrations of Cr(VI) and remedy byproducts, specifically manganese and arsenic, do not permanently increase outside of the baseline Cr(VI) plume.	Also mention that other constituents will (e.g., COPCs) and may (e.g., unknown constituent concentrations originating from different waste streams injected into IRL wells) be monitored as part of this DQO.	A monitoring program for COPCs was specified in Section 5.1 of the Sampling and Monitoring Plan (Volume 2 of the O&M Manual). The COPC monitoring network was designed to track COPC concentrations in areas where they are currently elevated as well as in areas where they may be transported during the remedial action. A reference to Section 5.1 will be added to the text in the referenced section.	Okay, pending review of the new COPC monitoring program.			Comment resolved.	O&M Manual Volume 2 Section 2.1
643	FMIT-174 Hualapai-126 Chemehuevi-126 Cocopah-126 CRIT-126	Append L-Vol 2 Section 2.1 p. 2-2	*Cr(VI) concentration trends will be evaluated and model projections compared to baseline estimates. If the plume remediation timeframes are lengthened, operational changes will be evaluated and implemented to the remediation system, as*	It is not clear from this statement what thresholds will lead to an increase in remediation timeframes. Please provide specific details that allow a clear understanding of the concentrations/events that will result in increased remedial timeframes.	To clarify, PG&E does not intend to increase the remediation timeframe based on any particular criteria; rather, the observed remediation timeframe may prove to be longer than originally predicted by the model. If the remedy's projected timeline becomes extended with respect to Cr(VI) remediation (i.e., if the anticipated timeframes for removal of Cr[VI] as outlined in Table 2.1-3 are not matching observations), then operational adjustments will be made. The text in this section will be updated for the 90% design as follows: "As part of the data quality objectives for RAO 3, wells located within the plume boundary (defined			Comment resolved pending review of 90% design.	Comment resolved.	O&M Manual Volume 2 Section 2.1

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			presented in the process control decision rules/ operational framework in Section 2.2 and in the Contingency Plan.		by the current 32 µg/L Cr[VI] plume boundary) will be monitored for Cr(VI), and concentration trends will be reviewed to assess progress toward this RAO. Table 2.1-3 includes anticipated timeframes for attenuation of Cr(VI) to below 32 µg/L for each inside-plume monitoring well based on the results of solute transport modeling. As the remedy progresses, if the observed concentration trends are not consistent with anticipated Cr(VI) attenuation timeframes (i.e., if the monitoring results indicate that Cr[VI] attenuation is actually taking substantially longer than anticipated), then operational changes to the remediation system will be evaluated and implemented as presented in the process control decision rules/operational framework described in Section 2.2 and presented in Figures 2.2-2 through 2.2-9. If operational adjustments are not successful in improving system performance, the Contingency Plan will be implemented, as described in Volume 3 of this Appendix."					
644a	FMIT-175	Append L-Vol 2 Section 2.1 p. 2-2	*Data will also be evaluated to determine when the appropriate time for monitored natural attenuation arises.*	Please provide more detail on how data will be used to indicate that MNA is appropriate. Once a decision is made that MNA is appropriate will the remediation system removal plan be designed? As you may recall, the Tribe supported NA and MNA as the primary final groundwater remedy.	This sentence will be revised to provide additional detail on how data will be used to assess the appropriate time for MNA: "Decisions on specific areas of the plume appropriate for MNA will be made based on: data collected under this DQO evaluating effectiveness of the active remediation systems for mass removal; the types and options for active remediation system adjustments; and the location of proposed MNA areas relative to natural reductive zones in the aquifer." In addition, reference will also be made to MNA language in the decision documents.			Comment resolved pending review of the 90% design.	Comment resolved.	O&M Manual Volume 2 Section 2.1
644b	Hualapai-127 Chemehuevi-127 Cocopah-127 CRIT-127	Append L-Vol 2 Section 2.1 p. 2-2	*Data will also be evaluated to determine when the appropriate time for monitored natural*	Please provide more detail on how data will be used to indicate that MNA is appropriate. Once a decision is made that MNA is appropriate will the remediation system removal plan be designed?	See response to comment #644a FMIT-175.			Comment resolved pending review of the 90% design.	Comment resolved.	O&M Manual Volume 2 Section 2.1

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			attenuation arises.							
645	DTSC-196	Appendix L O&M Plan Volume 2, NTH IRZ DQO-1, Page 2-3		The section summarizes the overall approach. Please add references to text (pages/sections), figures and tables so that the details (e.g., sampling points, frequency, constituents) of the sampling can be understood quickly. Ensure this is addressed for all DQO summaries.	References to relevant sections of Appendix L, Sections 3 and 4 (including references to sampling frequency tables and decision rule figures) will be added to the text for each DQO in the 90% Design Submittal. These references will also be provided in DQO Table 2.1-1, as indicated in the response to comment #671 DTSC-211. In addition, a figure will be prepared for NTH-DQO-1 to show sampling locations for the 90% Design Submittal.	Okay.			Comment resolved.	O&M Manual Volume 2 Sections 2.1, 2.2.1, 2.2.2, and 4.2.8 O&M Manual Volume 2 Table 2.1-1
646	DTSC-197	Appendix L O&M Plan Volume 2, NTH IRZ DQO-2, Page 2-3		DTSC requests that a detailed assessment of the monitoring program layout (selected wells) be conducted and documented in the design document. First, the vertical dimension of aquifer monitoring should be assessed and documented. It is suggested that cross sections along the NTH and shoreline be prepared showing monitoring well screens in relation to extractors and injectors (this should be done for all monitoring programs/subprograms). The chromium plume should also be placed on these cross-sections. Particle tracking (both outside and inside the plume), as was done in the 30% design, must be carried forward to assist in assessing program adequacy. If additional wells are needed, they should be called out along with the basis for adding the well. As example of this assessment, DTSC notes a likely problem with monitoring in the vicinity of IRZ-37 and IRZ-39. First, wells MW-23-060/080 are contaminated by grout and should be replaced if they cannot be rehabilitated. Well MW-21 is a very shallow well (it monitors the top 9 to 10 feet of the aquifer) and exhibits unusual/poor hydraulics as noted via muted pressure transducer data responses. Well MW-22 is a very shallow (11 feet deep) hand dug well completed in saline water (~20,000 ppm TDS) that monitors the top five feet of the aquifer. It would seem	Information on the vertical coverage of monitoring was presented in Table 3.6-1, which provided information on saturated thickness and potential number of monitoring well screens and lengths. As requested in this comment, cross-sections with monitoring well intervals posted for each monitoring program will be prepared and included in the 90% design (also included in **Attachment Q**, at the end of this table). Regarding particle tracking: particle flow paths are representative of a particle of water, while the solute transport model incorporates the behavior of the byproducts. Transport modeling is a superior tool for assessing remedy performance and designing the monitoring program. However, simulated flow fields will be provided to illustrate the simulated groundwater flow directions (included in **Attachment E**, at the end of this table). The flow fields are consistent with the simulated hydraulic capture zones presented in Appendix B, Section 6.5 and Figures 6.5-9 to 6.5-12. See response to comment #672 DTSC-212 in regards to MW-23. The saturated thickness of the aquifer is relatively thin in the area of MW-21 and MW-22 (i.e., approximately 10 feet). Thus, it is	Cross-sections for vertical layout: Comment resolved pending review of the 90%. However, the cross-sections should be provided prior to the 90% to allow for accelerated review/assessment of the monitoring programs. Particle tracking: Note: Figures for each layer should be prepared for the 90% design document. Early submittal requested as above. DTSC is concerned that the chemistry and water level data from MW-23 may not be representative due to grout contamination. Standard practice for well construction is to avoid grout contamination due to adverse impacts such as causing dissolved metals to precipitate from solution. Grout could certainly seal bedrock fractures and adversely impact hydraulic data as well. It may turn into a significant research project to assess the worthiness of the data from MW-23 cluster for hydraulic data and chemistry (e.g., every constituent sampled from this			Comment resolved. Per DTSC request, particle track figures for Layers 1-4 were submitted to DTSC on March 11, 2014 (see **Attachment R** at the end of this table). DTSC will continue to assess the monitoring program and provide any further input.	O&M Manual Volume 2 Table 2.1-2

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				that at a minimum, a deeper well is needed in the vicinity of MW-22 to monitor potential escape of contamination in the vicinity of the bedrock/alluvial interface. DTSC will continue to assess the monitoring programs after the requested information has been provided.	anticipated that shallow wells, such as MW-21, will be sufficient to monitor groundwater in this area. At the location of MW-22, a deeper boring and replacement monitoring well will be constructed if the alluvium is deeper in that area. The basis for the monitoring well locations is provided in this Appendix in Sections 3.1 and 4.2.1. MW-21 is designated an NTH dose response well. The general scheme for monitoring of the NTH IRZ was to place dose response monitoring wells in approximately half of the spaces between injection wells, and new monitoring well clusters were proposed in those locations. The placement in every other space allows for data collection along the full extent of the IRZ, balancing data density with infrastructure requirements. In places where existing wells were already present that could supplement the network, such as MW-21, the existing wells were added into the program. However, because multiple NTH IRZ dose response wells, staggered throughout the NTH IRZ line, have been identified for inclusion in the monitoring program, the removal of MW-21 from the monitoring program is not anticipated to result in a significant monitoring gap. For example, proposed monitoring well G will suffice as a dose response well for the southern portion of the NTH IRZ line.	well) and the data would need to be flagged appropriately. The well has certainly been compromised as evidenced by grout contamination (high pH) during well construction/ reconstruction. DTSC regards MW-23 as a significant monitoring point based on historical data (e.g., high chromium data) as well as its current isolated location with respect to the river and remedy components. DTSC requests that the wells be rehabilitated and replaced if rehabilitation fails to remove grout impacts. Aquifer thickness: DTSC is unsure of the actual aquifer thickness in the area based on data contained within existing PG&E reports and is a topic of concern. Aquifer thickness near MW-21 (along the end of the road) should be assessed during installation of IRZ 35, 37, and 39 and Well G. Aquifer thickness near MW-22 is not certain. Figure 2-3 and 2-4 of the RFI Volume 2 Addendum suggest if may be on the order of 30 to 50 feet and should be thicker than at Well G - saturated thickness of 32 feet (see Table 3.6-1). A deep exploration boring is requested at or near MW-22 to assess aquifer thickness. A well should be constructed at the bedrock/alluvial contact if the alluvium thickens as depicted in RFI figures. MW-21: DTSC concurs that proposed new Well G should suffice for dose response monitoring in the immediate area and that MW-21 can act to supplement shallow monitoring.				
647	DTSC-198	Appendix L O&M Plan Volume 2, NTH IRZ DQO-2, Page 2-3	Cr(VI): the presence or absence of Cr(VI) in groundwater will also serve	Add some cautionary text that the lack of chromium does not necessarily mean that treatment is occurring or that the area is not important. Fluctuations in chromium concentrations as the plume is	The following text will replace the last sentence in the second paragraph under the NTH-DQO-2 discussion: "It is important to note that, although Cr(VI) concentrations will be used as a line of evidence for	Okay.			Comment resolved.	O&M Manual Volume 2 Section 2.2.1

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			as a direct indicator of whether Cr(VI) treatment at a given location is occurring or necessary.	extracted and injected and pushed around should not be unexpected. Simple fluctuations in river stage can make chromium disappear for months only to return later. As with any assessment, multiple lines of evidence should be gathered and evaluated.	establishment of a treatment zone, decreases in dissolved Cr(VI) alone in the short-term are not necessarily a definitive metric for treatment. Multiple lines of evidence will be used to evaluate the establishment of the treatment zone, including the following:"					
648	FMIT-180 Hualapai-131 Chemehuevi-131 Cocopah-131 CRIT-131	Append L2- V2 Sect 2.2 p. 2-3	*Once the system operations are verified, sampling frequency will be reduced to quarterly or semi-annually…*	If sampling is reduced to semi-annual, one option to consider is to collect a subset of the data on alternating time periods, such that half of the wells are monitored each quarter. This provides some data each quarter without increasing the overall monitoring.	PG&E agrees that this is a good suggestion. The following text will be added to this paragraph in the 90% design submittal: "Once the system operations are verified, sampling frequency will be reduced to quarterly or semi-annually. If semi-annual monitoring is proposed, sampling events may be performed on a quarterly basis, with half of the injection well vaults sampled on alternating quarters. This would ensure that information on the system is collected quarterly, even if any given injection vault would only require semi-annual sampling."			Comment resolved pending review of 90% design documents.	Comment resolved.	O&M Manual Volume 2 Section 2.2.1
649	DOI-265	Section 2.2.1, NTH IRZ DQO-2, Page 2-4	"Selection of a carbon substrate with slower degradation rates could increase the distribution distances."	Please provide examples of carbon substrates that have slower degradation properties.	More complex substrates, such as whey and molasses, tend to have slower degradation properties. Text will be included in the 90% BOD to reflect this response.		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Volume 2 Section 2.2.1
650	DOI-266	Section 2.2.1, NTH IRZ DQO-2, Page 2-4	"It is anticipated that the IRZ operations will be cycled; for example the IRZ would be operated for six months to establish reducing conditions . . ."	As the project moves forward, field data may suggest that the system operation, dosage, and other factors need to be adjusted to establish an effective reducing environment. Will the six month time frame for operation be modified based on field data, increasing or decreasing as needed?	Yes. The remainder of the paragraph from which this statement was taken describes how redox parameters, Cr(VI) concentration, and other indicators including iron, nitrate, and sulfate, will be used to assess residual reducing capacity. As shown in Figure 2.2-2 (referenced in this paragraph), IRZ operations will be cycled based on these results.		Comment resolved.		Comment resolved.	Not applicable
651	DTSC-199	Appendix L O&M Plan Volume 2, NTH IRZ DQO-4, Page 2-5		There is some concern that the plume could migrate to the north between MW-35 and MW-41. It is proposed that a monitoring well location be established between these two monitoring areas in Bat Cave Wash just prior to reaching the tamarisk. This well would provide hydraulic and chemical data to ensure appropriate	PG&E is currently evaluating potential locations for installation of an additional monitoring well to the northwest of MW-35, between MW-35 and MW-41. This monitoring well will be added to the Sampling and Monitoring Plan (Volume 2 of the O&M Manual) for the 90% design.	Comment resolved pending review of the 90% design.			Comment resolved.	O&M Manual Volume 2 Figures 2.1-1, 2.1-2, and 2.2-1

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				capture. This location might also be used to monitor effects of freshwater injection. A back up location could be cited at the old Workman's resort area.						
652	DOI-267	Section 2.2.1, NTH IRZ DQO-5, Pages 2-5 and 2-6	"These operational adjustments, including the shutdown of any given injection or extraction well, would be coupled with an assessment of the strength of the IRZ and Cr(VI) treatment in that area per NTH IRZ DQO-2."	Will an analysis be performed to ascertain what impact, if any, shutting down an extraction or injection well will have on the capture zone?	Such an analysis will be performed with groundwater modeling prior to shutting down an extraction well. After shutting down such wells, lines of evidence will be used as part of the plume control assessment required under IRL-DQO-3 and IRL-DQO-4, including water level data, chromium concentration data, and modeling, as described in Section 4.3, Volume 2 of the O&M Manual (Appendix L), pp. 4-6 through 4-10.		Resolved.		Comment resolved.	Not applicable
653	DOI-268	Section 2.2.2, IRL DQO-1, Page 2-6	"Observed hydraulic gradients will be compared to anticipated gradients as simulated with flow modeling that will be periodically updated as field data are collected."	When does PG&E plan on updating the computer model runs to reflect existing conditions under full remedial systems operations?	There are several checkpoints during remedy implementation when the groundwater flow and solute transport model may be updated, including during installation, after system start-up, and during remedy operation. During the installation phase the model may be updated, if the data collected during construction significantly contradict the current CSM. For example, if large variations in saturated aquifer thickness, bedrock extent, permeability, chromium distribution, etc. are measured compared to what has been modeled to date, the model would be updated and re-run. The regional model would be updated first, then imported into the fate and transport submodel before transport runs are conducted. During remedy well testing and system start-up, information will be gathered about achievable flow rates for the remedy wells and system as installed and actual hydraulic gradients. That information will be fed back into the model and additional predictions will be made. As remedy implementation progresses, the observed data will		Comment resolved.		Comment resolved.	Not applicable

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					become more useful than model predictions and the modeling will be relied on less heavily. If actual data collected contradicts geochemical or solute transport parameters used in the modeling, it may be appropriate to update and re-run the model simulations.					
654	DTSC-200	Appendix L O&M Plan Volume 2, IRL DQO-1, Page 2-6	The process for evaluating the development of hydraulic gradients to facilitate Cr(VI) plume flushing is illustrated on the right-hand side of the flow diagram in Figure 2.2-4.	Figure 2.2-4 seems to only tie hydraulic assessment with anticipated chromium concentration trends. A separate hydraulic only assessment should be included in the figure/rule.	To assess whether the plume is being adequately flushed by operation of the IRL, Figure 2.2-4 has two branches on the right side of the flowchart. The first branch (Box 22) is for the case where it is early in remedy operations and not enough time has passed for Cr concentration changes to occur. Under this condition, the hydraulic gradient (i.e., water level) data will be evaluated and used with the model to evaluate whether the gradient is consistent with the desired remediation timeframe, as the commenter suggests is appropriate. To clarify, Box 23 will be revised to state: "Evaluate whether hydraulic gradients to facilitate flushing of the plume have been established, recalibrating the model with water level data, and projecting remedial timeframes as needed." Further into remedy implementation, changes in Cr concentrations are anticipated and evaluation of the concentrations becomes more important than the hydraulic gradient, as shown on the branch of the flowchart starting in Box 24. If Cr concentrations are not changing as anticipated, but the gradient is within expectations, action and adjustment still need to be made: this is why concentration trends become the more important indicator to evaluate as the remedy progresses.	Okay.			Comment resolved.	O&M Manual Volume 2 Figure 2.2-4
655	DTSC-201	Appendix L O&M Plan Volume 2, IRL DQO-1, Page 2-6	Observed hydraulic gradients will be compared to anticipated gradients as simulated with flow modeling that will be	Ensure that anticipated gradients for this and all DQOs are included in the 90%. Will specific well pairs be established similar to IM-3 hydraulic monitoring?	Remedy performance monitoring includes periodic assessment of the hydraulic gradient across the site via analysis of water levels measured in site wells. Water level contour maps, which take into account water levels measured in all wells relevant to the portion of the aquifer being assessed, will be used as the	In addition to what is proposed, gradient pair monitoring at critical areas should be developed and included in the 90%.			PG&E will work on items related to this comment as directed in the Agencies' direction letter dated April 4, 2014.	O&M Manual Volume 2 Sections 2.2.2, 2.2.3, and 4.3.3

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			periodically updated as field data are collected.		preferred method for assessing the hydraulic gradient. These maps are preferred over strictly well pair assessments because they are the result of the spatial integration of multiple water level data points. As discussed in Section 4.3.3.1 of the Sampling and Monitoring Plan (Appendix L, Volume 2), such contour maps will be constructed similarly to the maps presented in past quarterly and annual groundwater monitoring reports for the site. Thus it will not be necessary to establish specific well pairs to assess gradients. The 90% document will include a discussion of how the hydraulic control assessment will be performed using the multiple lines of evidence approach, and how the assessment will be an iterative process, consistent with the USEPA guidance document (2008). Also, a discussion will be included to show how the assessment might be summarized (i.e., in a table), illustrating conclusions from each of the lines of evidence used, with overall conclusions regarding hydraulic control, uncertainties and data gaps, and recommendations for future action. This discussion will be presented as an expansion of Section 4.3.4 of the Sampling and Monitoring Plan (Appendix L, Volume 2).					
656	DTSC-202	Appendix L O&M Plan Volume 2, IRL DQO-2, Page 2-6	If the carbon amendment system is active, data will be collected from the IRL injection dose response monitoring wells, listed in Table 2.1-2 and shown on Figure 2.2-1, to evaluate Cr(VI) treatment and by-product generation.	As the IRL wells screen the entire aquifer, it is requested that the neighboring CW wells be fitted with shallow zone monitoring wells. Cross sections of this area (and all critical areas) with remedial components displayed are requested. A deep well at MW-14 should be evaluated to determine if it would provide valuable hydraulic data (the deeper zone is contaminated in this portion of the plume so it would seem that monitoring that zone would be more important).	To strike a balance between data collection and minimizing monitoring well infrastructure, the monitoring network was designed to provide representative data throughout the remedial systems. In the case of the inner recirculation loop injection system, multi-depth monitoring wells were proposed near 2 of the 4 injection wells, i.e. proposed monitoring wells I, J, P and Q near IRL-1 and IRL-4, which are designated as outer plume compliance monitoring wells (Table 2.1-2). The preliminary design for I, J, P and Q includes 4 screen intervals to provide vertical coverage across the saturated thickness (Table 4.3-1). Additional monitoring wells with multiple screen intervals are also	Comment resolved.			Comment resolved.	Not applicable

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					being designed for arsenic monitoring. The data collected at proposed wells I, J, P and Q, and the arsenic monitoring network will be sufficient to bound and monitor the extent of Cr(VI) throughout the saturated interval.					
657	DOI-269	Section 2.2.2, IRL DQO-2, Page 2-7	"If injection well maintenance becomes unacceptably costly or burdensome due to the re-injection of reduced metals, treatment for removal of those metals prior to re-injection may be considered."	Should this occur, will the regulatory agencies and Tribal Nations be informed prior to commitment?	The text will be revised as follows (added text shown in underline typeface): "If injection well maintenance becomes unacceptably costly or burdensome due to the re-injection of reduced metals, treatment for removal of those metals prior to re-injection may be considered. Should this occur, the regulatory agencies and Tribes will be informed prior to commitment."		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Volume 2 Section 2.2.2
658	DOI-270	Section 2.2.2, IRL DQO-3 and 4, Page 2-7	"Operations may be improved by adjusting extraction rates or taking further contingency measures, such as adding additional extraction wells (see Volume 3, Contingency Plan)."	In order to assess potential impacts on controlling Cr(VI) and byproducts in the deeper units, will the flow model be run to measure potential impacts and addition of extraction well placement?	Yes, the flow model will be an integral part of the analysis used to assess the impact of these changes.		Resolved.		Comment resolved.	Not applicable
659	DTSC-203	Appendix L O&M Plan Volume 2, IRL DQO-3/4, Page 2-7		Note: DTSC desires to evaluate requested cross sections and particle tracking for the river bank and all areas.	Cross sections along the NTH IRZ and the shoreline will be produced to show monitoring well screens and chromium plume delineations (included in **Attachment Q**, at the end of this table). Particle flow paths are representative of a particle of water, while the solute transport model incorporates the behavior of the byproducts. Transport modeling is a superior tool for assessing remedy performance and designing the monitoring program. However, simulated flow fields will	Comment resolved pending review of the 90% design.			Comment resolved. Per DTSC request, particle track figures for Layers 1-4 were submitted to DTSC on March 11, 2014 (see **Attachment R** at the end of this table). DTSC will continue to assess the monitoring program and provide any further input.	O&M Manual Volume 2 Section 2.2.2

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					be provided to illustrate the simulated groundwater flow directions (included in **Attachment E**, at the end of this table). The flow fields are consistent with the simulated hydraulic capture zones presented in Appendix B Section 6.5 and Figures 6.5-9 to 6.5-12.					
660	DTSC-204	Appendix L O&M Plan Volume 2, IRL DQO-3/4, Page 2-7	Figure 2.2-5 14. Is Cr(VI) in the shallow unit controlled?	Change 14. to "Is Cr(VI) and/or byproducts in the shallow unit controlled?" Clarify in text and figure the need for hydraulic assessment of water level data to ensure appropriate capture/control is occurring. Also, discuss the need for additional extractors both shallow and deep (e.g., located between existing RB wells). Provisional well locations have not been called out.	As stated in Section 3.2.2.1 of the BOD/60% Design Submittal, the objectives of the River Bank Extraction Wells include: to control potential migration of Cr(VI) located downgradient of the NTH IRZ and to control byproduct migration in the deeper portion of the aquifer. Byproduct concentrations generated in the shallow unit are anticipated to be within the range of the naturally-occurring reducing rind that adjoins the Colorado River and therefore would not represent any additional threat to the river or be a target for capture. This is supported by the simulated solute transport results, which indicate that byproduct concentrations (manganese and arsenic) generated from the NTH IRZ are within the range of naturally occurring shallow manganese and arsenic concentrations in the floodplain. Shallow river bank extraction could have negative hydraulic impacts to the reducing rind. However, the shallow riverbank extraction will be added to the contingency plan as a potential option to address shallow byproduct concentrations significantly above naturally occurring concentrations and Figure 2.2-5 will be edited accordingly. Decisions on appropriate implementation of this contingency measure will be made based on evaluations of the water quality in the floodplain and/or the river, and of the remedy during implementation, weighing the need for capture with the potential negative impacts on the rind and remedy operations. Details of the hydraulic control evaluation are provided in Section 4.3 of this Volume (Volume 2 of the O&M Manual). A reference to this section will be added to Figure 2.2-5.	The figure needs to be revised to ensure that byproduct concentrations generated in the shallow unit are looked at and are within acceptable limits (i.e. naturally occurring concentration). If they are greater, then the figure should mention potential contingencies including bringing shallow river bank extractors online. Hydraulic control assessment: Concur with adding to figure. Add main applicable points if possible. Concur with Response to Comment 100 regarding provisional River Bank Extraction Wells.			Comment resolved.	O&M Manual Volume 2 Section 2.2.2 O&M Manual Volume 2 Figure 2.2-5

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					With regards to the need for additional extractors, see response to comment #100 DTSC-27. In addition, the River Bank Extraction Wells are designed with two screened intervals to allow for groundwater capture from both the shallow and deep units, if necessary. The shallow screens will be isolated from the well pump unless the need to pump in the shallow unit proves necessary.					
661	FMIT-176 Hualapai-128 Chemehuevi-128 Cocopah-128 CRIT-128	Append L-Vol 2 Section 2.1 p. 2-7	*IRL – DQO 5: The naturally occurring reducing rind will be monitored for changes in water quality.*	Which specific wells are intended to provide the data to monitor the reducing rind?	Generally speaking, the greatest emphasis will be placed on shallow monitoring wells within the NTH IRZ downgradient and riverbank extraction monitoring well networks (listed in Table 2.2-1), particularly those that fit the operational definition of the reducing rind as described in this paragraph and Appendix B, section 2.3. As is noted in the text, however, the entire monitoring data set (including historic data for existing wells and wells occurring outside of the reducing rind) will be considered when assessing reducing rind impacts. This will be necessary to provide the proper context on any apparent impacts for a given well in the network. For example, water quality may be highly variable in any given monitoring well in the floodplain, particularly when the flow regime is changed. Accordingly, changes in concentrations of redox parameters in any given well over a short timeframe may or may not be indicative of overall impacts to the reducing rind. This will need to be assessed within the context of the entire dataset. A discussion of these factors and a reference to Appendix B will be included for IRL DQO-5 in the 90% design submittal.			Comment resolved, provided further detail is included in the 90% design documents.	Comment resolved.	O&M Manual Volume 2 Section 2.2.2
662	FMIT-177 Hualapai-129 Chemehuevi-129 Cocopah-129 CRIT-129	Append L-Vol 2 Section 2.1 p. 2-7	*The entire dataset will be considered when evaluating the overall impact to the reducing rind, and*	Please provide additional detail on what further investigations may be conducted. Also if monitoring data indicate that reducing conditions in the rind are being negatively impacted will the river bank extraction wells be turned off until additional investigations have	The following text will be added as the second sentence to this section in the 90% design submittal: " The analytes in the groundwater are indicative of reducing conditions generated by the rind." In addition, the following text will be added at the end of this section in			Comment resolved pending review of the 90% design documents.	Comment resolved.	O&M Manual Volume 2 Section 2.2.2

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			multiple lines of investigation will be evaluated to understand the data trends. The presence and effectiveness of the engineered reducing zone will also be considered when evaluating changes to the natural reducing zone. If broad changes to the reducing conditions occur, further investigations may be warranted.	adequately characterized the potential impact?	the 90% design submittal: "The types of additional investigations conducted will be dependent on the nature of the observations. These additional investigations may include (but would not be limited to) supplementary groundwater sampling for additional analytes and/or increased monitoring frequency, installation of provisional wells, and/or sampling of aquifer solids and solid-phase analyses." Whether or not riverbank extraction will be shut down will be situational and will depend on the certainty of the data, the rate at which the reducing capacity of the rind may be decreasing, and the need for on-going operations of the riverbank extraction for hydraulic control. This is consistent with the adaptive operations approach.					
663	DTSC-205	Appendix L O&M Plan Volume 2, TCS DQO-1, Page 2-8	To evaluate treatment of Cr(VI) in groundwater beneath the TCS, data will be collected from the TCS Recirculation Loop dose response monitoring wells, listed in Table 2.1-2 and shown on Figure 2.2-1.	Include a dose response well for TCS-1. Can existing well TW-1 be utilized? Wells in Bat Cave Wash should be added to the TCS loop monitoring to ensure westward migration of the plume/byproducts is not occurring.	**Additional TCS-1 Dose Response Well:** In an effort to strike a balance between data collection and number of monitoring wells/ boreholes, a dose response well was proposed at only one of two of the injection wells for the TCS injection system. Including another dose response well in this area, where the injection wells are just approximately 300 feet apart, was not considered as valuable as the inclusion of multiple dose response wells in other areas, for instance along the NTH IRZ line where the injection wells cover a distance of approximately 3,000 feet. Well TW-1 was considered as a potential dose response well, but was originally not included in the program given that it has a screen length of 100 feet and was considered too long to provide useful information on reagent distribution and treatment from the approximately 40 to 50 foot long screen intervals of the TCS injection wells. TW-1 will be included in the 90% design monitoring program as an additional dose response well for	DTSC is alright with utilizing one dose response well provided TCS-1 and TCS-2 will always receive the same quantity and quality of injected water. If there is needed flexibility for varying the flow rates or quality of water received, then it would seem that separate dose wells are needed. During discussions with DTSC, PG&E indicated that they would check further into utilizing TW-1 with low flow monitoring methods. Regardless, attempts to use TW-1 should be included in the 90% and if it fails to provide valuable data, it could be dropped from the network in the future and replaced if necessary. Bat Cave Wash Wells- TCS Loop. Concur with proposal including adding byproducts to the three wells. How will this issue be linked in text/ table to know how to asses this item as part of monitoring? Add these			Comment resolved.	O&M Manual Volume 2 Section 2.2.3 O&M Manual Volume 2 Table 2.1-2 O&M Manual Volume 2 Figure 2.2-6

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					the TCS injection system with the following caveat: if sampling at TW-1 fails to provide adequate data, TW-1 will be removed from the monitoring program in the future and, if necessary, replaced. **Wells in Bat Cave Wash:** Monitoring wells MW-10 and MW-38S/D have been specified to the west of the TCS as inner plume compliance wells (Table 2.1-2 of the Sampling and Monitoring Plan) which are used to ensure that Cr(VI) concentration trends behave within expectations per Compliance DQO-2 (RAO 3) in Section 2.1 of the Sampling and Monitoring Plan. In addition, MW-9, located south of MW-10 and to the west of the TCS, will be added to the monitoring program network as an additional inner plume compliance well. Compliance wells MW-10, MW-38S/D, and MW-9 can also be monitored for byproducts to verify that westward migration of byproducts is not occurring. MW-9 will be added to the program in the 90% design. In addition, the 90% design Sampling and Monitoring Plan will be updated to include a data evaluation process to assess whether Cr(VI) and byproduct data indicate westward migration from the TCS Injection Wells.	wells to a TCS Loop column in Table 2.1-2. Comment resolved.				
664	DOI-271	Section 2.2.3, TCS DQO-2, Page 2-8	"If additional control is need, operational changes will be made such as increasing extraction rates or adding provisional extraction wells."	If extraction rates are increased, will provisions need to be made with regards to the injection system?	To the extent possible, the capacity of the two currently proposed TCS Injection Wells will be used to accommodate increases in extraction rates. The injection rates in these wells could likely be at least doubled in comparison to currently anticipated rates. Should the injection capacity of those two wells be exceeded, additional TCS Injection Wells would need to be considered along with increased extraction rates. Additionally, flexibility is included in the design to re-direct some or all of this flow to the NTH IRZ if needed or warranted.		Comment resolved.		Comment resolved.	Not applicable
665	DTSC-206	Appendix L O&M Plan Volume 2, TCS DQO-2,	Multiple lines of evidence will be used to evaluate and	The hydraulic control metric sought should be specified in the section and associated figure. Text referenced Section 4.4, but that	The correct reference for the lines of evidence to be used for the hydraulic control evaluation is Section 4.3, Volume 2 of the O&M Manual, pp. 4-	Ok pending review of the 90% design. See also response to comment #655 DTSC-201.			Comment resolved.	O&M Manual Volume 2 Sections 2.2.1, 2.2.2, 2.2.3, and 4.2.5 O&M Manual Volume 2 Figure 2.2-7

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		Page 2-8	optimize the hydraulic control of the Transwestern Bench extraction system, as outlined in Section 4.4 and shown on Figure 2.2-7.	section does not exist.	6 through 4-10. A reference to this section will be included on Figure 2.2-7.					
666	DTSC-207	Appendix L O&M Plan Volume 2, TCS DQO-2, Page 2-8	If additional control is need, operational changes will be made such as increasing extraction rates or adding provisional extraction wells.	Specify or reference appropriate sections discussing the basis for provisional wells and events that would trigger its installation. This applies to all provisional wells.	The events that would trigger installation of provisional wells are illustrated in the Decision Rules Framework laid out in Figure 2.2-7. The text in this section will be modified as follows: "If additional control is needed, operational changes will be made such as increasing extraction rates or adding provisional extraction wells (see Boxes 5 (short-term box 6 will be edited to Box 5) and 6, Figure 2.2-7). Increased extraction rates would be attempted in the short term, while addition of provisional extraction wells would be considered if short-term extraction rate increases were found to be insufficiently effective." Similar text will be added to other locations where provisional wells are described in the 90% Design Submittal.	Okay.			Comment resolved.	O&M Manual Volume 2 Sections 2.2.1, 2.2.2, and 2.2.3
667	DOI-272	Section 2.2.3, TCS DQO-3, Page 2-8	"The decision rules/ operational framework for the CS Recirculation Loop East Ravine extraction system are shown on Figure 2.2-8."	East Ravine extraction wells are completely in bedrock and will likely be operating at maximum capacity. Therefore, increasing extraction rates in the short term is not a plausible option.	Additional provisional extraction wells have been added in the East Ravine area (see response to comment #109 DTSC-30). Figure 2.2-8 and the associated text will be revised to reflect the likelihood that the provisional extraction wells, rather than increased extraction rates will be used for East Ravine adaptive operations.		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Volume 2 Section 2.2.3 O&M Manual Volume 2 Figure 2.2-8
668	DTSC-208	Appendix L O&M Plan Volume 2, TCS DQO-3, Page 2-8		See comments above for TSC DQO-2. Due to the tight bedrock conductivities anticipated, it is requested that two additional monitoring wells be added to the program to assess hydraulic influence and plume control between extractors. Specifically, it is requested that two monitoring well locations be	Additional monitoring wells as requested will not provide definitive conclusions with regard to hydraulic influence. The water levels in such monitoring wells will be higher than the adjacent extraction wells, and such evidence will not lead to a conclusive assessment of hydraulic control. Also, the presence or absence of Cr(VI) in wells at the	See comment #109 DTSC-30 regarding potential provisional extraction wells along the East Ravine. PG&E needs to provide paired piezometers for this area requested of USEPA capture zone/pump and treat guidance to assess if extraction/capture			Comment resolved.	O&M Manual Volume 2 Section 2.2.3

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				added midway between ER-2/ER-3 and ER-3/ER-4. These wells/boreholes could potentially be converted into extractors if needed in the future.	requested locations will not lead to a conclusive assessment of hydraulic control. All of the monitoring wells (specifically wells at locations MW-62, MW-63, and MW-72 which are located in the proximity of the proposed extraction wells) as identified as East Ravine Extraction Monitoring Wells on Table 2.1-2, Vol. 2 O&M Manual, will be used in conjunction with the proposed extraction wells to assess hydraulic control by employing the lines of evidence, including water level data, chromium concentration data, and modeling, as described in Section 4.3, Vol. 2 O&M Manual, pp. 4-6 through 4-10.	is effective. Modeling is less valuable in the fractured bedrock setting. Comment resolved.				
669	DTSC-209	Appendix L O&M Plan Volume 2, Freshwater DQO-1, Page 2-8		The DQO will need to be modified to address the freshwater water quality criteria needed for injection (including input from the State Board). Discharge limits for a wide suite of constituents (metals/general minerals/TDS) should be developed for freshwater injection. The section will also need to identify wells for monitoring arsenic impacts around injection points should the State Board allow elevated arsenic to be injected into the aquifer. A distal outboard monitoring well has not been identified for FW-2 injection.	On November 20, 2013, the State Water Resources Control Board issued a letter regarding remedy requirements associated with injection of groundwater containing naturally occurring arsenic. A new DQO will be added to the 90% design in this freshwater injection section to include: the monitoring required by the State Board letter, to verify modeling results; and the actions specified should arsenic exceed water quality objectives at 150 or 225 feet. Additional specifications on freshwater water quality are not necessary, were not established by the State Board, and will not be included in the DQOs.	DTSC notes that the State Board letter was responding to an inquiry from PG&E on the injection of water with natural arsenic above California MCL. The absence of discussion regarding other constituents should not be considered a waiver to not consider other constituents that may be injected into the subsurface. Also, see response to comments 38, 145, and 181.			Discussion between DTSC, DOI, RWQCB, and PG&E is ongoing to resolve this comment. This topic will be carried forward. Resolution of this comment will be included in the 90% design. PG&E will also work on items related to this comment as directed in the Agencies' direction letter dated April 4, 2014.	O&M Manual Volume 2 Sections 2.2.4 and 4.2.7
670	DTSC-210	Volume 2	Table 2.1-1	Page 1: Column 7 indicates "See Section 3", but uncertain if this is a holdover from a previous internal draft version.	The references in Column 7 to Section 3 for compliance monitoring objectives and Section 4 for performance monitoring objectives are in fact intended for the reader, highlighting that design optimization details are covered in the text.	Okay.			Comment resolved.	Not applicable
671	DTSC-211	Table 2.1-1 Interior of the plume	If hexavalent chromium concentrations are not decreasing within expected timeframes, operational changes (potentially including the	Cite specific section/figure/ pages so that decision criteria are quickly linked to the DQO and understood.	References to relevant sections of Appendix L will be added to Table 2.1-1 for each DQO in the 90% Design Submittal.	Okay.			Comment resolved.	O&M Manual Volume 2 Table 2.1-1

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			addition of provisional IRZ wells) will be implemented per the process control decision rules.							
672	DTSC-212	Table 2.1-3		Include the following wells on the table: Outside Plume: MW-16$_1$, MW-17$_1$, MW-18, MW-22, MW-48, MW-62-190, MW-68BR-280, MW-72BR-200, OW-03S, OW-03M, OW-03D Inside the plume: MW-09, MW-24A, MW-60BR-245, MW-70-105, MW-70BR-225, 1 Consider utilizing as background/regional control well. Indicate why all PT wells/well clusters (PT1 through 9 including PTI wells) were not utilized. Same for not using any TW wells (TW-1 through TW-5). What purpose do these wells serve? Can wells PGE-7BR or PGE-8 be utilized for the remedy in any fashion? Update all tables to indicate if an outside plume well was historically contaminated (e.g., MW-14, MW-30-050, MW-31-135, MW-34-080, MW-35-060, MW-36-090, MW-39-050, MW-39-060, MW-39-070, MW-39-080, MW-47-055, MW-50-095, MW-58BR, MW-62-190). This list will hopefully grow over time and monitor remedy success and will also alert the reader to anticipate potential rebound, etc., in the future. Add an identifier to the Outside Plume wells in the "Currently-Anticipated Timeframe for Cr(VI) Concentration Changes" column that have had historic contamination, but are now clean. Assess if this should affect sampling frequency and make appropriate changes to sampling frequency. Note: Wells MW-23-060 and MW-23-080 have not recovered from grout contamination (elevated pH) and should be replaced if well rehabilitation measures do not improve the issue. Confirm the number of wells at	Monitoring wells MW-22, MW-48, MW-62-190, MW-68BR-280, and MW-72BR-200 will be added to the Outside Plume monitoring well network. Monitoring wells MW-09, and MW-60BR-245 will be added to the Inside Plume monitoring well network. The need to establish background or regional control with wells that are very far upgradient of the project, such as MW-16, MW-17, MW-18, and cluster OW-03 is not clear. Periodic sampling of these wells may be proposed in the future as the need arises, but specification of routine sampling of background/regional control wells is not currently necessary. MW-70-105 is included as an Outside Plume well. This well is screened in Model Layer 1 and does not exhibit Cr(VI) impacts, and therefore will remain in the Outside Plume well network. During final remedy construction, MW-70BR-225 will be converted into extraction well ER-6. As directed by the agencies, a deeper borehole is needed at this location to delineate the vertical extent of elevated Cr(VI) concentrations. As discussed with DTSC on November 21, 2013, in lieu of drilling an additional well, the additional characterization may be accomplished by deepening the existing MW-70BR-225 borehole. Depth-specific samples will be collected from the deepened borehole to assess Cr(VI) concentrations in permeable fractures encountered in the deeper portion of the borehole. After the	Outside: Okay Insider: Okay, but add MW-70-105 to inside as it is contaminated (see quarterly report). Control Well: Concur, but indicate how long it will take for injected water to reach these outer wells. Provide particle tracking figure to support this issue. Do make sure these wells are sampled during a baseline event prior to remedy start up. ER-6: Please recall that a deeper well/extension is required at this location.			Comment resolved.	O&M Manual Volume 1 Section 4.2 O&M Manual Volume 2 Tables 2.1-2 and 2.1-3 O&M Manual Volume 2 Figures 2.1-1, 2.1-2, and 2.2-1

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				location MW-45-095 (a & b wells) and the purpose of each and that tables appropriately reference them. Confirm in the table if well MW-53S is not operational (and any other inoperable wells). The current well designation for MW-58BR should be used noting that DTSC will likely request modification of the current well design. Same for MW-64BR. MW-70-105 is incorrectly identified as a clean, outside the plume well. Based on Q2, 2013 PMP/GMP report, this well contains Cr(6) at elevated concentrations. Please revise.	deeper characterization is complete (i.e., concentrations of Cr(VI) is not detected or are observed to decrease with depth), the MW-72BR-225 borehole will be converted to extraction well ER-6, screened to capture the elevated Cr(VI) concentrations observed shallower in the borehole and any additional zones of elevated Cr(VI) concentrations found in the deeper section. Most PT well clusters and MW-24A were not included in the monitoring program because these wells were influenced by pilot testing. Since pilot test activities created strong and persistent reducing conditions in the vicinity of these wells, they cannot be used with confidence to track Cr(VI) migration as a result of field implementation activities. Exceptions include those PT wells that were not influenced by pilot testing, including the PT-5 cluster, PT-9 cluster, and PT-8D, which have been retained in the monitoring program. The PT wells will be included in the table for periodic sampling. TW-1 has a 100-ft screen interval, which limits its usefulness in the monitoring program. See response to comment #663 DTSC-205. TW-2S/D, TW-3D, TW-4, and TW-5 will be considered for inclusion in the monitoring program as compliance and IRZ dose-response wells. PGE-7 will be added to the monitoring program. PGE-8 will be monitored in the short term for remedy effects. If there is no effect, then PGE-8 will be removed from the program unless it is yielding good information and can be retrofitted like PGE-7. The table will be modified for the	PT Wells/MW-24A: DTSC to confirm current condition. Sample to study byproduct persistence. Also plan to sample some of these wells after they rebound to baseline. TW-1: Attempt to use this well as a dose response well and inside the plume well. It is highly contaminated, even with its long screen. Other TW wells: Concur. PG&E-7/8: Monitor both periodically at beginning to confirm no changes/ effects from remedy implementation. Sample less frequent over time. Formerly contaminated wells:				

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					90% Design Submittal to include information on whether outside-plume wells were historically contaminated. Although it is not anticipated that this will have an impact on sampling frequency, the sampling frequency will be assessed based on this information. For the MW-23 nested wells, rehabilitation options to improve pH will be evaluated and implemented, as appropriate. The effects of pH on parameters specified in the monitoring program for this location will also be evaluated. If these evaluations indicate that the well is not suitable for the specified monitoring program, the installation of replacement wells in a new borehole in the vicinity of the existing MW-23 wells will be considered. As requested by DTSC, monitoring well acceptance criteria will be included in the 90% design (O&M Plan Volume 1, Section 4, Well Maintenance and Decommissioning) such that the potential pathways to monitoring well maintenance, reconstruction, or replacement is clear. The conditions that will be addressed include well collapse (preventing sample collection or compromising water quality), screen damage (resulting in elevated turbidity and/or sanding problems), and the effects of grout intrusion (resulting in abnormally high pH values). There are two casings at MW-45-095 (A and B). However, both wells are screened in the exact same interval, and only MW-45-095A is currently being sampled. Specifically, MW-45-095B is a smaller diameter well in which a ZIST sampling system was tested. MW-45-095B is considered inactive. These details will be included in Table 2.1-2, with only 095A included in Table 2.1-3.	Concur. MW-23: Do not concur. See DTSC response to cited comment. Need to develop well quality criteria and well maintenance flow chart. MW-45-095 Cluster: Concur.				

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					It is correct that MW-53S is not operational. A note to this effect will be added to the table. The comment regarding maintaining the current well designations for MW-58BR and MW-64BR has been noted. Currently, as approved in the first quarter of 2013, packers have been removed and single zone micro-purge sampling is being performed at 165 ft in MW-58BR and at 255 ft in MW-64BR. Due to the timing of the 60% Design Submittal, inside- versus outside-plume monitoring wells were assigned based on fourth quarter 2011 monitoring results. All inside/outside-plume assignments (including MW-70-105) will be reassessed based on the latest available data for the 90% Design Submittal.	MW-53S: Okay. MW-58BR and MW-64BR: Noted. Comment resolved pending review of the 90% design.				
673	DTSC-213	Appendix L O&M Plan Volume 2, Table 2.1-3	Currently-Anticipated Timeframe for Cr(VI) Concentration Changes	Clarify and define the referenced column heading in the table and some locations in the text where this table is referenced. The heading is not clear if it is referring to the arrival time of treated water at which point a change in concentration is anticipated or actual time to cleanup Cr(6) to less than 32 ppb. Some flood plain wells that one would expect to have a shorter cleanup duration are listed with a significant timeframe under this column (e.g. MW-34-100 has 20-30 years listed, MW-36-100 lists 2-10 years) These duration does not appear to correspond to model simulation for Cr(6) reduction.	The column headings in Table 2.1-3 and Table 2.2-1 will be changed for consistency to read "Currently-Anticipated Timeframe for Cr(VI) Concentration Decreases," and additional detail will be added to the text in Sections 2.1 and 2.2 where the tables are referenced. The timeframe ranges for Cr(VI) attenuation will also be re-assessed based on model results, and tighter timeframes provided in the 90% Design Submittal.	What are the anticipated changes between 60% and 90% that would cause PG&E to reconsider timeframe in 90%? Please clarify what defines a “decrease” (one ppb, 100 ppb, an order of magnitude, or ????). Clarify that this decrease is not necessarily the cleanup goal. For clarity, what’s the point of the column? Comment resolved pending review of 90% design.			Comment resolved.	O&M Manual Volume 2 Sections 2.1, and 2.2.1 O&M Manual Volume 2 Table 2.2-1
674	FMIT-179 Hualapai-130 Chemehuevi-130 Cocopah-130 CRIT-130	Append L2- V2 2.1 & 4.2 Table 2.1-3 &Table 4.2.1		Table 2.1-3 has the symbol “T” for wells that may be monitored continuously with a transducer, however, none of the compliance/monitor wells appear to have transducers planned. Some or all of the IRZ wells may have transducers installed (e.g. bot p. 3-7). Is there any plan to collect water level data from any of the compliance wellsmore frequently than quarterly? Might there be value in collecting	As the commenter notes, the monitoring wells selected for transducer locations are listed in Table 4.2-1 and Section 4.2.7. The groups of wells listed for transducers in Table 4.2-1 are locations where significant changes in water levels are anticipated. The wells in these groups overlap substantially with the wells, both inside and outside of the plume, that have been specified in the compliance monitoring program,			Comment resolved pending review of the 90% design.	Comment resolved.	O&M Manual Volume 2 Table 2.1-2

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				water level data more frequently (monthly? bi-weekly?) from a subset of monitor wells during remedy startup and duringthe first remedial cycle? Such data may aid in refining the GW model in evaluating lithologic heterogeneities and response of the system. Section 4.2.7 does indicate wells Q, P, S andothers may have transducers. And Table 4.2.1 indicates that some wells in various categories may have transducers.	resulting in a comprehensive set of continuous water level data. To help clarify this point, a column will be added to Table 2.1-2 in the 90% Design Submittal indicating which monitoring wells will be outfitted with transducers.					
675	FMIT-173 Hualapai-125 Chemehuevi-125 Cocopah-125 CRIT-125	Append L2- V2 2.1 Figure 2.1-1	Figure of compliance monitoring well network.	This figure does not show IRZ18, which appears to have been added during the modeling exercise due to potential breakthrough. (e.g. Append B, Fig. 6.4-2) With the addition of IRZ-18, does this impact the location of planned compliance well “D”?	The inclusion of IRZ-18 in Appendix B, Figure 6.4-2 was an error. IRZ-18 is still a future provisional well location and was not included in the modeling runs. The figure will be corrected in Appendix B for the 90% Design Submittal. See also response to comment #345a FMIT-61. The locations of IRZ-17 and IRZ-19 depicted in Figure 2.1-1 represent the most current planned locations. Based on these positions, the location of compliance well “D” is appropriate. If IRZ-17 and IRZ-19 are shifted based on future discussions, the location of compliance well “D” will also be reconsidered. Note that several of the IRZ Injection Well locations (including IRZ-17 and IRZ-19) may change based on ongoing discussions between PG&E and stakeholders. The 90% Design Submittal (including Appendix B and Appendix L) will be updated to reflect the finalized NTH IRZ well locations.			Comment resolved.	Comment resolved.	O&M Manual Volume 2 Figure 2.1-1
676	FMIT-178	Figure 2.1-3		Do the wells have to go inside the area between the extant lobes of the Maze? This area is extremely culturally-sensitive and the lack of discovered artifacts in this area does not mean that it is not culturally significant and is related to, and a part of the adjacent areas. Every effort should be made to avoid and minimize infrastructure in this area.	It is assumed that this comment refers to monitoring well “I”, in particular, and was perhaps written prior to resolution of the location for this proposed monitoring well in July. See also response to comment #707a FMIT-182. A site walk was held on July 30, 2013 to see the options for relocation of monitoring well “I”. During the site walk, the group visited the area of the westernmost alternative location. After walking the area and considering the alternatives, the group decided that: (1) a location approximately 45 to 50 feet south-southeast of the original location proposed during the July			Comment resolved pending review of the 90% design and relocation of well “I” based on site walk with the Tribes.	Comment resolved.	O&M Manual Volume 2 Figure 2.1-3

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					2013 TWG meeting was acceptable to stakeholders; and (2) while this location was more physically constrained than the original location, it likely provided sufficient room for construction. The easternmost alternative location was also discussed, but the group agreed that the westernmost alternative location was preferred from both a technical and stakeholder perspective. PG&E documented the discussions and satisfactory resolution of concerns in a letter to the FMIT and the Hualapai on August 30, 2013.					
677	DOI-261	Section 2.2, Figure 2.2-2	Decision Diamond 3	It seems the questions posed should have the same answer in order to move forward with the decision, i.e., indicate “AND” and not “OR”.	In this case "OR" is the appropriate decision point. If TOC or dissolved iron is present, then the conditions for chromium reduction are being provided and operations should continue. It is possible that Cr and iron would be present and Cr(VI) would be greater than 32 ppb because complete reduction has not yet occurred. If that is the case, then operations would still continue in the same manner.		Comment resolved.		Comment resolved.	Not applicable
678	DOI-262	Section 2.2, Figure 2.2-2	Decision Diamonds 16 and 18	Inclusion of both diamonds seems unnecessary. Also, it is not clear how the decision logic flows to these two decision diamonds. The decision diamonds could be deleted and Note 2 expanded to discuss using the Contingency Plan when short and long term modifications are ineffective. The Contingency Plan (Table 2.1-1) does not appear to provide more information than what is given in this diagram.	**Flowchart** Boxes 16 and 18 deal with two different issues: incomplete chromium treatment versus unanticipated migration of byproducts. The actions that would be taken to address these two issues are different, and so they were included as two separate branches of the diagram. The flowchart includes actions that are currently foreseen to potentially be needed to adapt the operations for various issues. Note 2 indicates that actions beyond those that are currently contained in the flowchart may be considered and implemented. Consequently, it is difficult to expand upon the list at this stage (i.e., in advance of knowing what conditions will occur that will not be covered by the current list of actions). **Contingency Plan** The Contingency Plan—referred to in Box 19 of the flowchart—provides two potential measures that may		Comment resolved.		Comment resolved.	O&M Manual Volume 2 Figure 2.2-2

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					need to be taken if Cr(VI) treatment at the NTH IRZ is not complete: (1) the construction of additional injection/extraction wells beyond the currently specified provisional wells; or (2) use of additional water sources, if the system is flow limited. These measures are stated under actions if the NTH IRZ "is not effective at removing Cr(VI) from groundwater as designed" in Table 2.1.1 (Appendix L, Volume 3). A note will be added to clarify this point at the branches to Box 18: "If operational adjustments prove to be ineffective at achieving system performance, then the adaptive operations process flows to the Contingency Plan." A note will be added to clarify this point at the branches to Box 16: "If operational adjustments prove to be ineffective at achieving system performance, then the adaptive operations process flows to the Riverbank Extraction Hydraulic Control Evaluation."					
679	DOI-263	Section 2.2, Figure 2.2-3	Box 14	The path to Box 14 is not clear from the logic diagram. The box could be eliminated and Note 1 expanded to discuss using the Contingency Plan when short and long term modifications are ineffective. Also, the Contingency Plan (Table 2.1-1) does not appear to give more information than that provided in this diagram.	If the evaluation in Decision Diamond 12 indicates that the northern NTH IRZ extraction in conjunction with the IRL extraction is still not adequately controlling Cr(VI), then additional adjustments need to be made cycling back to Box 4 on the diagram. However, if several rounds of adjustments have been made and the system is still not performing adequately, additional actions will need to be taken under the Contingency Plan. A note will be added to clarify this point at the branches to Box 14: "If operational adjustments prove to be ineffective at achieving system performance, then the adaptive operations process flows to the Contingency Plan."		Comment resolved.		Comment resolved.	O&M Manual Volume 2 Figure 2.2-3
680	DOI-264	Section 2.2, Figure 2.2-4	Box 33	The path to Box 33 is not clear from the logic diagram. The box could be eliminated and Note 1 expanded to discuss using the Contingency Plan when short and long term modifications are ineffective.	See response to comment #679 DOI-263. A similar note will be added to clarify that when rounds of adjustments listed on the flowchart do not appear to improve performance, the adaptive operations process will flow to the Contingency Plan.		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Volume 2 Figure 2.2-4

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681	DOI-273	Section 3.0, Page 3-1	General Comment	Will the sampling results of the monitoring program be discussed in the quarterly reports to the regulators, along with conclusions and recommendations?	As specified in the reporting template provided in Exhibit L2.2-4 of the Introduction to Appendix L, quarterly reports will include a performance summary with sampling results, an interpretation of results, and an interpretation of progress toward RAOs.		Comment resolved.		Comment resolved.	Not applicable
682	DOI-274	Section 3.1, Page 3-1	"The compliance monitoring program will include 156 pre-existing monitoring intervals, 19 proposed locations, and 16 surface water sampling locations."	Should the term "intervals" be changed to "locations"?	The term "interval" rather than "location" was meant to highlight that multiple vertical intervals at individual locations are available to evaluate performance in three dimensions.		Comment resolved.		Comment resolved.	Not applicable
683	DTSC-214	Appendix L O&M Plan Volume 2, 3.1 Monitoring Locations, Anticipated Concentration Changes, and Timeframes, Page 3-1		Requested cross-sections and particle tracking should be provided to DTSC so that the proposed Compliance Monitoring Program can be properly assess. See preliminary comments on Table 2.1-3. A list of all site wells should be developed (or added to Tables 2.1-2 and/or Table 2.1-3, even those not designated to a particular program.	Cross sections will be produced to show monitoring well screens and chromium plume delineations (included in **Attachment Q**, at the end of this table). Per discussions during the TWG and subsequent calls with the agencies, simulated flow fields will be provided to illustrate the simulated groundwater flow directions (included in **Attachment E**, at the end of this table). Transport modeling has been provided and is a superior tool for assessing remedy performance and designing the monitoring program. In the 90% Design Submittal, all existing site wells will be included in Table 2.1-2, including those that are not designated to a particular program.	Okay, DTSC is awaiting the flow field diagrams for all layers and will reserve comments for now. DTSC will utilize the flow fields and cross-sections to assess the Compliance Monitoring Program.			Per DTSC request, particle track figures for Layers 1-4 were submitted to DTSC on March 11, 2014 (see **Attachment R** at the end of this table). DTSC will continue to assess the monitoring program and provide any further input. Based on the submitted data, DTSC provided initial thoughts on potential new monitoring wells to PG&E in March 2014. PG&E and Agencies will continue to discuss additional monitoring wells and with resolution occurring prior to submittal of the 90%.	O&M Manual Volume 2 Table 2.1-2
684	DTSC-215	Appendix L O&M Plan Volume 2, 3.1 Monitoring Locations, Anticipated Concentration Changes, and Timeframes, Page 3-1	The surface water sampling network includes ten river channel sampling points, four shoreline sampling points located along the Colorado River, and two surface water	Describe the difference between shoreline/ surface water samples and in-channel samples as I don't recall the difference being stated elsewhere (e.g., multi-level samples for river channel locations). Describe what vertical horizon the samples are obtained and reference the surface water sampling SOP.	The following text will be inserted into the 90% BOD: "In channel surface water samples are collected with a peristaltic pump from a boat at two depths: 1 foot from the river bottom and 1 foot from the water surface. Shoreline samples are collected with a bailer or sampling pole from 4 to 6 inches below the water surface. These details are described in the Depth-Specific Surface Water Sampling SOP (SOP-A4)."	Comment resolved.			Comment resolved.	O&M Manual Volume 2 Section 3.1

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			sampling points in the East Ravine.							
685	DTSC-216	Appendix L O&M Plan Volume 2, 3.1 Monitoring Locations, Anticipated Concentration Changes, and Timeframes, Page 3-2		Site characterization efforts in the past focused on delineating the perimeter/extent of contamination that emanated from the PG&E Topock Compressor Station. As a result, the core of the plume was not well characterized. The core of the plume (where the greatest concentrations of contaminant mass occur) is an important component of the remedy as it will need to be aggressively "attacked" as part of the cleanup effort. Failure to identify the plume cores can lead to very extended cleanup timeframes as well as remedy failure. Suggest adding wells to characterize plume core. Perhaps the TWB-3 area and northeast of IRL-6. Are locations between I-40 and the railroad inaccessible to monitoring well drill rigs?	See also responses to comment #136 DTSC-43 and #137 DTSC-44. PG&E has considered the installation of additional wells to the north of TWB-3/northeast of IRL-6. However, due to constructability issues observed in the field (e.g., presence of multiple major gas pipelines and evidence of significant erosion) as well as access/right-of-way limitations associated, for example, with construction in the area between I-40 and the BNSF Railroad, these locations were dropped from consideration. Note that future provisional wells IRL-6 and IRL-7 were proposed as a contingency should monitoring indicate that cleanup is not progressing at the anticipated rate. These wells, located in the current central portion of the Cr(VI) plume, are designated as "late time" remedial wells that are intended to accelerate the remediation process once eastward migration of the Cr(VI) plume has occurred.	Okay. Comment resolved. See response to #136 DTSC-43 and #137 DTSC-44 to confirm well location constraint issues raised and related items.			Comment Resolved.	Not applicable
686	DTSC-217	Appendix L O&M Plan Volume 2, 3.2 Sampling Analytes and Frequencies, Page 3-2	Water level measurements will be collected at all locations on a quarterly basis for comparison against groundwater flow model predictions. The frequency of water level collection will be re-assessed after the first two years of operation. These results will be used to measure hydraulic gradients and directions as lines of	More detailed discussion of water level measurements and groundwater flow determinations must be presented in the design document due to the flat gradients and ever changing river stage. How many water level monitoring wells will be fitted with pressure transducers? Where are the critical locations for water level measurements based on anticipated modeled flows?	Comment noted. See response to comment #674 FMIT-179 and Hualapai/Chemehuevi/Cocopah/CRIT-130. The network of monitoring wells selected for transducer locations was described in the text in Section 4.2.7 and Table 4.2-1. To further clarify this network, a column designating transducer locations will be added to Table 2.1-2 in the 90% Design Submittal. A discussion of these continuous water level measurements will be added to the text in Section 3.2. See also response to comment 655 DTSC-201.	The response appears adequate pending review of the revised section 3.2. Also, see response to comment #655 DTSC-201.			See response to comment #655 DTSC-201	O&M Manual Volume 2 Section 3.2

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			evidence in the assessment of hydraulic plume control, as discussed in Section 4.4.							
687	DOI-275	Section 4.0, Page 4-1	General Comment	It is anticipated that up to two years may be required in order to make the necessary adjustments to extraction and injection wells and chemical dosage in order to achieve routine operations. During this start-up period, will performance monitoring be more frequent than what is shown in Table 4.2-1?	It may take two years to bring the components of the remediation system on-line, sequentially, as outlined in the proposed transition plan in Section 7.3.2 of the main body of the 60% BOD. The monitoring frequencies specified in Table 4.2-1 are for each component of the system and would be implemented as each component is brought on-line, as detailed in Note 5 of the table. This plan does provide for increased sampling frequencies during start-up of individual components. For example, the sampling frequency for the NTH IRZ dose response wells is high (i.e., monthly) during the first year of implementation, which is anticipated to include 6 months ON and 6 months OFF as specified in the table. Higher sampling frequencies are also anticipated for the extraction wells during the first few months of operation, as specified in the table.		Comment resolved.		Comment resolved.	Not applicable
688	DOI-276	Section 4.0, Table 4.2-1		Note 2 is not identified in the table.	Note 2 will be removed from the table and references to notes will be corrected in the 90% Design Submittal or added to the table.		Comment resolved.		Comment resolved.	O&M Manual Volume 2 Table 4.2-1
689	DOI-277	Section 4.1, Page 4-1	"These estimates will be updated as the 90 percent design is completed, as the system is installed, and as baseline sampling is conducted. The estimates will also be adjusted during remedy implementation as data are collected during operations and	Will the estimates be updated by re-running the computer model?	Yes, the estimates will be updated as the solute transport model is refined (see response to comment #653 DOI-268 for more detail).		Comment resolved.		Comment resolved.	O&M Manual Volume 2 Section 4.1

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			the solute transport model is refined."							
690	DOI-278	Section 4.1, Pages 4-1 and 4-2	TOC, Arsenic, Iron and Manganese sections	Will isopleth maps be developed in order to assess individual chemical concentration distributions, and also to compare concentration trends to earlier model runs?	Concentration maps for byproducts (iron, arsenic, and manganese) will periodically be prepared to compare concentration distribution with baseline data and model predictions. Color dot maps or concentration shading will be used to illustrate the distribution, rather than isopleths. Isopleths would be difficult to construct given the elevated concentrations of these constituents in the reducing rind. Concentration maps are less useful for TOC and are not planned; the distribution is expected to be limited to the dose response wells. Text will be included in the 90% BOD to reflect this response.		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Volume 2 Section 4.1
691	FMIT-181 Hualapai-132 Chemehuevi-132 Cocopah-132 CRIT-132	Append L-Vol 2 Section 4.1 p. 4-2	*Although arsenic concentrations are expected to increase due to IRZ operations, arsenic is expected to attenuate rapidly outside of the IRZ footprint. In NTH IRZ dose response wells, concentrations are expected to be between 2 and 10 µg/L, with a maximum of 15 µg/L.*	Are these expected arsenic concentrations based on known arsenic concentrations in HNWR-1?	The expected arsenic concentrations provided in this section for the in situ areas were based on organic carbon concentrations rather than known concentrations in HNWR-1. The 60% design assumed that water from HNWR-1 would be treated for arsenic; these assumptions will be updated in the 90% design if that changes.			Comment resolved pending review of 90% design documents.	Comment resolved.	O&M Manual Volume 2 Section 4.1
692	DTSC-218	Appendix L O&M Plan Volume 2, 4.2 Sampling Locations, Analytes and Frequencies, Page 4-3		Requested cross-sections and particle tracking should be provided to DTSC so that the proposed Process Control Monitoring Program can be properly assessed.	Cross-sections will be produced to show monitoring well screens and chromium plume delineations (included in **Attachment Q**, at the end of this table). Per discussions during the TWG and subsequent calls with the agencies, simulated flow fields will be provided to illustrate the simulated groundwater flow directions (included in **Attachment E**, at the end of this table). Transport	Okay, DTSC is still evaluating the flow field diagrams and will reserve comments for now. DTSC will utilize the flow fields and cross-sections to assess the Process Control Monitoring Program.			Per DTSC request, particle track figures for Layers 1-4 were submitted to DTSC on March 11, 2014 (see **Attachment R** at the end of this table). DTSC will continue to assess the monitoring program and provide any further input. See response to RTC #683	90% BOD Appendix B, Figures 6.5-13 through 6.5-20 90% BOD Section 3.1, Figures 3.1-1 through 3.1-7

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					modeling was provided and is a superior tool for assessing remedy performance and designing the monitoring program.				DTSC-214.	
693	DTSC-219	Appendix L O&M Plan Volume 2, 4.2 Sampling Locations, Analytes and Frequencies, Page 4-3	Regardless of sampling frequency specified in the Process Control Monitoring Program, baseline data will be collected from all monitoring wells in the program for the full suite of analytes listed in Table 4.2-1 where these data do not already exist.	Also indicate that the full suite will be collected if it has been a while since the last sampling round (e.g., 2 to 3 years).	The text in the 90% Design Submittal will be modified to read "…where these data do not already exist or have not been collected within the past two years."	Okay			Comment resolved.	O&M Manual Volume 2 Section 4.2
694	DOI-279	Section 4.2.1, Page 4-4	"Nitrate. Nitrate is a primary indicator of the establishment of reducing conditions . . . "	The presence of nitrate is an indicator of oxidizing conditions, not reducing conditions. Please clarify.	It is not the "presence" of nitrate that is an indicator of reducing conditions, but rather a decrease in nitrate concentrations. The bullet will be revised in the 90% Design Submittal to read: "The removal of nitrate from solution is a primary indicator of the establishment of reducing conditions..."		Comment resolved		Comment resolved.	O&M Manual Volume 2 Section 4.2.1
695	DOI-280	Section 4.2.1, Page 4-4	"General water quality parameters. . . . These parameters may be will be used to answer specific questions that arise, . . . "	Please clarify which terms are correct – "may be" or "will be"?	The text will be changed to "may be" throughout. General water quality parameters may be useful for troubleshooting as described in the section and may be analyzed on an as needed basis; however, sampling for general water quality parameters is not being specified definitively in the monitoring plan.		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Volume 2 Section 4.2.1
696	FMIT-184 Hualapai-134 Chemehuevi-134 Cocopah-134 CRIT-134	Append L2- V2 Sect 4.2.3 p. 4-5	*Monitoring wells on the Arizona side of the river (MW-54 and MW-55clusters) will be included in the river bank extraction monitoring well network. These will serve as*	Well cluster MW-55 is located some distance up in the Topock marsh, not really on opposite the river bank. Would it be suitable to include well cluster MW-58, although south of the MW-55 cluster, this location is on the river bank, between the south end of the IRZ and the East Ravine loop?	PG&E believes that the commenter is suggesting including well cluster MW-56 rather than MW-58. Well cluster MW-56 is in fact already included in the riverbank extraction monitoring well network and will be included in this sentence in the 90% design, as indicated in Table 2.1-2. MW-56 does serve as a sentinel well cluster, and the point will be clarified in the text in the 90% BOD. MW-58 is located south of National Trails			Comment resolved pending review of 90% design documents.	Comment resolved.	O&M Manual Volume 2 Section 4.2.3

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			sentinel wells…		Highway near East Ravine extraction well ER-6 and has been included in the monitoring program as part of the East Ravine Extraction monitoring well network.					
697	FMIT-185 Hualapai-135 Chemehuevi-135 Cocopah-135 CRIT-135	Append L2- V2 Sect 4.2.5 p. 4-5 & Table 2.1.3		Regarding extraction wells, Table 2.1.3 indicated water levels in these will also be taken only quarterly. It may be useful to collect water levels from at least a subset of extraction wells on a monthly basis, at least for the initial cycle, to aid in confirming that plume control is maintained consistently.	Extraction wells will be equipped with pressure transducers to allow for continuous water level monitoring. A column will be added to Table 2.1.3 to indicate which wells have pressure transducers.			Comment resolved pending review of 90% design.	Comment resolved.	O&M Manual Volume 2 Table 2.1-3
698	DTSC-220	Appendix L O&M Plan Volume 2, 4.2.7 Water Level Monitoring, Page 4-7	The water level measurements will be converted to elevations referenced to sea level so that the water levels can be integrated site-wide for interpretation of potentiometric levels and hydraulic gradients.	Discuss salinity and temperature corrections that will need to be made to water level measurements. Discuss when it will be mandatory to utilize pressure transducers.	These issues will be discussed in the 90% Design Submittal. Salinity and temperature corrections will be discussed in SOPs included in the 90% design. Text will be added to discuss the reasoning behind pressure transducer deployment. A column to specify transducer locations will be added to Table 2.1-2.	Comment resolved pending review of 90% design.			Comment resolved.	O&M Manual Volume 2 Section 4.3 O&M Manual Volume 2 Table 2.1-2
699	DOI-281	Section 4.3.1, Page 4-6	"The approach and methodology for this assessment will be consistent with regulatory guidance prepared and distributed by the U.S. Environmental Protection Agency (USEPA), including the document *A Systematic Approach for Evaluation of Capture Zones at Pump and Treat Systems*, dated January	Please refer to the Attachment D regarding Capture zone Analysis per USEPA 2008 Report.	**SPECIFIC COMMENT (DOI ATTACHMENT D TO DOI-281):** *Step 2 – Does the current recovery and treatment system adequately capture and treat deeper contamination in the deeper bedrock area?* The proposed East Ravine Extraction Wells will be within the fractured/faulted bedrock; therefore, sufficient well depth will be important to (1) address depth of potential Cr[VI] in groundwater, and (2) allow for enough available drawdown. It is anticipated that the extraction wells will be drilled to an elevation that is at least as deep as the deepest monitoring well used for monitoring Cr(VI) in groundwater in the East Ravine area. **SPECIFIC COMMENT (DOI ATTACHMENT D TO DOI-281):** *Step 2 – If IRZ-40 were to be incorporated*		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Volume 2 Sections 2.2.3, 4.2.9, 4.3.3, and 4.3.4

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			2008 (USEPA 2008).		*into the design as an active extraction well, what impact would this have on the capture zone? Has this been modeled?* IRZ-40 has not been simulated as an active extraction well. While it may produce a small simulated capture zone, due to the relatively thin saturated aquifer thickness in this area, only a limited sustainable rate would be achieved at this location. IRZ-40 would provide more benefit as a provisional carbon amended injection well in order to address potential Cr(VI) impacts in the aquifer. Also see response to comment #109 DTSC-30 with respect to additional extraction wells in the East Ravine area. **SPECIFIC COMMENT (DOI ATTACHMENT D TO DOI-281):** *Step 3 – Defining the capture zone within the field does include utilizing observed drawdown values within monitoring wells in response to pumping. How will PG&E factor in fluctuations of groundwater elevation in response to changes in river elevation to document drawdown within each monitoring well?* Monitoring studies at the site have shown that water levels in monitoring wells located near the river fluctuate in a sinusoidal pattern with a frequency of approximately one day. Wells closest to the river exhibit a daily fluctuation magnitude of between 1 and 2 feet per day (compared to a daily river stage fluctuation of up to 3 feet). However, this oscillation does not prohibit assessment of longer-term trends. To do this, a smoothed curve—representing a median water level elevation for any given day—will be created, and will serve as the source for the drawdown values used in assessment of groundwater gradients. The use of transducers in monitoring wells will allow for this method to be used. **SPECIFIC COMMENT (DOI ATTACHMENT D TO DOI-281):** *Step 3 – Please explain how PG&E will develop groundwater contours; hand*					

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					contouring or computer based contouring? If computer based, what software is anticipated to be used? When using water level data at extraction wells, will well inefficiency and well losses be taken into consideration in order to more accurately state water levels at extraction points? Does PG&E have piezometers located adjacent to each extraction well location? Hand contouring will be performed to generate water level contours for mapping. For water level values at extraction points, well efficiency effects will be considered. First, step tests will be performed at some extraction wells. Such test data will then be used to estimate well efficiency and, thus, a corrected water level will be calculated. Second, in lieu of having piezometers immediately adjacent to extraction wells (in order to address the borehole count restrictions), piezometers will be installed within the filter pack (outside of the extraction well casing) in some wells, and the difference between the water levels in the piezometer and in the extraction well casing during pumping will also aid in proper correction for well efficiency effects. **SPECIFIC COMMENT (DOI ATTACHMENT D TO DOI-281):** *Step 6 – How does PG&E plan on performing Step Six (Interpret actual capture based on Steps 1-5, compare to target capture zone, assess uncertainties and data gaps)? What data, analysis, modeling, and graphic presentations does PG&E plan on using to interpret actual capture and comparing these results to the targeted capture zones?* PG&E intends to present an assessment of plume control by using the available lines of evidence as discussed in Section 4.3 of the Sampling and Monitoring Plan (Appendix L, Volume 2). These lines of evidence are consistent with the USEPA (2008) guidance. This assessment will be presented in a way consistent with the recommended approach as outlined					

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					in the USEPA (2008) guidance document, pp. 26-29. Cr(VI) plume control will be assessed by: interpreting, to the extent possible, the extent and magnitude of hydraulic impact; assessing uncertainties and potential data gaps; and, evaluating the need to reduce or increase extraction rates.					
700	DTSC-221	Appendix L O&M Plan Volume 2, 4.3.2 Definition of the Target Capture Zone in Conjunction CSM and RAOs, Page 4-7	Based on this RAO, the objective of hydraulic capture of Cr(VI) in groundwater at the site is to protect the designated beneficial uses of the Colorado River.	The capture zone discussion appears to be applied to protection of surface water. It would appear necessary to include capture zone assessment to protect groundwater resources (e.g., prevent migration of chromium or byproducts to the east of the river bank line). The text should be expanded to discuss this issue.	The design of the river bank extraction system applies to both the river and groundwater beyond the river bank line. The extent to which plume control is required at various portions of the site can be defined by the RAOs and the DQOs for the selected groundwater remedy (RAOs are found in Section ES.2, 60% BOD Report, p. vii.; DQOs are found in Section 2, Draft O&M Plan, Volume 2, pp. 2-1 through 2-9.). The two RAOs relative to plume control are as follows. • RAO 2: Prevent or minimize migration of Cr(T) and Cr(VI) in groundwater to ensure concentrations in surface water do not exceed water quality standards that support the designated beneficial uses of the Colorado River (11 ug/L Cr[VI]). • RAO 4: Ensure that the geographic location of the target remediation area does not permanently expand following completion of the remedial action. RAO 4 will be added to section 4.3.2. The six DQOs relative to plume control are as follows. • NTH IRZ DQO-3: By-product generation and migration from the NTH IRZ must be controlled. • NTH IRZ DQO-4: Extraction on the north end of the NTH IRZ will be conducted to control Cr(VI) with the NTH and river bank extraction systems. • IRL DQO-3: Control migration of Cr(VI). • IRL DQO-4: Control the migration of by-products in the deeper units.	The section needs to be revised to clarify that capture zones will also be applied to protection of the groundwater basin as a resource.			PG&E will work on items related to this comment as directed in the Agencies' direction letter dated April 4, 2014.	O&M Manual Volume 2 Section 4.3.2

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					• TCS DQO-2: TCS Recirculation Loop Transwestern Bench Extraction Wells will be operated to remove Cr(VI) mass from the high concentration area in the vicinity of the TCS and control migration toward the East Ravine. • TCS DQO-3: East Ravine Extraction Wells will be operated to remediate Cr(VI) and control migration towards the river.					
701	FMIT-186 Hualapai-136 Chemehuevi-136 Cocopah-136 CRIT-136	Append L2- V2 4.3.3 p. 4.7 & Sect 4.3.3.4 p.4-9	*There are a number of methods or tools available to access plume control. Each of these methods is considered a separate line of evidence.*	Tracer testing is listed under 4.3.3 as one of the methods to assess plume control. However, on page 4-9, the text indicates that of all the "lines of evidence" listed, tracer testing was eliminated. It is confusing to list this as a "line of evidence" and then eliminate it later in the text. It would be clearer to just leave this element off the initial list, and include a discussion of this and any other methods that were considered and discarded as a separate paragraph(s).	The discussion that is referenced was designed to provide a comprehensive list of available methods and tools generally known to the profession as well as mentioned in the USEPA guidance. This will be clarified in the 90% design to satisfy the comment.			Comment resolved pending review of the 90% design.	Comment resolved.	O&M Manual Volume 2 Section 4.3.3
702	MWD-18	Appendix L, Draft O&M Manual, Section 4.3	Hydraulic Control Evaluation/ Capture zone analysis	For the 90% design report, this section should include a specific approach that will be used to confirm capture zone effectiveness over time. Due to the various stresses that will be placed on the aquifer over time due to the turning on and off of injection and extraction wells and natural stresses (such as changes in river stage, flooding of Bat Cave Wash, or seismic activity), various metrics should be established for these different time periods that meet plume treatment criteria and are shown to be protective of the Colorado River.	Sample collection will be coordinated with the transient water level data collected using the transducers, and sample timing may be adjusted to better reflect water quality variability as a function of seasonal variations in river stage and corresponding groundwater level changes.				Comment resolved.	O&M Manual Volume 2 Section 4.3.3
703	MWD-19	Appendix L, Draft O&M Manual, Section 4.3.3.1	Capture zone analysis	The use of river stage measurements compared to groundwater levels will be misleading because as the river stage declines in the winter months, there is a lag in the groundwater response, and the result would indicate flow towards the river. For the IM, a gradient between paired wells was used to assess capture. A similar metric should be developed for the planned remedy for times of high and low river stages.	See response to comment #699 DOI-281 for gradient assessments related to river stages and corresponding fluctuations of groundwater levels. See response to comment #655 DTSC-201 with regard to hydraulic gradient assessments.				Comment resolved.	O&M Manual Volume 2 Section 4.3.3

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704	DOI-282	Section 4.3.2, Page 4-7	"The current extent of Cr(VI) concentrations in groundwater that exceed 32 ug/L, the regional background concentration, is illustrated in Figure 2.1-1."	Do the combined outlines of both isopleths of Cr (VI) concentrations above 32 ug/L represent the horizontal capture zone that PG&E is targeting?	No. The proposed remedial design is not intended to provide complete hydraulic control of the Cr(VI) footprint defined as >32 ug/L. The remedy design is a combination of in situ groundwater treatment and hydraulic control, and is intended to remediate the Cr(VI) plume through implementation of IRZs as well as the hydraulic control in specific areas. While some portions of the Cr(VI) >32 ug/L will be captured by extraction wells, the remedy is designed to treat remaining Cr(VI) >32 ug/L that may not be hydraulically controlled. Thus, the Target Capture Zone (the term from USEPA, 2008) is not all Cr(VI) >32 ug/L but rather portions of the plume that are not reduced by the IRZ, including: (1) where Cr[VI] is >32 ug/L within the flood plain and to the east of the planned IRZ wells; (2) where Cr[VI] >32 ug/L is within the bedrock in the East Ravine area; and (3) where byproducts are at concentrations above natural levels within the deeper portion of the unconsolidated alluvium beneath the flood plain.		Resolved.		Comment resolved.	O&M Manual Volume 2 Section 4.3.2
705	DOI-283	Section 4.3.3.1, Water Level Pairs/Three-Point Gradient Analysis, Page 4-8	"This line of evidence (water level pairs/three-point gradient analysis) will be used to the extent allowed by the locations of the monitoring wells."	In the event that additional wells are required to more accurately reflect the gradient analysis, does PG&E plan on installing the additional wells?	The currently proposed monitoring network was designed to strike a balance between adequately describing the hydraulic gradients needed to assess hydraulic control objectives while minimizing infrastructure and honoring the well counts in the FEIR. If data gaps become apparent during initial data collection and evaluation, PG&E would use monitoring wells remaining within the well count to fill the data gap.		Resolved.		Comment resolved.	Not applicable
706	DOI-284	Sections 4.3.3.1 and 4.3.3.4, Pages 4-8 and 4-9		Is "USEPA (2008)" a citation? If so, it should be "(USEPA 2008)". A review of formatting would ensure continuity of referencing throughout the document.	The in-text citation will be changed to "(USEPA 2008)".					O&M Manual Volume 2 Section 4.3.3
707a	FMIT-182	Append L–Vol 2 Figure 4-2.1 "Proposed Monitoring Well I Location"	Note on Figure: *Area considered for monitoring Well location I. The proposed location shown*	Proposed monitoring well location "I" needs to be reevaluated in context of the new project EIR boundaries under recent consideration. It is not clear that a well in this location will not have cultural, visual and spiritual impacts and should only be placed	Comment noted. PG&E appreciates the FMIT and the Hualapai for working with the TWG to resolve the relocation of proposed monitoring well "I". A site walk was held on July 30, 2013			Comment resolved.	Comment resolved.	O&M Manual Volume 2 Figure 2.1-3

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			for monitoring wells within this area was selected based on topographic/access and field verification that the proposed location does not create any direct physical impact or effect on the Topock maze, as it is manifested archaeologically, in compliance with EIR mitigation measure cul-1a-20, PA and CHPMP mitigation measures.	after the latest round of archeological surveys and geoarchaeological studies have been fully incorporated into a updated EIR boundary. The placement of these wells should be discussed with the Tribes in light of the latest such surveys.	to see these options for monitoring well relocation. During the site walk, the group visited the area of the westernmost alternative location. After walking the area and considering the alternatives, the group decided that: (1) a location approximately 45 to 50 feet south-southeast of the original location proposed during the July 2013 TWG meeting was acceptable to stakeholders; and (2) while this location was more physically constrained than the original location, it likely provided sufficient room for construction. The easternmost alternative location was also discussed, but the group agreed that the westernmost alternative location was preferred from both a technical and stakeholder perspective. PG&E documented the discussions and satisfactory resolution of concerns in a letter to the FMIT and the Hualapai on August 30, 2013.					
707b	Hualapai-133 Chemehuevi-133 Cocopah-133 CRIT-133	Append L–Vol 2 Figure 4-2.1 "Proposed Monitoring Well I Location"	Note on Figure: *Area considered for monitoring Well location I. The proposed location shown for monitoring wells within this area was selected based on topographic/ access and field verification that the proposed location does not create any direct physical impact or effect on the Topock maze, as it is manifested archaeologically, in compliance with EIR mitigation measure cul-*	Proposed monitoring well location "I" needs to be reevaluated in context of the new project EIR boundaries established in the summer of 2013. It is not clear that a well in this location will not have cultural, visual and spiritual impact and should only be placed after the latest round of archeological surveys have been incorporated into a updated EIR boundary. The placement of this well should be discussed with all stakeholders in light of the latest archeological surveys.	See response to comment #703a FMIT-182.			Comment resolved.	Comment resolved.	O&M Manual Volume 2 Figure 2.1-3

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			1a-20, PA and CHPMP mitigation measures.							
708	FMIT-183	Figure 4.2-1		The Tribe objects to the conclusion in the legend that the proposed location does not create any direct physical impact or effect on the Topock Maze as it is manifested archaeologically. First, the Tribe questions the accuracy of the statement. Is this conclusion supported by recent filed studies and reports, including the draft geoarchaeological report? Second, the statement can mislead a reader into thinking that the well a) has no direct impact on a tribal cultural resource (it does) and b) has no indirect and cumulative effects on cultural resources (it does). Such legends need to be corrected throughout the BOD. Have the drafters of these documents been included in the required sensitivity training?	See response to comment #84a FMIT-22. Further, the drafters of the document are sensitive to the Tribe's viewpoint. The wording in the legend is intended to refer to similar language in the EIR.				PG&E's response was discussed with the FMIT, and revised in response to that discussion.	Not applicable
709	DTSC-222	Appendix L O&M Plan Volume 2, 5.0 Other Sampling and Monitoring, Page 5-1		A program to sample domestic/private water wells in the area should be added to this section. The objective of the program should be to evaluate potential effects the remedy could impart to private wells both chemically and hydraulically. Baseline values should be established for each well prior to system startup and then sampled periodically throughout the remedy. Wells such as the new Marina well, Sanders, Smith (abandoned?), Topock2/3, and the Park Moabi wells should be included at a minimum and possibly wells associated with the EPNG station and private Arizona wells to the north.	It is PG&E's understanding that EIR mitigation measure WATER-1 is intended to proactively identify and mitigate potentially significant effects on local groundwater levels associated with freshwater extraction wells. PG&E plans to demonstrate compliance with WATER-1 using computer simulations – information from the forthcoming pumping test at HNWR-1 (as part of FWIP) which includes measurement of water levels at nearby wells, will be used in this demonstration. It is unclear how the program suggested in this comment is different from WATER-1 from the perspective of *"evaluate potential effects the remedy could impart to private wells ….. hydraulically."* At this time, PG&E is aware of one private well (Sanders) located within the area where gradients may be significantly altered by pumping from HNWR-1 on the Arizona side of the Colorado River that may supply drinking water. A recent windshield reconnaissance in Sept 2013 showed the Smith well with both piping and power disconnected. PG&E will try to	The program requested should evaluate potential effects the remedy might impart to private wells both chemically and hydraulically. Hydraulic assessment could include monitoring water levels of the monitored wells over time to see if remedy related effects are noted. Additionally, the hydraulic pumping for monitored wells should tie into the model to most accurately depict flow fields. Infrequent monitoring will suffice (e.g., baseline and then every two or three years with options to modify frequency based on better understanding of actual flow dynamics and chemical transport after the remedy progresses.) Wells located in the vicinity of the remedy should be included (e.g., Topock Marina, Sanders, Smith) to ensure the viability of the wells are not jeopardized by the remedy. Topock 2/3 data collected for			Comment resolved. PG&E will implement the monitoring program as directed assuming well owners will allow sampling of their wells. Details will be included in the 90%.	90% BOD Section 3.3.2 O&M Manual Volume 2 Sections 5.2.2 and 5.4

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					make contact with the residents to determine if the Sanders well is still used for drinking water. Topock-2/3 are public supply wells that are monitored regularly under the Safe Drinking Water Act. It is unclear why the installation of another pumping well nearby should trigger additional monitoring beyond that which is already mandated by their use as public supply wells. As for the other AZ wells mentioned in the comment, based on information in the ADEQ Topock Groundwater Study, the wells at the Mohave Topock Compressor Station (MTS-1 and MTS-2) supply water that is not suitable for drinking and is used in cooling towers and restrooms. These wells are approximately 5,000 feet from the HNWR-1 and Site B locations. The direction of the gradient at MTS is not projected to change significantly due to HNWR-1 or Site B pumping. The nearest well to the north is GSRV (also known as RPGS), which is currently not in use. Gradients will remain southerly in this area with HNWR-1 or Site B pumping. Based on communications with the Topock Marina owner, PG&E understands that the new Marina well produces salty water (specific conductance 15,000 to 18,000) that is not suitable for drinking or irrigation, and therefore, will be used only for fire protection. It is not clear whether the existing 4" well at the Marina will remain when the Marina completes the planned new production well. If not, ongoing sampling the new production well could be problematic from a water management standpoint -- the purge water is likely too salty to discharge to the ground or to the river and the purge volume will be large due to the expected large diameter and depth of the well (286 feet). While PG&E does not see a technical merit for an ongoing monitoring program of these wells, PG&E agree that a baseline data set could be beneficial. Therefore, PG&E will research the logistics associated with sampling these wells and report back to the	supply purposes should suffice provided it can be provided to agencies DTSC assumed PG&E would continue to monitor the Park Moabi wells and would include them in the private well program. RPGS/GSRV-2 should be monitored more for assessing potential effects to the Arizona fresh water pumping well (same for MTS-1 and MTS-2) in an effort to minimize installation of new wells.				

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					agencies. As for the California side of the Colorado River, PG&E has been collecting and reporting baseline data from the Park Moabi wells.					
710	DTSC-223	Appendix L O&M Plan Volume 2, 5.1.1 Sampling Locations, Page 5-1	This monitoring network is designed <u>to</u> track COPC concentrations in areas where they are currently elevated as well as areas where they may be transported during the remedial action.	DTSC concurs with the overriding basis for the COPC monitoring captured in the cited sentence. However, detailed review of well locations and sampling frequencies will be conducted after DTSC receives requested particle tracking information (including 5 year tick marks). It is requested that a separate COPC monitoring table be assembled that distinguishes between elevated COPC wells and downgradient wells (as well as other pertinent information such as analytes and frequency). Modifications/corrections will be requested. For example, Figure 5.1-2 illustrates that wells MW-66-165, MW-67-185, MW-67-225, and TW-1 have the highest selenium concentrations across the entire site, but none of them are included for selenium monitoring according to Table 2.1-2. Similar issue for nitrate.	PG&E has prepared a separate COPC monitoring table and revised its format with input from DTSC to provide more information about which wells have elevated concentrations of COPCs and to include wells where nitrate will be sampled for process control monitoring (see **Attachment N**, at the end of this table). This table will be included in the 90% design.	Comment resolved.			Comment resolved.	O&M Manual Volume 2 Section 5.1.1
711	DTSC-224	Appendix L O&M Plan Volume 2, 5.2 Monitoring of Freshwater Source (HNWR-1), Page 5-2	A detailed discussion of the desired water quality for injection is included in the 60% BOD Report (Section 3.3, Freshwater Supply and Storage).	As noted in comments on section 3.3, a detailed discussion of the desired water quality for injection do not currently exist. Discharge limits should be established for all analytes that will be injected into the aquifer. Please revise Section 3.3 to contain the required information. It's good to see that an analyte list was developed in Exhibit 5.2-2.	See responses to comment #145 DTSC-50 and #181 DTSC-70.	Response noted. See responses to comment #145 DTSC-50 and #181 DTSC-70.			Discussion between DTSC, DOI, RWQCB, and PG&E is ongoing to resolve this comment. This topic will be carried forward. Resolution of this comment will be included in the 90% design. PG&E will also work on items related to this comment as directed in the Agencies' direction letter dated April 4, 2014.	O&M Manual Volume 2 Section 2.2.2
712	DTSC-225	Appendix L O&M Plan Volume 2, 5.2 Monitoring of Freshwater Source (HNWR-1), Page 5-2	The naturally occurring arsenic concentration in Well HNWR-1 ranges from 15 to 16 µg/L, below the site background concentration of 24.3 µg/L.	Indicate that the arsenic background concentration cited is a regional value and that the area of injection contains arsenic at lower concentrations below MCLs. This is the very reason that a separate decision by the State Water Resources Board is needed for the proposed water injection from HNWR-1.	The sentence will be revised to read: "The naturally occurring arsenic concentration in Well HNWR-1 ranges from 15 to 16 µg/L, below the regional background concentration of 24.3 µg/L <u>but above the concentration in existing wells near the freshwater injection area.</u>"	Okay, provided requested edits are incorporated.			Comment resolved.	O&M Manual Volume 2 Section 5.2

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713	DTSC-226	Appendix L O&M Plan Volume 2, 5.2.1 Proposed Analytes and Frequencies, Page 5-2	Exhibit 5.2-2	Please add the typical rad. chem. analytes to this exhibit. PG&E had agreed to sample for these water quality parameters previously.	Gross alpha and gross beta analyses will be added to the analytical suite for the freshwater supply well(s) in Exhibit 5.2-2.	Okay.			Comment resolved.	O&M Manual Volume 2 Table 5.2-4
714	DTSC-227	Appendix L O&M Plan Volume 2, 5.2.2 Source Water Assessment, Page 5-2		Several DTSC comments exist on a nearly equivalent section contained in Section 3 of the BOD 60%. Please make modifications to this section as well based on those previous comments.	Comment noted. Modifications in equivalent sections in the BOD will be carried to this section.	Okay, pending review of carry over text.			Comment resolved.	O&M Manual Volume 2 Section 5.2.2
715	FMIT-187 Hualapai-137 Chemehuevi-137 Cocopah-137 CRIT-137	Append L-Vol 2 Section 5.1 p. 5-2	*Monitoring frequency for the inorganic suite will be quarterly for the first year of operation, switching to semiannual in subsequent years.*	The HNWR-1 well will be pumping at least 600 gpm of water and will be injected into upland areas that have low metal concentrations associated with local groundwater. It is therefore suggested that the sampling frequency of this water be greater than quarterly to ensure that contamination of this upland groundwater not occur. During start up a monthly sampling frequency is suggested and monthly sampling continued during periods of heavy water usage.	PG&E agrees that more frequent sampling of the freshwater well during the initial startup could provide more confidence in the stability of the water quality and agrees to revise the sampling frequency to monthly for the first 6 months followed by quarterly, assuming that the water quality is generally stable at that time. If the water quality appears to be changing rapidly, monthly sampling would be continued beyond the first 6 months. It is not anticipated that the freshwater flow rate would be varied on any regular basis, however if there was a future reconfiguration of the remedy that caused a significant increase in freshwater pumping rate, the need for additional sampling frequency would be evaluated based on the data available at that time. Text will be updated in the 90% BOD to reflect this response.			Comment resolved pending review of 90% design documents.	Comment resolved.	O&M Manual Volume 2 Section 5.2.1
716	DOI-285	Section 6.1, Page 6-1	"In summary, laboratory data will be imported into the project database and the data will be validated by the project chemist or designee."	What type of training and/or certifications will the data validator be required to possess?	See response to comment #805 DOI-348.		See response to comment #805 DOI-348.		Comment resolved	Not applicable

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717	DTSC-228	Appendix L O&M Plan Volume 2, 6.1 Data Validation, Page 6-1	Data validation procedures are provided in Sections 6.3 and 6.4 of the PG&E Program Quality Assurance Program Plan (QAPP) (CH2M HILL 2012b).	If not already done, the entire QAPP (not just an Addendum) should be included in the design document.	The Program QAPP will be included in Appendix B of the O&M Manual Volume 2. Note that this is the same Program QAPP that was included in Appendix H to the Soil RFI/RI Work Plan (January 2013). The Program QAPP was written to cover multiple projects for PG&E and covers both soil and water. The individual addendum covers details specific to a particular project or site.	QAPP should be media specific to the project associated with it. Did the soil RFI/RI WP QAPP include water sampling? Comment resolved.			Comment resolved	O&M Manual Volume 2, Appendix B
718	DTSC-229	Appendix L O&M Plan Volume 2, 6.1 Data Validation, Page 6-1	Exhibit 6.3-1	"Offsite lab data" is repeated twice in heading balloons. Please revise.	Text in the second heading balloon will be changed to "Onsite lab data".	Okay.			Comment resolved	O&M Manual Volume 2 Exhibit 6.3-1
719	DOI-286	Section 6.3, Field Measurement/Process Monitoring Data, Page 6-1		Provide discussion on the quality control activities that will occur for this type of data.	Field data will be collected electronically using hand held device and/or via down-hole sensors. The data will be maintained in a data base and reviewed by experienced field staff or chemist. Historic trends, water quality data, and well construction details will also be made available to the field crew so that they can identify anomalous data (compared to historical values) in a timely manner and field verify/correct the data after consulting with experienced scientist or chemist as appropriate. Field work will be in accordance with written SOPs. Periodic field audits by experienced staff will be conducted to verify that SOPs are being followed. Equipment calibration will follow manufacturers' recommendation to ensure data quality. Text will be included in the 90% BOD to reflect this response.		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Section L3.1 O&M Manual Volume 2 Section 6.3
720	DOI-287	Section 6.3, Onsite Laboratory Data, Page 6-1		Please identify the analyses that will be performed at the onsite laboratory, and indicate in the text that these data will not be validated. Provide a discussion on the quality control activities that will occur.	The following text will be added to Section 6.3 (inserted verbiage shown in <u>underline</u> typeface, deleted verbiage shown in ~~strikethrough~~ typeface): "Certain testing for process control monitoring will be performed at an onsite laboratory in accordance with site-specific SOPs. <u>Onsite lab measurements could include at a</u>		Comment resolved.		Comment resolved.	O&M Manual Section L3.1 O&M Manual Volume 2 Section 6.3

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Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

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Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
					minimum, Cr(VI), Cr(T), Fe(II), Conductivity, Turbidity, and pH (see Appendix A for SOPs). Additional measurements could be added in the future. The onsite lab data ~~collected~~ will be recorded in a bench log book and entered into a spreadsheet and/or database periodically. Although the onsite data will not be validated using the same procedure as the offsite lab data, they are and will continue to be reviewed, and anomalous results will be reviewed, and if needed, reanalyzed at the direction of the project chemist. Onsite laboratory samples will periodically be analyzed in conjunction with offsite analysis, and the data will be reviewed/compared for quality and accuracy."					
721	DOI-288	Section 6.3, Offsite Laboratory Data, Page 6-1	"At a minimum, the laboratory will maintain the following records: . . . "	How long will the laboratory maintain such records?	See response to comment #527 DOI-203.		Comment resolved		Comment resolved.	O&M Manual Volume 2 Section 6.3
722	DTSC-230	Appendix L O&M Plan Volume 2, 6.5 Reporting, Page 6-4	Exhibit 6.5-1	Make the following edit: Monitored natural attenuation (MNA) as a long-term component to address residual Cr(VI) that may remain in recalcitrant portions of the aquifer after enhanced in-situ treatment.	The suggested text edit will be made.	Okay.			Comment resolved	O&M Manual Exhibit L2.2-2 O&M Manual Volume 2 Exhibit 6.5-1
723	MWD-20	Appendix L, Draft O&M Manual, Section 6.5, Reporting		In addition to presenting a template for quarterly reporting, annual reporting and 5-year performance review templates should also be included.	Content of five-year performance reviews is included in the Corrective Measure/ Remedial Design Work Plan (Section 4.4, page 4-12).	Concur with PG&E's response.	Concur with PG&E's response.		Comment resolved.	Not applicable
724	DTSC-231	Appendix L O&M Plan Volume 2, 7.0 Sampling Methods and Procedures, Page 7-1	Sampling and field measurements will be performed in accordance with the Standard Operating Procedures presented in Appendix A.	The SOPs contained on CD only were discovered late and will be reviewed as part of the 90%. However, Table of Content for this Volume and behind the cover to Appendix A should contain a list of the SOPs submitted so that readers can quickly refer to the document even if it is only on the CD.	Comment noted. A list of the SOPs included in Appendix A (on CD) was provided in Sections 7.1 (page 7-1) and 7.2 (page 7-4). A list of the SOPs will be added to the table of contents and cover sheet of Appendix A as requested.	Okay.			Comment resolved.	O&M Manual Volume 2 Table of contents O&M Manual Volume 2 Appendix A

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725	DOI-289	Section 7.1, Page 7-1	General Comment	What training will personnel receive on the proper use and calibration of equipment?	Equipment specific and site-specific training are initially provided by senior on-site personnel (experienced field personnel) familiar with the necessary techniques for proper use and calibration of on-site equipment. Field personnel will be trained on the appropriate procedures by the experienced field personnel using SOPs and equipment manufacturer's manuals as primary references. Periodic audits and training will be conducted by the project manager and project chemist. This practice would continue for remedy monitoring. Text will be included in the 90% BOD to reflect this response.		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Volume 2 Section 7.1
726	DOI-290	Section 7.1, Page 7-1	"Field measurements will be collected in accordance with the following SOPs (included in Appendix A)."	Recommend the following text be added to the Required Equipment sections of SOP-A7 and SOP-A8; "a set of spare batteries should be included with equipment for field measurements".	Spare batteries are included with the equipment for field measurements. SOP-A7 and SOP-A8 will be updated to state that "a set of spare batteries will be included for field equipment."		Comment resolved.		Comment resolved.	O&M Manual Volume 2 SOP A-7 and A-8
727	DOI-291	Section 7.1, Page 7-1	"Field measurements will be collected in accordance with the following SOPs (included in Appendix A)."	Recommend language be added to the Preparation section of SOP-A11; "ensure the tape measure is not crimped and that it will hang free and clear of any obstructions enabling it to fully extend to the bottom of the well".	This is assumed, and SOP-A11 will be updated with the recommended language.		Comment resolved.		Comment resolved.	O&M Manual Volume 2 SOP A-11
728	Hualapai-138 Chemehuevi-138 Cocopah-138 CRIT-138	Append L-Vol 2 Section 7.1 p. 7-2	CrVI samples should be preserved using added basic solution, raising the pH so that no CrVI reduction would occur, and standard operating procedures from the 60% design report (SOP-L1 and –A6) are cited.	Samples for analysis of CrVI by colorimetric method using Hach DR4000 (as shown in SOP-L1) should not be preserved with the basic solution (NaOH), and should be analyzed within 24 hours of collection. The diphenylcarbohydrazide method adds an acidic reagent buffer, which brings the sample down to about pH = 2. Interferences in the method include high pH; therefore, addition of the basic preservative would create interferences in the analytical method. Another method for CrVI analyses (EPA 218.6 using ion chromatography) does allow for	SOP-L1 is applicable for process samples within IM3 treatment plant – the NaOH solution is used for SC-201B or 300A samples which are water that have been treated using ferrous chloride. SOP-L12 is applicable to groundwater samples analyzed in the on-site lab. In SOP-L12, field filtered samples are used to analyze for Cr(VI) and no preservative is added. EPA method 218.6 is the method used by the commercial laboratories and Appendix B Section 4.1.3 (the Topock QAPP addendum) requires every groundwater sample to have a matrix spike analyzed to ensure			Comment resolved.	This comment and response were discussed with the Tribes and TRC at the November 5, 2013 TWG meeting. Additional written comments were also received from TRC (Win Wright) on November 18, 2013. PG&E provided written responses to the additional comments on December 9, 2013 (see **Attachment O**, at the end of this table). TRC (Win Wright) presented final information at the February 12, 2014 TWG meeting (see additional info to **Attachment O**).	Not applicable

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				sample preservation using the basic preservative; however, this method is not described in the 60% SOP's. Bench tests and matrix spikes could be done to determine the accuracy and precision of CrVI analyses given different pH's and carbon concentrations.	accuracy. See also response to TRC's (Win Wright) memorandum dated December 9, 2013, included in **Attachment O**, at the end of this table				Comment resolved.	
729	FMIT-188 Hualapai-139 Chemehuevi-139 Cocopah-139 CRIT-139	Append L-Vol 2 Section 7.1 p. 7-2	Cr(VI) samples should be preserved using added basic solution, raising the pH so that no Cr(VI) reduction would occur, and standard operating procedures from the 60% design report (SOP-L1 and –A6) are cited.	Many of the groundwater samples collected will have elevated carbon concentrations. As soon as a water sample is pumped from a well, reactions can be accelerated due to changes in dissolved oxygen and temperature, and Cr(VI) reduction could take place in the sample bottle, possibly giving a false reading. Even if a basic preservative is added, Cr(VI) reduction is known to occur in natural high pH waters. Bench tests and matrix spikes could be done to determine the accuracy and precision of Cr(VI) analyses given different pHs and carbon concentrations.	For groundwater samples, an inline filter is situated at the tip of the hose/ tube directly before the sample enters the pre-preserved sample container. Very little oxygen is introduced during the process and in fact, oxygen actually reacts with Ferrous iron inhibiting/slowing the reduction of Cr(VI) to Cr(III). Once the sample container is full the container is capped, placed in a zip-lock bag and placed on ice in a cooler. Reducing the temperature (ground water temperature is generally in the mid 80°F – 90°F) of the sample slows down any possible chemical or biological reactions. In addition the buffer solution (specified by EPA method 218.6) is not just for raising the pH but is designed to stop any reaction that might be occurring and provides a 28 day holding time.			Comment resolved.	This comment and response were discussed with the Tribes and TRC at the November 5, 2013 TWG meeting. TRC (Win Wright) presented final information at the February 12, 2014 TWG meeting (see additional info to **Attachment O**). Comment resolved.	Not applicable
730	Hualapai-140 Chemehuevi-140 Cocopah-140 CRIT-140	Append L-Vol 2 Section 7.1 p. 7-2	Field analyses of unstable constituents	Dissolved sulfide analyses may not be necessary for routine monitoring; however, sulfide measurements help to describe geochemical end products and electron acceptors. In addition to sulfide, the IRZ will generate hydrogen gas, and it is known that H2(g) is explosive. Collection and analysis of end-products could help verify geochemical modeling results.	Hydrogen sulfide will be periodically monitored in the on-site lab as a means to monitor subsurface conditions and understand how the process of reducing the Cr(VI) is progressing. The formation of hydrogen gas is not anticipated to be an issue. When in-situ treatment was first being introduced as a treatment for ground water contamination, the fear of excess hydrogen gas being produced at explosive levels was common. However, over time it has been shown that although hydrogen gas is produced it is not typically produced at explosive levels. Extra care needs to be taken in cases where hydrogen gas and hydrogen sulfide can displace the air such as confined spaced (e.g., well vaults)			Comment resolved pending review of 90% design documents.	Comment resolved	Not applicable

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731	FMIT-189 Hualapai-141 Chemehuevi-141 Cocopah-141 CRIT-141	Append L-Vol 2 Section 7.1p. 7-2	*Preservation and analysis of samples, unpreserved FeII samples can be transported for lab analyses.*	Oxidation of Fe(II) to Fe(III) is on the order of hours to days. Samples for Fe(II) concentration need to be analyzed immediately, or preserved using hydrochloric acid (HCl), then analyzed within a couple of days of sample collection. Samples for dissolved sulfide (S(II)) cannot be preserved, and need to be analyzed as soon as possible after sample collection. It is widely known that iron colloids can pass through a 0.45 micrometer filter (e.g. in water from turbid or muddy wells); therefore, turbid samples should be flagged. Protocols for turbid samples could include use of smaller filter sizes (e.g., 0.2 micrometers).	For Ferrous iron, a sample is treated with 1, 10-phenanthroline (HACH packet) at pH 3 to 3.5. Molecules of the phenanthroline chelate each atom of ferrous iron to form an orange-red complex. The colored solution obeys Beer's law; (concentration is proportional to the color intensity and is independent of pH as long as the pH is between 3 and 9. A pH between 2.9 and 3.5 ensures rapid color development in the presence of an excess of phenanthroline. The HACH packets are designed to acidify and provide the phenanthroline needed for the reaction, so adding additional HCl would drive the pH below the desired pH needed for the analysis and cause erroneous results. Samples should be field filtered, stored on ice or in a refrigerator and analyzed the same day as collection. Because the reaction is specific to ferrous iron, ferric iron colloids do not react with the phenanthroline.			Comment resolved.	This comment and response were discussed with the Tribes and TRC at the November 5, 2013 TWG meeting. TRC (Win Wright) presented final information at the February 12, 2014 TWG meeting (see additional info to **Attachment O**). Comment resolved.	Not applicable
732	DOI-292	Section 7.2, Page 7-4	"Surface water, groundwater, and process water sampling will be performed in accordance with the following SOPs . . . "	Regarding the Preparation and Set-up section of SOP-A14, will the SOP delineate the requirement of providing a safety flotation vest to each individual in a boat?	Safety flotation vests are listed in the preparation and setup section of SOP-A14. The forthcoming Topock Program Health and Safety Plan (draft at 90% design) will include expanded information on health and safety requirements. In addition to the program wide requirements/policies, it is expected that each contractor will have its own health and safety plan for their contracted work.		Comment resolved pending review of 90% design.		Comment resolved.	Not applicable
733	DOI-293	Section 7.5, Page 7-6	General Comment	Will field sampling personnel receive training on sampling techniques specific to this project?	As with current project practice, field sampling personnel will be trained on sampling procedures using project-specific SOPs.		Comment resolved.		Comment resolved.	Not applicable
734	DOI-294	Appendix A, SOP A-4, Page 1 of 5	"2) Applicable project work plan or monitoring plan."	The in-text citation for this is CH2M HILL, 2012; however, there are three references in the Reference list (CH2M HILL 2012a, CH2M HILL 2012b, CH2M HILL 2012c). Suggest that this in-text citation should be CH2M HILL 2012a.	Comment noted. Since the QAPP and QAPP Addendum could be updated over time without materially affect the SOP, it is suggested that the referenced in-text citation be removed from this SOP.		Comment resolved.		Comment resolved.	O&M Manual Volume 2 SOP A-4

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735	DOI-295	Appendix A, SOP A-6, Page 1 of 3	"2) Applicable project work plan or monitoring plan."	The in-text citation for this is CH2M HILL, 2012; however, there are three references in the Reference list (CH2M HILL 2012a, CH2M HILL 2012b, CH2M HILL 2012c). Suggest that this in-text citation should be CH2M HILL 2012a.	See response to comment #734 DOI-294.		Comment resolved.		Comment resolved.	O&M Manual Volume 2 SOP A-6
736	DOI-296	Appendix A, SOP-B16, Page 1 of 6	"This SOP describes the analysis of in-situ and ex-situ soil samples . ."	The in-text citation is CH2M HILL 2005; however, this item is not listed in the Reference list.	The following reference will be added to Section 8 of Volume 2 (pages 8-1 and 8-2): "CH2M HILL. 2005. *Sampling, Analysis, and Field Procedures Manual, PG&E Topock Program*."		Comment resolved.		Comment resolved.	O&M Manual Volume 2 Section 8
737	DOI-297	Appendix A, SOP-B16, Page 2 of 6	XRF Soil Analysis Documentation	The in-text citation is CH2M HILL 2005; however, this item is not listed in the Reference list.	See response to comment #736 DOI-296.		Comment resolved.		Comment resolved.	O&M Manual Volume 2 SOP B-16
738	DOI-298	Appendix B	General Comment	Does PG&E plan on auditing offsite laboratories?	Laboratory audits will be conducted to ensure compliance with the PG&E Program QAPP and its Addendum (Volume 2, Appendix B).		Comment resolved.		Comment resolved.	Not applicable
739	DOI-299	Appendix B	General Comment	Please address several questions related to river sampling procedures: • Will field data include river clarity, weather conditions, and river stage data? • Will the boat be anchored and the engine turned off prior to sampling? • Should bottom sediment be disturbed during sample preparation in the field, will time be allotted for settling to occur?	These topics are addressed in SOP-A4 as follows: • The field sheets do include weather conditions. One of the parameters is turbidity so clarity is recorded. River depth is also recorded at each location prior to sampling; no other river stage data is recorded in the field. • The boat is always anchored, but the engine is not always turned off in case there is an issue of dragging during the course of sampling. For this reason, ambient blanks are collected as a QC measure. In addition, the motor is always downstream of the sampling location since the boat is always pointed upstream. There is typically heavy boat traffic on the river so the motor is left running at all times as a safety precaution in case emergency avoidance action must be taken. • Sediments are generally not disturbed as the river water is typically traveling at 8-9 miles per hour. There are typically little to no sediments due to the speed of the river current. The river bottom is typically		Comment resolved.		Comment resolved.	Not applicable

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					rocky/sandy. Any sediments that are disturbed when the anchor is set are instantly carried away by the current long before any samples are collected.					
740	DOI-300	Appendix B, Section 1.0, Page 1		The section includes an in-text citation for CH2M HILL 2012; however, there are three CH2M HILL references in the Reference list (CH2M HILL 2012a, CH2M HILL 2012b, CH2M HILL 2012c). It seems that this in-text citation should be CH2M HILL 2012a.	The reference section 6.0 (Page 6 of Appendix B) only lists one 2012 reference.		Comment resolved.		Comment resolved.	Not applicable
741	DTSC-232	Appendix L O&M Plan Volume 2, Appendix B, 3.4 Additional QC Steps for Hexavalent Chromium in Select Floodplain Well Samples, Page 3	In addition to the QC steps discussed in Section 3.3, the additional QC steps outlined in this section will be followed during sampling of a) monitoring wells located in the floodplain that are currently non-detect (or detected at less than 5 parts per billion) for Cr(VI), and b) future floodplain wells as determined by the CH2M HILL project chemist. The applicable floodplain wells are listed in Exhibit 3-2. As water quality changes, the list of wells in Exhibit 3-2 will be reviewed periodically (initially on an annual basis) and updated as applicable.	Include the rationale for requiring additional QC steps in select floodplain wells. Note that wells MW-21 and MW-55 are not necessarily floodplain wells.	As an additional QC step, extra containers and equipment blanks (EBs) are collected to help determine the source for any possible anomalous results found in the listed wells. All the wells located near the river (specifically those around the active reducing zone) are susceptible to colloidal suspension of chromium which can cause a high variability between the Cr(T) and Cr(VI) results. The special EBs are collected to eliminate the possibility of cross contamination between the wells (i.e., to verify that carry over is not occurring). The MW-55 and MW-21 wells are not necessarily in the floodplain, but are located in areas “near” the river where the “normal” results are either non-detect or low concentrations. In the event results are “detected” higher than normal or where the Cr and Cr(VI) concentrations differed more than is considered normal, PG&E works to determine the likely causes and provide the analysis in the report where the results are reported.	Isn’t this true of most wells? Need to elaborate Seems like this should apply to all site wells with low level detections (less that ~5-10 ppb). Comment resolved.			The additional QC steps were put into place due to the sensitive nature of the sample locations, where low level detections could have large implications if shown to be correct. The additional QC steps are of little use for wells in the uplands where slight differences of a few ppb are of less concern, especially where the sample concentration is less than the background concentration. At the same time, samples with concentrations greater than 10 – 15 ppb can have sufficient variability within the analytical methods to exceed the possible influence from contamination sources or colloidal suspension concentrations. This discussion will be incorporated into the 90% design document. Comment resolved.	O&M Manual Volume 2 Apdx B Section 3.3

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742	DTSC-233	Appendix L O&M Plan Volume 2, Appendix B, 3.5 Additional QC Steps for Cr(T) and Cr(VI) — River Samples, Page 4	For surface water sampling events; three analyte-specific sample containers will be collected from each sample location for both total chromium (Cr[T]) and Cr(VI). The laboratory will analyze the initial sample aliquot; if that result is considered "suspect" (any detected concentration in the river will be considered suspect), an additional aliquot of the original sample will be reanalyzed along with an aliquot from each of the additional sample volumes for comparison purposes.	"Suspect" detections should also be reported with qualifier for trend analysis in standard reports.	Three containers are collected and provided to the laboratories for cases of unexpected detects in the initial analysis. When a "suspect" result is initially obtained by the laboratory, the laboratory performs analyses on all sample containers in an attempt to determine if the initial result is correct or if it is a laboratory "artifact" (contaminate). In either case, the laboratory will report the result determined to be the most accurate, and that is the result that is validated and reported to the agencies. To date, all the "suspect" or anomalous results have been related back to a contamination issue in the laboratory. PG&E will work with the laboratory to ensure a more detailed case narrative is provided whenever an anomalous result is encountered.	Shouldn't this be included in laboratory exception report? DTSC is requesting that "Suspect" detections also be reported with qualifier for trend analysis in standard reports. PG&E shall comply with the Agency directive letter dated April 4, 2014 with regards to sampling methodology and data reporting. Comment resolved			Comment resolved.	O&M Manual Volume 2 Apdx B Section 3.4
743	DTSC-234	Appendix L O&M Plan Volume 2, Appendix B, 4.0 Method Quality Objectives and Quality Assurance Program, Page 5	See Tables 4-1 through 4-3 for project specific reporting level requirements and EPA/ California screening-level information that may differ from the QAPP.	Please screen Table 4-2 QAPP RLs and identify those RLs that are greater than MCLs. Select analytical methods that can attain MCL reporting limits.	See revised Table 4-2 – two columns (I and J) have been added to include Federal and California MCLs. Currently all analytes with California MCLs have RLs that are below or at the MCLs. Five organic analytes have federal MCLs below the listed RLs – they are 1,2-Dibromo-3-Chloropropane; 1,2-Dibromoethane (EDB); bis (2-ethylhexyl) phthalate; Hexachlorobenzene; and Pentachlorophenol. To lower the RLs for these five analytes, water analysis would need to be performed using the USEPA drinking water methods by a laboratory certified for those methods. However, the	Okay, pending review of revised table.			Comment resolved	O&M Manual Volume 2 Apdx B Table 4-2

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					drinking water methods are not generally used for groundwater monitoring and are not approved under the "40 CFR Parts 136, 260, 423, 430, and 435 - Federal Register / Vol. 77, No. 97 / Friday, May 18, 2012 / Rules and Regulations.					
744	DOI-301	Appendix B, Section 4.1.1, Page 5	"RLs should be a minimum of two times greater than the calculated MDLs."	Table 4-1 indicates that the Cr (VI) RL exceeds the most stringent screening criterion. There should be some discussion on the acceptability of this situation.	Screening levels are established by use of statistical analysis and are not based on the analytical capabilities of laboratories or methods. The 0.4 mg/kg RL used for this project is currently the lowest RL achievable using SW7199/3060A and is well below the industrial soil screening level. Text will be included in the 90% BOD to reflect this response.		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Volume 2 Apdx B Section 4.1.1
745	DOI-302	Appendix B, Section 6, Page 6		The following items are on the Reference list but are not referenced in the text: DTSC 2008, CH2M HILL 2007, USEPA 1999, USEPA 2000, and USEPA 2009.	Since the QAPP Addendum will be updated to incorporate changes to Tables 4-2 (see response to comment #743 DTSC-234) and 4-3 (see response to comment #747 DOI-304), Section 6 will also be updated to remove the references listed in the comment.		Comment resolved.		Comment resolved.	O&M Manual Volume 2 Apdx B Section 6
746	DOI-303	Appendix B, Section 6, Page 6		Not all of the references on Page 6 are found in Appendix B. Also, is this reference list different from the reference list for the main text, found on Pages 8-1 and 8-2?	Since the QAPP Addendum is a stand-alone document, it has its own reference section, separate from the reference section for Volume 2 (pages 8-1 and 8-2).		Comment resolved.		Comment resolved.	Not applicable
747	DOI-304	Appendix B, Table 4-3		Please provide RLs for the organic analytes.	Table 4-3 has been revised to include RLs for the organic parameters.		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Volume 2 Apdx B Table 4-2
Specific Comments – Appendix L – Volume 3: Contingency Plan										
748	DTSC-235	Appendix L, Volume 3, Section 1.0 Introduction		Category A under FMEA should not only be limited to attainment of final RAO. PG&E should define short term goals and process to monitor for attainment of these short term goals. Nonattainment should then trigger corrective actions through contingency planning. These short term goals should be specified in 60% design contingency planning (e.g. by production formation that is not dissipated or reverted in expected time frame according to model, undesirable or unexpected changes in geochemical quality of water in injection, extraction and production wells).	Unacceptable remedy performance (Category A) of the FMEA is defined as "Remedy does not meet RAOs, cleanup goals, design objectives, or otherwise perform as required," which is inclusive of shorter term performance objectives. The Sampling and Monitoring Plan (Appendix L, Volume 2) establishes detailed performance metrics to ensure that the system is meeting the short term performance objectives of (1 establishing the NTH IRZ while controlling byproduct generation, (2) establishing hydraulic control as needed for Cr[VI] and byproducts in the deep zone of the aquifer, and (3) flushing of the	See response to comment #38 DTSC-6.			Comment resolved.	Not applicable

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					plume. Operational flowcharts for obtaining these goals are provided in the Sampling and Monitoring Plan. The flowcharts also specify contingency measures when adaptive operations are not sufficient to meet the performance objectives.					
749	DTSC-236	Appendix L, Volume 3, Section 1.0 Introduction	Causes of potential failures are mitigated in the design process, in adaptive operations, and/or in corrective action/ contingency response planning.	PG&E places heavy emphasis on adaptive operations to mitigate potential failures as can be seen in many of the FMEA tables that refers back to the O&M plan and sampling plan. DTSC is concerned that the range of operational adjustments may not be sufficient to mitigate the need for contingencies. For example, based on current design, there are only very limited numbers of additional wells that can be installed before reaching the total 170 well count, as PG&E install injection wells near the boundary of the plume at IRLs, the concentrations for Cr6 or other key compounds may not be below background, would that difference change the assumption of the predicative model, and how much latitude would PG&E have to move the IRL injection wells? What would PG&E do then?	Based on available data, PG&E anticipates that the proposed IRL locations (IRL-1 through IRL-4) are outside of the baseline hexavalent chromium plume (i.e., as defined by the 32 ppb background concentration). If, during the installation of these wells, it is identified that the hexavalent chromium plume extends further to the northwest in these areas than currently understood, PG&E would consider several alternatives. Alternatives that could be considered include well relocation, amendment of water injected into the IRL well with TOC to enhance hexavalent chromium treatment within the immediate vicinity of the well (if concentrations are near 32 ppb), or other alternatives. A contingency plan will be included in the Construction/Remedial Action Work Plan.	Comment resolved pending review of the 90%.			Comment resolved.	Construction/Remedial Action Work Plan Sections 3.2 and 5.
750	DTSC-237	Appendix L, Volume 3, Section 1.0, Category D	Changes (such as visual impact) that necessitate re-opening the EIR process.	DTSC would not be “re-opening the EIR process.” The proper procedure would be to consider the additional CEQA impacts that have either not been identified or with a condition that was not anticipated. Either case, it would not be re-opening a CEQA decision, but to conduct additional CEQA analysis based on new information received.	Comment noted. PG&E understands that under CEQA, DTSC would determine whether new information meets any of the conditions listed in Public Resources Code section 21166. Text in the referenced section will be revised in the 90% design to reflect the above CEQA process.	Comment resolved.			Comment resolved.	O&M Manual Volume 3 Section 1 and all FMEA tables.
751	DOI-305	Table 1.0-1		In the cells for Categories D and E, Severity of Effect 2 and 3, the test states “See A”. Please define.	Text in the cited cells will be corrected to state “Not defined”.		Comment resolved.		Comment resolved.	O&M Manual Volume 3 Table 1.0-1.
752	DOI-306	Table 2.1-1	General Comment	What will PG&E’s response be should the capture zone not be as extensive as predicted?	Appendix L, Volume 1 (O&M Plan) and Volume 2 (Sampling and Monitoring Plan) describe the decision rules and framework for the adaptive remedy operations that will be used to achieve the remedy objectives, including those for plume control. Volume 3 (Contingency Plan) outlines PG&E's response approach	See response to comment #655 DTSC-201.	Resolved.		PG&E will work on items related to this comment as directed in the Agencies’ direction letter dated April 4, 2014.	Not applicable

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Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

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					should the adaptive procedures in Volumes 1 and 2 not achieve the remedy objectives. The following DQOs listed in Table 2.1-1 of the Sampling and Monitoring Plan (Appendix L, Volume 2) specify the decision rules for evaluating plume control and the adaptive operations framework that will be implemented if this evaluation indicates that plume control is not adequate: NTH IRZ DQO-4, IRL DQO-3, IRL DQO-4, TCS DQO-2, and TCS DQO-3, as outlined on the flowchart figures that are referred to in Table 2.1-1 for each DQO. Operational adjustments and activities listed in the flowcharts include, but are not limited to, increasing flow rates or altering the flow balance of the system, and bringing provisional wells on-line. See also response to comment 655 DTSC-201.					
753	DOI-307	Table 2.1-1, Conveyance (General)		In Table 1.0-1, Category E effect is not defined for severity level 4, yet for the release from the conveyance pipeline, it is defined. For the failures with severity level 2, none of the categories are checked which is inconsistent with Table 1.0-1. The rationale appears to be due to the low likelihood of the event, but likelihood is a different criterion. The logic in Table 1.0-1 as applied to the Section 2 tables needs clarification.	PG&E will clarify the application of Table 1.0-1 (Appendix L, Volume 3) in the 90% submittal.		Resolved pending review of the 90% design.		Comment resolved.	O&M Manual Volume 3 Section 1 O&M Manual Volume 3 Table 1.0-1
754	DTSC-238	Appendix L, Volume 3, Table 2.1-1	Release from conveyance pipeline	DTSC notes that only limited sections of the pipeline will be double walled. Furthermore, human observation of slow leaks with below ground pipes are unlikely. DTSC recommends a more robust leak detection system throughout the conveyance pipeline. PG&E must log all occurrences of these failures (leaks, fouling, clogging, and releases to wells, etc.), identify remedial measures taken and conduct periodic evaluations (i.e. 5 year reviews) to determine if a change in design would be necessary based on frequency of occurrence. This approach should be applied to all potential failures and detailed in periodic remedy performance reports	As described in Appendix C, Section C.5.1, conveyance pipelines will be single-walled unless the pipe is used to convey: (1) groundwater or remedy-produced water that exhibits the hazardous waste characteristic or (2) concentrated carbon substrate. In these cases, double-walled piping will be used. Double-walled pipe segments will include appropriately designed leak detection systems. Additionally, pipeline segments installed within belowground concrete trenches will be designed with leak detection at low points. Conveyance system maintenance Standard Operating Procedures will be provided in the 90% Design Submittal and will include maintenance, inspection, and logging	Okay, please also see comment #559 DTSC-157.			Comment resolved.	O&M Manual Volume 3 Table 2.1-1

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				to be submitted to agencies.	procedures. O&M Manual Exhibit L2.2-3 provides the preliminary communication framework, including communication of potential releases. As described in Appendix L, Volume 3, Table 2.1-1, PG&E is taking several measures in the design and planned operations to mitigate potential leaks, releases, or other failures of the conveyance pipelines. Should leaks, releases, or other failures be identified during remedy implementation, potential improvements will be evaluated at that time.					
755	DOI-308	Table 2.1-1, Remediation Wells (General)	"Extraction Well Failure."	Is it possible for the water in the Colorado River to overflow its banks to the extent that it would impact the River Bank extraction wells?	As indicated on Page 10 of Table 2.1-1 under "Flooding", remedy infrastructure has been designed to be located outside of the ordinary high water mark and 100-year floodplain to the extent possible. The proposed River Bank Extraction Well locations are outside of the ordinary high water mark and 100-year floodplain. It is therefore not considered likely that Colorado River flooding would impact River Bank Extraction Well operation.		Resolved.		Comment resolved.	Not applicable
756	DOI-309	Table 2.1-1, NTH IRZ	"Extraction of organic carbon and/or significant byproducts."	Treatment of extracted river bank groundwater to remove carbon and byproducts should equate with all unacceptable conditions being checked.	PG&E does not anticipate that treatment of extracted river bank groundwater will be required, and this potential is being mitigated in several ways through the design and planned operations, as described in Table 2.1-1. If these efforts are not successful and treatment is required, it is expected to have a significant cost increase (i.e., unacceptable condition) as defined in Table 1.0-1. However, although treatment is considered undesirable, it would not be expected to cause unacceptable conditions A, B, D, or E as defined in Table 1.0-1. No changes to Table 2.1-1 are proposed.		Comment resolved.		Comment resolved.	Not applicable
757	DTSC-239	Appendix L, Volume 3, Table 2.2-1, Remedy produced water management system	4. Poor Quality Water to Wells: presence of scaling ions or high pH water	PG&E states that one mitigation in design is to "add conditioning units, if needed." Are these contingency designs currently included in remedy produced water conditional plant? If not, addition of units in future will likely trigger additional CEQA evaluations.	To facilitate CEQA evaluation of the 90% design, PG&E will include general information on contingency conditioning units to address scaling ions (primarily manganese, iron, magnesium, and calcium) in the 90% design. This information will include unit description and estimates of footprint, chemical use, electricity use, and waste generation.	Okay pending review of the 90% design.			Comment resolved.	O&M Manual Volume 3 Section 2.2 and Appendix A.

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758	FMIT-190	Table 2.2-1		This chart is also troubling as it lists Re-Opening of EIR as a type of "Unacceptable Condition." It is the Tribe's view that more flexibility should be given regarding this potential: if there are alternate designs, methods, mitigation that could reduce impacts/effects to cultural resources but might reopen the CEQA or other process, they should be analyzed on their merits - not potentially summarily rejected by PG&E or the agencies because it could reopen an EIR, etc. Please clarify if DTSC's position is that re-opening of an EIR, etc., no matter the context, is an unacceptable condition and if so, the basis for DTSC limiting its future discretion in this manner regardless of future circumstances. The chart also lists "Significant Cost Increase" as a type of "Unacceptable Condition." Please clarify if DTSC's position is that cost increases to the PRP, is an unacceptable condition. Do DTSC and DOI agree with the PRP on what a "significant" cost increase is? Might that metric not change under different circumstances and contexts? Again, what is the basis for the agencies limiting their lawful discretion in the future based on cost alone, which is only one criterion under the law for making decisions under applicable law and ARARs?	This chart has factors that PG&E's engineers consider as they design the remedy. With respect to DTSC's position, PG&E defers to DTSC. PG&E's understands this entry on the chart as intended to indicate that one of the design parameters is consistency with the remedy that was selected based on the EIR, and avoiding the need to redo or reopen the EIR process. PG&E recognizes that DTSC will review the final design in compliance with CEQA. PG&E likewise defers to DTSC and DOI for their position on the cost effectiveness factor. From PG&E's perspective, cost effectiveness is one of the evaluation criteria required by RCRA and CERCLA in the CMS/FS process. In the CMS/FS, the selected remedy was scored medium for cost effectiveness, other alternatives that received a similar score have an estimated cost of $7M to $41M more than the selected remedy (see Table 5-7, page 5-85). Therefore, for the purpose of contingency planning for the remedy, PG&E defines potential causes for the remedy to increase in cost by more than $10M to $50M as conditions that need further agency discussion to allow PG&E to consider the most cost effective options for preventing a failure event.				PG&E's response was discussed with the FMIT, and revised in response to that discussion.	Not applicable
759	FMIT-191	Note 1		Note 1 is unclear as to whether the described trucking is within or outside of the groundwater EIR scope. Please clarify.	The 60% design includes an automated backwashing and conditioning system that, when operated as designed, will minimize the amount of trucking needed during O&M. The design is consistent with the certified EIR. For clarity, Note 1 will be revised as follows: "Anticipated annual remedy-produced water volume is 7.6 million gallons (MG) per year. With provisional wells this volume could increase to 10 MG per year. The automated backwashing and conditioning system has been designed to accommodate this range	For Note 1, PG&E cited Section 3.5.3, Operation and Maintenance of the project. The FEIR assumed that there will be periodic maintenance activities associated with the remedy that would require additional vehicular traffic. Although the FEIR did not specifically consider the contingency generated vehicular traffic, the FEIR did consider the cited level of traffic as part of the project.		Comment noted.	Noted.	O&M Manual Volume 3 Table 2.2-1.

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					of anticipated volume of wastewater. If the system functions as designed, the amount of trucking needed during O&M would be minimal, and within the range analyzed in the certified EIR (see Section 3.5.3, page 3-26)."					
760	DTSC-240	Appendix L, Volume 3, Table 2.3-1, Freshwater Supply	Possible Contingency Measures	PG&E did not acknowledge DTSC's requirement for PG&E to include a pre-treatment plant as contingency. Instead, PG&E specifies seeking other sources of freshwater. DTSC would clarification from PG&E on possible additional freshwater locations that have not already been considered by PG&E in the current Freshwater Implementation Plan. Also, PG&E identifies provision of "alternate water supply for affected water users" as a contingency for freshwater pumping causing effects on water quality or capacity in nearby wells. **This is beyond the terms of DTSC's approval of the proposed remedy.** DTSC's approval is conditioned on PG&E's operation not impacting nearby wells.	PG&E interpreted DTSC's direction in the 12/31/12 letter as to include a pre-injection treatment system in the 60% design for actual remedy implementation, and not as a contingency. Therefore, the system was not included in the "Possible Contingency Measures" column in Table 2.3-1. However, as directed by DTSC (#21 DTSC-2), PG&E will design an arsenic only freshwater pre-injection treatment system and this will be included in the 90% design as a contingency. PG&E only listed possible contingency measures in Table 2.3-1, but did not develop these measures. At this time, PG&E has not considered additional locations outside of those included in the Alternative Freshwater Source Evaluation. This possible contingency measure will be deleted.	Okay. DTSC notes the length of time it has taken to site and evaluate the current site B alternative freshwater source location and cautions that this contingency measure may be lengthy. Furthermore, it is DTSC's interpretation that PG&E should test and monitor for conditions that may impact quality, not just quantity, of water to nearby wells.			Comment resolved.	O&M Manual Volume 3 Table 2.3-1 and Appendix B.
761	DTSC-241	Appendix L, Volume 3, Table 2.4-1, Power Supply	Utility or generated power supply failure	As part of DTSC's remedy approval condition, PG&E is required to "rent or otherwise obtain a single new primary 320 kW generator, of similar make and model of the existing generator (Isuzu Model 6WG1X), for purposes of providing backup electricity when needed at the site for implementation of the approved project." (see remedy approval letter to Yvonne Meeks, January 31, 2011)	Text under the column titled Mitigation-Design will be clarified as follows: "Interconnection to other source(s) of generated electrical power, connection point to dedicated portable generator".	Okay.			Comment resolved.	O&M Manual Volume 3 Table 2.4-1.
762	DOI-310	Table 2.5-1	General Comment	What are the potential consequences if alarms do not signal the SCADA system?	For the SCADA to not get alarms, it would mean that there was a loss of communications which results in loss of status, control, and alarms. In this system, individual wells and other loads do not operate on their own and must be connected to the main SCADA for instruction. Therefore, if communications are lost, systems are shut down. The system design includes layers of protection against such consequences that will be		Comment resolved pending review of 90% design.		Comment resolved.	O&M Manual Volume 3 Table 2.5-1.

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					described in more detail in the control systems narrative planned for inclusion in the 90% design. In general, the following elements are included in the design: • Motors and valves go to safe positions following failure. • Local devices are controlled by local PLCs. • The SCADA will continuous monitor to verify signals are being received. • The SCADA will also confirm (every 1 to 3 minutes) and verify that there are no alarm conditions that should cause a device to be turned on or off.					
Specific Comments – Appendix L – Volume 4: Soil Management Plan, including Appendix A Groundwater Remedy Implementation – Baseline Soil Sampling and Analysis Plan										
763a	FMIT-192		General comment	It is requested that PG&E evaluate the use of displaced soils for the development of a soil/plant nursery in place of or in addition to the use of stockpiles. This approach would provide habitat for displaced seeds and plants and would better ensure that the biological integrity of the soil is maintained over potential long-term storage. If the development of a nursery is decided to not be a viable option it is further requested that the rationale behind the decision be clearly provided to the Tribe.	Salvage of topsoil during installation of linear utility features is a common practice for PG&E and will be done where the proposed excavation will occur in areas where undisturbed topsoil may be present. In such areas the upper 4 inches of soil will be carefully removed and placed near the excavation. The remaining sub-soil will then be excavated and stored separately from the topsoil. Following the installation of the pipe and backfilling of the trench the topsoil will be replaced over the trench. Therefore, there will be no need for long-term storage of undisturbed topsoil. As for the rest of the excavated soils that are not undisturbed topsoil, these desert soils in general are low in nutrients and organic matter and soils such as these that have been subject to disturbance typically lose a large percentage of the available nutrient supply and important soil biota. Therefore there is no ecological benefit associated with the salvage of soils from existing disturbed areas and such soils would not be suitable for the establishment of a native plant nursery. Additionally, one of the primary goals of the remedy design is to avoid and minimize disturbance to special-status plants, and therefore a careful analysis of the 60% design			Comment resolved.	Comment resolved	Not applicable

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					was conducted to determine areas where the impacts to culturally significant annual plants may occur. Based on the analysis, it was determined that less than one percent of the proposed pipeline will be located in undisturbed habitat. It was therefore determined that the amount of impacts to native vegetation does not warrant the need for an onsite nursery. PG&E does not believe that a nursery, based on using unsuitable displaced site soil is a viable option.					
763b	Hualapai-142 Chemehuevi-142 Cocopah-142 CRIT-142		General comment	It is requested that PG&E evaluate the use of displaced soils for the development of a soil/plant nursery in place of, or in addition to, the use of stock-piles. This approach would provide habitat for displaced seeds and plants and would ensure that the biological integrity of the soil is maintained over long-term storage. If the development of a nursery is decided to not be a viable option it is further requested that the rationale behind the decision be clearly provided to all stakeholders.	See response to comment #763a FMIT-192.			Comment resolved.	Comment resolved.	Not applicable
764	FMIT-195	Section 1		First paragraph is unnecessarily vague about when PG&E will receive approval to decommission and remove the IM3 system. The recent settlement between the Tribe and DTSC sets forth specific criteria for the decommissioning of the IM-3 treatment plant. A specific even milestone should be established for the determination of whether those criteria have been achieved. It should also be revised to reflect that displaced soil can be a project resource, particularly regarding the plant technical report which acknowledged the value of the duff, etc., for restoration.	The second sentence of the first paragraph will be revised as follows: "~~At some point during the implementation of the groundwater remedy, PG&E would receive~~ In addition, after receipt of approval from DTSC, with DOI's concurrence, PG&E will decommission and remove the Interim Measures No. 3 (IM-3) Groundwater Extraction and Treatment System (referred to herein as the "IM-3 system")." Regarding the use of displaced soil as a project resource, see response to comments #763a FMIT-192, #763b Hualapai-142, and #774 FMIT-193/Hualapai-143.			Review in progress. Comment resolved pending review of the 90% design.	This comment and response were discussed at the December 17-18, 2013 TWG meeting.	O&M Manual Volume 4 Section 1.
765	DOI-311	Section 1, Page 1-2	"Soil and material originating in or near Soil RFI/RI	Because much of the soil that is displaced that is not in or near Soil RFI/RI Investigation Areas is from along roadways, where there is a potential for lead and PAH	Polycyclic aromatic hydrocarbons (PAH) and lead analysis in surface soil along the groundwater remedy pipeline and structures outside Soil RFI/RI Investigation areas (areas of		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Section 1.

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			Investigation Areas . . . "	contamination, the soil should not be reused within the APE until it is appropriately tested. Please clarify.	known or suspected soil contamination) and along roadways will be added to the baseline soil sampling proposed in Appendix A of Volume 4, Soil Management Plan to pre-characterize the surface soil prior to construction. Text will be revised as follows (inserted verbiage shown in underline typeface; deleted text shown in ~~strikethrough~~ typeface): "… Displaced soil and material originating outside areas of known or suspected contamination ~~are assumed to be uncontaminated and~~ will be pre-characterized prior to remedy construction to identify areas potentially impacted by nearby current and former roadways (PAHs and lead). Displaced soil from areas outside of known or suspected contamination areas that is impacted with PAHs and lead will be handled and managed in accordance with this SMP and the forthcoming HSPs for construction and O&M activities. The uncontaminated soil will be reused as backfill into the same trench or excavation area, if practicable. The uncontaminated soil that cannot be immediately used as backfill may be reused in other areas within the Area of Potential Effect (APE), or stockpiled for future reuse within the APE."					
766	DOI-312	Section 1.2, Page 1-3	"Results from the RFI/RI at the site are being documented in three volumes: . . . "	Should the correct phrase be read as "the results are being documented" or "the results were documented"?	The RFI/RI Volume 3 Report has not been written, so the phrase as currently written is correct "the results are being documented".		Comment resolved.		Comment resolved	Not applicable
767	DOI-313	Section 1.2, Page 1-3	"The SWMUs, AOCs, UAs, and other investigation areas still being characterized in support of the RFI/RI Volume 3 are presented in Exhibit 1.2-1 and shown on Figure 1.0-1."	Could any of these ongoing investigations result in adjustments to the current capture zone and remedial program?	Outcomes of the soil investigation are not expected to result in changes to the proposed groundwater remedial program. Data from the forthcoming supplemental soil investigation will be used to verify this expectation (Soil Investigation Data Quality Objective #3).		Comment resolved.		Comment resolved.	Not applicable

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768	DOI-314	Section 2.2 Page 2-2	General Comment	There is no mention of how soil that is not in or near Soil RFI/RI Investigation Areas will be characterized and managed. Although Section 1 indicates this soil will be placed back in the excavation without characterization or otherwise used in the APE, excess soil used in the APE may require testing. This is of particular concern with excess excavated material from roadways.	Please see response to comment #765 DOI-311. The first paragraph of Section 2.2 will be revised as follows (inserted verbiage shown in underline typeface, deleted text shown in ~~strikethrough~~ typeface): "Soil ~~in or near Soil RFI/RI Investigation Areas that are~~ in the vicinity of the groundwater remedy system expected to be displaced will be pre-characterized following the Groundwater Remedy Implementation—Baseline Soil sampling and Analysis Plan (Baseline SAP), included as Appendix A of this document." The first sentence of the second paragraph will be revised as follows: "Representative sample profile results, existing soil samples, and knowledge of the area history will be used to evaluate waste classification for displaced soil that has not been pre-characterized." The first sentence of the fourth paragraph of Section 2.2 has been revised and a sentence has been added: "The waste characterization samples collected within or near Soil RFI/RI Investigation Area will be analyzed for applicable Soil RFI/RI Investigation Area analytical suite presented in Tables 1.2-1 and 1.2-2. The samples collected outside areas of known or suspected contamination will be analyzed for PAHs and lead."		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Section 2, 2.2, 2.3, 2.5, 3, and 3.1.1
769	DOI-315	Section 2.2 Page 2-2	"Soil in or near Soil RFI/RI Investigation Areas that are in the vicinity of the groundwater remedy system . . . "	The first sentence indicates that soil in or near Soil RFI/RI Investigation Areas that are in the vicinity of the groundwater infrastructure will be pre-characterized. Later in the paragraph, the text states that there will be construction and O&M activities in or near Soil RFI/RI Investigation Areas that have not been pre-characterized. Why would soil not be pre-characterized and thus require special management considerations? Although drill cuttings from deep borings may be the appropriate course of action, this	Soil in the vicinity of the groundwater remedy infrastructure will be pre-characterized prior to construction, as stated in response to comment #768 DOI-314. The latter part of the paragraph discusses construction and O&M activities that could occur post-construction of the remedy as part of routine O&M, which is not part of the pre-characterization presented in Appendix A of Volume 4. In addition, pre-characterization of soil in the vicinity of groundwater remedy infrastructure will not be possible in		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Section 2.2

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				needs to be stated here to minimize confusion. Please clarify.	areas of IM3 and the MW-20 bench where specific IM3 facilities will be reused in the final remedy. The sentence has been clarified as follows (inserted verbiage shown in underline typeface, deleted text shown in ~~strikethrough~~ typeface): "Soil generated during post-construction ~~and~~ O&M in or near Soil RFI/RI Investigation Areas that have not been pre-characterized and during the decommissioning and removal of the IM-3 system infrastructure used for the groundwater remedy will be stockpiled or placed in lined roll-off bins at the work site, if practicable, or onsite in a temporary storage area designated by PG&E until they have been characterized."					
770	DOI-316	Section 2.2 Page 2-2	"The baseline soil sampling results will be screened following the process described below . . . "	The text refers to Section 2.4 regarding classification of displaced soil. The correct reference should be to Section 2.3.	The text will be revised as suggested.		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Section 2.2
771	DOI-317	Section 2.2, Pages 2-2 and 2-3	"Existing soil sample results and knowledge of the area history will be used to assess waste classification for displaced soil that has not been pre-characterized."	It should be clearly stated that drill cuttings from individual waste sites (AOCs and SWMUs) will be segregated. Comingling of waste from different impacted locations into a single storage container should not be considered.	A sentence has been added to the fifth paragraph of Section 2.2: "Drill cuttings from new monitoring, extraction, and injection well locations will not be fully characterized as part of the Baseline SAP; therefore, drill cuttings from monitoring wells installed in or near Soil RFI/RI Investigation Areas will be containerized in 55-gallon U.S. Department of Transportation (DOT) drums or lined roll-off bins. Drill cuttings from individual RFI/RI Investigation Areas will be segregated to prevent comingling of waste. The drill cuttings drums/bins will be stored onsite in a temporary storage area designated by PG&E until they have been characterized. Drum and roll-off bin storage are described in Section 3.1."		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Section 2.2
772	DOI-318	Section 2.2, Pages 2-3	"Characterization of drilling cuttings will be performed by collection of	What criteria will be used to determine if one discrete sample per drum is taken or if one composite per ten drums is taken?	The last paragraph of Section 2.2 will be revised as follows: "Characterization of drilling cuttings will be performed by collection of samples as follows:		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Section 2.2

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Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
			one discrete sample per 55-gallon DOT drum or at least one composite per ten drums,… .”		· For one drum, one discrete sample will be collected from the drum. The sample will be collected from the center of the drum from at least 12-inches below the surface of the soil. · For 2 to 10 drums, one discrete sample will be collected from each drum and composited into a single composite sample. · For more than 10 drums, one composite sample will be collected for every 10 drums. · For each roll-off bin, one four-point composite sample will be taken from the roll-off bin. Samples will be analyzed for applicable Soil RFI/RI Investigation Area analytical suite presented in Tables 1.2-1 and 1.2-2. Analytical results will be screened according to the procedure listed in Section 2.4 to classify the soil for handling, storage, and disposal purposes.”					
773	DOI-319	Section 2.4, Page 2-4		It should be noted that clay found in significant volumes will be set aside for special handling.	A significant amount of clay is not expected to be encountered during the installation of the groundwater remedy infrastructure. The predominant geology at the site consists of alluvial fan deposits on top of sloping bedrock, which is not the geologic environment where clays form. Shallow soil across the site consists mostly of weathered bedrock, sands, and gravel. However, consistent with the special handling procedures requested by the Hualapai Department of Cultural Resources for displaced clay material generated from clay beds (this does not include clay-containing sediment mixtures, only clay beds), PG&E will notify the agencies and Tribes in the event clay bed material is encountered and separated for storage on 100% cotton muslin (dye free) for future disposition. The following text will be added to the first paragraph in Section 2.4 (inserted verbiage shown in <u>underline</u> typeface: “Non-hazardous clean displaced soil will be stockpiled at the work site, if practicable, and recorded in an inventory as described in Section 5.0.		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Section 2.4

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					Clean soil that was removed from trenches or excavations will be reused as backfill into the same trench or excavation area, if practicable. Clean soil that cannot be immediately used as backfill may be reused in other areas within the APE, or stockpiled for future reuse within the APE. Displaced soil that is stockpiled for future use will be managed following the BMP Plan that will be submitted as part of the forthcoming Construction/Remedial Action Work Plan and the Groundwater Remedy O&M Storm Water Pollution Prevention Plan (Appendix E of Volume 1) that will be submitted as part of the 90 percent Basis of Design Report. Consistent with the special handling procedures requested by the Hualapai Department of Cultural Resources for displaced material generated from clay beds (this does not include clay-containing sediment mixtures, only clay beds), if clay bed(s) are encountered during construction, the clay material will be set aside on 100% cotton muslin (dye free) for future disposition, following discussions with the Tribes. PG&E will notify the agencies and Tribes in the event clay material is encountered and separated for storage."					
774	FMIT-193 Hualapai-143 Chemehuevi-143 Cocopah-143 CRIT-143	Sect. 2.4 p. 2-4 and Section 3.1	*Non-hazardous clean displaced soil will be stockpiled at the work site, if practicable, and recorded in an inventory as described in Section 5.0. Clean soil that was removed from trenches or excavations will be reused as backfill into the same trench or excavation area, if practicable.*	Suggested storage for displaced soils that are not hazardous wastes currently include roll-off bins, drums and stockpiles. It is important however to note that much of this stored soil will be returned to the landscape once final project specific soil risk values have been established. If any of this stored soil is replaced on the surface with the anticipation of supporting re-vegetation efforts, it is important that the biological integrity of the duff (top layer) is preserved during storage. For example as stated in Appendix E of Appendix A7 (Ethnobotany Survey Report): "In order to mitigate for annual species, such as chia or golden suncup, one should either collect and store seed prior to the disturbance	PG&E agrees that proper management of topsoil is important. As discussed in response to comment #763a FMIT-192, salvage of topsoil during installation of linear utility features is a common practice for PG&E and will be done where the proposed excavation will occur in areas where undisturbed topsoil may be present. In such areas, the upper 4 inches of soil will be carefully removed and placed near the excavation. The remaining sub-soil will then be excavated and stored separately from the topsoil. Following the installation of the pipe and backfilling of the trench the topsoil will be replaced over the trench. Therefore, there will be no need for long-term storage of undisturbed topsoil.			Comment resolved pending review of the 90% design.	Comment resolved.	90% BOD Appendix E Specification Sections 31 10 00 (Removal and Segregation) and 31 23 23 (Fill and Backfill)

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			Clean soil that cannot be immediately used as backfill may be reused in other areas within the APE, or stockpiled for future reuse within the APE.	and to re- seed post-construction or salvage the topsoil (3-4 inches) where construction or disturbance will take place and store that soil until after construction. Topsoil salvaged from short-term disturbance areas should be piled to no more than 4 feet high and stabilized to prevent loss during storage. It should be re-spread during site rehabilitation as an initial procedure following construction. These measures will preserve a portion of the existing seed bank through construction. In short-term disturbance areas, the existing seed bank present in the topsoil has advantages over subsequently sown seed in that it is pre-conditioned to the soils environment."	As for the rest of the excavated soils that are not undisturbed topsoil, as discussed in response to comment #763a FMIT-192, these desert soils in general are low in nutrients and organic matter and soils such as these that have been subject to disturbance typically lose a large percentage of the available nutrient supply and important soil biota. Therefore, PG&E does not propose to conduct any specific actions related to protecting biological integrity while these soils are being stored. Further detail will be provided in the 90% design.					
775	DOI-320	Section 2.5, Page 2-5	"The volume of displaced soil in and near Soil RFI/RI Areas from the decommission-ing and removal . . . "	Consideration should be given to storing soils from the IM-3 decommissioning and sampling activities in the local vicinity of IM-3.	Based on September 18 TWG discussion, areas in the local vicinity of IM-3 treatment plant were included in the updated Figure 7.6-1 and the Potential Soil Storage Location Evaluation Matrix (see **Attachment G**, at the end of this table).		DOI defers to PG&E and the FMIT regarding soil storage locations in this area.		Topics related to the draft soil matrices and updated map showing soil storage and construction staging areas (updated Figure 7.6-1) were discussed at various 60% RTCs TWG meetings. Updates to the matrices and map were made as a result of these discussions. The latest version is included in **Attachment G**, at the end of this table.	O&M Manual Volume 4 Sections 2.4 and 2.5, and Figure 2.4-1.
776a	FMIT-194	Sect 2.5p. 2-4 to 2-5	*Displaced soil that is non-hazardous but is unsuitable for final disposition onsite because contaminants are present above the interim screening level cannot be reused until project-specific soil cleanup goals are finalized and must be stored onsite.*	The current groundwater EIR does not specifically address long-term storage of soil within the APE. Please indicate how impacts to cultural and visual resources associated with long-term soil storage will be evaluated. While stakeholder input has been requested in regards to potential locations for soil storage it is not clear how the final decision will be made. This process needs to be transparent. Therefore please provide a matrix which includes all parameters used in the decision/rationale behind final storage locations that will be discussed with the Tribe. Parameters that should be transparently discussed in regards to the final soil storage location would include proximity to cultural resources, whether access routes are adjacent to cultural resources, distance of storage to point of origin and will potential locations have any visual	For the first part of this comment, please see response to comment #290 DTSC-115. PG&E agrees with and supports a process to identify and evaluate soil storage locations and construction staging areas for the groundwater remedy. To that end, PG&E has participated in discussions with Agencies and Tribes on this topic at various TWG meetings since March 2013. In response to comments from Tribes and DOI (see #288, #289, #775, #776a, and #776b) and through further discussions to resolve these comments, PG&E has modified Figure 7.6-1 to show current proposed locations for soil storage and construction staging areas, and drafted a strawman for two matrices – one for soil storage locations and one for construction staging areas (see **Attachment G**, at the end of this table).			The Tribes look forward to working with PG&E and federal agencies to complete the matrices prior to the 90% design. The Tribes look forward to seeing long term soil storage evaluated in DTSC's future CEQA analysis. On March 6, 2014, the FMIT provided to DTSC and DOI a comment letter on proposed soil storage and staging areas. This letter is included in **Attachment G** at the end of this table.	Topics related to the draft soil matrices and updated map showing soil storage and construction staging areas (updated Figure 7.6-1) were discussed at various 60% RTCs TWG meetings. Updates to the matrices and map were made as a result of these discussions. The latest version is included in **Attachment G**, at the end of this table.	O&M Manual Volume 4 Sections 2.4 and 2.5, and Figure 2.4-1.

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				impacts that are not currently addressed in the GW EIR.						
776b	Hualapai-144 Chemehuevi-144 Cocopah-144 CRIT-144	Sect 2.5p. 2-4 to 2-5	*Displaced soil that is non-hazardous but is unsuitable for final disposition onsite because contaminants are present above the interim screening level cannot be reused until project-specific soil cleanup goals are finalized and must be stored onsite.*	The current groundwater EIR does not specifically address long-term storage of soil within the APE. Please indicate how impacts to Cultural and Visual resources associated with long-term soil storage will be evaluated within the groundwater EIR. While stakeholder input has been requested in regards to potential locations for soil storage it is not clear how the final decision will be made. This process needs to be transparent. Therefore please provide a matrix which includes all parameters used in the decision/ rationale behind final storage locations that will be discussed amongst all stakeholders. Parameters that should be transparently discussed in regards to the final soil storage location would include proximity to cultural resources, whether access routes are adjacent to cultural resources, and will potential locations have any visual impacts that are not currently addressed in the groundwater EIR.	For the first part of this comment, please see response to comment #290 DTSC-115. For the second part of this comment, please see response to comment #776a FMIT-194.			The Tribes look forward to working with PG&E and federal agencies to complete the matrices prior to the 90% design. The Tribes look forward to seeing long term soil storage evaluated in DTSC's future CEQA analysis. The Hualapai Tribe and the Cocopah Indian Tribe provided to DTSC and DOI comment letters on proposed soil storage and staging areas on March 10 and March 13, 2014, respectively. These letters are included in **Attachment G** at the end of this table.	Topics related to the draft soil matrices and updated map showing soil storage and construction staging areas (updated Figure 7.6-1) were discussed at various 60% RTCs TWG meetings. Updates to the matrices and map were made as a result of these discussions. The latest version is included in **Attachment G**, at the end of this table.	O&M Manual Volume 4 Sections 2.4 and 2.5, and Figure 2.4-1.
777	DOI-321	Table 2.4.1, Notes	"This table presents a reference list of analytes and associated screening levels that may be applicable for making decisions related to disposition of displaced site materials. The specific analytes and screening levels applicable for characterization of displaced materials will be determined based on the origin of the material and potential disposition locations."	For the 90% Design submission, will PG&E develop a table defining what type of analyses and screening levels will be applicable with the known origin locations?	The intent of this footnote was to clarify that characterization of the displaced soil would not include analysis of all analytes listed in the table, instead the analytical suites would be decided based on origin of the displaced material. A separate table is not necessary in the 90% Design. The type of analyses for displaced material within or near an RFI/RI area is listed in Tables 1.2-1 and Table 1.2-2 Analytical Suites columns. Displaced material outside RFI/RI sites and near roadways will be analyzed for PAHs and lead as described in response to comment #765 DOI-311. Table 2.4-1 lists the appropriate screening criteria for each analyte.		Comment resolved.		Comment resolved.	Not applicable

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778	DOI-322	Table 2.4-1	Notes: Background	The in-text citation is CH2M HILL, May 2009; however, the Reference section lists CH2M HILL 2009a, CH2M HILL 2009b, and CH2M HILL 2009c. A consistent format is required.	The letter "c" will be added after 2009.		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Table 2.4-1.
779	DOI-323	Table 2.4-1	Notes: DTSC CHHSL	The in-text citation OEHHA, 2005 is not listed in the Reference section.	The following item will be listed in the Reference under OEHHA -- "California Environmental Protection Agency. 2005. *California Human Health Screening Levels (CHHSLs)*."		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Section 7.
780	DOI-324	Table 2.4-1	Notes: EPA RSL	The in-text citation is CH2M HILL, 5/2011; however, the Reference section lists CH2M HILL 2011a, CH2M HILL 2011b, and CH2M HILL 2011c. A consistent format is required.	The letter "c" will be added after 2011.		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Table 2.4-1.
781	DOI-325	Section 3.1.1, Page 3-1	General Comment	Does PG&E plan on stacking drums?	PG&E does not plan on stacking drums.		Comment resolved.		Comment resolved.	Not applicable
782	DOI-326	Section 3.1.1, Page 3-2	"If the contents are removed from the drums for offsite transportation and treatment or disposal, the drums will be reused only for compatible soil and waste streams."	Will the drums be cleaned prior to reuse?	The subject bullet will be revised to state: "Drums containing hazardous waste will not be reused"		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Section 3.1.1.
783	DOI-327	Section 3.1.2, Page 3-2	"RCRA and non-RCRA Hazardous Soil. If it is necessary to temporarily stockpile soil classified as RCRA or non-RCRA hazardous waste . . . "	Further describe the situations necessitating stockpiling of RCRA and non-RCRA hazardous waste/soil rather than storing the material in roll-offs or drums. It is the agency's preference to minimize stockpiling of RCRA and non-RCRA hazardous soil and material that exceeds screening criteria to the extent practicable. Further information should be provided on how wind and water erosion or infiltration will be addressed for hazardous waste/soil.	Stockpiling of soil RCRA and non-RCRA hazardous waste/soil is not planned. It is anticipated that all soil that is above soil screening levels will be placed in roll-off bins or similar containers. In the unlikely event that soil with contaminant concentrations above screening levels is stockpiled, best management practices described in Section 3.1.2 will be employed to prevent wind and water erosion.		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Section 3.1.2.
784	DOI-328	Section 3.1.3, Page 3-3	"The bins will be covered and inspected at a specified frequency."	Specify a proposed inspection frequency (as noted in Section 3.4).	Inspection frequencies are listed in Section 3.4. Weekly for containers storing hazardous waste, and monthly for containers storing non-hazardous waste. A reference to Section 3.4 will be added to the subject bullet.		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Section 3.1.3

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785	DOI-329	Section 3.3, Page 3-3	General Comment	Can the labels be color-coded so that soil classification can be ascertained from a distance?	Standard California Hazardous Waste Labels will be used for containers storing hazardous waste so changing the color of this label is not possible. However, different color labels will be used to distinguish between "Non-Hazardous Clean Soil" and "Non-Hazardous Soil for Long-Term Storage".		Comment resolved.		Comment resolved	O&M Manual Volume 4 Section 3.3.2
786	DOI-330	Section 3.4, Page 3-4	"Any deficiencies observed during inspection will be corrected, and corrective measures will be documented."	Should a deficiency be observed, what will be the time frame for correcting the deficiency, and who will be responsible for correcting and documenting the deficiency and remedy?	Deficiencies observed during inspections will be corrected upon discovery. The employee inspecting the storage areas will be responsible for correcting and documenting the deficiency and implementing its remedy.		Comment resolved pending review of BMPs for soil storage.		Comment resolved.	O&M Manual Volume 4 Section 3.4
787	DOI-331	Section 3.5, Page 3-4	"In compliance with 22 CCR 66264.14 (California action-specific ARAR #76), a barrier, such as temporary fencing, will be provided for hazardous waste accumulation areas that are otherwise accessible to the general public."	Will security be provided in all areas that store hazardous wastes, or only in those areas that are accessible to the general public?	Security will be provided in all areas that store hazardous wastes.		Comment resolved.		Comment resolved.	Not applicable
788	DOI-332	Section 3.5, Page 3-5	"In addition to the project-specific HSP procedures, hazardous waste accumulation areas will be provided with fire extinguishers, decontamination equipment including an eye wash station, and an alarm system . . . "	Does PG&E anticipate any remote locations of hazardous waste accumulation areas, and, if so, will these areas also contain decontamination equipment, security fencing, an eye wash station, and an alarm system?	PG&E does not anticipate utilizing any remote locations for storage of hazardous waste. If hazardous waste is encountered, it will likely be stored at the Compressor Station and/or the Transwestern Bench. Any hazardous waste accumulation area will be equipped with the equipment noted in Section 3.5. - Security/ Emergency Response.		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Section 3.1, 1st paragraph, last 2 sentences.

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789	DOI-333	Section 4.1, Page 4-1	"Waste management training, including OSHA 1910.120 HAZWOPER Annual 8-Hour Refresher."	Recommend adding more details regarding the type of training that will be provided. Please provide examples of the trainings specific to site activities that will be given.	The following text will replace the first bullet: "Hazardous waste management training that meets the requirements of 22 CCR 66265.16, that will address how to implement applicable provisions of the hazardous waste contingency plan and how to perform job duties related to hazardous waste management in a manner that complies with hazardous waste regulatory requirements. Each employer working at the site is responsible for providing this training to their employees. The specific content of this training will vary by employer and by job function."		Comment resolved.		Comment resolved.	OMM Volume 4 Section 4.1.
790	DOI-334	Section 4.3, Page 4-1	General Comment	Does PG&E plan on inspecting contracted waste disposal facilities?	PG&E's current policy is to inspect all potential contracted waste disposal facilities for compliance prior to negotiation and contracting.		Comment resolved.		Comment resolved.	Not applicable
791	DOI-335	Section 5, Page 5-1	"In addition, in accordance with the Management Protocol for Handling and Disposition of Displaced Site Material, PG&E will maintain a Displaced Material Inventory for all displaced soil, which will include: . . . "	How long will such records be maintained?	In compliance with Section XXV of the CD (DOI 2013), PG&E will maintain such records for 10 years following receipt of certification of completion. At the conclusion of the record retention period, PG&E will notify DOI and DTSC in writing at least 90 days prior to the destruction of any records and will provide DOI and DTSC with the opportunity to take possession of any records.		Comment resolved.		Comment resolved.	Not applicable
792	DOI-336	Section 7		The following items are present in the Section 7 Reference list, but are not referenced in the text: DTSC 1996, DTSC 2006, and DTSC 2011.	The listed items will be removed from Section 7 (References).		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Section 7
793	DOI-337	Section 7		The discrepancy between the different formats for the same citation, (CH2M HILL 2009c and CH2M HILL, May 2009), needs to be addressed, and a consistent format chosen.	The current convention is CH2M HILL 2009c. Citations will be reviewed and any with stray formatting will be corrected.		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Section 7
794	DOI-338	Section 7		The discrepancy between the different formats for the same citation, (CH2M HILL 2011b and CH2M HILL 5/2011), needs to be addressed, and a consistent format chosen.	See response to comment #793 DOI-337.		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Section 7

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795	DOI-339	Section 7		The discrepancy between the different formats for the same citation, (CH2M HILL 2011c and CH2M HILL 5/2011), needs to be addressed, and a consistent format chosen.	See response to comment #793 DOI-337.		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Section 7
796	DOI-340	Appendix A, Section 1.0, Page A-1	"To document baseline soil conditions prior to groundwater remedy implementation, . . . "	The in-text citation to PG&E 2012 is not included in the Appendix A Reference list.	The information for PG&E 2012 is in the References section (Section 7 of Volume 4); it will also be added to the reference list in Appendix A of Volume 4.		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Apdx A Section 6.
797	DOI-341	Appendix A, Section 2.1, Page A-2	"If the pipelines/conduit alignments are in or near Soil RFI/RI Investigation Areas, a soil sample will be collected at 1 foot bgs and at the bottom of the trench to assess conditions for management of disturbed soil."	Provide specific information on the spacing between a Soil RFI/RI Investigation Area and an alignment required in order for an alignment to qualify under this sampling protocol.	The alignment would need to be within 25 feet of the RFI/RI Investigation area to qualify under this sampling protocol. The following is an example of how the text will modified throughout Volume 4: "If the pipelines/ conduit alignments are in or <u>within 25 feet of</u> Soil RFI/RI Investigation Areas, a soil sample will be collected at 1 foot bgs and at the bottom of the trench to assess conditions for management of disturbed soil."		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Addx A Section 2.1.
798	DOI-342	Appendix A, Section 2.1, Page A-2	"If the pipelines/conduit alignments are in or near Soil RFI/RI Investigation Areas, . . . "	To clarify that subject sampling will not always occur, begin this sentence with "Except as noted below". Also, refer to the SMP Section 2.2 general comment.	The text will be revised as suggested. Please see response to Comment #765 DOI-311.		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Addx A Section 2.1.
799	DOI-343	Appendix A, Section 2.1, Page A-3	"Baseline soil samples will be analyzed for Title 22 metals and sodium."	Please provide the rationale for analyzing Title 22 metals.	Metals are generally a concern at Topock Compressor Station. The groundwater remedy is designed to address a chromium plume, and the agencies consider selenium and molybdenum of potential concern related to SWMU1/ AOC 1. In addition, transient by-products, which include arsenic, manganese, iron, and barium may exceed baseline and background concentrations during remedy implementation. Lead has been added to the baseline soil samples outside RFI/RI Investigation Areas and along roadways as described in		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Addx A Section 2.1.

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					response to Comment #765 DOI-311. Although some of these metals may not be present in influent and effluent at significant concentrations, obtaining baseline concentrations of all these metals in soil will allow PG&E to definitively assess potential affects to soil associated with the operation of the groundwater remedy. Therefore, the baseline soil samples will be analyzed for Title 22 metals because it includes all of the metals listed above, and is cheaper than analyzing for the individual metals. A summary of this rationale will be included in the 90% BOD.					
800	DOI-344	Appendix A, Section 2.2, Page A-4	"If the baseline soil sample location is within a Soil RFI/RI Investigation Area, the sample will also be analyzed . . . "	To clarify that subject sampling will not always occur, begin this sentence with "Except as noted below".	Text will be modified as suggested.		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Addx A Section 2.2.
801	DOI-345	Appendix A, Section 2.3, Page A-4	"A number of new monitoring wells are proposed (at the 60% design stage) to be installed to support the groundwater remedy system."	Information in this section conflicts with the sample strategy presented in SMP Section 2.2 regarding drill cuttings. Furthermore, a sample at 1 foot bgs is not representative of the cuttings generated at depth. Please resolve.	The sampling strategies listed in Section 2.2 of the SMP and Section 2.3 of the Baseline SAP serve two different purposes. The sampling strategy listed in Section 2.2 of the SMP is to characterize drill cuttings from the installation of wells for reuse, storage, or offsite disposal of the soil. The sample strategy listed in Section 2.3 of the Baseline SAP is to assess baseline conditions in areas where the monitoring wells will be installed to allow PG&E to definitively assess potential affects (e.g., incidental spills during sampling) to soil from the monitoring well.		Comment resolved.		Comment resolved.	Not applicable
802	DOI-346	Appendix A, Section 4.2, Page A-5		The in-text citation for PG&E 2012 is not listed in the Appendix A Reference list.	See response to comment #796 DOI-340.		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Apdx A Section 6.
803	DOI-347	Appendix A, Section 4.2, Page A-5	"Drill cuttings include fragments of rock and soil that are removed to	Section 2.5 of the Soil Management Plan (SMP) notes that decisions regarding the acceptable mode and location of storage of non-hazardous soils above screening criteria will be evaluated once the volume of soil is	The text in Section 4.2 will be revised to be consistent with Section 2.5 of the SMP. The text will read as follows: "Cuttings and any soil from excavation areas that are below		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Addx A Section 4.2.

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			create the borehole."	determined during the baseline sampling or RFI/RI investigation. The last sentence of this section notes that it will be stockpiled. Stockpiling of non-hazardous soils above screening criteria has not been agreed to by the agencies. The text should be consistent with Section 2.5 of the SMP.	hazardous waste characteristic levels, but above interim screening levels, will be ~~stockpiled and~~ managed ~~onsite~~ following protocols prescribed in this Soil Management Plan. ~~until project-specific cleanup goals have been established.~~"					
804a	FMIT-196	APPEND A Sect. 4.2 p. A-5	*Water generated during equipment decontaminatio n will be collected in bins or portable storage tanks temporarily located in staging areas near the drilling sites or at the Compressor Station as needed. Secondary containment will be set up at the drilling area for the portable storage tanks or bins. Rinsate will be processed at the IM No. 3 treatment plant, the new remedy-produced water conditioning plant, or transported to a PG&E contracted offsite disposal facility.*	It is our understanding that IM3 will be decommissioned during the early phases of the remediation. The IM3 location should not be considered as a possible site for rinsate processing. It is the Tribe's preference that IM3 facilities IM3 should not be included within the remediation design whenever possible.	PG&E does not intend to use the IM-3 treatment plant as part of the final remedy. Pursuant to the Settlement Agreement between the Tribe and DTSC, the IM-3 treatment plant will be decommissioned when DTSC determines that the final remedy is operating properly and successfully and has plume control, as long as DOI has concurred with DTSC's determination. PG&E understands the Tribe's preference, but until the time that the remedy is found to be operating properly and successfully and IM-3 is decommissioned, PG&E may need to use the IM-3 facilities and site to ensure timely functioning of the final remedy. See response to comment #857, FMIT-200.				PG&E's response was discussed with the FMIT, and revised in response to that discussion.	Not applicable
804b	Hualapai-145 Chemehuevi-145 Cocopah-145 CRIT-145	APPEND A Sect. 4.2 p. A-5	*Water generated during equipment decontaminatio n will be collected in bins or portable*	It is our understanding that IM3 will be decommissioned during the early phases of the remediation and therefore do not believe that it should be considered as a possible site for rinsate processing. IM3 should not be included within the remediation design. However if it is	See response to comment #804a FMIT-196.					Not applicable

TABLE I-1

Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
			storage tanks temporarily located in staging areas near the drilling sites or at the Compressor Station as needed. Secondary containment will be set up at the drilling area for the portable storage tanks or bins. Rinsate will be processed at the IM No. 3 treatment plant, the new remedy-produced water conditioning plant, or transported to a PG&E contracted offsite disposal facility.	to be used then a discussion should include what will be done with rinsate once IM3 is removed.						
805	DOI-348	Appendix A, Section 5.1, Page A-6	"Data validation procedures will include: … ."	Who will be performing the data validation, and what training or certifications will they have?	PG&E's contract chemists and scientists will perform the validation. There are no official certificates for data validation. However, the team consists primarily of individuals with a minimum of 3 to 5 years of experience in an environmental laboratory as chemists and are then trained to perform validation by a senior chemist using the software, QAPP, and methods associated with the project. The validation uses a two tiered approach where the senior chemist performs a second level validation (review) on all data. This allows the senior chemist to continuously mentor the primary validation staff (chemist/ scientist).		Comment resolved.		Comment resolved.	Not applicable
806	DOI-349	Appendix A, Table A-1A		Information on the TCLP and the California WET tests appear to be missing from the table. Please add these tests.	TCLP and California WET Test information will be added to the table.		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Apdx A Table A-1A
807	DOI-350	Appendix A, Table A-1A	General Comment	Which glass containers will be clear and which amber colored?	The color (amber or clear) of the glass container will be added to Table A-1A.		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Apdx A Table A-1A

TABLE I-1

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PG&E Topock Compressor Station, Needles, California

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808	DOI-351	Appendix A, Table A-2	Notes	The in-text citation for CH2M HILL, May 2009 it is not listed in the Reference section.	The information for CH2M HILL, May 2009 is in the References section (Section 7 of Volume 4); it will also be added to the reference list in Appendix A. Citation will also be updated.		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Apdx A Section 6
809	DOI-352	Appendix A, Table A-2	Notes	The in-text citation for OEHHA 2005 is not listed in the Reference section.	See response to comment #779 DOI-323.		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Section 7 O&M Manual Volume 4 Apdx A Section 6
810	DOI-353	Appendix A, Attachment 1, Section SOP-B3	Borehole Sampling by Drilling – General Procedure	The in-text citation for ASTM 1984 is not listed in the Reference section.	The in-text citation for ASTM 1984 is not listed because the reference is spelled out completely in the text as American Society of Testing Materials (ASTM) D1586, "Standard Method for Penetration Test and Split-Barrel Sampling of Soils" (ASTM 1984) (see SOP-B3, page 3 of 8).		Comment resolved.		Comment resolved.	Not applicable
811	DOI-354	Appendix A, Attachment 1, SOP-B15	"This standard operating procedure (SOP) provides guidance . . . "	The in-text citation for CH2M HILL 2005 is not listed in the Reference section.	The following reference will be added to Section 6 of Appendix A (page A-6): "CH2M HILL. 2005. *Sampling, Analysis, and Field Procedures Manual, PG&E Topock Program*."		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Apdx A Section 6
812	DOI-355	Appendix A, Attachment 1, SOP-B15	Soil Sampling Logs Documentation	The in-text citation for CH2M HILL 2005 is not listed in the Reference section.	See response to comment #811 DOI-354.		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Apdx A Section 6
813	DOI-356	Appendix A, Attachment 1, SOP-B15	" . . . covered in section 3.3 of the PG&E Program QAPP and in SOP-B5 . . . "	The in-text citation for CH2M HILL 2005 is not listed in the Reference section.	See response to comment #811 DOI-354.		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Apdx A Section 6
814	DOI-357	Appendix A, Attachment 1, SOP-B16	"This Standard Operating Procedure (SOP) describes the analysis of in situ and ex situ soil and debris . . . "	The in-text citation for CH2M HILL 2005 is not listed in the Reference section.	See response to comment #811 DOI-354.		Comment resolved.		Comment resolved.	O&M Manual Volume 4 Apdx A Section 6
815	DOI-358	Appendix A, Attachment 1, SOP-B16	Required Documents	The in-text citation for CH2M HILL 2012 is not listed in the Reference section.	The in-text citation for CH2M HILL 2012 is on the Reference list for Appendix A (see 3rd item).		Comment resolved.		Comment resolved.	Not applicable
Specific Comments – Appendix M – Freshwater Pre-injection Treatment System Design Basis Memorandum										
816	DOI-359		General Comment	The technical memorandum needs to address solid waste generation, storage, and disposal. Please revise the tables, figures, and text accordingly.	The 90% design will include arsenic-only pre-injection treatment as a contingency. The attached technical memorandum (included in **Attachment F**, at the end of this		Resolved pending review of technical memo provided.		Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.

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Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
					table) will replace the existing technical memorandum in Appendix M in the 90% BOD.					
817	DTSC-242	Appendix M, 1.0 Introduction, Page 1	… arsenic removal to concentrations less than the federal and California maximum contaminant level (MCL) of 10 micrograms per liter (µg/L) and fluoride removal to concentrations less than the California MCL of 2 milligrams per liter (mg/L)….	Attaining a goal of 2 mg/L for fluoride is futile as higher concentrations already exist in the area where fresh water will be injected. Please revise here and throughout the memorandum. A realistic treatment goal should be sought for fluoride.	As discussed in response to comment #145 DTSC-50, water quality in the proposed injection area exhibits elevated levels of naturally occurring fluoride. Fluoride concentrations in both HNWR-1 and the exploratory borehole at Site B are similar that in the proposed injection area. Therefore, treatment to remove fluoride is not needed pursuant to California standards, and hence, setting a treatment goal for fluoride is not needed. See also response to comment #21 DTSC-2.	PG&E should develop a background value for fluoride at the injection locations so that the injection standard for fluoride can be appropriately set. See response to comment #21 DTSC-2.			Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.
818	DTSC-243	Appendix M, Page 1	This information is based on ongoing studies and will be updated as additional bench-scale testing results become available, and as the detailed design/optimization efforts progress (target completion in summer 2013)	Please provide the update to agencies as soon as possible.	See attached technical memo for information on arsenic-only pre-injection treatment system (included in **Attachment F**, at the end of this table).	Comment resolution pending review of technical memo provided.			Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.
819	DTSC-244	Appendix M, 2.0 Freshwater Water Quality, Treatment Goals and Design Flow Rates, Page 2		This section should discuss receiving water quality as it is related to treatment goals. Arsenic and fluoride background values specific for the injections areas are suggested. All data and calculations utilized in derivation of the background numbers should be provided.	See response to comment #21 DTSC-2.	Noted. See response to comment #21 DTSC-2.			Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.
820	DTSC-245	Appendix M, 3.0 Evaluation and Selection of Treatment Technologies, Page 2		This section should discuss treatment technologies for arsenic only and allow them to be fully developed in following sections. As noted in section 5.6 of the memorandum, ferric hydroxide treatment would be	See attached technical memo for information on arsenic-only pre-injection treatment system (included in **Attachment F**, at the end of this table).	Comment resolution pending review of technical memo provided.			Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.

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Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

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				selected if fluoride treatment is not required.						
821	DOI-360	Section 4.0, Page 3	"A groundwater sample was collected from HNWR-1 well in early January 2013 and was shipped to ASL for bench-scale testing."	Provide more information on the sampling procedures. How much water was collected? What type of samples were collected – grab or from continuous water flow conditions?	A total of three 55-gallon drums was collected under continuous flow conditions.		Resolved.		Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.
822	DOI-361	Section 4.0, Page 3		The in-text citation for CH2M HILL, 2009 is not listed in the Reference section.	Comment noted. This has been corrected in the attached technical memorandum.		Resolved.		Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.
823	DTSC-246	Appendix M, 4.0 Summary of Ongoing Bench-scale Testing Results, Page 3	From a water quality perspective, the average concentration of arsenic and fluoride in the Topock Background Study was 12.3 µg/L and 3.8 mg/L, similar to that in HNWR-1 (CH2M HILL, 2009).	It is not understood why a comparison to regional background values are being made and, therefore, it is recommended that the cited sentence be deleted. It would seem more appropriate to cite the HNWR-1/Topock2-3 data because that is the water subject to testing and evaluation. The cited 12.3 average for regional arsenic appears to be in error. The mean and median regional background values for arsenic from the CH2M HILL 2009 Background Report (Table 2-13) are 5.9 and 5.5 ug/L respectively, and are not close to the 12.3 ug/L average cited. Average values were not summarized in the Background Report. The cited fluoride average of 3.8 mg/L also appears to be in error. Tables 2-10 and 2-12 of the Background Report indicate that the maximum mean and median fluoride concentrations are both 4.0 mg/L. Topock-2 well had the second highest fluoride concentration in the whole background well population. Based on the Background Report it would be more fair to say that HNWR-1 is mining some of the highest arsenic and fluoride bearing waters in the region. Please also recall that elevated water temperatures occur at the Topock-2 well area suggestive of hydrothermal activity.	"Topock Background Study" was cited in error in the reference text, the correct citation should be Topock-2 well. The cited average concentration of arsenic and fluoride are correct, and can be found in Tables 2-9 and 2-10, respectively, in the 2009 Background Study Report.	Please replace the cited text with the following: "From a water quality perspective, the average concentration of arsenic and fluoride in the Topock 2 well was 12.3 µg/L and 3.8 mg/L, similar to that in HNWR-1 (CH2M HILL, 2009). The Topock Background Study (CH2M HILL, 2009) indicates that these are some of the highest arsenic and fluoride concentrations in the region."			Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.

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Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

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824	DTSC-247	Appendix M, 4.0 Summary of Ongoing Bench-scale Testing Results, Page 3	The groundwater sample was processed continuously through the column, and the treated water was sampled and analyzed for arsenic and fluoride until breakthrough (defined as at least 70 percent of the average influent concentration).	For completeness, please indicate what volume(s) were utilized during these tests.	See attached technical memo for information on arsenic-only pre-injection treatment system ((included in **Attachment F**, at the end of this table. See Section 4, 3rd paragraph of the tech memo).	Comment resolution pending review of technical memo provided.			Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.
825	DOI-362	Section 5.1, Page 4	"Groundwater will be pumped and conveyed from the HNWR-1 well and the current TCS source wells (Topock-2 and -3) to the existing TCS storage tanks."	Since the groundwater is near neutral with a relatively high redox potential, the ongoing studies (see Introduction) should examine treatment effectiveness without pH adjustment and hypochlorite addition. If not required, removal of the treatment processes would reduce capital and operating costs.	Industry research and practice indicates the treatment process is most effective under oxidizing and slightly depressed pH conditions.		Comment resolved.		Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.
826	DTSC-248	Appendix M, 4.0 Summary of Ongoing Bench-scale Testing Results, Wastewater Generation, Page 4	Assuming that regenerating a vessel after 1,500 bed-volumes will meet the treatment goals, the number of media regenerations per year is estimated to be 70 per in-service vessel at the maximum flow rate of 900 gpm and 35 per in-service vessel at the nominal flow rate of 450 gpm. Based on	The section should also comment on anticipated waste generation volumes if only arsenic is treated. With AA it would appear to be a quarter less than that for fluoride treatment. Since section 5.6 indicates ferric hydroxide would be selected for arsenic, its associated waste generation should be discussed.	See attached technical memo for information on arsenic-only pre-injection treatment system ((included in **Attachment F**, at the end of this table. See Section 5.4 of tech memo).	Comment resolution pending review of technical memo provided.			Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.

TABLE I-1

Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
			these frequencies, the range of wastewater generated could be in the millions to tens of millions of gallons per year; therefore, it is critical to optimize the process and system design to minimize the amount of wastewater generated.							
827	DTSC-249	Appendix M, Treatment Effectiveness and Time to Breakthrough, Page 4	Figure 1 (located at the end of this memo) shows concentrations of arsenic and fluoride in treated water versus the number of bed-volumes of groundwater passed through (one bed-volume is equivalent to the amount of adsorptive media in the column).	Figure 1 was not easy to quickly comprehend. Perhaps a legend could be applied to the figure that repeats what is stated in text for each run. Also, it is not certain if AA-FS50 is plotted. Conclusions regarding fluoride treatment effectiveness and waste generation issues will need to be revised after a more reasonable fluoride treatment goal is established. For example, a very different conclusion would be derived for a fluoride target goal of 4mg/L (see Figure 1 of the memorandum)	See response to comment #816 DOI-359. See response to comment #817 DTSC-252, PG&E does not believe that fluoride treatment is warranted.	Comment resolution pending review of technical memo provided. Also see response to comment #21 DTSC-2.			Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.
828	FMIT-197 Hualapai-146 Chemehuevi-146 Cocopah-146 CRIT-146	Section 5.1 p. 4	Groundwater will be pumped and conveyed from the HNWR-1 well and the current TCS source wells (Topock-2 and -3) to the existing TCS storage tanks. Water will be pumped from these tanks and will be injected with hypochlorite	Will chlorine residual affect remedy performance and carbon dosing?	This depends on residual levels. PG&E is evaluating dechlorination steps to remove residual chlorine from the treated freshwater. Dechlorination is often accomplished by addition of 1) ascorbic acid, 2) calcium thiosulfate, or 3) hydrogen peroxide (chemical reactions are shown below). Ascorbic acid (vitamin C) and calcium thiosulfate work by breaking the hypochlorous acid into hydrochloric acid and water. Hydrogen peroxide works by breaking the hypochlorite ion to form chloride ion, water, and oxygen.			Comment resolved pending review of the 90% design.	Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.

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Response to Comments on Basis of Design Report/Intermediate (60%) Design
Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design
PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
			for arsenic oxidation and with acid to reduce pH to 6 to 6.5		1) C5H5O5CH2OH + HOCl => C5H3O 5CH2OH + HCl + H2O 2) CaS2O3 + 4HOCl + H2O => CaSO4 + 4HCl + H2SO4 3) H2O2 + -OCl => Cl- + O2 + H2O The equipment would involve storage containers, drums, or totes, metering pumps, and an inline static mixer. The proposed FWPTS location has sufficient space for this equipment. Additional details will be provided as part of the 90% design submittal.					
829	DOI-363	Section 5.2, Page 5		Discuss the disposition of the wastewater streams as shown in Table 4 and Figure 2 either at the end of this section or in a new subsequent section. Also, see the comment regarding modifications to Table 4, including the need for a new column.	For the disposition of the wastewater streams, please see attached technical memorandum (included in **Attachment F**, at the end of this table), Section 5.2, Wastewater and Solid Waste Generation.		Comment resolved.		Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.
830	DOI-364	Section 5.2, Page 5	"The testing is anticipated to be completed in summer 2013."	When will the ongoing bench-scale testing be completed?	The bench scale testing is complete, please see attached technical memo for a summary of testing results (included in **Attachment F**, at the end of this table).		Comment resolved.		Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.
831	DTSC-250	Appendix M, 5.2 Media Regeneration Process, Page 6	Exhibit 3 & 4	Exhibits will need to be revised for revised fluoride treatment goals and prepared for arsenic only treatment.	See response to comment #817 DTSC-252, PG&E does not believe that fluoride treatment is warranted in this case. See attached technical memo for information on arsenic-only pre-injection treatment system (included in **Attachment F**, at the end of this table).	Comment resolution pending review of technical memo provided.			Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.
832	DOI-365	Section 5.4, Page 6	"The system will be automated to reduce the need for continuous operator oversight."	Will alarms send electronic messages to on-site operators notifying them of system shutdown or troubles?	Yes.		Resolved.		Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.
833	DOI-366	Section 5.4, Page 6	"Grab samples will be collected periodically and tested in the sample room . . . "	What testing procedures and equipment will be used to test for arsenic?	An SOP for arsenic testing will be developed and included in O&M Manual Volume 1, for submittal at 90% design.		Resolved pending review of the 90% design.		Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.

TABLE I-1

Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
834	DOI-367	Section 5.6, Page 7	"As previously mentioned, the FWPTS will be designed to achieve a safe, efficient, and sustainable operation . . . "	The text describing disposable granular ferric hydroxide as the treatment technology of choice for arsenic removal only should reference Appendix A, and Appendix A should provide the evaluation leading to this conclusion.	See attached technical memo for information on arsenic-only pre-injection treatment system (included in **Attachment F**, at the end of this table).		Resolved pending review of the 90% design.		Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.
835	DTSC-251	Appendix M, 5.6 Design Philosophy/Uncertainties in Design, Page 7	For example, if fluoride treatment is not required, the treatment process would change to using disposable granular ferric hydroxide media (rather than regenerable AA), using the same treatment vessels described above. The resulting change would eliminate the need for the regeneration steps and regeneration-related equipment and chemicals. The building and outdoor tank area could be reduced in size.	Disposable ferric hydroxide treatment should be fully developed for the 90%/100%, even if only as a contingency. Figures similar to Figures 2 through 5 should be prepared for this treatment method within this memorandum.	Yes, as stated in response to comment #21 DTSC-2, PG&E will include a freshwater pre-injection treatment for arsenic only in the 90% and final designs as a contingency. Figures similar to Figures 2 through 4 were prepared and included in the attached memo (included in **Attachment F**, at the end of this table). Note that there was no Figure 5 in Appendix M in the 60% BOD.	Comment resolved.			Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.
836	DOI-368	Section 7.0, Page 8	References	The following item is in the Reference list but is not referenced in the text: CH2M HILL 2013.	Comment noted. This has been corrected in the attached technical memorandum.		Comment resolved.		Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.
837	DOI-369	Table 1		Because the text discussion focuses on arsenic and fluoride, all of the other data in the table can be deleted. Arsenic and fluoride data for Topock-2/-3 needs to be added, as it is a secondary source of water.	See Table 1 in the attached technical memo (included in **Attachment F**, at the end of this table).	As this may be the only current place where HNWR-1 data are presented, retention of the data is suggested.	Resolved pending review of the 90% design.		Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.

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838	DOI-370	Table 2		A goal of <1,000,000 gallons/year of wastewater is three to five times less than rates shown in Exhibit 3 and Table 4. Please explain the difference in values or correct if this is an error.	This value will be revised to reflect an arsenic-only pre-injection treatment system (see Table 2 in the attached technical memorandum, included in **Attachment F** at the end of this table).		Resolved pending review of the 90% design.		Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.
839	DTSC-252	Appendix M	Table 2, Page Tables-7 Minimum Groundwater Injection Flow Capacity 75 gpm	Re. Freshwater treatment: Minimum flow rates are not discussed much in the 60% design. Briefly, what is the basis and how might the remedy utilize the lower flows. Won't it affect cleanup time? PG&E should provide analysis of startup injection rates, and propose parameters (decision tree) requiring increase or decrease in injection rate.	Please see Exhibit 3.3-4 of the 60% BOD for the basis of the design flow rate. The minimum flow for freshwater pre-injection treatment system was set to be same as the minimum freshwater injection flow from groundwater modeling (for details on basis of the modeled flow rates and ranges, see Section 3.3.3.4 of the BOD, as well as Appendix B). Information regarding the potential low flow range scenarios will be included in the 90% BOD. The cited 75gpm will be corrected to 150gpm (see Table 2 in the attached technical memorandum).	Comment resolved pending review of the 90% design.			Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.
840	DOI-371	Table 4		The table is difficult to interpret. Recommend the following modifications: • The stream # should reference Figure 2 (Flowchart). • A heavy solid line should be inserted across the table between Wastewater Volume and Nominal Flow, highlighting the maximum flow conditions and nominal flow conditions values. • Include one more column (7d) to represent the flow to the IRZ/cooling towers, and the neutralization flow it receives, (if this is true). The final disposition of neutralization wastewater flow is not discussed in the text or identified in Exhibit 3 or Table 2, but is inferred in Figure 2 and Table 4. Please revise for clarity.	Please see Table 4 in the attached technical memorandum for an arsenic-only pre-injection treatment system (included in **Attachment F**, at the end of this table).		Comment resolved pending review of the technical memorandum.		Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.
841	DOI-372	Figure 1		Data for AA-F550, Fluoride and Arsenic, are not displayed.	The horizontal axis scale was inadvertently reduced so the AA-FS50 results were not visible. As this figure pertains to As/F system, it will not remain in Appendix M of the 90% BOD and therefore it will not be revised.		Comment resolved.		Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.

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Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
842	MWD-21	Figure-3	Arsenic and Fluoride Removal with Regenerated Activated Alumina	Per text, the anticipated amount of generated wastewater has not been estimated. 90% Design should provide further details — quantity and quality of wastewater, and disposal details. Figure 3 indicates that backwash water may be reused onsite at IRZ wells, Cooling Towers, or Existing Evaporation Ponds if not disposed off-site. Explain whether arsenic levels in wastewater would allow the water to be reused onsite.	See attached technical memo for information on arsenic-only pre-injection treatment system (included in **Attachment F**, at the end of this table).					See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.
843	DOI-373	Appendix A, Page A-1	"As part of the pre-conceptual design work, several treatment technologies were identified and screened . . . "	The text in the introductory paragraph states that a more detailed screening was completed on five technologies. According to Section A.1.1, only two technologies are reviewed.	Text was revised in Appendix A of the attached technical memo (included in **Attachment F**, at the end of this table)		Comment resolved pending review of the technical memorandum.		Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.
844	DTSC-253	Appendix M, Appendix A, Arsenic and Fluoride Treatment Technology Screening, A.1 Initial Screening, Page A-1	Iron-based Adsorbents Screened out, this process does not treat fluoride. **If arsenic-only treatment required, this process may be used.**	Highlight/discuss this issue in bold (iron treatment for arsenic-only) from the onset within this memorandum.	See attached technical memo for information on arsenic-only pre-injection treatment system (included in **Attachment F**, at the end of this table).	Comment resolution pending review of technical memo provided.			Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.
845	DOI-374	Appendix A, Section A.2, Page A-4	"The four processes – regenerable AA and disposable AA – were advanced to bench-scale testing. "	The text references only two technologies, regenerable AA and disposable AA, and should be changed. Appendix M indicates two types of each technology were bench-scale tested, but this information is not included in Appendix A.	Text was revised to include four technologies in Appendix A of the attached technical memo. A total of four technologies were bench scale tested. Test results for regenerable and disposal AA were presented in Appendix M of the 60% BOD. Test results for GFH and coagulation are presented in the attached technical memorandum (included in **Attachment F**, at the end of this table), and will be included in the 90% BOD.		Comment resolved pending review of the technical memorandum.		Comment resolved.	See the *Addendum to the Freshwater Pre-injection Treatment System Conceptual Design Basis* included as Appendix M of the 90% BOD.
Specific Comments – Cover Letter										
846	Cocopah-147	Cover Letter		It is apparent from the 30% to the 60% designs that certain tribal preferences relating to tribal religious and cultural issues were not factored or substantively considered in engineering designs. At a minimum, equal scientific/ engineering rigor	Regarding the placement of facilities aboveground vs. belowground and alternative designs, please see PG&E's responses to comment #8b Hualapai-3/CRIT-3/ Chemehuevi-3/ Cocopah-3, #9 FMIT-4 /Hualapai-4/CRIT-4/ Chemehuevi-4/ Cocopah-					See RTC #1 DOI-1.

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Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

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				should be given to these legitimate alternate design constraints. For example, the Tribes expressed strong preferences for above-ground utility routings, however, the utility routings in the 60% BOD are almost exclusively routed below ground. Additionally, at one of the TWG meetings, PG&E provided a screening matrix for alternative routings in the East Ravine area. While this type of decision information is quite helpful in understanding the underlying decision rationale, it does not factor in tribal preferences.	4, and #1 DOI-1. As mentioned in prior responses, PG&E has and will continue to collaborate with Tribes and Agencies towards a satisfactory resolution of Tribal concerns, for inclusion in the 90% BOD.					
847	Cocopah-148	Cover Letter		Proposed monitoring well location "I" needs to be reevaluated in context of the new project EIR boundaries established in the summer of 2013. It is not clear that a well in this location will not have cultural, visual and spiritual impact and should only be placed after the latest round of archeological surveys have been incorporated into a updated EIR boundary. The placement of this well should be discussed with all stakeholders in light of the latest archeological surveys.	Please see response to comment #707a FMIT-182			Comment resolved.	Comment resolved.	See RTC #707a FMIT-182.
848	Cocopah-149	Cover Letter		The current groundwater EIR does not specifically address long-term storage of soil within the APE. Please indicate how impacts to Cultural and Visual resources associated with long-term soil storage will be evaluated within the groundwater EIR. While stakeholder input has been requested in regards to potential locations for soil storage it is not clear how the final decision will be made. This process needs to be transparent. Therefore please provide a matrix which includes all parameters used in the decision/rationale behind final storage locations that will be discussed amongst all stakeholders. Parameters that should be transparently discussed in regards to the final soil storage location would include proximity to cultural resources, whether access routes are adjacent to cultural resources, and will potential locations have any visual impacts that are not currently addressed in the groundwater EIR.	For the first part of this comment, please see response to comment #290 DTSC-115. For the second part of this comment, please see responses to comment #776b Hualapai-144/CRIT-144/ Chemehuevi-144/ Cocopah-144.					See RTC #290 DTSC-115. See RTC #776b Hualapai-144/ CRIT-144/ Chemehuevi-144/ Cocopah-144.

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849	CRIT-147	Cover Letter		To that end, CRIT is particularly concerned about two issues: first, the implications of recently located cultural resources on the ground surface, since, as of that time, those surface resources were unrecorded, and outside the apparent delimited preservation zones marked on Project resource protection maps. The import of this discovery is obvious, but nonetheless, disconcerting. It points to constant vigilance - by all concerned - as the only sure method of minimizing needless impacts to what is, for area Tribal members, a most sacred site.	The Tribe's comment and concerns are duly noted. As part of the project implementation, PG&E is committed to comply with all mitigation measures in the PA and CHPMP as well as in the certified EIR, which will result in the avoidance, minimization, or mitigation of potential impacts on cultural resources in the Area of Potential Effects and the project area, to the extent practicable. A number of the mitigation measures in the PA, CHPMP and EIR address discoveries of archaeological or historic resources. For example, a pre-project archaeological survey field verification will be conducted prior to any ground-disturbing activities (CHPMP, Stipulation 7.1.2). A Qualified Cultural Resources Consultant will be retained to observe ground-disturbing activities and will request the participation of tribal monitors during those activities, to ensure that historically significant resources are avoided to the maximum extent feasible (EIR CUL-1b/c-4). Further, all protocols in the future CIMP (EIR CUL-1a-8) will be followed during implementation to reduce the potential for impacts on historical resources within the project area, and to help preserve the values of and access to the Topock Cultural Area for local tribal users. Additionally, the CHPMP includes a Discovery Plan that provides procedures to be followed in the event that previously unidentified archaeological or historical resources are encountered during implementation of the Project. Also, consistent with current site practice, Agencies, Stakeholders, and Tribes will be invited to the site for a project initiation meeting to discuss various cultural sensitivities associated with the work activities.					90% BOD Section 6 Tables 6.1-1 through 6.2-3. Construction/Remedial Action Work Plan Sections 2 and 4.
850	CRIT-148	Cover Letter		Second, the uniform Tribal preference of placing as much piping and electrical conduit above ground, thereby avoiding both the extensive ground disturbance, and the need to	Regarding the placement of facilities aboveground vs. belowground, please see responses to comment #8b Hualapai-3/CRIT-3/Chemehuevi-3/Cocopah-3, #9 FMIT-4/Hualapai-4/					See RTCs #1 DOI-1, #8b Hualapai-3/CRIT-3/Chemehuevi-3/ Cocopah-3, and #9 FMIT-4/ Hualapai-4/ CRIT-4/Chemehuevi-4/Cocopah-4,

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				move and store masses of soil on-site or elsewhere is still an active area of concern for CRIT. While we understand the safety concerns of above-ground facilities, and the visual impacts that they will engender, it remains our strong preference to thousands of feet of deep, wide, destructive trenches in the Project area. CRIT has had recent, very disagreeable experience with excavations presumed to pose little or no risk to Tribal cultural resources. These excavations were undertaken by fully-qualified investigators with the best intentions, and employing the best available pre-screening methods, and still, the remains of CRIT's ancestors were crushed in the maw of heavy machines, their life's articles were smashed and tumbled, their jewelry shattered. We will work with DTSC, DOI, PG&E, and their consultants to keep this issue, this preference at the forefront of the design process.	CRIT-4/ Chemehuevi-4/ Cocopah-4, and #1 DOI-1. As mentioned in prior responses, PG&E has and will continue to collaborate with Tribes and Agencies towards a satisfactory resolution of Tribal concerns, for inclusion in the 90% BOD.					
851	Hualapai-147	Cover Letter		**<u>Consideration of Tribal Sensitivities as Design Criteria</u>** - While the Hualapai appreciates the opportunity for continued contribution towards a successful and effective remediation design, it is apparent from the 30% to the 60% designs that the expressed tribal preferences relating to Tribal religious and cultural issues were not substantively factored or considered in engineering designs. The Hualapai requests, at a minimum, equal scientific/engineering rigor should be given to legitimate alternate design constraints. During discussions with PG&E consultants, it is clear that various alternative design options proposed by the Tribes and intended to contribute to the 60% design process were dismissed without an unbiased quantitative comparative analysis. The Hualapai continue to believe however, that some of these discarded options may be substantially preferable to the design shown in the 60% BOD report. Therefore, in future discussions regarding design alternatives the	Regarding consideration of design alternatives, please see PG&E's response to comment #8b Hualapai-3/CRIT-3/Chemehuevi-3/Cocopah-3, #9 FMIT-4/Hualapai-4/CRIT-4/ Chemehuevi-4/ Cocopah-4, and #1 DOI-1. As mentioned in prior responses, PG&E has and will continue to collaborate with Tribes and Agencies towards a satisfactory resolution of Tribal concerns, for inclusion in the 90% BOD.			The Hualapai Tribe appreciates being involved in all stages of the Topock project and look forward to continuing our relationship with all the agencies and stakeholders involved in the project.	This comment and response were discussed at the December 17-18, 2013 TWG meeting.	See RTCs #8b Hualapai-3/CRIT-3/Chemehuevi-3/Cocopah-3, #9 FMIT-4/Hualapai-4/CRIT-4/ Chemehuevi-4/ Cocopah-4, and #1 DOI-1.

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				Hualapai and any interested Tribes involved with the Topock Remedial Project, would like to be provided with a detailed quantitative decision matrix that provides transparency into how and why final design options have been selected.						
852	Hualapai-148	Cover Letter		**Consideration of Alternative Design Options** – The Tribes, who have been living on and caring for this land for thousands of years, desire that their cultural values and input be equally weighted in the remedial design to those of PG&E and the remediation contractors who are merely temporary visitors to the Sacred landscape. This is of particular importance to Hualapai, who perceive portions of the remediation effort as an additional desecration to the land. Therefore, there is a strong desire on the part of the Hualapai, that special emphasis be focused on the avoidance and minimization of subsurface impacts at this area. Of particular importance is that sacred ground has existed here for hundreds of years, and should be protected for future generations. Specifically the planned installation of nearly 5 miles of large infrastructure trenches and vaults is a hugely disturbing and invasive construction. Subsurface disturbances permanently change the natural order of the land and require disruptive removal of these utilities once the remedy is complete. Invasive subsurface disturbances need to be avoided to the extent practicable. The Hualapai on numerous occasions have voiced their preference for the short-term visual impacts associated with aboveground pipework over the currently proposed permanent impacts associated with belowground trenching. The attached comments which include alternative designs to some sections of the infrastructure alignments provide a reasonable approach to lessening this impact. These alternative designs should be given full and fair consideration toward the goal of reducing the impacts to this area.	Regarding the placement of facilities aboveground vs. belowground, please see PG&E's responses to comment #8b Hualapai-3/CRIT-3/Chemehuevi-3/Cocopah-3, #9 FMIT-4/Hualapai-4/CRIT-4/ Chemehuevi-4/ Cocopah-4, and #1 DOI-1. As mentioned in prior responses, PG&E has and will continue to collaborate with Tribes and Agencies towards a satisfactory resolution of Tribal concerns, for inclusion in the 90% BOD.			The Hualapai Tribe appreciates being involved in all stages of the Topock project and look forward to continuing our relationship with all the agencies and stakeholders involved in the project.	This comment and response were discussed at the December 17-18, 2013 TWG meeting.	See RTC #8b Hualapai-3/CRIT-3/Chemehuevi-3/Cocopah-3, #9 FMIT-4/Hualapai-4/CRIT-4/ Chemehuevi-4/ Cocopah-4, and #1 DOI-1.

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853	Hualapai-149	Cover Letter		**Consideration for Placement of Staging and Displaced Soils Storage Areas** – The location of displaced soil storage and equipment staging areas is of particular concern, as these locations will inevitably see increased construction vehicle and truck traffic, dust and excessive noise. Therefore, the Hualapai's opinion is that storage and staging areas be located as much as possible away from, and out of sight of all Topock Maze areas. The Hualapai appreciates the ongoing discussions and efforts by all parties to address this issue, and support the continued effort to identify suitable locations for these activities which will address Tribal concerns.	The Tribe's comment is duly noted. PG&E appreciates the Tribe's participation and inputs on identifying and evaluation of suitable locations for soil storage and construction staging areas. PG&E hopes that current open discussions and transparent processes will yield a satisfactory solution that allows the project to move forward expeditiously.			The Hualapai Tribe appreciates being involved in all stages of the Topock project and look forward to continuing our relationship with all the agencies and stakeholders involved in the project.	This comment and response were discussed at the December 17-18, 2013 TWG meeting.	Construction/Remedial Action Work Plan, Figures 4-3 (Locations of Construction Facilities in Moabi Regional Park) and 4-5 (Construction Site Plan and Access Routes).
854	Hualapai-150	Cover Letter		**Consideration for Notification of Chemical Usage** – Chemicals that are foreign to the natural environment and are dissipated into the Sacred landscape are a significant concern to the Hualapai. Therefore, it is requested that full transparency into the specific types of chemicals used within the remediation project be provided prior to the construction and operation of the system. In addition, chemical usage volumes and frequencies should be provided to the stakeholders for review and comment.	See response to comment #13b Hualapai/CRIT/Chemehuevi/Cocopah -8.				Comment resolved.	O&M Manual Main Text, Exhibit L2.2-1 (Communication Framework During O&M).
855	FMIT-198	Cover Letter		**Incorporating Tribal Sensitivities as Design Criteria** - It is apparent that the expressed tribal preferences relating to tribal religious and cultural issues have not been factored or substantively considered in engineering design changes from the 30% to the 60% designs. For example, in its comments on the 30% BOD report, the Tribe expressed a preference for minimizing subsurface pipeline routings. Instead, the intermediate design calls for nearly all the water piping and utilities to be buried without any consideration of the Tribe's reasoning supporting its preference for above-ground alternatives. At a minimum, equal scientific/engineering rigor should be given to these legitimate alternate design constraints in the 90% BOD. Also, PG&E should provide the agencies a choice on how to proceed in balancing different criteria.	Regarding the placement of facilities aboveground vs. belowground and alternative design, please see responses to comment #8a FMIT-3, #9 FMIT-4/Hualapai-4/ CRIT-4/Chemehuevi-4/ Cocopah-4, and #1 DOI-1. As mentioned in prior responses, PG&E has and will continue to collaborate with Tribes and Agencies towards a satisfactory resolution of Tribal concerns, for inclusion in the 90% BOD.			The FMIT appreciates being involved in all stages of the Topock project and look forward to continuing our relationship with all the agencies and stakeholders involved in the project. The FMIT would like to see specifics of how the design achieves the goals of the tribe prior to the 90% design submittal.	This comment and response were discussed at the December 17-18, 2013 TWG meeting.	See RTCs #8a FMIT-3, #9 FMIT-4/Hualapai-4/ CRIT-4/Chemehuevi-4/ Cocopah-4, and #1 DOI-1.

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856	FMIT-199	Cover Letter		**Avoidance and Minimization of Infrastructure and Project Disturbances -** The Tribe expects that all above- and below-ground disturbances of any duration (short-, mid- and long-term) will be avoided and minimized to the extent feasible. Subsurface infrastructure not only permanently changes the natural order of the land but to respect tribal views, also generally require removal of these utilities once the remedy is complete, which causes additional disruptions. Intrusive subsurface disturbances therefore need to be avoided from the outset to the maximum extent feasible. Installation of remedial infrastructure on the ground surface itself also needs to be minimized in terms of its footprint. As discussed above, the Tribes have previously provided input on their preferences for installation methods that minimize subsurface disturbances throughout the remedies' lifecycles.	Regarding the placement of facilities aboveground vs. belowground, please see responses to comment #8a FMIT-3, #9 FMIT-4/Hualapai-4/CRIT-4/ Chemehuevi-4/ Cocopah-4, and #1 DOI-1. As mentioned in prior responses, PG&E has and will continue to collaborate with Tribes and Agencies towards a satisfactory resolution of Tribal concerns, for inclusion in the 90% BOD.			The FMIT appreciates being involved in all stages of the Topock project and look forward to continuing our relationship with all the agencies and stakeholders involved in the project. The FMIT would like to see specifics of how the design achieves the goals of the tribe prior to the 90% design submittal.	This comment and response were discussed at the December 17-18, 2013 TWG meeting.	See RTCs #8a FMIT-3, #9 FMIT-4/ Hualapai-4/CRIT-4/Chemehuevi-4/ Cocopah-4, and #1 DOI-1.
857	FMIT-200	Cover Letter		**Coordination of Removal of IM-3 with Final Remedy Implementation -** Project documents, including the FEIR, show that concurrent operation of Interim Measure No. 3 (IM-3) and the final groundwater remedy is incompatible. Operation of the IM-3 treatment plant will terminate upon start-up of the final remedy. Pursuant to the December 19, 2012, Settlement Agreement between DTSC and the Tribe ("Tribe/DTSC Agreement") the IM-3 *treatment plant,* will remain in place no longer than a determination that the final remedy is "operating properly and successfully" (OPS). The start-up strategy for the final remedy needs to be efficient, to ensure the earliest possible demonstration that the remedy is "operating properly and successfully" (OPS) so that the IM-3 plant can be decommissioned in a manner consistent with the settlement agreement between the Tribe and PG&E. Immediate restoration of the IM-3 parking/staging area and timely removal and restoration of the IM-3 treatment plant area are of critical importance to the Tribe due to the extreme cultural sensitivity of this	The Tribe correctly states that pursuant to the 2012 Settlement Agreement, the IM-3 treatment facility will be decommissioned when DTSC, with DOI's concurrence, finds that the final remedy is "operating properly and successfully." PG&E intends to abide by the terms of the 2012 Settlement Agreement. The start-up strategy for the final remedy will occur as efficiently as possible, subject to field conditions and the requirements of the agencies that have jurisdiction over this project. PG&E has concluded after consideration that it cannot remove pipelines and wells associated with the IM-3 treatment plant until the final remedy is operating properly and successfully. Wells, pipelines, and other components that are part of the IM-3 system and outside the treatment plant area, if removed, would prevent IM-3 from operating. IM-3's primary purpose is to provide hydraulic gradient control. The four IM-3 wells are used to maintain the gradient. Two extraction wells operate continuously and one injection well is in service with the other in standby mode to allow the extraction wells to continue pumping				This comment and the response were discussed by PG&E and the FMIT.	IM-3 Decommissioning, Removal, and Restoration Work Plan

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				particular area. In addition, apart from removal of the treatment plant, removal of such items as pipelines and wells that are associated with IM-3 should be considered in conjunction with the implementation of the final groundwater remedy to avoid additional disruption of the land surface and to economies during construction.	and maintain the gradient. The piping and electrical conduit connecting the injection and extraction wells are needed to convey water to the treatment system or from the treatment system for re-injection. The extracted groundwater cannot be re-injected without treatment and therefore all of these IM-3 components must be retained. See response to comment FMIT-44, which addresses restoration of the IM-3 treatment plan area, including parking and staging areas.					
858	FMIT-201	Cover Letter		**Avoidance or Minimal Use of FMIT Property -** The above issues regarding the minimization of infrastructure and project disturbance as well as addressing Tribal sensitivities in design apply in particular to the parcel owned in fee by the FMIT due to the extreme cultural sensitivity of the area. In addition, except to the extent DTSC expressly requires the use of the parcel owned by FMIT for specific purposes, FMIT consent will be required for such uses, consistent with the 2006 settlement agreement with PG&E and the PG&E easement recorded on the property. All planning and design should attempt to avoid and minimize existing and new infrastructure including utility lines, piping, staging or parking areas, storage areas, wells of all types, etc. All future remedy activities should also avoid this property to the maximum extent feasible, consistent with the 2006 settlement agreement between the Tribe and PG&E.	The terms of the 2006 Settlement Agreement and Easement Agreement between PG&E and the FMIT allow for PG&E to "install, access, use, operate, maintain, modify, upgrade and remove any and all additional Remediation-related Facilities required by the DTSC or another agency or governmental body with jurisdiction over the Property or the Remediation, including but not limited to additional treatment equipment, pipelines, extraction wells, injection wells, slurry walls, and in-situ facilities," on the IM-3 Property. Easement Agreement, § 3. The Settlement Agreement also acknowledges that the IM-3 Property may continue to be used for the groundwater remedy - "The Parties recognize that as part of the operation of the IM-3 or the final remedy, construction of additional facilities, such as additional wells, may be required and that this work may require the temporary use of heavy construction equipment, lighting facilities and associated activity." 2006 Settlement Agreement, § VI(B)(2)(a). PG&E agrees that it has an obligation to consult the FMIT on the location of remediation facilities on the IM-3 Property and to honor Tribal concerns to the maximum extent practicable and believes in its design of the groundwater remedy it has fulfilled and is fulfilling the requirements of the 2006 Settlement Agreement. If the FMIT has concerns				This comment and the response were discussed by PG&E and the FMIT.	90% BOD Executive Summary Section ES.3 (see Remedy proposed on FMIT Parcel).

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					about the location of specific infrastructure PG&E would be happy to discuss those concerns further with the FMIT, as it has done in the past.					
859	FMIT-202	Cover Letter		**Compliance with Mitigation Measures and ARARs -** Proper and full accounting of all mitigation measures and ARARs applicable to Native American, cultural, native flora, and wildlife values must be assured and independently verified by the lead agencies. Periodic reviews and specific reporting of compliance with each mitigation measure should be implemented. The agencies also must provide a transparent process for proposed revisions to existing mitigation measures or proposed application of mitigation measures from one project phase to another.	In compliance with the mitigation measures set forth in the certified EIR, PG&E has and will continue to prepare and submit to DTSC quarterly compliance reports (the first report was published in fourth quarter of 2011). In addition, PG&E has and will continue to submit to DOI documentation of compliance activities with specific ARARs in the design documents and progress reports. PG&E defers to the Agencies on request for process for proposed revisions to existing mitigation measures or proposed application of mitigation measures from one project phase to another.	PG&E is required to provide periodic reporting of the mitigation measures compliance to the agencies. Those compliance reports are considered public document. In response to inquiry on revision to mitigation measures, DTSC cannot substantively change or modify mitigation measures adopted as part of the certified EIR without formal CEQA process, which includes analysis and notifications. Mitigation measures are design to apply to the entire project unless the compliance period is specified.	In accordance with Section 9.4 of the CHPMP, BLM may amend the finalized CHPMP as additional information is developed regarding cultural and historic resources within the APE, in the event that the APE is revised, and for any other reason deemed appropriate by BLM. Revision of the CHPMP shall not require an amendment of the PA. The CHPMP may be revised in phases as the Undertaking progresses as identified in PA Stipulation VII.F.	Okay with DOI's response.	Comment resolved.	90% BOD Section 6, Tables 6.1-1 through 6.2-3.
860	FMIT-203	Cover Letter		**Establishing an Adequate Review Process through the 90% BOD Report -** The recent review experience of the 60% BOD report indicates that the currently scheduled comment period for the 90% design review may not be of sufficient length to allow for complete and meaningful review and comment by the Tribes. The BOD reports are extremely large with many detailed appendices that need review, not only by the Tribe, but its consultants. In addition, at each stage of the design review process, sections have been introduced that have not been previously seen by the reviewers. DTSC and other agencies must allow sufficient time for the Tribes to consult with 1) the Tribes' technical internal consultants; 2) the TRC; 3) Tribal elders and leadership; and 4) other Tribes. The Tribes also need sufficient time to exercise their rights to government-to-government consultations with the agencies in regard to project impacts, an aspect which our Tribe does not want to see curtailed due to arbitrary schedule demands. One resolution might be the provision of interim review between the agencies and Tribes of how Tribal issues and comments will be incorporated into the design prior to submittal of the 90% BOD report.	Please see response to comment #11a FMIT-6.			The FMIT appreciates being involved in all stages of the Topock project and look forward to continuing our relationship with all the agencies and stakeholders involved in the project. The FMIT would like to see specifics of how the design achieves the goals of the tribe prior to the 90% design submittal.	This comment and response were discussed at the December 17-18, 2013 TWG meeting.	CIMP CUL-1a-8d (Protocol for The Review of Project Design Documents)

TABLE I-1

Response to Comments on Basis of Design Report/Intermediate (60%) Design

Groundwater Remedy Basis of Design Report/Pre-Final (90%) Design

PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
861	FMIT-204	Cover Letter		**Consideration of Alternative Designs -** During various discussions with PG&E and its consultants at the 11/VG, CWG, and other meetings, it is evident that PG&E consultants evaluated internally and then discarded certain options during the 60% design process. These options were disregarded without any proactive discussion or consultation with the Tribes before being set aside. The Tribes are concerned that some of these discarded options may be substantially preferable to the designs presented in the 60% BOD report and provide greater compliance with ARARs. Resolution of the utility of design alternatives might include PG&E consultants/ engineers engaging the Tribes in more detailed discussions with regarding alternative options for such features as transformer configuration, use of potential overhead and/or aboveground utility conveyances, etc., prior to release of the 90 % BOD report. The 90% BOD report should also include a brief summary of design alternatives considered but rejected with an explanation of why they were rejected. Where there are options that might better meet the Tribe's concerns, such options should also be summarized for the agencies in the BOD report.	Regarding alternative designs, Please see responses to comment #8a FMIT-3 and #1 DOI-1. PG&E has and will continue to collaborate with Tribes and Agencies towards a satisfactory resolution of Tribal concerns, for inclusion in the 90% BOD.			The FMIT appreciates being involved in all stages of the Topock project and look forward to continuing our relationship with all the agencies and stakeholders involved in the project. The FMIT would like to see specifics of how the design achieves the goals of the tribe prior to the 90% design submittal.	This comment and response were discussed at the December 17-18, 2013 TWG meeting.	See RTCs #8a FMIT-3 and #1 DOI-1.
862	FMIT-205	Cover Letter		**Avoidance of All Sensitive Areas -** The current "project boundary" limits, as depicted in various project maps, have been shown to be incomplete and/or inconsistent with sensitive areas that should be avoided. This conflict needs to be resolved such that all sensitive areas are excluded from any project activity prior to completion of the 90% BOD report. Recent surveys performed by various Tribal, BLM,PG&E, and DTSC representatives need to be properly accounted for in mapping project boundaries and exclusion areas.	Please see response to comment #12 FMIT-7/Hualapai-7/CRIT-7/ Chemehuevi-7/ Cocopah-7.			The FMIT appreciates being involved in all stages of the Topock project and look forward to continuing our relationship with all the agencies and stakeholders involved in the project. The FMIT would like to see specifics of how the design achieves the goals of the tribe prior to the 90% design submittal.	Ongoing discussion between Tribes and Agencies. This is an open item that will be carried forward.	90% BOD Section 6 Tables 6.1-1 through 6.2-3.
863	FMIT-206	Cover Letter		**Minimization of Chemical Usage -** Chemicals that are foreign to the natural environment are a concern to the Tribe. Additionally, some chemicals may be more offensive for use in a sacred area than others. PG&E should fully disclose the types, volumes, and frequencies of chemical usage associated with the project. The Tribe should be notified of any proposed	See response to comment #13a FMIT-8.			See comment #13a FMIT-8.	Comment resolved.	O&M Manual Main Text Exhibit 2.2-1 (Communications Framework during O&M).

TABLE I-1

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PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution	Where responses are reflected in the 90% design documents?
				changes in the types or significant quantities of chemicals used.						
864	Chemehuevi-147	Cover Letter		In reviewing the 60% BOD document, it was apparent that tribal preferences relating to spiritual and cultural matters were not factored into the proposed design. Alternate routings and design specifics which do address tribal preferences are discussed and presented within the attached comments. At a minimum, equal consideration and fair evaluation should be given to these legitimate and alternative designs. Any design screening evaluation criteria should also specifically consider and include tribal preferences.	Regarding alternative designs, please see responses to comment #8b Hualapai-3/CRIT-3/ Chemehuevi-3/Cocopah-3 and #1 DOI-1.					
865	Chemehuevi-148	Cover Letter		To the extent possible, invasive subsurface disturbances should be avoided, as these are permanent injuries to the natural order of the land. Installation of remedial structures in the subsurface should be minimized both in total volume of earth disturbed, and in the total foot print of the construction.	Regarding the placement of facilities aboveground vs. belowground, please see responses to comment #8b Hualapai-3/CRIT-3/ Chemehuevi-3/ Cocopah-3 and #9 FMIT-4/Hualapai-4/ CRIT-4/Chemehuevi-4/Cocopah-4.					
866	Chemehuevi-149	Cover Letter		The current "project boundary" as indicated in the 60% BOD figures has been shown to not adequately represent the actual culturally sensitive areas. Significant time and effort on the part of the Tribes, DTSC and others has been expended to address this problem and any final documents prepared should reflect that all sensitive areas be excluded from any project activity. This conflict needs to be address and resolved prior to the issuance of the 90%. In addition, the plume boundaries as depicted should reflect the current plume configuration.	Please see response to comment #12 FMIT-7/Hualapai-7/CRIT-7/ Chemehuevi-7/Cocopah-7. An updated Cr(VI) plume boundary will be included in the 90% BOD.				.	
867	Chemehuevi-150	Cover Letter		During construction activities for the remedy installation, due care should be taken, and preparation made for unforeseen encounter with contaminated soils during the significant excavation activities and disturbances. The Tribe is concerned that sufficient contingencies are in place to contain and minimize any additional impacts related to discovery of existing contamination,	The Tribe's comment is duly noted. The Soil Management Plan (Volume 4 of the O&M Manual) addresses the management and handling of potential contaminated soils that may be encountered during remedy construction/O&M activities. Close coordination with the upcoming Soil RFI/RI sampling effort will continue to ensure that the Soil Management Plan reflects the most current					

TABLE I-1

Response to Comments on Basis of Design Report/Intermediate (60%) Design

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				and any potential release of chemicals or materials utilized during the construction phase.	information on known contaminated soils at the site. In addition, the forthcoming Construction/ Remedial Action Work Plan will include sampling and monitoring as well as contingencies during construction. This Work Plan will be submitted with the 90% design for agencies, Tribes, and stakeholders review and inputs.					
868	Chemehuevi-151	Cover Letter		Chemicals that will be utilized during the operation of the remedy are by definition foreign to the natural environment. The use of chemicals should be minimized, and any chemicals utilized should be fully disclosed with regard to the type, volume, storage and frequency of use.	See response to comment #13b Hualapai/CRIT/Chemehuevi/Cocopah-8.				Comment resolved.	

Attachment A: RTC #1

Pipeline Evaluation Matrix, Visual Simulations, TRC's Response, and Tribes' Letters/Email

TABLE 1

Alternative Pipeline A/H & B Configuration Summary Description

Groundwater Remedy Project

PG&E Topock Compressor Station, Needles, California

Alternative Number	Name	Total Piping Length [a], feet	Underground Piping Length [a], feet	Aboveground Piping Length [a], feet	Bridges (Length, feet)	Power Poles	Radio Towers	Conceptual Layout [c]
0	Pipelines A/H Current Design	4,800	4,600	200	1 (180 feet)	0	0	Figure 1
0a	Pipelines A/H Current Route Above Ground [d]	4,800	830	3,970	3 (180 feet; and 2-30 foot pipe bridges (grade separations))	26	3	Figure 2
1	Pipelines A/H Alternative Route 1 [d]	4,300	830	3,470	4 (140-feet; 1-50-foot, and 2-30 foot pipe bridges (grade separations))	26	3	Figure 3
2	Pipelines A/H Alternative Route 2 [d]	4,000	650	3,350	5 (280-feet, 330-feet, and 3-30 foot pipe bridge (grade separation))	26	3	Figure 4
B0	Pipeline B - Current Design [b]	2,500	1,900	600	0	0	0	Figure 21
B0a	Pipeline B Alternative 1 (Current Route Aboveground) [b]	2,500	0	2,500	1-30 foot pipe bridge (grade separation))	0	0	Figure 21

Notes:

a. Lengths rounded to nearest 100 feet and represent length of corridor which may consist of 1 or more pipes and conduit.

b. Electrical cable is underground for this alternative and extends for about 1,600 feet.

c. Figures included with visual simulations.

d. Approximately 360 feet of underground conduit is included for this alternative to enable safe access to wells and equipment.

Pipeline A - Segment 1

Evaluation Factors	Evaluation Criteria	Basis for Evaluation[3]	Comments/Notes
Construction Impacts	N, L, I, H[2]	Analysis	**H - Construction impacts are rated high because:** a) This piping alignment is on a steep slope (up to 2:1), which contains loose surface soils. Access is difficult and is less safe than the 60% design alignment. Further, drainage will be required to protect piping/electrical conduits. b) There is an existing, underground 30-inch SoCal gas pipe on the steep slope. Approximately 30-75 ft south of the gas pipe is the BNSF property line, and 25-60 ft north of the gas pipe is a culturally sensitive area as described by Tribes. Taking into account the SoCal Gas ROW (50-ft), the available work space on the south side of the ROW is only 5 ft at the pinch point and up to 50 ft at the widest spread. Construction on a steep slope will require adequate set back/work zone for not only the trench, but also staging of construction equipment staging, benching, etc. Since encroachment into the BNSF RR property is not viable, the south side is eliminated from further consideration. On the north side, the available work space is 0 ft at the pinch point, and up to 35 ft at the widest spread. Cutting into the undisturbed or culturally sensitive area to the north is required for adequate work space. c) New piping/conduits and associated work zone will be conducted outside of the 50-ft SoCal ROW, unless agreed to otherwise by SoCal Gas and allowed otherwise by BLM. d) To allow for future maintainability of the pipes, underground vaults will be required at the bottom and top of slope. Approximate vault dimension is 12-ft long x 6-ft wide. The estimated cost for this segment alone is $300,000.
Ecological Impacts[6]	N, L, I, H[2]	Analysis	**L - Ecological impacts are rated low because:** Segment 1 primarily runs underground with the majority of the route in previously disturbed open creosote bush scrub community, No impacts to desert tortoise are anticipated. Pipeline route is not within potential SWFL and other migratory bird habitat. Several mature plants would likely be removed during construction; such removal of large vascular plants to accomodate the pipeline would pose special problems for transplantation (due to large size and deep roots) or replacement planting (due to the difficulty of establishing native woody plantings in arid environments).
Displaced soil volume (or exacavated soil volume)	cubic yds	Calculation	Cutting into the undisturbed area to the north is required to create adequate work space. The estimated volume of displaced soil is 1,585 cubic yards (cy), excavated soil is 1,745 cy, of which, 300 cy is inside the area outlined as culturally sensitive area by the Tribes.
Worker Safety Impacts (Construction)	N, L, I, H[2]	Analysis	**H - Worker Safety Impacts during construction are rated high because:** a) Limited work space and work on steep slope increase safety risk. b) Construction near high natural gas pipeline increase risk.
Worker Safety Impacts (Operational)	N, L, I, H[2]	Analysis	**I - Worker Safety Impacts during operation are rated Intermediate because:** a) For O&M, there is an increased risk of incidents while working on slope, and while lifting or working in vaults. b) Working in vaults could involve confined space entry.
EIR Impacts	N, L, I, H[2]	(Legal) Opinion	**I - Additional CEQA review will be needed to evaluate the potential impacts of the new route.** The type of additional CEQA review required depends whether the design has new, significant impacts that were not disclosed in the EIR. If there are new, significant impacts, a supplemental EIR would be required; an addendum would not suffice. Further analysis will allow the technical team to determine whether this alternative may have new, significant impacts; one of the primary areas to be evaluated in this respect is the increased earthwork and ongoing maintenance.
Historical/Archaeological Impacts[4, 5]	N, L, I, H[2]	Analysis	**None - Historical/Archaeological impacts are rated none** because: All archaeological and historical sites are avoided.
Likelihood of Failure to Detect or Contain Leaks	N, L, I, H[2]	Analysis	**L - Likelihood of failure to detect or contain leaks is rated low** because of the vault at the bottom of the slope.
O&M Impacts	N, L, I, H[2]	Analysis	**I -** Majority of the maintenance activities will include O&M of erosion control measures (e.g., fix slope to reduce erosion) and cleaning of the vaults. Maintenance of the underground pipes is anticipated to be infrequent. The estimated annuall cost of this maintenance is $10,000.
Public Safety Impacts	N, L, I, H[2]	Analysis	**L** - If required, bollards will be installed to protect the vault at the bottom of the steep slope. The bollards could create safety hazard for motorists travel on NTH.
Ground Disturbance	Lineal Feet	Estimation	Length of pipe on the steep slope is approximately 310 linear feet. Approximately 125 feet traverse an area designated as possibly having cultural significance by the Tribes.

NOTES

[1] Segment description noted below

Segment 1 - Below ground water pipe and electrical conduit in larger casings going west from NTH parallel to SoCal gas pipeline to top of hill. See Figures 22 and 25.

[2] Ratings: N = "None"; L = "Low"; I = "Intermediate"; and H = "High." These are qualitative ratings based upon the rationale provided and not to be used in a quantitative manner, i.e., the ratings are not additive.

[3] Indicate whether the basis for evaluation is an opinion, calculation, analysis, etc.

[4] Alternatives for Pipeline A & H do not extend into the floodplain for the purposes of this evaluation factor.

[5] PG&E assumes impacts on the Traditional Cultural Property within the APE determined by BLM to be eligible for the National Register of Historic Places will be analyzed under "Cultural Integrity"

[6] Alternatives for Pipeline A & H do not extend into the floodplain for the purposes of this evaluation factor.

Pipeline A - Segment 2

Evaluation Factors	Evaluation Criteria	Basis for Evaluation[3]	Comments/Notes
Construction Impacts	N, L, I, H[2]	Analysis	**I - Construction impacts are rated intermediate because:** a) Constraints along this segment include narrow road sections, cultural resources, mature vegetation, and access roads for BNSF and SoCal Gas. In addition, the City of Needles power poles intersect with this segment as shown in Figure 22. Therefore, the aboveground portions of this alignment would be located off the road. Aboveground pipe rack and guard rail would require 8-ft of clear space for O&M and access. b) New electrical and communication cables would be installed on new poles installed on the abandoned Route 66 to avoid the City of Needles poles. Another reason for this routing is that the poles would run along an existing access new road; placement of power poles elswhere would likely require construction of new access roads (see Figure 22).
Ecological Impacts[6]	N, L, I, H[2]	Analysis	**I - Ecological impacts are rated intermediate because:** Segment 2 runs both above and underground with one bridge structure proposed over Bat Cave Wash. Portions of the route are established in previously disturbed road and open creosote bush scrub community; however, the pipeline alignment goes through approximately 3.45 acres of the blue Palo Verde community. No impacts to desert tortoise are anticipated. Pipeline route is not within potential SWFL and other migratory bird habitat. While this alignment appears to mostly follow along the edge of a previously disturbed roadway, the first above ground segment (southernmost portion approximately 200 feet) appears to pass through a area with large vascular plants (that were not specifically mapped as palo verde or mesquite). Any removal of blue palo verde (a culturally important plant) or any other large vascular plants to accomodate the above-ground pipeline would pose special problems for transplantation (due to large size and deep roots) or replacement planting (due to the difficulty of establishing native woody plantings in arid environments). In addition, the above ground segment runs separately from an above ground power line, which could represent a separate but small additional potential impact for bird strikes.
Displaced soil volume (or exacavated soil volume)	cubic yds	Material take-off	The estimated volume of displaced soil and excavated soil is 210 and 930 cubic yards, respectively.
Worker Safety Impacts (Construction)	N, L, I, H[2]	Analysis	**H - Worker Safety Impacts during construction are rated high because:** a) Limited work space and work on steep slope increase safety risk. b) Construction near high natural gas pipeline increase risk.
Worker Safety Impacts (Operational)	N, L, I, H[2]	Analysis	**L - Worker Safety Impacts during operation are rated low because:** a) For O&M, there is an increased risk of incidents while working on aboveground pipe off the access road and while working in vaults near the pipe bridge. b) Working in vaults could involve confined space entry.
EIR Impacts	N, L, I, H[2]	(Legal) Opinion	**H - Additional CEQA review will be needed because the EIR did not contemplate aspects of this design, including aboveground piping infrastructure, aboveground utility poles, and a potential variance to the Fire Code.** The type of additional CEQA review required depends whether the design has new, significant impacts that were not disclosed in the EIR. Such impacts could include new aesthetic impacts from aboveground utilities and pipelines or new impacts from additional earthwork or possible fire code violations. If there are new, significant impacts, a supplemental EIR would be required; an addendum would not suffice. Further analysis will allow the technical team to determine whether this alternative may have new, significant impacts. For example, if the technical team determines that the location of the poles near Loci B would have new significant aesthetic impacts or new significant impacts on cultural resources, and those impacts cannot be mitigated to a less than significant level, then a supplemental EIR would be required. Following the same pipeline route as the design contemplated in the EIR helps from a CEQA perspective. Tribes and agencies may be concerned, however, about the impact of locating new, above-ground infrastructure so close to Maze Loci B.
Historical/Archaeological Impacts[4, 5]	N, L, I, H[2]	Analysis	**None - Historical/Archaeological impacts are rated none** because: All archaeological and historical sites are avoided.
Likelihood of Failure to Detect or Contain Leaks	N, L, I, H[2]	Analysis	**L - Likelihood of failure to detect or contain leaks is rated low.** All secondary containment piping accessible for visual inspection, but water carrier pipes not accessible. Low point sumps equipped with level switches will be primary means of monitoring for and containing leaks. See also O&M Impacts caused by use of double-contained steel pipe.
O&M Impacts	N, L, I, H[2]	Analysis	**H - O&M Impacts rated high**. O&M impacts are higher than 60% design in large part due to the use of steel pipe through most of the route. Mortar lined steel pipe will resist corrosion, but the lining has a shorter life than underground plastic piping. In addition, the liner will not be suitable for pipe cleaning using strong chemicals or aggressive mechanical methods. In addition, minerals in the groundwater may precipitate on the liner or biological materials may to adhere to the liner reducing pipe capacity. Aboveground pipe supports and steel pipe increase difficulty of maintenance of piping requiring more equipment and personnel. in addition, the aboveground structures will require sand blasting and painting every 10 years. Other maintenance activities will include cleaning of the vaults and maintenance of the underground pipes is anticipated to be infrequent.
Public Safety Impacts	N, L, I, H[2]	Analysis	**I - Public Safety Impacts are rated intermediate.** Aboveground structures increase risk of public safety incidents due to potential vehicle impacts on IM-3 access road and Route 66 west of IM-3. Greater impact given the inherent vulnerability of aboveground piping (members of the public have been known to shoot pipes) and large rocks or other debris that may strike the pipe during a storm event.
Ground Disturbance	Lineal Feet	Material take-off	339

NOTES

[1] Segment description noted below

Segment 2 - Underground across IM-3 access road and run above-ground water pipe on pipe supports along 60% design route to Bat Cave Wash pipe bridge. Electrical power and fiber optic run on new poles from top of hill near SoCal gas pipeline along abandoned Route 66 to Bat Cave Wash. See Figures 22.

[2] Ratings: N = "None"; L = "Low"; I = "Intermediate"; and H = "High." These are qualitative ratings based upon the rationale provided and not to be used in a quantitative manner, i.e., the ratings

[3] Indicate whether the basis for evaluation is an opinion, calculation, analysis, etc.

[4] Alternatives for Pipeline A & H do not extend into the floodplain for the purposes of this evaluation factor.

[5] PG&E assumes impacts on the Traditional Cultural Property within the APE determined by BLM to be eligible for the National Register of Historic Places will be analyzed under "Cultural Integrity"

[6] Alternatives for Pipeline A & H do not extend into the floodplain for the purposes of this evaluation factor.

Evaluation Factors	Description of Baseline (Pre-Construction) Conditions
Cultural Integrity	
Visual Impacts	Baseline views/vistas of the natural landscape include Needles Rock, Topock Maze Loci A, B & C, Chemehuevi Mountains, Colorado River, BLM ACEC and the Havasu National Wildlife Refuge. Baseline views also include manmade features including I-40, BNSF Railroad, the pipeline bridge, Topock Marina, Park Moabi, the Topock Compressor Station and IM-3.
Ecological Impacts	The dominant plant communities at the site consist of creosote bush scrub (generally west of National Trails Highway) and salt cedar (generally between National Trails Highway and the Colorado River and at the mouth of Bat Cave Wash). The habitat in and around the Topock site is suitable for bighorn sheep, bobcats, chuckwallas, red-tailed hawks and other mammals, reptiles, and birds. Observations of mountain lion activity have been reported in this area as well. The Topock area provides foraging and/or nesting habitat for a variety of special-status bird species. Desert tortoise may have historically used the project area, but no evidence of current use has been documented during the protocol-level surveys conducted yearly since 2004.
Noise Impacts	See Final EIR[5] Section 4.9.1.5 for baseline conditions.
Worker Safety Impacts	Under baseline conditions, no work is occurring.
Schedule Impacts	Under baseline conditions, there are no delays to the project.
EIR Impacts	Final EIR for the Topock Compressor Station Groundwater Remediation Project, January 2011[5].
Historical/Archaeological Impacts	Under baseline conditions, no additional impacts to historical/archeological resources occur for the groundwater project.
Likelihood of Failure to Detect or Contain Leaks	Under baseline conditions, no leaks occur.
Public Safety Impacts	Under baseline conditions, there is no increase impact to public safety due to the project.
Decommissioning Impacts	Under baseline conditions, no system is built therefore there are no decommissioning impacts.
Ground Disturbance	Under baseline conditions, no additional ground disturbance occurs based on the Aerial Map of Disturbed Areas, November 2011 (Appendix A-2 60% Design BOD)
Displaced soil volume	Under baseline conditions, no soil is displaced.
Capital Cost	0
O&M Cost	0
Decommissioning Costs	0
Construction Impacts [14]	Under baseline conditions, no project.
Fire Department Impacts [14]	Under baseline conditions, no project.
O&M Impacts [14]	Under baseline conditions, no project.

	Evaluation Criteria	**Pipelines A/H Current Design**	**Basis for Evaluation[3]**	**Comments/Notes**	**Pipelines A/H Current Route Above Ground**	**Basis for Evaluation[3]**	**Comments/Notes**
Evaluation Factors							
Cultural Integrity	Present/Not Present[6]						
Visual Impacts	N, L, I, H[2]	L	Simulations of views of Alternative 0 based on design drawings as seen from FEIR Key Viewpoints 6 and 9		H	Simulations of views of Alternative 0a based on design drawings as seen from FEIR Key Viewpoints 6 and 9 and two new viewpoints established on elevated areas providing foreground to middleground views of the proposed changes.	Installation of radio tower near compressor station will have little to no impact. From most views, impacts of new wood pole utility lines, above-ground pipelines on low racks, and grade separation structures will have an intermediate level of impact. Bridge crossing structures will have high levels of impacts in both foreground and middleground views. Other project elements will have high levels of impact in foreground views..
Ecological Impacts [11]	N, L, I, H[2]	I	Analysis	The current route primarily runs underground with one bridge structure proposed over Bat Cave Wash. The majority of the route is established in previously disturbed road and open creosote bush scrub community; however, the pipeline alignment goes through approximately 3.45 acres of the blue Palo Verde community and may result in the loss of individual Palo Verde. No impacts to desert tortoise are anticipated. Pipeline route is not within potential SWFL and other migratory bird habitat.	I	Analysis	This alternative route primarily runs aboveground with one bridge structure proposed over Bat Cave Wash. The majority of the route is established in previously disturbed road and open creosote scrub community; however, the pipeline alignment goes through approximately 3.45 acres of the blue Palo Verde community and may result in the loss of individual Palo Verde. No impacts to desert tortoise are anticipated. Pipeline route is not within potential SWFL and other migratory bird habitat.
Noise Impacts (construction)	N, L, I, H[2]	L	65 days (see Note 7 below for equipment list)	Construction noise impacts are created by the number of equipment and duration of construction.	I	85 days (see Notes 7 and 8 below for equipment list)	Construction noise impacts are created by the number of equipment and duration of construction.
Noise Impacts (operational)	N, L, I, H[2]	L	Analysis	Operational noise impacts: The majority of pumps and motors will be located either underground, inside a well, or inside an enclosure (e.g., building). Placing pumps and motors in these locations effectively minimizes the sound emissions. The remaining non-emergency above ground equipment is limited to transformers which are similar in size to the one already operating at IM-3, and communication/control panels.	I	Analysis	Operational noise impacts: The majority of pumps and motors or other equipment will be located either underground, inside a well, or inside an enclosure (e.g., building). Placing equipment in these locations effectively minimizes the sound emissions. The remaining non-emergency above ground equipment is limited to transformers which are similar in size to the one already operating at IM-3, and communication/control panels. Additional noise will be created by wind whistling by and impacting with aboveground structures.

Construction Impacts	N, L, I, H[2]	L	Analysis	Natural gas pipe crossings - 3 crossings will follow normal utility owner procedures to gain approval of crossings (see Worker Safety Impacts).	I	Analysis	Natural gas pipe crossings - 2 crossings will be made using with underground pipes. This would follow normal utility owner procedures to gain approval of crossings (see Worker Safety Impacts). One crossing of Southwest Gas (4") east of Bat Cave Wash on IM-3 access road will be made using aboveground structures. This type of crossing may not be allowed by Southwest Gas (4") resulting in potential design changes and delays. Adding aboveground structures (pipe supports and guard rails) will result several narrow sections of primarily Route 66 west of IM-3 and also at a few points along the IM-3 access road. This can be mitigated by extending the piping into undisturbed areas off the road if there is space available. Using power poles to carry electrical and communications will result in some additional disturbance to enable access to well vaults and other equipment. Safety considerations during design may require greater separation between aboveground structures and poles, resulting in even more disturbance.
Fire Department Impacts	N, L, I, H[2]	L	Analysis	Reducing the available width of Route 66 and IM-3 may result in violations of the San Bernardino County Fire Code for vehicle road access. The Code (Section 503.1 Article III states that roads must be 26 feet in width. Variances may be needed to obtain a permit as long as there are sufficient turnouts located every 600 feet. The existing access roads would likely serve that purpose.	H	Analysis	Reducing the available width of Route 66 and IM-3 may result in violations of the San Bernardino County Fire Code for vehicle road access. The Code (Section 503.1 Article III) states that roads must have 14 feet 6 inches vertical clearance and 26 feet in width. The low pipe racks and other pipe bridges considered for this alternative may need to be changed to taller structures or to an elevated continuous structure to meet the vertical space requirements. Variances for narrow roads are allowed if there are sufficient turnouts (every 600 feet), however these aboveground structures may prevent the minimum width (not specified in the Code, but designated by the Fire Department). The result of seeking this variance may cause additional disturbance to re-locate the pipe supports off the road. Due to the rough terrain and numerous gullies, this may also require additional support structures.
Worker Safety Impacts (Construction)	N, L, I, H[2]	I	Analysis	Underground construction is in general more hazardous than working aboveground. The route follows existing roads enabling relatively easy access and safe working conditions. Increased risk for 180 foot long pipe bridge involving scaffolding and lifting equipment and route to IRL-4 along a steep narrow road. -Natural gas (Southwest (4") and SoCal Gas (34")) pipe crossings south of IRL-3 along pipeline H and Southwest Gas (4") east of Bat Cave Wash on IM-3 access road present safety hazards.	I	Analysis	Aboveground construction is in general less hazardous than working underground. The route follows existing access roads enabling access and safe working conditions except as noted. -Increased risk for 180 foot long pipe bridge and 2-30 foot pipe bridges (grade separation) requiring scaffolding and lifting equipment and route to IRL-4 along a steep narrow road. -Addition of the aboveground pipe on steel support structures, would require the addition of guard rails to protect the pipe from incidental contact. This would reduce the width of the IM-3 access road and Route 66 west of IM-3 in several locations (see also Construction Impacts) resulting in additional safety hazards. -Natural gas (Southwest (4") and SoCal Gas (34")) pipe crossings south of IRL-3 along pipeline H and Southwest Gas (4") east of Bat Cave Wash on IM-3 access road present safety hazards.
Worker Safety Impacts (Operational)	N, L, I, H[2]	L	Analysis	For O&M, underground equipment enables ground-level access to system components, but increases risk of incidents while lifting or working in vaults. Personnel working inside secondary containment vaults (4 for this alternative) would require a confined space entry.	H	Analysis	For O&M, routing electrical overhead puts power lines closer to well vaults, which increases risk of inadvertent contact or static discharge during well maintenance. Guard rails and aboveground piping structures limit access to equipment increasing risk of incidents during maintenance or for O&M personnel vehicle accidents. Personnel working inside secondary containment vaults (9 for this alternative) would require a confined space entry.
Worker Safety Impacts (Decommissioning)	N, L, I, H[2]	L	Analysis	During decommissioning, removal of aboveground structures increase safety hazard (see Decommissioning Impacts below), but as most of the alternative is installed underground, the safety hazard is much lower.	I	Analysis	During decommissioning, removal of aboveground structures increase safety hazard (see Decommissioning Impacts below).
Schedule Impacts [15]	N, L, I, H[2]	65 days	Taken from 60% design schedule	Construction only as the alternative is described here.	85 days	Scaled based on material take-off and compared to 60% design schedule	Construction only as the alternative is described here. Additional EIR review or re-design caused by others would increase overall project schedule. A supplemental EIR review could extend the schedule 1 to 2 years.
EIR Impacts	N, L, I, H[2]	L	Opinion	The current design reflects the assumptions in the EIR. Although project refinement may necessitate further CEQA analysis, the analysis likely will be within the scope of what can be covered in an EIR addendum.	I	Opinion	Additional CEQA review will be needed. The type of additional CEQA review required depends whether the design has new, significant impacts that were not disclosed in the EIR. If there are new, significant impacts, a supplemental EIR would be required and an addendum would not suffice. Further analysis will allow the technical team to determine whether this alternative may have new, significant impacts. Following the same route as the design contemplated in the EIR helps from a CEQA perspective to the extent that the impacts caused by disturbance along this route have been analyzed by the existing EIR. Whether this option causes increased aesthetic impacts will need to be evaluated; if such impacts can be mitigated to a less than significant level, then an addendum could be prepared. If not, a supplemental EIR would be required. A supplemental EIR would result in a delay of approximately 12 to 24 months. The County Fire Code allows for variances from certain requirements. If a variance cannot be obtained, this could result in Fire Code violations and this would be is a new impact that has not been evaluated. If this impact can be mitigated to a less than significant level, an addendum can be prepared. If this impact cannot be mitigated and a variance is required, DTSC could interpret the need for a variance as a new impact triggering the need for a subsequent EIR.

Historical/Archaeological Impacts [12, 13]	N, L, I, H[2]	L	Analysis	Available site location information utilized along with draft Geoarchaeological report. Approx. 30% of route will impact Route 66. All other sites avoided.	L	Analysis	Available site location information utilized along with draft Geoarchaeological report. Approx. 30% of route will impact Route 66. All other sites avoided.
Likelihood of Failure to Detect or Contain Leaks	N, L, I, H[2]	L	Analysis	Almost all piping is underground elminating access to secondarily contained piping. Subject piping[10] is double contained with low point sumps equipped with level switches to detect a release. The majority of piping is plastic which has excellent corrosion resistance resulting in reduced risk of leaks. Underground installation prevents incidental contact further reducing chance of leaks.	I	Analysis	All secondary containment piping accessible for visual inspection, but water carrier pipes not accessible. Low point sumps equipped with level switches will be primary means of monitoring for and containing leaks. See also O&M Impacts caused by use of double-contained steel pipe.
O&M Impacts	N, L, I, H[2]	L	Analysis	O&M impacts are minimal due to use of plastic piping (HDPE) materials for majority of route. Plastic resists corrosion greatly limiting chance of leaks and has excellent record for long-term performance. Underground construction limits access to piping and electrical conduit for most of the line with the exception of the pipe bridge and the concrete trench section (approximately 1,000 feet).	I	Analysis	O&M impacts are higher than the current design in large part due to the use of steel pipe through most of the route. Mortar lined steel pipe will resist corrosion, but the lining has a shorter life than underground plastic piping. In addition, the liner will not be suitable for pipe cleaning using strong chemicals or aggressive mechanical methods. In addition, minerals in the groundwater may precipitate on the liner or biological materials may to adhere to the liner reducing pipe capacity. Aboveground pipe supports and steel pipe increase difficulty of maintenance of piping requiring more equipment and personnel. in addition, the aboveground structures will require sand blasting and painting every 10 years. This alternative is based on the City of Needles supplying power for the remedy facilities. Needles currently supplies the IM No. 3 plant and due to several factors is subject to numerous outages, particularly during the summer monsoon season. In the absence of a backup generator installed in the area, there would be many shutdowns every year. Using radio as a transmission method for control and communications is less reliable than a cable or wired connection. This would affect either control of injection wells or logging of flows into or out of the wells. Results of this include service interruptions for well backwashing and reducing the accuracy of water accounting from the Colorado River basin. Currently multiple companies (PG&E, BNSF, Southwest Gas, SoCal Gas, City of Needles) use the IM No. 3 access road and Route 66 west of IM No. 3. These roads already function as a one-way road (as mentioned by Curt at Jan 23 TWG) when heavy/wide equipment (8 foot wide semi trailers carrying frac tanks requires approximately 21 feet working room for turns).This would primarily affect annual well rehabilitations for the 5 injection wells in the area and any major maintenance activity. Therefore, PG&E cannot reduce the width of the access road.
Public Safety Impacts	N, L, I, H[2]	N	Analysis	Almost no public safety impact due to nearly all piping and electrical installed underground.	H	Analysis	Aboveground structures increase risk of public safety incidents due to potential vehicle impacts on IM-3 access road and Route 66 west of IM-3. Greater impact given the inherent vulnerability of aboveground piping (members of the public have been known to shoot pipes) and large rocks or other debris that may strike the pipe during a storm event.
Decommissioning Impacts	N, L, I, H[2]	L	Analysis	Remove aboveground structures, vaults, equipment, and 1 pipe bridge (180 feet). Abandon in place underground piping and conduit. The removal of belowground infrastructure/piping as an alternative to current proposal to abandon in place would result in soil excavation and disturbance along entire length of Pipelines A and H (approximately 3,800 feet).	I	Analysis	Remove power poles, pipe supports, and other aboveground equipment. (26 power poles and 180 pipe supports. 3630 lf of guard rail @ 6' spacing ~600 supports, 1 pipe bridge (180 feet)) The removal of belowground infrastructure/piping as an alternative to current proposal to abandon in place would result in soil excavation and disturbance along portions of piping and electrical conduit west of Bat Cave Wash to FW-1 and IRL-4. This would occur over a distance of approximately 800 feet.
Ground Disturbance	Lineal Feet	209	Material take-off		209	Material take-off	Not updated for change to underground for approximately 800 feet.
Displaced soil volume	cubic yds	1,869	Material take-off		736	Material take-off	Not updated for change to underground for approximately 800 feet.
Capital Cost	$	$4,900,000	Cost estimate	AACE Level 4[9] estimate based on conceptual layouts and material takeoffs	$7,600,000	Cost estimate	AACE Level 4[9] estimate based on conceptual layouts and material takeoffs
O&M Cost	$ (30 year PV, 7% interest)	$410,000	Cost estimate	AACE Level 4[9] estimate based on conceptual layouts and material takeoffs	$1,700,000	Cost estimate	AACE Level 4[9] estimate based on conceptual layouts and material takeoffs
Decommissioning Costs	$	$350,000	Cost estimate	AACE Level 4[9] estimate based on conceptual layouts and material takeoffs	$1,900,000	Cost estimate	AACE Level 4[9] estimate based on conceptual layouts and material takeoffs

	Evaluation Criteria	Pipelines A/H Alternative Route 1	Basis for Evaluation[3]	Comments/Notes	Pipelines A/H Alternative Route 2	Basis for Evaluation[3]	Comments/Notes
Evaluation Factors							
Cultural Integrity	Present/Not Present[6]						
Visual Impacts	N, L, I, H[2]	H	Simulations of views of Alternative 1 based on design drawings as seen from FEIR Key Viewpoints 6 and 9 and two new viewpoints established on elevated areas providing foreground to middleground views of the proposed changes	Installation of radio tower near compressor station will have little to no impact. From most views, impacts of new wood pole utility lines, above-ground pipelines on low racks, and grade separation structures will have an intermediate level of impact. From views in which project elements are visible in the foreground impacts will be high.	H	Simulations of views of Alternative 2 based on design drawings as seen from FEIR Key Viewpoints 6 and 9 and two new viewpoints established on elevated areas providing foreground to middleground views of the proposed changes	Installation of radio tower near compressor station will have little to no impact. From most views, impacts of new wood pole utility lines, above-ground pipelines on low racks, and grade separation structures will have an intermediate level of impact. Bridge crossing structures will have high levels of impacts in both foreground and middleground views. Other project elements will have high levels of impact in foreground views..
Ecological Impacts [11]	N, L, I, H[2]	I	Analysis	This alternative route primarily runs aboveground with one bridge structure proposed over Bat Cave Wash. The majority of the route is established in previously disturbed road and open creosote scrub community. The pipeline alignment goes through approximately 3.55 acres of the blue Palo Verde community and may result in the loss of individual Palo Verde. A larger disturbance area within creosote bush scrub habitat will be required for this alignment due to the section of pipeline ascending a steep slope near National Trails Highway. No impacts to desert tortoise are anticipated. Pipeline route is not within potential SWFL and other migratory bird habitat.	I	Analysis	This alternative route primarily runs aboveground with two bridge structures proposed over Bat Cave Wash. The majority of the route is established in previously disturbed road and open creosote scrub community. The pipeline alignment goes through approximately 2.55 acres of the blue Palo Verde community and may result in the loss of individual Palo Verde. No impacts to desert tortoise are anticipated. Pipeline route is not within potential SWFL and other migratory bird habitat.
Noise Impacts (construction)	N, L, I, H[2]	I	65 days (see Notes 7 and 8 below for equipment list)	Construction noise impacts are created by the number of equipment and duration of construction.	I	75 days (see Notes 7 and 8 below for equipment list)	Construction noise impacts are created by the number of equipment and duration of construction.
Noise Impacts (operational)	N, L, I, H[2]	I	Analysis	Operational noise impacts: The majority of pumps and motors or other equipment will be located either underground, inside a well, or inside an enclosure (e.g., building). Placing equipment in these locations effectively minimizes the sound emissions. The remaining non-emergency above ground equipment is limited to transformers which are similar in size to the one already operating at IM-3, and communication/control panels. Additional noise will be created by wind whistling by and impacting with aboveground structures.	I	Analysis	Operational noise impacts: The majority of pumps and motors or other equipment will be located either underground, inside a well, or inside an enclosure (e.g., building). Placing equipment in these locations effectively minimizes the sound emissions. The remaining non-emergency above ground equipment is limited to transformers which are similar in size to the one already operating at IM-3, and communication/control panels. Additional noise will be created by wind whistling by and impacting with aboveground structures.
Construction Impacts	N, L, I, H[2]	H	Analysis	This route would run in the Southwest Gas (4") right of way from the IM-3 access road to Bat Cave Wash on Route 66. Installation of aboveground pipe supports would not be typical within a gas pipe right of way. This approach might be rejected resulting in re-design or delays or additional disturbance. Construction of an aboveground pipe on the steep slope located west of the MW-20 Bench will be near the SoCal gas (34") pipeline. To protect the pipe storm drainage improvements are needed (4 drain pipes and earthwork) and would be within the right-of-way. This approach might need to be modified resulting in re-design or delays.	H	Analysis	This route would run in the Southwest Gas (4") right of way from the IM-3 access road to Bat Cave Wash on Route 66. Installation of aboveground pipe supports would not be typical within a gas pipe right of way. This approach might be rejected resulting in re-design or delays or additional disturbance. Construction of an aboveground pipe on the steep slope located west of the MW-20 Bench will be near the SoCal gas(34") pipeline. To protect the pipe storm drainage improvements are needed (4 drain pipes and earthwork) and would be within the right-of-way. This approach might need to be modified resulting in re-design or delays. Construction of two bridges - 330 feet long to cross Bat Cave Wash and 280 feet long to cross a BNSF access road will require consultation with the owners resulting in potential design changes or delays.
Fire Department Impacts	N, L, I, H[2]	H	Analysis	Reducing the available width of Route 66 and IM-3 may result in violations of the San Bernardino County Fire Code for vehicle road access. The Code (Section 503.1 Article III) states that roads must have 14 feet 6 inches vertical clearance and 26 feet in width. The low pipe racks and other pipe bridges considered for this alternative may need to be changed to taller structure or to an elevated continuous structure to meet the vertical space requirements. Variances for narrow roads are allowed if there are sufficient turnouts (every 600 feet), however these aboveground structures may prevent the minimum width (not specified in the Code, but designated by the Fire Department). The result of seeking this variance may cause additional disturbance to re-locate the pipe supports off the road. Due to the rough terrain and numerous gullies, this may also require additional support structures.	H	Analysis	Reducing the available width of Route 66 and IM-3 may result in violations of the San Bernardino County Fire Code for vehicle road access. The Code (Section 503.1 Article III) states that roads must have 14 feet 6 inches vertical clearance and 26 feet in width. The low pipe racks and other pipe bridges considered for this alternative may need to be changed to taller structure or to an elevated continuous structure to meet the vertical space requirements. Variances for narrow roads are allowed if there are sufficient turnouts (every 600 feet), however these aboveground structures may prevent the minimum width (not specified in the Code, but designated by the Fire Department). The result of seeking this variance may cause additional disturbance to re-locate the pipe supports off the road. Due to the rough terrain and numerous gullies, this may also require additional support structures.

Worker Safety Impacts (Construction)	N, L, I, H[2]	H	Analysis	Aboveground construction is in general less hazardous than working underground. The route follows some existing access roads, but has some cross-country routes that increase risk. -Increased risk for 140 foot long pipe bridge and 1-50 foot pipe bridge (grade separation) requiring scaffolding and lifting equipment; segment from MW-20 Bench west up steep slope, and route to IRL-4 along a steep narrow road. -Addition of the aboveground pipe on steel support structures, would require the addition of guard rails to protect the pipe from incidental contact. This would reduce the width of the IM-3 access road and Route 66 west of IM-3 in several locations (see also Construction Impacts) resulting in additional safety hazards. -Natural gas (Southwest (4") and SoCal Gas (34")) pipe crossings south of IRL-3 along pipeline H and SoCal Gas (34") at the top of the slope overlooking National Trails Highway and the MW-20 Bench present safety hazards.	H	Analysis	Aboveground construction is in general less hazardous than working underground. The route follows some existing access roads, but has some cross-country routes that increase risk. -Increased risk for 280-foot and 330-foot pipe bridges and 1-30 foot pipe bridge (grade separation) requiring scaffolding and lifting equipment, segment from MW-20 Bench west up steep slope, and route to IRL-4 along a steep narrow road. -Addition of the aboveground pipe on steel support structures, would require the addition of guard rails to protect the pipe from incidental contact. This would reduce the width of the IM-3 access road and Route 66 west of IM-3 in several locations (see also Construction Impacts) resulting in additional safety hazards. -Natural gas (Southwest (4") and SoCal Gas (34")) pipe crossings south of IRL-3 along pipeline H and SoCal Gas (34") at the top of the slope overlooking National Trails Highway and the MW-20 Bench present safety hazards.
Worker Safety Impacts (Operational)	N, L, I, H[2]	H	Analysis	For O&M, routing electrical overhead puts power lines closer to well vaults, which increases risk of inadvertent contact or static discharge during well maintenance. Guard rails and aboveground piping structures limit access to equipment increasing risk of incidents during maintenance or for O&M personnel vehicle accidents. Working near active gas pipelines creates additional safety hazards. Personnel working inside secondary containment vaults (11 for this alternative) would require a confined space entry.	H	Analysis	For O&M, routing electrical overhead puts power lines closer to well vaults, which increases risk of inadvertent contact or static discharge during well maintenance. Guard rails and aboveground piping structures limit access to equipment increasing risk of incidents during maintenance or for O&M personnel vehicle accidents. Working near active gas pipelines creates additional safety hazards. Personnel working inside secondary containment vaults (11 for this alternative) would require a confined space entry.
Worker Safety Impacts (Decommissioning)	N, L, I, H[2]	H	Analysis	During decommissioning, removal of aboveground structures increase safety hazard (see Decommissioning Impacts below) especially when working near active natural gas pipelines.	H	Analysis	During decommissioning, removal of aboveground structures increase safety hazard (see Decommissioning Impacts below) especially when working near active natural gas pipelines.
Schedule Impacts [15]	N, L, I, H[2]	65 days	Scaled based on material take-off and compared to 60% design schedule	Construction only as the alternative is described here. Additional EIR review or re-design caused by others would increase overall project schedule. A supplemental EIR review could extend the schedule 1 to 2 years.	75 days	Scaled based on material take-off and compared to 60% design schedule	Construction only as the alternative is described here. Additional EIR review or re-design caused by others would increase overall project schedule. A supplemental EIR review could extend the schedule 1 to 2 years.
EIR Impacts	N, L, I, H[2]	H	Opinion	Additional CEQA review will be needed. The type of additional CEQA review required depends whether the design has new, significant impacts that were not disclosed in the EIR. If there are new, significant impacts, a supplemental EIR would be required and an addendum would not suffice. Further analysis will allow the technical team to determine whether this alternative may have new, significant impacts. Whether this option causes increased aesthetic impacts will need to be evaluated; if such impacts can be mitigated to a less than significant level, then an addendum could be prepared. If not, a supplemental EIR would be required. A supplemental EIR would result in a delay of approximately 12 to 24 months. The County Fire Code allows for variances from certain requirements. If a variance cannot be obtained, this could result in Fire Code violations and this would be is a new impact that has not been evaluated. If this impact can be mitigated to a less than significant level, an addendum can be prepared. If this impact cannot be mitigated and a variance is required, DTSC could interpret the need for a variance as a new impact triggering the need for a subsequent EIR.	H	Opinion	Additional CEQA review will be needed. The type of additional CEQA review required depends whether the design has new, significant impacts that were not disclosed in the EIR. If there are new, significant impacts, a supplemental EIR would be required and an addendum would not suffice. Further analysis will allow the technical team to determine whether this alternative may have new, significant impacts. Whether this option causes increased aesthetic impacts will need to be evaluated; if such impacts can be mitigated to a less than significant level, then an addendum could be prepared. If not, a supplemental EIR would be required. A supplemental EIR would result in a delay of approximately 12 to 24 months. The County Fire Code allows for variances from certain requirements. If a variance cannot be obtained, this could result in Fire Code violations and this would be is a new impact that has not been evaluated. If this impact can be mitigated to a less than significant level, an addendum can be prepared. If this impact cannot be mitigated and a variance is required, DTSC could interpret the need for a variance as a new impact triggering the need for a subsequent EIR.
Historical/Archaeological Impacts [12, 13]	N, L, I, H[2]	L	Analysis	Available site location information utilized along with draft Geoarchaeological report. Approx. 50% of route will impact Route 66. All other sites avoided.	L	Analysis	Available site location information utilized along with draft Geoarchaeological report. Approx. 25% of route will impact Route 66. All other sites avoided.
Likelihood of Failure to Detect or Contain Leaks	N, L, I, H[2]	I	Analysis	All secondary containment piping accessible for visual inspection, but water carrier pipes not accessible. Low point sumps equipped with level switches will be primary means of monitoring for and containing leaks. See also O&M Impacts caused by use of double-contained steel pipe.	I	Analysis	All secondary containment piping accessible for visual inspection, but water carrier pipes not accessible. Low point sumps equipped with level switches will be primary means of monitoring for and containing leaks. See also O&M Impacts caused by use of double-contained steel pipe.

O&M Impacts	N, L, I, H[2]	I	Analysis	O&M impacts are higher than the current design in large part due to the use of steel pipe through most of the route. Mortar lined steel pipe will resist corrosion, but the lining has a shorter life than underground plastic piping. In addition, the liner will not be suitable for pipe cleaning using strong chemicals or aggressive mechanical methods. In addition, minerals in the groundwater may precipitate on the liner or biological materials may to adhere to the liner reducing pipe capacity. Aboveground pipe supports and steel pipe increase difficulty of maintenance of piping requiring more equipment and personnel. in addition, the aboveground structures will require sand blasting and painting every 10 years. This alternative is based on the City of Needles supplying power for the remedy facilities. Needles currently supplies the IM No. 3 plant and due to several factors is subject to numerous outages, particularly during the summer monsoon season. In the absence of a backup generator installed in the area, there would be many shutdowns every year. Using radio as a transmission method for control and communications is less reliable than a cable or wired connection. This would affect either control of injection wells or logging of flows into or out of the wells. Results of this include service interruptions for well backwashing and reducing the accuracy of water accounting from the Colorado River basin. Currently multiple companies (PG&E, BNSF, Southwest Gas, SoCal Gas, City of Needles) use the IM No. 3 access road and Route 66 west of IM No. 3. These roads already function as a one-way road (as mentioned by Curt at Jan 23 TWG) when heavy/wide equipment (8 foot wide semi trailers carrying frac tanks requires approximately 21 feet working room for turns).This would primarily affect annual well rehabilitations for the 5 injection wells in the area and any major maintenance activity. Therefore, PG&E cannot reduce the width of the access road.	I	Analysis	O&M impacts are higher than the current design in large part due to the use of steel pipe through most of the route. Mortar lined steel pipe will resist corrosion, but the lining has a shorter life than underground plastic piping. In addition, the liner will not be suitable for pipe cleaning using strong chemicals or aggressive mechanical methods. In addition, minerals in the groundwater may precipitate on the liner or biological materials may to adhere to the liner reducing pipe capacity. Aboveground pipe supports and steel pipe increase difficulty of maintenance of piping requiring more equipment and personnel. in addition, the aboveground structures will require sand blasting and painting every 10 years. This alternative is based on the City of Needles supplying power for the remedy facilities. Needles currently supplies the IM No. 3 plant and due to several factors is subject to numerous outages, particularly during the summer monsoon season. In the absence of a backup generator installed in the area, there would be many shutdowns every year. Using radio as a transmission method for control and communications is less reliable than a cable or wired connection. This would affect either control of injection wells or logging of flows into or out of the wells. Results of this include service interruptions for well backwashing and reducing the accuracy of water accounting from the Colorado River basin. Currently multiple companies (PG&E, BNSF, Southwest Gas, SoCal Gas, City of Needles) use the IM No. 3 access road and Route 66 west of IM No. 3. These roads already function as a one-way road (as mentioned by Curt at Jan 23 TWG) when heavy/wide equipment (8 foot wide semi trailers carrying frac tanks requires approximately 21 feet working room for turns).This would primarily affect annual well rehabilitations for the 5 injection wells in the area and any major maintenance activity. Therefore, PG&E cannot reduce the width of the access road.
Public Safety Impacts	N, L, I, H[2]	H	Analysis	Aboveground structures increase risk of public safety incidents due to potential vehicle impacts on IM-3 access road and Route 66 west of IM-3. Greater impact given the inherent vulnerability of aboveground piping (members of the public have been known to shoot pipes) and large rocks or other debris that may strike the pipe during a storm event.	H	Analysis	Aboveground structures increase risk of public safety incidents due to potential vehicle impacts on IM-3 access road and Route 66 west of IM-3. Greater impact given the inherent vulnerability of aboveground piping (members of the public have been known to shoot pipes) and large rocks or other debris that may strike the pipe during a storm event.
Decommissioning Impacts	N, L, I, H[2]	H	Analysis	Remove power poles, pipe supports, and other aboveground equipment. (26 power poles and 170 pipe supports. 3410 lf of guard rail @ 6' spacing approx. 570 supports, 140 foot long pipe bridge and 1-50 foot pipe bridge (grade separation)) The removal of belowground infrastructure/piping as an alternative to current proposed abandon in place would result in soil excavation and disturbance along portions of piping and electrical conduit west of Bat Cave Wash to FW-1 and IRL-4. This would occur over a distance of approximately 800 feet.	H	Analysis	Remove power poles, pipe supports, and other aboveground equipment. (26 power poles and 120 pipe supports. 2380 lf of guard rail @ 6' spacing approx. 400 supports, 280-foot and 330-foot pipe bridges and 1-30 foot pipe bridge (grade separation)). The removal of belowground infrastructure/piping as an alternative to current proposed abandon in place would result in soil excavation and disturbance along portions of piping and electrical conduit west of Bat Cave Wash to FW-1 and IRL-4. This would occur over a distance of approximately 800 feet.
Ground Disturbance	Lineal Feet	121	Material take-off	Not updated for change to underground for approximately 800 feet.	210	Material take-off	Not updated for change to underground for approximately 800 feet.
Displaced soil volume	cubic yds	562	Material take-off	Not updated for change to underground for approximately 800 feet.	356	Material take-off	Not updated for change to underground for approximately 800 feet.
Capital Cost	$	$6,800,000	Cost estimate	AACE Level 4[9] estimate based on conceptual layouts and material takeoffs	$9,800,000	Cost estimate	AACE Level 4[9] estimate based on conceptual layouts and material takeoffs
O&M Cost	$ (30 year PV, 7% interest)	$1,500,000	Cost estimate	AACE Level 4[9] estimate based on conceptual layouts and material takeoffs	$2,000,000	Cost estimate	AACE Level 4[9] estimate based on conceptual layouts and material takeoffs
Decommissioning Costs	$	$1,700,000	Cost estimate	AACE Level 4[9] estimate based on conceptual layouts and material takeoffs	$2,400,000	Cost estimate	AACE Level 4[9] estimate based on conceptual layouts and material takeoffs

PIPELINE B DESIGN ALTERNATIVE - WITH BASIS FOR EVALUATION [4]

	Evaluation Criteria	Pipeline B - Current Design	Basis for Evaluation[3]	Comments/Notes	Pipeline B Alternative 1	Basis for Evaluation[3]	Comments/Notes
Evaluation Factors							
Cultural Integrity	Present/Not Present[6]						
Visual Impacts	N, L, I, H[2]	L	Analysis	Review of remedy route and disturbance maps, site photos, Google Earth, and design drawings. First 600 feet extending west from arch bridge, would have low pipe rack on northern side of low level of visual contrast with setting and low visibility to potential viewers. The rest of the pipeline would be buried under existing roadway and would have no visual effects.	I	Analysis	Review of remedy route and disturbance maps, site photos and Google earth, and design drawings. Pipeline alternative has potential to be highly visible and cause ground disturbance that may persist in contrast to surrounding landscape. Although there is potential for high level of visual contrast, the impact will be moderate because the changes will not be visible to viewing public.
Ecological Impacts [11]	N, L, I, H[2]	L	Analysis	Pipeline route within disturbed habitat. No impacts to desert tortoise are anticipated. Work restrictions during the nesting season will minimize effects to nesting birds (SWFL and other migratory birds).	I	Analysis	Pipeline route primarily within disturbed habitat and creosote bush scrub. Some impact to hillside Palo Verde community resulting in the potential loss of individuals may occur. No impacts to desert tortoise are anticipated. Work restrictions during the nesting season will minimize effects to nesting birds (SWFL and other migratory birds).
Noise Impacts (construction)	N, L, I, H[2]	L	Similar to Pipeline B Alternative 1 configuration. (see Notes 7 and 8 below for equipment list)	Construction noise impacts are created by the number of equipment and duration of construction.	L	Similar to Pipeline B current design configuration. (see Notes 7 and 8 below for equipment list)	Construction noise impacts are created by the number of equipment and duration of construction.
Noise Impacts (operational)	N, L, I, H[2]	L	Analysis	Operational noise impacts: No pumps or motors are included in this pipeline. Additional noise will be created by wind whistling by and impacting with aboveground structures.	L	Analysis	Operational noise impacts: No pumps or motors are included in this pipeline. Additional noise will be created by wind whistling by and impacting with aboveground structures.

Construction Impacts	N, L, I, H[2]	N	Analysis	Work is within existing roadway.	L	Analysis	Work is on slopes within right of way for PG&E Line 300A. Exiting from bridge aboveground will likely require using Kinder Morgan infrastructure for use as supports. Kinder Morgan and SoCal Gas will need to grant permission to cross under their pipes. Design may need to be changed to obtain approval for installation resulting in re-design or delays or additional disturbance. Construction along slopes will likely involve installing pipe supports on rock.
Fire Department Impacts	N, L, I, H[2]	N	Analysis	No fire access is needed.	N	Analysis	No fire access is needed.
Worker Safety Impacts (Construction)	N, L, I, H[2]	L	Analysis	Similar since construction methods are almost the same.	I	Analysis	Similar since construction methods are almost the same. Greater than current design due to pipe being placed on slope south of existing gas line (Line 300A).
Worker Safety Impacts (Operational)	N, L, I, H[2]	L	Analysis	Operational safety concerns are related to accessing piping (aboveground or underground). Some sections are near active gas pipeline (Line 300A).	I	Analysis	Operational safety concerns are somewhat greater than current design alternative because of route being placed on slope. Alternative route crosses active gas lines.
Worker Safety Impacts (Decommissioning)	N, L, I, H[2]	N	Analysis	No decommissioning safety impacts (see Decommissioning Impacts.	N	Analysis	No decommissioning safety impacts (see Decommissioning Impacts.
Schedule Impacts [15]	N, L, I, H[2]	33 days	Taken from 60% design schedule and scaled based on length of the pipeline under evaluation (see Notes).	Construction only as the alternative is described here. The 60% design schedule lumps the construction schedule together for all of the 9 sections of Pipeline B, while there are 3 sections under which is about 1/3 of the total length.	38 days	Taken from 60% design schedule and scaled based on length of the pipeline under evaluation.	Construction only as the alternative is described here. Additional EIR review or re-design caused by others would increase overall project schedule. A supplemental EIR review could extend the schedule 1 to 2 years.
EIR Impacts	N, L, I, H[2]	L	Opinion	The current design reflects the assumptions in the EIR. Although project refinement may necessitate further CEQA analysis, the analysis likely will be within the scope of what can be covered in an EIR addendum.	I	Opinion	Additional CEQA review will be needed. The type of additional CEQA review required depends whether the design has new, significant impacts that were not disclosed in the EIR. If there are new, significant impacts, a supplemental EIR would be required and an addendum would not suffice. Further analysis will allow the technical team to determine whether this alternative may have new, significant impacts. Following the same route as the design contemplated in the EIR helps from a CEQA perspective.
Historical/Archaeological Impacts [12, 13]	N, L, I, H[2]	L	Analysis	Available site location information utilized along with draft Geoarchaeological report. Approx. 20% of route will impact Route 66. All other sites avoided. Virtually no potential for buried archaeological sites.	L	Analysis	Available site location information utilized along with draft Geoarchaeological report. Approx. 20% of route will impact Route 66. All other sites avoided.
Likelihood of Failure to Detect or Contain Leaks	N, L, I, H[2]	N		Does not apply to freshwater piping [10].	N		Does not apply to freshwater piping [10].
O&M Impacts	N, L, I, H[2]	L	Analysis	Pipeline is accessible. The aboveground structures will require sand blasting and painting every 10 years.	I	Analysis	Additional equipment and personnel required for major pipeline maintenance. In addition, the aboveground structures will require sand blasting and painting every 10 years. The area around the west end of the Arch bridge is congested requiring additional additional equipment and personnel for maintenance .
Public Safety Impacts	N, L, I, H[2]	N	Analysis	Locked gates nearly eliminate public access to this pipeline.	N	Analysis	Locked gates nearly eliminate public access to this pipeline.
Decommissioning Impacts	N, L, I, H[2]	N	Analysis	Facilities left in service after project is completed, so no decommissioning is needed.	N	Analysis	Facilities left in service after project is completed, so no decommissioning is needed.
Ground Disturbance	Lineal Feet	245	Material take-off		280	Material take-off	
Displaced soil volume	cubic yds	126	Material take-off		77	Material take-off	
Capital Cost	$	$360,000	Cost estimate	AACE Level 4[9] estimate based on conceptual layouts and material takeoffs. Electrical not included since common (underground) to both Pipeline B alternatives.	$900,000	Cost estimate	AACE Level 4[9] estimate based on conceptual layouts and material takeoffs. Electrical not included since common (underground) to both Pipeline B alternatives.
O&M Cost	$ (30 year PV, 7% interest)	$70,000	Cost estimate	AACE Level 4[9] estimate based on conceptual layouts and material takeoffs. Electrical not included since common (underground) to both Pipeline B alternatives.	$260,000	Cost estimate	AACE Level 4[9] estimate based on conceptual layouts and material takeoffs. Electrical not included since common (underground) to both Pipeline B alternatives.
Decommissioning Costs	$	$0		Facilities retained after project ends	$0		Facilities retained after project ends

NOTES

[1] Pipelines A/H alternative descriptions noted below

Both Alternatives: above-ground electrical on poles, distributed to FW-1, IRL-1 thru IRL-4 from City of Needles supply on north side of IM-3; fiber optic on same poles, or use wireless telecom/SCADA.
Alternative Route 1: Above-ground water pipe on pipe supports going west from NTH parallel to SoCal gas pipeline to abandoned Rt. 66 alignment, then along said alignment to the north, then northwest, then west to the existing Rt. 66 alignment where it crosses Bat Cave Wash. Then follow, continuing above-ground, following pipe sections A/H routes as laid out in the 60% Basis of Design Report. Presume aerial crossing of Bat Cave Wash, per 60% Basis of Design Report.

Alternative Route 2: Above-ground water pipe on pipe supports going west from NTH parallel to SoCal gas pipeline to intersection with pipe section H route as presented in the 60% Basis of Design Report, then follow, continuing above-ground, pipe sections A & H routes as presented in the Report to wells FW-1, and IRL-1 thru IRL-4.

[2] Ratings: N = “None”; L = “Low”; I = “Intermediate”; and H = “High.” These are qualitative ratings based upon the rationale provided and not to be used in a quantitative manner, i.e., the ratings are not additive.

[3] Indicate whether the basis for evaluation is an opinion, calculation, analysis, etc.

[4] Pipeline Section B Alternative 1 - As presented in 60% design but pipe sections B1, B2 & B3 are above ground on pipe supports and power is either buried, or above-ground on power poles.

[5] Final Environmental Impact Report Volume 2 for the Topock Compressor Station Groundwater Remediation Project, California Department of Toxic Substances Control, January 2011

[6] In the Tribes’ view, this relates to a whole state of being, so there would be no graduation in the rating. Integrity is either present or it is not. Input on this criterion is to be provided by the interested tribes.

[7] Pickup truck (3 ea), Mechanics truck (1 ea), Water Truck (1 ea), Front End Loader (1 ea), Excavator (1 ea), Lift Truck (1 ea), 45 ton crane (1 ea), Welding machine (1 ea), Forklift (1 ea), Boom Truck (1 ea), Backhoe (1 ea), Walk behind compactor (1 ea),

[8] Skid Steer w/auger attachment (could be truck mounted drill rig) (1 ea (only for AG pipe supports)), Two pole trucks with a pickup for electrical OH construction.

[9] AACE = AACE International (cost engineering professional society) Level 4 estimate has +50%/-30% accuracy. This is an estimate for alternative evaluation purposes only.

[10] Piping with secondary containment includes remedy produced water and carbon-amended groundwater.

[11] Alternatives for Pipeline A & H do not extend into the floodplain for the purposes of this evaluation factor. For the Pipeline B alternatives, the eastern end of the pipeline encroaches upon potential SWFL and other migratory bird habitat near the Colorado River.

[12] Alternatives for Pipeline A & H do not extend into the floodplain for the purposes of this evaluation factor.

[13] PG&E assumes impacts on the Traditional Cultural Property within the APE determined by BLM to be eligible for the National Register of Historic Places will be analyzed under “Cultural Integrity”

[14] PG&E proposed this factor for inclusion in the matrix.

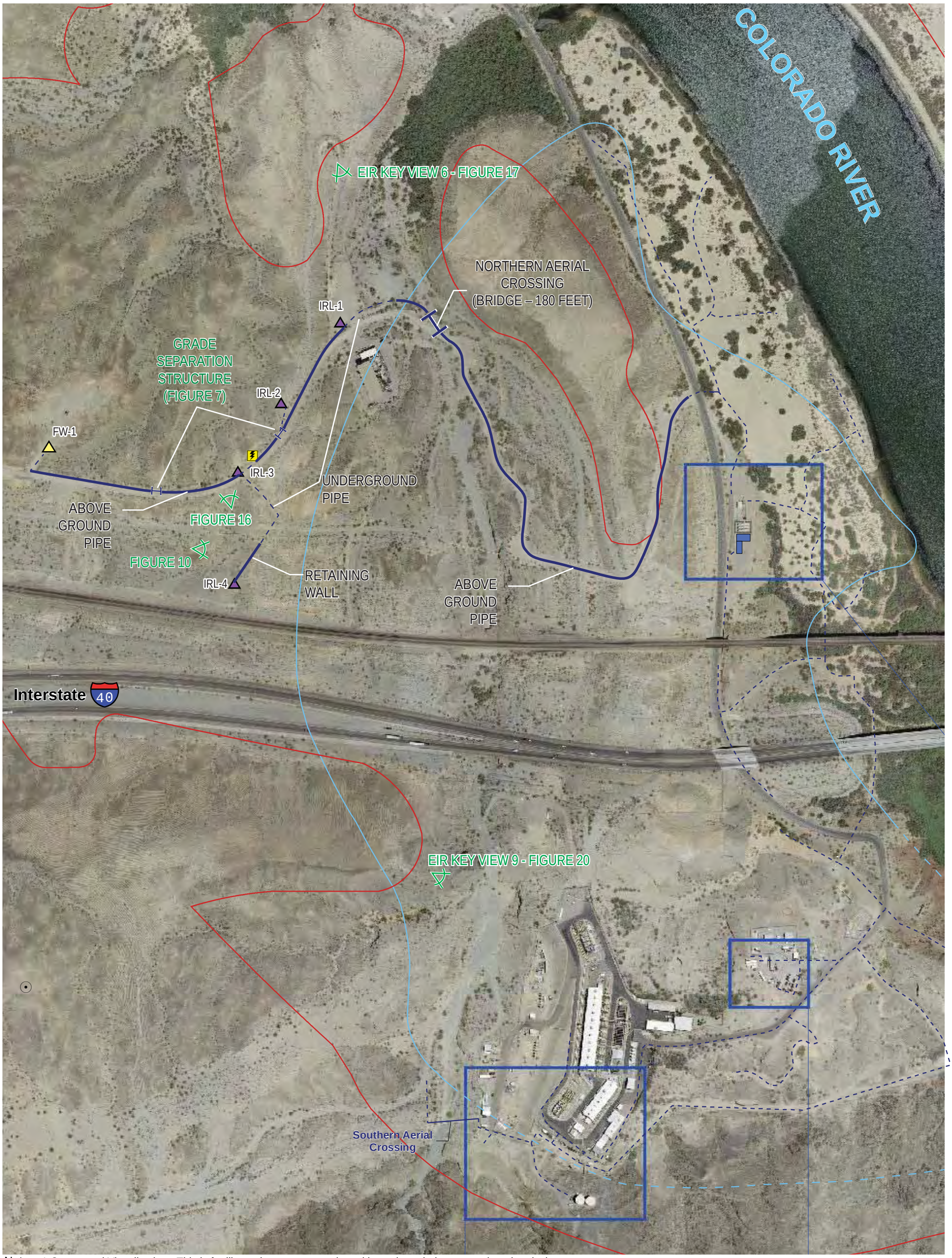
[15] Duration estimates are based on the schedule provided with the 60 percent design submittal including the location of staging areas as shown on Figure 7.6-1. Each alternative assumes multiple construction operations may be occurring simultaneously to achieve a reasonably expedited schedule. Operations could include items such as pipe support installation, pipe welding, and electrical installation. Actual duration is a function of overall project requirements, anticipated duration, resource availability, and location and availability of staging areas.



LEGEND

- EIR Project Area
- Approximate extent of hexavalent chromium [Cr(VI)] concentrations exceeding 32 micrograms per liter (µg/L) at any depth in groundwater based on fourth quarter 2011 sampling events. Dashed where based on limited data.
- Freshwater Injection Well
- Injection Well (Inner Recirculation Loop)
- Proposed Electrical Transformer Location

FIGURE 1
PIPELINES A/H CURRENT DESIGN (ALTERNATIVE 0)
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA



Notes: 1.Conceptual Visualization - This is for illustration purposes only and is not intended as an engineering design.
2. See Figure 5 for Overhead Electical.

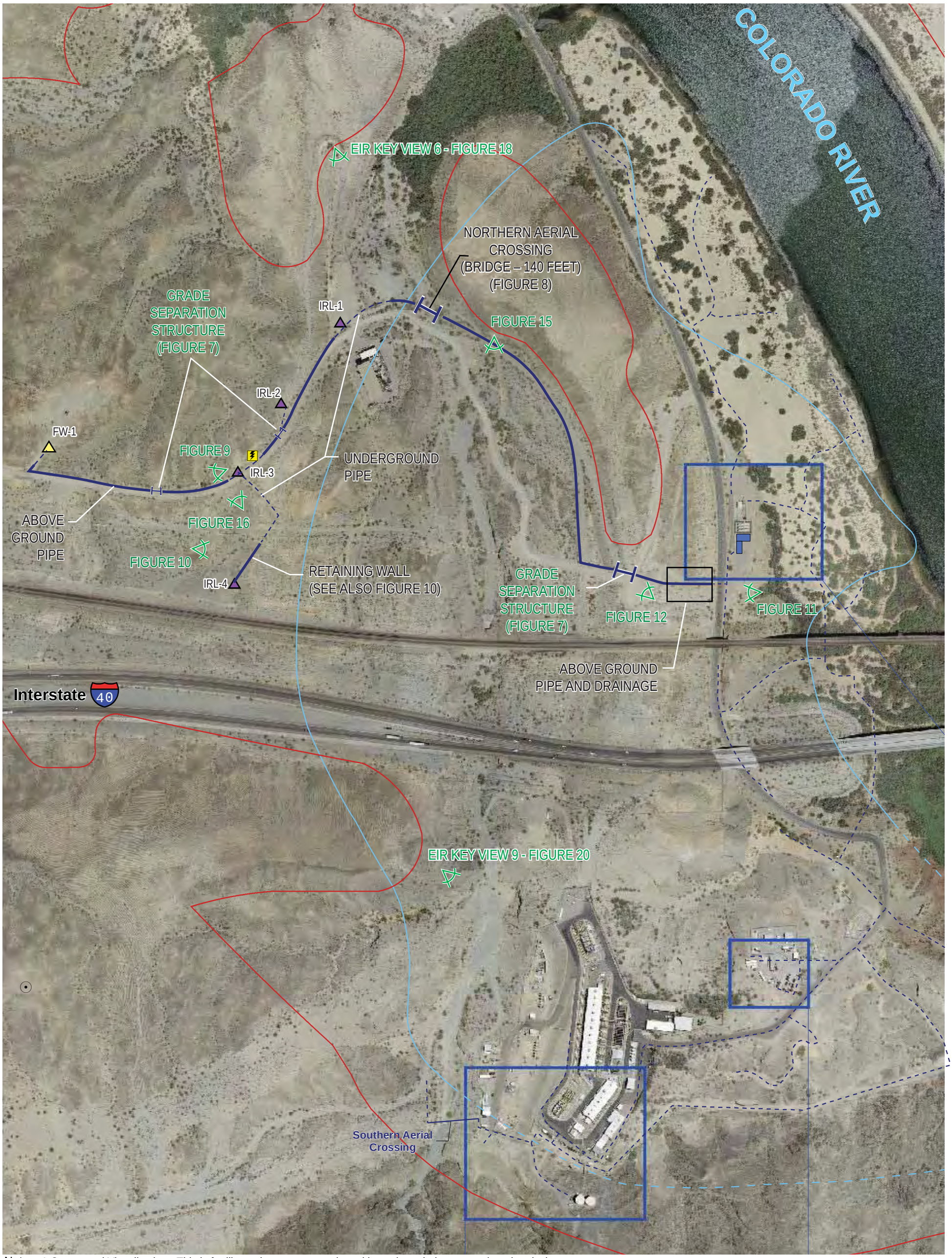
LEGEND

- EIR Project Area
- Approximate extent of hexavalent chromium [Cr(VI)] concentrations exceeding 32 micrograms per liter (µg/L) at any depth in groundwater based on fourth quarter 2011 sampling events. Dashed where based on limited data.
- Freshwater Injection Well
- Injection Well (Inner Recirculation Loop)
- Proposed Electrical Transformer Location
- Bridge or Grade Separation Structure
- Aboveground Pipe
- Underground Pipe
- Viewpoint
- Proposed New Remedy Structure

FIGURE 2
PIPELINES A/H CURRENT ROUTE ABOVE GROUND (ALTERNATIVE 0a)
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION, NEEDLES, CALIFORNIA

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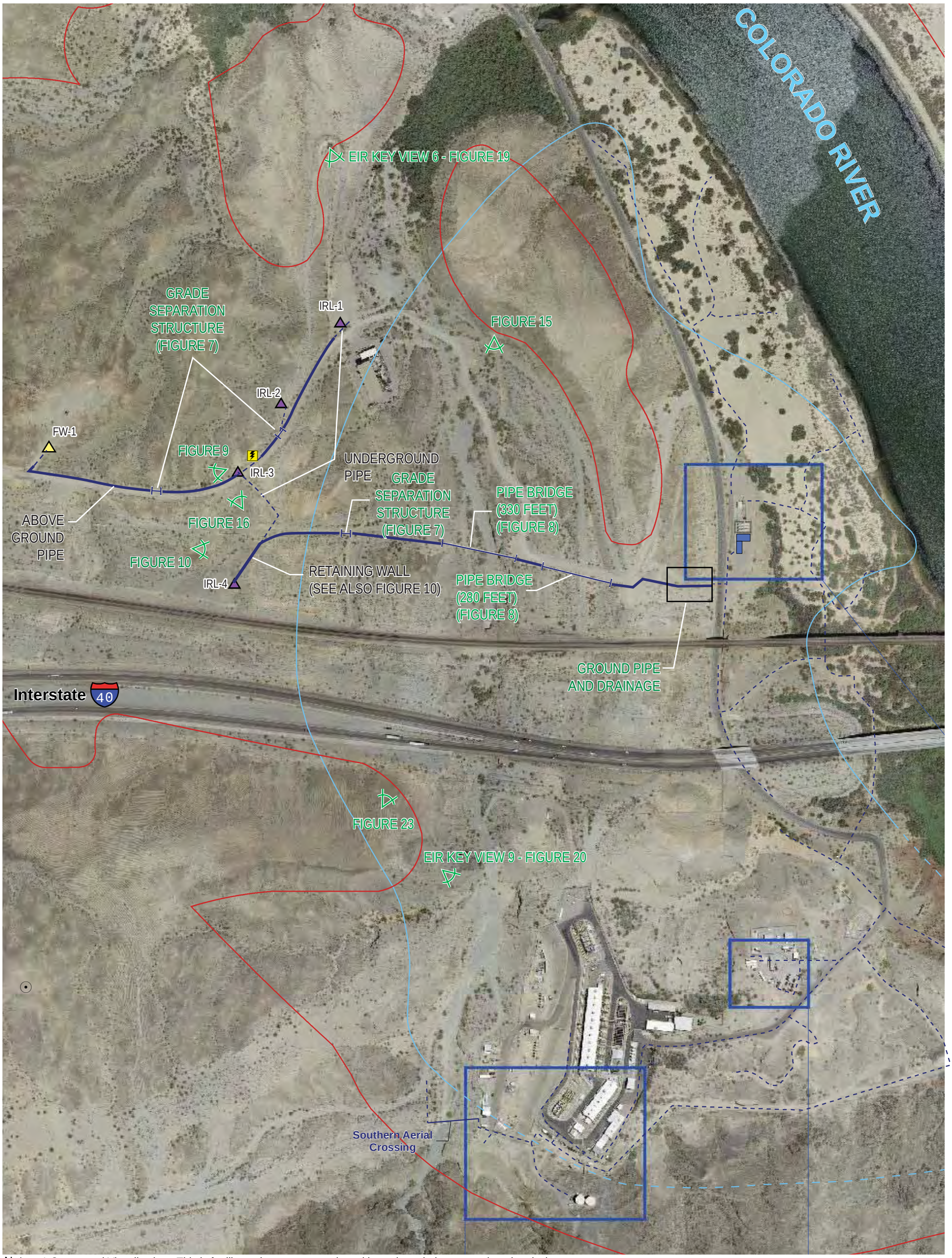
Notes: 1.Conceptual Visualization - This is for illustration purposes only and is not intended as an engineering design.
2. See Figure 5 for Overhead Electical.

LEGEND

- EIR Project Area
- Approximate extent of hexavalent chromium [Cr(VI)] concentrations exceeding 32 micrograms per liter (µg/L) at any depth in groundwater based on fourth quarter 2011 sampling events. Dashed where based on limited data.
- Freshwater Injection Well
- Injection Well (Inner Recirculation Loop)
- Proposed Electrical Transformer Location
- Bridge or Grade Separation Structure
- Aboveground Pipe
- Underground Pipe
- Viewpoint
- Proposed New Remedy Structure

FIGURE 3
PIPELINES A/H ALTERNATIVE ROUTE 1 (ALTERNATIVE 1)
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

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Notes: 1.Conceptual Visualization - This is for illustration purposes only and is not intended as an engineering design.
2. See Figure 5 for Overhead Electical.

LEGEND

- EIR Project Area
- Approximate extent of hexavalent chromium [Cr(VI)] concentrations exceeding 32 micrograms per liter (µg/L) at any depth in groundwater based on fourth quarter 2011 sampling events. Dashed where based on limited data.
- Freshwater Injection Well
- Injection Well (Inner Recirculation Loop)
- Proposed Electrical Transformer Location
- Bridge or Grade Separation Structure
- Aboveground Pipe
- Underground Pipe
- Viewpoint
- Proposed New Remedy Structure

FIGURE 4
PIPELINES A/H ALTERNATIVE ROUTE 2 (ALTERNATIVE 2)
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

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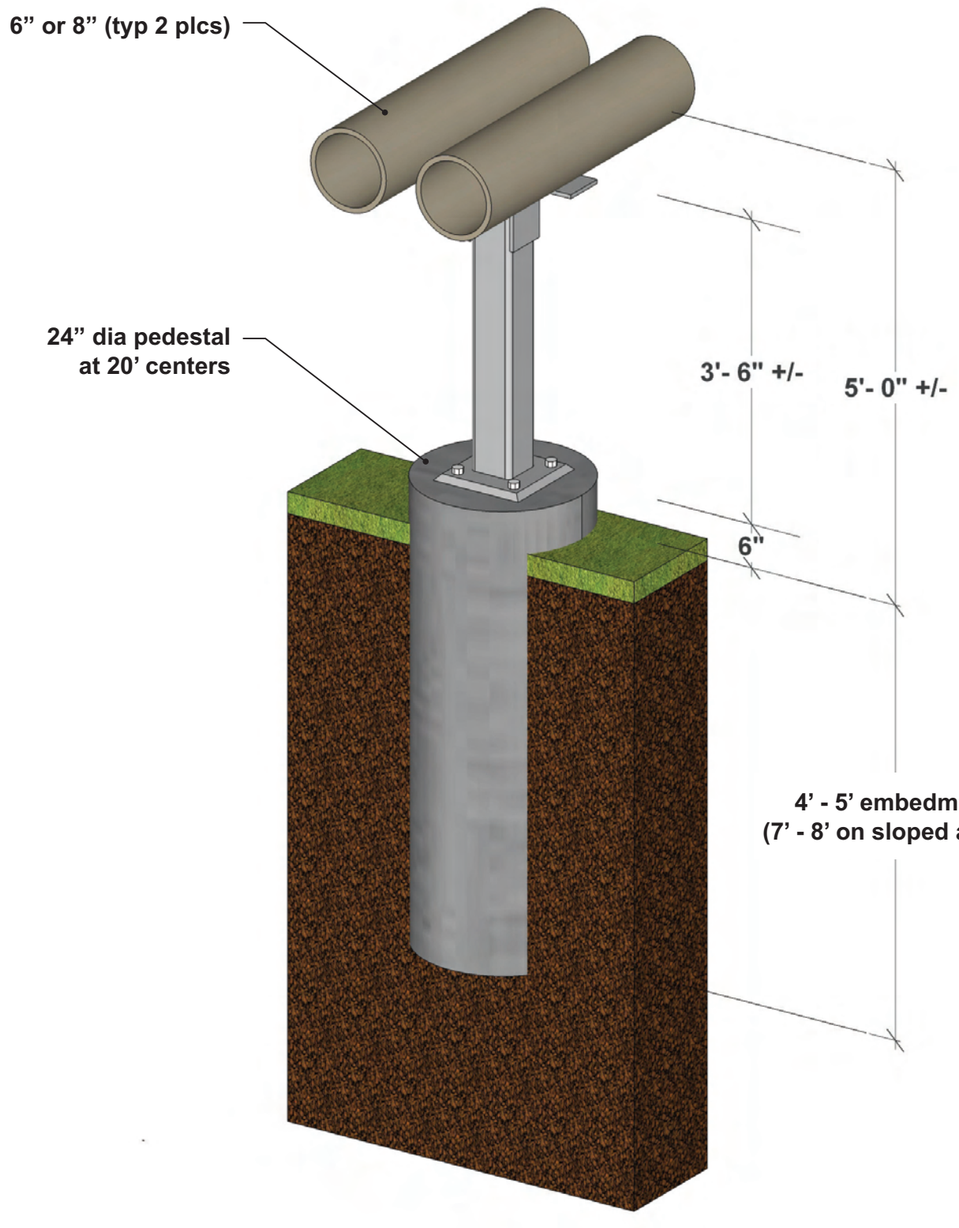
Notes: 1.Conceptual Visualization - This is for illustration purposes only and is not intended as an engineering design.
2.Three Radio transmitter towers assumed to be used to transmit signals from wells to Remedy SCADA. Towers if required would be located after field radio testing.

LEGEND

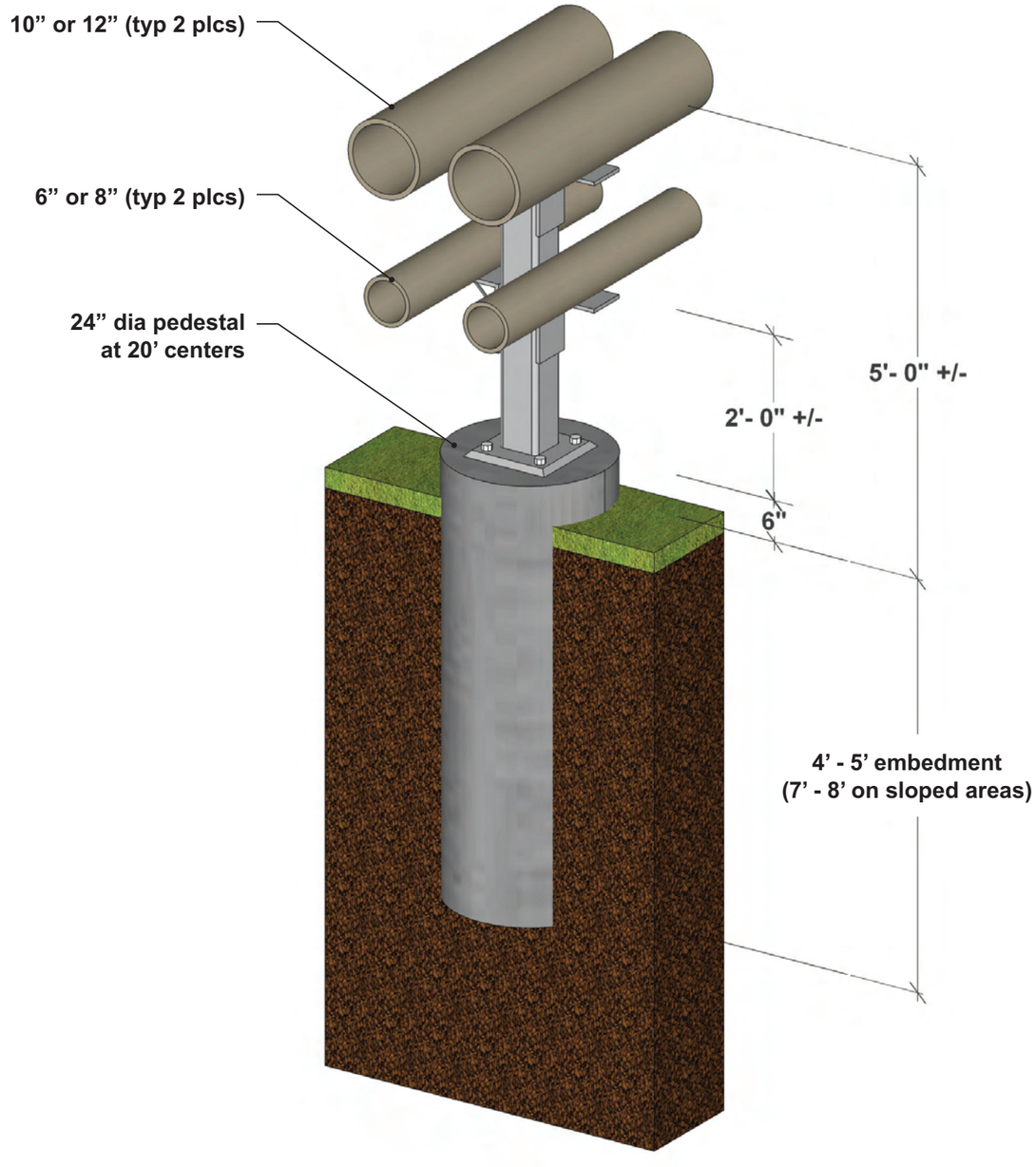
- EIR Project Area
- Approximate extent of hexavalent chromium [Cr(VI)] concentrations exceeding 32 micrograms per liter (µg/L) at any depth in groundwater based on fourth quarter 2011 sampling events. Dashed where based on limited data.
- Freshwater Injection Well
- Injection Well (Inner Recirculation Loop)
- Proposed Electrical Transformer Location
- Power Pole Location

FIGURE 5
OVERHEAD ELECTRICAL LAYOUT FOR ALTERNATIVES 0A, 1 AND 2
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

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Two Pipe Low Rack

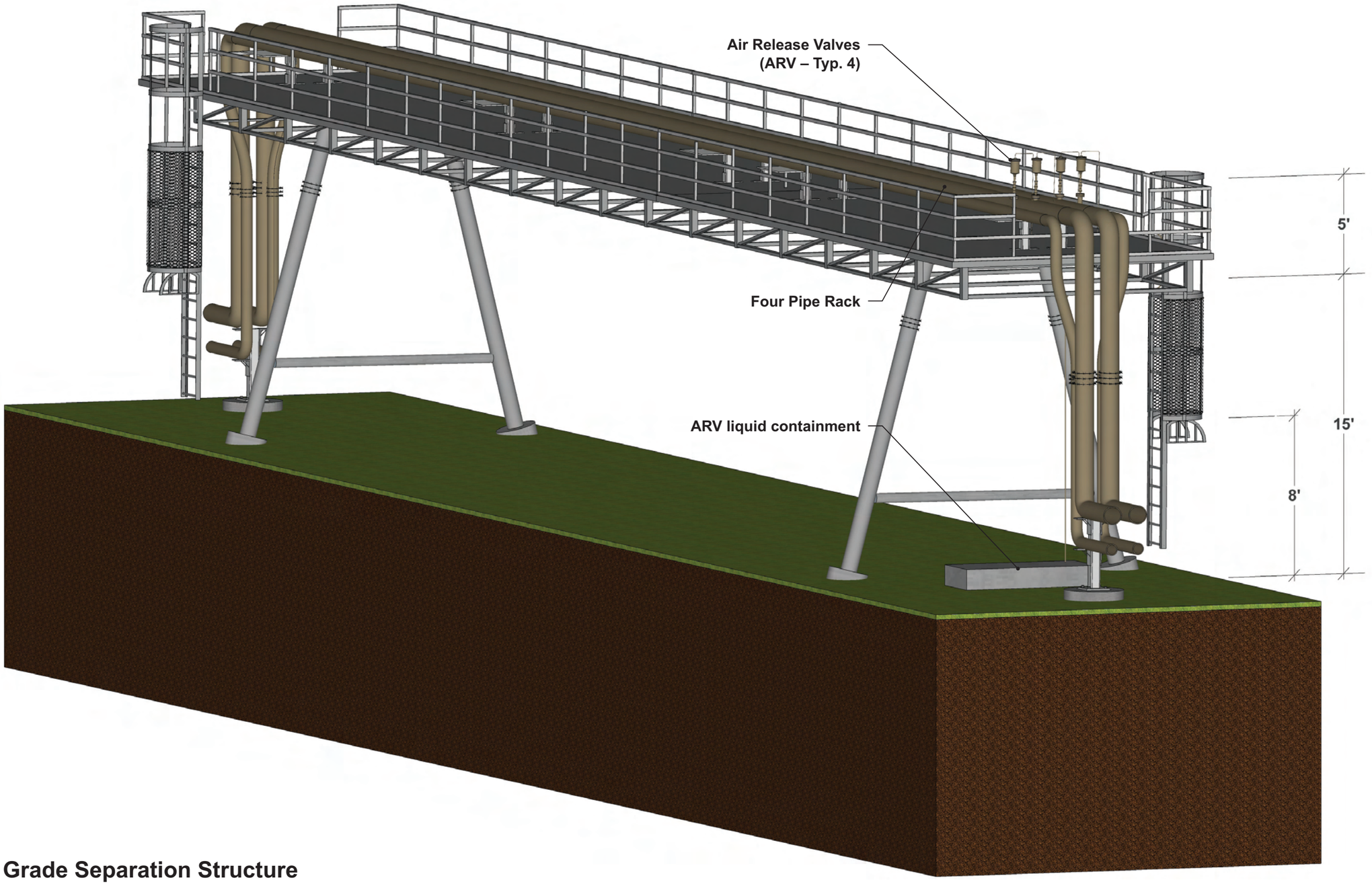


Four Pipe Low Rack

Notes:
Conceptual Visualization - This is for illustration purposes only and is not intended as an engineering design.

FIGURE 6
LOW PIPE RACKS
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

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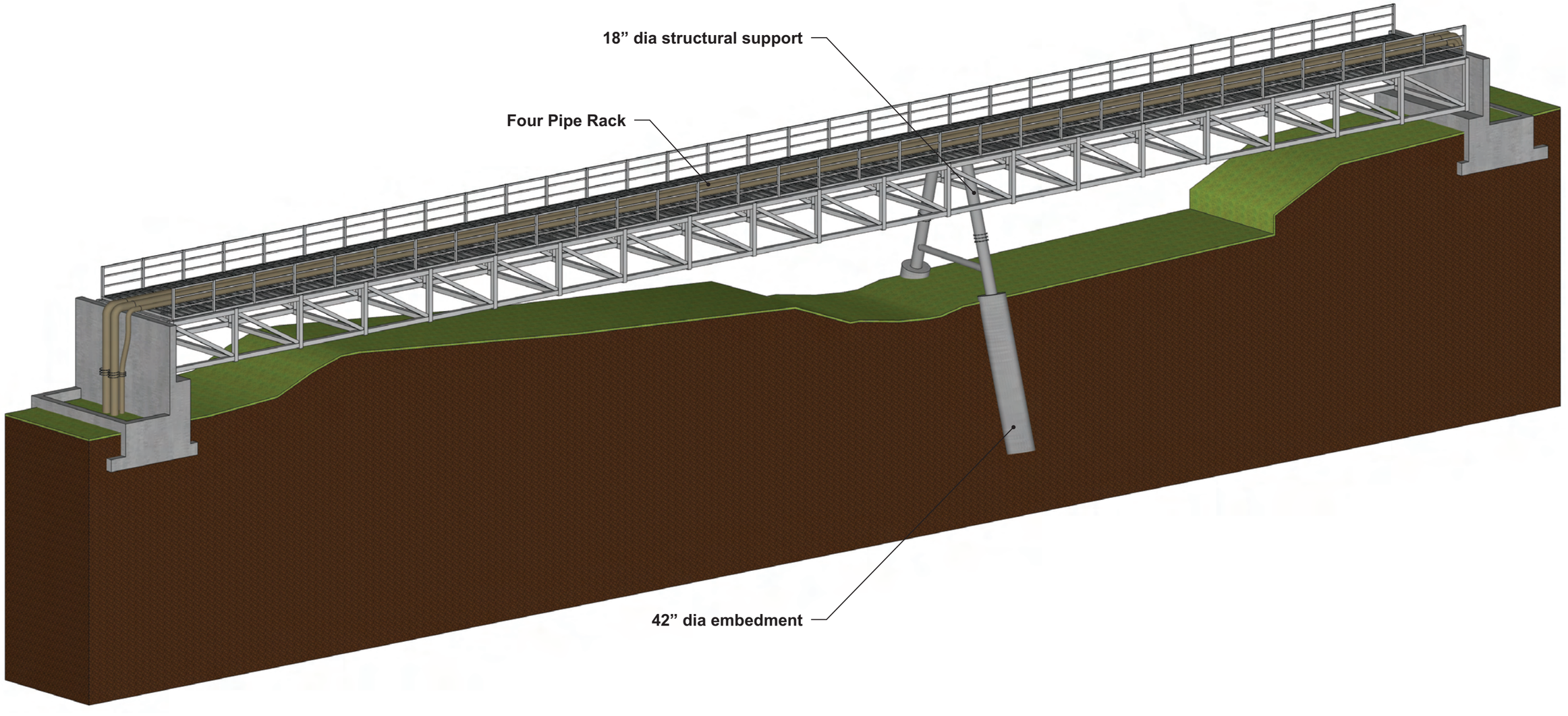


Grade Separation Structure

Notes:
Conceptual Visualization - This is for illustration purposes only and is not intended as an engineering design.

FIGURE 7
GRADE SEPARATION STRUCTURE
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

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Bridge Crossing Structure

Notes:
Conceptual Visualization - This is for illustration purposes only and is not intended as an engineering design.

FIGURE 8
BRIDGE CROSSING STRUCTURE
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

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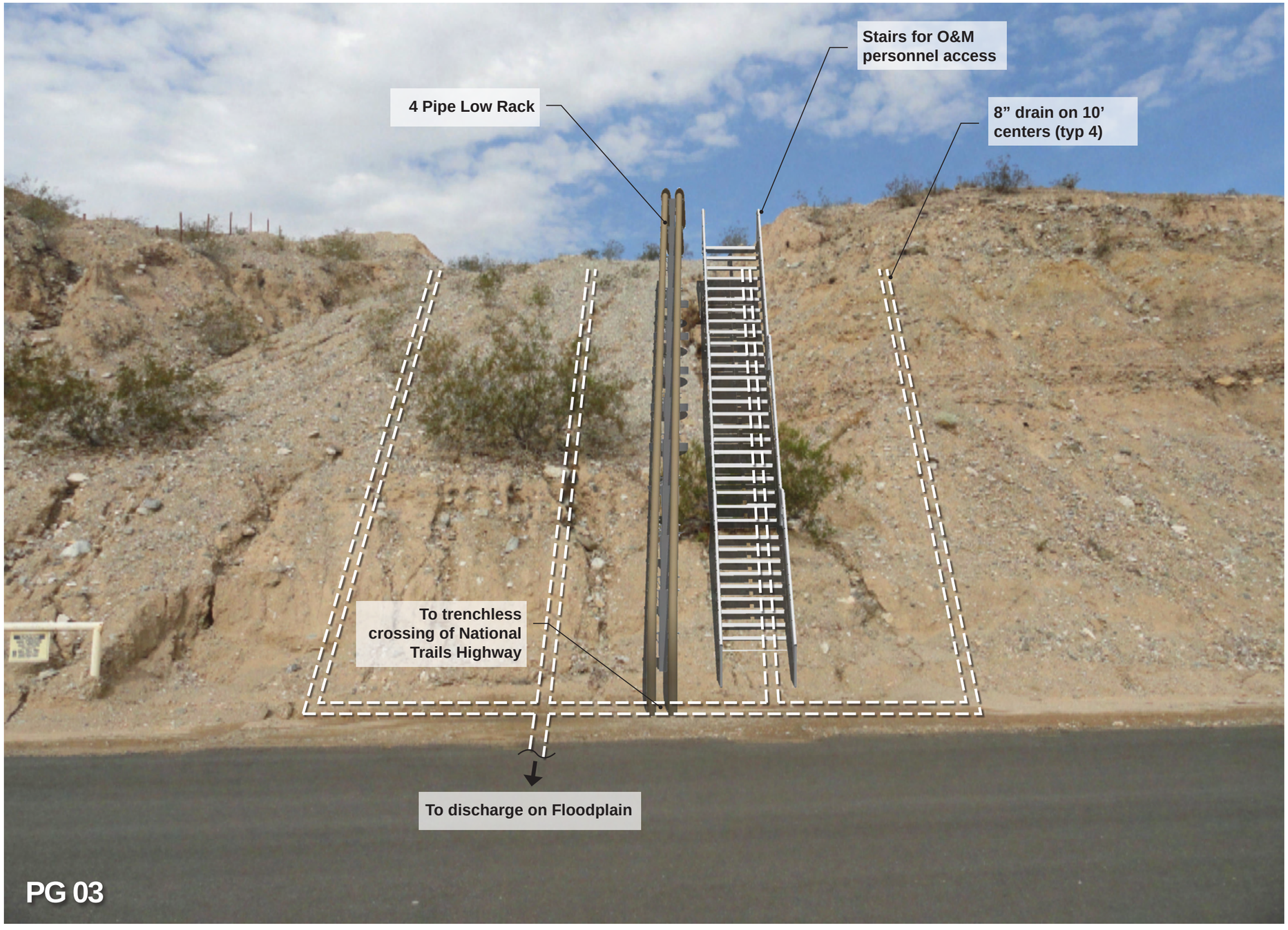
Notes:
Conceptual Visualization - This is for illustration purposes only and is not intended as an engineering design.
This figure applies to Alternatives 0a (60% design current route aboveground configuration), 1 (along historic Route 66), and 2 (parallel to SoCal gas pipeline).

FIGURE 9
LOOKING WEST ON ROUTE 66 NEAR IRL-3
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA



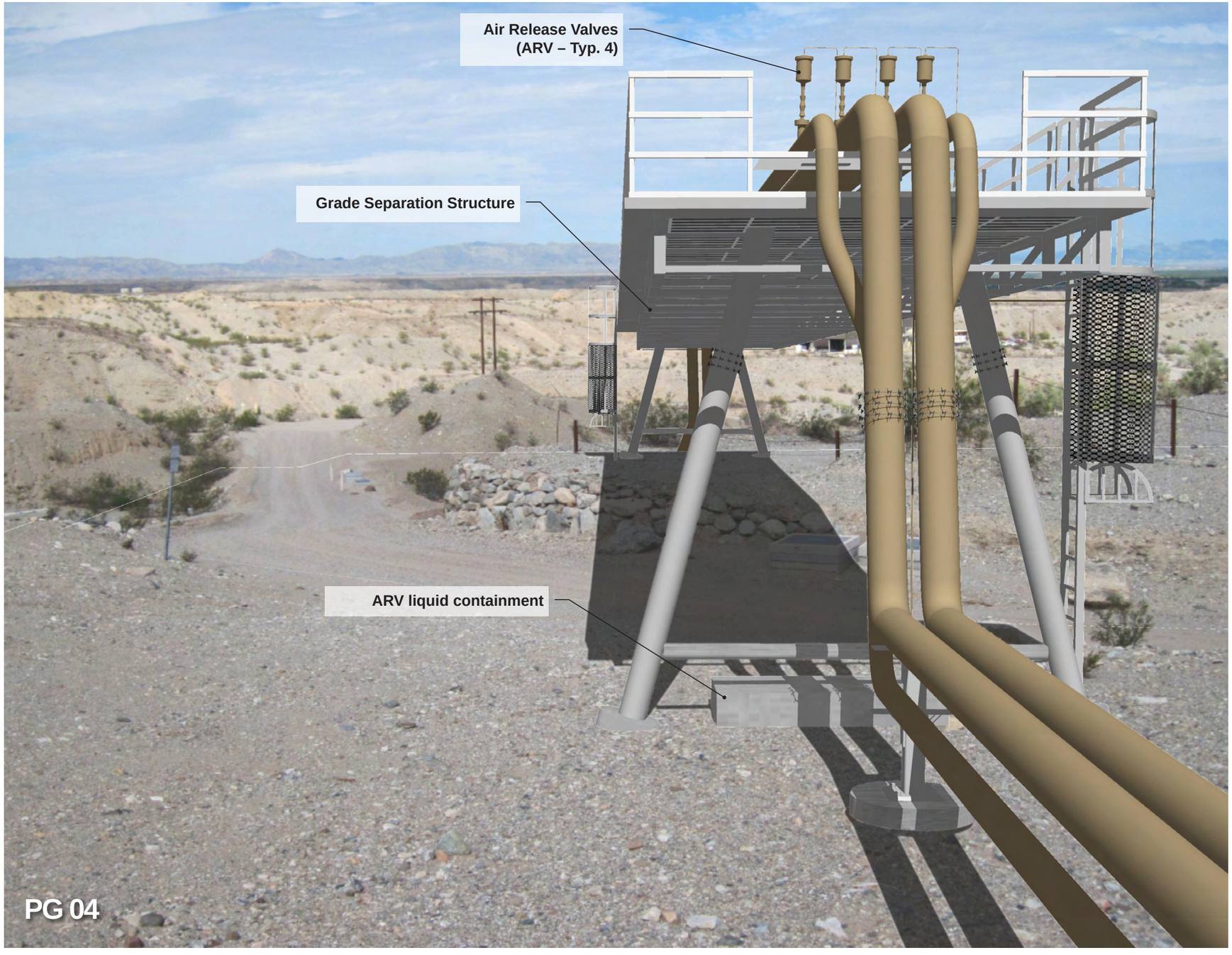
Notes:
Conceptual Visualization - This is for illustration purposes only and is not intended as an engineering design.
This figure applies to Alternatives 0a (60% design current route aboveground configuration), 1 (along historic Route 66), and 2 (parallel to SoCal gas pipeline).

FIGURE 10
LOOKING EAST AT PIPELINE H NEAR IRL-4
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA



Notes:
Conceptual Visualization - This is for illustration purposes only and is not intended as an engineering design.
This figure applies to Alternatives 1 (along historic Route 66) and 2 (parallel to SoCal gas pipeline).

FIGURE 11
LOOKING WEST FROM MW-20 BENCH
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA



Notes:
Conceptual Visualization - This is for illustration purposes only and is not intended as an engineering design.
This figure applies to Alternative 1 (along historic Route 66).

FIGURE 12
LOOKING AT ROUTE 66 ROCK WALL AT IM-3 ACCESS ROAD
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA



Notes:
Conceptual Visualization - This is for illustration purposes only and is not intended as an engineering design.
This figure applies to Alternative 2 (parallel to SoCal gas pipeline).

FIGURE 13
LOOKING AT BAT CAVE WASH PIPE BRIDGE FOR ALTERNATIVE 2
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA



Notes:

Conceptual Visualization - This is for illustration purposes only and is not intended as an engineering design.

This figure applies to Alternative 1 (along historic Route 66).

FIGURE 14
SOUTH FACING PANORAMA - ALTERNATIVE 1
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

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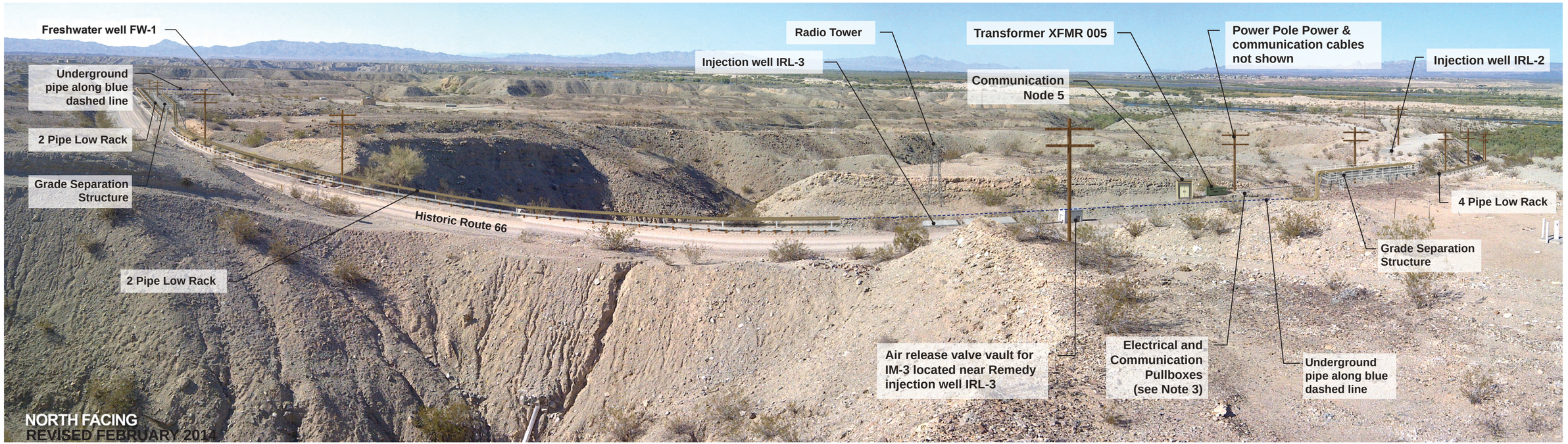


Notes:

Conceptual Visualization - This is for illustration purposes only and is not intended as an engineering design.

This figure applies to Alternative 2 (parallel to SoCal gas pipeline).

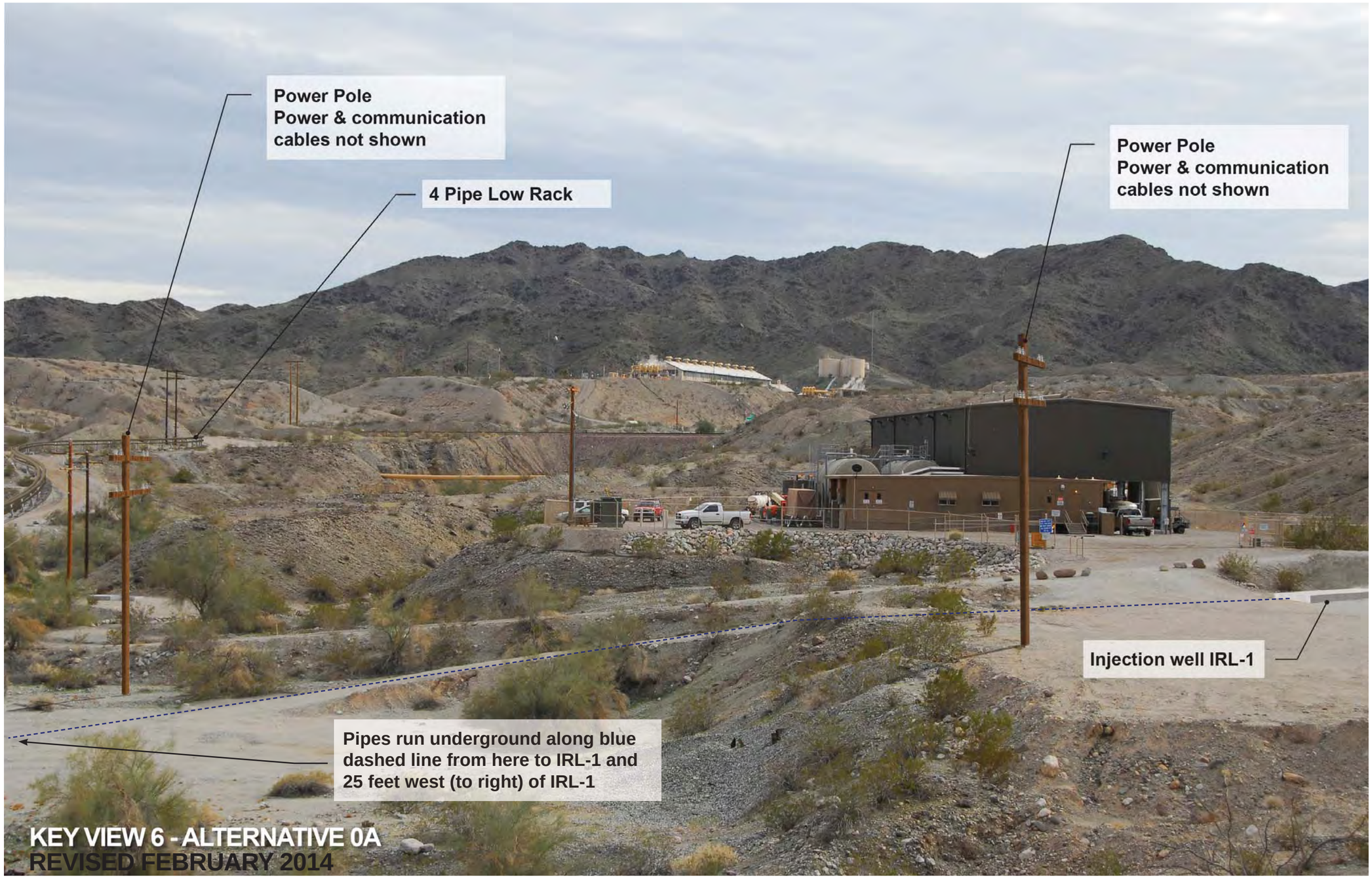
FIGURE 15
SOUTH FACING PANORAMA - ALTERNATIVE 2
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA



Notes:

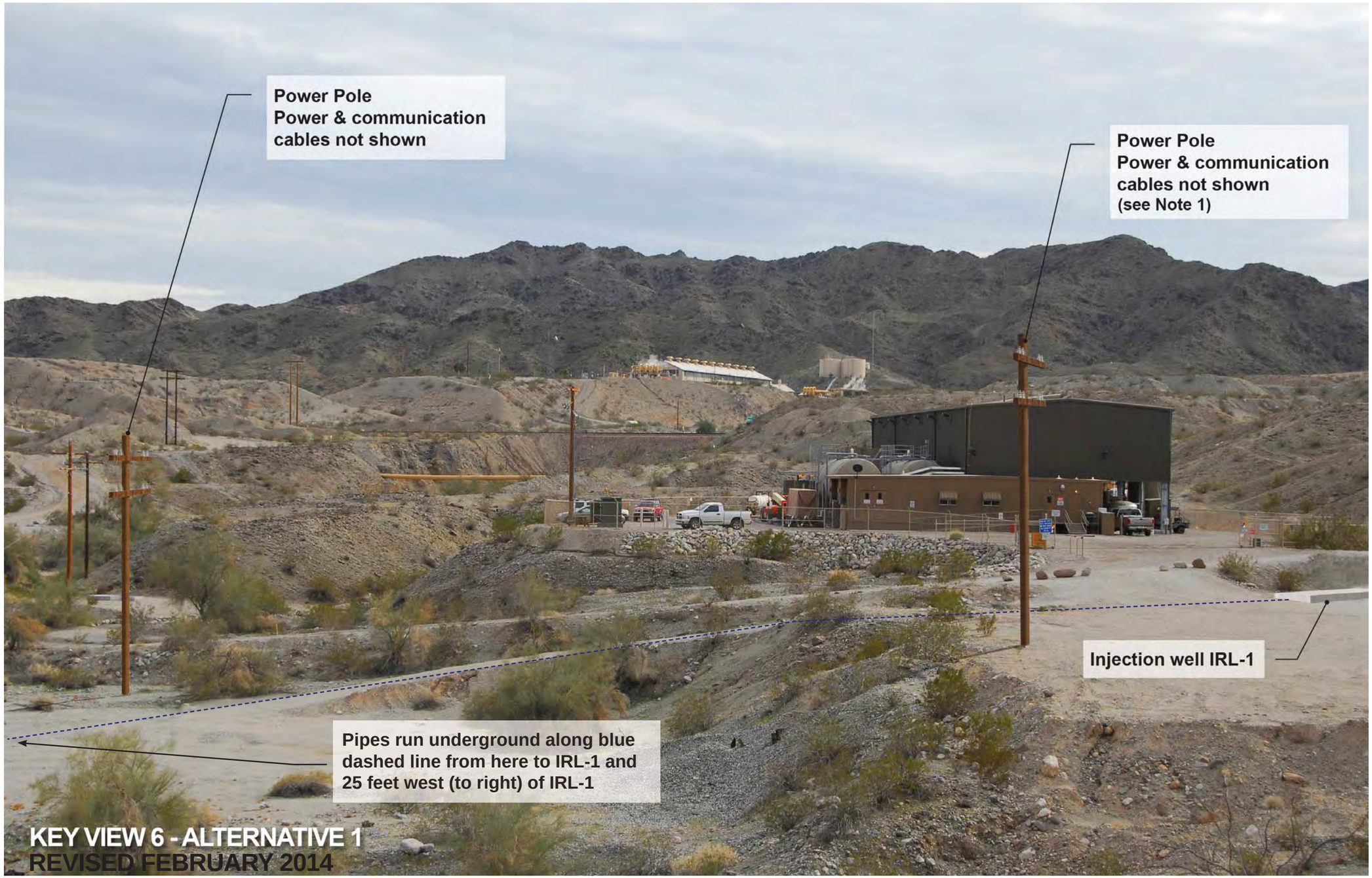
1. Conceptual Visualization - This is for illustration purposes only and is not intended as an engineering design.
2. This routing is common to the current (60%) design with aboveground configuration, Alternative 1 (along historic Route 66), and Alternative 2 (parallel to SoCal gas pipeline).
3. Five additional electrical and communication pullboxes are included in the design but do not appear in this figure because they are hidden by the terrain.

FIGURE 16
NORTH FACING PANORAMA - ALTERNATIVES 0A, 1 AND 2
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA



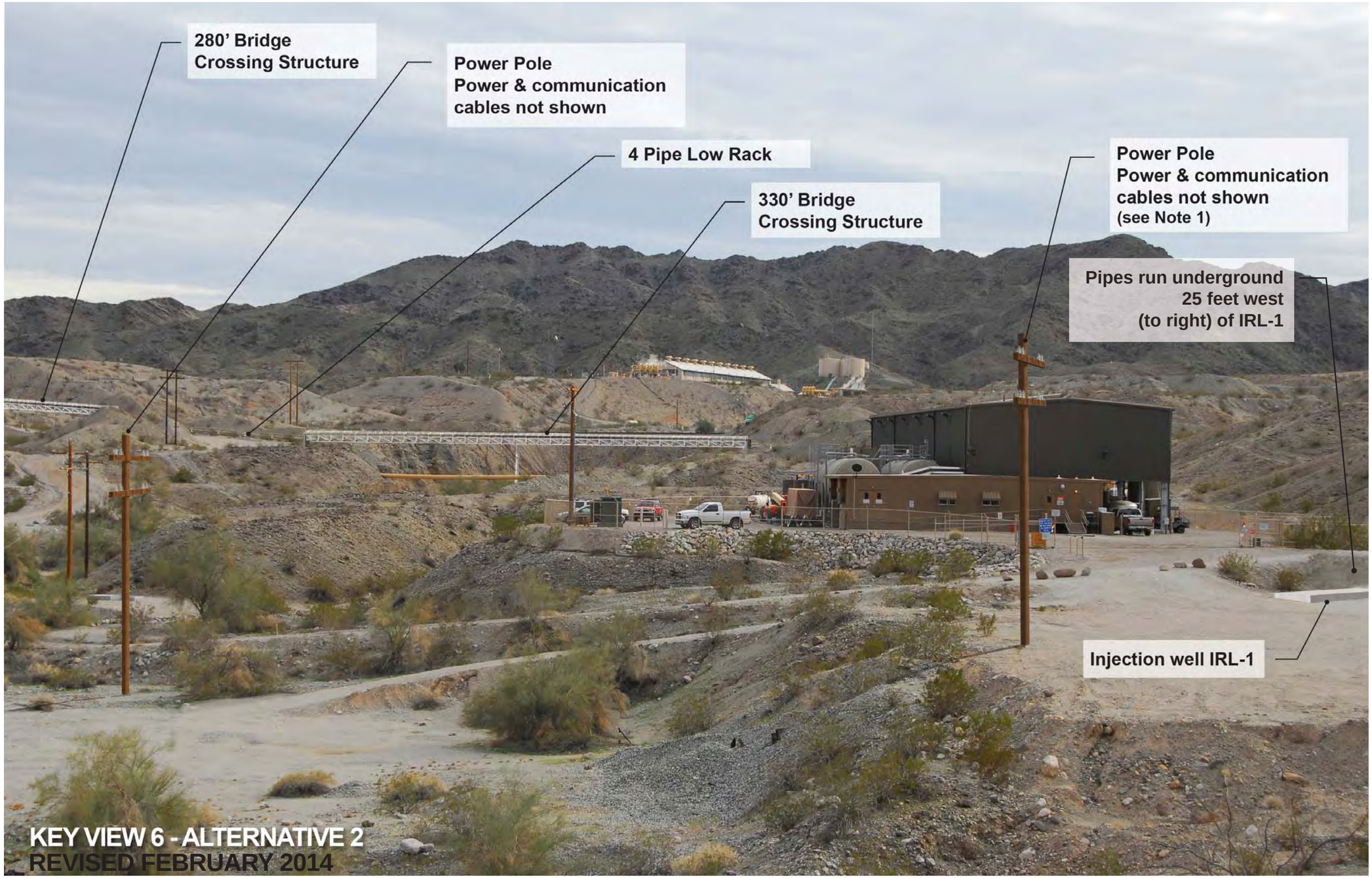
Notes:
1. Conceptual Visualization - This is for illustration purposes only and is not intended as an engineering design.
2. This figure applies to Alternative 0a (60% design current route aboveground configuration).

FIGURE 17
EIR KEY VIEW 6 - ALTERNATIVE 0A
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA



Notes:
1. Underground electrical conduit from this pole to IRL-1 not shown
2. Conceptual Visualization - This is for illustration purposes only and is not intended as an engineering design.
3. This figure applies to Alternative 1 (along historic Route 66).

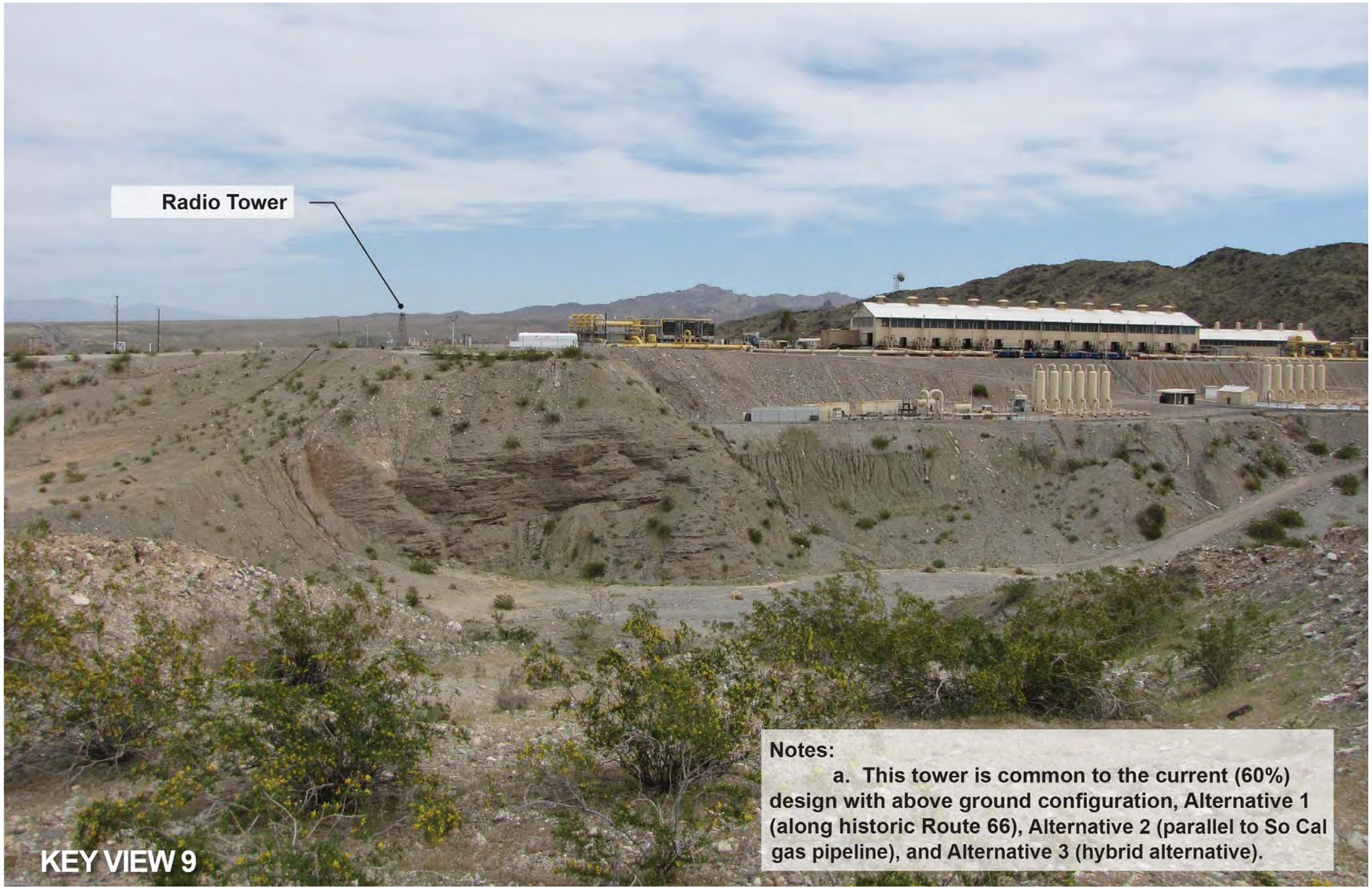
FIGURE 18
EIR KEY VIEW 6 - ALTERNATIVE 1
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA



Notes:
1. Underground electrical conduit from this pole to IRL-1 not shown
2. Conceptual Visualization - This is for illustration purposes only and is not intended as an engineering design.
3. This figure applies to Alternative 2 (parallel to SoCal gas pipeline).

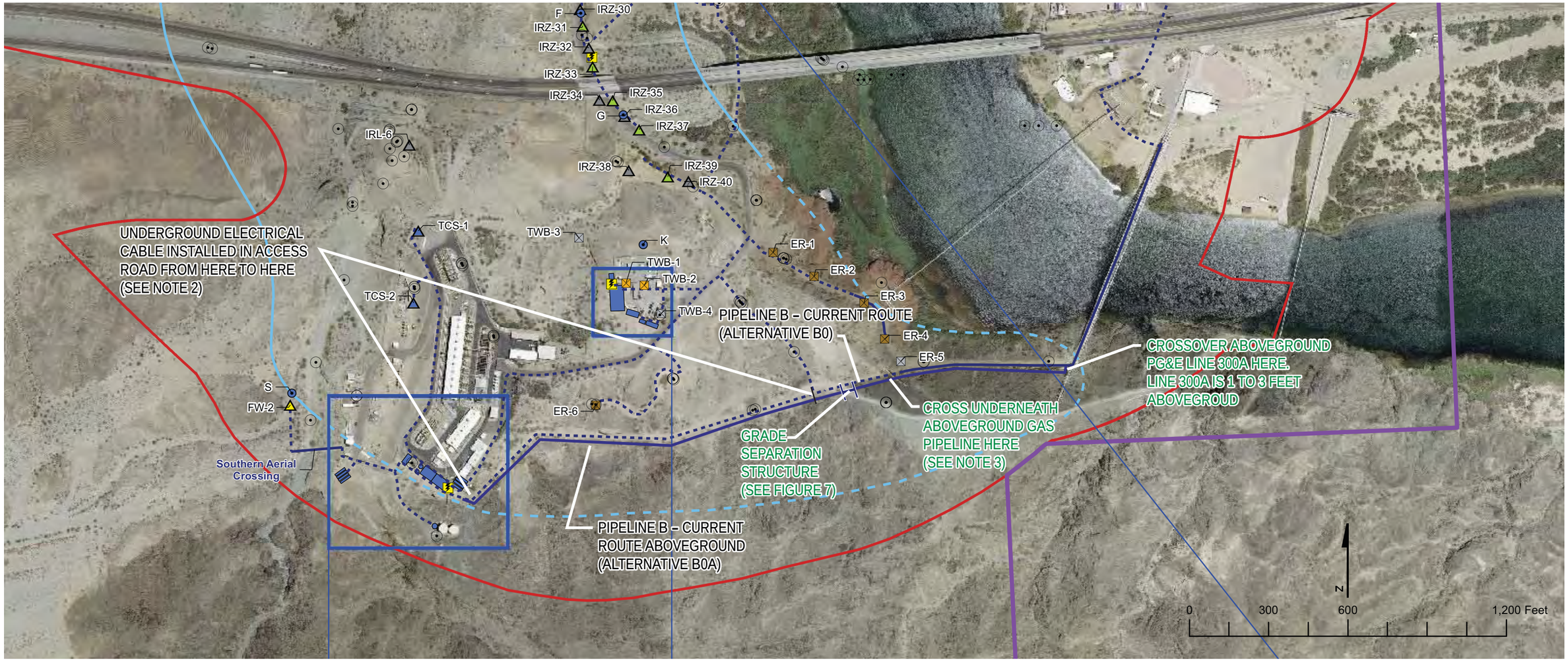
FIGURE 19
EIR KEY VIEW 6 - ALTERNATIVE 2
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

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Notes:
Conceptual Visualization - This is for illustration purposes only and is not intended as an engineering design.

FIGURE 20
EIR KEY VIEW 9 - ALTERNATIVES 0A, 1, 2 AND 3
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA



LEGEND

Existing Monitoring Well

Existing Freshwater Supply Well

Area of Potential Effects (APE)

Approximate extent of hexavalent chromium [Cr(VI)] concentrations exceeding 32 micrograms per liter (µg/L) at any depth in groundwater based on fourth quarter 2011 sampling events. Dashed where based on limited data.

EIR Project Area

Remedy Wells

- Contingent Freshwater Source
- Freshwater Source
- Remedy Monitoring Well
- Extraction Well (East Ravine)
- Extraction Well (NTH IRZ)
- Extraction Well (Riverbank)
- Extraction Well (Transwestern Bench)
- Freshwater Injection Well
- Injection Well (Inner Recirculation Loop)
- Injection Well (NTH IRZ)
- Injection Well (Topock Compressor Station)
- Future Provisional Extraction Well
- Future Provisional Injection Well

Pipeline Corridor for Remedy

- Aboveground Pipe
- Underground Pipe/Conduit
- Future Provisional/Contingent Fresh Water Pipe

Remedy Facilities

- Proposed New Remedy Structure
- Future Provisional Electrical Transformer
- Proposed Electrical Transformer Location

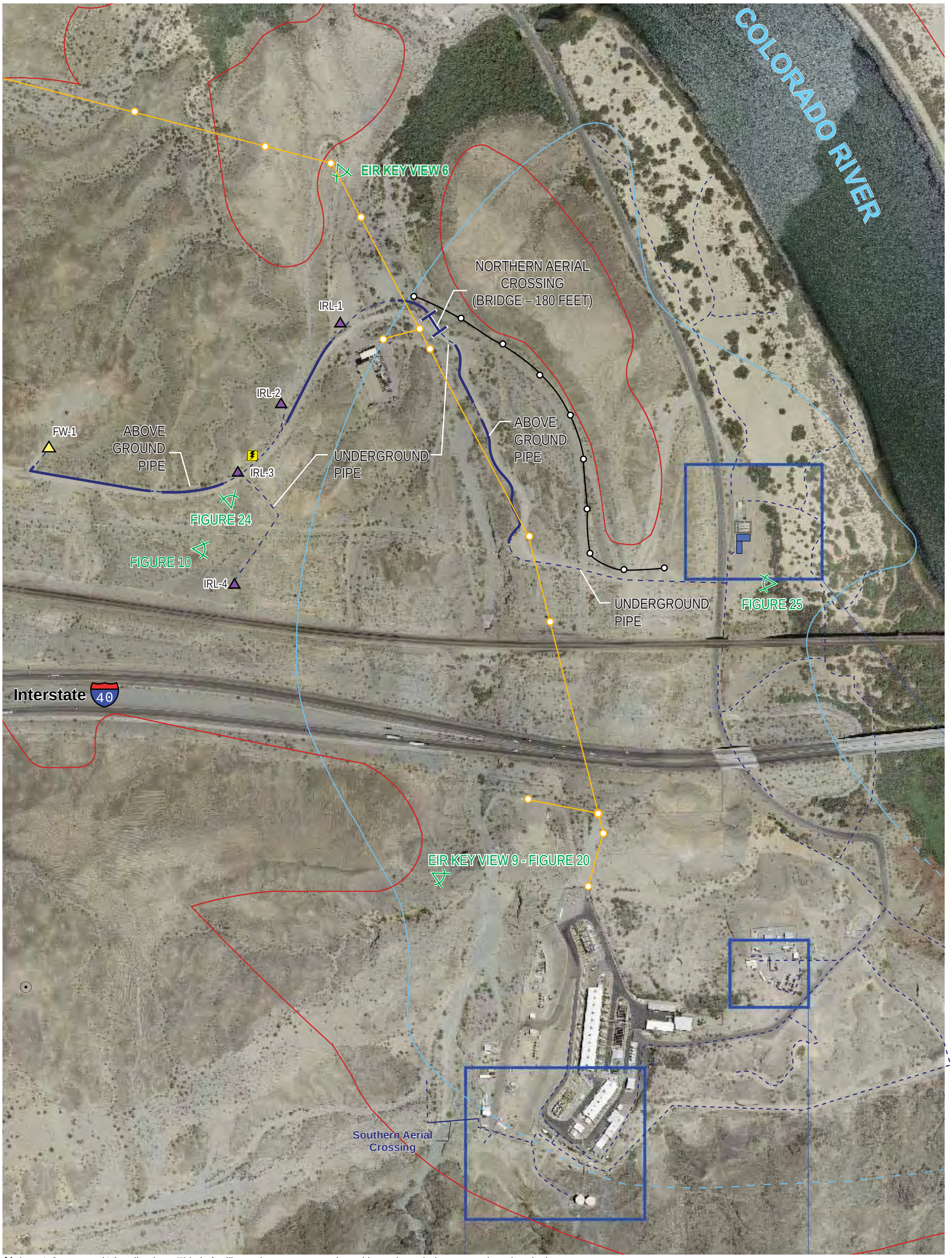
Notes:

1. Conceptual Visualization - This is for illustration purposes only and is not intended as an engineering design.
2. Electrical (12 kV direct-buried cable) is underground from Pipeline J to Compressor Station for both alternatives.
3. For this figure, it is assumed that the water line can be installed beneath the aboveground gas pipeline and also stay 12 feet away from PG&E's Line 300A gas pipeline. If this is not allowed, then possible options include installing a longer pipe bridge (see Figure 8) encompassing the grade separation structure, a 30 foot grade separation structure could be installed here, or the pipe could be re-routed further south to cross over the pipeline when it is underground.

FIGURE 21
PIPELINE B - CURRENT ROUTE (ALTERNATIVE B0) AND CURRENT ROUTE ABOVEGROUND (ALTERNATIVE B0A)

GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

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Notes: 1.Conceptual Visualization - This is for illustration purposes only and is not intended as an engineering design.
2. For a simulation of this alternative see Figure 17.

LEGEND

- EIR Project Area
- Approximate extent of hexavalent chromium [Cr(VI)] concentrations exceeding 32 micrograms per liter (µg/L) at any depth in groundwater based on fourth quarter 2011 sampling events. Dashed where based on limited data.
- Freshwater Injection Well
- Injection Well (Inner Recirculation Loop)
- Proposed Electrical Transformer Location
- Bridge or Grade Separation Structure
- Aboveground Pipe
- Underground Pipe
- Viewpoint
- Proposed New Remedy Structure
- Power Pole Location
- Overhead Power Line
- City of Needles Power Pole Location
- City of Needles Power Line

FIGURE 22
PIPELINES A/H HYBRID ALTERNATIVE WITH OVERHEAD ELECTRICAL LAYOUT (ALTERNATIVE 3)
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION, NEEDLES, CALIFORNIA

CH2MHILL



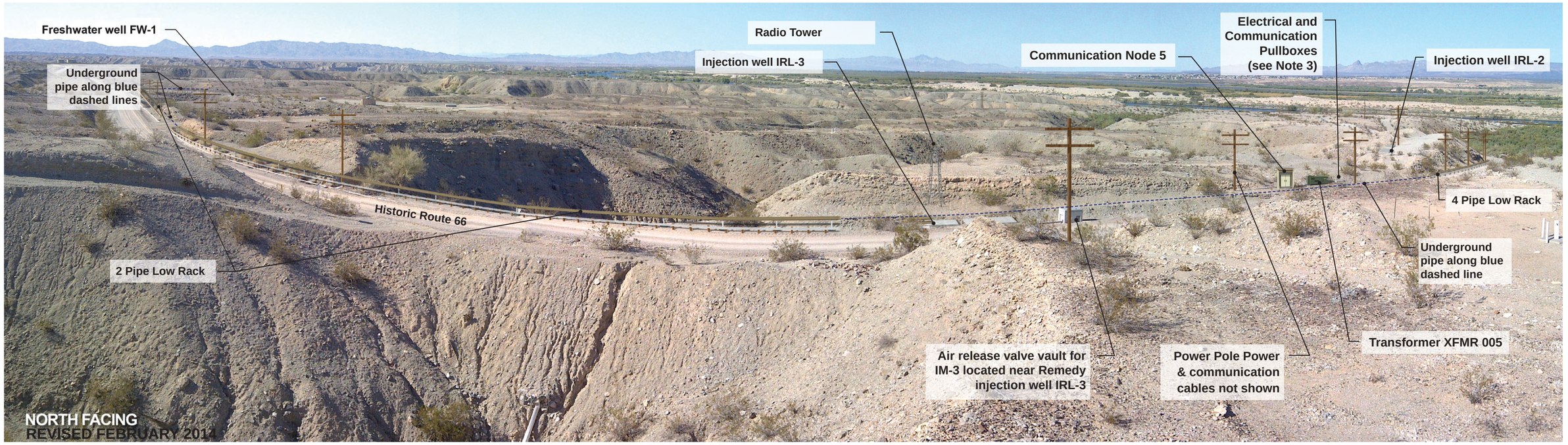
Notes:

Conceptual Visualization - This is for illustration purposes only and is not intended as an engineering design.

This figure applies to Alternative 2 (parallel to SoCal gas pipeline).

FIGURE 23
NORTH FACING PANORAMA - ALTERNATIVE 2
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

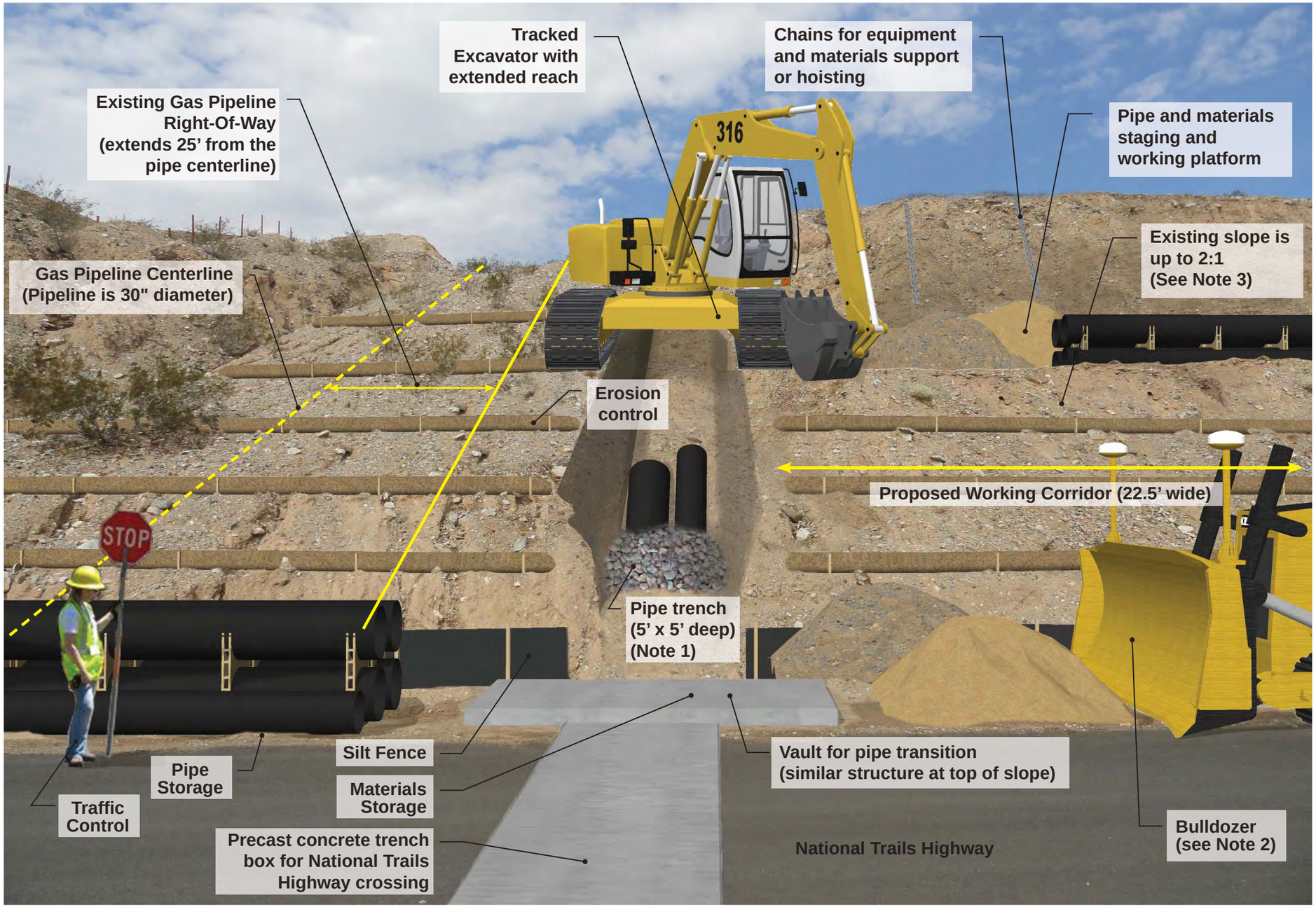
CH2MHILL



Notes:

1. Conceptual Visualization - This is for illustration purposes only and is not intended as an engineering design.
2. This routing is for the hybrid alternative 3.
3. Five additional electrical and communication pullboxes are included in the design but do not appear in this figure because they are hidden by the terrain.

FIGURE 24
NORTH FACING PANORAMA - ALTERNATIVE 3
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA



Notes:
Conceptual Visualization - This is for illustration purposes only and is not intended as an engineering design. Dimensions shown are not to scale.
This figure applies to Alternative 3 TRC Hybrid Alternative.

1. Water pipes and electrical conduit will be installed in larger casing or carrier pipes (24” dia. and 18” dia., respectively).
2. Additional equipment not shown may include pipe welding machines, skid steer loader, second bulldozer, trucks for materials transport, and generator.
3. A drainage system consisting of surface grading (to the north), 3 catch basins, and a buried drain pipe (12” diameter) is assumed to be placed in the working corridor and is not shown. The drain pipe is assumed to extend across National Trails Highway and discharge to the Floodplain.

FIGURE 25
SEGMENT 1 SCHEMATIC OF TRENCH CONSTRUCTION
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

DRAFT Technical Memorandum

From: TRC
To: DTSC and DOI/BLM
Re: Suggested Alternative for Pipeline Segment A/H and B
Date: December 17, 2013

After discussing and evaluating the Department of Interior's Pipeline Evaluation Matrix, PG&E's responses to 60% comments, and the PG&E maps and visual simulations (provided at the November 19-20, 2013 TWG meeting in Henderson, NV), the TRC provides the following recommendations concerning pipeline segments.

All Pipeline Segments

The TRC recommends that ALL below ground infrastructure for all pipeline segments be removed upon completion of the remedy, as part of the decommissioning process.

Pipeline Segment A/H

We recommend Pipeline Alternative A/H Route 2 (Figure 4 of the above-identified visual simulations - attached), with the following recommended modifications and clarifications. The recommendation for Alternative Route 2 is based on our understanding of Tribal preference that the pipeline segment be relocated away from area B to the greatest extent possible.

- Evaluate the feasibility of a subsurface bore, suggested by Curt Russell in the November 19-20 TWG meeting, at the eastern end of the alignment, where the Alternative A/H Route 2 pipeline segment meets National Trails Highway. This would eliminate the need for the staircase feature illustrated in Figure 11 of the above-referenced visual simulations.
- Evaluate the feasibility of locating IRL-2 in the center of the roadway, with buried vaults, to avoid intrusion into culturally-sensitive areas or major slope excavation. The roadway would need to be periodically closed for maintenance on the well or related buried infrastructure, but it would still be possible to access other project and IM-3 facilities from the east or west.
- Evaluate the feasibility of using simpler pipe bridges supported in a manner similar to the existing large-diameter Southern California high pressure gas pipeline Bat Cave Wash crossing shown in Figure 13 of the above-referenced visual simulations. Another possibility might be to suspend the pipes from a steel cable, possibly with support/stabilization at points along the ground. The objective would be to minimize the complexity, footprint, cost, maintenance, etc., of the currently-proposed pipe bridge structures. In this scenario, maintenance for the remedy infrastructure would be done in a manner similar to what is presumably presently done for the large-diameter Southern California high pressure gas pipe where it crosses valleys and washes.
- For the portion of the alignment in the area of the shorter of the two proposed pipe bridges, evaluate the feasibility of placing the pipeline above-ground, but without using a pipe bridge.
- Evaluate the feasibility of substituting underground crossings in place of the above-ground grade separation structures, shown in Figure 7 of the above-referenced visual simulations, at all other locations where above-ground grade separation structures are required.
- Evaluate the feasibility of alternative methods of slope support in the area of IRL-4. Alternatives would include shotcrete (sprayed on mixture of sand, cement, fine gravel and water) or sand-cement bags – tinted to match the surroundings. The recent Cost-Effective and Sustainable Road

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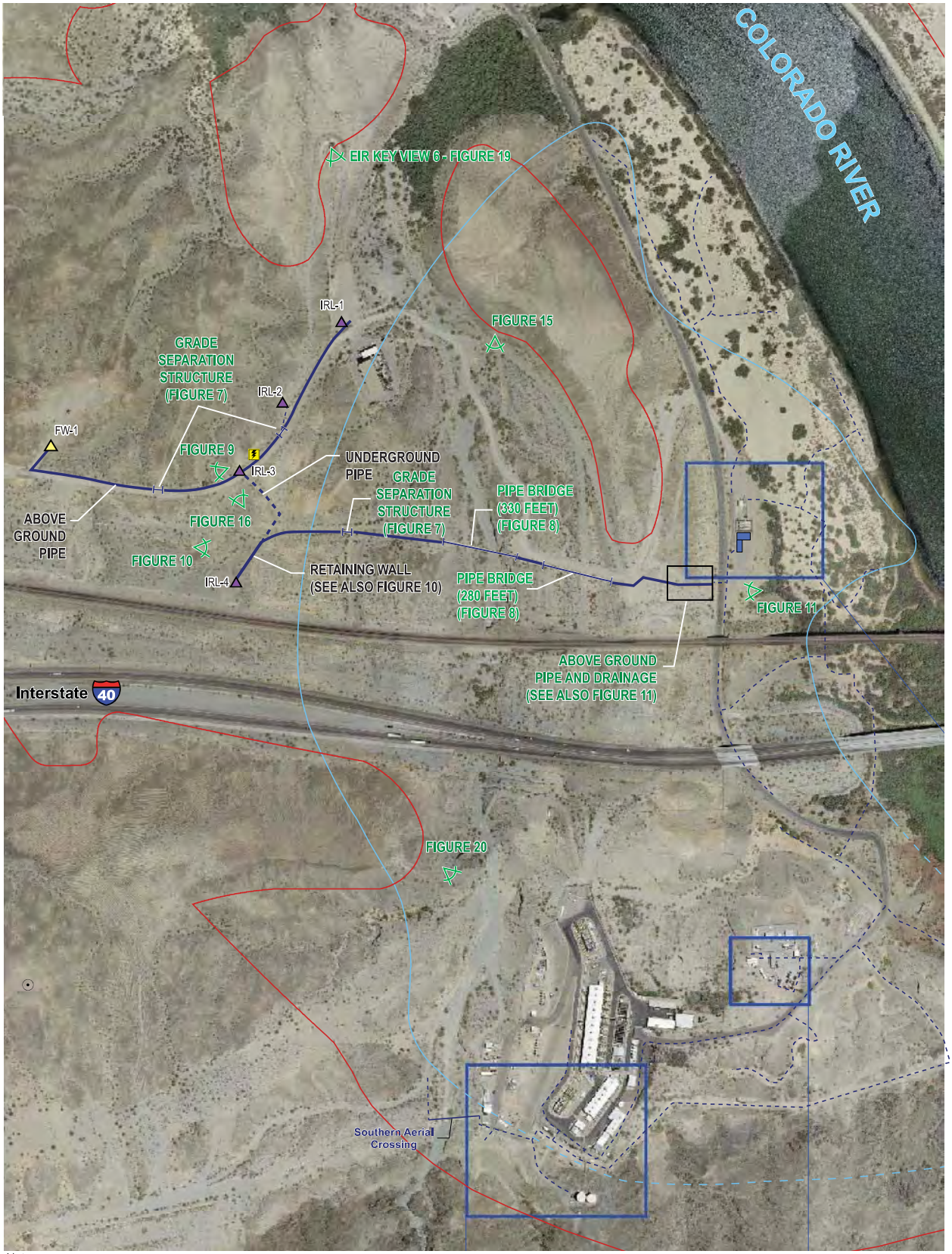
Slope Stabilization and Erosion Control synthesis by NCHRP (National Co-Operative Highway Research Program) may offer applicable solutions, though bio-engineered methods are probably not applicable in the desert setting of Topock. The simpler the better. The objective would be to minimize the complexity, footprint, visual impact, cost and maintenance of the slope support.

- Evaluate the feasibility of a temporary vehicular closure to the public of what is often referred to as "Route 66" between Park Moabi road and the IM-3/IRL-1 location, for the duration of the project. The road would have locked gates at either end, and be closed to public motorized vehicular traffic, but not closed to public pedestrian access. BLM, PG&E, San Bernardino County Fire Department, the Fort Mojave Indian Tribe and possibly other parties would have gate keys to access the road for their specific needs. If there is no public vehicular access, then the need for guardrail may be eliminated. NOTE: It is very likely, that, from a San Bernardino County point of view, this road is already in a substandard condition: in places, it is only one lane in width, and, in other places, there are drop-offs.
- Evaluate the feasibility of minimizing or eliminating the use of double-contained (dual-wall) water line piping for above-ground portions of the pipelines. If there is a leak, won't it be visible during routine inspections?
- Evaluate the feasibility of using smaller-diameter pipe for above-ground portions of the pipeline in general, and for pipe bridges in particular – to reduce the weight of the pipeline. For the pipe bridges, the friction losses would be higher but the length of pipe is relatively small.
- Evaluate the feasibility of placing above-ground piping closer to the ground to reduced design moments and thus reduce the required support and foundation sizes.
- Evaluate the feasibility of designing the pipeline to have suitable wildlife crossings. For example, above-ground pipeline segment could periodically dive underground for a lateral distance of 5 or 10 feet.
- Evaluate the feasibility of placing all of pipeline segment H above ground.
- Utilize above-ground electrical, fiber-optic and telecommunication utilities per Figure 5 of the above-referenced visual simulations.

Pipeline Segment B

We recommend Pipeline Alternative B0A (Figure 21 of the above-identified visual simulations).

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Notes: 1.Conceptual Visualization - This is for illustration purposes only and is not intended as an engineering design.
2. See Figure 5 for Overhead Electical.

LEGEND

- EIR Project Area
- Approximate extent of hexavalent chromium (Cr(VI)) concentrations exceeding 32 micrograms per liter (µg/L) at any depth in groundwater based on fourth quarter 2011 sampling events. Dashed where based on limited data.
- Freshwater Injection Well
- Injection Well (Inner Recirculation Loop)
- Proposed Electrical Transformer Location

FIGURE 4
PIPELINES A/H ALTERNATIVE ROUTE 2 (ALTERNATIVE 2)
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL

ES1108131834498AO_Topock_AboveGroundPipeline_Design_Alt.ai_111113_lho/it

Discussion regarding "Segment 1 – Pipeline A"

Slope access from NTH up to south end of mesa

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Segment 1 Pipeline A: Slope access vs. original 60% BOD route along access road thru Locus B

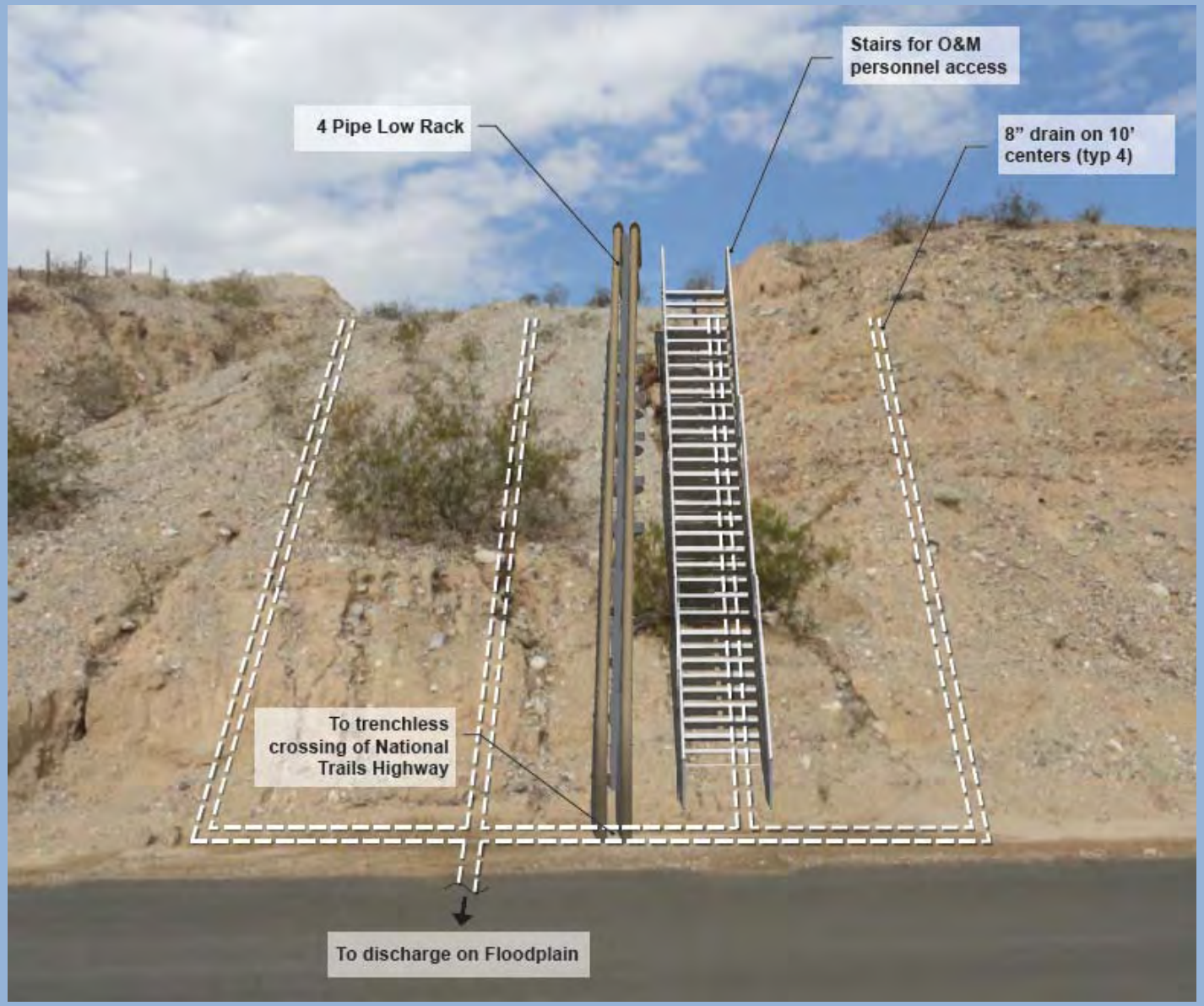


Segment 1 Pipeline A: Location of slope access

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Simulation of possible above-ground structures

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Summary of Options for Segment 1- Pipeline A (slope access)

- Bring infrastructure up slope in a trench, adjacent to existing pipeline/easement.
- Bring infrastructure up slope on above ground supports, includes access stairway, pipeline supports, buried drainage pipes and basins; likely additional cut into slope on northern side to accommodate structures within existing pipeline easements.
- Underground “direct piping” bore from NTH to top of slope using tunnel boring machine (TBM). All piping and utilities would be run through permanent 42” casing. Casing is not removable.

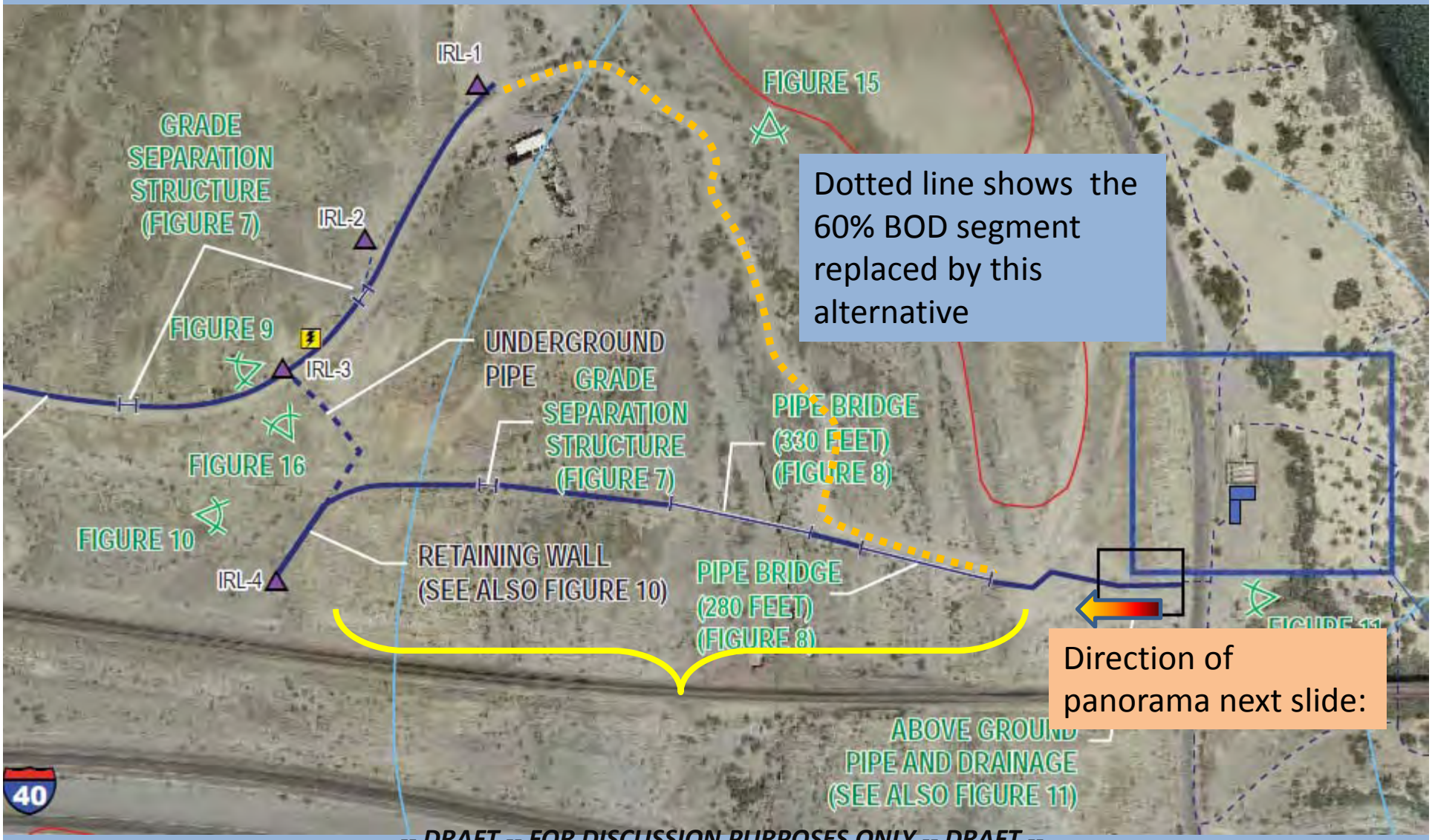
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Discussion regarding "Segment 4 – Pipeline A"

From top of slope access, across Bat Cave Wash to IRL-4

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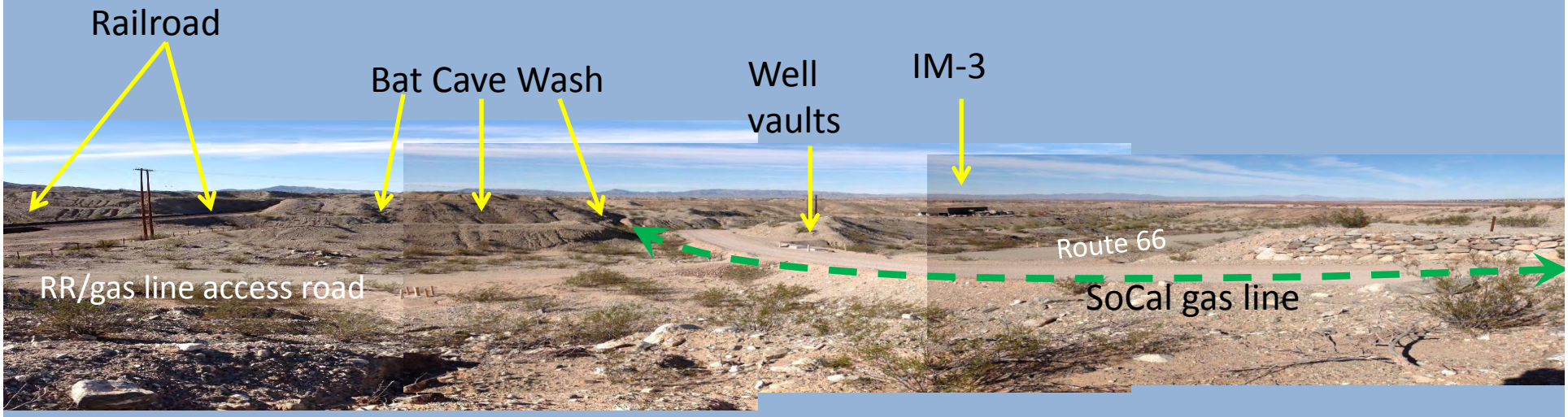
Alternate Proposed Alignment



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Tribal Option for Segment 4 Pipeline A Panorama of Alternate Route

(view looking west from top of slope at SoCal pipeline easement)



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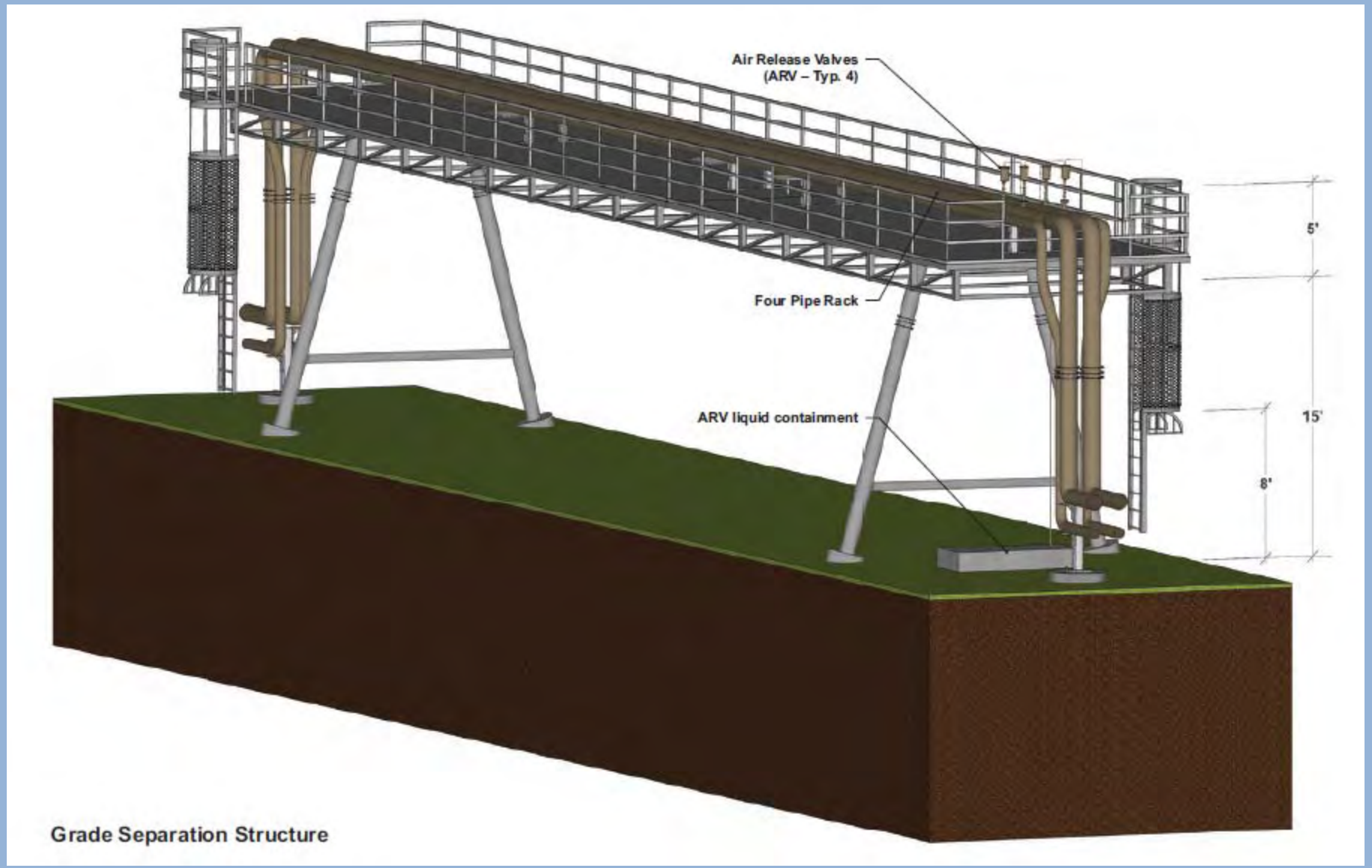
Existing SoCal gas line crossing over Bat Cave Wash

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Simulation of possible pipe bridge across Bat Cave Wash

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Simulation of possible grade separation over SoCal pipeline

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Simulation of possible view of pipe bridges and grade separation

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Possible considerations for this alternate routing (Segment 4):

- Two pipe bridge structures of ~330’ and ~280’ will extend above the top of Bat Cave Wash One grade separation structure to cross existing SoCal pipeline will also extend well above the land surface. These structures may be visible when viewed from the south Maze area.

Discussion regarding “Pipeline H”

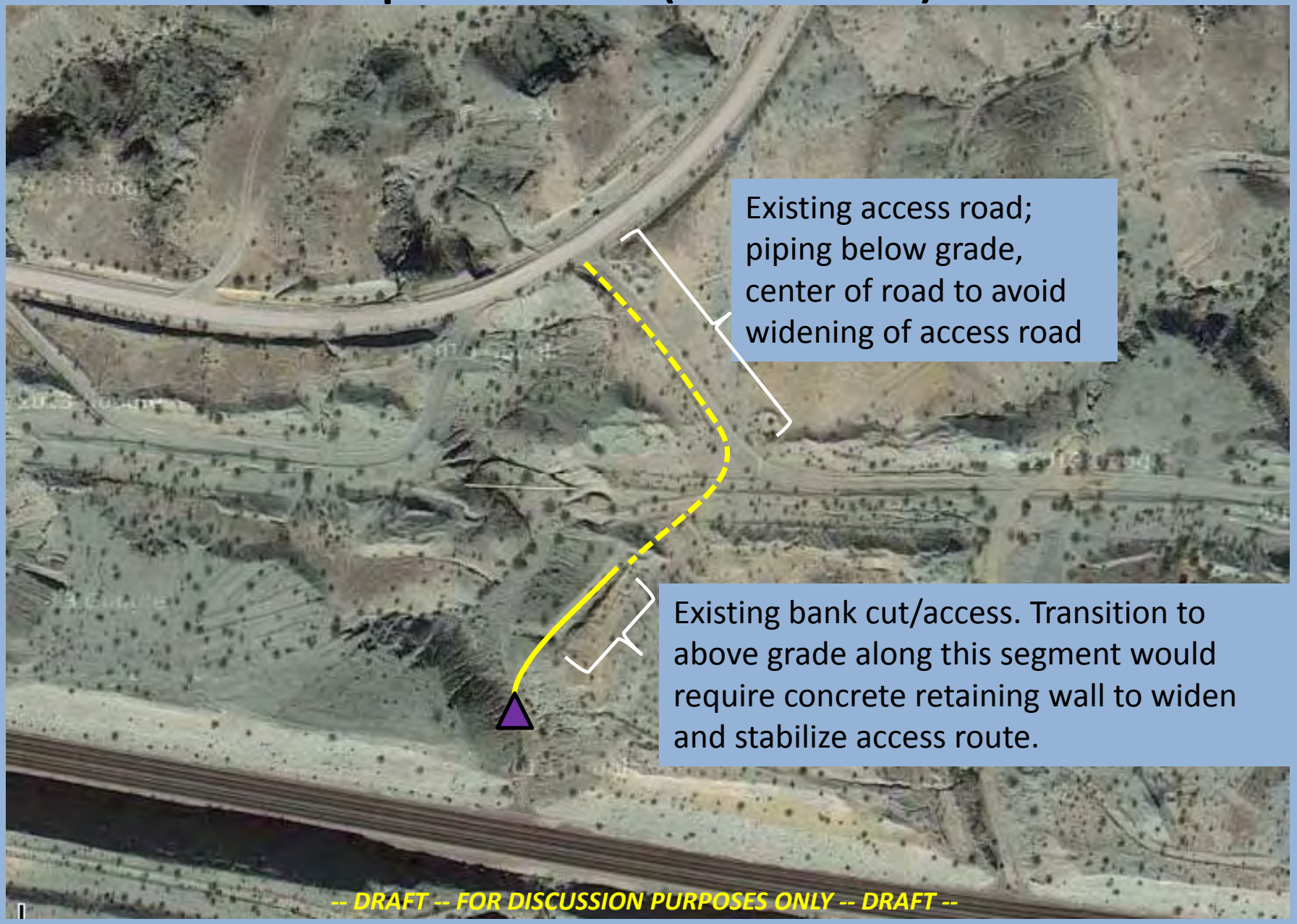
Access route from Route-66/IRL-3 down into to wash at IRL-4

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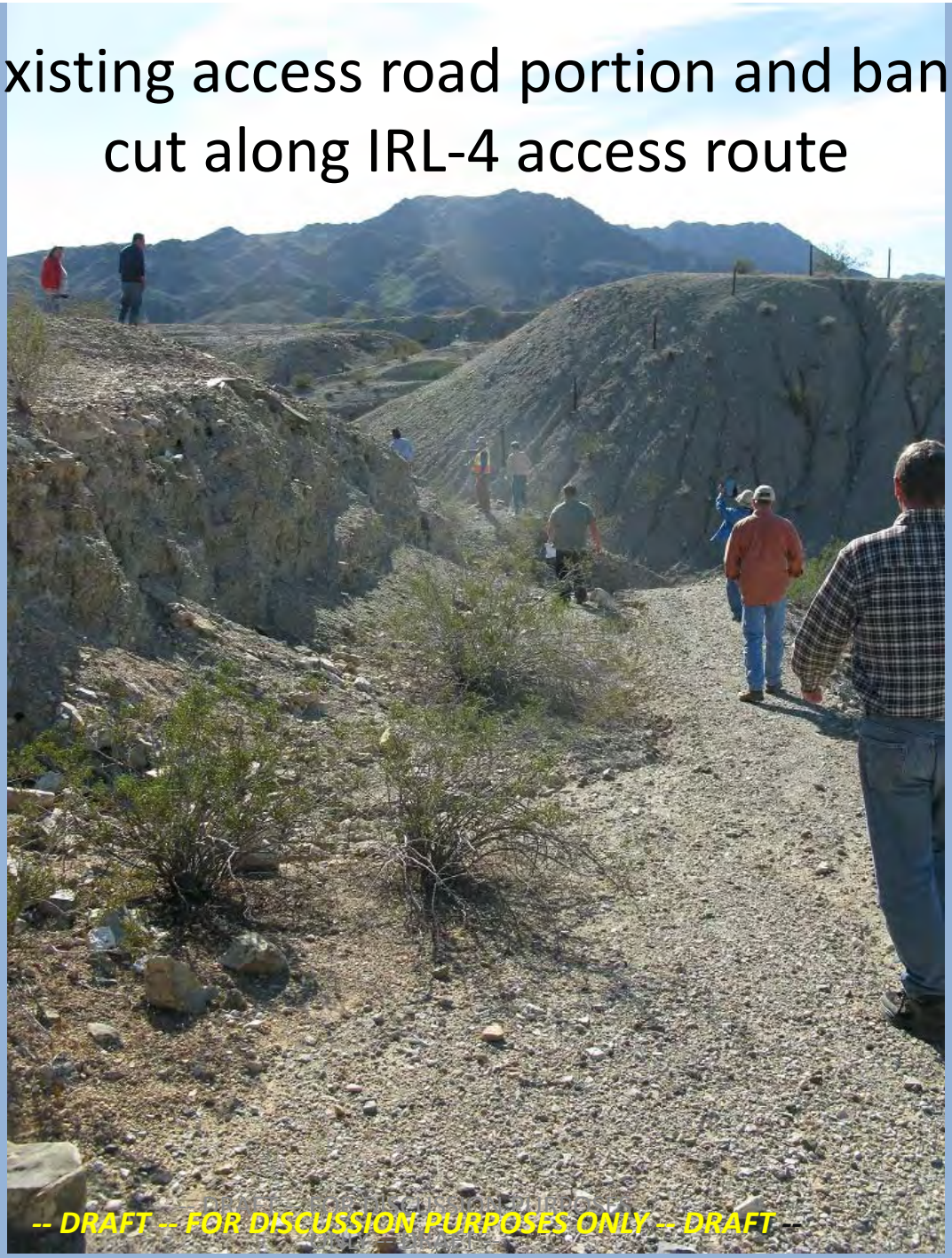
Pipeline H (to IRL-4)



Pipeline H (to IRL-4)



Existing access road portion and bank cut along IRL-4 access route



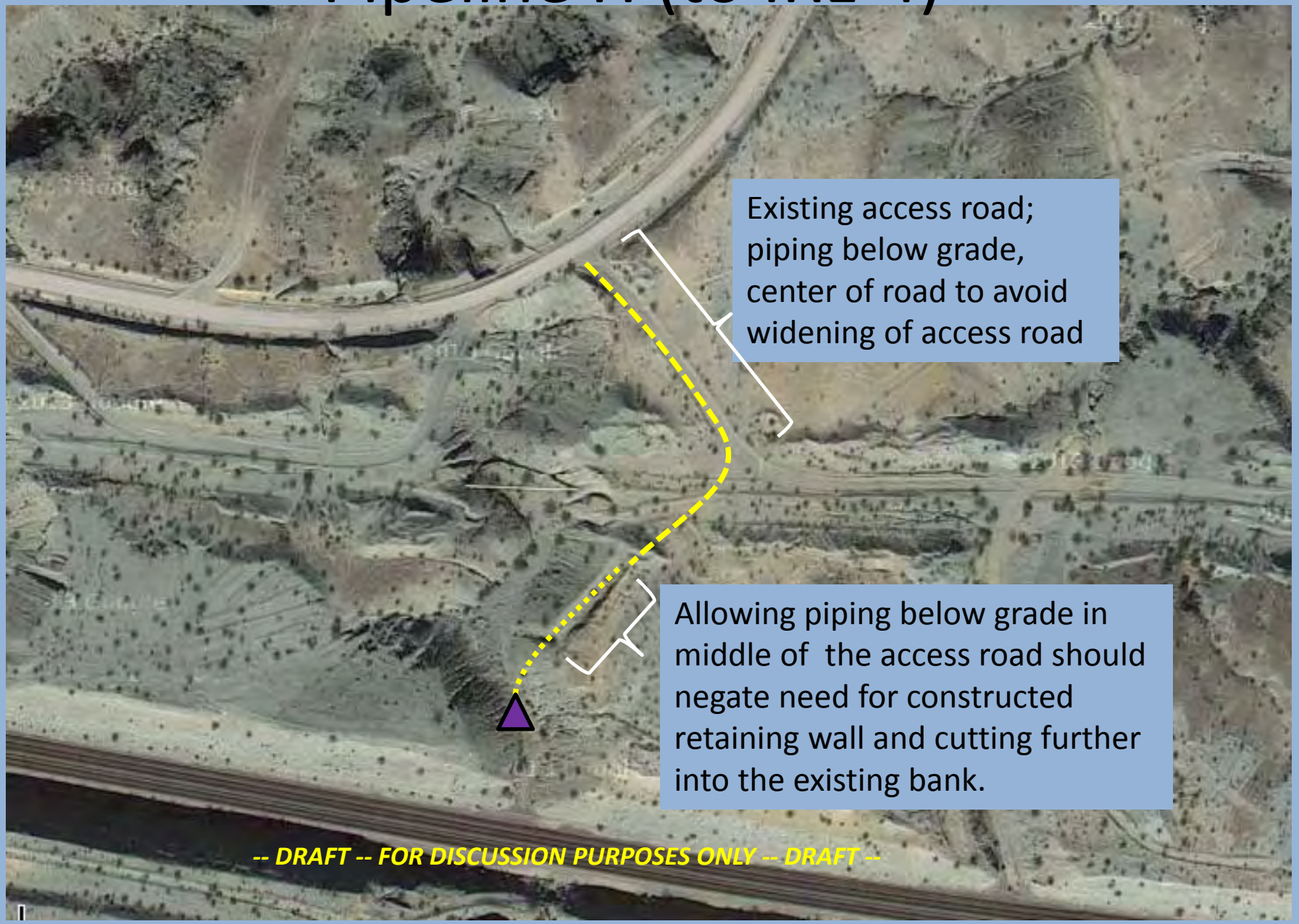
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Simulation of proposed retaining wall along existing bank down to IRL-4

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Pipeline H (to IRL-4)



Summary of Options for Pipeline H – access to IRL-4

- Existing access road is narrow. Installation of piping to IRL-4 within the center of existing access road should prevent encroachment of the road width into the adjacent landscape.
- Any construction of remaining access road down into wash to IRL-4 should be done along existing pathway using fill only.
- If piping running down to IRL-4 is located within the roadway, this should avoid construction of retaining wall, and minimize width of access and additional encroachment into existing bank.

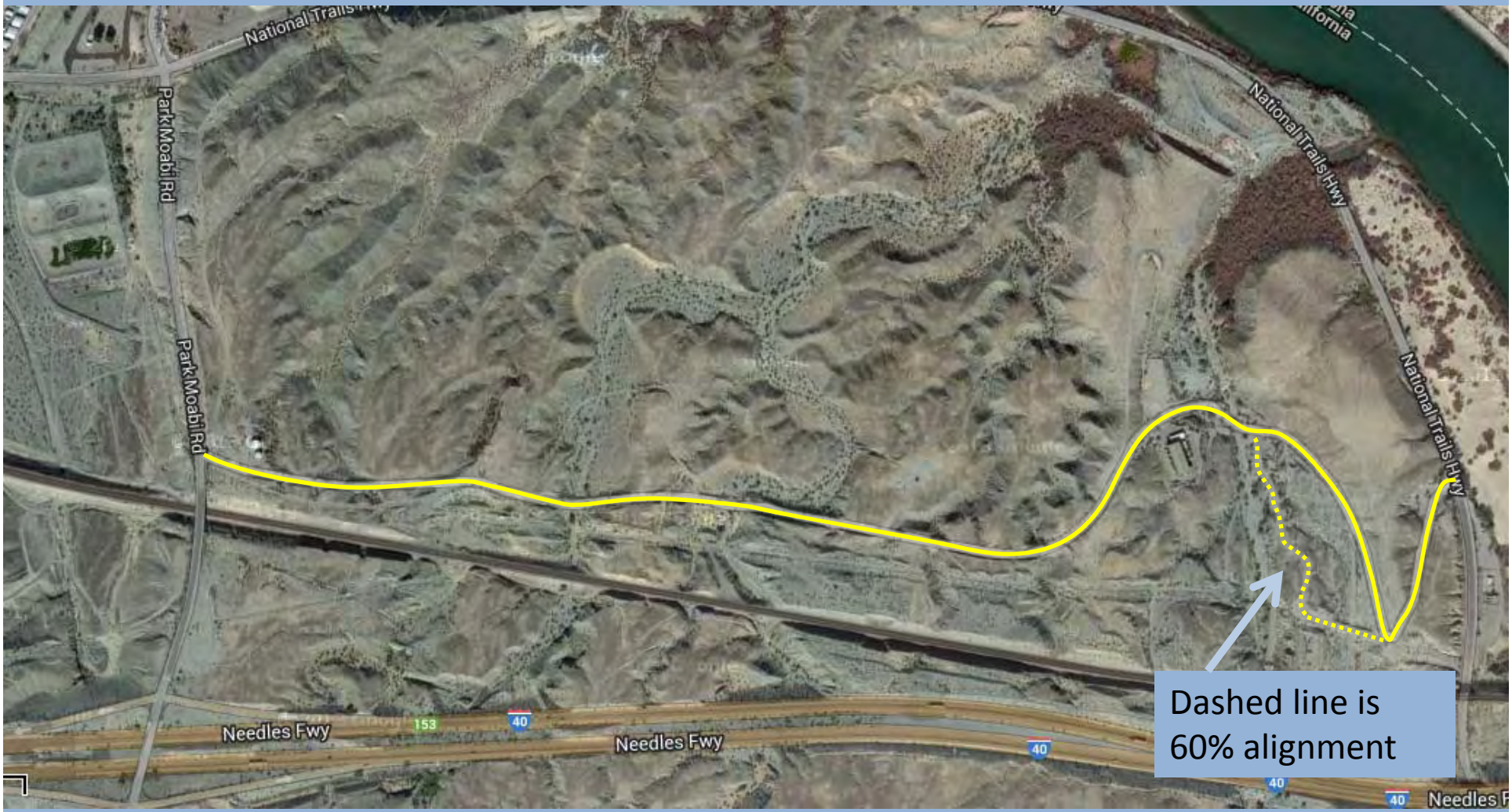
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Discussion regarding Segment 3 – Pipeline A

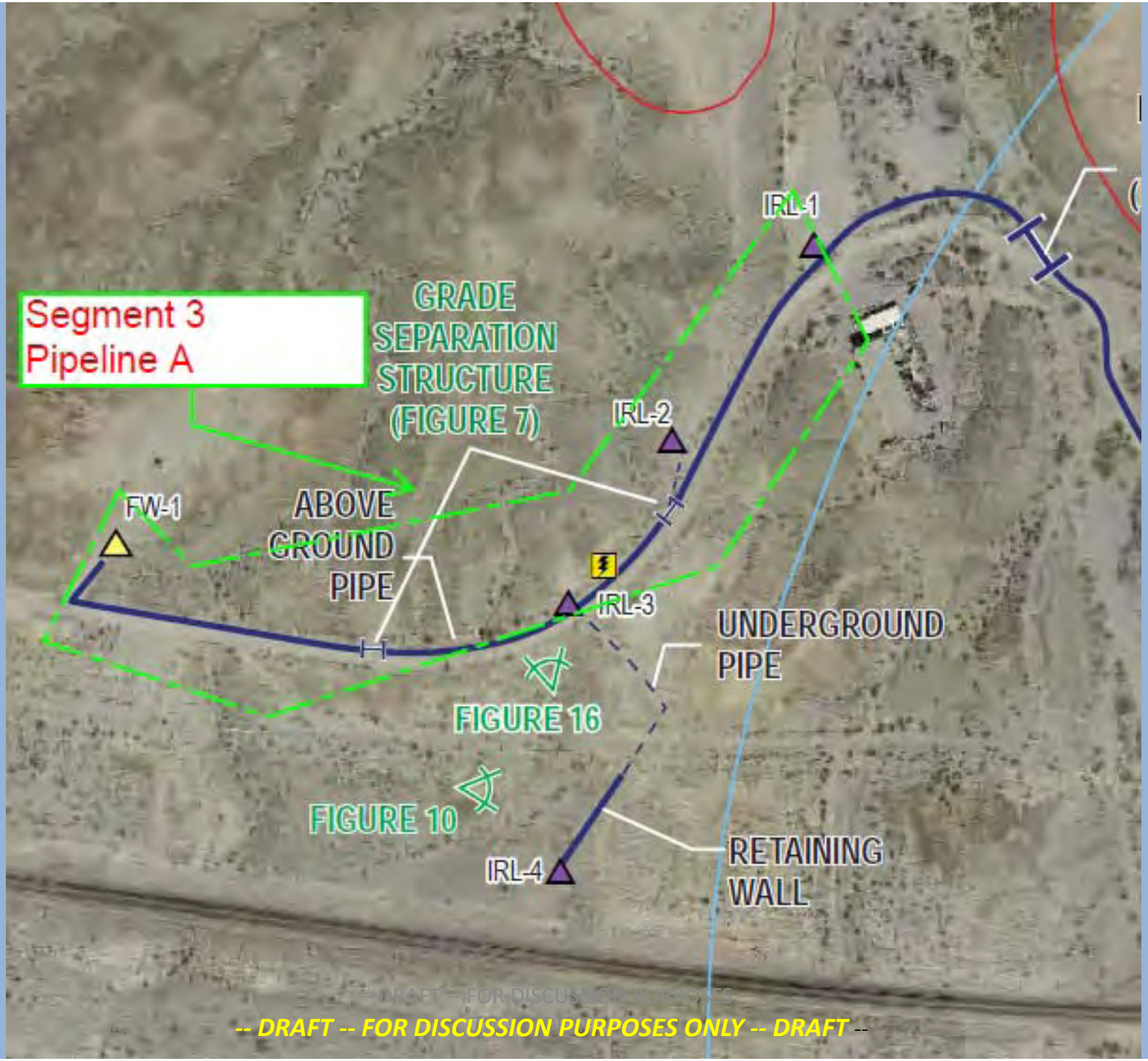
Route 66 from FW-1 to IRL-1

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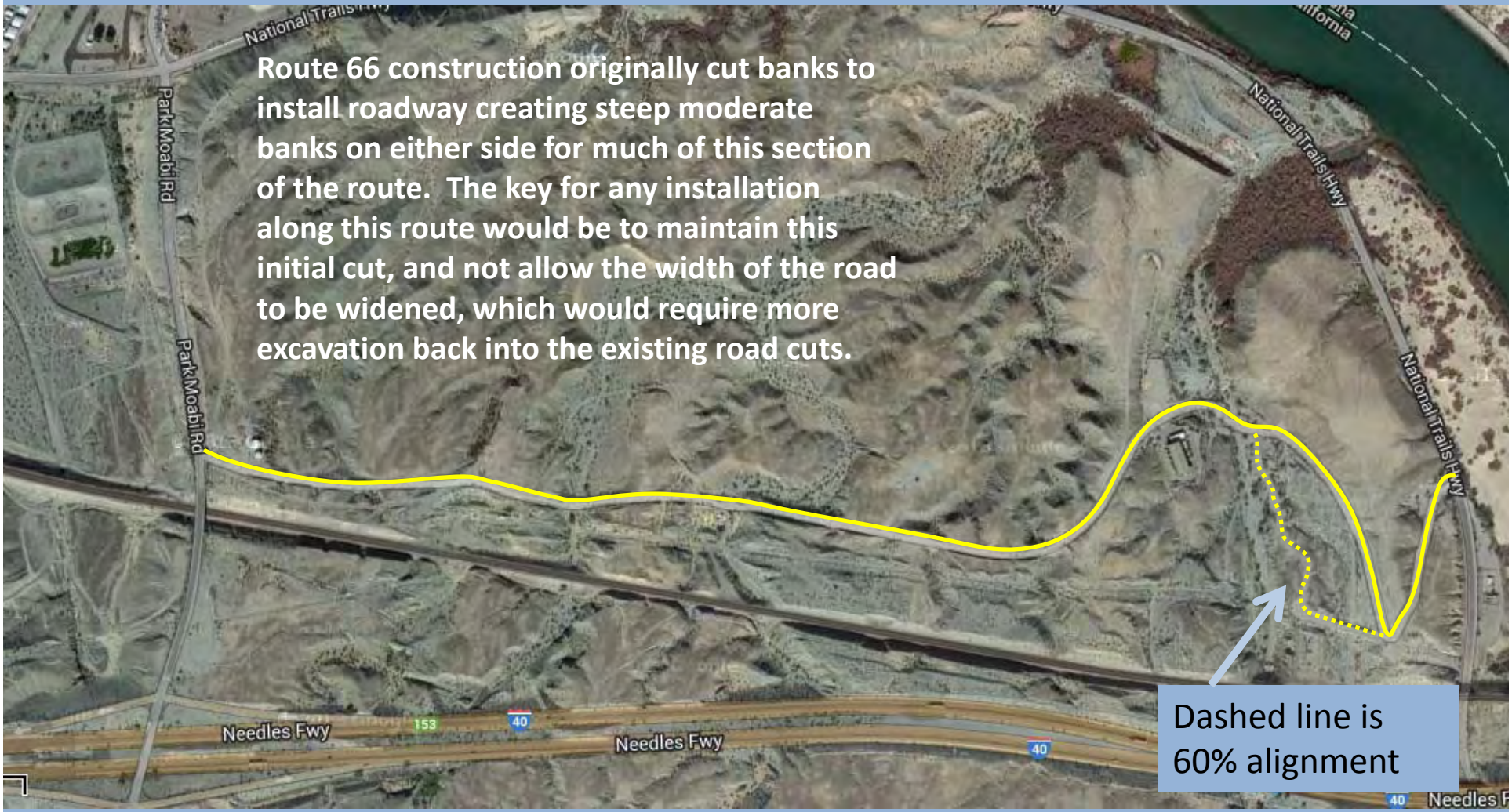
Discussion re Route 66 width/access



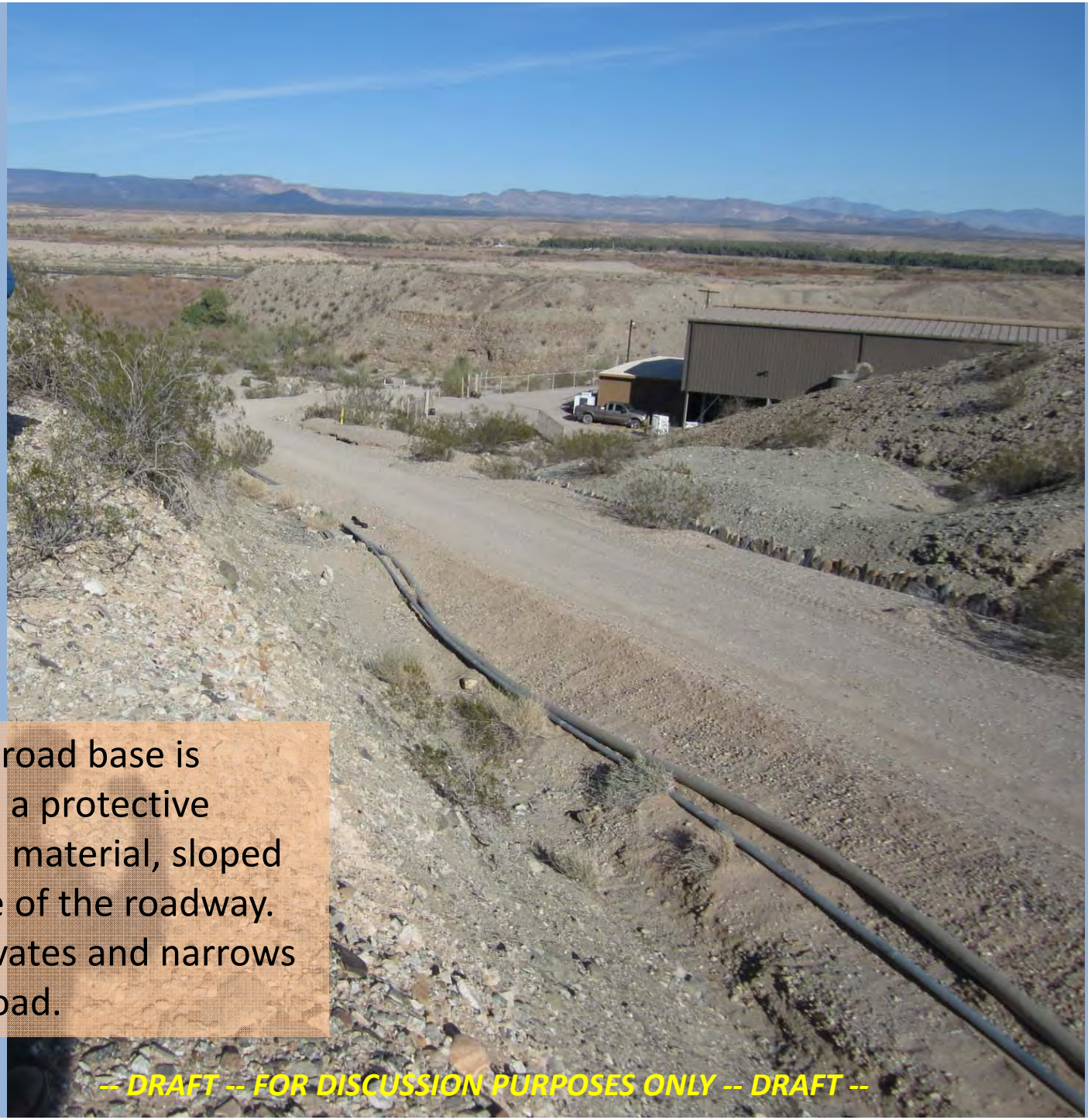
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Segment 3
Pipeline A
GRADE SEPARATION STRUCTURE (FIGURE 7)
IRL-1
IRL-2
FW-1
ABOVE GROUND PIPE
IRL-3
UNDERGROUND PIPE
FIGURE 16
FIGURE 10
IRL-4
RETAINING WALL
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Discussion re Route 66 width/access



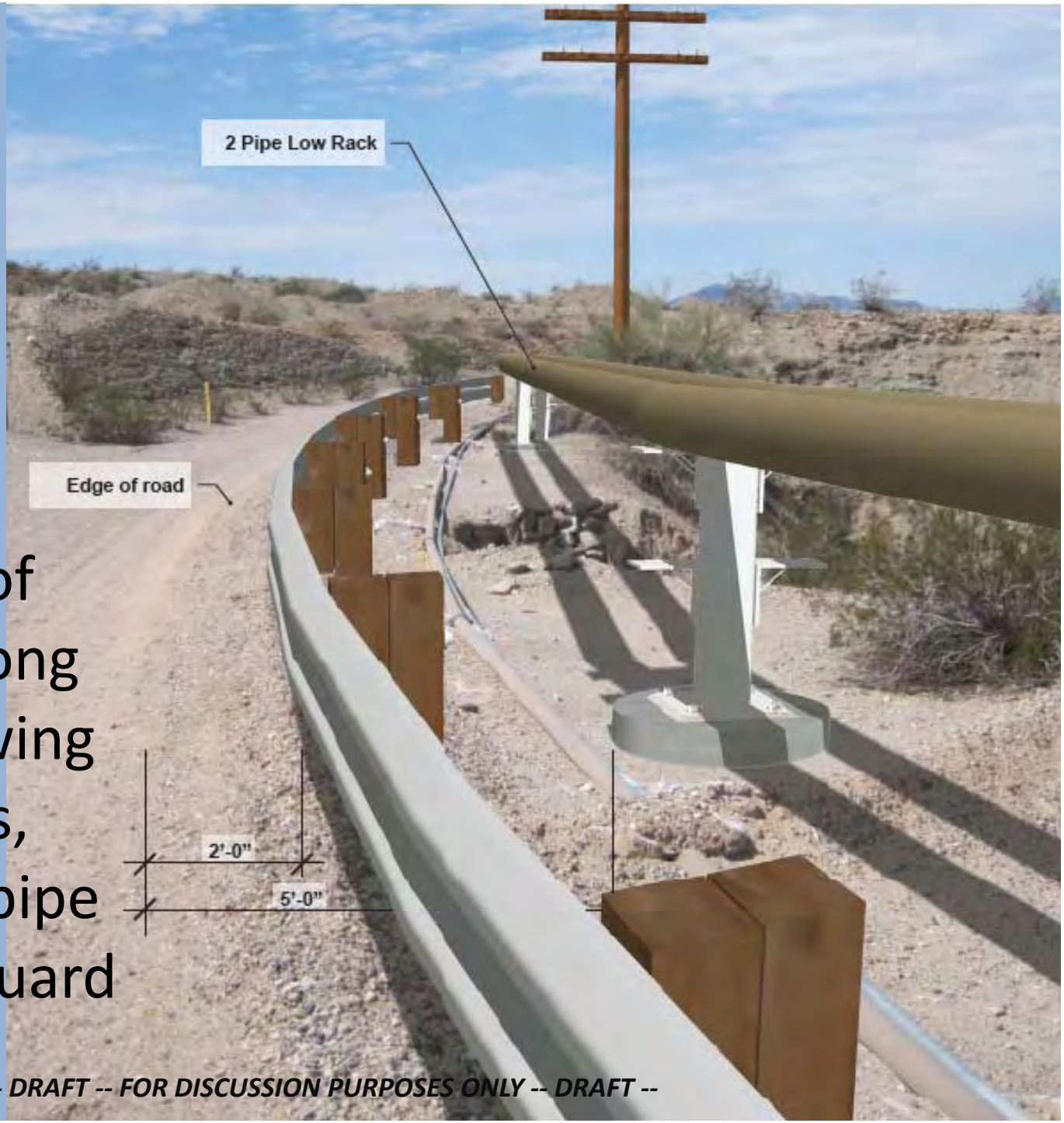
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Note original road base is covered with a protective textile and fill material, sloped on either side of the roadway. This both elevates and narrows the original road.

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Simulation of Segment 3 along Route 66 showing power poles, aboveground pipe supports and guard railing



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Discussion re Route 66 width/access



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COMMENT RESOLUTION PIPELINE SECTIONS A/H: ALTERNATIVE ROUTINGS & COMPONENT DESIGNS
BASIS OF DESIGN REPORT - INTERMEDIATE (60%) DESIGN
PG&E Topock Compressor Station, Needles, California

TECHNICAL COMMENTS OF THE TRIBAL TECHNICAL REVIEW TEAM

PURPOSE

This evaluation has been prepared for tribal consideration and discussion. If there is a consensus among the Tribal representatives that alternatives developed as part of this approach are preferred over corresponding components of the 60% design submittal by PG&E, then the Tribes may want to propose any or all of the recommended alternatives to the TWG.

CONTEXT

This evaluation is based primarily on technical and engineering reviews of the 60% BOD. Additionally there have been several site walks and discussions during the 60% design review and comment period during which the Tribes' technical review team has had the opportunity to view features in the field and to discuss issues with Tribal representatives and form overall impressions. Still, the Tribes' technical reviewers cannot speak to or fully understand the spiritual and cultural impacts of the proposed project. Nevertheless, the reviewers have endeavored to summarize the physical impacts that would be associated with construction of various design options. In particular, the team has noted that the Tribes seem to prefer designs that, to the extent practicable, a) preserve existing natural materials in-place, and b) avoid specific culturally significant areas. In a broader sense, the team understands that the Topock site is, in its entirety, a sacred landscape within the Mojave Valley. This evaluation attempts to emphasize both of these two considerations.

SCOPE

This evaluation provides a design process and design criteria that PG&E should use while developing the 90% design for pipeline sections A & H. Additionally, this evaluation provides analysis of alternative pipeline and electrical infrastructure routings for pipeline Sections identified in the 60% BOD report and design drawings. Alternative routings are presented for Pipeline Sections A and H. Analysis is presented for four segments of Pipeline A, and for Pipeline H:

- Segment 1 Pipeline A (See Figure): MW-20 Bench to Access Road routed parallel to Southwest Gas Pipeline easement north side (600 feet long)
- Segment 2 Pipeline A (See Figure): Access Road to IM-3 Plant along 60% BOD Report alignment
- Segment 3 Pipeline A (See Figure): 60% BOD Report alignment from IM-3 Plant to FW-1
- Segment 4 Pipeline A (See Figure): Alternative II TRC Routing Memo Access Road to IRL-4 Branch Pipeline H
- Pipeline H (See Figure): 60% BOD Report alignment from Pipeline A to IRL-4

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DESIGN PROCESS AND CRITERIA FOR PIPELINE SECTIONS A & H

Continuing through the present time, stakeholder and particularly Tribal input to the project design has been reactive, rather than collaborative. That is, one party does something and the other reacts. Then, the other party then counter-reacts. This continues until an agreement or impasse is reached. Thus, the process largely becomes piece-meal. Consider that, while the status of the project is being reported as 60% (intermediate design), the potential for having to reroute pipelines with all the attendant considerations of above- vs. below-ground, clearing rights of way, etc. essentially reverts the design to a significantly lesser completion status. To improve this process, it would be better if PG&E would engage in an ongoing collaborative dialogue during preparation of the 90% design. Specifically, we recommend an alternative collaborative approach for pipeline sections A & H, as well as for related infrastructure served by those pipeline sections, e.g., IRL-1 thru IRL-4 and monitoring wells in the vicinity. Basically, this would be a separate process from the current Response to Comment (RTC) process which by design is simply reactive. Not having upfront Tribal involvement in the actual ongoing design decisions is inefficient and unlikely to achieve reasonable resolution of the issues. During collaboration, the respective parties would sit down together in a facilitated setting and discuss the options and jointly craft the parameters of the design. This collaboration should include the agencies throughout the process .

With the above in mind, we recommend the following design criteria for pipeline sections A & H. These criteria should be applied to each and every system and subsystem for pipeline sections A & H.

- Minimize excavation, disturbances, and visual impacts, with areas of greatest sensitivity identified as cultural and spiritual areas identified by Tribes.

Examples of minimization might include but are not limited to:

- Where above-ground power is used, select line routing to minimize access roads, e.g., by installing poles at the margins of existing roadways, so that the poles can be installed and maintained with no need for access roads to minimize further encroachment into the landscape.
- If wells and related infrastructure can be installed in the middle of an existing roadway, that is preferable to constructing new access roads (e.g., IRL-2).
- If small changes in well locations lead to reduced excavation or area of disturbance, make those changes.
- Minimizing infrastructure on the upper mesa areas avoids proximity to culturally sensitive areas as well as visibility from these places of significance.

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Segment 1 Pipeline A





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Options for bringing piping up the slope alongside the existing large-diameter high-pressure Southern California gas pipeline are discussed below. This routing avoids the culturally sensitive area on the south end of Locus B.

Options for Segment 1 Pipeline A

A) Install water piping and electrical on slope, in a buried trench along north side of existing gas line trench	**B) Install water piping and electrical on slope, above ground**	**C) Install piping within 36-42" pipe installed using "direct piping" methods**
Structural components include: A1) Concrete boxes at base of embankment, top of embankment for valves, electrical pull boxes. A2) Pipeline and electrical trenches approximately 8.5 wide depth 4 to 6 feet A3) Electrical trench will include red concrete encasement around the high voltage line (approximately 1/2-foot by 1-foot). A4) drainage structures and erosion control may be required over and around vaults and structures. The burial depth would depend on detailed engineering of the slope to provide stable slope and minimize potential for pipe exposure.	Structural components include: B1) <u>structural pipe supports</u> (concrete footings ~10' deep into slope were suggested by CH_2MHill during the 12/27 site walk). With a slope length of approximately 200 lineal feet, supports will be required every 20 feet. B2) <u>access stairway</u> alongside aboveground pipes to allow maintenance and access to piping. Platforms every 40 feet. B3) <u>Drainage structures including:</u> basin/structure at the top of the slope to collect runoff, divert to buried pipes alongside structure, beneath NTH, and to culvert/erosion basin on flood plain B4) Vaults would be needed at either end. B5) discussion on 12/27 site walk indicated that this overall approach would likely require <u>additional cutting into slope on north side of gas line easement</u> in order to fit pipe supports, drainage structures, and access stairway <u>outside of</u> existing gas line easement. B5) Installation of ~40-foot power poles on 100 feet centers going up slope B6) Installation of pipe 2 boxes for Southwest Gas Pipeline Crossing.	Note this is a relatively new method for installing trenchless conduits. This method has been used in only a few projects so far in the US, it has been utilized mainly in Europe. it has not been confirmed with the contractors who do this type of work would be willing to bid on this particular job. (Note: traditional directional drilling does not appear possible due to cobbles & boulders, and the unconsolidated nature of geologic materials in this area.)

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Range of estimated soil removed for trenching: Given the assumption of 600 lineal feet and 8.5 feet wide and an average excavation depth of 4 to 6 feet assumptions, potential range of disturbed earth may range between 750 to 1130 cubic yards.	Range of estimated soil removed for approximately 600 lineal feet (200 ft. of slope and an additional 400 ft. to the west of the top of the slope). Footings for structural pipe supports: 40 cubic yards Footings for stairway support: Assuming for 4 concrete piers per platform and 2 supports between platform: 50 cubic yards Trenching/installation of drainage basin/pipes: 80 cubic yards Additional Trenching/installation of drainage beneath NTH, to storm water basin on flood plain: ~100 cu yds. Potential excavation into side of existing notch, into in-place bank soils to provide additional room for structures assuming 5 feet width and 3 foot of depth for 200 lineal feet: 110 cubic yards. Total estimated soil excavation: 280 cubic yards	Assuming beginning in the flood plain and boring beneath NTH and the existing slope/gas lines and daylighting beyond the top of the slope, approximately 400 west of the top of slope; assuming 42" piping conduit installed: 220 cubic yards The work areas required for mobilization and construction of the 42" conduit would be quite large and damaging, as use of a tunnel boring machine (TBM) requires extensive work area to lay out the equipment and drill string. These drilling cuttings would be mixed with some sort of drilling fluid, so would not be able to be reused on site, at least not without further dewatering, and possible other processing.
Removal/Demo issues: Trench could be dug out to remove piping – either for repair or replacement during the project life, or for decommissioning.	Removal/Demo issues: Above grade structures such as stairway, pipe supports and piping could be removed. Deep concrete footings for these structures could be excavated and removed, but it would be difficult achieve structurally stable soil compacting in the excavations to prevent erosion. Buried drainage pipes could be excavated and removed.	Removal/Demo issues: Once installed, the outer 36-42"casing installed using this method could NOT be removed. Piping running inside the casing could be pulled out for repair, replacement or decommissioning.

SUMMARY EVALUATION for SEGMENT 1, PIPELINE A : These options to the PG&E 60% BOD Report approach offer positive modifications which help avoid specific areas, reduce the length of the infrastructure and overall excavation volume, and avoid much of the upper mesa that would have been traversed for implementation of the original 60% BOD Report approach. One issue that needs to be resolved is that of the right of

way associated with the existing gas pipeline. This would determine whether the new pipelines could be placed within the area of the existing disturbance or whether they need to be moved further north into areas where soils have not been previously disturbed.

Option C (direct piping) is not considered viable because it introduces a large, permanent disturbance to the subsurface at the site. In addition, mobilization and work areas required for the construction of the 42" conduit could be quite large and damaging. Also, there is considerable uncertainty associated with viability of this option.

Analysis of the volumes of potentially excavated soils suggests that, although the stairway, pipe rack and drainage (Option B) would create a lot of disturbance, it would still result in a lesser volume of disturbed soil than required to construct the large trench needed piping and electrical. This seems to stay true even if up to 5-feet of the existing bank needs to be cut into to widen existing gas pipeline easement notch. Even if the side bank excavation needed to be wider, the massive dimensions of the anticipated trench (est. 7 to 8.5 feet wide, 4 to 6 feet in depth) still makes the above-grade scenario the lesser of the two with respect to volume of natural soils that would need to be removed. The Tribes may wish to also take into consideration issues related to the potential nuisance associated with public access to the mesa area adjacent to Locus B. The Tribes may wish to recommend omitting the proposed maintenance staircase in favor of alternative ways for personnel to inspect and maintain the pipes. This is supported by the fact that the purpose of the stairway access would primarily be for visual inspection. Significant or frequent "hands on" maintenance would presumably (and hopefully) not be required.

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Note that for the segments where there is electrical, this may be conveyed in a trench with the rest of the piping if in a trench, or aboveground using telephone poles. One suggested alternative requires power to the segment between IRL-1 and IRL4 be provided by the City of Needles. The expressed desire of PG&E is that all power for the remedy be provided by the compressor station itself.

Options for Segment 2 Pipeline A (60% BOD Report Routing)

A) Install Pipeline per 60-% BOD Report design approach	**B) Install water piping below grade and electrical above-grade**	**C) Install water piping and electrical above-grade. Install guard rail and grade separation structures**
Structural components include: A1) Pipeline and electrical trenches approximately 7 to 8.5 wide depth 3 to 4 feet per the basis of design report A2) Northern aerial crossing of Bat Cave Wash A3) Buried electrical lines [[A1=maximum excavation]] [[A2=B2=C2 (aerial crossing same for all]] Range of Excavation for trenching: [[10'*8.5'*4'= 12.6 cu yds 10'*7'*3'= 7.8 cu yds]]	Structural components include: B1) Pipeline trenches approximately 6 to 7 wide depth 3 to 4 feet per the basis of design report B2) Northern aerial crossing of Bat Cave Wash B3) Above grade electrical lines and control on poles ~40-foot power poles on average of 100 feet centers B4) Potential for access roads to power poles depending upon location. . The final specific spacing and location of power poles is highly relevant as it directly impacts disturbance related to installation and maintenance of the electric lines. [[B1=A1 LESS electrical trench volume, but adds unknown potential access roads and pole installation auger holes]] Range of Excavation for trenching for comparison: [[10'*7'*4'= 10.4 cu yds (~82% of A1 version) 10'*6'*3'=6.7 cu yds (~85% of A1 version)]]	Structural components include: C1) structural pipe supports (concrete footings ~2' diameter 6' deep into based by CH2M conceptualizations) spaced 20 feet on center C2) Northern aerial crossing of Bat Cave Wash. C3) Above grade electrical lines and control on poles ~40-foot power poles on average of 100 feet centers C4) Potential for access roads to power poles depending upon location. C5) Installation of W-style guard rail; assumes post imbedded 4 feet every 6 feet.
Range of estimated soil removed for trenching: Given the assumption of 100 lineal feet and	Range of estimated soil removed for trenching and poles: Given the assumption of 100 lineal feet and 6	Range of estimated soil removed for guard rails, supports and poles: Given the assumption of 100 lineal feet:

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8.5 feet wide and an average excavation depth of 3 to 4 feet assumption, potential disturbed earth would be 100 cubic yards per 100 feet of pipeline and electrical.	feet wide and an average excavation depth of 3.5 feet assumption, potential disturbed earth would be 70 cubic yards per 100 feet of pipeline and electrical. Disturbance associated with power poles would be less than a 0.2 cubic yards per pole, but does not include access roads for power poles. Aboveground electric lines also eliminates the need for red concrete trench liner mandated for buried electrical lines	Disturbance associated with power poles would be less than 0.2 cubic yards per pole, but this does not include access roads for power poles. Disturbance associated with pipe supports are 3.5 cubic yards per 100 feet. Disturbance associated with guard rail is 1 cubic yard per 100 lineal feet. Greater area may be need to be disturbed if road needs to be widened. [[Should note that a) this caveat may be significant, and b) likely that any road widening would cut into in-place roadside materials, c) closing the Route 66 segment to public traffic should reduce but may not eliminate the need for road widening]]

SUMMARY EVALUATION for SEGMENT 2, PIPELINE A : Above-ground electrical infrastructure would require a lower volume trench excavation, eliminate the need for red-concrete, as compared with the original 60% BOD. Nevertheless, the overall the trench excavation is massive for both Options A & B. If considering the amount of material excavated alone, the above-ground installation (Option C) is much less impactful than either trenching scenario. Other factors regarding the impacts of the above-ground scenario that should be considered by the Tribes include that the placement of power poles, above-ground pipe supports, guard rails, and multiple access roads (to power poles). Collectively, these could result in more encroachment onto the undisturbed landscape. The largest unknown factor will be the degree and location where the road may need to be widened to accommodate both vehicle traffic and the aboveground alignment of pipe supports, guard rail, and power poles.

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Options for Segment 3 Pipeline A

A) Install Pipeline per 60% BOD Report Structural components include: A1) Pipeline and electrical trenches approximately 7 to 8.5 wide depth 3 to 4 feet per the 60% BOD Report A2) Buried electrical lines Range of Excavation for trenching: [[10'*8.5'*4'= 12.6 cu yds 10'*7'*3'= 7.8 cu yds]]	**B) Install water piping below grade and electrical above-grade** Structural components include: B1) Pipeline trenches approximately 6 to 7 wide depth 3 to 4 feet per the basis of design report B2) Above grade electrical lines and control on poles ~40-foot power poles on average of 100 feet centers. The final, specific spacing and location of power poles is highly relevant as it directly impacts disturbance related to installation and maintenance of the electric lines. B3) Potential for access roads to power poles depending upon location Range of Excavation for trenching for comparison: [[10'*7'*4'= 10.4 cu yds (~82% of A1 version) 10'*6'*3'=6.7 cu yds (~85% of A1 version)]]	**C) Install water piping and electrical above-grade. Install guard rail and grade breaks.** Structural components include: C1) <u>structural pipe supports</u> (concrete footings ~2' diameter 6' deep into based by CH2M conceptualizations) spaced 20 feet on center C2) Above grade electrical lines and control on poles ~40-foot power poles on average of 100 feet centers C3) Potential for access roads to power poles depending upon location. C4) Two grade separation structures for access across pipeline (could be above or below grade. Above grade would require pipe bridge for vehicle access across. Below grade would include two pipe vaults and underground trench between vaults) C5) Installation of W style guard rail; assumes post imbedded 4 feet every 6 feet. Road widening could result from detailed engineering of guard rail system and additional area of disturbance.
Range of estimated soil removed for trenching: Given the assumption of 100 lineal feet and 8.5 feet wide and an average excavation depth of 3 to 4 feet assumption, potential disturbed earth would be 100 cubic yards per 100 feet of pipeline and electrical.	Range of estimated soil removed for trenching and poles Given the assumption of 100 lineal feet and 6 feet wide and an average excavation depth of 3.5 feet assumption, potential disturbed earth would be 70 cubic yards per 100 feet of pipeline and electrical. Disturbance associated with power poles would be less than a 0.2 cubic yards per pole, but does not	Range of estimated soil removed for trenching and poles Range of estimated soil removed for guard rails, supports and poles Given the assumption of 100 lineal feet. Disturbance associated with power poles would be less than a 0.2 cubic yards per pole, but does not include access roads for power poles. Disturbance associated with pipe

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	include access roads for power poles.	supports are 3.5 cubic yards per 100 feet. Disturbance associated with guard rail is 1 cubic yard per 100 lineal feet. Greater area may be need to be disturbed if road needs to be widened.
Removal/Demo issues: Above grade structures panels could be removed. Buried pipes and electrical conduit could be excavated and removed. Area would need to be backfilled with appropriate material. Dyed concrete would require removal.	Removal/Demo issues: Above grade structures panels, power poles could be removed. Buried pipes and pole footings could be excavated and removed. Area would need to be backfilled with appropriate material	Removal/Demo issues: Above grade structures panels, pipe, pipe supports, power poles, and guard rails could be removed. Pipe support and pole footings could be excavated and removed. Area would need to be backfilled with appropriate material

SUMMARY EVALUATION for SEGMENT 3, PIPELINE A: Although above-ground electrical infrastructure would result in a lower volume trench excavation, eliminate the need for red-concrete, overall, the trench excavation is massive for both Options A & B. If considering the amount of material excavated for trenching alone, the above-ground installation (Option C) appears much less impactful than either trenching scenario.

However, this section of Route 66 is generally narrow, and in many places bordered by a drop off, or a several-foot high cut slope/embankment. These features were likely created when the original Route 66 roadway was cut into the landscape. Therefore, along this segment, the width of the roadway is constrained on both sides by topographic changes, and also by the buried relatively small-diameter Southwest Gas pipeline which runs along the south side of the road. The present width of the roadway is probably narrower than the original roadways as a result of the emplacement of the thick layer of aggregate that PG&E has placed on top of the road to protect the road bed.

To allow for the installation of above-ground pipes and protective guard rails, PG&E has stated that, along some portions of this segment, the road must be widened to allow for the above-ground infrastructure in conjunction with 2-way public traffic. It has been indicated that this would be required by the County of San Bernardino since this is a "public road." Unfortunately, the degree to which additional slope cuts would be necessitated to accommodate above ground piping has not been evaluated since this alternative was not part of the 60% design. Any expansion of the original roadway cuts could result in large volumes of native materials being excavated, and also significant changes in the topography along the roadway. This represents the largest unknown factor since there is no specific design to indicate the degree and location where the road may need to be widened to accommodate both vehicle traffic and the aboveground alignment of pipe supports, guard rail, and power poles.

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Other factors that the tribes may wish to consider regarding the impacts of the above-ground scenario include that the placement of power poles, above-ground pipe supports, guard rails, and multiple access roads (to power poles) could collectively result in more encroachment onto the undisturbed landscape.

It may be difficult for the Tribes to be able to weigh the various options when there remains so much uncertainty as far as how a given option will be implemented at this point in time. However, it may be possible to provide a set of construction and/or design constraints which could be used to move the design forward along this segment, while limiting potential damage:

- Since additional slope cuts would be required, mainly due to road width requirements, anything that would reduce the required width could also limit further potential road cuts. There have been two suggestions, 1) to close this road from just west/south of IM-3 out to Park Moabi road. This would mean locked gates at each end. PG&E voiced significant concerns regarding access to this route as there are various maintenance crews which inspect/work on the gas lines and require access. This may be addressed by an automated gate such that any service crews would need to get out of the vehicle to lock or unlock the gate. 2) a simpler suggestion may be to simply make this road 1-way from IM-3 out to Park Moabi road. This should result in a narrower road width requirement, which could hopefully mean little or no additional road cuts in the existing slopes.
- The Tribes could request that, when designing the short access roads, such as up to IRL-2, only fill material be used, and no additional excavation or road cuts be made to the extent possible.

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Tribal Option for Segment 4 Pipeline A

A) Install water pipeline above-grade and electrical above-grade from top of slope at east end to pipeline section H; control via radio. (The route in the existing 60% BOD Report follows existing Route 66 alignment all the way out to NTH, bisecting the southern portion of Loci B, and the approach is to put everything underground.) Structural components include: A1) Concrete valve boxes (vaults) at underground crossings of gas lines or access roads. A2) Pipeline supports spaced on 20 foot centers A3) Two pipeline bridges, one 330 feet across Bat Cave Wash, one 280 feet east of Bat Cave Wash A4) One grade separation structure west of Bat Cave Wash		
Range of estimated soil removed for Bat Cave Wash bridge: The western bridge landing based on conversations on 12/27/13 in the field would require removal of part of a slope on the southern side of the Southern California Gas Company pipeline easement to provide separation from the pipeline. Soil removal amounts would be in the hundreds of cubic yards but detailed engineering would be necessary to evaluate.		

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Removal/Demo issues: Above grade structures such as bridges, pipe supports and piping could be removed. Deep concrete footings for bridge structures may be left in place or removed by breaking and removing concrete and digging out footings. Grade would be restored by installation of backfill in the footings.		

SUMMARY EVALUATION for SEGMENT 4, PIPELINE A: While this is listed as single-option segment, there is another option that could be followed, with above-ground infrastructure, the proposed 60% BOD Report pipeline section A alignment from the western end of Segment 1, discussed above, to the eastern end of Segment 2, also discussed above. We provide this option, because it will likely be less-intrusive, visually. If City of Needles' power is used for IRL-1 thru IRL-4 and FW-1, there would be no power poles along this segment. If PG&E provides its own power, power poles would be required. One pipeline bridge would be eliminated, and the Bat Cave Wash pipeline bridge would be moved to a lower elevation and farther to the north. We anticipate that considerably less excavation and ground disturbance would be required. PG&E would likely need to close the road or convert it to one-way traffic in order to fit the above-ground infrastructure onto the edge of the existing roadway.

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Options for connection of groundwater pipelines from IRL-3 to IRL-4. The 60 % BOD Report alignment is along a narrow access road that has culturally sensitive land on each side, so it is imperative to prevent additional disturbance which would be caused by widening the access road. A buried pipeline and conduits through this section would minimize the footprint in this area.

Options for Pipeline H

A) Install Pipeline and electrical based on 60-% BOD Report design but aligned in the center of the existing access road and the newly extended road to IRL-4 Structural components include: A1) Buried electrical and control conduits and water pipelines from IRL-3 to IRL-4 A2) Pipeline and electrical trenches approximately 7 feet wide depth 3 to 4 feet A3) Electrical trench will include red concrete encasement around the high voltage line (approximately 1/2-foot by 1-foot). A4) Grading of access road from mesa to IRL-4 location, using existing cut slope. This alternative would be attractive if the retaining wall going to IRL-4 could be eliminated and the trench could be installed in the new access road that would be constructed down to IRL-4.	**B) Install Pipeline and electrical based on 60-percent BOD design but aligned in the existing access road and transition to above-grade along the newly extended road to IRL-4. Install retaining wall along access road.** Structural components include: B1) Buried electrical and control conduits and groundwater pipelines from IRL-3 to new access road to IRL-4 B2) Above ground-electrical and control conduits and groundwater pipelines along new access road to IRL-4. B3) structural pipe supports (concrete footings ~2' diameter 6' deep into based by CH2M conceptualizations) spaced 20 feet on center B4) Above-ground electrical lines and control on poles ~40-foot power poles on average of 100 feet centers B5) Installation of W style guard rail; assumes post imbedded 4 feet every 6 feet. Road widening would probably result from detailed engineering of guard rail system and additional area of disturbance. B6) Install approximately 90 feet of retaining wall, cut back undisturbed slope approximately 6-8 feet.	

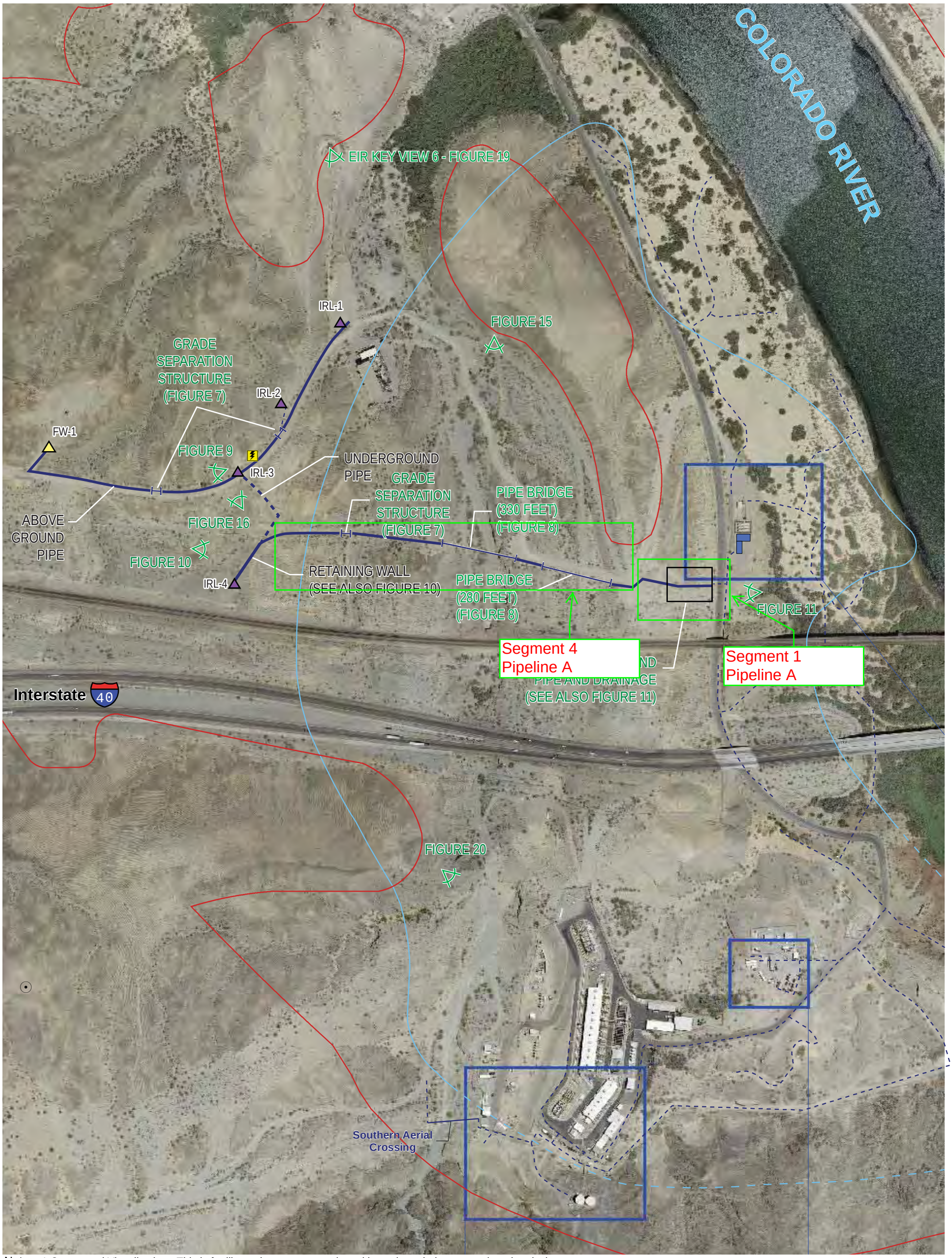
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Range of estimated soil removed for trenching: Given the assumption of 100 lineal feet and 7 feet wide and an average excavation depth of 3.5 feet assumption, potential disturbed earth would be 90 cubic yards per 100 feet of pipeline and electrical.	Range of estimated soil removed for trenching: For the below grade section given the assumption of 100 lineal feet and 7 feet wide and an average excavation depth of 3.5 feet assumption, potential disturbed earth would be 90 cubic yards per 100 feet of pipeline and electrical. The retaining wall would take a minimum 200 cubic yards of disturbance, approximately double the volume of disturbance resulting from the buried pipeline.	
Removal/Demo issues: Trench could be dug out to remove piping and dyed concrete.	Removal/Demo issues: Above grade structures panels, pipe, pipe supports, power poles, and guard rails could be removed. Retaining wall would not likely be removed since it would protect the access road to IRL-4. If road removed then the wall could be re-contoured and re-vegetated. Pipe support and pole footings could be excavated and removed. Area would need to be backfilled with appropriate material	

SUMMARY EVALUATION for SEGMENT H: The narrow width of the existing one-lane access road, and existing embankment where road would be built to provide access down to IRL-4 does not appear to allow for both vehicle access and above grade piping and supports. The additional width would also require a retaining wall on the existing cut slope, and more slope cutback to provide safe wide enough access for field vehicles. It appears clear that the Tribes may wish the foot print of activity in this area to remain strictly constrained to the existing dirt road, therefore, in this instance placing the water pipes in the center of the access road for segment H may be preferable in order to prevent additional encroachment in this area.

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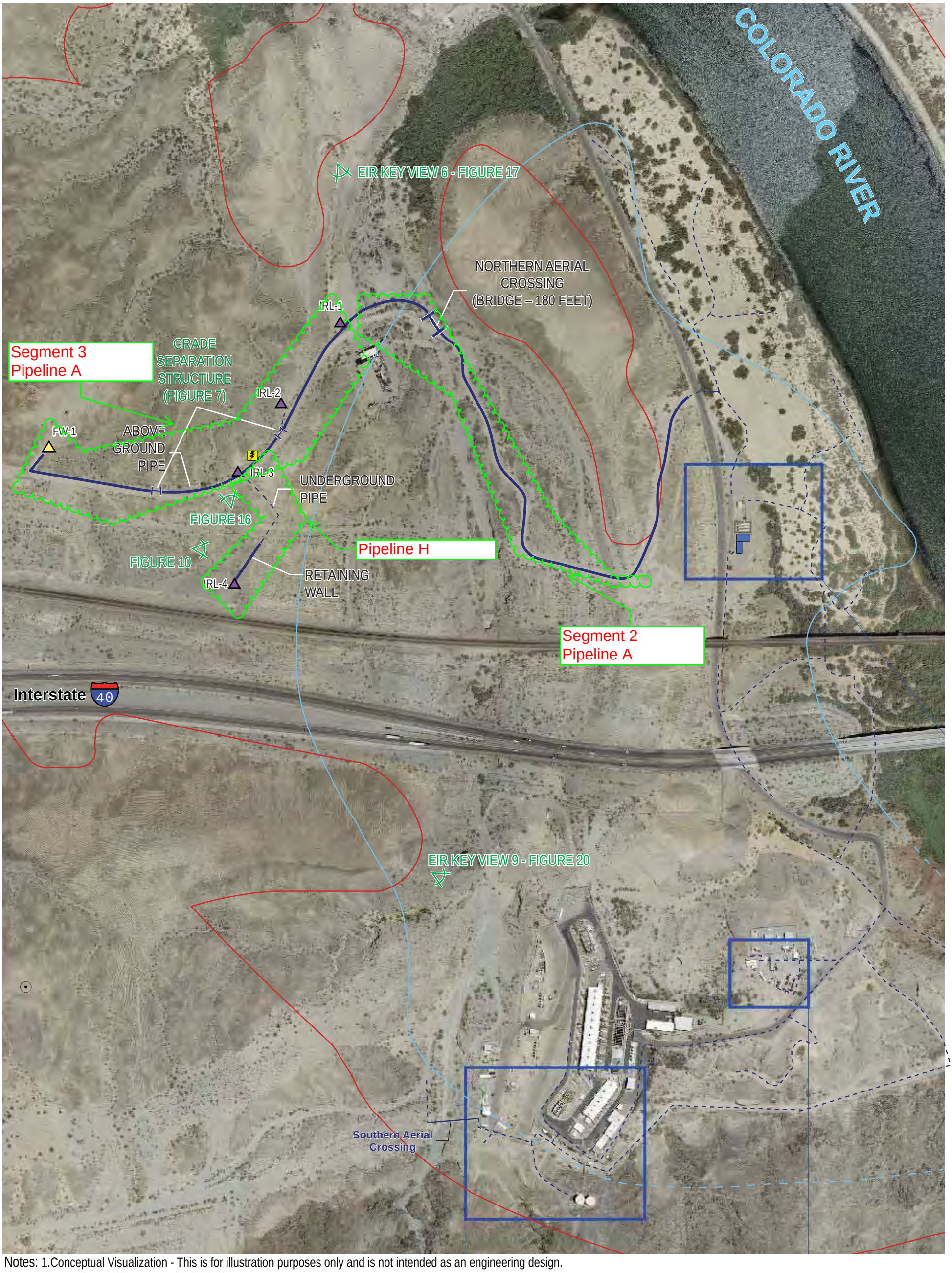
Notes: 1.Conceptual Visualization - This is for illustration purposes only and is not intended as an engineering design.
2. See Figure 5 for Overhead Electical.

LEGEND

- EIR Project Area
- Approximate extent of hexavalent chromium [Cr(VI)] concentrations exceeding 32 micrograms per liter (µg/L) at any depth in groundwater based on fourth quarter 2011 sampling events. Dashed where based on limited data.
- Freshwater Injection Well
- Injection Well (Inner Recirculation Loop)
- Proposed Electrical Transformer Location

FIGURE 4
PIPELINES A/H ALTERNATIVE ROUTE 2 (ALTERNATIVE 2)
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

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Notes: 1.Conceptual Visualization - This is for illustration purposes only and is not intended as an engineering design.
2. See Figure 5 for Overhead Electical.

LEGEND

- EIR Project Area
- Approximate extent of hexavalent chromium [Cr(VI)] concentrations exceeding 32 micrograms per liter (µg/L) at any depth in groundwater based on fourth quarter 2011 sampling events. Dashed where based on limited data.
- Freshwater Injection Well
- Injection Well (Inner Recirculation Loop)
- Proposed Electrical Transformer Location

FIGURE 2
PIPELINES A/H CURRENT ROUTE ABOVE GROUND (ALTERNATIVE 0a)
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

HARGIS + ASSOCIATES, INC.
HYDROGEOLOGY • ENGINEERING

7400 North Oracle Road, Suite 202
Tucson, AZ 85704
Phone: 520.881.7300
Fax: 520.529.2141

VIA ELECTRONIC MAIL

March 6, 2014

Mr. Aaron Yue
Topock Project Manager
DEPARTMENT OF TOXIC SUBSTANCES CONTROL
5796 Corporate Avenue
Cypress, California 90630

Ms. Pamela S. Innis
Topock Remedial Project Manager
Office of Environmental Policy and Compliance
U.S. DEPARTMENT OF THE INTERIOR
P.O. Box 25007 (D-108)
Denver, Colorado 80225-007

Re: Fort Mojave Indian Tribe Comments on Alternative Pipeline Routings and Proposed Soil Storage/Staging Areas for the Topock Compressor Station 60% Groundwater Remedy Design

Dear Mr. Yue and Ms. Innis:

Hargis + Associates, Inc. ("H+A"), on behalf of and at the request of its client, the Fort Mojave Indian Tribe ("the Tribe" or "FMIT"), is hereby providing this letter regarding the Tribe's review of alternative pipeline routings for the Topock Compressor Station 60% groundwater remedy design (Enclosure A).

As you are aware, these alternative routings have been the subject of discussion at recent meetings of the Technical Working Group ("TWG") and, most recently, the FMIT along with representatives of the Hualapai, Colorado River Indian Tribes, and Cocopah, performed a site walk on February 21, 2014, during which tribal representatives and their technical consultants conferred on the acceptability of these various alternatives. The FMIT was represented by nine Tribal members including a member of Tribal Council. Afterwards, the FMIT members conferred and completed the enclosed matrix providing the Tribe's position on each of the various segments along the pipeline route (Enclosure A). This information is being provided as the Tribe's final comments on the 60% design, with the understanding that you will be directing the Pacific Gas & Electric Company ("PG&E") to take this information into consideration during the preparation of the 90% Basis of Design. The matrix also assumes that any construction or deconstruction would be done in the least impactful manner and in consultation with the Tribe.

Additionally, the Tribe is also presenting herein its position on the various staging and soils storage areas proposed by PG&E (Enclosures B & C). Please find an attached matrix addressing those preferences. Please note that on the matrix, there are several sites for which the Tribe has outstanding questions. Therefore, before the Tribe can determine the final acceptability of these sites, answers to these questions need to be provided to the Tribes.

Finally, the Tribe wishes to add that the comments and preferences as expressed herein do not in any way constitute an endorsement or acceptance of the design as originally presented or as potentially modified by these alternatives. For as you have repeatedly been made aware, many of the adverse impacts associated with this project are permanent and irreversible.

Thank you in advance for consideration of these comments. Please contact me if you have further questions.

Sincerely,

HARGIS + ASSOCIATES, INC.



Leo S. Leonhart, PhD, PG, CHG
Principal Hydrogeologist

LSL/keh

Enclosures: A -FMIT Pipeline Segment Analysis
B - Soils Staging / Construction Areas FMIT Comment Table
C – Staging Areas Map

cc w/encl: C. Coyle
C. Garcia, FMIT
K. Liebhauser, BLM
N. McDowell, FMIT
L. Otero, FMIT
T. Williams, FMIT
Tribal Representatives for Hualapai, CRIT, Chemehuevi, Cocopah

ENCLOSURE A

FMIT PIPELINE SEGMENT ANALYSIS

PIPELINE SEGMENT ANALYSIS

PIPELINE POINTS (Segment Description)	ABOVE/BELOW GROUND	CONDITIONS OF USE COMMENTS
A TO B (NTH near MW20 Bench, access upslope to top of slope, adjacent to the SoCal pipeline easement)	NEITHER	After much review and consideration, there does not seem to be either an above- or below-ground alternative for this segment that appears acceptable. Assuming it will not be possible to intrude into the easement, instead, use the "C to B" segment for piping alignment
C TO B (Entrance along NTH, along road south of Locus B; to top of slope, across from MW20 bench)	Below	Although above-ground is generally preferred, the narrowness of the roadway along this segment makes it unlikely the piping could be placed above ground with sufficient road access without making significant cuts and disturbance into the in-place geologic materials alongside this road segment. Note this segment of road runs through a large cultural area on either side, therefore no additional disturbance, outside of the present-day existing roadway, should be made. 1) No additional cuts would be made into the banks on either side of the roadway. 2) Existing slopes would not be disturbed. 3) No activity, storage or personnel activity should extend beyond the current roadway. This includes the slopes adjacent to the existing road. All below ground piping will be removed after remedy completion.
B TO D (Section of dirt access road from top of slope west to Bat Cave Wash)	Above	Given the wide road access along this segment, above-ground piping could be installed. 1) Construction activity, storage and personnel activity should be limited to the roadway to the extent possible to minimize encroachment into the areas adjacent to the existing road.
D TO E (Continuing along access road, along the east side of Bat Cave Wash to where road crosses wash near IM-3)	Above	1) Construction activity, storage and personnel activity should be limited to the roadway to the extent possible to minimize encroachment into the areas adjacent to the existing road.
E TO F (From Bat Cave Wash crossing, along Route 66 westward past IM-3 to IRL-3)	Above	Above-ground installation is preferred. 1) No additional cuts would be made into the banks on either side of the roadway. 2) Existing slopes would not be disturbed.

PIPELINE SEGMENT ANALYSIS

PIPELINE POINTS (Segment Description)	ABOVE/BELOW GROUND	CONDITIONS OF USE COMMENTS
F TO G (From IRL-3 along single land dirt access road, down into wash and location of IRL-4.)	Below	This short section from IRL-3 to IRL-4 in the wash is along a narrow, one-lane access road. The narrow width of the existing one-lane access road, and existing embankment where road would be built to provide access down to IRL-4 does not appear to allow for both vehicle access and above-ground piping and supports. While above-ground installation is preferred where possible, placing the injection well piping below-ground along this segment should constrain disturbance to the foot print of the existing roadway 1) Activity and construction in this area to remain strictly constrained to the existing dirt road. 2) Construction of the roadway down into the wash for IRL-4 should consist of fill placement, rather than any additional cut, to the extent possible. 3) All below ground piping will be removed after remedy completion.
F TO H TO I (From IRL-3, west along Route 66 to FW-1)	Above	Above ground installation is preferred. 1) No additional cuts would be made into the banks on either side of the roadway. 2) Existing slopes would not be disturbed.

PIPELINE SEGMENT ANALYSIS



ENCLOSURE B

SOILS STAGING / CONSTRUCTION AREAS
FMIT COMMENT TABLE

Soils Staging / Construction Areas FMIT Comment Table

STORAGE/STAGING AREA	ACERAGE	LOCATIONS / NOTES	COMMENTS
1-5 Soils storage	11.1	All in Park Moabi Area	*Tribes said yes (CHPMP 1/14)*
6 Soils storage	0.67	Across from IM-3	*Tribes said no (CHPMP 1/14)*
7 Soils storage	0.28	East of #6	*Tribes said no* (CHPMP 1/14)
8 Soils storage	0.17	Southeast of #7	*Tribes said no* (CHPMP 1/14)
9 Construction Staging			*Tribes said yes (CHPMP 1/14)*
10 Construction Staging	0.51		*Tribes said yes (CHPMP 1/14)*
11 Construction Staging	5.69		*Tribes said no (CHPMP 1/14)*
12 Construction Staging	1.53		*Tribes said no (CHPMP 1/14)*
13 Soils storage	0.15		*Tribes said no (CHPMP 1/14)*
14 This site is proposed for construction materials	0.28	This is CA-SBR-11862H. BLM is the agency to make determinations of eligibility, not PGE as in PGE's report [1](pp22-25). On the map in the report, (see footnote 1) page 25, maze remnants are visible slightly southwest of the boundary of CA-SBR-11862H.	Tribes have questions: 1. Is it temporary? 2. Fencing? With what? 3. SHPO Clearance? 4. What activities? 5. Lighting? 6. Extent of the staging area? From where to where? 7. What has BLM determined regarding eligibility and potential impacts to this area?
15 This site is proposed for construction materials	1.11	*On the map, this site is across Old National Trails Highway along the river. There is creosote here. Animals go down into the outlet area for water. Has a rock-lined walkway down. There is a small beach area (when low water). This is the end of Bat Cave Wash.*	Tribes have questions: 1. Vegetation removal? Tribes do not want vegetation removed. 2. Wider access = modifications? Tribes do not want that. 3. Watchmen, guards, restrooms? 4. What activities? 5. Lighting? Generators? 6. When was this area last surveyed for cultural materials? 7. Extent of the staging area? From where to where?
16	0.06		*Tribes said no*

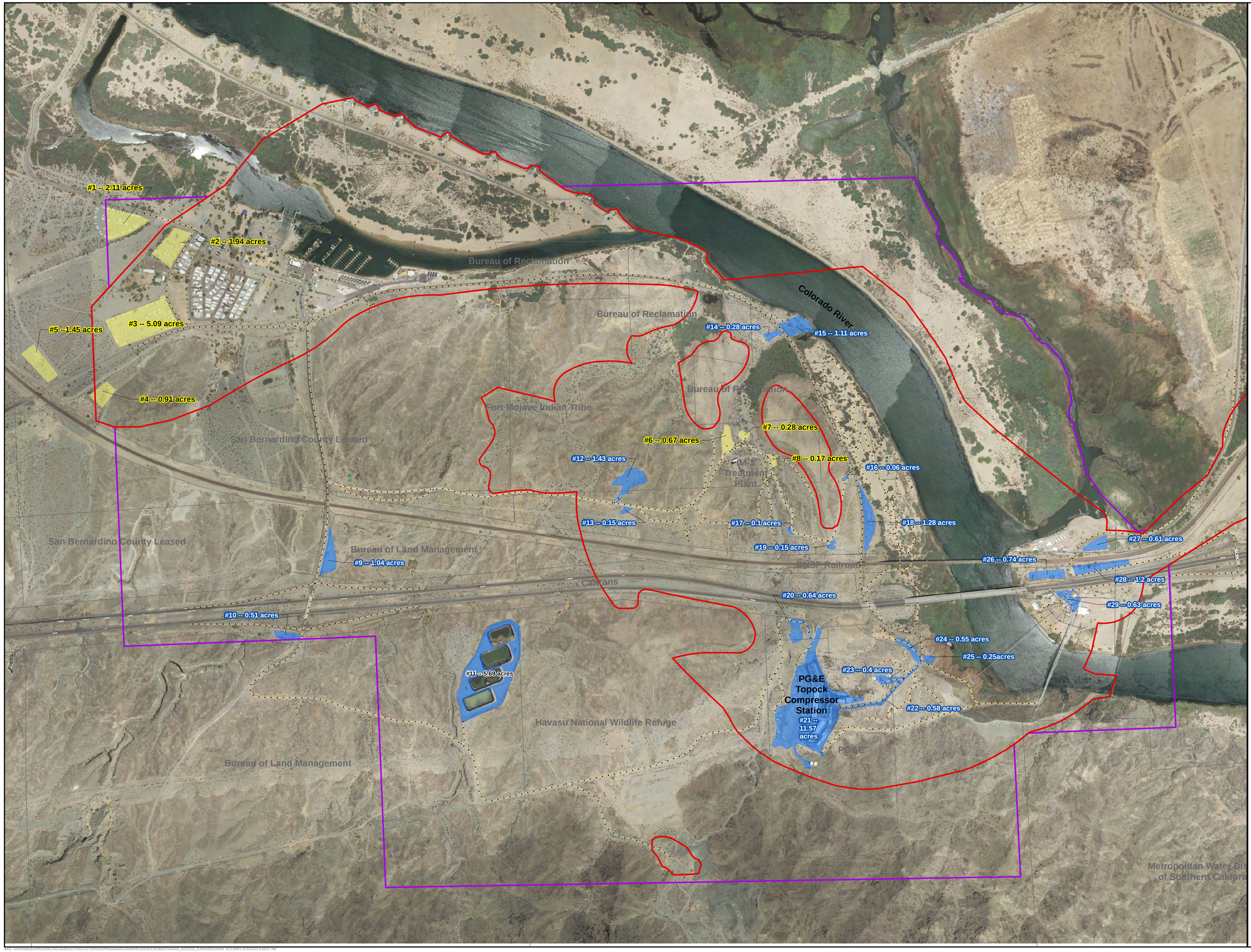
[1] National Register of Historic Places Eligibility Evaluation of CA-SBR-11862H, San Bernardino California, David D. Earle and Barry A. Price. Prepared by Applied Earthworks and Earle and Associates, submitted to Pacific Gas and Electric Co. September 2013.

Soils Staging / Construction Areas FMIT Comment Table

17	**This site is proposed for construction materials**	0.1		*Tribes have questions:* 1. Modifications? 2. Fencing? With what? 3. Structures? 4. Blading, leveling, gravel import? 5. Lighting? Generators? 6. Berm cuts along road?
18		1.28		*Tribes said yes (CHPMP 1/14)*
19	**This site is proposed for construction materials**	0.15	Located across from the southern tip of CA-SBR-219 Locus B (Maze). There is a better place to the west (down the slope) where there already exists a large level place with a well (MW25) Why not go there instead? Proposed IRL7 near- by. Also N (?).	*Tribes have questions:* 1. Modifications? 2. Fencing? With what? 3. Structures? 4. Blading, leveling, gravel import? 5. Lighting? Generators? 6. Berm cuts along road?
20	**This site is proposed for construction materials**	0.1		*Tribes still need to visit this site*
21	**Construction Staging**	11.57	Compressor Station	*Tribes said yes (CHPMP 1/14)*
22	**Construction Staging**	0.58		*Tribes said yes (CHPMP 1/14)*
23	**Construction Staging**	0.4		*Tribes said yes (CHPMP 1/14)*
24	**Construction Staging**	0.55		*Tribes said yes (CHPMP 1/14)*
25	**Construction Staging**	0.25		*Tribes said no (CHPMP 1/14)*
26	**Construction Staging**	0.74		*Tribes said yes (CHPMP 1/14)*
27	**Construction Staging**	0.61		*Tribes said yes (CHPMP 1/14)*
28	**Construction Staging**	1.2		*Tribes said yes (CHPMP 1/14)*
29	**Construction Staging**	0.63		*Tribes said yes (CHPMP 1/14)*

ENCLOSURE C

STAGING AREA MAP



LEGEND

- EIR Project Area
- Area of Potential Effects (APE)
- Proposed Access Routes
- Potential Soil Storage Area/ Proposed Staging Area
- Proposed Staging Areas

Notes:

1. PG&E may use all or a subset of these potential temporary staging areas during remedy construction.
2. Note that in compliance with EIR mitigation measure CUL-1a-9 as well as PA and CHPMP mitigation measures, the proposed access route west of National Trails Highway is located in an existing, previously disturbed, access road. The location of the access road was field verified and does not create any direct physical impact or effect on the Topock Maze, as it is manifested archaeologically, in compliance with EIR mitigation measure CUL-1a-10 and PA and CHPMP mitigation measures

N

0 300 600 1,200 Feet

Updated per September 17-18 TWG Discussion

FIGURE 7.6-1
PROPOSED STAGING AREAS, CONSTRUCTION YARD, AND ACCESS ROUTES
GROUNDWATER REMEDY BASIS OF DESIGN REPORT
INTERMEDIATE (60%) DESIGN
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

CH2MHILL

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Hualapai Department of Cultural Resources
P.O. Box 310
Peach Springs, Arizona 86434
Office: 928.769.2223 FAX: 928.769.2235

March 10, 2014 **HDCR File: 2014-663**

VIA ELECTRONIC MAIL
Mr. Aaron Yue
Topock Project Manager
DEPARTMENT OF TOXIC SUBSTANCES CONTROL
5796 Corporate Avenue
Cypress, California 90630

Ms. Pamela S. Innis
Topock Remedial Project Manager
Office of Environmental Policy and Compliance
U.S. DEPARTMENT OF THE INTERIOR
P.O. Box 25007 (D-108)
Denver, Colorado 80225-007

Re: 60% Pipeline Alternatives and Soils / Staging Matrices

Dear Mr. Yue:
On behalf of the Hualapai Tribe, we appreciate being able to discuss pipeline alternatives as presented in various meetings and consultative group walks regarding the 60% Basis of Design for the Topock Remediation Project. As you are aware, the Hualapai along with other Tribal representatives met at Topock on February 21st, 2014 to visit and discuss alternative pipeline routings for the 60% groundwater remedy. Hualapai tribal representatives and two Hualapai Tribal Council members were present during this meeting. After the meeting it was agreed that a pipeline matrix and soils staging area table would be sent to interested tribes that included tribal comments wile in the field.

In this letter we formally present Hualapai's comments regarding pipeline alternatives and soils / staging areas considered by Pacific Gas & Electric for the 90% Basis of Design. Even though we are aware that the groundwater remedy infrastructure is creating permanent and irreversible cumulative negative impacts, both spiritually and to the cultural landscape at Topock, we are confident that PG&E will do everything in their power to remove all infrastructure components (whether or not pipelines are placed above or below ground) five years after all remediation activity ceases.

Figure 1 below, shows pipeline alternatives with Table 1 documenting comments from Hualapai. Regarding Table 2, below, this table has tribal responses that were solicited on January 14, 2014. It also has comments and questions regarding several areas visited on February 21st. Perhaps we can discuss these at the March 14th CHPMP meeting with BLM. There is one outstanding soils location (#20) that still requires visitation. Perhaps we can do this on March 14th, 2014 (CHPMP meeting with BLM, in the morning followed by visit to Topock), when we will be out at Topock.

We appreciate our on-going consultations and collaborations with the Topock Remediation Project and look forward to meaningful dialogue through-out the up-coming years. If you have any concerns please feel free to contact myself, or Dawn Hubbs, Program Manager and we will be happy to assist you.

Sincerely,

Loretta Jackson-Kelly, Director and Tribal Historic Preservation Officer
Hualapai Department of Cultural Resources

Cc:
Mr. Rudy Clark, Sr., Councilman, Hualapai Tribal Council
Mr. Robert Bravo, Councilman, Hualapai Tribal Council
Karen Baker, CHG, CEG, Chief, Geological Services Branch
Tribal Reps

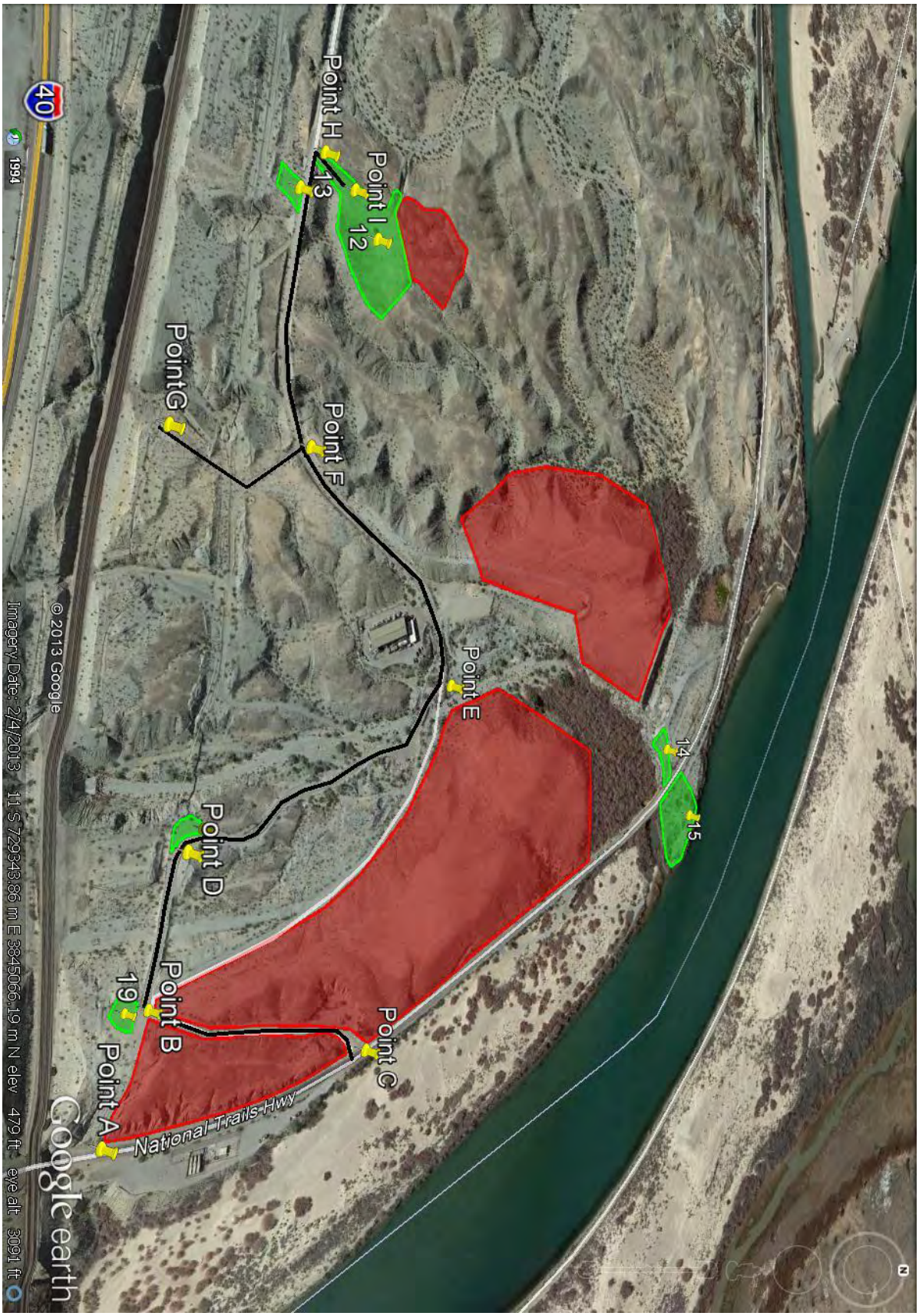


Figure 1: Red Areas = Cultural Sites - Green Areas = Soils Staging Areas - Black Line = Pipeline

Table 1: Hualapai Department of Cultural Resources Pipeline Points and Comments

PIPELINE POINTS	ABOVE/BELOW GROUND	CONDITIONS OF USE COMMENTS
A TO B	**Neither.** Hualapai do not want to see this alternative used at all.	Hualapai do not want this segment of the pipeline to be used. There is significant damage to this area (which is not being refurbished or maintained for erosion and run-off) and this segment would cause more damage. It would also impact a multi-component archaeological site. Avoidance is recommended.
B TO C	**Below Ground**	The segment is in an existing road. Please go in the center of the road, no additional widening or slope cutting due to cultural materials on the upper slopes. All infrastructure materials to be removed five years after achieving acceptable ground water tolerance levels of Chrome VI.
B TO D	**Above Ground or Below Ground**	The segment is in an existing road. Please go in the center of the road, no additional widening or slope cutting. Soils location 19 is near this segment. We would prefer that this segment not utilize location 19 as there is a point west and down the road that would be preferable for staging. See Table 2. All infrastructure materials to be removed five years after achieving acceptable ground water tolerance levels of Chrome VI.
D TO E	**Above Ground or Below Ground**	The segment is in an existing road. Please go in the center of the road, no additional widening or slope cutting. Cultural materials are in this vicinity. All infrastructure materials to be removed five years after achieving acceptable ground water tolerance

		levels of Chrome VI.
E TO F	**Above Ground or Below Ground**	The segment is in an existing road. Please go in the center of the road, no additional widening or slope cutting. Prefer minimal bridge construction considerations. All infrastructure materials to be removed five years after achieving acceptable ground water tolerance levels of Chrome VI.
F TO G	**Below Ground**	This is a very small area without a lot of room. There is an archaeological site (CA-SBR-11939) in this area and there is a plan to put IRL3 in this vicinity also. There is going to be a great deal of activity in this small area, so we request cultural clearances with tribal monitors in attendance, prior and during this segment's construction phase. All infrastructure materials to be removed five years after achieving acceptable ground water tolerance levels of Chrome VI.
F TO H TO I	**Above Ground**	This area is very close to cultural materials. Prefer that there be no additional widening of the existing road. We request cultural clearances with tribal monitors in attendance, prior and during this segment's construction phase. There is a plan to put FW1 near this location also. All infrastructure materials to be removed five years after achieving acceptable ground water tolerance levels of Chrome VI.

Table 2: Soils Staging / Construction Areas Hualapai Comment Table

STORAGE/STAGING AREA	ACERAGE	LOCATIONS / NOTES	COMMENTS
1-5 Soils storage	11.1	All in Park Moabi Area	*Tribes said yes (CHPMP 1/14)*
6 Soils storage	0.67	Across from IM-3	*Tribes said no (CHPMP 1/14)*
7 Soils storage	0.28	East of #6	*Tribes said no* (CHPMP 1/14)
8 Soils storage	0.17	Southeast of #7	*Tribes said no* (CHPMP 1/14)
9 Construction Staging			*Tribes said yes (CHPMP 1/14)*
10 Construction Staging	0.51		*Tribes said yes (CHPMP 1/14)*
11 Construction Staging	5.69		*Tribes said no (CHPMP 1/14)*
12 Construction Staging	1.53		*Tribes said no (CHPMP 1/14)*
13 Soils storage	0.15		*Tribes said no (CHPMP 1/14)*
14 ***This site is proposed for construction materials***	0.28	This is CA-SBR-11862H. BLM is the agency to make determinations of eligibility, not PGE as in PGE's report [1](pp22-25). On the map in the report, (see footnote 1) page 25, maze remnants are visible slightly southwest of the boundary of CA-SBR-11862H.[2]	Tribes have questions: 1. Is it temporary? 2. Fencing? With what? 3. SHPO Clearance? 4. What activities? 5. Lighting? 6. Extent of the staging area? From where to where? 7. What has BLM determined regarding eligibility and potential impacts to this area?
15 ***This site is proposed for construction materials***	1.11	*On the map, this site is across Old National Trails Highway along the river. There is creosote here. Animals go down into the outlet area for water. Has a rock-lined walkway down. There is a small beach area (when low water). This is the end of Bat Cave Wash.*	Tribes have questions: 1. Vegetation removal? Tribes do not want vegetation removed. 2. Wider access = modifications? Tribes do not want that. 3. Watchmen, guards, restrooms? 4. What activities? 5. Lighting? Generators? 6. When was this area last surveyed for cultural materials? 7. Extent of the staging area? From where to where?
16	0.06		*Tribes said no*
17 ***This site is proposed for construction materials***	0.1		*Tribes have questions:* 1. Modifications? 2. Fencing? With what? 3. Structures? 4. Blading, leveling, gravel import? 5. Lighting? Generators? 6. Berm cuts along road?
18	1.28		*Tribes said yes (CHPMP 1/14)*
19 ***This site is proposed for construction materials***	0.15	Located across from the southern tip of CA-SBR-219 Locus B (Maze). There is a better place to the west (down the slope) where there already exists a large level place with a well	*Tribes have questions:* 1. Modifications? 2. Fencing? With what? 3. Structures? 4. Blading, leveling, gravel import? 5. Lighting? Generators? 6. Berm cuts along road?

[1] National Register of Historic Places Eligibility Evaluation of CA-SBR-11862H, San Bernardino California, David D. Earle and Barry A. Price. Prepared by Applied Earthworks and Earle and Associates, submitted to Pacific Gas and Electric Co. September 2013.

[2] Please note that management recommended that this site be avoided. Therefore this location is not suitable for staging. Please refer to *Topock Remediation Project Additional Soils Investigation, Condition Assessments at Fourteen Archaeological and Historical Sites,* Hearth, et. Al. Prepared by Applied Earthworks Inc., submitted to PG&E November 2013, reference site recordCA-SBR-11862H #8, page 1 of 5.

		(MW25) Why not go there instead? Proposed IRL7 near- by. Also N (?).	

STORAGE/STAGING AREA	ACERAGE	LOCATIONS / NOTES	CONDITIONS OF USE COMMENTS
20 ***This site is proposed for construction materials***	0.1		*Tribes still need to visit this site*
21 Construction Staging	11.57	Compressor Station	*Tribes said yes (CHPMP 1/14)*
22 Construction Staging	0.58		*Tribes said yes (CHPMP 1/14)*
23 Construction Staging	0.4		*Tribes said yes (CHPMP 1/14)*
24 Construction Staging	0.55		*Tribes said yes (CHPMP 1/14)*
25 Construction Staging	0.25		*Tribes said no (CHPMP 1/14)*
26 Construction Staging	0.74		*Tribes said yes (CHPMP 1/14)*
27 Construction Staging	0.61		*Tribes said yes (CHPMP 1/14)*
28 Construction Staging	1.2		*Tribes said yes (CHPMP 1/14)*
29 Construction Staging	0.63		*Tribes said yes (CHPMP 1/14)*

Table 2: Soils Staging / Construction Areas Hualapai Comment Table (Continued from page 3)

THE COCOPAH INDIAN TRIBE
Cultural Resource Department
14515 S. Veterans Drive
Somerton, Arizona 85350
Telephone (928) 627-4849
Fax (928) 627-3173

Project Number: CCR-032-06-001

VIA ELECTRONIC MAIL March 13, 2014

Mr. Aaron Yue
Topock Project Manager
DEPARTMENT OF TOXIC SUBSTANCES CONTROL
5796 Corporate Avenue
Cypress, California 90630

Ms. Pamela S. Innis
Topock Remedial Project Manager
Office of Environmental Policy and Compliance
U.S. DEPARTMENT OF THE INTERIOR
P.O. Box 25007 (D-108)
Denver, Colorado 80225-007

Re: 60% Pipeline Alternatives and Soils / Staging Areas

Dear Mr. Yue/Ms. Innis:

The Cocopah Indian Tribe appreciates the opportunity to provide comments and discuss the 60% Pipeline Alternatives and Soils / Staging Areas.

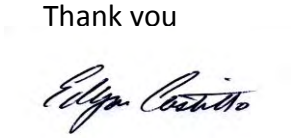
The Cocopah Indian Tribe along with council members and representatives from other interested tribes, visited the Topock area on February 21, to view and walk the Soil Staging areas proposed by PG&E and the alternative pipeline route for the Topock Compressor Station 60% groundwater remedy design. During this meeting and site walk, it was agreed that a table and map illustrating the staging and pipeline route would be produced and used to provide comments regarding the staging areas and pipeline route.

Attached you will find Cocopah's comments regarding the Pipeline route and Staging areas. The attachments are as follows:

- Figure 1 is a map illustrating the Staging areas and Pipeline
- Table 1: Cocopah Comments regarding Pipeline Points
- Table 2: Cocopah Comments regarding Soils Staging / Construction Areas

If you have any questions feel free to contact me at: Cell: 928-287-5042 or Office: 928-627-4849, or by email at CocopahTPM@Gmail.com

Thank vou



Edgar Castillo
Cocopah Indian Tribe
Topock Project Manager

Cc:
Aaron Yue, DTSC
Pam Innis, DOI
Jill McCormick, Cocopah Indian Tribe
Nora McDowell, Fort Mojave Indian Tribe
Dawn Hubbs, Hualapai Indian Tribe
Doug Bonamici, Colorado River Indian Tribes
Karen Baker, CHG, CEG, Chief, Geological Services Branch

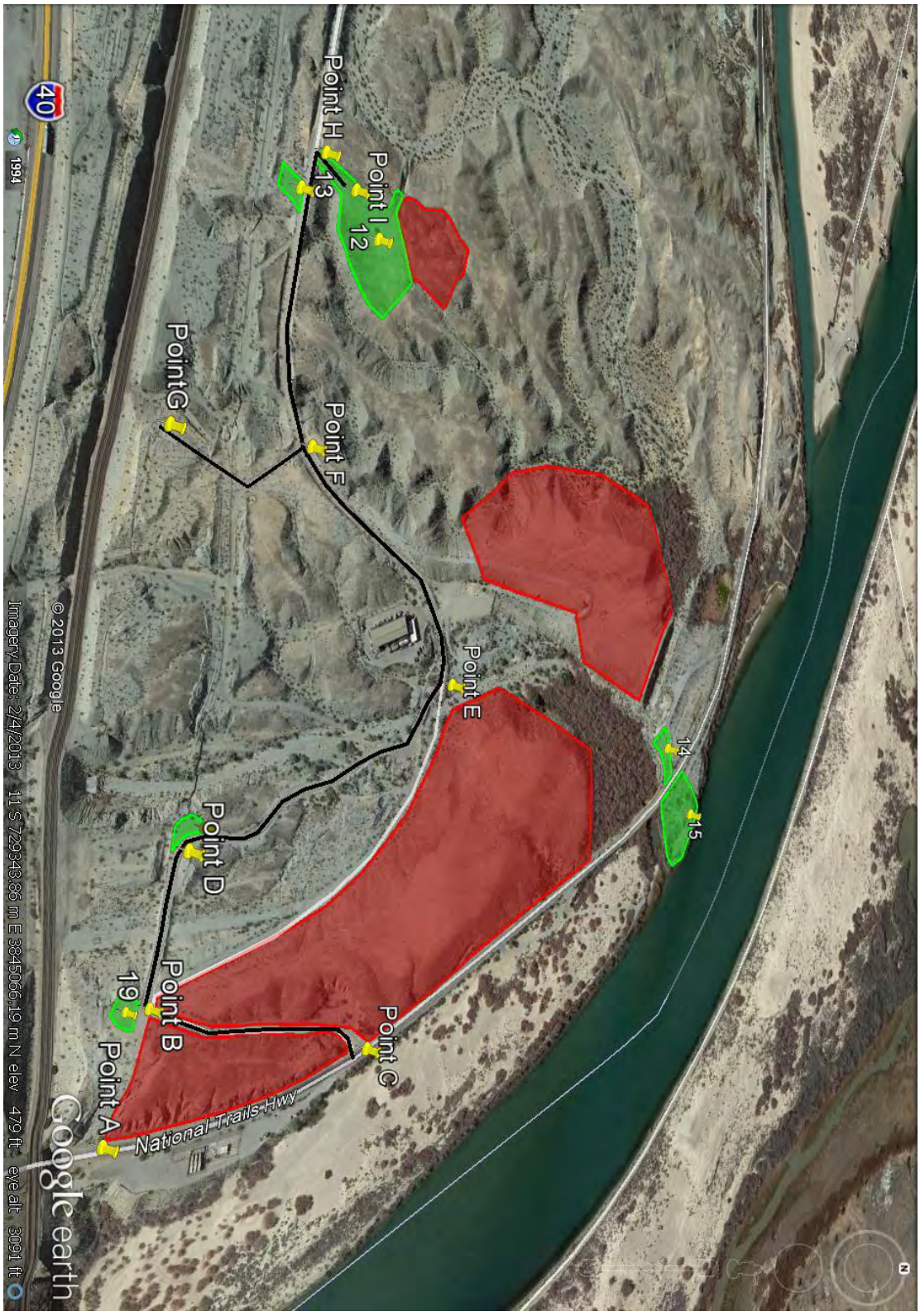


Figure 1: Red Areas = Cultural Sites
Green Areas = Soils Staging Areas
Black Line = Pipeline

Table 1: Cocopah Comments on the Pipeline Points

PIPELINE POINTS	ABOVE/BELOW GROUND	CONDITIONS OF USE COMMENTS
A TO B	Neither	Tribe's conclusion is that this is not an acceptable route for the pipeline. It is noted that there is significant damage to this area and this pipeline segment would cause more damage. The tribe recommends that this area be avoided.
C TO B	Above/Below	This segment intersects a large Cultural Resources Area. Any additional widening or cutting into the sides of the road is to be avoided as to not cause any damage to the cultural materials present on the slopes. All activity including staging, storage or personnel would be strictly limited to the roadway. Piping should go in the center of the existing roadway. All infrastructure materials to be removed five years after achieving acceptable Chrome VI levels.
B TO D	Above/Below	This segment is in an existing roadway. All activity including staging, storage or personnel would be strictly limited to the roadway. Piping should go in the center of the existing roadway. All infrastructure materials to be removed five years after achieving acceptable Chrome VI levels.
D TO E	Above/Below	This segment is in an existing roadway. All activity including staging, storage or personnel would be strictly limited to the roadway. Piping should go in the center of the existing roadway. All infrastructure materials to be removed five years after achieving acceptable Chrome VI levels.
E TO F	Above/Below	This segment is in an existing roadway. All activity including staging, storage or personnel would be strictly limited to the roadway. Piping should go in the center of the existing roadway. All infrastructure materials to be removed five years after achieving acceptable Chrome VI levels.
F TO G	Above/Below	This is a small area that contains archaeological site CA-SBR-11939. Cultural clearances with tribal monitors are requested, prior to and during construction. All infrastructure materials to be removed five years after achieving acceptable Chrome VI levels.
F TO H TO I	Above/Below	This area is very close to cultural materials. Cultural clearances with tribal monitors are requested, prior to and during construction as with the previous point. All infrastructure materials to be removed five years after achieving acceptable Chrome VI levels.

Table 2: Cocopah Comments on the Soils Staging / Construction Areas

STORAGE/STAGING AREA	ACERAGE	LOCATIONS / NOTES	COMMENTS
1-5 Soils storage	11.1	All in Park Moabi Area	*Tribes said yes (CHPMP 1/14)*
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15 ***This site is proposed for construction materials***	1.11	*On the map, this site is across Old National Trails Highway along the river. There is creosote here. Animals go down into the outlet area for water. Has a rock-lined walkway down. There is a small beach area (when low water). This is the end of Bat Cave Wash.*	Tribes have questions: 1. Vegetation removal? Tribes do not want vegetation removed. 2. Wider access = modifications? Tribes do not want that. 3. Watchmen, guards, restrooms? 4. What activities? 5. Lighting? Generators? 6. When was this area last surveyed for cultural materials? 7. Extent of the staging area? From where to where?
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[1] National Register of Historic Places Eligibility Evaluation of CA-SBR-11862H, San Bernardino California, David D. Earle and Barry A. Price. Prepared by Applied Earthworks and Earle and Associates, submitted to Pacific Gas and Electric Co. September 2013.

Table 2: Cocopah Comments on the Soils Staging / Construction Areas (Cont. from page 5)

STORAGE/STAGING AREA	ACERAGE	LOCATIONS / NOTES	CONDITIONS OF USE COMMENTS
20 ***This site is proposed for construction materials***	0.1		*Tribes still need to visit this site*
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29 Construction Staging	0.63		*Tribes said yes (CHPMP 1/14)*

From: Doug Bonamici [mailto:dbonamici@critdoj.com]
Sent: Monday, March 10, 2014 2:36 PM
To: Yue, Aaron@DTSC
Cc: howard.magill@crit-nsn.gov; Wilene Fisher-Holt; Margaret R. Eggers; Nora McDowell; Dawn Hubbs; Edgar Castillo; Charlie Schlinger; Baker, Karen@DTSC
Subject: Comments on Noise/ Vibration and Pipeline Routing

Mr. Yue, the Colorado River Indian Tribes will not be submitting further comment for the 60% Design phase on the Noise and Vibration issues nor on the Pipeline Routing issues at this time. We have participated in the discussions of those issues, and are satisfied the DTSC, DOI and PG&E have heard our concerns directly, and through the other Tribal comments. We will consider adding further input as the design process moves forward.
Thank you for your efforts in this regard. db

Douglas F. Bonamici
Law Clerk, Office of the Attorney General
Colorado River Indian Tribes
26600 Mohave Rd.,
Parker, Arizona 85344
Phone: 928-669-1271
Email: doug.bonamici@crit-nsn.gov

Attachment B: RTC# 2

Info for the Refuge's Appropriate Use Analysis/Compatibility Determination

Information for the Refuge's Appropriate Use Analysis and Compatibility Determination (AUA/CD)	
Items listed in DOI's October 23, 2008 letter *"PG&E Topock Compressor Station Remediation Site – Evaluation of Attainment of Fish and Wildlife Service Location-Specific ARARs for the Proposed Remedial Alternatives"*	**Action (60% Design Report Compliance Status)**
What the proposed actions/ facilities are – including specifics (such as how many wells, the spacing of wells, detailed sizes/lengths of facilities, etc.)	The 60% design was submitted to DOI on April 5, 2013. Section ES. 3 and Table ES-1 (Summary of Engineering Design Parameters and Key features) of the 60% BOD report provide an executive summary and high level description of the remedy features (wells, pipelines, supporting systems and utilities, structures/buildings, access roads, etc.) including references to specific report figures that show the locations of these features. Detailed descriptions of the remedy features are provided throughout the BOD report, specifically: • Section 3.2 describes the in-situ remediation system and its configuration including the IRZ wells, the Riverbank extraction wells, the Inner Recirculation Loop wells, the TCS Recirculation Loop wells, the Freshwater injection wells, and the associated pipeline alignment. • Section 3.3 describes the source of freshwater, the pre-injection treatment system, and freshwater piping conveyance including storage. • Section 3.4 describes the remedy-produced water management system. • Section 3.5 describes the utilities and other supporting facilities including power supply, SCADA, and structures/ buildings to support the remedy. • Section 3.6 describes the monitoring network/wells. • Section 5 describes the ICs which are also required components of the remedy.
Where the use would be conducted – including specific areas of use, habitat types and acres, key wildlife species that occur there, proportion of refuge or habitat type involved, and other areas affected incidental to use – provide in site maps	Section 2.4 (Other Site Conditions Affecting Design) of the 60% BOD report describes the baseline site conditions that affect remedy design. Among the documented conditions related to ecological resources at the site are surface water and wetlands, vegetation communities, special status plants, and special status wildlife, avian, and aquatic species. A series of maps were provided in Section 2.4 that overlays the remedy features on surveyed ecological resources – notably Figure 2.4-5 (Jurisdictional Waters and Wetlands), Figure 2.4-9 (Vegetation Communities), Figure 2.4-10 (Habitat of Desert Tortoise Species), and Figure 2.4-11 (Indigenous Plants of Traditional Cultural Significance). Updates to these site maps will be included in the 90% design. In addition, an additional map will be prepared to reflect the survey results for arrowweed and lycium conducted in response to 60% design comment #311 DOI-140.

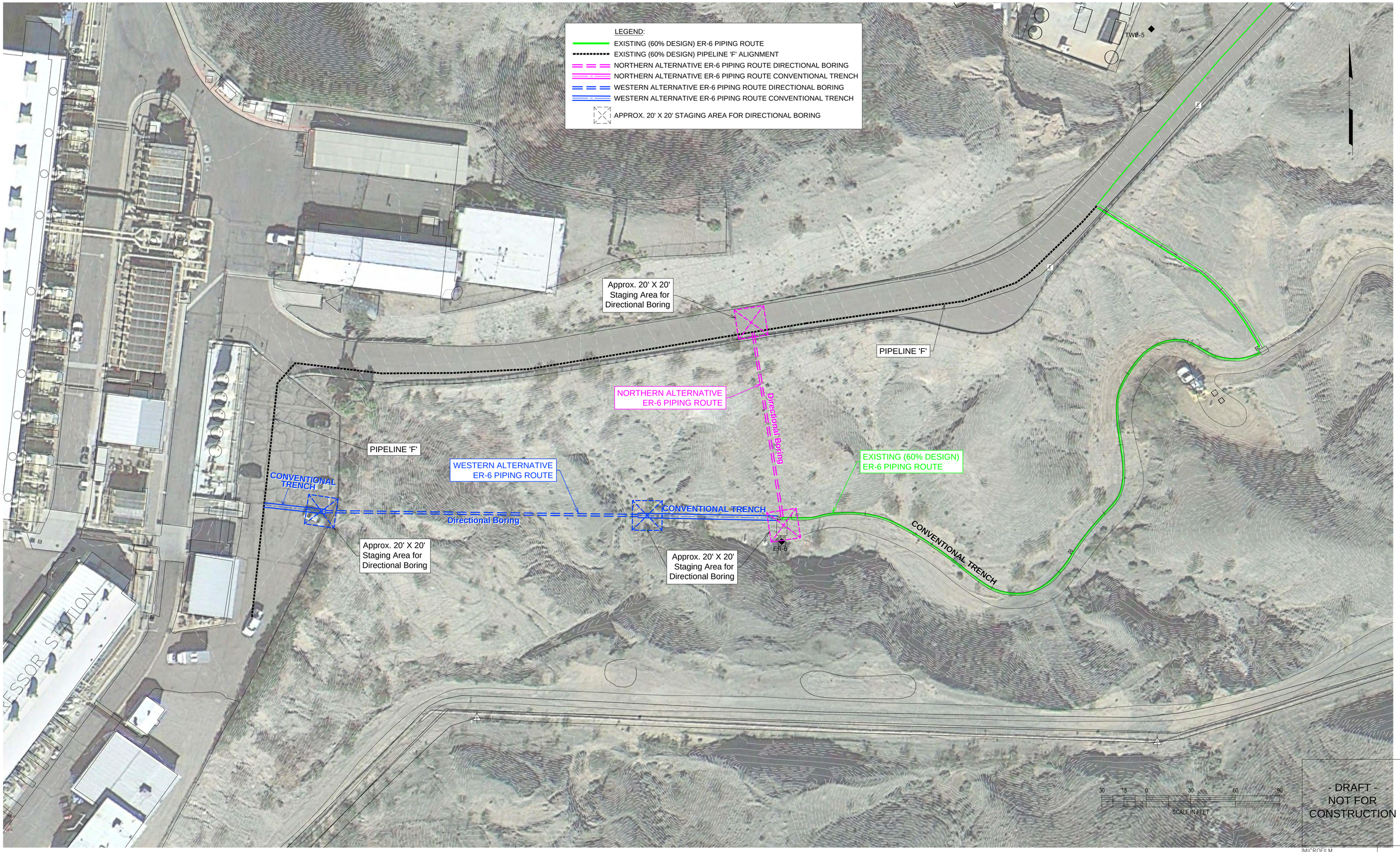
When the use would be conducted—including time of day and year; duration of use; and a timeline of implementing, performing/ maintaining, and closing out the actions/facilities	An estimated project schedule is included in Exhibit 7.5-1 of the 60% BOD report. Exhibit 7.5-1 provides an estimated timeline for implementing the remedial action through remedy start-up and start of full remedy operations (anticipate end of 2017). Consistent with the CMS/FS and Agencies Decision Documents (ROD, Statement of Basis), it is anticipated that this remedy could require 30 years of operations on refuge lands. Per the November 20, 2013 State Water Resources Control Board letter, monitoring on refuge land will be required in order to demonstrate that the water quality objective for arsenic in the receiving groundwater is met "within the earlier of (i) 20 years after achieving the remedial action objective for chromium or (ii) 20 years after ceasing injection of the water containing naturally occurring arsenic at concentrations above the water quality objective." After the remedial action is complete, the remedy facilities will be decommissioned. An updated project schedule will be included in the 90% design and the future Remedial Action Work Plan.
How the use would be conducted—including techniques and equipment used, the number of people involved, routine operation and maintenance procedures	O&M procedures are described in Volume 1 of the Draft O&M Manual (Appendix L of the 60% BOD). Additional details will be provided for O&M of the freshwater supply in the 90% design, after a freshwater water well site is selected for the remedy. Additional details related to construction of the remedy will be included in the future Remedial Action Work Plan.
What would be the anticipated impacts—identifying and describing the impacts; citing available sources of information (plans, environmental assessments, narratives, research, state plans, field experience, consultation with others); distinguishing between long-term and short-term impacts; documenting direct, indirect, and cumulative impacts on refuge resources	Section 2.4 (Other Site Conditions Affecting Design) of the 60% BOD report describes the baseline site conditions that affect remedy design. Among the documented conditions related to ecological resources at the site are surface water and wetlands, vegetation communities, special status plants, and special status wildlife, avian, and aquatic species. A series of maps were provided in Section 2.4 that overlays the remedy features on surveyed ecological resources – notably Figure 2.4-5 (Jurisdictional Waters and Wetlands), Figure 2.4-9 (Vegetation Communities), Figure 2.4-10 (Habitat of Desert Tortoise Species), and Figure 2.4-11 (Indigenous Plants of Traditional Cultural Significance). PG&E, USFWS, and DOI are coordinating on the Programmatic Biological Assessment (PBA) for the final groundwater remedy. The ESA Section 7 consultation will be completed prior to the approval of the Construction/Remedial Action Work Plan. Measures outlined in the forthcoming PBA and associated USFWS determination will be implemented before and during construction activities. Biological completion reports will be submitted to USFWS documenting areas of impacts and monitoring of construction activities.

	Impact analysis for proposed construction and operation activities are also described in the EIR Section 4.3.3.3 and include: BIO-1 – Potential Fill of Wetlands and Other Waters of the US or removal of Riparian Habitat; BIO-2 – Direct Disturbance of and Loss of Habitat for Special-Status Birds and Desert Tortoise; and BIO-3 Fish Mortality, Interference with Spawning Habitat, and Other Adverse Effects. Of these, only BIO-1 and BIO-2 are related to the proposed activities. The certified EIR summarizes results from site-specific surveys that were conducted for Southwestern willow flycatcher, Mojave desert tortoise, Yuma clapper rail, and other avian species which were also identified during these surveys. Implementation of the EIR mitigation measures would reduce all of these impacts to a less-than-significant level. Subsequent studies have been conducted to document the type and extent of jurisdictional wetlands and waters of the US (Wetland Delineation Report, Aug 2013); as well as the type and location of rare and protected plants (Floristic Survey Report, Aug 2013) and culturally significant plants (Ethnobotany Survey Report, Aug 2013). Additional survey for lycium and arrowweed was conducted in response to comment #311 DOI0140. Potential impacts to sensitive resources during remedy implementation will be documented as required by the EIR. Additionally, applicable cultural resource mitigation measures included in the Programmatic Agreement (PA) (BLM 2010), Cultural and Historic Properties Management Plan (CHPMP) and the EIR Section 4.4 are being and will continue to be implemented to avoid, minimize, or mitigate adverse effects to cultural and historic properties on refuge land.
What mitigation is planned for loss of functional value of refuge while use is in operation	The future Remedial Action Work Plan will include a Habitat Restoration Plan in compliance with the CD, Appendix C (Scope of Work), Article 3. PG&E is committed to working with DOI and the HNWR beginning in 2014, on mitigation planning for potential loss of functional value of the refuge while use is in operation.
How and when the actions/facilities would be closed out—including restoration plans	In compliance with the CD, Appendix C (Scope of Work), Article 9, the Remedy Decommissioning Plan will include procedures for the removal and decommissioning of the groundwater remedy. The Plan will also incorporate planning/approaches for post-remedy restoration (including, but not limited, to a series of photo points). This future Plan will be submitted to DOI within 120 days of DOI's certification of completion of the remedial action and a determination by DOI that removal of such facilities is protective of human health and the environment. In addition, the future Remedial Action Work Plan will include a Habitat Restoration Plan in compliance with the CD, Appendix C (Scope of Work), Article 3.

What contingency plans will be in place—identifying actions that will be taken should an accident, unintended discharge, etc. occur.	Contingency Plans are described in Volume 3 of the Draft O&M Manual of the 60% BOD report. Additional details on Contingency Plans for the Remedy Construction will also be included in the future Remedial Action Work Plan.

Attachment C: RTC #39

Alternate Piping Routes near the ER-6 Area



ETIC ENGINEERING

ARCADIS

NO.	DATE	DESCRIPTION	GM/SPEC	DWN	CHKD	SUPV	APVD BY

REVISIONS

NO.	DATE	DESCRIPTION	GM/SPEC	DWN	CHKD	SUPV	APVD BY

REVISIONS

APPROVED BY	
	SO
	SUPV
	DSGN BAS
	DWN AJW
	CHKD
	OK
	DATE
	SCALES 1" = 30'

TOPOCK GROUNDWATER REMEDIATION PROJECT

ER-6 PIPING ROUTE ALTERNATIVES

GAS TRANSMISSION & DISTRIBUTION
PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

MICROFILM	
BILL OF MATL	
DWG LIST	
SUPSDS	
SUPSD BY	
SHEET NO. 1 of SHEETS	REV

N1808

Attachment D: RTC #84a/b, #100, #109, #135

Proposed Locations for Future Provisional Wells

LEGEND:

- PROPOSED INJECTION WELL
- PROPOSED EXTRACTION WELL
- APPROXIMATE LOCATION OF FUTURE PROVISIONAL INJECTION WELL
- APPROXIMATE LOCATION OF FUTURE PROVISIONAL EXTRACTION WELL
- APPROXIMATE LOCATION OF FUTURE PROVISIONAL WELL LOCATIONS RELOCATED OR ADDED AS A RESULT OF 60% RTC's
- PROPOSED ACCESS ROUTE

NATIONAL TRAIL HWY.

COLORADO RIVER

MOHAVE COUNTY HIGHWAY 10

BNSF RAILROAD

BAT CAVE WASH

40

ARCH BRIDGE

SCALE IN FEET: 200 100 0 200 400 600

- DRAFT - NOT FOR CONSTRUCTION

ETIC ENGINEERING

ARCADIS

NO.	DATE	DESCRIPTION	GM/SPEC	DWN	CHKD	SUPV	APVD BY

REVISIONS

APPROVED BY

SO	
SUPV	
DSGN	KD
DWN	AJW
CHKD	
OK	
DATE	
SCALES	1" = 200'

TOPOCK GROUNDWATER REMEDIATION PROJECT

60% FUTURE PROVISIONAL WELL PROPOSED LOCATIONS

GAS TRANSMISSION & DISTRIBUTION
PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

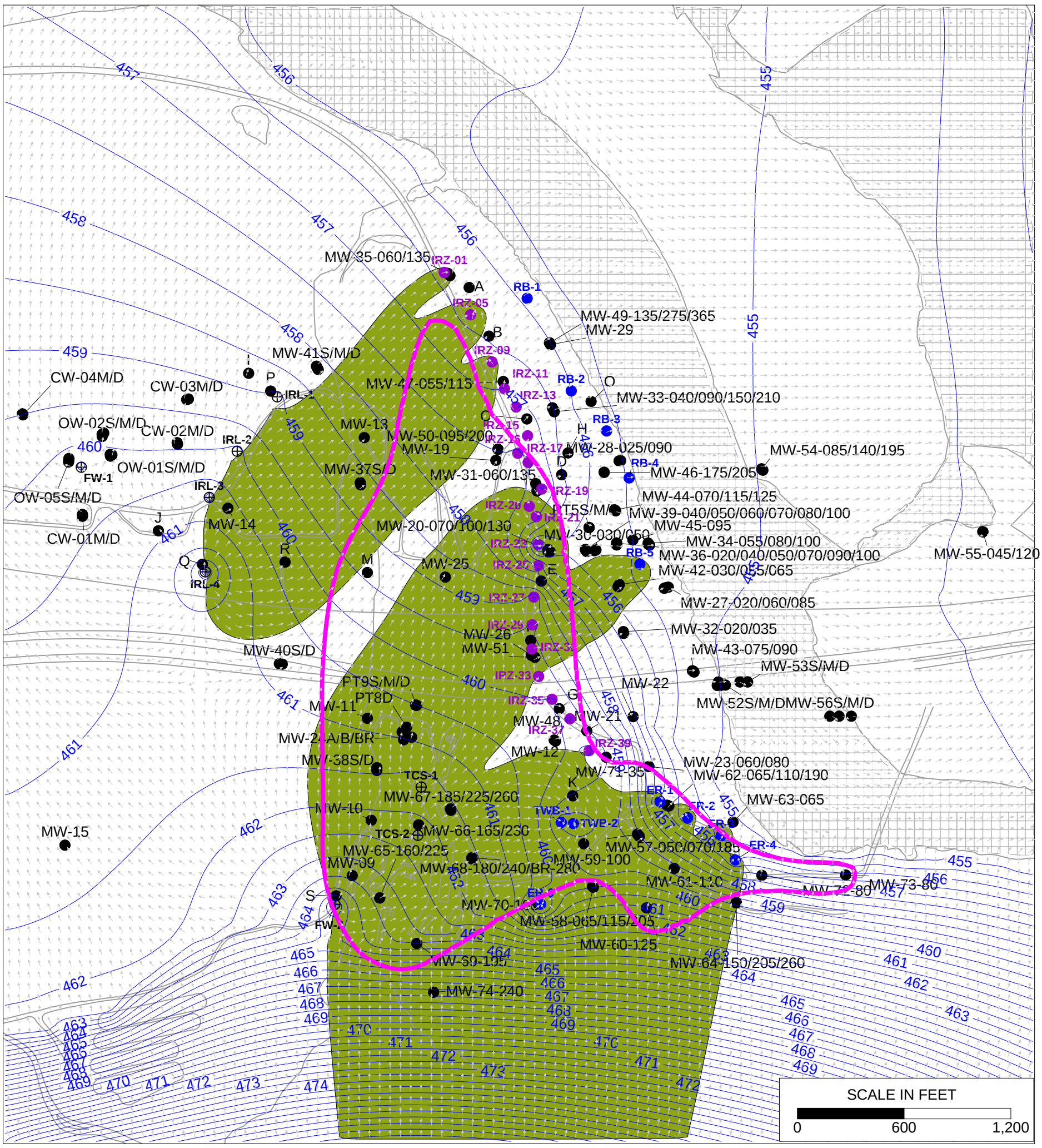
MICROFILM	
BILL OF MATL	
DWG LIST	
SUPSDS	
SUPSD BY	
SHEET NO.	of SHEETS
1	REV

N1808

01/31/2014, 09:18, C:\Graphics\ARTOPOCK-01\Post 60%\F1-2-3_Add\ Well Locations.dwg, Tab: F1

Attachment E: RTC #99, #216, #646, #659, 683, #692

Simulated Groundwater Flow and Capture Figures



LEGEND

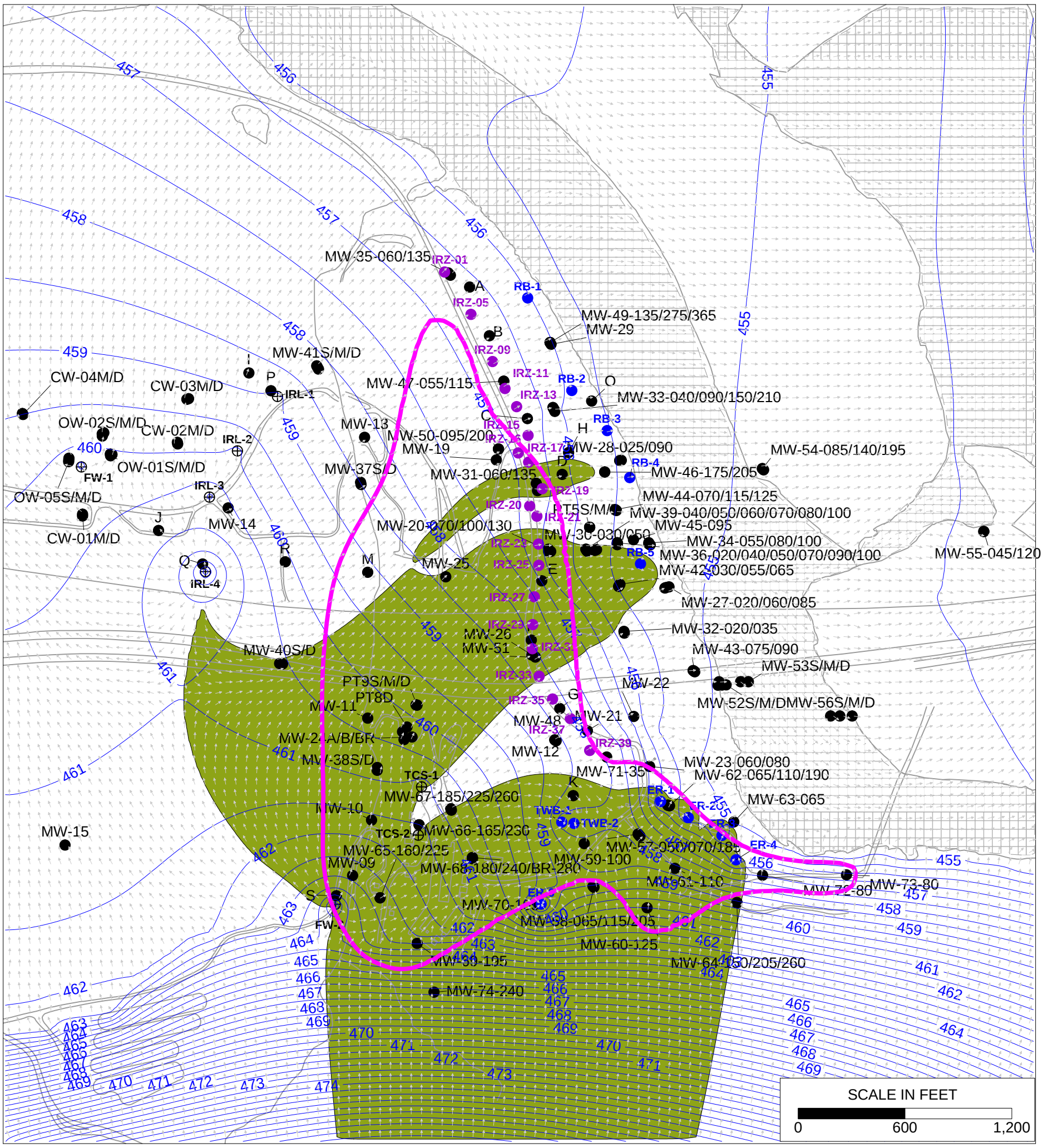
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- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- MONITORING WELLS
- 460 SIMULATED GROUNDWATER LEVELS (FT MSL)
- ESTIMATED HEXAVALENT CHROMIUM 32 ug/L CONTOUR
- SIMULATED GROUNDWATER CAPTURE ZONE
- SIMULATED GROUNDWATER FLOW VECTOR

PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
MODELING APPENDIX

SIMULATED SUBSURFACE GROUNDWATER FLOW AND CAPTURE MODEL LAYER 1 - NTH IRZ ON

ARCADIS

FIGURE
1A



LEGEND

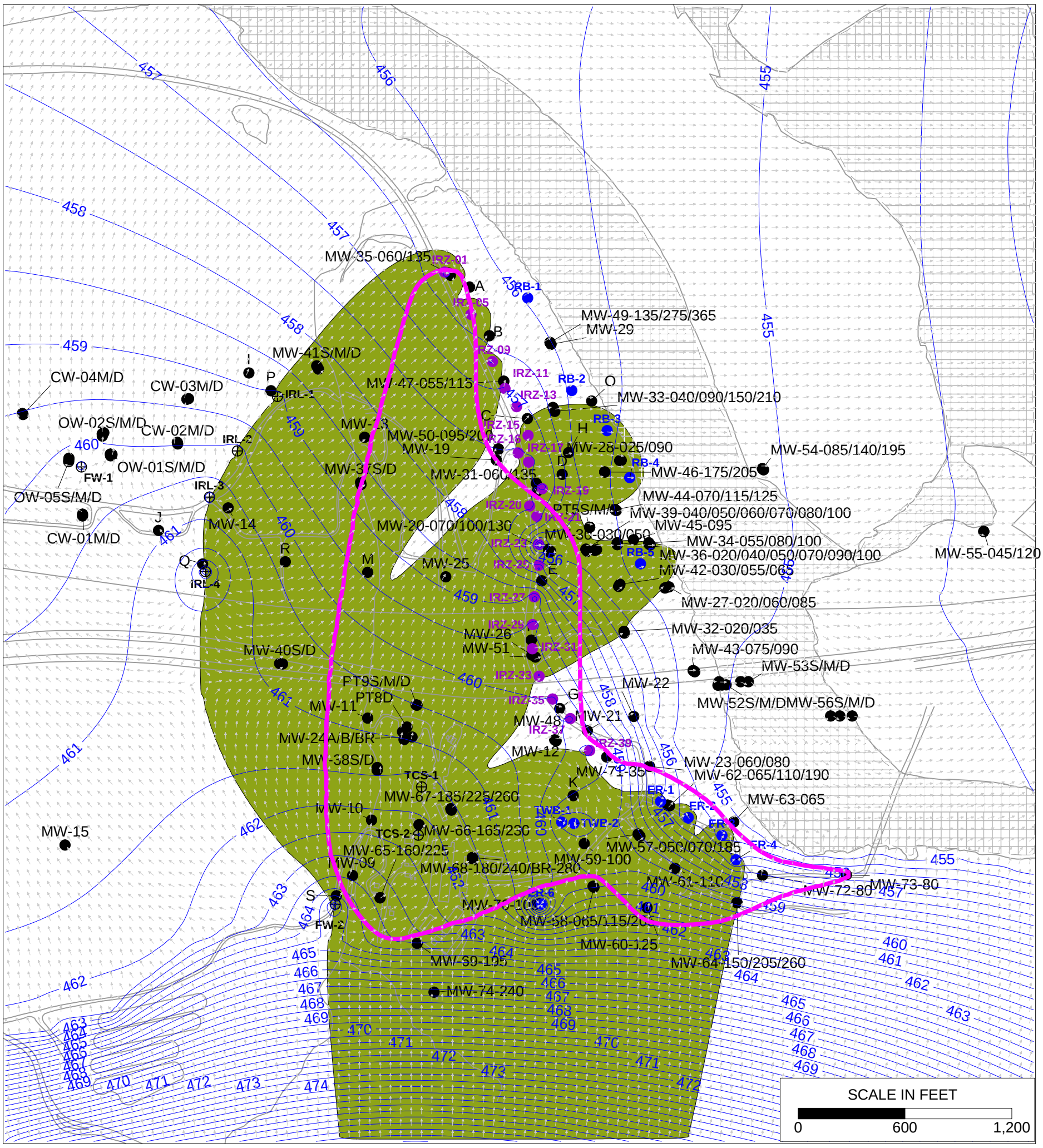
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- EXTRACTION WELLS
- MONITORING WELLS
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- SIMULATED GROUNDWATER FLOW VECTOR

PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
MODELING APPENDIX

SIMULATED SUBSURFACE GROUNDWATER FLOW AND CAPTURE MODEL LAYER 1 - NTH IRZ OFF

ARCADIS

FIGURE
1B



LEGEND

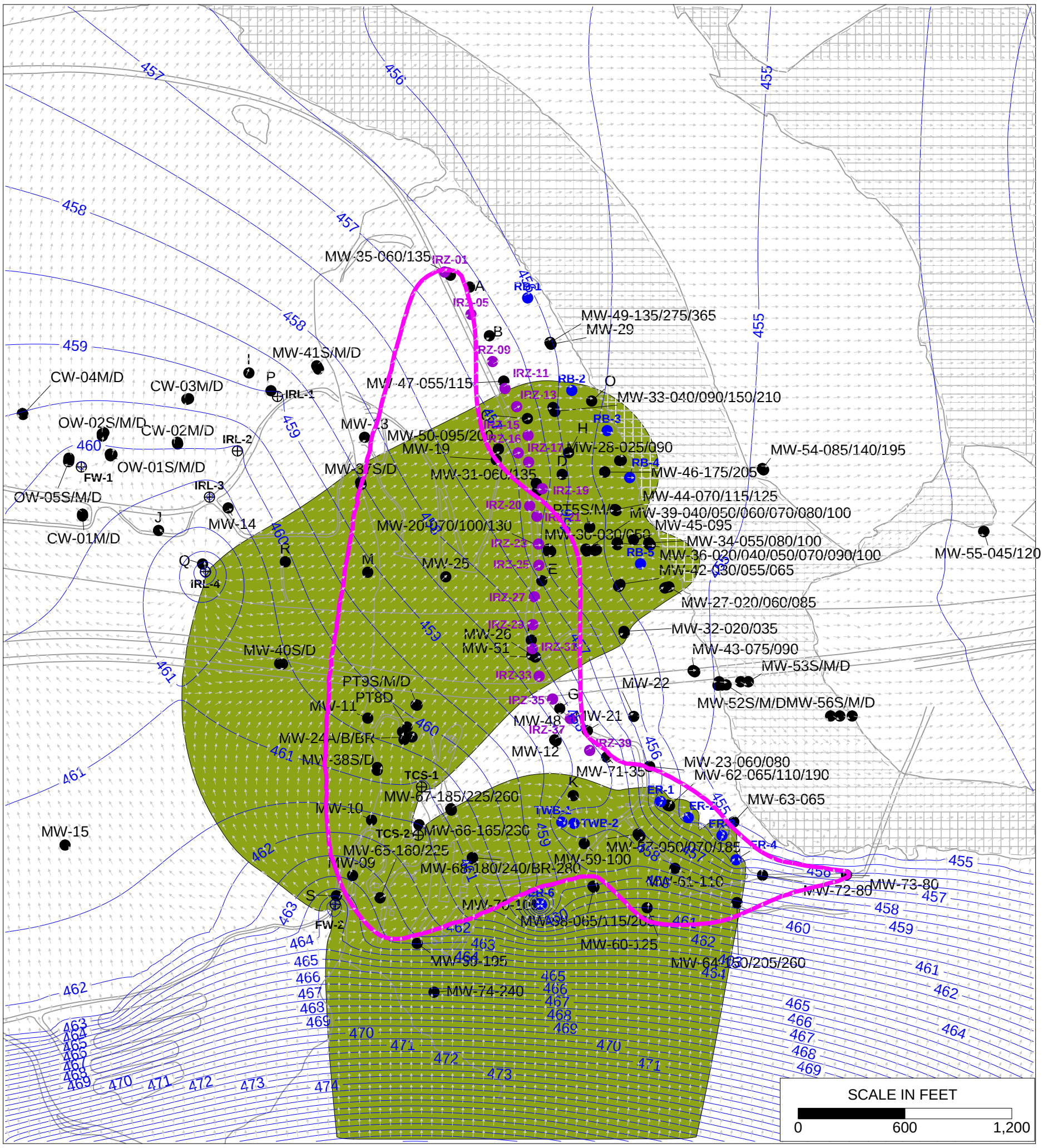
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- EXTRACTION WELLS
- MONITORING WELLS
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TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
MODELING APPENDIX

SIMULATED SUBSURFACE GROUNDWATER FLOW AND CAPTURE MODEL LAYER 2 - NTH IRZ ON

ARCADIS

FIGURE
2A



LEGEND

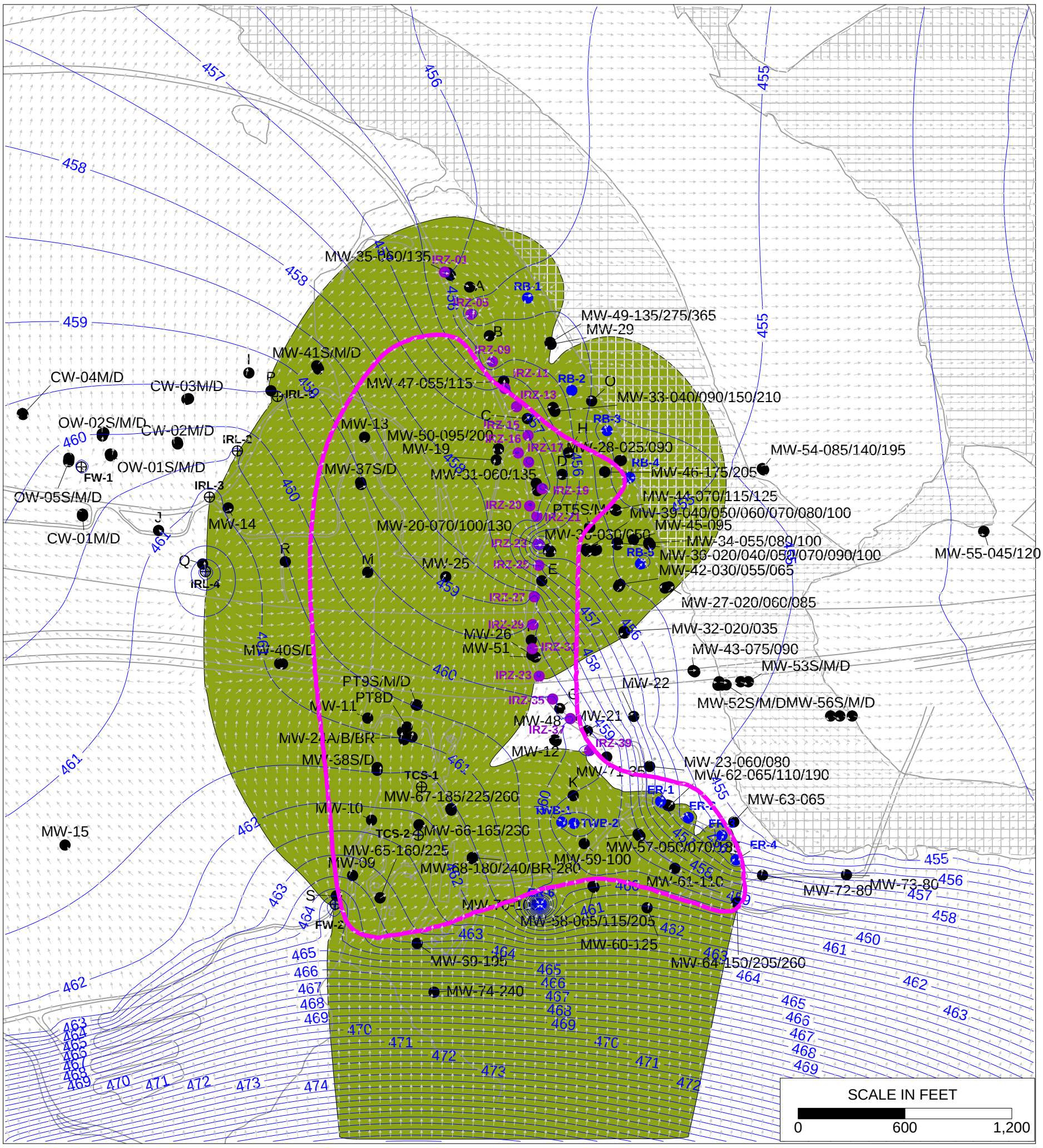
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TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
MODELING APPENDIX

SIMULATED SUBSURFACE GROUNDWATER FLOW AND CAPTURE MODEL LAYER 2 - NTH IRZ OFF

ARCADIS

FIGURE
2B



LEGEND

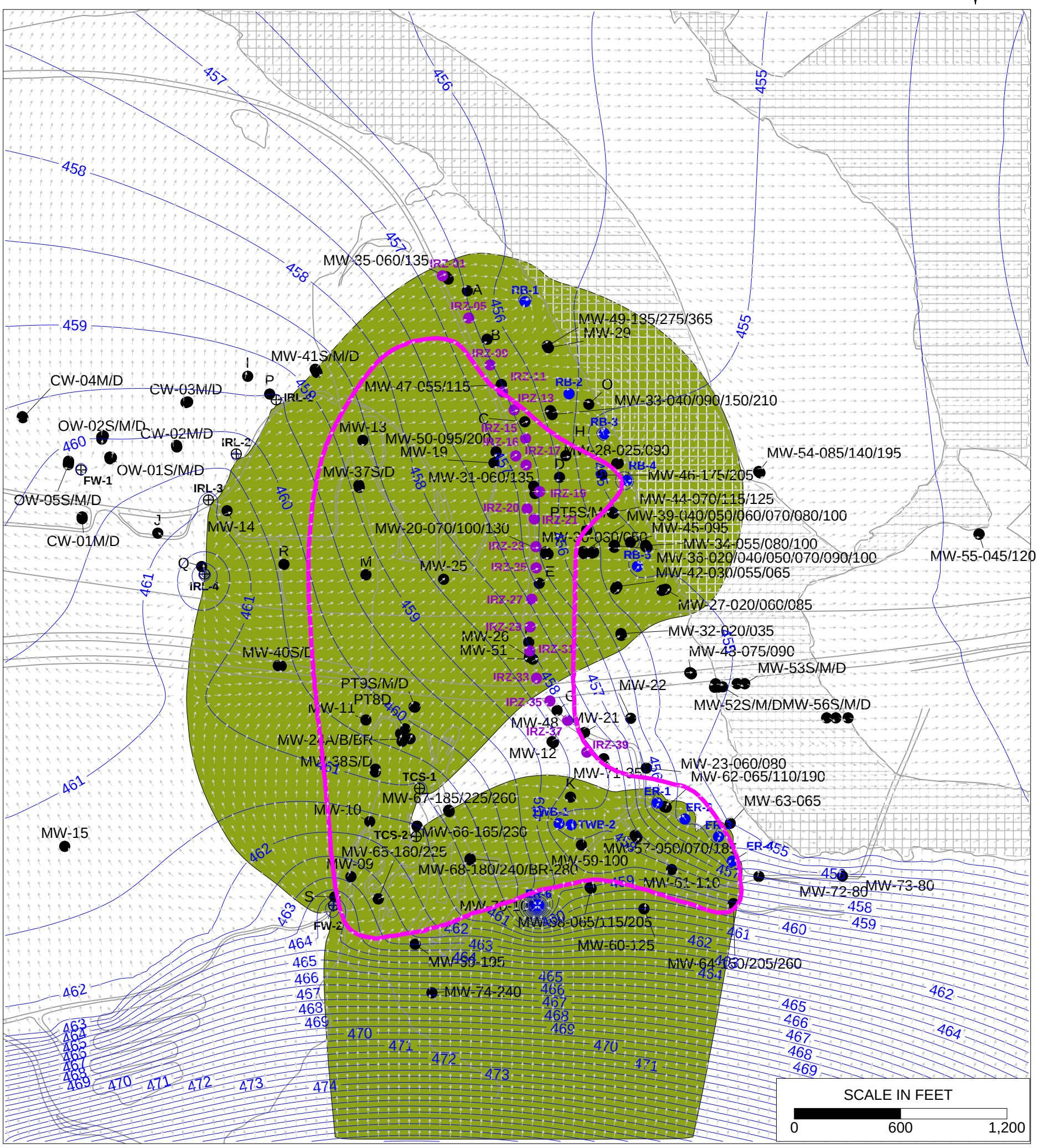
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PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
MODELING APPENDIX

SIMULATED SUBSURFACE GROUNDWATER FLOW AND CAPTURE MODEL LAYER 3 - NTH IRZ ON

ARCADIS

FIGURE
3A



LEGEND

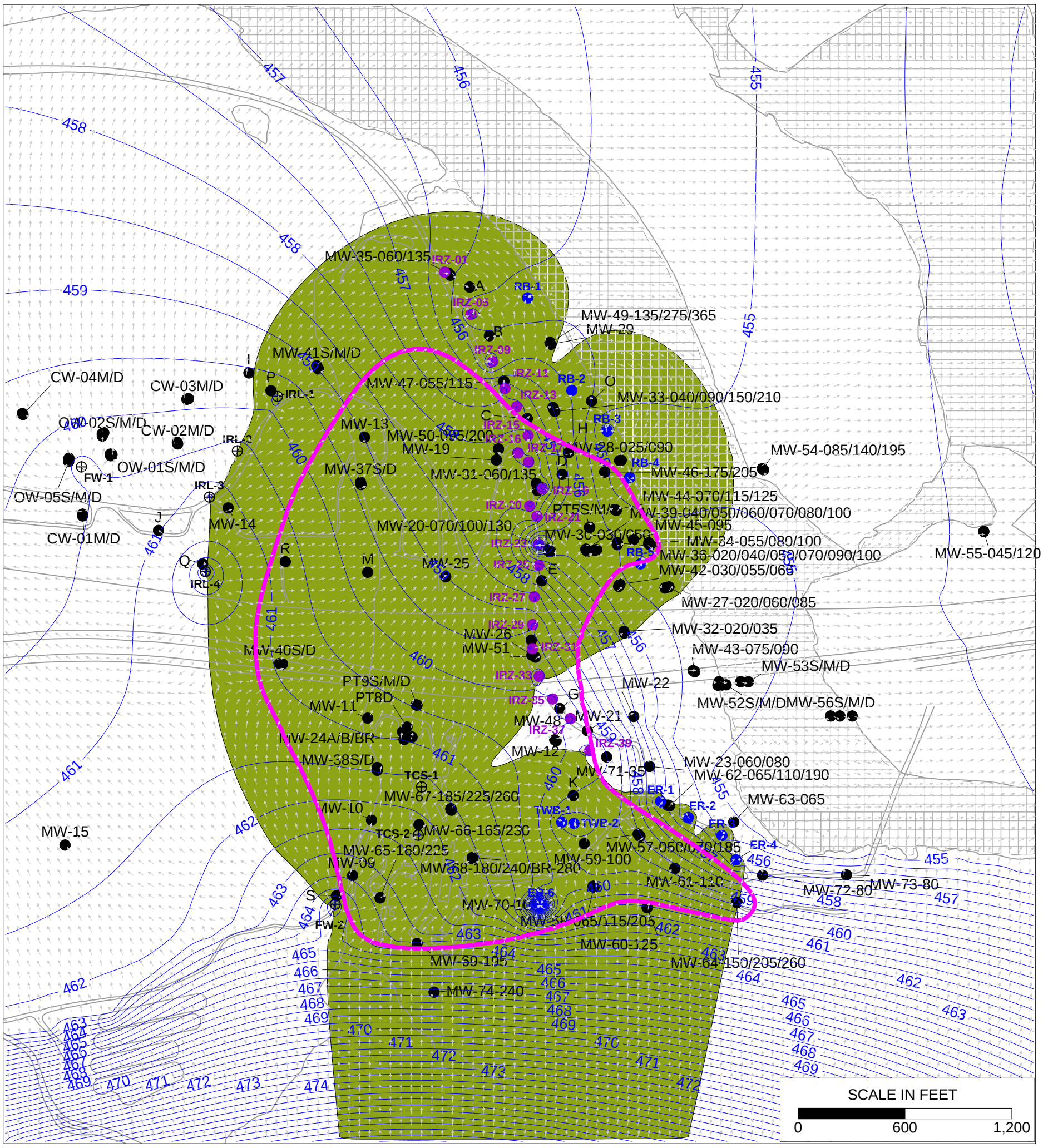
- IRZ WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- MONITORING WELLS
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- SIMULATED GROUNDWATER FLOW VECTOR

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TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
MODELING APPENDIX

SIMULATED SUBSURFACE GROUNDWATER FLOW AND CAPTURE MODEL LAYER 3 - NTH IRZ OFF

ARCADIS

FIGURE
3B



LEGEND

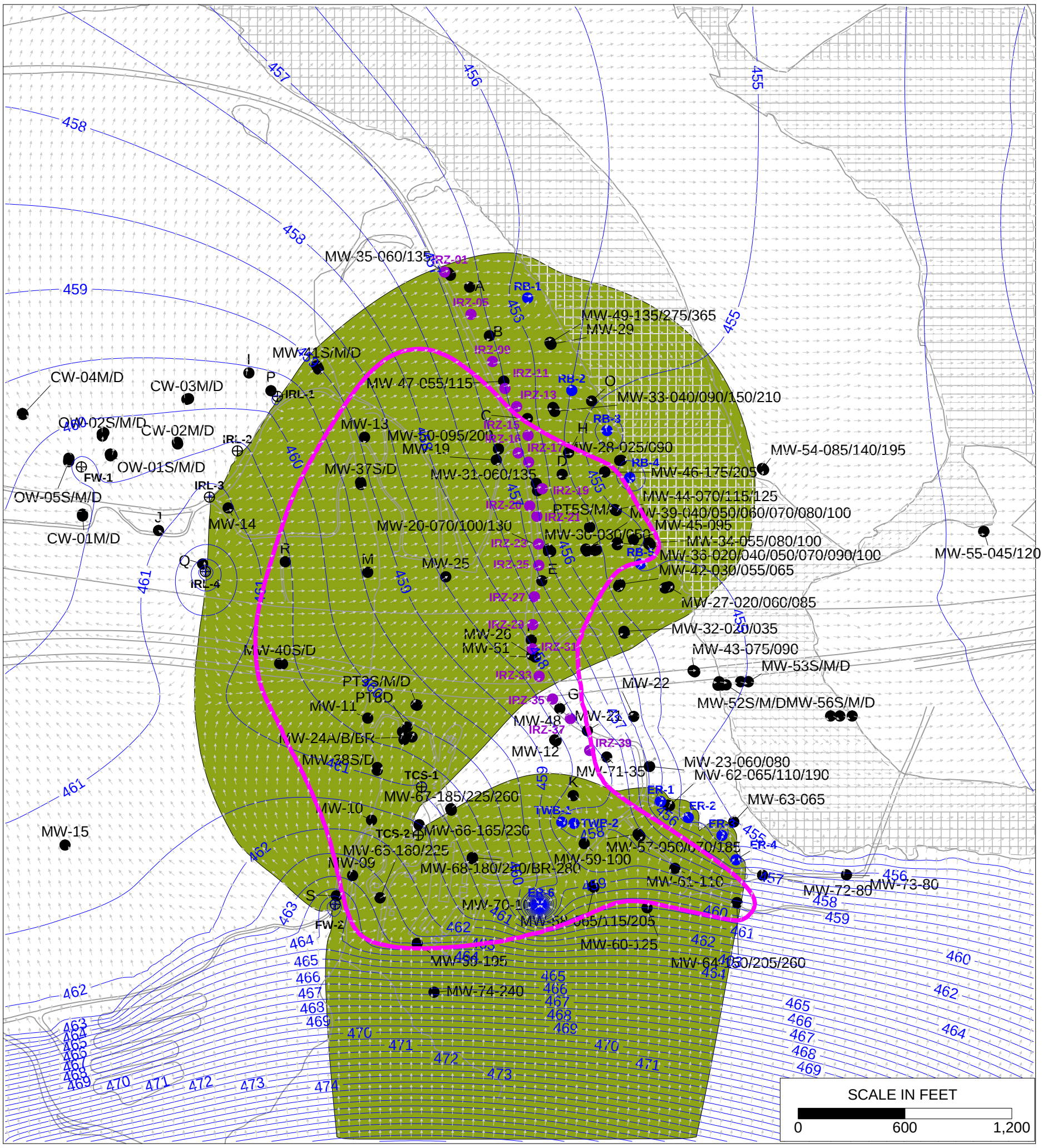
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- SIMULATED GROUNDWATER FLOW VECTOR

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TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
MODELING APPENDIX

SIMULATED SUBSURFACE GROUNDWATER FLOW AND CAPTURE MODEL LAYER 4 - NTH IRZ ON

ARCADIS

FIGURE
4A



LEGEND

- IRZ WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- MONITORING WELLS
- −460− SIMULATED GROUNDWATER LEVELS (FT MSL)
- ESTIMATED HEXAVALENT CHROMIUM 32 ug/L CONTOUR
- SIMULATED GROUNDWATER CAPTURE ZONE
- SIMULATED GROUNDWATER FLOW VECTOR

PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
MODELING APPENDIX

SIMULATED SUBSURFACE GROUNDWATER FLOW AND CAPTURE MODEL LAYER 4 - NTH IRZ OFF

ARCADIS

FIGURE
4B

Attachment F: RTC #168, #178, #816-845

Freshwater Pre-injection Treatment System Design Basis

Addendum to Freshwater Pre-injection Treatment System Design Basis, PG&E Topock Compressor Station, Needles, California

PREPARED FOR: Pacific Gas and Electric Company

PREPARED BY: CH2M HILL

DATE: December 5, 2013

1.0 Introduction

Since the submittal of the 60% design (CH2M HILL 2013), the State Water Resources Control Board (State Board) has issued a decision letter on November 20, 2013, and DTSC has provided direction in its comment on the 60% design (#145 DTSC-50) that the design criteria for the potential future pre-treatment of freshwater at Topock will be limited to arsenic removal only and will be included in the 90% design only as a contingency. In compliance with this recent DTSC's directive, this technical memorandum presents the design basis for a potential future pre-treatment option for freshwater.

This pre-treatment option assumes that the primary source is groundwater from a well in Arizona and the secondary source is water from the current PG&E Topock Compressor Station (TCS) source wells (Topock-2/3). This assumption will be revisited after completion of the alternative freshwater source evaluation—the field work is currently under way. The potential future treatment system, referred to herein as the freshwater pre-injection treatment system (FWPTS), will be located in the vicinity of the planned remedy-produced water-conditioning plant. All components of the FWPTS are located on previously disturbed areas within the PG&E-owned parcel.

The treatment goals of the FWPTS are arsenic removal to concentrations less than the federal and California maximum contaminant level (MCL) of 10 micrograms per liter (µg/L) (California Department of Public Health, 2013). This technical memorandum discusses the evaluation of available treatment technologies for arsenic; the selection of technologies for bench-scale testing; the results from bench-scale testing at CH2M HILL's Applied Science Laboratory (ASL) in Corvallis, Oregon; and the design basis/design criteria for the FWPTS. This document also includes a process flow diagram, a preliminary equipment layout, and a preliminary list of key equipment.

The design information presented herein has been developed based on Topock-specific information (that is, bench-scale testing results of HNWR-1 water) and experience in designing and operating arsenic groundwater treatment systems on non-Topock projects. Because of its location, the potential future FWPTS will be designed to achieve a safe, harmonious, and sustainable operation within TCS. Engineering efforts are being conducted and design details of the FWPTS will be included in the 90% design.

2.0 Freshwater Water Quality, Treatment Goals, and Design Flow Rates

For the purpose of this conceptual design, it is assumed that the water quality from the future supply well in Arizona is similar to that of the HNWR-1 well. PG&E has collected and analyzed six samples from HNWR-1 starting in November 2010. Analytical results from November 2010 through January 2013 indicate that the naturally-occurring arsenic concentrations in HNWR-1 water were 15-16 µg/L, greater than the federal and California MCL of 10 µg/L arsenic. The average concentration of arsenic in Topock-2 was 12.3 µg/L (CH2M HILL 2009) and in Topock-3 was 14 µg/L (CH2M HILL 2013). Table 1 summarizes available arsenic results for HNWR-1 and Topock-2/3 wells. As previously mentioned, the treatment goals for the FWPTS are to remove arsenic to concentrations less than 10 µg/L.

The total freshwater supply flow rates are based on the sum of the modeled freshwater flows into the Freshwater and Inner Recirculation Loop injection wells. The FWPTS will be designed to treat freshwater for remedy injection only. Exhibit 1 shows the FWPTS design flow rates.

EXHIBIT 1
Design Flow Rates
Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum
PG&E Topock Compressor Station, Needles, California

Element	Unit	Minimum Flow	Nominal Flow	Maximum Flow
Freshwater Pre-Injection Treatment System (FWPTS)	gpm	150	450	900

3.0 Evaluation and Selection of Treatment Technologies

For this conceptual design basis, PG&E has identified and evaluated proven treatment technologies for arsenic that are United States Environmental Protection Agency (USEPA) Best Available Technologies and have been successfully used by municipalities and industry. Unproven technologies or technologies that have not been used in full-scale applications were not considered.

The initial list included nine technologies: anion exchange, activated alumina (AA) adsorbents, reverse osmosis (RO), electrodialysis reversal (EDR), lime softening, distillation, iron-based adsorbents, titanium-based adsorbents, and coagulation/filtration (see Exhibit 2). These technologies were evaluated and screened in a two-step process: (1) the initial screening was based the experience of the engineering team with the individual technology, and (2) the second-level screening was based on a set of criteria - namely treatment effectiveness, reliability and flexibility, operational complexity, waste generation, footprint, and cost effectiveness. After completion of the technology screening and evaluation process, the AA technology with disposable and regenerable (AA) adsorptive media, coagulation filtration, and iron-based adsorbent granular ferric hydroxide (GFH) were selected for bench-scale testing. For more details of this screening and a description of the evaluation processes, see Appendix A.

EXHIBIT 2
Technologies Considered for Arsenic Removal
Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum, PG&E Topock Compressor Station, Needles, California

Technology	Evaluation Status
Anion exchange	Screened out, significant waste generation.
AA	Selected for bench-testing
Titanium-based adsorbents	Screened out, similar as other adsorbents considered, with less experience.
Reverse osmosis (RO)	Screened out, significant waste generation.
Electrodialysis reversal (EDR)	Screened out, significant waste generation.
Lime softening	Screened out, significant waste generation.
Distillation	Screened out, significant energy use and capital cost.
Coagulation filtration	Selected for bench-testing
Iron-based adsorbents	Selected for bench-testing

4.0 Summary of Bench-scale Testing Results

The objectives of bench-scale testing were to: (1) verify the effectiveness of each adsorptive media in removing arsenic from HNWR-1 water to the treatment goals, (2) understand the time to break through (critical for equipment sizing and waste management) for AA and GFH, (3) understand effectiveness of coagulation with a jar test, and (4) understand waste generation amounts. This section summarizes the testing and results to date as it relates to arsenic treatment.

To accomplish the first two objectives, CH2M HILL's ASL employs a testing procedure for evaluating adsorptive media effectiveness in removing arsenic in a small-diameter laboratory column analogous to the rapid small-scale column test method developed for assessing granular-activated carbon in a continuous flow system. This method significantly reduces the amount of time and water required for testing compared to pilot-scale and full-scale systems (USEPA 1996). A jar test was performed to evaluate the effectiveness of ferric chloride as coagulant.

A groundwater sample was continuously pumped, sampled, and collected in three 55-gallon drums from HNWR-1 well in early January 2013 and was shipped to ASL for bench-scale testing. The groundwater sample was processed continuously through the column, and the treated water was sampled and analyzed for arsenic until breakthrough (defined as at least 70 percent of the average influent concentration). After the first breakthrough, the media was regenerated, and the test was repeated. Two treatment cycles (termed Service Cycle 1 and Service Cycle 2) were conducted for regenerable AA. Because of time constraints, not all media samples were able to be tested until breakthrough. In total, 133 liters of HNWR-1 well water were processed using disposable AA and 204 liters using GFH. These samples were tested for as long as time permitted in the laboratory. The rapid small-scale column test results provide information on adsorption capacity (extent of adsorption) and the rate of adsorption (adsorption kinetics), which are the two dominant factors affecting breakthrough in the media columns.

The rapid small-scale column test for arsenic removal was performed using the following media

- Regenerable AA (BASF AA-400G)
- Disposable AA (BASF AA-FS50)
- Alum-impregnated AA (AIAA)
- GFH

Prior to passing the water over the media, the groundwater was pretreated as follows: the pH was adjusted to 6.5 with hydrochloric acid and the water was injected with chlorine to maintain a residual concentration of 1 mg/L for 60 seconds (this is to oxidize any arsenite present in the water to arsenate), and was followed by inline filtration.

Column Testing Treatment Effectiveness and Time to Breakthrough

Figure 1 (located at the end of this memo) shows concentrations of arsenic in treated water versus the number of bed-volumes of groundwater passed through (one bed-volume is equivalent to the amount of adsorptive media in the column). During the first service cycle, the regenerable AA performs well, but in the second service cycle the effluent concentration begins to increase more rapidly indicating after the initial service cycle the media loses capacity to adsorb arsenic. Due to this fact and the difficulty in regenerating AA media which requires using strong chemicals like caustic and sulfuric acid, this method is eliminated from further analysis. The AIAA performed somewhat better than the regenerable AA, but not as well as the disposable AA media. The poorer performance and the additional effort to impregnate the alum onto the AA, eliminates this media from further evaluation. The disposable media performed well to more than 44,000 bed volumes, although the arsenic effluent concentration appears to have increased more than the effluent from the GFH media column.

To ascertain the relative performance of the two media, another figure was prepared (Figure 2), which shows the effluent concentration as a function of the amount of arsenic adsorbed on the treatment media. The effluent concentration in the disposable AA, begins to rise rapidly when the adsorption reaches 0.4 µg/mg media where as in the GFH varies between 0.15 and 0.35 µg/mg media until the test was stopped. These results more clearly indicate GFH will perform better.

Jar Testing Results

Jar testing was performed to test arsenic removal by coagulation with ferric chloride. Water samples were pre-oxidized with free chlorine dosed to provide approximately 1 mg/L free chlorine residual for 60 seconds prior to ferric chloride addition and mixing. Ferric chloride was added to reach doses 5, 10, 15, and 20 mg/L. The mixers were run at 70 revolutions per minute (rpm) for 30 seconds followed by 25 rpm for 20 minutes. The samples were then filtered through a 0.45 micron filter and the filtered water tested for arsenic and pH.

Figure 3 shows the arsenic concentration versus ferric chloride dose applied during testing. Jar testing demonstrated that arsenic could effectively be removed to <10 µg/L with ferric chloride dosed to 5 mg/L.

Process Selection

As shown above, the GFH was effective at removing arsenic to below the treatment goals (the federal and California MCL of 10 µg/L). The effluent remained less than 1 µg/L of arsenic for over 70,000 bed-volumes. The GFH media performed better than the disposable AA offering longer running periods between media change-outs. Coagulation and filtration although effective creates a solid waste stream that must be transported and disposed of off-site and is more difficult to operate. Based on these reasons, GFH was selected for the FWPTS design.

Section 5 discusses the treatment and backwash process in more details and provides a summary of the sustainability factors.

5.0 Freshwater Treatment Process and System Description

As previously mentioned, GFH was selected as the treatment technology to be carried forward into the design of the FWPTS. GFH is a granular, ferric-based, non-regenerative media that adsorbs arsenic and other heavy metal ion from solution. The USEPA has identified GFH as an effective media to remove arsenic (USEPA 2003). This section describes the design philosophy, the treatment process, and the system configuration envisioned at this stage. This section also discusses the uncertainties with the ongoing design and the work that is currently underway or being planned to address these uncertainties.

5.1 Treatment System Description

Groundwater will be pumped and conveyed from the future water supply well in Arizona to the remedy freshwater storage tank. Water will be pumped from this tank and will be injected with hypochlorite for arsenic oxidation and with acid to reduce pH to 6.5; both hypochlorite and lower pH improve arsenic removal in the

media vessels. After chemical injection, water will be passed through bag or cartridge filters to remove solids that would otherwise clog the media, reducing performance and runtime. With the solids removed, the water will be divided into two or three streams (nominal or maximum flow) and each will be processed through a single treatment media vessel (configured in parallel) in a downward flow direction. Automatic valves will divert the flow to the proper vessels and will control the flow rate into each in service vessel. During nominal flow, the third and fourth treatment media vessel will be in standby mode. During maximum flow, three treatment media vessels will be operating. Prior to backwashing a vessel, a standby vessel will be brought on line and the first vessel requiring backwash will be put into standby. The remaining in service vessels will be backwashed in turn.

PG&E is evaluating dechlorination alternatives to remove residual chlorine from the treated freshwater. Dechlorination is often accomplished by addition of chemicals such as ascorbic acid, calcium thiosulfate, and hydrogen peroxide. The equipment would involve chemical storage drums or totes, metering pumps, and an inline static mixer. The proposed FWPTS location has sufficient space for this equipment. Additional details will be provided as part of the 90% design submittal.

5.2 Media Backwash & Replacement Process

The amount of wastewater generated is primarily a function of backwash frequency. Backwashing prevents over compaction of the media bed enabling good flow conditions. The media bed should be backwashed once a month for proper media maintenance. Backwashing occurs in an upflow mode, the reverse of normal forward down-flow operation. Once the backwash process is complete, normal forward down-flow operation may resume. Each media vessel backwash process is expected take ten minutes.

At some point during treatment operations, the media will lose its adsorptive capacity and will need to be replaced. Based on bench scale testing, this point is anticipated to be after more than 70,000 bed-volumes or about 8 months at maximum flow rates. The actual replacement frequency will be determined during full-scale operation. For the purpose of the conceptual design, it is assumed that the media will be replaced once a year. Spent media will be removed from each vessel and sent to a landfill. Prior experience operating GFH treatment process shows the spent media is not hazardous (Ela 2006). Waste characterization testing will be performed in accordance with state and federal requirements and facility waste acceptance procedures. Virgin media will be placed in the media vessel and normal forward down-flow operation may resume.

Wastewater & Solid Waste Generation

The volume of wastewater needing to be managed is estimated based on the following assumptions:

- Backwash rate is 15 gpm/sq. ft. and vessel cross section area is 50 sq. ft.
- Backwashing time is 10 minutes resulting in 7,550 gallons per backwash
- Four vessels backwashed monthly at 900 gpm and two vessels backwashed monthly at 450 gpm
- 95 percent of the backwash water is recycled to the beginning of the process

At 450 gpm – 7,550 gallons/backwash x 2 vessels per month x 12 months per year x 5% = 9,000 gallons per year

For 900 gpm – 7,550 gallons/backwash x 4 vessels per month x 12 months per year x 5% = 18,000 gallons per year

The remaining (5 percent of the) backwash water can be discharged to the cooling tower makeup, the TCS evaporation ponds, or disposed offsite at permitted facilities. There is no need to treat or neutralize the pH of the discharged backwash water as it will be within acceptable ranges. Treated water is used for backwashing and no arsenic desorbs from the media during the backwashing process. Discharged backwash water will have more solids compared to the treated water but it will be able to be used for cooling tower makeup, TCS evaporation ponds, or disposed offsite without treatment.

Periodic disposal of the spent GFH media would be required also as a solid waste stream. Based on the bench testing, this would be no more frequently than every 8 months, but is expected to be less frequent. For the purposes of this conceptual design, it is assumed that the media will require annual replacement. The mass of solid waste to be managed

- The media has a specific gravity of 1.1 with water density of 62.4 pounds per cubic foot

- Each vessel has 200 cubic feet of media
- Four vessels need replacement at a rate 900 gpm and 2 vessels at a rate of 450 gpm

At 450 gpm – 200 cubic feet/vessel x 2 vessels per year x 1.1 x 62.4 pounds per cubic foot / 2,000 tons/pound = 13.7 tons per year

At 900 gpm – 200 cubic feet/vessel x 4 vessels per year x 1.1 x 62.4 pounds per cubic foot / 2,000 tons/pound = 27.5 tons per year

5.3 Chemical and Media Use

Chemicals will be used in the treatment system. Chlorine in the form of calcium hypochlorite tablets is used to oxidize arsenite to arsenate. Arsenate is more readily removed by the treatment process. Acid is used in pretreatment to improve adsorption by lowering the pH to about 6.5. Dechlorination of the treated water is under consideration and will be developed further for the 90% design submittal. The estimated chemical use is shown in Exhibit 3.

EXHIBIT 3
Annual Chemical Usage Rates
Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum
PG&E Topock Compressor Station, Needles, California

Flow Case	Flowrate, gpm	Hypochlorite, pounds/year	93% Sulfuric Acid, gallons/year	Dechlorination Chemical[a]
Nominal	450	3,500	5,150	TBD
Maximum	900	7,000	10,300	TBD

a. Typical dechlorination agents include ascorbic acid, calcium thiosulfate, and hydrogen peroxide.

5.4 Sustainability Summary

For each of the treatment plant operating scenarios (450 and 900 gpm), sustainability parameters such as waste generation, chemical usage, energy use, and greenhouse gas emissions were estimated for the FWPTS as shown on Exhibit 4.

EXHIBIT 4
Sustainability Summary [a]
Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum,
PG&E Topock Compressor Station, Needles, California

				Operations						***Construction***	
Treatment Case	**Chemical Truck Trips**	**Solid Waste Truck Trips**	**Electricity, kw-hr/yr**	**Wastewater Generation, MG/yr**	**Solid Waste Generated, tons/ year**	**Chemical Use, gal/yr**	**Total Miles/ year**	**Emissions, CO2 eq, Tons/year** [b]	**CO2 eq, Tons** [c]	**Footprint, sf** [d]
450 gpm	14	2	280,000	Minimal	18	20,000	5,000	180	210	2,400
900 gpm	27	~3	320,000	Minimal	35	40,000	10,000	200	250	3,900

Notes: Units: kw-hr/year = kilowatt-hours per year; MG/yr = million gallons per year; gal = gallons; sf = square feet; gpm=gal per minute; CO2 eq – carbon dioxide equivalent
a: Previously submitted on March 29, 2013. Additional effects for using a dechlorination agent if required will be added to this table in the 90% design submittal.
b: Operational emissions include vehicle emission and electricity generation
c: Construction includes site work, material delivery, and workers travel
d: Footprint based on foundations for building, process tanks, and chemical storage

5.5 Controls Philosophy

The system will be automated to reduce the need for continuous operator oversight. Electronic notifications will be sent automatically to on-site operators that notify them of system alarms, shutdown, or other issues. System automation will be controlled using a programmable logic controller that will communicate with the groundwater remedy supervisory control and data acquisition system. Pneumatic valves will be automated to control flow. Online pH, turbidity, and conductivity sensors will be incorporated to enable remote process monitoring and control. Arsenic cannot be monitored using an online analyzer. Grab samples will be collected periodically and analyzed using a bench top colorimetric instrument in the sample room (located in the Remedy Produced Water Conditioning Building or the Central Maintenance Facility) to monitor arsenic levels.

5.6 Other Related Systems and Infrastructure

Electricity will be provided from the compressor station in a new building located next to the Remedy Produced Water Conditioning Building. The new FWPTS location will have a heating, ventilation, and air conditioning (HVAC) system for only critical equipment such as electrical and controls equipment.

5.7 Design Philosophy/Uncertainties in Design

As previously mentioned, the FWPTS will be designed to achieve a safe, efficient, and sustainable operation within the compressor station over the anticipated decades-long life of the remedy. Most of the uncertainty in the design is related to the bed life and adsorptive capacity of the media. Based on bench testing, it is anticipated that the media will not need to be replaced before 70,000 bed volumes are processed– or every 8 months. The actual adsorptive capacity will need to be determined during full-scale operation and the result will greatly influence the amount of wastewater and solid waste generated by the process.

6.0 Design Information

Process calculations used to develop the design criteria were prepared using the conservative assumption that the treatment vessels each needed to be backwashed once a month and media replaced annually. Conceptual design information is presented in Tables 2, 3, and 4 and on Figures 4, 5, and 6 at the end of this technical memorandum. More detailed design information will be included in the 90% design.

7.0 References

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United States Environmental Protection Agency (USEPA). 1996. *ICR Manual for Bench- and Pilot-Scale Treatment Studies.* EPA 814/B-96-003. April.

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Tables

TABLE 1

Arsenic Concentrations in HNWR-1 and Topock-2/3 Wells

Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum,
PG&E Topock Compressor Station, Needles, California

HNWR-1 Well – As Concentration					
11/10/2010	2/23/2012	3/15/2012	4/4/2012	6/27/2012	1/22/2013
15µg/L	15µg/L	16µg/L	15µg/L	16µg/L	16µg/L
(Source: April 2013 Freshwater Pre-Injection Treatment System Design Basis Memorandum, Table 1)					
Topock-2 Well					
Average As concentration = 12.3 µg/L *(Source: November 2009 Groundwater Background Study Report, Table 2-9, Footnote 5)*					
Topock-3 Well					
Average As concentration = 14 µg/L *(Source: April 2012 Freshwater Sources Evaluation Technical Memorandum, Table 3-1)*					

TABLE 2
Design Criteria for Arsenic Treatment System
Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum, PG&E Topock Compressor Station, Needles, California

Subject	Criteria	Comments/Reason
OPERATIONAL CRITERIA		
Maximum Groundwater Injection Flow Capacity	900 gpm	
Minimum Groundwater Injection Flow Capacity	150 gpm	
Average Groundwater Injection Flow Capacity	450 gpm	
SITE CIVIL		
Location	Designated freshwater treatment at PG&E Topock Compressor Station near Needles, California.	
Building Finish Floor Elevation	Finished first floor, Elevation 626 feet (NGVD88).	
Grading	Longitudinal Slopes: Minimum 1% away from structures (2% desirable).	
Vehicle Access	WB 50 (turning radius for semi-truck and trailer with 50-foot wheel base). HS 20 (wheel loading on access roadways and parking areas). 50-foot minimum turning radius. Designated site accommodates truck circulation. Roads will be constructed at new facility for maintenance activities.	Required for delivery of chemicals, pumps, motors, and fire vehicles.
Site Constraints	Proposed facility located within the boundary of the compressor station. Access to all critical compressor station facilities must be maintained.	No modifications to the perimeter site fence or entrance gate will be made.
Parking	No parking will be required for new facility.	
Pedestrian Traffic	Limited to paved roadways, sidewalks are not located between existing facilities.	
PROCESS EQUIPMENT, MOTORS, VALVES, AND ANCILLARIES		
Remedy Freshwater Storage Tank		
Material	Steel	Welded steel in accordance with American Water Works Association Standard D-100. Internal coatings will be applied for corrosion resistance.
Number	One	
Capacity	10,000-gallons	Based on remedy design flow of 900 gpm and four freshwater supply well pump starts per hours plus provision for dead storage. Assumes fire water will be supplied by the existing freshwater storage tanks.

TABLE 2
Design Criteria for Arsenic Treatment System
Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum, PG&E Topock Compressor Station, Needles, California

Subject	Criteria	Comments/Reason
Treatment Process	Pre-oxidation, influent pH adjustment, followed by ligand exchange with granular ferric hydroxide for arsenic removal. Periodic backwash of media with treated water and annual media replacement. Treated water may be dechlorinated to enhance remedy performance (see Dechlorination System below).	Design criteria listed below is what is expected from planned pre-purchase bid, but not a guarantee of what equipment will be selected. The information in this section will be verified during the detailed design.
Granular Ferric Hydroxide (GFH) Treatment		
Treatment Objective	Arsenic removal	
Number of Vessels	Four when operating a maximum flow: Four: three online, one on standby. Two online when operating at nominal flow;	
Residence Time	5 minutes empty bed contact time	USEPA guidance.
Vessel Height	10.5 feet overall	
Vessel Diameter	8 feet	4 to 8 gpm/ft^2 hydraulic loading.
Materials of Construction	Low-carbon steel with epoxy lining that is NSF 61 listed.	
Media	Granular ferric hydroxide	Siemens, Severn Trent, or equal
Performance Limits		
Effluent Arsenic Concentration	< 10 µg/L	
Wastewater Volume	9,000 – 18,000 gal/year	
Chlorine Feed System		
Chemical Feed System	One calcium hypochlorite tablet feeder system—HDXLPE (with oxidation resistant liner) mix tank, feed pump, tablet hopper, controller and panel with disconnect. Sized for 0.2 to 2 lbs/hour of chlorine. Three days' minimum tablet capacity.	Feed system located in a containment area.
Safety Equipment	One eyewash and shower unit	
Coatings/Finishes	Chemical resistant coatings in chemical areas	
Controls	Chemical flow meter flow rate and totalizer Chemical feed pump speed control	
Sulfuric Acid Feed System		
Chemical Feed System	One 1,000-gallon carbon steel with baked phenolic lining. Desiccant drier installed on vent. Sulfuric acid tank with tank pad.	Tank will be located in a containment area. Weekly fill frequency is the design basis,
	One chemical feed skid with two controllable chemical feed pumps	Solution concentration will be 93%.
Safety Equipment	One eyewash and shower unit	
Coatings/Finishes	Chemical resistant coatings in chemical areas	
Controls	Chemical flow meter flow rate and totalizer Chemical feed pump speed control	
Backwash Tank and Treated Water Tank		

TABLE 2
Design Criteria for Arsenic Treatment System
Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum, PG&E Topock Compressor Station, Needles, California

Subject	Criteria	Comments/Reason
Material	Fiberglass Reinforced Plastic (FRP)	
Number	Two	
Capacity	10,000-gallons tanks	Backwash is anticipated to be just over 7,000 gallons per vessel – 10 minutes of backwashing at 15 gpm/ft^2. Backwash tank will have floating decanter or cone bottom to aid in solids recovery and improve backwash recycle rate. Selection to be made in 90 per cent design.
Dechlorination System		Agent and strength to be determined – likely substances include ascorbic acid, calcium thiosulfate, hydrogen peroxide.
Chemical Feed System	Drums or chemical tote compatible with dechlorination agent. One chemical feed skid with two controllable chemical feed pumps	Container will be located in a containment area. Monthly fill frequency is the design basis, It is assumed there is sufficient space for this equipment.
Safety Equipment	One eyewash and shower unit	
Coatings/Finishes	Chemical resistant coatings in chemical areas	
Controls	Chemical flow meter flow rate and totalizer Chemical feed pump speed control Inline static mixer	
Flow Meters		
Type	Magnetic	
Number	Nine	
Flow Control Strategy	FWPTS will receive raw water from the primary source wells into a new freshwater storage tank (10,000 gallons). The secondary source Topock-2/-3 wells will flow by gravity from the existing TCS storage tanks only when required.) A booster pump with variable frequency drive will vary the flow through the treatment plant to maintain set point water levels in the treated water tank and prevent pump operating when the remedy freshwater storage tank water levels are below the setpoint. Media vessel inlet control valves equalize flows through each vessel.	
Pressure Transmitters	Furnished before/after media vessels.	
Static Mixer		
Number	One (at the inlet)	
Diameter	One 10-inch	
Type	Wafer style with integral injection ports	
Piping Materials		

TABLE 2

Design Criteria for Arsenic Treatment System

Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum, PG&E Topock Compressor Station, Needles, California

Subject	Criteria	Comments/Reason
Process	HDPE SDR 11 or CPVC Schedule 80, per ASTM D1784, ASTM D1785, and NSF/ANSI 14 and NSF 61 listed	
Treatment Media Vessel Manifold	HDPE SDR 11 or CPVC Schedule 80, per ASTM D178, ASTM D1785, NSF/ANSI 14 and NSF-61 listed	
Potable Water	Buried: Copper, Type K, per ASTM B88 Exposed: Copper, Type L, per ASTM B88 or CPVC Sch. 80	
Process Piping Installation	Major process piping headers will be installed in pipe trenches inside the treatment building and buried outside the building. Media vessel piping will be aboveground. Actuated valves will be installed above grade whenever possible.	
Remedy freshwater storage tank Interface	Inlet from Remedy freshwater storage tank	
	YARD PIPING	
Design Criteria	Appendix C, Basis of Design Report (CH2M HILL 2013)	
	CORROSION CONTROL	
Design Criteria	Appendix C, Basis of Design Report (CH2M HIL, 2013)	
	ARCHITECTURAL/STRUCTURAL	
Building Code	Appendix C, Basis of Design Report (CH2M HILL 2013)	
Building Design Concept	Single building adjacent to Remedy Produced Water Conditioning System	
Building Construction Materials	Appendix C, Basis of Design Report (CH2M HILL 2013)	
Loads	Appendix C, Basis of Design Report (CH2M HILL 2013)	
	HVAC	
Codes/Standards	Appendix C, Basis of Design Report (CH2M HILL 2013)	
Design Conditions		
Site Elevation	See Section C.2 Civil, Appendix C, Basis of Design Report (CH2M HILL 2013)	
Cooling Load Basis	Building envelope heat gain and internal heat gains from equipment.	
System Type		
Process Building	A space for electrical and controls equipment in the building will be ventilated and cooled by a packaged air conditioning unit (Appendix C, Basis of Design Report [CH2M HILL 2013]). A thermostat will be located near the electrical controls and will maintain the desired temperature in that area.	

TABLE 2
Design Criteria for Arsenic Treatment System
Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum, PG&E Topock Compressor Station, Needles, California

Subject	Criteria	Comments/Reason
	PLUMBING	
Lavatory/Toilet Room	No facilities provided.	
Potable Water	Emergency shower/eye wash stations.	Per 2010 California Plumbing Code, and ANSI Z358.1.
Non-potable Water	The non-potable water supply will have a reduced pressure backflow preventer. Non-potable water will be supplied for wash down water. Wash down hose valves, hoses and hose racks will be furnished in the area as required.	Per 2010 California Plumbing Code.
	ELECTRICAL	
Electrical Load	The electrical load will consist of process pumps, motor operated valves, filter system, control panel and instrumentation, building HVAC, convenience receptacles and interior and exterior lighting. Power distribution will be sized in accordance with NFPA 70 (National Electric Code) to operate process and facility loads. Short-circuit current interrupting capacity of power distribution equipment will be coordinated with existing power distribution system.	.
Service Voltage	480V, 3-phase, 3-wire power will be supplied from XFMR 099	
Utilization Voltage	Appendix C, Basis of Design Report (CH2M HILL 2013)	
Redundancy Requirements	Power distribution system redundancy will be limited to equipment supporting the operation of back-up process and facility equipment (i.e. motor control combination starters, and breakers,). Power distribution system for FWPTS will incorporate spare breakers and fuses. Supporting quick replacement of failed components. Backup power by diesel generator located at Transwestern Bench.	.
Manufacturers of Electrical Equipment, Grounding, Lightning Protection, Illumination, Emergency Lights, Stand-by/Backup Power, Raceways, and Duct Banks	Appendix C, Basis of Design Report (CH2M HILL 2013)	
	SECURITY	
Security	None	All security covered through TCS main facility

TABLE 2

Design Criteria for Arsenic Treatment System

Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum, PG&E Topock Compressor Station, Needles, California

Subject	Criteria	Comments/Reason
	CONTROL AND TELEMETRY	
Control and Telemetry Design Criteria	The treatment vessels will be a packaged system with the equipment manufacturer providing a fully configured programmable logic controller based system control panel with panel-mounted operator interface terminal. The control panel will be specified with an uninterruptible power supply to provide true online conditioned power sized to operate the connected load for 30 minutes.	
Communications, Other Networks, Supervisory Control and Data Acquisition, Instrumentation	Appendix C, Basis of Design Report (CH2M HILL 2013)	
Environmental Requirements	Equipment and instrumentation will be suitable for the following conditions: Air-conditioned Spaces: 10°C to 35°C and a relative humidity of 10 to 80 percent. Non-air-conditioned Spaces: 0°C to 50°C and a relative humidity of 10 to 95 percent. Outdoors: 0°C to 60°C and a relative humidity of 5 to 100 percent.	Environmental controls, such as heaters, fans, and air conditioning will be provided to maintain equipment within the operating conditions recommended by the manufacturer.
Standards/References	Appendix C, Basis of Design Report (CH2M HILL 2013)	

TABLE 3
Major Equipment List
Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum, PG&E Topock Compressor Station, Needles, California

Quantity	Name	Description
4	Treatment Media Vessels	8-feet-diameter low-carbon steel with epoxy lining (9 - 18 gpm/ft^2 hydraulic loading rate)
1	Hypochlorite Feeder	Calcium hypochlorite tablet feeder: HDXLPE (with oxidation-resistant liner) mix tank, feed pump, tablet hopper, controller, and panel with disconnect
1	Sulfuric Acid Tank	1,000-gallon, (93% sulfuric acid), desiccant drier installed on vent. Baked phenolic lining on steel.
1	Acid Feed System	Pre-engineered skid with two chemical metering pumps for 93% sulfuric acid (0.5 to 2 gph)
1	Dechlorination System	To be determined – Pre-engineered chemical feed skid, storage tote or drum, and static mixer.
1	Pre-treatment Wafer-Style Static Mixer	With integral injection ports
2	Booster Pumps	Centrifugal pump with variable frequency drive
3	Filters skids with replaceable elements	Package unit with differential pressure indication and alarm. Bag or cartridge type
2	Backwash Recycle Pumps	Centrifugal pump with VFD
2	Backwash Pumps	Centrifugal pump 755 gpm (15 gpm/ft^2 hydraulic loading rate) with VFD
2	Treated Water Pumps	Centrifugal pump with VFD

TABLE 4

Mass Balance Table

Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum, PG&E Topock Compressor Station, Needles, California

DRAFT

Stream # (see Figure 4)	1	2	3	4	5	6	7	7d
Waste Stream	Downstream of the Booster Pumps	To the Media Filters	To the Treated Water Tank	To the Injection Wells	Backwash	Recycle	Liquid Phase Separator	Cooling Tower/TCS Pond/Offsite Disposal
Maximum Flow (gpm)	900	900	900	900				
Maximum Flow (ac-ft/Year)	1,452	1,452	1,452	1,452				
Arsenic (mg/L)	0.015	0.015	0.001	0.001	0.001			
Arsenic (lbs/yr)	59.1	59.1						
pH	8.0	6.5	6.5	6.5	6.5			
Chlorine (mg/L)	0	1.15	1.15	1.15	1.15			
Calcium Hypochlorite (lb/year)		6,969						
Sulfuric Acid (mg/L)		40						
Acid (gal/year)		10,297						
Wastewater Volume (MG/yr)					0.36	0.344	0.018	0.018
Wastewater Volume (ac-ft/yr)					1.11	1.055	0.056	0.056
Nominal Flow (gpm)	450	450	450	450				
Nominal Flow (ac-ft/Year)	726	726	726	726				
Arsenic (mg/L)	0.015	0.015	0.001	0.001	0.001			
Arsenic (lbs/yr)	29.5	29.5						
pH	8.0	6.5	6.5	6.5	6.5			
Chlorine (mg/L)	0	1.15	1.15	1.15	1.15			
Calcium Hypochlorite (lb/year)		3,485						
Sulfuric Acid (mg/L)		40						
Acid (gal/year)		5,148						
Wastewater Volume (MG/yr)					0.18	0.172	0.009	0.009
Waste Volume (ac-ft/yr)					0.56	0.528	0.028	0.028

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GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CA

PROCESS

FRESHWATER PRE-INJECTION TREATMENT SYSTEM – MASS BALANCE

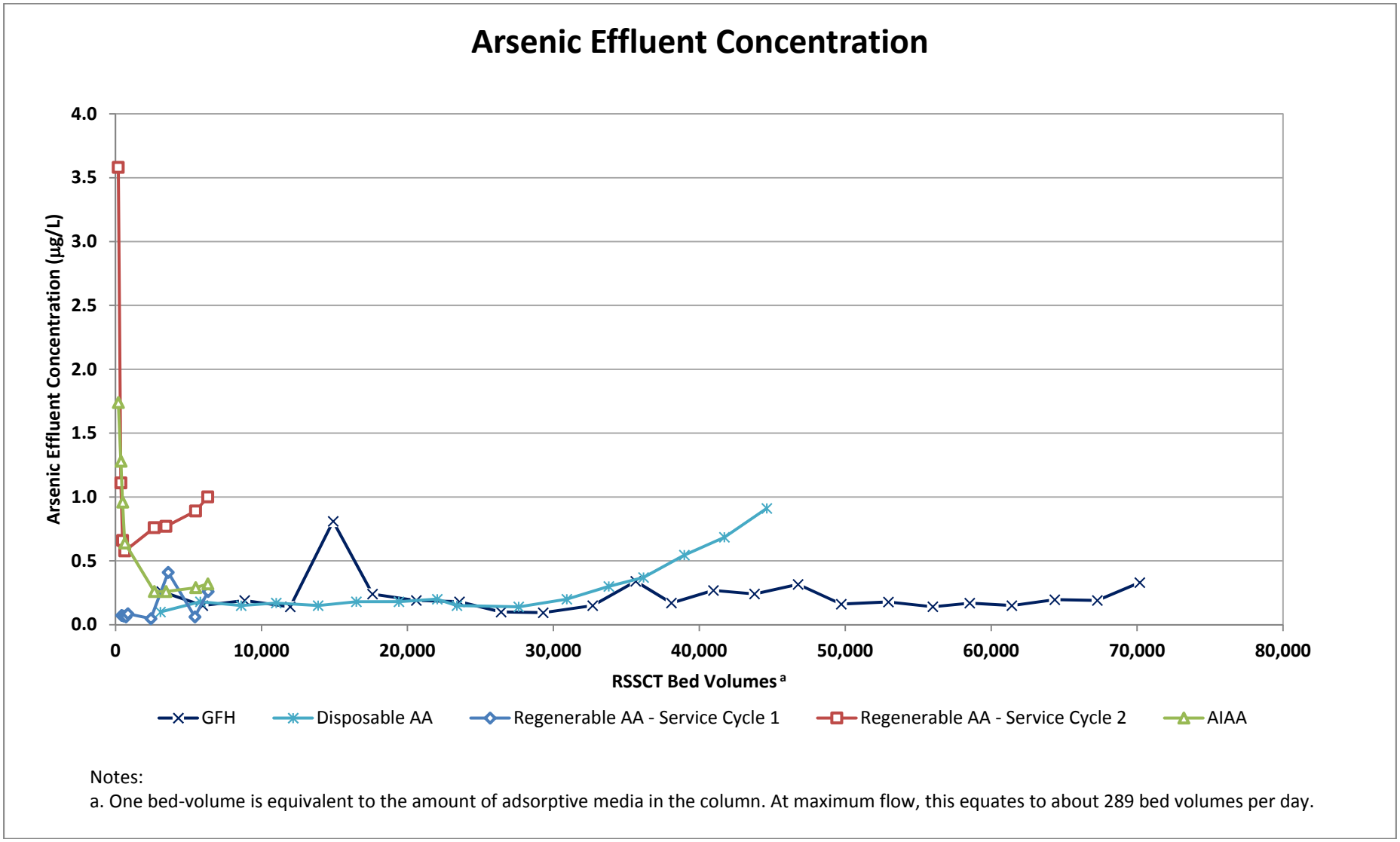
SHEET
DWG NO. 1
DATE 11/21/2013 02:51
REV

PRINTED NOVEMBER 21, 2013 02:50

Figures

FIGURE 1

Arsenic Effluent Concentration versus Bed Volumes



Notes:

a. One bed-volume is equivalent to the amount of adsorptive media in the column. At maximum flow, this equates to about 289 bed volumes per day.

FIGURE 2

Arsenic Effluent and Adsorption Rate

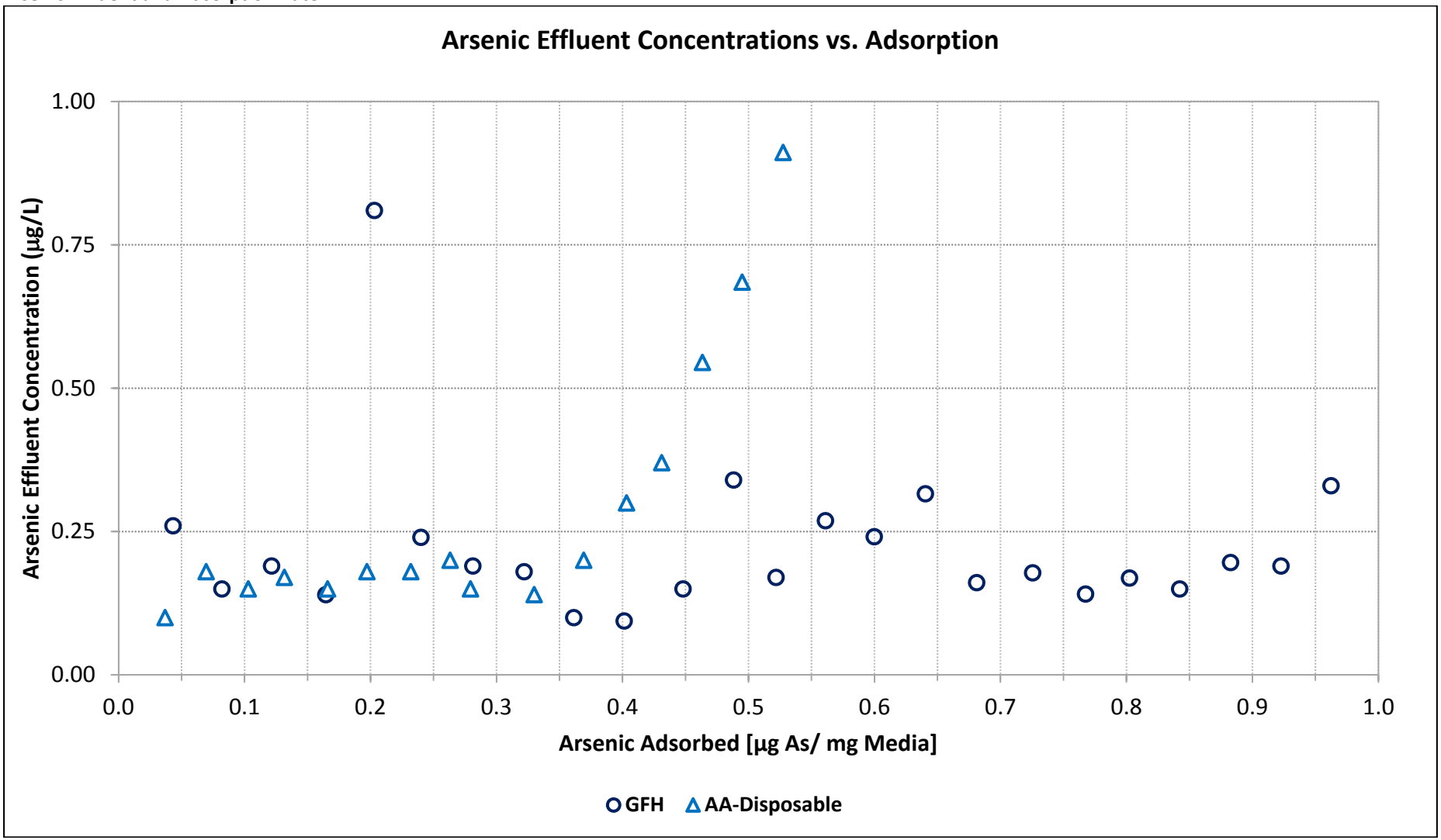


FIGURE 3
Jar Test Results

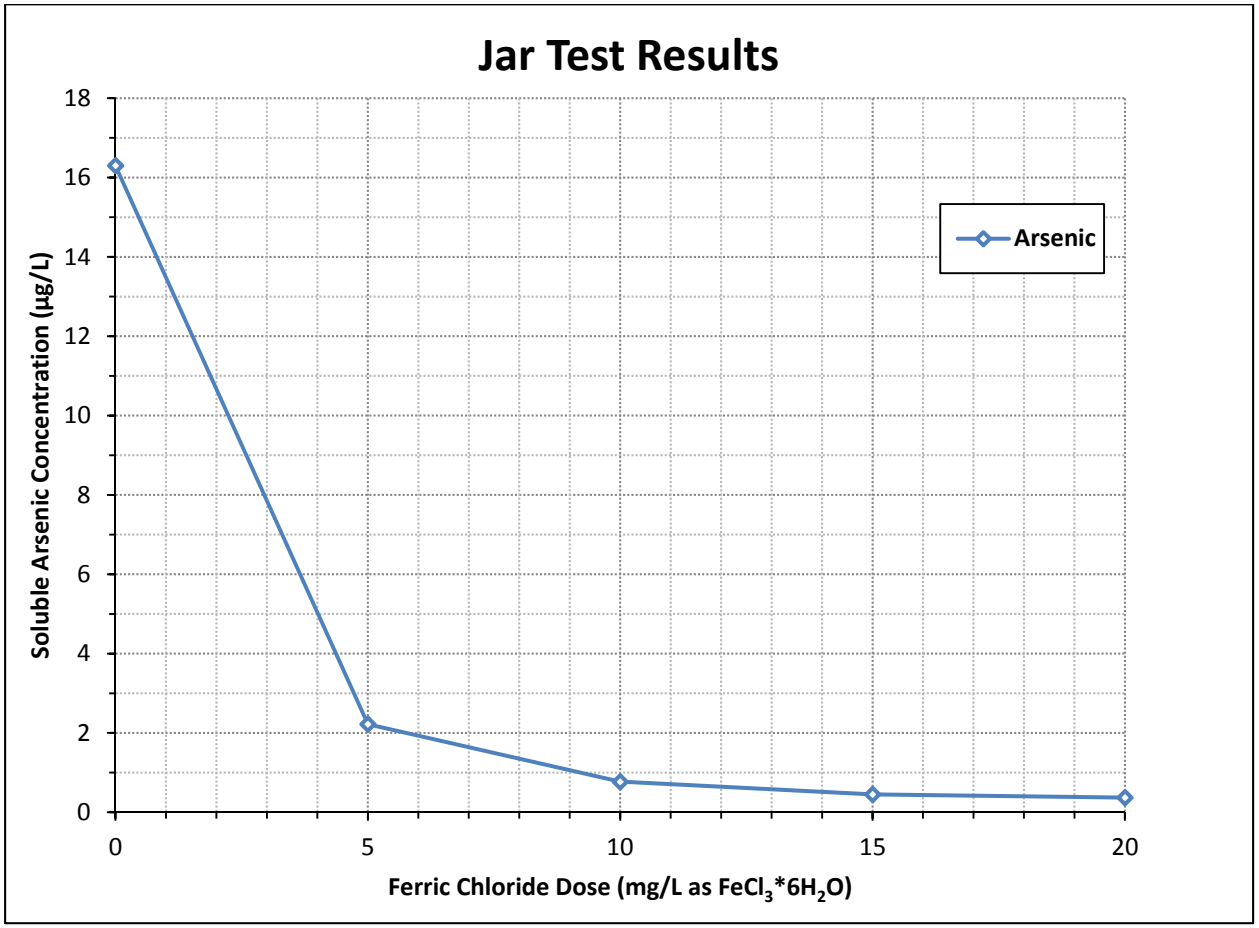
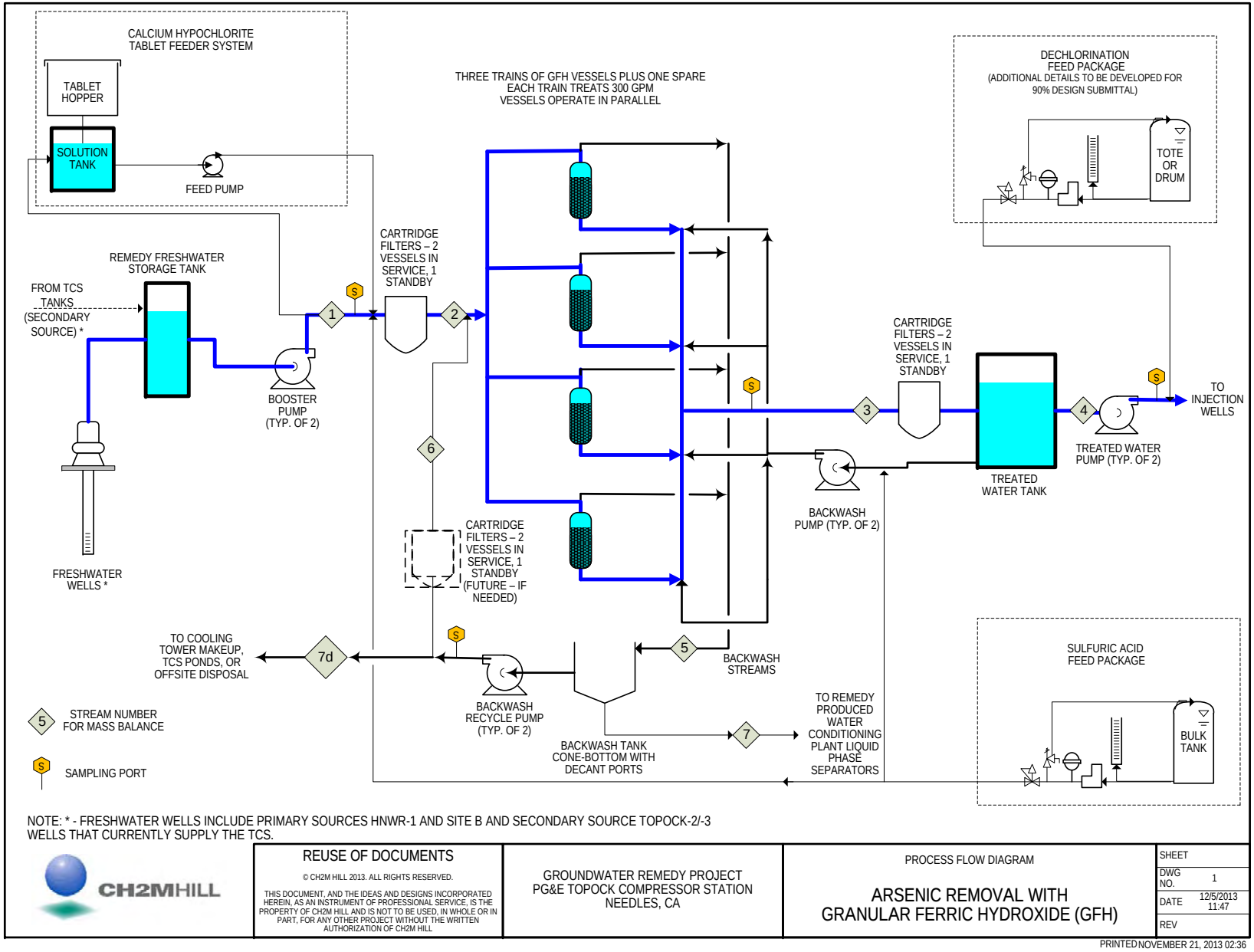


FIGURE 4
Process Flow Diagram



NOTE: * - FRESHWATER WELLS INCLUDE PRIMARY SOURCES HNWR-1 AND SITE B AND SECONDARY SOURCE TOPOCK-2/-3 WELLS THAT CURRENTLY SUPPLY THE TCS.

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GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CA

PROCESS FLOW DIAGRAM

ARSENIC REMOVAL WITH GRANULAR FERRIC HYDROXIDE (GFH)

SHEET	
DWG NO.	1
DATE	12/5/2013 11:47
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PRINTED NOVEMBER 21, 2013 02:36

Freshwater Pre-Injection Treatment System Tank Area

Chemical Storage Area

Sulfuric Acid Tank, 1,000 gal cap.

Chemical Feed Skid

Dechl-orination Tote or Drum**

Hypochlorite Tablet Feeder System

Dechlo-rination Feed Skid**

MW-69

Process Tanks Area

Remedy Freshwater Storage Tank 10,000 gal cap.

Backwash Tank 10,000 gal cap.

Treated Water Tank 10,000 gal cap.

0 ft. 6 ft. 10 ft. 20 ft.

Note: Scale applies within buildings and on foundations. Space between structures is aproximate. Detailed design efforts may result in changes to accommodate site constraints

** A dechlorination process is under evaluation for treated freshwater. Additional details will be developed for the 90% design submittal.

Freshwater Pre-Injection Treatment System Building

(located within former Water Conditioning Building space)

52'-0"

32'-0"

Treatment Vessel

Treatment Vessel

Treatment Vessel

Treatment Vessel

Back-wash Pumps

Treated Water Pumps

Recycle Pumps

Booster Pumps

1st floor

Electrica. Room (MCC & Control Panel

Filter Skid

Filter Skid

2nd floor

PRELIMINARY

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DSGN	ODELL
DR.	ODELL
CHK	MARTINEZ
APVD	PORCELLA

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GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CA

GENERAL

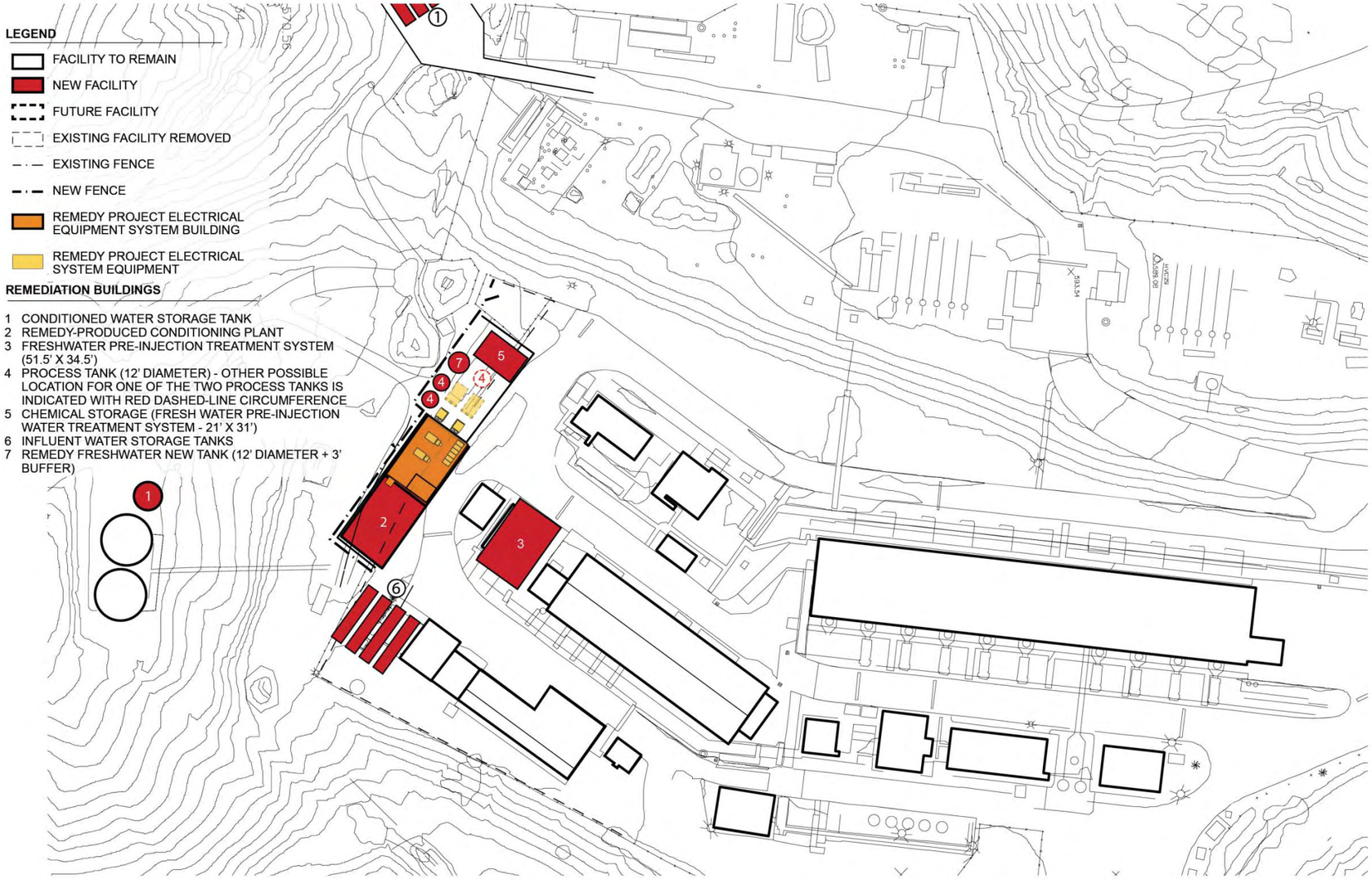
FRESHWATER PRE-INJECTION TREATMENT SYSTEM – EQUIPMENT LAYOUT

SHEET
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DATE 12/5/2013 12:10
REV

NOVEMBER 25, 2013 12:05

FIGURE 5

Equipment Layout



REMEDY PRODUCED WATER CONDITIONING AND FRESHWATER PRE-INJECTION TREATMENT SYSTEM FACILITY SITE PLAN

PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

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FIGURE 6
Site Layout

Appendix A
Arsenic and Fluoride Treatment Technology Screening

APPENDIX A

Arsenic and Fluoride Treatment Technology Screening

As part of the pre-conceptual design work, several treatment technologies were identified and screened to help select an effective and efficient treatment process. After technology identification, the list was screened qualitatively with a more detailed screening was completed on a short list of five technologies. Bench-scale testing was then performed to select the technology to carry forward into design.

A.1 Initial Screening

The United States Environmental Protection Agency, water and wastewater utilities, industrial concerns, research universities and centers, and industry groups have published numerous case studies and reports on testing and performance of these technologies in treating arsenic and fluoride in water (American Water Works Association, 1999; Odell, 2010). The initial list of technologies evaluated for the Topock freshwater pre-injection treatment system was developed from those technologies that have been successfully used by municipalities and industry. Unproven technologies or technologies that have not been used in full-scale applications were not considered in the screening. The initial list included anion exchange, activated alumina (AA), reverse osmosis (RO), electrodialysis reversal (EDR), lime softening, distillation, iron-based adsorbents, titanium-based adsorbents, and coagulation/filtration. The status of selection is summarized in Table A-1.

TABLE A-1
Technologies Considered for Arsenic and Fluoride Removal
Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum, PG&E Topock Compressor Station, Needles, California

Technology	Status
Anion exchange	Screened out, significant waste generation.
AA	**Selected for bench-testing. Primary treatment option is regenerable AA if arsenic and fluoride treatment required.**
Titanium-based adsorbents	Screened out, similar as other adsorbents considered, with less experience.
RO	Screened out, significant waste generation.
EDR	Screened out, significant waste generation.
Lime Softening	Screened out, significant waste generation.
Distillation	Screened out, significant energy use and capital cost.
Coagulation Filtration	Screened out, this process does not treat fluoride. If arsenic-only treatment is required, this technology would be screened out due to more residuals are generated, additional chemicals are used, and the process is more complex than iron-based adsorbents.
Iron-based Adsorbents	Screened out, this process does not treat fluoride. **If arsenic-only treatment required, this process may be used.**

A brief process description is provided below.

Anion Exchange. Anions such as fluoride, nitrate, arsenate, selenate, and chromate can be removed from water by using ion exchange with resin. This physical-chemical process involves an easily displaceable ion on the solid phase, exchanging with an unwanted ion in the water that adsorbs to the solid phase. To accomplish the exchange reaction, a packed bed of ion-exchange resin beads is used. Source water is continually passed through the bed in a downflow or upflow mode until the adsorbent is exhausted, as evidenced by the appearance (breakthrough) of the unwanted contaminant at an unacceptable concentration in the effluent.

The most useful ion-exchange reactions are reversible. In the simplest cases, the exhausted bed is regenerated using an excess of the displaceable ion in the form of salt brine. Ideally, no permanent media structural change occurs during the exhaustion/regeneration cycle. This is a proven technology, is widely used, and is easy to automate, but it generates considerable wastewater.

Activated Alumina*.* AA is a semi-crystalline porous inorganic adsorbent, is a proven technology for fluoride removal, and effectively removes arsenic. The removal mechanism, which is one of exchange of contaminant anions for surface hydroxides on the alumina, is generally called adsorption, although ligand exchange is a more appropriate term for the highly specific surface reactions involved. Packed beds of AA are used in water treatment plants in a similar manner to anion exchange. Regeneration is accomplished using a basic solution like sodium hydroxide (caustic). The adsorbent media can be purchased in a disposable form as well. In this case, the spent media is disposed in an offsite facility. This is a proven technology, is widely used, is easy to automate, but it generates considerable wastewater.

Titanium-based adsorbents*.* These are porous adsorbents made with titanium that work similarly to AA in that surface hydroxides exchange with fluoride in the water stream. Similarly, caustic is used to regenerate the adsorbent in the packed beds. This is a newer process with fewer systems in service.

Reverse Osmosis. RO is a membrane water treatment system in which water is pressurized to more than 100 pounds per square inch and is directed through small pores in a synthetic membrane. Treated water is produced through the other side of the small pores while larger particulates are retained on the inlet side of the membrane. RO is effective in removing uranium, radium, arsenic, fluoride, nitrates, microbial contaminants, and many chemicals. Because of the high pressure required for the process, RO systems typically are energy-intensive and have high initial costs. Furthermore, these systems can require more operator attention and can require membrane integrity testing. RO systems also risk fouling and scaling from hard water, colloids, and bacteria. The fouling and scaling increase the pressure drop and result in a shorter lifetime for the membrane or frequent chemical cleaning. In addition, this process generates considerable volumes of wastewater.

Electrodialysis Reversal. EDR is a membrane water treatment process that relies on polarizing electrodes to remove contaminants. The ions in the water are attracted to the membrane by a cathode or anode. Once attracted to the membrane, the ion is transported electrically through the membrane. EDR systems reverse the polarity of the electrodes every 15 to 20 minutes. This process releases accumulated ions and has the following advantages:

- Breaks up scale and reduces the potential for scaling.
- Reduces microbiological growth on the membrane.
- Reduces membrane cleaning frequency.

EDR systems operate at higher pressures than most water treatment systems but not as high as RO systems. They are maintenance intensive and generate considerable volumes of wastewater.

Lime Softening. Hardness in water is characterized by elevated levels of magnesium and calcium. Lime softening removes the hardness by mixing lime (slaked or hydrated) during the treatment process. The lime addition increases the pH of the water and causes the magnesium and calcium to precipitate out. Flocculation and sedimentation units are employed to provide a sufficient time and space to accumulate solids. Magnesium requires a higher pH than calcium to cause precipitation and results in water with a pH as high as 11. Carbon dioxide is used commonly to reduce the pH back to desired levels. This process, although used often, requires

careful chemical dosing and process monitoring, requires large amounts of chemicals, and generates large amounts of waste sludge.

Distillation. To distill water, water is heated until boiling and vaporized. The resulting steam is collected and condensed in a clean storage tank. Distillation is effective in removing metals, hardness, and particulates because they do not vaporize with the water. The boiling process also kills bacteria and some viruses. Distillation is ineffective in removing contaminants with a lower boiling point than water, such as benzene. These contaminants must be removed before condensation or recontamination will occur. This process is straightforward to operate but uses high amounts of energy and requires costly metal alloys for construction.

Coagulation Filtration. Coagulation is a process in which smaller particles in suspension attach to one another through electrostatic forces. As the particles attach to one another, larger particles start to form. Aluminum and ferric salts are the most commonly used compounds to enhance coagulation because aluminum or iron hydroxide is formed. Once finished with the coagulation process, the water is filtered through a media filter or microfilter to remove the aggregated particles. Coagulation filtration has been found very effective in removing arsenic from water. While often some form of pretreatment is needed (usually chlorine oxidation), coagulation filtration systems can achieve over a 90 percent reduction in arsenic. However, this process does not treat fluoride. The process is relatively easy to operate.

Iron-based Adsorbents. Contaminated water is passed through a pressure vessel that contains iron based adsorbents that remove arsenic. Granular ferric hydroxide is a common example that is in an amorphous crystalline form. Iron-based adsorbents have been shown effective in removing arsenic (not fluoride) at pH levels normally found in drinking water; however, best performance happens at lower pH levels. Lower pH levels may result in the need for more operator attention and the possibility of handling hazardous chemicals. Once the media has been lost its adsorbent capacity, the spent media is replaced.

A.1.1 Initial Screening Results

As a result of the screening, five technologies were retained for further evaluation:

- Anion exchange
- AA adsorption – disposal media and regenerable media
- Iron-based adsorbents
- Coagulation/filtration

The following technologies were rejected based on the reasons listed below.

- **EDR and RO:** processes generate large residual wastewater streams that must be disposed of.
- **Lime softening:** generates large volume of waste sludge that is difficult and costly to dispose of.
- **Titanium-based adsorbents:** effective at very low pH or with expensive rare earth metals and has the fewest number of operating systems.
- **Distillation:** high cost for energy use.

A.2 Second-level Screening

The two remaining technologies were screened at a second level with AA divided into regenerable and disposable forms. The screening criteria were as follows:

1. Treatment Effectiveness
   - Ability to achieve treatment goals
2. Reliability and Flexibility
   - Ability to allow variation in influent water
   - Expandability

3. Operational Complexity
   - Ease of operation
   - Safety
4. Waste Generation
   - Quantity and quality
5. Footprint
6. Cost Effectiveness

As a result of the screening, anion exchange was not carried forward and was dropped from further consideration because of its lower effectiveness, greater operational complexity, the wastewater volumes generated, and its higher operating cost. The four processes— regenerable AA and disposable AA, iron-based adsorbents, and coagulation/filtration —were advanced to bench-scale testing.

A.3 Bench-scale Testing

As described in the body of the Design Basis Technical Memorandum, bench-scale testing was performed after the technology screening. Testing showed that regenerable AA and iron-based adsorbent were the technologies that best met design needs if both arsenic and fluoride removal, or arsenic removal alone is required Disposable AA was eliminated from further evaluation.

A.4 References

American Water Works Association. 1999. *Water Quality and Treatment - A Handbook of Community Water Supplies*, 5th Edition. Ed. by R.D. Letterman.

Odell, Lee H. 2010. *Treatment Technologies for Groundwater*. American Water Works Association.

Attachment G: RTC #260, #263, #288-291, #320, #321, #776a

Soil Storage/Construction Staging Areas - Decision Matrices/Figure 7.6-1

HARGIS + ASSOCIATES, INC.
HYDROGEOLOGY • ENGINEERING

7400 North Oracle Road, Suite 202
Tucson, AZ 85704
Phone: 520.881.7300
Fax: 520.529.2141

VIA ELECTRONIC MAIL

March 6, 2014

Mr. Aaron Yue
Topock Project Manager
DEPARTMENT OF TOXIC SUBSTANCES CONTROL
5796 Corporate Avenue
Cypress, California 90630

Ms. Pamela S. Innis
Topock Remedial Project Manager
Office of Environmental Policy and Compliance
U.S. DEPARTMENT OF THE INTERIOR
P.O. Box 25007 (D-108)
Denver, Colorado 80225-007

Re: Fort Mojave Indian Tribe Comments on Alternative Pipeline Routings and Proposed Soil Storage/Staging Areas for the Topock Compressor Station 60% Groundwater Remedy Design

Dear Mr. Yue and Ms. Innis:

Hargis + Associates, Inc. ("H+A"), on behalf of and at the request of its client, the Fort Mojave Indian Tribe ("the Tribe" or "FMIT"), is hereby providing this letter regarding the Tribe's review of alternative pipeline routings for the Topock Compressor Station 60% groundwater remedy design (Enclosure A).

As you are aware, these alternative routings have been the subject of discussion at recent meetings of the Technical Working Group ("TWG") and, most recently, the FMIT along with representatives of the Hualapai, Colorado River Indian Tribes, and Cocopah, performed a site walk on February 21, 2014, during which tribal representatives and their technical consultants conferred on the acceptability of these various alternatives. The FMIT was represented by nine Tribal members including a member of Tribal Council. Afterwards, the FMIT members conferred and completed the enclosed matrix providing the Tribe's position on each of the various segments along the pipeline route (Enclosure A). This information is being provided as the Tribe's final comments on the 60% design, with the understanding that you will be directing the Pacific Gas & Electric Company ("PG&E") to take this information into consideration during the preparation of the 90% Basis of Design. The matrix also assumes that any construction or deconstruction would be done in the least impactful manner and in consultation with the Tribe.

Additionally, the Tribe is also presenting herein its position on the various staging and soils storage areas proposed by PG&E (Enclosures B & C). Please find an attached matrix addressing those preferences. Please note that on the matrix, there are several sites for which the Tribe has outstanding questions. Therefore, before the Tribe can determine the final acceptability of these sites, answers to these questions need to be provided to the Tribes.

Finally, the Tribe wishes to add that the comments and preferences as expressed herein do not in any way constitute an endorsement or acceptance of the design as originally presented or as potentially modified by these alternatives. For as you have repeatedly been made aware, many of the adverse impacts associated with this project are permanent and irreversible.

Thank you in advance for consideration of these comments. Please contact me if you have further questions.

Sincerely,

HARGIS + ASSOCIATES, INC.



Leo S. Leonhart, PhD, PG, CHG
Principal Hydrogeologist

LSL/keh

Enclosures: A -FMIT Pipeline Segment Analysis
B - Soils Staging / Construction Areas FMIT Comment Table
C – Staging Areas Map

cc w/encl: C. Coyle
C. Garcia, FMIT
K. Liebhauser, BLM
N. McDowell, FMIT
L. Otero, FMIT
T. Williams, FMIT
Tribal Representatives for Hualapai, CRIT, Chemehuevi, Cocopah

ENCLOSURE A

FMIT PIPELINE SEGMENT ANALYSIS

PIPELINE SEGMENT ANALYSIS

PIPELINE POINTS (Segment Description)	ABOVE/BELOW GROUND	CONDITIONS OF USE COMMENTS
A TO B (NTH near MW20 Bench, access upslope to top of slope, adjacent to the SoCal pipeline easement)	NEITHER	After much review and consideration, there does not seem to be either an above- or below-ground alternative for this segment that appears acceptable. Assuming it will not be possible to intrude into the easement, instead, use the "C to B" segment for piping alignment
C TO B (Entrance along NTH, along road south of Locus B; to top of slope, across from MW20 bench)	Below	Although above-ground is generally preferred, the narrowness of the roadway along this segment makes it unlikely the piping could be placed above ground with sufficient road access without making significant cuts and disturbance into the in-place geologic materials alongside this road segment. Note this segment of road runs through a large cultural area on either side, therefore no additional disturbance, outside of the present-day existing roadway, should be made. 1) No additional cuts would be made into the banks on either side of the roadway. 2) Existing slopes would not be disturbed. 3) No activity, storage or personnel activity should extend beyond the current roadway. This includes the slopes adjacent to the existing road. All below ground piping will be removed after remedy completion.
B TO D (Section of dirt access road from top of slope west to Bat Cave Wash)	Above	Given the wide road access along this segment, above-ground piping could be installed. 1) Construction activity, storage and personnel activity should be limited to the roadway to the extent possible to minimize encroachment into the areas adjacent to the existing road.
D TO E (Continuing along access road, along the east side of Bat Cave Wash to where road crosses wash near IM-3)	Above	1) Construction activity, storage and personnel activity should be limited to the roadway to the extent possible to minimize encroachment into the areas adjacent to the existing road.
E TO F (From Bat Cave Wash crossing, along Route 66 westward past IM-3 to IRL-3)	Above	Above-ground installation is preferred. 1) No additional cuts would be made into the banks on either side of the roadway. 2) Existing slopes would not be disturbed.

PIPELINE SEGMENT ANALYSIS

PIPELINE POINTS (Segment Description)	ABOVE/BELOW GROUND	CONDITIONS OF USE COMMENTS
F TO G (From IRL-3 along single land dirt access road, down into wash and location of IRL-4.)	Below	This short section from IRL-3 to IRL-4 in the wash is along a narrow, one-lane access road. The narrow width of the existing one-lane access road, and existing embankment where road would be built to provide access down to IRL-4 does not appear to allow for both vehicle access and above-ground piping and supports. While above-ground installation is preferred where possible, placing the injection well piping below-ground along this segment should constrain disturbance to the foot print of the existing roadway 1) Activity and construction in this area to remain strictly constrained to the existing dirt road. 2) Construction of the roadway down into the wash for IRL-4 should consist of fill placement, rather than any additional cut, to the extent possible. 3) All below ground piping will be removed after remedy completion.
F TO H TO I (From IRL-3, west along Route 66 to FW-1)	Above	Above ground installation is preferred. 1) No additional cuts would be made into the banks on either side of the roadway. 2) Existing slopes would not be disturbed.

PIPELINE SEGMENT ANALYSIS



ENCLOSURE B

SOILS STAGING / CONSTRUCTION AREAS
FMIT COMMENT TABLE

Soils Staging / Construction Areas FMIT Comment Table

STORAGE/STAGING AREA	ACERAGE	LOCATIONS / NOTES	COMMENTS
1-5 Soils storage	11.1	All in Park Moabi Area	*Tribes said yes (CHPMP 1/14)*
6 Soils storage	0.67	Across from IM-3	*Tribes said no (CHPMP 1/14)*
7 Soils storage	0.28	East of #6	*Tribes said no* (CHPMP 1/14)
8 Soils storage	0.17	Southeast of #7	*Tribes said no* (CHPMP 1/14)
9 Construction Staging			*Tribes said yes (CHPMP 1/14)*
10 Construction Staging	0.51		*Tribes said yes (CHPMP 1/14)*
11 Construction Staging	5.69		*Tribes said no (CHPMP 1/14)*
12 Construction Staging	1.53		*Tribes said no (CHPMP 1/14)*
13 Soils storage	0.15		*Tribes said no (CHPMP 1/14)*
14 This site is proposed for construction materials	0.28	This is CA-SBR-11862H. BLM is the agency to make determinations of eligibility, not PGE as in PGE's report [1](pp22-25). On the map in the report, (see footnote 1) page 25, maze remnants are visible slightly southwest of the boundary of CA-SBR-11862H.	Tribes have questions: 1. Is it temporary? 2. Fencing? With what? 3. SHPO Clearance? 4. What activities? 5. Lighting? 6. Extent of the staging area? From where to where? 7. What has BLM determined regarding eligibility and potential impacts to this area?
15 This site is proposed for construction materials	1.11	*On the map, this site is across Old National Trails Highway along the river. There is creosote here. Animals go down into the outlet area for water. Has a rock-lined walkway down. There is a small beach area (when low water). This is the end of Bat Cave Wash.*	Tribes have questions: 1. Vegetation removal? Tribes do not want vegetation removed. 2. Wider access = modifications? Tribes do not want that. 3. Watchmen, guards, restrooms? 4. What activities? 5. Lighting? Generators? 6. When was this area last surveyed for cultural materials? 7. Extent of the staging area? From where to where?
16	0.06		*Tribes said no*

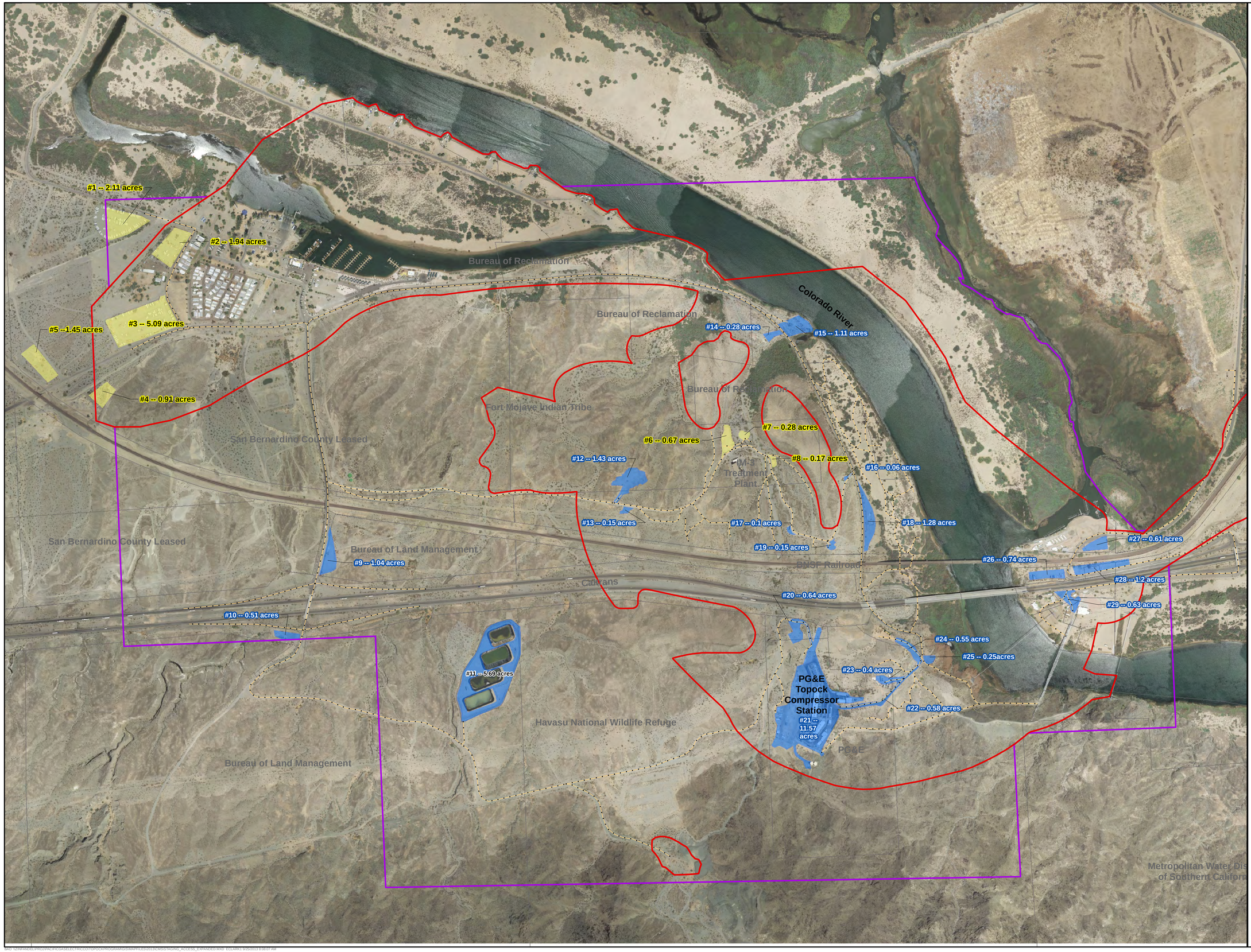
[1] National Register of Historic Places Eligibility Evaluation of CA-SBR-11862H, San Bernardino California, David D. Earle and Barry A. Price. Prepared by Applied Earthworks and Earle and Associates, submitted to Pacific Gas and Electric Co. September 2013.

Soils Staging / Construction Areas FMIT Comment Table

17	**This site is proposed for construction materials**	0.1		*Tribes have questions:* 1. Modifications? 2. Fencing? With what? 3. Structures? 4. Blading, leveling, gravel import? 5. Lighting? Generators? 6. Berm cuts along road?
18		1.28		*Tribes said yes (CHPMP 1/14)*
19	**This site is proposed for construction materials**	0.15	Located across from the southern tip of CA-SBR-219 Locus B (Maze). There is a better place to the west (down the slope) where there already exists a large level place with a well (MW25) Why not go there instead? Proposed IRL7 near- by. Also N (?).	*Tribes have questions:* 1. Modifications? 2. Fencing? With what? 3. Structures? 4. Blading, leveling, gravel import? 5. Lighting? Generators? 6. Berm cuts along road?
20	**This site is proposed for construction materials**	0.1		*Tribes still need to visit this site*
21	**Construction Staging**	11.57	Compressor Station	*Tribes said yes (CHPMP 1/14)*
22	**Construction Staging**	0.58		*Tribes said yes (CHPMP 1/14)*
23	**Construction Staging**	0.4		*Tribes said yes (CHPMP 1/14)*
24	**Construction Staging**	0.55		*Tribes said yes (CHPMP 1/14)*
25	**Construction Staging**	0.25		*Tribes said no (CHPMP 1/14)*
26	**Construction Staging**	0.74		*Tribes said yes (CHPMP 1/14)*
27	**Construction Staging**	0.61		*Tribes said yes (CHPMP 1/14)*
28	**Construction Staging**	1.2		*Tribes said yes (CHPMP 1/14)*
29	**Construction Staging**	0.63		*Tribes said yes (CHPMP 1/14)*

ENCLOSURE C

STAGING AREA MAP



LEGEND

- EIR Project Area
- Area of Potential Effects (APE)
- Proposed Access Routes
- Potential Soil Storage Area/ Proposed Staging Area
- Proposed Staging Areas

Notes:

1. PG&E may use all or a subset of these potential temporary staging areas during remedy construction.
2. Note that in compliance with EIR mitigation measure CUL-1a-9 as well as PA and CHPMP mitigation measures, the proposed access route west of National Trails Highway is located in an existing, previously disturbed, access road. The location of the access road was field verified and does not create any direct physical impact or effect on the Topock Maze, as it is manifested archaeologically, in compliance with EIR mitigation measure CUL-1a-10 and PA and CHPMP mitigation measures

N

0 300 600 1,200 Feet

Updated per September 17-18 TWG Discussion

FIGURE 7.6-1
PROPOSED STAGING AREAS, CONSTRUCTION YARD, AND ACCESS ROUTES
GROUNDWATER REMEDY BASIS OF DESIGN REPORT
INTERMEDIATE (60%) DESIGN
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

CH2MHILL

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Hualapai Department of Cultural Resources
P.O. Box 310
Peach Springs, Arizona 86434
Office: 928.769.2223 FAX: 928.769.2235

March 10, 2014 **HDCR File: 2014-663**

VIA ELECTRONIC MAIL
Mr. Aaron Yue
Topock Project Manager
DEPARTMENT OF TOXIC SUBSTANCES CONTROL
5796 Corporate Avenue
Cypress, California 90630

Ms. Pamela S. Innis
Topock Remedial Project Manager
Office of Environmental Policy and Compliance
U.S. DEPARTMENT OF THE INTERIOR
P.O. Box 25007 (D-108)
Denver, Colorado 80225-007

Re: 60% Pipeline Alternatives and Soils / Staging Matrices

Dear Mr. Yue:
On behalf of the Hualapai Tribe, we appreciate being able to discuss pipeline alternatives as presented in various meetings and consultative group walks regarding the 60% Basis of Design for the Topock Remediation Project. As you are aware, the Hualapai along with other Tribal representatives met at Topock on February 21st, 2014 to visit and discuss alternative pipeline routings for the 60% groundwater remedy. Hualapai tribal representatives and two Hualapai Tribal Council members were present during this meeting. After the meeting it was agreed that a pipeline matrix and soils staging area table would be sent to interested tribes that included tribal comments wile in the field.

In this letter we formally present Hualapai's comments regarding pipeline alternatives and soils / staging areas considered by Pacific Gas & Electric for the 90% Basis of Design. Even though we are aware that the groundwater remedy infrastructure is creating permanent and irreversible cumulative negative impacts, both spiritually and to the cultural landscape at Topock, we are confident that PG&E will do everything in their power to remove all infrastructure components (whether or not pipelines are placed above or below ground) five years after all remediation activity ceases.

Figure 1 below, shows pipeline alternatives with Table 1 documenting comments from Hualapai. Regarding Table 2, below, this table has tribal responses that were solicited on January 14, 2014. It also has comments and questions regarding several areas visited on February 21st. Perhaps we can discuss these at the March 14th CHPMP meeting with BLM. There is one outstanding soils location (#20) that still requires visitation. Perhaps we can do this on March 14th, 2014 (CHPMP meeting with BLM, in the morning followed by visit to Topock), when we will be out at Topock.

We appreciate our on-going consultations and collaborations with the Topock Remediation Project and look forward to meaningful dialogue through-out the up-coming years. If you have any concerns please feel free to contact myself, or Dawn Hubbs, Program Manager and we will be happy to assist you.

Sincerely,

Loretta Jackson-Kelly, Director and Tribal Historic Preservation Officer
Hualapai Department of Cultural Resources

Cc:
Mr. Rudy Clark, Sr., Councilman, Hualapai Tribal Council
Mr. Robert Bravo, Councilman, Hualapai Tribal Council
Karen Baker, CHG, CEG, Chief, Geological Services Branch
Tribal Reps

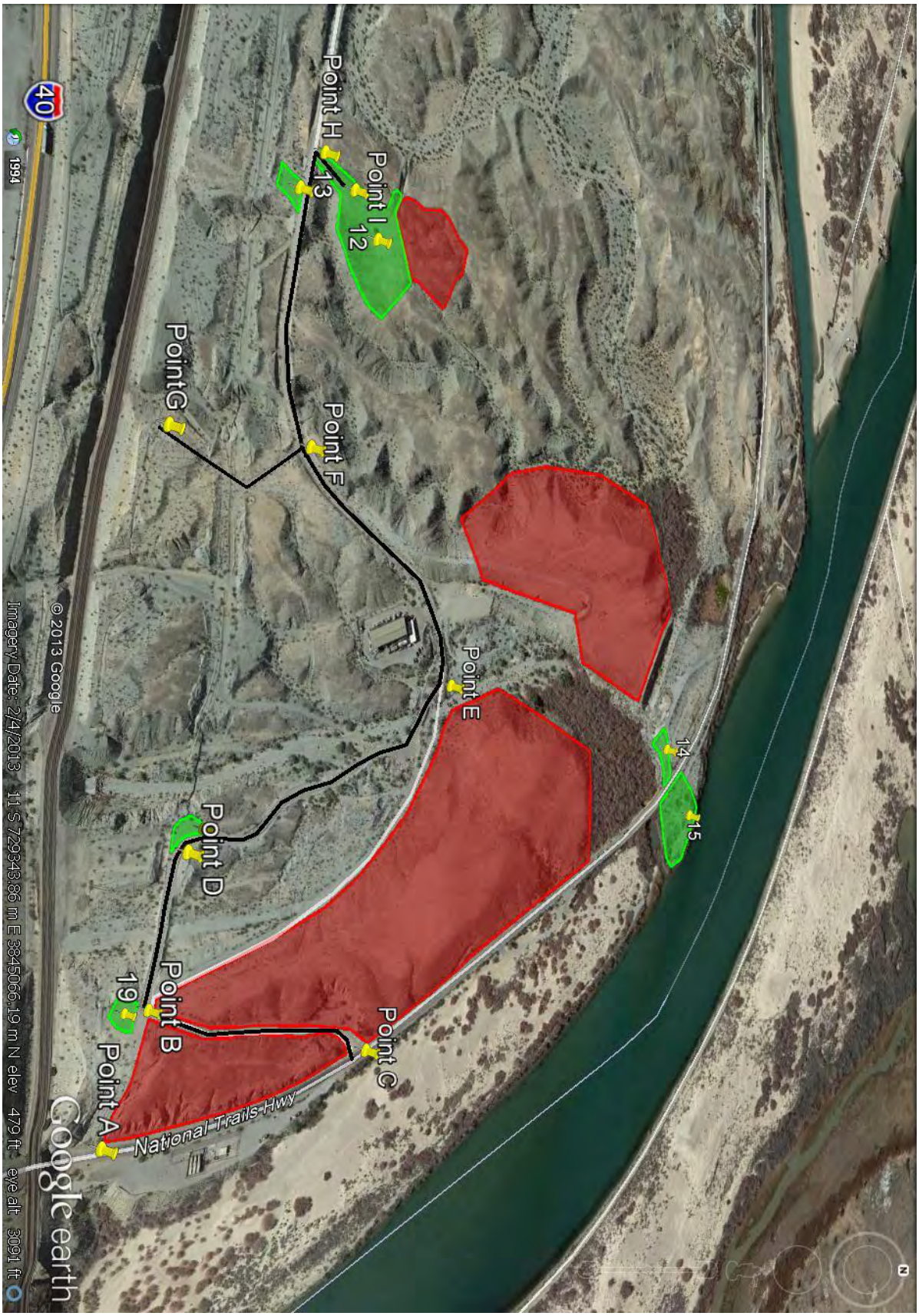


Figure 1: Red Areas = Cultural Sites - Green Areas = Soils Staging Areas - Black Line = Pipeline

Table 1: Hualapai Department of Cultural Resources Pipeline Points and Comments

PIPELINE POINTS	ABOVE/BELOW GROUND	CONDITIONS OF USE COMMENTS
A TO B	**Neither.** Hualapai do not want to see this alternative used at all.	Hualapai do not want this segment of the pipeline to be used. There is significant damage to this area (which is not being refurbished or maintained for erosion and run-off) and this segment would cause more damage. It would also impact a multi-component archaeological site. Avoidance is recommended.
B TO C	**Below Ground**	The segment is in an existing road. Please go in the center of the road, no additional widening or slope cutting due to cultural materials on the upper slopes. All infrastructure materials to be removed five years after achieving acceptable ground water tolerance levels of Chrome VI.
B TO D	**Above Ground or Below Ground**	The segment is in an existing road. Please go in the center of the road, no additional widening or slope cutting. Soils location 19 is near this segment. We would prefer that this segment not utilize location 19 as there is a point west and down the road that would be preferable for staging. See Table 2. All infrastructure materials to be removed five years after achieving acceptable ground water tolerance levels of Chrome VI.
D TO E	**Above Ground or Below Ground**	The segment is in an existing road. Please go in the center of the road, no additional widening or slope cutting. Cultural materials are in this vicinity. All infrastructure materials to be removed five years after achieving acceptable ground water tolerance

		levels of Chrome VI.
E TO F	**Above Ground or Below Ground**	The segment is in an existing road. Please go in the center of the road, no additional widening or slope cutting. Prefer minimal bridge construction considerations. All infrastructure materials to be removed five years after achieving acceptable ground water tolerance levels of Chrome VI.
F TO G	**Below Ground**	This is a very small area without a lot of room. There is an archaeological site (CA-SBR-11939) in this area and there is a plan to put IRL3 in this vicinity also. There is going to be a great deal of activity in this small area, so we request cultural clearances with tribal monitors in attendance, prior and during this segment's construction phase. All infrastructure materials to be removed five years after achieving acceptable ground water tolerance levels of Chrome VI.
F TO H TO I	**Above Ground**	This area is very close to cultural materials. Prefer that there be no additional widening of the existing road. We request cultural clearances with tribal monitors in attendance, prior and during this segment's construction phase. There is a plan to put FW1 near this location also. All infrastructure materials to be removed five years after achieving acceptable ground water tolerance levels of Chrome VI.

Table 2: Soils Staging / Construction Areas Hualapai Comment Table

STORAGE/STAGING AREA	ACERAGE	LOCATIONS / NOTES	COMMENTS
1-5 Soils storage	11.1	All in Park Moabi Area	*Tribes said yes (CHPMP 1/14)*
6 Soils storage	0.67	Across from IM-3	*Tribes said no (CHPMP 1/14)*
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11 Construction Staging	5.69		*Tribes said no (CHPMP 1/14)*
12 Construction Staging	1.53		*Tribes said no (CHPMP 1/14)*
13 Soils storage	0.15		*Tribes said no (CHPMP 1/14)*
14 ***This site is proposed for construction materials***	0.28	This is CA-SBR-11862H. BLM is the agency to make determinations of eligibility, not PGE as in PGE's report [1](pp22-25). On the map in the report, (see footnote 1) page 25, maze remnants are visible slightly southwest of the boundary of CA-SBR-11862H.[2]	Tribes have questions: 1. Is it temporary? 2. Fencing? With what? 3. SHPO Clearance? 4. What activities? 5. Lighting? 6. Extent of the staging area? From where to where? 7. What has BLM determined regarding eligibility and potential impacts to this area?
15 ***This site is proposed for construction materials***	1.11	*On the map, this site is across Old National Trails Highway along the river. There is creosote here. Animals go down into the outlet area for water. Has a rock-lined walkway down. There is a small beach area (when low water). This is the end of Bat Cave Wash.*	Tribes have questions: 1. Vegetation removal? Tribes do not want vegetation removed. 2. Wider access = modifications? Tribes do not want that. 3. Watchmen, guards, restrooms? 4. What activities? 5. Lighting? Generators? 6. When was this area last surveyed for cultural materials? 7. Extent of the staging area? From where to where?
16	0.06		*Tribes said no*
17 ***This site is proposed for construction materials***	0.1		*Tribes have questions:* 1. Modifications? 2. Fencing? With what? 3. Structures? 4. Blading, leveling, gravel import? 5. Lighting? Generators? 6. Berm cuts along road?
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[1] National Register of Historic Places Eligibility Evaluation of CA-SBR-11862H, San Bernardino California, David D. Earle and Barry A. Price. Prepared by Applied Earthworks and Earle and Associates, submitted to Pacific Gas and Electric Co. September 2013.

[2] Please note that management recommended that this site be avoided. Therefore this location is not suitable for staging. Please refer to *Topock Remediation Project Additional Soils Investigation, Condition Assessments at Fourteen Archaeological and Historical Sites,* Hearth, et. Al. Prepared by Applied Earthworks Inc., submitted to PG&E November 2013, reference site recordCA-SBR-11862H #8, page 1 of 5.

		(MW25) Why not go there instead? Proposed IRL7 near- by. Also N (?).	

STORAGE/STAGING AREA	ACERAGE	LOCATIONS / NOTES	CONDITIONS OF USE COMMENTS
20 ***This site is proposed for construction materials***	0.1		*Tribes still need to visit this site*
21 Construction Staging	11.57	Compressor Station	*Tribes said yes (CHPMP 1/14)*
22 Construction Staging	0.58		*Tribes said yes (CHPMP 1/14)*
23 Construction Staging	0.4		*Tribes said yes (CHPMP 1/14)*
24 Construction Staging	0.55		*Tribes said yes (CHPMP 1/14)*
25 Construction Staging	0.25		*Tribes said no (CHPMP 1/14)*
26 Construction Staging	0.74		*Tribes said yes (CHPMP 1/14)*
27 Construction Staging	0.61		*Tribes said yes (CHPMP 1/14)*
28 Construction Staging	1.2		*Tribes said yes (CHPMP 1/14)*
29 Construction Staging	0.63		*Tribes said yes (CHPMP 1/14)*

Table 2: Soils Staging / Construction Areas Hualapai Comment Table (Continued from page 3)

THE COCOPAH INDIAN TRIBE
Cultural Resource Department
14515 S. Veterans Drive
Somerton, Arizona 85350
Telephone (928) 627-4849
Fax (928) 627-3173

Project Number: CCR-032-06-001

VIA ELECTRONIC MAIL March 13, 2014

Mr. Aaron Yue
Topock Project Manager
DEPARTMENT OF TOXIC SUBSTANCES CONTROL
5796 Corporate Avenue
Cypress, California 90630

Ms. Pamela S. Innis
Topock Remedial Project Manager
Office of Environmental Policy and Compliance
U.S. DEPARTMENT OF THE INTERIOR
P.O. Box 25007 (D-108)
Denver, Colorado 80225-007

Re: 60% Pipeline Alternatives and Soils / Staging Areas

Dear Mr. Yue/Ms. Innis:

The Cocopah Indian Tribe appreciates the opportunity to provide comments and discuss the 60% Pipeline Alternatives and Soils / Staging Areas.

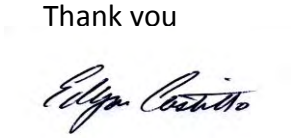
The Cocopah Indian Tribe along with council members and representatives from other interested tribes, visited the Topock area on February 21, to view and walk the Soil Staging areas proposed by PG&E and the alternative pipeline route for the Topock Compressor Station 60% groundwater remedy design. During this meeting and site walk, it was agreed that a table and map illustrating the staging and pipeline route would be produced and used to provide comments regarding the staging areas and pipeline route.

Attached you will find Cocopah's comments regarding the Pipeline route and Staging areas. The attachments are as follows:

- Figure 1 is a map illustrating the Staging areas and Pipeline
- Table 1: Cocopah Comments regarding Pipeline Points
- Table 2: Cocopah Comments regarding Soils Staging / Construction Areas

If you have any questions feel free to contact me at: Cell: 928-287-5042 or Office: 928-627-4849, or by email at CocopahTPM@Gmail.com

Thank vou



Edgar Castillo
Cocopah Indian Tribe
Topock Project Manager

Cc:
Aaron Yue, DTSC
Pam Innis, DOI
Jill McCormick, Cocopah Indian Tribe
Nora McDowell, Fort Mojave Indian Tribe
Dawn Hubbs, Hualapai Indian Tribe
Doug Bonamici, Colorado River Indian Tribes
Karen Baker, CHG, CEG, Chief, Geological Services Branch

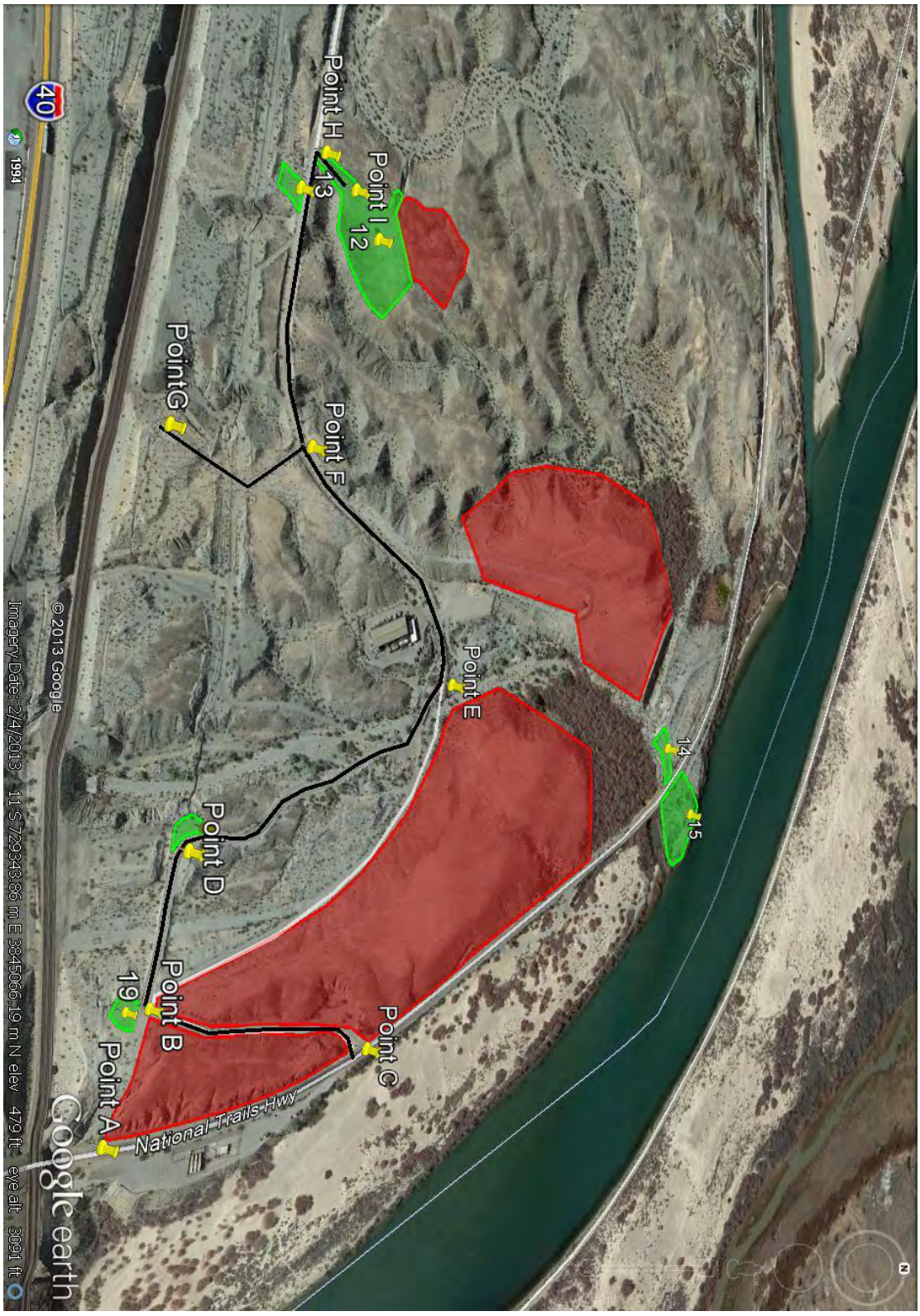


Figure 1: Red Areas = Cultural Sites
Green Areas = Soils Staging Areas
Black Line = Pipeline

Table 1: Cocopah Comments on the Pipeline Points

PIPELINE POINTS	ABOVE/BELOW GROUND	CONDITIONS OF USE COMMENTS
A TO B	Neither	Tribe's conclusion is that this is not an acceptable route for the pipeline. It is noted that there is significant damage to this area and this pipeline segment would cause more damage. The tribe recommends that this area be avoided.
C TO B	Above/Below	This segment intersects a large Cultural Resources Area. Any additional widening or cutting into the sides of the road is to be avoided as to not cause any damage to the cultural materials present on the slopes. All activity including staging, storage or personnel would be strictly limited to the roadway. Piping should go in the center of the existing roadway. All infrastructure materials to be removed five years after achieving acceptable Chrome VI levels.
B TO D	Above/Below	This segment is in an existing roadway. All activity including staging, storage or personnel would be strictly limited to the roadway. Piping should go in the center of the existing roadway. All infrastructure materials to be removed five years after achieving acceptable Chrome VI levels.
D TO E	Above/Below	This segment is in an existing roadway. All activity including staging, storage or personnel would be strictly limited to the roadway. Piping should go in the center of the existing roadway. All infrastructure materials to be removed five years after achieving acceptable Chrome VI levels.
E TO F	Above/Below	This segment is in an existing roadway. All activity including staging, storage or personnel would be strictly limited to the roadway. Piping should go in the center of the existing roadway. All infrastructure materials to be removed five years after achieving acceptable Chrome VI levels.
F TO G	Above/Below	This is a small area that contains archaeological site CA-SBR-11939. Cultural clearances with tribal monitors are requested, prior to and during construction. All infrastructure materials to be removed five years after achieving acceptable Chrome VI levels.
F TO H TO I	Above/Below	This area is very close to cultural materials. Cultural clearances with tribal monitors are requested, prior to and during construction as with the previous point. All infrastructure materials to be removed five years after achieving acceptable Chrome VI levels.

Table 2: Cocopah Comments on the Soils Staging / Construction Areas

STORAGE/STAGING AREA	ACERAGE	LOCATIONS / NOTES	COMMENTS
1-5 Soils storage	11.1	All in Park Moabi Area	*Tribes said yes (CHPMP 1/14)*
6 Soils storage	0.67	Across from IM-3	*Tribes said no (CHPMP 1/14)*
7 Soils storage	0.28	East of #6	*Tribes said no* (CHPMP 1/14)
8 Soils storage	0.17	Southeast of #7	*Tribes said no* (CHPMP 1/14)
9 Construction Staging			*Tribes said yes (CHPMP 1/14)*
10 Construction Staging	0.51		*Tribes said yes (CHPMP 1/14)*
11 Construction Staging	5.69		*Tribes said no (CHPMP 1/14)*
12 Construction Staging	1.53		*Tribes said no (CHPMP 1/14)*
13 Soils storage	0.15		*Tribes said no (CHPMP 1/14)*
14 ***This site is proposed for construction materials***	0.28	This is CA-SBR-11862H. BLM is the agency to make determinations of eligibility, not PGE as in PGE's report [1](pp22-25). On the map in the report, (see footnote 1) page 25, maze remnants are visible slightly southwest of the boundary of CA-SBR-11862H.	Tribes have questions: 1. Is it temporary? 2. Fencing? With what? 3. SHPO Clearance? 4. What activities? 5. Lighting? 6. Extent of the staging area? From where to where? 7. What has BLM determined regarding eligibility and potential impacts to this area?
15 ***This site is proposed for construction materials***	1.11	*On the map, this site is across Old National Trails Highway along the river. There is creosote here. Animals go down into the outlet area for water. Has a rock-lined walkway down. There is a small beach area (when low water). This is the end of Bat Cave Wash.*	Tribes have questions: 1. Vegetation removal? Tribes do not want vegetation removed. 2. Wider access = modifications? Tribes do not want that. 3. Watchmen, guards, restrooms? 4. What activities? 5. Lighting? Generators? 6. When was this area last surveyed for cultural materials? 7. Extent of the staging area? From where to where?
16	0.06		*Tribes said no*
17 ***This site is proposed for construction materials***	0.1		*Tribes have questions:* 1. Modifications? 2. Fencing? With what? 3. Structures? 4. Blading, leveling, gravel import? 5. Lighting? Generators? 6. Berm cuts along road?
18	1.28		*Tribes said yes (CHPMP 1/14)*
19 ***This site is proposed for construction materials***	0.15	Located across from the southern tip of CA-SBR-219 Locus B (Maze). There is a better place to the west (down the slope) where there already exists a large level place with a well (MW25) Why not go there instead? Proposed IRL7 near- by. Also N (?).	*Tribes have questions:* 1. Modifications? 2. Fencing? With what? 3. Structures? 4. Blading, leveling, gravel import? 5. Lighting? Generators? 6. Berm cuts along road?

[1] National Register of Historic Places Eligibility Evaluation of CA-SBR-11862H, San Bernardino California, David D. Earle and Barry A. Price. Prepared by Applied Earthworks and Earle and Associates, submitted to Pacific Gas and Electric Co. September 2013.

Table 2: Cocopah Comments on the Soils Staging / Construction Areas (Cont. from page 5)

STORAGE/STAGING AREA	ACERAGE	LOCATIONS / NOTES	CONDITIONS OF USE COMMENTS
20 ***This site is proposed for construction materials***	0.1		*Tribes still need to visit this site*
21 Construction Staging	11.57	Compressor Station	*Tribes said yes (CHPMP 1/14)*
22 Construction Staging	0.58		*Tribes said yes (CHPMP 1/14)*
23 Construction Staging	0.4		*Tribes said yes (CHPMP 1/14)*
24 Construction Staging	0.55		*Tribes said yes (CHPMP 1/14)*
25 Construction Staging	0.25		*Tribes said no (CHPMP 1/14)*
26 Construction Staging	0.74		*Tribes said yes (CHPMP 1/14)*
27 Construction Staging	0.61		*Tribes said yes (CHPMP 1/14)*
28 Construction Staging	1.2		*Tribes said yes (CHPMP 1/14)*
29 Construction Staging	0.63		*Tribes said yes (CHPMP 1/14)*

From: Doug Bonamici [mailto:dbonamici@critdoj.com]
Sent: Monday, March 10, 2014 2:36 PM
To: Yue, Aaron@DTSC
Cc: howard.magill@crit-nsn.gov; Wilene Fisher-Holt; Margaret R. Eggers; Nora McDowell; Dawn Hubbs; Edgar Castillo; Charlie Schlinger; Baker, Karen@DTSC
Subject: Comments on Noise/ Vibration and Pipeline Routing

Mr. Yue, the Colorado River Indian Tribes will not be submitting further comment for the 60% Design phase on the Noise and Vibration issues nor on the Pipeline Routing issues at this time. We have participated in the discussions of those issues, and are satisfied the DTSC, DOI and PG&E have heard our concerns directly, and through the other Tribal comments. We will consider adding further input as the design process moves forward.
Thank you for your efforts in this regard. db

Douglas F. Bonamici
Law Clerk, Office of the Attorney General
Colorado River Indian Tribes
26600 Mohave Rd.,
Parker, Arizona 85344
Phone: 928-669-1271
Email: doug.bonamici@crit-nsn.gov

PG&E's Responses to Tribes' Questions about Staging Areas #14, #15, #17, and #19

Construction Staging Area #14

1. Is it temporary?

Response: Yes, all construction staging areas are temporary by nature, and are specifically set up to provide support for specific construction activities in specific areas.

2. Fencing? With what?

Response: Yes, some construction staging areas are anticipated to include temporary fencing for security and safety reasons. Fencing will likely be chain link fences with posts or panels.

3. SHPO Clearance?

Response: In accordance with the Programmatic Agreement, it is PG&E's understanding that the groundwater remedy will require BLM review and concurrence prior to start of construction. SHPO consultation is also likely to be necessary, consistent with the Programmatic Agreement's Consultation Protocol.

4. What Activities?

Response: Staging areas (also called support zones) are located adjacent to or near a primary work zone where actual construction activities will take place. Staging areas will be used for location of temporary facilities such as portable toilets and breaks areas. Staging areas are also used for lay-down of construction equipment (including heavy equipment), materials, supplies, and tools needed for construction activities in the primary work zones. In addition, most temporary stockpiling (less than 90 days) of displaced soils/materials will take place in the staging areas. Management of displaced soils and materials will be in accordance with the Displaced Soils Management Protocol.

In addition, PG&E plans to conduct daily planning and health and safety meetings at the main construction yard and, as needed, in the support zones prior to commencing work. Staging areas will also serve as the communication and coordination center for emergency situations.

5. Lighting?

Response: Since staging areas, in general, are not intended to be staffed 24/7, PG&E does not consider night-time lighting at these staging areas to be necessary, except for limited circumstances such as when PG&E personnel or contractors need to enter the staging areas during nighttime hours because they must continue to work during the night on work that cannot be disrupted or suspended. If needed, temporary lighting may be powered by portable generators. PG&E will comply with the EIR mitigation measures to reduce impacts from construction lighting.

6. Extent of Staging Areas? From where to where?

Response: For practical reasons, a useful staging area would occupy an accessible, flat, well graded, and previously disturbed area while avoiding sensitive resources. The extent of staging areas will be field verified and demarcated prior to set up, with participation from qualified archaeological monitor(s) and biologist(s). Tribal monitors will be invited to participate in/or observe the demarcation of all staging areas.

7. What has BLM determined regarding eligibility and potential impacts to this area?

Response: A report titled National Register of Historic Places Eligibility Evaluation of CA-SBR-11862H, San Bernardino County, California (September 2013) was prepared by AE. The report concluded that significant historical associations of the site, and its representativeness as a historically significant type, were lost with the removal of the buildings and other features. This loss of integrity means that the site cannot be considered eligible for the NRHP under Criteria A or C; however, the archaeological remains at CA-SBR-11862H do meet standards of both significance and integrity with respect to NRHP Criterion D and the site is eligible for the NRHP under this criterion. PG&E understands that BLM has concurred with this recommendation.

Based upon current information, the construction staging area which may be sited within CA-SBR-11862H boundaries as part of the Project avoids the historical debris deposits that contribute to the property's significance. Therefore, BLM has concluded that this historic property would not be affected adversely. The BLM is seeking the concurrence the CA SHPO regarding the determination of eligibility to the NRHP and the determination of no adverse effect.

Construction Staging Area #15

1. Vegetation Removal? Tribes do not want vegetation removed.

Response: Consistent with the EIR mitigation measures to reduce visual impacts, PG&E will work to avoid and protect woody or perennial plants in this area. PG&E assumes that occasional removal of weeds, if needed for the purpose of staging is acceptable. Again, as mentioned above, the extent of staging areas will be verified and demarcated prior to construction set up, with participation from qualified biologist(s). Tribal monitors will be invited to participate in/or observe the demarcation of all staging areas.

2. Wider access/modifications? Tribes do not want that.

Response: PG&E does not intend to modify or widen access to this area for use as construction staging. For access to this area, PG&E plans to open up the existing entrance by moving the large rocks that currently block the entrance. The precise locations of the rocks will be determined in the field concurrent with the pre-construction field verification and demarcation of the staging area.

3. Watchmen? Guards? Restroom?

Response: As mentioned above, PG&E does not intend to staff construction staging areas, therefore, there will not be watchmen and guards stationed at the staging areas. It is likely that there will be portable toilets at some staging areas, although, which staging areas will have these facilities and their precise locations within the staging areas have yet to be determined.

4. What activities?

Response: See response to #4 above.

5. Lighting?

Response: See response to #5 above.

6. When was this area last surveyed for cultural materials?

Response: This area was last formally surveyed in 2004 and reported in AE's 2007 report. Since that time, the area has been revisited during the course of considering this area as a staging area. Per PG&E's standard process, the area will be reexamined prior to any ground disturbing activities.

7. Extent of Staging Areas? From where to where?

Response: See response to #6 above.

Construction Staging Areas #17 and #19

1. Modifications?

Response: PG&E does not intend to improve or modify these areas.

2. Fencing? With what?

Response: Unlike other staging areas, these two areas are currently used as turnaround and parking areas for vehicle traffic along the access road. Therefore, to preserve this functionality, PG&E does not intend to install temporary fences in these two areas.

3. Structures?

Response: PG&E does not intend to install any structures in these two areas.

4. Blading, leveling, gravel import?

Response: PG&E does not intend to make surface improvements to these areas. Gravel import is neither planned nor anticipated to level or blade these areas.

5. Lighting? Generators?

Response: See response to #5 above.

6. Berm cuts along road?

Response: PG&E does not intend to do any berm cuts along road.

For Area #19, the Tribes also had the following question: "There is a better place to the west (down the slope) where there already exists a large level place with a well (MW25). Why not go there instead? Proposed IRL-7 nearby. Also N (?).

Response: The level place to the west of Area #19 serves as an access road used by BNSF, Southwest Gas Company, and PG&E gas transmission department. The access to their facilities cannot be impeded by PG&E's remediation work. Although a small portion of this area may be periodically useful and available for PG&E remediation work, these other utility constraints and limited access using a steep driveway and tight turning radius led PG&E to conclude that this potential staging area has little value to the project.

PUNCH LIST #5 FROM SEPTEMBER 17 – 18 TWG MEETING

60% Design, Appendix L – Volume 4: Soil Management Plan

Comment FMIT-194, Hualapai/Chemehuevi/Cocopah/CRIT-144 - Potential Soil Storage Location Decision Matrix

The current groundwater EIR does not specifically address long-term storage of soil within the APE. Please indicate how impacts to cultural and visual resources associated with long-term soil storage will be evaluated. While stakeholder input has been requested in regards to potential locations for soil storage it is not clear how the final decision will be made. This process needs to be transparent. Therefore please provide a matrix which includes all parameters used in the decision/rationale behind final storage locations that will be discussed with the Tribe. Parameters that should be transparently discussed in regards to the final soil storage location would include proximity to cultural resources, whether access routes are adjacent to cultural resources, distance of storage to point of origin and will potential locations have any visual impacts that are not currently addressed in the GW EIR

Potential Soil Storage Location Decision Matrix

Potential Soil Storage and Staging Locations	Total Area (acres)*	Approximate distance to storage location from remedy construction area	Acceptable to Tribes?	Impacts to Cultural Value	Potential visual impacts of storage location	Access to storage location (existing or improvements needed)	Potential ecological impacts of storage location
Soil Storage Areas (shown in yellow on map)							
1 - Park Moabi RV Storage Area	2.11	2 miles	TBD	TBD	TBD	Good No improvements needed	Low Located in relatively unvegetated/disturbed area; not within sensitive plant or wildlife habitat
2 - Park Moabi RV Storage Area	1.94	2 miles	TBD	TBD	TBD	Good No improvements needed	Low Located in relatively unvegetated/disturbed area; not within sensitive plant or wildlife habitat
3 - Park Moabi RV Storage Area	5.09	2 miles	TBD	TBD	TBD	Good No improvements needed	Low Located in relatively unvegetated/disturbed area; not within sensitive plant or wildlife habitat
4 -Paintball Area	0.91	2 miles	TBD	TBD	TBD	Good Minor improvements needed	Low Located in relatively unvegetated/disturbed area; not within sensitive plant or wildlife habitat
5 - BOR OHV Staging Area	1.45	2 miles	TBD	TBD	TBD	Good No improvements needed	Low Located in relatively unvegetated/disturbed area; not within sensitive plant or wildlife habitat

Potential Soil Storage and Staging Locations	Total Area (acres)*	Approximate distance to storage location from remedy construction area	Acceptable to Tribes?	Impacts to Cultural Value	Potential visual impacts of storage location	Access to storage location (existing or improvements needed)	Potential ecological impacts of storage location
6 - Area near IM-3 treatment plant	0.67	0-1 mile	TBD	TBD	TBD	Good No improvements needed	Low Located in relatively unvegetated/disturbed area; not within sensitive plant or wildlife habitat
7 -Area near IM-3 treatment plant	0.28	0-1 mile	TBD	TBD	TBD	Good No improvements needed	Low Although appears to be located within vegetation polygon, actual location is in unvegetated area adjacent to access road
8- Area near IM-3 treatment plant	0.17	0-1 mile	TBD	TBD	TBD	Good No improvements needed	Low Although appears to be located within vegetation polygon, actual location is in unvegetated area adjacent to access road

* - Estimated total acreage for the subject area (actual area available for remedy use will be less and will need to be verified).

Proposed Remedy Construction Staging Areas Matrix

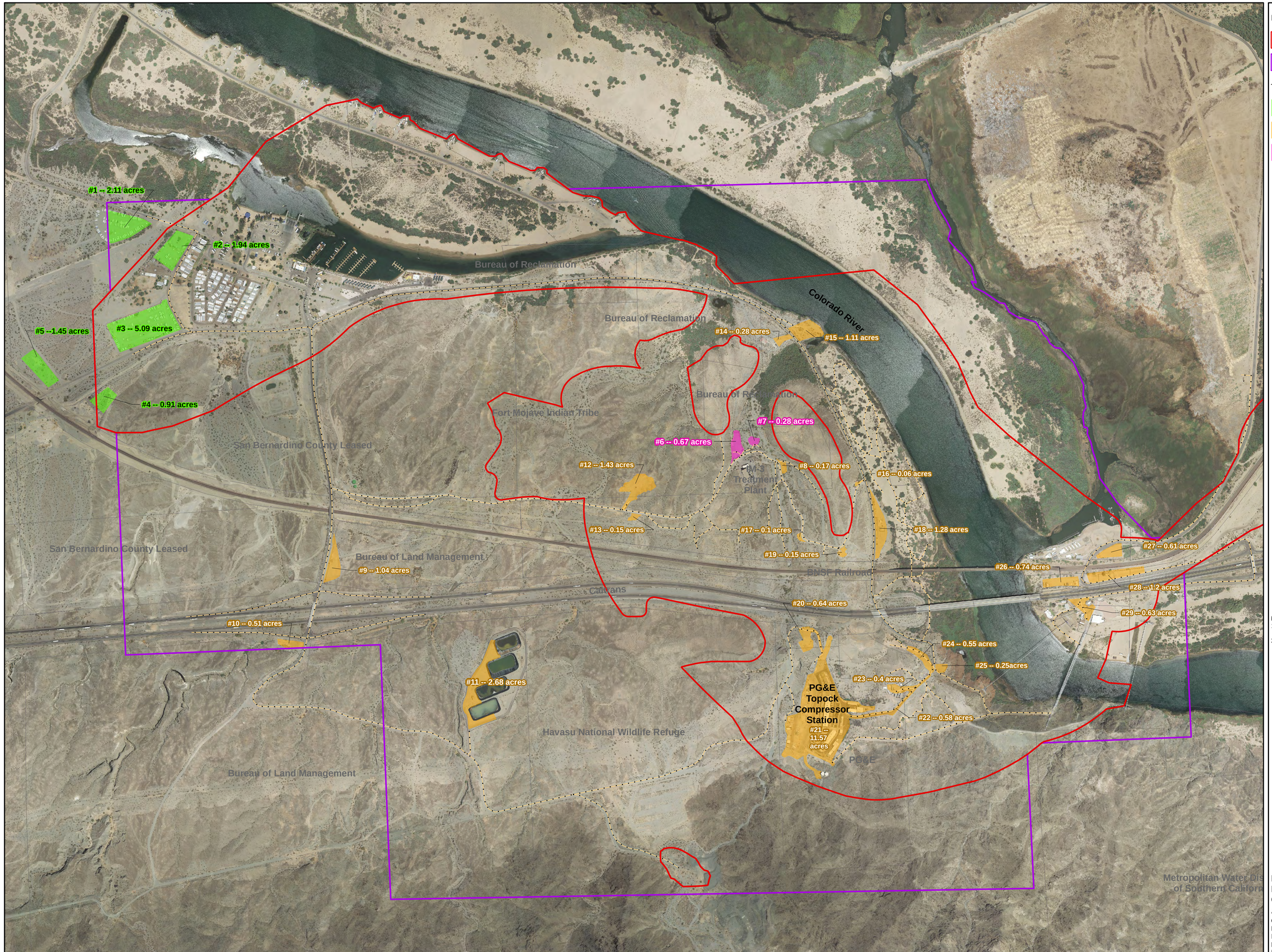
Staging Locations	Total Area (acres)*	Acceptable to Tribes?	Impacts to Cultural Value	Potential visual impacts of staging location	Potential ecological impacts of storage location
9	1.04				Low Located in disturbed area; not within sensitive plant or wildlife habitat
10	0.51				Low Located in disturbed area; not within sensitive plant or wildlife habitat
11	5.69				Low Located in disturbed area; not within sensitive plant or wildlife habitat
12	1.43				Low Located in disturbed area; not within sensitive plant or wildlife habitat
13	0.15				Low Located in disturbed area; not within sensitive plant or wildlife habitat
14	0.28				Low Located in disturbed area; not within sensitive plant or wildlife habitat

Staging Locations	Total Area (acres)*	Acceptable to Tribes?	Impacts to Cultural Value	Potential visual impacts of staging location	Potential ecological impacts of storage location
15	1.11				Low Located in disturbed area; not within sensitive plant or wildlife habitat
16	0.06				Low Located in disturbed area; not within sensitive plant or wildlife habitat
17	0.1				Low Located in disturbed area; not within sensitive plant or wildlife habitat
18	1.28				Low Located in disturbed area; not within sensitive plant or wildlife habitat
19	0.15				Low Located in disturbed area; not within sensitive plant or wildlife habitat
20	0.64				Low Located in disturbed area; not within sensitive plant or wildlife habitat

Staging Locations	Total Area (acres)*	Acceptable to Tribes?	Impacts to Cultural Value	Potential visual impacts of staging location	Potential ecological impacts of storage location
21 - Compressor Station	11.57				Low Located in disturbed area; not within sensitive plant or wildlife habitat
22	0.58				Low Located in disturbed area; not within sensitive plant or wildlife habitat
23	0.4				Low Located in disturbed area; not within sensitive plant or wildlife habitat
24	0.55				Low Located in disturbed area; not within sensitive plant or wildlife habitat
25	0.25				Low Located in disturbed area; not within sensitive plant or wildlife habitat
26	0.74				Low Located in disturbed area; not within sensitive plant or wildlife habitat

Staging Locations	Total Area (acres)*	Acceptable to Tribes?	Impacts to Cultural Value	Potential visual impacts of staging location	Potential ecological impacts of storage location
27	0.61				Low Located in disturbed area; not within sensitive plant or wildlife habitat
28	1.2				Low Located in disturbed area; not within sensitive plant or wildlife habitat
29	0.63				Low Located in disturbed area; not within sensitive plant or wildlife habitat

* - Estimated total acreage for the subject area (actual area available for remedy use will be less and will need to be verified).



LEGEND

- EIR Project Area
- Area of Potential Effects (APE)
- Proposed Access Routes
- Potential Soil Storage Area/ Proposed Staging Area for Remediation Project
- Proposed Staging Areas for Remediation Project
- Areas #6 and #7 are proposed by DOI for consideration as soil storage areas only from the IM-3 decommissioning and sampling activities (see comment #775 DOI-320). PG&E proposes these two areas as staging areas during construction of the remedy and decommissioning of IM-3 facilities. Area #6 is also proposed as a waste management area for non-hazardous waste only during decommissioning of IM-3 (see Draft IM3 Decommissioning Work Plan).
  Note that the FMIT has opposed the use of these two areas for any remediation related purposes. See FMIT comment on 60% design, #291 FMIT-44

Notes:

1. PG&E may use all or a subset of these potential temporary staging areas during remedy construction.
2. Note that in compliance with EIR mitigation measure CUL-1a-9 as well as PA and CHPMP mitigation measures, the proposed access route west of National Trails Highway is located in an existing, previously disturbed, access road. The location of the access road was field verified and does not create any direct physical impact or effect on the Topock Maze, as it is manifested archaeologically, in compliance with EIR mitigation measure CUL-1a-10 and PA and CHPMP mitigation measures

N

0 300 600 1,200 Feet

Updated November 2013

FIGURE 7.6-1
PROPOSED STAGING AREAS, CONSTRUCTION YARD, AND ACCESS ROUTES

GROUNDWATER REMEDY BASIS OF DESIGN REPORT
INTERMEDIATE (60%) DESIGN
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

CH2MHILL

DWG: \\ENFANDELIP002\PACIFICGASELECTRIC\COMTOPOCKPROGRAM\GIS\MAPFILES\2013\CM\SITSTAGING_ACCESS_EXPANDED_CULTURAL MXD ECLARK1 11/22/2013 10:35:48 AM

Attachment H: RTC #317-321

PG&E's Response to TRC Technical Memorandum on Appendix A8 and Tribe's Letter to close-out unresolved noise and vibration comments

Responses to Charlie Schlinger's Memo (12/10/13)

Comment Item 317 addressed Appendix A8 and requested a narrative "that explains how these baseline data will be used in any decision-making process(es), and as a part of Mitigation Measures NOISE-1, NOISE-2 or NOISE-3". The PG&E response to this comment provides some background as to why the supplemental data were collected, and how these data are part of documenting site conditions prior to remedy implementation. This background information helps with the broader understanding of the work done so far, and should be included in the upcoming 90% BoD report. However, the RTC response does not explain how these data will be used. As I considered this comment, the response, and reviewed the Appendix A8 data, I identified several additional pertinent questions:

A) I understand that there was considerable discussion about the meaning of the term "baseline". Will the meaning of "baseline" as used in Appendix A8 be clarified and agreed upon as part of resolution of this or other sound/noise-related comments?

RESPONSE: *As discussed at the November 19-20, 2013 TWG meeting, baseline site conditions means conditions of the site prior to remedy implementation.*

B) It seems clear that some parties decided (and I concur) that the sound level data gathered as part of EIR development were insufficient, and therefore the additional data were acquired. Is there a record of that discussion and decision?

RESPONSE: *There was no determination that sound level data gathered as part of EIR development was insufficient.*

C) The response to the comment indicates that these noise data are available for use, if needed and as appropriate. The response needs to indicate how the data will be or should be used.

RESPONSE: *Until there is an actual construction or operational noise concern, PG&E cannot opine on how or if this data will be useful. Rather, this was a pro-active step taken by PGE to be as prepared as possible for a meaningful discussion should the need arise.*

D) Why were no frequency (spectral) characteristics of the measured noise determined? Also, why were no sound recordings made, e.g., of events that exceed a certain threshold? My understanding is that the 831 sound level meter can readily collect this information, which is most informative, for example, when trying to understand if the noise has a characteristic frequency range, or, to identify the source(s) of loud noise(s) that influence the record at a site.

RESPONSE: *The EIR identified the applicable criteria as A-weighted, therefore the measurement results were summarized on the A-weighted scale. Should the need arise to evaluate an actual concern, additional data collection and analysis can be conducted.*

Comment Item 318 requested a tabular inventory and map of noise source locations. I very much appreciate PG&E's willingness to provide this – as indicated in the PG&E Response to 60% Design Comments column.

A challenge of this project is to quantify, in advance, the environmental noise impact(s) of the remedy. Clearly, the FEIR made an effort to do this, but that attempt was done well in advance of actual knowledge of the remedy design. Now that design is well underway, it would make sense to re-valuate the likely noise impacts based on the actual design. I expect that noise impacts during routine operation and maintenance will be minor – assuming that permanent stationary noise sources are selected for low noise emission or are buried, enclosed, etc. I expect that noise impacts during the main construction period and during decommissioning will be significant. Similar activities may also intermittently occur during the life span of the remedy due to repairs or equipment updates or replacements. Until mobile and stationary noise source locations are identified, and source noise levels are quantified, cumulative environmental noise impacts on noise-sensitive Tribal (or other) receptors cannot be properly anticipated, forecast or assessed. It is probably worthwhile to note on the map or inventory that not all noise sources will be generating noise at the same time.

> **RESPONSE:** *PG&E agrees that the quantitative sound levels from the project operations will likely be low. Construction including decommissioning are considered short term, isolated noise events. The EIR analyzed the potential noise impacts from the construction and operation of the project and established mitigation measures. PG&E is committed to complying with the thresholds established in the EIR and implementing the mitigation measures.*

Comment Item 319 concerns how the selection and specification of equipment will utilize noise restrictive criteria. This focuses on the selection of all equipment with specific consideration for its capacity to generate noise. The PG&E response addresses this partially, but the response language seems to focus on equipment selection for the permanent (life-of-project) infrastructure, whereas the response needs to address equipment selection for each of the construction, operation & maintenance, and, decommissioning periods. The PG&E comment response references Section C.11 in Appendix C – Design Criteria (page C-32) of the 60% BoD Report, and I have several questions concerning that section, which is reproduced below.

1) A design margin of 3 to 5 A-weighted decibels (dB[A]) will be considered in all noise design criteria.
2) In conformance with the EIR mitigation measures NOISE-3 and CUL-1a-10, the operational noise design criteria for the project will be per San Bernardino County Development Code 83.01.080 for acceptable exterior noise standards for place of worship, which is 55 dB(A) Leq daytime (7 a.m.-10 p.m.) and 45 dB(A) Leq nighttime (10 p.m.-7 a.m.) (Leq is the equivalent average hourly noise level) (see page 4.9-24 of the EIR [DTSC 2011]). The noise measurement locations will be at the edge of the Maze closest to the subject facilities and at the short-term ambient noise measurement locations (ST-1, ST-2, and ST-3) in Exhibit 4.9-2 of the certified EIR (DTSC 2011).
3) For remedy facilities in Arizona, the operational noise design criteria will be 60 dB daytime and 50 dB nighttime average at closest residences (per current Mohave General Plan, Exhibit V-5, Maximum Noise Levels for Various Land Use).
4) For remedy facilities on the Refuge, the operational noise design criteria will be 60 dB.
5) For remedy facilities located on the Compressor Station and within PG&E property, the operational noise design criteria will be consistent with the noise environment at the Station, per San Bernardino County Development Code 83.01.080 for industrial land use, 70 dB(A).
6) The construction noise criteria will conform to San Bernardino Development Code and Mojave County standards, as well as the EIR mitigation measures NOISE-1, -2, and -3.
Per San Bernardino County Code Division 3 Chapter 83.01.080, temporary construction, maintenance, repair, or demolition activities between 7:00 a.m. and 7:00 p.m., except Sundays and federal holidays, are exempt from noise limits.

> A) Regarding the first bulleted item, please explain what is meant by this statement. How will this design margin be applied, and what facilities are being designed using the margin?

RESPONSE: *Anticipated overall operational sound levels for the groundwater remediation project will be compared to the criteria stated in Items 2 through 5 above. The design goal will be that the operational sound levels are 3-5 dBA less that the stated criteria. That is, as the project proceeds through detailed design, it will not be designed right up to the stated criteria. This is considered good engineering practice. The facilities are those related to the remedy, are stationary and of non-emergency nature.*

B) Concerning the second bulleted item, operational noise criteria are identified, and noise measurement locations that will supplement existing locations ST-1, ST-2 & ST-3 are called out. Will the Tribes be consulted in the selection of these supplemental locations? Will these supplemental locations and the existing ST locations be utilized for construction-period noise monitoring? Will background noise levels be established at these supplemental locations in advance of the construction period – similar to what is being done for Short-Term locations ST-1, ST-2 & ST-3? To what does the term "subject facilities" refer?

RESPONSE:
Once the groundwater remedy is in operation, should the Tribes have concerns about operational noise that is generated by the remedy, PG&E will work with the Tribes to select measurement locations at the edge of or within the Maze, if the Tribes desire, and conduct monitoring at these selected locations. Subject facilities noted under Item 2 refer to remedy facilities that are stationary and of non-emergency nature.

Item 6 above pertains to noise generated during construction. With regard to noise monitoring during construction, PG&E will comply with the EIR mitigation measure NOISE-2c which states that "When construction activities are conducted within the distances outlined above (i.e., 1,850 feet and 5,830 feet from California receptors and 330 feet and 735 feet from Arizona receptors for daytime and nighttime noise, respectively) relative to noise-sensitive uses in the project area, noise measurements shall be conducted by a qualified acoustical consultant at the nearest noise-sensitive land use relative to the construction activities with a sound level meter that meets the standards of the American National Standards Institute (ANSI Section S14 1979, Type 1 of Type 2) to ensure that construction noise associated with the project component complies with applicable daytime and nighttime noise standards." Coordination and communication with Tribes on all project noise-generating activities will be in accordance with the Draft CIMP protocol for CUL-1a-8h, which is intended to reduce auditory impacts during remedy implementation.

C) In the fourth bulleted item, will noise data, if and when measured, be collected at the property line of the Refuge or at other locations, possibly within the Refuge? Where, specifically?

RESPONSE: *PG&E does not anticipate operation of this project will result in an exceedance of the design criteria. Should a specific and actual concern arise during operations, PG&E will conduct appropriate measurements to address that concern. It would be purely speculative to identify specific locations at this time as there is no reason to anticipate a specific concern.*

D) Is the 70 dB(A) noise criterion, identified in bulleted item 5, an Leq value, and if so is it a daytime, nighttime or 24-hr value?

RESPONSE: *San Bernardino County Development Code 83.01.080, specifically Table 83-2, establishes an Leq metric during both the day and night. It is reproduced below:*

Table 83-2 Noise Standards for Stationary Noise Sources		
Affected Land Uses (Receiving Noise)	7 am-10 pm Leq	10 pm-7 am Leq
Residential	55 dB(A)	45 dB(A)
Professional Services	55 dB(A)	55 dB(A)
Other Commercial	60 dB(A)	60 dB(A)
Industrial	70 dB(A)	70 dB(A)
Leq = (Equivalent Energy Level). The sound level corresponding to a steady-state sound level containing the same total energy as a time-varying signal over a given sample period, typically 1, 8 or 24 hours.		
dB(A) = (A-weighted Sound Pressure Level). The sound pressure level, in decibels, as measured on a sound level meter using the A-weighting filter network. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound, placing greater emphasis on those frequencies within the sensitivity range of the human ear.		
Ldn = (Day-Night Noise Level). The average equivalent A-weighted sound level during a 24-hour day obtained by adding 10 decibels to the hourly noise levels measured during the night (from 10 pm to 7 am). In this way Ldn takes into account the lower tolerance of people for noise during nighttime periods.		

E) The sixth bulleted item, states (correctly) that the San Bernardino County Code exempts temporary construction, maintenance and repair activities from noise limits provided that the activity occurs between the hours of 7 AM and 7 PM, Sundays and Federal holidays excluded. (They have a similar exemption for vibration.) The inclusion of this statement in the design documents is troubling, because it is at odds with Section 4.9.3.2 of the FEIR (Thresholds of Significance), in which this basically unlimited noise threshold was rejected. Why then, is it used as a noise criterion in the Basis of Design report?

RESPONSE: *This was not intended to be confusing. Construction noise was appropriately identified as potentially significant and mitigation measures were established in "Mitigation Measure NOISE-2: Project Generated Construction-Related Noise Levels."*

Comment Item 320 concerns the importance of meteorological effects on noise propagation. The comment response appears to address stationary/permanent noise sources during the operational period, but it should be expanded to address mobile and transient sources, such as those used during well construction and rehabilitation, because those latter sources will generate higher noise levels, and quite possibly at lower frequency.

RESPONSE: *Construction equipment noise levels and ranges, as well as potential influence of meteorology on sound propagation are well documented. Construction noise for the project was appropriately identified as potentially significant and mitigation measures were established in "Mitigation Measure NOISE-2: Project Generated Construction-Related Noise Levels."*

Comment Item 321 as initially worded, concerned what was felt to be a nearly complete absence of data interpretation and discussion in Appendix A8. Additional clarification to the comment was provided subsequent to the comment period. The PG&E and DTSC responses provide sought-after background on the various metrics used in the Appendix A8 report, and on the ST site selection, and that is much-appreciated. While one could have made their own assumptions, quite possibly erroneous, it is most helpful to have an explanation of what was measured, averaged, statistically-

developed, and recorded. This information and discussion should be included in Appendix A8 of the 90% BoD Report. The comment response mentions the November 8, 2012, PG&E Topock Groundwater Remediation Project Sound Level Measurements Protocol, which, I recollect, perhaps incorrectly, was issued (based on its date) after supplemental sound level measurements had already commenced. Please clarify if the protocol was developed before the August 2012 measurement period and if so, was it distributed to all interested parties?

> **RESPONSE:** *The protocol was developed prior to the August 2012, and was distributed to interested parties in November 2012. The Tribes were notified of the field work associated with the August 2012 and subsequent noise monitoring events.*

Hualapai Department of Cultural Resources
P.O. Box 310
Peach Springs, Arizona 86434
Office: 928.769.2223 FAX: 928.769.2235

March 10, 2014 **HDCR File: 2014-662**

VIA ELECTRONIC MAIL
Mr. Aaron Yue
Topock Project Manager
DEPARTMENT OF TOXIC SUBSTANCES CONTROL
5796 Corporate Avenue
Cypress, California 90630

Ms. Pamela S. Innis
Topock Remedial Project Manager
Office of Environmental Policy and Compliance
U.S. DEPARTMENT OF THE INTERIOR
P.O. Box 25007 (D-108)
Denver, Colorado 80225-007

Re: Invitation to Review and Comment on Unresolved Noise- and Vibration-Related Comments

Dear Mr. Yue:
On behalf of the Hualapai Tribe, we appreciate being able to respond to unresolved noise and vibration related comments. With the assistance of the Technical Review Committee, Hualapai supports the following language usage for the below stated comments in regards to the close out for the 60% Design.

Comments 260 & 263

Use the following language for closure of each of these comments:

> The DTSC response indicates that Noise and Vibration-Sensitive Land Uses in section 4.9.1.5 did identify the Topock Cultural Area as a sensitive land use. We note that, apparently, no impacts to this use were analyzed. The development of the 90% Basis of Design Report should include a consultation with the Tribes to consider and identify vibration- and noise-sensitive Tribal uses and users.
>
> Comment closed. The Tribes would request that as the sound monitoring details are resolved, the usage of the Topock area as a location of deep spiritual meaning and associated usage would be taken into account to the fullest extent possible.

Comments 320 & 321

Use the following additional language for closure of each of these comments:

1. Revise the noise measurement protocol in consultation with the Tribes. Specifically, the protocol needs to include the collection and archiving of noise measurements that include spectral content (noise level as a function of frequency, which consist of unfiltered and un-weighted, or un-averaged, raw data, aka band spectra), and noise recordings accompanied by a spoken or written narrative addressing what noise and sounds are being heard.
2. Following the above revised protocol, collect additional noise data during the summer and early winter of 2014.
3. Adopt the protocol for use on the project, going forward.

Comment closed.

Comment 322

Comment 322 should be considered as closed.

We appreciate our on-going consultations and collaborations with the Topock Remediation Project and look forward to meaningful dialogue through-out the up-coming years. If you have any concerns please feel free to contact myself, or Dawn Hubbs, Program Manager and we will be happy to assist you.

Sincerely,

Loretta Jackson-Kelly, Director and Tribal Historic Preservation Officer
Hualapai Department of Cultural Resources

Cc:
Mr. Rudy Clark, Sr., Councilman, Hualapai Tribal Council
Mr. Robert Bravo, Councilman, Hualapai Tribal Council
Karen Baker, CHG, CEG, Chief, Geological Services Branch

Item	Comment Number	Section/ Page	Reference Text	60% Design Comment	PG&E Response to 60% Design Comments	DTSC Response to 60% Design Comments	DOI Response to 60% Design Comments	Tribe Response to 60% Design Comments	Final Comment Resolution
General Comments									
260	FMIT-36 Hualapai-25 Chemehuevi-25 Cocopah-25 CRIT-25	Table 6.1-1 p. 6-37	Noise-1a	Vibration-sensitive land uses are assumed to consist only of residential and mobile home parks. Based on this assumption Tribal land uses are neglected. Tribal land use must be considered.	The stated assumption is consistent with the certified EIR (see page 4.9-20), and was expressly mentioned in both the 30% and 60% designs. No comments were received on this topic in the 30% design.	Noise and Vibration-Sensitive Land Uses in section 4.9.1.5 which did identify the Topock Cultural Area as a sensitive land use. NOTE TO KEEPER OF THE MATRIX: THIS DTSC RESPONSE, AS PRESENTLY WORDED, APPEARS TO BE INCOMPLETE (COMPARE TO THE DTSC RESPONSE FOR ITEM 263, BELOW.)			This comment and the responses were discussed at the December 12, 2013 TWG telecon.
263	FMIT-39 Hualapai-28 Chemehuevi-28 Cocopah-28 CRIT-28	Table 6.1-1 p. 6-38	Noise-2c	While vibration-sensitive receptors are discussed and identified as part of Noise-1, there is no similar discussion and identification of noise- sensitive receptors.	The certified EIR defined noise sensitive receptors in Chapter 4.9.1.5 (Existing Noise Environment, page 4.9-5).	Noise and vibration- sensitive receptors are discussed in the Noise and Vibration-Sensitive Land Uses section 4.9.1.5 which did identify the Topock Cultural Area as a sensitive land use.			This comment and the responses were discussed at the December 12, 2013 TWG telecon.
320	FMIT-53 Hualapai-39 Chemehuevi-39 Cocopah-39 CRIT-39	Append A8		The important effect(s) of meteorological conditions on the long-range propagation of sound should be addressed.	Meteorological effects are most pronounced for elevated sources or very loud sources, particularly those with strong low frequency content (such as a train). The operational sources of noise associated with this project are primarily located within buildings or underground, therefore their sound emissions are minimized and are not elevated. This project does not utilize equipment which is known to emit high levels of low frequency noise (such as train engines or unsilenced simple-cycle combustion exhaust stacks). See also response to TRC's (Charlie Schlinger) memorandum dated December 10, 2013, included in **Attachment H**, at the end of this table.				Written comments on the responses to this comment were received from the TRC (Charlie Schlinger) on November 15, 2013. PG&E provided a response to the written comment on December 10, 2013 (see memo included in **Attachment H**, at the end of this table).
321	FMIT-54 Hualapai-40 Chemehuevi-40 Cocopah-40 CRIT-40	Append A8 p. 1 and Figure 1	*The sound measurement locations were selected near the short term measurement locations in the Final Environmental Impact Report (FEIR) (DTSC,2011).*(shown in Exhibit 4.9-2 as ST-1, ST-2, and ST-3) (see Figure 1)	The three sites, ST-1, ST-2 & ST-3, have quite different levels of background sound levels and time—distributions, but this is not discussed. The report as it stands provides practically no quantitative evidence about the nearby noise sources and their (expected/measured) spatial contribution to the background noise. Such information is crucial to properly analyze and understand the highly variable background noise which was measured across the three sites. Further, it is unclear as to why these sites were chosen. *"PGE asked for clarification of this comment prior to response. The following clarification of comment was obtained from TRC on October 17, 2013. Response addresses the clarified comment.* *It is unclear what the data entries included in*	American National Standards Institute (ANSI) S1.4 Type 1 (precision) sound level meters were used to monitor ambient sound levels. The sound level meters were programmed to report the average (L_{eq}) and statistical sound level	A specific rationale for the selection of individual sites for noise measurements was not provided in the Groundwater Final EIR. Based on the locations of the monitoring locations, the following can be inferred: ST 1 was chosen for its proximity to Maze Loci A; ST 2 was chosen for its proximity to Maze Loci C; ST 3 was chosen for its proximity to residences and traffic intersection at Park Moabi; LT A was chosen to provide ambient noise data from I-40; and LT B was chosen to provide ambient noise data from the BNSF rail line. It can also be inferred from the text in the Final		The Tribe was not involved in the selection of the sites in the FEIR and the 2012-2013 study. The Tribes also note that there is no noise monitoring plan.	Written comments on the responses to this comment were received from the TRC (Charlie Schlinger) on November 15, 2013. PG&E provided a response to the written comment on December 10, 2013 (see memo included in **Attachment H**, at the end of this table).

				Appendix A8 Tables (1 & 2) represent? It is assumed that these data represent averages of other numbers presumably numbers in the Appendices (C-H) of Appendix A8. Please confirm if this assumption is correct. In addition it is not clear what the numbers in Appendices C-H represent? Presumably, they too are "averages" of other numbers - these latter numbers probably being what was actually measured. Please provide additional detail that allows the reader to understand what was actually measured and for what duration(s). That is, what are the basic measurements for this baseline sound characterization, and what "averaging" methods were used to develop the tabular summary information?	metrics (Leq, L50, and L90) at hourly intervals. The sound level meters continuously monitor the sound levels during each hourly interval and automatically calculate and report the average and statistical levels at the conclusion of the hourly interval. This process repeats continuously until the meters are manually turned off or the batteries are depleted and the meter automatically turns off. Appendices C through H present the data reported by the sound level meters in tabular and graphical format. The data in Table 1 is a summary of the data presented in Appendices C through H. Table 1 presents the maximum and minimum hourly Leq sound pressure level and corresponding wind speed for each monitoring location during both the daytime (7 a.m. to 10 p.m.) and nighttime (10 p.m. to 7 a.m.) periods for both the summer and winter monitoring events. For example, the data presented in Appendix C (ST-1, August 2012) was reviewed to identify the maximum and minimum L_{eq} during the daytime and nighttime periods. These maximum and minimum levels were summarized for in Table 1 along with the wind speed that occurred during those maximum and minimum periods for ST-1 during August 2012. Table 2 presents the same sound pressure level data that is in Table 1 alongside the data collected from the 2008 EIR (the wind speed which was reported in Table 1 was omitted from Table 2 to enhance readability of Table 2). Table 2 shows that the short-term data collected for the 2008 EIR is within the range of the longer-term data collected over both a summer and winter period. Had the 2008 EIR sound level data fallen substantially outside the range of that recorded during this longer term monitoring event, its reproducibility could have been questioned. This did not occur. That is, there was nothing anomalous or spurious occurring during the time the sound level data reported in the 2008 EIR was collected.	EIR that the five locations were identified in recognition of the existing noise environment associated with the site (i.e., the diversity of background sound levels that exist on the site) and the existing noise-sensitive land uses. Further, because intervening topography exists between the compressor station and other portions of the project areas in the form of mesas that generally shield noise-sensitive receptors from full exposure of current on-site operations, multiple representative sites for ambient noise measurements were necessary. To accurately describe potential noise related impacts, the Final EIR used the ambient noise survey data from the individual locations to determine impacts to nearest sensitive receptors from the proposed project (i.e., the data collected for the three sites was not averaged). The normalization of the data described above, was conducted for individual sites only.			
				Site selection is a critical matter when it comes to developing a baseline. In the case of noise on this project, 3 sites were selected, with very little basis/justification provided in the FEIR. (The initial response to comments for this comment goes a long way in providing some explanation, but it is not complete, as ST-1 and ST-2 are indeed located on "mesa" tops (upland areas) and one, ST-3, is located down off of the "mesa",	These sites were chosen by the EIR preparer for noise measurements because mesas that generally shield noise sensitive receptors from full exposure of operations that were occurring when the EIR was prepared, exist between the compressor station and other portions of the project areas (see FEIR, page 4.9-5). Additional data				

				at a street intersection.) Please provide additional detail regarding what is it about these sites that is representative and meaningful when it comes to baseline noise measurements? Why are these locations appropriate for developing the baseline sound characterization? *The reporting in Appendix A8 is too clinical and terse; there are no more than a half-dozen sentences given to the discussion of results, mainly with an eye toward wind effects on noise measurements. While there are essential footnotes related to measured wind speed, which is highly relevant to noise measurements, there is no interpretation and discussion of the numerical values in Tables 1-2, or in the Tables in Appendices C-H in terms of individual site location and proximity to known noise sources, time of day, actual noise from these sources, season, atmospheric conditions, topographic conditions, or any other factor known to influence the measurements.* *There needs to be clear communication, in the design documents, of how these most recent noise data, together with the FEIR noise data collected in 2008, will be used as part of the project design.*	was collected in proximity to these sites in 2012 – 2013. Agencies, Tribes, and Stakeholders were informed of this selection as documented in the *Sound Level Measurements Protocol Technical Memorandum* (Appendix B to the 60% BOD Appendix A8). See also response to comment #322 FMIT-55/Hualapai-41. The *Sound Level Measurements Technical Memorandum* in Appendix A8 is intended to report the supplemental data collected during the 2012-2013 event. Since the existing site conditions (e.g., noise environment, topographic condition) are well documented in the FEIR, that body of information is intentionally not repeated in this technical memorandum. If helpful, additional references to the FEIR can be added to this technical memorandum. See responses to comment #317 FMIT-50/Hualapai-36 and #319 FMIT-52/ Hualapai-38, as well as TRC's (Charlie Schlinger) memorandum dated December 10, 2013, included in **Attachment H**, at the end of this table.				
322	FMIT-55 Hualapai-41 Chemehuevi-41 Cocopah-41 CRIT-41	Append A8 p.1 and Photo 1 & 2		The 60% BOD Report Appendix A-8 noise measurement locations are reported to be "near" and "in proximity to" the certified EIR noise measurement locations. The meanings of these terms are ambiguous and need clarification. Why were the certified EIR noise measurement locations not used?	Precise GPS locations were not available for the locations used in the certified EIR. The 2012 – 2013 noise measurement locations were selected based on their suitability for a longer term noise measurement. All of these locations are within approximately 100 feet of the EIR noise measurement locations and are well within the same acoustical environment.			The Tribes were not involved in the selection of the sites in the FEIR and the 2012-2013 study. The Tribes also note that there is no noise monitoring plan.	This comment and response were discussed at the October 16-17, 2013 TWG meeting.

Appendix 2

This issue has its origins with DTSC's EIR requirement for very minimal 15-minute-duration acoustic measurements at 3 locations, ST-1, ST-2 & ST-3, which were not selected in consultation with the Tribes. Further, the protocol for EIR acoustic measurement was developed without Tribal consultation. To its credit, the EIR well-addressed and quantified known noise sources – the railway and interstate highway, and the data from those noise source measurements, provided in the EIR, forms a part of our understanding of the "noise-scape" at Topock.

As part of its design process, PG&E, apparently voluntarily and unilaterally, collected additional acoustic measurements, of much greater duration than those obtained as part of the EIR development. The protocol for these measurements was circulated to the stakeholders after the first half (August 2012) of the acoustic measurements had been completed. The sites consisted of the same 3 locations identified above.

This additional information goes part of the way toward remedying the situation, but that other vital information was not recorded. This comes down to a matter of measurement protocol.

In order to have a complete record of the baseline, it is essential to not only record 15-minute or hourly averages of noise levels, but to also record information on the frequency content of the noise being measured, to actually record typical identifiable noise, and to provide a written narrative that explains the origins (railroad, interstate, compressor station, motorized watercraft, wind, etc.) of signals that have been recorded, and links this knowledge to the corresponding measured averaged noise levels. This would allow the contributions of specific and well-known noise sources to be quantified for the locations of interest, and understood by all parties, not just acoustic engineers. The instrumentation that has been used is certainly capable of recording this data, though the observer must keenly observe, take good field notes, and prepare the narrative. However, due to a narrowly-focused protocol, this was not done. Instead, the information provided represents averages of noise levels observed over extended time periods (typically an hour).

From: Doug Bonamici [mailto:dbonamici@critdoj.com]
Sent: Monday, March 10, 2014 2:36 PM
To: Yue, Aaron@DTSC
Cc: howard.magill@crit-nsn.gov; Wilene Fisher-Holt; Margaret R. Eggers; Nora McDowell; Dawn Hubbs; Edgar Castillo; Charlie Schlinger; Baker, Karen@DTSC
Subject: Comments on Noise/ Vibration and Pipeline Routing

Mr. Yue, the Colorado River Indian Tribes will not be submitting further comment for the 60% Design phase on the Noise and Vibration issues nor on the Pipeline Routing issues at this time. We have participated in the discussions of those issues, and are satisfied the DTSC, DOI and PG&E have heard our concerns directly, and through the other Tribal comments. We will consider adding further input as the design process moves forward.
Thank you for your efforts in this regard. db

Douglas F. Bonamici
Law Clerk, Office of the Attorney General
Colorado River Indian Tribes
26600 Mohave Rd.,
Parker, Arizona 85344
Phone: 928-669-1271
Email: doug.bonamici@crit-nsn.gov

Attachment I: RTC #384a/b

Parameters used to calculate the mixed convection ratio, M in FW-1/FW-2

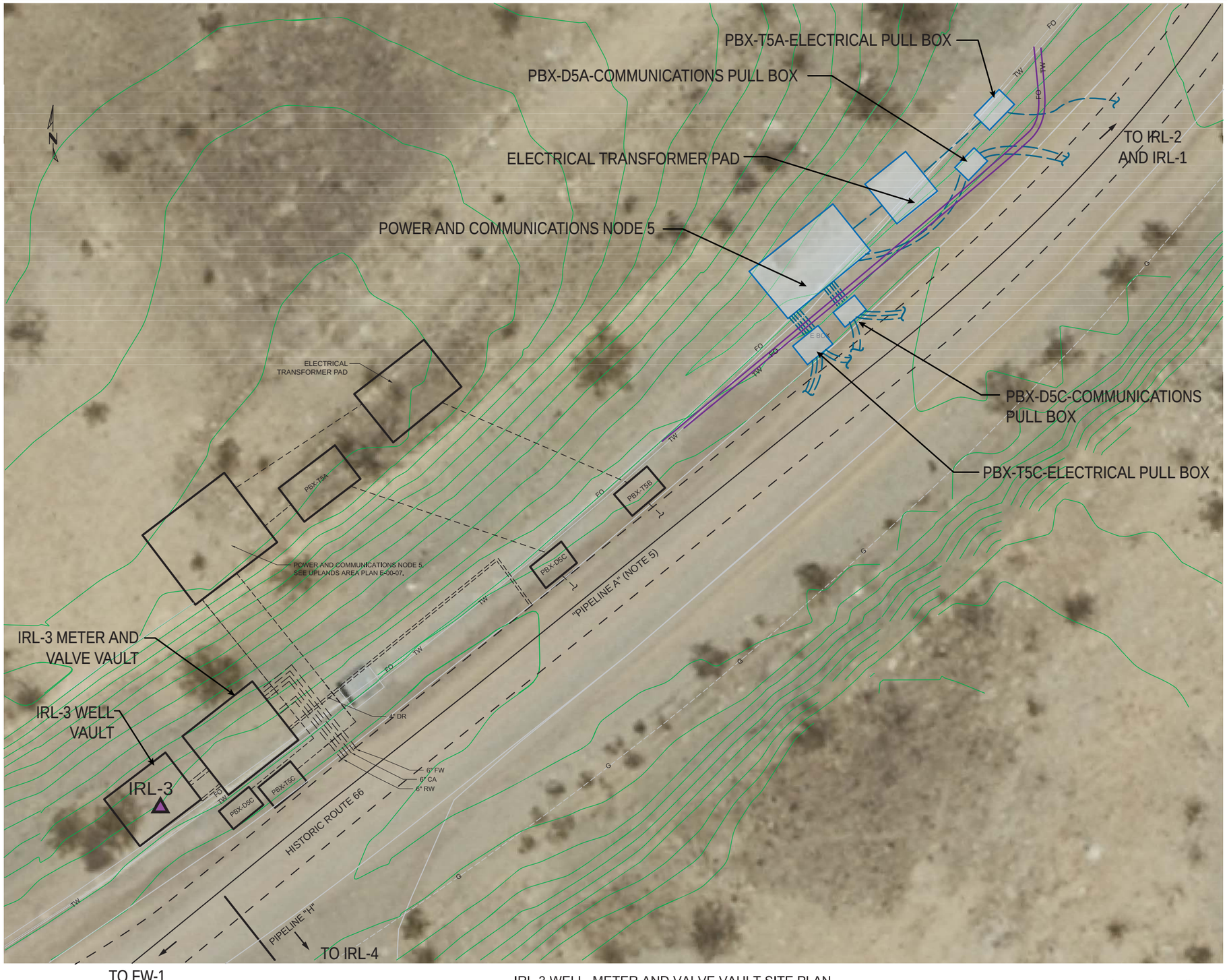
RTC #384a/b FMIT-94/Hualapai-80/Chemehuevi-80/Cocopah-80/CRIT-80
Parameters used to calculate the mixed convection ratio, M in FW-1/FW-2

FW-1		**M =**	**0.22**
r	740	Ft	Approximate distance from FW-1 to IRL wells
β	250	Ft	Aquifer thickness near FW-1
Q	19250	ft3/day	Nominal 100 gpm pumping rate for FW-1
Kv	0.75	ft/day	Average Kv from model - range is 0.5 to 1.0 ft/day near FW-1
ρ	996.18	g/L	Density of 450 ppm water at 85 deg F
ρ_0	1001.07	g/L	Density of 7,000 ppm water at 85 deg F - representative of deep zone water near FW-1

FW-2		**M=**	**0.35**
r	600	Ft	Approximate distance from FW-2 to TCS injection wells
β	60	Ft	Aquifer thickness near FW-2
Q	9625	ft3/day	Nominal 50 pumping rate for FW-2
Kv	1.5	ft/day	Default value in model for areas where no Kv measurements are available
ρ	996.18	g/L	Density of 450 ppm water at 85 deg F
ρ_0	1006.27	g/L	Density of 14,000 ppm water at 85 deg F - representative of deep zone water near FW-2

Attachment J: RTC #438, #440, #442

Changes to Infrastructure Locations for Node 5/FW-1, Visualizations for IRL-2



IRL-3 WELL, METER AND VALVE VAULT SITE PLAN

0 5 10 15

LEGEND

- EXISTING UNDERGROUND LINE
- EXISTING ABOVEGROUND LINE
- EXISTING ABOVEGROUND LINE, RELOCATED
- EDGE OF ROAD (HISTORIC ROUTE 66)
- TOPOGRAPHIC CONTOUR LINES
- NEW UNDERGROUND LINE, INITIAL LOCATION
- NEW UNDERGROUND LINE, REVISED LOCATION
- NEW INJECTION WELL (IRL-3), INITIAL LOCATION
- NEW VAULT (FOOTPRINT DIMENSION INCLUDES FOOTING)
- NEW VAULT OR PULL BOX, REVISED LOCATION (FOOTPRINT DIMENSION INCLUDES FOOTING)

PBX PULL BOX

PIPELINE SERVICE

CA	CARBON AMENDED
FO	FIBER OPTIC
FW	FRESH WATER
G	GAS
RW	REMEDY PRODUCED WATER
TW	TREATED (FILTERED) REMEDY PRODUCED WATER

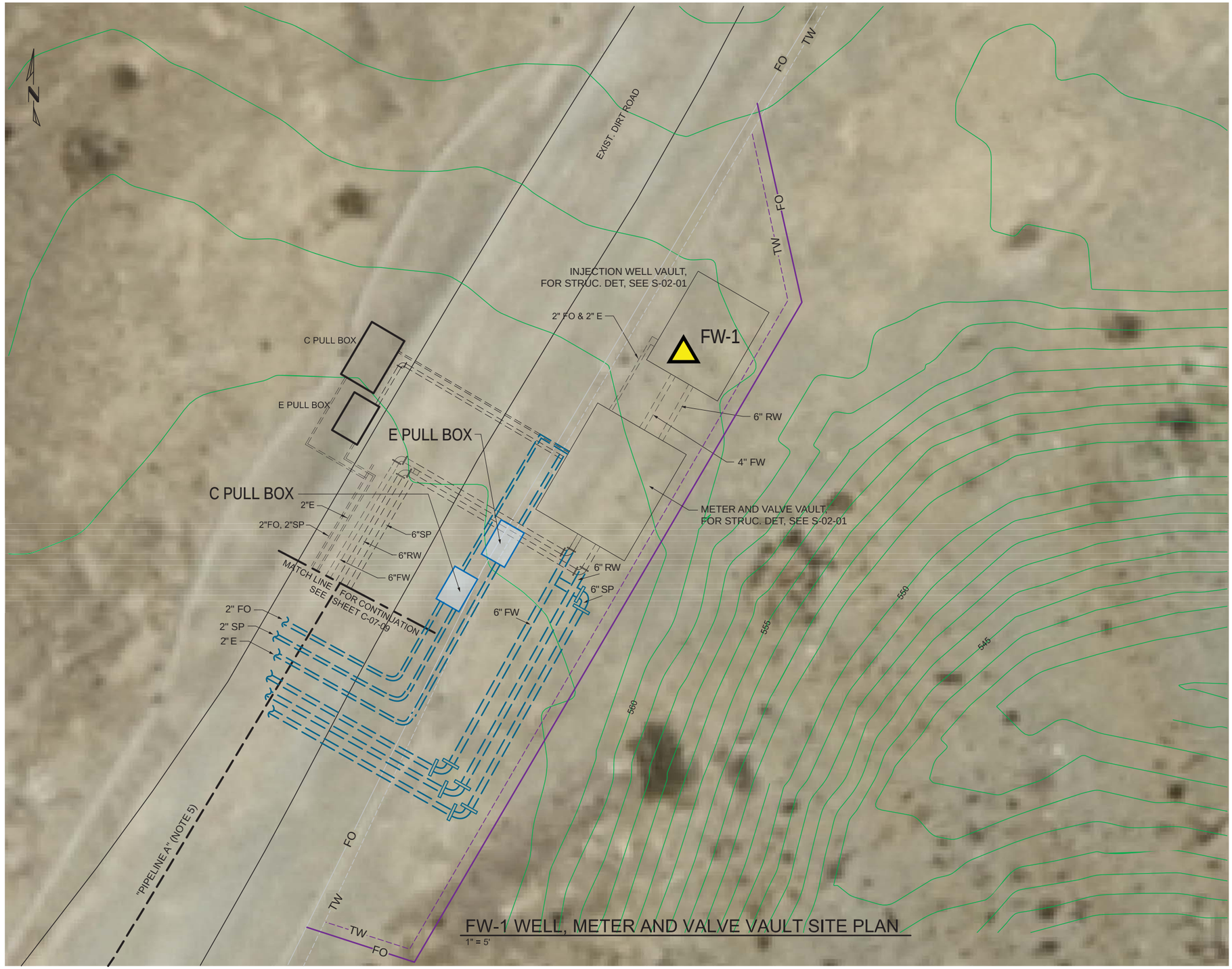
6" FW
- PIPELINE SERVICE
- PIPELINE SIZE (INCHES)

NOTES:

1. THIS IS A CONCEPTUAL LAYOUT AND IS NOT INTENDED AS AN ENGINEERING DESIGN.
2. FOR INJECTION WELL AND METER VAULT STRUCTURAL DETAILS, SEE DWGS. S-05-01 THROUGH S-05-05.
3. FOR WELL, METER AND VALVE VAULT MECHANICAL DETAILS, SEE DWGS. M-05-05 AND M-05-06.
4. SURVEILLANCE CAMERA LOCATION AND DETAILS TO BE DETERMINED LATER.
5. THIS REPRESENTS THE CENTERLINE OF THE PRE-CAST CONCRETE TRENCH SECTION WITH THE DASHED PARALLEL LINES SHOWING THE LATERAL EXTENT OF THE TRENCH.

Node 5/IRL-3: RTC to FMIT-130
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL



LEGEND

- EXISTING UNDERGROUND LINE
- EXISTING ABOVE GROUND LINE
- EDGE OF ROAD
- EXISTING UNDERGROUND LINE, RELOCATED
- EXISTING ABOVE GROUND LINE, RELOCATED
- TOPOGRAPHIC CONTOUR LINES
- NEW UNDERGROUND LINE, INITIAL LOCATION
- NEW ABOVE GROUND LINE, INITIAL LOCATION
- NEW UNDERGROUND LINE, REVISED LOCATION
- NEW FRESHWATER INJECTION WELL (FW-1)
- NEW VAULT OR PULL BOX, INITIAL LOCATION (FOOTPRINT DIMENSION INCLUDES FOOTING)
- NEW VAULT OR PULL BOX, REVISED LOCATION (FOOTPRINT DIMENSION INCLUDES FOOTING)
- 90° ELBOW

PIPELINE SERVICE

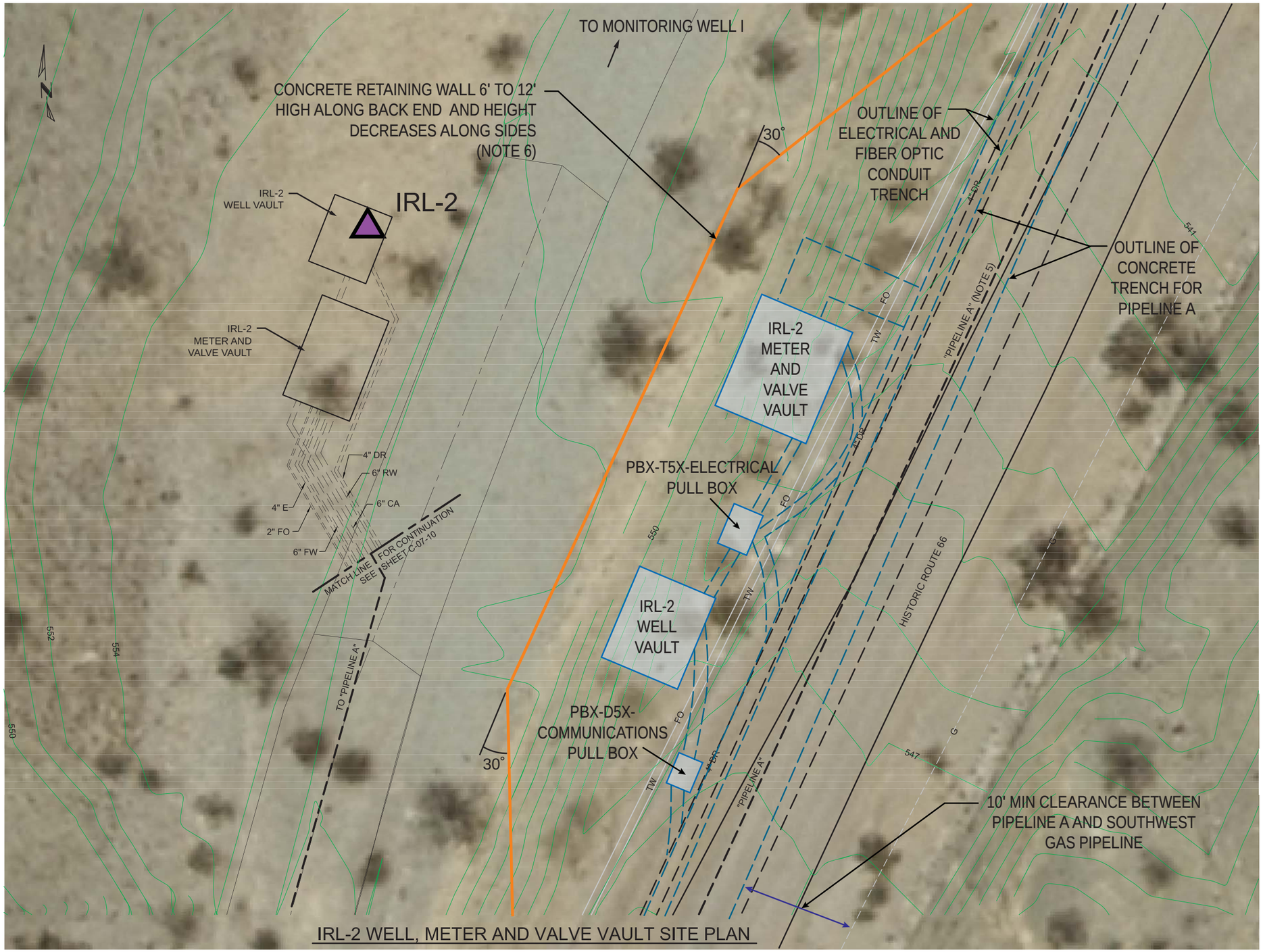
C	COMMUNICATION
E	ELECTRICAL
FO	FIBER OPTIC
FW	FRESH WATER
RW	REMEDY PRODUCED WATER
TW	TREATED (FILTERED) REMEDY PRODUCED WATER
SP	SPARE

6" FW
- PIPELINE SERVICE
- PIPELINE SIZE (INCHES)

NOTES:

1. THIS IS A CONCEPTUAL LAYOUT AND IS NOT INTENDED AS AN ENGINEERING DESIGN.
2. FOR STANDARD PLANS OF WELL VAULT AND METER VAULT, SEE DWG S-02-01.
3. FOR MECHANICAL PLANS OF WELL VAULT AND METER VAULT, SEE DWG M-02-01.
4. FOR PLC PANEL, SEE DWG E-02-01.
5. THIS REPRESENTS THE CENTERLINE OF THE TRENCH SECTION. THE LATERAL EXTENT OF THE TRENCH IS NOT SHOWN, BUT IT IS APPROXIMATELY 5'6".

FW-1: RTC to FMIT-132
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA



IRL-2 WELL, METER AND VALVE VAULT SITE PLAN

LEGEND

- EXISTING UNDERGROUND LINE
- EXISTING ABOVE GROUND LINE
- EDGE OF ROAD
- TOPOGRAPHIC CONTOUR LINES
- NEW UNDERGROUND LINE, INITIAL LOCATION
- NEW UNDERGROUND LINE, REVISED LOCATION
- NEW UNDERGROUND LINE TRENCH ALIGNMENT
- CONCRETE RETAINING WALL
- NEW INJECTION WELL (IRL-2), INITIAL LOCATION
- NEW VAULT, INITIAL LOCATION (FOOTPRINT DIMENSION INCLUDES FOOTING)
- NEW VAULT OR PULL BOX, REVISED LOCATION (FOOTPRINT DIMENSION INCLUDES FOOTING)

PBX PULL BOX

PIPELINE SERVICE

CA	CARBON AMENDED
DR	DRAIN
E	ELECTRICAL
FO	FIBER OPTIC
FW	FRESH WATER
G	GAS
RW	REMEDY PRODUCED WATER
TW	TREATED (FILTERED) REMEDY PRODUCED WATER

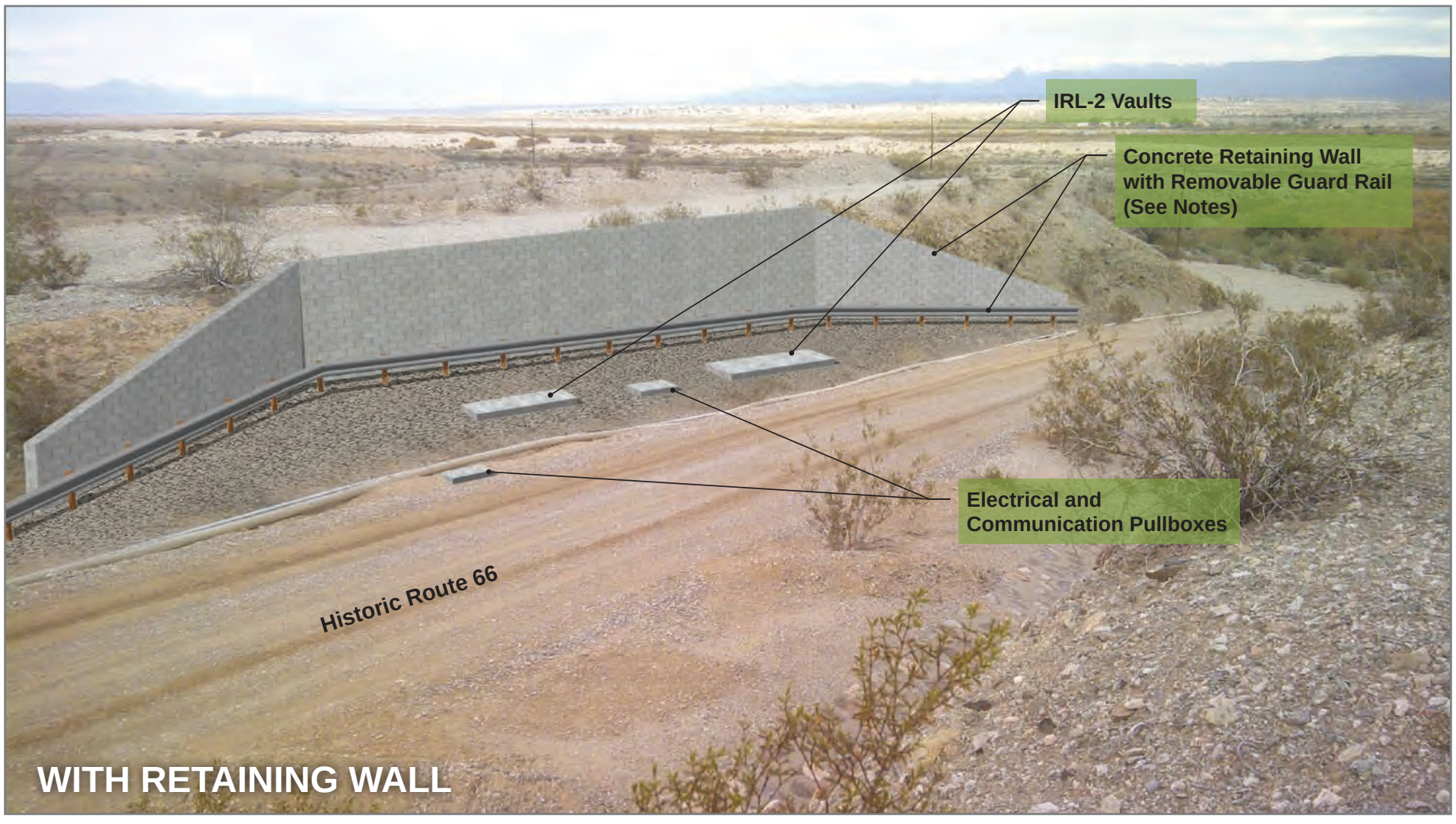
6" FW
- PIPELINE SERVICE
- PIPELINE SIZE (INCHES)

NOTES:

1. THIS IS A CONCEPTUAL LAYOUT AND IS NOT INTENDED AS AN ENGINEERING DESIGN.
2. FOR INJECTION WELL AND METER VAULT STRUCTURAL DETAILS, SEE DWGS. S-05-01 THROUGH S-05-05.
3. FOR WELL, METER AND VALVE VAULT MECHANICAL DETAILS, SEE DWGS. M-05-05 AND M-05-06.
4. SURVEILLANCE CAMERA LOCATION AND DETAILS TO BE DETERMINED LATER.
5. THIS REPRESENTS THE CENTERLINE OF THE PRE-CAST CONCRETE TRENCH SECTION WITH THE DASHED PARALLEL LINES SHOWING THE LATERAL EXTENT OF THE TRENCH.
6. THE CONCRETE RETAINING WALL WILL HAVE AN IMPACT PREVENTION SYSTEM (NOT SHOWN). THIS WILL CONSIST OF COMPONENTS LIKE K-RAIL, BOLLARDS OR GUARD RAILS. THESE WILL BE REMOVABLE FOR WELL AND EQUIPMENT MAINTENANCE.

IRL-2: RTC to FMIT-133
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA





NOTES:

1. THIS IS A CONCEPTUAL VISUALIZATION FOR ILLUSTRATION PURPOSES ONLY AND IS NOT INTENDED AS AN ENGINEERING DESIGN.
2. IMAGE IS NORTH-FACING.
3. “PIPELINE A” IS BURIED UNDERGROUND AND RUNS IN HISTORIC ROUTE 66. “PIPELINE A” IS A PRE-CAST CONCRETE TRENCH WITH A LATERAL EXTENT OF APPROXIMATELY 4’ 6” AND A DEPTH OF APPROXIMATELY 2’. ELECTRICAL AND COMMUNICATION LINES ARE LOCATED UNDERGROUND ADJACENT TO “PIPELINE A” (1’ MINIMUM DISTANCE AWAY) WITH A LATERAL EXTENT OF APPROXIMATELY 2’ AND DEPTH OF APPROXIMATELY 4’.
4. THE CONCRETE RETAINING WALL WILL BE APPROXIMATELY 6’ TO 12’ HIGH ALONG THE BACK AND THE HEIGHT WILL DECREASE ALONG THE SIDES.
5. THE CONCRETE RETAINING WALL WILL HAVE AN IMPACT PREVENTION SYSTEM. THIS WILL CONSIST OF COMPONENTS LIKE GUARD RAILS (AS SHOWN), K-RAIL OR BOLLARDS. THESE WILL BE REMOVABLE FOR WELL AND EQUIPMENT MAINTENANCE.

IRL-2 VISUALIZATION: RTC to FMIT-133
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

Attachment K: RTC #68, #471

Recommended Modifications to Arched Bridge

HALF UPPER-CHORD LATERAL SYSTEM.

HALF LOWER-CHORD LATERAL SYSTEM

DET 2 SK-2 TYP. EA. SIDE

SECTION B-B

SECTION M-M

ARIZONA

CALIFORNIA

FLOOR LEVEL=503.5'

FLOOR LEVEL=503.5'

HINGE ELEV.=450.5

HINGE ELEV.=450.5

EXTREME HIGH WATER MARK (1857?) ELEV 456.0

HIGH WATER MARK 1914 ELEV. 449.0 (HIGHEST SINCE 1857)

WATER LEVEL FEBRUARY 1915 ELEV 433.0

SAND BAR

SAND AND GRAVEL

BED ROCK

LOOSE ROCK & DENSE GRAVEL

HARD GRAVEL, SAND & GRAVEL

SIDE ELEVATION MAIN SPAN.

SCALE: 1"=20'-0".

32 SPA. @ 18'-6". 592'-0" C-C PINS

608'-0"

56'-0" 56'-0" 56'-0" 56'-0"

DET. 1 TYP. SK-1

832'-0"

EXPANSION JOINT

EXPANSION JOINT

GIRD B3 GIRD C3 GIRD A3 GIRD D3 GIRD D3 GIRD C3 GIRD A3 GIRD B3

FLOOR SYSTEM

SECTION A-A

SECTION D-D.

SECTION E-E

SECTION F-F.

SECTION G-G.

SECTION H-H.

SECTION K-K

SECTION L-L

DET 3 SK-3 TYP. 2 PLA.

SECTION C-C

END VIEW

HALF FLOOR SECTION THROUGH PIER

ELEVATION FLOOR BEAM

(SECTION THROUGH BUSHING)

HALF LONGITUDINAL SECTION

EXPANSION

¾" HOOK BOLT

JOINT

3"x8"x1'-0" RISER

3"x8" CURB

TYPICAL CURB DETAIL

REGISTERED PROFESSIONAL ENGINEER
SAVAS KOLANKAYA
S 3563
EXP. 12/31/2012
STRUCTURAL
STATE OF CALIFORNIA

← Modifications Only

NOTE:
RETRACED FROM KANSAS-CITY STRUCTURAL STEEL CO.'S DWG
ORDER 7744-7745-7746

REFERENCES
SHOP DETAILS DWG: # F 1589

APPROVED

NO	DATE	DESCRIPTION	APPD
1	1/10/12	Mod's	SK

TABLE OF CHANGES

APPROVED BY

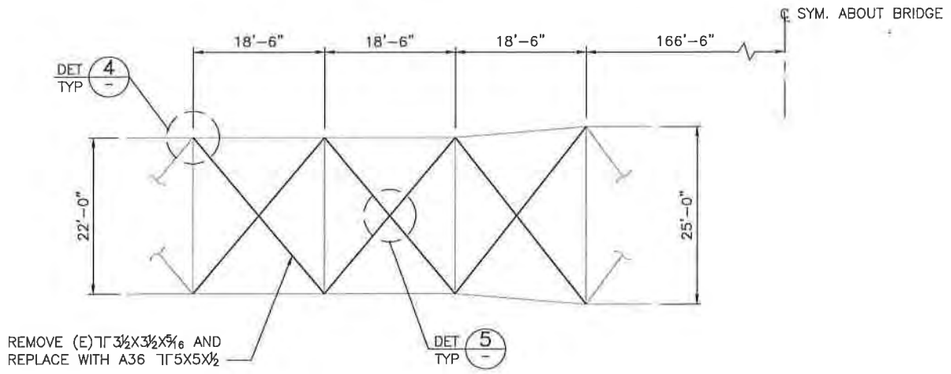
GM 101688 DRAWING LIST

BR. Dept. of R.D.
DR. V.J. Peabody
CH.
CK.
DATE
SCALES As Shown

ERECTION PLAN
COLORADO RIVER HIGHWAY BRIDGE
TOPOCK-MILPITAS, MAIN 300
DEPARTMENT OF WAR OPERATION
PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO CALIFORNIA

BILL OF MATERIAL

SUPERSEDES
SUPERSEDED BY
SHEET NO. SHEETS
DRAWING NUMBER CHANGE
481620 1



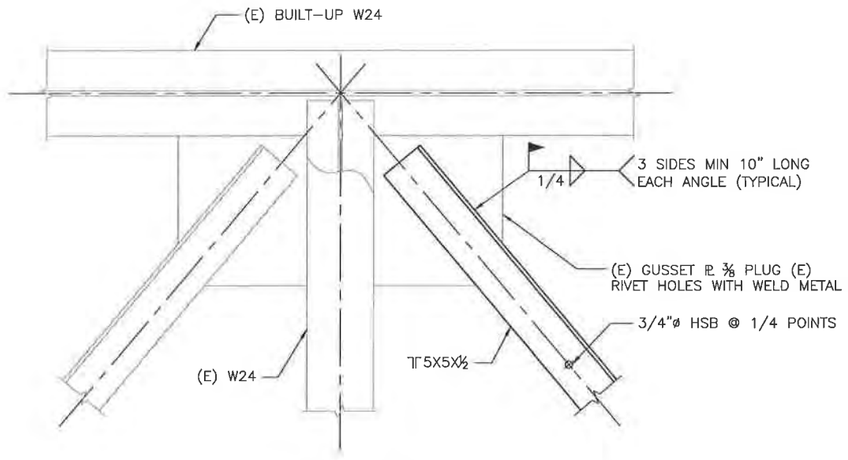
DETAIL 1
SCALE: 3/32" = 1'-0" 481620

NOTES

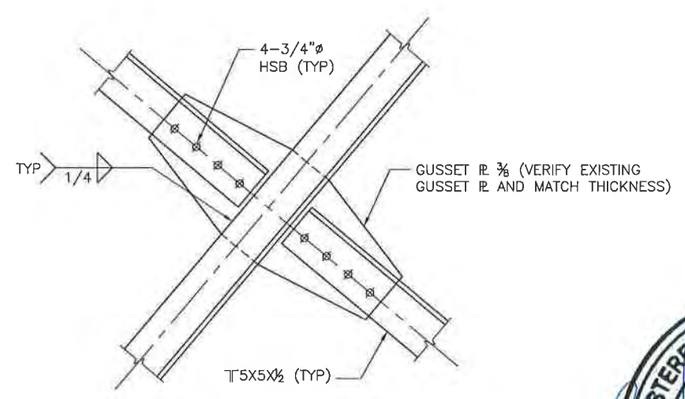
1. FOR LOCATION SEE DWG 481620.
2. CODES AND SPECIFICATIONS
   - A. INTERNATIONAL BUILDING CODE IBC–2009.
   - B. MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES, ASCE 7–05
   - C. AISC MANUAL OF STEEL CONSTRUCTION, 13TH EDITION.
   - D. AISC SPECIFICATION FOR STRUCTURAL STEEL BUILDINGS, MARCH 9,2005 (ANSI/AISC 360–05)
   - E. AISC SEISMIC PROVISIONS FOR STRUCTURAL STEEL BUILDINGS (ANSI/AISC 341)
   - F. AWS D1.5, BRIDGE WELDING CODE – AMERICAN WELDING SOCIETY.
   - G. AWS D1.8, STRUCTURAL WELDING CODE – SEISMIC SUPPLEMENT, AMERICAN WELDING SOCIETY.
   - H. SPECIFICATION FOR STRUCTURAL JOINTS USING ASTM A325 OR A490 BOLTS, JUNE 30, 2004. HEREIN REFERRED TO AS THE RCSC SPECIFICATION.
   - I. AISC CODE OF STANDARD PRACTICE FOR STEEL BUILDINGS, MARCH 18, 2005.
3. MATERIALS

   UNLESS OTHERWISE NOTED ON THE DESIGN DRAWINGS, MATERIALS SHALL CONFORM TO THE FOLLOWING SPECIFICATIONS:

   - A. STRUCTURAL STEEL W–SHAPES ——— ASTM A992, Fy=50 ksi
   - B. OTHER STRUCTURAL STEEL SHAPES, PLATES AND BARS ——— ASTM A36 , Fy=36 ksi
   - C. STRUCTURAL STEEL TUBING ——— ASTM A500 GRADE B; Fy=46 ksi
   - D. HIGH STRENGTH BOLTS, NUTS AND WASHERS ——— ASTM A325
   - E. WELDING ELECTRODES ——— AWS A5.1 SERIES E70
4. PAINTING SHALL MATCH THE EXISTING STRUCTURE.
5. FIELD MEASURE AND VERIFY ALL DIMENSIONS AND CONDITIONS BEFORE FABRICATING STEEL.
6. FOR CONNECTION PROBLEMS REPORT TO THE ENGINEER FOR APPROVAL.



DETAIL 4
SCALE: 1 1/2" = 1'–0" –



DETAIL 5
SCALE: 1 1/2" = 1'–0" –

REGISTERED PROFESSIONAL ENGINEER
SAVAS KOLANKAYA
S 3563
EXP. 12/31/2012
STRUCTURAL
STATE OF CALIFORNIA

AECOM
2101 WEBSTER STREET SUITE 1000
OAKLAND, CA 94612-3060

PROJECT NO.
60229232

REFERENCE DRAWINGS

NOTES

NO.	DATE	REVISION	DES	DWN	CHK	APPR
0	01/10/12	ISSUED FOR CONSTRUCTION	SK	KG	SK	

PROFESSIONAL SEAL

		DATE
SCALE:	AS NOTED	
DESIGNED BY	S. KOLANKAYA	1/10/12
DRAWN BY	K. GRAHAM	1/10/12
CHECKED BY	S. KOLANKAYA	1/10/12
APPROVED BY		
APPROVED BY		

STRUCTURAL DETAILS
HORIZONTAL DECK BRACES

TOPOCK L300–A ARCH BRIDGE

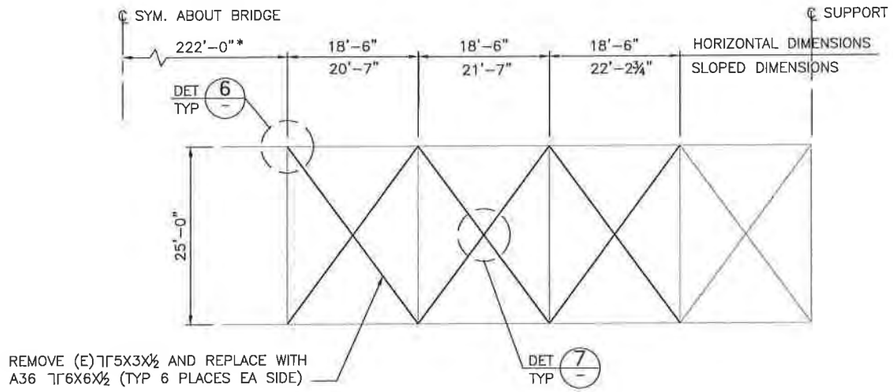
DWG NO. 481620 – SK1

REV 0

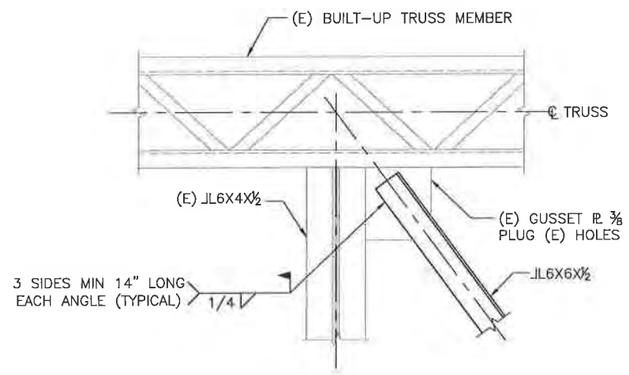
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NOTES

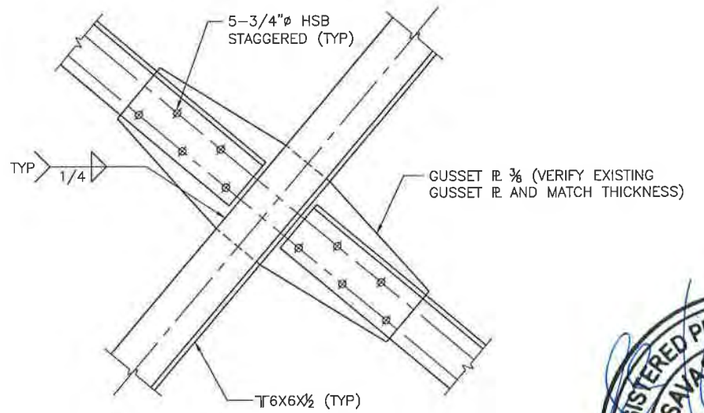
1. FOR NOTES SEE DWG 481620 – SK1



DETAIL 2
SCALE: 3/32" = 1'–0"



DETAIL 6
SCALE: 3/4" = 1'–0"



DETAIL 7
SCALE: 1 1/2" = 1'–0"

REGISTERED PROFESSIONAL ENGINEER
SAVAS KOLANKAYA
S 3563
EXP. 12/31/2012
STRUCTURAL
STATE OF CALIFORNIA

AECOM
2101 WEBSTER STREET SUITE 1900
OAKLAND, CA 94612-3060

PROJECT NO.
60229232

REFERENCE DRAWINGS

NOTES

NO.	DATE	REVISION	DES	DWN	CHK	APPR
0	01/10/12	ISSUED FOR CONSTRUCTION	SK	KG	SK	

PROFESSIONAL SEAL

SCALE:	AS NOTED	DATE
DESIGNED BY	S. KOLANKAYA	1/10/12
DRAWN BY	K. GRAHAM	1/10/12
CHECKED BY	S. KOLANKAYA	1/10/12
APPROVED BY		
APPROVED BY		

STRUCTURAL DETAILS
BOTTOM CHORD HORIZONTAL BRACES

TOPOCK L300–A ARCH BRIDGE

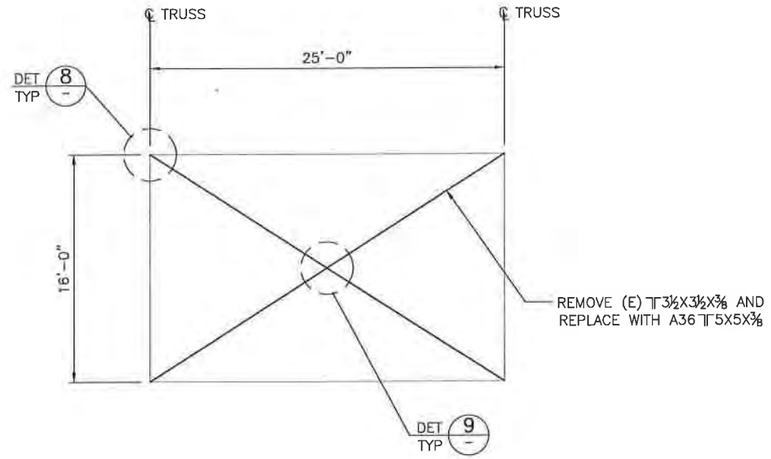
DWG NO. 481620 – SK2

REV 0

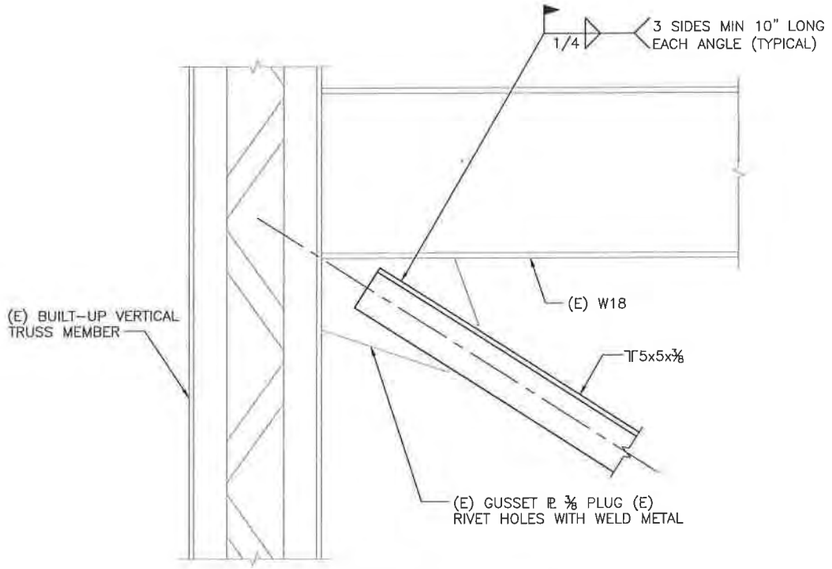
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NOTES

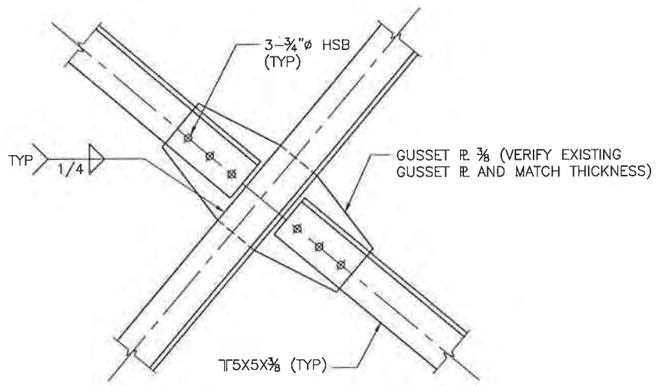
1. FOR NOTES SEE DWG 481620 – SK1.



DETAIL 3 — SCALE: 3/16" = 1'-0" — 481620



DETAIL 8 — SCALE: 1 1/2" = 1'-0"



DETAIL 9 — SCALE: 1 1/2" = 1'-0"

REGISTERED PROFESSIONAL ENGINEER
SAVAS KOLANKAYA
S 3563
EXP. 12/31/2012
STRUCTURAL
STATE OF CALIFORNIA

AECOM
2101 WEBSTER STREET SUITE 1000
OAKLAND, CA 94612-3060

PROJECT NO. 60229232

REFERENCE DRAWINGS

NOTES

NO.	DATE	REVISION	DES	DWN	CHK	APPR
0	01/10/12	ISSUED FOR CONSTRUCTION	SK	KG	SK	

PROFESSIONAL SEAL

		DATE
SCALE:	AS NOTED	
DESIGNED BY	S. KOLANKAYA	1/10/12
DRAWN BY	K. GRAHAM	1/10/12
CHECKED BY	S. KOLANKAYA	1/10/12
APPROVED BY		
APPROVED BY		

STRUCTURAL DETAILS
VERTICAL TRUSS BRACES @ 222'

TOPOCK L300-A ARCH BRIDGE

DWG NO. 481620 – SK3 — REV 0

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Attachment L: RTC #565

Geoarch Potential Layer and 60% Remedy Layout

Future Provisional Well for Freshwater Supply

650-151-03

650-151-04

COLORADO RIVER

Bureau of Reclamation (Managed by BLM) 650-151-05

Fort Mojave Indian Tribe 650-151-06

Northern Aerial Crossing

650-161-09

Interstate 40

Caltrans Leased

650-161-12*

Havasu National Wildlife Refuge (Managed by USFWS) 650-161-09

Southern Aerial Crossing

PG&E 650-161-08

Metropolitan Water District of Southern California 650-141-04

HNWR-1

Topock-2

Topock-3

IRZ-1 IRZ-02 IRZ-03 IRZ-04 IRZ-5 IRZ-06 IRZ-07 IRZ-08 IRZ-9 IRZ-10 IRZ-11 IRZ-12 IRZ-13 IRZ-14 IRZ-15 IRZ-16 IRZ-17 IRZ-18 IRZ-19 IRZ-20 IRZ-21 IRZ-22 IRZ-23 IRZ-24 IRZ-25 IRZ-26 IRZ-27 IRZ-28 IRZ-29 IRZ-30 IRZ-31 IRZ-32 IRZ-33 IRZ-34 IRZ-35 IRZ-36 IRZ-37 IRZ-38 IRZ-39 IRZ-40

A B C D E F G H I J K L M N O P Q R S

RB-1 RB-2 RB-3 RB-4 RB-5

IRL-1 IRL-2 IRL-3 IRL-4 IRL-5 IRL-6 IRL-7

FW-1 FW-2

TCS-1 TCS-2

TWB-1 TWB-2 TWB-3 TWB-4

ER-1 ER-2 ER-3 ER-4 ER-5 ER-6

Compressor Station

Chemical Storage
Process Tanks
Freshwater Pre-Injection Treatment System
Conditioned Water Storage Tanks
Remedy-Produced Water Conditioning Building
Influent Water Storage Tanks
TCS Freshwater Storage Tanks
Conditioned Water Storage Tank

Transwestern Bench

New Septic System
New Maintenance Facility
New Storage Building
New Carbon Amendment Storage Tank (3,000 gallons)
New Carbon Amendment Building

MW-20 Bench

New Carbon Amendment Storage Tank (15,000 gallons)
New Carbon Amendment Building

LEGEND

- Existing Monitoring Well
- Existing Freshwater Supply Well
- Property Boundaries
- Area of Potential Effects (APE)
- EIR Project Area
- Approximate extent of hexavalent chromium [Cr(VI)] concentrations exceeding 32 micrograms per liter (µg/L) at any depth in groundwater based on fourth quarter 2011 sampling events. Dashed where based on limited data.

Remedy Wells

- Contingent Freshwater Source
- Freshwater Source
- Remedy Monitoring Well
- Extraction Well (East Ravine)
- Extraction Well (NTH IRZ)
- Extraction Well (Riverbank)
- Extraction Well (Transwestern Bench)
- Freshwater Injection Well
- Injection Well (Inner Recirculation Loop)
- Injection Well (NTH IRZ)
- Injection Well (Topock Compressor Station)
- Future Provisional Extraction Well
- Future Provisional Injection Well
- Future Provisional Electrical Transformer
- Proposed Electrical Transformer Location

Pipeline Corridor for Remedy

- Aboveground Pipe
- Underground Pipe/Conduit
- Future Provisional/Contingent Fresh Water Pipe

Remedy Facilities

- Proposed New Remedy Structure

GeoArch - Potential

- None
- Moderate
- Lower
- Higher

Note:
Note that in compliance with EIR mitigation measure CUL-1a-9, as well as PA and CHPMP mitigation measures, the pipeline along the dirt road west of National Trails Hwy is located in an existing, previously disturbed, access road. In addition, the location of the road and pipeline was field verified and does not create any direct physical impact or effect on the Topock Maze, as it is manifested archaeologically, in compliance with EIR mitigation measure CUL-1a-10, PA, and CHPMP mitigation measures.

N

0 300 600 1,200 Feet

FIGURE 3.0-1
GENERAL REMEDY SYSTEM LAYOUT

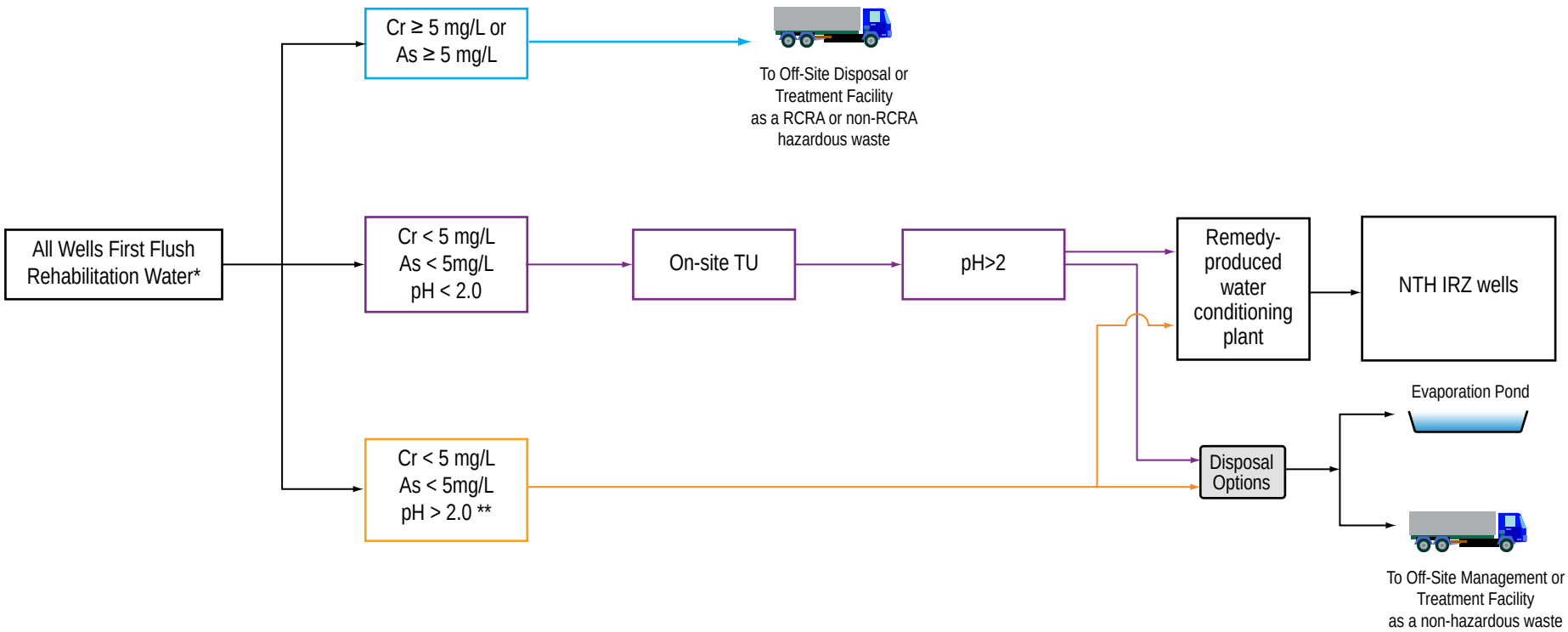
GROUNDWATER REMEDY BASIS OF DESIGN REPORT
INTERMEDIATE (60%) DESIGN
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL

Path: \\zinfandel\Proj\PacificGasElectricCo\TopockProgram\GIS\MapFiles\2013\EC_Working\GenRemLayout_GeoArch_Sensitivity.mxd

Attachment M: RTC #619

Revised Figure 6.1-2



LEGEND

Piping

Conveyed by truck

TU	Treatment Unit permitted for (pH adjustment) hazardous waste treatment per California Code of Regulations Title 22. TU may be equipped with filters to remove solids.
Cr	Chromium (dissolved)
As	Arsenic (dissolved)
IRZ	In-situ Reactive Zone
*	Conveyance by trucking is backup option for IRZ and injection wells. For extraction wells, some trucking may be required.
**	An optional approach to pH adjustment at the Remedy-Produced Water Conditioning Plant is to adjust it in the field with an On-Site TU
RCRA	Resource Conservation and Recovery Act

Update – October 2013

FIGURE 6.1-2
REMEDY-PRODUCED WATER SCHEMATIC – FIRST FLUSH REHABILITATION

GROUNDWATER REMEDY IMPLEMENTATION – OPERATIONS AND MAINTENANCE PLAN,
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

Attachment N: RTC #710

New COPCs Monitoring Table

DRAFT Table 2.1-X
Monitoring Program Wells and Surface Water Sampling Points for COPC Monitoring
Operations and Maintenance Manual Volume 2: Sampling and Analysis Plan
Revised Basis of Design Report/Intermediate (60%) Design Submittal for the Final Groundwater Remedy
PG&E Topock Compressor Station, Needles, California

Location ID	Nitrate	Molyb-denum	Selen-ium
Existing Monitoring Wells			
CW-02D		A	
CW-02M	As needed		
CW-03D		A	
CW-03M		A	
MW-10	A	A	
MW-12	A	A	A
MW-13	SA		
MW-14	Q[3]		
MW-20-070	M(yr), Q		
MW-20-100	M(yr), Q		
MW-20-130	A	A	A
MW-21			A
MW-22	A	A	A
MW-23-060	A	A	A
MW-23-080	A	A	A
MW-24A	A	A	A
MW-24B	A	A	A
MW-26	A	A	A
MW-27-020	Q		
MW-27-060	As needed		
MW-27-085	As needed		
MW-28-025	Q		
MW-28-090	A	A	A
MW-29	Q		
MW-30-030	Q		
MW-30-050	Q		
MW-32-020	As needed[2]		
MW-25	A	A	A
MW-32-035	A	A	A
MW-33-040	A	A	A
MW-33-090	A	A	A
MW-33-150	A	A	A
MW-33-210	Q		
MW-34-055	A	A	A
MW-34-080	A	A	A
MW-34-100	A	A	A
MW-35-060	A	A	A
MW-35-135	A	A	A
MW-36-020	As needed[2]		
MW-36-040	As needed[2]		
MW-36-050	As needed[2]		
MW-36-070	As needed[2]		
MW-36-090	Q		
MW-36-100	Q		
MW-37D	A	A	A
MW-37S	A	A	A
MW-38D		A	
MW-38S	A	A	
MW-39-040	As needed[2]		
MW-39-050	Q		
MW-39-060	Q		
MW-39-070	Q		
MW-39-080	Q		
MW-39-100	Q		
MW-41D	As needed		
MW-41M	Q		
MW-41S	Q		
MW-41S	A	A	A
MW-41M	A	A	A
MW-41D	A	A	A
MW-42-030	A	A	A
MW-42-055	As needed[2]		

A — Red font indicates newly added samples / wells

Gray highlight indicates avg. concentraiton above threshold
(10 mg/L for Nitrate, 70 mg/L for Molybdnemum, 50 mg/L for Selenium)

SA — Light gray font indicates wells monitored for nitrate under compliance or process control programs, at frequency indica

DRAFT Table 2.1-X
Monitoring Program Wells and Surface Water Sampling Points for COPC Monitoring
Operations and Maintenance Manual Volume 2: Sampling and Analysis Plan
Revised Basis of Design Report/Intermediate (60%) Design Submittal for the Final Groundwater Remedy
PG&E Topock Compressor Station, Needles, California

Location ID	Nitrate	Molyb-denum	Selen-ium
MW-42-065	As needed[2]		
MW-43-025	A	A	A
MW-43-075	As needed[2]		
MW-43-090	As needed[2]		
MW-44-070	A	A	A
MW-44-115	A	A	A
MW-44-125	A	A	A
MW-45-095	Q		
MW-46-175	A	A	A
MW-46-205	A	A	A
MW-47-055	M(yr), Q		
MW-47-115	M(yr), Q		
MW-49-135	Q		
MW-49-275	Q		
MW-49-365	As needed		
MW-50-200	A	A	A
MW-51	A	A	A
MW-52D	As needed[2]		
MW-52M	As needed[2]		
MW-52S	As needed[2]		
MW-53D	As needed[2]		
MW-53M	As needed[2]		
MW-53S	As needed[2]		
MW-54-085	As needed	A	
MW-54-140	As needed	A	
MW-54-195	As needed	A	
MW-55-045	As needed		
MW-55-120	As needed		
MW-56D	As needed		
MW-56M	As needed		
MW-56S	As needed		
MW-57-070		A	
MW-57-185		A	
MW-58-BR		A	
MW-59-100		A	
MW-60-125		A	
MW-61-110		A	
MW-62-065		A	
MW-62-110		A	
MW-62-190		A	
MW-63-065		A	
MW-64-BR		A	
MW-65-160		A	
MW-65-225		A	
MW-66-165	A	A	A
MW-66-230	A	A	
MW-67-185	A	A	A
MW-67-225	A	A	A
MW-67-260	A	A	
MW-68-180	A	A	
MW-68-240		A	
MW-69-195	A	A	
MW-70-105		A	
MW-71-35	A	A	
MW-72-80		A	
MW-73-80		A	
MW-74-240		A	
OW-02S		A	
PT-5D	Q		
PT-5M	Q		
PT-5S	As needed		
PT-9D	A	A	A
PT-9M	A	A	A

DRAFT Table 2.1-X
Monitoring Program Wells and Surface Water Sampling Points for COPC Monitoring
Operations and Maintenance Manual Volume 2: Sampling and Analysis Plan
Revised Basis of Design Report/Intermediate (60%) Design Submittal for the Final Groundwater Remedy
PG&E Topock Compressor Station, Needles, California

Location ID	**Nitrate**	**Molyb-denum**	**Selen-ium**
PT-9S	A	A	A
TW-1	A		A
Proposed monitoring Wells			
C	As needed[2]		
D	As needed[2]		
E	As needed[2]		
F	As needed[2]		
G	A	A	A

Attachment O: RTC #728

PG&E's Response to TRC Technical Memorandum on Chemistry

Response to Memo from Win Wright titled "RTC728_Memorandum_Nov18_2013_with comments_rev" (12/9/2013)

Comment 1 - For the Topock project, many of the groundwater samples will contain concentrations of ethanol or reaction products from the IRZ operations, and these samples will be inherently unstable.

Response – *As discussed below, PG&E believes that once preserved, stability is assured and approved method holding times apply.*

Comment 2 - Two graphs plotted by the commenter showing data from the Upland In-Situ Pilot Test (ISPT) report. During the ISPT ethanol-injection experiment, samples from monitoring wells were collected for analysis in the field (which were analyzed within 24 hours at the IM-3 facility laboratory), and samples were collected for analysis in the laboratory, where the holding time for Cr(VI) analysis was 28 days (per PG&E Holding Time Tech Memo, January 4, 2008, also attached).

Response - *PG&E believes that the basic construction of these plots is based on a questionable premise. The inherent assumption in these plots is that screening level field data quality are equal and comparable to laboratory data quality. Screening field data cannot reasonably be compared to fixed laboratory data quality and therefore, the conclusions of the table are somewhat suspect.*

Based on PG&E's experience with sampling chromium at Topock and Hinkley, any Cr(VI) present in the samples at the time of collection would be detected in the Cr(T) results, even if there were reaction in the sample bottle during transport or storage. In addition, in virtually all cases the Cr in the Cr(T) and Cr(VI) sample containers are approximately equal [Cr(T) ≅ Cr(VI)] (please note that there are specific conditions where this may not be true, see bottom of response to comment 3 below). Data at both the Topock and Hinkley project sites particularly demonstrate this connection at chromium concentrations that exceed 10 µg/l.

A graphic comparison of the laboratory Cr(T) results to laboratory Cr(VI) results yields better agreement in the range of 10-1000 µg/l (Figure 1, attached), than the graphs presented by the commenter using field Cr(VI) data to compare against laboratory Cr(VI) data. Below 10 µg/l, there is more scatter in the Cr(T) versus Cr(VI) results.

Comment 3 - Exhibit RTC-728a: Water from monitoring wells that showed TOC (ethanol) breakthrough, results plotting to the right of the 1:1 Line indicate that many of the field-analyzed Cr(VI) results were greater than the laboratory Cr(VI) results. Some samples showed positive results in the field, but showed below-detection results in the laboratory. An ideal scenario would be for all of the samples to fall on the 1:1 line.

Response - *A review of the Topock and Hinkley in situ data set yields the following observations with respect to the possibility of continued reduction of Cr(VI) to Cr(III) in the sample bottle after sample collection:*

- *For the Topock Upland ISPT, 443 samples were collected and analyzed for both Cr(T) and Cr(VI); 41 (9.3%) have results where the Cr(T) and the Cr(VI) are different by more than 10 µg/l and have a RPD that is greater than 20%. Of the 41 samples, six (1.4% of the 433 samples) have Cr(VI) results that are greater than Cr(T) results (i.e., reduction not possible) and 35 (7.9% of the 433 samples)*

have Cr(VI) results that are lower than the Cr(T) results. Therefore, assuming the difference between Cr(T) and Cr(VI) will vary equally for both analytes (based on the expected precision and accuracy levels of these methods), approximately 6.5% of the sample results could indicate a possibility of continued reduction in the sample bottle.

In addition, there was no correlation between samples with an RPD greater than 20% and a difference of 10 µg/l or greater and the presence of TOC. Only 15 samples (3.3% of the 433 samples) were associated with TOC that exceeded 50 mg/L and met the conditions necessary for continued reduction to have occurred [i.e., Cr(VI) results that are lower than the Cr(T) results, RPD greater than 20%, and a difference greater than 10 µg/l] (further explanation of these conditions is provided below). For the 24 samples with TOC concentrations that exceeded 1000 mg/l, the results showed no indication the samples continued to be reduced after sample collection and preservation.

- *For the Hinkley IRZ project, of the 8684 samples that have both Cr(T) and Cr(VI) results, 433 (5%) have results where the Cr(T) and the Cr(VI) are different by more than 10 µg/l and have a RPD that is greater than 20% . Of the 433 samples, 154 (1.8% of the 8684 samples) have Cr(VI) results that are greater than the Cr(T) results (i.e., reduction not possible), and 279 (3.2% of the 8684 samples) have Cr(VI) results that are lower than the Cr(T) results. Assuming the difference between Cr and Cr(VI) will vary equally for both analytes (based on the expected precision and accuracy levels of these methods), approximately 1.4% of the samples have results that could indicate possible continued reduction in the sample bottle.*

- *In summary, with over 9,000 sample results between the Topock and Hinkley in-situ projects, less than 2% show a possibility that continued reduction could occur in the sample container after sample collection and preservation.*

The following are considered the only conditions where Cr(VI) can possibly be reduced in a sample bottle after collection and preservation:

- ***Cr(VI)<Cr(T)** – If Cr(VI) is greater than Cr(T), reduction is not possible in the sample bottle during transport or storage.*

- ***RPD>20%** - Because the Cr(T) and Cr(VI) analyses are performed by different methods and use different instruments, a relative percent difference (RPD) of 20% or more is possible based on the expected precision and accuracy levels of these methods.*

- ***Difference between Cr(VI) and Cr(T)>10 µg/l** - Sample results that differ by less than 10 µg/l (for low concentration samples) could be caused by naturally occurring "dissolved" chromium, whether colloidal or trivalent. Such difference could also be caused if the rate of Cr(III) precipitation is lower than the rate of Cr(VI) reduction in the aquifer.*

Comment 4 - Exhibit RTC-728b: Even at low TOC breakthrough concentrations (146 mg/L), the field Cr(VI) results are 20-30% greater than the laboratory Cr(VI) results. These discrepancies could be inherent in the different methods, or could be caused by turbid field samples or high iron concentrations which interfere with the field colorimetric method. However, these discrepancies also could be caused by conversion of Cr(VI) to Cr(III) within the sample bottle during the 28-day holding time; hence, the laboratory Cr(VI) results were lower than the field Cr(VI) results.

Response - *See response to comment 2 for comparison of laboratory and field screening data. PG&E agrees with the possible causes of discrepancies identified in the comment, i.e., inherent in the*

different methods, or could be caused by turbid field samples or high iron concentrations which interfere with the field colorimetric method. PG&E believes that these are also reasons why the data cannot be compared to one another.

PG&E does not agree with the statement regarding the conversion of Cr(VI) to Cr(III) in a preserved sample regardless of holding time. Both chemical and biological reactions are severely slowed or stopped due to the decrease in temperature (samples are around 27 °C when they come out of the wells and are cooled to 4°C as soon as possible). In addition, after the buffer solution is added to the samples, pH (pH 9.3 - 9.7) also severely slows or stops all chemical and biological reactions.

Furthermore, the data collected at PT-9S (the location with a TOC breakthrough of 146 mg/L, as noted in the comment) do not indicate a relationship between the arrival of TOC with discrepancies between field and laboratory concentrations of Cr(VI). Results for laboratory and field measured Cr(IV), Cr(T), and TOC over time are plotted in Figure 2. A discrepancy was measured in the first, baseline sample collected, prior to introduction of TOC into the aquifer, and discrepancies also occurred in other samples collected before the TOC arrived on November 12, 2008. Following TOC arrival, the discrepancies do not correlate with the presence of TOC. Cr(T) and laboratory Cr(VI) concentrations were in better agreement than laboratory and field Cr(VI) throughout the dataset, reinforcing that the laboratory Cr(VI) concentrations are indicative of aquifer conditions.

It should also be noted that samples should always be analyzed as soon as possible after collection. The holding time listed by the method is a maximum time that samples may be held before the start of analysis and still be considered valid without being qualified. Although a maximum holding time of 28 days was established for Cr(VI), the average holding time over the last 4 years has been 8 days for the groundwater monitoring samples and under four days for the IM3 facility samples; analyzed by the off-site laboratory.

Comment 5 - Attached is a press release from the California Dept. of Public Health, where the holding time of 5 days is recommended for Cr(VI) analyses by EPA 218.6 (ion chromatography with post-column derivatization).

Response - T*he press release refers to recommendations regarding drinking water. Topock groundwater samples are collected for environmental data analysis, not drinking water analysis. The PG&E holding time study was performed over two sampling events covering 60 samples collected from randomly selected Topock wells with Cr(VI) concentrations ranging from 0.2 µg/L to 14,800 µg/L. The study results strongly support longer holding times (and follows the EPA Final Methods Update Rule published May 18, 2012).*

With regard to the use of the borate buffer solution referenced in the press release, the buffer was intended to be used as a way to make sure the desired pH range of the sample was obtained. The current buffer PG&E uses is approved by EPA and DTSC, and is mandated by the Water Board on the Hinkley project. There has been no issue with obtaining the desired pH. PG&E believes that changing buffer is not needed at Topock and is not required by the EPA method.

Recommendations:

1) Holding time of 5 days for analysis of Cr(VI) by EPA method 218.6 (or alternatively EPA 218.7). Field filtration and preservation with borate-carbonate buffer.
2) Holding time of 24 hours for SM-3500 Cr-B. Field filtration, and preservation with a basic solution (sodium hydroxide, or alternatively ammonium sulfate/ammonium hydroxide buffer). Since chlorine may be used as post-treatment for water from HNWR-1, the ammonium sulfate will help remove chlorine.

3) Holding time of 24 hours for the Hach hexavalent chromium method. Field filtration, no preservation.
4) Revisit and update the PG&E Holding Time Study, where different preservatives, holding times, TOC spike samples, and Cr(VI) spike samples can be compared.
5) Sample splits--continue to analyze for field Cr(VI) and laboratory Cr(VI). Splits should comprise 10% of all monitoring well samples collected as part of the groundwater remedy, until confidence can be proven that preservation methods and holding times are providing the best data regarding Cr(VI) results.

Response to Recommendations:

1) *Disagree. The five day holding time and the borate-carbonate buffer are recommendations from the State for drinking water analysis and were not intended for environmental analysis. It is more appropriate to use the May 2012 EPA Update Ruling which specifies the buffer and holding time criteria for CrVI) in environmental analysis. No changes are proposed to the 28 days holding time.*
2) *Disagree. The May 2012 EPA Update Ruling specifies the buffer and holding time criteria for Cr(VI) in environmental analysis and does not apply for just the EPA 218.6 method. Note method SM-3500 Cr-B is only used for samples when concentrations are expected to be greater than 100 µg/L. The standard ammonium sulfate/ammonium hydroxide buffer was showed to work for this method as well. No changes are proposed to the 28 days holding time.*
3) *Agree. The field laboratory protocols follow the 24 hour holding time, the field filtration, and the use of no preservative.*
4) *Disagree. PG&E does not believe that the additional holding time studies are needed or warranted because the current holding time follows the EPA Final Methods Update Rule published May 18, 2012. Furthermore, producing a carbon spike that would mimic the field conditions would be very difficult or impossible.*
5) *Disagree. See response to comment 2. Note that field screening data are intended as screening level data of process control purposes only and are not intended to replace laboratory data.*

Figure 1. Laboratory Measured Cr(VI) versus Cr(T) Concentrations
Uplands Pilot Study Data July 2007-July 2013
Wells with TOC arrival (PT-7S, PT-7M, PT-7D, PT-8S, PT-8M MW-24A, PT-9S)

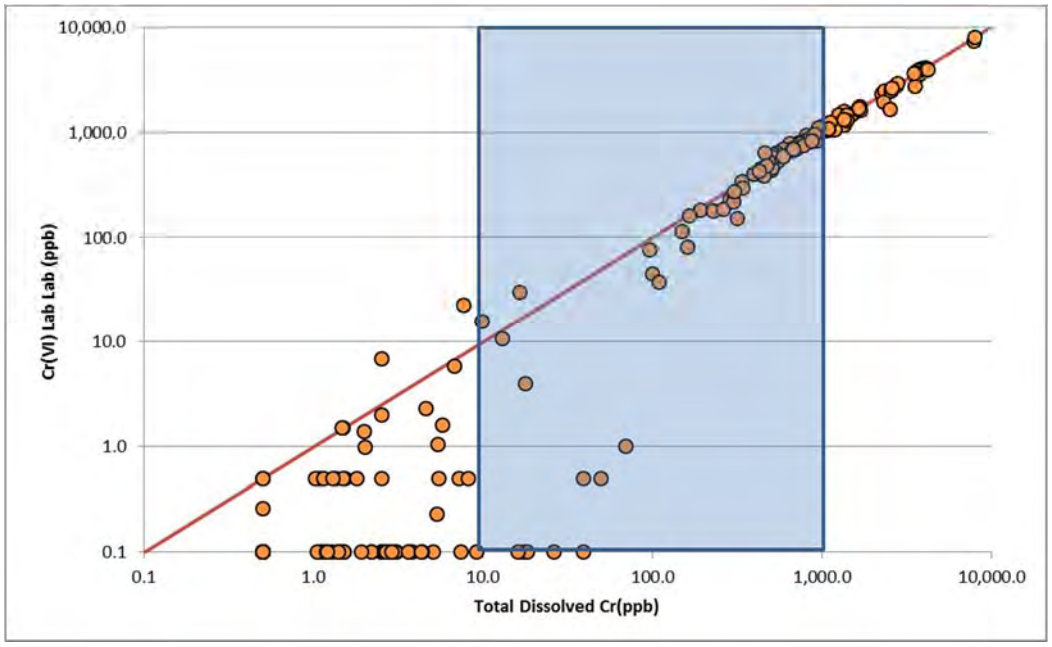
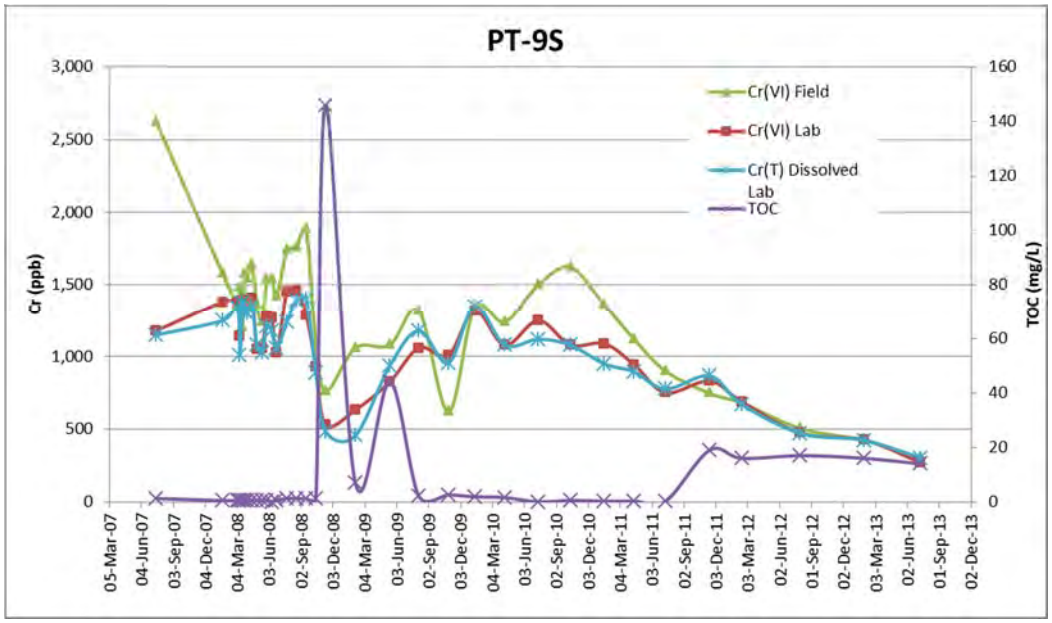


Figure 2. PT-9S Concentration Trends, July 2007-July 2013



Attachment P: RTC #181

Hinkley IRZ Well Fouling

PG&E Topock Compressor Station, Needles, CA
Summary of IRZ Well Fouling at Hinkley as it Relates to Re-Injection of Remedy Produced Water into IRZ Injection Wells at Topock
1/27/2014

One option for reuse of remedy produced water at the PG&E Topock Compressor Station site is to condition and re-inject into National Trails Highway (NTH) In Situ Reactive Zone (IRZ) injection wells. This summary presents information on the factors affecting IRZ injection well fouling based on experience at the PG&E Hinkley Compressor Station site; and an evaluation of the potential for re-injection of conditioned remedy produced water to affect IRZ injection well performance at Topock. Experience with IRZ well fouling at Hinkley has been incorporated into the remedy design for Topock. Operational information collected to date at Hinkley continues to support the design criteria for the remedy produced water conditioning system proposed in the 60% design.

Summary of IRZ Well Fouling at Hinkley

IRZ injection well fouling occurs as the result of the generation of biomass and/or formation of mineral precipitates caused by organic carbon injections. Two primary types of fouling have been observed in the Hinkley IRZ injection wells:

- Microbial biomass and associated extracellular polysaccharides.
- Mineral precipitates. These are comprised primarily of reduced iron sulfide minerals formed through the generation of ferrous iron from iron reduction and sulfide from sulfate reduction. In addition to these types of precipitates, carbonate minerals may also form within IRZ injection wells as carbonate is generated by microbial respiration.

IRZ well fouling is currently managed at Hinkley by chemical rehabilitation, typically with phosphoric acid (NuWell 120) and a biodispersant (NuWell 310). Water extracted from injection wells during rehabilitation is filtered for solids removal and blended with recirculated groundwater for re-injection.

Evaluation of Potential for Remedy Produced Water to Foul IRZ Injection Wells Conducted as Part of the Remedy Design

As indicated in Table F-1 in Appendix F of the 60% Basis of Design, the majority of remedy produced water is anticipated to be similar in water quality to the water from the Arizona aquifer or to the water from the aquifer at the NTH IRZ and Riverbank remedial wells, and may potentially contain sediment, IRZ byproducts, and rehabilitation chemicals. As discussed in the 60% Basis of Design, two parameters were considered important for the re-injection of remedy produced water into IRZ injection wells in order to minimize potential fouling based on this profile, and were included in the design specifications for the conditioning plant (Exhibit 3.4-5 on the 60% Basis of Design):

- **pH** - As stated in the design, the pH of the conditioned water will only be adjusted if it falls outside a neutral range (specifically a range of 6.5 to 8.5). The range was selected to match closely with the natural pH of the groundwater in the NTH IRZ and is prescribed to minimize adverse geochemical reactions that might increase the precipitation of minerals.

- **Sediment**- Solids will be removed from the remedy produced water to minimize IRZ injection well clogging, with a design specification of total suspended solids (TSS) less than 5 microns.

Other potential constituents in the remedy produced water were evaluated as part of the remedy design but not considered likely to have a significant effect on well fouling. Therefore, design criteria were not specified for constituents/parameters other than pH and sediment measured as TSS. Other constituents reviewed included the following:

- **IRZ Byproducts:** Elevated concentrations of IRZ byproducts, such as dissolved iron and dissolved manganese, are expected to remain soluble in the reducing environment of the IRZ and are not expected to have a significant effect on fouling.

- **Rehabilitation Chemicals:** The chemical rehabilitation process at Topock will employ similar techniques as have been used at Hinkley, including the use of commercially available well rehabilitation products that are designed for drinking water well rehabilitation and remediation well rehabilitation. Based on experience at Hinkley, management of water generated during well rehabilitation through solids removal, blending with re-circulated groundwater and re-injection does not exacerbate fouling.

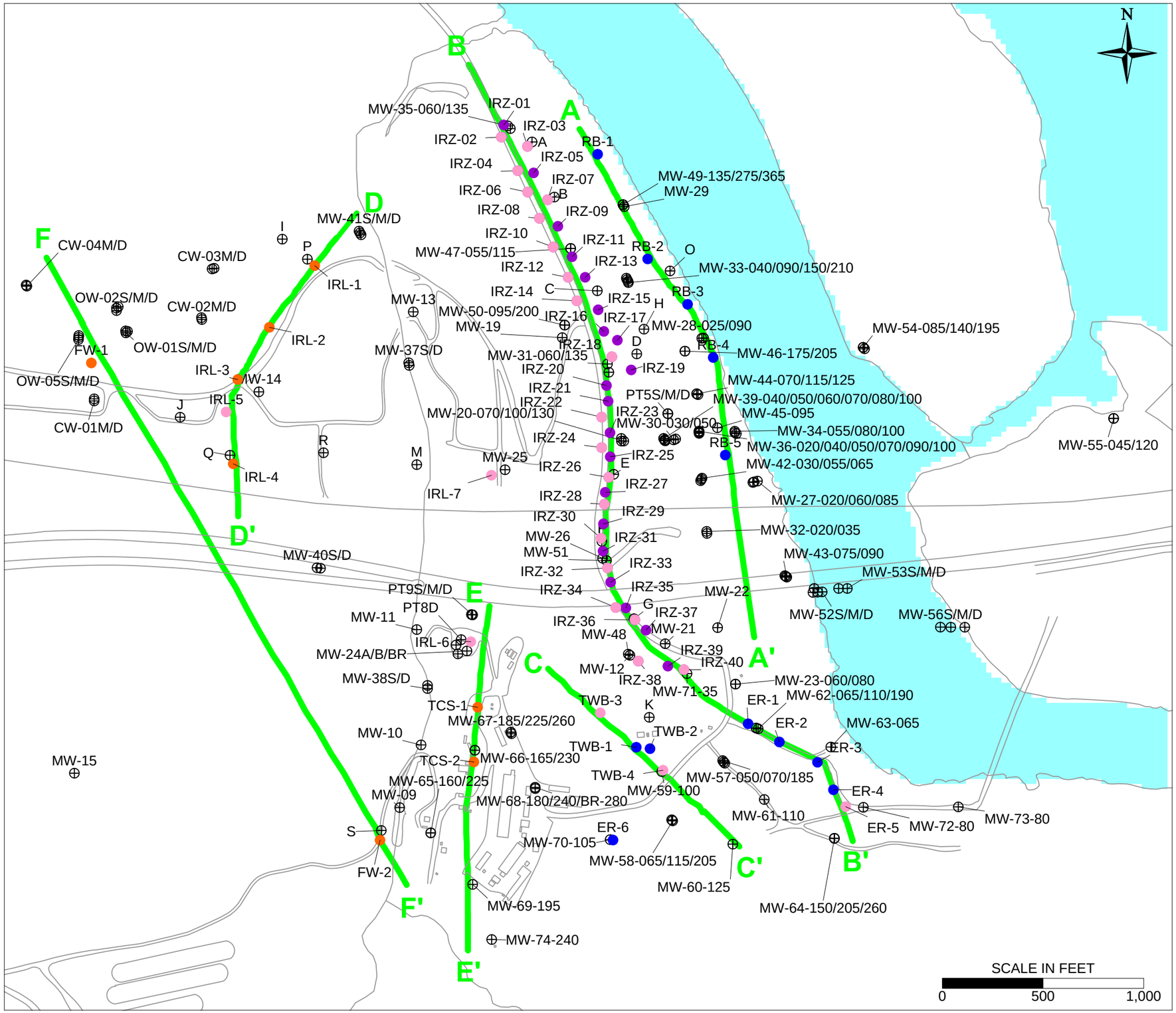
- **Total Dissolved Solids:** Total dissolved solids is comprised of cations, anions, alkalinity, and dissolved metals. Several of these ions (e.g. calcium, magnesium, bicarbonate/carbonate, and sulfate) could potentially precipitate as carbonate or gypsum minerals causing fouling. Others (e.g., sodium, potassium, chloride) are highly soluble and not anticipated to cause precipitation or fouling, even if added as sodium hydroxide or hydrochloric acid for conditioning. The potential for fouling of carbonate or gypsum was considered minimal, particularly in comparison with fouling due to iron sulfide minerals and biomass generated by the IRZ, based on the following:

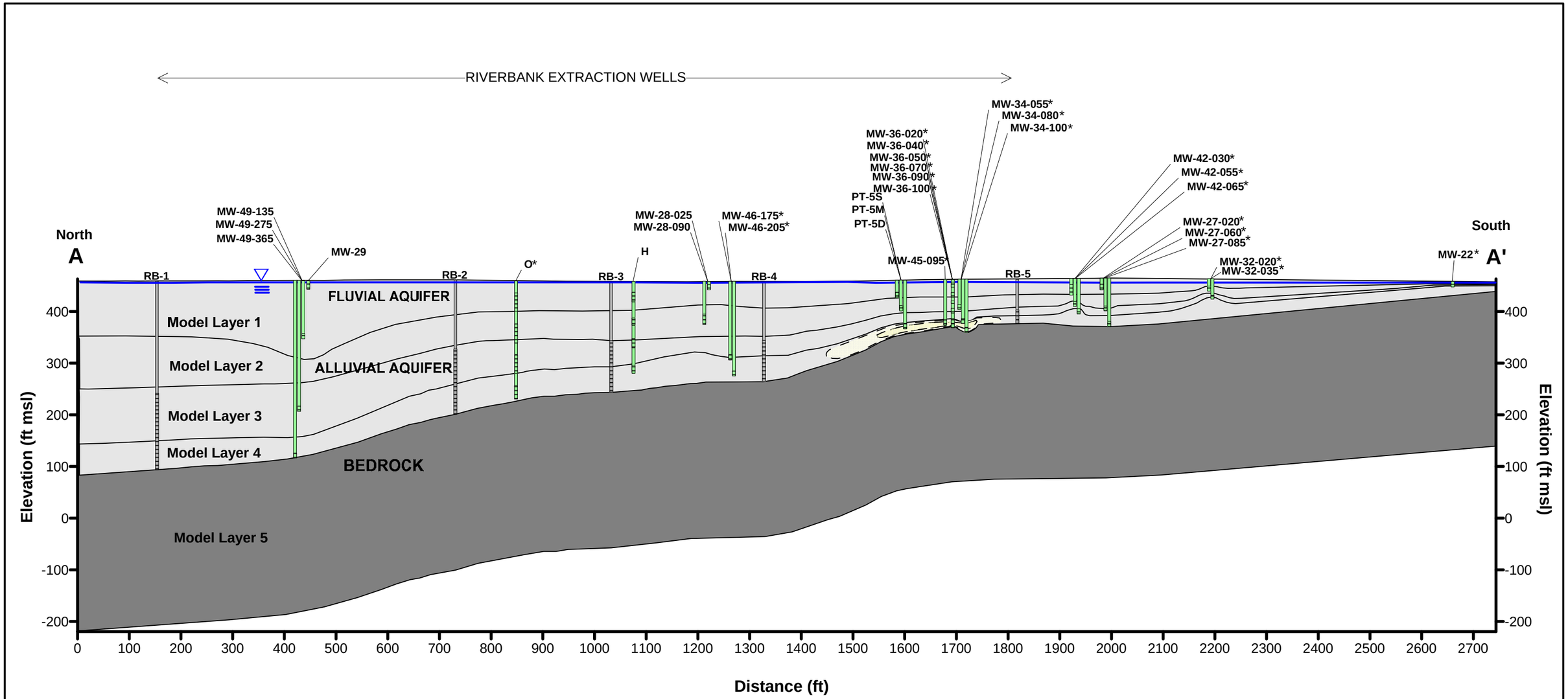
    - Concentrations of calcium, magnesium, and carbonate in the remedy produced water are anticipated to be lower or comparable to the aquifer in the vicinity of the NTH IRZ injection wells, limiting the potential for precipitation of carbonates and gypsum from mixing.

    - Gypsum, if formed from the addition of sulfuric acid for pH adjustment during conditioning, would be removed by filtration in the conditioning process prior to injection.

Attachment Q: RTC #99, #646, #659, #683, #692

Updated Cross Sections


N
A
A'
B
B'
C
C'
D
D'
E
E'
F
F'
MW-35-060/135
IRZ-01
IRZ-03
IRZ-02
IRZ-04
IRZ-05
IRZ-07
IRZ-06
IRZ-08
IRZ-09
IRZ-10
IRZ-11
MW-47-055/115
IRZ-12
IRZ-13
IRZ-14
IRZ-15
MW-13
MW-50-095/200
IRZ-16
IRZ-17
MW-19
IRZ-18
MW-31-060/135
IRZ-20
IRZ-19
IRZ-21
IRZ-22
MW-20-070/100/130
IRZ-23
IRZ-24
IRZ-25
MW-25
IRZ-26
IRZ-27
IRZ-28
IRZ-29
IRZ-30
MW-26
IRZ-31
MW-51
IRZ-33
IRZ-32
IRZ-34
IRZ-35
IRZ-36
IRZ-37
MW-48
IRZ-39
IRZ-40
MW-12
IRZ-38
MW-71-35
TWB-3
TWB-2
TWB-1
TWB-4
MW-59-100
ER-6
MW-70-105
MW-58-065/115/205
MW-60-125
MW-64-150/205/260
MW-69-195
MW-74-240
MW-67-185/225/260
MW-66-165/230
MW-65-160/225
MW-68-180/240/BR-280
MW-09
MW-10
TCS-1
TCS-2
MW-15
MW-40S/D
MW-11
PT9S/M/D
PT8D
IRL-6
MW-24A/B/BR
MW-38S/D
FW-2
S
MW-41S/M/D
IRL-1
IRL-2
IRL-3
IRL-4
IRL-5
IRL-7
MW-14
CW-04M/D
CW-03M/D
CW-02M/D
OW-02S/M/D
OW-01S/M/D
FW-1
OW-05S/M/D
CW-01M/D
MW-37S/D
RB-1
RB-2
RB-3
RB-4
RB-5
MW-49-135/275/365
MW-29
MW-33-040/090/150/210
MW-28-025/090
MW-46-175/205
MW-44-070/115/125
PT5S/M/D
MW-39-040/050/060/070/080/100
MW-45-095
MW-30-030/050
MW-34-055/080/100
MW-36-020/040/050/070/090/100
MW-42-030/055/065
MW-27-020/060/085
MW-32-020/035
MW-43-075/090
MW-53S/M/D
MW-52S/M/D
MW-56S/M/D
MW-22
MW-21
MW-23-060/080
MW-62-065/110/190
MW-63-065
ER-1
ER-2
ER-3
ER-4
ER-5
MW-57-050/070/185
MW-61-110
MW-72-80
MW-73-80
MW-54-085/140/195
MW-55-045/120
A
B
C
D
E
G
H
I
J
K
M
O
P
Q
R
S
SCALE IN FEET
0
500
1,000
LEGEND
CROSS-SECTION LOCATIONS
MONITORING WELL LOCATIONS*
PROPOSED REMEDIATION WELLS
NTH IRZ WELL LOCATIONS
FUTURE PROVISIONAL WELL LOCATIONS
RIVERBANK, TRANSWESTERN BENCH, AND EAST RAVINE EXTRACTION WELLS
FRESHWATER, IRL, AND TCS INJECTION WELLS
*WELLS A THROUGH S ARE PROPOSED WELLS
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TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
MODELING APPENDIX
CONCEPTUAL FINAL GROUNDWATER REMEDY
CROSS-SECTION LOCATIONS
ARCADIS
FIGURE
6.4-2



*Well is projected onto cross-section. Actual well screen elevations are honored in all wells. Model layer boudaries are adjusted to correlate to the projected wells.

Proposed Remediation Well

Monitoring Well

Hexavalent Chromium Concentration (ppb)

32 | 100 | 500 | 1,000 | 5,000 | 10,000 | 15,000

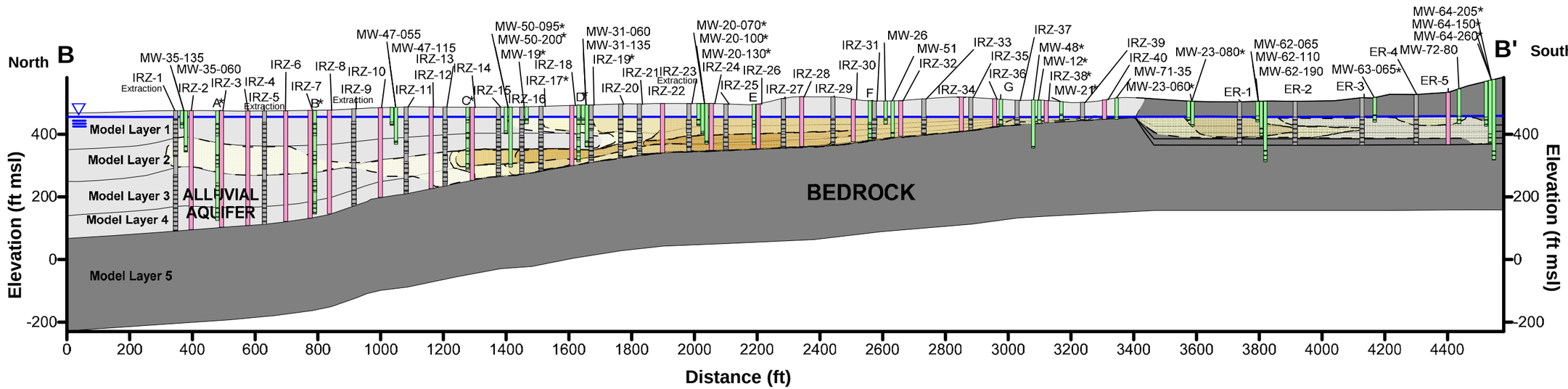
Number of wells, total screen intervals, and screen length and depth placement at each well location ID are for purposes of intermediate (60%) design submittal; they are continuing to be evaluated through the design process and will be further modified during field installation. River Bank Extraction wells will be installed with a second shallow screen interval for potential future use which will be isolated from the deeper screen interval with a pneumatic packer.

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CONCEPTUAL FINAL GROUNDWATER REMEDY
CROSS-SECTION A-A'

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FIGURE
6.4-3



Number of wells, total screen intervals, and screen length and depth placement at each well location ID are for purposes of intermediate (60%) design submittal; they are continuing to be evaluated through the design process and will be further modified during field installation. One well location ID may consist of multiple wells or screens, and one well screen interval may include more than one model layer. A maximum of two discrete screen intervals will be included per individual remediation well. Dual screen wells will consist of one well with two discrete screen intervals separated by a packer. Some well location IDs include two dual screen wells which will be installed in separate boreholes. Wells IRZ-1, 5, and 9 are constructed with a dedicated pump for each well screen with the intervals separated using a pneumatic packer. IRZ-23 well design and operation will target extraction of groundwater from all four model layers without being screened across all layers. East Ravine extraction wells are not expected to produce significant water and automated pump cycling could be required.

Hexavalent Chromium Concentration (ppb)

32 | 100 | 500 | 1,000 | 5,000 | 10,000 | 15,000

Proposed Well

Future Provisional Well

Monitoring Well

*Well is projected onto cross-section. Actual well screen elevations are honored in all wells. Model layer boudaries are adjusted to correlate to the projected wells.

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MODELING APPENDIX

CONCEPTUAL FINAL GROUNDWATER REMEDY
CROSS-SECTION B-B'

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FIGURE
6.4-4

North
C

TRANSWESTERN BENCH
EXTRACTION WELLS

South
C'

TWB-3
TWB-1
TWB-2
MW-59-100
TWB-4
MW-60-125

ALLUVIAL AQUIFER

Model Layer 1
Model Layer 2
Model Layer 3
Model Layer 4
Model Layer 5

BEDROCK

Elevation (ft msl)

550
500
450
400
350
300
250
200
150
100

0 50 100 150 200 250 300 350 400 450 500 550 600 650 700 750 800 850 900 950 1000 1050 1100 1150 1200 1250 1300

Distance (ft)

*Well is projected onto cross-section. Actual well screen elevations are honored in all wells. Model layer boudaries are adjusted to correlate to the projected wells.

Proposed Well

Future Provisional Well

Monitoring Well

Hexavalent Chromium Concentration (ppb)

32 100 500 1,000 5,000 10,000 15,000

Number of wells, total screen intervals, and screen length and depth placement at each well location ID are for purposes of intermediate (60%) design submittal; they are continuing to be evaluated through the design process and will be further modified during field installation. One well location ID may consist of multiple screens, and one well screen interval may include more than one model layer. A maximum of two discrete screen intervals will be included per individual remediation well. Dual screen wells will consist of one well with two discreet screen intervals separated by a packer. Extraction well design and operation will target extraction of groundwater from all four model layers without being screened across all layers.

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CONCEPTUAL FINAL GROUNDWATER REMEDY
CROSS-SECTION C-C'

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FIGURE
6.4-5

North

D

South

D'

INNER RECIRCULATION LOOP INJECTION WELLS

MW-41D*
MW-41M*
MW-41S*
MW-13*
I*
P*
IRL-1
MW-37D*
MW-37S*
CW-03D*
CW-03M*
IRL-2
CW-02D*
CW-02M*
IRL-3
MW-14*
IRL-5
J*
Q
IRL-4

Model Layer 1

Model Layer 2

Model Layer 3

Model Layer 4

Model Layer 5

ALLUVIAL AQUIFER

BEDROCK

Elevation (ft msl)

600
500
400
300
200
100
0
-100

0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700

Distance (ft)

*Well is projected onto cross-section. Actual well screen elevations are honored in all wells. Model layer boudaries are adjusted to correlate to the projected wells.

Proposed Remediation Well

Future Provisional Remediation Well

Monitoring Well

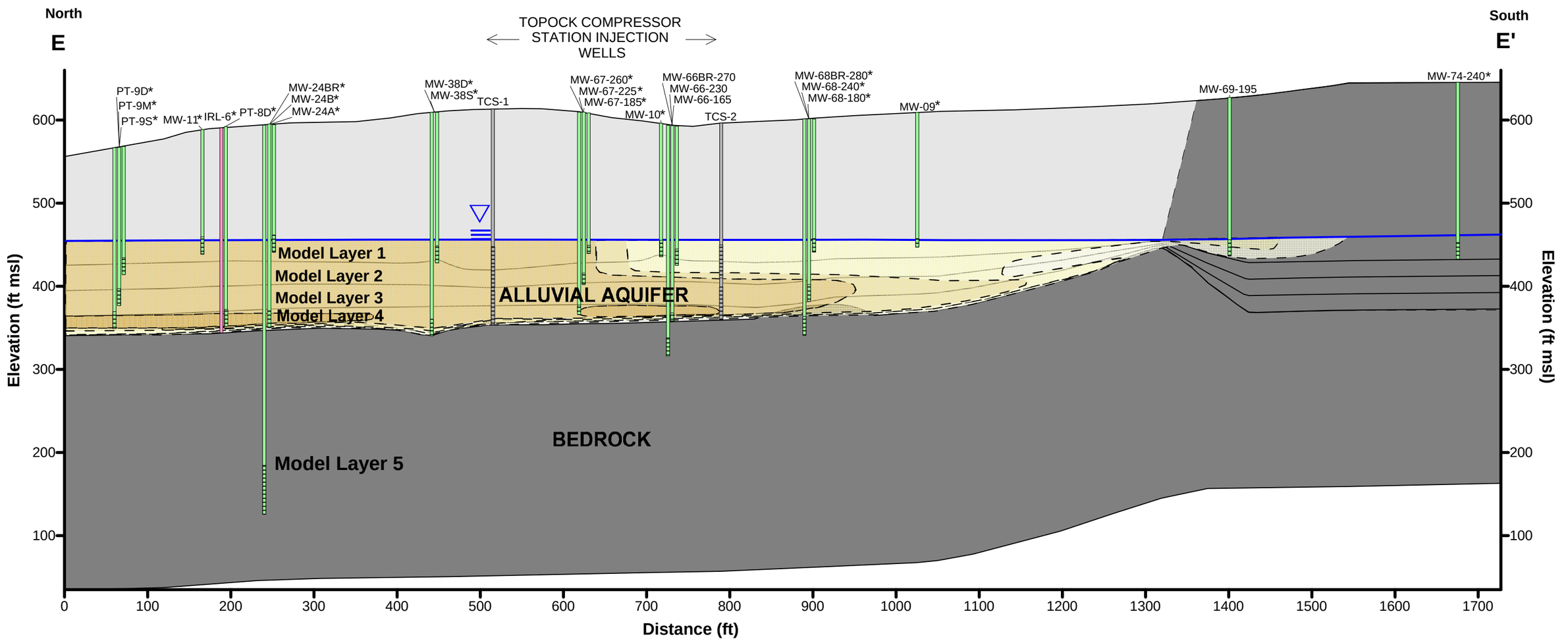
Number of wells, total screen intervals, and screen length and depth placement at each well location ID are for purposes of intermediate (60%) design submittal; they are continuing to be evaluated through the design process and will be further modified during field installation.

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NEEDLES, CALIFORNIA
MODELING APPENDIX

CONCEPTUAL FINAL GROUNDWATER REMEDY
CROSS-SECTION D-D'

ARCADIS

FIGURE
6.4-6



*Well is projected onto cross-section. Actual well screen elevations are honored in all wells. Model layer boudaries are adjusted to correlate to the projected wells.

Proposed Well

Future Provisional Well

Monitoring Well

Hexavalent Chromium Concentration (ppb)

32 | 100 | 500 | 1,000 | 5,000 | 10,000 | 15,000

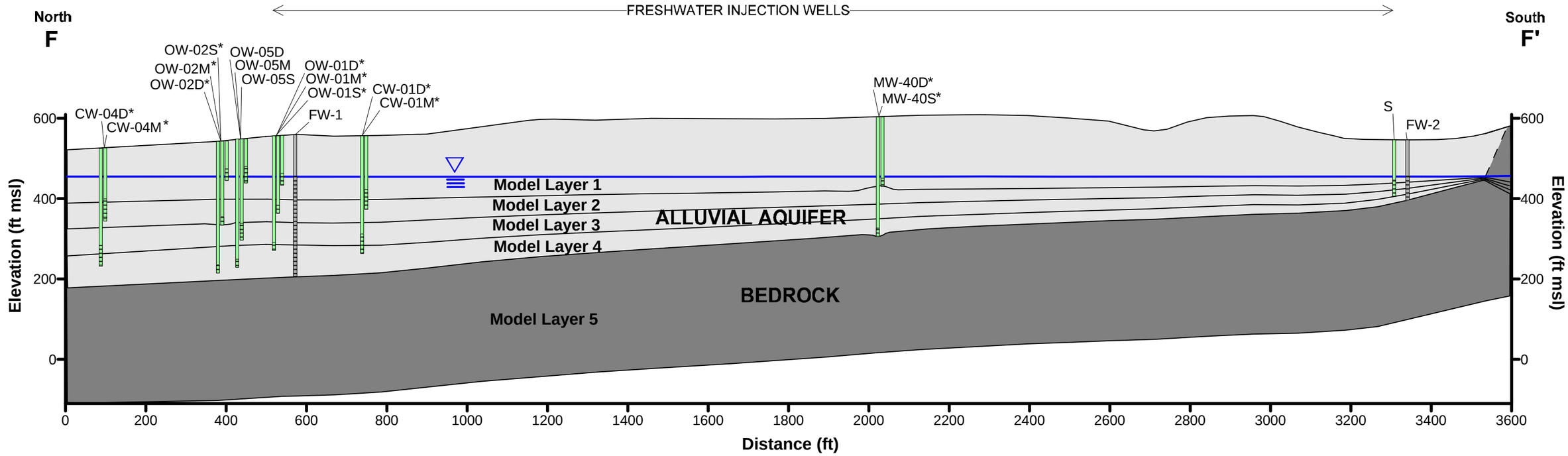
Number of wells, total screen intervals, and screen length and depth placement at each well location ID are for purposes of intermediate (60%) design submittal; they are continuing to be evaluated through the design process and will be further modified during field installation. One well location ID may consist of multiple screens, and one well screen interval may include more than one model layer. A maximum of two discrete screen intervals will be included per individual remediation well. Dual screen wells will consist of one well with two discreet screen intervals separated by a packer.

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MODELING APPENDIX

CONCEPTUAL FINAL GROUNDWATER REMEDY
CROSS-SECTION E-E'

ARCADIS

FIGURE
6.4-7



*Well is projected onto cross-section. Actual well screen elevations are honored in all wells. Model layer boudaries are adjusted to correlate to the projected wells.

Number of wells, total screen intervals, and screen length and depth placement at each well location ID are for purposes of intermediate (60%) design submittal; they are continuing to be evaluated through the design process and will be further modified during field installation.

Proposed Remediation Well

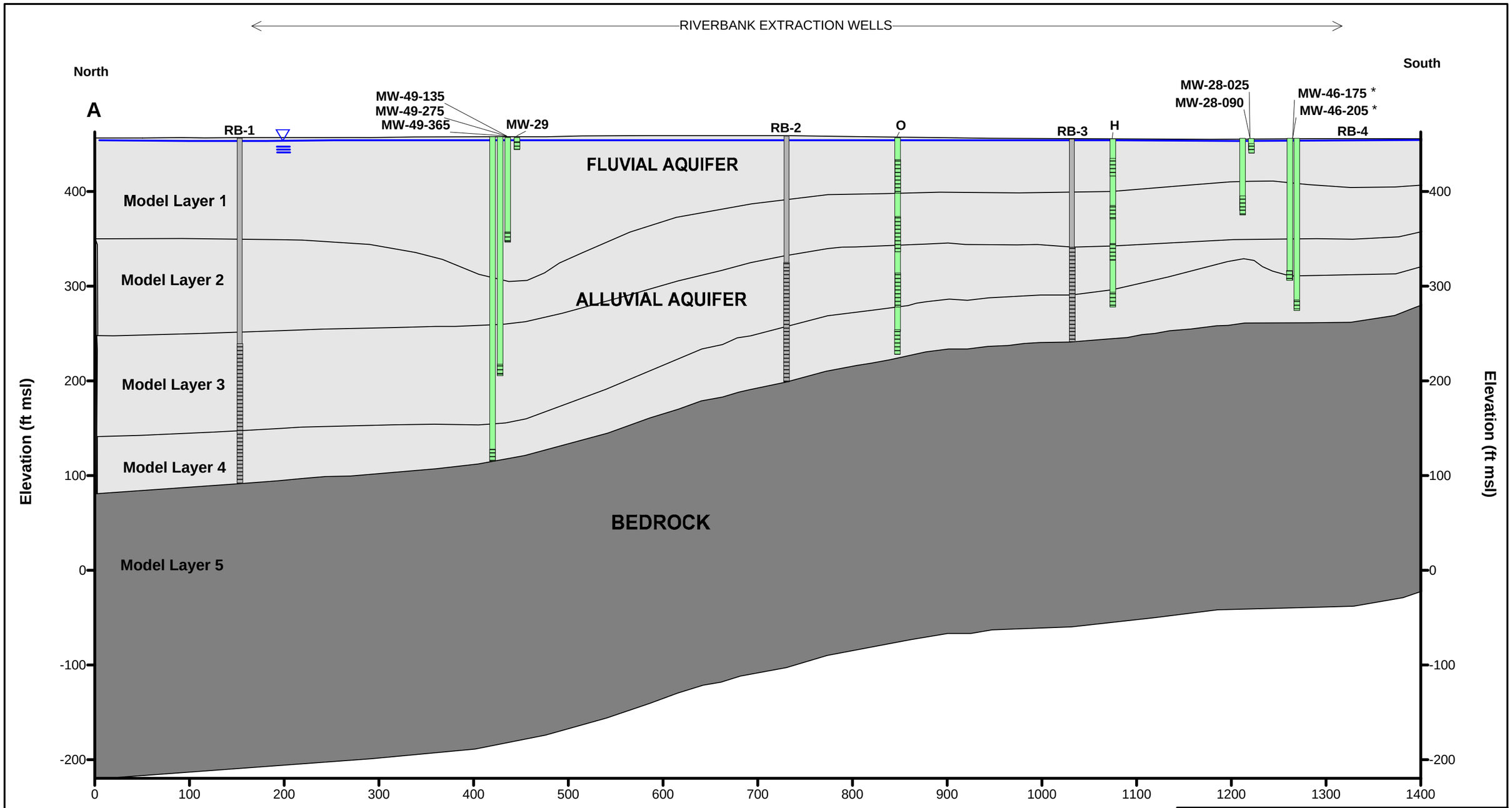
Monitoring Well

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TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
MODELING APPENDIX

CONCEPTUAL FINAL GROUNDWATER REMEDY
CROSS-SECTION F-F'

ARCADIS

FIGURE
6.4-8



*Well is projected onto cross-section. Actual well screen elevations are honored in all wells. Model layer boudaries are adjusted to correlate to the projected wells.

Number of wells, total screen intervals, and screen length and depth placement at each well location ID are for purposes of intermediate (60%) design submittal; they are continuing to be evaluated through the design process and will be further modified during field installation. River Bank Extraction wells will be installed with a second shallow screen interval for potential future use which will be isolated from the deeper screen interval with a pneumatic packer.

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MODELING APPENDIX

CONCEPTUAL FINAL GROUNDWATER REMEDY
CROSS-SECTION A-A'

ARCADIS

FIGURE
6.4-3

RIVERBANK EXTRACTION WELLS

North

South

A'

RB-4

RB-5

PT-5M
PT-5S
PT-5D

MW-36-020*
MW-36-040*
MW-36-050*
MW-36-070*
MW-36-090*
MW-36-100*
MW-45-095*

MW-34-055*
MW-34-080*
MW-34-100*

MW-42-030*
MW-42-055*
MW-42-065*

MW-27-020*
MW-27-060*
MW-27-085*

MW-32-035*
MW-32-020*

MW-22*

Model Layer 1
Model Layer 2
Model Layer 3
Model Layer 4
Model Layer 5

FLUVIAL AQUIFER
ALLUVIAL AQUIFER
BEDROCK

Elevation (ft msl)

400
300
200
100
0
-100
-200

1300 1400 1500 1600 1700 1800 1900 2000 2100 2200 2300 2400 2500 2600 2700

Proposed Remediation Well

Monitoring Well

Hexavalent Chromium Concentration (ppb)

32 100 500 1,000 5,000 10,000 15,000

*Well is projected onto cross-section. Actual well screen elevations are honored in all wells. Model layer boudaries are adjusted to correlate to the projected wells.

Distance (ft)

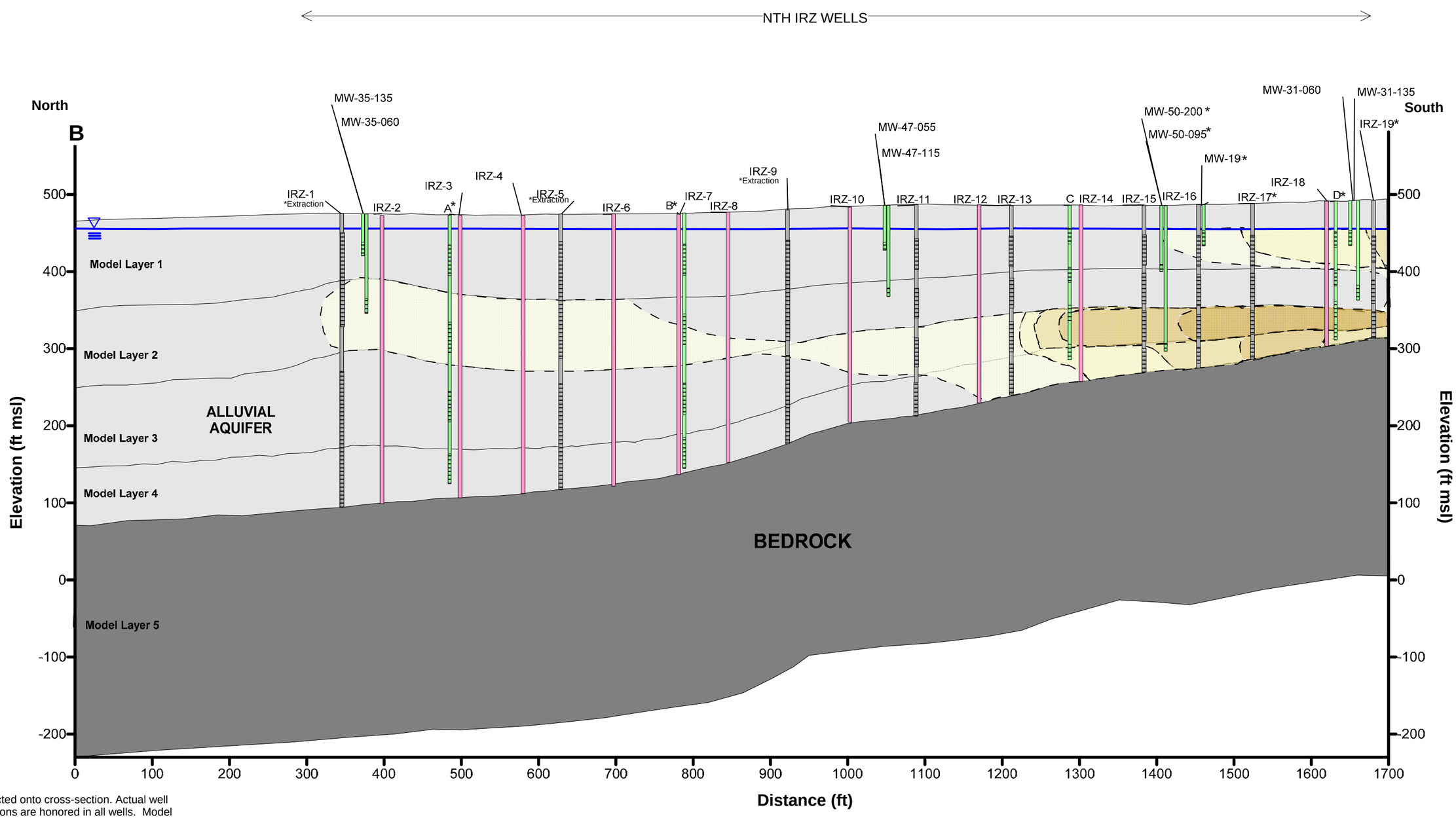
Number of wells, total screen intervals, and screen length and depth placement at each well location ID are for purposes of intermediate (60%) design submittal; they are continuing to be evaluated through the design process and will be further modified during field installation. River Bank Extraction wells will be installed with a second shallow screen interval for potential future use which will be isolated from the deeper screen interval with a pneumatic packer.

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MODELING APPENDIX

CONCEPTUAL FINAL GROUNDWATER REMEDY
CROSS-SECTION A-A'

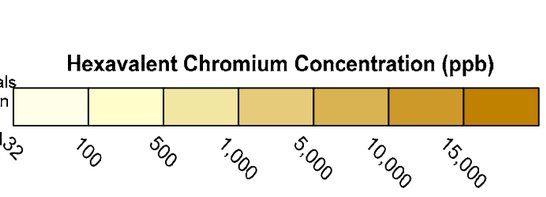
ARCADIS

FIGURE
6.4-3



*Well is projected onto cross-section. Actual well screen elevations are honored in all wells. Model layer boudaries are adjusted to correlate to the projected wells.

Number of wells, total screen intervals, and screen length and depth placement at each well location ID are for purposes of intermediate (60%) design submittal; they are continuing to be evaluated through the design process and will be further modified during field installation. One well location ID may consist of multiple wells or screens, and one well screen interval may include more than one model layer. A maximum of two discrete screen intervals will be included per individual remediation well. Dual screen wells will consist of one well with two discrete screen intervals separated by a packer. Some well location IDs include two dual screen wells which will be installed in separate boreholes. Wells IRZ-1, 5, and 9 are constructed with a dedicated pump for each well screen with the intervals separated using a pneumatic packer. IRZ-23 well design and operation will target extraction of groundwater from all four model layers without being screened across all layers. East Ravine extraction wells are not expected to produce significant water and automated pump cycling could be required.



Proposed Well

Future Provisional Well

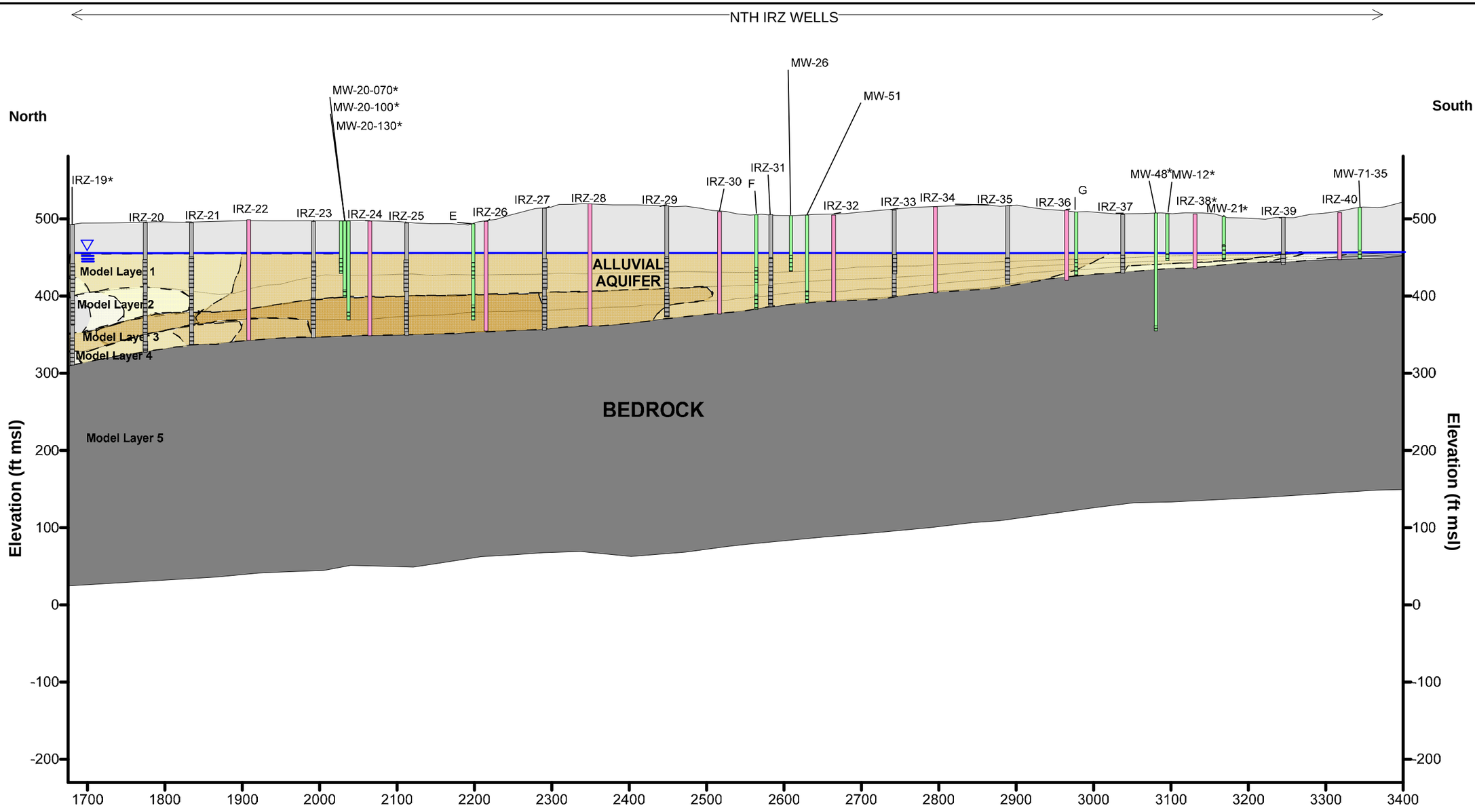
Monitoring Well

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MODELING APPENDIX

CONCEPTUAL FINAL GROUNDWATER REMEDY
CROSS-SECTION B-B'

ARCADIS

FIGURE
6.4-4



*Well is projected onto cross-section. Actual well screen elevations are honored in all wells. Model layer boudaries are adjusted to correlate to the projected wells.

Number of wells, total screen intervals, and screen length and depth placement at each well location ID are for purposes of intermediate (60%) design submittal; they are continuing to be evaluated through the design process and will be further modified during field installation. One well location ID may consist of multiple wells or screens, and one well screen interval may include more than one model layer. A maximum of two discrete screen intervals will be included per individual remediation well. Dual screen wells will consist of one well with two discrete screen intervals separated by a packer. Some well location IDs include two dual screen wells which will be installed in separate boreholes. Wells IRZ-1, 5, and 9 are constructed with a dedicated pump for each well screen with the intervals separated using a pneumatic packer. IRZ-23 well design and operation will target extraction of groundwater from all four model layers without being screened across all layers. East Ravine extraction wells are not expected to produce significant water and automated pump cycling could be required.

Hexavalent Chromium Concentration (ppb)

32 | 100 | 500 | 1,000 | 5,000 | 10,000 | 15,000

Proposed Well

Future Provisional Well

Monitoring Well

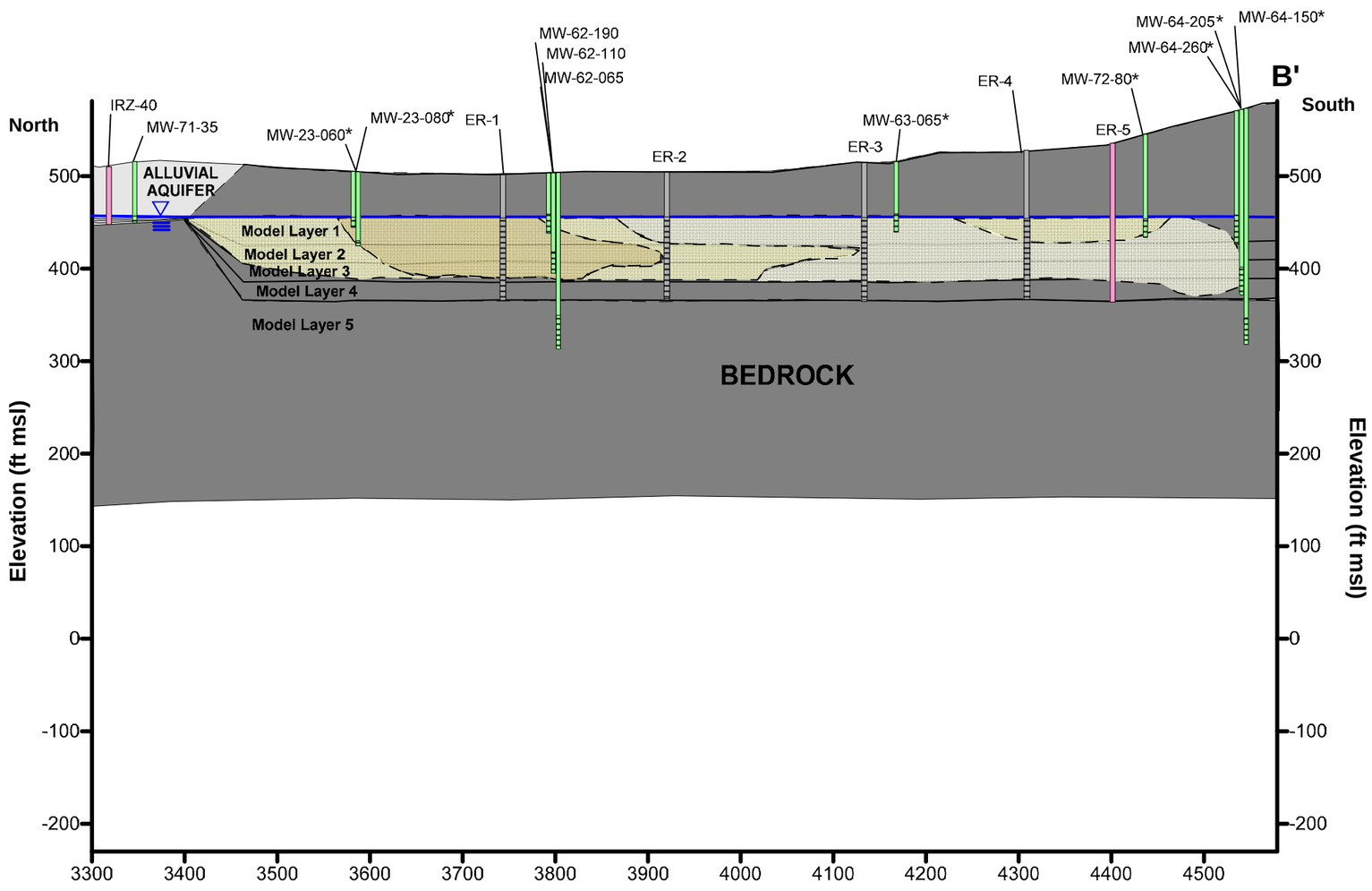
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NEEDLES, CALIFORNIA
MODELING APPENDIX

CONCEPTUAL FINAL GROUNDWATER REMEDY
CROSS-SECTION B-B'

ARCADIS

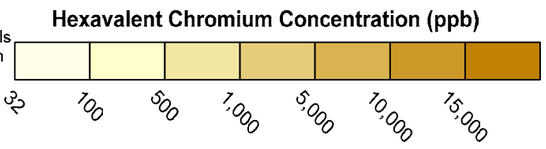
FIGURE
6.4-4

EAST RAVINE
EXTRACTION WELLS



*Well is projected onto cross-section. Actual well screen elevations are honored in all wells. Model layer boudaries are adjusted to correlate to the projected wells.

Number of wells, total screen intervals, and screen length and depth placement at each well location ID are for purposes of intermediate (60%) design submittal; they are continuing to be evaluated through the design process and will be further modified during field installation. One well location ID may consist of multiple wells or screens, and one well screen interval may include more than one model layer. A maximum of two discrete screen intervals will be included per individual remediation well. Dual screen wells will consist of one well with two discrete screen intervals separated by a packer. Some well location IDs include two dual screen wells which will be installed in separate boreholes. Wells IRZ-1, 5, and 9 are constructed with a dedicated pump for each well screen with the intervals separated using a pneumatic packer. IRZ-23 well design and operation will target extraction of groundwater from all four model layers without being screened across all layers. East Ravine extraction wells are not expected to produce significant water and automated pump cycling could be required.



Proposed Well

Future Provisional Well

Monitoring Well

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MODELING APPENDIX

CONCEPTUAL FINAL GROUNDWATER REMEDY
CROSS-SECTION B-B'

ARCADIS

FIGURE
6.4-4

Attachment R: RTC #216, #648, #692

Simulated Subsurface Groundwater Flow and Pathline Figures

N

SCALE IN FEET

0 600 1,200

LEGEND

- IRZ WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- MONITORING WELLS
- –460– SIMULATED GROUNDWATER LEVELS (FT MSL)
- ESTIMATED HEXAVALENT CHROMIUM 32 ug/L CONTOUR
- —5— SIMULATED GROUNDWATER PARTICLE PATHLINE* (5 YEAR POSTINGS)

SIMULATED PUMPING RATES

NTH IRZ (300 gpm)

EXTRACTION	INJECTION
NTH IRZ = 300 gpm	NTH IRZ = 300 gpm

TCS LOOP (27 gpm)

EXTRACTION	INJECTION
ER-1 = 0.5 gpm	TCS-1 = 13.5 gpm
ER-2 = 0.5 gpm	TCS-2 = 13.5 gpm
ER-3 = 0.5 gpm	
ER-4 = 0.5 gpm	
ER-6 = 3 gpm	
TWB-1 = 13 gpm	
TWB-2 = 9 gpm	

IRL LOOP (150 gpm)

EXTRACTION	INJECTION
RB-1 = 25 gpm	IRL-1 = 75 gpm
RB-2 = OFF	IRL-2 = 75 gpm
RB-3 = 50 gpm	
RB-4 = 50 gpm	
RB-5 = 25 gpm	

FRESHWATER (450 gpm)

EXTRACTION	INJECTION
HNWR-1 = 450 gpm	FW-1 = 100 gpm
	FW-2 = 50 gpm
	IRL-3 = 100 gpm
	IRL-4 = 200 gpm

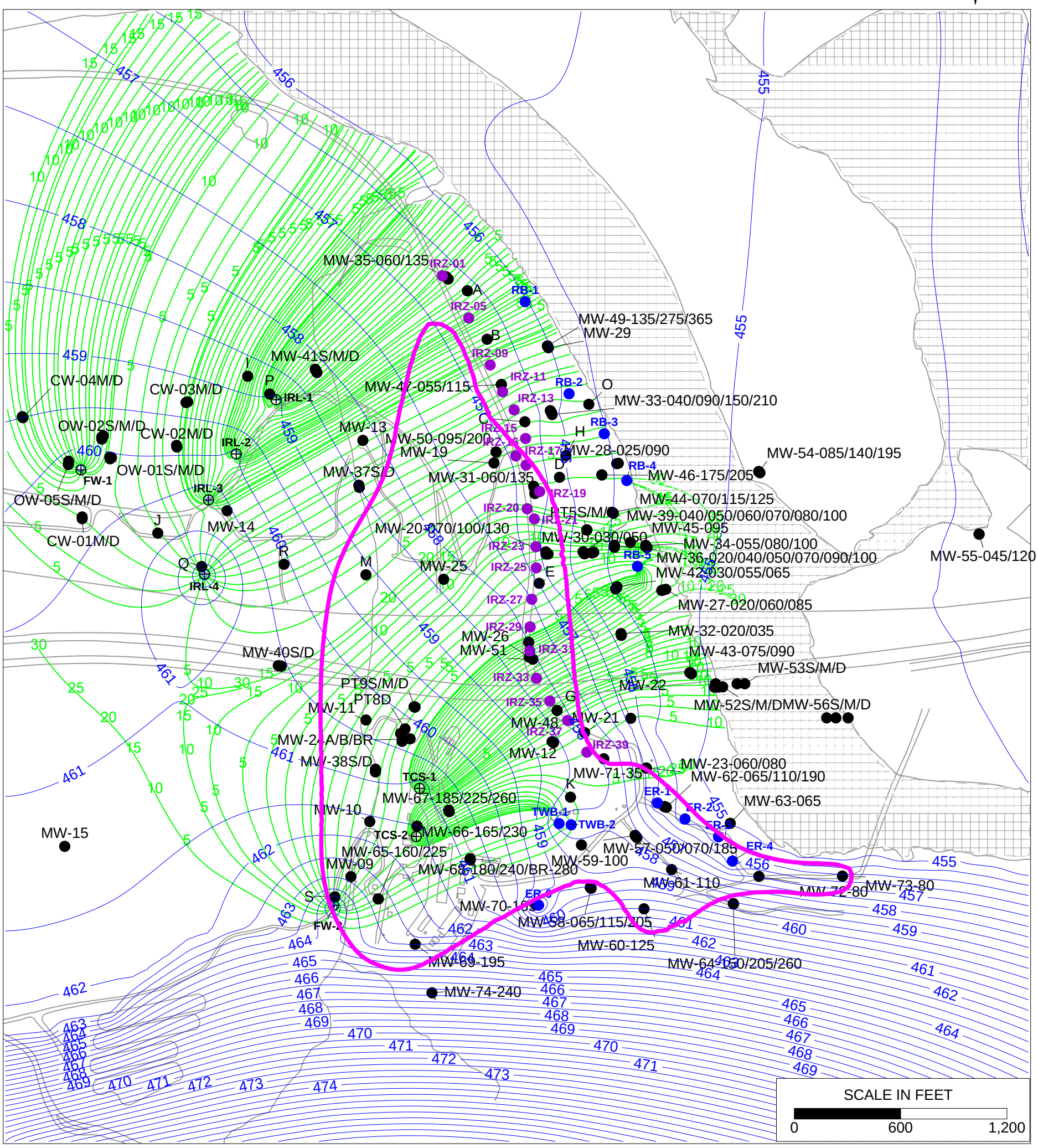
*Simulated particle pathlines depict simulated groundwater flow and are not representative of solute transport as they do not take into account mechanisms such as sorption, reduction, oxidation, degradation, etc.

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NEEDLES, CALIFORNIA
MODELING APPENDIX

SIMULATED SUBSURFACE GROUNDWATER FLOW AND PATHLINES MODEL LAYER 1 - NTH IRZ ON

ARCADIS

FIGURE
1A



LEGEND

- IRZ WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- MONITORING WELLS
- –460– SIMULATED GROUNDWATER LEVELS (FT MSL)
- ESTIMATED HEXAVALENT CHROMIUM 32 ug/L CONTOUR
- —5— SIMULATED GROUNDWATER PARTICLE PATHLINE* (5 YEAR POSTINGS)

SIMULATED PUMPING RATES

NTH IRZ (OFF)

EXTRACTION	INJECTION
NTH IRZ = OFF	NTH IRZ = OFF

TCS LOOP (27 gpm)

EXTRACTION	INJECTION
ER-1 = 0.5 gpm	TCS-1 = 13.5 gpm
ER-2 = 0.5 gpm	TCS-2 = 13.5 gpm
ER-3 = 0.5 gpm	
ER-4 = 0.5 gpm	
ER-6 = 3 gpm	
TWB-1 = 13 gpm	
TWB-2 = 9 gpm	

IRL LOOP (150 gpm)

EXTRACTION	INJECTION
RB-1 = 25 gpm	IRL-1 = 75 gpm
RB-2 = OFF	IRL-2 = 75 gpm
RB-3 = 50 gpm	
RB-4 = 50 gpm	
RB-5 = 25 gpm	

FRESHWATER (450 gpm)

EXTRACTION	INJECTION
HNWR-1 = 450 gpm	FW-1 = 100 gpm
	FW-2 = 50 gpm
	IRL-3 = 100 gpm
	IRL-4 = 200 gpm

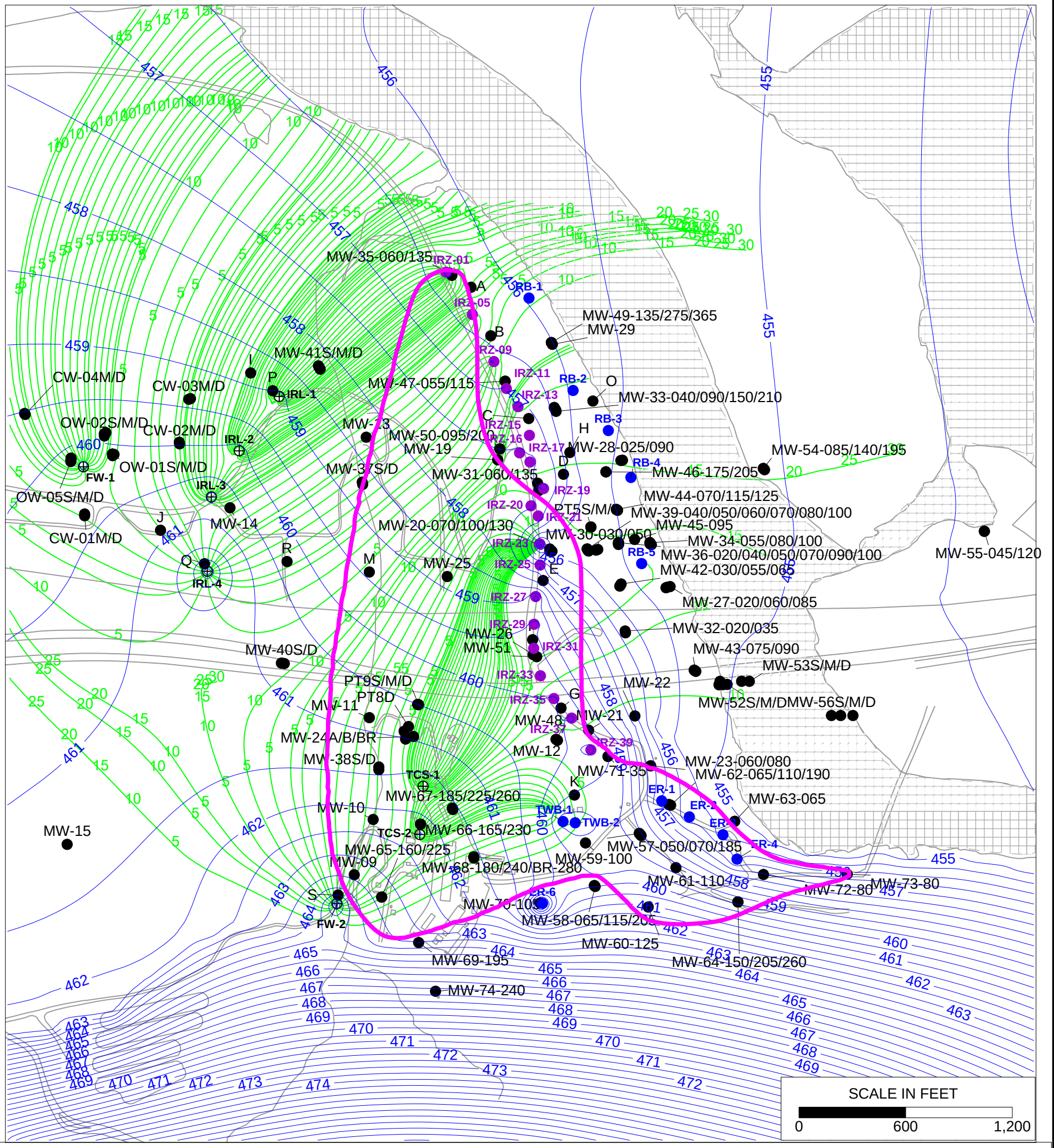
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MODELING APPENDIX

SIMULATED SUBSURFACE GROUNDWATER FLOW AND PATHLINES MODEL LAYER 1 - NTH IRZ OFF

ARCADIS

FIGURE
1B



LEGEND

- IRZ WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- MONITORING WELLS
- −460− SIMULATED GROUNDWATER LEVELS (FT MSL)
- ESTIMATED HEXAVALENT CHROMIUM 32 ug/L CONTOUR
- —5— SIMULATED GROUNDWATER PARTICLE PATHLINE* (5 YEAR POSTINGS)

SIMULATED PUMPING RATES

NTH IRZ (300 gpm)

EXTRACTION	INJECTION
NTH IRZ = 300 gpm	NTH IRZ = 300 gpm

TCS LOOP (27 gpm)

EXTRACTION	INJECTION
ER-1 = 0.5 gpm	TCS-1 = 13.5 gpm
ER-2 = 0.5 gpm	TCS-2 = 13.5 gpm
ER-3 = 0.5 gpm	
ER-4 = 0.5 gpm	
ER-6 = 3 gpm	
TWB-1 = 13 gpm	
TWB-2 = 9 gpm	

IRL LOOP (150 gpm)

EXTRACTION	INJECTION
RB-1 = 25 gpm	IRL-1 = 75 gpm
RB-2 = OFF	IRL-2 = 75 gpm
RB-3 = 50 gpm	
RB-4 = 50 gpm	
RB-5 = 25 gpm	

FRESHWATER (450 gpm)

EXTRACTION	INJECTION
HNWR-1 = 450 gpm	FW-1 = 100 gpm
	FW-2 = 50 gpm
	IRL-3 = 100 gpm
	IRL-4 = 200 gpm

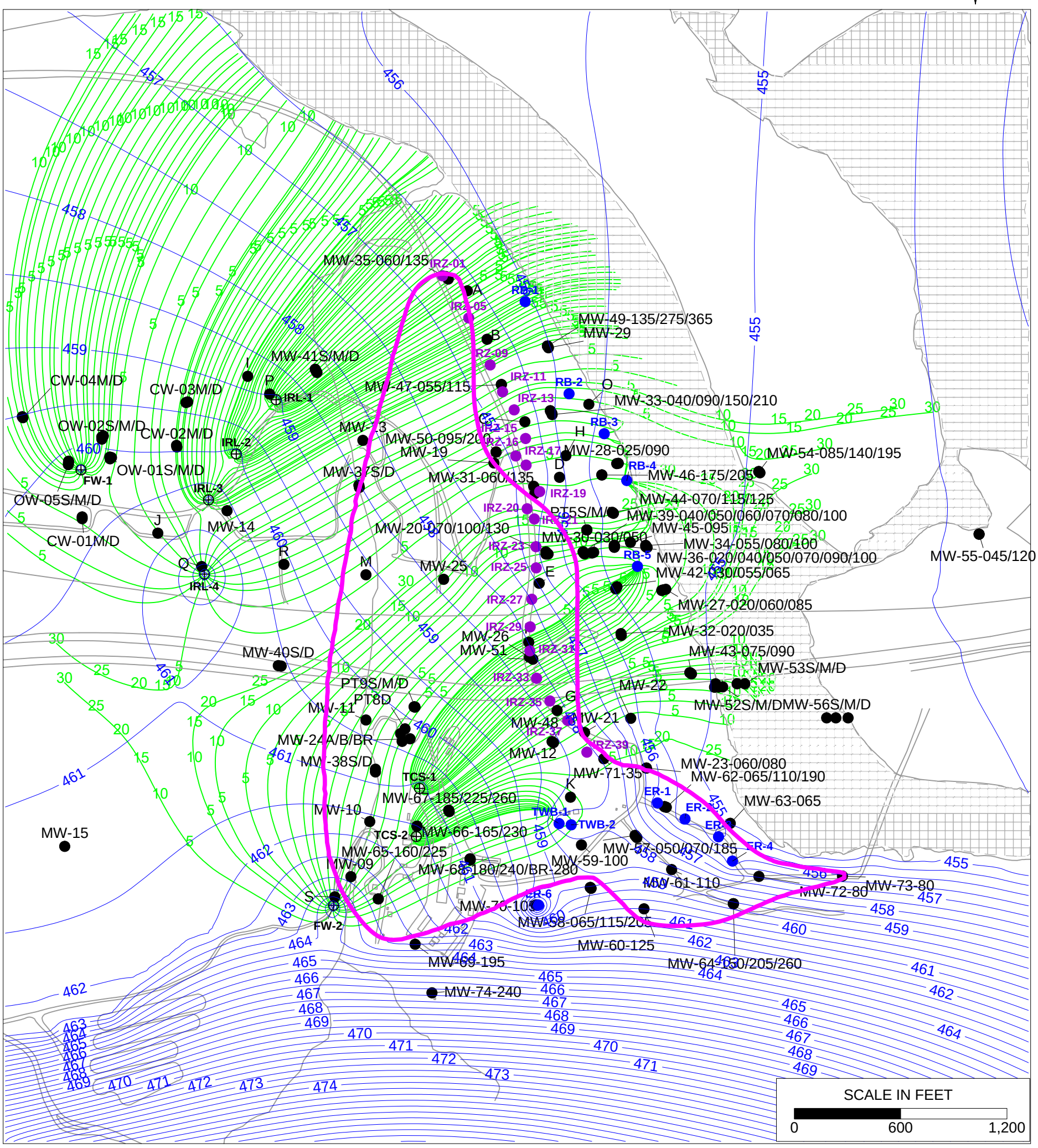
*Simulated particle pathlines depict simulated groundwater flow and are not representative of solute transport as they do not take into account mechanisms such as sorption, reduction, oxidation, degradation, etc.

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NEEDLES, CALIFORNIA
MODELING APPENDIX

SIMULATED SUBSURFACE GROUNDWATER FLOW AND PATHLINES MODEL LAYER 2 - NTH IRZ ON

ARCADIS

FIGURE
2A



LEGEND

- IRZ WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- MONITORING WELLS
- –460– SIMULATED GROUNDWATER LEVELS (FT MSL)
- ESTIMATED HEXAVALENT CHROMIUM 32 ug/L CONTOUR
- —5— SIMULATED GROUNDWATER PARTICLE PATHLINE* (5 YEAR POSTINGS)

SIMULATED PUMPING RATES

NTH IRZ (OFF)

EXTRACTION	INJECTION
NTH IRZ = OFF	NTH IRZ = OFF

TCS LOOP (27 gpm)

EXTRACTION	INJECTION
ER-1 = 0.5 gpm	TCS-1 = 13.5 gpm
ER-2 = 0.5 gpm	TCS-2 = 13.5 gpm
ER-3 = 0.5 gpm	
ER-4 = 0.5 gpm	
ER-6 = 3 gpm	
TWB-1 = 13 gpm	
TWB-2 = 9 gpm	

IRL LOOP (150 gpm)

EXTRACTION	INJECTION
RB-1 = 25 gpm	IRL-1 = 75 gpm
RB-2 = OFF	IRL-2 = 75 gpm
RB-3 = 50 gpm	
RB-4 = 50 gpm	
RB-5 = 25 gpm	

FRESHWATER (450 gpm)

EXTRACTION	INJECTION
HNWR-1 = 450 gpm	FW-1 = 100 gpm
	FW-2 = 50 gpm
	IRL-3 = 100 gpm
	IRL-4 = 200 gpm

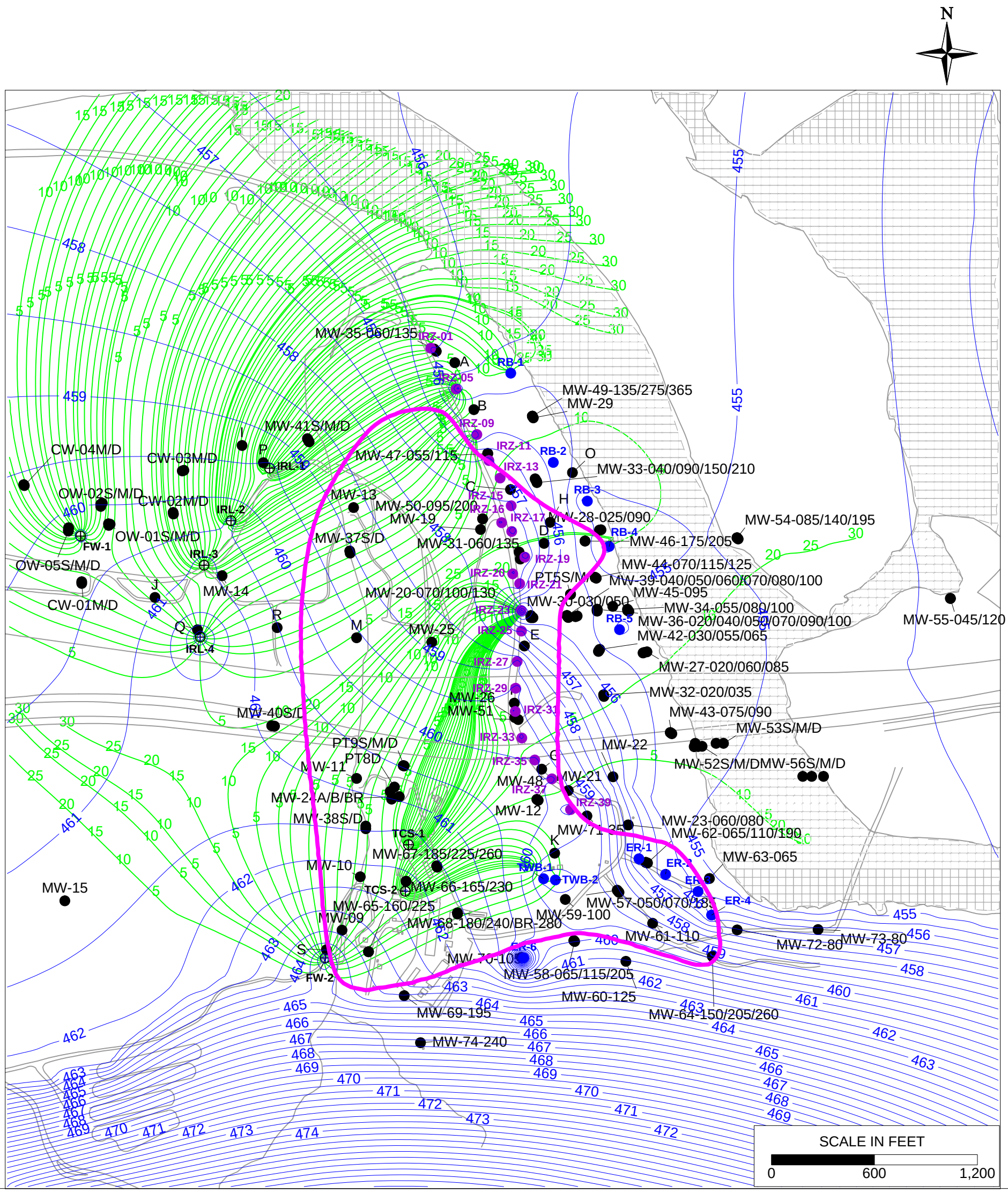
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NEEDLES, CALIFORNIA
MODELING APPENDIX

SIMULATED SUBSURFACE GROUNDWATER FLOW AND PATHLINES MODEL LAYER 2 - NTH IRZ OFF

ARCADIS

FIGURE
2B



LEGEND

- IRZ WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- MONITORING WELLS
- –460– SIMULATED GROUNDWATER LEVELS (FT MSL)
- ESTIMATED HEXAVALENT CHROMIUM 32 ug/L CONTOUR
- –5– SIMULATED GROUNDWATER PARTICLE PATHLINE* (5 YEAR POSTINGS)

SIMULATED PUMPING RATES

NTH IRZ (300 gpm)

EXTRACTION	INJECTION
NTH IRZ = 300 gpm	NTH IRZ = 300 gpm

TCS LOOP (27 gpm)

EXTRACTION	INJECTION
ER-1 = 0.5 gpm	TCS-1 = 13.5 gpm
ER-2 = 0.5 gpm	TCS-2 = 13.5 gpm
ER-3 = 0.5 gpm	
ER-4 = 0.5 gpm	
ER-6 = 3 gpm	
TWB-1 = 13 gpm	
TWB-2 = 9 gpm	

IRL LOOP (150 gpm)

EXTRACTION	INJECTION
RB-1 = 25 gpm	IRL-1 = 75 gpm
RB-2 = OFF	IRL-2 = 75 gpm
RB-3 = 50 gpm	
RB-4 = 50 gpm	
RB-5 = 25 gpm	

FRESHWATER (450 gpm)

EXTRACTION	INJECTION
HNWR-1 = 450 gpm	FW-1 = 100 gpm
	FW-2 = 50 gpm
	IRL-3 = 100 gpm
	IRL-4 = 200 gpm

*Simulated particle pathlines depict simulated groundwater flow and are not representative of solute transport as they do not take into account mechanisms such as sorption, reduction, oxidation, degradation, etc.

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MODELING APPENDIX

SIMULATED SUBSURFACE GROUNDWATER FLOW AND PATHLINES MODEL LAYER 3 - NTH IRZ ON

ARCADIS

FIGURE
3A

N

SCALE IN FEET

0 600 1,200

LEGEND

- IRZ WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- MONITORING WELLS
- –460– SIMULATED GROUNDWATER LEVELS (FT MSL)
- ESTIMATED HEXAVALENT CHROMIUM 32 ug/L CONTOUR
- —5— SIMULATED GROUNDWATER PARTICLE PATHLINE* (5 YEAR POSTINGS)

SIMULATED PUMPING RATES

NTH IRZ (OFF)

EXTRACTION	INJECTION
NTH IRZ = OFF	NTH IRZ = OFF

TCS LOOP (27 gpm)

EXTRACTION	INJECTION
ER-1 = 0.5 gpm	TCS-1 = 13.5 gpm
ER-2 = 0.5 gpm	TCS-2 = 13.5 gpm
ER-3 = 0.5 gpm	
ER-4 = 0.5 gpm	
ER-6 = 3 gpm	
TWB-1 = 13 gpm	
TWB-2 = 9 gpm	

IRL LOOP (150 gpm)

EXTRACTION	INJECTION
RB-1 = 25 gpm	IRL-1 = 75 gpm
RB-2 = OFF	IRL-2 = 75 gpm
RB-3 = 50 gpm	
RB-4 = 50 gpm	
RB-5 = 25 gpm	

FRESHWATER (450 gpm)

EXTRACTION	INJECTION
HNWR-1 = 450 gpm	FW-1 = 100 gpm
	FW-2 = 50 gpm
	IRL-3 = 100 gpm
	IRL-4 = 200 gpm

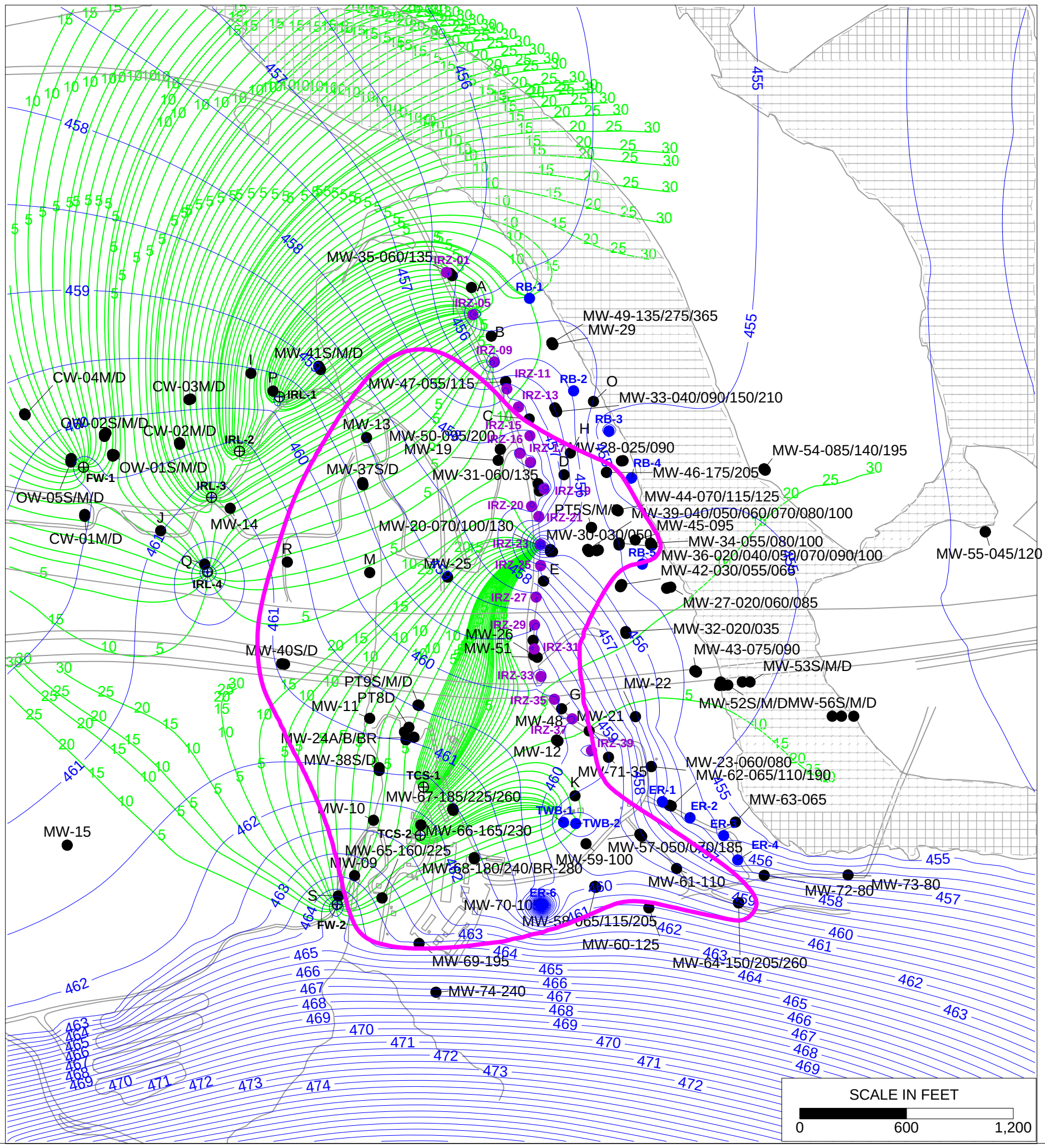
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MODELING APPENDIX

SIMULATED SUBSURFACE GROUNDWATER FLOW AND PATHLINES MODEL LAYER 3 - NTH IRZ OFF

ARCADIS

FIGURE 3B



LEGEND

- IRZ WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- MONITORING WELLS
- –460– SIMULATED GROUNDWATER LEVELS (FT MSL)
- ESTIMATED HEXAVALENT CHROMIUM 32 ug/L CONTOUR
- —5— SIMULATED GROUNDWATER PARTICLE PATHLINE* (5 YEAR POSTINGS)

SIMULATED PUMPING RATES

NTH IRZ (300 gpm)

EXTRACTION	INJECTION
NTH IRZ = 300 gpm	NTH IRZ = 300 gpm

TCS LOOP (27 gpm)

EXTRACTION	INJECTION
ER-1 = 0.5 gpm	TCS-1 = 13.5 gpm
ER-2 = 0.5 gpm	TCS-2 = 13.5 gpm
ER-3 = 0.5 gpm	
ER-4 = 0.5 gpm	
ER-6 = 3 gpm	
TWB-1 = 13 gpm	
TWB-2 = 9 gpm	

IRL LOOP (150 gpm)

EXTRACTION	INJECTION
RB-1 = 25 gpm	IRL-1 = 75 gpm
RB-2 = OFF	IRL-2 = 75 gpm
RB-3 = 50 gpm	
RB-4 = 50 gpm	
RB-5 = 25 gpm	

FRESHWATER (450 gpm)

EXTRACTION	INJECTION
HNWR-1 = 450 gpm	FW-1 = 100 gpm
	FW-2 = 50 gpm
	IRL-3 = 100 gpm
	IRL-4 = 200 gpm

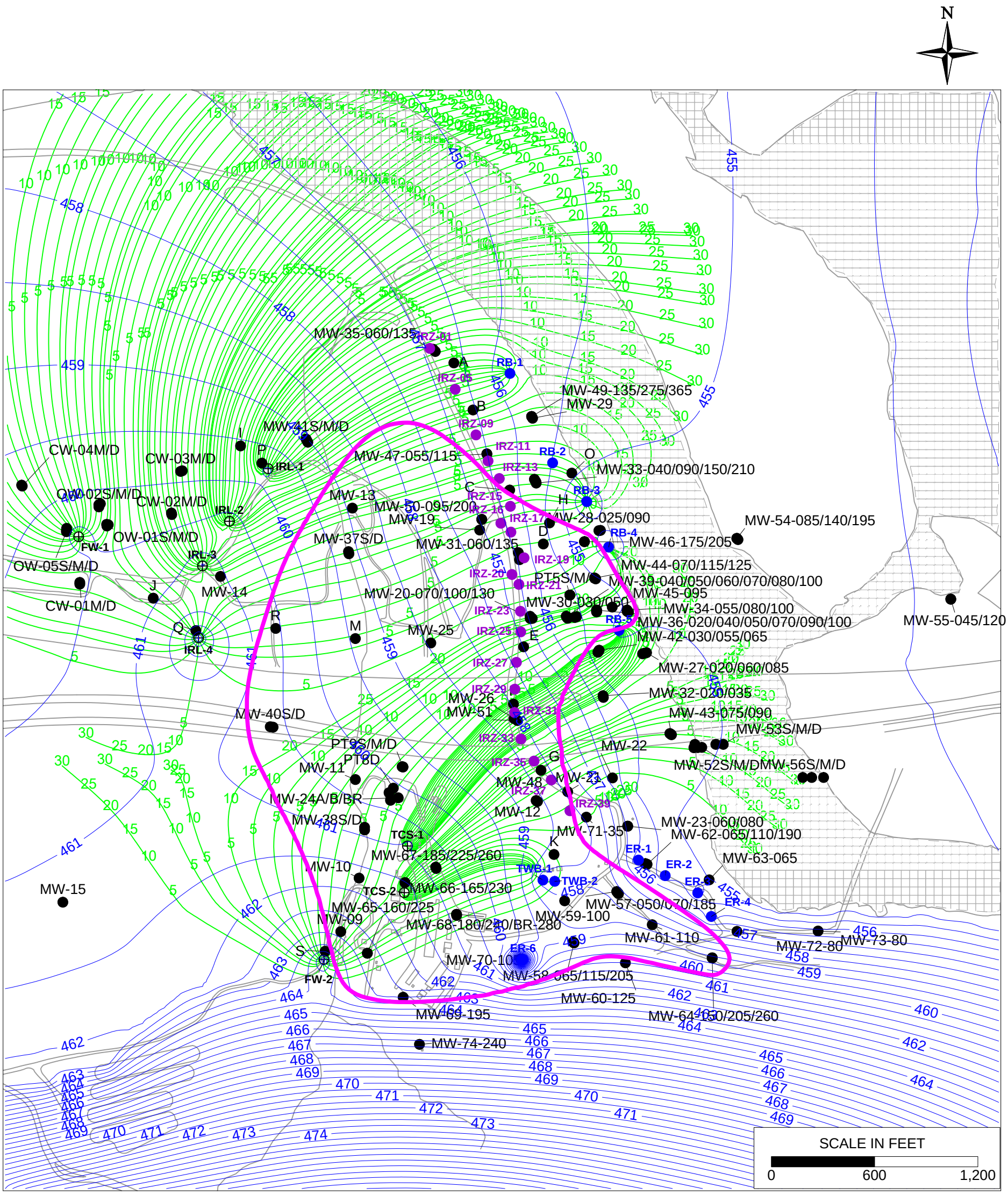
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MODELING APPENDIX

SIMULATED SUBSURFACE GROUNDWATER FLOW AND PATHLINES MODEL LAYER 4 - NTH IRZ ON

ARCADIS

FIGURE
4A



LEGEND

- IRZ WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- MONITORING WELLS
- –460– SIMULATED GROUNDWATER LEVELS (FT MSL)
- ESTIMATED HEXAVALENT CHROMIUM 32 ug/L CONTOUR
- —5— SIMULATED GROUNDWATER PARTICLE PATHLINE* (5 YEAR POSTINGS)

SIMULATED PUMPING RATES

NTH IRZ (OFF)

EXTRACTION	INJECTION
NTH IRZ = OFF	NTH IRZ = OFF

TCS LOOP (27 gpm)

EXTRACTION	INJECTION
ER-1 = 0.5 gpm	TCS-1 = 13.5 gpm
ER-2 = 0.5 gpm	TCS-2 = 13.5 gpm
ER-3 = 0.5 gpm	
ER-4 = 0.5 gpm	
ER-6 = 3 gpm	
TWB-1 = 13 gpm	
TWB-2 = 9 gpm	

IRL LOOP (150 gpm)

EXTRACTION	INJECTION
RB-1 = 25 gpm	IRL-1 = 75 gpm
RB-2 = OFF	IRL-2 = 75 gpm
RB-3 = 50 gpm	
RB-4 = 50 gpm	
RB-5 = 25 gpm	

FRESHWATER (450 gpm)

EXTRACTION	INJECTION
HNWR-1 = 450 gpm	FW-1 = 100 gpm
	FW-2 = 50 gpm
	IRL-3 = 100 gpm
	IRL-4 = 200 gpm

*Simulated particle pathlines depict simulated groundwater flow and are not representative of solute transport as they do not take into account mechanisms such as sorption, reduction, oxidation, degradation, etc.

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MODELING APPENDIX

SIMULATED SUBSURFACE GROUNDWATER FLOW AND PATHLINES MODEL LAYER 4 - NTH IRZ OFF

ARCADIS

FIGURE
4B

Attachment S: RTC #25, #357a/b, #358, #359, #360, #361, #362, #364a/b, #365, #366, #367a/b, #368, #369, #370, #371, #382, #384a/b, #385, #386, #388a/b, #391, #392, #393, #394, #398, #401, #402, #403a/b, #404, #405, #406

Tribes' Key Concerns Related to Modeling in the 60% BOD

HARGIS + ASSOCIATES, INC.
HYDROGEOLOGY • ENGINEERING

7400 North Oracle Road, Suite 202
Tucson, AZ 85704
Phone: 520.881.7300
Fax: 520.529.2141

April 7, 2014

VIA ELECTRONIC MAIL

Mr. Aaron Yue, Topock Project Manager
DEPARTMENT OF TOXIC SUBSTANCES CONTROL
5796 Corporate Avenue
Cypress, California 90630

Ms. Pamela S. Innis
Topock Remedial Project Manager
Office of Environmental Policy and Compliance
U.S. DEPARTMENT OF THE INTERIOR
P.O. Box 25007 (D-108)
Denver, Colorado 80225-007

Re: FMIT comments on modeling issues related to the 60% BOD Report for the PG&E Topock Compressor Station

Dear Mr. Yue and Ms. Innis:

Hargis + Associates, Inc., at the request of its client, the Fort Mojave Indian Tribe ("FMIT" or "the Tribe") is herewith forwarding the enclosed comments and recommendations received from the Topock Technical Review Committee ("TRC") regarding concerns related to modeling performed in support of the 60% Basis of Design ("BOD") Report for the Pacific Gas & Electric, Company ("PG&E") Topock Compressor Station groundwater remedy.

As you may be aware, the Tribe relied heavily on the TRC's technical expertise in numerical modeling in preparing its comments on the 60% BOD Report. The enclosed comments from the TRC represent a summary of subsequent discussions arising from the Technical Working Group ("TWG") meetings, remaining concerns, and proposed recommendations for resolution at the forthcoming 90% BOD stage. The Tribe supports this analysis by the TRC and is forwarding the technical memorandum for inclusion in the 60% BOD Report Response to Comments (RTC).

However, the Tribe would like to add a few edits to the comments for the purposes of clarification. These are as follow:

- p. 1, 2nd to last paragraph – The Tribe wants to make clear that "… all remaining 60% BOD comments …," refers to only the resolution of outstanding *modeling* comments, not *all* comments and issues that the Tribe has raised in regard to the entire 60% BOD.

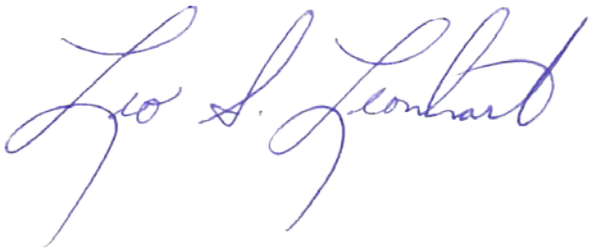
Other Offices:
Mesa, AZ
San Diego, CA

- p. 4, at the 3rd bullet – There are a few typos including an extra “the” after PG&E in the first line, and there should be a “c)” before “chemical reactions.”
- p. 7 – The Tribe wants to make it clear that the bolded text refers to the attainment of RAO *as presently stated*. In other words, the Tribe leaves open the option for “improving” the RAOs.

Please contact me or Ms. Nora McDowell if you have questions concerning this submittal.

Sincerely,

HARGIS + ASSOCIATES, INC.



Leo S. Leonhart, PhD, PG
Principal Hydrogeologist

Enclosure

cc w/encl:
C. Coyle
S. McDonald
N. McDowell
Y. Meeks
L. Otero
T. Williams
Tribal Representatives
TRC Members

839.07 Modeling RTC

INTEGRATED HYDRO SYSTEMS, LLC

Thursday, April 3, 2014

To: Topock Tribal Representatives, TRC Members

From: Bob Prucha, TRC

Subject: Overview of Key Concerns Related to Modeling in the 60% BOD and Recommendations for Comment Resolution

Overview

I reviewed the PG&E April 2013 60% BOD Report, focusing primarily on the modeling section (Appendix B) but also Section 3 and the Executive Summary. I focused my comments primarily on the numerical modeling as it relates to the proposed system design and operation. My comments generally fell into the following categories:

- Modeling Objectives
- Model Sensitivity Analysis/Calibration
- Model Prediction Uncertainty
- Model Optimization
- Possible Effects of High TDS/Density on Remedial Performance

Though the majority of comments were resolved through the RTC process, many remain unresolved. Based on things learned going through the RTC process (i.e., original 60% BOD review/comments and subsequent discussions in TWG meetings, in phone calls, emails, and iterations on RTC tables), I identified two main issues, related to uncertain model predictions about the length of time needed to clean up the plume so the remediation system can be removed. I believe these issues could be resolved if PG&E follows these two recommendations:

a) The 90% BOD Report should include a plan detailing specific data that will be collected **during remedy installation and commissioning** (such as hydraulic testing), specific details on how these data will be used to update and re-calibrate the model, and what scenarios would be re-run. This important data set would be critical to assessing the preliminary design/operation assumptions and allow for adjustments to operational parameters.

b) The 90% BOD Report should also present a detailed plan on how the models (i.e., flow, fate/transport, geochemical) will be updated, re-calibrated, and which scenarios are re-run **during operation**, including adjustments to the operations over time. More details are needed on the proposed basis for triggering when models are updated, and that any operational adjustments improve system performance towards meeting both short- and long-term RAOs.

If such plans and details are developed by PG&E, for example in the 90% BOD Report, all remaining unresolved 60% BOD comments could simply point to these plans in the RTC tables. To date, it has not been possible to adequately address these larger concerns and recommendations in a single RTC comment. I believe detailed plans to update and utilize the numerical models in an ongoing fashion, for example when adjustments to the operation are made, would greatly help reduce potential negative surprises in the currently proposed (60% BOD) remediation system and operation, much of which was designed and developed using these important modeling tools. This should benefit all stakeholders.

I first provide general concerns and recommendations related to each of the modeling areas above, and then summarize the two main issues and recommendations in the last section of this Memo.

Proposed Comment Resolution – by Category

Modeling Objectives

Associated Comments:

25, 367a, 388a, 388b, 391, 402, 404,

For standard modeling projects, modeling objectives must be stated as clearly and unambiguously as possible, because this strongly influences exactly how models are set up, what simulations are needed, and how accurate results must be.

General Concerns:

In my review, I found that modeling objectives as stated in Appendix B appear inconsistent with the broader objectives of the Remedial Action Objectives (RAOs) as outlined in the body of the report. For example:

RAOs (stated in Executive Summary) include:

1) ***Prevent ingestion of groundwater*** as a potable water source having Cr(VI) in excess of the regional background concentration of 32 µg/L.
2) ***Prevent or minimize migration*** of total chromium (Cr[T]) and Cr(VI) in groundwater to ensure concentrations in surface water do not exceed water quality standards that support the designated beneficial uses of the Colorado River (11 µg/L Cr[VI]).
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4) Ensure that the geographic location of the ***target remediation area does not permanently expand*** following completion of the remedial action.

Modeling Objectives (Stated in Appendix B of the 60% BOD Report):

The objectives of this modeling study were to develop a groundwater flow and solute transport model for use as follows:

1) **evaluate** subsurface flow conditions
2) **evaluate** the fate and transport of Cr(VI)
3) **evaluate** fate and transport of manganese and arsenic
4) **evaluate** potential remedial system configurations

It appears as though the objectives of the 60% BOD Report modeling were to only 'evaluate' flow, fate/transport and remedial system configurations. However, for a 60% Design and Operation Plan – I was expecting the modeling objectives to clearly state how the model would be used to:

a) Determine 'optimum' well layout (locations, spacing, total depths, screened zones) to meet RAO objectives;
b) Define operations necessary (injection/extraction flow rates, organic carbon injection locations and rates etc.) to meet RAO objectives;
c) Identify procedures to optimize the long-term operation of the system;
d) Determine where additional remediation wells could go;
e) Optimize the IM-3 decommissioning and startup of the new remediation system to minimize negative impacts to the system (to meet RAO objectives);
f) Determine a range of impacts due to manganese and arsenic by product generation.

PG&E's 60% BOD Report (Page 3, App B.) indicates that the modeling tool(s) represent the most important guide for the design and operation of the proposed remediation system: "*For the Site, the conceptual model forms the single most important guide for the design and operation of the proposed remediation system, as it is the basis for the numeric modeling, comprised of groundwater flow and contaminant fate and transport that simulate the operation of the remediation system*."

In my experience, a primary reason for 'failure' of models (i.e., poor predictions) is poor definition of modeling objectives. The objectives stated in the 60% BOD Report seem to point to a fundamental problem with the overall strategy for using the modeling tool(s):

a) Objectives were vague and unclear. For example, which objective is the most important, or which provides the greatest constraints on model optimizations?

b) A standard methodology in developing/applying/testing/validating the models or considering uncertainty was not presented. Some standard methodologies are mentioned (i.e., American Standards Testing Methods – ASTM), but a clearly-organized modeling method, based on clearly-defined objectives, is not provided.

c) A clear plan was not presented for how this primary design tool will be updated or used during and following system installation, during which a substantial amount of new data in key areas will be collected in a short period of time. Discussions with Arcadis and CH2MHill modelers seemed to confirm that limited consideration has been given to the following:

    a. How will modeling tool(s) be re-calibrated with new data obtained during initial installation, and shaped by additional data obtained over the long-term?
    b. How will the newly re-calibrated model be used to assess the final (100% BOD Report predictions?
    c. How will the newly re-calibrated model be used to modify things like well locations, depths, pumping rates etc. prior to completing the initial installation?
    d. How will the newly re-calibrated model be used to assess the location and design of potential provisional wells, or modify groundwater pumping and/or TOC injection rates?

Recommendations

1) Though not much can be done in the 60% BOD Report, all modeling objectives that have been attained should be clearly defined.

2) Objectives and scope of work should be clearly defined in the 90% BOD Report for all modeling to be conducted during installation, startup and long-term operation (this is described more in the last section of this memo).

Model Prediction Uncertainty

Associated Comments:

359, 370, 371, 382, 385, 388a, 388b, 392, 394, 401, 402, 404, 405, 406

General Problem:

- Uncertainty related to model predictions was not adequately addressed in the 60% BOD Report. A standard, comprehensive uncertainty analysis was not conducted, and an uncertainty analysis was confused with a sensitivity analysis. Though, this would have been challenging to perform, given the complexity of their models, it should have been considered at some level, and discussed in a standard fashion, given the scale and complexity of the design and operation, and overall investment by all stakeholders. I've worked on other projects, where the modeling is quite complicated, but modeling teams have used standard approaches/methodologies to both evaluate and convey uncertainty in design/operation. During discussions, the PG&E consultants indicated that they believe enough 'flexibility' has been built into the system design and operation to account for the effects of any uncertainties.

- The model is the primary tool used to design the remediation system; well locations, depths, screened zones, pumping rates, injected organic carbon, etc., are each and all based on the model. As a result, the design of these components and their operation are uncertain. The consultants (Arcadis/CH2MHill) acknowledge the lack of an uncertainty analysis and the uncertainty in the design, but simply assumed, based on 'professional judgment', a certain amount of 'flexibility' to account for this uncertainty (i.e., additional, contingent wells, and a range of possible flow rates at each well, among others). Changes in the original design and operation at Hinkley represent an example of what happens when incorrect assumptions, or guesses are made. If they don't have enough flexibility built into the system design/operation, they will need more wells, or the system may operate for 50 years or even longer to meet RAO objectives.

- The modeling conducted by PG&E the consultants simulates three things: a) water flow; b) transport/reaction of chemical species; and, geochemical reactions. It is standard engineering (and modeling) practice to provide an estimate of uncertainty with any modeling predictions, and this seems especially warranted in this instance given the overall costs and complexity of this system design and operation.

- The modelers were uncertain how long it would take to remediate the Cr(VI) concentrations to meet RAO objectives. The range seemed to be from 30 years, to even 200+ years in discussions. This is probably one of the most important issues identified during my review.

Recommendations

a) Although the 60% BOD is complete, the 90% BOD should include further evaluation and discussion on the uncertainty in model predictions associated with:

a. The length of time the system will need to operate to meet objectives of the remediation system.
b. The placement of wells, well screens, total depths. How confident is PG&E that the placement of proposed wells, including contingent wells, is adequate to meet objectives?
c. The number of wells required. How confident is PG&E that the proposed maximum number of wells is adequate to meet objectives? How confident are they that they haven't proposed too many wells?
d. Operational factors (flow rates, water quality, TOC inputs etc.). What is the confidence in the combination of proposed well #/locations and operational ranges (i.e., pumping rates) will be sufficient to meet remedial objectives?

b) Determine implications of predictive uncertainty on the proposed design and operation. Some sort of assessment could be provided in the 90% BOD Report.

c) The 90% BOD should consider the benefits of a phased installation and testing plan. Data obtained from early well drilling and testing could be fed back into the model and adjustments to the final BOD could be made before the entire system is installed and begins operating.

Model Sensitivity Analysis/Calibration

Associated Comments:

360, 361, 362

General Problems:

- Two types of sensitivity analyses are typically conducted; calibration and prediction. A calibration sensitivity analysis attempts to identify and rank the most important factors to which groundwater flow is most sensitive. Prediction sensitivity analyses assess sensitivity of model predictions to variations of important model parameters. No distinction was made in the 60% BOD Report about which type of analysis was performed, and the sensitivity analysis was confused with a standard uncertainty analysis.

- The consultants did not test the sensitivity of groundwater flow/heads to all factors, or combinations of factors. Instead, they showed the sensitivity of predicted groundwater conditions to adjustments of only a select set of parameters. In addition, they failed to demonstrate that groundwater flow or water quality predictions were most sensitive to the selected parameter set. The parameter adjustments evaluated did not seem to cover a realistic range based on reported field observations. So, sensitivity predictions don't really convey a realistic range of what might occur upon actually startup and commissioning of the remediation system.

- The model has many factors (r 'knobs' that can be adjusted to change the operation of the system). Once operating, any changes to the system will certainly have the potential to change long-term performance of the system regarding achieving RAOs. Without conducting a comprehensive evaluation of key flow and fate/transport parameters (or boundary conditions), PG&E will likely experience the following during operation because of the limited sensitivity analysis they conducted:

    - Problems in determining which of the many factors (model inputs) that affect the performance of the remediation system should be adjusted (in priority) to meet long-term RAOs (optimally);

    - Not knowing how much to adjust these factors to meet long-term RAOs.

Recommendations:

A list of all model parameters and input should be prepared. These model parameters should be ranked based on the sensitivity of groundwater flows and water quality transport sensitivity to them. This will help operators better understand which 'knob' to adjust, by how much, and what the system response might be. Such a list should be refined as new data is obtained during installation and operation. Failure to maintain such a list and the model, could result in reduced performance of the system towards achieving RAOs.

Model Optimization

Associated Comments:

358, 364a, 364b, 365, 366, 367a, 367b, 368, 369, 386, 388a, 388b, 393, 398, 403a, 403b

General Concerns:

- The modelers mention optimization many times, but this was not described well, nor did it constitute a formal engineering optimization to support the proposed design of this type of complex, large, long-term remediation system. A clear optimization strategy was never presented in the 60% BOD, describing appropriate performance targets and metrics. I attribute much of this to the very poorly/vaguely defined modeling objectives.

- Though the consultants claim the proposed remediation design/operation were 'optimized', this was never adequately demonstrated in the document (i.e., describing/showing multiple simulations aimed at 'optimizing' key targets.)

- No performance metrics were really defined to optimize the system. They show current proposed well locations, screened intervals, pumping rates, TOC injection rates etc., but also show that complete reduction of Cr(VI) can take 50+ years. **The design and operation, even if uncertain, should be based on a performance target of achieving RAOs within 30 years, or less.** The modeling conducted here appears more like an evaluation of a conceptual design (and operation), than an actual basis for an engineering design and operation document at 60%.

Recommendations

A clear methodology should be presented on how the modeling tool(s) will be used in conjunction with installation and subsequent hydraulic testing to optimize or refine fixed design features (i.e., well placement, screened zones etc.) that can't be changed once installed.

A clear methodology should be presented on how the primary design tool will be used to optimize/refine operational factors (i.e., pumping rates, TOC injection rates etc.) Show explicitly how and when modeling tools (flow, transport and geochemical) will be updated, with what data, and how and where new model predictions will be used in these operational schematics (see Figures 2.2-2 through 2.2-9 in Appendix L).

Possible Effects of High TDS/Density on Remedial Performance

Associated Comments:

357a, 357b, 384a, 384b

General Problems

- Contrasts in water density (fresh water and denser, 'saltier' water) can affect system performance. When fresh, lighter water is injected into denser water, depending on a number of factors, the difference in densities can cause lighter water to float on top of the denser water due to buoyancy. As a result, this can limit the ability of freshwater injection wells to fully flush water through denser water zones (lower in aquifer, because dense water sinks).

- Two issues with simply assuming this won't be a problem are:

    - A detailed plan describing exactly how they will actually confirm whether water densities are causing a problem was not provided.

    - Without knowing if density contrasts are a problem at a given location, incorrect 'knobs' could be adjusted the wrong amount, or the wrong way, thereby reducing the performance of the remediation system in achieving RAOs.

Recommendations

In the 90% BOD:

1) The possibility of density contrasts affecting performance should be acknowledged, even though this may not be highly likely in most wells.

2) Discuss what can be monitored to confirm this will or won't be a problem.

3) Finally, if it is determined to be a problem (i.e., poor flushing at depth due to buoyant 'bypass') – A plan should be developed, describing what will be done to 'adjust' the problem within current proposed design and operational constraints.

Key Issues and Recommendations

Installation, Startup, Long-term Operation and Use of Modeling

General Concerns

Through various discussions with PG&E consultants (Arcadis and CH2MHill), mostly during TWG meetings and phone meetings to discuss modeling comments, I've identified two additional concerns:

1) When PG&E installs the system, a large amount of new data will be collected in key areas.

Problems:

a) Aracadis and CH2MHill did not appear to concur with each other on the type, or level of hydraulic testing to be conducted as a part of well installation and commissioning.

b) I saw no detailed plan on what hydraulic testing would be done as the system is installed. These details are not covered in Appendix L (Operations and Maintenance), which focus on groundwater monitoring, but not testing. Nor is anything presented in Appendix L on future modeling details with the exception of very vague text related to their Adaptive Operations Approach – Section 1.2.2) which Arcadis has referenced in response to my comments. Given the limitations on number and location of proposed remedial wells, it makes sense to conduct hydraulic tests on all wells as they are installed, or even better on groups of wells in localized areas to identify problem wells and develop mitigation plans. Having done this, there is a greater likelihood that the original model predictions (which are uncertain – see discussion on the lack of uncertainty analysis) will still be valid and still allow the system to perform, within the somewhat arbitrary 'flexible' ranges assumed by modelers, without having to add more wells. Testing could also suggest that fewer wells are needed than originally planned in the Final BoD Report. Either way, as new test results are used to update the model, the model can then be used to improve initial startup and operational factors to minimize potential negative impacts upon startup. Incorrect adjustments may not only increase cleanup times, but can potentially exacerbate the existing problem.

c) In discussions, consultants appeared to lack concurrence on how, or even whether the model would be used during installation, or afterward the remedy commences operation. The model's proposed use during installation and operation does not appear to have been well thought out. This is surprising because the model is clearly the primary tool used to design the remediation well layout (i.e., pumping/injection well locations, depths, screened intervals, pumping rates, TOC injection locations, timing and rates/cycles etc.). Given the lack of any formal analysis of uncertainty in model predictions, or an adequate sense of which factors to adjust and by how much (i.e., limited sensitivity analysis) to meet long-term performance metrics (RAOs), all new data should be used to update the model during construction, re-calibrate it to be consistent with hydraulic test results obtained during well installation, and to re-run long-term simulations of proposed operations to assess whether the 100% design needs any modifications. The installation period, when drilling rigs are mobilized and on-site is the best time to adjust the 100% design (i.e., well locations, well numbers, well depths, etc).

2) Once the system is running, Arcadis indicated that they will rely mostly on observation data as a basis for making any adjustments to the remediation system and its operation.

Problems:

a) Where and when model updates are discussed, the basis and specific approach for the updating is vague. For example, in response to comment #360, Arcadis states "*The groundwater flow and solute transport model will be updated and recalibrated if significant differences from the conceptual site model are encountered with respect to hydrogeologic characterization or remedy performance. This will allow the model to be used as a tool to evaluate the performance and guide the operation of the remedial design after including the adjusted data."*

I don't believe the consultants have defined the conceptual flow and transport model well enough to know when 'significant' differences would be encountered. The entire system design and operation has been designed based on model simulations, which they also admit are uncertain, and the model was only tested in a limited fashion (i.e., limited sensitivity analyses), and wasn't really optimized in a standard engineering way. I am convinced that the model remains the only tool available to assess how any changes to model inputs will affect long-term system performance. I also believe that without updating these modeling tools constantly, and especially early in the installation and operational phases, it will be difficult for them to convince the Tribes (and other stakeholders, as well as the owner) that the current, complicated operational cycling/injection/extraction system will reduce Cr(VI) concentrations, plume size, and by-product development within the 30 year time frame.

b) It is clear that many 'knobs' can be adjusted in the proposed remediation system operation, for either the new wells or to replacement and contingency wells that may be added over time. Information learned at the Hinkley Site indicates significant problems resulted when the plume bypassed a portion of the initial proposed well network, moving between wells, and on the sides and below the well network. The limited sensitivity analysis Arcadis conducted for Topock gives little confidence they will adjust the right 'knobs', and by how much (in the right direction, magnitude and priority) to 'optimize' system performance to meet long-term (decades) RAO remediation objectives. Arcadis has argued that observation data will be the primary information used to guide any changes to the remediation system and its operation. Although observation data will certainly be useful in assessing **current** system performance, for guiding appropriate adjustment of the right 'knobs' to meet long-term objectives, the model must be updated and improved (calibrated) systematically, using the observation data. This is especially true given the proposed long cycles of on/off TOC injections.

c) The consultants have provided no detailed plan on how and when they will update the model, what simulations they'd run, or generally how they'd use the modeling along with observation data to help optimize system performance (i.e., achieve overall objectives most efficiently, such as minimizing overall remediation time, byproducts etc.).

Recommendations

During Installation:

1) Develop a plan that includes the following:

   a. Conduct hydraulic tests during installation for all wells, to confirm that well locations, depths, screened zones, productivity and drawdowns are within the proposed operational range. Through discussions with Arcadis and CH2MHill, this operational range was apparently determined 'through professional' judgment and not via a formal uncertainty analyses. This is fine, but this should be thoroughly tested **during the initial phases of well installation,** so that adjustments could be made before finalizing the entire installation and finding out that the system doesn't perform as expected (or predicted by the model(s)).

   b. A plan should be developed to update, re-calibrate and re-run short- and long-term model scenarios to confirm that the proposed design and operation are within the largely assumed ranges of performance and will still meet RAOs. Given the expected duration for installation, the model(s) could be continuously updated and used to confirm performance in specific areas.

   c. Results should be provided on all model updates and simulations to the Tribes and all stakeholders.

During Operation:

1) A plan should be developed showing a more realistic basis for when the model(s) will be updated. I believe model(s) should be updated every TOC on/off injections cycle, at least for the first few years, when the most significant changes to the existing system will occur. When changes in operation are made, for example, to TOC injection rates, locations, depths, timing, or injection/extraction well flow rates, the model(s) should be updated.

2) In the plan, discuss how the model(s) will be updated, and also re-calibrated against newly acquired 'operational' flow and water quality data , and how long-term simulations will be re-run to evaluate and confirm that long-term projections don't deviate from what is proposed in the 60%BOD Report (which is actually unclear) towards achieving RAOs.

3) Every time the model(s) are updated, re-calibrated and long-term simulations re-run, results should be documented and submitted to stakeholders.

THE COCOPAH INDIAN TRIBE
Cultural Resource Department
14515 S. Veterans Drive
Somerton, Arizona 85350
Office (928) 627-4849
Fax (928) 627-3173

Project Number: CCR-032-06-001

Via Electronic Mail

April 9, 2014

Mr. Aaron Yue
Topock Project Manager
California Department of Toxic Substances Control
5796 Corporate Avenue
Cypress, CA 90630

Ms. Pamela S. Innis
Topock Remedial Project Manager
Office of Environmental Policy and Compliance
U.S. DEPARTMENT OF THE INTERIOR
P.O. Box 25007 (D-108)
Denver, Colorado 80225-007

Re: Comments on Modeling Issues related to the 60% BOD Report for the PG&E Topock Compressor Station

Dear Mr. Yue and Ms. Innis:

Attached to this letter you will find comments prepared by the TRC regarding key concerns related to modeling in the 60% BOD. If you have any questions feel free to contact me at: Cell: 928-287-5042 or by email at CocopahTPM@gmail.com

Thank you

Edgar Castillo
Cocopah Indian Tribe
Topock Project Manager

Cc:
Tribal Representatives
Yvonne Meeks
TRC Members

INTEGRATED HYDRO SYSTEMS, LLC

Thursday, April 3, 2014

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3) ***Reduce the mass of Cr(T) and Cr(VI) in groundwater*** at the site to achieve compliance with the applicable or relevant and appropriate requirements (ARARs) in groundwater. This RAO will be achieved through the cleanup goal of the regional background concentration of 32 µg/L of Cr(VI).
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Modeling Objectives (Stated in Appendix B of the 60% BOD Report):

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e) Optimize the IM-3 decommissioning and startup of the new remediation system to minimize negative impacts to the system (to meet RAO objectives);
f) Determine a range of impacts due to manganese and arsenic by product generation.

PG&E's 60% BOD Report (Page 3, App B.) indicates that the modeling tool(s) represent the most important guide for the design and operation of the proposed remediation system: "*For the Site, the conceptual model forms the single most important guide for the design and operation of the proposed remediation system, as it is the basis for the numeric modeling, comprised of groundwater flow and contaminant fate and transport that simulate the operation of the remediation system*."

In my experience, a primary reason for 'failure' of models (i.e., poor predictions) is poor definition of modeling objectives. The objectives stated in the 60% BOD Report seem to point to a fundamental problem with the overall strategy for using the modeling tool(s):

a) Objectives were vague and unclear. For example, which objective is the most important, or which provides the greatest constraints on model optimizations?

b) A standard methodology in developing/applying/testing/validating the models or considering uncertainty was not presented. Some standard methodologies are mentioned (i.e., American Standards Testing Methods – ASTM), but a clearly-organized modeling method, based on clearly-defined objectives, is not provided.

c) A clear plan was not presented for how this primary design tool will be updated or used during and following system installation, during which a substantial amount of new data in key areas will be collected in a short period of time. Discussions with Arcadis and CH2MHill modelers seemed to confirm that limited consideration has been given to the following:

    a. How will modeling tool(s) be re-calibrated with new data obtained during initial installation, and shaped by additional data obtained over the long-term?
    b. How will the newly re-calibrated model be used to assess the final (100% BOD Report predictions?
    c. How will the newly re-calibrated model be used to modify things like well locations, depths, pumping rates etc. prior to completing the initial installation?
    d. How will the newly re-calibrated model be used to assess the location and design of potential provisional wells, or modify groundwater pumping and/or TOC injection rates?

Recommendations

1) Though not much can be done in the 60% BOD Report, all modeling objectives that have been attained should be clearly defined.

2) Objectives and scope of work should be clearly defined in the 90% BOD Report for all modeling to be conducted during installation, startup and long-term operation (this is described more in the last section of this memo).

Model Prediction Uncertainty

Associated Comments:

359, 370, 371, 382, 385, 388a, 388b, 392, 394, 401, 402, 404, 405, 406

General Problem:

- Uncertainty related to model predictions was not adequately addressed in the 60% BOD Report. A standard, comprehensive uncertainty analysis was not conducted, and an uncertainty analysis was confused with a sensitivity analysis. Though, this would have been challenging to perform, given the complexity of their models, it should have been considered at some level, and discussed in a standard fashion, given the scale and complexity of the design and operation, and overall investment by all stakeholders. I've worked on other projects, where the modeling is quite complicated, but modeling teams have used standard approaches/methodologies to both evaluate and convey uncertainty in design/operation. During discussions, the PG&E consultants indicated that they believe enough 'flexibility' has been built into the system design and operation to account for the effects of any uncertainties.

- The model is the primary tool used to design the remediation system; well locations, depths, screened zones, pumping rates, injected organic carbon, etc., are each and all based on the model. As a result, the design of these components and their operation are uncertain. The consultants (Arcadis/CH2MHill) acknowledge the lack of an uncertainty analysis and the uncertainty in the design, but simply assumed, based on 'professional judgment', a certain amount of 'flexibility' to account for this uncertainty (i.e., additional, contingent wells, and a range of possible flow rates at each well, among others). Changes in the original design and operation at Hinkley represent an example of what happens when incorrect assumptions, or guesses are made. If they don't have enough flexibility built into the system design/operation, they will need more wells, or the system may operate for 50 years or even longer to meet RAO objectives.

- The modeling conducted by PG&E the consultants simulates three things: a) water flow; b) transport/reaction of chemical species; and, geochemical reactions. It is standard engineering (and modeling) practice to provide an estimate of uncertainty with any modeling predictions, and this seems especially warranted in this instance given the overall costs and complexity of this system design and operation.

- The modelers were uncertain how long it would take to remediate the Cr(VI) concentrations to meet RAO objectives. The range seemed to be from 30 years, to even 200+ years in discussions. This is probably one of the most important issues identified during my review.

Recommendations

a) Although the 60% BOD is complete, the 90% BOD should include further evaluation and discussion on the uncertainty in model predictions associated with:

a. The length of time the system will need to operate to meet objectives of the remediation system.
b. The placement of wells, well screens, total depths. How confident is PG&E that the placement of proposed wells, including contingent wells, is adequate to meet objectives?
c. The number of wells required. How confident is PG&E that the proposed maximum number of wells is adequate to meet objectives? How confident are they that they haven't proposed too many wells?
d. Operational factors (flow rates, water quality, TOC inputs etc.). What is the confidence in the combination of proposed well #/locations and operational ranges (i.e., pumping rates) will be sufficient to meet remedial objectives?

b) Determine implications of predictive uncertainty on the proposed design and operation. Some sort of assessment could be provided in the 90% BOD Report.

c) The 90% BOD should consider the benefits of a phased installation and testing plan. Data obtained from early well drilling and testing could be fed back into the model and adjustments to the final BOD could be made before the entire system is installed and begins operating.

Model Sensitivity Analysis/Calibration

Associated Comments:

360, 361, 362

General Problems:

- Two types of sensitivity analyses are typically conducted; calibration and prediction. A calibration sensitivity analysis attempts to identify and rank the most important factors to which groundwater flow is most sensitive. Prediction sensitivity analyses assess sensitivity of model predictions to variations of important model parameters. No distinction was made in the 60% BOD Report about which type of analysis was performed, and the sensitivity analysis was confused with a standard uncertainty analysis.

- The consultants did not test the sensitivity of groundwater flow/heads to all factors, or combinations of factors. Instead, they showed the sensitivity of predicted groundwater conditions to adjustments of only a select set of parameters. In addition, they failed to demonstrate that groundwater flow or water quality predictions were most sensitive to the selected parameter set. The parameter adjustments evaluated did not seem to cover a realistic range based on reported field observations. So, sensitivity predictions don't really convey a realistic range of what might occur upon actually startup and commissioning of the remediation system.

- The model has many factors (r 'knobs' that can be adjusted to change the operation of the system). Once operating, any changes to the system will certainly have the potential to change long-term performance of the system regarding achieving RAOs. Without conducting a comprehensive evaluation of key flow and fate/transport parameters (or boundary conditions), PG&E will likely experience the following during operation because of the limited sensitivity analysis they conducted:

    - Problems in determining which of the many factors (model inputs) that affect the performance of the remediation system should be adjusted (in priority) to meet long-term RAOs (optimally);

    - Not knowing how much to adjust these factors to meet long-term RAOs.

Recommendations:

A list of all model parameters and input should be prepared. These model parameters should be ranked based on the sensitivity of groundwater flows and water quality transport sensitivity to them. This will help operators better understand which 'knob' to adjust, by how much, and what the system response might be. Such a list should be refined as new data is obtained during installation and operation. Failure to maintain such a list and the model, could result in reduced performance of the system towards achieving RAOs.

Model Optimization

Associated Comments:

358, 364a, 364b, 365, 366, 367a, 367b, 368, 369, 386, 388a, 388b, 393, 398, 403a, 403b

General Concerns:

- The modelers mention optimization many times, but this was not described well, nor did it constitute a formal engineering optimization to support the proposed design of this type of complex, large, long-term remediation system. A clear optimization strategy was never presented in the 60% BOD, describing appropriate performance targets and metrics. I attribute much of this to the very poorly/vaguely defined modeling objectives.

- Though the consultants claim the proposed remediation design/operation were 'optimized', this was never adequately demonstrated in the document (i.e., describing/showing multiple simulations aimed at 'optimizing' key targets.)

- No performance metrics were really defined to optimize the system. They show current proposed well locations, screened intervals, pumping rates, TOC injection rates etc., but also show that complete reduction of Cr(VI) can take 50+ years. **The design and operation, even if uncertain, should be based on a performance target of achieving RAOs within 30 years, or less.** The modeling conducted here appears more like an evaluation of a conceptual design (and operation), than an actual basis for an engineering design and operation document at 60%.

Recommendations

A clear methodology should be presented on how the modeling tool(s) will be used in conjunction with installation and subsequent hydraulic testing to optimize or refine fixed design features (i.e., well placement, screened zones etc.) that can't be changed once installed.

A clear methodology should be presented on how the primary design tool will be used to optimize/refine operational factors (i.e., pumping rates, TOC injection rates etc.) Show explicitly how and when modeling tools (flow, transport and geochemical) will be updated, with what data, and how and where new model predictions will be used in these operational schematics (see Figures 2.2-2 through 2.2-9 in Appendix L).

Possible Effects of High TDS/Density on Remedial Performance

Associated Comments:

357a, 357b, 384a, 384b

General Problems

- Contrasts in water density (fresh water and denser, 'saltier' water) can affect system performance. When fresh, lighter water is injected into denser water, depending on a number of factors, the difference in densities can cause lighter water to float on top of the denser water due to buoyancy. As a result, this can limit the ability of freshwater injection wells to fully flush water through denser water zones (lower in aquifer, because dense water sinks).

- Two issues with simply assuming this won't be a problem are:

    - A detailed plan describing exactly how they will actually confirm whether water densities are causing a problem was not provided.

    - Without knowing if density contrasts are a problem at a given location, incorrect 'knobs' could be adjusted the wrong amount, or the wrong way, thereby reducing the performance of the remediation system in achieving RAOs.

Recommendations

In the 90% BOD:

1) The possibility of density contrasts affecting performance should be acknowledged, even though this may not be highly likely in most wells.

2) Discuss what can be monitored to confirm this will or won't be a problem.

3) Finally, if it is determined to be a problem (i.e., poor flushing at depth due to buoyant 'bypass') – A plan should be developed, describing what will be done to 'adjust' the problem within current proposed design and operational constraints.

Key Issues and Recommendations

Installation, Startup, Long-term Operation and Use of Modeling

General Concerns

Through various discussions with PG&E consultants (Arcadis and CH2MHill), mostly during TWG meetings and phone meetings to discuss modeling comments, I've identified two additional concerns:

1) When PG&E installs the system, a large amount of new data will be collected in key areas.

Problems:

a) Aracadis and CH2MHill did not appear to concur with each other on the type, or level of hydraulic testing to be conducted as a part of well installation and commissioning.

b) I saw no detailed plan on what hydraulic testing would be done as the system is installed. These details are not covered in Appendix L (Operations and Maintenance), which focus on groundwater monitoring, but not testing. Nor is anything presented in Appendix L on future modeling details with the exception of very vague text related to their Adaptive Operations Approach – Section 1.2.2) which Arcadis has referenced in response to my comments. Given the limitations on number and location of proposed remedial wells, it makes sense to conduct hydraulic tests on all wells as they are installed, or even better on groups of wells in localized areas to identify problem wells and develop mitigation plans. Having done this, there is a greater likelihood that the original model predictions (which are uncertain – see discussion on the lack of uncertainty analysis) will still be valid and still allow the system to perform, within the somewhat arbitrary 'flexible' ranges assumed by modelers, without having to add more wells. Testing could also suggest that fewer wells are needed than originally planned in the Final BoD Report. Either way, as new test results are used to update the model, the model can then be used to improve initial startup and operational factors to minimize potential negative impacts upon startup. Incorrect adjustments may not only increase cleanup times, but can potentially exacerbate the existing problem.

c) In discussions, consultants appeared to lack concurrence on how, or even whether the model would be used during installation, or afterward the remedy commences operation. The model's proposed use during installation and operation does not appear to have been well thought out. This is surprising because the model is clearly the primary tool used to design the remediation well layout (i.e., pumping/injection well locations, depths, screened intervals, pumping rates, TOC injection locations, timing and rates/cycles etc.). Given the lack of any formal analysis of uncertainty in model predictions, or an adequate sense of which factors to adjust and by how much (i.e., limited sensitivity analysis) to meet long-term performance metrics (RAOs), all new data should be used to update the model during construction, re-calibrate it to be consistent with hydraulic test results obtained during well installation, and to re-run long-term simulations of proposed operations to assess whether the 100% design needs any modifications. The installation period, when drilling rigs are mobilized and on-site is the best time to adjust the 100% design (i.e., well locations, well numbers, well depths, etc).

2) Once the system is running, Arcadis indicated that they will rely mostly on observation data as a basis for making any adjustments to the remediation system and its operation.

Problems:

a) Where and when model updates are discussed, the basis and specific approach for the updating is vague. For example, in response to comment #360, Arcadis states "*The groundwater flow and solute transport model will be updated and recalibrated if significant differences from the conceptual site model are encountered with respect to hydrogeologic characterization or remedy performance. This will allow the model to be used as a tool to evaluate the performance and guide the operation of the remedial design after including the adjusted data."*

I don't believe the consultants have defined the conceptual flow and transport model well enough to know when 'significant' differences would be encountered. The entire system design and operation has been designed based on model simulations, which they also admit are uncertain, and the model was only tested in a limited fashion (i.e., limited sensitivity analyses), and wasn't really optimized in a standard engineering way. I am convinced that the model remains the only tool available to assess how any changes to model inputs will affect long-term system performance. I also believe that without updating these modeling tools constantly, and especially early in the installation and operational phases, it will be difficult for them to convince the Tribes (and other stakeholders, as well as the owner) that the current, complicated operational cycling/injection/extraction system will reduce Cr(VI) concentrations, plume size, and by-product development within the 30 year time frame.

b) It is clear that many 'knobs' can be adjusted in the proposed remediation system operation, for either the new wells or to replacement and contingency wells that may be added over time. Information learned at the Hinkley Site indicates significant problems resulted when the plume bypassed a portion of the initial proposed well network, moving between wells, and on the sides and below the well network. The limited sensitivity analysis Arcadis conducted for Topock gives little confidence they will adjust the right 'knobs', and by how much (in the right direction, magnitude and priority) to 'optimize' system performance to meet long-term (decades) RAO remediation objectives. Arcadis has argued that observation data will be the primary information used to guide any changes to the remediation system and its operation. Although observation data will certainly be useful in assessing **current** system performance, for guiding appropriate adjustment of the right 'knobs' to meet long-term objectives, the model must be updated and improved (calibrated) systematically, using the observation data. This is especially true given the proposed long cycles of on/off TOC injections.

c) The consultants have provided no detailed plan on how and when they will update the model, what simulations they'd run, or generally how they'd use the modeling along with observation data to help optimize system performance (i.e., achieve overall objectives most efficiently, such as minimizing overall remediation time, byproducts etc.).

Recommendations

During Installation:

1) Develop a plan that includes the following:

   a. Conduct hydraulic tests during installation for all wells, to confirm that well locations, depths, screened zones, productivity and drawdowns are within the proposed operational range. Through discussions with Arcadis and CH2MHill, this operational range was apparently determined 'through professional' judgment and not via a formal uncertainty analyses. This is fine, but this should be thoroughly tested **during the initial phases of well installation,** so that adjustments could be made before finalizing the entire installation and finding out that the system doesn't perform as expected (or predicted by the model(s)).

   b. A plan should be developed to update, re-calibrate and re-run short- and long-term model scenarios to confirm that the proposed design and operation are within the largely assumed ranges of performance and will still meet RAOs. Given the expected duration for installation, the model(s) could be continuously updated and used to confirm performance in specific areas.

   c. Results should be provided on all model updates and simulations to the Tribes and all stakeholders.

During Operation:

1) A plan should be developed showing a more realistic basis for when the model(s) will be updated. I believe model(s) should be updated every TOC on/off injections cycle, at least for the first few years, when the most significant changes to the existing system will occur. When changes in operation are made, for example, to TOC injection rates, locations, depths, timing, or injection/extraction well flow rates, the model(s) should be updated.

2) In the plan, discuss how the model(s) will be updated, and also re-calibrated against newly acquired 'operational' flow and water quality data , and how long-term simulations will be re-run to evaluate and confirm that long-term projections don't deviate from what is proposed in the 60%BOD Report (which is actually unclear) towards achieving RAOs.

3) Every time the model(s) are updated, re-calibrated and long-term simulations re-run, results should be documented and submitted to stakeholders.

Attachment T: RTC #6, Narrative on Key Decommissioning Steps

Attachment T

Response to Comment #6 FMIT-1/Hualapai-1/Chemehuevi-1/CRIT-1/Cocopah-1

Comment #6: *A conceptual narrative for the anticipated steps in the decommissioning of this proposed remedy should be included to assist in both evaluating the design elements and how they would impact removal of the remedy infrastructure, and in evaluating the total, cumulative impacts of this project.*

Response to Comment:

Conceptually, the key steps in the decommissioning of remedy facilities may include, but not limited to the following:

- **Site preparation and demarcation** – typical activities include mobilization of resources (personnel, equipment, materials), delineate access/haul routes, demarcate work and support zones including staging areas, and set up temporary facilities. Temporary facilities may include trailers, restroom facilities, safety and security lighting, equipment storage area, and parking area.
- **Utility survey and isolation** – typical activities include locating and marking underground utilities prior to intrusive work, and isolation of identified utilities. Utilities may include water, sewer, gas, phone, and power lines. Underground Service Alert or "Dig Alert" will be contacted to identify public utilities that operate within the work areas. Identified utilities will be isolated and disconnected by the utility provider prior to decommissioning and removing portions of a utility.
- **System components decommissioning** – decommissioning renders the components permanently out of service. Typical activities include decontamination and removal or abandonment in place. Decontamination will involve cleaning and removing waste materials, and render the components appropriate for reuse, recycle, or disposal. After decontamination, the components will be removed or abandoned in place.
- **Waste characterization and management –** waste generated from decommissioning may include liquid wastes, solid wastes, and sludge. Waste will be characterized and managed appropriately.

- **Soil confirmation sampling, as needed** – subsequent to decommissioning and removal, soil confirmation sampling may be conducted to assess soil conditions as needed.
- **Post-decommissioning restoration** – after decommissioning and confirmation sampling are complete, site restoration will commence. Restoration activities will start with returning the land to a safe condition, backfilling of excavated infrastructure, and compacting uneven areas. Light grading and contouring may be required to provide proper drainage and to control erosion. Revegetation will occur after final grading and contouring.

The above conceptual steps apply to pipelines and vertical infrastructure. Decommissioning of wells will be in accordance with the approach outlined in the project Well Decommissioning SOP (Well-SOP-01).

Appendix J
Freshwater Supply Technical Memorandum and Responses to Comments

Pacific Gas and Electric Company

Yvonne J. Meeks
Manager

Environmental Remediation

Mailing Address
4325 South Higuera Street
San Luis Obispo, CA 93401

Location
6588 Ontario Road
San Luis Obispo, CA 93405

805.234.2257
Fax: 805.773.8281
E-Mail: yjm1@pge.com

April 27, 2012

Mr. Aaron Yue
Project Manager
California Department of Toxic Substances Control
5796 Corporate Avenue
Cypress, CA 90630

Ms. Pamela Innis
Topock Remedial Project Manager
U.S. Department of the Interior
Office of Environmental Policy and Compliance
Denver Federal Center, Bldg. 67, Room 118
P.O. Box 25007, MS D108
Denver, CO 80225-0007

Subject: Submittal of Freshwater Source Evaluation Technical Memorandum

Dear Aaron and Pam:

In response to comments from the California Department of Substances Control on the Preliminary (30%) Design document, Pacific Gas and Electric (PG&E) has prepared the attached technical memorandum that discusses the three potential sources of fresh water, their advantages and limitations, and PG&E's preferred option. These potential sources were each presented in the project's Corrective Measures Study/Feasibility Study (CMS/FS), and they are consistent with the water supply options in the certified Environmental Impact Report (EIR). The criteria used to evaluate fresh water sources was included as part of the Preliminary (30%) Remedy Design.

The three potential fresh water sources outlined in the memo – and a brief discussion of the advantages and disadvantages of each – are as follows:

1. An existing well (HNWR-1) in Arizona

Advantages

- Proven water source
- Capacity of nearby wells not impacted
- Existing well means reduced installation impact

Disadvantages

- Naturally occurring arsenic in water supply wells in Topock, Arizona above MCL (10μg/L). Geochemical modeling indicates that arsenic will not migrate far from the injection points in California and will dissipate at the end of remediation. Monitoring will be conducted to verify

modeling results. Water treatment facilities to remove arsenic could be installed if arsenic does not behave as predicted

2. A new well or wells located in proximity to the site in California (near Moabi Regional Park)

Advantages

- Lower concentration of arsenic, compared to Arizona well(s)
- Nearby electric power and pipeline route facilitate delivery to project site

Disadvantages

- Smaller capacity of aquifer at Moabi Regional Park means use of multiple wells and increased installation impact
- Pumping large volumes from a well or wells near Park Moabi could impact capacity, water quality in nearby existing Moabi Regional Park wells
- Water treatment facilities would likely be required to remove iron and manganese prior to injection to protect wells
- Salinity of water from a high capacity well at Park Moabi may be above the range considered potable by the Regional Water Quality Control Board

3. The Colorado River

Advantages

- Sufficient capacity
- Low concentrations of arsenic and dissolved salts

Disadvantages

- Implementability issues due to special status fish species that occur in the Topock area, specifically the razorback sucker and the bonytail chub. Both are federally-listed and state-listed as endangered; the razorback sucker is also a California Fully Protected Species. Preliminary discussion with the California Department of Fish and Game (CDFG) indicated that approval of a fish screen and intake structure that would avoid incidental take of the razorback sucker may be difficult to obtain. This issue will need to be explored further, may not be feasible, and would likely add more time to the project
- Environmental and sustainability considerations related to implementation and operation of a river intake structure
- Potentially susceptible to future contamination as a result of upstream discharges or spills
- Water treatment facilities to remove suspended solids, potentially organic carbon, and disinfection to remove microbes required prior to injection to protect wells

The use of the existing well in Arizona is the preferred freshwater supply option for the remedial action, as it is a proven well that can provide adequate water quality and quantity, presents less disturbance of

the site, less uncertainty, and less risk to project schedule. The basis for this conclusion, along with a comprehensive review of each option, is presented in detail in this tech memo.

Sincerely,

Yvonne Meeks
Topock Project Manager

Enclosure
Freshwater Source Evaluation Technical Memorandum

cc:

Karen Baker/DTSC
Robert Perdue/RWQCB

Freshwater Source Evaluation, PG&E Topock Compressor Station, Needles, California

PREPARED FOR: Pacific Gas and Electric Company

PREPARED BY: CH2M HILL

DATE: April 27, 2012

1.0 Introduction

A major component of the selected groundwater remedy at the Pacific Gas and Electric Company (PG&E) Topock Compressor Station (TCS, or the Compressor Station) is freshwater injection. The primary objectives of the freshwater injection are to assist with flushing the chromium plume through the *In Situ* Reactive Zone (IRZ) located along the National Trails Highway (NTH) and to constrain westward spread of carbon-amended water and in-situ byproducts from the Inner Recirculation Loop.

The potential sources of fresh water were originally presented in the Corrective Measures Study/Feasibility Study (CMS/FS) (CH2M HILL 2009a). The CMS/FS considered three potential sources of fresh water: a well or wells in Arizona (in proximity to the project site), a well or wells in California (in proximity to the project site), and water from the Colorado River. These potential sources are consistent with the water supply options in the certified Environmental Impact Report (EIR) (AECOM 2011). An initial evaluation of these options was presented in the Corrective Measure Implementation/ Remedial Design (CMI/RD) Work Plan (CH2M HILL 2011a). Further evaluation was conducted during the development of the design documents, and the results were presented in the Draft Basis of Design (BOD) Report/Preliminary (30%) Design (CH2M HILL 2011b).

In response to specific comments on the preliminary (30%) design (comments #142 DTSC-55 through #153 DTSC-66), this Technical Memorandum (TM) provides additional details and analysis and is organized as follows:

- **Section 2.0** describes the quantity of water required for remedy performance derived from the modeling and the desired water quality for freshwater injection.
- **Section 3.0** compares the three freshwater sources to the evaluation criteria identified below.
- **Section 4.0** summarizes the rationale for selection of the preferred alternative.
- **Section 5.0** includes a list of references cited in this TM.
- **Attachment A** contains three reports from Moabi Regional Park's consultant LeRoy Crandall and Associates.
- **Attachment B** contains a TM on the preliminary engineering survey/evaluation of river intake and fish screen.
- Subsequent to the 30% design, changes were made to the groundwater transport model to improve the accuracy of manganese and arsenic simulations. The revised model was then used to evaluate the different freshwater alternatives with regard to chromium removal and manganese/arsenic migration. **Attachment C** provides a brief summary of the changes to the model and the results of model simulations conducted to support the evaluation of freshwater sources.

The following criteria are used to evaluate the freshwater supply options in this TM:

1. Influence of freshwater pumping on remedy performance
2. Quantity of water available
3. Water quality and potential need for conditioning of water prior to injection
4. Implementability and sustainability considerations

The first three criteria were identified in the preliminary (30%) design. A fourth criterion, "Disturbance associated with construction," was also identified in the 30% design. The California Department of Toxic Substances Control (DTSC) also requested that a contingency criterion be added to the evaluation. Both the disturbance and the contingency criteria have been incorporated, along with additional considerations, into criterion no. 4 (Implementability and sustainability considerations).

2.0 Water Quantity and Quality

This section describes the quantity of fresh water required for remedy performance and the desired water quality for freshwater injection.

2.1 Water Quantity

The groundwater remedy is designed to move the chromium plume across the NTH IRZ line in an easterly direction by injecting water to the west and pumping from wells near the river bank. The freshwater injection system is designed to provide a hydraulic barrier to prevent movement of chromium or *in situ* byproducts beyond the plume footprint to the north and west and provide the hydraulic gradient needed to push the plume across the IRZ. The current design and modeled flow rate for freshwater extraction is 600 gallons per minute (gpm). However, the potential maximum flow rate for freshwater injection is 1,200 gpm, which includes the maximum aggregate flow rate for the entire Outer Loop injection well network (including FW-INJ-4) of 600 gpm and the maximum aggregate freshwater flow rate for the Inner Loop injection well network (e.g., UPGRAD-INJ-2, UPGRAD-INJ-3, and UPGRAD-INJ-4 are receiving fresh water at the maximum flow rate) of 600 gpm.

It is necessary to obtain a sufficient supply of water that will be reliable over the long term. There should be excess capacity in the freshwater source to offset future declines in well efficiency and allow for adjustment of freshwater injection rates to optimize the performance of the remedy. During remedy implementation, several of the freshwater injection wells will be installed in areas where no previous wells have been drilled and hydrogeologic conditions are unknown. If the aquifer is more transmissive than anticipated in these areas, additional fresh water would be needed to create the gradient necessary for remedy operation. On the other hand, if the aquifer is less transmissive than anticipated, less water would be needed.

2.2 Water Quality

This section discusses desired water quality for the freshwater injection system. There are several water quality parameters that need to be considered for the freshwater source in order to prevent plugging of the injection wells and the aquifer as well as degradation of the water quality in the aquifer.

2.2.1 Prevention of Well and Aquifer Plugging

Well and aquifer plugging could be caused by geochemical reactions between the injected water and the native water or aquifer materials or by the presence of suspended solids in the injected water. Well plugging could also be caused by microbial growth in the injection wells. Prevention of aquifer plugging is essential to remedy performance. Prevention of well plugging is critical to good well health and long well life. Examples of potential clogging characteristics that may be present in sources of injected water near the Topock site include the following:

- Dissolved iron and/or manganese content that could result in precipitation of iron/manganese oxides on the well screen
- Very low total dissolved solids (TDS) that could dissolve minerals such as gypsum and calcite adjacent to the well screen and reprecipitate these minerals in a narrow zone downgradient from the injection well, reducing porosity to a degree that could result in production loss
- High total suspended solids (TSS) in the injection water that could eventually plug the screen openings
- Water with dissolved organic carbon content that could produce biofouling of the well

Dissolved Iron and Manganese

Iron and manganese are soluble in reduced geochemical conditions, such as are found in the reducing rind around the river and across much of the shallower portions of the floodplain. When reduced water containing dissolved iron and manganese is exposed to oxygen, the iron and manganese precipitate, in the case of iron very rapidly. This can cause very rapid fouling of injection wells. If the source of fresh water contains dissolved iron and manganese, pretreatment would be required to remove the precipitates prior to injection. Based on experience of well maintenance at Interim Measure No. 3 (IM3), the ideal concentrations of dissolved iron and dissolved manganese in injected water are 20 micrograms per liter (μg/L) and <10 μg/L, respectively.

Total Dissolved Solids

Water with very low concentrations of TDS tends to dissolve some of the minerals that are present in an aquifer matrix. Minerals such as gypsum and anhydrite can be dissolved from the area around the well and then re-precipitate as the low-TDS water moves outward from the well and begins to equilibrate with the native water in the aquifer. This re-precipitation can cause plugging of the aquifer. This was a concern when IM3 was designed and is one of the reasons that IM-3 was designed to produce water that matches the average TDS of the middle and lower zones of the aquifer where the IM-3 injection wells are screened.

The freshwater sources from the HNWR-1 well and from the river have average TDS of about 500 milligrams per liter (mg/L) and 680 mg/L, respectively. There was some concern initially that the low TDS of these freshwater sources may have the potential to cause diminished injection productivity due to the mechanism described above. A geochemical model simulation was performed using the U.S. Geological Survey's (USGS's) PHAST code (Parkhurst et al. 2010), in which injection of water chemistry from HNWR-1 (the lower TDS of the two waters) into the alluvial aquifer was simulated in a simplified model. The purpose was to calculate the mass of salts that would be re-precipitated at various distances from the injection well, and assess whether the volume of this mass would block a significant portion of the aquifer porosity. The simulation showed that less than one percent of the available porosity was blocked by re-precipitation. This was considered to be insignificant from a water production standpoint. These results were expected, since the native groundwater in the freshwater injection area is undersaturated with respect to gypsum and anhydrite, the calcium sulfate minerals that are most often associated with this mechanism of production loss through re-precipitation. The undersaturation indicates that gypsum is either absent or in negligible quantity in the aquifer matrix. Based on these simulation results, it is anticipated that surface or groundwater sources in the southern Mojave Basin will not be an issue for plugging due to low TDS.

Total Suspended Solids

Suspended solids are particulate matter that is small enough to remain suspended in water. These particulates can be large enough to plug the pore spaces in the aquifer near the well, resulting in well plugging. Most properly designed and developed water wells produce water that is very low in suspended solids (TSS <1-2 mg/L) and therefore suitable for injection. Wells that have poorly designed screens and gravel packs or screens that have corroded and become compromised can produce suspended solids. Surface water sources, including river water, typically have higher TSS which in most cases needs to be removed through filtration prior to injection.

Dissolved Organic Carbon Content

With the exception of iron bacteria that use dissolved iron as an energy source, the microbes associated with well fouling require some kind of organic carbon as an energy source. Under aerobic conditions organic carbon in the injected water can support growth of microbes in and near the well and result in rapid plugging of an injection well. Dissolved organic carbon is typically very low in natural groundwater. Dissolved organic carbon has been non-detect (<1 mg/L) in the HNWR-1 well and averages about 1.3 mg/L in the existing wells (PM-03 and PM-04) at Moabi Regional Park. If wells were used as a freshwater source, there would likely not be enough organic carbon in the injected water to cause biofouling in the injection wells. Based on data provided by Metropolitan Water District of Southern California (MWD), the average dissolved organic carbon content in the Colorado River near Topock is 9 mg/L. While this is considered low for a surface water source, it is considerably higher than the groundwater sources being considered and might be enough carbon to contribute to injection well fouling. The

fouling potential of the river water would depend on the bio-availability of the dissolved carbon present. If the carbon is relatively resistant to microbial uptake, the microbes would not be able to readily utilize it and there would be less potential for well fouling. If the carbon was in a form that the microbes could readily use, microbial growth could occur within or near the well and fouling would be more of a concern. If the river were selected as the freshwater source, laboratory tests would need to be conducted to determine the nature of the dissolved carbon present and whether or not it would be likely to cause problems with well fouling.

2.2.2 Protection of Aquifer Water Quality

In order to attain the remedial action objectives (RAOs) for hexavalent chromium (Cr[VI]) at the Topock site, substantial movement of groundwater in the target remediation area – either through natural or induced measures – will be necessary, and under active treatment for Cr(VI), it is expected that significant mixing of groundwater in the target remediation area would occur both vertically and horizontally. As a result, temporary fluctuations in water quality (up to or exceeding the upper tolerance limit [UTL]) will occur during remedy implementation prior to achieving RAOs, i.e., water quality and concentrations measured at individual monitoring wells are expected to change during the course of the remediation from concentrations present today.

The RAO for Cr(VI) at the conclusion of remedy implementation has been established as 32 µg/L based on the regional background concentration. There is no state or federal Maximum Contaminant Level (MCL) for Cr(VI). Concentrations of Cr(VI) and arsenic as an *in situ* byproduct may fluctuate above baseline levels within the treatment area during remedy implementation. In addition, as part of the preliminary (30%) design, fresh water from the Refuge well (HNWR-1) in Arizona is designed to be injected west of the plume, within the project's Area of Potential Effects (APE). The naturally occurring arsenic concentration in water from this well exceeds the MCL for arsenic of 10 µg/L. During the Topock Background Study, arsenic concentrations above the MCL were found in water supply wells in the vicinity of the Topock Marina, Arizona. Modeling indicates that arsenic concentrations that may temporarily be elevated by a) the injection of this water from Arizona and b) the generation from *in situ* remediation will attenuate under site conditions and return to pre-remedy baseline levels after the end of remediation (see Figures 3-9 through 3-12). Modeling also indicates that manganese generated from *in situ* remediation may be temporarily elevated at concentrations that fall within the range of naturally-occurring concentrations historically measured within the shallow fluvial aquifer. Monitoring will be performed during remedy implementation to verify the above modeling results, and appropriate adjustments will be made to remedy operations as needed.

Given the goal to restore the water quality to ambient conditions for Cr(VI) and any chemicals that could potentially be generated or introduced by the remediation, the following are examples of characteristics of injected water that could be a concern from a water quality perspective:

- TDS above 3,000 mg/L
- Constituents introduced at concentrations above site background or above water quality standards that do not attenuate after the end of remediation
- Emerging contaminants not yet identified

Total Dissolved Solids

The basin plan prepared by the Colorado River Basin RWQCB considers groundwater with less than 3,000 mg/L of TDS to be potable (RWQCB 2006). The TDS in groundwater in the upper portions of the aquifer at the Topock site is generally below 3,000 mg/L while the groundwater in the lower portion of the aquifer has TDS of 10,000 mg/L or greater. In order to flush the chromium plume efficiently through the IRZ, the freshwater injection wells are planned to be screened across the entire aquifer thickness. The TDS in the shallow zone of the aquifer near the planned injection wells ranges from about 900 mg/L to about 2,800 mg/L. Over the decades of remedy operations, most of the aquifer within the plume footprint will be flushed with fresh water from the injection wells. If the injected water has a TDS above 3,000 mg/L, portions of the aquifer that are currently below 3,000 mg/L and therefore considered potable would likely be above 3,000 mg/L for many decades . To preserve

the potable status of the upper zone water, it would therefore be desirable to have a freshwater source with a TDS less than 3,000 mg/L.

Note that for the IM-3 injected water, the TDS target was set at 4,200 mg/L. The IM-3 wells are selectively screened in the lower portion of the aquifer and this TDS target is consistent with that deeper zone. The IM-3 injection wells were not intended to flush the chromium plume, so there was no need to screen the shallow portion of the aquifer. Injecting water with TDS of 4,200 mg/L into the lower zone does not degrade the existing water quality and was therefore allowed for the IM-3 system.

Constituents Introduced Above Site Background or Above Water Quality Standards that Do Not Attenuate After the End of Remediation

Water quality at the Topock site could be compromised if the injected water contains persistent and mobile constituents at concentrations that are greater than site background or above applicable water quality standards. This could be particularly problematic for those constituents that do not attenuate after the end of remediation. The degree to which the water quality is compromised would depend on the toxicity, concentration, mobility, and persistence of the constituent in question.

As discussed above, modeling indicates that arsenic concentrations that may temporarily be elevated by injection of HNWR-1 well water (with naturally occurring arsenic level of 15µg/L, which is below site background of 24.3µg/L but above the MCL of 10µg/L) will attenuate under site conditions and return to pre-remedy baseline levels after the end of remediation (see Figures 3-9 through 3-12). Monitoring will be performed during remedy implementation to verify the above modeling results, and appropriate adjustments will be made to remedy operations as needed.

It should be noted that naturally occurring chromium (VI) in the fresh water used for injection will be at concentrations at or below the site background of 32µg/L. Any residual CrVI) introduced with the fresh water is expected to be persistent in the aerobic portions of the aquifer, but would continue to be attenuated in the natural reducing conditions in fluvial sediments adjacent to and beneath the river after the remedial action is complete.

Emerging Contaminants

Perchlorate and 1,4-dioxane are two of the more common emerging contaminants that have been identified in groundwater and surface water at other sites in recent years. Others on the list include endrocrine disrupting compounds and various types of pharmaceuticals. There have been several large-scale groundwater remediation projects where treated groundwater was injected back into the aquifer and then later found to contain an emerging contaminant that was not previously identified as harmful. Examples of this include the Tucson Airport Area Superfund site, where it was discovered in 2002 that 1,4-dioxane had been passing undetected through the air strippers since 1987and was injected into a previously uncontaminated portion of the aquifer. A similar problem occurred at the Aerojet site in Rancho Cordova, CA, where perchlorate passed undetected through air strippers and was injected into a clean portion of an aquifer. By the time perchlorate was recognized as a contaminant, it had already reached one of the municipal wells that the remediation system was intended to protect. Because the water in the Colorado River is used and reused several times in municipal and agricultural water supplies before it reaches Topock, it contains compounds that may become emerging contaminants in the future. Based on data provided by MWD, compounds considered to be pharmaceutical or personal care products that have been detected in the river below Davis Dam include caffeine, carbamazepine, N,N-Diethyl-meta-toluamide (DEET), ibuprofen, 4-n-Nonylphenol, Primidone, Sulfamethoxazole, Mitotane (o,p-DDD), Methylparaben, tris(2-carboxyethyl)phosphine (TCEP), acetaminophen, and Azithromycin. As the Colorado River basin becomes more populated, many of these compounds, along with others, are expected to become more prevalent. As analytical techniques improve, additional compounds may be detected that are present but below current detection limits. Because the river provides the primary source of water for the Mojave Valley, many of the compounds present in the river water will eventually be present in groundwater, but it may take many years for them to move from the river to a nearby well. Some of these emerging contaminant compounds are not mobile in the subsurface and may never move far from the river. If fresh water were obtained from a well rather

than from the river, this travel time from the river to a well would provide a buffer that might allow for mitigation measures to be implemented prior to injecting an emerging contaminant and having it spread across the site.

3.0 Evaluation of Freshwater Sources

This section presents a description of the evaluation criteria identified in Section 1.0. These criteria are used to assess the three freshwater sources. The various analysis factors and considerations associated with each criterion are shown in Exhibit 3-1. Each of these criteria is discussed below.

EXHIBIT 3-1
Alternative Evaluation Criteria
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

Evaluation Criteria	Analysis Factors and Considerations
1. Influence of Freshwater Pumping on Remedy Performance	• Quantitative description of hydraulic effect on plume due to pumping
2. Quantity of Water Available	• Quantity of water available • Quantity of backup and contingency water supplies • Current demand of existing wells and how the current and future water demands of those wells will be met
3. Water Quality/Potential Need for Conditioning Prior to Injection	• Comparison of source water quality to target water quality • The need for conditioning of water prior to reinjection
4. Implementability Considerations (including Disturbance from Construction and Contingency)	• Significance and type of disturbance - Volume of soil disturbed, aesthetics, construction duration, new facilities - Number and size of components such as wells, pipes, access roads, treatment and support facilities - Infrastructure footprint - Ability to make use of existing facilities • Administrative requirements - Substantive permitting requirements/Approvals, access easements, compliance with ARARs and EIR mitigation measures • Maintenance requirements of facilities • Ease of replacement or redundancy, or implementation of potential contingencies • Flexibility of design - Ability to handle changes in flow and quality

3.1 Evaluation Criterion #1 -- Influence of Freshwater Pumping on Remedy Performance

Solute transport model simulations were conducted to evaluate the effects on remedy performance for pumping 600 gpm from the three freshwater sources (HNWR-1 well, hypothetical well at Moabi Regional Park, and the Colorado River). Figure 3-1 shows the general locations of the three sources. Note that the location of the river intake structure/fish screen is not relevant to the hydraulic evaluation because pumping 600 gpm of water from the river has no effect on river or groundwater levels. The results of the transport model simulations that show the effects of the different fresh water supply options on the remedy are provided in Figures 3-2 and 3-3. These figures show the Cr(VI) concentrations remaining after 30 years of remedial operations in model layers 1 and 3. (The alluvial aquifer is broken into 4 layers in the model with Layer 1 being the uppermost and Layer 4 being the deepest). As shown, there is very little observable difference between the three freshwater sources. Therefore, the choice of freshwater source between HNWR-1, Park Moabi, or the river will have negligible effects on the effectiveness of the remedy. Note that there was no attempt to optimize the remedy in these simulations. The

flow rates in the model were held constant throughout the entire 30 year active remedy period. During the application of the remedy, it is anticipated that ongoing remedial process optimization will be applied to accelerate cleanup in recalcitrant areas of the plume, shortening the overall cleanup time.

As requested by DTSC, particle tracking simulations were conducted using the flow model to evaluate the effects of the three freshwater sources on the flow field in the vicinity of the remediation area. The results of these simulations are provided in Figures 3-4 and 3-5. These figures show the flowlines emanating from the freshwater injection wells after 30 years, in model layers 1 and 3. The flowlines for the HNWR-1 option and the river intake option are very similar, indicating that HNWR-1 pumping has only a minor effect on gradients. Pumping from Moabi Regional Park, however, has a noticeable effect on the direction of groundwater flow in the western portion of the site, where flowlines are drawn toward the hypothetical pumping well. While this has negligible effects on the rate of Cr(VI) removal, it could be important if there were some objectionable characteristic in the injected water because it is likely that some of the injected water would be drawn back close to or possibly within Park Moabi by the end of the active remedial action.

3.1.1 Conclusion

Based on the solute transport model simulations, there are negligible differences between the three freshwater sources from a hydraulic perspective.

3.2 Evaluation Criterion #2 - Quantity of Water Available

As stated in Section 2.0, based on modeling, the minimum quantity of fresh water required for the remedy is 600 gpm. However, the maximum case could be as much as 1,200 gpm. For this evaluation criterion, the Colorado River is the obvious best option amongst the three sources due to its plentiful supply (for all options, PG&E has water rights in excess of the amount of water required, as set forth in Chapter 4.12 of the certified EIR). However, the following discussion provides due consideration to the Arizona and California groundwater sources and addresses comments received on the preliminary (30%) design on this topic.

3.2.1 Well or Wells in Arizona

Table 3-1 (all tables are presented at the end of this TM) lists identified wells near Topock Marina, Arizona along with their construction data (if known). Each of the identified wells is discussed below. Note that in response to comment #134 DTSC-52, PG&E performed a well search in the Arizona Department of Water Resources (ADWR) Imaged Records Database but was unable to identify any additional wells in the area beyond those which were already known. Using the Earth Point Townships layer in Google Earth, the cadastral location of the Topock Marina area was determined. This included only Quadrant B, Township 15 North, Range 21 West, Section 3, as all other surrounding property on the Arizona side were determined to belong to the Havasu National Wildlife Refuge. This cadastral location was used to conduct the well search in the ADWR database records. The ADWR database is current as of December 13, 2011, as stated on the ADWR website. Available information regarding wells and their corresponding files in the section that includes the Topock Marina were downloaded from the database and reviewed. These wells were then compared to PG&E's current database of wells in that location. No new wells existed in the ADWR database that is not already in PG&E's database. PG&E recently learned from the Topock Marina Resort that no onsite well is currently planned and that water will be purchased from an existing water purveyor. PG&E will continue to inquire about the Resort's planned water use. New information, if any, obtained will be provided.

HNWR-1 Well

HNWR-1 is a 10-inch diameter well completed to a depth of 157 feet and screened over the interval from 92 to 157 feet. The bottom 40 feet of the well is wire-wrapped screen and the interval from 92 to 116 feet is steel casing that was perforated in place after the well was built. Sand and gravel was logged from 35 to 157 feet. The only fine grained silt or clays noted were interbedded with sand in a thin zone between 75 and 82 feet. The HNWR-1 well encountered a thicker and more consistent interval of sand and gravel than has been logged in any of the wells drilled at the Topock site or at Moabi Regional Park on the California side of the river. The high production rate at HNWR-1 is consistent with the coarse grained nature of the aquifer observed in this well.

In November 2010, the HNWR tested the well for a period of 24 hours at an average flow rate of approximately 900 gpm, which resulted in a sustained pumping water level at about 80 feet below the well head. When HNWR was operating this well to provide irrigation water for the Sacramento Wash Revegetation Project, it was intermittently operated at flow rates near or slightly above 1,000 gpm. Short-term capacity testing conducted at the well during recent sampling events indicate that when utilizing the existing pump setup, a maximum pumping rate of about 1,030 gpm can be achieved with a pumping level of approximately 82 feet below the well head. The feasibility of conducting a longer-term constant-rate extraction test at HNWR-1 well is still under evaluation. PG&E is coordinating with the Refuge regarding their planned use for this well and to confirm that the well has sufficient capacity to meet this use and that of the remedy.

Topock-2 and Topock-3 Wells

The Topock-2 and Topock-3 wells are operated by Southwest Water and supply water to the compressor station, the Topock Marina, and a few other nearby customers. Topock-2 is a 140 foot deep well that was drilled in 1980 as a replacement for the original Topock-2 well. Topock-3 was drilled in 1974. It was originally completed to a depth of 250 feet but it produced poor quality water. The bottom 100 feet of the well were plugged with cement and the water quality improved. A video log of Topock-3 was conducted by ADEQ during their Topock Groundwater Study (ADEQ 2006). It showed the well casing to be heavily corroded and in very poor condition. The bottom 20 feet of the casing appears to have collapsed. The well is blocked at a depth of 127 feet. The condition of Topock 2 is unknown.

Even though it is in poor condition, Topock-3 is far more productive than Topock-2. PG&E recently conducted some short term pumping tests at Topock-2 and Topock-3 wells. The results of these tests will be included in the intermediate (60%) design. The specific capacity of Topock-2 was about 11 gallons per min per foot (gpm/ft) while the specific capacity of Topock-3 was about 30 gpm/ft. The pumps currently installed in the Topock-2 and Topock-3 wells produce about 200 gpm max each. The wells themselves may be capable of producing more, but there is a risk of collapse in Topock-3 if it is pumped at rates that would produce excessive drawdown. There is also a risk of pulling the poor quality water up from depth if the Topock-2 and Topock-3 wells were over pumped. The average concentration of arsenic in the Topock-2 well during the Topock Background Study was 12.3μg/L, similar to that in HNWR-1. The Topock-2 and Topock-3 wells do not offer any advantages over the use of HNWR-1 because there are not currently significant differences in the water quality, and there is greater uncertainty about the future water quality as well as the quantity of water available. Therefore, these wells will only be considered as a backup source for HNWR-1 and/or be used to augment the flow needed for the remedy, as applicable.

There was a request in comment #142 DTSC-55 to state the reason for why Topock-1/2 were abandoned and replaced by Topock-2/3. The reason is not known to PG&E.

MW-55 Well Cluster, Sanders, PG&E-9S (Topock Marina Area)

There is sufficient area to install a well at the Topock Marina. MW-55 well clusters had arsenic concentrations of 4.7-5.2 μg/L (from a sample collected on 4/3/2012), Cr(VI) less than 7μg/L, and manganese ranges from less than 100 to 1,230μg/L. The nearby Sanders and PG&E 9S wells both had arsenic concentrations above 30μg/L. It is considered doubtful that the aquifer at MW-55 could provide a sufficient quantity of water for the remedy. The log of MW-55 shows predominantly silt and silty sand down to a depth of 137 feet, where bedrock was encountered. So the aquifer appears to be relatively thin and predominantly fine grained in this area. Lastly, it is likely that a high capacity well at the Topock Marina would create substantial drawdown at the nearby Smith and Sanders wells, and possibly limit those well owners ability to pump water. As mentioned above, PG&E recently learned from the Topock Marina Resort that no onsite well is currently planned and that water will be purchased from an existing water purveyor. PG&E will continue to contact the Topock Marina Resort to inquire about their planned water usage. New information, if any, obtained will be provided.

Using a well from the Topock Marina area does not offer any advantages over the use of HNWR-1 because there is greater uncertainty about the quantity of water available. Therefore, a well in this area is not considered further as an alternative for using a well or wells in Arizona as the freshwater supply source.

MW-54 Well Cluster

The MW-54 well cluster is located on the peninsula that separates the river channel from the Topock Marsh. The aquifer at MW-54 is predominately coarse grained and would appear to be potentially capable of providing a sufficient quantity of water. However, the water quality at MW-54 is poor. TDS is over 12,000 mg/L in the deep well (MW-54-195) and over 6,000 mg/L in the shallow MW-54-85 well. The average TDS from all three MW-54 wells is about 8,800 mg/L. If this water were used as fresh water for the Topock remedy, a large area of the aquifer beneath the Topock site would become non-potable due to high TDS for many decades after the chromium was removed. All three of the wells in the MW-54 cluster contain significant concentrations of dissolved iron and manganese, which would require pre-treatment prior to use in an injection well. The location of MW-54 is also problematic. To access to this area by road requires crossing the river at Needles, then driving south along the dike road through the refuge. The last several miles are on an unimproved dirt road. Drive time from the Topock Compressor Station is over an hour. To provide piping and power to the MW-54 location within the boundaries of the Project Area would require boring under the Colorado River or under the outlet to the Topock Marsh. The MW-54 area is also close to sensitive habitat, so there might be seasonal restrictions on some types of activity such as drilling and well maintenance during nesting seasons. Lastly, drawdown from pumping fresh water near MW-54 might adversely affect the ability of the river bank wells to provide capture for the chromium plume on the floodplain. MW-54 is just across the river from the floodplain extraction wells and there would undoubtedly be interference. Because of the significant disadvantages associated with a well from the MW-54 area, a well in this area is not considered further as an alternative for using a well or wells in Arizona as the freshwater supply source.

Conclusion for Arizona Groundwater Option

Based on the considerations described above for the available well options near Topock Marina, Arizona, it is unlikely that there is a suitable location within or even close to the Project Area on the Arizona side of the river where PG&E could construct a well that would provide a sufficient quantity of groundwater of suitable quality for injection without pretreatment and with arsenic concentrations much lower than at well HNWR-1. Well HNWR-1 appears to be the best option for a groundwater supply within or close to the Project Area in Arizona. As a result, the evaluation presented in this TM includes the HNWR-1 well as the source of fresh water from Arizona.

3.2.2 Well or Wells in California

Table 3-1 provides a listing of water wells, test boring, and infiltration gallery in or near Moabi Regional Park and their construction data (if known). As shown in Table 3-1, of the 6 wells or test borings drilled at Moabi Regional Park, only 2 were able to produce more than 100 gpm. In hopes of finding a better supply with better quality, Moabi Regional Park commissioned LeRoy Crandall and Associates to conduct an evaluation of the water supply options in 1986. Three reports are available that document this evaluation. The first report provides a summary of the available data on the groundwater conditions at the park (Crandall 1986a). The second report documents the results of an exploratory drilling program consisting of collection of geologic information and depth specific groundwater samples from three exploratory boreholes (Crandall 1986b). The third report documents the construction and testing of well PM-03, one of the two supply wells currently in use at the park (Crandall 1986c). All three Crandall reports are included in Attachment A of this TM.

Based on the available data from the driller's log, former well PM-01 was tested at a flow rate of 300 gpm with a specific capacity of about 16 gpm/ft. Well PM-01 was used for several years, but reportedly produced water with a TDS concentration of 3,000 mg/L. Former well PM-02 was tested at 430 gpm but there was no record of the drawdown so no estimate of specific capacity could be made. Both of these two wells had mineralized water. The water from well PM-02 was so saline that it was considered unusable and the well was apparently never put into production (Crandall 1986a).

The wells currently in use at Moabi Regional Park (PM-03 and PM-04) produce water with lower mineral content, but at rates of only 40 to 60 gpm. Attempts were made (by parties other than PG&E) to develop water supplies at two other locations near Moabi Regional Park. An exploratory boring was installed (by parties other than PG&E) south of the park entrance, near the present day location of the Moabi Regional Park water storage tank (along

Park Moabi road about 500 feet north of Interstate I-40). This boring was extended to a depth of over 500 feet but produced only a small volume of water and was never completed as a well. Another well was drilled about a half mile west of Moabi Regional Park to supply water for the construction of I-40. This well reportedly produced less than 5gpm (Crandall 1986a). Based on this information, the capacity of the aquifer to support a 600 gpm well in the areas south or west of Moabi Regional Park appears doubtful. Wells previously drilled within Moabi Regional Park have produced as much as 430gpm, however these high-volume wells have exhibited relatively high mineral content. Wells that have produced better quality water in or near the park have exhibited low pumping capacity.

The conceptual model expressed by LeRoy Crandall and Associates is that "the best quality ground water in the vicinity of the Park occurs in the shallow alluvial deposits that traverse a large portion of the Park, and extend southwesterly toward the Chemehuevi Mountains" (Crandall 1986a). Apparently, the higher quality water that is presently used at Park Moabi is limited to a relatively thin subsurface zone. Existing wells completed in this zone of higher-quality water cannot sustain rates of more than about 70-80 gpm.

DTCS asked whether it would be possible to install multiple wells at Moabi Regional Park to obtain the necessary capacity for the remedy. It might be possible to get an adequate quantity of water from two or more wells, however these wells would need to be located far enough apart to avoid interference with each other. The separation distance would depend primarily on the transmissivity of the aquifer. Based on the transmissivity estimates currently in the model (5,700 gpd/ft), two wells pumping 275 gpm each and screened across the upper 200 feet of the aquifer would need to be at least 1,000 feet apart to minimize interference effects. This would result in more than 100 feet of drawdown at each well. The drawdown created by these two hypothetical wells could also affect the ability of Moabi Regional Park to obtain adequate amounts of water from their existing wells.

There was a suggestion that hydraulic data be collected from former wells PM-01 and PM-02 due to their higher yields (#142 DTSC-55). The location of the PM-02 well is unknown (Crandall 1986a). During a subsequent 1986 investigation, LeRoy Crandall and Associates reported that the bottom 90 feet of the PM-01 well was cemented shut in an attempt to improve the water quality in the well (Crandall 1986b). After cementing, PM-01 was only open to a depth of 100 feet below surface. The report does not mention what effect this had on the capacity of the well, but it had relatively little effect on water quality. The current condition or even existence of the PM-01 well is unknown. Therefore, it is not clear what an aquifer test at PM-01 would determine, particularly because the well is likely in poor condition due to age and disuse and has been partially cemented shut.

In comments on the 30% design report (#142 DTSC-55), DTSC requested that the best place for a water supply well in California be identified. Because it appears the aquifer at Moabi Regional Park would not be able to supply a sufficient quantity of good quality water to simultaneously meet the needs of the remediation project and the Park, the best location for a production well would likely be outside the APE to the north or northwest. Based on current understanding of the geology and water quality at the Topock site, there is little possibility that a well with sufficient capacity and quality could be located between Moabi Regional Park and the Compressor Station, so it would need to be located further away. The presence of the Bouse formation is considered a limiting factor for both quantity and quality of water in the Needles area (Metzger and Loeltz 1973). The Bouse contains brackish water and generally does not yield large quantities of water. The Bouse overlies the Miocene Fanglomerate and older alluvium, neither of which is considered likely targets for large capacity, high quality wells. Drilling through the Bouse in hopes of finding better quality below is not likely to be successful. The best chance of finding a high capacity well with low TDS is in a location where the Bouse formation has been eroded away and the channel has been backfilled with a coarse sequence of recent sand and gravel. The erosion of the Bouse formation occurred in drainages when sea level was lowered during the ice ages. If a sizeable gravel-filled paleo channel in the Bouse can be located, a well completed in it might be able to provide sufficient quantity and quality for the remedial action.

The Bouse formation outcrops at the surface just north of Moabi Regional Park. It was also encountered in all of the Park Moabi wells. It is therefore unlikely that a large paleo channel exists between Moabi Regional Park and the surface outcrop to the north. For that reason, the best place to prospect for a water supply well appears to be in the next drainage to the north of Park Moabi. This is a sizeable drainage with no surficial outcrop of Bouse present. The Bouse may have been eroded beneath this wash, and the paleo channel may have been filled with

sand and gravel rather than clay and silt. The proposed locations for 4 exploratory borings in this wash are shown on Figures 3-6 and 3-7. There no known existing wells in this area. The closest known well is the California Ag Station well, which is between 1 and 2 miles from any of the proposed well locations. Exploratory drilling would be required to determine whether any of the locations to the north of Park Moabi could yield a sufficient quantity and quality of water for the remedy.

Conclusion for California Groundwater Option

Written reports produced by Moabi Regional Park's consultant, LeRoy Crandall and Associates, present a conceptual model that states "the best quality ground water in the vicinity of the Park occurs in the shallow alluvial deposits that traverse a large portion of the Park, and extend southwesterly toward the Chemehuevi Mountains". Existing wells completed in this zone of higher-quality water cannot sustain rates of more than about 70-80 gpm and Crandall concluded that higher pumping rates from the existing PM-03 well would likely result in degradation of water quality as poor quality water was drawn vertically up from below or laterally in from near the river.

Another consideration in determining new extraction well location is compliance with EIR mitigation measure (WATER-1), which requires no substantial effects on production rates of existing nearby wells. Using a simple Theis analysis based on the transmissivity in the groundwater model, a well pumping 600 gpm at Park Moabi would produce 25 feet of drawdown at a radius of 2,500 feet. It is therefore unlikely that a high capacity well within Park Moabi could demonstrate compliance with mitigation measure WATER-1.

Based on available data, it appears unlikely that a well or wells could be sited within the APE in California that would supply an adequate quantity of water for the remedial action while insuring the protection of the quantity and quality of water from the existing wells at Moabi Regional Park.

3.2.3 Conclusion

For criterion #2 (Quantity of Water Available), the Colorado River is the obvious best option amongst the three sources due to its plentiful supply. Without additional exploratory drilling in California, the Arizona groundwater option (existing HNWR-1 well) is more favorable than the California option (Moabi Regional Park wells). As previously mentioned, PG&E is coordinating with the Refuge on the demand for water from the HNWR-1 well and to confirm the well capacity to meet this and other needs (note that Topock-2 and -3 wells can be used to augment the flow needed for the remedy, as applicable). The necessity for and feasibility of a longer-term constant-rate extraction test at HNWR-1 well is still under evaluation at this time.

3.3 Evaluation Criterion #3 - Quality of Water/Potential Need for Conditioning of Water Prior to Injection

This criterion evaluates and compares the three freshwater sources from a water quality perspective and the potential need for conditioning prior to injection.

3.3.1 Well or Wells in Arizona

Table 3-1 summarizes the available data from wells near Topock Marina, Arizona and each of these wells (HNWR-1, Topock-2/3, MW-54/MW-55 Well Clusters, Sanders, and PG&E-9S) is discussed below.

HNWR-1 Well

Table 3-2 presents the HNWR-1 well sample results collected since November 2010. Based on data collected to date, arsenic is the only compound that exceeded an MCL. A discussion about this naturally occurring arsenic (in Topock, Arizona) and the fate and transport modeling is presented below. TDS, total dissolved chromium, and hexavalent chromium are also discussed.

Arsenic

As shown in Table 3-2, arsenic is present in HNWR-1 at concentrations ranges from 15 to 16µg/L, below the site background level of 24.3µg/L (CH2M HILL 2009b). The naturally occurring arsenic concentration exceeds the MCL of 10µg/L, which is typical of water quality in water supply wells in the vicinity of Topock, Arizona. This water is

likely the result of a hydrothermal source to the east and its elevated temperature (95-97 °F). Elevated arsenic concentrations are commonly associated geothermal waters (Hem 1986). Temperatures up to 100 degrees F were noted in the water from the Topock-2 and-3 wells during the Topock Groundwater Background Study. Average arsenic concentration in Topock-2 was about 12µg/L, based on the six samples collected for the Background Study. Water at a temperature of about 115 degrees F was encountered in well MTS-2 at the Mohave Topock Compressor Station, about a mile northeast of the HNWR-1 well, during the Topock Groundwater Study (ADEQ 2006). ADEQ did not analyze the samples from MTS-2 for arsenic. However, ADEQ did conduct a study of the ambient groundwater quality in the Sacramento Valley Groundwater Basin (immediately east of the Mohave Valley basin where the Topock Site and HNWR-1 are located) and found the average arsenic concentration to be about 14 µg/L, similar to that in HNWR-1 (ADEQ 2001). Based on all available information, arsenic in HNWR-1 and nearby wells is the result of natural conditions in the Sacramento Valley. Figure 3-6 shows the average arsenic concentrations in wells sampled as part of the Topock Background Study.

Figure 3-8 shows the maximum arsenic concentrations in wells at the Topock site. In the upland area near the planned freshwater injection wells, arsenic concentrations are generally less than 5µg/L, however arsenic has been detected at concentrations between 5.2 µg/L and 14.4µg/L in the vicinity of the current IM-3 injection wells. Elsewhere across the Topock site it is not unusual to find arsenic concentrations above the MCL of 10 µg/L. Concentrations similar to or above the 15 µg/L measured in the HNWR-1 well have been observed in wells near the river, bedrock wells, and near the current evaporation ponds. Thus, the concentration of arsenic in water from HNWR-1 is within the range of arsenic concentrations found at the Topock site and well below the background concentration of 24.3µg/L.

Model simulation of HNWR-1 water injection into California was performed to evaluate the fate and transport of arsenic over time. Geochemical modeling was done with the same simplified PHAST model described above, along with the current site transport model (MODFLOW/MT3D/PHT3D) have shown that arsenic concentrations above the MCL of 10µg/L would be limited to areas within a few hundred feet of the injection wells during the course of the remedy (Figures 3-9 and 3-10). This is due to the abundance of iron oxide minerals in the aquifer matrix in California. Amorphous iron oxide mineral concentrations used in the model were based on measured concentrations from the Aerobic Core Study (CH2M HILL 2005a) and the *in situ* pilot studies conducted by ARCADIS at Topock. Modeled arsenic adsorption to these iron oxides was based on published arsenic adsorption constants on iron oxides contained in the PHREEQC database (Parkhurst and Appelo, 1999; Dzombak and Morel, 1990). Following the end of active remediation, the model simulations predict that the remaining “halos” surrounding the injection wells are dispersed and adsorbed to downgradient iron oxides (Figures 3-11 and 3-12). In summary, although the arsenic in the HNWR-1 well source is above the MCL, transport modeling predicts that the arsenic will not be mobile in the environment surrounding the proposed injection wells and will attenuate under site conditions and return to pre-remedy baseline levels after the end of active remediation.

There was a comment as to why dissolved arsenic is stable in aerobic waters withdrawn from well HNWR-1, but would become unstable when injected into aerobic waters in California (#147 DTSC-60). The most likely explanation is that iron oxide minerals, effective adsorbers of arsenic, are undoubtedly present in the aquifer matrix in Arizona, however, long-term exposure to the groundwater with naturally occurring arsenic has saturated all the adsorption sites on these minerals. There are a finite number of adsorption sites for matrix minerals, and if the groundwater has excess concentration of an adsorbing constituent (such as arsenic), then the matrix minerals and groundwater will form an equilibrium state, with the adsorption sites at capacity (Schindler 1991, Stumm 1992). By contrast, groundwater on the California side of the river does not have a similar hydrothermal source, and has markedly lower arsenic concentrations in the oxidized portions of the alluvial aquifer. Arsenic in areas surrounding the proposed injection is generally below 10 µg/L. The iron oxides in these areas are not saturated with arsenic, and may act as effective adsorbers where arsenic is introduced.

The potential well fouling associated with arsenic in HNWR-1 water was also evaluated (#147 DTSC-60). Arsenic from the proposed fresh water source is geochemically favored to adsorb to iron oxide minerals present throughout the alluvial aquifer matrix. Based on measured concentrations of iron oxides from core samples and published geochemical relationships for arsenic adsorption (Dzombak and Morel, 1990), the injected arsenic is not

expected to persist in groundwater more than a few hundred feet away from the injection wells. The adsorption occurs via a chemical bond between the negatively charged arsenate ion to positively charged sites on the iron oxide surface. There are a finite number of such sites on each iron oxide crystal, so when those sites are saturated with arsenate ions, newly introduced arsenate will travel to the next available crystal with open sites. This results in a thin layer of adsorbed arsenate ions on the surface of the iron oxide in aquifer matrix. Because it is an adsorption reaction and not a precipitation reaction, there is no solid phase being formed that would preclude the movement of water through the pores of the aquifer matrix. The thin layer of arsenic ions sorbed to the iron oxide would not measurably change the effective porosity of the aquifer.

Evaluation of water from areas with lower arsenic outside the influence of hydrothermal activities

There was a concern about injecting HNWR-1 water because it contains chromium above the localized concentrations in the upland injection wells and arsenic level above the MCL of 10 µg/L (#134 DTSC-52). DTSC has requested that areas with lower arsenic outside the influence of hydrothermal activities also be evaluated for freshwater supply (#146 DTSC-59).

Figure 3-6 shows the distribution of arsenic in wells sampled in Arizona and California. The geothermal conditions on the Arizona side of the river are likely associated with the recent volcanic activity that formed the Black Mountains. It is noteworthy that the wash to the north of Sacramento Wash is named Warm Springs Wash. This wash flows directly out of the Black Mountains about 1.5 miles north of the Sacramento Wash. The extent of the geothermal area is not well defined. Temperature data from wells included in the Topock Background Study were provided in the Step 2 Background Study Report (CH2M HILL 2005b). The warmest wells sampled in the Background Study were Topock-2 and Topock-3 with temperatures around 100 degrees F. The third warmest well was TMLP-2, with a temperature of about 93 degrees F. TMLP-2 is located more than 5 miles up the Sacramento Wash from Topock-2 and Topock-3. Three of the Golden Shores wells had temperatures above 90 degrees F, suggesting that geothermal effects may extend to several miles to the north as well as east from Topock.

If it becomes necessary to develop a water supply from a well in Arizona other than HNWR-1, it would likely be from a well outside the APE to the north. There are two wells north of HNWR-1 for which some information exists. Well GSRV-2 is located along Highway 95 just south of Warm Springs Wash, approximately 1.6 miles north of HNWR-1. Approximately 0.4 miles further to the north along Highway 95 is the Serrano landscaping well. Figures 3-6 and 3-7 show the locations of these wells. Based on the well logs for these wells provided in the ADEQ report (ADEQ 2006), the geology in this area appears to be favorable for a high capacity well, with sand gravel logged down to a depth of about 250 feet. The capacity of the existing GSRV and Serrano wells has not been assessed. Without data on the aquifer properties, pumping rates, and pumping water levels in the GSRV-2 and Serrano wells, it is not possible to predict whether a new production well to supply the remedy would have adverse effects on the existing Serrano wells.

The water temperature in GSRV-2 was about 88 degrees F, indicating it may be mildly affected by geothermal conditions. This well was sampled 7 times during the Topock Background Study. At the direction of DTSC, one of these samples was excluded for the purposes of calculating background statistics. Although, this sample was excluded from the background calculations, it represents a valid sample result and should therefore be considered in the freshwater source evaluation. Based on the 7 available samples, the mean arsenic concentration was 5.6 µg/L, which is considerably lower than HNWR-1. The maximum and average Cr(VI) concentrations were 38.6 and 27.1 µg/L, respectively. Based on the results from GSRV-2, it is possible that a water supply well near GSRV-2 could produce Cr(VI) in excess of the established background for the Topock site. The Serrano well was sampled during the ADEQ Topock Groundwater Study (ADEQ 2006) and contained Cr(VI) at 26.2 µg/L. ADEQ did not analyze for arsenic. Both GSRV-2 and Serrano wells are located near or within Warm Springs Wash. The elevated Cr(VI) in area may be associated with the volcanic rocks in the recharge area for these wells, along the channel of Warm Springs Wash and in the Black Mountains to the east.

Exploratory drilling would need to be conducted in order to evaluate the quantity and quality of water that could be provided by a new production well to the north of HNWR-1. Some preliminary potential locations for exploration boreholes are show on Figures 3-6 and 3-7. These locations have not been field checked and property ownership has not been determined. The southernmost location is about 0.6 miles north of HNWR-1. The

northernmost is about 2 miles, by road. If wells were developed in these locations, piping would need to be extended to these locations.

Total Dissolved Solids (TDS)

Well HNWR-1 produces water with TDS (about 500 mg/L) lower than the Colorado River (about 680 mg/L). There was some concern initially that the low TDS of HNWR-1 water may have the potential to cause diminished injection productivity and aquifer plugging. A geochemical model simulation was performed using the U.S. Geological Survey's PHAST code (Parkhurst et al., 2010), in which injection of water chemistry from HNWR-1 (the lower TDS of the two waters) into the alluvial aquifer was simulated in a simplified model. The purpose was to calculate the mass of salts that would be re-precipitated at various distances from the injection well, and assess whether the volume of this mass would block a significant portion of the aquifer porosity. The simulation showed that less than one percent of the available porosity was blocked by re-precipitation. This was considered to be insignificant from a water production standpoint. These results were expected, since the native groundwater in the freshwater injection area is undersaturated with respect to gypsum and anhydrite, the calcium sulfate minerals that are most often associated with this mechanism of production loss through re-precipitation. The undersaturation indicates that gypsum is either absent or in negligible quantity in the aquifer matrix.

According to Bradley Guay of the U.S. Army Corps of Engineers (USACE), who supervised the installation and testing of HNWR-1 and authored a PhD dissertation titled "Hydroglogic Investigation of Topock Marsh," the isotopic signature of the water from HNWR-1 is more similar to other wells further up Sacramento Wash than to the Colorado River (personal communication between Bradley Guay and other representatives of DOI and representatives of PG&E, November 19, 2010). At present, it appears that HNWR-1 does not draw a lot of water from the river, but rather intercepts groundwater moving down the Sacramento Wash. This conclusion is also supported by the fact that the temperature of the water pumped from HNWR-1 is 95-97 degrees F, much warmer than the water in the river.

The estimated volume of groundwater to be moving down Sacramento Wash is about 100 acre-feet per year, or approximately 60 gpm. Thus, there is likely not enough water being provided by the Sacramento Wash drainage to supply the minimum 600 gpm needed for the remedy. It is likely that HNWR-1 would draw increasing amounts of water from the Topock Marsh over time. There are no wells between HNWR-1 and the marsh, so the groundwater quality in this area is unknown. Similarly, it is not known how far below the bottom of HNWR-1 the high TDS water lies. It is therefore not possible to predict what changes might occur in water quality at HNWR-1 over time with any degree of certainty. It is likely that the TDS will increase as more river water is pulled in.

Total Dissolved Chromium and Hexavalent Chromium

Based on data collected to date, HNWR-1 well contains about 16-19.2 μg/L total dissolved chromium and 15-18 μg/L Cr(VI), both below the site background levels for chromium of 34.1 μg/L and Cr(VI) of 31.8 μg/L (CH2M HILL 2009). The total chromium level is also below the MCL of 50μg/L.

There was a comment that the HNWR-1 well should be noted that it exhibits a Cr(VI) concentration about double PMM-Supply (#145DTSC-58). PMM-Supply is PM-03. The level of Cr(VI) in PM-03 ranges from 0.23 μg/L (in a sample collected in 2003) to 12 μg/L (in a sample collected in 2010) (Table 3-3 and PG&E 2012). While the Cr(VI) level in HNWR-1 is higher than PMM-Supply (or PM-03), it cannot be stated that the level in HNWR-1 well is double that in PMM-Supply, as suggested in the comment. In fact, Cr(VI) level in Moabi Regional Park water supply well PM-04 (13 to 21.4 μg/) is slightly higher than HNWR-1 (Table 3-3 and PG&E 2012). These levels are consistent with the range of concentrations found in other Topock area wells that contain naturally occurring ("background") chromium concentrations. See Section 3.3.2 for additional discussion on water quality for Moabi Regional Park wells.

Topock-2/3 Wells

As shown in Table 3-1, Topock-2/3 wells contain TDS of 800-900 mg/L, Cr(VI) of 7-11 μg/L, and arsenic of 12-14 μg/L. Manganese in Topock-2 averages around 3.1 μg/L. Similar to HNWR-1 well, the arsenic level in these wells is also above the MCL of 10 μg/L.

MW-55 Well Cluster, Sanders, PG&E-9S (Topock Marina Area)

There is sufficient area to install a well at the Topock Marina. MW-55 well had arsenic concentration of 4.7-5.2 μg/L (from a sample collected on 4/3/2012), Cr(VI) less than 7μg/L, and manganese ranges from less than 100 to 1,230μg/L. The nearby Sanders and PG&E 9S wells both had arsenic concentrations above 34 μg/L and manganese above 99μg/L.

MW-54 Well Cluster

The MW-54 well cluster is located on the peninsula that separates the river channel from the Topock Marsh. The aquifer at MW-54 is predominately coarse grained and would appear to be potentially capable of providing a sufficient quantity of water. However, TDS at MW-54 is over 12,000 mg/L in the deep well (MW-54-195) and over 6,000 mg/L in the shallow MW-54-85 well. The average TDS from all three MW-54 wells is about 8,800 mg/L. If this water were used as fresh water for the Topock remedy, a large area of the aquifer beneath the Topock site would become non-potable due to high TDS for many decades after the chromium was removed. Arsenic at MW-54 ranges from non-detect to 4.5μg/L. All three of the wells in the MW-54 cluster contain significant concentrations of dissolved iron and manganese, which would require pre-treatment prior to use in an injection well.

Conclusion for Arizona Groundwater Option

Based on the information presented above, naturally occurring arsenic levels in past and current water supply wells (HNWR-1, Topock-2/3, Sanders, and PGE-9S) are all above the MCL. Arsenic data from existing monitoring well clusters (MW-54 and MW-55), though limited, are below the MCL. Cr(VI) in both supply and monitoring wells are well below the Topock site background level of 31.8 μg/L. TDS is low in all wells, with the exception of MW-54 clusters.

With regard to arsenic level above the MCL, transport modeling predicts that the arsenic will not be mobile in the environment surrounding the proposed remedy injection wells and will attenuate under site conditions and return to pre-remedy baseline levels after the end of active remediation. Therefore, it is PG&E's assessment that treatment of arsenic is not needed. Monitoring will be implemented during remedy implementation to verify the modeling results and adjustments will be made as needed. Potential contingency actions include adding ex-situ arsenic treatment or switching to another source (see Section 3.4).

At DTSC's request, the following discusses potential options to reduce arsenic in HNWR-1 water from 15μg/L to less than the MCL of 10μg/L, prior to injection. For the purpose of this discussion, it is assumed that the arsenic would be reduced to 5μg/L. The target concentration of 5μg/L was selected to provide a factor of safety below the MCL.

Potential Options for Reducing Arsenic Concentrations in HNWR-1 Water Prior to Injection

Blending with water sources with lower arsenic (River water, Moabi Regional Park well water)

River water has low concentrations of arsenic – using data provided by MWD (January 2008-April 2011) – the average value from this data set is 2.7 μg/L, with a maximum of 3 μg/L. If the maximum arsenic value is assumed, a blending ratio of 5 to 1 of river water to HNWR-1 water is required to produce a blended stream with 5μg/L arsenic. Because the blended water will be overwhelmingly dominated by the river water, the treatment considerations and footprint required for this option are essentially the same as they would be for conditioning of the river water (see Section 3.3.3, Colorado River). Therefore, this blending option does not offer any advantages over obtaining all the water from the river. In fact, blending will require additional infrastructure (piping and power to HNWR-1) and create additional disturbance that are not needed.

There is limited, current arsenic data for the Moabi Regional Park water supply wells (PM-03 and PM-04). Available data showed low levels of arsenic ranging from ND to 2μg/L, similar to or lower than the arsenic in the river water. If the maximum arsenic value is assumed, a blending ratio of 5 to 1 or higher of Moabi Regional Park well water to HNWR-1 water is required to produce a blended stream with 5μg/L arsenic. Because the blended water will be overwhelmingly dominated by Moabi Regional Park well water, the treatment considerations and

footprint required for this option are essentially the same as they would be for the California option (see Section 3.3.2, Well or Wells in California). In addition, it is doubtful that adequate volume of water could be obtained from the relatively thin zone of higher quality water tapped by PM-01 and PM-04. Arsenic concentrations from a hypothetical high capacity well at Park Moabi are unknown. Therefore, this blending option does not offer any advantages over not blending. In fact, blending will require additional infrastructure and create additional disturbance that are not needed.

***In situ* arsenic treatment**

At DTSC's request, PG&E has reviewed a Scientific Investigations Report published by the USGS regarding a possible method for *in situ* treatment of arsenic (USGS 2010). This report documents a pilot scale test of an experimental *in situ* arsenic removal technology. The technology involves several above ground treatment steps that are similar to conventional arsenic treatment; however the actual arsenic precipitation occurs in the aquifer. The principal advantage of the technology over conventional above-ground treatment is the absence of a solid waste stream from the iron/arsenic precipitation process. Because much of the treatment is above ground, the footprint of this *in situ* technology could be similar to a conventional above-ground arsenic removal process. In addition, depending on how the technology was applied, there would either be a need for several more injection wells near the HNWR-1 well, or the life of the remedy freshwater injection wells could be shortened.

During the first USGS test, the injection wells plugged within an hour. In the second test, the injection wells plugged within 3 to 4 hours and the filters needed to be backwashed every 30 minutes. The cause of this plugging was suspected to be air entrainment. The USGS report noted that: "Switching injection or air-lifting among wells and filters may alleviate many problems; however, the maintenance of such a system may be substantial."

The process tested by the USGS involves several steps. First, the water is aerated, which was accomplished through airlift pumping in the USGS test. Air lift pumping would not be practical at the 600 to 1,200 gpm design flow rates required in the final remedy, so the aeration step would be done after the water was pumped from the well. Following aeration, chlorine was added to further oxidize the arsenic. Then the water was passed through carbon filters to remove the chlorine. Next, hydrochloric acid was added to reduce the pH to 5.5. In the last step just prior to injection, ferric chloride was added. The low pH of the water was necessary in order to prevent the ferric iron from precipitating until the water moved out of the injection well bore and into the surrounding aquifer. Under the normal pH of the water at Topock, ferric iron will precipitate in a matter of minutes when oxygen is present. Arsenic is removed through co-precipitation with the ferric iron in the aquifer near the injection wells.

The USGS pilot test was designed to control arsenic in a production well by injecting iron in nearby injection wells and creating an *in situ* remediation zone (IRZ) around the pumping well. If PG&E were to apply this technology in the same way at Topock, it would involve installation of three or four injection wells in the vicinity of HNWR-1. A portion of the water pumped from HNWR-1 would be passed through an aboveground treatment facility and returned to the aquifer in the injection wells. A process flow diagram for this is provided in Exhibit 3-2. In theory, only a fraction of the water pumped from HNWR-1 would need to be returned to the aquifer near the well to maintain the IRZ, however the USGS paper does not provide enough data to estimate what that fraction would be. Additional water quality and process analysis and a pilot test would be needed to develop operational parameters for the application of this experimental technology at HNWR-1. The size of the above ground treatment plant needed at HNWR-1 would be dependent on the amount of water that needed to be treated and returned to the injection wells.

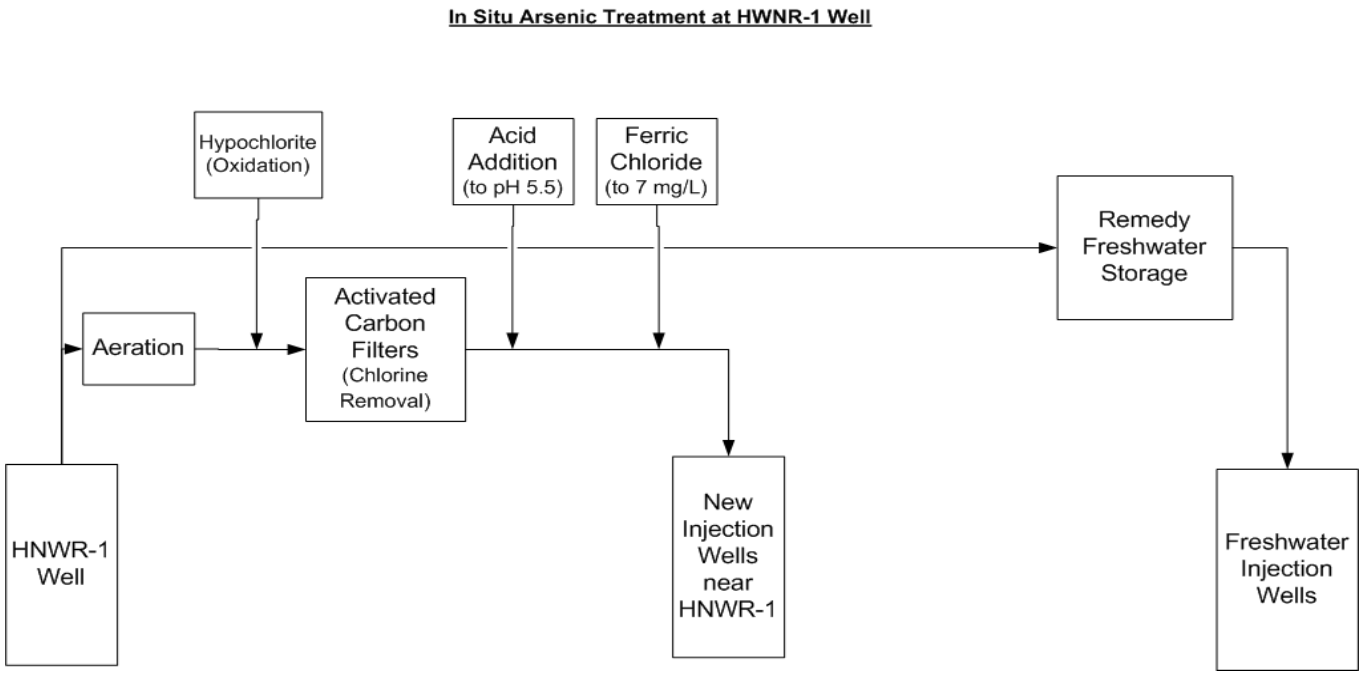


EXHIBIT 3-2
HNWR-1 Source with In Situ Arsenic Treatment at HNWR-1 Well
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

Rather than trying to treat the water being produced by HNWR-1, it might be possible to apply this technology by treating the water prior to injection in the freshwater wells. A process flow diagram for this application is provided in Exhibit 3-3. The disadvantage of treating injected water rather than maintaining an IRZ around HNWR-1 is that it would require treatment of the full 600 to 1,200 gpm of freshwater flow. The footprint for the above ground components of the *in situ* arsenic treatment plant would be similar to the footprint for conventional above-ground arsenic treatment. In addition, the *in situ* treatment scheme presents a risk to the injection wells. Well plugging could occur through air entrainment or iron precipitation in the well bore. If the pH adjustment system ever failed, the injection wells could be plugged in a matter of hours. Even if the system functioned perfectly, injecting 7 mg/L of iron would plug about 8 percent of the aquifer pore space within a 10 foot radius of the injection wells over the 30 year design life of the remediation system. This could have an adverse effect on injection rates over time. The low pH necessary to prevent iron precipitation in the injection wells might cause accelerated corrosion of pumps, valves, and other components or it might result in adverse geochemical reactions in the aquifer, such as dissolution of other metals. Further analysis would be needed to determine if this *in situ* approach of injecting low pH water containing iron would be feasible for the Topock freshwater injection wells.

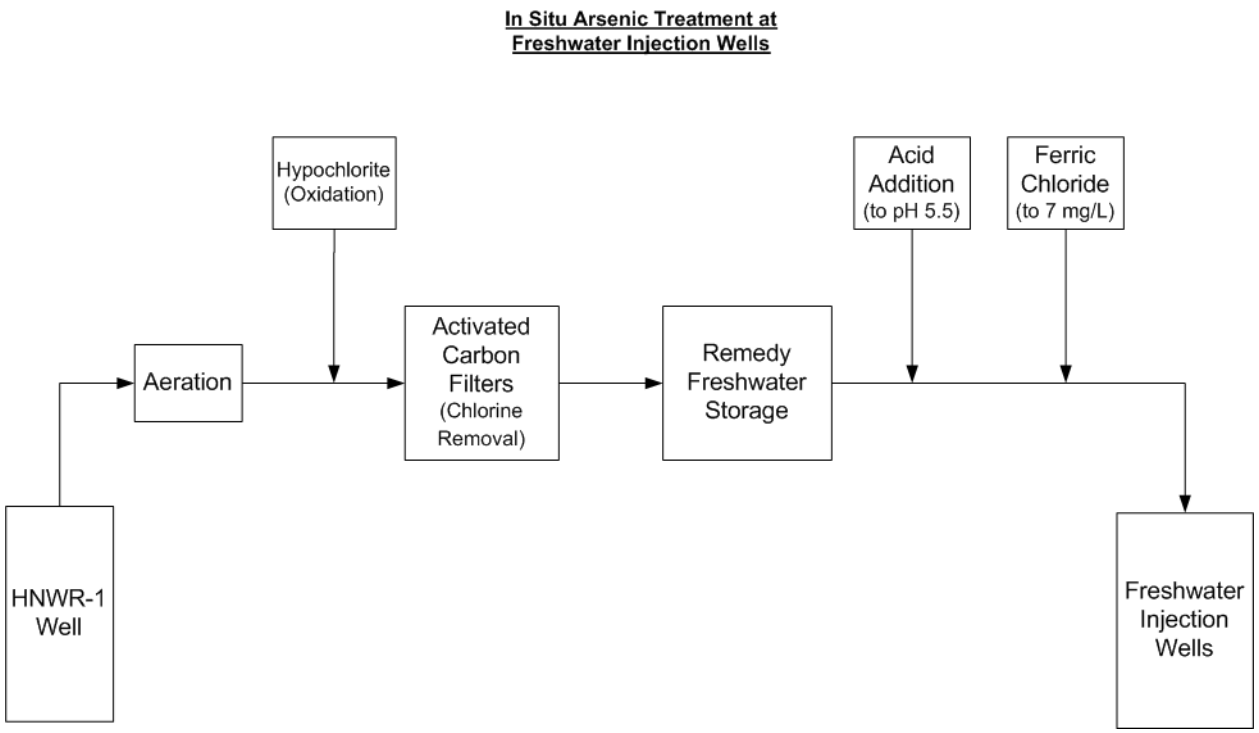


EXHIBIT 3-3
HNWR-1 Source with In Situ Arsenic Treatment at Freshwater Injection Well(s)
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

Overall, the experimental *in situ* approach described in the USGS report does not seem to have any significant advantage over conventional arsenic treatment technology for the Topock remediation project. In addition, because it is an experimental technology, pilot testing would likely be required to determine feasibility and develop design parameters prior to implementation.

Ex-situ arsenic treatment

The treatment process included is to use coagulation followed by media filtration. To optimize the process, hypochlorite will be added 30 to 60 seconds prior to the addition of ferric chloride. The process is shown schematically in Exhibit 3-4.

Filtered water would be pumped to the existing freshwater tanks and from there flow by gravity to the TCS for process and non-potable use and to the injection wells. The filters would be backwashed periodically and the backwash flow would be sent to a tank (“Decant Tank”) to decant the solids. Solids would be accumulated and then vacuumed out of the decant tank. These solids would be taken to the Produced Water Conditioning System liquid phase separators and disposed of offsite with the Produced Water solids. Water from the decant tank would overflow and be re-processed through the filtration system. More than 90 percent of the water can be recycled this way thereby reducing water use. Filter media is permanent and requires no regeneration or treatment.

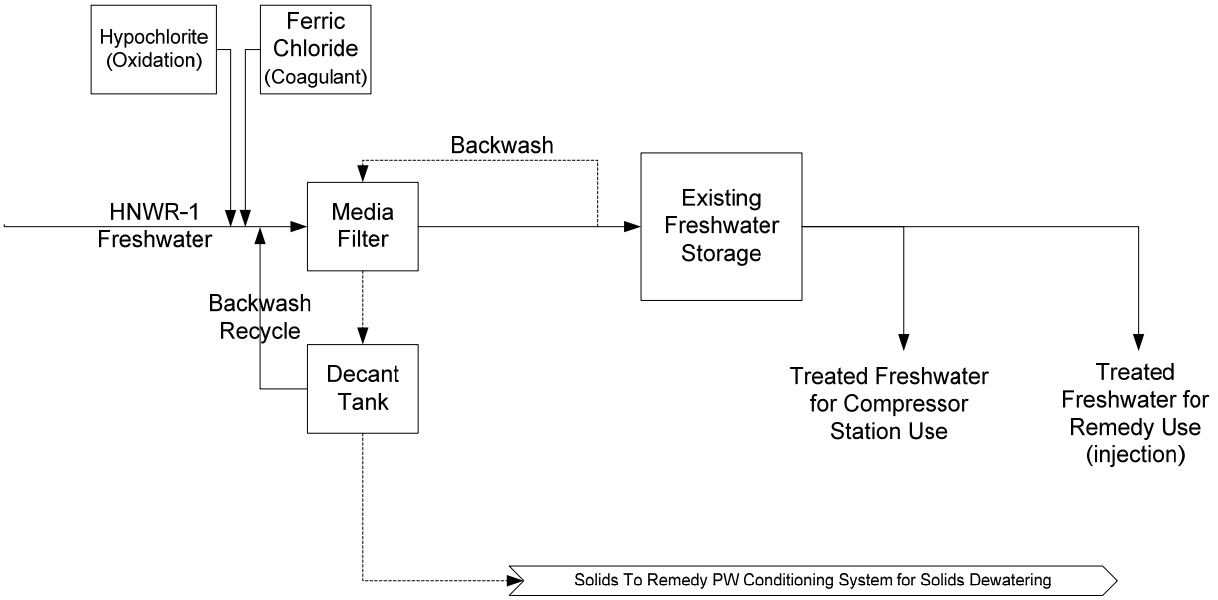


EXHIBIT 3-4
HNWR-1 Source with Ex-Situ Arsenic Treatment Process Schematic
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

Major equipment would include the following:

- Filters with manganese dioxide filter media in pressure rated housings complete with piping, automated valves for diverting flow from treatment to backwash modes.
- Process pumps for filter feed, backwash, decant water.
- Decant tank (cone-bottom tank) for backwash water storage and solids settling
- Chemical storage tanks and metering pumps for sodium hypochlorite (12.5 percent strength) and ferric chloride (35 to 45 percent strength)
- A pipe reactor would be built to allow sufficient hypochlorite mixing time before filtration.

The arsenic treatment system would be constructed at the TCS on a new concrete foundation with a building and partially sided roof structure (sunshade) for outdoor equipment like chemical storage. The footprint is estimated to be 2,000 square feet. For this assessment, it was assumed that the entire freshwater stream would receive arsenic treatment. In a more detailed design analysis, the option of treating a portion of the freshwater and blending with an untreated portion to meet arsenic concentration targets could be evaluated.

3.3.2 Well or Wells in California

This section discusses the water quality of wells water wells in and near Moabi Regional Park, and addresses the potential need for conditioning prior to injection. Table 3-1 provides a summary of available water quality information. Tables 3-3 thru 3-5 provide additional water quality data for wells PM-03 and PM-04, respectively (PG&E 2012).

Total Dissolved Solids

As shown in Table 3-1, one of the wells drilled at Moabi Regional Park (well PM-02) produced highly mineralized water and was never put into service. The other high-capacity well (PM-01) produced water with a TDS concentration around 3,000 mg/L (Crandall 1986b). The infiltration gallery that was installed near the river was equipped with a reverse osmosis system to remove minerals and make the water suitable for use by the park. The previous high capacity wells and infiltration gallery at Moabi Regional Park produced water with TDS that was considered undesirable by Moabi Regional Park.

Previous consultants have expressed concerns that higher pumping rates at Moabi Regional Park might pull in poor quality resulting in degradation of the water quality in existing wells (Crandall 1986c and Roberts 2006). LeRoy Crandall and Associates stated that for PM-03, "Pumping at rates greater than 60 gpm could also induce migration of poor quality water that is present in the vicinity of the trailer park and the old water well. Excessive pumping could also induce an upward flow of poor quality water that is present at depths below 200 feet" (LeRoy Crandall & Associates, 1986c). A similar concern was expressed by another consultant who designed and tested well PM-04 (Roberts 2006). Mr. Roberts recommended that PM-04 be pumped at rates not exceeding 40 gpm and used in conjunction with PM-03 to minimize stress on the aquifer.

Based on information presented in the Crandall Reports, there is significant variation in groundwater quality across relatively short distances and depths in the aquifer at Moabi Regional Park. The previous high capacity wells at Moabi Regional Park produced water with TDS greater than 1,500 mg/L. This relatively salty water appears to be more prevalent than the better water quality represented by wells PM-03 and PM-04. If a high capacity well were to be installed at Moabi Regional Park to supply the remedy, it would likely produce high TDS water. As mentioned above, previous consultants have expressed concerns that pumping from a high capacity well might draw high TDS water into the relatively low TDS zones tapped by current Park Moabi wells. This could occur by "upconing" of higher TDS water from depth, or lateral movement of higher TDS water from other portions of the aquifer. Upconing of high TDS water is more likely in a well that produces a lot of drawdown.

In the vicinity of Moabi Regional Park, the shallow alluvium is thin and does not produce sufficient water for the remedy. Even the deep wells that have been drilled previously at Moabi Regional Park have not produced sufficient water for the remedy. Although the TDS of the water from the high capacity wells at Moabi Regional Park might be suitable for injection at Topock, it was not considered acceptable for use by the Park. If a high capacity well were installed at Moabi Regional Park and the water used to for injection at Topock, there would be two concerns about water quality. As expressed by prior consultants, the pumping of a high capacity well could result in migration of nearby poor quality water into the existing Moabi Regional Park wells. In addition, the northward gradient induced by pumping fresh water at Moabi Regional Park would eventually draw some of the injected water back to Moabi Regional Park. If the quality of the injected water was objectionable to Moabi Regional Park, this could result in additional degradation of the water quality at the park.

Sulfide Odor

The Crandall report indicates that in addition to elevated salts, well PM-01 had a sulfide odor and an elevated temperature (LeRoy Crandall & Associates 1986a). The observation of sulfide odor suggests that the water from PM-01 may have been in a reduced or partly reduced geochemical state and could therefore have contained dissolved iron or manganese at concentrations that may require pre-treatment to prevent injection well plugging.

Chromium and Trace Metals

PG&E sampled wells PM-03 and PM-04 on annual basis and submitted the results to the Moabi Regional Park and DTSC. Data reported in the most recent letter report submitted on February 12, 2012 (PG&E 2012) indicate that the chromium concentrations continue to be below both the state and federal drinking water standards and are consistent with the range of concentrations found in other Topock area wells that contain naturally occurring ("background") chromium concentrations. No other compounds analyzed exceeded state and federal drinking water standards.

Well PM-03 (also called PMM-Supply) has the most extensive trace metal dataset in all available Park Moabi wells data (see Tables 3-4 and 3-5). Dissolved iron ranges from <100 to 931 μg/L, the most recent dissolved iron data was 50 μg/L (December 2011). Manganese ranges from <1 to 3.5 μg/L. Well PM-04 has dissolved iron ranges from <20 to 617 μg/L, the most recent dissolved iron data was 60 μg/L (December 2011). Manganese was below reporting limits of 10μg/L. PM-04 has one trace data set, zinc level of 605 μg/L exceeded the site background level of 77.7 μg/L.

No trace metals data are available for other older wells in the Moabi Regional Park. The potential for well clogging in the deeper water in this area due to iron and/or manganese concentrations remains unknown.

Conclusion for California Groundwater Option

The quality of water at a quantity adequate for the remedy use remains unknown. Exploratory drilling would be needed to find the desired water quality at a quantity adequate for the remedy. Again, the conceptual model expressed by Moabi Regional Park's consultants LeRoy Crandall and Associates and Mark Roberts is that "the best quality ground water in the vicinity of the Park occurs in the shallow alluvial deposits that traverse a large portion of the Park, and extend southwesterly toward the Chemehuevi Mountains" (Crandall 1986a). Existing wells (PM-03 and PM-04) completed in this zone apparently cannot sustain pumping rates of more than 70-80 gpm (Crandall 1986c, Roberts 2006).

Since water quality in the deeper water in this area is not known, it may be prudent to consider some water conditioning to remove iron and manganese for protection of injection wells from clogging. Below is a conceptual level discussion of a conditioning system that can be used to remove iron and manganese. There are many effective iron and manganese treatment methods such as oxidation (e.g., potassium permanganate) and filtration, adsorptive filtration, ion exchange, membrane filtration (e.g., reverse osmosis) and biological filtration. For the purpose of this discussion, adsorptive or greensand filtration is assumed.

As shown in Exhibit 3-5, hypochlorite is used to oxidize the iron and manganese into less soluble forms and then the water flows through a filter. The filter media consists of an adsorptive media or greensand, both of which increase iron and manganese removal by adsorbing the oxidized compounds. Excess chlorine is added to regenerate the media surface for sorption. The treatment process is illustrated schematically in Exhibit 3-5.

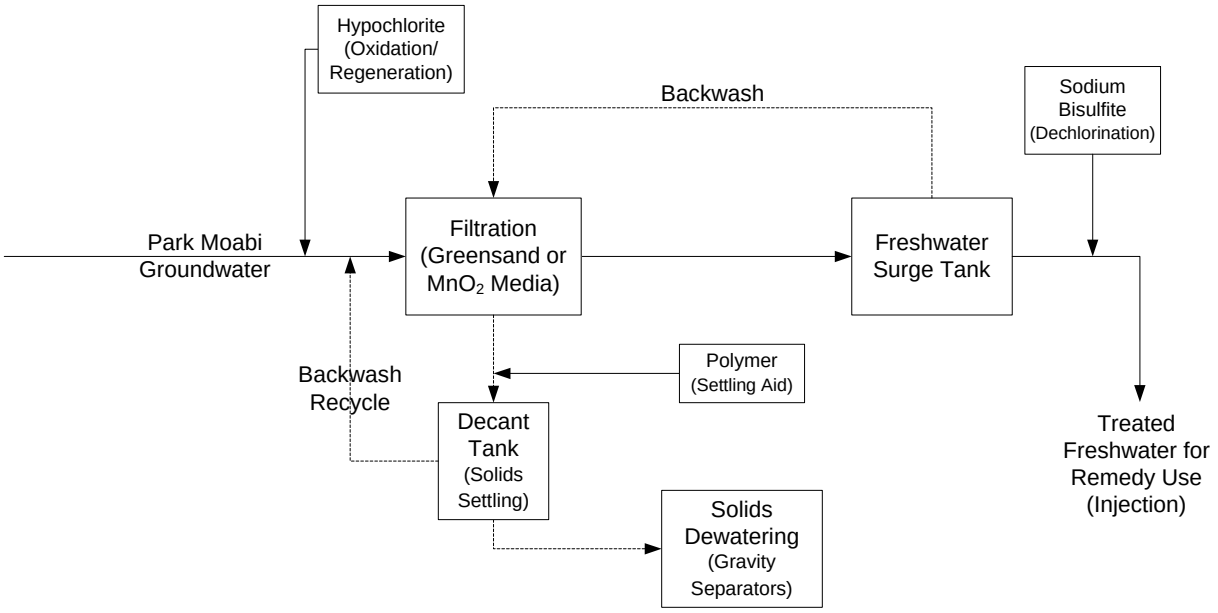


EXHIBIT 3-5
Park Moabi Source with Iron Conditioning Process Schematic
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

The filters would be backwashed periodically to remove accumulated and adsorbed solids and the backwash flow would be sent to a cone-bottom decant tank to settle the solids. A polymer would be injected into the stream to aid in settling. Settled solids would be vacuumed out of the decant tank when it reached a pre-designated level. These solids would be pumped to liquid phase separators located at the Remedy Produced Water Conditioning System and the dewatered solids would be disposed of offsite (see Section 3.4 for Implementability and Sustainability Considerations). Water from the decant tank would overflow and be re-processed through the filtration system. More than 90 percent of the water can be recycled this way thereby reducing consumptive water use. Filtered water would flow to a surge tank prior to flowing by gravity to the injection wells.

To prevent chlorinated water from affecting the IRZ, excess chlorine would be removed by the addition of a chemical such as sodium bisulfite.

Major equipment would include the following:

- Filters with filter media in pressure rated housings complete with piping and automated valves for diverting flow from treatment to backwash modes. Two banks of eight filters would be installed to treat the entire flow.
- Submersible pump for groundwater extraction located at Moabi Regional Park
- Process pumps for backwash, and decant water.
- Chemical storage tanks and metering pumps for sodium hypochlorite, polymer, and sodium bisulfite.
- Surge tank for filtered water.
- Decant tank (cone-bottom tank) for backwash water storage and solids settling.

The equipment would be mounted on a concrete foundation with a building or partially sided roof structure (sunshade). The footprint is estimated to be about 2,500 square feet.

3.3.3 Colorado River

This section evaluates the river water quality relative to the desired water quality for injection at the Topock site, and the potential need for conditioning prior to injection. Table 3-6 provides a summary statistics of surface water sample results collected by PG&E from July 1997 through June 2011 as part of its surface water sampling program. Tables 3-7 and 3-8 provides a summary statistics of the river data collected by MWD from 2008 through March 2012 for trace metals and other compounds with primary and secondary MCLs, as well as compounds in pharmaceuticals and personal care products (PPCP).

Total Dissolved Solids

The TDS averages around 680 mg/L in the river which is higher than the average in the HNWR-1 well (500 mg/L) but not considered to be a problem for injection at the Topock site (see Section 3.3.1).

Dissolved Organic Carbon Content

The average dissolved organic carbon content in the Colorado River near Topock is 9 mg/L. While this is considered low for a surface water source, it might be enough carbon to contribute to injection well fouling. It would likely depend on the bio-availability of the dissolved carbon present. If the carbon is relatively resistant to microbial uptake, the microbes would not be able to readily utilize it and well fouling potential would be less. If the carbon was in a form that the microbes could readily use, microbial growth would occur within or near the well and fouling would be more of a concern. If the river were selected as the freshwater source, laboratory tests would need to be conducted to determine the nature of the dissolved carbon present and whether or not it would be likely to cause problems with well fouling.

Turbidity

Turbidity in river water ranges from 2-2.6 NTU near Lake Havasu to 5 NTU at the Wildlife Refuge. There is no reliable way to relate the turbidity to total suspended solids, but it is anticipated that the river water would need filtration prevent plugging of the injection wells.

Coliform Bacteria

Based on data reported in MWD's 2011 Annual Water Quality Report, the Coliform Bacteria level in river water at Lake Havasu ranges from 3 to 1,700 cfu/100 ml (median is 330 cfu/100 mL). The Colorado River Sanitary Survey reported the following on the level of Coliform Bacteria in Lake Havasu at Whitsett Intake, 2005-2010:

	Total Coliforms	Fecal Coliform	E. coli
No. of Samples	72	59	72
Minimum	< 1	< 2	< 1
10th Percentile	9	< 2	< 1
Median	120	< 2	< 1
Average	370	3	< 1
90th Percentile	880	2	1
Maximum	7,700	130	3

Injection of water containing bacteria and microbes is likely result in biological growth on the well screens. The reason is the river water is oxygenated and pumping will add more oxygen. The injection areas are also oxygenated so the bacteria and microbes will have favorable conditions to multiply. Physical methods are somewhat effective in removing the biological growth from the well screens, but to stop the growth requires disinfection. The injection stream will be a continuous source of bacteria and microbes if disinfection is not used.

Trace Metals and Hexavalent Chromium

As shown in Tables 3-6 and 3-7, none of the compounds analyzed in river water exceeded the MCLs and Topock site background levels, where available.

Perchlorate and Nitrate

Low levels of perchlorate (3μg/L max) were detected in about 30 percent of the samples collected below Davis Dam and at the Lake Havasu Intake. At the Lake Mead Out Structure, perchlorate was detected in more than 75 percent of the samples analyzed with the maximum level detected was 4.6μg/L. These levels are below the California primary MCL of 6μg/L. Perchlorate was not analyzed in samples collected near the Topock site.

Nitrate was detected in most samples analyzed. In surface water samples collected by PG&E, average nitrate level is less than 1mg/L. In MWD samples, the maximum level of nitrate was found at 2.5mg/L in samples collected below Davis Dam and at the Wildlife Refuge. The maximum nitrate level is below the primary MCL of 10mg/L (as nitrogen) and 45mg/L (as NO3).

Contaminants with Secondary MCLs

Of the contaminants with secondary MCLs, aluminum was the only compound detected above the MCL of 200μg/L. The maximum level detected was 540μg/L above the railroad at the Topock site.

Compounds Associated with Pharmaceuticals and Personal Care Products (PPCP)/Emerging Contaminants

Due to the intensive use and re-use of the water in the Colorado River, it could contain many trace contaminants such as pharmaceuticals, personal care products, and possibly other contaminants that have not yet been identified. Table 3-7 shows a summary statistic of PPCP compounds in samples from the Colorado River. In general, the PPCP compounds are found in samples collected in more populated areas such as Lake Havasu than less populated areas such as the Wildlife Refuge or below Davis Dam. As areas become more or less populated over the next few decades, it is expected that the presence of PPCP compounds in river water to vary accordingly. In addition, as new and more advanced/exotic personal care products and pharmaceuticals are brought to the market as society advances over the next few decades, it is likely that new trace contaminants could be found in river water.

As analytical techniques improve, additional compounds may be detected that are present but below current detection limits. Because the river provides the primary source of water for the Mojave Valley, many of the compounds present in the river water will eventually be present in groundwater, but it may take many years for them to move from the river to a nearby well. Some of these emerging contaminant compounds are not mobile in the subsurface and may never move far from the river. If fresh water were obtained from a well rather than from

the river, this travel time from the river to a well provides a buffer that might allow for mitigation measures to be implemented prior to injecting an emerging contaminant and having it spread across the site.

Potential Need for Conditioning of River Water Prior to Injection

Based on available data, river water quality is generally good, with relatively low dissolved solids and trace compounds. Maintaining high injection well efficiency is an important consideration for the project regardless of the freshwater source. The common threats to injection efficiency are solids or particulate matter that could clog the well screens, and biological materials (bacteria or microorganisms) that could grow on the well screens reducing the open area. Therefore, solids and bacteria/microorganisms will need to be removed prior to injection.

To avoid the need for filtration and disinfection of water from a river intake, the 30% design discussed the option of drawing water from a shallow infiltration gallery beneath the river bottom. Under this option, the sand in the river bottom would provide filtration, removing suspended solids and microbes. However, the discussion also pointed out that the groundwater in the shallow zone beneath the river contains water that is geochemically reduced and contains elevated concentrations of iron and manganese which could clog the injection wells. It is therefore, likely that a conditioning system would be needed to remove iron and manganese before the water could be used for injection. There was a question as to whether a “river well” could be designed to preferentially filter oxygenated river water from the river and minimize extraction of the geochemically reduced water in the shallow groundwater (#134 DTSC-52). It should be noted that PG&E plans to selectively screen the river bank extraction wells in the lower, oxic portion of the aquifer specifically to avoid pumping the reduced water in the fluvial sediments. It is possible that reduced water may eventually be drawn down into the screened intervals of these wells, however experience with operation of PE-1 suggests that there is significant retardation of iron and manganese. Water in PE-1 has acquired the isotopic signature of river water but iron and manganese concentrations have not increased significantly. PGE-8 and 9 were designed to pump water from the river. They are screened over the entire thickness of the aquifer. After extended purging of these wells over a period of weeks, the water quality remained poor. The river water was not drawn in to any great extent. The Park Moabi infiltration trench was constructed at a shallow depth on the bank of the river and produced water with high TDS, which required RO treatment to be usable. Therefore, prior experience suggests it would be difficult to design a well that would preferentially pump river water.

Therefore, no matter whether the water is extracted directly from the river or beneath the river bed, some type of conditioning system would be needed to make river water suitable for injection. Multi-media filters could be used for solids removal and disinfection for removing bacteria and microorganisms. The process is illustrated schematically in Exhibit 3-6. It is assumed that no advanced treatment would be needed to remove trace / emerging contaminants.

Ferric chloride, a coagulant, would be added upstream of the filters to improve performance by removing more of the fine particles in the River water. Ferric chloride is commonly used in drinking water treatment plants. The filters would be backwashed periodically to remove accumulated solids and the backwash flow would be sent to a cone-bottom decant tank to settle the solids. A polymer would be injected into the stream to aid in settling. Settled solids would be vacuumed out of the decant tank when it reached a pre-designated level. These solids would be pumped to liquid phase separators and the dewatered solids would be disposed of offsite (see Section 3.4 for Implementation Considerations). Water from the decant tank would overflow and be re-processed through the filtration system. More than 90 percent of the water can be recycled this way thereby reducing consumptive water. Filtered water would flow to a surge tank prior to being pumped to the injection wells.

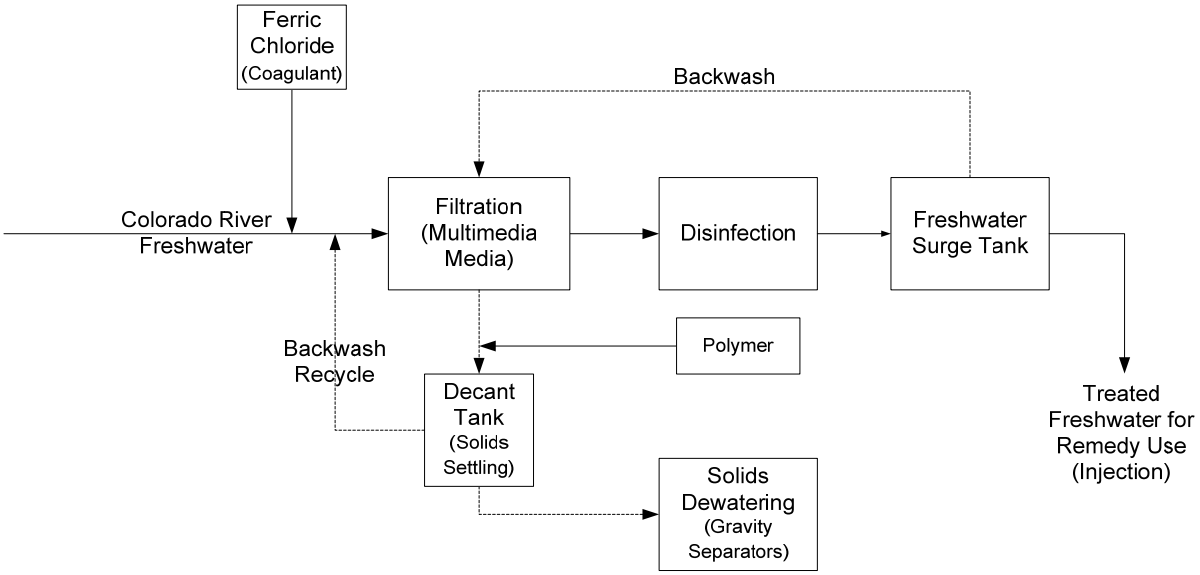


EXHIBIT 3-6
River Water Conditioning Process Schematic
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

Disinfection can be accomplished with chlorination, ultraviolet light, or ozone, and each approach has advantages and disadvantages. Chlorination uses hazardous chemicals such as gaseous chlorine or liquid sodium hypochlorite. It can result in unwanted byproducts such as trihalomethanes and requires dechlorination to remove excess chlorine prior to injection. UV disinfection is a physical disinfection process rather than a chemical disinfection process. It uses electromagnetic energy in the 200 to 300 nanometer wavelength ranges to inactivate microorganisms. UV light is generated by a flow of electrons from an electrical source through ionized mercury vapor within UV lamps. UV lamps are housed in quartz sleeves and arranged in a UV reactor. Ozone is generated electrically and is a very strong oxidizer that is effective for bacterial and microorganism control. The systems require cooling water, an ozone quench system (to remove residual ozone), instrumentation to monitor for ozone leaks since it affects health, and off-gas control to prevent ozone escape to the ambient air. Neither UV nor ozone have residuals which would need to be managed as a waste stream Injecting residual chlorine could potentially impinge on the IRZ and affect performance and introduce chloramines to the aquifer. UV uses no hazardous chemicals, is relatively safe, takes less space, and uses less power than ozone. Therefore, it was considered for this evaluation.

Major equipment would include the following:

- Filters with multiple filter media (e.g., garnet, anthracite, sand) in pressure rated housings complete with piping and automated valves for diverting flow from treatment to backwash modes. Two banks of 3 filters would be installed to treat the entire flow. In each bank (or train), two filters would be in service and one filter in standby or backwash mode to enable full time operation.
- Process pumps for backwash, decant water return, and injection.
- Surge tank for filtered water (20,000 gallons nominal capacity).
- Decant tank (cone-bottom tank) for backwash water storage and solids settling.
- Chemical storage tanks and metering pumps for ferric chloride and polymer.
- A pipe reactor would be built to allow sufficient ferric chloride mixing time before filtration.
- UV lamps would be installed in quartz sleeves fixed inside a stainless steel reactor vessel. Lamps would be replaced periodically.
- Two liquid phase separators (similar to those used at the IM No. 3 groundwater treatment plant)

A conditioning facility to house the equipment is estimated to be 5,400 square feet. It should be noted that the tanks (chemical storage, surge, and decant tanks) and filtration equipment occupies more than 85 percent of the plant footprint. The footprint for UV disinfection is relatively small compared to filtration.

3.3.4 Conclusion

For criterion #3 (Water Quality/Potential Need for Conditioning Prior to Injection), all three candidate water sources have pros and cons. Groundwater from Arizona is the only source that is not expected to require conditioning and the associated construction and operational footprint. River water currently has good quality, but the presence of TSS and organic carbon would likely be detrimental to well performance unless conditioned (filtration/disinfection) prior to injection. From a water quality perspective, the primary risk of using river water as a freshwater source is that it is susceptible to future contamination and the possibility that the water could contain compounds that may become emerging contaminants in the future and require cleanup.

Amongst the two groundwater well options, the California option has significant unknowns. Exploratory drilling is required to find the best well location from a water quantity and quality perspective. If a Park Moabi well is considered, it would be prudent to condition the water since there were reports of sulfide odor in some of the early analyses. There were no iron, manganese, sulfide, or other redox indicators (Dissolved Oxygen, Oxidation Reduction Potential, Nitrate, Total Organic Carbon, etc.) analyzed for the early samples to verify this, so it remains a possibility that the deeper water at Park Moabi could pose well clogging potential.

The Arizona well option (HNWR-1) has an arsenic level above the MCL. Transport modeling predicts that the arsenic will not be mobile in the environment surrounding the proposed injection wells and will attenuate under site conditions and return to pre-remedy baseline levels after the end of active remediation. Therefore, based on the modeling, treatment for arsenic in HNWR-1 water is not needed. Monitoring will be implemented during remedy implementation to verify the modeling results and adjustments will be made as needed. Potential contingency actions include adding ex-situ arsenic treatment or switching to another source (see Section 3.4).

To complete the evaluation/comparison of these options, Section 3.4 considers factors related to implementability and sustainability.

3.4 Evaluation Criterion #4 – Implementability and Sustainability

This section evaluates and compares the three freshwater sources against the fourth criterion – Implementability considerations. This criterion includes the following factors:

- Significance and type of disturbance
  - Volume of soil disturbed, construction duration, new facilities
  - Number and size of components such as wells, pipes, access roads, treatment and support facilities
  - Infrastructure footprint
  - Ability to make use of existing facilities
- Administrative requirements
  - Substantive permitting requirements/approvals, easements/access, compliance with ARARs and EIR mitigation measures
- Maintenance requirements of facilities
- Ease of replacement or redundancy, or implementation of potential contingencies
- Flexibility of design
  - Ability to handle changes in flow and quality

For this evaluation, the Arizona groundwater source will be the HNWR-1 well and the California groundwater source will be one or more hypothetical wells in Moabi Regional Park. River water will be extracted directed from the Colorado River via an intake structure and a fish screen. Multiple locations for an intake structure exist with the Project Area, therefore, surveys were performed to evaluate potential locations from an engineering and fish protection perspective. Below is a summary of the surveys.

3.4.1 Summary of Preliminary Engineering Survey/Evaluation of River Intake Structure and Fish Screen and Fish Habitat Survey

Potential locations for a river intake structure and fish screen within the EIR Project Area were reviewed and field surveyed on March 9, 2012. Locations that are considered not desirable for construction, installation, and operation of an intake structure are areas of known habitats for special-status fish and avian species, other sensitive habitats such as jurisdictional wetlands, areas with shallow waters, and areas with high likelihood for high turbidity water (e.g., along the Arizona shore south of the Topock Marsh). Exhibit 3-6 shows five potential locations evaluated. Attachment B contains the technical memorandum with details on the engineering evaluation.



EXHIBIT 3-6
Potential Locations of River Intake Structure and Fish Screen
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

Initial Design

The initial design criteria for the river intake and fish screen are:

- Design flowrate is 1,200 gpm (the potential maximum flow for freshwater injection)
- A 12-inch intake pipe with a submersible pump and a 30-inch end-of-pipe type fish screen (Exhibit 3-7 presents pictures of a similar design). The fish screen will comply with the California Department of Fish and Game (CDFG) and National Marine Fisheries Service (NMFS) fish screen design criteria for maximum approach velocity and size of screen openings.



EXHIBIT 3-7
Example of End-of-Pipe Type Fish Screen Design
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

The intake structure/fish screen design and the location of the intake structure is subject to Agencies approval. The substantive permitting requirements and requirements for compliance with ARARs/EIR mitigation measures associated with river intake and fish screen are extensive, and so is the potential number of Federal and State Agencies that are likely to be involved. The Federal Agencies will include US Fish and Wildlife Services, the US Army Corps of Engineers, the US Coast Guard, and the Bureau of Reclamation. The State Agencies will include CDFG and State Lands Commission, and could include the Regional Water Quality Control Board and San Bernardino County. Therefore, additional time would be required which may impact the project schedule for consultation with the Agencies throughout the design phase and for obtaining the necessary approvals prior to construction.

For the purpose of this TM, the criteria used to evaluate potential locations for the intake and fish screen are as follows:

- **Long-term Siting** --- Water Depth, Debris Protection, Site Space Constraints, Access for Operations and Maintenance, and Water Quality
- **Construction** --- Constructability, Temporary Construction Impacts, and Relative Costs
- **Approvals/Compliance with ARARs and EIR** --- Right of ways, Fisheries Impact, and Compliance with ARARs/EIR

Implementability issues also arise due to special status fish species that occur in the Topock area, specifically the razorback sucker and the bonytail chub. Both are federally-listed and state-listed as endangered and are covered under the Lower Colorado River Multi-Species Conservation Program. Of special concern is the razorback sucker which is also a California Fully Protected Species. The Colorado River is also designated critical habitat for bonytail chub ~~both fish species~~ under federal law. The Lower Colorado River supports the largest remaining populations of razorback sucker (AECOM 2011). Dam construction and subsequent habitat degradation have led to the decline of these fish species. The ARARs and EIR Mitigation and Monitoring Program for the groundwater remedy contain requirements to protect endangered fish species and to mitigate potential negative impacts from the construction and operation of a river intake structure and fish screen.

Specifically, the DOI Record of Decision (ROD) (DOI 2010) states that "[t]he Selected Remedy will be designed and implemented to attain action-specific ARARs, including, for example, the following. . . . Installation of wells, piping, and reagent storage equipment will be performed in a manner that does not result in a "take" of threatened or endangered species, [or] damage their critical habitat (50 CFR part 402) . . . ." (ROD at 39-40). See also ROD at 57-58 (ARAR Table: "Any remedial action selected for the Topock site will not result in the take of, or adverse impacts to, threatened and endangered species or their habitats, as determined based on consultation with the Fish and Wildlife Service under section 7 of the ESA."). California state law also prohibits the take of state-listed "Fully Protected Species", such as the razorback sucker, except where a conservation plan has been approved and is being implemented to ensure protection of those species pursuant to the California Natural Community

Conservation Planning Act. Preliminary discussion with CDFG indicated that approval of a fish screen and intake structure that would avoid incidental take of the razorback sucker may be difficult to obtain. This issue will need to be explored further, may not be feasible, and would likely add more time to the project.

To assess fisheries impact at the potential intake structure locations, a fish habitat survey was conducted on April 4, 2012 in compliance with the EIR mitigation measure BIO-3b. The purpose of the fish habitat survey is to determine the preferred locations for spawning and rearing of the razorback sucker and bonytail chub. Field methodology included documentation of bottom topography and depth using sonar and GPS, photo documentation of bank area, and visual inspection of substrate using view box from boat and Ponar dredge. A fish habitat assessment report is forthcoming.

General observations from the fish habitat survey are as follows:

- **Sites 1 and 2** - Ranged from 6 to 20 feet water depth in areas 10 to 50 feet from shoreline. Fast currents, bedrock on shoreline grading to boulder, cobble, gravel, and sand.
- **Site 3** - Ranged from 6 to 24 feet water depth in areas 10 to 50 feet from shoreline. Fast currents with calm back eddies; bedrock shoreline grading to boulder, cobble, gravel, and sand. Largemouth bass and their nests seen at this site in shallow, unscoured depositional areas (see Exhibit 3-8).
- **Site 4** - Ranged from 3 to 13 feet water depth in areas 10 to 50 feet from shoreline. Fast currents, bedrock or sand on shoreline grading to boulder, cobble, gravel, and sand. Mostly as bedrock to scoured sand (see Exhibit 3-8).

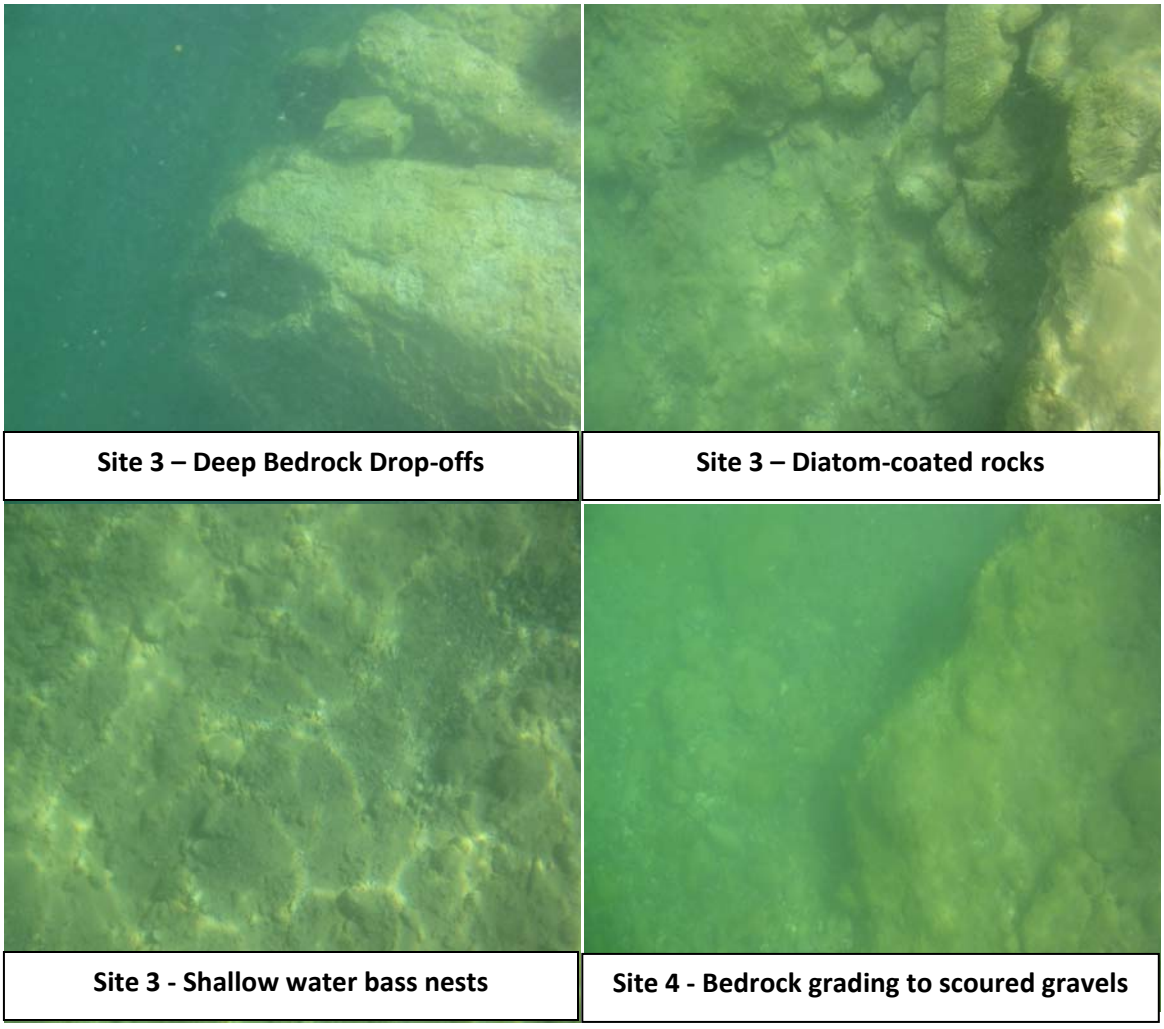


EXHIBIT 3-8
Underwater Views – Sites 3 and 4
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

Based on the preliminary engineering evaluation and fish habitat surveys, Site 4 appears to be the most feasible location for a river intake structure and fish screen (see Exhibit 3-6 above and Exhibit 3-9 below). This location is north of Bat Cave Wash and south of the Moabi Regional Park Slough. The surface of the site is previously disturbed. Consultation and approvals from the agencies will be required prior to the final determination of a suitable location. However, for the purpose of comparing the three freshwater source options, it is assumed that Site 4 is the selected location.



EXHIBIT 3-9
Views of Site 4 from Top of Bank and from the Colorado River
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needle s, California

3.4.2 Summary of Evaluation of Implementability and Sustainability Considerations

Exhibit 3-10 summarizes the evaluation and comparison for the three freshwater sources (the 30% design is also included in the exhibit for reference). The basic assumptions for this evaluation are as follows:

- Infrastructure such as the sunshade, equipment pads, power supply, communications and controls, surge tanks, and conveyance piping will be built to service the maximum flowrate of 1,200 gpm. Information on soil disturbance is based on the infrastructure for the 1,200 gpm flowrate.
- The conditioning components to be housed within the sunshade will be built to service half the maximum flowrate or 600 gpm. Information on energy use, waste generation, and maintenance requirements are based on the 600 gpm flowrate and the assumption that new treatment/conditioning facilities are located at TCS.

Exhibit 3-11 presents a contingency matrix for some of the more serious types of problems that might be associated with the freshwater sources or with the injection of fresh water at the Topock site. This matrix addresses issues associated with river water separate from issues associated with well.

3.4.3 Conclusion

For this criterion #4 (Implementability and Sustainability Considerations), the River water option carries many unknowns compared to the groundwater options. Consultation with Agencies on suitable locations and intake/fish screen design, as well as substantive permitting requirements will be needed, and additional time will be required to comply with these requirements. Additionally, the DOI ROD states that remedial design will be performed in a manner that does not result in a “take” of threatened or endangered species, or damage their critical habitat. California state law also prohibits the take of state-listed “Fully Protected Species”, such as the razorback sucker, except where a conservation plan has been approved and is being implemented to ensure

protection of those species pursuant to the California Natural Community Conservation Planning Act. Preliminary discussion with CDFG indicated that approval of a fish screen and intake structure that would avoid incidental take of the razorback sucker may be difficult to obtain. This issue will need to be explored further, may not be feasible, and would likely add more time to the project.

From a disturbance perspective, disturbance of soil/habitat in the river and on the river bank will occur from construction of the intake structure. Construction would require a coffer dam at the base of the river bank to allow for dewatering of the work area. Further up the bank, construction would require trenching and/or a shoring system within the area excavated for the river intake structure. The coffer dam would be approximately 10 feet by 10 feet if constructed using sheet piles and the trenched area further up the bank could be as wide as 50 feet. The exact footprint of these construction areas would depend on the contractor's means and methods.

Operation of the river intake/fish screen will require routine inspections, more inspections are needed for areas with high debris exposure. Replacement or modification of intake structure can be challenging and time consuming, depending on the nature and extent of repairs needed. With advanced planning and approvals, replacement of a well can be less challenging and less time consuming.

The river supply and CA groundwater supply are assumed to require conditioning prior to use. All new conditioning facilities or arsenic treatment facility will require electricity and strong chemicals for operations and will also generate wastes (e.g., sludge) that will need to be managed. Trained and qualified personnel will be required to operate these facilities. It is anticipated that waste sludge will be disposed offsite at appropriate permitted landfills. The electricity needed to operate these new facilities will add to the electrical loads for the remedy in California. The existing HNWR-1 well will continue to use existing power supplied by Mojave Electric in Arizona.

Using the existing HNWR-1 well is consistent with the mitigation directives in the EIR to give priority to re-use of existing physical improvements. PG&E is working with the Refuge to confirm that this well has sufficient capacity to meet the Refuge's use and that of the remedy. Topock-2/3 wells can be used as backup for HNWR-1 well.

EXHIBIT 3-10
Comparison of Implementability and Sustainability Considerations
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

Factors Considered	Arizona Groundwater		California Groundwater Hypothetical Well(s) in Moabi Regional Park with a Conditioning Facility at TCS	River Water River Intake Structure/Fish Screen at Site 4 and a Conditioning Facility at TCS	Summary
	HNWR-1 with no treatment (30% Design)	**HNWR-1 with Ex-Situ Arsenic Treatment Facility at TCS**			
New Infrastructure Footprint	• Approx. 7,100 feet of new freshwater pipe from HNWR-1 well to the TCS water storage tanks.	• Approx. 7,100 feet of new freshwater pipe from HNWR-1 well to the TCS water storage tanks. • New arsenic treatment plant at TCS (2,000 sq. ft.)	• One or multiple new test wells and extraction well(s) and new access roads. • A new conditioning facility (2,500 sq. ft.) at TCS. Alternate locations include the MW-20 bench and Site 4. • Approx. 7,400 feet of new underground trench from Moabi Regional Park to the northern end of the existing utility corridor at NTH. • The freshwater system would be separate from the TCS freshwater system.	• A new river intake structure and fish screen (with associated electrical/controls equipment) at Site 4. • A new conditioning facility (5,400 sq. ft.) at TCS. Alternate locations include MW-20 Bench and Site 4. • The freshwater system would be separate from the TCS freshwater system.	• In general, the River water option requires a larger footprint than the groundwater options (e.g., a larger conditioning footprint, additional footprint for the river intake structure). • The proposed 30% design (HNWR-1 well) has the least amount of footprint and allows for the use of the existing well and co-use of the TCS freshwater storage tanks. If the arsenic treatment were to be added, the Arizona and California groundwater options will have similar footprint. However, if exploratory drilling north of Moabi Regional Park is needed to find the appropriate quantity and quality of water for the remedy, additional footprint is likely required for new access roads, well vaults/houses, and control/electrical/ communication equipment.
Use of existing facilities	• Existing HNWR-1 well [a] • Existing TCS freshwater storage tanks • Minor surface improvements to HNWR-1 wellhead • Improvements to existing roads	• Existing HNWR-1 well • Existing TCS freshwater storage tanks • Minor surface improvements to HNWR-1 wellhead • Improvements to existing roads	• Use of the existing utility corridor along NTH to transport water to TCS.	• Use of the existing utility corridor along NTH to transport water to TCS.	
Soil disturbance	• The underground trench for the pipeline connecting to the HNWR-1 well is assumed to be 3 feet wide by 3 feet deep and the total length is about 4,000 feet resulting in approximately 1,320 cubic yards of soil disturbed. The trenchless crossing under I-40 in Arizona is 236 feet long (43 cubic yards for a 30 inch diameter casing) and there would be a bore pit and receiving pit (320 cubic yards). An approximate disturbed volume of 1,700 cubic yards of soil would be required.	• The underground trench for the pipeline connecting to the HNWR-1 well is assumed to be 3 feet wide by 3 feet deep and the total length is about 4,000 feet resulting in approximately 1,320 cubic yards of soil disturbed. The trenchless crossing under I-40 in Arizona is 236 feet long (43 cubic yards for a 30 inch diameter casing) and there would be a bore pit and receiving pit (320 cubic yards). An approximate disturbed volume of 1,700 cubic yards of soil would be required. • Soil disturbance related to construction of the new arsenic treatment facility (2,000 sq. ft.). Soil borings needed for foundation design of the new treatment facility.	• An estimated 7,400-foot long section of new underground trench (3’ wide by 3’ deep) with a total disturbed volume of 2,460 cubic yards of soil would be required. All other pipe is assumed to follow the existing utility corridor. • Soil disturbance related to construction of the new conditioning facility (2,500 sq. ft.). Soil borings needed for foundation design of the new conditioning facility.	• To pipe water from the intake structure at Site 4, a 100-foot long section of new underground trench (3’ wide by 3’ deep) with a total disturbed volume of 33 cubic yards would be required. The remaining pipe run to the TCS will follow the existing utility corridor. • Disturbance related to construction of the new conditioning facility (5,400 sq.ft.). Soil borings needed for foundation design of the new conditioning facility. • Construction of the river intake structure would require a coffer dam at the base of the river bank to allow for dewatering of the work area. Further up the bank, construction would require trenching and/or a shoring system within the area excavated for the river intake structure. The coffer dam would be approximately 10 feet by 10 feet if constructed using sheet piles and the trenched area further up the bank could be as wide as 50 feet; the exact footprint of these construction areas would depend on the contractor’s means and methods. • Geotechnical borings needed for engineering design.	• The volume of soil disturbed is smaller for the Arizona groundwater option (HNWR-1 well) than the California option because of the trenchless crossing under I-40 in Arizona. • With regards to construction of conditioning facilities, the River water option has the largest soil disturbance associated with the largest facility footprint. • Construction of the river intake structure will disturb soil on the bank of the river as well as soil in the river. The exact amount of soil disturbance and associated impacts will depend on further consultation with the Agencies on the intake/fish screen design, suitable locations, and further details on the mitigation measures that would be required for the construction and operation of such structure on the bank of the Colorado River. The coffer dam would be approximately 10 feet by 10 feet if constructed using sheet piles and the trenched area further up the bank could be as wide as 50 feet; the exact footprint of these construction areas would depend on the contractor’s means and methods.

EXHIBIT 3-10
Comparison of Implementability and Sustainability Considerations
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

Factors Considered	Arizona Groundwater		California Groundwater Hypothetical Well(s) in Moabi Regional Park with a Conditioning Facility at TCS	River Water River Intake Structure/Fish Screen at Site 4 and a Conditioning Facility at TCS	Summary
	HNWR-1 with no treatment (30% Design)	**HNWR-1 with Ex-Situ Arsenic Treatment Facility at TCS**			
Energy Use [b]	• 1,400,000 kw-hr/year for the HNWR-1 well pump **(source of electricity is Mohave Electric Cooperative in Arizona)**	• 1,400,000 kw-hr/year for the HNWR-1 well pump **(source of electricity is Mohave Electric Cooperative in Arizona)** • **New electric loads in California**: o 4,000 kw-hr/year for process pumps o 175,000 kw-hr/year for additional facilities (an allowance for items like heating & cooling, lights, chemical metering pumps, instruments, power panels and transformers)	• **New electric loads in California**: o 6,000 kw-hr/year for process pumps o 1,100,000 kw-hr/year for the Moabi Regional Park well pump o 175,000 kw-hr/year for additional facilities (an allowance for items like heating & cooling, lights, chemical metering pumps, instruments, power panels and transformers)	• **New electric loads in California**: o 17,000 kw-hr/year for process pumps o 11,000 kw-hr/year for UV disinfection o 1,100,000 kw-hr/year for the river intake pump o 175,000 kw-hr/year for additional facilities (an allowance for items like heating & cooling, lights, chemical metering pumps, instruments, power panels and transformers)	• The existing HNWR-1 well is powered by Mohave Electric Cooperative in Arizona, and is designed as such in the 30%. • The new conditioning facilities at TCS, the new hypothetical wells in Moabi Regional Park, and the new river intake structure/fish screen will all require electricity to operate and will add to the current electrical loads for the remedy in California.
Waste Generation		• The arsenic treatment system will generate between 40 and 195 cubic yards of dewatered sludge per year. The sludge is assumed to be non-hazardous and hauled offsite to an appropriate landfill in 4 to 20 phase separators bins.	• The conditioning system will generate 150 to 310 cubic yards of dewatered sludge per year. This will result in 15 to 31 phase separator bins being hauled offsite to an appropriate Class III landfill.	• The conditioning system will generate 100 to 670 cubic yards of dewatered sludge per year. This will result in 10 to 67 phase separator bins being hauled offsite to an appropriate Class III landfill.	• Sludge will be generated from conditioning/ treatment facilities. In general, the River water option will generate more sludge than the groundwater options as the ground acts as a natural filter for the extracted groundwater.
Maintenance Requirements		• This type of equipment is commonly used in water treatment facilities across the country and should be operated by trained personnel. • It is estimated that 10 to 30 chemical deliveries (ferric chloride, sodium hypochlorite and polymer) would be required per year. • Safety procedures need to be followed during chemical loading transfers and to make sure safe chemical injection occurs to prevent worker exposures or releases to the environment. Both chemicals (hypochlorite and ferric chloride) although widely used are strong chemicals.	• This type of conditioning equipment is commonly used in water treatment facilities across the country and should be operated by trained personnel. • It is estimated that 20 to 27 chemical deliveries (sodium bisulfite, sodium hypochlorite, and polymer) would be required per year. • Safety procedures need to be followed during chemical loading transfers and to make sure safe chemical injection occurs to prevent worker exposures or releases to the environment. These chemicals (sodium hypochlorite and bisulfite), although widely used are strong chemicals.	• This type of conditioning equipment is commonly used in water treatment facilities across the country and should be operated by trained personnel. • Maintenance of river intake and fish screen requires routine inspection similar to typical pumping facilities. Annual maintenance would include changing the oil filter on the power unit and miscellaneous maintenance. The screen itself will be visually inspected when the river is low; more frequent visual inspections would be required in areas where the debris exposure is high. • It is estimated that 10 to 22 chemical deliveries (ferric chloride and polymer) would be required per year. • Safety procedures need to be followed during chemical loading transfers and to make sure safe chemical injection occurs to prevent worker exposures or releases to the environment. Although widely used, ferric chloride is a strong chemical.	• For all three options, the aboveground conditioning/treatment facilities will require trained and qualified personnel to maintain and operate the system. Strong chemicals will be used in all processes. The amount of chemical use and frequency of chemical deliveries will depend on actual water quality. • The River water option will require additional O&M of the river intake and fish screen. Routine inspection is necessary. Frequent visual inspections of the fish screen is recommended, especially in areas with high debris exposure; therefore, higher likelihood the structure being damaged by debris.

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Factors Considered	Arizona Groundwater		California Groundwater Hypothetical Well(s) in Moabi Regional Park with a Conditioning Facility at TCS	River Water River Intake Structure/Fish Screen at Site 4 and a Conditioning Facility at TCS	Summary
	HNWR-1 with no treatment (30% Design)	HNWR-1 with Ex-Situ Arsenic Treatment Facility at TCS			
Administrative requirements	• Easements and access agreements would be needed for the operation of HNWR-1, road improvements, and construction under I-40. • Modification to lease with State Lands Commission for adding pipe to bridge would be required. • Use of HNWR-1 (on the Refuge) will require agreement with the USFWS.	• Easements and access agreements would be needed for the operation of HNWR-1, road improvements, and construction under I-40. • Modification to lease with State Lands Commission for adding pipe to bridge would be required. • Use of HNWR-1 (on the Refuge) will require agreement with the USFWS.	• Easements and access agreements would be needed for exploration drilling to locate, as well as installation of new well(s), new facility at Site 4, road improvements and construction under I-40.	• Easements and access agreements would be needed for construction of new river water conditioning facility, road improvements, and construction under I-40 on non-federal lands. • The river intake structure location/design, and the fish screen design requires approvals from Agencies. Compliance with the substantive requirements of the identified ARARs and the EIR mitigation measures for the construction and operation of the intake structure/fish screen is extensive. The DOI ROD states that remedial design will be performed in a manner that does not result in a "take" of threatened or endangered species, or damage their critical habitat. California state law also prohibits the take of state-listed "Fully Protected Species", such as the razorback sucker, except where a conservation plan has been approved and is being implemented to ensure protection of those species pursuant to the California Natural Community Conservation Planning Act. Preliminary discussion with CDFG indicated that approval of a fish screen and intake structure that would avoid incidental take of the razorback sucker may be difficult to obtain. This issue will need to be explored further, may not be feasible, and would likely add more time to the project. • Federal -- Compliance with substantive permitting requirements includes Section 404 of the Clean Water Act, Endangered Species Act (ESA) Section 7, and Section 10 River and Harbors Act. • State -- Compliance with substantive permitting requirements includes Section 1601 under the California Department of Fish and Game Code, California Endangered Species Act, Section 401 of the Clean Water Act, Clean Water Act Section 402 Construction SWPP, leases under State Lands Commission, etc. Additional consultation would be required if the project design included a log screen or upstream diversion structure to protect the intake from surface and submerged debris.	• Additional time will need to be budgeted in the project schedule to fulfill the administrative requirements anticipated for both the California groundwater and the River water options. • At this time, the implementability/feasibility of the River water option cannot be determined without consultation with the Agencies on suitable locations, the intake/fish screen design, associated mitigation measures and anticipated impacts to endangered species and designated critical habitat. Multiple agencies will need to be consulted. • If exploratory drilling is required to site a suitable well location in California, research on property ownership and any required easements access agreements will need to be secured. • Use of the HNWR-1 well will require an agreement with the USFWS.

EXHIBIT 3-10
Comparison of Implementability and Sustainability Considerations
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

Factors Considered	Arizona Groundwater		California Groundwater	River Water	Summary
	HNWR-1 with no treatment (30% Design)	HNWR-1 with Ex-Situ Arsenic Treatment Facility at TCS	Hypothetical Well(s) in Moabi Regional Park with a Conditioning Facility at TCS	River Intake Structure/Fish Screen at Site 4 and a Conditioning Facility at TCS	
Flexibility of design	• Can accommodate moderate changes in flow (up to maximum 1200 gpm) as remedy needs dictate. • Changes in water quality or quantity at the HNWR-1 well would require rehab or installation of new wells, with backup from Topock 2 and 3, if needed.	• Can accommodate moderate changes in flow (up to maximum 1,200 gpm) as remedy needs dictate. • Changes in water quality or quantity at the HNWR-1 well would require rehab or installation of new wells, with backup from Topock-2/3 wells, if needed.	• Can accommodate moderate changes in flow (up to maximum 1,200 gpm) as remedy needs dictate. • Changes in water quality or quantity at the well would require rehab or new wells, with backup from Topock-2/3, if needed.	• Can accommodate moderate changes in flow (up to maximum 1,200 gpm) as remedy needs dictate. • Source vulnerable to changes in water quality as a result of upstream discharges or spills. • Short term changes in water quality at the intake would require shut down and reliance on stored water. Permanent changes in water quality would require alternative source.	• The aboveground infrastructure needed for the options will be designed with flexibility to accommodate the quantity needed by the remedy (up to the maximum flow of 1,200 gpm). • For the HNWR-1 well, PG&E is working with the Refuge to confirm that this well has sufficient capacity to meet the Refuge's use and that of the remedy. Topock-2/3 wells can be used as backup for HNWR-1 well. • With advanced planning and approvals in the design, installation of new wells (in the vicinity of HNWR-1) can be executed with fewer challenges and require less time than installation of a new river intake structure.
Ease of replacement or redundancy	• New wells would require exploration and drilling new wells, rerouting of piping will be required. • With proper planning, pumps and associated parts can be replaced with ease.	• New wells would require exploration and drilling new wells, rerouting of piping will be required. • With proper planning, pumps and associated parts can be replaced with ease.	• New wells would require exploration and drilling new wells, rerouting of piping of pipe will be required. • With proper planning, pumps and associated parts can be replaced with ease.	• Replacement or modification to river intake structure can be made, the degree of ease or difficulty depends on the nature and extent of the modifications required. • With proper planning, pumps and associated parts can be replaced.	• With advanced planning and approvals in the design, installation of new wells (in the vicinity of HNWR-1) can be executed with fewer challenges and require less time than installation of a new river intake structure. • Replacement or modification to river intake structure can be made, the degree of ease or difficulty depends on the nature and extent of the modifications required.

Notes - Additional design and optimization, siting considerations (including alternate locations for conditioning facilities), testing, and analysis may result in altered configurations and different equipment being selected and changing the estimated values described in this TM. Alternate locations for conditioning facilities include Site 4 and MW-20 Bench.

[a] HNWR-1 well has sufficient capacity for the remedy. Please note that PG&E is coordinating with the Refuge to confirm this assumption.

[b] Energy usage for pumps based on calculated motor nameplate power.

EXHIBIT 3-11
Contingency Matrix
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

	Failure Mode	Likely Causes for Failure	Effects of Failure	Possible Contingency Measures
Failure Modes Associated with Groundwater Source	Well yield declines below the minimum required for optimal remedy operation	• Extraction well fouling • Excessive drawdown due to competing water users	• Delay in reaching RAOs • Potential westerly spread of water from "inner loop" injection wells	• Rehab or replace fouled well • Seek other location for well(s) • Seek alternative freshwater water supply to augment primary supply • Enforce institutional control to prevent excessive drawdown from competing water users
	Quality of water in freshwater well declines over time	• Pumping draws in saline water from below or geochemically reduced water from river / marsh	• Could result in shutting down remedial action if water quality is not suitable for injection	• Install treatment to remove harmful constituents • Seek other sources of fresh water or other locations for well(s)
	Freshwater pumping causes adverse effects on water quality or capacity in nearby wells	• Over pumping of aquifer in areas with marginal groundwater quality / transimssivity	• Could result in shutting down remedial action if affected water users cannot be made whole	• Seek other sources of fresh water or other locations for well(s) • Provide alternate water supply for affected water users
	Arsenic is more mobile or persistent than expected after injection	• Heterogeneity of geochemical and/or hydraulic conditions in the aquifer near freshwater injection wells	• Could result in shutting down remedial action if there is a risk that harmful concentrations of arsenic could reach receptors	• Implement arsenic treatment on all or part of freshwater stream • Seek other source of fresh water
Failure Modes Associated with River Source	Short term or localized decline in water quality	• Spill or release of harmful substance into river between Topock and Davis Dam	• Could result in shutting down remedial action if water quality is not suitable for injection	• Shut down freshwater injection until harmful substance flushes out (likely a few days to a week) • Implement interim treatment to remove harmful substance prior to injection

EXHIBIT 3-11
Contingency Matrix
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

	Failure Mode	Likely Causes for Failure	Effects of Failure	Possible Contingency Measures
	Long term or regional decline in river water quality	• Major spill or release of harmful substance to river basin, such as collapse of uranium tailings dam in Utah • Identification of a new emerging contaminant in the river system, such as with perchlorate in the 1990's	• Could result in shutting down remedial action if water quality is not suitable for injection • In worst case, could result in the need to clean up a plume of an emerging contaminant that had been injected prior to being identified.	• Seek other source of fresh water • Implement treatment to remove harmful substance prior to injection

4.0 Selection of Preferred Freshwater Source

All of the freshwater options evaluated have some advantages and some drawbacks. The following section summarizes the relative strengths and weaknesses of each option and proposes a preferred option.

The HNWR-1 well is a proven water source, and initial testing shows that the capacity of nearby wells would not be affected if fresh water for the remedy was obtained from HNWR-1. The fact that it is an existing well with power already connected means that there would be less disturbance associated with use of HNWR-1 than with construction of a new well or river intake. The TDS of the HNWR-1 water is well within the requirements for the remedy. Piping can be routed over existing corridors between HNWR-1 and the compressor station. The primary drawback to the use of HNWR-1 is the elevated concentration of arsenic in the well. Geochemical modeling indicates that this arsenic will not migrate far from the injection points and will dissipate within a reasonable period of time after the completion of the remedy. If arsenic does not behave as predicted, a treatment plant could be constructed at the compressor station to remove arsenic from the water prior to injection. Another possible drawback is that HNWR-1 is located outside the existing APE, but this is offset because by using an existing well, the disturbance that would be associated with installation of new well can be avoided, and the APE can be amended under the Programmatic Agreement should use of HNWR-1 be selected as desirable.

Water obtained from a well or wells near Moabi Regional Park in California would likely not have arsenic elevated above the MCL. Electric power is available nearby and there is a pipeline route along National Trials Highway to deliver the water to the compressor station. The primary drawback is that the aquifer at Moabi Regional Park does not appear to be capable of delivering a sufficient quantity of water for the remedial action without adversely affecting the quality and quantity of water available from the existing wells that supply water to Moabi Regional Park. It is also likely that the TDS of the water from a high capacity well would be greater than 3,000 mg/L, making it undesirable for injection into the less saline, upper portions of the aquifer at the Topock site. It might also contain iron and manganese at concentrations that would require conditioning prior to injection.

It is possible that a well or wells drilled some distance to the north of Moabi Regional Park might provide an adequate supply of freshwater, but these wells would be far outside the existing APE in a relatively undisturbed area with no power or improved roads. Exploratory drilling would be required to determine if the aquifer in this area north of the Park could provide a sufficient quantity and quality of water. Piping and power would need to be extended over relatively large distances through a relatively undisturbed area. There would likely be significant delays to the project associated with development of a water supply from wells north of Moabi Regional Park.

A river intake structure could offer a secure source of water for the duration of the remedy. Availability of water from the river would not be affected by development in the local area. The river water has low TDS, As, and Cr(VI). One of the key drawbacks to a river intake is the process and the time needed for getting approvals (which may ultimately be infeasible) and authorizations necessary prior to construction. Multiple agencies will be involved in the consultation and approvals. Specifically, the DOI ROD states that remedial design will be performed in a manner that does not result in a “take” of threatened or endangered species, or damage their critical habitat. California state law also prohibits the take of state-listed “Fully Protected Species”, such as the razorback sucker, except where a conservation plan has been approved and is being implemented to ensure protection of those species pursuant to the California Natural Community Conservation Planning Act. Preliminary discussion with CDFG indicated that approval of a fish screen and intake structure that would avoid incidental take of the razorback sucker may be difficult to obtain. This issue will need to be explored further, may not be feasible, and would likely add more time to the project.

In addition, river water needs to be conditioned to remove suspended solids and bacteria. Presuming that a river intake structure could be allowed to be built within the Project Area, there would be disturbance associated with the construction of the structure and a cofferdam and the associated conditioning facility. Lastly, the river water contains some trace contaminant compounds such as perchlorate, pharmaceuticals, and personal care products, these might in the future become contaminants of concern, requiring treatment or possible remediation of the area affected by the freshwater injection.

After reviewing the available options for a freshwater supply, the use of the HNWR-1 well presents less uncertainty, less risk to project schedule, and less disturbance of the site. Arsenic treatment is not necessary and the arsenic will be monitored during the progress of the remedy. Because the contingency of arsenic treatment could be implemented within the compressor station property, the downtime due to approvals and consultation could be minimized with pre-planning. HNWR-1 is therefore considered the preferred freshwater supply option for the remedial action.

5.0 References

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Figures

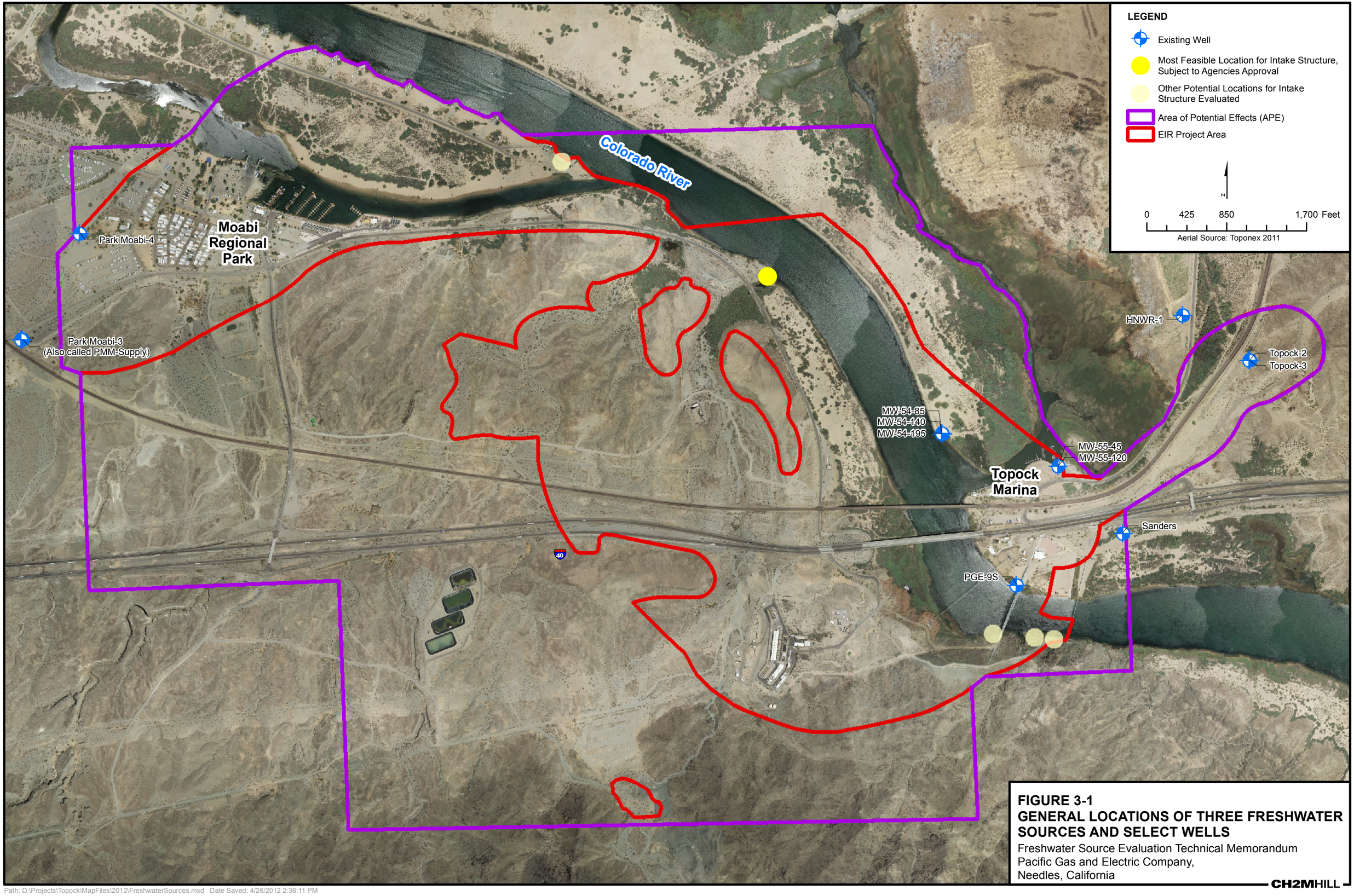
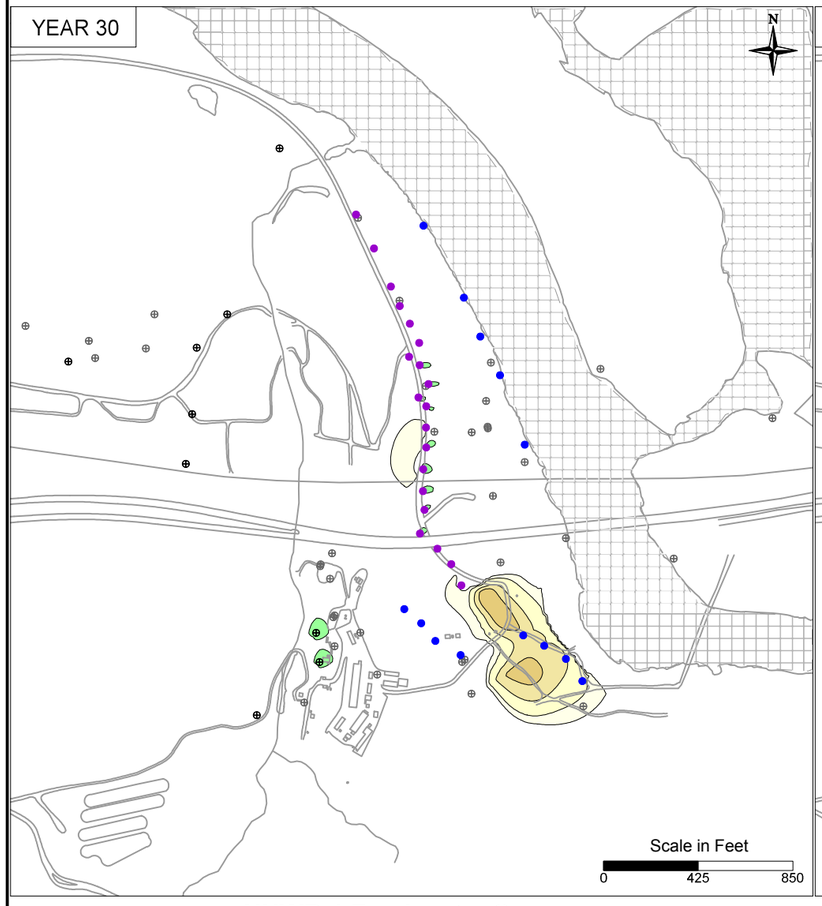


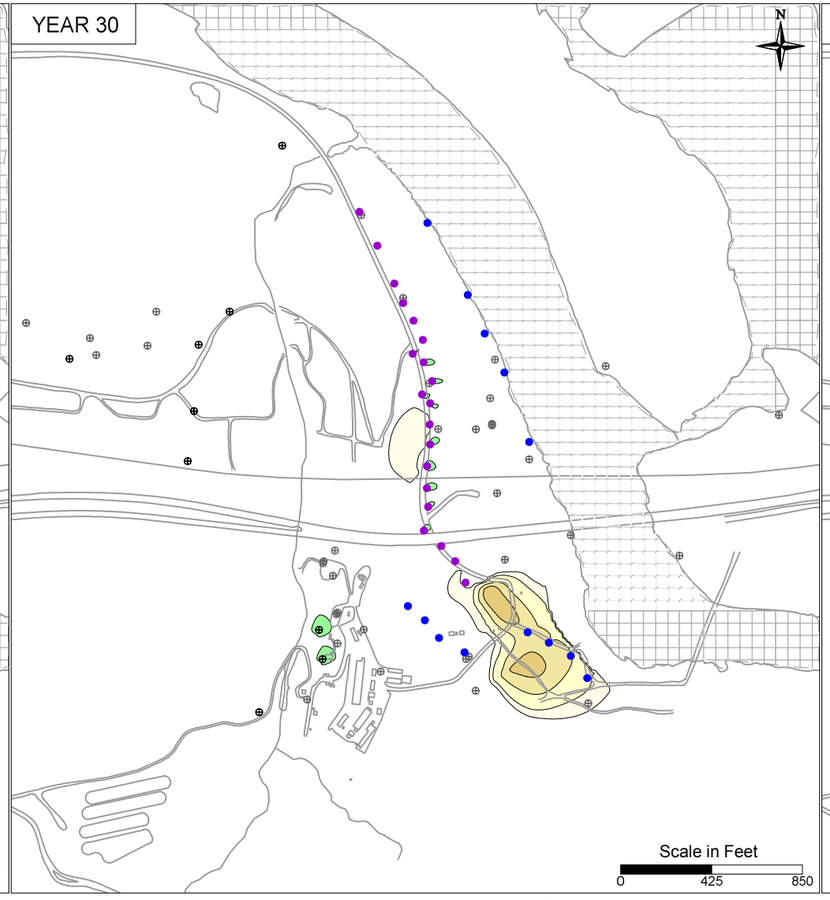
FIGURE 3-1
GENERAL LOCATIONS OF THREE FRESHWATER SOURCES AND SELECT WELLS
Freshwater Source Evaluation Technical Memorandum
Pacific Gas and Electric Company,
Needles, California

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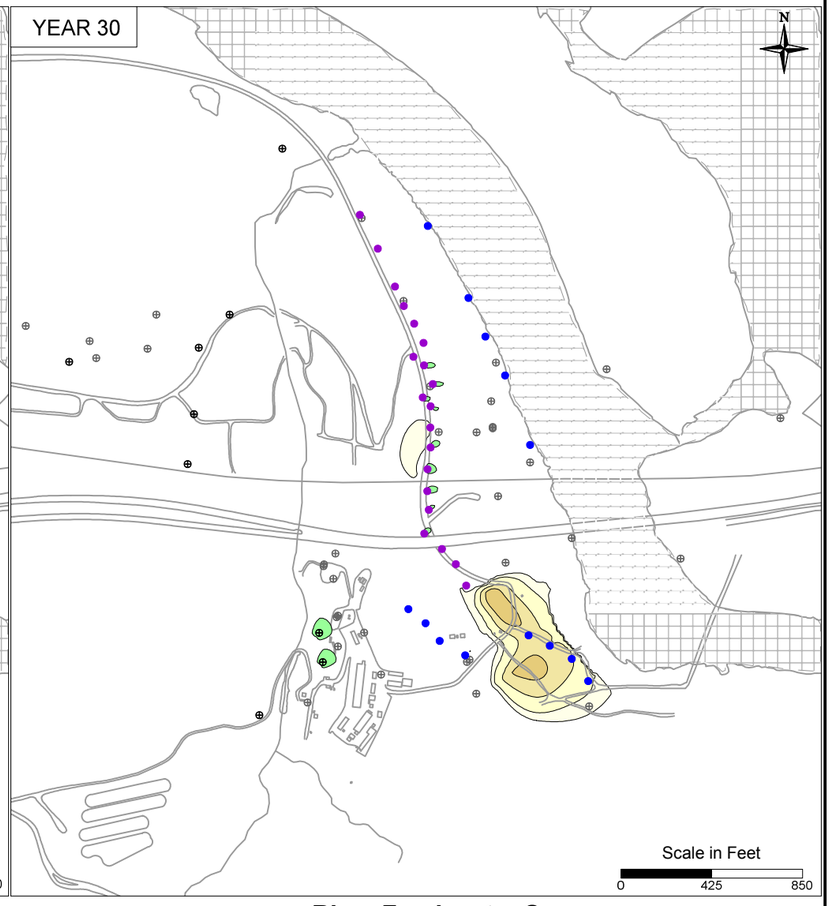
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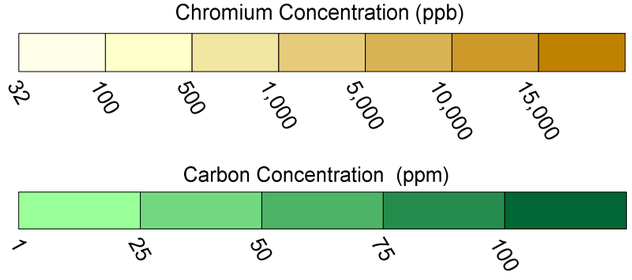
HNWR-1 Freshwater Source



Park Moabi Freshwater Source



River Freshwater Source



LEGEND

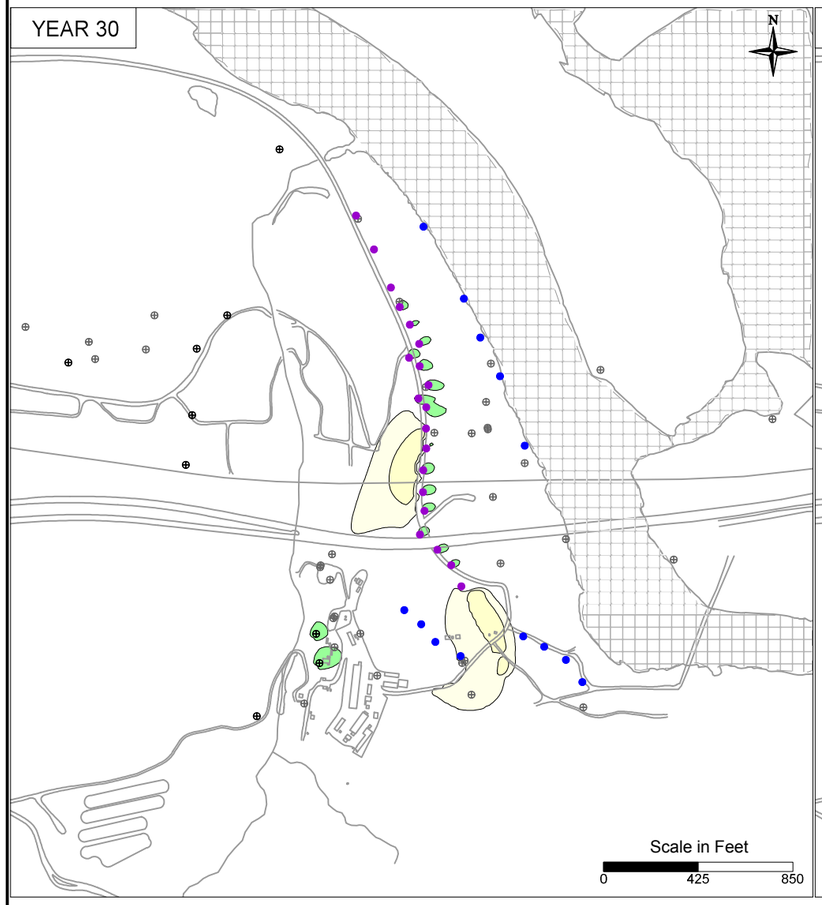
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PG&E
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NEEDLES, CALIFORNIA
MODELING APPENDIX

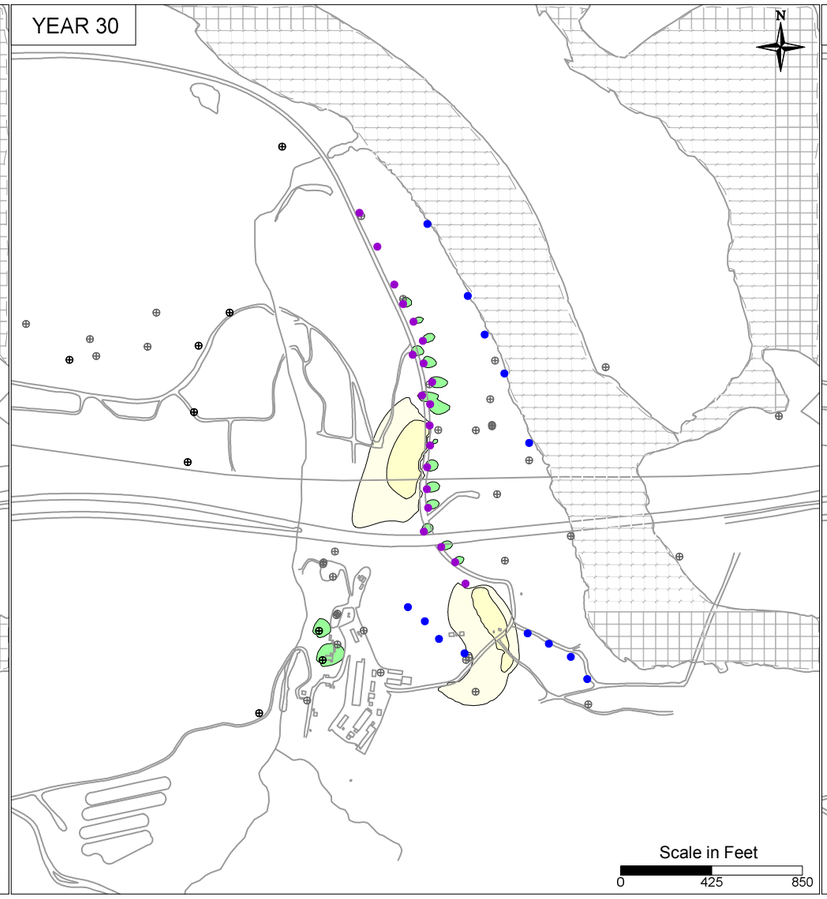
FRESHWATER SOURCE EVALUATION:
30 YEAR SIMULATED HEXAVALENT CHROMIUM TRANSPORT RESULTS IN MODEL LAYER 1

ARCADIS

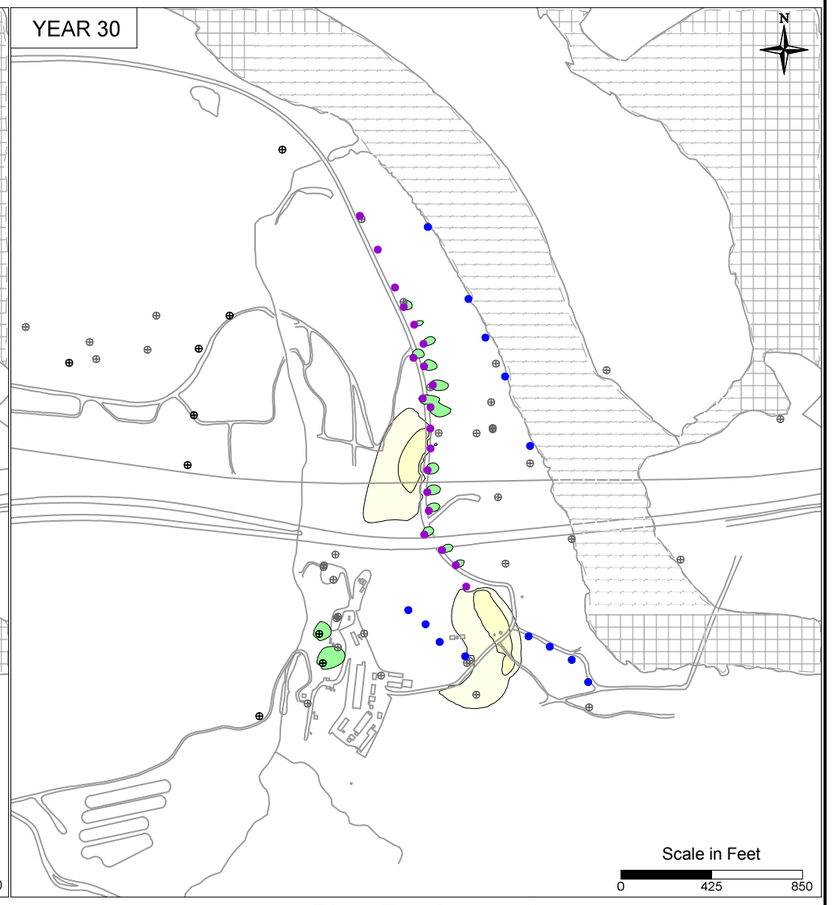
FIGURE
3-2



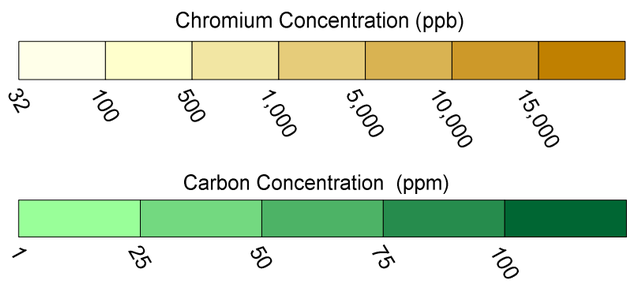
HNWR-1 Freshwater Source



Park Moabi Freshwater Source



River Freshwater Source



LEGEND

- IRZ WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- MONITORING WELLS

PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
MODELING APPENDIX

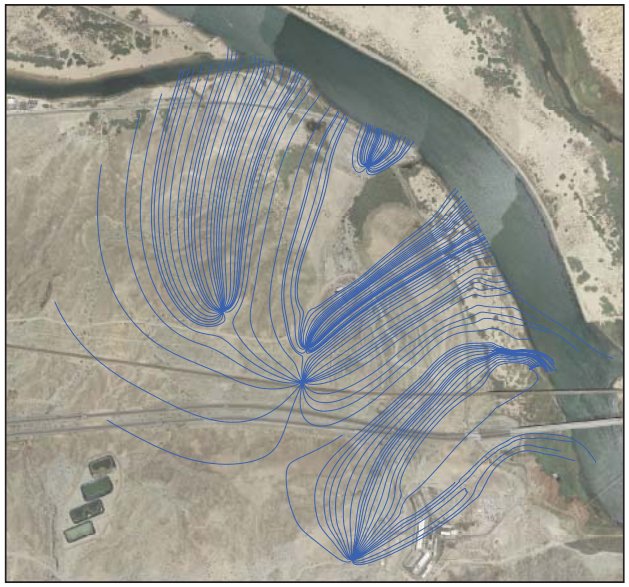
FRESHWATER SOURCE EVALUATION:
30 YEAR SIMULATED HEXAVALENT CHROMIUM TRANSPORT RESULTS IN MODEL LAYER 3

ARCADIS

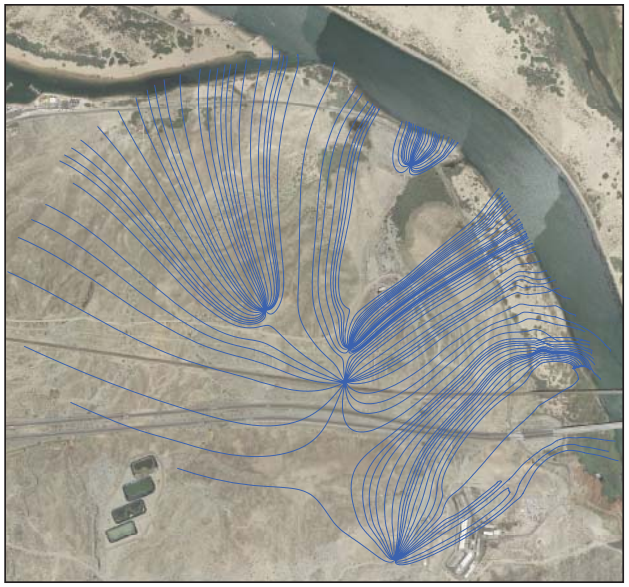
FIGURE
3-3

Sub-surface particle tracks from Freshwater Injection Points (Layer 1)

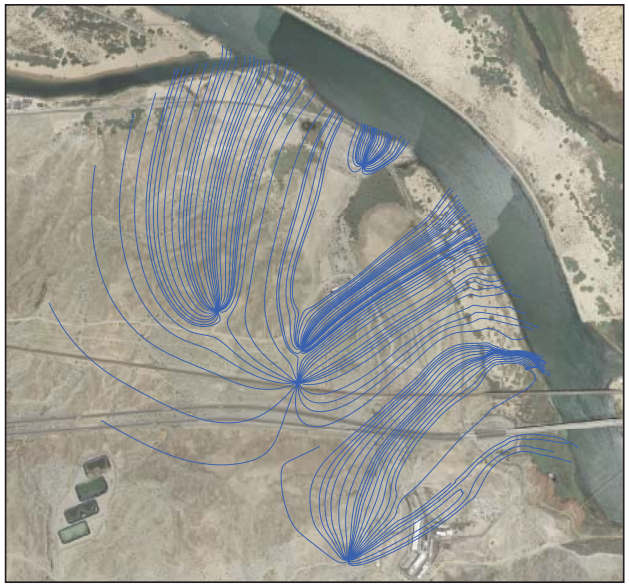
Simulation Time = 30 yr



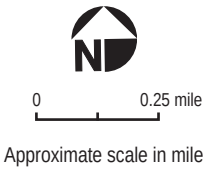
HNWR-1



Park Moabi



River

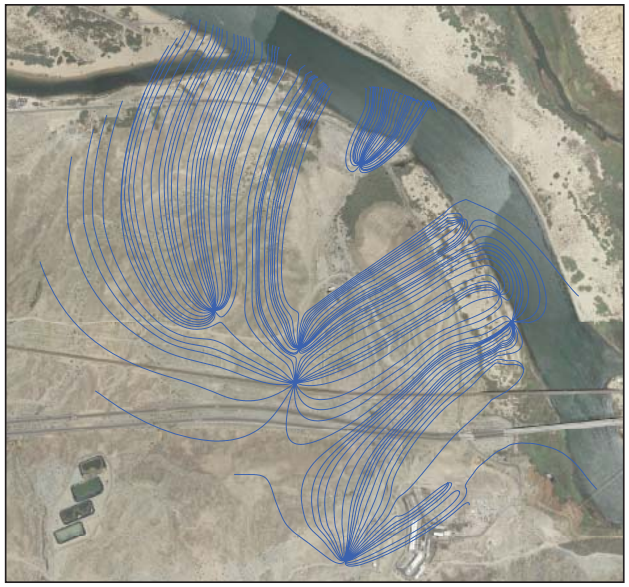


Approximate scale in mile

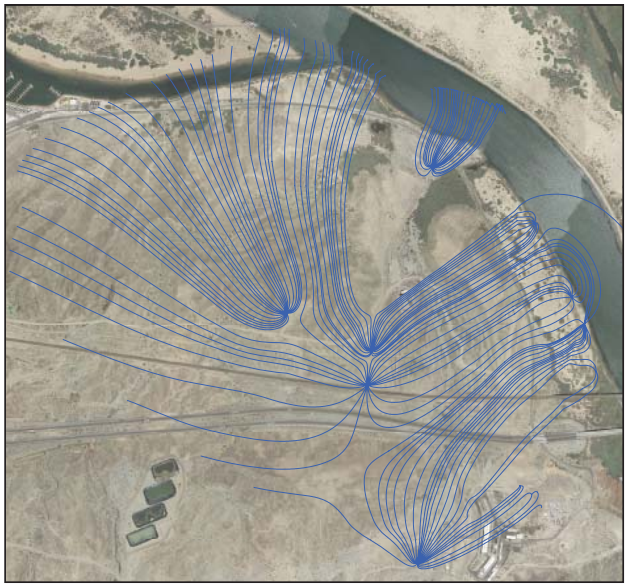
FIGURE 3-4
Freshwater Source Evaluation Technical Memorandum
PG&E Topock Compressor Station
Needles, California

Sub-surface particle tracks from Freshwater Injection Points (Layer 3)

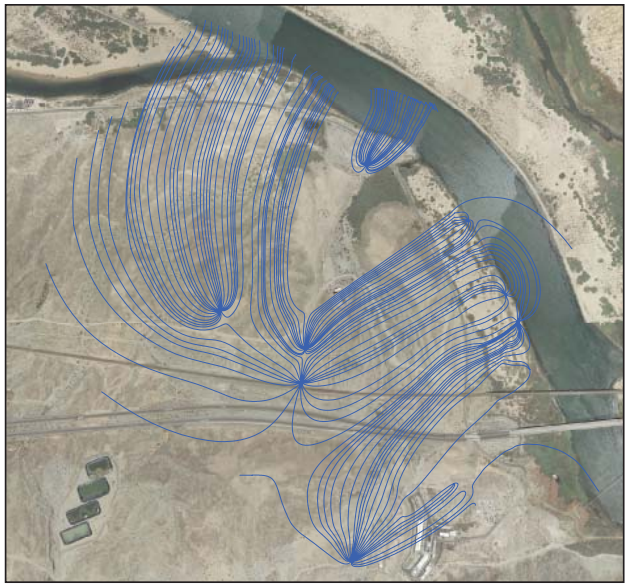
Simulation Time = 30 yr



HNWR-1



Park Moabi



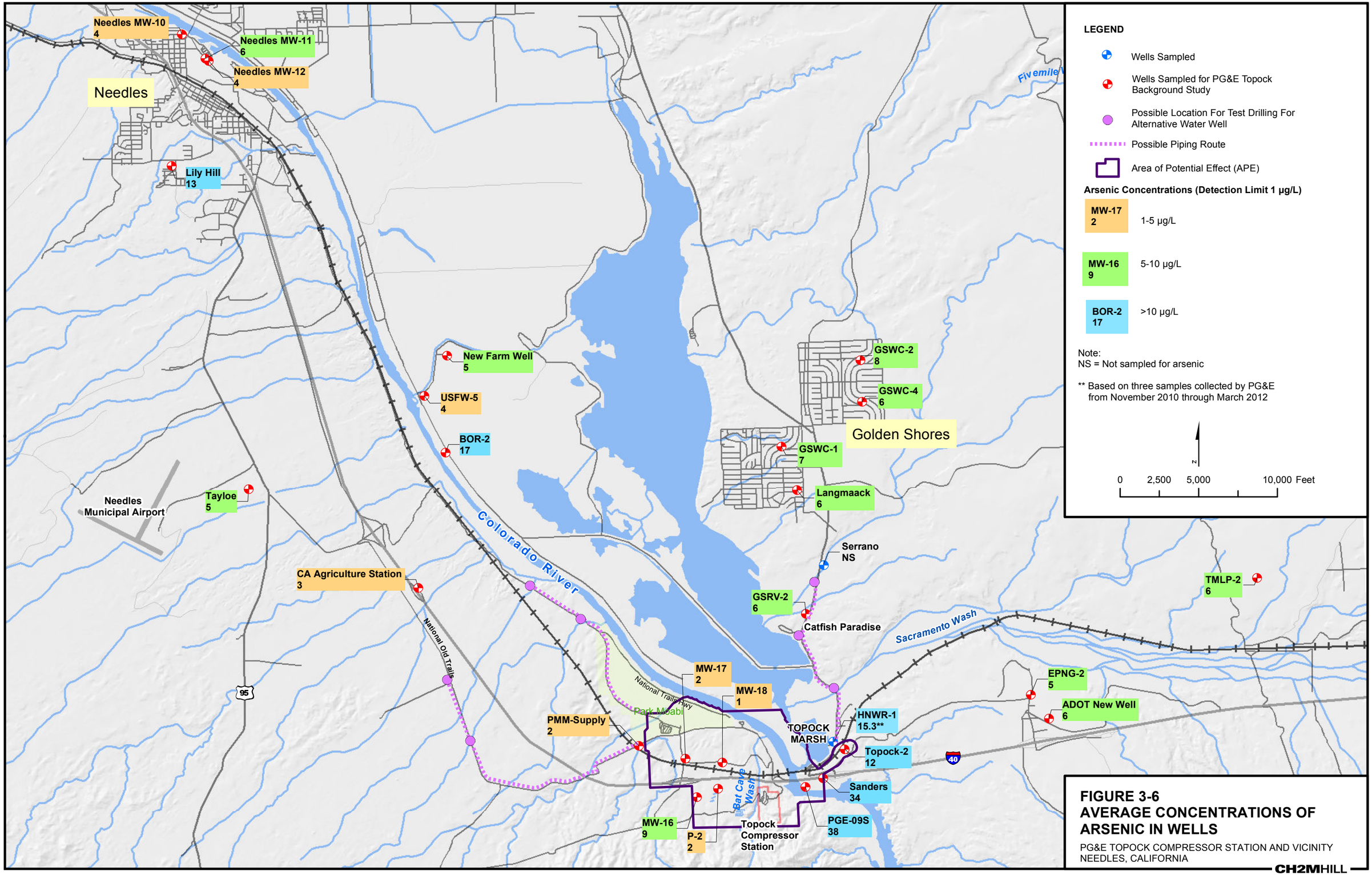
River



Approximate scale in mile

FIGURE 3-5
Freshwater Source Evaluation Technical Memorandum
PG&E Topock Compressor Station
Needles, California

CH2MHILL



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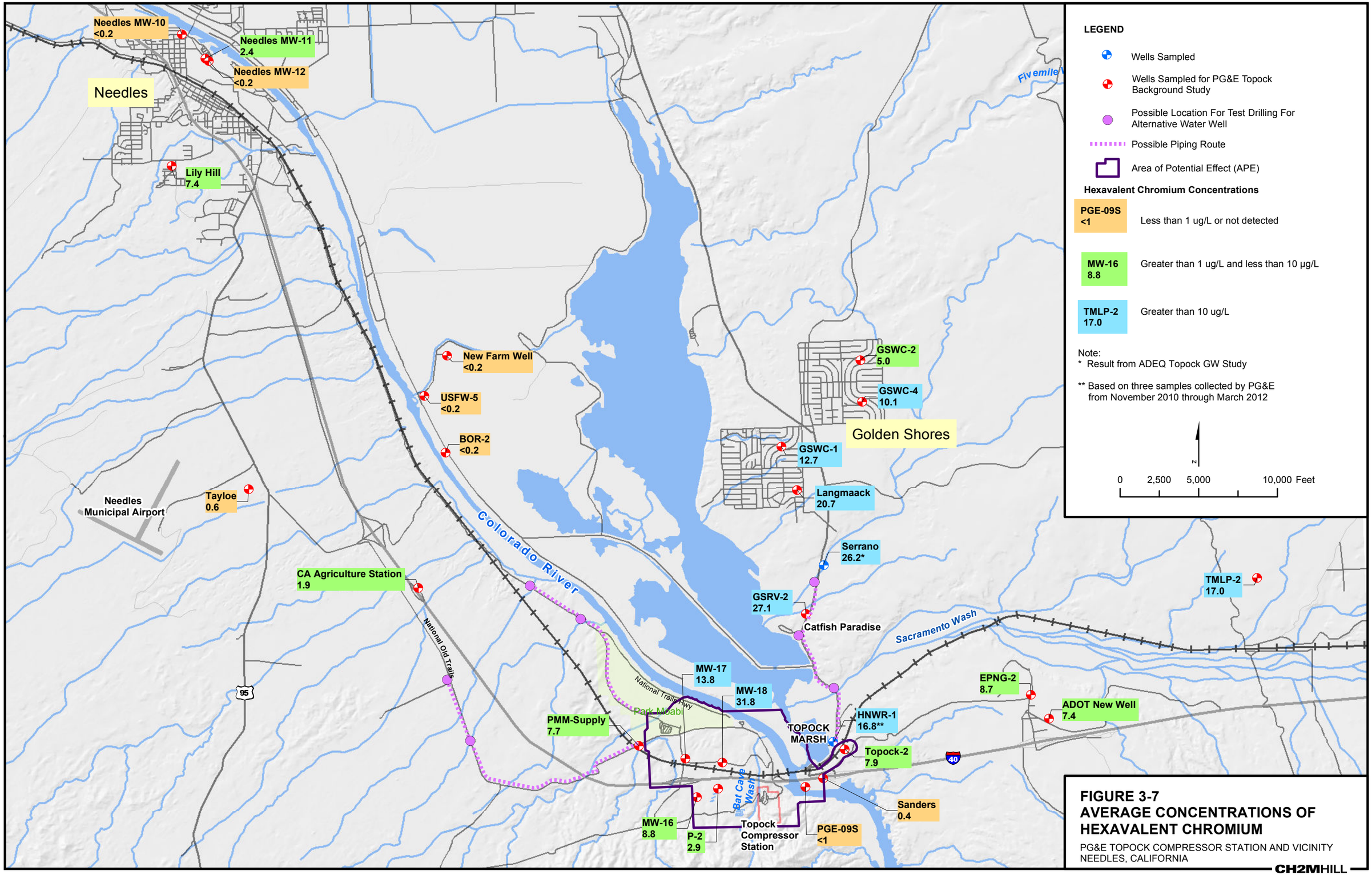
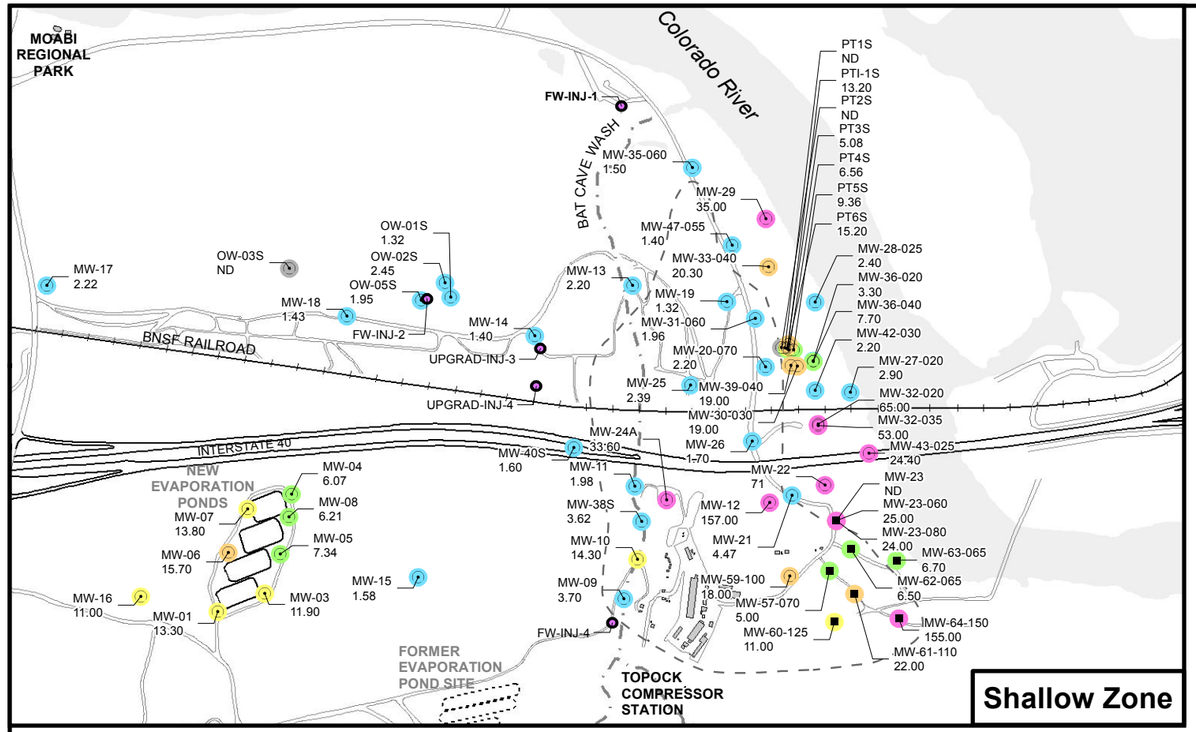
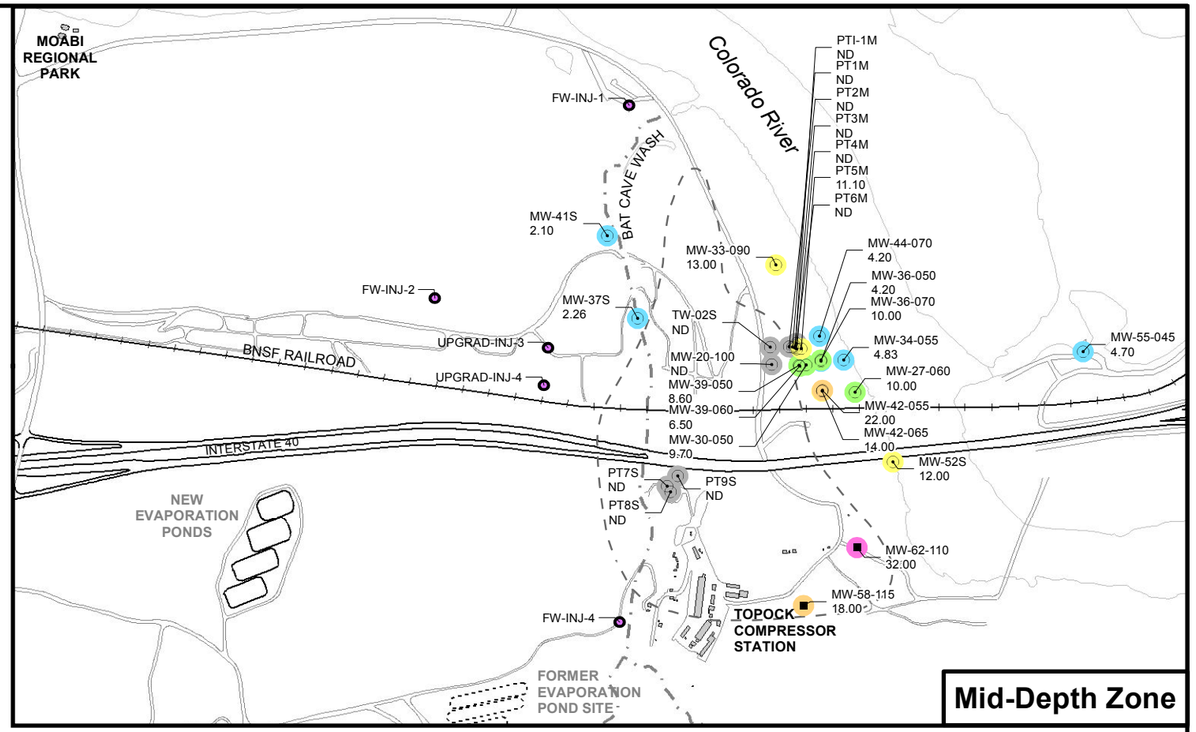


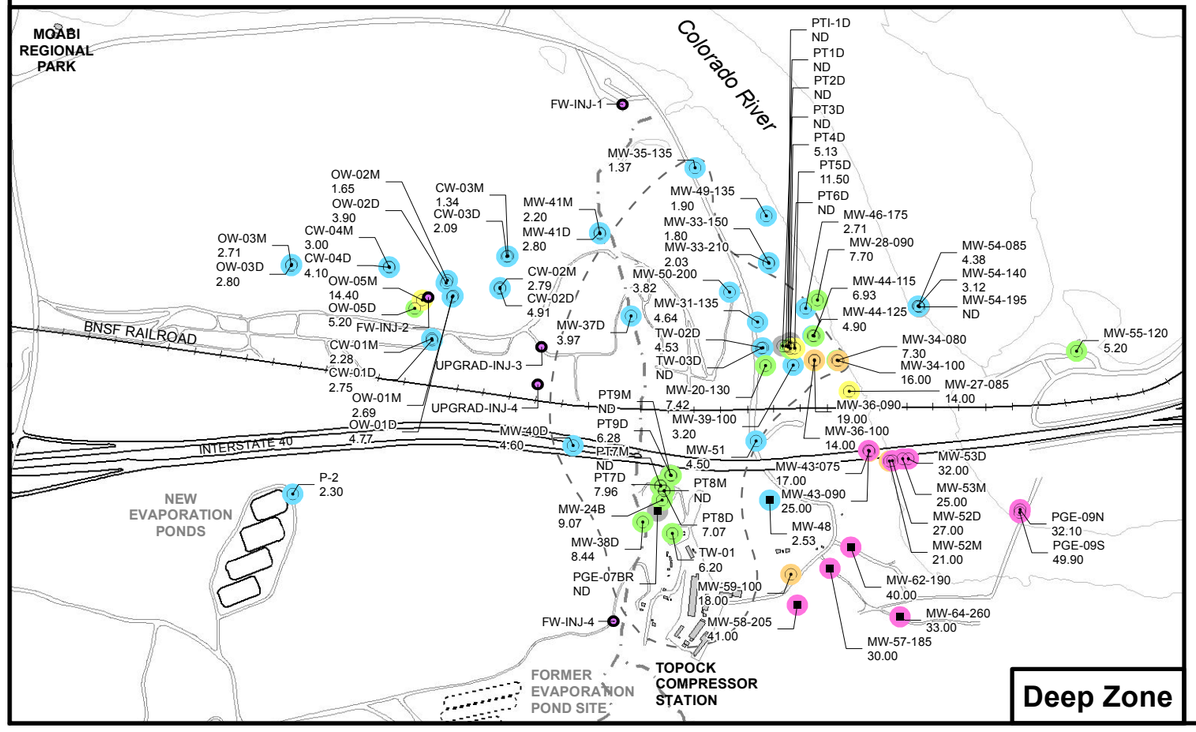
FIGURE 3-7
AVERAGE CONCENTRATIONS OF HEXAVALENT CHROMIUM
PG&E TOPOCK COMPRESSOR STATION AND VICINITY
NEEDLES, CALIFORNIA

CH2MHILL

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LEGEND

- Bedrock Well
- Groundwater Well completed in Alluvial Aquifer (Shallow, Mid-depth or Deep Zones)
- Freshwater Injection Well

Dissolved Arsenic Concentrations

MW-10 ← Well ID

5.8 ← Maximum concentration, micrograms per liter (µg/L) 1997-2011 groundwater sampling

- ND
- < 5 µg/L
- 5 - 10 µg/L
- 10.1 - 15 µg/L
- 15.1 - 24.3 µg/L
- > 24.3 µg/L

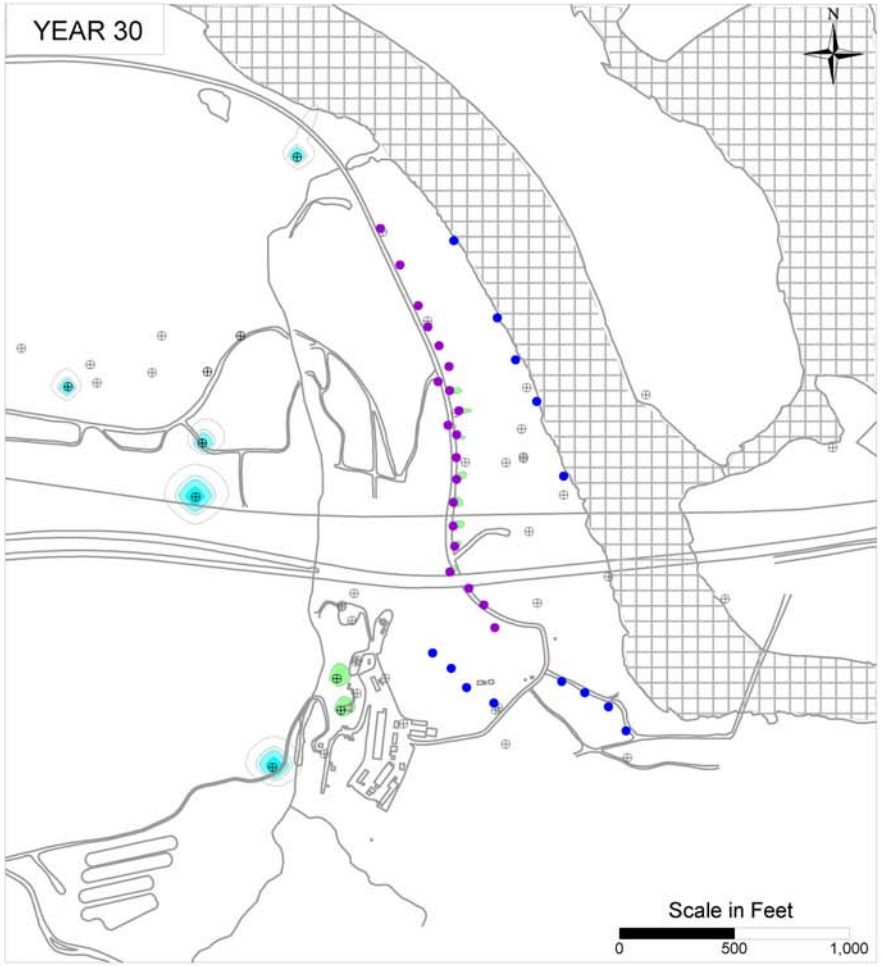
Approximate outline of Cr(VI) in Aluvial Aquifer depth zone ≥ 32 µg/L, Fourth Quarter 2011.

Notes:
Arsenic Background Study Upper Tolerance Limit (UTL) = 24.3 µg/L
Arsenic Applicable or Relevant and Appropriate Requirement (ARAR) = 10 µg/L

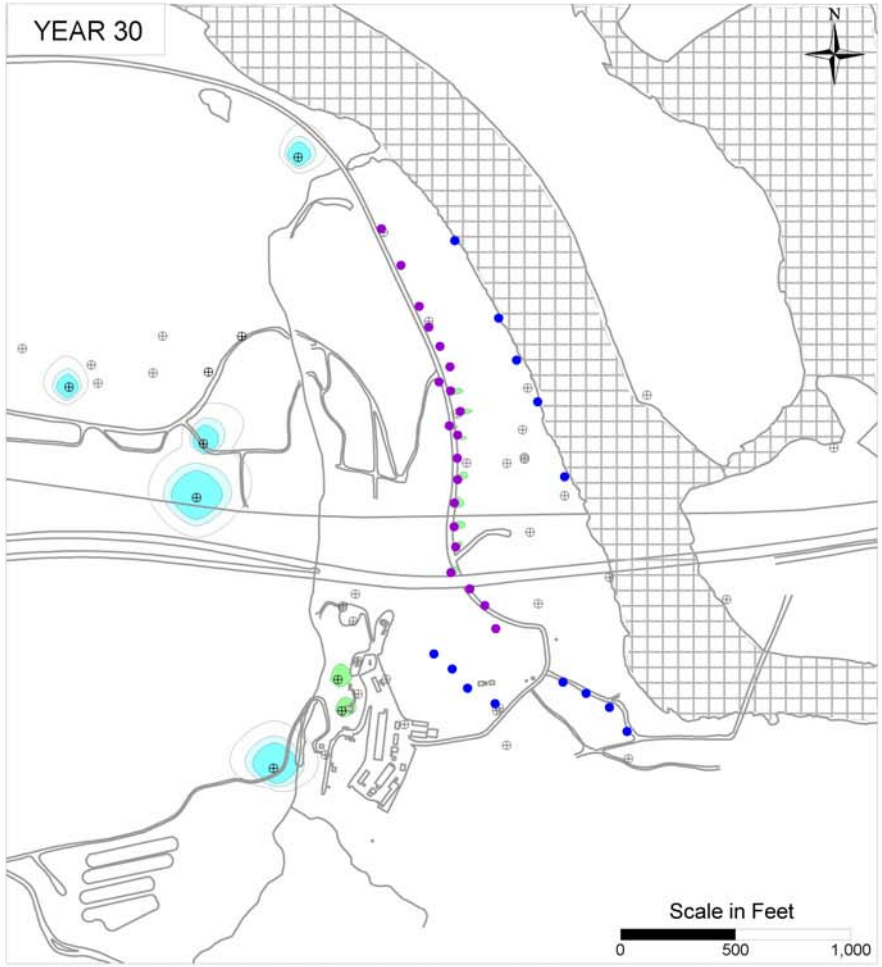
FIGURE 3-8
MAXIMUM ARSENIC CONCENTRATIONS IN GROUNDWATER, 1997 THROUGH 2011

RCRA FACILITY INVESTIGATION/REMEDIAL INVESTIGATION REPORT (VOLUME 2 ADDENDUM)
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

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30% Design: Arsenic Precipitation Only



Update: Uplands Arsenic Sorption Only

Arsenic Concentration (ppm)

0.005 0.01 0.012 0.015

Carbon Concentration (ppm)

1 25 50 75 100

LEGEND

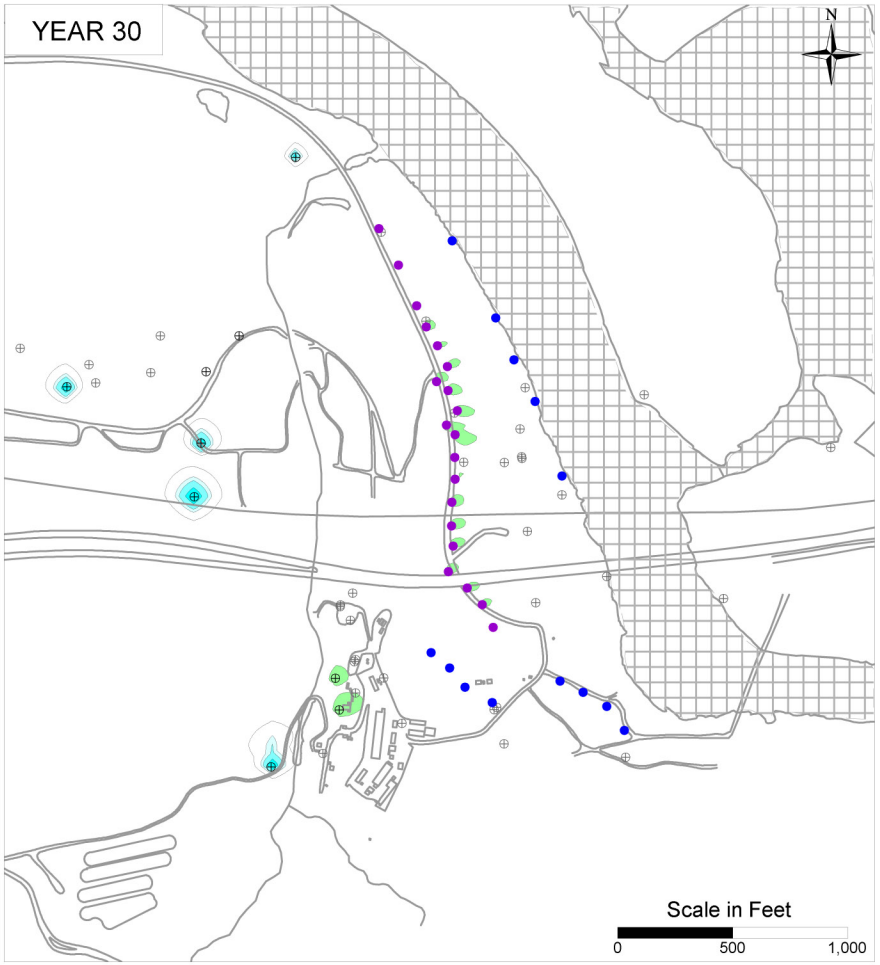
- IRZ WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- MONITORING WELLS

PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

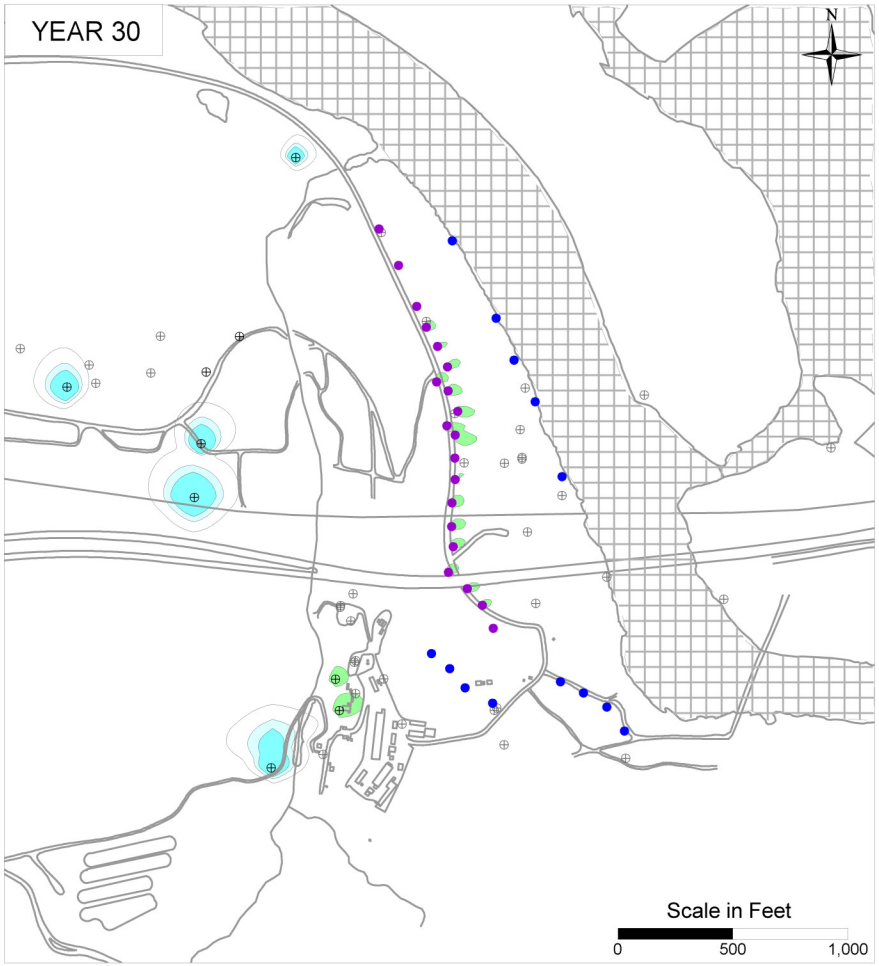
ARSENIC PARAMETER REFINEMENT:
30 YEAR SIMULATED ARSENIC TRANSPORT
RESULTS IN MODEL LAYER 1

ARCADIS

FIGURE
3-9



30% Design: Arsenic Precipitation Only



Update: Uplands Arsenic Sorption Only

Arsenic Concentration (ppm)

0.005 0.01 0.012 0.015

Carbon Concentration (ppm)

1 25 50 75 100

LEGEND

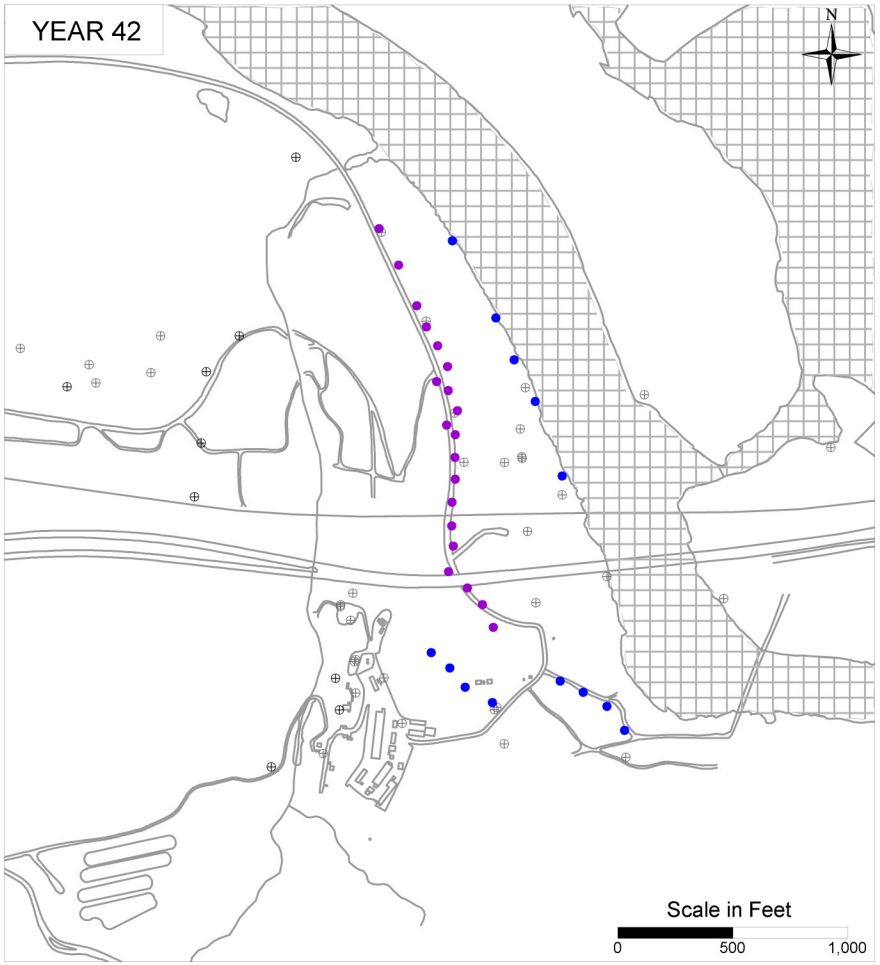
- IRZ WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- MONITORING WELLS

PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

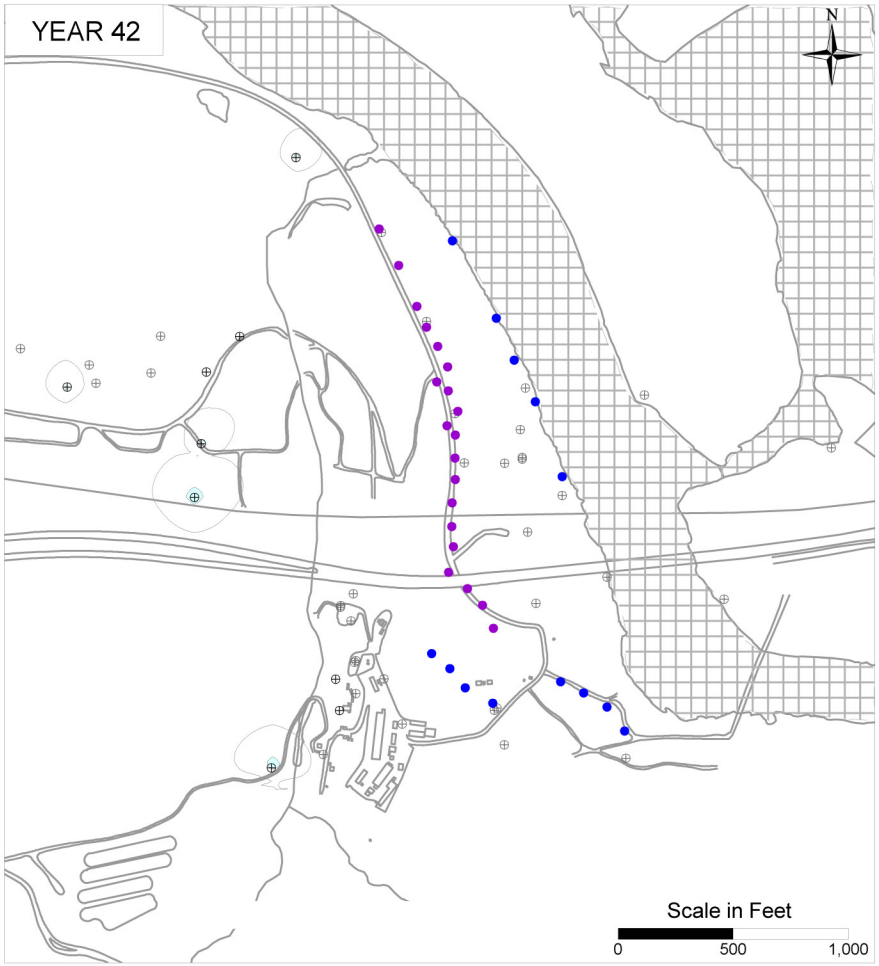
ARSENIC PARAMETER REFINEMENT:
30 YEAR SIMULATED ARSENIC TRANSPORT
RESULTS IN MODEL LAYER 3

ARCADIS

FIGURE
3-10



30% Design: Arsenic Precipitation Only



Update: Uplands Arsenic Sorption Only

Arsenic Concentration (ppm)

0.005 0.01 0.012 0.015

Carbon Concentration (ppm)

1 25 50 75 100

LEGEND

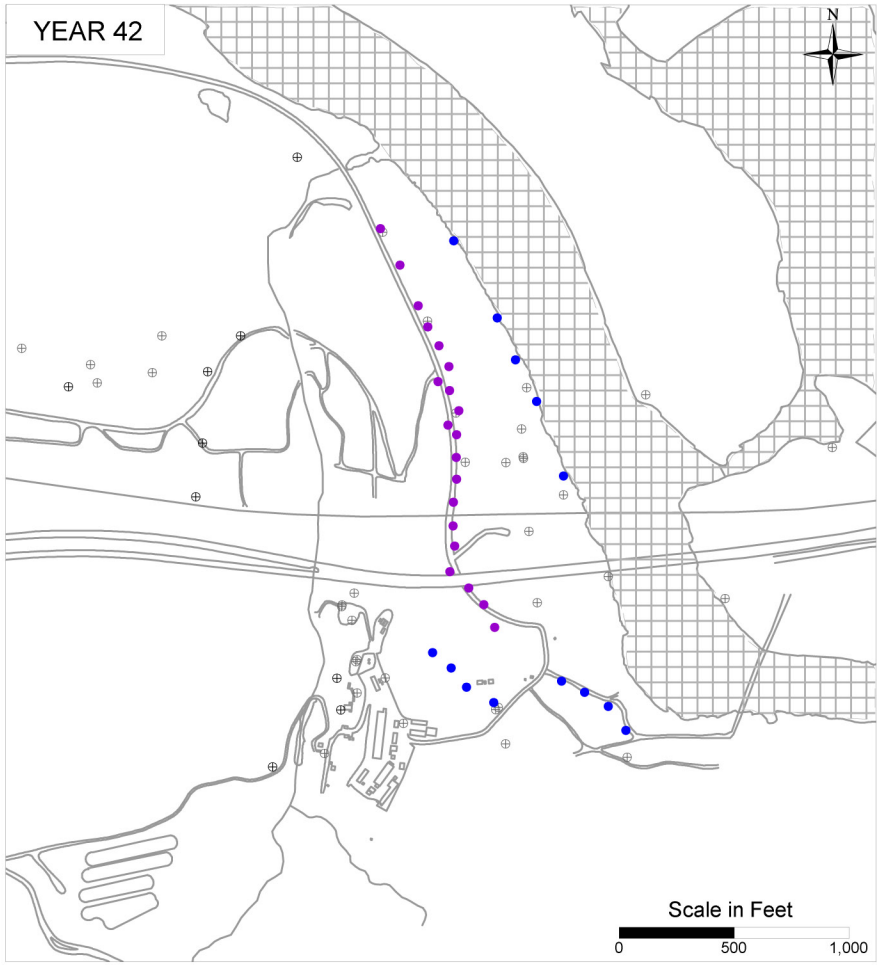
- IRZ WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- MONITORING WELLS

PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

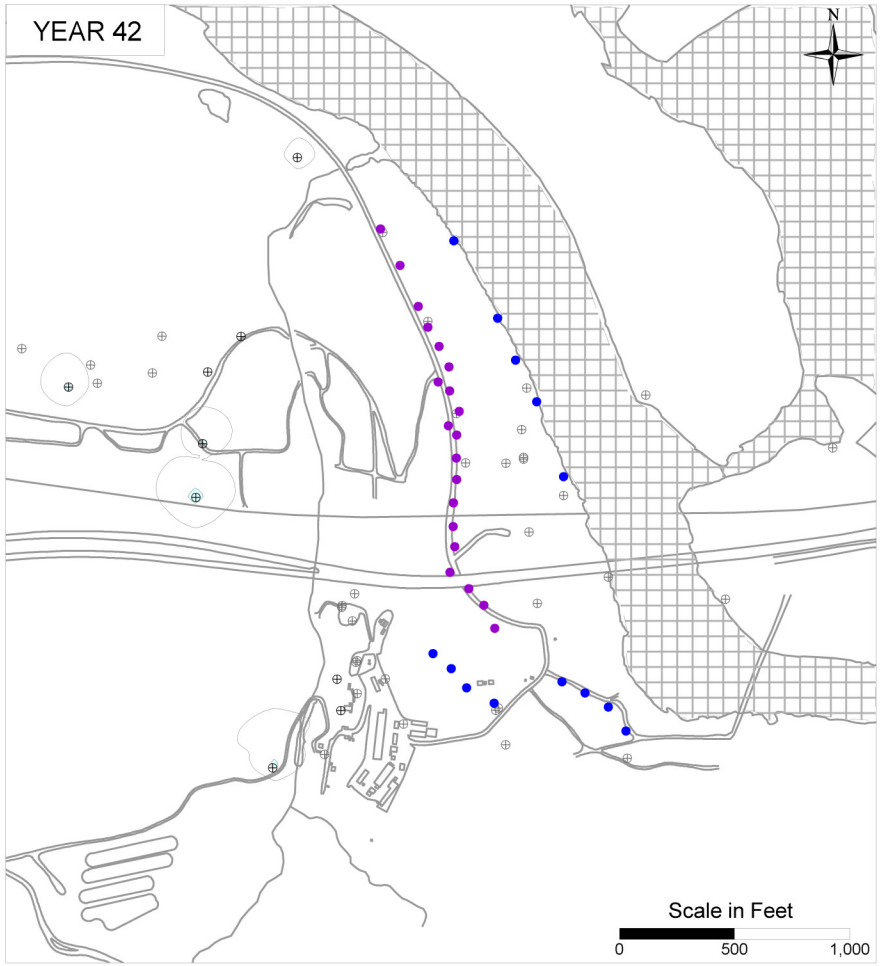
ARSENIC PARAMETER REFINEMENT:
42 YEAR SIMULATED ARSENIC RECOVERY
TRANSPORT RESULTS IN MODEL LAYER 1

ARCADIS

FIGURE
3-11



30% Design: Arsenic Precipitation Only



Update: Uplands Arsenic Sorption Only

Arsenic Concentration (ppm)

0.005 0.01 0.012 0.015

Carbon Concentration (ppm)

1 25 50 75 100

LEGEND

- IRZ WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- MONITORING WELLS

PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

ARSENIC PARAMETER REFINEMENT:
42 YEAR SIMULATED ARSENIC RECOVERY
TRANSPORT RESULTS IN MODEL LAYER 3

ARCADIS

FIGURE
3-12

Tables

TABLE 3-1
Summary of Available Data from Wells near Park Moabi, California and near Topock Marina, Arizona
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

	Well No. / Name	Description	Casing Depth	Casing Diameter	Perforated Interval	Pumping Rate (gpm)	Specific Capacity	Available Water Quality Information	Current Status
Wells Near Moabi Regional Park, California	**PM-01**	Original well drilled in 1961	190'	10"	28' to 180'	350 gpm	16 gpm/ft	TDS = 1,500 to 3,000 mg/L* (Cr(VI) and As not available)	Unknown. Well was sounded in 1986.
	PM-02	Unused PM supply well. Exact location unknown	114'	10"	86' to 106'	430 gpm	Unknown	Well reportedly produced highly saline water and was considered unusable	Unknown
	PM-03 (also called PMM-Supply)	Well installed in 1986 near where Natl. Trails Highway crosses RR tracks	210'	8"	80' to 200'	60 gpm	0.8 gpm/ft	TDS = 500 mg/L Cr(VI) <= 9.6 µg/L Arsenic = 1.7 µg/L Manganese <10 µg/L Dissolved Iron = 50 µg/L Nitrate = 3.1 mg/L Avg. Selenium = 1.6 µg/L Avg. Molybdenum = 5.4 µg/L	Active
	PM-04	Well installed in 2006 near bathrooms	145'	8"	93' to 140'	40 gpm	0.8 gpm/ft	TDS = 900 mg/L Cr(VI) <=21.4 µg/L Arsenic <=1.0 µg/L Manganese <10 µg/L Dissolved Iron = 60 µg/L Nitrate = 2.2 mg/L Selenium = 1.47 µg/L Molybdenum = 6.02 µg/L	Active
	Park Moabi Infiltration Gallery	Consisted of 300' of perforated pipe laid near river draining a 26' deep sump	26' deep sump	4' diameter sump	300' of horizontal pipe	Estimated to be 40 to 70 gpm	Unknown	TDS = 2,000 mg/L (Cr(VI) and As not available) Reverse osmosis was needed to make water usable. R.O. system produced 18 gpm	Unknown
	Park Moabi Test Boring	Test boring installed near existing Park Moabi water tanks	512' borehole depth	No casing installed	NA	NA	Unknown	Not sampled	Abandoned Borehole produced very little water so no well was installed.
	Unnamed Well Used for Highway Construction	Located about 1/2 mile west of Park Moabi	86'	12"	Unknown	< 5 gpm	Unknown	Unknown	Unknown. Well was sounded in 1986.

TABLE 3-1
Summary of Available Data from Wells near Park Moabi, California and near Topock Marina, Arizona
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

	Well No. / Name	Description	Casing Depth	Casing Diameter	Perforated Interval	Pumping Rate (gpm)	Specific Capacity	Available Water Quality Information	Current Status
Wells near Topock Marina, Arizona**	**Topock - 2**	Water Supply Well Installed 1980	140'	12"	100' to 140'	Est. 200 gpm with current pump	11 gpm/ ft***	TDS = 900 mg/L Cr(VI) = 7 µg/L Arsenic = 12 µg/L Avg Mn = 3.1 µg/L	Active
	Topock - 3	Water Supply Well Installed 1974	130'	12"	85' to 130'	Est. 200 gpm with current pump	30 gpm/ ft***	TDS = 800 mg/L Cr(VI) = 11 µg/L Arsenic = 14 µg/L	Active
	HNWR -1	Irrigation Well for Pilot Revegetation Project	157'	10"	92' to 157'	900 gpm	12 gpm/ft	TDS = 480-500 mg/L Cr(T) = 16 µg/L Cr(VI) = 15-16 µg/L Arsenic = 14-15 µg/L Manganese = 0.64-1.9 µg/L Dissolved Iron = <20-37 µg/L Nitrate = 2.5-2.6 mg/L Selenium = 0.73-0.87 µg/L Molybdenum = 9.4-11 µg/L	Active
	MW-54 Cluster	Monitoring Well, Nested	85', 140', 195'	2" each	10-foot screen	NA	NA	TDS>= 6,000 mg/L (MW-54-85) TDS> 12,000 mg/L (MW-54-195) Avg TDS = 8,800 mg/L (all 3 wells) Cr(VI)<reporting limit (all 3 wells) Mn = 199 to 1090 µg/L As < 4.4 µg/L	Active
	MW-55 Cluster	Monitoring Well, Nested	45', 120'	2" each	10-foot screen	NA	NA	As = 4.7-5.2 ug/L Cr(VI)<=6.91 ug/L (MW-55-120) Mn = <100 to 1,230 µg/L	Active
	PGE-9S	Water Supply Well	100'	12"	70-foot screen	NA	NA	Cr(VI)<1 µg/L Avg As = 38.5 µg/L Avg Mn = 1,320 µg/L	No
	Sanders	Water Supply Well	230'	12"	Unknown	NA	NA	Cr(VI)<1 µg/L Avg As = 33.7µg/L Avg Mn = 99.8 µg/L	Unknown

Notes:
* In its comments #142 DTSC-55 and #143DTSC-56, DTSC noted that the 3,000 mg/L value cited in the report appears to be an error as PG&E data indicates TDS ranged from 800 to 1,000 mg/L circa 2005 to 2006 in well PM-1 and that unlike what was presented in Exhibit 3-1, well PM-01 data for chromium and arsenic are available. Cr(VI) measures about 9µg/L while arsenic is around 2µg/L. In response to these comments, PG&E reviewed its database and did not locate any PM-01 well data. The TDS value of 3000 mg/L cited came from the Crandall report (Crandall 1986b). The values cited in DTSC comments are data for well PMM-Supply, also known as well PM-03.

TABLE 3-1
Summary of Available Data from Wells near Park Moabi, California and near Topock Marina, Arizona
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

Well No. / Name	Description	Casing Depth	Casing Diameter	Perforated Interval	Pumping Rate (gpm)	Specific Capacity	Available Water Quality Information	Current Status

** - In response to comments DTSC-55 through DTSC-57 and DTSC-66, PG&E performed a well search in the Arizona Department of Water Resources (ADWR) Imaged Records Database but was unable to identify any new wells in the area. Using the Earth Point Townships layer in Google Earth, the cadastral location of the Topock Marina area was determined. This included only Quadrant B, Township 15 North, Range 21 West, Section 3, as all other surrounding property on the Arizona side were determined to belong to the Havasu National Wildlife Refuge. This cadastral location was used to conduct the well search in the ADWR database records. The ADWR database is current as of December 13, 2011, as stated on the ADWR website. Available information regarding wells and their corresponding files in the section that includes the Topock Marina were downloaded from the database and reviewed. These wells were then compared to PG&E's current database of wells in that location. It was determined that no new wells existed in the ADWR database near the Topock Marina.

PG&E recently learned from the Topock Marina Resort that no onsite well is currently planned and that water will be purchased from an existing water purveyor. PG&E will continue to inquire about the Resort's planned water use. New information, if any, obtained will be provided.

*** From pump test conducted by PG&E in 2012.

TABLE 3-2

SUMMARY OF HNWR-1 WELL SAMPLE RESULTS

Freshwater Sources Evaluation Technical Memorandum

PG&E Topock Compressor Station, Needles, California

	Location:	HNWR-01	HNWR-01	HNWR-01	HNWR-01
	Sample Date:	**11/10/2010**	**2/23/2012**	**3/14/2012**	**4/4/2012**
Parameter	**Units**				
Field					
Dissolved oxygen	mg/L	**5.33**	**3.52**	**3.29**	**3.72**
Oxidation reduction potential	mV	**159**	**172**	**200**	**112**
pH	pH units	**7.84**	**7.68**	**7.61**	**8.07**
Salinity	%	**0.42**	**0.0662**	**0.0537**	**0.0509**
Specific conductance	µS/cm	**870**	**1,024**	**830**	**787**
Temperature	°C	**35.9**	**38.3**	**38.1**	**38.0**
Turbidity	NTU	**5.10**	**5.10**	**2.50**	**---**
Anions					
Chloride	mg/L	**---**	**130**	**130**	**130**
Fluoride	mg/L	**3.80**	**---**	**---**	**---**
Nitrate (as nitrogen)	mg/L	**2.50**	**2.60**	**2.50**	**2.50**
Sulfate	mg/L	**47.0**	**45.0**	**44.0**	**45.0**
General Chemistry					
Alkalinity, bicarb as CaCO3	mg/L	**---**	**110**	**110**	**110**
Alkalinity, carb as CaCO3	mg/L	**---**	ND (5.0)	ND (5.0)	ND (5.0)
Alkalinity, hydroxide	mg/L	**---**	ND (5.0)	ND (5.0)	ND (5.0)
Alkalinity, total as CaCO3	mg/L	**100**	**110**	**110**	**110**
Ammonia as nitrogen	mg/L	ND (0.1)	**0.13**	**0.12**	**0.15**
Cyanide	mg/L	**---**	**---**	ND (0.01)	**---**
Deuterium	0/00	**-75.3**	**-73.8**	**---**	**---**
Oxygen 18	0/00	**-10.3**	**-10.2**	**---**	**---**
Soluble silica	mg/L	**28.6**	**---**	**---**	**---**
Specific conductance	µS/cm	**740**	**---**	**---**	**---**
Total dissolved solids	mg/L	**490 J**	**480**	**510**	**430**
Total Kjeldahl Nitrogen	mg/L	ND (0.4)	**---**	**---**	**---**
Total organic carbon	mg/L	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Total Suspended Solids (TSS)	mg/L	**---**	**---**	ND (10)	**---**
Herbicides					
2,4,5-T	µg/L	**---**	**---**	ND (2.7)	**---**
2,4,5-TP (Silvex)	µg/L	**---**	**---**	ND (2.7)	**---**
2,4-D	µg/L	**---**	**---**	ND (2.7)	**---**
2,4-DB	µg/L	**---**	**---**	ND (2.7)	**---**
4-Nitrophenol	µg/L	**---**	**---**	ND (2.7)	**---**
Dalapon	µg/L	**---**	**---**	ND (4.4)	**---**
Dicamba	µg/L	**---**	**---**	ND (2.7)	**---**
Dichlorprop	µg/L	**---**	**---**	ND (2.7)	**---**

TABLE 3-2
SUMMARY OF HNWR-1 WELL SAMPLE RESULTS
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

	Location:	HNWR-01	HNWR-01	HNWR-01	HNWR-01
	Sample Date:	11/10/2010	2/23/2012	3/14/2012	4/4/2012
Parameter	**Units**				
Herbicides					
Dinoseb	µg/L	---	---	ND (2.7)	---
MCPA	µg/L	---	---	ND (2.7)	---
MCPP	µg/L	---	---	ND (2.7)	---
Pentachloro phenol	µg/L	---	---	ND (2.7)	---
Metals					
Aluminum, dissolved	µg/L	ND (50)	---	ND (50)	ND (50)
Antimony, dissolved	µg/L	ND (10)	ND (10)	ND (10)	ND (10)
Arsenic, dissolved	µg/L	**15.0**	**15.0**	**16.0**	**15.0**
Barium, dissolved	µg/L	**130**	**110**	**110**	**110**
Beryllium, dissolved	µg/L	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Boron, dissolved	µg/L	**380**	---	---	---
Cadmium, dissolved	µg/L	ND (3.0)	ND (3.0)	ND (3.0)	ND (3.0)
Calcium, dissolved	µg/L	**23,000**	**19,000 J**	**19,000**	**20,000**
Chromium, Hexavalent	µg/L	**17.5**	**15.0**	**18.0**	**14.0**
Chromium, total dissolved	µg/L	**19.2**	**16.0**	**18.0**	**17.0**
Cobalt, dissolved	µg/L	ND (3.0)	ND (3.0)	ND (3.0)	ND (3.0)
Copper, dissolved	µg/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
Iron, dissolved	µg/L	ND (20)	**37.0**	ND (20)	**25.0**
Lead, dissolved	µg/L	ND (10)	ND (10)	ND (10)	ND (10)
Magnesium, dissolved	µg/L	**4,000**	**3,100**	**3,200 J**	**3,100 J**
Manganese, dissolved	µg/L	ND (10)	**1.90**	**0.64**	**1.70**
Mercury, dissolved	µg/L	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
Molybdenum, dissolved	µg/L	**11.0**	**9.40**	**10.0**	**9.00**
Nickel, dissolved	µg/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
Potassium, dissolved	µg/L	**5,100**	**4,400**	**4,000**	**3,700**
Selenium, dissolved	µg/L	**0.73**	**0.87**	**0.75**	**0.75**
Silver, dissolved	µg/L	ND (3.0)	ND (3.0)	ND (3.0)	ND (3.0)
Sodium, dissolved	µg/L	**130,000**	**130,000**	**130,000**	**130,000**
Thallium, dissolved	µg/L	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
Vanadium, dissolved	µg/L	**20.0**	**21.0**	**22.0 J**	**20.0**
Zinc, dissolved	µg/L	ND (10)	ND (10)	**16.0**	ND (10)
Perchlorate					
Perchlorate	µg/L	---	---	ND (2.0)	ND (2.0)
Pesticides					
4,4-DDD	µg/L	---	---	ND (0.053)	ND (0.052)
4,4-DDE	µg/L	---	---	ND (0.053)	ND (0.052)

TABLE 3-2
SUMMARY OF HNWR-1 WELL SAMPLE RESULTS
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

	Location:	HNWR-01	HNWR-01	HNWR-01	HNWR-01
	Sample Date:	11/10/2010	2/23/2012	3/14/2012	4/4/2012
Parameter	**Units**				
Pesticides					
4,4-DDT	µg/L	---	---	ND (0.053)	ND (0.052)
Aldrin	µg/L	---	---	ND (0.027)	ND (0.026)
alpha-BHC	µg/L	---	---	ND (0.027)	ND (0.026)
alpha-Chlordane	µg/L	---	---	ND (0.027)	ND (0.026)
beta-BHC	µg/L	---	---	ND (0.027)	ND (0.026)
delta-BHC	µg/L	---	---	ND (0.027)	ND (0.026)
Dieldrin	µg/L	---	---	ND (0.053)	ND (0.052)
Endo sulfan I	µg/L	---	---	ND (0.027)	ND (0.026)
Endo sulfan II	µg/L	---	---	ND (0.053)	ND (0.052)
Endosulfan sulfate	µg/L	---	---	ND (0.053)	ND (0.052)
Endrin	µg/L	---	---	ND (0.053)	ND (0.052)
Endrin aldehyde	µg/L	---	---	ND (0.053)	ND (0.052)
gamma-BHC	µg/L	---	---	ND (0.027)	ND (0.026)
gamma-Chlordane	µg/L	---	---	ND (0.027)	ND (0.026)
Heptachlor	µg/L	---	---	ND (0.027)	ND (0.026)
Heptachlor Epoxide	µg/L	---	---	ND (0.027)	ND (0.026)
Methoxy chlor	µg/L	---	---	ND (0.27)	ND (0.26)
Toxaphene	µg/L	---	---	ND (2.7) J	ND (2.6) J
Polyaromatic Hydrocarbons					
1-Methyl naphthalene	µg/L	---	---	ND (0.22)	ND (0.2)
2-Methyl naphthalene	µg/L	---	---	ND (0.22)	ND (0.2)
Acenaphthene	µg/L	---	---	ND (0.22)	ND (0.2)
Acenaphthylene	µg/L	---	---	ND (0.22)	ND (0.2)
Anthracene	µg/L	---	---	ND (0.22)	ND (0.2)
Benzo (a) anthracene	µg/L	---	---	ND (0.22)	ND (0.2)
Benzo (a) pyrene	µg/L	---	---	ND (0.22)	ND (0.2)
Benzo (b) fluoranthene	µg/L	---	---	ND (0.22)	ND (0.2)
Benzo (ghi) perylene	µg/L	---	---	ND (0.22)	ND (0.2)
Benzo (k) fluoranthene	µg/L	---	---	ND (0.22)	ND (0.2)
Chrysene	µg/L	---	---	ND (0.22)	ND (0.2)
Dibenzo (a,h) anthracene	µg/L	---	---	ND (0.22)	ND (0.2)
Fluoranthene	µg/L	---	---	ND (0.22)	ND (0.2)
Fluorene	µg/L	---	---	ND (0.22)	ND (0.2)
Indeno (1,2,3-cd) pyrene	µg/L	---	---	ND (0.22)	ND (0.2)
Naphthalene	µg/L	---	---	ND (0.22)	ND (0.2)
Phenanthrene	µg/L	---	---	ND (0.22)	ND (0.2)
Pyrene	µg/L	---	---	ND (0.22)	ND (0.2)

TABLE 3-2
SUMMARY OF HNWR-1 WELL SAMPLE RESULTS
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

Location:		HNWR-01	HNWR-01	HNWR-01	HNWR-01
Sample Date:		**11/10/2010**	**2/23/2012**	**3/14/2012**	**4/4/2012**
Parameter	**Units**				
Polychlorinated Biphenyls					
Aroclor 1016	µg/L	---	---	ND (0.53)	ND (0.52)
Aroclor 1221	µg/L	---	---	ND (1.1)	ND (1.0)
Aroclor 1232	µg/L	---	---	ND (0.53)	ND (0.52)
Aroclor 1242	µg/L	---	---	ND (0.53)	ND (0.52)
Aroclor 1248	µg/L	---	---	ND (0.53)	ND (0.52)
Aroclor 1254	µg/L	---	---	ND (0.53)	ND (0.52)
Aroclor 1260	µg/L	---	---	ND (0.53)	ND (0.52)
Total Petroleum Hydrocarbons					
TPH as diesel	µg/L	---	---	**190**	ND (51) J
TPH as gasoline	µg/L	---	---	ND (100)	ND (100)
TPH as motor oil	µg/L	---	---	ND (53)	ND (51)
Volatile Organic Compounds					
1,1,1,2-Tetrachloroethane	µg/L	---	---	ND (1.0)	ND (1.0)
1,1,1-Trichloroethane	µg/L	---	---	ND (1.0)	ND (1.0)
1,1,2,2-Tetrachloroethane	µg/L	---	---	ND (1.0)	ND (1.0)
1,1,2-Trichloroethane	µg/L	---	---	ND (1.0)	ND (1.0)
1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	---	---	ND (1.0)	ND (1.0)
1,1-Dichloroethane	µg/L	---	---	ND (1.0)	ND (1.0)
1,1-Dichloroethene	µg/L	---	---	ND (1.0)	ND (1.0)
1,1-Dichloropropene	µg/L	---	---	ND (1.0)	ND (1.0)
1,2,3-Trichlorobenzene	µg/L	---	---	ND (1.0)	ND (1.0)
1,2,3-Trichloropropane	µg/L	---	---	ND (1.0)	ND (1.0)
1,2,4-Trichlorobenzene	µg/L	---	---	ND (1.0)	ND (1.0)
1,2,4-Trimethylbenzene	µg/L	---	---	ND (1.0)	ND (1.0) J
1,2-Dibromo-3-chloropropane	µg/L	---	---	ND (2.0)	ND (2.0)
1,2-Dibromoethane	µg/L	---	---	ND (1.0)	ND (1.0)
1,2-Dichlorobenzene	µg/L	---	---	ND (1.0)	ND (1.0)
1,2-Dichloroethane	µg/L	---	---	ND (1.0)	ND (1.0)
1,2-Dichloropropane	µg/L	---	---	ND (1.0)	ND (1.0)
1,3,5-Trimethylbenzene	µg/L	---	---	ND (1.0)	ND (1.0) J
1,3-Dichlorobenzene	µg/L	---	---	ND (1.0)	ND (1.0)
1,3-Dichloropropane	µg/L	---	---	ND (1.0)	ND (1.0)
1,4-Dichlorobenzene	µg/L	---	---	ND (1.0)	ND (1.0)
2,2-Dichloropropane	µg/L	---	---	ND (1.0)	ND (1.0)
2-Chlorotoluene	µg/L	---	---	ND (1.0)	ND (1.0)
4-Isopropyltoluene	µg/L	---	---	ND (1.0)	ND (1.0)

TABLE 3-2
SUMMARY OF HNWR-1 WELL SAMPLE RESULTS
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

	Location:	HNWR-01	HNWR-01	HNWR-01	HNWR-01
	Sample Date:	**11/10/2010**	**2/23/2012**	**3/14/2012**	**4/4/2012**
Parameter	**Units**				
Volatile Organic Compounds					
Acetone	µg/L	---	---	ND (10)	ND (10)
Acrolein	µg/L	---	---	ND (20)	ND (20)
Acrylonitrile	µg/L	---	---	ND (20)	ND (20)
Benzene	µg/L	---	---	ND (1.0)	ND (1.0)
Bromobenzene	µg/L	---	---	ND (1.0)	ND (1.0)
Bromochloromethane	µg/L	---	---	ND (1.0)	ND (1.0)
Bromodichloromethane	µg/L	---	---	ND (1.0)	ND (1.0)
Bromoform	µg/L	---	---	ND (1.0)	ND (1.0)
Bromomethane	µg/L	---	---	ND (1.0)	ND (1.0)
Carbon disulfide	µg/L	---	---	ND (1.0)	ND (1.0)
Carbon tetrachloride	µg/L	---	---	ND (1.0)	ND (1.0)
Chloro methane	µg/L	---	---	ND (1.0)	ND (1.0)
Chlorobenzene	µg/L	---	---	ND (1.0)	ND (1.0)
Chloroethane	µg/L	---	---	ND (1.0)	ND (1.0)
Chloroform	µg/L	---	---	ND (1.0)	ND (1.0)
cis-1,2-Dichloroethene	µg/L	---	---	ND (1.0)	ND (1.0)
cis-1,3-Dichloropropene	µg/L	---	---	ND (1.0)	ND (1.0)
Dibromochloromethane	µg/L	---	---	ND (1.0)	ND (1.0)
Dibromomethane	µg/L	---	---	ND (1.0)	ND (1.0)
Dichlorodifluoromethane	µg/L	---	---	ND (1.0)	ND (1.0)
Ethylbenzene	µg/L	---	---	ND (1.0)	ND (1.0)
Hexachlorobutadiene	µg/L	---	---	ND (1.0)	ND (1.0)
Isopropylbenzene	µg/L	---	---	ND (1.0)	ND (1.0)
m,p-Xylenes	µg/L	---	---	ND (1.0)	ND (1.0)
Methyl ethyl ketone	µg/L	---	---	ND (10)	ND (10)
Methyl isobutyl ketone	µg/L	---	---	ND (10)	ND (10)
Methyl tert-butyl ether (MTBE)	µg/L	---	---	ND (1.0)	ND (1.0) J
Methylene chloride	µg/L	---	---	ND (5.0)	ND (5.0)
N-Butylbenzene	µg/L	---	---	ND (1.0)	ND (1.0)
N-Propylbenzene	µg/L	---	---	ND (1.0)	ND (1.0)
o-Xylene	µg/L	---	---	ND (1.0)	ND (1.0)
p-Chlorotoluene	µg/L	---	---	ND (1.0)	ND (1.0)
sec-Butylbenzene	µg/L	---	---	ND (1.0)	ND (1.0)
Styrene	µg/L	---	---	ND (1.0)	ND (1.0) J
tert-Butylbenzene	µg/L	---	---	ND (1.0)	ND (1.0)
Tetrachloroethene	µg/L	---	---	ND (1.0)	ND (1.0)
Toluene	µg/L	---	---	ND (2.5)	ND (2.5)

TABLE 3-2

SUMMARY OF HNWR-1 WELL SAMPLE RESULTS

Freshwater Sources Evaluation Technical Memorandum

PG&E Topock Compressor Station, Needles, California

	Location:	HNWR-01	HNWR-01	HNWR-01	HNWR-01
	Sample Date:	**11/10/2010**	**2/23/2012**	**3/14/2012**	**4/4/2012**
Parameter	**Units**				
Volatile Organic Compounds					
trans-1,2-Dichloroethene	µg/L	---	---	ND (1.0)	ND (1.0)
trans-1,3-Dichloropropene	µg/L	---	---	ND (1.0)	ND (1.0)
Trichloroethene	µg/L	---	---	ND (1.0)	ND (1.0)
Trichlorofluoromethane (Freon 11)	µg/L	---	---	ND (1.0)	ND (1.0)
Vinyl chloride	µg/L	---	---	ND (1.0)	ND (1.0)
Xylenes, total	µg/L	---	---	ND (2.0)	ND (2.0)

Notes:

---	not collected or not available.
%	percent
0/00	differences from global standards in ppt.
°C	degrees Celcius.
J	analyte was present, but reported value was estimated.
mg/L	milligrams per liter.
mV	millivolts.
ND	parameter not detected at the listed reporting limit.
NTU	nephelometric turbidity units.
µg/L	micrograms per liter.
µS/cm	microSiemens per centimeter.

TABLE 3-3
Moabi Regional Park, San Bernardino County, CA; Analytical Results - Historical Chemicals of Potential Concern
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

Location ID	Sample Date	Hexavalent Chromium (µg/L)	Dissolved ^ Chromium (µg/L)	Total Chromium (µg/L)	pH (phunits)	Specific Conductance (µS/cm)	Oxygen Reduction Potential (mV)	Dissolved Copper (µg/L)	Dissolved Nickel (µg/L)	Dissolved Zinc (µg/L)
PM-03	07/01/1997	ND (10)	18.0 J	---	7.88	1040	96.4	3.80 J	ND (25)	6.10
PM-03	09/01/1997	ND (10)	13.0 J	---	7.96	1140	---	ND (10)	ND (25)	12.0
PM-03	02/18/1998	ND (10)	ND (20)	---	7.94	1070	263	ND (10)	ND (25)	10.0
PM-03	06/15/1998	ND (10)	11.0 J	---	7.72	1120	189	3.70 J	ND (25)	11.0 J
PM-03	06/15/1999	ND (10)	ND (20)	---	7.89	1700	---	ND (10)	ND (25)	8.20
PM-03	09/14/1999	ND (10)	12.0 J	---	7.84	1330	249	18.0	ND (25)	15.0
PM-03	12/03/1999	ND (10)J	ND (20)	---	7.88 J	1210	113	ND (10)	5.00	21.0
PM-03	03/23/2000	ND (10)	12.0 J	---	7.44	877	198	4.10 J	ND (25)	47.0
PM-03	06/13/2000	ND (10)	13.0 J	---	7.86	1210	136	12.0	0.99 J	13.0
PM-03	09/01/2000	ND (10)	10.0 J	---	7.58	1570	250	3.60 J	1.70 J	4.80 J
PM-03	12/01/2000	ND (10)	ND (20)	---	7.79	1150	---	3.70 J	5.00	16.0
PM-03	03/28/2001	ND (10)	11.0 J	---	7.66	1650	263	ND (10)	1.30 J	6.40 J
PM-03	06/06/2001	ND (10)	ND (20)	---	7.72	1480	230	3.50 J	ND (25)	3.90 J
PM-03	08/25/2001	ND (10)	16.0 J	---	7.41	1040	301	3.40 J	1.10 J	57.0
PM-03	09/12/2001	ND (10)	ND (20)	---	7.89	1050	310	5.00 J	ND (25)	27.0
PM-03	11/29/2001	ND (10)	17.0 J	---	7.93	1680	183	5.80 J	ND (400)	24.0
PM-03	03/05/2002	ND (10)	---	22.3	7.70	2200	15.0 (a)	9.20 *	8.70 *	54.6 *
PM-03	03/18/2003	ND (10)	11.4	---	8.54 (a)	---	---	ND (11)	ND (28)	303
PM-03	11/04/2003	0.28	1.20	---	8.20 (a)	---	51.0 (a)	---	---	---
PM-03	12/11/2003	6.70	7.00	---	7.91	1250	-88 (a)	ND (10)	ND (20)	54.4

Notes:

(a) field measurements.
µg/L micrograms per liter (parts per billion).
µS/cm microSiemens per centimeter.
mV millivolts.
ND parameter not detected at the listed reporting limit.
J analyte was present, but reported value was estimated.
--- not collected or not available.
FD field duplicate.
* not filtered.
^ From May 2, 2007 onward, samples were collected for total (unfiltered) chromium rather than dissolved chromium.

TABLE 3-3
Moabi Regional Park, San Bernardino County, CA; Analytical Results - Historical Chemicals of Potential Concern
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

Location ID	Sample Date	Hexavalent Chromium (µg/L)	Dissolved ^ Chromium (µg/L)	Total Chromium (µg/L)	pH (phunits)	Specific Conductance (µS/cm)	Oxygen Reduction Potential (mV)	Dissolved Copper (µg/L)	Dissolved Nickel (µg/L)	Dissolved Zinc (µg/L)
PM-03	03/16/2004	2.60	2.10	7.60	7.87	1260	204 (a)	ND (10)	ND (20)	74.8 J
PM-03	06/09/2004	ND (0.2)	ND (1.0)	6.40	7.70	1140	-81 (a)	ND (10)	ND (20)	ND (120)
PM-03	09/22/2004	9.40	7.70	---	7.88	1260	118 (a)	---	---	---
PM-03	12/15/2004	ND (0.2)	ND (1.0)	---	8.08	1300	-235 (a)	---	---	---
PM-03	03/11/2005	0.35	ND (1.0)	---	8.03	1260	-59 (a)	---	---	---
PM-03 (FD)	05/18/2005	10.0	10.9	11.0	7.77	1260	---	4.75	ND (1.0)J	25.6
PM-03	05/18/2005	10.2	11.5	10.9	7.74	1220	93.0 (a)	4.64	2.71 J	37.5
PM-03	06/15/2005	9.90	8.60	---	8.16	1200	158 (a)	---	---	---
PM-03	07/21/2005	9.70	10.2	---	7.82 (a)	---	37.0 (a)	2.41	ND (1.0)	14.5
PM-03 (FD)	07/21/2005	9.60	10.8	---	---	---	---	1.52	ND (1.0)	24.7
PM-03	10/05/2005	9.20	7.60	---	7.69	1280	93.0 (a)	---	---	---
PM-03	11/02/2005	0.50	5.47	---	7.56 (a)	---	-131 (a)	1.98	ND (1.0)	51.6
PM-03	12/16/2005	ND (0.2)	ND (1.0)	---	7.38	2100	-26 (a)	---	---	---
PM-03	12/19/2005	7.90	9.89	---	7.72 (a)	---	27.0 (a)	ND (1.0)	ND (1.0)	22.2
PM-03	02/22/2006	8.40	9.46	---	7.16 (a)	---	214 (a)	1.02	ND (1.0)	29.0
PM-03	03/06/2006	9.50	7.80	---	7.69	1260	275 (a)	---	---	---
PM-03	05/01/2006	9.50	10.6	---	7.31 (a)	---	18.0 (a)	ND (1.0)	ND (1.0)	17.4
PM-03	05/03/2006	9.60	---	11.8	7.92	1300	112 (a)	---	---	---
PM-03	10/04/2006	2.00	6.30	---	7.25	1150	69.0 (a)	---	---	---
PM-03	05/02/2007	0.90	---	1.30	7.82 J	1890	14.0 (a)	---	---	---

Notes:

(a) field measurements.
µg/L micrograms per liter (parts per billion).
µS/cm microSiemens per centimeter.
mV millivolts.
ND parameter not detected at the listed reporting limit.
J analyte was present, but reported value was estimated.
--- not collected or not available.
FD field duplicate.
* not filtered.
^ From May 2, 2007 onward, samples were collected for total (unfiltered) chromium rather than dissolved chromium.

TABLE 3-3
Moabi Regional Park, San Bernardino County, CA; Analytical Results - Historical Chemicals of Potential Concern
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

Location ID	Sample Date	Hexavalent Chromium (µg/L)	Dissolved ^ Chromium (µg/L)	Total Chromium (µg/L)	pH (phunits)	Specific Conductance (µS/cm)	Oxygen Reduction Potential (mV)	Dissolved Copper (µg/L)	Dissolved Nickel (µg/L)	Dissolved Zinc (µg/L)
PM-03	10/04/2007	ND (1.0)	---	ND (1.0)	7.93 J	1920	-92.4 (a)	---	---	---
PM-03	10/02/2008	8.74	---	8.35	7.42 (a)	1400	-30 (a)	---	---	---
PM-03	10/01/2009	9.90	---	9.50	7.72 (a)	1400	345 (a)	---	---	---
PM-03	12/10/2010	11.9	---	10.5	7.57 (a)	1200	47.8 (a)	---	---	---
PM-03	12/12/2011	6.60	---	7.00	7.50 (a)	1400	13.4 (a)	---	---	---
PM-04	05/02/2007	ND (0.2)	---	ND (1.0)	7.99 J	1530	---	1.96	6.30	605 J
PM-04	10/04/2007	21.4	---	23.5	8.14 J	1720	-62.2 (a)	---	---	---
PM-04	11/13/2007	13.4	---	21.9	8.01 J	1470	-120 (a)	---	---	---
PM-04	10/02/2008	20.6	---	18.5	7.44 (a)	1700	-7.0 (a)	---	---	---
PM-04	10/01/2009	21.0	---	18.0	7.91 (a)	1800	726 R (a)	---	---	---
PM-04	12/10/2010	21.0	---	20.6	7.44 (a)	1700	39.5 (a)	---	---	---
PM-04	12/12/2011	18.9	---	18.2	7.70 (a)	1800	---	---	---	---

Notes:

(a)	field measurements.
µg/L	micrograms per liter (parts per billion).
µS/cm	microSiemens per centimeter.
mV	millivolts.
ND	parameter not detected at the listed reporting limit.
J	analyte was present, but reported value was estimated.
---	not collected or not available.
FD	field duplicate.
*	not filtered.
^	From May 2, 2007 onward, samples were collected for total (unfiltered) chromium rather than dissolved chromium.

TABLE 3-4
Moabi Regional Park, San Bernardino County, CA; Analytical Results, PM-03 - Sampling Events with Expanded Analyte Suite
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

Group	Analyte	Units	PM-03 1997 Qtr 2 7/1/1997	PM-03 2000 Qtr 3 9/1/2000	PM-03 2001 Qtr 4 11/29/2001	PM-03 2004 Qtr 2 6/9/2004 (a)	PM-03 BKG Study 01 5/18/2005	PM-03 (FD) BKG Study 01 5/18/2005	PM-03 BKG Study 02 7/21/2005	PM-03 (FD) BKG Study 02 7/21/2005	PM-03 BKG Study 03 11/2/2005	PM-03 BKG Study 04 12/19/2005	PM-03 BKG Study 05 2/22/2006	PM-03 BKG Study 06 5/1/2006	PM-03 2007 Qtr 3 10/4/2007	PM-03 2008 Qtr 3 10/2/2008	PM-03 2009 Qtr 3 10/1/2009	PM-03 2010 Qtr 4 12/10/2010	PM-03 2011 Qtr 4 12/12/2011
Anion																			
	Bromide	mg/L	---	---	---	---	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	---	---	---	---	---	---	---	---	---
	Chloride	mg/L	197	241	411	290	297	290	314	310	402	307	323	321	---	320	320	270	340
	Fluoride	mg/L	0.72	2.69	2.50	2.30	2.32	2.27	2.18	2.16	2.28	2.31	2.26	2.11	---	---	---	---	---
	Nitrate (as nitrogen)	mg/L	3.90	2.80	3.00	3.40	3.03	3.04	3.14 J	3.15 J	2.86	3.02	3.15	3.07	---	3.50	3.20	3.30	3.10
	Nitrite	mg/L	ND (0.02)	0.004 J	ND (0.02)	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Sulfate	mg/L	44.6	47.0	75.4	59.0	62.4	61.0	58.3	58.2	64.0	61.0	63.2	74.1	---	61.0	58.0	54.0	59.0
General																			
	Alkalinity, hydroxide	mg/L	---	---	---	ND (5.0)	---	---	---	---	---	---	---	---	---	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
	Alkalinity, bicarb as CaCO3	mg/L	90.4	93.0	78.8	85.0	90.1	85.0	81.1	83.6	67.4	82.7	68.2	90.6	---	88.0	83.0	89.0	89.0
	Alkalinity, carb as CaCO3	mg/L	ND (2.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	---	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
	Alkalinity, total as CaCO3	mg/L	---	---	---	85.0	90.1	85.0	81.1	83.6	67.4	82.7	68.2	90.6	65.0 J	88.0	83.0	89.0	89.0
	Ammonia	mg/L	ND (0.2)	0.20 J	ND (0.2)	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Ammonia as nitrogen	mg/L	---	---	---	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	---	---	---	ND (0.1)	ND (0.1)
	Bicarbonate	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	79.3 J	---	---	---	---
	Carbonate	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	ND (5.0)J	---	---	---	---
	Deuterium	0/00	---	---	---	-65	-88	-70	-66	-65	-65	-64	-68	-62.7	---	---	---	---	---
	Dissolved organic carbon	mg/L	---	---	---	---	1.30	ND (1.0)	1.08	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	---	---	---	---	---
	Iodide	µg/L	---	---	---	---	ND (500)J	ND (500)J	ND (500)J	ND (500)J	---	---	---	---	---	---	---	---	---
	Orthophosphate	mg/L	---	---	---	ND (0.5)	---	---	ND (0.1)	ND (0.1)	---	---	---	---	---	---	---	---	---
	Oxidation reduction potential	mV	96.4	250	183	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Oxygen 18	0/00	---	---	---	-8.4	-8.9	-8.9	-9.0	-8.8	-9.1	-9.0	-9.8	-9.6	---	---	---	---	---
	Perchlorate	µg/L	---	---	---	---	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	---	---	---	---	---	---	---	---	---
	pH	pH units	7.88	7.58	7.93	7.70	7.74	7.77	---	---	---	---	---	---	7.93 J	7.42 **(b)**	7.72**(b)**	7.57 **(b)**	7.50 **(b)**
	Phosphate	mg/L	0.098	0.03 J	0.019 J	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Soluble silica	mg/L	---	---	---	---	22.0	22.4	18.0	18.7	21.2	21.3	23.2	21.1	---	---	---	---	---
	Specific conductance	µS/cm	1040	1570	1680	1140	1220	1260	---	---	---	---	---	---	1920	1400	1400	1200	1400
	Sulfide	mg/L	ND (0.2)	ND (0.2)J	ND (0.2)	ND (0.4)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	---	---	---	---	---	---	---	---	---
	Total dissolved solids	mg/L	581	694	1080	820	905	875	870	850	1070	885	915	790	---	---	---	---	---
	Total Kjeldahl Nitrogen	mg/L	---	---	---	---	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	0.511	ND (0.5)	ND (0.5)	ND (0.5)	---	---	---	---	---
	Total organic carbon	mg/L	1.00	2.40	ND (1.0)	ND (0.5)	1.01	ND (1.0)	ND (1.0)	ND (1.0)	1.13	ND (1.0)	ND (1.0)	ND (1.0)	---	---	---	---	---
	Total suspended solids	mg/L	---	---	---	---	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	---	---	---	---	---
	Tritium	pCi/L	---	---	---	---	ND (350)	ND (350)	ND (14)	ND (-8.2)	---	---	---	---	---	---	---	---	---
	Turbidity	NTU	---	---	---	---	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	2.29	ND (1.0)	ND (1.0)	---	---	---	---	---
Metals (Dissolved)																			
	Aluminum, dissolved	µg/L	---	---	---	---	ND (50)	57.8	60.0	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	---	---	---	---	---
	Antimony, dissolved	µg/L	---	---	---	---	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	---	---	---	---	---
	Arsenic, dissolved	µg/L	---	---	---	---	1.58	1.64	2.06	1.89	1.52	1.63	1.69	1.56	---	---	---	---	---
	Barium, dissolved	µg/L	109	130	170	140	143	141	155	158	188	149	148	153	---	---	---	---	---

Notes:
(a) PM-03 for event 2004 Q2 was sampled on 6/9/2004, 7/30/2004 and 8/4/2004, each for different analytes.
(b) pH results from October 2008 onwards are field measurements.
^ From May 2, 2007 onward, samples were collected for total (unfiltered) chromium rather than dissolved chromium.

µg/L micrograms per liter (parts per billion).
mg/L milligrams per liter (parts per million).
0/00 differences from global standards in parts per thousand.
NTU nephelometric turbidity units.
µS/cm microSiemens per centimeter.
mV millivolts.
pci/L pico curies per liter.

FD field duplicate.
ND parameter not detected at the listed reporting limit (listed in the adjacent parenthesis).
J analyte was present, but reported value was estimated.
--- not collected or not available.

TABLE 3-4
Moabi Regional Park, San Bernardino County, CA; Analytical Results, PM-03 - Sampling Events with Expanded Analyte Suite
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

Group	Analyte	Units	PM-03 1997 Qtr 2 7/1/1997	PM-03 2000 Qtr 3 9/1/2000	PM-03 2001 Qtr 4 11/29/2001	PM-03 2004 Qtr 2 6/9/2004 (a)	PM-03 BKG Study 01 5/18/2005	PM-03 (FD) BKG Study 01 5/18/2005	PM-03 BKG Study 02 7/21/2005	PM-03 (FD) BKG Study 02 7/21/2005	PM-03 BKG Study 03 11/2/2005	PM-03 BKG Study 04 12/19/2005	PM-03 BKG Study 05 2/22/2006	PM-03 BKG Study 06 5/1/2006	PM-03 2007 Qtr 3 10/4/2007	PM-03 2008 Qtr 3 10/2/2008	PM-03 2009 Qtr 3 10/1/2009	PM-03 2010 Qtr 4 12/10/2010	PM-03 2011 Qtr 4 12/12/2011
Metals (Dissolved)																			
	Beryllium, dissolved	µg/L	---	---	---	---	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	---	---	---	---	---
	Boron, dissolved	µg/L	---	---	---	---	201	200	205	206	211	192	199	188	---	---	---	---	---
	Cadmium, dissolved	µg/L	---	---	---	---	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	---	---	---	---	---
	Calcium, dissolved	µg/L	49900	64400	98100	91000	82000	80400	86100	89300	106000	87500	93900	80400	144000	75600	87000	78000	90000
	Chromium, Hexavalent	µg/L	ND (10)	ND (10)	ND (10)	ND (0.2)	10.2	10.0	9.70	9.60	0.50	7.90	8.40	9.50	ND (1.0)	8.74	9.90	11.9	6.60
	Chromium, total dissolved	µg/L	18.0 J	10.0 J	17.0 J	ND (1.0)	11.5	10.9	10.2	10.8	5.47	9.89	9.46	10.6	---	---	---	---	---
	Cobalt, dissolved	µg/L	---	---	---	---	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	---	---	---	---	---
	Copper, dissolved	µg/L	3.80 J	3.60 J	5.80 J	ND (10)	4.64	4.75	2.41	1.52	1.98	ND (1.0)	1.02	ND (1.0)	---	---	---	---	---
	Iron (+2)	µg/L	17.0	50.0	ND (10)	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Iron, dissolved	µg/L	12.0 J	---	---	880	ND (100)	ND (100)	ND (100)	ND (100)	144	ND (100)	ND (100)	ND (100)	931	ND (20)	ND (20)	ND (20)	50.0
	Lead, dissolved	µg/L	1.20 J	ND (5.0)	1.80 J	---	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	1.62	ND (1.0)	ND (1.0)	ND (1.0)	---	---	---	---	---
	Magnesium, dissolved	µg/L	9890	12800	19200	14200	16300	15900	16900	18000	21500	17400	17500	17400	30900	14900	15000	14000	17000
	Manganese, dissolved	µg/L	ND (5.0)	1.80 J	4.20 J	ND (10)	1.14	ND (1.0)	ND (1.0)	ND (1.0)	3.46	1.13	1.93	ND (1.0)	ND (20)	ND (10)	ND (10)	ND (10)	ND (10)
	Mercury, dissolved	µg/L	---	---	---	---	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	---	---	---	---	---
	Molybdenum, dissolved	µg/L	5.00	5.60	3.70 J	---	5.31	5.44	5.41	5.35	4.77	5.36	5.76	5.63	---	---	---	---	---
	Nickel, dissolved	µg/L	ND (25)	1.70 J	ND (400)	ND (20)	2.71 J	ND (1.0)J	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	---	---	---	---	---
	Potassium, dissolved	µg/L	5220	6600	8900	9670	6520	6360	6810	6900	7230	6590	6410	6280	---	---	---	---	---
	Selenium, dissolved	µg/L	---	---	---	---	1.36	1.84	1.51	1.41	1.60	1.68	2.09	1.58	---	---	---	---	---
	Silver, dissolved	µg/L	---	---	---	---	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	1.25	ND (1.0)	ND (1.0)	ND (1.0)	---	---	---	---	---
	Sodium, dissolved	µg/L	115000	130000	177000	133000	149000	148000	155000	163000	181000	162000	173000	148000	245000	155000	130000	130000	160000
	Thallium, dissolved	µg/L	---	---	---	---	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	---	---	---	---	---
	Vanadium, dissolved	µg/L	7.00 J	8.20 J	7.90 J	---	9.65	9.96	9.31	9.16	10.0	9.55	8.54	9.10	---	---	---	---	---
	Zinc, dissolved	µg/L	6.10	4.80 J	24.0	ND (120)	37.5	25.6	14.5	24.7	51.6	22.2	29.0	17.4	---	---	---	---	---
Metals (Total)																			
	Aluminum	µg/L	---	---	---	---	ND (50)	74.0	---	---	---	---	---	---	---	---	---	---	---
	Antimony	µg/L	---	---	---	---	ND (2.0)	ND (2.0)	---	---	---	---	---	---	---	---	---	---	---
	Arsenic	µg/L	---	---	---	---	1.62	1.71	---	---	---	---	---	---	---	---	---	---	---
	Barium	µg/L	---	---	---	---	145	144	---	---	---	---	---	---	---	---	---	---	---
	Beryllium	µg/L	---	---	---	---	ND (1.0)	ND (1.0)	---	---	---	---	---	---	---	---	---	---	---
	Boron	µg/L	---	---	---	---	205	198	---	---	---	---	---	---	---	---	---	---	---
	Cadmium	µg/L	---	---	---	---	ND (1.0)	ND (1.0)	---	---	---	---	---	---	---	---	---	---	---
	Calcium	µg/L	---	---	---	---	82400	81100	---	---	---	---	---	---	---	---	---	---	---
	Chromium, total	µg/L	---	---	---	6.40	10.9	11.0	---	---	---	---	---	---	ND (1.0)	8.35	9.50	10.5	7.00
	Cobalt	µg/L	---	---	---	---	ND (1.0)	ND (1.0)	---	---	---	---	---	---	---	---	---	---	---
	Copper	µg/L	---	---	---	---	4.92 J	5.00 J	---	---	---	---	---	---	---	---	---	---	---
	Iron	µg/L	---	35.0	260	---	ND (100)	ND (100)	---	---	---	---	---	---	---	---	---	---	---
	Lead	µg/L	---	---	---	---	ND (1.0)	ND (1.0)	---	---	---	---	---	---	---	---	---	---	---
	Magnesium	µg/L	---	---	---	---	16500	16200	---	---	---	---	---	---	---	---	---	---	---

Notes:
(a) PM-03 for event 2004 Q2 was sampled on 6/9/2004, 7/30/2004 and 8/4/2004, each for different analytes.
(b) pH results from October 2008 onwards are field measurements.
^ From May 2, 2007 onward, samples were collected for total (unfiltered) chromium rather than dissolved chromium.

µg/L micrograms per liter (parts per billion).
mg/L milligrams per liter (parts per million).
0/00 differences from global standards in parts per thousand.
NTU nephelometric turbidity units.
µS/cm microSiemens per centimeter.
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pci/L pico curies per liter.

FD field duplicate.
ND parameter not detected at the listed reporting limit (listed in the adjacent parenthesis).
J analyte was present, but reported value was estimated.
--- not collected or not available.

TABLE 3-4
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Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

Group	Analyte	Units	PM-03 1997 Qtr 2 7/1/1997	PM-03 2000 Qtr 3 9/1/2000	PM-03 2001 Qtr 4 11/29/2001	PM-03 2004 Qtr 2 6/9/2004 (a)	PM-03 BKG Study 01 5/18/2005	PM-03 (FD) BKG Study 01 5/18/2005	PM-03 BKG Study 02 7/21/2005	PM-03 (FD) BKG Study 02 7/21/2005	PM-03 BKG Study 03 11/2/2005	PM-03 BKG Study 04 12/19/2005	PM-03 BKG Study 05 2/22/2006	PM-03 BKG Study 06 5/1/2006	PM-03 2007 Qtr 3 10/4/2007	PM-03 2008 Qtr 3 10/2/2008	PM-03 2009 Qtr 3 10/1/2009	PM-03 2010 Qtr 4 12/10/2010	PM-03 2011 Qtr 4 12/12/2011
Metals (Total)																			
	Manganese	µg/L	---	---	---	---	ND (1.0)	1.20	---	---	---	---	---	---	---	---	---	---	---
	Mercury	µg/L	---	---	---	---	ND (0.2)	ND (0.2)	---	---	---	---	---	---	---	---	---	---	---
	Molybdenum	µg/L	---	---	---	---	5.39	5.61	---	---	---	---	---	---	---	---	---	---	---
	Nickel	µg/L	---	---	---	---	ND (1.0)	ND (1.0)	---	---	---	---	---	---	---	---	---	---	---
	Potassium	µg/L	---	---	---	---	6490	6460	---	---	---	---	---	---	---	---	---	---	---
	Selenium	µg/L	---	---	---	---	1.45	2.09	---	---	---	---	---	---	---	---	---	---	---
	Silver	µg/L	---	---	---	---	ND (1.0)	ND (1.0)	---	---	---	---	---	---	---	---	---	---	---
	Sodium	µg/L	---	---	---	---	151000	149000	---	---	---	---	---	---	---	---	---	---	---
	Thallium	µg/L	---	---	---	---	ND (1.0)	ND (1.0)	---	---	---	---	---	---	---	---	---	---	---
	Vanadium	µg/L	---	---	---	---	9.72	9.47	---	---	---	---	---	---	---	---	---	---	---
	Zinc	µg/L	---	---	---	---	17.9	28.5	---	---	---	---	---	---	---	---	---	---	---

Notes:

(a) PM-03 for event 2004 Q2 was sampled on 6/9/2004, 7/30/2004 and 8/4/2004, each for different analytes.
(b) pH results from October 2008 onwards are field measurements.
^ From May 2, 2007 onward, samples were collected for total (unfiltered) chromium rather than dissolved chromium.

µg/L micrograms per liter (parts per billion).
mg/L milligrams per liter (parts per million).
0/00 differences from global standards in parts per thousand.
NTU nephelometric turbidity units.
µS/cm microSiemens per centimeter.
mV millivolts.
pci/L pico curies per liter.

FD field duplicate.
ND parameter not detected at the listed reporting limit (listed in the adjacent parenthesis).
J analyte was present, but reported value was estimated.
--- not collected or not available.

TABLE 3-5
Moabi Regional Park, San Bernardino County, CA; Analytical Results, PM-04 - Sampling Events with Expanded Analyte Suite
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

Group	Analyte	Units	PM-04 2007 Qtr 2 5/2/2007	PM-04 2007 Qtr 3 10/4/2007	PM-04 2008 Qtr 3 10/2/2008	PM-04 2009 Qtr 3 10/1/2009	PM-04 2010 Qtr 4 12/10/2010	PM-04 2011 Qtr 4 12/12/2011
Anion								
	Bromide	mg/L	ND (0.2)	---	---	---	---	---
	Chloride	mg/L	330	---	440	470	480	490
	Fluoride	mg/L	---	---	---	---	---	---
	Nitrate (as nitrogen)	mg/L	2.80 **(a)**	---	2.50	2.20	2.20	2.20
	Nitrite	mg/L	---	---	---	---	---	---
	Sulfate	mg/L	73.9	---	85.0	82.0	92.0	91.0
General								
	Alkalinity, hydroxide	mg/L	---	---	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
	Alkalinity, bicarb as CaCO3	mg/L	67.5	---	64.0	68.0	61.0	58.0
	Alkalinity, carb as CaCO3	mg/L	ND (5.0)	---	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
	Alkalinity, total as CaCO3	mg/L	67.5	77.0 J	64.0	68.0	61.0	58.0
	Ammonia	mg/L	---	---	---	---	---	---
	Ammonia as nitrogen	mg/L	ND (0.5)	---	---	---	0.12	ND (0.1)
	Bicarbonate	mg/L	---	93.9 J	---	---	---	---
	Carbonate	mg/L	---	ND (5.0)J	---	---	---	---
	Deuterium	0/00	---	---	---	---	---	---
	Dissolved organic carbon	mg/L	---	---	---	---	---	---
	Iodide	µg/L	---	---	---	---	---	---
	Orthophosphate	mg/L	---	---	---	---	---	---
	Oxidation reduction potential	mV	---	---	---	---	---	---
	Oxygen 18	0/00	---	---	---	---	---	---
	Perchlorate	µg/L	---	---	---	---	---	---
	pH	pH units	7.99 J	8.14 J	7.44 **(b)**	7.91 **(b)**	7.44 **(b)**	7.70 **(b)**
	Phosphate	mg/L	---	---	---	---	---	---
	Soluble silica	mg/L	---	---	---	---	---	---
	Specific conductance	µS/cm	1530	1720	1700	1800	1700	1800
	Sulfide	mg/L	ND (2.0)	---	---	---	---	---
	Total dissolved solids	mg/L	928	---	---	---	---	---
	Total Kjeldahl Nitrogen	mg/L	---	---	---	---	---	---
	Total organic carbon	mg/L	0.376	---	---	---	---	---
	Total suspended solids	mg/L	---	---	---	---	---	---
	Tritium	pCi/L	---	---	---	---	---	---

Notes:

(a) The nitrate result of 2.8 mg/L is from a sample collected from PM-04 on July 18, 2007 in response to the anomalous nitrate result of 25.9 mg/L reported from the May 2, 2007 sample.

(b) pH results from October 2008 onward are field measurements.

^ From May 2, 2007 onward, samples were collected for total (unfiltered) chromium rather than dissolved chromium.

µg/L micrograms per liter (parts per billion).
mg/L milligrams per liter (parts per million).
0/00 differences from global standards in parts per thousand.
NTU nephelometric turbidity units.
µS/cm microSiemens per centimeter.
mV millivolts.
pci/L pico curies per liter.
FD field duplicate.
ND parameter not detected at the listed reporting limit (listed in the adjacent parenthesis).
J analyte was present, but reported value was estimated.
--- not collected or not available.

TABLE 3-5
Moabi Regional Park, San Bernardino County, CA; Analytical Results, PM-04 - Sampling Events with Expanded Analyte Suite
Freshwater Sources Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

Group	Analyte	Units	PM-04 2007 Qtr 2 5/2/2007	PM-04 2007 Qtr 3 10/4/2007	PM-04 2008 Qtr 3 10/2/2008	PM-04 2009 Qtr 3 10/1/2009	PM-04 2010 Qtr 4 12/10/2010	PM-04 2011 Qtr 4 12/12/2011
General								
	Turbidity	NTU	---	---	---	---	---	---
Metals (Dissolved)								
	Aluminum, dissolved	µg/L	---	---	---	---	---	---
	Antimony, dissolved	µg/L	ND (2.0)	---	---	---	---	---
	Arsenic, dissolved	µg/L	ND (1.0)	---	---	---	---	---
	Barium, dissolved	µg/L	112	---	---	---	---	---
	Beryllium, dissolved	µg/L	ND (1.0)	---	---	---	---	---
	Boron, dissolved	µg/L	---	---	---	---	---	---
	Cadmium, dissolved	µg/L	ND (1.0)	---	---	---	---	---
	Calcium, dissolved	µg/L	---	89300	72000	88000	93000	91000
	Chromium, Hexavalent	µg/L	ND (0.2)	21.4	20.6	21.0	21.0	18.9
	Chromium, total dissolved	µg/L	---	---	---	---	---	---
	Cobalt, dissolved	µg/L	ND (1.0)	---	---	---	---	---
	Copper, dissolved	µg/L	1.96	---	---	---	---	---
	Iron (+2)	µg/L	---	---	---	---	---	---
	Iron, dissolved	µg/L	---	617	ND (20)	ND (20)	ND (20)	60.0
	Lead, dissolved	µg/L	ND (1.0)	---	---	---	---	---
	Magnesium, dissolved	µg/L	---	22300	12400	14000	15000	15000
	Manganese, dissolved	µg/L	---	ND (20)	ND (10)	ND (10)	ND (10)	ND (10)
	Mercury, dissolved	µg/L	ND (0.2)	---	---	---	---	---
	Molybdenum, dissolved	µg/L	6.02	---	---	---	---	---
	Nickel, dissolved	µg/L	6.30	---	---	---	---	---
	Potassium, dissolved	µg/L	---	---	---	---	---	---
	Selenium, dissolved	µg/L	1.45	---	---	---	---	---
	Silver, dissolved	µg/L	ND (1.0)	---	---	---	---	---
	Sodium, dissolved	µg/L	---	280000	234000	220000	230000	260000
	Thallium, dissolved	µg/L	ND (1.0)	---	---	---	---	---
	Vanadium, dissolved	µg/L	1.57	---	---	---	---	---
	Zinc, dissolved	µg/L	605 J	---	---	---	---	---
Metals (Total)								
	Aluminum	µg/L	---	---	---	---	---	---
	Antimony	µg/L	---	---	---	---	---	---

Notes:

(a) The nitrate result of 2.8 mg/L is from a sample collected from PM-04 on July 18, 2007 in response to the anomalous nitrate result of 25.9 mg/L reported from the May 2, 2007 sample.

(b) pH results from October 2008 onward are field measurements.

^ From May 2, 2007 onward, samples were collected for total (unfiltered) chromium rather than dissolved chromium.

µg/L micrograms per liter (parts per billion).
mg/L milligrams per liter (parts per million).
0/00 differences from global standards in parts per thousand.
NTU nephelometric turbidity units.
µS/cm microSiemens per centimeter.
mV millivolts.
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FD field duplicate.
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Group	Analyte	Units	PM-04 2007 Qtr 2 5/2/2007	PM-04 2007 Qtr 3 10/4/2007	PM-04 2008 Qtr 3 10/2/2008	PM-04 2009 Qtr 3 10/1/2009	PM-04 2010 Qtr 4 12/10/2010	PM-04 2011 Qtr 4 12/12/2011
Metals (Total)								
	Arsenic	µg/L	---	---	---	---	---	---
	Barium	µg/L	---	---	---	---	---	---
	Beryllium	µg/L	---	---	---	---	---	---
	Boron	µg/L	---	---	---	---	---	---
	Cadmium	µg/L	---	---	---	---	---	---
	Calcium	µg/L	---	---	---	---	---	---
	Chromium, total	µg/L	ND (1.0)	23.5	18.5	18.0	20.6	18.2
	Cobalt	µg/L	---	---	---	---	---	---
	Copper	µg/L	---	---	---	---	---	---
	Iron	µg/L	---	---	---	---	---	---
	Lead	µg/L	---	---	---	---	---	---
	Magnesium	µg/L	---	---	---	---	---	---
	Manganese	µg/L	---	---	---	---	---	---
	Mercury	µg/L	---	---	---	---	---	---
	Molybdenum	µg/L	---	---	---	---	---	---
	Nickel	µg/L	---	---	---	---	---	---
	Potassium	µg/L	---	---	---	---	---	---
	Selenium	µg/L	---	---	---	---	---	---
	Silver	µg/L	---	---	---	---	---	---
	Sodium	µg/L	---	---	---	---	---	---
	Thallium	µg/L	---	---	---	---	---	---
	Vanadium	µg/L	---	---	---	---	---	---
	Zinc	µg/L	---	---	---	---	---	---

Notes:

(a) The nitrate result of 2.8 mg/L is from a sample collected from PM-04 on July 18, 2007 in response to the anomalous nitrate result of 25.9 mg/L reported from the May 2, 2007 sample.

(b) pH results from October 2008 onward are field measurements.

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µg/L micrograms per liter (parts per billion).
mg/L milligrams per liter (parts per million).
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TABLE 3-6
Summary Statistics of Surface Water Sampling Results, July 1997 through June 2011
Freshwater Source Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

	Hexavalent Chromium (µg/L)		Dissolved Chromium (µg/L)		Dissolved Arsenic (µg/L)		Dissolved Manganese (µg/L)		Dissolved Iron (µg/L)		Dissolved Selenium (µg/L)		Dissolved Molybdenum (µg/L)		Dissolved Nitrate (µg/L)		Specific Conductance (µS/cm)		pH (pH Units)	
Chemical-Specific ARAR[1]	11 (a)		NA		150 (a)		NA		NA		5 (b)		NA		NA		NA		NA	
Station ID[2]	**Frequency of Detection (Number of Detects/Number of Samples) and Average Concentration[3]**																			
Shoreline Surface Water Monitoring Locations																				
A-Dock	0 \ 6	ND	0 \ 6	ND	0 \ 0	---	0 \ 1	ND	0 \ 0	---	0 \ 0	---	0 \ 1	ND	0 \ 0	---	4 \ 4	944	4 \ 4	8.02
CON	0 \ 75^	ND	6 \ 76	3.23	0 \ 0	---	2 \ 4	65.0	0 \ 1	ND	0 \ 0	---	2 \ 3	4.93	1 \ 1	370	41 \ 41	1120	39 \ 39	8.12
C-TM-1	0 \ 3	ND	0 \ 3	ND	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---
C-TM-2	0 \ 3	ND	0 \ 3	ND	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---
R63	0 \ 13	ND	1 \ 13	0.554	1 \ 1	2.40	0 \ 1	ND	0 \ 1	ND	0 \ 1	ND	0 \ 1	ND	0 \ 1	ND	13 \ 13	979	13 \ 13	8.21
I-3	0 \ 70^	ND	7 \ 71	3.13	0 \ 0	---	3 \ 5	54.1	0 \ 2	ND	0 \ 0	---	3 \ 3	4.73	3 \ 4	488	40 \ 40	957	38 \ 38	8.20
Needles Gauge	0 \ 2	ND	0 \ 2	ND	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---
NR-1	0 \ 48	ND	1 \ 49	0.614	0 \ 0	---	0 \ 1	ND	0 \ 1	ND	0 \ 0	---	0 \ 0	---	0 \ 1	ND	18 \ 18	1020	17 \ 17	8.22
NR-2	0 \ 48	ND	1 \ 49	0.635	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	18 \ 18	1010	17 \ 17	8.23
NR-3	0 \ 46	ND	0 \ 47	ND	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	18 \ 18	1000	17 \ 17	8.22
R-19	0 \ 17	ND	0 \ 17	ND	1 \ 1	2.40	0 \ 1	ND	0 \ 1	ND	0 \ 1	ND	0 \ 1	ND	0 \ 1	ND	17 \ 17	957	17 \ 17	8.27
R-19-B	0 \ 2	ND	0 \ 2	ND	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	1 \ 1	901	1 \ 1	7.82
R-19-C	0 \ 2	ND	0 \ 2	ND	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	2 \ 2	892	2 \ 2	7.84
R-20	0 \ 1	ND	0 \ 1	ND	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	1 \ 1	902	1 \ 1	7.95
R-20-B	0 \ 2	ND	0 \ 2	ND	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	2 \ 2	893	2 \ 2	7.84
R-20-C	0 \ 2	ND	0 \ 2	ND	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	2 \ 2	891	2 \ 2	7.77
R-22	0 \ 69^	ND	7 \ 70	2.68	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	35 \ 35	974	35 \ 35	8.23
R-27	0 \ 70^	ND	6 \ 71	2.67	0 \ 0	---	0 \ 3	ND	0 \ 3	ND	0 \ 0	---	0 \ 0	---	4 \ 18	320	35 \ 35	960	34 \ 34	8.20
R-28	0 \ 83^	ND	7 \ 84	2.74	1 \ 1	2.10	0 \ 4	ND	0 \ 4	ND	0 \ 1	ND	1 \ 2	5.20	6 \ 27	562	51 \ 51	999	50 \ 50	8.25
RRB	0 \ 78^	ND	8 \ 79	2.68	1 \ 1	2.70	1 \ 2	5.00	0 \ 1	ND	0 \ 1	ND	1 \ 2	6.00	0 \ 1	ND	49 \ 49	1190	48 \ 48	8.07
Seasonal Wetlands	0 \ 8	ND	0 \ 8	ND	0 \ 0	---	1 \ 1	8.00	0 \ 0	---	0 \ 0	---	1 \ 1	5.00	0 \ 0	---	8 \ 8	4800	8 \ 8	7.97
River Channel Surface Water Monitoring Locations																				
C-BNS	0 \ 14	ND	0 \ 14	ND	1 \ 1	2.80	0 \ 1	ND	0 \ 1	ND	0 \ 1	ND	0 \ 1	ND	0 \ 1	ND	14 \ 14	959	14 \ 14	8.22
C-CON	0 \ 99	ND	0 \ 99	ND	2 \ 2	2.45	0 \ 2	ND	0 \ 2	ND	0 \ 2	ND	0 \ 2	ND	0 \ 2	ND	71 \ 71	1000	71 \ 71	8.25
C-I-3	0 \ 99	ND	0 \ 99	ND	2 \ 2	2.65	0 \ 2	ND	0 \ 2	ND	0 \ 2	ND	0 \ 2	ND	3 \ 5	423	71 \ 71	977	71 \ 71	8.27
C-MAR	0 \ 63	ND	0 \ 63	ND	2 \ 2	2.45	2 \ 2	16.9	1 \ 2	25.5	0 \ 2	ND	0 \ 2	ND	1 \ 4	657	46 \ 46	1150	46 \ 46	7.93
C-NR1	0 \ 99	ND	0 \ 99	ND	2 \ 2	2.15	0 \ 2	ND	0 \ 2	ND	0 \ 2	ND	0 \ 2	ND	0 \ 2	ND	71 \ 71	994	71 \ 71	8.32
C-NR3	0 \ 99	ND	0 \ 99	ND	2 \ 2	2.25	0 \ 2	ND	0 \ 2	ND	0 \ 2	ND	0 \ 2	ND	0 \ 2	ND	71 \ 71	995	71 \ 71	8.31
C-NR4	0 \ 99	ND	0 \ 99	ND	2 \ 2	2.20	0 \ 2	ND	0 \ 2	ND	0 \ 2	ND	0 \ 2	ND	0 \ 2	ND	71 \ 71	991	71 \ 71	8.31
C-R22	1 \ 74	0.115	0 \ 74	ND	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	3 \ 3	538	39 \ 39	1000	39 \ 39	8.25
C-R22a	0 \ 31	ND	0 \ 31	ND	2 \ 2	2.70	0 \ 2	ND	0 \ 2	ND	0 \ 2	ND	0 \ 2	ND	0 \ 2	ND	31 \ 31	962	31 \ 31	8.30
C-R27	0 \ 94	ND	0 \ 94	ND	2 \ 2	2.50	0 \ 2	ND	0 \ 2	ND	0 \ 2	ND	0 \ 2	ND	3 \ 5	420	67 \ 67	979	67 \ 67	8.27
C-TAZ	0 \ 96	ND	0 \ 99	ND	2 \ 2	2.50	0 \ 2	ND	0 \ 2	ND	0 \ 2	ND	0 \ 2	ND	3 \ 5	421	71 \ 71	982	71 \ 71	8.28
Other Surface Water Monitoring Locations																				
SW2	0 \ 12	ND	0 \ 12	ND	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	12 \ 12	987	12 \ 12	7.83
SW1	1 \ 20	0.107	0 \ 20	ND	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	0 \ 0	---	18 \ 18	1020	18 \ 18	7.79

TABLE 3-6
Summary Statistics of Surface Water Sampling Results, July 1997 through June 2011
Freshwater Source Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

Notes:

ND	not detected
NA	not available
(a)	Freshwater aquatic life protection, continuous concentration 4-day average; expressed as dissolved.
(b)	Freshwater aquatic life protection, continuous concentration 4-day average; expressed as total recoverable.
^	According to the data quality review for the June 2002 monitoring, the results were determined to be false positive due to unidentified interference for these samples, and no action should be taken or project decisions made based on the results. These results were not included in the statistical analyses.
µS/cm	microsiemens per centimeter
µg/L	micrograms per liter
---	not analyzed

At each of the river channel surface water locations, depth specific samples were collected at shallow (1 foot from water surface), middle (middle samples no longer collected after 6/18/2008), and deep depths (1 foot from river bottom). Results for each location summarize the samples collected at depth.

At locations R-19B, R-19C and R-20B, multiple samples were collected at surface, 5-foot, and 10-foot depths and locations. Results for each location summarized the samples collected at depth.

Refer to Appendix A for complete analytical data for surface water sampling.

1 Source: Groundwater Record of Decision, Table 2, Federal Chemical-Specific ARAR #3, Citation: Federal Water Pollution Control Act (Clean Water Act) - 33 USC §§ 1251-1387; 40 CFR 131.38.
2 Surface water locations are listed in order of their position on the river, from north to south.
3 Average concentrations of all results (including estimated concentrations) in micrograms per liter, with half the reporting limit used for non detects. Detected results are the maximum concentrations from primary or duplicate samples.

TABLE 3-7

Summary of Select Contaminants and Compounds in Pharmaceuticals and Personal Care Products in Colorado River Samples Collected by Others (2008-2012)

Freshwater Source Evaluation Technical Memorandum

PG&E Topock Compressor Station, Needles, California

Contaminants	Detection Limit	Units	Lake Havasu Contact Point				Lake Havasu Intake				Lake Havasu Inlet				Lake Havasu				Lake Mead Out Structure				Colorado Stream Below Davis Dam				Colorado Stream Wildlife Refuge_NWB				Colorado Stream Topock Above Railroad				Colorado Stream Topock Bat Cave Wash				Colorado Stream Topock Down River				Colorado Stream Topock Near Park Moabi				Hoover Dam			
			Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples
Select Contaminants with Primary MCLs																																																		
Perchlorate	2	µg/L	--	--	--	--	2.3	ND	16	48	--	--	--	--	--	--	--	--	4.6	ND	143	189	3.0	ND	5	19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitrate	0.1	mg/L	2.4	1.1	0	85	2.4	0.9	0	162	--	--	--	--	--	--	--	--	--	--	--	--	2.5	1.4	0	23	2.5	1.3	0	46	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitrite-Nitrogen	0.005	mg/L	0.007	ND	68	77	0.022	ND	127	144	--	--	--	--	--	--	--	--	--	--	--	--	0.005	ND	20	21	0.009	ND	36	41	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Contaminants with Secondary MCLs																																																	
Calcium	0.1	mg/L	--	--	--	--	80	71	0	50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Magnesium	0.1	mg/L	--	--	--	--	31	25	0	50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MTBE	0.5	µg/L	--	--	--	--	ND	ND	75	75	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Thiobencarb	1	µg/L	--	--	--	--	ND	ND	3	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Turbity	--	NTU	2.6	0.26	0	85	2	0.21	0	106	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5	0.26	0	41	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chloride	2	mg/L	--	--	--	--	95	81	0	49	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfate	4	mg/L	260	219	0	79	262	216	0	144	--	--	--	--	--	--	--	--	--	--	--	--	257	215	0	19	258	218	0	38	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Specific Conductance	--	umho/cm	1060	1040	0	6	1060	932	0	56	--	--	--	--	--	--	--	--	1100	895	0	196	--	--	--	--	1060	1030	0	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Threshold Odor	1	--	--	--	--	--	20	17	0	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Foaming Agents (MBAS)	0.05	mg/L	--	--	--	--	ND	ND	3	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Color	1	color units	--	--	--	--	6.0	2	0	17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Trace Elements																																																		
Aluminum	10	µg/L	--	--	--	--	150	ND	3	55	--	--	--	--	--	--	--	--	--	--	--	--	18	ND	1	2	--	--	--	--	540	13	0	7	69	31	0	2	62	14	0	7		12	0	7	--	--	--	--
Antimony	2	µg/L	--	--	--	--	ND	ND	7	7	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	2	2	--	--	--	--	ND	ND	7	7	ND	ND	2	2	ND	ND	7	7	ND	ND	7	7	--	--	--	--
Arsenic	0.5	µg/L	--	--	--	--	3.0	2.4	0	55	--	--	--	--	--	--	--	--	--	--	--	--	2.7	2.6	0	2	--	--	--	--	2.8	2.6	0	7	2.9	2.8	0	2	2.7	2.6	0	7	2.8	2.6	0	7	--	--	--	--
Barium	5	µg/L	--	--	--	--	154	125	0	7	--	--	--	--	--	--	--	--	--	--	--	--	147	139	0	2	--	--	--	--	153	136	0	7	152	151	0	2	156	135	0	7	151	141	0	7	--	--	--	--
Beryllium	0.5	µg/L	--	--	--	--	ND	ND	7	7	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	2	2	--	--	--	--	ND	ND	7	7	ND	ND	2	2	ND	ND	7	7	ND	ND	7	7	--	--	--	--
Boron	0.02	mg/L	--	--	--	--	0.14	0.12	0	10	--	--	--	--	--	--	--	--	--	--	--	--	0.13	0.13	0	2	--	--	--	--	0.18	0.13	0	7	0.15	0.13	0	2	0.14	0.13	0	7	0.14	0.13	0	7	--	--	--	--
Cadmium	0.1	µg/L	--	--	--	--	ND	ND	6	6	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	2	2	--	--	--	--	ND	ND	9	9	ND	ND	2	2	ND	ND	7	7	ND	ND	7	7	--	--	--	--
Copper	10	µg/L	--	--	--	--	ND	ND	55	55	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	2	2	--	--	--	--	ND	ND	7	7	ND	ND	2	2	ND	ND	7	7	ND	ND	7	7	--	--	--	--
Iron	50	µg/L	--	--	--	--	120	ND	1	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Lead	1	µg/L	--	--	--	--	ND	ND	7	7	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	2	2	--	--	--	--	ND	ND	7	7	ND	ND	2	2	ND	ND	7	7	ND	ND	7	7	--	--	--	--
Manganese	5	µg/L	--	--	--	--	ND	ND	7	7	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	2	2	--	--	--	--	ND	ND	7	7	ND	ND	2	2	ND	ND	7	7	ND	ND	7	7	--	--	--	--
Mercury	0.2	µg/L	--	--	--	--	ND	ND	7	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Molybdenum	2	µg/L	--	--	--	--	6	4	0	7	--	--	--	--	--	--	--	--	--	--	--	--	6	6	0	2	--	--	--	--	6	6	0	6	6	6	0	2	6	6	0	6	6	6	0	6	--	--	--	--
Nickel	2	µg/L	--	--	--	--	3.0	ND	2	7	--	--	--	--	--	--	--	--	--	--	--	--	4.0	3.0	0	2	--	--	--	--	4.0	ND	1	7	3.0	2.0	0	2	4.0	2.0	0	7	4.0	ND	1	7	--	--	--	--
Potassium	0.1	mg/L	--	--	--	--	5.2	4.3	0	49	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Selenium	5	µg/L	--	--	--	--	ND	ND	7	7	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	2	2	--	--	--	--	ND	ND	7	7	ND	ND	2	2	ND	ND	7	7	ND	ND	7	7	--	--	--	--
Silver	5	µg/L	--	--	--	--	ND	ND	7	7	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	2	2	--	--	--	--	ND	ND	7	7	ND	ND	2	2	ND	ND	7	7	ND	ND	7	7	--	--	--	--
Sodium	0.1	mg/L	--	--	--	--	100	85	0	50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

TABLE 3-7
Summary of Select Contaminants and Compounds in Pharmaceuticals and Personal Care Products in Colorado River Samples Collected by Others (2008-2012)
Freshwater Source Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

Contaminants	Detection Limit	Units	Lake Havasu Contact Point				Lake Havasu Intake				Lake Havasu Inlet				Lake Havasu			
			Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples
Thallium	1	µg/L	--	--	--	--	ND	ND	6	6	--	--	--	--	--	--	--	--
Vanadium	1	µg/L	--	--	--	--	2.7	2.2	0	7	--	--	--	--	--	--	--	--
Zinc	20	µg/L	--	--	--	--	ND	ND	7	7	--	--	--	--	--	--	--	--
Compounds in Pharmaceuticals and Personal Care Products (PPCP)																		
Caffeine	5	ng/L	--	--	--	--	338	ND	1	4	1370	ND	1	3	29.6	ND	2	6
Carbamazepine	1	ng/L	--	--	--	--	3.4	2	0	5	3.3	2	0	4	5	ND	1	6
DEET	20	ng/L	--	--	--	--	28.0	ND	3	4	297	ND	0	3	--	--	--	--
Ibuprofen	10	ng/L	--	--	--	--	ND	ND	4	4	35.6	ND	2	3	--	--	--	--
4-n-Nonylphenol	50	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	3	3	--	--	--	--
o,p-DDD	20	ng/L	--	--	--	--	44.0	ND	3	4	23.0	ND	2	3	--	--	--	--
Diuron	5	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	ND	ND	5	5
Methylparaben	20	ng/L	--	--	--	--	35.0	ND	3	4	ND	ND	3	3	--	--	--	--
Primidone	2	ng/L	--	--	--	--	4.0	2	0	4	4.0	ND	1	3	4.5	ND	2	6
Sulfamethoxazole	1	ng/L	--	--	--	--	13.3	ND	0	4	14.4	ND	0	3	--	--	--	--
TCEP	5	ng/L	--	--	--	--	9.0	ND	2	4	5.0	ND	2	3	--	--	--	--
Acetaminophen	10	ng/L	--	--	--	--	14.0	ND	1	4	5.3	ND	0	3	--	--	--	--
Azithromycin	1	ng/L	--	--	--	--	5.5	ND	3	4	ND	ND	3	3	--	--	--	--
17a-Estradiol	10	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
17b-Estradiol	10	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
2,4,6-Trichlorophenol	1000	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
4-n- and 4-t-Octylphenol	20	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
4-Phenylphenol	1000	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Anthracene	10	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Atrazine	1	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Atrazine-Desethyl	20	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Atrazine-Desisopropyl	20	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Benzo(a)pyrene	25	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Bisphenol A	30 (MWD)	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Butylparaben	20	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Ciprofloxacin	10	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Cyanazine	20	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Cyprazine	20	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Diclofenac	5	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Diethylstilbestrol	10	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Dilantin	5	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--

Contaminants	Lake Mead Out Structure				Colorado Stream Below Davis Dam				Colorado Stream Wildlife Refuge_NWB				Colorado Stream Topock Above Railroad			
	Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples
Thallium	--	--	--	--	ND	ND	2	2	--	--	--	--	ND	ND	7	7
Vanadium	--	--	--	--	2.6	2.4	0	2	--	--	--	--	2.8	2.4	0	7
Zinc	--	--	--	--	ND	ND	2	2	--	--	--	--	ND	ND	7	7
Compounds in Pharmaceuticals and Personal Care Products (PPCP)																
Caffeine	--	--	--	--	109	ND	6	9	5.0	ND	1	6	--	--	--	--
Carbamazepine	--	--	--	--	4	2	0	9	5	ND	1	6	--	--	--	--
DEET	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Ibuprofen	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
4-n-Nonylphenol	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
o,p-DDD	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Diuron	--	--	--	--	ND	ND	8	8	ND	ND	5	5	--	--	--	--
Methylparaben	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Primidone	--	--	--	--	4	ND	2	9	4.3	ND	2	6	--	--	--	--
Sulfamethoxazole	--	--	--	--	15	ND	0	4	--	--	--	--	--	--	--	--
TCEP	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Acetaminophen	--	--	--	--	ND	ND	3	3	--	--	--	--	--	--	--	--
Azithromycin	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
17a-Estradiol	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
17b-Estradiol	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
2,4,6-Trichlorophenol	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
4-n- and 4-t-Octylphenol	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
4-Phenylphenol	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Anthracene	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Atrazine	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Atrazine-Desethyl	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Atrazine-Desisopropyl	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Benzo(a)pyrene	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Bisphenol A	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Butylparaben	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Ciprofloxacin	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Cyanazine	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Cyprazine	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Diclofenac	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Diethylstilbestrol	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Dilantin	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--

Contaminants	Colorado Stream Topock Bat Cave Wash				Colorado Stream Topock Down River				Colorado Stream Topock Near Park Moabi				Hoover Dam			
	Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples
Thallium	ND	ND	2	2	ND	ND	7	7	ND	ND	7	7	--	--	--	--
Vanadium	2.5	2.5	0	2	2.6	2.4	0	7	2.6	2.5	0	7	--	--	--	--
Zinc	ND	ND	1	1	ND	ND	7	7	ND	ND	7	7	--	--	--	--
Compounds in Pharmaceuticals and Personal Care Products (PPCP)																
Caffeine	--	--	--	--	--	--	--	--	--	--	--	--	28.1	ND	1	10
Carbamazepine	--	--	--	--	--	--	--	--	--	--	--	--	9	ND	1	10
DEET	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Ibuprofen	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
4-n-Nonylphenol	--	--	--	--	--	--	--	--	--	--	--	--	143	ND	3	4
o,p-DDD	--	--	--	--	--	--	--	--	--	--	--	--	31	ND	3	4
Diuron	--	--	--	--	--	--	--	--	--	--	--	--	6.91	ND	8	9
Methylparaben	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Primidone	--	--	--	--	--	--	--	--	--	--	--	--	3.8	ND	1	10
Sulfamethoxazole	--	--	--	--	--	--	--	--	--	--	--	--	17.05	ND	0	4
TCEP	--	--	--	--	--	--	--	--	--	--	--	--	8	ND	2	4
Acetaminophen	--	--	--	--	--	--	--	--	--	--	--	--	2.5	ND	2	4
Azithromycin	--	--	--	--	--	--	--	--	--	--	--	--	13	ND	3	4
17a-Estradiol	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
17b-Estradiol	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
2,4,6-Trichlorophenol	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
4-n- and 4-t-Octylphenol	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
4-Phenylphenol	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Anthracene	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Atrazine	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Atrazine-Desethyl	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Atrazine-Desisopropyl	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Benzo(a)pyrene	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Bisphenol A	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Butylparaben	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Ciprofloxacin	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Cyanazine	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Cyprazine	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Diclofenac	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Diethylstilbestrol	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Dilantin	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4

TABLE 3-7

Summary of Select Contaminants and Compounds in Pharmaceuticals and Personal Care Products in Colorado River Samples Collected by Others (2008-2012)

Freshwater Source Evaluation Technical Memorandum

PG&E Topock Compressor Station, Needles, California

Contaminants	Detection Limit	Units	Lake Havasu Contact Point				Lake Havasu Intake				Lake Havasu Inlet				Lake Havasu			
			Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples
Epitestosterone	10	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Estriol	10	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Estrone	10	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Ethylparaben	20	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Ethynylestradiol (EE2)	10	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Gemfibrozil	5	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Lindane	10	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Linuron	5	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Methoxychlor	20	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Nonylphenol ethoxylates (total)	10000	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Pentachlorophenol	1000	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Progesterone	10	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Propazine	20	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Propylparaben	20	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Simazine	20	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Testosterone	10	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Tetrabromobisphenol A	1000	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--
Triclosan	5	ng/L	--	--	--	--	ND	ND	4	4	ND	ND	4	4	--	--	--	--

Contaminants	Lake Mead Out Structure				Colorado Stream Below Davis Dam				Colorado Stream Wildlife Refuge_NWB				Colorado Stream Topock Above Railroad			
	Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples
Epitestosterone	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Estriol	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Estrone	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Ethylparaben	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Ethynylestradiol (EE2)	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Gemfibrozil	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Lindane	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Linuron	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Methoxychlor	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Nonylphenol ethoxylates (total)	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Pentachlorophenol	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Progesterone	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Propazine	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Propylparaben	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Simazine	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Testosterone	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Tetrabromobisphenol A	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--
Triclosan	--	--	--	--	ND	ND	4	4	--	--	--	--	--	--	--	--

Contaminants	Colorado Stream Topock Bat Cave Wash				Colorado Stream Topock Down River				Colorado Stream Topock Near Park Moabi				Hoover Dam			
	Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples	Maximum	Minimum	Number of Non-Detects	Total Number of Samples
Epitestosterone	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Estriol	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Estrone	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Ethylparaben	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Ethynylestradiol (EE2)	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Gemfibrozil	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Lindane	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Linuron	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Methoxychlor	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Nonylphenol ethoxylates (total)	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Pentachlorophenol	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Progesterone	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Propazine	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Propylparaben	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Simazine	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Testosterone	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Tetrabromobisphenol A	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4
Triclosan	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	4	4

Source: Metropolitan Water District

TABLE 3-8
Summary of Tracers for Pharmaceuticals and Personal Care Products in Colorado River Samples (July 2009-October 2010)
Freshwater Source Evaluation Technical Memorandum
PG&E Topock Compressor Station, Needles, California

Sample Name	Sampling Date	Caffeine	Primidone (Drug)	Carbamazepine (Drug)	Diuron (Herbicide)
		Maximum Reporting Limit (ng/L)			
		5	2	1	5
Hoover Dam	Jul-09	6	2	2	ND
	Nov-09	8	2	3	ND
	Jan-10	10	3	4	ND
	Apr-10	10	3	3	7
	Jul-10	13	2	ND	ND
	Oct-10	6	3	3	ND
Below Davis Dam	Jul-09	59	4	3	ND
	Nov-09	NS	NS	NS	NS
	Jan-10	ND	2	2	ND
	Apr-10	ND	3	3	ND
	Jul-10	109	2	2	ND
	Oct-10	ND	ND	ND	ND
Wildlife Refuge	Jul-09	8	4	3	ND
	Nov-09	9	ND	1	ND
	Jan-10	10	2	2	ND
	Apr-10	8	2	3	ND
	Jul-10	48	2	ND	ND
	Oct-10	ND	ND	ND	ND
Lake Havasu	Jul-09	10	4	2	ND
	Nov-09	16	ND	2	ND
	Jan-10	ND	2	2	ND
	Apr-10	ND	2	3	ND
	Jul-10	12	2	ND	ND
	Oct-10	30	ND	ND	ND

Notes:
ND=Not detected
NS=Not sampled

Source: Metropolitan Water District

Attachment A
LeRoy Crandall and Associates Reports

REC'D 12/22/86

*COUNTY OF SAN BERNARDINO
REGIONAL PARKS DEPT.
825 EAST THIRD ST.
SAN BERNARDINO CA
92415-0733

RESULTS OF EXPLORATORY DRILLING FOR A WATER SUPPLY SOURCE AT PARK MOABI SAN BERNARDINO COUNTY, CALIFORNIA

LeRoy Crandall & Associates — Report (2)

April 1986

Prepared For
General Services Agency
Facilities Management Department
Architecture and Engineering Division
San Bernardino County, California
Purchase Order No. J5259-M
Our Job No. E-85417-B

ATTACHMENT B-2

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Appendices

A. Lithologic Logs

B. Laboratory Analyses of Water Samples

C. Technical Specifications <not included in L-W word copy>

RESULTS OF EXPLORATORY DRILLING FOR A WATER SUPPLY SOURCE AT PARK MOABI SAN BERNARDINO COUNTY, CALIFORNIA

INTRODUCTION

This report presents a summary of our exploration program for a water supply well at Park Moabi, California. The exploration program commenced on March 26, 1986, and concluded on March 27, 1986. Drilling was carried out on a subcontract basis by Becker Drills, Inc. of Denver, Colorado. One exploratory boring was located near the Reverse Osmosis (R.O.) unit and is designated Boring No. 1. Two other exploratory borings were drilled southwest of the trailer park area, and are designated Boring Nos. 2 and 3. Figure 1, Location of Wells, shows the location of these exploratory borings and existing wells. All rocks penetrated by the borings were logged by a staff geologist from our company. Electrical conductivities (EC) of the water encountered were measured at approximately 10-foot intervals. Lithologic logs of borings are presented in Appendix A.

Our professional services have been performed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable geologists practicing in this or similar localities. No other warranty, expressed or implied, is made as to the professional advice included in this report.

GEOLOGIC CONDITIONS

Water-bearing and nonwater-bearing rocks in the area can be divided into four units: bedrock, fanglomerate, Bouse Formation and Recent alluvium. Figures 1 and 2 illustrate the areal extent and x-section stratigraphic relationship of the rocks that occur above the bedrock.

The bedrock is exposed in the Chemehuevi Mountains located south to southwest of the park. It is comprised of metamorphic, igneous and volcanic rocks which are considered nonwater-bearing. They are overlain by a fanglomerate composed of bedrock and meta-sedimentary gravels, sands and clays derived from the local mountains and areas northwest of the Park. The fanglomerate is exposed south of Interstate Highway 40. It is areally extensive and forms a ground water recharge area for the aquifers that occur beneath the Park. It also appears to include the Toa deeper aquifer that was penetrated by exploration Borings 1 and 3 at depths of 177 and 69 feet, respectively. The depth of the contact between the bedrock and fanglomerate beneath the Park is unknown, but it may reach a depth of 1,000 feet.

The fanglomerate is overlain by gray to blue silt and clay deposits of the Bouse Formation that were observed in all borings. They have a very low permeability that forms an aquitard which confines the aquifer within the underlying fanglomerate, and isolates it from the overlying Recent Alluvium.

The Bouse Formation is overlain by Recent Alluvium that is exposed at ground surface throughout the Park and in the adjacent

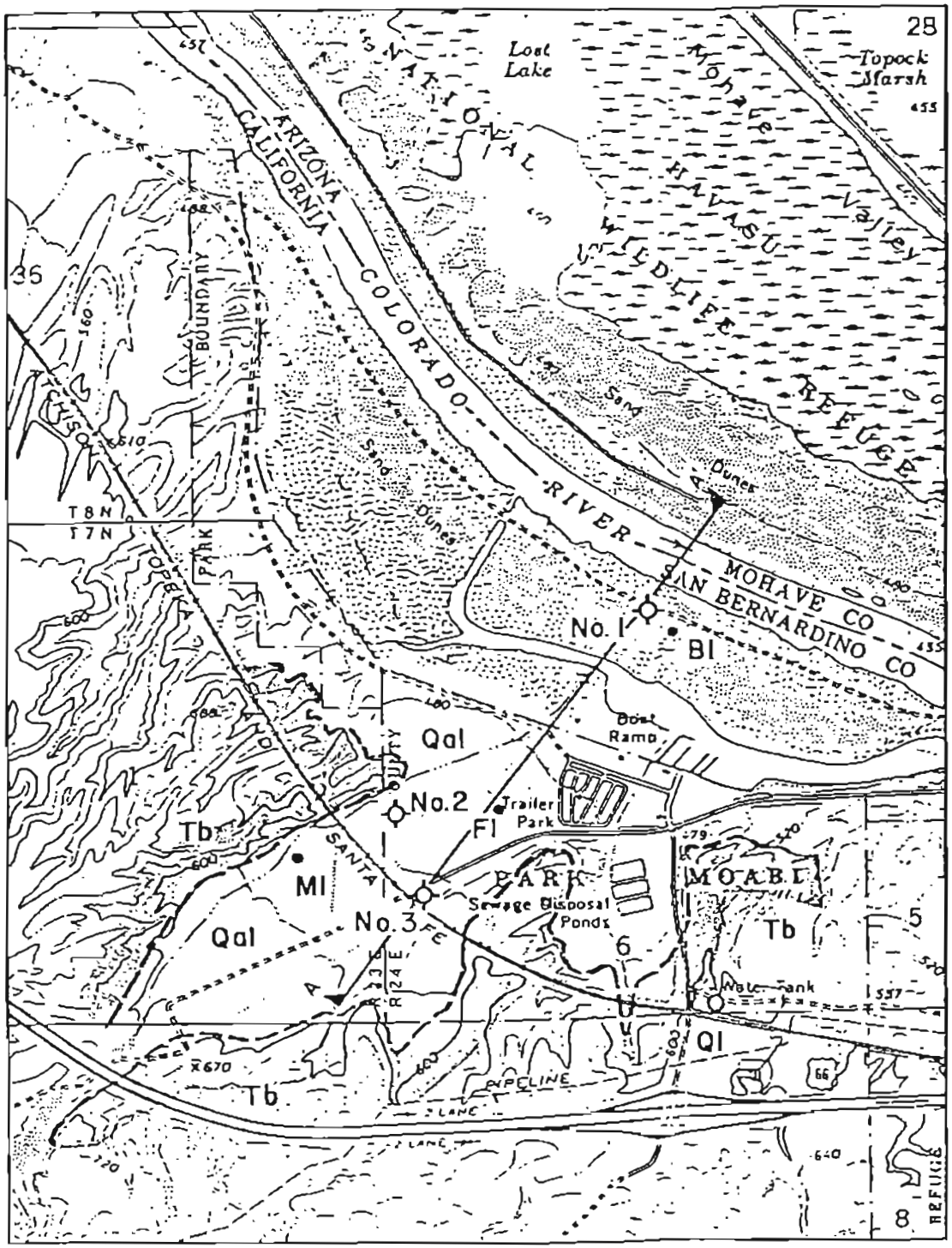
canyons. The alluvium is composed of eroded bedrock fragments, fanglomerate and Colorado River sediments that form an unconfined aquifer. The aquifer is 20 to 60 feet thick, and generally yields poor quality ground water beneath most of the Park property.

EXPLORATORY DRILLING

Boring No. 1 was drilled from ground surface to a depth of 250 feet. This boring penetrated 115 feet of recent Colorado River alluvium consisting primarily of sand and gravel with a few interbeds of organic rich silts and clays. A clayey zone was penetrated between 115 to 177 feet. Below this unit are fanglomerates consisting of sand and gravels derived from the local mountains to the west. A small quantity of good quality ground water was encountered from approximately 40 to 70 feet. Below 70 feet to a depth of 250 feet, conductivity measurements indicated the presence of poor quality ground water.

Boring No. 2 was drilled to a depth of 80 feet without encountering a viable source of ground water. The borehole penetrated 10 feet of Recent Alluvium before encountering silts and clays of the Bouse Formation.

Boring No. 3 revealed the probable presence of good quality ground water. This boring penetrated Recent alluvium from ground surface to a depth of 35 feet. Silts and clays were found between 35 and 69 feet, which probably are lower members of the Bouse Formation. A fanglomerate occurs below these deposits which extends from 69 feet to a depth greater than 250 feet. The conductivity of water samples obtained



EXPLANATION

Qal — ALLUVIUM
Recent sand, gravel and silt

Tb — BOUSE FORMATION
Pliocene sand, silt, clay, limestone and tufa.

GEOLOGIC CONTACT
Approximately located

Fl • WATER WELL

Ql ○ EXPLORATORY BORING

No.2 ⊙ EXPLORATORY BORING BY LC&A

A — A' GEOLOGIC SECTION

Reference: Base map from U.S.G.S. 7½' Whale Mtn. Quadrangle, 1971.

N

SCALE IN FEET
0 1000 2000 3000 4000

LOCATION OF WELLS

PARK MOABI

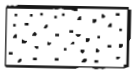
SAN BERNARDINO COUNTY, CALIF.

Figure 2

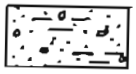
EXPLANATION



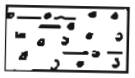
CLAY, SILT



SAND



SAND AND GRAVEL (WITH SOME CLAY)



GRAVEL WITH SOME CLAY

DEPTH TO WATER

NaCl

CHEMICAL CHARACTER OF GROUND WATER

ELEVATION IN FEET

0 550 1100

SCALE IN FEET

GEOLOGIC SECTION

PARK MOABI,

SAN BERNARDINO COUNTY

LeROY CRANDALL AND ASSOCIATES

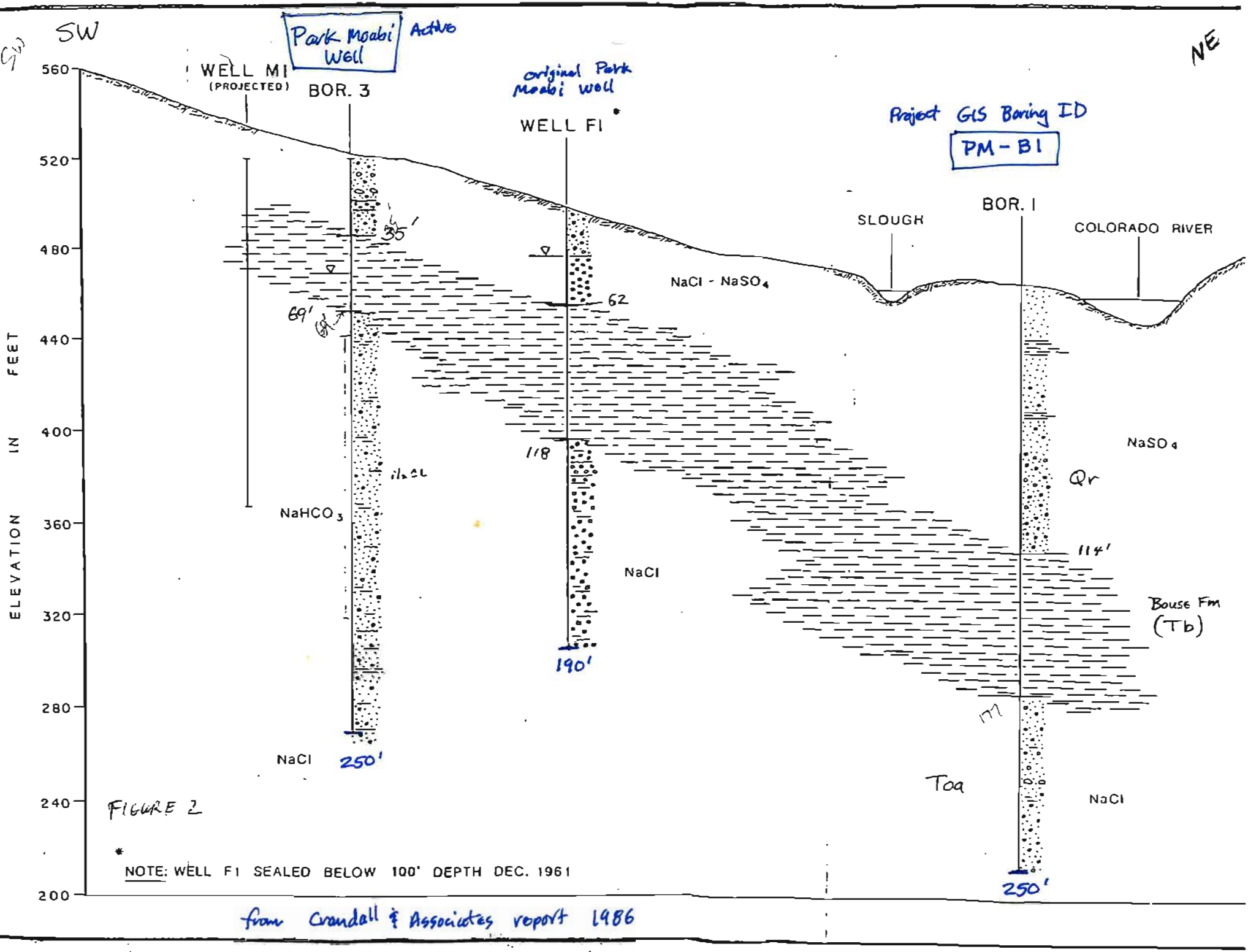
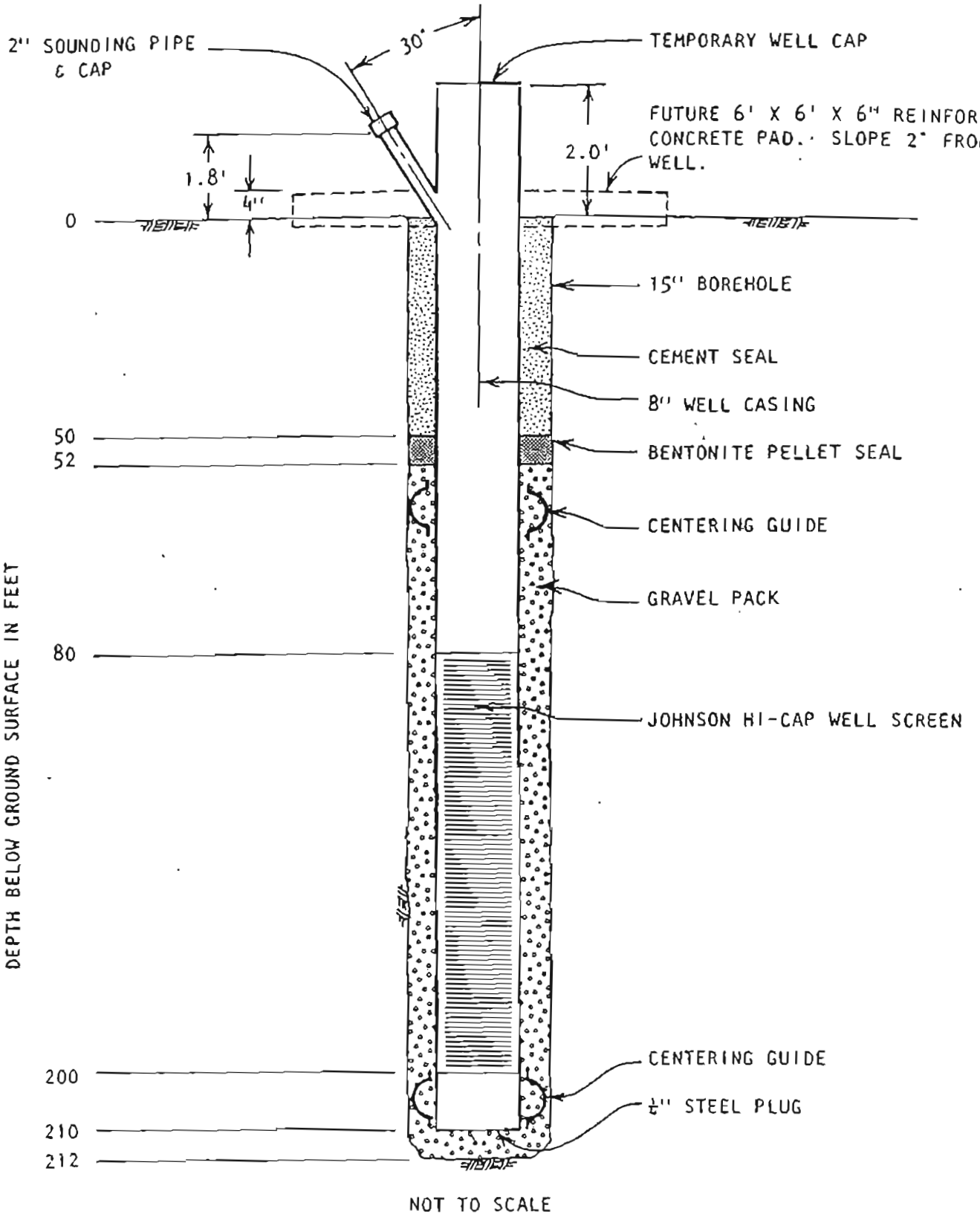


FIGURE 2

from Crandall & Associates report 1986

JOB E-85152-B

FIGURE 3



WELL CONSTRUCTION DETAILS

LeROY CRANDALL AND ASSOCIATES

during drilling indicates that good quality water exists from 69 to 220 feet. Below 220 feet, ground water becomes poorer in quality with increasing depth.

GROUND WATER QUALITY

The chemical character of ground water within the Park is variable. Water samples from the Colorado River between Davis Dam and Parker Dam indicate the water to be sodium sulfate in character. During the period 1967-1985, mineral concentrations ranged between 600 and 700 milligrams per liter (mg/l), but have been occasionally higher. Water samples from the Park's gravel collector (B1), which provides feed water for the RO plant, have been similarly sodium sulfate in chemical character. However, samples have had a much higher mineral concentration, with electrical conductances ranging from 2,340 micromhos/cm in 1961, to over 3,000 micromhos/cm in 1977.

Water samples from the unused Park well (F1) have differed in chemical character and contained more dissolved minerals. They have been sodium chloride in character with electrical conductances ranging between 2,370 and 4,130 micromhos/cm (equivalent to mineral concentrations of 1,540 and 2,680 mg/l). The source of the high salinity appears to be directly related to salts contained within the Bouse Formation. However, it could be partially related to decaying vegetation. Discharge from the well is reported to have had a hydrogen sulfide odor and an elevated temperature. As shown by the SO_4/Cl ratios in Table 1, the chemical character of the well discharge is related to the duration of

TABLE 1

CHEMICAL ANALYSES OF WATER SAMPLES

Well Number	Date Sampled	EC x 10^6 at 25°C	pH	Mineral constituents in milligrams per liter											SO_4/Cl
				Ca	Mg	Na	K	CO	HCO_3	SO_4	Cl	NO_3	F	B	
7N/24E-6F1 Pumping:															
15 Min.	10-12-61	2,050	7.9	100	1	340	6.6	0	100	170	485	13.0	0.98	0.37	0.26
9 Hrs.	10-13-61	2,970	7.5	107	57	440	10.4	0	164	385	655	16.0	1.18	0.48	0.43
72 Hrs.	10-23-61	3,960	7.5	142	87	569	14.0	0	217	582	838	11.4	1.00	0.54	0.51
89 Hrs.	10-24-61	4,130	7.6	91	101	600	14.0	0	227	607	895	19.3	0.72	0.58	0.50
	12- -61		(Well Sealed Below 100 Foot Depth)												
1 Hr.	01-29-62	2,380	7.9	86	27	364	9.2	0	112	241	554	11.9	1.17	0.38	0.32
Boring 1 at 40'	03-27-86	1,270	7.8	70	30	170	8.0	0	192	288	151	0.0		1.27	1.41
Boring 2 at 200'	03-27-86	2,290	8.0	41	7	455	7.0	0	106	158	610	12.0		0.47	0.19
Boring 3* at 160'	03-27-86	525	8.1	45	8	66	5.0	1	138	40	63	2.8	1.8		0.47
Boring 3 at 250'	03-27-86	1,190	7.8	67	13	162	7.0	0	83	110	270	18.0		0.21	0.30

E-85417-B

pumping. Initial discharge was chloride in character, but after a few hours of pumping, the sulfate concentration almost doubled. It appears that long duration pumping had the effect of inducing a westward migration of sulfate water that must be present between Well F1 and the RO plant.

Initially, Well F1 obtained water from two separate aquifers, as shown on Figure 2. The aquifers are separated by a silt and clay aquitard 40 to 70 feet in thickness that probably occurs beneath most of the Park. Both aquifers yield a chloride water, but after the deeper confined aquifer was sealed during December 1961, ground water could only be obtained from the upper unconfined aquifer which contains high concentrations of sulfate.

As shown by Figure 2 and Table 1, Exploratory Boring No. 1 encountered a sodium sulfate water in the upper aquifer and a sodium chloride water in the deeper aquifer. Water in the upper aquifer has a lower concentration of dissolved minerals than water yielded by the gravel collector, but would still require some demineralization to be suitable for drinking water. Ground water in the deeper aquifer is more mineralized and would similarly require demineralization prior to use for drinking water.

Exploratory Boring No. 3 also penetrated the two aquifers penetrated by Well F1 and Boring No. 1, but the upper aquifer was unsaturated. Ground water in the deeper aquifer above a depth of 200 feet is considerably different in chemical character and mineralization

than the water obtained from Well F1 and Boring No. 1. It is a sodium bicarbonate water with a low total dissolved mineral concentration of 525 micromhos/cm. It is generally suitable for drinking water with several restrictions. Below a depth of 200 feet, ground water is sodium chloride in character which is similar to the water encountered in the deeper aquifer at Well F1 and Boring No. 1. The water sample collected at 250 feet had an electrical conductance of 1,190 micromhos/cm and would be only marginally suitable for drinking water.

The water sample collected from Boring No. 3 at a depth of 160 feet indicates that the ground water in the vicinity of the boring site is suitable for drinking water with several exceptions. As shown in Table 1, the sample had a fluoride concentration of 1.8 mg/l, which is slightly above the recommended maximum contaminant level (MCL) of 1.4 mg/l for the average of maximum daily air temperature of 86.4 degrees F which has been recorded at Needles. However, the EPA is proposing a recommended MCL of 4.0 mg/l. If the MCL is adopted in California, the fluoride concentration in ground water in the vicinity of Boring No. 3 would be acceptable. An MCL is the highest concentration of a particular contaminant that is allowed in drinking water. The sample also contained excessively high concentrations of iron (6.8 mg/l) and manganese (0.52 mg/l). Concentrations of other elements found in the sample from 160 feet for which MCL's have been established are shown in Table 2. The laboratory report is presented in Appendix B.

Table 2
CONCENTRATIONS OF MINOR ELEMENTS
(concentrations in mg/l)

Element	Concentration	MCL
Copper	< 0.007	1.0
Iron	6.8	0.3
Manganese	0.52	0.05
Zinc	0.019	5.0
Arsenic	0.002	0.05
Barium	0.19	1.0
Cadmium	< 0.003	0.01
Chromium	< 0.029	0.05
Silver	< 0.005	0.05
Lead	0.004	0.05
Mercury	< 0.0002	0.02
Selenium	0.005	0.01

As shown in the table, only iron and manganese concentrations exceeded MCL's. Water containing these elements may be objectionable to an appreciable number of people, but they are not generally hazardous to health. The high concentrations of iron and manganese may be related to incomplete filtering of the sample prior to analysis. Additional analyses of samples from the proposed test well will be required for confirmation.

Exploratory drilling at Site No. 2 was terminated at a depth of 80 feet without encountering ground water. The deeper aquifer may be present at the site, but it would probably be thinner than it is at Site No. 3.

CONCLUSIONS AND RECOMMENDATIONS

Exploratory drilling at three sites within the Park boundaries indicate that a test well drilled in the vicinity of Boring No. 3 should be capable of yielding about 100 gallons per minute. It may be possible to pump at higher rates for short periods of time, but the safe yield of the ground water reservoir would be exceeded. In any event, we recommend that ground water not be used for irrigation because of the limited supply available. Pumping at rates greater than 100 gpm would probably also induce migration of poor quality water that is present in the vicinity of the trailer park, and the old water well. Excessive pumping could also induce an upward flow of poor quality water that is present at depths below 200 feet. A water sample collected from Boring No. 3 indicated the presence of generally good quality water between the depths of 70 and 220 feet. The sample had a total dissolved solids concentration of 300 milligrams per liter (mg/l), considerably below the recommended maximum concentration limit of 500 mg/l for drinking water. However, the sample contained a fluoride concentration of 1.8 mg/l which is slightly above the recommended maximum contaminant level (MCL) of 1.4 mg/l. The sample also contained moderately high concentrations of iron and manganese which exceed MCL's. These two elements may be objectionable to some people, but they are not generally hazardous to health. In view of the only occasional use of ground water by Park visitors, the County could probably obtain a waiver of the requirements from the California Department of Health Services or the designated health officer for San Bernardino County.

The high iron and manganese concentrations could be related to incomplete filtration of the water sample from Boring No. 3 prior to analysis. In order to verify the concentration of these elements and test the yield of the aquifer, we recommend the construction of a test well at the site. The test well should be constructed to a depth of about 210 feet. In the event the water quality and tested well yields are acceptable, the test well can be completed as a production well at a modest additional cost. Proposed well construction details are shown on the following Figure 3. Technical specifications are presented in Appendix C. Prior to construction of the well, the County should verify that the well site is not within the Santa Fe Railroad right-of-way.

Appendix A

LITHLOGIC LOG

1986

PM-B1

Park Moabi Water Supply Investigation
Crandall & Assoc.

Boring only ~~Well~~ No. 1

Depth	Graphic Log	EC (umhos)		Description of Materials
				Road base material
			SAND	Brown silty sand, very fine to medium grained sand, soft, damp to moist, few rounded gravels
10				
20				
			CLAY	Black silty clay, soft
30		790	SAND	Brown silty sand Decaying organic odor
40		950		Gravels increase, rounded, pebble size to 3/4", 3 gpm, collect water sample
50		600		Clayier
			CLAY	Black sandy silty clay, soft
60		500	SAND	Brown clayey silty sand, very fine to medium grained sand, soft, some fine gravels
70		980		Gravels increase, angular to rounded, caving
		1,000		5 gpm, collect water sample

LITHLOGIC LOG

1986
PM-B1

Park Moabi — Crandall & Associates Water Supply Investigation

Well No. 1

Depth	Graphic Log	EC (umhos)		Description of Materials
				Caving gravels
90		1,200		
100		1,900		
				Gravels decrease, sands increase
110		3,500		
			CLAY	Grey silty clay, moderately firm, plyable
120		1,800		
130		3,500		
140		7,000		Some fine sand
150		4,100		
		5,200		

LITHLOGIC LOG

Well No. 1

Depth	Graphic Log	EC (umhos)	Description of Materials	
170		4,350		
180		2,400	SAND & GRAVEL	Green to brown silty gravelly sand, very fine to coarse grained sand, fine angular gravels predominately meta-igneous composition
190		2,200		
200		2,400		38 gpm, collect water sample
210		2,300		
220		2,400		50 gpm
230		3,600		
				236' to 238' sand bed
		3,200		

LITHLOGIC LOG

Well No. 1

Depth	Graphic Log	EC (umhos)	Description of Materials
		4,750	Total Depth: 250 ft., 60 gpm, water sample collected
250			
260			

LITHLOGIC LOG

Explor. Boring
~~Well~~ No. 2

Depth	Graphic Log	EC (umhos)		Description of Materials
			SAND & GRAVEL	Brown, fine to coarse grained sand with some fine gravels
				Gravel size increases
10			CLAY & SILT	Brown silts and grey clay, moderately firm, Bouse Formation
20				Some fine grained sand
30				Clayey silt, reddish-brown
40		2,000		Some coarse grained sand to fine gravel
50				Color changes to grey
60		2,550		Some very fine sand, decaying organic odor
70				Color changes to mottled grey and tan, grey clay, semiplastic
				Total Depth: (80 ft.), no water to collect for samples

LITHLOGIC LOG

Well No. 3

Depth	Graphic Log	EC (umhos)	Description of Materials	
			SAND & GRAVEL	Brown, fine to coarse grained sand with fine angular gravel, gravels are meta-igneous composition
10				
				Gravel size increases
20				Gravel bed
30				Clays increase
			CLAY	Brown, silty clay to clay, soft, with some very fine grained sand
40		1,700		
				Some fine gravels
50				
				Color changes to grey
60		1,600		Siltier, mottled tan and grey, decaying organic odor
				White clay, caliche
70			SAND & GRAVEL	Brown and green, fine to coarse grained sand and fine angular gravels, gravels are predominately meta-igneous composition
		820		Color changes to black, collect water

LITHLOGIC LOG

Well No. 3

Depth	Graphic Log	EC (umhos)	Description of Materials
			Predominately coarse grained sand, brown
90		800	Siltier, sands increase
100		850	
110		590	
120		720	Gravels increase 12 gpm
130		690	Silty sand bed, very fine to medium grained
140		540	20 gpm
			Siltier
150		650	
			Clayier
		550	30 gpm, collect water sample

LITHLOGIC LOG

Well No. 3

Depth	Graphic Log	EC (umhos)		Description of Materials
				Silts increase
170		700		
				Gravels increase
180		550		33 gpm
				Clays increase
				Siltier, clays decrease
190		850		
200		590		43 gpm
210		750	SAND & GRAVEL	Red sand and gravel, fine to coarse sand, fine angular gravel, some silts and clays, gravels are predominately volcanic and meta sediments
220		610		Collect water sample
				White clay bed with some fine gravel
230		850		Clays decrease
		1,000		38 gpm

LITHLOGIC LOG

Well No. 3

Depth	Graphic Log	EC (umhos)	Description of Materials
250		1,100	Color changes to brown, meta-igneous gravels Total Depth: 250 ft., 60 gpm, collect water sample
260			

Appendix B

Soil and Plant Laboratory, Inc.

P.O. Box 11744, Santa Ana, California 92711-1 (714) 558-8333
P.O. Box 153, Santa Clara, California 95052-0153/(408) 727-0330
P.O. Box 1648, Bellevue, Washington 98009-1648/(206) 746-6665

LEROY CRANDALL & ASSOCIATES
711 N. Alvarado
Los Angeles, CA 90026-4099

WATER AGRICULTURAL SUITABILITY ANALYSIS
(A71)

April 10, 1986
Lab No. 90045
P O No. E-85417-B

Sample Description: Bor No 1 3-27-86 40'

CATIONS

Sample #	Na ppm	Na meq/l	Ca ppm	Ca meq/l	Mg ppm	Mg meq/l	K ppm	K meq/l	NH_4 ppm	NH_4 meq/l	SUM OF CATIONS
1	170	7.39	70	3.05	30	2.50	8	0.21			13.66

ANIONS

Sample #	Cl ppm	Cl meq/l	SO_4 ppm	SO_4 meq/l	HCO_3 ppm	HCO_3 meq/l	CO_3 ppm	CO_3 meq/l	NO_3 ppm	NO_3 meq/l	PO_4 ppm	PO_4 meq/l	SUM OF ANIONS
1	151	4.25	288	6.00	192	3.15			0	0.00			13.40

Sample #	pH	pHc	Ecx10^3	SAR_{adj}	ppm Cu	Zn	Mn	Fe	B	F	Li
1	7.8	7.33	1.27	8.84					1.27		

ppm - parts per million parts water meq/l - milliequivalents per liter
*Below the detection limit for the element
Data are supplied without recommendation or comment.

LORI LITTLEFORD
Analytical Laboratory Director

Soil and Plant Laboratory, Inc.

P.O. Box 11744, Santa Ana, California 92711-17[illegible] 714) 558-8333
P.O. Box 153, Santa Clara, California 95052-015[illegible] (408) 727-0330
P.O. Box 1648, Bellevue, Washington 98009-1648/(206) 746-6665

LEROY CRANDALL & ASSOCIATES
711 N. Alvarado
Los Angeles, CA 90026-4099

WATER AGRICULTURAL SUITABILITY ANALYSIS
(A71)

April 10, 1986
Lab No. 90045
P O No. E-85417-B

Sample Description: Bor No 1 3-27-86 200'

CATIONS

Sample #	Na ppm	Na meq/l	Ca ppm	Ca meq/l	Mg ppm	Mg meq/l	K ppm	K meq/l	NH_4 ppm	NH_4 meq/l	SUM OF CATIONS
2	455	19.78	41	2.05	7	0.58	5	0.13			22.54

ANIONS

Sample #	Cl ppm	Cl meq/l	SO_4 ppm	SO_4 meq/l	HCO_3 ppm	HCO_3 meq/l	CO_3 ppm	CO_3 meq/l	NO_3 ppm	NO_3 meq/l	PO_4 ppm	PO_4 meq/l	SUM OF ANIONS
2	610	17.18	158	3.29	106	1.74			12	0.19			22.40

Sample #	pH	pHc	Ecx10^3	SAR_{adj}	ppm Cu	ppm Zn	ppm Mn	ppm Fe	ppm B	ppm F	ppm Li
1	8.0	8.01	2.29	23.98					0.47		

ppm - parts per million parts water meq/l - milliequivalents per liter
*Below the detection limit for the element
Data are supplied without recommendation or comment.

LORI LITTLEFORD
Analytical Laboratory Director

Soil and Plant Laboratory, Inc.

P.O. Box 11744, Santa Ana, California 92711-1[illegible] (714) 558-8333
P.O. Box 153, Santa Clara, California 95052-0153/(408) 727-0330
P.O. Box 1648, Bellevue, Washington 98009-1648/(206) 746-6665

LEROY CRANDALL & ASSOCIATES
711 N. Alvarado
Los Angeles, CA 90026-4099

WATER AGRICULTURAL SUITABILITY ANALYSIS
(A71)

April 10, 1986
Lab No. 90045
P O No. E-85417-B

Sample Description: Bor No 3 3-27-86 250'

CATIONS

Sample #	Na ppm	Na meq/l	Ca ppm	Ca meq/l	Mg ppm	Mg meq/l	K ppm	K meq/l	NH_4 ppm	NH_4 meq/l	SUM OF CATIONS
3	162	7.04	67	3.35	13	1.08	7	0.18			11.65

ANIONS

Sample #	Cl ppm	Cl meq/l	SO_4 ppm	SO_4 meq/l	HCO_3 ppm	HCO_3 meq/l	CO_3 ppm	CO_3 meq/l	NO_3 ppm	NO_3 meq/l	PO_4 ppm	PO_4 meq/l	SUM OF ANIONS
3	270	7.61	110	2.29	83	1.36			18	0.29			11.55

Sample #	pH	pHc	Ecx10^3	SAR_{adj}	ppm Cu	Zn	Mn	Fe	B	F	Li
3	7.8	7.81	1.19	7.52					0.21		

ppm - parts per million parts water meq/l - milliequivalents per liter
*Below the detection limit for the element
Data are supplied without recommendation or comment.

LORI LITTLEFORD
Analytical Laboratory Director

MONTGOMERY LABORATORIES
a division of James M. Montgomery, Consulting Engineers, Inc.
555 East Walnut Street, Pasadena, California 91101
(818) 796-9141 / (213) 681-4255 Telex 67-5420

Report of General Mineral Analysis

Crandall & Assoc., Leroy
711 N. Alvarado
Los Angeles, CA 90026
Attn: Richard Shatz

Job#/PO#: 437.0184
Workorder#: W06913
Report#: R26460
Phone #: 213-413-3550

Date Sampled: 3/27/86
Date Completed: 4/22/86

Date Received: 4/2/86

Sample Lab Number: G46029 Sample ID: # E-85417-B (BORING #3-160')

CATIONS:	(mg/l)	(meq/l)	ANIONS:	(mg/l)	(meq/l)
			Bicarbonate	138	2.26
Sodium	69.7	3.03	Carbonate	1.1	0.0365
Potassium	4.6	0.118	Chloride	63	1.77
Calcium	27	1.35	Sulfate	40	0.833
Magnesium	6.2	0.517	Nitrate-N	2.8	0.20
			Fluoride	1.8	0.0947
			Hydroxide	0.00	0.00

CATION SUM = 5.01 meq/l ANION SUM = 5.19 meq/l

OTHER WATER QUALITY PARAMETERS DETERMINED (mg/l):

pH (unitless)	8.1	Copper	<0.007
Conductance (umho/cm)	525	Iron	6.8
Alkalinity	115	Manganese	0.52
TDS	300	Surfactants	<0.02
Hardness	93.4	Zinc	0.019
Langelier Index	0.15	Arsenic	0.002
pH of CaCO3 saturation (25C)	7.95	Barium	0.19
pH of CaCO3 saturation (60C)	7.43	Cadmium	<0.003
Free CO2 (25C)	2.19	Total Chromium	<0.029
		Silver	<0.005
Mercury	<0.0002	Lead	0.004
Total Selenium	0.005		

NA: Not Analyzed ND: Not Detected

Approved by

APR 22 1986

APPROVED
QC OFFICER

Appendix C

Tech. Specifications

(not included in CH2M copy)

COMPLETION REPORT

CONSTRUCTION AND TESTING OF TEST WELL NO. 3

PARK MOABI, COUNTY OF SAN BERNARDINO

(OUR JOB NO. E-85417-C)

LeRoy Crandall & Associates

Sept. 17, 1986 — Report (3)

ATTACHMENT B-3

LeROY CRANDALL AND ASSOCIATES geotechnical consultants □ 900 grand central avenue □ glendale, california 91201-3009 □ (818) 243-4140
a subsidiary of Law Engineering Testing Company

September 17, 1986

General Services Agency
Facilities Management Department
Architecture and Engineering Divisions
County of San Bernardino
200 South Lena Road
San Bernardino, California 92415

(Our Job No. E-85417-C)

Attention: Mr. Robert G. Wilkinson
Project Manager

The attached report describes the drilling, construction and testing of the recently completed Test Well No. 3 located at Park Moabi, County of San Bernardino. The report also contains recommendations for long-term pumping of the well.

Respectfully submitted,

LeROY CRANDALL AND ASSOCIATES

by
Richard Shatz
Staff Geologist

by
Donald L. McCann, C.E.G. 395
Senior Hydrogeologist

SE8/sle
(5 copies submitted)

cc: (1) John Eagan & Associates
Attn: Mr. Lloyd Lapp

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Well Testing	3
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2. Well Construction Details	2
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4. Plot of Well Test Data	4
5. Water Level Recovery	4

Appendices

A. Well Data and Lithologic Log

B. Chemical Analyses of Water Samples

COMPLETION REPORT
CONSTRUCTION AND TESTING OF TEST WELL NO. 3
PARK MOABI, COUNTY OF SAN BERNARDINO

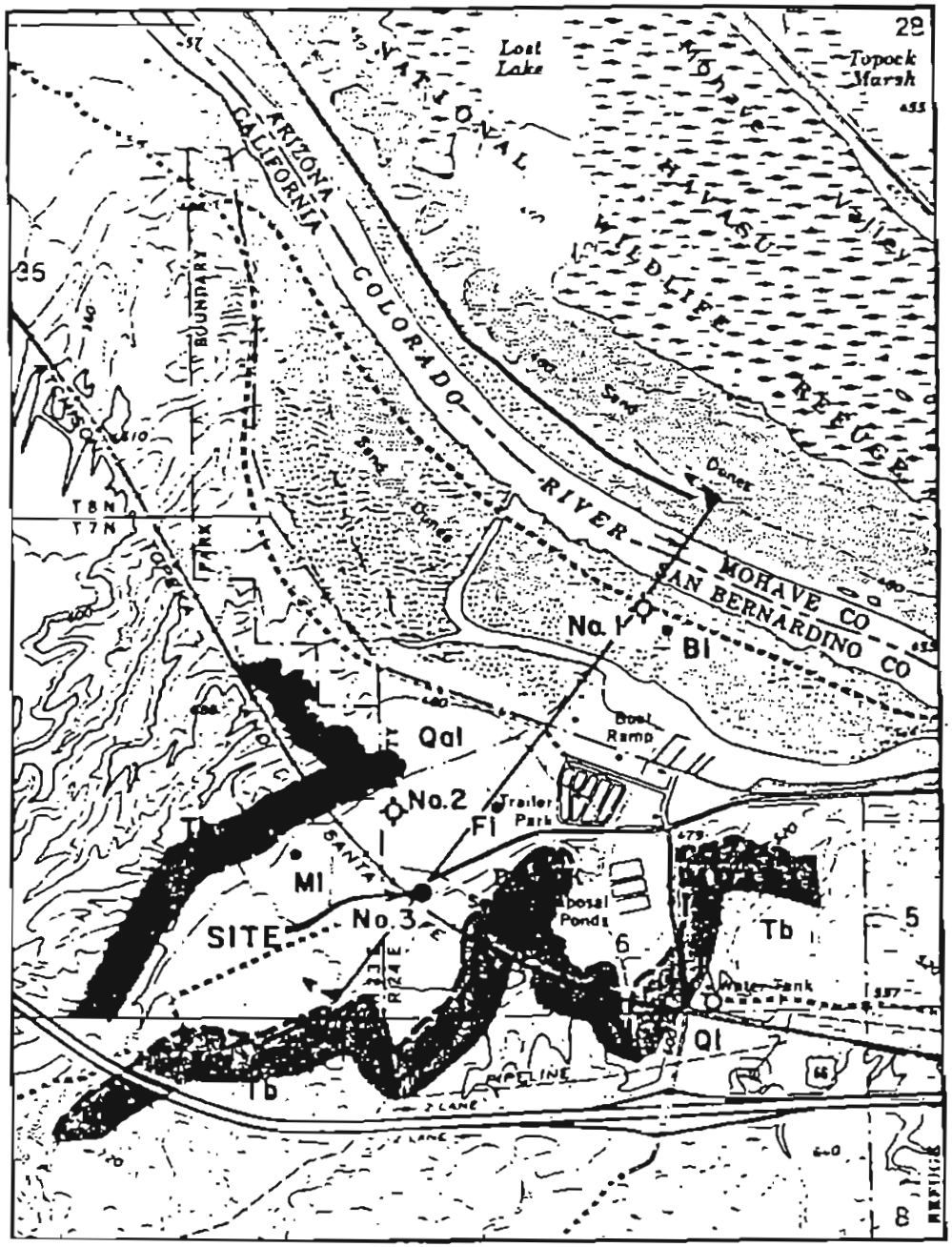
INTRODUCTION

This report presents a summary of drilling, construction and testing of Test Well No. 3 at Park Moabi, County of San Bernardino. All work related to construction of the test well was carried out during the period July 28, 1986 through August 12, 1986. Figure 1, Location of Wells, shows the location of the test well and other wells in the vicinity of the park.

The test well location was selected as the basis of information obtained from a previous exploration drilling program that was summarized in our report "Results of Exploratory Drilling" dated April 25, 1986. Historic records indicate that the aquifer penetrated by the well is not being utilized within the immediate area. The aquifer selected for development occurs between the depths of 70 to 210 feet below ground surface.

Well drilling and construction services were provided by Rottman Drilling Company of Lancaster, California. Well design, observation of test well construction, and testing were provided by LeRoy Crandall and Associates of Glendale, California.

Our professional services have been performed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable geologists practicing in this or similar localities. No other



EXPLANATION

Qal — ALLUVIUM
Recent sand, gravel and silt

Tb — BOUSE FORMATION
Pliocene sand, silt, clay, limestone and tufa.

GEOLOGIC CONTACT
Approximately located

Fl ● WATER WELL

Ql ○ EXPLORATORY BORING

No.2 ☼ EXPLORATORY BORING BY LC&A

A — A' GEOLOGIC SECTION

Reference: Base map from U.S.G.S. 7½' Whale Mtn. Quadrangle, 1971.

N

SCALE IN FEET
0 1000 2000 3000 4000

LOCATION OF WELLS

PARK MOABI

SAN BERNARDINO COUNTY, CALIF.

Figure 1

LeROY CRANDALL AND ASSOCIATES

warranty, expressed or implied, is made as to the professional advice included in this report.

HYDROGEOLOGIC CONDITIONS

The lithologic log of Test Well No. 3 is presented in Appendix A. The materials penetrated by the boring consist of sandy gravel from ground surface to a depth of 35 feet. Silts and clays separate this unit from the underlying aquifer which yields water to the well. The aquifer is composed of sandy gravels to clayey gravels and occurs from 69 feet to depths greater than 250 feet. Field measurements of the electrical conductivity of water samples obtained during March 1986, between 90 to 210 feet, indicated the presence of good quality water which was subsequently confirmed by laboratory analyses presented in our report dated April 25, 1986.

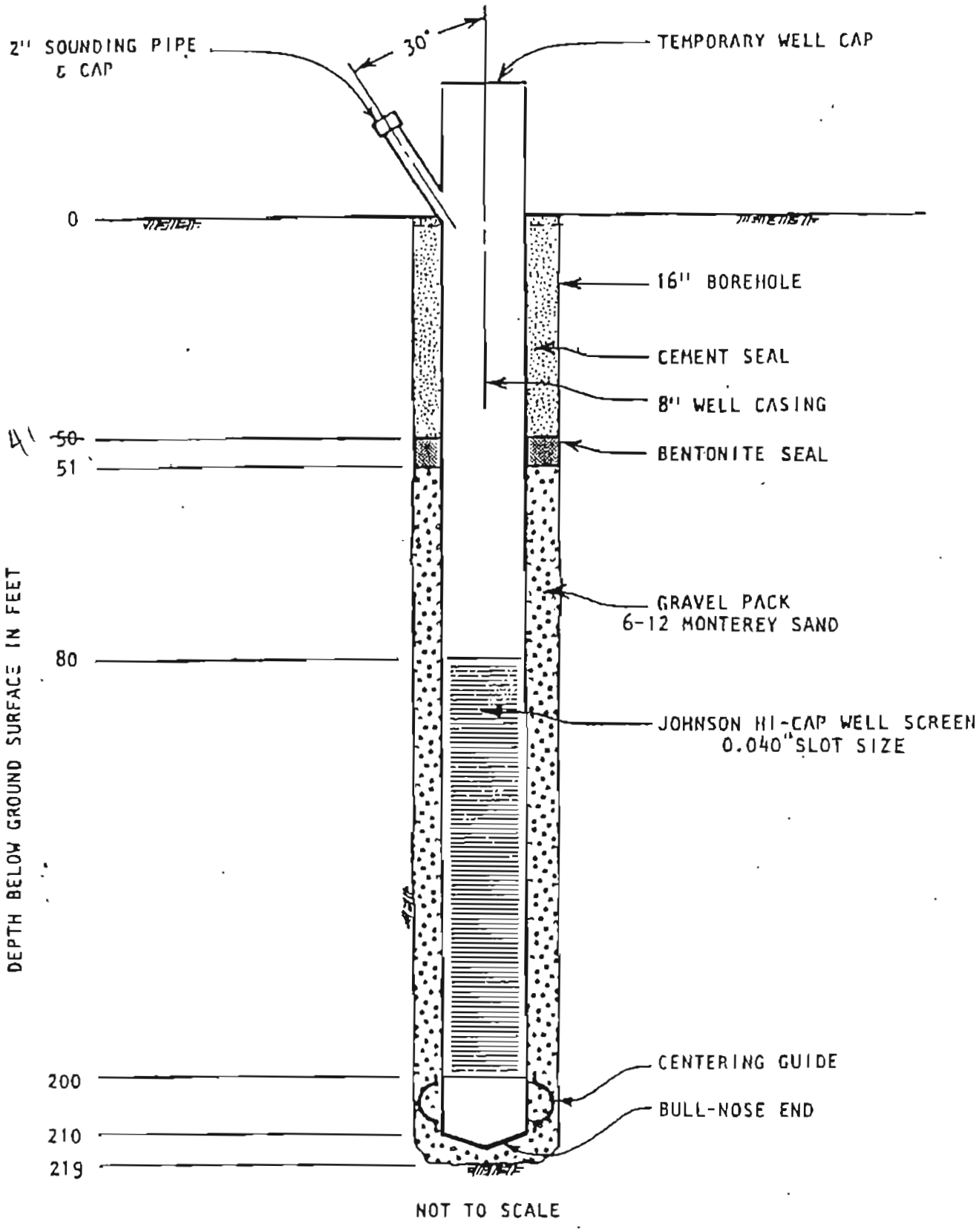
TEST WELL CONSTRUCTION

Drilling of the well borehole commenced on July 29, 1986, by drilling a 12¼-inch-diameter pilot borehole to a depth of 220 feet. On July 30, 1986 through July 31, 1986, the pilot hole was then reamed to 16 inches to a depth of 219 feet. The borehole was drilled by the conventional rotary method using bentonite drilling mud to stabilize the borehole and to remove drill cuttings.

Following completion of the boring, an 8-inch-diameter casing was installed to a total depth of 210 feet. A Johnson hi-cap well screen was installed between the depths of 80 to 200 feet with a 10-foot sediment sump set at the bottom of the well between 200 to 210 feet. Well Construction Details are illustrated by Figure 2. Centering guides

JOB E-85417-C

FIGURE 2



PARK MOABI WELL NO. 3
WELL CONSTRUCTION DETAILS

were placed at 20-foot centers on the screened interval. The annulus between the borehole and well screen was packed with sieve size 6-12 Monterey sand while circulating clear water upwards through the annulus. A 10-foot bentonite slurry was placed on top of the sand filter through a tremie pipe from 41 to 51 feet. A concrete sanitary seal was installed after well testing was completed. The well was preliminarily developed by high velocity jetting until most of the colloidal and fine sediments were removed from the well.

A shaft-turbine test pump was then installed for further development and well testing. A Rossum sand tester was installed for measuring sand content. Development consisted of pumping and surging the well until the discharge became clear and sand-free. During the latter part of the development process, the sand content was less than 1 ppm, 20 minutes after surging.

The electrical conductance of well discharge was measured periodically during well development and testing. Conductance ranged from 1,300 micromhos/cm at the beginning of development and then declined to 820 micromhos/cm at the end of the testing.

WELL TESTING

Well testing commenced on August 6, 1986 and was conducted for a period of 24 hours. The well was tested using a shaft-turbine pump driven by a 150 horsepower diesel engine. The pump intake was set at 169 feet below ground surface. Discharge from the well was measured by a flowmeter that was periodically checked with a 5-gallon container. The test consisted of pumping the well at two discharge rates and

observing the water level drawdown in the well. Throughout the test, only traces of sand were measured in the Rossum sand tester. The following Table 1 summarizes test results.

TABLE 1

SUMMARY OF WELL TESTING

Discharge Rate gpm	Pumping Level Feet	Drawdown Feet	Specific Capacity gpm/ft	Electrical Conductance µmhos/cm	Sand Content ppm
40	87.18	33.60	1.19	1,150	<1 ppm
60	121.19	77.75	0.77	820	<1 ppm

At the end of the 24-hour period, the well discharge was increased to determine the maximum flow without breaking suction. This rate was found to occur between 67 to 70 gpm.

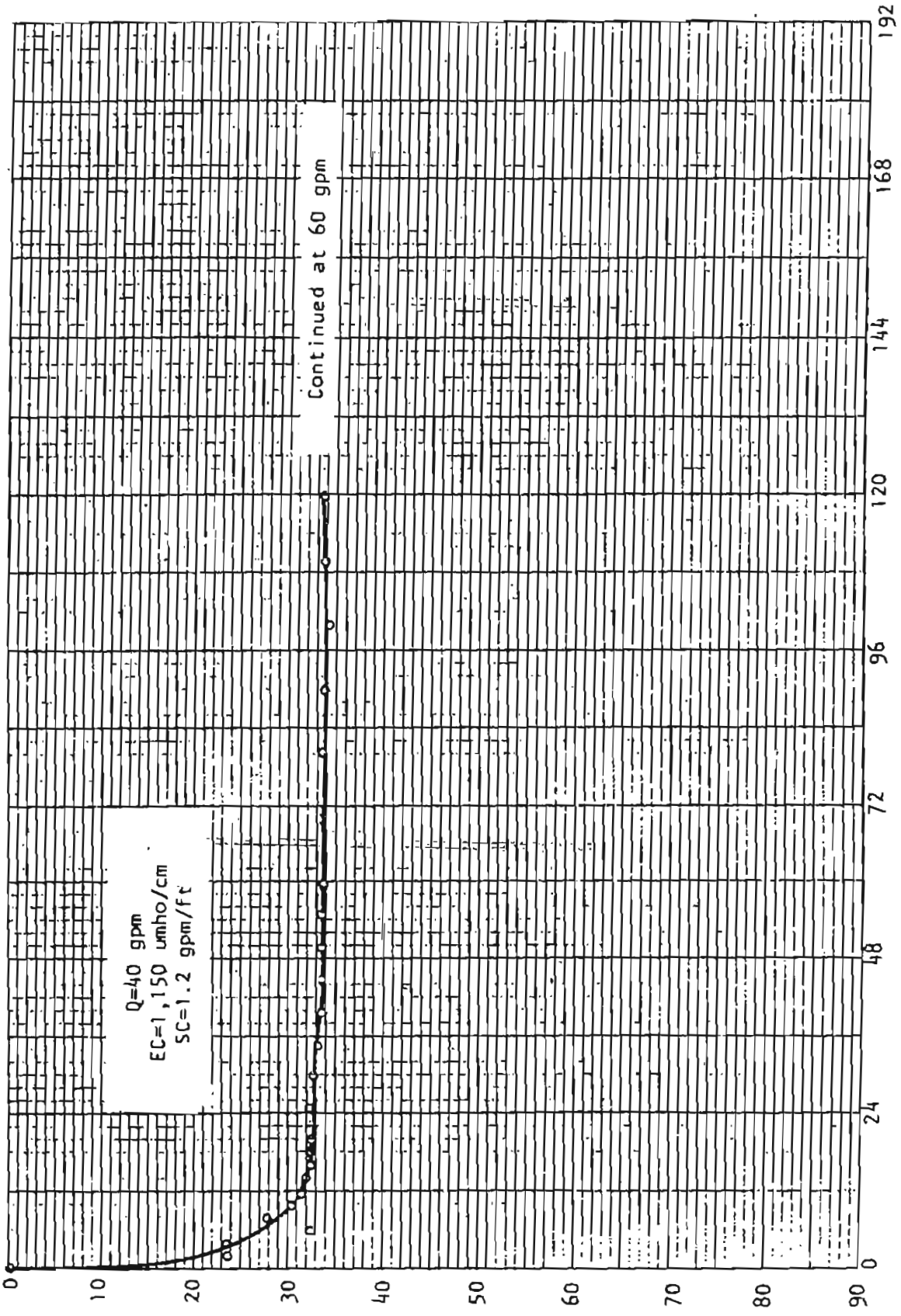
Water level measurements were made for 70 minutes after the pumping was stopped to determine the water level recovery rate. Recovery was found to be about 52 percent complete after 10 minutes and 96 percent complete after 70 minutes. Recovery measurements are illustrated graphically by Figure 5, Water Level Recovery.

GROUND WATER QUALITY

Previous chemical analyses of water samples from the test hole drilled at the site during March 1986 indicted that the site was underlain by alluvial materials containing a shallow sodium bicarbonate water and a deeper sodium chloride water. The shallow water sample had a

E-85417 -C

FIGURE 3

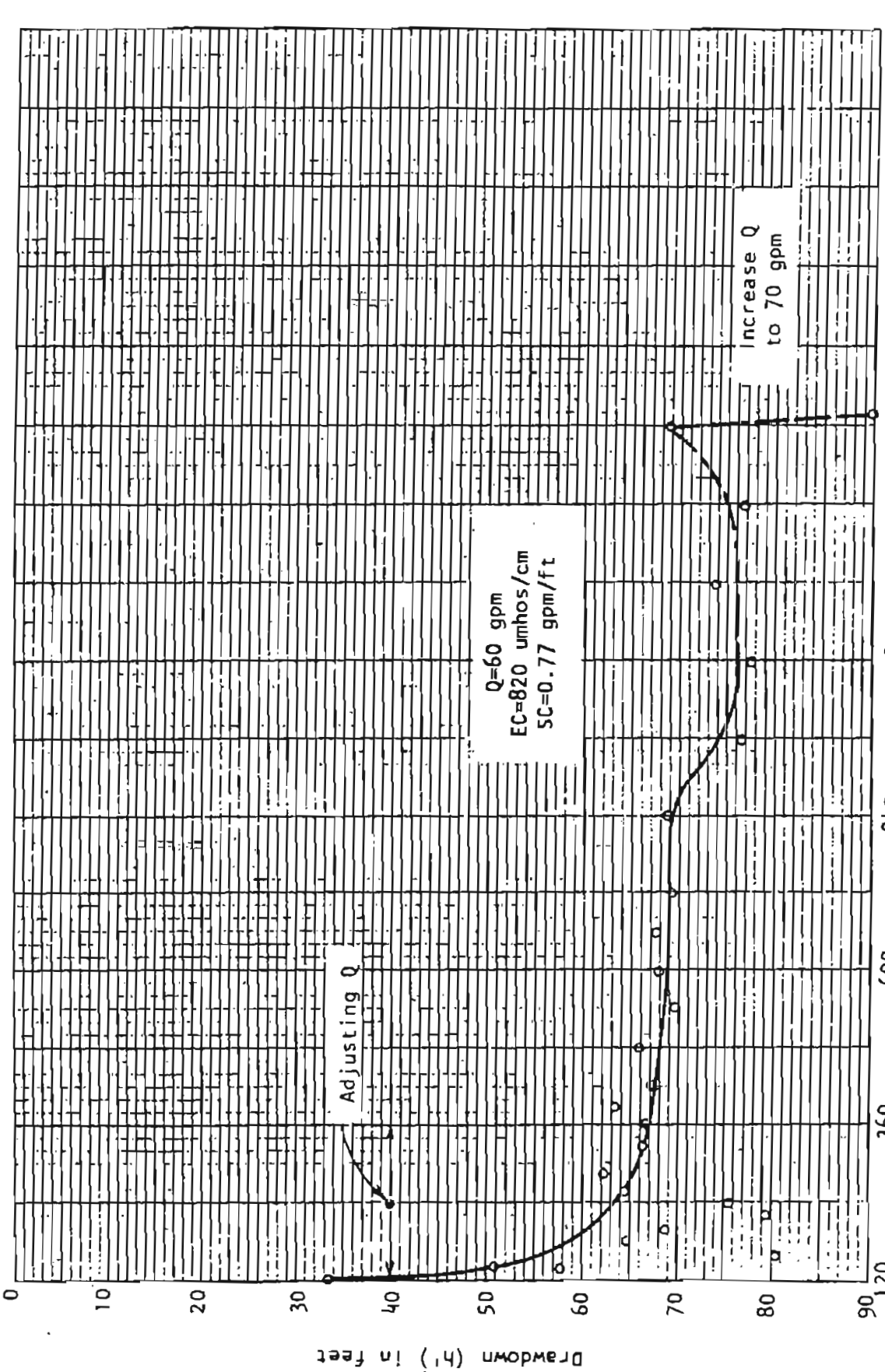


PARK MOABI TEST WELL 3

PLOT OF WELL TEST DATA

E-85417-C

FIGURE 4

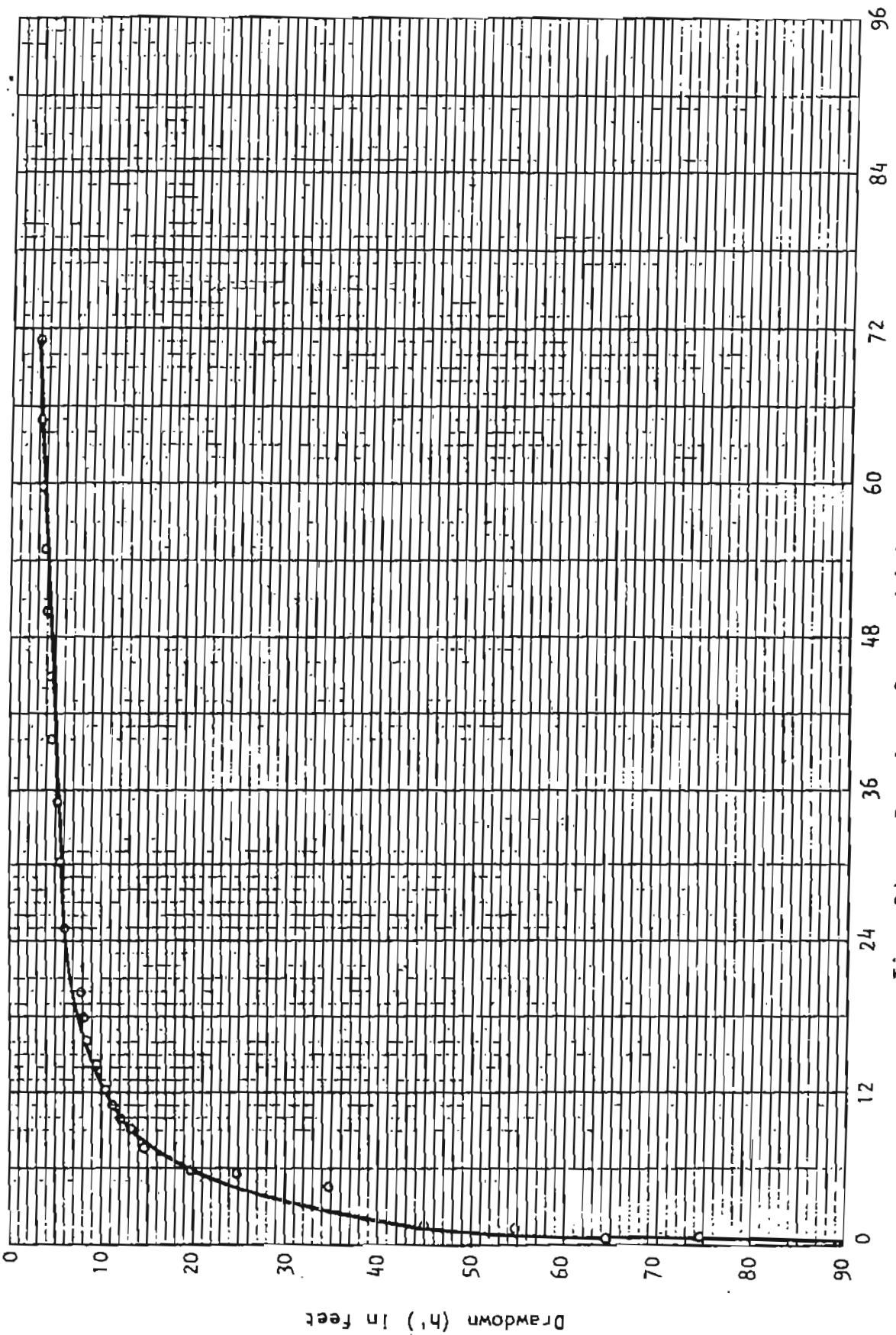


PARK MOABI TEST WELL 3

PLOT OF WELL TEST DATA

E-85417-C

FIGURE 5



PARK MOABI TEST WELL 3

WATER LEVEL RECOVERY

total dissolved solids (TDS) concentration of 300 mg/l, while the deeper sample had a higher concentration of 780 mg/l.

Two water samples were collected during the August 1986 24-hour well pumping test for chemical analyses. The first sample was collected after pumping for two hours at a rate of 40 gpm. It had an electrical conductance of 1,140 micromhos/cm (about 740 mg/l TDS) and was sodium chloride in character. The salinity and chemical character of the discharge at this time were similar to that of the sample collected from the test well at a depth of 250 feet during March 1986. The salinity of the discharge diminished as pumping progressed and after 24 hours the TDS content declined to 490 mg/l. The chemical character at this time remained sodium chloride, but the chloride/bicarbonate ratio decreased. It appears that as pumping progressed, development of the well was continuing and a proportionally larger amount of bicarbonate water entered the well from the shallow portion of the aquifer.

With the exception of fluoride, chemical analyses of the water sampler collected from the well at the conclusion of the test indicate that it is suitable for drinking water. General mineral, physical and organic chemical analyses all indicated that constituent concentrations were below maximum contaminant levels (MCLs) prescribed by the California Health and Safety Code. However, the fluoride concentration was 1.8 mg/l, slightly above the recommended MCL of 1.4 mg/l. The elevated fluoride concentration probably would not be detrimental to the occasional Park visitor, but would not be suitable for the permanent

Park resident. This problem could be mitigated by providing the permanent residents with bottled water for drinking and culinary uses, or blending with water from the RO unit. The August 1986 sample had a Langelier Index of -0.12 which indicates water from the well has a corrosive tendency. The earlier March sample had a positive index and less of a tendency toward corrosion.

Chemical analyses of samples collected from the test well borehole during March and those collected during the well test are summarized on the following Table 2. Laboratory reports are presented in Appendix B.

RECOMMENDATIONS

Pump testing of Test Well No. 3 was carried out August 6 and 7, 1986 at rates of 40 and 60 gpm. The test indicates that the well should not be pumped at rates in excess of 60 gpm, preferable 50 gpm until long-term sustained yield can be determined after several months of pumping. It may be possible to pump at higher rates for short periods of time, but the safe yield of the ground water reservoir would be exceeded. In any event, we recommend that ground water not be used for irrigation because of the limited supply available. Pumping at rates greater than 60 gpm could also induce migration of poor quality water that is present in the vicinity of the trailer park and the old water well. Excessive pumping could also induce an upward flow of poor quality water that is present at depths below 200 feet.

TABLE 5

CHEMICAL ANALYSES OF WATER SAMPLES

Well Number	Date Sampled	EC x 10^6 at 25°C	pH	Mineral constituents in milligrams per liter											TDS in mg/l
				Ca	Mg	Na	K	CO_3	HCO_3	SO_4	Cl	NO_3	F	B	
Boring 3 at 160'	03-27-86	525	8.1	45	8	66	5.0	1	138	40	63	2.8	1.8		300
at 250'	03-27-86	1,190	7.8	67	13	162	7.0	0	83	110	270	18.0		0.21	780*
Test Well 3 Pumping 120 min. @ 40 gpm	08-06-86	1,140		57	12	165			78	72	291	16.0			740*
Pumping 1,440 min. @ 60 gpm	08-07-86	790	7.9	42	9	111	5.3	0	84	49	172	3.4	1.9		490

*NOTE: (*) Estimated from EC.

The static water level in the well was 54 feet from ground surface. At a discharge rate of 60 gpm, the pumping level from ground surface may reach a depth of 145 feet after six months of continuous pumping. In view of the large drawdown anticipated, we recommend that the pump intake be set at a depth of 160 feet. Since motor cooling may be marginal, we recommend that a shroud be installed over the pump intake and motor to insure adequate cooling. Since the pump will be set within the well screen, nonabrasive (rubber) centering guides should be installed on the riser pipe at 20-foot intervals below a depth of 80 feet. We also suggest that a liquid level control system be installed. The low level cutoff could be set at 150 feet, and the high level start set at 80 feet.

After the well is placed in operation, static and pumping water levels should be made on a monthly basis. It would also be desirable to measure the electrical conductance on a monthly basis. The data obtained would be most useful in a future evaluation of the long-term yield of the aquifer.

Chemical analyses of the water sample collected at the end of the test indicate that, with the exception of fluoride, water from the well is generally suitable for drinking water. The sample was sodium chloride in character and had a total dissolved mineral content of 490 mg/l. Fluoride concentration was 1.8 mg/l which is slightly above the recommended maximum contaminant level of 1.4 mg/l. The slightly elevated concentration probably would not be harmful to the occasional Park visitor, but it would not be suitable for the long-term permanent



resident. However, they could be provided with bottled water for drinking and culinary uses. In view of the only occasional use of ground water by Park visitors, the County should ascertain if a waiver of the fluoride requirement can be obtained from the California Department of Health Services or the designated health officer for San Bernardino County.

-oOo-

Appendix A

WELL DATA

PM
Active Supply well

Project No. E-85417-C

Well No. 3
USGS No.

Owner: County of San Bernardino
Address of Owner: Park Moabi
Well Location: 1,200' N and 300' E of SW corner Sec. 6, T 7 N, R24E, SBB&M

Drilled by: Rottman Drilling Company, Inc.
Drilling Method: Mud Rotary Type of Well: Domestic
Drilling Commenced: 7-28-86 Date Completed: 8-4-86

WELL CONSTRUCTION
Borehole Depth: 219.2 feet Borehole Diameter: 16 In.
Conductor Casing: None
Well Casing: 8 5/8" O.D. - steel, 0-80.2'
Perforations: Johnson Hi-cap well screen, 0.040" slots, 80.2' - 200'
Gravel Pack: Monterey sand 6 x 12, 51' - 215'
Well Seal: Cement 0-51'

WELL TESTING
Static Water level: 53.58 ft. Pumping Water Level: 131.3 ft.
Duration of Test: 24 hours Date of Test: 8-6-86 & 8-7-86
Discharge: 60 gpm Drawdown: 77.75 ft.
Specific Capacity: 0.77 gpm/ft. Electrical Conductance: 820 micromhos

REFERENCE ELEVATIONS
Ground Elevation: ft. Top of Casing Elevation: ft.
Description of Reference Point Elevations for Water Level Measurements:

Date: 8-4-86 Elevation ft. Description: Ground surface

Date: Elevation ft. Description:

Date: Elevation ft. Description:

Remarks:

LITHLOGIC LOG

Explor. Borings for PM Supply Well Well No. 3

Depth	Graphic Log	EC (umhos)	Description of Materials	
			SAND & GRAVEL	Brown, fine to coarse grained sand with fine angular gravel, gravels are meta-igneous composition
10				
				Gravel size increases
20				Gravel bed
30				Clays increase
			CLAY	Brown, silty clay to clay, soft, with some very fine grained sand
40		1,700		
				Some fine gravels
50				
				Color changes to grey
60		1,600		Siltier, mottled tan and grey, decaying organic odor
				White clay, caliche
70			SAND & GRAVEL	Brown and green, fine to coarse grained sand and fine angular gravels, gravels are predominately meta-igneous composition
		820		Color changes to black, collect water

LITHLOGIC LOG

Well No. 3

Depth	Graphic Log	EC (umhos)	Description of Materials
			Predominately coarse grained sand, brown
90		800	Siltier, sands increase
100		850	
110		590	
120		720	Gravels increase 12 gpm
130		690	Silty sand bed, very fine to medium grained
140		540	20 gpm
			Siltier
150		650	Clayier
		550	30 gpm, collect water sample

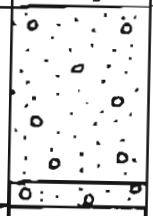
LITHLOGIC LOG

Well No. 3

Depth	Graphic Log	EC (umhos)		Description of Materials
				Silts increase
170		700		
				Gravels increase
180		550		33 gpm
				Clays increase
				Siltier, clays decrease
190		850		
200		590		43 gpm
210		750	SAND & GRAVEL	Red sand and gravel, fine to coarse sand, fine angular gravel, some silts and clays, gravels are predominately volcanic and meta sediments
220		610		Collect water sample
				White clay bed with some fine gravel
230		850		Clays decrease
		1,000		38 gpm

LITHLOGIC LOG

Well No. 3

Depth	Graphic Log	EC (umhos)	Description of Materials
			
250		1,100	Color changes to brown, meta-igneous gravels Total Depth: 250 ft., 60 gpm, collect water sample
260			

Appendix B

Soil and Plant Laboratory, Inc.

P.O. Box 11744, Santa Ana, California 92711-174 558-8333
P.O. Box 153, Santa Clara, California 95052-0153/(408) 727-0330
P.O. Box 1648, Bellevue, Washington 98009-1648/(206) 746-6665

LE ROY CRANDALL
& ASSOCIATES
900 Grand Central Avenue
Glendale, CA 91201-3009

WATER AGRICULTURAL SUITABILITY ANALYSIS
(A71)

August 18, 1986
Lab No. 91270
P O No. E-85417-B C

Sample Description: Park Moabi Well No 3 8-6-86 After 120 minutes at 40 gpm

CATIONS

Sample #	Na ppm	Na meq/l	Ca ppm	Ca meq/l	Mg ppm	Mg meq/l	K ppm	K meq/l	NH_4 ppm	NH_4 meq/l	SUM OF CATIONS
1	165	7.17	57	2.85	12	1.00					

ANIONS

Sample #	Cl ppm	Cl meq/l	SO_4 ppm	SO_4 meq/l	HCO_3 ppm	HCO_3 meq/l	CO_3 ppm	CO_3 meq/l	NO_3 ppm	NO_3 meq/l	PO_4 ppm	PO_4 meq/l	SUM OF ANIONS
1	291	8.20	72	1.50	78	1.28			16	0.26			

Sample #	pH	pHc	Ecx10^3	SAR_{adj}	ppm Cu	ppm Zn	ppm Mn	ppm Fe	ppm B	ppm F	ppm Li
			1.14								

ppm - parts per million parts water meq/l - milliequivalents per liter
*Below the detection limit for the element

Data are supplied without recommendation or comment.

LORI LITTLEFORD

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LeRoy Crandall and Associates
AUG 21 1986
File:

MONTGOMERY LABORATORIES
a division of James M. Montgomery, Consulting Engineers, Inc.
555 East Walnut Street, Pasadena, California 91101
(818) 796-9141 / (213) 681-4255 Telex 67-5420

Report of General Mineral Analysis

Crandall & Associates, Leroy
900 Grand Central Ave.
Glendale, CA 90201-3009
Attn: Tom Regan

Job#/PO#: 437.0687
Workorder#: W08323
Report#: R32808
Phone #: 818-243-4140

Date Sampled: 8/7/86
Date Completed: 9/2/86

Date Received: 8/8/86

Sample Lab Number: G85159 Sample ID: WELL #3 (E85417-C)

CATIONS:	(mg/l)	(meq/l)	ANIONS:	(mg/l)	(meq/l)
			Bicarbonate	84.4	1.38
Sodium	111	4.83	Carbonate	0.463	0.0154
Potassium	5.3	0.136	Chloride	172	4.85
alcium	41.7	2.09	Sulfate	49	1.02
agnesium	8.7	0.725	Nitrate-N	3.4	0.243
			Fluoride	1.9	0.10
			Hydroxide	0.00	0.00

CATION SUM = 7.78 meq/l ANION SUM = 7.61 meq/l

OTHER WATER QUALITY PARAMETERS DETERMINED (mg/l):

pH (unitless)	7.9	Copper	<0.007
Conductance (umho/cm)	790	Iron	0.27
Alkalinity	70	Manganese	<0.012
TDS	490	Surfactants	<0.02
Hardness	141	Zinc	0.039
Langelier Index	-.12	Arsenic	0.003
pH of CaCO3 saturation (25C)	8.02	Barium	0.087
pH of CaCO3 saturation (60C)	7.51	Cadmium	<0.003
Free CO2 (25C)	2.13	Total Chromium	<0.029
		Silver	<0.005
Mercury	<0.0002	Lead	<0.002
Total Selenium	0.002		

A: Not Analyzed ND: Not Detected

Approved by

APPROVED
E85417-C
SEP 03 1986
QC OFFICER

MONTGOMERY LABORATORIES
a division of James M. Montgomery, Consulting Engineers, Inc.
555 East Walnut Street, Pasadena, California 91101
(818) 796-9141 / (213) 681-4255 Telex 67-5420

Report on Analysis of Water for National Primary Drinking Water Regulation Pesticides

Crandall & Associates, Leroy		Job#/PO#:	437.0687
900 Grand Central Ave.		Workorder#:	W08323
Glendale, CA 90201-3009		Report#:	R32810
Attn: Tom Regan		Phone #:	818-243-4140

Date Sampled:	8/7/86	Date Received:	8/8/86
Date Extracted:	8/11/86	Date Analyzed:	8/13/86

Lab Number: G85159 c
Sample I.D.: WELL #3 (E85417-B)

Compound	Concentration (micrograms/liter)	Detection Limit (micrograms/liter)
Gamma-BHC (Lindane)	ND	0.01
Aldrin	ND	0.01
Methoxychlor	ND	0.5
Toxaphene	ND	0.5

RECEIVED
LeRoy Crandall and Associates
AUG 25 1986
File: E85417-C
GAB ☒ ☐
☐ ☐

ND: Not Detected
NA: Not Analyzed

Approved by Carole J. Lung

APPROVED
AUG 21 1986
QC OFFICER

MONTGOMERY LABORATORIES
a division of James M. Montgomery, Consulting Engineers, Inc.
555 East Walnut Street, Pasadena, California 91101
(818) 796-9141 / (213) 681-4255 Telex 67-5420

Report of General Physical Analysis

Crandall & Associates, Leroy
900 Grand Central Ave.
Glendale, CA 90201-3009
Attn: Tom Regan

Job#/PO#: 437.0687
Workorder#: W08323
Report#: R32809
Phone #: 818-243-4140

Date Sampled: 8/7/86
Date Completed: 8/19/86

Date Received: 8/8/86

Lab#	Sample I.D.	Turb NTU	ODOR TON	Color ACU
G85159	WELL #3 (E85417-C)	1.1	2	5

RECEIVED
LeRoy Crandall and Associates
AUG 22 1986
File: E85417-C

I: Not Analyzed

Approved by A Eaton

APPROVED
AUG 20 1986
QC OFFICER

INVESTIGATION OF POTENTIAL WATER SUPPLY SOURCES FOR PARK MOABI SAN BERNARDINO COUNTY, CALIFORNIA (OUR JOB NO. E-85417)

LeRoy Crandall & Associates — Report (1)
Feb. 11, 1986

Prepared For
General Services Agency
Facilities Management Department
Architecture and Engineering Division
San Bernardino County, California
Purchase Order No. J5078-M

ATTACHMENT B-1

LeROY CRANDALL AND ASSOCIATES consulting geotechnical engineers, 711 n. alvarado st., los angeles, ca. 90026, (213) 413-3550

February 11, 1986

General Services Agency
Facilities Management Department
Architecture and Engineering Divisions
County of San Bernardino
200 South Lena Road
San Bernardino, California 92415

P.O. No. J5078-M
(Our Job No. E-85417)

Attention: Mr. Robert G. Wilkinson,
Project Manager

Gentlemen:

The attached report "Investigation of Potential Water Supply Sources for Park Moabi, San Bernardino County, California" describes the hydrogeologic and water quality conditions in the vicinity of Park Moabi. It also contains a description of various options that could be adopted to provide a long term water supply for the park. In the event you choose to adopt one of the options, we would be pleased to assist the County in implementing your decision.

Yours very truly,

LeROY CRANDALL AND ASSOCIATES

by
Donald L. McCann, C.E.G. 395
Principal Hydrogeologist

by
Glenn A. Brown, C.E.G. 3
Director of Geological Services

G/jj
(5 copies submitted)

cc: Environmental Public Works Agency
Attn: Mr. Edward Ciabattini

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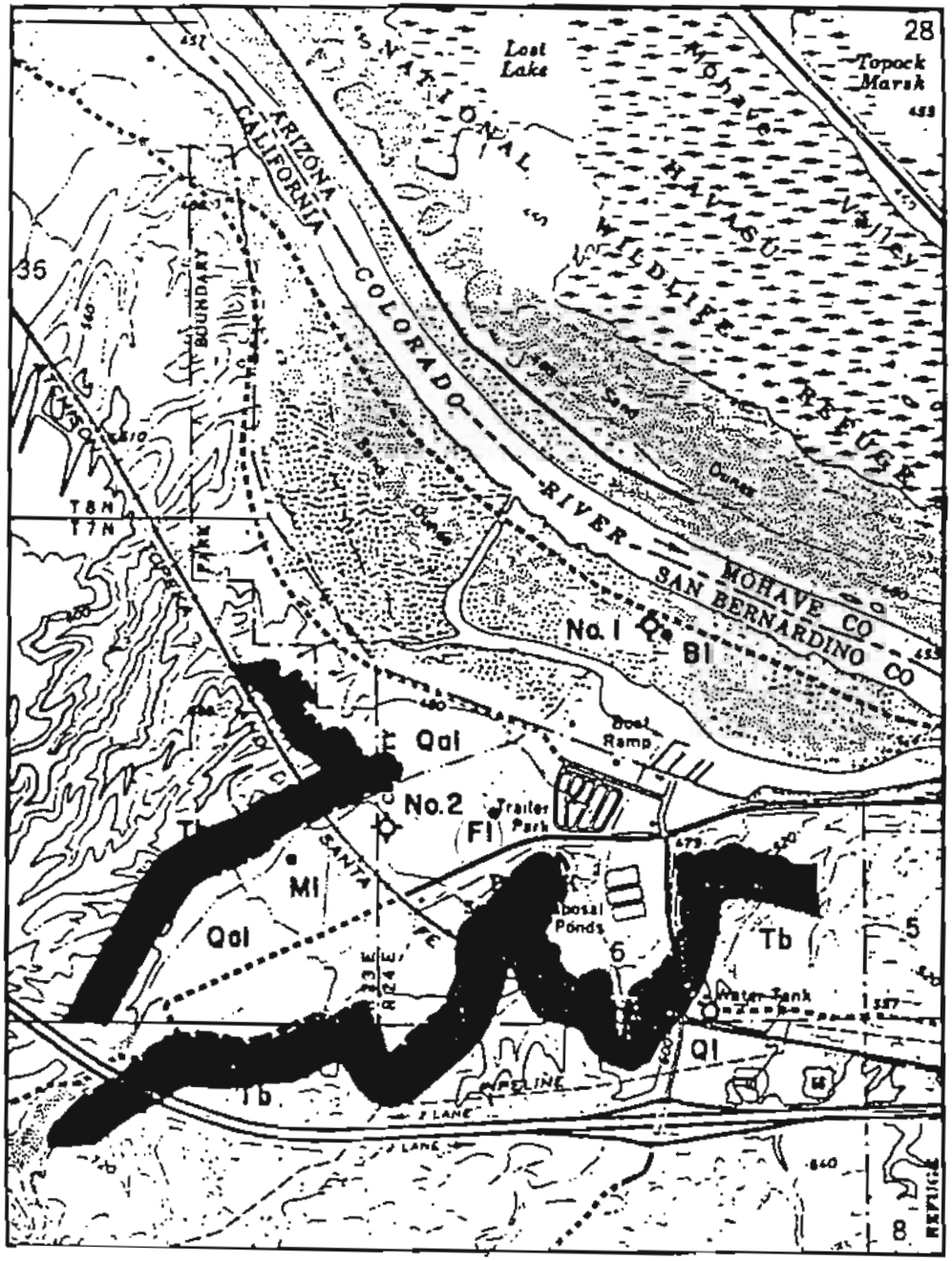
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Plate

1. Location of Wells	Following Page 1



EXPLANATION

Qal — ALLUVIUM
Recent sand, gravel and silt

Tb — BOUSE FORMATION
Pliocene sand, silt, clay, limestone and tufa.

GEOLOGIC CONTACT
Approximately located

F1 ● WATER WELL

Q1 ○ EXPLORATORY BORING

No.2 ◇ PROPOSED EXPLORATORY DRILLING SITE

Reference: Base map from U.S.G.S. 7½' Whale Mtn. Quadrangle, 1971.

N

SCALE IN FEET
0 1000 2000 3000 4000

PLATE 1

LOCATION OF WELLS

PARK MOABI

SAN BERNARDINO COUNTY, CALIF.

LeROY CRANDALL AND ASSOCIATES

BACKGROUND

Park Moabi is located along the west bank of the Colorado River about 10 miles southeast of Needles, California. The Park provides a variety of recreational activities including camping, boating and fishing. Water supply for the Park has been a continuing problem. Several attempts have been made to develop ground water, but all have been unsuccessful because of high ground water salinity. The locations of previously constructed wells are shown on Plate 1, Location of Wells.

At present, the Park obtains its water supply from an underground gravel collector (7N/24E-6B1) that has been constructed a few hundred feet from the River. However, pumpage from the collector well must be treated because of occasional bacterial contamination and the high mineralization that has ranged from 1,000 to over 2,000 milligrams per liter (mg/l). A reverse osmosis (RO) process is used to reduce the high mineralization to a level of about 200 mg/l. The RO plant is expensive to operate, and has only a capacity of about 40,000 gallons per day (gpd) which is inadequate to meet the park's peak demand of 80,000 gpd.

This report presents the results of our investigation of ground water conditions in the vicinity of the Park and the various options available for providing a long-term water supply. The investigation was authorized by the General Services Agency of the County of San Bernardino by Purchase Order J5078-M, dated December 19, 1985.

HYDROGEOLOGIC CONDITIONS

Park Moabi is located adjacent to the Colorado River at the foot of the Sacramento Mountains to the west and the Chemehuevi Mountains to the south. The mountain blocks are comprised of pre-Tertiary sedimentary, igneous and metamorphic rocks. These rocks underlie the Park at depths exceeding 1,000 feet, and probably are not capable of yielding an adequate water supply. They are overlain by a Miocene Fanglomerate comprised of cemented sand, gravel and silt. Water wells drilled in the vicinity of the Park have not penetrated the Fanglomerate, but elsewhere it has been reported to yield small to moderate supplies of water to wells. If present beneath the Park, it probably occurs at depths approaching 800 to 1,000 feet.

The Bouse Formation (Tb) of Pliocene age is exposed in the bluffs that rise several hundred feet above the River near the Park boundary and beneath most of the Park facilities at depths ranging from 0 to 100 feet. Locally, it is comprised of horizontally bedded clays, silts and fine sands that yield small quantities of water to wells. The Park Moabi Well No. 1 (7N/24E-6F1) penetrated the Bouse Formation at a depth of 44 feet. The well was constructed during March 1961. It is located adjacent to the Park maintenance building west of the trailer Park. The only lithologic log of rocks underlying the Park was recorded during the drilling of the well borehole. The log, which was published in the U.S. Geological Survey Professional Paper 486J, shows the following sequence of alluvial deposits.

Park Moabi #1
PM-01

SEQUENCE OF ALLUVIAL DEPOSITS

Description of Material	Thickness	Depth
Alluviums of Colorado River and its tributaries:		
Gravel, 3 in. to sand	22	22
Gravel, 2 to 8 in. rock	22	44
Bouse Formation:		
Clay	18	62
Shale	8	70
Clay, blue	32	102
Clay, gray, with rock	10	112
Rock, gray solid	6	118
Clay, gray, with rock	20	138
Clay, with softer rock	16	154
Rock, with clay	36	190

44 — 102
44
58

The log indicates the Bouse Formation at the well site is comprised of rather thick clay beds that would yield very little water. The well is reported to have yielded about 300 gpm, but well effluent contained excessively high concentrations of dissolved minerals that approached 3,000 mg/l. Other water wells north of the Park that have penetrated the Bouse Formation have also often yielded poor quality water.

Recent alluvial deposits (Qal) overlie the Bouse Formation. They are comprised of fine to coarse sands, gravels, and silts and are exposed throughout most of the flat-lying Park property, as shown on Plate 1, Location of Wells. Most of the water yielded by the Park Moabi Well No. 1 (7N/24E-6F1) was probably obtained form these deposits. The log of the borehole indicates they reach a depth of 44 feet at the well

site. They are probably much thicker several hundred feet to the north where surface runoff from the Chemehuevi Mountains is conveyed in a broad stream channel toward the Colorado River.

Recent sand dunes occur between the Park boundary and the River. They have little topographic relief and support a dense growth of native vegetation. The gravel collector and RO plant described previously are located within this area.

GROUND WATER DEVELOPMENT

Information on ground water development in the vicinity of the Park is limited to the incomplete construction records of four wells and one deep exploratory boring. The location of one of the wells, Park Moabi No. 2 (7N/24E-6X1) is unknown, but it apparently was never used because of the highly saline water it yielded. Construction details are summarized in the following Table 1.

Table 1
DESCRIPTION OF WATER WELLS

Well No.	Borehole Depth	Casing Depth	Casing Diameter	Perforated Interval	Capacity (gpm)
7N/23E-1M1 Abandoned	153'	86'	12"	Unknown	<5
7N/24E-6B1 Park Moabi	26'	26'	4'±	NA	
7N/24E-6F1 Park Moabi #1	190'	190'	10"	1 - 189'	300
7N/24E-6Q1 Test Hole	512'	None	None	None	Dry
7N/24E-6X1 Park Moabi #2	?	114'	10"	86 - 106'	430

Ground water for Park use is now obtained from a gravel collector located about 500 feet from the River. Construction details are not available, but it is reported to be about 300 feet in length which drains into a large diameter 26 foot deep sump. The sump is referred to as well 7N/24E-6B1 in Tables 1 and 2. Ground water is pumped from the sump to the adjacent RO plant where mineral concentration is reduced to about 200 mg/l at a production rate of 18 gpm. Storage is provided by an 80,000 gallon tank located near the Park entrance as shown on Plate 1.

Well No. 1 (T7N/24E-6F1) was constructed during March 1961. Well records are rather vague, but it apparently was constructed to a depth of 190 feet with perforations from 1 to 189 feet. The well is reported to have yielded 300 gpm with a drawdown of 12 feet from a static water level of 22 feet. If the records are valid, the well would have a moderately high specific capacity of 16 gpm/ft. When the well was tested during October 1961, the discharge had an electrical conductance ranging from 2,370 micromhos at the beginning of the test to 4,130 micromhos when the test was terminated after pumping 89 hours.

A test hole (7N/24E-6Q1) was drilled to a reported depth of 512 feet near the water storage tank. A small amount of water was encountered at a depth of about 150 feet, but the hole was dry when the total depth of 512 feet was reached. The test hole apparently only penetrated the Brouse Formation which is only known to yield small quantities of ground water.

MW-17
base of silts 365'
water @ 131
TD 150'

An abandoned well (7N/23E-1M1) was constructed about one-half mile west of the Park during the 1970's to provide water for highway construction. Construction details are unknown, but the well is reported by the Park ranger to have yielded less than 5 gpm.

I-40 in 1965

GROUND WATER LEVELS

Ground water levels in water wells in the vicinity of the Park are related primarily to the elevation of the Colorado River, and have probably varied within a range of 10 feet. Water levels have not been systematically recorded, but recent measurements made during January 1986 show that the water table within the recent alluvial materials to have a northeasterly slope toward the River. January measurements indicate the depth to the water table ranged from about 16 feet at the RO plant to 89 feet at the abandoned well (M1) located west of the Park. At that time, the depth to the water table in the Park unused well (F1) was 23.3 feet.

WATER QUALITY

Water samples collected from the Colorado River between Davis Dam and Parker Dam indicate River water to be sodium sulfate in chemical character. During the period 1967-85 mineral concentrations ranged between 600 and 700 mg/l. It is generally suitable for drinking water with little treatment required. Water samples from the parks gravel collector surveys (B1) have been similarly sodium sulfate in chemical character, but samples have had electrical conductances ranging from 2,340 micromhos in 1961 to over 3,000 micromhos in 1977. Water from the

sump during this time would have an equivalent mineral concentration of 1,500 to 2,000 mg/l, which has required the costly removal of minerals before being used for domestic use. A recent sample collected during January 1986 had a rather low electrical conductance of 1,300 micromhos, which would be marginally suitable for drinking water. The source of high salinity water from the well is unknown, but it may be related to inflow from the embayment south of the well, decaying vegetation, or a consequence of leaching salts from alluvium and sand dune deposits in the vicinity of the well.

Water samples from the unused well (E1) have differed in chemical character and contained more dissolved minerals. They have been sodium chloride in character with electrical conductances ranging between 2,370 and 4,130 micromhos (equivalent to mineral concentrations of 1,540 and 2,680 mg/l). The source of the high salinity appears to be directly related to salts contained within the Bouse Formation. However, it could be partially related to decaying vegetation. Discharge from the well is reported to have had a hydrogen sulfide odor and an elevated temperature.

The best quality ground water in the vicinity of the Park occurs in the shallow alluvial deposits that traverse a large portion of the Park, and extend southwesterly toward the Chemehuevi Mountains. A January 1986 sample from the abandoned well (M1) east of the Park had an electrical conductance of 450 micromhos. A chemical analysis was not made, but ground water at the well site is probably sodium or calcium bicarbonate in character with a mineral concentration of about 300 mg/l.

CHEMICAL ANALYSES OF WATER SAMPLES
PARK MOABI

Well Number	Date Sampled	ECx10^6 at 25°C	pH	Mineral constituents in milligrams per liter											TDS in mg/l
				Ca	Mg	Na	K	CO_3	HCO_3	SO_4	Cl	NO_3	F	B	
7N/23E-1M1	01-15-86	450													
7N/24E-6B1	11-08-61	2,340	7.6	127	57	319	8.5	0	351	492	310	1	0.8	0.38	
	06-16-62	2,430	7.2												
	01-19-77	3,082	7.7	140	73	480	4.4		424	695	430	3	0.7	0.43	2,055
	01-15-86	1,300													
7N/24E-6F1	10-09-61	2,370	7.8	78	30	375	7.6	0	124	234	554	14	1.0		
	10-13-61	2,970	7.5	107	57	440	10.4	0	164	385	655	16	1.2		
	10-24-61	4,130	7.6	91	101	600	14.0	0	227	607	895	19	0.7		
	03-07-62	2,520	7.6	104	34	378			124	288	595		1.2		1,470
7N/24E-6X1	05-31-62	5,490													
	06-07-62	6,580													
Colorado River, 6 miles downstream from Davis Dam															
	01-09-85	930	8.2	76	27	81	4.0	0	169	244	66	4			608*
Colorado River, at Needles															
	06-19-79	1,050*		92	25	106	–	–	143	295	91				685
Colorado River, near Parker Dam															
	09-09-67	1,090	8.5	75	29	100	5.0	2	123	289	90	0.6	0.4		663

*NOTE: (*) = Estimated

RECOMMENDATIONS

Our investigation of ground water conditions in the vicinity of Park Moabi indicates that there are only two viable sources of long-term water supply:

1. The shallow alluvium that traverses the Park.
2. The Colorado River.

Plate 1 shows the location of two well sites that may yield good quality ground water. Site No. 1 is located near the existing RO plant well. The poor quality water at the site may be related to mineralization within the upper 20 to 30 feet of alluvium. If so, this zone could be sealed during well construction, which would permit the development of deeper good quality water. Since the site is near the RO plant, pipeline and power transmission costs would be minimized. Site No. 2 is located near the western Park property boundary. If the recent alluvial deposits at the site exceed 150 feet in thickness, it should be possible to construct a well capable of yielding about 100 gpm.

We recommend that exploratory drilling be undertaken at both sites before well design and construction is undertaken. Exploratory drilling should be undertaken using the dual-tube reverse air drilling method. This method permits the collection of point source water samples during the drilling process which is of considerable assistance in defining zones of poor quality water. If an adequate supply of good quality water is found to be present within the Park, a well design can

then be prepared for the preferred site. The cost of exploratory drilling should be relatively inexpensive, probably less than 20 percent of well construction costs.

Other options are related to the Colorado River diversions. It is our understanding that there are two programs being managed by the Bureau of Reclamation that permit taking water directly from the River. One program permits users to take water during years of excess flow. Under provisions of this program, the County could negotiate a contract with the Bureau to obtain the right to take water during the calendar year of 1986. The County could presumably continue to take water from the River during future years when excess flow occurs.

Another program under study by the Bureau would authorize participation in a project that envisions pumping seepage losses from the All American Canal in California, returning the losses to the canal, and establishing a credit for River diversions. This program is scheduled for implementation in 1988. The cost of participation would be based on the volume of water diverted, which has been estimated to range from $40 to $60 per acre foot, plus modest annual fees. Additional information on both programs can be obtained from:

Edward Hallenbeck, Regional Director
Lower Colorado River Region
U.S. Bureau of Reclamation
P.O. Box 427
Boulder City, Nevada 89005

Alden Briggs, Chief
Water Scheduling Branch
U.S. Bureau of Reclamation
P.O. Box 427
Boulder City, Nevada 89005
Telephone (702) 293-8677

We have not made an economic appraisal of the various options available to the County, but participation in one or both of the Bureau programs would probably be the least expensive. The County should also consider the cost of water treatment, as some will be required to meet drinking water standards. In view of the forecast water shortage, a decision to participate in the project to recover seepage losses from the All American Canal should include consideration of the Bureau's ability to implement the project on a timely basis.

In the event the County elects to proceed with ground water exploration and development, the services of LeRoy Crandall and Associates will be available for preparing technical specifications for exploratory drilling, water well construction, and the design of related facilities.

-oOo-

Attachment B
Engineering Evaluation of River Intake Structure/Fish Screen

Preliminary Engineering Evaluation of Colorado River Intake and Fish Screen

PREPARED FOR: Pacific Gas and Electric

PREPARED BY: CH2M HILL

DATE: 15 April 2012

Purpose and Scope

The purpose of this Technical Memorandum (TM) is to describe the Colorado River freshwater source alternative in support of the fresh water source evaluation for the Pacific Gas & Electric (PG&E) Topock Compressor Station (TCS) Basis of Design Report / Preliminary (30%) Design Submittal for the Final Groundwater Remedy. This evaluation included the following components:

- Identification of design criteria
- Development of site location evaluation criteria
- Identification of potential site locations
- Comparison and evaluation of potential site locations
- Conclusion

These evaluation components are described below.

Design Criteria

The selected groundwater remedy includes injection of freshwater to assist with flushing the plume through the treatment zone at a rate of 600 to 1,200 gallons per minute (gpm). Extracting water from the Colorado River as the source of this freshwater would require an intake structure and fish screen. Water from the intake would be pumped for treatment adjacent to the existing TCS freshwater storage tanks (Figure 1) then stored in new tanks prior to injection.

Intake Structure

The river intake would include a concrete structure, 12-inch intake pipe, a slide gate, and two submersible pumps, duty and standby, sized to deliver 1200 gpm.

Construction of the river intake structure would require a coffer dam at the base of the river bank to allow for dewatering of the work area. Further up the bank, construction would require trenching and/or a shoring system within the area excavated for the river intake structure. The coffer dam would be approximately ten feet by ten feet if constructed using sheet piles and the trenched area further up the bank could be as wide as 50 feet; the exact footprint of these construction areas would depend on the contractor's means and methods.

Fish Screen

The fish screen would also be sized to deliver 1200 gpm and designed to meet the California Department of Fish and Game (CDFG) and National Marine Fisheries Service (NMFS) fish screen design criteria for maximum approach velocity. Preliminary analysis indicates that a 30-inch diameter cylinder end of pipe type screen would work (Figure 2). The screen should have a minimum submergence of 1-foot below the river water surface elevation (WSE) and a minimum of 1-foot clearance from the screen to the river channel invert.



FIGURE 1
Potential River Intake and Fish Screen Locations

The screen unit would be an all stainless-steel unit using wedgewire screens with 50 percent open area. The wedgewire openings would also be sized to meet CDFG and NMFS fish screen design criteria. A baffled suction tube inside the screen will be used to support the screens and to distribute the intake flows uniformly across the entire screen surface. The screen cylinders will be cleaned using an automated brush cleaning system powered by a hydraulic power unit.



Source: http://intakescreensinc.com/projects/delta-cove/

FIGURE 2
Photographs of an End of Pipe Type Fish Screen

Operations and maintenance (O&M) activities would be minimal for an end of pipe type fish screen. Routine O&M would include a short weekly inspection similar to typical pumping facilities. Annual maintenance would include changing the oil filter on the power unit. The screen itself should be visually inspected when the river WSE is low; more frequent visual inspections would be required in areas where the debris exposure is high.

Site Location Evaluation Criteria

Evaluation criteria were developed to assess the feasibility of each potential river intake locations and to allow for comparison across the evaluated sites. The evaluation criteria fall into three main categories:

- Long-term siting
- Construction
- Permitting

Evaluation criteria are described below.

Long-Term Siting Criteria

Water Depth. As described above, the fish screen requires a minimum submergence of 1-foot below the river WSE to meet fish screen design criteria. Because the Colorado River WSE varies between 6 to 8 feet, the selected location must have sufficient depth at the lowest WSE.

Debris Protection. The fish screen should be located so as to minimize river debris damage potential.

Site Space Constraints. Sufficient space is required at top of bank (TOB) above the river intake and fish screen for a fence enclosure where the required cabinets, pumps, and other equipment can be located.

Operations and Maintenance Access. The river intake and fish screen must be accessible for long-term O&M activities.

Water Quality. Water from the river intake will have to be treated before it can be injected into the groundwater wells. Intake locations downstream of drainages and washes that enter the Colorado River and are known to experience high sediment loads after rain events will require more treatment to achieve water quality requirements.

Construction Criteria

Constructability. Issues impacting the constructability of the river intake and fish screen at a given site, particularly construction access.

Construction Impacts. Temporary impacts associated with construction, such as disturbed area.

Relative Cost. Comparative cost associated with the potential river intake and fish screen locations will be determined by proximity to the TCS storage tanks; the further from the tanks, the longer the pipeline.

Approvals, ARARs, and EIR Compliance

Visibility. The river intake and fish screen will be a visible addition and will require security and yard lighting.

Right-of-Way. Right-of-way (ROW) acquisition or easements may be required for construction or long-term O&M activities; depending on the property owner, obtaining the necessary rights could impede the project schedule.

Approvals/Compliance with ARARs and EIR.

Federal -- Compliance with substantive permitting requirements includes Section 404 of the Clean Water Act, Endangered Species Act (ESA) Section 7, and Section 10 River and Harbors Act.

State -- Compliance with substantive permitting requirements includes Section 1601 under the California Department of Fish and Game Code, California Endangered Species Act, Section 401 of the Clean Water Act, Clean Water Act Section 402 Construction SWPP, leases under State Lands Commission, etc. Additional consultation would be required if the project design included a log screen or upstream diversion structure to protect the intake from surface and submerged debris.

Potential Site Locations

Potential river intake locations are shown in Figure 1 and described below in Table 1. All locations are on the California side of the Colorado River. Photographs of each location are included in Attachment 1.

TABLE 1
Potential River Intake Locations
Freshwater Source Evaluation Technical Memorandum

Site No.	Location	Description
1	SoCal Gas Pipeline Bridge	Upstream of the natural gas pipeline and adjacent to the bridge structure located on the downstream edge of the project area.
2	Downstream of Arched Bridge	Just upstream from Site No. 1.
3	Historic Arched Bridge	On the bank upstream of the bridge.
4	North of Bat Cave Wash	Upstream of the Floodplain, downstream of the Moabi Regional Park Slough, and adjacent to the National Trails Highway (Historic Route 66).
5	Moabi Regional Park Peninsula	Upstream of the Moabi Park Slough.

It should be noted that some potential locations were not included due to identified fatal flaw(s). For example, there is a sand bar adjacent to the 20 Bench Floodplain that is exposed when the river WSE is low , making it infeasible to located the intake and fish screen along this section of river bank.

The area between the Arched Bridge and I-3 Pipeline Bridge was not evaluated. The Colorado River is shallow in this location and includes wetland type vegetation. Construction of a river intake and fish screen in this area would require significant disturbance of this vegetation in order to reach far enough into the river for the fish screen to have sufficient submergence during times of low WSE.

An intake and fish screen attached to the Arched Bridge was also not evaluated. While in theory this would minimize temporary construction and long-term impacts, this is not the case at this site. Steep slopes at the bridge would necessitate significant grading to facilitate site access during construction. Permanent vehicular access would need to remain after construction to facilitate O&M. O&M access would be particularly important as an intake and fish screen installed on a bridge pier is vulnerable to damage by river debris; a large log was seen caught against one of the Arched Bridge piers during a site visit.

Finally, the Arizona side of the Colorado River was not evaluated for a river intake and fish screen structure. River depths are not as great and turbidity is known to increase significantly following rainfall events along this side of the river.

Comparison and Evaluation of Potential Site Locations

Each site was compared and evaluated against the identified evaluation criteria as favorable, neutral, or unfavorable. This comparison and evaluation is summarized below in Table 2.

Site 5 was eliminated from further evaluation and not included in this analysis. A river intake and fish screen located at Site 5 would require constructing a pipe across or underneath the Moabi Park Slough in order to move water off the peninsula to the treatment facility. The slough is a navigable channel leading to a popular park. Therefore this is not a preferred site from a disturbance and compliance perspective.

TABLE 2
Comparison and Evaluation of Potential Site locations
Freshwater Source Evaluation Technical Memorandum

Evaluation Criteria	Site 1	Site 2	Site 3	Site 4	Comments
Water Depth	Favorable	Favorable	Favorable	Neutral	Sites with insufficient water depth are rated as unfavorable; sites with enough water depth are rated as neutral; sites with excess water depth are rated as favorable.
Debris Protection	Neutral	Favorable	Unfavorable	Neutral	Sites with limited debris protection are rated as unfavorable; sites with some debris protection are rated as neutral; sites with significant debris protection are rated as favorable.
Site Space Constraints	Unfavorable	Neutral	Unfavorable	Favorable	Sites with limited space are rated as unfavorable; sites with sufficient space are rated as neutral; sites with ample space are rated as favorable.
O&M Access	Neutral	Neutral	Unfavorable	Favorable	Sites with poor accessibility are rated as unfavorable; sites with sufficient accessibility are rated as neutral; sites with good accessibility are rated as favorable.
Water Quality	Unfavorable	Neutral	Neutral	Neutral	Sites with poor water quality are rated as unfavorable; sites with acceptable water quality are rated as neutral; sites with good water quality are rated as favorable.
Constructability	Neutral	Neutral	Unfavorable	Favorable	Sites with poor constructability are rated as unfavorable; sites with acceptable constructability are rated as neutral; sites with good constructability are rated as favorable.
Temporary Construction Impacts	Neutral	Neutral	Unfavorable	Favorable	Sites with significant temporary construction impacts are rated as unfavorable; sites with some temporary construction impacts are rated as neutral; sites with minimal temporary construction impacts are rated as favorable.
Relative Cost	Favorable	Favorable	Neutral	Neutral [a]	Sites with greater relative costs are rated as unfavorable; sites with average relative costs are rated as neutral; sites with less relative costs are rated as favorable.
Visibility	Unfavorable	Unfavorable	Unfavorable	Favorable	Sites with significant visibility are rated as unfavorable; sites with some visibility are rated as neutral; sites with sites with limited visibility are rated as favorable.
ROW	Unfavorable	Neutral	Neutral	Neutral	Sites with potentially significant ROW issues are rated as unfavorable; sites with manageable ROW issues are rated as neutral; sites with no ROW issues are rated as favorable.
Approvals and compliance with ARARs and EIR	Subject to consultation with Agencies	Subject to consultation with Agencies	Subject to consultation with Agencies	Subject to consultation with Agencies	Subject to consultation with Agencies.

[a.] It is assumed that water from the river intake and fish screen will be pumped for treatment adjacent to the existing TCS freshwater storage tanks. However, it is possible that freshwater from Site 4 could be treated directly adjacent to the river intake and fish screen structure. This would decrease the distance from intake to treatment and injection and, therefore, make the relative cost favorable.

Conclusion

Based on the above analysis, Site 4 appears to be a feasible location for a river intake and fish screen structure with the evaluation criteria being neutral or favorable. Easy site access at this location is a major driver of this result. Site 4 is close to the road and there is sufficient space at TOB for construction access and a fenced enclosure, which will minimize temporary construction and long-term impacts. It should be noted the applicable consultations and agency approvals will ultimately determine if Site 4 is feasible for a river intake and fish screen structure.

Attachments

1 Potential Site Location Photographs

Attachment 1



Picture 1: Site 1 from TOB.



Picture 2: Site 1 from the Colorado River.



Picture 3: Site 2 from TOB.



Picture 4: Site 2 from the Colorado River.



Picture 5: Site 3 from TOB.



Picture 6: Site 3 from the Colorado River.

Attachment 1

	
Picture 7: Site 4 from TOB.	**Picture 8:** Site 4 from the Colorado River.

Attachment C
Model Updates (Prepared by ARCADIS)

MODEL UPDATES

Incorporation of Manganese oxidation

Manganese is naturally present in the soil at Topock in the form of insoluble Mn(III)/(IV) oxides. In actively reducing zones, manganese can be released into solution as Mn(II) via reductive dissolution of these Mn oxides. This process occurs naturally within the Topock floodplain, and it is expected to occur as a result of organic carbon injections during IRZ treatment of Cr(VI).

Once released into solution, the transport of Mn(II) within reducing environments will primarily be limited by sorption to mineral surfaces. This is expected to be the dominant mechanism controlling Mn transport within Topock downgradient of the IRZ and within the floodplain, due to sustained reducing conditions. Mn sorption is well-characterized using the surface complexation model approach (see discussion for arsenic sorption below), and sorption of Mn(II) has been incorporated into the Topock solute transport model to describe Mn transport downgradient of the IRZ and within the floodplain. Details on how Mn sorption was incorporated into the Topock solute transport model can be found in Appendix B of the 30% design document.

In less reducing environments at Topock, including the uplands and the alluvial aquifer beneath the floodplain, Mn(II) oxidation is expected to play a stronger role in the attenuation of aqueous manganese. Aqueous Mn(II) can be reoxidized biotically and abiotically in the presence of oxygen, resulting in precipitation. Abiotic oxidation of Mn(II) is slow, with a rate that is dependent on Mn concentration, dissolved oxygen concentration, and pH. For example, at pH 8 with a dissolved oxygen content of 2 mg/L (~25% air-saturation), the half life for Mn(II) oxidation is approximately 400 days (Morgan, 2005). Although abiotic oxidation of Mn(II) is slow, microbially-catalyzed oxidation of Mn(II) is much faster. Biotic oxidation of Mn has been studied extensively in the context of mining-derived pollution of streams, where Mn(II) oxidation can occur at the sediment-surface water interface, or hyporheic zone (Gandy et al., 2006, Harvey and Fuller, 1998; Kay et al., 2001). These results demonstrate that metal oxidation can be rapid, particularly at redox interfaces with active microbial consortia and an adequate nutrient supply. Harvey and Fuller (1998) studied the oxidation Mn(II) within the hyporheic zone of Pinal Creek, AZ. Oxidation rates were observed to be first order with respect to Mn concentration, with Mn(II) half lives between 0.7 and 8 hours. Laboratory work further confirmed these rates, while demonstrating the importance of solid:solution ratio (highlighting the combined role of mineral surface and microbial catalysis) and nutrient availability. Further work (Marble et al., 1999) demonstrated that these rates were independent of dissolved oxygen concentration above 30% saturation (~2.5 mg/L) and first-order with respect to oxygen below 30%.

Oxidation of Mn(II) was incorporated in the Topock solute transport model assuming a half life of 29 days. This value was obtained by starting with a first-order rate coefficient of 0.1 h^{-1}, representing the slowest rate observed by Harvey and Fuller (1998) at the Pinal Creek, AZ site, and scaling it back by two orders of magnitude to conservatively account for potential differences in nutrient status and microbial population. This rate was used to simulate Mn(II) oxidation in the uplands and beneath the floodplain, at interfaces where geochemically-reducing water (e.g., fluvial groundwater) contacts less-reducing water (e.g., alluvial aquifer with higher dissolved oxygen). At these interfaces, biotic oxidation of Mn will occur due to the presence of organic carbon and naturally-occurring microorganisms.

Updated Manganese solute transport modeling results

The 30% design simulated manganese transport in the solute transport model using only sorption as a mechanism to attenuate manganese migration throughout the solute transport model domain. This manganese sorption was utilized for both the naturally occurring manganese concentrations present in the reducing rind as well as manganese concentrations generated as a byproduct from IRZ's.

The solute transport model for manganese behavior was recently refined to incorporate oxidation as described in the section above. This manganese oxidation reaction was only simulated to occur in the uplands and in the deeper portion of the aquifer below the naturally occurring reducing zone. No manganese oxidation was simulated within the IRZ footprint, downgradient of the IRZ footprint, or within the naturally occurring reducing rind.

Figure 1 depicts the relative change in the manganese concentrations based on the original 30% design parameters and the recently refined manganese oxidation model with respect to manganese generated as byproducts from active insitu remediation after 30 years of simulated transport in model layer 1. The manganese distribution downgradient of the NTH IRZ and the TCS injection wells is identical between the two models because there is no manganese oxidation simulated in these areas. The primary difference in the manganese distribution in Figure 1 is evident in the uplands. This is due to the byproduct manganese extracted from the riverbank extraction wells and injected into the two upland inner loop recirculation wells. In the original 30% design model (left panel) the upland manganese distribution is significantly larger because manganese migration is only controlled by sorption. The refined manganese oxidation model (right panel) has a much smaller manganese distribution in the uplands due to active oxidation simulated in this area. Figure 2 depicts the same manganese model comparison after 30 years of simulated transport for model layer 3. The resulting distribution patterns in model layer 3 are similar to those presented in model layer 1, with the primary difference being the smaller manganese footprint in the uplands in the updated model due to manganese oxidation.

Figure 3 compares the relative change in the manganese concentrations based on the original 30% design parameters with the recently refined manganese oxidation model. The results are shown for layer 1 after 30 years with the naturally occurring manganese liberated in the reducing rind. There is no difference seen in Figure 3 (model layer 1) in the shallow aquifer within the footprint of the reducing rind because the same mechanism (sorption) is present in both model runs. In the Uplands injection area, where manganese oxidation has been incorporated in the recent model simulation, the manganese introduced in the uplands injection wells attenuates through oxidation minimizing the footprint.

The 30 year comparative results for model layer 3 are presented in Figure 4. Both panels depict the projected impacts of manganese sourced in the reducing-zone rind that has migrated or been injected into model layer 3, after 30 years of remediation. The panel on the left is the projection using the 30% design model; the panel on the right is from the updated model that incorporates manganese oxidation. The incorporation of manganese oxidation in this layer results in simulations that demonstrate a much smaller manganese footprint in Layer 3 of the model.

Incorporation of Arsenic adsorption

Downgradient of the IRZ, the arsenic released into solution due to the reductive dissolution of oxide minerals will attenuate via co-precipitation with iron oxide phases that form as Fe(III) reoxidizes. This process has been included in the Topock solute transport model by allowing aqueous arsenic to attenuate when organic carbon concentrations decrease below a threshold level. The arsenic attenuation rate was calibrated based on pilot test observations of arsenic transport. Further details on the incorporation of

arsenic co-precipitation within the solute transport model can be found in Appendix B of the 30% design document. This co-precipitation mechanism, however, is only relevant within redox “recovery” zones where dissolved Fe(III) is available for oxidation and precipitation. In other areas, the mobility of aqueous arsenic in groundwater is limited by adsorption to mineral surfaces. Both arsenate (As(III), which tends to be dominant in suboxic environments) and arsenite (As(V), dominant under oxidizing conditions) are known to adsorb strongly to mineral surfaces, particularly iron oxides (e.g., Dixit and Hering, 2003). Electrostatic attraction also plays a role in this adsorption process; at a pH below 9, the iron oxides which are positively charged, and attract dissolved species that are negatively charged (e.g., Appelo et al., 2002). The strong adsorption between iron and arsenic is due to a specific, “inner-sphere” binding mechanism, where oxygen ligands on arsenic displace surface hydroxyl groups on iron oxides. This particular reaction consumes protons, and is therefore more favorable at the lowered pH within and downgradient of the reducing zones. In this way, arsenic sorption is dependent on solution pH. For arsenate adsorption on iron oxide, the adsorption affinity decreases (i.e., less sorption) with increasing pH. The relationship is more complicated for arsenite, where sorption may increase or decrease with pH depending on solution conditions and mineralogy (Dixit and Hering, 2003).

Other species in solution, such as oxoanions (e.g., sulfate) and cations (e.g., Ca^{2+} and Mg^{2+}) can also compete with the sorption sites on iron oxide surfaces. These interactions have been studied extensively for iron oxides, particularly ferrihydrite. By quantifying adsorption interactions separately for different ions under different solution conditions, a combined model can be constructed that includes specific geochemical adsorption reactions for multiple species simultaneously, thereby accounting for the effects of pH and ion competition. This model is referred to as a surface complexation model (SCM).

It was assumed that As(V) (arsenate) would be the dominant species in the freshwater injection, given the oxidizing conditions of both the freshwater and the Upland groundwater. Ferrihydrite was assumed as the dominant adsorbent in the system; although ferrihydrite is not the dominant iron oxide mineral by mass, it is the dominant phase in terms of surface reactivity, given its very high surface area and sorption site density. Adsorption reactions were defined in the model using the SCM for ferrihydrite developed by Dzombak and Morel (1990). Estimation of surface site concentrations followed a procedure similar to that outlined in Appendix B of the 30% design. The groundwater chemistry (including pH, alkalinity, and major ion composition) used in the PHREEQC model was based on the average solution composition observed in monitoring well data within the freshwater injection zone. Arsenic adsorption was then incorporated into the transport model using a Freundlich isotherm, with the specific isotherm parameters calibrated using the SCM approach described above. The isotherm was calibrated by performing batch PHREEQC simulations with varying total arsenic content under site-relevant geochemical conditions.

Updated Arsenic solute transport modeling results

The original 30% design solute transport model simulated arsenic transport using arsenic precipitation in both the uplands and downgradient of the IRZ’s; no precipitation was simulated in the naturally occurring reducing rind. This conceptual model was based on the principal that under oxidizing conditions, arsenic will co-precipitate with mobile iron in groundwater. The primary mechanism governing arsenic migration downgradient of the IRZ’s is still co-precipitation with iron because iron will be mobilized with arsenic under IRZ induced reducing conditions. As the reducing conditions return to oxic conditions, the mobile arsenic will readily co-precipitate with the mobile iron. For the freshwater injection areas the arsenic/iron co-precipitation mechanism was replaced with the adsorption process described in the section above. In addition to the arsenic sorption mechanism, additional refinements were made to the updated model to reflect observed site data. These refinements included the incorporation of a background arsenic concentration of 2 ppb and a freshwater injection concentration of 15 ppb.

Figure 5 depicts the relative change in the arsenic footprint based on the original 30% design model (left panel) and the updated model (right panel) after 30 years of simulated transport in model layer 1. It is evident that the refined arsenic parameters result in a slightly larger arsenic footprint emanating from the freshwater injection wells relative to the precipitation only 30% design model. This is because there is no active mechanism to remove simulated arsenic from groundwater in the uplands, it only migrates at a slower velocity than the groundwater due to sorption. Both versions of the arsenic model indicate that any arsenic generated at the NTH IRZ or TCS injection wells is lower than 5 ppb after 30 years of simulated transport. Figure 6 depicts the comparative arsenic results for model layer 3 after 30 years of simulated transport. Similar to the model layer 1 results, the relative difference between the two models is apparent in the freshwater injection wells. The updated arsenic sorption model results in a slightly larger footprint than the original 30% design.

After 30 years of simulated active remediation, all of the remedial design elements were turned off to allow the system to return to ambient conditions. Figures 7 depicts the first year of simulated recovery (year 31) in model layer 1. These figures indicate that with the 30% design (left panel), arsenic concentrations will drop below 5 ppb within 1 year. The revised arsenic sorption parameter simulation (right panel) also shows a decreased arsenic footprint, it just retracts at a slower rate than the original 30% design. Figure 8 depicts the first year of simulated recovery in model layer 3. Similar to the model layer 1, the original 30% design arsenic distribution in layer 3 drops below 5 ppb after 1 year of recovery, while the updated model indicates a receding arsenic footprint.

Figure 9 shows the simulated arsenic results for the original 30% design and the updated model after 12 years of recovery (year 42) in model layer 1. The right panel showing the updated model results indicates that after 12 years of simulated recovery, only a trace amount of arsenic remains above 10 ppb, and the 5 ppb arsenic footprint has further decreased in size. Figure 10 shows the 12 year arsenic results for model layer 3. Similar to Figure 9, the model layer 3 results indicate the majority of the remaining arsenic concentrations are below 10 ppb, and the 5 ppb arsenic footprint is decreasing in size.

ALTERNATIVE FRESHWATER SOURCE SOLUTE TRANSPORT MODELING RESULTS

The solute transport model was utilized to evaluate the alternative freshwater source options considered within the 30% design. These included, the existing Havasu Natural Wildlife Refuge well (HNWR-1), a hypothetical new well(s) in Park Moabi, and the Colorado River. In order to reflect the appropriate freshwater source within the submodel domain, the regional groundwater model was run for each freshwater source individually and the submodel boundary conditions were extracted directly from the respective regional groundwater model run. The submodel thus reflects the associated hydraulic stresses induced by each freshwater source. Next, the solute transport model was run for each freshwater source with the following water quality parameters:

- chromium,
- arsenic,
- manganese associated with IRZ byproduct, and
- manganese associated with the naturally occurring reducing rind.

Figures 11 presents the chromium transport results for each of the three freshwater sources after 30 years of transport in model layer 1. The HNWR-1 source results are shown on the left panel, the Park

Moabi source results are shown in the center panel, and the Colorado River source results are shown in the right panel. This figure indicates that the different freshwater sources have a minimal impact on the solute transport results for the chromium plume. There is slightly more chromium mass remaining in the Park Moabi freshwater source scenario after 30 years than in the other scenarios due to a slightly lower hydraulic gradient. This would result in a slightly longer remediation timeframe for a Park Moabi well source. Comparing the results between the HNWR-1 and River freshwater sources indicates that these two sources result in nearly identical results for the transport and remediation of the chromium plume. Figure 12 depicts the chromium transport results for each of the three freshwater sources after 30 years of transport in model layer 3. Similar to Figure 11, the chromium mass remaining for each of the freshwater sources is very similar in model layer 3. This indicates that with respect to the chromium plume migration and remediation timeframe, the source of freshwater does not produce significantly different results.

Figure 13 presents the manganese byproduct transport results for the three different freshwater sources after 30 years of transport in model layer 1. The manganese solute transport run for all three freshwater sources incorporated manganese oxidation as per the updated manganese model described in the previous section. Figure 13 indicates that despite the three different potential freshwater sources, the manganese byproduct distribution downgradient of the NTH IRZ, downgradient of the TCS injection, and in the uplands are similar for all three scenarios. Figure 14 depicts the manganese byproduct results for model layer 3. Similar to the results for model layer 1, there were minimal differences between the three different freshwater sources.

Figure 15 presents the manganese in the naturally occurring rind transport results for the three different freshwater sources after 30 years of transport in model layer 1.The manganese solute transport run for all three freshwater sources incorporated manganese oxidation as per the updated manganese model described in the previous section. Figure 15 indicates that the three different potential freshwater sources result in very similar manganese distribution in the rind. Figure 16 depicts the manganese rind results for model layer 3. Similar to the results for model layer 1, there were minimal differences between the three different freshwater sources.

Figure 17 presents the arsenic transport results for the three freshwater sources after 30 years of transport for model layer 1. With respect to arsenic concentrations present in the freshwater injection wells, 15 ppb arsenic was utilized for HNWR-1 and Park Moabi, while only 2.6 ppb was utilized for the River source. While the exact arsenic concentration for Park Moabi is unknown, a value of 15 ppb was assigned as an approximate value to directly compare the impact to the HNWR-1 modeling results. Figure 17 indicates very similar arsenic impacts between the HNWR-1 and Park Moabi sources, with only a slightly biased northwest flow component observed at FW-INJ-2 due to the Park Moabi extraction. Arsenic concentrations for the River source remained below 5 ppb for the duration of the model at the freshwater injection wells. Figure 18 depicts the 30 year freshwater source analyses for model layer 3. Similar to the layer 1 results, the model layer 3 results indicate similar arsenic distributions between HNWR-1 and Park Moabi freshwater sources, while the river freshwater source remained below 5 ppb throughout the model domain.

Freshwater Injection Well FW-INJ-1

During the freshwater source analysis, the importance of well FW-INJ-1 (northeast freshwater injection well near the river), was evaluated. In the original 30% design, FW-INJ-1 was injecting at a rate of 100 gpm. In order to evaluate the impact FW-INJ-1 has on the chromium plume migration and remedial timeframe, as well as the impact on manganese and arsenic, the flow and transport models were run with FW-INJ-1 turned off. With respect to the chromium plume, there was no difference in simulated chromium

plume migration or remedial timeframe with FW-INJ-1 turned off. With respect to the manganese there was no difference in the manganese byproduct or rind without FW-INJ-1 operating. The only significant difference was with respect to the arsenic contained within the freshwater injection. Due to the limited benefit of FW-INJ-1 and agency comments regarding freshwater injection at this location, it is recommended to further analyze the FW-INJ-1 location as part of the 60% design process.

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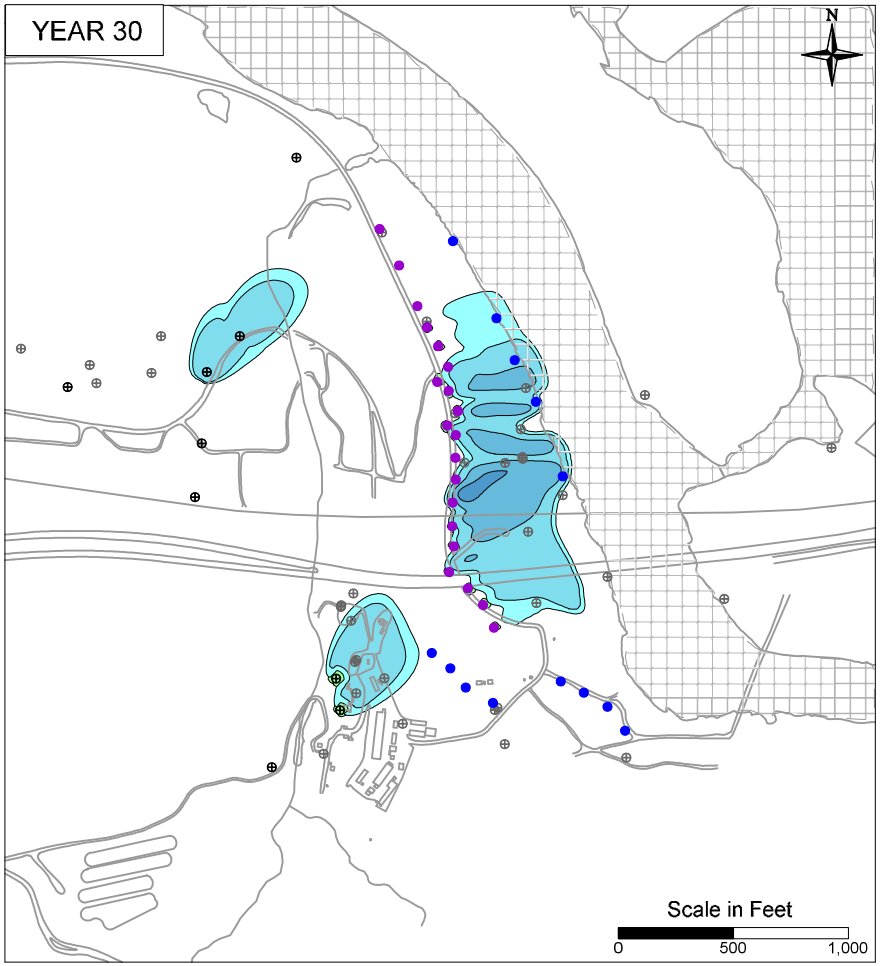
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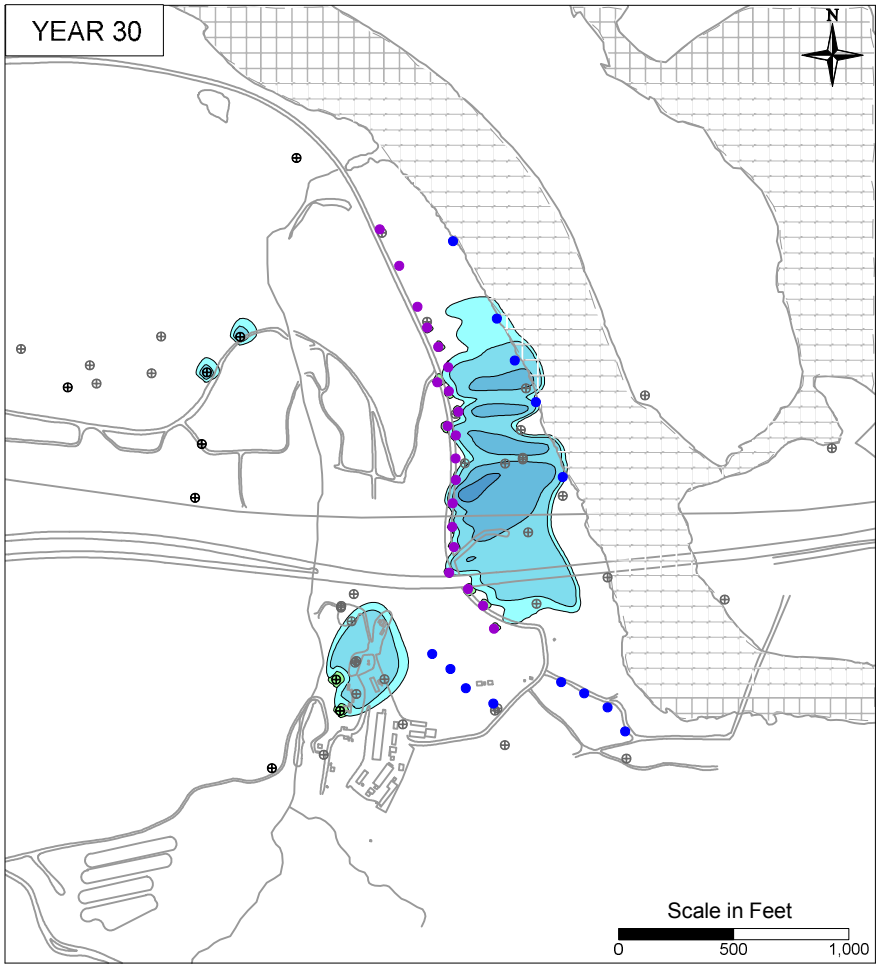
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30% Design: Byproduct Manganese



Update: Byproduct Manganese with Oxidation

Manganese Concentration (ppm)

0.13 0.25 0.5 0.75 1 2

Carbon Concentration (ppm)

1 25 50 75 100

LEGEND

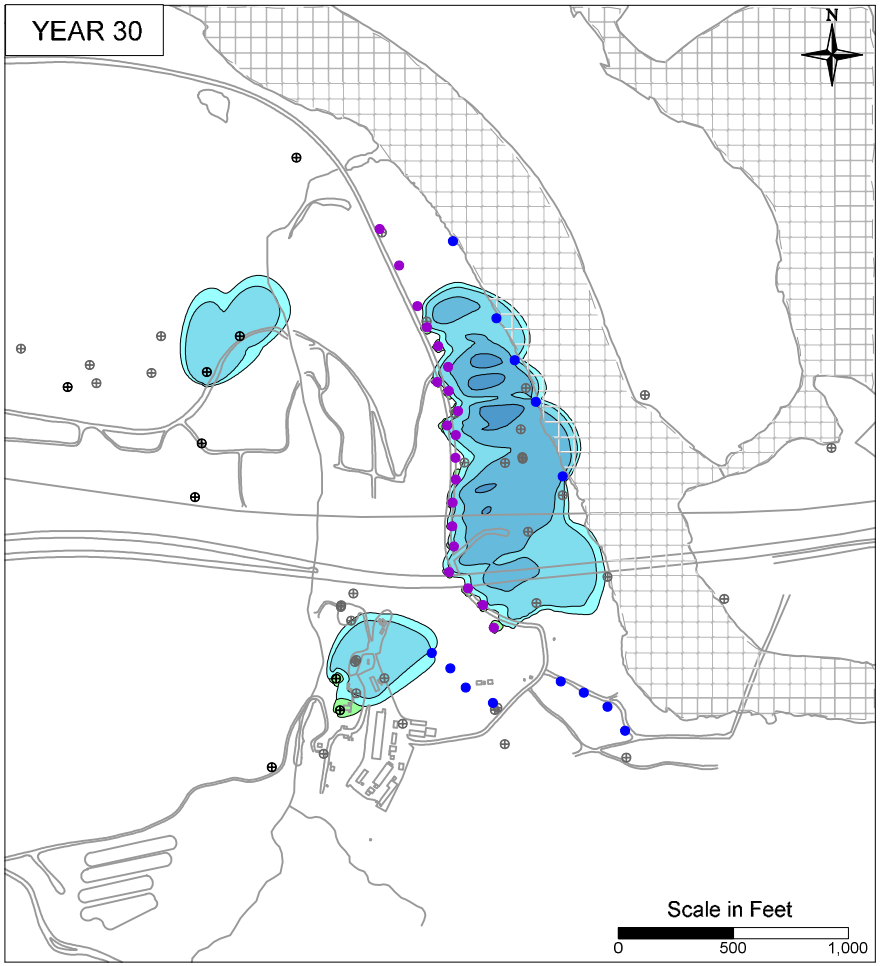
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- UPGRADIENT INJECTION WELLS
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- MONITORING WELLS

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TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
MODELING APPENDIX

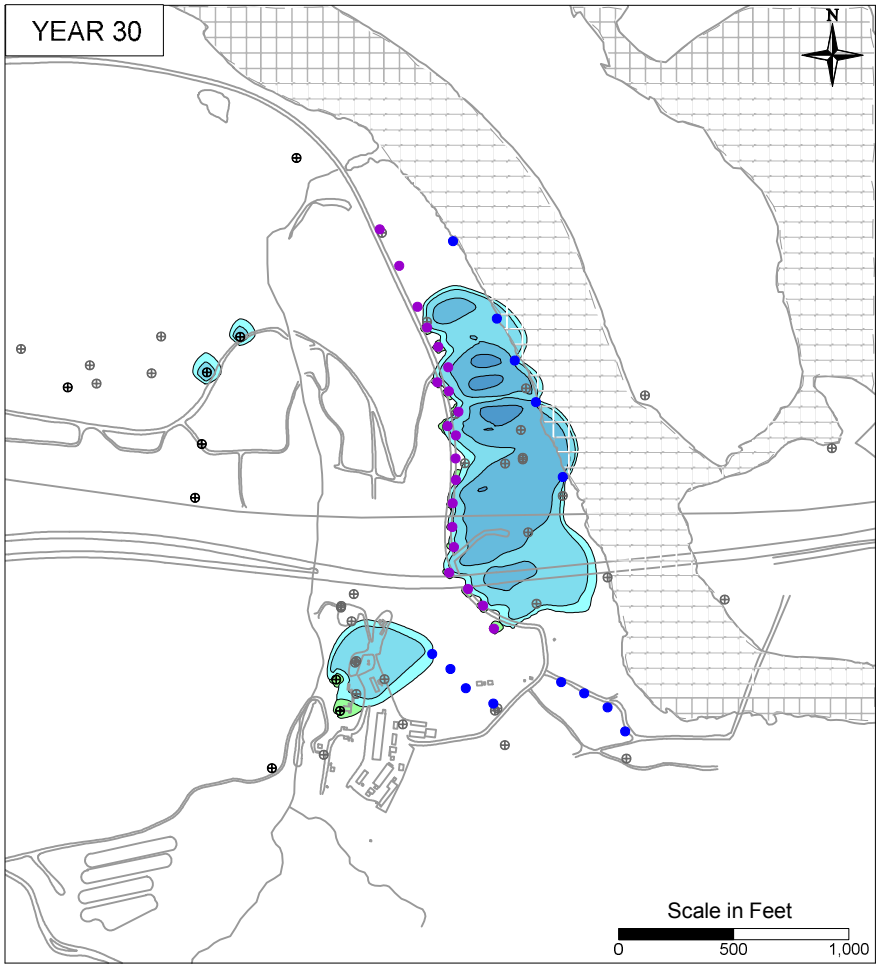
MANGANESE PARAMETER REFINEMENT:
30 YEAR SIMULATED BYPRODUCT MANGANESE
TRANSPORT RESULTS IN MODEL LAYER 1

ARCADIS

FIGURE
1



30% Design: Byproduct Manganese



Update: Byproduct Manganese with Oxidation

Manganese Concentration (ppm)

0.13 0.25 0.5 0.75 1 2

Carbon Concentration (ppm)

1 25 50 75 100

LEGEND

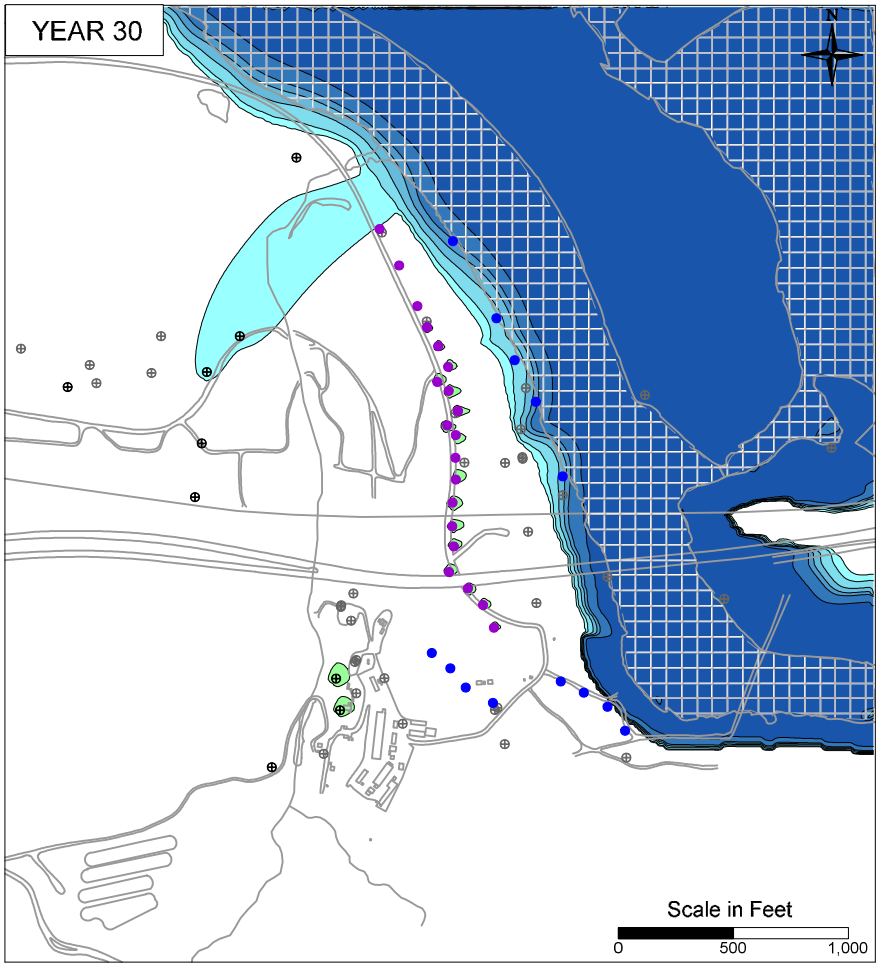
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NEEDLES, CALIFORNIA
MODELING APPENDIX

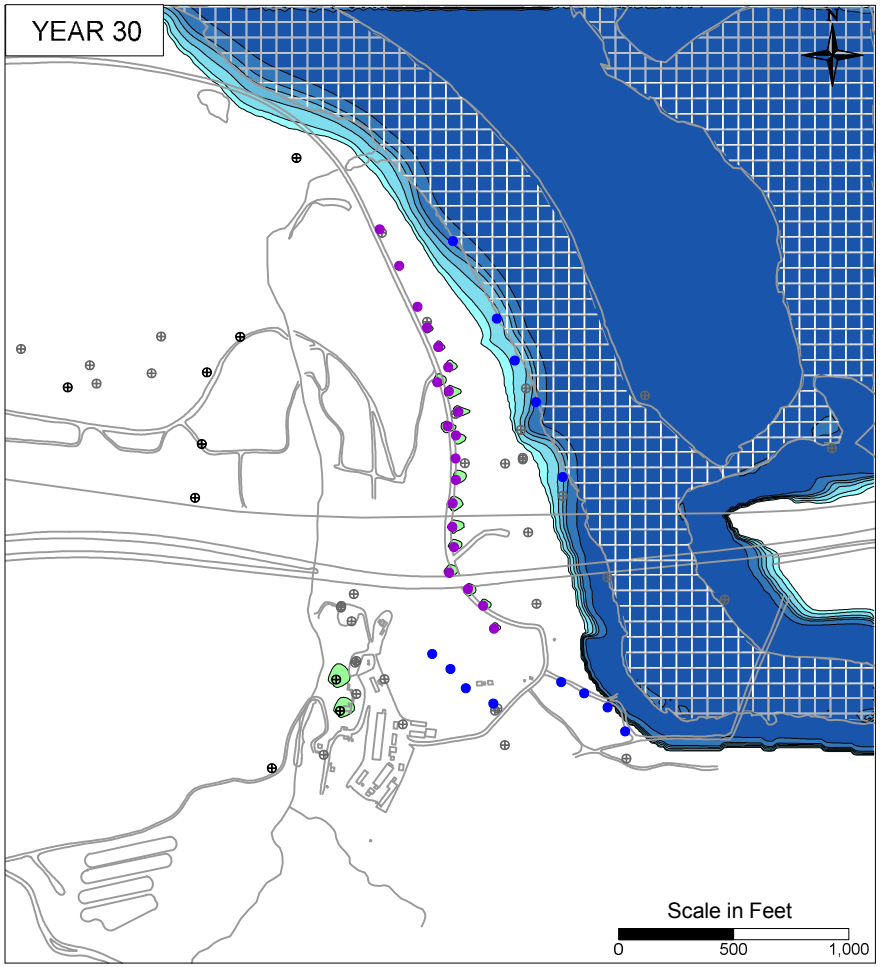
MANGANESE PARAMETER REFINEMENT:
30 YEAR SIMULATED BYPRODUCT MANGANESE
TRANSPORT RESULTS IN MODEL LAYER 3

ARCADIS

FIGURE
2



30% Design:Rind Manganese



Update: Rind Manganese with Oxidation

Manganese Concentration (ppm)

0.13 0.25 0.5 0.75 1 2

Carbon Concentration (ppm)

1 25 50 75 100

LEGEND

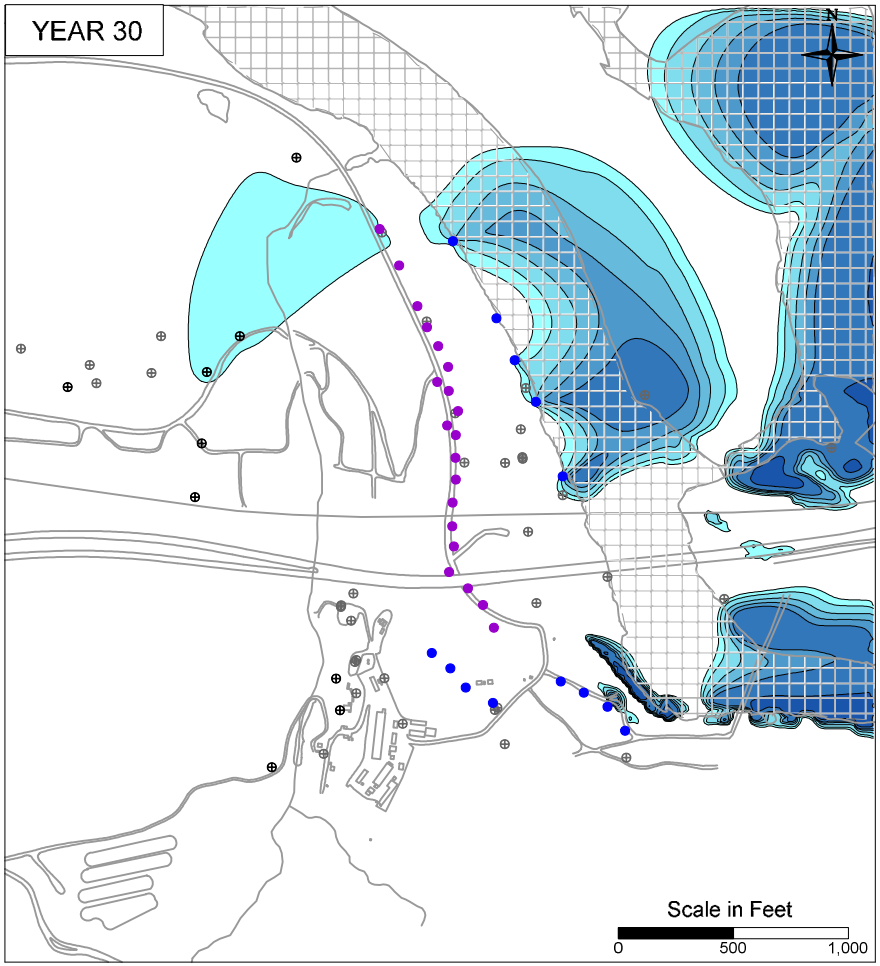
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TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
MODELING APPENDIX

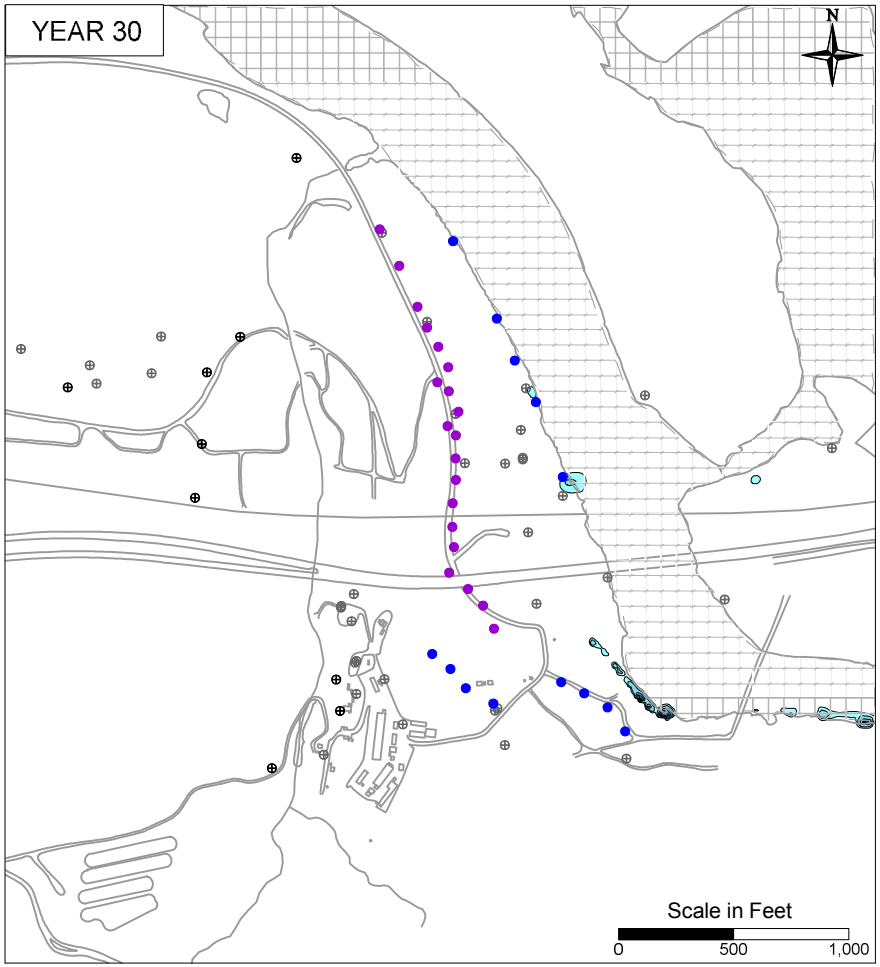
MANGANESE PARAMETER REFINEMENT:
30 YEAR SIMULATED RIND MANGANESE
TRANSPORT RESULTS IN MODEL LAYER 1

ARCADIS

FIGURE
3



30% Design:Rind Manganese



Update: Rind Manganese with Oxidation

Manganese Concentration (ppm)

0.13 0.25 0.5 0.75 1 2

Carbon Concentration (ppm)

1 25 50 75 100

LEGEND

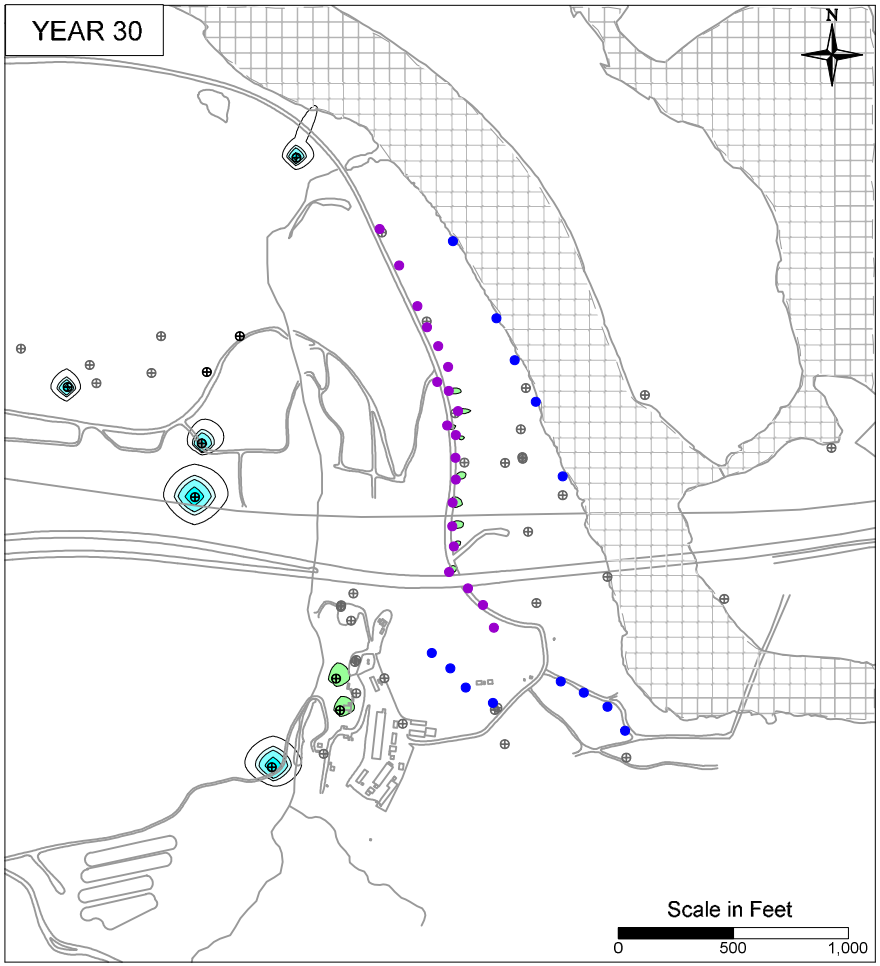
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NEEDLES, CALIFORNIA
MODELING APPENDIX

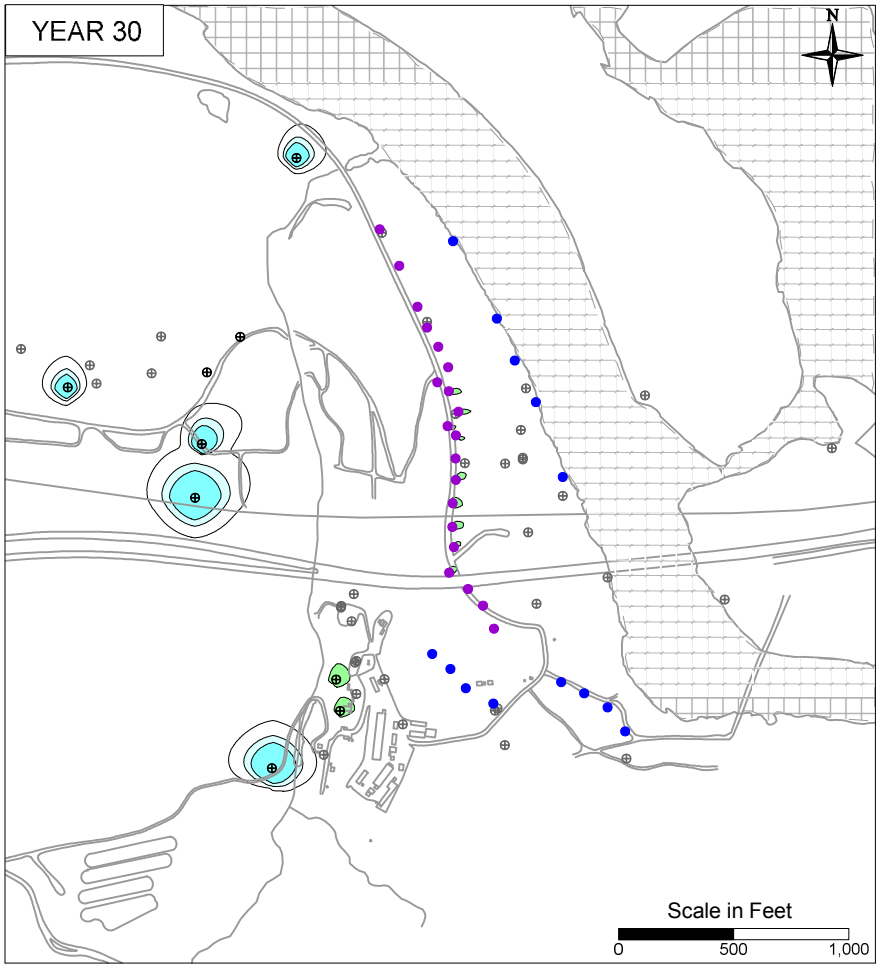
MANGANESE PARAMETER REFINEMENT:
30 YEAR SIMULATED RIND MANGANESE
TRANSPORT RESULTS IN MODEL LAYER 3

ARCADIS

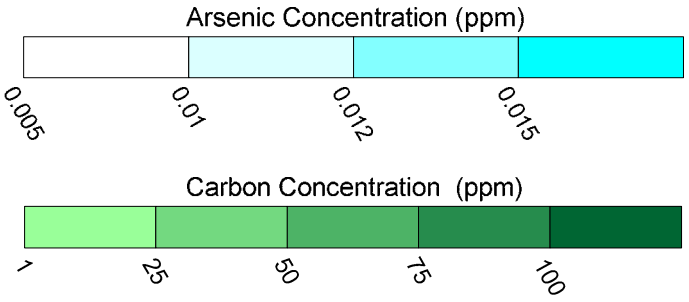
FIGURE
4



30% Design: Arsenic Precipitation Only



Update: Uplands Arsenic Sorption Only



LEGEND

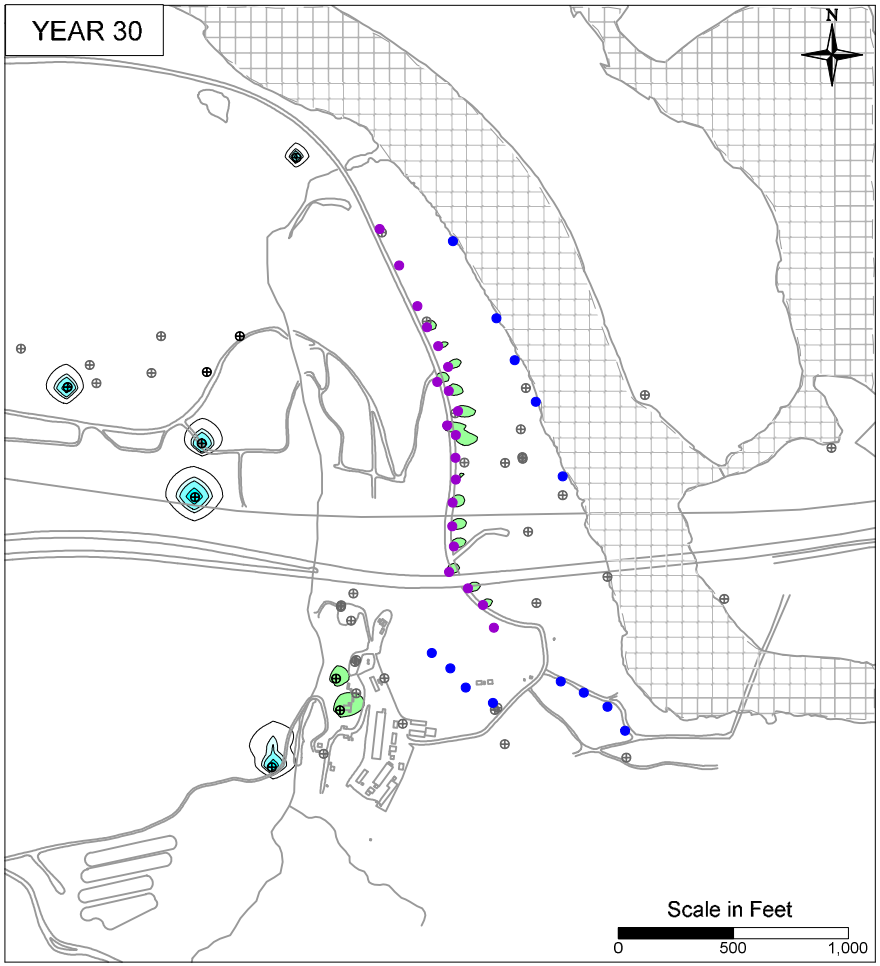
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TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
MODELING APPENDIX

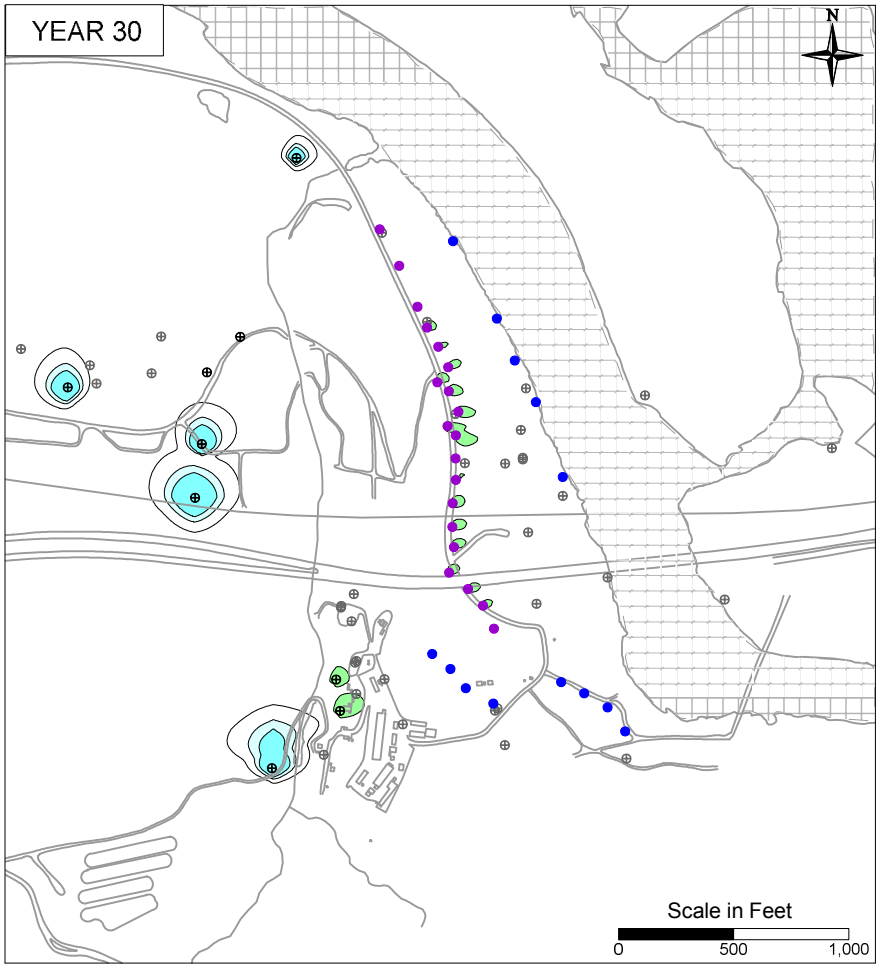
ARSENIC PARAMETER REFINEMENT:
30 YEAR SIMULATED ARSENIC TRANSPORT
RESULTS IN MODEL LAYER 1

ARCADIS

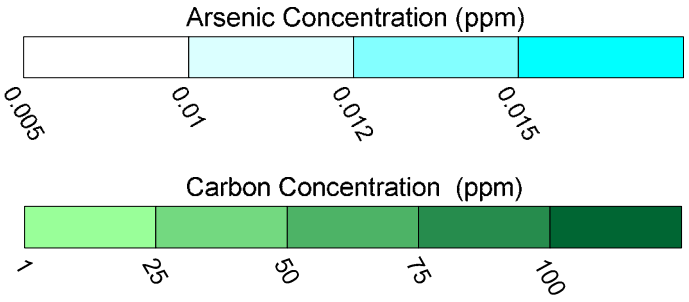
FIGURE
5



30% Design: Arsenic Precipitation Only



Update: Uplands Arsenic Sorption Only



LEGEND

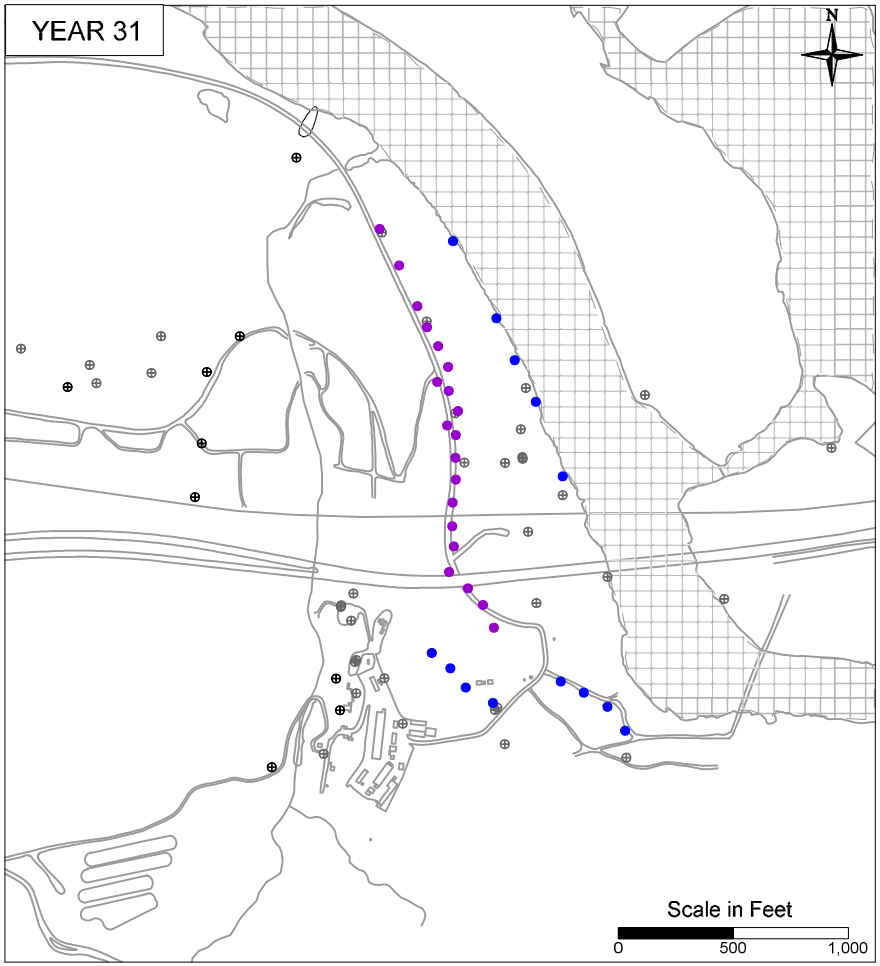
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- UPGRADIENT INJECTION WELLS
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NEEDLES, CALIFORNIA
MODELING APPENDIX

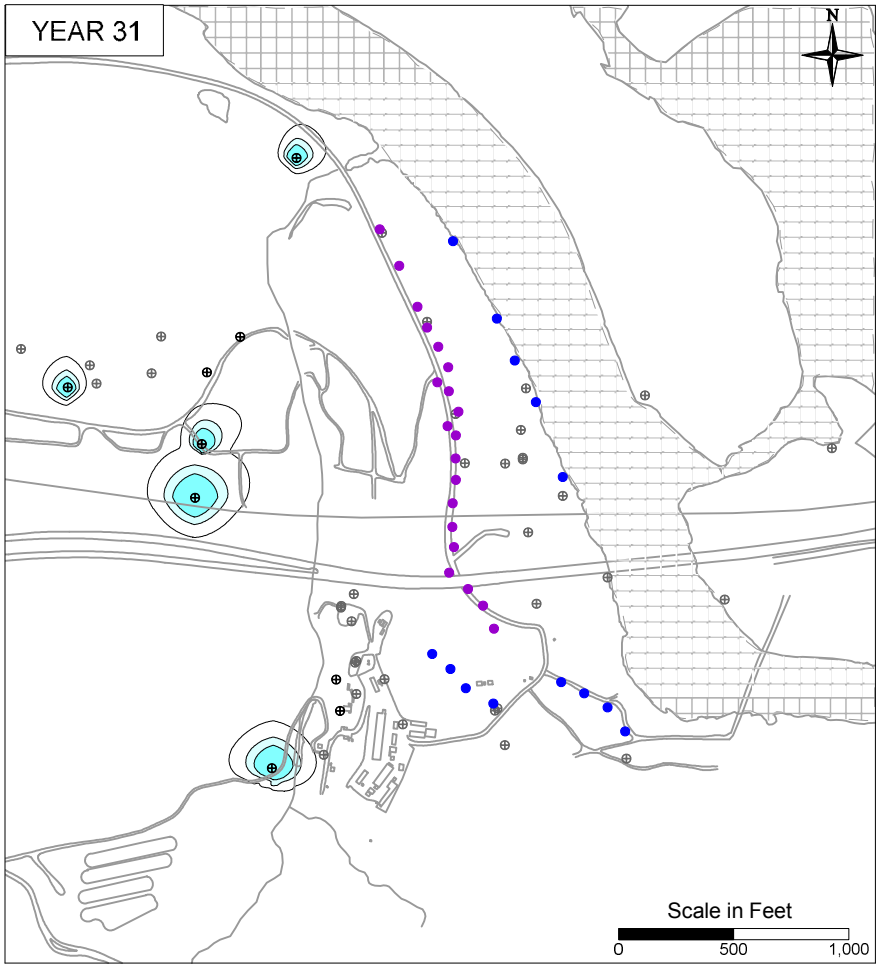
ARSENIC PARAMETER REFINEMENT:
30 YEAR SIMULATED ARSENIC TRANSPORT
RESULTS IN MODEL LAYER 3

ARCADIS

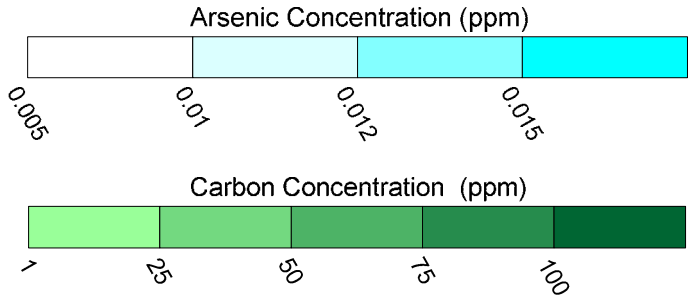
FIGURE
6



30% Design: Arsenic Precipitation Only



Update: Uplands Arsenic Sorption Only



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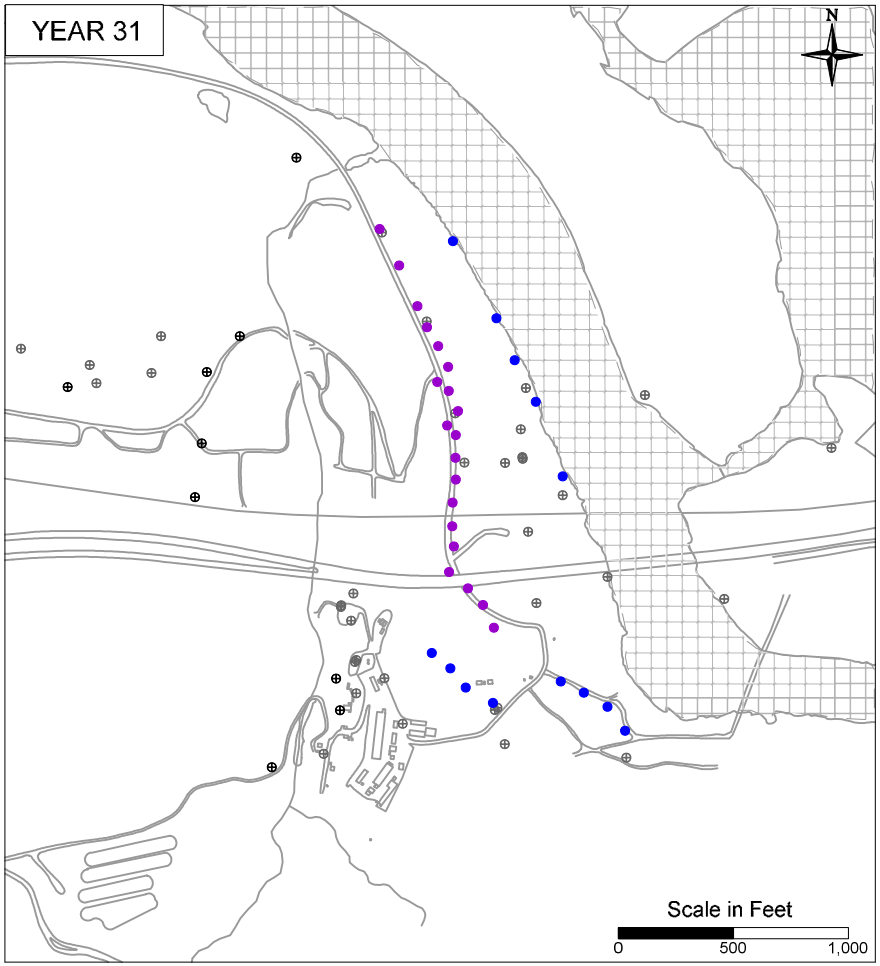
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- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- MONITORING WELLS

PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
MODELING APPENDIX

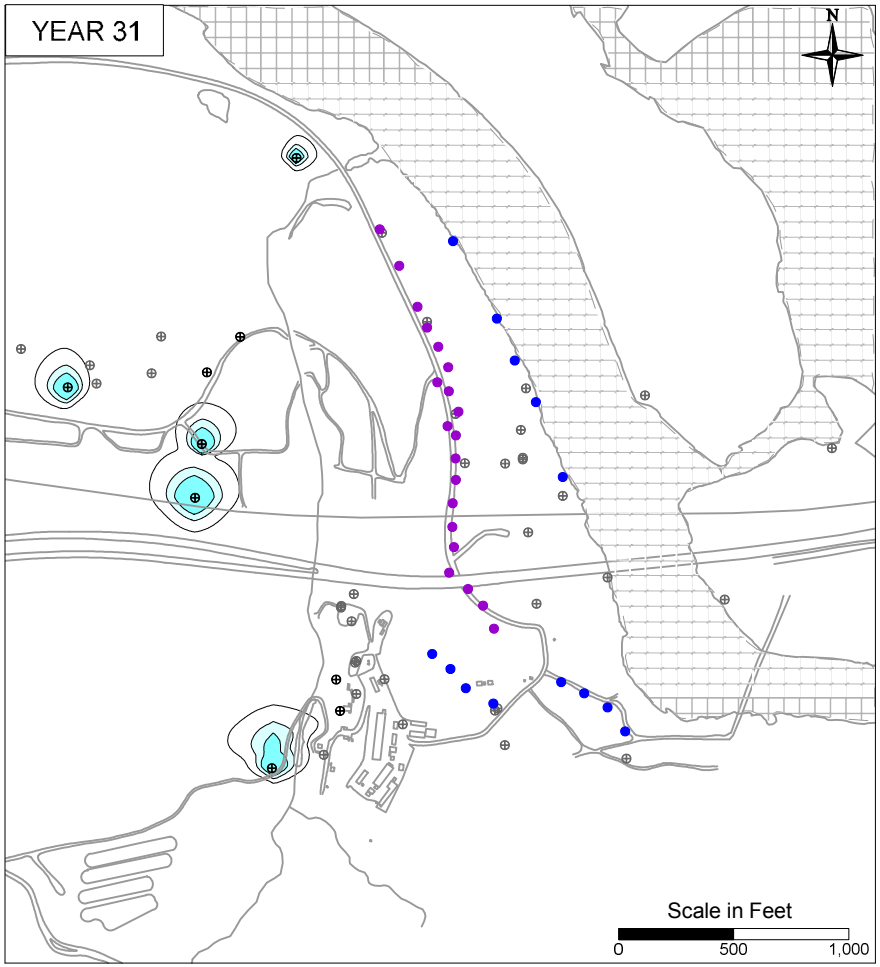
ARSENIC PARAMETER REFINEMENT:
31 YEAR SIMULATED ARSENIC RECOVERY
TRANSPORT RESULTS IN MODEL LAYER 1

ARCADIS

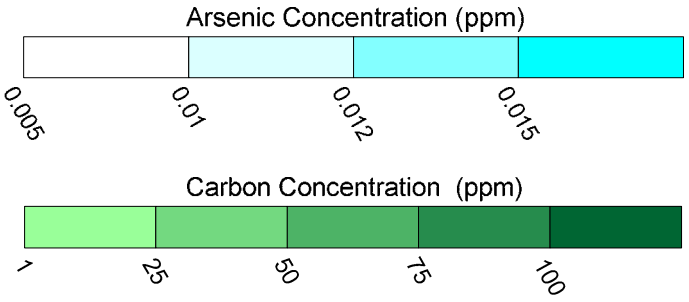
FIGURE
7



30% Design: Arsenic Precipitation Only



Update: Uplands Arsenic Sorption Only



LEGEND

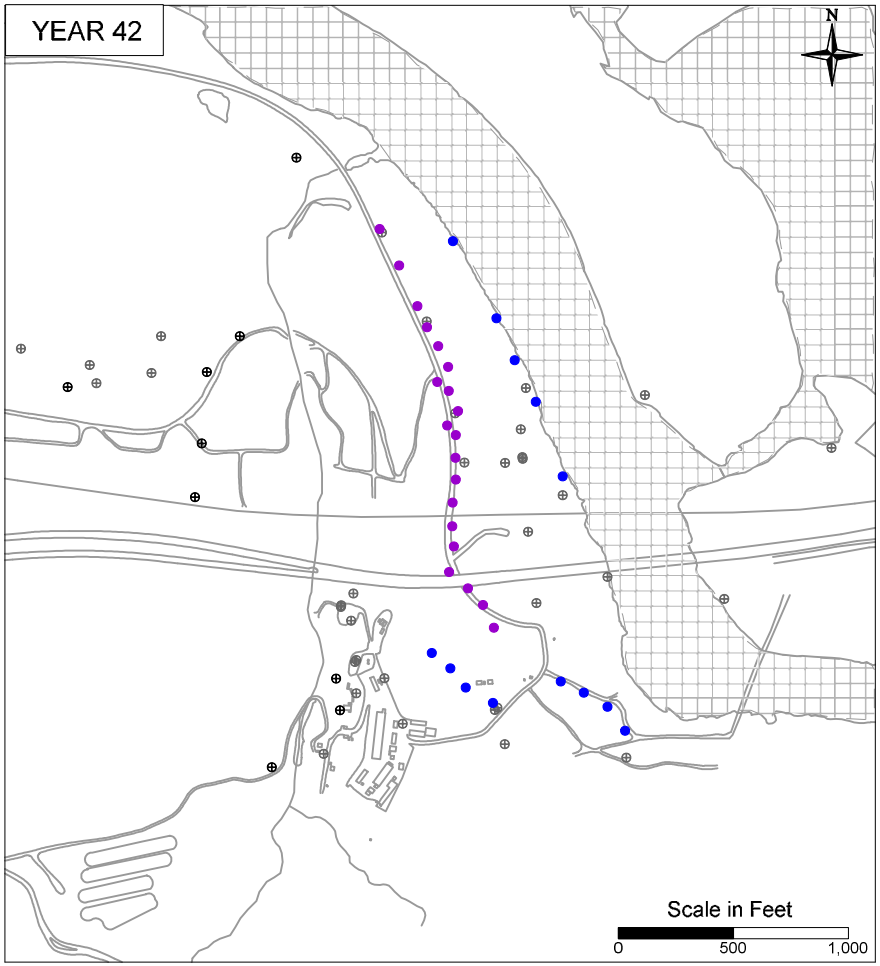
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- UPGRADIENT INJECTION WELLS
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PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
MODELING APPENDIX

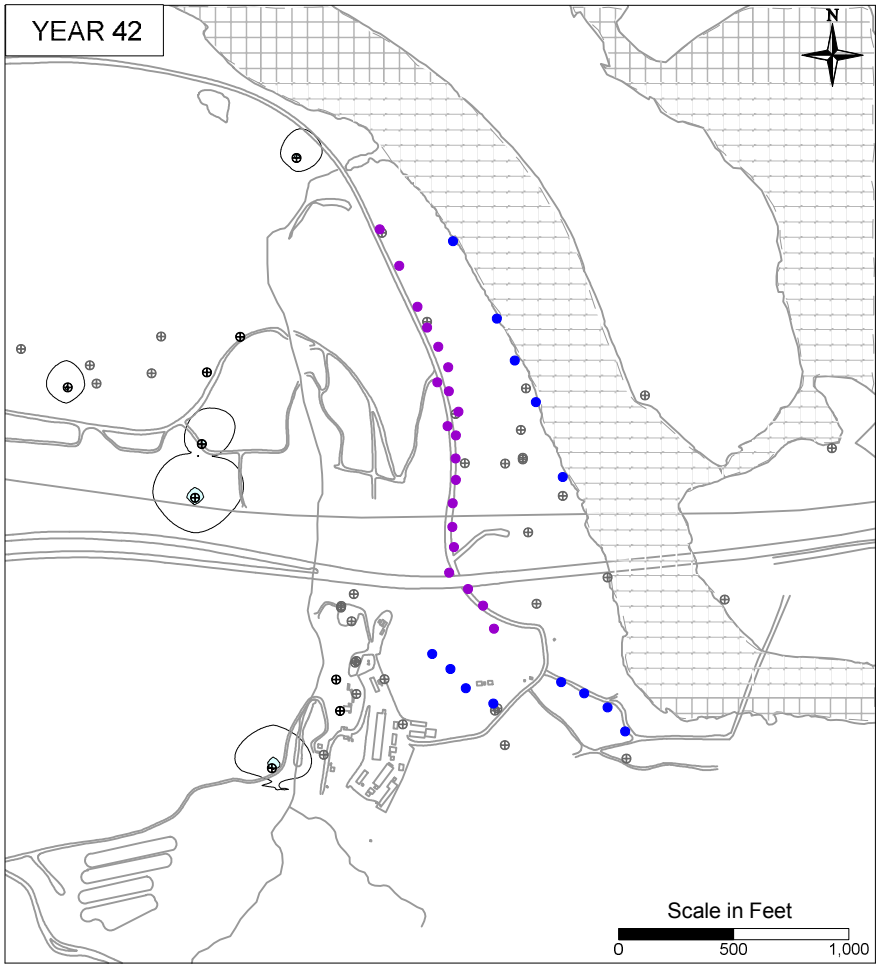
ARSENIC PARAMETER REFINEMENT:
31 YEAR SIMULATED ARSENIC RECOVERY
TRANSPORT RESULTS IN MODEL LAYER 3

ARCADIS

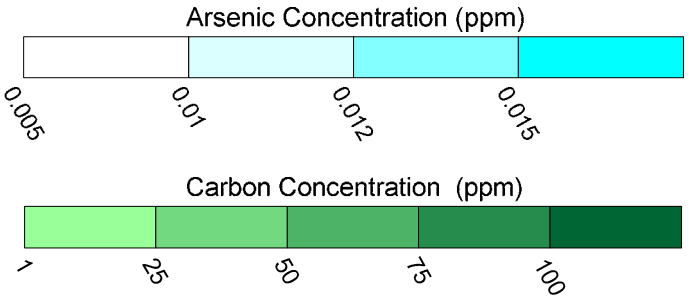
FIGURE
8



30% Design: Arsenic Precipitation Only



Update: Uplands Arsenic Sorption Only



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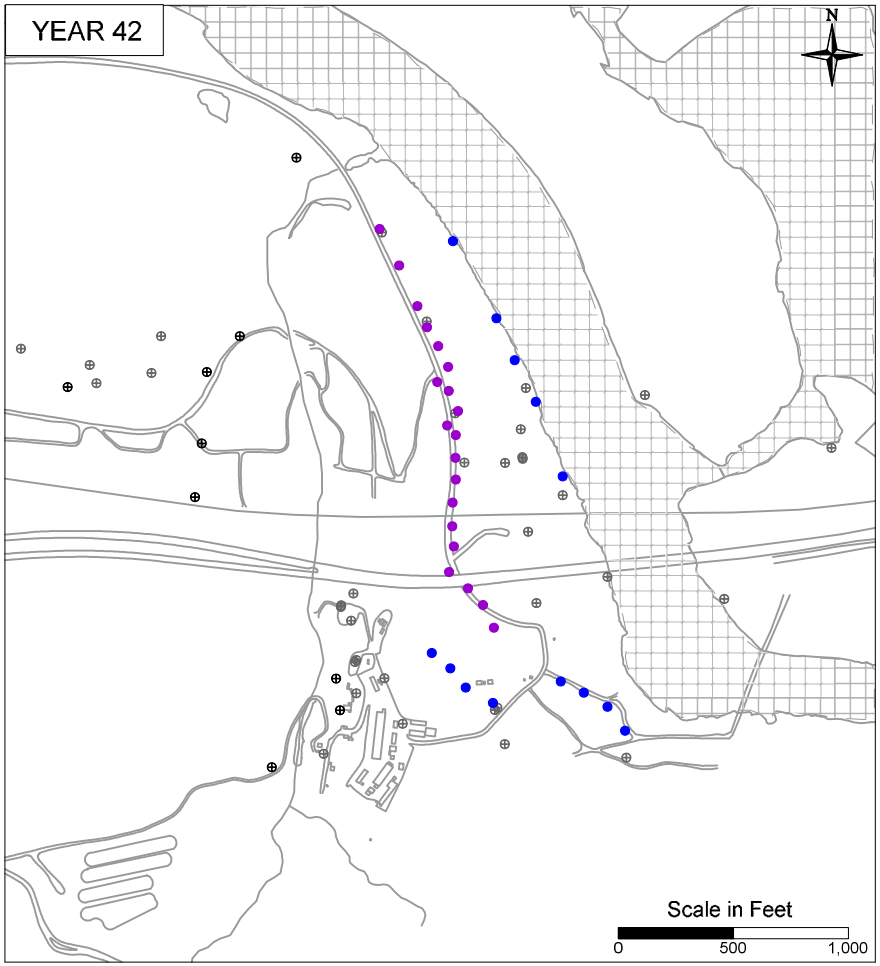
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- UPGRADIENT INJECTION WELLS
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- MONITORING WELLS

PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
MODELING APPENDIX

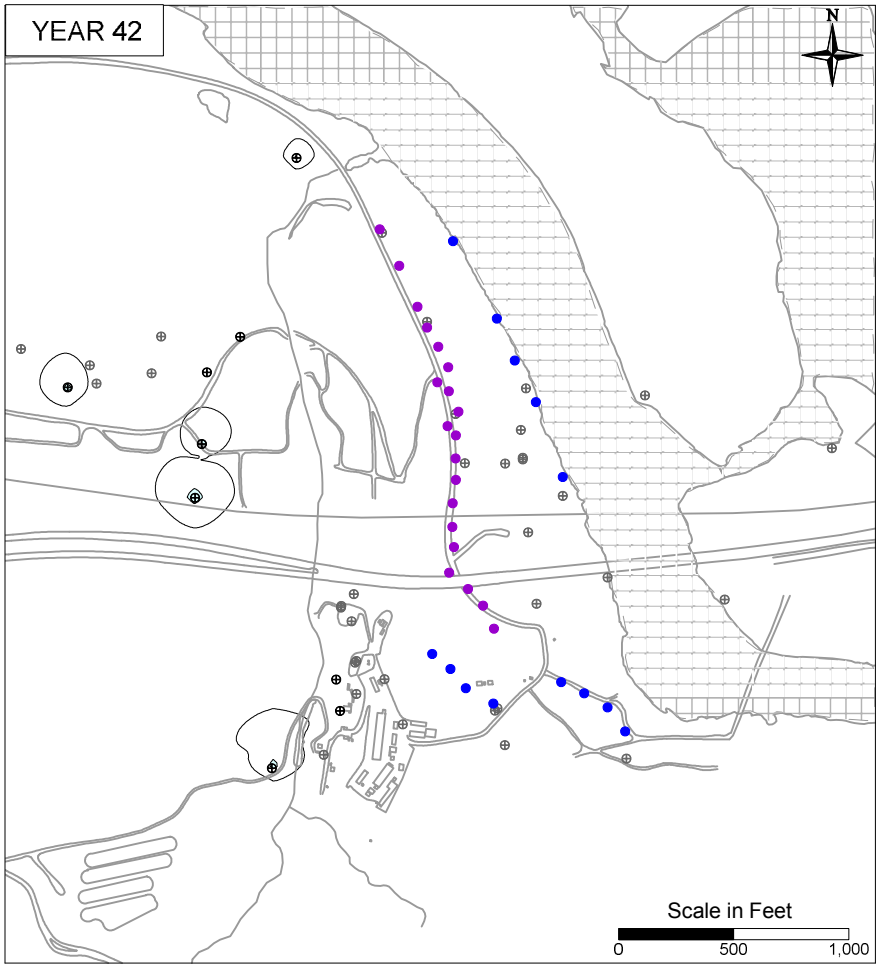
ARSENIC PARAMETER REFINEMENT:
42 YEAR SIMULATED ARSENIC RECOVERY
TRANSPORT RESULTS IN MODEL LAYER 1

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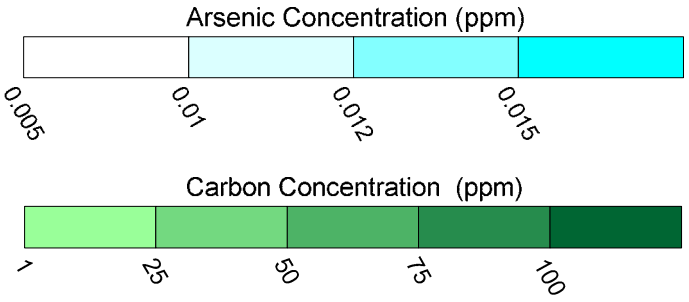
FIGURE
9



30% Design: Arsenic Precipitation Only



Update: Uplands Arsenic Sorption Only



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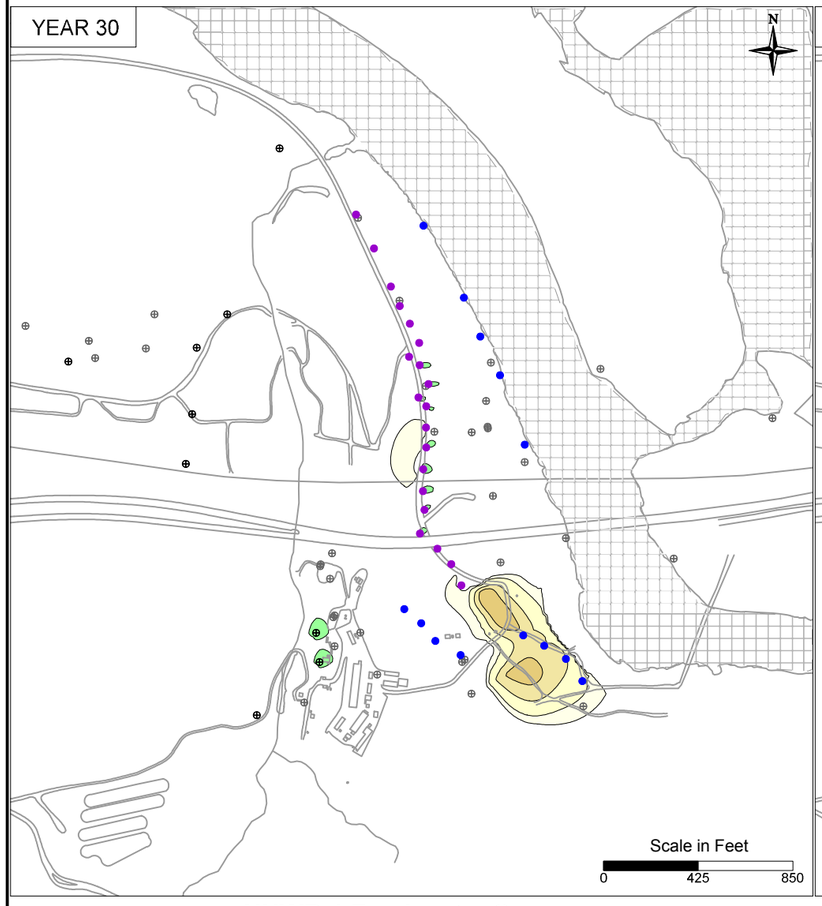
- IRZ WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- MONITORING WELLS

PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
MODELING APPENDIX

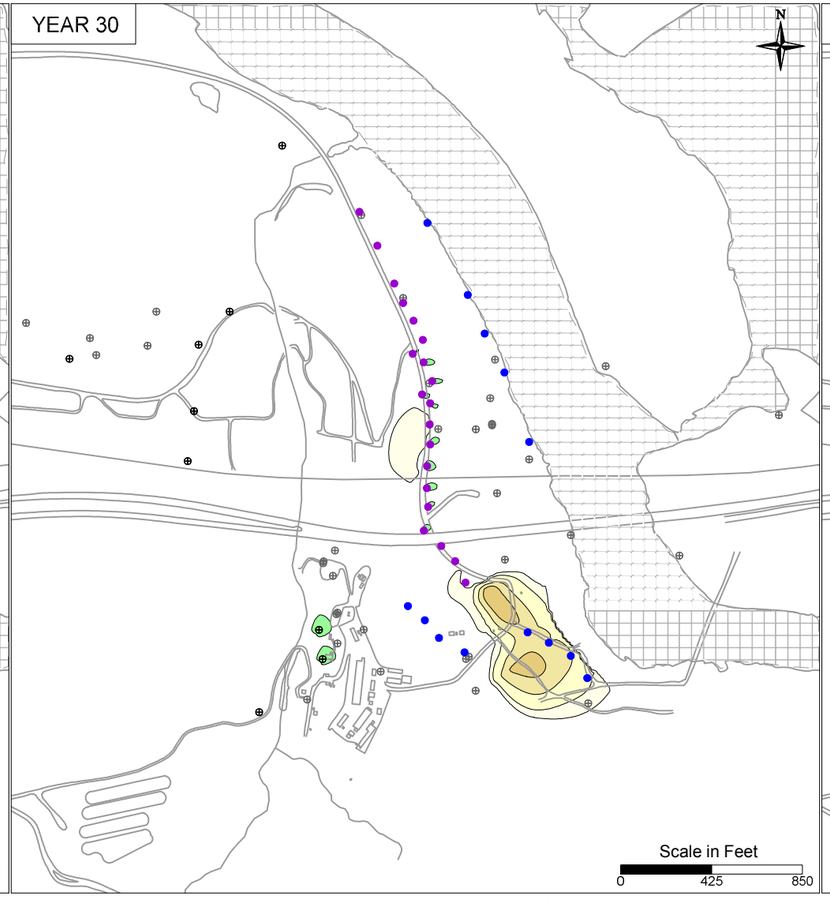
ARSENIC PARAMETER REFINEMENT:
42 YEAR SIMULATED ARSENIC RECOVERY
TRANSPORT RESULTS IN MODEL LAYER 3

ARCADIS

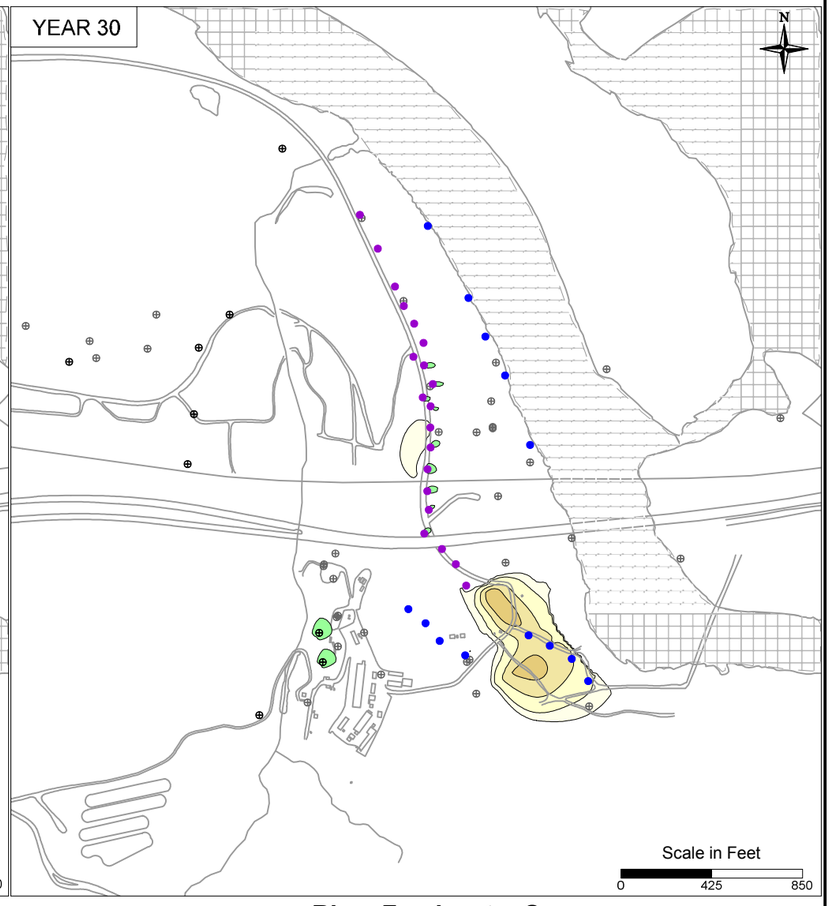
FIGURE
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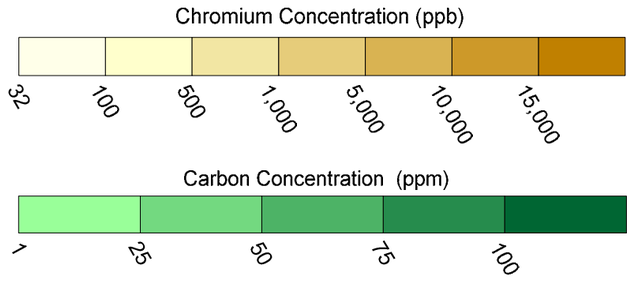
HNWR-1 Freshwater Source



Park Moabi Freshwater Source



River Freshwater Source



LEGEND

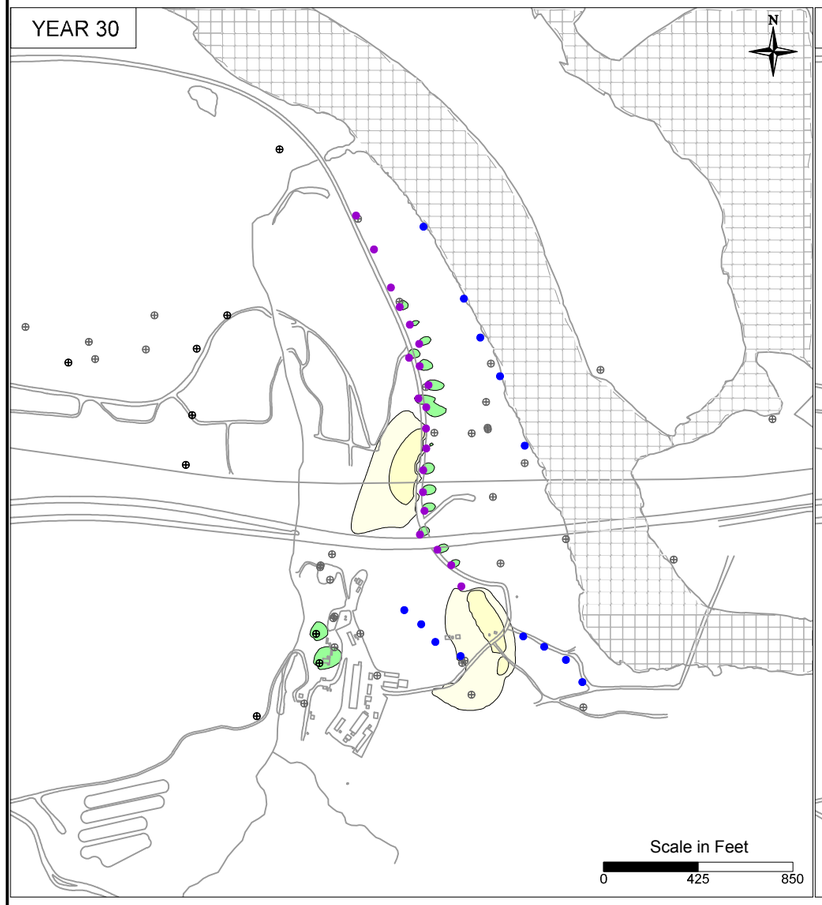
- IRZ WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- MONITORING WELLS

PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
MODELING APPENDIX

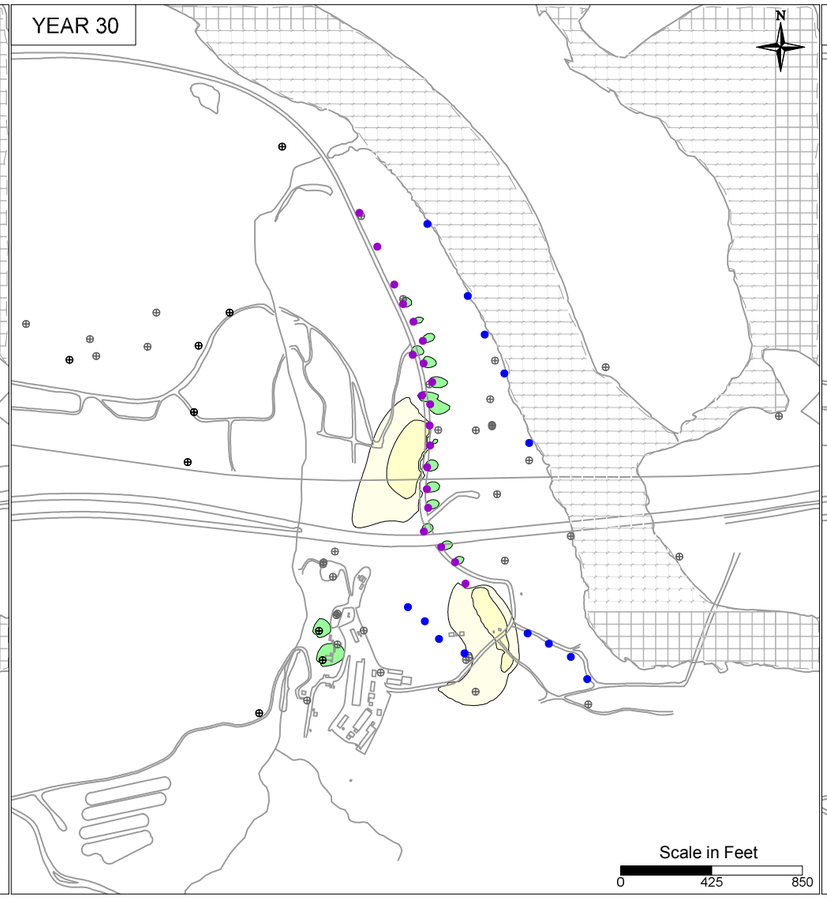
FRESHWATER SOURCE EVALUATION:
30 YEAR SIMULATED HEXAVALENT CHROMIUM TRANSPORT RESULTS IN MODEL LAYER 1

ARCADIS

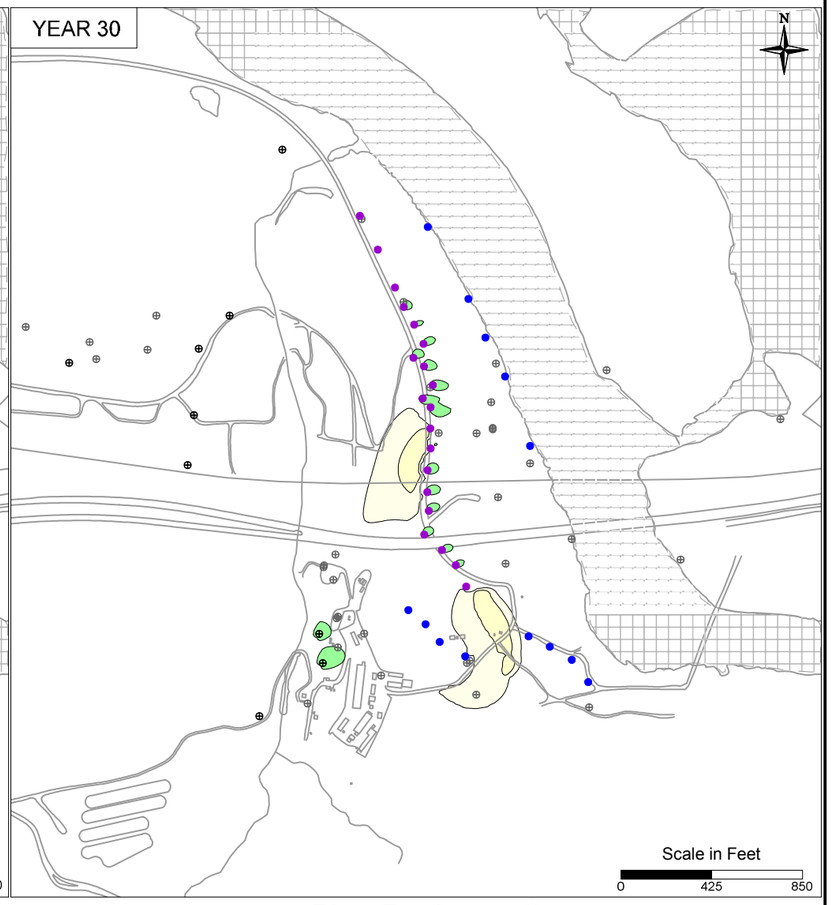
FIGURE
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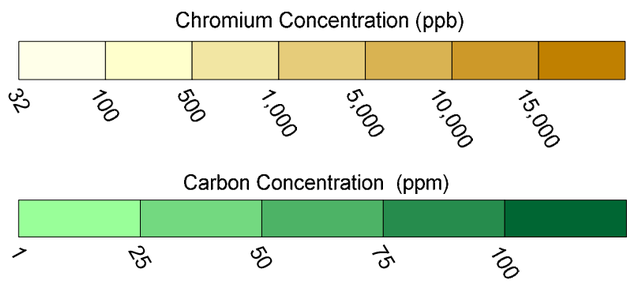
HNWR-1 Freshwater Source



Park Moabi Freshwater Source



River Freshwater Source



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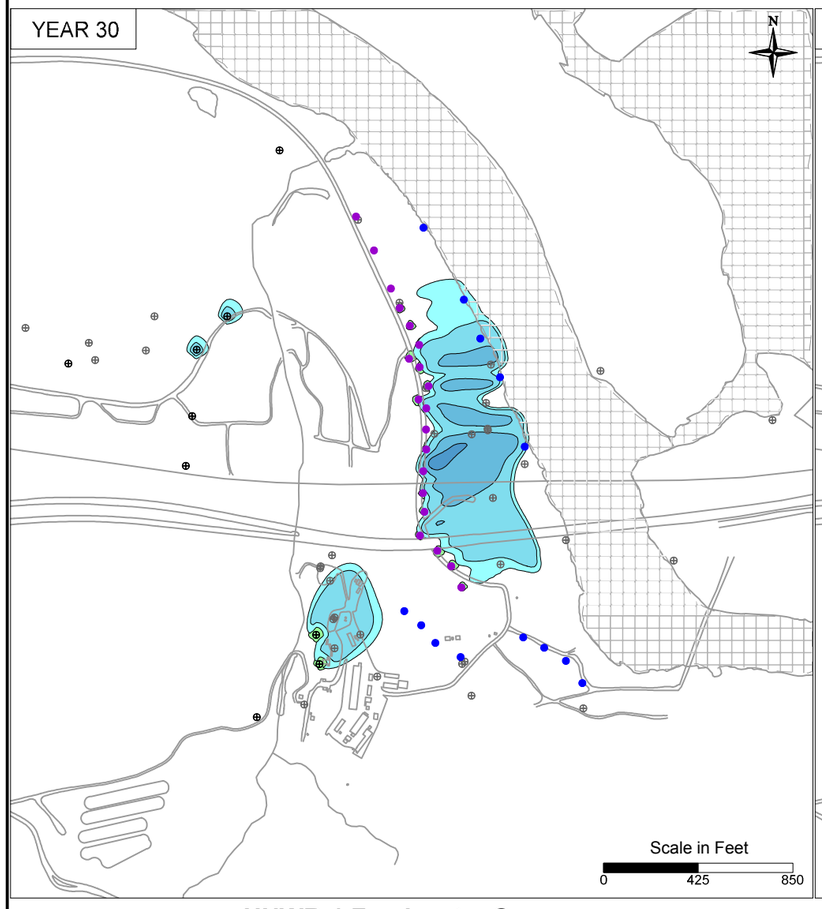
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- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- MONITORING WELLS

PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
MODELING APPENDIX

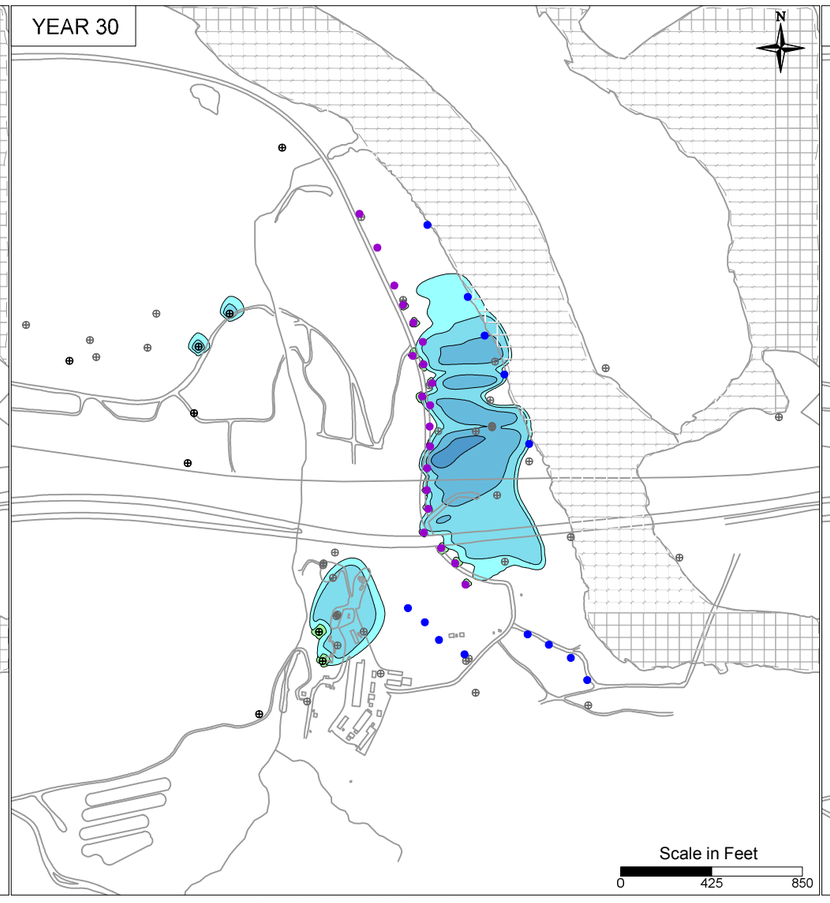
FRESHWATER SOURCE EVALUATION:
30 YEAR SIMULATED HEXAVALENT CHROMIUM TRANSPORT RESULTS IN MODEL LAYER 3

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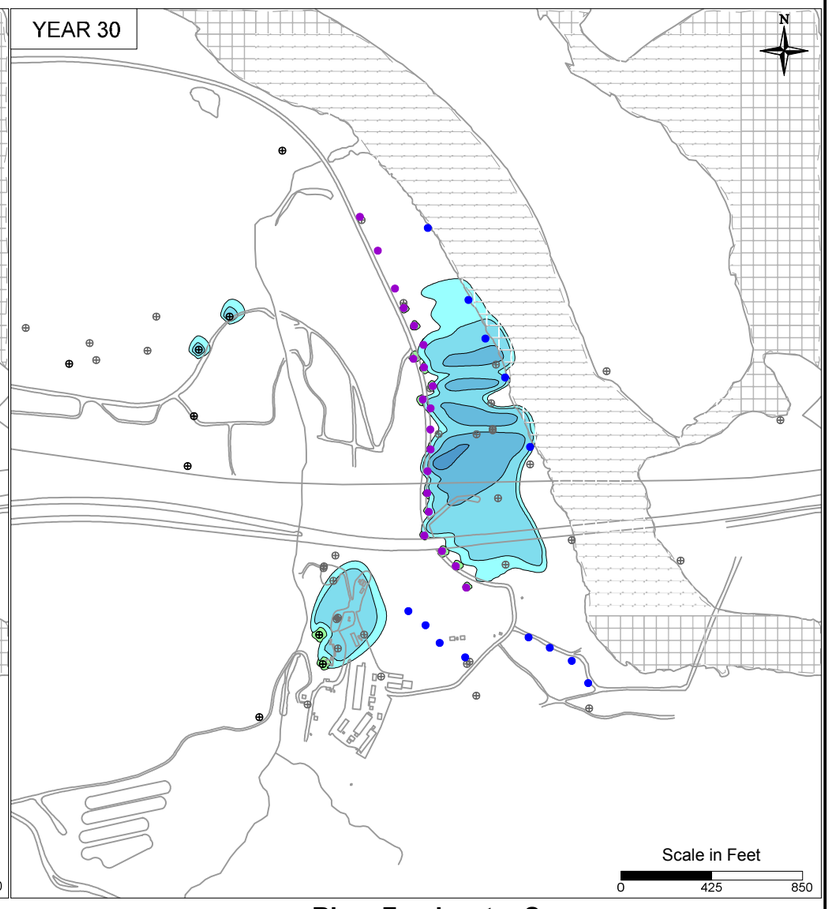
FIGURE
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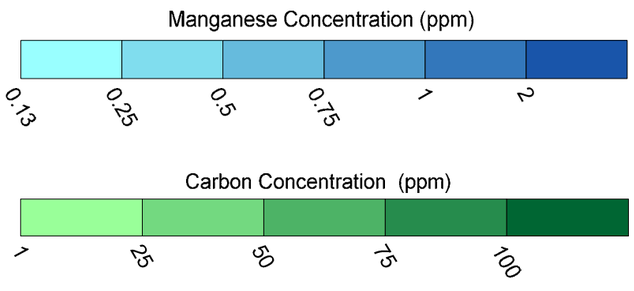
HNWR-1 Freshwater Source



Park Moabi Freshwater Source



River Freshwater Source



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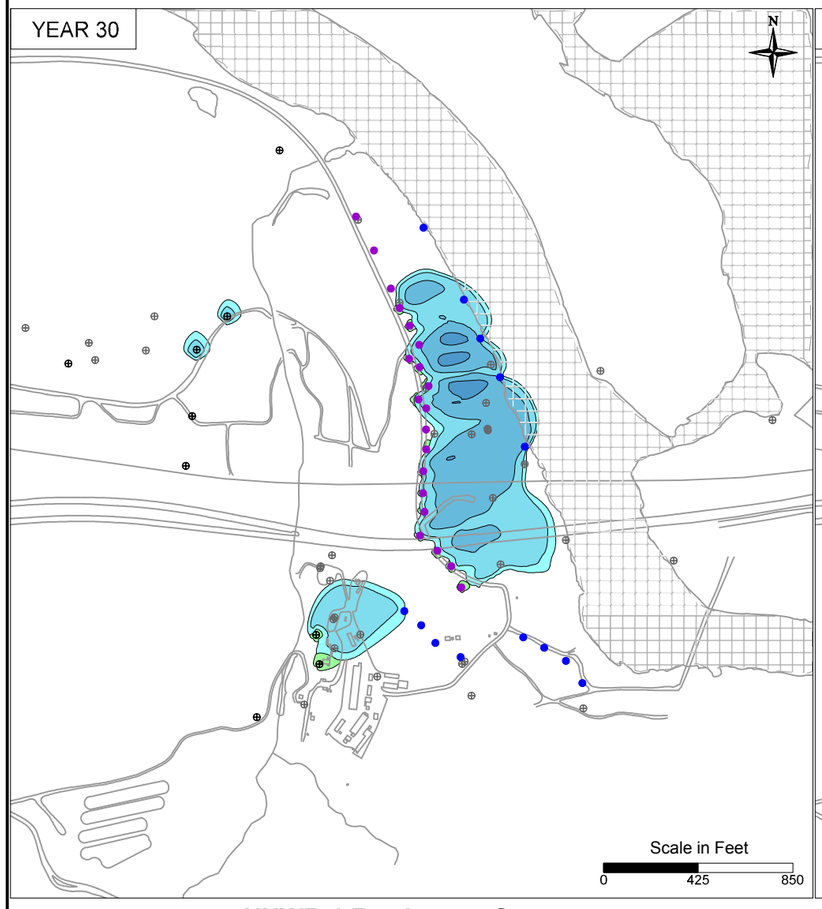
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- UPGRADIENT INJECTION WELLS
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PG&E
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NEEDLES, CALIFORNIA
MODELING APPENDIX

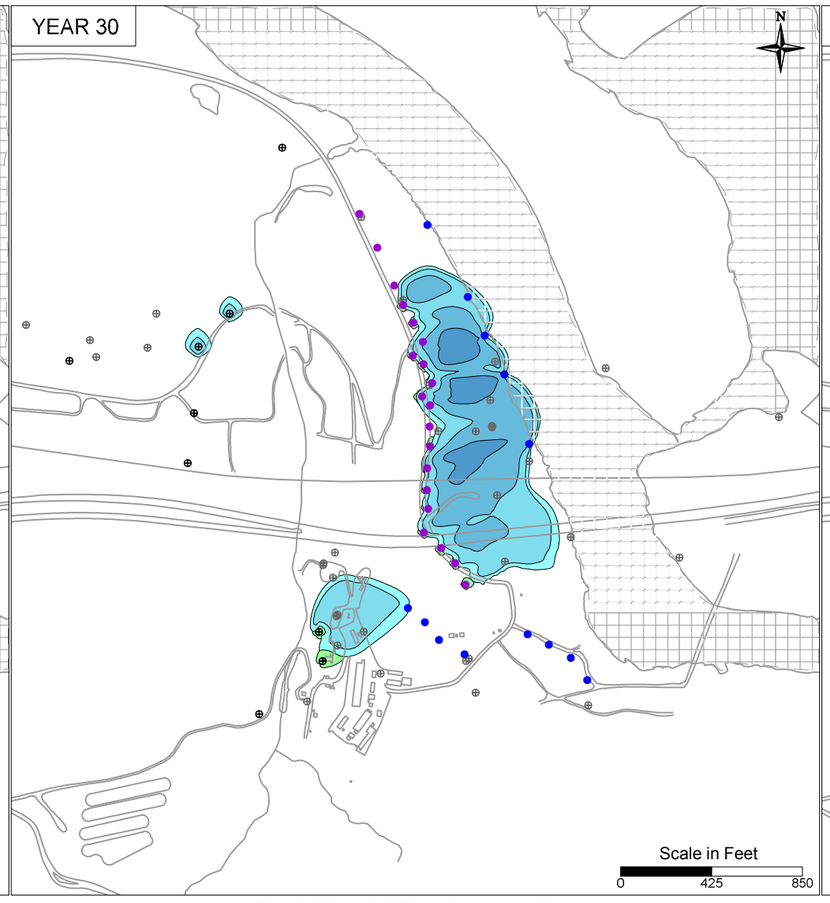
FRESHWATER SOURCE EVALUATION:
30 YEAR SIMULATED MANGANESE BYPRODUCT TRANSPORT RESULTS IN MODEL LAYER 1

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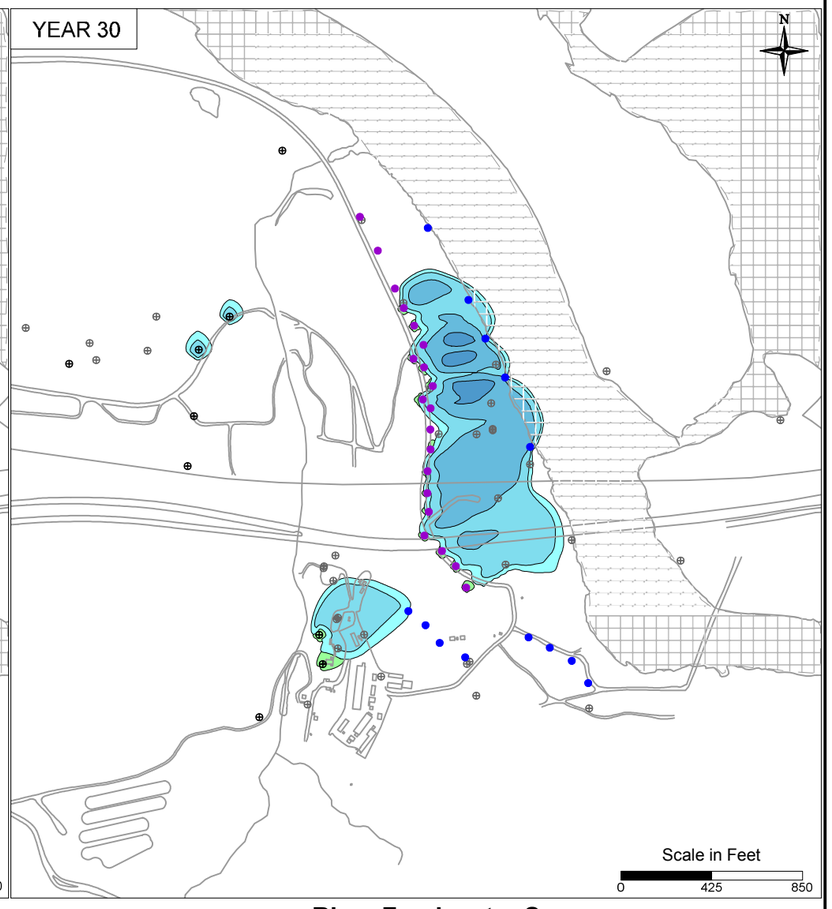
FIGURE
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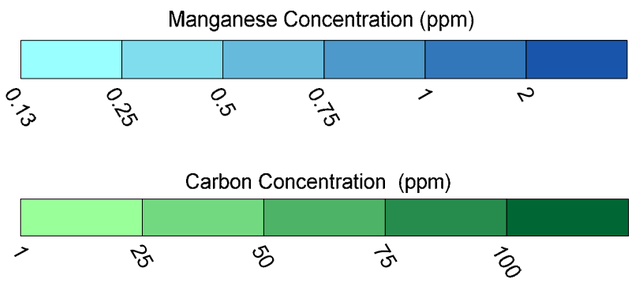
HNWR-1 Freshwater Source



Park Moabi Freshwater Source



River Freshwater Source



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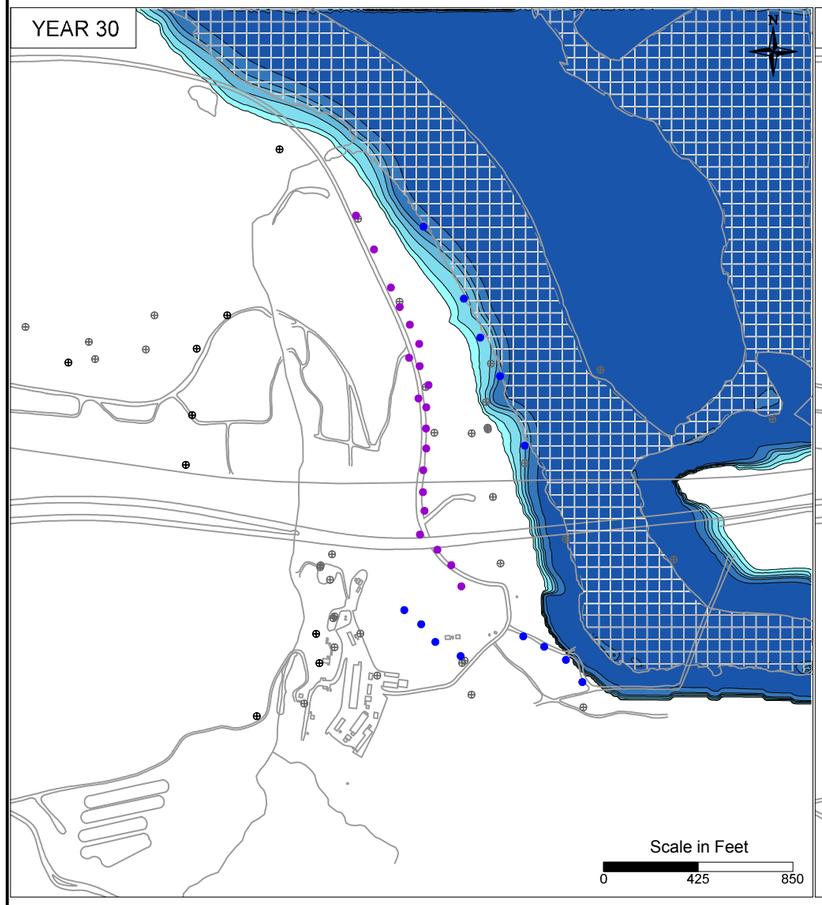
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- UPGRADIENT INJECTION WELLS
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- MONITORING WELLS

PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
MODELING APPENDIX

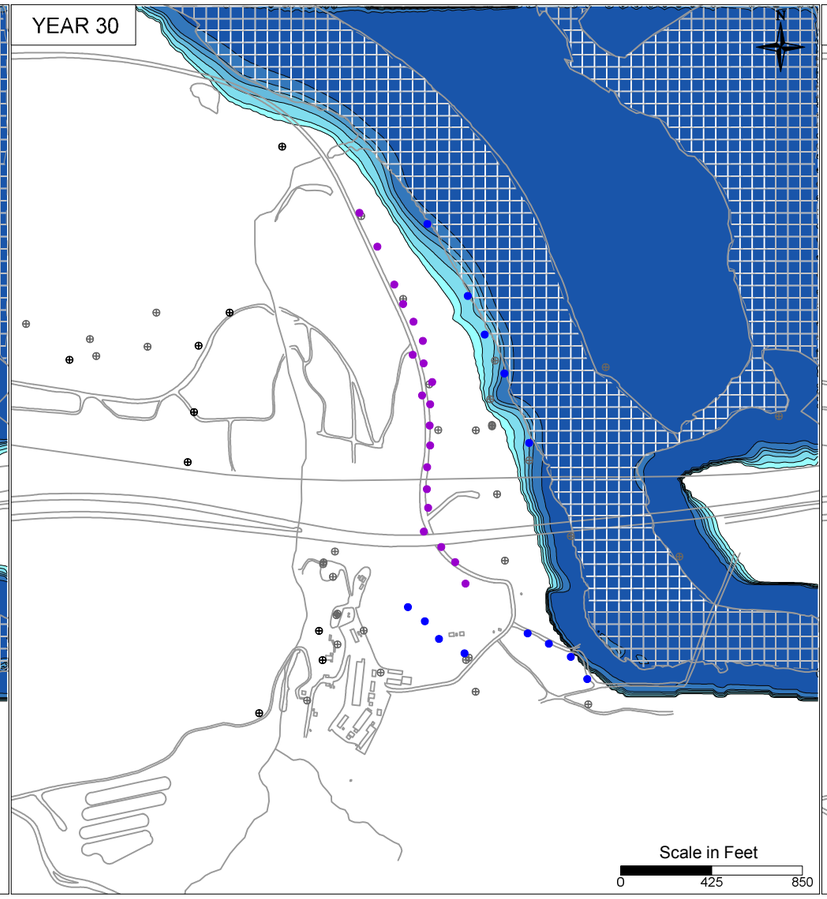
FRESHWATER SOURCE EVALUATION:
30 YEAR SIMULATED MANGANESE BYPRODUCT TRANSPORT RESULTS IN MODEL LAYER 3

ARCADIS

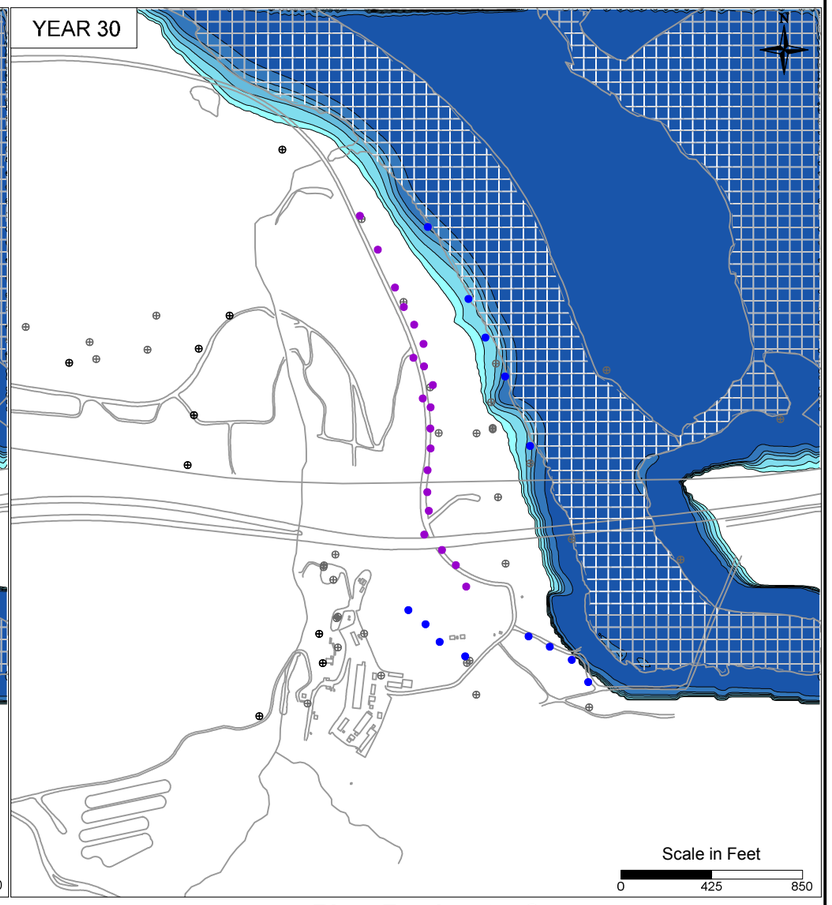
FIGURE
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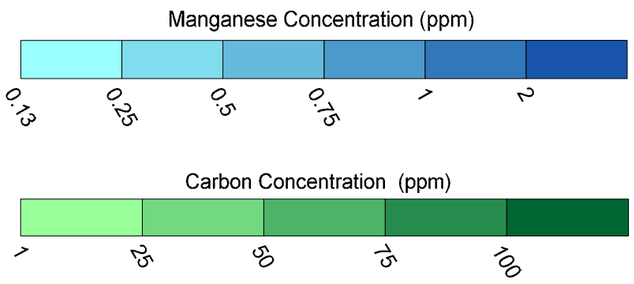
HNWR-1 Freshwater Source



Park Moabi Freshwater Source



River Freshwater Source



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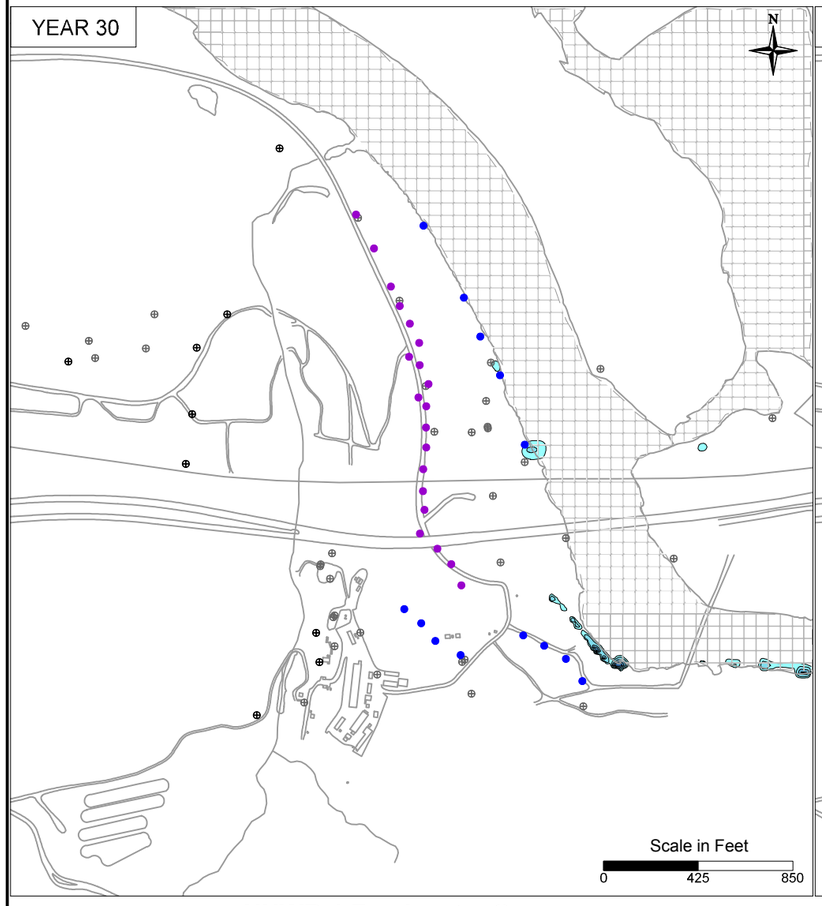
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- UPGRADIENT INJECTION WELLS
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PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
MODELING APPENDIX

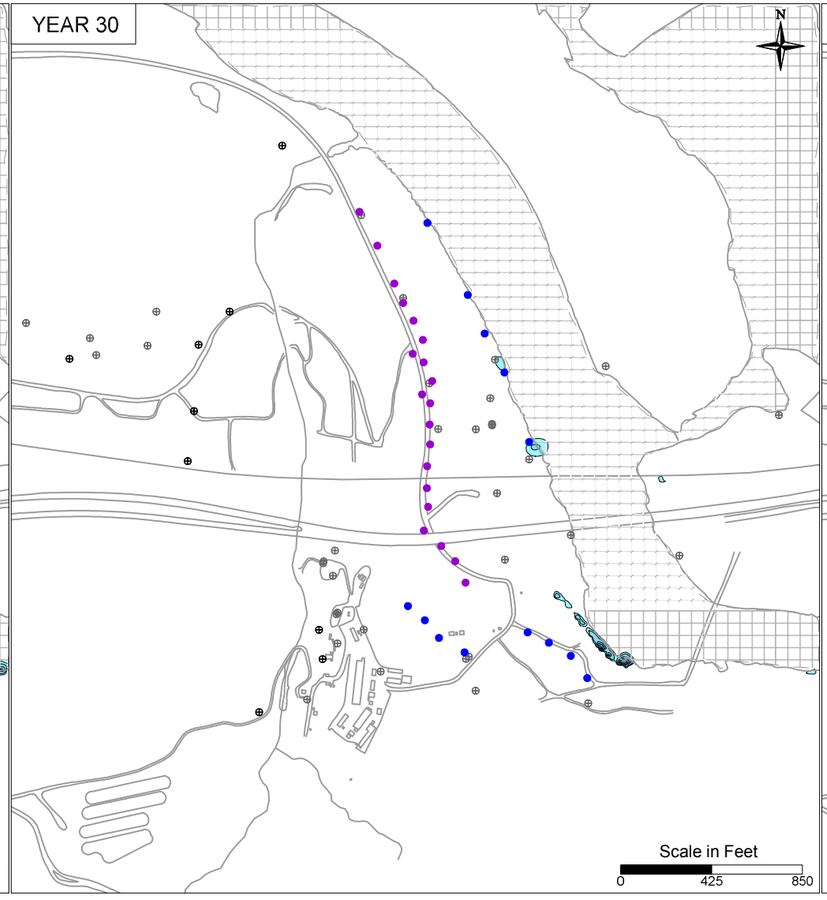
FRESHWATER SOURCE EVALUATION:
30 YEAR SIMULATED MANGANESE RIND
TRANSPORT RESULTS IN MODEL LAYER 1

ARCADIS

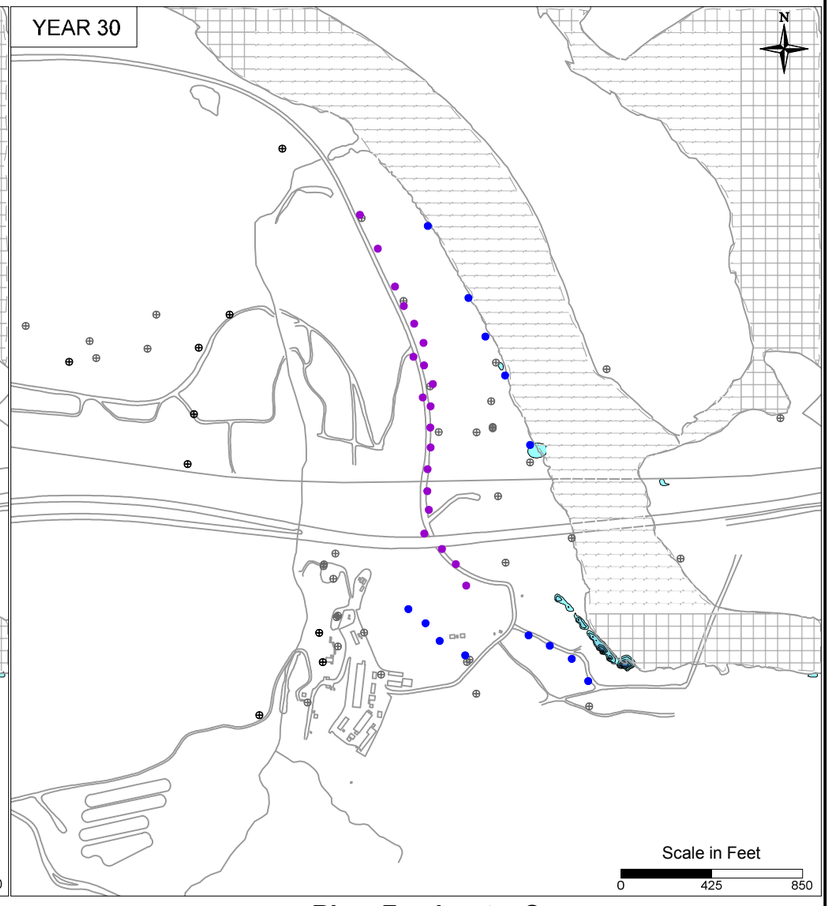
FIGURE
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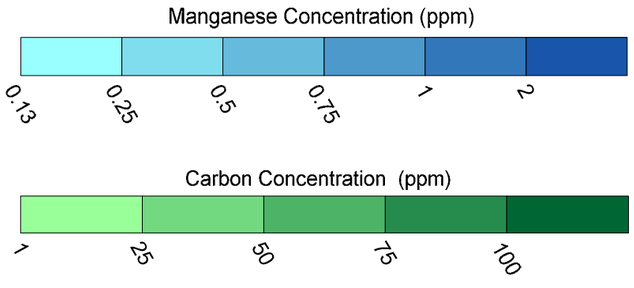
HNWR-1 Freshwater Source



Park Moabi Freshwater Source



River Freshwater Source



LEGEND

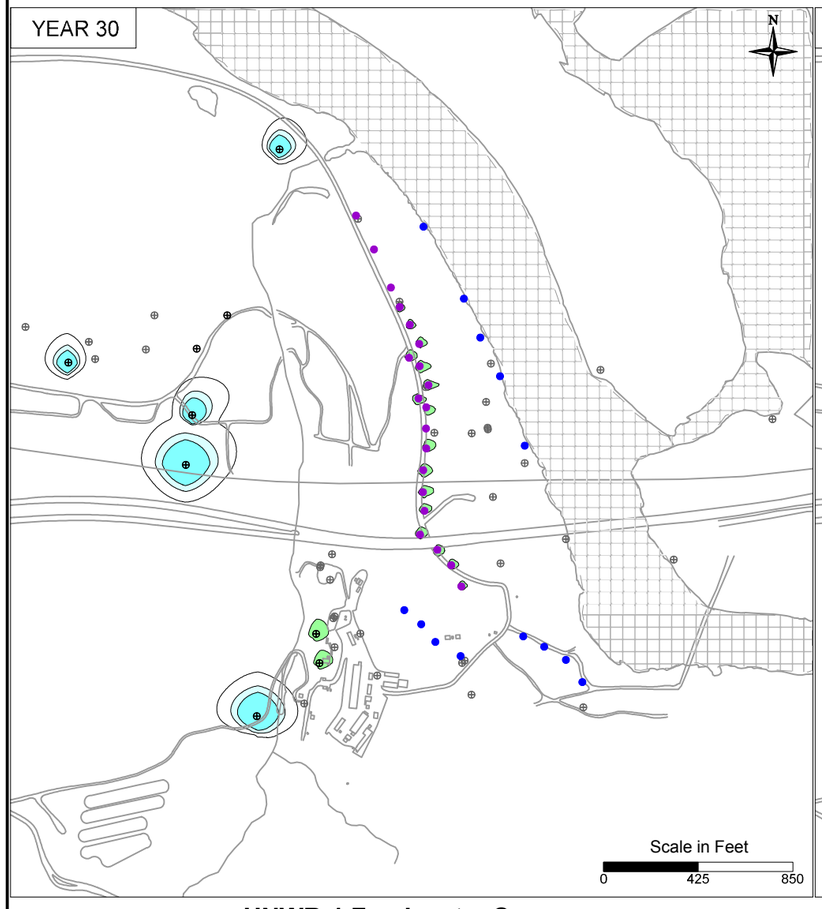
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PG&E
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NEEDLES, CALIFORNIA
MODELING APPENDIX

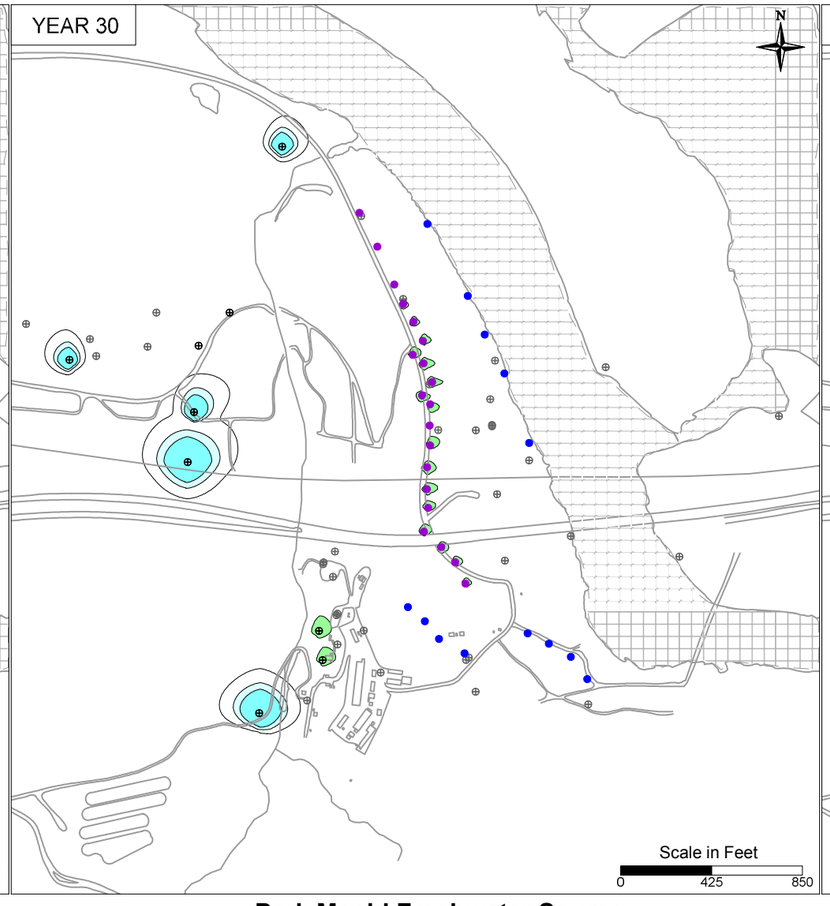
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30 YEAR SIMULATED MANGANESE RIND
TRANSPORT RESULTS IN MODEL LAYER 3

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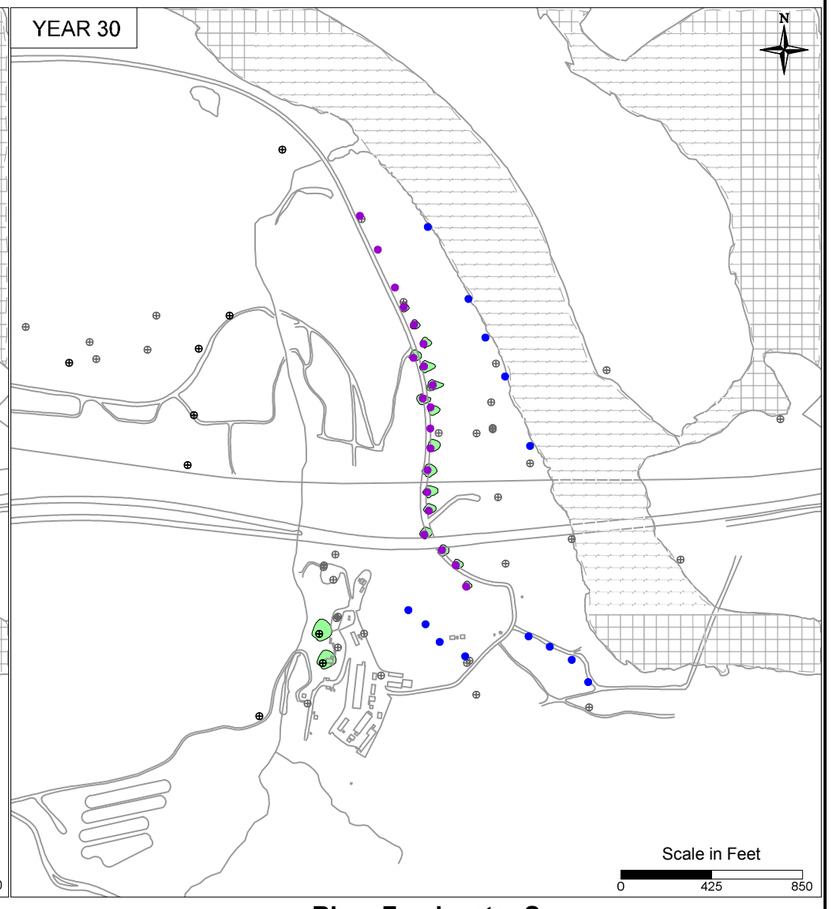
FIGURE
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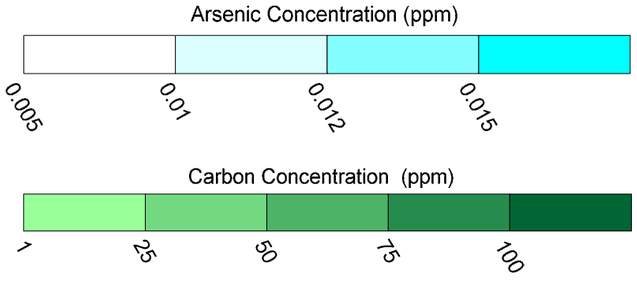
HNWR-1 Freshwater Source



Park Moabi Freshwater Source



River Freshwater Source



LEGEND

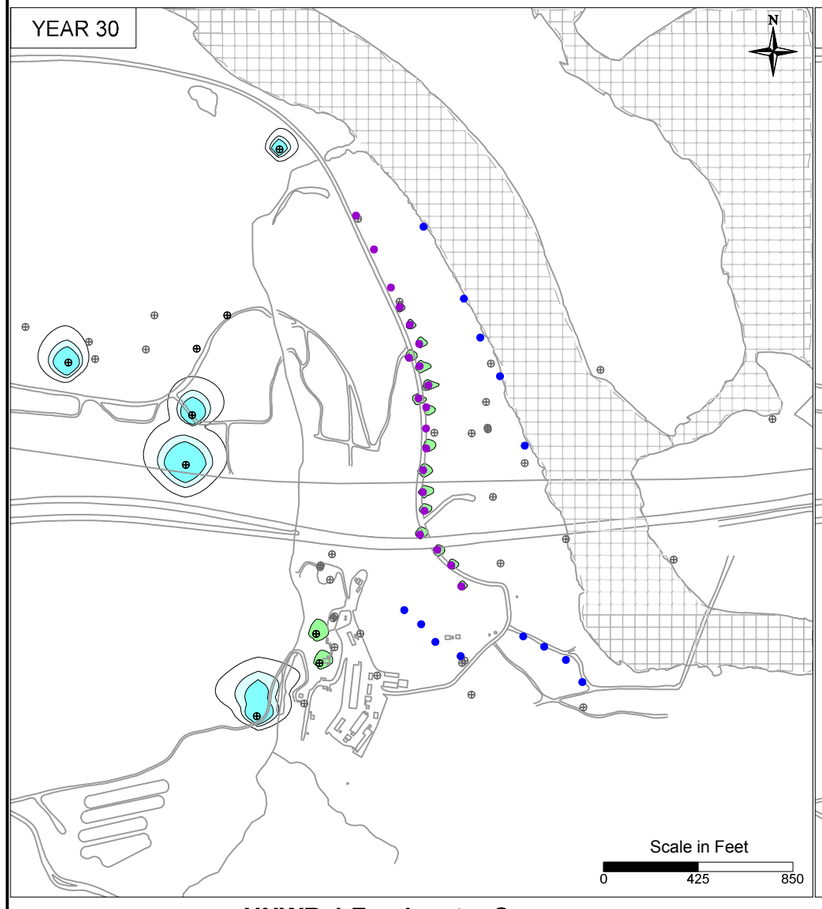
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- UPGRADIENT INJECTION WELLS
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PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
MODELING APPENDIX

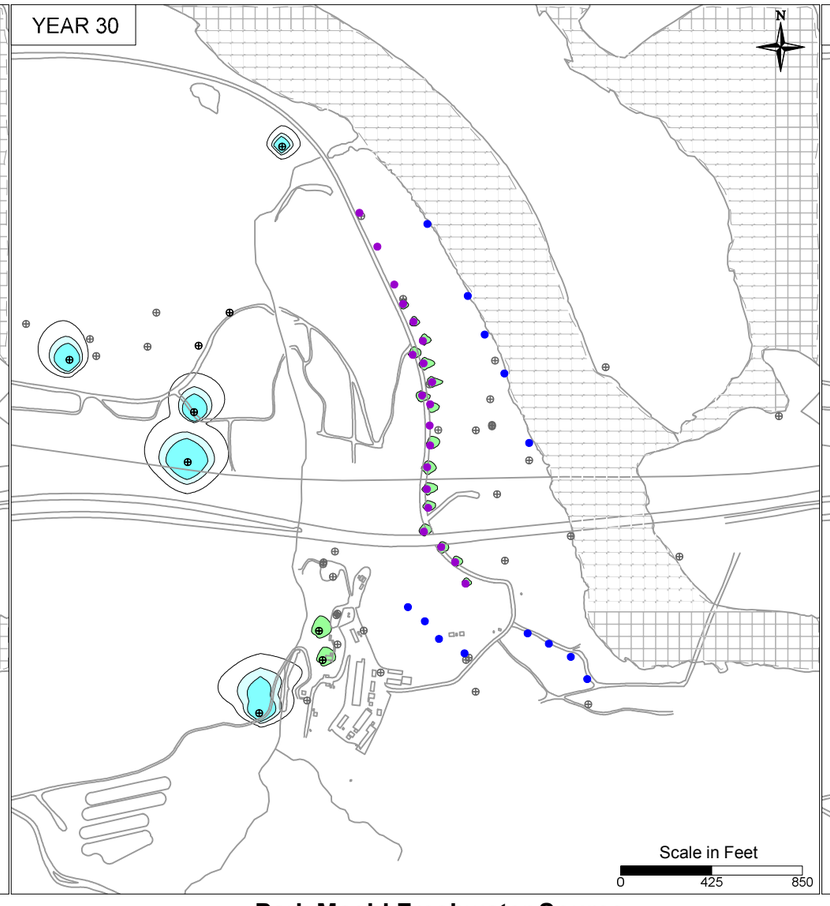
FRESHWATER SOURCE EVALUATION:
30 YEAR SIMULATED ARSENIC
TRANSPORT RESULTS IN MODEL LAYER 1

ARCADIS

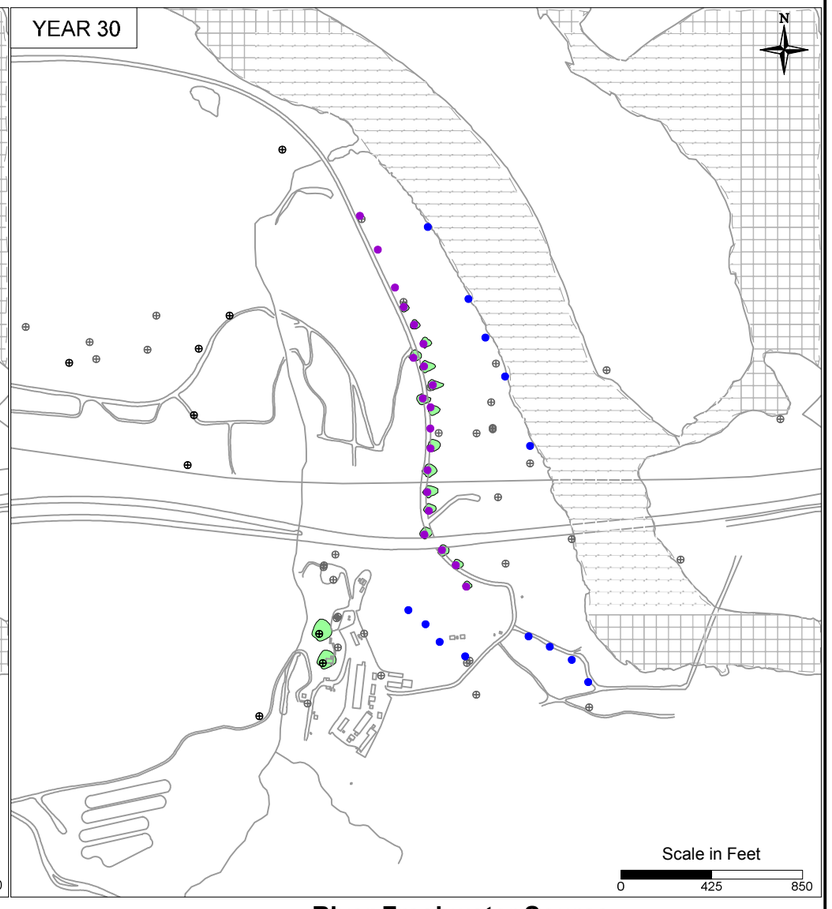
FIGURE
17



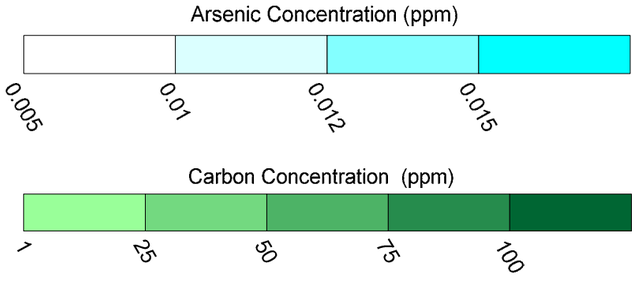
HNWR-1 Freshwater Source



Park Moabi Freshwater Source



River Freshwater Source



LEGEND

- IRZ WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- MONITORING WELLS

PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
MODELING APPENDIX

FRESHWATER SOURCE EVALUATION:
30 YEAR SIMULATED ARSENIC
TRANSPORT RESULTS IN MODEL LAYER 3

ARCADIS

FIGURE
18

Responses to Comments

U.S. Department of the Interior Review Comments on the Freshwater Source Evaluation Technical Memorandum

DOI Review Comments and PG&E Responses

Comment Number	Comment Location (Section/Page/ Paragraph/Sentence)	DOI Comment	PG&E Response
1	General	The Freshwater Source Evaluation Technical Memorandum (FWTM) is responsive to comments #142 DTSC-55 through #153 DTSC-66. It represents considerable additional technical evaluation of the three principal sources for freshwater, and provides a sound basis for PG&E's selection the HNRW-1 well as the source for freshwater for use in the groundwater remedy when considering water quality and quantity, implementability and sustainability, and the influence of freshwater pumping on remedy performance. Additionally, based on the technical review of the modeling, DOI supports the premise that the arsenic in the water from the HNWR-1 well will result in minimal contamination of the aquifer and that the aquifer will return to background concentrations post-remedy.	Comment noted.
2	Section 2.2.1, Page 3, Total Dissolved Solids - 2nd para.	Can PG&E provide the geochemical model simulation performed using the U.S. Geological Survey's (USGS's) PHAST code that shows that less than one percent of the available porosity was blocked by reprecipitation? Also, this information is provided in Section 3.3.1 and is not directly applicable to Section 2.2.1 where the purpose is to only discuss the significance of TDS on aquifer plugging, not the specific analysis for HNRW-1.	The PHAST simulations were performed on a simplified model grid using average site hydraulic parameters, ambient water quality in the vicinity of the proposed injection area, and HNWR-1 water quality for injected water. These simulations are attached to this RTC table.
3	Section 2.2.2, Page 4, Total Dissolved Solids, 1st para.	Within this paragraph, there is discussion about groundwater in the lower portion of the aquifer reaching TDS of 10,000 mg/L. It also discusses low TDS in the upper portion. If the injection wells (UPGRAD-INJ-1 thru 4) are to receive both fresh water injection and carbon-amended floodplain water for reinjection, is it true that these wells can then only be screened in layers 3 and 4?	The injection wells need to be screened in all layers in order to effectively flush the plume through the IRZ. Water from the floodplain is currently planned to be delivered only to IRL-1 and IRL-2 (formerly UPGRAD-INJ-1 and 2); however, the design of all the injection wells will include screen throughout the saturated thickness of the aquifer.
4	Section 2.2.2, Page 5, Constituents Introduced Above Site Background …, 1st para.	There are no examples of the constituents that do not attenuate after the end of remediation. Does this pertain to emerging contaminants as covered in the next section?	Correct, this pertains to the emerging contaminants covered in the tech memo.

DOI Review Comments and PG&E Responses

Comment Number	Comment Location (Section/Page/ Paragraph/Sentence)	DOI Comment	PG&E Response
5	Section 3.1.1	As stated in the Technical Memo, groundwater extracted from HNWR-1 could be recharged from a number of different sources including the Colorado River. There is the potential that dissolved organic carbon (DOC) could be drawn into the aquifer supplying groundwater to HNWR-1. One scenario is that reactive DOC in groundwater causes reductive dissolution of iron and manganese oxides on aquifer sediment, resulting in an increase in the concentrations of Fe(II) and Mn(II). As(V) associated with these oxides could be released to solution and possibly reduced to As(III). If such a scenario occurs, groundwater from HNWR-1 injected into the upland aquifer could have greater concentrations of Fe(II), Mn(II), and As(III) or As(V) than were modeled for the Technical Memo. In addition, any DOC that has not reacted with aquifer sediment could be introduced into the upland aquifer. Because of the oxidizing nature of the upland aquifer, reoxidation of Fe(II) and precipitation iron oxides should provide additional sorption sites for any potential increase in As concentrations. The potential consequences of increased DOC in groundwater in the vicinity of HNWR-1 need to be discussed.	Although river water has been being pulled into the floodplain since 2005 in response to IM-3 pumping, the effects postulated in this comment have not yet been observed. It is possible that this could occur at HNWR-1 due to the higher pumping rate and likely different hydrogeologic conditions on the Arizona side of the river. Iron and manganese cause plugging in injection wells, even in relatively small concentrations. Any significant concentrations of iron and manganese in water from HNWR-1 would likely result in increased maintenance to the injection wells. Dissolved organic carbon (DOC) could also contribute directly to well plugging if it is in a form that can be readily metabolized by microbes. Frequent automatic backwashing of injection wells (included in 60% design) may be effective in preventing well plugging. However, depending on the concentrations of DOC and its form, additional treatment would likely be necessary to remove DOC prior to injection.
6	Section 3.1.1, Page 7, 1st para.	The conclusion should also mention that injected water withdrawn from wells at Park Moabi will likely be drawn back to Park Moabi by the end of the active remedial action.	This discussion was included in the discussion of freshwater supply in Exhibit 3.3-1 (Evaluation Criteria #1) of the 60% design document.

DOI Review Comments and PG&E Responses

Comment Number	Comment Location (Section/Page/ Paragraph/Sentence)	DOI Comment	PG&E Response
7	Section 3.3.1, and Attachment C, Page 3	Phreeqc simulations of arsenic mobility in the upland aquifer were conducted by adding As(V), at concentrations measured in groundwater from HNWR-1, to groundwater of the composition measured in the upland aquifer. The rationale for ignoring HNWR-1 groundwater chemistry should be explained. For example, is the volume of groundwater from HNWR-1 injected into the upland aquifer small enough so as not to alter the chemistry of the upland groundwater? Are the chemistries of both groundwaters similar?	Comment noted. The groundwater chemistry within the freshwater injection zone was used in the PHREEQC model because it was assumed that this chemistry will be most important in determining the long-term stability of adsorbed arsenate. After injection, and after the freshwater flows away from the injection point, the arsenic concentration in solution will be governed by equilibrium between sorbed arsenate and the native groundwater. Further, the average alkalinity and pH, two of the most important controlling factors for arsenate adsorption, are not substantially different between HNWR-1 and background alluvial groundwater. Although the TDS of HNWR-1 water is lower than in the native groundwater, the TDS of the injected water may increase slightly due to ion exchange and mineral dissolution. In addition, the effects of TDS on arsenate adsorption can be subtle and tend to partially cancel out (e.g., whereas ions may compete for arsenic sorption sites, adsorbed positively-charged ions can enhance the attraction of arsenate). PHREEQC tests using HNWR-1 chemistry and native groundwater chemistry suggest that differences in sorption are minimal. Note that as directed by DTSC on December 31, 2012, PG&E included a pre-injection treatment system in this 60% design. The decision by the State Water Resources Control Board (SWRCB) is anticipated to guide further direction from DTSC regarding the ultimate use of the freshwater source and what level of treatment if any will be required for various constituents. As such guidance is still forthcoming, in this 60% design BOD PG&E has made the conservative assumption for freshwater pre-injection treatment goals, specifically that the arsenic treatment goal is to reduce concentrations to below the federal/state Maximum Contaminant Level (MCL) of 10 micrograms per liter (µg/L) and that the fluoride treatment goal is concentrations below the state MCL of 2 milligrams per liter (mg/L). Therefore, as the freshwater source will be treated for arsenic, the fate and transport of naturally occurring arsenic associated with freshwater injection is no longer applicable and has been removed from the 60% design.

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8	Section 3.3.1, Page 12, 2nd full para.	The Technical Memo states that amorphous iron oxide having sorption properties measured by Dzombak and Morel (1990) where used to define the concentration of sorption sites in the upland aquifer. Amorphous iron oxide is usually associated with iron oxides that have precipitated more recently. Over time, amorphous iron oxides tend to recrystallize forming iron oxide minerals such as goethite which can have different sorption characteristics than amorphous iron oxides. The evidence for using amorphous iron oxides as the adsorbent for arsenic needs to be discussed.	The concentration of sorption sites was estimated using measured amorphous iron oxide concentrations in aerobic core study samples (CH2M HILL 2005a, as referenced in this TM), along with published properties of adsorption sites per unit mass of amorphous iron oxides. The method of measurement referenced from the Aerobic Core Study was Dithionite-Citrate-Bicarbonate, which selectively measures amorphous iron (as opposed to crystalline forms such as goethite).
9	Section 3.3.1, Page 12, 2nd full para.	State the thermodynamic database used in the Phreeqc modeling (Wateq4f).	Wateq4f was not the database used in the PHREEQC modeling. The default PHREEQC thermodynamic database was used in geochemical calculations (Parkhurst and Appelo 1999 as cited in the TM), supplemented with parameters for arsenate adsorption on iron oxides obtained from Dzombak and Morel (1990). Note that as directed by DTSC on December 31, 2012, PG&E included a pre-injection treatment system in this 60% design. The decision by the SWRCB is anticipated to guide further direction from DTSC regarding the ultimate use of the fresh water source and what level of treatment if any will be required for various constituents. As such guidance is still forthcoming, in this 60% design BOD PG&E has made the conservative assumption for freshwater pre-injection treatment goals, specifically that the arsenic treatment goal is to reduce concentrations below the federal/state MCL of 10 µg/L and that the fluoride treatment goal is concentrations below the state MCL of 2 mg/L. Therefore, as the freshwater source will be treated for arsenic, the fate and transport of naturally occurring arsenic associated with freshwater injection is no longer applicable and has been removed from the 60% design.
10	Section 3.3.1, Page 12, last full para.	The oxidation state of arsenic used in the Phreeqc modeling needs to be stated. Under oxidizing conditions, arsenic +5 [As(V)] is stable; under reducing conditions, arsenic +3 [As(III)] is stable. Each oxidation state of arsenic has different sorption characteristics. A brief explanation of the HNWR-1 modeling results would be useful. For example, 'groundwater from HNWR-1 is oxidizing as indicated by the presence of dissolved oxygen. Phreeqc modeling of groundwater chemistry from HNWR-1 indicates that As(V) is the stable oxidation state of arsenic.'	The oxidation state of arsenic was not specified for the input to PHREEQC. The program uses the specified redox characteristics of the system to calculate the proportions of As(V) and As(III). In the environment surrounding the injection wells (and in HNWR-1), the As is predominantly As(V). The PHREEQC database contains separate adsorption criteria for each oxidation state of arsenic.

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11	Section 3.3.1, Page 12, last full para.	The explanation regarding the stability of dissolved arsenic is adequate but it is not apparent that a simple model of a complex hydrogeologic system could explain difference in arsenic concentrations that only range approximately a factor of 2 or 3 and are at very low levels. As stated in discussions, groundwater monitoring is needed to determine the fate of As in the uplands and to determine the appropriate corrective action as deemed necessary.	As directed by DTSC on December 31, 2012, PG&E included a pre-injection treatment system in this 60% design. A monitoring plan is also included in Volume 2 of the Draft O&M Manual. As previously mentioned, the decision by the SWRCB is anticipated to guide further direction from DTSC regarding the ultimate use of the fresh water source and what level of treatment if any will be required for various constituents. The freshwater source details will be included in an addendum to this 60% design, after such requirements are determined and completion of planned source water studies.
12	Section 3.3.1, Page 13, 2nd complete para.	Arsenic in well TLMP-2 is relatively low and it is in the geothermal groundwater. Simply based on the distribution of arsenic concentrations, it appears that something in the hydrogeologic environment from HNWR-1 to PGE-95 is causing arsenic concentrations to be higher than elsewhere on the Arizona or California side of the river. It may be related to geothermal water, but it seems apparent that some other factor(s) is causing the high arsenic concentrations.	Agreed. It is not clear exactly what factors contribute to the elevated arsenic concentrations in the area near HNWR-1 and PGE-9S.
13	Section 3.3.1, Page 14, 3rd complete para.	This new assessment of the limited amount of water sourced from the Sacramento Wash is a significant finding of this TM and implies likely changes to the TDS of the water being withdrawn overtime, particularly since there are shallow high TDS environments nearby (MW-54-85). A backup plan (as suggested) for additional wells to the north should be developed. One of the potential considerations regarding the long term pumping of the HNWR-1 well is that arsenic concentrations could be reduced over time as drawdown pulls from areas of less geothermal activity. If an addition pump test is planned, it is recommended that As be sampled both before and after pumping.	A contingency well site has been identified north of HNWR-1 and is shown and discussed in Section 3.3.2 of the 60% design. A long-term pump test is being planned for HNWR-1 (as part of the Alternative Freshwater Source Evaluation Implementation Plan, currently under review by DTSC and DOI) that will include sampling for As and other constituents prior to and throughout the pumping period to look for any trends in arsenic and other constituents.
14	Section 3.3.1, Page 17, 1st bullet	Manganese dioxide implies a greensand filter which is used to oxidize iron and arsenic causing precipitation and removal. However, iron and arsenic has been oxidized already. It appears it is being used for its adsorption capacity.	Manganese dioxide media has higher adsorptive capacity and is a very durable media.

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15	Section 3.3.1, Page 19	It is assumed that the treatment of all the HNWR-1 water was considered in the estimate of the facility size. If blending of HNWR-1 treated water and untreated water were considered, couldn't the facility size be reduced?	Correct, the size of the arsenic treatment system depicted in the Tech Memo was based on assumptions regarding influent arsenic concentration (15 µg/L), treatment process (capable of achieving 5 µg/L), and effluent arsenic concentration (5 µg/L to provide a factor of safety below the MCL). There would be no size reduction since blending water with 15 µg/L arsenic with treated water with 5 µg/L arsenic to achieve effluent of 5 µg/L arsenic, would require treatment of all water. A bench-scale test is currently being conducted to optimize system processes/design which might result in a smaller overall footprint. Results from the bench-scale were incorporated into the 60% design (see the Freshwater Pre-Injection Treatment System Design Basis Technical Memorandum included in Appendix M of this 60% BOD). Additional information from the ongoing testing will be included in the addendum of the 60% design.
16	Section 3.3.2, Pages 20-21	No data is included for arsenic for the California well(s). Data, if available, should be provided for the California well(s) for comparison.	Arsenic data for California wells PM-03 and PM-04 were included in Tables 3-4 and 3-5 of the Freshwater Source Evaluation Technical Memorandum, respectively.
17	Section 3.4.1, Page 27, Initial Design	Management of Quagga Muscles should be included as a consideration for river water intake structures.	Approaches to prevent quagga mussel attachment or growth fall into two categories, non-chemical and chemical control. Typically, several control approaches are implemented together as part of an overall control strategy based on a host of design criteria. Example control approaches are: • Removal/cleaning/replacement of screen • Physical removal • Filtration • Chemical treatment • Application of either an anti-fouling or biocide coating In summary, quagga mussel management will have additional impacts to the infrastructure required (e.g., footprint size, pre-treatment, and intake structure design) as well as O&M of the fish screen (e.g., recoating, chemical delivery and storage, and additional process piping and pumping). A more detailed analysis would be required to find the optimum control strategy.

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18	Exhibit 3-11, Contingency Matrix, Page 37, Item 4.	If arsenic is more mobile than expected in the upland aquifer, another possible contingency measure would be *in situ* treatment of arsenic. Iron could be added to the injected groundwater, thereby increasing the number of sorption sites in the aquifer. Fe(II) added to the aquifer would be oxidized by dissolved oxygen in groundwater resulting in precipitation of amorphous iron oxide. Fe(II) would likely disperse into the aquifer before oxidation and precipitation minimizing any change in permeability. Fe(III) could also be added; however, there is the potential problem of more rapid precipitation near the well screen causing decreased permeability.	As reported in the Freshwater Tech Memo, PG&E reviewed a pilot test of in-situ arsenic treatment involving ferric iron. The process required considerable above-ground treatment infrastructure and the wells in this pilot test plugged in a matter of hours. It is possible that an in-situ arsenic treatment scheme could be made to work, but it would likely require a pilot scale test to develop the technology prior to full scale application. As directed by DTSC on December 31, 2012, PG&E included a pre-injection treatment system in this 60% design. The decision by the SWRCB is anticipated to guide further direction from DTSC regarding the ultimate use of the fresh water source and what level of treatment if any will be required for various constituents. The freshwater source details will be included in an addendum to this 60% design, after such requirements are determined and completion of planned source water studies.

California Department of Toxic Substances Control Review Comments on the Freshwater Source Evaluation Technical Memorandum

DTSC Comments and PG&E Responses

Comment Number	Comment Location (Section/Paragraph/ Page)	DTSC Comment	PG&E Response
1	General Comment regarding arsenic in HNWR-1	Based on California State Water Resources Control Board's anti-degradation policy, discharge of arsenic from Arizona above the background for the receiving water body will require a Waste Discharge Requirement. Currently this issue is being discussed by the agencies and PG&E. DTSC understands that PG&E can consider in-situ or ex-situ arsenic pre-treatment prior to injection with technologies discussed in the Tech Memo. However, PG&E should recognize such action to be a disadvantage in the use of the HNWR-1. Currently, PG&E concludes that pre-treatment is not necessary; therefore, it is an advantage for the use of HNWR-1. Another disadvantage to the use of the HNWR-1 is that modeling indicates, at a minimum, an additional 12 years would be necessary for the injected arsenic concentration to significantly attenuate. This adds time to the remedy to be completed. Additional monitoring infrastructure would also be required and for a longer period of time to adequately monitor for arsenic. Finally, if arsenic does not behave as modeled, a potential exists for a separate action to cleanup arsenic around the injection areas. Impacts associated with importing arsenic bearing water from HNWR-1 have been modeled based on preliminary assumptions. It might become necessary to increase HNWR-1 injection rates into the upland areas to contain the plume. If so, would there be additional impact associated with the imported arsenic? Similarly, it may be necessary to install additional injections wells to ensure contaminated groundwater does not improperly migrate to the west or north. This would also result in a larger arsenic contaminant footprint. Finally, it may be advantages to increase flow HNWR-1 flow rates to increase cleanup time. While HNWR-1 contains arsenic above regulatory criteria, it will continuously burden remedy decisions now and in the future.	The well network being designed for monitoring water quality near the injection wells during the active phase of the remedy will be adequate for monitoring arsenic following cessation of injection. If the arsenic behaves as expected and does not migrate more than a few hundred feet from the injection wells during the active phase of the remedy, there is no reason to think it would migrate further after the injection stops. Therefore, the post injection monitoring would likely consist of sampling the inactive injection wells and possibly a few nearby monitor wells to confirm that arsenic is not moving and concentrations are declining. It will not require any additional infrastructure and will likely only require a minimal amount of monitoring. As directed by DTSC on December 31, 2012, PG&E included a pre-injection treatment system in this 60% design. The decision by the SWRCB is anticipated to guide further direction from DTSC regarding the ultimate use of the fresh water source and what level of treatment if any will be required for various constituents. The freshwater source details will be included in an addendum to this 60% design, after such requirements are determined and completion of planned source water studies.
2	2.1 Water Quantity, Page 2	The section states, "*If the aquifer is more transmissive than anticipated in these areas, additional fresh water would be needed to create the gradient necessary for remedy operation. On the other hand, if the aquifer is less transmissive than anticipated, less water would be needed."* The process for changing the injection rate should be include in the Operations and Maintenance Plan and must allow for communication with agencies and approval.	The injection wells will be tested after installation and if hydraulic properties are different than anticipated, additional model simulations will be conducted to evaluate the effect on the design. This process is described in Section 3.3.3.4 of the 60% BOD.

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Comment Number	Comment Location (Section/Paragraph/ Page)	DTSC Comment	PG&E Response
3	2.2.1 Prevention of Well and Aquifer Plugging, Total Dissolved Solids, Page 3	Aquifer plugging occurring at the IM-3 injection well(s) must be discussed as it is a site specific example of aquifer plugging that occurs within the exact area of the remedy. Such site specific knowledge cannot be overlooked. The mechanism(s) for clogging in IM-3 wells should be discussed and compared to model runs. Does the model perform adequately when compared to plugging/reduced well efficiency at IM-3 injection wells?	Reduced performance of IM-3 injection wells has been observed periodically over the last several years. The incrustation on the well screens has been identified as a thin layer of manganese oxide, and thermodynamic calculations using PHREEQC have identified manganese mineral phases that are at or above saturation in the injection water. The precipitation kinetics for these compounds are varied, making it difficult to precisely predict how quickly and how much manganese will precipitate, but observations indicate that production drops when manganese is above 10 µg/L in the injection water. A manganese impurity in the ferrous chloride used by the treatment plant is suspected to be the source of manganese causing the precipitation. Due to uncertainty in the kinetics of manganese precipitation and lack of sufficient data on the concentrations of manganese in the effluent during much of the IM-3 operational history, modeling of the IM-3 well plugging due to manganese would not provide any additional confidence in the geochemical model. The desired water quality goal for manganese included in the freshwater tech memo (<10 µg/L) is based on recent experience with well plugging during operation of the IM-3 wells. It has been observed that the IM-3 wells perform much better when Mn concentrations in the injected water are <10 µg/L. Thus, the site specific IM-3 experience has been incorporated into the Freshwater Tech Memo.
4	2.2.1 Prevention of Well and Aquifer Plugging, Dissolved Organic Carbon Solids, Page 3/4	PG&E states that "*the average dissolved organic carbon content in the Colorado River near* *Topock is 9 mg/L. While this is considered low for a surface water source, it is considerably higher than the groundwater sources being considered and might be enough carbon to contribute to injection well fouling*." Can river water be tested now to determine if treatment to prevent well fouling is needed? Does data already exist in MWD databases for a proper assessment?	There are no existing data to support an evaluation of the plugging potential the dissolved carbon in the river water. Laboratory microcosm tests could be conducted at any time to evaluate the bio-availability of the dissolved carbon in the river. A microcosm test would provide a basis from which to estimate plugging potential, but might not provide definitive results about the need for a treatment plant. A pilot test using an injection well at the Topock site would be the best means of evaluating plugging potential of organic carbon in river water.

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5	2.2.2 Protection of Aquifer Water Quality, Page 4	According to the RWQCB anti-degradation policy (State Water Resources Control Board Resolution No. 68-16), injection of arsenic above MCL outside of the current plume into a receiving body that has lower concentration would not meet ARAR for anti-degradation. Although PG&E is still evaluating this matter, a potential for schedule delay exists if a pre-treatment system would prove to be necessary. To avoid a potential significant schedule delay, it is recommended that PG&E include the location and design of this hypothetical arsenic pre-treatment system in the 60% Design as it may be required to comply with RWQCB requirements. The section states, "During the Topock Background Study, arsenic concentrations above the MCL were found in water supply wells in the vicinity of the Topock Marina, Arizona." Figure 3-6 of the Tech Memo includes an arsenic concentration map developed from the background study. It unfortunately indicates that the Arizona well is located in an area of some of the highest arsenic concentrations in the entire region.	As directed by DTSC on December 31, 2012, PG&E included a pre-injection treatment system in this 60% design. The decision by the SWRCB is anticipated to guide further direction from DTSC regarding the ultimate use of the fresh water source and what level of treatment if any will be required for various constituents. The freshwater source details will be included in an addendum to this 60% design, after such requirements are determined and completion of planned source water studies.

DTSC Comments and PG&E Responses

Comment Number	Comment Location (Section/Paragraph/ Page)	DTSC Comment	PG&E Response
6	2.2.2 Protection of Aquifer Water Quality, Constituents Introduced Above Site Background or Above Water Quality Standards that Do Not Attenuate After the End of Remediation, Page 5,	The section states, "*As discussed above, modeling indicates that arsenic concentrations that may temporarily be elevated by injection of HNWR-1 well water (with naturally occurring arsenic level of 15µg/L, which is below site background of 24.3µg/L but above the MCL of 10µg/L) will attenuate under site conditions and return to pre-remedy baseline levels after the end of remediation (see Figures 3-9 through 3-12). Monitoring will be performed during remedy implementation to verify the above modeling results, and appropriate adjustments will be made to remedy operations as needed.*" This paragraph does not portray arsenic issues in an appropriate light. Arsenic modeling results pictured in Figure 3-12 yields, upon close examination, that elevated arsenic concentrations, including values above the MCL, will still persist at least 12 years after the outboard injection of water ceases. Therefore, it must take even longer for arsenic levels to revert to pre-remedy, baseline conditions. See other arsenic comments regarding RWQCB's anti-degradation policy; long term arsenic persistence and, therefore, long term monitoring requirements. Furthermore, the 24.3 µg/L arsenic value cited in the paragraph is a regional value and not site specific. DTSC commented on this very issue during development of the background study report. PG&E needs to site language from the 2009 background study report acknowledging limitations with the regional values. The next paragraph states, "*It should be noted that naturally occurring chromium (VI) in the fresh water used for injection will be at concentrations at or below the site background of 32µg/L. Any residual Cr(VI) introduced with the fresh water is expected to be persistent in the aerobic portions of the aquifer, but would continue to be attenuated in the natural reducing conditions in fluvial sediments adjacent to and beneath the river after the remedial action is complete."* Again, PG&E should acknowledge that the 32µg/L chromium value is a regional value. Chromium concentrations in the freshwater injection areas decrease to non-detects with depth. Therefore, any chromium introduced into the lower portions of the aquifer is providing an additional flux of hexavalent chromium above baseline conditions. Again, PG&E needs to site language from the 2009 background study report acknowledging limitations with the regional values (i.e., depth).	As stated in the technical memorandum, monitoring for arsenic will be performed during remedy implementation to verify the fate and transport modeling results, and appropriate adjustments will be made to remedy operations as needed. The Topock groundwater background study commenced in 2004 with an approved work plan and ended in 2009. This step-wise (Steps 1 through 4), multi-year study was conducted with interaction and approvals from DTSC (early years), and DTSC/DOI (later years) at every step. In January 2008, at the direction of DTSC, PG&E presented discussions of the following three topics (see attached cover letter to the January 2008 revised background study report): • Future Uses of the Groundwater Background Study Results • Potential Limitations for Use of the Groundwater Background Study • Rationale for a Single (rather than Multiple) Background Concentrations for the Topock Groundwater Study In this 2008 letter, PG&E presented the basis for its belief that the groundwater background study is not overly conservative, and may actually underestimate the natural range in background values due to the number of upper end data points eliminated during Step 2 and Step 3. As required by DTSC in the November 30, 2007 letter, a total of 30 analyses were deleted from the background study data set (including arsenic data from three background study wells in Arizona). This deletion of 30 data points has resulted in changes in the UTLs for lead and arsenic. Furthermore, PG&E presented the case that having multiple (rather than a single) background concentrations at the Topock site would result in significant scientific uncertainty, is not practical from a regulatory standpoint, and would hinder rather than advance the progress toward selection and implementation of a final groundwater remedy.

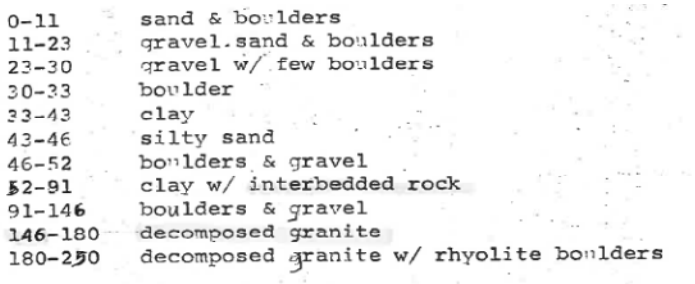
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7	2.2.2 Protection of Aquifer Water Quality, Emerging Contaminants, Page 5	The section states, "*Examples of this include the Tucson Airport Area Superfund site, where it was discovered in 2002 that 1,4-dioxane had been passing undetected through the air strippers since 1987 and was injected into a previously uncontaminated portion of the aquifer. A similar problem occurred at the Aerojet site in Rancho Cordova, CA, where perchlorate passed undetected through air strippers and was injected into a clean portion of an aquifer*." The examples cited are isolated incidences and are not the norm. It is unlikely that significant concentrations of emerging chemicals would be detected within the Topock site area due to the absence of known source areas upstream and dilution effects. Issues associated with emerging contaminants must be supported with site specific data. While emergent contaminants have been detected away from the Topock site, DTSC is unaware of any detections of perchlorate or 1,4-dioxane in any Topock site river or water well samples. PG&E tested for perchlorate as part of the interim measures activities to ensure that the contaminant would not be injected into the uplands area. DTSC assumes similar testing precautions would be taken for river water. River water could be periodically monitored for large suites of constituents. Discussion of hypothetical emergent contaminant scenarios in the future will need to be supported with site specific data or at least data in the vicinity of the site. Absent of site specific data, emergent contaminants do not appear to be a significant disadvantage to the use of river water. Please note that emerging contaminants are issues only if they exceed regulatory water quality standards. Regulatory criteria for emergent contaminants may take decades to develop and will allow for reasonable assessment and planning in the future. The section states, *"Some of these emerging contaminant compounds are not mobile in the subsurface and may never move far from the river."* If they are not mobile in the subsurface, it would seem they would also not travel much after injection.	Fortunately, examples of emerging contaminants being present in injection wells have been rare, but the consequences are severe, resulting in contamination of large areas of previously pristine groundwater. Thus, while the risk of injecting an unrecognized trace contaminant may be low, the consequences are high. The following quote is excerpted from the website of the Colorado River Regional Sewer Coalition (CRRSCo), a non-profit corporation of Arizona, California and Nevada river communities, local governments, Indian tribes, and regional water providers in the Lower Colorado River Basin. It highlights the several risks to water quality in the Colorado River, including risks from emerging contaminants: *"In April 2004, however, the environmental organization American Rivers and its partners designated the Colorado River as the nation's "most endangered river," citing mounting problems with radioactive, human and toxic waste that are contaminating groundwater levels to unsafe conditions. The situation has been compounded by rapid population growth, with the result being that areas already being served by outdated wastewater technology and septic tanks that can no longer function to treat wastewater without creating further contamination problems.* *Contamination increasingly threatens the livelihoods of those millions of Americans living in the Lower Basin states. It threatens their health. It threatens their lives. But people living in the Lower Basin are not alone in facing this water crisis. If the spread of contamination is not addressed sooner, rather than later, not only the quality of water in the Lower Basin but the quantity of water along the entire river will be in jeopardy.* *Three sources of pollution are at the heart of the contamination crisis confronting both the upper and lower basins: nitrates, uranium and chromium. In addition, there are a number of emerging pollution and biological issues further contributing to the problem, such as pesticide residues, pharmaceuticals, industrial contaminants and other endocrine disrupting compounds, salinity and quagga mussels."* DTSC is correct that regulatory standards for emerging contaminants may take decades to develop. That is precisely the concern that PG&E has. If presently unregulated contaminants are injected into the aquifer and regulations are later put in place, PG&E could be held responsible for cleanup of a newly regulated contaminant over an area much larger than the original chromium plume.

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8	3.1 Evaluation Criterion #1 -- Influence of Freshwater Pumping on Remedy Performance, Page 6	Model simulations are based on using a 600 gpm freshwater pumping rate. Would the simulations change if the pumping rate increases to the maximum of 1200 gpm as stated by PG&E? The 60% Design should also evaluate by modeling the potential issues associated with pumping at 1200 gpm as pumping may range up to this threshold.	The maximum freshwater pumping rate in the 60% design is 1,010 gpm (900 gpm for the groundwater remedy injections plus 110 gpm for TCS operations), which corresponds to injecting a maximum combined rate of 1,200 gpm into the Inner Recirculation Loop/Freshwater injection wells (900 gpm freshwater plus 300 gpm from the River Bank extraction wells). Additional model runs to examine this condition were not completed for the 60% design but are expected to show further nominal reductions in the remedial timeframe.
9	3.1.1 Conclusion, Page 7	The section states, *"Based on the solute transport model simulations, there are negligible differences between the three freshwater sources from a hydraulic perspective."* Would the conclusion be different if injection rate is ramped up to 1200 gpm?	See responses to DTSC Comment #9 as it relates to the maximum freshwater injection rate condition for the 60% design. No, within the area of concern the hydraulics are similar under elevated freshwater injection rates for the three potential freshwater sources.
10	3.2.1 Well or Wells in Arizona, Topock-2 and Topock-3 Wells, Page 7	Please provide any and all information regarding old wells Topock 1 and 2 in the 60% Design. PG&E must have information on these wells as they supplied the compressor station for years. Identify these wells on Figure 3-1 or equivalent. Indicate what maintenance/rehabbing was done to all Topock wells. The history of these older wells may help in understanding the potential future behavior of well HNWR-1. The geology/log of Topock 2 and 3 (1 & the "old" 2 also) is missing. Please provide and discuss. Topock 3 is stated to produce "poor quality water". Please elaborate on what poor quality water is. Include analytical data of poor water quality. Indicate current and historical pumping rates at all Topock wells.	PG&E purchased water from the owners of the Topock 2 and 3 wells but had no involvement in the operation of maintenance of the wells. PG&E therefore has no data on historical maintenance activities or pumping rates from these wells. The ADEQ Arizona Groundwater Study reports that the Topock 2 and 3 wells pump about 74 acre feet per year. Logs of Topock 2 and 3 are provided in Appendix B2 of the RFI/RI Volume 2 Report (CH2M HILL 2009a) but will also be included herein as requested, at the end of this RTC table. PG&E is not aware of any log for the original (old) Topock 2 well. This well was reportedly drilled in 1959 and abandoned in 1974. PG&E did locate some laboratory reports of samples from the Topock 3 well in 1978 and 1979. This is believed to be prior to the plugging of the bottom 100 feet of this well. These reports (attached at the end of this RTC table) show sodium and TDS at concentrations above recommended drinking water standards. PG&E also located some information on the former Topock 1 well, which is also attached. The data show that this well was about 34 feet deep but there is no well log. There are laboratory results of water samples from 1957, 1968, and 1980.

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11	3.2.1 Well or Wells in Arizona, Conclusion for Arizona Groundwater Option, Page 9	The section should discuss the geology and hydrology of the area – detailed preferably. Knowing the geologic units in the area might help to locate areas with higher yields. Ancestral Colorado River deposits might contain more sands and gravels. Please provide a basic hydrogeologic description of the area before making hydrogeologic conclusions. Place the requested information in the 60% Design.	Unfortunately, there is no good information on the geologic units in this area. The driller's logs from existing wells are sparse and inconsistent in their descriptions. The only existing well that is installed in the Sacramento wash bottom in the vicinity of the Project Area is the HNWR-1 well. The log for this well was provided on page 7 of the Freshwater Tech Memo. This clean sand and gravel material between 83' and 156.5' is likely the desired Holocene sand and gravel that is the target for the new production well. The next nearest wells are the Topock 2 and 3 wells. These wells are located outside the channel of Sacramento Wash, so they would not have penetrated the desired Holocene gravels. The driller's log of Topock 3, the more detailed of the two logs, is provided below:  0-11 sand & boulders 11-23 gravel.sand & boulders 23-30 gravel w/ few boulders 30-33 boulder 33-43 clay 43-46 silty sand 46-52 boulders & gravel 52-91 clay w/ interbedded rock 91-146 boulders & gravel 146-180 decomposed granite 180-250 decomposed granite w/ rhyolite boulders After completion, Topock 3 well produced poor quality water. It was cemented back to a depth of 150 feet and the water quality improved. The present Topock 3 well is screened from 85 to 130 feet. It is unlikely that any of the units encountered in Topock 3 correlate with those in HNWR-1. The next nearest wells are at the Kinder Morgan compressor station and at the ADOT yard, but these wells produce water from the older alluvial fan deposits and/or bedrock, so they are not considered relevant to the target geologic units for new production wells. The next nearest well that is located near the river and might considered relevant is the RPGS (aka GSRV-2) well, located about 1.6 miles north of HNWR-1. The driller's log of the RPGS Well contains very little detail. It notes sand down to 18 feet, clay from 18 to 25 feet, and a mixture of sand and gravel down to 245 feet. Large gravel was noted between 120 and 124 feet. No bedrock was encountered. The well is not located in the bottom of a large wash where Quaternary gravels would be expected to be found, so it is likely the gravel encountered in RPGS are older than we are targeting with the new wells. About one-half mile further north from RPGS is the Serrano Landscaping well. The drillers log for this well also contains very little

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Comment Number	Comment Location (Section/Paragraph/ Page)	DTSC Comment	PG&E Response
			detail. It indicates a mixture of sand, sand and gravel, and some gravelly sand to a depth of 260 feet. Boulders are noted in the uppermost 25 feet. In summary, the data from existing wells is not adequate to define any specific hydrogeologic in this area. It is encouraging that, with the exception of Topock 3, sediments encountered in all of the wells drilled along the river on the Arizona side were predominantly sand and gravel. In general, the sediments along the Arizona shore appear to be coarser grained than those typically encountered on the California side of the river.
12	3.3.1 Well or Wells in Arizona, Arsenic, Page 12	It is clear that arsenic in Arizona is elevated above the MCL of 10. Nevertheless, the receiving body of water in California is below the MCL and the proposed action will cross state jurisdiction. Currently, California Regional Water Quality Control Board is requiring PG&E to conduct additional study and possible WDR for the proposed injection.	Comment noted. As previously mentioned, the RWQCB, subject to its invitation for PG&E to seek review by the State Water Resources Control Board, indicated that the HNWR-1 water would likely need treatment to remove naturally occurring arsenic prior to injection. With the RWQCB's consent, PG&E has opened discussions with the SWRCB regarding the need to treat naturally occurring arsenic. As the SWRCB has not yet made a decision on this matter, PG&E continued to evaluate options for freshwater supply by seeking location(s) for new well(s) that could supply an adequate quantity of water of sufficient quality to not require treatment prior to use for remedy operation, and on November 20, 2012, submitted an Implementation Plan for Alternative Fresh Water Sources Evaluation (Implementation Plan) (CH2M HILL 2012g). Comments from Tribes, Agencies, and Stakeholders were received, and a Revised Implementation Plan was submitted on January 28, 2013 (CH2M HILL 2013a). The Revised Implementation Plan is currently under review by DTSC and DOI. As directed by DTSC on December 31, 2012, PG&E included a pre-injection treatment system in this 60% design. The decision by the SWRCB is anticipated to guide further direction from DTSC regarding the ultimate use of the fresh water source and what level of treatment if any will be required for various constituents. The freshwater source details will be included in an addendum to this 60% design, after such requirements are determined and completion of planned source water studies.

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13	3.3.1 Well or Wells in Arizona, Arsenic, Page 12	The section states, "*The most likely explanation is that iron oxide minerals, effective adsorbers of arsenic, are undoubtedly present in the aquifer matrix in Arizona, however, long-term exposure to the groundwater with naturally occurring arsenic has saturated all the adsorption sites on these minerals. There are a finite number of adsorption sites for matrix minerals, and if the groundwater has excess concentration of an adsorbing constituent (such as arsenic), then the matrix minerals and groundwater will form an equilibrium state, with the adsorption sites at capacity (Schindler 1991, Stumm 1992).*" If this is true, shouldn't PG&E conduct a bench test to determine the capacity of the adsorption sites to test this theory in California? If the continued loading of arsenic can potentially overwhelm the localized adsorption site causing equilibrium to be formed with arsenic, this can be a significant data gap. Wouldn't PG&E test this theory prior to actually injecting a known toxin into a beneficial aquifer? DTSC believes it to be PG&E's responsibility to ensure the protection of the State's water in every way possible.	The concentration of amorphous iron oxide that provides adsorption sites has been measured in core samples during the Aerobic Core testing study (CH2M HILL 2005a, see response to Comment 8 above). Amorphous iron oxides have been studied for their adsorption capacities and adsorption site densities (i.e. number of adsorption sites per unit mass of oxide) have been published and used in the current site model (Dzombak and Morel 1990). The combination of the measured site data and the published adsorption site densities provides a reasonable model of fate and transport of arsenic at the site. Additional sample collection and testing would add time and scope to the project. PG&E believes that groundwater monitoring would be a more effective evaluation of the modeled fate and transport. As directed by DTSC on December 31, 2012, PG&E included a pre-injection treatment system in this 60% design. The decision by the SWRCB is anticipated to guide further direction from DTSC regarding the ultimate use of the fresh water source and what level of treatment if any will be required for various constituents. The freshwater source details will be included in an addendum to this 60% design, after such requirements are determined and completion of planned source water studies.
14	3.3.1 Well or Wells in Arizona, Arsenic, Page 13	Although we do not anticipate a drastic change in geochemistry at the injection sites, what could cause desorption of the arsenic from the iron oxide in the aquifer? Would well rehabilitation measures adversely impact arsenic concentrations around injection sites?	Desorption of arsenic would require a drastic change in water chemistry surrounding the aquifer matrix. This would be in the form of a large concentration of an ion that is geochemically similar to the adsorbed arsenate, such as phosphate. Positively-charged metal ions would not have an effect, since arsenate is negatively charged, nor would anions with different properties such as sulfate and bicarbonate. Well rehabilitation rinses would only effect several feet around the well, and these fluids are not likely to contain ions that would cause significant desorption. Also, the rinses are pumped back out of the well, limiting if not eliminating their effect on the aquifer matrix near the well.

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15	3.3.1 Evaluation of water from areas with lower arsenic outside the influence of hydrothermal activities, Page 13	It is stated that "*If it becomes necessary to develop a water supply from a well in Arizona other than HNWR-1, it would likely be from a well outside the APE to the north. There are two wells north of HNWR-1 for which some information exists. Well GSRV-2 is located along Highway 95 just south of Warm Springs Wash, approximately 1.6 miles north of HNWR-1.*" Although the concentration of arsenic is below MCL at GSRV-2 area, the higher than established regional background concentration for hexavalent chromium is a concern. That Cr6 may confound the clean-up effort of the anthropogenic contamination of the same chemical. This is also not desirable for the Topock remediation.	The average Cr(VI) concentration in GSRV-2 during the background study was 25 µg/L, which is higher than in HNWR-1 but below the regional background of 32 µg/L. PG&E is proposing a contingency well much closer to HNWR-1 than to GSRV-2, where Cr(VI) is anticipated to be lower than GSRV-2 . In fact, the proposed contingency well location in this 60% design is in the vicinity of the proposed Site B in the Revised Implementation Plan for Alternative Fresh Water Sources Evaluation Tech Memo (CH2M HILL 2013a). If allowed to proceed with the Implementation Plan, water quality data will be collected at Site B.
16	3.3.1 Total Dissolved Solids (TDS), Page 14	This section discusses modeling to *"assess whether the volume of this mass would block a significant portion of the aquifer porosity. The simulation showed that less than one percent of the available porosity was blocked by re-precipitation."* However, the Tech Memo never evaluated the current IM-3 injection wells or discusses what the root causes were for the degradation of injection efficiencies at existing injection wells. Since IM-3 injection wells have been in operation for approximately six years, and well rehabilitations have taken place, the experience from those wells may be more beneficial than model simulations.	The desired concentration of manganese (<10 µg/L) specified in the tech memo is based directly on experience operating the IM-3 injection wells. When manganese concentrations are greater than 10 µg/L, plugging of the IM-3 injection wells occurs much more rapidly. Because manganese is the only constituent known to be associated with plugging at the IM-3 wells, there is no data from the IM-3 operations to evaluate plugging potential from iron or arsenic.

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Comment Number	Comment Location (Section/Paragraph/ Page)	DTSC Comment	PG&E Response
17	3.3.1 Total Dissolved Solids (TDS), Page 14	This section states "*There are no wells between HNWR-1 and the marsh, so the groundwater quality in this area is unknown. Similarly, it is not known how far below the bottom of HNWR-1 the high TDS water lies. It is therefore not possible to predict what changes might occur in water quality at HNWR-1 over time with any degree of certainty. It is likely that the TDS will increase as more river water is pulled in.*" PG&E regards potential water quality issues of the Colorado River, including emerging chemicals, as a major disadvantage of using that water. Contrarily, PG&E anticipates the water quality of HNWR-1 to decrease over time, but PG&E has not identified any potential testing or further evaluation of the water in that area for sustainability. Shouldn't PG&E evaluate or test the current water quality at the marsh as an indicator of possible outcome prior to selection of HNWR-1 as the preferred option? DTSC expects this level of evaluation to support the design.	The water in the marsh comes from the river and there are no sources of emerging contaminants or other pollutants in the Topock Marsh. The primary factor that would cause a difference in water quality between the marsh and the river is evaporative concentration of minerals in the marsh. In his Ph.D. dissertation, Bradley Guay estimates about 46% of the water entering the marsh is lost to evaporation. The data show a 5- to 6-fold increase in specific conductance between the marsh inlet and the downstream sampling point which was somewhere above the south dike. HNWR-1 is located in a portion of the marsh below the south dike. There is an exchange of water in this section of the marsh as the river level fluctuates. The TDS is likely somewhat lower in this part of the marsh due to dilution with river water. There are likely seasonal changes in water quality associated with differences in evaporation rate and river levels. Establishing baseline water quality in the marsh near HNWR-1 would likely require multiple sampling events at different times of the day and different seasons. However, even if the water quality in the marsh is known, there is no way to accurately predict how this would affect the water quality in HNWR-1 because one does not know how much river water will be drawn in and what the character of that water will be after it passes through the reducing rind and reaches HNWR-1. There are adequate data available from the MWD database to assess the quality of water in the river. There is no reason to suspect any exotic contaminants would be introduced as water flows through the marsh. It can therefore be assumed that the concentrations of whatever is in the river would be increased by about a factor of 5 or 6 in the marsh. Not all the constituents present in river water would be mobile in groundwater. For those constituents that are mobile, there would be considerable attenuation through dilution and dispersion prior to reaching HNWR-1. Therefore, obtaining water from HNWR-1 provides a significant buffer against inadvertent injection of anything harmful that might be present in river water. Unfortunately, without detailed hydrogeologic studies involving installation of multiple monitor wells and long term pumping tests at HNWR-1, it is not possible to predict how the water quality in the marsh may affect the water quality in HNWR-1 over the decades long operational period of the remedial action.

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18	3.3.1 Conclusion for Arizona Groundwater Option, Page 15	PG&E concluded that treatment of arsenic is not needed. However, as stated in prior comments, this conclusion may not be supported by California agencies and may not meet ARAR for the California Water Resources Control Board's resolution 68-16. PG&E is currently evaluating this issue.	Comment noted.
19	3.3.1 Blending with water sources with lower arsenic, Page 16	PG&E has neglected, in this tech memo, to evaluate the possibility of blending water from Park Moabi area with existing Topock 2 and 3 water. PG&E is currently acquiring water from Topock 2 and 3 for compressor station use, therefore no additional infrastructure is needed. Importing additional water from Topock 2 and 3 seems possible based on combined yield. By installing only well(s) from Park Moabi for blending, the additional infrastructure would be minimal while possibly meeting the water quality and quantities needed for the remedy.	As described in the Freshwater Source Evaluation tech memo, a careful review of the available data indicates that a well producing from the high quality water zone at Park Moabi would produce less than 100 gpm and the pumping would likely produce adverse impacts on existing Park Moabi wells. The Topock 2 well could likely produce about 400 gpm, but there is a risk of upconing of more saline water from depth. In addition, the arsenic concentration of Topock 2 is similar to that of HNWR-1 (about 15 µg/L). In order to have arsenic below the MCL of 10 µg/L, assuming that the new Park Moabi well contained no arsenic, it would be necessary to blend water at a ratio of approximately 1/3 from Park Moabi and 2/3 from Topock 2. With the maximum modeled fresh water flow rate of 900 gpm, the new well at Park Moabi would need to produce about 300 gpm. If it contained any arsenic, the amount of water needed from Park Moabi would be even greater. Based on the available data, PG&E does not believe that a well at Park Moabi would provide a sufficient volume of water to blend with Topock 2/3 water and result in an arsenic concentration below the MCL. The existing pipeline from Topock 2/3 would also need to be replaced or a second pipeline installed in order to accommodate the balance of the maximum modeled flow rate. In addition, another well in Arizona would need to be installed to ensure adequate quantity from Arizona, and this well would need to somewhere far enough from Topock 2/3 to avoid interference. Therefore, the amount of infrastructure needed to blend water from two sources could be greater than for the HNWR-1 well alone because it would require new piping to be installed from both Park Moabi and from Arizona and a new well in Arizona. In PG&E's opinion, the concept of blending water from Park Moabi and Topock 2/3 does not appear to offer any advantages over obtaining water from HNWR-1.

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20	3.3.3 Colorado River, Total Dissolved Solids, Page 22	The average TDS of the river is stated, but the source of the data set in not identified. DTSC assumes that the TDS exhibited by the river, while ranging, would exhibit consistent values over the years that it has been monitored, and, therefore, would be consistent over the life of the remedy. This would be in contrast to HNWR-1 where the TDS values from the well as it is pumped continuously over the life of the remedy could change significantly. Projecting TDS variability during the life of the remedy for both the river and HNWR-1 should be evaluated and addressed in the 60% Design. This is important as low TDS is a major desirable quality of the HNWR-1 source.	The TDS data are from the PG&E river monitoring program. As noted previously, there are no data to support a projection of the possible trends in water quality in HNWR-1 over the life of the remedy. Neither are there data to support a projection of TDS in the river. This is stated in Section 3.3.2 of the 60% design.
21	3.3.3 Colorado River, Coliform Bacteria, Page 22 & 23	The section cites coliform bacteria levels measured from Lake Havasu located at least 15 miles downstream of Topock and Whitsett Intake located at least 35 miles downstream. Citing data so far away and near a major city seems inappropriate for this evaluation and casts doubt on the utility of the data and statements in the section. Is this an issue at the Topock area?	There are no data on coliform bacteria in the river at Topock, however it should be noted that Topock is downstream from Needles and Laughlin so there is the potential for bacterial contamination to be present at Topock due to discharges from septic systems or sewage treatment plants.
22	3.3.3 Colorado River, Perchlorate and Nitrate, Page 23	The section states that perchlorate was not analyzed in samples collected near the Topock site. This is an incorrect statement. PG&E should review its data set and note the couple of perchlorate nondetects from locations CON and I-3 in 2003. Mention of the perchlorate analyses in groundwater (all nondetects), especially in wells located adjacent to the river, should also be mentioned.	DTSC is correct. There are two perchlorate sample results in the PG&E river monitoring database, both non-detect with a detection limit of 4 ppb. Prior to the IM-3 pumping there was a net discharge of groundwater in the floodplain to the river. Therefore, perchlorate might not be detected in wells near the river even if it were present in the river.
23	3.3.3 Colorado River, Contaminants with Secondary MCLs, Page 23	The section notes a maximum elevated aluminum concentration of 540 µg/L in river water. As this value appears anomalous compared to the other data, PG&E should evaluate why it might be elevated. Are the data presented in Tables 3-7 and 3-8 samples that were filtered or unfiltered or a mixture of both?	According to MWD, the only filtered water is the water for Cr(VI) analysis.
24	3.3.3 Coliform Bacteria, Page 23	What are the physical methods that can be used to remove biological growth from well screens? If disinfection is required, will the disinfectant process also adversely impact microbes necessarily to establish the reduction zone?	Biological fouling doesn't generally respond well to strictly physical methods of removal. In IRZ wells, citric acid is sometimes used to help break down slime forming microbial growth prior to surging and bailing or pumping. Disinfectants are not typically used in IRZ well rehab because of the potential for damage to the microbial community needed to maintain reducing conditions. Disinfectants could be used in freshwater injection wells where there is no need to maintain a microbial community.

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25	3.3.3 Compounds Associated with Pharmaceuticals and Personal Care Products, Page 23	PG&E concludes that "*As areas become more or less populated over the next few decades, it is expected that the presence of PPCP compounds in river water to vary accordingly. In addition, as new and more advanced/exotic personal care products and pharmaceuticals are brought to the market as society advances over the next few decades, it is likely that new trace contaminants could be found in river water.*" While this may be true, this same argument can be applied to additional population that could impact the quality of water from the Sacramento wash on which the HNWR-1 depends.	The potential for significant population increases in existing communities along the Colorado River seems much greater than for sparsely inhabited and somewhat austere Sacramento Valley.
26	3.3.3 Colorado River, Compounds Associated with Pharmaceuticals and Personal Care Products (PPCP)/Emerging Contaminants, Page 23 & 24	PG&E's concerns with PPCP and emerging contaminants appears speculative at this point as a data gap exists regarding river water quality in the immediate vicinity of the site. The site is located away from more populated areas where these contaminants are stated to be more of a concern. There may simply be no problem with the river water in the Topock area. Data should be collected at the site to determine if there is any concern. Continued monitoring during the remedy would ensure that river water quality was always acceptable. The section states, "*Some of these emerging contaminant compounds are not mobile in the subsurface and may never move far from the river. If fresh water were obtained from a well rather than from the river, this travel time from the river to a well provides a buffer that might allow for mitigation measures to be implemented prior to injecting an emerging contaminant and having it spread across the site.*" This is not a concern as monitoring would always be conducted to provide a warning system against undesirable constituents. Non-mobile constituents would also not move far in groundwater away from an injection well.	See response to DTSC comment 7. Concentrations in the river could change rapidly due to upsets in sewage treatment plants or rainfall events. Monitoring for compounds for which there are currently no standards would not prevent injecting them at concentrations above a future standard. The safest course is to not inject raw river water, but rather seek a groundwater supply which is buffered from the potential short term fluctuations in concentrations in the river and not likely to become contaminated with river water for many years.
27	3.3.3 Potential Need for Conditioning of River Water Prior to Injection, Page 24	PG&E states that it plans to screen extraction wells in the lower, oxic portion of the aquifer. Please note, however, that many stakeholders are expecting these extractors to be a stop gap for any contaminants which may flow into the river. The current design will not meet that expectation and PG&E must consider a separate contingency plan for capturing contaminants that may move toward the river.	The 60% design document discusses possible contingency measures for the river bank wells. If it becomes necessary to pump from the reduce zone in the shallow aquifer, treatment will likely be required to remove iron and manganese prior to injection.

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Comment Number	Comment Location (Section/Paragraph/ Page)	DTSC Comment	PG&E Response
28	3.3.3 Colorado River, Potential Need for Conditioning of River Water Prior to Injection, Page 24	• The section states that solids and bacteria/microorganisms will need to be removed prior to injection. The level at which conditioning is required should be stated. What concentrations of solids and bacteria/microorganisms are considered undesirable and would require conditioning? • Shallow infiltration galley: It is uncertain what different type of intake structures can be designed. The Tech Memo/30% should have discussed the range of alternatives. Can an intake screen be placed on the bottom of the river and then covered with permeable materials and armor to allow freshwater infiltration? • The section discusses PGE-8 and PGE-9 without discussing where these wells are located. DTSC believes they are misnamed and referring to wells PGE-9N and PGE-9S located on the Arizona shore under the arch bridge.	• Ideally, suspended solids and bacteria should be less than 2 mg/L. Less is better as any amount contributes to plugging and over the 50 year life of the remedy, even a small amount could significantly reduce the live of the injection wells. • Park Moabi attempted a shallow infiltration gallery and it produced very poor quality water. The pore water samples showed reduced conditions in all but one of 64 locations at shallow depths (~6feet) below the river bottom. If an intake were installed in the geochemically reduced bottom sediments, a treatment plant would likely be needed, at least initially, to remove iron and manganese prior to injection. • DTSC is correct, the memo should refer to PG&E 9N and 9S.
29	3.3.3 Potential Need for Conditioning of River Water Prior to Injection, Page 26	PG&E estimated the conditioning facility to be 5,400 square feet. It is unclear how this estimate was developed. With the exception of the disinfection tank, the treatment system process appears very similar to the pre-treatment system for arsenic. What is changed so that the treatment system would be more than doubling the size?	The disinfection function and the phase separators (similar to IM-3) were the primary differences between the River Water Conditioning Facility and the arsenic treatment system. In addition, Additional space was allocated to incorporate elements such as electrical transformers, and other items needed to integrate this facility with the Remedy and TCS operations.
30	3.4.1 Initial Design, Page 28	DTSC understands that there are numerous intake and fish screen designs, why did PG&E selected the round pipe with circular continuously cleaning design as the preliminary choice? Non-continuously cleaning or flat screens?	The round, continuously cleaning (ISI) screen is a proven design in small-flow, river applications similar to Topock. The screen can be removed from the water for easy inspection and maintenance.
31	3.4.1 Initial Design, Page 29	PG&E states "*Preliminary discussion with CDFG indicated that approval of a fish screen and intake structure that would avoid incidental take of the razorback sucker may be difficult to obtain.*" Perhaps this is a good discussion to invite Fish and Game for CWG meeting to provide understanding and hurdles involved.	Comment noted.
32	3.4.1 Initial Design, Page 29	When will the fish habitat assessment report be available? Since that would dictate, in part, the viability of an intake structure.	The Instream Habitat Typing Survey Technical Memorandum was submitted to DTSC on May 25, 2012, and is included in Appendix A6 of this 60% BOD.
33	3.4.1 Initial Design, Page 29	Where are the representative visuals for Sites 1 and 2? Are they similar to Site 3? There is limited explanation for the photo provided.	The visuals for Sites 1 and 2 are included in the *Instream Habitat Typing Survey Technical Memorandum* (CH2M HILL 2012f). This memorandum was submitted to DTSC on May 25, 2012, and is included in Appendix A6 of this 60% BOD.

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Comment Number	Comment Location (Section/Paragraph/ Page)	DTSC Comment	PG&E Response
34	3.4.1 Initial Design, Page 30	PG&E states that "Based on the preliminary engineering evaluation and fish habitat survey, Site 4 appears to be the most feasible location for a river intake structure and fish screen…" However, there is no supporting discussion on the criteria used for this determination or the rationale for this statement. More importantly, Site 4 is also the closest location to the visible manifestation of the maze. This area also has more recreational users and boaters traveling through the area. A more thorough evaluation and discussion should have been prepared.	Section 3.4.1 (Initial Design) of the Freshwater Source Evaluation Tech Memo is intended to present a summary of the preliminary engineering survey and initial design. Attachment B of the Tech Memo includes additional details and evaluation including a comparison table of the sites evaluated against the evaluation criteria that support the conclusion.
35	4.0 Selection of Preferred Freshwater Source, Page 39	PG&E concludes that the HNWR-1 well in Arizona is the preferred freshwater supply option for the remedial action because it *"…presents less uncertainty, less risk to project schedule, and less disturbance of the site."* PG&E may be correct in selecting HNWR-1 as the preferred option; however, based on the comments above, DTSC believes that there are still significant uncertainties associated with its use. Specifically, the arsenic above MCL and above the concentration of the receiving water body may be problematic. If pretreatment of the arsenic is necessary prior to injection, site disturbance would be significant as a water treatment plant and significant length of pipeline would be needed for this option. Furthermore, PG&E has not evaluated the long term water quality at HNWR-1. What would be PG&E's response if TDS increases sharply from sustained extraction?	Exhibit 3-11 of Freshwater Source Evaluation Tech Memo presents a contingency matrix for some of the more serious types of problems that might be associated with the freshwater sources or with the injection of fresh water at the Topock site. One of the contingencies described in the matrix is pumping that draws in saline water from below or geochemically reduced water from the river or the marsh. The possible contingency measures listed for this contingency include install treatment to remove harmful constituents or seek other source(s) of fresh water or other location for well(s). As directed by DTSC on December 31, 2012, PG&E included a pre-injection treatment system in this 60% design. The decision by the SWRCB is anticipated to guide further direction from DTSC regarding the ultimate use of the freshwater source and what level of treatment if any will be required for various constituents. The freshwater source details will be included in an addendum to this 60% design, after such requirements are determined and completion of planned source water studies.

Attachment 1
PHAST Simulations

(*On CD-ROM only*)

```
DATABASE C:\Program Files\USGS\phast-1.5.1\database\phreeqd.dat
TITLE       Simulated Injection of HNWR-1 water into upland alluvial aquifer at
Topock
SOLUTION 1  CW-03D  09/16/05 representative of upland alluvial aquifer deep zone
Temp    31.6
pH      7.72
pe      8   Manganite  0.0
redox   pe
units   mg/l
density 1
Na      3030
K       39.8
Ca      422
Mg      29.2
Cl      4930
Mn      0.259
S(+6)   672     as SO4
Alkalinity      33.1
N       0.304   as N
F       1.4
Si      23.5    as SiO2
EQUILIBRIUM_PHASES 1
   Calcite  0.0 10.0
   Gypsum  0.0  0.0
   Manganite 0.0 1.0
END
SOLUTION 2  HNWR-1 (CH2M)  11/11/10
Temp    35.9
pH      7.84
pe      10
redox   O(0)/O(-2)
units   mg/l
density 1
Na      130
K       5.1
Ca      23
Mg      4
Cl      150
S(+6)   47      as SO4
Alkalinity      100
N(+5)   2.5     as N
F       3.8
Si      28.6    as SiO2
O(0)    8.0
END
SELECTED_OUTPUT
        -file ex1.dummy.sel
        -reset false
#        -ph
#        -saturation_indices  anglesite otavite smithsonite
#        -molalities CdX2 PbX2 ZnX2
#        -molalities
USER_PUNCH
# Prints concentrations in ug/kgw to Injection(n).xyz.chem
-heading    pH  Calcite Manganite Ca+2 HCO3- Mn+2 SI_Calcite SI_Manganite SI_Gypsum
10 PUNCH LA("H+")*-1
20 PUNCH EQUI("Calcite")
30 PUNCH EQUI("Manganite")
40 PUNCH ACT("Ca+2")
50 PUNCH ACT("HCO3-")
60 PUNCH ACT("Mn+2")
70 PUNCH SI("Calcite")
80 PUNCH SI("Manganite")
```

```
90 PUNCH SI("Gypsum")
END
```

```
TITLE
        Simulated Injection of HNWR-1 into deep alluvial aquifer for Topock
UNITS
        -time                   day
        -horizontal_grid        ft
        -vertical_grid          ft
        -head                   ft
        -hydraulic_conductivity ft/day
        -specific_storage       1/ft
        -dispersivity           m
        -flux                   ft/day
        -well_diameter          in
        -well_flow_rate         ft3/day

STEADY_FLOW false
        -minimum_time_step      0.03  d
        -maximum_time_step      30000  d
        -head_change_target     25.

FREE_SURFACE_BC false

SOLUTE_TRANSPORT true

SOLUTION_METHOD
        -direct_solver          true
        -space_differencing     0.5
        -time_differencing      0.5

GRID
        -uniform        X     0.  2000000.   11
        -uniform        Y     0.  2000000.   11
        -uniform        Z     0.   100.   2
        -overlay_uniform  X   998000.   1002000.  41
        -overlay_uniform  Y   998000.   1002000.  41
        -chemistry_dimensions   XYZ
        -print_orientation      XY
MEDIA
        -zone   0 0 0 2000000 2000000 100
                -Kx                         20.
                -Ky                         20.
                -Kz                         2.
                -porosity                    0.12
                -storage                       0.000005
                -longitudinal_dispersivity    7.5
                -horizontal_dispersivity      7.5
                -vertical_dispersivity         0.75

SPECIFIED_HEAD_BC
        -zone   0.  0.  0.    2000000.   0.   100.

                -head                   0    10.0
                -associated_solution    0       1
        -zone   2000000.  0.  0.    2000000.   2000000.   100.

                -head                   0    10.0
                -associated_solution    0       1
        -zone   0.  2000000.  0.    2000000.   2000000.   100.

                -head                   0    10.0
                -associated_solution    0       1
        -zone   0.  0.  0.    0.   2000000.   100.

                -head                   0    10.0
```

```
                -associated_solution    0       1

HEAD_IC
        -zone   0. 0. 0.                2000000. 2000000. 100.
        -head   10.0

CHEMISTRY_IC
        -zone   0. 0. 0.                2000000. 2000000. 100.
                -solution               1
                -equilibrium_phases     1

WELL
        1000000.   1000000.
        -injection_rate
                0       0
                0.1     9626.
        -solution
                0.      1
                0.1     2
        -diameter       0.5
        -elevation      0.      100.

TIME_CONTROL
        -time_step      0.      30.0
        -time_end       0.      3600.0

PRINT_FREQUENCY
        0.
        -hdf_chemistry                          180 days
        -xyz_chemistry                          180 days

END
```

Attachment 2
Cover Letter to 2009 Background Study Report

(*On CD-ROM only*)

Pacific Gas and Electric Company

Yvonne Meeks
Manager

Environmental Remediation
Gas T&D Department

Mailing Address
4325 South Higuera Sreet
San Luis Obispo, CA 93401
Location
6588 Ontario Road
San Luis Obispo, CA 93405
Tel: (805) 234-2257
Email: yjm1@pge.com

January 14, 2008

Mr. Aaron Yue
Project Manager
Geology Permitting and Corrective Action Branch
California Department of Toxic Substances Control
5796 Corporate Avenue
Cypress, CA 90630

Subject: Revised Groundwater Background Study, Steps 3 and 4: Report of Results PG&E Topock Compressor Station, Needles, California

Dear Mr. Yue:

This letter transmits the *Revised Groundwater Background Study Step 3 and 4: Report of Results* for the Pacific Gas and Electric Company (PG&E) Topock Compressor Station site. This report incorporates changes to the *Groundwater Background Study Steps 3 and 4 Results* report dated January 26, 2007, in response to the California Department of Toxic Substances Control (DTSC's) letter dated November 30, 2007, and the U.S Department of Interior's (DOI's) letter dated December 20, 2007. As agreed with DTSC and DOI, this revised report does not address two comments:

1. The outlier evaluations documented in this *Revised Groundwater Background Study Step 3 and 4: Report of Results* were performed using the mean concentrations for each analyte and well, for the reasons described in Section 2.2. DTSC has requested an additional outlier evaluation for each constituent considering all the measured concentrations for that constituent, rather than each well's mean concentration for that constituent. This additional outlier evaluation will be performed and the results will be reported separately from this report at a future date.
2. The background study wells included in this *Revised Groundwater Background Study Step 3 and 4: Report of Results* were those selected and approved through Steps 1 and 2 of the groundwater background study. DOI's letter dated December 20, 2007 indicates that the inclusion of three of the selected wells should be conditional on the results of the planned groundwater investigation in Arizona. If chromium is found above regional background levels on the Arizona side of the River, the decision to include the three wells in the vicinity of the Arizona investigation in the background study would need to be re-evaluated.

The remaining comments in DTSC's November 30, 2007 letter and DOI's December 20 letter are addressed in the *Revised Groundwater Background Study Step 3 and 4: Report of Results.* As directed by DTSC in the November 30, 2007 letter, the following three discussion topics are presented in this letter:

Topic 1 - Future Uses of the Groundwater Background Study Results

As discussed in the approved work plan[1], the objective of the background study is to define an upper threshold background concentration for total chromium, hexavalent chromium and other inorganic constituents in groundwater at the Topock site. The upper threshold concentration represents the upper concentration of the constituent in natural groundwater not affected by contamination and is referred to as a background concentration. These concentrations are reported in the form of statistical upper tolerance limits (UTLs). The UTL is an EPA-recommended, and widely accepted, statistical method for determining a background value from a set of data. The UTL represents a value that 95 percent of the population will fall below with 95 percent confidence.

The background study will be used during the Resource Conservation and Recovery Act (RCRA) and Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) processes to:

- Support the RCRA Facility Investigation/Remedial Investigation (RFI/RI) and risk assessment activities at the Topock site and to provide a basis by which the list of constituents of potential concern (COPCs) can be evaluated and, if necessary, revised. For site characterization, this would include using the background concentrations to help distinguish the nature and extent of site-related contamination vs. naturally occurring levels of inorganic constituents. For COPC evaluation, the background concentrations can be used as points of comparison so that assessment is focused on those constituents that are elevated above naturally occurring levels. For risk assessment, background concentrations can be used to help identify the site-related chemicals so that they can be evaluated in the risk assessment, and those that contribute most significantly to risk can be identified. Background concentrations can also be useful in communicating risk to the public, putting site-related risks in perspective by comparing those risks to risks associated with background conditions at the site.

- Assist with the Corrective Measures Study/Feasibility Study (CMS/FS) activities at the Topock site during the development of remedial action/corrective action goals. Consistent with the National Contingency Plan, remedial action goals are derived based on two threshold criteria: overall protection of human health and the environment, and compliance with Applicable, or Relevant and Appropriate, Requirements (ARARs). Background concentrations may be used during the risk assessment process to develop remedial goals, particularly if the risk assessment indicates that risk-based remedial goals are lower than naturally occurring background levels. Background concentrations are also cited in certain chemical-specific ARARs, such as California's groundwater and vadose zone protection standards that are applicable to RCRA hazardous waste interim status treatment, storage and disposal facilities[2].

[1] Work Plan for Assessing Background Metals Concentrations in Groundwater, PG&E Topock Compressor Station and Vicinity, Needles, California. June 2004.

[2] U.S. Department of the Interior Preliminary Determination of Applicable, or Relevant and Appropriate, Requirements for the Pacific Gas and Electric Company Topock CERCLA Site

Topic 2 - Potential Limitations for Use of the Groundwater Background Study

As has been discussed with DTSC and DOI and noted in DTSC's November 30 letter and DOI's December 20 letter, the data collected for this study may be interpreted to represent two or more populations based on geochemical or geological distinctions. During preparation of the RFI/RI, risk assessment, and CMS/FS, the use of the background groundwater concentrations determined through calculation of UTLs for the study area as a whole will be evaluated, noting that the calculated UTLs may not be appropriate for all constituents in all portions of the site or at all depths.

Examples of populations or subpopulations that could be separated out from the background data set are discussed below:

- Groundwater in fluvial material that is influenced by the Colorado River vs. groundwater in alluvial material away from the river's influence. The latter is typically geochemically oxidizing whereas the former is relatively reducing, and this difference is expressed by differences in concentrations of several chemical parameters, including nitrate, ammonia, and oxidation-reduction potential. Section 2.2 of the *Revised Groundwater Background Study Step 3 and 4: Report of Results* identifies which inorganic constituents are dominant in the fluvial and alluvial waters and which are detected at low frequency.

- Groundwater in the alluvial aquifer is stratified and shows distinct differences from shallow to deep zones. For example, shallow alluvial groundwater in the area around well MW-18 and the Interim Measure No. 3 injection field contain hexavalent chromium, Cr(VI), concentrations that are greater than concentrations found in deeper wells in the same area, coupled with relatively low dissolved solids and major ion concentrations. Although these relatively elevated Cr(VI) concentrations are naturally occurring, they may be interpreted as representing a distinct geochemical zone that is not found elsewhere. It is common to observe shallow alluvial wells in non-plume areas of the Topock Site with relatively lower dissolved solids concentrations and more oxidizing conditions than in deeper alluvial wells. Consistent with the geochemical environment of the shallow zone, Cr(VI) concentrations in shallow wells also tend to be greater than in deeper wells.

- Three background study wells located immediately across the Colorado River from the site contain relatively higher concentrations of arsenic and fluoride, and may represent another distinct geochemical environment. Slightly elevated groundwater temperature has been observed in samples from one of these wells. These observations suggest there may be localized geothermal influences in this area. At DTSC's request, arsenic concentrations from these three wells and fluoride concentrations from one of these wells were excluded from the data set.

These groupings are subject to interpretation, and are described in Section 2.2 of the *Revised Groundwater Background Study Step 3 and 4: Report of Results*.

As required by DTSC's November 30th letter, a total of 30 analyses have been removed from the background study database that had been used to calculate UTLs for the *Groundwater Background Study Steps 3 and 4 Results* report dated January 26, 2007. Using box-and-whisker and probability plots, these analyses were interpreted by DTSC as being non-representative of

the database as a whole. The deletion of these 30 analyses from the background study data set has resulted in changes in the UTLs for lead and arsenic.

Topic 3 - Rationale for a Single (rather than Multiple) Background Concentrations for the Topock Groundwater Study

The approach to and design of the groundwater background study was documented in the approved work plan and study results (Phase 1, Phase 2, Phase 3/4 results). The definition of the background groundwater study area is the unconsolidated alluvial aquifer of the Mohave Groundwater Basin stretching from the Topock site in the south to Needles in the north (approximately 15 miles north of the Topock Site) and from the edge of the alluvial aquifer along the mountain front in the west to several miles east of the site in Arizona. Over 150 wells in the study area were evaluated during Step 1 of the background study. During Step 2 of the background study, 36 wells were sampled and screened for inclusion in the final data set. Factors considered in including the final set of wells included whether the groundwater general chemistry is consistent with the southern Mohave Valley groundwater general chemistry; whether a potential anthropogenic source may affect the concentrations of metals in groundwater; and whether the well was located within a cluster of other background wells which could cause a geographic bias. And as documented in the *Revised Groundwater Background Study Step 3 and 4: Report of Results,* outlier and geochemical evaluations were performed during Step 3 to maximize the representativeness of the groundwater background study data to the Topock site. One of the defining goals of the DTSC-approved background study protocol was to consider a wide range of geologic and geochemical regimes in developing a background number that would truly be representative of the area as a whole. The Cr(VI) concentrations found in the background study are consistent with those reported in other published studies in the region.

PG&E believes that the results of the groundwater background study are appropriate for completion of the RFI/RI and CMS/FS, are not overly conservative, and may actually underestimate the natural range in background values due to the number of upper end data points eliminated during Step 2 and Step 3. Although there is scatter in the dataset, this is expected in natural geochemical environments.

The derivation of separate background concentrations for various portions of the site has been suggested by some DTSC and DOI reviewers. PG&E believes that the development of multiple background concentrations would be subject to significant scientific uncertainty in categorizing well populations (and accommodating ranges of and changes to well chemistry), is not practical from a regulatory standpoint, and would hinder rather than advance the progress toward selection and implementation of a final groundwater remedy at the site. Moreover, the dataset collected for this study based on the approved work plan is aimed at identifying one background number for the entire study area. More specifically:

- Under a multiple population approach, the dynamic nature of groundwater flowing under the influence of current or future extraction/injection remedies could result in wells being shifted from one population to the other over time – resulting in a complex and potentially conflicting regulatory framework with no commensurate benefits.
- The methodology for defining which wells are associated with which population would be arbitrary and would be difficult to apply in practice. The boundaries of the datasets

would be indistinct, with individual wells falling partly in several different populations, depending on which constituent was being considered.

- Developing multiple populations would significantly delay proceeding to the final remedy as various aspects of the approach are challenged by stakeholders and/or further background study data collection is necessary to address an issue that was not the objective of the approved Background Study workplan.

Do not hesitate to contact me at (805) 234-2257 with any questions or comments on this information or the enclosed report.

Sincerely,

Yvonne Meeks
Topock Project Manager

cc: Chris Guerre/DTSC
Karen Baker/DTSC
Kris Doebbler/DOI

Attachment 3
Topock-1 Well Information

(*On CD-ROM only*)

DEPARTMENT OF WATER RESOURCES
99 EAST VIRGINIA AVENUE
PHOENIX, ARIZONA 85004

SEP 1981 DEPARTMENT OF WATER RESOURCES

REGISTRATION OF EXISTING WELLS

READ INSTRUCTIONS ON BACK OF THIS FORM BEFORE COMPLETING
PRINT OR TYPE — FILE IN DUPLICATE

REGISTRATION FEE (CHECK ONE)	
EXEMPT WELL (NO CHARGE)	☐
NON-EXEMPT WELL — $10.00	☒

FOR OFFICE USE ONLY
REGISTRATION NO. 55- 600188
FILE NO. B(16-21) 35 cdd
FILED 9-18-81 (DATE) AT 8 am (TIME)
INA ✓
AMA ✓

1. Name of Registrant:
Southwest Gas of Arizona Well No. 1
Box 646, Bullhead City, AZ 86430
(Address) (City) (State) (Zip)

2. File and/or Control Number under previous groundwater law: (08-33)
B (16-21) 35- cdd
(File Number) (Control Number)
Topock-1

3. a. The well is located within the SE ¼ SE ¼ SW ¼, Section 35, of Township 16N N/S, Range 21W E/W, G & SRB & M, in the County of Mohave.

b. If in a subdivision: Name of subdivision _____, Lot No. _____, Address _____.

4. The principal use(s) of water (Examples: irrigation - stockwater - domestic - municipal - industrial)
PG&E Gas Compressor Station and 4 meters serving 30 people.

5. If for irrigation use, number of acres irrigated from well N/A.

6. Owner of land on which well is located. If same as Item 1, check this box ☐
Santa Fe Railroad
Winslow, AZ 86047
(Address) (City) (State) (Zip)

7. Well data (If data not available, write N/A)
a. Depth of Well 33'8" feet
b. Diameter of casing 12-1/2 inches
c. Depth of casing N/A feet
d. Type of casing Steel.
e. Maximum pump capacity N/A gallons per minute.
f. Depth to water N/A feet below land surface.
g. Date well completed _____ (Month) _____ (Day) 1962 (Year).

8. The place(s) of use of water. If same as Item 3, check this box ☐.
____¼ ____¼ ____¼, Section ____ Township 8T7N (?) Range 24E
____¼ ____¼ ____¼, Section ____ Township ____ Range ____
Attach additional sheet if necessary.

9. DATE 9/15/81 SIGNATURE OF REGISTRANT [signature]

DEPARTMENT OF WATER RESOURCES
GROUNDWATER MANAGEMENT SUPPORT SECTION
500 North Third Street
Phoenix, Arizona 85004-3903
Phone (602) 417-2470 Fax (602) 417-2422

RECEIVED
NOV 17 1995
GROUNDWATER MGT

REQUEST FORM TO CHANGE WELL INFORMATION OWNERSHIP * DRILLER

Please complete the appropriate section of this request form and return to the above address with applicable fee. NOTE: A.R.S. §45-593.C requires that the Department be notified of change of well ownership and that the new owner is required to keep the Department's Well Registration records current and accurate. Well data and ownership changes must be submitted within thirty days after changes take place.

SAVE THIS FORM TO REPORT FUTURE CHANGES IN OWNERSHIP, CHANGES IN ADDRESS, OR CHANGE IN WELL DATA SUCH AS PUMP CAPACITY, CORRECTION OF LEGAL DESCRIPTION, CHANGE OF WELL DRILLER AND AMENDING INFORMATION PREVIOUSLY FILED.

RECEIVED
JAN 3 1996
GROUNDWATER MGT

1. **CHANGE OF WELL INFORMATION: (NO FEE REQUIRED)**

NOTE: If the location of the proposed well changes after drilling authority has been issued, attach a $10.00 reissue fee for each well.

WELL REGISTRATION NO. 55- N/A FILE NO: _____

If known, I/We request the following well information be changed: _____

2. **STATEMENT OF CHANGE OF WELL OWNERSHIP: ($10.00 FEE REQUIRED)**

If this change consists of more than one well and the names are common: attach a $10.00 fee. Otherwise, each well requires a separate fee of $10.00.

I, The City of Needles, state that I am the Previous/New Owner of the well described below: WELL #1 (Topock)

SE ¼ SE ¼ SW ¼ Section 35 Township 16N N/S Range 21W E/W
10 Acre 40 Acre 160 Acre

Well Registration No. 55- 600188 File No. B(16-21) 35 cdd (if known)

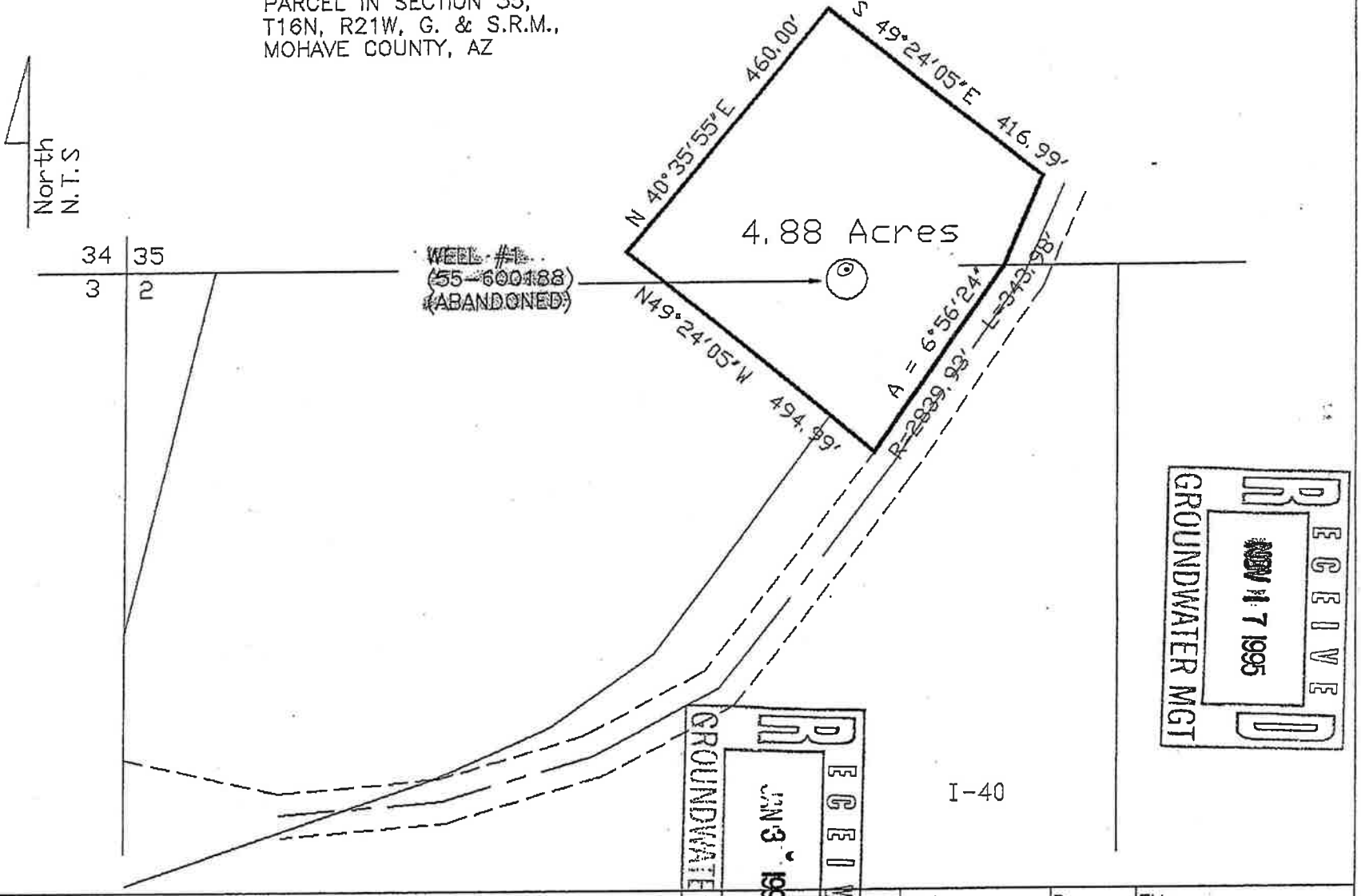
Southwest Gas of Arizona	City of Needles
PRINT Previous Owner's Name	PRINT New Owner's Name
P.O. Box 646	817 Third Street
Mailing Address	Mailing Address
Bullhead City, AZ 86430	Needles, CA 92363
City State Zip	City State Zip
(520) 754-2263	(619) 326-5700
Telephone	Telephone

Date November 7, 1995 Signature of Previous/New Well Owner _____

DWR 55-71 (Rev 10/95)

ENTERED JAN - 5 1996

CITY OF NEEDLES WELL No. 1
PARCEL IN SECTION 35,
T16N, R21W, G. & S.R.M.,
MOHAVE COUNTY, AZ



Title	Date	By	File
SITE PLAN FOR REGISTERED WELL No. 55-600188	11/07/95	J.W.	TOPOCK3.DWG

Mohave Engineering Associates, Inc.
Consulting Civil Engineers & Land Surveyors

John A. Proffit, P.E.
PRESIDENT

(602) 753-2627
FAX (602) 753-9118

Robert L. Schuetz, P.E.
Vice Pres., Office Mngr.
Thomas R. Christopher, R.L.S.
Vice Pres., Survey Mngr.

LEGAL DESCRIPTION: WELL SITE NO.1

A Parcel of land being situate in and parts of Lot 1, Section 2, Township 15 North, Range 21 West and Section 35, Township 16 North, Range 21 West of the Gila and Salt River Meridian, Mohave County, Arizona and being more particularly described by metes and bounds as follows;

Commencing at the 1/4 Section Corner common to said Section 2 and said Section 35, which point is marked by a 3" Aluminum Cap, set by the U.S. Fish and Wildlife Service, thence along the line common to said Section 2 and Section 35, S 89°44'18"W, 1504.30 feet to an intersection with and a point in the westerly right of way line of old U.S. Highway 66 and a point in the southerly line of herein described Parcel and the True Point Of Beginning;

Thence from said True Point Of Beginning and along the northwesterly right-of-way line of said old U.S. Highway 66, and the southeasterly line of herein described Parcel and along the arc of a true curve to the right, having a radius of 2839.93 feet and a back tangent of N 28°44'47"E, and through a central angle of 6°56'24" southwesterly 343.98 feet to a point and corner of herein described Parcel;

Thence leaving the northwesterly right-of-way line of old U.S. Highway 66, and along the southwesterly line of herein described Parcel, N 49°24'05"W, 494.99 feet to a point and corner of herein described Parcel;

Thence along the northwesterly line of herein described Parcel, N 40°35'55"E, 460.00 feet to a point and corner of herein described Parcel;

Thence along the northeasterly line of herein described Parcel, S 49°24'05"E, 416.99 feet to an intersection with and a point in the northwesterly right-of-way of said old U.S. Highway 66 and a corner of herein described Parcel;

Thence along the northwesterly right-of-way line of said old U.S. Highway 66, and the southeasterly line of herein described Parcel, and along the arc of a true curve to the right, having a radius of 2839.93 feet and a back tangent of N 26°15'45"E, and through a central angle of 2°29'02", southwesterly 123.11 feet to the True Point Of Beginning, said herein described Parcel containing 4.88 acres, more or less and is conveyed subject to any and all easements, reservations and rights-of-way of record or as may otherwise exist.

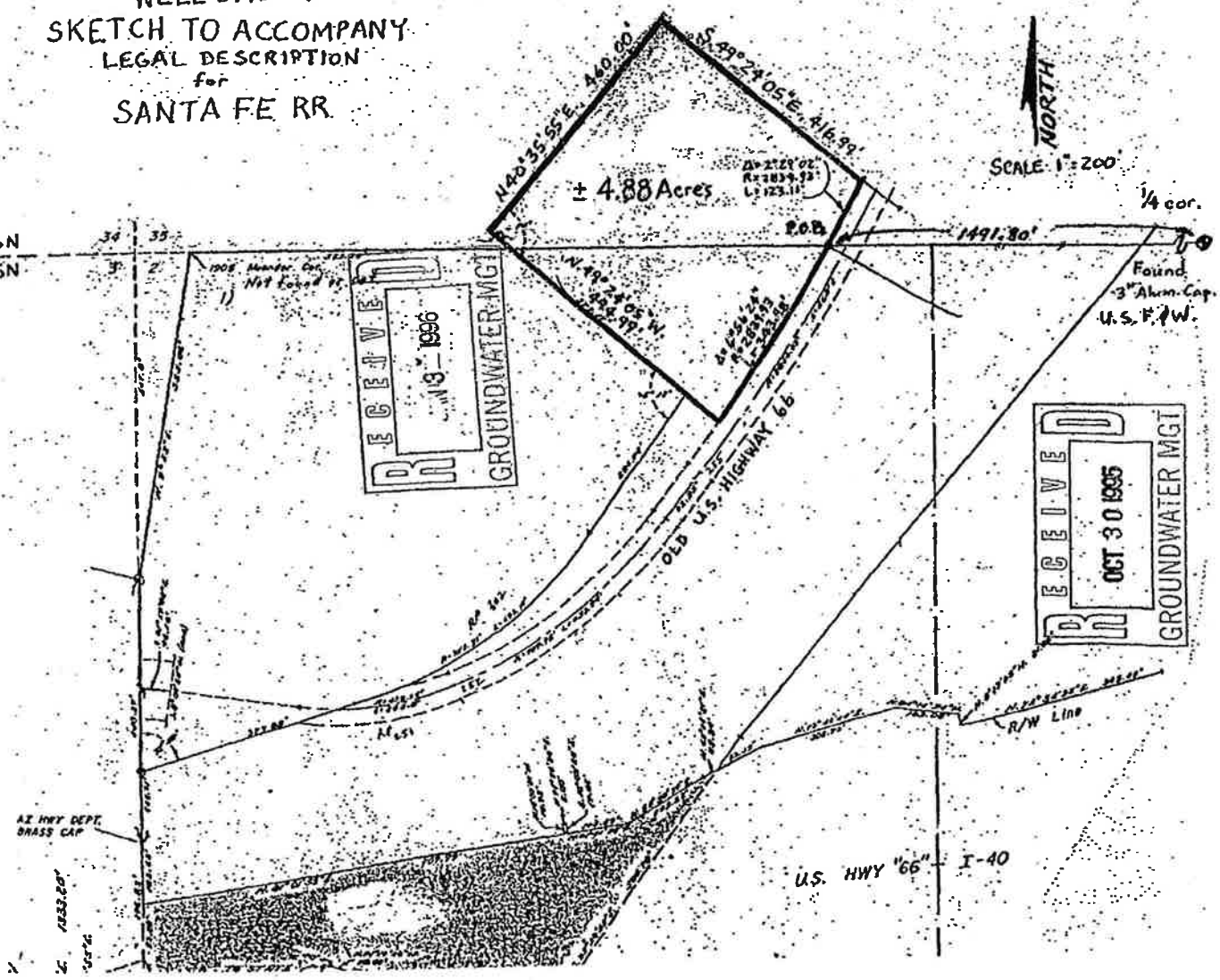
RECEIVED
NOV 3 1995
GROUNDWATER MGT

RECEIVED
OCT 30 1995
GROUNDWATER MGT

REGISTERED LAND SURVEYOR
CERTIFICATE NO.
25401
KENNETH W.
SHUMWAY
Date Signed 6-8-95
ARIZONA, U. S. A.

PAGE.006
11004510
Page 5 of 6
AUG 15 '95 9:29 FROM ASSET MANA :NT

"WELL SITE #1"
SKETCH TO ACCOMPANY
LEGAL DESCRIPTION
for
SANTA FE RR



(602) 268-1381

Topock #1

WATER QUALITY ANALYSIS - CHEMICAL

SPECIMEN NUMBER	SYSTEM NUMBER	CERTIFICATION NUMBER
	08-033	0010

NAME OF CLIENT: Southwest Gas Co.

ADDRESS: Box 646

CITY	STATE	ZIP CODE	COUNTY
Bullhead	Arizona	86430	Mohave

LAB USE ONLY
Lab Performing Test
Outside [4] 27
28 [1]

MAILING ADDRESS OF REPORT
ADDRESS: Box 646
CITY: Bullhead STATE: Arizona ZIP CODE: 86430

SYSTEM OR SOURCE NAME	CITY	WELL NUMBER
Well #1	Topock	08-033

LOCATION OF SAMPLING POINT	WELL NAME
Well Site	#1

COUNTY	TOWNSHIP	RANGE	SECTION	COLLECTED BY
Mohave	Topock			Dolan

LATITUDE	LONGITUDE	STATION NUMBER	DATE COLLECTED	HOUR
			5/16/80	1300

STORET NUMBER	CONTROL NUMBER	PRESERVATIVE ADDED?
		☐ YES ☑ NO

Lab No. 221-0505
Date Received 5-20-80
Time 1:pm S.C.

SPECIMEN UNSATISFACTORY
Reason: _____ CODE

SOURCE TYPE (check one)
☑ Well ☐ Surface ☐ Sewage ☐ Industrial ☐ Seepage

SOURCE DATA (check each applicable box)
☐ Public System ☐ Treated ☑ Routine Sample
☐ Individual System ☑ Untreated ☐ Re-Sample
☑ Semi Public System ☐ Special
☐ Grab Sample ☐ New Source
☐ Composite Sample ☑ Existing Source

SAMPLER'S COMMENTS: _____

		ME/L	Mg/L
10	☐ ROUTINE WATER CHEMISTRY		
11	☐ Electrical Conductivity, mmhos/cm 1.03		
12	☐ pH 7.9		
13	☐ CATIONS		
14	☐ Calcium		24
15	☐ Magnesium		6
16	☐ Sodium		131
17	☐ Iron		<.1
18	☐ Copper		<.02
19	☐ Manganese		<.02
20	☐ Zinc		.06
59	☐ Potassium		6
	TOTAL CATIONS		
21	☐ ANIONS		
22	☐ Alk P ($CaCO_3$)		<1.2
23	☐ Alk MO ($CaCO_3$)		119.6
24	☐ Chloride		186
25	☐ Nitrate (10.0)		3.3 ✓
26	☐ Sulfate		63.8
27	☐ Phosphate		
28	☐ Fluorides (1.4-2.4)		.5 ✓
38	☐ Nitrite		
60	☐ Sulfide		
61	☐ Silica		
	TOTAL ANIONS		

		Mg/L
29	☐ Solids	514
30	☐ Residue	
31	☐ Total Dissolved Solids (Calc.)	493
32	☐ Hardness ($CaCO_3$)	85
62	☐ Total Alkalinity as ($CaCO_3$)	98
33	☐ Total Soluble Salts (EC)	659
34	☐ V.S.S.	
35	☐ Foaming Agents (MBAS)	
36	☐ B.O.D.	
37	☐ C.O.D.	
39	☐ Kjeldahl Nitrogen Total	
40	☐ Other	
63	☐ Dissolved Oxygen (DO)	

		Mg/L
41	☐ TRACE METALS (Mg/l)	✓
42	☐ Arsenic (.05)	<.02
43	☐ Silver (.05)	<.02
44	☐ Chromium (0.05)	<.02
45	☐ Cadmium (0.01)	<.005
46	☐ Lead (0.05)	<.02
47	☐ Selenium (0.01)	<.01
48	☐ Mercury (.002)	<.001
57	☐ Barium (1.0)	<.5
58	☐ Chromium Hexavalent	
50	☐ SPECIAL	
49	☐ Boron	
51	☐ Radiological	
52	☐ Oil and Grease	
53	☐ C.C.E.	
54	☐ Phenols	
55	☐ Pesticides	
56	☐ PHYSICAL	
	☐ Color	
	☐ Taste	
	☐ Odor	
	☐ Turbidity	

☒ Acceptable for Public Usage
☐ Rejected for Public Usage
☐ Based on Parameters Run
Evaluated by M Nichols
Bureau of Water Quality Control
Date 6-11-80

PGS434588

Comments _____

Analyst _____ Date Reported 5-29-80

ARIZONA DEPARTMENT OF HEALTH SERVICES

#1 well

Division of Environmental Health Services

BRUCE BABBITT, Governor
SUZANNE DANDOY, M.D., M.P.H., Director

Date: 6-23-80

Southwest Gas Co
Box 646
Bullhead AZ 86430

Gentlemen:

RE: Chemical Analysis for addressee

Water System No. 08-033, Collected on 5-16-80

Sample type: Source X, System _____, Unknown _____

The interpretation of the chemical examination of the attached laboratory report No. 221-0505 shows that this sample does not exceed the maximum contaminant levels for inorganic chemicals and therefore is acceptable for use in a public water system in accordance with State regulation R9-8-221. This is not an approval of the referenced public water system, but merely an evaluation of the chemical quality of a sample of water which has been taken from that system.

BUREAU OF WATER QUALITY CONTROL
Safe Drinking Water Unit
by M Nelson

ff
cc: Northern Regional Office
Mohave County Health Department
Facility File

Enclosures

PGS434587

INTER-OFFICE MEMO

WRITE IT — DON'T SAY IT

To: Dennis Wood

Date 7-1-80

☐ Reply requested

☐ No reply necessary

Subject: Report # 221-0505

Here is a copy of the above report.
The water chemical analysis tested OK and
is acceptable for Public Usage.

From [signature]

FORM NO. 126

PGS434586

Topock #1

TEL. FAIRVIEW 7-8566

P. O. BOX 867

HORNKOHL LABORATORIES, Inc.

CHEMICAL AND TESTING ENGINEERS

714 TRUXTUN AVENUE

BAKERSFIELD, CALIFORNIA

January 15, 1968

LABORATORY NO. 188804

SAMPLE MARKED: Arizona Well #1, 1-5-68.

RECEIVED: January 11, 1968

SUBMITTED BY: Pacific Gas and Electric Company
P . O. Box 488
Barstow, California 92311
Attn: R.W. Horton

Purchase Order #LO-893141

DOMESTIC WATER ANALYSIS

CONSTITUENTS		PARTS PER MILLION		GRAINS PER GALLON		CLASSIFICATION
Carbonates (CO_3)	–	0.0	–	0.00	–	Good
Bicarbonates (HCO_3)	–	123.2	–	7.20	–	Good
Chlorides (Cl)	–	256.7	–	15.01	–	Fair
Sulfates (SO_4)	–	99.8	–	5.84	–	Good
Sulfides (S)	–	0.0	–	0.00	–	Good
Ammonia (NH_3)	–	Trrace	–	Trace	–	Good
Nitrites (NO_2)	–	0.0	–	0.00	–	Good
Nitrates (NO_3)	–	10.8	–	0.63	–	Good
Calcium (Ca)	–	36.4	–	2.13	–	Good
Magnesium (Mg)	–	7.8	–	0.46	–	Good
Sodium (Na)	–	204.2	–	11.94	–	Good
Iron (Fe)	–	0.1	–	0.01	–	Good
Silica, Si		27.5		1.61		Good
Hardness as $CaCO_3$	–	123.0	–	7.19	–	Fair
Total Solids @ 105°C.	–	708.9	–	41.46	–	Fair
pH	–	– –	7.8			Good
Conductivity Mhos/cm x10^5 @ 25°C.	–	– –	137.9			Good
Color	–	– –	Water White			
Odor	–	– –	None			
Turbidity	–	– –	Clear			
Fluorides, F	-	4.0		0.23		Should not exceed 1 ppm.
Manganese, Mn	-	0.00		---		Good

Thecretical Analysis

Calcium Bicarbonate	-	147.5	8.63
Magnesium Bicarbonate	-	14.6	0.85
Magnesium Sulfate	-	26.5	1.55
Sodium Sulfate	-	116.5	6.81
Sodium Chloride	-	423.3	24.75

PGS435942

Remarks: As noted by the classification column, the Chlorides, Fluorides, Hardness and Total Solids are above the recommendations of the State Department of Public Health.

Respectfully submitted,
HORNKOHL LABORATORIES, INC.

Heinz D. Pickel

Heinz D. Pickel, Chief Chemist

P:ap

STATE OF CALIFORNIA, DEPARTMENT OF PUBLIC HEALTH, APPROVED WATER LABORATORY

ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS. AUTHORIZATION FOR PUBLICATION OF OUR REPORTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING THEM IS RESERVED PENDING OUR WRITTEN APPROVAL AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES.

TEL. FAIRVIEW 7-8567 P.O. BOX 867

HORNKOHL LABORATORIES, Inc.

CHEMICAL AND TESTING ENGINEERS
714 TRUXTUN AVENUE
BAKERSFIELD, CALIFORNIA

January 15, 1168

Laboratory No. 188806
Sample Water
Received January 11, 1968
Submitted by Pacific Gas and Electric Company
P. O. Box 488
Barstow, California 92311
Attn: R. W. Horton

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC HEALTH
APPROVED WATER LABORATORY

Purchase Order #LO-893141

BACTERIOLOGICAL EXAMINATION

DATE AND HOUR COLLECTED: January 5, 1968
COLLECTED BY: R. P. Jacobs
ORIGINAL SOURCE: Well
POINT SAMPLE OBTAINED: Arizona Well #1

	LACTOSE BROTH 24 HOURS	LACTOSE BROTH 48 HOURS	BILE BROTH 24 HOURS	BILE BROTH 48 HOURS
10 CC. SAMPLES				
No. 1	—	Negative - Negative	—	
No. 2	—	Negative - Negative	—	
No. 3	—	Negative - Negative	—	
No. 4	—	Negative - Negative	—	
No. 5	—	Negative - Negative	—	
1 CC. SAMPLE				
No. 1	—		—	
0.1 CC. SAMPLE				
No. 1	—		—	

M.P.N.: Less than 2.2/100 ml.

TOTAL BACTERIA COUNT (PLATE COUNT/24 HOURS) 7900

COLOR Water White
ODOR None

TURBIDITY Clear

PGS435945

DP:ap

RESPECTFULLY SUBMITTED,
HORNKOHL LABORATORIES, INC.

Heinz D. Pickel

Heinz D. Pickel, Chief Chemist

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Topack #1

TEL. 8-3567 W. V. Calder

P. O. BOX 867

HORNKOHL LABORATORIES

CHEMICAL AND TESTING ENGINEERS
714 TRUXTUN AVENUE
BAKERSFIELD, CALIFORNIA

January 17, 1957

Laboratory No. 93355 *Marked* Santa Fe Well #1
Topack PG&E Comp Station

Sample Water

Received January 14, 1957

Submitted by The Pacific Gas and Electric Company
Box 3246
H Street Annex
Bakersfield, California

#1

* * * * * * * * * * *

COMPLETE INDUSTRIAL WATER ANALYSIS

Constituents	Parts Per Million	Grains Per Gallon
Carbonates	0.0	0.00
Bicarbonates	115.9	6.78
Chlorides	200.0	11.70
Sulfates	84.5	4.94
Sulfides	0.0	0.00
Calcium	31.2	1.82
Magnesium	4.9	0.29
Sodium	168.8	9.87
Iron	0.1	
Hardness as $CaCO_3$	98.0	5.73
Total Solids @ 105°C:	545.0	31.87
Total Solids @ Red Heat	505.0	29.53

pH: 7.3
Color: Water White
Odor: None
Turbidity: Clear
Conductivity: Mhos/cm^3x10^5@25°C: 87.2

THEORETICAL ANALYSIS

PGS435943

Calcium Bicarbonate	126.4	7.39
Magnesium Bicarbonate	24.9	1.46
Magnesium Sulfate	3.6	0.21
Sodium Sulfate	120.7	7.06
Sodium Chloride	329.7	19.28

Respectfully submitted,

HORNKOHL LABORATORIES

Frank Hornkohl

mk

ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS. AUTHORIZATION FOR PUBLICATION OF OUR REPORTS, CONCLUSIONS OR EX-
TRACTS FROM OR REGARDING THEM IS RESERVED PEND-

TEL. 8-8567 W. V. Adler

P. O. BOX

HORNKOHL LABORATORIES

CHEMICAL AND TESTING ENGINEERS

714 TRUXTUN AVENUE

BAKERSFIELD, CALIFORNIA

January 24, 1957

Laboratory No. 93854 - 93855 *Marked* See Below

Sample Water

Received January 14, 1957

Submitted by Pacific Gas and Electric Company
Box 3246
H Street Annex
Bakersfield, California

* * * * * * * * * * *

SILICA CONTENT

	Parts Per Million	Grains Per Gallon
Colorado River Water Topaz PG&E Comp. Station ----	59.2	3.46
Santa Fe Well #1 Topaz PG&E Comp. Station ----	29.6	1.73

Respectfully submitted,

HORNKOHL LABORATORIES

Chief Chemist

mk

PGS435944

ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS. AUTHORIZATION FOR PUBLICATION OF STATEMENTS OR CONCLUSIONS OR EXTRACTS FROM OR REGARDING THEM IS RESERVED PENDING OUR WRITTEN APPROVAL AS A MUTUAL PROTECTION TO OURSELVES AND CLIENTS.
KERN PTG. CO.

Attachment 4
Topock-2 and -3 Wells Information

(*On CD-ROM only*)

DEPARTMENT OF WATER RESOURCES
99 EAST VIRGINIA AVENUE
PHOENIX, ARIZONA 85004

SEP 1981 DEPARTMENT OF WATER RESOURCES

REGISTRATION OF EXISTING WELLS

READ INSTRUCTIONS ON BACK OF THIS FORM BEFORE COMPLETING
PRINT OR TYPE — FILE IN DUPLICATE

02

REGISTRATION FEE (CHECK ONE)	
EXEMPT WELL (NO CHARGE)	☐
NON-EXEMPT WELL — $10.00	☒

FOR OFFICE USE ONLY
REGISTRATION NO. 55- 600187
FILE NO. B(16-21)35 cdd
FILED 9-18-81 (DATE) AT 8am (TIME)
INA ✓
AMA ✓

1. Name of Registrant:
Southwest Gas of Arizona Well No. 3
Box 646, (Address) Bullhead City, (City) AZ (State) 86430 (Zip)

2. File and/or Control Number under previous groundwater law: (08-33)
B (16-21) (File Number) 35- cdd (Control Number)

3. a. The well is located within the SE ¼ SE ¼ SW ¼, Section 35, of Township 16N N/S, Range 21W E/W, G & SRB & M, in the County of Mohave.
b. If in a subdivision: Name of subdivision _____, Lot No. _____, Address _____.

4. The principal use(s) of water (Examples: irrigation - stockwater - domestic - municipal - industrial)
PG&E Gas Compressor Station and 4 meters serving 30 people.

5. If for irrigation use, number of acres irrigated from well N/A.

6. Owner of land on which well is located. If same as Item 1, check this box ☐
Santa Fe Railroad
Winslow, (City) AZ (State) 86047 (Zip) (Address)

7. Well data (If data not available, write N/A)
a. Depth of Well 250 feet
b. Diameter of casing 12 inches
c. Depth of casing N/A feet
d. Type of casing Steel.
e. Maximum pump capacity 300 gallons per minute.
f. Depth to water N/A feet below land surface.
g. Date well completed 5 (Month) 17 (Day) 74 (Year).



8. The place(s) of use of water. If same as Item 3, check this box ☐.
____¼ ____¼ ____¼, Section ____ Township 8T 7N Range 24E
____¼ ____¼ ____¼, Section ____ Township ____ Range ____
Attach additional sheet if necessary.

9. DATE 9/15/81 SIGNATURE OF REGISTRANT Don Tutts

DEPARTMENT OF WATER RESOURCES
GROUNDWATER MANAGEMENT SUPPORT SECTION
500 North Third Street
Phoenix, Arizona 85004-3903
Phone (602) 417-2470 Fax (602) 417-2422

RECEIVED
NOV 17 1995
GROUNDWATER MGT

REQUEST FORM TO CHANGE WELL INFORMATION
OWNERSHIP * DRILLER

Please complete the appropriate section of this request form and return to the above address with applicable fee. NOTE: A.R.S. §45-593.C requires that the Department be notified of change of well ownership and that the new owner is required to keep the Department's Well Registration records current and accurate. Well data and ownership changes must be submitted within thirty days after changes take place.

SAVE THIS FORM TO REPORT FUTURE CHANGES IN OWNERSHIP, CHANGES IN ADDRESS, OR CHANGE IN WELL DATA SUCH AS PUMP CAPACITY, CORRECTION OF LEGAL DESCRIPTION, CHANGE OF WELL DRILLER AND AMENDING INFORMATION PREVIOUSLY FILED.

1. CHANGE OF WELL INFORMATION: (NO FEE REQUIRED)

NOTE: If the location of the proposed well changes after drilling authority has been issued, attach a $10.00 reissue fee for each well.

WELL REGISTRATION NO. 55- N/A FILE NO: _____

If known, I/We request the following well information be changed: _____

RECEIVED
JAN 3 1996
GROUNDWATER MGT

2. STATEMENT OF CHANGE OF WELL OWNERSHIP: ($10.00 FEE REQUIRED)

If this change consists of more than one well and the names are common: attach a $10.00 fee. Otherwise, each well requires a separate fee of $10.00.

I, The City of Needles, state that I am the Previous/~~New Owner~~ of the well described below:

WELL #3 (Topock) Topock-3

SE ¼ SE ¼ SW ¼ Section 35 Township 16N N/S Range 21W E/W
10 Acre 40 Acre 160 Acre

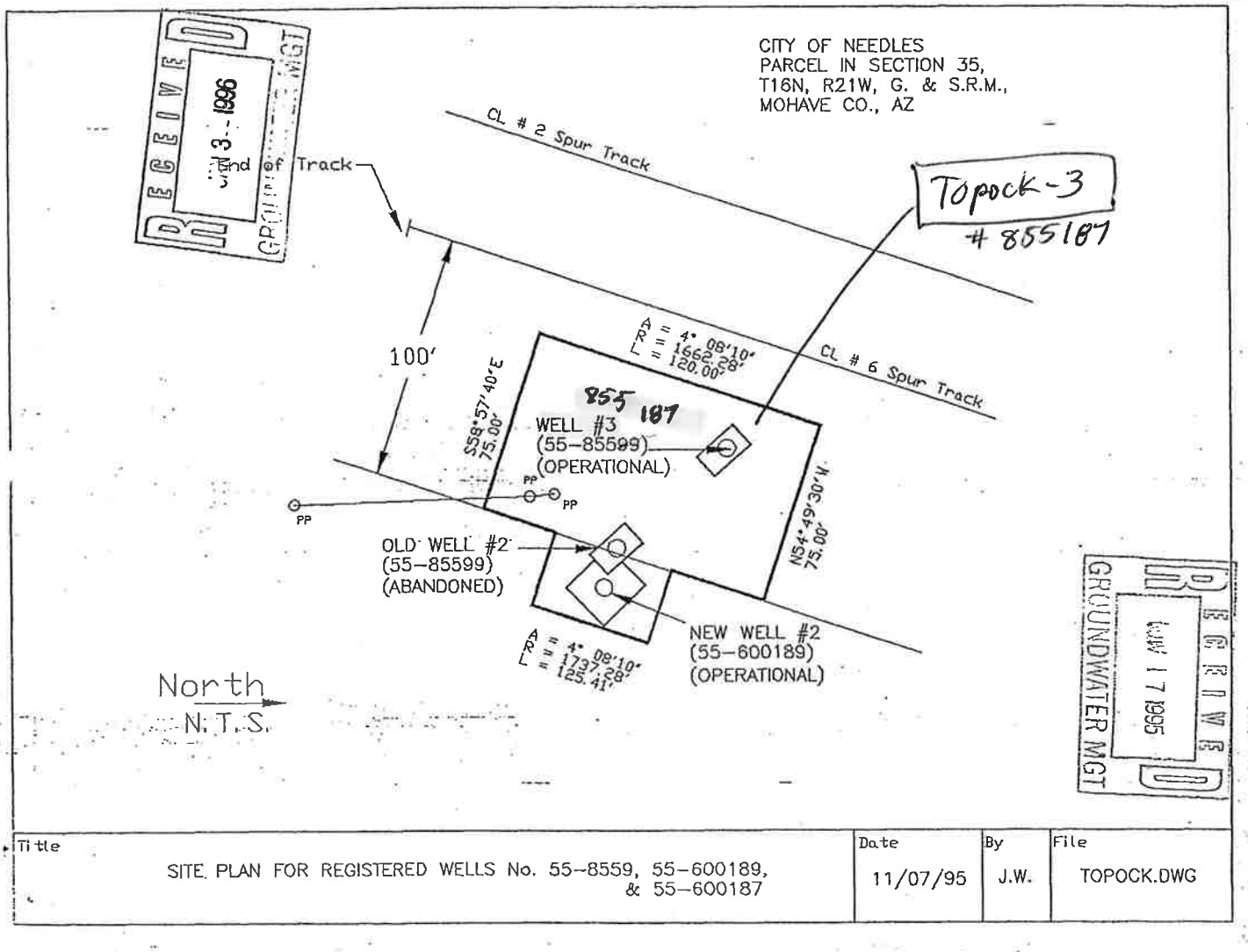
Well Registration No. 55- 600187 File No. B(16-21) 35 cdd (if known)

Southwest Gas of Arizona	City of Needles
PRINT Previous Owner's Name	PRINT New Owner's Name
P.O. BOX 646	817 Third Street
Mailing Address	Mailing Address
Bullhead City, AZ 86430	Needles, CA 92363
City State Zip	City State Zip
(520) 754-2263	(619) 326-5700
Telephone	Telephone

Date Nov. 7, 1995 Signature of Previous/~~New Well Owner~~ _____

DWR 55-71 (Rev 10/95)

ENTERED JAN - 5 1996



Title	Date	By	File
SITE PLAN FOR REGISTERED WELLS No. 55-8559, 55-600189, & 55-600187	11/07/95	J.W.	TOPOCK.DWG

Topock #3

Phone (702) 878-7757

DRILLING & PUMPS INC.
3521 SPRING MOUNTAIN ROAD
LAS VEGAS, NEV. 89102

Topock-3

June 5 1974

Southwest Gas Corporation
P O Box 246
Bullhead City Ariz

Well #3 at Topack Ariz

Drillers log of formations

0-11	sand & boulders
11-23	gravel.sand & boulders
23-30	gravel w/ few boulders
30-33	boulder
33-43	clay
43-46	silty sand
46-52	boulders & gravel
52-91	clay w/ interbedded rock
91-146	boulders & gravel
146-180	decomposed granite
180-250	decomposed granite w/ rhyolite boulders

DEPARTMENT OF WATER RESOURCES
99 EAST VIRGINIA AVENUE
PHOENIX, ARIZONA 85004



REGISTRATION OF EXISTING WELLS

READ INSTRUCTIONS ON BACK OF THIS FORM BEFORE COMPLETING
PRINT OR TYPE — FILE IN DUPLICATE

02

FOR OFFICE USE ONLY	
REGISTRATION NO. 55-	600189
FILE NO.	B(16-21)35cdd
FILED (DATE)	9-18-81
AT (TIME)	8am
INA	✓
AMA	✓

REGISTRATION FEE (CHECK ONE)	
EXEMPT WELL (NO CHARGE)	☐
NON-EXEMPT WELL — $10.00	☒

Topock-2

1. Name of Registrant:
   Southwest Gas of Arizona Well No. 2
   Box 646, Bullhead City, Arizona 86430
   (Address) (City) (State) (Zip)

2. File and/or Control Number under previous groundwater law: (08-33)
   B (16-21) 35- cdd
   (File Number) (Control Number)

3. a. The well is located within the SE ¼ SE ¼ SW ¼, Section 35, of Township 16N N/S, Range 21W E/W, G & SRB & M, in the County of Mohave.
   b. If in a subdivision: Name of subdivision _____, Lot No. _____, Address _____.

4. The principal use(s) of water (Examples: irrigation - stockwater - domestic - municipal - industrial)
   PG&E Gas Compressor Station and 4 meters serving 30 people.

5. If for irrigation use, number of acres irrigated from well N/A.

6. Owner of land on which well is located. If same as Item 1, check this box ☐
   Santa Fe Railroad
   Winslow, AZ 86047
   (Address) (City) (State) (Zip)

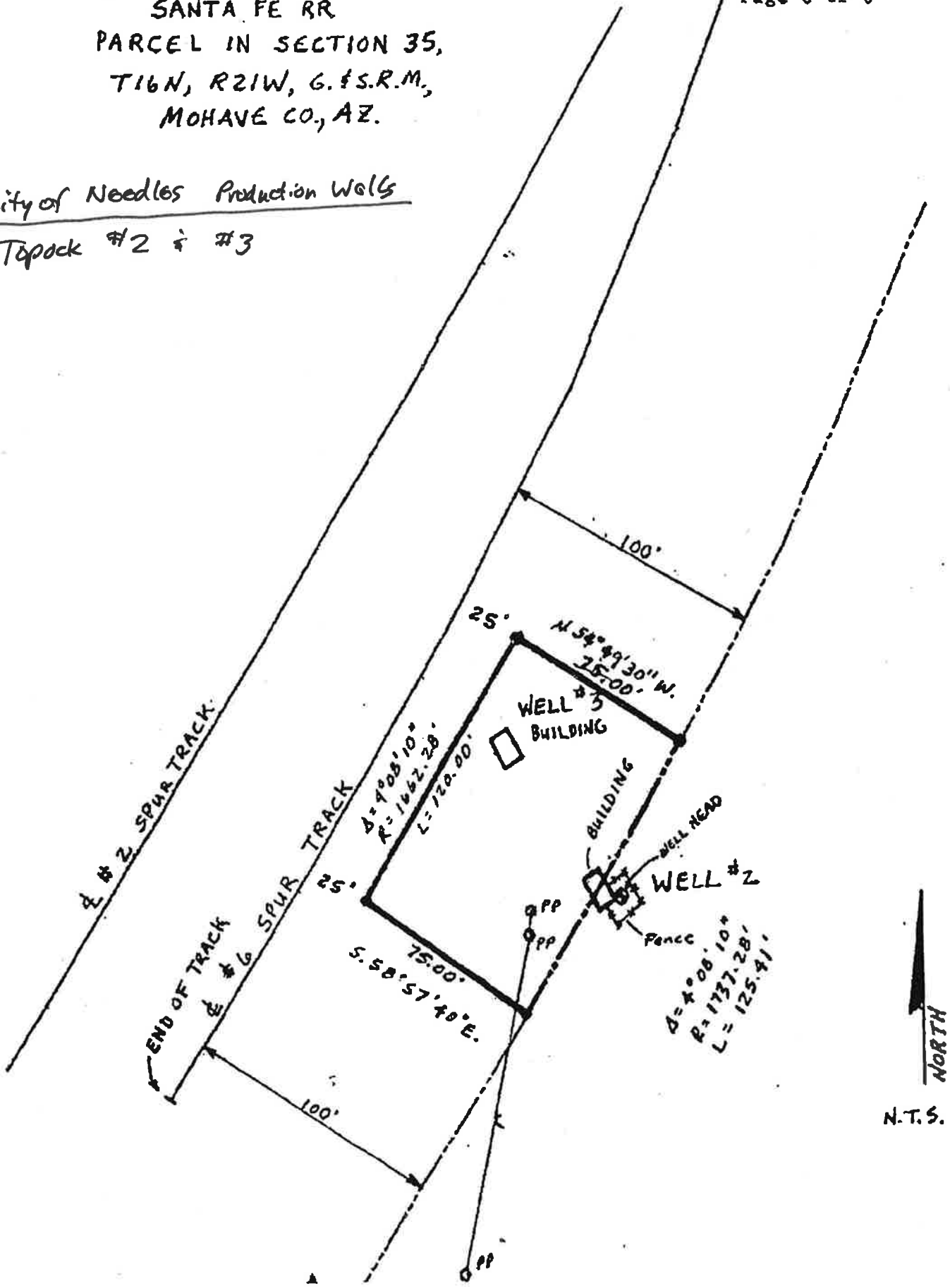
7. Well data (If data not available, write N/A)
   a. Depth of Well 150 feet
   b. Diameter of casing 12" inches
   c. Depth of casing N/A feet
   d. Type of casing Steel.
   e. Maximum pump capacity 400 gallons per minute.
   f. Depth to water N/A feet below land surface.
   g. Date well completed N/A (Month) (Day) (Year).

8. The place(s) of use of water. If same as Item 3, check this box ☐.
   ____¼ ____¼ ____¼, Section ____ Township 8T 7N Range 24E
   ____¼ ____¼ ____¼, Section ____ Township ____ Range ____
   Attach additional sheet if necessary.

9. DATE 9/15/81 SIGNATURE OF REGISTRANT [signature]

SKETCH WELL SITE No. 2 & 3
SANTA FE RR
PARCEL IN SECTION 35,
T16N, R21W, G. & S.R.M.,
MOHAVE CO., AZ.

City of Needles Production Wells
Topock #2 & #3



Mohave Engineering Associates, Inc.
Consulting Civil Engineers & Land Surveyors

John A. Proffit, P.E.
PRESIDENT

(602) 753-2627
FAX (602) 753-9118

Robert L. Schuetz, P.E.
Vice Pres., Office Mngr.
Thomas R. Christopher, R.L.S.
Vice Pres., Survey Mngr.

LEGAL DESCRIPTION: WELL SITE NO. 2 & 3

A Parcel of land situate in and being a part of Section 35, Township 16 North, Range 21 West of the Gila and Salt River Meridian, Mohave County, Arizona and being more particularly described as follows;

Commencing at the South one quarter (1/4) of said Section 35, thence along the southerly line of said Section 35, S 89°44'18"W, 1007.15 feet to an intersection with and a point in the easterly right-of-way line of The Atchison, Topeka and Santa Fe Railway;

Thence along the easterly right-of-way line of The Atchison, Topeka and Santa Fe Railway, N 38°39'33"E, 501.01 feet to a point of curve;

Thence along the arc of a true curve to the left having a radius of 1737.28 feet and through a central angle of 7°37'13", northeasterly an arc distance of 231.06 feet to the True Point Of Beginning and the corner of herein described Parcel;

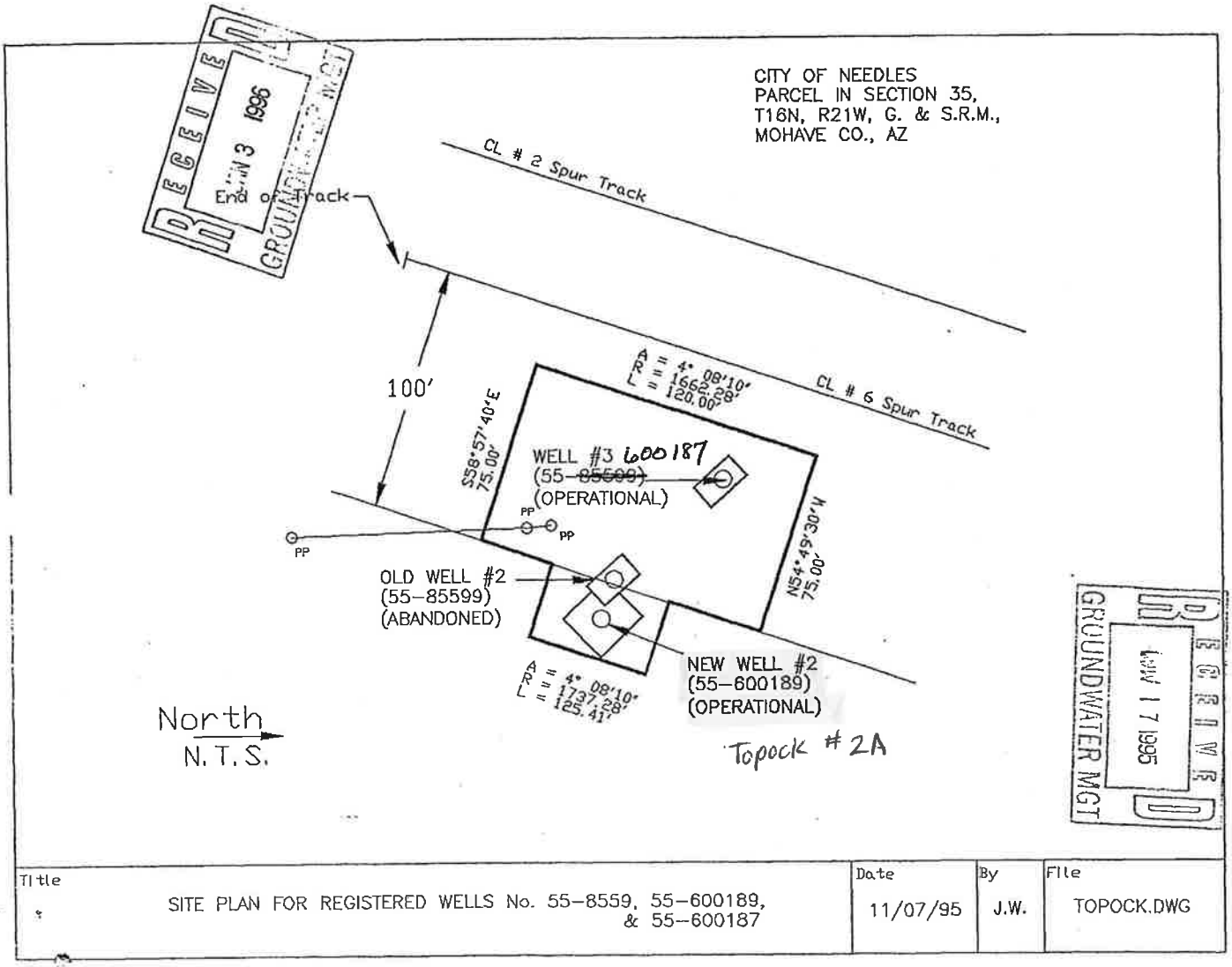
Thence from the True Point of Beginning and corner of herein described Parcel and continuing along the easterly right-of-way line of The Atchison, Topeka and Santa Fe Railway and the arc of a true curve to the left having a radius of 1737.28 feet and through a central angle of 4°08'10", northeasterly an arc distance of 125.41 feet to a point and corner of herein described Parcel;

Thence leaving the easterly right-of-way line of The Atchison, Topeka and Santa Fe Railway and along the northeasterly line of herein described Parcel, N 54°49'30"W, 75.00 feet to a point and corner of herein described Parcel;

Thence along the northwesterly line of herein described Parcel and along the arc of a true curve to the right, having a radius of 1662.28 feet and through a central angle of 4°08'10", southwesterly an arc distance of 120.00 feet to a point and corner of herein described Parcel;

Thence along the southwesterly line of herein described Parcel, S 58°57'40"E, 75.00 feet to the True Point Of Beginning, said herein described Parcel containing 0.21 acres, more or less, and is conveyed subject to any and all easements, reservations and rights-of-way of record or as may otherwise exist.





Title	Date	By	File
SITE PLAN FOR REGISTERED WELLS No. 55-8559, 55-600189, & 55-600187	11/07/95	J.W.	TOPOCK.DWG

15

STATE OF ARIZONA

DEPARTMENT OF
WATER RESOURCES

WELL DRILLER'S REPORT

This report should be prepared by the driller in all detail and filed with the Department within 30 days following completion of the well.

1. Owner Southwest Gas of Arizona
Name
Box 646, Bullhead City, Az 86430
Address

2. Lessee or Operator SAME AS BELOW
Name
Address

3. Driller ~~Wellotte & Askow~~
Name
Address

4. Location of well: T16N, R21W, Sec. 35, SE¼ SE¼ SW¼

5. Permit No. (if issued) 55-85599

DESCRIPTION OF WELL

6. Total depth of hole 140' ft.
7. Type of Casing STEEL
8. Diameter and length of casing 12 in. from 0' to 140', _____ in from _____ to _____.
9. Method of sealing at reduction points _____
10. Perforated from 100' to 140', from _____ to _____, from _____ to _____
11. Size of cuts ¼" x 3" Number of cuts per foot 10
12. If screen was installed: Length _____ ft. Diam _____ in. Type _____
13. Method of construction _____ (drilled) dug, driven, bored, jetted, etc.
14. Date started 9 (Month) 24 (day) 80 (year)
15. Date completed 9 (Month) 29 (day) 80 (year)
16. Depth to water 47' ft. (If flowing well, so state.)
17. Describe point from which depth measurements were made, and give sea-level elevation if available.
ground level approx. 550' above sea level
18. If flowing well, state method of flow regulation _____
19. REMARKS: _____

DO NOT WRITE IN THIS SPACE
OFFICE RECORD
Registration No. 55-85599
Received _____ By _____
Entered OCT 2 8 1980 By [illegible]
File No. B(16-21)35 cdd

(Well log to appear on Reverse side)



Topock - 2

LOG OF WELL

Indicate depth at which water was first encountered, and the depth and thickness of water bearing beds. If water is artesian, indicate depth at which encountered, and depth to which it rose in well.

FROM (FEET)	TO (FEET)	DESCRIPTION OF FORMATION MATERIAL
0'	50'	Boulders
50'	60'	SANDSTONE
60'	97'	" + CLAY
97	107	GRAVEL
107	130	Broken granite (sm. amount of clay).
130	140	Broken granite
		1st h²O 97'
		Bearing h²O strata 97 - 140'

I hereby certify that this well was drilled by me (or under my supervision), and that each and all of the statements herein contained are true to the best of my knowledge and belief.

Driller Wellette + A. Sikes
Name

POB 2268 Blue Ar. 86430
Address

Date 10-7-80

222 North Central Ave., Suite 850
Phoenix, Arizona 85004

Registration No. 55-85599
Owner of
Well Site Southwest Gas of Arizona

File No. B(16-21)35 cdd

COMPLETION REPORT

1. Completion Report to be filed with the Department within 30 days after installation of pump equipment.

2. The tested pumping capacity of the well in gallons per minute for a non-flowing well should be determined by measuring the discharge of the pump after continuous operation for at least 4 hours and for a flowing well by measuring the natural flow at the land surface.

3. Drawdown of the water level for a non-flowing well should be measured in feet after not less than 4 hours of continuous operation and while still in operation and for a flowing well the shut-in pressure should be measured in feet above the land or in pounds per square inch at the land surface.

4. The static groundwater level should be measured in feet from the land surface immediately prior to the well capacity test.

LOCATION OF THE WELL

Topock-2

T16N, R21W, Sec. 35, SE¼ SE¼ SW¼ .

Date Well Completed 9-24-80 Depth of Well 140'

1. Well Test:
Test Pumping Capacity 400 (Gal. per min.) Date Well Tested 10/15/80

Method of Discharge Measurement Current Meter (weir, orifice, current meter, etc.)

Static Groundwater Level 50' 8" ft. Drawdown 25' ft.

Total Pumping Lift 425' ft. Drawdown _____ lbs. (Flowing Well)

2. Equipment Installed:

Kind of Pump Submersible Turbine (turbine, centrifugal, etc.)

Kind of Power Elec (Elec., Nat. Gas, Etc.) H.P. Rating of Motor 60

I HEREBY CERTIFY that the above statements are true to the best of my knowledge and belief.

Signature

P.O. Box 1178
Address

12/10/80, 19
Date

Bullhead City Az 86430
City State Zip

Attachment 5
HNWR-1 Well Information

(*On CD-ROM only*)

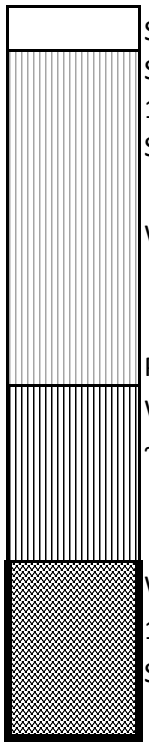
General Description of Sacramento Wash Irrigation Well
Havasu Nationa Wildlife Refuge
Summarized: Brad Guay, 11/24/2010

Water Quality

Depth (Ft below grade)

From	To	Temp °C	pH	TDS
0	10			
10	20			
20	30			
30	40	26.7°	8.0	495
40	50	30.2°	7.5	430
50	60	31.8°	7.5	429
60	70	32.0°	7.0	403
70	80	33.0°	7.0	398
80	90	32.5°	7.0	338
90	100	34.7°	6.5	356
100	110	33.5°	7.0	349
110	120	34.1°	7.0	392
120	130	33.5°	7.0	420
130	140	34.1°	7.0	435
140	150	30.8°	7.0	445
150	160	30.0°	7.0	435

Well Diagram



Stratigraphy

Depths

0 - 34'	**Silty Clay**, Lt. Br with some sand and gravel, saturated after 6'
35 - 74'	**Sand and Gravel,** mostly med-coarse sand, w/ some pea to cobble sized gravel; fluvial?, good water yield
75 - 82'	**Sand**, some clay and gravel; possibly interbedded layers; maybe fluvial/alluvial contact?, more sub-angular and sub-rounded material; @ 82' water bearing again, with foamy "milky coffee" appeareance; TDS drop
83 - 156.5'	**Sand, w/ gravel,** f-c sand with variable gravel; esp. coarse, hard gravel 85-92' that was water bearing; fairly uniform after 92', moderate water yield.

Attachment 6
Additional Topock-3 Well Information

(*On CD-ROM only*)

ENGINEERS TESTING LABORATORIES, INC.
3737 East Broadway Road
P. O. Box 21387
Phoenix, Arizona 85036
(602) 268-1381

423 South Olsen Avenue
Tucson, Arizona 85719
(602) 624-8894

2400 East Industrial Drive
Flagstaff, Arizona 86001
(602) 774-4881

Topock #3

LABORATORY REPORT

WATER QUALITY ANALYSIS - CHEMICAL

SPECIMEN NUMBER	SYSTEM NUMBER	CERTIFICATION NUMBER
	08-033	0010

NAME OF CLIENT: SOUTHWEST GAS CO.

ADDRESS: BOX 646

CITY	STATE	ZIP CODE	COUNTY
BULLHEAD CITY	AZ.	86430	MOHAVE

LAB USE ONLY
Lab Performing Test
Outside [4] 27
28 [1]

MAILING ADDRESS OF REPORT: GLEN D. DOLAN
ADDRESS: P.O. BOX 187

CITY	STATE	ZIP CODE
NEEDLES	CALIF.	92363

SYSTEM OR SOURCE NAME	CITY	WELL NUMBER

LOCATION OF SAMPLING POINT: #3 WELL
WELL NAME:

COUNTY	TOWNSHIP	RANGE	SECTION	COLLECTED BY
MOHAVE				DOLAN

LATITUDE	LONGITUDE	STATION NUMBER	DATE COLLECTED	HOUR
			2-26-79	

STORET NUMBER	CONTROL NUMBER	PRESERVATIVE ADDED?
		☐ YES ☐ NO

Lab No. 241-2915
Date Received 2-28-79
Time 8A

SPECIMEN UNSATISFACTORY
Reason: _____ CODE

SOURCE TYPE (check one)
☒ Well ☐ Surface ☐ Sewage ☐ Industrial ☐ Seepage

SOURCE DATA (check each applicable box)
☒ Public System ☐ Treated ☐ Routine Sample
☐ Individual System ☒ Untreated ☐ Re-Sample
☐ Semi Public System ☒ Special
☐ Grab Sample ☒ New Source
☐ Composite Sample ☐ Existing Source

SAMPLER'S COMMENTS: GIVE FULL ANALYSIS TO SEE IF WATER IS DRINKABLE.

10 ☐ ROUTINE WATER CHEMISTRY
11 ☐ Electrical Conductivity, mmhos/cm .21
12 ☐ pH 8.4

	ME/L	Mg/L
13 ☐ CATIONS		
14 ☐ Calcium		38.3
15 ☐ Magnesium		.9
16 ☐ Sodium		486
17 ☐ Iron		.98
18 ☐ Copper		.05
19 ☐ Manganese		0.02
20 ☐ Zinc		0.04
59 ☐ Potassium		
TOTAL CATIONS		
21 ☐ ANIONS		
22 ☐ Alk P ($CaCO_3$)		0.01
23 ☐ Alk MO ($CaCO_3$)		97.6
24 ☐ Chloride		616
25 ☐ Nitrate (10.0)		1.0
26 ☐ Sulfate		38.7
27 ☐ Phosphate		
28 ☐ Fluorides (1.4-2.4)		5.0
38 ☐ Nitrite		
60 ☐ Sulfide		
61 ☐ Silica		
TOTAL ANIONS		

	Mg/L
29 ☐ Solids	1376
30 ☐ Residue	
31 ☐ Total Dissolved Solids (Calc.)	1278.5
32 ☐ Hardness ($CaCO_3$)	41.8
62 ☐ Total Alkalinity as ($CaCO_3$)	80
33 ☐ Total Soluble Salts (EC)	138.2
34 ☐ V.S.S.	
35 ☐ Foaming Agents (MBAS)	
36 ☐ B.O.D.	
37 ☐ C.O.D.	
39 ☐ Kjeldahl Nitrogen Total	
40 ☐ Other	
63 ☐ Dissolved Oxygen (DO)	

	Mg/L
41 ☐ TRACE METALS (Mg/l)	
42 ☐ Arsenic (.05)	< .02
43 ☐ Silver (.05)	< 0.05
44 ☐ Chromium (0.05)	< 0.05
45 ☐ Cadmium (0.01)	< .0005
46 ☐ Lead (0.05)	< .02
47 ☐ Selenium (0.01)	< 0.01
48 ☐ Mercury (.002)	.0007
57 ☐ Barium (1.0)	< .5
58 ☐ Chromium Hexavalent	
50 ☐ SPECIAL	
49 ☐ Boron	
51 ☐ Radiological	
52 ☐ Oil and Grease	
53 ☐ C.C.E.	
54 ☐ Phenols	
55 ☐ Pesticides	
56 ☐ PHYSICAL	
☐ Color	
☐ Taste	
☐ Odor	
☐ Turbidity	

☐ Acceptable for Public Usage
☐ Rejected for Public Usage
☐ Based on Parameters Run
Evaluated by _____
Bureau of Water Quality Control
Date _____

PGS434671

Comments: CHLORIDE EXCEEDS RECOMMENDED LIMITS
SOLIDS EXCEED RECOMMENDED LIMITS

Analyst: John J. Kline
Date Reported 3/20/79

20-74

Topock #3

FOX TESTING LABORATORIES, INC.

201 PARIS BOX 1299
LUBBOCK, TEXAS 79408
(806) 763-4518

11/22/78

f- #3

Mineral
Water Analysis

Dater Received: 11/[illegible]/78 17-Nov-78 Sample Date
Lab Number 123[illegible]3
Date Tested: 11/27/78

For: Coley Chemcial Corporation P. O. Box 2039 Lubbock, Texas 79408

pH	7.6 mg/l	Chloride (Cl)	930 mg/l
Total Iron (Fe)	0.10 mg/l	'P' Alkalinity ($CaCO_3$)	2.0 mg/l
Manganese (Mn)	0.01 mg/l	Total Alkalinity ($CaCO_3$)	86.0 mg/l
Nitrogen Nitrate (N)	1.0 mg/l	Hydroxide (OH)	0 mg/l
Sulfate (SO_4)	150 mg/l	Bicarbonate (HCO_3)	82.0 mg/l
Nitrate (NO_3)	4.4 mg/l	Carbonate CO_3	4.0 mg/l
Fluoride (F)	6.2[illegible] mg/l	Magnesium (Mg)	3 mg/l
Silica (S_1O_2)	32.7 mg/l	Sodium (Na)	536 mg/l
Calcium (Ca)	46 mg/l	Dissolved Solids	1747.3 mg/l
Total Hardness	132.8 mg/l		

Other: _____ _____

_____ _____

This water sample ( ) does or (X) does not meet USPHS drinking requirements.

Reasons: Chloride should not exceed 250 mg/l. Fluoride should not exceed 1.2mg/l
Total Dissolved Solids should not exceed 500mg/l

Respectfully submitted,
Fonnie Fox
Fox Testing Laboratories, Inc.

PGS434668

COTEY CHEMICAL CORPORATION

Area Code 806 747-2096 Box 2039 Lubbock, Texas 79408

November 30, 1978

OFFICE &
WAREHOUSE
E. AVENUE G

Please find attached a copy of the analysis on the water sample you recently sent us. The well is most likely clogged with both hard water and calcium carbonate scale. We would recommed using our Dry Acid Special to clear up this problem.

Please also note the high chloride content and the statement that this water does not meet USPHS drinking requirements.

Very truly your,

COTEY CHEMICAL CORPORATION

Ken James
President

Encls:

PGS434669

Attachment 7
Topock-2/3 Pump Test Results

(*On CD-ROM only*)

Summary of Pumping Tests at Topock 2 and 3 Wells, PG&E Topock Compressor Station, Needles, California

PREPARED FOR: Pacific Gas and Electric Company

PREPARED BY: CH2M HILL

DATE: July 25, 2012

Introduction

In support of the groundwater remedy design, pumping tests were conducted in the Topock 2 and Topock 3 wells in December 2011. The purpose of these tests was to evaluate the pumping capacity and efficiency of these wells as a potential supply of fresh water for the remedy. The wells, which are currently owned and operated by Southwest Water, provide water to three residences and the PG&E Topock Compressor Station (referred herein as "Compressor Station"). The usage by the residences averages less than one gallon per minute (gpm), assuming continuous pumping. The Compressor Station uses about 100-110 gpm. The wells feed a storage tank in Arizona that serves the residential customers and two storage tanks at the Topock Compressor Station that provide water to the Compressor Station.

Both wells are equipped with the same make and model of pump, with a maximum pumping rate of about 200 gpm. The pumps are set at a depth of about 105 feet ('). Static depth to water at the time of the test ranged between 54' and 57', allowing for a maximum of 50' of available drawdown in each well. The Topock 3 well (referred to as SWW-2 by Southwest Water) was pumped in the afternoon of December 13th, between about 2:30 and 4:10 pm. The Topock 2 well (SWW-1) was pumped in the morning of December 14th, between about 8:30 and 10:00 am.

The pump test method was a step-drawdown test, where the pumping rate was increased incrementally in a series of steps while drawdown was measured in the pumping well. This test was designed to evaluate the performance of the well rather than measure the properties of the aquifer. The test method is based on an equation developed by Jacob (1946) that describes the drawdown in the well as a sum of a first order (laminar) component (BQ) and a second order (turbulent) component (CQ^2):

$$s = BQ + CQ^2$$

Where s represents drawdown, Q represents pumping rate, and B and C are constants specific to the well and aquifer.

Biershenk (1964) developed a graphical method to solve for B and C. By plotting s/Q against Q, the data from a step test forms a straight line with slope C and intercept B.

Topock 2 (SWW-1) Test Results

The Topock 2 well was pumped in a series of four steps at rates ranging from 108 to 202 gpm (Figure 1). The maximum drawdown observed was about 5.6'. This well appears to be fairly efficient. The driller's report from 1980 notes a drawdown of 25' at a pumping rate of 400 gpm, corresponding to a specific capacity of 16 gpm per foot. During the step test, the drawdown was about 5.6' at a pumping rate of 202 gpm, resulting in a specific capacity of 36 gpm per foot. The Beirshenk plot of the data is provided in Figure 2. From this plot, B is calculated to be 0.0217 and C is 0.00003. These values suggest that the well could produce over 900 gpm with the available drawdown. It is unlikely that the efficiency of a 30+ year old well would be more than double that when it was new. It is more likely that the step test has over-estimated the capacity of this well due to the inability of the current pump to adequately stress the well. When a well is not adequately stressed during the step test, the

turbulent flow term (CQ^2) may be underestimated. The step test did, however, indicate that the performance of the Topock 2 well has not declined dramatically since it was drilled. It remains a fairly efficient well, likely capable of producing at least 400 gpm.

Topock 3 (SWW-2) Test Results

The Topock 3 well was pumped in a series of four steps at rates ranging from 19 to 200 gpm (Figure 3). The maximum drawdown observed was about 49.5'. In contrast to Topock 2, the Topock 3 well appears to be no longer efficient. The driller's report from 1974 notes a drawdown of 10' at a pumping rate of 600 gpm, resulting in a specific capacity of 60 gpm per foot. During the step test, the drawdown was about 49.5' at a pumping rate of 200 gpm, resulting in a specific capacity of 4 gpm per foot. The pump exhibited surging, indicating intermittent cavitation due to lack of sufficient water depth above the pump intake.

The well was originally drilled to a depth of 250', with perforated casing from 88' to 130', 150' to 190', and 210' to 250'. It is assumed that this was the condition of the well when it was originally tested at 600 gpm. It was reported that the well was found to produce poor quality water and at some point the bottom 100' of the well were cemented shut. There is no record of what effect this had on the capacity of the well.

A video of the well taken by the Arizona Department of Environmental Quality (ADEQ) as part of their Topock Groundwater Study shows blank casing to a depth of 114' with stainless steel wire-wrapped screen from 114' to about 128' (ADEQ 2006). The well was reported by ADEQ to be blocked at 128' with sediment in the bottom and what appears to be a piece of railroad track iron extending about 1 foot up out of the bottom of the well. Based on the well video (ADEQ 2006), the stainless steel screen appears to be mostly open and in good condition, but the mild steel casing above the screen appears to be badly corroded and in relatively poor condition. In its current condition, the maximum production rate for this well is slightly less than 200 gpm. The Beirshenk plot of the data is provided in Figure 4. From this plot, B is calculated to be 0.048 and C is 0.001.

Conclusions

Step drawdown tests of approximately 1.5 hour duration were conducted on consecutive days at wells Topock 2 and Topock 3. These tests utilized the existing 200 gpm pumps installed in the wells. The Topock 2 well appears to be fairly efficient such that the 200 gpm pump installed in the well is not capable of producing enough drawdown to sufficiently stress the well for an aquifer test. The Topock 3 well is inefficient such that it can be pumped dry at a flow rate of 200 gpm. The two wells are located about 70' apart. There would be hydraulic interference if both wells were pumped at the same time. Consequently, it is likely that not much more water could be produced by pumping both wells than by pumping Topock 2 alone.

References

Arizona Department of Environmental Quality (ADEQ) 2006**.** *Topock Groundwater Study, Topock, Arizona*. August.

Biershenk, W.H., 1964. *Determining Well Efficiency by Multiple Step-Drawdown Tests*. Publication 64, International Association of Scientific Hydrology.

Jacob, C.E., 1946. Drawdown test to determine effective radius of artesian well. *Transactions, American Society of Civil Engineers*, Vol. 112, pp 1047-1070.

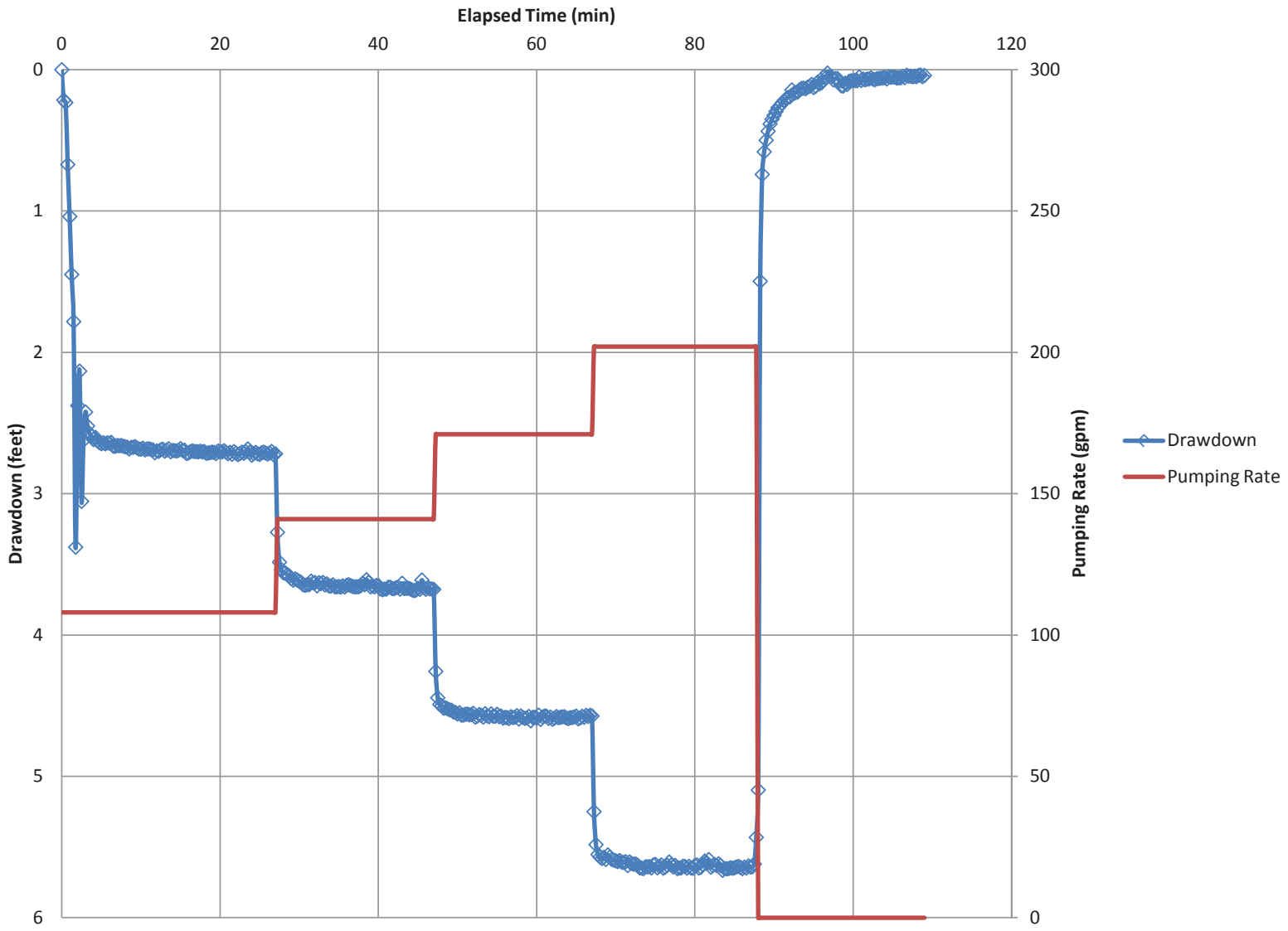


FIGURE 1
Topock-2 (SWW-1) Drawdown and Pumping Rate – December 2012
Groundwater Remedy Basis of Design Report
Intermediate (60%) Design
PG&E Topock Compressor Station
Needles, California

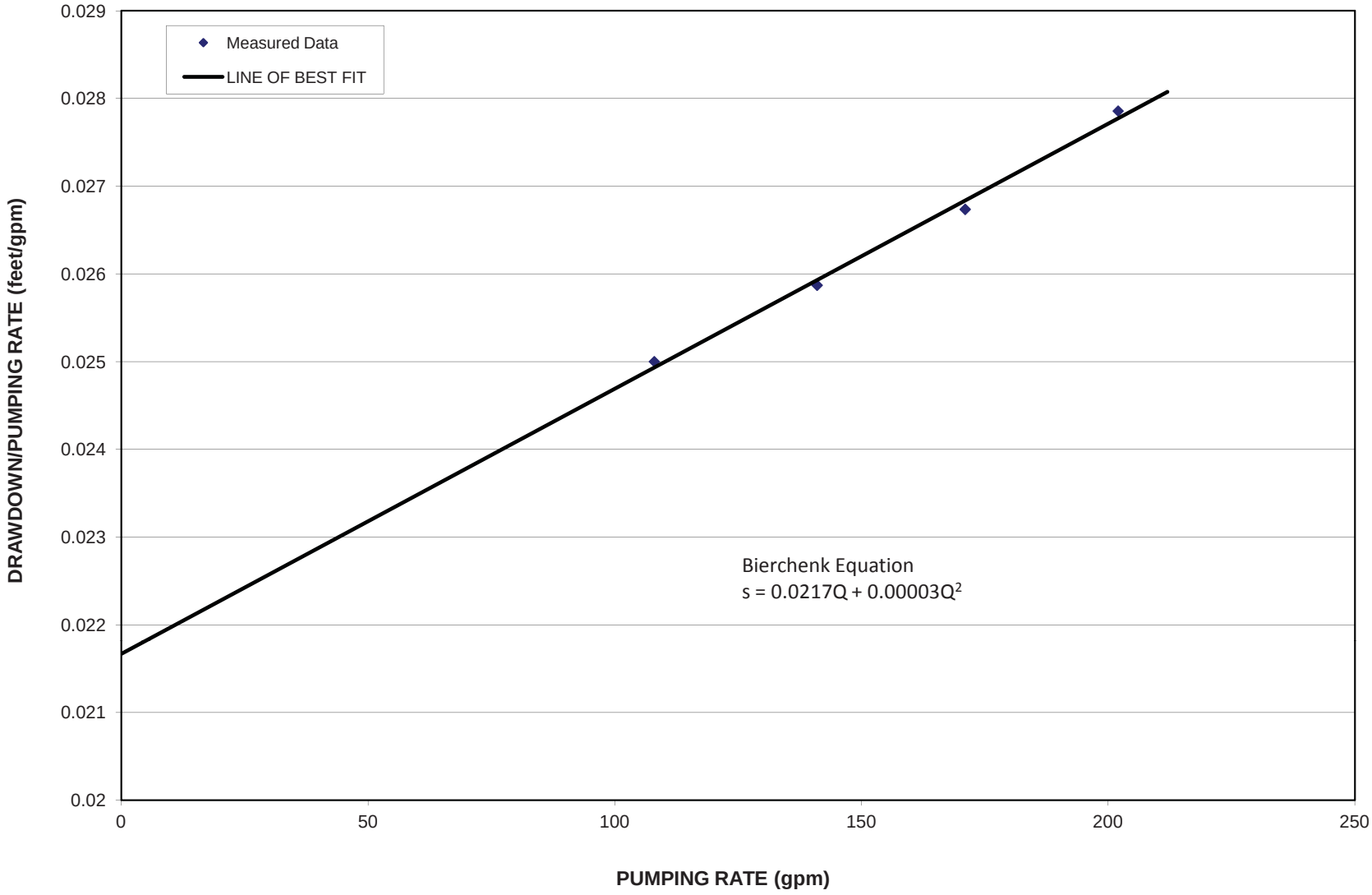


FIGURE 2
Hantush-Biershenk Plot of Topock-2 (SWW-1) Step Test – December 2012
Groundwater Remedy Basis of Design Report
Intermediate (60%) Design
PG&E Topock Compressor Station
Needles, California

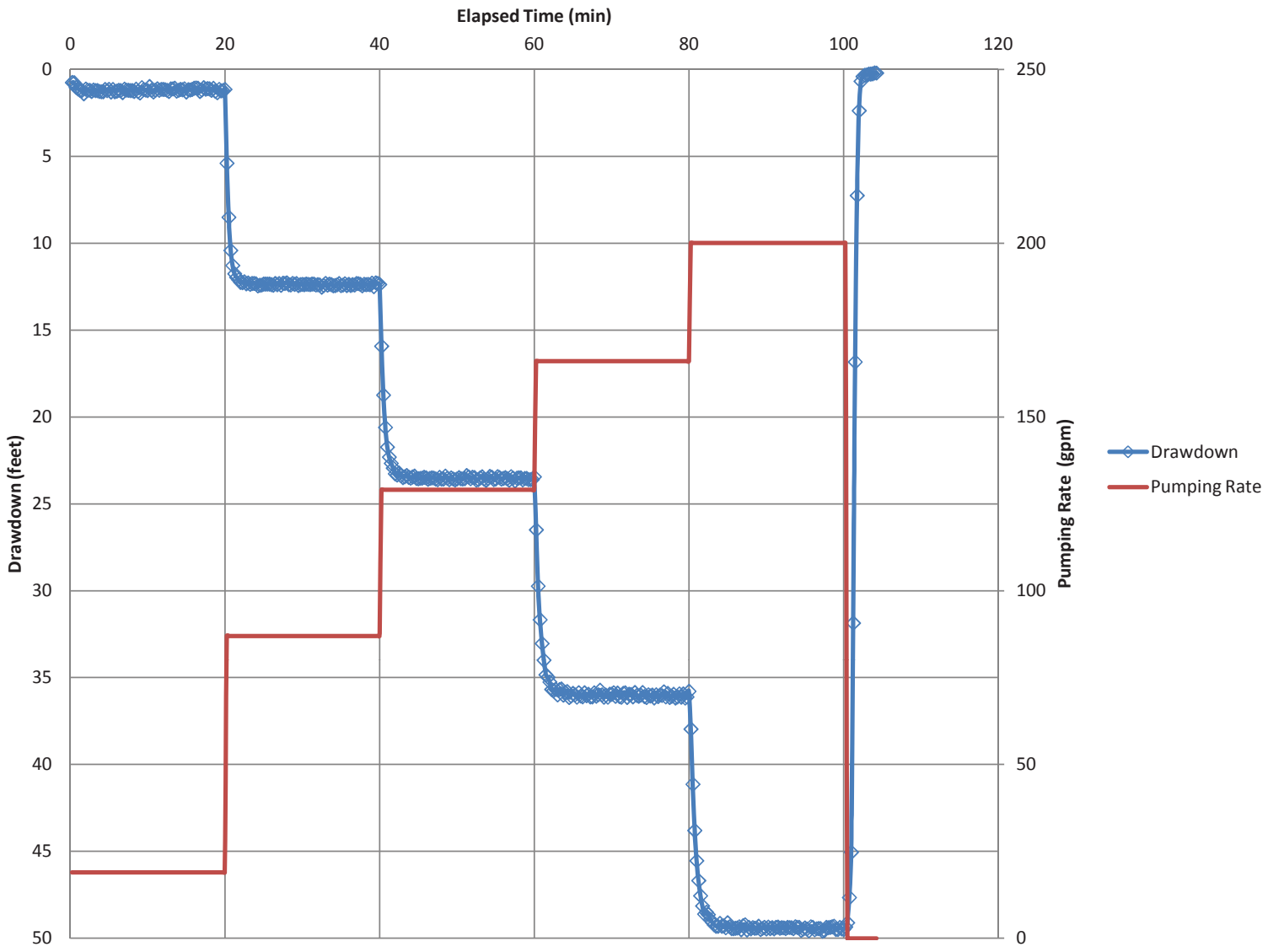


FIGURE 3
Topock-3 (SWW-2) Drawdown and Pumping Rate – December 2012
Groundwater Remedy Basis of Design Report
Intermediate (60%) Design
PG&E Topock Compressor Station
Needles, California

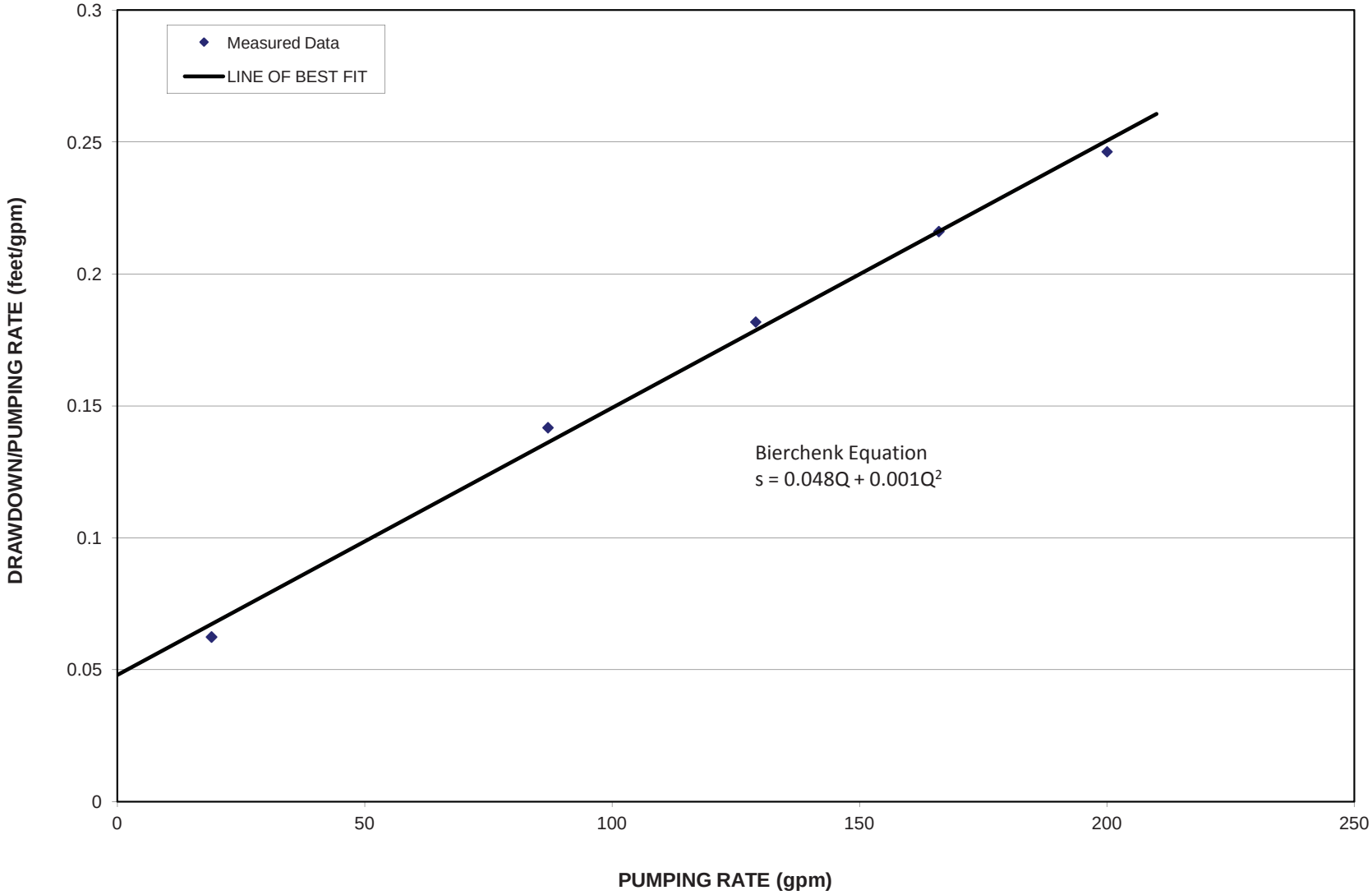


FIGURE 4
Hantush-Biershenk Plot of Topock-3 (SWW-2) Step Test – December 2012
Groundwater Remedy Basis of Design Report
Intermediate (60%) Design
PG&E Topock Compressor Station
Needles, California

Appendix K
Final Addendum to the East Ravine Groundwater Investigation Report and Responses to Comments

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation, Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

PREPARED FOR Pacific Gas and Electric Company

PREPARED BY: Michael Cavaliere/CH2M HILL
Martin Barackman/CH2M HILL

DATE: September 8, 2014



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- A-1 Borehole Construction Narrative
- A-2 Lithologic Logs
- A-3 Well Completion Diagrams
- A-4 California DWR Logs

B Field Screening Data
- B-1 Hydrophysical Data
- B-2 Screening-Level GW Data

C Laboratory Analytical Results for Soil and Groundwater
- C-1 Soil Analytical Data Tables
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E Data Quality Evaluation
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F Agency Comments
- F-1 DOI Comments on Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation
- F-2 DTSC Comments on Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

Acronyms and Abbreviations

µS/cm	micro-Siemens per centimeter
%	percent
AOC	Area of Concern
BLM	Bureau of Land Management
BOR	United States Bureau of Reclamation
BTVs	background threshold values
CDFW	California Department of Fish and Wildlife
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Cr(T)	total chromium
Cr(VI)	hexavalent chromium
DOI	United States Department of the Interior
DQE	data quality evaluation
DTSC	Department of Toxic Substances Control
EB	equipment blank
ECVs	ecological screening values
EIR MMRP	Environmental Impact Report Mitigation Monitoring Reporting Program
ERGI	East Ravine Groundwater Investigation
ER-TCS	East Ravine-Topock Compressor Station
FDs	field duplicates
FEC	fluid electrical conductivity
Final EIR	*Final Environmental Impact Report for the Topock Compressor Station Groundwater Remediation Project*
Final RFI/RI Report	*Final RCRA Facility Investigation/Remedial Investigation Report*
gpm	gallons per minute
GMP	groundwater monitoring program
gpm/ft	gallons per minute per foot
HNWR	Havasu National Wildlife Refuge
IM	Interim Measures
LCS	laboratory control sample
LES	Liquid Environmental Solutions
MCL	maximum contaminant level
MCPP	meta-chlorophenylpiperazine
mg/kg	milligrams per kilogram
MMRP	Mitigation Monitoring and Reporting Program
MS/MSD	matrix spike/matrix spike duplicate

ORP	oxidation reduction potential
PAHs	polycyclic aromatic hydrocarbons
PBA	*Programmatic Biological Assessment for the Pacific Gas and Electric Topock Compressor Station Remedial and Investigative Action*
PCBs	polychlorinated biphenyls
PG&E	Pacific Gas and Electric Company
pg/L	picograms per liter
RCRA	Resource Conservation and Recovery Act
RFI/RI	RCRA Facility Investigation/Remedial Investigation
RWQCB	California Regional Water Quality Control Board
TCS	Topock Compressor Station
TEQ	toxicity equivalents quotient
TPH	total petroleum hydrocarbons
TRC	Technical Review Committee
Work Plan Addendum	*Revised Addendum to the Revised Work Plan for East Ravine Groundwater Investigation*
USA	California Underground Service Alert
USFWS	United States Fish and Wildlife Service
UTL	upper tolerance limit

Executive Summary

Additional soil and groundwater characterization activities were conducted as part of Phase 2 of the Pacific Gas and Electric Company (PG&E) East Ravine-Topock Compressor Station (ER-TCS) groundwater investigation in the areas of the East Ravine and Topock Compressor Station (TCS) to collect supplemental information regarding groundwater occurrence, groundwater quality, and potential contaminant sources. As with the prior investigation phase conducted in 2009 (Phase 1), data summary teleconferences (referred to as screen calls) were conducted during this investigation to discuss field data, available laboratory analytical results, and the path forward for the investigation with the agencies, stakeholders, interested Tribes, and members of the Technical Review Committee (TRC). A total of 11 screen calls were held from March 2011 through September 2012.

During the Phase 2 activities, CH2M HILL installed an additional 20 groundwater monitoring wells within the unconsolidated alluvium and consolidated bedrock using 16 boreholes at 11 investigation sites. Soil samples were collected at six investigation sites in the area of the TCS and at one site in the East Ravine. Hydraulic testing, including flow characterization within three bedrock boreholes and a constant-rate extraction test at one of these locations, was conducted to refine the understanding of groundwater occurrence and flow within the saturated bedrock. Phase 2 field investigation activities were completed in July 2012, and all new monitoring wells have been incorporated into the Topock site-wide groundwater monitoring program and are being sampled quarterly. Results from the ER-TCS groundwater investigation have also been incorporated into the design of the groundwater remedy (e.g., two injection wells were located on the compressor station to address hexavalent chromium [Cr(VI)] concentrations in the alluvial groundwater underneath the station).

Summary of Key Findings

1. **Refined understanding of hydrogeology.** The depth and location of the contact between saturated unconsolidated sediments and consolidated bedrock has been refined based on lithologic data collected from the boreholes drilled. The depth to bedrock beneath the TCS was found to be deeper than previously estimated, which indicates a larger area of saturated alluvium in this area than previously estimated. Bedrock

core recovered indicates that Miocene conglomerate bedrock is present beneath a portion of TCS with decreasing thickness to the south, where metadiorite bedrock is observed directly beneath the conglomerate. The occurrence of the metadiorite bedrock was confirmed at investigation sites in the East Ravine and to the south. Figures 3-1 through 3-5 present the updated hydrogeologic information.

2. **Refined understanding of groundwater occurrence in bedrock.** Hydraulic data collected during this investigation suggest that groundwater occurrence in the bedrock is within relatively widely spaced, discrete fractures. Although the rock is highly fractured in some zones, most of the fractures are gouge filled. The gouge filled fractures and bulk rock matrix do not readily transmit water. This flow regime, which is typical of crystalline bedrock systems, is consistent with the existing conceptual site model for the East Ravine area. As inferred based on the borehole flow characterization testing and analysis of the bedrock core recovered, the locations of inflow to the boreholes are generally not correlated with highly fractured zones or zones of poor quality rock, but rather with discrete fractures in relatively competent rock. Based on the widespread distribution of Cr(VI) in East Ravine bedrock, the discrete fractures observed in the boreholes may form an interconnected network. Constituents can travel relatively quickly through networks of interconnected fractures. Compared to a porous media aquifer where water occupies all the spaces between the grains in the porous matrix, a relatively small amount of water is required to fill a sparse fracture network in a block of low porosity bedrock. Based on estimates of specific capacity, developed from measurements of drawdown during well development and routine well sampling, which provide a qualitative means of comparing the production rate of the different wells, the bedrock produces little groundwater relative to the nearby unconsolidated aquifer (See Attachment B2). The two bedrock wells with the highest specific capacity estimates are located near the contact between the bedrock and saturated unconsolidated sediments, which might indicate hydraulic connection with the unconsolidated aquifer. Contoured groundwater levels collected during this investigation confirm previous estimates of groundwater gradient, which is generally to the northeast along the axis of East Ravine and to the north from the TCS. In fractured bedrock, groundwater tends to follow conductive fractures so that the direction of groundwater movement through a fracture or a network of fractures might not be directly down gradient. Vertical gradients at well pairs within the saturated bedrock and between the bedrock and unconsolidated aquifer are all upward.

3. **Refined extent of Cr(VI) contamination in groundwater.** Multiple groundwater sampling events were conducted as a part of this investigation, and the extent of Cr(VI) contamination in the East Ravine and TCS areas has been further defined both laterally and vertically. Key observations regarding Cr(VI) contamination in new wells is described as follows, and Figures 3-2 through 3-6 and 3-8 illustrate the extent of Cr(VI) in groundwater:

    a. **East Ravine area.** With the exception of concentrations detected in the parts per million in the western area of the East Ravine (Site H, MW-70BR-225), Cr(VI) concentrations observed in the new wells are similar to the previously installed wells and do not indicate any previously unknown groundwater hotspots. The easternmost well (Site I, MW-73-80) had Cr(VI) concentrations near alluvial aquifer background (a background concentration for Cr(VI) concentrations in bedrock has not been developed).

    b. **TCS site.** Elevated levels (part per million), including the highest concentrations of Cr(VI) that have been detected on the site, were found in the alluvial aquifer beneath the TCS. The bedrock beneath the central portion of the station did not contain Cr(VI). Low levels of Cr(VI) were found where the water table occurs in bedrock at the southern edge of the TCS, but were not detected at the southernmost location (Site J, MW-74-240).

Conclusion

Data collected during Phase 2 of this ER-TCS investigation have resulted in the addition of two alluvial aquifer injection wells near the compressor station, and a bedrock extraction well near MW-70 to the remedial design. In addition, the data from the Phase II investigation show that the overall design of the final groundwater remedy in East Ravine, which relies on pumping from bedrock, do not need to be modified.

As communicated by the Department of Toxic Substances Control (DTSC) in a May 10, 2012, email (DTSC, 2012), Phase 2 field investigation activities are complete with the exception of Site H (MW-70 well series), where the agencies have directed PG&E to conduct additional characterization to determine the vertical extent of Cr(VI) in groundwater. This work and any further well installation will be considered as part of the groundwater monitoring program to be established as part of the groundwater remedy.

1.0 Introduction

Pacific Gas and Electric Company (PG&E) is addressing chromium in groundwater at the Topock Compressor Station (TCS) located in San Bernardino County, approximately 15 miles to the southeast of Needles, California, as shown in Figure 1-1. Investigative and remedial activities at the TCS are being performed under the Resource Conservation and Recovery Act (RCRA) corrective action process, as well as the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), under agreements with the California Environmental Protection Agency, Department of Toxic Substances Control (DTSC, and the United States Department of the Interior (DOI), respectively.

This technical memorandum documents groundwater investigation and associated activities in two areas of the Topock site: 1) the ravine area east of the TCS designated as Area of Concern (AOC) 10 (hereafter referred to as the East Ravine), and 2) the area beneath the TCS site. Specifically, this technical memorandum documents the findings of the investigation activities as outlined in the *Revised Addendum to the Revised Work Plan for East Ravine Groundwater Investigation* (Work Plan Addendum) (CH2M HILL, 2010). The investigation activities defined in the Work Plan Addendum are collectively referred to in this technical memorandum as the East Ravine-Topock Compressor Station (ER-TCS) groundwater investigation, or Phase 2. Phase 1 activities, also referred to as the East Ravine Groundwater Investigation (ERGI), were conducted in 2009 in accordance with the *Revised Work Plan for East Ravine Groundwater Investigation* (CH2M HILL, 2008). The findings associated with the ER-TCS (Phase 2) investigation are presented in this technical memorandum as an addendum to the Phase 1 work, which are documented in the *Summary of Findings Associated with the East Ravine Groundwater Investigation* (East Ravine Report) (CH2M HILL, 2009a).

This technical memorandum was initially submitted to DTSC and DOI on November 15, 2012 and has been revised based on comments received from the agencies (comments and summary of clarification discussion provided in Attachment F). Primary revisions to the document include the following:

- Key investigation data collected during Phase 1 of the investigation (e.g., boring logs, well construction information, etc.) has been brought forward from the Phase 1 summary report and included in this technical memorandum.
- The scope of laboratory analytical results for groundwater samples included in this document has been expanded to include results from Phase 1 and groundwater monitoring program (GMP) events conducted subsequent to Phase 1. This document now includes laboratory analytical results through March 2013, which are the most recently published GMP data.
- The presentation and discussion of groundwater analytical results for key constituents has been modified to address average water quality conditions observed over the entire duration of the investigation (Phase 1, Phase 2, and GMP events conducted from Phase 1 through March 2013). The presentation of data also considers minimum and maximum concentrations observed during this timeframe. The presentation and summary of data for specific groundwater sampling events are presented in the associated GMP reports.
- The scope of laboratory analytical results for soil samples included in this document has been expanded to include results from borings installed during Phase 1; however, the detailed discussion of the soil analytical results in the context of other soil samples collected in the investigation area as part of the Soil RCRA Facility Investigation/Remedial Investigation (RFI/RI) has been deferred to reports associated with the RFI/RI. Discussion of soil data in this document has been focused to how these data support the groundwater conceptual model for the ER-TCS Area.

Groundwater monitoring wells were installed at 11 sites during the Phase 2 of this groundwater investigation to provide additional groundwater and soil characterization data for the Topock site. This additional information supplements the existing data set collected from monitoring wells installed at the eight Phase 1 sites (note that one of the Phase 1 investigation sites, Site F, was also included in Phase 2 well installation activities). The majority of Phase 2 well installation activities were conducted between March 2011 and September 2011, while groundwater sampling and hydraulic testing activities specific to this investigation continued through February 2012. Well installation and testing activities for one location (Site K, MW-72BR-200) were conducted in June and July 2012. As stated in the Work Plan Addendum, the primary objectives of the Phase 2 investigation were to accomplish the following:

- East Ravine area
  - Define the nature and extent of the groundwater contamination within the bedrock and/or alluvium.
  - Identify the source(s) of bedrock groundwater contamination.
- TCS site
  - Define the nature and extent of the groundwater contamination within the bedrock and/or alluvium.
  - Characterize hydrogeologic conditions within the bedrock and alluvium.
  - Determine whether groundwater contaminant sources are present within the TCS boundary that could affect the immediate area or surrounding land, including the East Ravine area.

In addition to these objectives, data and associated findings from the investigation have been considered in the design of the final groundwater remedy.

1.1 Approvals and Authorizations

The ER-TCS groundwater investigation was executed in conformance with the following approvals and authorizations:

- DTSC approval (DTSC, 2011) of the Work Plan Addendum subject to the condition set forth in the Mitigation Monitoring and Reporting Program (MMRP) adopted as part of the January 31, 2011 *Final Environmental Impact Report for the Topock Compressor Station Groundwater Remediation Project* (Final EIR) (DTSC, 2011).
- DOI, Bureau of Land Management (BLM), United States Fish and Wildlife Service (USFWS), and United States Bureau of Reclamation (BOR) acceptance of the Work Plan Addendum and approval for implementation subject to conditions set forth in the letter (DOI, 2011).
- Agreement to Amend Lake or Streambed Alteration Agreement (Notification No. 1600-2005-0140-R6 between the California Department of Fish and Wildlife (CDFW) and PG&E (CDFW, 2007).
- Pre-construction and post-construction biological surveys were conducted in compliance with the *Programmatic Biological Assessment for the Pacific Gas and Electric Topock Compressor Station Remedial and Investigative Action* (PBA) (CH2M HILL, 2007).

1.2 Technical Memorandum Organization

This technical memorandum has been organized to correspond with the structure of the East Ravine Report so that the work summary conducted as part of the ER-TCS groundwater investigation can be easily referenced with the data collected as part of the 2009 ERGI. The rest of the memorandum is organized in the following manner:

- **Section 2** summarizes the borehole drilling, well installation, borehole characterization, hydraulic testing, groundwater sampling, and associated field activities performed.
- **Section 3** presents the results of the drilling investigation, including lithologic observations, borehole flow characterization, borehole groundwater sample data (screening-level), soil sample data, groundwater monitoring well data, and hydraulic testing data.

- **Section 4** summarizes the refinements made to the conceptual site model presented in the East Ravine Report by incorporating the ER-TCS investigation data and presents conclusions and recommendations for consideration in the design of the final groundwater remedy.
- **Section 5** provides a list of works cited in this technical memorandum.

2.0 Summary of Field Activities

This section summarizes the borehole drilling, well installation, borehole characterization, hydraulic testing, groundwater sampling, and associated field activities performed in accordance with the Work Plan Addendum. Phase 2 investigation activities were initiated at Sites 2 through 6, and F, H, K, and L, which were designated in the Work Plan Addendum as "primary" investigation locations (see Figure 2-1). Based on the data collected from the primary investigation locations, PG&E was directed by DTSC and DOI to expand the investigation to Sites I and J, which are designated as "contingency" locations in the Work Plan Addendum. During Phase II investigations, well installation activities were not conducted at contingency Sites 1, I-Alt, or J-Alt.

In most cases, multiple monitoring wells have been installed at each investigation site. Throughout the remainder of the document activities and data will be presented according to the specific monitoring well name and not the investigation site name (with the exception of soil data presentation). For reference, the investigation site names from Phases 1 and 2 and the corresponding monitoring well numbers are defined below, and in more detail on Table 2-1:

Site Name	Monitoring Well Series	Well Installation Phase(s)
A	MW-58 wells	Phase 1
B	MW-57 wells	Phase 1
C	MW-61 well	Phase 1
C-Alt	MW-64 wells	Phase 1
D	No wells installed	--
E	MW-62 wells	Phase 1
E-Alt-1	No wells installed	--
E-Alt-2	MW-63 well	Phase 1
F	MW-60 wells	Phases 1 and 2
G	MW-59 well	Phase 1
H	MW-70 wells	Phase 2
I	MW-73 well	Phase 2
I-Alt	No wells installed	--
J	MW-74 well	Phase 2
J-Alt	No wells installed	--
K	MW-72 wells	Phase 2
L	MW-71 well	Phase 2
1	No wells installed	Phase 2
2	MW-67 wells	Phase 2
3	MW-68 wells	Phase 2
4	MW-69 well	Phase 2

Site Name	Monitoring Well Series	Well Installation Phase(s)
5	MW-65 wells	Phase 2
6	MW-66 wells	Phase 2
MW-23	MW-23 wells	Phase 1 (reconstruction only)

Figure 2-1 presents the Phase 1 and Phase 2 primary and contingency investigation sites as originally shown in the Work Plan and Work Plan Addendum, and the groundwater monitoring wells installed at each site. Table 2-1 summarizes key drilling and well installation details. Major elements of the Phase 2 field investigation included the following:

- Site access, preparation, and compliance monitoring
- Drilling and lithologic logging
- Soil sample collection
- Monitoring well installation and development
- Borehole flow characterization
- Groundwater monitoring well sample collection
- Hydraulic testing and monitoring
- Investigation-derived waste management

2.1 Site Access, Preparation, and Compliance Monitoring

An onsite biologist conducted a pre-construction survey before work began and a post-construction survey following the completion of work at each investigation site to assess and document compliance with the PBA. The results of these surveys are provided in the *Biological Resources Completion Report for the East Ravine Groundwater Investigation, Topock Compressor Station, Needles, California* (CH2M HILL, 2012b), which was submitted to BLM and the Havasu National Wildlife Refuge (HNWR) in December 2012. The drilling sites were accessed by the approved, preexisting routes identified in the Work Plan Addendum. No vegetation was cleared during this investigation. No listed species or nesting birds were observed during the pre-activity or post-activity surveys.

Representatives of DTSC, BLM, DOI, HNWR, and Native American Indian Tribes were present during a project initiation meeting held at the TCS on March 15, 2011, immediately before investigation activities were initiated. In addition, representatives of the Fort Mojave Indian Tribe and Colorado River Indian Tribe were present during portions of the work to observe investigation activities.

Each drilling location (including contingency sites) was surveyed for underground utilities prior to work. The surveys included participating in the California Underground Service Alert (USA) mark-and-locate program and using surface geophysics. In addition, soft-clearance excavation techniques were used at all TCS locations (Sites 1 through 6) to comply with site-specific protocols (see Section 2.3).

Compliance monitoring activities associated with the Environmental Impact Report Mitigation Monitoring Reporting Program (EIR MMRP) were conducted continuously during field work associated with the Work Plan Addendum and are documented in the quarterly compliance reports, which are available on the DTSC website for the Topock Project Site.

2.2 Drilling Methods and Lithologic Logging

All drilling and lithologic logging activities were performed under the supervision of a California Professional Geologist. Soil and rock recovered during drilling were logged in accordance with the methods and procedures identified in the Work Plan Addendum. Three different drilling methods were used to install boreholes during the Phase 2 investigation: rotosonic, rotary-core, and air percussion hammer. One track-mounted drilling rig was modified in the field to conduct drilling by each of these methods for all boreholes with the exception of MW-72BR-200, which was drilled using a truck-mounted rig capable of rotosonic and rotary-core drilling. Continuous core was collected from the unconsolidated portion of all boreholes, and from all bedrock intervals of interest (i.e., typically all portions of the borehole deeper than existing boreholes at a given site).

Rotosonic drilling was used to drill through unconsolidated materials above bedrock and within consolidated bedrock when highly disturbed bedrock core was acceptable or to widen boreholes initially drilled using another method. Diamond-bit rotary core drilling with HQ-size tools (3.8-inch diameter) were used to drill through consolidated bedrock when relatively undisturbed bedrock core was required. Air percussion hammer drilling was used to drill through consolidated bedrock when core was not required and the rotosonic or rotary core methods were not practicable (i.e., when an appreciable thickness of bedrock needed to be drilled). Air percussion hammer drilling was used at only one location (within the vadose zone of Site J) while rotary-core and/or rotosonic drilling was used at all other locations. All freshwater that was used for drilling was collected from the TCS freshwater storage tanks, which are filled by supply wells on the Arizona side of the Colorado River.

Attachment A-1 describes the drilling and construction of each borehole installed during this investigation. The core obtained during this investigation was used to prepare the lithologic logs provided in Attachment A-2, and key sections of the core have been retained at the site as part of the Topock core archive. Section 2.4 discusses well installation rationale and details, and Section 3.1 discusses site lithology and hydrostratigraphy.

2.3 Soil Sample Collection

Soil samples were collected at Sites 1 through 6 and H based on the approach presented in the Work Plan Addendum. The Work Plan Addendum indicated that soil samples should be collected from Site J if there were any alluvial sediment above bedrock; however, because bedrock was encountered at the ground surface, no soil samples were collected at Site J. All soil samples were collected from the rotosonic core using the standard operating procedures established for previous phases of soil sample collection at the site with the exception of samples collected in the upper 3 to 6 feet of all sites on the TCS (Sites 1 through 6), which were collected during the soft-clearance excavation activities required to clear the boreholes for underground utilities. Specifically, the three shallowest soil samples (i.e., intervals of 0 to 0.5 foot, 2 to 3 feet, and 5 to 6 feet below ground surface [bgs]) at Sites 1, 2, 3, and 6 and the two shallowest soil samples at Sites 4 and 5 were collected during soft-clearance activities. All deeper samples at each location were collected from the rotosonic drill core with the exception of the 5- to 6-foot bgs sample at Site 5, which could not be collected due to boulder concentration (i.e., lack of soil), and the 9- to 10-foot bgs sample from Site 6, which could not be collected due to lack of core recovery. Deeper samples at Site 1 were not collected because a borehole was not drilled at this location.

The procedure used to collect soil samples during soft-clearance excavation on the TCS, which is based on the standard operating procedures established for previous phases of soil sample collection at the site, is as follows:

1. Conduct excavation using pressurized water, as necessary, and vacuum. Once the borehole has been excavated to a depth 0.5 foot shallower than a planned sample collection depth, excavation is continued using vacuum only (no water) to the depth of sample collection.
2. Using hand tools, an appropriate volume of soil required for all planned analyses (except volatile analyses) is collected and transferred to a stainless-steel mixing bowl and for subsequent homogenization.
3. The tool required for volatile aliquot collection (e.g., disposable syringe) is then used to collect a sample from a freshly exposed surface at the bottom of the borehole. This is conducted by reaching down the hole by hand; however, once the bottom of the borehole can no longer be reached, an extension tool (e.g. hand auger) is used to collect fresh soil, and the aliquot is collected at the surface from the least disturbed portion of the recovered soil.
4. The soil collected for the nonvolatile analyses are homogenized and distributed to the appropriate sample containers.

Section 3.4 presents the results of laboratory analysis of the soil samples.

2.4 Monitoring Well Installation and Development

In accordance with the logic presented in Section 2.1 of the Work Plan Addendum, each borehole installed during the Phase 2 investigation was used to install monitoring well(s), or as is the case for select bedrock boreholes, was left open for subsequent testing and groundwater monitoring activities. For locations where screening-level characterization data were collected during drilling or as a part of testing activities, monitoring well design was

established in consultation with the DTSC, DOI, and other stakeholders. Well design was based on evaluation of lithologic data from recovered core or drill cuttings, borehole flow characterization (hydrophysical data), and screening-level groundwater quality data. Once installed, each well was surveyed for location, ground surface elevation, and groundwater level measurement reference elevation. The majority of well installation and development activities were conducted from March 2011 to September 2011 with the installation and development of MW-72BR-200 taking place in June and July 2012.

The materials and methods used for installing and developing groundwater monitoring wells are presented in this section. Table 2-1 summarizes well installation details, and Attachment A-3 provides the well construction diagrams. Although drilling and well installation activities conducted as part of the Work Plan Addendum are exempt from the requirement to obtain well installation permits from San Bernardino County pursuant to the CERCLA permitting exemption, the substantive requirements associated with the permits were followed. Further, well completion reports were filed with the California Department of Water Resources and San Bernardino County by the drilling company (Boart-Longyear) and are provided in Appendix A-4.

Conventional, single-screen monitoring wells and nested monitoring wells were constructed during the investigation. Nested monitoring wells were used when it was determined that two separate monitoring zones were of interest in one borehole. The well casing, screen, and borehole completion materials were the same for the construction of both well types with the exception of the specialized centralizers that are required for nested well construction. Conventional monitoring wells were constructed to monitor intervals within the unconsolidated sediments or within the shallowest portion of saturated bedrock at MW-67-185, MW-69-195, MW-70-105, MW-71-80, MW-73-80, MW-74-240, and MW-71-35; nested monitoring wells were constructed to monitor two separate intervals within the unconsolidated sediments at MW-67-225 and MW-67-260, MW-68-180 and MW-68-240, MW-65-160 and MW-65-225, and MW-66-165 and MW-66-230. All single casings were constructed within a minimum 6-inch-diameter rotosonic drill casing, which was retracted as the well was constructed. Nested casings were installed within a minimum 10-inch diameter rotosonic drill casing. Each well was constructed with threaded, 2-inch-diameter, schedule 40 polyvinyl chloride (PVC) casing and screen (0.02-inch factory-slotted). Filter pack material consisting of no. 3 Monterey silica sand was installed around the screen and a minimum of 2 feet above the top of the screened interval with an additional 0.5 to 1 foot of no. 60 transition sand. The screened interval was then sealed from the remainder of the borehole with approximately 5 feet of bentonite chips. Grout was installed via positive pressure tremie from the top of the bentonite seal up to near ground surface displacing water that had collected in the borehole above the bentonite seal.

Boreholes MW-68BR-280, MW-66BR-270, MW-60BR-245, MW-70BR-225, and MW-72BR-200 were drilled into bedrock through permanent conductor casing. For each of these boreholes, the permanent conductor casing was installed to isolate deeper portions of the borehole from shallower intervals of the aquifer, which were monitored by separate wells. Specifically, the deeper boreholes at MW-68BR-280 and MW-66BR-270 were isolated from the unconsolidated portion of the aquifer, and deeper boreholes at MW-60BR-245, MW-70BR-225, and MW-72BR-200 were isolated from shallower portions of the bedrock aquifer. These boreholes were not completed with permanent well screen and casing in addition to the conductor casing, and remain as open bedrock boreholes for subsequent testing and groundwater monitoring, as determined necessary. Five inch diameter PVC conductor casing was used at MW-60BR-245, and MW-70BR-225, and 6-inch diameter was used at MW-72BR-200. Five inch diameter steel conductor casing was used at MW-68BR-280 and MW-66BR-270 due to the depth of installation. All conductor casings were constructed with a minimum 2-inch annulus between the casing and the borehole wall. Portland cement grout was used to seal the annulus between the conductor casing and the borehole wall from the total depth of installation to the ground surface.

Small volumes of drilling fluids and/or grout were observed to “daylight” in the slope nearby the boreholes during the installation process for wells at the MW-60 cluster and the MW-72 cluster. The work area at each of these sites is situated on an artificial pathway/road that was created on the edge of a steep slope. Therefore, a steep slope that drops to a lower elevation is located approximately 10-20 feet from the borehole. Shallow, gravel containing fill comprises the upper 8 and 13 feet at MW-60 and MW-72, respectively. When the boreholes are filled with fluids, either for the purpose of drilling or grouting, the open pore spaces in the fill that are typically dry

provide a conduit for these fluids to migrate away from the borehole. The migration of fluids during drilling in the vadose zone is not uncommon; however, because most drill sites are not adjacent to a steeply dipping slope, the migration of fluids isn't typically visible at the ground surface. Due to the proximity of the steeply dipping slopes at these two sites, the fluids were visible on the surface of the slope. At MW-60 approximately 10-20 gallons of grout accumulated at the base of the slope during the installation the MW-60-125 well casing (during Phase 1), and a minor amount grout was observed on the slope during the conductor casing installed for MW-60BR-245 (Phase 2). The grout that accumulated near MW-60 was removed from the base of the slope following work. During initial drilling of both MW-72 boreholes, small areas (less than one square foot) became noticeably wet, but fluids did not accumulate on or at the base of the slope. Grout was not observed on the surface of the slope near MW-72.

After well construction or borehole drilling activities were completed, each well or borehole was developed to remove fluids introduced during drilling and installation. All monitoring wells were developed using a combination of surging, bailing, and pumping, as necessary. All open boreholes were initially flushed from the bottom of the hole using freshwater to remove drilling cuttings and then developed using a combination of bailing and pumping, as necessary. During development, temperature, pH, specific conductance, oxidation reduction potential (ORP), dissolved oxygen, and turbidity were measured using field instruments. Well development was continued until the minimum purge volume (based on estimates of water loss during drilling) had been removed and field water quality parameters had stabilized in ranges indicative of groundwater (i.e., different water quality signature than that from the source water used during installation). Once development was complete, screening-level groundwater samples were collected for analysis at the offsite laboratory for hexavalent chromium [Cr(VI)] and Title 22 metals (results are discussed in Section 3.3).

2.5 Borehole Flow Characterization

Borehole flow characterization testing was conducted in the open bedrock boreholes at MW-60BR-245, MW-70BR-225, and MW-72BR-200 to identify groundwater producing fractures within the metadiorite bedrock. This testing was not conducted at Sites 3 and 6 due to the relatively small length of open borehole (approximately 20 feet of open borehole at these locations compared to the 80 to 100 feet at MW-60BR-245, MW-70BR-225, and MW-72BR-200). Based on the low range of inflow rates detected during the ERGI investigation, borehole dilution testing (here forth referred to as hydrophysical testing or hydrophysics) was selected for characterization during the Phase 2 investigation. Hydrophysical testing was conducted by RAS, Inc. in October and November 2011 at MW-60BR-245 and MW-70BR-225, and during July 2012 at MW-72BR-200.

Hydrophysical testing uses the contrast in fluid electrical conductivity (FEC) and temperature between deionized water and groundwater in the formation to identify intervals of groundwater inflow and outflow in the borehole. The testing is conducted in two phases to characterize flow under both ambient and, subsequently, induced flow or pumping conditions.

During testing under ambient flow conditions, higher FEC formation water within the borehole is replaced with deionized water (FEC near zero), taking care to maintain static water levels during deionized water emplacement. After the deionized water was emplaced, the rates and depths where higher FEC groundwater flows from the formation into and out of the borehole were logged over time using a specialized, down-hole FEC measurement tool.

Following ambient flow characterization, testing was conducted in a similar manner under induced flow (i.e., pumping) conditions to increase the probability of detecting conductive intervals that may not be identified in the ambient flow condition. Due to the location of conductive intervals identified during ambient flow characterization in each of the three boreholes, induced flow testing was conducted using a submersible pump placed near the bottom of the borehole. At MW-60BR-245, where constant rate pumping was not practicable due to low borehole yield, induced flow testing was conducted by removing a slug of water from the borehole and logging the FEC into the borehole during recovery. The data collected were analyzed to evaluate intervals of inflow and outflow in the borehole during well production, in conjunction with drawdown data, so that the flow rate and hydraulic conductivity values for each zone and cumulative flow rate within the borehole could be estimated.

Depth-specific groundwater samples were collected from the boreholes at MW-60BR-245 and MW-72BR-200 where multiple flow intervals were identified through the field analysis of the ambient and induced flow hydrophysical data. The depth-specific samples were collected using a wireline straddle packer tool to isolate fractures in the interval of interest. This tool consists of bladder pump assembled between two inflatable packers, and it is operated on a wireline. With the sample interval identified, the straddle packer tool is moved into place, the packers are inflated, and the zone is purged and sampled using the bladder pump. With only one interval of inflow identified in MW-70BR-225 the straddle packer tool was not necessary, and the groundwater sample was collected from the pump discharge at the conclusion of induced flow testing. Samples collected during borehole flow characterization testing were analyzed for Cr(VI) and Title 22 metals at the offsite laboratory. Sections 3.2 and 3.3 summarize the testing activities and results conducted at MW-60BR-245, MW-70BR-225, and MW-72BR-200.

2.6 Groundwater Monitoring Well Sampling

Groundwater monitoring wells and exploratory boreholes installed during the Phase 2 investigation were sampled during monthly sampling events conducted from June through November 2011. Each well was added to these events as installation was completed. A contemporaneous groundwater monitoring event was conducted in December 2011, which included all wells then installed as part of the Phase 2 investigation and all wells installed during the Phase 1. All Phase 1 and 2 wells were subsequently sampled in February, May, and September 2012 as part of the quarterly events associated with the Topock Groundwater Monitoring Program (GMP). The initial sample from MW-72BR-200, which was installed and tested in June and July 2012, was collected during the September 2012 event. Table 2-2 summarizes the groundwater sampling events conducted as part of the entire duration of the investigation (Phase 1, Phase 2, and GMP events conducted from Phase 1 through February 2013), and Section 3.5 summarizes the laboratory analytical results.

2.7 Hydraulic Testing and Monitoring

Hydraulic data were collected during Phase 2 to assist with refining the conceptual model for the East Ravine and TCS areas. Hydraulic testing and water level gauging activities were performed in January 2012. A constant-rate extraction test was performed at Site H (MW-70BR-225) to evaluate the effect of pumping in this well on nearby wells completed in the bedrock and unconsolidated aquifer. During the test, the MW-70BR-225 well was pumped at a sustained rate of approximately 9.5 gallons per minute (gpm) for a period of approximately 12 hours. Water levels were monitored in the pumping well (MW-70BR-225) and 20 observation wells using pressure transducers with data-logging capability: MW-12, MW-48, MW-23-060, MW-23-080, MW-57-070, MW-57-185, MWR-58BR[1], MW-59-100, MW-60-125, MW-60BR-225, MW-61-110, MW-62-065, MW-63-065, MW-64BR-UPR , MW-68-180, MW-69-195, MW-71-35, MW-72-080, MW-73-080, and MW-74-240. In addition, another eight observation wells were monitored manually during the test: MW-65-160, MW-65-225, MW-66-165, MW-66-230, MW-67-185, MW-67-225, MW-67-260, MW-68-240, MW-68BR-280, and MW-70-105. Groundwater samples were collected from the pump effluent at the beginning, during, and end of the 12-hour test for analysis at the onsite Interim Measures (IM) No. 3 laboratory. Water level measurements were collected to evaluate horizontal and vertical gradients within wells installed in the East Ravine and TCS areas over a period of approximately 1 hour immediately prior to the start of the MW-70BR-225 constant-rate extraction test. This “water level snapshot” was collected using manual depth-to-water measurements.

2.8 Investigation-Derived Waste Management

Investigation-derived waste was managed in accordance with the procedures detailed in the Work Plan Addendum. All waste generated during the 2011 and 2012 investigation was non-hazardous. Solid and liquid wastes generated during this investigation were temporarily stored at the work area in hoppers (drill cuttings) and portable tanks (liquids), and then transferred to lined roll-off bins and storage tanks located on the decontamination pad. Waste from respective storage tanks and roll-off bins were sampled for waste characterization. Disposal characterization samples were submitted to certified laboratories for the same analyses

[1] The packer installed in the MW-58BR borehole was not functional at the time of the test. Therefore, the water level monitored during the test represents the entire borehole.

during previous drilling projects, including Title 22 metals, mercury, and percent moisture for drill cuttings and total organics and Title 22 metals for liquids.

Based on the waste characterization results, liquid waste was either transferred to the IM No. 3 groundwater treatment facility for onsite treatment and injection in compliance with California Regional Water Quality Control Board (RWQCB) Order No. R7-2006-0060 (2006), or transported to an offsite treatment facility: Liquid Environmental Solutions (LES), located in Phoenix, Arizona. Typically, waste that was transported to LES had detections of total petroleum hydrocarbons (TPH) (both diesel and motor oil range), which cannot be treated at the IM No. 3 treatment facility. It is assumed that the TPH introduced to the waste stream during the decontamination of the drilling rig and associated equipment, which are prone to minor leakage (e.g., motor oil or hydraulic oil). A total of approximately 25,000 gallons was treated at IM No. 3 and 20,000 gallons was transported offsite and treated at LES. Waste that was shipped to LES was treated under PG&E's profile number—202805.

Approximately 100 cubic yards of drill cuttings were generated during this investigation. Based on the composite soil characterization sample results, dry drill cuttings were either stored onsite or transported offsite to the US Ecology, Inc., Beatty, Nevada, Hazardous Waste Treatment and Disposal Facility (all waste shipped to the facility was non-hazardous). Waste that was stored onsite was stockpiled in a designated location where soil will be used for future uses. Waste that was shipped offsite for disposal had concentrations that were at or above the established screening levels for the Topock site for either TPH (motor oil range) and/or metals or had physical properties that were not conducive to storage (i.e., rock flour suspended in thick slurry). Approximately 20 cubic yards of drill cuttings were stockpiled onsite for future use, and 80 cubic yards of drill cuttings were transported offsite to the US Ecology disposal facility. Waste that was shipped offsite for disposal was shipped and/or disposed under PG&E's profile number—070181764-0.

Incidental trash was removed from the work area daily and was transferred to a standard trash bin at the TCS for offsite disposal.

3.0 Investigation Results

This section presents the results of the soil, hydrogeologic, and water quality sampling and testing activities conducted as part of the investigation. Section 4.0 discusses the integration of all of the available data from the East Ravine area investigations into the TCS site hydrogeologic conceptual model.

3.1 Lithology and Hydrostratigraphy

A primary objective of this investigation was to further characterize the site hydrogeologic conditions in the East Ravine and TCS areas. Table 3-1 summarizes the lithology encountered during Phase 1 and Phase 2 well installation. Five hydrogeologic cross-sections have been prepared to illustrate the lithologic and hydrogeologic data collected during drilling and well sampling. These cross-sections present the interpreted hydrostratigraphy, well-screen intervals, primary lithologic contacts, Cr(VI) laboratory results for soil samples collected during Phases 1 and 2, and the average Cr(VI) laboratory analytical results from select wells sampled over the entire duration of the investigation (these results further discussed in Section 3.5). Figure 3-1 shows the locations of these cross-sections, and Figures 3-2 through 3-6 present the hydrogeologic cross-sections.

Following are the key findings from incorporating the lithologic data collected during the Phase 2 investigation:

- The depth to bedrock beneath the TCS was found to be deeper than previously estimated, which indicates a larger area of saturated alluvium in this area. Figure 3-1 presents a revised estimated contact between the alluvial aquifer and bedrock.
- Saturated alluvium in the East Ravine area was only encountered at MW-71-035 (Site L), where the saturated thickness above conglomerate bedrock was relatively thin. Sediments at this location were relatively fine-grained compared with areas of saturated sediments to the east.
- The contact between conglomerate and metadiorite bedrock was encountered at MW-68BR-280 (Site 3). The interval of degraded cementation in the conglomerate above the contact and the mylonitic structure of the bedrock across this contact was similar to that observed at MW-57-185 (ERGI Site B), which is the only other

place where this contact has been drilled. At both locations, this contact has been observed to yield very little groundwater.

- Metadiorite bedrock was encountered as estimated in all of the drilling sites located in the East Ravine and to the south. The physical nature of the recovered bedrock core was similar to that observed during the Phase 1.

3.2 Borehole Flow Characterization Results

Borehole flow logging was conducted using fluid replacement and fluid-column conductivity logging or "hydrophysical" logging methods at three of the exploratory boreholes (MW-60BR-245, MW-70BR-255, and MW-72BR-200) to identify water-bearing intervals within the bedrock. Testing was conducted under ambient (static-water level) and induced (decrease-water level) flow conditions. Based on the identified intervals of flow, depth-specific groundwater samples were also collected in boreholes MW-60BR-245 and MW-72BR-200 to estimate an interval-specific chromium concentration. Attachment B-1 figures presents a summary of these data.

Several flow zones were identified in borehole MW-60BR-245 above 200 feet in depth; however, the contribution of these shallower intervals to total flow within the borehole was minor. The dominant flow zone was located near the bottom of the borehole at a depth between 236 and 240 feet. Three depth-specific grab samples were collected using packers. Concentrations of Cr(VI) were 130 micrograms per liter (µg/L), 290 µg/L, and 78 µg/L in the shallow, middle, and deep samples, respectively.

Only one flow zone was identified in borehole MW-70BR-255. This interval is located near the bottom of the borehole at a depth of 208 and 220 feet. The flow rate calculated for this interval is the highest of all intervals identified during hydrophysical testing as part of both Phases 1 and 2. Because there was only one flow zone encountered in the borehole, packers were not used to collect depth-specific samples. It was assumed that any sample collected from the well would represent this single, dominant flow zone.

Two primary flow zones and one very minor flow zone were identified in borehole MW-72BR-200. The dominant interval of flow was observed in the middle of the borehole at a depth of approximately 148 to 168 feet and represents about 80 percent of the total flow in the borehole under ambient head conditions. A lesser interval of flow was identified at the bottom of the borehole at a depth of about 195 feet, representing less than 20 percent of the flow in the ambient condition. Depth-specific grab samples were collected from the two primary flow zones (148 to 168 feet and 191 to 198.5 feet) using packers. An attempt at collecting a sample from the minor flow zone near the top of the open portion of the borehole was made, but due to the extremely low rate of recover after pumping, the sample could not be collected. Concentrations of Cr(VI) observed in the middle and deep depth-specific samples were 2 µg/L and non-detect (less than 1 µg/L), respectively.

3.3 Screening-level Groundwater Sample Results

Three types of screening-level groundwater samples were collected during the Phase 2 investigation:

- Depth-specific samples collected during bedrock borehole flow characterization using packers
- Depth-specific samples collected from saturated, unconsolidated sediments during drilling using the Iso-Flow® sampling method
- Pump effluent samples collected immediately following the completion of well development activities (all wells) or during well testing (MW-70BR-225 only)

Some of these screening level data were evaluated by PG&E, DTSC, DOI, and other stakeholders during the field investigation to guide decisions on contingency well installation and well design. Screening-level groundwater samples were analyzed for Cr(VI) and Title 22 metals at either the IM No. 3 onsite laboratory (samples from MW-70BR-225 well testing only) or the offsite Advanced Technologies Laboratory. Groundwater samples obtained during well development, aquifer testing, and borehole flow characterization activities (i.e., grab samples) are considered screening-level data for use as a qualitative assessment of water quality conditions in the aquifer. Therefore, the screening-level samples are not directly compared with laboratory analytical data obtained from completed monitoring wells (provided in Section 3.5). Attachment B-2 summarizes the results of screening-level samples.

As noted in Section 3.2 above, three depth-specific screening level samples were collected from the open bedrock borehole in MW-60BR-245 and two in MW-72BR-200 during the borehole flow characterization testing. Subsequent samples from the MW-60BR-245 and MW-72BR-200 boreholes during the GMP events have generally been within or slightly below the range of concentration represented by the screening level samples. No other depth-specific samples were collected from bedrock during this phase of the investigation.

Depth-specific samples were collected from saturated, unconsolidated portions of the borehole at four locations on the TCS (Sites 2 [BH-67], 3 [BH-68], 5 [BH-65] and 6 [BH-66]) using Iso-Flow® sampling method. Saturated alluvium was also encountered at Site L (BH-71), but there was not enough saturated thickness above bedrock to use the Iso-Flow® method. This method involves pulling back the drive casing and sampling the water in the exposed portion of the borehole using a submersible pump with a rubber diaphragm above the pump to isolate the sampling zone. Where well screens were later installed at the same depths as the Iso-Flow® samples were collected, the concentrations can be compared; however, there is no consistent trend in comparing chromium results. Some Iso-Flow® samples had lower chromium than the subsequent well samples and some had higher. For many other constituents, the variability between Iso-Flow® results and subsequent well results seems to be less than for chromium.

Pump effluent samples were collected after development activities at each completed well or exploratory borehole were completed and during the MW-70BR-225 well test. The post-development data were used for field planning and purged water characterization purposes only. Samples collected during the MW-70BR-225 well test were used to evaluate any trends in the chromium concentration over time during the test and are further discussed in Section 3.6.

3.4 Soil Sample Results

Soil sampling was conducted at each drilling site at the TCS site and at Site H to evaluate the extent of contamination (if present) in the soil (as discussed in Section 2.3). A total of 95 soil samples were collected and analyzed at the laboratory during Phase 2. These data have been incorporated into the existing Soil RFI/RI data set, and specifically, were included in the *Final Soil RCRA Facility Investigation/Remedial Investigation Work Plan* (Final Soil RFI/RI Work Plan; CH2M HILL, 2012a). As presented in the Final Soil RFI/RI Work Plan, soil sample results were compared to the following different screening levels: a) background threshold values (BTVs) and residential and ecological screening levels (if greater than BTV) if collected outside the TCS fence line, and b) commercial screening levels if collected inside the TCS fence line. For the purpose of this report, where analysis of the soil data is focused on the development of the conceptual site model for the ER-TCS areas, results inorganic analytes are compared only to BTVs. For organic analytes, results inside the compressor station fence line were compared to commercial screening levels and results outside the fence line were compared to residential screening levels. If the appropriate DTSC CHHSL was not established, the U.S. Environmental Protective Agency regional screening level was used.

Soil samples were analyzed for metals, inorganics, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and TPH. Soil samples that were collected from fill material were also analyzed for dioxins and furans. Tables for detected analytes in Phase 1 and Phase 2 soil samples are provided as Attachment C-1 of this technical memorandum.

3.4.1 Summary of Hexavalent Chromium, Total Chromium, and Other Metals Results

The following summarizes the soil sample results for Cr(VI), total chromium [Cr(T)], and other metals detected above screening levels at each Phase 2 site where soil samples were collected. Cr(VI) and Cr(T) results for all Phase 1 and Phase 2 soil samples are shown on Figure 3-7.

Site H (BH-70, in which MW-70-105 was installed). Bedrock was encountered at approximately the same depth as the water table at 69 feet bgs; a total of 12 soil samples (including one duplicate sample) were collected above the bedrock/water table. Samples were collected from 0 to 0.5, 2 to 3, 5 to 6, 9 to 10, 14 to 15, 19 to 20, and every 10 feet thereafter to 70 feet bgs. This borehole is located outside the TCS fence line.

- Concentrations of Cr(T) ranged from 7.3 to 66 milligrams per kilogram (mg/kg), five detected concentrations exceeded the BTV of 39.8 mg/kg.

- Cr(VI) was detected above laboratory reporting limits in three samples collected from 0 to 0.5, 2 to 3, and 5 to 6 feet bgs at concentrations of 1.1, 1.6, and 0.43 mg/kg, respectively. Two of the detected concentrations exceeded the BTV of 0.83 mg/kg.
- Aluminum, barium, cobalt, copper, lead, magnesium, manganese, nickel, vanadium, and zinc were also detected above respective BTVs.
- Remaining metals, if detected above laboratory reporting limits, were detected at concentrations below respective BTVs.

Site 1. No boreholes or wells were installed at Site 1; however, soil samples were collected from 0 to 0.5, 2 to 3, and 5 to 6 feet bgs while clearing the location for utilities. This site is located outside the TCS fence line.

- Detected concentrations of Cr(T) ranged from 8.9 to 13 mg/kg, which are below the BTV of 39.8 mg/kg.
- Cr(VI) was not detected above laboratory reporting limits.
- All other metals, if detected above laboratory reporting limits, were detected at concentrations below respective BTVs.

Site 2 (BH-67, in which nested wells MW-67-225 and MW-67-260 were installed). The water table was encountered at approximately 170 feet bgs; a total of 22 soil samples (including two duplicate samples) were collected from ground surface to 160 feet bgs. Samples were collected from 0 to 0.5, 2 to 3, 5 to 6, 9 to 10, 14 to 15, 19, to 20 feet bgs, and every ten feet thereafter to 160 feet bgs. This borehole is located inside the TCS fence line.

- Detected concentrations of Cr(T) ranged from 2.1 to 32 mg/kg, which are below the BTV of 39.8 mg/kg.
- Cr(VI) was detected in one sample at a concentration below the BTV.
- Barium, cobalt, lead, molybdenum, nickel, vanadium, and zinc were detected above respective BTVs.
- Remaining metals, if detected above laboratory reporting limits, were detected at concentrations below respective BTVs.

Site 3 (BH-68, in which nested wells MW-68-180 and MW-68-240 were installed). The water table was encountered at approximately 164 feet bgs; a total of 22 soil samples (including two duplicate samples) were collected from ground surface to 160 feet bgs. Samples were collected from 0 to 0.5, 2 to 3, 5 to 6, 9 to 10, 14 to 15, 19 to 20 feet bgs, and every 10 feet thereafter to 160 feet bgs. This borehole is located inside the TCS fence line.

- Detected concentrations of Cr(T) s ranged from 4.2 to 48 mg/kg. Two detected concentrations (45 mg/kg collected from 139 to 140 feet bgs and 48 mg/kg collected from 149 to 150 feet bgs) slightly exceeded the BTV of 39.8 mg/kg.
- Cr(VI) was not detected above laboratory reporting limit.
- Copper, lead, and nickel were also detected above respective BTVs.
- Remaining metals, if detected above laboratory reporting limits, were detected at concentrations below respective BTVs.

Site 4 (BH-69, in which MW-69-195 was installed). Bedrock was encountered above the water table at 42 feet bgs; a total of 8 soil samples were collected above the bedrock. Samples were collected from 0 to 0.5, 2 to 3, 5 to 6, 9 to 10, 14 to 15, 19 to 20, 19 to 30, and 39 to 40 feet bgs. This borehole is located outside the TCS fence line.

- Detected concentrations of Cr(T) concentrations ranged from 45 to 63 mg/kg, and all detected concentrations exceeded the BTV of 39.8 mg/kg.
- Cr(VI) was detected in one soil sample at a concentration below the BTV.

- Aluminum, calcium, copper, lead, magnesium, manganese, nickel, potassium, vanadium, and zinc were also detected above the BTV.
- Remaining metals, if detected above laboratory reporting limits, were detected at concentrations below respective BTVs.

Site 5 (BH-65, in which nested wells MW-65-160 and MW-65-225 were installed). The water table was encountered at approximately 140 feet bgs; a total of 18 soil samples (including one duplicate sample) were collected between ground surface and 140 feet bgs. Samples were collected from 0 to 0.5, 2 to 3, 5 to 6, 9 to 10, 14 to 15, 19 to 20 feet bgs, and every 10 feet thereafter to 140 feet bgs. This borehole is located inside the TCS fence line.

- Detected concentrations of Cr(T) ranged from 12 to 66 mg/kg. Eight detected concentrations (including one duplicate sample) exceeded the BTV of 39.8 mg/kg
- Cr(VI) was detected in two soil samples at 0.52 mg/kg collected from 0 to 0.5 feet bgs and 0.79 mg/kg collected from 2 to 3 feet bgs, which are below the BTV of 0.83 mg/kg.
- Barium, cobalt, copper, lead, nickel, vanadium, and zinc were also detected above the BTV.
- Remaining metals, if detected above laboratory reporting limits, were detected at concentrations below respective BTVs.

Site 6 (BH-66, in which nested wells MW-66-165 and MW-66-230 were installed). The water table was encountered at approximately 130 feet bgs; a total of 18 soil samples (including two duplicate samples) were collected between ground surface and 130 feet bgs. Samples were collected from 0 to 0.5, 2 to 3, 5 to 6, 9 to 10, 14 to 15, 19 to 20 feet bgs, and every 10 feet thereafter to 130 feet bgs. This borehole is located inside the TCS fence line.

- Detected concentrations of Cr(T) ranged from 5.3 to 29 mg/kg, which are below the BTV of 39.8 mg/kg.
- Cr(VI) were not detected above laboratory reporting limits.
- Lead was also detected above the BTVs.
- Remaining metals, if detected above laboratory reporting limits, were detected at concentrations below respective BTVs.

3.4.2 Summary of TPH and Organics Results

Detected concentrations of PAHs and calculated quantities (Benzo(a)pyrene equivalents, total low-molecular-weight PAHs, and total high-molecular-weight PAHs) were below respective screening levels at BH-67, BH-69, BH-65, BH-66, and BH-70 and were not detected above laboratory reporting limits at Site 1 and BH-68.

PCBs and total PCBs were detected at concentrations below respective screening levels at Sites BH-68, BH-69, BH-65, BH-66, and BH-70, and were not detected above laboratory reporting limits at Site 1 and BH-67.

TPH as diesel and motor oil were detected in soil samples at all sites where soil samples were collected (BH-65 though BH-70, and Site 1) at various depths ranging from 0 and 20 feet bgs, but all detected concentrations were below RWQCB environmental screening levels.

Calculated quantities of dioxins and furans (toxicity equivalents quotient [TEQ]) were below the human-TEQ screening value of 50 mg/kg at all sites where fill was encountered including Site 1, BH-67, BH-68, BH-65, BH-66, and BH-69 (dioxins and furans were not analyzed at BH-70 as fill was not encountered). However, the 0 to 0.5 foot bgs sample from BH-69 exceeded the avian-TEQ and mammal-TEQ ecological screening values (ECVs) and the 2 to 3 feet bgs sample from BH-69 exceeded the mammal-TEQ ECV. No other samples exceeded the ECVs.

Volatile organic compounds were not detected in any of the samples collected with the exception of the surface soil sample at BH-70 where 4-isopropyl toluene was detected and the sample from 60 feet in BH-67 where isopropyl benzene was detected.

3.5 Groundwater Sample Results

This section discusses the results of groundwater samples collected from the wells installed during the ER-TCS investigation. Some of the data discussed in the following sections were provided in previous GMP reports. Analytical results for chromium and other metals are presented on Table 3-2 with average, minimum, and maximum calculations for these data calculated on Table 3-3. The data for general chemistry parameters and field parameters are presented using the same approach on Tables 3-4 through 3-7. Complete laboratory analytical results for groundwater constituents collected as part of the ER-TCS investigation are provided in Attachment C-2.

3.5.1 Distribution of Chromium and Field Measurements

The distribution of Cr(VI) in groundwater is presented on Figure 3-8. This figure shows the minimum, maximum, and average concentrations observed in each well, along with the number of samples in the data set for that well. Tables 3-2 and 3-3 provide the data that are displayed on Figure 3-8. Average Cr(VI) concentration is also presented on the geologic cross sections, Figures 3-2 through 3-6.

The highest concentrations of Cr(VI) in any of the ER-TCS wells were observed in the shallow alluvial well MW-68-180, located in east-central part of the TCS, where Cr(VI) as high as 22,000 µg/L occurred in December 2011. The average Cr(VI) concentration in MW-68-180 is 14,200 µg/L. This well is located near the former "hot well", a concrete tank which acted as a reservoir and surge tank for the jacket water cooling system. Chromium was formerly used as a corrosion inhibitor in the jacket water. Overflows from the hot well are known to have occurred in the past and may be associated with the elevated Cr(VI) concentrations at MW-68-180. Cr(VI) concentrations at MW-68-180 have fluctuated over a relatively wide range, from 1,400 µg/L to 22,000 µg/L. Large fluctuations in concentration are often observed in wells located near contaminant source areas, where steep concentration gradients are present in the aquifer and slight changes in groundwater flow direction result in relatively large changes in concentration in nearby wells. It is also worth noting that the isotopic signature of MW-68-180 is heavier than any of the other ER-TCS wells, with a $\delta^{18}O$ value of minus 7.2 parts per mil (Table 3-5). MW-68-180 is plotted as the green diamond furthest to the right on Figure 3-14, indicating a strong industrial water signature. The TDS in this well is relatively low, averaging 2,450 mg/L.

The highest concentrations of Cr(VI) in any of the ER-TCS wells completed in bedrock were in well MW-70BR-225, where Cr(VI) has ranged from 1,600 to 2,460 µg/L with an average of 2,160 µg/L. As discussed in subsequent sections, MW-70BR-225 produces more water (based on review of specific capacity data and permeability calculations from the hydrophysical testing) and has an isotopic signature that is more similar to alluvial water than most other bedrock wells. This well may be connected through fractures to the relatively nearby alluvial aquifer, and may therefore, produce water that represents a mixture of bedrock and alluvial aquifer water.

As shown in plan view on Figure 3-8 and in cross section on Figure 3-2, the existing monitor wells do not fully define the extent of the area of elevated Cr(VI) in bedrock to the south of the East Ravine. Installation of additional monitor wells further to the south would have required extensive earth works to construct roads and drill pads in extremely steep and rocky terrain. The degree of disturbance that would be necessary to construct additional monitor wells further south was not considered justified. There are no suspected sources of chromium south of the East Ravine and current groundwater gradients are northward. It is therefore unlikely that the plume extends to the south beyond the inferred plume boundary shown on Figure 3-8.

Field parameters shown on Tables 3-6 and 3-7 include specific conductance, temperature, pH, ORP, dissolved oxygen, salinity, and turbidity. These parameters are measured at the time of sampling using portable monitoring equipment. No consistent trends are evident in the ORP or pH data. There are some trends in the specific conductance data from the ER-TCS wells that are consistent with most of the ER-TCS wells. In general, specific conductance is higher and the dissolved oxygen is lower in the deeper wells within each well cluster. This trend is observed in both alluvial and bedrock wells and is consistent with the theory that in this lower portion of the Mohave basin, older connate water is upwelling from the deeper portions of basin. During the eons that it could take for groundwater to move through the basin, the salts are leached from the rocks, increasing specific conductance, and dissolved oxygen is lost through reactions with reduced mineral species. This gradient of

decreasing concentrations from deep to shallow is consistent with the conceptual model of upward movement of groundwater from bedrock to alluvium and from deep to shallower alluvium.

The DTSC geologist questioned whether the fresher water may have infiltrated from surface flows in East Ravine and flushed out the shallow groundwater zone, resulting in lower specific conductance in shallow wells completed in the bottom of the East Ravine. There are four shallow bedrock wells completed in the bottom of East Ravine. From upstream to downstream, these wells are MW-70-105, MW-58BR-UPR, MW-57-70, and MW-62-065. In addition, there are two "perched zone" wells, MW-58-65 and MW-57-50 which are located in the bottom of the ravine but have been dry since shortly after they were drilled. There is only one sample from each of these perched zone wells and it is likely that those samples were compromised due to the inability to develop out all the water that was added during drilling due to low yield. The most reliable data are therefore considered to be from the four shallow bedrock wells. The average specific conductance for these wells in micro-Siemens per centimeter (µS/cm) is 3,050, 11,200, 2,510, and 6,390, respectively. For comparison, the specific conductance of the two shallow bedrock wells in the southern portion of the compressor station are 3,840 µS/cm in MW-69-195 and 1,120 µS/cm in MW-74-240. Shallow bedrock wells further to the south, away from the axis of the East Ravine, appear to have higher specific conductance; 12,100 µS/cm at MW-64BR-UPR, 15,700 µS/cm at MW-72-80, and 11,300 µS/cm at MW-73-80. In conclusion, the four shallow bedrock wells in the bottom of the East Ravine have specific conductance within the same general range as shallow bedrock wells further from the axis of the ravine where focused recharge of surface water would not be expected.

3.5.2 Sample Results for Non-chromium Contaminants of Potential Concern in the ER-TCS Wells

DTSC and DOI have directed that molybdenum, selenium, and nitrate be monitored in the GMP and their associated impacts be considered in future soil and soil to groundwater risk evaluations based on the fact that they were present at concentrations that resulted in risk above a hazard index of 1. Therefore, discussion of the distribution of these three compounds is included:

Molybdenum. Molybdenum concentrations above the alluvial aquifer background upper tolerance limit (UTL) of 36.3 µg/L have been observed in most of the ER-TCS wells (Figure 3-9). There is no California maximum contaminant level (MCL) for molybdenum. The highest average concentrations of 138 µg/L and 129 µg/L were respectively found in shallow bedrock wells MW-70-105, located in the bottom of East Ravine east of the TCS and MW-74-240, located on the hill near the water tanks south of the TCS. The highest average concentration observed in any of the ER-TCS alluvial wells was 75.4 µg/L at well MW-67-260, located near the north gate of the compressor station. The lowest average molybdenum concentration in the alluvial wells beneath the TCS was 11 µg/L in MW-66-165. The higher concentrations were generally found in the deeper alluvial wells; however, there is no apparent pattern to the distribution of molybdenum across the ER-TCS area wells.

Nitrate. Average nitrate concentrations above the UTL of 5.03 mg/L were found in eleven wells, while concentrations above the California MCL of 10 mg/L were found in eight wells on the compressor station, with higher concentrations generally in shallower wells (Figure 3-10). The highest concentrations, 39.1 and 31 mg/L, were present in shallow alluvial wells MW-66-165 and MW-68-180, respectively. The highest concentration in bedrock was in shallow bedrock well MW-69-195 where the maximum concentration was 22.4 mg/L. Other compressor station wells where nitrate was above the MCL included alluvial wells MW-65-160, MW-65-225, MW-67-185 and MW-67-225. Nitrate was below the MCL in all the other ER-TCS wells.

Selenium. Selenium concentrations above the alluvial aquifer background UTL of 10.3 µg/L were present in several ER-TCS wells on the TCS. The California MCL for selenium is 50 µg/L. The highest concentrations (up to 100 µg/L) were in wells MW-67-185 and MW-67-225, located near the north gate of the TCS (Figure 3-11). Average concentrations above alluvial aquifer background were also found in the shallow alluvial wells MW-66-165 and MW-68-180 and the shallow bedrock well MW-69-195. Average selenium concentrations were below alluvial aquifer background in the deeper alluvial and bedrock wells on the TCS and in all the ER-TCS wells in East Ravine. Maximum concentrations exceeded alluvial aquifer background in both the deep and shallow wells in the MW-60 cluster and in the shallower well at the MW-64 cluster. Both of these well clusters are located south of the axis of the East Ravine.

3.5.3 Sample Results for Additional Constituents

In addition to the constituents listed above, the select ER-TCS wells were sampled for a relatively long list of constituents as defined in the Work Plan Addendum, including Title 22 metals, volatile and semi-volatile organics, PCBs, dioxins/furans, pesticides, PAHs, and fuel hydrocarbons. Highlights of these results include the following:

Inorganics. Compounds present at concentrations above the respective alluvial aquifer background UTL values included arsenic, barium, cobalt, copper, fluoride, mercury, silver, and thallium. As requested by the agencies, detailed evaluation of the occurrence of arsenic and fluoride in the ER-TCS area is provided.

- There were five wells where maximum arsenic concentrations were above the alluvial aquifer UTL of 24.3 µg/L (Figure 3-12)These wells included MW-23-60, MW-62-110, MW-62-190 and MW-57-185 located near the downstream end of the East Ravine, and well MW-74-240 located near the water tanks above the compressor station (Figure 3-12). These are all bedrock wells. Average arsenic concentrations were below the alluvial aquifer UTL in all wells. The highest average concentration was 20.4 µg/L in MW-74-240. There is no apparent pattern of higher concentration in deep or shallow wells. Overall, arsenic concentrations appear to be slightly higher in wells near the river than in wells at the compressor station.
- Fluoride above the UTL of 7.12 µg/L was present in six wells at a maximum concentration of 13 µg/L in well MW-68BR-280 (Figure 3-13). Average fluoride concentrations were above UTL at two locations, MW-67-260, located near the north gate of the compressor station and MW-64BR-LWR, located in the southeast portion of the East Ravine investigation area. Fluoride at average concentrations above the California MCL of 2 µg/L was relatively widespread, occurring in 16 wells. There is no apparent pattern of fluoride distribution with depth or location across the ER-TCS investigation area.

Organics. Organic compounds are not prevalent in ER-TCS area groundwater. The following is a summary of laboratory results for organic compounds.

- Volatile and semi-volatile organics were generally not detected except for low concentrations of acetone, chloromethane, naphthalene, and benzoic acid in well MW-66BR-270, and chloroform in four wells on the TCS.
- PCB compounds were not detected in any of the samples.
- Dioxins were present in seven wells at a maximum concentration of 18 picograms per liter (pg/L), which is the human toxic equivalency); however, of the five wells where follow-up samples were collected, four were nondetect and one had at a decreased concentration of 1.2 pg/L (human toxic equivalency). The MCL for dioxin is 30 pg/L.
- The only pesticides detected were beta- and delta-BHC in the initial sample from MW-65-160; however, these analytes were not detected in the follow-up sample collected from this well.
- The only herbicide detected was meta-chlorophenylpiperazine (MCPP) in the initial sample from MW-67-185 and MW-60BR-245; however, this analyte was not detected in the follow-up samples collected from these wells.
- The only PAH compounds detected were naphthalene and 2-methylnaphthalene in MW-72-80; however, these analytes were not detected in the follow-up sample collected from this well.
- Fuel hydrocarbons were detected in four bedrock wells, with the maximum concentration being 580 µg/L in well MW-74-240.

3.5.4 Stable Isotope Evaluation

In the *Final RCRA Facility Investigation/Remedial Investigation Report* (Final RFI/RI Report); CH2M HILL, 2009b), stable isotopes of oxygen and hydrogen were used to generally identify three water groups: (1) river water and river-influenced groundwater, (2) local alluvial groundwater, and (3) industrial water from historical facility discharges. The groups are intermixed to varying degrees. Figure 3-14 shows the Phase 1 and 2 wells plotted along with offsite alluvial and fluvial non-plume wells. The ovals defining the three water groups on this figure were

developed from an analysis of all the wells at the site at the time of the Final RFI/RI Report. Although there is some overlap between bedrock and alluvial ER-TCS area wells, most of the bedrock wells show a lighter isotopic signature than the alluvial wells. There are two apparent outliers among the bedrock wells. Well MW-63-65 has a significantly lighter signature than other bedrock wells, similar to the river and the offsite fluvial wells. MW-63-65 is located approximately 100 feet from the river. Bedrock well MW-69-195 has a significantly heavier isotopic signature than other bedrock wells, and plots near the isotopically heavy end of the ER-TCS area alluvial wells. MW-69-195 has a higher specific capacity than any of the other ER-TCS area bedrock wells and may be in communication with the nearby alluvial aquifer. Isotopic signatures of bedrock wells such as the MW-23 nested wells, MW-70 cluster, MW-57-70, MW-62-110, and MW-72-80 are intermediate between the bedrock and alluvial groups and may reflect mixing of alluvial and bedrock waters.

3.6 Hydraulic Testing and Water Level Monitoring Results

Hydraulic testing during the Phase 2 consisted of a constant rate-pumping test in well MW-70BR-225 (Site H). Additional hydraulic information is provided by rough estimates of specific capacity obtained during development sampling of the wells.

3.6.1 Constant Rate Extraction Testing

The primary purpose of this test was to provide a qualitative evaluation of the area of influence of MW-70BR-225, which has an open borehole interval that extends from 130 to 227 feet below ground surface. During well development and sampling, it was observed that MW-70BR-225 could sustain a pumping rate of several gallons per minute, which is a significantly higher pumping rate than many other bedrock wells. This test was designed to determine whether the pumping rate could be maintained for an extended period of time and if the drawdown associated with pumping in MW-70BR-225 could be observed in any of the nearby alluvial wells.

MW-70BR-225 was pumped for a period of 12 hours on January 15, 2012. The pumping rate averaged 9.3 gpm and the drawdown recorded was approximately 34 feet. Water levels were monitored with transducers in approximately 20 surrounding wells. The drawdown caused by pumping was too small to observe directly in any but the closest well, MW-70-105 (shallower well pair to the pumping well), where the well exhibited a consistent dewatering trend and a total of 1.6 feet of drawdown during the period of pumping. At other surrounding wells, the water level fluctuations caused by daily changes in river level masked the drawdown caused by pumping. Mathematical deconvolution of the transducer data was necessary to evaluate whether pumping-related drawdown could be observed. Deconvolution was applied to data from seven of the wells closest to the pumping well. Pumping-related drawdown of approximately 0.18 feet was observed at bedrock well MW-58BR, located approximately 300 feet to the east. Pumping-related drawdown was observed but the amount was too small to be accurately quantified in two other bedrock wells, MW-60BR-245 located about 600 feet to the east and MW-69-195 located about 700 feet to the southwest. No pumping-related drawdown was observed in the alluvial wells at MW-59 or MW-68, which are located about 420 feet to the northeast and 450 feet to the northwest, respectively. Figure 3-15 shows the locations of these wells and the drawdown or absence of quantifiable drawdown at each well. Attachment D provides drawdown curves for the pumping well and MW-70-105 and summary graphs of deconvolution analysis.

The nearest alluvial well to MW-70BR-225 is MW-59-100, which is nearly 500 feet away. With the relatively small pumping rate at MW-70BR-225, drawdown would not be expected to be observable in the alluvial aquifer at a radius of 500 feet, and in fact, no drawdown was observed at MW-59-100. Thus, the hydraulic data from the pumping test are considered inconclusive with regard to the possible connection between MW-70BR-225 and the alluvial aquifer, however the relatively high flow rate, the elevated chromium concentration, and the stable isotope signature showing a mixture of bedrock and alluvial water at MW-70BR-225 are all consistent with the theory that this well may be drawing water from the alluvium through a bedrock fracture system.

Groundwater samples were collected from the pump effluent at the beginning, during, and at the end of the MW-70BR-225 test. Analysis of these samples indicated stable Cr(VI) concentrations throughout the test with concentrations ranging from 2,000 to 2,300 µg/L. Measurements of key water quality parameters including pH (7.41), specific conductance (13,030 µS/cm), and ORP (60 millivolts), also remained stable throughout the test.

3.6.2 Specific Capacity Estimates

Specific capacity (the ratio of pumping rate to drawdown) provides a qualitative means of comparing the productivity rate of the different wells. This is considered a rough estimate of well productivity because the pumping rate during sampling is not always held steady and in the more productive wells, the rate and duration of sampling pumping may not be sufficient to stress the well enough to provide a good measurement. Attachment B-2 includes a table summarizing the specific capacity measurements from the various sampling events that occurred at the Phase 2 wells through May 2012, and a figure summarizing available specific capacity data from the ER-TCS area (Figure B2-1). There is often considerable variability between different sampling events in the same well, so these data are considered qualitative. The higher specific capacity (typically greater than 3 gpm per foot [gpm/ft]) is typically observed in the alluvial wells. Several of the bedrock wells pump dry, precluding measurement of specific capacity. The bedrock well with the highest specific capacity (averaging about 2.8 gpm/ft) is MW-69-195, located on the TCS. MW-69-195 is a shallow zone well with 20 feet of screen just below the water table in bedrock. The second-highest bedrock specific capacity (averaging about 0.6 gpm/ft) was observed at well MW-70BR-225, where the constant rate pumping test was conducted. The stable isotope plot (Figure 3-14 shows the isotopic signature of MW-69-195 to be similar to the Phase 2 alluvial wells. MW-70BR-225 appears to be a blend of alluvial and bedrock water types.

3.6.3 Groundwater Gradients

With the installation of the Phase 2 wells, additional monitoring points are available to measure groundwater levels and gradients in the study area. The Phase 1 wells drilled in East Ravine area generally showed that gradients were upward from the bedrock to the alluvium and northward or northeastward from East Ravine area bedrock toward the alluvial aquifer or the river. Figure 3-16 shows the water levels measured on January 15, 2012. Wells are color-coded according to unconsolidated aquifer zone as determined by the elevation monitored. Bedrock wells are identified by a separate color (green). The inset on this figure shows the vertical gradients at seven locations. These gradients are all upward. Figure 3-17 shows contoured groundwater levels in the shallow bedrock and alluvial wells. The contours show groundwater gradients generally to the northeast along the axis of East Ravine and to the north from the TCS. In fractured bedrock, groundwater tends to follow conductive fractures so that the direction of groundwater movement might not be directly down-gradient.

3.7 Data Quality Evaluation Summary

A data quality evaluation (DQE) was conducted to assess the data quality of analytical results included in this technical memorandum. The complete DQE is provided as Attachment E-1 and E-2 for soil and groundwater data, respectively.

3.7.1 Soil Data Quality Evaluation Summary

The following summary highlights the soil DQE findings:

1. The completeness objective for the PG&E program is 90% for soil samples. The completeness objectives were met for all method/analyte combinations with the exception of 1,1´-Biphenyl (SW8270C). Although found in natural gas and used as a precursor for the production of PCBs this compound is difficult to analyze and is unlikely to be found in any significant amounts at the Topock Compressor Station. Although all of the 1,1´-Biphenyl results were non-detect, only 36.8% of the 1,1´-Biphenyl results met the completeness objectives.
2. Samples were collected and analyzed based on approved methods/procedures and the results are reported using industry-standardized units.
3. The routinely acceptable performance of field and laboratory QC indicators (field duplicates [FDs], field blanks, laboratory blanks, laboratory control samples [LCS], matrix spike/matrix spike duplicate [MS/MSD], surrogate, and calibrations) generally show the accuracy and precision of the data meet the project objectives.
    - Eight dioxin samples (SW8290) had results that were qualified as not detected due to method blank contamination.

- 2,2-Dichloropropane results from nineteen volatiles samples (SW8260) were qualified as estimated values due to calibration criteria exceedances.
- One PCB (SW8082) and one dioxin (SW8290) sample were qualified due to surrogate recovery outside the method criteria.
- Six metals samples (SW6010B/SW6020A), four semi-volatile samples (SW8270C), one Cyanide sample (SW9014), nine TOCs samples (SW9060), and one TPH Motor Oil (SW8015B) sample were qualified as estimated values due to matrix spike exceedances.
- Eight FD pairs for metals (SW6010B) and six FD pairs for TOC (SW9060) exceeded the relative percent difference (RPD) criteria.
- The semi-volatile (SW8270C) samples discussed above, had no recovery of 1,1´-Biphenyl in the LCS; the 1,1´-Biphenyl results of 12 samples were rejected.
- Seven semi-volatile samples (SW8270C) had five compounds (1,1´-Biphenyl, Benzaldehyde, Acetophenone, Hexachlorocyclopentadiene, and 1,2,4,5-Tetrachlorobenzene) qualified as estimated due to LCS recovery exceedances. All five compounds are compounds that are not part of the laboratory's normal reporting list of compounds.

4. Results from six cyanide (SW9014) samples were qualified as estimated due to holding time exceedance.
5. Analytical data as qualified meet the data quality objectives and may be used in project decision making with the exception of 1,1´-Biphenyl (SW8270C).

3.7.2 Groundwater Data Quality Evaluation Summary

The following summary highlights the groundwater DQE findings:

1. The completeness objective for the PG&E program is 95 percent (%) for groundwater samples. The completeness objective was met for all method/analyte combinations.
2. Samples were collected and analyzed based on approved methods/procedures and the results are reported using industry-standardized units.
3. The routinely acceptable performance of field and laboratory QC indicators (FDs, field blanks, laboratory blanks, LCS, MS/MSD, surrogate, and calibrations) generally show the accuracy and precision of the data meet the project objectives.
    - One chromium (SW6020A) and three toluene (SW8260) results were qualified as not detected due to equipment blank (EB) contamination.
    - Thirty three samples were associated with negative laboratory blanks that exceeded the absolute value of the RL for one or more metals (SW6010B - aluminum, beryllium, cobalt, iron, nickel, and silver).
    - Three dioxin samples (SW8290) and two semi-volatile samples (SW8270C) had results that were qualified as not detected due to method blank contamination.
    - Two samples analyzed for magnesium and nickel (SW6010B) were qualified due to calibration blank contamination.
    - One Cr(VI) sample (EPA218.6), two metals samples (SW6010B), three herbicides samples (SW8151), nine semi-volatile samples (SW8270C), 15 volatile samples (SW8260B), and four dioxin samples (SW8290) were qualified as estimated values due to calibration exceedances.
    - One herbicide sample (SW8151), one semi-volatile sample (SW8270C), Two TPH-Diesel/TPH-Motor Oil samples (SW8015B), and two PCB samples (SW8082) were qualified due to surrogate recovery outside the method criteria.

- Two dioxin (SW8290) samples were qualified due to internal standard recovery outside the method criteria.
- One TPH-Diesel sample (SW8015B), One TPH-Gasoline sample (SW8015B), eight volatiles samples (SW8260B), Twenty one metals samples (SW6010B/SW6020A), and twelve orthophosphate samples (EPA300.0) were qualified as estimated values due to MS/MSD exceedances.
- One FD pair for Nitrate (E300.0), one FD pair for Ammonia (SM4500N H3 C), two FD pairs for Alkalinity (SM2320 B), and three FD pairs for Iron (SW6010B) exceeded the RPD criteria.
- Twenty one carbonate alkalinity samples (SM2320B), two herbicides samples (SW8151), three semi-volatile samples (SW8270C), two PAH samples (SW8270SIM), and three dioxin samples (SW8290) were qualified as estimated values due to LCS recovery exceedances.

4. Two herbicide samples (SW8151) and two semi-volatile samples (SW8270C) were extracted outside the EPA recommended holding time.
5. Matrix effects were identified in eight samples for Cr(VI) (E218.6) analyses and the RLs were raised to the concentrations where the matrix effects were overcome as indicated by acceptable MS analyses

4.0 Refinements to the Topock Conceptual Site Model

Analysis of the data collected during the installation, sampling, and testing of ER-TCS investigation wells has not resulted in any major revisions to the conceptual site model. The distribution of chromium and other COPCs has been better defined by the ER-TCS wells. The nitrate concentrations in the recently installed alluvial wells beneath the TCS are generally higher than in other wells at the site. DTSC comment notes that the nitrate distribution may suggest the station is/was a source. Lithologic data collected during the installation of these wells provide better definition of the topography of the bedrock contact below the TCS and, as a result, indicate a larger area of saturated alluvium beneath the TCS than previously estimated. The highest concentrations of Cr(VI) yet detected at the site are observed in the saturated alluvium beneath the TCS within an area of elevated concentrations in the parts per million on the north and east sides of the TCS. Although these concentrations are not unlike concentrations previously observed to the north and northeast of the TCS, it does appear that the area of elevated concentrations around the compressor station is larger than previously understood during the 30% design. This finding has been taken into account in the subsequent phases of the design by adding two carbon-amended injection wells (TCS-1 and TCS-2) to accelerate remediation of Cr(VI) in the alluvium under the TCS. Based on the data from MW-66BR-270 and MW-68BR-280, concentrations of Cr(VI) in the alluvium do not extend into the bedrock directly beneath the TCS. Concentrations of Cr(VI) are observed in bedrock well MW-69-195 immediately south of the TCS fence line where saturated alluvium is not present, but Cr(VI) has not been detected in the southern most bedrock well MW-74-240.

The extent of Cr(VI) contamination in the East Ravine area has been further defined both laterally and vertically. With the exception of concentrations detected in the parts per million at MW-70BR-225, Cr(VI) concentrations observed in the new wells are similar to the previously installed wells and do not suggest any previously unknown hotspots or contaminant sources outside the compressor station, which was always considered a potential source location. As discussed above, MW-70BR-225 and the well immediately south of the TCS fence line (MW-69-195) exhibit higher specific capacity than previous bedrock wells. These two higher-producing bedrock wells, which are located relatively close to the inferred contact of the alluvial aquifer and bedrock, also exhibit water quality similar to the alluvial aquifer. The data collected suggest a localized fracture connection to the alluvium rather than to some as yet undiscovered zone of highly fractured and more permeable bedrock.

The distribution of conductive fractures can be inferred from the hydrophysical logging. The hydrophysical logs typically indicate a few (zero to four) zones of discrete flow within an interval of open borehole ranging from 90 to 150 feet in length. Often, one of these zones was dominant and others were relatively minor. The conceptual model suggested by the hydrophysical logging is that groundwater flow occurs in relatively widely spaced discrete fractures. Based on the flow characterization conducted in the boreholes, the bulk rock matrix and many of the fractures do not transmit water, which is a flow regime that is typical in crystalline bedrock systems. The locations

of inflow to the boreholes are generally not correlated with highly fractured zones or zones of poor quality rock (based on rock core recovered) but rather with discrete fractures in relatively competent rock. [2]

Based on the widespread distribution of Cr(VI) in East Ravine bedrock, the discrete fractures observed in the boreholes may form an interconnected network. Constituents can travel relatively quickly through networks of interconnected fractures. Compared to a porous media aquifer where water occupies all the spaces between the grains in the porous matrix, a relatively small amount of water is required to fill a sparse fracture network in a block of low porosity bedrock. The chromium distribution in East Ravine bedrock likely resulted from Cr(VI) in water that ponded in the East Ravine. The ponded water could have infiltrated through the alluvium beneath the ponds and into fractures in the underlying bedrock. The head in the ponds would have been 60 to 80 feet higher than the head in the fractures, so the infiltrating water would have sufficient driving force to displace the water in the fractures, allowing Cr(VI) to enter the fracture network. Because the volume of the water in the fracture network is small, a relatively short period of ponding could have provided a sufficient volume of water to displace the groundwater in a network of bedrock fractures. Because of the sparse nature of the fractures, the volume of the Cr(VI) plume in bedrock likely represent less than 2% of the total volume in the plume.

The groundwater model for the Topock has been modified to more accurately represent the transport in the fractured rock. The current model treats the fractured bedrock the same as the alluvial aquifer but with lower permeability. In reality, groundwater flow through the bedrock occurs through a network of discrete fractures. However the obtaining the data necessary to define the complex geometry of the interconnecting fracture network would require the installation of many additional boreholes and combined with extensive hydraulic and tracer testing. Due to the impracticality of defining and simulating the fracture network, the modeling approach will simulate the fractured rock portion of the model as a porous media with very small mobile porosity. The Topock transport model is set up to simulate dual-porosity. The mobile porosity represents the connected pores or fractures that transmit water. The immobile porosity simulates the dead end pores or blocked fractures that are saturated and may provide a reservoir of contaminant mass but do not readily transmit water. Currently, the mobile porosity in the Topock model is set to 12% and the immobile is 23%, adding up to a total porosity of 35%. These are typical values for an alluvial aquifer but are not considered reasonable for fractured rock. In fractured crystalline rock, typical mobile porosity (representing the fracture network) is 1% or less.

The approach of using a dual porosity model to simulate fractured rock is based on the fact that at a large enough scale, many fractured rock flow systems can be effectively simulated as porous media with low mobile porosity. As a general rule of thumb, the size of the block of fractured rock that may be treated as a porous media is often considered to be about 100 times the average fracture spacing (Gerber, Bither, and Muff, 1991). An analysis of the rock core logs from the Phase 1 and 2 ER-TCS area boreholes (see boring logs in Attachment A-2) shows average fracture spacing in the saturated zone to be about 0.29 feet. The transport model grid cells in the East Ravine / TCS area are 25 feet square. The current model grid spacing is therefore close to the 100 times the fracture spacing, suggesting that it is not unreasonable to use the existing model to simulate the fractured rock at Topock. Measurements of drawdown and pumping rate collected during purging prior to sampling can be used to estimate specific capacity, which then can be used to infer the relative hydraulic conductivity of the bedrock at different locations. The relatively wide range in specific capacity suggests a similarly wide range in hydraulic conductivity, which is typical of wells in fractured crystalline bedrock. At the higher end, the average specific capacity in bedrock wells MW-70BR-225 and MW-69-195 appears to be between 2 and 3 gpm/ft; the lower end of the specific capacity range is 0.01 gpm/ft or less. Several of the bedrock wells pump dry such that specific capacity cannot be accurately measured. Pumping from the bedrock during the MW-70BR-225 constant rate test did not induce discernible drawdown in the nearest wells completed in the alluvial aquifer, but this is not surprising given the distance to the nearest alluvial monitor wells and the relatively low pumping rate considering the relatively large storage of the alluvial aquifer. Overall, the metadiorite bedrock exhibits relatively low specific capacity indicating similarly low hydraulic conductivity in comparison with the alluvial aquifer.

[2] This and the next paragraph regarding conductive fractures were included to speak more directly to the comment DOI-18 on the Preliminary (30 percent) Design Submittal for the Final Groundwater Remedy (CH2M HILL, 2011).

Data collected as part of the ER-TCS confirm the hydrogeologic setting for the conceptual site model. Groundwater in the bedrock occurs in irregularly distributed, highly localized, and discontinuous water-bearing zones that is characteristic of fractured crystalline rocks. This refined conceptual site model confirms previously available data, therefore assumptions associated with the anticipated design and operation of the final groundwater remedy do not need to be modified.

Based on discussions held with the agencies and stakeholders during implementation, investigation activities included in the Work Plan Addendum are complete with the exception of Site H (MW-70 well series). The agencies have directed PG&E to conduct additional characterization to determine the vertical extent of Cr(VI) in groundwater at Site H. As discussed with the agencies, this work will be coordinated with the remedial design and conducted as part of the implementation of the groundwater remedy.

5.0 References

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Tables

TABLE 2-1

Summary of Well Installation Details

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

ER-TCS Site	Location ID	Northing	Easting	Date Installed	Well/Borehole Configuration	Total Borehole Depth (ft bgs)	Monitoring Zone	Monitoring Length (feet)	Ground Elevation (NAVD 88)	TOC Elevation (NAVD 88)	Top of Screen		Bottom of Screen		Top of Borehole Interval		Bottom of Borehole Interval		Well Diameter PVC (inch)	Boring Diameter (inch)
											Depth (ft bgs)	Elevation (ft MSL)	Depth (ft bgs)	Elevation (ft MSL)	Depth (ft bgs)	Elevation (ft MSL)	Depth (ft bgs)	Elevation (ft MSL)		
MW-23	MW-23-060	7616448.25	2101286.36	May-09	Nested Monitoring Well	80	BR - Tmc	10	504.50	504.08	50	454.50	60	444.50	--	--	--	--	2	10.7
	MW-23-080	7616448.50	2101286.32	May-09	Nested Monitoring Well	80	BR - Tmc	5	504.50	504.13	75	429.50	80	424.50	--	--	--	--	2	10.7
B	MW-57-050	7616384.35	2100906.35	Jan-09	Conventional Monitoring Well	50	PA	10	508.97	508.76	40	468.97	50	458.97	--	--	--	--	2	6.3
	MW-57-070	7616394.98	2100893.58	Jan-09	Conventional Monitoring Well	70	BR - Tmc	15	509.67	509.37	55	454.67	70	439.67	--	--	--	--	2	6.3
	MW-57-185	7616389.44	2100899.56	Feb-09	Conventional Monitoring Well	192	BR - Tmc / pTbr	114	509.39	508.97	70	439.39	184	325.39	--	--	--	--	3	3.8
A	MW-58-065	7616136.25	2100607.15	Feb-09	Conventional Monitoring Well	64	PA	10	521.41	523.26	54	467.41	64	457.41	--	--	--	--	2	6.3
	MW-58BR Open Borehole (Shallow)	7616131.91	2100612.36	Feb-09	Open Bedrock Borehole	115	BR - pTbr	60	521.78	523.83	--	--	--	--	55	466.78	115	406.78	--	3.8
	MW-58BR Open Borehole (Deeper)	7616131.91	2100612.36	Mar-09	Open Bedrock Borehole	206	BR - pTbr	152	521.78	523.83	--	--	--	--	54	467.78	206	315.78	--	3.8
	MW-58BR Flute (Upper Zone)	7616131.91	2100612.36	Jul-09	Multi-level Well (FLUTe™)	206	BR - pTbr	20	521.78	524.44	95	426.64	115	406.64	--	--	--	--	--	3.8
	MW-58BR Flute (Lower Zone)	7616131.91	2100612.36	Jul-09	Multi-level Well (FLUTe™)	206	BR - pTbr	46	521.78	524.42	160	361.64	206	315.64	--	--	--	--	--	3.8
	MW-58BR Packer (Shallow Set) Upper Zone	7616131.91	2100612.36	Sep-10	Open Bedrock Borehole with Packer	206	BR - pTbr	47	521.78	523.83	--	--	--	--	66	455.78	113	408.78	--	3.8
	MW-58BR Packer (Shallow Set) Deeper Zone	7616131.91	2100612.36	Sep-10	Open Bedrock Borehole with Packer	206	BR - pTbr	89	521.78	523.83	--	--	--	--	117	404.78	206	315.78	--	3.8
	MW-58BR Packer (Deeper Set) Upper Zone	7616131.91	2100612.36	Feb-11	Open Bedrock Borehole with Packer	206	BR - pTbr	92	521.78	523.83	--	--	--	--	66	455.78	158	363.78	--	3.8
	MW-58BR Packer (Deeper Set) Deeper Zone	7616131.91	2100612.36	Feb-11	Open Bedrock Borehole with Packer	206	BR - pTbr	44	521.78	523.83	--	--	--	--	162	359.78	206	315.78	--	3.8
G	MW-59-100	7616081.90	2100851.96	Feb-09	Conventional Monitoring Well	101	UA	15	538.94	541.61	86	452.94	101	437.94	--	--	--	--	2	6.3
F	MW-60-125	7616434.82	2100491.63	Mar-09	Conventional Monitoring Well	123	BR - pTbr	20	555.78	555.47	103	452.78	123	432.78	--	--	--	--	2	6.3
	MW-60BR-245	2100495.02	7616444.42	Jun-11	Open Bedrock Borehole	245	BR - pTbr	NA	555.86	554.95	NA	NA	NA	NA	136	419.90	245	310.90	NA	3.8
C	MW-61-110	7616591.04	2100713.02	Mar-09	Conventional Monitoring Well	112	BR - pTbr	20	544.12	544.03	92	452.12	112	432.12	--	--	--	--	2	6.3
E	MW-62-065	7616560.96	2101064.51	Mar-09	Conventional Monitoring Well	65	BR - Tmc	20	503.56	503.56	45	459.06	65	439.06	--	--	--	--	2	6.3
	MW-62BR	7616551.06	2101068.31	Apr-09	Open Bedrock Borehole*	192	BR - Tmc	127	504.60	503.96	65	440.10	192	313.10	64.5	440.10	191.5	313.10	3	3.8
	MW-62-110	7616550.88	2101068.16	Jul-09	Multi-level Well (FLUTe™)	192	BR - Tmc	25	504.60	504.05	85	419.60	110	394.60	--	--	--	--	--	3.8
	MW-62-190	7616550.99	2101068.29	Jul-09	Multi-level Well (FLUTe™)	192	BR - Tmc	37	504.60	504.05	155	349.60	192	312.60	--	--	--	--	--	3.8
E-Alt2	MW-63-065	7616921.60	2100973.93	Apr-09	Conventional Monitoring Well	66	BR - Tmc	20	505.03	504.47	46	459.03	66	439.03	--	--	--	--	--	6.3
C-Alt	MW-64BR Open Borehole	7616939.41	2100520.49	May-09	Open Bedrock Borehole*	258	BR - pTbr	148	576.05	575.60	2	574.05	258	318.05	110	466.05	258	318.05	3	3.8
	MW-64BR Flute (Upper Zone)	7616939.41	2100520.49	Jul-09	Multi-level Well (FLUTe™)	258	BR - pTbr	30	576.05	575.90	120	456.05	150	426.05	--	--	--	--	--	3.8
	MW-64BR Flute (Middle Zone)	7616939.41	2100520.49	Jul-09	Multi-level Well (FLUTe™)	258	BR - pTbr	30	576.05	575.92	175	401.05	205	371.05	--	--	--	--	--	3.8
	MW-64BR Flute (Lower Zone)	7616939.41	2100520.49	Jul-09	Multi-level Well (FLUTe™)	258	BR - pTbr	28	576.05	575.90	230	346.05	260	316.05	--	--	--	--	--	3.8
	MW-64BR Packer (Upper Zone)	7616939.41	2100520.49	Jan-11	Open Bedrock Borehole with Packer	258	BR - pTbr	28	576.05	--	--	--	--	--	120	456.05	148	428.05	--	3.8
	MW-64BR Packer (Lower Zone)	7616939.41	2100520.49	Jan-11	Open Bedrock Borehole with Packer	258	BR - pTbr	108	576.05	--	--	--	--	--	152	424.05	260	316.05	--	3.8
2	MW-67-185	2101040.21	7615335.52	Sep-11	Conventional Monitoring Well	187	UA	10	626.18	625.91	177	449.18	187	439.18	--	--	--	--	2	7
	MW-67-225	2101047.85	7615332.58	May-11	Nested Monitoring Well	272.5	UA	15	626.32	625.83	210	416.32	225	401.32	--	--	--	--	2	10
	MW-67-260	2101047.67	7615332.38	May-11	Nested Monitoring Well	272.5	UA	10	626.32	625.81	250	376.32	260	366.32	--	--	--	--	2	6
3	MW-68-180	2100773.64	7615453.36	May-11	Nested Monitoring Well	250	UA	15	621.58	621.17	165	456.58	180	441.58	--	--	--	--	2	10
	MW-68-240	2100773.73	7615453.13	May-11	Nested Monitoring Well	250	UA	20	621.58	621.17	220	401.58	240	381.58	--	--	--	--	2	6
	BH-68-280BR	2100767.09	7615453.92	Aug-11	Open Bedrock Borehole	279	BR - Tmc / pTbr	22	621.41	620.64	--	--	--	--	257	364.40	279	342.40	NA	3.8
4	MW-69-195	2100291.55	7615142.96	Jun-11	Conventional Monitoring Well	197.5	BR - pTbr	20	632.09	631.36	176	456.09	196	436.09	--	--	--	--	2	6

TABLE 2-1

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ER-TCS Site	Location ID	Northing	Easting	Date Installed	Well/Borehole Configuration	Total Borehole Depth (ft bgs)	Monitoring Zone	Monitoring Length (feet)	Ground Elevation (NAVD 88)	TOC Elevation (NAVD 88)	Top of Screen		Bottom of Screen		Top of Borehole Interval		Bottom of Borehole Interval		Well Diameter PVC (inch)	Boring Diameter (inch)
											Depth (ft bgs)	Elevation (ft MSL)	Depth (ft bgs)	Elevation (ft MSL)	Depth (ft bgs)	Elevation (ft MSL)	Depth (ft bgs)	Elevation (ft MSL)		
5	MW-65-160	2100547.44	7614934.72	Apr-11	Nested Monitoring Well	237	UA	10	596.99	596.59	150	446.99	160	436.99	--	--	--	--	2	10
	MW-65-225	2100547.68	7614934.95	Apr-11	Nested Monitoring Well	237	UA	10	596.99	596.58	215	381.99	225	371.99	--	--	--	--	2	6
6	MW-66-165	2100957.66	7615153.76	Apr-11	Nested Monitoring Well	234	UA	20	586.60	586.16	142	444.60	162	424.60	--	--	--	--	2	10
	MW-66-230	2100957.94	7615153.62	Apr-11	Nested Monitoring Well	234	UA	10	586.60	586.22	218	368.60	228	358.60	--	--	--	--	2	6
	BH-66-270BR	2100950.25	7615153.99	Sep-11	Open Bedrock Borehole	271	BR - Tmc	23	586.54	586.15	--	--	--	--	248	338.50	271	315.50	NA	3.8
H	MW-70-105	2100513.91	7615825.97	May-11	Conventional Monitoring Well	107.8	BR - pTbr	20	538.87	541.47	85	453.87	105	433.87	--	--	--	--	2	6
	MW-70BR-225	2100513.04	7615840.08	Oct-11	Open Bedrock Borehole	227	BR - pTbr	99	538.87	539.84	--	--	--	--	130	407.60	229	308.60	NA	3.8
I	MW-73-80	2100676.49	7617554.90	Sep-11	Conventional Monitoring Well	80.5	BR - pTbr	20	506.32	505.84	60.2	446.12	80.2	426.12	--	--	--	--	2	6
J	MW-74-240	2100017.52	7615237.66	Oct-11	Conventional Monitoring Well	241	BR - pTbr	20	672.90	672.34	220	452.90	240	432.90	--	--	--	--	2	6
K	MW-72-80	2100674.44	7617083.44	Aug-11	Conventional Monitoring Well	81	BR - pTbr	20	513.53	513.32	60	453.53	80	433.53	--	--	--	--	2	6
	MW-72BR-200	2100681.09	7617058.15	Jun-12	Open Bedrock Borehole	200	BR - pTbr	93	514.51	513.79	--	--	--	--	107	407.51	200	314.51	NA	3.8
L	MW-71-35	2101338.43	7616207.60	Sep-12	Conventional Monitoring Well	71	UA	10	483.99	483.69	26	457.99	36	447.99	--	--	--	--	2	6

Notes:

Monitoring zones:

PA = Perched Alluvial Aquifer

UA = Unconsolidated Alluvial Aquifer

BR = bedrock formations: including Miocene Conglomerate (Tmc) and pre-Tertiary metadiorite bedrock (pTbr).

bgs = below ground surface

MSL = Mean Sea Level

TABLE 2-2
Summary of Well Sampling Events
Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation
Pacific Gas and Electric Company, Topock Compessor Station, Needles, California

	Phase 1 Investigation						Groundwater Monitoring Program Events																	Phase 2 Investigation							
Location ID	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Sep-09	Oct-09	Nov-09	Dec-09	Jan-10	Feb-10	Mar-10	May-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11	Jan-12
MW-23-060	--	--	--	--	--	X	X	--	--	X	--	--	X	X	--	X	--	--	X	--	X	--	--	X	--	--	--	X	--	--	X	--
MW-23-080	--	--	--	--	--	X	X	--	--	X	--	--	X	X	--	X	--	--	X	--	X	--	--	X	--	--	--	X	--	--	X	--
MW-57-050	--	--	--	--	--	--	--	--	--	--	--	X	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-57-070	X	--	--	X	X	X	X	--	--	X	--	--	X	X	--	X	--	--	X	--	X	--	--	X	--	--	--	X	--	--	X	--
MW-57-185	--	--	--	--	--	X	X	--	--	X	--	--	X	X	--	X	--	--	X	--	X	--	--	X	--	--	--	X	--	--	X	--
MW-57BR	--	X	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-58-065	--	--	--	--	--	--	--	--	--	--	--	X	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-58BR Flute (Lower Zone)	--	--	--	--	--	X	X	--	--	X	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-58BR Flute (Upper Zone)	--	--	--	--	--	X	X	--	--	X	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-58BR Open Borehole (Deeper)	--	--	--	--	--	--	--	--	--	--	--	--	X	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-58BR Open Borehole (Shallow)	--	X	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-58BR Packer (Deeper Set) Lower Zone	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X	--	X	--	--	X	X	--	X	X	X	--
MW-58BR Packer (Deeper Set) Upper Zone	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X	X	--	--	--	X	X	--	X	X	X	--
MW-58BR Packer (Shallow Set) Lower Zone	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X	X	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-58BR Packer (Shallow Set) Upper Zone	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X	X	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-59-100	--	X	--	X	X	X	X	--	--	X	--	--	X	X	--	X	--	--	X	--	X	--	--	X	--	--	--	--	X	--	X	--
MW-60-125	--	X	--	--	--	X	X	--	--	X	--	--	X	X	--	X	--	--	X	--	X	--	--	X	--	--	--	--	X	--	X	--
MW-60BR-245	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X	X	X	X	X	--
MW-61-110	--	X	--	--	--	X	X	--	--	X	--	--	X	X	--	X	--	--	X	--	X	--	--	X	--	--	--	X	--	--	X	--
MW-62-065	--	X	--	--	--	X	X	--	--	X	--	--	X	X	--	X	--	--	X	--	X	--	--	X	--	--	--	X	--	--	X	--
MW-62-110	--	--	--	--	--	X	X	--	--	X	--	X	X	X	--	X	--	--	X	--	X	--	--	X	--	--	--	X	--	--	X	--
MW-62-190	--	--	--	--	--	X	X	--	--	X	--	X	X	X	--	X	--	--	X	--	X	--	--	X	--	--	--	X	--	--	X	--
MW-63-065	--	--	X	--	--	X	X	--	--	X	--	--	X	X	--	X	--	--	X	--	X	--	--	X	--	--	--	X	--	--	X	--
MW-64BR Flute (Lower Zone)	--	--	--	--	--	X	X	X	X	X	X	X	X	X	X	X	X	X	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-64BR Flute (Middle Zone)	--	--	--	--	--	X	X	X	X	X	X	X	X	X	X	X	X	X	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-64BR Flute (Upper Zone)	--	--	--	--	--	X	X	X	X	X	X	X	X	X	X	X	X	X	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-64BR Open Borehole	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-64BR Packer (Lower Zone)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X	--	X	--	--	X	X	X	X	X	X	--
MW-64BR Packer (Upper Zone)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X	--	--	X	--	--	X	X	X	X	X	X	--
MW-65-160	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X	X	X	X	X	X	X	X	--
MW-65-225	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X	X	X	X	X	X	X	X	--
MW-66-165	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X	X	X	--	X	X	X	X	--
MW-66-230	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X	X	X	--	X	X	X	X	--
MW-66BR-270	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X	--	X	--
MW-67-185	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X	X	X	X	--	--
MW-67-225	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X	X	X	X	X	X	X	--	--
MW-67-260	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X	X	X	X	X	X	X	--	--
MW-68-180	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X	X	--	X	X	X	X	--
MW-68-240	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X	X	--	X	X	X	X	--
MW-68BR-280	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X	X	X	X	--
MW-69-195	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X	X	X	X	X	X	X	--
MW-70-105	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X	X	X	X	--	X	X	--
MW-70BR-225	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X	X	X	--
MW-71-035	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X	X	--
MW-72-080	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X	X	X	X	X	--
MW-72BR-200	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-73-080	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X	X	X	--
MW-74-240	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X

TABLE 2-2
Summary of Well Sampling Events
Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation
Pacific Gas and Electric Company, Topock Compessor Station, Needles, California

	Groundwater Monitoring Program Events										
Location ID	Feb-12	Mar-12	Apr-12	May-12	Jul-12	Sep-12	Oct-12	Nov-12	Dec-12	Feb-13	Mar-13
MW-23-060	X	--	X	--	--	X	--	X	--	X	--
MW-23-080	X	--	X	--	--	X	--	X	--	X	--
MW-57-050	--	--	--	--	--	--	--	--	--	--	--
MW-57-070	X	--	--	X	--	X	--	--	X	X	X
MW-57-185	X	--	X	--	--	X	--	X	--	X	--
MW-57BR	--	--	--	--	--	--	--	--	--	--	--
MW-58-065	--	--	--	--	--	--	--	--	--	--	--
MW-58BR Flute (Lower Zone)	--	--	--	--	--	--	--	--	--	--	--
MW-58BR Flute (Upper Zone)	--	--	--	--	--	--	--	--	--	--	--
MW-58BR Open Borehole (Deeper)	--	--	--	--	--	--	--	--	--	X	--
MW-58BR Open Borehole (Shallow)	--	--	--	--	--	--	--	--	--	--	--
MW-58BR Packer (Deeper Set) Lower Zone	X	--	--	X	--	--	X	--	--	--	--
MW-58BR Packer (Deeper Set) Upper Zone	X	--	--	X	--	--	X	--	--	--	--
MW-58BR Packer (Shallow Set) Lower Zone	--	--	--	--	--	--	--	--	--	--	--
MW-58BR Packer (Shallow Set) Upper Zone	--	--	--	--	--	--	--	--	--	--	--
MW-59-100	X	--	--	X	--	--	X	X	--	X	--
MW-60-125	X	--	--	X	--	X	--	--	X	X	--
MW-60BR-245	X	--	--	X	--	X	--	--	X	--	X
MW-61-110	X	--	--	X	--	X	--	X	--	X	--
MW-62-065	X	--	--	X	--	X	--	--	X	X	--
MW-62-110	X	--	--	X	--	X	--	--	X	X	--
MW-62-190	X	--	--	X	--	X	--	--	X	X	--
MW-63-065	X	--	X	--	--	X	--	X	--	X	--
MW-64BR Flute (Lower Zone)	--	--	--	--	--	--	--	--	--	--	--
MW-64BR Flute (Middle Zone)	--	--	--	--	--	--	--	--	--	--	--
MW-64BR Flute (Upper Zone)	--	--	--	--	--	--	--	--	--	--	--
MW-64BR Open Borehole	--	--	--	--	--	--	--	--	--	--	X
MW-64BR Packer (Lower Zone)	X	--	X	--	--	--	X	--	--	--	--
MW-64BR Packer (Upper Zone)	X	--	X	--	--	--	X	--	--	--	--
MW-65-160	X	--	--	X	--	X	--	--	X	X	--
MW-65-225	X	--	--	X	--	X	--	--	X	X	--
MW-66-165	X	--	--	X	--	X	--	--	X	X	--
MW-66-230	X	--	--	X	--	X	--	--	X	X	--
MW-66BR-270	--	X	--	X	--	--	X	--	X	--	X
MW-67-185	X	--	--	X	--	X	--	--	X	X	--
MW-67-225	X	--	--	X	--	X	--	--	X	X	--
MW-67-260	X	--	--	X	--	X	--	--	X	X	--
MW-68-180	X	--	--	X	--	X	--	--	X	X	--
MW-68-240	X	--	--	X	--	X	--	--	X	X	--
MW-68BR-280	X	--	--	X	--	--	X	X	--	X	--
MW-69-195	X	--	--	X	--	X	--	--	X	X	--
MW-70-105	X	--	--	X	--	X	--	--	X	X	--
MW-70BR-225	X	--	--	X	--	X	--	--	X	X	--
MW-71-035	X	--	--	X	--	X	--	X	--	X	--
MW-72-080	X	--	--	X	--	X	--	--	X	X	--
MW-72BR-200	--	--	--	--	X	X	--	X	--	X	--
MW-73-080	X	--	--	X	--	X	--	--	X	X	--
MW-74-240	X	--	--	X	--	X	--	--	X	--	X

TABLE 3-1

Summary of Lithology Encountered During the ER-TCS Groundwater Investigation

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

Site ID	Monitoring Wells Completed	Approximate Depth to Groundwater (ft bgs)	Total Boring Depth (ft bgs)	Start Depth (ft bgs)	End Depth (ft bgs)	Summary of Lithologic Description
A	MW-58-065 MW-58-115 MW-58-205	66	206	0	60	**Unconsolidated alluvium:** silt with sand and silty gravel, silty sand with gravel, and poorly graded sand with gravel.
				60	65.5	Highly weathered **metadiorite bedrock** becoming more competent toward the bottom of the interval.
				65.5	206	Competent pre-tertiary **metadiorite bedrock** (metadiorite);dusky yellowish green with intermediate (dioritic) mineralogy, and a medium grained, strong, unweathered, and massive to foliated rock mass.
B	MW-57-050 MW-57-070 MW-57-185	52	192	0	46	**Unconsolidated alluvium:** sandy silt with gravel and silty gravel.
				46	144.5	Competent Miocene **conglomerate bedrock** (conglomerate); yellowish red, fine- to coarse-grained, medium strong, unweathered, matrix supported and massive.
				144.5	153	Completely weathered **conglomerate bedrock** similar to that from 46 to 144.5 feet bgs, but cement has been largely replaced or removed. The conglomerate is medium strong; however, the matrix rapidly dissolved when exposed to water.
				153	154.5	**Metaconglomerate:** dark yellowish-orange, strong, and unweathered. The matrix composed of moderate reaction to hydrochloric acid (HCl) solution minerals; however, the relict conglomerate structure was still apparent.
				154.5	155.5	**Altered metadiorite bedrock:** yellowish-brown with largely felsic mineralogy; medium-grained, strong, and unweathered. No reaction to HCl solution. Portions of this interval exhibited a mylonitic texture, inferred to be associated with displacement along a portion of the Chemehuevi detachment fault.
				155.5	192	**Metadiorite bedrock:** dusky yellowish-green, with an intermediate (dioritic) mineralogy and fine- to medium-grained, strong, unweathered, and massive to foliated rock mass.
C	MW-61-110	87	112.5	0	63	**Unconsolidated alluvium:** poorly graded silty sand with gravel and poorly graded sand with silt and gravel.
				63	112.5	**Metadiorite bedrock:** dusky yellowish-green, hard to very hard, with intermediate (dioritic) mineralogy and fine-grained, unweathered, and massive to foliated rock mass.
C-Alt	MW-64-150 MW-64-205 MW-64-260	120	260.5	0	260.5	**Metadiorite bedrock**; grayish olive, intermediate (dioritic) mineralogy, with a strong, unweathered to slightly weathered, massive to foliated rock mass.
E	MW-62-065 MW-62-110 MW-62-190	47	191.5	0	4.5	**Unconsolidated alluvium:** silty sand.
				4.5	191.5	**Conglomerate bedrock:** reddish-brown, strong, unweathered, and massive, with a fine-grained matrix and coarse sand to gravel-sized clasts of no dominant mineralogy.
E-Alt2	MW-63-065	49	66	49	66	**Conglomerate bedrock** was observed from ground surface. Bedrock moderate brown, matrix supported, and friable, with a moderately to completely weathered rock mass and clasts as large as 4 centimeters.
F	MW-60-125* MW-60BR-245	98	200	0	9	**Unconsolidated alluvium:** dark yellowish-brown silty sand.
				9	200	**Metadiorite bedrock:** grayish-green to dusky green with intermediate (dioritic) mineralogy with a medium-grained, unweathered, and massive to foliated rock mass.
G	MW-59-100	84	101	0	82	**Unconsolidated alluvium:** brown to yellowish-brown silty sand.
				82	101	**Unconsolidated alluvium:** dark grayish-brown and dark reddish-brown gravelly sand with appearance of completely weather conglomerate bedrock.
MW-23	MW-23-060 MW-23-080	48	80	NA	NA	**Conglomerate bedrock**.
H	MW-70-105 MW-70-225	84	227	0	69	**Unconsolidated alluvium:** light yellowish-brown silty sand.
				69	227	**Metadiorite bedrock:** dusky yellow green with intermediate (dioritic) mineralogy with a medium-grained, unweathered, and massive to non-foliated rock mass.
I	MW-73-80	52	123	0	7	**Unconsolidated alluvium:** brown silty sand.
				7	81	**Metadiorite bedrock:** dusky yellow green with phaneritic mineralogy with a medium-grained, unweathered, highly fractured, and massive to non-foliated rock mass.
J	MW-74-240	216	240	0	240	**Metadiorite bedrock:** dusky yellow green with intermediate (dioritic) mineralogy with a medium-grained, unweathered, and massive to non-foliated rock mass.
K	MW-72-080 MW-72BR-200	59	200	0	13	**Unconsolidated alluvium:** light brownish gray silty sand with gravel.
				13	200	**Metadiorite bedrock:** dusky yellow green with phaneritic mineralogy with a medium-grained, slightly weathered, fractured, and massive to non-foliated rock mass.
L	MW-71-35	8	71	0	35	**Unconsolidated alluvium:** brown silty sand.
				35	71	**Conglomerate bedrock:** dark reddish-brown, strong, slightly weathered, and massive, with a fine-grained matrix and coarse sand to gravel-sized clasts of no dominant mineralogy.
2	MW-67-185 MW-67-225 MW-67-260	171	272.5	0	264	**Unconsolidated alluvium:** sand from 0'-53', clay from 53'-73', silt from 73'-92', gravel from 92'-197', silt from 197'-211', sand from 211'-221', silt from 221'-264'.
				264	271	**Conglomerate bedrock:** dark reddish-brown, strong, slightly weathered, and massive, with a fine-grained matrix and coarse sand to gravel-sized clasts of no dominant mineralogy.
				271	272.5	**Metadiorite bedrock:** dusky yellowish-green with phaneritic mineralogy with a medium-grained, slightly weathered, fractured, and massive to non-foliated rock mass.
3	MW-68-180 MW-68-240 MW-68BR-280	166	280.5	0	243	**Unconsolidated alluvium:** sand from 0'-62', gravel from 62'-243'
				243	258	**Conglomerate bedrock:** dark reddish-brown, massive, with a fine-grained matrix and coarse sand to gravel-sized clasts of no dominant mineralogy.
				258	280.5	**Metadiorite bedrock:** pale yellowish-brown with phaneritic mineralogy with a medium-grained, weathered, and massive to non-foliated rock mass.
4	MW-69-195	176	227	0	42	**Unconsolidated alluvium:** light yellowish-brown gravel.
				42	197.5	**Metadiorite bedrock:** dusky yellowish-green with phaneritic mineralogy with a medium-grained, slightly weathered, fractured, and massive to non-foliated rock mass.
5	MW-65-160 MW-65-225	141	237	0	228	**Unconsolidated alluvium:** sand from 0'-168', gravel from 168'-228'
				228	237	**Metadiorite bedrock:** dusky yellowish-green with phaneritic mineralogy with a medium-grained, slightly weathered, fractured, and massive to non-foliated rock mass.
6	MW-66-165 MW-66-230 MW-66BR-270	131	237	0	233	**Unconsolidated alluvium:** sand from 0'-19', silt from 19'-32', from 32'-132', gravel from 132'-157', sand from 157'-162.5', gravel from 162.5'-233'.
				233	271	**Conglomerate bedrock:** dark reddish-brown, massive, with a fine-grained matrix and coarse sand to gravel-sized clasts of no dominant mineralogy, highly cemented.

TABLE 3-2

Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Hexavalent Chromium and Selected Dissolved Metals

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

			Dissolved Metals									
Location	**Sample Date**	**Hexavalent Chromium (µg/L)**	**Arsenic (µg/L)**	**Calcium (µg/L)**	**Chromium (µg/L)**	**Iron (µg/L)**	**Magnesium (µg/L)**	**Manganese (µg/L)**	**Molydenum (µg/L)**	**Potassium (µg/L)**	**Selenium (µg/L)**	**Sodium (µg/L)**
MW-23-060	21-Jul-09	26.0	25.0	830,000	30.0	ND (0.04)	49,000	ND (10)	50.0	100,000	2.70	2,700,000
	24-Sep-09	30.5	---	830,000	25.6	41.0	35,000	ND (10)	---	---	---	2,800,000
	10-Dec-09	25.8	---	---	25.6	---	---	---	---	---	---	---
	08-Mar-10	19.7	---	---	17.2	---	---	---	---	---	---	---
	03-May-10	24.7	---	---	23.9	---	---	---	---	---	---	---
	29-Sep-10	29.6	---	---	31.1	---	---	---	---	---	---	---
	14-Dec-10	30.4	3.00	760,000	33.3	ND (0.02)	11,000	ND (10)	---	---	---	2,600,000
	09-Feb-11	31.5	---	---	30.8	---	---	---	---	---	---	---
	04-May-11	30.2	2.50	---	31.3	---	---	0.51	---	---	---	---
	29-Sep-11	26.8	2.10	---	29.8	---	---	ND (2.5)	---	---	---	---
	13-Dec-11	29.9	2.20	830,000	30.6	ND (0.04)	28,000	ND (20)	12.0	57,000	4.70	2,900,000
	14-Feb-12	30.2	3.30	---	32.1	---	---	ND (10)	9.60	---	4.50 J	---
	30-Apr-12	29.7	2.60	---	32.4	---	---	ND (2.5)	---	---	---	---
	30-Apr-12 FD	29.9	2.20	---	33.4	---	---	ND (2.5)	---	---	---	---
	12-Sep-12	32.8	5.90	---	35.2	---	---	ND (0.5)	---	---	---	---
	08-Nov-12	31.6	5.30	860,000	35.5	ND (0.1)	7,900	ND (0.5)	---	---	---	3,200,000
	18-Feb-13	33.7	5.50	---	34.8	---	---	ND (0.5)	---	---	---	---
MW-23-080	21-Jul-09	34.0	24.0	900,000	44.0	ND (0.04)	190	ND (10)	95.0	94,000	0.82	2,900,000
	23-Sep-09	29.7	---	820,000	28.1	ND (0.02)	ND (0.1)	ND (10)	---	---	---	3,200,000
	10-Dec-09	21.8	---	---	22.4	---	---	---	---	---	---	---
	08-Mar-10	11.3	---	---	9.60	---	---	---	---	---	---	---
	04-May-10	21.8	---	---	20.5	---	---	---	---	---	---	---
	29-Sep-10	6.00	---	---	8.00	---	---	---	---	---	---	---
	14-Dec-10	12.2	2.60	750,000	12.8	ND (0.02)	7,100	ND (10)	---	---	---	2,900,000
	09-Feb-11	19.8	---	---	20.7	---	---	---	---	---	---	---
	04-May-11	14.1	3.30	---	13.3	---	---	ND (0.5)	---	---	---	---
	04-May-11 FD	14.4	3.40	---	12.5	---	---	ND (2.5)	---	---	---	---
	29-Sep-11	5.60	3.50	---	5.60	---	---	ND (2.5)	---	---	---	---
	12-Dec-11	8.70	3.30	760,000	8.80	ND (0.04) J	1,500	ND (20)	41.0	51,000 J	4.80	3,100,000 J
	12-Dec-11 FD	8.20	3.30	780,000	8.60	ND (0.04) J	1,800	ND (20)	41.0	52,000 J	5.30	3,100,000
	14-Feb-12	9.50	3.70	---	10.8	---	---	ND (10)	31.0	---	5.30	---
	30-Apr-12	6.00	4.10	---	8.20	---	---	ND (12)	---	---	---	---

TABLE 3-2

Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Hexavalent Chromium and Selected Dissolved Metals

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

			Dissolved Metals									
Location	**Sample Date**	**Hexavalent Chromium (µg/L)**	**Arsenic (µg/L)**	**Calcium (µg/L)**	**Chromium (µg/L)**	**Iron (µg/L)**	**Magnesium (µg/L)**	**Manganese (µg/L)**	**Molydenum (µg/L)**	**Potassium (µg/L)**	**Selenium (µg/L)**	**Sodium (µg/L)**
MW-23-080	12-Sep-12	12.8	3.30	---	15.9	---	---	ND (0.5)	---	---	---	---
	12-Sep-12 FD	14.2	3.00	---	15.2	---	---	ND (2.5)	---	---	---	---
	08-Nov-12	19.2	2.70	780,000	21.6	ND (0.1)	15,000	ND (0.5)	---	---	---	3,200,000
	18-Feb-13	11.2	3.10	---	10.6	---	---	ND (0.5)	---	---	---	---
MW-57-050	17-Feb-10	86.0	---	---	88.0	---	---	---	---	---	---	---
MW-57-070	11-Feb-09	660	4.10	340,000	720	ND (0.5)	24,000	31.0	13.0	11,000	ND (10)	110,000
	21-Jul-09	340	5.00	420,000	350	ND (0.04)	28,000	86.0	22.0	12,000	4.40	110,000
	24-Sep-09	132	---	420,000	139	43.0	27,000	33.0	---	---	---	87,000
	10-Dec-09	84.4	---	460,000	103	34.0	29,000	17.0	---	---	---	110,000
	16-Mar-10	542	---	---	449	---	---	---	---	---	---	---
	05-May-10	452	---	---	452	---	---	---	---	---	---	---
	30-Sep-10	856	---	---	733	---	---	---	---	---	---	---
	15-Dec-10	456 J	1.40	260,000	438	79.0	18,000	17.0	3.00	11,000	2.00	92,000
	15-Dec-10 FD	330 J	1.50	260,000	368	69.0	18,000	25.0	3.10	11,000	1.90	95,000
	10-Feb-11	507	---	---	612	---	---	---	---	---	---	---
	05-May-11	486	---	---	475	---	---	---	---	---	---	---
	05-May-11 FD	500	---	---	421	---	---	---	---	---	---	---
	29-Sep-11	309	---	---	352	---	---	---	---	---	---	---
	15-Dec-11	291	ND (2.5)	370,000	296	ND (0.02)	26,000	ND (10)	ND (5.0)	10,000	3.00	100,000
	15-Feb-12	454	1.20	---	520	---	---	---	ND (5.0)	---	3.60	---
	03-May-12	288	1.60	---	314	---	---	6.30	4.40	---	2.70	---
	12-Sep-12	609	---	---	614	---	---	---	---	---	---	---
	13-Dec-12	724	1.40	280,000	799	49.0	19,000	5.40	2.20	---	3.50	86,000
	13-Dec-12 FD	752	1.40	270,000	851	42.0	19,000	5.80	2.30	---	3.40	86,000
	20-Feb-13	272	---	---	338	---	---	---	---	---	---	---
	20-Feb-13 FD	268	---	---	376	---	---	---	---	---	---	---
	11-Mar-13	594	---	---	562	---	---	---	---	---	---	---
MW-57BR	01-Mar-09	14.0	---	---	19.0	---	---	---	---	---	---	---
	01-Mar-09	36.0	---	---	35.0	---	---	---	---	---	---	---
	01-Mar-09	13.0	---	---	14.0	---	---	---	---	---	---	---
	01-Mar-09	13.0	---	---	14.0	---	---	---	---	---	---	---
	01-Mar-09	13.0	---	---	14.0	---	---	---	---	---	---	---

TABLE 3-2

Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Hexavalent Chromium and Selected Dissolved Metals

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

			Dissolved Metals									
Location	**Sample Date**	**Hexavalent Chromium (µg/L)**	**Arsenic (µg/L)**	**Calcium (µg/L)**	**Chromium (µg/L)**	**Iron (µg/L)**	**Magnesium (µg/L)**	**Manganese (µg/L)**	**Molydenum (µg/L)**	**Potassium (µg/L)**	**Selenium (µg/L)**	**Sodium (µg/L)**
MW-57-185	20-Jul-09	1.40	30.0	330,000	ND (4.9)	ND (0.04)	3,300	1,100	99.0	66,000	ND (2.5) J	3,600,000
	23-Sep-09	1.13	---	310,000	2.38	ND (0.02)	3,300	1,000	---	---	---	3,800,000
	09-Dec-09	2.09	---	320,000	2.62	21.0	3,100	850	---	---	---	3,500,000
	09-Mar-10	6.80	---	---	6.70	---	---	---	---	---	---	---
	05-May-10	3.90	---	---	4.70	---	---	---	---	---	---	---
	29-Sep-10	5.60	---	---	5.90	---	---	---	---	---	---	---
	09-Dec-10	3.70	11.0	350,000	2.40	ND (0.02)	3,100	580	87.0	66,000	0.52	3,700,000
	08-Feb-11	5.90	---	---	6.60	---	---	---	---	---	---	---
	03-May-11	6.30	12.0	---	7.20	---	---	540	88.0	---	3.30	---
	28-Sep-11	7.00	13.0	---	8.50	---	---	520	88.0	---	ND (2.5)	---
	13-Dec-11	7.40	12.0	330,000	7.30	ND (0.04)	3,600	550	78.0	56,000	ND (2.5)	3,800,000
	10-Feb-12	7.20	12.0	---	8.50	---	---	470	69.0	---	ND (2.5)	---
	10-Feb-12 FD	7.30	13.0	---	8.90	---	---	500	72.0	---	ND (2.5)	---
	30-Apr-12	7.10	14.0	---	8.60	---	---	470	93.0	---	ND (2.5)	---
	11-Sep-12	7.80	14.0	---	9.10	---	---	400	86.0	---	ND (2.5)	---
	08-Nov-12	9.50	13.0	350,000	10.7	ND (0.1)	4,000	400	85.0	---	ND (0.5)	4,300,000
	06-Feb-13	10.4	13.0	---	11.4	---	---	270	77.0	---	ND (0.5)	---
MW-58-065	17-Feb-10	ND (0.2)	---	---	8.00	---	---	---	---	---	---	---
MW-58BR Open Borehole (Shallow)	05-Mar-09	180	---	---	180	---	---	---	---	---	---	---
	05-Mar-09	200	---	---	200	---	---	---	---	---	---	---
	05-Mar-09	230	25.0 J	---	240	---	---	---	---	---	---	---
MW-58BR Open Borehole (Deeper)	25-Mar-10	9.10	13.0	---	15.0	---	---	---	---	---	---	---
	28-Feb-13	ND (1.0)	1.10	---	ND (1.0)	---	---	---	---	---	---	---
MW-58BR Flute (Upper Zone)	22-Jul-09	ND (1.0)	110 R'	610,000	3.00	130	33,000	2,500	62.0	47,000	ND (0.5)	1,700,000
	29-Sep-09	ND (1.1)	---	530,000	ND (1.0)	160	27,000	2,300	---	---	---	1,400,000
	16-Dec-09	ND (1.1)	18.0 J	470,000	1.40	190	22,000	1,300	---	---	---	1,200,000
MW-58BR Flute (Lower Zone)	22-Jul-09	ND (1.0)	340 R'	470,000	6.30	57.0	25,000	310	51.0	33,000	ND (0.5)	1,100,000
	29-Sep-09	4.69	---	420,000	9.70	ND (0.02)	22,000	200	---	---	---	1,100,000
	16-Dec-09	7.56	41.0 J	360,000	26.6	ND (0.02)	18,000	130	---	---	---	920,000
MW-58BR Packer (Shallow Set) Upper Zone	14-Sep-10	3.80	5.90	---	3.50	---	---	---	---	---	---	---
	06-Oct-10	4.70	5.60	---	8.40	---	---	---	---	---	---	---

TABLE 3-2

Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Hexavalent Chromium and Selected Dissolved Metals

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

			Dissolved Metals									
Location	**Sample Date**	**Hexavalent Chromium (µg/L)**	**Arsenic (µg/L)**	**Calcium (µg/L)**	**Chromium (µg/L)**	**Iron (µg/L)**	**Magnesium (µg/L)**	**Manganese (µg/L)**	**Molydenum (µg/L)**	**Potassium (µg/L)**	**Selenium (µg/L)**	**Sodium (µg/L)**
MW-58BR Packer (Shallow Set) Lower Zone	16-Sep-10	200	3.20	---	200	---	---	---	---	---	---	---
	07-Oct-10	199	3.20	---	173	---	---	---	---	---	---	---
MW-58BR Packer (Deeper Set) Upper Zone	01-Feb-11	ND (1.0)	1.90	---	ND (1.0)	---	---	---	---	---	---	---
	18-Mar-11	ND (5.0)	1.80	---	ND (1.0)	---	---	---	---	---	---	---
	06-Jul-11	ND (1.0)	1.20	---	ND (1.0)	---	---	---	---	---	---	---
	02-Aug-11	ND (5.0)	0.89	---	ND (0.5)	---	---	---	---	---	---	---
	30-Aug-11	ND (1.0)	1.10	---	2.30	---	---	---	---	---	---	---
	11-Oct-11	ND (1.0)	0.93	---	ND (0.5)	---	---	---	16.0	---	ND (2.5)	---
	08-Nov-11	ND (1.0)	0.79	---	3.00	---	---	---	14.0	---	2.60	---
	08-Dec-11	ND (1.0)	0.74	620,000	ND (0.5)	1,300	30,000	940	21.0	29,000	ND (2.5)	2,000,000
	08-Feb-12	ND (1.0)	ND (0.5)	---	ND (1.0)	---	---	---	19.0	---	ND (2.5)	---
	15-May-12	ND (1.0)	---	---	1.40	---	---	---	---	---	---	---
	03-Oct-12	ND (1.0)	0.49	---	ND (1.0)	---	---	---	---	---	---	---
MW-58BR Packer (Deeper Set) Lower Zone	10-Feb-11	140	1.60	---	130	---	---	---	---	---	---	---
	04-Apr-11	100	1.60	---	110	---	---	---	---	---	---	---
	07-Jul-11	210	1.90	---	210	---	---	---	---	---	---	---
	23-Aug-11	150	1.40	---	150	---	---	---	---	---	---	---
	31-Aug-11	200	2.00	---	170	---	---	---	---	---	---	---
	13-Oct-11	28.0	0.75	---	28.0	---	---	---	12.0	---	ND (2.5)	---
	09-Nov-11	210	1.80	---	190	---	---	---	14.0	---	2.80	---
	09-Dec-11	88.0	1.60	580,000	89.0	ND (0.02)	29,000	160	18.0	27,000	ND (2.5)	1,400,000
	09-Feb-12	79.0	1.60	---	68.0	---	---	---	17.0	---	1.90	---
	16-May-12	2.40	---	---	7.40	---	---	---	---	---	---	---
	04-Oct-12	2.30	0.71	---	10.2	---	---	---	---	---	---	---
MW-59-100	18-Mar-09	4,300	13.0	870,000	4,800	ND (1.0)	31,000	2,400	38.0	46,000	ND (10)	1,500,000
	22-Jul-09	5,100	18.0	830,000	4,900	ND (0.04)	26,000	290	38.0	55,000	5.10	1,300,000
	22-Jul-09 FD	5,100	17.0	820,000	4,800	ND (0.04)	25,000	290	39.0	51,000	ND (0.5)	1,300,000
	24-Sep-09	4,630	---	940,000	5,300	35.0	26,000	91.0	---	---	---	1,600,000
	11-Dec-09	4,340	---	830,000	4,420	26.0	22,000	51.0	---	---	---	1,400,000
	17-Mar-10	5,320	---	---	5,270	---	---	---	---	---	---	---

TABLE 3-2

Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Hexavalent Chromium and Selected Dissolved Metals

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

			Dissolved Metals									
Location	**Sample Date**	**Hexavalent Chromium (µg/L)**	**Arsenic (µg/L)**	**Calcium (µg/L)**	**Chromium (µg/L)**	**Iron (µg/L)**	**Magnesium (µg/L)**	**Manganese (µg/L)**	**Molydenum (µg/L)**	**Potassium (µg/L)**	**Selenium (µg/L)**	**Sodium (µg/L)**
MW-59-100	06-May-10	4,940	---	---	4,850	---	---	---	---	---	---	---
	30-Sep-10	5,140	---	---	4,630	---	---	---	---	---	---	---
	16-Dec-10	5,660	2.10	760,000	4,830	ND (0.02)	24,000	ND (10)	4.60	44,000	5.00	1,300,000
	10-Feb-11	5,090	---	---	5,020	---	---	---	---	---	---	---
	10-Feb-11 FD	5,110	---	---	5,120	---	---	---	---	---	---	---
	06-May-11	5,240	2.00	---	4,520	---	---	3.40	ND (12)	---	4.70	---
	04-Oct-11	4,330	2.00	---	4,850	---	---	1.90	ND (12)	---	5.60	---
	15-Dec-11	4,600	2.00	690,000	4,950	ND (0.02)	23,000	ND (10)	ND (5.0)	33,000	5.30	1,300,000
	15-Dec-11 FD	4,990	1.50	690,000	4,890	ND (0.02)	23,000	ND (10)	ND (5.0)	31,000	3.70	1,400,000
	22-Feb-12	4,070	2.00	---	4,690	---	---	ND (10)	ND (5.0)	---	3.80	---
	08-May-12	4,610	2.10	---	4,690	---	---	11.0	5.70	---	4.60	---
	02-Oct-12	4,510	2.90	628,000	4,640	ND (0.02)	22,700	1.30	4.90	---	ND (5.0)	1,560,000
	28-Nov-12	3,980	4.40	691,000	3,970	ND (0.02)	26,100	0.78	4.30	---	ND (5.0)	1,440,000
	27-Feb-13	3,920	2.60	637,000	4,030	ND (0.02)	23,400	ND (0.5)	3.80	---	ND (5.0)	1,590,000
MW-60-125	20-Mar-09	810	8.70	450,000 J	840	ND (0.5)	29,000	120	25.0	39,000	ND (10)	1,500,000 J
	21-Jul-09	780	11.0	480,000	810	ND (0.04)	29,000	140	45.0	41,000	4.20	1,100,000
	24-Sep-09	570	---	470,000	619	57.0	27,000	100	---	---	---	1,200,000
	10-Dec-09	532	---	470,000	592	160	24,000	41.0	---	---	---	1,200,000
	17-Mar-10	657	---	---	592	---	---	---	---	---	---	---
	06-May-10	1,120	---	---	1,080	---	---	---	---	---	---	---
	30-Sep-10	806	---	---	795	---	---	---	---	---	---	---
	16-Dec-10	1,090	1.40	540,000	992	ND (0.02)	29,000	29.0	17.0	43,000 J	5.20 J	1,300,000
	16-Dec-10 FD	1,070	1.50	550,000	1,000	ND (0.02)	29,000	35.0	18.0	40,000 J	5.30 J	1,300,000
	10-Feb-11	1,160	---	---	1,170	---	---	---	---	---	---	---
	05-May-11	1,040	1.80	---	959	---	---	ND (0.5)	32.0	---	34.0	---
	04-Oct-11	715	1.70	---	760	---	---	14.0	20.0	---	ND (12)	---
	14-Dec-11	901	1.50	480,000	915	ND (0.02)	25,000	13.0	15.0	26,000	5.40	1,300,000
	15-Feb-12	918	1.20	---	1,100	---	---	15.0	14.0	---	5.50	---
	03-May-12	882	1.70	---	936	---	---	11.0	19.0	---	5.40	---
	20-Sep-12	848	1.70	---	846	---	---	10.0	18.0	---	5.20	---
	06-Dec-12	867	1.80	410,000	804	ND (0.02)	25,000	14.0	21.0	---	6.20	1,400,000
	20-Feb-13	1,020	1.60	---	1,000	---	---	ND (0.5)	19.0 J	---	6.10	---

TABLE 3-2

Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Hexavalent Chromium and Selected Dissolved Metals

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

			Dissolved Metals									
Location	**Sample Date**	**Hexavalent Chromium (µg/L)**	**Arsenic (µg/L)**	**Calcium (µg/L)**	**Chromium (µg/L)**	**Iron (µg/L)**	**Magnesium (µg/L)**	**Manganese (µg/L)**	**Molydenum (µg/L)**	**Potassium (µg/L)**	**Selenium (µg/L)**	**Sodium (µg/L)**
MW-60BR-245	03-Aug-11	61.0	7.00	---	53.0	---	---	---	62.0	---	ND (2.5)	---
	09-Aug-11	64.0	6.90	340,000	69.0	ND (0.02)	5,600	14.0	47.0	37,000	ND (5.0)	3,000,000
	07-Sep-11	77.0	8.80	370,000	71.0	ND (0.02)	5,400	17.0	46.0	44,000	ND (2.5)	3,500,000
	16-Oct-11	200	6.90	---	220	---	---	---	44.0	---	ND (2.5)	---
	02-Nov-11	78.0	7.60	---	70.0	---	---	---	54.0	---	ND (12)	---
	03-Nov-11	290	4.80	---	260	---	---	---	48.0	---	ND (2.5)	---
	04-Nov-11	130	5.20	---	130	---	---	---	43.0	---	17.0 J	---
	16-Nov-11	130	8.00	380,000	150	1,400	8,100	170	44.0	39,000	ND (2.5)	3,300,000
	14-Dec-11	260	5.90	440,000	240	25.0	10,000	ND (20)	46.0	44,000	ND (2.5)	3,500,000
	16-Feb-12	250	4.00	---	250	---	---	13.0	43.0	---	ND (12) J	---
	17-May-12	74.2	8.80	---	77.0	---	---	12.0	56.0	---	ND (2.5)	---
	19-Sep-12	89.7	8.10	---	97.2	---	---	5.90	54.0	---	ND (2.5)	---
	05-Dec-12	61.4	8.10	390,000	59.2	ND (0.1)	6,100	9.60	62.0	---	2.10	3,800,000
	14-Mar-13	90.6	7.50	---	125	---	---	ND (0.5)	46.0	---	1.70	---
	14-Mar-13 FD	93.9	7.10	---	110	---	---	ND (0.5)	47.0	---	1.80	---
MW-61-110	23-Mar-09	620	17.0	510,000	670	ND (1.0)	22,000	700	38.0	58,000	ND (10)	2,800,000
	21-Jul-09	240	22.0	630,000	260	ND (0.04)	23,000	820	60.0	73,000	ND (0.5)	2,700,000
	24-Sep-09	360	---	640,000	363	47.0	21,000	590	---	---	---	2,900,000
	10-Dec-09	433	---	660,000	450	30.0	20,000	500	---	---	---	3,000,000
	17-Mar-10	484	---	---	406	---	---	---	---	---	---	---
	06-May-10	480	---	---	511	---	---	---	---	---	---	---
	30-Sep-10	512	---	---	507	---	---	---	---	---	---	---
	15-Dec-10	567	3.20	670,000	510	130	20,000	520	27.0	58,000	1.00	2,600,000
	09-Feb-11	684	---	---	653	---	---	---	---	---	---	---
	05-May-11	522	3.40	---	531	---	---	360	23.0	---	ND (2.5)	---
	30-Sep-11	611	3.30	---	698	---	---	270	24.0	---	ND (2.5)	---
	14-Dec-11	682	3.20	690,000 J	722	ND (0.02)	22,000	260	17.0	53,000	ND (2.5)	4,200,000
	15-Feb-12	634	3.20	---	680	---	---	220	16.0	---	ND (2.5)	---
	03-May-12	486	3.20	---	578	---	---	280	22.0	---	ND (2.5)	---
	27-Sep-12	656	2.00	637,000	714	ND (0.02)	23,400	172	24.1	---	ND (5.0)	2,840,000
	27-Sep-12 FD	661	2.10	624,000	738	ND (0.02)	22,900	165	20.2	---	ND (5.0)	2,790,000
	27-Nov-12	666	3.20	604,000	709	ND (0.02)	21,600	165	21.9	---	ND (5.0)	2,750,000

TABLE 3-2

Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Hexavalent Chromium and Selected Dissolved Metals

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

			Dissolved Metals									
Location	**Sample Date**	**Hexavalent Chromium (µg/L)**	**Arsenic (µg/L)**	**Calcium (µg/L)**	**Chromium (µg/L)**	**Iron (µg/L)**	**Magnesium (µg/L)**	**Manganese (µg/L)**	**Molydenum (µg/L)**	**Potassium (µg/L)**	**Selenium (µg/L)**	**Sodium (µg/L)**
MW-61-110	27-Nov-12 FD	678	3.10	637,000	716	ND (0.02)	21,800	179	20.9	---	ND (5.0)	2,860,000
	25-Feb-13	637	3.40	629,000	682 J	ND (0.02)	23,300	133	24.0	---	ND (5.0)	2,850,000
MW-62-065	27-Mar-09	720	6.10	200,000	740	ND (0.5)	24,000	37.0	23.0	29,000	ND (10)	1,400,000
	22-Jul-09	290	6.50	200,000	300	ND (0.04)	25,000	62.0	28.0	36,000	2.70	860,000
	24-Sep-09	236	---	210,000	251	76.0	25,000	39.0	---	---	---	1,100,000 J
	10-Dec-09	219	---	200,000	247	ND (0.02)	23,000	31.0	---	---	---	910,000
	16-Mar-10	397	---	---	372	---	---	---	---	---	---	---
	06-May-10	436	---	---	456	---	---	---	---	---	---	---
	30-Sep-10	500	---	---	462	---	---	---	---	---	---	---
	15-Dec-10	598	0.99	220,000	494	ND (0.02)	24,000	ND (10)	13.0	28,000	3.10	980,000
	09-Feb-11	481	---	---	475	---	---	---	---	---	---	---
	05-May-11	488	---	---	472	---	---	---	---	---	---	---
	29-Sep-11	457	1.30	---	500	---	---	13.0	14.0	---	3.00	---
	13-Dec-11	532	0.98	230,000	500	ND (0.02) J	27,000	ND (10)	12.0	25,000	3.20	1,100,000
	17-Feb-12	452	1.50	---	530	---	---	---	11.0	---	3.10	---
	02-May-12	443	1.80	---	433	---	---	4.20	18.0	---	ND (2.5)	---
	12-Sep-12	588	---	---	627	---	---	---	---	---	---	---
	10-Dec-12	505	1.40	210,000	543	ND (0.02)	24,000	1.10	15.0	---	3.50	1,100,000
	19-Feb-13	404	---	---	406	---	---	---	---	---	---	---
MW-62-110	22-Jul-09	74.0	430 R'	150,000	71.0	ND (0.04)	7,000	440	110	35,000	1.40	1,400,000
	29-Sep-09	4.40	---	170,000	31.3	27.0	8,000	490	---	---	---	1,700,000
	16-Dec-09	381	32.0 J	160,000	460	ND (0.02)	7,100	350	---	---	---	1,500,000
	11-Mar-10	628	10.3	---	684	---	---	---	---	---	---	---
	04-May-10	579	12.0	---	569	---	---	---	---	---	---	---
	29-Sep-10	414	19.5	---	363	---	---	---	---	---	---	---
	16-Dec-10	390	14.0	170,000	378	ND (0.02)	8,400	230	57.0	37,000	2.40	1,600,000
	09-Feb-11	565	14.0	---	540	---	---	---	---	---	---	---
	05-May-11	569	14.0	---	531	---	---	240	60.0	---	2.50	---
	29-Sep-11	598	11.0	---	739	---	---	210	54.0	---	3.20	---
	14-Dec-11	1,140	10.0	180,000	1,300	ND (0.02)	8,700	160	44.0	24,000	ND (12)	1,700,000
	16-Feb-12	842	6.30	---	880	---	---	190	44.0	---	ND (12)	---
	10-May-12	828	8.80	---	941	---	---	180	50.0	---	3.40	---

TABLE 3-2

Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Hexavalent Chromium and Selected Dissolved Metals

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

			Dissolved Metals									
Location	**Sample Date**	**Hexavalent Chromium (µg/L)**	**Arsenic (µg/L)**	**Calcium (µg/L)**	**Chromium (µg/L)**	**Iron (µg/L)**	**Magnesium (µg/L)**	**Manganese (µg/L)**	**Molydenum (µg/L)**	**Potassium (µg/L)**	**Selenium (µg/L)**	**Sodium (µg/L)**
MW-62-110	13-Sep-12	894	8.50	---	923	---	---	140	45.0	---	3.60	---
	11-Dec-12	904	12.0	170,000	944	ND (0.02)	8,200	130	46.0	---	3.40	1,600,000
	26-Feb-13	1,050	10.0	---	969	---	---	83.0	47.0	---	3.00	---
MW-62-190	22-Jul-09	ND (1.0)	270 R'	350,000	2.00	55.0	14,000	2,200	100	62,000	ND (0.5)	3,500,000
	29-Sep-09	147	---	250,000	50.3	ND (0.02)	11,000	1,200	---	---	---	2,500,000
	16-Dec-09	ND (1.1)	40.0 J	350,000	1.60	56.0	13,000	1,900	---	---	---	3,500,000
	11-Mar-10	ND (1.1)	9.40	---	ND (1.0)	---	---	---	---	---	---	---
	04-May-10	ND (1.0)	9.40	---	ND (1.0)	---	---	---	---	---	---	---
	29-Sep-10	ND (1.0)	9.50	---	ND (1.0)	---	---	---	---	---	---	---
	16-Dec-10	ND (1.0)	8.10	370,000	1.30	49.0	14,000	1,300	87.0	69,000	0.51	3,300,000
	09-Feb-11	ND (1.0)	8.00	---	ND (1.0)	---	---	---	---	---	---	---
	05-May-11	ND (1.0)	6.50	---	ND (1.0)	---	---	1,000	82.0	---	ND (2.5)	---
	29-Sep-11	ND (1.0)	6.60	---	ND (1.0)	---	---	1,100	85.0	---	ND (12)	---
	14-Dec-11	ND (1.0)	6.70	310,000	ND (1.0)	35.0	13,000	920	76.0	42,000	ND (2.5)	3,500,000
	16-Feb-12	ND (1.0)	6.40	---	ND (1.0)	---	---	840	63.0	---	ND (12)	---
	10-May-12	ND (1.0)	5.40	---	ND (1.0)	---	---	760	68.0	---	ND (2.5)	---
	13-Sep-12	ND (1.0)	5.90	---	ND (1.0)	---	---	790	76.0	---	ND (2.5)	---
	11-Dec-12	ND (1.0)	5.80	320,000	ND (1.0)	46.0	12,000	710	82.0	---	3.30	4,200,000
	26-Feb-13	ND (1.0)	5.90	---	ND (1.0)	---	---	620	81.0	---	ND (2.5)	---
MW-63-065	15-Apr-09	ND (0.2)	5.20	150,000	2.30	ND (0.5)	21,000	520	41.0	26,000	ND (10)	1,200,000
	20-Jul-09	0.54	6.70	200,000	ND (2.9)	ND (0.04)	21,000	240	50.0	33,000	ND (0.5)	1,200,000
	20-Jul-09 FD	0.54	6.60	200,000	ND (3.0)	ND (0.04)	21,000	230	49.0	32,000	ND (0.5)	1,200,000
	22-Sep-09	0.65	---	200,000	1.20	56.0	23,000	150	---	---	---	1,200,000
	22-Sep-09 FD	0.54	---	200,000	1.90	52.0	22,000	170	---	---	---	1,300,000
	09-Dec-09	0.63	---	190,000	1.10	34.0	20,000	110	---	---	---	1,100,000
	09-Dec-09 FD	ND (1.1)	---	190,000	ND (1.0)	25.0	20,000	91.0	---	---	---	1,100,000
	09-Mar-10	ND (1.1)	---	---	ND (1.0)	---	---	---	---	---	---	---
	09-Mar-10 FD	1.10	---	---	ND (1.0)	---	---	---	---	---	---	---
	03-May-10	1.40	---	---	2.10	---	---	---	---	---	---	---
	03-May-10 FD	1.40	---	---	2.40	---	---	---	---	---	---	---
	27-Sep-10	1.70	---	---	2.20	---	---	---	---	---	---	---
	27-Sep-10 FD	1.70	---	---	2.20	---	---	---	---	---	---	---

TABLE 3-2

Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Hexavalent Chromium and Selected Dissolved Metals

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

			Dissolved Metals									
Location	**Sample Date**	**Hexavalent Chromium (µg/L)**	**Arsenic (µg/L)**	**Calcium (µg/L)**	**Chromium (µg/L)**	**Iron (µg/L)**	**Magnesium (µg/L)**	**Manganese (µg/L)**	**Molydenum (µg/L)**	**Potassium (µg/L)**	**Selenium (µg/L)**	**Sodium (µg/L)**
MW-63-065	06-Dec-10	1.20	1.60	230,000	ND (1.0)	26.0	23,000	57.0	28.0	27,000	0.88	1,300,000
	08-Feb-11	1.30	---	---	1.70	---	---	---	---	---	---	---
	03-May-11	1.00	1.60	---	1.70	---	---	43.0	27.0	---	1.80	---
	28-Sep-11	1.60	1.50	---	2.80	---	---	15.0	24.0	---	ND (2.5)	---
	12-Dec-11	1.20	1.50	180,000	2.10	510	20,000	51.0	21.0	17,000	1.10	1,100,000
	13-Feb-12	ND (0.2)	1.20	---	1.40	---	---	44.0	21.0	---	0.83	---
	26-Apr-12	0.76	1.20	---	1.50	---	---	30.0	26.0	---	ND (2.5)	---
	10-Sep-12	1.50	1.70	---	2.30	---	---	11.0	20.0	---	1.80	---
	07-Nov-12	1.20	1.50	230,000	2.00	24.0	23,000	140	19.0	---	0.93	1,400,000
	06-Feb-13	1.20	1.60	---	1.50	---	---	3.40	22.0	---	0.81	---
MW-64BR Open Borehole	20-Dec-10	140	5.30	---	140	---	---	---	---	---	---	---
	01-Mar-13	ND (1.0)	2.90	---	ND (1.0)	---	---	---	---	---	---	---
MW-64BR Flute (Upper Zone)	22-Jul-09	ND (1.0)	450 R'	230,000	5.20	50.0	15,000	470	110	36,000	ND (0.5)	1,400,000
	29-Sep-09	ND (1.1)	---	310,000	1.50	130	18,000	1,300	---	---	---	1,800,000
	12-Oct-09	ND (1.1)	---	---	ND (1.0)	---	---	---	---	---	---	---
	04-Nov-09	ND (1.1)	---	---	ND (1.0)	---	---	---	---	---	---	---
	16-Dec-09	ND (1.1)	26.0 J	350,000	1.84	260	17,000	1,100	---	---	---	2,000,000
	19-Jan-10	ND (1.1)	---	---	ND (1.0)	---	---	---	---	---	---	---
	10-Feb-10	ND (1.1)	---	---	ND (1.0)	---	---	---	---	---	---	---
	11-Mar-10	ND (1.1)	12.5	---	ND (1.0)	---	---	---	---	---	---	---
	04-May-10	ND (1.0)	12.9	---	ND (1.0)	---	---	---	---	---	---	---
	25-Aug-10	ND (1.0)	10.4	---	ND (1.0)	---	---	---	---	---	---	---
	29-Sep-10	ND (1.0)	8.20	---	ND (1.0)	---	---	---	---	---	---	---
	20-Oct-10	ND (0.2)	---	---	ND (1.0)	---	---	---	---	---	---	---
	11-Nov-10	ND (0.2)	---	---	ND (1.0)	---	---	---	---	---	---	---
MW-64BR Flute (Middle Zone)	22-Jul-09	5.70	550 R'	330,000	17.0	ND (0.04)	15,000	270	93.0	47,000	ND (0.5)	2,100,000
	29-Sep-09	ND (1.1)	---	430,000	2.50	39.0	18,000	810	---	---	---	2,600,000
	12-Oct-09	1.60	---	---	6.00	---	---	---	---	---	---	---
	04-Nov-09	1.40	---	---	5.60	---	---	---	---	---	---	---
	16-Dec-09	ND (1.1)	26.0 J	450,000	5.60	170	16,000	710	---	---	---	3,100,000
	19-Jan-10	ND (1.1)	---	---	3.20	---	---	---	---	---	---	---
	10-Feb-10	ND (1.1)	---	---	ND (1.0)	---	---	---	---	---	---	---

TABLE 3-2

Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Hexavalent Chromium and Selected Dissolved Metals

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

			Dissolved Metals									
Location	**Sample Date**	**Hexavalent Chromium (µg/L)**	**Arsenic (µg/L)**	**Calcium (µg/L)**	**Chromium (µg/L)**	**Iron (µg/L)**	**Magnesium (µg/L)**	**Manganese (µg/L)**	**Molydenum (µg/L)**	**Potassium (µg/L)**	**Selenium (µg/L)**	**Sodium (µg/L)**
MW-64BR Flute (Middle Zone)	11-Mar-10	ND (1.1)	8.50	---	ND (1.0)	---	---	---	---	---	---	---
	04-May-10	ND (1.0)	8.50	---	2.60	---	---	---	---	---	---	---
	25-Aug-10	ND (1.0)	6.30	---	3.90	---	---	---	---	---	---	---
	29-Sep-10	ND (1.0)	6.60	---	3.80	---	---	---	---	---	---	---
	20-Oct-10	ND (1.0)	---	---	3.60	---	---	---	---	---	---	---
	11-Nov-10	ND (1.0)	---	---	4.00	---	---	---	---	---	---	---
MW-64BR Flute (Lower Zone)	22-Jul-09	ND (1.0)	770 R'	270,000	4.80	130	17,000	330	85.0	41,000	ND (0.5)	1,600,000
	29-Sep-09	1.40	---	390,000	1.40	28.0	19,000	1,200	---	---	---	2,300,000
	12-Oct-09	ND (1.1)	---	---	1.30	---	---	---	---	---	---	---
	04-Nov-09	1.90	---	---	1.20	---	---	---	---	---	---	---
	16-Dec-09	ND (1.1)	33.0 J	450,000	2.20	78.0	20,000	1,300	---	---	---	3,000,000
	19-Jan-10	ND (1.1)	---	---	ND (1.0)	---	---	---	---	---	---	---
	10-Feb-10	ND (1.1)	---	---	ND (1.0)	---	---	---	---	---	---	---
	11-Mar-10	ND (1.1)	2.90	---	ND (1.0)	---	---	---	---	---	---	---
	04-May-10	ND (1.0)	5.20	---	ND (1.0)	---	---	---	---	---	---	---
	25-Aug-10	ND (1.0)	3.40	---	ND (1.0)	---	---	---	---	---	---	---
	29-Sep-10	ND (1.0)	2.60	---	ND (1.0)	---	---	---	---	---	---	---
	20-Oct-10	ND (1.0)	---	---	ND (1.0)	---	---	---	---	---	---	---
	11-Nov-10	ND (1.0)	---	---	ND (1.0)	---	---	---	---	---	---	---
MW-64BR Packer (Upper Zone)	26-Jan-11	220	2.80	---	220	---	---	---	---	---	---	---
	12-Apr-11	130	3.10	---	140	---	---	---	---	---	---	---
	11-Jul-11	20.0	2.20	---	23.0	---	---	---	---	---	---	---
	15-Aug-11	60.0	2.50	---	57.0	---	---	---	---	---	---	---
	12-Sep-11	62.0	2.50	---	50.0	---	---	---	---	---	---	---
	24-Oct-11	51.0	4.70	---	50.0	---	---	---	40.0	---	11.0	---
	14-Nov-11	1.40	2.70	---	0.98	---	---	430	54.0	---	8.10	---
	12-Dec-11	6.80	1.60	440,000	6.60	ND (0.02) J	21,000	330	53.0	35,000	7.60	2,200,000
	13-Feb-12	ND (1.0)	1.70	---	ND (1.0)	---	---	---	49.0	---	1.80	---
	16-Apr-12	ND (1.0)	---	---	2.10	---	---	---	---	---	---	---
	08-Oct-12	ND (1.0)	7.40	---	ND (1.0)	---	---	---	---	---	---	---
MW-64BR Packer (Lower Zone)	24-Feb-11	100	4.50	---	97.0	---	---	---	---	---	---	---
	20-Apr-11	2.10	3.90	---	3.20	---	---	---	---	---	---	---

TABLE 3-2

Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Hexavalent Chromium and Selected Dissolved Metals

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

			Dissolved Metals									
Location	**Sample Date**	**Hexavalent Chromium (µg/L)**	**Arsenic (µg/L)**	**Calcium (µg/L)**	**Chromium (µg/L)**	**Iron (µg/L)**	**Magnesium (µg/L)**	**Manganese (µg/L)**	**Molydenum (µg/L)**	**Potassium (µg/L)**	**Selenium (µg/L)**	**Sodium (µg/L)**
MW-64BR Packer (Lower Zone)	21-Jul-11	68.0	3.00	---	58.0	---	---	---	---	---	---	---
	18-Aug-11	100	4.40	---	100	---	---	---	---	---	---	---
	15-Sep-11	82.0	3.50	---	72.0	---	---	---	---	---	---	---
	27-Oct-11	74.0	2.90	---	64.0	---	---	---	64.0	---	ND (2.5)	---
	17-Nov-11	90.0	3.40	---	80.0	---	---	77.0	63.0	---	ND (2.5)	---
	15-Dec-11	87.0	3.40	420,000	79.0	ND (0.02)	12,000	67.0	59.0	37,000	ND (12)	3,400,000
	16-Feb-12	56.0	3.60	---	50.0	---	---	---	57.0	---	ND (2.5)	---
	19-Apr-12	21.9	---	---	23.2	---	---	---	---	---	---	---
	10-Oct-12	ND (1.0)	1.70	---	1.00	---	---	---	---	---	---	---
MW-65-160	14-May-11	43.0	2.60	---	41.0	---	---	---	31.0	---	6.20	---
	13-Jun-11	13.0	1.20	210,000	17.0	46.0	37,000	590	42.0	23,000	2.50	510,000
	11-Jul-11	14.0	0.97	250,000	18.0	40.0	36,000	570	72.0	18,000	2.10	580,000
	09-Aug-11	24.0	0.98	230,000	28.0	46.0	35,000	490	38.0	15,000	2.60	540,000
	09-Aug-11 FD	23.0	0.98	230,000	28.0	64.0	35,000	500	38.0	14,000	2.60	520,000
	07-Sep-11	30.0	0.82	240,000	31.0	ND (0.02)	35,000	480	38.0	17,000	3.50	550,000
	17-Oct-11	18.0	0.78	220,000	21.0	ND (0.02)	35,000	530	37.0	11,000	5.00	550,000
	15-Nov-11	64.0	0.9	240,000	67.0	ND (0.02)	36,000	480	29.0	15,000	5.20	550,000
	15-Dec-11	45.0	0.91	260,000	48.0	ND (0.02)	38,000	470	31.0	17,000	5.70	590,000
	16-Feb-12	32.0	0.82	---	35.0	---	---	250	28.0	---	6.20	---
	01-May-12	51.0	0.96	---	54.6	---	---	140	31.0	---	7.10	---
	18-Sep-12	75.7	0.9	---	79.6	---	---	68.0	29.0	---	6.40	---
	04-Dec-12	78.5	0.88	250,000	85.1	ND (0.02)	33,000	33.0	29.0	---	8.50	550,000
	19-Feb-13	78.8	0.83	---	77.1	---	---	26.0	28.0	---	7.70	---
MW-65-225	14-May-11	130	1.70	---	110	---	---	---	38.0	---	2.70	---
	13-Jun-11	120	1.80	430,000	120	ND (0.02)	24,000	1,100	37.0	59,000	1.90	2,800,000
	11-Jul-11	210	1.70	490,000	210	ND (0.02)	25,000	570	65.0	45,000	2.60	2,700,000
	09-Aug-11	230	1.80	420,000	210	ND (0.02)	24,000	470	32.0	32,000	ND (5.0)	2,100,000
	07-Sep-11	250	2.00	410,000	250	ND (0.02)	23,000	430	32.0	39,000	3.30	2,400,000
	17-Oct-11	250	2.10	410,000	250	ND (0.02)	25,000	370	35.0	35,000	4.10	2,600,000
	15-Nov-11	310	2.00	370,000	300	ND (0.02)	22,000	310	31.0	32,000	4.10	2,400,000
	15-Nov-11 FD	310	2.00	370,000	320	ND (0.02)	22,000	320	31.0	33,000	3.90	2,500,000
	15-Dec-11	350	1.80	400,000	320	ND (0.02)	22,000	240	32.0	33,000	ND (12)	2,200,000

TABLE 3-2

Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Hexavalent Chromium and Selected Dissolved Metals

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

			Dissolved Metals									
Location	**Sample Date**	**Hexavalent Chromium (µg/L)**	**Arsenic (µg/L)**	**Calcium (µg/L)**	**Chromium (µg/L)**	**Iron (µg/L)**	**Magnesium (µg/L)**	**Manganese (µg/L)**	**Molydenum (µg/L)**	**Potassium (µg/L)**	**Selenium (µg/L)**	**Sodium (µg/L)**
MW-65-225	16-Feb-12	360	2.00	---	370	---	---	190	31.0	---	5.10	---
	02-May-12	365	2.20	---	387	---	---	140	38.0	---	4.10	---
	18-Sep-12	528	2.30	---	570	---	---	91.0	34.0	---	5.80	---
	05-Dec-12	634	2.30	310,000	637	ND (0.1)	20,000	49.0	38.0	---	8.10	1,800,000
	19-Feb-13	630	2.40	---	627	---	---	5.80	33.0	---	7.20	---
MW-66-165	12-May-11	480	1.60	---	440	---	---	---	14.0	---	36.0	---
	13-Jun-11	560	1.40	230,000 J	570	ND (0.02)	46,000	130	8.70	21,000 J	40.0	570,000 J
	12-Jul-11	560	1.30	260,000	560	63.0	46,000	130	39.0	13,000	37.0	630,000
	12-Jul-11 FD	550	1.20	260,000	570	73.0	46,000	130	39.0	14,000	37.0	670,000
	09-Aug-11	560	1.20	240,000	520	ND (0.02)	45,000	100	9.70	12,000	37.0	610,000
	18-Oct-11	440	1.20	260,000	480	ND (0.02)	50,000	72.0	10.0	14,000	33.0	580,000
	15-Nov-11	500	1.20	250,000	520	ND (0.02)	49,000	52.0	8.20	14,000	35.0	600,000
	15-Dec-11	490	0.97	290,000	470	ND (0.02)	55,000	35.0	8.30	16,000	37.0	620,000
	17-Feb-12	570	1.30	---	570	---	---	12.0	6.00	---	40.0	---
	02-May-12	651	1.30	---	682	---	---	ND (2.5)	7.40	---	43.0	---
	17-Sep-12	653	1.80	---	665	---	---	ND (2.5)	6.40	---	36.0	---
	06-Dec-12	622	1.30	270,000	583	ND (0.02)	52,000	ND (0.5)	7.10	---	37.0	550,000
	20-Feb-13	636	1.30	---	613	---	---	ND (0.5)	6.70	---	39.0	---
MW-66-230	12-May-11	4,600 J	4.70	---	4,200	---	---	---	57.0	---	4.90	---
	14-Jun-11	5,100	4.60	360,000	4,700	ND (0.02)	7,200	45.0	43.0	69,000	4.80	3,700,000
	12-Jul-11	5,000	4.00	420,000	4,900	ND (0.02)	7,200	45.0	70.0	54,000	6.30	3,900,000
	10-Aug-11	5,100	4.00	350,000	4,400	ND (0.02)	7,100	45.0	47.0	41,000	7.10	3,200,000
	19-Oct-11	4,400	4.50	400,000	4,700	ND (0.02)	7,400	50.0	69.0	47,000	7.30	3,800,000
	17-Nov-11	4,900	4.40	370,000	4,700	ND (0.02)	7,200	46.0	69.0	45,000	7.30	4,000,000
	15-Dec-11	5,400	3.70	410,000	5,300	ND (0.02)	8,100	33.0	75.0	47,000	ND (12)	3,900,000
	22-Feb-12	5,800	4.10	---	5,600	---	---	41.0	77.0	---	6.50	---
	10-May-12	5,880	4.80	---	5,900	---	---	27.0	82.0	---	9.60	---
	10-May-12 FD	5,560	5.40	---	5,720	---	---	29.0	86.0	---	9.90	---
	17-Sep-12	6,200	6.90	---	6,040	---	---	26.0	79.0	---	10.0	---
	10-Dec-12	6,190	6.30	430,000	5,910	ND (0.02)	5,900	18.0	84.0	---	12.0	4,100,000
	21-Feb-13	6,510	6.60	---	6,400	---	---	ND (2.5)	87.0	---	11.0	---
MW-66BR-270	03-Nov-11	ND (5.0)	ND (0.5)	---	ND (1.0)	---	---	---	55.0	---	ND (2.5)	---

TABLE 3-2

Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Hexavalent Chromium and Selected Dissolved Metals

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

			Dissolved Metals									
Location	**Sample Date**	**Hexavalent Chromium (µg/L)**	**Arsenic (µg/L)**	**Calcium (µg/L)**	**Chromium (µg/L)**	**Iron (µg/L)**	**Magnesium (µg/L)**	**Manganese (µg/L)**	**Molydenum (µg/L)**	**Potassium (µg/L)**	**Selenium (µg/L)**	**Sodium (µg/L)**
MW-66BR-270	17-Nov-11	ND (1.0)	ND (2.5)	230,000	ND (0.5)	32.0	590	ND (10)	40.0	72,000	ND (2.5)	3,700,000
	16-Jan-12	ND (1.0)	0.32	260,000	ND (0.5)	34.0	530 J	ND (10)	39.0	74,000	ND (0.5)	3,500,000
	07-Mar-12	ND (1.0)	ND (0.5)	---	ND (1.0)	---	---	11.0	19.0	---	ND (12)	---
	24-May-12	ND (1.0)	ND (0.5)	---	1.10	---	---	73.0	27.0	---	ND (2.5)	---
	02-Oct-12	ND (1.0)	0.32	---	ND (1.0)	---	---	ND (0.5)	28.0	---	7.50	---
	20-Dec-12	ND (1.0)	0.24	87,000	ND (1.0)	ND (0.04)	21,000	41.0	36.0	---	0.85	3,600,000
	12-Mar-13	ND (1.0)	0.32	---	ND (1.0)	---	---	ND (0.5)	21.0	---	ND (0.5)	---
MW-67-185	24-Sep-11	910	1.90	---	1,000	---	---	---	17.0	---	33.0	---
	18-Oct-11	1,100	2.30	130,000	1,300	ND (0.02)	28,000	150	18.0	12,000	35.0	570,000
	18-Oct-11 FD	1,100	2.30	140,000	1,300	27.0	29,000	160	18.0	12,000	36.0	580,000
	16-Nov-11	1,500	1.80	140,000	1,600	ND (0.02)	30,000	92.0	18.0	13,000	42.0	660,000
	14-Dec-11	1,700	1.80	170,000	1,700	ND (0.02)	34,000	69.0	17.0	14,000	45.0	700,000
	21-Feb-12	2,000	1.80	---	2,000	---	---	31.0	15.0	---	55.0	---
	03-May-12	2,180	1.70	---	2,230	---	---	8.30	16.0	---	100	---
	20-Sep-12	2,370	1.70	---	2,320	---	---	5.60	14.0	---	86.0	---
	06-Dec-12	2,300	1.80	200,000	2,270	ND (0.02)	40,000	ND (0.5)	12.0	---	110	710,000
	21-Feb-13	2,190	1.70	---	2,100	---	---	ND (0.5)	17.0	---	110	---
	21-Feb-13 FD	2,180	1.60	---	2,110	---	---	ND (0.5)	17.0	---	110	---
MW-67-225	16-May-11	1,800	3.30	150,000	1,800	160 J	9,200	230	52.0	28,000 J	60.0	1,200,000
	16-May-11 FD	1,800	3.40	150,000	1,700	ND (0.02) J	9,200	230	53.0	29,000	61.0	1,200,000
	14-Jun-11	1,900	2.70	150,000	1,900	ND (0.02)	10,000	240	37.0	32,000	68.0	1,400,000
	12-Jul-11	2,100	2.30	190,000	2,200	ND (0.02)	12,000	240	64.0	26,000	63.0	1,500,000
	09-Aug-11	2,400	2.00	160,000	2,200	ND (0.02)	11,000	210	37.0	21,000	62.0	1,200,000
	08-Sep-11	2,600	2.50	170,000	2,800	42.0	11,000	190	35.0	23,000	72.0	1,500,000
	19-Oct-11	2,800	2.60	170,000	3,100	ND (0.02)	11,000	180	33.0	22,000	76.0	1,500,000
	17-Nov-11	3,100	2.70	160,000	3,100	ND (0.02)	11,000	150	31.0	25,000	80.0	1,700,000
	14-Dec-11	3,200	2.90	180,000	3,200	ND (0.02)	11,000	130	31.0	23,000	75.0	1,500,000
	21-Feb-12	3,200	2.50	---	3,100	---	---	110	30.0	---	63.0	---
	21-Feb-12 FD	3,100	2.80	---	3,200	---	---	110	30.0	---	75.0	---
	07-May-12	3,180	2.80	---	3,260	---	---	83.0	33.0	---	79.0	---
	20-Sep-12	3,200	2.80	---	3,420	---	---	42.0	33.0	---	67.0	---
	10-Dec-12	3,210	3.20	160,000	3,110	ND (0.02)	8,700	32.0	33.0	---	80.0	1,500,000

TABLE 3-2

Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Hexavalent Chromium and Selected Dissolved Metals

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

			Dissolved Metals									
Location	**Sample Date**	**Hexavalent Chromium (µg/L)**	**Arsenic (µg/L)**	**Calcium (µg/L)**	**Chromium (µg/L)**	**Iron (µg/L)**	**Magnesium (µg/L)**	**Manganese (µg/L)**	**Molydenum (µg/L)**	**Potassium (µg/L)**	**Selenium (µg/L)**	**Sodium (µg/L)**
MW-67-225	21-Feb-13	3,310	3.20	---	3,110	---	---	ND (0.5)	36.0	---	75.0	---
MW-67-260	15-May-11	2,000	14.0	---	1,900	---	---	---	78.0	---	ND (2.5)	---
	14-Jun-11	1,800	11.0	250,000	1,600	ND (0.02)	5,100	600	72.0	62,000	ND (2.5)	3,500,000
	12-Jul-11	1,900	11.0	300,000	1,900	ND (0.02)	4,500	550	88.0	50,000	ND (2.5)	3,800,000
	09-Aug-11	2,000	9.70	260,000	1,800	ND (0.02)	4,300	430	64.0	35,000	ND (5.0)	3,100,000
	08-Sep-11	2,100	12.0	280,000	2,100	120	4,100	410	66.0	46,000	ND (2.5)	3,800,000
	19-Oct-11	1,900	12.0	280,000	2,100	ND (0.02)	3,900	420	66.0	44,000	3.20	3,700,000
	17-Nov-11	2,000	11.0	260,000	2,000	ND (0.02)	3,800	370	66.0	48,000	ND (2.5)	3,800,000
	14-Dec-11	2,300	13.0	290,000	2,100	ND (0.02)	3,900	280	70.0	44,000	ND (12)	3,800,000
	21-Feb-12	1,700	8.40	---	1,600	---	---	390	78.0	---	ND (2.5)	---
	07-May-12	2,130	12.0	---	2,090	---	---	230	81.0	---	ND (2.5)	---
	20-Sep-12	2,130	11.0	---	2,160	---	---	190	81.0	---	1.60	---
	06-Dec-12	2,020	12.0	300,000	1,930	ND (0.1)	3,700	170	85.0	---	2.10	1,900,000
	21-Feb-13	2,130	11.0	---	2,060	---	---	88.0	85.0	---	1.60	---
MW-68-180	11-Jun-11	11,000	5.10	---	11,000	---	---	---	49.0	---	9.30	---
	14-Jun-11	2,600	2.80	100,000	2,300	310 J	14,000	130	54.0	17,000	5.50	460,000
	14-Jun-11 FD	2,700	3.10	100,000	2,400	1,800 J	14,000	150	53.0	17,000	5.10	450,000
	12-Jul-11	1,400	2.50	100,000	1,500	36.0	13,000	83.0	63.0	10,000	4.30	500,000
	08-Sep-11	18,000	2.10	320,000	19,000	ND (0.02)	36,000	53.0	43.0	15,000	13.0	530,000
	18-Oct-11	19,000	2.20	370,000	23,000	ND (0.02)	40,000	35.0	43.0	14,000	15.0	520,000
	17-Nov-11	20,000	2.30	380,000	23,000	ND (0.02)	37,000	27.0	42.0	15,000	16.0	560,000
	15-Dec-11	22,000	2.30	470,000	21,000	ND (0.02)	47,000	18.0	49.0	16,000	16.0	590,000
	22-Feb-12	16,000	2.50	---	17,000	---	---	ND (10)	39.0	---	13.0	---
	10-May-12	5,970	2.90	---	5,990	---	---	ND (2.5)	37.0	---	10.0	---
	20-Sep-12	16,400	2.20	---	16,900	---	---	ND (0.5)	42.0	---	13.0	---
	11-Dec-12	20,200	2.70	370,000	21,800	ND (0.02)	39,000	ND (0.5) J	47.0	---	18.0 J	560,000
	11-Dec-12 FD	20,400	2.80	370,000	21,700	ND (0.02)	38,000	41.0 J	47.0	---	25.0 J	550,000
	21-Feb-13	17,300	2.50	---	15,600	---	---	ND (0.5)	47.0	---	14.0	---
MW-68-240	11-Jun-11	640	2.70	---	660	---	---	---	22.0	---	3.60	---
	14-Jun-11	420	1.70	330,000	400	260	14,000	360	21.0	55,000	4.00	2,400,000
	12-Jul-11	920	1.70	410,000	870	ND (0.02)	15,000	300	48.0	45,000	4.00	2,700,000
	07-Sep-11	1,100	1.80	450,000	1,100	ND (0.02) J	17,000	270	17.0	45,000	4.80	3,000,000

TABLE 3-2

Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Hexavalent Chromium and Selected Dissolved Metals

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

			Dissolved Metals									
Location	**Sample Date**	**Hexavalent Chromium (µg/L)**	**Arsenic (µg/L)**	**Calcium (µg/L)**	**Chromium (µg/L)**	**Iron (µg/L)**	**Magnesium (µg/L)**	**Manganese (µg/L)**	**Molydenum (µg/L)**	**Potassium (µg/L)**	**Selenium (µg/L)**	**Sodium (µg/L)**
MW-68-240	07-Sep-11 FD	1,100	1.80	450,000	1,100 J	62.0 J	17,000	270	18.0	48,000	4.60	3,000,000
	18-Oct-11	1,300	1.90	460,000	1,500	ND (0.02)	18,000	230	15.0	39,000	5.30	2,900,000
	16-Nov-11	1,500	2.00	440,000	1,500	ND (0.02)	18,000	200	14.0	43,000	5.10	3,100,000
	14-Dec-11	1,600	ND (2.5)	480,000	1,600	ND (0.02)	19,000	190	16.0	45,000	ND (12)	3,000,000
	17-Feb-12	1,800	1.60	---	1,800	---	---	150	13.0	---	4.90	---
	03-May-12	1,820	1.90	---	1,900	---	---	140	21.0	---	4.80	---
	20-Sep-12	2,000	1.70	---	1,980	---	---	100	19.0	---	4.10	---
	06-Dec-12	1,990	2.00	510,000	1,870	ND (0.1)	22,000	94.0	23.0	---	5.10	3,300,000
	20-Feb-13	1,970	1.90	---	2,020	---	---	82.0	22.0	---	4.60	---
MW-68BR-280	08-Sep-11	ND (5.0)	2.70	340,000 J	ND (1.0)	230	5,400	890	96.0	39,000	ND (2.5)	4,300,000 J
	21-Oct-11	ND (5.0)	1.60	320,000	ND (2.5)	110	5,500 J	540	71.0	47,000	ND (2.5)	4,300,000 J
	16-Nov-11	ND (5.0)	2.10	350,000	ND (0.5)	120	5,300	510	77.0	51,000	ND (2.5)	4,700,000
	14-Dec-11	ND (5.0)	1.80	370,000	ND (2.5)	140	6,000	730	77.0	51,000	ND (12)	4,500,000
	14-Feb-12	ND (1.0)	1.80	---	ND (1.0)	---	---	340	65.0	---	ND (2.5)	---
	09-May-12	ND (1.0)	2.40	---	ND (1.0)	---	---	270	94.0	---	ND (2.5)	---
	03-Oct-12	ND (1.0)	2.50	---	ND (1.0)	---	---	220	95.0	---	ND (2.5)	---
	12-Nov-12	ND (1.0)	2.10	370,000	ND (1.0)	ND (0.1)	5,400	300	90.0	---	ND (2.5)	4,600,000
	18-Feb-13	ND (1.0)	2.30	---	ND (1.0)	---	---	180	88.0	---	ND (2.5)	---
MW-69-195	30-Jun-11	120	1.70	---	120	---	---	---	71.0	---	9.00	---
	11-Jul-11	140	1.60	160,000	140	ND (0.02)	17,000	280	78.0	11,000	10.0	550,000
	09-Aug-11	210	1.50	160,000	200	33.0	17,000	190	48.0	11,000	11.0	460,000
	07-Sep-11	260	1.80	170,000	260	ND (0.02)	17,000	140	40.0	11,000	12.0	560,000
	18-Oct-11	310	1.80	170,000	340	ND (0.02)	19,000	79.0	38.0	11,000	13.0	590,000
	15-Nov-11	380	1.90	160,000	380	23.0	19,000	52.0	36.0	11,000	14.0	610,000
	14-Dec-11	360	2.00	180,000	360	ND (0.02)	18,000	24.0	40.0	12,000	14.0	700,000
	17-Feb-12	280	2.40	---	290	---	---	14.0	41.0	---	12.0	---
	02-May-12	446	2.10	---	488	---	---	6.70	46.0	---	15.0	---
	19-Sep-12	789	2.10	---	840	---	---	3.90	50.0	---	14.0	---
	05-Dec-12	849	2.10	140,000	869	ND (0.02)	14,000	1.80	57.0	---	15.0	650,000
	20-Feb-13	909	2.20	---	852	---	---	ND (0.5)	65.0	---	13.0	---
MW-70-105	10-Jun-11	16.0	7.50	---	19.0	---	---	---	160	---	1.50	---
	13-Jun-11	0.38	4.90	29,000	1.20	36.0	5,200	190	170	14,000	0.97	370,000

TABLE 3-2

Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Hexavalent Chromium and Selected Dissolved Metals

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

			Dissolved Metals									
Location	**Sample Date**	**Hexavalent Chromium (µg/L)**	**Arsenic (µg/L)**	**Calcium (µg/L)**	**Chromium (µg/L)**	**Iron (µg/L)**	**Magnesium (µg/L)**	**Manganese (µg/L)**	**Molydenum (µg/L)**	**Potassium (µg/L)**	**Selenium (µg/L)**	**Sodium (µg/L)**
MW-70-105	11-Jul-11	3.80	4.60	40,000	7.00	40.0	6,100	200	180	9,500	1.30	420,000
	08-Aug-11	18.0	4.80	46,000	23.0	50.0	6,300	210	150	9,200	1.20	450,000
	06-Sep-11	13.0	3.40	50,000	14.0	22.0	6,600	200	140	10,000	0.8	460,000 J
	14-Nov-11	31.0	5.20	53,000	34.0	31.0	7,100	220	140	11,000	1.40	510,000
	12-Dec-11	55.0	4.80	66,000	63.0	ND (0.04)	7,700	230	130	13,000	1.60	510,000
	16-Feb-12	13.0	4.50	---	16.0	---	---	230	130	---	0.87	---
	01-May-12	76.3	5.40	---	77.9	---	---	220	120	---	2.00	---
	12-Sep-12	80.8	6.20	---	85.6	---	---	220	120	---	2.20	---
	04-Dec-12	65.1	5.20	81,000	71.1	32.0	8,600	210	110	---	2.20	580,000
	19-Feb-13	93.2	5.80	---	91.7	---	---	210	110	---	2.60	---
MW-70BR-225	24-Oct-11	1,600	2.00	---	1,800	---	---	---	21.0	---	2.80	---
	07-Nov-11	2,300	1.90	---	2,400	---	---	---	10.0	---	3.00	---
	16-Nov-11	2,300	2.10	600,000	2,400	ND (0.02)	30,000	ND (10)	13.0	33,000	2.80	2,500,000
	15-Dec-11	2,200	2.10	650,000	2,400	ND (0.02)	31,000	ND (10)	16.0	33,000	ND (12)	2,300,000
	16-Feb-12	2,200	1.90	---	2,300	---	---	ND (10)	12.0	---	2.70	---
	17-May-12	2,460	2.00	---	2,460	---	---	ND (0.5)	18.0	---	ND (2.5)	---
	17-May-12 FD	2,380	2.10	---	2,550	---	---	ND (0.5)	18.0	---	2.60	---
	18-Sep-12	2,410	2.10	---	2,500	---	---	ND (0.5)	16.0	---	ND (5.0)	---
	13-Dec-12	1,980	1.90	660,000	1,980	ND (0.02)	31,000	ND (0.5)	19.0	---	3.10	2,400,000
	26-Feb-13	1,960	1.90	---	1,880	---	---	ND (2.5)	19.0	---	2.60	---
MW-71-035	03-Nov-11	ND (1.0)	1.50	---	ND (1.0)	---	---	---	83.0	---	5.20	---
	15-Nov-11	ND (1.0)	1.50	220,000	ND (0.5)	60.0	24,000 J	350	85.0	32,000	2.50	1,200,000
	14-Dec-11	ND (1.0)	ND (2.5)	300,000	ND (2.5)	ND (0.02) J	27,000	400	82.0	39,000	ND (12)	1,300,000
	15-Feb-12	ND (1.0)	1.80	---	ND (1.0)	---	---	340	64.0	---	2.40	---
	03-May-12	ND (1.0)	---	---	ND (1.0)	---	---	---	---	---	---	---
	03-May-12	---	1.70	---	---	---	---	65.0	91.0	---	ND (2.5)	---
	19-Sep-12	ND (0.2)	1.70	---	ND (1.0)	---	---	190	58.0	---	2.50	---
	08-Nov-12	ND (0.2)	1.40	300,000	ND (1.0)	ND (0.02)	23,000	69.0	65.0	---	2.30	71,000
	07-Feb-13	0.78	1.50	---	ND (1.0)	---	---	51.0	59.0	---	2.20	---
MW-72-080	31-Aug-11	40.0	9.10	---	44.0	---	---	---	83.0	---	2.50	---
	06-Sep-11	60.0	7.50	250,000	61.0	100	12,000	190	69.0	30,000	2.40	2,200,000
	17-Oct-11	95.0	8.80	320,000	91.0	28.0	11,000	370	69.0	34,000	ND (12)	3,100,000

TABLE 3-2

Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Hexavalent Chromium and Selected Dissolved Metals

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

			Dissolved Metals									
Location	**Sample Date**	**Hexavalent Chromium (µg/L)**	**Arsenic (µg/L)**	**Calcium (µg/L)**	**Chromium (µg/L)**	**Iron (µg/L)**	**Magnesium (µg/L)**	**Manganese (µg/L)**	**Molydenum (µg/L)**	**Potassium (µg/L)**	**Selenium (µg/L)**	**Sodium (µg/L)**
MW-72-080	14-Nov-11	90.0	9.40	300,000	92.0	33.0	10,000	340	68.0	41,000	ND (2.5)	3,100,000
	15-Dec-11	130	9.30	360,000	130	ND (0.02)	11,000	240	64.0	35,000	ND (12)	3,200,000
	13-Feb-12	110	9.40	---	99.0	---	---	200	68.0	---	ND (2.5)	---
	01-May-12	87.6	9.70	---	89.0	---	---	210	75.0	---	ND (2.5)	---
	19-Sep-12	151	11.0	---	158	---	---	120	76.0	---	2.00	---
	05-Dec-12	150	11.0	350,000	150	ND (0.1)	9,600	100	77.0	---	1.80	3,200,000
	19-Feb-13	122	11.0	---	119	---	---	81.0	73.0	---	ND (2.5)	---
MW-72BR-200	23-Jul-12	2.00	13.0	---	2.20	---	---	---	65.0	---	ND (2.5)	---
	24-Jul-12	ND (1.0)	9.20	---	ND (1.0)	---	---	---	57.0	---	ND (2.5)	---
	13-Sep-12	3.90	15.0	270,000 J	4.50	ND (0.04)	3,100 J	28.0	63.0	39,000 J	ND (2.5)	3,100,000
	13-Sep-12 FD	3.80	15.0	280,000	4.30	ND (0.04)	3,200	30.0	63.0	34,000	ND (2.5)	3,100,000
	14-Nov-12	6.40	15.0	280,000	7.30	ND (0.04)	3,100	15.0	77.0	---	ND (0.5)	3,100,000
	07-Feb-13	7.90	14.0	---	8.20	---	---	9.10	65.0	---	ND (0.5)	---
MW-73-080	22-Oct-11	21.0	1.10	---	20.0	---	---	---	26.0	---	6.20	---
	15-Nov-11	28.0	1.20	340,000	26.0	ND (0.02)	28,000	60.0	20.0	21,000	5.00	1,600,000
	14-Dec-11	36.0	1.70	410,000	35.0	71.0	31,000	53.0	21.0	20,000	5.50	1,700,000
	14-Feb-12	36.0	1.30	---	31.0	---	---	37.0	17.0	---	4.70	---
	02-May-12	32.9	1.40	---	38.0	---	---	33.0	23.0	---	5.40	---
	13-Sep-12	37.3	1.60	---	39.3	---	---	22.0	23.0	---	6.20	---
	05-Dec-12	35.6	1.50	440,000	36.2	ND (0.1)	34,000	21.0	24.0	---	4.80	2,000,000
	19-Feb-13	25.1	2.10	---	25.8	---	---	ND (0.5)	23.0	---	4.00	---
MW-74-240	16-Jan-12	ND (0.2)	58.0	3,900	ND (0.5)	86.0	ND (0.1) J	ND (10)	190	36,000	3.60	300,000
	17-Feb-12	ND (0.2)	15.0	---	ND (1.0)	---	---	ND (10)	150	---	2.70	---
	10-May-12	ND (0.2)	15.0	---	ND (1.0)	---	---	ND (2.5)	210	---	ND (2.5)	---
	27-Sep-12	0.28	9.30	---	ND (1.0)	---	---	4.90	47.0	---	3.80	---
	20-Dec-12	ND (0.2)	15.0	11,000 J	ND (1.0)	160	1,200 J	3.30	110	---	1.40	190,000
	20-Dec-12 FD	ND (0.2)	16.0	8,800 J	ND (1.0)	170	950 J	3.30	110	---	1.10	200,000
	01-Mar-13	ND (0.2)	8.80	---	ND (1.0)	---	---	ND (0.5)	68.0	---	1.70	---

TABLE 3-2

Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Hexavalent Chromium and Selected Dissolved Metals

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Notes:

-- = not analyzed

FD = field duplicate

J = concentration estimated by laboratory or data validation

ND = not detected at listed reporting limit

R' = Due to the influence of well construction materials, the results were shown to not be representative of aquifer conditions and were considered to be unusable and

µg/L = micrograms per liter

TABLE 3-3

Average Groundwater Analytical Results for ER-TCS Area Station Groundwater Investigation Monitoring Wells, Hexavalent Chromium and Selected Dissolved Metals

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location		Metals Data																			
		Arsenic, dissolved µg/L		Calcium, dissolved µg/L		Chromium, Hexavalent µg/L		Chromium, total dissolved µg/L		Iron, dissolved µg/L		Magnesium, dissolved µg/L		Manganese, dissolved µg/L		Molybdenum, dissolved µg/L		Potassium, dissolved µg/L		Selenium, dissolved µg/L		Sodium, dissolved µg/L	
MW-23-060	Min		2.10		760,000		19.7		17.2		ND		7,900		ND		9.60		57,000		2.70		2,600,000
	Max	**5.74**	25.0	**822,000**	860,000	**29.0**	33.7	**30.0**	35.5	**8.20**	41.0	**26,200**	49,000	**0.046**	0.51	**23.9**	50.0	**78,500**	100,000	**3.97**	4.70	**2,840,000**	3,200,000
	Total Count		10		5		16		16		5		5		11		3		2		3		5
MW-23-080	Min		2.60		750,000		5.60		5.60		ND		ND		ND		31.0		52,000 J		0.82		2,900,000
	Max	**5.15**	24.0	**806,000**	900,000	**15.2**	34.0	**16.2**	44.0	**ND**	ND	**4,820**	15,000	**ND**	ND	**55.7**	95.0	**73,000**	94,000	**3.81**	5.30	**3,060,000**	3,200,000
	Total Count		11		5		17		17		5		5		12		3		2		3		5
MW-57-050	Min		---		---		86.0		88.0		---		---		---		---		---		---		---
	Max	**---**	---	**---**	---	**86.0**	86.0	**88.0**	88.0	**---**	---	**---**	---	**---**	---	**---**	---	**---**	---	**---**	---	**---**	---
	Total Count		---		---		1		1		---		---		---		---		---		---		---
MW-57-070	Min		ND		260,000		84.4		103		ND		18,000		ND		ND		10,000		ND		86,000
	Max	**2.11**	5.00	**364,000**	460,000	**450**	856	**464**	851	**29.3**	79.0	**24,400**	29,000	**25.5**	86.0	**6.40**	22.0	**11,000**	12,000	**2.74**	4.40	**99,700**	110,000
	Total Count		7		7		18		18		7		7		8		7		4		7		7
MW-57BR	Min		---		---		13.0		14.0		---		---		---		---		---		---		---
	Max	**---**	---	**---**	---	**17.8**	36.0	**19.2**	35.0	**---**	---	**---**	---	**---**	---	**---**	---	**---**	---	**---**	---	**---**	---
	Total Count		---		---		5		5		---		---		---		---		---		---		---
MW-57-185	Min		11.0		310,000		1.13		ND		ND		3,100		270		72.0		56,000		ND		3,500,000
	Max	**14.5**	30.0	**332,000**	350,000	**5.83**	10.4	**6.44**	11.4	**3.50**	21.0	**3,400**	4,000	**598**	1,100	**85.3**	99.0	**62,700**	66,000	**0.38**	3.30	**3,780,000**	4,300,000
	Total Count		10		6		16		16		6		6		12		10		3		10		6
MW-58-065	Min		---		---		ND		8.00		---		---		---		---		---		---		---
	Max	**---**	---	**---**	---	**ND**	ND	**8.00**	8.00	**---**	---	**---**	---	**---**	---	**---**	---	**---**	---	**---**	---	**---**	---
	Total Count		---		---		1		1		---		---		---		---		---		---		---
MW-58BR Packer (Deeper) Lower Zone *	Min		0.71		580,000		2.30		7.40		ND		29,000		160		12.0		27,000		ND		1,400,000
	Max	**1.50**	2.00	**580,000**	580,000	**110**	210	**106**	210	**ND**	ND	**29,000**	29,000	**160**	160	**15.3**	18.0	**27,000**	27,000	**1.17**	2.80	**1,400,000**	1,400,000
	Total Count		10		1		11		11		1		1		1		4		1		4		1
MW-58BR Packer (Deeper) Upper Zone *	Min		ND		620,000		ND		ND		1,300		30,000		940		14.0		29,000		ND		2,000,000
	Max	**0.98**	1.90	**620,000**	620,000	**ND**	ND	**0.61**	3.00	**1,300**	1,300	**30,000**	30,000	**940**	940	**17.5**	21.0	**29,000**	29,000	**0.65**	2.60	**2,000,000**	2,000,000
	Total Count		10		1		11		11		1		1		1		4		1		4		1
MW-59-100	Min		2.00		628,000		3,920		3,970		ND		22,000		ND		ND		33,000		ND		1,300,000
	Max	**4.83**	18.0	**764,000**	940,000	**4,720**	5,660	**4,730**	5,300	**6.78**	35.0	**24,900**	31,000	**219**	2,400	**9.12**	39.0	**44,500**	55,000	**3.10**	5.60	**1,450,000**	1,600,000
	Total Count		11		9		17		17		9		9		13		11		4		11		9
MW-60-125	Min		1.20		410,000		532		592		ND		24,000		ND		14.0		26,000		ND		1,100,000
	Max	**3.11**	11.0	**473,000**	550,000	**866**	1,160	**872**	1,170	**31.0**	160	**26,900**	29,000	**39.5**	140	**22.4**	45.0	**37,300**	43,000 J	**7.03**	34.0	**1,290,000**	1,500,000 J
	Total Count		11		7		17		17		7		7		13		11		4		11		7
MW-60BR-245	Min		4.00		340,000		61.0		53.0		ND		5,400		ND		43.0		37,000		ND		3,000,000
	Max	**6.97**	8.80	**384,000**	440,000	**133**	290	**134**	260	**285**	1,400	**7,040**	10,000	**26.8**	170	**49.7**	62.0	**41,000**	44,000	**1.49**	17.0 J	**3,420,000**	3,800,000
	Total Count		14		5		14		14		5		5		9		14		4		14		5
MW-61-110	Min		2.10		510,000		240		260		ND		20,000		133		16.0		53,000		ND		2,600,000
	Max	**6.11**	22.0	**633,000**	690,000 J	**547**	684	**569**	738	**23.0**	130	**21,900**	23,400	**385**	820	**27.0**	60.0	**60,500**	73,000	**0.091**	1.00	**2,950,000**	4,200,000
	Total Count		11		10		17		17		9		10		13		11		4		11		10
MW-62-065	Min		0.98		200,000		219		247		ND		23,000		ND		11.0		25,000		ND		860,000
	Max	**2.57**	6.50	**210,000**	230,000	**456**	720	**459**	740	**10.9**	76.0	**24,600**	27,000	**20.8**	62.0	**16.8**	28.0	**29,500**	36,000	**2.32**	3.50	**1,060,000**	1,400,000
	Total Count		8		7		17		17		7		7		9		8		4		8		7
MW-62-110	Min		6.30		150,000		4.40		31.3		ND		7,000		83.0		44.0		24,000		ND		1,400,000
	Max	**13.0**	32.0 J	**167,000**	180,000	**616**	1,140	**645**	1,300	**4.50**	27.0	**7,900**	8,700	**237**	490	**55.7**	110	**32,000**	37,000	**2.29**	3.60	**1,580,000**	1,700,000
	Total Count		14		6		16		16		6		6		12		10		3		10		6

TABLE 3-3

Average Groundwater Analytical Results for ER-TCS Area Station Groundwater Investigation Monitoring Wells, Hexavalent Chromium and Selected Dissolved Metals

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location		Metals Data																			
		Arsenic, dissolved µg/L		Calcium, dissolved µg/L		Chromium, Hexavalent µg/L		Chromium, total dissolved µg/L		Iron, dissolved µg/L		Magnesium, dissolved µg/L		Manganese, dissolved µg/L		Molybdenum, dissolved µg/L		Potassium, dissolved µg/L		Selenium, dissolved µg/L		Sodium, dissolved µg/L	
MW-62-190	Min		5.40		250,000		ND		ND		ND		11,000		620		63.0		42,000		ND		2,500,000
	Max	**9.54**	40.0 J	**325,000**	370,000	**9.19**	147	**3.45**	50.3	**40.2**	56.0	**12,800**	14,000	**1,110**	2,200	**80.0**	100	**57,700**	69,000	**0.38**	3.30	**3,420,000**	4,200,000
	Total Count		14		6		16		16		6		6		12		10		3		10		6
MW-63-065	Min		1.20		150,000		ND		ND		ND		20,000		3.40		19.0		17,000		ND		1,100,000
	Max	**2.30**	6.70	**197,000**	230,000	**1.0**	1.70	**1.58**	2.80	**92.9**	510	**21,600**	23,000	**110**	520	**27.2**	50.0	**25,800**	33,000	**0.74**	1.80	**1,230,000**	1,400,000
	Total Count		11		7		17		17		7		7		13		11		4		11		7
MW-64BR Packer Lower Zone *	Min		1.70		420,000		ND		1.00		ND		12,000		67.0		57.0		37,000		ND		3,400,000
	Max	**3.43**	4.50	**420,000**	420,000	**61.9**	100	**57.0**	100	**ND**	ND	**12,000**	12,000	**72.0**	77.0	**60.8**	64.0	**37,000**	37,000	**ND**	ND	**3,400,000**	3,400,000
	Total Count		10		1		11		11		1		1		2		4		1		4		1
MW-64BR Packer Upper Zone *	Min		1.60		440,000		ND		ND		ND		21,000		330		40.0		35,000		1.80		2,200,000
	Max	**3.12**	7.40	**440,000**	440,000	**50.1**	220	**50.0**	220	**ND**	ND	**21,000**	21,000	**380**	430	**49.0**	54.0	**35,000**	35,000	**7.13**	11.0	**2,200,000**	2,200,000
	Total Count		10		1		11		11		1		1		2		4		1		4		1
MW-65-160	Min		0.78		210,000		13.0		17.0		ND		33,000		26.0		28.0		11,000		2.10		510,000
	Max	**1.04**	2.60	**238,000**	260,000	**43.6**	78.8	**46.3**	85.1	**18.8**	64.0	**35,600**	38,000	**345**	590	**35.6**	72.0	**16,600**	23,000	**5.28**	8.50	**553,000**	590,000
	Total Count		13		8		13		13		8		8		12		13		7		13		8
MW-65-225	Min		1.70		310,000		120		110		ND		20,000		5.80		31.0		32,000		ND		1,800,000
	Max	**2.01**	2.40	**405,000**	490,000	**336**	634	**337**	637	**ND**	ND	**23,100**	25,000	**331**	1,100	**36.6**	65.0	**39,400**	59,000	**3.77**	8.10	**2,390,000**	2,800,000
	Total Count		13		8		13		13		8		8		12		13		7		13		8
MW-66-165	Min		0.97		230,000 J		440		440		ND		45,000		ND		6.00		12,000		33.0		550,000
	Max	**1.32**	1.80	**257,000**	290,000	**560**	653	**557**	682	**10.4**	73.0	**49,000**	55,000	**48.3**	130	**11.0**	39.0	**15,200**	21,000 J	**37.5**	43.0	**600,000**	670,000
	Total Count		12		7		12		12		7		7		11		12		6		12		7
MW-66-230	Min		3.70		350,000		4,400		4,200		ND		5,900		ND		43.0		41,000		ND		3,200,000
	Max	**4.93**	6.90	**391,000**	430,000	**5,420**	6,510	**5,230**	6,400	**ND**	ND	**7,160**	8,100	**34.4**	50.0	**70.3**	87.0	**50,500**	69,000	**7.26**	12.0	**3,800,000**	4,100,000
	Total Count		12		7		12		12		7		7		11		12		6		12		7
MW-66BR-270	Min		ND		87,000		ND		ND		ND		530 J		ND		19.0		72,000		ND		3,500,000
	Max	**0.15**	0.32	**192,000**	260,000	**ND**	ND	**0.14**	1.10	**22.0**	34.0	**7,370**	21,000	**17.9**	73.0	**33.1**	55.0	**73,000**	74,000	**1.04**	7.50	**3,600,000**	3,700,000
	Total Count		8		3		8		8		3		3		7		8		2		8		3
MW-67-185	Min		1.70		140,000		910		1,000		ND		29,000		ND		12.0		12,000		33.0		580,000
	Max	**1.83**	2.30	**163,000**	200,000	**1,810**	2,370	**1,840**	2,320	**6.75**	27.0	**33,300**	40,000	**45.7**	160	**16.0**	18.0	**13,000**	14,000	**68.6**	110	**663,000**	710,000
	Total Count		9		4		9		9		4		4		8		9		3		9		4
MW-67-225	Min		2.00		150,000		1,800		1,800		ND		8,700		ND		30.0		21,000		61.0		1,200,000
	Max	**2.76**	3.40	**166,000**	190,000	**2,770**	3,310	**2,800**	3,420	**22.4**	160 J	**10,500**	12,000	**141**	240	**37.4**	64.0	**25,100**	32,000	**71.8**	80.0	**1,440,000**	1,700,000
	Total Count		13		9		13		13		9		9		13		13		8		13		9
MW-67-260	Min		8.40		250,000		1,700		1,600		ND		3,700		88.0		64.0		35,000		ND		1,900,000
	Max	**11.4**	14.0	**278,000**	300,000	**2,010**	2,300	**1,950**	2,160	**15.0**	120	**4,160**	5,100	**344**	600	**75.4**	88.0	**47,000**	62,000	**0.65**	3.20	**3,430,000**	3,800,000
	Total Count		13		8		13		13		8		8		12		13		7		13		8
MW-68-180	Min		2.10		100,000		1,400		1,500		ND		13,000		ND		37.0		10,000		4.30		460,000
	Max	**2.71**	5.10	**301,000**	470,000	**14,200**	22,000	**14,800**	23,000	**262**	1,800 J	**32,300**	47,000	**37.0**	150	**46.3**	63.0	**14,500**	17,000	**12.8**	25.0 J	**531,000**	590,000
	Total Count		12		7		12		12		7		7		11		12		6		12		7
MW-68-240	Min		ND		330,000		420		400		ND		14,000		82.0		13.0		39,000		ND		2,400,000
	Max	**1.74**	2.70	**440,000**	510,000	**1,420**	2,000	**1,430**	2,020	**46.0**	260	**17,600**	22,000	**192**	360	**21.0**	48.0	**45,800**	55,000	**4.19**	5.30	**2,910,000**	3,300,000
	Total Count		12		7		12		12		7		7		11		12		6		12		7

TABLE 3-3

Average Groundwater Analytical Results for ER-TCS Area Station Groundwater Investigation Monitoring Wells, Hexavalent Chromium and Selected Dissolved Metals

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location		Metals Data																			
		Arsenic, dissolved µg/L		Calcium, dissolved µg/L		Chromium, Hexavalent µg/L		Chromium, total dissolved µg/L		Iron, dissolved µg/L		Magnesium, dissolved µg/L		Manganese, dissolved µg/L		Molybdenum, dissolved µg/L		Potassium, dissolved µg/L		Selenium, dissolved µg/L		Sodium, dissolved µg/L	
MW-68BR-280	Min	2.14	1.60	350,000	320,000	ND	ND	ND	ND	120	ND	5,520	5,300	442	180	83.7	65.0	47,000	39,000	ND	ND	4,480,000	1,300,000
	Max		2.70		370,000		ND		ND		230		6,000		890		96.0		51,000		ND		4,700,000
	Total Count		9		5		9		9		5		5		9		9		4		9		5
MW-69-195	Min	1.93	1.50	163,000	140,000	421	120	428	120	8.00	ND	17,300	14,000	71.9	ND	50.8	36.0	11,200	11,000	12.7	9.00	589,000	460,000
	Max		2.40		180,000		909		869		33.0		19,000		280		78.0		12,000		15.0		700,000
	Total Count		12		7		12		12		7		7		11		12		6		12		7
MW-70-105	Min	5.19	3.40	52,100	29,000	38.8	0.38	42.0	1.20	30.1	ND	6,800	5,200	213	190	138	110	11,100	9,200	1.55	0.8	471,000	370,000
	Max		7.50		81,000		93.2		91.7		50.0		8,600		230		180		14,000		2.60		580,000
	Total Count		12		7		12		12		7		7		11		12		6		12		7
MW-70BR-225	Min	2.00	1.90	637,000	600,000	2,160	1,600	2,250	1,800	ND	ND	30,700	30,000	ND	ND	16.0	10.0	33,000	33,000	2.18	ND	2,400,000	2,300,000
	Max		2.10		660,000		2,460		2,550		ND		31,000		ND		21.0		33,000		3.10		2,500,000
	Total Count		9		3		9		9		3		3		7		9		2		9		3
MW-71-035	Min	1.39	ND	273,000	220,000	0.097	ND	ND	ND	20.0	ND	24,700	23,000	209	51.0	73.4	58.0	35,500	32,000	2.14	ND	857,000	71,000
	Max		1.80		300,000		0.78		ND		60.0		27,000		400		91.0		39,000		5.20		1,300,000
	Total Count		8		3		8		8		3		3		7		8		2		8		3
MW-72-080	Min	9.62	7.50	316,000	250,000	104	40.0	103	44.0	32.2	ND	10,700	9,600	206	81.0	72.2	64.0	35,000	30,000	0.87	ND	2,960,000	2,200,000
	Max		11.0		360,000		151		158		100		12,000		370		83.0		41,000		2.50		3,200,000
	Total Count		10		5		10		10		5		5		9		10		4		10		5
MW-72BR-200	Min	13.5	9.20	277,000	270,000 J	4.00	ND	4.42	ND	ND	ND	3,130	3,100 J	20.5	9.10	65.0	57.0	36,500	34,000	ND	ND	3,100,000	3,100,000
	Max		15.0		280,000		7.90		8.20		ND		3,200		30.0		77.0		39,000 J		ND		3,100,000
	Total Count		6		3		6		6		3		3		4		6		2		6		3
MW-73-080	Min	1.49	1.10	397,000	340,000	31.5	21.0	31.4	20.0	23.7	ND	31,000	28,000	32.3	ND	22.1	17.0	20,500	20,000	5.22	4.00	1,770,000	1,600,000
	Max		2.10		440,000		37.3		39.3		71.0		34,000		60.0		26.0		21,000		6.20		2,000,000
	Total Count		8		3		8		8		3		3		7		8		2		8		3
MW-74-240	Min	20.4	8.80	6,350	3,900	0.047	ND	ND	ND	128	86.0	475	ND	1.37	ND	129	47.0	36,000	36,000	2.20	ND	250,000	200,000
	Max		58.0		8,800 J		0.28		ND		170		950 J		4.90		210		36,000		3.80		300,000
	Total Count		6		2		6		6		2		2		6		6		1		6		2

Notes:

When calculating averages, zero was used for non-detect results.

* Monitoring wells MW-58BR and MW-64BR have used multiple monitoring configurations throughout the East Ravine investigation (see well construction information).

Average, minimum, and maximum values shown are for the most recent, depth-specific monitoring well configuration, which is the most comprehensive data set of all past monitoring configurations.

See Table 3-2 for results from other configurations.

-- = not analyzed

J = concentration estimated by laboratory or data validation

ND = not detected at listed reporting limit

µg/L = micrograms per liter

TABLE 3-4

Groundwater Analytical Results for ER-TCS Area Station Groundwater Investigation Monitoring Wells, General Chemistry Parameters

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location	Sample Date	Alkalinity, as carbonate (mg/L)	Alkalinity, bicarbonate as CaCo3 (mg/L)	Alkalinity, total as CaCO3 (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Sulfate (mg/L)	Nitrate/Nitrite as nitrogen (mg/L)	Total Dissolved Solids (mg/L)	Total Organic Carbon (mg/L)	Ammonia as nitrogen (mg/L)	Deuterium (0/00)	Oxygen 18 (0/00)
MW-23-060	21-Jul-09	ND (5.0)	28.0	28.0	5,500	---	540	---	11,000	1.60	ND (0.1)	-75	-9
MW-23-060	24-Sep-09	8.50	28.0	36.0	5,800	---	560	---	---	---	---	---	---
MW-23-060	14-Dec-10	32.0	ND (5.0)	43.0	5,200	---	500	---	---	---	ND (0.1)	---	---
MW-23-060	13-Dec-11	ND (5.0)	36.0	36.0	5,700	ND (5.0)	640	---	10,000	ND (1.0)	ND (0.1)	-71	-8.3
MW-23-060	08-Nov-12	26.0	ND (5.0)	34.0	6,000	---	670	5.73	---	---	0.1	---	---
MW-23-080	21-Jul-09	25.0	ND (5.0)	140	5,400	---	650	---	11,000	1.70	ND (0.1)	-73	-8.7
MW-23-080	23-Sep-09	23.0	ND (5.0)	120	5,700	---	660	---	---	---	---	---	---
MW-23-080	14-Dec-10	28.0	ND (5.0)	70.0	5,600	---	940	---	---	---	0.27	---	---
MW-23-080	12-Dec-11	18.0 J	ND (5.0)	41.0	5,700	ND (10)	940	---	9,900	ND (1.0)	0.18	-72	-8.4
MW-23-080	12-Dec-11 FD	39.0 J	ND (5.0)	50.0	5,600	ND (10)	960	---	10,000	ND (1.0)	0.11	-72	-8.4
MW-23-080	08-Nov-12	19.0	ND (5.0)	49.0	5,900	---	880	6.82	---	---	0.1	---	---
MW-57-050	17-Feb-10	---	---	---	350	---	220	---	1,100	---	---	-65	-8.6
MW-57-070	11-Feb-09	ND (5.0)	81.0	81.0	710	---	130 J	---	1,700	1.60	ND (0.1)	-65	-8.6
MW-57-070	21-Jul-09	ND (5.0)	75.0	75.0	840	---	100	---	2,000	1.30	ND (0.1)	-66	-9.3
MW-57-070	24-Sep-09	ND (5.0)	81.0	81.0	930	---	110	---	---	---	---	---	---
MW-57-070	10-Dec-09	ND (5.0)	78.0	78.0	880	---	100	---	---	---	---	---	---
MW-57-070	15-Dec-10	ND (5.0)	100	100	520	---	120	---	1,600	ND (1.0)	ND (0.1)	---	---
MW-57-070	15-Dec-10 FD	ND (5.0)	100	100	520	---	120	---	1,600	ND (1.0)	ND (0.1)	---	---
MW-57-070	15-Dec-11	ND (5.0)	59.0	59.0	700	ND (1.0)	98.0	---	2,200	ND (1.0)	ND (0.1)	-63	-8.5
MW-57-070	13-Dec-12	ND (5.0)	120	120	510	---	98.0 J	8.35	---	---	ND (0.1)	---	---
MW-57-070	13-Dec-12 FD	ND (5.0)	100	100	500	---	120 J	7.99	---	---	ND (0.1)	---	---
MW-57-185	20-Jul-09	6.30	20.0	26.0	6,100	---	680	---	11,000	0.57	ND (0.1)	-79	-10
MW-57-185	23-Sep-09	ND (5.0)	18.0	22.0	6,000	---	700	---	---	---	---	---	---
MW-57-185	09-Dec-09	ND (5.0)	23.0	23.0	6,100	---	710	---	---	---	---	---	---
MW-57-185	09-Dec-10	ND (5.0)	20.0	22.0	6,400	---	700	---	11,000	ND (1.0)	ND (0.1)	---	---
MW-57-185	13-Dec-11	ND (5.0)	110	110	6,400	ND (10)	730	---	11,000	ND (1.0)	ND (0.1)	-76	-10
MW-57-185	08-Nov-12	ND (5.0)	21.0	21.0	6,600	---	740	0.03	---	---	---	---	---
MW-57-185	06-Feb-13	---	---	---	---	---	---	0.012	---	---	---	---	---

TABLE 3-4

Groundwater Analytical Results for ER-TCS Area Station Groundwater Investigation Monitoring Wells, General Chemistry Parameters

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location	Sample Date	Alkalinity, as carbonate (mg/L)	Alkalinity, bicarbonate as CaCo3 (mg/L)	Alkalinity, total as CaCO3 (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Sulfate (mg/L)	Nitrate/Nitrite as nitrogen (mg/L)	Total Dissolved Solids (mg/L)	Total Organic Carbon (mg/L)	Ammonia as nitrogen (mg/L)	Deuterium (0/00)	Oxygen 18 (0/00)
MW-58-065	17-Feb-10	---	---	---	45.0	---	97.0	---	370	---	---	-78	-10
MW-58BR Open Borehole (Deeper)	25-Mar-10	---	---	---	---	---	---	---	---	2.10	---	---	---
MW-58BR Flute (Upper Zone)	22-Jul-09	ND (5.0)	43.0	43.0	4,000	---	550	---	7,800	17.0 J	ND (0.1)	-77	-10
MW-58BR Flute (Upper Zone)	29-Sep-09	ND (5.0)	47.0	47.0	3,000	---	490	---	---	---	---	---	---
MW-58BR Flute (Upper Zone)	16-Dec-09	ND (5.0)	42.0	42.0	2,400	---	420	---	---	35.0	---	---	---
MW-58BR Flute (Lower Zone)	22-Jul-09	ND (5.0)	45.0	45.0	2,800	---	490	---	5,700	18.0 J	ND (0.1)	-77	-10
MW-58BR Flute (Lower Zone)	29-Sep-09	ND (5.0)	76.0	76.0	2,100	---	370	---	---	---	---	---	---
MW-58BR Flute (Lower Zone)	16-Dec-09	ND (5.0)	100	100	1,600	---	280	---	---	41.0	---	---	---
MW-58BR Packer (Shallow Set) Upper Zone	14-Sep-10	---	---	---	3,600	---	---	---	---	ND (1.0)	---	---	---
MW-58BR Packer (Shallow Set) Upper Zone	06-Oct-10	---	---	---	3,500	---	---	---	6,400	ND (1.0)	---	---	---
MW-58BR Packer (Shallow Set) Lower Zone	16-Sep-10	---	---	---	2,900	---	---	---	---	ND (1.0)	---	---	---
MW-58BR Packer (Shallow Set) Lower Zone	07-Oct-10	---	---	---	2,900	---	---	---	5,700	ND (1.0)	---	---	---
MW-58BR Packer (Deeper Set) Upper Zone	01-Feb-11	---	---	---	3,870	---	---	---	7,100	ND (1.0)	---	---	---
MW-58BR Packer (Deeper Set) Upper Zone	18-Mar-11	---	---	---	3,900	---	---	---	6,900	ND (1.0)	---	---	---
MW-58BR Packer (Deeper Set) Upper Zone	06-Jul-11	---	---	---	3,400	---	---	---	6,600	ND (1.0)	---	---	---
MW-58BR Packer (Deeper Set) Upper Zone	02-Aug-11	---	---	---	4,300	---	---	---	7,400	ND (1.0)	---	---	---
MW-58BR Packer (Deeper Set) Upper Zone	30-Aug-11	---	---	---	3,100	---	---	---	7,300	ND (1.0)	---	---	---
MW-58BR Packer (Deeper Set) Upper Zone	11-Oct-11	---	---	---	3,900	---	---	---	7,400	ND (1.0)	---	---	---
MW-58BR Packer (Deeper Set) Upper Zone	08-Nov-11	---	---	---	2,800	---	---	---	6,200	ND (1.0)	---	---	---
MW-58BR Packer (Deeper Set) Upper Zone	08-Dec-11	ND (5.0)	37.0	37.0	3,400	2.80 J	550	---	6,300	ND (1.0)	0.14	-76	-9.8
MW-58BR Packer (Deeper Set) Lower Zone	10-Feb-11	---	---	---	2,600	---	---	---	5,200	ND (1.0)	---	---	---

TABLE 3-4

Groundwater Analytical Results for ER-TCS Area Station Groundwater Investigation Monitoring Wells, General Chemistry Parameters

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location	Sample Date	Alkalinity, as carbonate (mg/L)	Alkalinity, bicarbonate as CaCo3 (mg/L)	Alkalinity, total as CaCO3 (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Sulfate (mg/L)	Nitrate/Nitrite as nitrogen (mg/L)	Total Dissolved Solids (mg/L)	Total Organic Carbon (mg/L)	Ammonia as nitrogen (mg/L)	Deuterium (0/00)	Oxygen 18 (0/00)
MW-58BR Packer (Deeper Set) Lower Zone	04-Apr-11	---	---	---	2,900	---	---	---	5,600	ND (1.0)	---	---	---
MW-58BR Packer (Deeper Set) Lower Zone	07-Jul-11	---	---	---	3,400	---	---	---	7,000	ND (1.0)	---	---	---
MW-58BR Packer (Deeper Set) Lower Zone	23-Aug-11	---	---	---	3,200	---	---	---	5,800	ND (1.0)	---	---	---
MW-58BR Packer (Deeper Set) Lower Zone	31-Aug-11	---	---	---	3,300	---	---	---	6,600	ND (1.0)	---	---	---
MW-58BR Packer (Deeper Set) Lower Zone	13-Oct-11	---	---	---	3,000	---	---	---	4,800	ND (1.0)	---	---	---
MW-58BR Packer (Deeper Set) Lower Zone	09-Nov-11	---	---	---	2,900	---	---	---	6,000	ND (1.0)	---	---	---
MW-58BR Packer (Deeper Set) Lower Zone	09-Dec-11	ND (5.0)	37.0	37.0	2,600	2.60	510	---	5,700	ND (1.0)	0.19	-76	-9.8
MW-59-100	18-Mar-09	ND (5.0)	110	110	3,300 J	---	760 J	---	7,800	3.40	ND (0.5)	-62	-7.8
MW-59-100	22-Jul-09	ND (5.0)	110	110	3,500	---	750	---	7,500	ND (0.6) J	ND (0.1)	-63	-8.4
MW-59-100	22-Jul-09 FD	ND (5.0)	110	110	3,500	---	750	---	7,500	0.8 J	ND (0.1)	-62	-7.8
MW-59-100	24-Sep-09	ND (5.0)	100	100	3,700	---	780	---	---	---	---	---	---
MW-59-100	11-Dec-09	ND (5.0)	120	120	3,100	---	690	---	---	---	---	---	---
MW-59-100	16-Dec-10	ND (5.0)	330	330	2,800	---	660	---	6,700	ND (1.0)	ND (0.1)	---	---
MW-59-100	15-Dec-11	ND (5.0)	56.0 J	56.0 J	2,800	ND (2.5)	700	---	5,800	ND (1.0)	ND (0.1)	-60	-7.9
MW-59-100	15-Dec-11 FD	ND (5.0)	110 J	110 J	2,700	ND (10)	700	---	5,800	ND (1.0)	ND (0.1)	-60	-7.6
MW-59-100	02-Oct-12	ND (5.0)	120	120	2,900	---	660	---	---	---	---	---	---
MW-59-100	28-Nov-12	ND (5.0)	120	120	3,100	---	680	4.52	---	---	ND (0.1)	---	---
MW-59-100	27-Feb-13	ND (5.0)	120	120	3,100	---	660	4.02	---	---	---	---	---
MW-60-125	20-Mar-09	ND (5.0)	58.0	58.0	2,500	---	450 J	---	5,400	1.20	ND (0.5)	-71	-9.3
MW-60-125	21-Jul-09	ND (5.0)	77.0	77.0	2,600	---	390	---	5,200	0.42	ND (0.1)	-73	-9.5
MW-60-125	24-Sep-09	ND (5.0)	62.0	62.0	2,600	---	420	---	---	---	---	---	---
MW-60-125	10-Dec-09	ND (5.0)	62.0	62.0	2,400	---	400	---	---	---	---	---	---
MW-60-125	16-Dec-10	ND (5.0)	51.0	51.0	2,700	---	450	---	6,100	ND (1.0)	ND (0.1)	-72	-9.3
MW-60-125	16-Dec-10 FD	ND (5.0)	52.0	52.0	2,700	---	440	---	5,800	ND (1.0)	ND (0.1)	-72	-8.9
MW-60-125	14-Dec-11	ND (5.0)	80.0	80.0	2,600	ND (2.5)	440	---	5,200	ND (1.0)	ND (0.1)	-70	-9

TABLE 3-4

Groundwater Analytical Results for ER-TCS Area Station Groundwater Investigation Monitoring Wells, General Chemistry Parameters

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location	Sample Date	Alkalinity, as carbonate (mg/L)	Alkalinity, bicarbonate as CaCo3 (mg/L)	Alkalinity, total as CaCO3 (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Sulfate (mg/L)	Nitrate/Nitrite as nitrogen (mg/L)	Total Dissolved Solids (mg/L)	Total Organic Carbon (mg/L)	Ammonia as nitrogen (mg/L)	Deuterium (0/00)	Oxygen 18 (0/00)
MW-60-125	06-Dec-12	ND (5.0)	46.0	46.0	2,800	---	460	4.26	---	---	ND (0.1)	---	---
MW-60-125	20-Feb-13	---	---	---	---	---	---	4.26	---	---	---	---	---
MW-60BR-245	09-Aug-11	ND (5.0)	23.0	23.0	5,600	ND (10)	740	---	4,400	ND (1.0)	ND (0.1)	---	---
MW-60BR-245	07-Sep-11	ND (5.0)	24.0	24.0	5,800	12.0	750	---	9,700	ND (1.0)	ND (0.1)	---	---
MW-60BR-245	16-Nov-11	ND (5.0)	28.0	28.0	5,700	7.60	780	---	10,000	ND (1.0)	ND (0.1)	---	---
MW-60BR-245	14-Dec-11	ND (5.0)	37.0	37.0	5,700	6.90	740	---	9,600	ND (1.0)	ND (0.1)	-75	-9.8
MW-60BR-245	05-Dec-12	ND (5.0)	22.0	22.0	6,100	---	770	0.23	---	---	ND (0.1)	---	---
MW-60BR-245	14-Mar-13	---	---	---	---	---	---	0.2	---	---	---	---	---
MW-60BR-245	14-Mar-13 FD	---	---	---	---	---	---	0.22	---	---	---	---	---
MW-61-110	23-Mar-09	ND (5.0)	52.0	52.0	4,700	---	620 J	---	9,100	3.30	ND (0.5)	-76	-9.9
MW-61-110	21-Jul-09	ND (5.0)	51.0	51.0	5,200	---	640	---	9,600	1.90	0.15	-77	-10
MW-61-110	24-Sep-09	ND (5.0)	46.0	46.0	5,200	---	690	---	---	---	---	---	---
MW-61-110	10-Dec-09	ND (5.0)	42.0	42.0	4,900	---	660	---	---	---	---	---	---
MW-61-110	15-Dec-10	ND (5.0)	43.0	43.0	5,400	---	670	---	9,200	ND (1.0)	0.14	---	---
MW-61-110	14-Dec-11	14.0	13.0	27.0	5,300	ND (5.0)	700	---	8,700	ND (1.0)	ND (0.1)	-72	-9.4
MW-61-110	27-Sep-12	ND (5.0)	45.0	45.0	5,400	---	690	---	---	---	---	---	---
MW-61-110	27-Sep-12 FD	ND (5.0)	46.0	46.0	5,300	---	700	---	---	---	---	---	---
MW-61-110	27-Nov-12	ND (5.0)	46.0	46.0	5,500	---	680	0.87	---	---	0.37 J	---	---
MW-61-110	27-Nov-12 FD	ND (5.0)	43.0	43.0	5,500	---	700	0.9	---	---	ND (0.1) J	---	---
MW-61-110	25-Feb-13	ND (5.0)	53.0	53.0	5,300	---	660	1.0	---	---	---	---	---
MW-62-065	27-Mar-09	ND (5.0)	110	110	1,900	---	400	---	3,800	2.70	ND (0.5)	-67	-8.9
MW-62-065	22-Jul-09	ND (5.0)	120	120	1,600	---	360	---	3,600	0.95 J	0.12	-71	-9.8
MW-62-065	24-Sep-09	ND (5.0)	130	130	1,600	---	370	---	---	---	---	---	---
MW-62-065	10-Dec-09	ND (5.0)	130	130	1,500	---	350	---	---	---	---	---	---
MW-62-065	15-Dec-10	ND (5.0)	110	110	1,700	---	380	---	3,400	ND (1.0)	ND (0.1)	-69	-8.7
MW-62-065	13-Dec-11	ND (5.0)	100	100	1,800	3.40	400	---	2,900	ND (1.0)	ND (0.1)	-67	-8.8
MW-62-065	10-Dec-12	ND (5.0)	110	110	1,900	---	410	3.70	---	---	ND (0.1)	---	---
MW-62-110	22-Jul-09	ND (5.0)	74.0	74.0	2,500	---	450	---	5,000	25.0 J	ND (0.1)	-71	-9.3

TABLE 3-4

Groundwater Analytical Results for ER-TCS Area Station Groundwater Investigation Monitoring Wells, General Chemistry Parameters

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location	Sample Date	Alkalinity, as carbonate (mg/L)	Alkalinity, bicarbonate as CaCo3 (mg/L)	Alkalinity, total as CaCO3 (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Sulfate (mg/L)	Nitrate/Nitrite as nitrogen (mg/L)	Total Dissolved Solids (mg/L)	Total Organic Carbon (mg/L)	Ammonia as nitrogen (mg/L)	Deuterium (0/00)	Oxygen 18 (0/00)
MW-62-110	29-Sep-09	ND (5.0)	82.0	82.0	2,600	---	470	---	---	---	---	---	---
MW-62-110	16-Dec-09	ND (5.0)	76.0	76.0	2,400	---	470	---	---	31.0	---	---	---
MW-62-110	10-Feb-10	---	---	---	---	---	---	---	---	17.0	---	---	---
MW-62-110	11-Mar-10	---	---	---	---	---	---	---	---	13.0	---	---	---
MW-62-110	04-May-10	---	---	---	---	---	---	---	---	14.0	---	---	---
MW-62-110	29-Sep-10	---	---	---	---	---	---	---	---	15.0	---	---	---
MW-62-110	16-Dec-10	ND (5.0)	77.0	77.0	2,500	---	490	---	4,800	17.0	0.27	-66	-8.1
MW-62-110	09-Feb-11	---	---	---	---	---	---	---	---	6.20	---	---	---
MW-62-110	29-Sep-11	---	---	---	---	---	---	---	---	9.90	---	---	---
MW-62-110	14-Dec-11	ND (5.0)	45.0	45.0	2,500	4.30	520	---	4,900	5.50	0.12	-64	-8.1
MW-62-110	11-Dec-12	ND (5.0)	82.0	82.0	2,700	---	540	3.61	---	---	ND (0.1)	---	---
MW-62-110	26-Feb-13	---	---	---	---	---	---	4.26	---	---	---	---	---
MW-62-190	22-Jul-09	ND (5.0)	49.0	49.0	6,300	---	690	---	11,000	58.0 J	ND (0.1)	-79	-11
MW-62-190	29-Sep-09	ND (5.0)	54.0	54.0	4,400	---	590	---	---	---	---	---	---
MW-62-190	16-Dec-09	ND (5.0)	38.0	38.0	6,000	---	680	---	---	31.0	---	---	---
MW-62-190	10-Feb-10	---	---	---	---	---	---	---	---	12.0	---	---	---
MW-62-190	11-Mar-10	---	---	---	---	---	---	---	---	8.50	---	---	---
MW-62-190	04-May-10	---	---	---	---	---	---	---	---	10.0	---	---	---
MW-62-190	29-Sep-10	---	---	---	---	---	---	---	---	8.60	---	---	---
MW-62-190	16-Dec-10	ND (5.0)	41.0	41.0	6,000	---	710	---	10,000	13.0	ND (0.1)	-78	-10
MW-62-190	09-Feb-11	---	---	---	---	---	---	---	---	5.40	---	---	---
MW-62-190	29-Sep-11	---	---	---	---	---	---	---	---	5.90	---	---	---
MW-62-190	14-Dec-11	ND (5.0)	46.0	46.0	5,900	6.80	700	---	9,000	4.70	ND (0.1)	-76	-10
MW-62-190	11-Dec-12	ND (5.0)	44.0	44.0	6,300	---	730	0.03	---	---	ND (0.1) J	---	---
MW-62-190	26-Feb-13	---	---	---	---	---	---	ND (0.01)	---	---	---	---	---
MW-63-065	15-Apr-09	ND (5.0)	200	200	1,500	---	540 J	---	3,400	6.40	ND (0.1)	---	---
MW-63-065	20-Jul-09	ND (5.0)	210	210	1,800	---	570	---	4,100	0.69	ND (0.1)	-98	-12
MW-63-065	20-Jul-09 FD	ND (5.0)	210	210	1,700	---	560	---	4,100	ND (1.2)	ND (0.1)	-98	-12

TABLE 3-4

Groundwater Analytical Results for ER-TCS Area Station Groundwater Investigation Monitoring Wells, General Chemistry Parameters

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location	Sample Date	Alkalinity, as carbonate (mg/L)	Alkalinity, bicarbonate as CaCo3 (mg/L)	Alkalinity, total as CaCO3 (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Sulfate (mg/L)	Nitrate/Nitrite as nitrogen (mg/L)	Total Dissolved Solids (mg/L)	Total Organic Carbon (mg/L)	Ammonia as nitrogen (mg/L)	Deuterium (0/00)	Oxygen 18 (0/00)
MW-63-065	22-Sep-09	ND (5.0)	190	190	1,800	---	580	---	---	---	---	---	---
MW-63-065	22-Sep-09 FD	ND (5.0)	200	200	1,800	---	580	---	---	---	---	---	---
MW-63-065	09-Dec-09	ND (5.0)	210	210	1,800	---	580	---	---	---	---	---	---
MW-63-065	09-Dec-09 FD	ND (5.0)	200	200	1,800	---	570	---	---	---	---	---	---
MW-63-065	06-Dec-10	ND (5.0)	190	190	2,000	---	600	---	4,400	ND (1.0)	0.12	---	---
MW-63-065	12-Dec-11	ND (5.0)	210	210	1,800	ND (2.5)	580	---	4,000	ND (1.0)	ND (0.1)	-98	-13
MW-63-065	07-Nov-12	ND (5.0)	200	200	2,100	---	640	1.05	---	---	ND (0.1)	---	---
MW-63-065	06-Feb-13	---	---	---	---	---	---	1.07	---	---	---	---	---
MW-64BR Open Borehole	20-Dec-10	---	---	---	4,600	---	---	---	8,300	ND (1.0)	---	---	---
MW-64BR Flute (Upper Zone)	22-Jul-09	ND (5.0)	57.0	57.0	2,600	---	450	---	5,100	16.0 J	0.2	-78	-10
MW-64BR Flute (Upper Zone)	29-Sep-09	ND (5.0)	120	120	3,200	---	470	---	---	---	---	---	---
MW-64BR Flute (Upper Zone)	16-Dec-09	ND (5.0)	74.0	74.0	3,000	---	530	---	---	1.10 J	---	---	---
MW-64BR Flute (Upper Zone)	10-Feb-10	---	---	---	---	---	---	---	---	2.50	---	---	---
MW-64BR Flute (Upper Zone)	11-Mar-10	---	---	---	---	---	---	---	---	2.00	---	---	---
MW-64BR Flute (Upper Zone)	04-May-10	---	---	---	---	---	---	---	---	2.90	---	---	---
MW-64BR Flute (Upper Zone)	29-Sep-10	---	---	---	---	---	---	---	---	2.20	---	---	---
MW-64BR Flute (Middle Zone)	22-Jul-09	ND (5.0)	54.0	54.0	4,500	---	580	---	8,000	19.0 J	0.14	-78	-9.7
MW-64BR Flute (Middle Zone)	29-Sep-09	ND (5.0)	110	110	4,400	---	540	---	---	---	---	---	---
MW-64BR Flute (Middle Zone)	16-Dec-09	ND (5.0)	64.0	64.0	4,700	---	650	---	---	1.80 J	---	---	---
MW-64BR Flute (Middle Zone)	10-Feb-10	---	---	---	---	---	---	---	---	4.20	---	---	---
MW-64BR Flute (Middle Zone)	11-Mar-10	---	---	---	---	---	---	---	---	3.70	---	---	---
MW-64BR Flute (Middle Zone)	04-May-10	---	---	---	---	---	---	---	---	5.30	---	---	---
MW-64BR Flute (Middle Zone)	29-Sep-10	---	---	---	---	---	---	---	---	1.80	---	---	---
MW-64BR Flute (Lower Zone)	22-Jul-09	ND (5.0)	66.0	66.0	3,200	---	470	---	6,200	25.0 J	0.18	-79	-9.9
MW-64BR Flute (Lower Zone)	29-Sep-09	ND (5.0)	140	140	3,900	---	450	---	---	---	---	---	---
MW-64BR Flute (Lower Zone)	16-Dec-09	ND (5.0)	79.0	79.0	4,700	---	600	---	---	3.70	---	---	---
MW-64BR Flute (Lower Zone)	10-Feb-10	---	---	---	---	---	---	---	---	11.0	---	---	---
MW-64BR Flute (Lower Zone)	11-Mar-10	---	---	---	---	---	---	---	---	8.40	---	---	---

TABLE 3-4

Groundwater Analytical Results for ER-TCS Area Station Groundwater Investigation Monitoring Wells, General Chemistry Parameters

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location	Sample Date	Alkalinity, as carbonate (mg/L)	Alkalinity, bicarbonate as CaCo3 (mg/L)	Alkalinity, total as CaCO3 (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Sulfate (mg/L)	Nitrate/Nitrite as nitrogen (mg/L)	Total Dissolved Solids (mg/L)	Total Organic Carbon (mg/L)	Ammonia as nitrogen (mg/L)	Deuterium (0/00)	Oxygen 18 (0/00)
MW-64BR Flute (Lower Zone)	04-May-10	---	---	---	---	---	---	---	---	12.0	---	---	---
MW-64BR Flute (Lower Zone)	29-Sep-10	---	---	---	---	---	---	---	---	3.50	---	---	---
MW-64BR Packer (Upper Zone)	26-Jan-11	---	---	---	4,100	---	---	---	8,300	ND (1.0)	---	---	---
MW-64BR Packer (Upper Zone)	12-Apr-11	---	---	---	3,500	---	---	---	7,800	ND (1.0)	---	---	---
MW-64BR Packer (Upper Zone)	11-Jul-11	---	---	---	3,300	---	---	---	5,800	ND (1.0)	---	---	---
MW-64BR Packer (Upper Zone)	15-Aug-11	---	---	---	3,600	---	---	---	7,400	ND (1.0)	---	---	---
MW-64BR Packer (Upper Zone)	12-Sep-11	---	---	---	3,600	---	---	---	6,500	ND (1.0)	---	---	---
MW-64BR Packer (Upper Zone)	24-Oct-11	---	---	---	3,400	---	---	---	6,300	ND (1.0)	---	---	---
MW-64BR Packer (Upper Zone)	14-Nov-11	---	---	---	3,600	4.70	---	---	6,200	ND (1.0)	---	---	---
MW-64BR Packer (Upper Zone)	12-Dec-11	ND (5.0)	70.0	70.0	3,700	4.70	600	---	6,900	ND (1.0)	0.24	-72	-9.2
MW-64BR Packer (Lower Zone)	24-Feb-11	---	---	---	5,300	---	---	---	9,700	ND (1.0)	---	---	---
MW-64BR Packer (Lower Zone)	20-Apr-11	---	---	---	5,500	---	---	---	9,600	ND (1.0)	---	---	---
MW-64BR Packer (Lower Zone)	21-Jul-11	---	---	---	5,100	---	---	---	8,400	ND (1.0)	---	---	---
MW-64BR Packer (Lower Zone)	18-Aug-11	---	---	---	5,600	---	---	---	9,000	ND (1.0)	---	---	---
MW-64BR Packer (Lower Zone)	15-Sep-11	---	---	---	5,600	---	---	---	8,900	ND (1.0)	---	---	---
MW-64BR Packer (Lower Zone)	27-Oct-11	---	---	---	5,400	---	---	---	11,000	ND (1.0)	---	---	---
MW-64BR Packer (Lower Zone)	17-Nov-11	---	---	---	5,500	7.00	---	---	9,100	ND (1.0)	---	---	---
MW-64BR Packer (Lower Zone)	15-Dec-11	ND (5.0)	88.0	88.0	5,500	7.50	740	---	9,000	ND (1.0)	0.18	-74	-9.4
MW-65-160	13-Jun-11	ND (5.0)	71.0	71.0	990	2.60	360	---	2,500	ND (1.0)	0.54	---	---
MW-65-160	11-Jul-11	ND (5.0)	63.0	63.0	1,000	2.50	370	---	2,500	ND (1.0)	0.67	---	---
MW-65-160	09-Aug-11	ND (5.0)	63.0	63.0	1,100	2.50	380	---	2,600	ND (1.0)	0.72 J	---	---
MW-65-160	09-Aug-11 FD	ND (5.0)	64.0	64.0	1,100	2.70	380	---	2,400	ND (1.0)	0.11 J	---	---
MW-65-160	07-Sep-11	ND (5.0)	62.0	62.0	1,100	ND (2.5)	380	---	2,500	ND (1.0)	0.84	---	---
MW-65-160	17-Oct-11	ND (5.0)	72.0	72.0	1,100	3.00	400	---	2,500	ND (1.0)	0.28	---	---
MW-65-160	15-Nov-11	ND (5.0)	71.0	71.0	1,100	1.50	400	---	2,600	ND (1.0)	0.44	---	---
MW-65-160	15-Dec-11	ND (5.0)	63.0	63.0	1,100	1.60	390	---	2,600	ND (1.0)	0.11	-65	-8.5
MW-65-160	04-Dec-12	ND (5.0)	110	110	1,000	---	440	11.4	---	---	ND (0.1)	---	---
MW-65-160	19-Feb-13	---	---	---	---	---	---	10.8	---	---	---	---	---

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PG&E Topock Compressor Station Needles, California

Location	Sample Date	Alkalinity, as carbonate (mg/L)	Alkalinity, bicarbonate as CaCo3 (mg/L)	Alkalinity, total as CaCO3 (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Sulfate (mg/L)	Nitrate/Nitrite as nitrogen (mg/L)	Total Dissolved Solids (mg/L)	Total Organic Carbon (mg/L)	Ammonia as nitrogen (mg/L)	Deuterium (0/00)	Oxygen 18 (0/00)
MW-65-225	13-Jun-11	ND (5.0)	56.0	56.0	5,200	10.0	910	---	9,600	ND (1.0)	0.34	---	---
MW-65-225	11-Jul-11	ND (5.0)	63.0	63.0	4,200	7.80	790	---	7,300	ND (1.0)	0.28	---	---
MW-65-225	09-Aug-11	ND (5.0)	70.0	70.0	4,300	ND (5.0)	800	---	7,800	ND (1.0)	0.32	---	---
MW-65-225	07-Sep-11	ND (5.0)	73.0	73.0	4,200	7.50	790	---	7,300	ND (1.0)	0.25	---	---
MW-65-225	17-Oct-11	ND (5.0)	70.0	70.0	4,100	8.10	760	---	7,600	ND (1.0)	0.24	---	---
MW-65-225	15-Nov-11	ND (5.0)	73.0	73.0	3,700	4.40	740	---	6,600	ND (1.0)	0.22	---	---
MW-65-225	15-Nov-11 FD	ND (5.0)	73.0	73.0	3,700	5.10	750	---	6,800	ND (1.0)	0.12	---	---
MW-65-225	15-Dec-11	ND (5.0)	22.0	22.0	3,500	4.30	740	---	6,200	ND (1.0)	0.13	-62	-7.5
MW-65-225	05-Dec-12	ND (5.0)	97.0	97.0	2,800	---	710	11.2	---	---	ND (0.1)	---	---
MW-65-225	19-Feb-13	---	---	---	---	---	---	9.82	---	---	---	---	---
MW-66-165	13-Jun-11	ND (5.0)	94.0	94.0	980	ND (5.0)	510	---	2,900	ND (1.0)	0.16	---	---
MW-66-165	12-Jul-11	ND (5.0)	96.0	96.0	1,000	ND (5.0)	520	---	2,800	ND (1.0)	0.13	---	---
MW-66-165	12-Jul-11 FD	ND (5.0)	97.0	97.0	1,000	ND (2.5)	520	---	2,900	ND (1.0)	0.19	---	---
MW-66-165	09-Aug-11	ND (5.0)	96.0	96.0	1,000	ND (1.0)	530	---	2,600	ND (1.0)	0.19	---	---
MW-66-165	18-Oct-11	ND (5.0)	85.0	85.0	1,000	ND (1.0)	520	---	2,600	ND (1.0)	0.14	---	---
MW-66-165	15-Nov-11	ND (5.0)	82.0	82.0	1,000	ND (2.5)	510	---	2,600	ND (1.0)	0.18	---	---
MW-66-165	15-Dec-11	ND (5.0)	22.0	22.0	1,000	ND (2.5)	490	---	2,900	ND (1.0)	ND (0.1)	-65	-8.5
MW-66-165	06-Dec-12	ND (5.0)	87.0	87.0	1,100	---	490	38.4	---	---	ND (0.1)	---	---
MW-66-165	20-Feb-13	---	---	---	---	---	---	39.1	---	---	---	---	---
MW-66-230	14-Jun-11	ND (5.0)	35.0	35.0	5,900	ND (25)	910	---	10,000	ND (1.0)	ND (0.1)	---	---
MW-66-230	12-Jul-11	ND (5.0)	39.0	39.0	5,900	ND (10)	870	---	10,000	ND (1.0)	0.12	---	---
MW-66-230	10-Aug-11	ND (5.0)	36.0	36.0	6,000	ND (10)	910	---	9,000	ND (1.0)	0.12	---	---
MW-66-230	19-Oct-11	ND (5.0)	38.0	38.0	5,900	ND (10)	1,000	---	10,000	ND (1.0)	0.15	---	---
MW-66-230	17-Nov-11	ND (5.0)	34.0	34.0	5,700	6.90	1,000	---	9,800	ND (1.0)	ND (0.1)	---	---
MW-66-230	15-Dec-11	ND (5.0)	38.0	38.0	5,900	ND (10)	1,100	---	9,600	ND (1.0)	ND (0.1)	-67	-8.3
MW-66-230	10-Dec-12	ND (5.0)	32.0	32.0	6,600	---	1,100	15.2	---	---	ND (0.1)	---	---
MW-66-230	21-Feb-13	---	---	---	---	---	---	14.1	---	---	---	---	---
MW-66BR-270	16-Jan-12	36.0	ND (5.0)	110	6,000	ND (10)	180	---	11,000	4.70	0.25	---	---

TABLE 3-4

Groundwater Analytical Results for ER-TCS Area Station Groundwater Investigation Monitoring Wells, General Chemistry Parameters

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location	Sample Date	Alkalinity, as carbonate (mg/L)	Alkalinity, bicarbonate as CaCo3 (mg/L)	Alkalinity, total as CaCO3 (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Sulfate (mg/L)	Nitrate/Nitrite as nitrogen (mg/L)	Total Dissolved Solids (mg/L)	Total Organic Carbon (mg/L)	Ammonia as nitrogen (mg/L)	Deuterium (0/00)	Oxygen 18 (0/00)
MW-66BR-270	20-Dec-12	26.0	ND (5.0)	26.0	6,100	---	210	0.078	---	---	0.31	---	---
MW-66BR-270	12-Mar-13	---	---	---	---	---	---	ND (0.01)	---	---	---	---	---
MW-67-185	18-Oct-11	ND (5.0)	130	130	780	ND (2.5)	490	---	2,000	ND (1.0)	0.21	---	---
MW-67-185	18-Oct-11 FD	ND (5.0)	130	130	800	ND (2.5)	480	---	2,100	ND (1.0)	ND (0.1)	---	---
MW-67-185	16-Nov-11	ND (5.0)	120	120	760	1.10	520	---	2,100	ND (1.0)	0.18	---	---
MW-67-185	14-Dec-11	ND (5.0)	130	130	790	ND (2.5)	530	---	2,300	ND (1.0)	0.19	-69	-9.1
MW-67-185	06-Dec-12	ND (5.0)	120	120	1,100	---	630	21.6	---	---	ND (0.1)	---	---
MW-67-185	21-Feb-13	---	---	---	---	---	---	19.0	---	---	---	---	---
MW-67-185	21-Feb-13 FD	---	---	---	---	---	---	22.5	---	---	---	---	---
MW-67-225	14-Jun-11	ND (5.0)	120	120	1,800	5.50	910	---	4,100	ND (1.0)	0.38	---	---
MW-67-225	12-Jul-11	ND (5.0)	130	130	1,800	5.70	990	---	4,500	ND (1.0)	0.46	---	---
MW-67-225	09-Aug-11	ND (5.0)	130	130	1,800	5.00	1,000	---	4,200	ND (1.0)	0.48	---	---
MW-67-225	08-Sep-11	ND (5.0)	130	130	1,900	5.70	1,100	---	4,300	ND (1.0)	0.44	---	---
MW-67-225	19-Oct-11	ND (5.0)	120	120	1,900	6.30	1,100	---	4,500	ND (1.0)	0.13	---	---
MW-67-225	17-Nov-11	ND (5.0)	110	110	1,700	4.00	1,000	---	4,400	ND (1.0)	0.16	---	---
MW-67-225	14-Dec-11	ND (5.0)	120	120	1,800	4.20	1,100	---	4,400	ND (1.0)	0.12	-68	-8.2
MW-67-225	10-Dec-12	ND (5.0)	140	140	1,800	---	1,100	20.6	---	---	ND (0.1)	---	---
MW-67-225	21-Feb-13	---	---	---	---	---	---	23.1	---	---	---	---	---
MW-67-260	14-Jun-11	ND (5.0)	32.0	32.0	5,400	10.0	760	---	8,900	ND (1.0)	0.17	---	---
MW-67-260	12-Jul-11	21.0 J	18.0	38.0	5,200	9.30	720	---	9,100	ND (1.0)	0.3	---	---
MW-67-260	09-Aug-11	ND (5.0)	30.0	30.0	5,800	ND (5.0)	790	---	9,200	ND (1.0)	0.1	---	---
MW-67-260	08-Sep-11	ND (5.0)	31.0	31.0	5,900	11.0	800	---	9,300	ND (1.0)	0.14	---	---
MW-67-260	19-Oct-11	ND (5.0)	25.0	25.0	6,000	12.0	880	---	9,300	ND (1.0)	0.13	---	---
MW-67-260	17-Nov-11	ND (5.0)	29.0	29.0	5,600	7.20	790	---	9,000	ND (1.0)	0.14	---	---
MW-67-260	14-Dec-11	ND (5.0)	43.0	43.0	5,800	7.10	810	---	9,400	ND (1.0)	0.1	-69	-8.8
MW-67-260	06-Dec-12	ND (5.0)	29.0	29.0	6,100	---	830	1.56	---	---	0.12	---	---
MW-67-260	21-Feb-13	---	---	---	---	---	---	1.49	---	---	---	---	---
MW-68-180	14-Jun-11	ND (5.0)	120	120	480	2.20	400	---	1,600	ND (1.0)	0.17	---	---

TABLE 3-4

Groundwater Analytical Results for ER-TCS Area Station Groundwater Investigation Monitoring Wells, General Chemistry Parameters

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location	Sample Date	Alkalinity, as carbonate (mg/L)	Alkalinity, bicarbonate as CaCo3 (mg/L)	Alkalinity, total as CaCO3 (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Sulfate (mg/L)	Nitrate/Nitrite as nitrogen (mg/L)	Total Dissolved Solids (mg/L)	Total Organic Carbon (mg/L)	Ammonia as nitrogen (mg/L)	Deuterium (0/00)	Oxygen 18 (0/00)
MW-68-180	14-Jun-11 FD	ND (5.0)	110	110	500	2.20	420	---	1,700	ND (1.0)	0.24	---	---
MW-68-180	12-Jul-11	ND (5.0)	110	110	500	2.40	410	---	1,700	ND (1.0)	0.17	---	---
MW-68-180	08-Sep-11	ND (5.0)	73.0	73.0	740	2.60	900	---	2,800	1.30	0.19	---	---
MW-68-180	18-Oct-11	ND (5.0)	73.0	73.0	780	ND (2.5)	960	---	2,900	1.30	0.13	---	---
MW-68-180	17-Nov-11	ND (5.0)	73.0	73.0	790	1.70	970	---	2,700	1.50	0.18	---	---
MW-68-180	15-Dec-11	14.0	57.0	71.0	770	1.70	930	---	2,900	1.30	ND (0.1)	-65	-7.2
MW-68-180	11-Dec-12	ND (5.0)	75.0	75.0	830	---	990	31.0	---	---	ND (0.1) J	---	---
MW-68-180	11-Dec-12 FD	ND (5.0)	75.0	75.0	840	---	1,000	30.5	---	---	ND (0.1) J	---	---
MW-68-180	21-Feb-13	---	---	---	---	---	---	27.3	---	---	---	---	---
MW-68-240	14-Jun-11	ND (5.0)	68.0	68.0	4,100	5.50	730	---	7,700	ND (1.0)	0.15	---	---
MW-68-240	12-Jul-11	ND (5.0)	66.0	66.0	4,400	5.60	730	---	7,400	ND (1.0)	0.13	---	---
MW-68-240	07-Sep-11	ND (5.0)	63.0	63.0	5,000	ND (2.5)	810	---	8,700	ND (1.0)	0.16	---	---
MW-68-240	07-Sep-11 FD	ND (5.0)	62.0	62.0	5,000	ND (2.5)	810	---	8,900	ND (1.0)	ND (0.1)	---	---
MW-68-240	18-Oct-11	ND (5.0)	64.0	64.0	5,100	ND (10)	910	---	8,900	ND (1.0)	0.11	---	---
MW-68-240	16-Nov-11	ND (5.0)	62.0	62.0	4,800	ND (5.0)	840	---	8,600	ND (1.0)	0.14	---	---
MW-68-240	14-Dec-11	ND (5.0)	28.0	28.0	5,200	ND (5.0)	830	---	8,600	ND (1.0)	ND (0.1)	-69	-8.7
MW-68-240	06-Dec-12	ND (5.0)	62.0	62.0	5,600	---	860	4.82	---	---	ND (0.1)	---	---
MW-68-240	20-Feb-13	---	---	---	---	---	---	4.58	---	---	---	---	---
MW-68BR-280	08-Sep-11	ND (5.0)	33.0	33.0	6,800	ND (5.0)	650	---	11,000	ND (1.0)	ND (0.1)	---	---
MW-68BR-280	21-Oct-11	ND (5.0)	48.0	48.0	6,900	13.0	710	---	11,000	ND (1.0)	ND (0.1)	---	---
MW-68BR-280	16-Nov-11	ND (5.0)	33.0	33.0	7,200	7.70	720	---	12,000	ND (1.0)	ND (0.1)	---	---
MW-68BR-280	14-Dec-11	ND (5.0)	120	120	7,500	ND (5.0)	700	---	12,000	ND (1.0)	ND (0.1)	-77	-10
MW-68BR-280	12-Nov-12	ND (5.0)	24.0	24.0	7,500	---	740	0.01	---	---	ND (0.1)	---	---
MW-68BR-280	18-Feb-13	---	---	---	---	---	---	ND (0.01)	---	---	---	---	---
MW-69-195	11-Jul-11	ND (5.0)	140	140	670	2.90	420	---	2,000	ND (1.0)	0.41	---	---
MW-69-195	09-Aug-11	ND (5.0)	140	140	710	3.30	450	---	2,000	ND (1.0)	0.22	---	---
MW-69-195	07-Sep-11	ND (5.0)	140	140	740	3.00	480	---	2,100	ND (1.0)	0.2	---	---
MW-69-195	18-Oct-11	ND (5.0)	130	130	770	3.30	520	---	2,100	ND (1.0)	0.16	---	---

TABLE 3-4

Groundwater Analytical Results for ER-TCS Area Station Groundwater Investigation Monitoring Wells, General Chemistry Parameters

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location	Sample Date	Alkalinity, as carbonate (mg/L)	Alkalinity, bicarbonate as CaCo3 (mg/L)	Alkalinity, total as CaCO3 (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Sulfate (mg/L)	Nitrate/Nitrite as nitrogen (mg/L)	Total Dissolved Solids (mg/L)	Total Organic Carbon (mg/L)	Ammonia as nitrogen (mg/L)	Deuterium (0/00)	Oxygen 18 (0/00)
MW-69-195	15-Nov-11	ND (5.0)	150	150	730	2.30	560	---	2,200	1.00	0.12	---	---
MW-69-195	14-Dec-11	ND (5.0)	130	130	680	2.60	570	---	2,600	1.30	ND (0.1)	-64	-7.8
MW-69-195	05-Dec-12	ND (5.0)	200	200	680	---	690	20.3	---	---	ND (0.1)	---	---
MW-69-195	20-Feb-13	---	---	---	---	---	---	22.4	---	---	---	---	---
MW-70-105	13-Jun-11	ND (5.0)	86.0	86.0	480	4.70	130	---	1,100	1.10	ND (0.1)	---	---
MW-70-105	11-Jul-11	ND (5.0)	74.0	74.0	540	4.70	130	---	1,300	ND (1.0)	0.1	---	---
MW-70-105	08-Aug-11	ND (5.0)	95.0	95.0	630	5.00	160	---	1,500	ND (1.0)	0.14	---	---
MW-70-105	06-Sep-11	ND (5.0)	88.0	88.0	670	4.70	170	---	1,500	ND (1.0)	0.1	---	---
MW-70-105	14-Nov-11	ND (5.0)	90.0	90.0	670	3.90	190	---	1,400	ND (1.0)	ND (0.1)	---	---
MW-70-105	12-Dec-11	ND (5.0)	91.0	91.0	780	3.50	200	---	1,500	ND (1.0)	ND (0.1)	-70	-9.2
MW-70-105	04-Dec-12	ND (5.0)	87.0	87.0	930	---	240	2.05	---	---	ND (0.1)	---	---
MW-70-105	19-Feb-13	---	---	---	---	---	---	2.55	---	---	---	---	---
MW-70BR-225	16-Nov-11	ND (5.0)	45.0	45.0	4,000	4.40	730	---	8,000	ND (1.0)	ND (0.1)	---	---
MW-70BR-225	15-Dec-11	ND (5.0)	50.0	50.0	4,100	ND (10)	790	---	8,000	ND (1.0)	ND (0.1)	-71	-9
MW-70BR-225	13-Dec-12	ND (5.0)	43.0	43.0	4,200	---	770	3.80	---	---	ND (0.1)	---	---
MW-70BR-225	26-Feb-13	---	---	---	---	---	---	4.13	---	---	---	---	---
MW-71-035	15-Nov-11	---	---	---	---	---	---	---	---	1.10	---	---	---
MW-71-035	16-Nov-11	---	---	---	---	---	---	---	---	---	ND (0.1)	---	---
MW-71-035	17-Nov-11	ND (5.0)	69.0	69.0	2,000	3.10	450	---	3,700	---	---	---	---
MW-71-035	17-Nov-11	ND (5.0)	68.0	68.0	2,000	3.00	460	---	3,700	---	---	---	---
MW-71-035	14-Dec-11	---	---	---	---	---	---	---	---	---	---	-70	-9.3
MW-71-035	15-Dec-11	---	---	---	---	---	---	---	---	ND (1.0)	ND (0.1)	---	---
MW-71-035	16-Dec-11	ND (5.0)	79.0	79.0	2,200	3.40	480	---	4,300	---	---	---	---
MW-71-035	08-Nov-12	ND (5.0)	77.0	77.0	2,500	---	540	1.66	---	---	0.1	---	---
MW-71-035	07-Feb-13	---	---	---	---	---	---	1.63	---	---	---	---	---
MW-72-080	06-Sep-11	ND (5.0)	56.0	56.0	3,600	7.10	510	---	6,900	ND (1.0)	0.1	---	---
MW-72-080	17-Oct-11	ND (5.0)	49.0	49.0	4,700	9.60	630	---	7,900	ND (1.0)	0.12	---	---
MW-72-080	14-Nov-11	ND (5.0)	51.0	51.0	4,500	6.70	630	---	7,700	ND (1.0)	0.13	---	---

TABLE 3-4

Groundwater Analytical Results for ER-TCS Area Station Groundwater Investigation Monitoring Wells, General Chemistry Parameters

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location	Sample Date	Alkalinity, as carbonate (mg/L)	Alkalinity, bicarbonate as CaCo3 (mg/L)	Alkalinity, total as CaCO3 (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Sulfate (mg/L)	Nitrate/Nitrite as nitrogen (mg/L)	Total Dissolved Solids (mg/L)	Total Organic Carbon (mg/L)	Ammonia as nitrogen (mg/L)	Deuterium (0/00)	Oxygen 18 (0/00)
MW-72-080	15-Dec-11	ND (5.0)	41.0	41.0	5,000	ND (10)	690	---	8,700	ND (1.0)	ND (0.1)	-73	-9.5
MW-72-080	05-Dec-12	ND (5.0)	42.0	42.0	5,400	---	700	1.47	---	---	ND (0.1)	---	---
MW-72-080	19-Feb-13	---	---	---	---	---	---	1.15	---	---	---	---	---
MW-72BR-200	13-Sep-12	13.0	16.0	29.0	4,700	ND (10)	630	---	9,100	ND (1.0)	ND (0.1)	-77	-10
MW-72BR-200	13-Sep-12 FD	13.0	16.0	29.0	4,900	ND (10)	630	---	9,200	ND (1.0)	ND (0.1)	-79	-9.9
MW-72BR-200	14-Nov-12	ND (5.0)	25.0	25.0	5,300	---	680	0.098	---	---	0.23	---	---
MW-72BR-200	07-Feb-13	---	---	---	---	---	---	0.14	---	---	---	---	---
MW-73-080	15-Nov-11	ND (5.0)	90.0	90.0	3,000	2.80	390	---	6,000	ND (1.0)	0.14	---	---
MW-73-080	14-Dec-11	ND (5.0)	70.0	70.0	3,100	ND (2.5)	390	---	5,300	2.50	ND (0.1)	-70	-9.3
MW-73-080	05-Dec-12	ND (5.0)	86.0	86.0	3,500	---	420	4.98	---	---	ND (0.1)	---	---
MW-73-080	19-Feb-13	---	---	---	---	---	---	4.01	---	---	---	---	---
MW-74-240	16-Jan-12	210	ND (5.0)	240	270	4.70	120	---	1,100	15.0	2.50	---	---
MW-74-240	20-Dec-12	37.0	110	150	160	---	96.0	0.074 J	---	---	0.54	---	---
MW-74-240	20-Dec-12 FD	37.0	110	150	160	---	94.0	0.055 J	---	---	0.48	---	---
MW-74-240	01-Mar-13	---	---	---	---	---	---	0.16	---	---	---	---	---

Notes:

-- = not analyzed

0/00 = differences from global standard in parts per thousand

FD = field duplicate

J = concentration estimated by laboratory or data validation

mg/L = milligrams per liter

ND = not detected at listed reporting limit

TABLE 3-5

Average Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, General Chemistry Parameters

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location		General Chemistry Data																							
		Alkalinity, bicarb as CaCO3		Alkalinity, carb as CaCO3		Alkalinity, total as CaCO3		Ammonia as nitrogen		Chloride		Deuterium		Fluoride		Nitrate/Nitrite as Nitrogen		Oxygen 18		Sulfate		Total dissolved solids		Total organic carbon	
		mg/L		mg/L		mg/L		mg/L		mg/L		0/00		mg/L		mg/L		0/00		mg/L		mg/L		mg/L	
MW-23-060	Min	18.4	ND	13.3	ND	35.4	28.0	0.025	ND	5,640	5,200	-73	-75	ND	ND	5.73	5.73	-8.6	-9	582	500	10,500	10,000	0.8	ND
	Max		36.0		32.0		43.0		0.1		6,000		-71		ND		5.73		-8.3		670		11,000		1.60
	Total Count		5		5		5		4		5		2		1		1		2		5		2		2
MW-23-080	Min	ND	ND	26.8	19.0	85.8	49.0	0.14	ND	5,660	5,400	-73	-73	ND	ND	6.82	6.82	-8.5	-8.7	818	650	10,500	10,000	0.85	ND
	Max		ND		39.0 J		140		0.27		5,900		-72		ND		6.82		-8.4		960		11,000		1.70
	Total Count		5		5		5		4		5		2		1		1		2		5		2		2
MW-57-050	Min	---	---	---	---	---	---	---	---	350	350	-65	-65	---	---	---	---	-8.6	-8.6	220	220	1,100	1,100	---	---
	Max		---		---		---		---		350		-65		---		---		-8.6		220		1,100		---
	Total Count		---		---		---		---		1		1		---		---		1		1		1		---
MW-57-070	Min	84.9	59.0	ND	ND	84.9	59.0	ND	ND	727	510	-64	-66	ND	ND	8.35	8.35	-8.8	-9.3	108	98.0 J	1,880	1,600	0.72	ND
	Max		120		ND		120		ND		930		-63		ND		8.35		-8.5		130 J		2,200		1.60
	Total Count		7		7		7		5		7		3		1		1		3		7		4		4
MW-57-185	Min	35.3	18.0	1.05	ND	37.3	21.0	ND	ND	6,270	6,000	-77	-79	ND	ND	0.021	0.012	-10	-10	710	680	11,000	11,000	0.19	ND
	Max		110		6.30		110		ND		6,600		-76		ND		0.03		-10		740		11,000		0.57
	Total Count		6		6		6		3		6		2		1		2		2		6		3		3
MW-58-065	Min	---	---	---	---	---	---	---	---	45.0	45.0	-78	-78	---	---	---	---	-10	-10	97.0	97.0	370	370	---	---
	Max		---		---		---		---		45.0		-78		---		---		-10		97.0		370		---
	Total Count		---		---		---		---		1		1		---		---		1		1		1		---
MW-58BR Packer * (Deeper) Lower Zone	Min	37.0	37.0	ND	ND	37.0	37.0	0.19	0.19	2,990	2,600	-76	-76	2.60	2.60	---	---	-9.8	-9.8	510	510	5,840	4,800	ND	ND
	Max		37.0		ND		37.0		0.19		3,400		-76		2.60		---		-9.8		510		7,000		ND
	Total Count		1		1		1		1		8		1		1		---		1		1		8		8
MW-58BR Packer * (Deeper) Upper Zone	Min	37.0	37.0	ND	ND	37.0	37.0	0.14	0.14	3,580	2,800	-76	-76	2.80	2.80 J	---	---	-9.8	-9.8	550	550	6,900	6,200	ND	ND
	Max		37.0		ND		37.0		0.14		4,300		-76		2.80 J		---		-9.8		550		7,400		ND
	Total Count		1		1		1		1		8		1		1		---		1		1		8		8
MW-59-100	Min	138	100	ND	ND	138	100	ND	ND	3,140	2,800	-62	-62	ND	ND	4.27	4.02	-7.7	-7.8	704	660	6,950	5,800	1.05	ND
	Max		330		ND		330		ND		3,700		-60		ND		4.52		-7.6		780		7,800		3.40
	Total Count		9		9		9		5		9		3		1		2		3		9		4		4
MW-60-125	Min	62.4	46.0	ND	ND	62.4	46.0	ND	ND	2,600	2,400	-71	-73	ND	ND	4.26	4.26	-9.2	-9.5	430	390	5,480	5,200	0.41	ND
	Max		80.0		ND		80.0		ND		2,800		-70		ND		4.26		-8.9		460		6,100		1.20
	Total Count		7		7		7		5		7		4		1		2		4		7		4		4
MW-60BR-245	Min	26.8	22.0	ND	ND	26.8	22.0	ND	ND	5,780	5,600	-75	-75	6.63	ND	0.23	0.23	-9.8	-9.8	756	740	8,430	4,400	ND	ND
	Max		37.0		ND		37.0		ND		6,100		-75		12.0		0.23		-9.8		780		10,000		ND
	Total Count		5		5		5		5		5		1		4		1		1		5		4		4
MW-61-110	Min	43.6	13.0	1.56	ND	45.1	27.0	0.13	ND	5,210	4,700	-75	-77	ND	ND	0.95	0.9	-9.8	-10	671	620 J	9,150	8,700	1.30	ND
	Max		53.0		14.0		53.0		0.37 J		5,500		-72		ND		1.0		-9.4		700		9,600		3.30
	Total Count		9		9		9		5		9		3		1		2		3		9		4		4
MW-62-065	Min	116	100	ND	ND	116	100	0.024	ND	1,710	1,500	-68	-71	3.40	3.40	3.70	3.70	-9	-9.8	381	350	3,430	2,900	0.91	ND
	Max		130		ND		130		0.12		1,900		-67		3.40		3.70		-8.7		410		3,800		2.70
	Total Count		7		7		7		5		7		4		1		1		4		7		4		4
MW-62-110	Min	72.7	45.0	ND	ND	72.7	45.0	0.098	ND	2,530	2,400	-67	-71	4.30	4.30	3.94	3.61	-8.5	-9.3	490	450	4,900	4,800	15.4	5.50
	Max		82.0		ND		82.0		0.27		2,700		-64		4.30		4.26		-8.1		540		5,000		31.0
	Total Count		6		6		6		4		6		3		1		2		3		6		3		10

TABLE 3-5

Average Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, General Chemistry Parameters

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location		General Chemistry Data																			
		Alkalinity, bicarb as CaCO3		Alkalinity, carb as CaCO3		Alkalinity, total as CaCO3		Ammonia as nitrogen		Chloride		Deuterium		Fluoride		Nitrate/Nitrite as Nitrogen		Oxygen 18		Sulfate		Total dissolved solids		Total organic carbon	
		mg/L		mg/L		mg/L		mg/L		mg/L		0/00		mg/L		mg/L		0/00		mg/L		mg/L		mg/L	
MW-62-190	Min	45.3	38.0	ND	ND	45.3	38.0	ND	ND	5,820	4,400	-78	-79	6.80	6.80	0.015	ND	-10	-11	683	590	10,000	9,000	15.7	4.70
	Max		54.0		ND		54.0		ND		6,300		-76		6.80		0.03		-10		730		11,000		58.0 J
	Total Count		6		6		6		4		6		3		1		2		3		6		3		10
MW-63-065	Min	203	190	ND	ND	203	190	0.024	ND	1,830	1,500	-98	-98	ND	ND	1.06	1.05	-12	-13	584	540 J	3,980	3,400	1.77	ND
	Max		210		ND		210		0.12		2,100		-98		ND		1.07		-12		640		4,400		6.40
	Total Count		7		7		7		5		7		2		1		2		2		7		4		4
MW-64BR Packer * Lower Zone	Min	88.0	88.0	ND	ND	88.0	88.0	0.18	0.18	5,440	5,100	-74	-74	7.25	7.00	---	---	-9.4	-9.4	740	740	9,340	8,400	ND	ND
	Max		88.0		ND		88.0		0.18		5,600		-74		7.50		---		-9.4		740		11,000		ND
	Total Count		1		1		1		1		8		1		2		---		1		1		8		8
MW-64BR Packer * Upper Zone	Min	70.0	70.0	ND	ND	70.0	70.0	0.24	0.24	3,600	3,300	-72	-72	4.70	4.70	---	---	-9.2	-9.2	600	600	6,900	5,800	ND	ND
	Max		70.0		ND		70.0		0.24		4,100		-72		4.70		---		-9.2		600		8,300		ND
	Total Count		1		1		1		1		8		1		2		---		1		1		8		8
MW-65-160	Min	72.0	62.0	ND	ND	72.0	62.0	0.45	ND	1,060	990	-65	-65	1.99	ND	11.1	10.8	-8.5	-8.5	390	360	2,540	2,500	ND	ND
	Max		110		ND		110		0.84		1,100		-65		3.00		11.4		-8.5		440		2,600		ND
	Total Count		8		8		8		8		8		1		7		2		1		8		7		7
MW-65-225	Min	65.5	22.0	ND	ND	65.5	22.0	0.22	ND	4,000	2,800	-62	-62	6.11	ND	10.5	9.82	-7.5	-7.5	781	710	7,510	6,200	ND	ND
	Max		97.0		ND		97.0		0.34		5,200		-62		10.0		11.2		-7.5		910		9,600		ND
	Total Count		8		8		8		8		8		1		7		2		1		8		7		7
MW-66-165	Min	80.4	22.0	ND	ND	80.4	22.0	0.12	ND	1,010	980	-65	-65	ND	ND	38.8	38.4	-8.5	-8.5	510	490	2,750	2,600	ND	ND
	Max		97.0		ND		97.0		0.19		1,100		-65		ND		39.1		-8.5		530		2,900		ND
	Total Count		7		7		7		7		7		1		6		2		1		7		6		6
MW-66-230	Min	36.0	32.0	ND	ND	36.0	32.0	0.056	ND	5,990	5,700	-67	-67	1.15	ND	14.7	14.1	-8.3	-8.3	984	870	9,730	9,000	ND	ND
	Max		39.0		ND		39.0		0.15		6,600		-67		6.90		15.2		-8.3		1,100		10,000		ND
	Total Count		7		7		7		7		7		1		6		2		1		7		6		6
MW-66BR-270	Min	ND	ND	31.0	26.0	68.0	26.0	0.28	0.25	6,050	6,000	---	---	ND	ND	0.078	0.078	---	---	195	180	11,000	11,000	4.70	4.70
	Max		ND		36.0		110		0.31		6,100		---		ND		0.078		---		210		11,000		4.70
	Total Count		2		2		2		2		2		---		1		1		---		2		1		1
MW-67-185	Min	125	120	ND	ND	125	120	0.14	ND	863	760	-69	-69	0.37	ND	22.1	21.6	-9.1	-9.1	543	490	2,170	2,100	ND	ND
	Max		130		ND		130		0.21		1,100		-69		1.10		22.5		-9.1		630		2,300		ND
	Total Count		4		4		4		4		4		1		3		2		1		4		3		3
MW-67-225	Min	125	110	ND	ND	125	110	0.27	ND	1,810	1,700	-68	-68	5.20	4.00	21.9	20.6	-8.2	-8.2	1,040	910	4,340	4,100	ND	ND
	Max		140		ND		140		0.48		1,900		-68		6.30		23.1		-8.2		1,100		4,500		ND
	Total Count		8		8		8		8		8		1		7		2		1		8		7		7
MW-67-260	Min	29.6	18.0	2.63	ND	32.1	25.0	0.15	0.1	5,730	5,200	-69	-69	8.09	ND	1.52	1.49	-8.8	-8.8	798	720	9,170	8,900	ND	ND
	Max		43.0		21.0 J		43.0		0.3		6,100		-69		12.0		1.56		-8.8		880		9,400		ND
	Total Count		8		8		8		8		8		1		7		2		1		8		7		7
MW-68-180	Min	83.0	57.0	2.00	ND	85.0	71.0	0.13	ND	703	500	-65	-65	1.77	ND	29.1	27.3	-7.2	-7.2	797	410	2,450	1,700	0.9	ND
	Max		120		14.0		120		0.24		840		-65		2.60		31.0		-7.2		990		2,900		1.50
	Total Count		7		7		7		7		7		1		6		2		1		7		6		6
MW-68-240	Min	59.0	28.0	ND	ND	59.0	28.0	0.099	ND	4,890	4,100	-69	-69	1.85	ND	4.70	4.58	-8.7	-8.7	816	730	8,350	7,400	ND	ND
	Max		68.0		ND		68.0		0.16		5,600		-69		5.60		4.82		-8.7		910		8,900		ND
	Total Count		7		7		7		7		7		1		6		2		1		7		6		6

TABLE 3-5

Average Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, General Chemistry Parameters

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location		General Chemistry Data																					
		Alkalinity, bicarb as CaCO3		Alkalinity, carb as CaCO3		Alkalinity, total as CaCO3		Ammonia as nitrogen		Chloride		Deuterium		Fluoride		Nitrate/Nitrite as Nitrogen		Oxygen 18		Sulfate		Total dissolved solids		Total organic carbon	
		mg/L		mg/L		mg/L		mg/L		mg/L		0/00		mg/L		mg/L		0/00		mg/L		mg/L		mg/L	
MW-68BR-280	**Min**		24.0		ND		24.0		ND		6,800		-77		ND		ND		-10		650		11,000		ND
	Max	**51.6**	120	**ND**	ND	**51.6**	120	**ND**	ND	**7,180**	7,500	**-77**	-77	**5.17**	13.0	**0.005**	0.01	**-10**	-10	**704**	740	**11,500**	12,000	**ND**	ND
	Total Count		5		5		5		5		5		1		4		2		1		5		4		4
MW-69-195	**Min**		130		ND		130		ND		670		-64		2.30		20.3		-7.8		420		2,000		ND
	Max	**147**	200	**ND**	ND	**147**	200	**0.16**	0.41	**711**	770	**-64**	-64	**2.90**	3.30	**21.3**	22.4	**-7.8**	-7.8	**527**	690	**2,170**	2,600	**0.38**	1.30
	Total Count		7		7		7		7		7		1		6		2		1		7		6		6
MW-70-105	**Min**		74.0		ND		74.0		ND		480		-70		3.50		2.05		-9.2		130		1,100		ND
	Max	**87.3**	95.0	**ND**	ND	**87.3**	95.0	**0.049**	0.14	**671**	930	**-70**	-70	**4.42**	5.00	**2.30**	2.55	**-9.2**	-9.2	**174**	240	**1,380**	1,500	**0.18**	1.10
	Total Count		7		7		7		7		7		1		6		2		1		7		6		6
MW-70BR-225	**Min**		43.0		ND		43.0		ND		4,000		-71		ND		3.80		-9		730		8,000		ND
	Max	**46.0**	50.0	**ND**	ND	**46.0**	50.0	**ND**	ND	**4,100**	4,200	**-71**	-71	**2.20**	4.40	**3.97**	4.13	**-9**	-9	**763**	790	**8,000**	8,000	**ND**	ND
	Total Count		3		3		3		3		3		1		2		2		1		3		2		2
MW-71-035	**Min**		68.0		ND		68.0		ND		2,000		-70		3.00		1.63		-9.3		450		3,700		ND
	Max	**73.3**	79.0	**ND**	ND	**73.3**	79.0	**0.033**	0.1	**2,180**	2,500	**-70**	-70	**3.17**	3.40	**1.64**	1.66	**-9.3**	-9.3	**483**	540	**3,900**	4,300	**0.55**	1.10
	Total Count		4		4		4		3		4		1		3		2		1		4		3		2
MW-72-080	**Min**		41.0		ND		41.0		ND		3,600		-73		ND		1.15		-9.5		510		6,900		ND
	Max	**47.8**	56.0	**ND**	ND	**47.8**	56.0	**0.07**	0.13	**4,640**	5,400	**-73**	-73	**5.85**	9.60	**1.31**	1.47	**-9.5**	-9.5	**632**	700	**7,800**	8,700	**ND**	ND
	Total Count		5		5		5		5		5		1		4		2		1		5		4		4
MW-72BR-200	**Min**		16.0		ND		25.0		ND		4,700		-79		ND		0.098		-10		630		9,100		ND
	Max	**19.0**	25.0	**8.67**	13.0	**27.7**	29.0	**0.076**	0.23	**4,970**	5,300	**-78**	-77	**ND**	ND	**0.12**	0.14	**-9.9**	-9.9	**647**	680	**9,150**	9,200	**ND**	ND
	Total Count		3		3		3		3		3		2		2		2		2		3		2		2
MW-73-080	**Min**		70.0		ND		70.0		ND		3,000		-70		ND		4.01		-9.3		390		5,300		ND
	Max	**82.0**	90.0	**ND**	ND	**82.0**	90.0	**0.047**	0.14	**3,200**	3,500	**-70**	-70	**1.40**	2.80	**4.50**	4.98	**-9.3**	-9.3	**400**	420	**6.40**	6,000	**1.25**	2.50
	Total Count		3		3		3		3		3		1		2		2		1		3		2		2
MW-74-240	**Min**		ND		37.0		150		0.54		160		---		4.70		0.074 J		---		96.0		1,100		15.0
	Max	**55.0**	110	**124**	210	**195**	240	**1.52**	2.50	**215**	270	**---**	---	**4.70**	4.70	**0.12**	0.16	**---**	---	**108**	120	**1,100**	1,100	**15.0**	15.0
	Total Count		2		2		2		2		2		---		1		2		---		2		1		1

Notes:

When calculating averages, zero was used for non-detect results.

* Monitoring wells MW-58BR and MW-64BR have used multiple monitoring configurations throughout the East Ravine investigation (see well construction information).

Average, minimum, and maximum values shown are for the most recent, depth-specific monitoring well configuration, which is the most comprehensive data set of all past monitoring configurations.

See Table 3-4 for results from other configurations.

-- = not analyzed

0/00 = differences from global standard in parts per thousand

J = concentration estimated by laboratory or data validation

mg/L = milligrams per liter

ND = not detected at listed reporting limit

TABLE 3-6

Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Field Water Quality Parameters

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location	Sample Date	Field Data						
		Specific Conductance (µS/cm)	Temperature (°C)	pH (pH units)	ORP (mV)	Dissolved Oxygen (mg/L)	Salinity (%)	Turbidity (NTU)
MW-23-060	21-Jul-09	16,400	31.3	8.43 R	146	4.41	0.11	30.0
	24-Sep-09	17,000	32.6	9.37 R	24.1	3.46	---	18.0
	10-Dec-09	16,200	26.8	11.3 R	-1.9 R	2.11	1.05	11.0
	08-Mar-10	10,700	28.4	9.96 R	-9 R	1.94	6.12 R	19.0
	03-May-10	14,700	30.7	9.13 R	-32	4.00	---	2.95
	29-Sep-10	16,500	34.1	8.94 R	51.2	2.26	---	5.00
	14-Dec-10	16,100	31.8	10.3 R	53.4	3.03	9.30 R	2.80
	09-Feb-11	16,900	30.7	9.01 R	93.2	3.29	---	7.00
	04-May-11	17,400	33.2	9.30 R	-77	2.81	1.13	2.00
	29-Sep-11	17,700	33.4	8.95 R	-29	2.85	1.14	1.20
	13-Dec-11	19,200	31.1	8.43 R	114	5.37	1.24	6.00
	14-Feb-12	18,900	30.7	9.09 R	67.0	5.24	1.22	3.12
	30-Apr-12	16,800	31.4	10.2 R	-76	3.61	1.08	1.00
	12-Sep-12	17,100	32.2	10.0 R	-46	3.84	1.11	20.0
	08-Nov-12	16,600	30.2	10.1 R	60.7	4.98	1.07	3.00
	18-Feb-13	15,800	28.3	10.0	63.4	3.90	1.02	1.00
MW-23-080	21-Jul-09	16,900	32.7	11.0 R	87.9	4.99	0.11	5.00
	23-Sep-09	17,700	31.8	11.3 R	-5.4 R	2.79	---	5.00
	10-Dec-09	17,700	28.4	11.1	-41 R	0.87	1.14	3.00
	08-Mar-10	18,100	29.1	10.8 R	-46 R	0.38	10.7 R	1.10
	04-May-10	18,000	32.0	10.9 R	-77	0.27	---	1.60
	29-Sep-10	17,300	32.8	10.6 R	-53	0.26	---	2.00
	14-Dec-10	17,400	30.3	10.4 R	3.50	1.70	---	1.20
	09-Feb-11	17,400	32.0	10.4 R	63.1	2.37	---	4.00
	04-May-11	17,700	31.8	10.8 R	-170	1.09	1.15	2.00
	29-Sep-11	17,800	31.5	10.5 R	-66	0.54	1.15	1.40
	12-Dec-11	19,400	31.2	10.0 R	-43	0.95	1.26	2.00
	14-Feb-12	19,300	31.2	7.60	-140	0.38	1.25	1.78
	30-Apr-12	16,900	32.0	10.5 R	-130	0.25	1.09	1.00
	12-Sep-12	17,100	29.9	10.4 R	-110	1.44	1.10	11.0
	08-Nov-12	16,600	29.9	10.4 R	-80	3.05	1.07	1.00
	18-Feb-13	16,000	28.9	10.7	50.0	1.67	1.03	1.00
MW-57-050	17-Feb-10	1,900	---	7.40	---	---	---	---
MW-57-070	11-Feb-09	2,910	28.2	7.30	-94	2.55	1.51	---
	10-Jun-09	3,060	31.7	6.97	48.0	1.09	---	9.00
	21-Jul-09	3,140	31.9	6.60	287	1.13	0.2	13.0
	24-Sep-09	3,160	32.3	7.22	34.2	0.74	---	12.0
	10-Dec-09	3,270	29.0	7.30	-32 R	0.65	0.23	35.0
	16-Mar-10	1,250	30.5	7.29	41.1	3.31	---	---
	05-May-10	1,830	34.1	7.41	3.50	3.79	---	5.71
	30-Sep-10	1,940	32.5	7.18	35.7	3.23	---	11.0
	15-Dec-10	2,160	30.6	7.16	1.80	2.02	1.09	24.0
	10-Feb-11	2,510	31.9	7.27	128	3.54	---	9.00
	05-May-11	2,490	31.1	7.04	58.0	2.48	0.16	9.40
	29-Sep-11	2,710	31.5	6.93	55.6	2.27	0.18	42.8
	15-Dec-11	2,740	30.5	7.08	-21	2.70	0.18	20.0
	15-Feb-12	3,160	31.7	6.42	92.0	5.10	0.2	6.22

TABLE 3-6

Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Field Water Quality Parameters

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location	Sample Date	Field Data						
		Specific Conductance (µS/cm)	Temperature (°C)	pH (pH units)	ORP (mV)	Dissolved Oxygen (mg/L)	Salinity (%)	Turbidity (NTU)
MW-57-070	03-May-12	2,720	32.1	7.10	120	4.91	0.18	25.0
	12-Sep-12	2,230	29.9	7.11	9.20	3.74	0.14	2.00
	13-Dec-12	1,980	31.2	6.98	125	4.82	0.13	8.00
	20-Feb-13	2,260	28.4	7.05	190	3.03	0.15	9.00
	11-Mar-13	2,350	29.0	7.06	153	5.99	0.15	11.0
MW-57-185	20-Jul-09	18,300	29.7	8.19	194	0.2	0.12	2.00
	23-Sep-09	19,000	29.7	8.90	-42 R	0.17	---	4.00
	09-Dec-09	18,900	29.4	8.51	-190	0.07	1.22	2.00
	09-Mar-10	19,200	28.7	9.45	-38	0.23	1.13	12.0
	05-May-10	19,700	29.8	8.73	-50	0.06	---	3.00
	29-Sep-10	18,900	30.1	8.64	11.2	0.08	---	3.00
	09-Dec-10	19,500	29.9	8.66	-180	0.07	---	2.90
	08-Feb-11	19,200	29.9	8.60	-20	0.09	11.3	2.00
	03-May-11	19,700	29.8	8.43	-320 R	0.11	1.28	3.00
	28-Sep-11	19,700	29.9	8.47	-130	0.09	1.28	1.30
	13-Dec-11	21,000	29.9	8.29	-130	-0.03	1.36	1.00
	10-Feb-12	20,500	30.0	8.15	-170	-0.03	1.33	1.29
	30-Apr-12	18,500	29.5	8.86	-59	0.06	1.20	1.00
	11-Sep-12	16,600	29.8	10.8 R	-50	0.09	1.07	12.0
	08-Nov-12	18,300	29.8	8.65	-130	0.44	1.18	4.00
	06-Feb-13	19,000	29.7	8.27	168	0.1	1.23	2.00
MW-58-065	17-Feb-10	737	---	8.00	---	---	---	---
MW-58BR Open Borehole (Deeper)	28-Feb-13	8,200	26.7	7.57	5.00	0.28	0.53	8.00
MW-58BR Flute (Upper Zone)	22-Jul-09	6,590	30.5	6.78	-320	0.27	0.37	4.10
	29-Sep-09	12,300	28.7	7.30	-160	0.66	---	1.97
	16-Dec-09	8,810	27.9	7.44	-180	0.16	0.57	3.50
MW-58BR Flute (Lower Zone)	22-Jul-09	16,300	29.4	7.38	-340	0.0	0.89	1.50
	29-Sep-09	4,550	28.9	7.41	-250	0.08	---	2.20
	16-Dec-09	5,330	28.0	7.82	-280	0.08	0.34	3.20
MW-58BR Packer (Shallow Set) Upper Zone	14-Sep-10	11,800	30.8	7.97	-27	0.24	---	1.20
	06-Oct-10	11,800	28.2	7.95	-78	0.15	6.69	1.10
MW-58BR Packer (Shallow Set) Lower Zone	16-Sep-10	9,960	29.7	7.72	-20	0.19	---	0.8
	07-Oct-10	9,890	28.6	7.49	-66	0.04	5.52	1.10
MW-58BR Packer (Deeper Set) Upper Zone	01-Feb-11	12,000	25.9	7.49	-110	1.10	0.78	0.8
	18-Mar-11	12,800	27.8	7.94	-120	0.19	0.83	0.9
	06-Jul-11	12,000	29.5	8.14	-190	0.05	0.78	0.9
	02-Aug-11	12,000	31.0	8.43	-110	0.08	0.77	1.00
	30-Aug-11	10,500	34.2	7.82	-110	0.1	---	0.9
	11-Oct-11	12,300	29.1	7.21	-140	0.07	---	5.80
	08-Nov-11	9,880	26.7	7.53	-130	0.18	0.64	0.9
	08-Dec-11	11,000	26.5	7.42	-140	0.16	0.71	3.00
	08-Feb-12	10,100	26.9	7.15	-120	0.6	0.65	2.90
	15-May-12	11,000	31.6	7.47	-120	0.1	0.71	2.30
	03-Oct-12	9,630	30.9	7.00	-120	0.5	0.62	2.90
MW-58BR Packer (Deeper Set) Lower Zone	10-Feb-11	8,950	24.9	8.42	120	0.18	0.58	3.00
	04-Apr-11	9,940	28.7	7.87	-61	0.17	0.64	0.8
	07-Jul-11	11,700	31.6	8.38	-64	0.07	0.76	0.9

TABLE 3-6

Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Field Water Quality Parameters

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location	Sample Date	Field Data						
		Specific Conductance (µS/cm)	Temperature (°C)	pH (pH units)	ORP (mV)	Dissolved Oxygen (mg/L)	Salinity (%)	Turbidity (NTU)
MW-58BR Packer (Deeper Set) Lower Zone	23-Aug-11	10,800	31.4	7.73	-18	0.13	0.7	0.9
	31-Aug-11	10,900	36.2	7.72	-20	0.17	---	0.9
	13-Oct-11	9,950	32.7	7.25	-18	0.16	---	2.00
	09-Nov-11	9,950	25.8	7.58	-9.9	0.14	0.64	1.00
	09-Dec-11	8,620	24.6	7.65	27.4	0.08	0.56	1.10
	09-Feb-12	8,060	22.2	7.24	85.2	0.47	0.52	2.40
	16-May-12	11,300	29.4	8.40	-88	---	0.73	19.0
	04-Oct-12	11,600	31.3	7.99	-91	0.04	0.75	4.10
MW-59-100	18-Mar-09	25,600	30.6	7.16	46.0	2.70	1.58	4.40
	10-Jun-09	11,100	30.2	6.87	53.0	4.72	---	3.00
	22-Jul-09	10,800	30.8	6.92	90.1	4.51	6.04 R	27.0
	24-Sep-09	11,900	30.7	6.99	62.5	4.50	---	9.00
	11-Dec-09	11,200	28.7	7.06	199	5.11	0.72	24.0
	17-Mar-10	13,100	30.7	6.94	104	5.45	---	6.70
	06-May-10	10,500	31.3	7.00	93.4	4.76	---	7.97
	30-Sep-10	10,700	30.5	6.90	244	6.29	---	4.70
	16-Dec-10	9,940	30.2	6.97	106	5.21	---	4.00
	10-Feb-11	10,200	30.4	7.15	206	7.38	---	9.00
	06-May-11	11,400	31.3	6.90	122	4.83	0.74	6.00
	04-Oct-11	10,900	30.3	6.82	118	6.31	0.71	5.90
	15-Dec-11	9,460	29.4	6.94	1.80	3.27	0.61	5.00
	22-Feb-12	10,100	29.8	6.95	180	6.51	0.65	1.43
	08-May-12	11,200	29.2	6.95	134	5.61	0.72	6.00
	02-Oct-12	9,930	30.0	6.63	306	6.59	0.64	5.90
	28-Nov-12	10,400	29.7	6.78	171	6.70	0.68	1.00
	27-Feb-13	10,900	29.7	6.79	169	6.51	0.7	3.00
MW-60-125	20-Mar-09	15,500	32.6	7.44	99.0	3.46	0.88	9.20
	21-Jul-09	8,200	32.5	7.24	70.6	1.01	0.53	22.0
	05-Aug-09	6,220	32.8	7.58	-140	1.17	3.34 R	7.00
	24-Sep-09	8,240	31.6	7.54	-14	1.06	---	96.0
	10-Dec-09	8,320	29.1	7.51	-71	1.51	0.54	74.0
	17-Mar-10	9,480	28.0	7.48	77.2	1.69	---	203
	06-May-10	9,610	32.7	7.41	76.4	2.06	---	9.27
	30-Sep-10	9,210	33.9	7.35	-16	1.69	---	24.0
	16-Dec-10	9,250	32.7	7.32	48.6	2.05	---	10.1
	10-Feb-11	9,330	31.9	7.53	168	2.96	---	3.00
	05-May-11	9,160	32.7	7.28	-14	2.05	0.59	9.00
	04-Oct-11	8,880	31.6	7.28	-27	2.69	0.57	6.80
	14-Dec-11	8,120	32.3	7.39	-53	1.78	0.53	6.00
	15-Feb-12	9,780	33.2	7.36	106	3.41	0.63	5.34
	03-May-12	8,990	30.7	7.40	97.5	3.80	0.58	2.00
	20-Sep-12	9,030	32.3	7.55	63.1	1.83 R	0.58	3.00
	06-Dec-12	10,100	31.8	7.53	-76	2.81	0.65	4.00
	20-Feb-13	8,620	29.4	7.31	137	3.19	0.56	4.00
MW-60BR-245	09-Aug-11	9,500 R	31.4	9.33	-130	0.53	0.5	3.25
	07-Sep-11	16,200	32.1	9.62	-45	0.95 R	0.94	16.0
	16-Nov-11	17,700	29.0	8.95	95.2	0.41	1.15	11.0

TABLE 3-6

Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Field Water Quality Parameters

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location	Sample Date	Field Data						
		Specific Conductance (µS/cm)	Temperature (°C)	pH (pH units)	ORP (mV)	Dissolved Oxygen (mg/L)	Salinity (%)	Turbidity (NTU)
MW-60BR-245	14-Dec-11	18,700	28.9	9.02	-59	0.51	1.21	4.00
	16-Feb-12	19,100	29.4	9.39	11.0	0.8	1.24	4.98
	17-May-12	17,400	28.1	8.59	-130	0.29	1.12	2.00
	19-Sep-12	18,500	29.8	8.64	-140	0.23	1.20	3.00
	05-Dec-12	18,600	30.5	8.65	-8	2.29	1.20	10.0
	14-Mar-13	17,700	29.9	8.04	124	0.68	1.14	2.70
MW-61-110	23-Mar-09	20,000	29.9	7.52	-120	0.02	1.20	3.50
	21-Jul-09	15,100	33.4	7.27	-9.6	0.23	0.098	7.00
	24-Sep-09	15,900	31.5	7.73	-20	0.22	---	3.00
	10-Dec-09	16,400	29.7	7.66	-76	0.19	1.06	6.00
	17-Mar-10	15,700	28.2	7.56	24.1	0.36	---	8.00
	06-May-10	16,600	29.6	7.48	113	0.39	---	7.37
	30-Sep-10	16,400	30.5	7.39	38.0	0.22	---	7.00
	15-Dec-10	16,600	31.4	7.60	-100	0.26	9.65 R	69.0
	09-Feb-11	16,300	30.4	7.45	60.1	0.35	---	6.00
	05-May-11	16,000	31.2	7.27	-31	0.12	1.04	1.10
	30-Sep-11	17,100	30.5	7.34	-30	0.45	1.11	1.70
	14-Dec-11	15,600	29.8	7.34	-46	0.29	1.01	3.00
	15-Feb-12	17,700	30.4	7.34	-29	0.21	1.15	2.16
	03-May-12	16,600	28.7	7.36	54.8	0.29	1.07	1.00
	27-Sep-12	16,000	30.8	7.13	5.00	0.31	1.03	1.78
	27-Nov-12	16,300	29.1	7.21	12.0	0.34	1.05	4.00
	25-Feb-13	16,700	29.0	7.33	16.4	0.2	1.08	1.00
MW-62-065	27-Mar-09	7,410	30.1	7.40	148	3.36	0.4	3.80
	22-Jul-09	5,810	34.0	7.31	51.8	1.10	0.38	8.00
	24-Sep-09	5,780	32.6	7.60	29.0	1.34	---	7.00
	10-Dec-09	5,760	28.3	7.50	-17 R	1.60	0.37	7.00
	16-Mar-10	6,170	29.8	7.33	63.7	1.19	---	4.00
	06-May-10	6,580	30.9	7.36	120	2.27	---	0.91
	30-Sep-10	6,640	31.7	7.28	126	1.94	---	1.70
	15-Dec-10	6,270	30.3	7.37	18.9	2.35	---	5.00
	09-Feb-11	6,430	31.1	7.39	108	2.45	---	2.00
	05-May-11	6,250	31.5	7.29	51.2	2.23	0.4	1.90
	29-Sep-11	6,520	32.2	7.40	44.3	2.31	0.42	1.20
	13-Dec-11	6,350	30.5	7.34	30.0	2.23	0.41	2.00
	17-Feb-12	7,010	30.2	6.26 R	85.0 R	3.80	0.45	1.52
	02-May-12	6,170	29.8	7.57	34.3	3.72	0.4	19.0
	12-Sep-12	6,080	30.6	7.28	-28	2.00 R	0.39	3.00
	10-Dec-12	6,560	28.2	7.37	46.0	2.65	0.42	4.00
	19-Feb-13	6,460	28.2	7.79	61.0	2.90	0.42	5.00
MW-62-110	22-Jul-09	8,950	29.4	8.09	-94	0.0 R	0.5	2.20
	29-Sep-09	8,580	28.5	7.78	-130	0.21	---	1.30
	16-Dec-09	8,840	27.5	7.73	-120	0.24	0.57	1.00
	20-Jan-10	8,830	27.3	7.78	-70	0.22	4.90 R	1.70
	10-Feb-10	8,960	27.7	7.91	-110	0.09	---	1.10
	11-Mar-10	9,360	27.3	7.84	-110	0.09	---	0.4
	04-May-10	9,220	28.0	7.96	-54	0.42	5.14 R	1.21

TABLE 3-6

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PG&E Topock Compressor Station Needles, California

Location	Sample Date	Field Data						
		Specific Conductance (µS/cm)	Temperature (°C)	pH (pH units)	ORP (mV)	Dissolved Oxygen (mg/L)	Salinity (%)	Turbidity (NTU)
MW-62-110	29-Sep-10	9,130	28.2	7.83	-60	0.05	5.08 R	1.80
	16-Dec-10	8,880	27.3	7.83	110	0.21	---	3.00
	09-Feb-11	8,850	27.3	7.64	190	0.88	---	2.00
	05-May-11	9,040	27.9	7.63	95.2	1.32	0.58	3.03
	29-Sep-11	9,230	28.3	7.69	-60	0.48	0.6	0.7
	14-Dec-11	8,460	27.6	7.90	-87	0.2	0.55	3.00
	16-Feb-12	9,510	27.2	7.61	155	0.34	0.62	4.81
	10-May-12	9,030	26.5	7.51	177	0.45	0.58	1.00
	13-Sep-12	7,720	28.1	7.44	127	0.04	0.5	1.00
	11-Dec-12	8,710	27.2	6.61	126	0.37	0.56	1.00
	26-Feb-13	9,490	27.3	7.84	-51	184 R	0.61	2.34
MW-62-190	22-Jul-09	28,800	29.5	7.71	-310	0.14	1.80	2.00
	29-Sep-09	18,600	28.6	7.58	-230	0.11	---	1.80
	16-Dec-09	18,300	27.6	7.70	-190	0.17	1.18	1.70
	20-Jan-10	18,700	26.7	7.83	-160	0.18	11.1 R	2.30
	10-Feb-10	18,700	27.5	7.96	-150	0.08	---	0.6
	11-Mar-10	19,600	27.2	7.93	-140	0.05	---	0.3
	04-May-10	19,500	28.1	8.02	-95	0.39	11.6 R	0.8
	29-Sep-10	19,100	28.2	7.65	42.5	0.15	11.3 R	1.10
	16-Dec-10	17,500	26.9	7.90	-30	0.37	---	4.00
	09-Feb-11	18,100	27.5	7.80	135	0.44	---	2.00
	05-May-11	18,600	28.0	7.71	-110	1.11	1.20	2.76
	29-Sep-11	18,900	28.3	7.73	-88	0.25	1.22	1.60
	14-Dec-11	17,000	27.2	7.69	-110	0.83	1.10	3.00
	16-Feb-12	18,500	27.3	7.76	-130	0.21	1.19	4.58
	10-May-12	18,200	26.6	7.69	-210	0.13	1.18	1.00
	13-Sep-12	15,400	28.2	7.80	-280	0.01	0.99	1.00
	11-Dec-12	17,600	27.5	7.54	103	0.11	1.14	1.00
	26-Feb-13	19,400	27.5	7.96	-14	0.2	1.25	18.0
MW-63-065	15-Apr-09	10,900	27.1	7.08	12.0	1.27	0.61	7.10
	20-Jul-09	6,650	28.2	6.49	308	0.7	0.43	21.0
	22-Sep-09	6,930	27.8	7.26	66.1	1.01	---	10.0
	09-Dec-09	6,840	26.3	7.09	40.4	1.01	0.44	7.00
	09-Mar-10	7,620	26.2	7.11	12.2	0.74	0.42	3.00
	03-May-10	8,070	27.4	7.12	14.5	0.98	---	8.61
	27-Sep-10	7,440	29.2	7.13	72.5	1.49	---	7.00
	06-Dec-10	8,250	27.9	7.14	-23	1.35	---	4.40
	08-Feb-11	7,530	28.0	7.22	61.3	1.50	---	5.00
	03-May-11	7,760	27.5	6.99	-120	1.50	0.5	3.00
	28-Sep-11	7,880	28.4	7.14	4.50	1.67	0.51	2.00
	12-Dec-11	7,600	27.9	7.12	57.0	2.10	0.49	---
	13-Feb-12	7,410	27.1	7.12	28.0	0.62	0.48	137
	26-Apr-12	7,320	26.8	7.33	26.4	1.48	0.47	480
	10-Sep-12	6,850	27.1	8.04	96.4	2.17	0.44	---
	07-Nov-12	7,400	27.4	7.32	22.7	6.29	0.48	98.9
	06-Feb-13	7,300	26.0	6.95	194	1.45	0.47	5.00
MW-64BR Open Borehole	20-Dec-10	14,700	29.0	7.28	31.9	2.48	---	---

TABLE 3-6

Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Field Water Quality Parameters

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PG&E Topock Compressor Station Needles, California

Location	Sample Date	Field Data						
		Specific Conductance (µS/cm)	Temperature (°C)	pH (pH units)	ORP (mV)	Dissolved Oxygen (mg/L)	Salinity (%)	Turbidity (NTU)
MW-64BR Open Borehole	01-Mar-13	13,900	27.2	7.24	-19	1.16	0.9	65.0
MW-64BR Flute (Upper Zone)	22-Jul-09	8,860	30.0	7.37	-30 R	0.0 R	0.49	2.10
	29-Sep-09	9,760	29.2	6.77	-200	-1.1 R	---	1.40
	12-Oct-09	9,760	28.0	7.05	-320	0.08	5.50	1.70
	04-Nov-09	9,820	27.8	7.11	-300	0.1	5.40	1.40
	16-Dec-09	10,900	26.2	7.14	-290	0.11	0.7	1.30
	19-Jan-10	11,900	26.3	7.04	-95	0.13	6.80	2.70
	10-Feb-10	11,800	25.7	7.34	-44	0.13	---	1.40
	11-Mar-10	11,500	24.9	6.87	67.5	0.13	---	0.5
	04-May-10	11,300	26.8	6.88	37.6	0.39	6.39	1.34
	25-Aug-10	10,900	29.2	7.19	-51	0.43	6.20	1.30
	29-Sep-10	10,500	28.3	6.71	18.0	0.22	5.93	2.40
	20-Oct-10	8,340	26.9	7.10	-49	1.21	4.60	1.50
	11-Nov-10	8,550	26.8	7.34	-26	0.48	4.60	2.90
MW-64BR Flute (Middle Zone)	22-Jul-09	14,800	29.9	7.34	26.0 R	0.0 R	0.88	3.50
	29-Sep-09	14,200	29.0	6.74	-240	0.14	---	1.00
	12-Oct-09	13,800	27.9	7.07	-300	0.1	7.90	1.20
	04-Nov-09	14,100	27.7	7.14	-310	0.14	7.70	1.00
	16-Dec-09	15,200	26.1	7.00	-180	0.08	0.98	1.60
	19-Jan-10	15,400	26.4	7.05	-190	0.1	9.30	1.50
	10-Feb-10	16,300	25.9	7.40	-81	0.1	---	0.6
	11-Mar-10	16,700	25.2	7.24	-140	0.08	---	0.5
	04-May-10	16,300	27.0	7.18	-170	0.43	9.52	0.87
	25-Aug-10	15,800	28.9	7.58	-72	0.37	9.20	0.7
	29-Sep-10	15,900	28.3	6.78	-110	0.06	9.22	3.00
	20-Oct-10	14,900	27.0	6.99	-46	1.23	8.60	1.00
	11-Nov-10	14,700	26.7	7.27	-56	0.22	8.50	0.7
MW-64BR Flute (Lower Zone)	22-Jul-09	10,900	29.6	7.33	29.0 R	0.0 R	0.6	3.10
	29-Sep-09	14,200	29.2	6.82	-280	0.09	---	1.70
	12-Oct-09	13,300	27.9	7.18	-310	0.13	7.70	1.40
	04-Nov-09	11,600	27.1	7.10	-290	0.19	7.50	1.20
	16-Dec-09	15,100	26.0	6.99	-210	0.13	0.97	1.90
	19-Jan-10	15,700	26.3	6.97	-210	0.11	9.20	1.50
	10-Feb-10	16,400	25.9	7.23	-210	0.1	---	0.7
	11-Mar-10	16,600	25.5	7.17	-220	0.09	---	0.3
	04-May-10	16,100	27.1	7.18	-190	0.39	9.39	0.97
	25-Aug-10	15,900	29.2	8.09	-210	0.34	9.10	0.5
	29-Sep-10	15,900	28.4	6.74	-180	0.05	9.25	2.70
	20-Oct-10	14,800	27.0	6.91	-140	1.33 R	8.60	1.30
	11-Nov-10	14,500	26.7	7.22	-160	0.22	8.40	0.8
MW-64BR Packer (Upper Zone)	26-Jan-11	14,000	22.3	7.49	88.0	0.71	0.9	0.9
	12-Apr-11	13,000	29.5	7.46	-50	0.11	0.84	0.9
	11-Jul-11	12,100	31.3	7.84	-39	0.23	0.78	1.00
	15-Aug-11	11,800	37.8	6.98	15.1	1.62	0.76	1.00
	12-Sep-11	12,200	31.8	7.60	-63	0.45	---	1.00
	24-Oct-11	12,100	30.3	7.76	-120	0.04	0.78	1.00
	14-Nov-11	11,600	24.5	8.08	-140	0.11	0.75	1.00

TABLE 3-6

Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Field Water Quality Parameters

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location	Sample Date	Field Data						
		Specific Conductance (µS/cm)	Temperature (°C)	pH (pH units)	ORP (mV)	Dissolved Oxygen (mg/L)	Salinity (%)	Turbidity (NTU)
MW-64BR Packer (Upper Zone)	12-Dec-11	11,600	24.7	8.02	-170	0.09	0.75	1.00
	13-Feb-12	11,400	21.4	8.24	-260	0.07	0.74	4.60
	16-Apr-12	11,500	27.9	8.02	-140	0.2	0.74	58.0
	08-Oct-12	11,500	28.6	7.97	-140	0.16	0.74	20.0
MW-64BR Packer (Lower Zone)	24-Feb-11	17,200	25.4	7.61	46.0	0.76	1.11	0.7
	20-Apr-11	17,400	28.5	7.83	-100	0.09	1.13	0.8
	21-Jul-11	17,000	31.4	8.24	-530 R	2.38	1.10	0.9
	18-Aug-11	17,500	33.0	8.12	-23	2.29	1.13	0.9
	15-Sep-11	17,300	29.9	7.70	-27	1.40	---	1.00
	27-Oct-11	17,200	26.7	7.89	67.7	1.38	1.11	1.00
	17-Nov-11	16,300	26.5	7.87	104	1.80	1.05	1.00
	15-Dec-11	16,500	24.8	7.89	79.3	1.26	1.07	1.00
	16-Feb-12	15,700	24.8	7.71	-33	1.58	1.02	2.40
	19-Apr-12	15,200	27.7	7.91	-34	1.42	0.98	2.80
	10-Oct-12	15,600	29.2	7.87	-180	0.06	1.01	2.90
MW-65-160	13-Jun-11	4,150	33.0	7.76	-130	0.19	0.22	5.00
	11-Jul-11	3,680	31.8	7.61	-73	0.24	0.19	4.00
	09-Aug-11	3,690	31.6	7.71	-4.7	0.36	0.19	1.00
	07-Sep-11	4,360	32.3	7.57	-54	0.19	0.23	2.00
	17-Oct-11	4,290	31.7	7.52	17.8	0.2	0.23	4.00
	15-Nov-11	4,510	30.9	8.35	98.0	0.56	0.29	6.00
	15-Dec-11	4,810	31.1	7.41	24.0	0.35	0.31	2.00
	16-Feb-12	4,850	32.3	7.23	12.0	0.25	0.31	2.80
	01-May-12	4,090	31.1	7.31	-2.2	---	0.26	1.00
	18-Sep-12	4,380	31.9	7.16	-76	0.45	0.28	1.00
	04-Dec-12	4,400	30.9	7.34	-9.7	1.00	0.28	4.00
	19-Feb-13	4,120	31.0	7.77	116	0.43	0.27	2.00
MW-65-225	13-Jun-11	15,300	31.1	7.48	-36	0.33	0.88	20.0
	11-Jul-11	12,600	30.4	7.16	-52	0.38	0.72	1.00
	09-Aug-11	12,200	30.4	7.37	2.10	0.5	0.69	2.00
	07-Sep-11	13,900	30.7	7.24	-17	0.59	0.79	3.00
	17-Oct-11	13,700	30.5	7.23	43.1	0.63	0.79	5.00
	15-Nov-11	13,300	30.5	8.09	106	0.59	0.086	1.00
	15-Dec-11	13,200	30.3	7.25	71.0	0.81	0.86	2.00
	16-Feb-12	14,100	31.2	7.23	95.0	0.78	0.91	2.41
	02-May-12	12,800	30.2	7.68	109	0.67	0.82	1.00
	18-Sep-12	12,300	30.9	6.95	-69	0.9	0.79	1.00
	05-Dec-12	10,500	30.3	7.35	-16	1.40	0.68	2.00
	19-Feb-13	10,600	30.4	7.62	45.0	1.14	0.69	1.00
MW-66-165	13-Jun-11	4,620	31.1	7.32	28.2	5.38	0.24	75.0
	12-Jul-11	4,140	30.5	7.22	-10	3.08	0.22	10.0
	09-Aug-11	3,990	30.8	7.29	-8.5	4.20	0.21	10.0
	18-Oct-11	4,800	30.7	7.25	104	3.03	0.26	10.0
	15-Nov-11	4,680	30.3	8.08	105	2.52	0.3	7.00
	15-Dec-11	4,500	30.6	7.27	-33	2.64	0.29	4.00
	17-Feb-12	5,210	31.0	7.13	101	4.43	0.34	5.60
	02-May-12	4,500	30.2	7.67	48.4	4.70	0.29	2.00

TABLE 3-6

Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Field Water Quality Parameters

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location	Sample Date	Field Data						
		Specific Conductance (µS/cm)	Temperature (°C)	pH (pH units)	ORP (mV)	Dissolved Oxygen (mg/L)	Salinity (%)	Turbidity (NTU)
MW-66-165	17-Sep-12	3,940	30.5	7.16	10.9	5.05	0.25	1.00
	06-Dec-12	5,100	30.4	7.32	45.7	3.82	0.33	3.00
	20-Feb-13	4,530	30.3	7.15	106	5.24	0.29	2.00
MW-66-230	14-Jun-11	19,100	31.1	7.85	-52	0.09	1.12	3.00
	12-Jul-11	17,000	30.8	7.80	-87	0.15	0.99	2.00
	10-Aug-11	16,300	31.0	7.92	86.4	0.38	0.95	1.00
	19-Oct-11	18,900	31.0	7.94	84.2	0.09	1.11	2.00
	17-Nov-11	19,500	30.8	8.45	91.0	0.22	1.26	1.00
	15-Dec-11	19,000	30.8	7.86	-88	0.18	1.23	1.00
	22-Feb-12	21,100	30.8	7.86	141	0.14	1.37	1.24
	10-May-12	19,000	29.2	7.83	25.6	0.21	1.23	1.00
	17-Sep-12	18,900	30.7	7.95	-89	0.29	1.22	1.00
	10-Dec-12	19,800	30.6	8.02	-34	0.38	1.28	2.00
	21-Feb-13	20,200	30.6	7.88	149	0.37	1.31	1.97
MW-66BR-270	17-Nov-11	16,800	26.4	11.0	-1	---	1.09	15.0
	13-Dec-11	20,300	31.0	10.4	-150	0.0	1.31	116
	16-Feb-12	20,000	31.1	9.92	-330	-0.04	1.29	127
	02-Oct-12	16,900	31.6	10.6	-97	0.08	1.09	68.0
	20-Dec-12	19,000	32.9	9.75	42.2	0.26	1.23	134
	12-Mar-13	17,700	33.0	9.68	-210	0.03	1.15	81.0
MW-67-185	18-Oct-11	3,950	32.8	7.49	-23	2.59	0.21	2.00
	16-Nov-11	3,670	31.8	8.50	95.7	2.43	0.24	4.00
	14-Dec-11	3,800	32.2	7.41	-48	2.23	0.25	7.00
	21-Feb-12	4,730	33.3	7.12	150	3.74	0.31	4.00
	03-May-12	4,690	31.3	7.34	104	4.82	0.3	2.00
	20-Sep-12	4,470	32.5	7.42	39.8	4.01	0.29	1.00
	06-Dec-12	5,190	32.8	7.39	-56	2.11	0.34	5.00
	21-Feb-13	4,880	30.1	7.39	139	5.44	0.32	2.00
MW-67-225	14-Jun-11	7,800	31.5	7.71	-90	0.94	0.43	5.00
	12-Jul-11	7,090	31.4	7.60	-60	0.92	0.39	14.0
	09-Aug-11	6,910	31.7	7.67	-40	1.19	0.38	3.00
	08-Sep-11	8,060	32.0	7.51	-6.1	1.41	0.44	2.00
	19-Oct-11	8,110	31.3	7.60	89.0	1.38	0.45	2.00
	17-Nov-11	8,190	31.2	8.36	94.8	1.13	0.53	2.00
	14-Dec-11	8,880	31.0	7.49	91.0	1.76	0.57	1.00
	21-Feb-12	8,610	31.1	7.01	161	1.66	0.56	1.26
	07-May-12	7,800	30.0	7.54	99.6	1.44	0.5	0.44
	20-Sep-12	8,010	31.8	7.21	306	1.86	0.52	1.00
	10-Dec-12	7,860	31.1	7.51	-30	1.89	0.51	2.00
	21-Feb-13	7,940	31.0	7.35	144	2.11	0.51	0.4
MW-67-260	14-Jun-11	17,500	32.3	8.21	-170	0.1	1.02	9.00
	12-Jul-11	15,900	31.1	8.20	-97	0.12	0.92	2.00
	09-Aug-11	15,500	31.4	8.23	-93	0.14	0.9	20.0
	08-Sep-11	18,200	31.4	8.08	-100	0.04	1.06	2.00
	19-Oct-11	18,400	31.2	8.26	6.50	0.06	1.08	1.00
	17-Nov-11	18,700	31.1	8.76	89.4	0.21	1.21	1.00
	14-Dec-11	17,500	31.0	8.23	-130	0.17	1.13	1.00

TABLE 3-6

Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Field Water Quality Parameters

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location	Sample Date	Field Data						
		Specific Conductance (µS/cm)	Temperature (°C)	pH (pH units)	ORP (mV)	Dissolved Oxygen (mg/L)	Salinity (%)	Turbidity (NTU)
MW-67-260	21-Feb-12	20,100	31.6	8.15	-37	0.04	1.30	1.00
	07-May-12	17,800	29.6	8.19	65.0	0.23	1.15	1.00
	20-Sep-12	17,700	31.1	8.50	-140	0.03	1.14	1.00
	06-Dec-12	20,200	30.9	8.31	-100	0.11	1.31	2.00
	21-Feb-13	18,700	31.0	8.12	173	0.85	1.21	7.00
MW-68-180	14-Jun-11	2,760	33.9	7.95	-34	1.23	0.14	170
	12-Jul-11	2,520	33.1	7.73	-39	2.28	0.13	20.0
	08-Sep-11	4,350	32.8	7.47	48.1	3.56	0.23	9.00
	18-Oct-11	4,780	32.5	7.46	83.7	5.09	0.25	8.00
	17-Nov-11	4,660	32.4	8.30	105	3.66	0.3	9.00
	15-Dec-11	4,490	31.5	7.48	-25	2.30	0.29	28.0
	22-Feb-12	4,470	31.7	7.46	175	5.85	0.29	39.3
	10-May-12	3,200	30.6	7.37	76.3	5.56	0.21	4.00
	20-Sep-12	4,080	33.1	7.33	370	5.31	0.26	6.00
	11-Dec-12	4,470	32.2	7.44	45.1	3.98	0.29	7.00
	21-Feb-13	4,100	32.0	7.36	140	5.52	0.26	9.00
MW-68-240	14-Jun-11	14,300	31.7	7.53	60.1	0.3	0.82	122
	12-Jul-11	13,400	30.8	7.42	-59	0.17	0.76	1.60
	07-Sep-11	16,300	31.6	7.38	-28	0.05	0.94	1.00
	18-Oct-11	17,000	31.2	7.38	95.1	0.06	0.99	1.00
	16-Nov-11	14,900	30.9	8.92	67.3	0.13	0.96	1.00
	14-Dec-11	15,500	30.8	7.40	-69	0.16	1.00	1.00
	17-Feb-12	18,400	31.7	7.29	50.0	0.0	1.19	0.84
	03-May-12	16,900	29.5	7.34	86.5	0.11	1.09	0.3
	20-Sep-12	16,600	30.9	7.48	110 R	0.05	1.08	1.00
	06-Dec-12	18,700	30.8	7.45	-110	0.14	1.21	2.00
	20-Feb-13	16,400	30.8	7.24	141	0.04	1.06	12.0
MW-68BR-280	08-Sep-11	20,600	32.0	7.93	-160	0.37	1.22	13.0
	21-Oct-11	19,400	30.7	7.69	85.0	2.09	1.14	143
	16-Nov-11	20,200	27.9	7.73	75.1	0.58	1.30	11.0
	14-Dec-11	22,800	27.6	7.99	-130	1.71	1.48	33.0
	14-Feb-12	22,000	26.5	8.28	-110	1.84	1.42	6.04
	09-May-12	20,800	31.1	8.52	-130	1.63	1.35	2.00
	03-Oct-12	20,600	31.5	8.24	-140	1.80	1.33	1.30
	12-Nov-12	20,500	28.7	8.29	-120	1.68	1.32	3.00
	18-Feb-13	20,000	26.7	8.51	-36	1.91	1.29	2.00
MW-69-195	11-Jul-11	3,120	32.5	7.26	-84	1.85	0.16	2.40
	09-Aug-11	3,150	31.9	7.33	-3.9	3.04	0.16	2.00
	07-Sep-11	3,800	33.0	7.22	4.10	3.43	0.2	3.00
	18-Oct-11	4,080	31.7	7.19	153	3.33	0.21	2.00
	15-Nov-11	4,090	31.7	8.10	108	2.33	0.26	2.00
	14-Dec-11	4,330	31.3	7.26	78.0	4.36	0.28	2.00
	17-Feb-12	4,080	31.5	7.09	128	4.54	0.26	1.50
	02-May-12	3,680	31.3	7.65	71.1	4.29	0.24	3.00
	19-Sep-12	3,910	32.6	7.07	76.2	3.68	0.25	1.00
	05-Dec-12	4,170	31.8	7.32	-47	2.36	0.27	3.00
	20-Feb-13	3,770	30.9	7.13	126	4.04	0.24	1.00

TABLE 3-6

Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Field Water Quality Parameters

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location	Sample Date	Field Data						
		Specific Conductance (µS/cm)	Temperature (°C)	pH (pH units)	ORP (mV)	Dissolved Oxygen (mg/L)	Salinity (%)	Turbidity (NTU)
MW-70-105	13-Jun-11	2,170	31.9	8.19	-230	0.12	0.11	61.0
	11-Jul-11	2,070	30.6	8.03	-160	0.21	0.11	2.10
	08-Aug-11	2,610	29.9	7.99	-150	0.67	0.13	5.00
	06-Sep-11	2,710	30.4	8.14	-200	0.15	0.14	2.00
	14-Nov-11	2,990	29.6	8.34	50.2	0.35	0.19	2.00
	12-Dec-11	3,290	30.0	7.87	-110	0.24	0.21	6.00
	16-Feb-12	3,480	30.6	7.85	-180	0.08	0.22	5.10
	01-May-12	3,110	30.1	7.92	-30	---	0.2	1.00
	12-Sep-12	3,340	31.0	7.92	-150	0.23	0.22	2.00
	04-Dec-12	3,740	29.5	7.97	18.0	0.3	0.24	8.00
	19-Feb-13	3,500	29.4	8.36	-130	1.18	0.23	4.00
MW-70BR-225	16-Nov-11	12,300	29.9	8.81	75.8	0.24	0.8	2.00
	15-Dec-11	15,000	29.9	7.41	98.0	0.0	0.97	1.00
	16-Feb-12	15,100	30.0	7.33	81.0	-0.01	0.98	4.10
	17-May-12	14,100	29.2	7.44	42.0	0.08	0.91	3.00
	18-Sep-12	14,900	30.5	7.18	42.2	0.05	0.96	1.00
	13-Dec-12	14,200	29.9	7.43	-39	0.05	0.92	1.00
	26-Feb-13	14,700	30.0	7.65	141	0.05	0.95	0.71
MW-71-035	15-Nov-11	7,920	26.6	7.37	88.3	4.52	0.51	---
	14-Dec-11	7,980	27.8	7.09	191	2.80	0.52	63.0
	15-Feb-12	7,940	27.6	7.65	114	5.76	0.51	55.8
	03-May-12	8,240	28.1	7.51	21.1	---	0.53	804
	19-Sep-12	8,510	27.8	7.11	116	---	0.55	---
	08-Nov-12	8,600	28.7	7.42	186	---	0.56	---
	07-Feb-13	8,360	26.7	7.05	226	5.72	0.54	252
MW-72-080	06-Sep-11	8,030	28.4	7.83	-49	1.13	0.7	9.00
	17-Oct-11	15,900	28.3	7.67	-31	0.74	0.92	4.00
	14-Nov-11	16,600	27.4	8.22	54.4	0.83	1.07	3.00
	15-Dec-11	16,800	27.3	7.74	-55	0.9	1.09	4.00
	13-Feb-12	16,900	28.8	7.76	-25	0.66	1.10	0.66
	01-May-12	16,100	27.6	7.68	-26	0.21	1.04	1.00
	19-Sep-12	15,500	28.2	7.74	36.5	0.94	1.00	8.00
	05-Dec-12	17,400	28.1	7.82	89.1	0.98	1.12	5.00
	19-Feb-13	16,600	27.0	8.21	-46	0.74	1.07	3.00
MW-72BR-200	13-Sep-12	14,500	28.0	8.66	-200	0.01	0.94	1.00
	14-Nov-12	15,700	27.7	8.26	-99	0.02	1.01	2.00
	07-Feb-13	14,500	27.6	8.33	35.2	0.01	0.93	7.00
MW-73-080	15-Nov-11	9,580	28.2	7.83	69.8	2.99	0.62	9.00
	14-Dec-11	9,870	28.6	12.5 R	12.4	1.65	5.52	---
	14-Feb-12	10,800	28.2	7.28	-18	1.05	0.7	5.01
	02-May-12	10,100	26.7	7.23	15.4	---	0.66	9.00
	13-Sep-12	10,100	27.9	7.27	-15	2.78	0.65	---
	05-Dec-12	11,500	26.2	7.23	47.3	3.86	0.74	3.00
	19-Feb-13	17,000	27.1	8.95	40.0	4.00	1.10	66.2
MW-74-240	17-Feb-12	1,390	27.4	9.77 R	-250	---	0.09	10.5
	10-May-12	1,250	27.5	9.71	-240	0.08	0.081	7.00
	27-Sep-12	1,200	31.2	9.57	-210	0.1	0.077	15.4

TABLE 3-6

Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Field Water Quality Parameters

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location	Sample Date	Field Data						
		Specific Conductance (µS/cm)	Temperature (°C)	pH (pH units)	ORP (mV)	Dissolved Oxygen (mg/L)	Salinity (%)	Turbidity (NTU)
MW-74-240	20-Dec-12	850	24.2	8.96	-12	0.15	0.055	40.0
	01-Mar-13	1,050	25.7	9.06	-41	0.28	0.068	13.0

Notes:

-- = not analyzed

°C = degree centigrade

% = percentage

FD = field duplicate

mg/L = milligrams per liter

mV = millivolts

ND = not detected at listed reporting limit

NTU = Nephelometric Turbidity Unit

ORP = oxidation reduction potential, results rounded off to whole point

µS/cm = microSiemens per centimeter

TABLE 3-7

Average Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Field Water Quality Parameters

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location		Field Data													
		Dissolved Oxygen		ORP		pH		Salinity		Specific Conductance		Temperature		Turbidity	
		mg/L		mV		pH units		%		µS/cm		°C		NTU	
MW-23-060	Min	3.72	1.94	34.3	-77	9.72	9.43	1.03	0.11	16,600	10,700	30.9	26.8	7.89	1.00
	Max		6.07		146		10.0		1.24		19,200		34.1		30.0
	Total Count		17		15		2		11		17		17		17
MW-23-080	Min	1.52	0.25	-43	-170	9.90	7.60	1.05	0.11	17,600	16,000	30.9	28.4	2.71	1.00
	Max		4.99		87.9		11.1		1.26		19,400		32.8		11.0
	Total Count		17		14		4		11		17		17		17
MW-57-050	Min	---	---	---	---	7.40	7.40	---	---	1,900	1,900	---	---	---	---
	Max		---		---		7.40		---		1,900		---		---
	Total Count		---		---		1		---		1		---		---
MW-57-070	Min	3.12	0.65	80.2	-94	7.08	6.42	0.33	0.13	2,510	1,250	30.9	28.2	14.2	2.00
	Max		5.99		287		7.41		1.51		3,270		34.1		42.8
	Total Count		20		19		20		14		20		20		18
MW-57-185	Min	0.11	-0.03	-42	-190	8.61	8.15	1.92	0.12	19,100	16,600	29.7	28.7	3.62	1.00
	Max		0.44		194		9.45		11.3		21,000		30.0		12.0
	Total Count		17		15		16		13		17		17		17
MW-58-065	Min	---	---	---	---	8.00	8.00	---	---	737	737	---	---	---	---
	Max		---		---		8.00		---		737		---		---
	Total Count		---		---		1		---		1		---		---
MW-58BR Packer * (Deeper) Lower Zone	Min	0.16	0.04	-12	-91	7.84	7.24	0.65	0.52	10,200	8,060	29.0	22.2	3.28	0.8
	Max		0.47		120		8.42		0.76		11,700		36.2		19.0
	Total Count		10		11		11		9		11		11		11
MW-58BR Packer * (Deeper) Upper Zone	Min	0.28	0.05	-130	-190	7.60	7.00	0.72	0.62	11,200	9,630	29.1	25.9	2.03	0.8
	Max		1.10		-110		8.43		0.83		12,800		34.2		5.80
	Total Count		11		11		11		9		11		11		11
MW-59-100	Min	5.46	2.70	135	1.80	6.92	6.63	0.77	0.61	11,600	9,460	30.2	28.7	7.11	1.00
	Max		7.38		306		7.16		1.58		25,600		31.3		27.0
	Total Count		19		19		19		11		19		19		19
MW-60-125	Min	2.33	1.01	39.1	-140	7.41	7.24	0.6	0.53	9,230	6,220	31.6	28.0	26.4	2.00
	Max		3.80		209		7.58		0.88		15,500		33.9		203
	Total Count		18		19		19		12		19		19		19
MW-60BR-245	Min	0.65	0.08	-59	-310	8.84	8.04	1.09	0.5	18,000	16,200	29.9	28.1	5.87	1.80
	Max		2.29		124		9.62		1.24		19,100		32.1		16.0
	Total Count		9		10		10		10		9		10		10
MW-61-110	Min	0.26	0.02	-3.4	-120	7.41	7.13	1.0	0.098	16,600	15,100	30.2	28.2	7.42	1.00
	Max		0.45		113		7.73		1.20		20,000		33.4		69.0
	Total Count		18		18		18		12		18		18		18
MW-62-065	Min	2.41	1.10	64.7	-28	7.41	7.28	0.41	0.37	6,390	5,760	30.5	28.2	4.45	0.91
	Max		3.80		148		7.79		0.45		7,410		34.0		19.0
	Total Count		17		16		17		12		18		18		18
MW-62-110	Min	0.34	0.04	7.30	-130	7.70	6.61	0.57	0.5	8,980	7,720	27.7	26.5	1.93	0.4
	Max		1.32		190		8.09		0.63		9,740		29.4		4.81
	Total Count		17		18		19		11		19		19		19
MW-62-190	Min	0.26	0.01	-110	-310	7.77	7.54	1.23	0.99	18,900	15,400	27.7	26.6	2.66	0.3
	Max		1.11		135		8.02		1.80		28,800		29.5		18.0
	Total Count		19		19		19		11		19		19		19

TABLE 3-7

Average Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Field Water Quality Parameters

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location		Field Data													
		Dissolved Oxygen		ORP		pH		Salinity		Specific Conductance		Temperature		Turbidity	
		mg/L		mV		pH units		%		µS/cm		°C		NTU	
MW-63-065	Min		0.62		-120		6.49		0.42		6,650		25.8		2.00
	Max	**1.59**	6.29	**56.0**	308	**7.15**	8.04	**0.48**	0.61	**7,630**	10,900	**27.3**	29.2	**50.1**	480
	Total Count		18		18		18		13		18		18		16
MW-64BR Packer * Lower Zone	Min		0.06		-180		7.61		0.98		15,200		24.8		0.7
	Max	**1.31**	2.38	**-11**	104	**7.88**	8.24	**1.07**	1.13	**16,600**	17,500	**28.0**	33.0	**1.40**	2.90
	Total Count		11		10		11		10		11		11		11
MW-64BR Packer * Upper Zone	Min		0.04		-260		6.98		0.74		11,400		21.4		0.9
	Max	**0.34**	1.62	**-94**	88.0	**7.77**	8.24	**0.78**	0.9	**12,100**	14,000	**28.2**	37.8	**8.22**	58.0
	Total Count		11		11		11		10		11		11		11
MW-65-160	Min		0.19		-130		7.16		0.19		3,680		30.9		1.00
	Max	**0.41**	1.00	**11.7**	233	**7.54**	8.35	**0.26**	0.31	**4,280**	4,850	**31.6**	33.0	**2.75**	6.00
	Total Count		12		13		13		13		13		13		13
MW-65-225	Min		0.33		-69		6.95		0.086		10,500		30.2		1.00
	Max	**0.75**	1.40	**40.7**	249	**7.37**	8.09	**0.73**	0.91	**12,800**	15,300	**30.5**	31.1	**3.26**	20.0
	Total Count		13		13		13		13		13		13		13
MW-66-165	Min		2.52		-33		7.13		0.21		3,940		30.2		1.00
	Max	**4.15**	5.72	**60.9**	233	**7.33**	8.08	**0.28**	0.34	**4,570**	5,210	**30.6**	31.1	**11.0**	75.0
	Total Count		12		12		12		12		12		12		12
MW-66-230	Min		0.09		-89		7.80		0.95		16,300		29.2		1.00
	Max	**0.25**	0.5	**37.1**	219	**7.93**	8.45	**1.20**	1.37	**19,100**	21,100	**30.7**	31.1	**1.52**	3.00
	Total Count		12		12		12		12		12		12		12
MW-66BR-270	Min		-0.04		-330		9.68		1.09		16,800		26.4		15.0
	Max	**0.066**	0.26	**-120**	42.2	**10.2**	11.0	**1.19**	1.31	**18,500**	20,300	**31.0**	33.0	**90.2**	134
	Total Count		5		6		6		6		6		6		6
MW-67-185	Min		2.11		-56		7.12		0.21		3,670		30.1		1.00
	Max	**3.65**	5.47	**76.8**	289	**7.47**	8.50	**0.29**	0.35	**4,530**	5,380	**32.1**	33.3	**3.11**	7.00
	Total Count		9		9		9		9		9		9		9
MW-67-225	Min		0.92		-90		7.01		0.38		6,910		30.0		0.4
	Max	**1.51**	2.11	**70.3**	306	**7.54**	8.36	**0.48**	0.57	**7,930**	8,880	**31.2**	32.0	**2.70**	14.0
	Total Count		13		13		13		13		13		13		13
MW-67-260	Min		0.03		-170		8.08		0.9		15,500		29.6		1.00
	Max	**0.17**	0.85	**-31**	173	**8.26**	8.76	**1.12**	1.31	**18,000**	20,200	**31.1**	32.3	**3.85**	20.0
	Total Count		13		13		13		13		13		13		13
MW-68-180	Min		1.23		-39		6.74		0.13		2,520		30.6		4.00
	Max	**4.22**	6.35	**84.1**	370	**7.51**	8.30	**0.24**	0.3	**3,930**	4,780	**32.4**	33.8	**27.6**	170
	Total Count		12		12		12		12		12		12		12
MW-68-240	Min		ND		-110		7.24		0.76		13,400		29.5		0.3
	Max	**0.11**	0.3	**27.6**	141	**7.51**	8.92	**1.02**	1.21	**16,300**	18,700	**31.0**	31.7	**12.1**	122
	Total Count		12		11		12		12		12		12		12
MW-68BR-280	Min		0.37		-160		7.69		1.14		19,400		26.5		1.00
	Max	**1.52**	2.09	**-72**	85.0	**8.17**	8.54	**1.33**	1.48	**20,900**	22,800	**29.2**	32.0	**21.5**	143
	Total Count		10		10		10		10		10		10		10

TABLE 3-7

Average Groundwater Analytical Results for ER-TCS Area Groundwater Investigation Monitoring Wells, Field Water Quality Parameters

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station Needles, California

Location		Field Data													
		Dissolved Oxygen		ORP		pH		Salinity		Specific Conductance		Temperature		Turbidity	
		mg/L		mV		pH units		%		µS/cm		°C		NTU	
MW-69-195	**Min**		1.85		-84		6.85		0.16		3,120		30.9		1.00
	Max	**3.45**	4.54	**70.2**	234	**7.29**	8.10	**0.23**	0.28	**3,840**	4,330	**31.8**	33.0	**1.99**	3.00
	Total Count		12		12		12		12		12		12		12
MW-70-105	**Min**		0.08		-230		7.80		0.11		2,070		29.3		1.00
	Max	**0.41**	1.18	**-100**	50.2	**8.03**	8.36	**0.19**	0.24	**3,050**	3,740	**30.2**	31.9	**8.35**	61.0
	Total Count		11		12		12		12		12		12		12
MW-70BR-225	**Min**		-0.01		-39		7.18		0.8		12,300		29.2		0.71
	Max	**0.061**	0.24	**75.9**	166	**7.57**	8.81	**0.93**	0.98	**14,300**	15,100	**29.9**	30.5	**1.73**	4.10
	Total Count		8		8		8		8		8		8		8
MW-71-035	**Min**		2.80		21.1		7.05		0.51		7,920		26.6		55.8
	Max	**4.60**	5.76	**146**	226	**7.31**	7.65	**0.54**	0.6	**8,360**	9,310	**27.7**	28.7	**294**	804
	Total Count		5		8		8		8		8		8		4
MW-72-080	**Min**		0.21		-55		7.67		0.7		8,030		27.0		0.66
	Max	**0.8**	1.13	**7.93**	132	**7.84**	8.22	**1.02**	1.12	**15,700**	17,400	**27.8**	28.8	**4.17**	9.00
	Total Count		10		10		10		10		10		10		10
MW-72BR-200	**Min**		0.01		-200		8.22		0.93		14,500		27.6		1.00
	Max	**0.027**	0.07	**-45**	86.0	**8.37**	8.66	**1.00**	1.13	**15,600**	17,500	**28.7**	31.3	**2.75**	7.00
	Total Count		4		4		4		4		4		4		4
MW-73-080	**Min**		1.05		-18		7.23		0.62		9,580		26.2		3.00
	Max	**3.26**	6.48	**53.0**	271	**7.60**	8.95	**1.34**	5.52	**11,300**	17,000	**27.5**	28.6	**16.4**	66.2
	Total Count		7		8		7		8		8		8		6
MW-74-240	**Min**		0.08		-250		8.68		0.055		850		24.2		6.00
	Max	**0.15**	0.28	**-130**	-12	**9.20**	9.71	**0.072**	0.09	**1,120**	1,390	**27.4**	31.2	**15.3**	40.0
	Total Count		5		6		5		6		6		6		6

Notes:

When calculating averages, zero was used for non-detect results.

* Monitoring wells MW-58BR and MW-64BR have used multiple monitoring configurations throughout the East Ravine investigation (see well construction information).

Average, minimum, and maximum values shown are for the most recent, depth-specific monitoring well configuration, which is the most comprehensive data set of all past monitoring configurations.

See Table 3-6 for results from other configurations.

-- = not analyzed

°C = degree centigrade

% = percentage

mg/L = milligrams per liter

mV = millivolts

ND = not detected at listed reporting limit

NTU = Nephelometric Turbidity Unit

ORP = oxidation reduction potential, results rounded off to whole point

µS/cm = microSiemens per centimeter

Figures

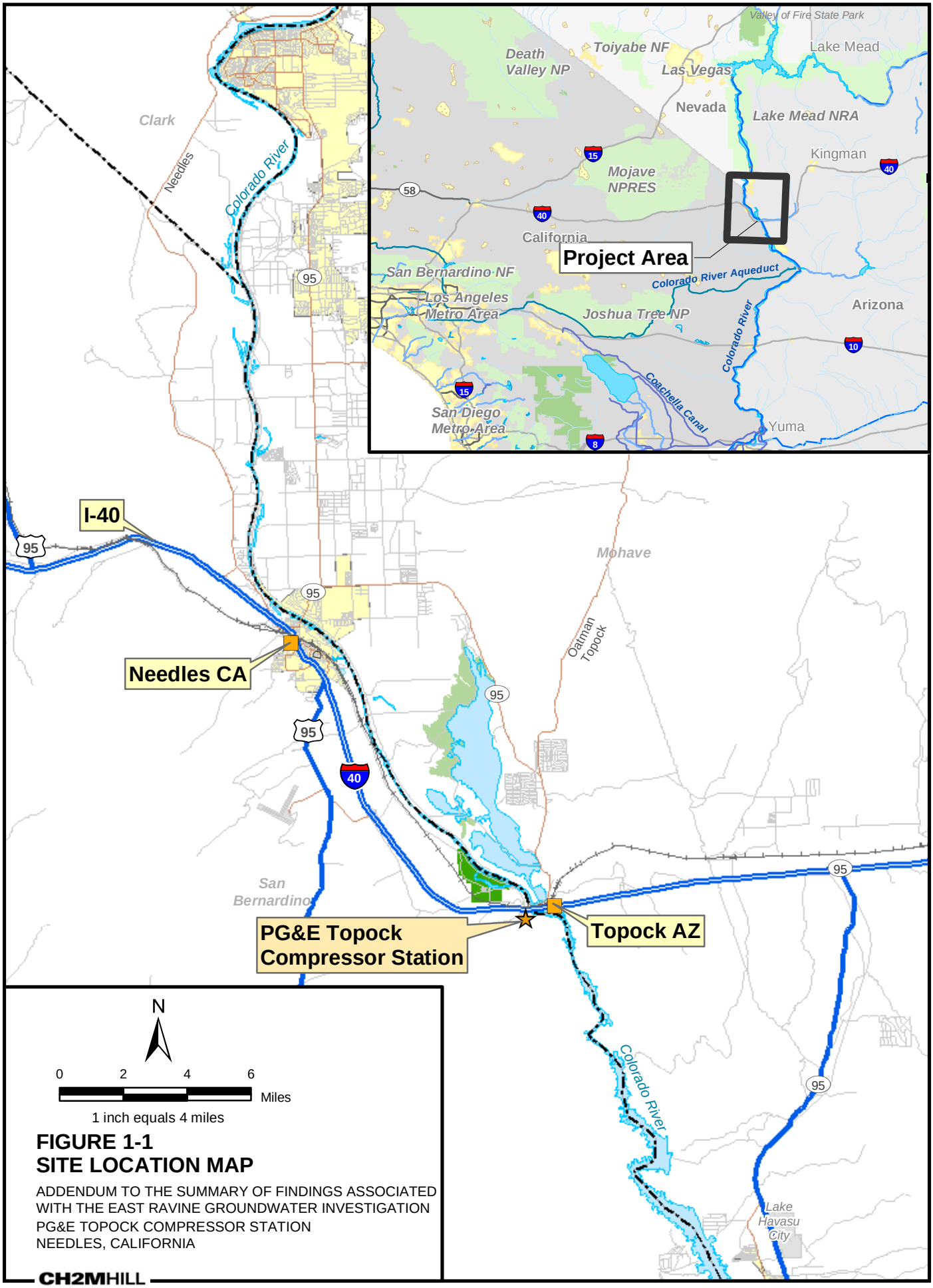


FIGURE 1-1
SITE LOCATION MAP

ADDENDUM TO THE SUMMARY OF FINDINGS ASSOCIATED WITH THE EAST RAVINE GROUNDWATER INVESTIGATION
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

CH2MHILL

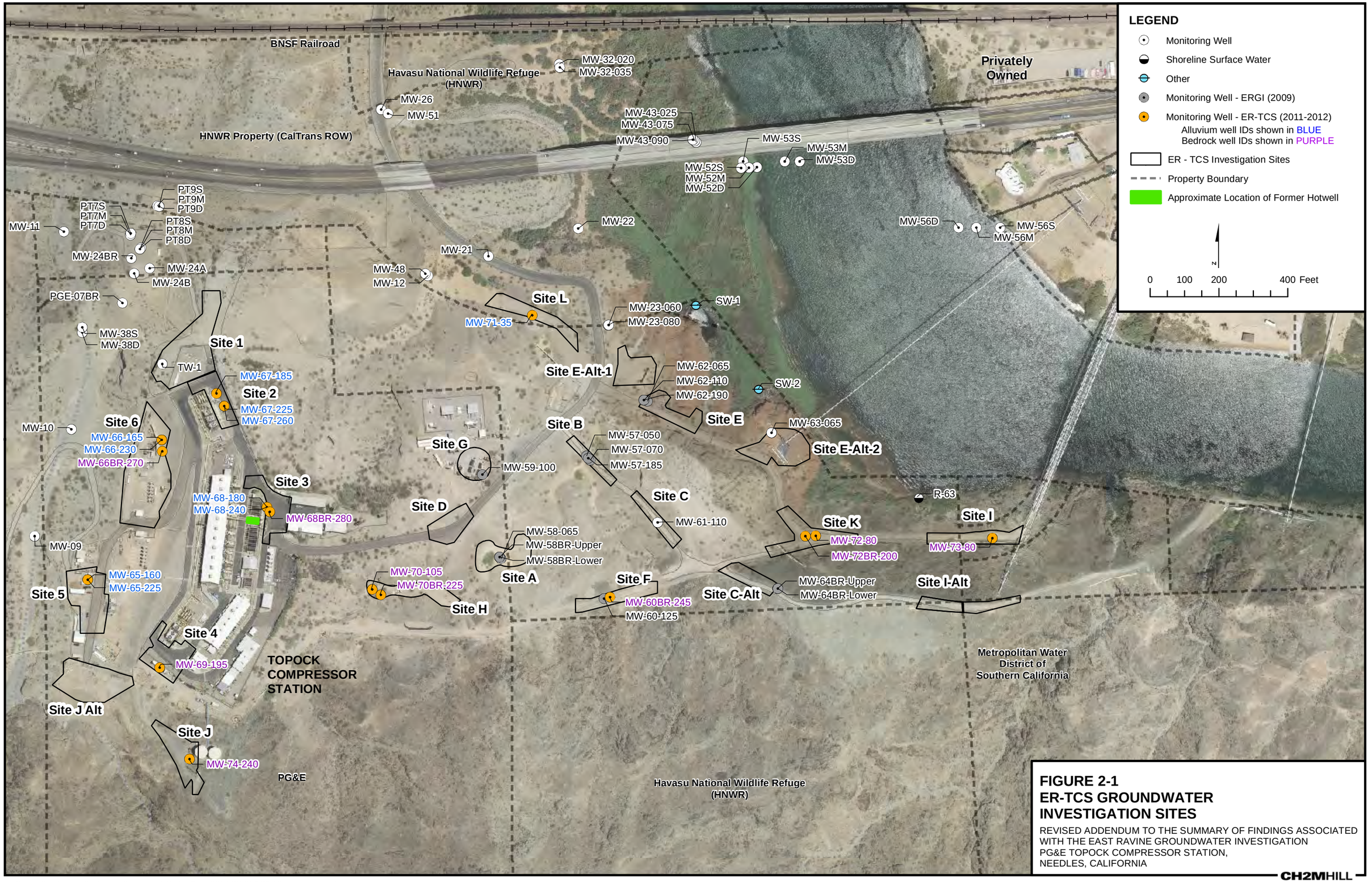


FIGURE 2-1
ER-TCS GROUNDWATER INVESTIGATION SITES

REVISED ADDENDUM TO THE SUMMARY OF FINDINGS ASSOCIATED WITH THE EAST RAVINE GROUNDWATER INVESTIGATION
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL

Path: \\zinfandel\proj\PacificGasElectricCo\TopockProgram\GIS\MapFiles\2014\ERGI\ERTCS_InvestigationSites.mxd

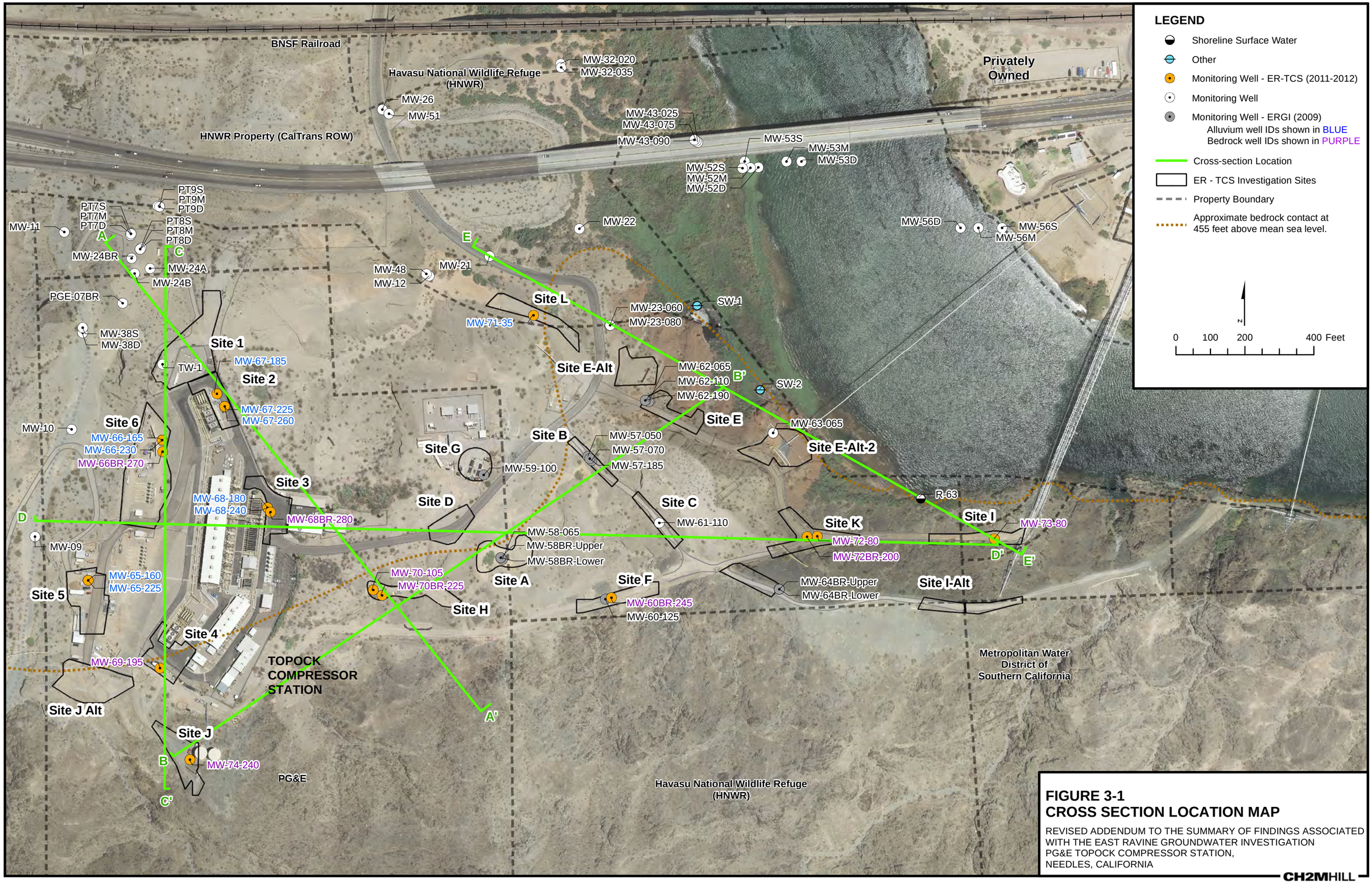
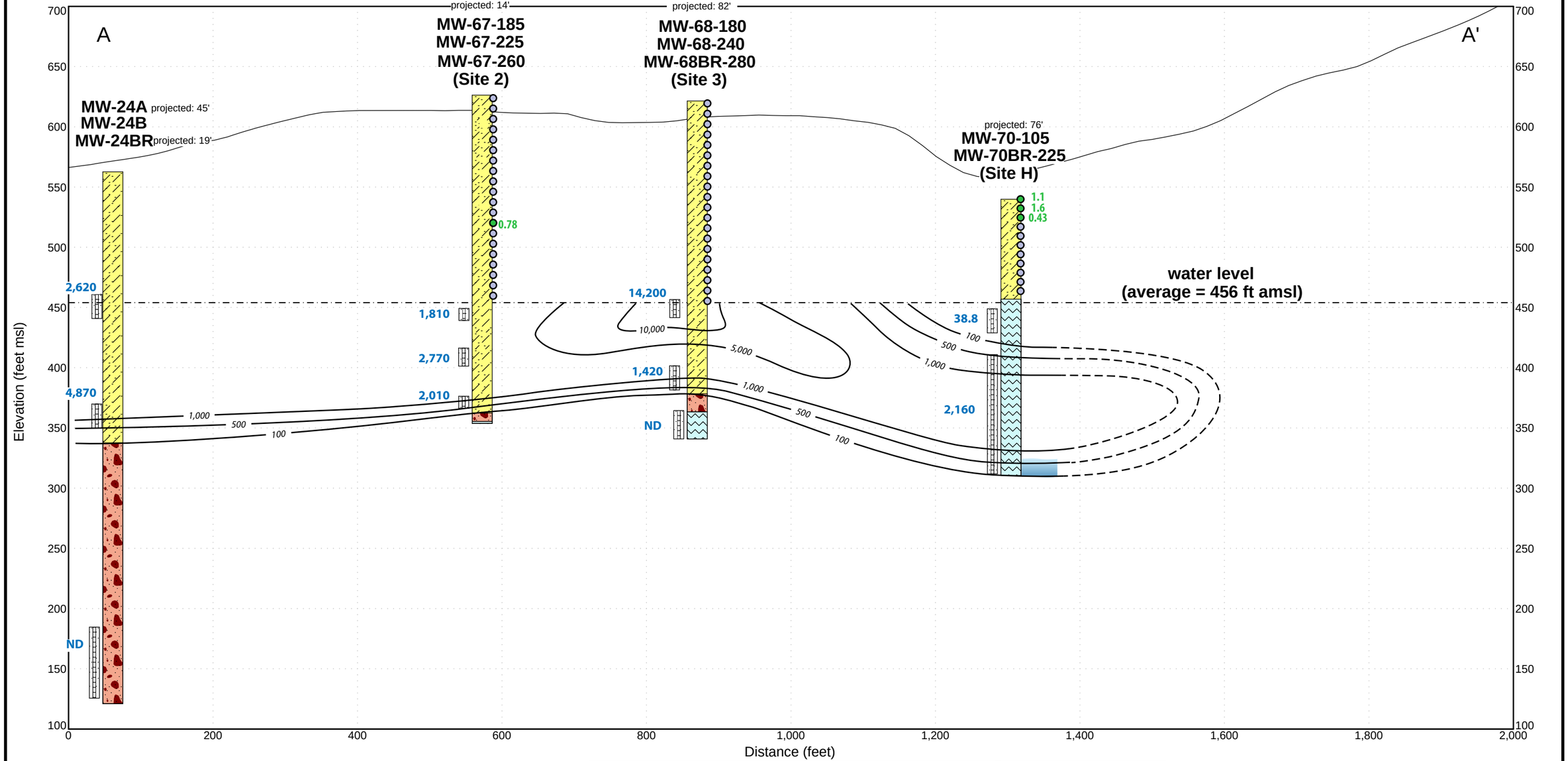


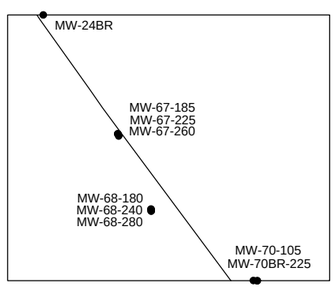
FIGURE 3-1
CROSS SECTION LOCATION MAP

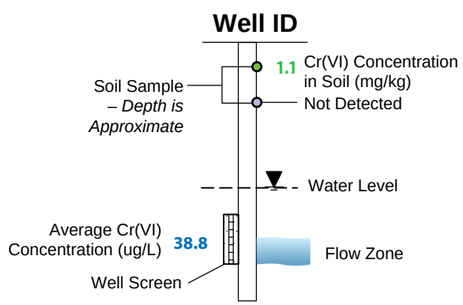
REVISED ADDENDUM TO THE SUMMARY OF FINDINGS ASSOCIATED WITH THE EAST RAVINE GROUNDWATER INVESTIGATION
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL

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ND – Not Detected
ug/L – micrograms per liter
mg/kg – milligrams per kilogram
ft amsl – feet above mean sea level

Notes:
1. Inferred isoconcentration lines are provided at agency request to assist with conceptual data interpretation. These lines are not intended to represent the actual plume distribution for reasons including that concentrations contoured represent calculated average concentrations, do not incorporate any bedrock fracture complexities, and that most wells are projected onto the section.
2. Well clusters shown as single boring
3. Flow zones identified are based on the results of flow profiling within the given borehole. Groundwater flow directions flow within the fractured bedrock cannot be inferred from borehole to borehole given the nature of the fracture network.

LITHOLOGY

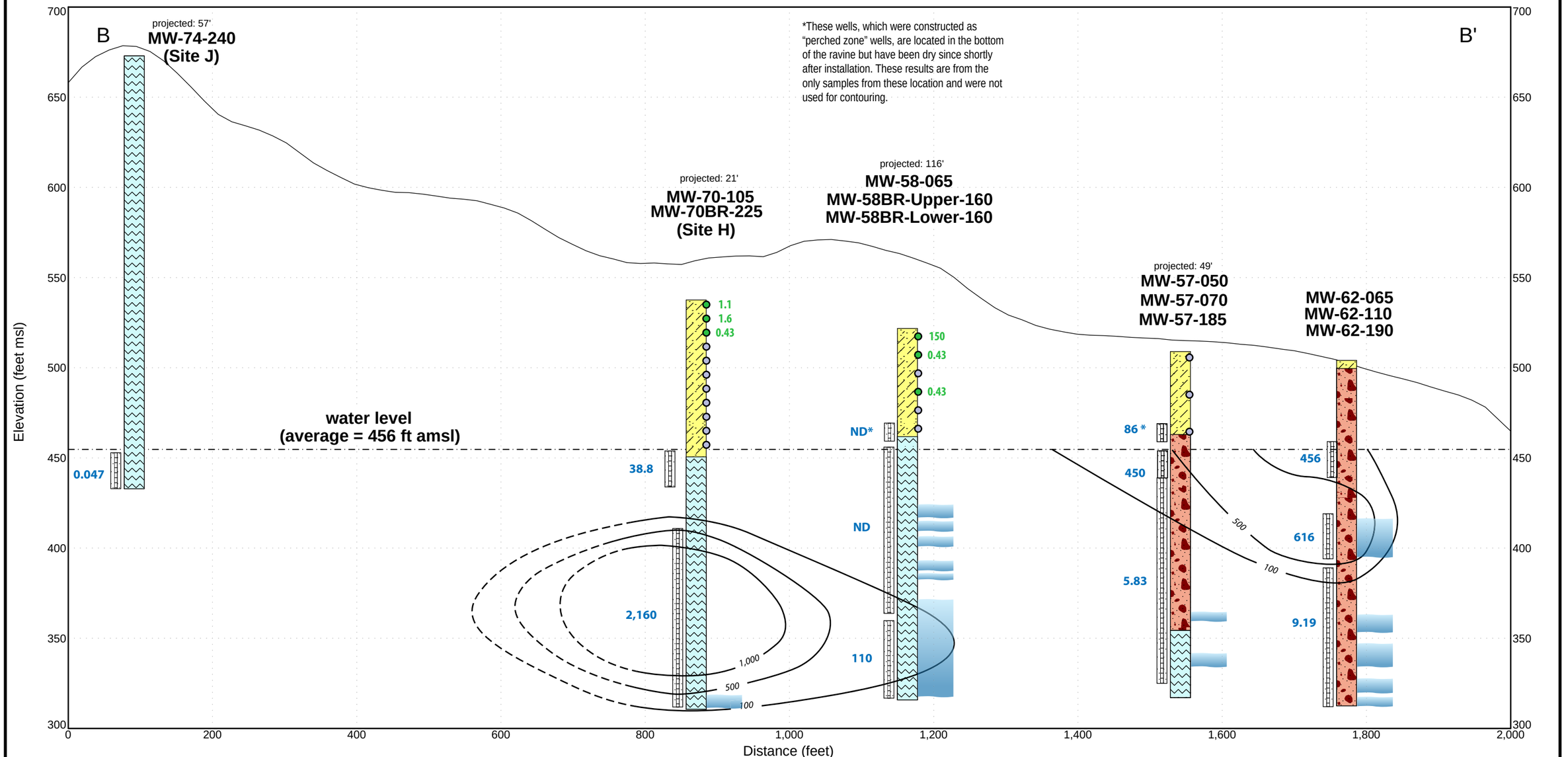
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- **Miocene Conglomerate**
- **Metadiorite**
- 100 **Cr(VI) Isoconcentration Line (Inferred)**

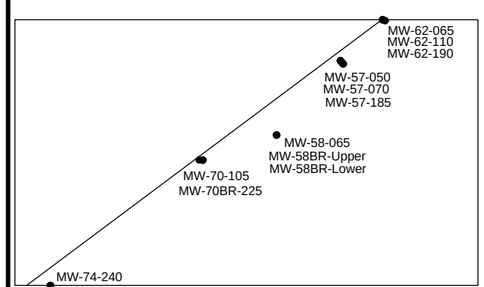
Figure 3-2

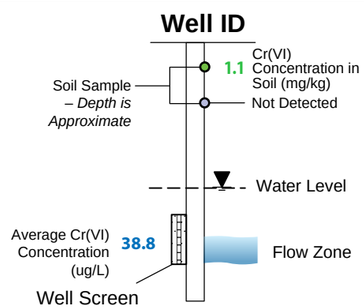
Cross Section A-A'

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation, PG&E Topock Compressor Station, Needles, California

\\ZINFANDEL\Proj\PacificGasElectricCo\TopockProgram\gINT\Input\gINT_Work_File_Types\gpj\topock_alg.GPJ;
ES052113153457SAC cross_section_A-A_v3.ai 082014_lho







ND – Not Detected
ug/L – micrograms per liter
mg/kg – milligrams per kilogram
ft amsl – feet above mean sea level

Notes:
1. Inferred isoconcentration lines are provided at agency request to assist with conceptual data interpretation. These lines are not intended to represent the actual plume distribution for reasons including that concentrations contoured represent calculated average concentrations, do not incorporate any bedrock fracture complexities, and that most wells are projected onto the section.
2. Well clusters shown as single boring
3. Flow zones identified are based on the results of flow profiling within the given borehole. Groundwater flow directions flow within the fractured bedrock cannot be inferred from borehole to borehole given the nature of the fracture network.

LITHOLOGY

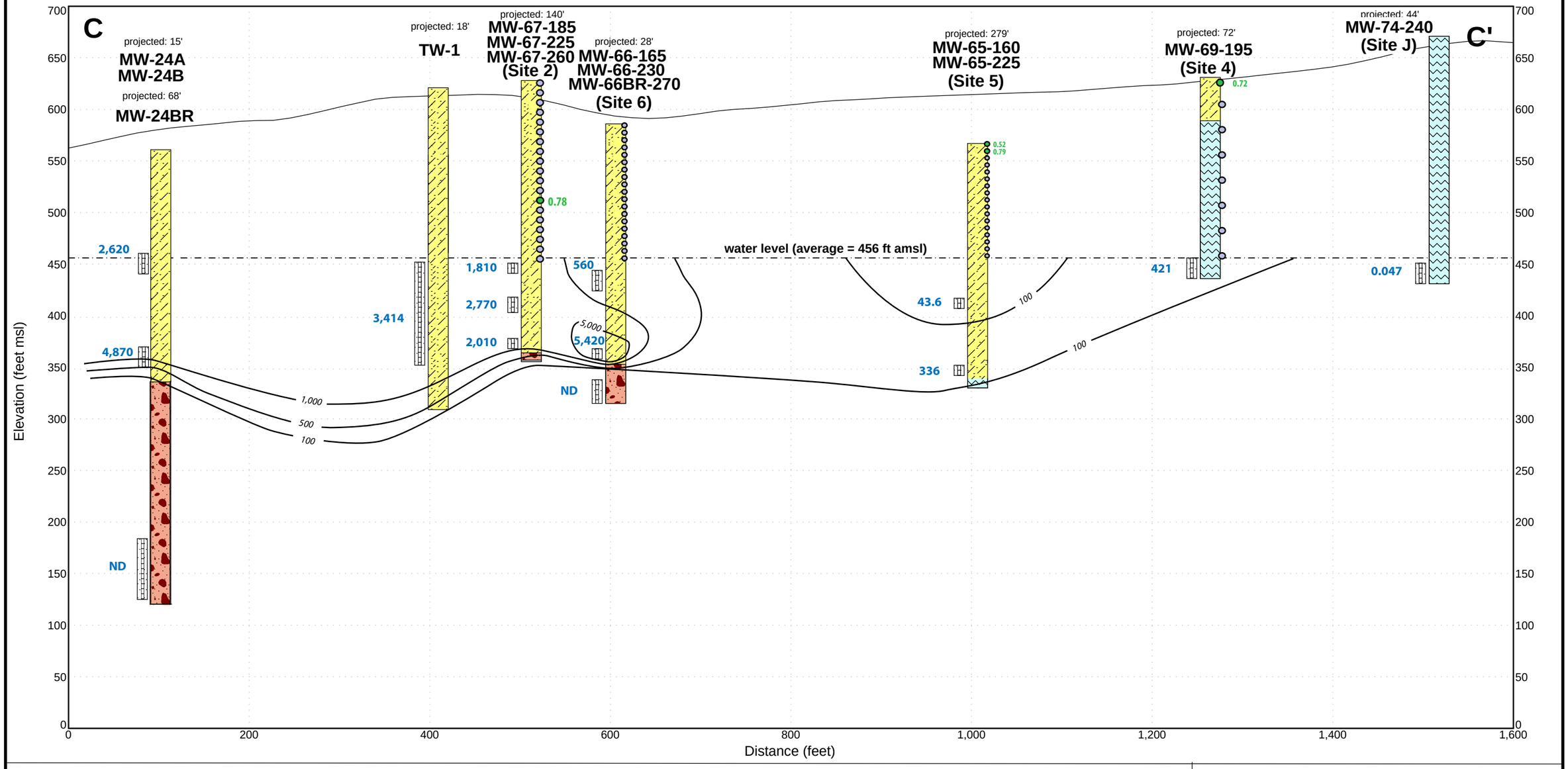
- **Alluvium**
- **Miocene Conglomerate**
- **Metadiorite**
- 100 **Cr(VI) Isoconcentration Line (Inferred)**

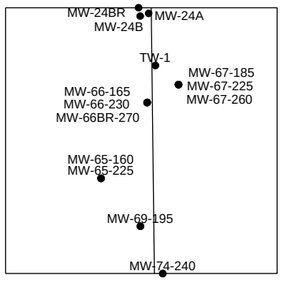
Figure 3-3

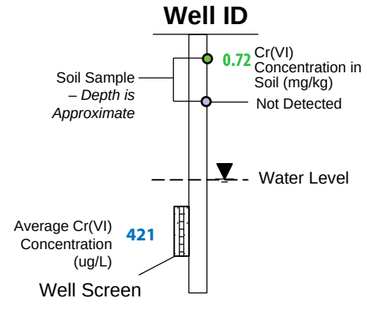
Cross Section B-B'

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation, PG&E Topock Compressor Station, Needles, California

\\ZINFANDEL\Proj\PacificGasElectricCo\TopockProgram\gINT\Input\gINT_Work_File_Types\gpj\topock_alg.GPJ;
ES052113153457SAC cross_section_B-B_v3.ai 082014_lho







ND – Not Detected
ug/L – micrograms per liter
mg/kg – milligrams per kilogram
ft amsl – feet above mean sea level

Notes:
1. Inferred isoconcentration lines are provided at agency request to assist with conceptual data interpretation. These lines are not intended to represent the actual plume distribution for reasons including that concentrations contoured represent calculated average concentrations, do not incorporate any bedrock fracture complexities, and that most wells are projected onto the section.

2. Well clusters shown as single boring.

LITHOLOGY

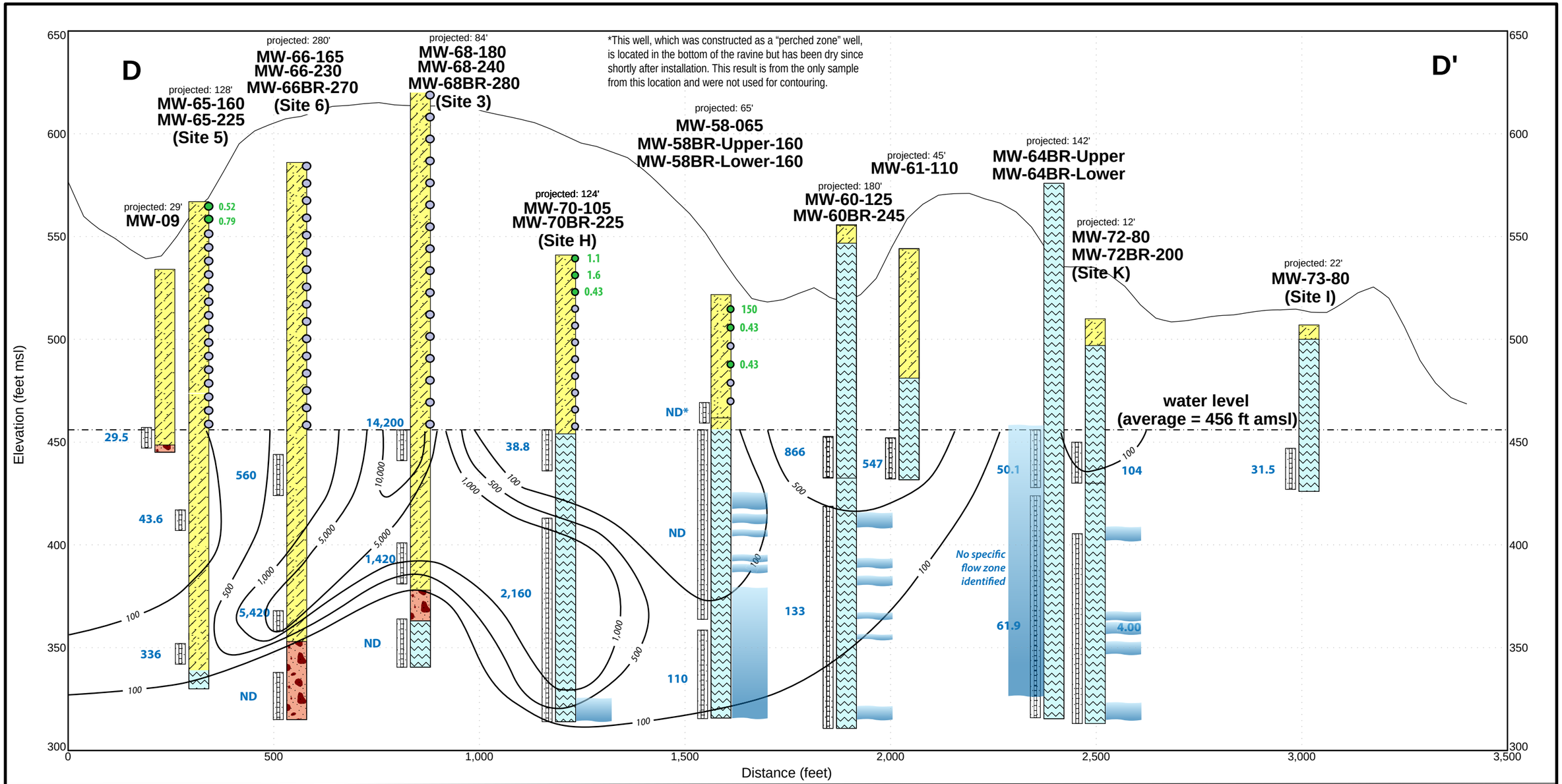
- **Alluvium**
- **Miocene Conglomerate**
- **Metadiorite**
- 100 **Cr(VI) Isoconcentration Line (Inferred)**

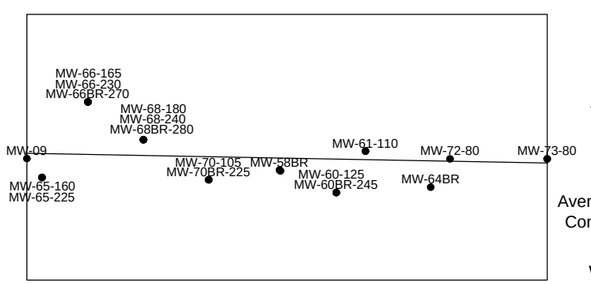
Figure 3-4

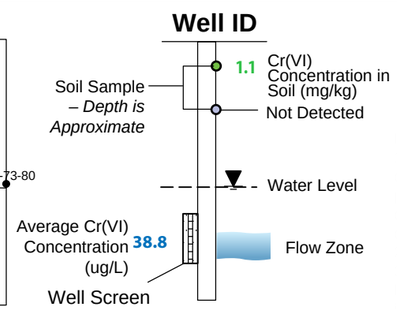
Cross Section C-C'

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation, PG&E Topock Compressor Station, Needles, California

\\ZINFANDEL\Proj\PacificGasElectricCo\TopockProgram\gINT\Input\gINT_Work_File_Types\gpj\topock_alg.GPJ;
ES052113153457SAC cross_section_C-C_v2.ai 061713_lho







ND – Not Detected
µg/L – micrograms per liter
mg/kg – milligrams per kilogram
ft amsl – feet above mean sea level

Notes:
1. Inferred isoconcentration lines are provided at agency request to assist with conceptual data interpretation. These lines are not intended to represent the actual plume distribution for reasons including that concentrations contoured represent calculated average concentrations, do not incorporate any bedrock fracture complexities, and that most wells are projected onto the section.
2. Well clusters shown as single boring
3. Flow zones identified are based on the results of flow profiling within the given borehole. Groundwater flow directions flow within the fractured bedrock cannot be inferred from borehole to borehole given the nature of the fracture network.

LITHOLOGY

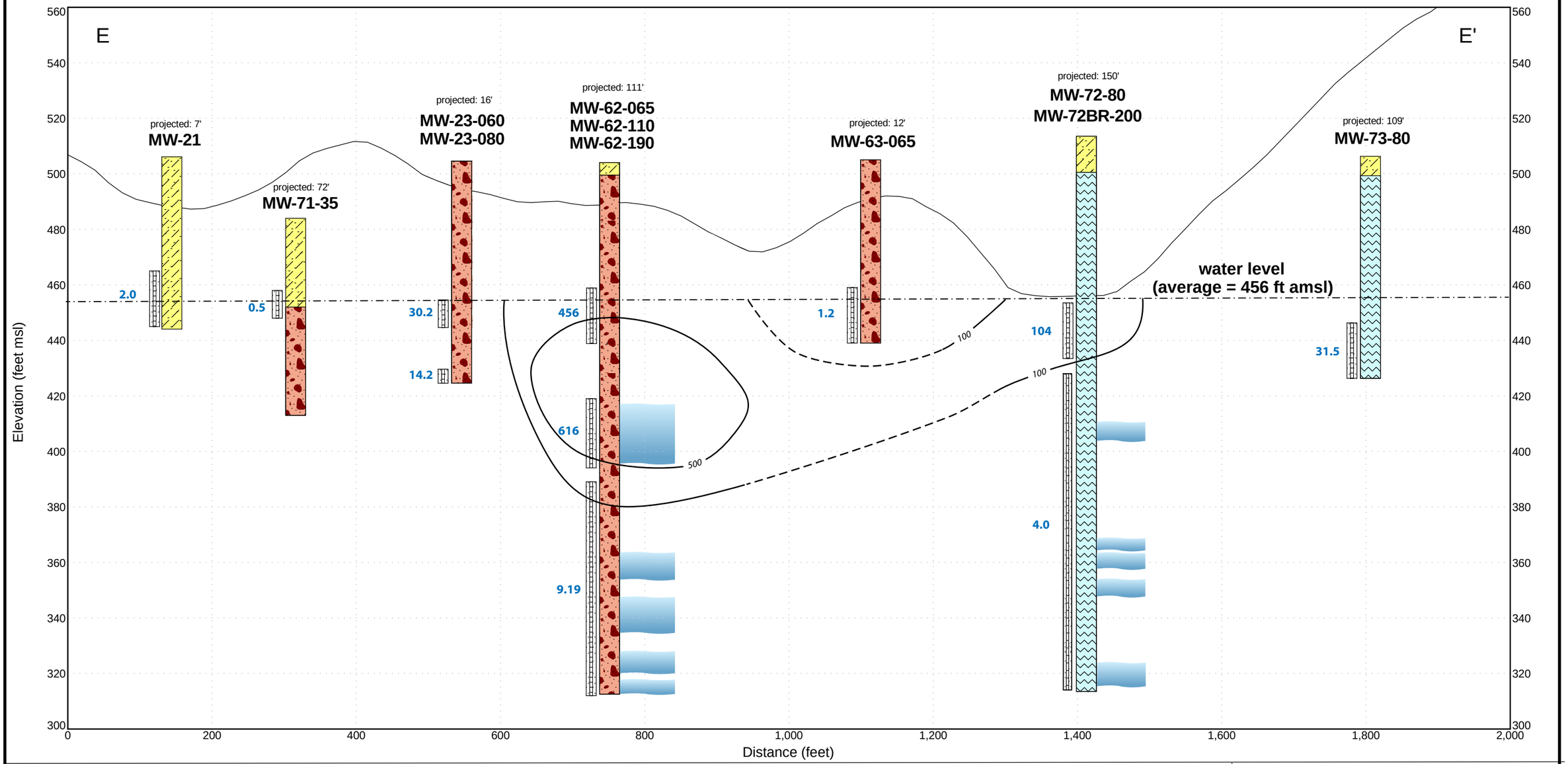
- **Alluvium**
- **Miocene Conglomerate**
- **Metadiorite**
- 100 **Cr(VI) Isoconcentration Line (Inferred)**

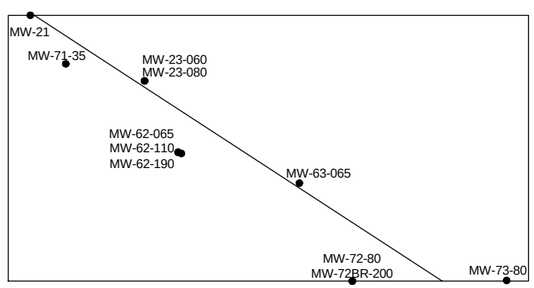
Figure 3-5

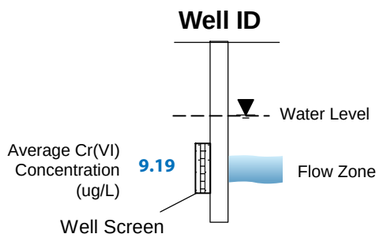
Cross Section D-D'

Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation, PG&E Topock Compressor Station, Needles, California

\\ZINFANDEL\Proj\PacificGasElectricCo\TopockProgram\gINT\Input\gINT_Work_File_Types\gpj\topock_alg.GPJ;
ES052113153457SAC cross_section_D-D_v4.ai 082014_lho







ND – Not Detected
ug/L – micrograms per liter
mg/kg – milligrams per kilogram
ft amsl – feet above mean sea level

Notes:
1. Inferred isoconcentration lines are provided at agency request to assist with conceptual data interpretation. These lines are not intended to represent the actual plume distribution for reasons including that concentrations contoured represent calculated average concentrations, do not incorporate any bedrock fracture complexities, and that most wells are projected onto the section.
2. Well clusters shown as single boring
3. Flow zones identified are based on the results of flow profiling within the given borehole. Groundwater flow directions flow within the fractured bedrock cannot be inferred from borehole to borehole given the nature of the fracture network.

LITHOLOGY

- **Alluvium**
- **Miocene Conglomerate**
- **Metadiorite**
- 100 **Cr(VI) Isoconcentration Line (Inferred)**

Figure 3-6

Cross Section E-E'

Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation, PG&E Topock Compressor Station, Needles, California

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Printed on 7/8/2014
ES052113153457SAC cross_section_E-E_v3.ai 082014_lho

Site 1

Depth	Cr(VI) Results	Cr(T) Results
0 - 0.5	ND (0.42)	13 J
2 - 3	ND (0.42)	8.9
5 - 6	ND (0.42)	9.1

BH-66

Depth	Cr(VI) Results	Cr(T) Results
(0 - 0.5)	ND (0.43)	12
(2 - 3)	ND (0.42)	9.1
(5 - 6)	ND (0.45)	14
(14 - 15)	ND (0.41)	15 J
(19 - 20)	ND (0.41)	10
(29 - 30)	ND (0.41)	7
(39 - 40)	ND (0.41)	28
(49 - 50)	ND (0.41)	28
(59 - 60)	ND (0.42)	25
(69 - 70)	ND (0.43)	18
(79 - 80)	ND (0.42)	17
(89 - 90)	ND (0.43)	18
(99 - 100)	ND (0.43)	21
(109 - 110)	ND (0.42)	22
(119 - 120)	ND (0.41)	23
(129 - 130)	ND (0.43)	29

BH-65

Depth	Cr(VI) Results	Cr(T) Results
(0 - 0.5)	0.52	12
(2 - 3)	0.79	17
(9 - 10)	ND (0.41)	15
(19 - 20)	ND (0.41)	16
(14 - 15)	ND (0.42)	24
(29 - 30)	ND (0.4)	25
(37 - 40)	ND (0.42)	48
(49 - 50)	ND (0.43)	50
(59 - 60)	ND (0.42)	40
(69 - 70)	ND (0.42)	23
(79 - 80)	ND (0.42)	61
(89 - 90)	ND (0.43)	20
(99 - 100)	ND (0.42)	66
(109 - 110)	ND (0.43)	50
(119 - 120)	ND (0.41)	26
(129 - 130)	ND (0.42)	25
(139 - 140)	ND (0.43)	49

BH-67

Depth	Cr(VI) Results	Cr(T) Results
(0 - 0.5)	ND (0.43)	32
(2 - 3)	ND (0.42)	11
(5 - 6)	ND (0.4)	2.8
(9 - 10)	ND (0.42)	4.4
(14 - 15)	ND (0.41)	2.4
(19 - 20)	ND (0.41)	6.6
(29 - 30)	ND (0.41)	18
(39 - 40)	ND (0.4)	2.4
(49 - 50)	ND (0.42)	12
59 - 60)	ND (0.47)	18
69 - 70)	ND (0.41)	3.2
(79 - 80)	ND (0.44)	13
(89 - 90)	0.78	22
(99 - 100)	ND (0.41)	22
(109 - 110)	ND (0.41)	31
(119 - 120)	ND (0.42)	20
(129 - 130)	ND (0.42)	26
(139 - 140)	ND (0.42)	19
(149 - 150)	ND (0.41)	17
(159 - 160)	ND (0.41)	19

BH-68

Depth	Cr(VI) Results	Cr(T) Results
(0 - 0.5)	ND (0.43)	22
(2 - 3)	ND (0.42)	4.2
(5 - 6)	ND (0.47)	4.6
(9 - 10)	ND (0.42)	12 J
(14 - 15)	ND (0.41)	2.8
(19 - 20)	ND (0.42)	31
(29 - 30)	ND (0.42)	35
(39 - 40)	ND (0.42)	32
(49 - 50)	ND (0.41)	16
(59 - 60)	ND (0.42)	22
(69 - 70)	ND (0.42)	26
(79 - 80)	ND (0.42)	36
(89 - 90)	ND (0.43)	28
(99 - 100)	ND (0.43)	38
(109 - 110)	ND (0.42)	16
(119 - 120)	ND (0.43)	25
(129 - 130)	ND (0.42)	15
(139 - 140)	ND (0.43)	45
(149 - 150)	ND (0.42)	48
(159 - 160)	ND (0.42)	22

MW-57BR

Depth	Cr(VI) Results	Cr(T) Results
(3 - 4)	ND (0.16)	26
(8 - 9)	ND (0.16)	22
(18 - 19)	ND (0.16)	25

MW-58BR

Depth	Cr(VI) Results	Cr(T) Results
(1.5 - 2)	150	4000
(19 - 20)	0.43	33
(29 - 30)	ND (0.17)	26
(39 - 40)	0.43	35
(49 - 50)	ND (0.17)	24
(59 - 60)	ND (0.18)	27

BH-70

Depth	Cr(VI) Results	Cr(T) Results
(0 - 0.5)	1.1	40
(2 - 3)	1.6	66
(5 - 6)	0.43	26
(9 - 10)	ND (0.41)	34
(14 - 15)	ND (0.42)	41
(19 - 20)	ND (0.42)	40 J
(29 - 30)	ND (0.44)	29
(39 - 40)	ND (0.41)	35
(49 - 50)	ND (0.43)	34
(59 - 60)	ND (0.44)	46
(69 - 70)	ND (0.41)	7.3

BH-69

Depth	Cr(VI) Results	Cr(T) Results
(0 - 0.5)	0.72	58
(2 - 3)	ND (0.45)	49
(5 - 6)	ND (0.41)	63
(9 - 10)	ND (0.42)	57
(14 - 15)	ND (0.41)	45
(19 - 20)	ND (0.41)	55
(29 - 30)	ND (0.4)	57
(39 - 40)	ND (0.43)	48

LEGEND

- Borehole Sample Location
- Approximate Bedrock Contact at 455 ft MSL

Location ID

BH-70

Depth	Cr(VI) Results	Cr(T) Results
(0 - 0.5)	1.1	40

Analyte

Sample Result (mg/kg)
(Orange color indicates exceedence background value)

Sample Depth, Feet Below Ground Surface

Notes:
1. Background value for Cr(VI) = 0.83 mg/kg.
2. Background value for Cr(T) = 39.8 mg/kg.
3. Location of Site 1 is approximate.

N

0 150 300 600 Feet

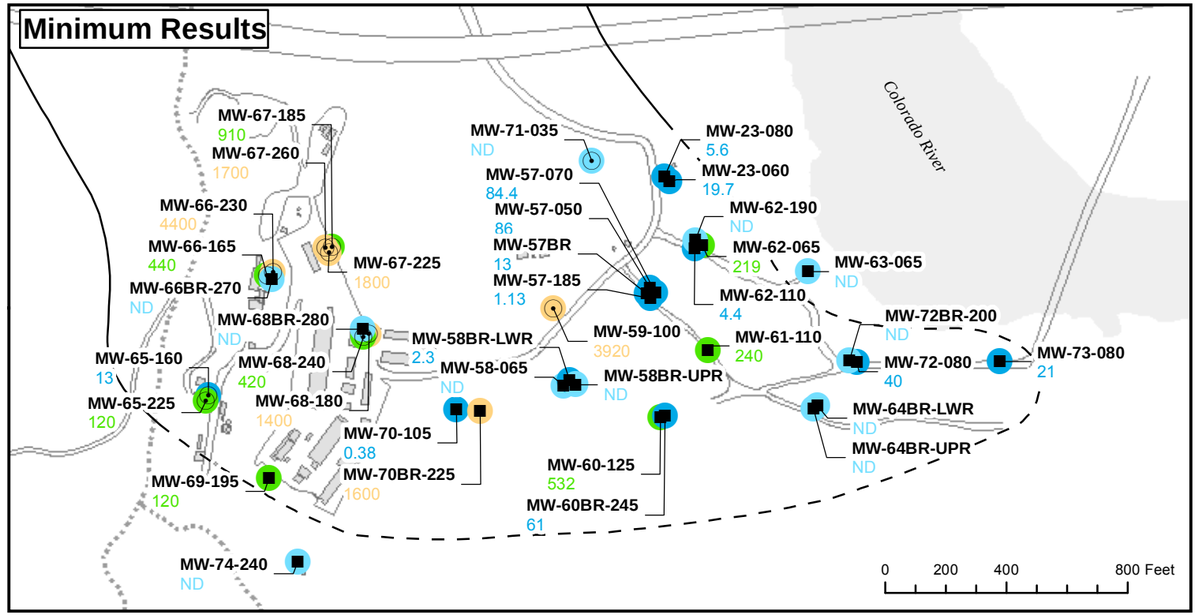
FIGURE 3-7
SUMMARY OF SOIL SAMPLE RESULTS FOR HEXAVALENT CHROMIUM FROM ER-TCS AREA BOREHOLES

REVISED ADDENDUM TO THE SUMMARY OF FINDINGS ASSOCIATED WITH THE EAST RAVINE GROUNDWATER INVESTIGATION
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

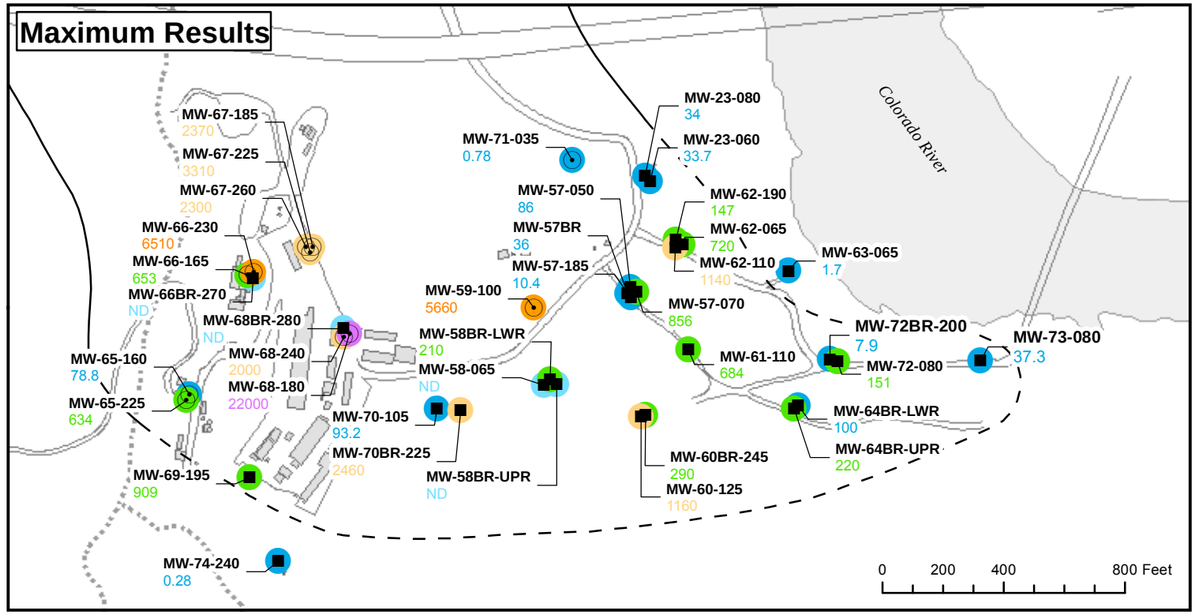
CH2MHILL

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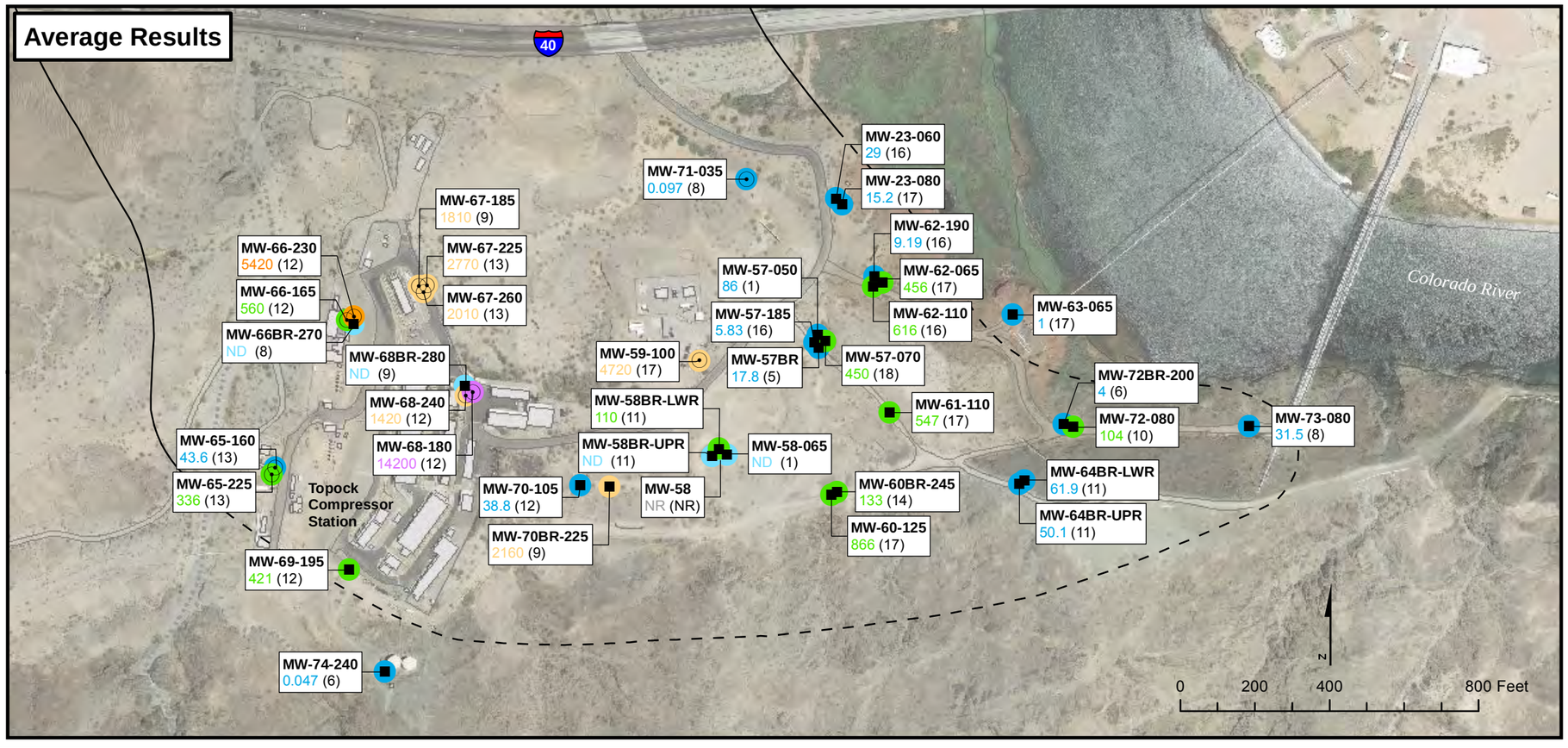
Minimum Results



Maximum Results



Average Results



LEGEND

- Monitoring Well Completed in Alluvial Aquifer
- Monitoring Well Completed in Bedrock

Hexavalent Chromium (Cr6) Results

- No Result (NR)
- Non Detect (ND)
- 1 - 100 µg/L
- 101-1000 µg/L
- 1001 - 5000 µg/L
- 5001 - 1000 µg/L
- > 1000 µg/L

MW-67-185 — Location ID
1810 (9) — Sample Count / Sample Result

Approximate extent of hexavalent chromium [Cr(VI)] concentrations exceeding 32 micrograms per liter (µg/L) at any depth in groundwater based on fourth quarter 2011 sampling events. Dashed where based on limited data.

Note:
1. Select locations have been moved for presentation purposes. See Figure 2-1 for surveyed locations.

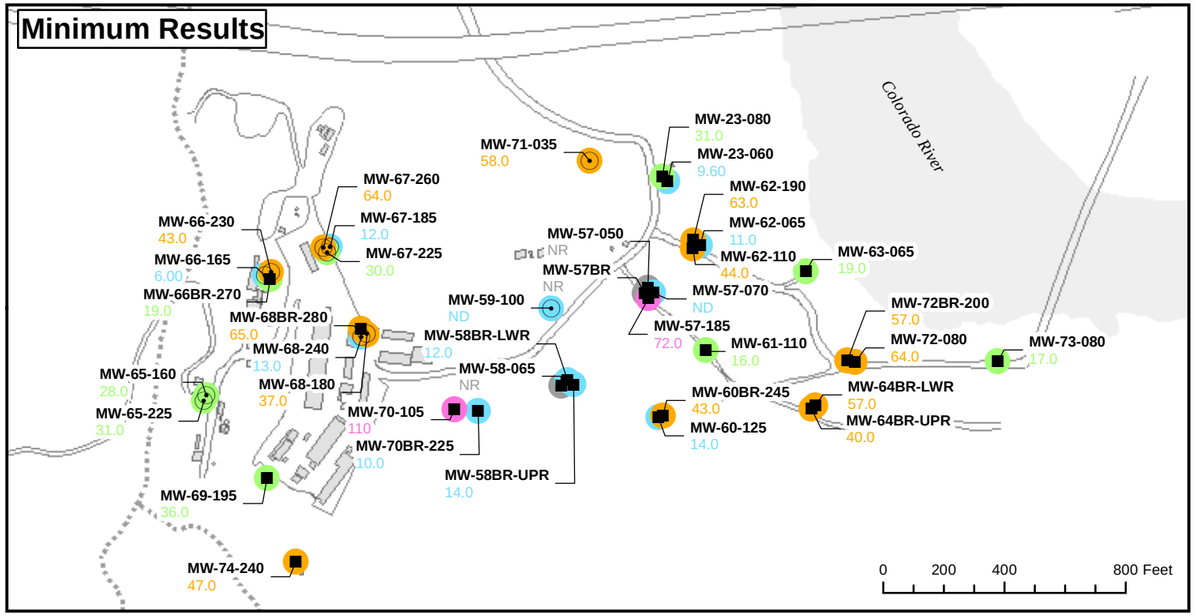
FIGURE 3-8
MINIMUM, MAXIMUM AND AVERAGE HEXAVALENT CHROMIUM RESULTS IN ER-TCS WELLS

REVISED ADDENDUM TO THE SUMMARY OF FINDINGS ASSOCIATED WITH THE EAST RAVINE GROUNDWATER INVESTIGATION
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

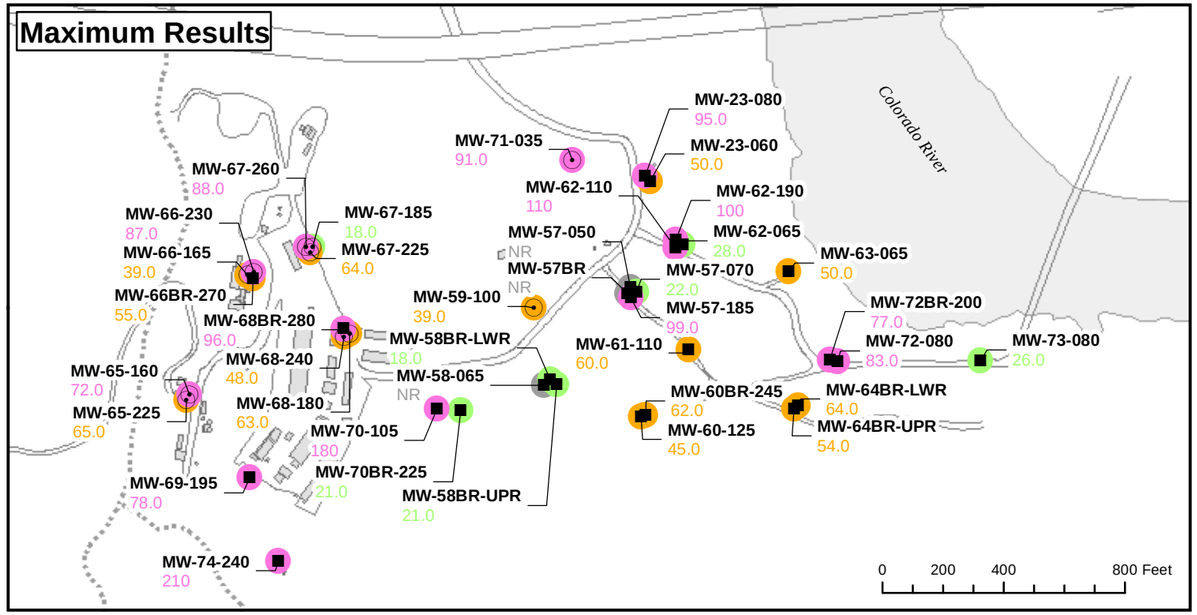
CH2MHILL

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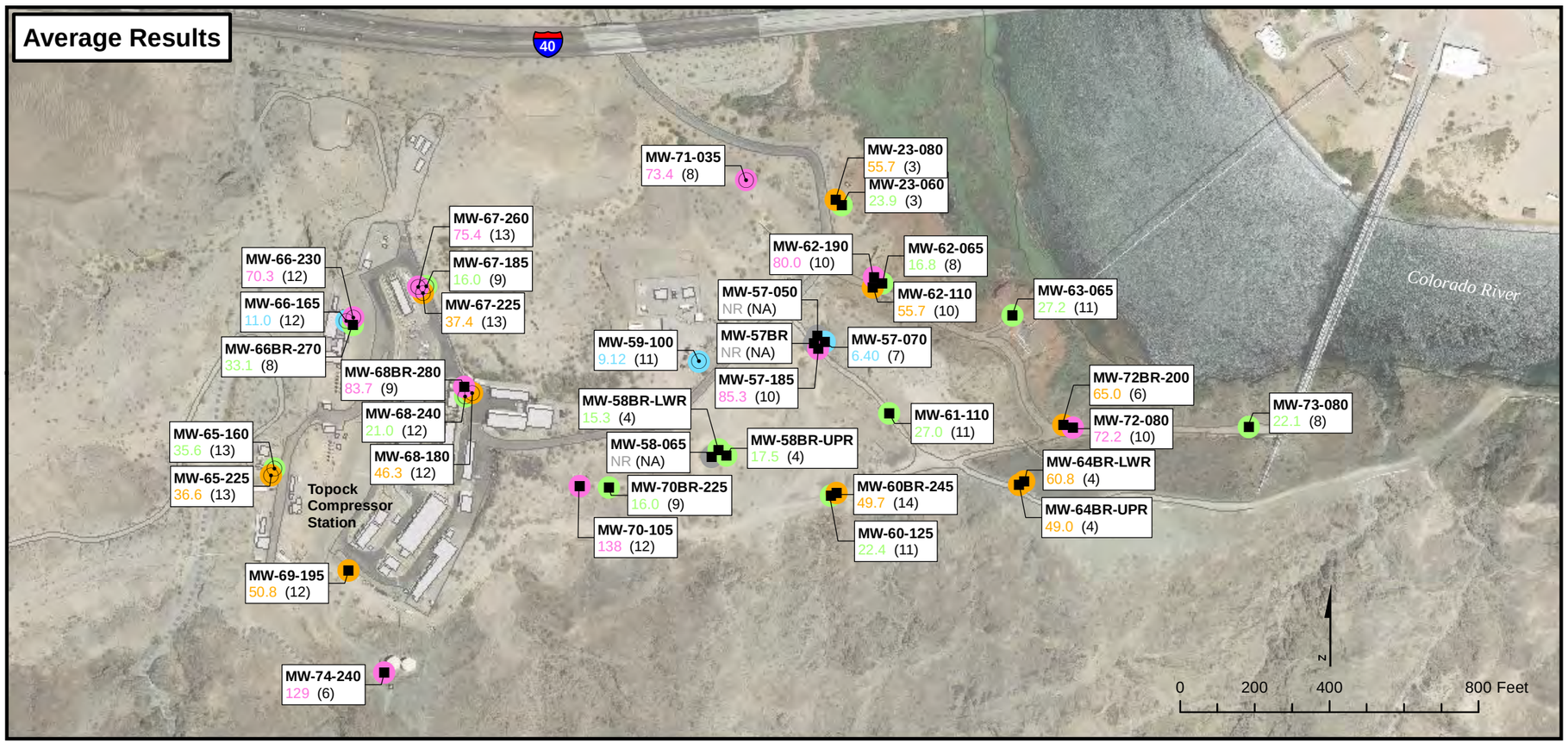
Minimum Results



Maximum Results



Average Results



LEGEND

- Monitoring Well Completed in Alluvial Aquifer
- Monitoring Well Completed in Bedrock

Molybdenum Concentrations

- No Result (NR)
- < 15 µg/L (or not detected [ND])
- 15 - 36.3 µg/L
- 36.4 - 70 µg/L
- > 70 µg/L

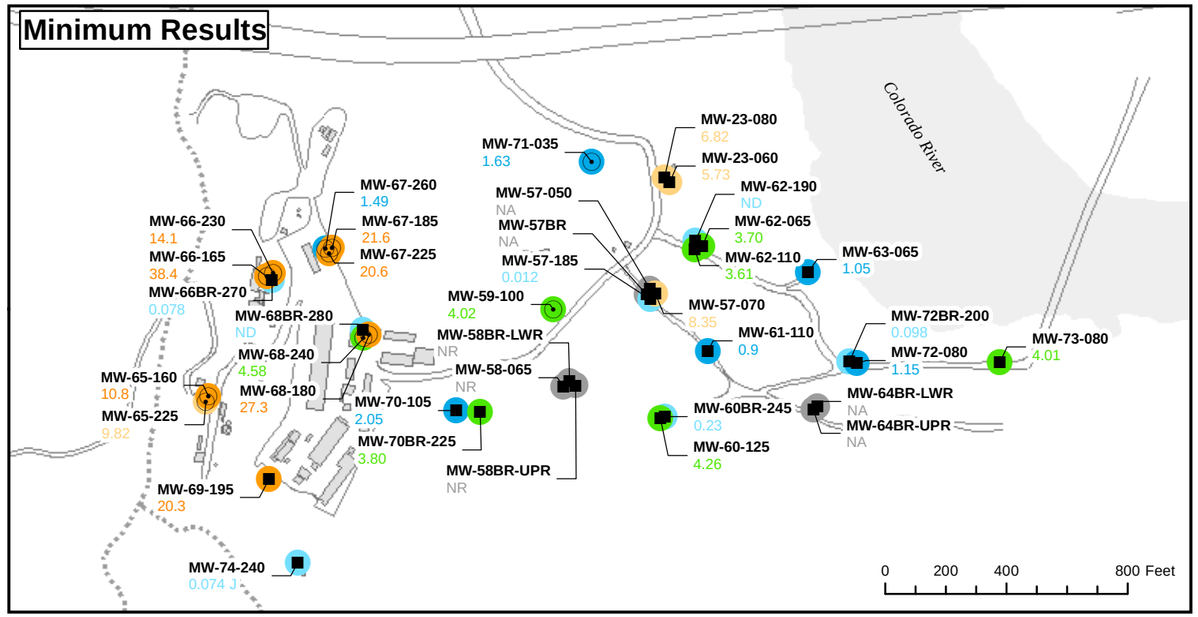
MW-67-185 — Location ID
22.1 (8) — Sample Count
Sample Result

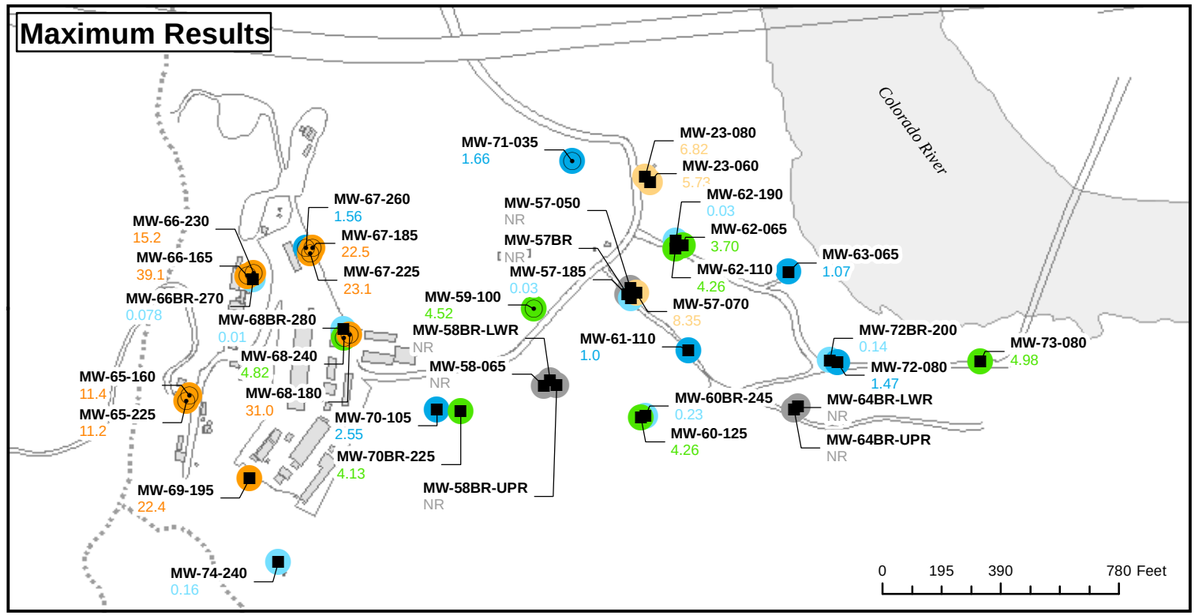
Note:
1. Select locations have been moved for presentation purposes. See Figure 2-1 for surveyed locations.

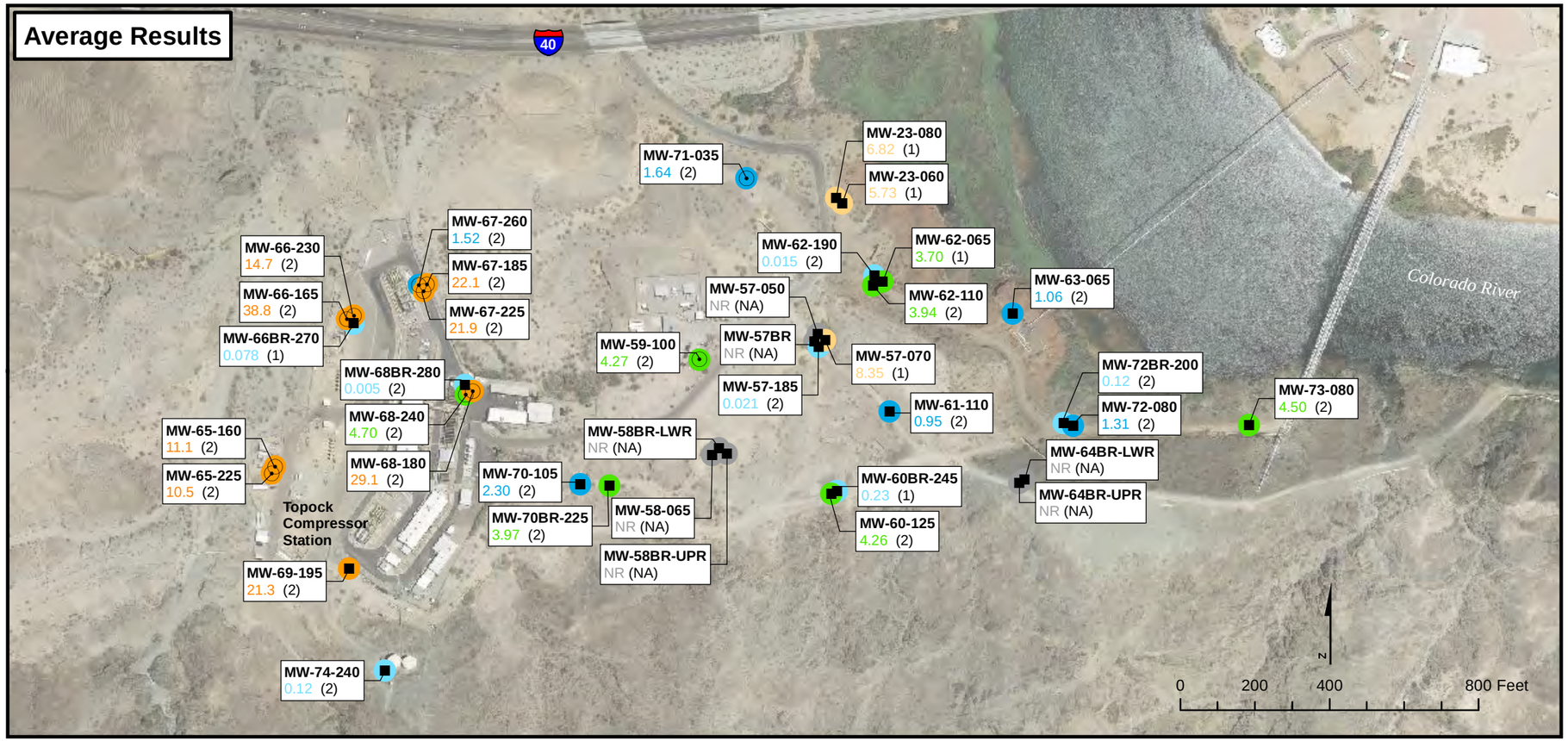
FIGURE 3-9
MINIMUM, MAXIMUM AND AVERAGE MOLYBDENUM RESULTS IN ER-TCS WELLS
REVISED ADDENDUM TO THE SUMMARY OF FINDINGS ASSOCIATED WITH THE EAST RAVINE GROUNDWATER INVESTIGATION
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL

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LEGEND

- Monitoring Well Completed in Alluvial Aquifer
- Monitoring Well Completed in Bedrock

Nitrate Results

- No Result (NR)
- 0 - 0.5 mg/L
- 0.5 - 3 mg/L
- 3 - 5 mg/L
- 5 - 10 mg/L
- > 10 mg/L

MW-67-260 — Location ID
5.73 (2) — Sample Count / Sample Result

Note:
1. Select locations have been moved for presentation purposes. See Figure 2-1 for surveyed locations.

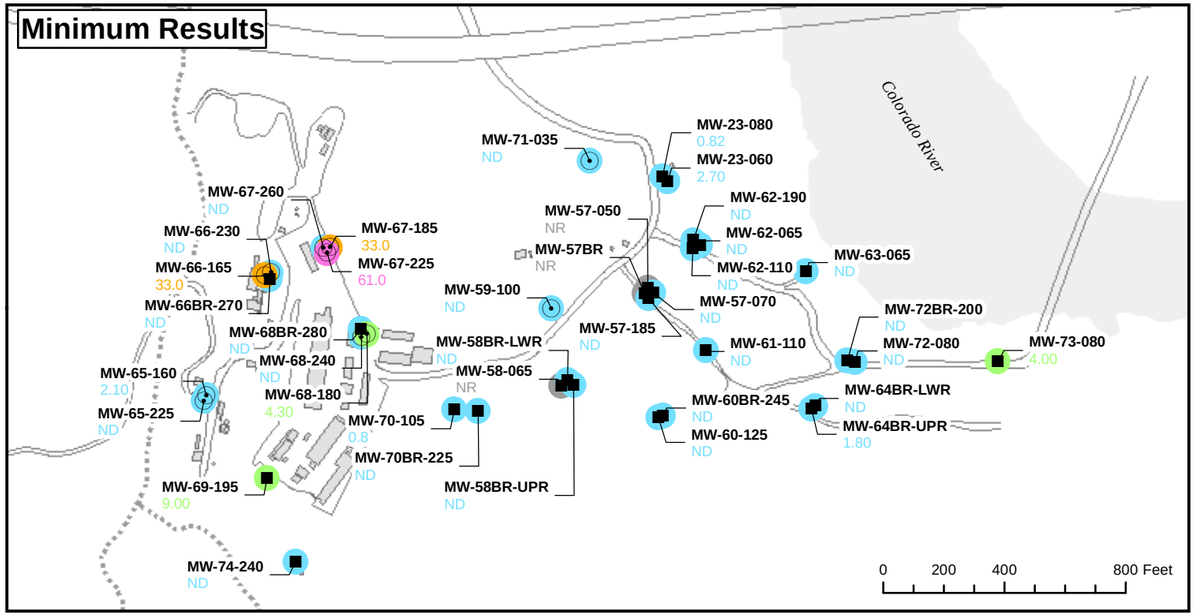
FIGURE 3-10
MINIMUM, MAXIMUM AND AVERAGE NITRATE RESULTS IN ER-TCS WELLS

REVISED ADDENDUM TO THE SUMMARY OF FINDINGS ASSOCIATED WITH THE EAST RAVINE GROUNDWATER INVESTIGATION
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

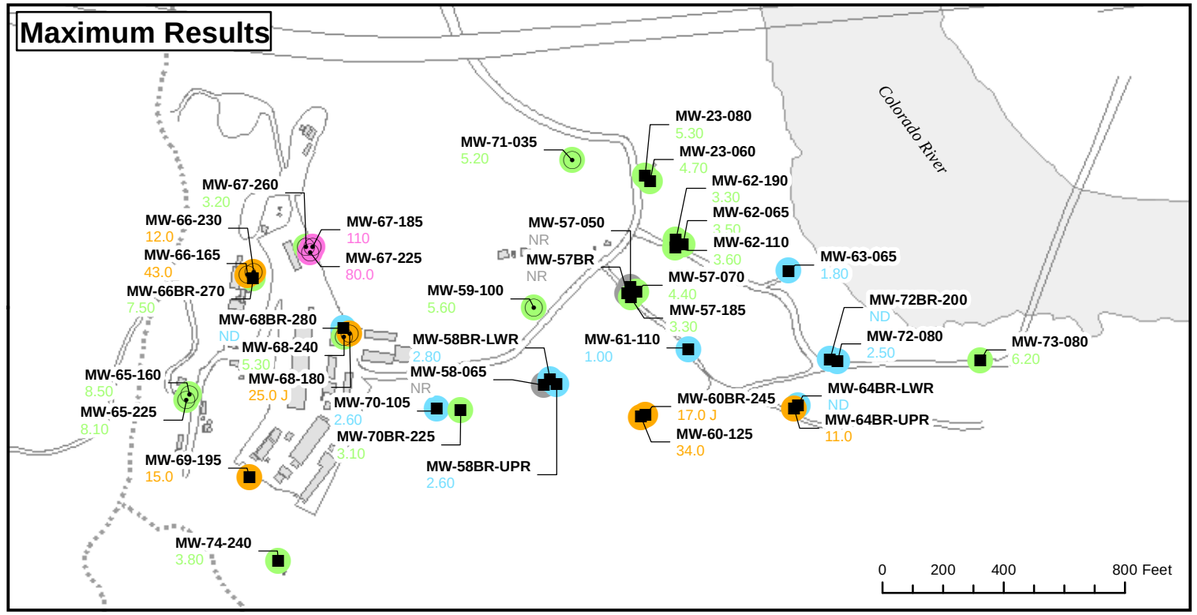
CH2MHILL

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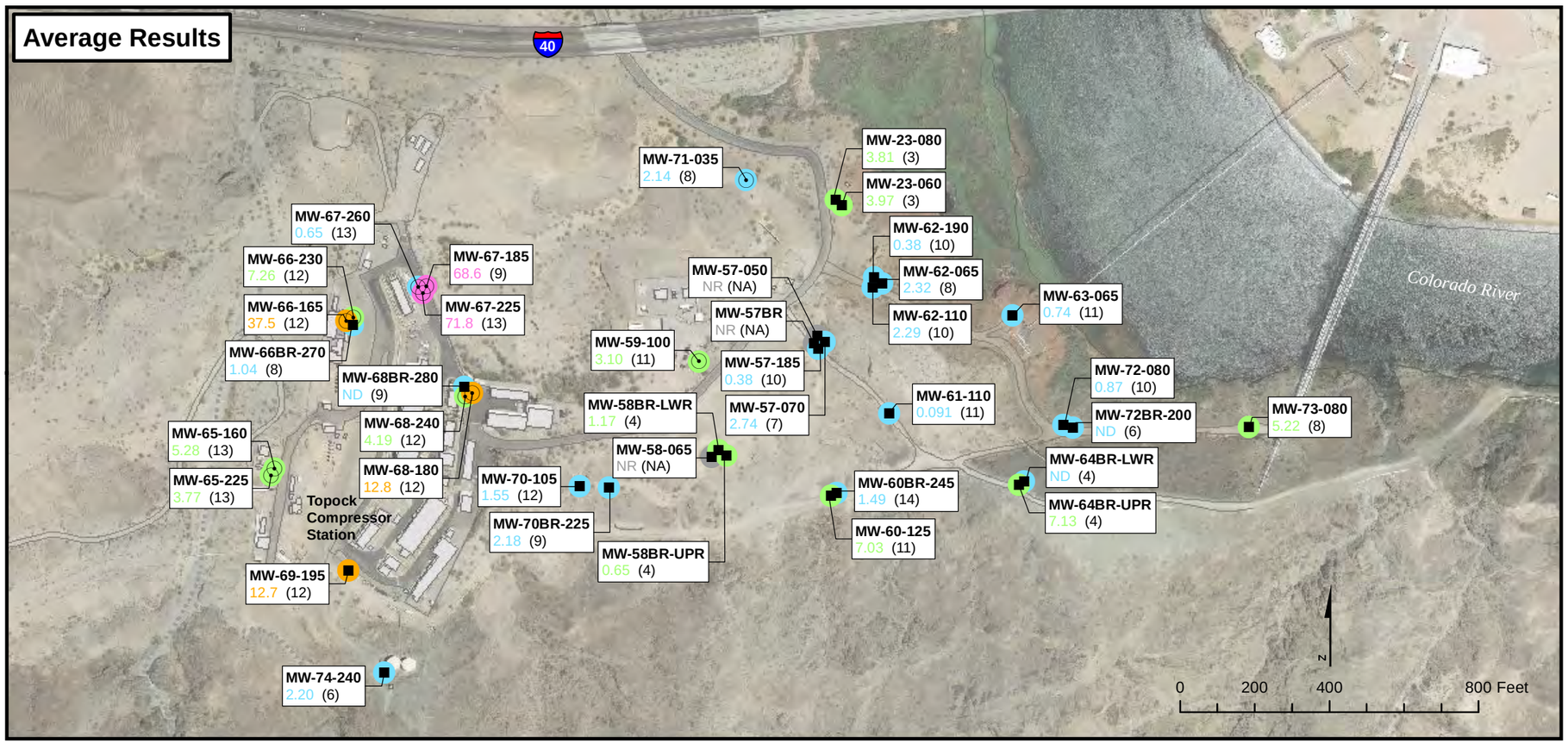
Minimum Results



Maximum Results



Average Results



LEGEND

- Monitoring Well Completed in the Alluvial Aquifer
- Monitoring Well Completed in Bedrock

Selenium Concentrations

- No Result (NR)
- < 3 µg/L (or not detected [ND])
- 3 - 10.3 µg/L
- 10.4 - 50 µg/L
- > 50 µg/L

MW-67-225 — Location ID
2.32 (8) — Sample Count
Sample Result

Note:
1. Select locations have been moved for presentation purposes. See Figure 2-1 for surveyed locations.

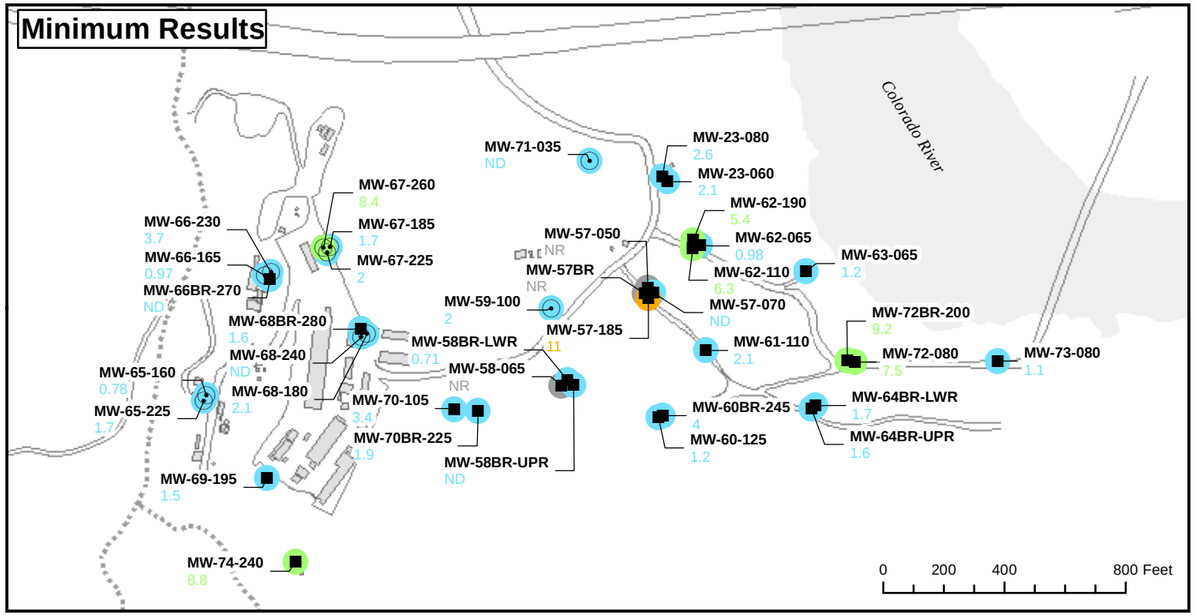
FIGURE 3-11
MINIMUM, MAXIMUM AND AVERAGE SELENIUM RESULTS IN ER-TCS WELLS

REVISED ADDENDUM TO THE SUMMARY OF FINDINGS ASSOCIATED WITH THE EAST RAVINE GROUNDWATER INVESTIGATION
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

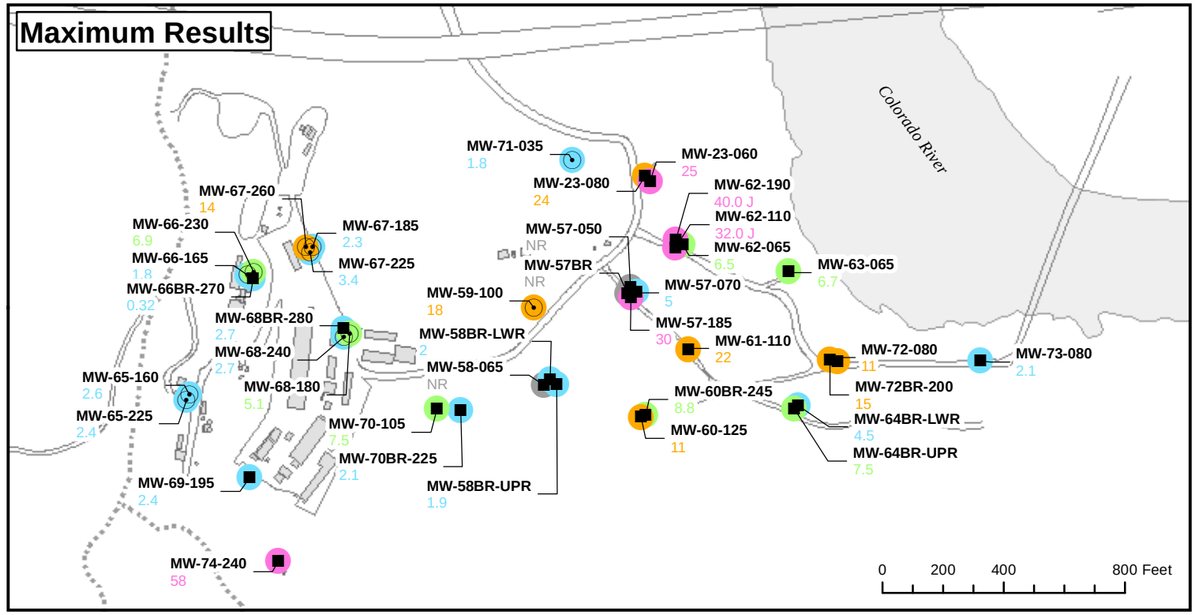
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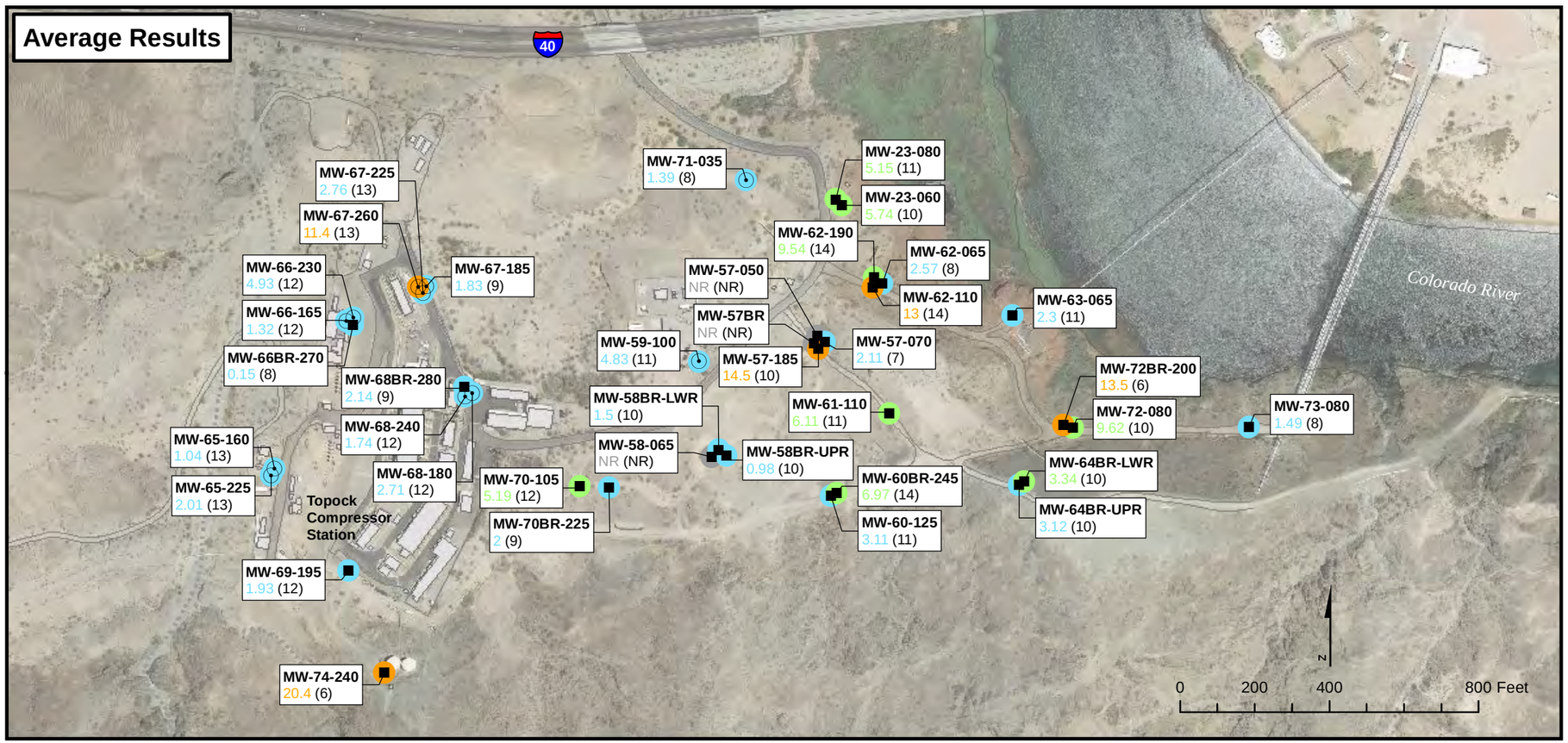
Minimum Results



Maximum Results



Average Results



LEGEND

- Monitoring Well Completed in Alluvial Aquifer
- Monitoring Well Completed in Bedrock

Arsenic Result

- No Result (NR)
- < 5 µg/L (or not detected [ND])
- 5 - 10 µg/L
- 10.1 - 24.3 µg/L
- > 24.3 µg/L

MW-67-260 — Location ID
11.4 (13) — Sample Count, Sample Result

Note:
1. Select locations have been moved for presentation purposes. See Figure 2-1 for surveyed locations.

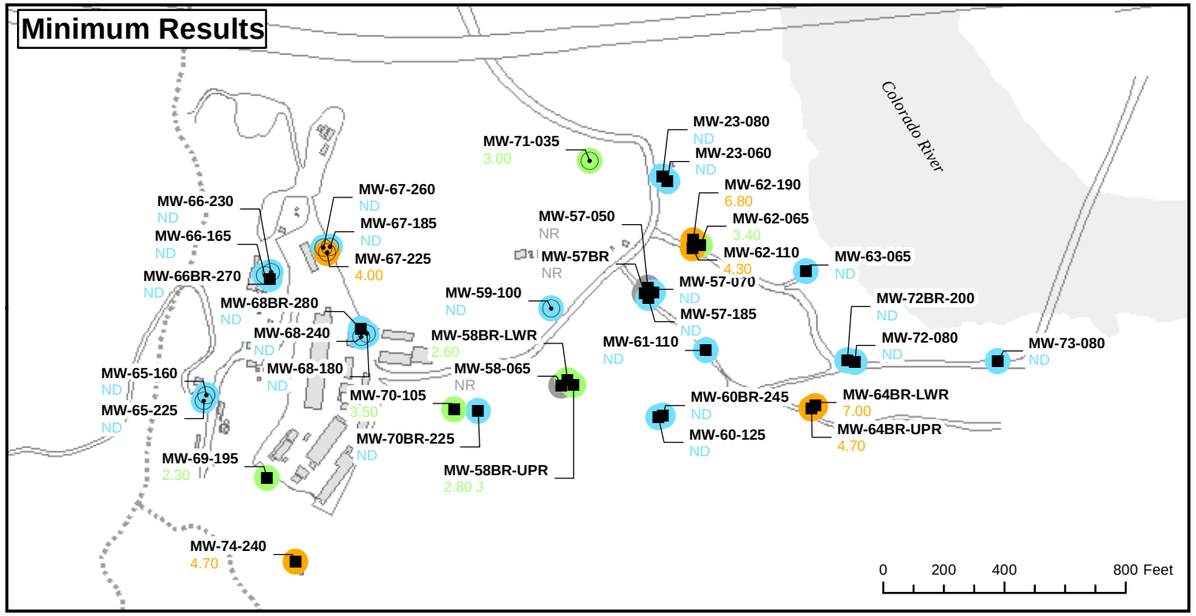
FIGURE 3-12
MINIMUM, MAXIMUM AND AVERAGE ARSENIC RESULTS IN ER-TCS WELLS

REVISED ADDENDUM TO THE SUMMARY OF FINDINGS ASSOCIATED WITH THE EAST RAVINE GROUNDWATER INVESTIGATION
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

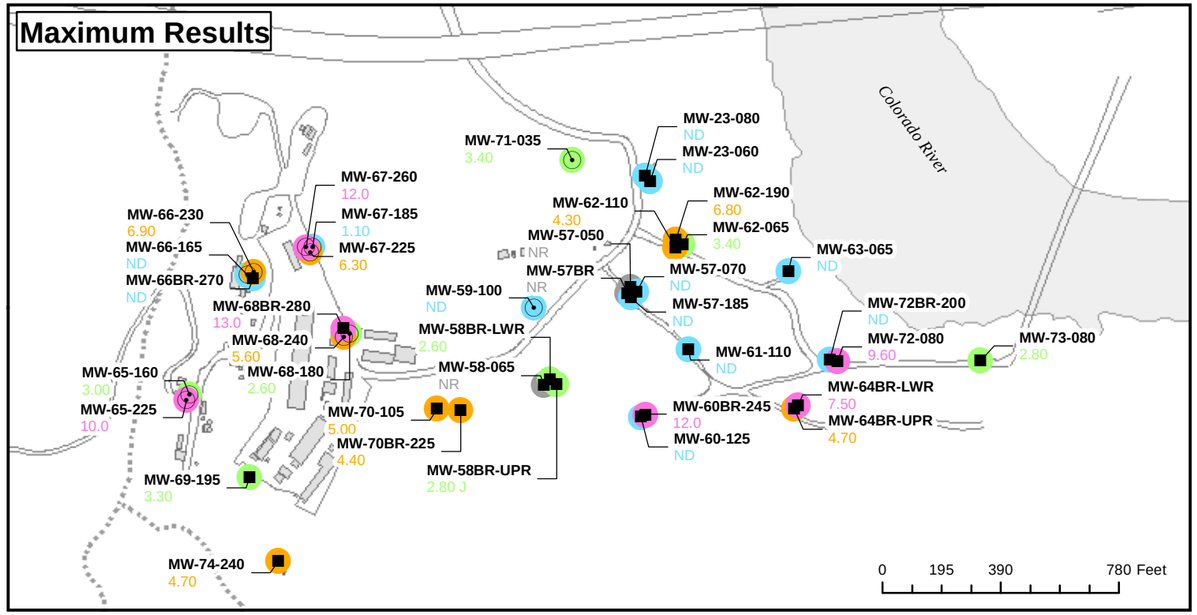
CH2MHILL

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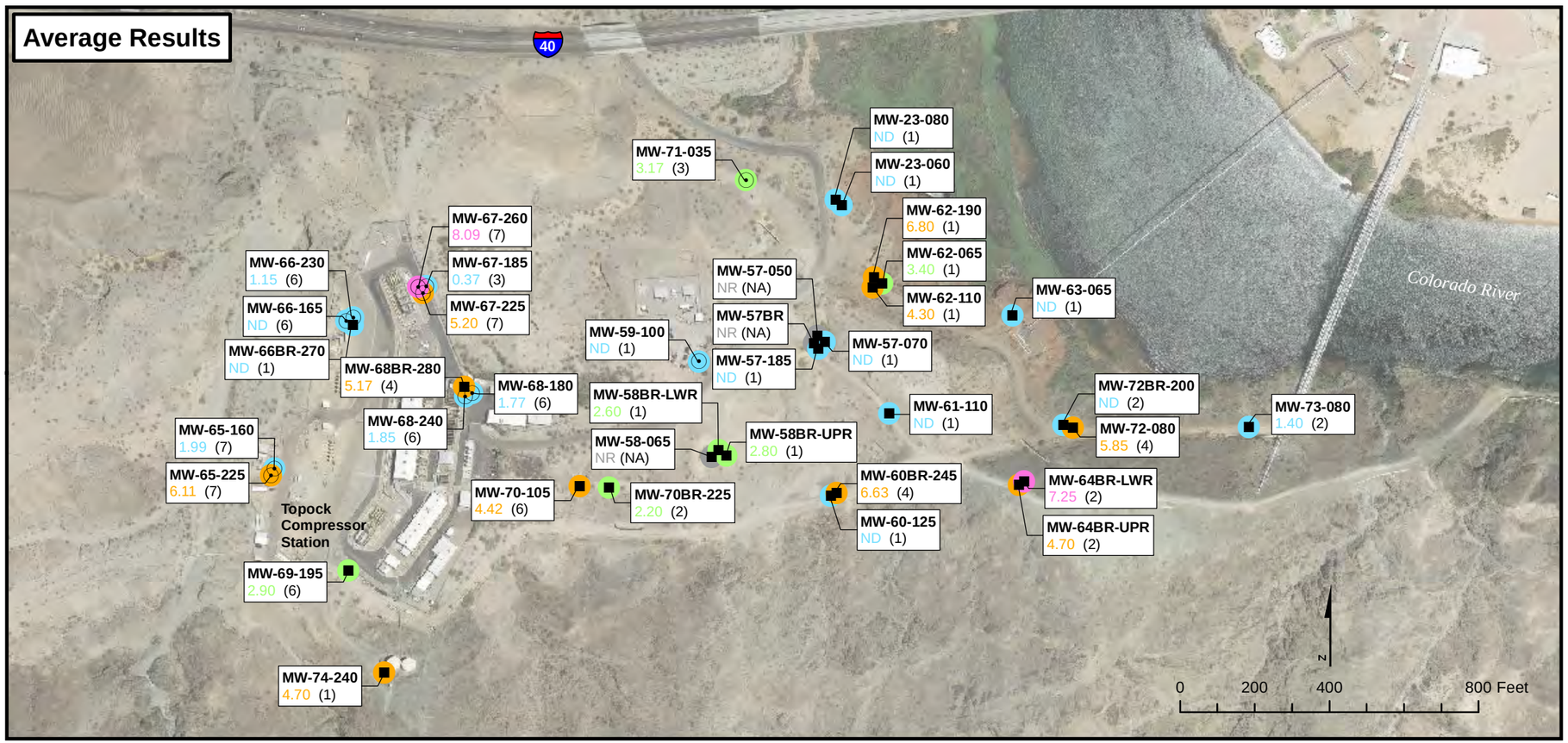
Minimum Results



Maximum Results



Average Results



LEGEND

- Monitoring Well Completed in Alluvial Aquifer
- Monitoring Well Completed in Bedrock

Fluoride Results

- No Result (NR)
- < 2 mg/L (or not detected [ND])
- 2 - 4 mg/L
- 4 - 7.1 mg/L
- > 7.1 mg/L

MW-67-225 — Location ID
5.2 (1) — Sample Count / Sample Result

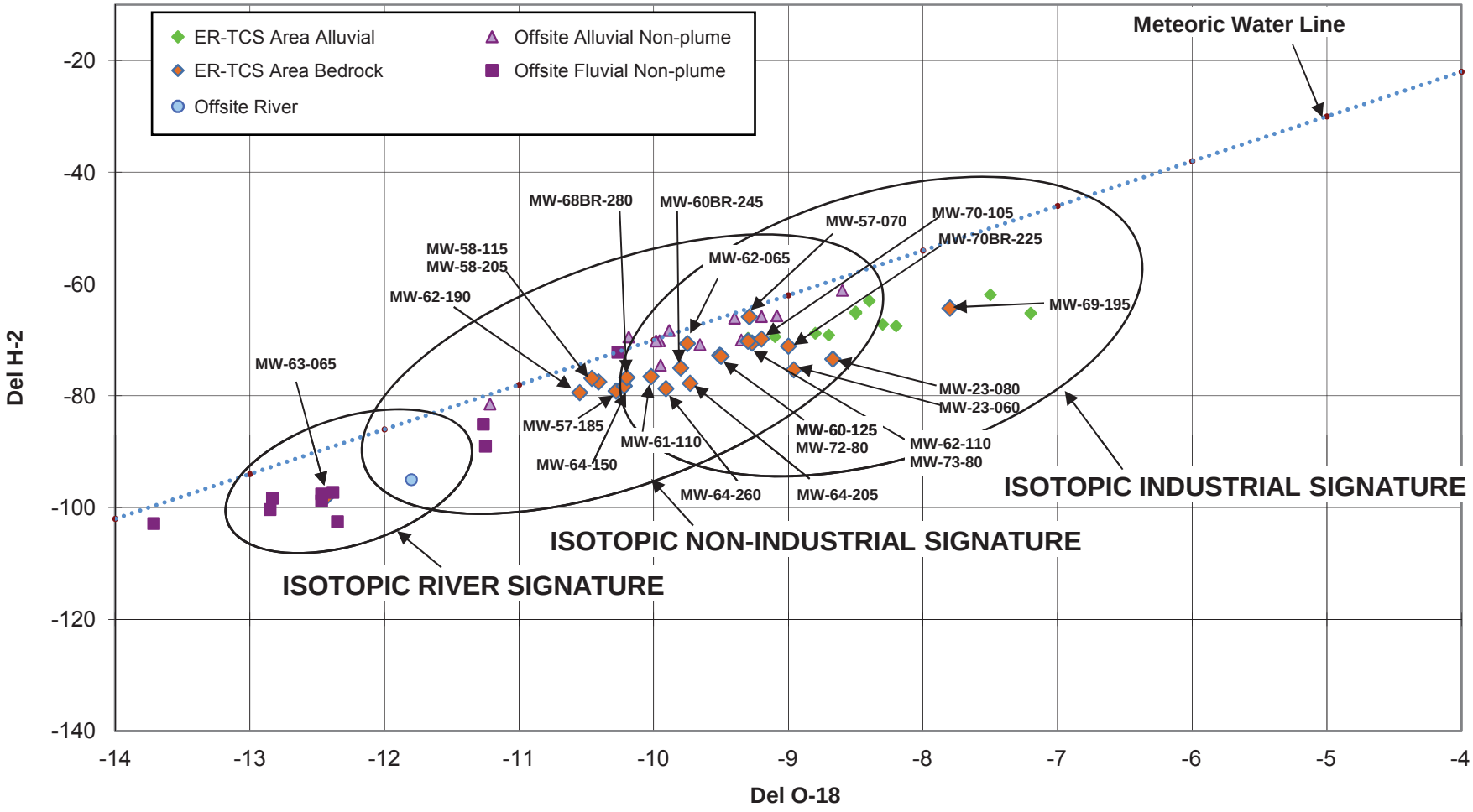
Note:
1. Select locations have been moved for presentation purposes. See Figure 2-1 for surveyed locations.

FIGURE 3-13
MINIMUM, MAXIMUM AND AVERAGE FLUORIDE RESULTS IN ER-TCS WELLS

REVISED ADDENDUM TO THE SUMMARY OF FINDINGS ASSOCIATED WITH THE EAST RAVINE GROUNDWATER INVESTIGATION
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

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Note: Data for wells not completed during the ER-TCS Investigation were previously reported in the Performance Monitoring Report for Fourth Quarter 2008 and Annual Performance Evaluation using averaged data for February 2008 through January 2009.

Figure 3-14
Stable Isotope Data
Revised Addendum to the Summary of FIndings Associated with the East Ravine Groundwater Investigation,
PG&E Topock Compressor Station,
Needles, California



FIGURE 3-15
RESULTS OF AQUIFER TEST

REVISED ADDENDUM TO THE SUMMARY OF FINDINGS ASSOCIATED WITH THE EAST RAVINE GROUNDWATER INVESTIGATION
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL

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MW-31-060
453.66

MW-20-070
452.68

MW-39-040
453.82

MW-36-020
454.04

MW-36-040
454.07

MW-25
454.08

MW-42-030
453.7

MW-27-020
454.08

MW-32-035
453.85

MW-26
453.78

MW-43-025
454.32

MW-22
453.62

MW-48 1
454.36

MW-21
454.01

MW-12
454.14

MW-71-035
454.18

MW-23-080 1
454.09

MW-23-060 1
454.01

MW-67-185
454.92

MW-67-225
454.71

MW-67-260
454.83

MW-62-065 1
454.09

MW-62-110 2

MW-62-190 5

MW-66-165
454.81

MW-66-230
454.99

MW-68-180
454.97

MW-59-100
455.1

MW-57-050
Dry

MW-57-070 1
455.3

MW-63-065 1
454.33

MW-68-240
455.07

MW-57-185 5
455.98

MW-66BR-270 5
456.54

MW-68BR-280 5
456.64

MW-61-110 1
455.22

MW-58-BR-UPR 2
456.04

MW-72-080 1
454.51

MW-73-080 1
454.61

MW-65-160
455.11

MW-58-65
Dry

MW-58-BR-LWR 5

MW-65-225
455.19

MW-70BR-225 5
455.94

MW-60-125 1
455.28

MW-64BR-UPR 1
455.06

MW-60BR-245 5
455.82

MW-64BR-LWR 4

MW-70-105 1
455.87

MW-69-195 1
455.55

MW-74-240 1
455.92

Groundwater Vertical Gradient Calculations, January 2012

Upper Well ID	Upper Well: Geologic Type	Lower Well ID	Lower Well: Geologic Type	Vertical Gradient Direction	Calculated Gradient (negative = upward)
MW-23-060	Bedrock	MW-23-080	Bedrock	Upward	**-0.004**
MW-12	Alluvium	MW-48	Bedrock	Upward	**-0.002**
MW-57-070	Bedrock	MW-57-185	Bedrock	Upward	**-0.010**
MW-60-125	Bedrock	MW-60BR-245	Bedrock	Upward	**-0.007**
MW-66-230	Alluvium	MW-66BR-270	Bedrock	Upward	**-0.042**
MW-68-240	Alluvium	MW-68BR-280	Bedrock	Upward	**-0.041**
MW-70-105	Bedrock	MW-70BR-225	Bedrock	Upward	**-0.001**

NOTES:

1. All water levels are based on measurments collected during the 1/15/2012 "snap-shot" event, except for MW-66BR-270, which is from 9/22/2011.
2. Colors related to geologic type are explained in the map legend.

LEGEND

- Monitoring Well
- Bedrock Well or Borehole
- Approximate Bedrock Contact at 455 ft MSL
- MW-43-025- - - - Location ID
  454.32- - - - Groundwater Elevation (feet MSL)

Groundwater Model Layers

- MW-31-060 = Upper Layer
- MW-67-225 = Middle Layer
- MW-59-100 = Lower Layer

  (Unconsolidated Aquifer)
- MW-61-110 = Bedrock Zone
  Bedrock Layer

Notes:

1. Reported groundwater elevations are based on manual water level and pressure transducer data collected on 1/15/2012, except for MW-66BR-270, which is from 9/22/2011. Due to the very low permeability at MW-66BR-270, the water level in January was still recovering from the previous sampling event.
2. Due to the FLUTe$_{TM}$ sampling equipment installed in well MW-62 water levels could not be measured in MW-62-110 and MW-62-190 during this event.
3. During the "snap-shot" water level event, it was noted that the inflatable packer in MW-58BR had deflated; therefore the water level measured at this well is representative of the groundwater elevation for MW-58BR-LWR, as it is reported.
4. Due to the inflatable packer installed in well MW-64BR, only the water level of the upper zone, MW-64BR-UPR, could be measured during the "snap-shot" event.

N

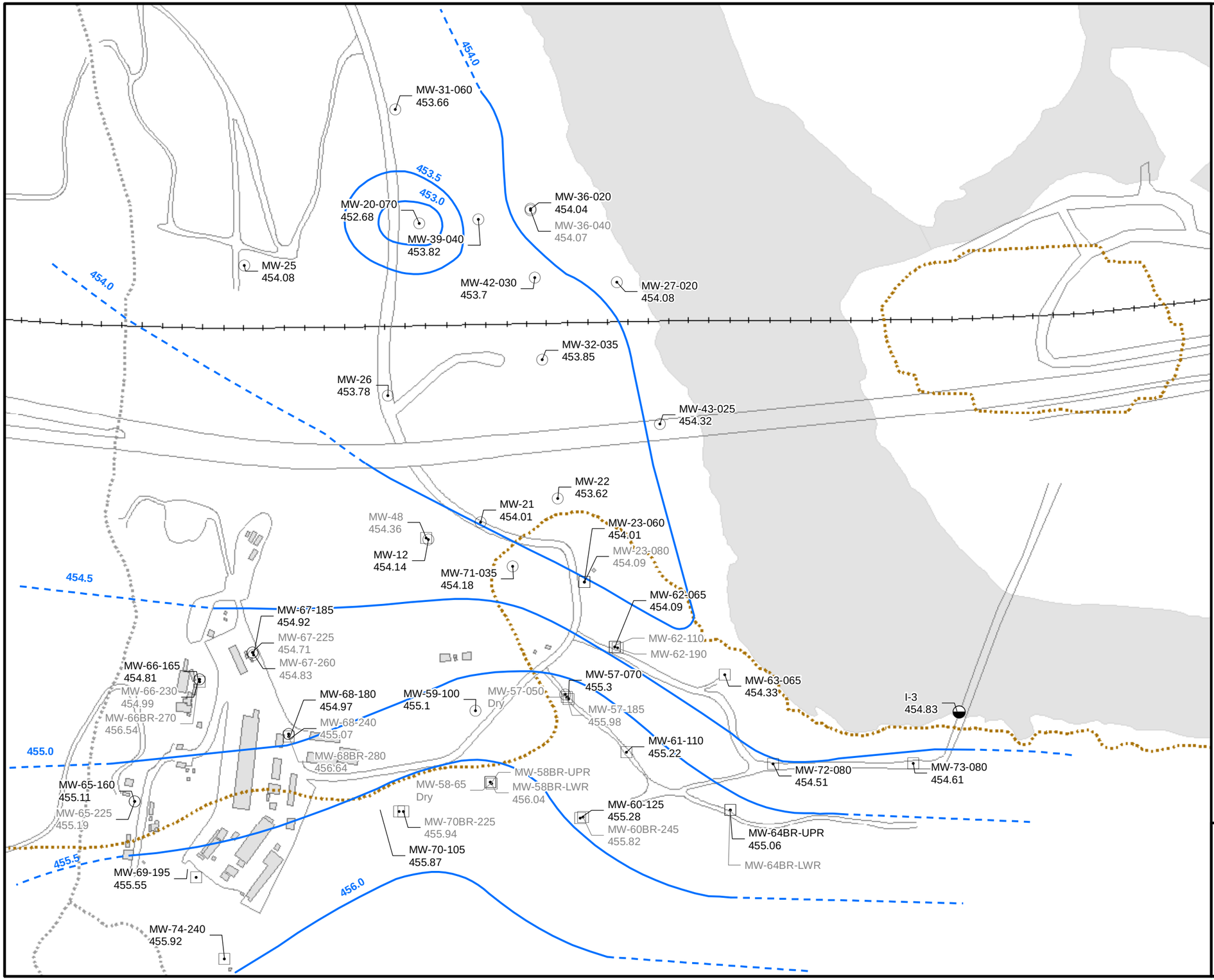
0 250 500
Feet

FIGURE 3-16
GROUNDWATER ELEVATION SNAPSHOT JAUNARY 15, 2012, FOR SELECT WELLS IN THE EAST RAVINE AREA

REVISED ADDENDUM TO THE SUMMARY OF FINDINGS ASSOCIATED WITH THE EAST RAVINE GROUNDWATER INVESTIGATION
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

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LEGEND

- Monitoring Well
- Bedrock Well or Borehole
- River Monitoring Location
- Approximate Bedrock Contact at 455 ft MSL
- Groundwater Elevation Contour (Feet MSL) (Based on wells screend nearest the water table: the shallowest well)
- Estimated Groundwater Elevation Contour (Feet MSL)
- MW-43-025- - - - Location ID
  454.32- - - - Groundwater Elevation (feet MSL)
- MW-58-BR - - - - Location ID
  456.04 - - - - Groundwater Elevation (not used for contouring due to a more shallow well screen at location)

Notes:

1. Reported groundwater elevations are based on manual water level and pressure transducer data collected on 1/15/2012, except for MW-66BR-270, which is from 9/22/2011. Due to the very low permeability at MW-66BR-270, the water level in January was still recovering from the previous sampling event.
2. Due to the FLUTe$_{TM}$ sampling equipment installed in well MW-62 water levels could not be measured in MW-62-110 and MW-62-190 during this event.
3. During the "snap-shot" water level event, it was noted that the inflatable packer in MW-58BR had deflated; therefore the water level measured at this well is representative of the groundwater elevation for MW-58BR-LWR, as it is reported.
4. Due to the inflatable packer installed in well MW-64BR, only the water level of the upper zone, MW-64BR-UPR, could be measured during the "snap-shot" event.
5. The river water level shown for I-3 is a calculated average of measurements collected through the day of January 15, 2012.

N

0 250 500 Feet

FIGURE 3-17
GROUNDWATER ELEVATION SNAPSHOT AND CONTOURS JAUNARY 15, 2012, FOR SELECT WELLS IN THE EAST RAVINE AREA

REVISED ADDENDUM TO THE SUMMARY OF FINDINGS ASSOCIATED WITH THE EAST RAVINE GROUNDWATER INVESTIGATION
PG&E TOPOCK COMPRESSOR STATION, NEEDLES, CALIFORNIA

CH2MHILL

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Attachments

Attachment A
Drilling and Well Construction Records

Attachment A-1
Borehole Construction Narrative

Appendix A-1: Borehole Construction Narrative (Phase 1)

The following bullets provide a summary of the drilling activities conducted to facilitate lithologic and hydrogeologic characterization, and well installation at each ERGI investigation site:

- Site A (MW-58 well series) – Two boreholes were advanced at Site A. An initial exploratory borehole was advanced to 115 feet bgs using a combination of rotosonic and rotary core drilling. To facilitate rotary coring and segregate the deeper portion of the borehole, a permanent 6-inch poly vinyl chloride (PVC) conductor casing was installed to 65.5 ft bgs and sealed with Portland cement grout. Subsequent to testing the 115-foot borehole, it was deepened to a final total depth of 206 feet bgs. Based lithologic and hydraulic data collected from the initial borehole, a second borehole was installed to 64 feet bgs for well installation.

- Site B (MW-57 well series) – Three boreholes were advanced at Site B. An initial exploratory borehole was advance to 192 feet bgs using a combination of rotosonic and rotary core drilling. To facilitate rotary coring and segregate the deeper portion of the borehole, a permanent 5-inch PVC conductor casing was installed to 70 feet bgs and sealed with Portland cement grout. Based on lithologic and hydraulic data collected from the initial borehole, two additional boreholes were installed to 50 and 70 feet bgs for well installation.

- Site C (MW-61-110) – One borehole was advanced at Site C to a total depth of 112 feet bgs for well installation. The borehole was initially advanced to 68 feet bgs using rotosonic drilling methods. The rotosonic casing was then used as a temporary conductor casing to facilitate rotary core drilling, which was used to advance the borehole to total depth. The cored borehole was then over-drilled from 68 feet bgs to total depth using rotosonic methods to facilitate well installation.

- Site C-Alternate (MW-64 well series) – One borehole was advanced at Site C-Alternate to a total depth of 260.5 feet bgs. The borehole was initially drilled 20 feet bgs using rotosonic drilling for the installation of a permanent 6-inch PVC conductor casing (sealed with Portland cement grout). Rotary core drilling was then used to advance the borehole to total depth.

- Site D – No borings were installed at Site D.

- Site E (MW-62 well series) – Two boreholes were advanced at Site E. The initial borehole was advanced to a total depth of 75 feet bgs for well installation. This borehole was initially advanced to 21 feet bgs using rotosonic drilling, and then to total depth with rotary core drilling using the rotosonic casing as a temporary conductor casing. The cored borehole was then over-drilled from 21 feet bgs to total depth using rotosonic methods to facilitate well installation. The second borehole was initially advanced to 75 feet bgs using rotosonic drilling for the installation of a permanent 6-inch PVC conductor casing (sealed with Portland cement grout). The boring was then advanced to a total depth of 191.5 feet bgs using rotary core drilling.

- Site E-Alternate 1 (MW-23 re-build) – No borings were installed at Site E-Alternate 1. In lieu of installing a new boring at this location, nearby existing monitoring well MW-23

was re-built to address the objectives of this investigation. MW-23 was over-drilled using rotosonic drilling to facilitate well re-installation within the pre-existing borehole.

- Site E-Alternate 2 (MW-63-065) – One borehole was advanced at Site E-Alternate 2 to a total depth of 66 feet bgs for well installation. The borehole was initially advanced to 30 feet bgs using rotosonic drilling methods. The rotosonic casing was then used as a temporary conductor casing to facilitate rotary core drilling, which was used to advance the borehole to total depth. The cored borehole was then over-drilled from 30 feet bgs to total depth using rotosonic methods to facilitate well installation.
- Site F (MW-60-125) – One borehole was advanced at Site F to a total depth of 123 feet bgs for well installation. The borehole was initially advanced to 86.5 feet bgs using rotosonic drilling methods. The rotosonic casing was then used as a temporary conductor casing to facilitate rotary core drilling, which was used to advance the borehole to total depth. The cored borehole was then over-drilled from 86.5 feet bgs to total depth using rotosonic methods to facilitate well installation.
- Site G (MW-59-100) – One borehole was advanced at Site G to a total depth of 101 feet bgs for well installation. This borehole was installed using only rotosonic drilling.

Appendix A-1: Borehole Construction Narrative (Phase 2)

The following bullets provide a summary of the drilling activities conducted to facilitate lithologic and hydrogeologic characterization, and well installation at each ER-TCS investigation site:

- Site F (MW-60 well series) – Two boreholes were advanced at Site F: the shallow one during the 2009 investigation and the deeper during the 2011 investigation. The initial borehole advanced to 86.5 feet bgs using rotosonic drilling, and then to 123 feet bgs with rotary core drilling using the rotosonic casing as a temporary conductor casing. The cored borehole was then over-drilled from 86.5 feet bgs to total depth using rotosonic methods to facilitate well installation. The second borehole was initially advanced to 137 feet bgs using rotosonic drilling for the installation of a permanent 5-inch PVC conductor casing (sealed with Portland cement grout). The boring was then advanced to a total depth of 245 feet bgs using rotary core drilling.

- Site H (MW-70 well series) – Two boreholes were advanced at Site H. The initial borehole was advanced to 87 feet bgs using rotosonic drilling, and then to 107.8 feet bgs with rotary core drilling using the rotosonic casing as a temporary conductor casing. The cored borehole was then over-drilled from 87 feet bgs to total depth using rotosonic methods to facilitate well installation. The second borehole was initially advanced to 130 feet bgs using rotosonic drilling for the installation of a permanent 5-inch PVC conductor casing (sealed with Portland cement grout). The boring was then advanced to a total depth of 227 feet bgs using rotary core drilling.

- Site I (MW-73-80) - One borehole was advanced at Site I to a total depth of 81 feet bgs. The borehole was advanced to 7 feet bgs using rotosonic drilling, and then to 81 feet bgs with rotary core drilling using the rotosonic casing as a temporary conductor casing. The cored borehole was then over-drilled from 7 feet bgs to total depth using rotosonic methods to facilitate well installation.

- Site J (MW-74-240) - One borehole was advanced at Site J to a total depth of 240 feet bgs for well installation. The borehole was initially advanced to 19 feet bgs using rotosonic drilling methods. The rotosonic casing was then used as a temporary conductor casing to facilitate air hammer and rotary core drilling. Air hammer was used to advance the borehole from 19 to 211 feet using, and rotary core drilling was then used from 211 feet total depth. The borehole was then over-drilled from 19 feet bgs to total depth using rotosonic methods to facilitate well installation.

- Site K (MW-72 well series) – Two boreholes were advanced at Site K. The initial borehole was advanced to 17 feet bgs using rotosonic drilling, and then to 80 feet bgs with rotary core drilling using the rotosonic casing as a temporary conductor casing. The cored borehole was then over-drilled from 17 feet bgs to total depth using rotosonic methods to facilitate well installation. The second borehole was initially advanced to 107 feet bgs using rotosonic drilling for the installation of a permanent 6-inch PVC conductor casing (sealed with Portland cement grout). The boring was then advanced to a total depth of 200 feet bgs using rotary core drilling.

- Site L (MW-71-35) - One borehole was advanced at Site L to a total depth of 71 feet bgs for well installation. The borehole was initially advanced to 37 feet bgs using rotosonic drilling methods. The rotosonic casing was then used as a temporary conductor casing to facilitate rotary core drilling, which was used to advance the borehole to total depth. The cored borehole was then backfilled with bentonite chips to form a seal from 71 feet to 39 feet. The well was then installed to a total depth of 36 feet bgs.
- Site 2 (MW-67 well series) – Two boreholes were advanced at Site 2. The initial 6-inch diameter borehole was advanced to 272.5 feet bgs using rotosonic drilling and then over-drilled with 10-inch diameter tools from ground surface to 227 feet bgs to facilitate installation of a nested well. The second borehole was advanced using rotosonic drilling to a total depth of 187 feet bgs for well installation.
- Site 3 (MW-68 well series) –Two boreholes were advanced at Site 3. The initial 6-inch diameter borehole was advanced to 250 feet bgs using rotosonic drilling and then over-drilled with 10-inch diameter tools from ground surface to 185 feet bgs to facilitate installation of a nested well. The second borehole was initially advanced to 257 feet bgs using rotosonic drilling for the installation of a permanent 5-inch steel conductor casing (sealed with Portland cement grout). The boring was then advanced to a total depth of 280.5 feet bgs using rotary core drilling.
- Site 4 (MW-69-195) – One borehole was advanced at Site 4 to a total depth of 197.5 feet bgs. The borehole was advanced to 42 feet bgs using rotosonic drilling, and then to 197.5 feet bgs with rotary core drilling using the rotosonic casing as a temporary conductor casing. The cored borehole was then over-drilled from 42 feet bgs to total depth using rotosonic methods to facilitate well installation.
- Site 5 (MW-65 well series) – One borehole was advanced at Site 5 to a total depth of 237 feet bgs. A 6-inch diameter borehole was advanced to 237 feet bgs using rotosonic drilling and then over-drilled with 10-inch diameter tools from ground surface to 167 feet bgs to facilitate installation of a nested well.
- Site 6 (MW-66 well series) - Two boreholes were advanced at Site 6. The initial 6-inch diameter borehole was advanced to 234 feet bgs using rotosonic drilling and then over-drilled with 10-inch diameter tools from ground surface to 167 feet bgs to facilitate installation of a nested well. The second borehole was initially advanced to 248 feet bgs using rotosonic drilling for the installation of a permanent 5-inch steel conductor casing (sealed with Portland cement grout). The boring was then advanced to a total depth of 271 feet bgs using rotary core drilling.

Attachment A-2
Lithologic Logs

PROJECT NUMBER:	BORING NUMBER:
382653.FP.04.FW	MW-57 SHEET 1 OF 11

SOIL BORING LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site B (2100899.6 N, 7616389.4 E)

ELEVATION : 509.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

DRILLING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic drill head and tools

ORIENTATION : Vertical

WATER LEVELS : Approx. 52 ft BGS

START : 1/14/2009

END : 1/20/2009

LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
		COMPLETE		ML	**Sandy Silt With Gravel (ML)** 0.0-3.0' - dark brown, (7.5YR 3/3), dry, loose, 20% gravel, 30% sand, 50% fines, angular gravel, poorly graded, no dominant mineralogy, matrix-supported, max clast size = 10 mm		Boring initially drilled to 70' bgs using Rotosonic tools up to 10-in in diameter. Permanent 5-in PVC conductor casing installed from ground surface to 70' bgs (portland cement grout). Boring drilled from 70' bgs to total depth of 192' bgs using diamond bit rotary core tools (HQ-size, 3.8-in diameter)
	3.0 4.0		10:10		**Silty Gravel (GM)** 3.0-46.0' - dark brown, (7.5YR 3/3), dry, loose, 40% gravel, 20% sand, 40% fines, angular gravel, poorly graded, no dominant mineralogy, matrix-supported, max clast size = 100 mm		
5							
	8.0 9.0		11:00, 14:00 (FD)				
10				GM			
15							
	18.0 19.0		11:10				
20							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-57	SHEET 2 OF 11

SOIL BORING LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site B (2100899.6 N, 7616389.4 E)

ELEVATION : 509.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

DRILLING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic drill head and tools

ORIENTATION : Vertical

WATER LEVELS : Approx. 52 ft BGS

START : 1/14/2009

END : 1/20/2009

LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft) / RECOVERY (in) / LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
25	COMPLETE	GM	**Silty Gravel (GM)** 3.0-46.0' - dark brown, (7.5YR 3/3), dry, loose, 40% gravel, 20% sand, 40% fines, angular gravel, poorly graded, no dominant mineralogy, matrix-supported, max clast size = 100 mm		
30					
35					
40					

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
382653.FP.04.FW	MW-57 SHEET 3 OF 11

SOIL BORING LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site B (2100899.6 N, 7616389.4 E)

ELEVATION : 509.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

DRILLING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic drill head and tools

ORIENTATION : Vertical

WATER LEVELS : Approx. 52 ft BGS

START : 1/14/2009

END : 1/20/2009

LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
45		COMPLETE		GM	**Silty Gravel (GM)** 3.0-46.0' - dark brown, (7.5YR 3/3), dry, loose, 40% gravel, 20% sand, 40% fines, angular gravel, poorly graded, no dominant mineralogy, matrix-supported, max clast size = 100 mm		
50				Tmc	**Conglomerate (Tmc)** 46.0-145.5' - bedrock is consolidated. Drilling method pulverizes most of the core. Intact portions of core are yellowish red (5YR 4/6), dry, matrix-supported conglomerate with no dominant clast mineralogy		
55							
60							

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-57	SHEET 4 OF 11

SOIL BORING LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site B (2100899.6 N, 7616389.4 E)

ELEVATION : 509.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

DRILLING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic drill head and tools

ORIENTATION : Vertical

WATER LEVELS : Approx. 52 ft BGS

START : 1/14/2009

END : 1/20/2009

LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
65		COMPLETE		Tmc	**Conglomerate (Tmc)** 46.0-145.5' - bedrock is consolidated. Drilling method pulverizes most of the core. Intact portions of core are yellowish red (5YR 4/6), dry, matrix-supported conglomerate with no dominant clast mineralogy		
70	70.0				Begin rock coring from 70.0 ft bgs See the next page for the rock core log.		Boring by Rotosonic completed 1/14/09. Install permanent 5-in diameter PVC conductor casing (portland cement grout). Begin rotary core drilling at 70.0' bgs.
75							
80							

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-57	SHEET 5 OF 11

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site B (2100899.6 N, 7616389.4 E)

ELEVATION : 509.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 52 ft BGS

START : 1/14/2009

END : 1/20/2009

LOGGER : A. Brewster (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	70.0					**No Recovery** 70-75.3'	
	R1 5.3 ft 0%	0	NR				
75	75.3						R1 = 23.0 min
			0			**Conglomerate (Tmc)** 75.3-145.5' - light brown, (5YR 5/6), no dominant clast mineralogy, fine to coarse grained, medium strong (R3), unweathered, matrix-supported, massive	
			0				
			0				
			0				
	R2 9.5 ft 103%		0				
80		100	0				
			0				
			0				
			0				
			0				
			0				
	84.8		0				Added Approx. 50 gallons of water
85			0				
			0				
			0				
			0				
	R3 10 ft 100%		0				
90		100					

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-57	SHEET 6 OF 11

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site B (2100899.6 N, 7616389.4 E)

ELEVATION : 509.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 52 ft BGS

START : 1/14/2009

END : 1/20/2009

LOGGER : A. Brewster (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			0			**Conglomerate (Tmc)** 75.3-145.5' - light brown, (5YR 5/6), no dominant clast mineralogy, fine to coarse grained, medium strong (R3), unweathered, matrix-supported, massive	
			0				
			0				
			0				
			0				Added approx. 25 gallons of water. R3 = 10.0 min
95	94.8		0				
			0				
			0				
			0				
			1	98.5, 99.0' - Joint, 35 deg, rough, undulating, reddish staining, tight		98.5-98.7' - slightly weathered	
	R4 10 ft 100%		1				
100		70	0				
			0				
			0				
			>10	103.0-105.0' - Multiple breaks, difficult to ascertain if jointed or caused by drilling.			
			>10				R4 = 10.5 min
105	104.8		0				
			0				
			0				
			0				
	R5 10 ft 100%		0				
110		97					

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-57	SHEET 7 OF 11

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site B (2100899.6 N, 7616389.4 E)

ELEVATION : 509.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 52 ft BGS

START : 1/14/2009

END : 1/20/2009

LOGGER : A. Brewster (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			0			**Conglomerate (Tmc)** 75.3-145.5' - light brown, (5YR 5/6), no dominant clast mineralogy, fine to coarse grained, medium strong (R3), unweathered, matrix-supported, massive	
			0				
			0				
			1	113.1' - Joint, 35 deg, rough, undulating, reddish staining, tight			
			0				Added approx. 25 gallons of water. R5 = 12.5 min
115	114.8						
			0				
			0				
			0				
			0				
	R6 10 ft 100%		1	119.3' - Joint, 35 deg, rough, planar, reddish staining, tight			
120		100					
			0				
			0				
			0				
			0				
			0				R6 = 14.0 min
125	124.8						
			0				
			0				
			0				
			0				
	R7 9.9 ft 100%		0				
130		100					

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-57	SHEET 8 OF 11

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site B (2100899.6 N, 7616389.4 E)

ELEVATION : 509.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 52 ft BGS

START : 1/14/2009

END : 1/20/2009

LOGGER : A. Brewster (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			0			**Conglomerate (Tmc)** 75.3-145.5' - light brown, (5YR 5/6), no dominant clast mineralogy, fine to coarse grained, medium strong (R3), unweathered, matrix-supported, massive	
			0				
			0				
			1	133' - Joint, 35 deg, rough, planar, < 1 mm calcite infilling, reddish staining, tight (likely caused by drilling)			
	134.7		0				R7 = 15.0 min
135			1	135' - Joint, 60 deg, rough, undulating, < 2 mm calcite infilling, reddish staining, tight			
			0				
			1	137.1' - Joint, 35 deg, rough, undulating, reddish staining, minor yellow staining, tight			
			0				
	R8 10.1 ft 100%	100	0				
140			0				
			1	141' - Joint, 80 deg, rough, undulating, reddish staining, tight (likely caused by drilling)			
			0				
			0				
			1	144' - Joint, 45 deg, rough, stepped, reddish staining, tightness uncertain			R8 = 14.5 min
	144.8						
145			0				
			0			145.5-153.1' - moderate reddish orange, (10R 6/6), no dominant clast mineralogy, fine to coarse grained, medium strong (R3), completely weathered, matrix-supported, foliated	Conglomerate from 144.5.-153.1 is altered. The matrix of the rock rapidly dissolves on contact with water as evident from the outer portion of the recovered core exposed to drilling fluids and fragments of core intentionally submersed in water.
			0	146.8-152.6' - Multiple fractures caused by drilling. Preferential clevage 25 to 35 deg, undulating, slickensided, no infill, reddish staining			
			0				
	R9 10.1 ft 99%	98	0				
150							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-57	SHEET 9 OF 11

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site B (2100899.6 N, 7616389.4 E)

ELEVATION : 509.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 52 ft BGS

START : 1/14/2009

END : 1/20/2009

LOGGER : A. Brewster (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			0			**Conglomerate (Tmc)** 145.5-153.1' - moderate reddish orange, (10R 6/6), no dominant clast mineralogy, fine to coarse grained, medium strong (R3), completely weathered, matrix-supported, foliated	
			0				
			0				
			0	153.5, 154.5' - Mechanical break, 35 deg, undulating to planar, brownish with black staining, no infill, slickensided, tight		**Metaconglomerate (Tmc)** 153.1-154.6' - dark yellowish orange, (10YR 6/6), strong (R4), unweathered, massive, moderate HCl reaction, conglomerate matrix has been largely replaced with minerals that have a moderate reaction with HCl, however relict conglomerate structure is apparent.	R9 = 17.5 min
			0				
155	154.9			154.6-155.6' - Fracture zone, healed fractures with random orientation			
			>10				
	R10 4.8 ft 100%	58	0			**Altered Metadiorite (pTbr)** 154.6-155.6' - moderate yellowish brown, (10YR 5/4), largely felsic mineralogy, medium grained, strong (R4), unweathered, no HCL reaction, portions of this interval exhibit mylonitic texture	
			0				
			1	158.2' - Joint, 60 deg dip along multiple planes, rough, undulating, < 1 mm calcite infilling covering 50% of one plane, yellowish staining, tightness uncertain		**Metadiorite (pTbr)** 155.6-191.9' - dusky yellowish green, (10GY 3/2), intermediate (dioritic) mineralogy, fine to medium grained, strong (R4), unweathered, massive to foliated	General Note: The metadiorite bedrock exhibits many small healed fractures (1-3 mm) of somewhat random orientation. These healed fractures create weaknesses in the rock. It can be difficult to determine if the metadiorite is jointed in-situ, or if the discontinuities are caused by the drilling method. Intervals with fracture per foot counts >10 are likely caused by drilling.
	159.7		0				
160							
			0				
	R11 4.7 ft 100%	51	>10	160.9-164.2' - Fracture zone, reddish staining, yellow staining from 162.3-164.2'			R10 = 23.0 min
			>10				
			>10				
	164.4		0				R11 = 13.3 min
165							
			0				
	R12 4.6 ft 100%	53	1	166.1' - Mechanical break, near 90 deg, calcite infilling, calcite healed fracture, most likely induced by drilling		166.8-167.0' - slightly weathered	
			0				
			0	167.7-170.0' - Mechanical break (6), 35 deg and 45 deg, calcite infilling, along calcite healed fractures, likely induced by drilling			
	169.0						R12 = 19.3 min
			0				
170							

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-57	SHEET 10 OF 11

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site B (2100899.6 N, 7616389.4 E)

ELEVATION : 509.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 52 ft BGS

START : 1/14/2009

END : 1/20/2009

LOGGER : A. Brewster (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: RQD (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	R13 4.8 ft 100%	69	0			**Metadiorite (pTbr)** 155.6-191.9' - dusky yellowish green, (10GY 3/2), intermediate (dioritic) mineralogy, fine to medium grained, strong (R4), unweathered, massive to foliated	Last 1.5' = 2-3x faster drill rate
			0				
			>10	172.2-173.8' - Fracture zone, reddish staining			
	R14 0.5 ft 100%		>10				R13 = 25.3 min
	173.8						
	174.3	0					R14 = 7.5 min
			1	174.4' - Joint, 30 deg, smooth, undulating, < 1 mm calcite infilling, reddish staining, tight			
175							
	R15 3.4 ft 100%	71	0	175.2' - Mechanical break, 35 deg, < 2 mm calcite infilling, along calcite healed fracture			@ 175' bgs: drill rate increases
			1	176.6' - Joint, 60 deg, rough, undulating, reddish staining, tight			
	177.7		1	177.3' - Joint, 30 deg, rough, undulating, < 1 mm calcite infilling, reddish staining, tight			R15 = 17.0 min
			0				
	R16 4.2 ft 100%	100	1	179.1' - Joint, 20 deg, rough, undulating, < 1 mm calcite infilling, reddish staining, tight			
180							
			1	180' - Joint, 30 deg, rough, undulating, minor reddish staining, tight			
			1	181.2' - Joint, 25 deg, rough, undulating, < 1 mm calcite infilling, reddish and black staining, tight			R16 = 15.5 min
	181.9						
			1	182.1, 189.6' - Joint (2), 10 deg, smooth, undulating, < 1 mm clay infilling, reddish staining, tight, clay infilling is dark-reddish brown			
			0				
			0				
185							
			0				
	R17 10 ft 100%	92	0	185.8 - 186.0' - Multiple breaks, likely induced by drilling			
			0				
			1				
			0				
190							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-57	SHEET 11 OF 11

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site B (2100899.6 N, 7616389.4 E)

ELEVATION : 509.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 52 ft BGS

START : 1/14/2009

END : 1/20/2009

LOGGER : A. Brewster (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			0			**Metadiorite (pTbr)** 155.6-191.9' - dusky yellowish green, (10GY 3/2), intermediate (dioritic) mineralogy, fine to medium grained, strong (R4), unweathered, massive to foliated	R17 = 35.5 min
			0				
191.9						End Drilling on 1/20/2009 Total Borehole Depth: 191.9 ft bgs	
195							
200							
205							
210							

PROJECT NUMBER:	BORING NUMBER:
382653.FP.04.FW	MW-58 SHEET 1 OF 11

SOIL BORING LOG

PROJECT : PG&E Topock - ERGI
LOCATION : Site A (2100612.1 N, 7616131.8 E)
ELEVATION : 521.8 ft
DRILLING CONTRACTOR : Boart Longyear (D. Roberts)
DRILLING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic drill head and tools
ORIENTATION : Vertical
WATER LEVELS : Approx. 66 ft BGS
START : 1/29/2009
END : 3/27/2009
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
	1.5 2.0	COMPLETE	14:00	ML	**Silt With Sand(ML)** 0.0-2.0' - brown, (7.5YR 4/4), dry, loose, 0% gravel, 20% sand, 80% fines, sand is angular to subangular, poorly graded, no dominant mineralogy		Boring initially drilled to 65.5' bgs using Rotosonic tools up to 10-in in diameter. Permanent 6-in PVC conductor casing installed from ground surface to 65.5' bgs (portland cement grout). Boring drilled from 65.5' bgs to an initial total depth of 115' bgs using diamond bit rotary core tools (HQ-size, 3.8-in diameter). Following testing, boring was deepend to a total depth of 206' bgs using rotary core tools.
5				GM	**Silty Gravel With Sand(GM)** 2.0-17.0' - brown, (7.5YR 4/3), dry, loose, 40% gravel, 30% sand, 30% fines, gravel is angular to subangular, poorly graded, no dominant mineralogy, matrix supported, max clast size = 90 mm.		
10							
15							
	19.0 20.0		14:50	SM	**Silty Sand With Gravel(SM)** 16.0-51.0' - brown, (7.5YR 4/3), dry, loose, 15% gravel, 60% sand, 25% fines, gravel is angular to subrounded, poorly graded, no dominant mineralogy, matrix supported, max clast size = 100 mm		
20							

PROJECT NUMBER:	BORING NUMBER:
382653.FP.04.FW	MW-58 SHEET 2 OF 11

SOIL BORING LOG

PROJECT : PG&E Topock - ERGI
LOCATION : Site A (2100612.1 N, 7616131.8 E)
ELEVATION : 521.8 ft
DRILLING CONTRACTOR : Boart Longyear (D. Roberts)
DRILLING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic drill head and tools
ORIENTATION : Vertical
WATER LEVELS : Approx. 66 ft BGS
START : 1/29/2009
END : 3/27/2009
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
25		COMPLETE			**Silty Sand With Gravel (SM)** 16.0-51.0' - brown, (7.5YR 4/3), dry, loose, 15% gravel, 60% sand, 25% fines, gravel is angular to subrounded, poorly graded, no dominant mineralogy, matrix supported, max clast size = 100 mm		
	29.0		15:10				
30	30.0			SM			
35							
	39.0		16:30				
40	40.0						

PROJECT NUMBER:	BORING NUMBER:
382653.FP.04.FW	MW-58 SHEET 3 OF 11

SOIL BORING LOG

PROJECT : PG&E Topock - ERGI
LOCATION : Site A (2100612.1 N, 7616131.8 E)
ELEVATION : 521.8 ft
DRILLING CONTRACTOR : Boart Longyear (D. Roberts)
DRILLING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic drill head and tools
ORIENTATION : Vertical
WATER LEVELS : Approx. 66 ft BGS
START : 1/29/2009
END : 3/27/2009
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
45		COMPLETE		SM	**Silty Sand With Gravel (SM)** 16.0-51.0' - brown, (7.5YR 4/3), dry, loose, 15% gravel, 60% sand, 25% fines, gravel is angular to subrounded, poorly graded, no dominant mineralogy, matrix supported, max clast size = 100 mm		
50	49.0 – 50.0		17:10				
				ML	**Silt (ML)** 51.0-53.0' - dark brown, (7.5YR 3/2), dry, stiff, 0% gravel, 0% sand, 100% fines, no apparent structure, max clast size = 20 mm. Occurrence of lenses of white clayey silt up to 10 mm thick, cohesive.		
55				SP	**Poorly Graded Sand With Gravel (SP)** 53.0-60.0' - dark yellowish brown, (10YR 4/6), dry, loose to medium dense, 30% gravel, 65% sand, 5% fines, sand is fine to medium grained, subangular to subrounded, poorly graded, no dominant mineralogy, matrix supported, max clast size = 30 mm.		
60	59.0 – 60.0		17:30				Total depth of Rotosonic boring is 65.5 ft bgs. Install permanent 6-in conductor casing (portland cement grout). See rock core log for 60.0-65.5 lithlologic description.
					Begin rock coring from 65.5 ft bgs See the next page for the rock core log.		

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-58	SHEET 4 OF 11

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site A (2100612.1 N, 7616131.8 E)

ELEVATION : 521.8 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 66 ft BGS

START : 1/29/2009

END : 3/27/2009

LOGGER : A. Brewster (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	60.0					**Metadiorite (pTbr)** 60.0-62.0' - Metadiorite.Highly weathered.	
						Metadiorite (pTbr) 62.0-65.5' - Metadiorite. Rock is competent, but shattered and partially pulverized by Rotosonic drilling method.	
65							
	65.5		>10	65.5-70.0' - core recovered, but largely broken by drilling.		**Metadiorite (pTbr)** 65.5-206.0' - dusky yellowish green, (10GY 3/2), intermediate (dioritic) mineralogy, medium grained, strong (R4), unweathered, massive to foliated	65.5': Begin rotary core drilling General Note: The metadiorite bedrock exhibits many small healed fractures (1-3 mm) of somewhat random orientation. These healed fractures create weaknesses in the rock. It can be difficult to determine if the metadiorite is jointed in-situ, or if the discontinuities are caused by the drilling method. Intervals with fracture per foot counts >10 are likely caused by drilling.
	R1 3 ft 100%	13	>10				
			>10				
	68.5 R2 1 ft 100%	0	1	68.5' - Joint, 50 deg, rough, undulating, < 1 mm calcite infilling, no staining, tight			
	69.5 R3 0.5 ft 100%	0	>10				
70	70.0		1				
			0	70.9' - Joint, 30 deg, rough, undulating, < 1 mm calcite infilling, no staining, tight			
	R4 5.5 ft 95%	100	3	72.2' - Joint, 35 deg, rough, undulating, < 1 mm calcite infilling, no staining, tight			R1 = 11.5 min R2 = 13.2 min R3 = 8.0 min
			1	72.7' - Joint (2), 40 deg and 60 deg, rough, undulating, < 1 mm calcite infilling, yellowish staining on 40 deg face, tight			
			0	73.9' - Joint, 40 deg, rough, undulating, yellowish silty infill (< 1 mm) and < 1 mm calcite infilling, yellowish staining, tight			
75							
	75.5		3	75.2' - Joint, 40 deg, rough, undulating, < 1 mm calcite infilling, no staining, tight			R4 = 23.3 min
			0	75.7, 76.0' - Joint, 60 deg, rough, undulating, < 1 mm calcite infilling, no staining, tight			
			1	77.2' - Joint, 60 deg, rough, undulating, < 1 mm calcite infilling, no staining, tight			
			2	78.3' - Joint, 40 deg, rough, stepped, no staining, tight			
	R5 8.5 ft 100%	67	2	78.8' - Joint, 60 deg, rough, undulating, no staining, tight			
80							

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-58	SHEET 5 OF 11

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site A (2100612.1 N, 7616131.8 E)

ELEVATION : 521.8 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 66 ft BGS

START : 1/29/2009

END : 3/27/2009

LOGGER : A. Brewster (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			1	79.3, 79.6' - Joint, 40 deg, rough, undulating, no staining, tight		**Metadiorite (pTbr)**	
			>10	80.4' - Joint, 15 deg, rough, undulating, some red staining, tight		65.5-206.0' - dusky yellowish green, (10GY 3/2), intermediate (dioritic) mineralogy, medium grained, strong (R4), unweathered, massive to foliated	
			2	81.1' - Joint, 15 deg, rough, undulating, < 0.5 mm calcite infilling, no staining, tight			
			1	81.4-82.1' - Fracture zone, rough, undulating, < 1 mm calcite infilling, no staining, tight, 60 deg dip at 82.1'			R5 = 39.2 min
	84.0			82.5-84.0' - Joint, near 90 deg, rough, undulating, < 2 mm calcite infilling, no staining, tight			
85	R6 1.5 ft 100%	80	1				
	85.5		2	84.9' - Joint, 25 deg, rough, undulating, < 1 mm calcite infilling, no staining, tight			R6 = 4.5 min
			>10	85.3, 85.5' - Joint, 40 deg, rough, stepped, < 0.5 mm calcite infilling, no staining, tight			
	R7 4.4 ft 100%	32	>10	86' - Joint, 10 deg, rough, undulating, < 1 mm calcite infilling, no staining, tight			
			>10	86.4' - Joint, 40 deg, rough, undulating, < 1 mm calcite infilling, yellowish staining, tight, 86.4-88.9' multiple fractures, rough, undulating, minor calcite growth (< 1 mm), some yellowish staining, tight. 60 deg dip at 88.9'.			
			>10				R7 = 19.6 min
90	89.9						
			>10	90.3' - Joint, 30 deg, rough, undulating, no staining, tight			
	R8 4.5 ft 100%	51	2	90.5-90.9' - Fracture zone, rough, undulating, no staining, tight, 60 deg dip at 90.9'			
			2	91.0' - Joint, 60 deg, rough, undulating, reddish staining, tight 91.5' - Joint, 30 deg, rough, undulating, reddish staining, tight			
			>10	92.4' - Joint, 10 deg, rough, undulating, calcite infilling, no staining, tight			
	94.4 R9 1 ft 100%		>10	92.8' - Joint, 40 deg, rough, undulating, reddish staining, tight			R8 = 30.5 min
95		33		93.4-93.9' - Fracture zone, rough, undulating, brownish-grey microcrystalline infill (< 1 mm), reddish-yellow staining, tight, no reaction to HCl			
	95.4		>10	94.6-97.8' - Multiple healed fractures, rough, undulating, > 3 mm black infill, some rust-colored staining, tight.			R9 = 4.5 min
			>10	96.1' - Joint, 40 deg, rough, undulating, < 1 mm calcite infilling, no staining, tight			
	R10 4.6 ft 100%	17	>10	97.0, 97.9' - Joint, 60 deg, rough, undulating, no staining, tight			
			>10	97.9-100.0' - Fracture zone, rough, undulating, < 1 mm black infill, reddish staining			
			>10				R10 = 23.3 min
100	100.0						

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-58	SHEET 6 OF 11

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site A (2100612.1 N, 7616131.8 E)

ELEVATION : 521.8 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 66 ft BGS

START : 1/29/2009

END : 3/27/2009

LOGGER : A. Brewster (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			1	100.4' - Joint, 40 deg, rough, undulating, no staining, tight		**Metadiorite (pTbr)** 65.5-206.0' - dusky yellowish green, (10GY 3/2), intermediate (dioritic) mineralogy, medium grained, strong (R4), unweathered, massive to foliated	
			0				
	R11 5.5 ft 100%	100	0				
			2	103.1' - Joint, 20 deg, rough, undulating, < 0.5 mm calcite infilling, no staining, tight			
			1	103.9' - Joint, 40 deg, rough, undulating, < 0.5 mm calcite infilling, no staining, tight			
105				104.2' - Joint, 40 deg, rough, undulating, < 0.5 mm calcite infilling, some red staining, tight			
	105.5		0				R11 = 21.9 min
			1	106.4' - Joint, 40 deg, rough, undulating, no staining, tight			
			0				
			>10	108.3-108.7' - Fracture zone, rough, undulating, no staining, tight			
			0				
110	R12 9.7 ft 100%	79	0				
			1	111.1' - Joint, 30 deg, rough, undulating, no staining, tight			
			0				
			1	113' - Joint, 60 deg, rough, undulating, < 1 mm calcite infilling, reddish staining, tight			
			2	114.1' - Joint, 40 deg, rough, undulating, < 2 mm calcite infilling, no staining, tight			R12 = 36.7 min
115				114.7' - Joint, 15 deg, rough, undulating, < 1 mm calcite infilling, reddish staining, tight			
	115.2		1	115.3, 116.7, 116.8' - Joint, 35 deg, rough, undulating, < 2 mm calcite infilling, no staining, tight			Drilling to 115.2 ft bgs ends on 2/4/2009, following testing, drilling resumes on 3/25/2009.
			2				
			0				
			1	118.5' - Joint, 55 deg, rough, undulating, < 5 mm calcite infilling, no staining, tight			
120			0				

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-58	SHEET 7 OF 11

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site A (2100612.1 N, 7616131.8 E)

ELEVATION : 521.8 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 66 ft BGS

START : 1/29/2009

END : 3/27/2009

LOGGER : A. Brewster (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	R13 10.8 ft 100%	100	1	120.7' - Joint, 35 deg, rough, undulating, < 2 mm calcite infilling, no staining, tight		**Metadiorite (pTbr)** 65.5-206.0' - dusky yellowish green, (10GY 3/2), intermediate (dioritic) mineralogy, medium grained, strong (R4), unweathered, massive to foliated	
			0				
			0				
			2	123.4, 123.5' - Joint, 35 deg and 45 deg, rough, undulating, < 1 mm calcite infilling, no staining, tight			
			1	124.5' - Joint, 70 deg, rough, undulating, < 1 mm calcite infilling, no staining, moderately tight			
125			0				
	126.0						R13 = 25.1 min
			0				
			1	127.2' - Joint, 65 deg, rough, undulating, < 2.5-inch dark reddish brown (10R 3/4) consolidated fine sediment infilling, no staining, tight			
	R14 6.5 ft 100%	65	0				
			0				
130							
			>10	130.2-132.5' - Fracture zone, rough, undulating to stepped, < 2 mm calcite infilling, reddish staining, no dominant orientation		130.2-132.5' - slightly weathered	
			>10				
	132.5		>10				R14 = 20.3 min
	R15 3.7 ft 100%	100	0				
			0				
135							
	136.2		1	135.7' - Joint, 15 deg, rough, undulating, < 1 mm calcite infilling, no staining, tight			R15 = 14.5 min
			0				
			0				
			0				
			0				
140							

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-58	SHEET 8 OF 11

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site A (2100612.1 N, 7616131.8 E)

ELEVATION : 521.8 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 66 ft BGS

START : 1/29/2009

END : 3/27/2009

LOGGER : A. Brewster (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	R16 10.2 ft 100%	100	0			**Metadiorite (pTbr)** 65.5-206.0' - dusky yellowish green, (10GY 3/2), intermediate (dioritic) mineralogy, medium grained, strong (R4), unweathered, massive to foliated	
			0				
			0				
			1				
			1	143.9, 144.6' - Joint, 40 deg, rough, undulating to stepped, < 5 mm calcite infilling, no staining, moderately tight			
145			3	145.1, 145.3, 145.5' - Joint, 40 deg, rough, undulating, < 5 mm calcite infilling, reddish staining, tight to moderately tight			
	146.4		0				R16 = 33.0 min
			1	147.4' - Joint, 40 deg, rough, undulating, < 1 mm calcite infilling, no staining, tight			
			2	148.1, 148.3, 149.6' - Joint, 65 deg, rough, undulating, < 5 mm calcite infilling, reddish staining, tight			
			1				
150			1	150.1, 152.9, 153.4, 154.5' - Joint, 25, 25, 25, and 65 deg, rough, undulating, < 1 mm calcite infilling, no staining, tight			
	R17 9.8 ft 100%	90	0				
			1				
			1				
			1				
155			1	155.0, 156.1, 156.4, 156.7' - Joint, 30 deg, rough, undulating, < 1 mm calcite infilling, dark red to black staining, tight			
	156.2		3				R17 = 37.8 min
			0				
			1	158.5' - Joint, 85 deg, rough, undulating, < 1 mm calcite infilling, reddish staining, tight			
160			0				

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-58	SHEET 9 OF 11

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site A (2100612.1 N, 7616131.8 E)

ELEVATION : 521.8 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 66 ft BGS

START : 1/29/2009

END : 3/27/2009

LOGGER : A. Brewster (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	R18 10 ft 100%	80	0			**Metadiorite (pTbr)** 65.5-206.0' - dusky yellowish green, (10GY 3/2), intermediate (dioritic) mineralogy, medium grained, strong (R4), unweathered, massive to foliated	
			0				
			0				
			0				
			>10	164.5-166.7' - Fracture zone, rough, undulating, < 1 mm calcite infilling, reddish staining, no dominant orientation, moderately tight			
165			>10				
	166.2		>10				R18 = 39.0 min
	R19 7 ft 100%	57	1	167.4' - Joint, 65 deg, rough, undulating, < 3 mm calcite infilling, no staining, moderately tight			
			>10	168.2-169.0' - Fracture zone, rough, undulating, < 5 mm calcite infilling, no staining, no dominant orientation, tight			
			1	169.5, 170.5' - Joint, 65 deg, rough, undulating, < 3 mm calcite infilling, no staining, tight			
170			1				
			1	171.5' - Joint, 30 deg, rough, undulating, < 1 mm calcite infilling, reddish staining, tight		171.7-172.2' - medium to coarse grained	
			>10	171.7-178.0' - Fracture zone, rough, undulating, reddish staining, tight		172.2-177.4' - yellowish gray, (5Y 8/1), largely felsic mineralogy, fine grained, unweathered	
	173.2						R19 = 38.0 min
	R20 2 ft 100%	40	>10				
			>10				
175	175.2						R20 = 11.3 min
	R21 2 ft 100%	20	>10				
			>10				
	177.2						R21 = 12.2 min
			>10			177.4-179.4' - light grey (N7), largely felsic mineralogy, coarse grained, unweathered	
	R22 4.3 ft 100%	81	3	178.1, 178.3, 178.7' - Joint, 45, 45, 85 deg, rough, undulating, < 1 mm fine-grained white sediment/silt (no reaction to HCl) infilling, no staining, moderately tight			
180			1			179.4' - fine grained	

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-58	SHEET 10 OF 11

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site A (2100612.1 N, 7616131.8 E)

ELEVATION : 521.8 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 66 ft BGS

START : 1/29/2009

END : 3/27/2009

LOGGER : A. Brewster (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			1	179.7, 180.7' - Joint, 60 deg, rough, undulating, < 1 mm calcite infilling, reddish staining, tight		**Metadiorite (pTbr)** 65.5-206.0' - dusky yellowish green, (10GY 3/2), intermediate (dioritic) mineralogy, medium grained, strong (R4), unweathered, massive to foliated	
	181.5		>10	181.2-181.5' - Fracture zone, rough, undulating, reddish staining, no dominant orientation, tight			R22 = 24.0 min
			0			182.3-183.2' - coarse grained	
	R23 4.5 ft 100%	100	0				
			3	184.0, 184.1, 184.5' - Joint, 60 deg, rough, undulating, < 3 mm white silt/clay infilling (no HCl reaction, greasy when wet), no staining, tight			
185			1			184.5-185.0' - increase in felsic minerals	
	186.0			185.6, 186.8, 186.9' - Joint, 25, 25, and 55 deg, rough, undulating, < 2 mm calcite infilling, no staining, tight			R23 = 17.8 min
			2				
			>10	187.2-187.9' - Fracture zone, rough, undulating, < 1 mm calcite infilling, reddish staining, no dominant orientation, moderately tight		187.0-195.2' - medium grained	
	R24 6.5 ft 100%	62	3	188.3, 2 at 188.7' - Joint, 60, 85, and 85 deg, rough, undulating, < 1 mm calcite infilling, rusty staining, tight			
190			2	189.1, 189.6, 190.3' - Joint, 75, 15, and 75 deg, rough, undulating, < 2 mm calcite infilling, rusty staining, moderately tight			
			1				
			>10	191.5-192.5' - Fracture zone, rough, undulating, rusty staining, no dominant orientation, tight			
	192.5		>10				R24 = 39.0 min
			1	193.3, 194.1, 194.3, 194.7' - Joint, 25 deg, rough to smooth, undulating, rusty staining, tight			
	R25 3.5 ft 100%	57	3				
195			>10	195.0-198.8' - Fracture zone, rough, undulating, reddish staining, no dominant orientation, tight		195.2-197.3' - yellowish grey (5Y 8/1), largely felsic minerals, fine grained, unweathered	
	196.0						R25 = 13.0 min
			>10				
	R26 2.6 ft 100%	23	>10				
	198.6		>10	198.1, 199.4, 199.7' - Joint, 30 deg, rough, stepped to undulating, < 1 mm calcite infilling, reddish staining, tight			R26 = 17.7 min
			3				
200							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
382653.FP.04.FW	MW-58 SHEET 11 OF 11

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site A (2100612.1 N, 7616131.8 E)

ELEVATION : 521.8 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 66 ft BGS

START : 1/29/2009

END : 3/27/2009

LOGGER : A. Brewster (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	R27 4.4 ft 100%	39	3	200.1, 200.6, 200.9' - Joint, 60, 30, and 30 deg, rough, undulating to stepped, < 1 mm calcite infilling, reddish staining, moderately tight		**Metadiorite (pTbr)** 199.1-206.0' - greenish gray, (5GY 6/1), intermediate (dioritic) mineralogy, medium grained, strong (R4), unweathered, massive to foliated	
			0				
			>10	202.0-206.0' - Fracture zone, rough, undulating to stepped, < 3 mm calcite infilling, reddish staining, moderately tight			R27 = 27.0 min
203.0							
	R28 3 ft 100%	17	>10				
205			>10				
			>10				
206.0						End Drilling on 3/27/2009 Total Borehole Depth: 206.0 ft bgs	
210							
215							
220							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-59	SHEET 1 OF 6

SOIL BORING LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site G (2100852.0 N, 7616081.9 E)

ELEVATION : 538.9 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

DRILLING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic drill head and tools

ORIENTATION : Vertical

WATER LEVELS : Approx. 84 ft BGS

START : 2/25/2009

END : 2/26/2009

LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
0		COMPLETE		SM	**Silty Sand (SM)** 0-82.0' - brown, (10YR 4/3), dry, loose, 10% gravel, 75% sand, 15% fines, angular to subangular, poor to moderate grading, matrix supported, max clast size = 80 mm.		Target depth of boring is 15 feet past static water level.
					3.5-18.5' - yellowish brown, (10YR 5/4)		
5							
10							
15							
					18.5-71.0' brown, (10YR 4/3)		
20							

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-59	SHEET 2 OF 6

SOIL BORING LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site G (2100852.0 N, 7616081.9 E)

ELEVATION : 538.9 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

DRILLING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic drill head and tools

ORIENTATION : Vertical

WATER LEVELS : Approx. 84 ft BGS

START : 2/25/2009

END : 2/26/2009

LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
25		COMPLETE		SM	**Silty Sand (SM)** 0-82.0' - brown from 18.5', (10YR 4/3), dry, loose, 10% gravel, 75% sand, 15% fines, angular to subangular, poor to moderate grading, matrix supported, max clast size = 80 mm.		
30							
35							
40							

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-59	SHEET 3 OF 6

SOIL BORING LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site G (2100852.0 N, 7616081.9 E)

ELEVATION : 538.9 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

DRILLING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic drill head and tools

ORIENTATION : Vertical

WATER LEVELS : Approx. 84 ft BGS

START : 2/25/2009

END : 2/26/2009

LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
45		COMPLETE		SM	**Silty Sand (SM)** 0-82.0' - brown from 18.5', (10YR 4/3), dry, loose, 10% gravel, 75% sand, 15% fines, angular to subangular, poor to moderate grading, matrix supported, max clast size = 80 mm.		
50							
55							
60							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-59	SHEET 4 OF 6

SOIL BORING LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site G (2100852.0 N, 7616081.9 E)

ELEVATION : 538.9 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

DRILLING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic drill head and tools

ORIENTATION : Vertical

WATER LEVELS : Approx. 84 ft BGS

START : 2/25/2009

END : 2/26/2009

LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
65		COMPLETE			**Silty Sand (SM)** 0-82.0' - brown from 18.5', (10YR 4/3), dry, loose, 10% gravel, 75% sand, 15% fines, angular to subangular, poor to moderate grading, matrix supported, max clast size = 80 mm.		
70				SM	71.0-82.0' brown, (7.5YR 4/3)		
75							
80							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-59	SHEET 5 OF 6

SOIL BORING LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site G (2100852.0 N, 7616081.9 E)

ELEVATION : 538.9 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

DRILLING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic drill head and tools

ORIENTATION : Vertical

WATER LEVELS : Approx. 84 ft BGS

START : 2/25/2009

END : 2/26/2009

LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft) / RECOVERY (in) / LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
	COMPLETE	SM	**Silty Sand (SM)** 0-82.0' - brown from 71.0', (7.5YR 4/3), dry, loose, 10% gravel, 75% sand, 15% fines, angular to subangular, poor to moderate grading, matrix supported, max clast size = 80 mm.		
85		SP	**Poorly Graded Sand With Gravel (SP)** 82.0-101.0' - dark brown, (10YR 3/3), dry, loose to medium dense, 40% gravel, 60% sand, 0% fines, subangular to subrounded, poorly graded, matrix supported, max clast size = 50 mm. 83.0' - moist 84.0' - saturated		
90					
95			95.0' - very dark greyish brown (10YR 3/3)		
100			97.5' - a mixture of very dark greyish brown, (10YR 3/2), and dark reddish brown, (5YR 3/4)		

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-59	SHEET 6 OF 6

SOIL BORING LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site G (2100852.0 N, 7616081.9 E)

ELEVATION : 538.9 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

DRILLING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic drill head and tools

ORIENTATION : Vertical

WATER LEVELS : Approx. 84 ft BGS

START : 2/25/2009

END : 2/26/2009

LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
		COMPLETE		SP	**Poorly Graded Sand With Gravel (SP)** 82.0-101.0' - mixture of very dark greyish brown, (10YR 3/2), and dark reddish brown, (5YR 3/4), from 97.0', loose to medium dense, 40% gravel, 60% sand, 0% fines, subangular to subrounded, poorly graded, saturated from 84.0', matrix supported, max clast size = 50 mm. End Drilling on 2/26/2009 Total Borehole Depth: 101.0 ft bgs		
105							
110							
115							
120							

PROJECT NUMBER:	BORING NUMBER:
382653.FP.04.FW	MW-60 SHEET 1 OF 7

SOIL BORING LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site F (2100491.6 N, 7616434.8 E)

ELEVATION : 555.8 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

DRILLING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic drill head and tools

ORIENTATION : Vertical

WATER LEVELS : Approx. 98 ft BGS

START : 2/27/2009

END : 3/3/2009

LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
5		COMPLETE		SM	**Silty Sand (SM)** 0.0-9.0' - dark yellowish brown, (10YR 4/4), dry, loose, 15% gravel, 60% sand, 25% fines, angular to subangular, poorly graded, no dominant mineralogy, matrix supported, max clast size = 60 mm.		Boring initially drilled to 86.5' bgs using Rotosonic tools up to 6-in in diameter. 6-in conductor casing then used as a temporary conductor casing to facilitate rotary core drilling. Boring drilled from 86.5' bgs to a total depth of 123.0' bgs using diamond bit rotary core tools (HQ-size, 3.8-in diameter), and then overdrilled to total depth using 6-in Rotosonic tools.
10				pTbr	**Metadiorite (pTbr)** 9.0-86.5' - bedrock is consolidated. Drilling method pulverizes most of the core. Intact portions of core are described, as appropriate.		
15					16.0-26.0'- greyish green (5G 5/2), fine grained, some calcite infill (1 mm max) and reddish staining observed on fracture surfaces		
20							

PROJECT NUMBER:	BORING NUMBER:
382653.FP.04.FW	MW-60 SHEET 2 OF 7

SOIL BORING LOG

PROJECT : PG&E Topock - ERGI
LOCATION : Site F (2100491.6 N, 7616434.8 E)
ELEVATION : 555.8 ft
DRILLING CONTRACTOR : Boart Longyear (D. Roberts)
DRILLING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic drill head and tools
ORIENTATION : Vertical
WATER LEVELS : Approx. 98 ft BGS
START : 2/27/2009
END : 3/3/2009
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft) / RECOVERY (in) / LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
25	COMPLETE	pTbr	**Metadiorite (pTbr)** 16.0-26.0'- greyish green (5G 5/2), fine grained, some calcite infill (1 mm max) and reddish staining observed on fracture surfaces 26.0-35.0'- dusky yellowish green (10GY 3/2), fine grained, some calcite infill (1 mm max) and reddish staining observed on fracture surfaces		
30					
35			36.0-73.0'- dusky green (5G 3/2), fine grained, no infill, very little reddish staining on fracture surfaces		
40					

PROJECT NUMBER:	BORING NUMBER:
382653.FP.04.FW	MW-60 SHEET 3 OF 7

SOIL BORING LOG

PROJECT : PG&E Topock - ERGI LOCATION : Site F (2100491.6 N, 7616434.8 E)

ELEVATION : 555.8 ft DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

DRILLING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic drill head and tools ORIENTATION : Vertical

WATER LEVELS : Approx. 98 ft BGS START : 2/27/2009 END : 3/3/2009 LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
45		COMPLETE		pTbr	**Metadiorite (pTbr)** 36.0-73.0'- dusky green (5G 3/2), fine grained, no infill, very little reddish staining on fracture surfaces		
50							
55							
60							

PROJECT NUMBER:	BORING NUMBER:
382653.FP.04.FW	MW-60 SHEET 4 OF 7

SOIL BORING LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site F (2100491.6 N, 7616434.8 E)

ELEVATION : 555.8 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

DRILLING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic drill head and tools

ORIENTATION : Vertical

WATER LEVELS : Approx. 98 ft BGS

START : 2/27/2009

END : 3/3/2009

LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
65		COMPLETE			**Metadiorite (pTbr)** 36.0-73.0'- dusky green (5G 3/2), fine grained, no infill, very little reddish staining on fracture surfaces		
70				pTbr			
					73.0-86.5'- dusky green (5G 3/2) rock mass with very light grey (N8) mottling, medium grained, calcite infill and reddish staining on fracture surfaces		73.0-86.5'- Nearly 100% of core recovered is intact.
75							
80							

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-60	SHEET 5 OF 7

SOIL BORING LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site F (2100491.6 N, 7616434.8 E)

ELEVATION : 555.8 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

DRILLING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic drill head and tools

ORIENTATION : Vertical

WATER LEVELS : Approx. 98 ft BGS

START : 2/27/2009

END : 3/3/2009

LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
85	86.5	COMPLETE		pTbr	73.0-86.5'- dusky green (5G 3/2) rock mass with very light grey (N8) mottling, medium grained, calcite infill and reddish staining on fracture surfaces		Total depth of initial Rotosonic boring is 86.5 ft bgs. Begin rotary core drilling.
					Begin rock coring from 86.5 ft bgs See the next page for the rock core log.		
90							
95							
100							

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-60	SHEET 6 OF 7

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI | LOCATION : Site F (2100491.6 N, 7616434.8 E)

ELEVATION : 555.8 ft | DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit) | ORIENTATION : Vertical

WATER LEVELS : Approx. 98 ft BGS | START : 2/27/2009 | END : 3/3/2009 | LOGGER : A. Brewster (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
86.5			>10	86.5-89.5' - Fracture zone, rough, undulating, < 1 mm calcite infilling, reddish staining, no dominant orientation		**Metadiorite (pTbr)** 86.5-123.0' - dusky green, (5G 3/2), intermediate (dioritic) mineralogy, medium grained, unweathered, massive to foliated	General Note: The metadiorite bedrock exhibits many small healed fractures (1-3 mm) of somewhat random orientation. These healed fractures create weaknesses in the rock. It can be difficult to determine if the metadiorite is jointed in-situ, or if the discontinuities are caused by the drilling method. Intervals with fracture per foot counts >10 are likely caused by drilling.
	R1 3 ft 100%	0	>10				
			>10				
89.5			>10				
90				89.5-96.5' - Fracture zone, 30 deg, rough, undulating, < 1 mm calcite infilling, reddish staining, tight			
			2				
			2				R1 = 23.0 min
	R2 7 ft 100%	53	3			92.0' - fine grained	
			2				
			>10				
95			>10				
96.5			0				R2 = 36.0 min
			1	97' - Joint, 60 deg, rough, undulating, < 1 mm calcite infilling, reddish staining, tight			
			0				
			1				
100			1	100' - Joint, 60 deg, rough, undulating, < 1 mm calcite infilling, no staining, tight			
	R3 9.9 ft 100%	48	2	100.5-105.0' - Fracture zone, 30 deg and 60 deg, rough, undulating, < 1 mm calcite infilling, reddish staining, rusty staining at 102.5' and 103.6', tight.			
			1				
			1				
			1				
105			1			104.5' - medium grained	
			0				
106.4							R3 = 50.0 min

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-60	SHEET 7 OF 7

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site F (2100491.6 N, 7616434.8 E)

ELEVATION : 555.8 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 98 ft BGS

START : 2/27/2009

END : 3/3/2009

LOGGER : A. Brewster (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			1			**Metadiorite (pTbr)**	
			1	107.5' - Joint, 70 deg, rough, undulating, < 1 mm calcite infilling, reddish staining, tight		86.5-123.0' - dusky green, (5G 3/2), intermediate (dioritic) mineralogy, medium grained, unweathered, massive to foliated	
	R4 6 ft 100%	90	0				
110			0				
			0			110.5' - coarse grained	
			0				
	112.4		1	112.0-115.0' - Fracture zone or mechanical break, 30 deg and 60 deg, < 1 mm calcite infilling, rusty-reddish staining, tight, likely mechanical breaks along healed joints		112.0' - fine grained	R4 = 33.0 min
	R5 3.6 ft 100%	0	1			113.5' - yellow-orange staining	
115			1				
	116.0		>10	115.0-116.0' - Fracture zone, rough, undulating, no staining, no dominant orientation			
			1	116.0-123.0' - Fracture zone, 30 deg, rough, undulating, < 0.05 mm calcite infilling, no staining, tight			R5 = 45.0 min
			1				
	R6 7 ft 100%	77	2				
120			1				
			0				
			1			121.0-122.0' - yellow-orange staining	
			1				R6 = 31.0 min
	123.0						
						End Drilling on 3/3/2009 Total Borehole Depth: 123.0 ft bgs	
125							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-60	SHEET 1 OF 6

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site F (2100495.0 N, 7616444.4 E)

ELEVATION : 555.9 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

CORING EQUIPMENT AND METHOD : HQ Wire-Line Rotary
ORIENTATION : Vertical

WATER LEVELS : Approx. 99 ft BGS
START : 6/24/2011
END : 7/28/2011
LOGGER : C. Kreller (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	137.0		5	137' - Grout material 137.1' - Mechanical fracture		**Metadiorite** dusky yellow green, (5GY 5/2), predominantly sodium feldspar and amphibole, phaneritic, fresh, hard, no foliation, highly fractured and healed with chlorite cement, massive.	Run 1: 10 minutes 0 sec
	R1 3 ft 100%	33	2	137.4,137.6' - Joint, 65 deg and 30 deg, smooth, undulating, iron staining, narrow, no calcite infill			
			2	138.1, 138.8' - Joint, 40 deg and 80 deg, smooth, undulating, iron staining, narrow, no calcite infill			
140	140.0			138.9' - Mechanical break			
			2	139.1, 139.5' - Joint, 80 deg and 70 deg, smooth, undulating, iron staining, tight at 139.1', narrow at 139.5, no calcite infill			Run 2: 17 min 11 sec
			>10	140.0-141.0' - predominantly mechanical fractures			
	R2 5 ft 100%	16	>10	141' - multiple fractures, iron staining			
			>10				
			>10	144' - Joint, 20 deg, smooth, undulating, iron staining, no calcite infill, narrow			
145	145.0						
			1	145.0-147.0' - Mechanical fractures predominant			Run 3: 14 min 11 sec
			>10				
	R3 5 ft 100%	73	2	147.1, 147.4' - Joint, 70 deg and 30 deg, smooth, undulating, <2 mm calcite infilling, no iron staining, tight			
			5	148.3, 148.5' - Joint, 60 deg and 80 deg, smooth, undulating, minor iron staining, narrow			
			0				Run 3: 14 min 11 sec
150	150.0						
			2	150' - Predominantly mechanical fractures			Run 4: 16 min 51 sec
			1	151' - Predominantly mechanical fractures			
	R4 5 ft 100%	70	2	152' - Mechanical fractures			
			0				
			0				
155	155.0						
			3	155.5, 155.7, 155.8' - Joint (3), 30, 90, and 60 deg, smooth, undulating, iron staining, tight			Run 5: 15 min 20 sec
			1	156.7' - Joint, 50 deg, smooth, undulating, iron staining, tight			

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-60 SHEET 2 OF 6

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation | LOCATION : Site F (2100495.0 N, 7616444.4 E)

ELEVATION : 555.9 ft | DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

CORING EQUIPMENT AND METHOD : HQ Wire-Line Rotary | ORIENTATION : Vertical

WATER LEVELS : Approx. 99 ft BGS | START : 6/24/2011 | END : 7/28/2011 | LOGGER : C. Kreller (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	R5 5 ft 100%	80	2	157.2, 157.9' - Joint, 10 deg and 10 deg, rough, undulating, iron staining, narrow		**Metadiorite** dusky yellow green, (5GY 5/2), predominantly sodium feldspar and amphibole, phaneritic, fresh, hard, no foliation, highly fractured and healed with chlorite cement, massive.	Run 5: 15 min 20 sec
			1	158.9' - Joint, 50 deg, smooth, undulating, iron staining, tight			
			0				
160	160.0						
			1	160.5' - Joint, 40 deg, rough, undulating, <2mm calcite infilling, iron staining, tight			Run 6: 15 min 0 sec
			1	161.7' - Mechanical fracture			Run 6: 15 min 0 sec
	R6 5 ft 100%	100	1	162.8' - Joint, 40 deg, smooth, undulating, iron staining, tight			
			1	163.7' - Joint, 20 deg, smooth, undulating, iron staining, tight			
			0				
165	165.0						
			2	165.3, 165.7, 165.8' - Joint (3), 50, 60, and 60 deg, rough, undulating, iron staining, narrow			Run 7: 17 min 52 sec
			0				
	R7 5 ft 100%	86	1	167.1' - Joint, horizontal, smooth, undulating, iron staining, moderately narrow			
			1	167.8' - Joint, 10 deg, smooth, undulating, iron staining, tight			
			0	168.8' - Joint, 20 deg, smooth, undulating, minor iron staining, moderately narrow			Run 7: 17 min 52 sec
170	170.0						
			1				Run 8: 60 min 0 sec, water pump issues on rig.
			1	170.8' - Joint, 40 deg, smooth, undulating, iron staining, narrow, no calcite infill			
				171.7' - Mechanical fracture			
	R8 5 ft 100%	86	1	172.6' - Mechanical fracture			
			1				Run 8: 60 min 0 sec, water pump issues on rig.
			0	173.8' - Joint, 20 deg, smooth, undulating, minor iron staining, narrow			
175	175.0						
			0				Run 9: 20 min 10 sec
			2				

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-60 SHEET 3 OF 6

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site F (2100495.0 N, 7616444.4 E)

ELEVATION : 555.9 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

CORING EQUIPMENT AND METHOD : HQ Wire-Line Rotary
ORIENTATION : Vertical

WATER LEVELS : Approx. 99 ft BGS
START : 6/24/2011
END : 7/28/2011
LOGGER : C. Kreller (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	R9 5 ft 100%	93	1	176.2, 176.7' - Joint, 20 deg and 30 deg, rough, minor iron staining, stepped, narrow, no calcite infill		**Metadiorite** dusky yellow green, (5GY 5/2), predominantly sodium feldspar and amphibole, phaneritic, fresh, hard, no foliation, highly fractured and healed with chlorite cement, massive.	Run 9: 20 min 10 sec
			1	177.9' - Mechanical fracture			
			1	178.8' - Joint, 30 deg, rough, undulating, iron staining, moderately narrow			
180	180.0		1	179.3, 179.6' - Joint, 35 deg, smooth, undulating, no iron staining, tight, no calcite infill			Run 10: 17 min 37 sec
			1	180.4' - Joint, 60 deg, smooth, undulating, minor iron staining, tight, no calcite infill			
			1	181.3' - Mechanical fracture along a plane of weakness, <2mm calcite infilling			Run 10: 17 min 37 sec
	R10 5 ft 100%	91	1	182' - Mechanical fracture along a plane of weakness, <2mm calcite infilling			
			1	183.5' - Mechanical fracture			
185	185.0		0				
			2	185.5' - Joint, 50 deg, smooth, undulating, slight iron staining, tight			Run 11: 15 min 31 sec
			6	185.9' - Joint, 50 deg, smooth, undulating, slight iron staining, narrow, chlorite present			
	R11 5 ft 100%	60	2	186.4-186.9' - Joint, 50 deg, smooth, undulating, slight iron staining, narrow to tight. Some mechanical fracturing associated with retrieving core out of barrel, chlorite present			
			1	187.4' - Joint, 45 deg, smooth, undulating, slight iron staining, tight			
190	190.0		0	187.9' - Joint, 60 deg, smooth, undulating, slight iron staining, tight, chlorite present			Run 11: 15 min 31 sec
			1	188.5' - Joint, 25 deg, smooth, undulating, slight iron staining, tight, chlorite present			Run 12: 29 min 30 sec
			1	190.8' - Joint, 35 deg, smooth, undulating, iron staining, tight			
	R12 5 ft 100%	78	0	191.9' - Mechanical fracture			
			3	193.1' - Joint, 30 deg, smooth, undulating, iron staining, tight			Run 12: 29 min 30 sec
			2	193.5' - Mechanical fracture 193.9' - Joint, 30 deg, smooth, undulating, iron staining, tight			
195	195.0			194.3' - Mechanical fracture along a plane of weakness, <2mm calcite infilling			Run 13: 23 min 30 sec
			1	194.5' - Joint, 35 deg, smooth, undulating, slight iron staining, tight			
			0	195.4' - Joint, 60 deg, smooth, undulating, slight iron staining, tight			

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-60	SHEET 4 OF 6

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site F (2100495.0 N, 7616444.4 E)

ELEVATION : 555.9 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

CORING EQUIPMENT AND METHOD : HQ Wire-Line Rotary
ORIENTATION : Vertical

WATER LEVELS : Approx. 99 ft BGS
START : 6/24/2011
END : 7/28/2011
LOGGER : C. Kreller (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	R13 5 ft 100%	92	1	196.8' - Mechanical fracture		**Metadiorite** dusky yellow green, (5GY 5/2), predominantly sodium feldspar and amphibole, phaneritic, fresh, hard, no foliation, highly fractured and healed with chlorite cement, massive.	Run 13: 23 min 30 sec
			0	197.9' - Mechanical fracture, calcite present (<2mm)			
			1				
200	200.0			199.5' - Joint, 20 deg, smooth, undulating, slight iron staining, no calcite present			
			1				Run 14: 39 min 38 sec
			1	200.9' - Mechanical fracture			Run 14: 39 min 38 sec
	R14 5 ft 100%	90	1	201.9' - Mechanical fracture 202.6' - Mechanical fracture			
			2	203.2' - Mechanical fracture			
				203.8' - Mechanical fracture			
			1	204.4' - Mechanical fracture			
205	205.0						
			0				Run 15: unknown
			2	206' - Mechanical fracture			
	R15 5 ft 100%	93	0	206.9' - Mechanical fracture			
			2	208' - Mechanical fracture			
				208.6' - Mechanical fracture			
			0				Run 15: unknown
210	210.0						
			2	210.4' - Mechanical fracture along a preferential plane, <2mm calcite infilling			Run 16: 15 min 0 sec
			0	210.9' - Mechanical fracture along a preferential plane, <2mm calcite infilling			
	R16 5 ft 100%	93	2	212' - Mechanical fracture along a preferential plane, <2mm calcite infilling			
			0	212.9' - Mechanical fracture			Run 16: 15 min 0 sec
			0	214.3' - Mechanical fracture			
215	215.0			214.7' - Mechanical fracture			
			1	215.1' - Mechanical fracture along a preferential plane, <2mm calcite infilling			Run 17: 12 min 29 sec
			0				

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-60 SHEET 5 OF 6

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation | LOCATION : Site F (2100495.0 N, 7616444.4 E)

ELEVATION : 555.9 ft | DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

CORING EQUIPMENT AND METHOD : HQ Wire-Line Rotary | ORIENTATION : Vertical

WATER LEVELS : Approx. 99 ft BGS | START : 6/24/2011 | END : 7/28/2011 | LOGGER : C. Kreller (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	R17 5 ft 100%	88	1	217.5' - Joint, 30 deg, smooth, undulating, <2mm calcite infilling, no iron staining, tight		**Metadiorite** dusky yellow green, (5GY 5/2), predominantly sodium feldspar and amphibole, phaneritic, fresh, hard, no foliation, highly fractured and healed with chlorite cement, massive.	Run 17: 12 min 29 sec
			1	218.7' - Mechanical fracture			
220	220.0		1	219.4' - Mechanical fracture			
			0				Run 18: 17 min 10 sec
			1	221.3' - Mechanical fracture			Run 18: 17 min 10 sec
	R18 5 ft 100%	95	1	222' - Mechanical fracture			
			1	223.5' - Mechanical fracture along a plane of weakness, <2mm calcite infilling			
225	225.0		1	224.3' - Mechanical fracture along a plane of weakness, <2mm calcite infilling			
			0				Run 19: 21 min 30 sec
			0				
	R19 5 ft 100%	100	1	227.3' - Mechanical fracture			
			1				
			0	228.8' - Mechanical fracture			Run 19: 21 min 30 sec
230	230.0						
			2	230.0-230.7' - Joint, 45 deg, smooth, undulating, <2mm calcite infilling, iron staining, narrow		230.0-230.7' - cemented, breccia zone.	Run 20: 20 min 6 sec, increase in water production (230-231' bgs)
			2	230.9' - Joint, 45 deg, smooth, undulating, <2mm calcite infilling, iron staining, tight			
	R20 5 ft 100%	70	1	231.2, 231.4' - Mechanical fracture along a preferential plane, iron staining, <2mm calcite infilling			
			1	232.4' - Joint, 15 deg, smooth, undulating, <2mm calcite infilling, iron staining, narrow			Run 20: 20 min 6 sec
			0	233.4' - Joint, 20 deg, smooth, undulating, <2mm calcite infilling, iron staining, narrow			
235	235.0						
			0				Run 21: 12 min 20 sec
			1				

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-60	SHEET 6 OF 6

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site F (2100495.0 N, 7616444.4 E)

ELEVATION : 555.9 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

CORING EQUIPMENT AND METHOD : HQ Wire-Line Rotary
ORIENTATION : Vertical

WATER LEVELS : Approx. 99 ft BGS
START : 6/24/2011
END : 7/28/2011
LOGGER : C. Kreller (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	R21 5 ft 100%	78	1	236.4' - Mechanical fracture along a plane of weakness, <2mm calcite infilling		**Metadiorite** dusky yellow green, (5GY 5/2), predominantly sodium feldspar and amphibole, phaneritic, fresh, hard, no foliation, highly fractured and healed with chlorite cement, massive.	Run 21: 12 min 20 sec
			1	237.1' - Joint, 30 deg, smooth, undulating, <2mm calcite infilling, minor iron staining, presence of copper colored infill in the joint, tight			
			>10	238.8' - Joint, 25 deg, smooth, undulating, <2mm calcite infilling, tight			
240	240.0			239.4' - Highly fractured zone			
			0	240.1' - Mechanical fracture along a preferential plane, <2mm calcite infilling			Run 22: 29 min 51 sec
			0	240.8' - Joint, 40 deg, smooth, undulating, <2mm calcite infilling, no iron staining			Run 22: 29 min 51 sec
	R22 5 ft 100%		2	242.2' - Joint, 50 deg, rough, undulating, <2mm calcite infilling, minor iron staining			Increase drill rate
			>10	242.4' - Mechanical fracture			
			0	243' - Joint, 45 deg, smooth, undulating, <2mm calcite infilling, minor iron staining			
245	245.0						
						End Drilling on 7/28/2011 Total Borehole Depth: 245.0 ft bgs	This borehole was converted into the following monitoring well(s): MW-60BR-245
250							
255							

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-61	SHEET 1 OF 7

SOIL BORING LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site C (2100713.0 N, 7616591.0 E)

ELEVATION : 544.1 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

DRILLING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic drill head and tools

ORIENTATION : Vertical

WATER LEVELS : Approx. 87 ft BGS

START : 3/4/2009

END : 3/12/2009

LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
5		COMPLETE		SM	**Silty Sand With Gravel (SM)** 0.0-14.0' - dark brown, (7.5YR 3/3), dry, loose, 30% gravel, 50% sand, 20% fines, sand is angular to subangular, poorly graded, no dominant mineralogy, matrix supported, max clast size = 40 mm		Boring initially drilled to 68.0' bgs using Rotosonic tools up to 6-in in diameter. 6-in Rotosonic casing then used as a temporary conductor casing to facilitate the rotary core drilling. Boring drilled from 68.0' bgs to a total depth of 112.4' bgs using diamond bit rotary core tools (HQ-size, 3.8-in diameter) and then overdrilled to total depth using 6-in Rotosonic tools.
10							
15				SP-SM	**Poorly Graded Sand With Silt And Gravel (SP-SM)** 14.0-63.0' - dark brown, (7.5YR 3/3), dry, loose, 20% gravel, 70% sand, 10% fines, sand is angular to subangular, poorly graded, no dominant mineralogy, matrix supported, max clast size = 50 mm		
20							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-61	SHEET 2 OF 7

SOIL BORING LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site C (2100713.0 N, 7616591.0 E)

ELEVATION : 544.1 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

DRILLING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic drill head and tools

ORIENTATION : Vertical

WATER LEVELS : Approx. 87 ft BGS

START : 3/4/2009

END : 3/12/2009

LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
25		COMPLETE		SP-SM	**Poorly Graded Sand With Silt And Gravel (SP-SM)** 14.0-63.0' - dark brown, (7.5YR 3/3), dry, loose, 20% gravel, 70% sand, 10% fines, sand is angular to subangular, poorly graded, no dominant mineralogy, matrix supported, max clast size = 50 mm		
30							
35							
40							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-61	SHEET 3 OF 7

SOIL BORING LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site C (2100713.0 N, 7616591.0 E)

ELEVATION : 544.1 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

DRILLING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic drill head and tools

ORIENTATION : Vertical

WATER LEVELS : Approx. 87 ft BGS

START : 3/4/2009

END : 3/12/2009

LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft) / RECOVERY (in) / LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
45	COMPLETE	SP-SM	**Poorly Graded Sand With Silt And Gravel (SP-SM)** 14.0-63.0' - dark brown, (7.5YR 3/3), dry, loose, 20% gravel, 70% sand, 10% fines, sand is angular to subangular, poorly graded, no dominant mineralogy, matrix supported, max clast size = 50 mm		
50					
55					
60					

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-61	SHEET 4 OF 7

SOIL BORING LOG

PROJECT : PG&E Topock - ERGI
LOCATION : Site C (2100713.0 N, 7616591.0 E)
ELEVATION : 544.1 ft
DRILLING CONTRACTOR : Boart Longyear (D. Roberts)
DRILLING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic drill head and tools
ORIENTATION : Vertical
WATER LEVELS : Approx. 87 ft BGS
START : 3/4/2009
END : 3/12/2009
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
		COMPLETE		SP-SM	**Poorly Graded Sand With Silt And Gravel (SP-SM)** 14.0-63.0' - dark brown, (7.5YR 3/3), dry, loose, 20% gravel, 70% sand, 10% fines, sand is angular to subangular, poorly graded, no dominant mineralogy, matrix supported, max clast size = 50 mm		
65				pTbr	**Metadiorite (pTbr)** 63.0-112.4' - bedrock is consolidated. Drilling method pulverizes most of the core.		
	68.0						Total depth of initial Rotosonic boring is 68.0 ft bgs. Begin rotary core drilling.
					Begin rock coring from 68.0 ft bgs See the next page for the rock core log.		
70							
75							
80							

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-61	SHEET 5 OF 7

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site C (2100713.0 N, 7616591.0 E)

ELEVATION : 544.1 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 87 ft BTOC

START : 3/4/2009

END : 3/12/2009

LOGGER : A. Brewster (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	68.0		0			**Metadiorite (pTbr)** 63.0-112.4' - dusky yellowish green, (10GY 3/2), intermediate (dioritic) mineralogy, fine grained, hard to very hard, unweathered, massive to foliated, pale greenish yellow (10YR 8/2) banding throughout	General Note: The metadiorite bedrock exhibits many small healed fractures (1-3 mm) of somewhat random orientation. These healed fractures create weaknesses in the rock. It can be difficult to determine if the metadiorite is jointed in-situ, or if the discontinuities are caused by the drilling method. Intervals with fracture per foot counts >10 are likely caused by drilling.
70			>10	69.3-69.6' and 70.4-70.6' - Fracture zone, rough, undulating, < 1 mm calcite infilling, reddish staining, tight, no dominant orientation (two at 60 deg)			
	R1 7 ft 100%	53	>10				
			0				
			1	72.5' - Joint, 30 deg, rough, undulating, < 5 mm calcite infilling, some reddish staining, tight			
			>10	73.6-74.0' - Fracture zone, rough, undulating, < 1 mm calcite infilling, no staining, moderately tight, no dominant orientation			R1 = 17.0 min
75	75.0		1	74.4, 75.3' - Joint, 60 deg, rough, undulating, < 3 mm calcite infilling, reddish staining, tight			
			1				
			0			76.0' - yellow-orange staining	
			1				
			1	77.9, 78.4, 79.5, 80.9' - Joint, 60 deg, rough, undulating, < 3 mm calcite infilling, some reddish staining, tight			
	R2 9.3 ft 100%	86	1				
80			1				
			>10			81.0-94.5' - dusky yellow green, (5GY 5/2)	
			1	81.8-82.0' - Fracture zone, rough, undulating, no staining, infill by calcite (primary) and dark greyish black material (< 3 mm), moderately tight, no dominant orientation			
			>10	82.5' - Joint, 80 deg, rough, undulating, calcite (< 1 mm) and dark greyish black material (< 2 mm), no staining, moderately tight			R2 = 33.0 min
	84.3		>10	83.5-84.6' - Fracture zone, < 1 mm calcite infilling, no staining, tight, no dominant orientation			
85			1				
			2	85.5, 86.4, 86.5, 87.4' - Joint, rough, undulating, < 5 mm calcite infilling, prominent reddish staining, 45, 80, 80, and 10 deg respectively, tight			
	R3 6 ft 100%	57	1			87.0' - yellow-orange staining	

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-61	SHEET 6 OF 7

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site C (2100713.0 N, 7616591.0 E)

ELEVATION : 544.1 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 87 ft BTOC

START : 3/4/2009

END : 3/12/2009

LOGGER : A. Brewster (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
90			0			**Metadiorite (pTbr)** 63.0-112.4' - dusky yellow green, (5GY 5/2), intermediate (dioritic) mineralogy, fine grained, hard to very hard, unweathered, massive to foliated, pale greenish yellow (10YR 8/2) banding throughout 89.0-94.5' - medium grained	
			0				
	90.3		1				R3 = 12.5 min
	R4 4.2 ft 100%	71	1	90.9' - Joint, 20 deg, rough, undulating, < 1 mm calcite infilling, prominent reddish staining, tight			
			>10	91.9' - Joint, 80 deg, rough, undulating, calcite (< 3 mm) and dark greyish black material (< 1 mm), no staining, tight			
			>10	92.2-93.4' - Fracture zone, rough, undulating, primary calcite infill, secondary reddish staining, tertiary dark greyish-black infill, tight, no dominant orientation			
	94.5		2	94.2, 94.5, 95.6, 96.4' - Joint, rough, undulating, < 1 mm calcite infilling, reddish staining, 60, 30, 60, and 30 deg (respectively), tight			R4 = 11.8 min
95			1			94.5-109.2' - dusky yellowish green, (10GY 3/2), fine grained	
			1				
			>10	97.0-97.7' - Fracture zone, no staining, < 1 mm dark greyish-black infill, tight, no dominant orientation			
			0				
	R5 10 ft 100%	90	1	99.4, 101.2, 101.8, 102.5, 103.3' - Joint, rough, undulating, < 1 mm calcite infilling, some reddish staining, 40, 40, 10, 40, and 60 deg (respectively), tight			
100			0				
			2				
			1				
			1				
	104.5		0				R5 = 30.0 min
105			1	105.4, 106.2, 106.7' - Joint, 10 deg, rough, undulating, < 5 mm calcite infilling, some reddish staining, tight			
	R6 4.7 ft 100%	94	2				
			0				

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-61	SHEET 7 OF 7

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site C (2100713.0 N, 7616591.0 E)

ELEVATION : 544.1 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 87 ft BTOC

START : 3/4/2009

END : 3/12/2009

LOGGER : A. Brewster (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			1	108.1, 109.2, 109.9, 110.3, 111.8' - Joint, 60, 40, 10, 20, and 30 deg (respectively), rough, undulating to stepped, calcite growth (< 1 mm), reddish to dark reddish staining, tight.		**Metadiorite (pTbr)** 63.0-112.4' - dusky yellowish green, (10GY 3/2), intermediate (dioritic) mineralogy, fine grained, hard to very hard, unweathered, massive to foliated, pale greenish yellow (10YR 8/2) banding throughout 109.2-112.4' - greyish pink, (5R 8/2), coarse grained, greyish pink, (5R 8/2), coarse grained	
109.2			2				R6 = 24.0 min
110	R7 3.2 ft 100%	100	1				
			1				
112.4			0			End Drilling on 3/12/2009 Total Borehole Depth: 112.4 ft bgs	R7 = 22.0 min
115							
120							
125							

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-62	SHEET 1 OF 11

SOIL BORING LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site E (2101068.3 N, 7616551.0 E)

ELEVATION : 503.6 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

DRILLING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic drill head and tools

ORIENTATION : Vertical

WATER LEVELS : Approx. 47 ft BGS

START : 3/14/2009

END : 4/22/2009

LOGGER : A. Brewster/C. Kreller (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
0		COMPLETE		SM	**Silty Sand (SM)** 0.0-4.5' - dark yellowish brown, (10YR 4/4), dry, loose, 5% gravel, 80% sand, 15% fines, angular to subangular, poorly graded, no dominant mineralogy, matrix supported, max clast size = 30 mm		This log is the combination of two adjacent boreholes. Boring initially drilled to 21.0' bgs using Rotosonic tools up to 6-in in diameter. 6-in Rotosonic casing then used as temporary conductor casing to facilitate rotary core drilling. Boring drilled from 21.0' bgs to a total depth of 65.0' bgs using diamond bit rotary core tools (HQ-size, 3.8-in diameter) and then overdrilled to total depth using 6-in Rotosonic tools. Adjacent borehole (approximately 10' southeast) was drilled to 75' bgs using Rotosonic tools up to 10-in diameter. Permanent 6-in PVC conductor casing installed from ground surface to 75' bgs (portland cement grout). Boring drilled from 75' bgs to a total depth of 191.5' bgs using diamond bit rotary core tools (HQ-size, 3.8-in diameter).
5					**Conglomerate (Tmc)** 4.5-21.0' - reddish brown, (5YR 4/4), dry, consolidated, no dominant clast mineralogy. Drilling method pulverizes most of the core.		
10				Tmc			
15							
20							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-62	SHEET 2 OF 11

SOIL BORING LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site E (2101068.3 N, 7616551.0 E)

ELEVATION : 503.6 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

DRILLING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic drill head and tools

ORIENTATION : Vertical

WATER LEVELS : Approx. 47 ft BGS

START : 3/14/2009

END : 4/22/2009

LOGGER : A. Brewster/C. Kreller (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
21.0		COMPLETE		Tmc			Total depth of Rotosonic boring is 21.0 ft bgs. Begin rotary core drilling.
					Begin rock coring from 21.0 ft bgs See the next page for the rock core log.		
25							
30							
35							
40							

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-62	SHEET 3 OF 11

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site E (2101068.3 N, 7616551.0 E)

ELEVATION : 503.6 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 47 ft BGS

START : 3/14/2009

END : 4/22/2009

LOGGER : A. Brewster/C. Kreller (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION — DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS	SYMBOLIC LOG	LITHOLOGY — ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS	COMMENTS — SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.
21.0			0			**Conglomerate(Tmc)** 21.0-64.5' - moderate reddish brown, (10R 4/6), no dominant clast mineralogy, strong (R4), hard, unweathered, fine matrix, coarse sand to coarse gravel sized clasts, massive	
	R1 5.5 ft 18%	0	0				
			0				
			0				
25			0				
26.5			0				R1 = run time not available
			0				
			0				
			0				
30	R2 8 ft 28%	0	0				
			0				
			0				
			0				
			0				
34.5			0				R2 = 45.0 min
35			0				
			0				
			0				
			1	38.4' - Joint, 40 deg, rough, undulating, no staining, moderately tight			
	R3 10 ft 100%	83	0				
40			0				

PROJECT NUMBER:	BORING NUMBER:
382653.FP.04.FW	MW-62 SHEET 4 OF 11

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site E (2101068.3 N, 7616551.0 E)

ELEVATION : 503.6 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 47 ft BGS

START : 3/14/2009

END : 4/22/2009

LOGGER : A. Brewster/C. Kreller (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			0			**Conglomerate(Tmc)** 21.0-64.5' - moderate reddish brown, (10R 4/6), no dominant clast mineralogy, strong (R4), hard, unweathered, fine matrix, coarse sand to coarse gravel sized clasts, massive	
			1	42.8' - Joint, 60 deg, rough, undulating, no staining, moderately tight			
			0				
			0				R3 = 27.0 min
44.5							
45			0				
			0				
			0				
	R4 7 ft 100%	61	0				
			0				
			1	49' - Joint, 30 deg, rough, undulating to stepped, reddish staining, tight			
50			0				
			0				R4= 34.8 min
51.5							
	R5 3 ft 70%	63	0				
			0				
			0				R5 = 5.0 min
54.5							
55			0				
			0				
			0				
	R6 8.3 ft 100%	65	0				
			0				
60			0				
			0				

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-62	SHEET 5 OF 11

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site E (2101068.3 N, 7616551.0 E)

ELEVATION : 503.6 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 47 ft BGS

START : 3/14/2009

END : 4/22/2009

LOGGER : A. Brewster/C. Kreller (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION — DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS	SYMBOLIC LOG	LITHOLOGY — ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS	COMMENTS — SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.
			1	61.6' - Joint, 45 deg, rough, undulating, no staining, tight		**Conglomerate(Tmc)** 21.0-64.5' - moderate reddish brown, (10R 4/6), no dominant clast mineralogy, strong (R4), hard, unweathered, fine matrix, coarse sand to coarse gravel sized clasts, massive	R6 = 26.9 min
	62.8		0				
	R7 1.7 ft 100%	35	0				R7 = 3.7 min
	64.5		0				
65						**Conglomerate(Tmc)** 64.5-75.0' - Rotosonic drilling method pulverizes core.	
	COMPLETE						
70							
75	75.0						
	R1 1 ft 0%					**Conglomerate(Tmc)** 75.0-191.5' - moderate brown, (5YR 4/4), no dominant clast mineralogy, strong (R4), unweathered, fine matrix, coarse sand to coarse gravel sized clasts, massive	R1= 4.0 min
	76.0		0				
			0				
			0				
			0				
80			0				

PROJECT NUMBER:	BORING NUMBER:
382653.FP.04.FW	MW-62 SHEET 6 OF 11

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site E (2101068.3 N, 7616551.0 E)

ELEVATION : 503.6 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 47 ft BGS

START : 3/14/2009

END : 4/22/2009

LOGGER : A. Brewster/C. Kreller (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
		0	0			**Conglomerate(Tmc)** 75.0-191.5' - moderate brown, (5YR 4/4), no dominant clast mineralogy, strong (R4), unweathered, fine matrix, coarse sand to coarse gravel sized clasts, massive	
	R2 10 ft 65%						
85			NR				
	86.0						R2 = 80 min
			NR				
90	R3 10 ft 40%	40					
			0				
			0				
			1				
95				94.6' - Joint, 30 deg, rough, planar, < 1 mm calcite infilling, reddish staining, tight			
			0				
	96.0						
			0				R3 = 10 min
			0				
			0				
			0				
100			1				

PROJECT NUMBER:	BORING NUMBER:
382653.FP.04.FW	MW-62 SHEET 7 OF 11

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site E (2101068.3 N, 7616551.0 E)

ELEVATION : 503.6 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 47 ft BGS

START : 3/14/2009

END : 4/22/2009

LOGGER : A. Brewster/C. Kreller (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
		60	1	100.7' - Joint, 50 deg, rough, undulating, reddish staining, tight 101.2' - Joint, 20 deg, rough, undulating, reddish staining, tight		**Conglomerate(Tmc)** 75.0-191.5' - moderate brown, (5YR 4/4), no dominant clast mineralogy, strong (R4), unweathered, fine matrix, coarse sand to coarse gravel sized clasts, massive	
	R4 10 ft 80%		0				
			0				
105			0				
	106.0		0				R4 = 20 min
			0				
			0				
			0				
110			0				
	R5 10 ft 100%	100	0				
			0				
			0				
			0				
			0				
115			0				
	116.0		0				R5 = 20 min
			0				
			0				
			0				
120			0				
			0				

PROJECT NUMBER:	BORING NUMBER:
382653.FP.04.FW	MW-62 SHEET 8 OF 11

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI
LOCATION : Site E (2101068.3 N, 7616551.0 E)
ELEVATION : 503.6 ft
DRILLING CONTRACTOR : Boart Longyear (D. Roberts)
CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)
ORIENTATION : Vertical
WATER LEVELS : Approx. 47 ft BGS
START : 3/14/2009
END : 4/22/2009
LOGGER : A. Brewster/C. Kreller (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
		100	0			**Conglomerate(Tmc)**	
	R6 10 ft 100%		0			76.0-191.5' - moderate brown, (5YR 4/4), no dominant clast mineralogy, strong (R4), unweathered, fine matrix, coarse sand to coarse gravel sized clasts, massive	
			0				
			0				
125			0				
126.0							R6 = 20 min
			0			126.0' - moderate brown, (5YR 3/4), matrix supported, friable, moderately weathered	
			0				
			0				
			0				
130	R7 10 ft 80%	100	0				
			0				
			0				
			0				
			0				
135			0				
136.0							R7 = 25 min
			0				
			0				
			0				
			0				
140			0				

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-62	SHEET 9 OF 11

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site E (2101068.3 N, 7616551.0 E)

ELEVATION : 503.6 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 47 ft BGS

START : 3/14/2009

END : 4/22/2009

LOGGER : A. Brewster/C. Kreller (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
		100	0			**Conglomerate(Tmc)** 76.0-191.5' - moderate brown, (5YR 3/4), from 126.0', no dominant clast mineralogy, matrix supported and friable from 126.0', moderately weathered from 126.0'	
	R8 10 ft 100%		0				
			0				
			0				
145			0				
	146.0		0				R8 = 20 min
			0				146.0-156.0' add 300 gallons of water
			0				
			0				
			0				
150			0				
	R9 10 ft 100%	100	0				
			0				
			0				
			0				
			0				
155			0				
	156.0		0			155.5' - moderate brown (5YR 4/4)	R9 = 20 min
			0				
	R10 4 ft 100%	100	0				
			0				
			0				
160	160.0		0				R10 = 7 min
	R11 1 ft 161.0 50%	100	0				R11 = 5 min

PROJECT NUMBER:	BORING NUMBER:
382653.FP.04.FW	MW-62 SHEET 10 OF 11

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site E (2101068.3 N, 7616551.0 E)

ELEVATION : 503.6 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 47 ft BGS

START : 3/14/2009

END : 4/22/2009

LOGGER : A. Brewster/C. Kreller (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY: ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS	COMMENTS: SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.
	R12 1 ft 100%	100	0			**Conglomerate(Tmc)** 76.0-191.5' - moderate brown, (5YR 4/4), no dominant clast mineralogy, strong (R4), unweathered, fine matrix, coarse sand to coarse gravel sized clasts, massive	R12 = 10 min
162.0							
	R13 4 ft 90%	100	0				
			0				
			0				Add 300 gallons of water.
165			0				
166.0							R13 = 15 min
			0				
			0				
			0			168.0-169.0' - slightly weathered	
			0				
170			0				
	R14 10 ft 100%	100	0				
			0				
			0				
			0				
			0				
175			0				
176.0							R14 = 20 min
			0				
			1	177' - Joint, 80 deg, rough, planar, < 1 mm calcite infilling, reddish staining, tight			
			0				
			1	179.5' - Joint, 40 deg, rough, planar, < 1 mm calcite infilling, no staining, tight			
180			0				

PROJECT NUMBER:	BORING NUMBER:
382653.FP.04.FW	MW-62 SHEET 11 OF 11

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site E (2101068.3 N, 7616551.0 E)

ELEVATION : 503.6 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 47 ft BGS

START : 3/14/2009

END : 4/22/2009

LOGGER : A. Brewster/C. Kreller (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
185	R15 10 ft 100%	95	0			**Conglomerate(Tmc)** 76.0-191.5' - moderate brown, (5YR 4/4), no dominant clast mineralogy, strong (R4), unweathered, fine matrix, coarse sand to coarse gravel sized clasts, massive	
			0				
			0				
			0				
			0				
186.0							R15 = 20 min
	R16 5.5 ft 100%	100	0				
			0				
			0				
190			0				
			0				
191.5			0				R16 = 8 min
						End Drilling on 4/22/2009 Total Borehole Depth: 191.5 ft bgs	
195							
200							

PROJECT NUMBER:	BORING NUMBER:
382653.FP.04.FW	MW-63 SHEET 1 OF 4

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site E - Alternate 2 (2100973.9 N, 7616921.6 E)

ELEVATION : 505.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic and LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 48 ft BGS

START : 4/6/2009

END : 4/8/2009

LOGGER : R. Tweidt (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION — DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS	SYMBOLIC LOG	LITHOLOGY — ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS	COMMENTS — SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.
5						**Conglomerate(Tmc)** 0.0-30.0' - reddish brown, (5YR 4/4), dry, consolidated. Drilling method pulverizes most of core.	Boring initially drilled to 30.0 ft bgs on 4/6/2009 by Rotosonic tools up to 6-in in diameter. 6-in Rotosonic casing then used as a temporary conductor casing to facilitate rotary core drilling. Boring drilled from 30.0' bgs to total depth of 66.0' bgs using diamond bit rotary core tools (HQ-size, 3.8-in diameter) and then overdrilled to total depth using 6-in Rotosonic tools.
10							
15							
20							

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-63	SHEET 2 OF 4

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site E - Alternate 2 (2100973.9 N, 7616921.6 E)

ELEVATION : 505.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic and LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 48 ft BGS

START : 4/6/2009

END : 4/8/2009

LOGGER : R. Tweidt (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
25						**Conglomerate(Tmc)** 0.0-30.0' - reddish brown, (5YR 4/4), dry, consolidated. Drilling method pulverizes most of core.	
30	30.0						
	R1 6 ft 43%	0	NA	30.0-66.0' - poor rock quality and low recovery percentages. Difficult to assess natural discontinuities in core recovered. Fractures per foot not assessed (NA).		**Conglomerate(Tmc)** 30.0-66.0' - moderate brown, (5YR 3/4), no dominant clast mineralogy, strong to very weak (R4 to R1), moderately weathered to completely weathered, friable intervals, matrix supported, max clast size = 40 mm 34.0' - strong (R4), slightly weathered, max clast size = 50mm	
35	36.0						R1 = 26 min
40							

PROJECT NUMBER:	BORING NUMBER:
382653.FP.04.FW	MW-63 SHEET 3 OF 4

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site E - Alternate 2 (2100973.9 N, 7616921.6 E)

ELEVATION : 505.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic and LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 48 ft BGS

START : 4/6/2009

END : 4/8/2009

LOGGER : R. Tweidt (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	R2 10 ft 20%	0	NA	30.0-66.0' - poor rock quality and low recovery percentages. Difficult to assess natural discontinuities in core recovered. Fractures per foot not assessed (NA).		**Conglomerate(Tmc)** 30.0-66.0' - moderate brown, (5YR 3/4), no dominant clast mineralogy, strong to very weak (R4 to R1), moderately weathered to completely weathered, friable intervals, matrix supported, max clast size = 40 mm	
45						44.0-46.0' - medium strong (R3), moderately weathered	
	46.0						R2 = 24 min
	R3 3 ft 83%	14	NA			46.0-47.0' - slightly weathered, max clast size = 30 mm 47.0-49.0' - completely weathered	
	49.0						R3 = 18 min
50							
	R4 7 ft 50%	34	NA			52.5-56.5' - slightly weathered, max clast size = 25 mm	
55							Added approx. 15 gallons of water
	56.0						R4 = 42 min
	R5 3 ft 87%	35	NA			56.5-57.0' - moderately weathered 57.0-58.0' - slightly weathered, clasts are more fine grained, max clast size = 20 mm	
	59.0						R5 = 17 min
60	R6 1.5 ft 100%	40	NA				

PROJECT NUMBER:	BORING NUMBER:
382653.FP.04.FW	MW-63 SHEET 4 OF 4

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site E - Alternate 2 (2100973.9 N, 7616921.6 E)

ELEVATION : 505.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic and LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 48 ft BGS

START : 4/6/2009

END : 4/8/2009

LOGGER : R. Tweidt (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	60.5			30.0-66.0' - poor rock quality and low recovery percentages. Difficult to assess natural discontinuities in core recovered. Fractures per foot not assessed (NA).		**Conglomerate(Tmc)** 30.0-66.0' - moderate brown, (5YR 3/4), no dominant clast mineralogy, strong to very weak (R4 to R1), moderately weathered to completely weathered, friable intervals, matrix supported, max clast size = 40 mm	R6 = 15 min
	R7 2.5 ft 88%	32	NA				
	63.0						R7 = 23 min
	R8 3 ft 87%	18	NA				
65	66.0						R8 = 29 min
						End Drilling on 4/8/2009 Total Borehole Depth: 66.0 ft bgs	
70							
75							
80							

PROJECT NUMBER:	BORING NUMBER:
382653.FP.04.FW	MW-64 SHEET 1 OF 14

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site C - Alternate (2100520.2 N, 7616939.8 E)

ELEVATION : 576.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 119 ft BGS

START : 5/3/2009

END : 5/15/2009

LOGGER : B. Pelletier (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
5						**Metadiorite (pTbr)** 0-20.0' - dark greenish gray, (6Y 5/4), fine to medium grained, consolidated. Drilling method pulverizes most of the core.	Boring initially drilled to 20.0 ft bgs by Rotosonic tools up to 10-in in diameter. Permanent 6-in PVC conductor casing installed from ground surface to 20 ft bgs (portland cement grout). Boring drilled from 20.0' bgs to total depth of 260.5' bgs using diamond bit rotary core tools (HQ-size, 3.8-in diameter).
10							
15							
20	20.0						Total depth of Rotosonic boring is 20.0 ft bgs. Install permanent 6-in conductor casing (portland cement grout). Begin rotary core drilling.

PROJECT NUMBER:	BORING NUMBER:
382653.FP.04.FW	MW-64-260 SHEET 2 OF 14

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site C - Alternate (2100520.2 N, 7616939.8 E)

ELEVATION : 576.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 119 ft BGS

START : 5/3/2009

END : 5/15/2009

LOGGER : B. Pelletier (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	R1 5.5 ft 77%	90	2			**Metadiorite (pTbr)** 20.0-26.6' - dusky yellow green, (5GY 5/2), intermediate (dioritic) mineralogy, fine to medium grained, strong (R4), unweathered, massive to foliated	General Note: The metadiorite bedrock exhibits many small healed fractures (1-3 mm) of somewhat random orientation. These healed fractures create weaknesses in the rock. It can be difficult to determine if the metadiorite is jointed in-situ, or if the discontinuities are caused by the drilling method. Intervals with fracture per foot counts >10 are likely caused by drilling.
			1				
			>10	22.5' - Joint, >60 deg, iron staining, weathered			
			>5	23.5' - Joint, >60 deg, no staining			
			2				
25							
	25.5		>10				
	R2 1.1 ft 80%	20					R1 = 32.0 min
	26.6		>10				R2 = 18.0 min
			2	27.5' - Joint, 30 deg, 1-2 mm calcite infilling, no staining, relatively straight, tight		26.6-35.7' - grayish olive, (10Y 4/2), medium grained, rare serpentine replacement along fractures	
			5				
			8	28.8' - Joint, >60 deg, rough, undulating, calcite infilling, iron staining			
30							
	R3 8.9 ft 94%	55	3				
			>10				
			2				
			2	33' - Joint, > 60 deg, multiple fractures, dark brown staining			
			2				
35							
	35.5		3	35' - Joint, >60 deg, multiple fractures, some near 90 deg			R3 = 38.0 min
			3	36' - Joint, 25 deg, < 2 mm calcite infilling, staining, straight		35.7-40.0' - grayish olive, (10Y 4/2), medium to coarse grained, strong (R4), common calcite replacement, rare foliations	
			3				
			5	37.7' - Multiple joints, undulating, heavy staining 38.5' - Joint, 35 deg, straight			
			6	39' - Fracture zone, calcite and silica infilling, no staining			
40							

PROJECT NUMBER:	BORING NUMBER:
382653.FP.04.FW	MW-64 SHEET 3 OF 14

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site C - Alternate (2100520.2 N, 7616939.8 E)

ELEVATION : 576.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 119 ft BGS

START : 5/3/2009

END : 5/15/2009

LOGGER : B. Pelletier (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	R4 10 ft 100%	85	8	40' - Fracture zone, 60 deg and near 90 deg, calcite infilling, rare staining, some chlorite infill?		**Metadiorite (pTbr)** 40-65.3' - grayish olive, (10Y 4/2), intermediate (dioritic) mineralogy, medium to coarse grained, strong (R4), unweathered, massive to foliated	
			5				
			4				
			7				
			8				
45				44.5' - multiple fractures as above			
	45.5		6				R4 = 25.0 min
			4	46.5' - Joint, 60 deg, multiple smaller undulating joints, calcite infill, common iron staining			
			6				
	R5 8 ft 90%		>10	48' - Fracture zone, near 90 deg, common fine fractures (< 1 mm), predominately high angle			
		82	>10	49' - Joint, 60 deg, 1-2 mm calcite infilling			
50							
			8	50' - Fracture zone, common staining			
			>10	51.0-53.0' - Fracture zone, near 90 deg, undulating, moderate iron staining			
			8			52.0' - moderate foliation, silica and calcite replacement	
	53.5		6	53.0-55.0' - microfractures, undulating			R5 = 47.0 min
	R6 1.8 ft 90%	85	6				
55							
	55.3		6				R6 = 18.0 min
			8				
	R7 5.7 ft 95%		>10				
		42	>10	58' - Fracture zone, strong iron staining, heavy calcite and silica replacement			
			8				
60							

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-64	SHEET 4 OF 14

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site C - Alternate (2100520.2 N, 7616939.8 E)

ELEVATION : 576.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 119 ft BGS

START : 5/3/2009

END : 5/15/2009

LOGGER : B. Pelletier (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			6			**Metadiorite (pTbr)** 60-65.3' - grayish olive, (10Y 4/2), medium to coarse grained, foliated	R7 = 28.0 min
61.0						61' - massive	
			8				
	R8 4.5 ft 95%	70	8				
			>10				
			8	64' - multiple small (< 1mm) fractures			
65							
65.5			8				R8 = 11.0 min
						65.3-105.0' - grayish olive, (10Y 4/2), to light olive, (10Y 5/4), medium grained, strong (R4), unweathered to slightly weathered	
			8	66.5' - Joint, >60 deg, undulating, no staining, tight			
			8				
			>10				
	R9 8.3 ft 94%	39	>10				
70							
			>10	70' - Fracture zone, rough, undulating, no staining, tight			
			8				
			8				
			6	73' - Fracture, 20 deg, smooth, brown staining, tight			R9 = 24.0 min
73.8							
	R10 1.5 ft 100%	37	8				
75							
75.3							R10 = 22.0 min
			>10				
			>10	76' - Fracture zone, rough, undulating, stained		76.0' - slightly weathered	
			8	77.0-79.0' - Fracture zone, healed with silica		77.0-79.0' - foliated	
	R11 6.7 ft 93%	30	>10				
			8				
80							

PROJECT NUMBER:	BORING NUMBER:
382653.FP.04.FW	MW-64 SHEET 5 OF 14

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site C - Alternate (2100520.2 N, 7616939.8 E)

ELEVATION : 576.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 119 ft BGS

START : 5/3/2009

END : 5/15/2009

LOGGER : B. Pelletier (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			>10	80.0-82.0' - Fracture zone, calcite infilling		**Metadiorite (pTbr)** 80.0-105.0' - grayish olive, (10Y 4/2), to light olive, (10Y 5/4), intermediate (dioritic) mineralogy, medium grained, strong (R4), unweathered to slightly weathered, massive to foliated	
			>10				R11 = 23.0 min
	82.0						
	R12 3.3 ft 92%	73	8				
			8	83.5' - Fracture, 60 deg, calcite infilling, staining			
85			8	84.5' - Fracture zone, calcite infilling, staining			
	85.3						R12 = 14.0 min
			6				
			6	86.0-88.0' - Fractures (3), 40 deg, smooth, minor infilling, some staining, tight			
			8				
			8				
	R13 8.7 ft 97%	73	8	89' - Fracture zone, rough, undulating			
90			8				
			>10				
			>10	92.0-94.0' - Heavily fractured chlorite (?) rich fluid replacement, mostly healed, strong iron staining			
			>10				
	94.0						R13 = 36.0 min
	R14 1.3 ft 80%	10	>10				
95	95.3		2	95' - Fracture zone, undulating, staining			R14 = 4.0 min
			>10				
	R15 5 ft 90%	42	>10				
			8				
			>10	99.0-100.5' - Fracture zone, staining		99.0-100.5' - medium strong (R3)	
100							

PROJECT NUMBER:	BORING NUMBER:
382653.FP.04.FW	MW-64 SHEET 6 OF 14

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site C - Alternate (2100520.2 N, 7616939.8 E)

ELEVATION : 576.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 119 ft BGS

START : 5/3/2009

END : 5/15/2009

LOGGER : B. Pelletier (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	100.3					**Metadiorite (pTbr)**	R15 = 21.0 min
	R16 5 ft 84%	20	>10			100.0-105.0' - grayish olive, (10Y 4/2), to light olive, (10Y 5/4), intermediate (dioritic) mineralogy, medium grained, strong (R4), unweathered to slightly weathered, massive to foliated	
			8				
			>10	102.0-105.3' - Fracture zone, rough, undulating, < 1 mm infilling, heavy staining			
			>10				
			>10				
105	105.3						
	R17 5.7 ft 96%	29	8	105.3-108.0' - Fracture zone, rough, undulating, little to none infilling, staining		105.0-260.0' - grayish olive, (10Y 4/2), intermediate (dioritic) mineralogy, medium to coarse grained, strong (R4), unweathered to slightly weathered, massive to foliated	R16 = 27.0 min
			8				
			8				
			>10	108.0-111.0' - Fracture zone, little to none infilling, rock fragmented			
			>10				
110							
			>10				
	111.0						R17 = 15.5 min
	R18 2.5 ft 80%	20	8	111' - Fracture zone, staining			
			8				
	113.5						R18 = 26.0 min
	R19 1.8 ft 77%	0	>10			113.5' - medium strong (R3)	
			>10				
115	115.3						
			6	115.0-118.0' - Minor fracturing, some infill, mostly tight, weak staining		115.0' - medium to coarse grained, strong (R4)	R19 = 6.0 min
			6				
			8				
	R20 8.2 ft 98%	55	>10	118.0-120.0' - Fractures (3), 80-90 deg, weak staining, tight			
120			>10				

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-64	SHEET 7 OF 14

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site C - Alternate (2100520.2 N, 7616939.8 E)

ELEVATION : 576.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 119 ft BGS

START : 5/3/2009

END : 5/15/2009

LOGGER : B. Pelletier (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			8			**Metadiorite (pTbr)** 105.0-260.0' - grayish olive, (10Y 4/2), intermediate (dioritic) mineralogy, medium to coarse grained, strong (R4), unweathered to slightly weathered, massive to foliated	
			8	121.5-123.0' - Fracture zone, smooth, 2-3 mm infilling		121.5-123.0' - medium strong (R3), foliated	
			>10				
	123.5		8			123.0' - strong (R4)	R20 = 32.0 min
	R21 1.8 ft 100%	75	8	124' - Fracture zone, near 90 deg, rough, undulating, tight, healed			
125	125.3		>10	125.3-127.0' - Fracture zone, < 1 mm calcite infilling, heavy staining, some voids			R21 = 4.5 min
	R22 4.7 ft 93%	10	>10			127.0' - medium strong (R3)	
			>10				
			>10				
			>10				
130	130.0						R22 = 37.0 min
	R23 3.5 ft 86%	9	>10	130' - Highly fractured		130.0' - foliated	
			>10				
			>10				
	133.5		>10				R23 = 21.0 min
	R24 1.8 ft 55%	0	>10	133.5' - As above		133.5-135.3' - medium strong (R3)	
135	135.3						R24 = 11.5 min
	R25 2.7 ft 93%	15	>10			135.3' - strong (R4)	
			>10	136' - Fractures (2), 30 deg and vertical, rough, undulating, < 2 mm calcite infilling, most fractures healed			
	138.0		>10				R25 = 21.0 min
			>10	138' - Fractures (2), 70 deg and 20 deg, rough, abundant microfractures			
140			>10				

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-64	SHEET 8 OF 14

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site C - Alternate (2100520.2 N, 7616939.8 E)

ELEVATION : 576.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 119 ft BGS

START : 5/3/2009

END : 5/15/2009

LOGGER : B. Pelletier (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	R26 4.2 ft 71%	0	>10			**Metadiorite (pTbr)** 105.0-260.0' - grayish olive, (10Y 4/2), intermediate (dioritic) mineralogy, medium to coarse grained, strong (R4), unweathered to slightly weathered, massive to foliated	
			>10				
142.2			>10	142' - Fracture zone, rough, strong fe/cl staining		142.0' - coarse grained	R26 = 22.0 min
	R27 3.1 ft 97%	56	>10	143' - Fractures (2), 45 deg, smooth, < 2 mm silica infilling, abundant microfractures			
			>10				
145							
145.3			>10	145.0-146.0' - Fractures (2), 40 deg, smooth, stepped, silica infilling		145.3' - foliated	R27 = 7.0 min
			8	146.5' - Fracture zone, undulating, chlorite infilling, tight			
			8				
	R28 7.7 ft 99%	95	6				
			6				
150							
			8				
			8	151' - Fracture, 85 deg, rough, undulating			
			0	152' - Multiple tight fractures			
153.0							R28 = 34.0 min
	R29 2.3 ft 100%	96	0	153' - Fracture, 60 deg			
			0				
155							
155.3			1	155' - Fracture, 60 deg, rough, stepped, < 3 mm silica infilling			R29 = 9.0 min
			2	156' - Joint, 30 deg, rough, undulating, < 1 mm calcite infilling, iron staining, tight			
			0	156.2' - As above			
	R30 7.4 ft 100%	69	3	158.0, 158.2, 158.7' - As above			
			6				
160							

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-64	SHEET 9 OF 14

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site C - Alternate (2100520.2 N, 7616939.8 E)

ELEVATION : 576.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 119 ft BGS

START : 5/3/2009

END : 5/15/2009

LOGGER : B. Pelletier (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			>10	160' - Highly fractured		**Metadiorite (pTbr)** 105.0-260.0' - grayish olive, (10Y 4/2), intermediate (dioritic) mineralogy, medium to coarse grained, strong (R4), unweathered to slightly weathered, massive to foliated	
			>10				
	162.7		>10				R30 = 40.0 min
	R31 2.6 ft 100%	65	>10				
			2	163.8, 164.4, 164.6' - Joint, 30 deg, rough, undulating, < 1 mm calcite infilling, iron staining, moderately tight			
165							
	165.3		4	165.1, 165.2, 165.3, 165.4' - Joint, 10, 10, 10, and 30 deg, rough, undulating, < 1 mm calcite infilling, iron staining, tight to moderately tight			R31 = 5.0 min
			2	166.1, 166.6' - Joint, 30 deg, rough, undulating, no staining, moderately tight			
	R32 5.4 ft 100%	72	3	167.3, 167.5, 167.8' - Joint, 30, 30, and 60 deg, rough, undulating to stepped, iron staining, tight to moderately tight			
			2	168.1, 168.7, 169.6' - Joint, 30, 10, and 30 deg, rough, undulating to stepped, some iron staining, tight			
			1				
170							
	170.7		>10	170' - Fracture zone, < 2 mm calcite infilling, iron staining			R32 = 27.0 min
			3	171.0, 171.2, 171.9' - Joint, 10, 30, and 30 deg, rough, undulating to stepped, < 2 mm calcite infilling, iron staining, tight			
	R33 4.6 ft 100%	61	>10	172.5' - Highly fractured, < 5 mm calcite infilling, some iron staining			
			>10				
			2	174.0, 174.6' - Joint, 10 deg and 30 deg, rough, undulating, some iron staining, tight			
175						174.5' - fine grained, unweathered, foliated	
	175.3		>10	175' - Highly fractured		175.0-177.0' - grayish olive green, (5GY 3/2)	R33 = 18.0 min
			0				
			0			177.0' - dusky yellowish green, (10GY 3/2)	
	R34 8 ft 100%	86	0			178.5' - medium to coarse grained, foliated	
			2	179.2, 179.6' - Joint, 30 deg, rough, undulating, no staining, tight			
180							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-64	SHEET 10 OF 14

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site C - Alternate (2100520.2 N, 7616939.8 E)

ELEVATION : 576.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 119 ft BGS

START : 5/3/2009

END : 5/15/2009

LOGGER : B. Pelletier (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			2	180.1, 180.8' - Joint, 30 deg, rough, undulating, no staining, tight		**Metadiorite (pTbr)** 105.0-260.0' - dusky yellowish green, (10GY 3/2), intermediate (dioritic) mineralogy, medium to coarse grained, strong (R4), unweathered to slightly weathered, massive to foliated	
			1	181.3' - Joint, 30 deg, rough, stepped, no staining, tight			
			3	182.1, 182.4, 182.9, 183.3' - Joint, 30, 30, 30, and 10 deg, rough, undulating to stepped, no staining, tight			
	183.3						
	R35 1.3 ft 100%	100	1				R34 = 45.0 min
	184.6		0				R35 = 6.0 min
185							
	R36 2.9 ft 100%	90	1	185.3' - Joint, 10 deg, smooth, undulating to slickenslided, blackish staining, tight			
			0				
	187.5		>10	187' - Fracture zone, < 5 mm calcite infilling, some greenish staining			R36 = 8.0 min
			1	188.5' - Joint, 60 deg, rough, undulating, < 2 mm calcite infilling, iron staining, tight		188.5' - greenish staining	
			1	189.2' - Joint, 60 deg, smooth to slickenslided, undulating to planar, < 5 mm calcite infilling, iron staining, some blackish staining, tight			
190							
	R37 7.3 ft 100%	82	0				
			>10	191.5' - Fracture zone, < 1 mm calcite infilling, some reddish and blackish staining			
			1	192.6, 193.6' - Joint, 60 deg, rough to smooth, undulating, < 1 mm calcite infilling, some greenish staining, tight			
			1				
			>10	194.2' - Highly fractured, greenish staining		194.2' - greenish staining	
	194.8						R37 = 24.0 min
195			0				
			1	196.5' - Joint, 80 deg, rough, undulating, < 1 mm calcite infilling, some greenish staining, tight		196.0' - greenish staining	
			1	197.4' - Joint, 30 deg, rough, stepped, < 2 mm calcite infilling, no staining, moderately tight		197.0' - greenish staining	
			0				
	R38 10.2 ft 100%		0				
200							

PROJECT NUMBER:	BORING NUMBER:
382653.FP.04.FW	MW-64 SHEET 11 OF 14

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site C - Alternate (2100520.2 N, 7616939.8 E)

ELEVATION : 576.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 119 ft BGS

START : 5/3/2009

END : 5/15/2009

LOGGER : B. Pelletier (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: RQD (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
		87	0			**Metadiorite (pTbr)** 200.0-260.0' - dusky yellowish green, (10GY 3/2), intermediate (dioritic) mineralogy, medium to coarse grained, strong (R4), unweathered to slightly weathered, massive to foliated	
			>10	201.3' - Highly fractured, < 5 mm calcite infilling, iron staining			
			0			201.0' - dusky green, (5G 3/2)	
			1	203.1' - Joint, 30 deg, rough, undulating, no staining, moderately tight			
			>10	204.2' - Fracture zone, some iron staining			
205	205.0						R38 = 28.0 min
			0			205.5' - 12 mm felsic vein, 30 deg to 40 deg dips	
			0				
			0				
	R39 8 ft 80%		0			207.7' - 50 mm felsic vein, 30 deg to 40 deg dips	
		98	0			208.9' - 8 mm felsic vein, 30 deg to 40 deg dips	
210							
			0				
			0			211.2' - felsic vein, 70 deg dip	
			0			212.0' - dusky yellowish green, (10GY 3/2)	
	213.0						R39 = 32.0 min
	R40 2 ft 100%	0	>10	213.0-215.0' - Highly fractured, no infill, some greenish staining			
			>10				R40 = 8.0 min
215	215.0						
			0			215.0-218.5' - fine to medium grained	
			0				
			0				
			0				
			1			218.5-222.0' - medium to coarse grained, coarse feldspar phenocrysts (12 mm max), no foliation	
220							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-64	SHEET 12 OF 14

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site C - Alternate (2100520.2 N, 7616939.8 E)

ELEVATION : 576.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 119 ft BGS

START : 5/3/2009

END : 5/15/2009

LOGGER : B. Pelletier (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	R41 10 ft 100%	98	0	219.5' - Joint, 80 deg, smooth, undulating, < 2 mm calcite infilling, iron staining, greenish staining, light blue staining, tight		219.5-220.0' - presence of light-blue colored staining on fracture surfaces **Metadiorite (pTbr)** 220.0-260.0' - dusky yellowish green, (10GY 3/2), intermediate (dioritic) mineralogy, medium to coarse grained, strong (R4), unweathered to slightly weathered, massive to foliated	
			0				
			2	222.0, 222.3' - Joint, 60 deg and 30 deg, rough, undulating, < 2 mm calcite infilling, greenish staining, tight			
			>10	223.0, 223.3' - Joint, 60 deg, rough, undulating, < 1 mm calcite infilling, no staining, tight			
			>10	223.5-224.4' - Highly fractured			
225	225.0						R41 = 28.0 min
			0			225.0' - dusky green, (5G 3/2), foliated	
			1			225.0-226.0' - bands of felsic minerals, 10 to 60 deg dips, 10 mm max	
			2	226.8, 227.4' - Joint, 80 deg and 60 deg, rough to smooth, undulating, < 1 mm calcite infilling, iron staining, tight			
	R42 7.4 ft 100%	82	2	227.6, 228.1' - Joint, 30 deg, rough, undulating, < 1 mm calcite infilling, no staining, moderately tight			
			0	228.9' - Joint, 40 deg, smooth, undulating, some iron staining, tight		229.0' - fine grained	
230							
			2			230.0' - medium to coarse grained	
			0	230.6, 230.9' - Joint, 30 deg and 60 deg, rough, undulating, < 1 mm talc infilling, no staining, tight to moderately tight		230.6' - felsic vein, 60 deg dip, 25 mm max	
	232.4		>10	232' - Highly fractured, < 2 mm calcite infilling, no staining			R42 = 27.0 min
	R43 2.6 ft 8%	0	>10	232.4' - Highly fractured			
			>10				
235	235.0						R43 = 7.0 min
			>10	235' - Highly fractured			
			>10				
	R44 5 ft 40%	18	>10				
			>10				
			>10				
240	240.0						R44 = 20.0 min

PROJECT NUMBER:	BORING NUMBER:	
382653.FP.04.FW	MW-64	SHEET 13 OF 14

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site C - Alternate (2100520.2 N, 7616939.8 E)

ELEVATION : 576.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 119 ft BGS

START : 5/3/2009

END : 5/15/2009

LOGGER : B. Pelletier (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	R45 2 ft 100%	30	>10	240' - Highly fractured		**Metadiorite (pTbr)** 240.0-260.0' - dusky green, (5G 3/2), intermediate (dioritic) mineralogy, medium to coarse grained, strong (R4), unweathered to slightly weathered, massive to foliated	
			0				R45 = 5.0 min
242.0							
	R46 3 ft 70%	57	>10				
			1	243.6' - Joint, 60 deg, rough, undulating, < 2 mm talc infilling, no staining, loose			
			0				R46 = 4.0 min
245 245.0							
	R47 3.7 ft 100%	57	>10			245.0-246.0' - largely felsic mineralogy	
			2	246.4, 246.8' - Joint, 30 deg, rough, undulating to stepped, < 2 mm calcite infilling, no staining, loose			
			>10	247.0-249.0' - Highly fractured			
			>10	247.3-247.6' - Multiple parallel joints, 40 deg, rough to smooth, undulating, < 1 mm calcite infilling, tight		248.0' - quartz based silt infill	
248.7							R47 = 10.0 min
			0	248.8' - Joint, 60 deg, rough, undulating, < 5 mm calcite infilling, no staining, moderately tight			
250							
			0				
	R48 6.3 ft 100%	94	2	251.4, 251.7' - Joint, 10 deg and 30 deg, rough, undulating, < 2 mm calcite infilling, no staining, moderately tight			
			0				
			0			252.8-253.8' - felsic veins, 20 mm max, 10 to 30 deg dips	
			0				
255 255.0							R48 = 9.0 min
			0				
			0				
	R49 5.5 ft 100%	100	0				
			1	258.0, 259.5, 259.9' - Joint, 30 deg, rough, undulating, no staining, tight			
			2				
260							

PROJECT NUMBER:	BORING NUMBER:
382653.FP.04.FW	MW-64 SHEET 14 OF 14

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site C - Alternate (2100520.2 N, 7616939.8 E)

ELEVATION : 576.0 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 119 ft BGS

START : 5/3/2009

END : 5/15/2009

LOGGER : B. Pelletier (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION — DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS	SYMBOLIC LOG	LITHOLOGY — ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS	COMMENTS — SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.
	260.5						R49 = 8.0 min
						End Drilling on 5/15/2009 Total Borehole Depth: 260.5 ft bgs	
265							
270							
275							
280							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-65 SHEET 1 OF 12

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Groundwater Investigation LOCATION : Lower Bench of TCS (2100547.4 N, 7614934.7 E)

ELEVATION : 597.0 ft DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350 with 6 barrels., Rotosonic ORIENTATION : Vertical

WATER LEVELS : Approx. 139 ft BGS START : 3/17/2011 END : 3/23/2011 LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
5		COMPLETE		SW	**Well Graded Sand (SW)** 0.0-10.0' - dark yellowish brown, (10YR 4/4), dry, loose, 10% gravel, 85% sand, 5% fines, angular to subrounded, maximum clast diameter = 50mm.		Cleared to 10' bgs by hydro-vac rig (MPE)
10	9.0 10.0		10001				Soil sample collected between 9.0 and 10.0 ft bgs.
				SM	**Silty Sand (SM)** 10.0-87.0' - grayish brown, (2.5Y 5/2), dry, loose, 10% gravel, 60% sand, 30% fines, angular to subrounded, maximum clast diameter = 50mm.		
15	14.0 15.0		10002				Soil sample collected between 14.0 and 15.0 ft bgs.
					17.0-20.0' - Color change to brown (7.5YR 4/3), change to 5% gravel, 65% sand, 30% fines, change to subrounded.		
20	19.0 20.0		10003				Soil sample collected between 19.0 and 20.0 ft bgs.

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-65 SHEET 2 OF 12

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Groundwater Investigation LOCATION : Lower Bench of TCS (2100547.4 N, 7614934.7 E)

ELEVATION : 597.0 ft DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350 with 6 barrels., Rotosonic ORIENTATION : Vertical

WATER LEVELS : Approx. 139 ft BGS START : 3/17/2011 END : 3/23/2011 LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
25		COMPLETE			**Silty Sand (SM)** 10.0-87.0' - grayish brown, (2.5Y 5/2), dry, loose, 10% gravel, 60% sand, 30% fines, angular to subrounded, maximum clast diameter = 50mm.		
30	29.0 30.0		10004	SM			Soil sample collected between 29.0 and 30.0 ft bgs.
35					34' - Change to 15% gravel, 55% sand, 30% fines, angularity change to subangular to subrounded. 35' - Change from loose to partially consolidated.		
40	39.0 40.0		10005				Soil sample collected between 39.0 and 40.0 ft bgs.

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-65 SHEET 3 OF 12

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Groundwater Investigation LOCATION : Lower Bench of TCS (2100547.4 N, 7614934.7 E)

ELEVATION : 597.0 ft DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350 with 6 barrels., Rotosonic ORIENTATION : Vertical

WATER LEVELS : Approx. 139 ft BGS START : 3/17/2011 END : 3/23/2011 LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
45		COMPLETE			**Silty Sand (SM)** 10.0-87.0' - grayish brown, (2.5Y 5/2), dry, loose, 10% gravel, 60% sand, 30% fines, angular to subrounded, maximum clast diameter = 50mm. Metadiorite boulder.		
50	49.0 50.0		10006	SM			Soil sample collected between 49.0 and 50.0 ft bgs.
55					55.0-57.0' - Presence of > 100mm sized fragments of metadiorite.		Drilling very difficult
60	59.0 60.0		10007				Soil sample collected between 59.0 and 60.0 ft bgs.

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-65 SHEET 4 OF 12

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Groundwater Investigation LOCATION : Lower Bench of TCS (2100547.4 N, 7614934.7 E)

ELEVATION : 597.0 ft DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350 with 6 barrels., Rotosonic ORIENTATION : Vertical

WATER LEVELS : Approx. 139 ft BGS START : 3/17/2011 END : 3/23/2011 LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
		COMPLETE			**Silty Sand (SM)** 10.0-87.0' - grayish brown, (2.5Y 5/2), dry, loose to partially consolidated, 15% gravel, 55% sand, 30% fines, subangular to subrounded, maximum clast diameter = 50mm. Gravel component is mixed metadiorite and conglomerate fragments. Metadiorite fragments show rusty red staining or mineral deposits on most surfaces (ie, weathered on all surfaces).		
65							Stop at 64' at 3/17/2011, 1620. Resume 03/18/2011 at 0845.
	69.0		10008				Soil sample collected between 69.0 and 70.0 ft bgs.
70	70.0			SM			
75							
	79.0		10009, 50001				Soil sample collected between 79.0 and 80.0 ft bgs.
80	80.0						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-65	SHEET 5 OF 12

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Groundwater Investigation
LOCATION : Lower Bench of TCS (2100547.4 N, 7614934.7 E)

ELEVATION : 597.0 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350 with 6 barrels., Rotosonic
ORIENTATION : Vertical

WATER LEVELS : Approx. 139 ft BGS
START : 3/17/2011
END : 3/23/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
85		COMPLETE		SM	**Silty Sand (SM)** 10.0-87.0' - grayish brown, (2.5Y 5/2), dry, loose to partially consolidated, 15% gravel, 55% sand, 30% fines, subangular to subrounded, maximum clast diameter = 50mm, presence of highly weathered metadiorite fragments, red staining and/or deposits on gravel surfaces.		
90	89.0 90.0		10010	SW	**Well Graded Sand (SW)** 87.0-93.5' - dark yellowish brown, (10YR 4/4), dry, loose, angular to subangular, predominantly fine- to medium-grained quartz sand and metadiorite gravel, maximum clast size = 30mm.		Soil sample collected between 89.0 and 90.0 ft bgs.
95				SM	**Silty Sand (SM)** 93.5-168.0' - grayish brown, (2.5Y 5/2), dry to slightly moist, loose to partially consolidated, 15% gravel, 55% sand, 30% fines, subangular to angular, presence of highly weathered metadiorite, maximum clast size = 50mm.		
100	99.0 100.0		10011				Soil sample collected between 99.0 and 100.0 ft bgs.

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-65	SHEET 6 OF 12

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Groundwater Investigation
LOCATION : Lower Bench of TCS (2100547.4 N, 7614934.7 E)

ELEVATION : 597.0 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350 with 6 barrels., Rotosonic
ORIENTATION : Vertical

WATER LEVELS : Approx. 139 ft BGS
START : 3/17/2011
END : 3/23/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
105		COMPLETE			**Silty Sand (SM)** 93.5-168.0' - grayish brown, (2.5Y 5/2), dry to slightly moist, loose to partially consolidated, 15% gravel, 55% sand, 30% fines, subangular to angular, presence of highly weathered metadiorite, maximum clast size = 50mm.		
110	109.0 110.0		10012	SM			Soil sample collected between 109.0 and 110.0 ft bgs.
115					115.0-120.0' - increase in proportion of miocene conglomerate fragments.		
120	119.0 120.0		10013				Soil sample collected between 119.0 and 120.0 ft bgs.

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-65 SHEET 7 OF 12

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Groundwater Investigation LOCATION : Lower Bench of TCS (2100547.4 N, 7614934.7 E)

ELEVATION : 597.0 ft DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350 with 6 barrels., Rotosonic ORIENTATION : Vertical

WATER LEVELS : Approx. 139 ft BGS START : 3/17/2011 END : 3/23/2011 LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
125		COMPLETE			**Silty Sand (SM)** 93.5-168.0' - grayish brown, (2.5Y 5/2), dry to slightly moist, loose to partially consolidated, 15% gravel, 55% sand, 30% fines, subangular to angular, presence of highly weathered metadiorite, maximum clast size = 50mm.		Stop 3/18/2011 at 1530. Resume 3/19/2011 at 930.
130	129.0 130.0		10014	SM			Soil sample collected between 129.0 and 130.0 ft bgs.
135					138' - Light green silt on surface fractures.		
140	139.0 140.0		10015		139' - Color change to brown (10YR 4/3), moist.		Soil sample collected between 139.0 and 140.0 ft bgs.

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-65 SHEET 8 OF 12

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Groundwater Investigation LOCATION : Lower Bench of TCS (2100547.4 N, 7614934.7 E)

ELEVATION : 597.0 ft DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350 with 6 barrels., Rotosonic ORIENTATION : Vertical

WATER LEVELS : Approx. 139 ft BGS START : 3/17/2011 END : 3/23/2011 LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
145		COMPLETE			**Silty Sand (SM)** 93.5-168.0' - brown, (10YR 4/3), moist to saturated at 141', loose to partially consolidated, 15% gravel, 55% sand, 30% fines, subangular to angular, presence of highly weathered metadiorite, maximum clast size = 50mm.		
150				SM			
155							
	157.0						Grab groundwater sample collected from borehole between 157.0 and 167.0 ft bgs. Sustained pump rate of 2 gpm.
160							

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-65 SHEET 9 OF 12

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Groundwater Investigation LOCATION : Lower Bench of TCS (2100547.4 N, 7614934.7 E)

ELEVATION : 597.0 ft DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350 with 6 barrels., Rotosonic ORIENTATION : Vertical

WATER LEVELS : Approx. 139 ft BGS START : 3/17/2011 END : 3/23/2011 LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
165		COMPLETE	ISOFLOW #20001 at 1215	SM	**Silty Sand (SM)** 93.5-168.0' - grayish brown, (2.5Y 5/2), moist to saturated at 141', loose to partially consolidated, 15% gravel, 55% sand, 30% fines, subangular to angular, presence of highly weathered metadiorite, maximum clast size = 50mm. 162.0-164.0' - Color change to very dark brown (10YR 2/2). 166' - Color change to dark greyish brown (10YR 4/2).		
167.0							
170				GW	**Well Graded Gravel (GW)** 168.0-228.0' - black, saturated, loose to partially consolidated, 60% gravel, 30% sand, 10% fines, angular, presence of highly weathered metadiorite and Miocene conglomerate, clast-supported, maximum clast size = 50 mm. 170.5' - Dark red stringer. 176' - Color change to dark greyish brown (2.5YR 5/2). 179' - Reddish clay stringer.		Stop 03/19/2011 at 1440. Resume 03/20/2011 at 1440. Drilling very difficult.
175							
180							

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-65 SHEET 10 OF 12

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Groundwater Investigation LOCATION : Lower Bench of TCS (2100547.4 N, 7614934.7 E)

ELEVATION : 597.0 ft DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350 with 6 barrels., Rotosonic ORIENTATION : Vertical

WATER LEVELS : Approx. 139 ft BGS START : 3/17/2011 END : 3/23/2011 LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
185		COMPLETE			**Well Graded Gravel (GW)** 168.0-228.0' - dark greyish brown, (2.5Y 5/2), saturated, loose to partially consolidated, 60% gravel, 30% sand, 10% fines, angular, presence of highly weathered metadiorite fragments (gravel), clast-supported, maximum clast size = 50 mm. Fragments display red staining/mineralization on most surfaces.		
							Stop 03/20/2011 at 1700. Resume 03/21/2011 at 0845.
	187.0						Grab groundwater sample collected from borehole between 187.0 and 197.0 ft bgs.
190			ISOFLOW #20002 at 1510	GW			
							Drill rate slows to <1 in/min.
					193.0-194.0' - Metadiorite boulder.		Sustained pump rate of 8 gpm.
195							
	197.0						
							Stop 03/21/2011 at 1615. Resume 03/22/2011 at 0800.
200							

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-65	SHEET 11 OF 12

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Groundwater Investigation
LOCATION : Lower Bench of TCS (2100547.4 N, 7614934.7 E)

ELEVATION : 597.0 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350 with 6 barrels., Rotosonic
ORIENTATION : Vertical

WATER LEVELS : Approx. 139 ft BGS
START : 3/17/2011
END : 3/23/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
205		COMPLETE		GW	**Well Graded Gravel (GW)** 168.0-228.0' - brown, (7.5YR 4/3), saturated, loose to partially consolidated, 60% gravel, 30% sand, 10% fines, angular, presence of highly weathered metadiorite fragments (gravel), clast-supported, maximum clast size = 50 mm. Fragments display red staining/mineralization on most surfaces.		
210					213' - Color change to dark greyish brown (2.5Y 5/2) and change to 60% gravel, 30% sand, and 10% fines.		
215					216' - Color change to very dark brown (10YR 3/2).		
	217.0						Grab groundwater sample collected from borehole between 217.0 and 227.0 ft bgs.
220							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-65	SHEET 12 OF 12

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Groundwater Investigation
LOCATION : Lower Bench of TCS (2100547.4 N, 7614934.7 E)

ELEVATION : 597.0 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350 with 6 barrels., Rotosonic
ORIENTATION : Vertical

WATER LEVELS : Approx. 139 ft BGS
START : 3/17/2011
END : 3/23/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
		COMPLETE	ISOFLOW #20003 at 1518	GW	**Well Graded Gravel (GW)** 168.0-228.0' - very dark brown, (10YR 3/2), saturated, loose to partially consolidated, 60% gravel, 30% sand, 10% fines, angular, presence of highly weathered metadiorite fragments (gravel), clast-supported, maximum clast size = 50 mm. Fragments display red staining/mineralization on most surfaces. Metadiorite boulders to 213 ft bgs. 222.0-224.5' - Metadiorite boulder.		
225					224.5' - Color change to dark greyish brown (2.5Y 5/2).		
	227.0						Drill rate <1 in/min from 228.0-237.0'
					Metadiorite Bedrock (pTbr) 228.0-237.0' 229.0-230.0' - Rock fragments covered with iron staining on all surfaces.		
230							Stop 03/22/2011 at 1645. Resume 03/23/2011 at 0830.
				pTbr	232.0-236.5' - Core difficult to recover, clasts in recovered core disintegrate into rock flour (ie, no gravel). 233.5' - Presence of calcite infill on rock surfaces.		
235					236.5' - Interlocking metadiorite fragments.		
					End Drilling on 3/23/2011 Total Borehole Depth: 237.0 ft bgs		This borehole was converted into the following monitoring well(s): MW-65-160 and MW-65-225
240							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-66	SHEET 1 OF 15

SOIL BORING LOG

PROJECT : ER-TCS Investigation

LOCATION : Site 6 (TCS) (2100957.7 N, 7615153.8 E)

ELEVATION : 586.0 ft

DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD :

ORIENTATION : Vertical

WATER LEVELS : Approx. 131 ft BGS

START : 4/12/2011

END : 9/11/2011

LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
0	0.0	COMPLETE	10101		**Poorly Graded Sand (SP)** 0.0-14.0' - yellowish brown, (10YR 5/4), dry, loose, 5% gravel, 90% sand, 5% fines, angular to subangular, poorly graded, predominantly quartz.		Soil sample collected between 0.0 and 1.0 ft bgs.
	1.0						
	2.0		10102				Soil sample collected between 2.0 and 3.0 ft bgs.
	3.0						
5	5.0		10103				Soil sample collected between 5.0 and 6.0 ft bgs.
	6.0			SP			
10							
	14.0		10104, 50003		**Silty Sand (SM)** 14.0-17.0' - yellowish brown, (10YR 5/4), dry, loose, 10% gravel, 75% sand, 15% fines, angular to subangular, poorly graded, predominantly quartz.		Soil sample collected between 14.0 and 15.0 ft bgs.
15	15.0			SM			
				SP	**Poorly Graded Sand (SP)** 17.0-19.0' - yellowish brown, (10YR 5/4), dry, loose, 5% gravel, 90% sand, 5% fines, angular to subangular, poorly graded, predominantly quartz.		
	19.0		10105	ML	**Silt (ML)** 19.0-32.0' - dark yellow brown, (10YR 4/4), dry, loose to partially consolidated, poorly graded		Soil sample collected between 19.0 and 20.0 ft bgs.
20	20.0						

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-66 SHEET 2 OF 15

SOIL BORING LOG

PROJECT : ER-TCS Investigation
LOCATION : Site 6 (TCS) (2100957.7 N, 7615153.8 E)
ELEVATION : 586.0 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)
DRILLING EQUIPMENT AND METHOD :
ORIENTATION : Vertical
WATER LEVELS : Approx. 131 ft BGS
START : 4/12/2011
END : 9/11/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
25		COMPLETE		ML	**Silt (ML)** 19.0-32.0' - dark yellow brown, (10YR 4/4), dry, loose to partially consolidated, poorly graded		
30	29.0 30.0		10106				Soil sample collected between 29.0 and 30.0 ft bgs.
35				SM	**Silty Sand (SM)** 32.0-67.0' - yellowish brown, (10YR 5/4), dry, loose to partially consolidated, 10% gravel, 65% sand, 25% fines, angular to subangular, poorly graded, predominantly quartz.		
40	39.0 40.0		10107				Soil sample collected between 39.0 and 40.0 ft bgs.

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-66 SHEET 3 OF 15

SOIL BORING LOG

PROJECT : ER-TCS Investigation
LOCATION : Site 6 (TCS) (2100957.7 N, 7615153.8 E)
ELEVATION : 586.0 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)
DRILLING EQUIPMENT AND METHOD :
ORIENTATION : Vertical
WATER LEVELS : Approx. 131 ft BGS
START : 4/12/2011
END : 9/11/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
45		COMPLETE			**Silty Sand (SM)** 32.0-67.0' - yellowish brown, (10YR 5/4), dry, loose to partially consolidated, 10% gravel, 65% sand, 25% fines, angular to subangular, poorly graded, predominantly quartz. 46' - Change to 15% gravel, 60% sand, 25% fines.		
50	49.0 50.0		10108	SM			Soil sample collected between 49.0 and 50.0 ft bgs.
55							Stopped drilling at 1630, 4/12/2011 Resumed at 830, 4/13/2011
60	59.0 60.0		10109				Soil sample collected between 59.0 and 60.0 ft bgs.

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-66 SHEET 4 OF 15

SOIL BORING LOG

PROJECT : ER-TCS Investigation
LOCATION : Site 6 (TCS) (2100957.7 N, 7615153.8 E)
ELEVATION : 586.0 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)
DRILLING EQUIPMENT AND METHOD :
ORIENTATION : Vertical
WATER LEVELS : Approx. 131 ft BGS
START : 4/12/2011
END : 9/11/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
65		COMPLETE		SM	**Silty Sand (SM)** 32.0-67.0' - yellowish brown, (10YR 5/4), dry, loose to partially consolidated, 10% gravel, 65% sand, 25% fines, angular to subangular, poorly graded, predominantly quartz.		
	69.0		10110	SW	**Well Graded Sand (SW)** 67.0-83.0' - brown, (10YR 4/3), dry, loose, 5% gravel, 90% sand, 5% fines, angular to subangular, predominantly quartz.		Soil sample collected between 69.0 and 70.0 ft bgs.
70	70.0						
75					77' - Change to 5% gravel, 85% sand, 10% fines.		
	79.0		10111				Soil sample collected between 79.0 and 80.0 ft bgs.
80	80.0						

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-66 SHEET 5 OF 15

SOIL BORING LOG

PROJECT : ER-TCS Investigation
LOCATION : Site 6 (TCS) (2100957.7 N, 7615153.8 E)

ELEVATION : 586.0 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD :
ORIENTATION : Vertical

WATER LEVELS : Approx. 131 ft BGS
START : 4/12/2011
END : 9/11/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
		COMPLETE		SW	**Well Graded Sand (SW)** 67.0-83.0' - brown, (10YR 4/3), dry, loose, 5% gravel, 90% sand, 5% fines, angular to subangular, predominantly quartz.		
85				SM	**Silty Sand (SM)** 83.0-87.0' - yellowish brown, (10YR 5/4), dry, partially consolidated, 10% gravel, 70% sand, 20% fines, angular to subangular, poorly graded, predominantly quartz. 83.0-84.0' - Metadiorite boulder.		
	89.0		10112	SW	**Well Graded Sand With Gravel (SW)** 87.0-132.0' - yellowish brown, (10YR 5/4), dry to moist, loose, 20% gravel, 75% sand, 5% fines, angular to subangular, poorly graded, predominantly quartz and mixed gravel.		Soil sample collected between 89.0 and 90.0 ft bgs.
90	90.0						
95							
	99.0		10113				Soil sample collected between 99.0 and 100.0 ft bgs.
100	100.0						

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-66 SHEET 6 OF 15

SOIL BORING LOG

PROJECT : ER-TCS Investigation
LOCATION : Site 6 (TCS) (2100957.7 N, 7615153.8 E)
ELEVATION : 586.0 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)
DRILLING EQUIPMENT AND METHOD :
ORIENTATION : Vertical
WATER LEVELS : Approx. 131 ft BGS
START : 4/12/2011
END : 9/11/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
105		COMPLETE			104.0-105.0' - Metadiorite boulder.		
	109.0		10114	SW			Soil sample collected between 109.0 and 110.0 ft bgs.
110	110.0						
115							
				NR	**No Recovery (NR)** 117.0-119.0'		Rig down at 1200. Drilling resumes at 0845.
	119.0		10115, 50004		**Well Graded Sand With Gravel (SW)** 87.0-132.0' - yellowish brown, (10YR 5/4), dry to moist, loose, 20% gravel, 75% sand, 5% fines, angular to subangular, poorly graded, predominantly quartz and mixed gravel.		Soil sample collected between 119.0 and 120.0 ft bgs.
120	120.0						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-66 SHEET 7 OF 15

SOIL BORING LOG

PROJECT : ER-TCS Investigation
LOCATION : Site 6 (TCS) (2100957.7 N, 7615153.8 E)
ELEVATION : 586.0 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)
DRILLING EQUIPMENT AND METHOD :
ORIENTATION : Vertical
WATER LEVELS : Approx. 131 ft BGS
START : 4/12/2011
END : 9/11/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
125		COMPLETE		SW	**Well Graded Sand With Gravel (SW)** 87.0-132.0' - yellowish brown, (10YR 5/4), dry to moist, loose, 20% gravel, 75% sand, 5% fines, angular to subangular, poorly graded, predominantly quartz and mixed gravel.		
	129.0		10116				Soil sample collected between 129.0 and 130.0 ft bgs.
130	130.0						
135				SW	**Well Graded Sand With Gravel (SW)** 132.0-157.0' - brown, (10YR 5/3), saturated, loose to partially consolidated, 40% gravel, 40% sand, 20% fines, angular to subangular, poorly graded, Color change to brown (10YR 5/3), saturated, loose to partially consolidated, change to 40% gravel, 40% sand, 20% fines, mixed gravel.		
140							

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-66 SHEET 8 OF 15

SOIL BORING LOG

PROJECT : ER-TCS Investigation
LOCATION : Site 6 (TCS) (2100957.7 N, 7615153.8 E)
ELEVATION : 586.0 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)
DRILLING EQUIPMENT AND METHOD :
ORIENTATION : Vertical
WATER LEVELS : Approx. 131 ft BGS
START : 4/12/2011
END : 9/11/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
145		COMPLETE			**Well Graded Sand With Gravel (SW)** 132.0-157.0' - brown, (10YR 5/3), saturated, loose to partially consolidated, 40% gravel, 40% sand, 20% fines, angular to subangular, poorly graded, mixed gravel.		
	147.0		BH-66-20101	SW			Grab groundwater sample collected from borehole between 147.0 and 157.0 ft bgs.
150							
155							
	157.0			SP	**Poorly Graded Sand (SP)** 157.0-162.5' - greyish brown, (10YR 5/2), saturated, loose, 5% gravel, 90% sand, 5% fines, subangular to subrounded, poorly graded and fining upwards, predominantly quartz sand.		
160							

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-66 SHEET 9 OF 15

SOIL BORING LOG

PROJECT : ER-TCS Investigation
LOCATION : Site 6 (TCS) (2100957.7 N, 7615153.8 E)
ELEVATION : 586.0 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)
DRILLING EQUIPMENT AND METHOD :
ORIENTATION : Vertical
WATER LEVELS : Approx. 131 ft BGS
START : 4/12/2011
END : 9/11/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
		COMPLETE		SP	**Poorly Graded Sand (SP)** 157.0-162.5' - greyish brown, (10YR 5/2), saturated, loose, 5% gravel, 90% sand, 5% fines, subangular to subrounded, poorly graded and fining upwards, predominantly quartz sand.		
165				SW	**Well Graded Sand With Gravel (SW)** 162.5-233.0' - dark brown, (7.5YR 3/4), saturated, loose to partially consolidated, 40% gravel, 40% sand, 20% fines, angular to subangular, poorly graded, mixed gravel. 166.0-167.0' - Metadiorite boulder.		
170							
175							
	177.0				177' - Change to 40% gravel, 20% sand, 40% fines, dense.		Grab groundwater sample collected from borehole between 177.0 and 187.0 ft bgs.
180							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-66	SHEET 10 OF 15

SOIL BORING LOG

PROJECT : ER-TCS Investigation
LOCATION : Site 6 (TCS) (2100957.7 N, 7615153.8 E)
ELEVATION : 586.0 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)
DRILLING EQUIPMENT AND METHOD :
ORIENTATION : Vertical
WATER LEVELS : Approx. 131 ft BGS
START : 4/12/2011
END : 9/11/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft) / RECOVERY (in) / LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
185	COMPLETE; BH-66-20102	SW	**Well Graded Sand With Gravel (SW)** 162.5-233.0' - dark brown, (7.5YR 3/4), saturated, loose to partially consolidated, 40% gravel, 40% sand, 20% fines, angular to subangular, poorly graded, mixed gravel.		
187.0					Rig down at 1640. Drilling resumes at 1200.
190					
195			197' - Increase in metadiorite content in gravel component.		
200					

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-66	SHEET 11 OF 15

SOIL BORING LOG

PROJECT : ER-TCS Investigation
LOCATION : Site 6 (TCS) (2100957.7 N, 7615153.8 E)
ELEVATION : 586.0 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)
DRILLING EQUIPMENT AND METHOD :
ORIENTATION : Vertical
WATER LEVELS : Approx. 131 ft BGS
START : 4/12/2011
END : 9/11/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft) / RECOVERY (in) / LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
205	COMPLETE	SW	**Well Graded Sand With Gravel (SW)** 162.5-233.0' - dark brown, (7.5YR 3/4), saturated, loose to partially consolidated, 40% gravel, 40% sand, 20% fines, angular to subangular, poorly graded, mixed gravel. 204' - Change to 50% gravel and 50% fines, clast-supported.		
207.0	BH-66-20103				Grab groundwater sample collected from borehole between 207.0 and 217.0 ft bgs.
210					
215			214' - Color change to reddish brown (5YR 4/4) 215.0-216.0' - Metadiorite boulder.		
217.0			217' - Color change to brown (7.5YR 4/4).		
220					

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-66 SHEET 12 OF 15

SOIL BORING LOG

PROJECT : ER-TCS Investigation
LOCATION : Site 6 (TCS) (2100957.7 N, 7615153.8 E)
ELEVATION : 586.0 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)
DRILLING EQUIPMENT AND METHOD :
ORIENTATION : Vertical
WATER LEVELS : Approx. 131 ft BGS
START : 4/12/2011
END : 9/11/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft) / RECOVERY (in) / LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
225	COMPLETE; BH-66-20104	SW	**Well Graded Sand With Gravel (SW)** 162.5-233.0' - dark brown, (7.5YR 3/4), saturated, loose to partially consolidated, 40% gravel, 40% sand, 20% fines, angular to subangular, poorly graded, mixed gravel.		Grab groundwater sample collected from borehole between 224.0 and 234.0 ft bgs.
224.0					
230					Rig down at 1630. Drilling resumes at 0800.
234.0		Tmc	**Conglomerate Bedrock (Tmc)** 233.0-248.0' - massive.		Total depth reached at 0930.
235					
240					

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-66 SHEET 13 OF 15

SOIL BORING LOG

PROJECT : ER-TCS Investigation
LOCATION : Site 6 (TCS) (2100957.7 N, 7615153.8 E)
ELEVATION : 586.0 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)
DRILLING EQUIPMENT AND METHOD :
ORIENTATION : Vertical
WATER LEVELS : Approx. 131 ft BGS
START : 4/12/2011
END : 9/11/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
245		COMPLETE		Tmc	**Conglomerate Bedrock (Tmc)** 233.0-248.0' - massive.		
248.0					Begin rock coring from 248.0 ft bgs See the next page for the rock core log.		
250							
255							
260							

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-66	SHEET 14 OF 15

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site 6 (TCS) (2100957.7 N, 7615153.8 E)

ELEVATION : 586.6 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

CORING EQUIPMENT AND METHOD : HQ Wire-Line Rotary
ORIENTATION : Vertical

WATER LEVELS : Approx. 130 ft BGS
START : 4/12/2011
END : 9/11/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY: ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS	COMMENTS: SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.
	248.0		0	248' - Note: unless otherwise noted, all factures in core are mechanical breaks caused by the drilling process.		**Conglomerate** 248.0-271.0' - dark reddish brown, (10YR 3/4), no dominant mineralogy, highly cemented, moderate (), angular to subangular, massive (no bedding planes), matrix-supported.	R1=0.43 FPM
	R1 3 ft 100%	90	1	249.1' - Joint, 60 deg, planar, <1mm calcite infilling, iron staining, slickenslided, tight.			
250			0				
	251.0						
			0				R2=0.53 FPM
			0				
	R2 5 ft 100%	100	0				
			0				
255			0				
	256.0						
			0				R3=0.49 FPM
			0				
	R3 5 ft 100%	100	0				
			0				
260			0				
	261.0						
			0				R4=0.54 FPM
			0			Presence of foliation at approximately 30 degree dip.	
	R4 5 ft 100%	100	1	263.6' - Joint, 40 deg, smooth, undulating to planar, <1mm calcite infilling, iron staining, tight.			
265			0				
	266.0						
			0				R5=0.74 FPM
			0				

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-66	SHEET 15 OF 15

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site 6 (TCS) (2100957.7 N, 7615153.8 E)

ELEVATION : 586.6 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

CORING EQUIPMENT AND METHOD : HQ Wire-Line Rotary
ORIENTATION : Vertical

WATER LEVELS : Approx. 130 ft BGS
START : 4/12/2011
END : 9/11/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
270	R5 5 ft 100%	100	0 0 0			**Conglomerate** 248.0-271.0' - dark reddish brown, (10YR 3/4), no dominant mineralogy, highly cemented, moderate (), angular to subangular, massive (no bedding planes), matrix-supported.	
271.0						End Drilling on 9/11/2011 Total Borehole Depth: 271.0 ft bgs	This borehole was converted into the following monitoring well(s): MW-66-165, MW-66-230, and MW-66BR-270
275							
280							
285							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-67 SHEET 1 OF 14

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site 2 (2101040.2 N, 7615335.5 E)
ELEVATION : 626.2 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)
DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic
ORIENTATION : Vertical
WATER LEVELS : Approx. 170 ft BGS
START : 4/29/2011
END : 5/3/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
0.0							Start 04/29/2011 at 0800
1.0		COMPLETE	10201		**Poorly Graded Sand (SP)** 0.0-21.0' - light yellowish brown, (10YR 6/4), dry, loose, subangular to subrounded, poorly graded, predominantly quartz.		Soil sample collected between 0.0 and 1.0 ft bgs.
2.0			10202				Soil sample collected between 2.0 and 3.0 ft bgs.
3.0							
5							
5.0			10203				Soil sample collected between 5.0 and 6.0 ft bgs.
6.0							
9.0			10204				Soil sample collected between 9.0 and 10.0 ft bgs.
10 10.0				SP			
14.0			10205				Soil sample collected between 14.0 and 15.0 ft bgs.
15 15.0							
19.0			10206				Soil sample collected between 19.0 and 20.0 ft bgs.
20 20.0							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-67	SHEET 2 OF 14

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site 2 (2101040.2 N, 7615335.5 E)
ELEVATION : 626.2 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)
DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic
ORIENTATION : Vertical
WATER LEVELS : Approx. 170 ft BGS
START : 4/29/2011
END : 5/3/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
		COMPLETE		SP	**Poorly Graded Sand (SP)** 0.0-21.0' - light yellowish brown, (10YR 6/4), dry, loose, subangular to subrounded, poorly graded, predominantly quartz.		
				SW	**Well Graded Sand (SW)** 21.0-24.0' - yellowish brown, (10YR 5/4), dry, loose, subangular to subrounded, predominantly quartz.		
25					**Boulder** 24.0-28.0' - Unknown pulverized boulder.		
	29.0		10207	SM	**Silty Sand (SM)** 28.0-40.0' - yellowish brown, (10YR 5/4), dry, loose to partially consolidated, 10% gravel, 75% sand, 15% fines, subangular, poorly graded, predominantly quartz.		Soil sample collected between 29.0 and 30.0 ft bgs.
30	30.0						
35							
	39.0		10208, 50006				Soil sample collected between 39.0 and 40.0 ft bgs.
40	40.0						

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-67 SHEET 3 OF 14

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site 2 (2101040.2 N, 7615335.5 E)

ELEVATION : 626.2 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic
ORIENTATION : Vertical

WATER LEVELS : Approx. 170 ft BGS
START : 4/29/2011
END : 5/3/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
45		COMPLETE		SP	**Poorly Graded Sand (SP)** 40.0-47.0' - yellowish brown, (10YR 5/4), dry, loose, 5% gravel, 90% sand, 5% fines, subangular to subrounded, poorly graded, predominantly quartz.		
	49.0		10209	SM	**Silty Sand With Gravel (SM)** 47.0-52.0' - yellowish brown, (10YR 5/4), dry, loose, 15% gravel, 65% sand, 20% fines, subangular to angular, poorly graded, no predominant mineral.		Soil sample collected between 49.0 and 50.0 ft bgs.
50	50.0			SP	**Poorly Graded Sand (SP)** 52.0-53.0' - light yellowish brown, (10YR 6/4), dry, loose, subangular to subrounded, poorly graded, predominantly quartz.		
55				CL	**Lean Clay (CL)** 53.0-63.0' - brown, (7.5YR 4/4), moist, stiff, slow dilatancy, poorly graded		
	59.0		10210				Soil sample collected between 59.0 and 60.0 ft bgs.
60	60.0						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-67	SHEET 4 OF 14

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site 2 (2101040.2 N, 7615335.5 E)

ELEVATION : 626.2 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic
ORIENTATION : Vertical

WATER LEVELS : Approx. 170 ft BGS
START : 4/29/2011
END : 5/3/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
		COMPLETE		CL	**Lean Clay (CL)** 53.0-63.0' - brown, (7.5YR 4/4), moist, stiff, slow dilatancy, poorly graded		
				SP	**Poorly Graded Sand (SP)** 63.0-64.0' - light yellowish brown, (10YR 6/4), dry, loose, subangular to subrounded, poorly graded, predominantly quartz.		
65				CL	**Lean Clay (CL)** 64.0-73.0' - brown, (7.5YR 4/4), moist, stiff, slow dilatancy, rusty staining on some surfaces.		
	69.0		10211				Soil sample collected between 69.0 and 70.0 ft bgs.
70	70.0						
75				ML	**Silt (ML)** 73.0-92.0' - brown, (7.5YR 4/4), dry, stiff to medium stiff, moderate dilatancy, friable in spots.		
	79.0		10212				Soil sample collected between 79.0 and 80.0 ft bgs.
80	80.0						

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-67 SHEET 5 OF 14

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site 2 (2101040.2 N, 7615335.5 E)
ELEVATION : 626.2 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)
DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic
ORIENTATION : Vertical
WATER LEVELS : Approx. 170 ft BGS
START : 4/29/2011
END : 5/3/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
85		COMPLETE		ML	**Silt (ML)** 73.0-92.0' - brown, (7.5YR 4/4), dry, stiff to medium stiff, moderate dilatancy, friable in spots.		
	89.0		10213				Soil sample collected between 89.0 and 90.0 ft bgs.
90	90.0						
95				GW	**Well Graded Gravel (GW)** 92.0-197.0' - dark greyish brown, (10YR 4/2), dry, loose to partially consolidated, 40% gravel, 40% sand, 20% fines, angular to subangular, poorly graded, no dominant mineralogy.		
	99.0		10214				Soil sample collected between 99.0 and 100.0 ft bgs.
100	100.0						

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-67 SHEET 6 OF 14

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site 2 (2101040.2 N, 7615335.5 E)
ELEVATION : 626.2 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)
DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic
ORIENTATION : Vertical
WATER LEVELS : Approx. 170 ft BGS
START : 4/29/2011
END : 5/3/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
105		COMPLETE			**Well Graded Gravel (GW)** 92.0-197.0' - dark greyish brown, (10YR 4/2), dry, loose to partially consolidated, 40% gravel, 40% sand, 20% fines, angular to subangular, poorly graded, no dominant mineralogy.		
	109.0		10215				Soil sample collected between 109.0 and 110.0 ft bgs.
110	110.0			GW			
115							
	119.0		10216				Soil sample collected between 119.0 and 120.0 ft bgs.
120	120.0						

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-67 SHEET 7 OF 14

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site 2 (2101040.2 N, 7615335.5 E)
ELEVATION : 626.2 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)
DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic
ORIENTATION : Vertical
WATER LEVELS : Approx. 170 ft BGS
START : 4/29/2011
END : 5/3/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
125		COMPLETE			**Well Graded Gravel (GW)** 92.0-197.0' - dark greyish brown, (10YR 4/2), dry, loose to partially consolidated, 40% gravel, 40% sand, 20% fines, angular to subangular, poorly graded, no dominant mineralogy.		Stop 04/29/2011 at 1645 at 127 ft bgs. Resume on 4/30/2011 at 0700.
130	129.0 130.0		10217	GW			Soil sample collected between 129.0 and 130.0 ft bgs.
135							
140	139.0 140.0		10218, 50007				Soil sample collected between 139.0 and 140.0 ft bgs.

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-67 SHEET 8 OF 14

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site 2 (2101040.2 N, 7615335.5 E)
ELEVATION : 626.2 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)
DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic
ORIENTATION : Vertical
WATER LEVELS : Approx. 170 ft BGS
START : 4/29/2011
END : 5/3/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
145		COMPLETE			**Well Graded Gravel (GW)** 92.0-197.0' - dark greyish brown, (10YR 4/2), dry, loose to partially consolidated, 40% gravel, 40% sand, 20% fines, angular to subangular, poorly graded, no dominant mineralogy.		
150	149.0 150.0		10219	GW			Soil sample collected between 149.0 and 150.0 ft bgs.
155					157' - Change to moist.		
160	159.0 160.0		10220				Soil sample collected between 159.0 and 160.0 ft bgs.

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-67 SHEET 9 OF 14

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site 2 (2101040.2 N, 7615335.5 E)
ELEVATION : 626.2 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)
DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic
ORIENTATION : Vertical
WATER LEVELS : Approx. 170 ft BGS
START : 4/29/2011
END : 5/3/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft) / RECOVERY (in) / LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
165	COMPLETE	GW	**Well Graded Gravel (GW)** 92.0-197.0' - dark greyish brown, (10YR 4/2), dry, loose to partially consolidated, 40% gravel, 40% sand, 20% fines, angular to subangular, poorly graded, no dominant mineralogy, matrix-supported. 160.5-161.0' - Metadiorite boulder. 169' - Change to saturated, color change to brown (10YR 5/3).		
170					
175					
180					

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-67 SHEET 10 OF 14

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site 2 (2101040.2 N, 7615335.5 E)
ELEVATION : 626.2 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)
DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic
ORIENTATION : Vertical
WATER LEVELS : Approx. 170 ft BGS
START : 4/29/2011
END : 5/3/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
185		COMPLETE			**Well Graded Gravel (GW)** 92.0-197.0' - dark greyish brown, (10YR 4/2), dry, loose to partially consolidated, 40% gravel, 40% sand, 20% fines, angular to subangular, poorly graded, no dominant mineralogy.		
	187.0		BH-67-20201	GW			Grab groundwater sample collected from borehole between 187.0 and 197.0 ft bgs.
190							
195							
	197.0			ML	**Silt With Gravel (ML)** 197.0-211.0' - dark brown, (7.5YR 3/4), saturated, stiff, 15% gravel, 10% sand, 75% fines, moderate dilatancy, subangular to subrounded, poorly graded, no dominant mineralogy.		Stop 04/30/2011 at 1700 at 197 ft bgs. Resume on 05/01/2011 at 0730.
200							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-67	SHEET 11 OF 14

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site 2 (2101040.2 N, 7615335.5 E)

ELEVATION : 626.2 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic
ORIENTATION : Vertical

WATER LEVELS : Approx. 170 ft BGS
START : 4/29/2011
END : 5/3/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
205		COMPLETE		ML	**Silt With Gravel (ML)** 197.0-211.0' - dark brown, (7.5YR 3/4), saturated, stiff, 15% gravel, 10% sand, 75% fines, moderate dilatancy, subangular to subrounded, poorly graded, no dominant mineralogy.		
210							
215				SW	**Well Graded Sand With Gravel (SW)** 211.0-221.0' - dark brown, (7.5YR 3/4), saturated, loose, 35% gravel, 55% sand, 10% fines, subangular to subrounded, no dominant mineralogy.		
	217.0						Drilling very slow (<0.1 FPM) Grab groundwater sample collected from borehole between 217.0 and 227.0 ft bgs.
220							

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-67	SHEET 12 OF 14

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site 2 (2101040.2 N, 7615335.5 E)
ELEVATION : 626.2 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)
DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic
ORIENTATION : Vertical
WATER LEVELS : Approx. 170 ft BGS
START : 4/29/2011
END : 5/3/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft) / RECOVERY (in) / LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
	COMPLETE; BH-67-20202	SW	**Well Graded Sand With Gravel (SW)** 211.0-221.0' - dark brown, (7.5YR 3/4), saturated, loose, 35% gravel, 55% sand, 10% fines, subangular to subrounded, no dominant mineralogy.		
			Silt With Gravel (ML) 221.0-258.5' - dark brown, (7.5YR 3/4), saturated, stiff, 40% gravel, 5% sand, 55% fines, slow to moderate dilatancy, subangular to angular, poorly graded, no dominant mineralogy.		
225			225' - increase in proportion of metadiorite gravel.		
227.0					
230		ML			
235					
240					

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-67 SHEET 13 OF 14

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site 2 (2101040.2 N, 7615335.5 E)
ELEVATION : 626.2 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)
DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic
ORIENTATION : Vertical
WATER LEVELS : Approx. 170 ft BGS
START : 4/29/2011
END : 5/3/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft) / RECOVERY (in) / LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
245	COMPLETE		**Well Graded Sand With Gravel (SW)** 258.5-259.5' - dark brown, (7.5YR 3/4), saturated, loose, 40% gravel, 50% sand, 10% fines, subangular to subrounded, predominantly quartz sand and metadiorite gravel.		
247.0	BH-67-20203	ML			Grab groundwater sample collected from borehole between 247.0 and 257.0 ft bgs.
250					
255					
257.0			**Silt With Gravel (ML)** 221.0-258.5' - dark brown, (7.5YR 3/4), saturated, stiff, 40% gravel, 5% sand, 55% fines, slow to moderate dilatancy, subangular to angular, poorly graded, no dominant mineralogy.		Stop 05/01/2011 at 1700 at 257 ft bgs. Resume 05/02/2011 at 1400.
		SW	**Well Graded Sand With Gravel (SW)** 258.5-259.5' - dark brown, (7.5YR 3/4), saturated, loose, 40% gravel, 50% sand, 10% fines, subangular to subrounded, predominantly quartz sand and metadiorite gravel.		
260		ML			

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-67 SHEET 14 OF 14

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site 2 (2101040.2 N, 7615335.5 E)
ELEVATION : 626.2 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)
DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic
ORIENTATION : Vertical
WATER LEVELS : Approx. 170 ft BGS
START : 4/29/2011
END : 5/3/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
		COMPLETE		ML	**Silt With Gravel (ML)** 259.5-264.0' - dark brown, (7.5YR 3/4), saturated, stiff to moderately stiff, 40% gravel, 5% sand, 55% fines, moderate dilatancy, subangular to angular, poorly graded, predominantly metadiorite gravel.		
265				Tmc	**Conglomerate (Tmc)** 264.0-271.0' - Miocene conglomerate; yellowish red (5YR 4/6) from 264.0-265.0', red (2.5YR 4/6) from 265.0-271.0'.		Stop 05/02/2011 at 1600 at 264 ft bgs, refusal with 6" conductor at 254.0 ft bgs. Resume 05/03/2011 at 1330.
270				pTbr	**Metadiorite (pTbr)** 271.0-272.5' - Metadiorite bedrock.		
275					End Drilling on 5/3/2011 Total Borehole Depth: 272.5 ft bgs		This borehole was converted into the following monitoring well(s): MW-67-185, MW-67-225,and MW-67-260
280							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-68 SHEET 1 OF 15

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation LOCATION : Site 3 (2100773.6 N, 7615453.4 E)

ELEVATION : 621.6 ft DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic drill head and tools ORIENTATION : Vertical

WATER LEVELS : Approx. 164 ft BGS START : 5/13/2011 END : 5/16/2011 LOGGER : R. Tweidt (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
0	0.0	COMPLETE	10301	SP	**Poorly Graded Sand (SP)** 0.0-17.0' - dark yellowish brown, (10YR 4/4), dry, loose, 5% gravel, 90% sand, 5% fines, angular to subangular, poorly graded, predominantly quartz.		Soil sample collected between 0.0 and 1.0 ft bgs.
	1.0						
	2.0		10302				
	3.0						Soil sample collected between 3.0 and 4.0 ft bgs.
5	5.0		10303, 50009				Soil sample collected between 5.0 and 6.0 ft bgs.
	6.0						
	9.0		10304				Soil sample collected between 9.0 and 10.0 ft bgs.
10	10.0						
	14.0		10305		14' - Color change to yellowish brown, (10YR 5/4)		Soil sample collected between 14.0 and 15.0 ft bgs.
15	15.0						
	19.0		10306	SM	**Silty Sand (SM)** 17.0-35.0' - brown, (10YR 5/3), dry, loose to partially consolidated, 10% gravel, 60% sand, 30% fines, subangular to subrounded, poorly graded, predominantly quartz.		Soil sample collected between 19.0 and 20.0 ft bgs.
20	20.0						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-68 SHEET 2 OF 15

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation LOCATION : Site 3 (2100773.6 N, 7615453.4 E)

ELEVATION : 621.6 ft DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic drill head and tools ORIENTATION : Vertical

WATER LEVELS : Approx. 164 ft BGS START : 5/13/2011 END : 5/16/2011 LOGGER : R. Tweidt (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
25		COMPLETE		SM	**Silty Sand (SM)** 17.0-35.0' - brown, (10YR 5/3), dry, loose to partially consolidated, 10% gravel, 60% sand, 30% fines, subangular to subrounded, poorly graded, predominantly quartz.		
30	29.0 30.0		10307				Soil sample collected between 29.0 and 30.0 ft bgs.
35				SW	**Well Graded Sand With Gravel (SW)** 35.0-62.0' - brown, (10YR 5/3), dry, loose to partially consolidated, 25% gravel, 75% sand, subrounded to subangular, predominantly quartz.		
40	39.0 40.0		10308				Soil sample collected between 39.0 and 40.0 ft bgs.

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-68 SHEET 3 OF 15

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation LOCATION : Site 3 (2100773.6 N, 7615453.4 E)

ELEVATION : 621.6 ft DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic drill head and tools ORIENTATION : Vertical

WATER LEVELS : Approx. 164 ft BGS START : 5/13/2011 END : 5/16/2011 LOGGER : R. Tweidt (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
45		COMPLETE			**Well Graded Sand With Gravel (SW)** 35.0-62.0' - brown, (10YR 5/3), dry, loose to partially consolidated, 25% gravel, 75% sand, subrounded to subangular, predominantly quartz.		
					48.0-50.0' - Rock flour		
	49.0		10309				Soil sample collected between 49.0 and 50.0 ft bgs.
50	50.0			SW			
55							
	59.0		10310				Soil sample collected between 59.0 and 60.0 ft bgs.
60	60.0						

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-68 SHEET 4 OF 15

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation LOCATION : Site 3 (2100773.6 N, 7615453.4 E)

ELEVATION : 621.6 ft DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic drill head and tools ORIENTATION : Vertical

WATER LEVELS : Approx. 164 ft BGS START : 5/13/2011 END : 5/16/2011 LOGGER : R. Tweidt (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
		COMPLETE		SW	**Well Graded Sand With Gravel (SW)** 35.0-62.0' - brown, (10YR 5/3), dry, loose to partially consolidated, 25% gravel, 75% sand, subrounded to subangular, predominantly quartz.		
65				GW	**Well Graded Gravel (GW)** 62.0-243.0' - greyish brown, (10YR 5/2), dry, loose to partially consolidated, 40% gravel, 40% sand, 20% fines, angular to subangular, no dominant mineralogy.		
	69.0		10311		69' - color change to light yellow brown, (2.5Y 6/3)		Soil sample collected between 69.0 and 70.0 ft bgs.
70	70.0				70.0-71.0' - Rock flour		
75							
	79.0		10312				Soil sample collected between 79.0 and 80.0 ft bgs.
80	80.0						

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-68 SHEET 5 OF 15

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation LOCATION : Site 3 (2100773.6 N, 7615453.4 E)

ELEVATION : 621.6 ft DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic drill head and tools ORIENTATION : Vertical

WATER LEVELS : Approx. 164 ft BGS START : 5/13/2011 END : 5/16/2011 LOGGER : R. Tweidt (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
85		COMPLETE			**Well Graded Gravel (GW)** 62.0-243.0' - light yellow brown, (2.5Y 6/3), dry, loose to partially consolidated, 40% gravel, 40% sand, 20% fines, angular to subangular, no dominant mineralogy. 84' - Change to unconsolidated		
90	89.0 90.0		10313	GW			Soil sample collected between 89.0 and 90.0 ft bgs.
95							
100	99.0 100.0		10314, 50010				Soil sample collected between 99.0 and 100.0 ft bgs.

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-68 SHEET 6 OF 15

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation LOCATION : Site 3 (2100773.6 N, 7615453.4 E)

ELEVATION : 621.6 ft DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic drill head and tools ORIENTATION : Vertical

WATER LEVELS : Approx. 164 ft BGS START : 5/13/2011 END : 5/16/2011 LOGGER : R. Tweidt (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
		COMPLETE			**Well Graded Gravel (GW)** 62.0-243.0' - light yellow brown, (2.5Y 6/3), dry, loose to partially consolidated, 40% gravel, 40% sand, 20% fines, angular to subangular, no dominant mineralogy.		
					102' - Change to partially consolidated		
105					105' - Color change to light yellow brown (2.5Y 6/3)		
	109.0		10315		109.0-110.0' - Rock flour		Soil sample collected between 109.0 and 110.0 ft bgs.
110	110.0			GW			
					111.5-112.0' - Rock flour		
115					115.0-115.5' - Rock flour		
	119.0		10316				Soil sample collected between 119.0 and 120.0 ft bgs.
120	120.0						

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-68 SHEET 7 OF 15

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation LOCATION : Site 3 (2100773.6 N, 7615453.4 E)

ELEVATION : 621.6 ft DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic drill head and tools ORIENTATION : Vertical

WATER LEVELS : Approx. 164 ft BGS START : 5/13/2011 END : 5/16/2011 LOGGER : R. Tweidt (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
125		COMPLETE			**Well Graded Gravel (GW)** 62.0-243.0' - light yellow brown, (2.5Y 6/3), dry, 40% gravel, 40% sand, 20% fines, angular to subangular, no dominant mineralogy, partially consolidated from 102.0 ft		
	129.0		10317				Soil sample collected between 129.0 and 130.0 ft bgs.
130	130.0			GW			
135							Stop 05/13/2011 at 1700 at 137 ft bgs. Resume 05/14/2011 at 0730
	139.0		10318				Soil sample collected between 139.0 and 140.0 ft bgs.
140	140.0						

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-68 SHEET 8 OF 15

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation LOCATION : Site 3 (2100773.6 N, 7615453.4 E)

ELEVATION : 621.6 ft DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic drill head and tools ORIENTATION : Vertical

WATER LEVELS : Approx. 164 ft BGS START : 5/13/2011 END : 5/16/2011 LOGGER : R. Tweidt (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
145		COMPLETE			**Well Graded Gravel (GW)** 62.0-243.0' - light yellow brown, (2.5Y 6/3), dry, 40% gravel, 40% sand, 20% fines, angular to subangular, no dominant mineralogy, partially consolidated from 102.0 ft		
	149.0		10319	GW			Soil sample collected between 149.0 and 150.0 ft bgs.
150	150.0						
155							
	159.0		10320				Soil sample collected between 159.0 and 160.0 ft bgs.
160	160.0						

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-68 SHEET 9 OF 15

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation LOCATION : Site 3 (2100773.6 N, 7615453.4 E)

ELEVATION : 621.6 ft DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic drill head and tools ORIENTATION : Vertical

WATER LEVELS : Approx. 164 ft BGS START : 5/13/2011 END : 5/16/2011 LOGGER : R. Tweidt (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
		COMPLETE			**Well Graded Gravel (GW)** 62.0-243.0' - greyish brown, (10YR 5/2), dry, loose to partially consolidated, 40% gravel, 40% sand, 20% fines, angular to subangular, no dominant mineralogy.		
					163' - Increase in metadiorite fraction of gravel; increase in average gravel size to coarse; change to subangular. 164' - Saturated		163 ft bgs: Drill rate (~10 FPM to ~0.1 FPM)
165							
170				GW	170.0-172.0' - Decrease in average gravel size (fine), increase in average sand size (coarse).		170 ft bgs: Drill rate ~10 FPM
							172 ft bgs: Drill rate ~0.1 FPM
					173.0-177.0' - Change to highly angular		
175					175' - light yellow brown, (2.5Y 6/3)		
	177.0				177' - Color change to strong brown (7.5YR 4/6)		
180							

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-68 SHEET 10 OF 15

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation LOCATION : Site 3 (2100773.6 N, 7615453.4 E)

ELEVATION : 621.6 ft DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic drill head and tools ORIENTATION : Vertical

WATER LEVELS : Approx. 164 ft BGS START : 5/13/2011 END : 5/16/2011 LOGGER : R. Tweidt (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
185		COMPLETE	BH-68-20301	GW	**Well Graded Gravel (GW)** 62.0-243.0' - light yellow brown, (2.5Y 6/3), 40% gravel, 40% sand, 20% fines, higly angular from 173.0 ft bgs, predominantly metadiorite gravel from 163.0 ft bgs, partially consolidated from 102.0 ft bgs, matrix-supported, saturated from 164.0 ft bgs.		
187.0							Grab groundwater sample collected from borehole between 187.0 and 197.0 ft bgs.
190							
195					197.0-198.0' - Metadiorite boulder		
200							

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-68	SHEET 11 OF 15

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site 3 (2100773.6 N, 7615453.4 E)

ELEVATION : 621.6 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic drill head and tools
ORIENTATION : Vertical

WATER LEVELS : Approx. 164 ft BGS
START : 5/13/2011
END : 5/16/2011
LOGGER : R. Tweidt (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
205		COMPLETE			**Well Graded Gravel (GW)** 62.0-243.0' - light yellow brown, (2.5Y 6/3), 40% gravel, 40% sand, 20% fines, higly angular from 173.0 ft bgs, predominantly metadiorite gravel from 163.0 ft bgs, partially consolidated from 102.0 ft bgs, matrix-supported, saturated from 164.0 ft bgs. 205.0-207.0' - Coarse-grained sand		
	207.0		BH-68-20302	GW			Grab groundwater sample collected from borehole between 207.0 and 217.0 ft bgs.
210					212' - Color change to pale olive (5Y 6/3)		
215							
	217.0						Stop 05/14/2011 at 1700 at 217 ft bgs. Resume 05/15/2011 at 1130
220							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-68	SHEET 12 OF 15

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site 3 (2100773.6 N, 7615453.4 E)
ELEVATION : 621.6 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)
DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic drill head and tools
ORIENTATION : Vertical
WATER LEVELS : Approx. 164 ft BGS
START : 5/13/2011
END : 5/16/2011
LOGGER : R. Tweidt (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
		COMPLETE		GW	**Well Graded Gravel (GW)** 62.0-243.0' - olive grey, (5Y 5/2), 40% gravel, 40% sand, 20% fines, higly angular from 173.0 ft bgs, predominantly metadiorite gravel from 163.0 ft bgs, partially consolidated from 102.0 ft bgs, matrix-supported, saturated from 164.0 ft bgs.		
225				CL	**Clay With Silt (CL)** 226.5-227.0' - olive grey, (5Y 5/2), saturated, 100% fines, low dilatancy, soft, matrix-supported		
					Well Graded Gravel (GW) 227.0-243.0' - pale olive, (5Y 6/3), saturated, 40% gravel, 40% sand, 20% fines, angular to subangular, predominantly metadiorite gravel, dense. 229.0-230.0' - Rock flour		
230							
				GW	233.0-234.0' - Change to 40% gravel, 50% sand,10% fines, color change to light olive brown (2.5Y 5/3)		
235	235.0						Grab groundwater sample collected from borehole between 235.0 and 245.0 ft bgs.
					238.5-239.0' - Color change to black 239' - Color change to brown (10YR 5/3)		
240							

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-68	SHEET 13 OF 15

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site 3 (2100773.6 N, 7615453.4 E)

ELEVATION : 621.6 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic drill head and tools
ORIENTATION : Vertical

WATER LEVELS : Approx. 164 ft BGS
START : 5/13/2011
END : 5/16/2011
LOGGER : R. Tweidt (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
		COMPLETE	BH-68-20303	GW	**Well Graded Gravel (GW)** 227.0-243.0' - brown, (10YR 5/3), saturated, 40% gravel, 40% sand, 20% fines, angular to subangular, poorly graded, predominantly metadiorite gravel, dense, matrix-supported,		
245	245.0			Tmc	**Conglomerate (Tmc)** 243.0-257.0' - massive, red (2.5YR 4/8)		Stop 05/15/2011 at 1630 at 245 ft bgs. Resume 05/16/2011 at 1000
250							Stop 05/16/2011 at 1100. Drilling complete.
255							Initiate rock core drilling at 1115 on 8/10/2011
	257.0				Begin rock coring from 257.0 ft bgs See the next page for the rock core log.		
260							

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-68	SHEET 14 OF 15

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation | LOCATION : Site 3 (2100773.6 N, 7615453.4 E)

ELEVATION : 621.6 ft | DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

CORING EQUIPMENT AND METHOD : RS-350, Wire-Line Rotary | ORIENTATION : Vertical

WATER LEVELS : Approx. 164 ft BGS | START : 5/13/2011 | END : 5/16/2011 | LOGGER : R. Tweidt (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	257.0		NR			**Miocene Conglomerate (Tmc)** 257.0-257.8' - moderate brown, (5YR 4/4)	Run 1 (257 ft - 260 ft), Drill rate = 0.55 ft/min
	R1 3 ft 70%	28	8	258.0-258.5' - abundant joints, no dominant orientation, not healed, rough, dry		**Metadiorite (pTbr)** 257.8-280.5' - pale yellowish brown (10YR 8/6), non-foliated, uniform, slightly to moderately decomposed, slightly disintegrated, slightly to moderately fractured	
			>10	258.5-263.5' - fracture zone, no dominant orientation, presence of moderately to totally healed fractures, some 60 degree dip angles between 262 and 263 ft bgs.			
260	260.0						
			>10				Run 2 (260 ft - 264.5 ft), Drill rate = 0.28 ft/min
			3				
	R2 4.5 ft 75%	44	>10				
			>10	263.0-264.5' - shear zone, dry, rough			
	264.5		>10				
265			2	264.5-269.5' - undulating, few joints observed, narrow presence of totally healed fractures, mineralization, dry			Run 3 (264.5 ft - 269.5 ft), Drill rate = 0.41 ft/min
						265.5' - Color change to dusky yellow green (5GY 5/2)	
	R3 5 ft 80%	93	1				
			1				
			1				
	269.5		>10				
270	R4 1 ft	0		269.5-273.5' - undulating, fracture zones, no dominant orientation, not healed, dry			Run 4 (269.5 ft - 270.5 ft), Drill rate = 0.44 ft/min
	270.5 50%		>10				Run 5 (270.5 ft - 275.5 ft), Drill rate = 0.45 ft/min
			>10				
	R5 5 ft 70%	15	>10				
			3				
			5				
275							
	275.5		>10				Run 6 (275.5 ft - 280.5 ft), Drill rate = 0.3 ft/min
			>10	276.0-280.5' - undulating, fracture zone, no dominant orientation, not healed, surface staining			

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-68	SHEET 15 OF 15

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation

LOCATION : Site 3 (2100773.6 N, 7615453.4 E)

ELEVATION : 621.6 ft

DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

CORING EQUIPMENT AND METHOD : RS-350, Wire-Line Rotary

ORIENTATION : Vertical

WATER LEVELS : Approx. 164 ft BGS

START : 5/13/2011

END : 5/16/2011

LOGGER : R. Tweidt (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
280	R6 5 ft 70%	15	>10 >10 >10 >10	276.0-280.5' - undulating, fracture zone, no dominant orientation, not healed, surface staining		**Metadiorite (pTbr)** 257.8-280.5' - pale yellowish brown (10YR 8/6), non-foliated, uniform, slightly to moderately decomposed, slightly disintegrated, slightly to moderately fractured	
280.5						End Drilling on 5/16/2011 Total Borehole Depth: 280.5 ft bgs	This borehole was converted into the following monitoring well(s): MW-68-180, MW-68-240, and MW-68BR-280
285							
290							
295							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-69 SHEET 1 OF 10

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site 4 (2100291.6 N, 7615143.0 E)
ELEVATION : 632.1 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)
DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic
ORIENTATION : Vertical
WATER LEVELS : Approx. 178 ft BGS
START : 5/31/2011
END : 6/20/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
0.0	0.0 – 1.0	COMPLETE	10401	GW	**Well Graded Gravel (GW)** 0.0-42.0' - light yellowish brown, (2.5Y 6/3), dry, loose, 40% gravel, 40% sand, 20% fines, subangular to subrounded, no dominant mineralogy.		Soil sample collected between 0.0 and 1.0 ft bgs.
2.0	2.0 – 3.0		10402				Soil sample collected between 2.0 and 3.0 ft bgs.
5	5.0 – 6.0		10403				Soil sample collected between 5.0 and 6.0 ft bgs.
9.0	9.0 – 10.0		10404				Soil sample collected between 9.0 and 10.0 ft bgs.
10							
14.0	14.0 – 15.0		10405				Soil sample collected between 14.0 and 15.0 ft bgs.
15							
19.0	19.0 – 20.0		10406				Soil sample collected between 19.0 and 20.0 ft bgs.
20							

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-69 SHEET 2 OF 10

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site 4 (2100291.6 N, 7615143.0 E)

ELEVATION : 632.1 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic
ORIENTATION : Vertical

WATER LEVELS : Approx. 178 ft BGS
START : 5/31/2011
END : 6/20/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
25		COMPLETE			**Well Graded Gravel (GW)** 0.0-42.0' - light yellowish brown, (2.5Y 6/3), dry, loose, 40% gravel, 40% sand, 20% fines, subangular to subrounded, no dominant mineralogy.		
	29.0		10407				Soil sample collected between 29.0 and 30.0 ft bgs.
30	30.0			GW			
35							
	39.0		10408				Soil sample collected between 39.0 and 40.0 ft bgs.
40	40.0						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-69 SHEET 3 OF 10

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site 4 (2100291.6 N, 7615143.0 E)

ELEVATION : 632.1 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic
ORIENTATION : Vertical

WATER LEVELS : Approx. 178 ft BGS
START : 5/31/2011
END : 6/20/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
		COMPLETE		GW	**Well Graded Gravel (GW)** 0.0-42.0' - light yellowish brown, (2.5Y 6/3), dry, loose, 40% gravel, 40% sand, 20% fines, subangular to subrounded, no dominant mineralogy.		
42.0					**Metadiorite (pTbr)** 42.0-157.0' - pale olive, (10Y 6/2), predominantly sodium feldspar with chlorite cement in fractures, phaneritic, slight weathering to fresh, strong, massive, highly fractured and healed, slightly foliated.		Begin drilling while washing out cuttings; only returns are larger bedrock fragments from core barrel.
45							Stop 5/31/2011 at 1630 at 47'. Resume 6/1/2011 at 0700. Drill rate 47-57 ft: 0.40 feet per minute (FPM).
50				pTbr			
55					57' - Color change to greenish black (5G 2/1), change to aphanitic, change to non-foliated, change to no presence of feldspar, no fracturing.		Drill rate 57-67 ft: 0.16 FPM
60							

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-69 SHEET 4 OF 10

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site 4 (2100291.6 N, 7615143.0 E)

ELEVATION : 632.1 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic
ORIENTATION : Vertical

WATER LEVELS : Approx. 178 ft BGS
START : 5/31/2011
END : 6/20/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
65		COMPLETE		pTbr	**Metadiorite (pTbr)** 42.0-157.0' - greenish black, (5G 2/1), chlorite cement in fractures, aphanitic, slight weathering to fresh, strong, massive, non-foliated. 62' - Color change to dusky yellowish green (10GY 3/2), change to phaneritic, predominantly sodium feldspar, slightly weathered, non-foliated, less highly fractured.		Drill rate 67-77 ft: 0.43 FPM
70							
75							Drill rate 77-87 ft: 0.45 FPM
80							

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-69 SHEET 5 OF 10

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site 4 (2100291.6 N, 7615143.0 E)
ELEVATION : 632.1 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)
DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic
ORIENTATION : Vertical
WATER LEVELS : Approx. 178 ft BGS
START : 5/31/2011
END : 6/20/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft) / RECOVERY (in) / LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
	COMPLETE		**Metadiorite (pTbr)** 42.0-157.0' - dusky yellowish green, (10GY 3/2), predominantly sodium feldspar, phaneritic, slight weathered, strong, massive, slightly fractured and healed with chlorite cement, non-foliated. 82' - Color change to greenish black (5GY 2/1)		
85			87' - Change to moderately weathered, moderately foliated, highly fractured along foliation plane and perpendicular to foliation plane, presence of iron staining on all fracture surfaces and some calcite mineralization on surfaces.		Drill rate 87-97 ft: 0.77 FPM
90		pTbr			Lost circulating water at approximately 93 ft below ground surface (bgs).
95					Stop 6/1/2011 at 1530 at 97 ft bgs. Drill rate 97-107 ft: 0.91 FPM
100					

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-69 SHEET 6 OF 10

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site 4 (2100291.6 N, 7615143.0 E)

ELEVATION : 632.1 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic
ORIENTATION : Vertical

WATER LEVELS : Approx. 178 ft BGS
START : 5/31/2011
END : 6/20/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
105	105.0	COMPLETE			**Metadiorite (pTbr)** 42.0-157.0' - greenish black, (5G 2/1), moderately weathered, strong, massive, highly fractured and healed with chlorite cement, moderately foliated.		
					107' - Increase in proportion of amphiboles.		Drill rate 107-117 ft: 0.31 FPM
110				pTbr			
115					117' - pale olive, (10Y 6/2), predominantly sodium feldspar, strong (R4), slightly weathered, massive, moderately fractured with chlorite cement, non-foliated, some iron staining on surfaces, minor presence of calcite infill.		Drill rate 117-127 ft: 0.31 FPM
120							

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-69 SHEET 7 OF 10

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation | LOCATION : Site 4 (2100291.6 N, 7615143.0 E)

ELEVATION : 632.1 ft | DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic | ORIENTATION : Vertical

WATER LEVELS : Approx. 178 ft BGS | START : 5/31/2011 | END : 6/20/2011 | LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
		COMPLETE			**Metadiorite (pTbr)** 42.0-157.0' - pale olive, (10Y 6/3), predominantly sodium feldspar, strong (R4), slightly weathered, massive, moderately fractured with chlorite cement, non-foliated, some iron staining on surfaces, minor presence of calcite infill.		
125							
					127' - Less fracturing and moderately foliated; presence of iron and manganese staining on surfaces.		Drill rate 127-137 ft: 0.37 FPM
130				pTbr			
135					137' - Fracture at approximately 80 degree dip, iron and black-colored staining.		Drill rate 137-147 ft: 0.56 FPM
140							

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-69 SHEET 8 OF 10

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site 4 (2100291.6 N, 7615143.0 E)
ELEVATION : 632.1 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)
DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic
ORIENTATION : Vertical
WATER LEVELS : Approx. 178 ft BGS
START : 5/31/2011
END : 6/20/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft) / RECOVERY (in) / LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
145	COMPLETE	pTbr	**Metadiorite (pTbr)** 42.0-157.0' - pale olive, (10Y 6/2), predominantly sodium feldspar with moderate fraction of amphiboles, phaneritic, slight weathering, strong, massive, slightly fractured with chlorite cement, moderately foliated.		Drill rate 147-157 ft: 0.40 FPM
150					
155					
157.0			Begin rock coring from 157.0 ft bgs See the next page for the rock core log.		
160					

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-69	SHEET 9 OF 10

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation — LOCATION : Site 4 (2100291.6 N, 7615143.0 E)

ELEVATION : 632.1 ft — DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

CORING EQUIPMENT AND METHOD : RS-350, HQ Wire-Line Rotary — ORIENTATION : Vertical

WATER LEVELS : Approx. 178 ft BGS — START : 5/31/2011 — END : 6/20/2011 — LOGGER : A. Brewster (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	157.0		3	157.5, 157.8, 157.9' - Joint (3), 80, 30, and 30 deg, smooth at 157.5, rough at 157.8, 157.9, undulating, 5mm max calcite infilling, some iron staining, tight at 157.5, narrow at 157.8, 157.9.		**Metadiorite** dusky yellow green, (5GY 5/2), predominantly sodium feldspar and amphiboles, hard, slight to no foliation, highly fractured and healed with chlorite cement, massive.	Run 1: 13 min 50 sec
	Run 1 4 ft 100%	10.4	>10	158.0-158.6' - Highly fractured			
			>10	158.7, 158.8' - Joint, 30 deg, smooth, undulating, <2mm calcite infilling, iron staining, tight.			
160			>10	159.1, 159.2, 159.3' - Joint, 30, 50, and 40 deg, rough, undulating, <1mm calcite infilling, iron staining, narrow.			
	161.0		2	159.5-160.4' - Highly fractured, presence of sedimentary infill (coarse sand, silt).			Run 2: 25 min 0 sec
			>10	160.4, 160.9' - Mechanical breaks. 161.5, 161.7' - Joint, 30 deg and 20 deg, rough, undulating, iron staining, no infill, narrow.			
	Run 2 5 ft 100%	35	>10	162.0, 162.3' - Mechanical breaks. 162.2' - Joint, 80 deg, smooth, undulating, <4mm calcite infilling, iron staining, tight.			
			2	162.7-164.0' - Highly fractured, no infill, iron staining.			
165			1	164.2, 164.8' - Joint, 20 deg and 50 deg, rough, stepped at 164.2, undulating at 164.8, <1mm calcite infilling, no iron staining, tight			
	166.0			165.6' - Mechanical breaks.			
			>10	166.1-166.4' - Highly fractured, no infill, iron and black staining.			Run 3: 65 min 30 sec
	Run 3 3.3 ft 100%	12.5	>10	166.6' - Joint, 50 deg, rough, undulating, no infill, iron and black staining, narrow. 167.3-167.6, 167.8-168.1' - Highly fractured, calcite infill (<5mm), iron staining.			
			>10	168.1, 168.6' - Joint, 80 deg, smooth, undulating, iron staining, no infill, tight.			
	169.3		4	168.7-169.0' - highly fractured, some calcite infill (<1mm), iron staining. 169.3' - Mechanical breaks.			Run 4: 14 min 30 sec
170	Run 4 1.7 ft 100%	24.5	3	169.6, 169.7, 169.9' - Joint (3), 30, 10, and 40 deg, smooth, undualting, <1mm calcite infilling, some iron staining, tight.			
	171.0		2	170.4, 170.7, 170.9' - Joint (3), 20, 20, and 30 deg, rough, undualting, some iron staining, no infill, narrow.			Run 5: 22 min 10 sec
			2	171.1, 171.7' - Joint, 30 deg, rough, undualting, <1mm calcite infilling, iron staining, tight.			
	Run 5 5 ft 100%	35	3	172.1, 172.5' - Joint, 30 deg, rough, undualting, <1mm calcite infilling, iron staining, tight.			
			>10	173.3, 173.7, 173.8' - Joint (3), 30, 30, and 60 deg, rough, undualting, <5mm calcite infilling, iron staining, narrow.			
175			2	174.1, 174.9,' - Joint, 30 deg and 80 deg, rough, undualting, iron and black staining, narrow.			
	176.0			174.5-174.9' - Highly fractured, some iron staining.			Run 6: 14 min 30 sec
			3	175.3, 175.7' - Joint, 30 deg and 30 deg, rough, undulating, iron staining, narrow.		176.4' - Change to foliated	

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-69	SHEET 10 OF 10

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site 4 (2100291.6 N, 7615143.0 E)

ELEVATION : 632.1 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

CORING EQUIPMENT AND METHOD : RS-350, HQ Wire-Line Rotary
ORIENTATION : Vertical

WATER LEVELS : Approx. 178 ft BGS
START : 5/31/2011
END : 6/20/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	Run 6 5 ft 100%	80	0	176.4, 176.7, 176.9' - Joint (3), 20, 30, and 60 deg, rough, undulating, <1mm calcite infilling, iron staining, tight.		**Metadiorite** dusky yellow green, (5GY 5/2), predominantly sodium feldspar and amphiboles, hard, foliated from 176.4 ft. bgs, highly fractured and healed with chlorite cement, massive	
			2	178.1, 178.9' - Joint, 50 deg and 30 deg, rough, undulating, some black staining, tight.			
			2				
180			1	179.7. 179.8' - Joint, 30 deg and 60 deg, rough, undulating at 179.7, stepped at 179.8, <10 mm calcite infilling, iron staining, healing incomplete (voids).			
181.0	Run 7 5 ft 100%	58.3	0	180.5' - Joint, 30 deg, rough, undulating, <1mm calcite infilling, some iron staining, tight.			Run 7: 17 min 0 sec
			>10	182.3-183.0' - Highly fractured, calcite infill (<3mm), no staining.			
			5			183.0-185.0' - Healed shear zone with 5 mm displacement	
			3	183.6, 183.7, 183.7, 183.8, 183.9' - Joint (5), 30, 60, 30, 80, and 30 deg, rough, undulating, <1mm calcite infilling, iron staining, tight to narrow,			
185			3	184.1, 184.5, 184.9' - Joint (3), 30, 30, and 80 deg, rough, stepped, <1mm calcite infilling, iron staining, narrow.			
186.0	Run 8 5 ft 100%	56	1	185.5, 185.8, 186.0' - Joint (3), 30 deg, rough, undulating, <2mm calcite infilling, some iron staining, narrow.		186' - Change to slightly fractured and healed with chlorite cement	Run 8: 40 min 50 sec
			0	187' - Mechanical breaks.			
			3	188.2, 188.3, 188.7' - Joint (3), 20, 80, and 80 deg, rough, undulating to stepped, <1mm calcite infilling, some iron staining, tight.			
			2	189.4' - Mechanical breaks.			
190			>10	189.7' - Joint, 60 deg, rough, undulating, no staining, tight.			
191.0	Run 9 5 ft 100%	45	>10	190.6-191.0' - Multiple fractures, calcite infill (<1mm), manganede staining, narrow. 191.0-192.0' - Multiple mechanical fractures.			Run 9: 46 min 0 sec
			1	192.3' - Joint, 80 deg, rough, undulating, <0.5mm calcite infilling, some iron staining, narrow.			
			3	193.2, 193.3, 193.7' - Mechanical fractures.			
			3	194.3, 194.7' - Joint, 40 deg and 50 deg, rough, undulating, no staining, tight.			
195			>10	195.0-196.0' - Multiple fractures, no infill, iron staining.			
196.0						End Drilling on 6/20/2011 Total Borehole Depth: 196.0 ft bgs	This borehole was converted into the following monitoring well(s): MW-69-195

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-70 SHEET 1 OF 12

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : PG&E Topock, Site H (2100513.9 N, 7615826.0 E)
ELEVATION : 538.9 ft
DRILLING CONTRACTOR : Boart Longyear (B. Bradford)
DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic
ORIENTATION : Vertical
WATER LEVELS : Approx. 78 ft BGS
START : 5/24/2011
END : 10/22/2011
LOGGER : R. Tweidt (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
0.0	0.0–0.5	COMPLETE	10501	SM	**Silty Sand (SM)** 0-68.5' - yellowish brown, (10YR 5/4), dry, loose, 10% gravel, 60% sand, 30% fines, subangular to subrounded, poorly graded, predominantly quartz sand 1' - Color change to light olive brown (2.5Y 5/3)		Soil sample collected between 0.0 and 1.0 ft bgs.
2.0	2.0–3.0		10502				Soil sample collected between 2.0 and 3.0 ft bgs.
5	5.0–6.0		10503				Soil sample collected between 5.0 and 6.0 ft bgs.
9.0	9.0–10.0		10504				Soil sample collected between 9.0 and 10.0 ft bgs.
10							
14.0	14.0–15.0		10505				Soil sample collected between 14.0 and 15.0 ft bgs.
15							
19.0	19.0–20.0		10506, 50015				Soil sample collected between 19.0 and 20.0 ft bgs.
20							

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-70 SHEET 2 OF 12

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : PG&E Topock, Site H (2100513.9 N, 7615826.0 E)
ELEVATION : 538.9 ft
DRILLING CONTRACTOR : Boart Longyear (B. Bradford)
DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic
ORIENTATION : Vertical
WATER LEVELS : Approx. 78 ft BGS
START : 5/24/2011
END : 10/22/2011
LOGGER : R. Tweidt (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
		COMPLETE			**Silty Sand (SM)** 0-68.5' - light olive brown, (2.5Y 5/3), dry, loose, 10% gravel, 60% sand, 30% fines, subangular to subrounded, poorly graded, predominantly quartz sand		
					23' - Change to partially consolidated, color change to light olive brown (2.5Y 5/3)		
25							
	29.0 30.0		10507	SM			Soil sample collected between 29.0 and 30.0 ft bgs.
30					31' - Color change to olive brown (2.5Y 5/3)		
35							
	39.0 40.0		10508				Soil sample collected between 39.0 and 40.0 ft bgs.
40							

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-70 SHEET 3 OF 12

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : PG&E Topock, Site H (2100513.9 N, 7615826.0 E)
ELEVATION : 538.9 ft
DRILLING CONTRACTOR : Boart Longyear (B. Bradford)
DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic
ORIENTATION : Vertical
WATER LEVELS : Approx. 78 ft BGS
START : 5/24/2011
END : 10/22/2011
LOGGER : R. Tweidt (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
45		COMPLETE			**Silty Sand (SM)** 0-68.5' - light yellowish brown, (10YR 6/4), dry, partially consolidated from 23.0 ft. bgs, 10% gravel, 60% sand, 30% fines, subangular to subrounded, poorly graded, predominantly quartz sand and mixed gravel		
	49.0		10509				Soil sample collected between 49.0 and 50.0 ft bgs.
50	50.0			SM			
55							
	59.0		10510		59' - Increase in fraction of metadiorite in gravel; change to 20% gravel, 50% sand, and 30% fines.		Soil sample collected between 59.0 and 60.0 ft bgs.
60	60.0						

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-70 SHEET 4 OF 12

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : PG&E Topock, Site H (2100513.9 N, 7615826.0 E)

ELEVATION : 538.9 ft
DRILLING CONTRACTOR : Boart Longyear (B. Bradford)

DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic
ORIENTATION : Vertical

WATER LEVELS : Approx. 78 ft BGS
START : 5/24/2011
END : 10/22/2011
LOGGER : R. Tweidt (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
		COMPLETE			**Silty Sand (SM)** 0-68.5' - light yellowish brown, (10YR 6/4), dry, partially consolidated from 23.0 ft. bgs, 20% gravel, 50% sand, 30% fines, subangular to subrounded, poorly graded, predominantly quartz sand and mixed gravel		
				SM	64' - Color change to brown (10YR 5/3), change to moist		
65							
	69.0 70.0		10511		**Rock Flour (ML)** 68.5' - yellowish brown, (10YR 5/4), metadiorite fragments with weathered surfaces		Soil sample collected between 69.0 and 70.0 ft bgs.
70							
				ML	Color change to olive (5Y 5/3), highly angular metadiorite fragments with some weathering		
75							Stop 5/24/2011 at 1530 at 76 ft. bgs. Resume 5/25/2011 at 715.
80							

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-70 SHEET 5 OF 12

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : PG&E Topock, Site H (2100513.9 N, 7615826.0 E)
ELEVATION : 538.9 ft
DRILLING CONTRACTOR : Boart Longyear (B. Bradford)
DRILLING EQUIPMENT AND METHOD : RS-350, Rotosonic
ORIENTATION : Vertical
WATER LEVELS : Approx. 78 ft BGS
START : 5/24/2011
END : 10/22/2011
LOGGER : R. Tweidt (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft) / RECOVERY (in) / LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
85	COMPLETE	ML	**Rock Flour (ML)** 68.5-87.0' - yellowish brown, (10YR 5/4), metadiorite fragments with weathered surfaces		
87.0			Begin rock coring from 87.0 ft bgs See the next page for the rock core log.		
90					
95					
100					

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-70	SHEET 6 OF 12

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : PG&E Topock, Site H (2100513.9 N, 7615826.0 E)

ELEVATION : 538.9 ft
DRILLING CONTRACTOR : Boart Longyear (B. Bradford)

CORING EQUIPMENT AND METHOD : RS-350, HQ Wire-Line Rotary
ORIENTATION : Vertical

WATER LEVELS : Approx. 78 ft BGS
START : 5/24/2011
END : 10/22/2011
LOGGER : R. Tweidt (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	87.0		>10	87.0-87.2' - Highly fractured, iron stained, calcite infill. 87.6' - Mechanical break		**Metadiorite (pTbr)** greyish olive green, (5GY 3/2), strong (R4), slightly weathered, slightly foliated, moderately disintegrated and cemented. Chlorite cement throughout Change to phaneritic, predominantly feldspar and quartz	Run 1: 15 min 40 sec
	Run 1 3.2 ft 100%	71	>10	88.1' - Joint, 60 deg, rough, planar, iron staining, calcite mineralization (<1mm), iron staining, narrow.			
			2	88.2' - Fracture zone, 30 deg, 40mm chlorite infilling			
90	90.2		2	88.3' - Joint, 30 deg, rough, stepped, 5mm calcite infilling, no staining, tight 88.7' - Mechanical break		**Metadiorite (pTbr)** greyish olive green, (5GY 3/2), strong (R4), slightly weathered, slightly foliated, moderately disintegrated and cemented, predominantly quartz and feldspar with chlorite cement	
			3	89.9' - Joint, 15 deg, rough, stepped, 1mm calcite infilling, no staining, tight 90.2' - Mechanical break			Run 2: 24 min 40 sec
	Run 2 5 ft 100%	43	3	90.8' - Joint, 60 deg, rough, undulating, <1mm calcite infilling, no staining, tight 91' - Mechanical break			
			2	91.3' - Joint, 30 deg, smooth, undulating, <1mm calcite infilling, no staining, tight 91.7' - Joint, 30 deg, smooth, undulating, <1mm calcite infilling, no staining, tight			
			1	92.1' - Joint, 30 deg, smooth, undulating, <1mm calcite infilling, no staining, tight			
95	95.2		3	92.5, 92.6' - Joint, 30 deg, rough, stepped, <1mm calcite infilling, no staining, tight to narrow		95' - Change to thickly foliated	Run 3: 11 min 20 sec
	Run 3 2.1 ft 100%	42	>10	93.0, 93.2' - Joint, 60 deg and 30 deg, rough, stepped, iron staining, narrow 94.8' - Joint, 30 deg, rough, stepped, iron staining, narrow			Approximately 100 gallons of water lost at approximately 96 ft. bgs.
	97.3		>10	95.1, 95.3, 95.8' - Joint (3), 60, 30, and 30 deg, rough, stepped, no staining, tight 96.0-96.6' - highly fractured, evidence of joints at 80° dip, rough, stepped to undulating, some calcite infill in healed fractures (<1mm), presence of sedimentary infill (quartz silt, sand) on surfaces (<5mm thick), narrow apertures, no staining.		97' - Change to non-foliated	Run 4: 12 min 15 sec
	Run 4 2.9 ft 100%	44	>10			98.5' - Change to aphanitic	
			2	97.2, 97.3, 97.7, 97.8' - Joint (4), 20, 40, 20, and 20 deg, rough, stepped, 1mm calcite infilling, no staining, very narrow apertures 97.3-97.4' - Highly fractured		99.3' - Megacryst of chlorite (10 x 35mm) 99.5-100.0' - Megacryst of feldspar (>40mm) 100.4-100.7' - Color change to very dusky red (10R 2/2). 100.5' - Fracture at 40 degree dip healed with very dusky red (10R 2/2) mineralization 100.6' - presence of xenocryst (max diameter of 25mm) 100.9-101.4' - Medium banding (<120mm thick) with metadiorite, feldspar, and chlorite bands	
100	100.2		4				Run 5: 53 min 40 sec
			>10	98.3, 98.5' - Joint, 30 deg and 30 deg, smooth, stepped, <1mm calcite infilling, silt infill (<5mm), no staining, narrow aperture 98.5-99.2' - Highly fractured, iron staining			
	Run 5 4.5 ft 100%	20	>10	99.5, 99.6' - Joint, 20 deg, smooth, undulating, 1mm calcite infilling, no staining, very narrow apertures			
			>10	100.1, 100.2, 100.7, 100.8' - Joint (4), 20, 20, 30, and 60 deg, rough, undulating, <3mm calcite infilling, iron staining at 100.7 and 100.8, very narrow to tight apertures			
	104.7		>10				
105				100.3' - Healed shear with 50mm of displacement, 60° dip.			Run 6: 61 min 0 sec
			>10	101.3-107.8' - Highly fractured, calcite on some surfaces (<1mm), minimal iron staining, some silt infill (<1mm), rough, undulating			
	Run 6 3.1 ft 100%	0	>10				

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-70	SHEET 7 OF 12

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : PG&E Topock, Site H (2100513.9 N, 7615826.0 E)

ELEVATION : 538.9 ft
DRILLING CONTRACTOR : Boart Longyear (B. Bradford)

CORING EQUIPMENT AND METHOD : RS-350, HQ Wire-Line Rotary
ORIENTATION : Vertical

WATER LEVELS : Approx. 78 ft BGS
START : 5/24/2011
END : 10/22/2011
LOGGER : R. Tweidt (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	107.8		>10			**Metadiorite (pTbr)** greyish olive green, (5GY 3/2), strong (R4), slightly weathered, none-foliated, moderately disintegrated and cemented, chlorite cement in fractures	Stop 5/27/2011 at 1700.
110							
115							
120							
125							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-70	SHEET 8 OF 12

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : PG&E Topock, Site H (2100513.9 N, 7615826.0 E)
ELEVATION : 538.9 ft
DRILLING CONTRACTOR : Boart Longyear (B. Bradford)
CORING EQUIPMENT AND METHOD : RS-350, HQ Wire-Line Rotary
ORIENTATION : Vertical
WATER LEVELS : Approx. 78 ft BGS
START : 5/24/2011
END : 10/22/2011
LOGGER : R. Tweidt (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
						Metadiorite (pTbr) dusky yellow green, (5GY 5/2), predominantly quartz, feldspar, amphiboles, aphanitic, non-foliated, highly fractured and healed with chlorite cement, lightly weathered, strong, massive	Begin wire-line HQ rock coring
130	130.0						
	Run 1 2 ft 85%	55	0				Run 1: drill rate = 0.27 feet per minute (ft/min)
	132.0		2	131.4, 131.7' - Joint, 30 deg, rough, undulating, <1mm calcite infilling, manganese staining, narrow aperture		131' - Change to phaneritic	
	Run 2 4.5 ft 100%	27	>10				Run 2: drill rate = 0.35 ft/min
			2	133.5, 133.7' - Joint, 50 deg and 60 deg, rough, stepped, <1mm calcite infilling, no staining, tight aperture		134.0-135.0' - Foliated	
135			>10				
			2	135.6, 135.8' - Joint, 20 deg, rough, undulating, <1mm calcite infilling, iron staining, tight aperture		135.6-135.8' - Shear zone	Run 3: drill rate = 0.20 ft/min
	136.5		1	136' - Joint, 70 deg, rough, undulating, <2mm calcite infilling, no staining, narrow			
			3	137.3, 137.6, 137.8' - Joint, 30 deg, rough, undulating, <1mm calcite infilling, no staining, tight			
	Run 3 4.5 ft 100%	37	3	138.1, 138.3, 138.6' - Joint, 30 deg, rough, undulating, <1mm calcite infilling, no staining, tight			
			>10	139.0-140.0' - Multiple fractures, calcite infill (<1mm), iron and manganese staining			
140			4	140.2, 140.6, 140.7, 140.9' - Joint (4), 60, 70, 70, and 20 deg, rough, undulating, <2mm calcite infilling, iron and manganese stained, tight			
	141.0		1	141.5, 142.3, 142.6, 143.5' - Joint (4), 30, 20, 30, and 20 deg, rough, undulating, <1mm calcite infilling, iron and manganese stained, tight			Run 4: drill rate = 0.21 ft/min
			2				
	Run 4 5 ft 100%	50	>10				
			4	144.3, 144.4, 144.5, 144.6' - Joint (4), 30 deg, rough, undulating, no infill, iron stained, tight			
145			3	145.1, 145.5, 145.7' - Joint (3), 20, 20, and 70 deg, rough, undulating, no infill, iron stained, tight			
	146.0						
			>10				Run 5: drill rate = 0.25 ft/min

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-70	SHEET 9 OF 12

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : PG&E Topock, Site H (2100513.9 N, 7615826.0 E)
ELEVATION : 538.9 ft
DRILLING CONTRACTOR : Boart Longyear (B. Bradford)
CORING EQUIPMENT AND METHOD : RS-350, HQ Wire-Line Rotary
ORIENTATION : Vertical
WATER LEVELS : Approx. 78 ft BGS
START : 5/24/2011
END : 10/22/2011
LOGGER : R. Tweidt (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			0			**Metadiorite (pTbr)** dusky yellow green, (5GY 5/2), predominantly quartz, feldspar, amphiboles, non-foliated, highly fractured and healed with chlorite cement, strong, massive	
	Run 5 5 ft 100%	72	0				
			>10	148.8' - Joint, 10 deg, rough, undulating, <1mm calcite infilling, iron and manganese staining, tight			
150			>10				
	151.0						
			1	151.1' - Joint, 60 deg, rough, undulating, <1mm calcite infilling, iron and manganese staining, tight			Run 6: drill rate = 0.32 ft/min
	Run 6 3.5 ft 100%	79	1	152' - Joint, 10 deg, rough, highly fractured, white clay infill (<2mm), iron stained		152.4' - Change to aphanitic, lightly fractured and healed with chlorite cement, higher average density	
			0				
	154.5		>10				
155	Run 7 1.5 ft 100%	0	>10	154.5-156.0'			Run 7: drill rate is not available
	156.0						
			2	156.2, 156.8' - Joint, 10 deg and 30 deg, rough, undulating, <1mm calcite infilling, iron and manganese staining, tight			Run 8: drill rate = 0.20 ft/min
			>10				
	Run 8 4.2 ft 100%	45	>10	157.8-158.6' - Highly fractured, silt infill (<2mm), manganese staining		157.6' - Foliated	
			1			159.4-159.6' - Shear zone	
160	160.2						
			>10	160-161.4' - Highly fractured, some calcite (<2mm), some manganese and iron staining.			Run 9: drill rate = 0.21 ft/min
			>10				
	Run 9 5 ft 100%	58	2	161.8, 162.0, 162.9, 163.7, 164.0, 164.9' - Joint (6), 20, 20, 20, 10, 10, and 10 deg, rough, undulating, <1mm calcite infilling, manganese and iron staining, tight			
			1				
			2				
165	165.2						
			>10	165.2-166.0' - Highly fractured, calcite infill (<1mm), manganese staining			Run 10: drill rate = 0.18 ft/min
			1	166' - Joint, 20 deg, rough, undulating, <1mm manganese staining, tight		166.0-167.0' - Foliated	

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-70	SHEET 10 OF 12

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : PG&E Topock, Site H (2100513.9 N, 7615826.0 E)

ELEVATION : 538.9 ft
DRILLING CONTRACTOR : Boart Longyear (B. Bradford)

CORING EQUIPMENT AND METHOD : RS-350, HQ Wire-Line Rotary
ORIENTATION : Vertical

WATER LEVELS : Approx. 78 ft BGS
START : 5/24/2011
END : 10/22/2011
LOGGER : R. Tweidt (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	Run 10 4 ft 100%	33	>10	166.8-167.5' - Highly fractured, silty infill, manganese and iron staining		**Metadiorite (pTbr)** dusky yellow green, (5GY 5/2), predominantly quartz, feldspars, and amphiboles, aphanitic, non-foliated, lightly fractured and healed with chlorite cement, slightly weathered to fresh, strong, massive 167.6-168.0' - Phaneritic 169.2-187.3' - Phaneritic	
			1	167.5, 167.7, 168.9, 169.2, 170.0, 170.3' - Joint (6), 10, 20, 70, 30, 30, and 30 deg, rough, undulating, <1mm calcite infilling, manganese staining, tight			
	169.2						
170			1				Run 11: drill rate = 0.26 ft/min
			2				
	Run 11 5 ft 100%	78	1	171.6' - Joint, 70 deg, rough, stepped, no infill, manganese staining, tight.		171.2-179.2' - Intermittent veins (<10mm) of sodium feldspar	
			0				
			3	173.3, 173.6, 173.7' - Joint (3), 30, 10, and 30 deg, rough, undulating, <1mm manganese staining, tight			
	174.2						
			0				Run 12: drill rate = 0.20 ft/min
175							
			0				
	Run 12 5 ft 100%	68	4	176.0, 176.3, 176.4, 176.8' - Joint (4), 60, 60, 60, and 60 deg, rough, undulating, <1mm calcite infilling, manganese staining, tight		176.4-176.6' - Foliated	
			1	177.5, 178.2, 178.4, 178.7, 178.9' - Joint (5), 30, 30, 60, 30, and 60 deg, rough, undulating, <1mm manganese staining, narrow aperture			
			4				
	179.2						
			3	179.2, 179.4, 179.6' - Joint (3), 60, 30, and 30 deg, rough, undulating, <1mm calcite infilling, manganese staining, tight		179.4-180.5' - Large increase in proportion of quartz, sodium feldspar, and chlorite	Run 13: drill rate = 0.13 ft/min
180							
			0				
	Run 13 4.8 ft 100%	54	1	181.2, 182.2, 182.3, 182.5, 182.7, 182.8, 183.6' - Joint (7), 50, 30, 50, 40, 60, 60, and 40 deg, rough, undulating, <1mm calcite infilling, manganese and iron staining, tight			
			5				
			1				
	184.0						
			1				Run 14: drill rate = 0.24 ft/min
185				184.5' - Joint, 20 deg, rough, stepped, <1mm calcite infilling, manganese staining, tight			
			2	185.0, 185.5, 186.2, 186.4, 186.5, 186.6' - Joint (6), 20, 20, 50, 10, 50, and 40 deg, rough, undulating (stepped at 186.2), <1mm calcite infilling, white silt infill at 186.2 (<1mm), manganese staining, tight			
	Run 14 5 ft 100%	64	4				

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-70	SHEET 11 OF 12

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : PG&E Topock, Site H (2100513.9 N, 7615826.0 E)
ELEVATION : 538.9 ft
DRILLING CONTRACTOR : Boart Longyear (B. Bradford)
CORING EQUIPMENT AND METHOD : RS-350, HQ Wire-Line Rotary
ORIENTATION : Vertical
WATER LEVELS : Approx. 78 ft BGS
START : 5/24/2011
END : 10/22/2011
LOGGER : R. Tweidt (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			2	187.0, 187.2, 188.3, 188.6, 188.8' - Joint (5), 20, 20, 30, 30, and 60 deg, rough, undulating, <1mm calcite infilling, manganese staining, tight		**Metadiorite (pTbr)** dusky yellow green, (5GY 5/2), predominantly quartz, feldspars, and amphiboles, phaneritic, non-foliated, lightly fractured and healed with chlorite cement, slightly weathered to fresh, strong, massive	
			3				
	189.0						
190			2	189.4, 189.6, 190.7' - Joint (3), 50, 50, and 30 deg, rough, undulating, <1mm calcite infilling, iron and manganese staining, tight		187.3' - Change to aphanitic 188.0-199.0' - Phaneritic	Run 15: drill rate = 0.18 ft/min
			>10				
	Run 15 5 ft 100%	15	>10	190.8-193.0' - Highly fractured, moderately weathered, calicte infill (<4mm), manganese and iron staining		191.6-192.6' - Highly weathered	
			>10				
			>10				
	194.0			193.6-193.8' - Highly fracture, white silt infill (<1mm), iron staining			Run 16: drill rate = 0.28 ft/min
195			1				
	Run 16 2.5 ft 100%	80	2	194.7, 195.1, 195.5, 196.8' - Joint (4), 10, 60, 40, and 20 deg, rough, undulating, <1mm calcite infilling, iron and manganese staining, tight			
	196.5		1				Run 17: drill rate = 0.33 ft/min
			3	197.1, 197.4, 197.8' - Joint (3), 10, 30, and 30 deg, rough, undulating, no infill, iron staining, tight			
			0			198.5-199.0' - Aphanitic	
	Run 17 5 ft 100%	100	0			199.0-199.7' - Highly fractured and healed with chlorite cement.	
200			0				
	201.5		1	201.5, 202.4, 202.5, 202.6, 202.9' - Joint (5), 30, 30, 80, 20, and 20 deg, rough, undulating, <1mm calcite infilling, manganese and iron staining, tight		201.7-202.6' - Foliated	Run 18: drill rate = 0.22 ft/min
			4				
	Run 18 5 ft 100%	51	2	203.4, 203.7, 204.3, 204.5, 204.7' - Joint (5), 20, 70, 20, 60, and 30 deg, rough, undulating, <1mm calcite infilling, white silt infill (<1mm) in 203.7, manganese and iron staining, tight.			
205			3				
			2	205.5, 205.6, 206.5, 207.6' - Joint (4), 60, 40, 30, and 10 deg, rough, undulating, <1mm calcite infilling, iron staining, tight			
	206.5		1			206.2-207.1' - Foliated	

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-70	SHEET 12 OF 12

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : PG&E Topock, Site H (2100513.9 N, 7615826.0 E)

ELEVATION : 538.9 ft
DRILLING CONTRACTOR : Boart Longyear (B. Bradford)

CORING EQUIPMENT AND METHOD : RS-350, HQ Wire-Line Rotary
ORIENTATION : Vertical

WATER LEVELS : Approx. 78 ft BGS
START : 5/24/2011
END : 10/22/2011
LOGGER : R. Tweidt (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	207.4 Run 19 0.9 ft 100%	100	>10	207.4-207.6' - Multiple fractures, calcite infill, no staining		**Metadiorite (pTbr)** dusky yellow green, (5GY 5/2), predominantly quartz, feldspars, and amphiboles, phaneritic, non-foliated, lightly fractured and healed with chlorite cement, slightly weathered to fresh, strong, massive 208.8-209.4' - Aphanitic	Run 19: drill rate = 0.15 ft/min Run 20: drill rate = 0.27 ft/min
			2	208.2, 208.4, 209.2, 210.0, 210.1' - Joint (5), 10, 10, 40, 10, and 30 deg, rough, undulating, <1mm calcite infilling, manganese staining, tight			
	Run 20 4 ft 100%	80	1				
210			2				
	211.4		1	211.4, 212.4, 212.9, 213.1, 213.6' - Joint (5), 20, 20, 20, 20, and 30 deg, rough, undulating, <1mm calcite infilling, manganese and iron staining, tight			Run 21: drill rate = 0.25 ft/min
			2			212.5-212.8' - Foliated	
	Run 21 5 ft 100%	74	2				
			>10	214.2-214.9' - Highly fractured, calcite infill (<1mm), manganese and iron staining			
215			2	215.4, 215.7, 216.3, 216.4' - Joint (4), 40, 20, 40, and 30 deg, rough, undulating, <1mm calcite infilling, manganese and iron staining, tight			
	216.4		>10	216.4-220.4' - Highly fractured, no infill, heavy iron staining		216.6-219.2' - Increase in proportion of feldspars	Run 22: drill rate = 0.13 ft/min. Driller loses all drill fluid in this zone.
			>10				
	Run 22 4 ft 125%	0	>10				
			>10				
220							
	220.4		>10	216.4-220.4' - Highly fractured, no infill, heavy iron staining			Run 23: drill rate = 0.34 ft/min
			1	221.1, 222.0, 222.2, 222.6, 222.7' - Joint (5), 30, 60, 60, 60, and 30 deg, rough, undulating, <1mm calcite infilling, iron and manganese staining, tight			
	Run 23 5.1 ft 100%	80	4				
			3	223.3, 223.4, 223.7, 224.7, 224.8' - Joint (5), 30, 30, 40, 30, and 10 deg, rough, undulating, <1mm calcite infilling, iron and manganese staining, tight			
225			2				
	225.5		>10	225.5-226.4' - Highly fractured, calcite infill (<1mm), manganese and iron staining			Run 24: drill rate = 0.38 ft/min
	Run 24 1.5 ft 100%	30	>10	226.4, 227' - Joint, 30 deg and 40 deg, rough, undulating, <1mm calcite infilling, iron staining, tight			This borehole was converted into the following monitoring well(s): MW-70-105 and MW-70BR-225
	227.0					End Drilling on 10/22/2011 Total Borehole Depth: 227.0 ft bgs	

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-71 SHEET 1 OF 4

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site L (2101338.4 N, 7616207.6 E)

ELEVATION : 484.0 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

DRILLING EQUIPMENT AND METHOD : HQ wireline rotary
ORIENTATION : Vertical

WATER LEVELS : Approx. 29 ft BGS
START : 9/14/2011
END : 9/14/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
5		COMPLETE		SM	**Silty Sand (SM)** 0.0-35.0' - dark yellowish brown, (10YR 4/4), dry, loose, 5% gravel, 80% sand, 15% fines, subangular to subrounded, poorly graded, no dominant mineralogy.		
10							
15							
20							

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-71 SHEET 2 OF 4

SOIL BORING LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site L (2101338.4 N, 7616207.6 E)
ELEVATION : 484.0 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)
DRILLING EQUIPMENT AND METHOD : HQ wireline rotary
ORIENTATION : Vertical
WATER LEVELS : Approx. 29 ft BGS
START : 9/14/2011
END : 9/14/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
25		COMPLETE		SM	**Silty Sand (SM)** 0.0-35.0' - dark yellowish brown, (10YR 4/4), dry, loose, 5% gravel, 80% sand, 15% fines, subangular to subrounded, poorly graded, no dominant mineralogy.		
30					32' - Color change to reddish brown (5YR 4/4)		
35					Begin rock coring from 35.0 ft bgs See the next page for the rock core log.		
40							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-71	SHEET 3 OF 4

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site L (2101338.4 N, 7616207.6 E)

ELEVATION : 484.0 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

CORING EQUIPMENT AND METHOD : HQ wireline rotary
ORIENTATION : Vertical

WATER LEVELS : Approx. 29 ft BGS
START : 9/14/2011
END : 9/14/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
				35' - Note: All fractures in core are mechanical breaks generated during the drilling process, unless otherwise noted.		**Conglomerate (Tmc)** 35.0-71.0' - dark reddish brown, (10YR 4/4), no dominant mineralogy, heavily cemented, slightly weathered, moderate strength, massive. Angular to very angular clasts. Nobedding or foliation. Well-graded.	
37.0							
	R1 4 ft 100%	100	0				R1=0.82 FPM
			0				
			0				
40			0				
41.0							
	R2 5 ft 100%	100	0				R2=0.67 FPM
			0				
			0				
45			0				
46.0							
	R3 5 ft 100%	100	0				R3=0.72 FPM
			0				
			0				
50			0				
51.0							
	R4 5 ft 100%	100	0				R4=0.75 FPM
			0				
			0				
55			0				

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-71 SHEET 4 OF 4

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site L (2101338.4 N, 7616207.6 E)

ELEVATION : 484.0 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

CORING EQUIPMENT AND METHOD : HQ wireline rotary
ORIENTATION : Vertical

WATER LEVELS : Approx. 29 ft BGS
START : 9/14/2011
END : 9/14/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	56.0		0			**Conglomerate (Tmc)** 35.0-71.0' - dark reddish brown, (10YR 4/4), no dominant mineralogy, heavily cemented, slightly weathered, moderate strength, massive. Angular to very angular clasts. Nobedding or foliation. Well-graded.	
	R5 5 ft 100%	100	0				R5=0.59 FPM
			0				
			0				
60			0				
	61.0		0				
	R6 5 ft 100%	100	1	61.6' - Joint, 40 deg, rough, planar, no infill material, no staining, tight.			R6=0.57 FPM
			0				
			0				
65			0				
	66.0		0				
	R7 5 ft 100%	100	0				R7=0.77 FPM
			0				
			0				
70			0				
	71.0		0				
						End Drilling on 9/14/2011 Total Borehole Depth: 71.0 ft bgs	This borehole was converted into the following monitoring well(s): MW-71-35
75							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-72	SHEET 1 OF 10

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site K (2100674.4 N, 7617083.4 E)

ELEVATION : 513.5 ft
DRILLING CONTRACTOR : Boart Longyear (B. Bradford)

CORING EQUIPMENT AND METHOD : HQ Wire-Line Rotary
ORIENTATION : Vertical

WATER LEVELS : Approx. 58 ft BGS
START : 6/26/2012
END : 6/27/2012
LOGGER : A. Brewster (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION — DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS	SYMBOLIC LOG	LITHOLOGY — ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS	COMMENTS — SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.
						Silty Sand (SM) 0-4.0' - brown, (10YR 5/3), dry, metadioritic gravel, no odor.	Hand augered to 2'.
5						**Well Graded Sand (SW)** 4.0-13.0' - light brownish gray (10YR 6/2), silty sand with metadiorite and granitic gravel and cobble (50/30/20), dry, poorly sorted, no odor, gravel is subangular to angular, maximum diameter of 6 cm.	
10							
15						**Metadiorite Bedrock (pTbr)** 13.0-80.0' - dusky yellow green, (5GY 5/2), non-foliated, uniform, slightly decomposed to fresh, slightly fractured, competent, phaneritic.	13.0-17.0': drilled with 4-inch sonic. Logging based on broken fragments generated from drilling process.
	17.0		3				R1 Drill rate=0.1 ft/min
	R1 3 ft 96%	63	2				
20	20.0		2				

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-72	SHEET 2 OF 10

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site K (2100674.4 N, 7617083.4 E)

ELEVATION : 513.5 ft
DRILLING CONTRACTOR : Boart Longyear (B. Bradford)

CORING EQUIPMENT AND METHOD : HQ Wire-Line Rotary
ORIENTATION : Vertical

WATER LEVELS : Approx. 58 ft BGS
START : 6/26/2012
END : 6/27/2012
LOGGER : A. Brewster (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			1			**Metadiorite Bedrock (pTbr)** 13.0-80.0' - dusky yellow green, (5GY 5/2), non-foliated, uniform, slightly decomposed to fresh, slightly fractured, competent, phaneritic.	R2 Drill rate=0.08 ft/min
			1				
	R2 5 ft 100%	100	0				
			1				
25	25.0		1				
			0				R3 Drill rate=0.06 ft/min
	R3 3 ft 93%	87	1				
			1			27.0-29.5' - Quartz-rich interval, nonfoliated, uniform.	
	28.0						
			1	28.25-29.0' - Healed fractures at 85 degrees from horizontal. Calcite cement.			R4 Drill rate=0.07 ft/min
	R4 2 ft 100%	80	2				
30	30.0						
			1				
			0				R5 Drill rate=0.08 ft/min
	R5 5 ft 98%	96	1				
			1	32.8' - Fracture 80 degrees from horizontal. Black manganese mineralization on fracture surface.			
			0				
35	35.0						Resume 08/26/2011 at 0800
			0				R6 Drill rate=0.30 ft/min
			1	36.6' - Joint, 60 deg, rough, undulating, <1mm calcite infilling, iron staining, narrow.			
	R6 5 ft 100%	92	1	37.6' - Mechanical break at 50 degree dip.			
			4	38.4, 38.6, 38.7, 38.8' - Joint (4), 30, 60, 80, and 60 deg, rough, undulating, iron staining, no infill, narrow aperture.		38.5-40.0' - Highly fractured and healed with chlorite.	
			0				
40	40.0						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-72	SHEET 3 OF 10

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation | LOCATION : Site K (2100674.4 N, 7617083.4 E)

ELEVATION : 513.5 ft | DRILLING CONTRACTOR : Boart Longyear (B. Bradford)

CORING EQUIPMENT AND METHOD : HQ Wire-Line Rotary | ORIENTATION : Vertical

WATER LEVELS : Approx. 58 ft BGS | START : 6/26/2012 | END : 6/27/2012 | LOGGER : A. Brewster (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			2	40.5' - Joint, 60 deg, rough, undulating, <1mm calcite infilling, manganese staining, narrow, aperture.		**Metadiorite (pTbr)** 13.0-80.0' - dusky yellow green, (5GY 5/2), non-foliated, uniform, slightly decomposed to fresh, slightly fractured, phaneritic, strong.	R7=0.37 FPM
			0	40.6' - Mechanical break.			
	R7 5 ft 100%	100	1	42.4' - Mechanical break.			
			4	43.2, 43.4, 43.7' - Mechanical breaks. 43.5' - Joint, 60 deg, smooth, undulating, manganese staining, no infill, tight.			
			2				
45	45.0			44.7' - Joint, 60 deg, rough, undulating, iron staining, no infill, narrow aperture.			R8=0.50 FPM
			2	45' - Mechanical break. 45.4, 45.5' - Mechanical breaks. 46' - Mechanical break.			
			2	46.6' - Joint, 30 deg, rough, undulating, manganese staining, no infill, tight.			
	R8 5 ft 100%	80	1	47.5' - Mechanical break.		47.0-48.0' - Foliated	
			1	48.5' - Joint, 80 deg, rough, undulating, manganese staining, no infill, narrow aperture.			
			0				
50	50.0						R9=0.28 FPM
			0				
			1	51.5' - Joint, 30 deg		51.5-53.5' - Increased quartz content.	
	R9 5 ft 100%	97	0				
			1	53.3' - Joint, 70 deg, rough, undulating, dendritic manganese staining, no infill, tight aperture.			
			1	54.1' - Joint, 50 deg, rough, undulating, <1mm calcite infilling, manganese staining, tight aperture.			
55	55.0						R10=0.17 FPM
			0				
			>10	56.0-57.0' - Multiple fractures, no infill, manganese and iron staining.		56.0-58.0' - Increased quartz content.	
	R10 5 ft 100%	26	1	57' - Joint, 80 deg, rough, undulating, manganese and iron staining, no infill, narrow aperture.			
			>10	58.0-60.0' - Multiple fractures, no infill, manganese and iron staining.		58.0-60.0' - Moderately weathered.	
			>10				
60	60.0						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-72	SHEET 4 OF 10

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site K (2100674.4 N, 7617083.4 E)

ELEVATION : 513.5 ft
DRILLING CONTRACTOR : Boart Longyear (B. Bradford)

CORING EQUIPMENT AND METHOD : HQ Wire-Line Rotary
ORIENTATION : Vertical

WATER LEVELS : Approx. 58 ft BGS
START : 6/26/2012
END : 6/27/2012
LOGGER : A. Brewster (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			2	60.2, 60.7' - Joint, 60 deg, rough, undulating, <1mm calcite infilling, manganese staining, narrow aperture.		**Metadiorite (pTbr)** 13.0-80.0' - dusky yellow green, (5GY 5/2), non-foliated, uniform, slightly decomposed to fresh, slightly fractured, phaneritic, strong. 60.0-64.0' - Vuggy with coarse nodular calcite growth, brecciated.	R11=0.23 FPM
			1	61.4' - Joint, 80 deg, rough, undulating, <10mm calcite infilling, manganese staining, moderately narrow aperture.			
	R11 5 ft 100%	38	0				
			1	63.2' - Joint, 80 deg, rough, undulating, <10mm calcite infilling, manganese staining, moderately narrow aperture.			
			0				
65	65.0					64.5-66.0' - Increase in chlorite content.	
			1	65' - Joint, 60 deg, rough, undulating, <1mm calcite infilling, manganese staining, tight aperture.			R12=0.05 FPM
			>10	66.0-67.0' - Multiple fractures, some calcite infill (<1mm), manganese and iron staining.			
	R12 4 ft 100%	78	0				
			0			67.7' - Shear zone with offset of 25mm.	
	69.0						
			0				R13=0.18 FPM
70							
			2				
	R13 5 ft 100%	84	0	70.7, 70.9' - Joint (2), 60 deg, rough, undulating, <1mm calcite infilling, manganese and iron staining, tight aperture.		71.0-72.5' - Increase in quartz content.	
			0				
			1				
	74.0						
			0	73.8' - Joint, 70 deg, rough, undulating, <1mm calcite infilling, manganese and iron staining, narrow aperture.			R14=0.32 FPM
75							
			1	75' - Joint, 40 deg, rough, undulating, <1mm calcite infilling, iron staining, tight aperture.			
	R14 5 ft 100%	50	0				
			>10	77.0-79.0' - Multiple fractures, no infill, manganese staining.			
			>10				
	79.0						
	R15 1 ft 100%	20	2				R15=0.36 FPM
80	80.0						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-72	SHEET 5 OF 10

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site K (2100674.4 N, 7617083.4 E)

ELEVATION : 513.5 ft
DRILLING CONTRACTOR : Boart Longyear (B. Bradford)

CORING EQUIPMENT AND METHOD : HQ Wire-Line Rotary
ORIENTATION : Vertical

WATER LEVELS : Approx. 58 ft BGS
START : 6/26/2012
END : 6/27/2012
LOGGER : A. Brewster (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION — DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS	SYMBOLIC LOG	LITHOLOGY — ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS	COMMENTS — SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.
				79.7, 80.0' - Joint, 60 deg and 70 deg, rough, undulating, iron and manganese staining, no infill, tight aperture.			
85							
90							
95							
100							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-72	SHEET 6 OF 10

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site K (2100674.4 N, 7617083.4 E)

ELEVATION : 513.5 ft
DRILLING CONTRACTOR : Boart Longyear (B. Bradford)

CORING EQUIPMENT AND METHOD : HQ Wire-Line Rotary
ORIENTATION : Vertical

WATER LEVELS : Approx. 58 ft BGS
START : 6/26/2012
END : 6/27/2012
LOGGER : A. Brewster (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
105							
	107.0						
	R1 3 ft 100%	50	2	107.7, 107.9, 108.7, 109.0, 109.1' - Joint (6), 50, 30, 30, 50, 50, and 60 deg, rough, undulating, <1mm calcite infilling, iron and manganese staining, very narrow apertures		**Metadiorite** dusky yellow green, (5GY 5/2), medium foliation, uniform, slightly weathered, strong, phaneritic, slightly fractured, and healed with chlorite cement.	Run 1: drill rate = 0.5 feet per minute (ft/min)
			1				
			3				
110	110.0						
	R2 2.5 ft 100%	14	2	110.4, 110.8, 111.2, 111.5, 111.6' - Joint (5), 60, 30, 20, 40, and 40 deg, rough, undulating, <1mm calcite infilling, manganese staining, very narrow apertures			Run 2: drill rate = 0.6 ft/min
			3				
	112.5		>10	112.5-113.5' - Highly fractured			Run 3: drill rate = 0.7 ft/min
			>10				
			3	114.2. 114.6, 114.7, 115.5, 116.2, 116.8, 117.0, 117.6, 117.7, 117.9' - Joint (10), 30, 20, 30, 30, 20, 20, 30, 40, 60, and 60 deg, rough, undulating to stepped, <1mm calcite infilling, manganese staining, very narrow to narrow apertures		114.3' - Change to aphanitic, non-foliated.	
115	R3 5.5 ft 100%	53	1			115.5' - Change to phaneritic	
			2				
			4				
	118.0						
	R4 2 ft 100%	78	2	118.2, 118.4, 119.8' - Joint (3), 30, 30, and 40 deg, rough, undulating, <1mm calcite infilling, some manganese staining, narrow aperture			Run 4: drill rate = 0.5 ft/min
120	120.0		1				

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-72	SHEET 7 OF 10

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation | LOCATION : Site K (2100674.4 N, 7617083.4 E)

ELEVATION : 513.5 ft | DRILLING CONTRACTOR : Boart Longyear (B. Bradford)

CORING EQUIPMENT AND METHOD : HQ Wire-Line Rotary | ORIENTATION : Vertical

WATER LEVELS : Approx. 58 ft BGS | START : 6/26/2012 | END : 6/27/2012 | LOGGER : A. Brewster (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			0			**Metadiorite** dusky yellow green, (5GY 5/2), non-foliated, uniform, slightly weathered, strong, phaneritic, slightly fractured, and healed with chlorite cement	Run 5: drill rate = 0.6 ft/min
			2	121.0, 121.6, 123.0, 123.7' - Joint (4), 30, 60, 40, and 30 deg, rough, undulating, <1mm calcite infilling, no staining, tight			
	R5 5 ft 100%	95	0				
			2				
			0				
125	125.0						
	R6 1 ft 126.0 100%	35	2	125.6, 125.7' - Joint (2), 60 and 30 deg, rough, undulating, <1mm calcite infilling, iron staining, narrow aperture			Run 6: drill rate = 0.3 ft/min
			3	126.4, 126.7, 126.9, 127.8, 128.4, 128.9, 129.1, 129.5, 129.7' - Joint, 60, 40, 20, 30, 50, 50, 50, 20, and 60 deg, rough, undulating, <1mm calcite infilling, heavy manganese staining, smooth and undulating at 128.9 and 129.1, tight to very narrow aperture			Run 7: drill rate = 0.5 ft/min
	R7 4 ft 100%	82	1				
			2				
			3				
130	130.0						
			0				Run 8: drill rate = 0.5 ft/min
			0			130.8' - Change to aphanitic	
	R8 5 ft 100%	30	>10	132.0-135.0' - Highly fractured, calcite infill (<1mm), iron and manganese staining.			
			>10				
			>10				
135	135.0						
			>10	135.0-138.0' - Highly fractured, calcite infill (<1mm), manganese staining			Run 9: drill rate = 0.5 ft/min
	R9 3 ft 100%	0	>10				
			>10				
	138.0						
			>10	138.0-138.5' - Highly fractured, calcite infill (<1mm),			Run 10: drill rate = 0.6 ft/min
			0				
140							

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-72	SHEET 8 OF 10

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation | LOCATION : Site K (2100674.4 N, 7617083.4 E)

ELEVATION : 513.5 ft | DRILLING CONTRACTOR : Boart Longyear (B. Bradford)

CORING EQUIPMENT AND METHOD : HQ Wire-Line Rotary | ORIENTATION : Vertical

WATER LEVELS : Approx. 58 ft BGS | START : 6/26/2012 | END : 6/27/2012 | LOGGER : A. Brewster (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	R10 5.5 ft 100%	63	0			**Metadiorite** dusky yellow green, (5GY 5/2), non-foliated, uniform, slightly weathered, strong, aphanitic, slightly fractured, and healed with chlorite cement	
			>10	141.0-141.6' - Highly fractured, calcite infill (<1mm), manganese staining.			
			0	142.5' - Mechanical fracture		142.5' - Change to phaneritic 142.8' - Change to foliated	
	143.5		0			Change to non-foliated	Run 11: drill rate = 0.5 ft/min
			1				
145				144.6' - Joint, 70 deg, rough, undulating, <1mm calcite infilling, iron and manganese staining, narrow aperture			
	R11 5 ft 100%	34	>10	145.3-145.5' - Highly fractured, calcite infill (<1mm), iron staining			
			>10	145.6, 145.7' - Joint, 30 deg, rough, undulating, no infill, iron staining, tight			
			1	146.4-146.8' - Highly fractured			
				147.7' - Joint, 70 deg, <1mm calcite infilling, heavy iron staining, tight			
	148.5		1				Run 12: drill rate = 0.5 ft/min
			1	148.7, 149.6, 151.0' - Joint, 60, 60, and 30 deg, rough, undulating, some iron staining, narrow aperture			
150							
			1			150-150.6' - Increase in chlorite content	
	R12 5 ft 100%	45	>10	151.2-152.0' - Highly fractured, calcite infill (<3mm), no staining		151.2-152.0' - Highly weathered	
			0				
	153.5		0				Run 13: drill rate = 0.3 ft/min
			2				
155				154.7, 154.9' - Joint, 30 and 40 deg, rough, stepped, <2mm iron staining, moderately narrow aperture			
			0			155.3-155.6' - Increase in non-feldspar content	
	R13 5.5 ft 100%	65	>10	156.0-157.0' - Highly fractured, heavy manganese staining, some iron staining			
			1	157.3' - Joint, 70 deg, rough, undulating, manganese staining, narrow aperture		157.6-157.8' - Increase in non-feldspar content 158' - Change to foliated	
	159.0		0				
			0			159.3' - Change to non-foliated	Run 14: drill rate = 0.1 ft/min
160							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-72	SHEET 9 OF 10

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site K (2100674.4 N, 7617083.4 E)

ELEVATION : 513.5 ft
DRILLING CONTRACTOR : Boart Longyear (B. Bradford)

CORING EQUIPMENT AND METHOD : HQ Wire-Line Rotary
ORIENTATION : Vertical

WATER LEVELS : Approx. 58 ft BGS
START : 6/26/2012
END : 6/27/2012
LOGGER : A. Brewster (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	R14 2.5 ft 100%	40	2	160.5, 160.7' - Joint, 30 deg, rough, undulating to stepped, manganese staining, narrow aperture		**Metadiorite** dusky yellow green, (5GY 5/2), non-foliated, uniform, slightly weathered, strong, phaneritic, slightly fractured, and healed with chlorite cement	
	161.5		>10	161.0-161.3' - Highly fractured, manganese and iron staining			Run 15: drill rate = 0.2 ft/min
	R15 3.5 ft 100%	0	>10	162.5' - Joint, 70 deg, rough, undulating, <1mm manganese staining, tight			
			>10	162.6-163.5' - Highly fractured, manganese staining			
			>10	164' - Joint, 70 deg, rough, undulating, <1mm calcite infilling, iron and manganese staining, tight			
165	165.0						
			1	164.3-165.0' - Highly fractured			Run 16: drill rate = 0.3 ft/min
			0	165.6, 169.7' - Joint, 70 and 10 deg, rough, undulating, <1mm calcite infilling, iron staining, very narrow aperture			
	R16 5 ft 100%	38	>10				
			>10	167.7-168.4' - Highly fractured, manganese staining			
			1				
170	170.0						
	R17 1.5 ft 100%	100	0				Run 17: drill rate = 0.1 ft/min
	171.5		0				Run 18: drill rate = 0.1 ft/min
	R18 2 ft 100%	38	>10	172.6, 172.7, 172.8' - Joint, 30, 20, and 40 deg, rough, undulating, manganese staining, narrow aperture			
	173.5		5	172.8-173.0' - Highly fractured			Run 19: drill rate = 0.8 ft/min
	R19 1.5 ft 100%	57	0	173.3, 173.4, 173.6, 173.7, 173.9' - Joint, 30 deg, rough, undulating, iron and manganese staining, tight			
175	175.0						Run 20: drill rate = 0.9 ft/min
			1				
			>10	175.8, 176.2, 177.1, 177.2, 178.2' - Joint, 30, 30, 70, 80, and 60 deg, rough, undulating to stepped, iron and manganese staining, narrow aperture			
	R20 5 ft 100%	15	>10	176.5-177.0, 177.4-178.0, 178.4-180' - Highly fractured, no infill, iron staining			
			>10				
			>10				
180	180.0						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-72	SHEET 10 OF 10

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site K (2100674.4 N, 7617083.4 E)

ELEVATION : 513.5 ft
DRILLING CONTRACTOR : Boart Longyear (B. Bradford)

CORING EQUIPMENT AND METHOD : HQ Wire-Line Rotary
ORIENTATION : Vertical

WATER LEVELS : Approx. 58 ft BGS
START : 6/26/2012
END : 6/27/2012
LOGGER : A. Brewster (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			>10	180-185.0' - Highly fractured, calcite infill (<5mm), heavy iron staining		**Metadiorite** dusky yellow green, (5GY 5/2), non-foliated, uniform, slightly weathered, strong, phaneritic, slightly fractured, and healed with chlorite cement	Run 21: drill rate = 0.9 ft/min
			>10				
	R21 5 ft 100%	0	>10	182.2' - Joint, 80 deg, rough, undulating, <5mm calcite infilling, heavy iron staining, narrow aperture		182.5-182.8' - Change to highly weathered	
			>10				
185	185.0		>10				
			2	185.1, 185.6, 188.6, 189.7' - Joint, 60, 30, 50, and 40 deg, rough, undulating to stepped, heavy iron staining, moderately narrow apertures			Run 22: drill rate = 0.8 ft/min
			0				
	R22 5 ft 100%	66	0				
			>10	188.3-188.5' - Highly fractured			
			1				
190	190.0						
							Run 23: drill rate = 0.8 ft/min
			2	190.7, 190.9, 191.5, 191.6, 194.4, 195.0' - Joint, 30, 60, 40, 60, 40 and 40 deg, rough, undulating, <1mm some iron and manganese staining, tight to narrow appertures		191.0-192.0' - Increase in chlorite content	
	R23 5 ft 100%	27	>10	192.0-193.0' - Highly fractured, heavy iron staining		192.0-193.0' - Change to very highly weathered	
			0				
			2				
195	195.0						
			1				Run 24: drill rate = 0.7 ft/min
			0	195.9, 199.5' - Joint, 30 and 80 deg, rough, undulating, some iron and manganese staining, narrow apertures		196.6-198.0' - Change to aphanitic	
	R24 5 ft 100%	55	0				
			0				
			>10	199.0-200.0' - Highly fractured, calcite infill (<1mm)			This borehole was converted into the following monitoring well(s): MW-72-80 and MW-72BR-200
200	200.0						
						End Drilling on 6/27/2012 Total Borehole Depth: 200.0 ft bgs	

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-73	SHEET 1 OF 5

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site I (2100676.5 N, 7617554.9 E)

ELEVATION : 506.3 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

CORING EQUIPMENT AND METHOD : HQ Wire-Line Rotary
ORIENTATION : Vertical

WATER LEVELS : Approx. 52 ft BGS
START : 9/24/2011
END : 9/27/2011
LOGGER : R. Tweidt (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
5						**Silty Sand (SM)** 0-7.0' - Fill-brown (10YR 5/3), metadiorite gravel and cobble, dry, no odor.	
	7.0						
			>10			**Metadiorite** 7.0-81.0' - very strong, dusky, yellow green (5GY 5/2), non-foliated, massive, fresh, competent, intensely to moderately fractured, phaneritic.	
			>10	8.5-9.5' - Mechanical breakage			
	R1 4.5 ft 98%	18	>10				
10			>10	10' - Joint, 30 deg			
	11.5		>10				
			>10	11.5-13.0' - Highly fractured zone			
	R2 2.5 ft 96%	17	>10				
	14.0		1				
			2				Stop drilling at 14 ft. on 9/24/2011. Resume drilling on 9/26/2011. R3=0.1 ft/min
15	R3 2 ft 92%	70	2				
	16.0						
			1				R4=0.1 ft/min
			2				
	R4 5 ft 100%	66	1	18' - Joint, 60 deg			
			>10	19.0-19.5' - Highly fractured zone			
20							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-73	SHEET 2 OF 5

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site I (2100676.5 N, 7617554.9 E)

ELEVATION : 506.3 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

CORING EQUIPMENT AND METHOD : HQ Wire-Line Rotary
ORIENTATION : Vertical

WATER LEVELS : Approx. 52 ft BGS
START : 9/24/2011
END : 9/27/2011
LOGGER : R. Tweidt (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			>10	20' - Joint, 60 deg		**Metadiorite** 7.0-81.0' - very strong, dusky, yellow green (5GY 5/2), non-foliated, massive, fresh, competent, intensely to moderately fractured, phaneritic. 21.5-27' - Less competent zone with abundant oxidation along fractures, moderately decomposed.	
	21.0						
	R5 2.5 ft 100%	0	>10	21.5-23.5' - Moderately fractured zone			R5=0.4 ft/min
			>10	22' - Joint, 60 deg			
	23.5		>10				
			5	24' - Joint, 60 deg			R6=0.3 ft/min
25	R6 3.5 ft 91%	27	7				
			>10				
	27.0		>10	26.5' - Fracture, 60 deg			
	R7 1.5 ft 100%	83	1	27' - Joint, 30 deg			R7=0.4 ft/min
	28.5		5				
			>10	28.5-34.5' - Highly fractured zone			R8=0.4 ft/min
30	R8 2.5 ft 83%	0	>10				
	31.0		>10				
			>10				R9=0.3 ft/min
	R9 3.5 ft 54%	0	>10				
			>10				
	34.5		>10				
35			1				R10=0.42 ft/min
			1				
	R10 5 ft 100%	74	2	37.0-39.0' - Healed fractures		37.5-39.0' - Quartz and plagioclase-rich zone.	
			1	38.0-39.0' - Fracture, 80 deg			
	39.5		3				
40							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-73	SHEET 3 OF 5

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site I (2100676.5 N, 7617554.9 E)

ELEVATION : 506.3 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

CORING EQUIPMENT AND METHOD : HQ Wire-Line Rotary
ORIENTATION : Vertical

WATER LEVELS : Approx. 52 ft BGS
START : 9/24/2011
END : 9/27/2011
LOGGER : R. Tweidt (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			1	40.5' - Joint, 60 deg		**Metadiorite** 7.0-81.0' - very strong, dusky, yellow green (5GY 5/2), non-foliated, massive, fresh, competent, intensely to moderately fractured, phaneritic. 40.5-42.0' - Quartz and plagioclase-rich zone.	Stop drilling at 39.5 ft on 9/26/2011. Resume drilling on 9/27/2011. R11=0.36 ft/min
	R11 5 ft 100%	78	3				
			1				
			3	43' - Joint, 60 deg			
	44.5		4	44.25' - Joint, 80 deg			
45			1	45' - Fracture, 10 deg			R12=0.42 ft/min
			1	46' - Joint, 30 deg			
	R12 5 ft 100%	90	1				
			1	47.5' - Joint, 30 deg			
			2	48.5' - Joint, 30 deg			
	49.5						
50			1	50.25' - Joint, 30 deg			R13=0.3 ft/min
			2				
	R13 5 ft 95%	27	4				
			4				
			4				
	54.5						
55			4	55' - Fracture, 80 deg			R14=0.25 ft/min
			5				
	R14 5 ft 100%	23	4	57.0-58.0' - Highly fractured zone			
			>10				
			>10	59' - Fracture, 80 deg			
	59.5						
60							R15=0.3 FPM

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-73 SHEET 4 OF 5

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site I (2100676.5 N, 7617554.9 E)

ELEVATION : 506.3 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

CORING EQUIPMENT AND METHOD : HQ Wire-Line Rotary
ORIENTATION : Vertical

WATER LEVELS : Approx. 52 ft BGS
START : 9/24/2011
END : 9/27/2011
LOGGER : R. Tweidt (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			2			**Metadiorite** 7.0-81.0' - very strong, dusky, yellow green (5GY 5/2), non-foliated, massive, fresh, competent, intensely to moderately fractured, phaneritic.	
	R15 5 ft 100%	75	0				
			1				
			3				
	64.5		0				
65			1	65' - Fracture, 60 deg			R16=0.39 ft/min
			1				
	R16 5 ft 98%	94	1	66.25' - Fracture, 60 deg			
			1				
	69.5		1				
70			1				R17=0.4 ft/min
	R17 2 ft 65%	85	2	70.5' - Fracture, 40 deg			
	71.5		3	72' - Fracture, 80 deg			R18=0.36 ft/min
			4	73' - Fracture, 80 deg			
	R18 5 ft 100%	62	3				
75			0				
			2	75.5' - Fracture, 30 deg			
	76.5		1				R19 = 0.42 ft/min
			1				
	R19 4.5 ft 100%	86	3				
80			2				

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-73	SHEET 5 OF 5

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : Site I (2100676.5 N, 7617554.9 E)

ELEVATION : 506.3 ft
DRILLING CONTRACTOR : Boart Longyear (R. Sawrey)

CORING EQUIPMENT AND METHOD : HQ Wire-Line Rotary
ORIENTATION : Vertical

WATER LEVELS : Approx. 52 ft BGS
START : 9/24/2011
END : 9/27/2011
LOGGER : R. Tweidt (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			2	80' - Fracture, 60 deg		**Metadiorite**	
	81.0		4			7.0-81.0' - very strong, dusky, yellow green (5GY 5/2), non-foliated, massive, fresh, competent, intensely to moderately fractured, phaneritic.	This borehole was converted into the following monitoring well(s): MW-73-80
						End Drilling on 9/27/2011 Total Borehole Depth: 81.0 ft bgs	
85							
90							
95							
100							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-74	SHEET 1 OF 12

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation

LOCATION : PG&E Topock, Site J (2100017.5 N, 7615237.7 E)

ELEVATION : 672.9 ft

DRILLING CONTRACTOR : Boart Longyear (D. Osterberg)

CORING EQUIPMENT AND METHOD : Sonic 0-19; Air Hammer 19-211; Wireline Rotary 211-240'

ORIENTATION : Vertical

WATER LEVELS : Approx. 213 ft BGS

START : 10/7/2011

END : 10/10/2011

LOGGER : A. Brewster (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	0.0					0.0-2.0' - Road Base	Drilled using sonic 9-inch x 6-inch to set surface conductor.
						Metadiorite 0.0-2.0 Road Base' - dusky yellow green, (5GY 5/2), primarily quartz, feldspar, and amphiboles, presence of chlorite, calcite, and some iron and manganese staining on surfaces.	
5							
	19 ft						
10							
15							
	19.0						Switched to air hammer with 8-inch bit. Drill rate=1.09 FPM
20							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-74	SHEET 2 OF 12

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : PG&E Topock, Site J (2100017.5 N, 7615237.7 E)

ELEVATION : 672.9 ft
DRILLING CONTRACTOR : Boart Longyear (D. Osterberg)

CORING EQUIPMENT AND METHOD : Sonic 0-19; Air Hammer 19-211; Wireline Rotary 211-240'
ORIENTATION : Vertical

WATER LEVELS : Approx. 213 ft BGS
START : 10/7/2011
END : 10/10/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
25	12 ft					**Metadiorite** 0.0-240.0' - dusky yellow green, (5GY 5/2), primarily quartz, feldspar, and amphiboles, presence of chlorite, calcite, and some iron and manganese staining on surfaces.	
30	31.0						Drill rate=1.25 feet per minute (FPM)
35	10 ft						
40							

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-74 SHEET 3 OF 12

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : PG&E Topock, Site J (2100017.5 N, 7615237.7 E)

ELEVATION : 672.9 ft
DRILLING CONTRACTOR : Boart Longyear (D. Osterberg)

CORING EQUIPMENT AND METHOD : Sonic 0-19; Air Hammer 19-211; Wireline Rotary 211-240'
ORIENTATION : Vertical

WATER LEVELS : Approx. 213 ft BGS
START : 10/7/2011
END : 10/10/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	41.0					**Metadiorite** 0.0-240.0' - dusky yellow green, (5GY 5/2), primarily quartz, feldspar, and amphiboles, presence of chlorite, calcite, and some iron and manganese staining on surfaces.	Drill rate=1.11 FPM
45						45' - Increase in K-feldspar content.	
	10 ft						
50							
	51.0						Drill rate=1.67 FPM
55							
	10 ft						
60							

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-74 SHEET 4 OF 12

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : PG&E Topock, Site J (2100017.5 N, 7615237.7 E)

ELEVATION : 672.9 ft
DRILLING CONTRACTOR : Boart Longyear (D. Osterberg)

CORING EQUIPMENT AND METHOD : Sonic 0-19; Air Hammer 19-211; Wireline Rotary 211-240'
ORIENTATION : Vertical

WATER LEVELS : Approx. 213 ft BGS
START : 10/7/2011
END : 10/10/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
61.0						**Metadiorite** 0.0-240.0' - dusky yellow green, (5GY 5/2), primarily quartz, feldspar, and amphiboles, presence of chlorite, calcite, and some iron and manganese staining on surfaces.	Drill rate=1.43 FPM
65	10 ft						
70							
71.0							Drill rate=2.0 FPM
75	10 ft						
80							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-74	SHEET 5 OF 12

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation

LOCATION : PG&E Topock, Site J (2100017.5 N, 7615237.7 E)

ELEVATION : 672.9 ft

DRILLING CONTRACTOR : Boart Longyear (D. Osterberg)

CORING EQUIPMENT AND METHOD : Sonic 0-19; Air Hammer 19-211; Wireline Rotary 211-240'

ORIENTATION : Vertical

WATER LEVELS : Approx. 213 ft BGS

START : 10/7/2011

END : 10/10/2011

LOGGER : A. Brewster (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
81.0						**Metadiorite** 0.0-240.0' - dusky yellow green, (5GY 5/2), primarily quartz, feldspar, and amphiboles, presence of chlorite, calcite, and some iron and manganese staining on surfaces. 80.0-90.0' - Increase in K-feldspar content.	Drill rate=1.43 FPM
85							
	10 ft						
90							
91.0							Drill rate=1.67 FPM
95							
	10 ft						
100							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-74	SHEET 6 OF 12

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : PG&E Topock, Site J (2100017.5 N, 7615237.7 E)

ELEVATION : 672.9 ft
DRILLING CONTRACTOR : Boart Longyear (D. Osterberg)

CORING EQUIPMENT AND METHOD : Sonic 0-19; Air Hammer 19-211; Wireline Rotary 211-240'
ORIENTATION : Vertical

WATER LEVELS : Approx. 213 ft BGS
START : 10/7/2011
END : 10/10/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	101.0					**Metadiorite** 0.0-240.0' - dusky yellow green, (5GY 5/2), primarily quartz, feldspar, and amphiboles, presence of chlorite, calcite, and some iron and manganese staining on surfaces.	Drill rate=1.67 FPM
105							
	10 ft						
110							
	111.0						Drill rate=2.50 FPM
115							
	10 ft						
120							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-74	SHEET 7 OF 12

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : PG&E Topock, Site J (2100017.5 N, 7615237.7 E)

ELEVATION : 672.9 ft
DRILLING CONTRACTOR : Boart Longyear (D. Osterberg)

CORING EQUIPMENT AND METHOD : Sonic 0-19; Air Hammer 19-211; Wireline Rotary 211-240'
ORIENTATION : Vertical

WATER LEVELS : Approx. 213 ft BGS
START : 10/7/2011
END : 10/10/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	121.0					**Metadiorite** 0.0-240.0' - dusky yellow green, (5GY 5/2), primarily quartz, feldspar, and amphiboles, presence of chlorite, calcite, and some iron and manganese staining on surfaces.	Drill rate=2.50 FPM
125							
	10 ft						
130							
	131.0						Drill rate=2.00 FPM
135							
	10 ft						
140							

PROJECT NUMBER:	BORING NUMBER:
417981.ER.02.FW	BH-74 SHEET 8 OF 12

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : PG&E Topock, Site J (2100017.5 N, 7615237.7 E)

ELEVATION : 672.9 ft
DRILLING CONTRACTOR : Boart Longyear (D. Osterberg)

CORING EQUIPMENT AND METHOD : Sonic 0-19; Air Hammer 19-211; Wireline Rotary 211-240'
ORIENTATION : Vertical

WATER LEVELS : Approx. 213 ft BGS
START : 10/7/2011
END : 10/10/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	141.0					**Metadiorite** 0.0-240.0' - dusky yellow green, (5GY 5/2), primarily quartz, feldspar, and amphiboles, presence of chlorite, calcite, and some iron and manganese staining on surfaces. 140.0-150.0' - Increase in average grain size.	Drill rate=2.00 FPM
145	10 ft						
150	151.0						Drill rate=1.67 FPM
155	10 ft						
160							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-74	SHEET 9 OF 12

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : PG&E Topock, Site J (2100017.5 N, 7615237.7 E)

ELEVATION : 672.9 ft
DRILLING CONTRACTOR : Boart Longyear (D. Osterberg)

CORING EQUIPMENT AND METHOD : Sonic 0-19; Air Hammer 19-211; Wireline Rotary 211-240'
ORIENTATION : Vertical

WATER LEVELS : Approx. 213 ft BGS
START : 10/7/2011
END : 10/10/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	161.0					**Metadiorite** 0.0-240.0' - dusky yellow green, (5GY 5/2), primarily quartz, feldspar, and amphiboles, presence of chlorite, calcite, and some iron and manganese staining on surfaces.	Drill rate=1.43 FPM
165							
	10 ft						
170							
	171.0						Drill rate=1.0 FPM
175							
	10 ft						
180							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-74	SHEET 10 OF 12

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : PG&E Topock, Site J (2100017.5 N, 7615237.7 E)

ELEVATION : 672.9 ft
DRILLING CONTRACTOR : Boart Longyear (D. Osterberg)

CORING EQUIPMENT AND METHOD : Sonic 0-19; Air Hammer 19-211; Wireline Rotary 211-240'
ORIENTATION : Vertical

WATER LEVELS : Approx. 213 ft BGS
START : 10/7/2011
END : 10/10/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	181.0					**Metadiorite** 0.0-240.0' - dusky yellow green, (5GY 5/2), primarily quartz, feldspar, and amphiboles, presence of chlorite, calcite, and some iron and manganese staining on surfaces.	Drill rate=1.25 FPM
185							
	10 ft						
190							
	191.0						Drill rate=0.71 FPM
195							
	10 ft						
200							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-74	SHEET 11 OF 12

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : PG&E Topock, Site J (2100017.5 N, 7615237.7 E)

ELEVATION : 672.9 ft
DRILLING CONTRACTOR : Boart Longyear (D. Osterberg)

CORING EQUIPMENT AND METHOD : Sonic 0-19; Air Hammer 19-211; Wireline Rotary 211-240'
ORIENTATION : Vertical

WATER LEVELS : Approx. 213 ft BGS
START : 10/7/2011
END : 10/10/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	201.0					**Metadiorite** 0.0-240.0' - dusky yellow green, (5GY 5/2), primarily quartz, feldspar, and amphiboles, presence of chlorite, calcite, and some iron and manganese staining on surfaces.	Drill rate=1.25 FPM
205							
	10 ft						
210							
	211.0					211.0-240.0' - Rock is strong, slightly weathered, massive	Switched to wireline rotary with HQ-sized bit. Run 1=0.30 FPM
			0				
			0				
			2				
	Run 1 6 ft 100%	80	0	213.6, 214.0, 215.2' - Joint (3), 30,30, and 40 deg, rough and stepped for 213.6 and 215.2, planar for 214.0, <1mm in all calcite infilling, iron staining on 214.0, tight.		214.4-214.7' - Foliated.	
215			1				
			>10	215.8-218.0' - Highly fractured, calcite infill (<2mm), iron stained.			
	217.0			216.7' - Chalky, fine-grained white sediment, greasy when wet.			Run 2=0.25 FPM
			>10				
	Run 2 3.5 ft 100%	54	3	218.1, 218.3, 218.6, 219.1, 219.2' - Joint (6), 70, 30, 30, 30, 40, and 30 deg, rough, undulating to stepped, <1mm calcite infilling, iron staining, narrow.			
			3			219.3-219.4' - Foliated.	
220							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
417981.ER.02.FW	BH-74	SHEET 12 OF 12

ROCK CORE LOG

PROJECT : PG&E Topock, ER-TCS Investigation
LOCATION : PG&E Topock, Site J (2100017.5 N, 7615237.7 E)

ELEVATION : 672.9 ft
DRILLING CONTRACTOR : Boart Longyear (D. Osterberg)

CORING EQUIPMENT AND METHOD : Sonic 0-19; Air Hammer 19-211; Wireline Rotary 211-240'
ORIENTATION : Vertical

WATER LEVELS : Approx. 213 ft BGS
START : 10/7/2011
END : 10/10/2011
LOGGER : A. Brewster (Northstar)

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	220.5		0			**Metadiorite** 0.0-240.0' - dusky yellow green, (5GY 5/2), primarily quartz, feldspar, and amphiboles, presence of chlorite, calcite, and some iron and manganese staining on surfaces. 222.0-225.0' - Foliated.	Run 3=0.32 FPM
			0				
	Run 3 5.1 ft 100%	82	3	222.2, 222.7, 222.8' - Joint (3), 40, 60, and 50 deg, rough, undulating, <1mm calcite infilling, manganese and iron staining, narrow.			
			0				
			2				
225				224.6, 224.7' - Joint, 50 deg and 50 deg, rough, stepped, <1mm calcite infilling, iron staining, narrow.			
	225.6		>10	225.2-230.7' - HIghly fractured, calcite infill (<2mm), iron and manganese staining.		225.6-228.3' - Increase in proportion of sodium feldspar.	Run 4=0.27 FPM
			>10				
	Run 4 4.9 ft 100%	27	>10				
			>10				
			>10				
230							
	230.5		>10				Run 5=0.20 FPM
			1	231.4' - Joint, 50 deg, rough, undulating, <1mm calcite infilling, no staining, tight.			
	Run 5 4.2 ft 100%	26	>10	231.9-234.7' - Highly fractured, no infill, iron stained and heavily manganese stained.			
			>10				
	234.7		>10				
235						234.7-236.2' - Foliated.	Run 6=0.28 FPM
			2	235.6, 235.8, 236.5' - Joint (3), 70, 20, and 60 deg, rough, undulating, <1mm calcite infilling, very little iron staining, heavy manganese staining, tight.			
			1				
	Run 6 5.3 ft 100%	43	>10	237.2-238.5' - Highly fractured, iron staining, some calcite infill.			
			>10				
			0				
240	240.0					End Drilling on 10/10/2011 Total Borehole Depth: 240.0 ft bgs	This borehole was converted into the following monitoring well(s): MW-74-240

Attachment A-3
Well Completion Diagrams

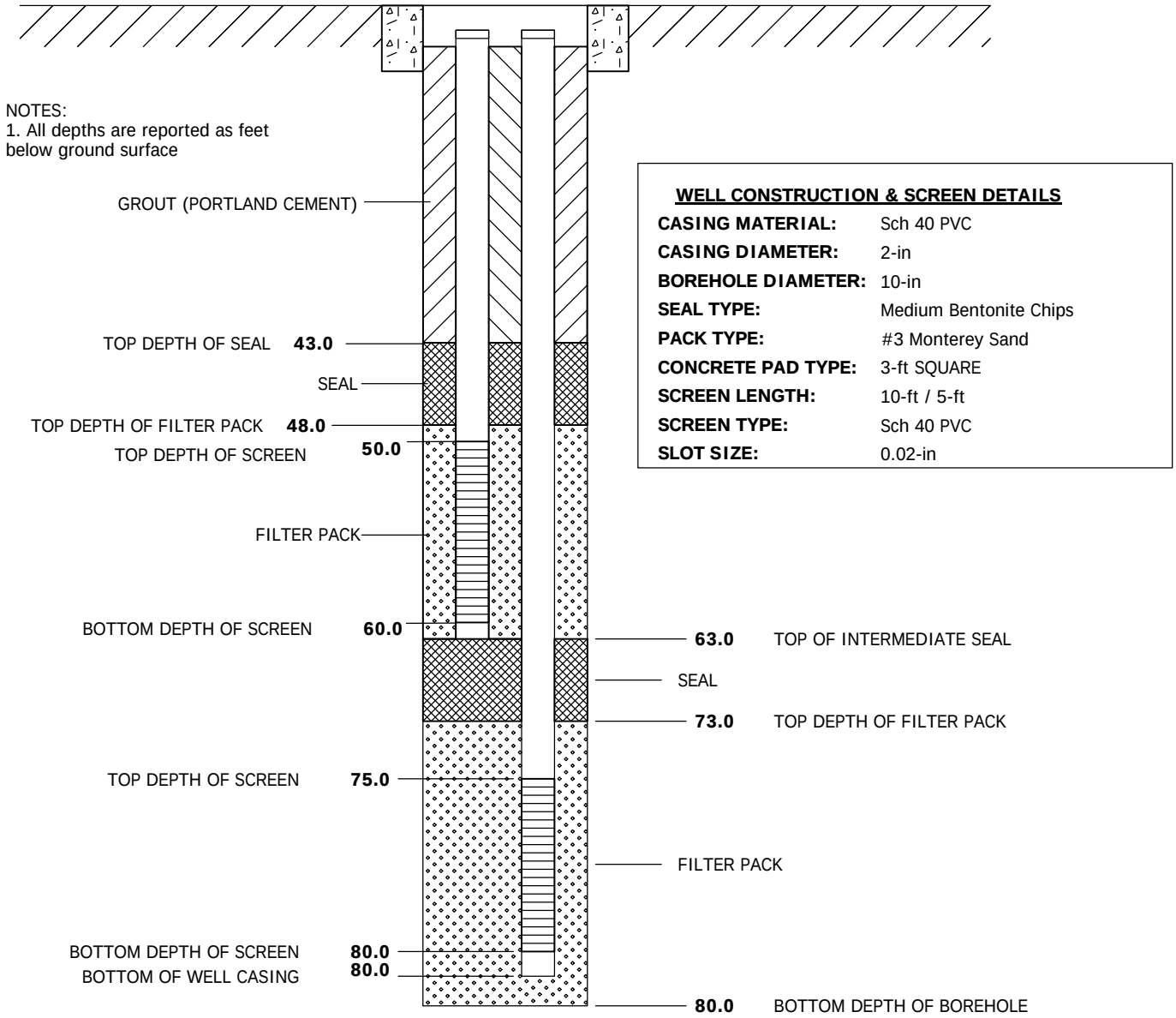
WELL COMPLETION DIAGRAM

PROJECT NO: 382653.FP.04.FW	**PROJECT:** PG&E Topock - ERGI	**WELL NO:** ***MW-23-060*** ***MW-23-080***

LOCATION: Former MW-23

DRILLING CONTRACTOR: Boart Longyear (D. Roberts)	**DRILLING START:** 4/30/2009
DRILLING METHOD: Rotosonic	**DRILLING END:** 5/2/2009
LOGGER: B. Pelletier (Northstar)	**WELL COMPLETION DATE:** 5/2/2009
GROUND SURFACE ELEVATION (NAVD 88): 504.6 ft AMSL	**GENERAL REMARKS:** Existing monitoring well MW-23 was over-drilled and reconstructed within the same borehole as two nested monitoring wells
NORTHING (CCS NAD 83 Z 5): 2101286.32 / **EASTING (CCS NAD 83 Z 5):** 7616448.50	

12-in DIAMETER WELL VAULT (FLUSH WITH GRADE)



WELL CONSTRUCTION & SCREEN DETAILS

CASING MATERIAL:	Sch 40 PVC
CASING DIAMETER:	2-in
BOREHOLE DIAMETER:	10-in
SEAL TYPE:	Medium Bentonite Chips
PACK TYPE:	#3 Monterey Sand
CONCRETE PAD TYPE:	3-ft SQUARE
SCREEN LENGTH:	10-ft / 5-ft
SCREEN TYPE:	Sch 40 PVC
SLOT SIZE:	0.02-in

WELL DIAGRAM IS NOT TO SCALE

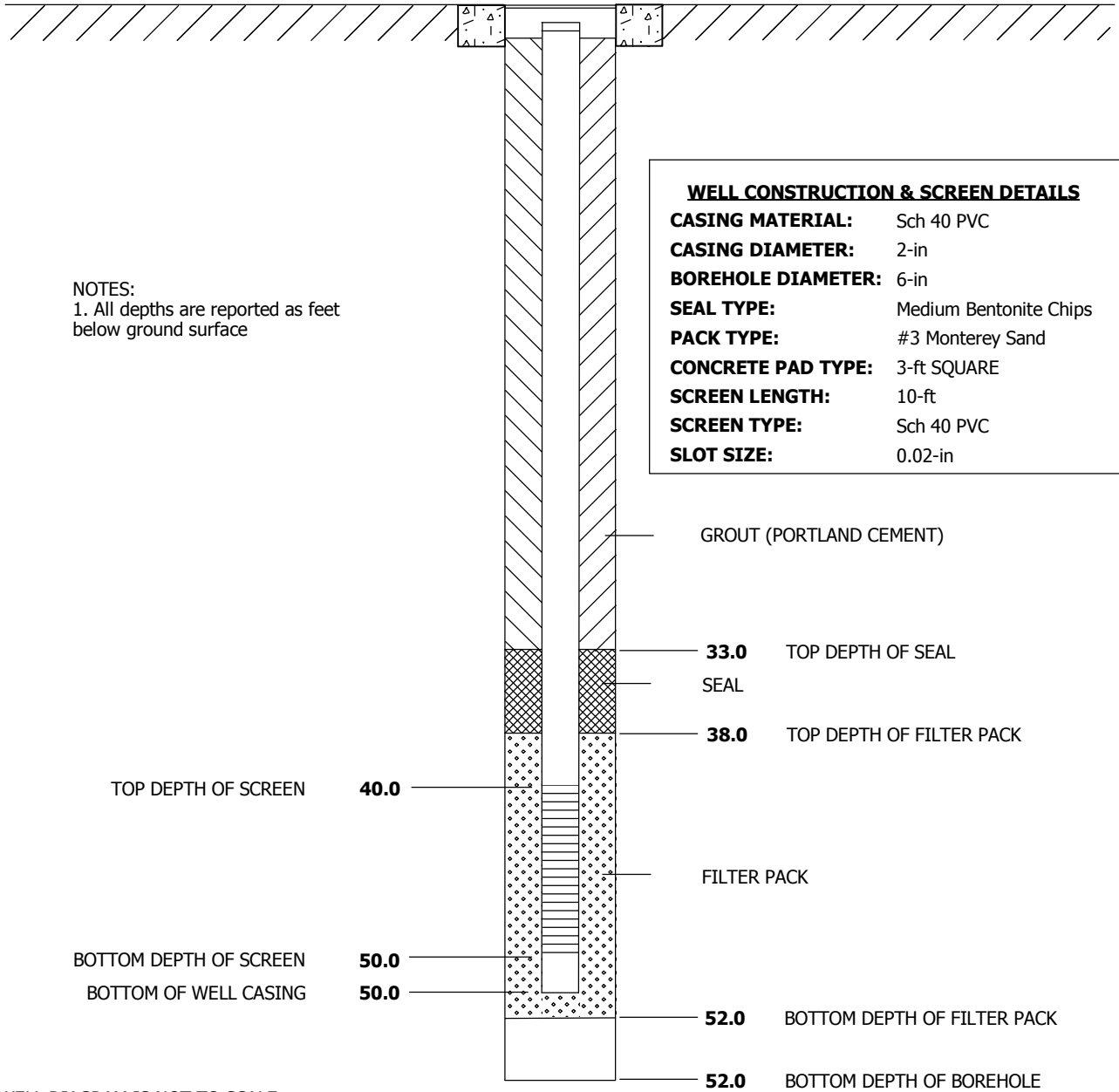
CH2MHILL

WELL COMPLETION DIAGRAM

PROJECT NO: 382653.FP.04.FW	**PROJECT:** PG&E Topock - ERGI	**WELL NO:** ***MW-57-050***
LOCATION: Site B		

DRILLING CONTRACTOR: Boart Longyear (D. Roberts)	**DRILLING START:** 1/21/2009
DRILLING METHOD: Rotosonic	**DRILLING END:** 1/21/2009
LOGGER: A. Brewster (Northstar)	**WELL COMPLETION DATE:** 1/21/2009
GROUND SURFACE ELEVATION (NAVD 88): 508.97 ft AMSL	**GENERAL REMARKS:** Alias during field work: MW-57S
NORTHING (CCS NAD 83 Z 5): 2100906.35 / **EASTING (CCS NAD 83 Z 5):** 7616384.35	

12-IN DIAMETER WELL VAULT (FLUSH WITH GRADE)



WELL CONSTRUCTION & SCREEN DETAILS

CASING MATERIAL:	Sch 40 PVC
CASING DIAMETER:	2-in
BOREHOLE DIAMETER:	6-in
SEAL TYPE:	Medium Bentonite Chips
PACK TYPE:	#3 Monterey Sand
CONCRETE PAD TYPE:	3-ft SQUARE
SCREEN LENGTH:	10-ft
SCREEN TYPE:	Sch 40 PVC
SLOT SIZE:	0.02-in

NOTES:
1. All depths are reported as feet below ground surface

WELL DIAGRAM IS NOT TO SCALE

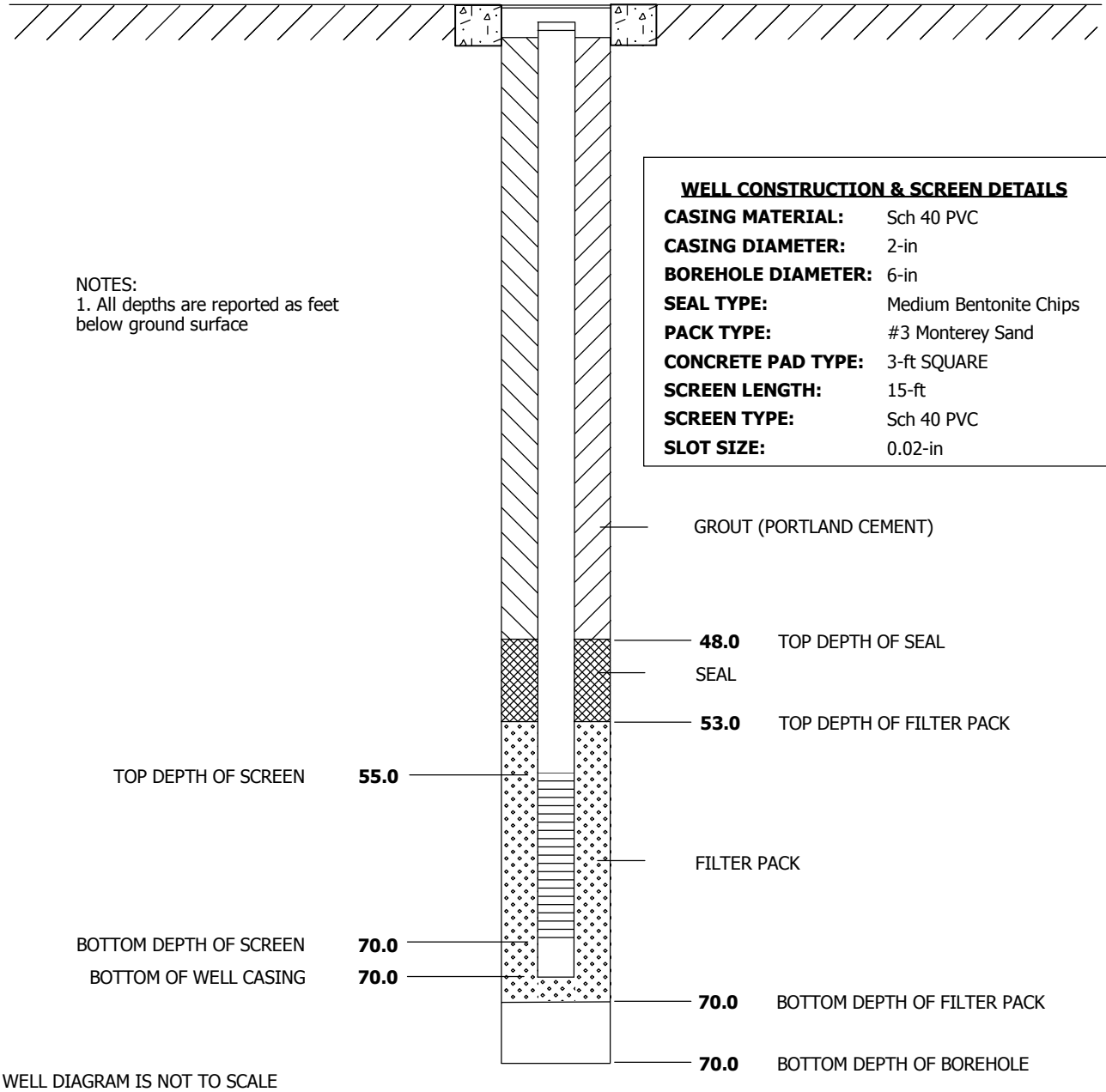
CH2MHILL

WELL COMPLETION DIAGRAM

PROJECT NO: 382653.FP.04.FW	**PROJECT:** PG&E Topock - ERGI	**WELL NO:** ***MW-57-070***
LOCATION: Site B		

DRILLING CONTRACTOR: Boart Longyear (D. Roberts)	**DRILLING START:** 1/28/2009
DRILLING METHOD: Rotosonic	**DRILLING END:** 1/28/2009
LOGGER: A. Brewster (Northstar)	**WELL COMPLETION DATE:** 1/28/2009
GROUND SURFACE ELEVATION (NAVD 88): 508.97 ft AMSL	**GENERAL REMARKS:** Alias during field work: MW-57M
NORTHING (CCS NAD 83 Z 5): 2100893.58 / **EASTING (CCS NAD 83 Z 5):** 7616394.98	

12-IN DIAMETER WELL VAULT (FLUSH WITH GRADE)



WELL CONSTRUCTION & SCREEN DETAILS

CASING MATERIAL:	Sch 40 PVC
CASING DIAMETER:	2-in
BOREHOLE DIAMETER:	6-in
SEAL TYPE:	Medium Bentonite Chips
PACK TYPE:	#3 Monterey Sand
CONCRETE PAD TYPE:	3-ft SQUARE
SCREEN LENGTH:	15-ft
SCREEN TYPE:	Sch 40 PVC
SLOT SIZE:	0.02-in

NOTES:
1. All depths are reported as feet below ground surface

WELL DIAGRAM IS NOT TO SCALE

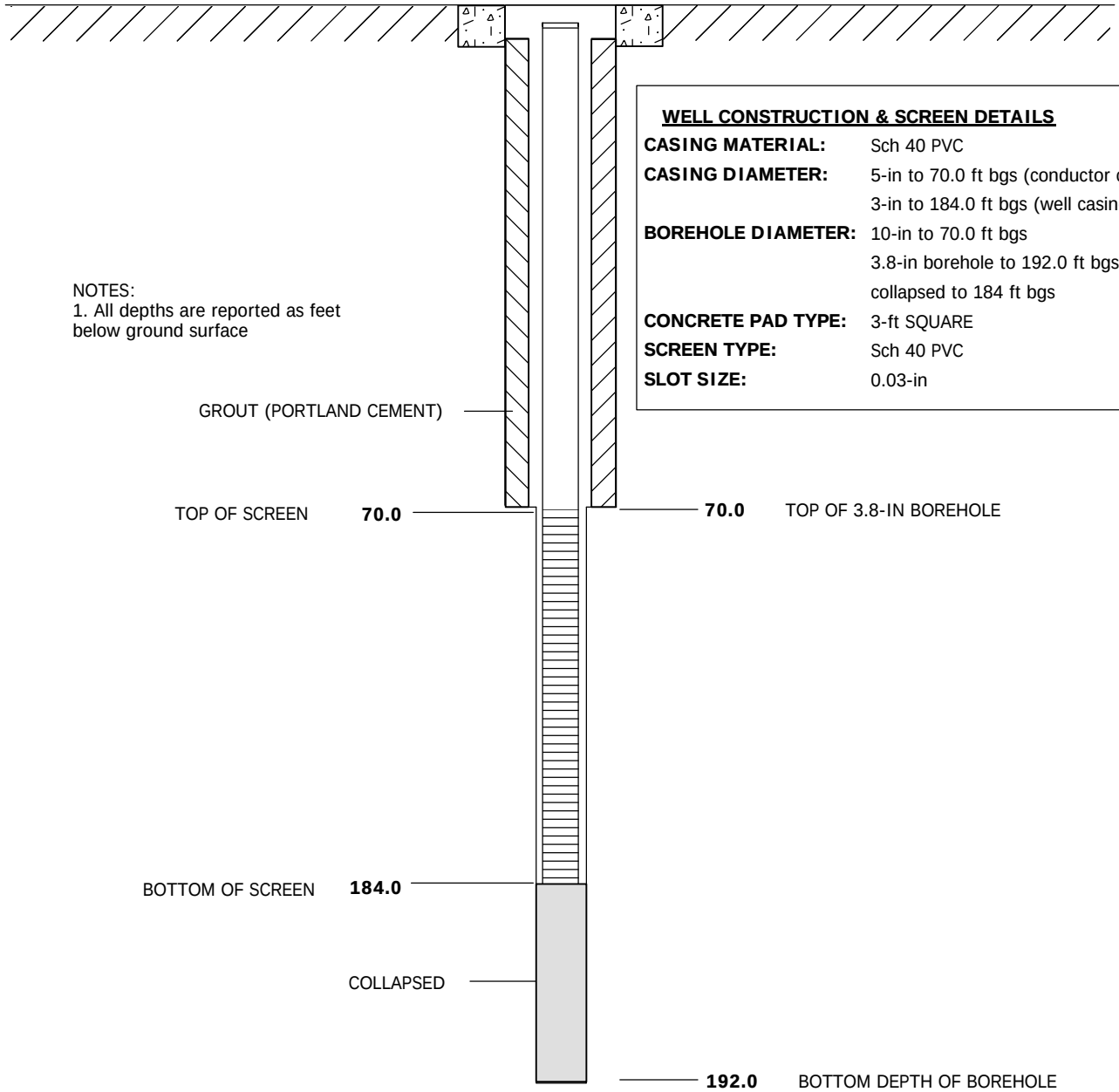
CH2MHILL

WELL COMPLETION DIAGRAM

PROJECT NO: 382653.FP.04.FW	**PROJECT:** PG&E Topock - ERGI	**WELL NO:** ***MW-57-185***
LOCATION: Site B		

DRILLING CONTRACTOR: Boart Longyear (D. Roberts)	**DRILLING START:** 1/14/2009
DRILLING METHOD: Rotosonic / Rotary Core (HQ)	**DRILLING END:** 1/20/2009
LOGGER: A. Brewster (Northstar)	**WELL COMPLETION DATE:** 2/16/2009
GROUND SURFACE ELEVATION (NAVD 88): 508.97 ft AMSL	**GENERAL REMARKS:** Alias during field work: MW-57BR
NORTHING (CCS NAD 83 Z 5): 2100899.56 / **EASTING (CCS NAD 83 Z 5):** 7616389.44	

12-IN DIAMETER WELL VAULT (FLUSH WITH GRADE)



WELL CONSTRUCTION & SCREEN DETAILS

CASING MATERIAL:	Sch 40 PVC
CASING DIAMETER:	5-in to 70.0 ft bgs (conductor casing)
	3-in to 184.0 ft bgs (well casing)
BOREHOLE DIAMETER:	10-in to 70.0 ft bgs
	3.8-in borehole to 192.0 ft bgs
	collapsed to 184 ft bgs
CONCRETE PAD TYPE:	3-ft SQUARE
SCREEN TYPE:	Sch 40 PVC
SLOT SIZE:	0.03-in

NOTES:
1. All depths are reported as feet below ground surface

WELL DIAGRAM IS NOT TO SCALE

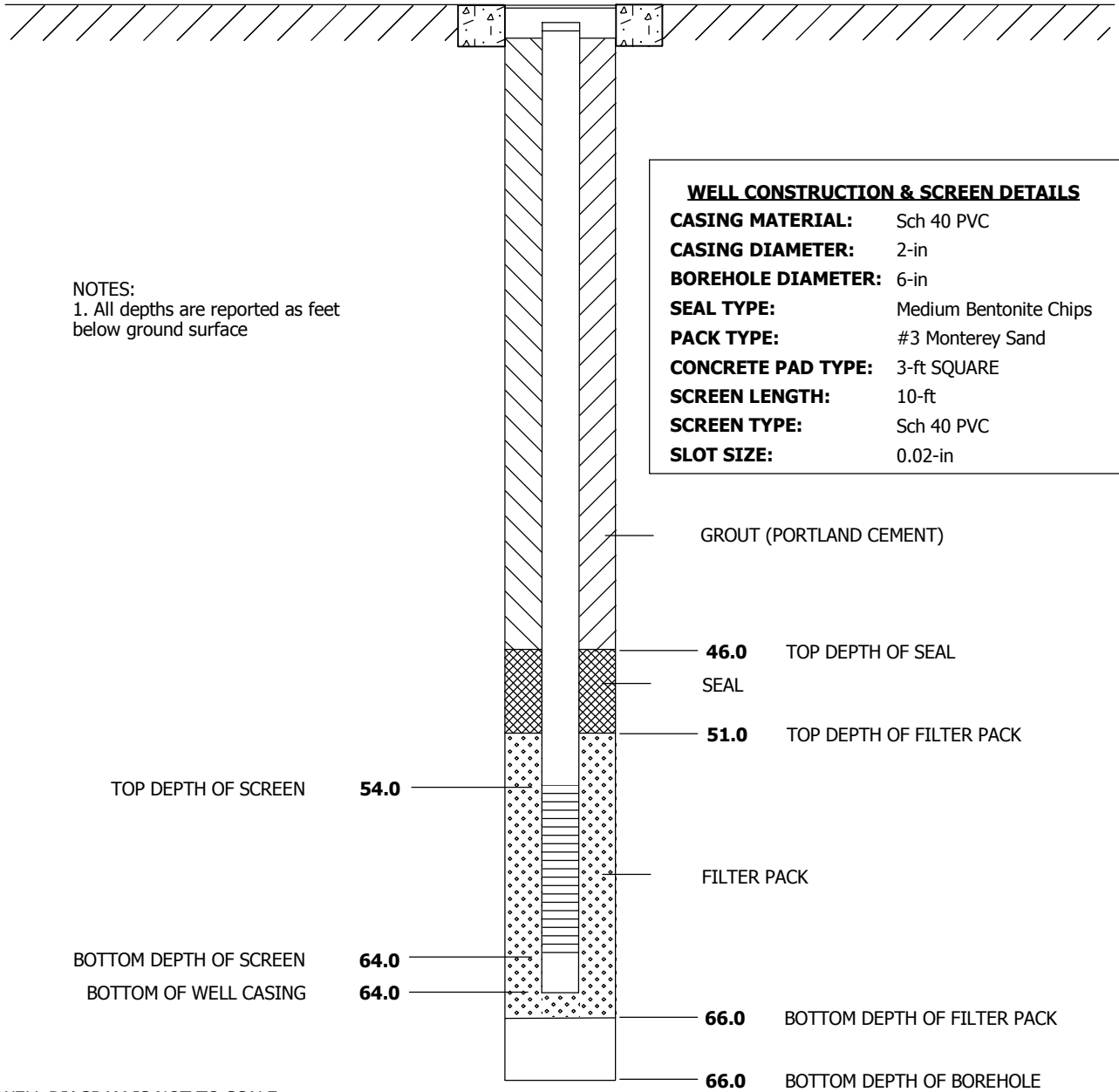
CH2MHILL

WELL COMPLETION DIAGRAM

PROJECT NO: 382653.FP.04.FW	**PROJECT:** PG&E Topock - ERGI	**WELL NO:** ***MW-58-065***
LOCATION: Site A		

DRILLING CONTRACTOR: Boart Longyear (D. Roberts)	**DRILLING START:** 2/11/2009
DRILLING METHOD: Rotosonic	**DRILLING END:** 2/12/2009
LOGGER: A. Brewster (Northstar)	**WELL COMPLETION DATE:** 2/12/2009
GROUND SURFACE ELEVATION (NAVD 88): 521.41 ft AMSL	**GENERAL REMARKS:** Alias during field work: MW-58S
NORTHING (CCS NAD 83 Z 5): 2100607.15 / **EASTING (CCS NAD 83 Z 5):** 7616136.25	

12-IN DIAMETER WELL VAULT (FLUSH WITH GRADE)



WELL CONSTRUCTION & SCREEN DETAILS

CASING MATERIAL:	Sch 40 PVC
CASING DIAMETER:	2-in
BOREHOLE DIAMETER:	6-in
SEAL TYPE:	Medium Bentonite Chips
PACK TYPE:	#3 Monterey Sand
CONCRETE PAD TYPE:	3-ft SQUARE
SCREEN LENGTH:	10-ft
SCREEN TYPE:	Sch 40 PVC
SLOT SIZE:	0.02-in

NOTES:
1. All depths are reported as feet below ground surface

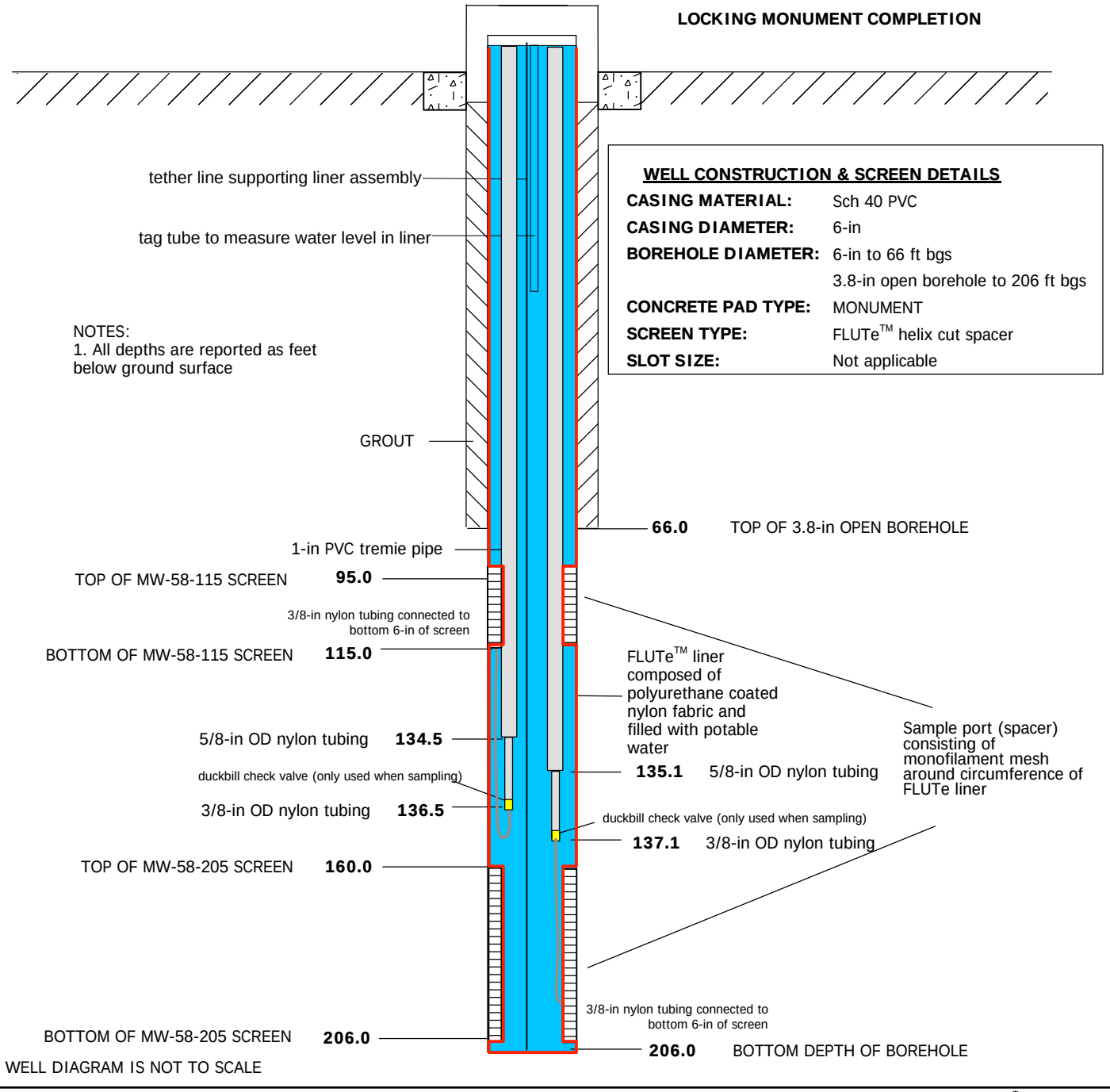
WELL DIAGRAM IS NOT TO SCALE

CH2MHILL

WELL COMPLETION DIAGRAM

PROJECT NO: 382653.FP.04.FW	**PROJECT:** PG&E Topock - ERGI	**WELL NO's:** ***MW-58-115*** ***MW-58-205***
LOCATION: Site A		

DRILLING CONTRACTOR: Boart Longyear (D. Roberts)	**DRILLING START:** 1/29/2009
DRILLING METHOD: Rotosonic	**DRILLING END:** 2/12/2009
LOGGER: A. Brewster (Northstar) and I. Wood	**WELL COMPLETION DATE:** 7/8/2009
GROUND SURFACE ELEVATION (NAVD 88): 521.78 ft AMSL	**GENERAL REMARKS:** 4-inch diameter, 2-port Guelph Water FLUTe™ multi-level system with helical screens installed into open 3.8-inch HQ borehole
NORTHING (CCS NAD 83 Z 5): 2100612.06 / **EASTING (CCS NAD 83 Z 5):** 7616131.80	



WELL CONSTRUCTION & SCREEN DETAILS

CASING MATERIAL:	Sch 40 PVC
CASING DIAMETER:	6-in
BOREHOLE DIAMETER:	6-in to 66 ft bgs
	3.8-in open borehole to 206 ft bgs
CONCRETE PAD TYPE:	MONUMENT
SCREEN TYPE:	FLUTe™ helix cut spacer
SLOT SIZE:	Not applicable

CH2MHILL

FLUTe™ Flexible Liner Underground Technologies, Ltd. L.C.
For a medley of innovative designs
6 Easy St., Santa Fe, NM 87506
505-455-1300, www.flut.com

As-Built Information

Job # 968-1

General:

Job Description:	206' 4"dia. 2 Port Guelph Water FLUTe
Customer:	CH2M Hill
Location:	155 Grand Ave. Suite 1000 Oakland, CA 94612
Well Designation:	MW-58BR
Hole Depth:	206'
Water Table:	67'
Drilling Method:	N/A
Casing Information:	N/A
Installation Method:	Water eversion
Bubbler / Tag:	67'

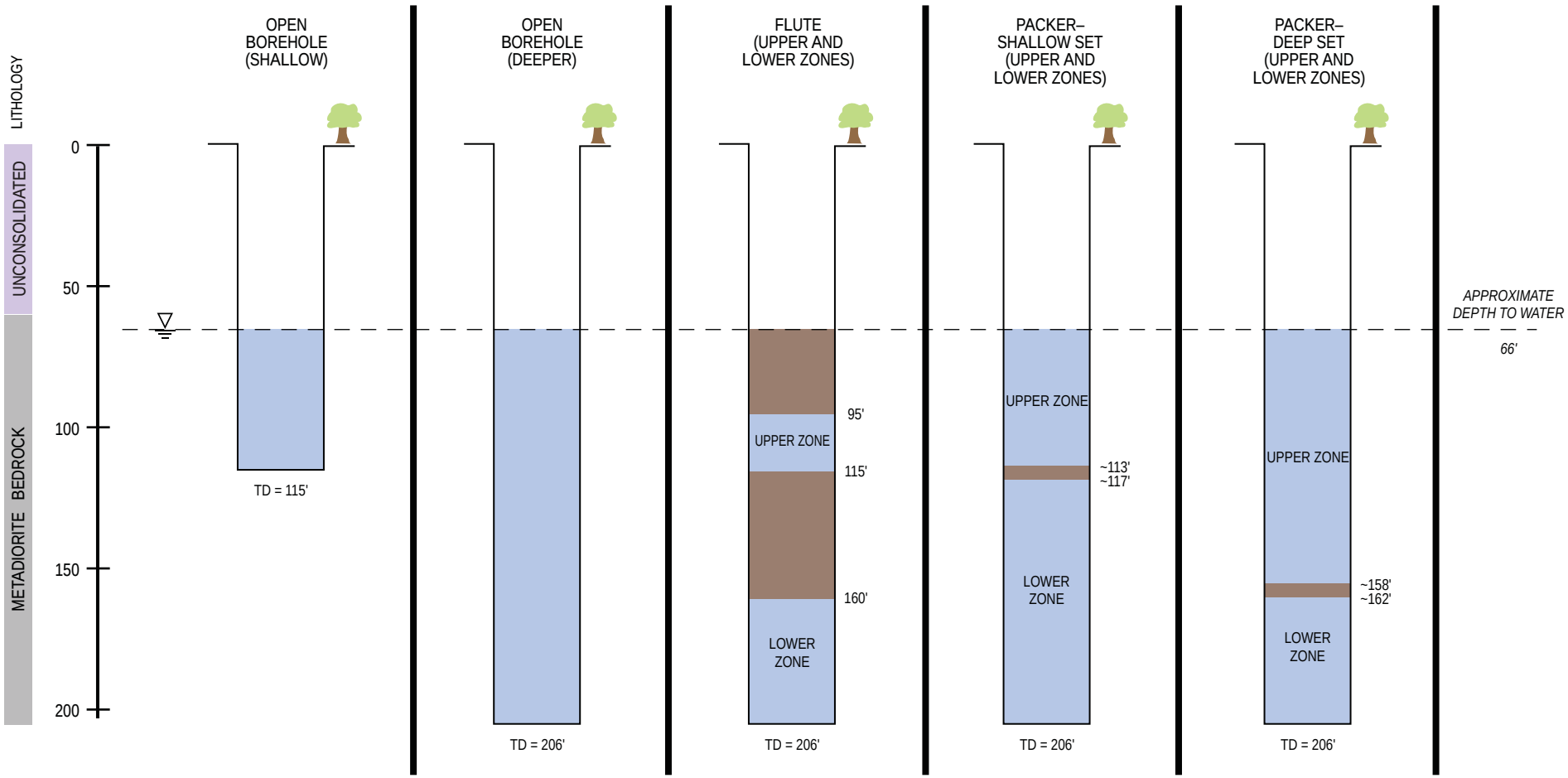
Liner:

Material:	210d Orange d/c 2 sleeve
Diameter:	4"
Material Above Casing:	3'
Uneverted Material:	4'
Rough Fabrication Legnth:	216'
Termination:	End Seal Knot
Knot Diameter Allowance:	2"
Markings on Liner:	Ink stamp indicating FLUTe TOC & FLUTe Job# 968-1
Spacer Design:	2 Material helix cut spacer Design (orange mesh) and Mylar

Spacer #	Spacer Bottom [ft]	Spacer Top [ft]
1	115'	95'
2	206'	160'

Tubing & Ports:							
Tubing In Bundle:			NYLON				
Tubing In Sleeves:			NYLON				
Bubbler Details:			1/4 NYLON				
Port Design:			Superthane feed thru				
Port Locations:			6" @ bottom of spacer				
Vent Design:			1/4 Superthane feed thru w/ 3/8 tygon tubing connected to duct				
Vent Location:			210'				
Pump Assembly:							
Port #:	**Transducer Serial #:**	**Transducer Pressure Rating [psi]:**	**Diaphragm Depth [ft. btoc]**	**Cable Serial #:**	**Cable Length [ft.]**	**5/8 x 3/8**	**3/8 x 1/4**
1						134'.5"	136'.5"
2						135'	137'

Other Info:	
Transducer Type:	N/A
Kellum Design:	1" Friction Kellum wrap Below Unions 1" Webbing with blue hig
Kellum Locations:	1st kellum @ 18' btoc: others every 40 there after
Tether:	1/4"
Marking on Tubing:	Port #'s and color code
Marking on Cables:	Port #'S
Bundle Sheating:	White 2.25" starting @ 134'
Marks on Bundle:	E.P. markings @ every 40'
Pump Tube:	216'
Reel / Packaging:	SF FLUTe
Casing Adapter Info:	ABQ FLUTe
Wellhead Info:	ABQ FLUTe
Vent Tube:	n/a
Clamps:	ABQ FLUTe
Shipped Via:	ABQ FLUTe
Other Notes:	Port # 1 Protrudes @ 134'.5"' Top Of Tube @ 131" W/ red caps
	Port # 2 Protrudes @ 135' Top Of Tube @ 133' W/ red caps



LEGEND

- Portion of borehole exposed during sample collection
- Portion of borehole sealed during sample collection

NOTES:
– Scale is approximate.
– All depths presented as feet below ground surface.

MW-58BR Sampling Configurations
PG&E Topock Compressor Station
Needles, California

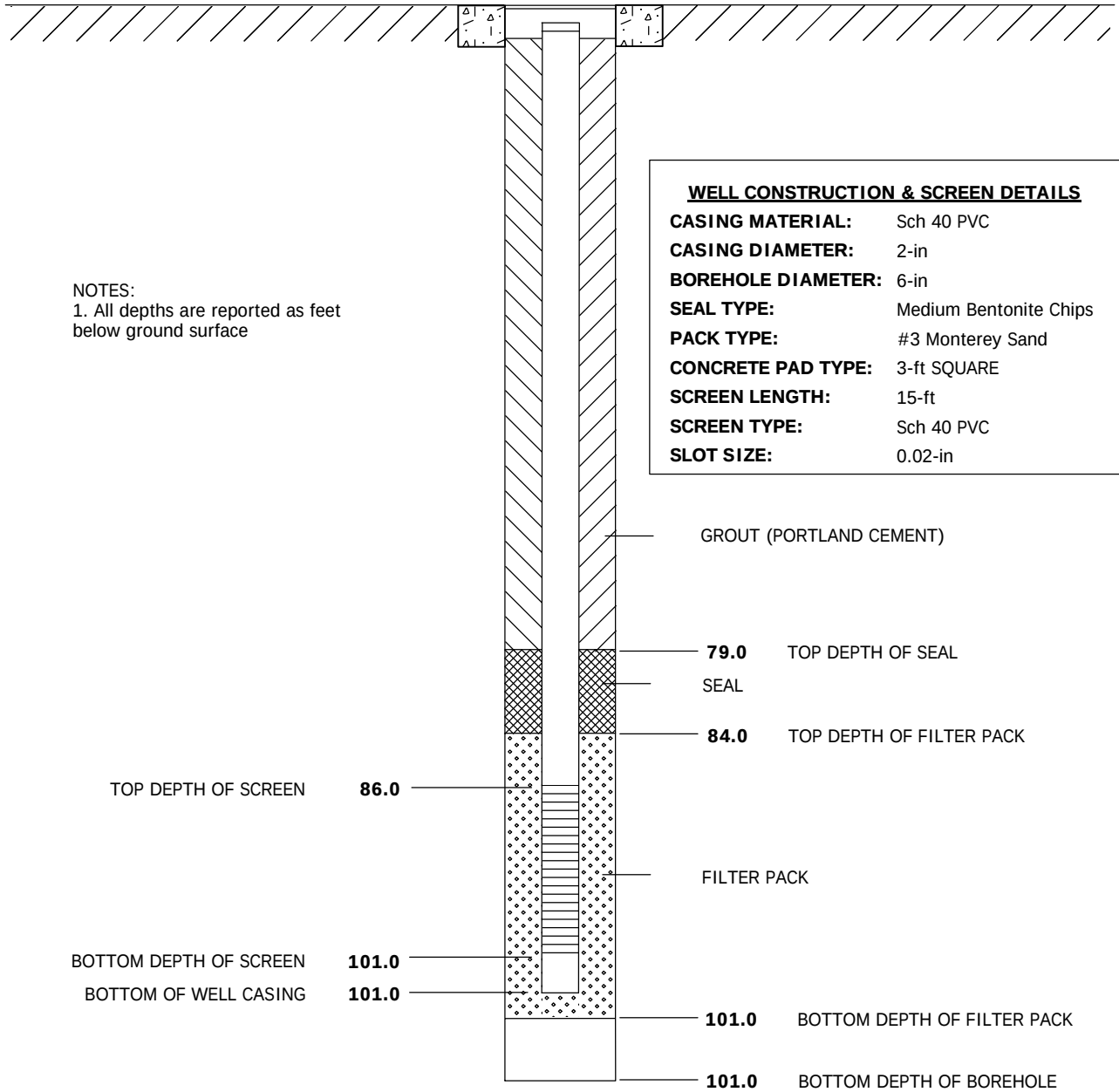
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WELL COMPLETION DIAGRAM

PROJECT NO: 382653.FP.04.FW	**PROJECT:** PG&E Topock - ERGI	**WELL NO:** ***MW-59-100***
LOCATION: Site G		

DRILLING CONTRACTOR: Boart Longyear (D. Roberts)	**DRILLING START:** 2/25/2009
DRILLING METHOD: Rotosonic	**DRILLING END:** 2/26/2009
LOGGER: A. Brewster (Northstar)	**WELL COMPLETION DATE:** 2/26/2009
GROUND SURFACE ELEVATION (NAVD 88): 538.94 ft AMSL	**GENERAL REMARKS:** Alias during field work: MW-59
NORTHING (CCS NAD 83 Z 5): 2100851.96 / **EASTING (CCS NAD 83 Z 5):** 7616081.90	

12-IN DIAMETER MONUMENT CASING



WELL CONSTRUCTION & SCREEN DETAILS

CASING MATERIAL:	Sch 40 PVC
CASING DIAMETER:	2-in
BOREHOLE DIAMETER:	6-in
SEAL TYPE:	Medium Bentonite Chips
PACK TYPE:	#3 Monterey Sand
CONCRETE PAD TYPE:	3-ft SQUARE
SCREEN LENGTH:	15-ft
SCREEN TYPE:	Sch 40 PVC
SLOT SIZE:	0.02-in

NOTES:
1. All depths are reported as feet below ground surface

WELL DIAGRAM IS NOT TO SCALE

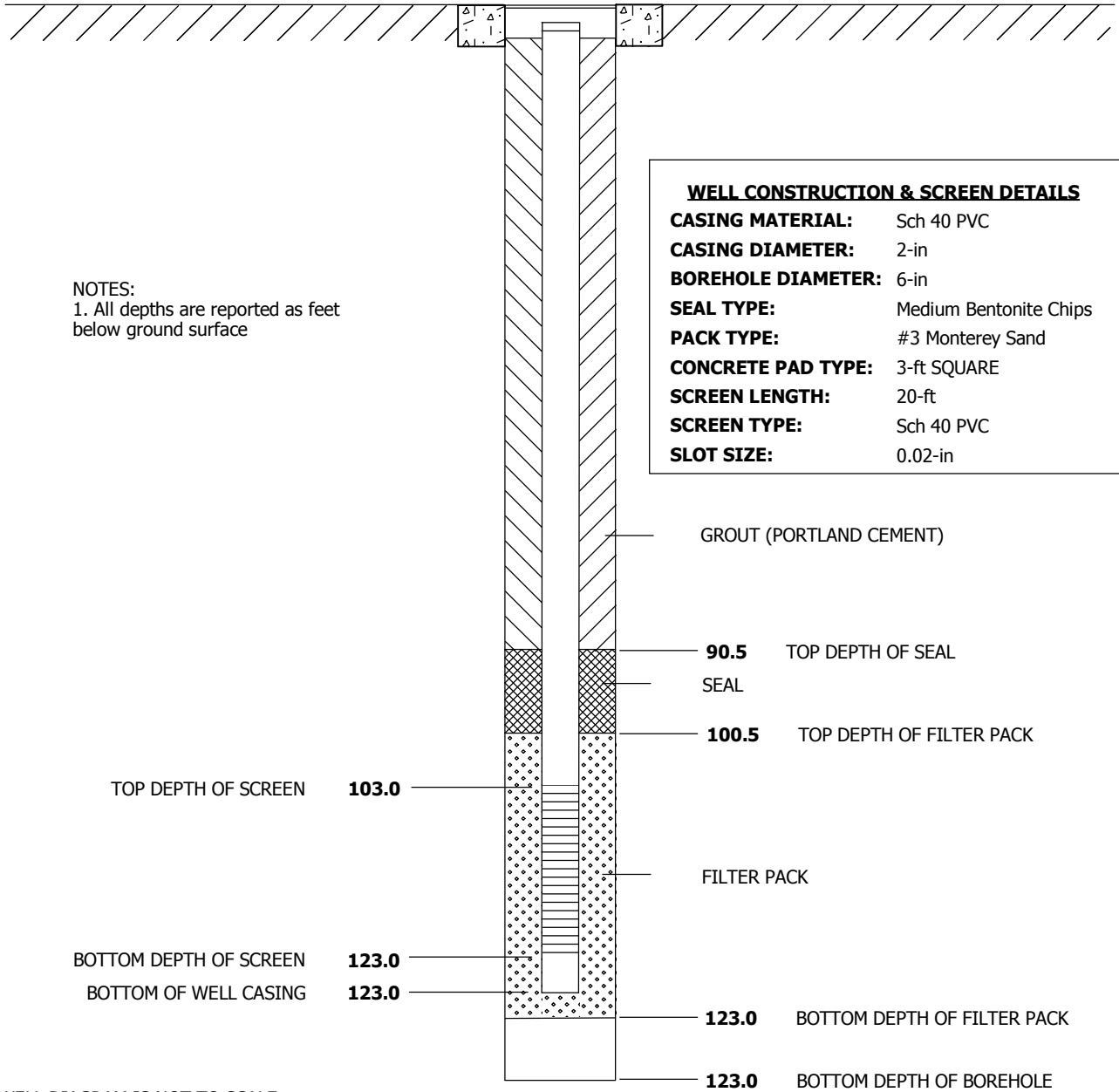
CH2MHILL

WELL COMPLETION DIAGRAM

PROJECT NO: 382653.FP.04.FW	**PROJECT:** PG&E Topock - ERGI	**WELL NO:** ***MW-60-125***
LOCATION: Site F		

DRILLING CONTRACTOR: Boart Longyear (D. Roberts)	**DRILLING START:** 2/27/2009
DRILLING METHOD: Rotary Core (HQ) - Rotosonic overdrill	**DRILLING END:** 3/3/2009
LOGGER: A. Brewster (Northstar)	**WELL COMPLETION DATE:** 3/3/2009
GROUND SURFACE ELEVATION (NAVD 88): 555.78 ft AMSL	**GENERAL REMARKS:** Alias during field work: MW-60
NORTHING (CCS NAD 83 Z 5): 2100491.63 / **EASTING (CCS NAD 83 Z 5):** 7616434.82	

12-IN DIAMETER WELL VAULT (FLUSH WITH GRADE)



WELL CONSTRUCTION & SCREEN DETAILS

CASING MATERIAL:	Sch 40 PVC
CASING DIAMETER:	2-in
BOREHOLE DIAMETER:	6-in
SEAL TYPE:	Medium Bentonite Chips
PACK TYPE:	#3 Monterey Sand
CONCRETE PAD TYPE:	3-ft SQUARE
SCREEN LENGTH:	20-ft
SCREEN TYPE:	Sch 40 PVC
SLOT SIZE:	0.02-in

NOTES:
1. All depths are reported as feet below ground surface

WELL DIAGRAM IS NOT TO SCALE

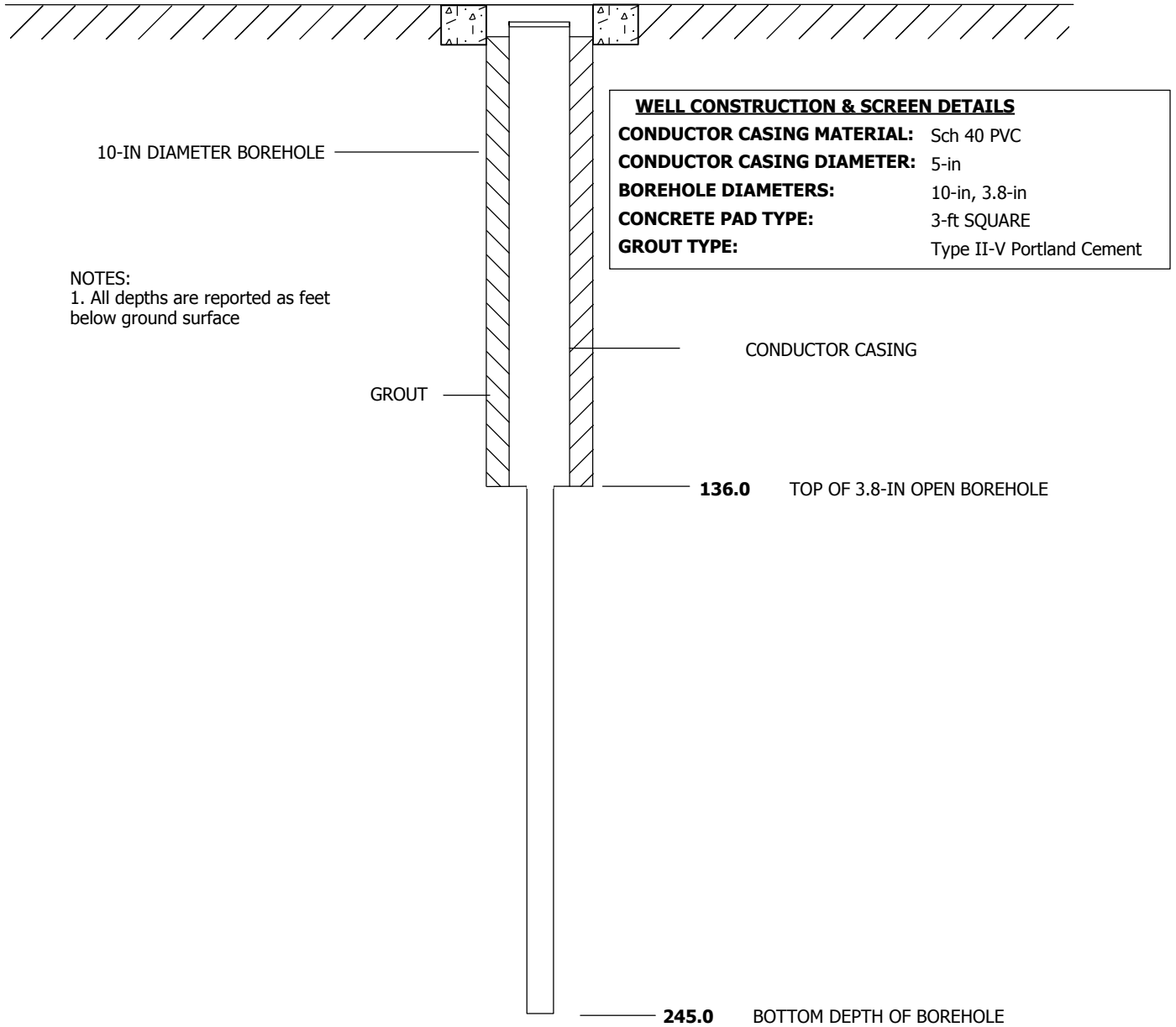
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WELL COMPLETION DIAGRAM

PROJECT NO: 417981.ER.02.FW	**PROJECT:** ER-TCS Groundwater Investigation	**WELL NO:** ***MW-60BR-245***
LOCATION: Site F		

DRILLING CONTRACTOR: Boart Longyear (R. Sawrey)	**DRILLING START:** 6/28/2011
DRILLING METHOD: Rotosonic/Wireline Rotary Core	**DRILLING END:** 7/28/2011
LOGGER: C. Keller (Northstar)	**WELL COMPLETION DATE:** 7/28/2011
GROUND SURFACE ELEVATION (NAVD 88): 555.9 ft AMSL	**GENERAL REMARKS:** Open 3.8" diameter borehole from 136 to 245 feet bgs. Centralizers at 10, 30, 50, 70, 90, and 110 ft bgs.
NORTHING (CCS NAD 83 Z 5): 2100495.02 / **EASTING (CCS NAD 83 Z 5):** 7616444.42	

12-in DIAMETER WELL VAULT (FLUSH WITH GRADE)



WELL CONSTRUCTION & SCREEN DETAILS

CONDUCTOR CASING MATERIAL:	Sch 40 PVC
CONDUCTOR CASING DIAMETER:	5-in
BOREHOLE DIAMETERS:	10-in, 3.8-in
CONCRETE PAD TYPE:	3-ft SQUARE
GROUT TYPE:	Type II-V Portland Cement

NOTES:
1. All depths are reported as feet below ground surface

WELL DIAGRAM IS NOT TO SCALE

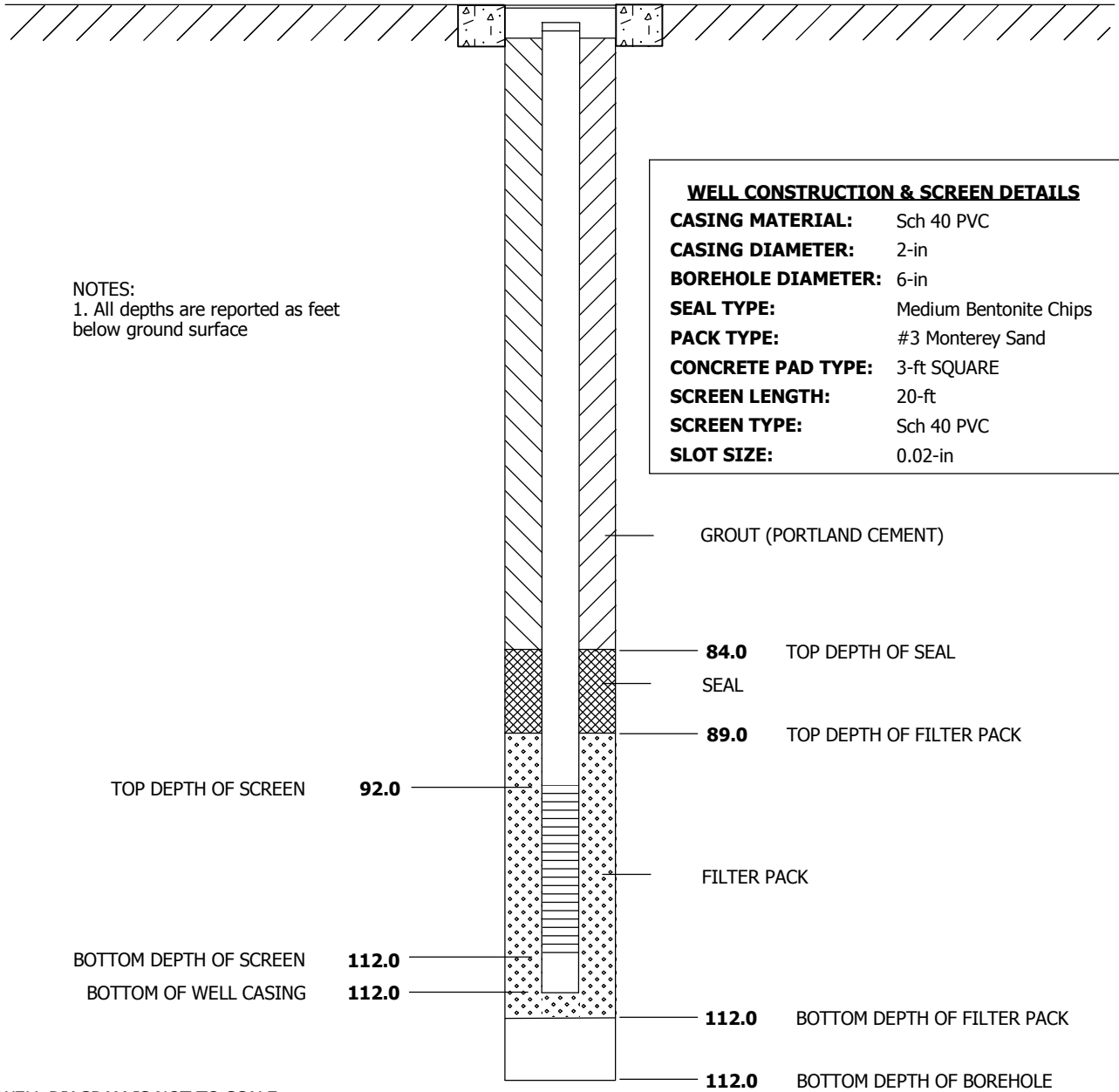
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WELL COMPLETION DIAGRAM

PROJECT NO: 382653.FP.04.FW	**PROJECT:** PG&E Topock - ERGI	**WELL NO:** ***MW-61-110***
LOCATION: Site C		

DRILLING CONTRACTOR: Boart Longyear (D. Roberts)	**DRILLING START:** 3/4/2009
DRILLING METHOD: Rotary Core (HQ) - Rotosonic overdrill	**DRILLING END:** 3/13/2009
LOGGER: A. Brewster (Northstar)	**WELL COMPLETION DATE:** 3/13/2009
GROUND SURFACE ELEVATION (NAVD 88): 544.12 ft AMSL	**GENERAL REMARKS:** Alias during field work: MW-61
NORTHING (CCS NAD 83 Z 5): 2100713.02 / **EASTING (CCS NAD 83 Z 5):** 7616591.04	

12-IN DIAMETER WELL VAULT (FLUSH WITH GRADE)



WELL CONSTRUCTION & SCREEN DETAILS

CASING MATERIAL:	Sch 40 PVC
CASING DIAMETER:	2-in
BOREHOLE DIAMETER:	6-in
SEAL TYPE:	Medium Bentonite Chips
PACK TYPE:	#3 Monterey Sand
CONCRETE PAD TYPE:	3-ft SQUARE
SCREEN LENGTH:	20-ft
SCREEN TYPE:	Sch 40 PVC
SLOT SIZE:	0.02-in

NOTES:
1. All depths are reported as feet below ground surface

WELL DIAGRAM IS NOT TO SCALE

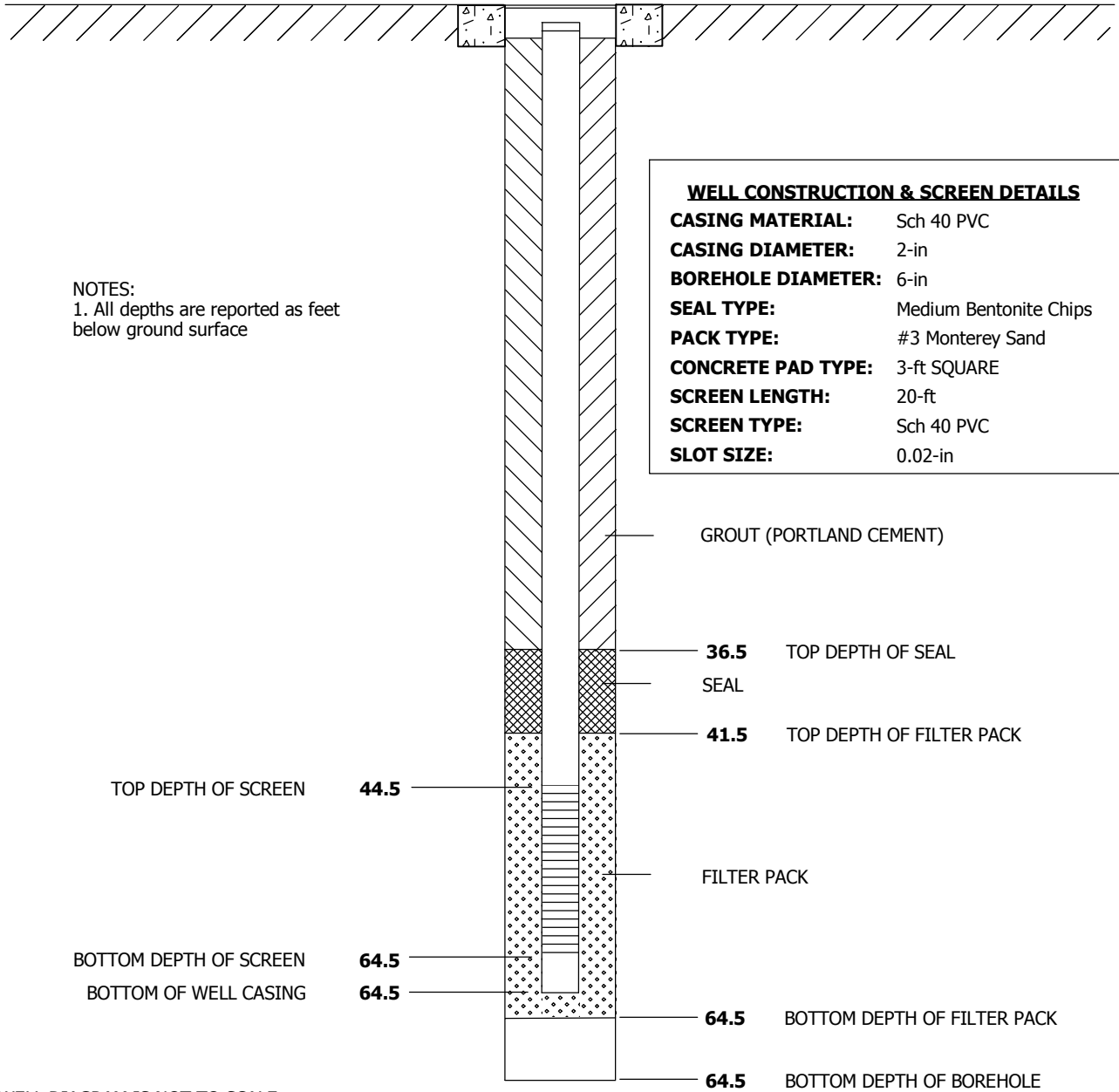
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WELL COMPLETION DIAGRAM

PROJECT NO: 382653.FP.04.FW	**PROJECT:** PG&E Topock - ERGI	**WELL NO:** ***MW-62-065***
LOCATION: Site E		

DRILLING CONTRACTOR: Boart Longyear (D. Roberts)	**DRILLING START:** 3/14/2009
DRILLING METHOD: Rotary Core (HQ) - Rotosonic overdrill	**DRILLING END:** 3/18/2009
LOGGER: A. Brewster (Northstar)	**WELL COMPLETION DATE:** 3/18/2009
GROUND SURFACE ELEVATION (NAVD 88): 503.55 ft AMSL	**GENERAL REMARKS:** Alias during field work: MW-62
NORTHING (CCS NAD 83 Z 5): 2101064.51 / **EASTING (CCS NAD 83 Z 5):** 7616560.96	

12-IN DIAMETER WELL VAULT (FLUSH WITH GRADE)



WELL CONSTRUCTION & SCREEN DETAILS

CASING MATERIAL:	Sch 40 PVC
CASING DIAMETER:	2-in
BOREHOLE DIAMETER:	6-in
SEAL TYPE:	Medium Bentonite Chips
PACK TYPE:	#3 Monterey Sand
CONCRETE PAD TYPE:	3-ft SQUARE
SCREEN LENGTH:	20-ft
SCREEN TYPE:	Sch 40 PVC
SLOT SIZE:	0.02-in

NOTES:
1. All depths are reported as feet below ground surface

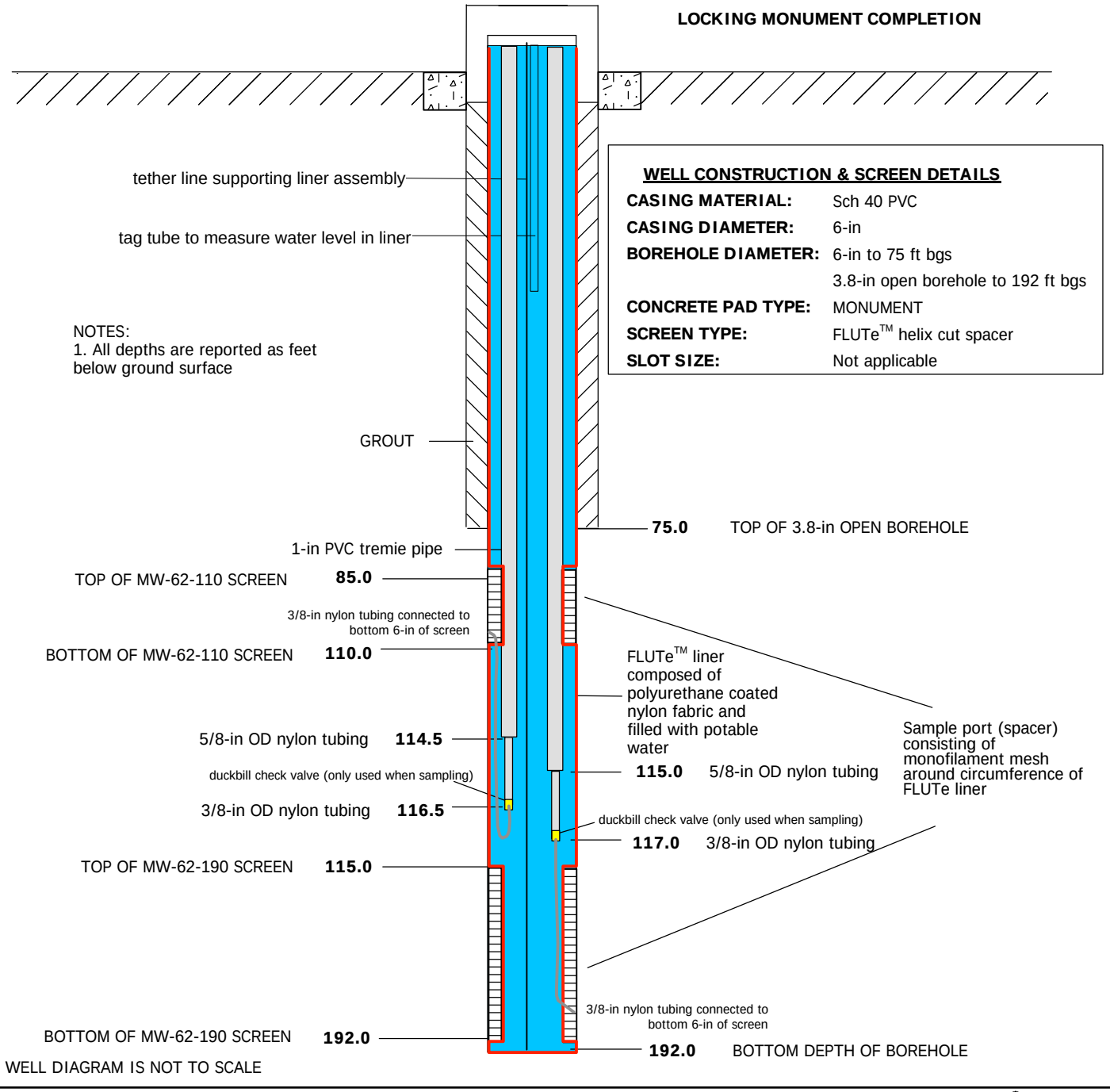
WELL DIAGRAM IS NOT TO SCALE

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WELL COMPLETION DIAGRAM

PROJECT NO: 382653.FP.04.FW	**PROJECT:** PG&E Topock - ERGI	**WELL NO's:** ***MW-62-110*** ***MW-62-190***
LOCATION: Site E		

DRILLING CONTRACTOR: Boart Longyear (D. Roberts)	**DRILLING START:** 3/14/2009
DRILLING METHOD: Rotosonic	**DRILLING END:** 3/18/2009
LOGGER: A. Brewster (Northstar) and I. Wood	**WELL COMPLETION DATE:** 7/7/2009
GROUND SURFACE ELEVATION (NAVD 88): 504.05 ft AMSL	**GENERAL REMARKS:** 4-inch diameter, 2-port Guelph Water FLUTe™ multi-level system with helical screens installed into open 3.8-inch HQ borehole
NORTHING (CCS NAD 83 Z 5): 2101068.16 / **EASTING (CCS NAD 83 Z 5):** 7616550.88	



WELL CONSTRUCTION & SCREEN DETAILS

CASING MATERIAL:	Sch 40 PVC
CASING DIAMETER:	6-in
BOREHOLE DIAMETER:	6-in to 75 ft bgs
	3.8-in open borehole to 192 ft bgs
CONCRETE PAD TYPE:	MONUMENT
SCREEN TYPE:	FLUTe™ helix cut spacer
SLOT SIZE:	Not applicable

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As-Built Information

Job # 968-2

General:

Job Description:	192' 4"dia. 2 Port Guelph Water FLUTe
Customer:	CH2M Hill
Location:	155 Grand Ave. Suite 1000 Oakland, CA 94612
Well Designation:	MW-62BR
Hole Depth:	192'
Water Table:	47'
Drilling Method:	N/A
Casing Information:	N/A
Installation Method:	Water eversion
Bubbler / Tag:	47'

Liner:

Material:	210d Orange d/c 2 sleeve
Diameter:	4"
Material Above Casing:	3'
Uneverted Material:	4'
Rough Fabrication Legnth:	202'
Termination:	End Seal Knot
Knot Diameter Allowance:	2"
Markings on Liner:	Ink stamp indicating FLUTe TOC & FLUTe Job# 968-2
Spacer Design:	2 Material helix cut spacer Design (orange mesh) and Mylar

Spacer #	Spacer Bottom [ft]	Spacer Top [ft]
1	110'	85'
2	192'	155'

Tubing & Ports:							
Tubing In Bundle:			NYLON				
Tubing In Sleeves:			NYLON				
Bubbler Details:			1/4 NYLON				
Port Design:			Superthane feed thru				
Port Locations:			6" @ bottom of spacer				
Vent Design:			1/4 Superthane feed thru w/ 3/8 tygon tubing connected to duct				
Vent Location:			202'				
Pump Assembly:							
Port #:	**Transducer Serial #:**	**Transducer Pressure Rating [psi]:**	**Diaphragm Depth [ft. btoc]**	**Cable Serial #:**	**Cable Length [ft.]**	**5/8 x 3/8**	**3/8 x 1/4**
1						114'.5"	116'.5"
2						115'	117'

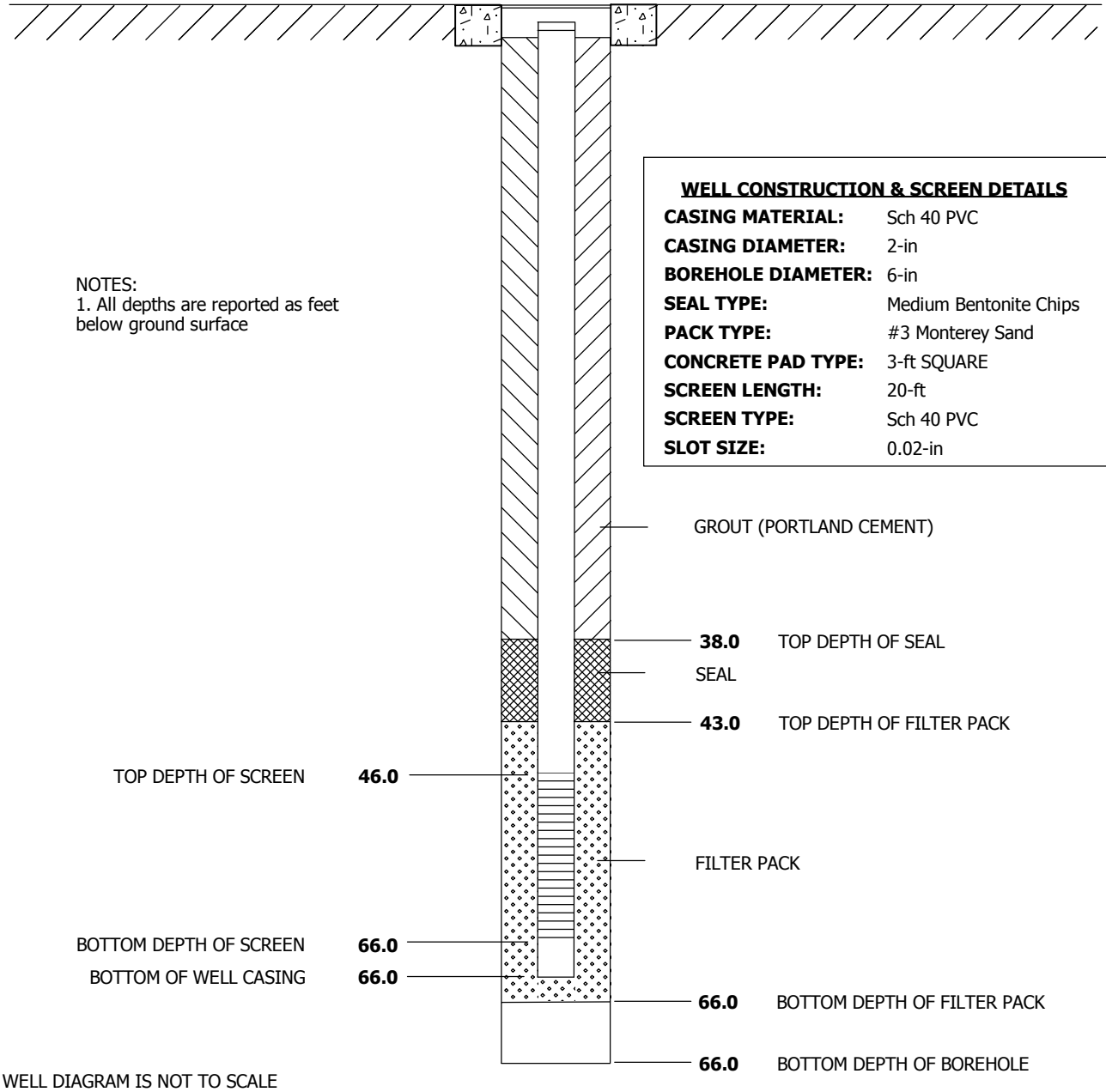
Other Info:	
Transducer Type:	N/A
Kellum Design:	1" Friction Kellum wrap Below Unions 1" Webbing with blue hig
Kellum Locations:	1st kellum @ 18' btoc: others every 40 there after
Tether:	1/4"
Marking on Tubing:	Port #'s and color code
Marking on Cables:	Port #'S
Bundle Sheating:	White 2.25" starting @ 1 116'
Marks on Bundle:	E.P. markings @ every 40'
Pump Tube:	202'
Reel / Packaging:	SF FLUTe
Casing Adapter Info:	ABQ FLUTe
Wellhead Info:	ABQ FLUTe
Vent Tube:	n/a
Clamps:	ABQ FLUTe
Shipped Via:	ABQ FLUTe
Other Notes:	Port # 1 Protrudes @ 114'.5"' Top Of Tube @ 111" W/ red caps
	Port # 2 Protrudes @ 115' Top Of Tube @ 113' W/ red caps

WELL COMPLETION DIAGRAM

PROJECT NO: 382653.FP.04.FW	**PROJECT:** PG&E Topock - ERGI	**WELL NO:** ***MW-63-065***
LOCATION: Site E - Alternate 2		

DRILLING CONTRACTOR: Boart Longyear (D. Roberts)	**DRILLING START:** 4/6/2009
DRILLING METHOD: Rotary Core (HQ) - Rotosonic overdrill	**DRILLING END:** 4/8/2009
LOGGER: R. Tweidt (Northstar)	**WELL COMPLETION DATE:** 4/8/2009
GROUND SURFACE ELEVATION (NAVD 88): 505.03 ft AMSL	**GENERAL REMARKS:** Alias during field work: MW-63
NORTHING (CCS NAD 83 Z 5): 2100973.93 / **EASTING (CCS NAD 83 Z 5):** 7616921.60	

12-IN DIAMETER WELL VAULT (FLUSH WITH GRADE)



WELL CONSTRUCTION & SCREEN DETAILS

CASING MATERIAL:	Sch 40 PVC
CASING DIAMETER:	2-in
BOREHOLE DIAMETER:	6-in
SEAL TYPE:	Medium Bentonite Chips
PACK TYPE:	#3 Monterey Sand
CONCRETE PAD TYPE:	3-ft SQUARE
SCREEN LENGTH:	20-ft
SCREEN TYPE:	Sch 40 PVC
SLOT SIZE:	0.02-in

NOTES:
1. All depths are reported as feet below ground surface

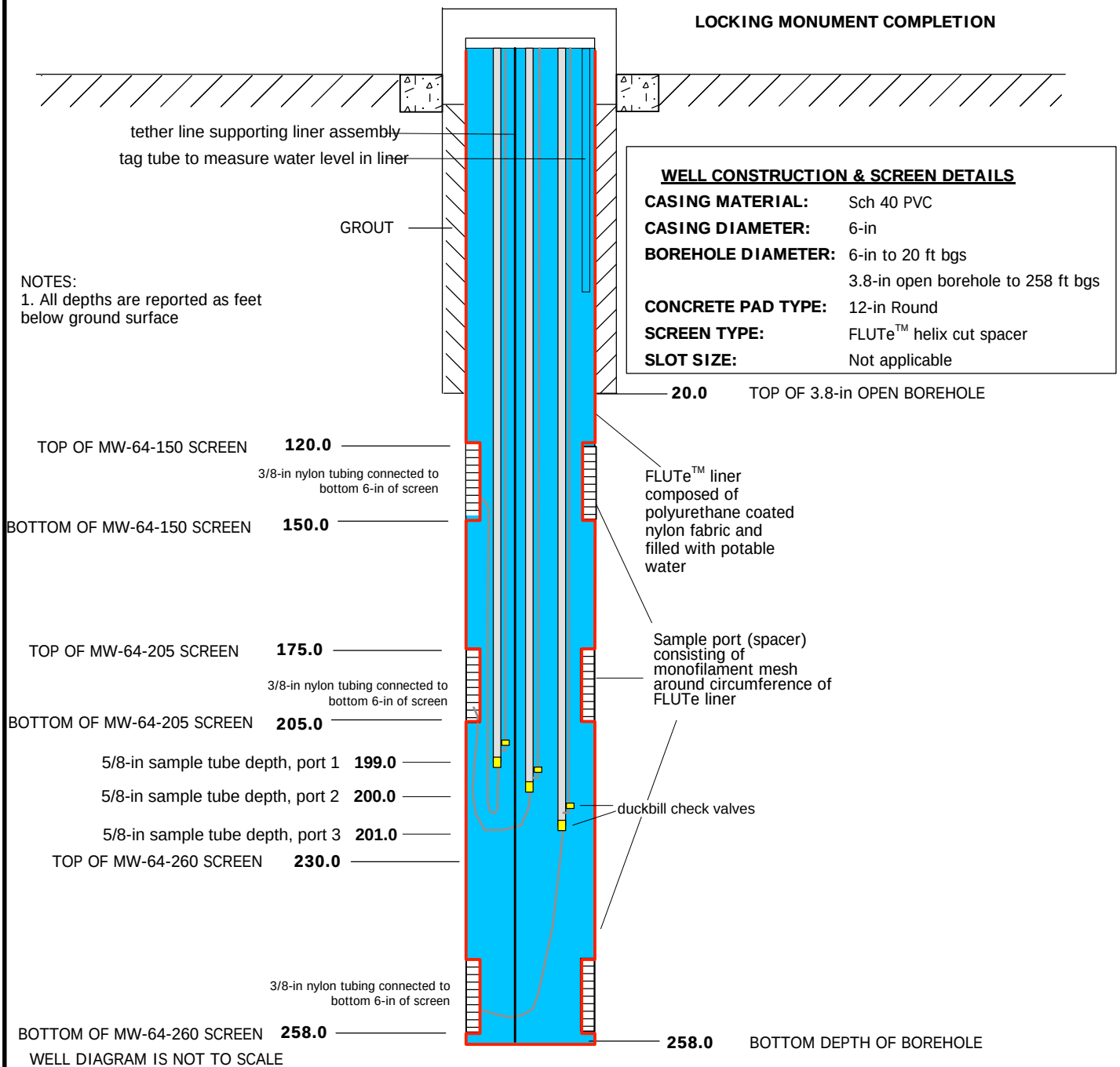
WELL DIAGRAM IS NOT TO SCALE

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WELL COMPLETION DIAGRAM

PROJECT NO: 382653.FP.04.FW	**PROJECT:** PG&E Topock - ERGI	**WELL NO's:** *MW-64-150 MW-64-205 MW-64-260*
LOCATION: Site C - Alternate		

DRILLING CONTRACTOR: Boart Longyear (D. Roberts)	**DRILLING START:** 4/6/2009
DRILLING METHOD: Rotosonic	**DRILLING END:** 4/8/2009
LOGGER: A. Brewster (Northstar) and I. Wood	**WELL COMPLETION DATE:** 7/11/2009
GROUND SURFACE ELEVATION (NAVD 88): 575.92 ft AMSL	**GENERAL REMARKS:** 4-inch diameter, 3-port Guelph Water FLUTe™ multi-level system with helical screens installed into open 3.8-inch HQ borehole
NORTHING (CCS NAD 83 Z 5): 2100520.82 / **EASTING (CCS NAD 83 Z 5):** 7616939.51	



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As-Built Information

Job # 968-3

General:

Job Description:	258' 4"dia. 3 Port Water FLUTe
Customer:	CH2M Hill
Location:	155 Grand Ave. Suite 1000 Oakland, CA 94612
Well Designation:	MW-64BR
Hole Depth:	258'
Water Table:	120'
Drilling Method:	N/A
Casing Information:	N/A
Installation Method:	Water eversion
Bubbler / Tag:	120'

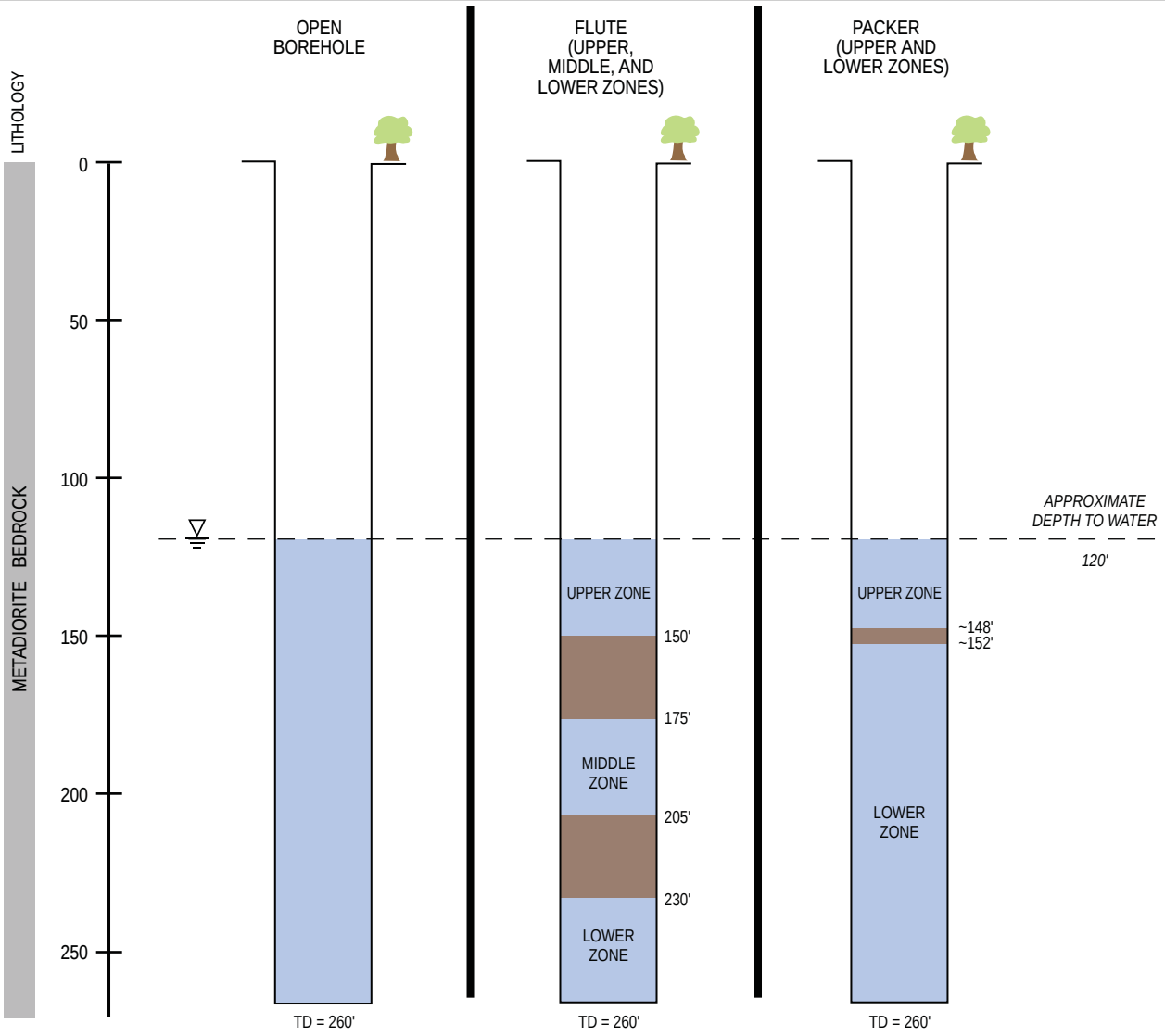
Liner:

Material:	210d Orange d/c 2 sleeve
Diameter:	4"
Material Above Casing:	3'
Uneverted Material:	4'
Rough Fabrication Legnth:	268'
Termination:	End Seal Knot
Knot Diameter Allowance:	2"
Markings on Liner:	Ink stamp indicating FLUTe TOC & FLUTe Job# 968-3
Spacer Design:	2 Material helix cut spacer Design (orange mesh) and Mylar

Spacer #	Spacer Bottom [ft]	Spacer Top [ft]
1	150'	120'
2	205'	175'
3	258'	230'

Tubing & Ports:							
Tubing In Bundle:			NYLON & PVDF				
Tubing In Sleeves:			NYLON & PVDF				
Bubbler Details:			1/4 NYLON				
Port Design:			Superthane feed thru				
Port Locations:			6" @ bottom of spacer				
Vent Design:			1/4 Superthane feed thru w/ 3/8 tygon tubing connected to duct				
Vent Location:			262'				
Pump Assembly:							
Port #:	**Transducer Serial #:**	**Transducer Pressure Rating [psi]:**	**Diaphragm Depth [ft. btoc]**	**Cable Serial #:**	**Cable Length [ft.]**	**Brass Elbow Depth [ft. btoc]**	**5/8" Tube Depth [ft. btoc]**
1	147349	100	218'	222554	228'	214'	199'
2	147219	100	219'	222555	228'	215'	200'
3	147347	100	220'	222556	228'	216'	201'

Other Info:	
Transducer Type:	Level Troll 500
Kellum Design:	2" & 1" webbing wrap
Kellum Locations:	1st kellum @ 18' btoc: others every 40 there after
Tether:	1/4"
Marking on Tubing:	Port #'s and color code
Marking on Cables:	Port #'S
Bundle Sheating:	Black Diagonal / Taped every 20' intervals
Marks on Bundle:	E.P. markings @ every 40'
Pump Tube:	268'
Reel / Packaging:	SF FLUTe
Casing Adapter Info:	ABQ FLUTe
Wellhead Info:	ABQ FLUTe
Vent Tube:	n/a
Clamps:	ABQ FLUTe
Shipped Via:	ABQ FLUTe
Other Notes:	



LEGEND

- Portion of borehole exposed during sample collection
- Portion of borehole sealed during sample collection

NOTES:
– Scale is approximate.
– All depths presented as feet below ground surface.

MW-64BR Sampling Configurations
PG&E Topock Compressor Station
Needles, California

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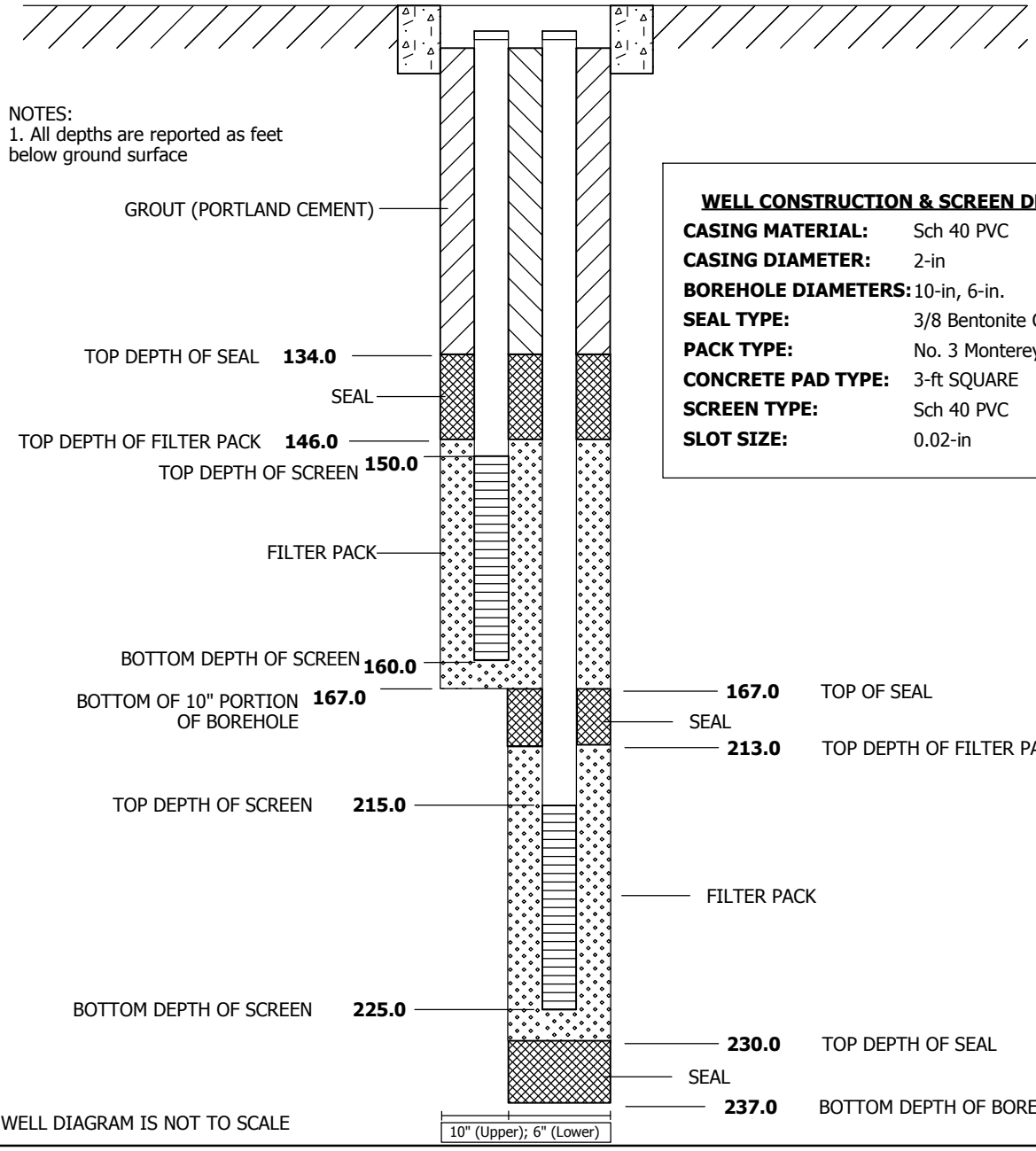
WELL COMPLETION DIAGRAM

PROJECT NO: 417981.ER.02.FW	**PROJECT:** ER-TCS Groundwater Investigation	**WELL NO:** ***MW-65-160*** ***MW-65-225***

LOCATION: Site 5

DRILLING CONTRACTOR: Boart Longyear (R. Sawrey)	**DRILLING START:** 3/17/2011
DRILLING METHOD: Rotosonic	**DRILLING END:** 4/4/2011
LOGGER: A. Brewster (Northstar)	**WELL COMPLETION DATE:** 4/7/2011
GROUND SURFACE ELEVATION (NAVD 88): 597.0 ft AMSL	**GENERAL REMARKS:** Centralizers at 5, 20, 35, 50, 65, 80, 95, 110, 125, 140, 165, 180, 195, and 210 ft bgs.
NORTHING (CCS NAD 83 Z 5): 2100547.44 / **EASTING (CCS NAD 83 Z 5):** 7614934.72	

12-in DIAMETER WELL VAULT (FLUSH WITH GRADE)



WELL CONSTRUCTION & SCREEN DETAILS

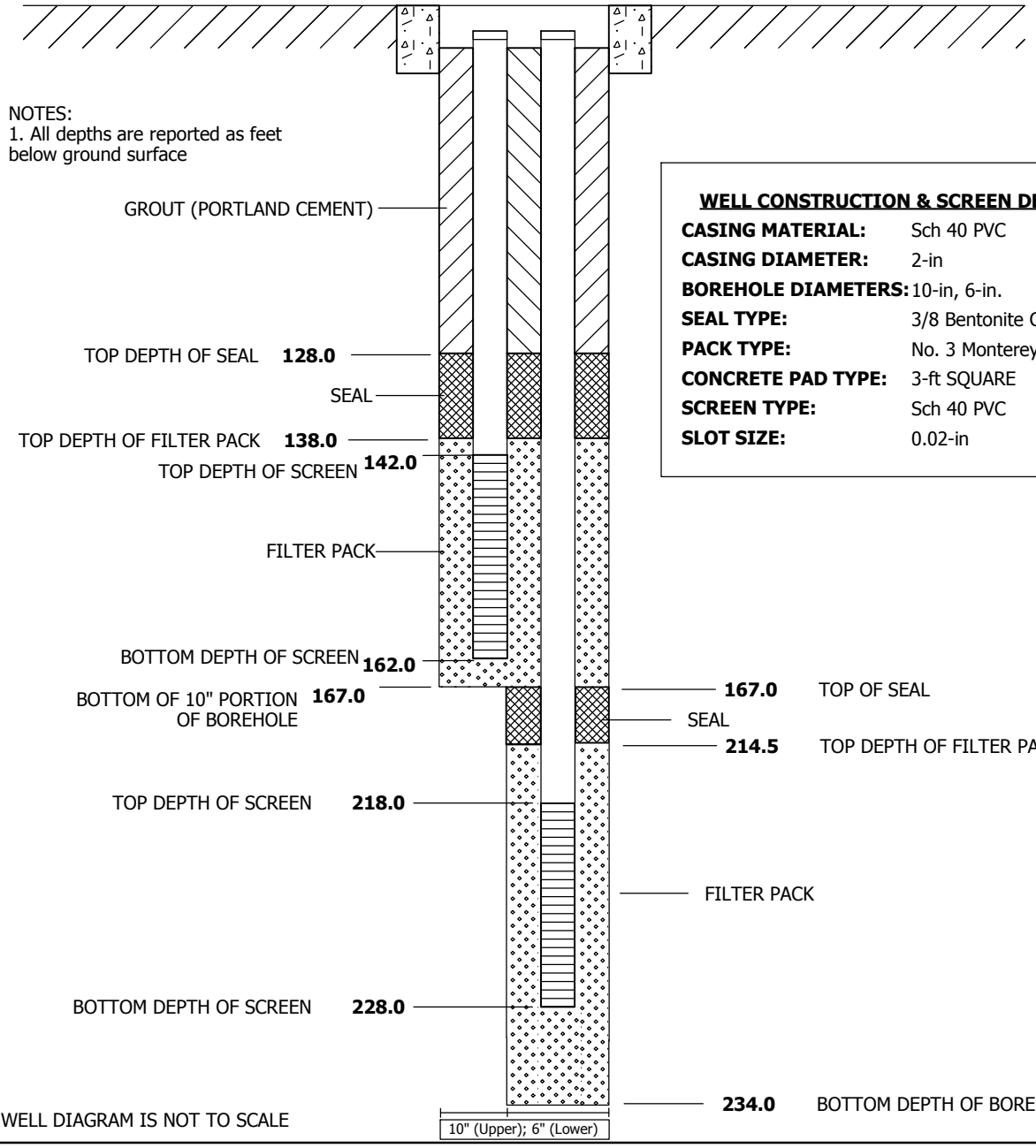
CASING MATERIAL:	Sch 40 PVC
CASING DIAMETER:	2-in
BOREHOLE DIAMETERS:	10-in, 6-in.
SEAL TYPE:	3/8 Bentonite Chips
PACK TYPE:	No. 3 Monterey Sand
CONCRETE PAD TYPE:	3-ft SQUARE
SCREEN TYPE:	Sch 40 PVC
SLOT SIZE:	0.02-in

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WELL COMPLETION DIAGRAM

PROJECT NO: 417981.ER.02.FW	**PROJECT:** ER-TCS Groundwater Investigation	**WELL NO:** ***MW-66-165*** ***MW-66-230***
LOCATION: Site 6		
DRILLING CONTRACTOR: Boart Longyear (R. Sawrey)		**DRILLING START:** 4/12/2011
DRILLING METHOD: Rotosonic		**DRILLING END:** 4/20/2011
LOGGER: A. Brewster (Northstar)		**WELL COMPLETION DATE:** 4/20/2011
GROUND SURFACE ELEVATION (NAVD 88): 586.6 ft AMSL		**GENERAL REMARKS:** Centralizers at 15, 30, 45, 60, 75, 90, 105, 120, 135, 165, and 215 ft bgs.
NORTHING (CCS NAD 83 Z 5): 2100957.66	**EASTING (CCS NAD 83 Z 5):** 7615153.76	

12-in DIAMETER WELL VAULT (FLUSH WITH GRADE)



WELL CONSTRUCTION & SCREEN DETAILS

CASING MATERIAL:	Sch 40 PVC
CASING DIAMETER:	2-in
BOREHOLE DIAMETERS:	10-in, 6-in.
SEAL TYPE:	3/8 Bentonite Chips
PACK TYPE:	No. 3 Monterey Sand
CONCRETE PAD TYPE:	3-ft SQUARE
SCREEN TYPE:	Sch 40 PVC
SLOT SIZE:	0.02-in

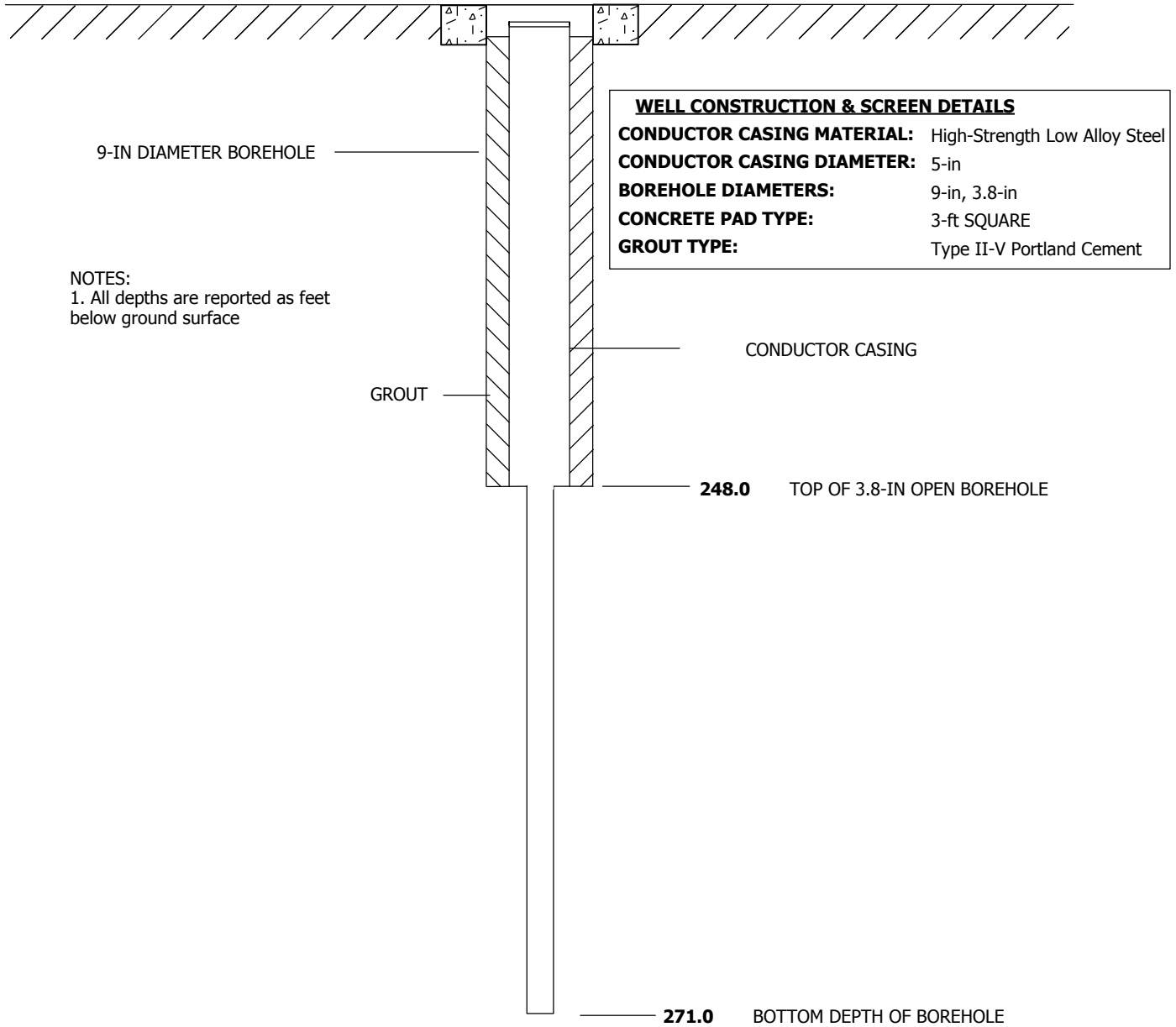
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WELL COMPLETION DIAGRAM

PROJECT NO: 417981.ER.02.FW	**PROJECT:** ER-TCS Groundwater Investigation	**WELL NO:** ***MW-66BR-270***
LOCATION: Site 6		

DRILLING CONTRACTOR: Boart Longyear (R. Sawrey)	**DRILLING START:** 8/30/2011
DRILLING METHOD: Rotosonic/Wireline Rotary Core	**DRILLING END:** 9/11/2011
LOGGER: A. Brewster (Northstar)	**WELL COMPLETION DATE:** 9/11/2011
GROUND SURFACE ELEVATION (NAVD 88): 586.5 ft AMSL	**GENERAL REMARKS:** Open 3.8" diameter borehole from 248 to 271 feet bgs. Centralizers at 50, 100, 150, 200, and 248 ft bgs.
NORTHING (CCS NAD 83 Z 5): 2100950.25 / **EASTING (CCS NAD 83 Z 5):** 7615153.99	

SQUARE WELL VAULT (FLUSH WITH GRADE)



WELL CONSTRUCTION & SCREEN DETAILS

CONDUCTOR CASING MATERIAL:	High-Strength Low Alloy Steel
CONDUCTOR CASING DIAMETER:	5-in
BOREHOLE DIAMETERS:	9-in, 3.8-in
CONCRETE PAD TYPE:	3-ft SQUARE
GROUT TYPE:	Type II-V Portland Cement

NOTES:
1. All depths are reported as feet below ground surface

WELL DIAGRAM IS NOT TO SCALE

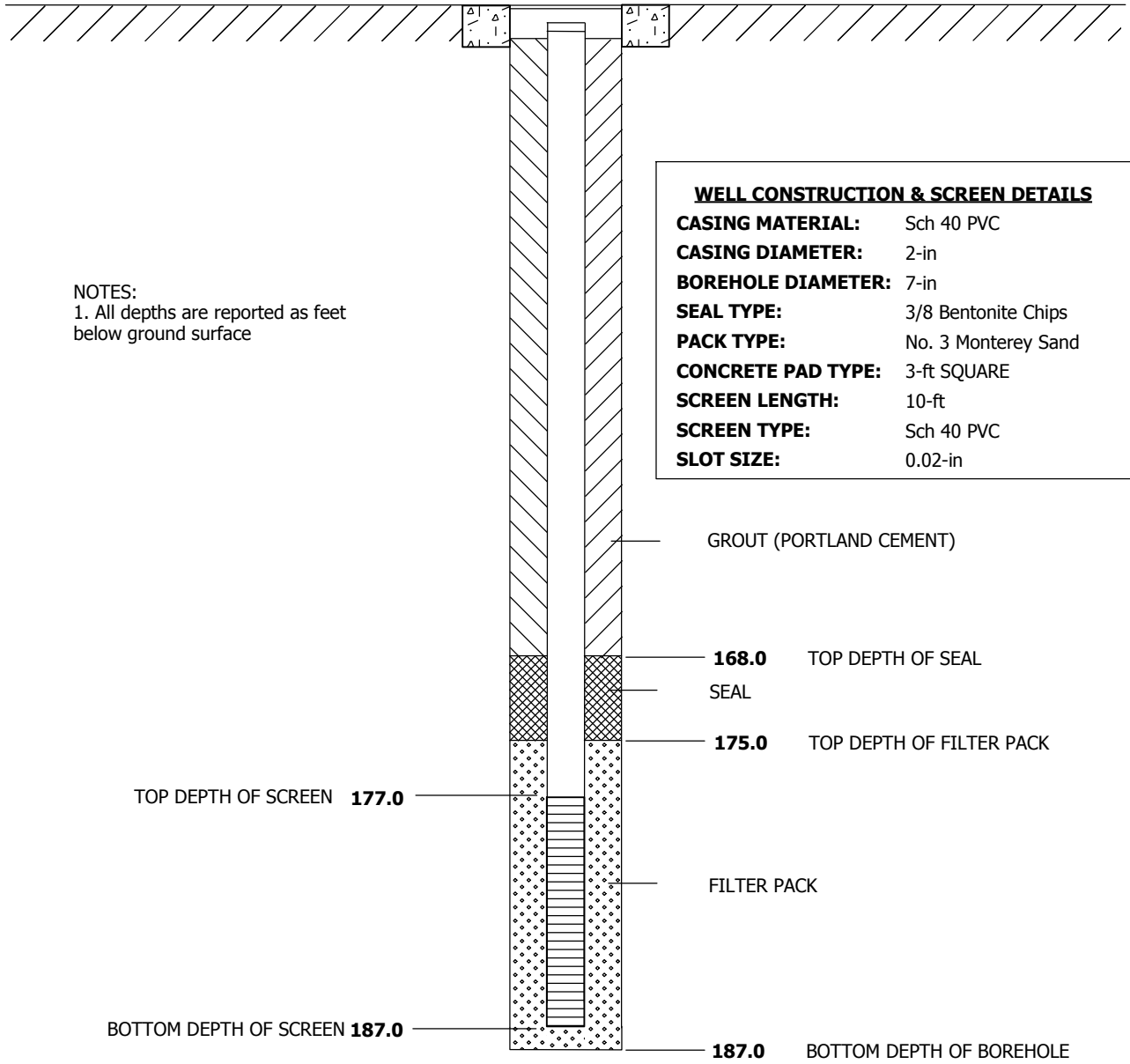
CH2MHILL

WELL COMPLETION DIAGRAM

PROJECT NO: 417981.ER.02.FW	**PROJECT:** ER-TCS Groundwater Investigation	**WELL NO:** ***MW-67-185***
LOCATION: Site 2		

DRILLING CONTRACTOR: Boart Longyear (R. Sawrey)	**DRILLING START:** 9/22/2011
DRILLING METHOD: Rotosonic/Wireline Rotary Core	**DRILLING END:** 9/23/2011
LOGGER: A. Brewster (Northstar)	**WELL COMPLETION DATE:** 9/23/2011
GROUND SURFACE ELEVATION (NAVD 88): 626.2 ft AMSL	**GENERAL REMARKS:** Centralizers at 15, 35, 55, 75, 95, 115, 135, and 155 ft bgs.
NORTHING (CCS NAD 83 Z 5): 2101040.21 / **EASTING (CCS NAD 83 Z 5):** 7615335.52	

12-IN DIAMETER WELL VAULT (FLUSH WITH GRADE)



WELL CONSTRUCTION & SCREEN DETAILS

CASING MATERIAL:	Sch 40 PVC
CASING DIAMETER:	2-in
BOREHOLE DIAMETER:	7-in
SEAL TYPE:	3/8 Bentonite Chips
PACK TYPE:	No. 3 Monterey Sand
CONCRETE PAD TYPE:	3-ft SQUARE
SCREEN LENGTH:	10-ft
SCREEN TYPE:	Sch 40 PVC
SLOT SIZE:	0.02-in

NOTES:
1. All depths are reported as feet below ground surface

WELL DIAGRAM IS NOT TO SCALE

CH2MHILL

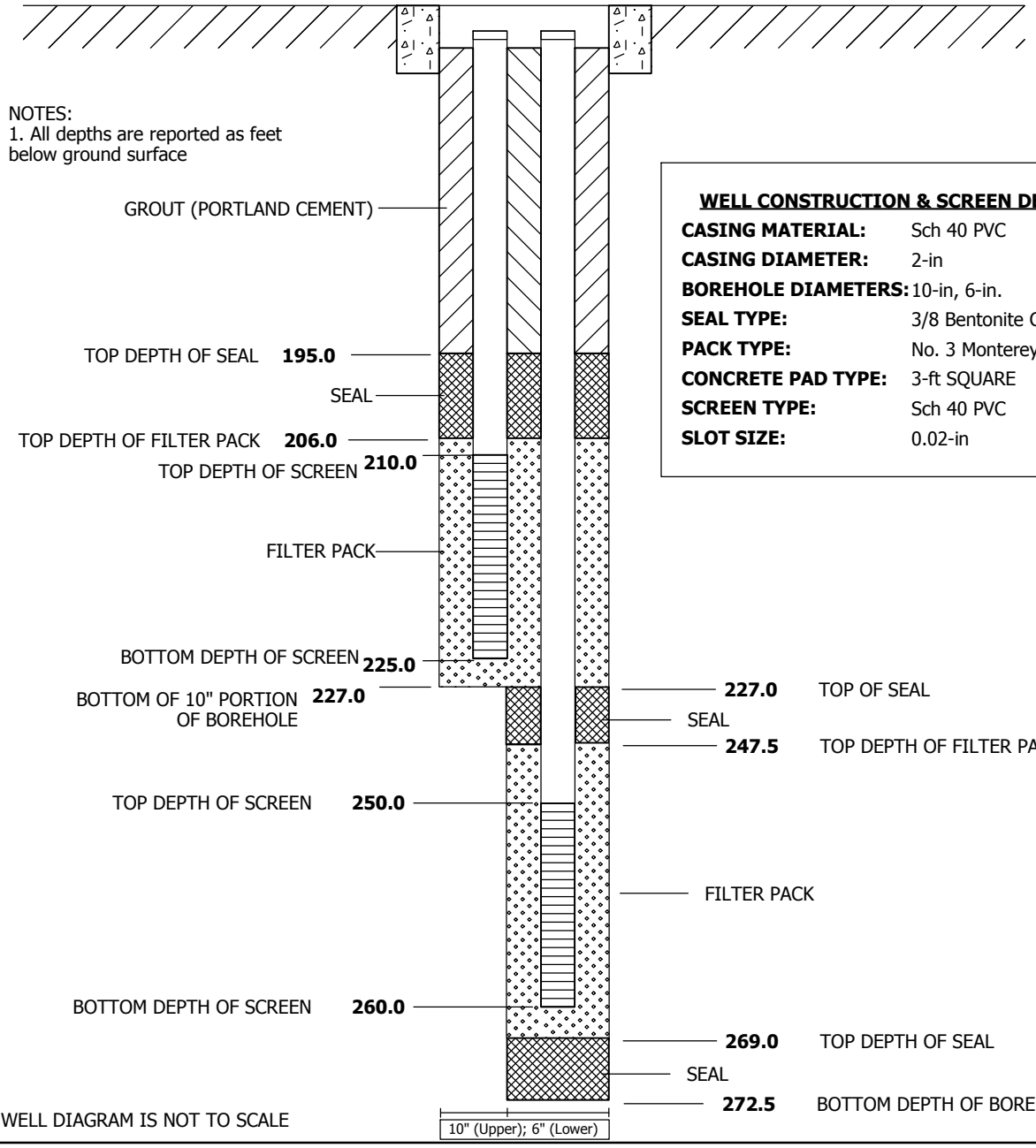
WELL COMPLETION DIAGRAM

PROJECT NO: 417981.ER.02.FW	**PROJECT:** ER-TCS Groundwater Investigation	**WELL NO:** ***MW-67-225*** ***MW-67-260***

LOCATION: Site 2

DRILLING CONTRACTOR: Boart Longyear (R. Sawrey)	**DRILLING START:** 4/29/2011
DRILLING METHOD: Rotosonic	**DRILLING END:** 5/2/2011
LOGGER: A. Brewster (Northstar)	**WELL COMPLETION DATE:** 5/10/2011
GROUND SURFACE ELEVATION (NAVD 88): 626.3 ft AMSL	**GENERAL REMARKS:** Centralizers at 10, 25, 40, 55, 70, 85, 100, 115, 130, 145, 160, 175, 190, 205, and 245ft bgs.
NORTHING (CCS NAD 83 Z 5): 2101047.85 / **EASTING (CCS NAD 83 Z 5):** 7615332.58	

12-in DIAMETER WELL VAULT (FLUSH WITH GRADE)



WELL CONSTRUCTION & SCREEN DETAILS

CASING MATERIAL:	Sch 40 PVC
CASING DIAMETER:	2-in
BOREHOLE DIAMETERS:	10-in, 6-in.
SEAL TYPE:	3/8 Bentonite Chips
PACK TYPE:	No. 3 Monterey Sand
CONCRETE PAD TYPE:	3-ft SQUARE
SCREEN TYPE:	Sch 40 PVC
SLOT SIZE:	0.02-in

CH2MHILL

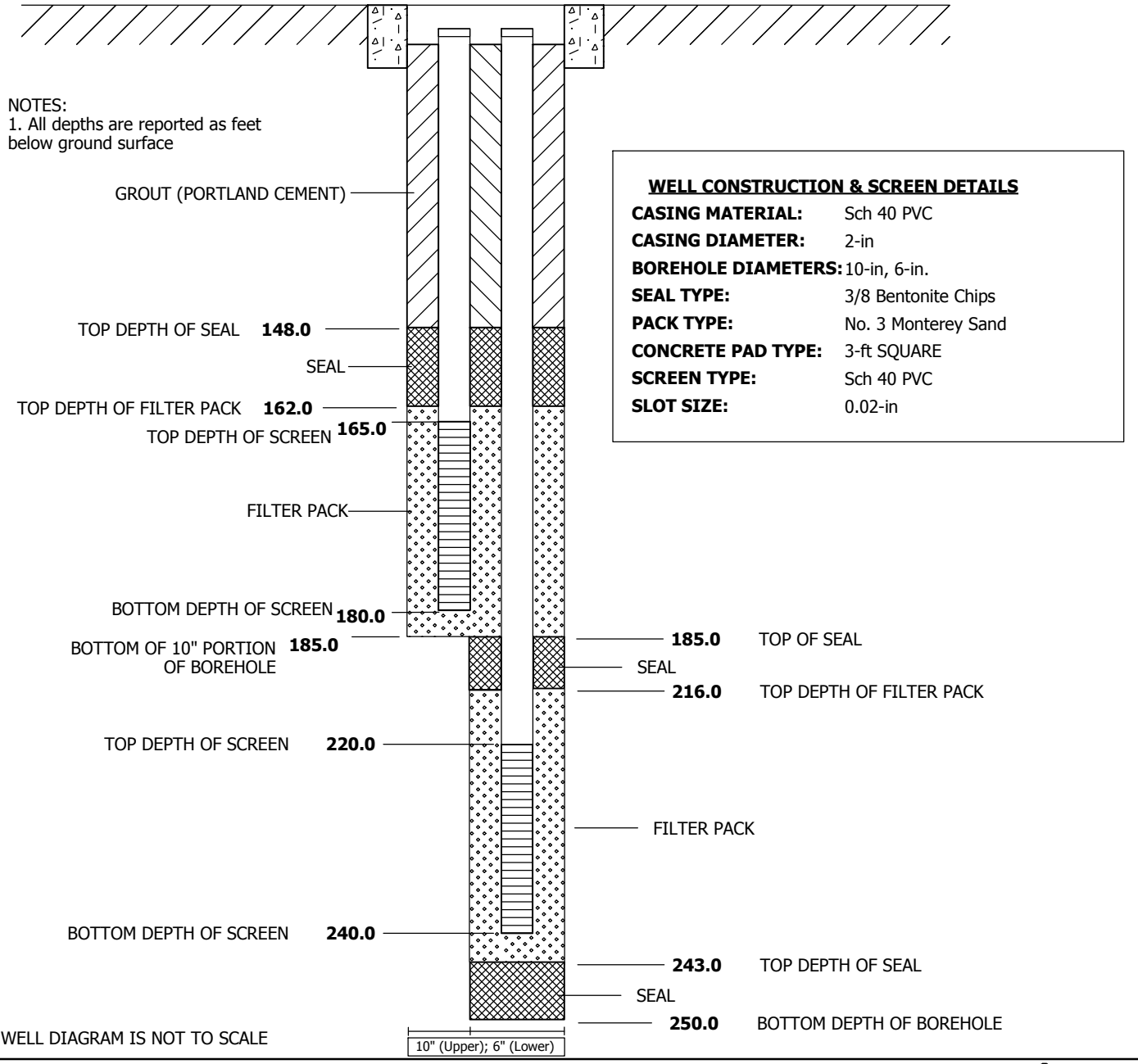
WELL COMPLETION DIAGRAM

PROJECT NO: 417981.ER.02.FW	**PROJECT:** ER-TCS Groundwater Investigation	**WELL NO:** ***MW-68-180*** ***MW-68-240***

LOCATION: Site 3

DRILLING CONTRACTOR: Boart Longyear (R. Sawrey)	**DRILLING START:** 5/13/2011
DRILLING METHOD: Rotosonic	**DRILLING END:** 5/16/2011
LOGGER: A. Brewster (Northstar)	**WELL COMPLETION DATE:** 5/18/2011
GROUND SURFACE ELEVATION (NAVD 88): 621.6 ft AMSL	**GENERAL REMARKS:** Centralizers at 10, 25, 40, 55, 70, 85, 100, 115, 130, 145, 160, and 215 ft bgs.
NORTHING (CCS NAD 83 Z 5): 2100773.64 / **EASTING (CCS NAD 83 Z 5):** 7615453.36	

12-in DIAMETER WELL VAULT (FLUSH WITH GRADE)



WELL CONSTRUCTION & SCREEN DETAILS

CASING MATERIAL:	Sch 40 PVC
CASING DIAMETER:	2-in
BOREHOLE DIAMETERS:	10-in, 6-in.
SEAL TYPE:	3/8 Bentonite Chips
PACK TYPE:	No. 3 Monterey Sand
CONCRETE PAD TYPE:	3-ft SQUARE
SCREEN TYPE:	Sch 40 PVC
SLOT SIZE:	0.02-in

CH2MHILL

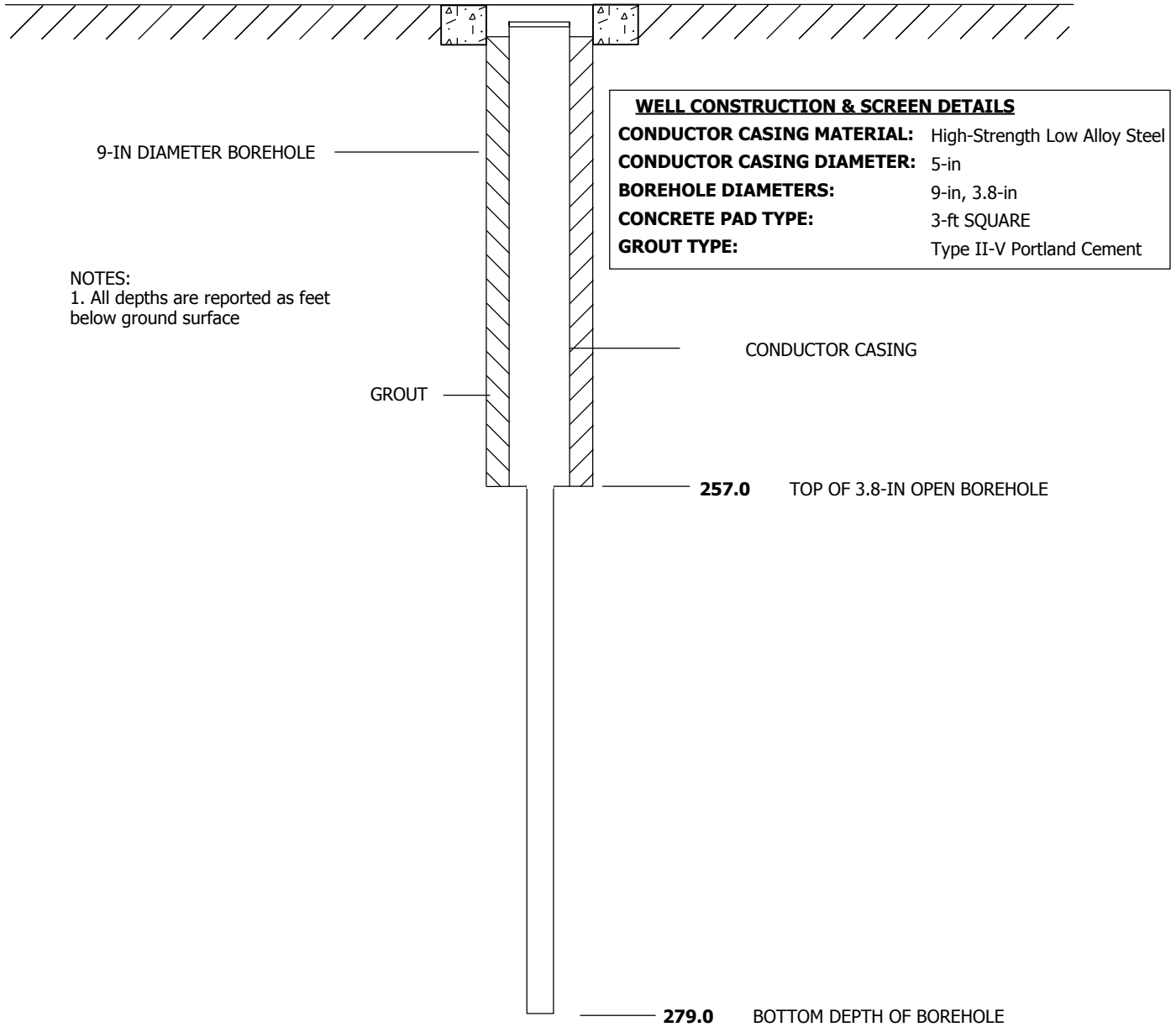
WELL COMPLETION DIAGRAM

PROJECT NO: 417981.ER.02.FW	**PROJECT:** ER-TCS Groundwater Investigation	**WELL NO:** ***MW-68BR-280***

LOCATION: Site 3

DRILLING CONTRACTOR: Boart Longyear (R. Sawrey)	**DRILLING START:** 8/3/2011
DRILLING METHOD: Rotosonic/Wireline Rotary Core	**DRILLING END:** 8/11/2011
LOGGER: R. Tweidt (Northstar)	**WELL COMPLETION DATE:** 8/11/2011
GROUND SURFACE ELEVATION (NAVD 88): 621.4 ft AMSL	**GENERAL REMARKS:** Open 3.8" diameter borehole from 257 to 279 feet bgs. Centralizers at 50, 100, 150, 200, and 250 ft bgs.
NORTHING (CCS NAD 83 Z 5): 2100767.09 / **EASTING (CCS NAD 83 Z 5):** 7615453.92	

SQUARE WELL VAULT (FLUSH WITH GRADE)



WELL CONSTRUCTION & SCREEN DETAILS

CONDUCTOR CASING MATERIAL:	High-Strength Low Alloy Steel
CONDUCTOR CASING DIAMETER:	5-in
BOREHOLE DIAMETERS:	9-in, 3.8-in
CONCRETE PAD TYPE:	3-ft SQUARE
GROUT TYPE:	Type II-V Portland Cement

NOTES:
1. All depths are reported as feet below ground surface

WELL DIAGRAM IS NOT TO SCALE

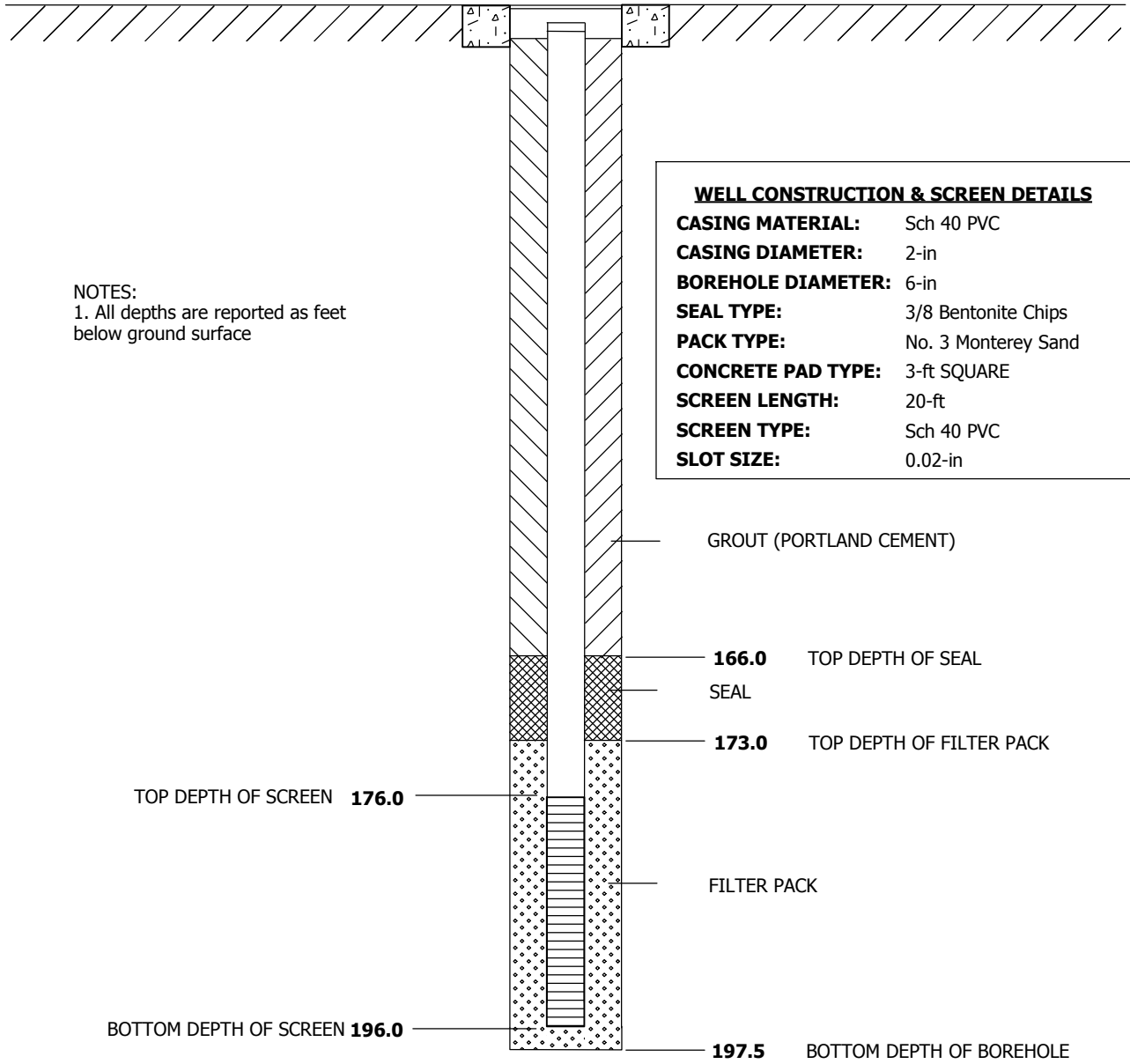
CH2MHILL

WELL COMPLETION DIAGRAM

PROJECT NO: 417981.ER.02.FW	**PROJECT:** ER-TCS Groundwater Investigation	**WELL NO:** ***MW-69-195***
LOCATION: Site 4		

DRILLING CONTRACTOR: Boart Longyear (R. Sawrey)	**DRILLING START:** 5/30/2011
DRILLING METHOD: Rotosonic/Wireline Rotary Core	**DRILLING END:** 6/22/2011
LOGGER: A. Brewster (Northstar)	**WELL COMPLETION DATE:** 6/22/2011
GROUND SURFACE ELEVATION (NAVD 88): 632.1 ft AMSL	**GENERAL REMARKS:** Centralizers at 22, 35, 55, 75, 95, 115, 135, 155, and 175 feet bgs.
NORTHING (CCS NAD 83 Z 5): 2100291.55 / **EASTING (CCS NAD 83 Z 5):** 7615142.96	

12-IN DIAMETER WELL VAULT (FLUSH WITH GRADE)



NOTES:
1. All depths are reported as feet below ground surface

WELL CONSTRUCTION & SCREEN DETAILS

CASING MATERIAL:	Sch 40 PVC
CASING DIAMETER:	2-in
BOREHOLE DIAMETER:	6-in
SEAL TYPE:	3/8 Bentonite Chips
PACK TYPE:	No. 3 Monterey Sand
CONCRETE PAD TYPE:	3-ft SQUARE
SCREEN LENGTH:	20-ft
SCREEN TYPE:	Sch 40 PVC
SLOT SIZE:	0.02-in

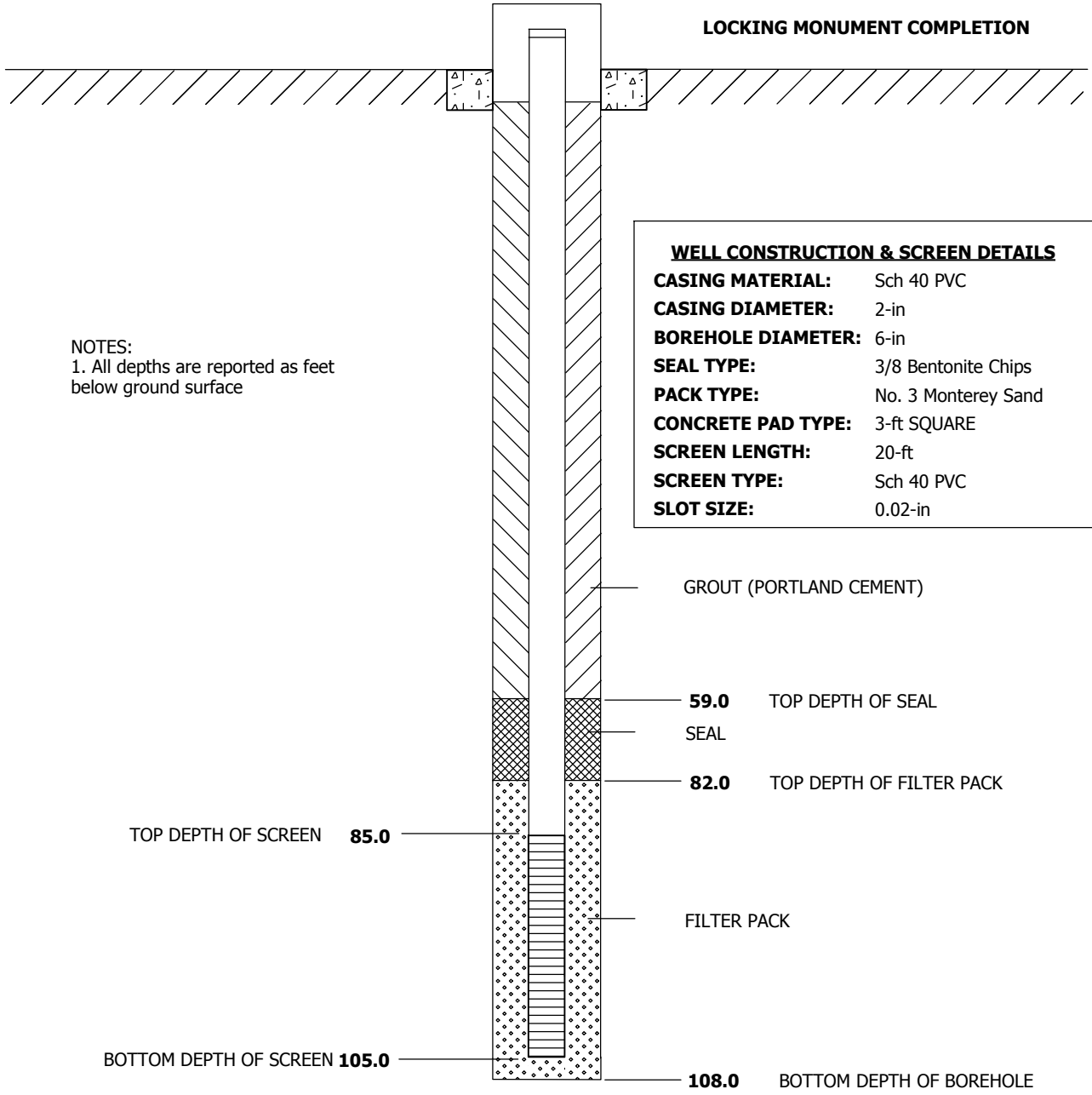
WELL DIAGRAM IS NOT TO SCALE

CH2MHILL

WELL COMPLETION DIAGRAM

PROJECT NO: 417981.ER.02.FW	**PROJECT:** ER-TCS Groundwater Investigation	**WELL NO:** ***MW-70-105***
LOCATION: Site H		

DRILLING CONTRACTOR: Boart Longyear (R. Sawrey)	**DRILLING START:** 5/24/2011
DRILLING METHOD: Rotosonic/Wireline Rotary Core	**DRILLING END:** 5/29/2011
LOGGER: A. Brewster (Northstar)	**WELL COMPLETION DATE:** 5/29/2011
GROUND SURFACE ELEVATION (NAVD 88): 538.9 ft AMSL	**GENERAL REMARKS:** Centralizers at 20, 40, 60, and 80 feet bgs.
NORTHING (CCS NAD 83 Z 5): 2100513.91 / **EASTING (CCS NAD 83 Z 5):** 7615825.97	



WELL CONSTRUCTION & SCREEN DETAILS

CASING MATERIAL:	Sch 40 PVC
CASING DIAMETER:	2-in
BOREHOLE DIAMETER:	6-in
SEAL TYPE:	3/8 Bentonite Chips
PACK TYPE:	No. 3 Monterey Sand
CONCRETE PAD TYPE:	3-ft SQUARE
SCREEN LENGTH:	20-ft
SCREEN TYPE:	Sch 40 PVC
SLOT SIZE:	0.02-in

NOTES:
1. All depths are reported as feet below ground surface

WELL DIAGRAM IS NOT TO SCALE

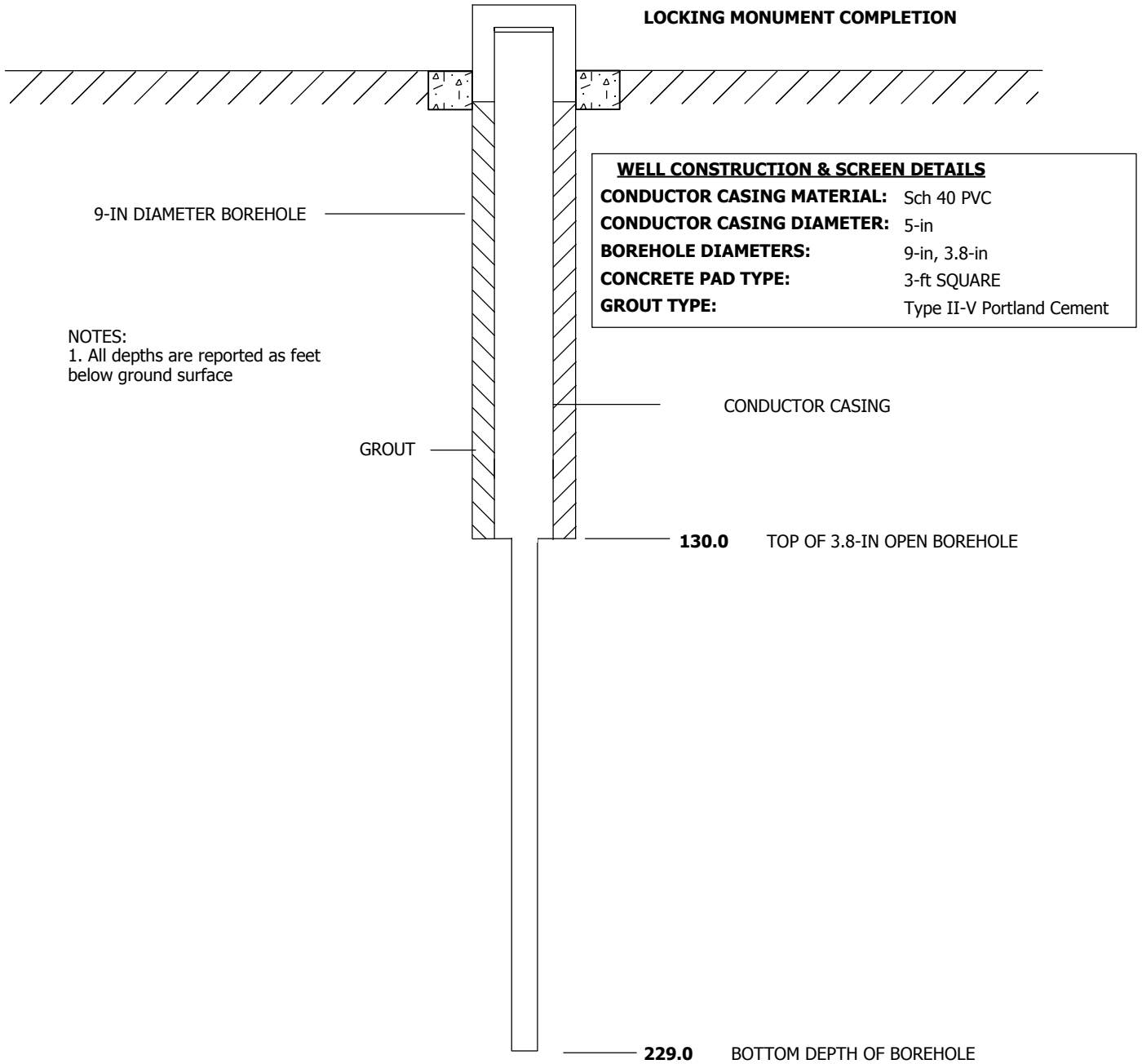
CH2MHILL

WELL COMPLETION DIAGRAM

PROJECT NO: 417981.ER.02.FW	**PROJECT:** ER-TCS Groundwater Investigation	**WELL NO:** ***MW-70BR-225***

LOCATION: Site H

DRILLING CONTRACTOR: Boart Longyear (B. Bradford)	**DRILLING START:** 10/13/2011
DRILLING METHOD: Rotosonic/Wireline Rotary Core	**DRILLING END:** 10/22/2011
LOGGER: A. Brewster (Northstar)	**WELL COMPLETION DATE:** 10/22/2011
GROUND SURFACE ELEVATION (NAVD 88): 537.6 ft AMSL	**GENERAL REMARKS:** Open 3.8" diameter borehole from 130 to 227 feet bgs. Centralizers at 50, 100, and 130 ft bgs.
NORTHING (CCS NAD 83 Z 5): 2100513.04 / **EASTING (CCS NAD 83 Z 5):** 7615840.08	



WELL CONSTRUCTION & SCREEN DETAILS

CONDUCTOR CASING MATERIAL:	Sch 40 PVC
CONDUCTOR CASING DIAMETER:	5-in
BOREHOLE DIAMETERS:	9-in, 3.8-in
CONCRETE PAD TYPE:	3-ft SQUARE
GROUT TYPE:	Type II-V Portland Cement

NOTES:
1. All depths are reported as feet below ground surface

WELL DIAGRAM IS NOT TO SCALE

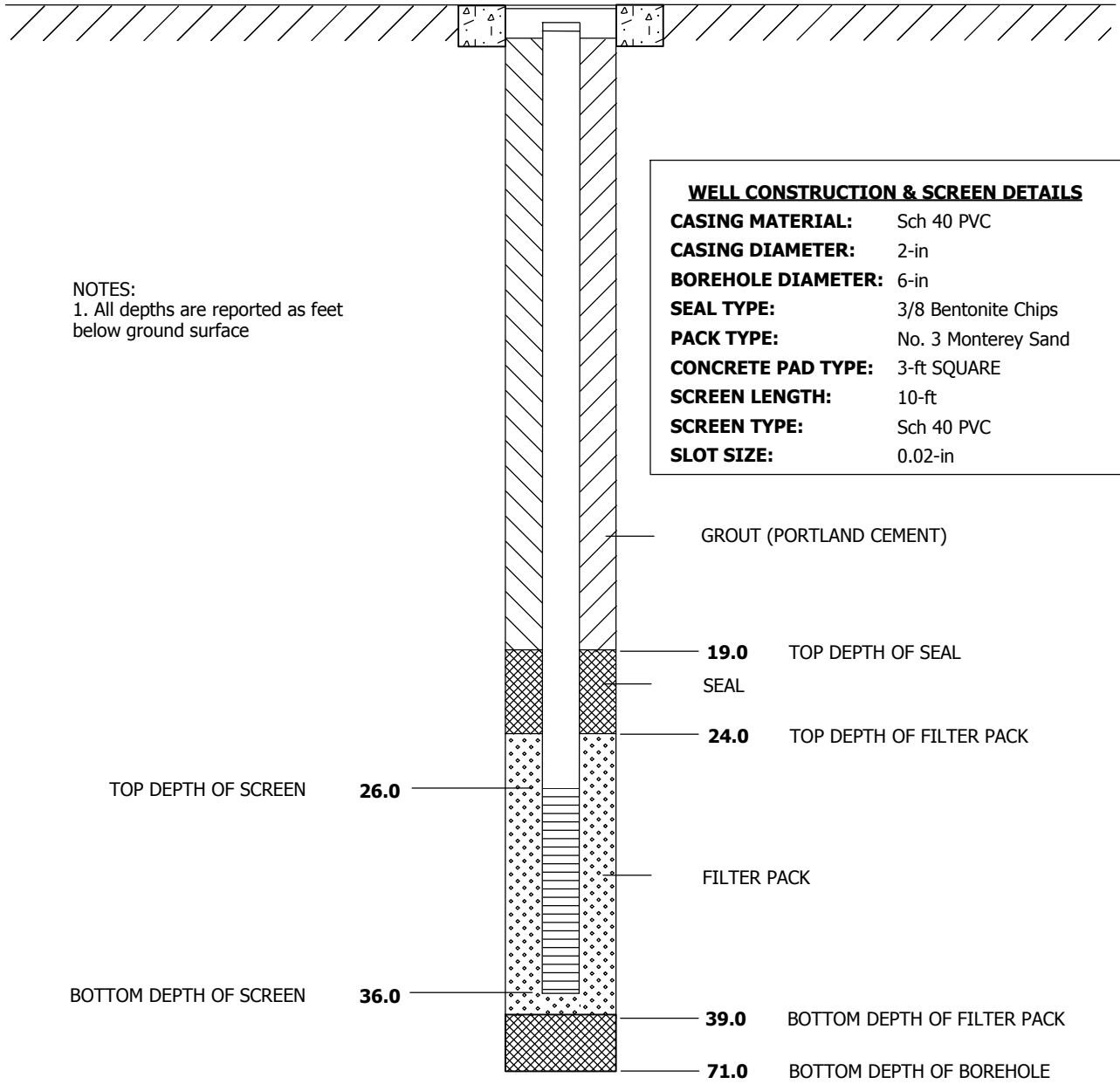
CH2MHILL

WELL COMPLETION DIAGRAM

PROJECT NO: 417981.ER.02.FW	**PROJECT:** ER-TCS Groundwater Investigation	**WELL NO:** ***MW-71-35***
LOCATION: Site L		

DRILLING CONTRACTOR: Boart Longyear (R. Sawrey)	**DRILLING START:** 9/12/2011
DRILLING METHOD: Rotosonic/Wireline Rotary Core	**DRILLING END:** 9/14/2011
LOGGER: A. Brewster (Northstar)	**WELL COMPLETION DATE:** 9/14/2011
GROUND SURFACE ELEVATION (NAVD 88): 484.0 ft AMSL	**GENERAL REMARKS:** Centralizers at15 feet bgs. HQ rock core hole 39 to 71 feet bgs backfilled with bentonite chips.
NORTHING (CCS NAD 83 Z 5): 2101338.43 / **EASTING (CCS NAD 83 Z 5):** 7616207.60	

12-IN DIAMETER WELL VAULT (FLUSH WITH GRADE)



WELL CONSTRUCTION & SCREEN DETAILS

CASING MATERIAL:	Sch 40 PVC
CASING DIAMETER:	2-in
BOREHOLE DIAMETER:	6-in
SEAL TYPE:	3/8 Bentonite Chips
PACK TYPE:	No. 3 Monterey Sand
CONCRETE PAD TYPE:	3-ft SQUARE
SCREEN LENGTH:	10-ft
SCREEN TYPE:	Sch 40 PVC
SLOT SIZE:	0.02-in

NOTES:
1. All depths are reported as feet below ground surface

WELL DIAGRAM IS NOT TO SCALE

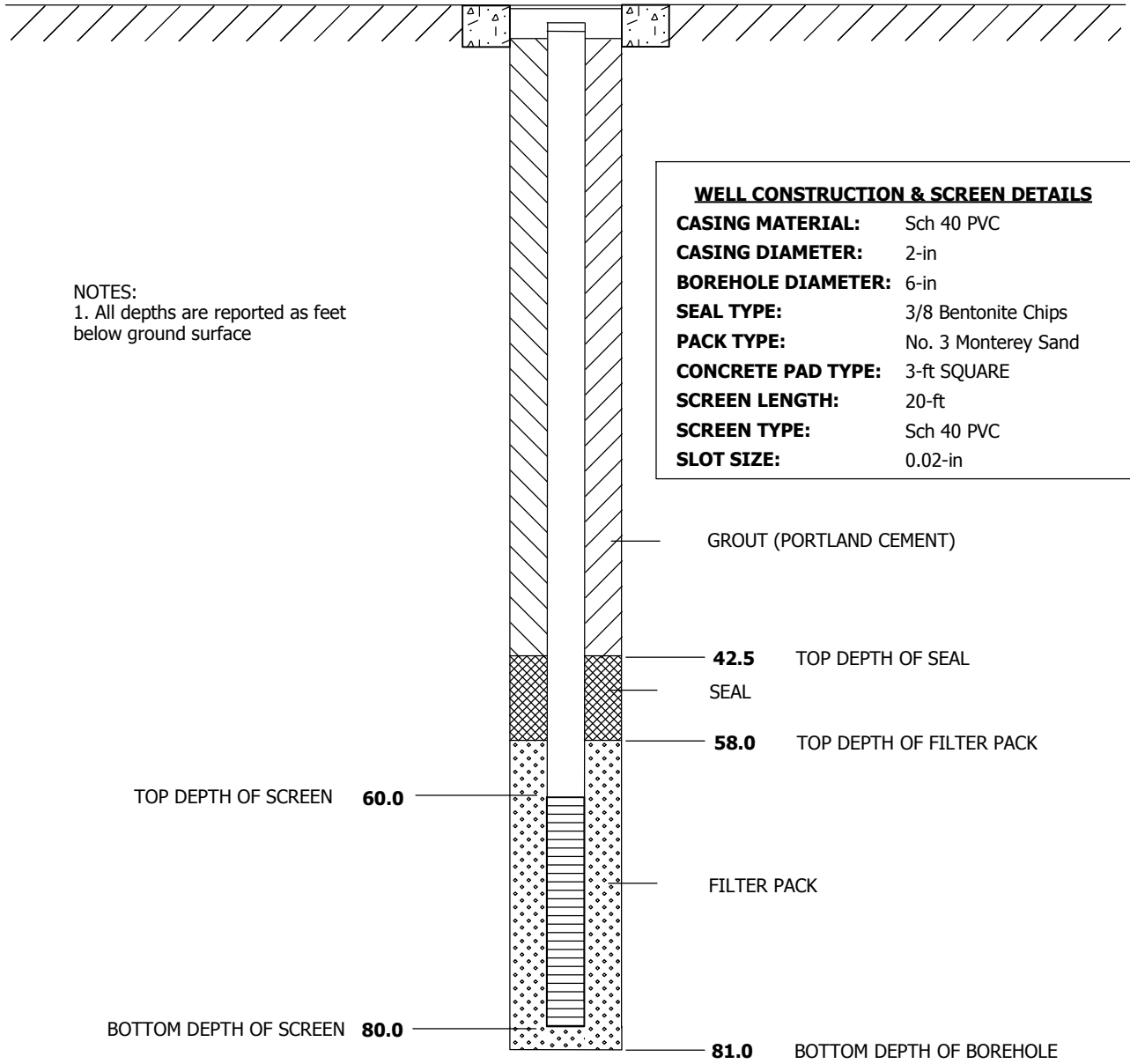
CH2MHILL

WELL COMPLETION DIAGRAM

PROJECT NO: 417981.ER.02.FW	**PROJECT:** ER-TCS Groundwater Investigation	**WELL NO:** ***MW-72-80***
LOCATION: Site K		

DRILLING CONTRACTOR: Boart Longyear (R. Sawrey)	**DRILLING START:** 8/20/2011
DRILLING METHOD: Rotosonic/Wireline Rotary Core	**DRILLING END:** 8/29/2011
LOGGER: A. Brewster (Northstar)	**WELL COMPLETION DATE:** 8/29/2011
GROUND SURFACE ELEVATION (NAVD 88): 513.5 ft AMSL	**GENERAL REMARKS:** Centralizers at 15, 35, and 55 feet bgs.
NORTHING (CCS NAD 83 Z 5): 2100674.44 / **EASTING (CCS NAD 83 Z 5):** 7617083.44	

12-IN DIAMETER WELL VAULT (FLUSH WITH GRADE)



WELL CONSTRUCTION & SCREEN DETAILS

CASING MATERIAL:	Sch 40 PVC
CASING DIAMETER:	2-in
BOREHOLE DIAMETER:	6-in
SEAL TYPE:	3/8 Bentonite Chips
PACK TYPE:	No. 3 Monterey Sand
CONCRETE PAD TYPE:	3-ft SQUARE
SCREEN LENGTH:	20-ft
SCREEN TYPE:	Sch 40 PVC
SLOT SIZE:	0.02-in

NOTES:
1. All depths are reported as feet below ground surface

WELL DIAGRAM IS NOT TO SCALE

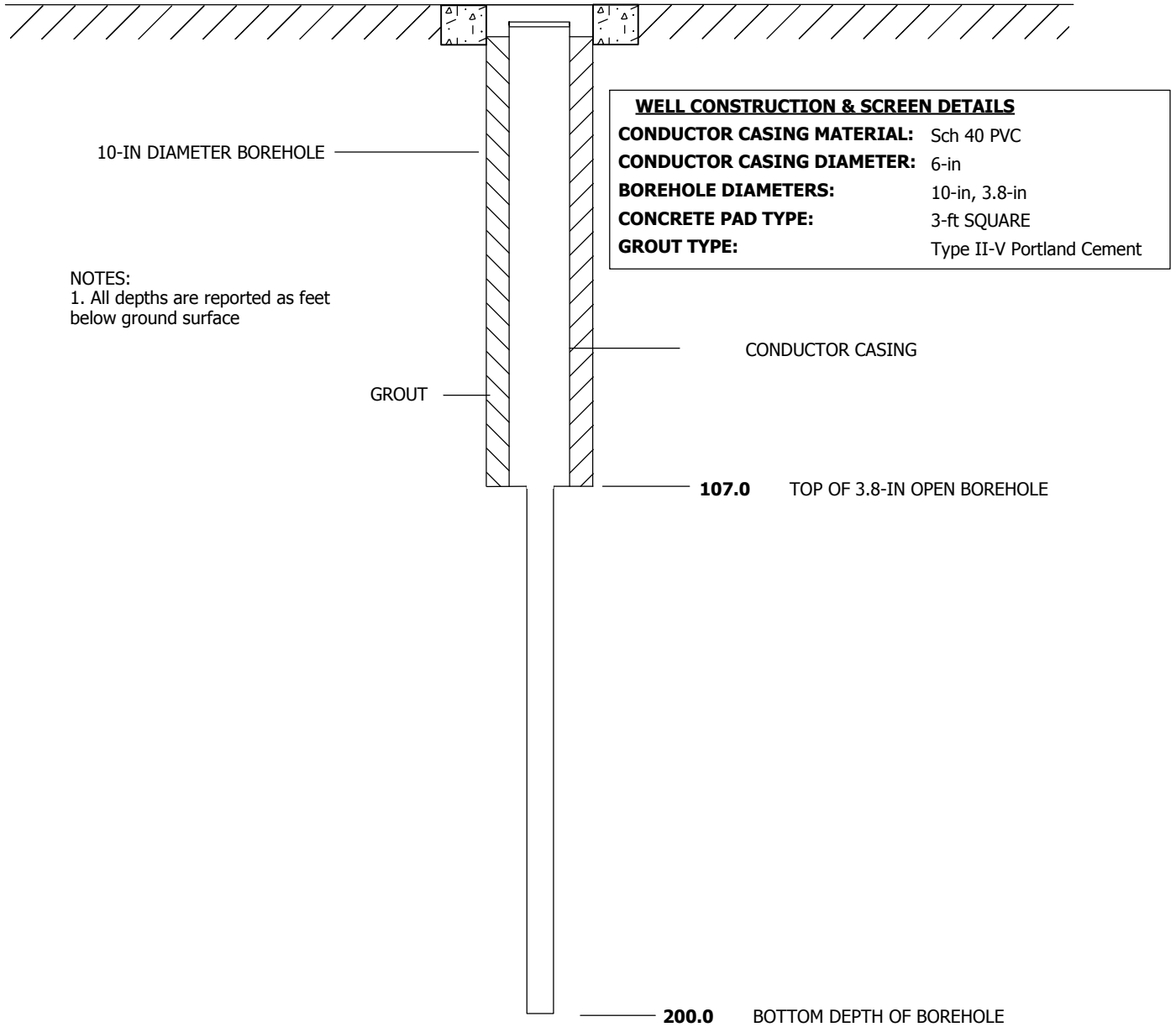
CH2MHILL

WELL COMPLETION DIAGRAM

PROJECT NO: 417981.ER.02.FW	**PROJECT:** ER-TCS Groundwater Investigation	**WELL NO:** ***MW-72BR-200***
LOCATION: Site K		

DRILLING CONTRACTOR: Boart Longyear (B. Bradford)	**DRILLING START:** 6/20/2012
DRILLING METHOD: Rotosonic/Wireline Rotary Core	**DRILLING END:** 6/27/2012
LOGGER: A. Brewster (Northstar)	**WELL COMPLETION DATE:** 6/27/2012
GROUND SURFACE ELEVATION (NAVD 88): 513.5 ft AMSL (Approx.)	**GENERAL REMARKS:** Open 3.8" diameter borehole from 107 to 200 feet bgs. Location survey for this well is not complete. Located approximately 15 feet west of MW-72-80.
NORTHING (CCS NAD 83 Z 5): --- / **EASTING (CCS NAD 83 Z 5):** ---	

12-in DIAMETER WELL VAULT (FLUSH WITH GRADE)



WELL CONSTRUCTION & SCREEN DETAILS

CONDUCTOR CASING MATERIAL:	Sch 40 PVC
CONDUCTOR CASING DIAMETER:	6-in
BOREHOLE DIAMETERS:	10-in, 3.8-in
CONCRETE PAD TYPE:	3-ft SQUARE
GROUT TYPE:	Type II-V Portland Cement

NOTES:
1. All depths are reported as feet below ground surface

WELL DIAGRAM IS NOT TO SCALE

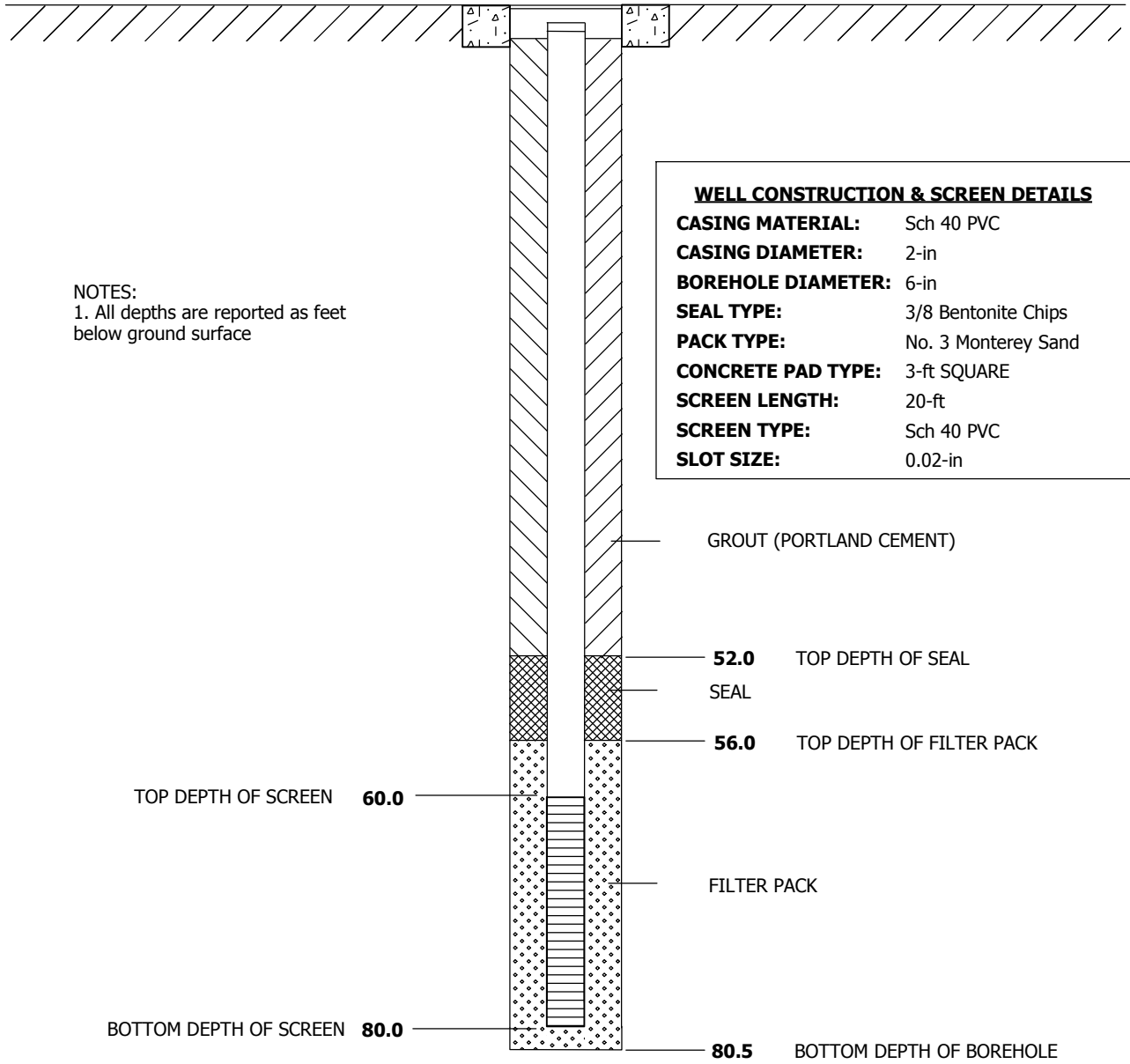
CH2MHILL

WELL COMPLETION DIAGRAM

PROJECT NO: 417981.ER.02.FW	**PROJECT:** ER-TCS Groundwater Investigation	**WELL NO:** ***MW-73-80***
LOCATION: Site I		

DRILLING CONTRACTOR: Boart Longyear (R. Sawrey)	**DRILLING START:** 9/24/2011
DRILLING METHOD: Rotosonic/Wireline Rotary Core	**DRILLING END:** 9/28/2011
LOGGER: A. Brewster (Northstar)	**WELL COMPLETION DATE:** 9/29/2011
GROUND SURFACE ELEVATION (NAVD 88): 506.3 ft AMSL	**GENERAL REMARKS:** Centralizers at 20, 40, and 60 feet bgs.
NORTHING (CCS NAD 83 Z 5): 2100676.49 / **EASTING (CCS NAD 83 Z 5):** 7617554.90	

12-IN DIAMETER WELL VAULT (FLUSH WITH GRADE)



WELL CONSTRUCTION & SCREEN DETAILS

CASING MATERIAL:	Sch 40 PVC
CASING DIAMETER:	2-in
BOREHOLE DIAMETER:	6-in
SEAL TYPE:	3/8 Bentonite Chips
PACK TYPE:	No. 3 Monterey Sand
CONCRETE PAD TYPE:	3-ft SQUARE
SCREEN LENGTH:	20-ft
SCREEN TYPE:	Sch 40 PVC
SLOT SIZE:	0.02-in

NOTES:
1. All depths are reported as feet below ground surface

WELL DIAGRAM IS NOT TO SCALE

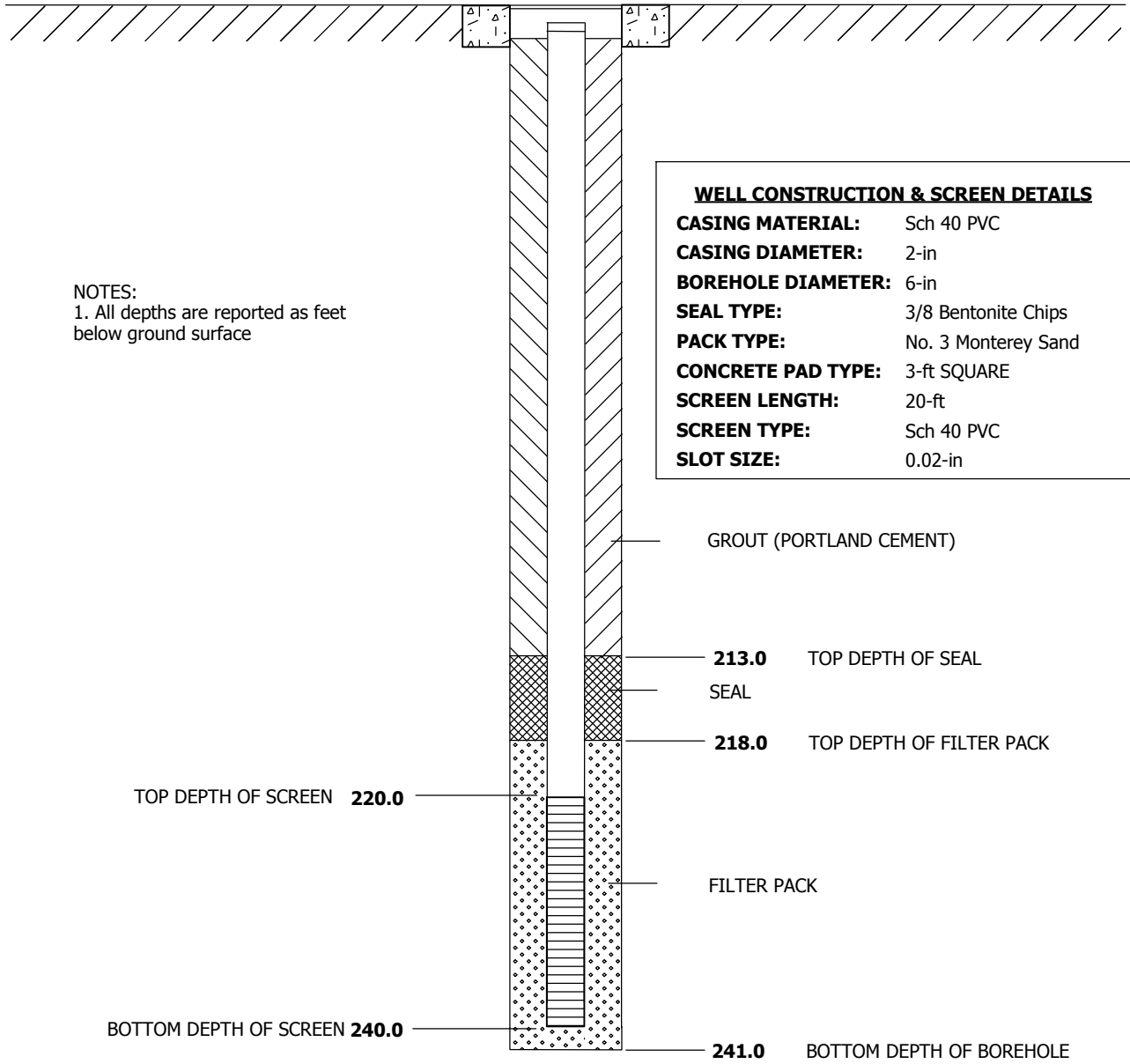
CH2MHILL

WELL COMPLETION DIAGRAM

PROJECT NO: 417981.ER.02.FW	**PROJECT:** ER-TCS Groundwater Investigation	**WELL NO:** ***MW-74-240***
LOCATION: Site J		

DRILLING CONTRACTOR: Boart Longyear (D. Osterberg)	**DRILLING START:** 10/7/2011
DRILLING METHOD: Air Hammer/ Wireline Rotary Core/ Rotosonic	**DRILLING END:** 10/12/2011
LOGGER: A. Brewster (Northstar)	**WELL COMPLETION DATE:** 10/12/2011
GROUND SURFACE ELEVATION (NAVD 88): 672.9 ft AMSL	**GENERAL REMARKS:** Centralizers at 20, 40, 60, 80, 100, 120, 140, 160, 180, and 200 ft bgs.
NORTHING (CCS NAD 83 Z 5): 2100017.52 / **EASTING (CCS NAD 83 Z 5):** 7615237.66	

12-IN DIAMETER WELL VAULT (FLUSH WITH GRADE)



WELL CONSTRUCTION & SCREEN DETAILS

CASING MATERIAL:	Sch 40 PVC
CASING DIAMETER:	2-in
BOREHOLE DIAMETER:	6-in
SEAL TYPE:	3/8 Bentonite Chips
PACK TYPE:	No. 3 Monterey Sand
CONCRETE PAD TYPE:	3-ft SQUARE
SCREEN LENGTH:	20-ft
SCREEN TYPE:	Sch 40 PVC
SLOT SIZE:	0.02-in

NOTES:
1. All depths are reported as feet below ground surface

WELL DIAGRAM IS NOT TO SCALE

CH2MHILL

Attachment A-4
California DWR Logs

*The free Adobe Reader may be used to view and complete this form. However, software must be purchased to complete, save, and reuse a saved form.

File Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. xxxxxxx

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Page 1 of 4

Owner's Well Number MW-23-060

Date Work Began 04/30/2009 Date Work Ended 5/2/2009

Local Permit Agency * No permit required by CERCLA exemption

Permit Number * Permit Date

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic Drilling Fluid

Depth from Surface Feet	to Feet	Description Describe material, grain size, color, etc.
0	1	Sandy gravel (GP)
1	60	(BR) Miocene conglomerate, red

Total Depth of Boring 80 Feet

Total Depth of Completed Well 60 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO BOX 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg Min Sec N Longitude Deg Min Sec W

Datum NAD83 Decimal Lat. 2101286.15 Decimal Long. 7616448.6

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

◉ New Well

○ Modification/Repair

○ Deepen

○ Other

○ Destroy

Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply

☐ Domestic ☐ Public

☐ Irrigation ☐ Industrial

○ Cathodic Protection

○ Dewatering

○ Heat Exchange

○ Injection

◉ Monitoring

○ Remediation

○ Sparging

○ Test Well

○ Vapor Extraction

○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 51 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	50	10	Blank	PVC Sch. 40	0.154	2.375	N/A	
50	60	10	Screen	PVC Sch. 40	0.154	2.375	Slotted	0.020

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	43	Cement	Portland grout
43	48	Bentonite	
48	60	Filter Pack	#3 Monterey sand

Attachments

☑ Geologic Log

☑ Well Construction Diagram

☐ Geophysical Log(s)

☐ Soil/Water Chemical Analyses

☐ Other

Attach additional information, if available

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name CH2M HILL
Person, Firm or Corporation

155 Grand Ave Suite 1000 Oakland CA 94612
Address City State Zip

Signed
C-57 Licensed Water Well Contractor

10/19/09 694686
Date Signed C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

*The free Adobe Reader may be used to view and complete this form. However, software must be purchased to complete, save, and reuse a saved form.

File Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. xxxxxxx

Page 1 of 4

Owner's Well Number MW-23-080

Date Work Began 04/30/2009 Date Work Ended 5/2/2009

Local Permit Agency * No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude N Longitude W

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic Drilling Fluid

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
0	1	Sandy grave (GP), grey
1	80	(BR) Miocene Conglomerate, red

Total Depth of Boring 80 Feet

Total Depth of Completed Well 80 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO BOX 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg Min Sec N Longitude Deg Min Sec W

Datum NAD83 Decimal Lat. 2101286.15 Decimal Long. 7616448.6

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

◉ New Well
○ Modification/Repair
○ Deepen
○ Other
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
◉ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 51 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	75	10	Blank	PVC Sch. 40	0.154	2.375	N/A	
75	80	10	Screen	PVC Sch. 40	0.154	2.375	Slotted	0.020

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	43	Cement	Portland grout
43	48	Bentonite	
48	63	Filter Pack	#3 Monterey sand
63	73	Bentonite	
73	80	Filter Pack	#3 Monterey sand

Attachments

☑ Geologic Log
☑ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other

Attach additional information, if any.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name CH2M HILL
Person, Firm or Corporation

155 Grand Ave Suite 1000 Oakland CA 94612
Address City State Zip

Signed 10/29/09 694686
C-57 Licensed Water Well Contractor Date Signed C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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State of California

Well Completion Report

Refer to Instruction Pamphlet

No. xxxxxxx

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude N Longitude W

APN/TRS/Other

Page 1 of 5

Owner's Well Number MW-57-050

Date Work Began 01/14/2009 Date Work Ended 1/21/2009

Local Permit Agency * No permit required by CERCLA exemption

Permit Number * Permit Date

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic Drilling Fluid

Depth from Surface Feet	to Feet	Description Describe material, grain size, color, etc.
0	3	Sandy silt with gravel (ML), dark brown
3	46	Silty gravel (GM), dark brown
46	52	(BR) Conglomerate, yellowish red

Total Depth of Boring 52.3 Feet

Total Depth of Completed Well 52.0 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO BOX 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg Min Sec N Longitude Deg Min Sec W

Datum NAD83 Decimal Lat. 2100906.35 Decimal Long. 7616384

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

◉ New Well

○ Modification/Repair

○ Deepen

○ Other

○ Destroy

Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply

☐ Domestic ☐ Public

☐ Irrigation ☐ Industrial

○ Cathodic Protection

○ Dewatering

○ Heat Exchange

○ Injection

◉ Monitoring

○ Remediation

○ Sparging

○ Test Well

○ Vapor Extraction

○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	40	6	Blank	PVC Sch. 40	0.154	2.375	N/A	
40	50	6	Screen	PVC Sch. 40	0.154	2.375	Slotted	0.010
50	52	6	Blank	PVC Sch. 40	0.154	2.375	N/A	

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	33	Cement	Portland grout
33	38	Bentonite	
38	52	Filter Pack	#3 Monterey sand

Attachments

☑ Geologic Log

☑ Well Construction Diagram

☐ Geophysical Log(s)

☐ Soil/Water Chemical Analyses

☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name CH2M HILL

Person, Firm or Corporation

155 Grand Ave Suite 1000 Oakland CA 94612

Address City State Zip

Signed [signature] 1/19/09 694686

C-57 Licensed Water Well Contractor Date Signed C-57 License Number

DWR 188 REV. 1/2000

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Page 1 of 6

Owner's Well Number MW-57-070

Date Work Began 01/14/2009 Date Work Ended 1/28/2009

Local Permit Agency * No permit required by CERCLA exemption

Permit Number * Permit Date

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. xxxxxxx

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Geologic Log

Orientation ⊙ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic Drilling Fluid

Depth from Surface Feet	to Feet	Description Describe material, grain size, color, etc
0	3	Sandy silt with gravel (ML), dark brown
3	46	Silty Gravel (GM), dark brown
46	70	(BR) conglomerate, yellowish red

Total Depth of Boring 70 Feet

Total Depth of Completed Well 70 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO BOX 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg Min Sec N Longitude Deg Min Sec W

Datum NAD83 Decimal Lat. 2100893.58 Decimal Long. 7616394

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Sketch or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

⊙ New Well
○ Modification/Repair
○ Deepen
○ Other
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
⊙ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 53 (Feet) Date Measured 03/31/2009

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	55	6	Blank	PVC Sch. 40	0.154	2.375	N/A	
55	70	6	Screen	PVC Sch. 40	0.154	2.375	Slotted	0.010

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	48	Cement	Portland grout
48	53	Bentonite	
53	70	Filter Pack	#3 Monterey sand

Attachments

☑ Geologic Log
☑ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other

Attach additional information, if available

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name CH2M HILL
Person, Firm or Corporation

155 Grand Ave Suite 1000 Oakland CA 94612
Address City State Zip

Signed [signature] 01/29/09 694686
C-57 Licensed Water Well Contractor Date Signed C-57 License Number

DWR 188 REV. 1/2006

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Well Completion Report

Refer to Instruction Pamphlet

No. xxxxxxx

Page 1 of 8

Owner's Well Number MW-57-185

Date Work Began 01/14/2009 Date Work Ended 2/16/2009

Local Permit Agency * No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Geologic Log

Orientation ⊙ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic+diamond bit rotary Drilling Fluid

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc.)
0	3	Silty sand with gravel (ML), dark brown
3	46	Silty gravel (GM), dark brown
46	146	(BR) Miocene conglomerate, yellowish red
146	153	(BR) Miocene conglomerate, reddish orange, wea
153	155	(BR) Metaconglomerate, dark yellowish orange
155	156	(BR) Altered Metadiorite, yellowish brown
156	192	(BR) Metadiorite, yellowish green

Total Depth of Boring 192 Feet

Total Depth of Completed Well 192 Feet

Well Owner

Name Paficic Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg Min Sec N Longitude Deg Min Sec W

Datum NAD83 Decimal Lat. 2100899.56 Decimal Long. 7616389

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Indicate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

⊙ New Well
○ Modification/Repair
○ Deepen
○ Other
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
⊙ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 52 (Feet) Date Measured 03/31/2009

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	70	6	Blank	PVC Sch. 40	0.280	6.625	N/A	
70	184	3.8	Screen	PVC Sch. 40	0.216	3.5	Slotted	0.030
184	192	3.8	Blank	PVC Sch. 40	0.216	3.5	N/A	

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	70	Cement	Portland grout
70	192	None	Open hole

Attachments

☑ Geologic Log
☑ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name CH2M HILL

Person, Firm or Corporation

155 Grand Ave Suite 1000 Oakland CA 94612

Address City State Zip

Signed 10/27/09 694686

C-57 Licensed Water Well Contractor Date Signed C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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Well Completion Report

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No. xxxxxxx

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N / W

Latitude / Longitude

APN/TRS/Other

Owner's Well Number MW-58-065

Date Work Began 01/29/2009 Date Work Ended 2/12/2009

Local Permit Agency * No permit required by CERCLA exemption

Permit Number * Permit Date

Geologic Log

Orientation ⊙ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic Drilling Fluid

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc.)
0	2	Sandy silt (ML), brown
2	17	Gravel, sand, silt (GM), brown
51	53	Silt (ML), dark brown
53	60	Gravelly sand (SP), yellowish brown
60	65	(BR) Metadiorite, highly weathered

Total Depth of Boring 66.5 Feet

Total Depth of Completed Well 66.0 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg Min Sec N Longitude Deg Min Sec W

Datum NAD83 Decimal Lat. 2100607.15 Decimal Long. 7616136

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North / West / East / South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

⊙ New Well

○ Modification/Repair

○ Deepen

○ Other

○ Destroy

Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply

☐ Domestic ☐ Public

☐ Irrigation ☐ Industrial

○ Cathodic Protection

○ Dewatering

○ Heat Exchange

○ Injection

⊙ Monitoring

○ Remediation

○ Sparging

○ Test Well

○ Vapor Extraction

○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 67 (Feet) Date Measured 04/01/2009

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (inches)	Type	Material	Wall Thickness (inches)	Outside Diameter (inches)	Screen Type	Slot Size if Any (inches)
0	54	6	Blank	PVC Sch. 40	0.154	2.375	N/A	
54	64	6	Screen	PVC Sch. 40	0.154	2.375	Slotted	0.010
64	66	6	Blank	PVC Sch. 40	0.154	2.375	N/A	

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	46	Cement	Portland grout
46	51	Bentonite	
51	66	Filter Pack	#3 Monterey sand

Attachments

☑ Geologic Log

☑ Well Construction Diagram

☐ Geophysical Log(s)

☐ Soil/Water Chemical Analyses

☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name CH2M HILL

Person, Firm or Corporation

155 Grand Ave Suite 1000 Oakland CA 94612

Address City State Zip

Signed [signature] 10/19/09 694686

C-57 Licensed Water Well Contractor Date Signed C-57 License Number

DWR 188 REV 10/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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State of California

Well Completion Report

Refer to Instruction Pamphlet

No. xxxxxxx

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude / Longitude

APN/TRS/Other

Owner's Well Number MW-58-115

Date Work Began 01/29/2009 Date Work Ended 3/27/2009

Local Permit Agency * No permit required by CERCLA exemption

Permit Number * Permit Date

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic+ Diamond-bit rotary Drilling Fluid

Depth from Surface Feet	to Feet	Description Describe material, grain size, color, etc
0	2	Sandy silt (ML), brown
2	17	Gravel, sand, silt (GM), brown
17	51	Silty sand with gravel (SM), brown
51	53	Silt (ML), dark brown
53	60	Gravelly sand (SP) yellowish brown
60	66	(BR) Weathered metadiorite
66	115	(BR) Metadiorite, yellowish green

Total Depth of Boring 206 Feet

Total Depth of Completed Well 115 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg Min Sec N Longitude Deg Min Sec W

Datum NAD83 Decimal Lat. 2100607.15 Decimal Long. 7616136.6

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North / West / East / South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

◉ New Well

○ Modification/Repair

○ Deepen

○ Other

○ Destroy

Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply

☐ Domestic ☐ Public

☐ Irrigation ☐ Industrial

○ Cathodic Protection

○ Dewatering

○ Heat Exchange

○ Injection

◉ Monitoring

○ Remediation

○ Sparging

○ Test Well

○ Vapor Extraction

○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 68 (Feet) Date Measured 04/01/2009

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	66	6	Conductor	PVC Sch. 40	0.280	6.625	N/A	
66	206	3.8	Open hole				N/A	

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	66	Cement	Portland Grout
0	206	Openhole	FLUTe multi-level

Attachments

☑ Geologic Log

☑ Well Construction Diagram

☐ Geophysical Log(s)

☐ Soil/Water Chemical Analyses

☐ Other

Attach additional information, if exists

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name CH2M HILL

Person, Firm or Corporation

155 Grand Ave Suite 1000 Oakland CA 94612

Address City State Zip

Signed 11/19/09 694686

C-57 Licensed Water Well Contractor Date Signed C-57 License Number

DWR 188 REV. 1/2005

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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State of California
Well Completion Report

Refer to Instruction Pamphlet

No. xxxxxxx

Page 1 of 7

Owner's Well Number MW-58-205

Date Work Began 01/29/2009 Date Work Ended 3/27/2009

Local Permit Agency * No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude N Longitude W

APN/TRS/Other

Geologic Log

Orientation ⊙ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic+ Diamond-bit rotary Drilling Fluid

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc.)
0	2	Sandy silt (ML), brown
2	17	Gravel, sand, silt (GM), brown
17	51	Silty sand with gravel (SM), brown
51	53	Silt (ML), dark brown
53	60	Gravelly sand (SP) yellowish brown
60	66	(BR) Weathered metadiorite
66	206	(BR) Metadiorite, yellowish green

Total Depth of Boring 206 Feet

Total Depth of Completed Well 206 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg Min Sec N Longitude Deg Min Sec W

Datum NAD83 Decimal Lat 2100607.15 Decimal Long. 7616136.8

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

(Landmarks and distance in feet from roads, buildings, fences, rivers, etc., and attach a map. Use additional paper if necessary.)
Please be accurate and complete

Activity

⊙ New Well
○ Modification/Repair
○ Deepen
○ Other
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
⊙ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 68 (Feet) Date Measured 04/01/2009

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	66	6	Conductor	PVC Sch. 40	0.280	6.625	N/A	
66	206	3.8	Open hole	N/A	N/A	N/A		

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	66	Cement	Portland Grout
0	206	None	FLUTe Multi-level

Attachments

☑ Geologic Log
☑ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name CH2M HILL
Person, Firm or Corporation

155 Grand Ave Suite 1000 Oakland CA 94612
Address City State Zip

Signed
C-57 Licensed Water Well Contractor

10/9/09
Date Signed

694686
C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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State of California

Well Completion Report

Refer to Instruction Pamphlet

No. xxxxxxx

Page 1 of 5

Owner's Well Number MW-59-100

Date Work Began 02/25/2009 Date Work Ended 2/26/2009

Local Permit Agency * No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic Drilling Fluid

Depth from Surface Feet	to Feet	Description Describe material, grain size, color, etc.
0	82	Silty Sand (SM), brown
82	101	Gravelly sand (SP), dark brown

Total Depth of Boring 101 Feet

Total Depth of Completed Well 101 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg Min Sec N Longitude Deg Min Sec W

Datum NAD83 Decimal Lat 2100851.96 Decimal Long 7616081.0

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

◉ New Well

○ Modification/Repair

○ Deepen

○ Other

○ Destroy

Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply

☐ Domestic ☐ Public

☐ Irrigation ☐ Industrial

○ Cathodic Protection

○ Dewatering

○ Heat Exchange

○ Injection

◉ Monitoring

○ Remediation

○ Sparging

○ Test Well

○ Vapor Extraction

○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 85 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	86	6	Blank	PVC Sch. 40	0.154	2.375	N/A	
86	101	6	Screen	PVC Sch. 40	0.154	2.375	Slotted	0.020

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	79	Cement	Portland grout
79	84	Bentonite	
84	101	Filter Pack	#3 Monterey sand

Attachments

☑ Geologic Log

☑ Well Construction Diagram

☐ Geophysical Log(s)

☐ Soil/Water Chemical Analyses

☐ Other

Attach additional information, if it exists

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name CH2M HILL

Person, Firm or Corporation

155 Grand Ave Suite 1000 Oakland CA 94612

Address City State Zip

Signed 10/9/09 694696

C-57 Licensed Water Well Contractor Date Signed C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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File Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. xxxxxxx

Page 1 of 6

Owner's Well Number MW-60-125

Date Work Began 02/27/2009 Date Work Ended 3/3/2009

Local Permit Agency * No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic+Diamond-bit rotary Drilling Fluid

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc.)
0	9	Silty Sand (SM), yellowish brown
9	123	(BR) Metadiorite, dusky green

Total Depth of Boring 123 Feet

Total Depth of Completed Well 123 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg Min Sec N Longitude Deg Min Sec W

Datum NAD83 Decimal Lat. 2100491.63 Decimal Long. 7616434

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

◉ New Well

○ Modification/Repair

○ Deepen

○ Other

○ Destroy

Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply

☐ Domestic ☐ Public

☐ Irrigation ☐ Industrial

○ Cathodic Protection

○ Dewatering

○ Heat Exchange

○ Injection

◉ Monitoring

○ Remediation

○ Sparging

○ Test Well

○ Vapor Extraction

○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 98 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	103	6	Blank	PVC Sch. 40	0.154	2.375	N/A	
103	123	6	Screen	PVC Sch. 40	0.154	2.375	Slotted	0.010

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	91	Cement	Portland grout
91	101	Bentonite	
101	123	Filter Pack	#3 Monterey sand

Attachments

☑ Geologic Log

☑ Well Construction Diagram

☐ Geophysical Log(s)

☐ Soil/Water Chemical Analyses

☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name CH2M HILL

Person, Firm or Corporation

155 Grand Ave Suite 1000 Oakland CA 94612

Address City State Zip

Signed 10/29/09 694686

C-57 Licensed Water Well Contractor Date Signed C-57 License Number

DWR 188 REV. 1/2008

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0161096

Page 1 of 8

Owner's Well Number MW-60BR-245

Date Work Began 06/28/2011 Date Work Ended 7/28/2011

Local Permit Agency *No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N Latitude Longitude W

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic Drilling Fluid

Depth from Surface Feet	to Feet	Description Describe material, grain size, color, etc
0	9	Silty Sand (SM)
9	245	(BR) Metadiorite, dusky yellow green

Total Depth of Boring 245 Feet

Total Depth of Completed Well 245 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg. Min. Sec. N Longitude Deg. Min. Sec. W

Datum NAD83 Decimal Lat. 2100495.02 Decimal Long. 7616444.4

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. **Please be accurate and complete.**

Activity

◉ New Well
○ Modification/Repair
○ Deepen
○ Other
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
◉ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 99 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	136	10	Conductor	PVC Sch. 40	0.280	6.625	N/A	
136	245	3.8	Open hole	N/A	N/A	N/A		

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	136	Cement	Portland Grout
136	245	None	

Attachments

☑ Geologic Log
☑ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other

Attach additional information, if it exists

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name BOART LONGYEAR CO.
Person, Firm or Corporation

7103 W AUGUSTA AVE GLENDALE AZ 85303
Address City State Zip

Signed
C-57 Licensed Water Well Contractor

10/10/12 694686
Date Signed C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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State of California

Well Completion Report

Refer to Instruction Pamphlet

No. xxxxxxx

Page 1 of 6

Owner's Well Number MW-61-110

Date Work Began 03/04/2009 Date Work Ended 3/13/2009

Local Permit Agency * No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic+Diamond-bit rotary Drilling Fluid

Depth from Surface Feet	to Feet	Description Describe material, grain size, color, etc
0	14	Gravel, sand, silt (GM), dark brown
14	63	Poorly graded sand with silt and gravel (SP-SM).
63	112	(BR) Metadiorite, dusky yellowish green

Total Depth of Boring 112 Feet

Total Depth of Completed Well 112.4 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude ___ Deg ___ Min ___ Sec N Longitude ___ Deg ___ Min ___ Sec W

Datum NAD83 Decimal Lat. 2100713.02 Decimal Long. 7616591

APN Book ___ Page ___ Parcel ___

Township ___ Range ___ Section ___

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

◉ New Well

○ Modification/Repair

○ Deepen

○ Other

○ Destroy

Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply

☐ Domestic ☐ Public

☐ Irrigation ☐ Industrial

○ Cathodic Protection

○ Dewatering

○ Heat Exchange

○ Injection

◉ Monitoring

○ Remediation

○ Sparging

○ Test Well

○ Vapor Extraction

○ Other

Water Level and Yield of Completed Well

Depth to first water ___ (Feet below surface)

Depth to Static Water Level 87 (Feet) Date Measured ___

Estimated Yield * ___ (GPM) Test Type ___

Test Length ___ (Hours) Total Drawdown ___ (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	92	6	Blank	PVC Sch. 40	0.154	2.375	N/A	
92	112	6	Screen	PVC Sch. 40	0.154	2.375	Slotted	0.010

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	84	Cement	Portland grout
84	89	Bentonite	
89	112	Filter Pack	#3 Monterey sand

Attachments

☑ Geologic Log

☑ Well Construction Diagram

☐ Geophysical Log(s)

☐ Soil/Water Chemical Analyses

☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name CH2M HILL

Person, Firm or Corporation

155 Grand Ave Suite 1000 Oakland CA 94612

Address City State Zip

Signed [signature] 10/09/09 694686

C-57 Licensed Water Well Contractor Date Signed C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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State of California

Well Completion Report

Refer to Instruction Pamphlet

No. xxxxxxx

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Page 1 of 7

Owner's Well Number MW-62-065

Date Work Began 03/14/2009 Date Work Ended 3/18/2009

Local Permit Agency * No permit required by CERCLA exemption

Permit Number * Permit Date

Geologic Log

Orientation ⊙ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic Drilling Fluid

Depth from Surface Feet	to Feet	Description Describe material, grain size, color, etc.
0	5	Silty sand (SM), yellowish brown
5	65	(BR) Miocene conglomerate, reddish brown
65	110	(BR) Miocene conglomerate, brown

Total Depth of Boring 112 Feet

Total Depth of Completed Well 112.4 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg Min Sec N Longitude Deg Min Sec W

Datum NAD83 Decimal Lat. 2101064.51 Decimal Long. 7616560.6

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

⊙ New Well

○ Modification/Repair

○ Deepen

○ Other

○ Destroy

Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply

☐ Domestic ☐ Public

☐ Irrigation ☐ Industrial

○ Cathodic Protection

○ Dewatering

○ Heat Exchange

○ Injection

⊙ Monitoring

○ Remediation

○ Sparging

○ Test Well

○ Vapor Extraction

○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 48 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	45	6	Blank	PVC Sch. 40	0.154	2.375	N/A	
45	65	6	Screen	PVC Sch. 40	0.154	2.375	Slotted	0.010

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	37	Cement	Portland grout
37	42	Bentonite	
42	65	Filter Pack	#3 Monterey sand

Attachments

☑ Geologic Log

☑ Well Construction Diagram

☐ Geophysical Log(s)

☐ Soil/Water Chemical Analyses

☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name CH2M HILL

Person, Firm or Corporation

155 Grand Ave Suite 1000 Oakland CA 94612

Address City State Zip

Signed 10/19/09 694686

C-57 Licensed Water Well Contractor Date Signed C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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State of California

Well Completion Report

Refer to Instruction Pamphlet

No. xxxxxxx

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude N Longitude W

APN/TRS/Other

Page 1 of 8

Owner's Well Number MW-62-110

Date Work Began 03/14/2009 Date Work Ended 3/18/2009

Local Permit Agency * No permit required by CERCLA exemption

Permit Number * Permit Date

Geologic Log

Orientation ⊙ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic+Diamond-bit rotary Drilling Fluid

Depth from Surface Feet	to Feet	Description Describe material, grain size, color, etc
0	5	Silty sand (SM), yellowish brown
5	65	(BR) Miocene conglomerate, reddish brown
65	110	(BR) Miocene conglomerate, brown

Total Depth of Boring 191.5 Feet

Total Depth of Completed Well 110 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg Min Sec N Longitude Deg Min Sec W

Datum NAD83 Decimal Lat 2101064.5 Decimal Long 7616561.0

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

⊙ New Well
○ Modification/Repair
○ Deepen
○ Other
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
⊙ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 48 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (inches)	Type	Material	Wall Thickness (inches)	Outside Diameter (inches)	Screen Type	Slot Size if Any (inches)
0	75	6	Conductor	PVC Sch. 40	0.280	6.625	N/A	
75	192	3.8	Open hole	N/A	N/A	N/A	N/A	

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	75	Cement	Portland grout
0	192	None	FLUTe multilevel

Attachments

☑ Geologic Log
☑ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other

Attach additional information, if any, as necessary.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name CH2M HILL

Person, Firm or Corporation

155 Grand Ave Suite 1000 Oakland CA 94612

Address City State Zip

Signed 10/19/09 694686

C-57 Licensed Water Well Contractor Date Signed C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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State of California

Well Completion Report

Refer to Instruction Pamphlet

No. xxxxxxx

Page 1 of 8

Owner's Well Number MW-62-190

Date Work Began 03/14/2009 Date Work Ended 3/18/2009

Local Permit Agency * No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic+Diamond-bit rotary Drilling Fluid

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc.)
0	5	Silty sand (SM), yellowish brown
5	65	(BR) Miocene conglomerate, reddish brown
65	192	(BR) Miocene conglomerate, brown

Total Depth of Boring 191.5 Feet

Total Depth of Completed Well 191.5 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg Min Sec N Longitude Deg Min Sec W

Datum NAD83 Decimal Lat 2101064.5 Decimal Long 7616561.0

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

◉ New Well

○ Modification/Repair

○ Deepen

○ Other

○ Destroy

Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply

☐ Domestic ☐ Public

☐ Irrigation ☐ Industrial

○ Cathodic Protection

○ Dewatering

○ Heat Exchange

○ Injection

◉ Monitoring

○ Remediation

○ Sparging

○ Test Well

○ Vapor Extraction

○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 48 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (inches)	Type	Material	Wall Thickness (inches)	Outside Diameter (inches)	Screen Type	Slot Size if Any (inches)
0	75	6	Blank	PVC Sch. 40	0.280	6.625	N/A	
75	192	3.8	Open hole					

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	75	Cement	Portland grout
0	192		FLUTe multilevel

Attachments

☑ Geologic Log

☑ Well Construction Diagram

☐ Geophysical Log(s)

☐ Soil/Water Chemical Analyses

☐ Other

Attach additional information, if it exists

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name CH2M HILL

Person, Firm or Corporation

155 Grand Ave Suite 1000 Oakland CA 94612

Address City State Zip

Signed 6/19/09 694686

C-57 Licensed Water Well Contractor Date Signed C-57 License Number

DWR 188 REV. 10/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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Page 1 of 5

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. xxxxxxx

Owner's Well Number MW-63-065

Date Work Began 04/06/2009 Date Work Ended 4/8/2009

Local Permit Agency * No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only - Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Geologic Log

Orientation ⊙ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Diamond-bit rotary Drilling Fluid

Depth from Surface Feet	to Feet	Description Describe material, grain size, color, etc
0	30	(BR) Miocene conglomerate, brown
30	66	(BR) Miocene conglomerate, moderate brown

Total Depth of Boring 66 Feet

Total Depth of Completed Well 66 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg Min Sec N Longitude Deg Min Sec W

Datum NAD83 Decimal Lat. 2100944.6 Decimal Long 7616913.3

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc.; and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

⊙ New Well

○ Modification/Repair

○ Deepen

○ Other

○ Destroy

Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply

☐ Domestic ☐ Public

☐ Irrigation ☐ Industrial

○ Cathodic Protection

○ Dewatering

○ Heat Exchange

○ Injection

⊙ Monitoring

○ Remediation

○ Sparging

○ Test Well

○ Vapor Extraction

○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 48 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (inches)	Type	Material	Wall Thickness (inches)	Outside Diameter (inches)	Screen Type	Slot Size if Any (inches)
0	46		Blank	PVC Sch. 40	0.154	2.375	N/A	
46	66		Screen	PVC Sch. 40	0.154	2.375	Slotted	0.020

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	38	Cement	Portland grout
38	43	Bentonite	
43	66	Filter Pack	#3 Monterey sand

Attachments

☑ Geologic Log

☑ Well Construction Diagram

☐ Geophysical Log(s)

☐ Soil/Water Chemical Analyses

☐ Other

Attach additional information, if available

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name CH2M HILL
Person, Firm or Corporation

155 Grand Ave Suite 1000 Oakland CA 94612
Address City State Zip

Signed
C-57 Licensed Water Well Contractor

10/09/09 694686
Date Signed C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEAT CONSECUTIVELY NUMBERED FORM

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File Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. xxxxxxx

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude N Longitude W

APN/TRS/Other

Page 1 of 9

Owner's Well Number MW-64-150

Date Work Began 05/03/2009 Date Work Ended 5/15/2009

Local Permit Agency * No permit required by CERCLA exemption

Permit Number * Permit Date

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic+Diamond-bit rotary Drilling Fluid

Depth from Surface Feet	to Feet	Description Describe material, grain size, color, etc.
0	20	(BR) Metadiorite, dark greenish grey
20	27	(BR) Metadiorite, dusky yellowish green
27	150	(BR) Metadiorite, grayish olive

Total Depth of Boring 260 Feet

Total Depth of Completed Well 150 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg Min Sec N Longitude Deg Min Sec W

Datum NAD83 Decimal Lat 2100509.0 Decimal Long 7616908.5

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Sketch to describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

◉ New Well

○ Modification/Repair

○ Deepen

○ Other

○ Destroy

Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply

☐ Domestic ☐ Public

☐ Irrigation ☐ Industrial

○ Cathodic Protection

○ Dewatering

○ Heat Exchange

○ Injection

◉ Monitoring

○ Remediation

○ Sparging

○ Test Well

○ Vapor Extraction

○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 120 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	20	6	Conductor	PVC Sch. 40	0.280	6.625	N/A	
20	260	3.8	Open hole					

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	20	Cement	Portland grout
0	260		FLUTe multilevel

Attachments

☑ Geologic Log

☑ Well Construction Diagram

☐ Geophysical Log(s)

☐ Soil/Water Chemical Analyses

☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name CH2M HILL

Person, Firm or Corporation

155 Grand Ave Suite 1000 Oakland CA 94612

Address City State Zip

Signed 10/19/09 694686

C-57 Licensed Water Well Contractor Date Signed C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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State of California

Well Completion Report

Refer to Instruction Pamphlet

No. xxxxxxx

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Owner's Well Number MW-64-205

Date Work Began 05/03/2009 Date Work Ended 5/15/2009

Local Permit Agency * No permit required by CERCLA exemption

Permit Number * Permit Date

Geologic Log

Orientation ⊙ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotasonic+Diamond-bit rotary Drilling Fluid

Depth from Surface Feet	to Feet	Description Describe material, grain size, color, etc
0	65	(BR) Metadiorite, weathered
20	27	(BR) Metadiorite, dusky yellowish green
27	205	(BR) Metadiorite, grayish olive

Total Depth of Boring 260 Feet

Total Depth of Completed Well 205 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg Min Sec N Longitude Deg Min Sec W

Datum NAD83 Decimal Lat. 2100509.0 Decimal Long 7616908.5

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

(Landmark or direction distance of well from roads, buildings, fences, rivers, etc., and attach a map. Use additional paper if necessary. Please be accurate and complete.)

Activity

⊙ New Well
○ Modification/Repair
○ Deepen
○ Other
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
⊙ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 120 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	20	6	Blank	PVC Sch. 40	0.280	6.625	N/A	
20	260	3.8	Open hole					

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	20	Cement	Portland grout
0	260		FLUTe Multilevel

Attachments

☑ Geologic Log
☑ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other

Attach additional information, if exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name CH2M HILL
Person, Firm or Corporation

155 Grand Ave Suite 1000 Oakland CA 94612
Address City State Zip

Signed
C-57 Licensed Water Well Contractor

10/19/09 694686
Date Signed C-57 License Number

DWR 188 REV. 10/2006

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State of California

Well Completion Report

Refer to Instruction Pamphlet

No. xxxxxxx

Page 1 of 8

Owner's Well Number MW-64-260

Date Work Began 05/03/2009 Date Work Ended 5/15/2009

Local Permit Agency * No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic+Diamond-bit rotary Drilling Fluid

Depth from Surface Feet	to Feet	Description Describe material, grain size, color, etc.
0	20	(BR) Metadiorite, dark greenish grey
20	27	(BR) Metadiorite, dusky yellowish green
27	260	(BR) Metadiorite, grayish olive

Total Depth of Boring 260 Feet

Total Depth of Completed Well 260 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg Min Sec N Longitude Deg Min Sec W

Datum NAD83 Decimal Lat. 2100509.0 Decimal Long. 7616908.5

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

◉ New Well

○ Modification/Repair

○ Deepen

○ Other

○ Destroy

Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply

☐ Domestic ☐ Public

☐ Irrigation ☐ Industrial

○ Cathodic Protection

○ Dewatering

○ Heat Exchange

○ Injection

◉ Monitoring

○ Remediation

○ Sparging

○ Test Well

○ Vapor Extraction

○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 120 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	20	6	Blank	PVC Sch. 40	0.280	6.625	N/A	
20	260	3.8	Open hole					

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	20	Cement	Portland grout
0	260		FLUTe multilevel

Attachments

☑ Geologic Log

☑ Well Construction Diagram

☐ Geophysical Log(s)

☐ Soil/Water Chemical Analyses

☐ Other

Attach additional information, if it exists

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name CH2M HILL

Person, Firm or Corporation

155 Grand Ave Suite 1000 Oakland CA 94612

Address City State Zip

Signed 10/19/09 694686

C-57 Licensed Water Well Contractor Date Signed C-57 License Number

DWR 188 REV. 1/2009

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Well Completion Report

Refer to Instruction Pamphlet

No. e0161487

Page 1 of 14

Owner's Well Number MW-65-160

Date Work Began 03/17/2011 Date Work Ended 4/7/2011

Local Permit Agency *No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic Drilling Fluid

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
0	10	Well Graded Sand (SW), dark yellowish brown
10	87	Silty Sand (SM), grayish brown
87	94	Well Graded Sand (SW), dark yellowish brown
94	188	Silty Sand (SM), grayish brown
188	228	Well Graded Gravel (GW), black
228	237	(BR) Metadiorite

Total Depth of Boring 237 Feet

Total Depth of Completed Well 160 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg. Min. Sec. N Longitude Deg. Min. Sec. W

Datum NAD83 Decimal Lat. 2100547.44 Decimal Long. 7614934.

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. **Please be accurate and complete.**

Activity

◉ New Well

○ Modification/Repair

○ Deepen

○ Other

○ Destroy

Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply

☐ Domestic ☐ Public

☐ Irrigation ☐ Industrial

○ Cathodic Protection

○ Dewatering

○ Heat Exchange

○ Injection

◉ Monitoring

○ Remediation

○ Sparging

○ Test Well

○ Vapor Extraction

○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 139 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	150	10	Blank	PVC Sch. 40	0.15	2.38	N/A	
150	160	10	Screen	PVC Sch. 40	0.15	2.38	Milled Slots	0.020

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	134	Cement	Portland Grout
134	146	Bentonite	
146	167	Filter Pack	#3 Monterey Sand

Attachments

☑ Geologic Log

☑ Well Construction Diagram

☐ Geophysical Log(s)

☐ Soil/Water Chemical Analyses

☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name BOART LONGYEAR CO. (Person, Firm or Corporation)

7103 W AUGUSTA AVE (Address) GLENDALE (City) AZ (State) 85303 (Zip)

Signed (C-57 Licensed Water Well Contractor) 10/9/12 (Date Signed) 694686 (C-57 License Number)

DWR 188 REV. 1/2006

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State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0161489

Page 1 of 14

Owner's Well Number MW-65-225

Date Work Began 03/17/2011 Date Work Ended 4/7/2011

Local Permit Agency *No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude N Longitude W

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic Drilling Fluid

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
0	10	Well Graded Sand (SW), dark yellowish brown
10	87	Silty Sand (SM), grayish brown
87	94	Well Graded Sand (SW), dark yellowish brown
94	188	Silty Sand (SM), grayish brown
188	228	Well Graded Gravel (GW), black
228	237	(BR) Metadiorite

Total Depth of Boring 237 Feet

Total Depth of Completed Well 237 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg. Min. Sec. N Longitude Deg. Min. Sec. W

Datum NAD83 Decimal Lat. 2100547.44 Decimal Long. 7614934.

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North / West / East / South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. **Please be accurate and complete**

Activity

◉ New Well
○ Modification/Repair
○ Deepen
○ Other
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
◉ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 139 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	215	10	Blank	PVC Sch. 40	0.15	2.38	N/A	
215	225	10	Screen	PVC Sch. 40	0.15	2.38	Milled Slots	0.020

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	134	Cement	Portland Grout
134	146	Bentonite	
146	167	Filter Pack	#3 Monterey Sand
167	213	Bentonite	
213	230	Filter Pack	#3 Monterey Sand
230	237	Bentonite	

Attachments

☑ Geologic Log
☑ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name BRYANT CONYEAR CO. (Person, Firm or Corporation)

2103 W Augusta Ave (Address) GLENDALE (City) AZ (State) 85303 (Zip)

Signed (C-57 Licensed Water Well Contractor) 12/10/12 (Date Signed) 694686 (C-57 License Number)

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0161491

Page 1 of 17

Owner's Well Number MW-66-165

Date Work Began 04/12/2011 Date Work Ended 4/20/2011

Local Permit Agency *No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic Drilling Fluid

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
0	14	Poorly Graded Sand (SP), yellowish brown
14	17	Silty Sand (SM), yellowish brown
17	19	Poorly Graded Sand (SP), yellowish brown
19	32	Silt (ML), Dark yellow brown
32	67	Silty Sand (SM), yellowish brown
67	83	Well Graded Sand (SW), brown
83	87	Silty Sand (SM), yellowish brown
87	132	Well Graded Sand with Gravel (SW), yellowish br
132	157	Well Graded Sand with Gravel (SW), brown
157	163	Poorly Graded Sand (SP), grayish brown
163	233	Well Graded Sand with Gravel (SW), dark brown
233	271	(BR) Conglomerate

Total Depth of Boring 234 Feet

Total Depth of Completed Well 162 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg. Min. Sec. N Longitude Deg. Min. Sec. W

Datum NAD83 Decimal Lat. 2100957.66 Decimal Long. 7615153.7

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. **Please be accurate and complete.**

Activity

◉ New Well
○ Modification/Repair
○ Deepen
○ Other
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
◉ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 130 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	142	10	Blank	PVC Sch. 40	0.15	2.38	N/A	
142	162	10	Screen	PVC Sch. 40	0.15	2.38	Milled Slots	0.020

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	128	Cement	Portland Grout
128	138	Bentonite	
138	167	Filter Pack	#3 Monterey Sand

Attachments

☑ Geologic Log
☑ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name BOART LONGYEAR CO.
Person, Firm or Corporation

7103 W Augusta Ave Glendale AZ 85303
Address City State Zip

Signed
C-57 Licensed Water Well Contractor

10/10/12 694686
Date Signed C-57 License Number

DWR 188 REV. 1/2006

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State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0161493

Page 1 of 17

Owner's Well Number MW-66-230

Date Work Began 04/12/2011 Date Work Ended 4/20/2011

Local Permit Agency *No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic Drilling Fluid

Depth from Surface Feet	to Feet	Description Describe material, grain size, color, etc
0	14	Poorly Graded Sand (SP), yellowish brown
14	17	Silty Sand (SM), yellowish brown
17	19	Poorly Graded Sand (SP), yellowish brown
19	32	Silt (ML), Dark yellow brown
32	67	Silty Sand (SM), yellowish brown
67	83	Well Graded Sand (SW), brown
83	87	Silty Sand (SM), yellowish brown
87	132	Well Graded Sand with Gravel (SW), yellowish br
132	157	Well Graded Sand with Gravel (SW), brown
157	163	Poorly Graded Sand (SP), grayish brown
163	233	Well Graded Sand with Gravel (SW), dark brown
233	271	(BR) Conglomerate

Total Depth of Boring 234 Feet

Total Depth of Completed Well 228 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg Min. Sec. N Longitude Deg Min. Sec. W

Datum NAD83 Decimal Lat. 2100957.66 Decimal Long. 7615153.7

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. **Please be accurate and complete.**

Activity

◉ New Well
○ Modification/Repair
○ Deepen
○ Other
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
◉ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 130 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	218	10	Blank	PVC Sch. 40	0.15	2.38	N/A	
218	228	10	Screen	PVC Sch. 40	0.15	2.38	Milled Slots	0.020

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	128	Cement	Portland Grout
128	138	Bentonite	
138	167	Filter Pack	#3 Monterey Sand
167	215	Bentonite	
215	234	Filter Pack	#3 Monterey Sand

Attachments

☑ Geologic Log
☑ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name BOART LONGYEAR CO. (Person, Firm, or Corporation)

2703 W Hatcher Rd Ave (Address) Glendale (City) AZ (State) 85303 (Zip)

Signed (C-57 Licensed Water Well Contractor) 4/19/11 (Date Signed) 694686 (C-57 License Number)

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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Well Completion Report

Refer to Instruction Pamphlet

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Page 1 of 17

Owner's Well Number MW-66BR-270

Date Work Began 08/30/2011 Date Work Ended 9/11/2011

Local Permit Agency *No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic/Wireline Rotary Core Drilling Fluid

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
0	14	Poorly Graded Sand (SP), yellowish brown
14	17	Silty Sand (SM), yellowish brown
17	19	Poorly Graded Sand (SP), yellowish brown
19	32	Silt (ML), Dark yellow brown
32	67	Silty Sand (SM), yellowish brown
67	83	Well Graded Sand (SW), brown
83	87	Silty Sand (SM), yellowish brown
87	132	Well Graded Sand with Gravel (SW), yellowish br
132	157	Well Graded Sand with Gravel (SW), brown
157	163	Poorly Graded Sand (SP), grayish brown
163	233	Well Graded Sand with Gravel (SW), dark brown
233	271	(BR) Conglomerate

Total Depth of Boring 271 Feet

Total Depth of Completed Well 271 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg. Min. Sec. N Longitude Deg. Min. Sec. W

Datum NAD83 Decimal Lat. 2100950.25 Decimal Long. 7615153.8

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. **Please be accurate and complete.**

Activity

◉ New Well
○ Modification/Repair
○ Deepen
○ Other
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
◉ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 130 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	248	10	Conductor	PVC Sch. 40	0.28	6.63	N/A	
248	271	3.8	Open hole	PVC Sch. 40			N/A	

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	248	Cement	Portland Grout
248	271	Open hole	

Attachments

☑ Geologic Log
☑ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Robert Conyear CO (Person, Firm or Corporation)

7103 W Augusta Ave (Address) Glendale (City) AZ (State) 85303 (Zip)

Signed (C-57 Licensed Water Well Contractor) 10/12/12 (Date Signed) 694686 (C-57 License Number)

DWR 188 REV 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0161497

Page 1 of 16

Owner's Well Number MW-67-185

Date Work Began 09/22/2011 Date Work Ended 9/23/2011

Local Permit Agency *No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic Drilling Fluid

Depth from Surface Feet	to Feet	Description Describe material, grain size, color, etc
0	21	Poorly Graded Sand (SP), light yellowish brown
21	24	Well Graded Sand (SW), yellowish brown
24	28	Boulder
28	40	Silty Sand (SM), yellowish brown
40	47	Poorly Graded Sand (SP), light yellowish brown
47	52	Silty Sand with Gravel (SM), yellowish brown
52	53	Poorly Graded Sand (SP), light yellowish brown
53	63	Lean Clay (CL), brown
63	64	Poorly Graded Sand (SP), light yellowish brown
64	73	Lean Clay (CL), brown
73	92	Silt (ML), brown
92	197	Well Graded Gravel (GW), dark grayish brown
197	211	Silt with Gravel (ML), dark brown
211	221	Well Graded Sand with Gravel (SW), dark brown
221	259	Silt with Gravel (ML), dark brown
259	260	Well Graded Sand with Gravel (SW), dark brown
260	264	Silt with Gravel (ML), dark brown
264	271	(BR) Conglomerate, yellowish red
271	273	(BR) Metadiorite

Total Depth of Boring 272.5 Feet

Total Depth of Completed Well 187 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg. Min. Sec. N Longitude Deg. Min. Sec. W

Datum NAD83 Decimal Lat. 2101040.21 Decimal Long. 7615335.6

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. **Please be accurate and complete.**

Activity

◉ New Well
○ Modification/Repair
○ Deepen
○ Other
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
◉ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 170 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	177	7	Blank	PVC Sch. 40	0.15	2.38	N/A	
177	187	7	Screen	PVC Sch. 40	0.15	2.38	Milled Slots	0.020

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	168	Cement	Portland Grout
168	175	Bentonite	
175	187	Filter Pack	#3 Monterey Sand

Attachments

☑ Geologic Log
☑ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name BOART LONGYEAR CO. (Person, Firm or Corporation)

2103 E AUGUSTA AVE (Address) GLENDALE (City) AZ (State) 85303 (Zip)

Signed (C-57 Licensed Water Well Contractor) 10/10/11 (Date Signed) 694686 (C-57 License Number)

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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File Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0161499

Page 1 of 16

Owner's Well Number MW-67-225

Date Work Began 04/29/2011 Date Work Ended 5/10/2011

Local Permit Agency *No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic Drilling Fluid

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
0	21	Poorly Graded Sand (SP), light yellowish brown
21	24	Well Graded Sand (SW), yellowish brown
24	28	Boulder
28	40	Silty Sand (SM), yellowish brown
40	47	Poorly Graded Sand (SP), light yellowish brown
47	52	Silty Sand with Gravel (SM), yellowish brown
52	53	Poorly Graded Sand (SP), light yellowish brown
53	63	Lean Clay (CL), brown
63	64	Poorly Graded Sand (SP), light yellowish brown
64	73	Lean Clay (CL), brown
73	92	Silt (ML), brown
92	197	Well Graded Gravel (GW), dark grayish brown
197	211	Silt with Gravel (ML), dark brown
211	221	Well Graded Sand with Gravel (SW), dark brown
221	259	Silt with Gravel (ML), dark brown
259	260	Well Graded Sand with Gravel (SW), dark brown
260	264	Silt with Gravel (ML), dark brown
264	271	(BR) Conglomerate, yellowish red
271	273	(BR) Metadiorite

Total Depth of Boring 272.5 Feet

Total Depth of Completed Well 225 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg. Min. Sec. N Longitude Deg. Min. Sec. W

Datum NAD83 Decimal Lat. 2101047.85 Decimal Long. 7615332.5

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

◉ New Well

○ Modification/Repair

○ Deepen

○ Other

○ Destroy

Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply

☐ Domestic ☐ Public

☐ Irrigation ☐ Industrial

○ Cathodic Protection

○ Dewatering

○ Heat Exchange

○ Injection

◉ Monitoring

○ Remediation

○ Sparging

○ Test Well

○ Vapor Extraction

○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 170 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	210	10	Blank	PVC Sch. 40	0.15	2.38	N/A	
210	225	10	Screen	PVC Sch. 40	0.15	2.38	Milled Slots	0.020

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	195	Cement	Portland Grout
195	206	Bentonite	
206	227	Filter Pack	#3 Monterey Sand

Attachments

☑ Geologic Log

☑ Well Construction Diagram

☐ Geophysical Log(s)

☐ Soil/Water Chemical Analyses

☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Boart Longyear Co.
Person, Firm or Corporation

1103 W Auqusta Ave Glendale AZ 85303
Address City State Zip

Signed
C-57 Licensed Water Well Contractor

10/10/11 694686
Date Signed C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0161504

Page 1 of 16

Owner's Well Number MW-67-260

Date Work Began 04/29/2011 Date Work Ended 5/10/2011

Local Permit Agency *No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic Drilling Fluid

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
0	21	Poorly Graded Sand (SP), light yellowish brown
21	24	Well Graded Sand (SW), yellowish brown
24	28	Boulder
28	40	Silty Sand (SM), yellowish brown
40	47	Poorly Graded Sand (SP), light yellowish brown
47	52	Silty Sand with Gravel (SM), yellowish brown
52	53	Poorly Graded Sand (SP), light yellowish brown
53	63	Lean Clay (CL), brown
63	64	Poorly Graded Sand (SP), light yellowish brown
64	73	Lean Clay (CL), brown
73	92	Silt (ML), brown
92	197	Well Graded Gravel (GW), dark grayish brown
197	211	Silt with Gravel (ML), dark brown
211	221	Well Graded Sand with Gravel (SW), dark brown
221	259	Silt with Gravel (ML), dark brown
259	260	Well Graded Sand with Gravel (SW), dark brown
260	264	Silt with Gravel (ML), dark brown
264	271	(BR) Conglomerate, yellowish red
271	273	(BR) Metadiorite

Total Depth of Boring 272.5 Feet

Total Depth of Completed Well 260 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg. Min. Sec. N Longitude Deg. Min. Sec. W

Datum NAD83 Decimal Lat. 2101047.85 Decimal Long. 7615332.5

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. **Please be accurate and complete.**

Activity

◉ New Well
○ Modification/Repair
○ Deepen
○ Other
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
◉ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 170 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	250	10	Blank	PVC Sch. 40	0.15	2.38	N/A	
250	260	6	Screen	PVC Sch. 40	0.15	2.38	Milled Slots	0.020

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	195	Cement	Portland Grout
195	206	Bentonite	
206	227	Filter Pack	#3 Monterey Sand
227	248	Bentonite	
248	269	Filter Pack	#3 Monterey Sand
269	273	Bentonite	

Attachments

☑ Geologic Log
☑ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Ronald Longyear Co. (Person, Firm or Corporation)

2103 W Augusta Ave (Address) Glendale (City) AZ (State) 85303 (Zip)

Signed (C-57 Licensed Water Well Contractor) 6/16/11 (Date Signed) 694686 (C-57 License Number)

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0161514

Page 1 of 17

Owner's Well Number MW-68-180

Date Work Began 05/13/2011 Date Work Ended 5/18/2011

Local Permit Agency *No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic Drilling Fluid

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
0	17	Poorly Graded Sand (SP), light yellowish brown
17	35	Silty Sand (SM), brown
35	62	Well Graded Sand with Gravel (SW), brown
62	243	Well Graded Gravel (GW), grayish brown
243	257	(BR) Conglomerate, red
257	281	(BR) Metadiorite, pale yellowish brown

Total Depth of Boring 280.5 Feet

Total Depth of Completed Well 180 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg. Min. Sec. N Longitude Deg. Min. Sec. W

Datum NAD83 Decimal Lat. 2100773.64 Decimal Long. 7615453.

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. **Please be accurate and complete.**

Activity

◉ New Well
○ Modification/Repair
○ Deepen
○ Other
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
◉ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 164 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	165	10	Blank	PVC Sch. 40	0.15	2.38	N/A	
165	180	10	Screen	PVC Sch. 40	0.15	2.38	Milled Slots	0.020

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	148	Cement	Portland Grout
148	162	Bentonite	
162	185	Filter Pack	#3 Monterey Sand

Attachments

☑ Geologic Log
☑ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Beaird Co/Yeaic Co. (Person, Firm or Corporation)

2103 W Augusta Ave (Address) Glendale (City) Az (State) 85303 (Zip)

Signed (C-57 Licensed Water Well Contractor) 10/4/12 (Date Signed) 694684 (C-57 License Number)

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0161516

Page 1 of 17

Owner's Well Number MW-68-240

Date Work Began 05/13/2011 Date Work Ended 5/18/2011

Local Permit Agency *No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic Drilling Fluid

Depth from Surface Feet	to Feet	Description Describe material, grain size, color, etc
0	17	Poorly Graded Sand (SP), light yellowish brown
17	35	Silty Sand (SM), brown
35	62	Well Graded Sand with Gravel (SW), brown
62	243	Well Graded Gravel (GW), grayish brown
243	257	(BR) Conglomerate, red
257	280	(BR) Metadiorite, pale yellowish brown

Total Depth of Boring 280.5 Feet

Total Depth of Completed Well 240 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg. Min. Sec N Longitude Deg. Min. Sec W

Datum NAD83 Decimal Lat. 2100773.64 Decimal Long. 7615453.6

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. **Please be accurate and complete.**

Activity

◉ New Well
○ Modification/Repair
○ Deepen
○ Other
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
◉ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 164 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	220	10	Blank	PVC Sch. 40	0.15	2.38	N/A	
220	240	6	Screen	PVC Sch. 40	0.15	2.38	Milled Slots	0.020

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	148	Cement	Portland Grout
148	162	Bentonite	
162	185	Filter Pack	#3 Monterey Sand
185	216	Bentonite	
216	243	Filter Pack	#3 Monterey Sand
243	250	Bentonite	

Attachments

☑ Geologic Log
☑ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Layne Christensen Co

Person, Firm or Corporation

7103 W August Ave Glendale AZ 85303

Address City State Zip

Signed

C-57 Licensed Water Well Contractor

10/10/12 Date Signed

1044686 C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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File Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0161521

Page 1 of 17

Owner's Well Number MW-68BR-280

Date Work Began 08/03/2011 Date Work Ended 8/11/2011

Local Permit Agency *No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic Drilling Fluid

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
0	17	Poorly Graded Sand (SP), light yellowish brown
17	35	Silty Sand (SM), brown
35	62	Well Graded Sand with Gravel (SW), brown
62	243	Well Graded Gravel (GW), grayish brown
243	257	(BR) Conglomerate, red
257	280	(BR) Metadiorite, pale yellowish brown

Total Depth of Boring 280.5 Feet

Total Depth of Completed Well 279 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg Min Sec N Longitude Deg Min Sec W

Datum NAD83 Decimal Lat. 2100763.09 Decimal Long. 7615453.8

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. **Please be accurate and complete.**

Activity

◉ New Well
○ Modification/Repair
○ Deepen
○ Other
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
◉ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 164 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	257	9	Blank	PVC Sch. 40	0.28	6.63	N/A	
257	279	3.8	Open hole				N/A	

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	257	Cement	Portland Grout
0	279	Open hole	

Attachments

☑ Geologic Log
☑ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Boart Longyear Co
Person, Firm or Corporation

703 W. August Ave Glendale AZ 85303
Address City State Zip

Signed
C-57 Licensed Water Well Contractor

10/10/12 694686
Date Signed C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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File Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0161521

Page 1 of 12

Owner's Well Number MW-69-195

Date Work Began 05/30/2011 Date Work Ended 6/22/2011

Local Permit Agency *No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic/Wireline Rotary Drilling Fluid

Depth from Surface Feet	to Feet	Description Describe material, grain size, color, etc
0	42	Well Graded Gravel (GW), light yellowish brown
42	196	(BR) Metadiorite, pale olive

Total Depth of Boring 196 Feet

Total Depth of Completed Well 196 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg. Min. Sec. N Longitude Deg. Min. Sec. W

Datum NAD83 Decimal Lat. 2100291.55 Decimal Long. 7615142.0

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. **Please be accurate and complete**

Activity

◉ New Well
○ Modification/Repair
○ Deepen
○ Other
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
◉ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 178 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	176	6	Blank	PVC Sch. 40	0.28	6.63	N/A	
176	197	6	Screen	PVC Sch. 40	0.15	2.38	Milled Slots	0.020

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	166	Cement	Portland Grout
166	173	Bentonite	
173	197	Filter Pack	#3 Monterey Sand

Attachments

☑ Geologic Log
☑ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other

Attach additional information, if it exists

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Doane Longyear Co.
Person, Firm or Corporation

7103 W Augusta Ave Glendale AZ 85303
Address City State Zip

Signed
C-57 Licensed Water Well Contractor

10/10/12 694686
Date Signed C-57 License Number

DWR 188 REV. 1/2006

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State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0161525

Page 1 of 14

Owner's Well Number MW-70-105

Date Work Began 05/24/2011 Date Work Ended 5/29/2011

Local Permit Agency *No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic/Wireline Rotary Drilling Fluid

Depth from Surface Feet	to Feet	Description Describe material, grain size, color, etc
0	69	Silty Sand (SM), yellowish brown
69	87	(BR),Weathered Metadiorite, yellowish brown
87	227	(BR) Metadiorite, dusky yellow green

Total Depth of Boring 227 Feet

Total Depth of Completed Well 105 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg. Min. Sec. N Longitude Deg. Min. Sec. W

Datum NAD83 Decimal Lat. 2100513.91 Decimal Long. 7615825.6

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. **Please be accurate and complete.**

Activity

◉ New Well

○ Modification/Repair

○ Deepen

○ Other

○ Destroy

Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply

☐ Domestic ☐ Public

☐ Irrigation ☐ Industrial

○ Cathodic Protection

○ Dewatering

○ Heat Exchange

○ Injection

◉ Monitoring

○ Remediation

○ Sparging

○ Test Well

○ Vapor Extraction

○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 78 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	85	6	Blank	PVC Sch. 40	0.28	6.63	N/A	
85	105	6	Screen	PVC Sch. 40	0.15	2.38	Milled Slots	0.020

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	59	Cement	Portland Grout
59	82	Bentonite	
82	108	Filter Pack	#3 Monterey Sand

Attachments

☑ Geologic Log

☑ Well Construction Diagram

☐ Geophysical Log(s)

☐ Soil/Water Chemical Analyses

☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name BOART LONGYEAR CO

Person, Firm or Corporation

2103 W Auguista Ave Glendale AZ 85303

Address City State Zip

Signed

C-57 Licensed Water Well Contractor

6/16/12

Date Signed

694680

C-57 License Number

DWR 188 REV. 1/2006

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Well Completion Report

Refer to Instruction Pamphlet

No. e0161537

Page 1 of 14

Owner's Well Number MW-70BR-225

Date Work Began 10/13/2011 Date Work Ended 10/22/2011

Local Permit Agency *No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Rotosonic/Wireline Rotary Drilling Fluid

Depth from Surface Feet	to Feet	Description Describe material, grain size, color, etc
0	69	Silty Sand (SM), yellowish brown
69	87	(BR),Weathered Metadiorite, yellowish brown
87	227	(BR) Metadiorite, dusky yeliow green

Total Depth of Boring 227 Feet

Total Depth of Completed Well 227 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg. Min. Sec. N Longitude Deg. Min. Sec. W

Datum NAD83 Decimal Lat. 2100513.04 Decimal Long. 7615840.6

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. **Please be accurate and complete.**

Activity

◉ New Well
○ Modification/Repair
○ Deepen
○ Other
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
◉ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 78 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	130	9	Blank	PVC Sch. 40	0.28	6.63	N/A	
130	229	3.8					N/A	

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	130	Cement	Portland Grout
0	229	Open hole	

Attachments

☑ Geologic Log
☑ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Boart Longyear Co. (Person, Firm or Corporation)

Address 7103 W Augusta Ave City Glendale State AZ Zip 85303

Signed (C-57 Licensed Water Well Contractor) Date Signed 10/10/12 C-57 License Number 694680

DWR 188 REV. 1/2006

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Well Completion Report

Refer to Instruction Pamphlet

No. e0161545

Page 1 of 6

Owner's Well Number MW-71-35

Date Work Began 09/12/2011 Date Work Ended 9/14/2011

Local Permit Agency *No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N Latitude W Longitude

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Wireline Rotary Drilling Fluid

Depth from Surface Feet	to Feet	Description Describe material, grain size, color, etc
0	35	Silty Sand (SM), dark yellowish brown
35	71	(BR) Conglomerate, dark reddish brown

Total Depth of Boring 71 Feet

Total Depth of Completed Well 36 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg Min Sec N Longitude Deg Min Sec W

Datum NAD83 Decimal Lat. 2101338.43 Decimal Long. 7616207.6

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North / West / East / South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. **Please be accurate and complete**

Activity

◉ New Well
○ Modification/Repair
○ Deepen
○ Other
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
◉ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 29 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	26	6	Blank	PVC Sch. 40	0.15	2.38	N/A	
26	36	6	Screen	PVC Sch. 40	0.15	2.38	Milled Slots	0.020

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	19	Cement	Portland Grout
19	24	Bentonite	
24	39	Filter Pack	#3 Monterey Sand
39	71	Bentonite	

Attachments

☑ Geologic Log
☑ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other

Attach additional information, if it exists

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name BOART LONGYEAR CO. (Person, Firm or Corporation)

2103 W Hueysha Ave (Address) Glendale (City) AZ (State) 85303 (Zip)

Signed (C-57 Licensed Water Well Contractor) 10/10/12 (Date Signed) 694686 (C-57 License Number)

DWR 188 REV 1/2006

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Well Completion Report

Refer to Instruction Pamphlet

No. e0161539

Page 1 of 12

Owner's Well Number MW-72-80

Date Work Began 08/20/2011 Date Work Ended 8/29/2011

Local Permit Agency *No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only -- Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Wireline Rotary Drilling Fluid

Depth from Surface Feet	to Feet	Description Describe material, grain size, color, etc
0	4	Silty Sand (SM), brown
4	13	Well Graded Sand (SW), light brownish gray
13	200	(BR) Metadiorite, dusky yellow green

Total Depth of Boring 200 Feet

Total Depth of Completed Well 80 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg. Min. Sec. N Longitude Deg. Min. Sec. W

Datum NAD83 Decimal Lat. 2100674.4 Decimal Long. 7617083.4

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. **Please be accurate and complete.**

Activity

◉ New Well
○ Modification/Repair
○ Deepen
○ Other
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
◉ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 58 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	60	6	Blank	PVC Sch. 40	0.15	2.38	N/A	
60	80	6	Screen	PVC Sch. 40	0.15	2.38	Milled Slots	0.020

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	42	Cement	Portland Grout
42	58	Bentonite	
58	81	Filter Pack	#3 Monterey Sand

Attachments

☑ Geologic Log
☑ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Boart Longyear Co
Person, Firm or Corporation

10340 Augusta Ave Glendale AZ 85303
Address City State Zip

Signed
C-57 Licensed Water Well Contractor

10/16/12 694686
Date Signed C-57 License Number

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Well Completion Report

Refer to Instruction Pamphlet

No. e0161543

Page 1 of 12

Owner's Well Number MW-72BR-200

Date Work Began 06/20/2012 Date Work Ended 6/27/2012

Local Permit Agency *No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only -- Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Wireline Rotary Drilling Fluid

Depth from Surface Feet	to Feet	Description Describe material, grain size, color, etc
0	4	Silty Sand (SM), brown
4	13	Well Graded Sand (SW), light brownish gray
13	200	(BR) Metadiorite, dusky yellow green

Total Depth of Boring 200 Feet

Total Depth of Completed Well 200 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg Min Sec N Longitude Deg Min Sec W

Datum NAD83 Decimal Lat. Decimal Long.

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc, and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

◉ New Well

○ Modification/Repair

○ Deepen

○ Other

○ Destroy

Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply

☐ Domestic ☐ Public

☐ Irrigation ☐ Industrial

○ Cathodic Protection

○ Dewatering

○ Heat Exchange

○ Injection

◉ Monitoring

○ Remediation

○ Sparging

○ Test Well

○ Vapor Extraction

○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 58 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	107	10	Blank	PVC Sch. 40	0.28	6.63	N/A	
107	200	3.8	Open hole				N/A	

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	107	Cement	Portland Grout
0	200	Open hole	

Attachments

☑ Geologic Log

☑ Well Construction Diagram

☐ Geophysical Log(s)

☐ Soil/Water Chemical Analyses

☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Boart Longyear Co

Person, Firm or Corporation

2103 W Auguste Ave Glendale Az 85303

Address City State Zip

Signed

C-57 Licensed Water Well Contractor

10/10/12 694686

Date Signed C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0161547

Page 1 of 7

Owner's Well Number MW-73-80

Date Work Began 09/24/2011 Date Work Ended 9/29/2011

Local Permit Agency *No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Wireline Rotary Drilling Fluid

Depth from Surface Feet	to Feet	Description Describe material, grain size, color, etc
0	7	Silty Sand (SM), brown
7	81	(BR) Metadiorite, yellow green

Total Depth of Boring 81 Feet

Total Depth of Completed Well 81 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg. Min. Sec. N Longitude Deg. Min. Sec. W

Datum NAD83 Decimal Lat. 2100676.5 Decimal Long. 7617554.9

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. **Please be accurate and complete.**

Activity

◉ New Well
○ Modification/Repair
○ Deepen
○ Other
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
◉ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 52 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	60	6	Blank	PVC Sch. 40	0.15	2.38	N/A	
60	80	6	Screen	PVC Sch. 40	0.15	2.38	Milled Slots	0.020

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	52	Cement	Portland Grout
52	56	Bentonite	
56	81	Filter Pack	

Attachments

☑ Geologic Log
☑ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Boart Longyear Co
Person, Firm or Corporation

2103 W Auqusta Ave Glendale AZ 85303
Address City State Zip

Signed 10/10/12 644680
C-57 Licensed Water Well Contractor Date Signed C-57 License Number

DWR 188 REV. 1/2006

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State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0161548

Page 1 of 14

Owner's Well Number MW-74-240

Date Work Began 10/07/2011 Date Work Ended 10/12/2011

Local Permit Agency *No permit required by CERCLA exemption

Permit Number * Permit Date

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Wireline Rotary Drilling Fluid

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
0	2	Road Base
2	240	(BR) Metadiorite, dusky yellow green

Total Depth of Boring 240 Feet

Total Depth of Completed Well 240 Feet

Well Owner

Name Pacific Gas & Electric

Mailing Address PO Box 337

City Needles State CA Zip 92363

Well Location

Address

City Topock County San Bernardino

Latitude Deg. Min. Sec. N Longitude Deg. Min. Sec. W

Datum NAD83 Decimal Lat. 2100017.5 Decimal Long. 7615237.7

APN Book Page Parcel

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc, and attach a map. Use additional paper if necessary. **Please be accurate and complete.**

Activity

◉ New Well

○ Modification/Repair

○ Deepen

○ Other

○ Destroy

Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply

☐ Domestic ☐ Public

☐ Irrigation ☐ Industrial

○ Cathodic Protection

○ Dewatering

○ Heat Exchange

○ Injection

◉ Monitoring

○ Remediation

○ Sparging

○ Test Well

○ Vapor Extraction

○ Other

Water Level and Yield of Completed Well

Depth to first water (Feet below surface)

Depth to Static Water Level 213 (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	220	6	Blank	PVC Sch. 40	0.15	2.38	N/A	
220	240	6	Screen	PVC Sch. 40	0.15	2.38	Milled Slots	0.020

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	213	Cement	Portland Grout
213	218	Bentonite	
218	241	Filter Pack	#3 Monterey Sand

Attachments

☑ Geologic Log

☑ Well Construction Diagram

☐ Geophysical Log(s)

☐ Soil/Water Chemical Analyses

☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Boart Longyear Co (Person, Firm or Corporation)

7103 W Augusta Ave (Address) Glendale (City) AZ (State) 85303 (Zip)

Signed (C-57 Licensed Water Well Contractor) 10/10/12 (Date Signed) 694686 (C-57 License Number)

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

Attachment B
Field Screening Data

Attachment B-1
Hydrophysical Data

Integrated Subsurface Evaluation

May 30, 2012

Mr. Mike Cavaliere
CH2MHill
155 Grand Avenue, Suite 1000
Oakland, CA 94612

RE Hydrophysical Logging and Wireline Straddle Packer Testing, PG&E Topock Compressor Station, Needles, California

Dear Mr. Cavalier:

RAS, Inc., Integrated Subsurface Evaluation (RAS) is pleased to provide this draft letter report of hydrophysical logging (HPL) and wireline straddle packer (WSP) testing at the PG&E site in Topock, California. This letter report presents the results from our HPL and WSP conducted in wells MW-60BR and MW-70BR.

INTRODUCTION

During the period from October 11 through November 7, 2011, RAS conducted borehole hydrophysics in two wellbores at the PG&E Topock Compressor Station in Needles, California. This work was performed for Northstar Environmental Remediation of Lake Forest, CA (Northstar) under contract to CH2MHill of Oakland, CA, in support of their contaminant migration investigation.

The objective of this work was to employ borehole hydrophysical and packer pressure testing methods to provide additional data for evaluation of the groundwater contaminant plume and to evaluate preferential groundwater migration pathways at the subject site.

Details of field activities can be found in the field notes and daily reports Appendix A of this report. Data processing and analysis notes for each well are included in Appendix B. Data montages are included in Appendix C.

SCOPE OF WORK

Well MW-60BR

RAS mobilized to Needles, California on October 10 and 11, 2011 and arrived at the site at approximately 1030 hours on October 11, 2011. Upon arrival at the site, RAS staff met with Mike Cavaliere of CH2MHill and discussed the scope of work to be conducted and the planned schedule. RAS also attended a site health and safety briefing, with CH2MHill staff.

On October 11, RAS conducted site setup activities at MW-60BR, which included equipment set up and check out, tool calibration, and initial decontamination of all downhole equipment. As reported by CH2MHill staff, MW-60BR was drilled to an approximate total depth of 244 feet below ground surface (ft bgs). PVC surface casing was installed to a depth of approximately 136 ft bgs. A casing stick-up height of 0.91 feet was measured for reference, however all depths were measured and reported herein as from ground surface. Ambient depth to water was measured at 98.51 ft bgs. Also, on October 11, RAS conducted an ambient fluid electrical conductivity (FEC) and temperature log. After which, an extraction pump (inlet at 243 ft bgs) was installed.

On October 12, 2011 RAS conducted a second ambient FEC and temperature log in this well, and began generation of deionized (DI) water for emplacement in preparation for ambient flow characterization (AFC). The ambient FEC and temperature log are presented in the HPL processing notes in Appendix B. The FEC log displays no significant step changes with depth. However a slight increase with depth is noted. The temperature log displays a typical geothermal gradient with a distinct increase in temperature at a depth of 236 ft bgs. The temperature increased from about 27 to 28.5 degrees Centigrade (C) over the saturated interval of 98.5 to 239 feet.

DI water emplacement was then conducted, and AFC initiated. Approximately 280 gallons of DI water were emplaced during AFC. Due to the slow recharge rate under ambient pressure conditions, logging was conducted over two days during recovery. FEC and temperature logs conducted during AFC on October 12 and 13 are included in Appendix B. Analysis of these logs using the centroid and integral methods suggest the presence of six water bearing intervals. However, analysis suggests an inflow rate of less than 0.001 gallon per minute (gpm) for the entire saturated interval. As such, the observable and recorded increase in FEC suggests both primary and secondary flow. As discussed below, additional flow during stressed conditions testing allowed the six intervals to be combined into two distinct flow zones for quantification. The upper four flow intervals, from 138 to 190 ft bgs, were combined and the lower two intervals from 200 to 240 ft bgs were combined.

On October 14 and 15, 2011, hydro-geologic evaluation of the subject well by slug after emplacement (SAE) testing was conducted. Two slug tests, a 20-foot removal and a 25-foot removal, were conducted on October 14. On October 15, 2011, an approximate 30-foot slug was removed. SAE logging was conducted on October 14 and 15, 2011 after removal of each slug. Analysis of the data collected during this testing suggested that the combined upper four intervals, from 138 to 190 ft was inflowing at 0.012 gpm and the lower interval from 200 to 240 was flowing at 0.14 gpm. These interval specific flow rates, resulted in interval specific hydraulic conductivity for the intervals at 138 to 190 and 200 to 240 ft of 0.06 and 2.07 ft/day, respectively. The HPL results also suggested that the upper and deeper flow intervals had interval specific FEC of about 20,000 µS/cm. Please refer to Appendix B for HPL data analysis details and a summary table of these results.

Upon completion of HPL in well MW-60BR, the RAS field crew demobilized from the site. RAS remobilized to the site on November 1, 2011. Based on the results of the HPL, during the second mobilization to the site on November 2 and 3, 2011, WSP conducted WSP pressure testing in well MW-60BR. On November 2, 2011, RAS installed the WSP as a single packer installation from 235 to 240 feet. Pressure data collected during sampling from within and above this interval suggest no apparent intra-formation hydraulic connection with the open water bearing interval.

On November 3, 2011, RAS installed a WSP at between 160 and 179 feet bgs. Upon completion of inflation, and isolation of the 19-foot packed interval, development pumping was conducted from the packed interval and pressure was logged within and both above and below the packed interval. A steady decrease in pressure in the zone above the packers (above 158 feet) during pumping suggests a hydraulic connection between the packed interval and the shallower portion of the aquifer.

Also on November 3, 2011, RAS installed a WSP at between 140 and 149 feet bgs. Upon completion of inflation, development pumping was conducted from the packed interval and pressures were logged within and both above and below the packed interval. A steady decrease in pressure in the zone above the packers during pumping suggests a hydraulic connection between the packed interval and the shallower portion of the aquifer. Please refer to Appendix B for HPL data analysis details and a summary table of these results.

Groundwater samples were collected during each of the pumping events. Chromium IV concentrations were provided to RAS and were reported be 130 micrograms per liter (µg/L), 290 µg/L, and 78 µg/L from the intervals between 140 and 149 feet bgs, 160 and 179 feet bgs, and 235 and 240 feet bgs, respectively. These data are included on the montage for MW-60BR.

Well MW-70BR

During the period from November 3 to November 7, 2011, RAS conducted hydrophysical logging in well MW-70BR. After equipment set-up, check out and calibration, all downhole equipment was decontaminated. As reported by CH2MHill staff, MW-70BR was drilled to an approximate total depth of 225 ft bgs. PVC surface casing was installed to a depth of approximately 128 ft bgs. A casing stick-up height of 2.4 feet was measured for reference, however all depths were measured and reported herein as from ground surface. Ambient depth to water was measured at 78.0 ft bgs. On November 3, RAS installed an extraction pump (inlet at 224 ft bgs) and, prior to pump installation, conducted an ambient FEC and temperature log.

The ambient FEC and temperature log is presented in the HPL Processing Notes for well MW-70BR in Appendix B. The FEC log displays a steady increase in FEC with depth with no significant distinct step changes. The temperature log displays a typical geothermal gradient with no discerning features of note. The temperature increased from about 28 to 29.7 degrees C over the saturated interval of 128 (bottom of casing) to 224 feet.

On November 5, 2011 RAS conducted a second ambient FEC and temperature log, and then began generation of DI water for emplacement in preparation for AFC. The FEC log displays no significant step changes with depth. However as with the previous days' FEC log, a steady increase in FEC with depth is noted. The temperature log displays a typical geothermal gradient with no discerning features of note.

DI water emplacement was then conducted, and AFC was initiated. Approximately 295 gallons of DI water were emplaced during AFC. Due to the slow recharge rate under ambient pressure conditions, logging was conducted over two days during recovery (November 5 and 6, 2011). FEC and temperature logs conducted during AFC are included in Appendix B. Analysis of these logs using the centroid and integral methods suggest the presence of one, distinct water bearing interval near the bottom of the well. Analysis of data from both days suggests an overall total inflow rate of less than 0.013 gpm for the entire saturated interval, and all quantifiable flow from the one distinct interval at the bottom of the well (below 219 ft bgs). As such, the observable and recorded increase in FEC suggests a small amount of primary flow from the entire saturated interval, and some additional flow with within the one flow zone at the bottom of the well. As discussed below, no additional inflow was observed during stressed condition testing over the remaining saturated interval.

On November 7, 2011, additional aquifer evaluation by slug test (rising head) after DI water emplacement testing was conducted with a water level head displacement of about 4 to 5 feet. Three slug tests were conducted. The largest drawdown of about 5.05 feet, was measured during the third slug.

SAE logging was conducted after removal of each slug and, contemporaneously, pressure data was recorded. Analysis of these logs using the centroid and integral methods suggest the presence of very low-rate horizontal flow occurring from a single interval at the bottom of the well (below 219 feet bgs). This interval contributed all of the flow during SAE testing. The pumping rate of 3.2 gpm resulted in an estimated hydraulic conductivity for the interval below 219 feet of 14.6 ft/day. The HPL results also suggested that this single flow interval had interval specific FEC of about 16,000 µS/cm. Please refer to Appendix B for HPL data analysis details and a summary table of these results.

Upon completion of HPL in well MW-60BR, the RAS field crew demobilized from the site.

CONCLUSIONS

Ambient flow characterization (native flow during ambient or background pressures conditions) was conducted in each well. In both wells, ambient flow was observed to be occurring at extremely low flow rates during the period of our testing. Overall ambient flow ranged from less than 0.001 to 0.013 gallons gpm. The lowest ambient flow was observed in well MW-60BR, where flow over the entire water bearing intervals (possibly via primary porosity) occurred at less than 0.001 gpm. The highest ambient flow rate was observed in Well MW-70BR at 0.013 gpm for the single water bearing interval.

Flow evaluation was also conducted during stressed conditions where flow was induced into the wellbore by slug testing methods. Aquifer conditions did not permit constant rate pumping to be conducted and were such that slug test procedures were required. The results of this testing suggested that the water bearing intervals are very low flowing units. The lowest interval specific flow rate occurred over the entire saturated portion of well MW-60BR (0.012 gpm) and the greatest interval specific flow rate occurred in Well MW-70BR of 3.2 gpm.

Hydraulic conductivity estimates were intended to be preliminary in nature and were not based on any site specific algorithms that may have been developed by others. Estimates are presented in the summary table for each well. In summary, the resulting interval specific hydraulic conductivity estimates ranged from 0.06 to 14.6 feet per day.

MW-60BR

Analysis of the data collected during AFC and SAE testing in well MW-60BR supports the very low flow ambient condition and suggests the presence of both primary and secondary flow. Analysis of the data suggests that the total ambient flow for the water bearing intervals was less than 0.001 gpm. No distinct flow zones

could be identified during ambient flow, suggesting primary flow with no preferential flow paths.

During SAE, the overall flow rate for the entire saturated interval was approximately 0.15 gpm. While six distinct flow zones were identified, the extremely low flow rate prevented quantification of flow without combining intervals. The very low inflow rate is also supported by the water level recovery curve. Based on the rising head data, a hydraulic conductivity based on Hvorslev (1951) of 2.07 feet per day was calculated for the productive flow zone at the bottom of the well.

Results of packer pressure testing in MW-60BR suggests a hydraulic connection between the packed intervals (160 to 179 and 140 to 149 feet) and the upper portions of the aquifer.

The HPL results also suggested an interval specific formation water concentration of 20,000 µS/cm for the saturated interval.

MW-70BR

Analysis of the data collected during AFC and SAE testing in well MW-70BR supports the very low flow ambient condition and suggests the presence of primary flow. Analysis of the data suggests that the total ambient flow over the entire saturated interval was less than 0.013 gpm. No distinct flow zones could be identified during ambient flow, suggesting primary flow with no preferential flow paths.

Analysis of data collected during SAE testing suggests the presence of one, distinct water bearing interval near the bottom of the well (below 219 ft bgs). Based on the rising head data, a hydraulic conductivity of 14.6 feet per day was calculated for the single identified water bearing interval at a depth of 220 to 229 feet (total depth).
The HPL results also suggested an interval specific formation water concentration of 16,000 µS/cm for the saturated interval.

Please refer to Appendix B for HPL data analysis details and a summary table of the results for each well.

We appreciate the opportunity to work with you on this project.

Please call with any questions.

Best Regards,
RAS, Inc.

Steven R Truesdale

Steven R. Truesdale, PG

APPENDIX A

FIELD NOTES AND DAILY REPORTS

311 Rock Avenue • Golden, CO 80401
Website: www.rasinc.org
Phone: 303.526.4432 • FAX: 303.526.4426

FIELD NOTES

Integrated Subsurface Evaluation

Job TCPOCK
Well MW-60BR - 225
Activity HPL SETUP
Date 10/11/11
Page 1 of 1

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1000		DEPART	HOTEL			
1020		MEET W/ MARK @ PARK McABI EXIT				
1070		ONSITE				
1040		MEET W/ MIKE - CH2MHILL				
1045		WELL RECON				
1100		UNLOAD EQUIPMENT ON DECON PAD				AND DI GEN. FOR MIKE TO P/U
1115		ON WELL - SETUP ON WELL				
1245		BARRY - CH2MHILL H+S OFFICER				- SITE SENSITIVITY MEETING
1315		RESUME SETUP				
1320	98.51'	STICKup = - 0.96'				TOW @ GS = 99.47'
1345	JM	SETUP D.I. GENERATION W/ MIKE				
1430		MIKE, MARK, + JIM MOVE D.I.				THANKS TO COMPRESSOR STATION
1450		SEE MARKS NOTES FROM HERE ON...				

Engineer's Name

CLIENT ~~MW~~ CH2MHILL/NORTHSTAR

JOB NO. Torock

*ALL DEPTHS REFERENCED TO: GROUND SURFACE X

STICKUP .96 TOP OF CASING

WELL I.D. MW 60BR225

DATE 10/11/11 -

DESIGN SETTINGS	ACTUAL SETTINGS
PUMP INLET 243'	
TOP OF TEST INTERVAL 110'	
BOTTOM OF CASING 136'	
AMBIENT WL 98.51	
PRESSURE TRANSDUCER 150'	
BOTTOM OF TEST INTERVAL 239'	
DI INJECTION 80-85'	
TOTAL DEPTH 244	

TESTING PROTOCOL - ACTION ITEMS

PUMP TYPE 15-290

OROFICE NO. N/A

INJ PUMP TYPE BOOSTER 1/2 H.P.

SEPARATE GENERATOR 5500 HONDA

TEST/ACTION #1 EMPLX

PUMPING RATE 5.5 gpm

INJECTION RATE 6 gpm

TEST #2 EMPLX FOR SAE

PUMPING RATE 5.5 gpm

INJECTION RATE 6 gpm

TEST #3

PUMPING RATE

INJECTION RATE

TEST#4

PUMPING RATE

INJECTION RATE

TEST #5

PUMPING RATE

INJECTION RATE

RAS
Integrated Subsurface Evaluation
311 Rock Avenue • Golden, CO 80401
PH 303.526.4432 • FAX 303.526.4426
email: PedlerRAS@aol.com • www.rasinc.org

311 Rock Avenue • Golden, CO 80401
Website: www.rasinc.org
Phone: 303.526.4432 • FAX: 303.526.4426

FIELD NOTES

Job TOPOCK
Well MW 60BR-225
Activity HPL
Date 10/12/11
Page 1 of 2

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
0650		DRIVE TO TOPOCK				
0713		ARRIVE AT TOPOCK				
0715		HEALTH & SAFETY PROCEDURES				
0820		ARRIVE AT WELL SITE				
0820		RIG UP HPL TOOL FOR CALIBRATION				CALFICE(3)
0835			98.55 + 0.96 = 99.51			TOTAL DEPTH OF WATER
0847			TOOL LENGTH 6.25			
0850		PRELOG CAL CHECK				
0851		TEMP STABALIZE LOG				
0852		SEND TOOL TO		110.00'		FOR TEMP STABILIZE
0905		AMBIENT LOG				- 239.72 T.D
	LOG 1	AMBIENT LOG				239.00
			ASDE 180.00 -			
0920		SET UP FOR EMPLACEMENT, RUN HOSES, LAY DOWN				
		MORE PLASTIC BARRIERS FOR SPILL CONTAINMENT				
		SET UP MANIFOLD, RUN INJECTION LINE DOWNHOLE				
1007		TURN ON PUMPS FOR EMPLX				
			DATUM	95'		
			LOG INT.	95 → 239'		
		PIPE WAS LEAKING AND DRAWDOWN OCCURED				
1010		JIM WAS FIXING LEAK AND MSS DIDN'T				
		NOTICE DRAWDOWN ALSO TOOL ENTERING				
		CREATED SPIKE				
1013	LOG 2	EMPLX LOG 1		95 → 239		
		ASDE	95.00 →	95.07		= 0.07
1027	LOG 3	EMPLX LOG 2		95.00		-239.00
		ASDE	95.00 →	94.99		= 0.01
1041	LOG 4	EMPLX LOG 3		95.00		- 239.
		ASDE		95.00 →	94.99	= 0.01
1053	LOG 5	AFC 1 (BACKGROUND LOG WHILE PUMPING)				95 → 239
		ASDE	95.00 →	95.02		= 0.02
1163		PUMPS	OFF			

Engineer's Name MSS/JDW

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Website: www.rasinc.org
Phone: 303.526.4432 • FAX: 303.526.4426

FIELD NOTES

Job TOPOCK
Well MW 60BR-225
Activity HPL
Date 10/12/11
Page 2 of 2

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1107		PRESSURE		STABILIZATION		
1110		Bailed	OFF	1 FOOT OF HEAD BEFORE AFC 2		
1133	LOG 6	AFC 2		95 - 239		
		ASDE		95.00 → 95.01 = 0.01		
1215	LOG 7	AFC	3	110.00 → 239.00		
1233			ASDE	110.00 → 109.96 = 0.04		
		MADE	NEW	DATUM POINT AT 110' SO AS TO		
		NOT	BRING	TOOL OUT OF WATER		
1300	LOG 8	AFC	4	110.00 — 239.00		
			ASDE	110.00 - 110.00 = 0.00		
1400	LOG 9	AFC	5	110.00 — 239.00		
			ASDE	110.00 - 109.98 = 0.02		
1500	LOG 10	AFC	6	110.00 — 239.00		
			ASDE	110.00 — 109.97 = 0.03		
1600	LOG 11	AFC	7	110.00 — 239.00		
			ASDE	110.00 — 109.99 = 0.01		
1700	LOG 12	AFC	8	110.00 — 239.00		
			ASDE	110.00 — 109.92 = 0.08		
1721		POST LOG CAL CHECK				
1739		BACK UP DATA				
1747		DRIVE TO HOTEL				
1810		BACK AT HOTEL				

Engineer's Name MJS/JDW

554 Orchard Street Unit 4, Golden, Colorado 80401
Website: www.rasinc.org
Phone: 303.526.4432 FAX: 303.526.4426

HC PUMPING NOTES

Project: Torock H&L 2011
Well: MW 66BR -225
Activity: Emflux / AFC
Date: 10/12/11
Page 1 of

Real Time	Depth to Water	Injection						Extraction						Discharge	Comments
		Pump Start	Manifold Gauge Pressure	Flow Rate (gpm)	Conduct (uS/cm)	Temp (° C)	Pump Stop	Pump Start	Manifold Gauge Pressure	Flow Rate (gpm)	Conduct (uS/cm)	Temp (° C)	Pump Stop	In ? sec	
1007		X						X							
1016			60	~5.5	1.9	28.7			100	~5.0	17,960	28.9			
1021			60	~6.0	1.3	28.5			100	~5.0	17780	28.4			
1026			60	~6.0	1.5	28.6			100	~5.0	6160	27.9			
1031			60	~6.0	1.2	28.9			100	~5.0	2630	28.8			
1036			60	~6.0	1.2	28.8			100	~5.0	1600	28.7			
1041			60	~6.0	1.2	28.7			100	~5.0	745	28.8			
1046			60	~6.0	1.2	28.8			100	~5.0	315	28.7			
1051			60	~6.0	1.2	28.7			100	~5.0	176.0	28.9			
1056			60	~6.0	1.2	28.7			100	~5.0	114.2	29.0			
1101			60	~6.0	1.2	28.8			100	~5.0	126.8	28.9			
1103			60	~6.0	1.2	28.7			100	~5.0	98.2	28.7			
1104							X						X		NO MORE D.I.

Engineer's Name:

311 Rock Avenue • Golden, CO 80401
Website: www.rasinc.org
Phone: 303.526.4432 • FAX: 303.526.4426

Integrated Subsurface Evaluation

FIELD NOTES

Job TOPOCK
Well MW 60BR-225
Activity HPL
Date 10/13/11
Page 1 of 2

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
0645		LEAVE HOTEL FOR WELL SITE				
0710		ARRIVE AT WELL SITE				
0730		Readjusted (minor) to CALIBRATION				
0735		PRECAL CHECK				
		NOTEABLE SPREAD IN 40,000 CAL TUBE				
		DIDN'T WANT TO CHANGE CAL #'S TOO MUCH B/C				
		OF AFC DAY 2 DATA BEING → 55 µs @ 19.8°C				
		97.55 + .96 = 98.51 → 37,300 @ 18.2°C				
0800		SENDING TOOL DOWN FOR TEMP STABILIZE @ 110.00'				
		TOOL LENGTH 6.73 Reference to ground level				
0804		DATUM = 110'.00				
0805		TEMP STABILIZE				
0810	LOG 1	AFC	DAY 2 LOG 1			110.00 − 239.00
			ASDE	110.00	—	109.96 = 0.04
0900	LOG 2	AFC	DAY 2 LOG 2	110	− 239.00	
			ASDE	110.00	—	109.96 = 0.04
1000	LOG 3	AFC	DAY 2 LOG 3	110'	− 239'	
			ASDE	110.00	− 110.00 = 0.00	
1100	LOG 4	AFC	DAY 2 LOG 4	110'	− 239'	
			ASDE	110.00	− 109.94 = 0.06	
1200	LOG 5	AFC	DAY 2 LOG #5	110'	− 239'	
			ASDE	110.00	− 109.83 = 0.17	
1220		BACK UP DATA SEND TO BILL FOR INTERPRETATION				
1301	LOG 6	AFC	DAY 2	LOG 6	110'	-239'
			ASDE	(110 − 109.94)	=	0.06'
1400	LOG 7	"		"	"	"
			ASDE	(110' − 109.95)	=	0.05
1500	LOG 8	AFC	DAY 2	LOG 8	110'	-239'
			ASDE	110.00 −	109.93	= 0107
1600	LOG 9	AFC	DAY 2	LOG 9	110	-239'
			ASDE	110.00 −	110.07	= 0.07

Engineer's Name MSS/JDW

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Website: www.rasinc.org
Phone: 303.526.4432 • FAX: 303.526.4426

FIELD NOTES

Integrated Subsurface Evaluation

Job ToRock
Well MW 60BR-225

Activity HPC

Date 10/13/11
Page 2 of 2

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1700	LOG 10	AFC	DAY 2	LOG 10	110' - 259'	
			ASDE	110.00 —	110.09	
1722		POST LOG CAL CHECK (TOOL WAS PUT IN 4000 tube on accident)				
1733	1733	DEPART WELL SITE FOR HOTEL				
1800		ARRIVE AT HOTEL				

Engineer's Name MJS/JDW

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Integrated Subsurface Evaluation
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Website: www.rasinc.org
Phone: 303.526.4432 • FAX: 303.526.4426

FIELD NOTES

Job Toprock
Well MW 60BR-225
Activity HPL
Date 10/14/11
Page 1 of

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
0650		LEAVE	HOTEL			
0713		ARRIVE AT WELL SITE				
		WATER LOG	97.60 + .94	=	98.56	
			TOOL LENGTH	6.34		[redacted]
0730		PU	UP TOOL / COMPUTER			
0756		PRE CAL LOG CHECK		MINOR ADJUSTMENTS MADE		
[redacted]	0822		TEMP STABILIZE @	110.00'		
	LOG 1		AFC	DAY 3 110' - 239'	LOG 1	
0846			ASDE -	(110 - 109.93)	= 0.07	
0857		TURNED ON	PUMPS			
0903	LOG 2		EMPL x	110' - 239'	LOG 1	
			ASDE	110.00 - 110.07	= 0.07	
	LOG 3		EMPL x	110' - 259	LOG 2	
			ASDE	110.00 - 109.93	= 0.07	
	*		TOOL	NOT BEHAVING	CORRECTLY.	
			BRINGING	OUT OF WELL	TO RECAL	
	*		STILL	NOT WORKING	CORRECTLY ??	
0942		PUMPS	OFF			
0943	*	PUT A LITTLE	HEAD ON	WELL	B/C VALVE LEFT OPEN	
	*	TOOL NOT RESPONDING	CORRECTLY	?? STILL AFTER RECAL?		
0950		BROUGHT	OUT OF	WELL TO REBUILD	+ RECAL	
		REBUILT	TOOL -	STILL NOT	WORKING IN 40K	
1115	R.C.D	RUN TOOL	@ 4K -	THEN LOCK		
1120		CAL 4K + LOCK	RANGE			
1149		TEMP	STABILIZING	TOOL		
1201	LOG 4	SAE -	BACKROUND	LOG		
		SLUG	20'			
		PUMP	OFF			
1215	LOG 5	SAE				
		ASDE	(110' -	109.96)	= 0.04'	
1222	LOG 6	SAE	2			
		ASDE	(110' -	109.955	= 0.05'	

530 891 8045

Engineer's Name MJS/JDW

RAS
Integrated Subsurface Evaluation
311 Rock Avenue • Golden, CO 80401
Website: www.rasinc.org
Phone: 303.526.4432 • FAX: 303.526.4426

FIELD NOTES

Job Topock
Well MW 60BR-225
Activity HPC
Date 10/14/11
Page 2 of 2

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1242		LOG 7	SAE 3			
			ASDE (110' -	109.97)	= 0.03'	
1254		LOG 8	SAE 4			
			ASDE (110'	- 109.98)	= 0.02'	
1323		LOG 9	SAE 5	SLUG	25'	110'-239'
			ASDE (110	- 110.00)	= 0.00	
1335		LOG 10	SAE 6	SLUG		
			ASDE (110	- 110.06)	= 0.06	
1347		LOG 11	SAE 7			
			ASDE	(110 —	110.04)	= 0.04
1401		LOG 12	SAE 8			
			ASDE	(110 —	110.01)	= 0.01
1415		LOG 13	SAE 9			
			ASDE	(110 —	110.03)	= 0.03
1434		LOG 14	SAE 10			
			ASDE	(110 -	110.01)	= 0.01
1455		POST	LOG	CAL	CHECK	
		USE A 20,000 MIX Cal tube as well as D.I & 4000				
1505		BACK UP DATA PHONE CALL WITH BILL				
		TALKED WITH CLIENT (MIKE) AND DECIDED TO				
		DE-WATER WELL WATER TO DEVELOP WELL ONE MORE				
		TIME FOR ACCURATED TO EXPEDITE PACKARD SAMPLING				
1600		PULLED PUMP & PIPE FROM WELL				
		TOOL	DATA			
		CH 1	= CH4			
1635		CH 2	= CH 2	CHANNEL		POSITIONS DETERMINED
		CH 3	= CH 1			
		CH 4	= CH 3			
1657		RIG DOWN		HPC AND		CLEAN WELL SITE FOR W.S.P.
1701		LEAVE		WELL SITE		
1730		ARRIVE AT HOTEL				

Engineer's Name MJS/JDW

554 Orchard Street Unit 4, Golden, Colorado 80401
Website: www.rasinc.org
Phone: 303.526.4432 FAX: 303.526.4426

HC PUMPING NOTES

Project Tobyhanna 2011 Activity: EMPLX FOR SAE Date: 10/14/11
Well: _____ _____ Page 1 of _____

Real Time	Depth to Water	Injection						Extraction						Discharge ___ in __?__ sec	Comments
		Pump Start	Manifold Gauge Pressure	Flow Rate (gpm)	Conduct (uS/cm)	Temp (° C)	Pump Stop	Pump Start	Manifold Gauge Pressure	Flow Rate (gpm)	Conduct (uS/cm)	Temp (° C)	Pump Stop		
0857		X						X							
0904				6.0	3.3	27.7				5.5	286	28.3			
0910				6.0	3.0	27.8				5.5	266	28.2			
				6.0	1.8	28.0				5.0	130	28.1			
				6.0	1.7	28.7				5.0	42.0	28.8			
										5.0	37.5	28.7			
											31.5				

Engineer's Name: _____

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FIELD NOTES

Job Topock
Well MW 60BR-225
Activity HPL
Date 10/15/11
Page 2 of 2

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1113	LOG	10	SAE 2	(110'	239')	LOG 6
			ASDE	(110'	109.94)	= 0.06
1130	LOG	11	SAE 2	SUG	to 28'	(110'-239') LOG 7
			ASDE	(110'	110.03)	= 0.03
1144	LOG	12	SAE 2	(110'	239')	LOG 8
			ASDE	(110'	110.03)	= 0.03
1157	LOG	13	SAE 2	(110'	239')	LOG 9
			ASDE	(110'	110.01)	= 0.01
1211	LOG	14	SAE 2	(110'	239')	LOG 10
			ASDE	(110'	109.99)	= 0.01
1226	LOG	15	SAE 2	(110'	239')	LOG 11
			ASDE	(110'	109.97)	= 0.03
1240	LOG	16	SAE 2	(110'	239')	LOG 12
			ASDE	(110'	110.04)	= 0.04
1301			POST CAL TOOL			DE-WATER WELL
1310			PULL PUMP & PIPE			
1400			RIG DOWN HPC EQUIP/SET UP PACKARD (WSP)			
1530			SETUP/BUILD WSP			
1630	LOG	17	CHECKOUT PACKER ASSEMBLY			
1710			LEAVE WELL SITE			
1740			ARRIVE AT HOTEL			

Engineer's Name MSS/JDW

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Integrated Subsurface Evaluation

FIELD NOTES

Job Tofock
Well MW 60BR-225
Activity W.S.P.
Date 10/15/11
Page 1 of

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
0600		LEAVE FOR		WELL	SITE	
0620		ARRIVE AT		WELL	SITE	
		WATER DEPTH		99.1 + 0.96 =		
0640		INSTALL PUMP				
0748	95.36	SETUP LINFLOW				
0750		RESUME H&L TOOL				
0815		RECAL TOOL				
0832		PRELOG CAL CHECK				
		DI	4K	20K		FROM METER
		35 MS/cm	4150 " "	17500 " "		
0843		SENDING TOOL D+H				
0854		PUT INJECTION LINE DOWN TO 80'				
0903		TURN ON PUMPS				
0908	LOG 1	EMPLX (1)		110' - 239'		
			ASDE	(110 - 109.98)		= 0.02
0923	LOG 2	EMPLX LOG 2		110' - 239'		
			ASDE	(110 - 109.98)		= 0.02
0940	LOG 3	"	LOG 3			
			ASDE	(110 - 109.96)		= 0.04
0955	LOG 4	SAE	LOG 1	(110 - 152)		
				ASDE	(110 - 110.00)	
1003	LOG 5	(SAE 2)		(110' - 239')		LOG 2
			ASDE	(110 - 109.99)		= 0.01
1018	LOG 6	(SAE (2)) 20'		SLUG	110' - 239'	LOG 2
			ASDE	(110 - 109.96)		= 0.04
1032	LOG 7	SAE 2	LOG 3	(110 - 239')		
			ASDE	(110 - 109.95)		= 0.05
1044	LOG 8	SAE 2	LOG 4	(110' - 239')		
			ASDE	(110 - 109.97)		= 0.03
1058	LOG 9	SAE 2	LOG 5	(110' - 239')		
			ASDE	(110 - 109.98)		= 0.02

Engineer's Name MJS/JDW

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FIELD NOTES

Job TOPOCK
Well MW 60BR 245
Activity WSP SAMPLING
Date 10/10/11
Page 1 of 2

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments				
0630		LEAVE HOTEL								
0650		ARRIVE AT		WELL	SITE					
0700		SETUP	PACKER	FOR	SAMPLING					
0750		LEAK	CHECK	PACKERS						
0801		"	"	GOOD						
0815		SENDING	D.H.	TO	165' - 175'					
0915	LOG 1	@ DEPTH	- WSP	LOG 1	@ 170'					
0917		PRIME	PUMP -	PUMPED	1.5 GALLONS					
0934		INFLATE	PACKERS							
0946		START	PUMPING							
	*	PRESSURE	INCREASE	SPIKE	- BALL VALVE ON PUMP NOT SEATED?					
		"	" FALL	OFF IN	BOTH	MIDDLE + LOWER F.T.				
0942		NO SEAL	- WAIT	10 MIN	+ TRY PUMPING AGAIN					
0951		START	PUMPING	AGAIN						
	*	FLOW RATE	=	361 mL	/MIN	= 0.095 GPM				
		17.14	GALLONS	FOR 3	BORE VOLUMES	BETWEEN PACKERS				
		180 MIN	/ 3 HR	DEVELOP	TIME					
1120		IN TO	TRAILER	FOR FLOW	CELL					
1130		IN BACK	/ SETUP	FLOW CELL						
		°C	mS/cm	DO mg/L	SAL	DO %	DO mg/L	pH	ORP	
1140		28.49	17.43	11.33	10.22	208.9	16.41	7.26	189.2	
1150		28.52	17.41	11.31	10.20	999.9	135.20	7.59	167.2	
1200		28.70	17.39	11.30	10.19	" "	112.50	7.86	147.6	
1210		28.90	17.42	11.32	10.21	" "	85.90	8.06	126.1	
1220		28.95	17.40	11.30	10.20	" "	87.98	8.16	99.4	
1230		29.50	17.34	11.27	10.15	" "	111.30	8.10	85.5	
1240		29.61	17.56	11.34	10.22	" "	91.18	8.08	74.2	
1250		29.65	17.79	11.36	10.21	" "	57.47	8.02	-64.3	
1256		SAMPLING								
1312		BLOW	PACKERS							
1315		BRINGING UP HOSE TO CHECK FOR LEAKS								
1325		TOOL	OUT CONFIRMED	LEAKING TOOL HOUSING →						

Engineer's Name

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FIELD NOTES

Job TCPOCK
Well MW 608R 24S
Activity LSP SAMPLING
Date 10/16/11
Page 2 of 2

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
CONT		TIGHTENED BULKHEAD		SWAGELOCK. REBUILT AS SINGLE PACKER		
		SETUP W/ NO		CIRCUIT BOARDS.		
1347		SENDING D.H.		TO LEAK CHECK		
1350		@ 230' - SIT		FOR 15 MIN.		
1425		PLOTTED P.T. DATA.		TEST GOOD BRINGING TOOL OUT OF WELL		
1500		TOOL OUT OF		WELL - STILL		LEAKING
1515		CALLED BILL				
1530		OFF CLOCK (BILLABLE		TIME)		TO FIX TOOL
1535		FIXING LEAK ON LSP 3				
1625 40		FINISHED TEFLON SEAL		- SENDING D.H. FOR LEAK CHECK		
1705		TOOL STILL LEAKING				
1710		CLEAN UP				
1725		OFFSITE - TO		BULLHEAD CITY		FOR SUPPLIES

Engineer's Name

WSP/DST TESTING NOTES

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Project Topock Activity: WSP Date: 10/16/11
Well: MW 608R 245 Page 1 of
BLADDER PUMP

Real Time	Depth to Water	Injection/ Extraction Flow Rate(gpm)	~~Injection/~~ Extraction Manifold Pressure	Packer Nitrogen Pressure	DST Pressure Gauge	Injection/ Extraction FECT	Flow Measurement ____ in ____ sec	TOTAL GALLONS ~~Comments~~ THUS FAR
0950	/	.095	CHARGE EXHAUST 12.5 (2) 12 sec	95 lbs.				0
1000		.095	12.5 sec 12 sec	98 lbs.				0.95 gal
1010		.095	12.5 sec 12 sec	98 lbs.				1.9 gal
1020		.095	12.5 sec 12 sec	98 lbs.				2.85 gal
1030		.095	12.5 sec 12 sec	98 lbs.				3.8 gal
1040		.095	12.5 sec 12 sec	97 lbs.				4.75 gal
1050		.095	12.5 sec 12 sec	98 lbs.				5.7 gal
1100		.095	12.5 sec 12 sec	98 lbs.				6.65 gal
1110		.095	12.5 sec 12 sec	98 lbs.				7.6 gal
1120		.095	12.5 sec 12 sec	99 lbs.				8.55 gal
1130		.095	12.5 sec 12 sec	105 lbs.				9.50 gal
1140		.095	12.5 sec 12 sec	104 lbs.				10.45 gal
1150		.095	12.5 sec 12 sec	104 lbs.				11.40 gal
1200		.095	12.5 sec 12 sec	103 lbs.				12.35 gal
1210		.095	12.5 sec 12 sec	98 lbs.				13.3 gal
1220		.095	12.5 sec 12 sec	99 lbs.				14.25 gal
1230		.095	12.5 sec 12 sec	99 lbs.				15.2 gal
1240		.095	12.5 sec 12 sec	96 lbs.				16.15 gal
1250		.095	12.5 sec 12 sec	98 lbs.				17.1 gal

Engineer's Name: MJS (MARC SCHUMACHER)

CLIENT _____

JOB NO. _____
WELL I.D. _____
DATE _____

ALL DEPTHS REFERENCED TO: GROUND SURFACE [X]
STICKUP _____ TOP OF CASING [ ]
OTHER [ ] _____

DESIGN SETTINGS

PUMP TYPE GEOTECH BLADDER PUMP

WSP SETUP
- [ ] UPPER ONLY
- [ ] BOTTOM ONLY
- [X] STRADDLE

LENGTH _____ ft

WATER LEVEL _____ ft

UPPER PT (#1) _____ ft

TOP OF TOP PACKER _____ ft

REFERENCE POINT:
BOTTOM OF TOP PACKER
OFFSET TO CABLEHEAD KNURL

INJ/EXT POINT _____ ft

MIDDLE PT (#2) _____ ft

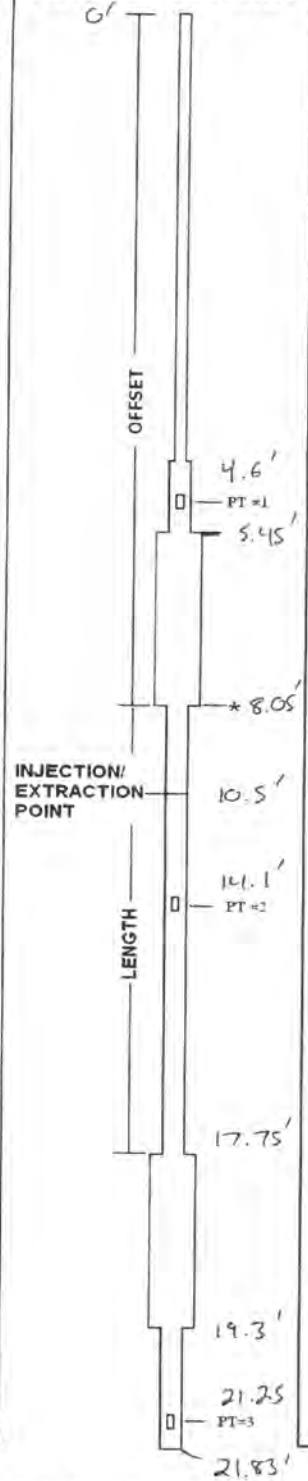
TOP OF BOTTOM PACKER _____ ft

BOTTOM OF BOTTOM PACKER _____ ft

LOWER PT (#3) _____ ft

TOTAL LENGTH _____ ft

ACTUAL SETTINGS



TESTING PROTOCOL - ACTION ITEMS

TEST/ACTION #1
TEST INTERVAL
TOP 165' ft
BOTTOM 175' ft

[ ] INJECTION [X] EXTRACTION [ ] OTHER _____
RATE _____
PSI @ SURFACE 90
EXHAUST 12
CHARGE 12.5
PACKER INFLATION
ABSOLUTE _____
DIFFERENTIAL _____

TEST/ACTION #2
TEST INTERVAL
TOP _____ ft
BOTTOM _____ ft

[ ] INJECTION [ ] EXTRACTION [ ] OTHER _____
RATE _____
PSI @ SURFACE _____
EXHAUST _____
CHARGE _____
PACKER INFLATION
ABSOLUTE _____
DIFFERENTIAL _____

TEST/ACTION #3
TEST INTERVAL
TOP _____ ft
BOTTOM _____ ft

[ ] INJECTION [ ] EXTRACTION [ ] OTHER _____
RATE _____
PSI @ SURFACE _____
EXHAUST _____
CHARGE _____
PACKER INFLATION
ABSOLUTE _____
DIFFERENTIAL _____

3 BORE VOL'S OF STRADDLE INTERVAL
17.4 GALLONS

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FIELD NOTES

Integrated Subsurface Evaluation

Job ICPOCK
Well MW 60BR 245
Activity LSP SAMPLING SETUP
Date 11/1/11
Page 1 of 1

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
0640		DEPART	HOTEL	CAR	- 11965	502 - 48048
0705		@ SITE	- CHECK IN			
0715		ON WELL	MW 60BR 245	- SETUP	TRUCK 48065	
0802	99.71'	98.75	(+0.96) = 99.71' G.S.			
0825		LEAK CHECK PACKER @ 235' - ROB ONSITE, NO LEAK CHECK				
0900		MOVE TO OTHER WELL TO REMOVE SCREEN.				
0915		ON WELL ??				
0925		MAKE LIFTING HOOK				
0935		PULL PIPE / SCREEN				
1010		PIPE/SCREEN OUT				
1015		TAG BOTTOM W/ WL METER - 2' LOST, WAS 226', NOW TO 224'				
1020	*	WL METER STUCK @ 136'				
1030	R.O.D.	USE 2" SCREEN TO DISLODGE WL METER, THEN CONTINUE				
		INSTALLING.				
1045		WL PROBE FREE!				
1115		SCREEN/PIPE INSTALLED. 110' SCREEN TO 222', THEN BLANK				
		ABOVE TO G.S.				
1120		BACK TO MW60BR 245				
1200		LEAK CHECK LSP				
1215		FAILED - STILL LEAKING				
1230		CALL BILL W/ UPDATE				
1250		FOUND LEAK - CABLE DAMAGED FROM SHIPPING				
1310		REPLACE CABLE W/ SPARE FROM CH2MHILL				
1600		TOOL REBUILT				
1610		SENDING D.H. TO ✓ OUT				
1616		@ 235' - 20 MIN LEAK CHECK				
1636		BRINGING OUT OF WELL				
1640		LEAK CHECK GOOD!!				
1645		CHECK OUT WHILE COLLECTING DATA				
1745		" " GOOD - GOOD DATA, NO LEAKS				
1755		OFF WELL				
1815		@ HOTEL - 12025 MI (CAR)				

Engineer's Name JW/MSS

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FIELD NOTES

Job Tetrock
Well MW60BR 245
LSP
Activity SAMPLING
Date 11/2/11
Page 1 of 2

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
0645		DEPART	HOTEL -	12025 MI		
0700		ONSITE	- H+S	MEETING		
0715	99.69'	ON WELL	- SETUP	LSP		
0725		SETUP	PACKER			
0735		INFLATION	LEAK CHECK	- 60 PSI	AMBIENT PRESSURE	INFLATION
0750		MEASURE	PACKERS	SETUP	+ RECORD	
0800		SETUP	SOFTWARE			
0802	LOG 1	DOWNHOLE	PRESSURE STEP	- SENDING	LSP D.H.	
0817		@235',	SETUP +	PRIME	BLADDER PUMP	
0826	LOG 2	~~TOP PACKER ONLY @ 235'~~		PACKER	INFLATION	
0830		INFLATE	PACKER			
	*	SOFTWARE	DROPPED ENCODER ??	RESTART	SOFTWARE AND APPEND	
0841	LOG 3	TOP	PACKER ONLY @ 235'			
0843		START	PUMPING			
0947		SAMPLING				
0951		BLOW OFF	PACKER			
1000		RESETTING	AS 19'	STRADDLE @	160'	
1050		SETUP	19' LSP	ON WELL		
1054	LOG 4	DOWNHOLE	PRESSURE STEP	LSP @	19' STRADDLE	
1117		PRIME	PUMP			
1121		START	PUMPING			
1119	LOG 5	19' STRADDLE	@	160'		
1222	*	NOTICED	DEPTH	ENCODER	FAILED	- RESTART AND APPEND FILE
1258	*	COMPRESSOR	STOPPED	WORKING ??		
1305						
1309		START	PUMPING	OFF	GAS	
1315		COMPRESSOR	WORKING	AGAIN	- RUNNING	OFF THAT AND FINDING REPLACEMENT,
1320		"	"	DIED	AGAIN	
1330		MARK TO	STORE	- WORKING	OFF GAS	
1450		MARK	BACK W/	COMPRESSOR		
1544	*	LOWER	PRESSURE	FLUCTUATING	FROM 36.6 - 37.5	PSI, NO CORRELATION
		TO	PUMPING	PRESSURE,	SEAL GOOD.	FIRST APPEARED @ 1525. STOP @ 1548.

Engineer's Name

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FIELD NOTES

Job Torolic
Well MW608R24S
Activity LSP Sampling
Date 11/2/11
Page 2 of 2

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1600	R.C.D.	TALKED W/ MIKE - TAKE SAMPLE				@ 1.5 BOREVOLUMES @ ~ 1700, LEAVE
		PACKERS INFLATED OVERNIGHT.				PURGE IN AM + SAMPLE AGAIN.
1609	*	MIDDLE PACKER		PRESSURE	DECREASED SLIGHTLY	
1702		SETUP	SAMPLES			
1705		SAMPLING				
1714		PUMP OFF - RECOVER				
1806		STOP TEST - BACKUP DATA				
1810		OFF SITE				
1830		@ Hotel	12113 mi			
						~~2453-533-6962~~

CLIENT CHEMICL / NORTHSTAR

JOB NO. _____
WELL I.D. MW BR60 245
DATE 11/2/11 + 11/3/11

ALL DEPTHS REFERENCED TO: GROUND SURFACE [X] TOP OF CASING [ ] OTHER [ ]
STICKUP _____

DESIGN SETTINGS

PUMP TYPE 3/4" BLADDER

WSP SETUP
- [ ] UPPER ONLY
- [X] BOTTOM ONLY
- [X] STRADDLE
  - LENGTH 19 ft

WATER LEVEL _____ ft

UPPER PT (#1) _____ ft →

TOP OF TOP PACKER _____ ft →

*REFERENCE POINT: →
BOTTOM OF TOP PACKER
OFFSET TO CABLEHEAD KNURL

INJ/EXT POINT _____ ft →

MIDDLE PT (#2) _____ ft →

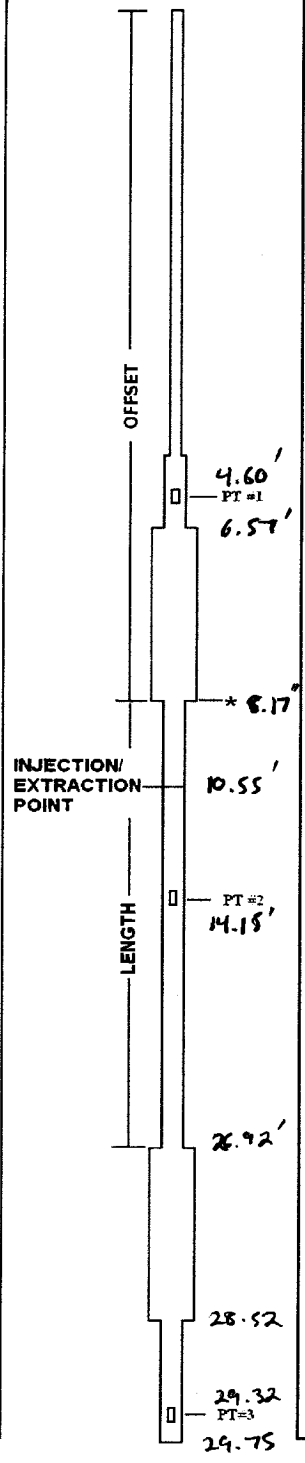
TOP OF BOTTOM PACKER _____ ft →

BOTTOM OF BOTTOM PACKER _____ ft →

LOWER PT (#3) _____ ft →

TOTAL LENGTH _____ ft →

ACTUAL SETTINGS



TESTING PROTOCOL - ACTION ITEMS

TEST/ACTION #1 11/2/11 TOP ONLY
TEST INTERVAL
TOP 235 ft
BOTTOM 245' ft

[ ] INJECTION [X] EXTRACTION [ ] OTHER
RATE 0.264 GPM
PSI @ SURFACE 130
EXHAUST 10
CHARGE 22
PACKER INFLATION
ABSOLUTE ~~150~~ 130
DIFFERENTIAL 65

TEST/ACTION #2 11/2/11 19' STRADDLE
TEST INTERVAL
TOP 160.01 ft
BOTTOM 178.76 ft

[ ] INJECTION [X] EXTRACTION [ ] OTHER
RATE
PSI @ SURFACE ~~105~~ 85
EXHAUST 13
CHARGE 9
PACKER INFLATION
ABSOLUTE 100
DIFFERENTIAL 65

TEST/ACTION #3 11/3/11 19' STRADDLE
TEST INTERVAL
TOP 160.01 ft
BOTTOM 178.76 ft

[ ] INJECTION [X] EXTRACTION [ ] OTHER
RATE
PSI @ SURFACE ~~100~~ 85
EXHAUST 30
CHARGE 12
PACKER INFLATION
ABSOLUTE 100
DIFFERENTIAL 65

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WSP/DST TESTING NOTES

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554 Orchard Street Unit 4, Golden, Colorado 80401
Website: www.rasinc.org
Phone: 303.526.4432 FAX: 303.526.4426

Project Topock WSP 2011 Activity: WSP (Sampling) Date: 11/2/11
Well: MW BR60 245 Top packer only @ 235' Page 1 of 1
BLADDER PUMP

Real Time	Depth to Water	~~Injection~~/ Extraction Flow Rate(gpm)	Injection/ Extraction Manifold Pressure		Packer Nitrogen Pressure	DST Pressure Gauge	Injection/ Extraction FECT	Flow Measurement _____ in ____sec	TOTAL GALLONS Comments THUS FAR
	/		CHARGE	EXHAUST					
0845		0.264	22	10	122				———
0855		0.264	22	10	113				2.64 gal
0905		0.264	22	10	129				5.28 gal
0915		0.264	22	10	130				7.92 gal
0925		0.264	22	10	125				10.56 gal
0935		0.264	22	10	128				13.2 gal
0945		0.264	22	10	127				15.84 gal

Engineer's Name: Marc T. S

3.8 ft^3 x 0.1337 = 0.508 x 30' = 15.2418 gals. = 3 Volumes of Borehole

WSP/DST TESTING NOTES

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Website: www.rasinc.org
Phone: 303.526.4432 FAX: 303.526.4426

Project Topock WSP 2011 Activity: WSP (Sampling) Date: 11/2/11
Well: MW BRG0 245 160'-179' INTERVAL Page 1 of 1

Real Time	Depth to Water	Injection/ Extraction Flow Rate(gpm)	Injection/ Extraction Manifold Pressure		Packer Nitrogen Pressure	DST Pressure Gauge	Injection/ Extraction FECT	Flow Measurement _____ in ____sec	Comments
			CHARGE	EXHAUST					TOTAL GAL THUS FAR
1125		0.0528	15	17	97 lbs				
1135		0.0528	12	16	100 lbs				1.056
1145		0.0528	12	17	98 lbs				1.564
1155		0.0528	10	16.5	98 lbs				2.112
1205		0.0528	10	16.5	98 lbs				2.64
1235		~~0.0528~~ .0544	10	18	110 lbs.				~~4.224~~ 4.422
1305		~~0.0528~~ .0210	10.5	18	110 lbs.	compressor failed			~~5.052~~ 5.052
1335		0.044103	9	13	105	(run on Nitrogen)/new Compressor			5.66
1405		" "	9	13	105				7.50
1435		" "	9	13	110				8.829
1505		" "	9	13	110				10.15
1535		0.04403	9	12	105				11.470
1605		0.04403	9	12	101				12.79
1635		0.04403	9	12	100				14.119
1705		0.04403	9	12	100				15.44
~~1735~~									
~~1805~~									

$3.8\ ft^3 \times 0.1337 = 0.508 \times 56.25' = 28.575$ gal → = 3 Volumes of Borehole

$1\ ft^3 = 0.1337$ gal.

Engineer's Name: Marc J. Schuemehl

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Integrated Subsurface Evaluation

Job Topock

Well MW60BR 245

Activity flow cell readings

Date 11/2/11

Page 1 of 2

INTERVAL 235' - 179'

TIME	°C	uS/cm	TDS	SAL	DO(%)	DO(mL)	PH	ORP
0850	# NEED BATTERIES - REPLACING							
0900	26.98	16843	10.95	9.87	876.7	999.9	7.82	154.1
0910	26.99	16872	10.97	9.88	999.99	173.30	7.86	143.1
0920	27.09	16852	10.96	9.87	" "	171.90	7.88	132.1
0930	27.11	16862	10.96	9.87	" "	171.40	7.88	123.7
0940	27.15	16827	10.94	9.85	" "	171.15	7.88	116.2
0947	SAMPLING							

INTERVAL 166 - 179'

12:00	24.90	16365	10.63	9.58	999.99	202.20	7.98	114.5
12:15	24.94	16357	10.63	9.58	" "	200.14	7.97	112.3
12:30	25.10	16349	10.63	9.57	" "	197.14	7.99	109.6
12:45	25.65	16359	10.63	9.57	" "	190.34	8.02	105.5
13:00	25.70	16361	10.63	9.57	" "	190.61	8.02	103.8
1315	25.73	16363	10.63	9.57	" "	189.57	8.04	102.7
1330	26.15	16366	10.63	9.57	" "	187.55	8.04	99.4
1345	26.06	16320	10.61	9.57	" "	185.92	8.05	98.8
1400	25.87	16309	10.60	9.54	" "	188.07	8.08	96.0
1415	26.01	16282	10.58	9.52	" "	185.36	8.08	94.2
1430	26.08	16265	10.57	9.51	" "	185.38	8.11	93.4
1445	26.01	16251	10.56	9.49	" "	185.70	8.13	91.6
1500	25.94	16241	10.54	9.48	" "	186.83	8.15	92.1
1515	25.96	16209	10.54	9.47	" "	186.51	8.16	90.9
1530	25.75	16177	10.53	9.46	" "	188.11	8.18	90.7
1545	25.67	16166	10.51	9.45	" "	190.65	8.19	96.3
1600	25.51	16150	10.50	9.45	" "	195.40	8.20	89.7

Engineer's Name

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Integrated Subsurface Evaluation

Job Torrey

Well

Activity Flow Cell Readings

Date 11/2/11

Page 2 of 2

Time	°C	µS/cm	TDS	SAL	DO (%)	DO (mL)	pH	ORP
1615	25.12	16138	16.49	9.44	999.99	198.62	8.23	88.5
1630	24.89	16029	16.45	9.40	" "		8.18	90.5
1645	23.51	15946	16.36	9.33	" "	222.90	8.12	96.3
1700	23.31	15904	16.34	9.30	" "	225.82	8.16	98.5
1705	SAMPLING							

Intrawell 160+179 Count

Engineer's Name

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FIELD NOTES

Job Toppock Rd 2011
Well MW60BR-245
Activity USP SAMPLING
Date 11/3/11
Page 1 of 1

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
0635		DEPART HOTEL		12113	MI	
0700		ARRIVE @ WELL SITE				
0702	97.63	PACKER PRESSURE DROPPED TO 60 PSI (FROM 90). REINFLATED TO 100.				
		REVIEWED PRESSURE - SEAL LOOKS GOOD.				
0715	LOG 1	SETUP SOFTWARE - START TEST INTERVAL 166'-179' DAY 2				
0731	*	ENCODER FAILED AGAIN - RESTART + APPEND				
0735		START PUMPING				
0750		CHANGED EXHAST RATE TO MAX PER BILL'S DIRECTION				
0816		SAMPLING				
0823		STOP PUMPING - RECOVERY				
0836		RELEASE PACKERS				
0840		SETUP 10' STRADDLE PACKER				
0922	LOG 2	AT DEPTH - PRIME PUMP				
0936		D.H. PRESSURE STEP 10' STRADDLE				
0937		INFLATE PACKERS				
1000		START PUMPING				
1001		SHORT CIRCUIT MIDDLE/LOWER - MOVE DOWN 1'				
1006		RELEASE PACKERS				
1010		MOVE TO 140' (1' DOWN)				
1022		INFLATE PACKERS				
1025	*	MAX OUT EXHAUST TO 30 SECONDS				
		SEE FLOW CELL READINGS				
1658		TAKE SAMPLES				
1702		STOP PUMPING - RECOVERY				
1750		BACKUP DATA				
		OFFSITE				

Engineer's Name

CH2MHILL

PROJECT NUMBER	WELL NUMBER
417981.ER.02.FW	BH-60BR-245

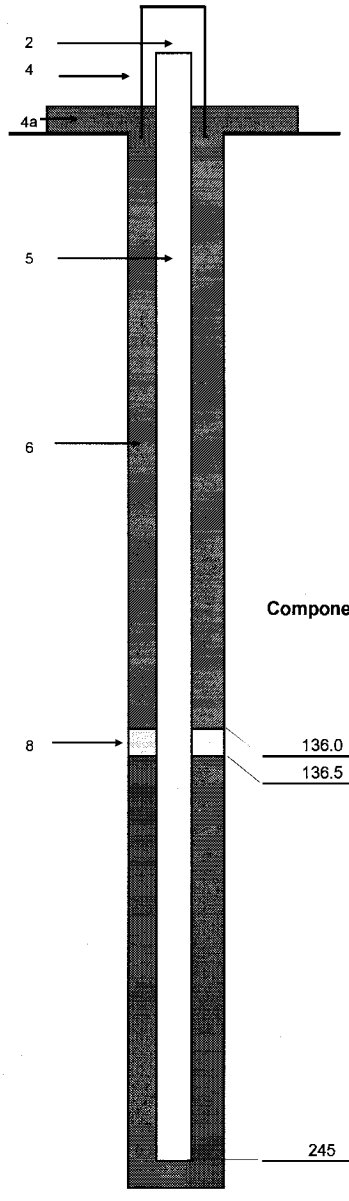
WELL COMPLETION DIAGRAM

PROJECT : ER-TCS INVESTIGATION LOCATION : Site F

DRILLING CONTRACTOR : BOART LONGYEAR DRILLING METHOD: Roto-sonic and wire-line cc EQUIPMENT

START DATE: 06/28/11 TIME: 0:00 END DATE: 07/28/11 TIME: 11:30

WATER LEVEL READINGS AND TIMES: 99 ft bgs LOGGER: C. Kreller



Component Depths in feet BGS

136.0	Bottom of grout
136.5	Bottom of transition sand
245	Bottom of boring (hard bottom sounding)

1- Ground elevation at well: 555 ft amsl
a) Northing:
b) Easting:

2- Top of casing elevation:
a) Stickup (feet above gs):

3- Diameter of boring (inches): 10 inches

4- Wellhead protection cover type: 2 x 2 foot vault
a) Concrete pad dimensions: 3 x 3 foot flush mount

5- Material of well casing: Sch. 40 PVC
a) Diameter of well casing (inche: 5

6- Grout mix used: Type II/V Portland Grout
a) Method of placement: Tremmie Pipe
b) Volume of grout (gallons): 400 gallons

7- Type of seal: N/A
a) Quantity used (pounds): N/A

8- Transition sand: No. 60 Monterey Sand
a) Quantity used (pounds): 100 pounds

9- Type of screen pack: N/A
a) Quantity used (pounds): N/A

10- Screen type: N/A
a) Slot size (inches): N/A
b) Total screen length (feet): N/A

11- Sump / end cap type: N/A
a) Length (feet): N/A

12- Centralizer type: 5" Stainless Steel
a) Depths (feet): 110, 90, 70, 50, 30, 10 feet bgs

Comments: Open borehole from 136 to 245 feet bgs.

NOTE: DRAWING NOT TO SCALE

CLIENT Topock HpL 2011

JOB NO. _____
WELL I.D. _____
DATE _____

ALL DEPTHS REFERENCED TO:
STICKUP _____

GROUND SURFACE [X]
TOP OF CASING [ ]
OTHER [ ] _____

DESIGN SETTINGS

PUMP TYPE 3/4" BLADDER

WSP SETUP
- [ ] UPPER ONLY
- [ ] BOTTOM ONLY
- [X] STRADDLE
  - LENGTH 10' ft

WATER LEVEL _____ ft

UPPER PT (#1) _____ ft →

TOP OF TOP PACKER
_____ ft →

*REFERENCE POINT: →
BOTTOM OF TOP PACKER
OFFSET TO CABLEHEAD KNURL

INJ/EXT POINT _____ ft →

MIDDLE PT (#2) _____ ft →

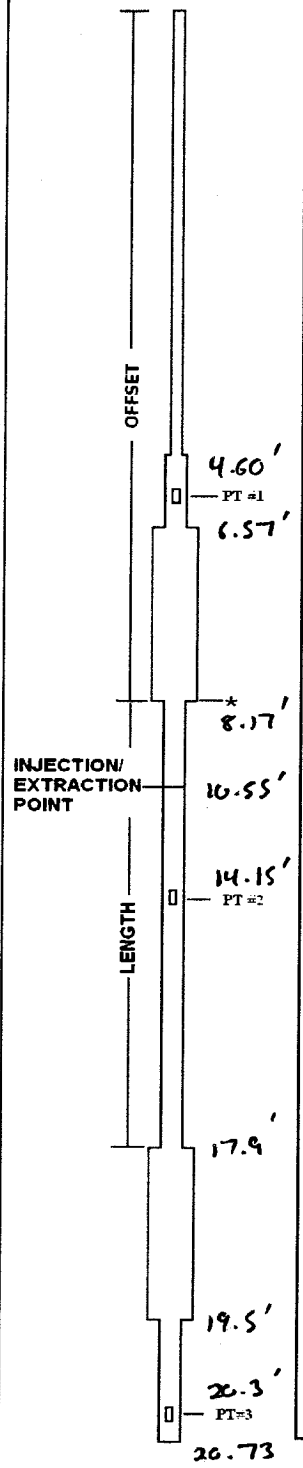
TOP OF BOTTOM PACKER
_____ ft →

BOTTOM OF BOTTOM PACKER
_____ ft →

LOWER PT (#3) _____ ft →

TOTAL LENGTH _____ ft →

ACTUAL SETTINGS



TESTING PROTOCOL - ACTION ITEMS

TEST/ACTION #1
TEST INTERVAL
TOP 139' ft
BOTTOM 149' ft

[ ] INJECTION [X] EXTRACTION [ ] OTHER _____
RATE _____
PSI @ SURFACE 55
EXHAUST _____
CHARGE _____
PACKER INFLATION
ABSOLUTE 90
DIFFERENTIAL 65 ?

TEST/ACTION #2
TEST INTERVAL
TOP _____ ft
BOTTOM _____ ft

[ ] INJECTION [ ] EXTRACTION [ ] OTHER _____
RATE _____
PSI @ SURFACE _____
EXHAUST _____
CHARGE _____
PACKER INFLATION
ABSOLUTE _____
DIFFERENTIAL _____

TEST/ACTION #3
TEST INTERVAL
TOP _____ ft
BOTTOM _____ ft

[ ] INJECTION [ ] EXTRACTION [ ] OTHER _____
RATE _____
PSI @ SURFACE _____
EXHAUST _____
CHARGE _____
PACKER INFLATION
ABSOLUTE _____
DIFFERENTIAL _____

6/22/15

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PH 303.526.4432 • FAX 303.526.4426
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WSP/DST TESTING NOTES

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Website: www.rasinc.org
Phone: 303.526.4432 FAX: 303.526.4426

Project Topock WSP 2011 Activity: WSP (Sampling) Date: 11/3/11
Well: MW BR60 245 160 - 179 DAY (2) Page 1 of 1

Real Time	Depth to Water	Injection/ Extraction Flow Rate(gpm)	Injection/ Extraction Manifold Pressure		Packer Nitrogen Pressure	DST Pressure Gauge	Injection/ Extraction FECT	Flow Measurement _____ in ____sec	Comments
			CHARGE	EXHAUST					TOTAL GAL THUS FAR
0735		0.0438	10	15	100 lbs.				
0750		0.0472	13	30	100 lbs.				0.62 gal
0810		0.0472	13	30	100 lbs				1.564
		TO FLUSH BLADDER PUMP LINES AND GET 3 VOLUMES							
		BEFORE TAKING A SAMPLE WE USED THIS FORMULA							
		TO DETERMINE 3 VOLUME'S BEFORE TAKING SAMPLES							
		1/4" ± 12 • 0.1337 (conversion rate) x 170 ft = 0.473 gal • 3 volumes							
					= 1.42 gals				

Engineer's Name: Mark J. Schuberth

1.056

WSP/DST TESTING NOTES

Integrated Subsurface Evaluation
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INTERVAL (140' - 149.75')

Project ToPock
Well: MW BRGO 245

Activity: WSP (SAMPLING) INTERVAL

Date: 11/3/11
Page 1 of 1

Real Time	Depth to Water	~~Injection~~ Extraction Flow Rate(gpm)	Injection/ Extraction Manifold Pressure		Packer Nitrogen Pressure	DST Pressure Gauge	Injection/ Extraction FECT	Flow Measurement _____ in ____sec	Comments
/	/		CHARGE	EXHAUST					TOTAL GALS.
1022						ADJUSTING	PUMP		0.5 gals
1040		0.0352	10	30	100 lbs.				0.5 gals
1110		0.0352	10	30	100 lbs.				1.55 gals
1140		0.0352	10	30	100 lbs				2.606 gals
1210		0.0300	10	30	100 lbs.				~~3.5 gal~~ 3.5 gals
1240		0.0213	7.5	30	100 lbs.				4.067 gals.
1310		0.0175	7.5	30	100 lbs.				4.592 gals.
1340		0.0175	7.5	30	100 lbs				5.117 gals
1410		0.0175	7.5	30	95 lbs				5.642 gals
1440		0.0175	7.5	30	95 lbs				6.167 gals.
1510		0.0175	7.5	30	95 lbs				6.692 gals
1540		0.0175	7.5	30	98 lbs.				7.217 gals.
1610		0.0175	7.5	30	95 lbs.				7.742 gals
1640		0.0175	7.5	30	95 lbs.				8.267 gals

$3.8 ft^3 \cdot 0.1337 = 0.508 \times 9.75' = 4.95 gals$ Engineer's Name: MARC I. SCHORMANN

$\times 3 = 14.86$ gal to flush borehole 3 times

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Integrated Subsurface Evaluation

Job TOROCK

Well MW60BR 245

Activity FLOW CELL READINGS

Date 11/3/11

Page 1 of 1

INTERVAL 160'-179' DAY 2

TIME	°C	µS/cm	TDS	SAL	DO %	DO mg/L	PH	ORP
0745	22.71	15877	10.32	9.30	579.6	47.57	7.53	69.3
0800	23.22	15860	10.31	9.28	999.99	227.85	8.21	121.9
0815	23.17	15856	10.31	9.28	"	228.63	8.23	117.6
0816	SAMPLING							
1030	24.19	15786	10.26	9.22	"	212.52	8.40	108.4
1045	24.54	15741	10.23	9.19	"	206.47	8.50	99.4
1100	24.65	15726	10.22	9.18	"	205.47	8.58	89.3
1130	24.60	15713	10.21	9.17	"	206.25	8.58	82.0
1200	24.45	15703	10.20	9.16	"	125.09	8.58	79.3
1230	25.85	15662	10.18	9.12	"	188.58	8.52	73.4
1300	25.51	15690	10.19	9.14	"	195.24	8.51	73.1
1330	25.31	15697	10.20	9.16	"	185.40	8.50	72.3
1400	26.09	15674	10.19	9.13	"	184.86	8.47	70.7
1430	26.74	15716	10.22	9.16	"	177.69	8.45	65.7
1500	26.28	15771	10.19	9.16	"	182.90	8.42	66.8
1530	26.00	15656	10.18	9.12	"	186.62	8.41	66.1
1600	25.39	15614	10.15	9.10	"	195.69	8.39	64.3
1630	25.27	15581	10.13	9.08	"	196.57	8.37	64.0
1700	24.65	15620	10.15	9.11	"	205.49	8.37	64.4

INTERVAL 140'-150'

Engineer's Name

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FIELD NOTES

Integrated Subsurface Evaluation

Job TOPOCK HpL

Date 11/4/11

Well MW60BR225 + MW70BR225

Activity LSP SAMPLING

Page 1 of 2

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
0640		DEPART	HOTEL	12130	NE	
0700		ONSITE				
0715		ON WELL				
	105.43'	SETUP LSP SOFTWARE -		PACKER		HELD @ 75. SEAL LOCKS GOOD.
0722	LOG 1	TEST INTERVAL		140' - 150'		DAY 2
0726		START COLLECTING				
		~~START~~	~~PUMPING~~			
736		BUMP UP PACKER INFLATION 80 → 90 (DROPPED 10 psi)				
0745		START PUMPING				
0848		SAMPLING				
0902		PUMP OFF - RECOVERY				
0945		STOP TEST				
0947		TRIPPING OUT LSP				
1115		LSP OUT - BREAKDOWN				
1125		DOWNLOADING PT DATA				
1145		PLOTTING DATA WHILE MARC CLEANS UP.				
1150		CONSULT W/ MIKE ABOUT PT				DATA - ALL GOOD, MOVE TO HpL
		MW70BR225				
1210		OFF WELL - MOVE EQUIPMENT OVER TO MW70BR225				
1415		ALL EQUIPMENT ONSITE		MW70BR225		- SETUP FOR HpL
1450		SETUP HpL TOOL				
1455		CALIBRATE HpL TOOL				
1530		CH2 SENSOR ON PRIMARY SENSOR ARRAY NOT WORKING RIGHT W/ EITHER				
		FFCT BOARD - SWAPPING SENSOR ARRAYS				
1554		CALIBRATING 2ND TOOL SETUP				
1602		PRE-LOG CAL CHECK				
1606		SETUP TOOL ON WELL				
		NOTE: 6.18 TOOL LENGTH		(6.18 - 2.4 STICKUP) = 3.78		
1609	80.40'	G.S.				
1610		SENDING TOOL D.H.				
		TEMP STABILIZING				
1631	LOG 2	AMBIENT				

Engineer's Name

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FIELD NOTES

Job Toprock HpL 2011
Well MW70 BR225
Activity HpL SETUP
Date 11/14/11
Page 2 of 2

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1645		ASDE	(3.78 - 3.68) = G.		10'	
1655		POST LOG CAL CHECK				
1700		PACKUP / CLEANUP				
1730		OFF WELL				
1755		@ HOTEL				

Engineer's Name

WSP/DST TESTING NOTES

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Project TOPOCK Activity: WSP (SAMPLING) (140' - 149.75') (2) Date: 11/4/11
Well: MW 60BR 245 Page 1 of 1

Real Time	Depth to Water	~~Injection~~/ Extraction Flow Rate(gpm)	Injection/ Extraction Manifold Pressure		Packer Nitrogen Pressure	DST Pressure Gauge	Injection/ Extraction FECT	Flow Measurement _____ in ____sec	Comments
			CHARGE	EXHAUST					TOTAL GAL.
0745		ADJUSTING		BLADDER PUMP					0.25 Gal
0800		0.0166	7.5	30	100 lbs.				0.50 Gal
0830		0.0166	7.5	30	93 lbs.				0.998 Gal
0900		0.0166	7.5	30	93 lbs.				1.496 Gal

$\frac{1}{4}" \div 12 \cdot 0.1337 \cdot 150' = 0.417$ gal

0.417 gal $\cdot$ 3 volumes $= 1.25$ gal.

Engineer's Name: _____

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Integrated Subsurface Evaluation

Job Tooele HpL 2011 Date 11/4/11

Well MW60BR245 Activity LWSP SAMPLING Page 1 of 1

TIME	°C	µS/cm	TDS	SAL	DO%	DO mg/L	PH	ORP
0745	23.95	15573	10.12	9.09	999.99	102.11	7.85	146.7
0800	23.99	15497	10.08	9.04	" "	215.60	8.17	122.4
0815	24.19	15520	10.09	9.05	" "	212.45	8.28	109.4
0830	24.47	15539	10.10	9.06	" "	207.78	8.31	98.9
0845	24.48	15530	10.09	9.06	" "	207.88	8.32	93.7
0850	SAMPLING							

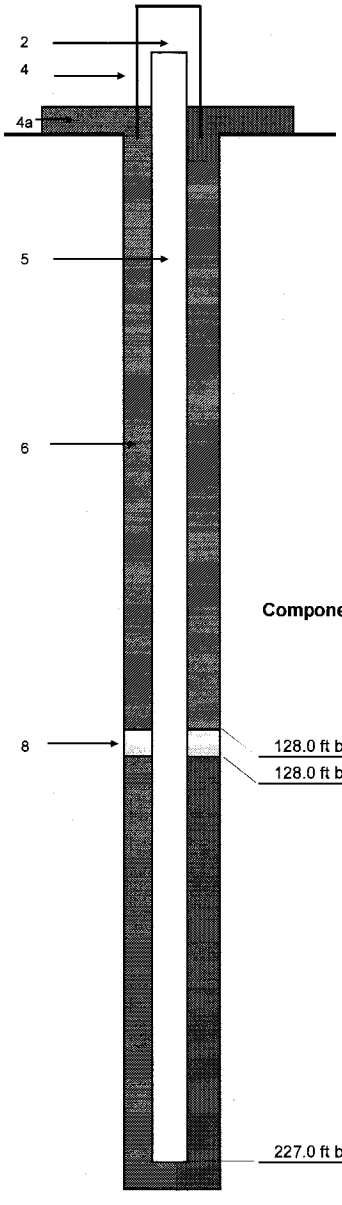
Engineer's Name

CH2MHILL

PROJECT NUMBER	WELL NUMBER
417981.ER.02.FW	MW-70BR-225

WELL COMPLETION DIAGRAM

PROJECT :	ER-TCS Investigation	LOCATION :	Site H
DRILLING CONTRACTOR :	Boart Longyear (Dale / Brigham)	DRILLING METHOD: Sonic and HQ Rotary	EQUIPMENT RS-350
START DATE: 10/19/11	TIME:	END DATE: 10/22/11	TIME:
WATER LEVEL READINGS AND TIMES:	84 feet bgs	LOGGER:	A. Brewster



Component Depths in feet BGS

128.0 ft bgs Bottom of grout
128.0 ft bgs Bottom of transition sand

227.0 ft bgs Bottom of boring (hard bottom sounding)

1- Ground elevation at well	541 ft amsl
a) Northing	
b) Easting	
2- Top of casing elevation	
a) Stickup (feet above gs)	
3- Diameter of boring (inches)	9 inches to 128 ft bgs, 3.8 inches from 128 - 227
4- Wellhead protection cover type	
a) Concrete pad dimensions	
5- Material of well casing	Sch. 40 PVC
a) Diameter of well casing (inche	5
6- Grout mix used	Type II/V Portland Grout
a) Method of placement	Tremmie Pipe
b) Volume of grout (gallons)	300 gallons
7- Type of seal	N/A
a) Quantity used (pounds)	N/A
8- Transition sand	No. 60 Monterey Sand
a) Quantity used (pounds)	100 pounds
9- Type of screen pack	N/A
a) Quantity used (pounds)	N/A
10- Screen type	N/A
a) Slot size (inches)	N/A
b) Total screen length (feet)	N/A
11- Sump / end cap type	N/A
a) Length (feet)	N/A
12- Centralizer type	5" Stainless Steel
a) Depths (feet)	200, 150, 100, 50

Comments Open borehole from 128 to 227 feet bgs.

NOTE: DRAWING NOT TO SCALE

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FIELD NOTES

Job Topock HpL 2011
Well MW 703R 225
Activity HpL - AFC
Date 11/5/11
Page 1 of 2

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
0645		DEPART	HOTEL	12179		
0705		ONSITE	- H+S TAILGATE			
0715		ON WELL	- RAINED LAST NIGHT, DRY OUT WORK FOOTPRINT			
0730		SETUP	LOGGING EQUIPMENT			
0802	80.50'	SETUP	INFLOW			
0810		PRELOG	CAL CHECK			
0831		TEMP	STABILIZE TOOL @			95.05
0941	LOG 1	AMB	LOG (75' - 222')			(222 - 3.78)
0906		ASDE				(3.78 - 3.71) = 0.07
0910		SETUP	FOR EMPLX			
0936		PRIME	INJ. PUMP			
0942		START	EMPLX			
1006	*	TRIED	INCREASING EXT RATE TO COMPENSATE DIFFERENTIAL FLOW			
		RATE	BETWEEN EXT/INJ. STARTED DRAWING DOWN. INJ/EXT			
		SCALERS	OFF. READJUSTED EXT. RATE BASED ON PRESSURE			
1015		TRIED	ADJUSTING INJ - SAME AS ABOVE. SCALERS OFF.			
1104		STOP	EMPLX			
1106		PULL	PUMP			
1110		SENDING	TOOL D.H.			
1112		TEMP	STABILIZE			
1117	LOG 2	AFC	(90' - 221.5')			
		ASDE	(90' - 89.96) =			0.04'
1136		AFC	LOG 2 (125' - 221.5)			
		CHANGED	LOGGING INTERVAL	SO	UPPER	HIGHER CONDUCTIVITY WATER
		IN 2"	BLANK	DOESN'T	LEAK	INTO SCREENED INTERVAL.
1201		ASDE	(125' - 124.99)	= 0.01'		
1230	LOG 3	AFC (2)	(125' - 221.5)			
		ASDE	(125' - 125')	= 0.00		
1245		CHANGING	LOGGING INTERVAL	TO		(115' - 221.5)
		AFTER	REVIEWING	INFO ON	CASING	DEPTH
1330	LOG 4	AFC	LOG #3	(115' - 221.5)		
		ASDE		(115' - 115')		= 0.00

Engineer's Name

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FIELD NOTES

Integrated Subsurface Evaluation

Job TOPOCK
Well MW 70BR 225
Activity HPC
Date 11/5/11
Page 2 of 2

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1430	LOG 5	AFC	LOG 4	(415 -	221.5)	
		ASDE		(115 -	114.96)	= 0.04
1530	LOG 6	AFC	LOG 5	(115' -	221.5')	
		ASDE	(115 - 114.98) =		0.02	
1630	LOG 7	AFC	LOG 6	(115' -	221.5')	
		ASDE	(115.00 - 114.98) =		0.02	
1730	LOG 8	AFC	LOG 7	(115' -	221.5')	
		ASDE	(115 - 114.98) =		0.02	
1745		POST LOG CAL CHECK				
1750		PACKUP/CLEANUP				
1805		OFFSITE				
1830		@ HOTEL - 122		14 MI		

Engineer's Name

HC PUMPING NOTES

RAS Integrated Subsurface Evaluation
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Project: Topock
Well: MW 13R 70 225
Activity: HPL EMPLX
Date: 11/3/11
Page 1 of

Real Time	Depth to Water	Injection						Extraction						Discharge	Comments
		Pump Start	Manifold Gauge Pressure	Flow Rate (gpm)	Conduct (uS/cm)	Temp (° C)	Pump Stop	Pump Start	Manifold Gauge Pressure	Flow Rate (gpm)	Conduct (uS/cm)	Temp (° C)	Pump Stop	___ in ?__ sec	
0945			0	3.92	29.9	17.2°			0	3.18	11,100	27.0°			
0955			0	3.88	8.8	17.7°			0	3.20	7,560	28.2°			
1000			0	3.81	6.3	17.6°			0	3.20	3,550	27.6°			
1005			0	3.90	2.8	17.3°			0	3.18	1,853	26.2°			
1010			0	3.92	2.3	16.7°			0	3.21	1790	25.0°			
1020			0	3.92	2.2	16.8°			0	3.23	1854	24.0°			
1030			0	3.92	2.0	18.9°			0	3.27	1,482	23.9°			
1040			0	3.92	2.8	18.5°			0	3.27	1394	23.8°			
1050			0	3.88	2.9	18.6°			0	3.32	1391	23.5°			
1100			0	3.92	4.0	18.9°			0	3.36	1220	22.4°			

Engineer's Name: Marc Schubmehl

CLIENT Chevron NORTHSTAR

JOB NO. Tcpock HPL 2011

*ALL DEPTHS REFERENCED TO: GROUND SURFACE X

STICKUP _____ TOP OF CASING _____

WELL I.D. _____

DATE _____

DESIGN SETTINGS

5" CASING TO 128' BGS

2" SCREEN 115' - 225'

2" BLANK - 2.4' - 115'

PUMP INLET 224'

TOP OF TEST INTERVAL 115'

BOTTOM OF CASING 128'

AMBIENT WL 80.50'

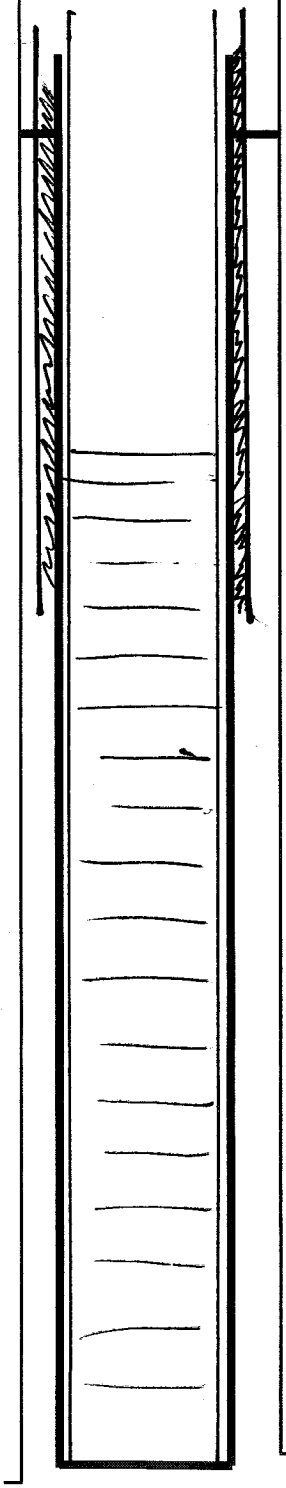
PRESSURE TRANSDUCER 125'

BOTTOM OF TEST INTERVAL 221.5'

DI INJECTION 80'

TOTAL DEPTH 225'

ACTUAL SETTINGS



NOT TO SCALE

TESTING PROTOCOL - ACTION ITEMS

PUMP TYPE 2" REDI FLO4

OROFICE NO. N/A

INJ PUMP TYPE 1/2 HP BOOSTER

SEPARATE GENERATOR 5.5 KW

TEST/ACTION #1 EMPLX

PUMPING RATE 3.3 GPM

INJECTION RATE 3.9 GPM

TEST #2 _____

PUMPING RATE _____

INJECTION RATE _____

TEST #3 _____

PUMPING RATE _____

INJECTION RATE _____

TEST#4 _____

PUMPING RATE _____

INJECTION RATE _____

TEST #5 _____

PUMPING RATE _____

INJECTION RATE _____

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Integrated Subsurface Evaluation
311 Rock Avenue • Golden, CO 80401
PH 303.526.4432 • FAX 303.526.4426
email: PedlerRAS@aol.com • www.rasinc.org

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Integrated Subsurface Evaluation
311 Rock Avenue • Golden, CO 80401
Website: www.rasinc.org
Phone: 303.526.4432 • FAX: 303.526.4426

FIELD NOTES

Job Toprock HPL 2011
Well MW 70BR 225
Activity HPL AFC
Date 11/6/11
Page 1 of 1

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
0540	DEPART HOTEL					
0605	ONSITE - H+S TAILGATE					
0618	ON WELL - SETUP HPL EQUIPMENT					
0632	PRELOG CAL CHECK					
0635	80.23 381					
0638		SETUP TOOL ON WELL				
0647		TEMP STABILIZE				
0700	LOG 1	AFC DAY 2 LOG 1 (115' - 221.5')				
		ASDE		(115 -	115.01)	= 0.01
0800	LOG 2	"	" LOG 2 (115'		-221.5')	
		ASDE		(115' -	114.99)	= 0.01
0900	LOG 3	"	" LOG 2 (115'		-221.5')	
		ASDE		(115' -	114.99')	= 0.01
1000	LOG 4	"	" LOG 4 (115		- 221.5')	
		ASDE		(115 -	115')	= 0.00
1100	LOG 5	"	" LOG 5 (115'		- 221.5')	
		ASDE		(115 -	115')	= 0.00
1200	LOG 6	"	" LOG 6 (115'		- 221.5')	
		ASDE	(115 - 114.99) =		0.01'	
1300	LOG 7	"	" LOG 7 (115'		- 221.5')	
		ASDE	(115 - 114.98) =		0.02'	
1400	LOG 8	"	"	LOG 8		
		ASDE	(115 - 115) = 0.00			
1500	LOG 9	"	"	LOG 9		
		ASDE	(115 - 114.99) =		0.00 01'	
1600	LOG 10	"	"	LOG 10		
		ASDE	(115 - 114.99)			
1625		POST LOG CAL CHECK				
1640		BREAKDOWN/CLEANUP				
1645		OFF SITE				
1715		@HOTEL 122.53				

Engineer's Name

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FIELD NOTES

Integrated Subsurface Evaluation

Job TOPock HPL 2011
Well MW 70BR 225
Activity HPL
Date 11/7/11
Page 1 of 2

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
0600		LEAVE	TO HOTEL FOR	WELL SITE		12253 mi
0625		ON WELL SITE LOCATION				
0640		RIG UP COMPUTERS, HPL TOOL				
0650		PRE LOG CAL CHECK				
0707		TEMP STABILIZE @		115'		
0715	Log 1	AFC DAY 3		(115'	- 221.5')	
		ASDE		(115' -	114.96)	= 0.04
0735		RIG UP PUMPS	FOR	~~EMPLX~~		SLUG TEST
		WAITING	FOR RECOVERY	(PUMP INSTALLED)		
0755		3' SLUG				
	*	REDI FLOW HAS NO CHECK VALVE - HARD TO QUANTIFY SPECIFIC				
		CAPACITY W/O VALVE.		SPECIFIC CAPACITY =		0.589 GPM/FT
0802		2ND ~~4~~ 3' SLUG - SHUT IN VALVE UPHOLE AND WAIT FOR VACUUM, THEN				
		USE RECOVERY CURVE AFTER THAT.				
0843		~~START~~ EMPLX				
	R.O.D.	TALKED W/ BILL - SAE AFTER EMPLX. PULL PUMP AFTER SLUG				
		WHILE RUNNING (NO CHECK VALVE) SO NO WATER BACK FLOWS.				
0948		@ 3 VOLS OF EMPLX'D DI, STABLE FEC READINGS.				
0953		PUMP OFF				
		PULLING PUMP W/ INJ STILL ~~OFF~~ ON TO MAINTAIN A CAP.				
		PUMP OUT / ~~INJ~~ OFF -		4' CAP		
0985		SENDING TOOL D.H.				
		WAITING FOR STABLE PRESSURE				
1002	LOG 2	SAE - BACKGROUND LOG		1	(115' - 221.5')	
1017		INSTALLED PUMP TO 90'				
		ASDE	(115 - 114.98) =	0.02'		
1023		4' SLUG				
1031	LOG 3	SAE - AFTER 4' SLUG 1		LOG 2		
1051		REINSTALL PUMP				
		ASDE	(115 - 114.99) =	0.01		
~~1054~~	1054	4' SLUG #2				
~~1153~~	LOG 4	SAE AFTER 4'	SLUG 2			

Engineer's Name

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Website: www.rasinc.org
Phone: 303.526.4432 • FAX: 303.526.4426

FIELD NOTES

Job Toprock HpL 2011
Well MW708R225
Activity HpL - SAE
Date 11/7/11
Page 2 of 2

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1110		ASDE	(115 - 115) = 0.00'			
1140		UPLOAD	DATA TO DIR			
1152		4' SLUG #3				
1200	LOC 5	SAE AFTER 4'	SLUG #3		(115'-221.5')	
		ASDE	(115'	114.96')	=0.04	
1222		PULL	PUMP from well			
1224		PULLING	TOOL OUT OF USE			
1228		ISTALL	PUMP			
1230		PUMP ON - START DEVELOPMENT FOR SAMPLING				
1510		SAMPLING				
1525		BREAKDOWN / CLEAN UP OFF LOCATION				
1640		OFFSITE				
1710		@HOTEL	12285			

Engineer's Name

HC PUMPING NOTES

RAS Integrated Subsurface Evaluation
554 Orchard Street Unit 4, Golden, Colorado 80401
Website: www.rasinc.org
Phone: 303.526.4432 FAX: 303.526.4426

Project: Topock HPL 2011 Activity: HPL Date: 11/7/11
Well: MW 703R 225 Page 1 of 1

Real Time	Depth to Water	Injection						Extraction						Discharge ____ In __?__ sec	Comments
		Pump Start	Manifold Gauge Pressure	Flow Rate (gpm)	Conduct (uS/cm)	Temp (° C)	Pump Stop	Pump Start	Manifold Gauge Pressure	Flow Rate (gpm)	Conduct (uS/cm)	Temp (° C)	Pump Stop		
0950			0	3.80	3.8	17.9°			0	3.24	10,260	27.8°			
0855			0	3.82	3.79	17.8°			0	3.20	3,630	27.7°			
0900			0	3.80	2	17.8°			0	3.18	2,980	27.3°			
0910			0	3.80	1.8	17.9°			0	3.10	1,251	25.7°			
0920			6	3.80	2	18.0°			0	3.12	1,123	24.5°			
0930			0	3.79	1.9	17.7°			0	3.16	1,085	23.4°			
0940			0	3.78	1.9	17.9°			0	3.16	1,058	23.8°			
0950			0	3.79	1.8	18.0°			0	3.16	1,013	23.1°			

Engineer's Name: MJS

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Integrated Subsurface Evaluation

Job Topock HRL 2011
Well MW 70BR 225
Activity SAMPLING
Date 11/7/11
Page 1 of 1

TIME	TEMP	COND	PH	ORP	TURB.	TURB.
1240	26.49°	11268	6.74	190.3		
1250	28.61°	11586	7.32	165.4		
1300	28.67°	11770	7.38	159.8		
1310	28.44°	11924	7.38	146.2		
1320	28.25°	11991	7.35	145.8		
1330	28.21°	11996	7.36	145.2		
1340	29.03°	11976	7.41	140.9		
1350	28.56°	12087	7.41	142.8		
1400	27.46°	12105	7.45	147.4		
1410	27.52°	12102	7.46	149.0		
1420	27.59°	12112	7.47	149.6		
1430	27.39°	12101	7.46	152.6		
1440	26.67°	12121	7.47	154.9		
1450	27.38°	12192	7.49	155.7		
1500	27.36°	12172	7.48	154.3		
~~1510~~						

Engineer's Name

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FIELD NOTES

Job TOPOCK HR 2011
Well MW70BR 225
Activity DECON/DEMOB
Date 11/8/11
Page 1 of

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
0845		DEPART	NEEDLES			
0900		ONSITE	- DECON	ALL EQUIPMENT		
1220		OFFSITE	W/ ALL	EQUIPMENT		

Engineer's Name

DAILY LOG

Integrated Subsurface Evaluation
311 Rock Avenue, Golden, CO 80401
Phone: 303-526-4432 FAX: 303-526-4426
www.rasinc.org - Email: PedlerRAS@aol.com

Client: CH2M HILL, NORTHSTAR

Date: 10/10/11

Project (Name/Number): TOPOCK HPL 2011

Site Location: TOPOCK, CA

Well Number: MW 60BR-225

Time		Activity Description
Start	Stop	
0545	1800	DRIVING #502 W/ T2 FROM GOLDEN, CO → FLAGSTAFF, A.Z.
		START MILEAGE 47047
		END MILEAGE 47824 TOTAL MI = 777

Log Measurement Summary	
Log Instrument	Total Footage Logged

Special Comments (Data Delivered, Problems Encountered, etc.)

MARC SCHOBMEHL
Logging Engineer

Client

DAILY LOG

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311 Rock Avenue, Golden, CO 80401
Phone: 303-526-4432 FAX: 303-526-4426
www.rasinc.org - Email: PedlerRAS@aol.com

Client: CH2MHILL / NORTHSTAR

Date: 10/11/11

Project (Name/Number): TOPOCK HPL 2011

Site Location: TOPOCK, CA

Well Number: MW60BR-225

Time		Activity Description
Start	Stop	
0700	1030	DRIVE #502/TZ FLAGSTAFF, A.Z. → TOPOCK, CA
		START 47824 → 48031 END = 207 MI.
1030	1040	MEET WITH MIKE (CH2MHILL)
1040	1115	SET UP ON WELL, UNLOAD EQUIPMENT
1115	1245	RIG UP ON WELL, SAFETY & CONTAMINATION CONTAINMENT
1245	1315	MEET WITH BARRY H&S OFFICER, SITE SENSITIVITY MEETING
1315	1430	D.I. GENERATION WITH MIKE, RESUME SET-UP
1430	1550	TOOL CALIBRATION, TEMP STABILIZE, PRE LOG CAL CHECK
1550	1602	RE-CAL TOOL, TEMP STABALIZE
1602	1624	AMB FECT LOG 95' - 242.78
1624	1630	POST LOG CAL CHECK
1630	1730	INSTALL PUMP @ 243' (PUMP INLET)
1730	1800	RUN TOOL DOWN HOLE TO CHECK FOR OBSTRUCTIONS
1800	1830	DRIVE RENTAL CAR TO NEEDLES, CA

Log Measurement Summary	
Log Instrument	Total Footage Logged
HPL (AMB FECT)	147.78

Special Comments (Data Delivered, Problems Encountered, etc.)

MARC J. SCHUBMEHL
Logging Engineer

Client

DAILY LOG

Integrated Subsurface Evaluation
311 Rock Avenue, Golden, CO 80401
Phone: 303-526-4432 FAX: 303-526-4426
www.rasinc.org - Email: PedlerRAS@aol.com

Client: CH2MILL NORTHSTAR **Date:** 10/12/11

Project (Name/Number): HPL 2011 **Site Location:** TOPOCK **Well Number:** MW 60BR-225

Time		Activity Description
Start	Stop	
0650	0713	TRAVEL TO SITE
0713	0810	H+S MEETING
0810	0905	SETUP FOR HPL
0905	0920	AMBIENT LOG 1
0920	1007	SETUP FOR EMPLACEMENT
1007	1103	EMPLACEMENT LOG 5 2-4
1103	1133	AMBIENT FLOWING CHARACTERIZATION LOGS 5-
1133	1215	" " " LOG 6
1215	1721	" " " LOG 7-12
1721	1739	POST LOG CAL CHECK
1739	1810	BACK UP DATA DRIVE TO HOTEL

Log Measurement Summary

Log Instrument	Total Footage Logged
HPL	
LOG 1	95' - 239'
2-4	95' - 239'
5-	95' - 239'
6	95' - 239'
7-12	110' - 239

Special Comments (Data Delivered, Problems Encountered, etc.)

MARC J. SCHUBMEHL
Logging Engineer

Client

DAILY LOG

Integrated Subsurface Evaluation
311 Rock Avenue, Golden, CO 80401
Phone: 303-526-4432 FAX: 303-526-4426
www.rasinc.org - Email: bpedler@rasinc.org

Client: CH2MHILL / NORTHSTAR

Date: 10/13/11

Personnel Present: MARC SCHUBMEHL JAMES WERTHER

Total Mileage: N/A

Project (Name/Number): TOPOCK HPL 2011

Site Location: TOPOCK, CA

Well Number: MW 60BR-225

Time		Activity Description
Start	Stop	
0645	0710	DRIVE FROM HOTEL TO WELL SITE
0710	0810	PRECAL CHECK TEMP STABILIZATION
0810	1722	AMBIENT FLOW CHARACTERIZATION DAY 2 LOGS 1-10
1722	1733	POST LOG CAL CHECK
1733	1800	DRIVE FROM WELL SITE TO HOTEL

Log Measurement Summary	
Log Instrument	Total Footage Logged
LOG 1-10	110'-239'

Special Comments (Data Delivered, Problems Encountered, etc.)

Logging Engineer Signature

Client Signature

DAILY LOG

Integrated Subsurface Evaluation
311 Rock Avenue, Golden, CO 80401
Phone: 303-526-4432 FAX: 303-526-4426
www.rasinc.org - Email: bpedler@rasinc.org

Client: CH2MHILL / NORTHSTAR

Date: 10/14/11

Personnel Present: MARC SCHUBERT / JAMES WORTHER

Total Mileage: N/A

Project (Name/Number): TOPOCK HPL 2011

Site Location: TOPOCK, CA

Well Number: MW 60BR-225

Time		Activity Description
Start	Stop	
0650	0713	DRIVE TO WELL SITE
0713	0822	RIG UP TOOL/COMPUTER
0822	0848	AMBIENT FLOW CHARACTERIZATION LOG 1 (DAY 3)
0848	0942	EMPLACEMENT LOGS 2-3
0942	1115	TROUBLESHOOT AND FIX TOOL
1115	1149	RECAL TOOL / TEMP STABILIZE
1149	1201	↓
1201	1254	SAE SLUG AFTER EMPLACEMENT 20' SLUG LOGS 4-8
1254	1434	SAE 25' SLUG LOGS 9-14
1434	1455	POST LOG CAL CHECK
1455	1600	DEWATERED WELL TO EXPEDITE PACKARD SAMPLING
1600	1635	PULLED PIPE AND PUMP FROM WELL
1635	1657	RIG DOWN HPL EQUIPMENT
1657	1730	LEAVE WELL SITE FOR HOTEL

Log Measurement Summary	
Log Instrument	Total Footage Logged
LOG 1	110'-239'
LOG 2-3	110'-239'
LOG 4-8	110'-239'
LOG 9-14	110'-239'

Special Comments (Data Delivered, Problems Encountered, etc.)

TALKED WITH CLIENT (MIKE) AND DECIDED TO DE-WATER WELL SO WE COULD DEVELOP WELL FOR PACKARD SAMPLING

TOOL WOULD NOT READ PROPERLY AT 0-40,000 RANGE, RECAL TOOL TO 0-400 RANGE AND 0-100,000 RANGE

MARC J. S

Logging Engineer Signature

Client Signature

DAILY LOG

Integrated Subsurface Evaluation
311 Rock Avenue, Golden, CO 80401
Phone: 303-526-4432 FAX: 303-526-4426
www.rasinc.org - Email: bpedler@rasinc.org

Client: CH2MHILL / NORTH STAR

Date: 10/15/2011

Personnel Present: JAMES WERTHER / MARC SCHUBMEHL

Total Mileage: N/A

Project (Name/Number): TOPOCK HPL 2011

Site Location: TOPOCK, CA

Well Number: MW 60BR 245

Time		Activity Description
Start	Stop	
0600	0620	DRIVE TO WELL SITE
0620	0750	INSTALL PUMP & PIPE
0750	0908	REBUILD HPL TOOL PRELOG RECAL TOOL
0908	0955	EMPLACEMENT LOGS 1-3
0955	1003	PREPARE FOR SAE LOG 4
1018	1130	SAE 2 LOGS 20' SLUG 5-10 LOGS
1130	1301	SAE 2 LOGS 28' SLUG 10-16 LOGS
1301	1310	POST LOG CAL CHECK
1310	1400	PULL OUT PUMP & PIPE
1400	1530	RIG DOWN HPL EQUIP. / SET UP WSP EQUIP
1530	1630	SET UP / BUILD WIRELINE STRADDLE PACKER
1630	1710	CHECKOUT PACKER ASSEMBLY
1710	1740	DRIVE TO HOTEL

Log Measurement Summary	
Log Instrument	Total Footage Logged
LOGS 1-3	110'-239'
LOG 4	110'-152
LOGS 5-10	110'-239'
LOGS 10-16	110'-239

Special Comments (Data Delivered, Problems Encountered, etc.)

Marc T. S

Logging Engineer Signature

Client Signature

Revised 08/20/2007

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DAILY LOG

Client: CH2MHill NorthStar

Date: 10/16/11

Personnel Present: Jim Werther Mike Schubmehl

Total Mileage: N/A

Project (Name/Number): HHL 2011

Site Location: Tooolik

Well Number: MW 60BK 245

Time		Activity Description
Start	Stop	
0650	0650	TRAVEL TO WELL
0650	0915	SETUP FOR WSP
0915	1256	WSP DEVELOPMENT 170'
1256	1312	SAMPLING
1312	1500	CHECKOUT TOOL LEAK
1500	1530	CONSULT RAS OFFICE

Log Measurement Summary	
Log Instrument	Total Footage Logged

Special Comments (Data Delivered, Problems Encountered, etc.)

TOOL STARTED LEAKING DURING FIRST TEST

Logging Engineer Signature

Client Signature

DAILY LOG

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Client: CH2M HILL NORTHSTAR

Date: 10/17/11

Personnel Present: JON WERTHER / MARC SCHNOEHL

Total Mileage: N/A

Project (Name/Number): HPL 2011

Site Location: TOPOCK

Well Number: MW 600R 245

Time		Activity Description
Start	Stop	
0630	0650	TRAVEL
0650	0930	REBUILD BULKHEAD
0930	1030	LEAK CHECK TOOL - CHECK CUT GOOD
1030	1300	REBUILT WSP W/ SHORTER WIRES - NOT RUNNING GOOD SIGNALS
1300	1500	TO HANGAR FOR EPOXY FOR REBUILD
1500	1630	REPOT BULKHEAD
1630	1700	P/U D.I. TANKS

Log Measurement Summary	
Log Instrument	Total Footage Logged

Special Comments (Data Delivered, Problems Encountered, etc.)

Logging Engineer Signature

Client Signature

Revised 08/20/2007

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DAILY LOG

Client: CH2M+Hill Northstar

Date: 10/18/11

Personnel Present: Jon Werther Marc Schlumbohl

Total Mileage: N/A

Project (Name/Number): HPL 2011

Site Location: Topocas

Well Number: MW 60BR 245

Time		Activity Description
Start	Stop	
0610	0630	TRAVEL TO SITE
0630	0815	SETUP WSP TEST
0815	0930	MU'S 1 WSP @ 230
0930	1200	BREAKDOWN EQUIPMENT
1200	1405	OFFSITE TO PACK
1405	1515	STANDY - PERMISSION WHERE TO LEAVE WORK TRUCK + TRAILER

Log Measurement Summary	
Log Instrument	Total Footage Logged

Special Comments (Data Delivered, Problems Encountered, etc.)

* TOOL STARTED LEAKING AGAIN DURING FIRST TEST @ 230'

Logging Engineer Signature

Client Signature

DAILY LOG

Integrated Subsurface Evaluation
311 Rock Avenue, Golden, CO 80401
Phone: 303-526-4432 FAX: 303-526-4426
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Client: CH2M HILL / NORTHSTAR

Date: 11/6/11

Personnel Present: JIM WERTHER / MARC SCHUBMEHL

Total Mileage: 33

Project (Name/Number): TEPOCK HPL 2011

Site Location: NEEDLES, CA

Well Number: MW-70BR225

Time		Activity Description
Start	Stop	
0540	0618	TRAVEL TO WELL
0618	0700	SETUP HPL EQUIPMENT
0700	1625	AFC DAY 2 LOGS 1 - 10
1625	1645	BREAKDOWN / CLEANUP
1645	1715	TRAVEL OFFSITE

Log Measurement Summary	
Log Instrument	Total Footage Logged
HPL	
LOG 1 -	115' - 221.5'

Special Comments (Data Delivered, Problems Encountered, etc.)

Logging Engineer Signature

Client Signature

DAILY LOG

Integrated Subsurface Evaluation
311 Rock Avenue, Golden, CO 80401
Phone: 303-526-4432 FAX: 303-526-4426
www.rasinc.org - Email: PedlerRAS@aol.com

Client: CH2MHILL / NORTHSTAR

Date: 11/7/11

Project (Name/Number): Topock HPL 2011 Site Location: NEEDLES, CA Well Number: MW 70BR 225

Time Start	Time Stop	Activity Description
0600	0625	DRIVE TO HOTEL 12253 → 12269 (16 mi.)
0625	0650	RIG UP WELL, TOOL FOR HPL
0650	0715	TEMP STABILIZE TOOL
0715	0735	LOG 1 AMBIENT FLOW CHARACTERIZATION DAY 3 (115'-221.5')
0735	0843	HYDRAULIC CHARACTERIZATION 3' & 4' SLUG TEST
0843	0953	EMPLACEMENT
0953	1002	SET UP FOR SAE LOG (SLUG AFTER EMPLACEMENT)
1002	1222	LOG 2-5 SAE (115'-221.5')
1222	1230	PULL PUMP FROM WELL,
1230	1510	SAMPLING PUMPING, DEVELOP WELL FOR SAMPLING
1510	1525	SAMPLING
1525	1640	RIG DOWN EQUIP. AT WELL SITE
1640	1710	DRIVE TO HOTEL 12269 → 12285 (16 mi)
		(TOTAL MI 32 miles)

Log Measurement Summary	
Log Instrument	Total Footage Logged
LOG 1 AFC	(115'-221.5')
LOGS 2-5 SAE	(115-221.5)

Special Comments (Data Delivered, Problems Encountered, etc.)

Logging Engineer

Client

DAILY LOG

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311 Rock Avenue, Golden, CO 80401
Phone: 303-526-4432 FAX: 303-526-4426
www.rasinc.org - Email: PedlerRAS@aol.com

Client: CH2MHILL/NORTHSTAR

Date: 11/8/11

Project (Name/Number): Topock Aril 2011

Site Location: NEEDLES, CA

Well Number: MW70DK225

Time		Activity Description
Start	Stop	
0845	0900	TRAVEL TO SITE
0900	1220	DECON AND PACK ALL EQUIPMENT
1220	1320	TRAVEL OFFSITE

Log Measurement Summary	
Log Instrument	Total Footage Logged

Special Comments (Data Delivered, Problems Encountered, etc.)

CAR MILEAGE - 32 TRUCK - 16 TOTAL 48

Logging Engineer

Client

APPENDIX B

DATA AND ANALYSIS

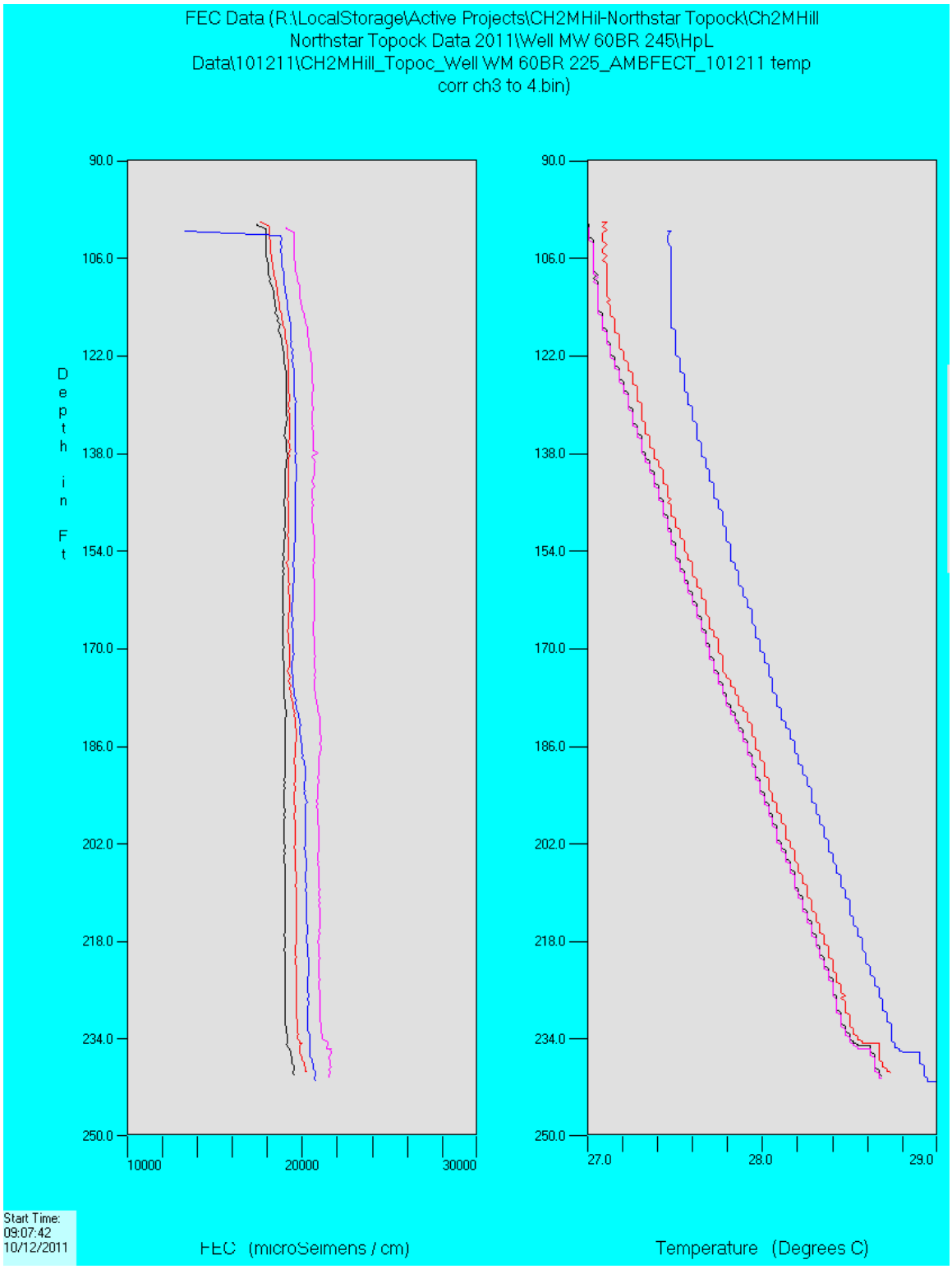


Figure 1. MW-60BR-245 - Ambient FEC and Temperature Logs, 12 Oct 2011.

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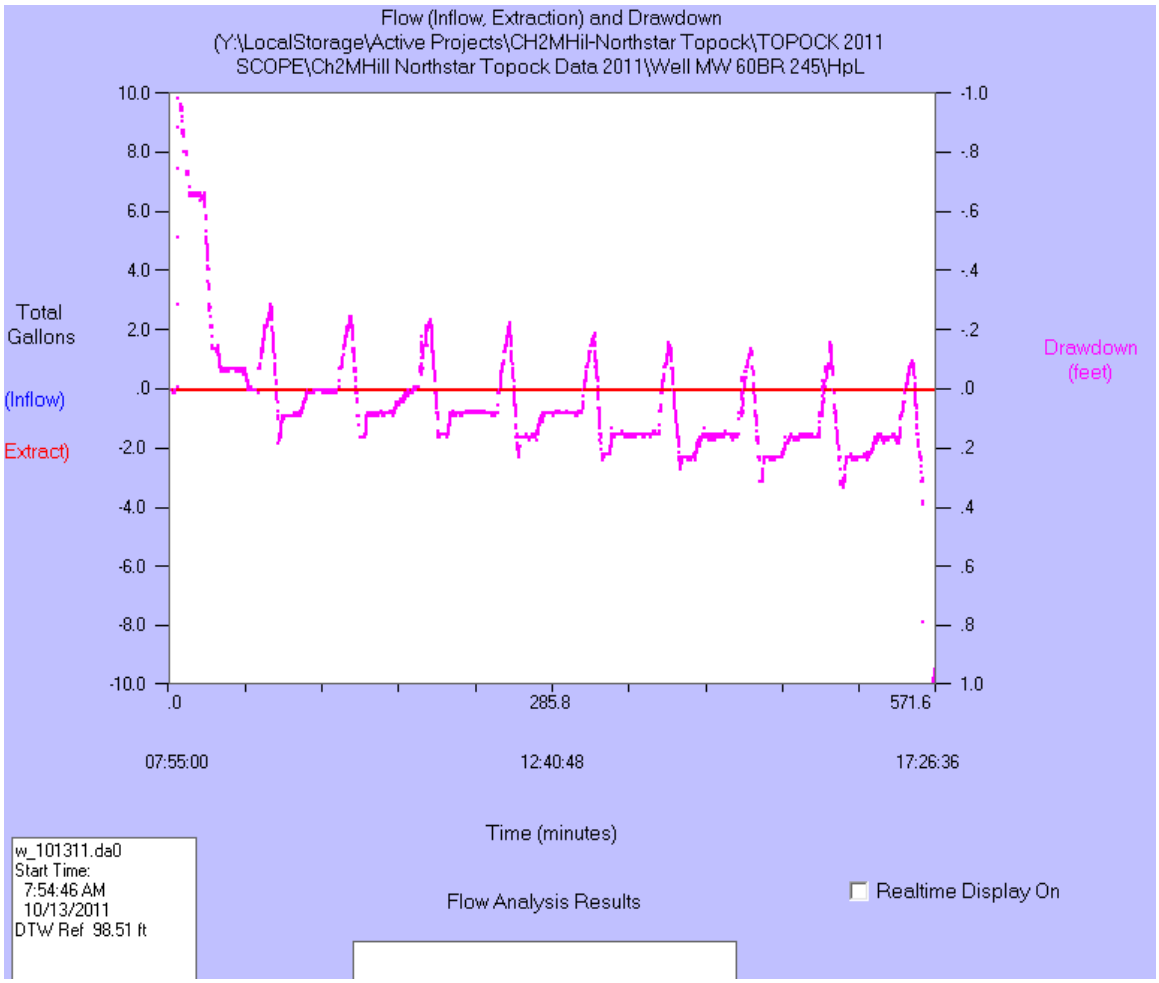


Figure 2. MW-60BR-245 - Pressure history during Ambient Flow Characterization, 13 Oct 2011.

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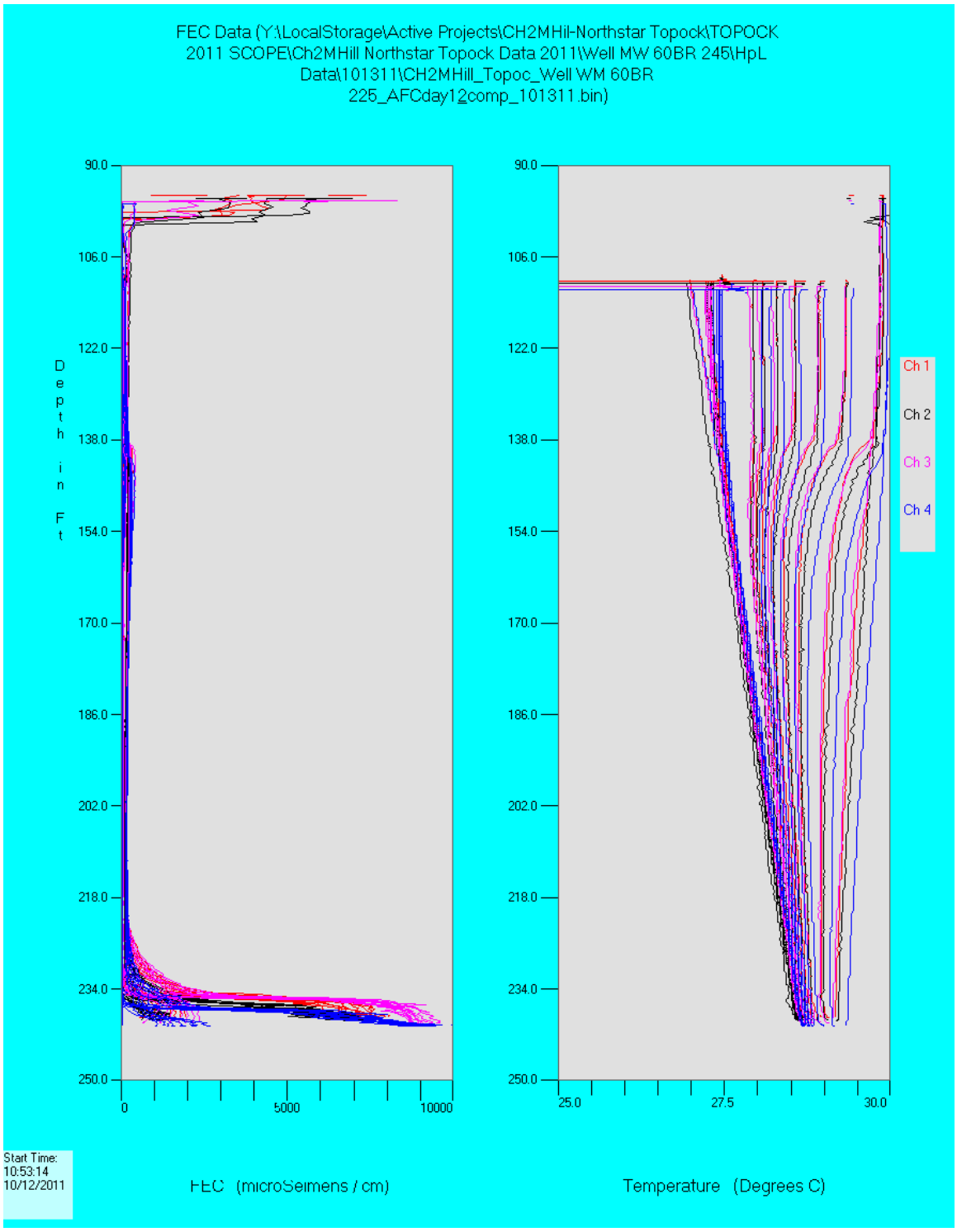


Figure 3. **MW-60BR-245 - Summary of FEC and Temperature logs for Ambient Flow Characterization. Compiled data from two days, 12-13 Oct 2011.**

RAS Inc. Copyright RAS, Inc. 2012.

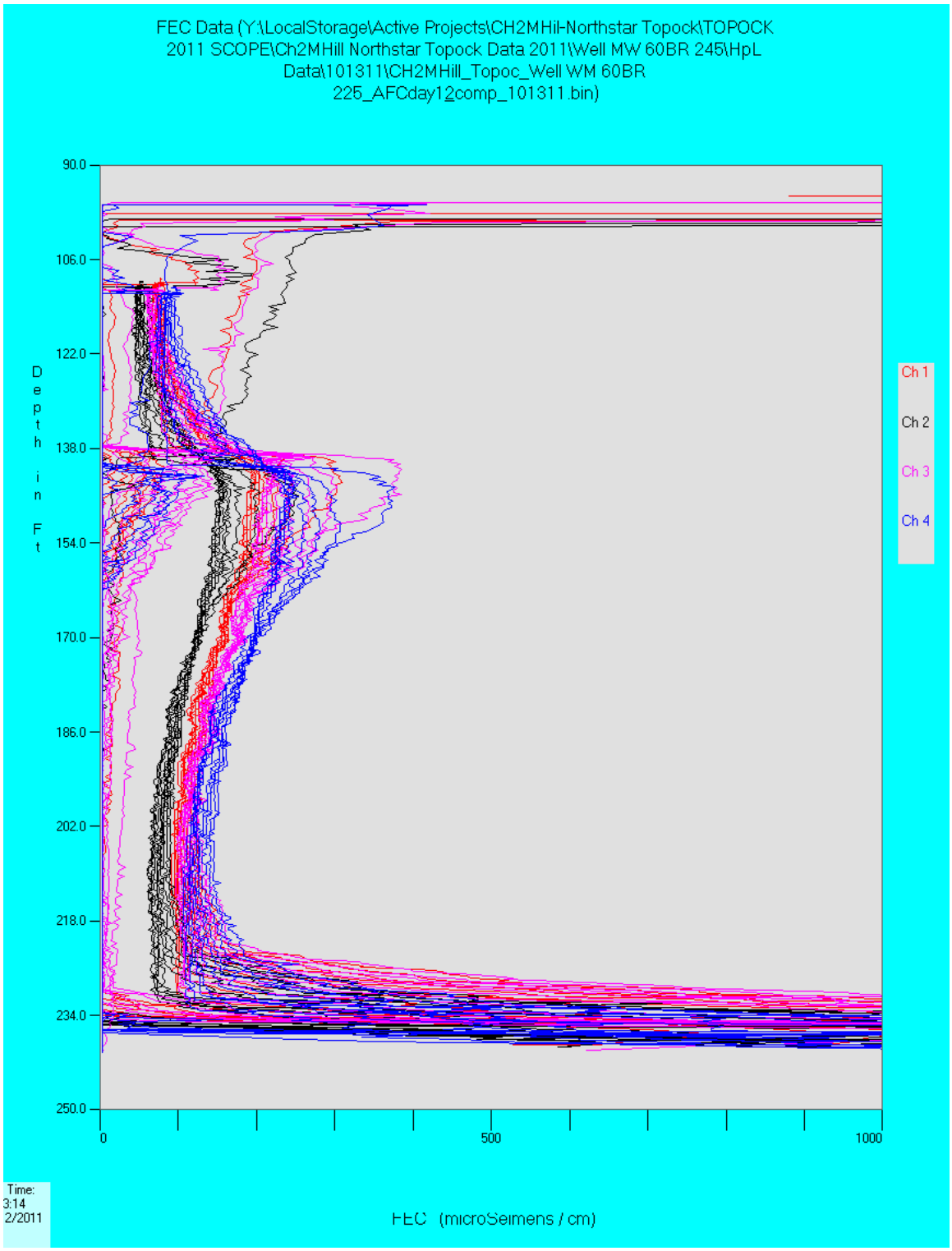


Figure 4. **MW-60BR-245 - Summary of logs for Ambient Flow Characterization. Enhanced FEC scale. Compiled data from two days, 12-13 Oct 2011.**

RAS Inc. Copyright RAS, Inc. 2012.

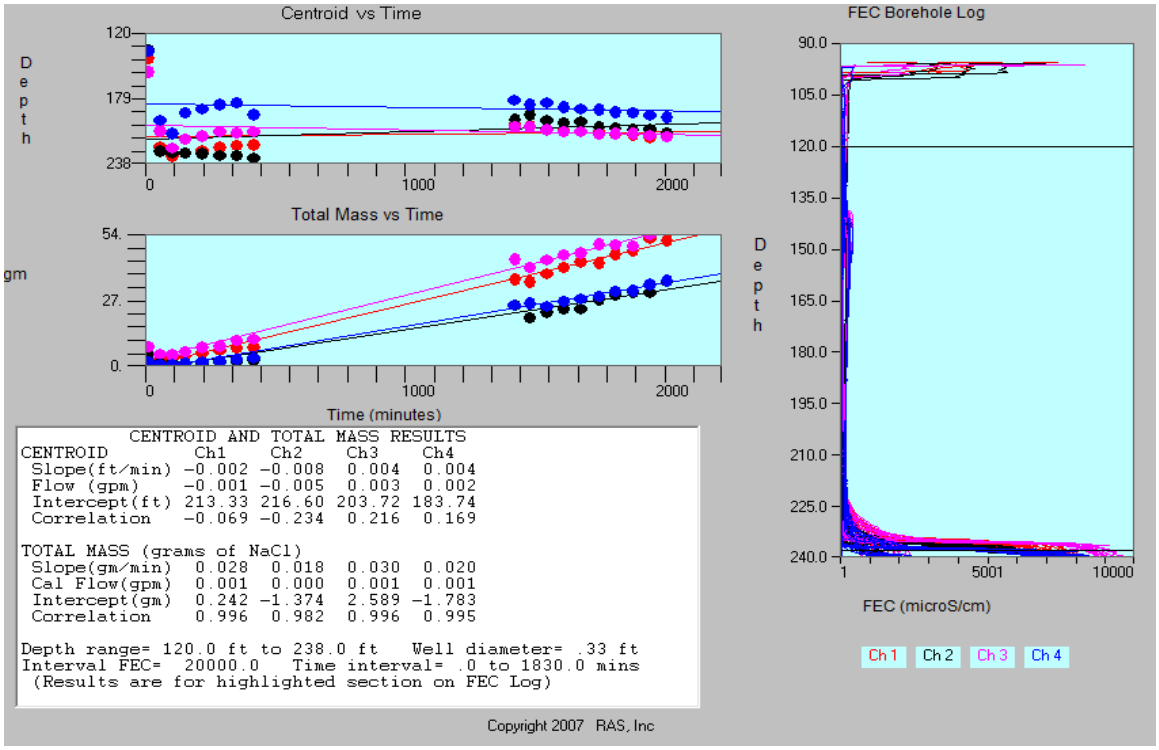


Figure 5. MW-60BR-245 - Analysis results of logs for Ambient Flow Characterization. Overall total flow during two days of AFC was extremely low flow. However, two distinct intervals of inflow are observed. Data for each interval is evaluated for horizontal flow as shown below.

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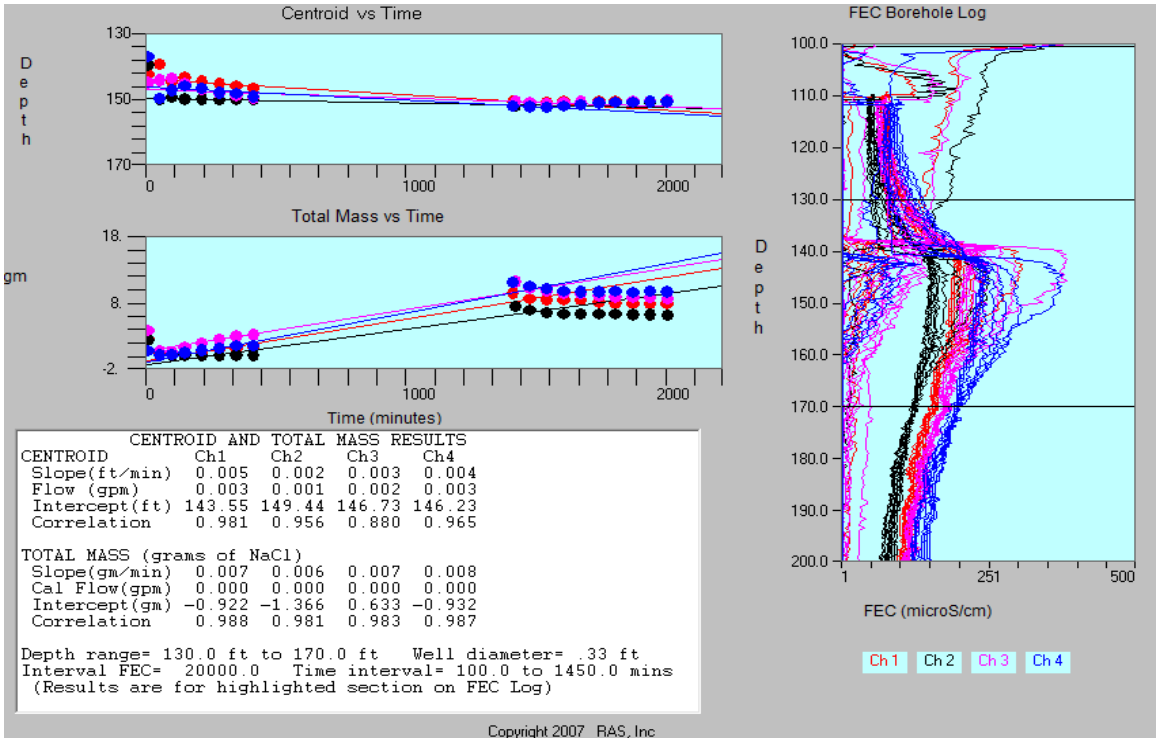


Figure 6. MW-60BR-245 - Analysis results of logs for Ambient Flow Characterization. Interval from 130 to 170 feet below top of PVC casing (ftbtoc). Data evaluated from Day 1, 12 Oct 2011.

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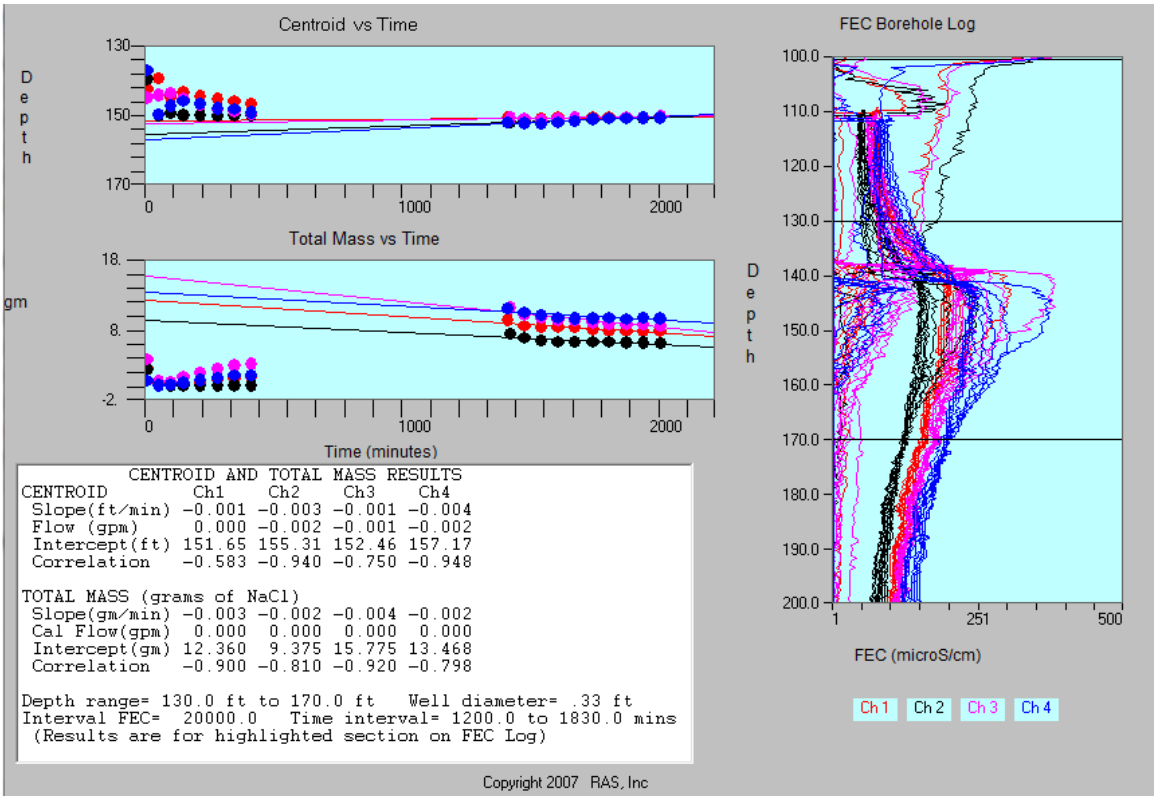


Figure 7. MW-60BR-245 - Analysis results of logs for Ambient Flow Characterization. Interval from 130 to 170 ftbtoc. Data evaluated from Day 2, 13 Oct 2011.

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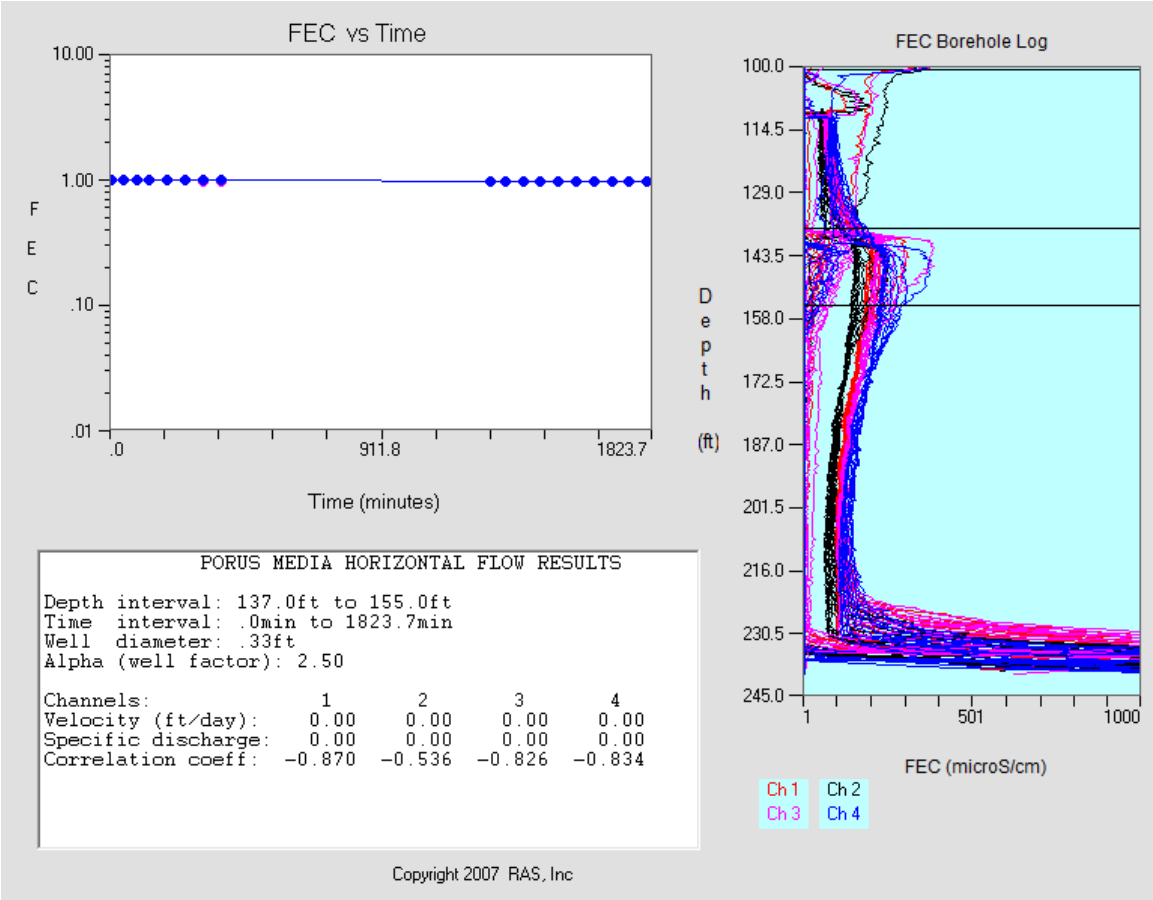


Figure 8. MW-60BR-245 - Analysis results of logs for Ambient Flow Characterization. Interval from 137 to 155 ftbtoc. FEC vs. Time.

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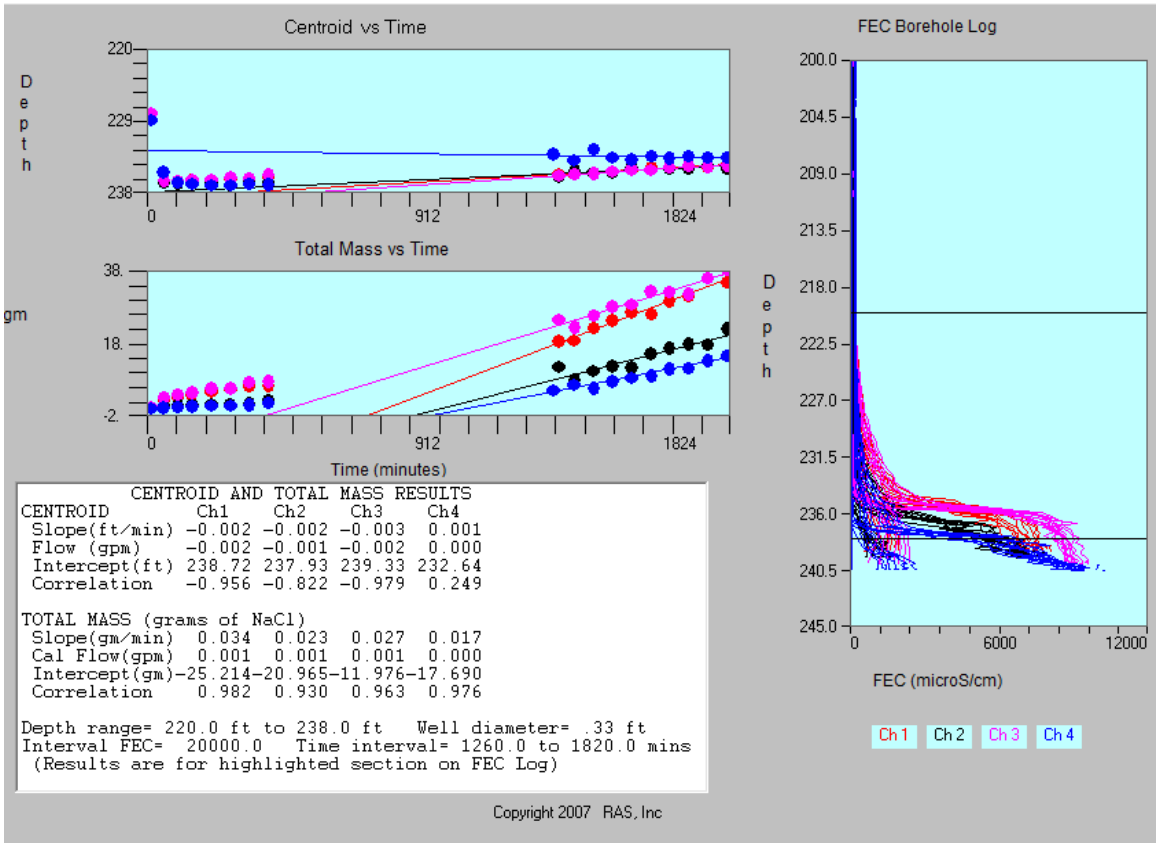


Figure 9. **MW-60BR-245 - Analysis results of logs for Ambient Flow Characterization. Interval from 220 to 238 ftbtoc. Data evaluated for Day 2, 13 Oct 2011. Total flow = < 0.001 gpm (average flow of four channels).**

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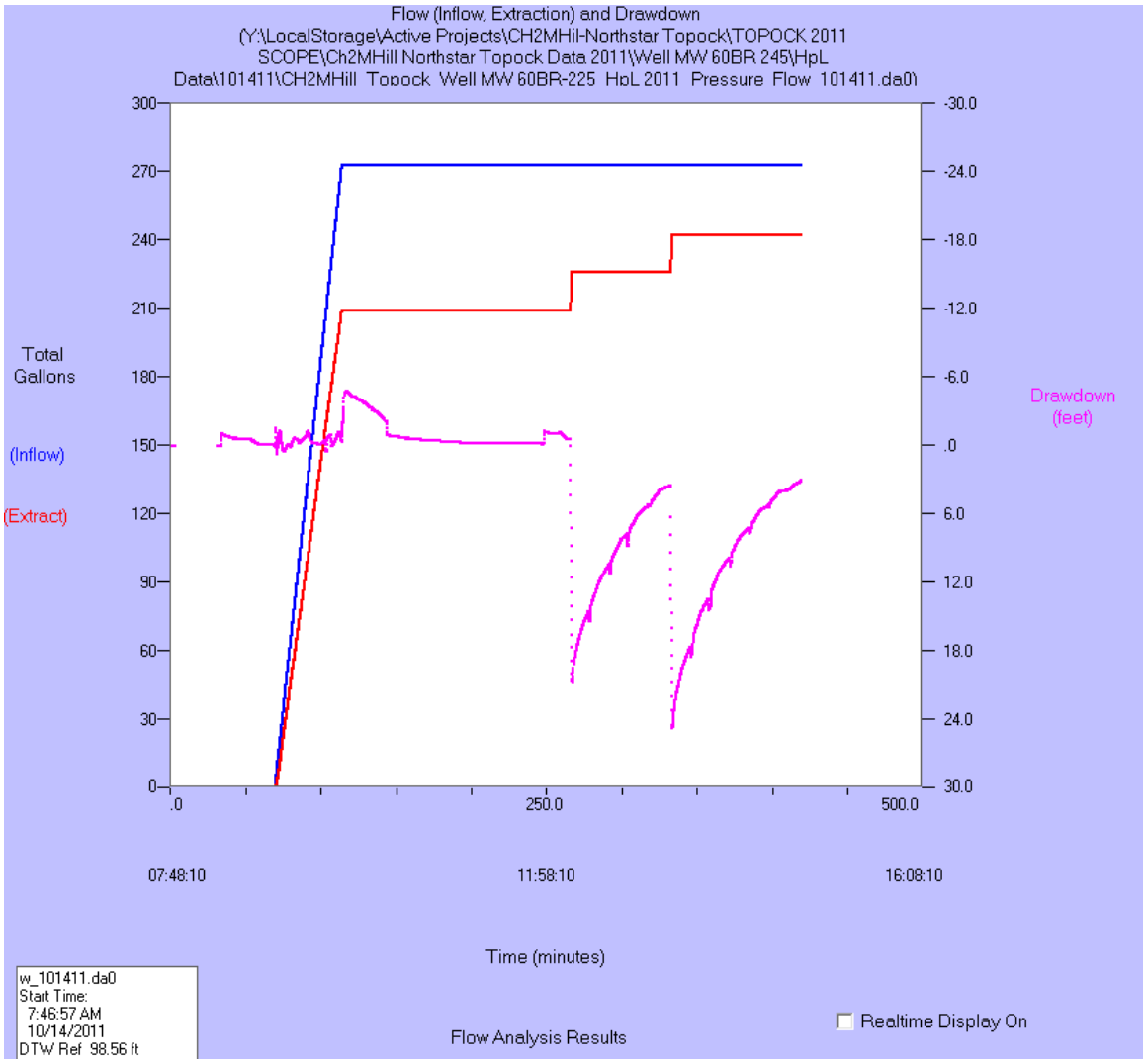


Figure 10. MW-60BR-245 - Flow and Drawdown data from Slug Test After Emplacement Testing. 20-foot slug test (beginning at approximately 267 minutes) and 25-foot slug test (beginning at approximately 334 minutes) are shown, 14 Oct 2011.

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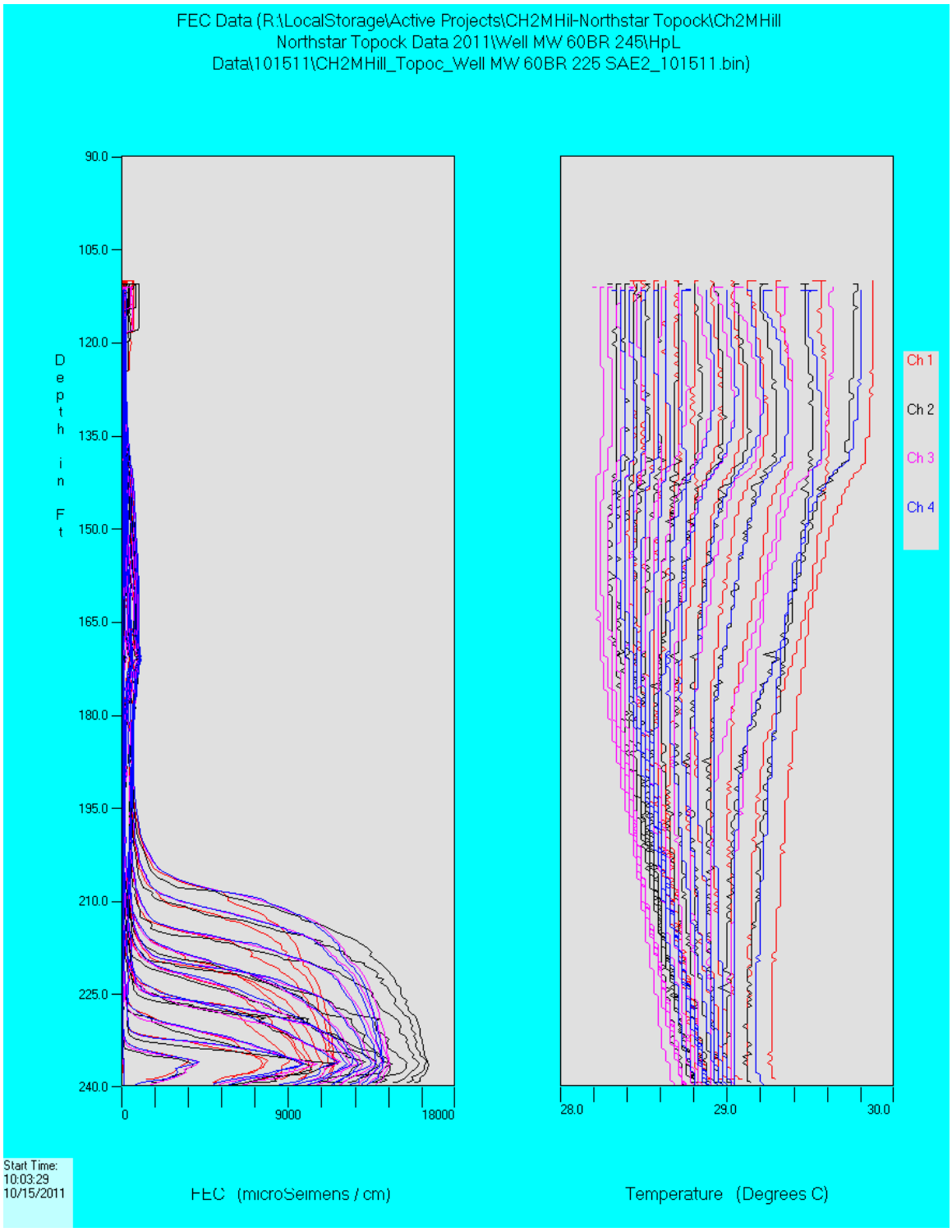


Figure 11. MW-60BR-245 - FEC and Temperature log summary from Slug Test After Emplacement Testing, 15 Oct 2011.

RAS Inc. Copyright RAS, Inc. 2012.

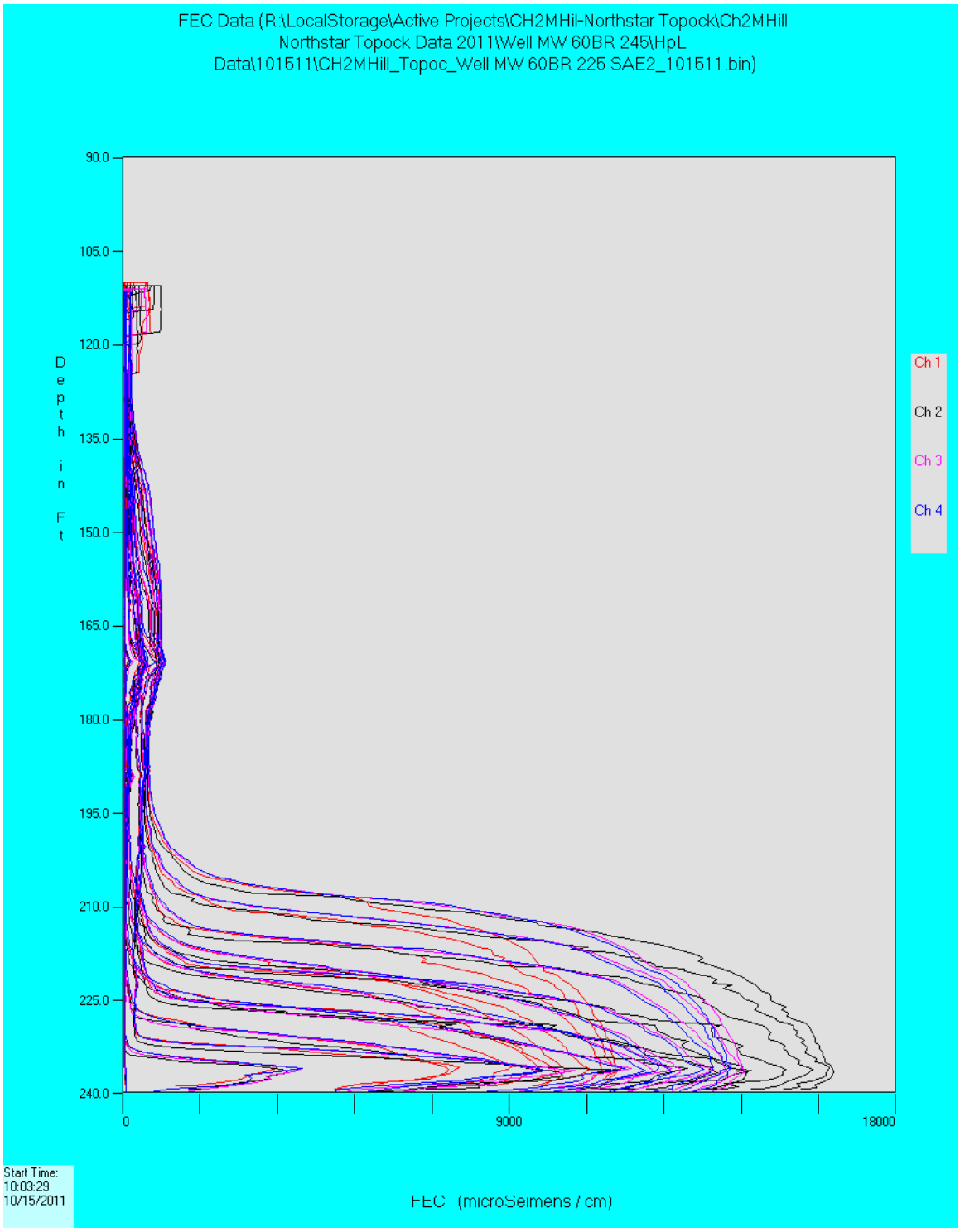


Figure 12. MW-60BR-245 - FEC log summary from Slug Test After Emplacement Testing, 15 Oct 2011.

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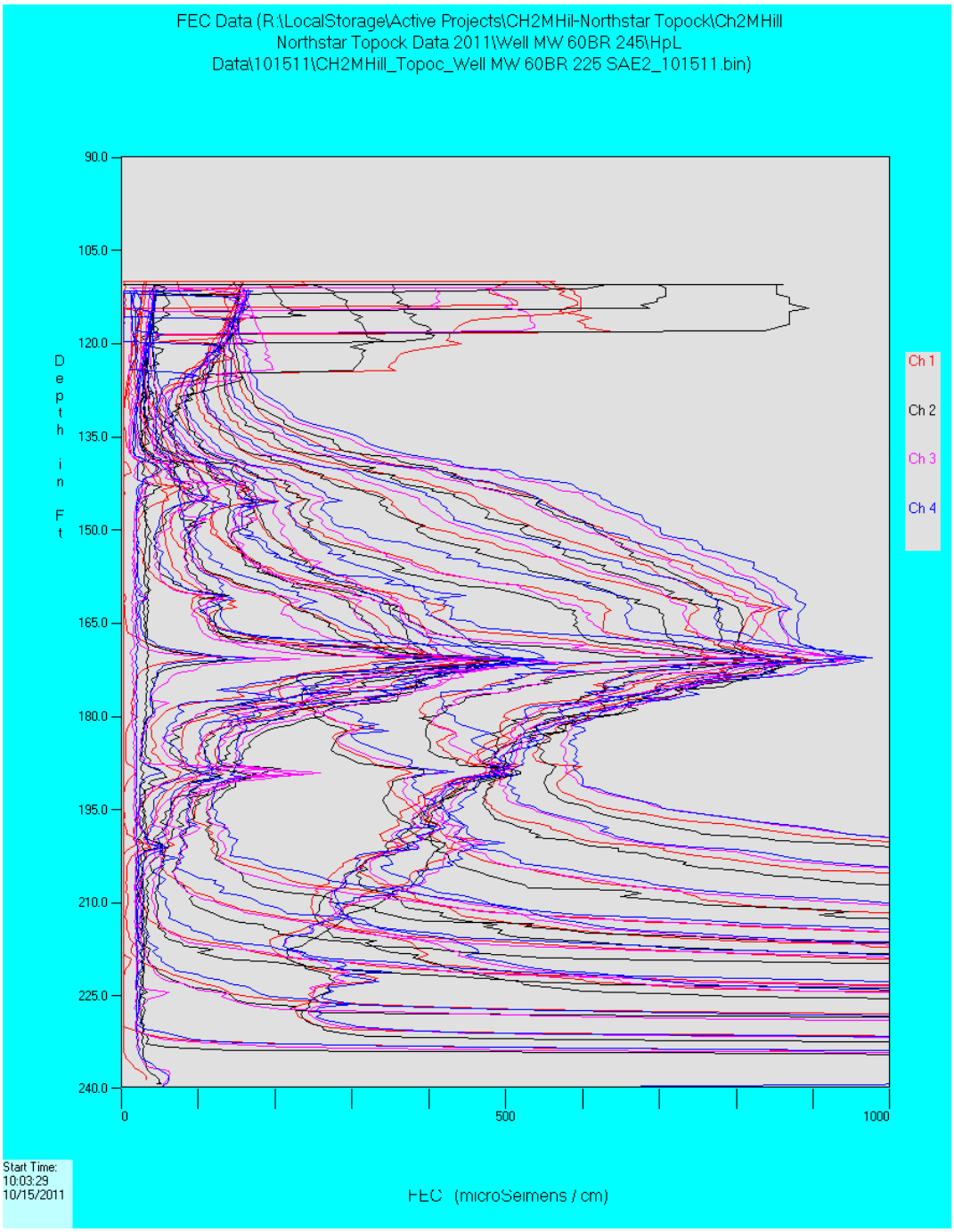


Figure 13. MW-60BR-245 - Log summary from Slug Test After Emplacement Testing. Enhanced FEC scale to highlight low rate inflow points, 15 Oct 2011.

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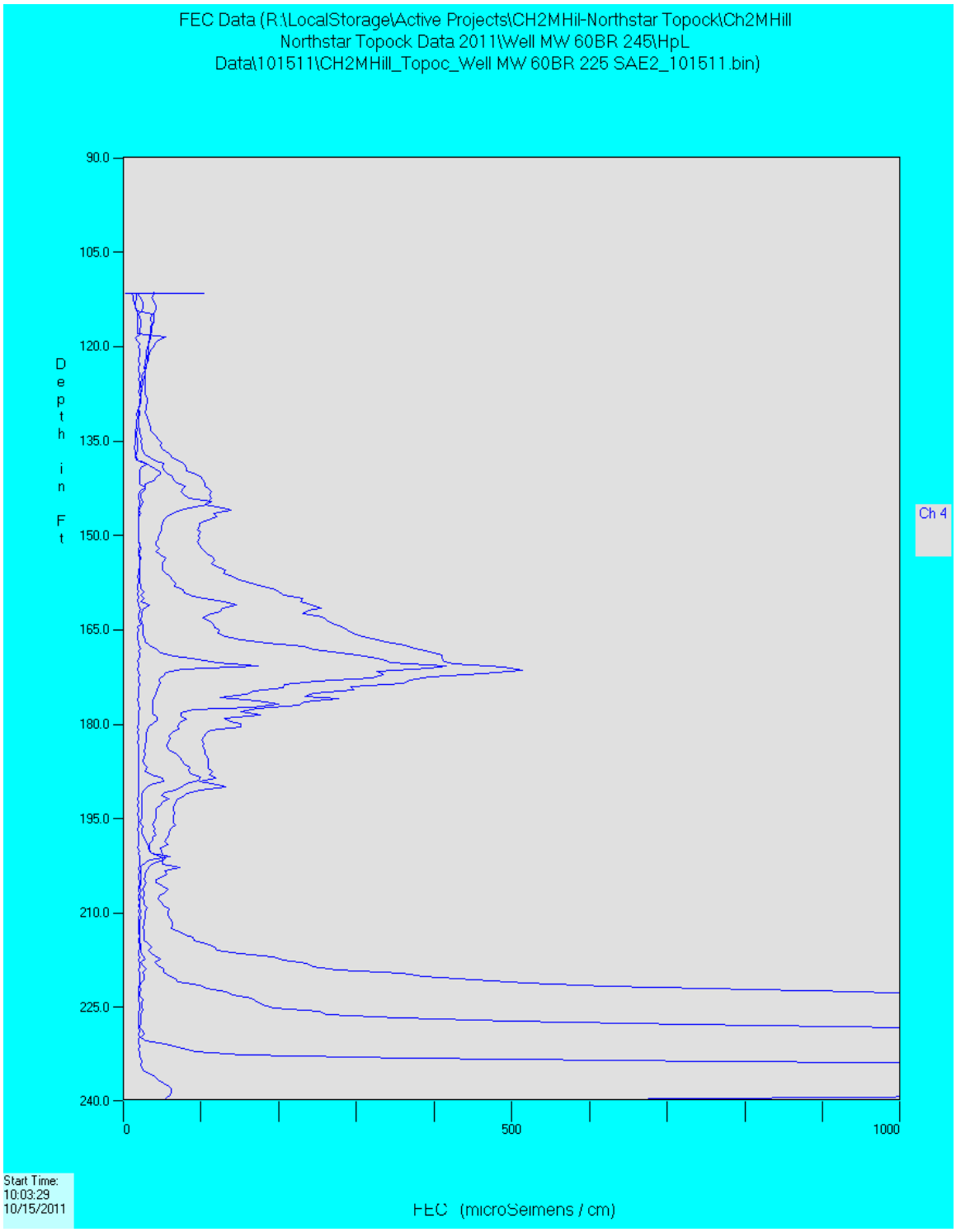


Figure 14. MW-60BR-245 - Log summary from Slug Test After Emplacement Testing. Enhanced FEC scale to highlight low rate inflow points, time clip of early logs and channel 4 only, 15 Oct 2011.

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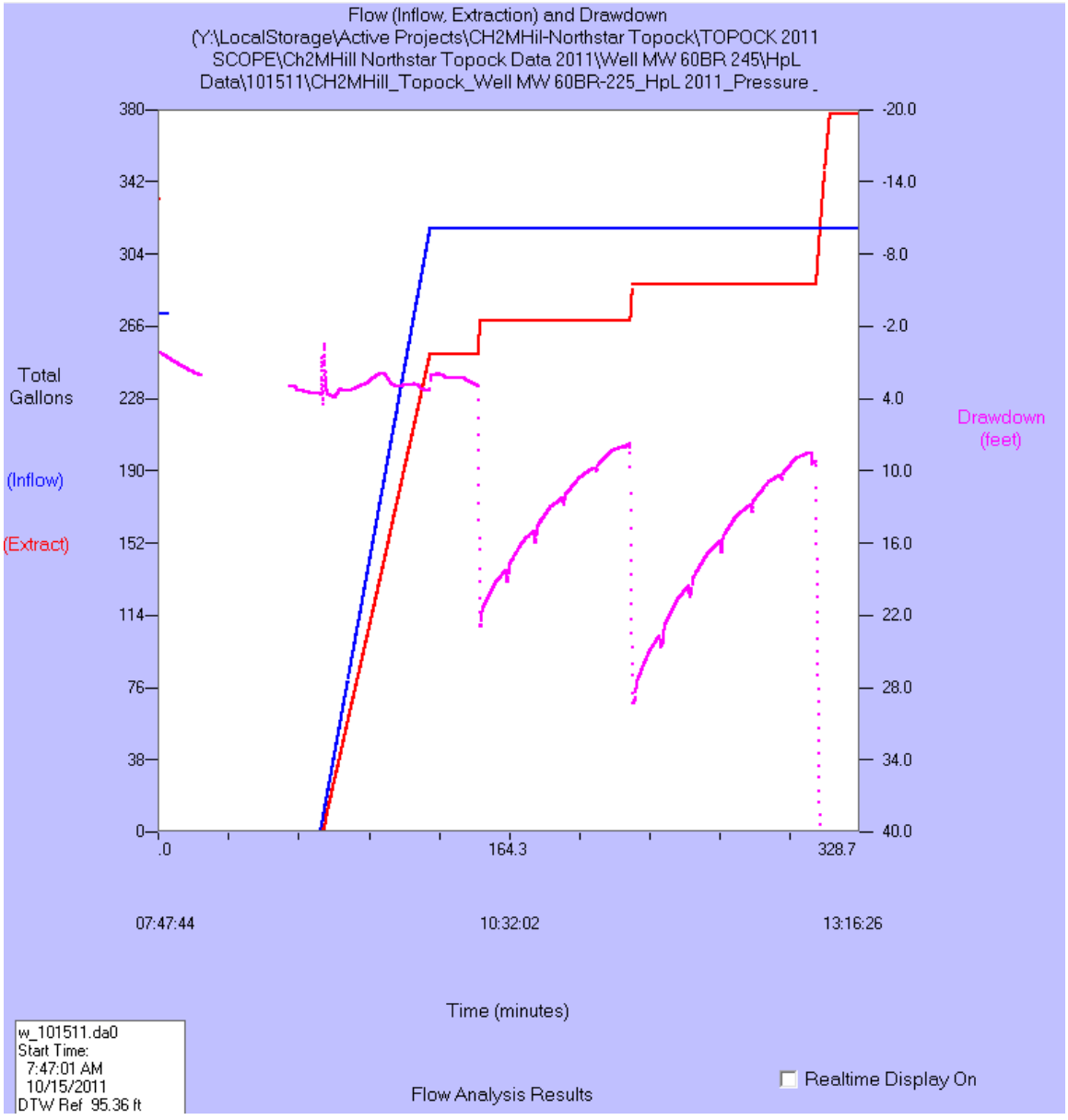


Figure 15. MW-60BR-245 - Flow and Drawdown data from Slug Test After Emplacement Testing. 23-foot (beginning at approximately 151 minutes) and 29.5-foot slugs are shown (beginning at approximately 223 minutes), 15 Oct 2011.

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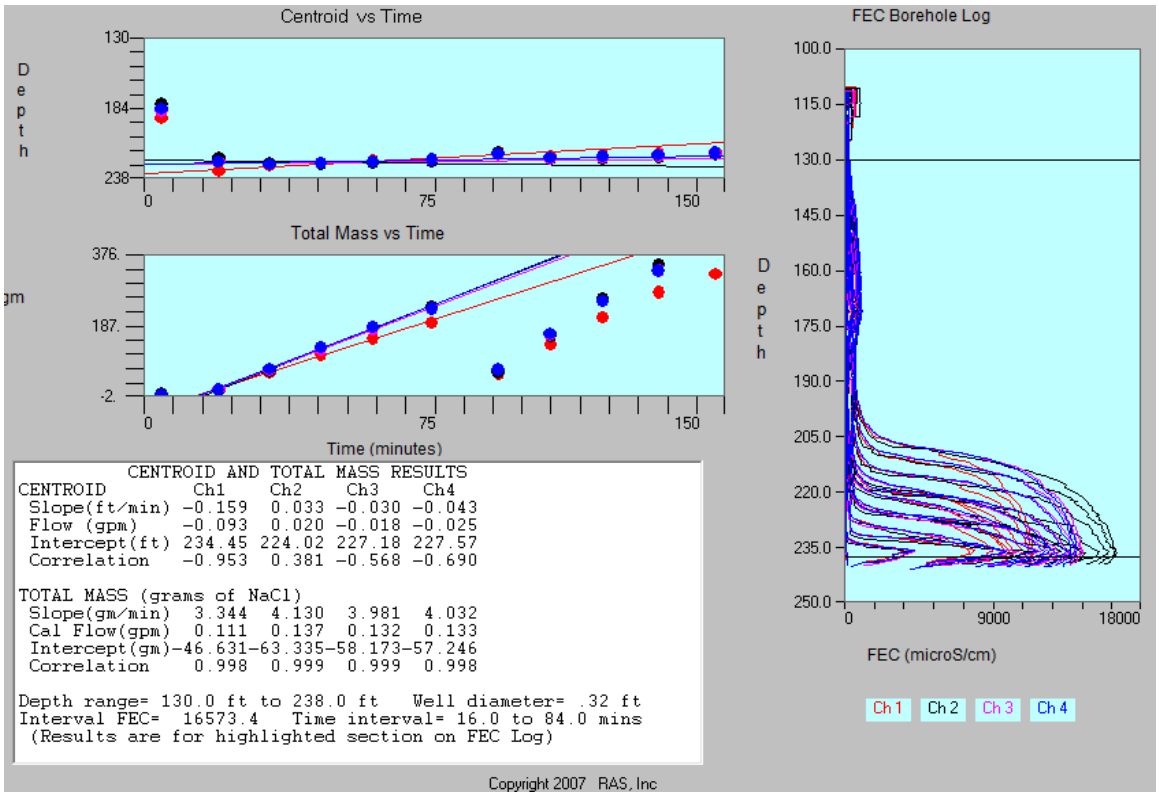


Figure 16. MW-60BR-245 - Analysis results of logs for Slug Test After Emplacement Testing. Interval from 130 to 238 ftbtoc. Early logs from 20-foot slug. Total flow = 0.128 gpm (average flow of four channels). 15 Oct 2011.

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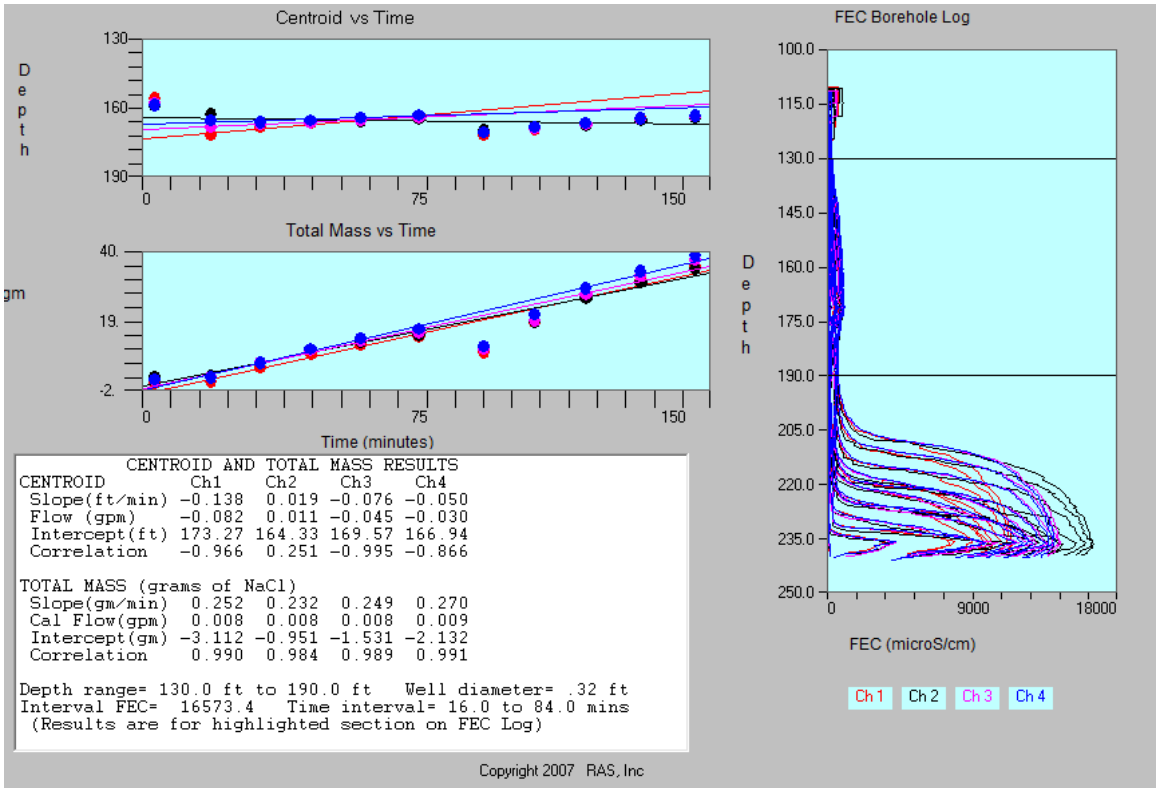


Figure 17. MW-60BR-245 - Analysis results of logs for Slug Test After Emplacement Testing. Interval from 130 to 190 ftbtoc. Early logs from 20-foot slug. Total flow = 0.008 gpm (average flow of four channels). 15 Oct 2011.

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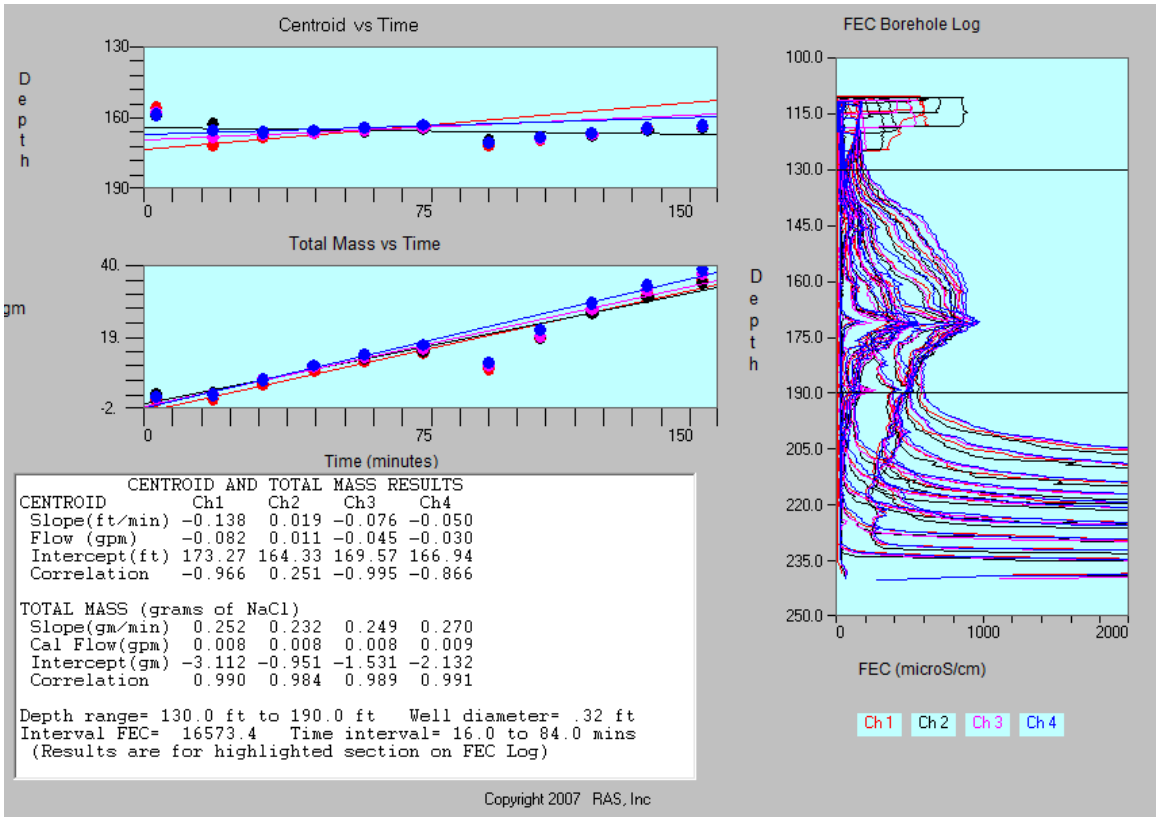


Figure 18. MW-60BR-245 - Analysis results of logs for Slug Test After Emplacement Testing. Interval from 130 to 190 ftbtoc. Early logs from 20-foot slug. Total flow = 0.008 gpm (average flow of four channels). Enhanced FEC scale to show detail. 15 Oct 2011.

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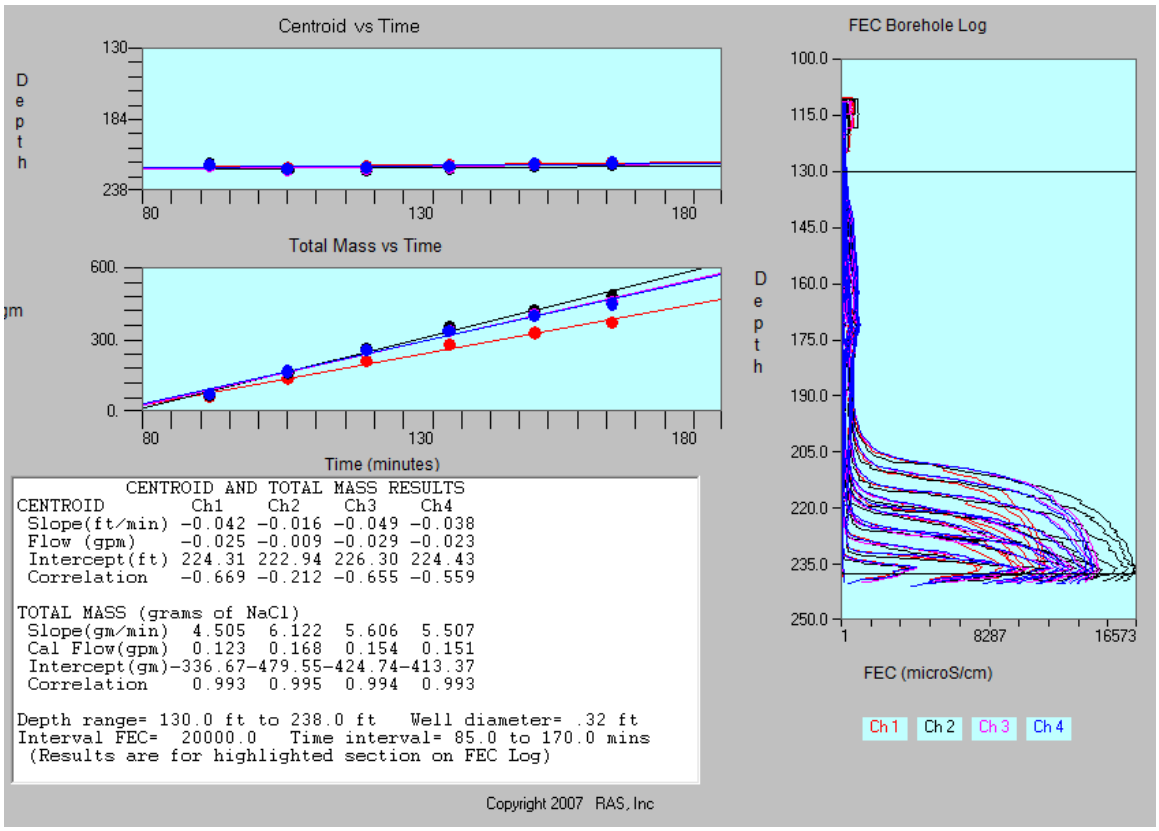


Figure 19. MW-60BR-245 - Analysis results of logs for Slug Test After Emplacement Testing. Interval from 130 to 238 ftbtoc. Late logs from 28-foot slug. Total flow = 0.149 gpm (average flow of four channels). 15 Oct 2011.

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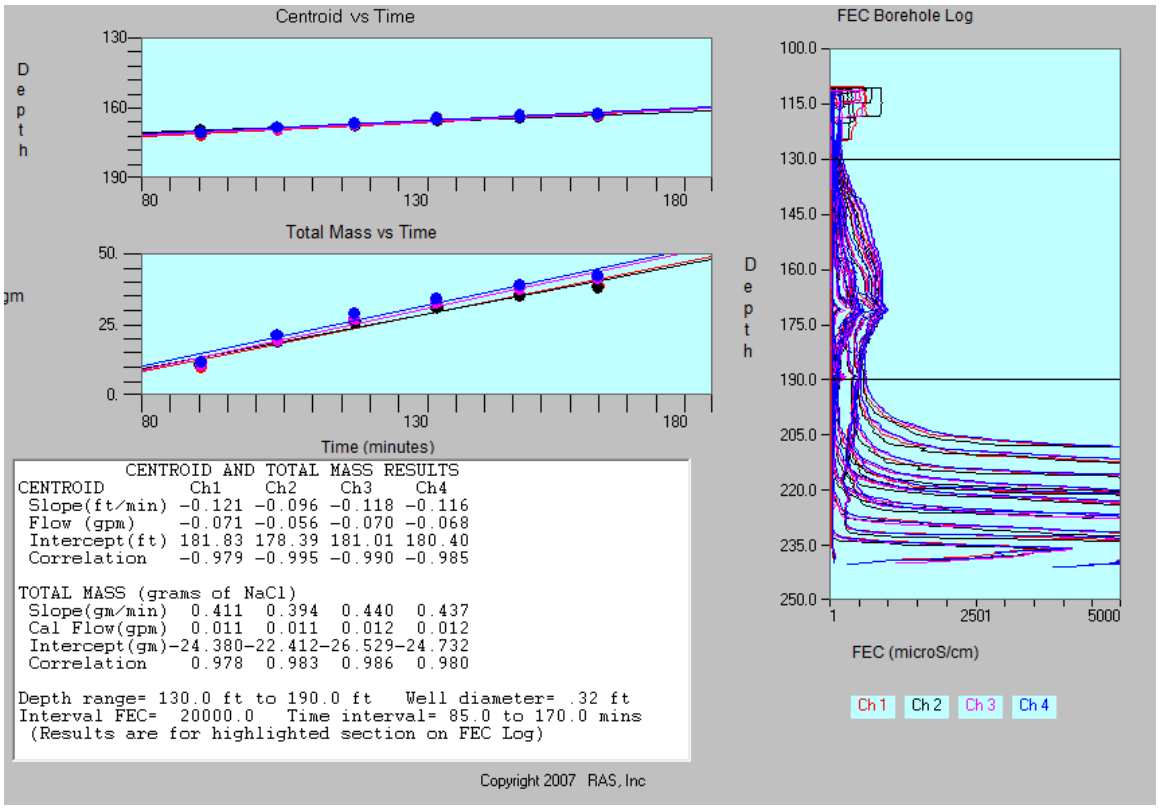


Figure 20. MW-60BR-245 - Analysis results of logs for Slug Test After Emplacement Testing. Interval from 130 to 190 ftbtoc. Late logs from 28-foot slug. Total flow = 0.012 gpm (average flow of four channels). 15 Oct 2011.

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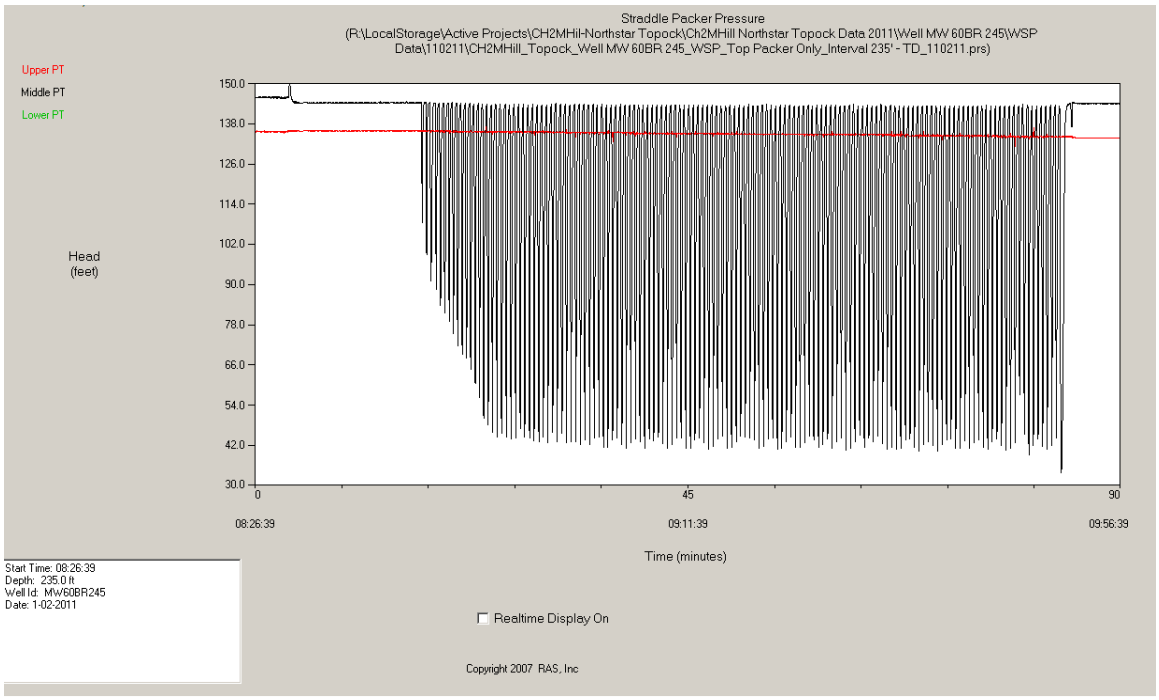
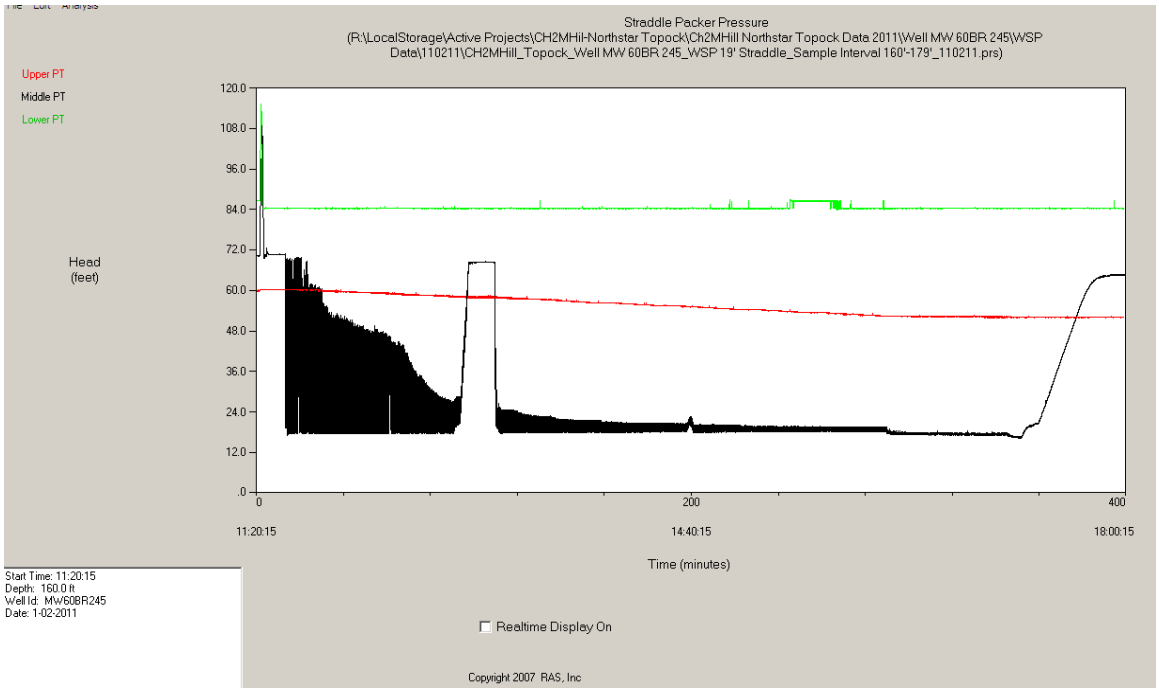
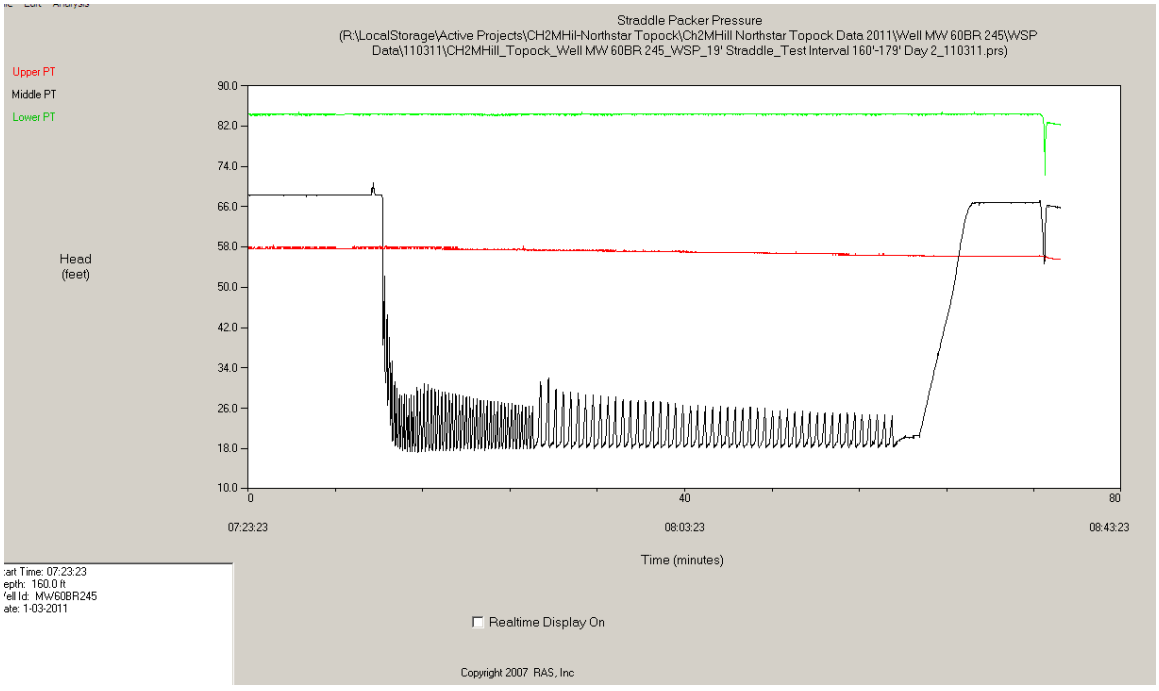


Figure 21. MW-60BR-245 Wireline Straddle Packer (WSP) pressure results during sampling at interval 235 to 240 ftbtoc. Single packer inflated. No apparent intra-formation hydraulic communication with open water bearing interval suggested by upper pressure transducer response. 2 Nov 2011.

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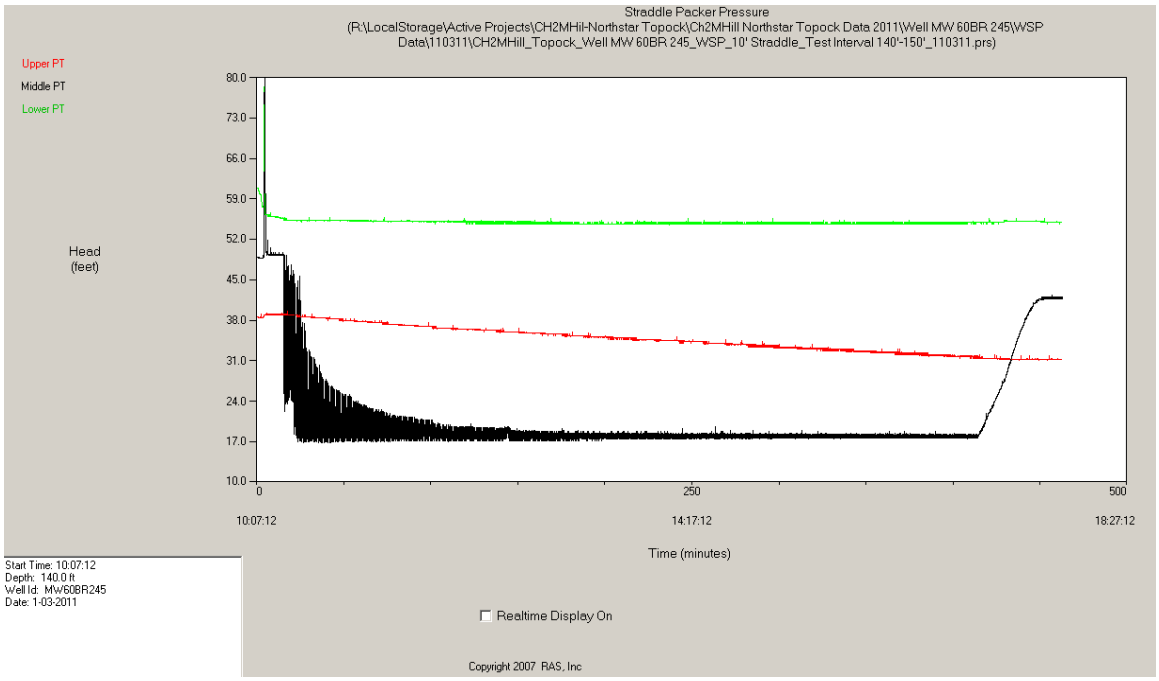
(Day 1, 2 Nov 2011)



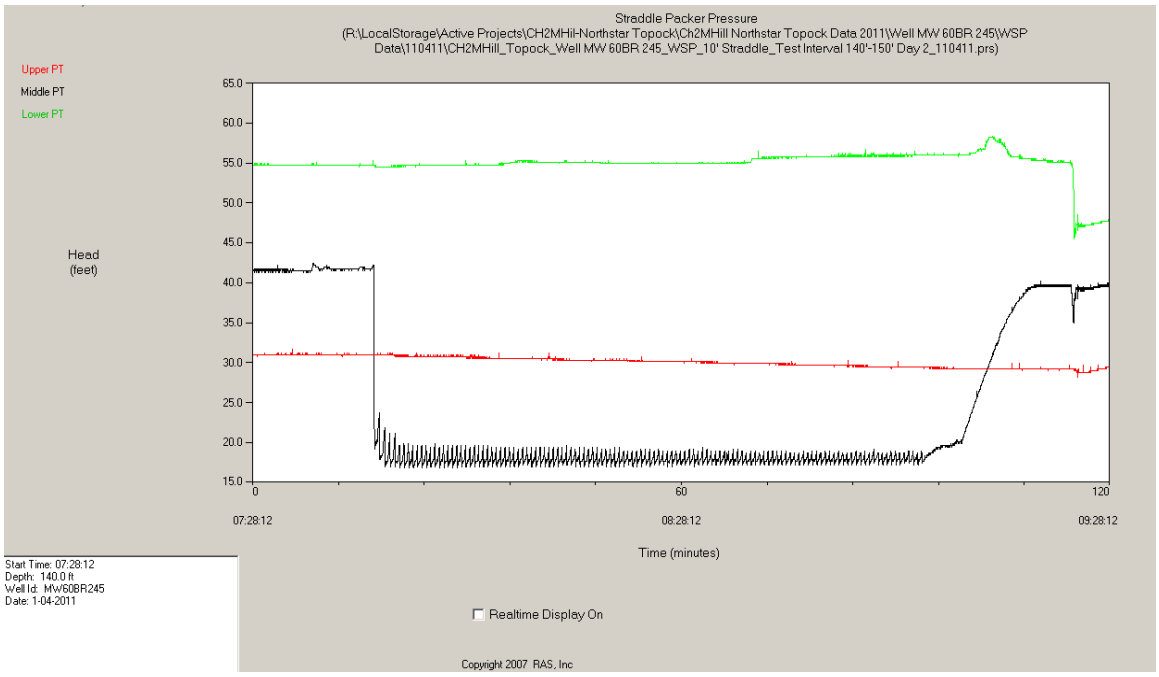
(Day 2, 3 Nov 2011)

Figure 22. MW-60BR-245 WSP pressure results during development pumping at interval 160 to 179 ftbtoc days 1 (upper) and 2 (lower). Straddle packers inflated. Steady decrease in upper pressure transducer (red trace) during pumping period suggests hydraulic connection within formation to upper portion of aquifer.

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(Day 1, 3 Nov 2011)



(Day 2, 4 Nov 2011)

Figure 23. MW-60BR-245 WSP pressure results during development pumping at interval 140 to 150 ftbtoc days 1 (upper) and 2 (lower). Straddle packers inflated. Steady decrease in upper pressure transducer (red trace) during pumping period suggests hydraulic connection within formation to upper portion of aquifer.

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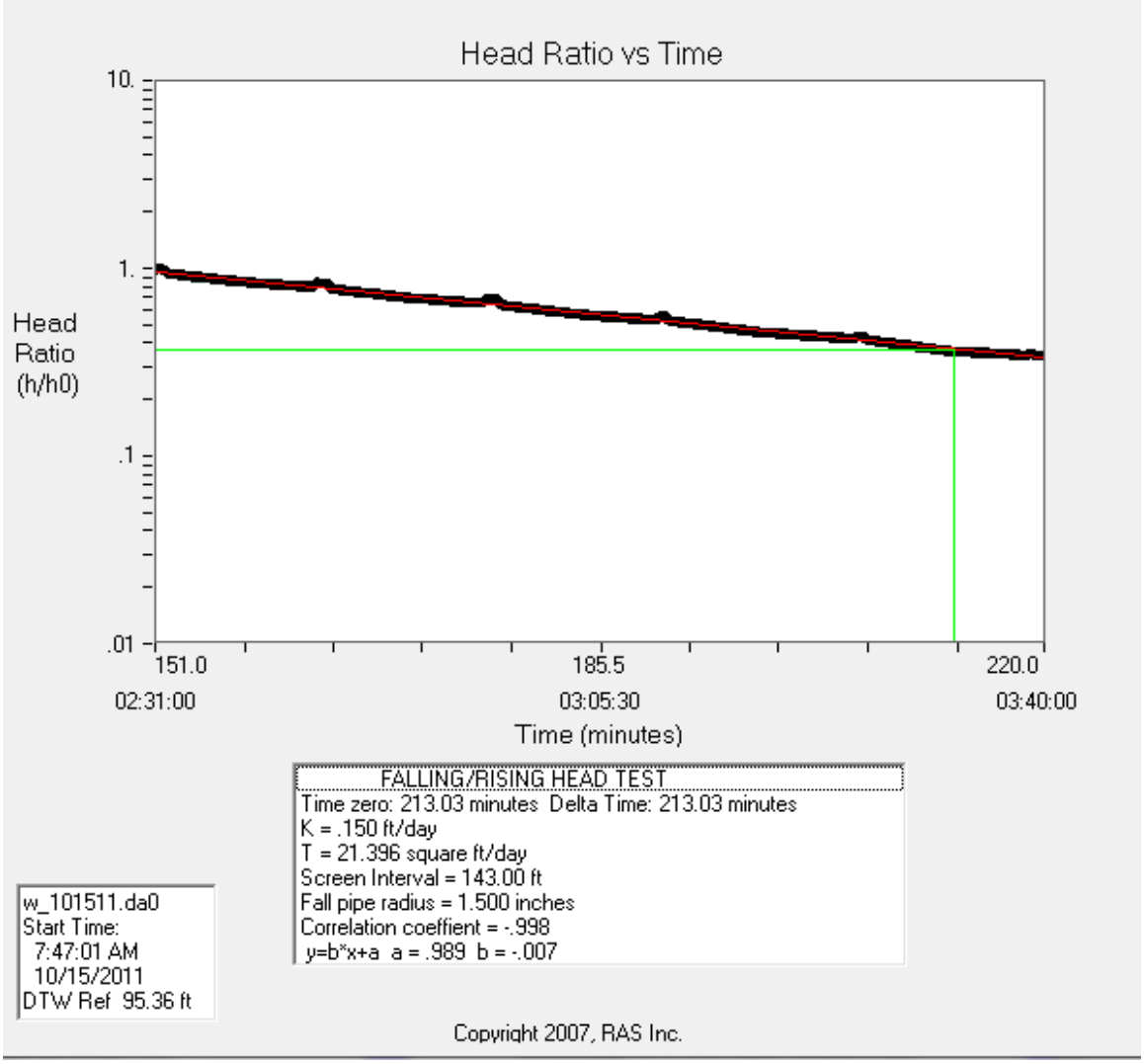


Figure 24. MW60BR245. Slug test analysis from 23-foot slug. 15 Oct 2011. Interval from 95 to 238 feet. K = 0.150 ft/day. T = 21.396 ft ^{2} /day.

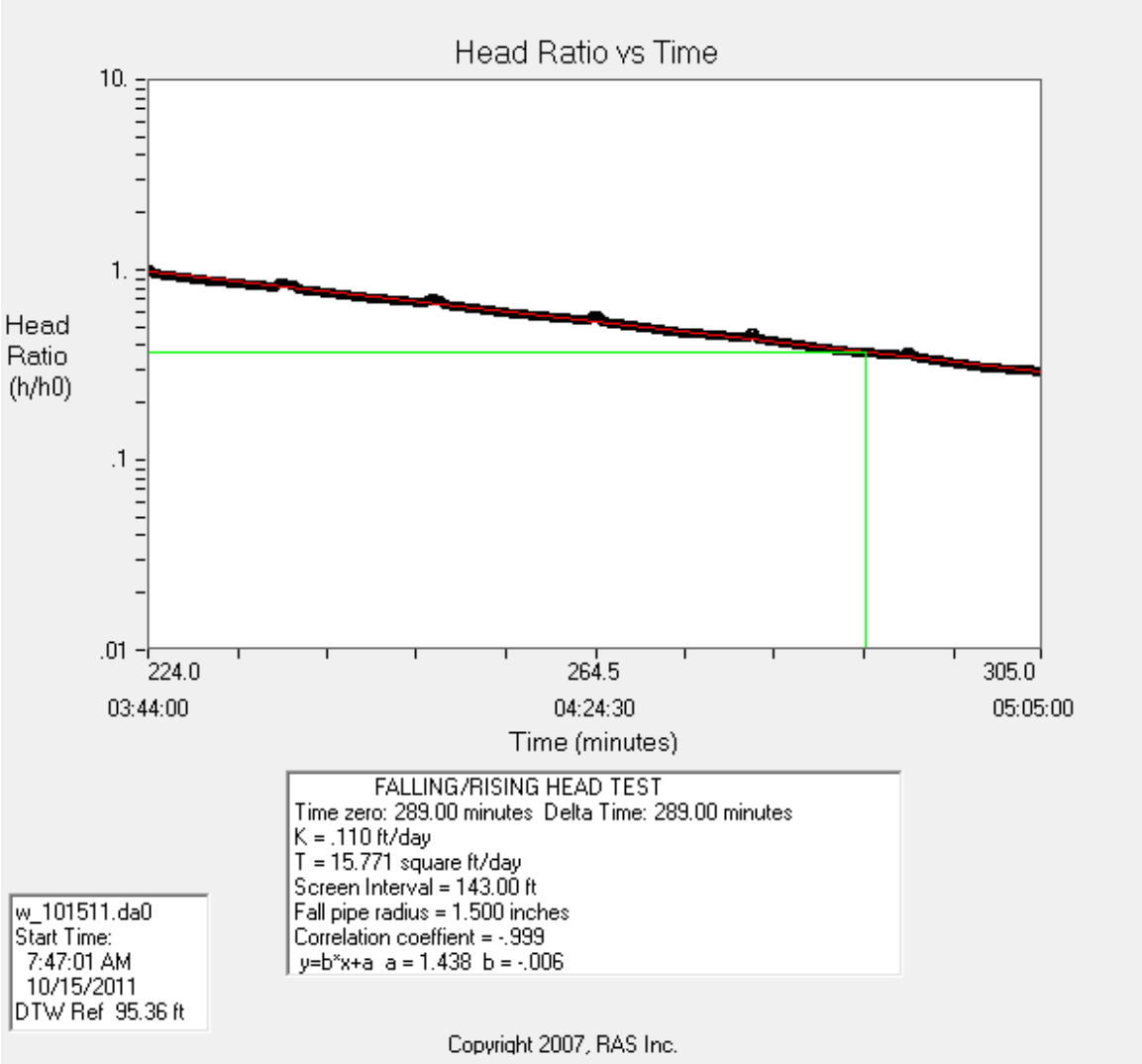


Figure 25. MW60BR245. Slug test analysis from 29-foot slug. 15 Oct 2011. Interval from 95 to 238 feet. K = 0.110 ft/day. T = 15.771 ft ^{2} /day.

Summary of HPL Results - Conductive Feature (CF) Depths						
			Interval Specific Flow Rate		Interval Specific Concentration	Interval Specific Hydraulic Conductivity
Conductive Feature	**Depth (ft)**		**Ambient**	**Rising Head Test # 2 (max qi)**	**µS/cm**	**ft/day**
	Top	**Bottom**				
1	138	146	~0.001	0.012	20,000	0.06 ft/day
2	160	163				
3	170	180				
4	188	190				
5	200	203		0.14		2.07 ft/day
6	236	240				
	Total flow observed at surface					
	Sum of Inflows			0.149		T=15.77
	ALL DEPTHS REFERENCED TO TOP OF PVC CASING					

$T_t = 15.77\ ft^2/day$

$T_t = L_t * K_t$

$T_{5-6} = 0.92 * 15.77 = 14.51\ ft^2/day$

$K_{5-6} = T_{5-6} / 7ft = 14.51\ ft^2/day / 7ft = 2.07\ ft/day$

$T_{1-4} = 0.08 * 15.77 = 1.26\ ft^2/day$

$K_{1-5} = T_{1-4} / 21ft = 1.26\ ft^2/day / 21\ ft = 0.06\ ft/day$

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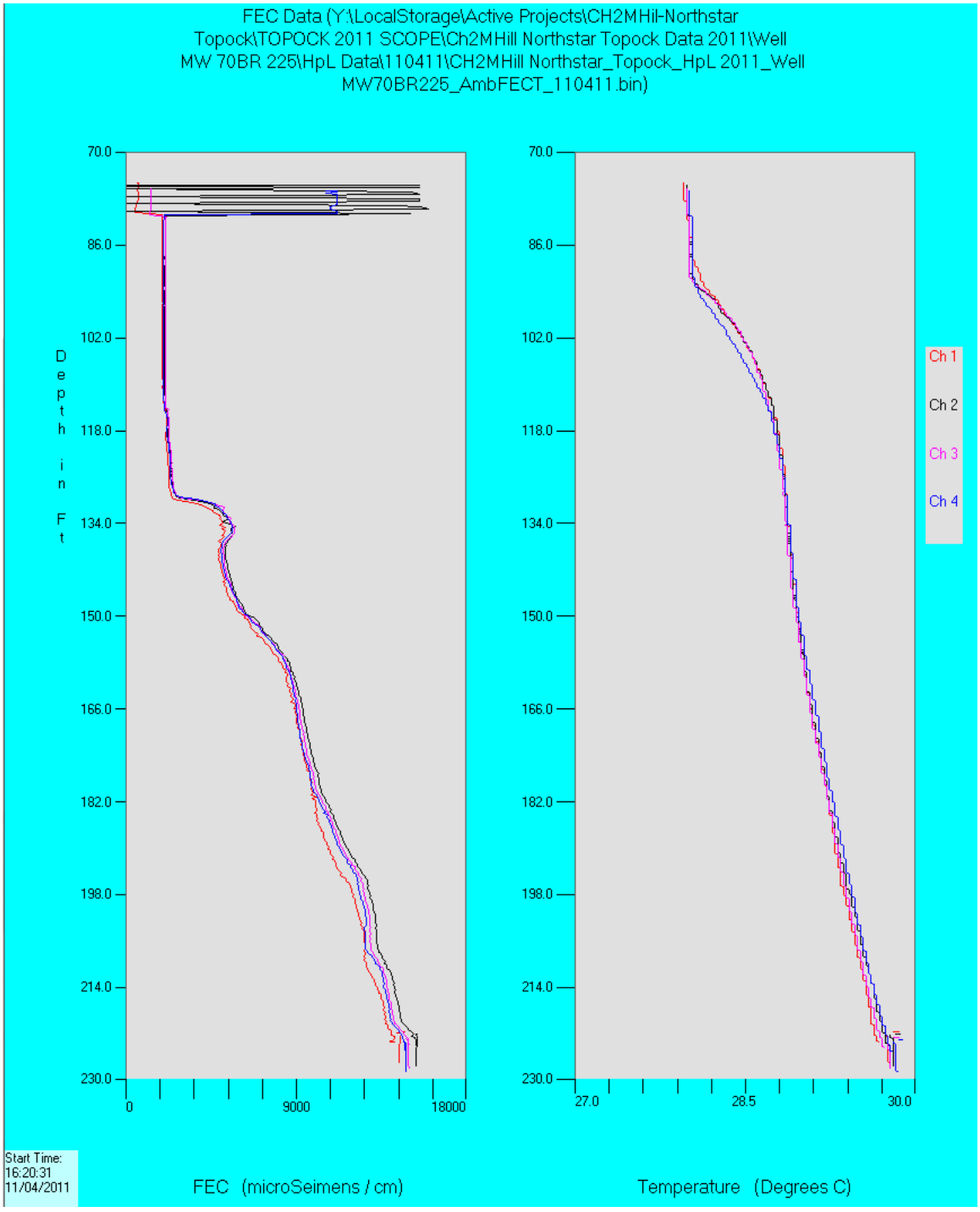


Figure 1. MW70BR225 - Ambient FEC and Temperature Logs, 4 Nov 2011.

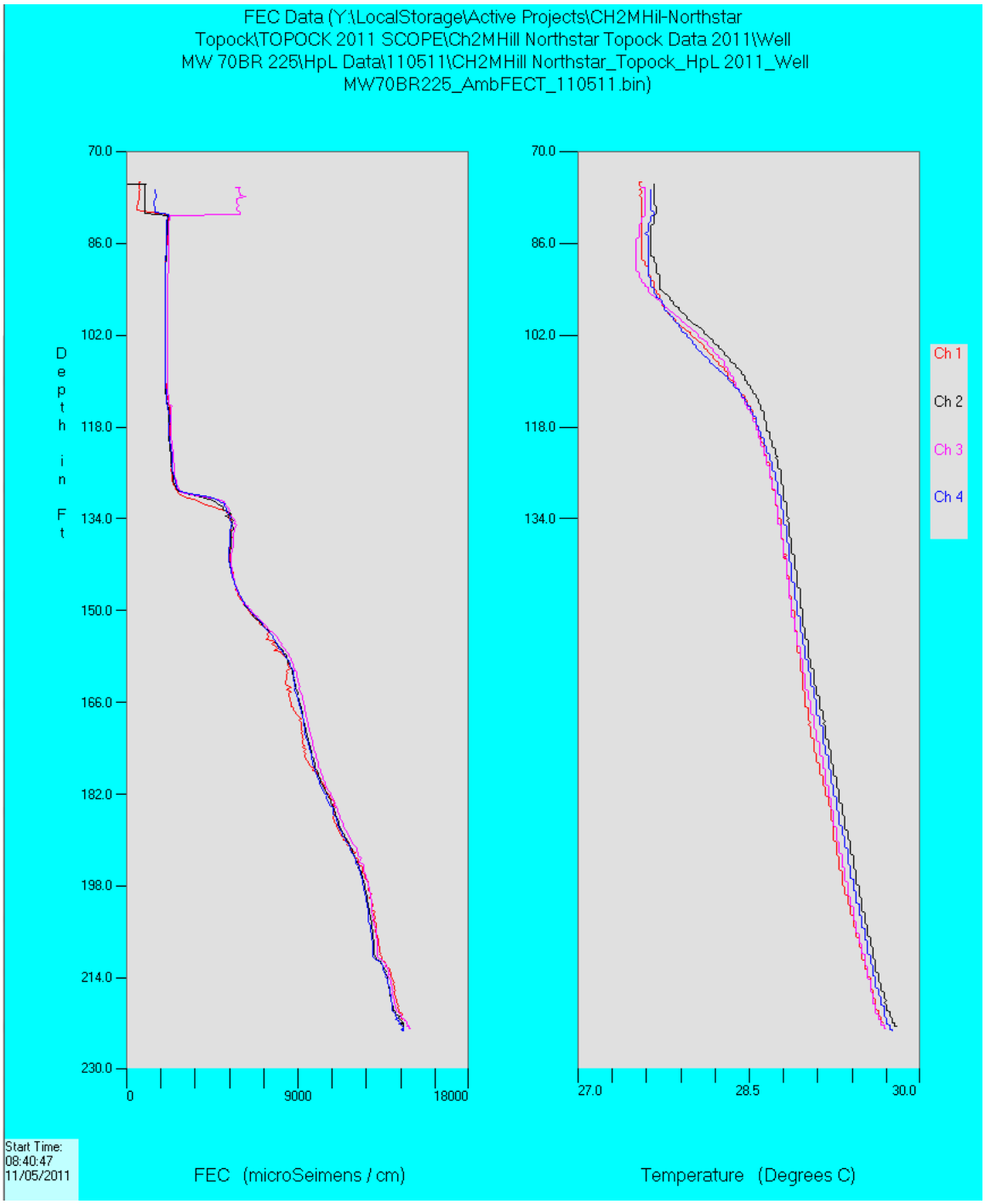


Figure 2. MW70BR225 - Ambient FEC and Temperature Logs, 5 Nov 2011.

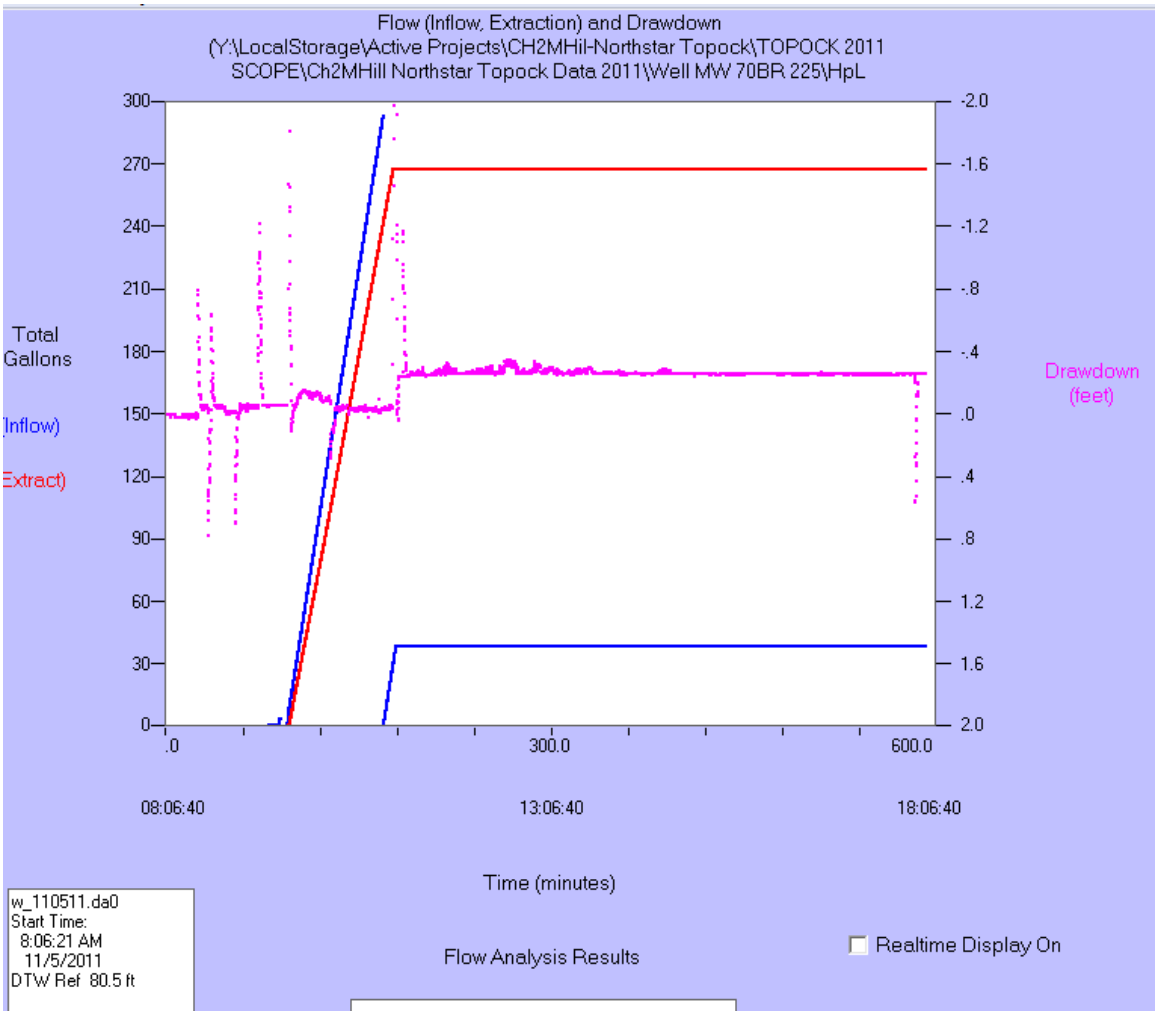


Figure 3. MW70BR225 - Pressure history during Ambient Flow Characterization, Day 1, 5 Nov 2011.

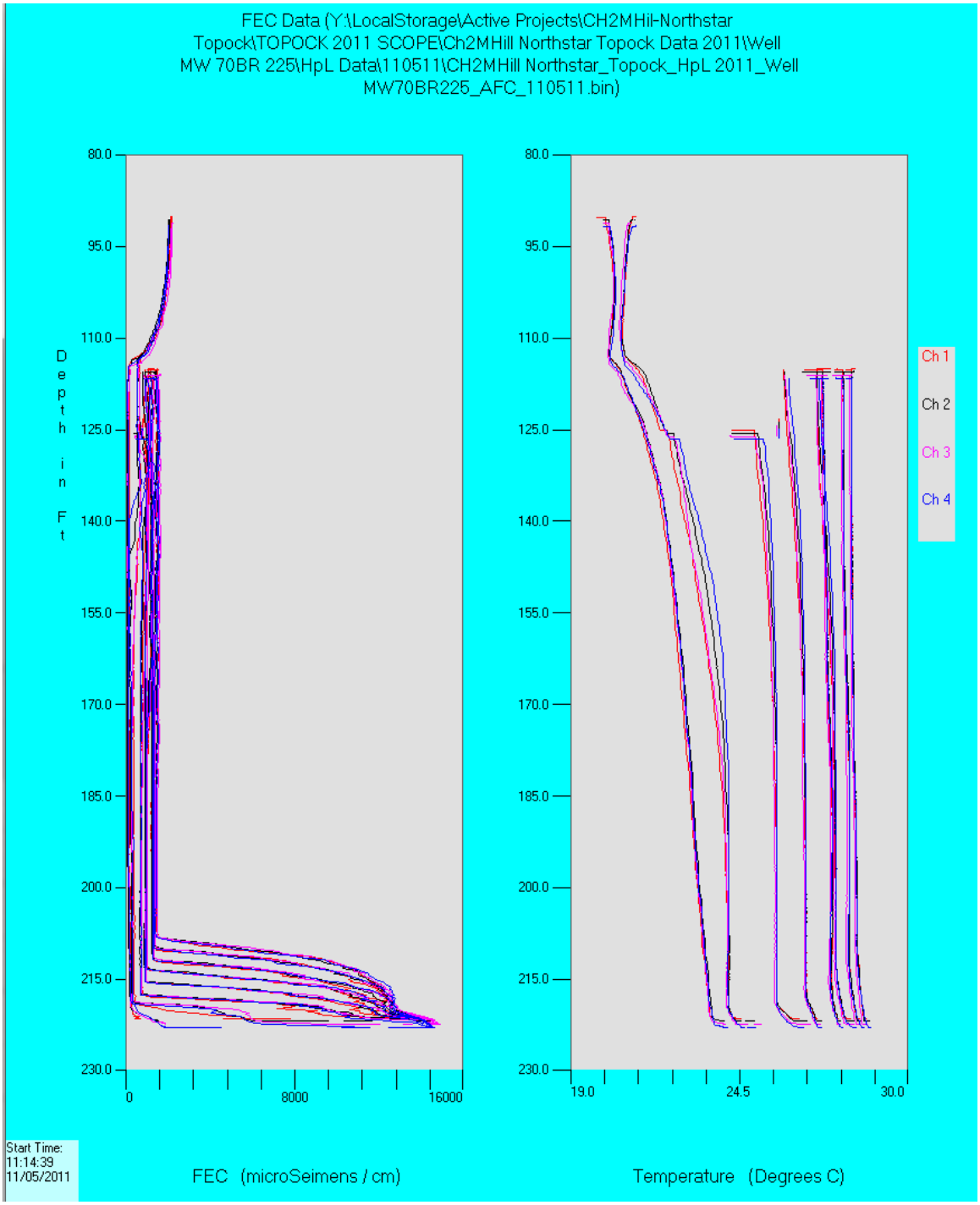


Figure 4. MW70BR225 - Summary of logs for Ambient Flow Characterization. FEC and Temperature. Day 1, 5 Nov 2011.

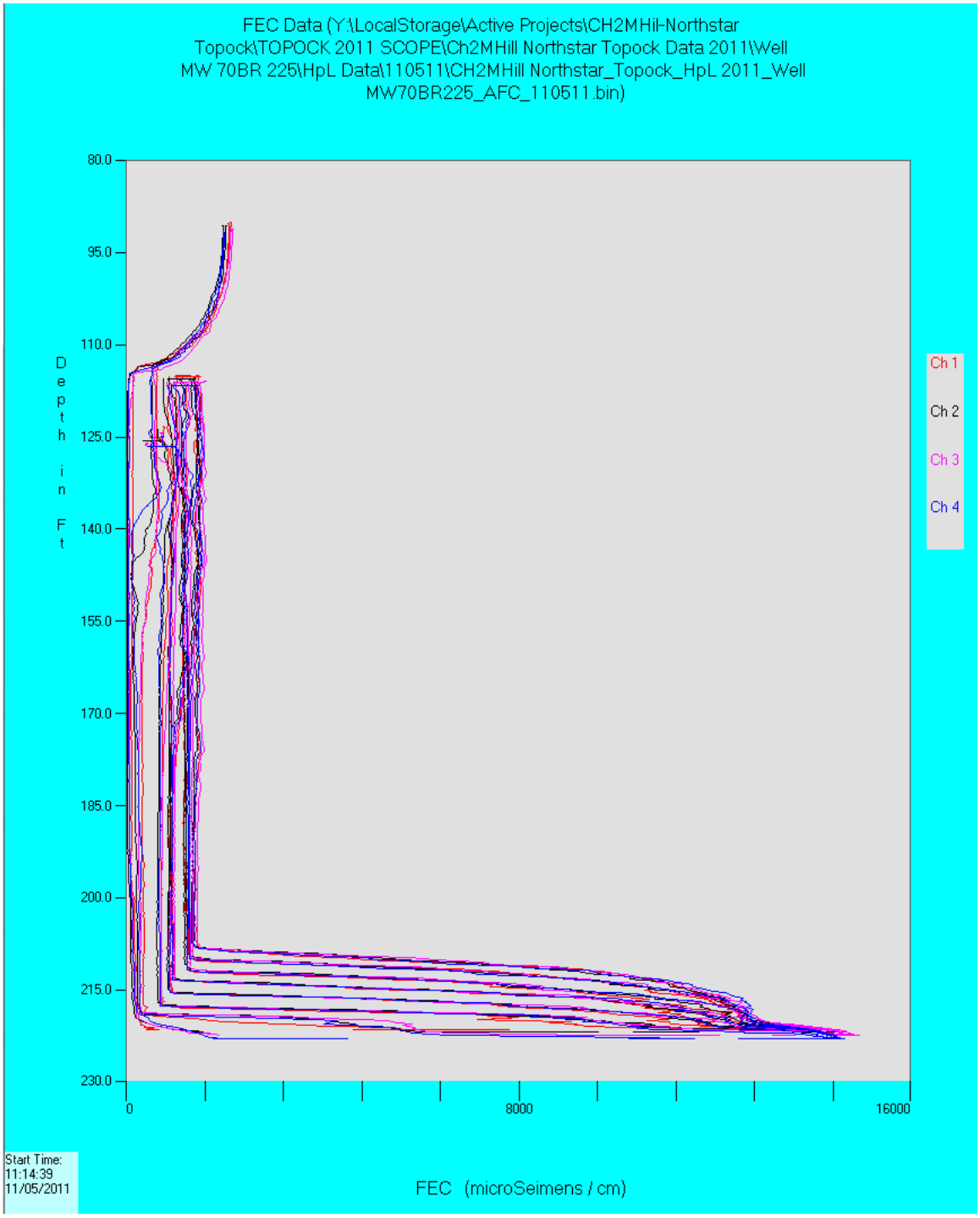


Figure 5. **MW70BR225 - Summary of logs for Ambient Flow Characterization. FEC only. Day 1, 5 Nov 2011**

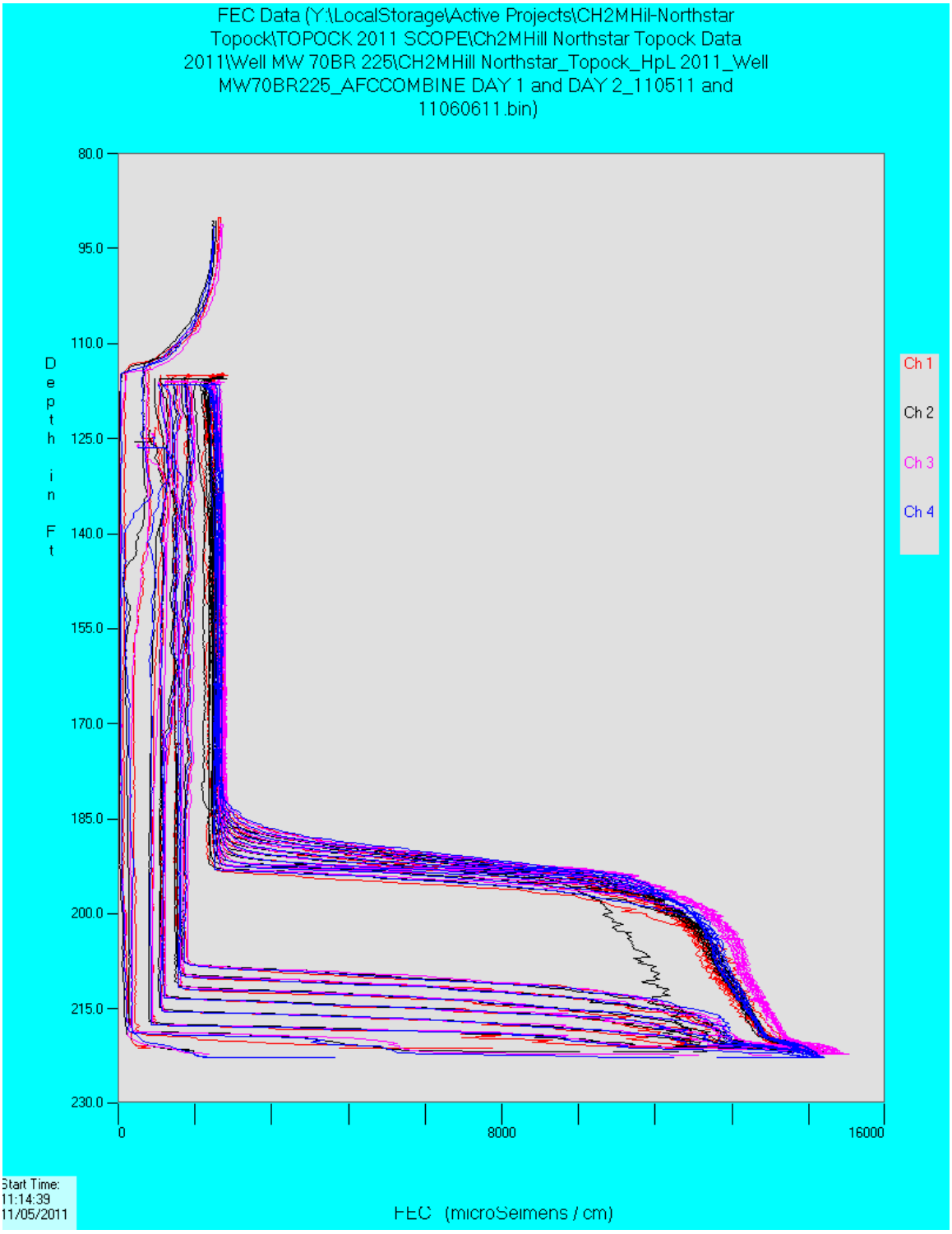


Figure 6. **MW70BR225 - Summary of logs for Ambient Flow Characterization. FEC only. Combined from Days 1 and 2. 5 and 6 Nov 2011**

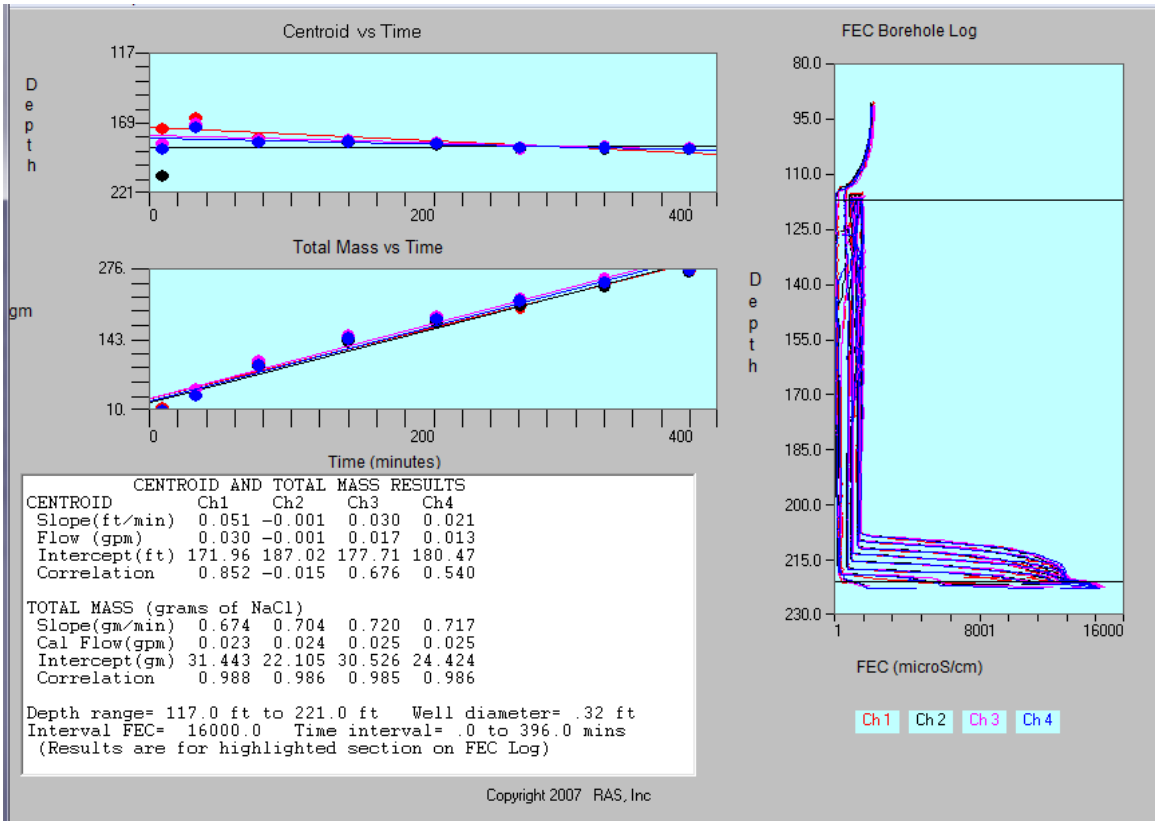


Figure 7. **MW70BR225 - Analysis results of logs for Ambient Flow Characterization. Day 1 only. Interval from 117 to 221 feet below top of PVC casing (ftbtoc). Overall total flow during AFC was extremely low flow (0.024 GPM) and only one distinct interval of inflow is observed, near the bottom of the well.**

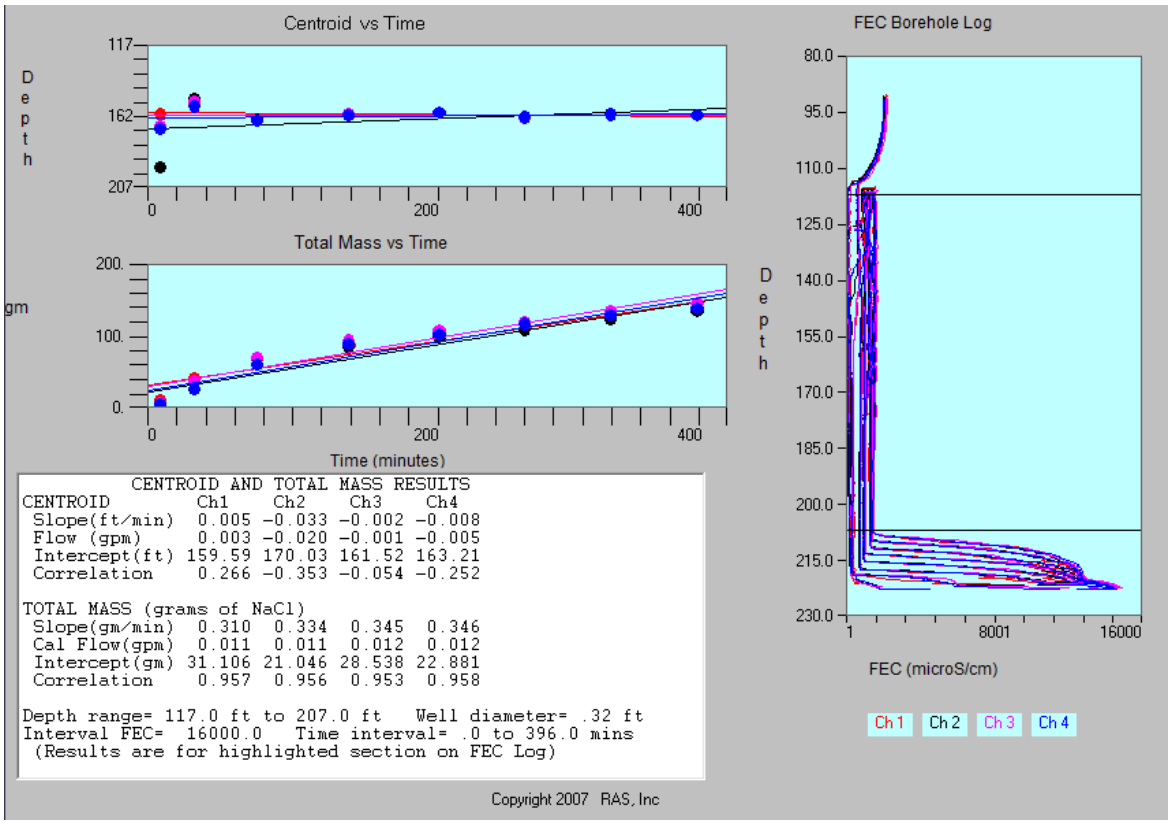


Figure 8. **MW70BR225 - Analysis results of logs for Ambient Flow Characterization. Day 1 only. Interval from 117 to 207 ftbtoc. Total flow during AFC was 0.012 GPM; this is about one-half the total ambient condition flow.**

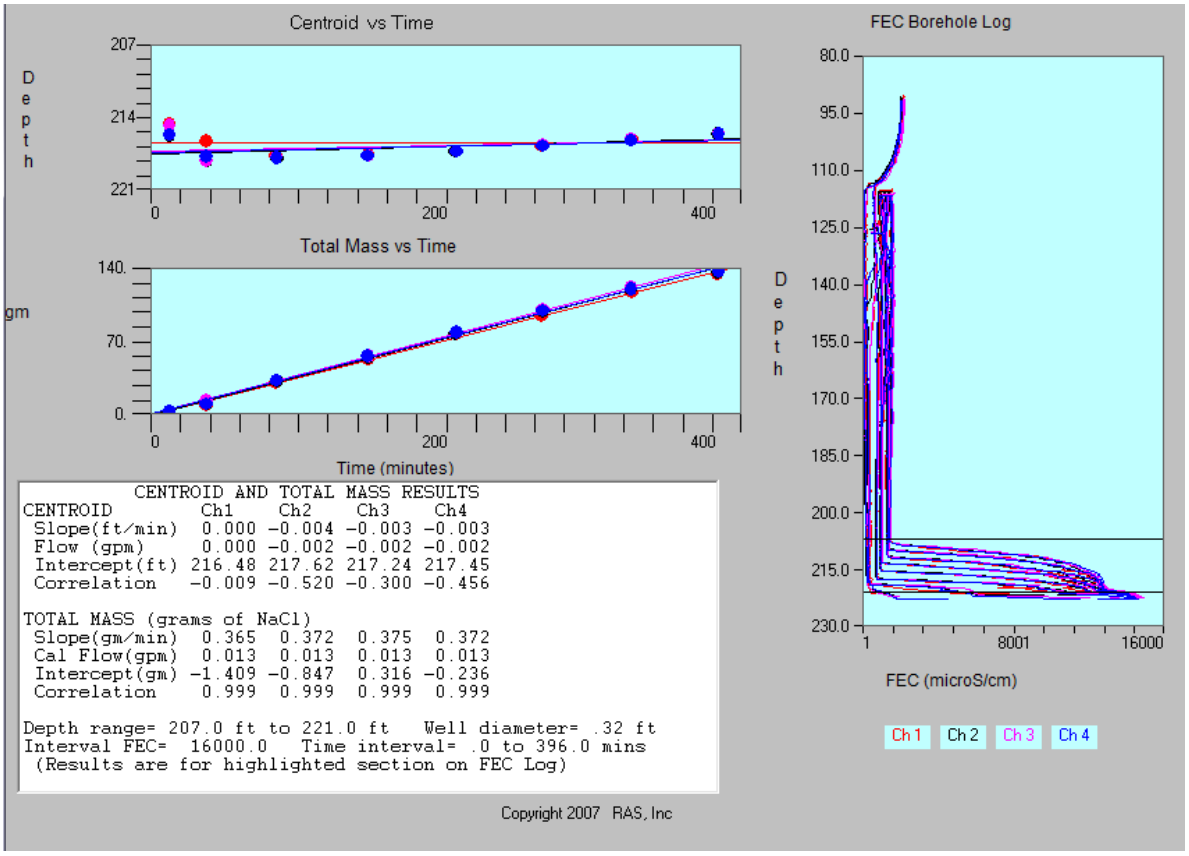


Figure 9. **MW70BR225 - Analysis results of logs for Ambient Flow Characterization. Day 1 only. Interval from 207 to 221 ftbtoc. Total flow during AFC was 0.013 GPM; also about one-half the total ambient condition flow.**

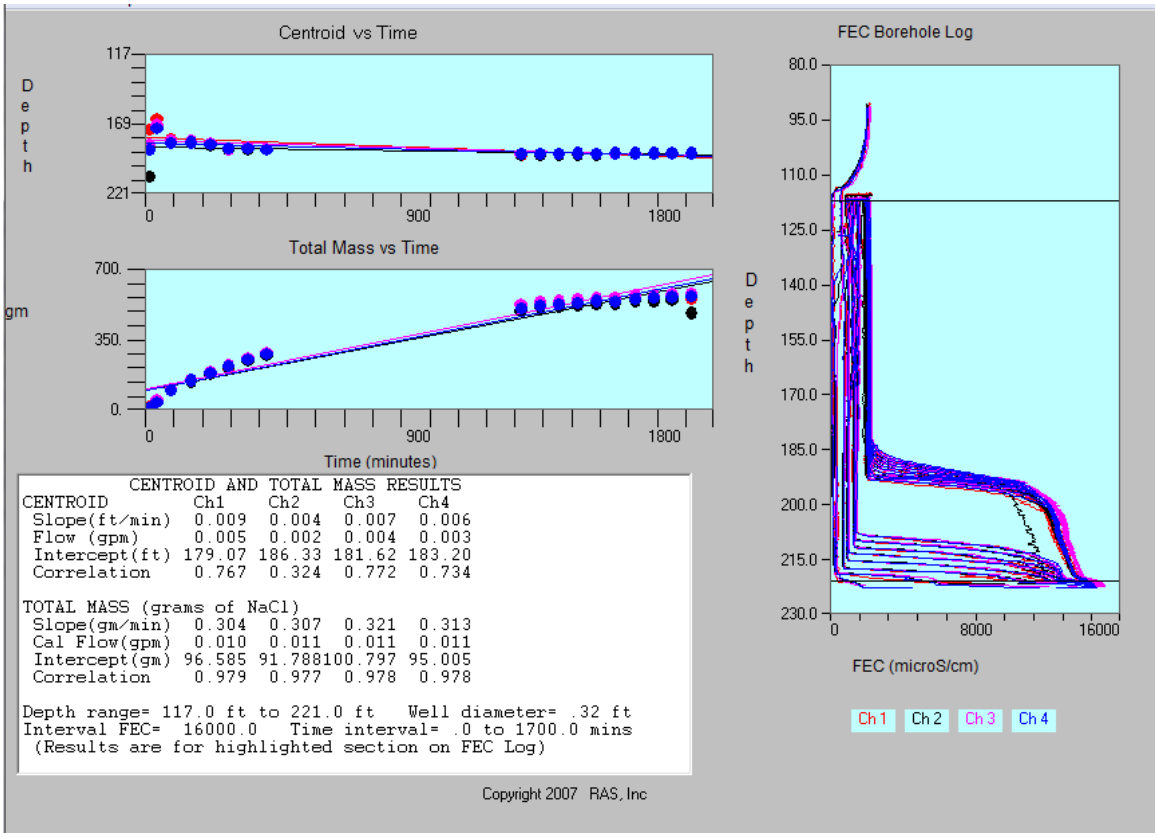


Figure 10. MW70BR225 - Analysis results of logs for Ambient Flow Characterization. Combined Days 1 and 2. Interval from 117 to 221 ftbtoc. Overall total flow during AFC was extremely low flow (0.011 GPM) and only one distinct interval of inflow is observed, near the bottom of the well.

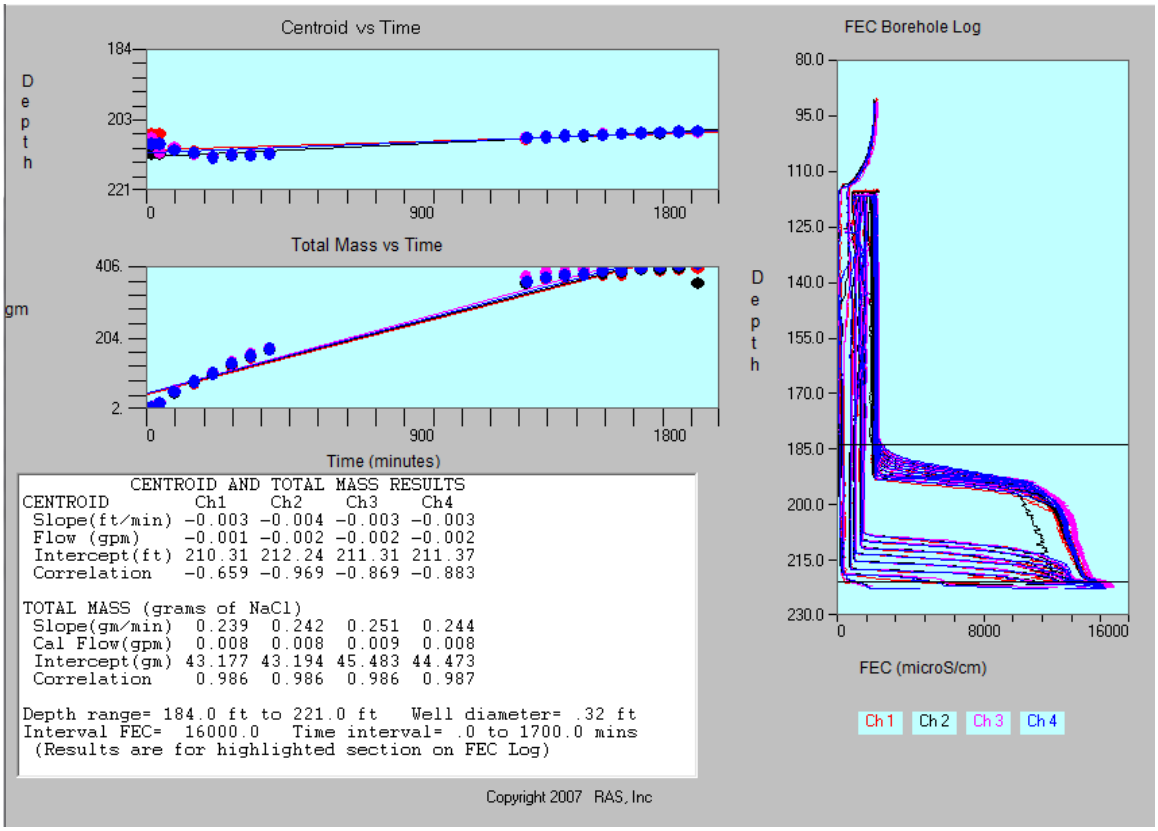


Figure 11. **MW70BR225 -Analysis results of logs for Ambient Flow Characterization. Combined Days 1 and 2. Interval chosen from 184 to 221 ftbtoc, to capture all mass from inflow at bottom of the well. Overall total flow during AFC was extremely low flow (0.008 GPM).**

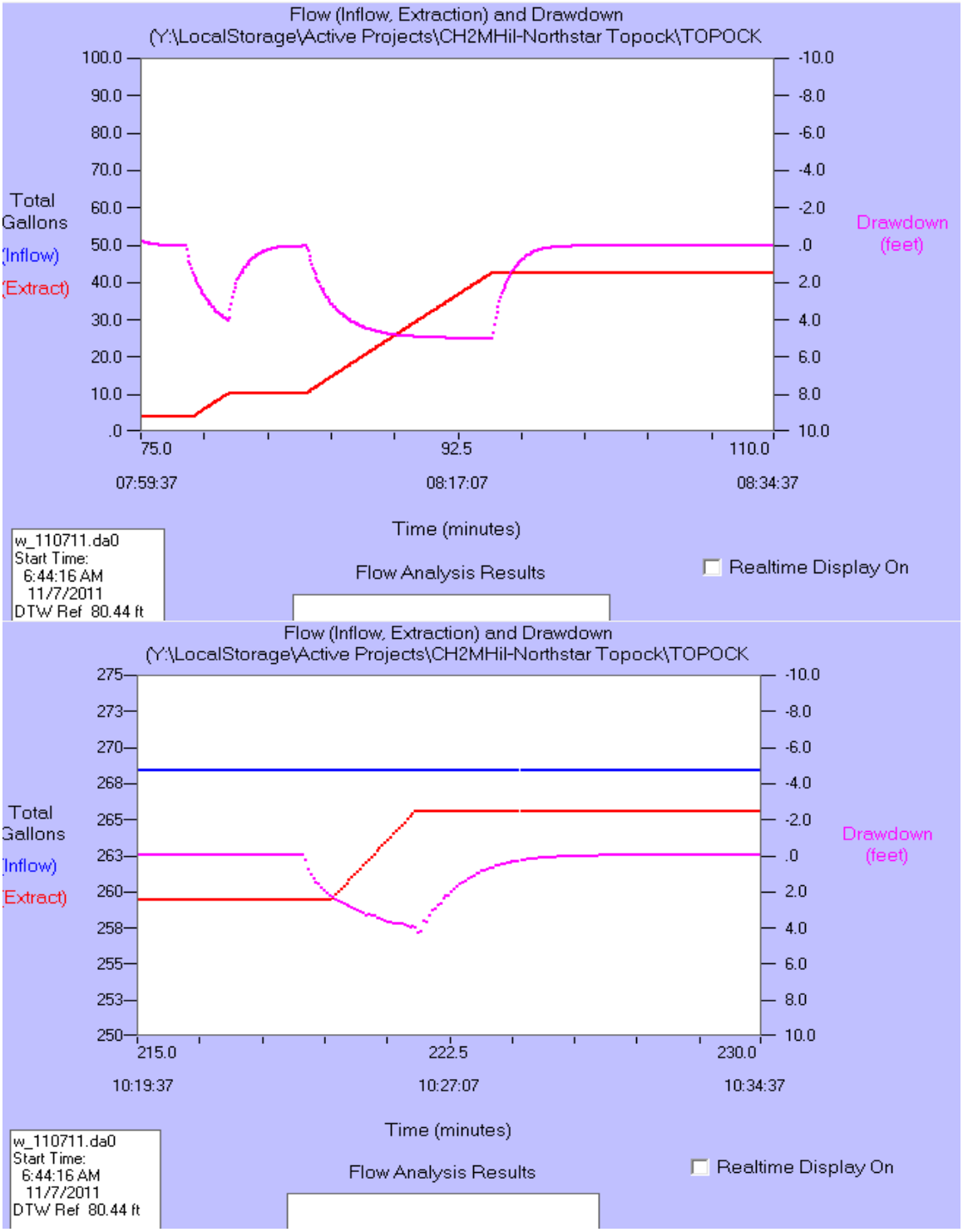


Figure 12. MW70BR225 - Flow and Drawdown data from Slug Test After Emplacement Testing. 5-foot slug is shown (upper) and first of three 4-foot slugs is shown (lower). 7 Nov 2011.

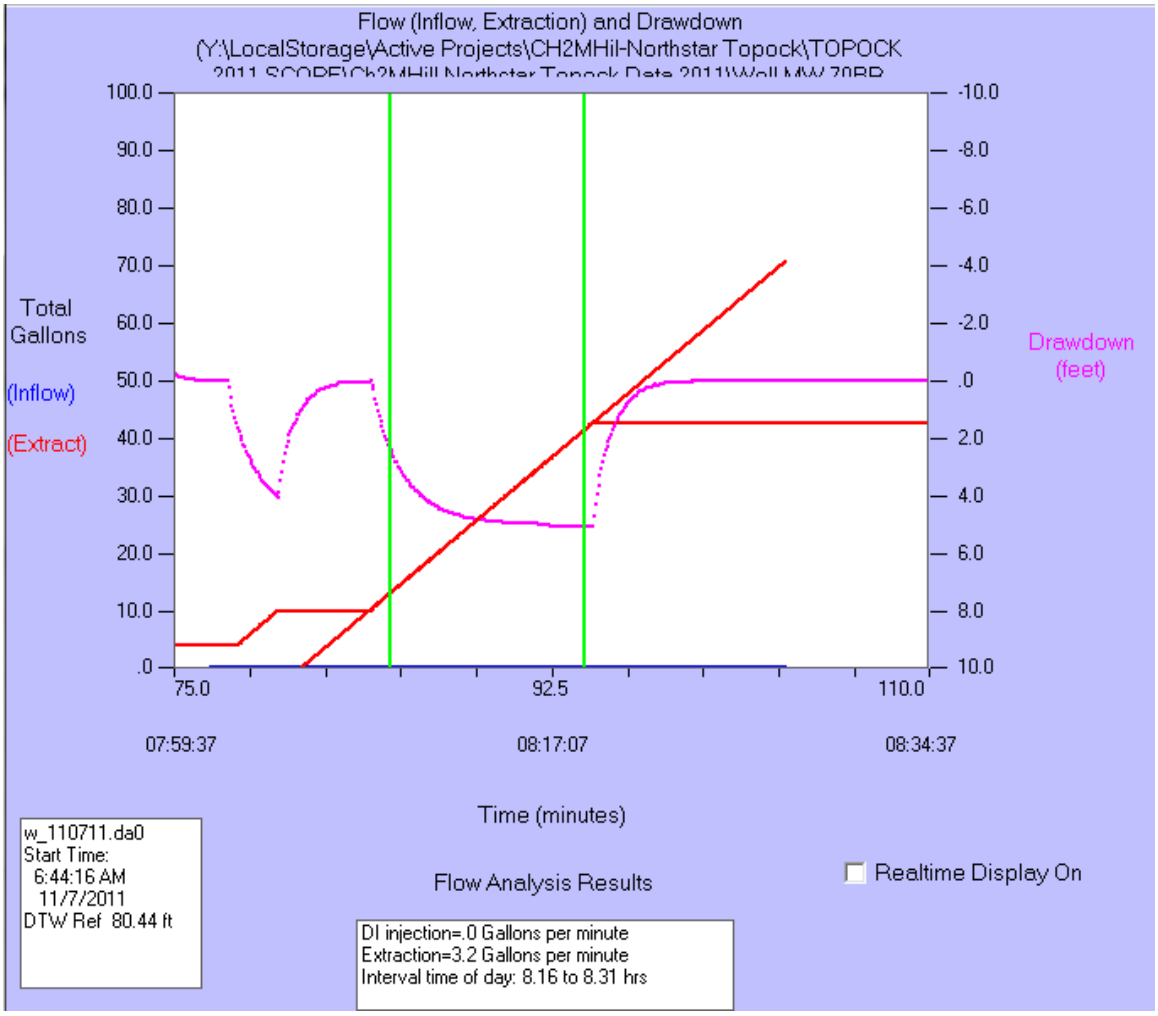


Figure 13. MW70BR225 - Flow and Drawdown data from Slug Test After Emplacement Testing. Drawdown of 5.05 feet of drawdown was measured at an average pump rate during the test of 3.2 GPM. 7 Nov 2011.

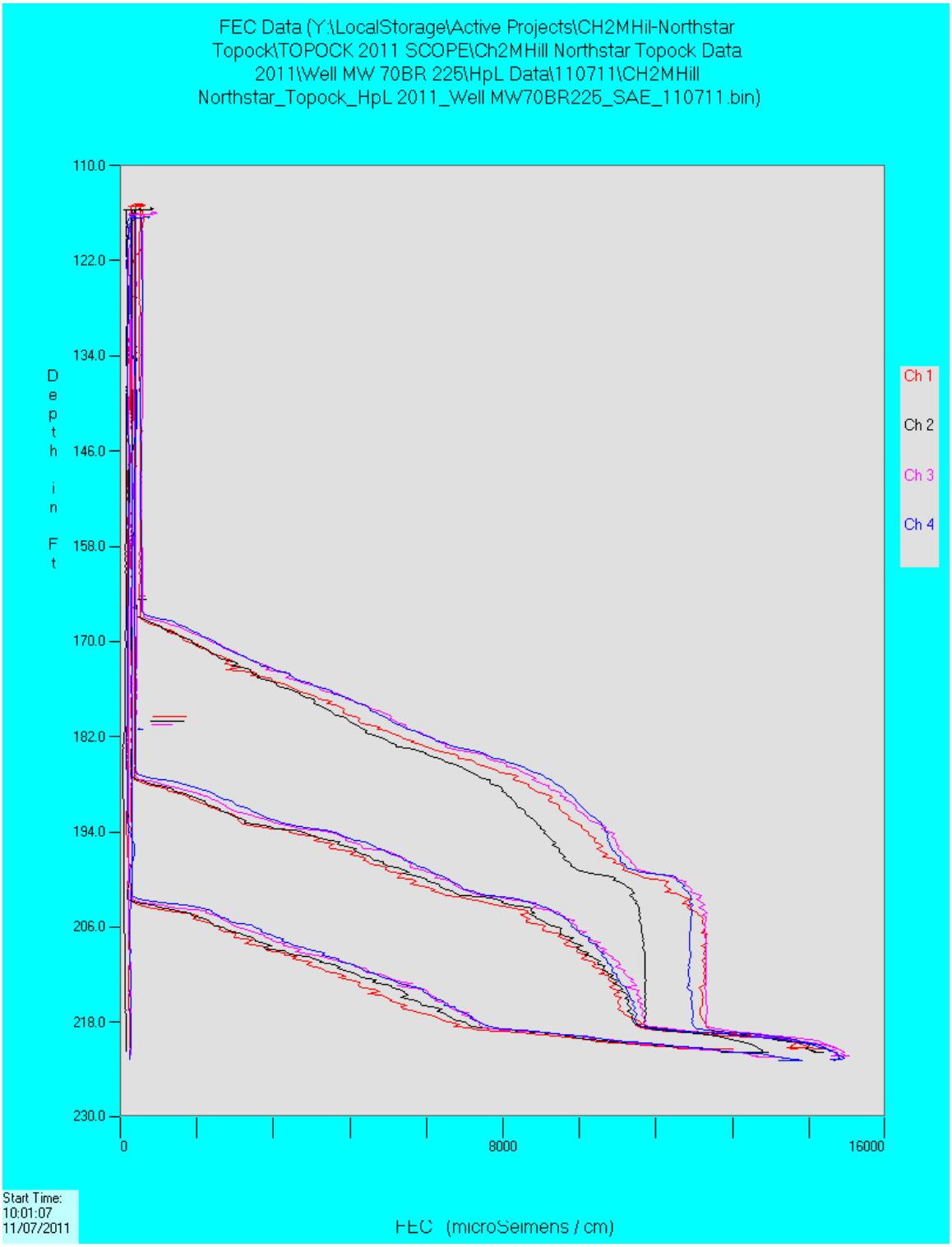


Figure 13. MW70BR225 - FEC log summary from Slug Test After Emplacement Testing. 7 Nov 2011.

CH2MHill – NorthStar PG&E Topock Site
Well MW70BR225
HPL PROCESSING AND NOTES
ALL DEPTHS REFERENCED TO TOP OF PVC CASING

Summary of HPL Results - Conductive Feature (CF) Depths								
					Interval Specific Flow Rate		Interval Specific Concen-tration	Interval Specific Hydraulic Conductivity
	Depth (ft)		Depth (m)		Ambient	Rising Head Test # 2 (Average qi During Pumping)	µS/cm	ft/day
CF	Top	Bottom	Top	Bottom				
1	220	229 (TD)			0.013	3.2	16000	14.6
	Total observed at surface							
	Sum of Inflows					3.2		
	ALL DEPTHS REFERENCED TO TOP OF PVC CASING							

APPENDIX C

DATA MONTAGES

WELL: MW-60BR-245

PROJECT: CH2MHill - PG&E Topock Compressor Station

RAS Integrated Subsurface Evaluation
PH 303.526.4432 • FAX 303.526.4426
email: bpedler@rasinc.org • www.rasinc.org

LEGEND

LITHOLOGY

- Alluvium
- Bedrock, Metadiorite

HYDROPHYSICAL LOGGING AND RESULTS:

Fluid Resistivity and Fluid Temperature
Log performed during ambient conditions

Interval Specific Flow rate derived from Ambient Flow Characterization (AFC) and Slug Test After Emplacement (SAE) hydrophysical data.

Horizontal flow observed during ambient conditions, inflows also evaluated during stressed (constant pumping or slug test) conditions. Horizontal flow rates based on integral method for q (Lowe, et. al., 1989) and dilution method for v (Drost, 1968).

HPL FEC logs presented were collected during Slug Test after Emplacement conditions.

- FEC 1019
- FEC 1045
- FEC 1114
- FEC 1158
- FEC 1241

FEC XXXX where XXXX is military time at start of log.

Flow Zones

Hydraulic conductivity estimates based on Hvorslev (1962), (Pedler, et al. 1988). Flow and velocity estimates based on hydrophysical logging results only.

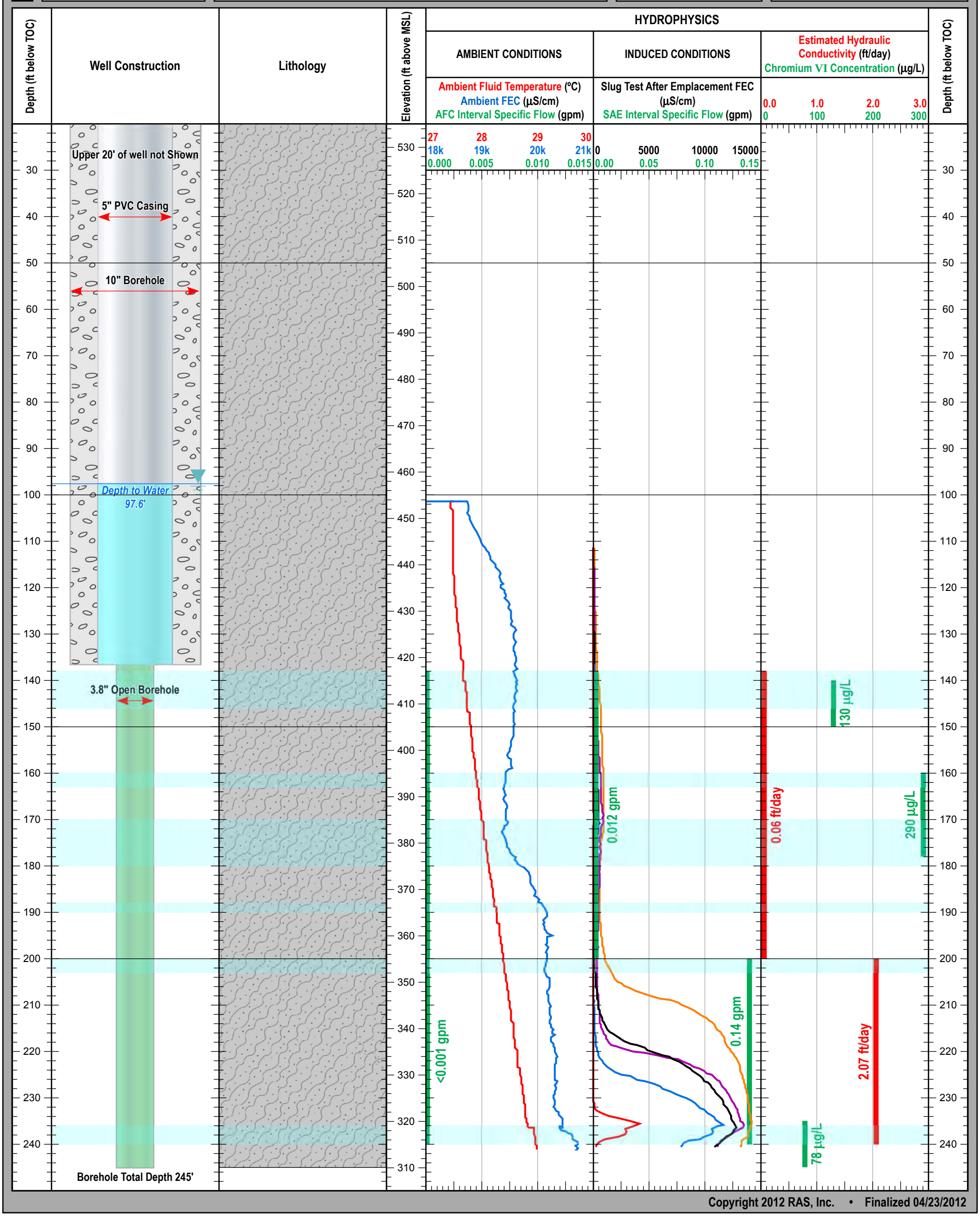
HEXAVALENT CHROMIUM EXPLANATION

Hexavalent Chromium - Cr(VI) (µg/L)

Contaminant concentrations based on samples collected in open borehole conditions.

MISCELLANEOUS NOTES:

1. Top of casing elevation: 554.95 feet (NAD83).
2. All depths referenced to top of PVC casing.
3. Coordinates of well:
   Northing: 2,100,495.02 Easting: 7,616,444.42
   State Plane - California Zone 5
4. Lithology and well construction from CH2MHill.
5. Hydrophysical logging conducted by RAS, Inc. on October 10, 11, 12, 13, 14 & 15, 2011.



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WELL: MW-70BR-225

PROJECT: CH2MHill - PG&E Topock Compressor Station

RAS Integrated Subsurface Evaluation
PH 303.526.4432 • FAX 303.526.4426
email: bpedler@rasinc.org • www.rasinc.org

LEGEND

LITHOLOGY

- Alluvium
- Bedrock, Metadiorite

HYDROPHYSICAL LOGGING AND RESULTS:

Fluid Resistivity and Fluid Temperature
Log performed during ambient conditions

Interval Specific Flow rate derived from Ambient Flow Characterization (AFC) and Slug Test After Emplacement (SAE) hydrophysical data.

Horizontal flow observed during ambient conditions, inflows also evaluated during stressed (constant pumping or slug test) conditions. Horizontal flow rates based on integral method for q (Lowe, et. al., 1989) and dilution method for v (Drost, 1968).

HPL FEC logs presented were collected during Slug Test after Emplacement conditions.

- FEC 1001
- FEC 1030
- FEC 1102
- FEC 1201

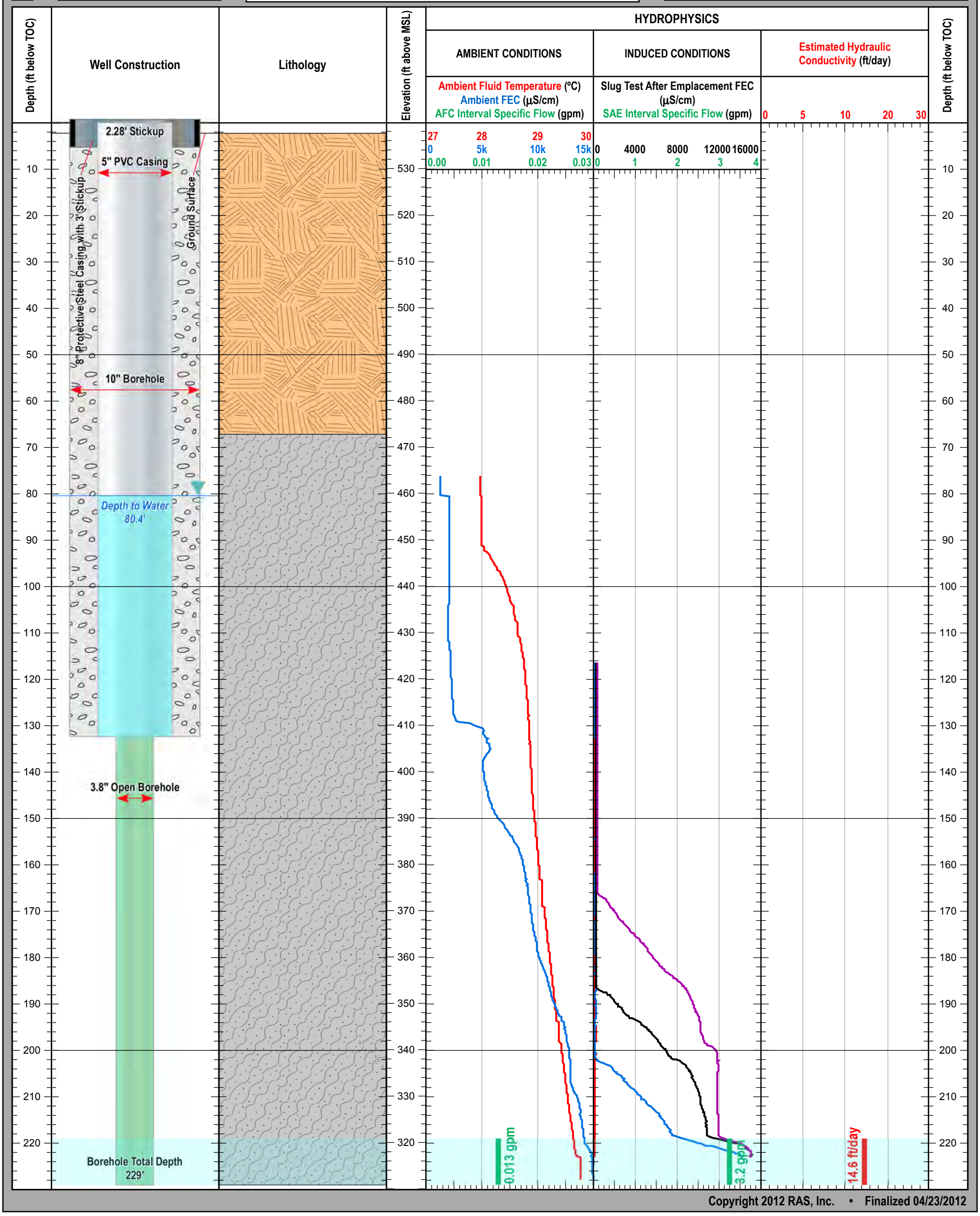
FEC XXXX where XXXX is military time at start of log.

Flow Zones

Hydraulic conductivity estimates based on Hvorslev (1962), (Pedler, et al. 1988). Flow and velocity estimates based on hydrophysical logging results only.

MISCELLANEOUS NOTES:

1. Top of casing elevation: 539.84 feet (NAD83).
2. All depths referenced to top of PVC casing.
3. Coordinates of well:
   Northing: 2,100,513.04 Easting: 7,615,840.08
   State Plane - California Zone 5
4. Lithology and well construction from CH2MHill.
5. Hydrophysical logging conducted by RAS, Inc. on November 4, 5, 6 & 7, 2011.



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September 14, 2012

Mr. Mike Cavaliere
CH2MHill
155 Grand Avenue, Suite 1000
Oakland, CA 94612

RE: Geophysical Logging, Hydrophysical Logging and Wireline Straddle Packer Testing, PG&E Topock Compressor Station, Needles, California

Dear Mr. Cavaliere:

RAS, Inc., Integrated Subsurface Evaluation (RAS) is pleased to provide this draft letter report of hydrophysical logging (HPL) and wireline straddle packer (WSP) testing at the PG&E site in Topock, California. This letter report presents the results from our HPL and WSP conducted in well MW-72BR-200.

INTRODUCTION

During the period from July 17 through July 25, 2012, RAS conducted borehole geophysics, hydrophysics, and wireline straddle packer testing in one well at the PG&E Topock Compressor Station in Needles, California. This work was performed for Northstar Environmental Remediation of Lake Forest, CA (Northstar) under contract to CH2MHill of Oakland, CA, in support of their groundwater investigation.

The objective of this work was to employ borehole hydrophysical testing and straddle packer sampling to provide additional data for groundwater contaminant evaluation and to evaluate preferential groundwater migration pathways at the subject site.

A summary table of HPL data collected form this field effort is included in Appendix A of this report. Details of field activities can be found in the field notes and daily reports Appendix B. Data processing and analysis notes are included in Appendix C. A data montage is included in Appendix D.

SCOPE OF WORK

RAS mobilized to Needles, California on July 16 and 17, 2012 and arrived at the site at approximately 1700 hours on July 17, 2012. Upon arrival at the site, RAS staff met with Arlin Brewster of Northstar and discussed the scope of work to be conducted and the planned schedule. RAS also dropped the equipment trailer on site.

On July 18, RAS attended a site health and safety briefing with Northstar and CH2MHill staff, and conducted initial decontamination of all downhole equipment. Upon completion of equipment decontamination, RAS mobilized to the well and conducted site setup activities at MW-72BR-200. Set-up included equipment set up and check out, tool calibration. Also on July 18, with the assistance of Northstar staff, RAS set up DI tanks at the potable water source at the site.

As reported by Northstar staff, MW-72BR-200 was drilled to an approximate total depth of 200 feet below ground surface (ft bgs). Temporary 3-inch PVC slotted casing was placed within the open borehole to the total depth as a precaution during borehole development activities. The top of the temporary casing was measured at 0.5 ft bgs, and the surface completion was a flush-mounted road box. However all depths were measured and reported herein as from ground surface. Ambient depth to water was measured at 58.15 ft bgs. Also, on July 18, RAS conducted an ambient fluid electrical conductivity (FEC) and temperature log. The Ambient FEC and temperature log on July 18 was conducted in the temporary 3-inch screen. RAS then installed a pressure transducer into the temporary well screen, and demobilized from the site at 1835 hours.

On July 19, 2012 RAS arrived at the site at 0650 hours and attended a health and safety briefing and then began site activities. RAS conducted tool calibration checks, and then conducted a second ambient FEC and temperature log in the temporary casing. The ambient FEC and temperature log are presented in the HPL processing notes in Appendix B. The FEC log displays four significant step changes in FEC and a significant general increase with depth is noted from about 12,000 µS/cm to about 22,000 µS/cm. The temperature log displays a thermal response typically associated with a native geothermal gradient and does not appear to be impacted by vertical advective groundwater flow in the borehole fluid column. The temperature increased from about 27 to 28 degrees Centigrade (C) over the saturated interval of 58.2 to 197 feet. Also on July 19, generation of deionized (DI) water for emplacement in

preparation for ambient flow characterization (AFC) was conducted with the assistance of Northstar staff. DI water was transported in a 300-gallon poly tank from the source to the well site by Northstar, and pumped into temporary storage tanks at the well site.

Upon completion of the ambient log, RAS removed the pressure transducer and temporary PVC well screen. The bottom of the open borehole was tagged with a measuring tape at 198.85 ft bgs. RAS then conducted a pre-log calibration check of the 3-arm mechanical caliper tool and then conducted a caliper log of the well. The caliper log suggested the bottom of the 6-inch conducted casing was at about 107 ft bgs. The open borehole below the conductor casing was approximately 3.7 inches in diameter, and the log suggested very little signature variation, one void to about 6 inches in aperture was present at about 111 ft bgs. Upon completion of the caliper log, an extraction pump (inlet at 194.5 ft bgs) was installed and the pressure transducer was reinstalled, in preparation for HPL testing. RAS conducted post-log calibration checks and left the site at 1745 hours.

On July 20, 2012 RAS arrived at the site at 0700 hours and attended a health and safety briefing and discussed the scope of work planned for the day, and then mobilized to the well. Upon arrival at the well, RAS conducted tool calibration checks, and then conducted an ambient FEC and temperature log. DI water emplacement was then conducted, and AFC initiated. Approximately 250 gallons of DI water were emplaced during AFC. Due to the low ambient flow under native pressure conditions, logging was conducted over two days during recovery. FEC and temperature logs conducted during AFC on July 20 and 21 are included in Appendix B. Analysis of these logs using the centroid and integral methods suggest the presence of three water bearing intervals. Two dominant flow features were suggested by analysis of the AFC logs, one at about 153 ft bgs, and another at the bottom of the logging interval about 191 ft bgs. However, analysis suggests an inflow rate of less than 0.01 gallon per minute (gpm) from each of these two features, and approximately 0.015 gpm for the entire saturated interval. As discussed below, additional flow testing during stressed conditions suggested the presence of four conductive features. The two additional flow features identified under stressed conditions were between 147 and 167 ft bgs, and while quantified independently during stressed conditions testing, were combined into one distinct flow zone for quantification during AFC. Flow from this combined feature during ambient conditions testing was 0.012 gpm. Equivalent in-hole velocities for each interval were estimated to be 1.0, 0.6, 0.8 and 0.7 feet per day (fpd) in-hole horizontal velocity, for conductive intervals 1, 2, 3 and 4, respectively.

Upon completion of AFC testing on July 21, RAS began hydraulic characterization (HC) testing. HC consisted of conducting one 10-foot and one 20-foot slug tests to quantify well recovery under stressed conditions. Analysis of the HC recovery data suggested that a low flow rate pumping during injection (PDI) would be feasible in this well. Upon completion of HC on July 21, RAS conducted post-log tool calibration checks, and departed the site at 1650 hours.

On July 22, 2012, RAS conducted a pre-log calibration check and an ambient FEC and temperature log. Hydro-geologic evaluation of the subject well by PDI testing was then conducted. PDI was begun with an extraction rate of about 1.4 gpm, and FEC logs were collected until three repeatable logs were noted. Then pumping during injection was begun, with at a total extraction rate of about 2.9 gpm, and an injection rate of 1.4 gpm; a net formation production of 1.5 gpm. Logging during PDI was continued until stable conditions were achieved and three repeatable logs were noted. Total drawdown during PDI was about 25.5 feet. Analysis of the data collected during this testing suggested that upper interval identified during AFC, from about 105 to 110 ft was inflowing at 0.1 gpm and the interval near the bottom of the well from 191 to TD was flowing at between 0.54 and 0.96 gpm. Because the entire interval of this conductive feature was not logged due to the presence of the pump, this range of interval specific flow rates was estimated by correlation of the HPL log data with total flow and mass balance analysis. Two additional conductive features, between 147 and 156 ft bgs, and between 161 and 167 ft bgs, were identified during PDI. Interval specific flow rates for these two features were 1.18 and 0.12 gpm, respectively. For reference purposes, the HPL data summary table included in Appendix A numerically identifies these four conductive features as 1 through 4, with increasing depth.

These interval specific flow rates, resulted in interval specific hydraulic conductivity for the intervals 1 through 4, at 0.16, 1.16, 0.16 and between 0.67 and 1.21 ft/day, respectively. The HPL results also suggested that FEC ranged between 12,700 and 24,000 µS/cm. Please refer to Appendix B for HPL data analysis details.

Upon completion of PDI well MW-72BR-200 on July 22, 2012 RAS conducted a post-log calibration check, and then removed the pump and piping in preparation for wireline straddle packer (WSP) testing and then demobilized from the site at 1830 hours.

On July 23, 2012 RAS arrived at the site at 0705 hours, attended a health and safety briefing, discussed the scope of work planned for the day, and then mobilized to the well to begin WSP testing and sampling. After checking tool operation on the surface, RAS installed the WSP as a double packer installation from 148 to 168 feet. Upon completion of inflation, and isolation of the 20-foot packed interval,

development pumping was conducted from the packed interval and pressure was logged within and both above and below the packed interval. Pressure data collected during pumping and sampling from within, above, and below this interval suggest no apparent intra-formation hydraulic connection. Upon extraction of approximately three borehole volumes (estimated as 10.5 gallons in the packed interval) and stabilization of extraction water parameters, a sample was collected from this interval. Approximately 33 gallons of groundwater was pumped from the interval prior to sampling.

On July 24, 2012 RAS arrived at the site at 0700, attended a health and safety briefing, and then mobilized to the well to begin additional WSP testing and sampling in the well. RAS installed the WSP as a double packer installation from 110 to 130 feet. HPL data suggested a conductive feature between approximately 105 and 110 feet. As reported by Northstar, the borehole telescopes to a 3.8-inch open hole at about 107 feet bgs. RAS set the packer with the upper bladder as shallow as was practicable given the large difference in borehole diameter above 107 feet.

After completion of inflation, and isolation of the 20-foot packed interval, development pumping and sampling was conducted from the packed interval and pressure was logged within and both above and below the packed interval. Pressure data collected during pumping from within the packed interval suggested very little flow in this zone and that sampling was not feasible, given the volumes needed. As such, at the direction of CH2MHill, RAS deflated the packer and brought it back to the surface in preparation for sampling a third zone.

RAS then reconfigured the packer as a single packer set and set the packer at 191 feet to isolate the lower portion of the borehole. Upon completion of inflation, development pumping was conducted from the packed interval (191 to 198.5 feet) and pressures were logged within and both above the packed interval. Pressure data collected during pumping and sampling from within and above this interval suggest no apparent intra-formation hydraulic connection. Upon extraction of approximately three borehole volumes (estimated as 3.5 gallons in the packed interval) and stabilization of extraction water parameters, a sample was collected form this interval. Approximately 11.5 gallons of groundwater was pumped from the interval prior to sampling. Please refer to Appendix B for HPL data analysis details.

Groundwater samples were collected from the interval between 148 and 168 ft bgs, and from the interval between 191 and the bottom of the borehole. Chromium VI concentrations, which were analyzed at an offsite laboratory and reported to RAS by CH2MHill to be 2.0 µg/L for the interval from 148 to 168 ft bgs and below the reporting limit of 1.0 µg/L (not detected) for the interval near the bottom of the well at 191 to 198.5 ft bgs. These data are included on the montage for MW-72BR-200.

On July 25, 2012, RAS conducted equipment decontamination, packed and secured equipment and demobilized from the site.

CONCLUSIONS

Ambient flow characterization (native flow during ambient or background pressures conditions) was conducted in the well. Ambient flow was observed to be occurring at extremely low flow rates during the period of our testing. Overall ambient flow of 0.015 gpm was measured in the well. The dominant flow zone was between 147 and 167 ft bgs. While two conductive features were identified in this interval during PDI, they were combined into one feature for quantification during AFC. A combined 0.012 gpm was measured from within this interval; or 80% of the total flow measured during AFC. The remaining 20% of the inflow, or 0.003 gpm, were from the remaining two conductive features between 105 and 110, and between 191.5 and 198.5 ft bgs.

Under ambient conditions, the equivalent in-hole velocities for each interval were estimated to be 1.0, 0.6, 0.8 and 0.7 fpd in-hole horizontal velocities, for conductive intervals 1, 2, 3 and 4, respectively.

Flow evaluation was also conducted during stressed conditions during PDI testing. The results of this testing suggested that the water bearing intervals are low to moderate flowing units, however the increase in flow rate during PDI suggested moderate transmissivity in these features. Interval specific flow rates measured or estimated during PDI ranged from 0.10 gpm in the upper conductive feature between 105 and 110 ft bgs, to 1.18 gpm in the dominant feature between 147 and 156 ft bgs. Flow from this feature was 60.8 % of the estimated flow during PDI. Flow from the feature near the bottom of the well between 191.5 and 198.5 ft bgs was 27.8 % of the total estimated flow; the two features combining for a total of 88.7 % of the total flow.

The interval specific hydraulic conductivities in well MW-72BR-200 ranged from 0.16 feet per day (fpd) in the zone between 105 and 110 ft bgs, to 1.18 fpd in the dominant flow zone between 147 and 156 ft bgs. The interval specific hydraulic conductivity for the interval near the bottom of the well between 191.5 and 198.5 ft bgs is expressed as a range between 0.67 and 1.21 fpd, using the lowest and the highest estimated interval specific flow values from the analysis.

Hydraulic conductivity estimates were intended to be preliminary in nature and were not based on any site specific algorithms that may have been developed by others. Estimates are presented in the summary table in Appendix A. In summary, the resulting interval specific hydraulic conductivity estimates ranged from 0.16 to 1.21 fpd.

SUMMARY

Analysis of the data collected during AFC and PDI testing in well MW-72BR-200 supports the very low flow ambient condition and suggests the presence of primary flow. Analysis of the data suggests that the total ambient flow over the entire saturated interval was approximately 0.015 gpm.

Analysis of data collected during PDI testing suggests the presence of four distinct water bearing intervals, with two co-dominate flow zones; between 147 and 156 ft bgs, and between 191.5 ft bgs and the bottom of the well (198.5 ft bgs).

Based on the HPL data, interval specific hydraulic conductivity ranged from between 0.16 fpd to 1.24 fpd. During PDI, the overall flow rate for the entire saturated interval was estimated at between 1.94 and 2.36 gpm. The HPL and WSP results also suggested an interval specific formation water concentration of between 12,700 and 24,000 µS/cm for the saturated interval, with a general increasing downward trend.

Results of WSP sampling in MW-72BR-200 suggest that Chromium VI concentration of 2.0 µg/L was present in the sample collected from between 148 and 168 ft bgs. The sample collected near the bottom of the well at between 191 and 198.5 ft bgs was reported to have no detectable concentrations (< 1.0 µg/L).

We appreciate the opportunity to work with you on this project.

Please call with any questions.

Best Regards,
RAS, Inc.

Steven R Truesdale

Steven R. Truesdale, PG (California 7141)

APPENDIX A

DATA SUMMARY TABLE

Well MW-72BR-200 Summary of HPL Results								
			Interval Specific Flow Rate (gpm)		WSP Sample Conc. (Cr VI)	Interval Specific FEC Conc.	Interval Specific Hydraulic K	Equivalent In-Hole Horizontal Velocity
CF	Interval Depth (ft) Top	Bottom	Ambient	Pumping	µg/L	µS/cm	ft/day	ft/day
1	**105**	**110**	**<0.01**	**0.10**	**-**	**12,700 [2]**	**0.16**	**1.0**
2	**147**	**156**	**0.012**	**1.18**	**2.0**	**24,000 [2] to 17,100 [3]**	**1.16**	**0.6**
3	**161**	**167**		**0.12**		**15,600 [2] to 17,100 [3]**	**0.16**	**0.8**
4	**191.5**	**198.5 (TD)**	**<0.01**	**0.54 [1] to 0.96 [1]**	**< 1 (non detect)**	**16,200 [2] to 19,100 [3]**	**0.67 [4] to 1.21 [4]**	**0.7**
Total observed at surface				**1.50**	**-**	**-**	**-**	
Sum of Inflows from QC Flow analysis				**1.40**	**-**	**- -**	**-**	
Total interval flow estimate				**1.94 – 2.36**				

Notes

1 - Interval specific flow rate is expressed as a range using the highest and lowest total formation flow estimates based on mass balance analysis.
2 - Interval specific FEC concentration from QC Flow analysis of PDI logs, July 22, 2012.
3 - Interval specific FEC concentration from WSP pumping observations, July 23-24, 2012.
4 - Interval specific Hydraulic Conductivity is expressed as a range using the lowest and the highest estimated interval specific flow values; see Note 1 above.

APPENDIX B

FIELD NOTES AND DAILY REPORTS

RAS
Integrated Subsurface Evaluation
311 Rock Avenue • Golden, CO 80401
Website: www.rasinc.org
Phone: 303.526.4432 • FAX: 303.526.4426

FIELD NOTES

Job CH2MHill
Well —
Activity Travel
Date 7-16-12
Page 1 of 1

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1104		- Depart	RAS			502: 53462 mi
1130		- Had	T2	tail light	swapped out at all american trailers	
1150		- Back	on the road	heading to Siemens for		
		filtration	tank swap.			
1210		- Arrive	at US filter			
1232		- Leave	US filter			
1315		- Stop to fill fuel	at Loaf n Jug	Castlerock CO	502: 53517 mi	
1335		- Leave Loaf n Jug				
1630		- Stopped in	NM	weigh station		
1700		- Back	on road			
1815		- Stop at	conoco for	fuel	502: 53769 mi	
1830		- Back	on road			
2020		- Arrive at	hotel in	Santa Fe		
2050		- Checked in	for	evening		
						502: 53881 mi
						Total: 419 mi

Engineer's Name TCW

RAS
Integrated Subsurface Evaluation
311 Rock Avenue • Golden, CO 80401
Website: www.rasinc.org
Phone: 303.526.4432 • FAX: 303.526.4426

FIELD NOTES

Job CH2MHill
Well —
Activity Travel
Date 7-17-12
Page 1 of 1

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
0700		- Check	out	of hotel / vehicle	inspection / Log books	
0740		- Leave	Santa Fe, NM			502: 53881 mi
1020		- Stopped	for fuel → Continental, NM			502: 54044 mi
1035		- Back	on road			
1048		- Stopped	in Arizona Port of entry to buy permit			
1058		- Back	on road			
1320		- Stopped	at conoco in AZ			for lunch (AZ time)
1335		- Back	on road			502: 54249 mi
1553		- Stopped	at home depot			in Kingman AZ.
1625		- Back	on road			
1720		- Met	w/ Adin and	dropped	trailer	#2 on site
[redacted]						
1755		- Left	site / heading	to needles		for evening
1900		- Arrive	at	Hotel		502: 54463 mi Total: 582 mi

Engineer's Name TCW

RAS
Integrated Subsurface Evaluation
311 Rock Avenue • Golden, CO 80401
Website: www.rasinc.org
Phone: 303.526.4432 • FAX: 303.526.4426

FIELD NOTES

Job CH2M Hill
Well MW-72BR-200
Activity Setup / Ambient
Date 7-18-12
Page 1 of 3

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
0640		- Depart hotel				502: 54463 mi.
0658		- Arrive onsite		(15 miles from hotel to site)		
0700		- Begin H&S meeting and discuss daily activities				
0830		- Meeting complete				
0840		- Prepare for setup and decon / Begin				
1215		- Take a quick break before MOB to well				
1230		- Begin setup on MW-72BR-200				
		~~- Reading~~				
1520		- Calibration Tool A (orange)				
		* DI → 2.1 ms/cm				} FECT meter
		* 40K → 38,950 ms/cm				
		* F/V values low in sensor 3 by ≈ 150 ms/cm in DI				
		* F/V value a bit low for sensor 2 by ≈ 6K ms/cm in 40K				
		* Intercept on ch. 3. ~~low~~ high for cal. file				
			1) -228			
			2) -293			
			3) -92			
			4) -208			
1541		- Test tool calibration in cal. tubes				

Engineer's Name TLW

RAS
Integrated Subsurface Evaluation
311 Rock Avenue • Golden, CO 80401
Website: www.rasinc.org
Phone: 303.526.4432 • FAX: 303.526.4426

FIELD NOTES

Job CH2MHill
Well MW-72BR-200
Activity Ambient
Date 7-18-12
Page 2 of 3

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1609		- Prelog	cal. check		FECT METER →	3) 1.9 mS/cm
						4) 472 mS/cm
						5) 4427 mS/cm
						6) 39800 mS/cm
		* Values in tube 3			reading	a little off (especially ~~tube~~ Ch. 2)
		* Values in tubes ~~1,2,3~~ 4,5,~~6~~			reading	w/in 10%
1639		- Done	w/ Prelog			
1650	58.35' GS	- Ambient FECT				
7.35		* Lower tool to 65'				
		* Tool length 7.35'				from knucal to 1st sensor
		* No stickup (TOC = GS)				
1702		- Move tool to 70'				to temp. stabalize again b/c
		tool was				so hot going in to water
1705		- Temp.	stabalized /			begin logging
1720		- Tagged bottom @			~~168.5'~~	198.5'
1726		- Test	stopped			ASDE: 7.35' - 6.9' = ~~3~~.45'
1738		- Post Log Cal.	check			FECT Meter → 3) 6 mS/cm
						4) 361 mS/cm
						5) 3444 mS/cm
						6) 38940 mS/cm
1753		- Dropping PT to			~~20~~ psi	20.2 psi
1835		- Site	packed up			at heading home

Engineer's Name TLW

RAS
Integrated Subsurface Evaluation

311 Rock Avenue • Golden, CO 80401
Website: www.rasinc.org
Phone: 303.526.4432 • FAX: 303.526.4426

FIELD NOTES

Job CH2MHill
Well MW-72BR-200
Activity Ambient
Date 7-18-12
Page 3 of 3

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1900		-Arrive	back	@	hotel	
						502: 54496mi
						Total: 32mi

Engineer's Name TCW

311 Rock Avenue • Golden, CO 80401
Website: www.rasinc.org
Phone: 303.526.4432 • FAX: 303.526.4426

Integrated Subsurface Evaluation

FIELD NOTES

Job CH2MHill
Well MW-72BR-200
Activity Ambient
Date 7-19-12
Page 1 of 3

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
0630		-Depart for		site		
0650		-ARRIVE	on	SITE		
0700		- H+S	meeting			
0745	58.20'	- Setup	for	the day		
0826		-Pre log	Cal.	Check		FECT Meter: 3) 3.8 ms/cm 4) 398 ms/cm 5) 3717 ms/cm 6) 40920 ms/cm
		*Software out out → New file				(B)
0956		-Begin	Ambient	FECT		
		*Set at 65' for	temp.	stabalization		
		*Interval 50'-197'				
		-Tagged	bottom	@ 197'		
0928		-Ambient	complete			ASDE: 7.35' - 7.06' = .29'
0930		- Pulling	casing			
1126		- Casing	pulled			
		*Did not	have a	lifing		hook so had to clamp
		in	sections	and lift		with rope
1137	58.20'	-Tag	bottom	of hole	w/	water level meter @ 198.85'
1139		-James	testing	Flow	stand	
		*Flow meters	are	reading		

Engineer's Name TLW

RAS
Integrated Subsurface Evaluation
311 Rock Avenue • Golden, CO 80401
Website: www.rasinc.org
Phone: 303.526.4432 • FAX: 303.526.4426

FIELD NOTES

Job CH2MHill
Well MW-72BR-200
Activity Caliper
Date 7-19-12
Page 2 of 3

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1150		- Pre calibration check (caliper)				
		* Large ring :	7.85"			
		* Small ring :	2 7/8"			
1205		STARTED CENTURY SYSTEM, CONNECTED TOOL.				
		LENTH OF TOOL				5.40 FEET TOP OF KNUKL
		TO BOTTOM OF TOOL, TOOL S/N 591				
		TYPE 9065 A.				
1220		PRE-LOG CAL CHECK.				
			3" RNG		= 2.96	
			8" RNA		= 7.75	
			3" RNE		= 3.03	
			8" "		= 7.77	
1300		AT	192.51	+ 5.43 =		197.94 - ≈ 6" OFF BOTTOM
1338		ASPE	~~0.00~~	0.25		BEGINNING REPEAT LOG.
1355		- During caliper repeat log system 6 box shut off by itself				
		* No visible damage internally or externally				
1411		- Attempted repeat again but sys. 6 box keeps shutting down. Probably due to heat.				
		* using ice to cool it down or moving box to AC in SOL				
1450		- ~~Be~~ Breakers in trailer tripped due to an unknown electrical		problem. J's looking into it.		
1500		SET-UP FOR CALIPER REPEAT IN SOL				

Engineer's Name

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FIELD NOTES

Integrated Subsurface Evaluation

Job CH2MHILL
Well MW-72BR-200
Activity Caliper
Date 19 JULY 2012
Page 3 of 3

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1510		CALIPER LOG		REPEAT -	AT 170 - 175.13	
		OPEN CALIPER				
1535		ASPE =		0.03'		LOG LOOKS GOOD.
1540		POST LOG		CAL CHECK -	ALL O.K.	
		JAMES READY TO SET				UP FOR PUMP INSTALL.
1550		SETTING PUMP				BOTTOM TO FIRST SWIVEL = 5.60 FEET.
						INTAKE IS 1.6' ABOVE TOTAL OF PUMP.
1645		PUMP IS IN -				
1650		PT set at 20.2 psi				
1717		Post cal. check				FECT METER → 3) 4.5 MS/cm 4) 391 MS/cm 5) 4167 MS/cm 6) 40350 MS/cm
1747		Packed up site / MOB to hotel				
1815		Back at hotel				

Engineer's Name TCW

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Phone: 303.526.4432 • FAX: 303.526.4426

FIELD NOTES

Integrated Subsurface Evaluation

Job CH2MHill
Well MW-72BR-200
Activity AFC
Date 7-20-12
Page 1 of 5

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
0640		- Depart hotel				
0700		- Onsite for		H+S	meeting	
0745		- Begin setting up for the day on well				
0755	58.15'	* Borehole diameter is .32' at bottom section				
0808		- Starting w/flow				
0816		- Pre bal check				3) 3.1 ms/cm 4) 451 ms/cm 5) 3848 ms/cm 6) 41260 ms/cm
0840		- Ambient FECT * Set @ 65' for		start temp		stabalization
						Using 60' of gravity head and 20psi of surface pressure, and targeting 6 gpm injection, we get 46psi, which on the orifice table calls for the 0060 orifice.
0908		- Tagged top of pump @				192.5'
0920		- Ambient complete				ASDE: 7.35' - 7.1' = .25'
0924		- Surface testing orifice 0600 * 5.5 gpm @ 70 psi				max @ surface
0925		- Surface test complete				

Engineer's Name TLW

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'ntegrated Subsurface Evaluation

FIELD NOTES

Job CH2MHill
Well MW-72BR-200
Activity AFC
Date 7-20-12
Page 2 of 5

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1001	58.1'	- Begin Emplx for		AFC		
		* Logging interval		(65'- 192')		
		* No during emplx		log due to constant fluxuation		
		of extraction rate				
1026		* PG+E onsite		Chris		Smith
1038		- Emplx complete				
		* Max drawdown:		[redacted]		-.47'
1039		- Start Logging AFC				
1055		- 7st complete AFC log				ASDE: 65'-64.83'
1100		Chris Smith (PG+E) brought lunch				
1111		- 2nd complete AFC log				ASDE: 65'-64.87'
1128		- 3rd "		"	"	ASDE: 65'-64.86'
1145		- 4th "		"	"	ASDE: 65'-64.87'
		* 10 min. interval		b/n		logs (WHP)
1155		- Start 5th		AFC log		
1211		- 5th complete		AFC	log	ASDE: 65'-64.84'
		* 10 min				
1222		- Start 6th		AFC	log	
1230		* JLS offsite				
1237		- 6th complete		AFC	log	ASDE: 65'-64.85'
		* 20 min.		intervals	b/n	logs

Engineer's Name TLW

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FIELD NOTES

Job CH2MHill
Well MW-728R-200
Activity AFC
Date 7-20-12
Page 3 of 5

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1258		- Start	7th	AFC	log	
1314		- 7th	Complete AFC log			ASDE: 65'-64.83'
1335		- Start	8th	AFC	log	
1350		- 8th	Complete AFC log			ASDE: 65'-64.85'
		*Software cut out during uplog around 100'				
		*Started AFC2 file and will resume logging in 20 minutes				
1410		- Start	9th	AFC	log in	new file
1426		- 9th	complete AFC log			ASDE: 65'-64.87'
		*Attempted water level reading but DI prevented proper meter reading -				Attempt DTW = 58.20
		*20 min. break b/w logs				
1446		- Start	10th	AFC	log	
1502		- 10th	complete AFC log			ASDE: 65'-64.89'
		*30 min. break b/w logs				(WHP)
1533		- Start	11th	AFC	log	
1538		- Chris	Smith (PG+E)	onsite		
1548		- 11th	complete AFC log			ASDE: 65'-64.87'
		*30 min. break				
1600		- TLW	offsite			
1620		- START	12TH	AFC	LOG	

Engineer's Name TLW

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Integrated Subsurface Evaluation

FIELD NOTES

Job CH2MHILL - TOPOCK
Well MW-72BR-200
Activity AFC
Date 7-20-12
Page 4 of 5

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1635		12TH	COMPLETE	AFC	LOG.	ASDE = 65 - 64.87 = 0.13'
1705		START	13TH	AFC	LOG.	CONTINUE SLOW DRAWDOWN 0.15'
1720		13 TH	COMPLETE	AFC	LOG.	ASDE = 65 - 64.88 = 0.12.
1750		START	14TH	AFC	LOG.	
1806		14 TH	COMPLETE	DOWN LOG	AFC.	ASDE 65 - 64.84 = 0.16
1835		START	15 TH	AFC	LOG.	SEE NOTE REGARDING DRAWDOWN
		~	0.15'		PRESSURE	~ 20.40 PSI.
		MANUEL		DEPTH	TO	WATER - NOT ACCURATE
		BUT	TUNE	AT	58.15	BGS. -
1850		15 TH	AFC	LOG	COMPLETE	- ASDE 65 - 64.90 = 0.10
1915		DTW	= 58.15			
1920		START	16TH	AFC	LOG.	
1935		16 TH	AFC	LOG	COMPLETE	ASDE = 65 - 64.90 = 0.10
		TOOL	STOP	TEST.		
		BRNG	TOOL	TO	SURFACE	ASDE = 7.30 - 7.26 = 0.04.
1940		FEL	TUBE #		FEC VALUE	
			3		4.3	
			4		517	
			5		4438	
			6		45,710	

Engineer's Name SRT

3.8' 509 200

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FIELD NOTES

Integrated Subsurface Evaluation

Job CH2MHILL - TOPOCK
Well MW - 72BR-700
Activity AFC
Date 7-20-12
Page 5 of 5

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1950		POST	LOG	CAL	CHECK -	TOOL AFTER RINSING
		TUBE	3	VALUES	VERY	HIGH - 100-500, RINSE AGAIN
		AND	CHECK	WATER	- RINSE TUBES,	STILL HIGH
		MOVE	TO	TUBE	#4.	
		TUBE	4 -	OK,	434 TO 515.	(517)
		TUBE	5 -	OK	4357 TO 4502	(4438)
		TUBE	6 -	OK	43428 TO 45511	(45,710)
		CHANGED	WATER	IN	TUBE 3,	RE RINSED TOOL
		RE PID	TUBE	3 -	TOOK A WHILE	TO SETTLE
		BUT OK.		* WHP	NOTIFIED - SAID	OK - DEMOB
		SAVED	DATA	TO	THUMB	DRIVE
2033		PACKED	UP -	LEFT	SITE -	

Engineer's Name SRT

HC PUMPING NOTES

554 Orchard Street Unit 4, Golden, Colorado 80401
Website: www.rasinc.org
Phone: 303.526.4432 FAX: 303.526.4426

Project CH2MHILL - NORTHSTAR TOPOCK
Well: MW - 72BR - 200

Activity: EMPLACEMENT FOR AFC

Date: JULY 20 2012
Page 1 of 1

Real Time	Depth to Water	Injection						Extraction						Total Gallons Pumped	Comments
		Pump Start	Manifold Gauge Pressure	Flow Rate (gpm)	FEC (uS/cm)	Temp (° C)	Pump Stop	Pump Start	Manifold Gauge Pressure	Flow Rate (gpm)	FEC (uS/cm)	Temp (° C)	Pump Stop		
1000	58.10	X	58					X	39		10.7 K				
1002			58						39		16.4 K	29.7			
1004			58						38		15.7 K	28.8			
1006			58						38		14.0 K	28.4			
1008			58						38		10.1	28.3			
1010			58						38		7.79 K	28.2			
1012			58	6.06					38	7.07	5.49 K	28.4			
1014			57						38		4.27 K	28.5			
1016			57	6.1					38	7.1	3.27 K	28.5			
1018			58						38		2,411	29.9			
1020			58	6.1					38	7.2	1143	32.2			
1022			58						38		747	33.5			
1023			58	6.1					38	7.1	527	34.4			
1024			58	6.1					39	7.1	592	35.1			
1025			58	6.1					39	7.1	558	35.1			
1026			58	6.1					39	7.0	431	35.7			
1027			58	6.1					40	7.0	420	35.9			
1028			58	6.1					40	7.0	433	35.8			
1029			58						40		465	36.1			
1030			58						40		446	36.2			
1032			58						40		388	36.4			
1034			58						40		405	36.4			
1036			58						40		423	36.4			

Engineer's Name: STEVEN TRUESDALL

CLIENT CH2MHILL - NORTHSTAR

JOB NO.

*ALL DEPTHS REFERENCED TO: GROUND SURFACE X

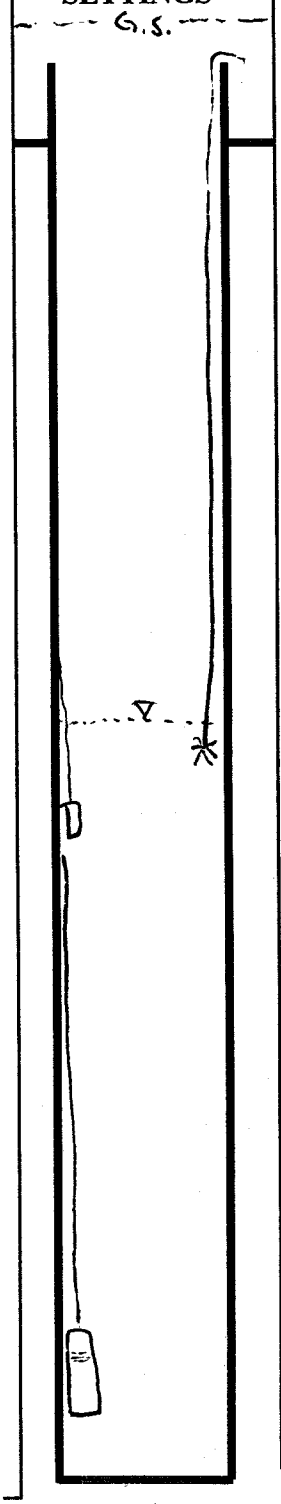
STICKUP

TOP OF CASING 0.5' BGS

WELL I.D. MW-72B

DATE 7/20/12

DESIGN SETTINGS	ACTUAL SETTINGS
PUMP INLET 194.5	G.S.
TOP OF TEST INTERVAL 65	
BOTTOM OF CASING 107	
AMBIENT WL 58.15	
PRESSURE TRANSDUCER 105.50	
BOTTOM OF TEST INTERVAL 192	
DI INJECTION 60	
TOTAL DEPTH 198	



TESTING PROTOCOL - ACTION ITEMS

PUMP TYPE

OROFICE NO. 0060

INJ PUMP TYPE

SEPARATE GENERATOR

TEST/ACTION #1 EMPTY FOR AFC

PUMPING RATE 7.1

INJECTION RATE 6.1

TEST #2

PUMPING RATE

INJECTION RATE

TEST #3

PUMPING RATE

INJECTION RATE

TEST#4

PUMPING RATE

INJECTION RATE

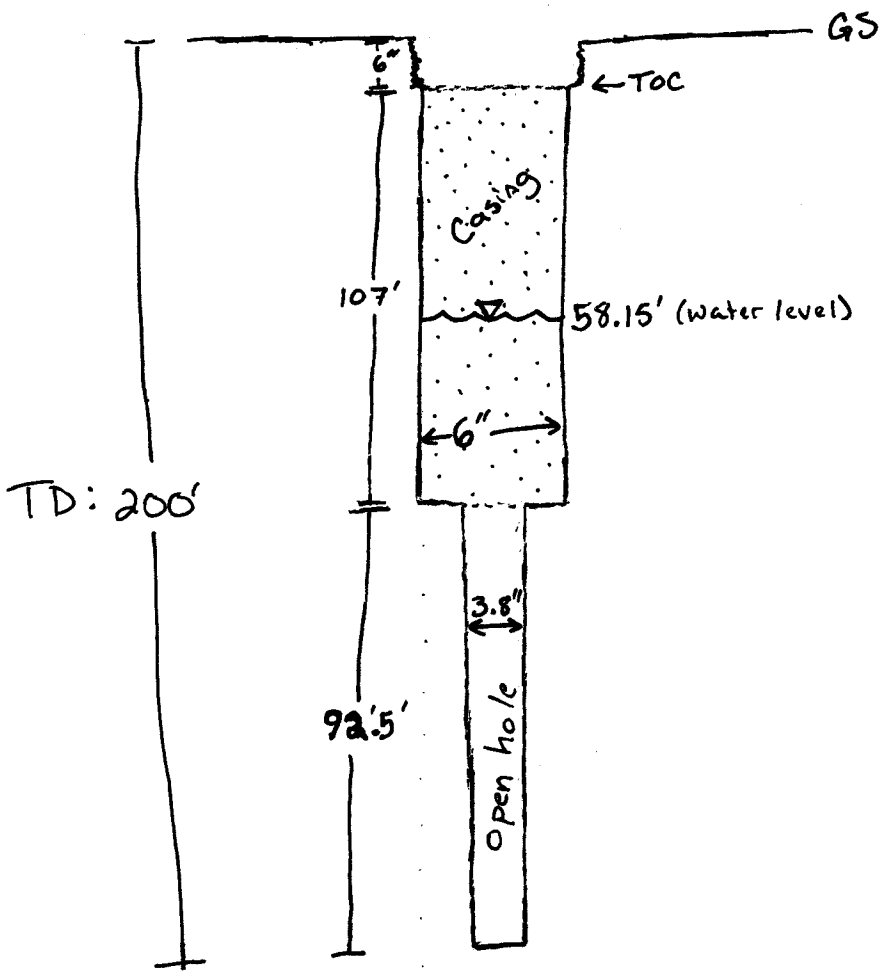
TEST #5

PUMPING RATE

INJECTION RATE

RAS
Integrated Subsurface Evaluation
311 Rock Avenue • Golden, CO 80401
PH 303.526.4432 • FAX 303.526.4426
email: PedlerRAS@aol.com • www.rasinc.org

WELL CONSTRUCTION



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Integrated Subsurface Evaluation
311 Rock Avenue • Golden, CO 80401
Website: www.rasinc.org
Phone: 303.526.4432 • FAX: 303.526.4426

FIELD NOTES

Job CH2MHill
Well MW-72BR-200
Activity AFC day 2
Date 7-21-12
Page 1 of 5

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
0640		- Leave	Hotel	For	site	
0700		- Onsite for	H+S	meeting		
0725		- Arrive	@ well	+ begin	setup	
0730		- Pulled	PT to	download	data	
0740	57.6'	* Appears river level ~~made~~				may have come up over night
		* River about 150' from well				*(20.687 psi)
0755		- Prelog Cal. check				FECTMETER -> 3) 6 ms/cm
		* Values reading a bit		high		across the 4) 414 ms/cm
		board				5) 3850 ms/cm
		* Didit want to change cal. for AFC				day 2 6) 40310 ms/cm
0820		- Begin	AFC	day 2'		(66'-192')
		* Set @ 65'		for temp	stabalization	
0851		- 1st complete		AFC	log	ASDE: 65'-64.75'
0930		- Begin	AFC	day 2+2		
0930		- Started 2nd AFC log				
		* Waiting to	hear	back	from WHP	to see if we
		can	move	to	SAE	
0945		- 2nd	Complete	AFC	log	ASDE: 65'-64.89'
1032		- Begin	~~AFC~~	3rd AFC	log	
1047		- 3rd	Complete	AFC	log	ASDE: 65'-64.90'

Engineer's Name TLW

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FIELD NOTES

Job CH2MHill
Well MW-72BR-200
Activity AFC day 2 / H.C.
Date 7-21-12
Page 2 of 5

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1131		- Start	4th	AFC	log	
1147		- 4th * AFC	complete AFC complete	log		ASDE: 65' - 64.85'
1203	57.70'	- ~~Pump~~ Pump test on ½" flow saddle * Looking for minimum rate * Must keep positive pressure on PT (water level above)				
		- 50 psi @ ↑ gauge		~~.82~~ .82 gpm		@ 19.5 psi (PT)
		* Could not sustain low rate w/out it cutting out				
1230		- 10' ~~Stg~~ HC		slug test		
		* 20.61 psi - 4.33 psi = 16.28 psi target				
1232		- Stopped @ 16.352 psi				
1245		- 2' drawdown = 8' recovery = 80%				(13 min.)
1254	58.16'	drawdown		.52'		@ 20.45 psi
1255		- 20' HC		slug test		start
		* 20.61 - 8.66 =		11.95 psi target		
1257		- Stopped @		14.7 psi		b/c of circuit breaker
1258		- Restarted pump				
1259		- Stopped @ 12.017 psi				OR 19.84 FEET OF DRAWDOWN.

Engineer's Name TCW

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FIELD NOTES

Job CH2MHILL
Well MW-72BR-200
Activity AFC PAY 2 / H.C.
Date 7-21-12
Page 3 of 5

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1313		DRAWDOWN =		7.0 FEET, OR		128' OF RECOVERY IN
		14 MINUTES.				
1323		Drawdown =		2.53'	@	19.58 psi
		=		17.31'	of recovery	
1333		HC Pump TEST START				
		Drawdown	Pressure	Flow Rate	Time	
		2.74	19.44	1.1	1334	
	63.27'	5.8	18.16	.92	1338	
	65.52'	7.8	17.33	.94	1341	Manifold pressure steady @ 46
		9.13	16.75	.92	1344	
	67.12'	9.52	16.55	.95	1345	
	68.1'	10.48	16.14	.95	1347	
	68.65'	11.00	15.95	.93	1350	
	69.3'	11.63	15.65	.92	1353	45 psi Manifold
	69.9'	12.2	15.36	.88	1356	
	70.55'	12.88	15.10	.94	1359	
	70.85'	13.24	14.95	.89	1402	
	71.1'	13.48	14.8	.92	1404	
	71.5'	13.84	14.68	.93	1407	
	72.36'	14.38	14.43	2.01	1408	43 psi
	73.4'	15.72	13.85	1.98	1410	
	75.3'	17.73	13.00	1.95	1413	
	77.2'	19.54	12.2	1.9	1416	
	78.85'	21.08	11.54	1.93	1419	
	79.95'	22.2	11.05	1.93	1422	
	81.1'	23.4	10.5	1.89	1425	
	82.6'	24.83	9.89	1.88	1430	

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FIELD NOTES

Job CH2MHill
Well MW-72BR-200
Activity HC
Date 7-21-12
Page 4 of 5

Real Time	Depth to Water	Gauge 1 Flow Total		Gauge 2 Flow Total		Elapsed Time/comments
		Drawdown	Pressure	Flow Rate	Time	
		[redacted]	[redacted]		[redacted]	
	83.6'	25.88	[redacted]	1.93	1433	
	84.35'	26.66'	9.101	1.91	1436	
	84.85'	27.1'	8.91	1.89	1438	
	89.3'	31.6'	6.91	3.92	1449	
	92.1'	34.7'	5.5	[redacted] 3.73	1443	
	97.5'	39.6	3.58	3.74	1446	
1447		*Shutdown @ 2			1447	due to pressure stopped
		dropping. Probably b/c				PT has a 3.35 psi offset
1451		-Pulling Tool up for pre cal check + letting				
		well recover for w/inflow				
1453		-Tool out of hole				ASDE: 7.35' - 7.15' = .20'
1457		-Post Cal. Check				FECT METER → 3) 2.7 µs/cm
		*All channels reading high in DI				4) 486.2 µs/cm
		*Giving it time to come down				5) 4650 µs/cm
						6) 46930 µs/cm
1506		-Runtime Error / Restart				aquisition
1510		-Restarted		Post	Cal.	
		IN TUBE		3 -	DATA	85 TO 120 - SAME ISSUE AS
		PRIOR CAL CHECKS.				
		TUBE 4 -			CH 1,2,4 - 408, 384, 397, TIGHT BUT LOW.	
					CH 3 - 480	
		TUBE 5 -		TIGHT.	4410, 4530, 4503, 4370. LOW BUT TIGHT.	
		TUBE 6 -		Ch. 1,2,3,4 →	41580, 44500, 42455, 43260	
					AVERAGE = 42,960 <10% LOW	

Engineer's Name TCW 85%

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FIELD NOTES

Job CH2M Hill
Well MW-72R-200
Activity MOB
Date 7-21-12
Page 5 of 5

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1640		- Pack	up	site		
1650		- MOB	home			
1655		- Stop	to check out the			Topock Maze
1735		- Arrive	back @ hotel			

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FIELD NOTES

Job CH2MHill
Well MW-72BR-200
Activity PDI
Date 7-22-12
Page 1 of 6

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
0640		- Depart Hotel				
0700		- Arrive @ Topock station for H+S meeting				
0730		- Setup onsite				6.0 ~~3.0~~
0825		- Calibrate Tool		FECT METER →		~~HK~~ DI: ~~2.5~~ µs/cm
		*Ch. 3 I/V value		low in DI		40K: 39820 µs/cm
		*Ch. 3 I/V slightly low & Ch. 4 I/V slightly high in 40k				
		~ Uncorrected 40k cond.		≈ 10000 high		
		*Intercept values		Ch. 1,2,3,&4 → -292, -369, -178, -254		
0836		- Flow chamber test log for calibration				
		*Readings really tight in 40K				
		* Ch. 3 reading high in DI, slowly comes down over time				
0857	57.93'	- Pre Cal. Check.		FECT METER →		3) 4.5 µs/cm
		*~~Ch.~~ Ch. 1,2,4 reading low in tube 4				4) 419 µs/cm
						5) 4005 µs/cm
						6) 40360 µs/cm
0904		- Surface test		injection orifice 0015 →		
				P	Q	ORRIFICE TABLE USED
				112	2.35	0015 IS SMALLEST WE
				70	1.63	HAVE - AT 50 PSI - 1.65
				48	1.19	GPM . 60PSI = 1.8 -
				28	0.78	
				20	0.49	
0911		SURFACE TEST STOP.				

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Phone: 303.526.4432 • FAX: 303.526.4426

Integrated Subsurface Evaluation

FIELD NOTES

Job CH2MHill
Well MW-72BR-200
Activity AMBIENT / PDI
Date 7-22-12
Page 2 of 6

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
0916		+ Lower tool to 65' for temp. stabalization for Ambient				
		* 7.35' from kwral to 1st sensor				
0930		+ Begin logging ambient From 65' to 192'				
0945		+ Ambient FECT complete				ASDE: 65'-64.83'
0950		+ Preparing For PDI				
		* Setting tool down to ~~95~~ ~~85~~ ~~90~~ 100' so we don't drawdown below tool				
1005		+ Preparing to pump for PDI				
		+ Tool set @ 100'				
		* Injection line set @ 90'				
1028		+ Start extraction pump				
1029		+ Start logging during pumping (100'-192')				
			LOCKWA TV RATE			EXT AT ~1.5
			STARTWA PRESSURE			AT 20.63
1033			LOCKED AT			1.44 GPM EXTRACTION
			PRESSURE AT			18.20
1038		+ 7st complete during pumping log				ASDE: 100'-99.74'
1048		+ 2nd complete during pumping log				ASDE: 100'-99.80'
1058		+ 3rd "		"	"	ASDE: 100'-99.87'
1107		+ 4th "		"	"	ASDE: 100'-99.84'
1117		+ 5th "		"	"	ASDE: 100'-99.85'

Engineer's Name TLW

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Website: www.rasinc.org
Phone: 303.526.4432 • FAX: 303.526.4426

FIELD NOTES

Job CH2MHill
Well MW-72BR-200
Activity PDI
Date 7-22-12
Page 3 of 6

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1126		- 6th	complete during pumping log			ASDE: 100' - 99.87'
1135		-7th	"	"	"	ASDE: 100' - 99.86'
1144		-8th	"	"	"	ASDE: 100' - 99.71'
1156		-9th	"	"	"	ASDE: 100' - 99.87'
1205		-10th	"	"	"	ASDE: 100' - 99.88'
1215		-11th	"	"	"	ASDE: 100' - 99.87'
1224		-12th	"	"	"	ASDE: 100' - 99.87'
1233		-13th	"	"	"	ASDE: 100' - 99.88'
1243		-14th	"	"	"	ASDE: 100' - 99.89'
1252		-15th	"	"	"	ASDE: 100' - 99.87'
1301		-16th	"	"	"	ASDE: 100' - 99.89'
1310		-17th	"	"	"	ASDE: 100' - 99.87'
1319		-18th	"	"	"	ASDE: 100' - 99.89'
1328		-19th	"	"	"	ASDE: 100' - 99.89'
1337		-20th	"	"	"	ASDE: 100' - 99.87'
		* Stopping during Pumping logs and moving to final pumping				

Engineer's Name TCW

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FIELD NOTES

Job CH2MHill
Well MW-72BR-200
Activity PDI
Date 7-22-12

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1340		- Begin FINAL Pumping Logs (9.89psi)				
1349		- 1st Complete		Final Pumping Log		ASDE: 100' - 99.93'
1357		- 2nd	"	"	"	ASDE: 100' - 99.91'
1407		- 3rd	"	"	"	ASDE: 100' - 99.82'
		* Doing one extra log b/c of a small feature that did not repea				
		in ~~2nd log~~ 1st log				
		* Collected discharge water in tube # 1				
1416		- 4th	"	"	"	ASDE: 100' - 99.86'
		* Stop FINAL Pumping + prepare for dilution				
1421		- Start injection				
		* Injection: ~~1.43 gpm~~ 1.52 gpm				
		* Extraction: 3.0 gpm				
1428		- Start dilution Logs				
1436		- 1st complete during dilution log				ASDE: 100' - 99.91'
1446		- 2nd	"	"	"	ASDE: 100' - 99.90'
1457		- 3rd	"	"	"	ASDE: 100' - 99.88'
1506		- 4th	"	"	"	ASDE: 100' - 99.92'
1515		- 5th	"	"	"	ASDE: 100' - 99.89'
1524		- 6th	"	"	"	ASDE: 100' - 99.92'
		* Throttling back ext.				

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FIELD NOTES

Job CH2MHill
Well MW-72BR-200
Activity PDI
Date 7-22-12
Page 5 of 6

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1531		- Resume logs				
1540		- 7th	Complete Dilution Log			ASDE: 100' - 99.89'
		* Moving to	FINAL	Dilution		Logs
1550		- 1st	complete	FINAL	Dilution	Log ASDE: 100' - 99.90'
1559		- 2nd	"	"	"	ASDE: 100' - 99.91'
1608		- 3rd	"	"	"	ASDE: 100' - 99.91'
		*Doing one additional log to				see if it traces a little better
		than 1st log (striving For				perfection)
1612		- Collected Final dilution discharge in tube # 7				
1617		- 4th	complete FINAL Dilution Log			ASDE: 100' - 99.90'
1621		- Pumps Shutdown				
1638		- Final	ASDE: 7.35' - 7.30' = .05'			
1700		- Post	Log Cal. check			FECT METER → 1) 19830 µs/cm
						3) 2.3 µs/cm
						4) 469.4 µs/cm
						5) 4433 µs/cm
						6) 44310 µs/cm
						7) 11260 µs/cm
1735		- Pulled	PT	+ downloaded		data
1738		- Pulling	pipe			

Engineer's Name TLW

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FIELD NOTES

Integrated Subsurface Evaluation

Job CH2MHill
Well MW-72BR-200
Activity ~~Pack~~ Cleanup
Date 7-22-12
Page 6 of 6

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
~~0615~~ 1815		- Pipe	pulled	/ Packing up		for evening
~~0630~~ 1830		- Pipe	out /	packed up		for night / Heading to hotel
~~0650~~ 1850		- Back	@	hotel		

Engineer's Name TLW

CLIENT CH2MHILL - NORTHSTAR

JOB NO.

*ALL DEPTHS REFERENCED TO: GROUND SURFACE X

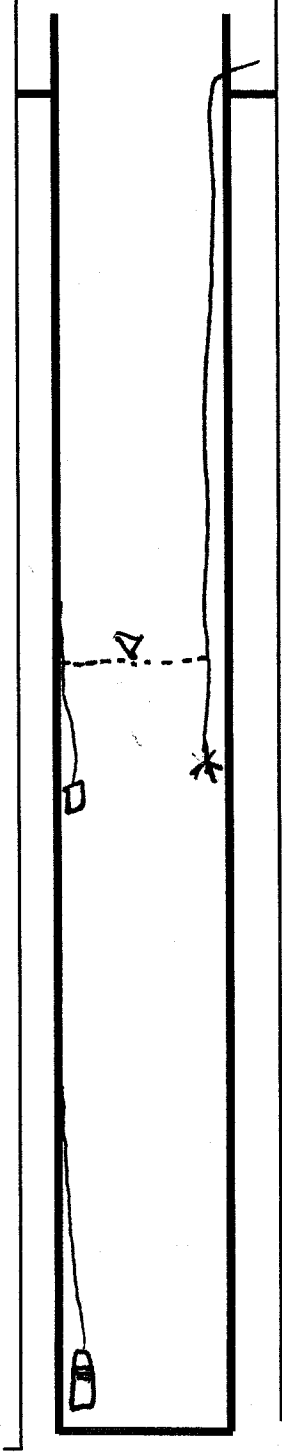
WELL I.D. MW-728

STICKUP

TOP OF CASING 0.5' BGS

DATE 7-22-12

DESIGN SETTINGS	ACTUAL SETTINGS
PUMP INLET @ 194.5	
TOP OF TEST INTERVAL 100	
BOTTOM OF CASING 107	
AMBIENT WL 57.93	
PRESSURE TRANSDUCER 105.5	
BOTTOM OF TEST INTERVAL 192	
DI INJECTION 90	
TOTAL DEPTH 198	



TESTING PROTOCOL - ACTION ITEMS

PUMP TYPE

OROFICE NO. 0015

INJ PUMP TYPE

SEPARATE GENERATOR

TEST/ACTION #1 DURING PUMPING

PUMPING RATE

INJECTION RATE

TEST #2

PUMPING RATE

INJECTION RATE

TEST #3

PUMPING RATE

INJECTION RATE

TEST#4

PUMPING RATE

INJECTION RATE

TEST #5

PUMPING RATE

INJECTION RATE

RAS
Integrated Subsurface Evaluation
311 Rock Avenue • Golden, CO 80401
PH 303.526.4432 • FAX 303.526.4426
email: PedlerRAS@aol.com • www.rasinc.org

HC PUMPING NOTES

RAS Integrated Subsurface Evaluation
554 Orchard Street Unit 4, Golden, Colorado 80401
Website: www.rasinc.org
Phone: 303.526.4432 FAX: 303.526.4426

Project CH2M Hill
Well: MW-72BR-200

Activity: PDI

Date: 7-22-12
Page 1 of 4

Real Time	Depth to Water	Injection						Extraction						Total Gallons Pumped	Comments
		Pump Start	Manifold Gauge Pressure	Flow Rate (gpm)	FEC (uS/cm)	Temp (° C)	Pump Stop	Pump Start	Manifold Gauge Pressure	Flow Rate (gpm)	FEC (uS/cm)	Temp (° C)	Pump Stop		
1028	57.8	X						X							
1033	64.9								46	1.44	10640	29.1			
1038	66.81								46	1.42	11200	29.9			
1042	69.1								45	1.41	12240	30.3			
1048	70.9								45	1.41	13,410	30.1			
1053	72.3								44	1.47	14,230	30.3			
1058	73.8								44	1.44	15,060	30.5			
1103	74.6								44	1.44	15,120	30.3			
1108	75.6								43	1.43	15,610	30.5			
1113	76.1								42	1.44	15,500	30.4			
1118	76.85								42	1.42	15,940	30.2			
1123	77.2								42	1.45	15,830	30.5			
1128	77.95								42	1.48	16,170	30.4			
1133	78.5								42	1.45	16,110	30.4			
1138	78.8								42	1.45	16,080	30.4			
1143	79.25								41	1.45	16,030	30.3			
1148	79.5								41	1.43	16,110	30.6			
1153	79.6								41	1.42	16,030	30.3			
1158	79.95								40	1.46	16,030	30.3			
1203	80.25								40	1.50	16,200	30.4			
1208	80.55								40	1.50	16,390	30.6			
1213	81.30								40	1.50	16,660	30.7			
1218	81.52								40	1.51	16,510	30.8			

Engineer's Name: [signature]

HC PUMPING NOTES

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Integrated Subsurface Evaluation

Project CH2MHILL - TOPOCK Activity: PDI Date: 7-22-12
Well: MW-72BR-200 Page 2 of 4

Real Time	Depth to Water	Injection						Extraction						Total Gallons Pumped	Comments
		Pump Start	Manifold Gauge Pressure	Flow Rate (gpm)	FEC (uS/cm)	Temp (° C)	Pump Stop	Pump Start	Manifold Gauge Pressure	Flow Rate (gpm)	FEC (uS/cm)	Temp (° C)	Pump Stop		
1223	81.78								40	1.47	16,480	30.5			
1228	81.79								40	1.46	16,480	30.7			
1233	82.01								40	1.45	16,580	30.9			
1238	82.02								39	1.47	16,530	30.9			
1243	82.25								39	1.45	16,230	30.8			
1248	82.2								39	1.47	16,150	30.7			
1253	82.3								39	1.45	16,330	30.6			
1258	82.4								39	1.47	16,190	30.6			
1303	82.5								39	1.40	16,090	30.7			
1308	82.55								38	1.44	16,010	30.8			
1313	82.5								38	1.44	16,270	30.5			
1318	82.65								38	1.44	15,840	30.7			
1323	82.55								38	1.45	16,410	30.8			
1328	82.75								38	1.44	15,860	30.5			
1333	82.65								38	1.45	16,500	30.6			
1338	82.8								38	1.44	16,230	30.7		Moving to final pumping	
1343	82.65								38	1.44	16,460	30.7			
1348	82.85								38	1.44	16,360	30.5			
1353	82.65								38	1.42	16,290	30.6			
1358	82.8								38	1.43	16,120	30.6			
1403	82.7								38	1.43	16,530	30.5			
1408	82.8								38	1.43	16,120	30.8			
1413	82.75								38	1.43	16,290	30.6			

Engineer's Name:

HC PUMPING NOTES

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Phone: 303.526.4432 FAX: 303.526.4426

Project CH2MHILL - TOPOCK Activity: PDI Date: 22 July 2017
Well: MW-723R-200 Page 3 of 4

Real Time	Depth to Water	Injection: Pump Start	Injection: Manifold Gauge Pressure	Injection: Flow Rate (gpm)	Injection: FEC (uS/cm)	Injection: Temp (° C)	Injection: Pump Stop	Extraction: Pump Start	Extraction: Manifold Gauge Pressure	Extraction: Flow Rate (gpm)	Extraction: FEC (uS/cm)	Extraction: Temp (° C)	Extraction: Pump Stop	Total Gallons Pumped	Comments
1418	82.85								38	1.44	16,200	30.5			
1421		X													
1428 ~~1433~~	81.1		18	1.44					36	3.0	16,090	30.0			
1433	81.35		21	1.5					36	3.0	16,210	~~30.~~ 29.8			
1438	82.3		20	1.5	3.0	42.4			35	2.96	13,480	30.3			Manual depth readings
1443	82.75		19	1.51					35	2.98	12,960	30.4			no longer possible due to
1448			19	1.51					35	2.98	11,750	30.5			DI Dilution
1453			19	1.51	3.0	42.4			35	2.98	9,560	30.5			
1458			19	1.5					35	2.97	9,520	30.7			
1503			19	1.5					35	2.98	8,920	31.9			
1508			19	1.5	3.0	42.5			35	2.97	9,610	31.6			
1513			19	1.51					35	2.96	8,110	31.8			
1518			19	1.5					35	2.95	10,130	32.2			
1523			18	1.5	3.0	42.5			34	2.83	~~10,210~~	32.8	9,970uS/cm		
1528			18	1.5					34	2.83	8,890	32.8			
1533			18	1.5					34	2.83	8,890	32.8			
1538			18	1.48	3.0	42.5			34	2.88	9,630	33.0			
1543			17	1.49					34	2.90	10,130	33.2			
1548			17	1.48					34	2.91	8,600	33.3			
1553			17	1.49	3.0	42.5			34	2.92	10,090	33.2			
1558			17	1.48					34	2.88	9,210	33.2			
1603			17	1.49					34	2.87	10,500	33.3			
1608			18	1.48					35	2.9	9,320	33.3			

Engineer's Name:

HC PUMPING NOTES

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Project CH2MHILL TOPOCK
Well: MW-72BR-200

Activity: PDI

Date: 22 July 2012
Page 4 of 4

Real Time	Depth to Water	Injection						Extraction						Total Gallons Pumped	Comments
		Pump Start	Manifold Gauge Pressure	Flow Rate (gpm)	FEC (uS/cm)	Temp (° C)	Pump Stop	Pump Start	Manifold Gauge Pressure	Flow Rate (gpm)	FEC (uS/cm)	Temp (° C)	Pump Stop		
1613			18	1.49	3.0	42.6			35	2.9	9.69	33.5			
1618			18	1.48					35	2.9	9.64	33.9			
1621							X						X		

Engineer's Name:

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FIELD NOTES

Job CH2MHill
Well MW-72BR-200
Activity WSP
Date 7-23-12
Page 1 of 4

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
0540		- Depart hotel				
0705		- Arrive @ station		for		H+S meeting
0800		- Onsite MW-72BR-200				
0805		- Break down HPL / setup for WSP				
0948	57.87'					
1045		- Surface pressure test * Tool is sealed				
1050		- Surface Tested		tool connection & PT's		
1140		- Setting up WSP		in well		
1215		- start lowering tool * 32.12' - 8.25' = * 28.04' - 8.25' = * 57.87' - 23.87' =		/ Set datum @ bottom of Top Gla 23.87' below datum (Bottom of top pac 19.79' distance b/n bottom of top packer and top of bottom pack 34' down bottom of tool will hit water level		
1228		- Starting WSP ~~for~~ * 5' intervals after ~~50~~ 50'		Desent log (20.17' depth) to start then move to 10' intervals		
1243		*Checking PT during decent file every 10' to confirm that they are		reading correctly		

Engineer's Name TLW

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FIELD NOTES

Job CH2M Hill
Well MW-72BR-200
Activity WSP
Date 7-23-12
Page 2 of 4

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1244						- Stopped @ 80' to do a pumptest
1305						- Bladder pump test beginning
1325						- Water being pumped out for our pumptest ~~* Not really a test~~ * Slight drop in head in PT data
1334						~~-~~ - Continuing to lower WSP
1335						- Hanging up trying to get down into 4" bore
1343						- Into 4" and set @ 90'
1350						- Hung up again going down to 110' around 103'
1410						- Tool set @ interval depth * Bottom of top gland at 148' * Doing one more pumptest before starting our packed off interval file
1415						- Sucessful pump test @ .25gpm (15,15) cycle
1418						- stopped decent log
1423						- started interval 148'-168' log
~~1223~~						*
						- Packer inflation calculations
	1)	* 700 psi max based on hole size table				
	2)	* Max water pressure above lower packer is 52.7 psi				
	4)	* 1.2 * 53 = 63.6 ≈ 64 psi is recomended minimum				

Engineer's Name JLW

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FIELD NOTES

Job CH2MHill
Well MW-72BR-200
Activity WSP
Date 7-23-12
Page 3 of 4

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1435		- Start inflating packers				PT pressures @ beginning → 41.1 45.2 52.7
1456		- Packer pressure set @ 100psi (WSP) * Letting pressure stabalize				WSP DEPTH 148.24
1507		* Stable pressure for 10min				preparing to pump
		[redacted]				
		- Geo Control Box not working * Spoke w/ Geotech to try and get a rental box overnighted				
		- JLS attempting [redacted] to hook up spare control box from Arlin				
		- SRT spoke w/ Amity @ Geotech * Will be overnighting a new control box for rental				
1604		- Back up control box * start pumping		*		works PT pressures @ start → 41.2 45.2 52.9
[redacted]	[redacted]					
1900		- Start sampling (WHP)				
1905		- Stopped pump				
1920		- Released pressaie from packer glands				

Engineer's Name TCW

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FIELD NOTES

Integrated Subsurface Evaluation

Job CH2MHill
Well MW-72BR-200

Activity WSP

Date 7-23-12
Page 4 of 4

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1935		- stopped		WSP log		
		- start packing up				
2000		~~Arrive~~ - offsite / MOB to hotel				
2020		- Back @ hotel				

Engineer's Name TCW

HC PUMPING NOTES

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Phone: 303.526.4432 FAX: 303.526.4426

Project CH2MHILL-North Star
Well:

Activity: WSP SAMPLING 148-168 FEET

Date: JULY 23, 2012
Page 1 of 1

Real Time	Depth to Water	Injection: Pump Start	Injection: Manifold Gauge Pressure	Injection: Flow Rate (gpm)	Injection: FEC (uS/cm)	Injection: Temp (° C)	Injection: Pump Stop	Extraction: Pump Start	Extraction: Manifold Gauge Pressure	Extraction: Flow Rate (gpm)	Extraction: FEC (uS/cm)	Extraction: Temp (° C)	Extraction: Pump Stop	Total Gallons Pumped	Comments
~~1511~~		X								.25					
1615		X													
1623											14960	31.4			
1628										.18	15,230	31.6			
1633											14,870	31.1			
1638											14,670	31.1			
1643											14,520	31.1		5.4	
1650											14,200	31.0			
switch Bucket → 1700											14,550	31.1		8.1	
1710											15,140	30.6			
1722											16,000	30.9			
Switch Bucket 1728 1730											16,400	30.6		13.5	
1740										.23	16,600	30.5			
Switch Bucket → 1750											16,740	30.3		18.5	
1800											16,810	30.3			
1812 →											17,100	30.4		23.0	
1822											17,100	30.1			
1830											17,050	30.0			
Switch Bucket → 1840											17,000	30.2		28.00	
1852											17,100	30.1			
1900											17,100	30.2			SAMPLED
1905													X	33.00	AT 1900

Engineer's Name: JLS

CLIENT CH2MHILL

JOB NO. _____
WELL I.D. MW-72BR-200
DATE JULY 23, 2012

ALL DEPTHS REFERENCED TO:
STICKUP _____

GROUND SURFACE [X]
TOP OF CASING [ ]
OTHER [ ] _____

DESIGN SETTINGS

PUMP TYPE _____

WSP SETUP
- [ ] UPPER ONLY
- [ ] BOTTOM ONLY
- [X] STRADDLE

LENGTH 19.83 ft

WATER LEVEL 57.95 ft

UPPER PT (#1) 4.8 ft

TOP OF TOP PACKER 6.66 ft

*REFERENCE POINT:
BOTTOM OF TOP PACKER
OFFSET TO CABLEHEAD KNURL

INJ/EXT POINT 10.6 ft

MIDDLE PT (#2) 15.1 ft

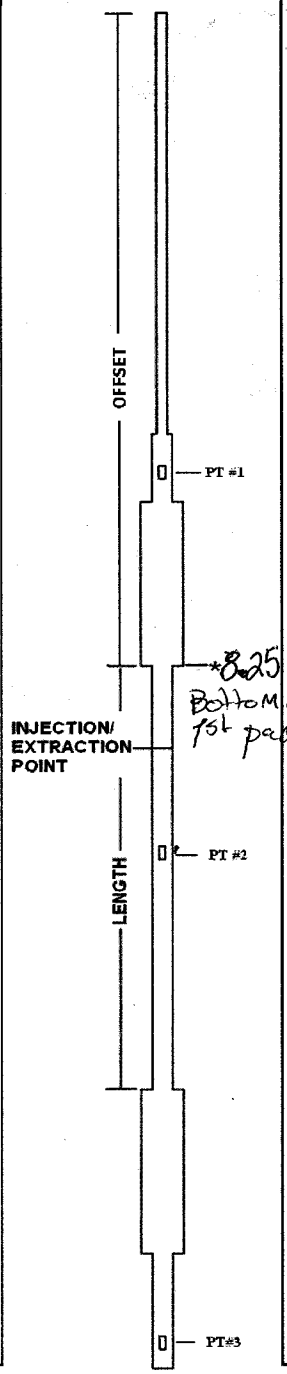
TOP OF BOTTOM PACKER 28.04 ft

BOTTOM OF BOTTOM PACKER 29.61 ft

LOWER PT (#3) 32 ft

TOTAL LENGTH 32.12 ft

ACTUAL SETTINGS



TESTING PROTOCOL - ACTION ITEMS

TEST/ACTION #1
TEST INTERVAL
TOP _____ ft
BOTTOM _____ ft

[ ] INJECTION [ ] EXTRACTION [ ] OTHER _____
RATE _____
PSI @ SURFACE _____
EXHAUST _____
CHARGE _____
PACKER INFLATION
ABSOLUTE _____
DIFFERENTIAL _____

TEST/ACTION #2
TEST INTERVAL
TOP _____ ft
BOTTOM _____ ft

[ ] INJECTION [ ] EXTRACTION [ ] OTHER _____
RATE _____
PSI @ SURFACE _____
EXHAUST _____
CHARGE _____
PACKER INFLATION
ABSOLUTE _____
DIFFERENTIAL _____

TEST/ACTION #3
TEST INTERVAL
TOP _____ ft
BOTTOM _____ ft

[ ] INJECTION [ ] EXTRACTION [ ] OTHER _____
RATE _____
PSI @ SURFACE _____
EXHAUST _____
CHARGE _____
PACKER INFLATION
ABSOLUTE _____
DIFFERENTIAL _____

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Integrated Subsurface Evaluation
311 Rock Avenue • Golden, CO 80401
PH 303.526.4432 • FAX 303.526.4426
www.rasinc.org

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Website: www.rasinc.org
Phone: 303.526.4432 • FAX: 303.526.4426

FIELD NOTES

Integrated Subsurface Evaluation

Job CH2MH:11
Well MW-72BR-200
Activity WSP
Date 7-24-12
Page 1 of 7

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
0640		- Depart hotel				
0702		- Arrive onsite for H+S meeting				
0740		- On MW-72BR-200 / Begin setup for the day				
0755		- Tool power on / Prepacing to log an ascent file from 148' to 109.5'				
0805	57.95'					
0815		- Begin Ascent from 148' to 109.5'				
		- Lower PT 53 psi @ start (32'-8.25' = 23.75' below d				
		* 53 psi / .433 = 122.4ft				
		* 148' + 23.75' = 171.75'				
		* 171.75' - 57.95' = 113.8'				
		* @ surface about 2.9 psi offset				
		* 113.8' + (2.9/.433) = 120.5'				
		- Lower PT 40.6 psi				
		* 40.6 psi / .433 = 93.76'				
		* 119.97' + 23.75' = 143.72'				
		* 143.72' - 57.95' = 85.77'				
		* 2.9 psi offset				
		* 85.77' + (2.9/.433) = 92.47'				
		* 93.76' - 92.47' = 1.29' offset (too high)				
		* Actual depth: 119.97' - 1.29' = 118.68'				

Engineer's Name TLW

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FIELD NOTES

Job CH2MHill
Well MW-72BR-200
Activity WSP
Date 7-24-12
Page 2 of 7

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
		- Upper PT 28.9 psi				
		* 28.9 psi 1.433 = 66.74				
0910		- Tape measure shows 107.15' bottom of hole				
		- Tape measure → 109.4' probable top of tool				
		-				
0925		- Lowering packer to 109.5' (SRT)				
0932		* Based on measurements and discussion with WHP we are setting packer @ 109.5' to see if we can isolate top flow zone.				
		* Being recorded in the Ascent from 148' File				
		- Lower PT @ 36.1 psi				
		* 36.1 psi / 1.433 = 83.37'				
		* 109.5' + 23.75' = 133.25'				
		* 133.25' - 57.9' = 75.35'				
		* 2.9 psi offset				
		* 75.35' + (2.9/.433) = 82.05'				
		* offset: 83.37' - 82.05' = 1.32'				
		* Actual: 109.5' - 1.32' = 108.18'				
0936		- Begin inflating packer for seal test (109.5)				
		* No Seal				
0939		- Deflating packer & lowering 6"				
		-				
0942		- Inflating packer to check for seal (110')				
		* After packer inflation no pressure change (no seal)				
0951		- Lowering another 6"				

Engineer's Name TCG

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FIELD NOTES

Job CH2MHill
Well MW-72BR-200
Activity WSP
Date 7-24-12
Page 3 of 7

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
0953		- 3rd	test	attempt	at 110.5'	the tool was hanging
		up				
0956		- Moved	down to 112'	to		inflate & check seal
		* Display depth may be off around 1.3' based				
		on PT calculations				and Tape measurements
1001		- Begin pumping w/ ~~top~~ glands set @ 112'				
1008		- Pump off				
		* Middle ~~packer~~ PT not recovering / Top and botto				
		PT's stable				
1013		- Middle ~~PT~~ Packer .3 recovering very slowly				
1022		- Middle PT fully recovered				
		- Lower PT malfunction (-63psi w/ 200 millivolts)				
1029		- Started new file for pumping packed interval				
		from 112' to 132'				
		* still have a lower PT malfunction				
1039		- Deflated packers and Lower PT came back				
		online and .3 working properly				
		* Getting stabalized background data				
1046		- Inflating packers				PT values → 25.5 U
		* 75 psi				@beginning 29.6 M
						37.2 L
						25.5 U
1100		- Pump start				PT values → 29.7 M
						37.2 L

Engineer's Name TLW

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FIELD NOTES

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Job CH2MHill
Well MW-72BR-200
Activity WSP
Date 7-23-12
Page 4 of 7

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1207		- Pump off				
		* Not sampling b/c data suggest it would take 100+ hours (Mike and Bill concur)				
	*	ROD - ARLIN TALKED TO MIKE RE: LACK OF FEAIBILITY OF SAMPLING. MIKE SAID STOP TEST PULL PACKER. STEVE SPOKE TO BILL AT 1204 - BILL CONCURS. 1207 - PUMP OFF WILL PULL PACKR.				
1220		- Deflate packers				
1236		- Pulling WSP to surface to reconfigure for loser interval and surface test new setup				
1257		- WSP @ surface				ASDE: 0'-(-.32') = .32'
		* PT offsets →				3.1 psi U 2.8 psi M 2.8 psi L
1258		- Pulling WSP to reconfigure				
1320		- Packer out of hole everything is fine * Begin reconfiguration.				
1337		- Tool positioned @ datum (bottom of top packer)				
1344		- Lowering Tool to * From bottom of gland * Total length from kerual				192' to bottom of tool is 6'11 : 8.25 + 6.83' = 15.08'
1403		- Working tool to get into 3.8" hole around 100' depth				

Engineer's Name JLW

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FIELD NOTES

Job CH2MHill
Well MW-72BR-200
Activity WSP
Date 7-24-12
Page 5 of 7

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1413		- Passed obstruction moving to 110' station				
1431		- Tool @ 190'				
		* Will now probe down and tag bottom then bring it back up to 192'				
1433		- Tagged bottom at 191.55'				
		* Depth: 191.55' + 6.83' = 198.38' to bottom of tool				
1438		- Pump test start				
		* Good flow around 1000 ml/min				
		* No drop in pressure				
1443		- Raised WSP to 191' to packe interval from 191' to TD (198')				
1457		- Begin inflating packer				
		#PT pressure before Inflation →				60.1 psi U
						64.1 psi M
1504		- Packer inflated				108 psi
		- [redacted]				
1507		- More air added				
		[redacted]				* Stayed @ 108psi
1509		- Stabilized		@ 60.1psi U		+ 64.2psi M
1519		- Pumping started				
1600		RATE	STEADY	AT	130 ml/m	

Engineer's Name TCW

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FIELD NOTES

Job CH2MHILL
Well MW-72BR-200
Activity WSP
Date 7-24-12
Page 6 of 7

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
1605		ST DIRECTED JLS TO BEGN PACKNG, TAYLOR TO ASSIST WITH READINGS, OR AS NEEDED. ST ADJUSTN FLOW RATE DOWN SLIGHTLY TO AVOID DEPRESSURE12NG INTERVAL.				
1630		STILL PUMPNG - STOWNG EQUIPMENT.				
1700		PACKNG EQUIPMENT, STILL PUMPNG ≈ 7.5 gal - 2.5 TO GO FEC UP TO 19,000 . FNAL PUMPNG FEC = 19400 ACTUAL INTERVAL FEC FROM AMFELT — 20,000 ?				
1730		NO CHANGE AT ALMOST 10 GALLONS FEC ≈ 19,100 TEMP HAS DROPPED TO 35.3 AND HOLDNG. WILL SAMLPE SOON.				
1740		- Take Samples				
1744		- Pump Shut off *Continue packing up site while waiting for stabalization.				
1757		- Deflate Packer - AFTER DESCALE WIRELINE				
1810		STOP DATA FILE, SAVE DATA TO STICK				
1815		PULLNG PACKER				
~~0810~~	1846	- WSP out of hole				ASDE: 0' - (-.11) = .11'
~~0820~~	1850	- Begin disassembly of WSP				
1920		PACKING TRAILER				

Engineer's Name

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FIELD NOTES

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Job CH2MHill
Well MW-72BR-200

Activity WSP

Date 7-24-12
Page 7 of 7

Real Time	Depth to Water	Gauge 1 Flow	Gauge 1 Total	Gauge 2 Flow	Gauge 2 Total	Elapsed Time/comments
[redacted]	2013	- Packed up / MOB to hotel				
[redacted]	2035	- Arrive @ hotel				

Engineer's Name TCW

HC PUMPING NOTES

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Project: CH2M HILL - NorthStar
Well: MW-72BR-200
Activity: Packer Sampling
Date: 24 July 2012
Page 1 of 1

Real Time	Depth to Water	Injection						Extraction						Total Gallons Pumped	Comments
		Pump Start	Manifold Gauge Pressure	Flow Rate (gpm)	FEC (uS/cm)	Temp (° C)	Pump Stop	Pump Start	Manifold Gauge Pressure	Flow Rate (gpm)	FEC (uS/cm)	Temp (° C)	Pump Stop		
1046															Inflate packer to 75psi
1100								X							
1110											22,200				
1120											22,000	45.4			
1130										.004	22,200	45.3			
1140											21,500	44.0			
1206													X		
															Pumping up packer
1518								X							~~Pumping~~ Started

Engineer's Name: JCS

HC PUMPING NOTES

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Project CH2MHILL - NORTHSTAR
Well: MW-72BR-200

Activity: Packer Sampling 191 - 198

Date: 24 July 2012
Page 1 of 1

Real Time	Depth to Water	Injection						Extraction						Total Gallons Pumped	Comments
		Pump Start	Manifold Gauge Pressure	Flow Rate (gpm)	FEC (uS/cm)	Temp (° C)	Pump Stop	Pump Start	Manifold Gauge Pressure	Flow Rate (gpm)	FEC (uS/cm)	Temp (° C)	Pump Stop		
1518								X	108						
1530									108	.0625	14,110	39.9			
1540									108	.0625	15,960	35.5		1.5	
1550									108	.0625	17,460	35.5			
1600									107	.0625	17,870	35.3			
1610									107-108	.05	18,380	35.8			* ADJUSTED PUMP RATE
1620									108	.05	18,340	35.9		5.0	
1630									108	.05	18,320	35.5			
1640									108	.05	18,590	35.7			
1650									108	.05	19,170	34.7			
1700									107	.05	19,440	35.0			
1710									107	.05	19,200	34.9			
1715									107	.05	19,040	34.3			
1720									107	.05	19,080	34.1		10.00	
1725									107	.05	19,240	34.3			
1730									107	.05	19,100	34.2			
1735															SAMPLE
1740													X		

Engineer's Name: JLS

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DAILY LOG

Client: CH2M Hill

Date: 7-16-12

Personnel Present: TLW, JLS

Total Mileage: 502:419mi

Project (Name/Number): CH2MHill-Topock-2012 Site Location: Road

Well Number: ——

Time		Activity Description
Start	Stop	
1104	1130	MOB to All American Trailers 502:534 62mi
1130	1232	Repiace T2 tail light and Pick up DF filter
1232	2030	MOB to Santa Fe for evening 502:5888 1mi

Log Measurement Summary	
Log Instrument	Total Footage Logged

Special Comments (Data Delivered, Problems Encountered, etc.)

Logging Engineer Signature

DAILY LOG

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Client: CH2MHill

Date: 7-17-12

Personnel Present: TLW, JLS

Total Mileage: 502: 582 mi

Project (Name/Number): CH2MHill-Topock-2012

Site Location: Road

Well Number: —

Time		Activity Description
Start	Stop	
0700	1720	MOB from Santa Fe to Topock 502:53881 mi
1720	1755	Meet w/ Arlin to drop T2
1755	1900	MOB to hotel in Needles 502: 54463 mi

Log Measurement Summary	
Log Instrument	Total Footage Logged

Special Comments (Data Delivered, Problems Encountered, etc.)

Logging Engineer Signature

Client Signature

Revised 08/20/2007

DAILY LOG

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Client: CH2MHill

Date: 7-18-12

Personnel Present: TLW, JLS, SRT

Total Mileage: 502: 32mi

Project (Name/Number): CH2MHill-Topock-2012

Site Location: Topock, CA

Well Number: MW-72BR-200

Time		Activity Description
Start	Stop	
0640	0700	MOB to site 502: 54463 mi
0700	0840	H+S meeting
0840	1520	Decon and setup on well
1520	1753	Calibration and Ambient
1753	1900	Pack up and MOB to hotel
		502: 54495 mi

Log Measurement Summary	
Log Instrument	Total Footage Logged

Special Comments (Data Delivered, Problems Encountered, etc.)

Logging Engineer Signature

DAILY LOG

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Client: CH2MHill

Date: 7-19-12

Personnel Present: TLW, JLS, SRT

Total Mileage: 502:15 mi

Project (Name/Number): CH2MHill-Topock-2012

Site Location: Topock, CA

Well Number: MW-72BR-200

Time		Activity Description
Start	Stop	
0630	0745	MOB to site and H&S meeting
0745	0930	AMbient Log and tool pre cal
0930	1137	Pull casing out of well
1137	1550	Caliper and test Flow stand
1550	1645	Set pump
1645	1747	Post calibration & Pack up
1747	1815	MOB to hotel

Log Measurement Summary	
Log Instrument	Total Footage Logged

Special Comments (Data Delivered, Problems Encountered, etc.)

* Electrical Problems due to heat

Logging Engineer Signature

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DAILY LOG

Client: CH2M Hill

Date: 7-20-12

Personnel Present: TLW, JLS, SRT

Total Mileage: N/A

Project (Name/Number): CH2MHill-Topock-202 Site Location: Topock, CA

Well Number: MW-72BR-200

Time		Activity Description
Start	Stop	
0640	0745	MOB to site and H+S meeting
0745	0924	Set up site and run ambient log
0924	1039	Set up for emplx and Emplace for AFC
1039	1940	AFC logging
1940	2000	Post log and pack up site for evening
2000	2023	MOB to hotel

Log Measurement Summary	
Log Instrument	Total Footage Logged

Special Comments (Data Delivered, Problems Encountered, etc.)

Logging Engineer Signature

Client Signature

DAILY LOG

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Client: CH2MHill

Date: 7-21-12

Personnel Present: TLW, JLS, SRT

Total Mileage: —

Project (Name/Number): CH2MHill-Topock-2012

Site Location: Topock, CA

Well Number: MW-72BR-200

Time		Activity Description
Start	Stop	
0610	0725	MOB to site & Health and Saftey Meeting
0725	0820	Setup onsite and prepare for AFC day 2
0820	1203	AFC day 2 logs
1203	1447	HC pump tests
1447	1735	Past cal. tool, Pack up, MOB to hotel

Log Measurement Summary	
Log Instrument	Total Footage Logged

Special Comments (Data Delivered, Problems Encountered, etc.)

Logging Engineer Signature

Client Signature

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DAILY LOG

Client: CH2MHill

Date: 7-22-12

Personnel Present: TLW, JCS, SRT

Total Mileage: —

Project (Name/Number): CH2MHill-Topock-2012

Site Location: Topock, CA

Well Number: MW-72BR-200

Time		Activity Description
Start	Stop	
0640	0825	MOB to site / H+S meeting / set up for day
0825	0950	Prepare tool and run ambient
0950	1736	PDI
1735	1830	Pulled pipe and packed up
1830	1850	MOB back to hotel

Log Measurement Summary	
Log Instrument	Total Footage Logged

Special Comments (Data Delivered, Problems Encountered, etc.)

Logging Engineer Signature

Client Signature

DAILY LOG

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Client: CH2MHill

Date: 7-23-12

Personnel Present: TCW, JLS, SRT

Total Mileage: —

Project (Name/Number): CH2MHill-Topock-2012

Site Location: Topock, CA

Well Number: MW-72BR-200

Time		Activity Description
Start	Stop	
0610	1045	MOB to site and setup for WSP
1045	1935	WSP Testing
1935	2020	Packe up and MOB to hotel

Log Measurement Summary	
Log Instrument	Total Footage Logged

Special Comments (Data Delivered, Problems Encountered, etc.)

* WSP control box broken, had to switch to backup

Logging Engineer Signature

Client Signature

DAILY LOG

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Client: CH2MHill

Date: 7-24-12

Personnel Present: TLW, JLS, SRT

Total Mileage: —

Project (Name/Number): CH2MHill-Topock-2012

Site Location: Topock, CA

Well Number: MW-72BR-20

Time		Activity Description
Start	Stop	
0640	0740	MOB to site / H+S meeting
0740	1344	WSP interval 112' to 132'
1344	1846	WSP interval 192' to TD
1846	2013	Breakdown and Pack up site
2013	2035	MOB to hotel

Log Measurement Summary	
Log Instrument	Total Footage Logged

Special Comments (Data Delivered, Problems Encountered, etc.)

Logging Engineer Signature

Client Signature

APPENDIX C

DATA AND ANALYSIS

WELL MW72-BR-200
Topock, CA
CH2MHill - NorthStar

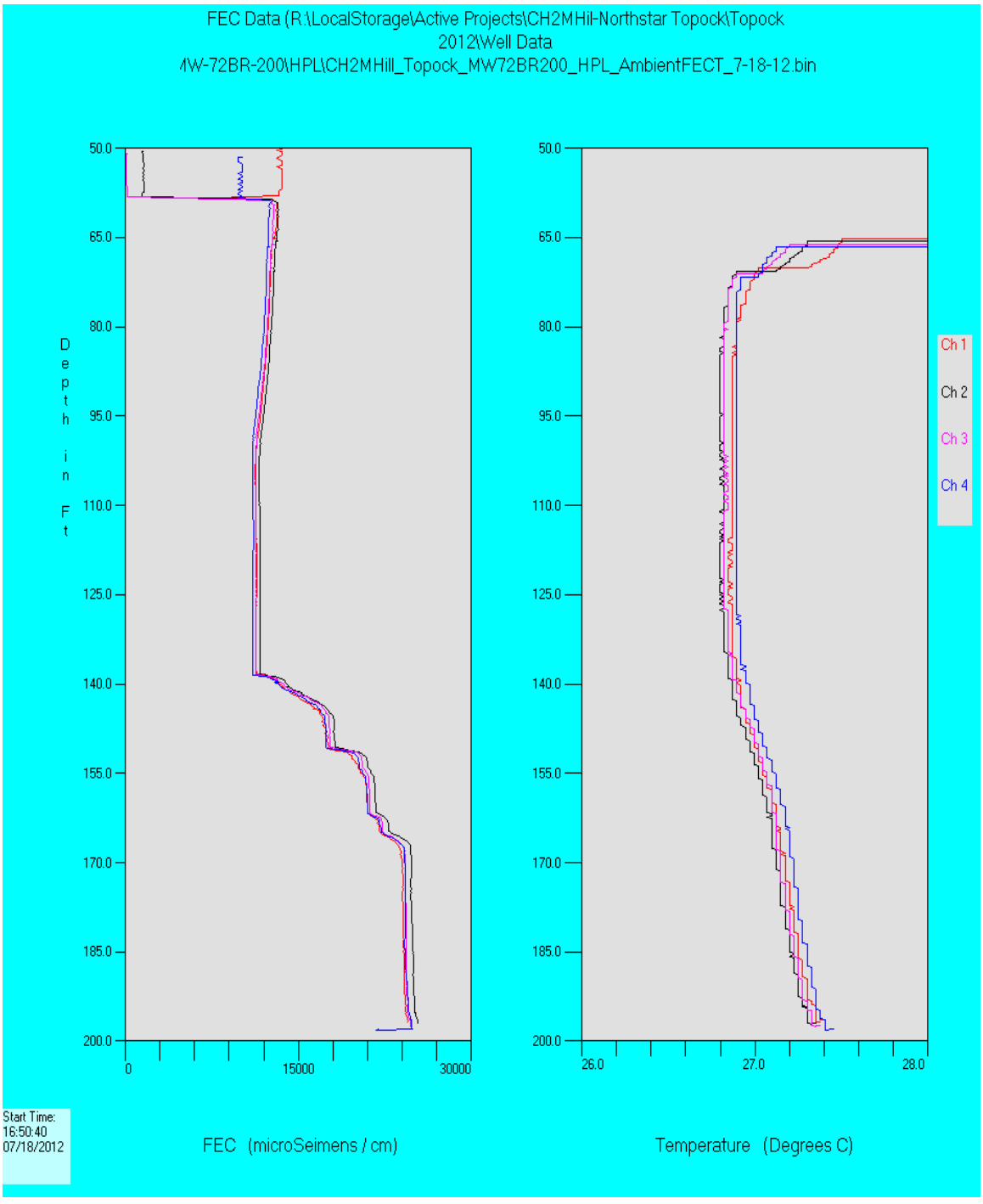


Figure 1. CH2MHill-Northstar, Topock - Well MW-72BR-200. Ambient FEC and Temperature log, July 18, 2012. Depth to water is 58.35 feet bgs. Log collected from within the temporary well screen, prior to removal. Bottom of 6 inch PVC conductor casing at105 feet bgs, temporary well screen from surface to 198 feet.

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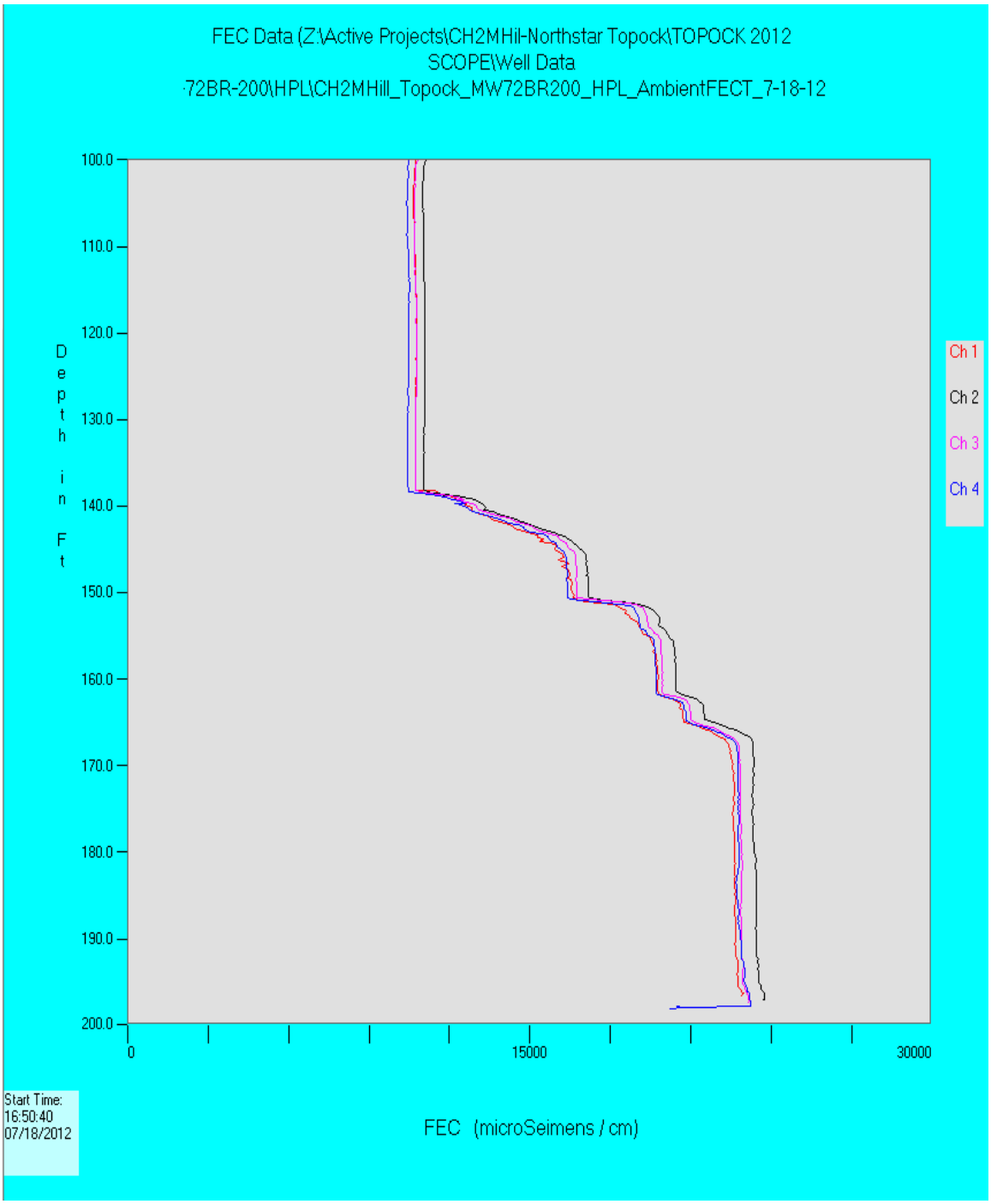


Figure 2. CH2MHill - Northstar, Topock - Well MW-72BR-200. Ambient FEC log, July 18, 2012. Log collected the day prior to removing temporary well casing. Enhanced interval from100 to 200 feet bgs to show detail.

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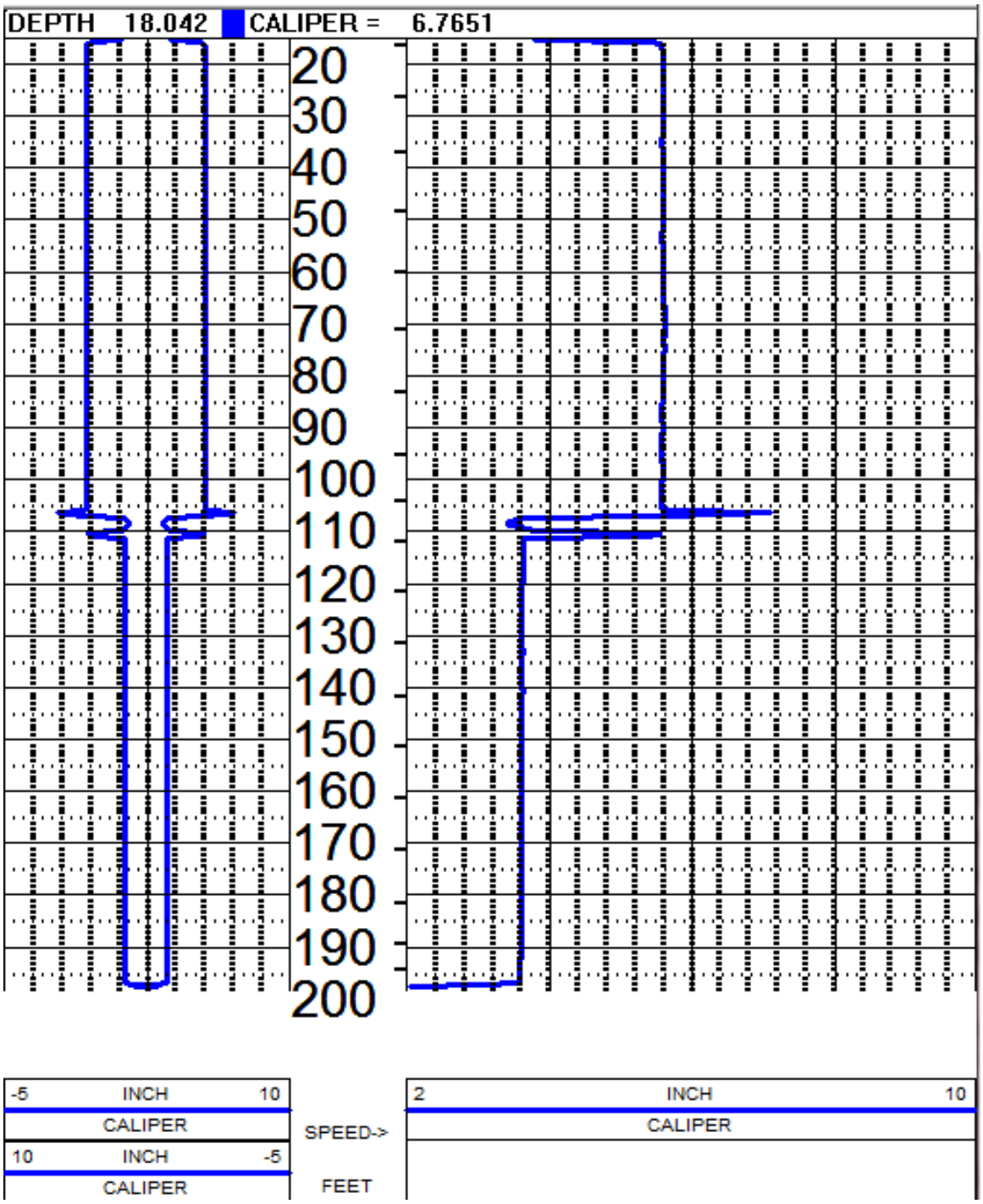


Figure 3. CH2MHill-Northstar, Topock - Well MW-72BR-200. Caliper log collected after removing the temporary well casing on July 19, 2012. Six-inch diameter PVC conductor from ground surface to 105 feet bgs. Open hole below conductor casing to 198 feet is approximately 3.7-inches in diameter.

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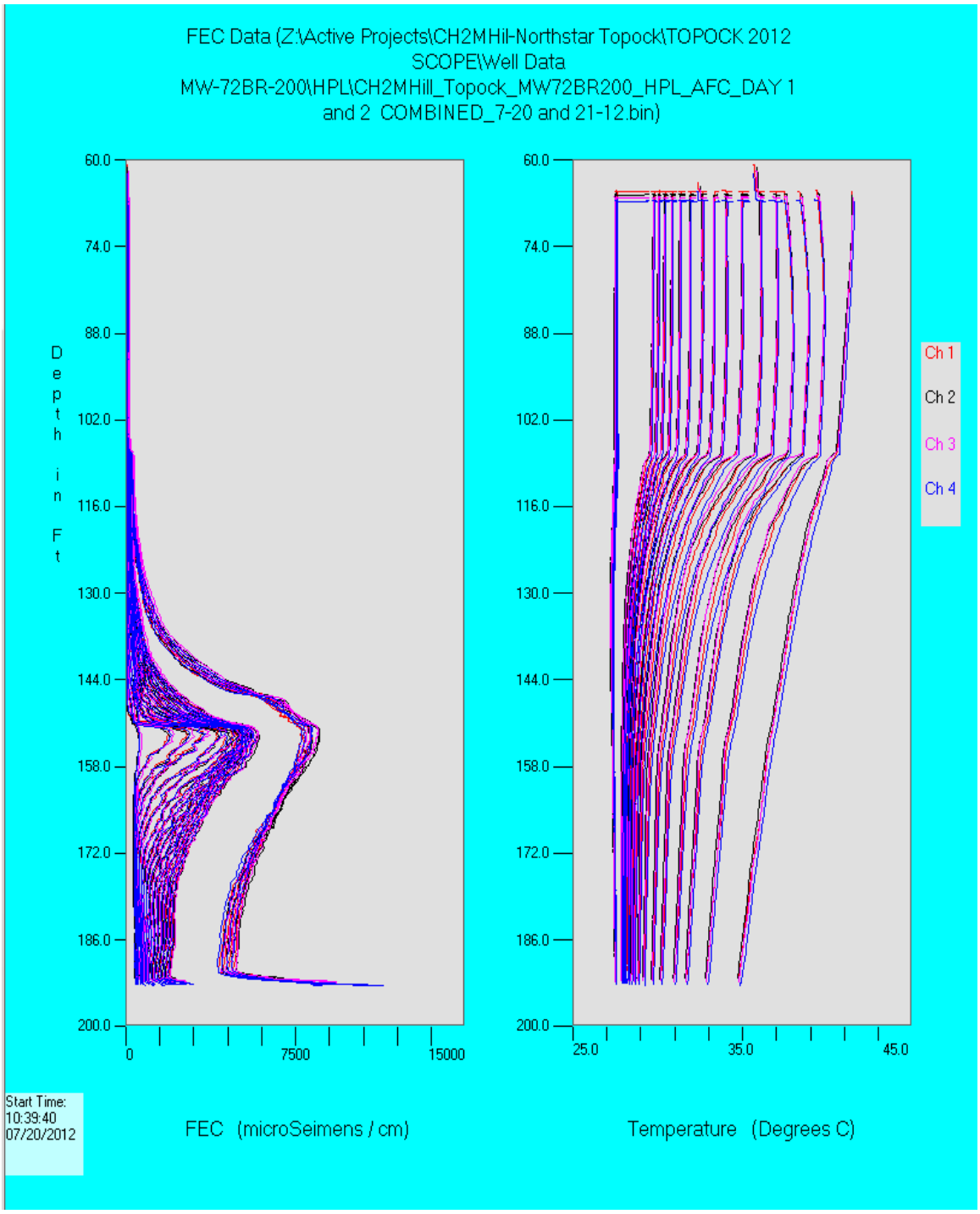


Figure 4. CH2MHill-Northstar, Topock - Well MW-72BR-200. Summary of AFC logs. Days 1 and 2 combined. July 20, and 21, 2012.

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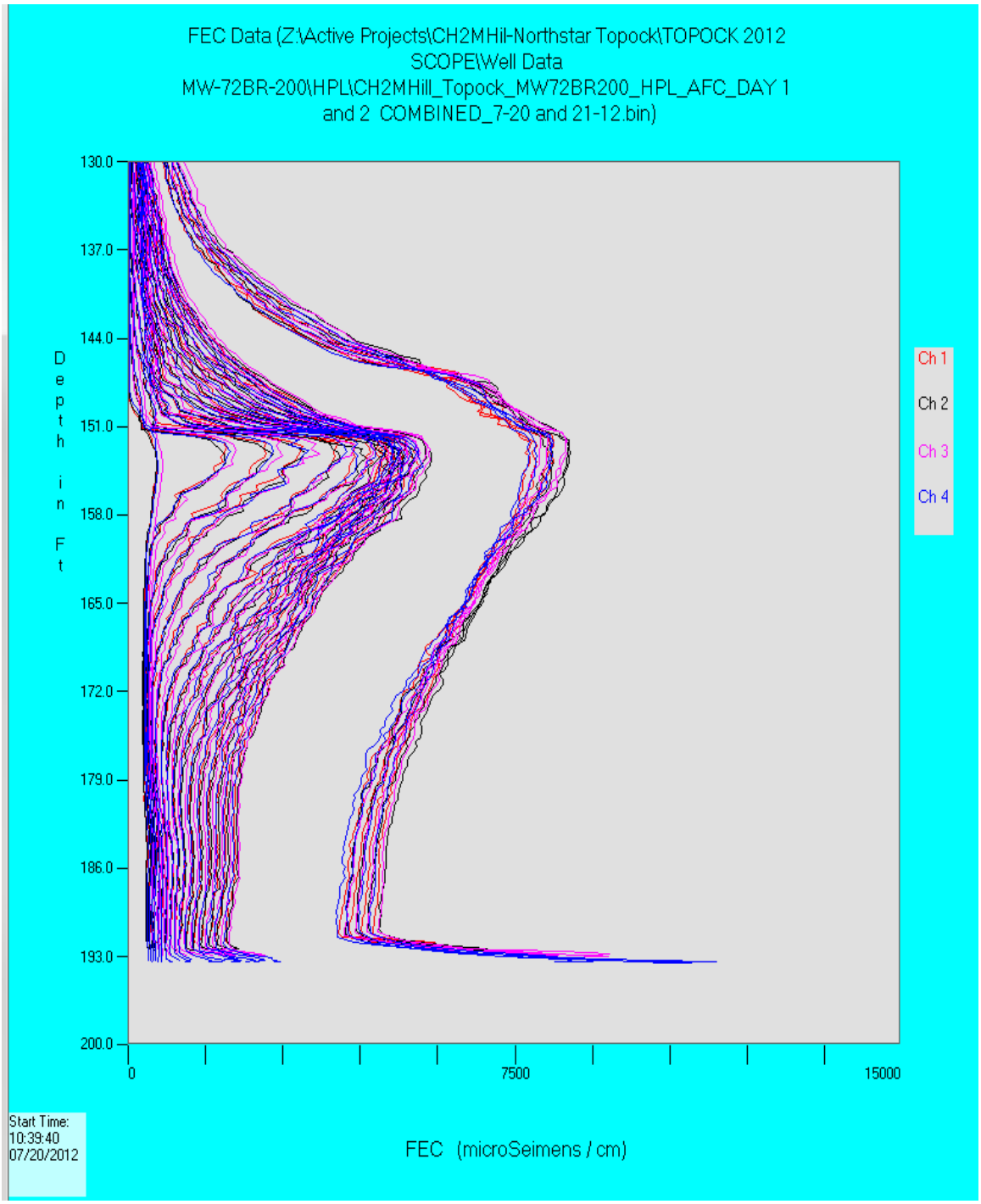


Figure 5. CH2MHill-Northstar, Topock - Well MW-72BR-200. Summary of AFC logs. Days 1 and 2 combined. July 20, and 21, 2012. Enhanced depth interval from 130 to 200 feet to show the dominant flow feature at approximately 153 feet bgs, and other feature near the bottom of the logged interval, below 191 feet bgs.

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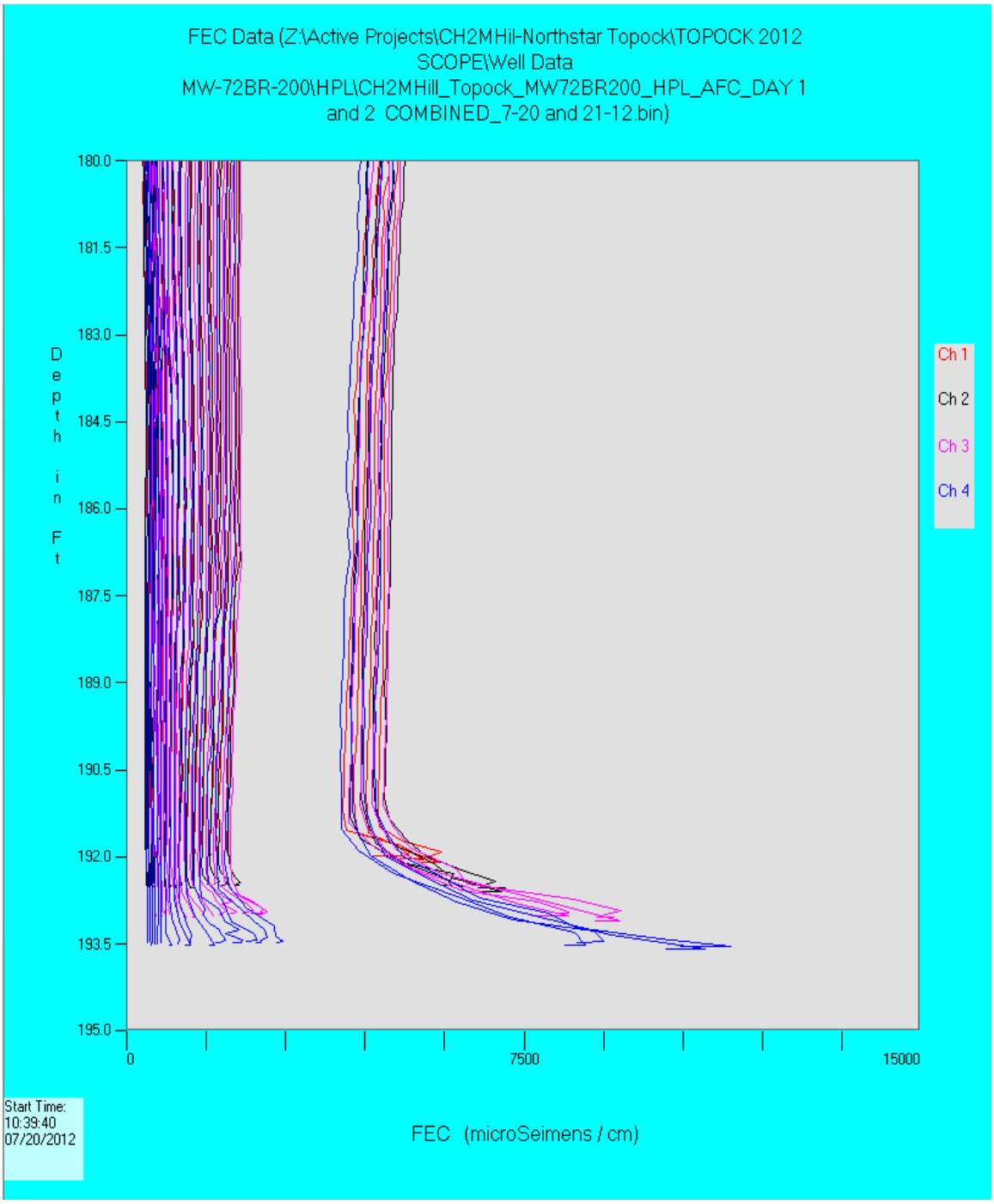


Figure 6. CH2MHill-Northstar, Topock - Well MW-72BR-200. Summary of AFC logs. Days 1 and 2 combined. July 20 and 21, 2012. Interval from 180 to 195 feet to show the flow feature present near the bottom of the logged interval.

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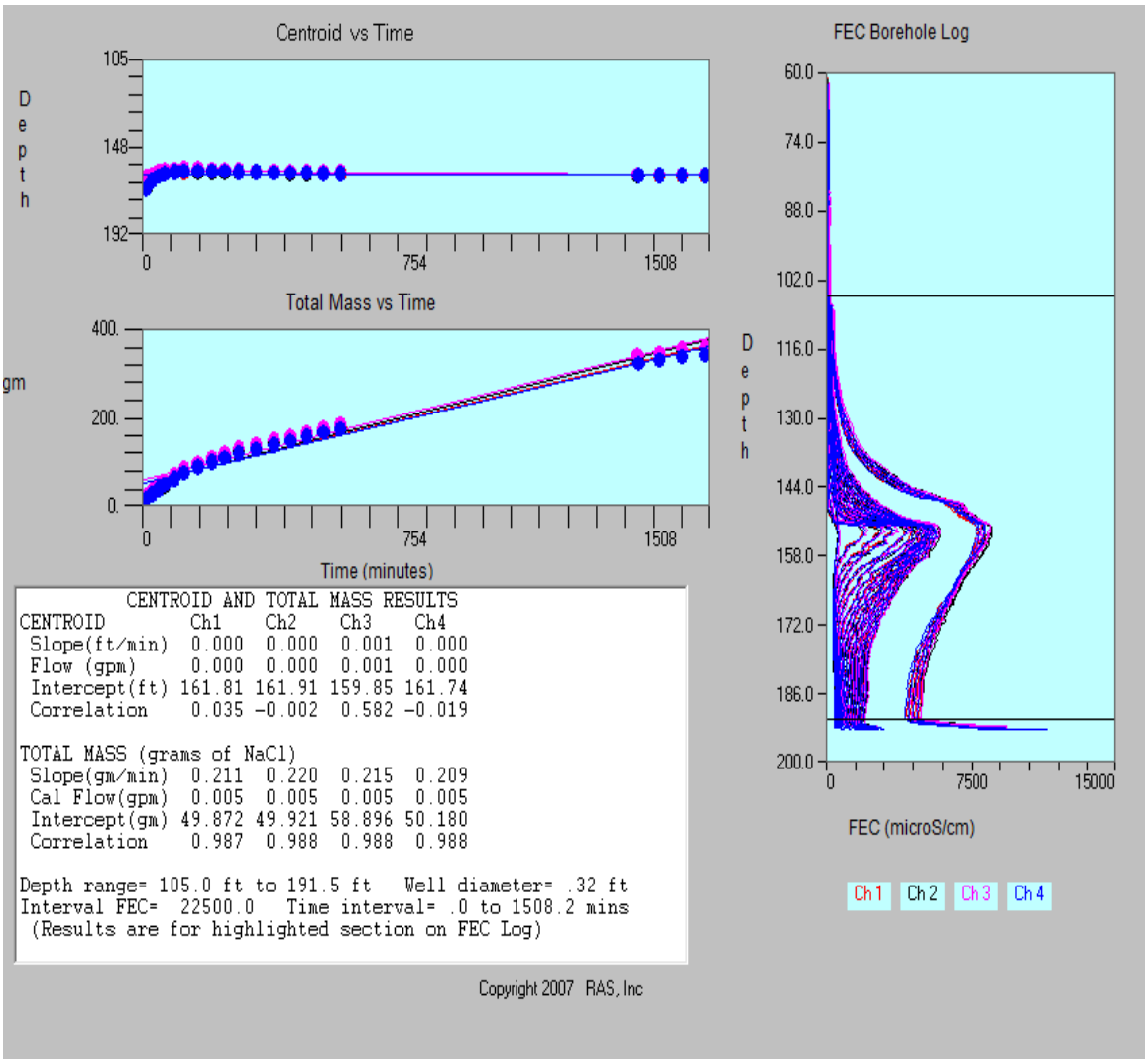


Figure 7. CH2MHill-Northstar, Topock - Well MW-72BR-200. Analysis of AFC logs Days 1 and 2 combined, July 20 and 21, 2012. Complete time interval shown. Interval FEC Value 22,500. Dominant inflow at 153 feet bgs is less than 50% saturation after less than 24 hours of recovery. Note that the logging interval lower limit was 191.5 feet and was insufficient to quantify inflow below this depth. As such, inflow from 191.5 to 198 (TD) was estimated.

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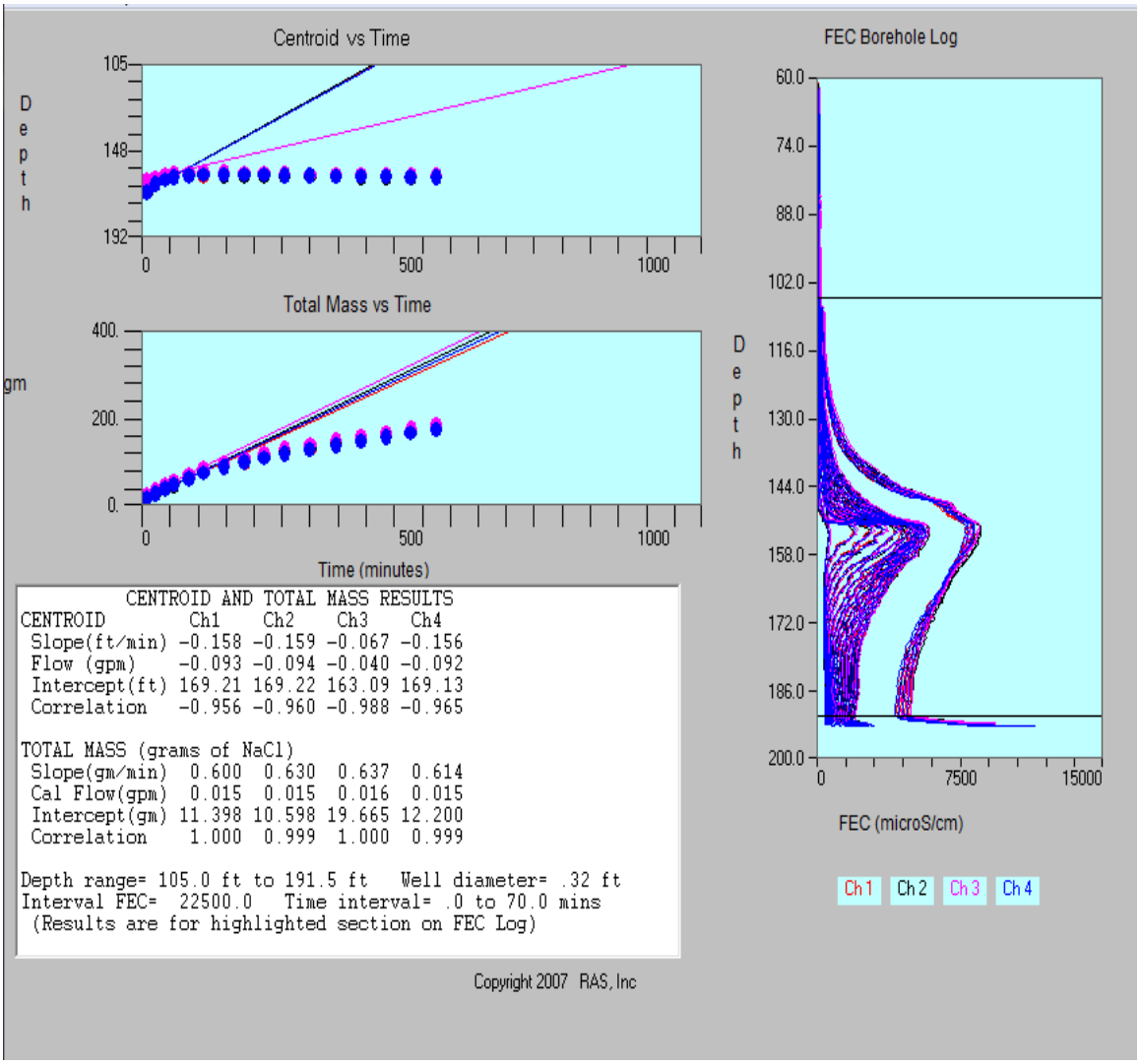


Figure 8. CH2MHill-Northstar, Topock - Well MW-72BR-200. Analysis of AFC logs Days 1 and 2 combined, July 20 and 21, 2012. Early logs only - time interval 0 to 70 minutes shown. Interval FEC Value 22,500. Total interval inflow = 0.015 gpm, not including flow form the bottom interval below 191.5 feet.

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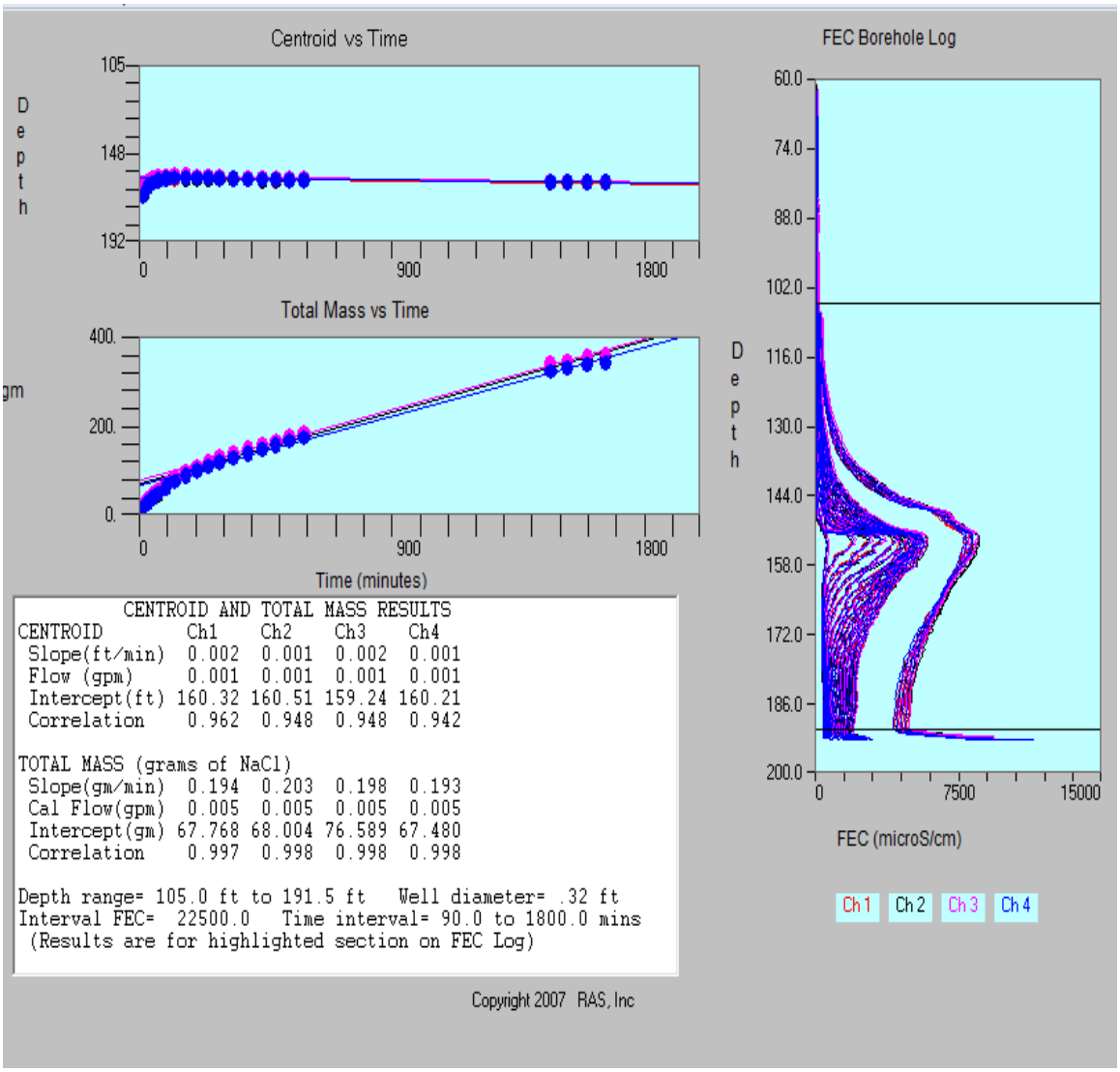


Figure 9. CH2MHill-Northstar, Topock - Well MW-72BR-200. Analysis of AFC logs Days 1 and 2 combined, July 20 and 21, 2012. Late logs only - time interval 90 to 1800 minutes shown. Interval FEC Value 22,500. Total interval inflow = 0.005 gpm.

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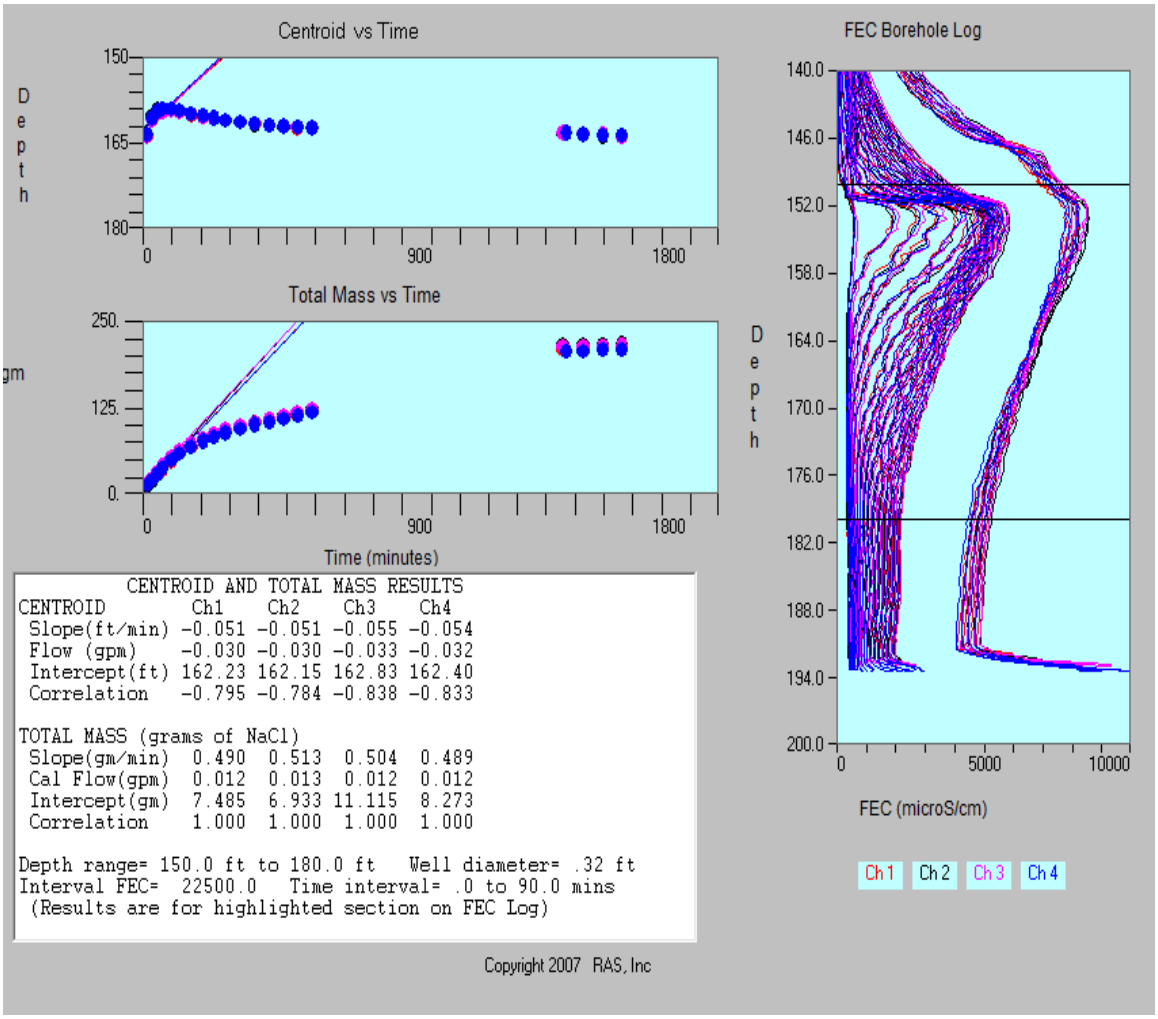


Figure 10. CH2MHill-Northstar, Topock - Well MW-72BR-200. Analysis of AFC logs Days 1 and 2 combined, July 20 and 21, 2012. Early logs only - time interval 0 to 90 minutes shown. Interval FEC Value 22,500. Total interval inflow = 0.012 gpm. Analysis of early logs suggests a dominant inflow interval of between 151 and 156 feet bgs. Analysis of QC flow data suggests other secondary features between 147 and 149 feet bgs and also between 161 and 167 feet bgs.

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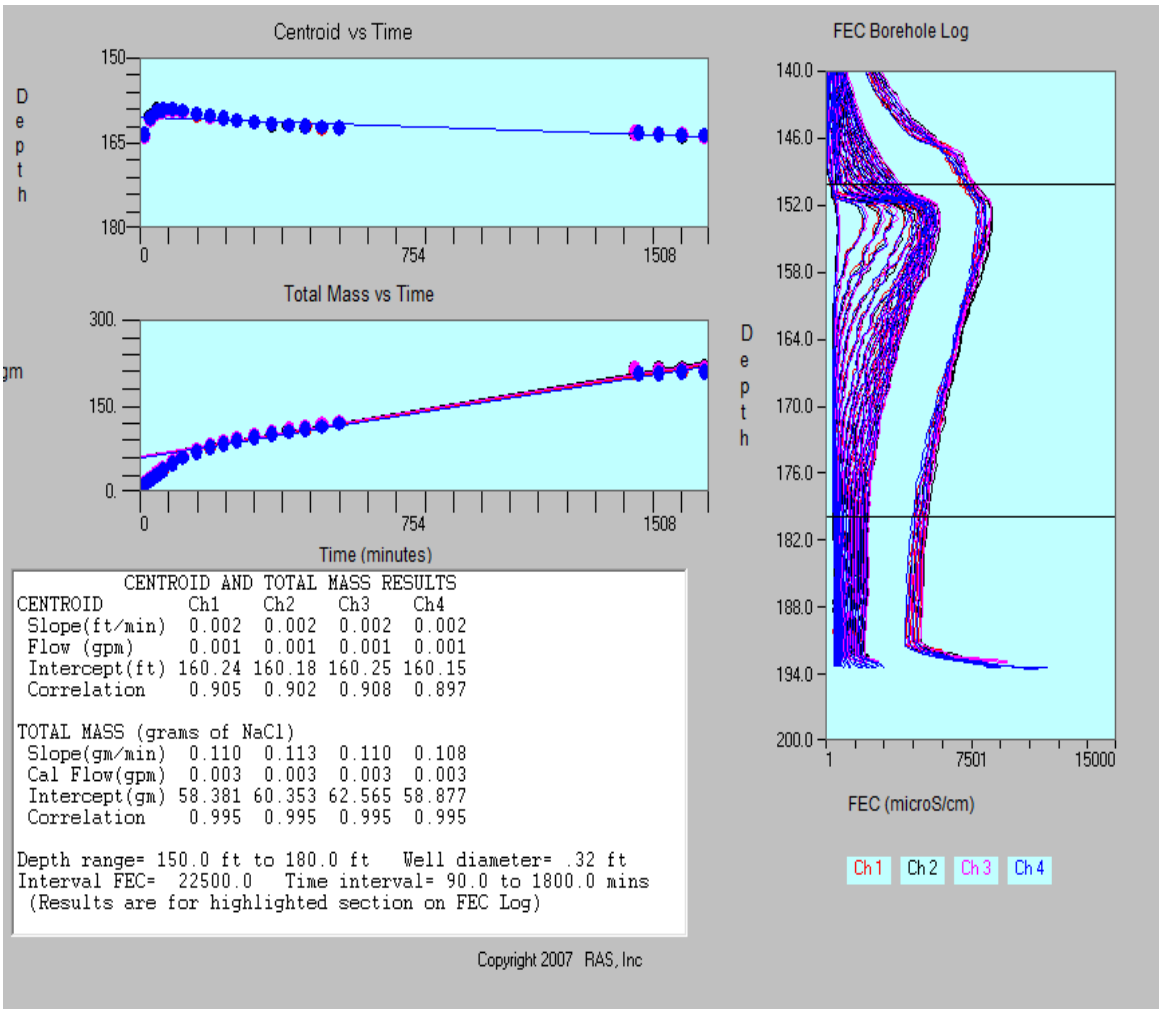


Figure 11. CH2MHill-Northstar, Topock - Well MW-72BR-200. Analysis of AFC logs Days 1 and 2 combined, July 20 and 21, 2012. Late logs only - time interval 90 to 1800 minutes shown. Interval FEC Value 22,500.

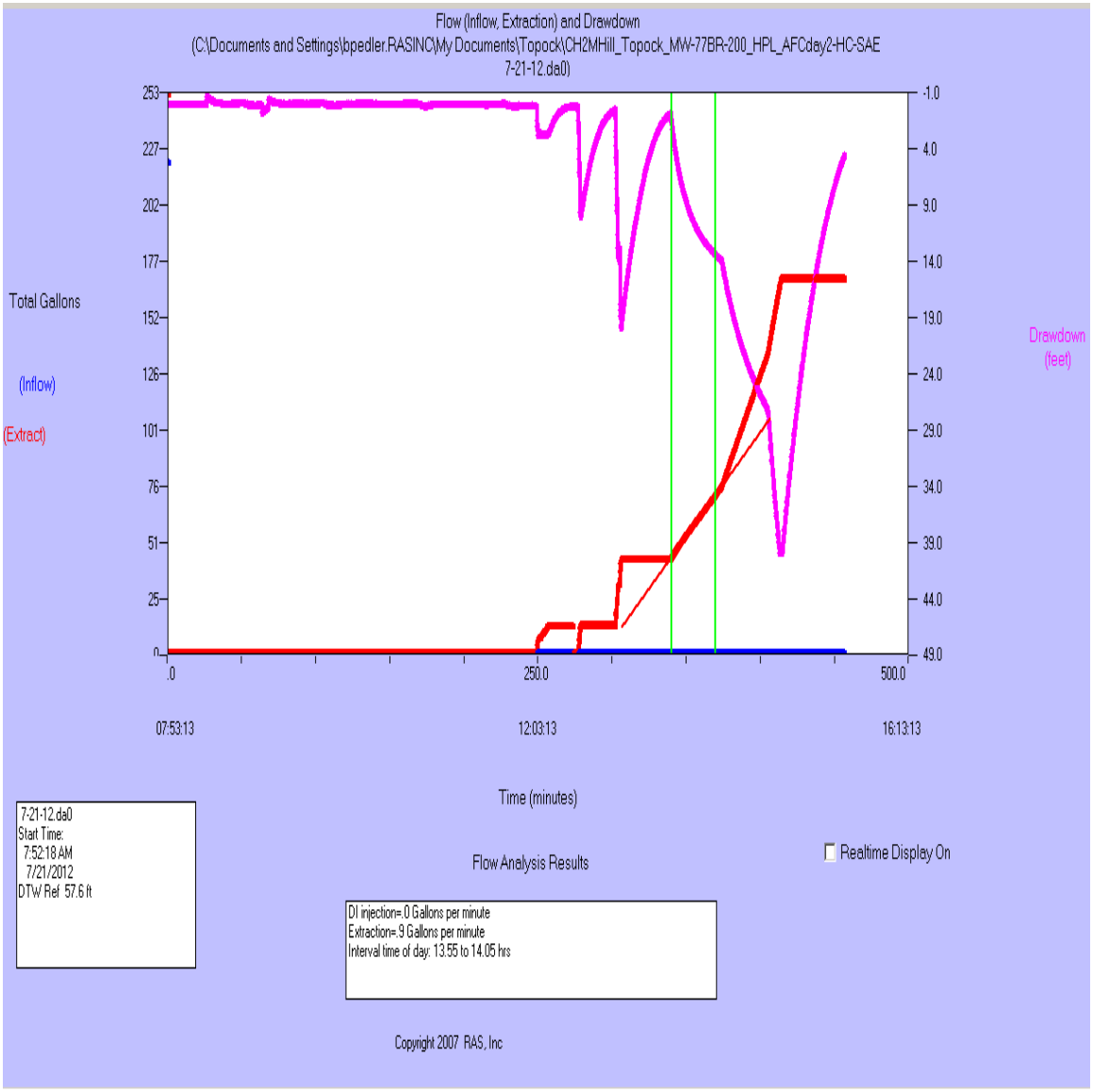


Figure 12. CH2MHill-Northstar, Topock - Well MW-72BR-200. Pressure and flow during day 2 of AFC and HC, July 22, 2012. Slug tests (2) and pumping at 1, 2, and 4 gpm. Data suggests that a PDI test may be feasible at a net formation production of less than 2 gpm.

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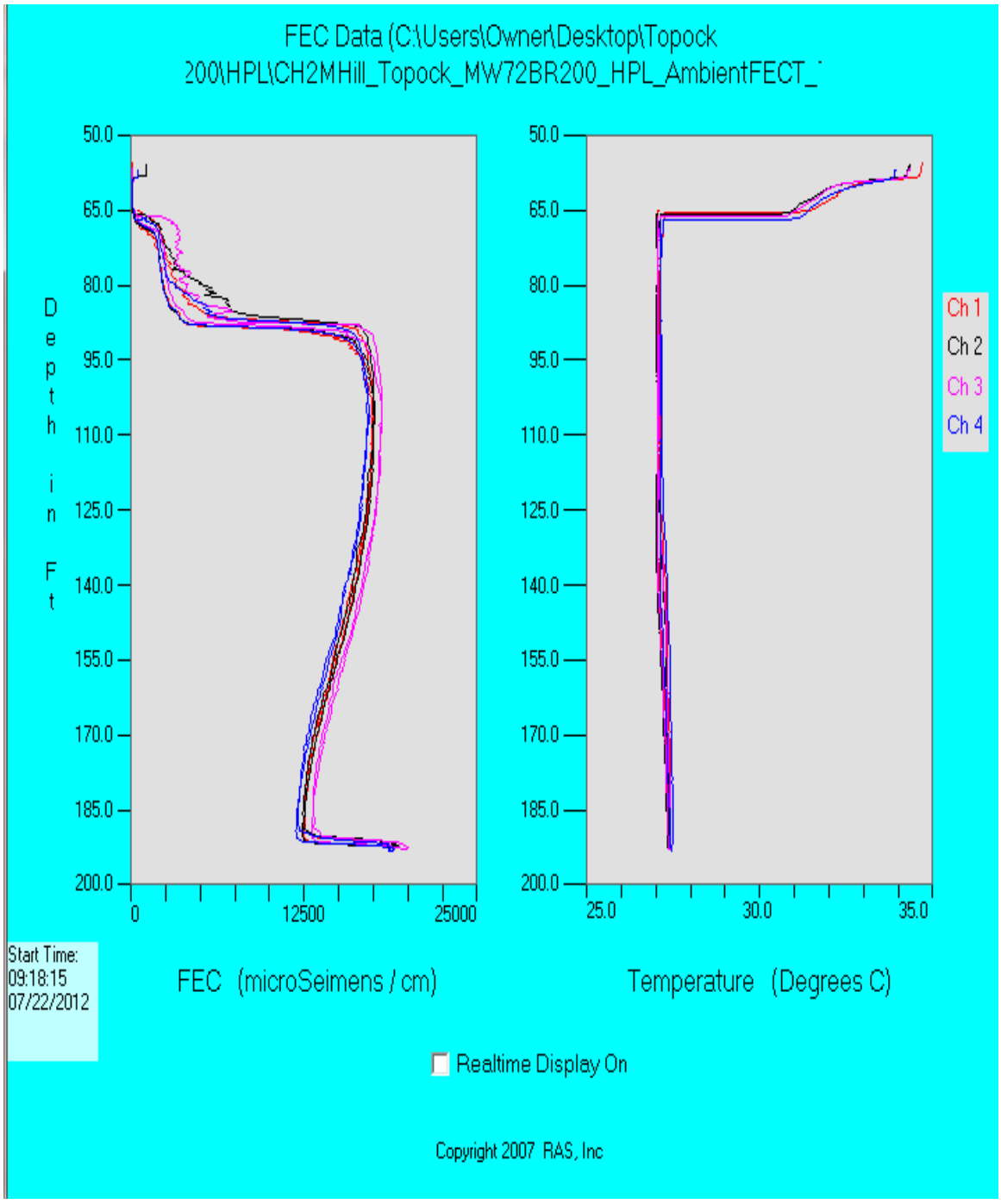


Figure 13. CH2MHill-Northstar, Topock - Well MW-72BR-200. Ambient FEC and Temperature log, July 22, 2012.

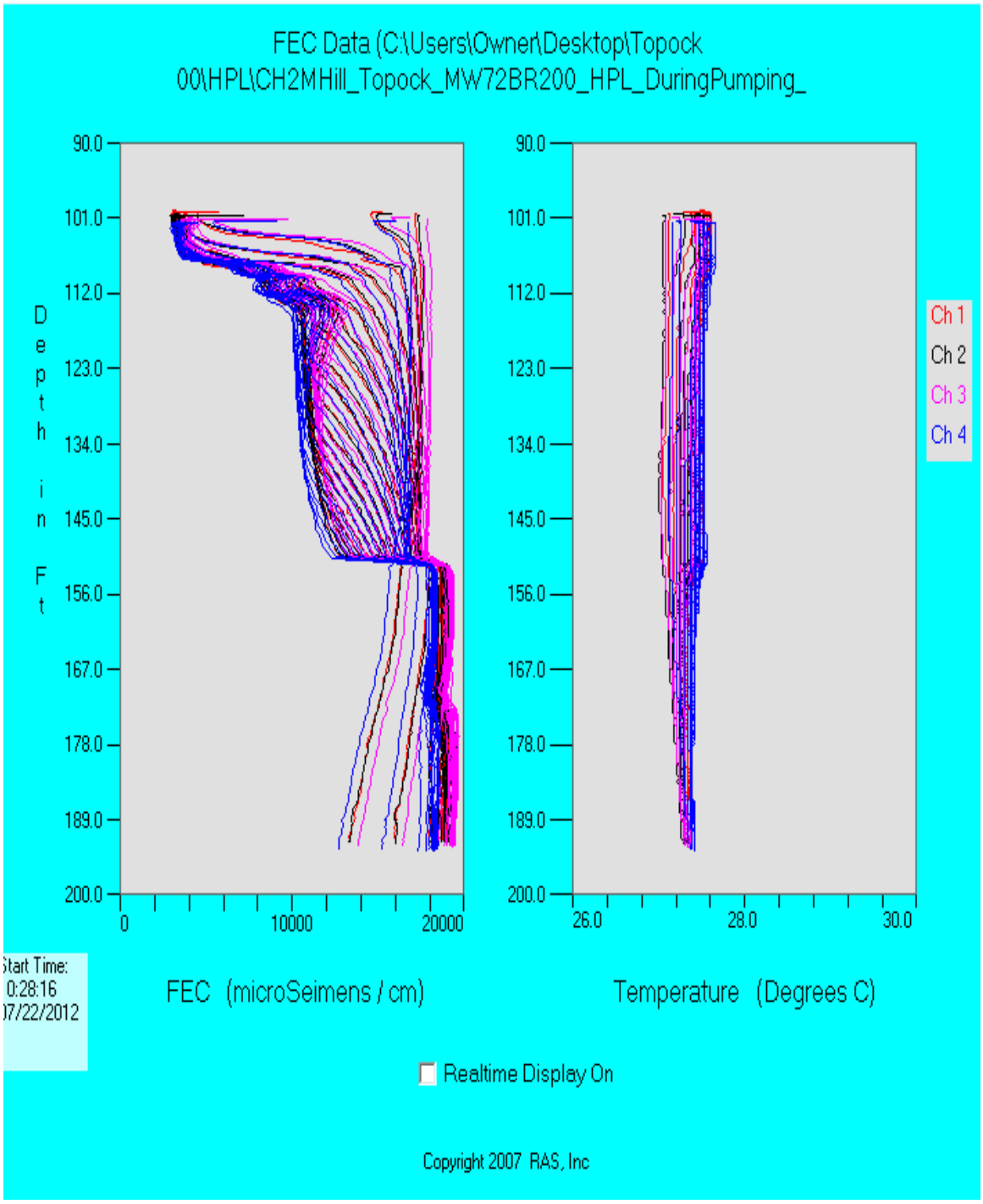


Figure 14. CH2MHill-Northstar, Topock - Well MW-72BR-200. During pumping logs. July 22, 2012.

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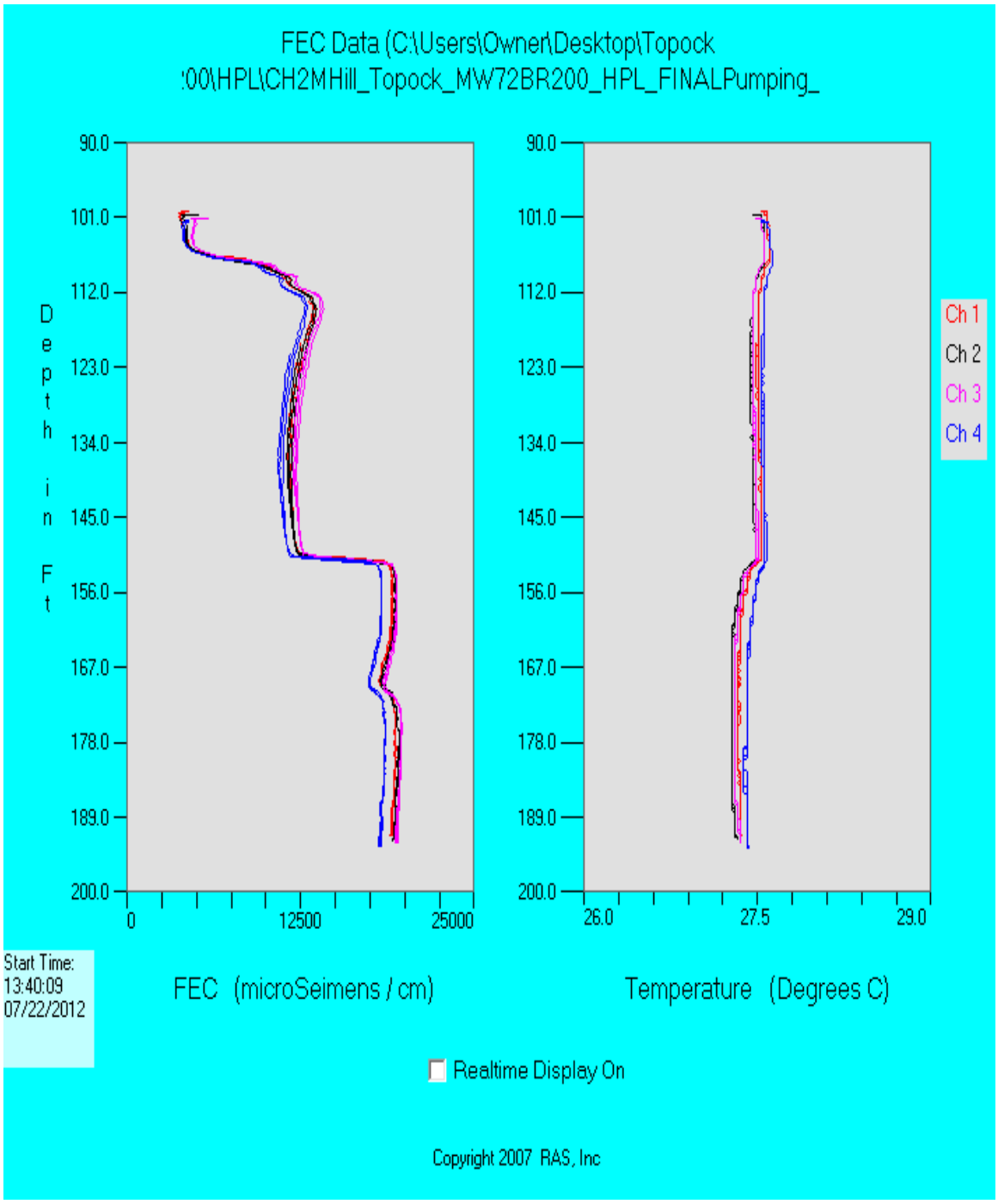


Figure 25. CH2MHill-Northstar, Topock - Well MW-72BR-200. Final pumping logs. July, 22, 2012.

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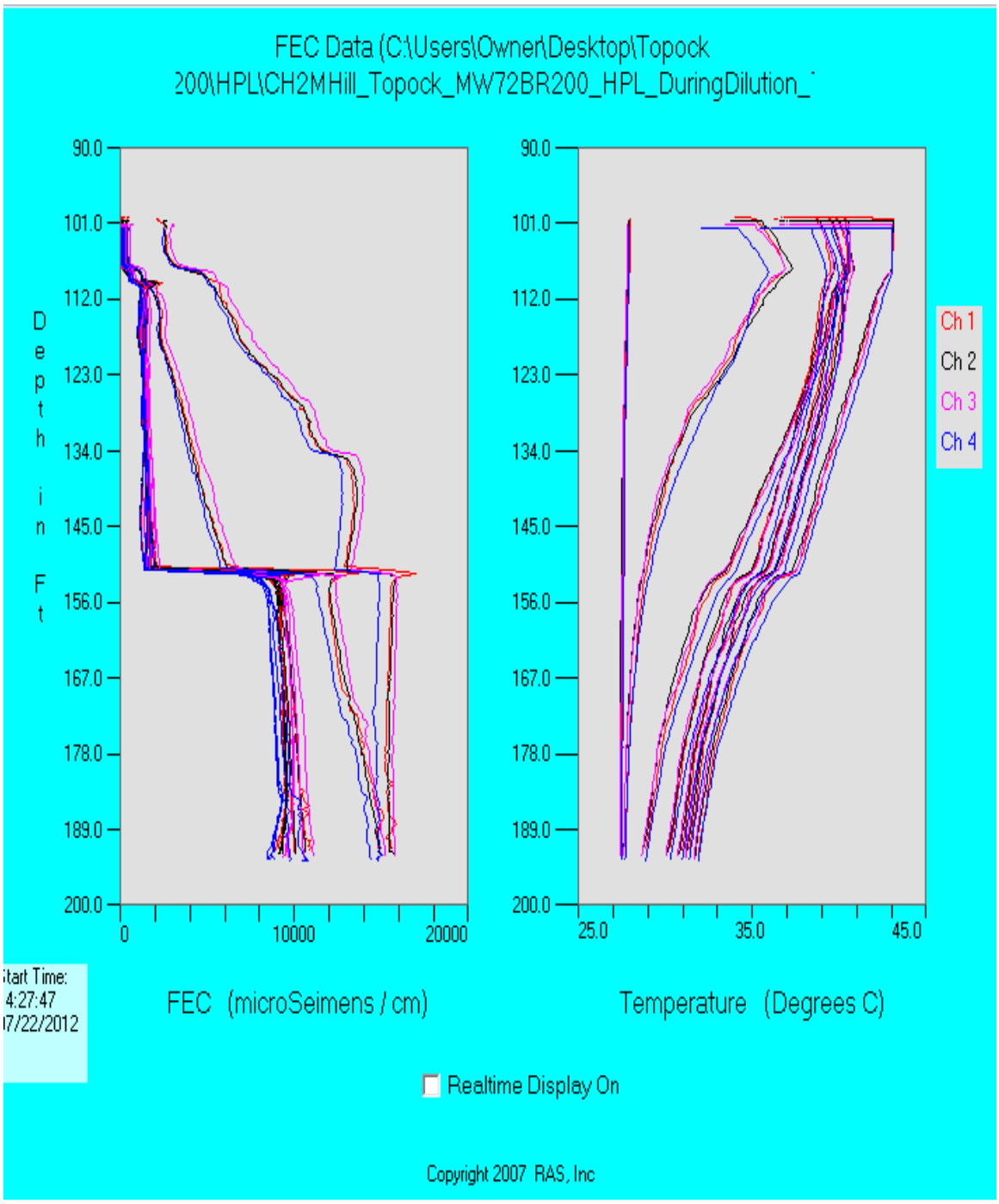


Figure 16. CH2MHill-Northstar, Topock - Well MW-72BR-200. During Dilution logs. July 22, 2012. Total time interval shown.

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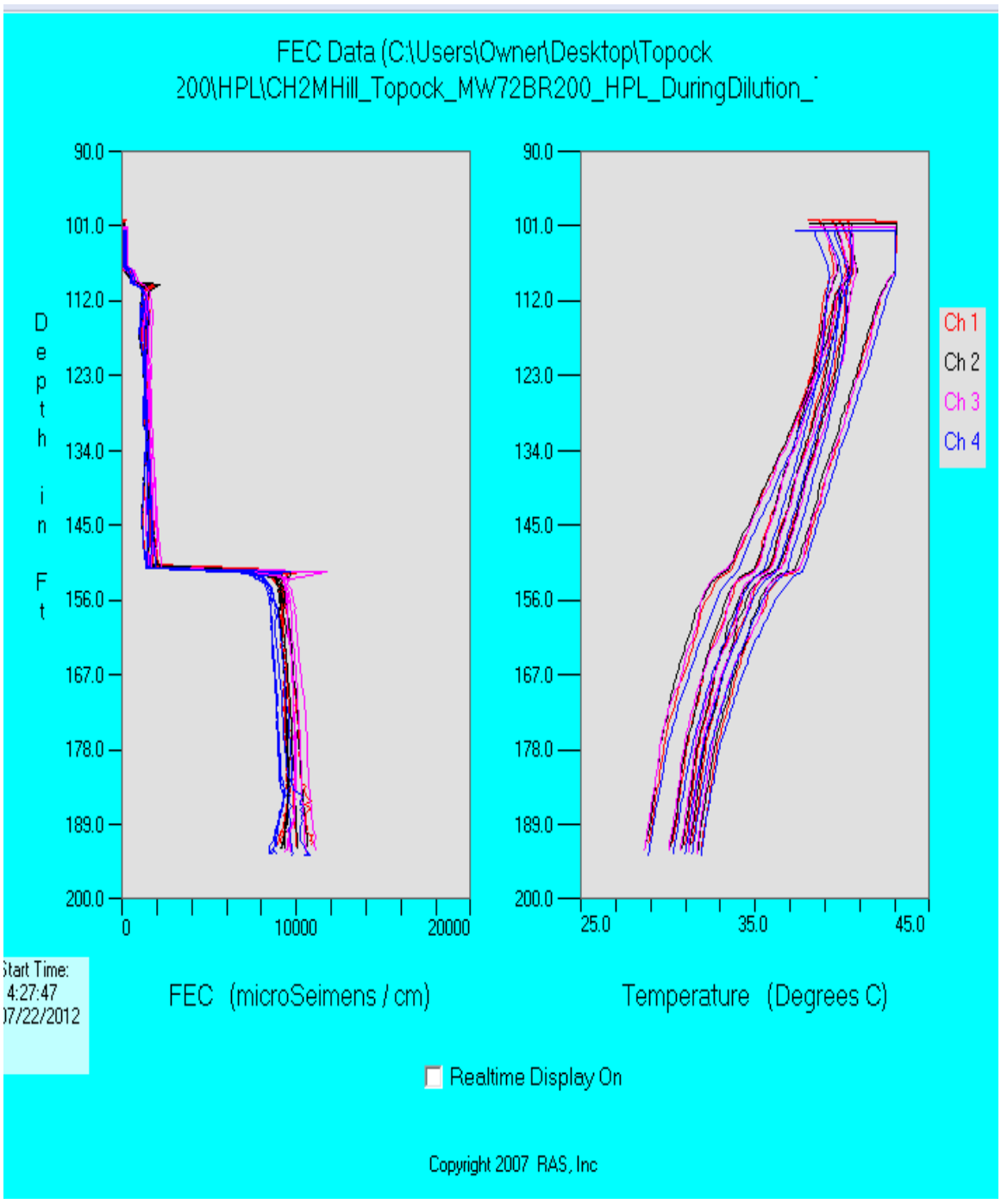


Figure 17. CH2MHill-Northstar, Topock - Well MW-72BR-200. During Dilution logs with first two logs time cut out. July 22, 2012.

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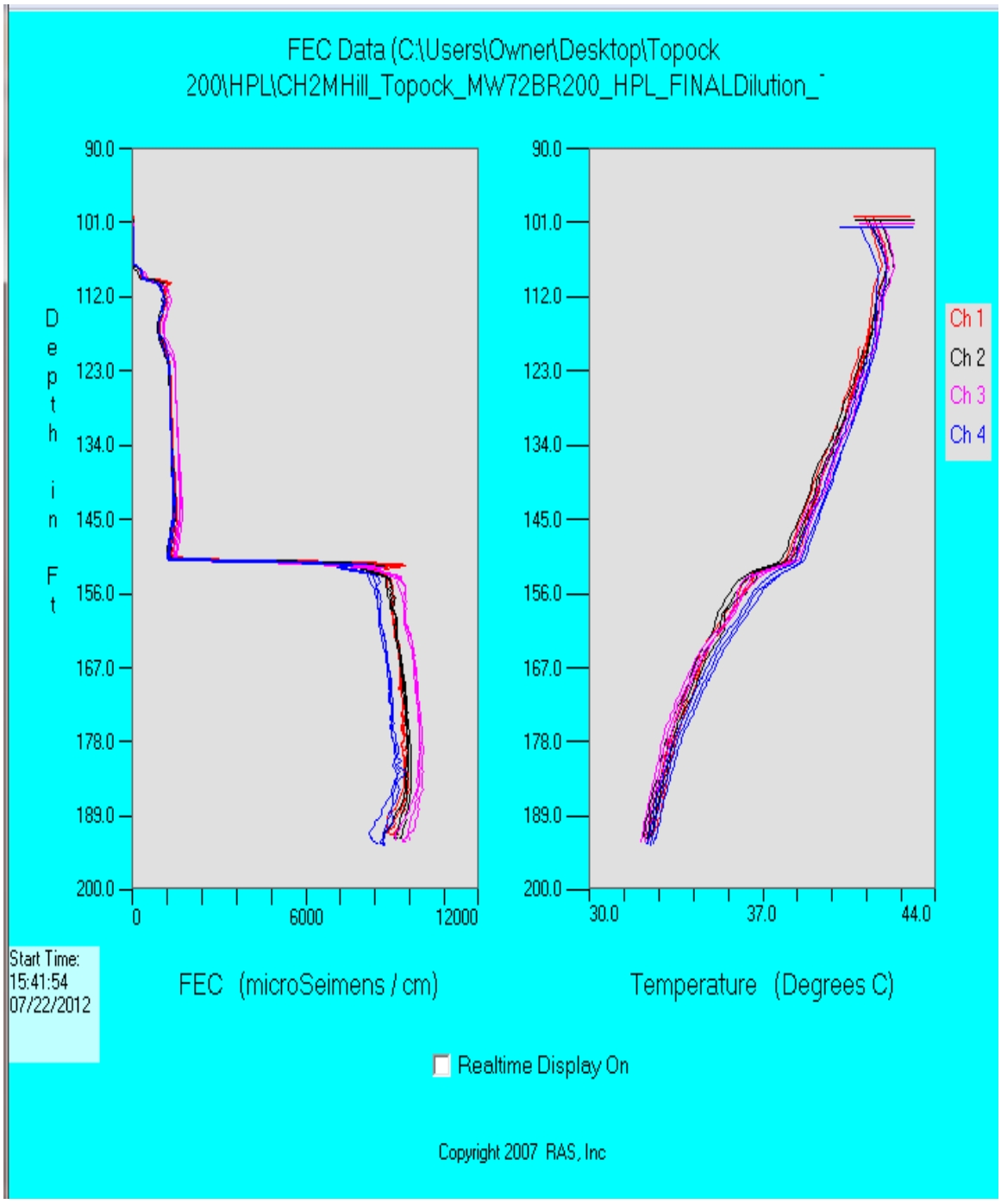


Figure 18. CH2MHill-Northstar, Topock - Well MW-72BR-200. Final Dilution logs July 22, 2012.

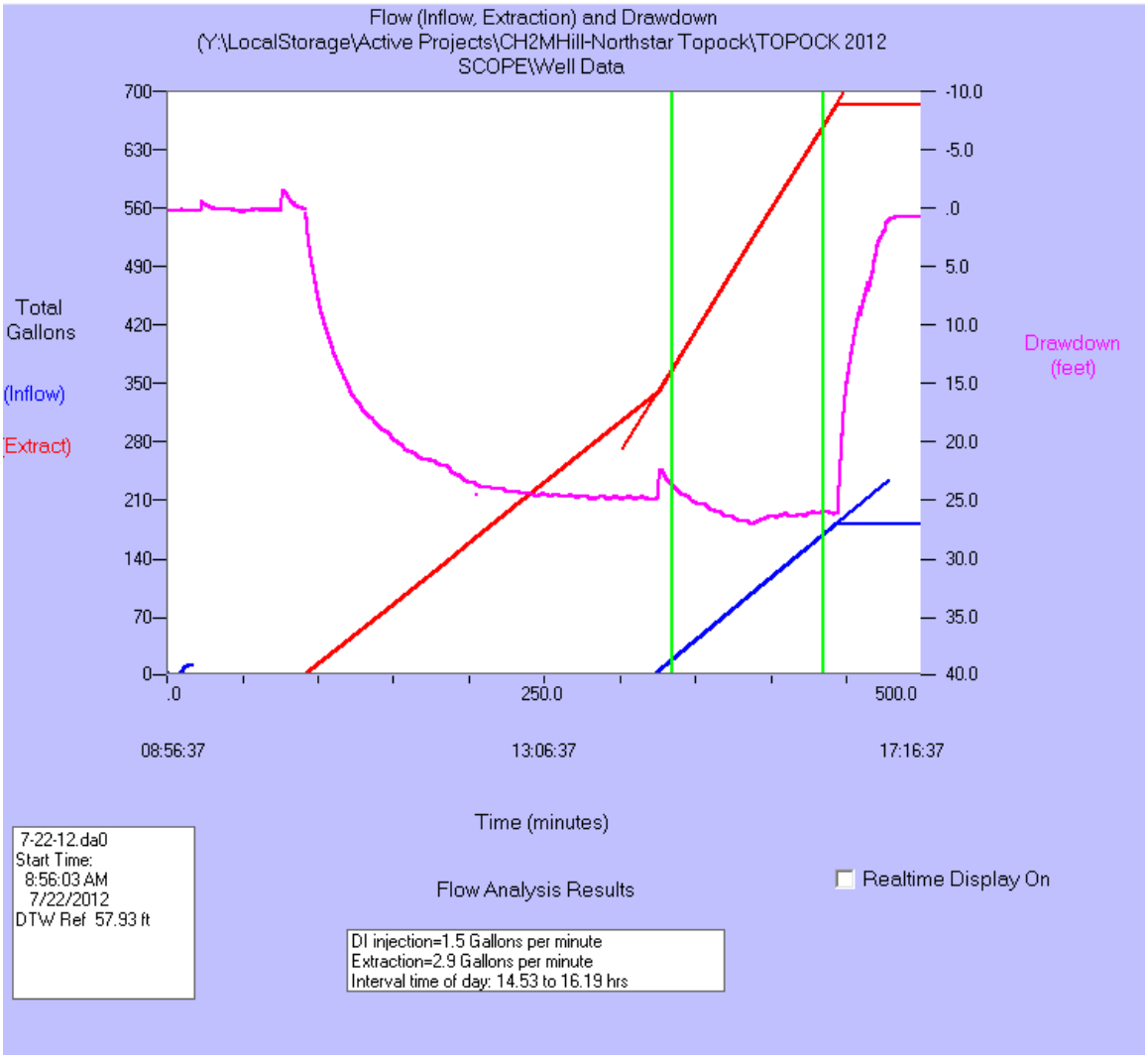


Figure 19. CH2MHill-Northstar, Topock - Well MW-72BR-200. Pressure and Flow history during PDI testing, July 22, 2012. NFM = 1.4 GPM.

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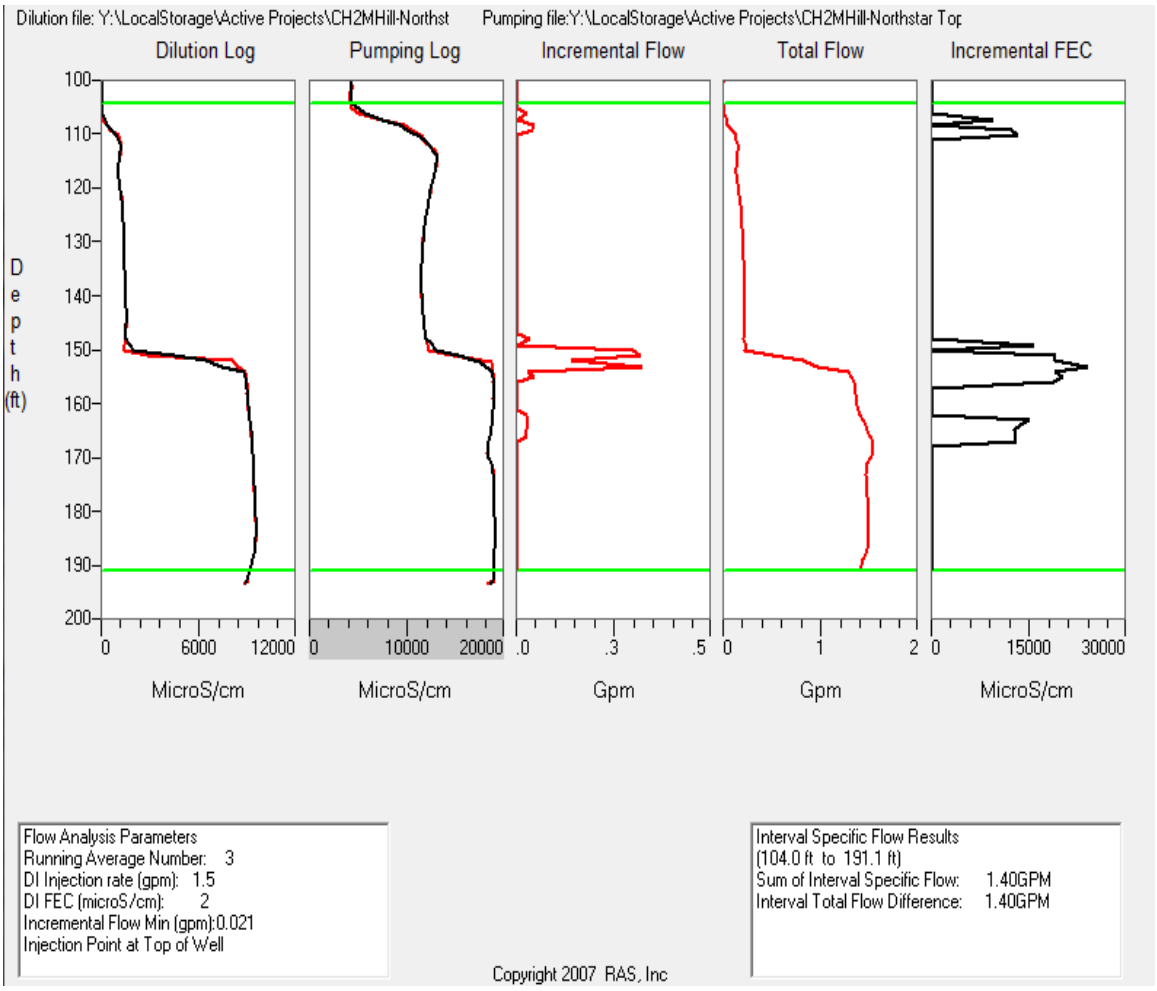


Figure 20. CH2MHill-Northstar, Topock - Well MW-72BR-200. QC Flow analysis of PDI data. July 22, 2012. 1.40 gpm sum of interval specific flow. NFP from surface observation was 1.5 gpm. To capture all inflow, analysis was from 104 feet bgs to 191.1 feet bgs.

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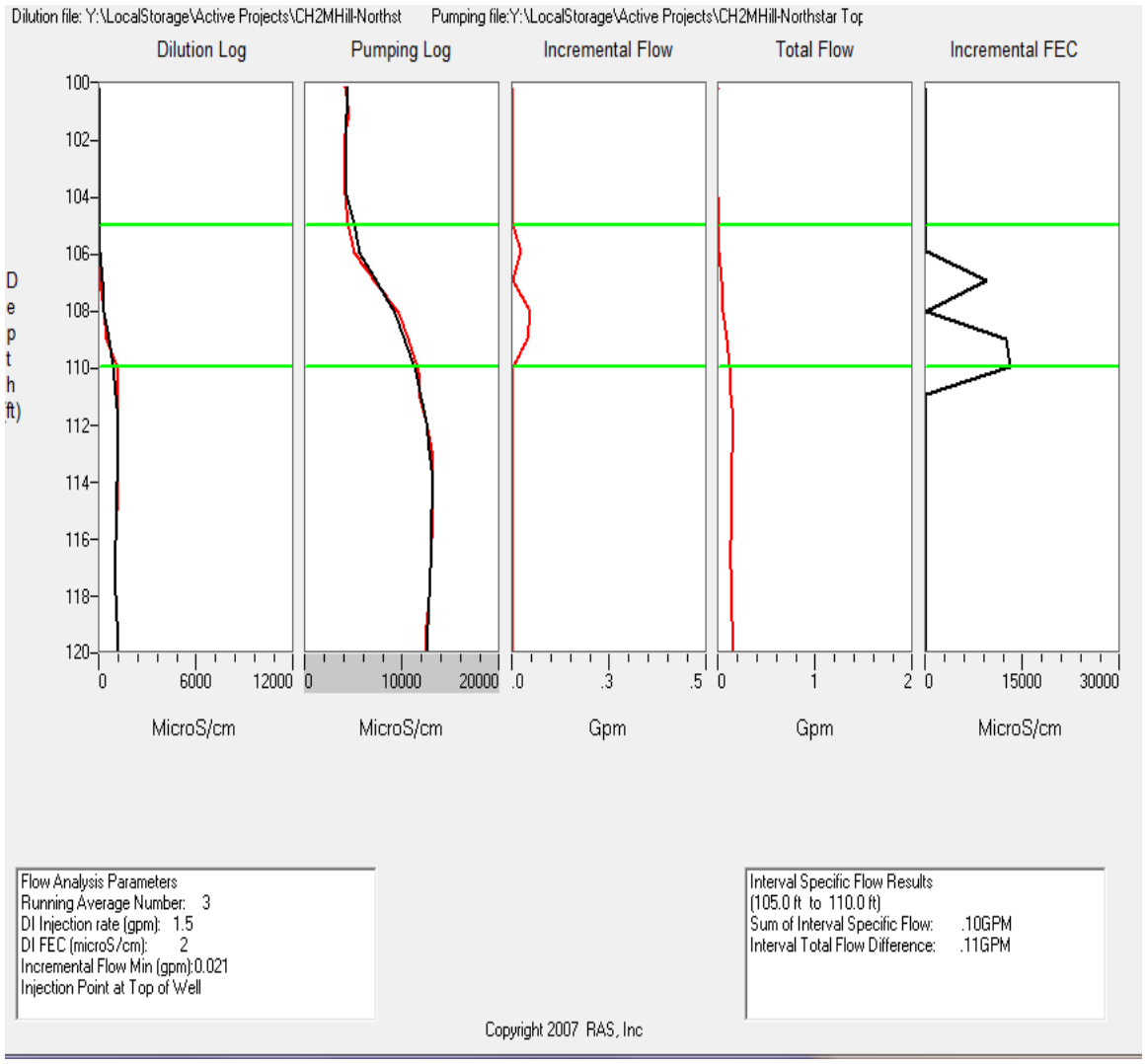


Figure 21. CH2MHill-Northstar, Topock - Well MW-72BR-200. QC Flow analysis of PDI data. July 22, 2012. Interval from 105 to 110 feet bgs suggests inflow of 0.10 gpm.

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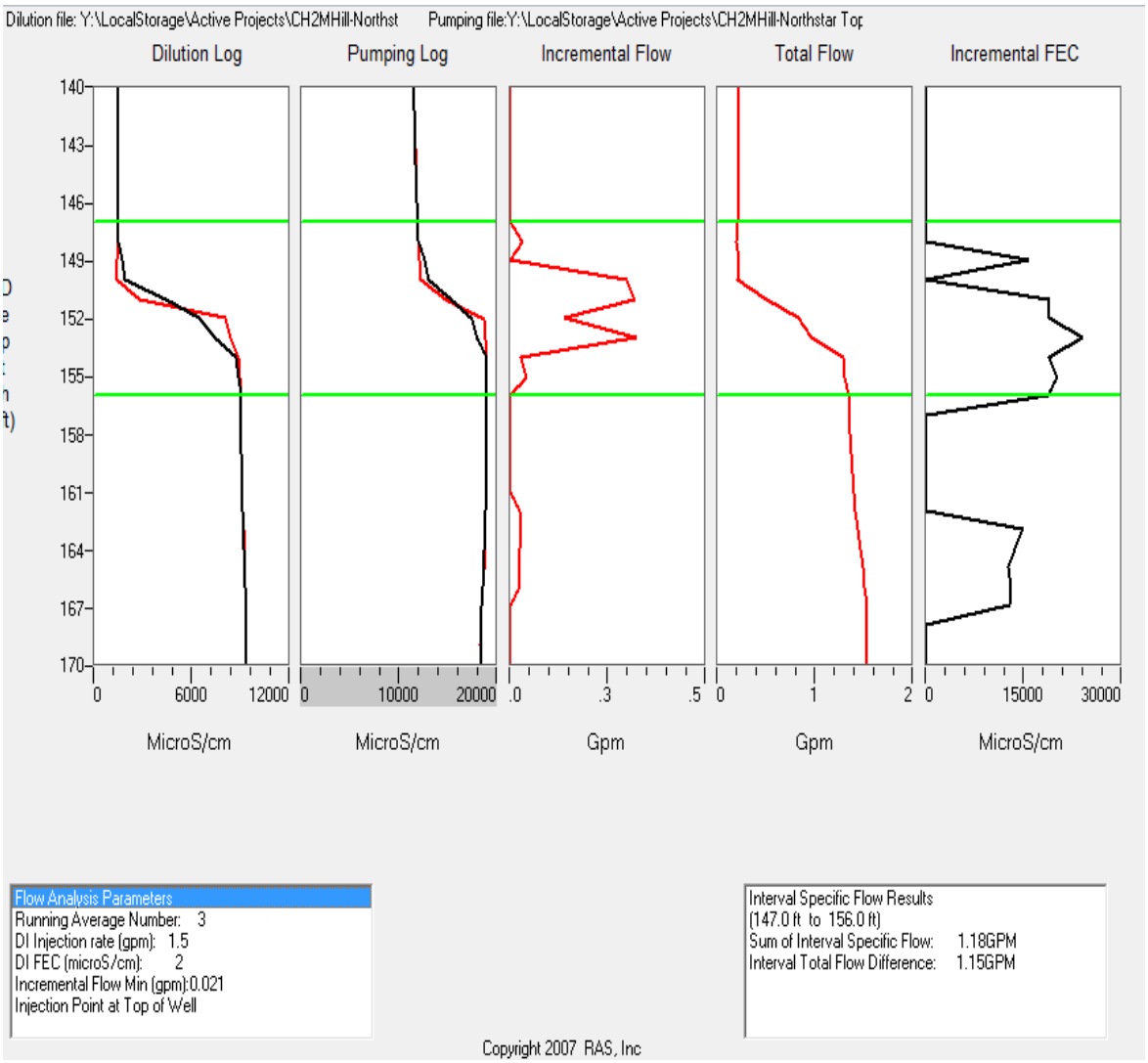


Figure 22. CH2MHill-Northstar, Topock - Well MW-72BR-200. QC Flow analysis of PDI data. July 22, 2012. Interval from 147 to 156 feet bgs suggests inflow of 1.18 gpm.

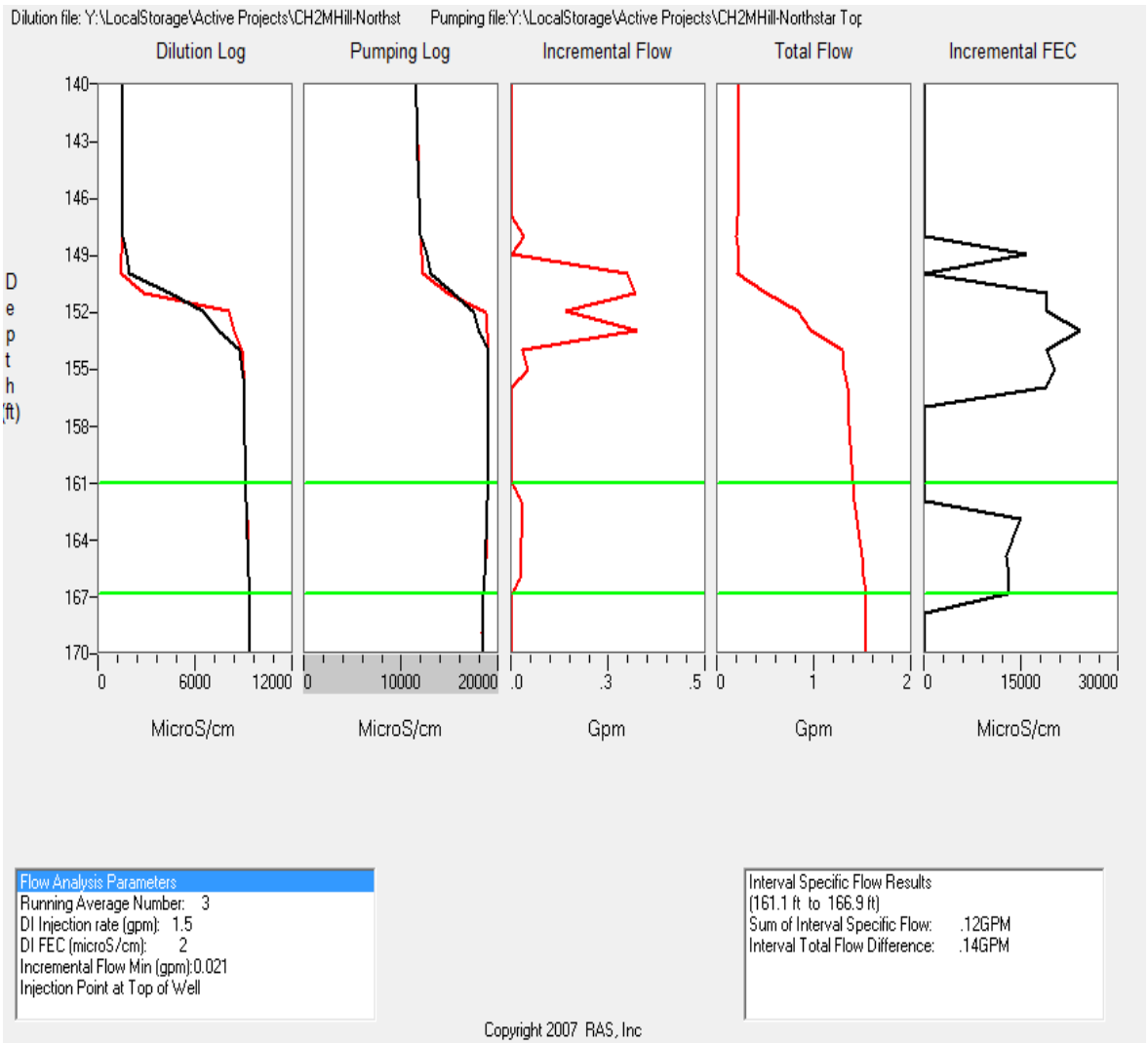


Figure 23. CH2MHill-Northstar, Topock - Well MW-72BR-200. QC Flow analysis of PDI data. July 22, 2012. Interval from 161 to 167 feet bgs suggests inflow of 0.12 gpm.

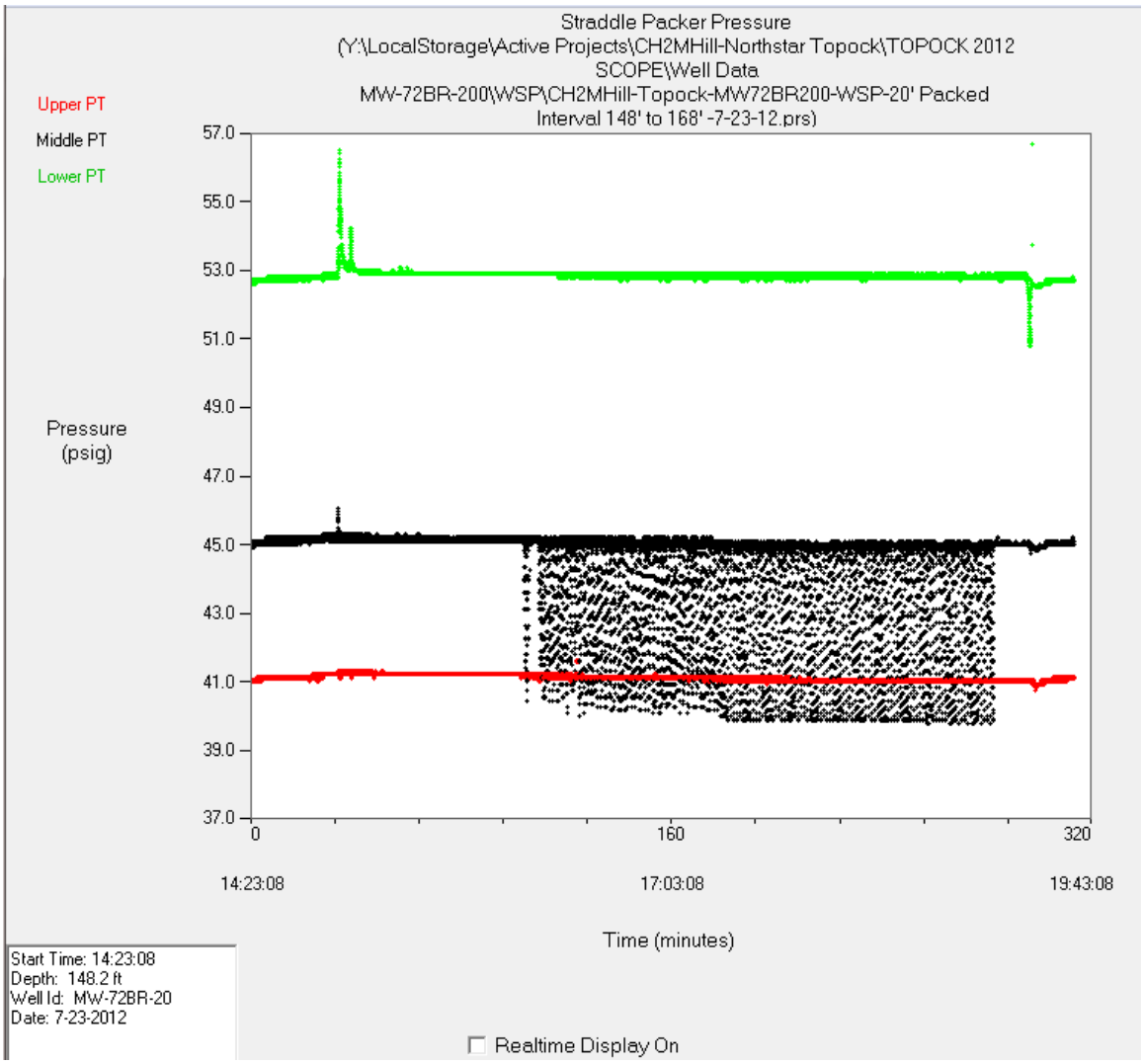


Figure 24. CH2MHill-Northstar, Topock - Well MW-72BR-200. Wireline Straddle Packer pressure data, interval from 148 feet to 168 feet bgs, July 23, 2012. Data suggests hydraulic isolation of packed interval as noted by consistent pressure during pumping in both the upper and lower transducer.

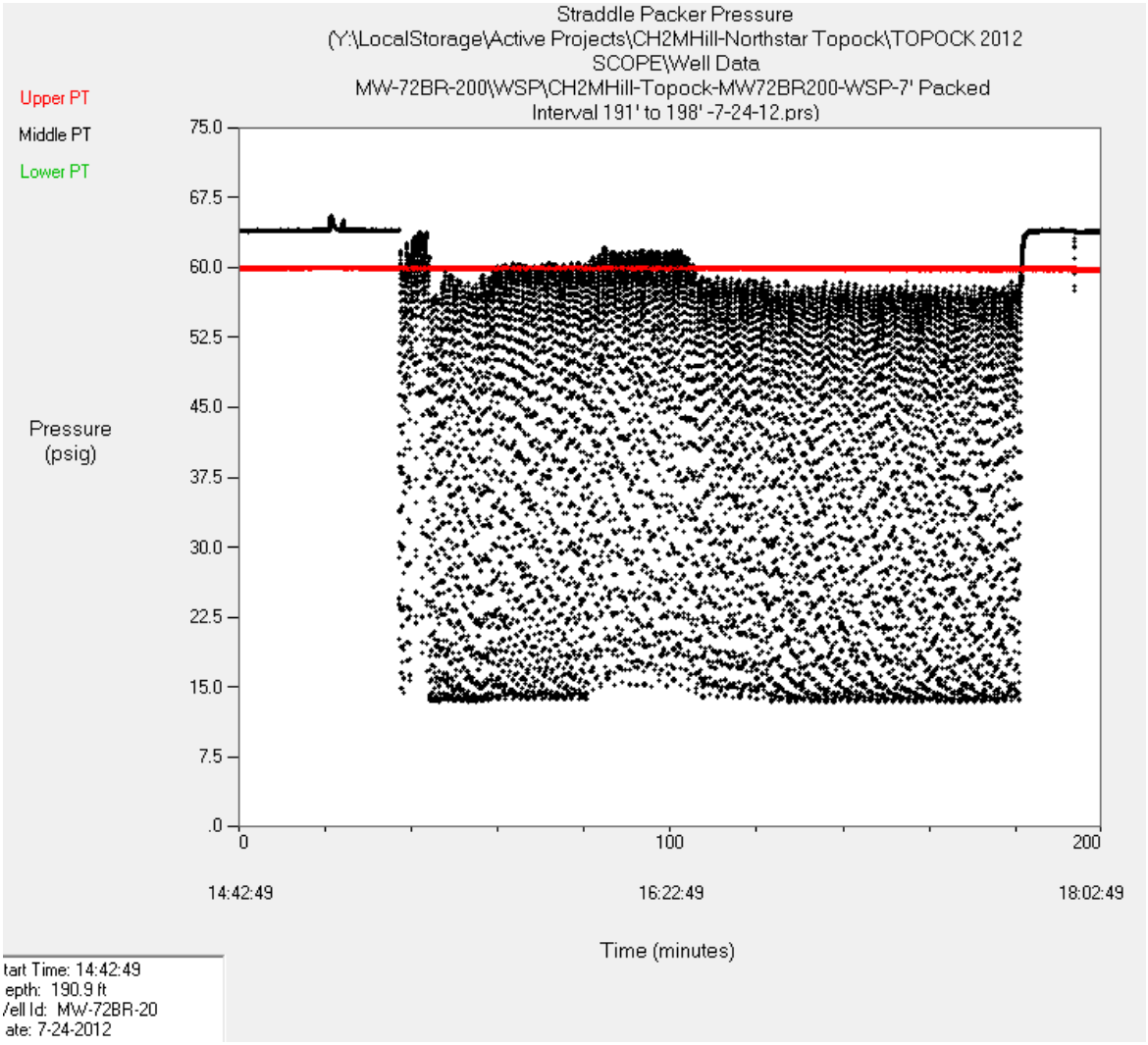


Figure 25. CH2MHill-Northstar, Topock - Well MW-72BR-200. Wireline Straddle Packer pressure data, interval from 191 feet to 198.5 (TD) feet bgs, July 24, 2012. Data suggests hydraulic isolation of packed interval as noted by consistent pressure during pumping in the upper transducer.

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APPENDIX D

MW-72BR-200 DATA MONTAGE

WELL: MW-72BR-200

PROJECT: CH2MHill - PG&E Topock Compressor Station

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LEGEND

LITHOLOGY

- Alluvium
- Bedrock, Metadiorite
- Fracture / Fracture Zone*

* Generic symbol does not indicate fracture orientation

HYDROPHYSICAL LOGGING AND RESULTS:

Fluid Resistivity and Fluid Temperature
Log performed during ambient conditions

AFC Interval Specific Flow
Flow recorded during Ambient Flow Characterization (AFC)

PDI Total, Incremental & Interval Specific Flow
Flow recorded while Pumping During Injection (PDI)

Horizontal flow observed during ambient conditions, inflows also evaluated during stressed (constant pumping) conditions. Horizontal flow rates based on integral method for q (Lowe, et. al., 1989) and dilution method for v (Drost, 1968).

Hydraulic conductivity estimates based on Hvorslev (1962), (Pedler, et al. 1988). Flow and velocity estimates based on hydrophysical logging results only.

Flow Zones

HEXAVALENT CHROMIUM EXPLANATION

Hexavalent Chromium - Cr(VI) (µg/L)

Contaminant concentrations based on samples collected with the interval isolated via wireline straddle packer and collected via bladder pump.

MISCELLANEOUS NOTES:

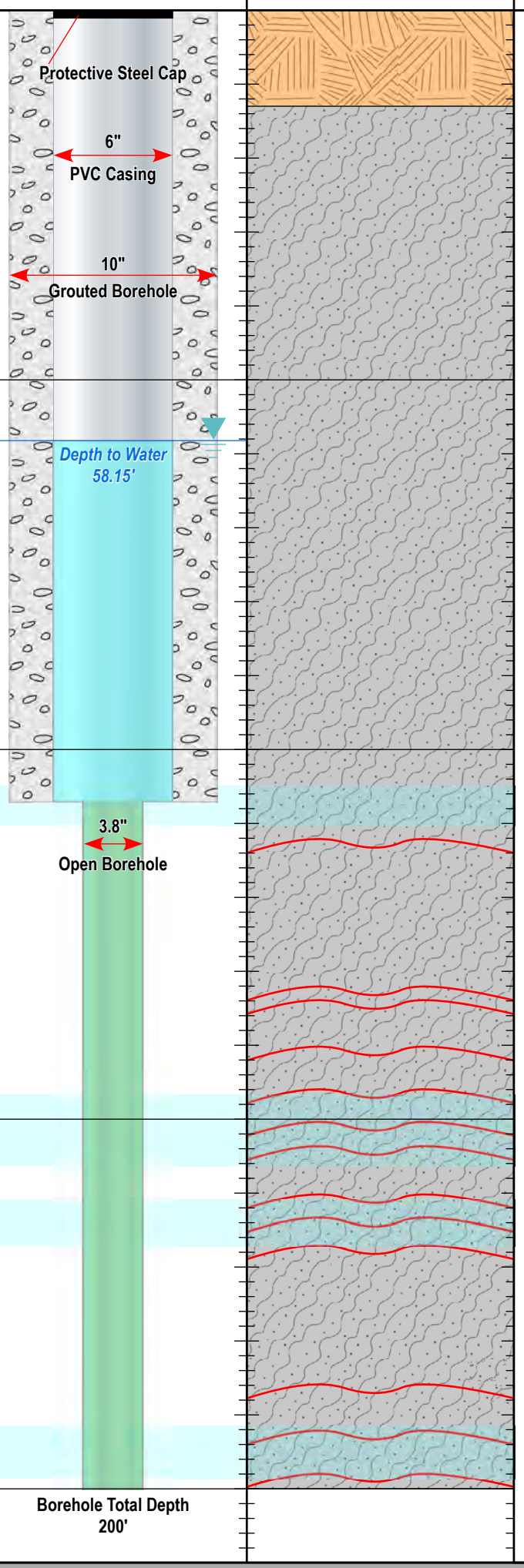
1. Top of casing elevation: Not Surveyed.
2. All depths referenced to Ground Surface.
3. Coordinates of well: Not Surveyed.
4. Lithology and well construction from CH2MHill.
5. Hydrophysical logging conducted by RAS, Inc. on July 19, 20, 21 & 22, 2012 .

Depth (ft below GS) | Well Construction | GEOLOGY: Lithology | Elevation (ft above MSL) | HYDROPHYSICS: AMBIENT CONDITIONS | INDUCED CONDITIONS | Estimated Hydraulic Conductivity (ft/day) / Chromium VI Concentration (µg/L) | Depth (ft below GS)

AMBIENT CONDITIONS: Ambient Fluid Temperature (°C) / Ambient FEC (µS/cm) / AFC Interval Specific Flow (gpm)

INDUCED CONDITIONS: PDI Total Flow (gpm) / PDI Incremental Flow (gpm) / PDI Interval Specific Flow (gpm)

Ambient Fluid Temperature (°C)	Ambient FEC (µS/cm)	AFC Interval Specific Flow (gpm)	PDI Total Flow (gpm)	PDI Incremental Flow (gpm)	PDI Interval Specific Flow (gpm)	Estimated Hydraulic Conductivity (ft/day)	Chromium VI Concentration (µg/L)
26.0	5k	0.00	0.0	0.0	0.0	0.0	0
26.5	10k	0.01	0.5	0.1	0.5	0.5	1
27.0	15k	0.02	1.0	0.2	1.0	1.0	2
27.5	20k	0.03	1.5	0.3	1.5	1.5	3
28.0	25k	0.04	2.0	0.4	2.0	2.0	4



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Attachment B-2
Screening-Level GW Data

Table B-2
Summary Phase 2 Screening-Level Field Data
Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation
PG&E Topock Compressor Station, Needles, California

						Water Quality Measurements (Final Reading)					Screening-Level Concentration Data		Hydraulic Measurements				
Site ID	Borehole or Well ID	Sample Interval (ft BGS)	Geologic Interval	Sample Type	Date	ORP (mV)	Spec. Conduct. (uS/cm)	Temp. (°C)	pH	Turbidity (NTU)	Hexavalent Chromium (µg/L)	Total Chromium (µg/L)	Volume Purged (gallons)	Approx. Pumping Rate (gpm)	Appx. Static WL (*see note)	Drawdown (feet)	Est. Specific Capacity (gpm/ft)
Site F	MW-60BR-245	137-245	Metadiorite BR	Development	Aug-11	-100	16,220	33.0	8.16	26	61	53	151	0.5	98.40	38.60	0.01
		137-245	Metadiorite BR	Monthly Event	Aug-11	NA	NA	NA	NA	NA	NA	NA	137.5	1.0	99.07	Runs Dry	--
		137-245	Metadiorite BR	Monthly Event	Sep-11	NA	NA	NA	NA	NA	NA	NA	140	1.0	98.00	Runs Dry	--
		137-245	Metadiorite BR	Monthly Event	Oct-11	NA	NA	NA	NA	NA	NA	NA	--	--	--	--	--
		140-150	Metadiorite BR	Packer	Nov-11	NA	NA	NA	NA	NA	130	NA	156	1.0	235.32	Runs Dry	--
		160-179	Metadiorite BR	Packer	Nov-11	NA	NA	NA	NA	NA	290	NA	--	--	--	--	--
		235-245	Metadiorite BR	Packer	Nov-11	NA	NA	NA	NA	NA	78	NA	--	--	--	--	--
		137-245	Metadiorite BR	Monthly Event	Nov-11	NA	NA	NA	NA	NA	NA	NA	--	--	--	--	--
		137-245	Metadiorite BR	Contemp. Event	Dec-11	NA	NA	NA	NA	NA	NA	NA	140	5.0	99.37	Runs Dry	--
		137-245	Metadiorite BR	Quarterly GMP	Feb-12	NA	NA	NA	NA	NA	NA	NA	188	4.0	99.20	Runs Dry	--
		137-245	Metadiorite BR	Quarterly GMP	May-12	NA	NA	NA	NA	NA	NA	NA	106	4.0	98.39	Runs Dry	--
Site 5	BH-65	157-167	Alluvium	Isoflow	Mar-11	34	4,414	30.9	7.41	>1000	72	72	105	2.0	142	5.6	0.36
	BH-65	187-197	Alluvium	Isoflow	Mar-11	-76	5,700	30.3	7.30	950	220	190	250	8.0	142	2.4	3.33
	BH-65	217-227	Alluvium	Isoflow	Mar-11	-97	15,390	31.3	7.51	>1000	140	88	240	9.0	141	5.7	1.58
	MW-65-160	150-160	Alluvium	Development	May-11	-95	4,110	31.3	7.68	3	43	41	155	1.0	139	--	--
		150-160	Alluvium	Monthly Event	Jun-11	NA	NA	NA	NA	NA	NA	NA	12	0.5	139.40	3.82	0.13
		150-160	Alluvium	Monthly Event	Jul-11	NA	NA	NA	NA	NA	NA	NA	12	0.5	139.26	4.44	0.11
		150-160	Alluvium	Monthly Event	Aug-11	NA	NA	NA	NA	NA	NA	NA	16	0.5	139.34	4.52	0.11
		150-160	Alluvium	Monthly Event	Sep-11	NA	NA	NA	NA	NA	NA	NA	14	0.5	139.68	3.54	0.14
		150-160	Alluvium	Monthly Event	Oct-11	NA	NA	NA	NA	NA	NA	NA	10	0.5	140.02	4.33	0.12
		150-160	Alluvium	Monthly Event	Nov-11	NA	NA	NA	NA	NA	NA	NA	14	0.5	140.48	5.47	0.09
		150-160	Alluvium	Contemp. Event	Dec-11	NA	NA	NA	NA	NA	NA	NA	18	0.5	140.97	4.89	0.10
		150-160	Alluvium	Quarterly GMP	Feb-12	NA	NA	NA	NA	NA	NA	NA	16	0.5	141.04	3.71	0.13
		150-160	Alluvium	Quarterly GMP	May-12	NA	NA	NA	NA	NA	NA	NA	16	0.5	139.59	3.44	0.15
	MW-65-225	215-225	Alluvium	Development	May-11	-8	13,350	31.6	7.52	4	130	110	310	1.5	139	--	--
		215-225	Alluvium	Monthly Event	Jun-11	NA	NA	NA	NA	NA	NA	NA	44	2.0	139.44	0.2	10.00
		215-225	Alluvium	Monthly Event	Jul-11	NA	NA	NA	NA	NA	NA	NA	44	2.0	139.15	0.69	2.90
		215-225	Alluvium	Monthly Event	Aug-11	NA	NA	NA	NA	NA	NA	NA	48	2.0	139.48	0.37	5.41
		215-225	Alluvium	Monthly Event	Sep-11	NA	NA	NA	NA	NA	NA	NA	44	2.0	139.76	0.34	5.88
		215-225	Alluvium	Monthly Event	Oct-11	NA	NA	NA	NA	NA	NA	NA	44	2.0	140.18	0.28	7.14
		215-225	Alluvium	Monthly Event	Nov-11	NA	NA	NA	NA	NA	NA	NA	62	2.0	140.51	0.29	6.90
		215-225	Alluvium	Contemp. Event	Dec-11	NA	NA	NA	NA	NA	NA	NA	60	2.0	140.94	0.35	5.71
		215-225	Alluvium	Quarterly GMP	Feb-12	NA	NA	NA	NA	NA	NA	NA	64	2.0	141.10	0.26	7.69
		215-225	Alluvium	Quarterly GMP	May-12	NA	NA	NA	NA	NA	NA	NA	48	2.0	139.72	0.28	7.14
Site 6	BH-66	147-157	Alluvium	Isoflow	Apr-11	42	3,800	31.9	7.21	417	160	150	150	5.0	130	5	1.00
	BH-66	177-187	Alluvium	Isoflow	Apr-11	-43	4,519	29.1	7.81	>1000	ND (<0.2)	ND (<0.5)	90	0.3	130	44	0.01
	BH-66	207-217	Alluvium	Isoflow	Apr-11	65	14,000	32.0	7.95	>1000	9,100	9,100	135	<0.25	130	NA	<0.01
	BH-66	224-234	Alluvium	Isoflow	Apr-11	110	22,260	31.3	7.90	>1000	7,000	7,200	155	<0.25	130	NA	<0.01
	MW-66-165	142-162	Alluvium	Development	May-11	-7	4,310	31.2	7.35	8	480	440	220	1.0	130	--	--
		142-162	Alluvium	Monthly Event	Jun-11	NA	NA	NA	NA	NA	NA	NA	21	1.0	130.12	0.39	2.56
		142-162	Alluvium	Monthly Event	Jul-11	NA	NA	NA	NA	NA	NA	NA	18	1.0	129.85	0.39	2.56
		142-162	Alluvium	Monthly Event	Aug-11	NA	NA	NA	NA	NA	NA	NA	21	1.0	128.04	0.44	2.27
		142-162	Alluvium	Monthly Event	Sep-11	NA	NA	NA	NA	NA	NA	NA	--	--	--	--	--
		142-162	Alluvium	Monthly Event	Oct-11	NA	NA	NA	NA	NA	NA	NA	26	1.0	130.00	0.25	4.00
		142-162	Alluvium	Monthly Event	Nov-11	NA	NA	NA	NA	NA	NA	NA	20	1.0	130.32	0.39	2.56
		142-162	Alluvium	Contemp. Event	Dec-11	NA	NA	NA	NA	NA	NA	NA	27	1.0	130.87	0.21	4.76
		142-162	Alluvium	Quarterly GMP	Feb-12	NA	NA	NA	NA	NA	NA	NA	23	1.0	130.95	0.3	3.33
		142-162	Alluvium	Quarterly GMP	May-12	NA	NA	NA	NA	NA	NA	NA	20	1.0	129.39	0.23	4.35
	MW-66-230	218-228	Alluvium	Development	May-11	-24	16,540	31.4	7.90	3	4,600 J	4,200	420	1.2	130	--	--
		218-228	Alluvium	Monthly Event	Jun-11	NA	NA	NA	NA	NA	NA	NA	52	2.0	129.85	0.39	5.13
		218-228	Alluvium	Monthly Event	Jul-11	NA	NA	NA	NA	NA	NA	NA	54	3.0	129.63	1.77	1.69
		218-228	Alluvium	Monthly Event	Aug-11	NA	NA	NA	NA	NA	NA	NA	54	3.0	130.11	1.22	2.46
		218-228	Alluvium	Monthly Event	Sep-11	NA	NA	NA	NA	NA	NA	NA	--	--	--	--	--
		218-228	Alluvium	Monthly Event	Oct-11	NA	NA	NA	NA	NA	NA	NA	54	3.0	130.19	1.22	2.46
		218-228	Alluvium	Monthly Event	Nov-11	NA	NA	NA	NA	NA	NA	NA	45	3.0	130.69	1.20	2.50
		218-228	Alluvium	Contemp. Event	Dec-11	NA	NA	NA	NA	NA	NA	NA	54	3.0	131.09	1.31	2.29
		218-228	Alluvium	Quarterly GMP	Feb-12	NA	NA	NA	NA	NA	NA	NA	54	3.0	130.11	2.23	1.35
		218-228	Alluvium	Quarterly GMP	May-12	NA	NA	NA	NA	NA	NA	NA	54	3.0	129.65	6.35	0.47
	MW-66BR-270	248-271	Conglomerate BR	Development	Nov-11	-10	18,620	29.5	11.13	15	--	--	313	--	--	Runs Dry	--
		248-271	Conglomerate BR	Monthly Event	Nov-11	NA	NA	NA	NA	NA	NA	NA	60	4.0	241.00	Runs Dry	--
		248-271	Conglomerate BR	Contemp. Event	Dec-11	NA	NA	NA	NA	NA	NA	NA	88	4.0	197.69	Runs Dry	--
		248-271	Conglomerate BR	Quarterly GMP	Feb-12	NA	NA	NA	NA	NA	NA	NA	128	4.0	165.59	Runs Dry	--
		248-271	Conglomerate BR	Quarterly GMP	May-12	NA	NA	NA	NA	NA	NA	NA	--	--	--	--	--
Site 2	BH-67	187-197	Alluvium	Isoflow	Apr-11	95	4,900	30.1	7.25	436	2,400	2,500	154	7.0	171	9	0.78
		217-227	Alluvium	Isoflow	May-11	52	8,260	30.3	7.55	>1,000	4,600	3,800	200	10.0	170	4	2.50
		247-257	Alluvium	Isoflow	May-11	-86	19,000	31.4	8.16	>1,000	2,900	2,500	204	7.0	170	22	0.32
	MW-67-185	177-187	Alluvium	Development	Sep-11	-33	3,550	35.8	7.56	3	910	1,000	31	0.3	170.00	2.8	0.11
		177-187	Alluvium	Monthly Event	Oct-11	NA	NA	NA	NA	NA	NA	NA	12	0.5	169.55	3.36	0.15
		177-187	Alluvium	Monthly Event	Nov-11	NA	NA	NA	NA	NA	NA	NA	10.5	0.5	170.04	4.10	0.12
		177-187	Alluvium	Contemp. Event	Dec-11	NA	NA	NA	NA	NA	NA	NA	12	0.5	170.50	3.72	0.13
		177-187	Alluvium	Quarterly GMP	Feb-12	NA	NA	NA	NA	NA	NA	NA	13	0.5	170.60	3.64	0.14
		177-187	Alluvium	Quarterly GMP	May-12	NA	NA	NA	NA	NA	NA	NA	10	0.5	169.09	2.51	0.20
	MW-67-225	210-225	Alluvium	Development	May-11	-57	6,584	32.6	7.82	6	1,800	1,800	430	0.5	169	--	--
		210-225	Alluvium	Monthly Event	Jun-11	NA	NA	NA	NA	NA	NA	NA	29	1.0	169.22	0.33	3.03
		210-225	Alluvium	Monthly Event	Jul-11	NA	NA	NA	NA	NA	NA	NA	30	1.0	168.88	0.36	2.78
		210-225	Alluvium	Monthly Event	Aug-11	NA	NA	NA	NA	NA	NA	NA	30	1.0	168.81	0.30	3.33
		210-225	Alluvium	Monthly Event	Sep-11	NA	NA	NA	NA	NA	NA	NA	30	1.0	169.28	0.28	3.57
		210-225	Alluvium	Monthly Event	Oct-11	NA	NA	NA	NA	NA	NA	NA	30	1.0	169.71	0.28	3.57
		210-225	Alluvium	Monthly Event	Nov-11	NA	NA	NA	NA	NA	NA	NA	30	1.0	170.19	0.32	3.13
		210-225	Alluvium	Contemp. Event	Dec-11	NA	NA	NA	NA	NA	NA	NA	30	1.0	170.59	0.41	2.44
		210-225	Alluvium	Quarterly GMP	Feb-12	NA	NA	NA	NA	NA	NA	NA	30	1.0	170.59	0.24	4.17
		210-225	Alluvium	Quarterly GMP	May-12	NA	NA	NA	NA	NA	NA	NA	30	1.0	169.17	0.33	3.03
	MW-67-260	250-260	Alluvium	Development	May-11	-136	16,430	33.2	8.34	1	2,000	1,900	235	0.6	169	--	--
		250-260	Alluvium	Monthly Event	Jun-11	NA	NA	NA	NA	NA	NA	NA	48	1.0	169.04	3.25	0.31
		250-260	Alluvium	Monthly Event	Jul-11	NA	NA	NA	NA	NA	NA	NA	48	2.0	168.74	8.12	0.25
		250-260	Alluvium	Monthly Event	Aug-11	NA	NA	NA	NA	NA	NA	NA	48	2.0	169.04	6.46	0.31
		250-260	Alluvium	Monthly Event	Sep-11	NA	NA	NA	NA	NA	NA	NA	48	2.0	169.35	6.70	0.30
		250-260	Alluvium	Monthly Event	Oct-11	NA	NA	NA	NA	NA	NA	NA	48	2.0	169.89	6.09	0.33
		250-260	Alluvium	Monthly Event	Nov-11	NA	NA	NA	NA	NA	NA	NA	44	2.0	173.80	2.70	0.74
		250-260	Alluvium	Contemp. Event	Dec-11	NA	NA	NA	NA	NA	NA	NA	52	2.0	170.78	6.97	0.29
		250-260	Alluvium	Quarterly GMP	Feb-12	NA	NA	NA	NA	NA	NA	NA	60	2.0	170.88	--	--
		250-260	Alluvium	Quarterly GMP	May-12	NA	NA	NA	NA	NA	NA	NA	50	2.0	169.38	7.22	0.28
Site 3	BH-68	177-187	Alluvium	Isoflow	May-11	-92	3,030	36.5	7.51	>1000	670	700	115	3.0	164	3	1.00
	BH-68	207-217	Alluvium	Isoflow	May-11	59	12,000	31.0	7.75	>1000	4,100	3,500	240	12.0	164	6.5	1.85

Table B-2
Summary Phase 2 Screening-Level Field Data
Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation
PG&E Topock Compressor Station, Needles, California

						Water Quality Measurements (Final Reading)					Screening-Level Concentration Data		Hydraulic Measurements				
Site ID	Borehole or Well ID	Sample Interval (ft BGS)	Geologic Interval	Sample Type	Date	ORP (mV)	Spec. Conduct. (uS/cm)	Temp. (°C)	pH	Turbidity (NTU)	Hexavalent Chromium (µg/L)	Total Chromium (µg/L)	Volume Purged (gallons)	Approx. Pumping Rate (gpm)	Appx. Static WL (*see note)	Drawdown (feet)	Est. Specific Capacity (gpm/ft)
	BH-68	235-245	Alluvium	Isoflow	May-11	-230	17,200	28.8	7.73	>1000	2,200	2,100	200	5.0	164	20	0.25
	MW-68-180	165-180	Alluvium	Development	Jun-11	-21	3,405	30.4	7.92	11	11,000	11,000	210	2.1	164	--	--
		165-180	Alluvium	Monthly Event	Jun-11	NA	NA	NA	NA	NA	NA	NA	24	1.0	164.31	0.34	2.94
		165-180	Alluvium	Monthly Event	Jul-11	NA	NA	NA	NA	NA	NA	NA	24	0.5	164.02	0.62	0.81
		165-180	Alluvium	Monthly Event	Aug-11	NA	NA	NA	NA	NA	NA	NA	--	--	--	--	--
		165-180	Alluvium	Monthly Event	Sep-11	NA	NA	NA	NA	NA	NA	NA	14	0.5	164.44	0.46	1.09
		165-180	Alluvium	Monthly Event	Oct-11	NA	NA	NA	NA	NA	NA	NA	10	0.5	164.91	0.34	1.47
		165-180	Alluvium	Monthly Event	Nov-11	NA	NA	NA	NA	NA	NA	NA	13.5	0.5	165.28	3.13	0.16
		165-180	Alluvium	Contemp. Event	Dec-11	NA	NA	NA	NA	NA	NA	NA	9.5	0.5	165.62	0.63	0.79
		165-180	Alluvium	Quarterly GMP	Feb-12	NA	NA	NA	NA	NA	NA	NA	11	0.5	165.69	0.52	0.96
		165-180	Alluvium	Quarterly GMP	May-12	NA	NA	NA	NA	NA	NA	NA	10	0.5	164.12	0.49	1.02
	MW-68-240	220-240	Alluvium	Development	Jun-11	-125	11,520	31.1	7.78	26	640	660	135	1.7	164	--	--
		220-240	Alluvium	Monthly Event	Jun-11	NA	NA	NA	NA	NA	NA	NA	40	2.0	164.29	0.97	2.06
		220-240	Alluvium	Monthly Event	Jul-11	NA	NA	NA	NA	NA	NA	NA	40	2.0	164.06	3.12	0.64
		220-240	Alluvium	Monthly Event	Aug-11	NA	NA	NA	NA	NA	NA	NA	--	--	--	--	--
		220-240	Alluvium	Monthly Event	Sep-11	NA	NA	NA	NA	NA	NA	NA	40	2.0	164.44	2.86	0.70
		220-240	Alluvium	Monthly Event	Oct-11	NA	NA	NA	NA	NA	NA	NA	40	2.0	164.97	3.01	0.66
		220-240	Alluvium	Monthly Event	Nov-11	NA	NA	NA	NA	NA	NA	NA	56	2.0	165.44	2.97	0.67
		220-240	Alluvium	Contemp. Event	Dec-11	NA	NA	NA	NA	NA	NA	NA	40	2.0	165.82	3.28	0.61
		220-240	Alluvium	Quarterly GMP	Feb-12	NA	NA	NA	NA	NA	NA	NA	52	2.0	166.05	2.9	0.69
		220-240	Alluvium	Quarterly GMP	May-12	NA	NA	NA	NA	NA	NA	NA	40	2.0	164.55	3.60	0.56
	MW-68BR-280	257-280	Metadiorite BR	Development	Sep-11	-218	4,370	31.1	9.19	22	ND (5)	ND (1)	80.5	0.2	162.10	Runs Dry	--
		257-280	Metadiorite BR	Monthly Event	Sep-11	NA	NA	NA	NA	NA	NA	NA	60.5	0.5	165.10	Runs Dry	--
		257-280	Metadiorite BR	Monthly Event	Oct-11	NA	NA	NA	NA	NA	NA	NA	--	--	--	--	--
		257-280	Metadiorite BR	Monthly Event	Nov-11	NA	NA	NA	NA	NA	NA	NA	58	2.0	164.85	65.04	0.03
		257-280	Metadiorite BR	Contemp. Event	Dec-11	NA	NA	NA	NA	NA	NA	NA	75	2.0	165.36	62.77	0.03
		257-280	Metadiorite BR	Quarterly GMP	Feb-12	NA	NA	NA	NA	NA	NA	NA	96.6	2.0	164.02	Runs Dry	--
		257-280	Metadiorite BR	Quarterly GMP	May-12	NA	NA	NA	NA	NA	NA	NA	74	2.0	162.88	63.62	0.03
Site 4	MW-69-195	176-196	Metadiorite BR	Development	Jun-11	7	3,261	31.7	7.40	3	120	120	156	1.0	176.93	0.29	3.45
		176-196	Metadiorite BR	Monthly Event	Jul-11	NA	NA	NA	NA	NA	NA	NA	12	0.5	176.80	0.25	2.00
		176-196	Metadiorite BR	Monthly Event	Aug-11	NA	NA	NA	NA	NA	NA	NA	15	0.5	173.70	0.26	1.92
		176-196	Metadiorite BR	Monthly Event	Sep-11	NA	NA	NA	NA	NA	NA	NA	15	0.5	174.08	0.17	2.94
		176-196	Metadiorite BR	Monthly Event	Oct-11	NA	NA	NA	NA	NA	NA	NA	15	0.5	174.51	0.14	3.57
		176-196	Metadiorite BR	Monthly Event	Nov-11	NA	NA	NA	NA	NA	NA	NA	16	0.5	174.83	0.19	2.63
		176-196	Metadiorite BR	Contemp. Event	Dec-11	NA	NA	NA	NA	NA	NA	NA	15	0.5	175.28	0.12	4.17
		176-196	Metadiorite BR	Quarterly GMP	Feb-12	NA	NA	NA	NA	NA	NA	NA	14	0.5	175.49	0.32	1.56
		176-196	Metadiorite BR	Quarterly GMP	May-12	NA	NA	NA	NA	NA	NA	NA	13.5	0.5	174.05	0.20	2.50
Site H	MW-70-105	85-105	Metadiorite BR	Development	Jun-11	-210	2,078	30.7	8.25	4.22	16	19	104	1.3	81	--	--
		85-105	Metadiorite BR	Monthly Event	Jun-11	NA	NA	NA	NA	NA	NA	NA	13	1.0	83.58	0.87	1.15
		85-105	Metadiorite BR	Monthly Event	Jul-11	NA	NA	NA	NA	NA	NA	NA	13	0.5	83.53	1.45	0.34
		85-105	Metadiorite BR	Monthly Event	Aug-11	NA	NA	NA	NA	NA	NA	NA	12	0.5	84.27	2.35	0.21
		85-105	Metadiorite BR	Monthly Event	Sep-11	NA	NA	NA	NA	NA	NA	NA	12	0.5	83.74	1.22	0.41
		85-105	Metadiorite BR	Monthly Event	Oct-11	NA	NA	NA	NA	NA	NA	NA	--	--	--	--	--
		85-105	Metadiorite BR	Monthly Event	Nov-11	NA	NA	NA	NA	NA	NA	NA	12	0.5	84.53	1.58	0.32
		85-105	Metadiorite BR	Contemp. Event	Dec-11	NA	NA	NA	NA	NA	NA	NA	12	0.5	84.92	1.56	0.32
		85-105	Metadiorite BR	Quarterly GMP	Feb-12	NA	NA	NA	NA	NA	NA	NA	14	0.5	85.18	0.75	0.67
		85-105	Metadiorite BR	Quarterly GMP	May-12	NA	NA	NA	NA	NA	NA	NA	17.5	0.5	83.90	1.00	0.50
	MW-70BR-225	128-227	Metadiorite BR	Development	Oct-11	113	9,260	30.7	7.43	7.7	1,600	1,800	420	1.3	82.20	1.49	0.84
		128-227	Metadiorite BR	Monthly Event	Nov-11	NA	NA	NA	NA	NA	NA	NA	252	4.0	82.91	7.12	0.56
		128-227	Metadiorite BR	Contemp. Event	Dec-11	NA	NA	NA	NA	NA	NA	NA	265	5.0	83.52	6.58	0.76
		128-227	Metadiorite BR	Pump Test	Jan-12	60	13,030	--	7.41	--	2,000 - 2,300	--	6,660	9.3	84.18	34	0.27
		128-227	Metadiorite BR	Quarterly GMP	Feb-12	NA	NA	NA	NA	NA	NA	NA	365	5.0	83.65	6.8	0.74
		128-227	Metadiorite BR	Quarterly GMP	May-12	NA	NA	NA	NA	NA	NA	NA	315	5.0	82.13	8.26	0.61
Site L	MW-71-35	26-36	Alluvium	Development	Nov-11	--	7,100	27.6	7.09	>1000	--	--	12.75	--	28.47	Runs Dry	--
		26-36	Alluvium	Monthly Event	Nov-11	NA	NA	NA	NA	NA	NA	NA	2	--	28.50	Runs Dry	--
		26-36	Alluvium	Contemp. Event	Dec-11	NA	NA	NA	NA	NA	NA	NA	1.75	--	28.91	Runs Dry	--
		26-36	Alluvium	Quarterly GMP	Feb-12	NA	NA	NA	NA	NA	NA	NA	1.75	--	29.20	Runs Dry	--
		26-36	Alluvium	Quarterly GMP	May-12	NA	NA	NA	NA	NA	NA	NA	2.5	--	27.61	Runs Dry	--
Site K	MW-72-80	60-80	Metadiorite BR	Development	Aug-11	0	8,060	27.8	7.79	9	40	44	305	1.0	57.50	3.20	0.31
		60-80	Metadiorite BR	Monthly Event	Sep-11	NA	NA	NA	NA	NA	NA	NA	12	0.5	60.87	1.30	0.38
		60-80	Metadiorite BR	Monthly Event	Oct-11	NA	NA	NA	NA	NA	NA	NA	13	0.5	58.72	1.11	0.45
		60-80	Metadiorite BR	Monthly Event	Nov-11	NA	NA	NA	NA	NA	NA	NA	13	0.5	59.29	1.32	0.38
		60-80	Metadiorite BR	Contemp. Event	Dec-11	NA	NA	NA	NA	NA	NA	NA	17	0.5	60.09	1.39	0.36
		60-80	Metadiorite BR	Quarterly GMP	Feb-12	NA	NA	NA	NA	NA	NA	NA	13	0.3	57.73	0.52	0.48
		60-80	Metadiorite BR	Quarterly GMP	May-12	NA	NA	NA	NA	NA	NA	NA	12.5	0.5	56.10	1.15	0.43
	MW-72BR-200	107-200	Metadiorite BR	Development	Jun-12	9	11,260	28.8	8.85	12	8	--	254	1 - 2.6	59.10	variable	--
		148-168	Metadiorite BR	Packer	Jul-12	--	17,000	--	--	--	2	2	--	--	--	--	--
		191-200	Metadiorite BR	Packer	Jul-12	--	19,000	--	--	--	ND (<0.1)	ND (<0.1)	--	--	--	--	--
		107-200	Metadiorite BR	Quarterly Event	Sep-12	NA	NA	NA	NA	NA	NA	NA	420	1.3	53.39	16	0.08
Site I	MW-73-80	60-80	Metadiorite BR	Development	Oct-11	39	9,210	27.5	7.64	17.1	21	20	106.5	0.3	51.70	Runs Dry	--
		60-80	Metadiorite BR	Monthly Event	Nov-11	NA	NA	NA	NA	NA	NA	NA	7	0.3	51.95	Runs Dry	--
		60-80	Metadiorite BR	Contemp. Event	Dec-11	NA	NA	NA	NA	NA	NA	NA	6.5	0.3	52.60	Runs Dry	--
		60-80	Metadiorite BR	Quarterly GMP	Feb-12	NA	NA	NA	NA	NA	NA	NA	16	0.5	50.19	Runs Dry	--
		60-80	Metadiorite BR	Quarterly GMP	May-12	NA	NA	NA	NA	NA	NA	NA	10	1.0	48.31	Runs Dry	--
Site J	MW-74-240	220-240	Metadiorite BR	Development	Dec-Jan	--	--	--	--	--	--	--	73	--	216.18	Runs Dry	--
		220-240	Metadiorite BR	Contemp. Event	Jan-11	NA	NA	NA	NA	NA	NA	NA	--	--	--	--	--
		220-240	Metadiorite BR	Quarterly GMP	Feb-12	NA	NA	NA	NA	NA	NA	NA	5.6	0.1	216.04	14.12	0.01
		220-240	Metadiorite BR	Quarterly GMP	May-12	NA	NA	NA	NA	NA	NA	NA	6.7	0.1	214.71	17.13	0.01

Notes:
NA - Not Applicable. Data are not screening-level. See Table 3-2.
ft MSL - Elevation in feet above mean sea level
ft BGS - Depth in feet below ground surface
ug/L - micrograms per liter
Water quality measurements collected using a field meter equipped with a flow cel
* Approximate static water level measurements during Isoflow sampling are expressed as feet below ground surface. All other measurements are expressed as feet below the top of casing. Casings have not been surveyed

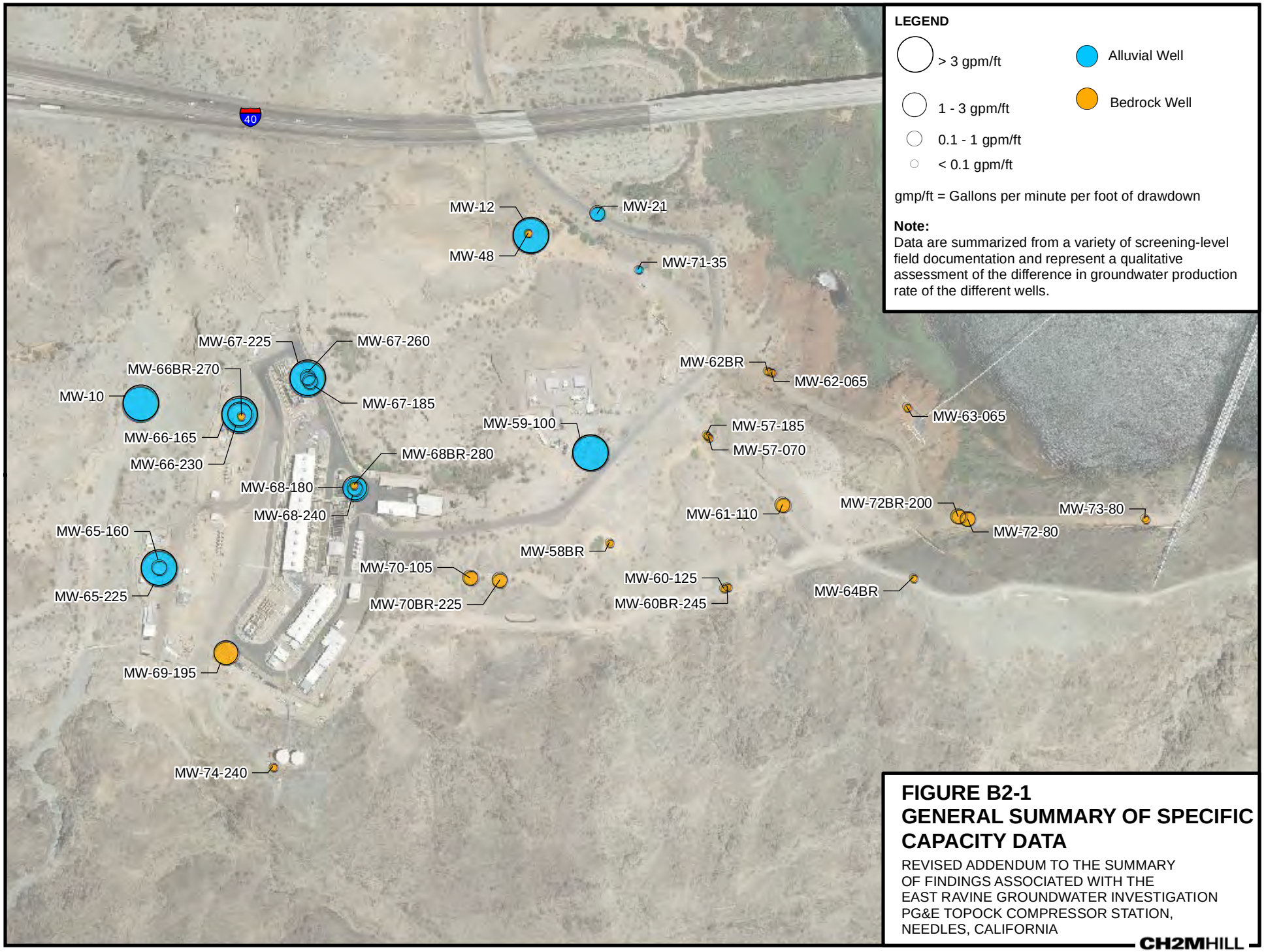


FIGURE B2-1
GENERAL SUMMARY OF SPECIFIC CAPACITY DATA

REVISED ADDENDUM TO THE SUMMARY
OF FINDINGS ASSOCIATED WITH THE
EAST RAVINE GROUNDWATER INVESTIGATION
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL

Path: D:\Projects\Topock\MapFiles\2013\ERGI\Capacity.mxd Date Saved: 5/28/2013 11:27:54 AM

Attachment B-3
Phase 1 Field Screening Data

PACIFIC SURVEYS

CALIPER
BOREHOLE VOLUME

Job No.
14457

Company CH2M HILL
Well MW-57-BR
Field TOPOCK
County SAN BERNARDINO State CA

Location:

N34*42.897' W114*29.387'
Pacific Gas & Electric Facility

Sec. Twp. Rge.

Other Services:

Dual Induction
ATV
OPTV

			Elevation
Permanent Datum	G.L.	Elevation	K.B.
Log Measured From	G.L. 0'	above perm. datum	D.F.
Drilling Measured From	G.L.		G.L.

Date	2/16/2009		
Run Number	TWO		
Depth Driller	185'		
Depth Logger	185'		
Bottom Logged Interval	184'		
Top Log Interval	0'		
Pump Set @	N/A		
Time Pumping Prior to Survey	N/A		
Density / Viscosity	N/A		
Max. Recorded Temp.	N/A		
Pump Rate (GPM)	N/A		
Time Well Ready	4:00 PM		
Time Logger on Bottom	4:30 PM		
Equipment Number	PS-1		
Location	L.A.		
Recorded By	ABREAU		
Witnessed By	A. BREWSTER		

Borehole Record				Tubing Record			
Run Number	Bit	From	To	Size	Weight	From	To

Casing Record	Size	Wgt/Ft	Top	Bottom
Surface String	5"	Sch 80 pvc	0'	70'
Prot. String				
Production String	3"	Sch 40 pvc	0'	184'
Liner				

<< Fold Here >>>

All interpretations are opinions based on inferences from electrical or other measurements and Pacific Surveys cannot and do not guarantee the accuracy or correctness of any interpretation, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages, or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to Pacific Surveys' general terms and conditions set out in our current Price Schedule.

Comments

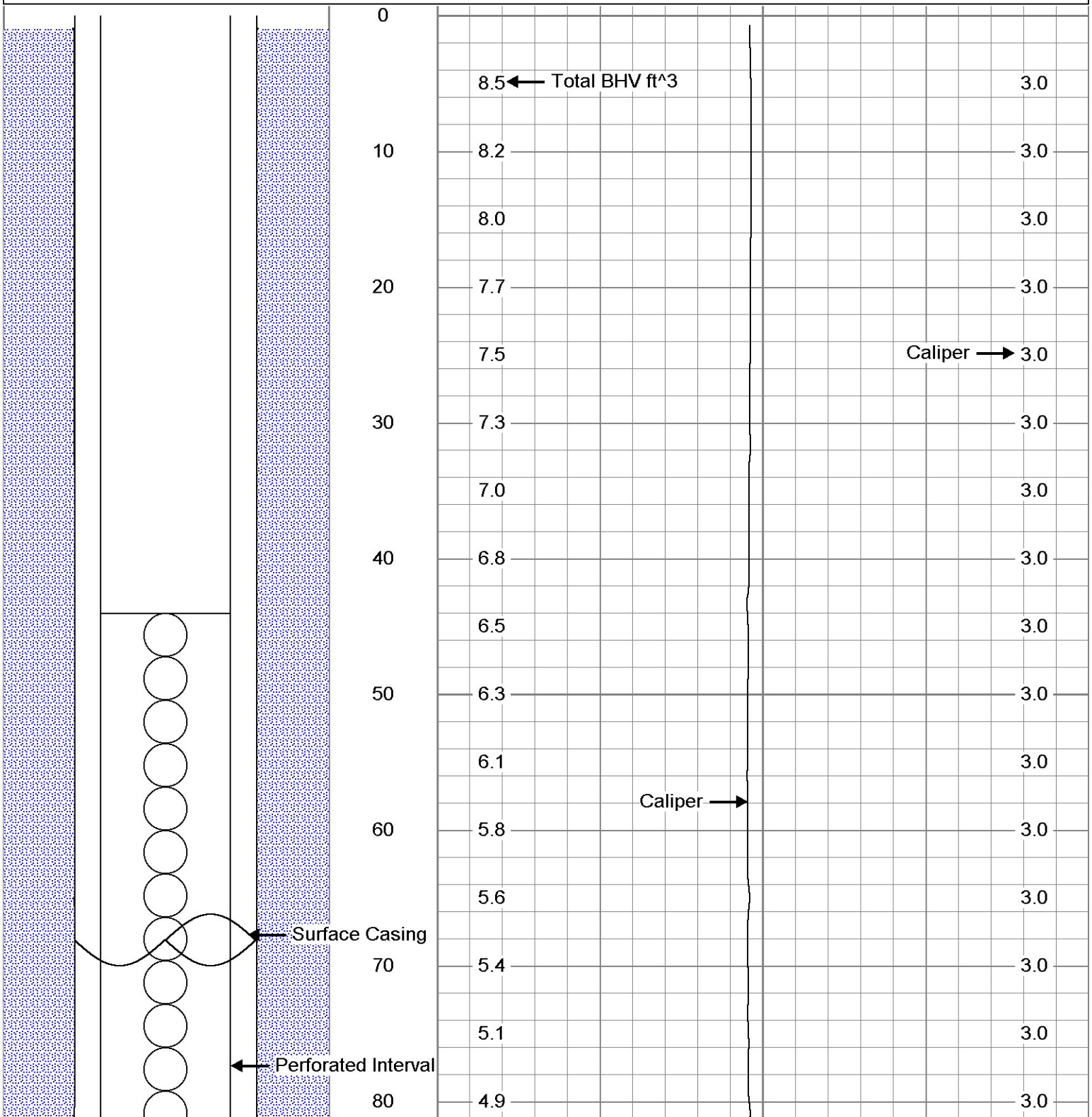
XY Caliper Calibration Report

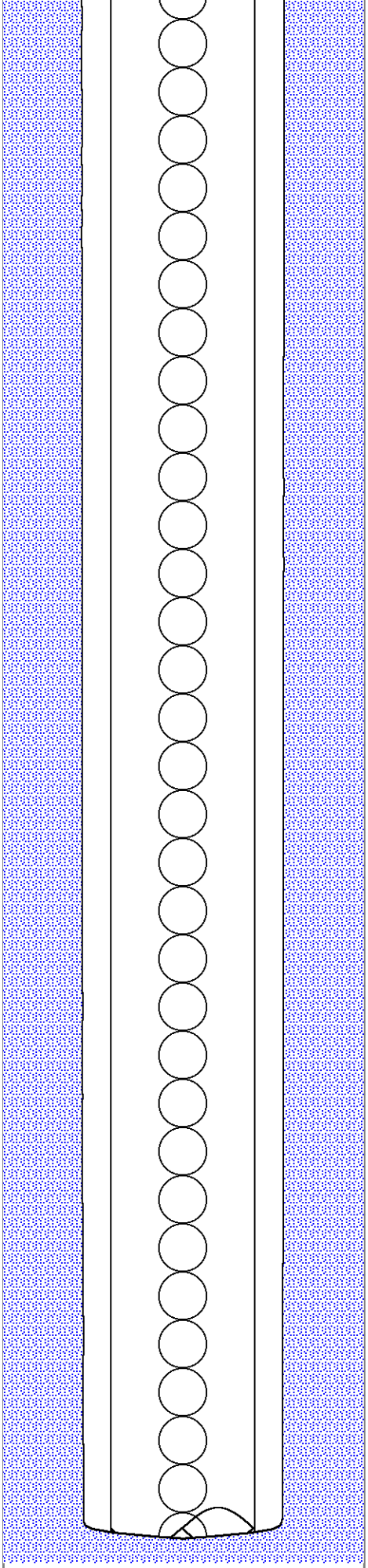
Serial Number: Short
Tool Model: Comprobe
Performed: Tue Dec 02 23:07:28 2008

Small Ring: 6 in
Large Ring: 16 in

	X Caliper	Y Caliper	
Reading with Small Ring:	762.874	762.874	cps
Reading with Large Ring:	1710.1	1710.1	cps
Gain:	0.0105572	0.0105572	
Offset:	-1.35379	-1.35379	

Database File: 14457.db
Dataset Pathname: pge/well/run1/cal_run2.
Presentation Format: XYC_GPH
Dataset Creation: Mon Feb 16 16:35:14 2009 by Calc Warrior Version 6.6
Charted by: Depth in Feet scaled 1:120





	90	4.6		3.0
		4.4		3.0
		4.2		3.0
	100	3.9		3.0
		3.7		2.9
	110	3.4		2.9
		3.2		2.9
	120	3.0		2.9
		2.7		2.9
	130	2.5		2.9
		2.3		2.9
	140	2.0		2.9
		1.8		2.9
	150	1.6		2.9
		1.3		2.9
	160	1.1		2.9
		0.8		2.9
	170	0.6		2.9
		0.4		2.9
	180	0.1		2.9
	190			
Borehole Image		2	Caliper (in)	4

PACIFIC SURVEYS

DUAL INDUCTION GAMMA-RAY

Job No. 14457

Company CH2M HILL
Well MW-57-BR
Field TOPOCK
County SAN BERNARDINO State CA

Location:

N34*42.897' W114*29.387'
Pacific Gas & Electric Facility

Sec. Twp. Rge.

Other Services:

Caliper
ATV
OPTV

			Elevation
Permanent Datum	G.L.	Elevation above perm. datum	K.B.
Log Measured From	G.L. 0'		D.F.
Drilling Measured From	G.L.		G.L.

Date	2/16/2009		
Run Number	TWO		
Depth Driller	185'		
Depth Logger	185'		
Bottom Logged Interval	184'		
Top Log Interval	0'		
Pump Set @	N/A		
Time Pumping Prior to Survey	N/A		
Density / Viscosity	N/A		
Max. Recorded Temp.	N/A		
Pump Rate (GPM)	N/A		
Time Well Ready	4:00 PM		
Time Logger on Bottom	4:30 PM		
Equipment Number	PS-1		
Location	L.A.		
Recorded By	ABREAU		
Witnessed By	A. BREWSTER		

Borehole Record				Tubing Record			
Run Number	Bit	From	To	Size	Weight	From	To

Casing Record	Size	Wgt/Ft	Top	Bottom
Surface String	5"	Sch 80 pvc	0'	70'
Prot. String				
Production String	3"	Sch 40 pvc	0'	184'
Liner				

All interpretations are opinions based on inferences from electrical or other measurements and Pacific Surveys cannot and do not guarantee the accuracy or correctness of any interpretation, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages, or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to Pacific Surveys' general terms and conditions set out in our current Price Schedule.

Comments

Dual Induction Calibration Report

Serial-Model: 0001-ALT
Surface Cal Performed: Wed Jul 16 12:29:06 2008

Results
References
Readings

>>>> Fold Here <<<<<

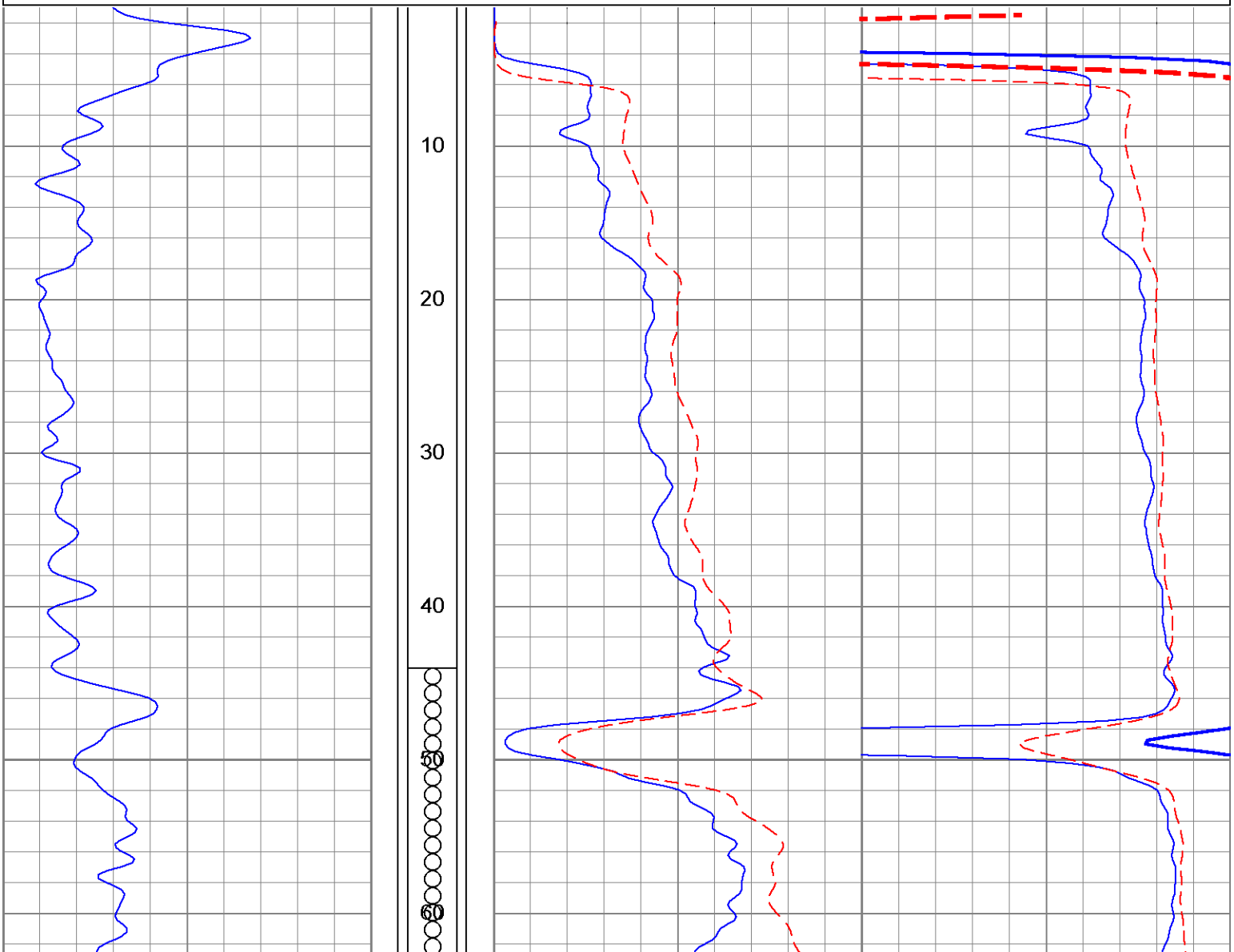
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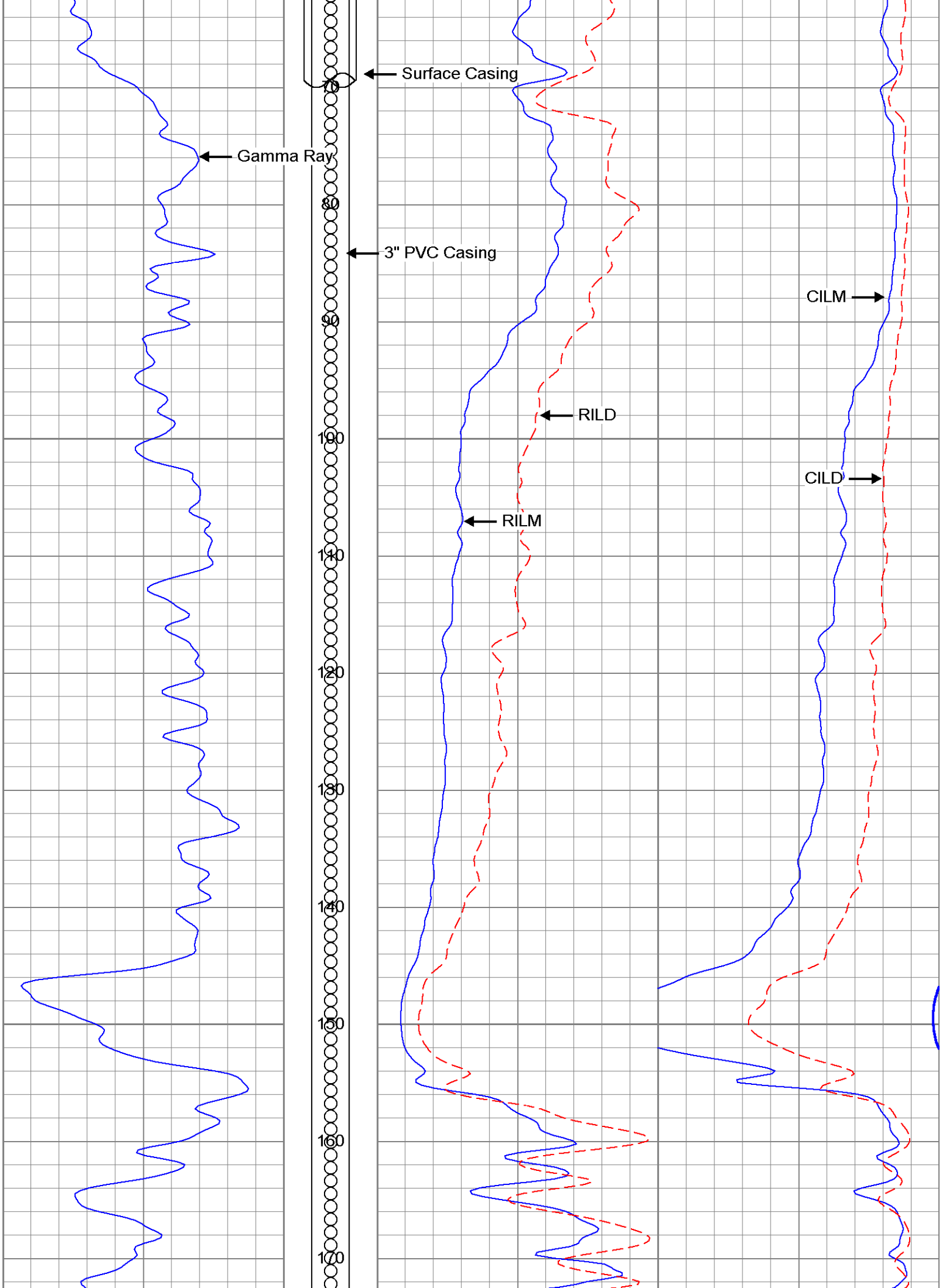
Gamma Ray Calibration Report

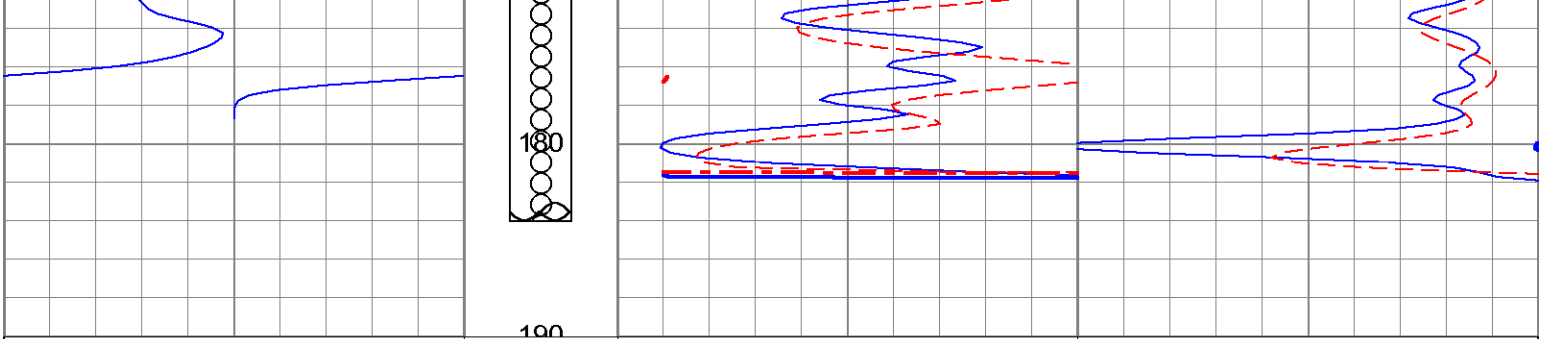
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Tool Model:	01	
Performed:	Wed Jul 16 12:42:11 2008	
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Background Reading:	41.1721	cps
Calibrator Reading:	160.188	cps
Sensitivity:	1.36116	GAPI/cps

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Dataset Pathname:	pge/well/run1/dil_run2.
Presentation Format:	DIL
Dataset Creation:	Mon Feb 16 16:05:55 2009 by Calc Warrior Version 6.6
Charted by:	Depth in Feet scaled 1:120

50	Gamma Ray (GAPI)	150			
			0	RILM (Ohm-m) 100	100 CILM (mmho-m) 0
			0	RILD (Ohm-m) 100	100 CILD (mmho-m) 0
			100	RILM backup (Ohm-m) 1000	1000 CILM backup (mmho-m) 100
			100	RILD backup (Ohm-m) 1000	1000 CILD backup (mmho-m) 100




Surface Casing
Gamma Ray
3" PVC Casing
RILD
RILM
CILM
CILD
70
80
90
100
110
120
130
140
150
160
170


180
190
50 Gamma Ray (GAPI) 150
0 RILM (Ohm-m) 100
100 CILM (mmho-m) 0
0 RILD (Ohm-m) 100
100 CILD (mmho-m) 0
100 RILM backup (Ohm-m) 1000
1000 CILM backup (mmho-m) 100
100 RILD backup (Ohm-m) 1000
1000 CILD backup (mmho-m) 100

PACIFIC SURVEYS

CALIPER
CASING VOLUME

Job No.
14458

Company CH2M HILL
Well MW-58-BR
Field TOPOCK
County SAN BERNARDINO State CA

Location:

N34*42.839' W114*29.429'
Pacific Gas & Electric Facility

Sec. Twp. Rge.

Other Services:

DUAL INDUCTION
GAMMA RAY

			Elevation
Permanent Datum	G.L.	Elevation above perm. datum	K.B.
Log Measured From	G.L. 0'		D.F.
Drilling Measured From	G.L.		G.L.

Date	2/13/2009		
Run Number	ONE		
Depth Driller	115'		
Depth Logger	114.4'		
Bottom Logged Interval	114'		
Top Log Interval	0'		
Pump Set @	N/A		
Time Pumping Prior to Survey	N/A		
Density / Viscosity	N/A		
Max. Recorded Temp.	N/A		
Pump Rate (GPM)	N/A		
Time Well Ready	8:30 AM		
Time Logger on Bottom	8:45 AM		
Equipment Number	PS-1		
Location	L.A.		
Recorded By	ABREAU		
Witnessed By	A. BREWSTER		

Borehole Record				Tubing Record			
Run Number	Bit	From	To	Size	Weight	From	To

Casing Record	Size	Wgt/Ft	Top	Bottom
Surface String	6"	Sch 80 pvc	0'	66'
Prot. String				
Production String	3"	Sch 80 pvc	0'	115'
Liner				

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All interpretations are opinions based on inferences from electrical or other measurements and Pacific Surveys cannot and do not guarantee the accuracy or correctness of any interpretation, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages, or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to Pacific Surveys' general terms and conditions set out in our current Price Schedule.

Comments

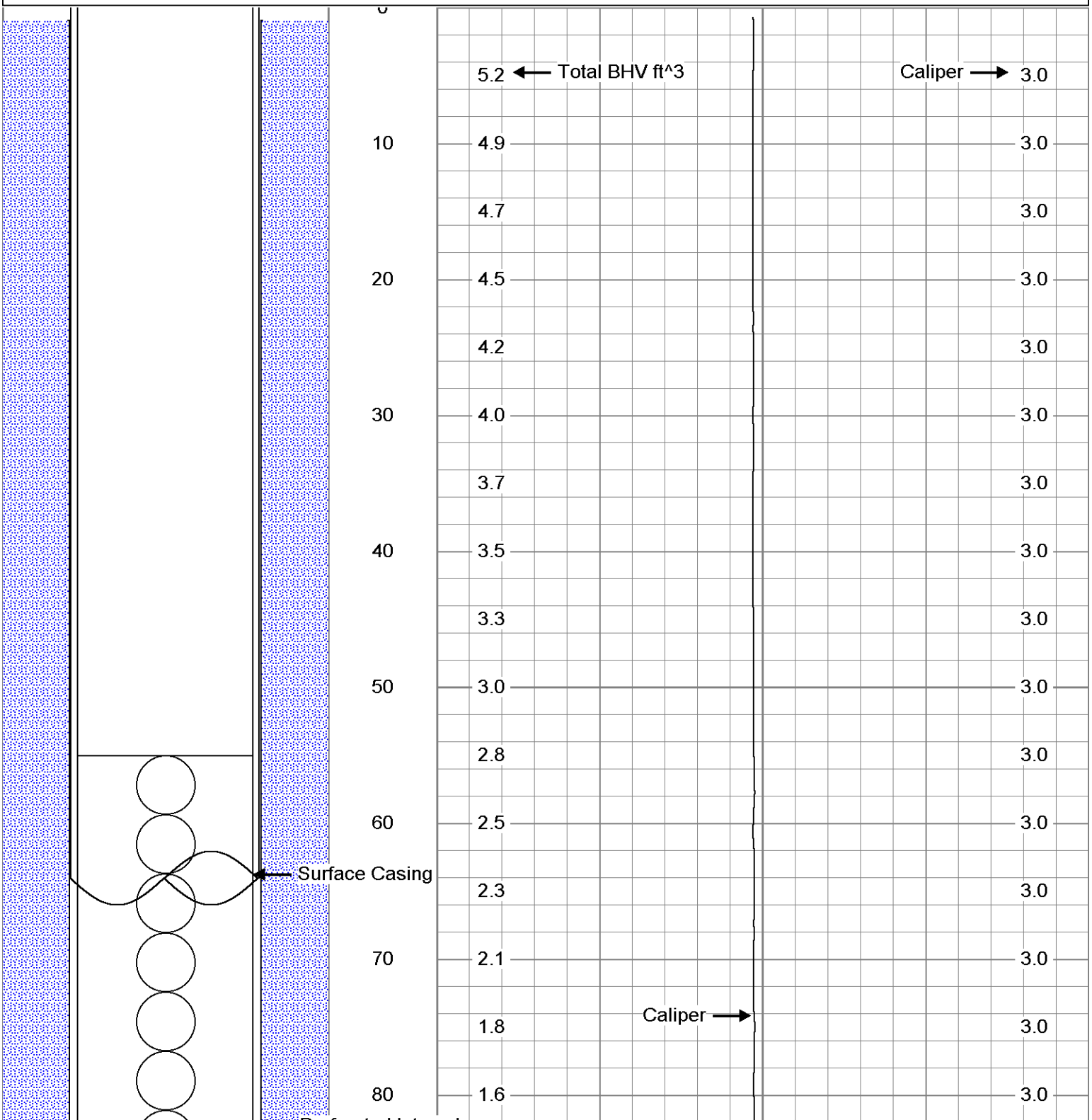
XY Caliper Calibration Report

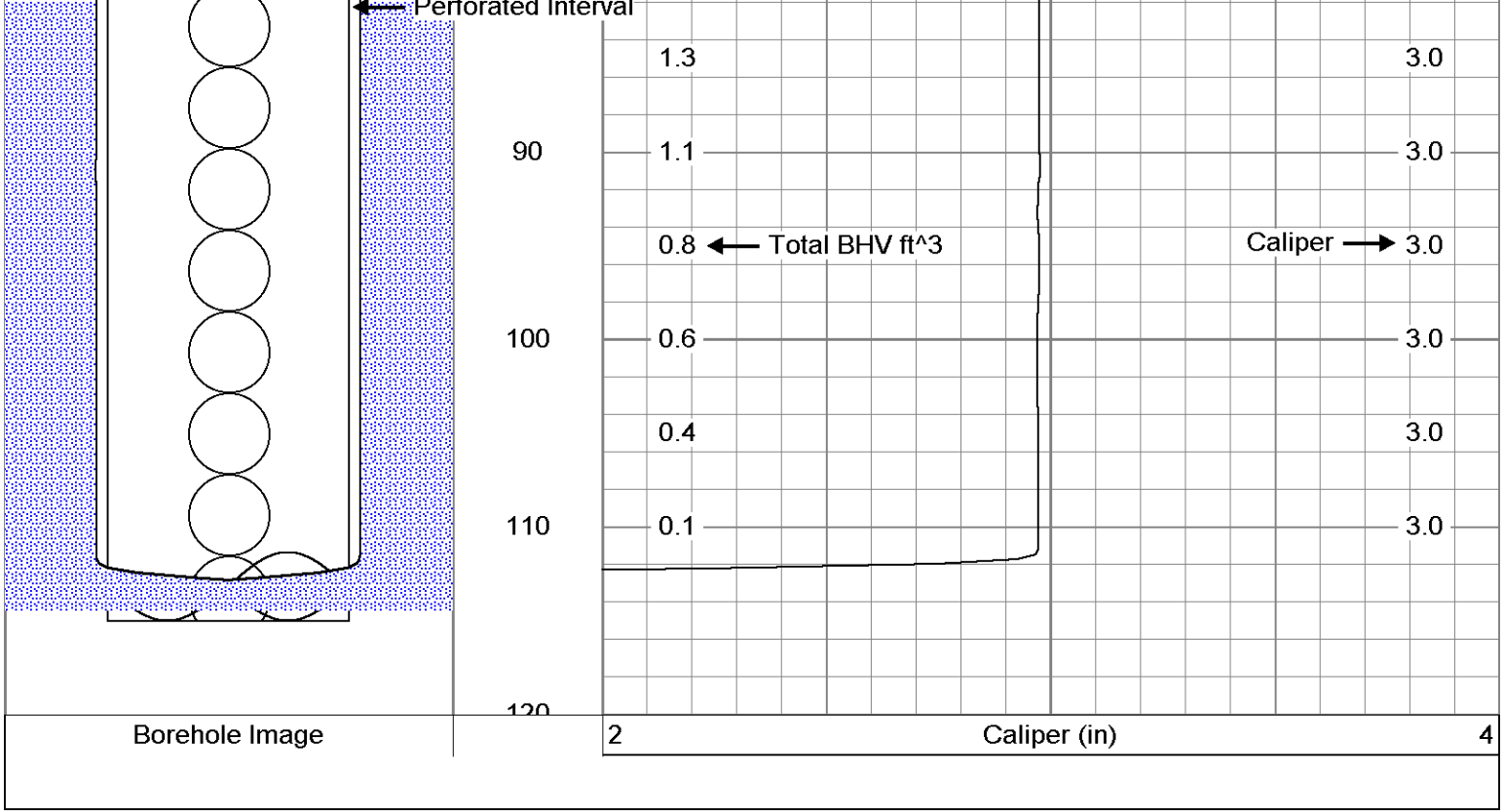
Serial Number: Short
Tool Model: Comprobe
Performed: Tue Dec 02 23:07:28 2008

Small Ring: 6 in
Large Ring: 16 in

	X Caliper	Y Caliper	
Reading with Small Ring:	762.874	762.874	cps
Reading with Large Ring:	1710.1	1710.1	cps
Gain:	0.0105572	0.0105572	
Offset:	-1.45379	-1.45379	

Database File:	14458.db
Dataset Pathname:	PGE/well/run1/CAL
Presentation Format:	XYC_GPH
Dataset Creation:	Fri Feb 13 12:00:44 2009 by Log Warrior Version 6.6
Charted by:	Depth in Feet scaled 1:120




Perforated Interval
1.3
3.0
90
1.1
3.0
0.8
Total BHV ft^3
Caliper
3.0
100
0.6
3.0
0.4
3.0
110
0.1
3.0
120
Borehole Image
2
Caliper (in)
4

PACIFIC SURVEYS

DUAL INDUCTION GAMMA-RAY

Job No. 14458

Company CH2M HILL
Well MW-58-BR
Field TOPOCK
County SAN BERNARDINO State CA

Location:

N34*42.839' W114*29.428'
Pacific Gas & Electric Facility

Sec. Twp. Rge.

Other Services:

CALIPER

Permanent Datum	G.L.	Elevation above perm. datum	Elevation K.B.
Log Measured From	G.L. 0'		D.F.
Drilling Measured From	G.L.		G.L.

Date	2/13/2009
Run Number	ONE
Depth Driller	115'
Depth Logger	114.4'
Bottom Logged Interval	114'
Top Log Interval	0'
Pump Set @	N/A
Time Pumping Prior to Survey	N/A
Density / Viscosity	N/A
Max. Recorded Temp.	N/A
Pump Rate (GPM)	N/A
Time Well Ready	8:30 AM
Time Logger on Bottom	8:45 AM
Equipment Number	PS-1
Location	L.A.
Recorded By	ABREAU
Witnessed By	A. BREWSTER

Borehole Record				Tubing Record			
Run Number	Bit	From	To	Size	Weight	From	To

Casing Record	Size	Wgt/Ft	Top	Bottom
Surface String	6"	Sch 80 pvc	0'	66'
Prot. String				
Production String	3"	Sch 80 pvc	0'	115'
Liner				

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Comments

Dual Induction Calibration Report

Serial-Model: 0001-ALT
Surface Cal Performed: Wed Jul 16 12:29:06 2008

Readings References Results

Loop:	Air	Loop		Air	Loop		m	b
Deep	1417.370	3879.020	cps	0.000	612.000	mmho-m	0.249	-352.377
Medium	1932.610	14228.100	cps	0.000	1960.000	mmho-m	0.159	-308.072

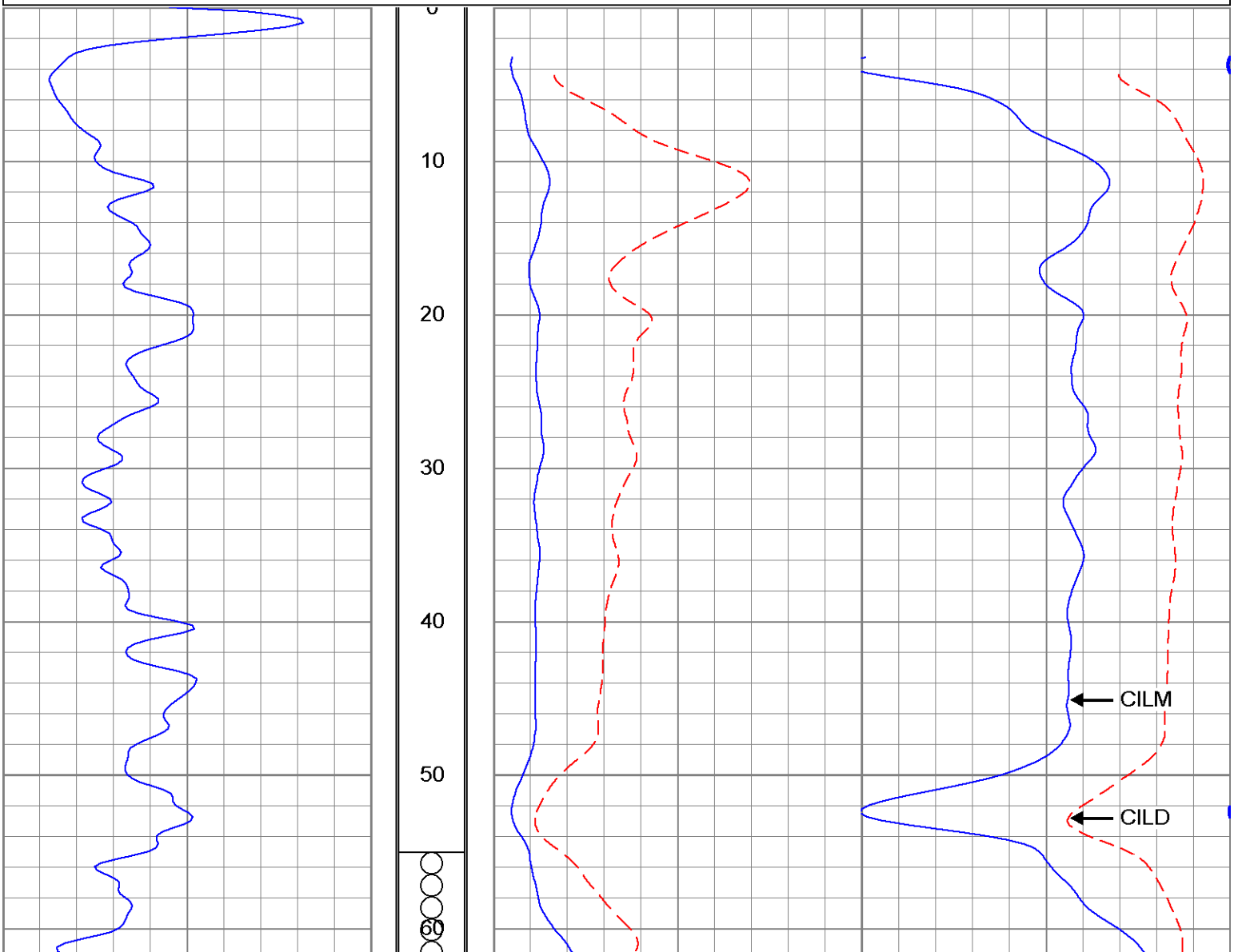
Gamma Ray Calibration Report

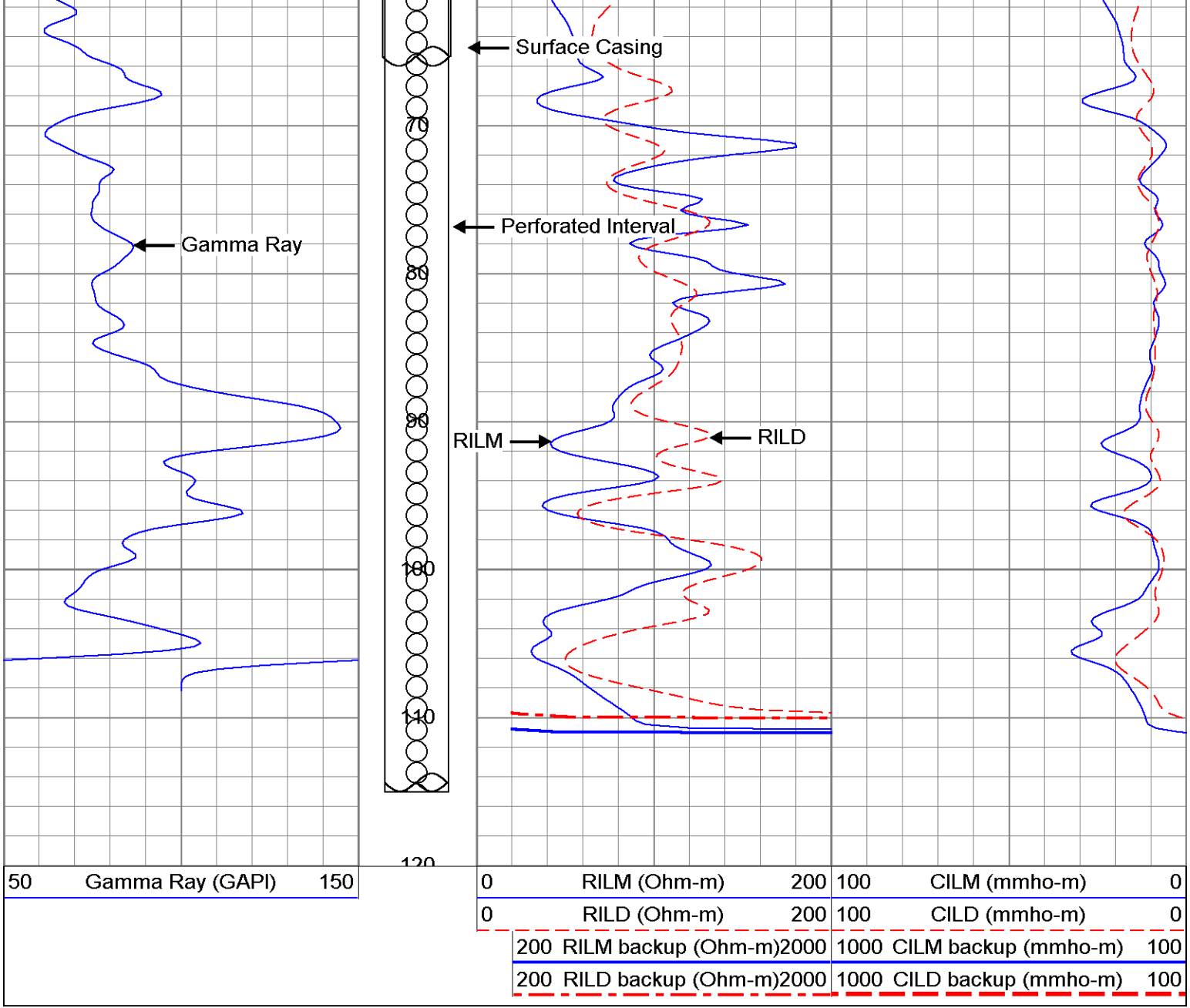
Serial Number:	PS_1	
Tool Model:	01	
Performed:	Wed Jul 16 12:42:11 2008	
Calibrator Value:	162	GAPI
Background Reading:	41.1721	cps
Calibrator Reading:	160.188	cps
Sensitivity:	1.36116	GAPI/cps

Database File:	14458.db
Dataset Pathname:	PGE/well/run1/DIL.2
Presentation Format:	DIL
Dataset Creation:	Fri Feb 13 08:58:55 2009 by Calc Warrior Version 6.6
Charted by:	Depth in Feet scaled 1:120

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			0	RILD (Ohm-m)	200
			200	RILM backup (Ohm-m)	2000
			200	RILD backup (Ohm-m)	2000

100	CILM (mmho-m)	0			
100	CILD (mmho-m)	0			
1000	CILM backup (mmho-m)	100			
1000	CILD backup (mmho-m)	100			




Surface Casing
Perforated Interval
Gamma Ray
RILM
RILD
70
80
90
100
110
120
50 Gamma Ray (GAPI) 150
0 RILM (Ohm-m) 200
0 RILD (Ohm-m) 200
200 RILM backup (Ohm-m) 2000
200 RILD backup (Ohm-m) 2000
100 CILM (mmho-m) 0
100 CILD (mmho-m) 0
1000 CILM backup (mmho-m) 100
1000 CILD backup (mmho-m) 100

Integrated Subsurface Evaluation

September 22, 2009

Mr. Rob Tweidt
Northstar Environmental Remediation
26225 Enterprise Court
Lake Forest, California 96230

RE: **Hydrophysical Logging and Discrete Point Sampling Investigation, PG&E Topock Compressor Station, Needles, California**

Dear Mr. Tweidt:

Attached please find RAS's Final Report presenting results from our Hydrophysical Logging and Discrete Point Sampling Investigation at the PG&E Topock Compressor Station, Needles, California. The wells tested included MW-57BR, MW-58BR (after deepening), MW-62BR and MW-64BR,

We appreciate the opportunity to work with you on this project.

Please call with any questions.

Best Regards,
RAS, Inc.

William H. Pedler
President

Executive Summary

During the period from February 25 through May 8, 2004, RAS conducted borehole hydrophysics in four wellbores at the PG&E Topock Compressor Station in Needles, California. This work was performed for Northstar Environmental Remediation of Lake Forest, CA (Northstar) under contract to CH2MHill of San Francisco, CA, in support of their contaminant migration investigation. The objective of this work was to employ borehole hydrophysical and discrete point sampling methods to provide additional data for evaluation of the groundwater contaminant plume and to evaluate preferential groundwater migration pathways at the subject site.

RAS applied hydrophysical logging (HPL), and discrete point sampling methods to evaluate four newly drilled wellbores. These wells were MW-57BR, MW-58BR, MW-62BR and MW-64BR. Well MW-58BR was tested twice, the second time after additional drilling was conducted to deepen the interval of investigation. Details of testing procedures can be founded in Appendix A of this report. Detailed field notes describing field activities are included in Appendix B, data logs and results of analysis are included in Appendix C and integrated data montages for each well can be found in Appendix D. A CD-ROM data disk with all these data and a copy of this report is also attached.

Ambient flow characterization (native flow during ambient or background pressures conditions) was conducted in each well. In all wells, ambient flow was observed to be occurring at extremely low flow rates during the period of our testing. Interval specific ambient flow ranged from less than 0.001 to 0.005 gallons per minute (gpm). The lowest ambient flow was observed in well MW-64BR, where flow over the entire saturated interval (apparently via primary porosity or extensive annealed micro-fracturing) occurred at less than 0.001 gallons per minute (gpm). The highest ambient flow rate was observed in Well MW-57BR at 0.005 gpm at the interval from 168 to 174 feet[1] (ftbtopvcc).

Flow evaluation was also conducted during stressed conditions where flow was induced into the wellbore by either pumping or slug testing methods. Aquifer conditions permitted constant rate pumping to be conducted in three of the four wells (MW-57BR, MW-58BR and MW-62BR). Aquifer conditions at MW-64BR were such that low rate pumping (<0.5 gpm) could not be sustained and as such, slug test procedures were required. The results of this testing suggested that, in general, the water bearing intervals were moderate to extremely low flowing units with interval specific flow rates ranging from 0.008 to 2.20 gpm. The lowest interval specific flow rate occurred over the entire saturated portion of well MW-

[1] All depths are referenced to feet below top of PVC casing (ftbtopvcc) or feet below ground surface (ftbgs). The data montages presented in Appendix D include a column of depth referenced to MSL.

64BR (0.008 gpm) and the greatest interval specific flow rate occurred in Well MW-57BR at a depth of 168 to 174 ftbtopvcc at 2.10 gpm. It should be noted that the interval of highest flow during pumping also corresponded to the interval displaying the greatest ambient flow (MW-57BR).

Discrete point sampling was conducted in each well to evaluate the interval specific concentration and vertical distribution of hexavalent chromium in each well. For each well, the depth location for the discrete point sampling was based on the hydrophysical logging results. This type of sampling was employed because borehole conditions required installation of a temporary slotted screen casing. The condition of the geologic material encountered at each of the subjects wells was deemed sufficiently unstable that there was a real threat of borehole collapse. The installation of the slotted screen prevented unstable geologic materials from entering the well and provided a safe downhole environment for testing.

The results of the discrete point sampling were incorporated with the interval specific flow results in order to estimate the interval specific concentrations. These calculations are based on the mass balance equation. The observed concentrations (those concentrations reported from the laboratory) and the calculated interval specific concentration are presented on each well montage in Appendix D. Observed concentrations varied from ND or <1ppb (collected at 203 ftbtopvcc in well MW-58BR during ambient flow conditions) to 1200ppb (two samples collected at 94.5 and 108 ftbtopvcc both in well MW-62BR). The calculated interval specific concentrations ranged from ND or <1ppb.

Based on pressure histories and corresponding interval specific flow rates observed during ambient and pumping conditions, interval specific hydraulic conductivities were estimated for each well. These estimates were intended to be preliminary in nature and were not based on any site specific algorithms that may have been developed by others. For simplicity, the estimates were based on Thiem (1906) and presented in the summary table for each well. These results were also plotted on data montages in Appendix D. In summary, the resulting interval specific hydraulic conductivity estimates ranged from 6.4E-2 to 8.09E0 feet per day.

Based on geologic logs, collected by others and presented in the data montages, the subject wells encountered a layer of unconsolidated sediment overlaying either conglomerate or metadiorite bedrock water. However, in the case of MW-57BR, both types of bedrock were encountered with the conglomerate overlying the metadiorite. The highest interval of hydraulic conductivity was found in metadiorite in MW-57BR. In general, both geologic units contained water bearing intervals and neither was significantly more hydraulically conductive than the other.

A figure of interval specific hydraulic conductivity and corresponding chromium concentrations is presented in Figure 1. Due to the apparent lack of linear correlation between contaminant concentrations and hydraulic conductivities, fractures may still be the dominant mechanism for contaminant transport.

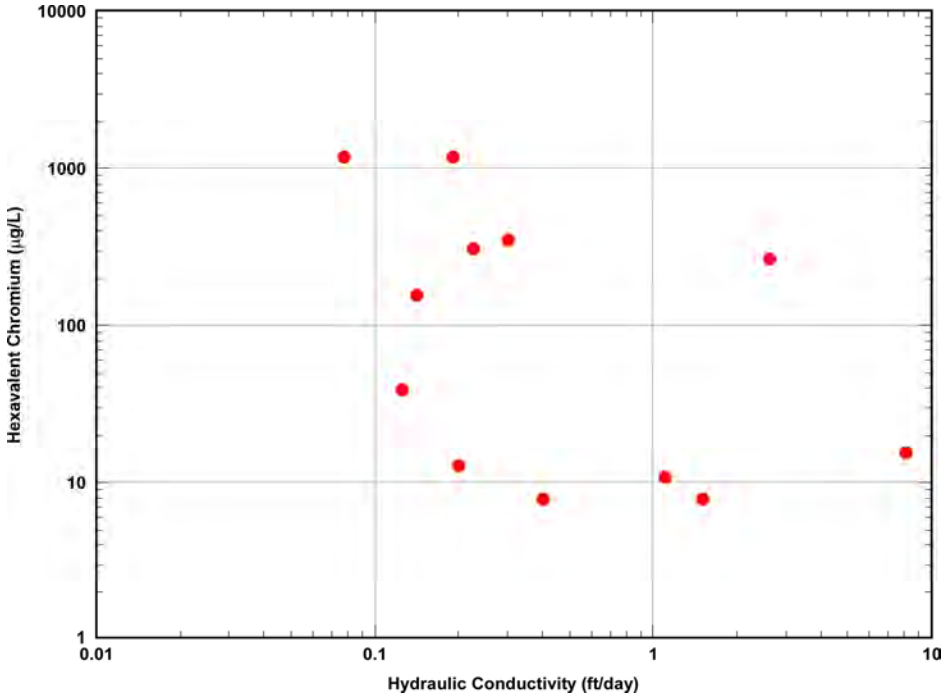


Figure 1. Interval Specific Hydraulic Conductivity versus Hexavalent Chromium.

Individual Well Discussion

On a well-specific basis, the RAS investigation suggested the following:

Well MW-57BR

During the period from February 26, 2009 to March 1, 2009, RAS conducted hydrophysical logging in well MW-57BR. The well had been recently drilled, properly developed and allowed sufficient time to stabilize prior to our arrival on site (greater than seven days). After conducting a health and safety meeting and being thoroughly briefed on site specific operational requirements, RAS personnel, under the direction and with assistance of Northstar, initiated equipment set up and check out. These procedures included initial decontamination of all downhole equipment, equipment move-in and configuration at the subject well. Test procedures, detailed notes of field activities and results of analyses can be found in Appendices A, B and C, respectively. The data montage for well MW-57BR with summarized results can be found in Appendix D. In addition, the final well construction and geology are included in this montage. This montage is the cornerstone of the following discussion of our results and is intended to be read together with this report.

The ambient FEC and temperature log is presented in panel nine of the MW-57BR data montage. The FEC log displays two distinct step change increases in FEC with depth. These step changes occurred from 117 to 130 and 145.5 to 156 ftbtopvcc. The temperature log displays a typical geothermal gradient with no discerning features of note. The temperature increased from about 25 to 28 degrees Centigrade (C) over the saturated interval of 56.5 to 177 feet. This equates to a thermal gradient of about 2.5 C per 100 feet.

Ambient flow characterization (AFC) was conducted on February 27, 2009. Please refer to Appendix A for detailed procedures of the test. At the time of testing, the depth to water was 53.09 ftbtopvcc. Flow characterization was conducted during the period from 12:50 to 17:40 hours, during which period, fourteen logging runs were conducted. Water level returned to within 0.1 feet of the background value after about 30 minutes. A final log was collected the following morning prior to commencing additional testing. Analysis of these logs using the centroid and integral methods suggest the presence of two water bearing intervals from 146 to 151 and 168 to 174 feet[2]. Ambient flow for these intervals was extremely low at 0.003 and 0.005 gpm, respectively.

On February 28, 2009, evaluation of these intervals by pumping during injection testing was conducted with a formation production rate of about 2.1 gpm. Analysis of the data collected during this testing suggested that the upper interval,

[2] All depths referenced to top of PVC casing.

from 146 to 151 ft was inflowing at 0.03 gpm and the lower interval from 168 to 174 was flowing at 2.1 gpm. These interval specific flow rates, with an associated drawdown of about 10.3 feet, resulted in interval specific hydraulic conductivity for the intervals at 146 to 151 and 168 to 174 ft of 1.25E-1 and 8.1E+0 ft/day, respectively. The HPL results also suggested that the upper and deeper flow intervals had interval specific FEC of about 2500 µS/cm and 20,000 µS/cm, respectively. Please refer to Appendix B for HPL data analysis details and a summary table of these results.

Based on the results of the HPL, discrete point sampling was conducted during ambient and pumping conditions. These groundwater samples were collected to evaluate the interval specific concentrations of hexavalent chromium concentrations. Sampling was conducted at 92.6, 102.0, 114.0, 154.0 and 174.9 feet. The results of the discrete point sampling were incorporated with the interval specific flow results in order to estimate the interval specific concentrations. These calculations are based on the mass balance equation. The observed concentrations (those concentrations reported from the laboratory) and the calculated interval specific concentration are the montage in Appendix D. In summary, the calculated interval specific contaminant concentrations for the intervals from 146 to 151 and 168 to 174 ft were 39 and 16 ppb, respectively.

Review of the natural gamma and induction/resistivity data and comparison to the HPL results does not suggest an obvious relationship between the flow intervals and a geophysical response. The details from the geologic log do not correspond or account for the geophysical responses. The cross-over signatures of the medium and deep induction/resistivity logs near the flow interval at 168 to 174 feet suggest a thin bed response and perhaps have some relationship to the flow interval. However, without high resolution optical or acoustic data over this interval, the physical nature of the flow intervals is challenging to discern.

Well MW-58BR

During the period from March 3 to March 5, 2009, RAS conducted hydrophysical logging in well MW-58BR. The well had been recently drilled, properly developed and allowed sufficient time to stabilize prior to our arrival on site (greater than seven days). Prior to installation, all downhole equipment was decontaminated. Following decontamination procedures, equipment move-in and configuration at the subject well were conducted. After equipment set-up, check out and calibration, RAS initiated hydrophysical testing and downhole sampling at well MW-58BR. Test procedures, detailed notes of field activities and results of analyses can be found in Appendices A, B and C, respectively. Based on these results, the well was subsequently drilled deeper and re-tested. As the subsequent testing included the originally drilled interval, only the later testing will be discussed and present in this report.

On April 30, 2009, RAS returned to the subject well and tested MW-58BR after additional drilling to deepen the subject well was completed. The total depth of the original wellbore was about 110 feet and with an ambient depth to water of 67.74 feet. The total depth after re-drilling was approximately 206 feet with the ambient depth to water at 67.44. Again, the well was allowed sufficient time to stabilize prior to testing. Hydrophysical logging and discrete point sampling were conducted during the period from April 30 to May 3, 2009. The results are summarized in the data montage for MW-57BR found in Appendix D. In addition, the final well construction and geology are included in this montage. This montage is the cornerstone of the following discussion of our results and should be read together with this report.

The ambient FEC and temperature log is presented in panel six of the MW-58BR data montage. The FEC log displays two distinct step change increases in FEC with depth. These step changes occurred from 86 to 93 ft with a more gradual increase with depth from 160 to 186 ftbtopvcc. The temperature log displays a typical geothermal gradient with no discerning features of note. The temperature increased from about 28 to 29.3 degrees Centigrade (C) over the saturated interval of 98 to 207 feet. This equates to a thermal gradient of about 1.2 C per 100 feet.

Ambient flow characterization (AFC) was conducted May 1 through May 2, 2009. Two days were required for AFC given the extremely low flow that was observed. Please refer to Appendix A for detailed procedures of the test. During the period of testing, the depth to water was relatively stable and only varied from 67.06 to 67.11 ftbtopvcc. A detailed pressure history is provided in the attached Processing Notes. Flow characterization was concluded on the morning of May 3, when the final AFC log was collected prior to initiating pumping. During this period, twenty logging runs were conducted. Analysis of these logs using the centroid and integral methods suggest the presence of very low-rate upflow occurring from the bottommost water bearing interval from 190 to 207 ftbtopvcc. Analysis of these data suggests that the inflow rate for this interval was extremely low at 0.004 gpm. The outflow location(s) could not be determined from these data due to the extremely low inflow rate and the extended period of additional testing time required (approximately five additional days).

On May 3, 2009, additional aquifer evaluation by slug test (rising head) after DI water emplacement testing was conducted with a water level head displacement of about 7 feet. The average formation production rate during logging was about 0.5 gpm. Analysis of the data collected during this testing suggested that seven (7) conductive, or water bearing, intervals were present. These intervals were at the depths of 95.9 to 103.7, 106.6 to 111.3, 114.7 to 120.1, 128.0 to 130.5, 132.4 to 136.3, 148 to 190 and 190.0 to 207 ftbtopvcc. The interval specific flow rates ranged from 0.003 to 0.27 gpm. The minimum and maximum inflow rates occurred at 128.0 to 130.5 and 148 to 190 ftbtopvcc, respectively. These interval specific flow rates, with an associated drawdown of about 6.8 feet, resulted in interval specific hydraulic conductivity estimates ranging from 0.2 to 2.6 feet per

day. The HPL results also suggested that the flow intervals had reasonably similar interval specific FEC of about 10,000 µS/cm. Please refer to Appendix B for HPL data analysis details and a summary table of these results.

On May 8, 2009, discrete point sampling was conducted during ambient and pumping conditions. These groundwater samples were collected to evaluate the interval specific concentrations of hexavalent chromium. Sampling during pumping at approximately 0.5 gpm was conducted at 125, 140 180 and 206 ftbtopvcc. Prior to initiating pumping, a sample was collected from 203 ftbtopvcc under ambient, upflowing, conditions. The results from the lab of the discrete point samples collected during pumping were incorporated with the interval specific flow results to estimate the actual interval specific concentrations, as based on the mass balance equation. The observed concentrations (those concentrations reported from the laboratory) and the calculated interval specific concentrations are presented on the montage for MW-57BR in Appendix D. In summary, the calculated interval specific contaminant concentration increased dramatically with depth, from 8 ppb for the conductive intervals at 95.9 to 103.7, 106.6 to 111.3, and 114.7 to 120.1 ft to 256ppb for the bottommost interval at 190.0 to 207 ft. However, the sample collected during ambient conditions was reported at <1ppb. This observation suggests that while this interval was uncontaminated during ambient pressure and flow conditions, after several hours of pumping, contaminated groundwater was drawn either vertically and or horizontally to the deepest interval in the subject well.

Limited geophysical data were available for comparison with the hydrophysical results. The interval over which the natural gamma and induction/resistivity data is available for comparison was 0 to 110 ftbtopvcc. This depth corresponds to the original depth of well MW-58BR prior to re-drilling. The uppermost water bearing interval occurs within this interval, from 95.9 to 103.7 ft. This water bearing interval encapsulates an increase in deep and medium resistivity. A decrease in natural gamma is also noted over this interval.

The details from the geologic log do not correspond or account for the geophysical responses. The cross-over signatures of the medium and deep induction/resistivity logs near the flow interval at 69 to 95 feet occurs in the meta-diorite and suggest either a variation in petrology, fracturing, fracture fill material, a combination of these factors or something else. Without high resolution optical or acoustic data over this interval, the physical nature of the flow intervals is very challenging to discern.

Please refer to Appendix B for HPL data analysis details and a summary table of these results.

MW-62BR

During the period from May 5 to May 8, 2009, RAS conducted hydrophysical logging in well MW-62BR. The well had been recently drilled, properly developed and allowed sufficient time to stabilize prior to our arrival on site (greater than seven days). Prior to installation, all downhole equipment was decontaminated. Following decontamination procedures, equipment move-in and configuration at the subject well were conducted. After equipment set-up, check out and calibration, RAS initiated hydrophysical testing and downhole sampling. Test procedures, detailed notes of field activities and results of analyses can be found in Appendices A, B and C, respectively.

On May 5, 2009, after tool calibration and an ambient FEC and temperature log hydrophysical logging for ambient flow characterization (AFC) was initiated. Ambient flow characterization was initiated on May 5 and conducted for two days due to extremely low inflow rates observed. Following AFC, flow characterization during stressed (pumping) and discrete point sampling were conducted from May 7 to May 8, 2009. The results are summarized in the data montage for MW-62BRfound in Appendix D. In addition, the final well construction and geology are included in this montage. This montage is the cornerstone of the following discussion of our results and should be read by the reader during his review of this report.

The ambient FEC and temperature log is presented in panel four of the MW-62BR data montage. The FEC log displays two distinct step change increases in FEC with depth. These step changes occurred from 88 to 99 ft with another at depth from 147 to 153 ftbtopvcc. The temperature log displays an atypical geothermal gradient with a distinct “swoosh” type signature. The temperature log was constant with depth at about 28.3 C to about 76.4 feet, and then the temperature gradually decreases to about 27.9 C at 139 feet, before resuming a traditional geothermal gradient to total depth (191 ftptopvcc).

Ambient flow characterization was initiated on May 5 and concluded the morning of May 7, 2009. This extended period of time was required given the extremely low flow that was observed. Please refer to Appendix A for detailed procedures of the test. After an initial stabilization period of about two hours following emplacement, the depth to water was relatively stable and varied only about 0.2 feet during the period of testing. A detailed pressure history is provided in the Processing Notes in Appendix B. Ambient flow characterization was concluded on the morning of May 7 when the final AFC log was collected prior to initiating pumping. During this period twenty logging runs were conducted. Analysis of these logs using the centroid and integral methods suggest the presence of a very low rate upflow occurring from the bottommost water bearing interval at 185 to 190 ftbtopvcc. Analysis of these data suggests that the inflow rate for this interval was extremely low at 0.01 gpm. The outflow location could not be unequivocally

determined from these data, but this analysis does suggests that the outflow zone was the uppermost water bearing interval from 85 to 95 feet.

On May 7, 2009, additional aquifer evaluation by pumping during deionized water injection was conducted. The average formation production rate during logging was 1.3 gpm with a reasonably stable drawdown of about 23.10 feet. Analysis of the data collected during this testing suggested that six (6) conductive, or water bearing, intervals were identified. These intervals were at depths 85.8 to 95.0, 95 to 107, 142 to 151.2, 156 to 171.2, 173.9 to 182.1 and 185 to total depth (~190) ftbtopvcc. The interval specific flow rates ranged from 0.04 to 0.56 gpm. The minimum and maximum inflow rates occurred at 142 to 151.2 and 185 to 190 ftbtopvcc, respectively. These interval specific flow rates, with an associated drawdown of about 23.1 feet, resulted in interval specific hydraulic conductivity estimates ranging from 4.45E-02 to 3.00E-01 feet per day. The HPL results also suggested that the flow intervals had increasing interval specific FEC with depth, specifically increasing from 6,000 at the uppermost interval to 12,200 µS/cm for the deepest water bearing interval. Please refer to Appendix B for HPL data analysis details and a summary table of these results.

On May 8, 2009, discrete point sampling was conducted during ambient and pumping conditions. These groundwater samples were collected to evaluate the interval specific concentrations of hexavalent chromium. Samples during pumping at approximately 1.2 gpm were collected from 94.5, 108, 149, 170, 184.5 feet and from the pump discharge. Prior to pumping, a sample was collected at 187 ftbtopvcc under ambient, upflowing, conditions. The results from the laboratory of the discrete point samples collected during pumping were incorporated with the interval specific flow results to estimate the actual interval specific concentrations, as based on the mass balance equation. The observed concentrations (those concentrations reported from the laboratory) and the calculated interval specific concentrations are presented on the well MW-62BR montage in Appendix D. In summary, the calculated interval specific contaminant concentrations notably decreased with depth, from 1200 ppb for the conductive intervals at 95.9 to 103.7, 106.6 to 111.3, 114.7 to 120.1 to 256ppb for the bottommost interval at 190.0 to 207 ft. However, the sample collected during ambient conditions was reported at <1ppb. This observation suggests that while this interval was uncontaminated during ambient pressure and flow conditions, after several hours of pumping, contaminated groundwater was drawn either vertically and/or horizontally to the subject well's deepest interval.

No geophysical data was available for comparison with the hydrophysical results.

Please refer to Appendix B for HPL data analysis details and a summary table of these results.

MW-64BR

During the period from May 27 to June 1, 2009, RAS conducted hydrophysical logging in well MW-64BR. The well had been recently drilled, properly developed and allowed sufficient time to stabilize prior to our arrival on site (greater than seven days). After conducting a health and safety meeting and being thoroughly briefed on site specific operational requirements, RAS personnel initiated equipment set up and check out. These procedures included initial decontamination of all downhole equipment, equipment move-in and configuration at the subject well. Downhole sampling was not conducted at well MW-64BR due to extremely low overall well yield and lack of any significant preferential flow intervals. Test procedures, detailed notes of field activities and results of analyses can be found in Appendices A, B and C, respectively. The results summarized the data montage for MW-64BR can be found in Appendix D. In addition, the final well construction and geology are included in this montage. This montage should be reviewed by the reader during his reading of this report.

The ambient FEC and temperature log is presented in panel four of MW-64BR data montage. The FEC log displays an increase in FEC with depth over the upper 40 feet of the fluid column. The temperature log displays a "swoosh" type signature, first decreasing to a depth 174 feet, then increasing to total depth. During the initial ambient FEC and temperature log, some residual drilling material was encountered at about 228 feet. This material fouled the FEC sensors causing the decrease in FEC at this depth and the remaining errant readings to TD. As such, the FEC data is not representative of the fluid column from 228 to 258 feet. This residual material was removed from the wellbore and all subsequent logs were successfully collected.

Ambient flow characterization was initiated on May 29, 2009. Please refer to Appendix A for detailed procedures of the test. At the time of testing, the depth to water was 119.48 ftbtopvcc. Ambient flow characterization was initiated May 29 at 12:05 and concluded on May 31 at 09:05 hours. During this period, fifteen (15) logging runs were conducted. At the completion of emplacement procedures, the water level was elevated approximately 6.5 feet above the ambient elevation. Hand bailing was conducted immediately after emplacement, and prior to logging, to carefully return the water level elevation back to the ambient elevation. Analysis of these logs using the centroid and integral methods suggest extremely low inflow over the entire saturated interval. No distinct or preferred flow intervals were apparent. As such, the observable and recorded increase in FEC suggests primary flow. Analysis suggests an inflow rate of less than 0.001 gpm for the entire saturated interval.

On May 31, 2009, flow evaluation of the saturated interval was conducted using the HPL slug test after emplacement (SAE) method. Analysis of the data collected during SAE testing supports the ambient flow characterization and confirms the lack of any preferential flow paths. Analysis of the data suggests

that the total flow over the entire saturated interval was 0.008 gpm. This overall flow rate is also supported by the water level recovery curve. Based on the rising head data, an overall hydraulic conductivity based on Hvorslev (1951) of 6.4E-2 feet per day was calculated.

The HPL results also suggested an interval specific formation water concentration of 11,000 µS/cm for the saturated interval. Please refer to Appendix B for HPL data analysis details and summary table of these results.

Based on the results of the HPL, discrete point sampling was not conducted as the well could not produce sufficient volumes of formation water without dewatering the interval(s) of interest.

Similar to MW-62BR, no geophysical logs were collected in this well.

Please refer to Appendix B for HPL data analysis details and a summary table of these results.

Limitations

Water levels have been measured in the well bores at the times and under the conditions stated in the report. These data have been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall and other factors different from those prevailing at the time measurements were made.

Except as noted within the text of the report, no quantitative laboratory testing was performed to verify the calibration of the logging tool. Where such analyses have been conducted by an outside laboratory, RAS, Inc. has relied upon the data provided, and has not conducted an independent evaluation of the reliability of these data.

Conclusions and recommendations contained in this report may be based in part upon various types of chemical data and are contingent upon their validity. These data have been reviewed and interpretations made in the report. As indicated within the report, these data are developed based on the field calibration of the logging tool. Where more specific information is necessary, the tool measurements should be verified based on quantitative lab analyses of grab samples obtained directly from the wellbore. Moreover, it should be noted that the variations in the types and concentrations of groundwater constituents and variations in their flow paths may occur due to seasonal water table fluctuations, past site practices, the passage of time, and other factors. Should additional chemical data become available in the future, these data should be reviewed by RAS, and the conclusions and recommendations presented herein modified accordingly.

The values for bedrock hydraulic conductivity given in this report should be viewed as "equivalent hydraulic conductivities", which are computed based on an assumed, or equivalent, interval length and a uniformly pervious porous media behavior. This industry standard approach has several limitations, which are well documented in the current literature. In addition, the accuracy of the equivalent hydraulic conductivities when presented herein is subject to the applicability of the boundary condition assumptions inherent in the permeameter/slug test/pumping test analysis method used.

RAS's logging was performed in accordance with generally accepted industry practices involving similar studies at the same time and in the same general area. RAS has observed that degree of care and skill generally exercised by others under similar circumstances and conditions. Interpretation of logs from the newly developed techniques, Scanning Colloidal Borescope Flowmeter, Hydrophysical Logging ("NxHpL™") and Wireline Straddle Packer Testing ("WSP™") (whether made directly from visual observations or by data processing or otherwise), or

interpretation of test or other data, and any recommendation or hydrogeologic description based upon such interpretations, are opinions based upon inferences from measurements, empirical relationships and assumptions. These inferences and assumptions require engineering judgment, and therefore are not scientific certainties. As such, other professional engineers or analysts may differ as to their interpretation. Accordingly, RAS cannot and does not warrant the accuracy, correctness or completeness of any such interpretation, recommendation or hydrogeologic description.

All technical data, evaluations, analysis, reports, and other work products are instruments of RAS's professional services intended for one time use on this project. Any reuse of work product by Client for other than the purpose for which they were originally intended will be at Client's sole risk and without liability to RAS. RAS makes no warranties, either express or implied. Under no circumstances shall RAS or its employees be liable for consequential damages.

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APPENDIX A

TECHNICAL PROCEDURES

RAS, Inc., Integrated Subsurface Evaluation
311 Rock Avenue
Golden, Colorado 80401 (303) 526-4432
bpedler@rasinc.org
www.rasinc.org

Hydrophysical Logging for Aquifer Characterization

TP-19

Prepared by: _____ Date: 7-15-2008

William H. Pedler

Reviewed by: _____ Date: _____

Approved by: _____ Date: _____

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TP-19

Revision History

Revision Level	Issue Date	Change Summary
6	07/15/08	Revisions to Sampling protocol and format TOC
5	03/16/07	Edits for Intera Bruce Site Test Plan
4	2/14/07	Draft version editing for Intera Bruce Site Test Plan
3	06/05/06	New contact information.
2	11/03/03	Includes procedures for Depth Specific Sampling
1	07/8/02	Technical Editing
0	08/15/98	RAS Issue date

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1.0 SCOPE

1.1 Purpose

The purpose of this procedure is to assure the accuracy, validity, and applicability of the methods used to record hydrophysical logs in a previously drilled borehole. This procedure provides a guide for the Client's contractor to perform the described activity. From this procedure the Client can evaluate these activities for meeting the requirements of the Project.

This procedure describes the components of Hydrophysical logging, the principles of the methods used and their limits. It also describes the detailed methods to be used for calibration, operation and performance verification of the equipment. In addition, requirements for data acceptance, documentation, and control are defined, and means of data traceability are provided.

1.2 Applicability

This procedure applies to all personnel contractor personnel who may perform work or use data obtained from this procedure if it is deemed to potentially affect public health and safety related the Project

2.0 REFERENCES

2.1 Tsang, C.F., F.V. Hale, and P. Hufschmied, "Determination of. Fracture Inflow Parameters with a Borehole Fluid Conductivity Logging Method," Water Resources Research, Vol. 26, No., 4, 561-578, April 1990.

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2.3 Hvorslev, M.J. Time lag and soil permeability in ground water observations waterways experiments station Corps of Engineers, U.S. Army, 1951.

2.4 Work instructions as called out herein.

2.5 Technical procedure TP-13.

3.0 DEFINITIONS

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3.1 Hydrophysical Logging: Technology for evaluating hydrologic conditions surrounding a borehole.

Specifically, The Hydrophysical (HPL) logging method uses repeat logs of FEC and temperature to analyze and determine the location of hydraulically conductive intervals within a wellbore. The results can be used in conjunction with drawdown data obtained during active pumping to determine interval specific hydraulic conductivity or transmissivity. The technique can also be used to characterize ambient (non-pumping) flow conditions.

3.2 FEC: Fluid electrical conductivity.

3.3 Standard Reference Solution: A solution of known electrochemical properties, calibrated to a known FEC, to be used for calibration of HpL Sonde.

3.4 HPL Sonde: Wireline logging tool which measures FEC and temperature for use during Hydrophysical Logging.

3.6 Emplacement - The process of replacing ambient fluids in a borehole with deionized water.

3.7 Injection line - Either flexible tubing or rigid pipe used for emplacement.

3.8 Affected Interval: That interval in a borehole into which fluids flow during inflow or out of which fluids flow during outflow.

During ambient testing, the affected interval is defined as the zone between the deepest productive interval in a given well and the water surface.

During active pumping or DI emplacement, the affected interval is defined as the zone between the deepest hydraulically active interval in a given well and the inlet of the extraction pump.

3.9 Low yield well: Any well having a specific capacity less than 0.1 gallon per minute per foot of drawdown.

3.10 Moderate yield well: Any well having a specific capacity between 0.1 gallon per minute and 4.0 gallons/minute per foot of drawdown.

3.11 High yield well: Any well having a specific capacity greater than 4.0 gallons per minute per foot of drawdown.

3.12 Specific capacity is defined as the rate of fluid influx of a borehole, in units of flow rate per unit drawdown.

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3.13 Slug test: Method for testing flow in a well which involves rapid extraction of a finite fluid volume to produce a one-time, sudden, finite decrease in fluid level in the well, and monitoring subsequent fluid recovery.

3.14 Pumping test: Method for testing flow in a well which involves continuous extraction of fluid at a constant rate to maintain a fixed decrease in fluid level in the well, while monitoring fluid extraction rate and water level. In HpL testing, a pumping test may also include simultaneous fluid injection at a fixed rate.

7.1 Deionized (DI) water: Water with a very low concentration of dissolved species and having typically between 5 and 25 µS/cm conductivity.

7.2 Discrete Point Fluid Sampler: Down hole logging tool that is used to collect a depth specific fluid sample lowered to a depth pre-selected by hydrophysical logging results.

3.17 Personnel

3.17.1 Principal Investigator (PI): Responsible for assuring full compliance with this procedure. PI shall require that all personnel assigned to work under this procedure have the necessary technical training, experience, and personnel skills to adequately perform this procedure.

The PI is also responsible for overall operations and data quality.

The PI shall determine whether the data and procedures meet the acceptance criteria.

3.17.2 If necessary due to field conditions, the PI may perform the duties of the Logging Engineer and/or the Technician.

3.17.3 If necessary due to field conditions, the Logging Engineer may perform the duties of the Technician.

4.0 REQUIREMENTS

4.1 Prerequisites

4.1.1 Borehole of appropriate size and completion methodology.

In open bedrock boreholes, casing shall be installed through the overburden and grouted at the rock/alluvium interface to inhibit water leakage into the borehole from the saturated alluvium. For cased boreholes, the well shall be fully cased and gravel packed with single or multiple screened intervals.

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The diameter of the borehole shall be 4 inches or greater. For boreholes which require higher pumping rates (> 4 gpm) a 4 inch diameter pump may be required. For use with a 4 inch diameter pump, the diameter of the borehole shall be 6 inches or greater.

For newly drilled wells, cuttings and drill fluids shall be removed from the affected fractures by standard well development procedures.

4.1.2 Source of DI water. If DI water is prepared at the site, the pre-treated water shall be potable and less than 1000 µS/cm FEC.

4.1.3 Surface injection and submersible extraction pump(s) for HPL testing.

4.2 Tools, Material, and Equipment

Typical field equipment includes for shallow (less than 300 feet total depth):

- Fluid management system
  - Back Pressure Regulator or orifices
  - Rubber hose (0.75-inch i.d.) for injection
  - Submersible Pump
  - Evacuation Line
  - Storage tanks (as required) with inlet/outlet valves
  - Surface Pump
  - Fluid management manifold/Monitoring Panel
  - Mechanical hose spoolers (pump, injection)
  - Data Acquisition System (for recording volumes, flow rates, time)
  - Wireline System
  - Cable
  - Power supply
    - Wireline winch unit
    - Boom and drawworks
  - Depth encoder
  - Water level indicator
  - Computer System
  - NxHpl™ Logging tool
  - Downhole Fluid Sampler

- Deionized water (prepared with wellbore fluids or transported on-site)
- Appropriate water sample containers (typically provided by client)
- Steam Cleaner (for logging/sampling tools)
- Deionizing Units

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4.2.2 For wells greater than 300 feet total depth, an independent pumping system and standard wireline logging truck is required. This includes:

Wireline System, Cable, Power supply, Wireline winch unit, Boom and drawworks, Depth encoder, Water level indicator, Computer System, Hydrophysical Logging tool, and Downhole Fluid Sampler.

4.2.3 RAS independent pumping system includes:

Fluid management system, Back Pressure Regulator or orifices, 1" galvanized pipe for injection lines, 2" galvanized pipe for evacuation lines, Submersible Pump, Storage tanks (as required) with inlet/outlet valves, Surface Pump, Fluid management manifold/Monitoring Panel, and Data Acquisition System (for recording volumes, flow rates, time).

4.2.4 Deionized water (prepared with wellbore fluids or transported onto the site).

4.2.3 Standard reference solutions: A minimum of 4 prepared solutions for calibration check of FEC measurements by the HpL sonde.

4.2.4 Surface flow meters may be provided by the client.

4.2.5 Steam cleaning equipment, if required.

4.3 Precautions and Limits

7.1.1 The operational temperatures and pressures for the RAS's advanced, multi FEC/T arrayed hydrophysical tool are:

- Maximum operating pressure is approximately 1,000 PSI.
- Maximum practical operational temperature is 80^{o}C.

4.3.2 Hydrophysical tests require that the borehole fluid be emplaced with deionized water. Improper emplacement of the DI water or its subsequent contamination can drastically affect the quality of the test.

4.3.3 The minimum borehole size is 4". Larger boreholes (6" or greater) may be required to utilize 4" diameter pumps if it is necessary to achieve flow rates higher than approximately 4 gpm. This may occur when testing of a high yield well.

4.3.4 The Hydrophysical technique requires a fluid filled borehole.

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7.1.1 Bridges, constrictions in the borehole diameter, will make it impossible to lower the tool into the borehole and difficult to retrieve the tool.

4.4 Acceptance Criteria

7.1.1 Forms shall be filled out as called for in this Technical Procedure.

7.1.2 Field calibration checks shall meet the criteria outlined in TP-13.

7.1.3 Evaluation of the test procedure and data for acceptability shall be the sole responsibility of the PI.

5.0 DETAILED PROCEDURE

When logging for hydrologic purposes only, as in this procedure, FEC and temperature measurements are sufficient to characterize the well.

5.1 Before Arrival On Site

5.1.1 Examine any previously obtained wireline logs, noting in particular conditions which may cause tool sticking or variations in data quality.

5.1.2 Note depths of water table, surface casing, hole size changes, and hole bottom for use in calibrating depth measurements during logging.

5.1.3 The PI shall discuss hole conditions with the drillers, or review drilling reports for information which may affect the design of the HpL tests.

5.1.4 The PI shall review recent field activities carried out in the borehole of interest which may impact hydrology or fluid chemistry within the interval affected by the HpL tests. This includes but is not limited to any pump tests, interference tests, or load tests.

5.1.5 The PI shall also review all pre-existing hydrogeological data from the site and develop a preliminary testing plan, based on all information which can allow determination of whether the well will be low, moderate, or high yield.

5.1.6 Evaluation water quality and determine if it is necessary to provide an external water source for DI water.

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5.1.7 Prepare a list of materials requirements, including pump(s) if necessary, tubing, measurement equipment, and the necessity to provide a source of DI water.

5.1.8 Each measurement device which affects quality shall be calibrated prior to use.

5.2 Upon Arrival On-Site

In addition to the requirements of TP-13:

5.2.1 The well site shall be clear of all equipment within a 25 foot radius of the well head.

5.2.2 Calibration documents for all quality affecting measurement devices shall be made available to the site manager upon request.

5.3 Verify on site conditions

5.3.1 Review well construction details and record available site conditions, well conditions and flow yield information, verify the previously designed testing program.

5.3.2 Review and record additional wellbore construction/site details recorde the following information:

Ambient depth-to-water, depth of casing, depth of well, lithology (if available), estimated well yield and any available drawdown data, and type and concentration of contamination (if any).

5.3.3 Prepare deionized (DI) water. Consult with DI water tank firm for assistance if necessary. If DI water has not been transported to the site, surface or groundwater may be used if it is of suitable quality. Generally, source water containing less than 1000 micro Siemens per centimeter (µS/cm) and less then 20 ppb VOCs will not significantly affect the deionizing units, but this should be confirmed with the DI water firm. If the groundwater from the well under test cannot be used for DI water generation, then DI water must be transported to the site and containerized at the wellhead.

Depending on the amount of Hydrophysical testing to be performed (ambient and/or active) the typical volume of DI water required for each borehole is approximately three times the volume of the standing column of formation water in the wellbore per type of Hydrophysical characterization.

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If preparation takes place on site, pump the source water through a pre-filter, to deionizing units, and into the storage tanks.

Monitor the FEC of the DI water in-line to verify homogeneity; the target value is 5 to 25 µS/cm. Record the results.

5.3.4 A pre-survey calibration check of the HPL sonde shall be performed.

5.4 Conduct ambient FEC/Temperature log

5.4.1 Set datum on the depth encoder with the FEC sensor on the tool as 0 depth at the top of casing. If no space is available at the wellhead, measure 10 feet from the FEC sensor up the cable (using measuring tape) and reference with a wrap of electrical tape. Lower the tool down the hole to the point where the tape equals the elevation at the top of the casing and reference that as 10 feet depth on the depth encoder.

5.4.2 Place the top of the tool approximately 3 feet below the free-water surface to allow it to achieve thermal equilibrium. Monitor the temperature output until thermal stabilization is observed at approximately ± 0.2 °C. The rate of change of temperature shall be less than 1 °C/minute.

5.4.3 After thermal stabilization of the logging tool is observed, log the ambient conditions of the wellbore (temperature and FEC). During the logging run, the data shall be plotted in real time in log format on the computer screen and the data string shall be simultaneously recorded on the hard drive.

Log the ambient fluid conditions in both directions (i.e. record down and up). The ideal logging speed is 5 feet per minute (fpm).

5.4.4 At the completion of the ambient FEC/Temperature test, the recorded data shall be backed up *immediately* to floppy disk (high density disk) or CD-R.

At completion of the ambient log, place the tool approximately 10 feet below the free water surface. The tool may remain there during equipment set up as long as borehole conditions permit. The Logging Engineer under PI direction may choose to remove the logging tool from the well during installation of the pumping equipment.

5.4.5 Measure and record ambient depth.

5.5 Conduct ambient flow characterization

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Ambient flow characterization consists of a time series of FEC logs recorded after DI water emplacement. Continuous logging of the interval of interest is required. In addition to the logging results, pressure and flow data shall be recorded throughout the test in digital form and periodically in field notes.

5.5.1 DI Emplacement Procedure.

DI water is injected at the bottom of the well. Water is extracted from the top to maintain a constant water level in the well, to minimize disturbance to the local hydrologic system. The HpL sonde is used during emplacement to monitor the position of the DI water front as it moves up the well. A pressure transducer placed immediately below the extraction pump is used to monitor the water level in the well.

5.5.1.1 Attach back pressure regulator or orifice, if used, and weighted boot, to end of emplacement line and secure. Insure that the injection line is of adequate length to reach the bottom of the wellbore.

5.5.1.2 Lower the flexible emplacement line to the bottom of the well allowing one foot of clearance from the well bottom to the outlet of the injection line.

5.5.1.3 Lower tool about 10 feet below the water surface. The tool will be stationed beneath the submersible pump during non-logging times.

5.5.1.4 Lower submersible pump in the well to a depth just above the logging tool. Record approximate depth of the pump location.

5.5.1.5 Lower a pressure transducer a minimum of 5 feet below the bottom of the pump.

(The sequence of 5.5.1.3 through 5.5.1.5 may be changed as required at the discretion of the PI or Logging Engineer.)

5.5.1.6 Record all initial readings of gauges at elapsed time 0.0 minutes.

5.5.1.7 Mark hoses with a round of electrical tape for reference. In addition, establish datum for tool depth to the nearest foot and mark on wire with wrap of tape. Reset datum on optical encoder for this depth.

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5.5.1.8 Pump DI water to the bottom of the wellbore using the surface pump and the injection riser. Simultaneously use the submersible pump to maintain a stable, elevated total head by extracting groundwater from near the free water surface. The injection and extraction rates should be approximately the same. When groundwater from the subject well is used for DI water generation, generate DI water from the extracted formation water and recirculate to the well bottom via the solid riser.

5.5.1.9 Throughout this procedure, the water level and flow data shall be recorded digitally. In addition, a hand-held water level meter shall be used to periodically record the elevated total head. All flow data shall be periodically recorded to field notes.

5.5.1.10 Evaluate the rate at which the DI water advances up the well. In the event that it is necessary to modify the rate of injection/extraction, the PI shall oversee the change.

If borehole conditions permit (i.e. the absence of constricted borehole intervals), the logging tool is used to monitor the advancement of the fluid up the borehole as it displaces the standing formation water. Draw the logging tool up the wellbore in successive increments as the DI water is emplaced. The logged FEC value changes from that of the ambient fluid to that of DI water at the depth of the DI water interface. Continuous profiling may also be performed to monitor the progress of DI water emplacement.

5.5.1.11 Monitor and record the electrical conductivity of the fluid expelled from the extraction pump during emplacement procedures. Record these values and the times at which they were measured.

5.5.1.12 Emplacement is complete when DI water, or sufficiently diluted formation water, is observed from the evacuation pump or when logging tool stationed near the pump indicates DI water or sufficiently diluted formation water.

5.5.1.13 Upon completion, turn off the evacuation pump. Then turn off the injection line.

5.5.1.14 If a pumping rig is used, check valves shall be installed in the extraction line to ensure that fluid is not drawn back

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into the well when the pump is turned off. In this case, leave the emplacement line, the extraction pump, the pressure transducer, and the HpL sonde in the well.

5.5.1.15 If appropriate, the extraction line shall be removed from the well immediately after emplacement is complete.

5.5.1.16 Record volumes of extracted and injected fluids. Calculate the volume of DI water lost to the formation: $V_{injected} - V_{extracted} = V_{lost}$. This value will be negative if there is a net flow into the well.

5.5.2 After DI emplacement is complete, perform continuous FEC/Temperature logging until 80% saturation is observed in the affected interval, or until 5 hours of logging has been performed.

5.6 Characterize the well for additional testing

The RAS PI shall determine at this time (based on all information available, including the data obtained in 5.5) whether the well is characterized by a low, intermediate, or high yield. If the PI feels that enough information is available to define the well type, testing shall proceed with item 5.8. If the PI determines that additional testing is needed, it shall proceed so as to minimize disturbance to the aquifer(s) under test.

5.6.1 Conduct a slug test.

5.6.1.1 Rapidly extract 1-2 ft of fluid from the well.

5.6.1.2 Monitor and record the fluid level as it recovers.

5.6.1.3 If the fluid recovers more slowly than 1 foot/minute the well is of a low yield type. Skip the remainder of 5.6.1 and initiate 5.7.

5.6.2 Conduct a second slug test at a higher drawdown.

5.6.3 If necessary , conduct a controlled, short term well production test (pump test) to further characterize the overall hydraulics of the wellbore.

5.6.3.1 Select the pumping rate as follows: The rate(s) of pumping are determined by drawdown information previously obtained or at rate(s) appropriate for the wellbore diameter and saturated interval thickness. The appropriate extraction rate is a function of length of saturated interval, borehole diameter, and previous well

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yield knowledge. The appropriate pumping procedures to be employed are also dictated by the length of the exposed rock interval. In general, the extraction flow rate should be sufficient to induce adequate inflow from the producing intervals. The concern is that the extraction flow rate does not cause extreme drawdown within the well i.e. lowering the free water surface to the depth of the shallowest conductive interval.

5.6.3.2 Treat extracted water as follows: On-site pre-treatment of groundwater using activated carbon, can be conducted prior to DI water generation, if there is a contaminated groundwater source. In addition, on-site treatment can also be considered to handle extracted fluids that would require containerization and treatment prior to disposal.

5.6.3.3 While extraction proceeds, manually record elapsed time of pumping, depth to water determined using a hand-held water level indicator, total gallons extracted, and extraction flow rate. This provides a manual back-up of the data recorded digitally during the test.

5.6.3.4 Continue pumping until at least three wellbore volumes have been extracted from the wellbore, or a stabilized water level elevation is obtained. Record wellbore volume.

5.7 Review data obtained during the pumping test to determine pumping and logging procedures.

Extraction procedures for detection and characterization of hydraulically conductive intervals are determined based on the pumping test information. The emplacement, testing and pumping procedures will differ depending upon well yield and determined lengths of intervals of interest. In wellbore situations where intervals of interest are small (less than 30 feet) and hydraulic characteristics observed during drilling and preliminary hydraulic testing indicate hydraulically conductive intervals with extremely low flow rates (i.e. <0.10 gpm/foot of drawdown), a slug testing procedure may be employed. In wellbore cases where the preliminary hydraulic testing indicates low to moderate total yield (i.e. $0.10 < Q < 4$ gpm/foot of drawdown), constant low flow rate pumping after DI water emplacement procedures may be employed. In wellbore situations where intervals of interest are large, and high total yield (i.e. > 4 gpm/foot of drawdown) is observed, constant pumping during DI water injection procedures shall be employed.

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5.8 DI water emplacement

After the PI has determined the test protocol, the fluid in the well shall be replaced again with DI water, following the procedure outlined in 5.5.1 above.

5.9 Conduct active flow testing

5.9.1 Low yield active test procedure:

If the well is of low yield type, proceed as follows:

5.9.1.1 Perform a slug test in accordance with procedures developed by Hvorslev (1951). Rapidly extract a small volume of water from near the free water surface using the extraction riser and pump. A drop in piezometric head of 2-10 feet should be adequate for the initial test. Record the rise in the free water surface with time using the pressure transducer, and develop a conventional time-lag plot. Log the well continuously with the HpL sonde to monitor changes in the fluid column.

5.9.1.2 The completion of the slug test shall be defined as follows: Either (a) 80% of the head disturbance has decayed, or (b) a 20-hour time period has elapsed, whichever occurs first.

5.9.1.3 Repeat the DI emplacement procedure 5.8 and the low yield active test procedure 5.9.1 with successive increases in the drop of piezometric head (or volume extracted) associated with each slug test. Let the wellbore recover and record the rise in the free water surface. Repeat logging of the wellbore fluid after the free water surface has recovered to a satisfactory elevation.

5.9.1.4 The number of repetitions shall be determined by the PI in the field after review of previous results.

5.9.1.5 Record digitally the data from the pressure transducer throughout the test. Periodically manually record the borehole fluid level.

5.9.2 Moderate yield active test procedure:

Time Series Hydrophysical Logging During Continuous Pumping After DI water Emplacement

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5.9.2.1 The PI shall select a pumping rate such that drawdown of the free water surface produced during pumping shall not overlap any identified water producing interval.

5.9.2.2 Maintain a constant flow rate from the evacuation pump and record the total volume of groundwater evacuated from the wellbore. Employ a continuous reading pressure transducer (or equivalent device) to monitor and record digitally the depressed total head during pumping, along with the associated pumping rate. Manually record depth to water and the flow data.

5.9.2.3 Conduct HydroPhysical logging continuously. The number of logging runs and the length of time required to conduct all logging is a function of the particular hydraulic conditions.

5.9.2.4 Logging and pumping shall continue until the FEC of the fluid in the affected interval is more than 80% the FEC of the formation water.

5.9.2.5 This process may be repeated, at the PI's discretion, starting with DI emplacement procedure 5.6 and the moderate yield active test procedure 5.7.2, increasing the pumping rate.

5.9.2.6 The number of repetitions is determined in the field after review of previous results.

5.9.2.7 Record digitally the data from the pressure transducer and from the extraction line flow meter throughout the test.

5.9.3 High yield active test procedure.

Time Series Wellbore Fluid Logging During Continuous Pumping and Simultaneous DI Water Injection

5.9.3.1 The RAS PI shall select a pumping rate such that drawdown of the free water surface produced during pumping does not overlap any identified water producing interval.

5.9.3.2 Maintain a constant flow rate from the evacuation pump and record this rate and the associated drawdown. During this period, conduct HydroPhysical logging until reasonably similar Hydrophysicallogs are observed and a reasonably stable drawdown is achieved.

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5.9.3.3 After reasonably similar downhole fluid conditions are observed and simultaneous with extraction pumping, inject DI water at the bottom of the well at a constant rate of 10 to 30% of that employed for extraction. Increase the total rate of extraction to maintain total formation production reasonably similar to that prior to DI water injection (i.e. increase the total extraction by amount equal to the DI water injection rate).

5.9.3.4 Continuous logging shall be conducted until stabilized and consistent diluted FEC logs are observed. A minimum of 6 downward logs shall be recorded in the stable, diluted condition prior to terminating the test.

5.9.3.5 After stabilized and consistent FEC logs are observed, terminate DI water injection. Reduce the total extraction flow rate to the net formation rate and conduct continuous logging. Conduct logging until stable and consistent FEC values are observed.

5.9.3.6 Record digitally the data from the pressure transducer and from the extraction and injection line flow meters throughout the test.

5.9.3 If inflow characterization at a second pumping rate is desired, the following procedure shall be followed:

5.9.3.1 Terminate DI injection.

5.9.3.2 Increase the extraction rate to the new value.

5.9.3.3 Follow the procedures detailed in 5.9.3.1 to 5.9.3.6.

5.9.4 Although pumping and testing procedures vary depending upon wellbore hydraulics and construction detail, there are several requirements which are common to all of the active tests described above.

5.9.4.1 Periodically record the total volume and flow rate of well fluids extracted and the total volume and flow rate of DI water injected. Use a continuous reading pressure transducer or similar device to monitor the depressed total head during pumping. Manually record the depressed total head (piezometric surface) periodically, with the associated pumping and injection data.

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5.10 Depth Specific Sampling

At the conclusion of hydrophysical testing, downhole, depth specific sampling can be conducted. The contamination concentration values derived from the collected samples, in conjunction with the hydrophysical logging results, can be used to estimate the interval specific contaminant concentration for the sampled hydraulically conductive intervals.

5.10.1 Pumping at the same formation production rate as employed during hydrophysical testing is initiated, or maintained.

5.10.2 Periodic FEC/Temperature logs are conducted during pumping until stable logs are observed and any residual DI water has been pumped out of the well.

5.10.3 Based on review of the hydrophysical logging results, the location of the water bearing intervals are identified and sampling depths are selected. Typically, the sampling depth is located 1-5 feet above an identified water bearing interval.

5.10.4 Prior to each sampling run, the inside of the sampler barrel and petcock are thoroughly cleaned with deionized water and Alconox soap, rinsed with DI water and dried off.

5.10.5 The sampler ports are closed at the surface. The operator will physically confirm that the ports are closed prior to placing in the wellbore.

5.10.6 Depth datum for the location of inlet port is referenced to same datum as hydrophysical logging.

5.10.7 The sampler is lowered to the selected depth, opened for at least 5 minutes to insure complete filling, closed and withdrawn to the surface. At the surface, the ASDE is recorded and the sampler is decanted into laboratory containers and reassembled.

5.10.8 Prior to each sampling run, the inside of the sampler barrel and petcock are thoroughly cleaned with deionized water and Alconox soap, rinsed with DI water and dried off.

5.10.9 Procedures 5.10.6 through 5.10.8 repeated until all selected intervals sampled.

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5.11 Post-log calibration

Carry out post-log calibration, following procedures in TP-FEC.

5.12 Departure from site

5.12.1 Turn all pumps off. Clean evacuation line and outside of pump as required by site-specific procedures.

5.12.2 Remove the tool from the well. Clean the wireline and the tool as required by site-specific procedures.

5.12.3 Remove the injection line from the well. Clean the injection line as required by site-specific procedures.

5.12.4 Store the pumps and logging tools properly for transport.

5.12.5 Place cover on well and lock (if available).

6.0 RECORDS

Records of the data obtained from each measurement shall be produced as follows:

6.1 Paper copies of HpL logs shall be provided as shown in Appendix 7.9.

6.2 Digitally acquired flow, pressure, and head data shall be recorded along with on-site calibration data.

6.3 Forms shall be completed as detailed in this procedure and in TP-13.

6.3.1 As provided by contractor.

6.4 Exceptions shall be handled as detailed in TP-13.

6.5 Field Modifications shall be handled as detailed in TP-13.

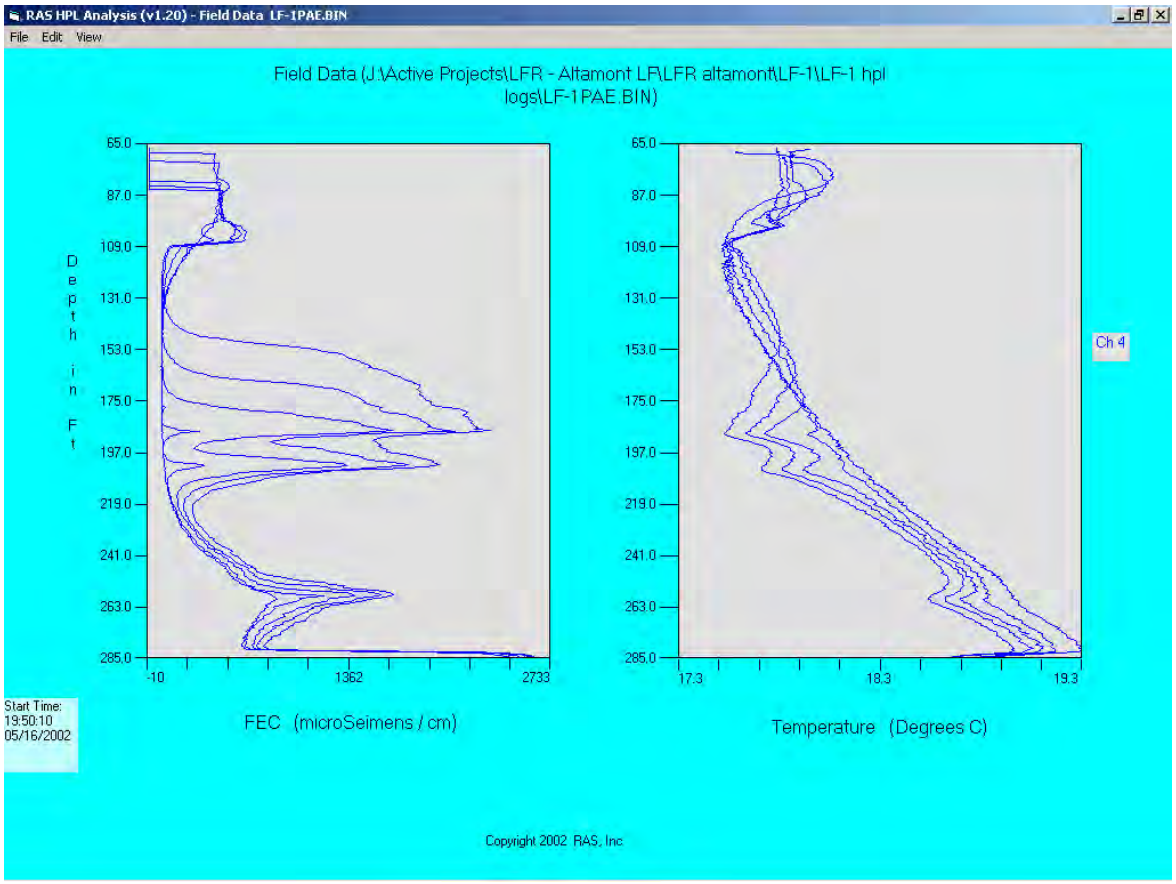
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7.0 APPENDICES

7.1 Typical HPL log data.

7.2 Forms as provided by Contractor

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RAS HPL Analysis (v1.20) - Field Data LF-1PAE.BIN
File Edit View
Field Data (J:\Active Projects\LFR - Altamont LF\LFR altamont\LF-1\LF-1 hpl logs\LF-1PAE.BIN)
Depth in Ft
65.0
87.0
109.0
131.0
153.0
175.0
197.0
219.0
241.0
263.0
285.0
-10
1362
2733
FEC (microSeimens / cm)
17.3
18.3
19.3
Temperature (Degrees C)
Ch 4
Start Time:
19:50:10
05/16/2002
Copyright 2002 RAS, Inc

APPENDIX B

FIELD NOTES AND DAILIES REPORTS

APPENDIX C

DATA AND ANALYSIS

CH2MHill – NorthStar
PG&E Topock Compressor Station
Monitoring Well MW-57BR
HPL PROCESSING NOTES
ALL DEPTHS REFERENCED TO TOP OF PVC CASING

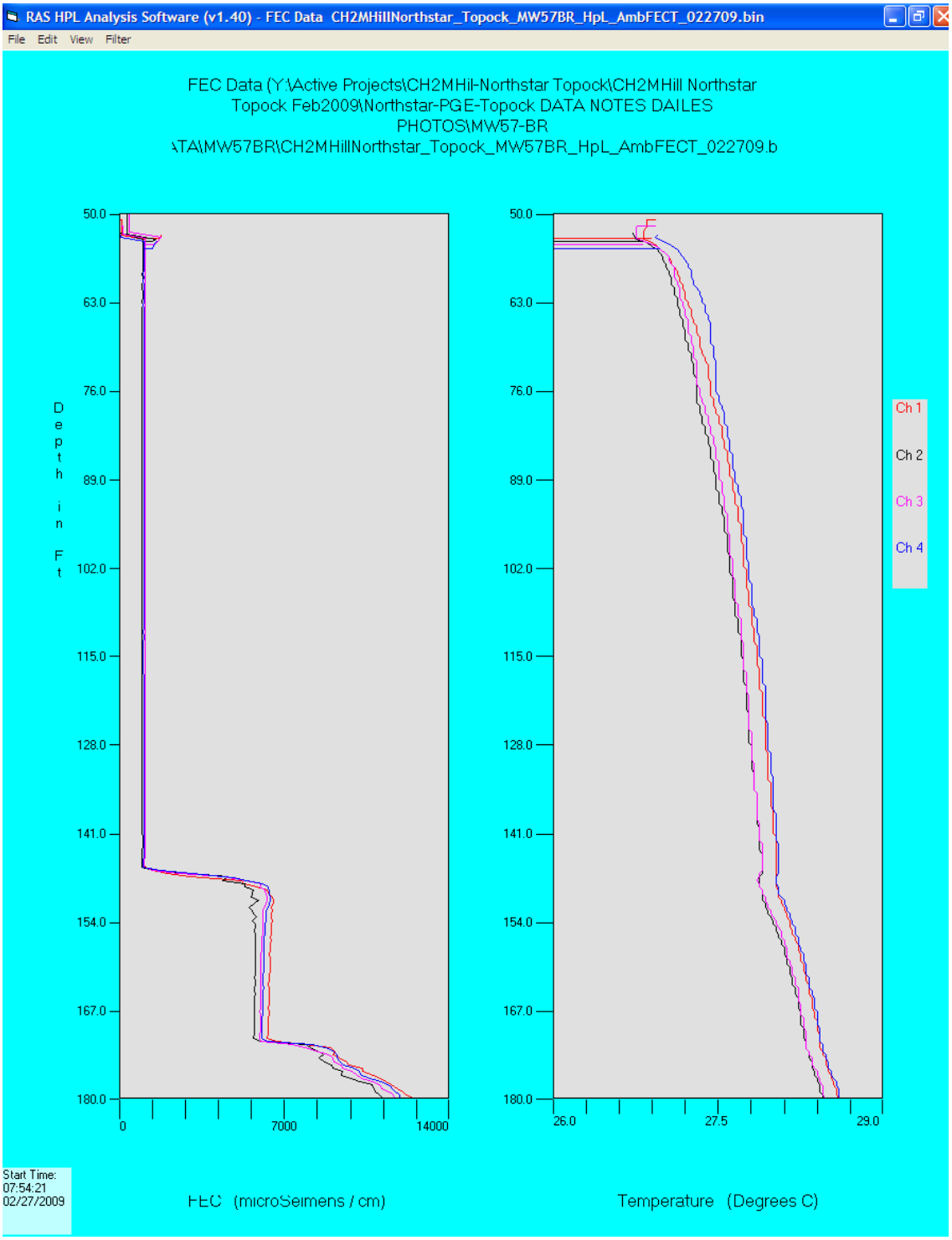


Figure 1. MW-57BR Ambient FEC and Temperature Log.

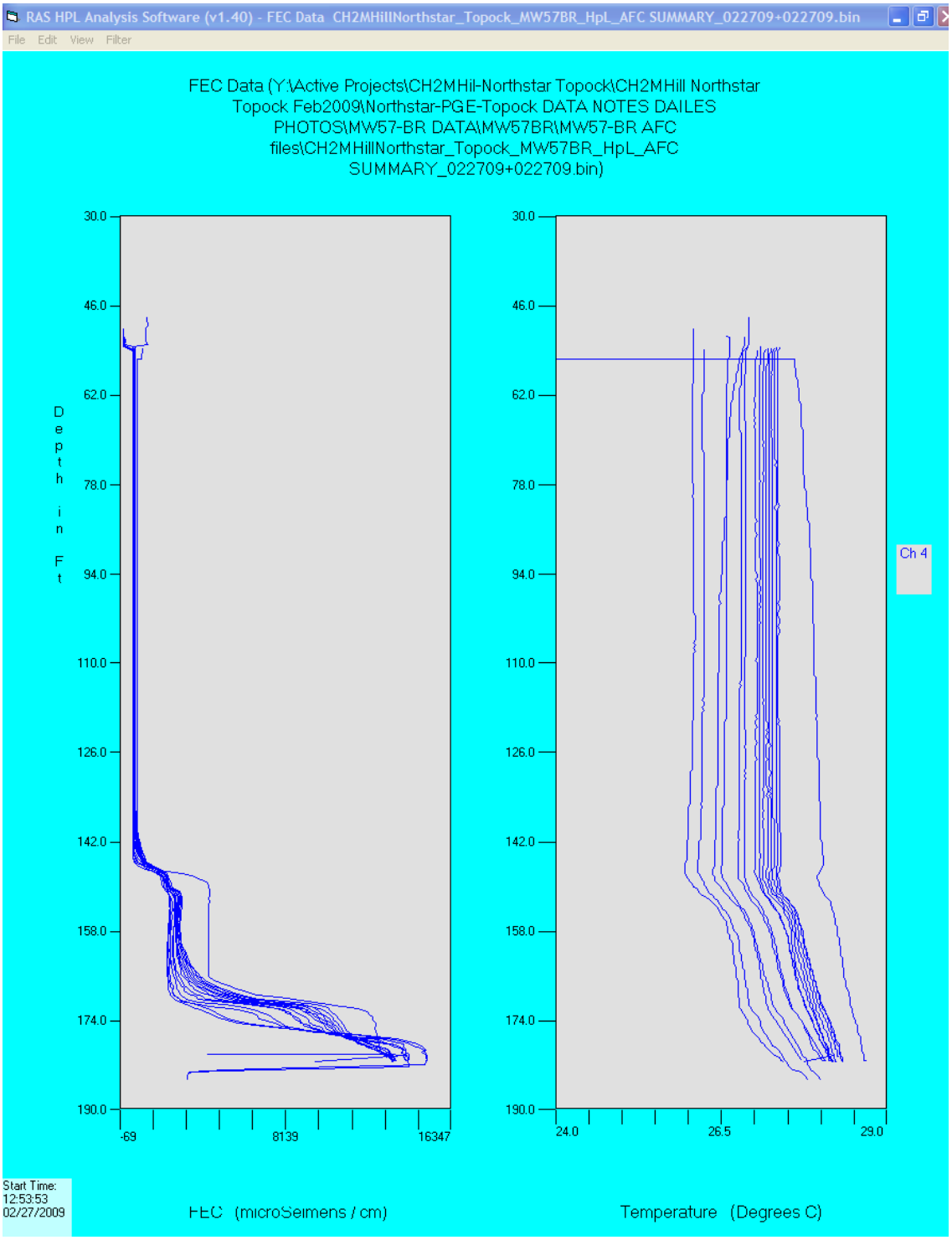


Figure 2. MW-57BR Summary of FEC Logs for Ambient Flow Characterization.

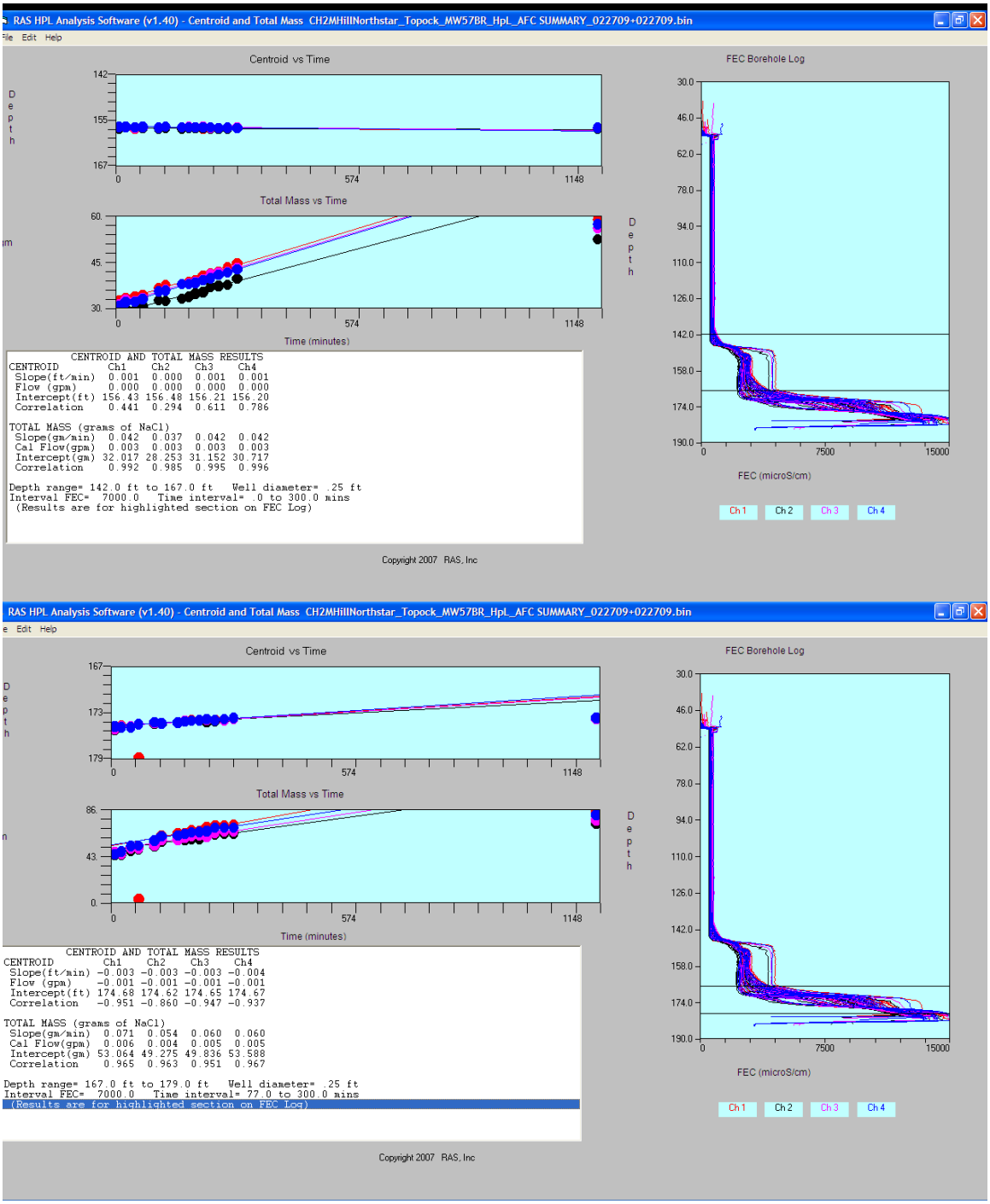
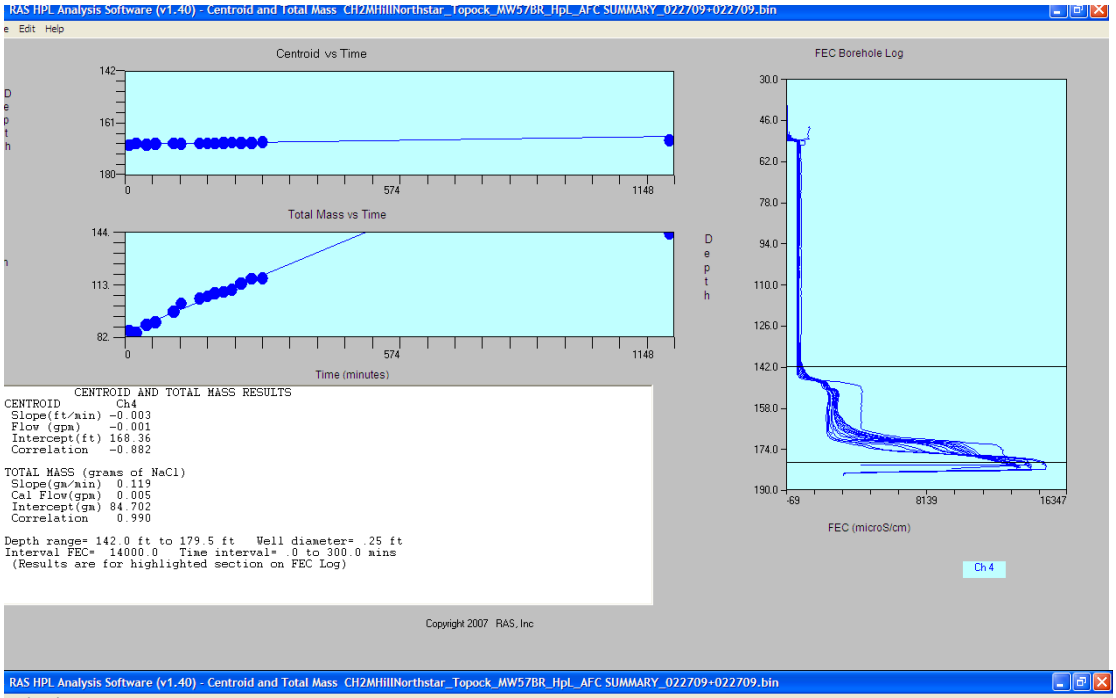


Figure 3. MW-57BR Centroid and Integral Analysis Logs for Ambient Flow Characterization.



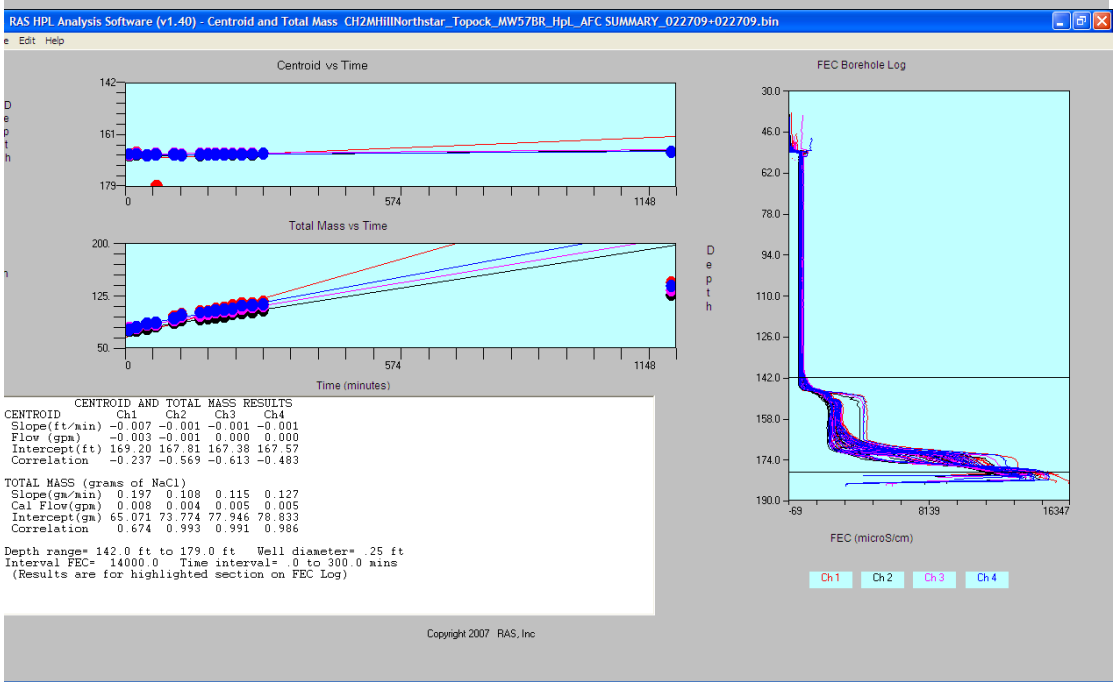


Figure 4. MW-57BR Centroid and Integral Analysis Logs for Ambient Flow Characterization.

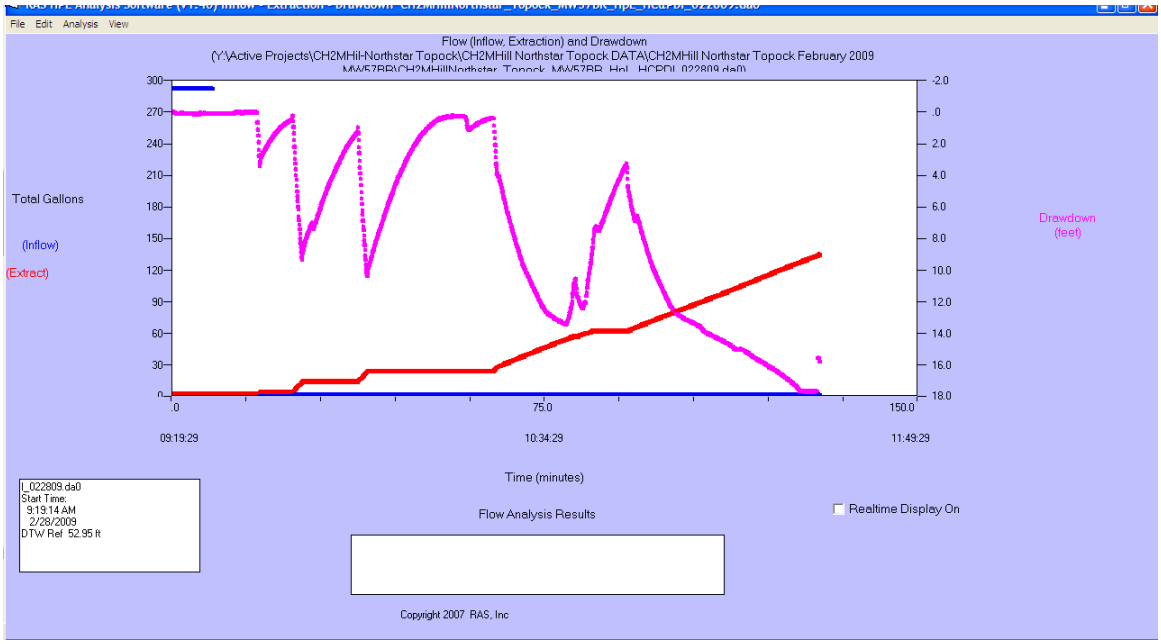


Figure 5. MW-57BR Pressure and Flow data during Overall Hydraulic Characterization.

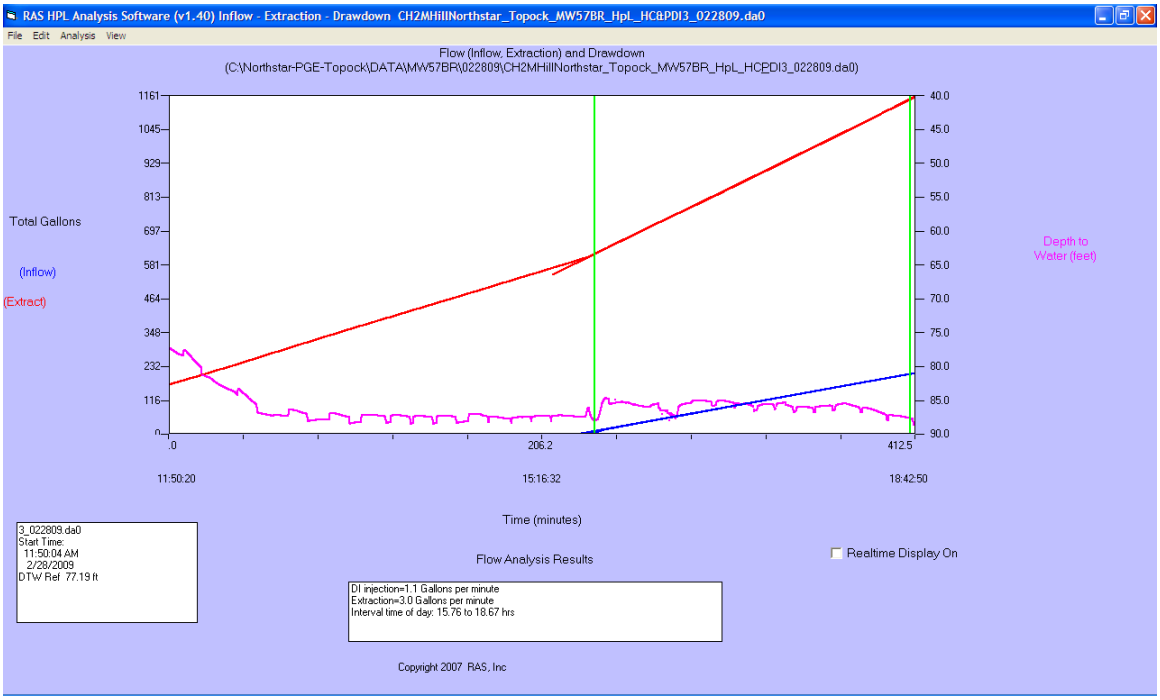


Figure 6. MW-57BR Pressure and Flow data during Pumping During Injection Testing.

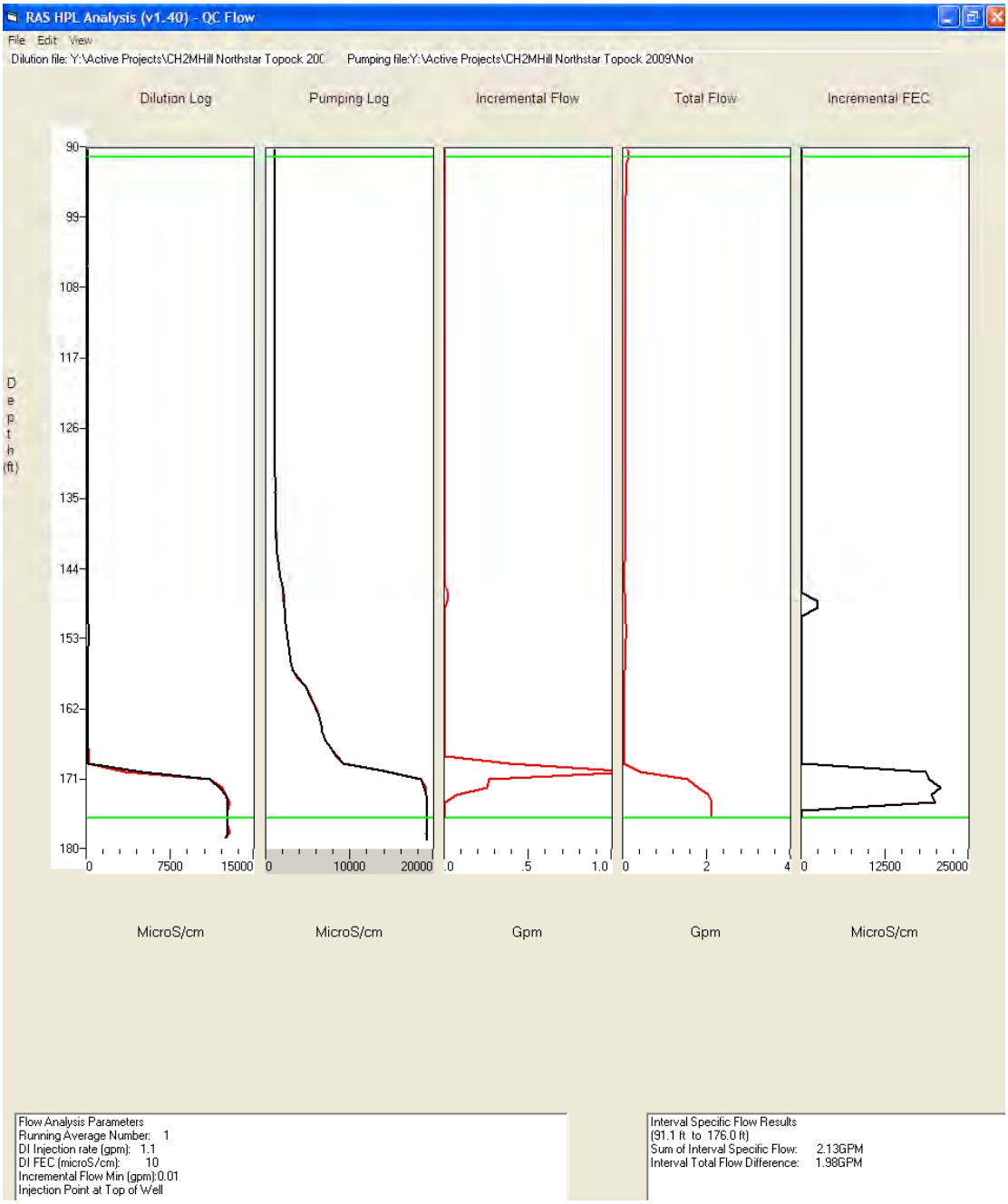


Figure 7. MW-57BR Results of Hydrophysical Testing, Pumping During Injection, complete interval.

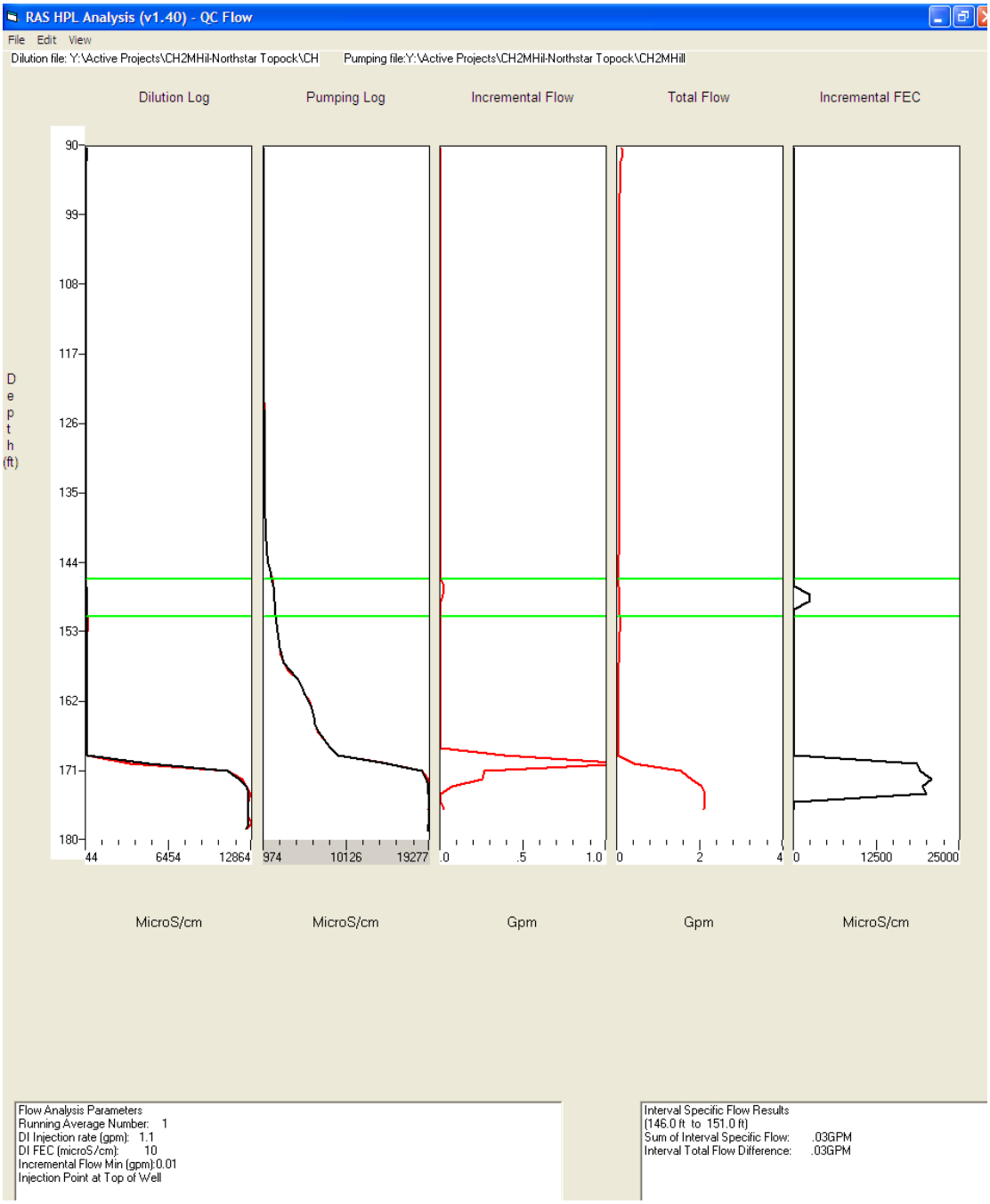


Figure 8. MW-57BR Results of Hydrophysical Testing, Pumping During Injection, interval of analysis from 146 to 151 feet.

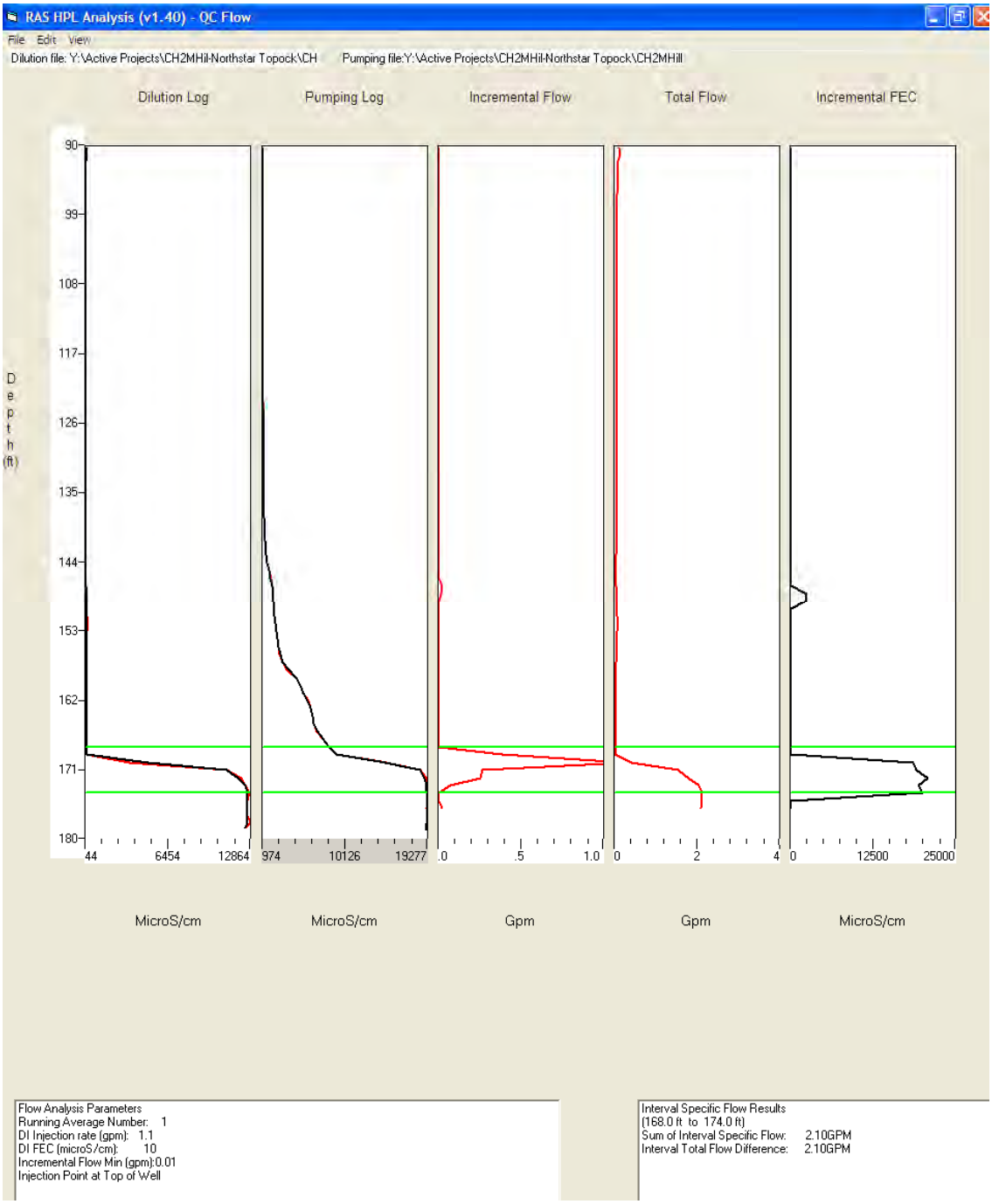


Figure 9. MW-57BR Results of Hydrophysical Testing, Pumping During Injection, interval of analysis from 146 to 151 feet.

CH2MHill – NorthStar
PG&E Topock Compressor Station
Monitoring Well MW-58BR
HPL PROCESSING NOTES
ALL DEPTHS REFERENCED TO TOP OF PVC CASING

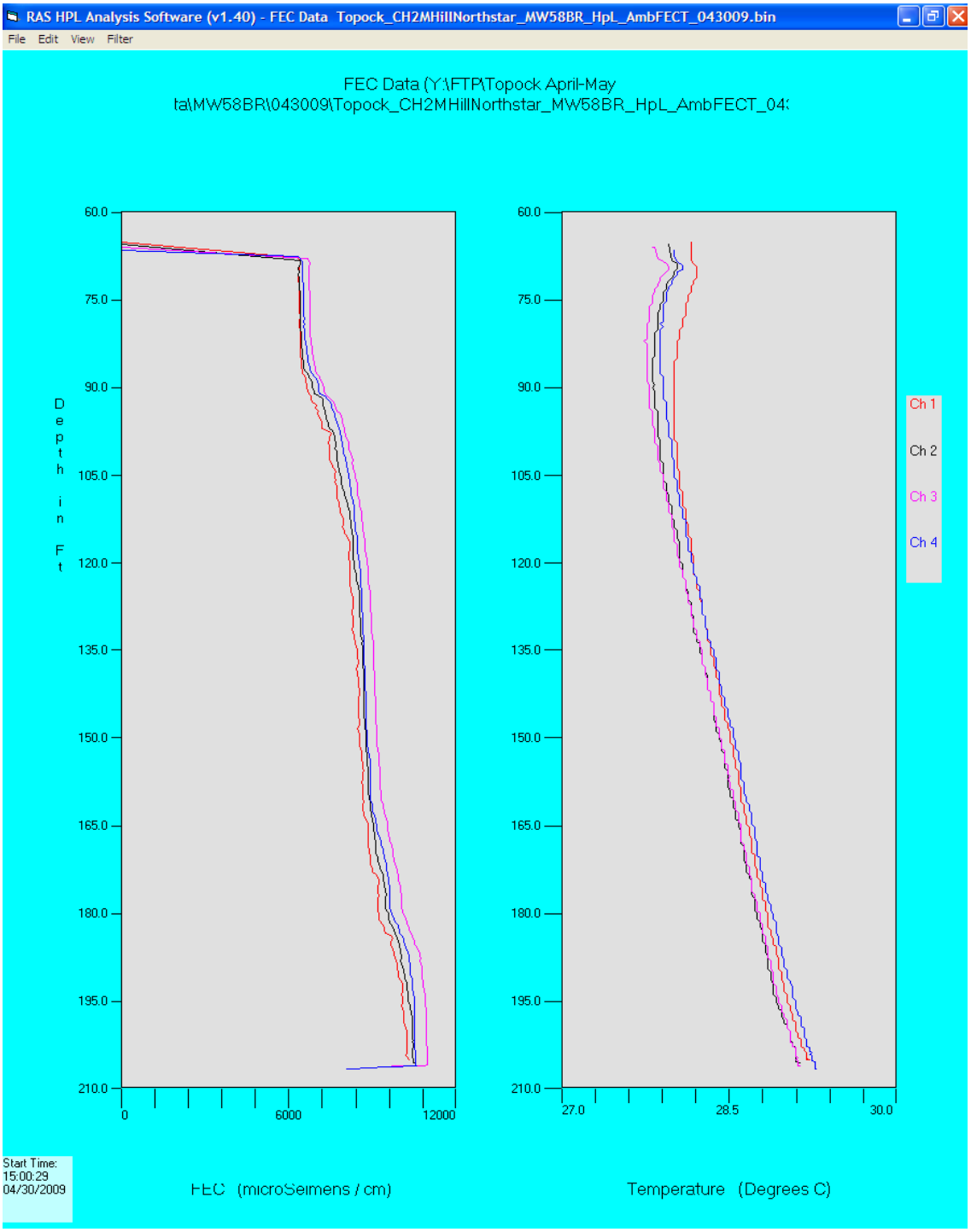


Figure 1. MW-58BR Ambient FEC and Temperature Log.

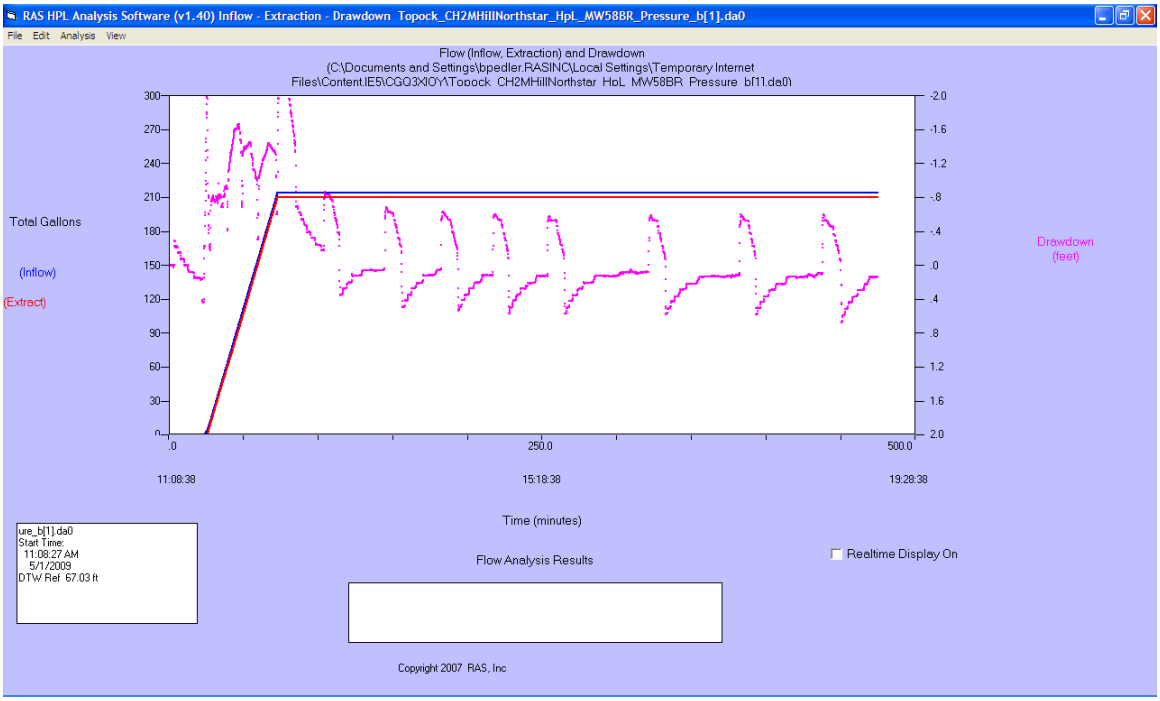


Figure 2. MW-58BR. Pressure History During Ambient Flow Characterization.

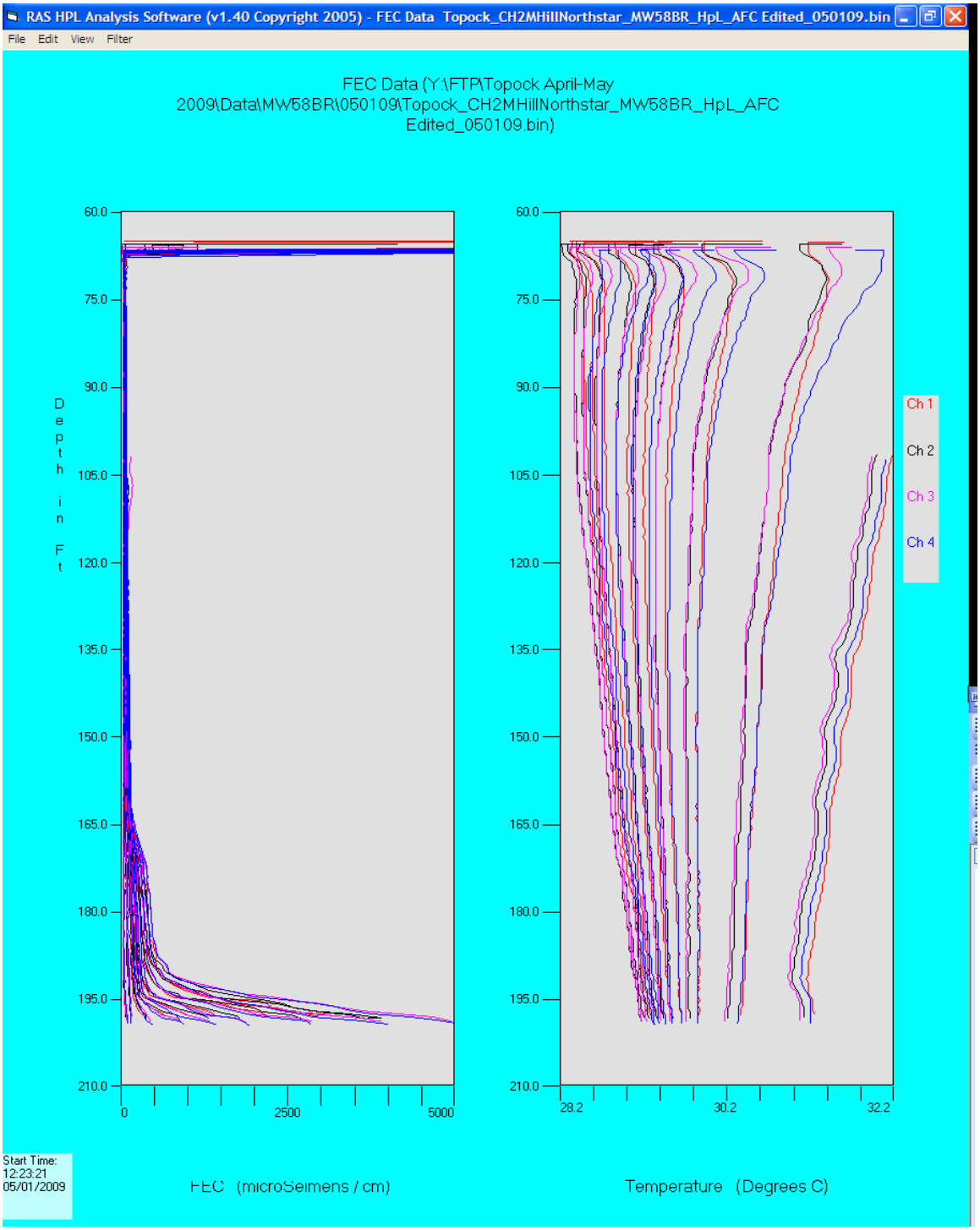


Figure 3. MW-58BR. Summary of logs collected during Day 1 of AFC Testing.

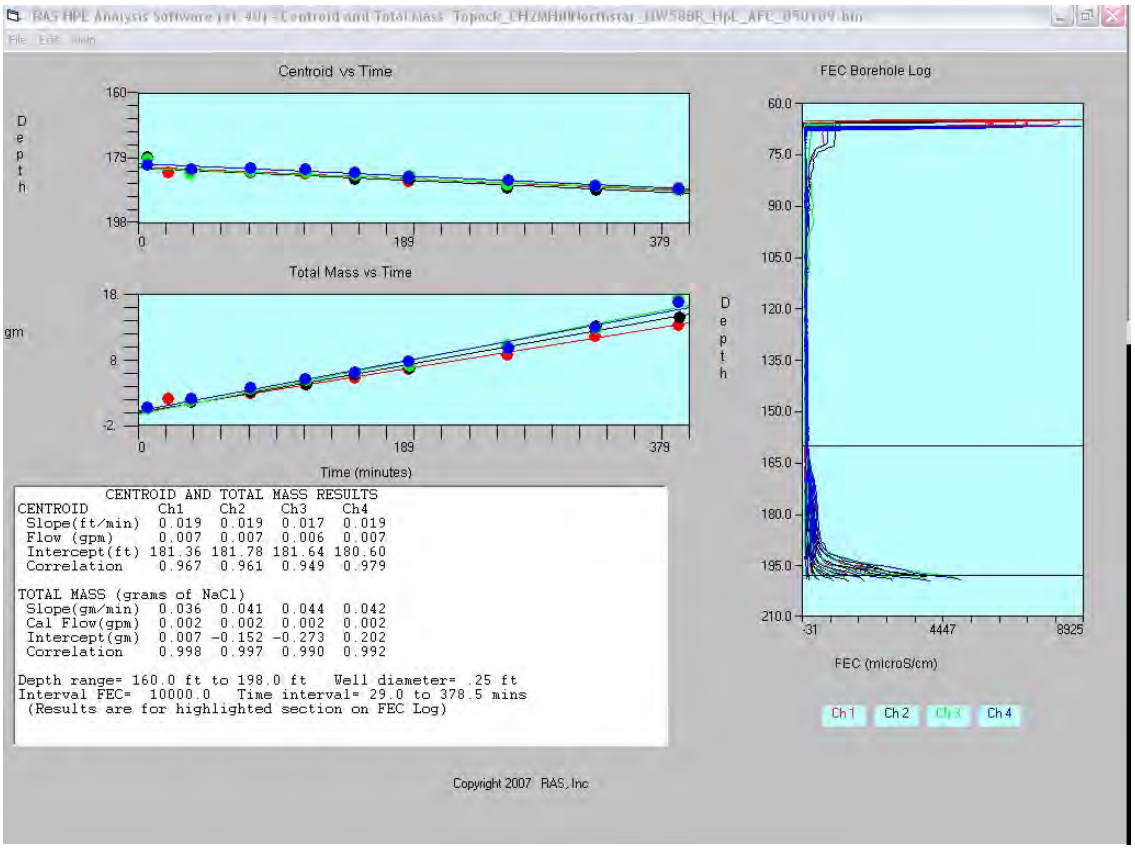


Figure 4. MW-58BR. Integral and Centroid analysis of Day 1 data.

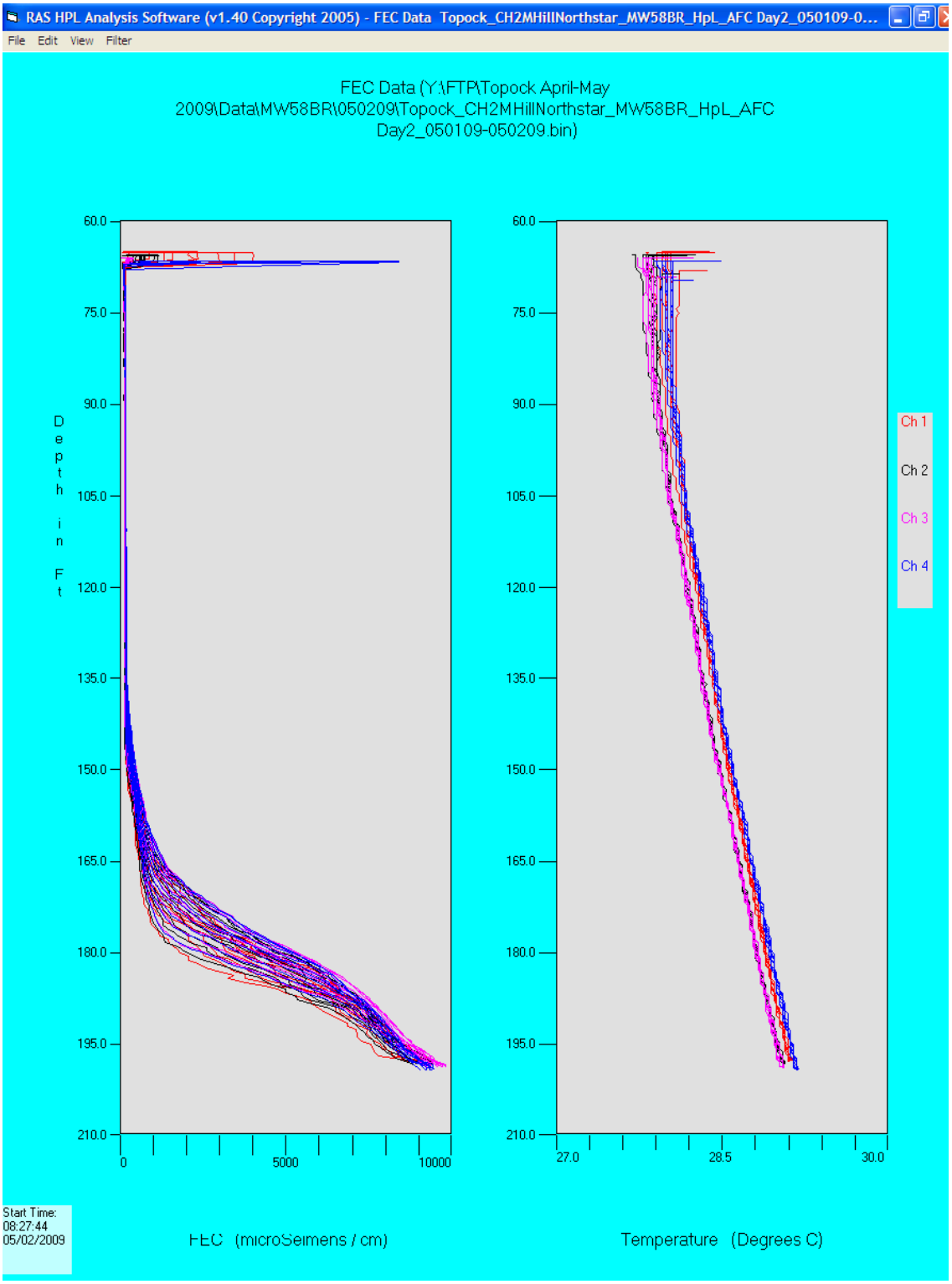


Figure 5. MW-58BR. Summary of Logs for AFC Day 2.

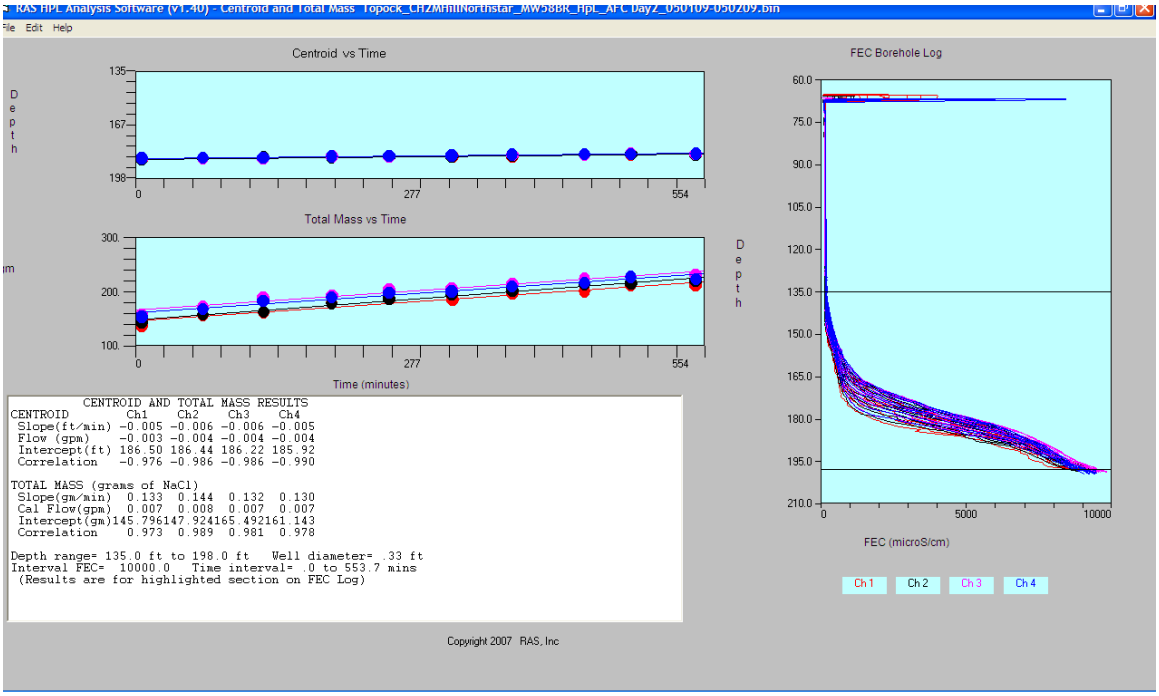


Figure 6. MW-58BR. Centroid/Integration Analysis Day 2 AFC data only

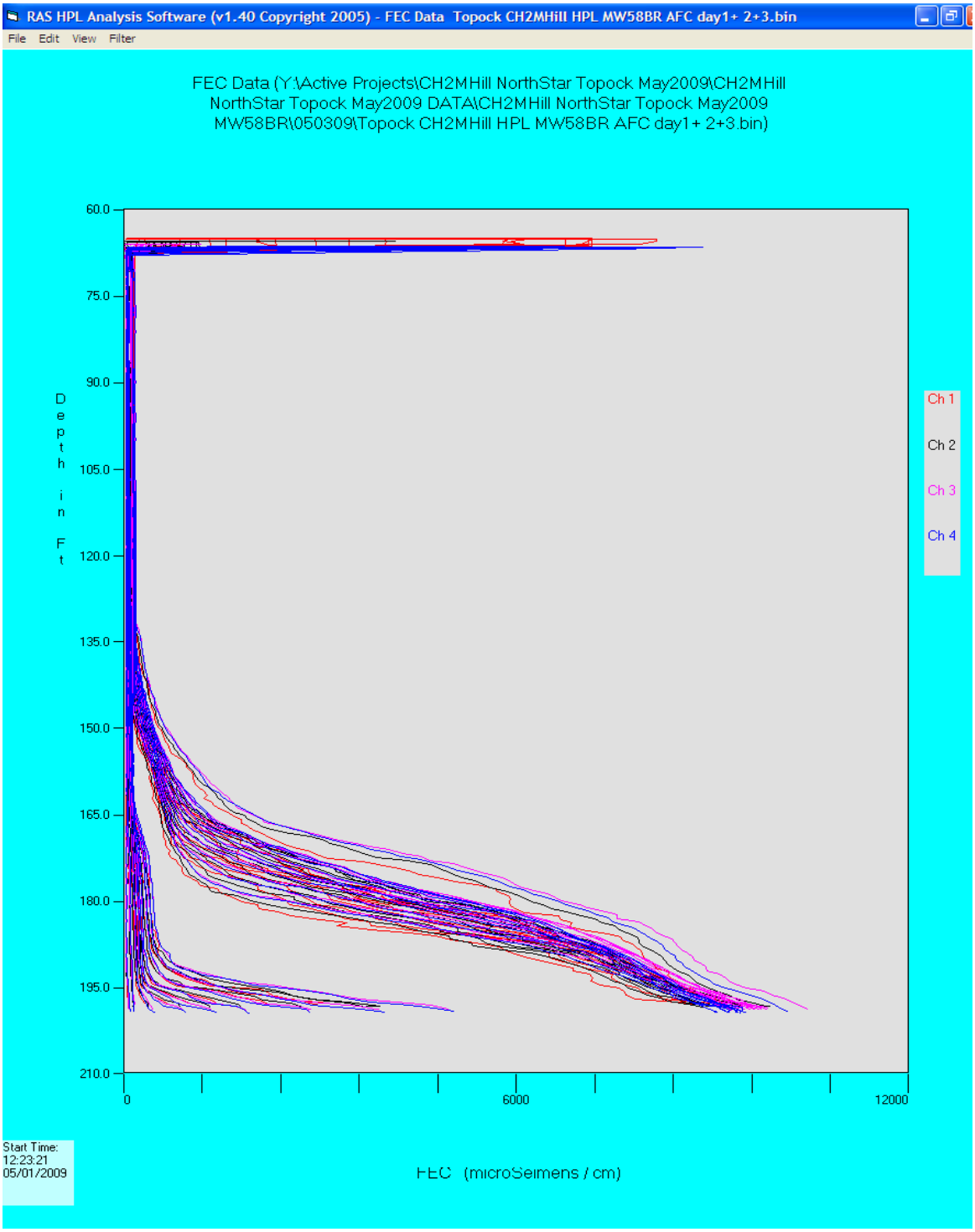


Figure 7. MW-58BR. Summary of Logs Collected on Day 1 & Day 2.

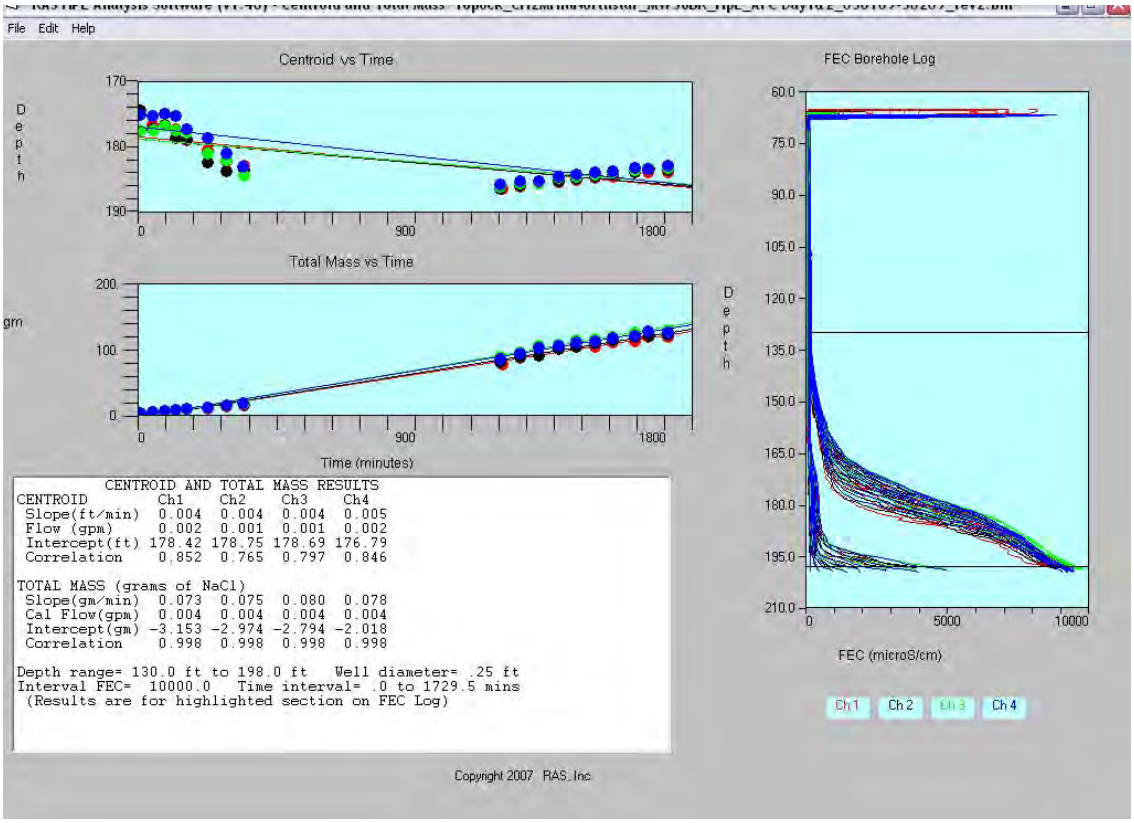


Figure 8. MW-58BR. Centroid and Integration Analysis Day 1& 2 AFC data.

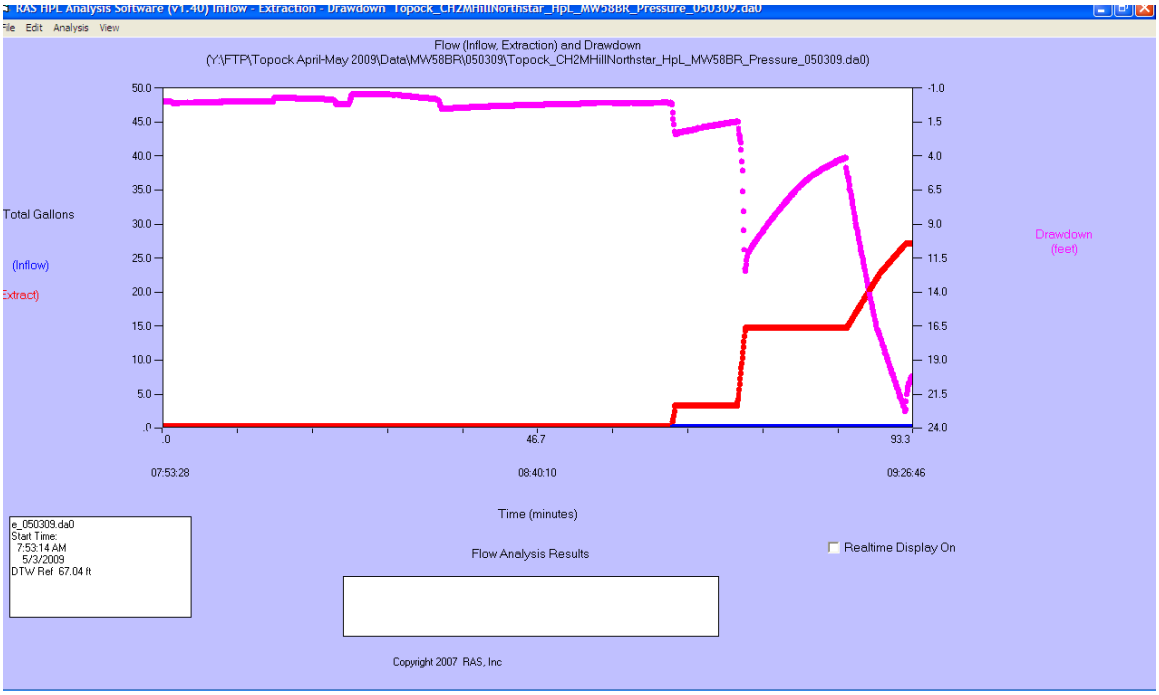


Figure 9. MW-58BR. Overall Well Hydraulic Characterization before Emplacement for for Slug Test After Emplacement (SAE).

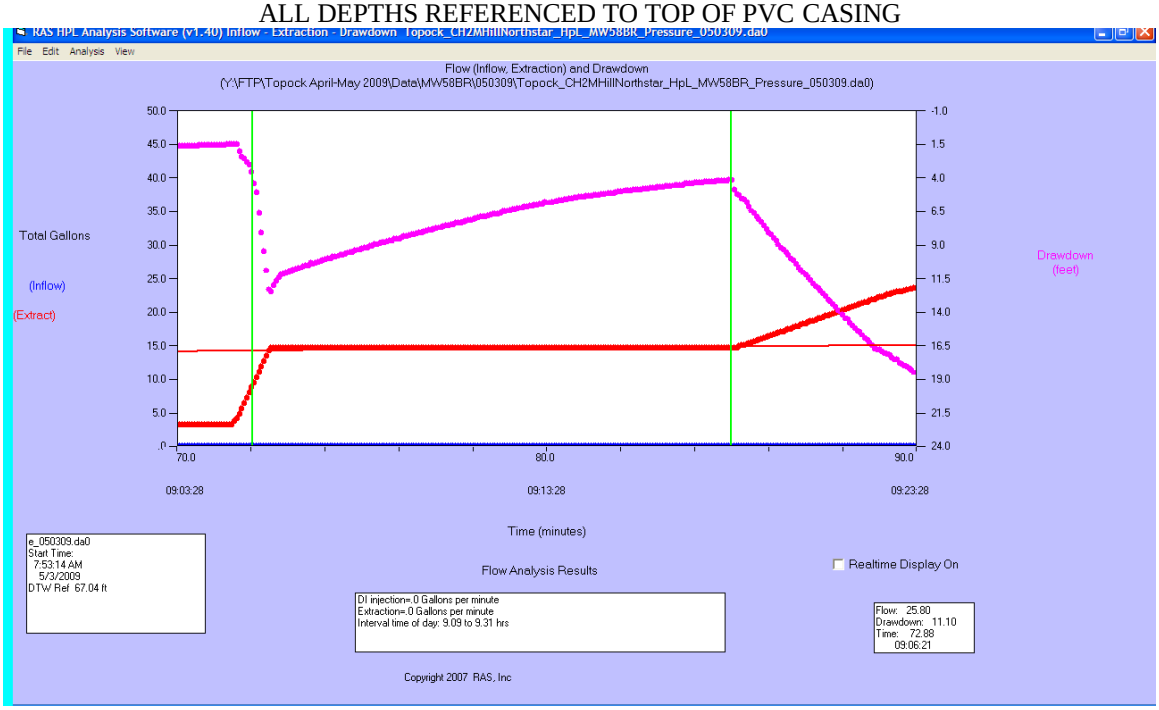


Figure 10. MW-58BR. Summary of Rising Head Data during SAE. Average Volumetric Flow Rates.

DD = 11.1 ft @ 72.9 mins

DD = 5.67 @ 80.05 mins

Average flowrate

11.1-5.67 = 5.43 feet
In 7.15 mins

4 inch well = 0.66 gallons per foot

0.66*5.43 = 3.58 gallons in 7.15 mins or

0.5 gpm average rate

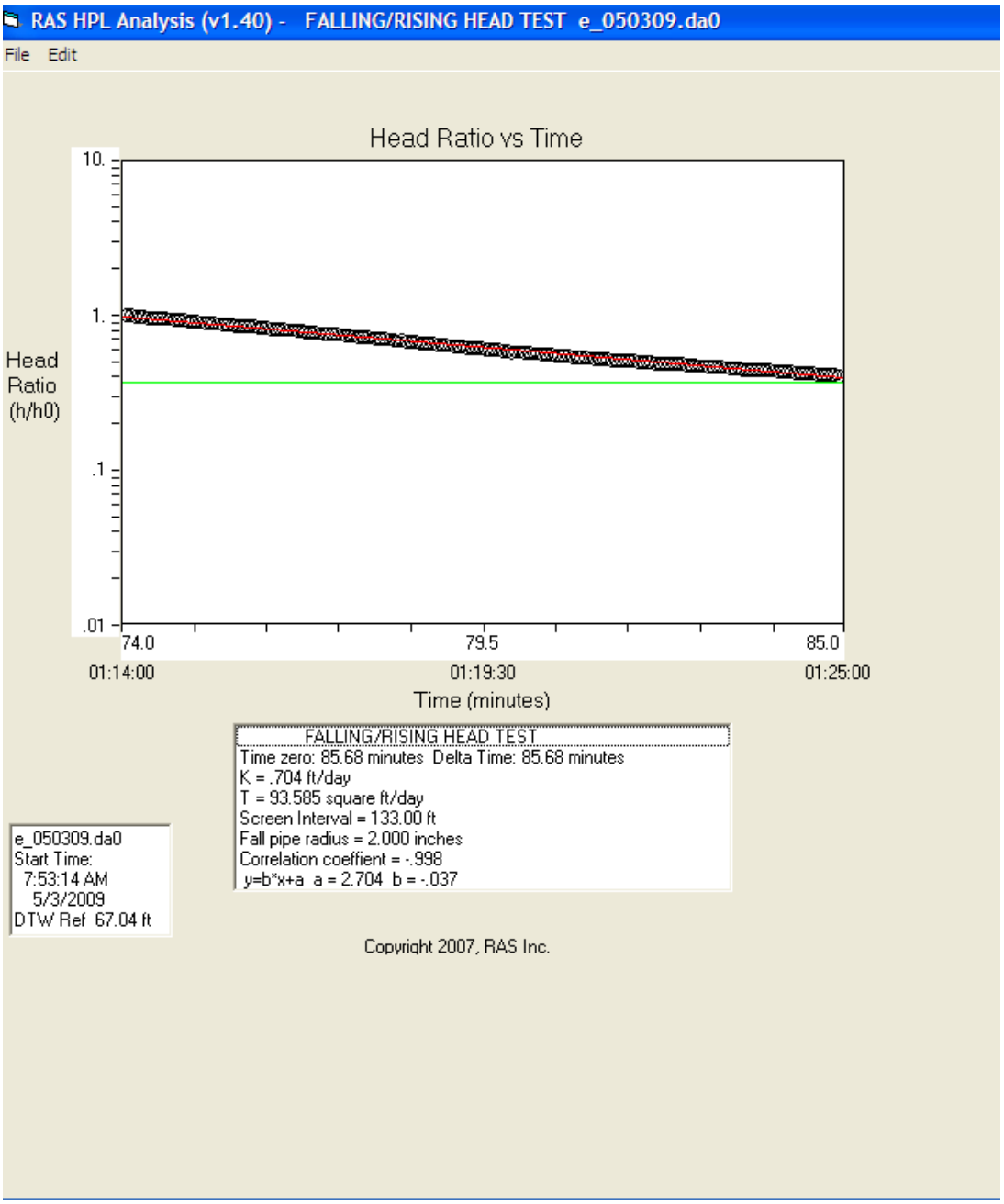


Figure 11. MW-58BR. Results of 10 ft dP slug test

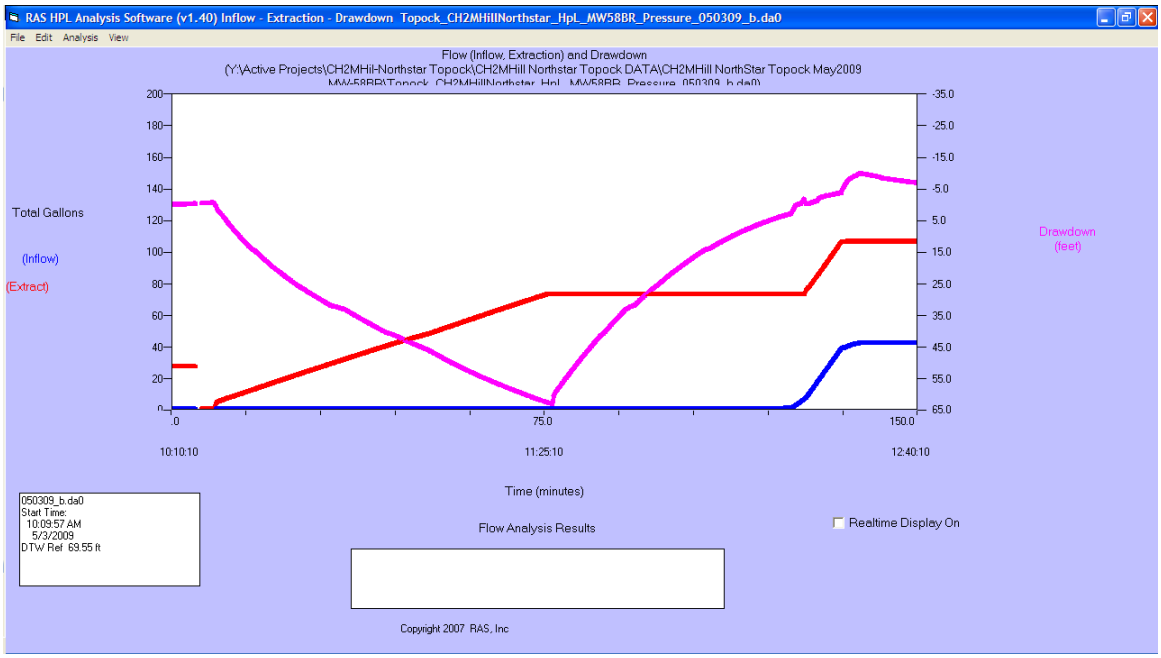


Figure 12. MW-58BR. Pressure and Flow Results of Short Term Pump Test.

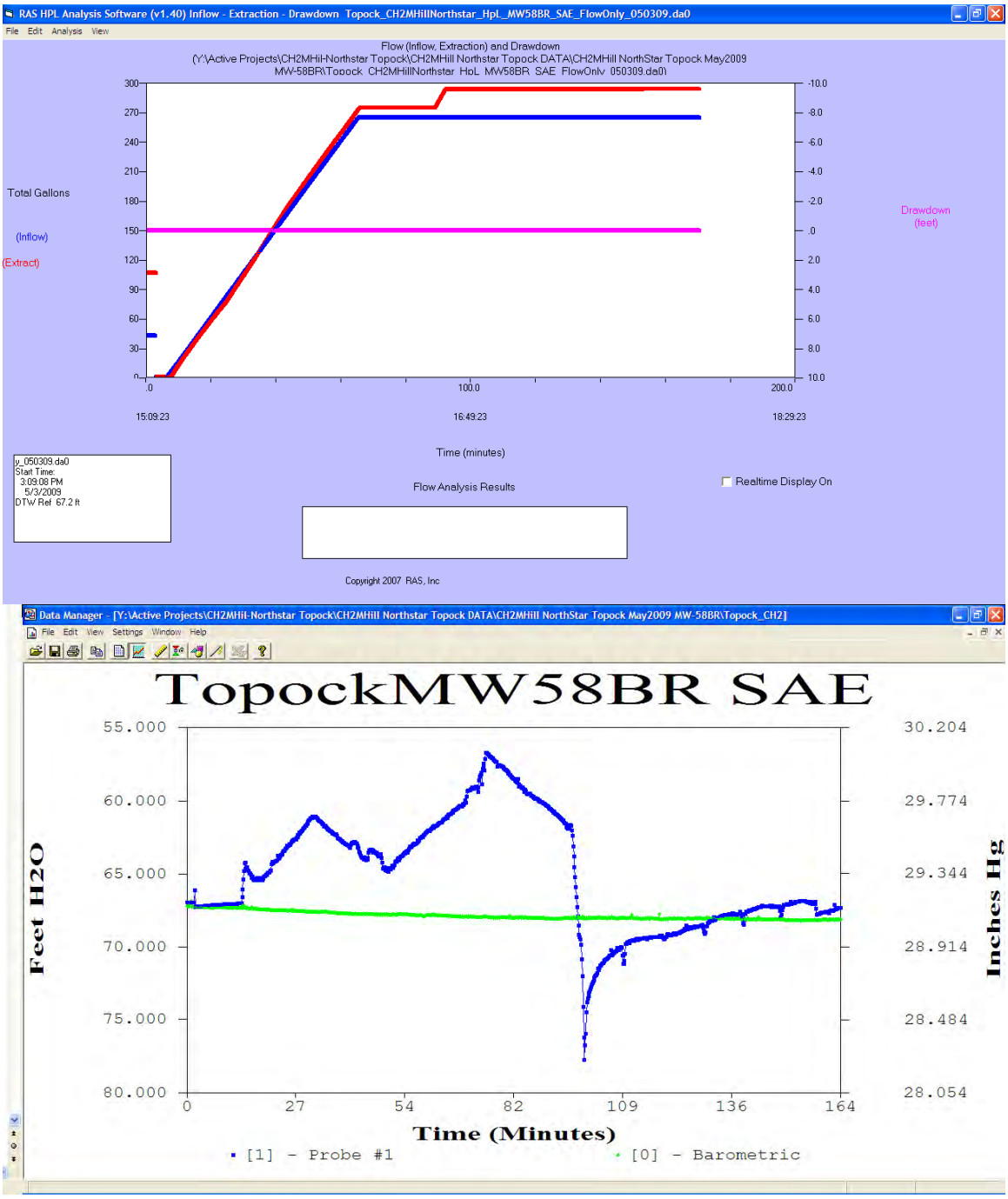
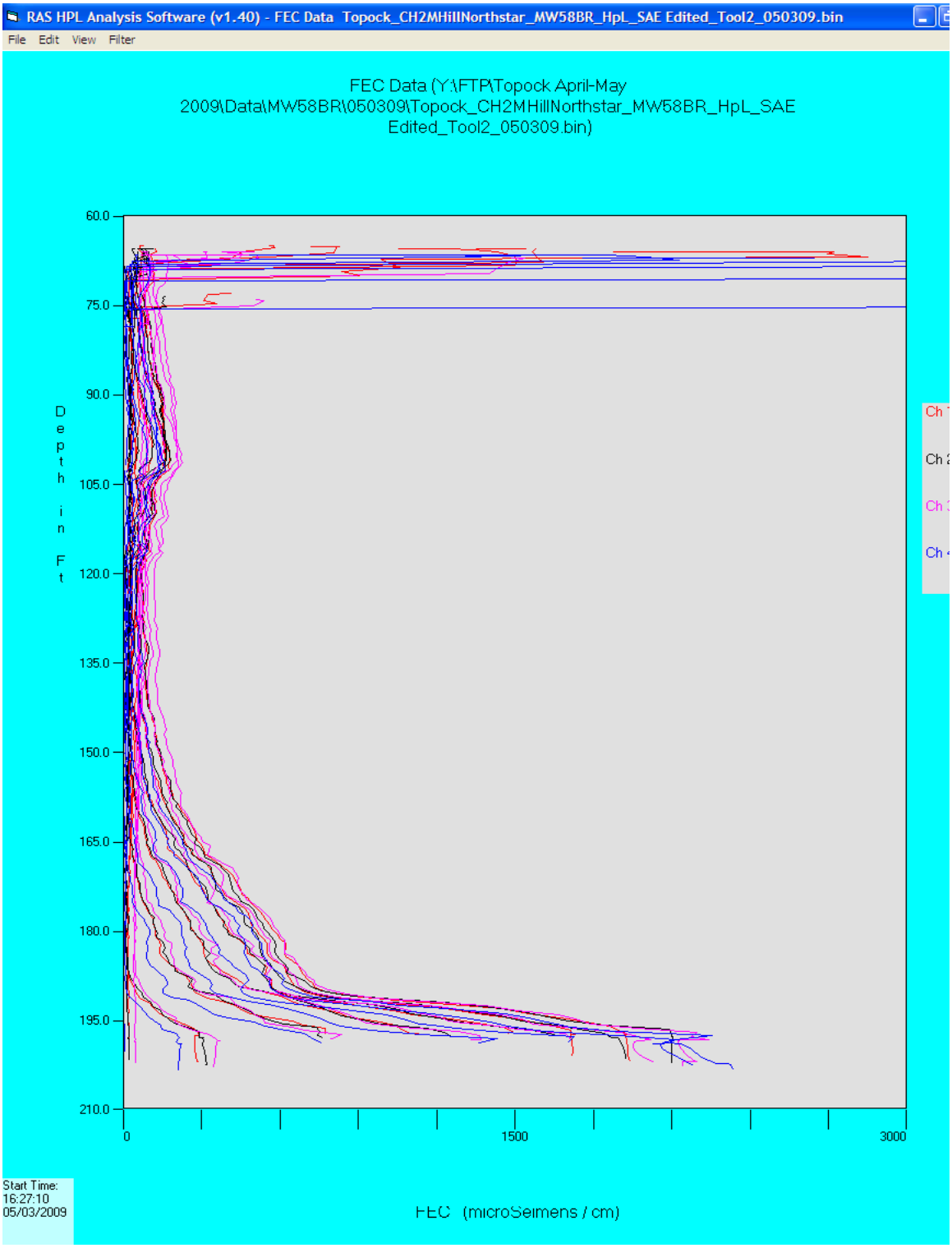


Figure 13. MW-58BR pumping history during SAE test. Pressure measured by Hermit PT in lower figure. T = 0 mins at 15:02:30 hours. Slug withdrawal occurred at 16:38 for SAE testing, 73.88 DTW maximum displacement. Ambient DTW was 67.10 or 6.78 delta.



Figrue 14. MW-58BR. Summary of Logs Collected during SAE testing.

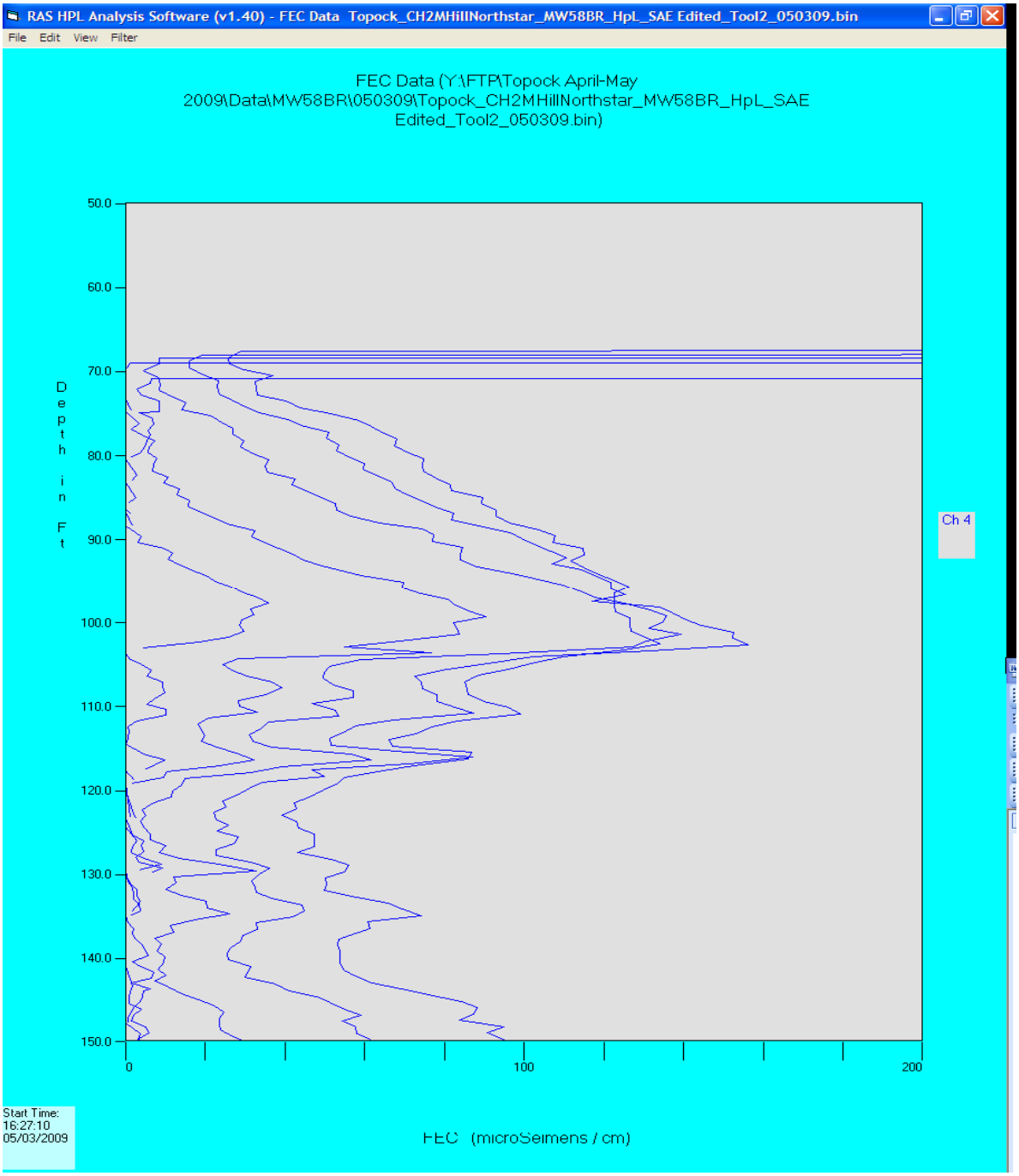


Figure 15. MW-58BR Summary of Hydrophysical logs collected during SAE Testing. Channel 4 only, enhanced scales for inflow indentification.

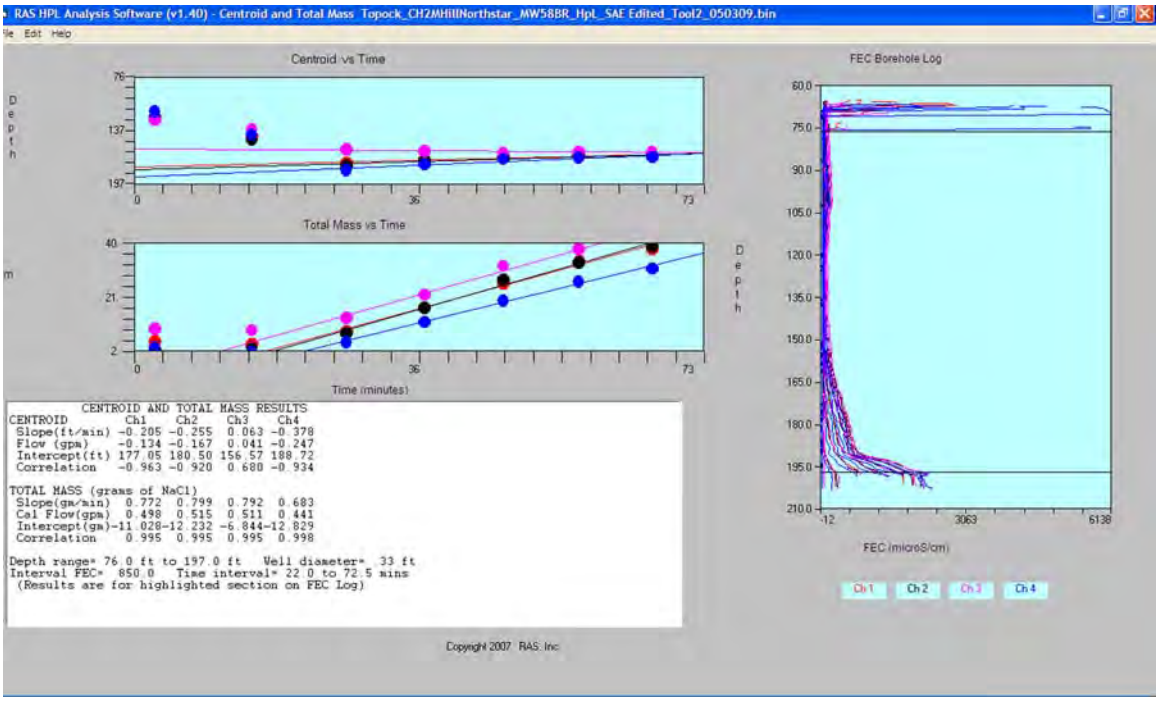


Figure 16. MW-58BR Normalized interval FEC to match volumetric flow rate calculated above (0.5gpm)

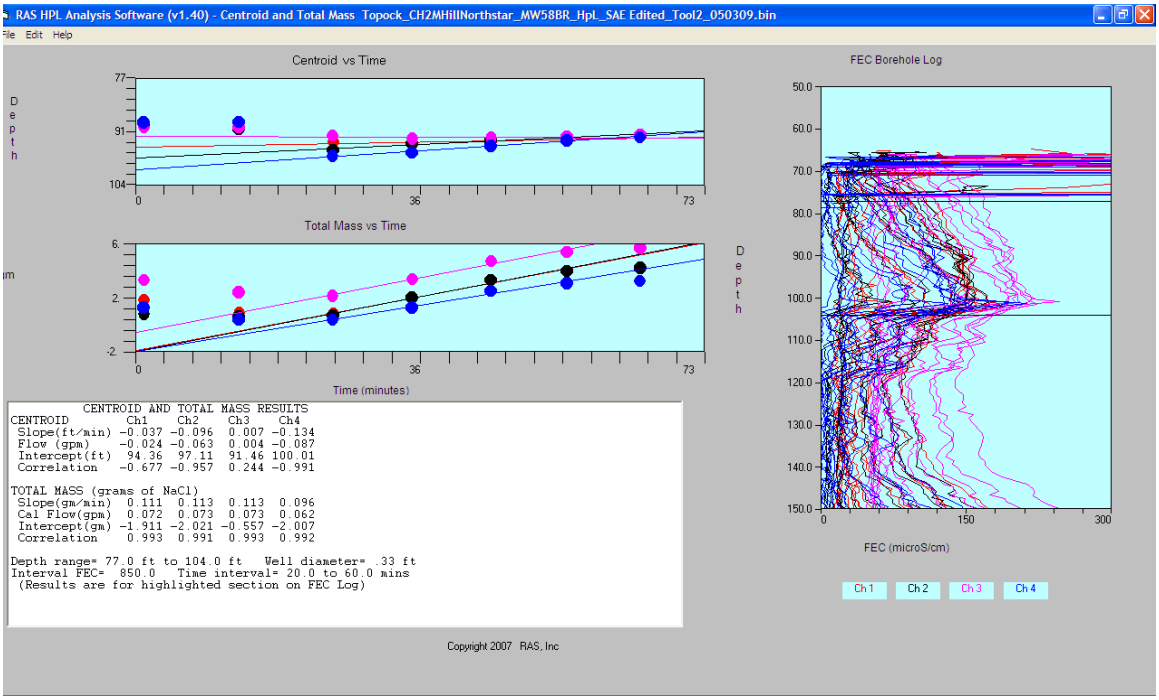


Figure 17. MW-58BR Results of Integral and Centroid Analysis, interval of analysis for inflow at 95.9 to 103.7 feet.

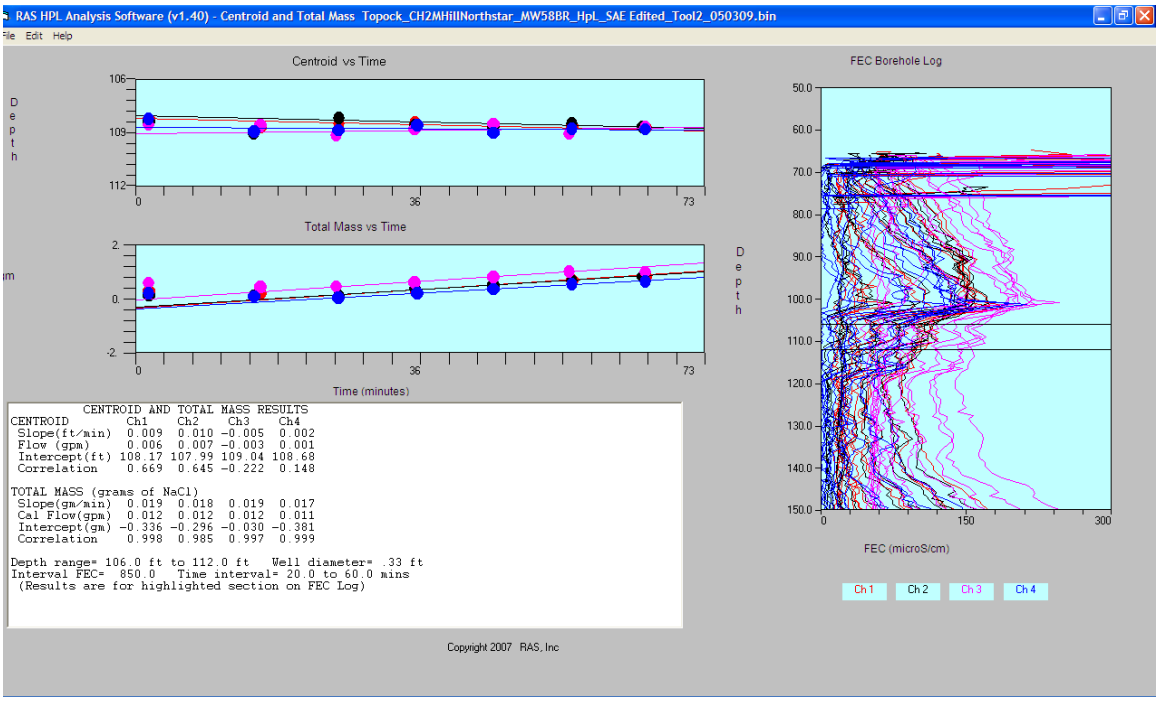


Figure 18. MW-58BR Results of Integral and Centroid Analysis, interval of analysis for inflow at 106.6 to 111.3 feet.

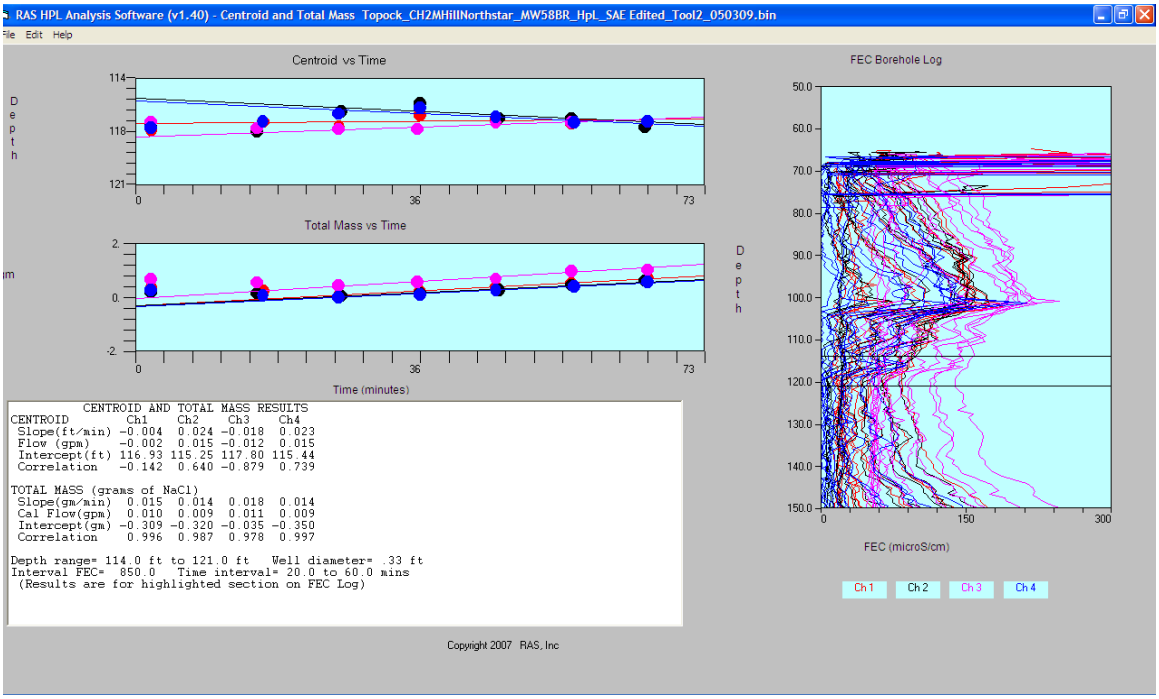


Figure 19. MW-58BR Results of Integral and Centroid Analysis, interval of analysis for inflow at 114.7 to 120.1 feet.

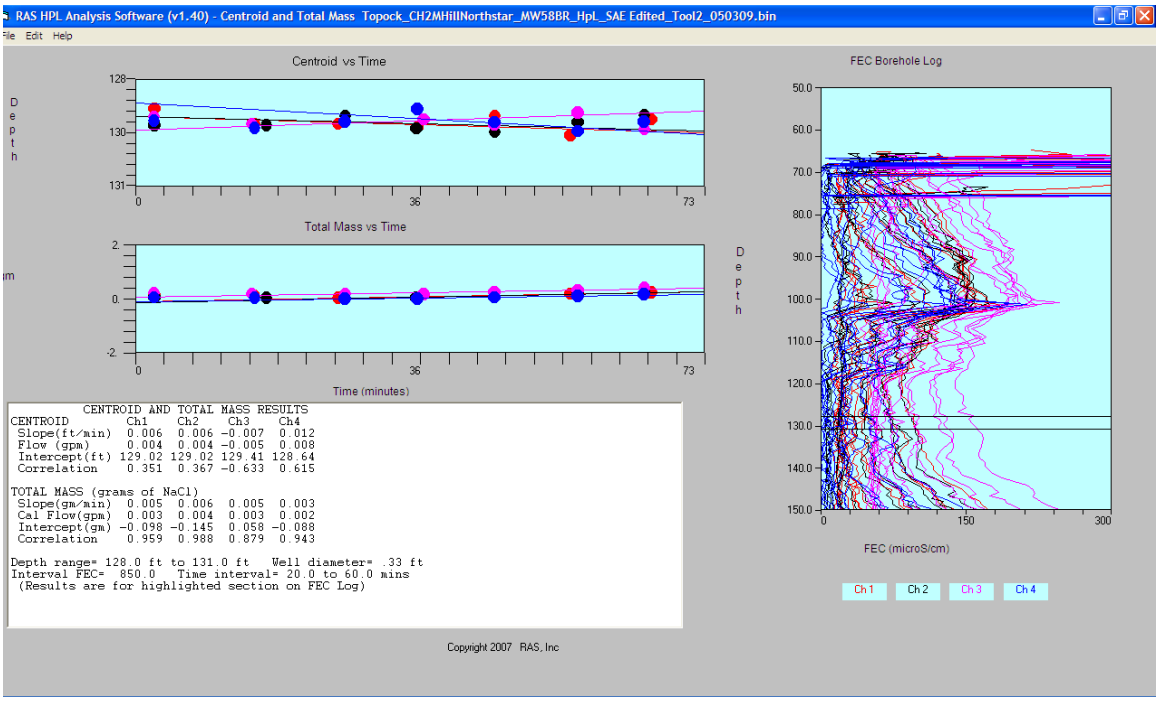


Figure 20. MW-58BR Results of Integral and Centroid Analysis, interval of analysis for inflow at 128.0 to 130.5 feet.

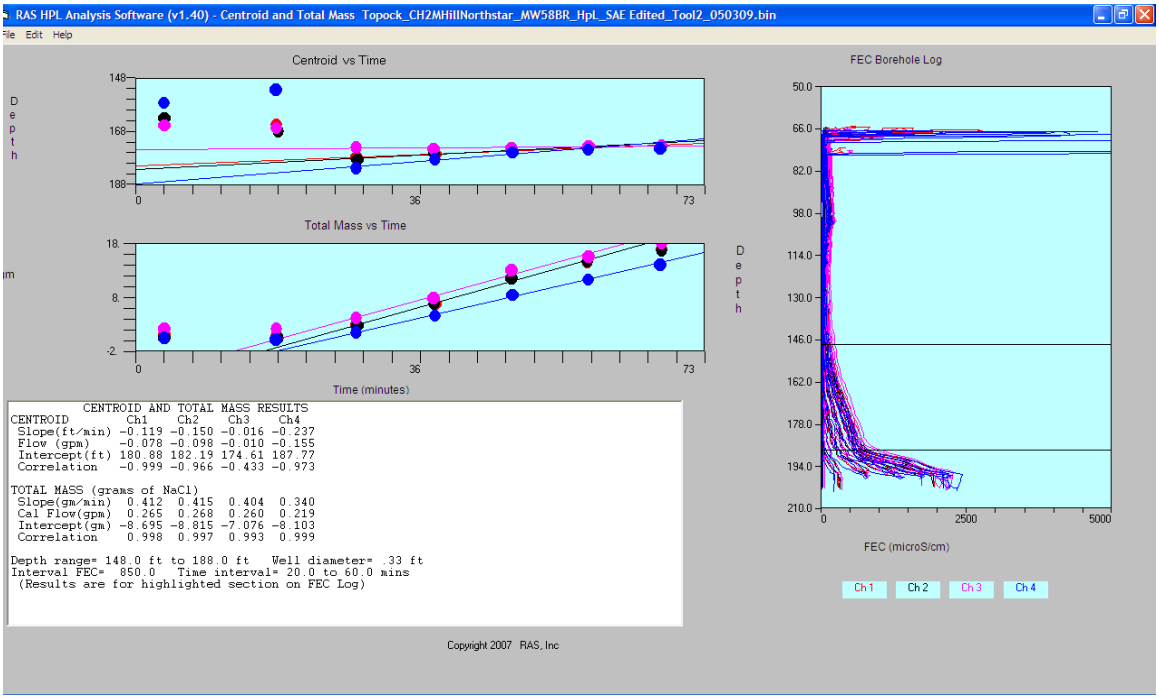


Figure 21. MW-58BR Results of Integral and Centroid Analysis, interval of analysis for inflow at 132.4 to 136.3 feet.

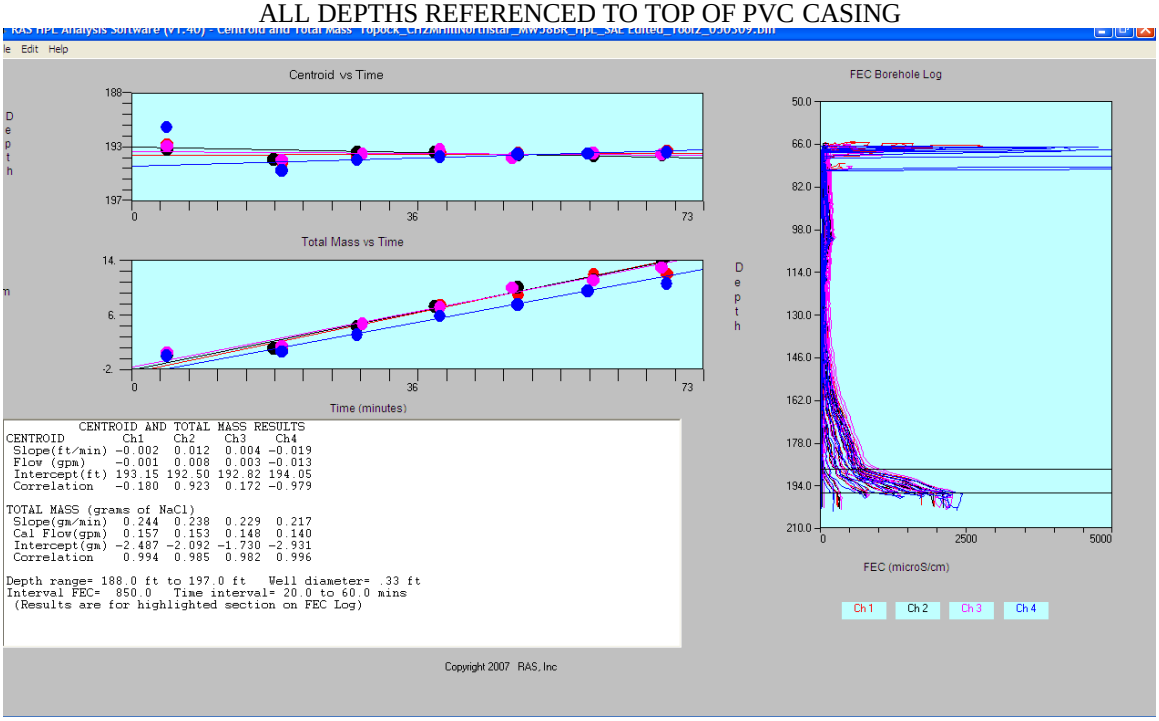


Figure 22. MW-58BR Results of Integral and Centroid Analysis, interval of analysis for inflow at 190.0 to 207.0 feet.

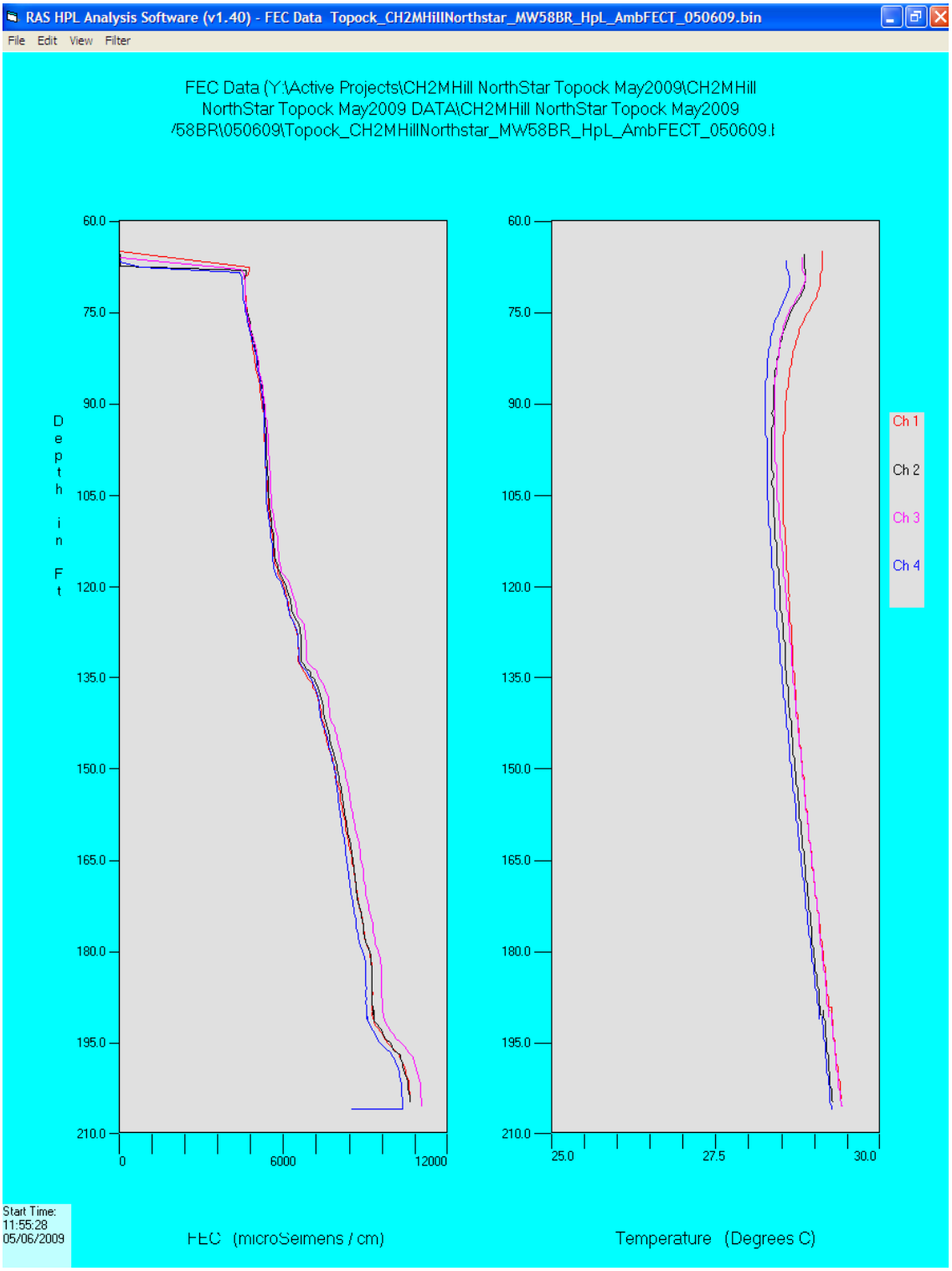


Figure 23. MW-58BR Ambient FEC and Temperature Log Collected before Ambient Discrete Fluid Sample at 203 feet.

Summary of Preliminary HPL Results Conductive Feature (CF) Depths						
			Ambient Conditions Interval Specific Flow Rate	**Pumping Conditions Interval Specific Flow Rate**	**Interval Specific Concen-tration**	**Interval Specific Hydraulic Conductivity**
	Depth (ft)		gpm (US)	gpm (US)	µS/cm	ft/day
CF	top	Bottom				
1	95.9	103.7	0	0.07	~10,000	1.5
2	106.6	111.3	0	0.01	~10,000	0.4
3	114.7	120.1	0	0.01	~10,000	0.3
4	128.0	130.5	0	0.003	~10,000	0.2
5	132.4	136.3	0	0.01	~10,000	0.4
6	148	190	0	0.27	~10,000	1.1
7	190.0	207	.004	0.15	~10,000	2.6
	Sum of Interval Specific Flowrates			0.523		
	Total observed at from rising head			0.5		
	ALL DEPTHS REFERENCED TO TOP OF CASING (TOC); CASING STICKUP = 27.25”					

Table 1. CH2MHill Topock Well MW-58BR, Summary of Results, Ambient Flow Characterization and Slug After Emplacement Tests.

CH2MHill – NorthStar
PG&E Topock Compressor Station
Monitoring Well MW-62BR
HPL PROCESSING NOTES
ALL DEPTHS REFERENCED TO TOP OF PVC CASING

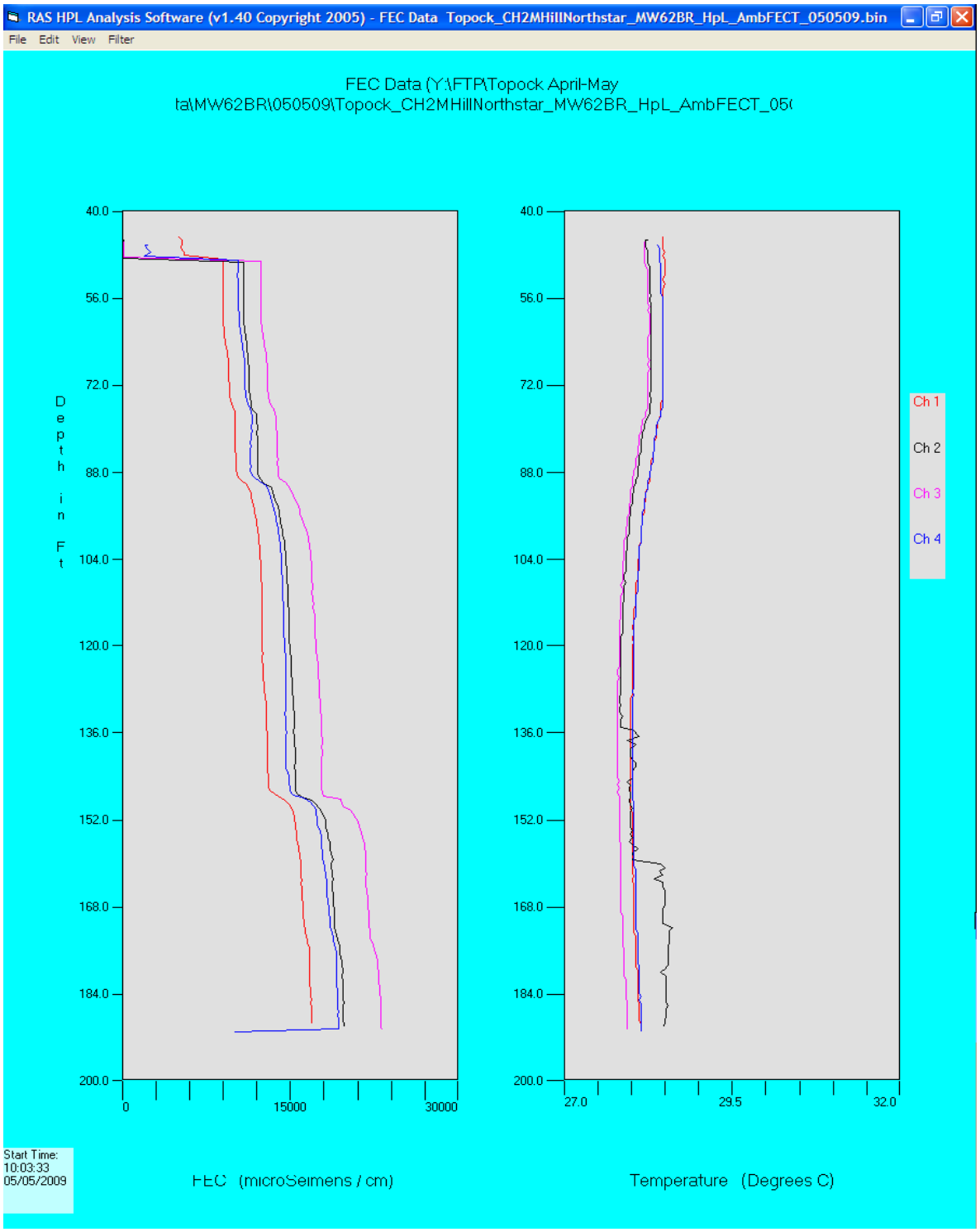


Figure 1. MW-62BR Ambient Fluid Electrical Conductivity and Temperature.

CH2MHill – NorthStar
PG&E Topock Compressor Station
Monitoring Well MW-64BR
HPL PROCESSING NOTES
ALL DEPTHS REFERENCED TO TOP OF PVC CASING

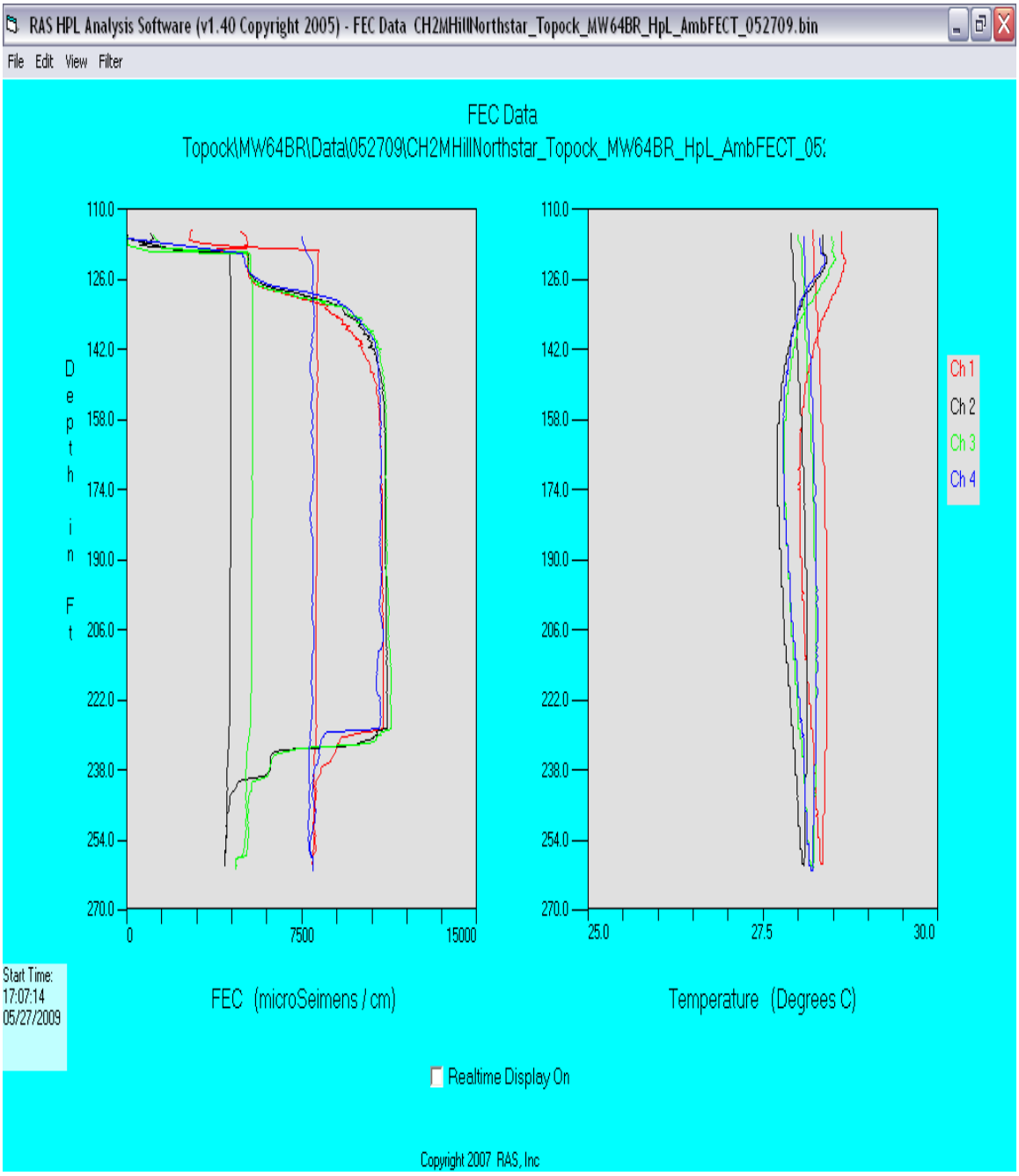


Figure 1. MW-64BR Ambient FEC and Temperature Log, **Note:** Bentonite plug @ 230' fouling all 4 sensors. Well screen was pressure washed with DI water and bentonite material removed from well.

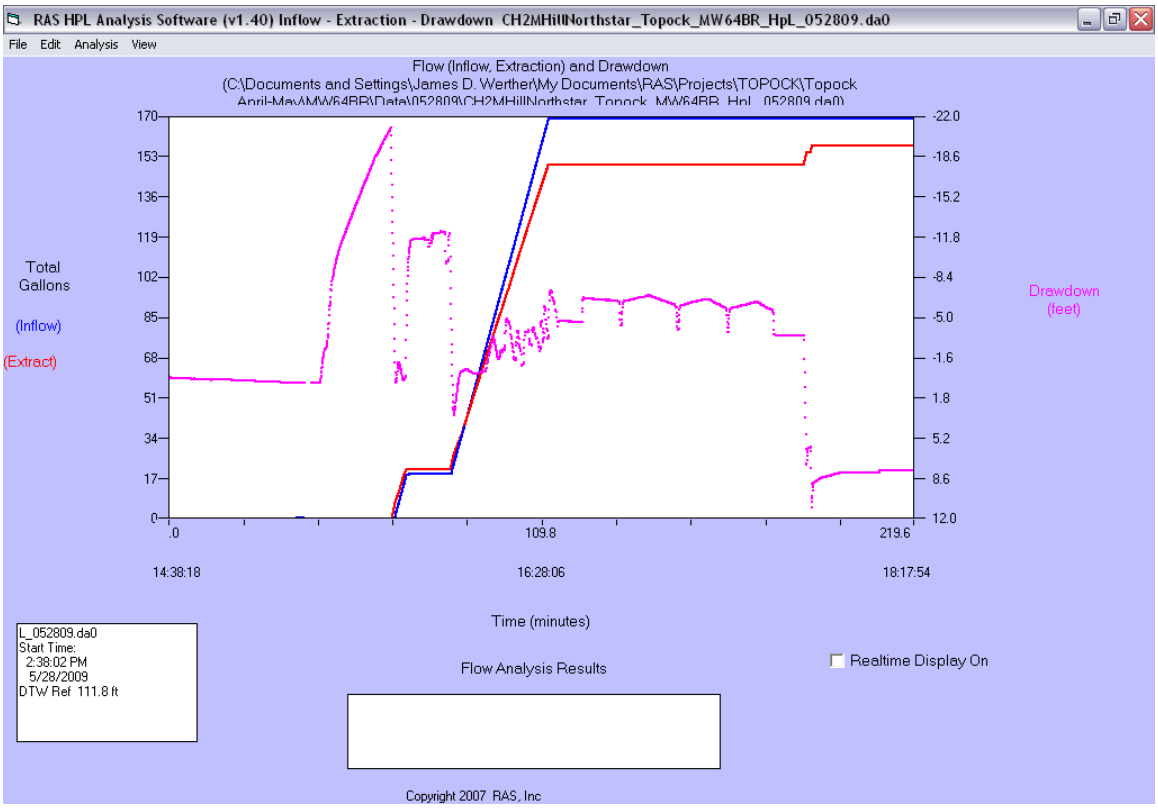


Figure 2. MW-64BR Pressure data – during pressure washing and pumping of well to clean out screen of bentonite material.

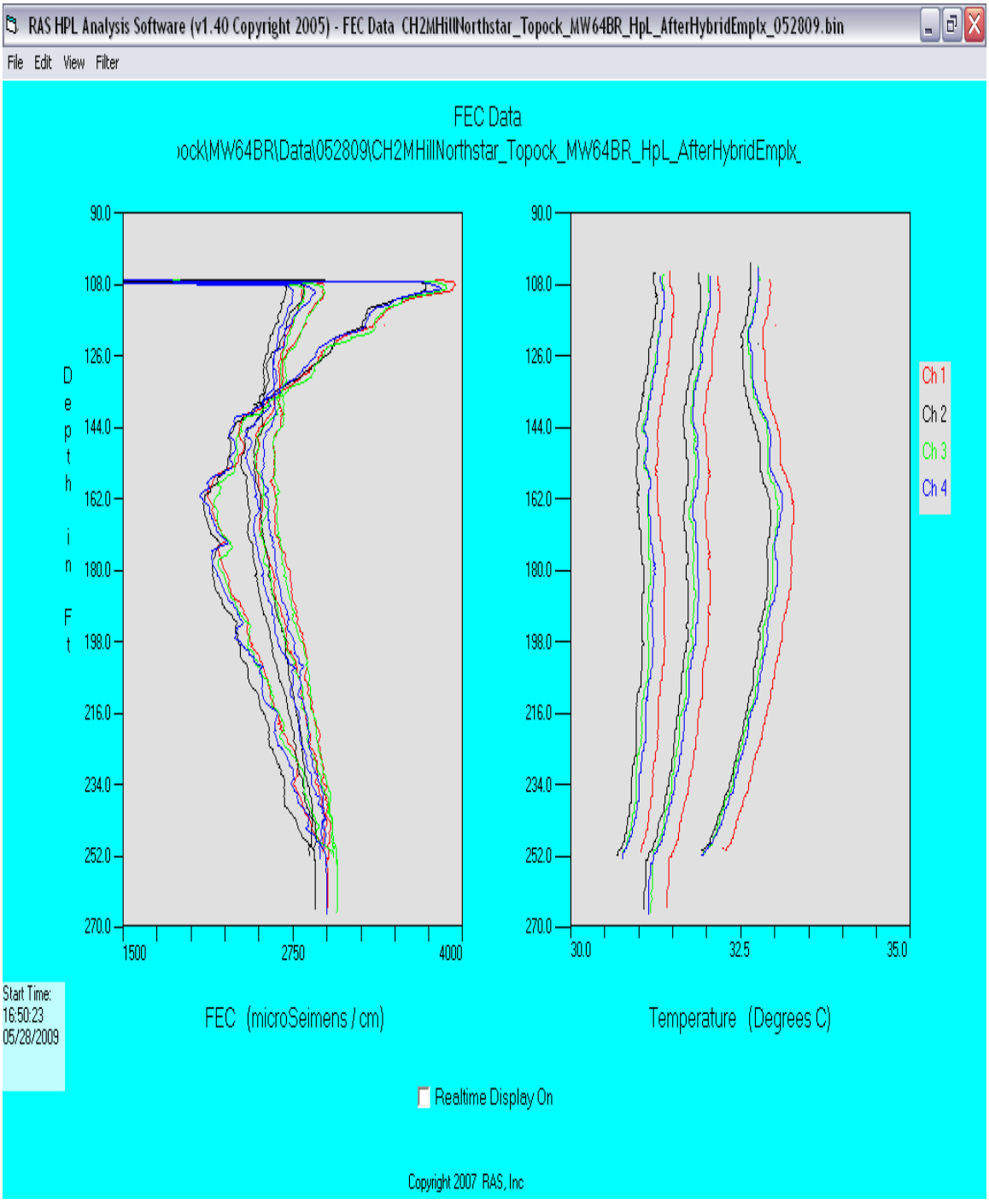


Figure 3. MW-64BR Post pressure washing of screen logs. Material previously fouling HPL tool sensors removed. Tool performed properly as demonstrated by these logs.

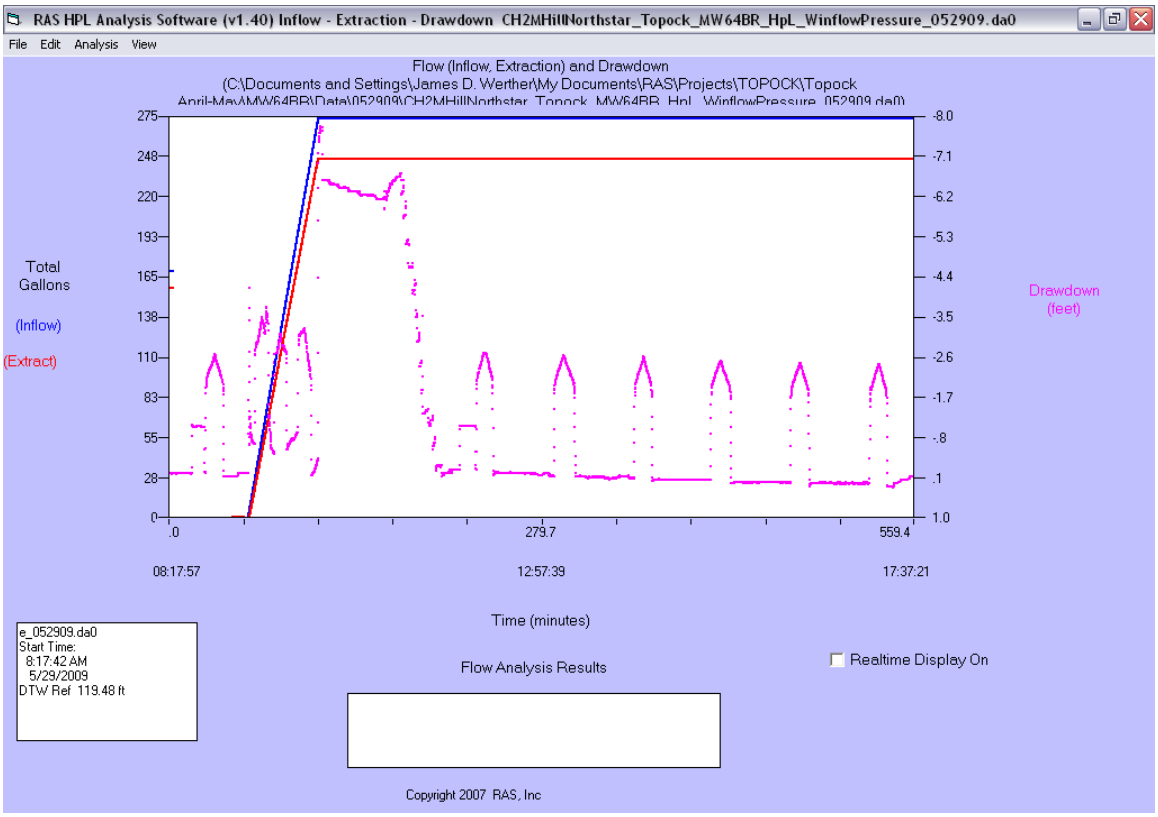


Figure 4. MW-64BR Flow and Pressure Data During Emplacement and Ambient Flow Characterization. Day 1 data.

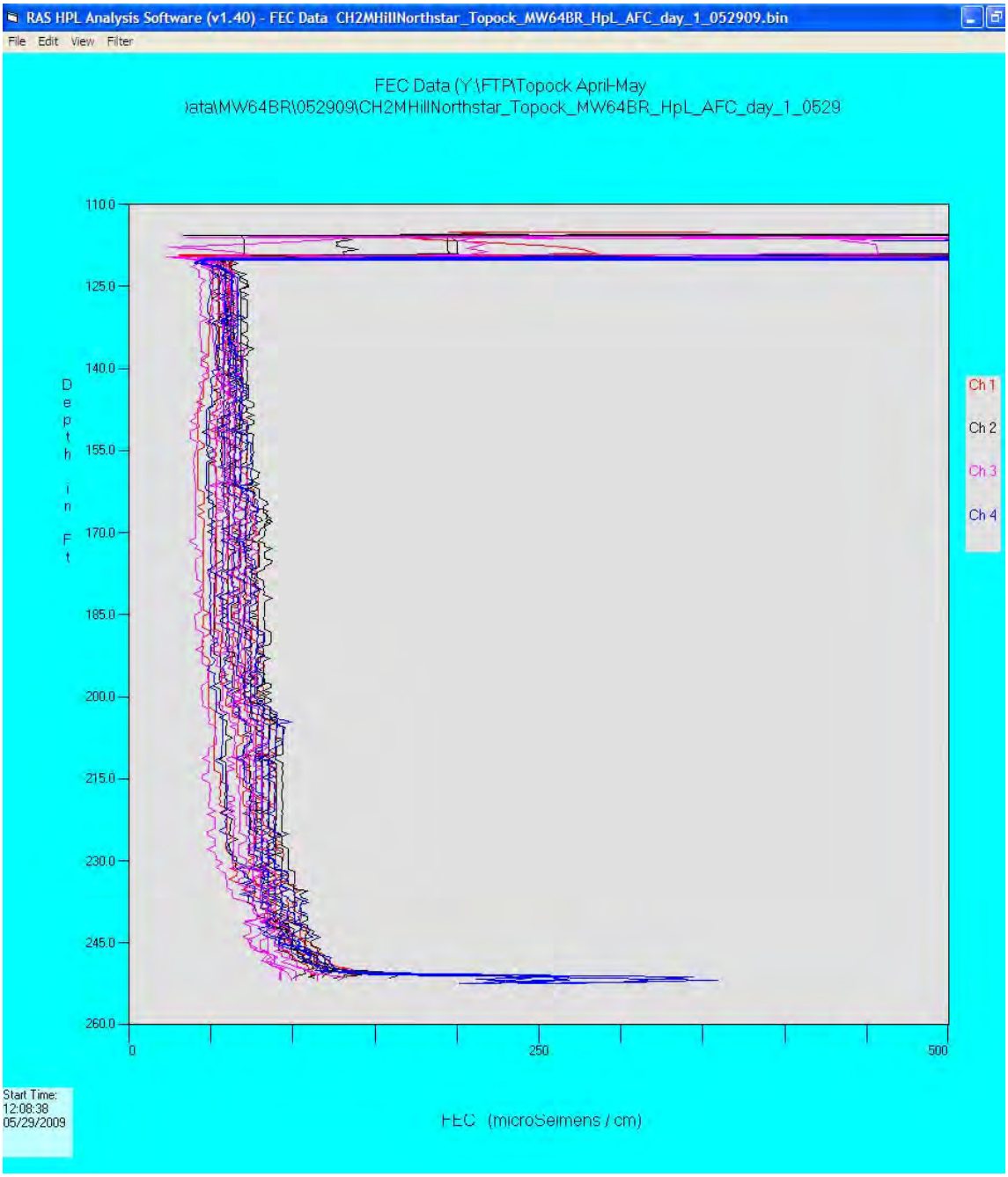


Figure 5. MW-64BR, Summary of Logs collected during Day 1 of Ambient Flow Characterization.

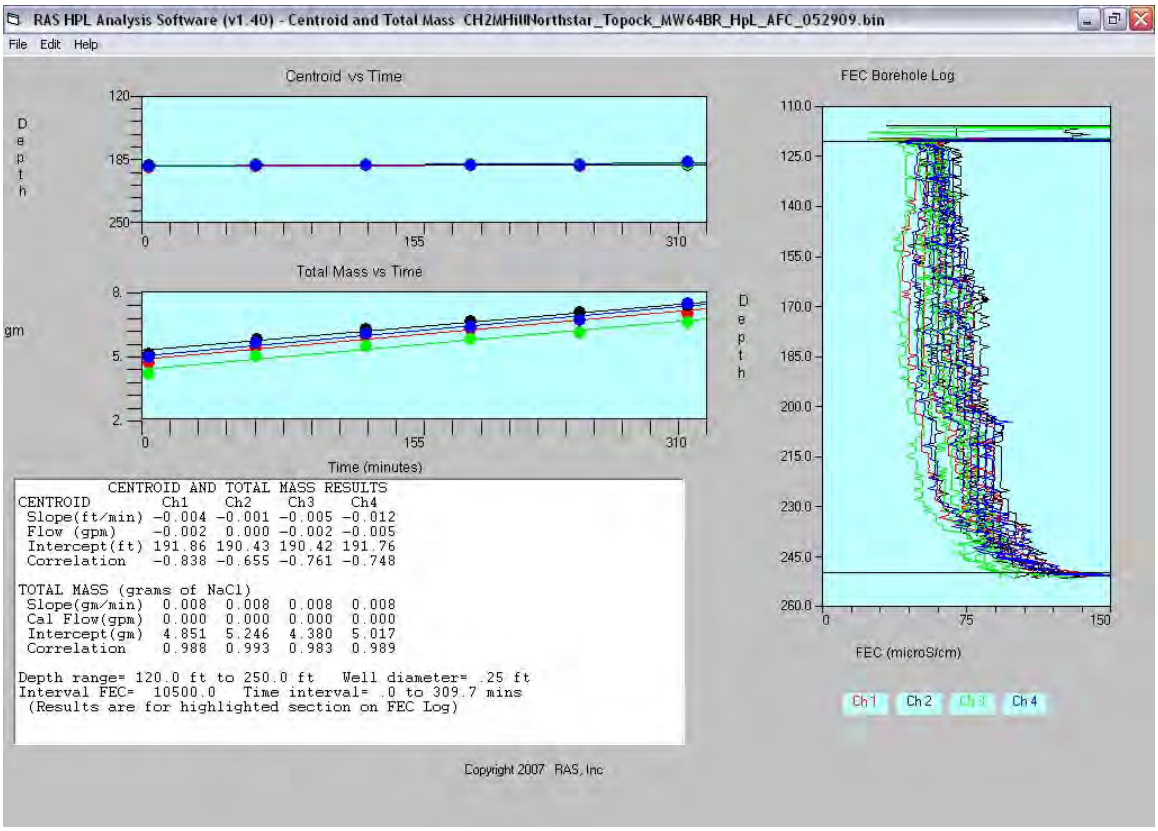


Figure 6. MW-64BR Centroid & Total Mass Analysis – AFC Day 1- Data suggest flow was less than 0.001 gpm.

053009 – Ambient Flow Characterization Day 2

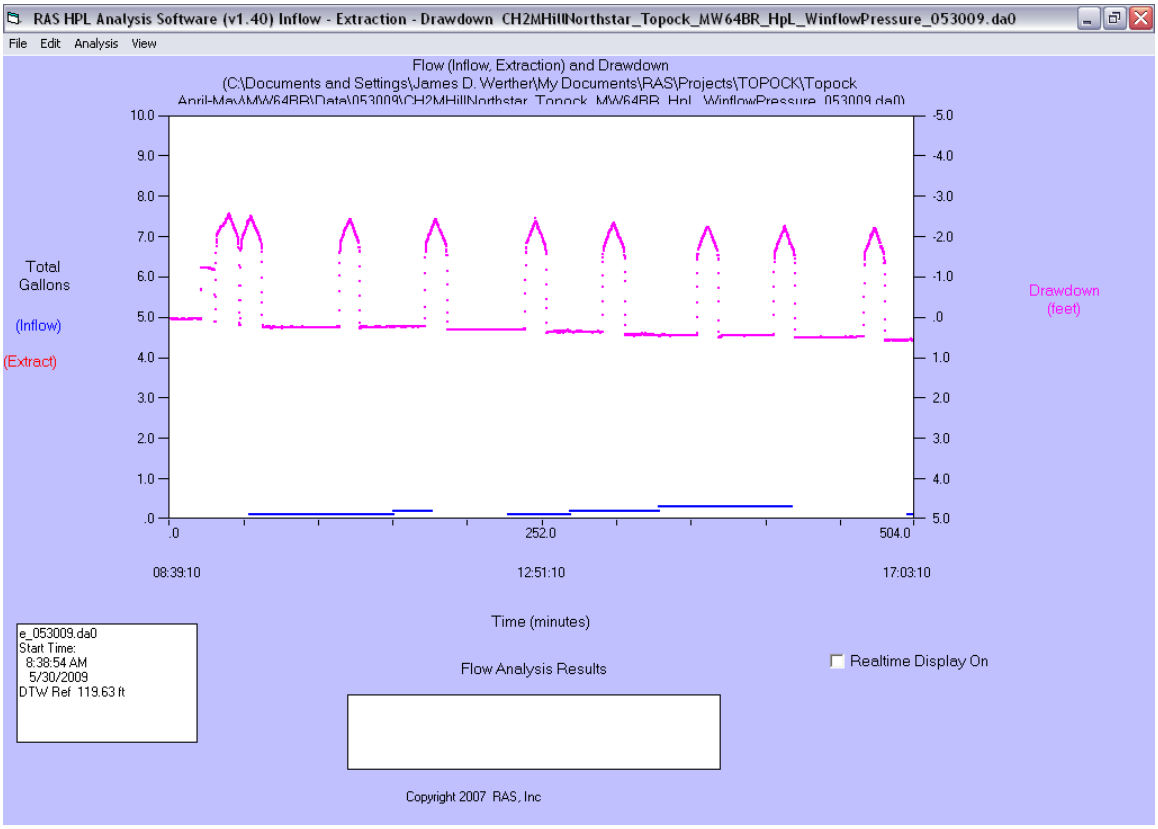


Figure 7. MW-64BR Pressure history during Day 2 of Ambient Flow Characterization.

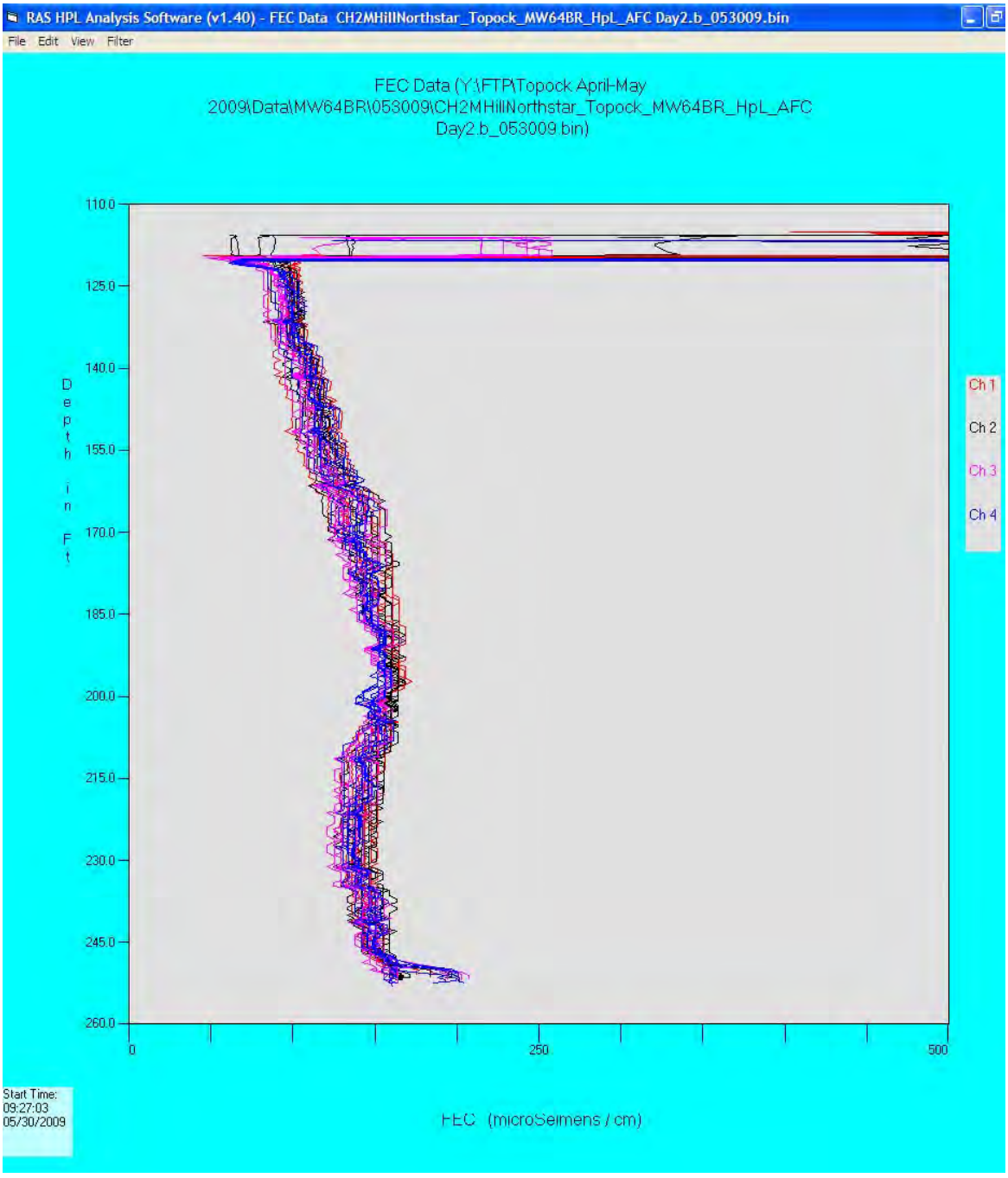


Figure 8. MW-64BR, Summary of Logs collected during Day 2 of AFC.

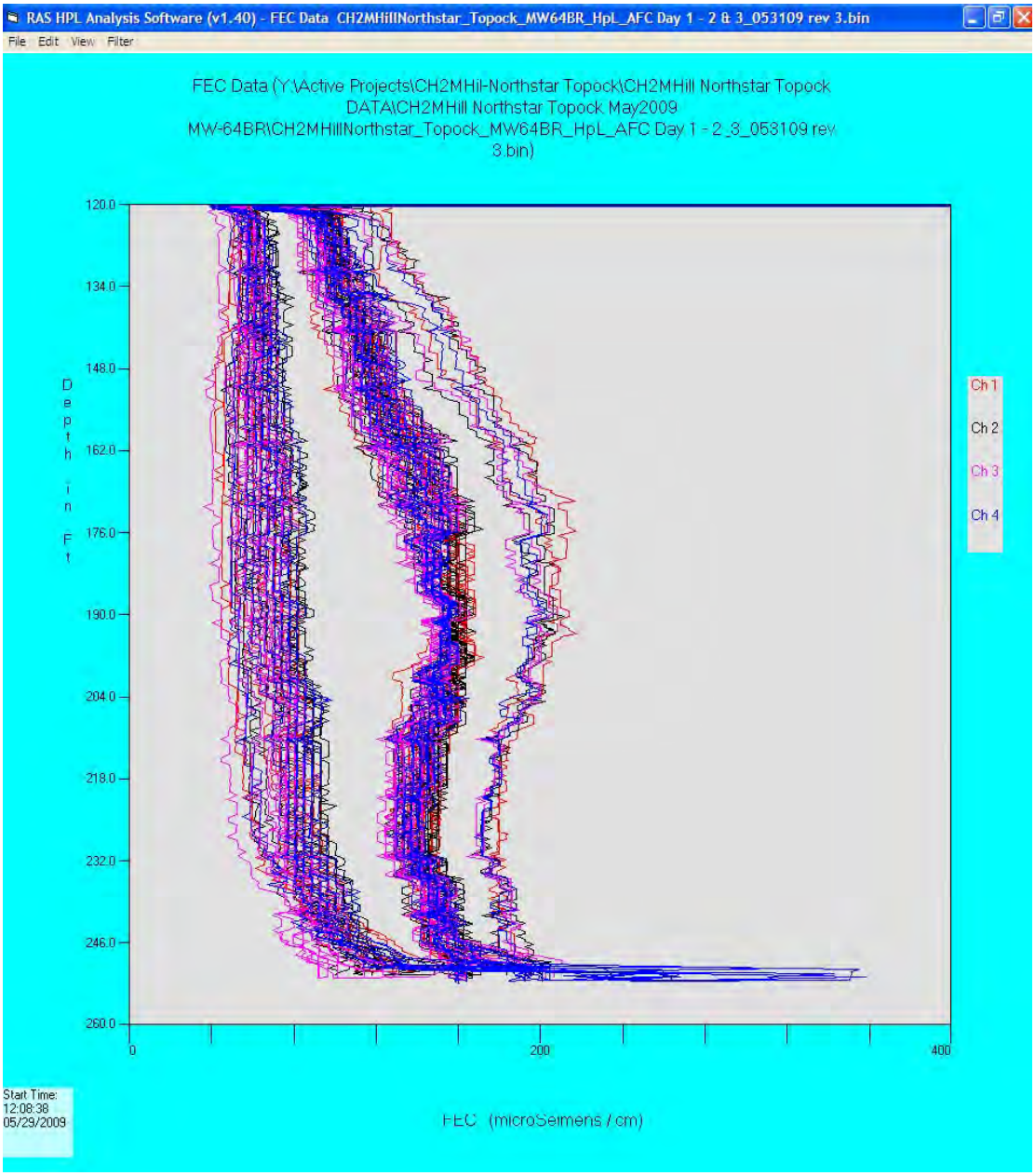


Figure 9. MW-64BR, AFC Days 1, 2 and 3 compiled for analysis.

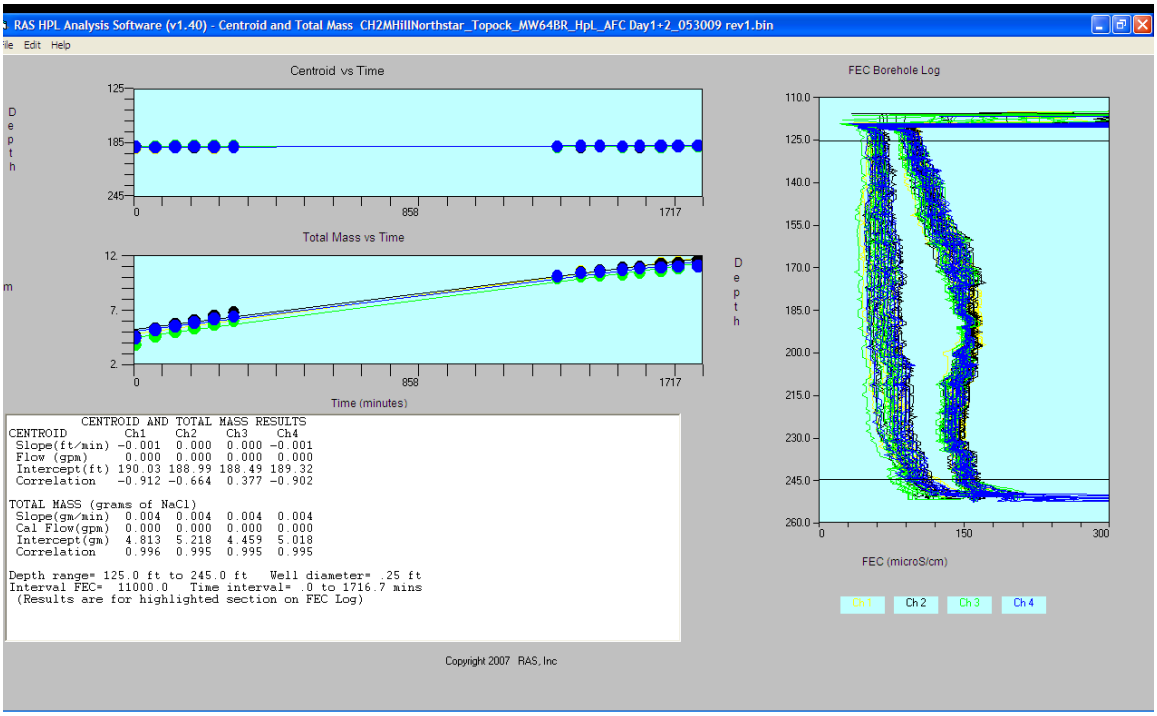


Figure 10. MW-64BR Integral and Centroid Analysis of HPL Data Collected on Day 1 and Day 2. Still below 0.001 gpm

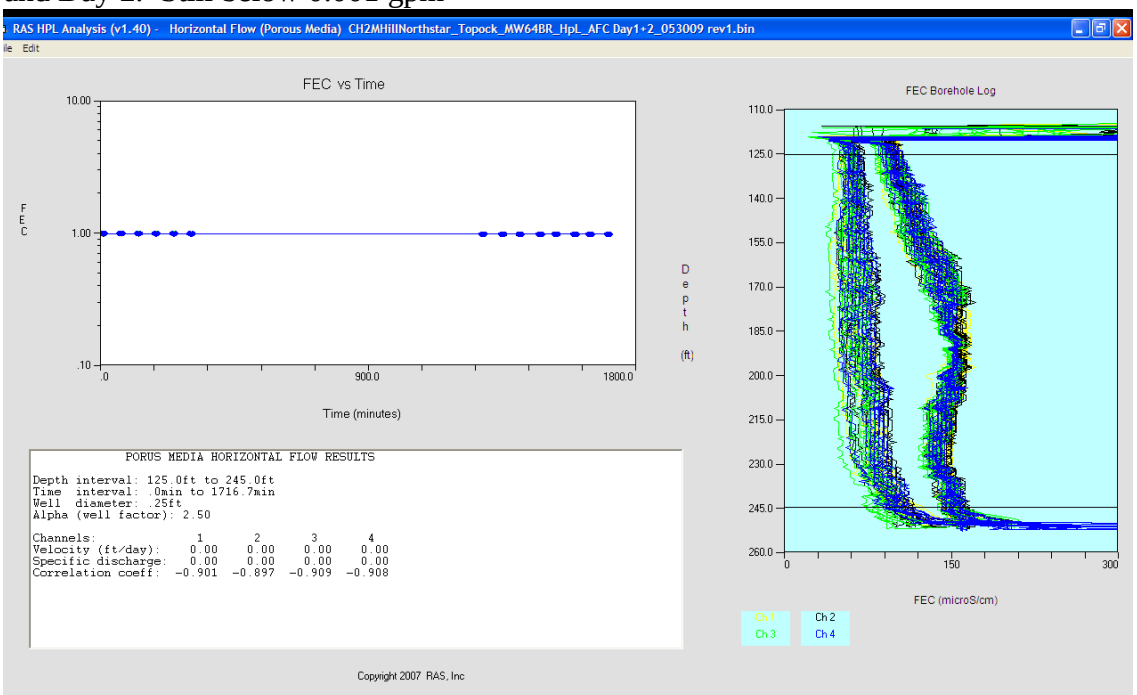


Figure 11. MW-64BR, Traditional Dilution Analysis of HPL Data Collected on Day 1 and Day 2. Flow velocity less than 0.01 feet per day.

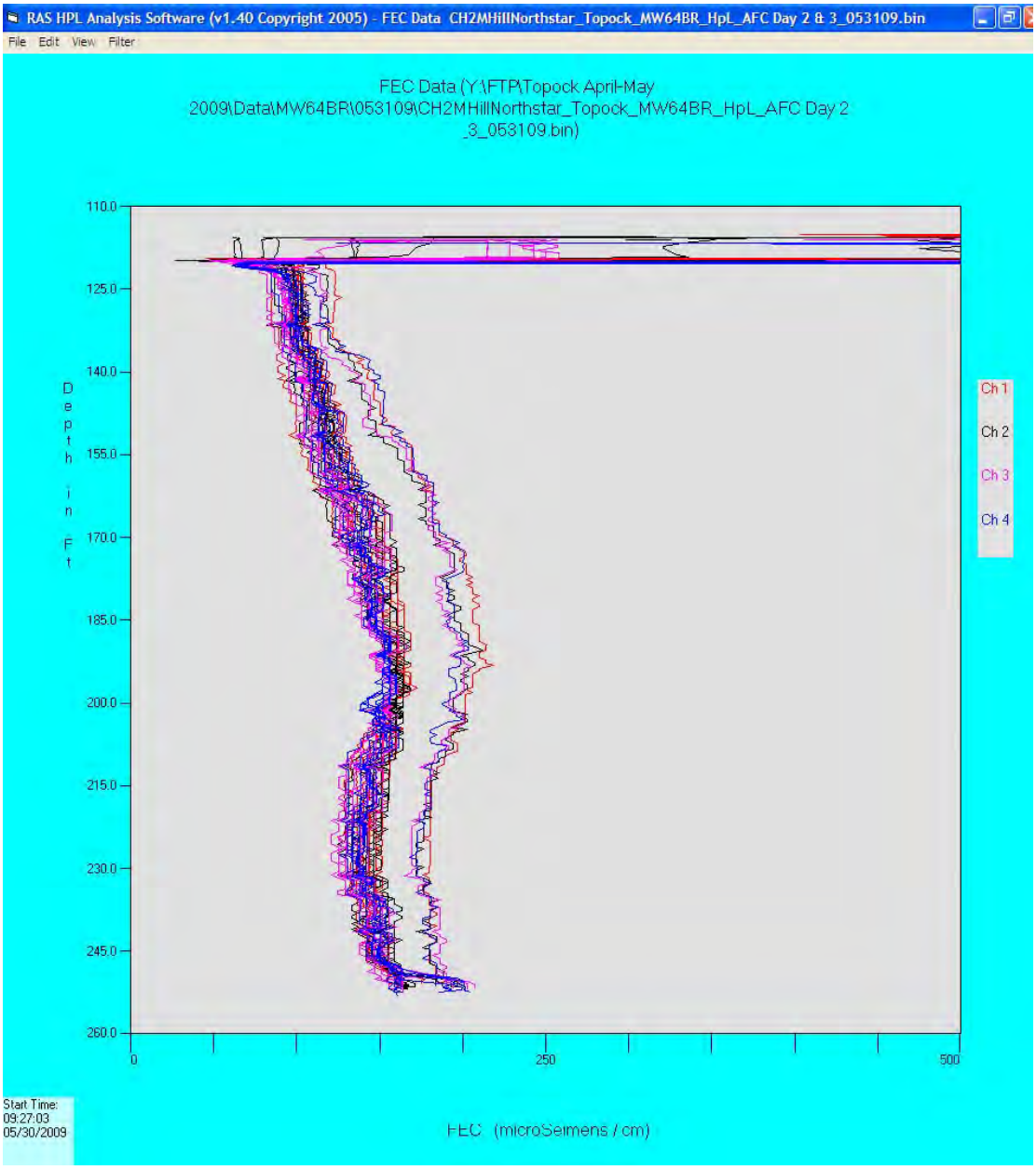


Figure 12. MW-64BR, Summary of Logs from Day 2 and single log collected in AM of Day 3.

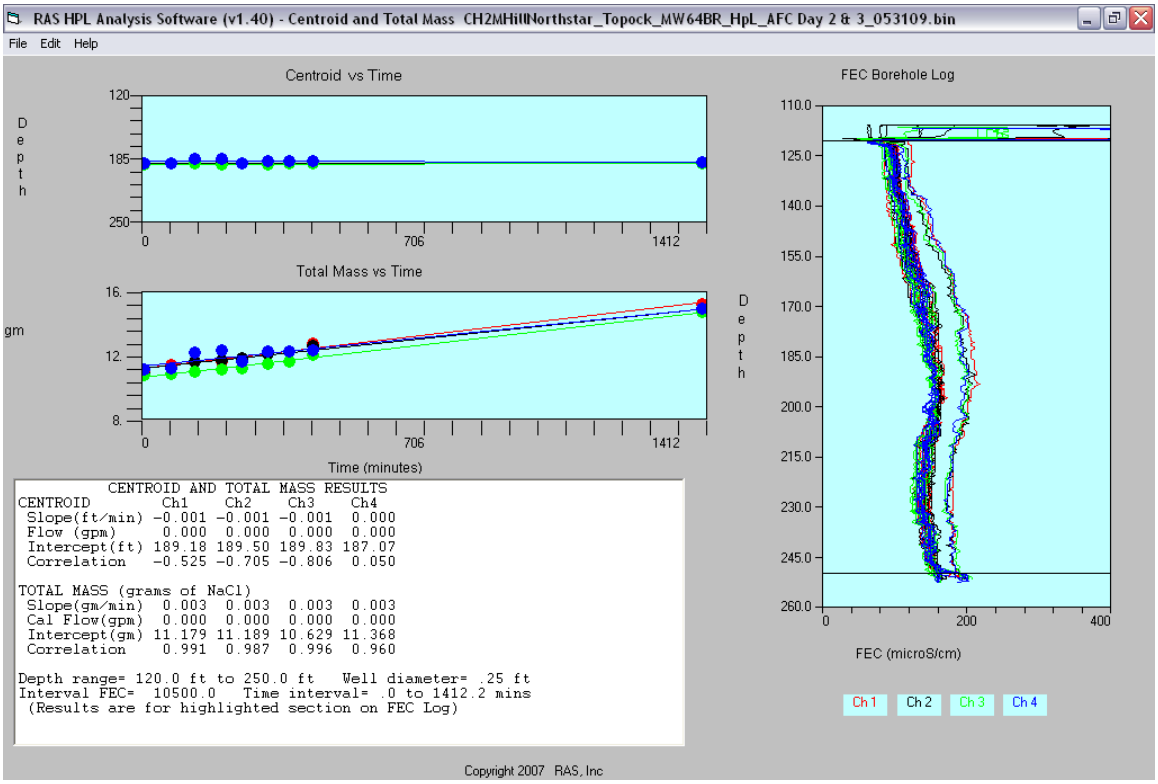


Figure 13. MW-64BR Centroid & Total Mass Analysis - AFC Day 2 & 3 - Data suggest flow was less than 0.001 gpm.

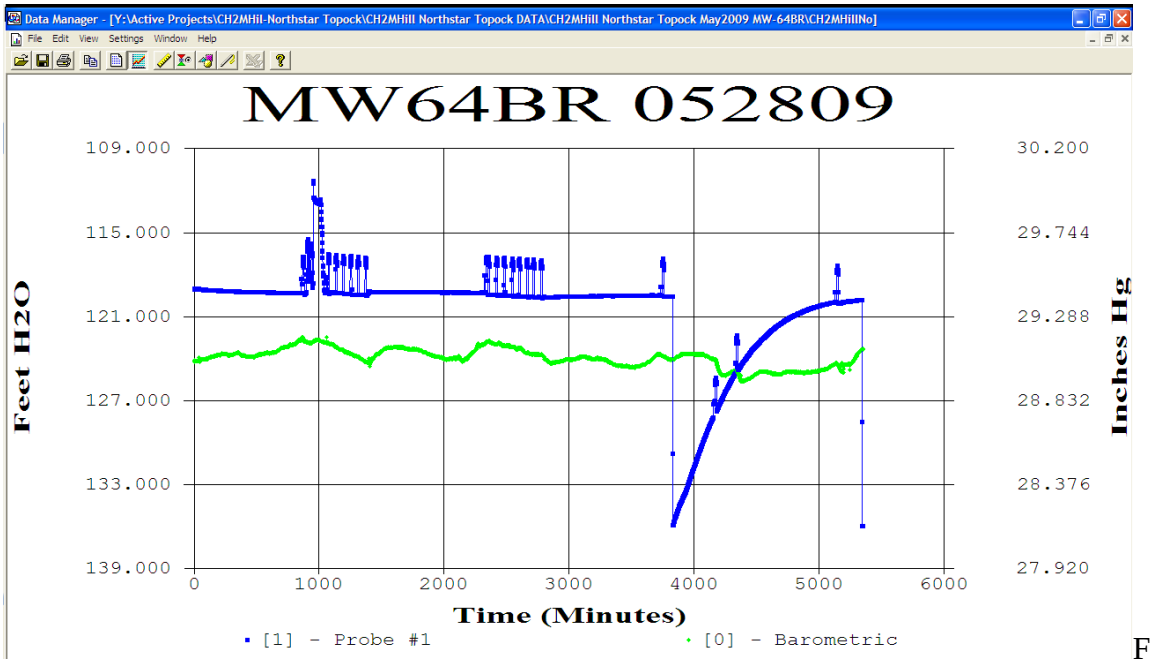


Figure 14. MW-64BR Complete Pressure History During HPL Testing, T = 0 @ 5/28/09 20:18 hours. Pressure monitoring completed at 6/1/09 13:34 hours. AFC logging noted by series of pressure spikes. Slug test and recover at ~ 3800 minutes.

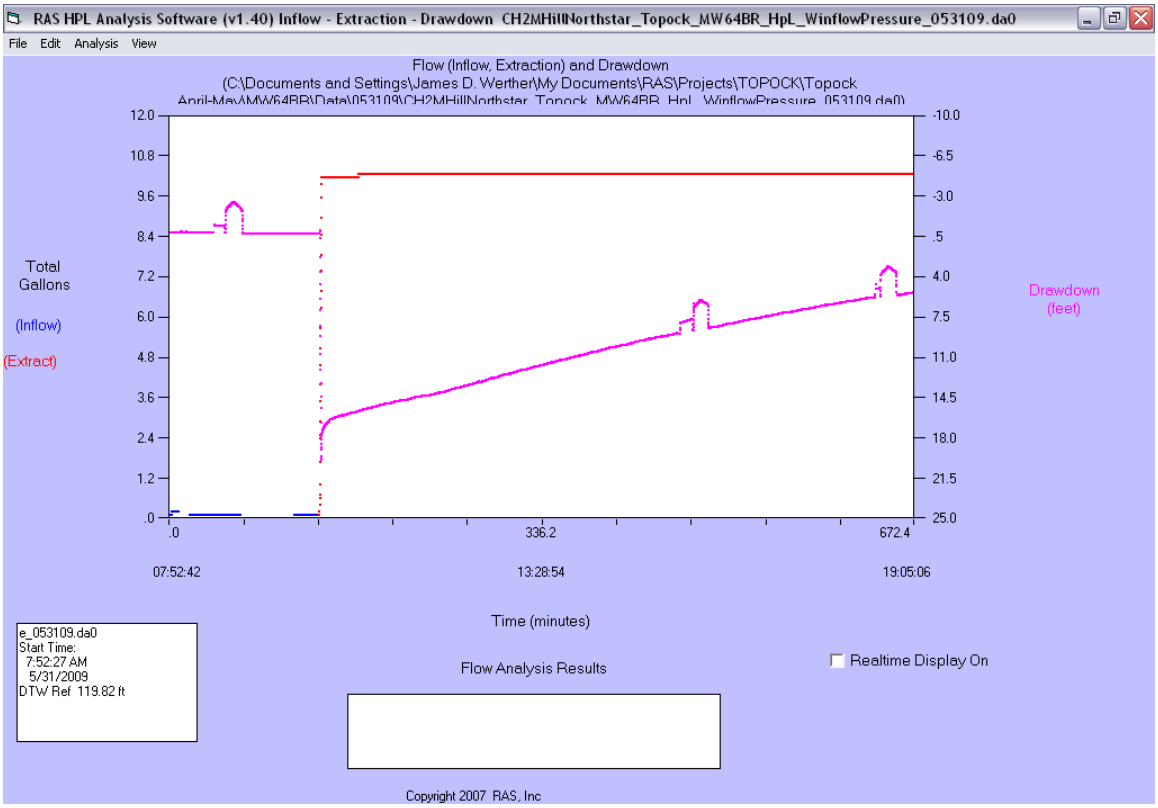


Figure 15. MW-64BR. Pressure history during Slug Test After Emplacement Procedures (SAE)

Volumetric Average Flowrate Calculations (average inflow rate from rising head data and casing diameter)

T1 = 153 min @ 16.1 feet

T2 = 639 min @ 5.6 feet

dT = 486 minutes
dDD = 10.5 feet

In 3 inch well, 1 foot = 0.367 gallons

Therefore,
(10.5*0.367)/486 mins = 0.008 gpm

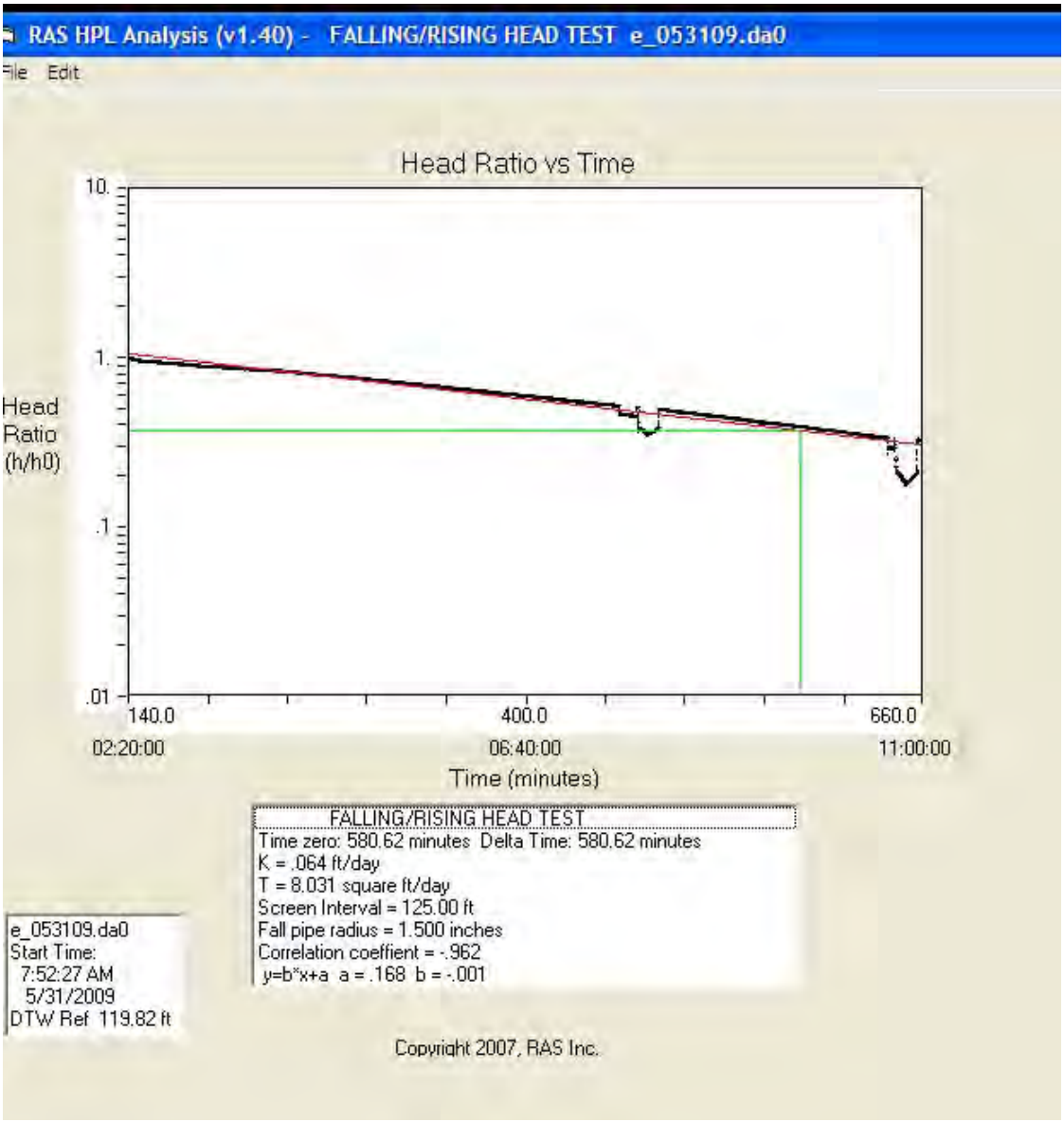


Figure 16. MW-64BR. Rising Head Test Analysis

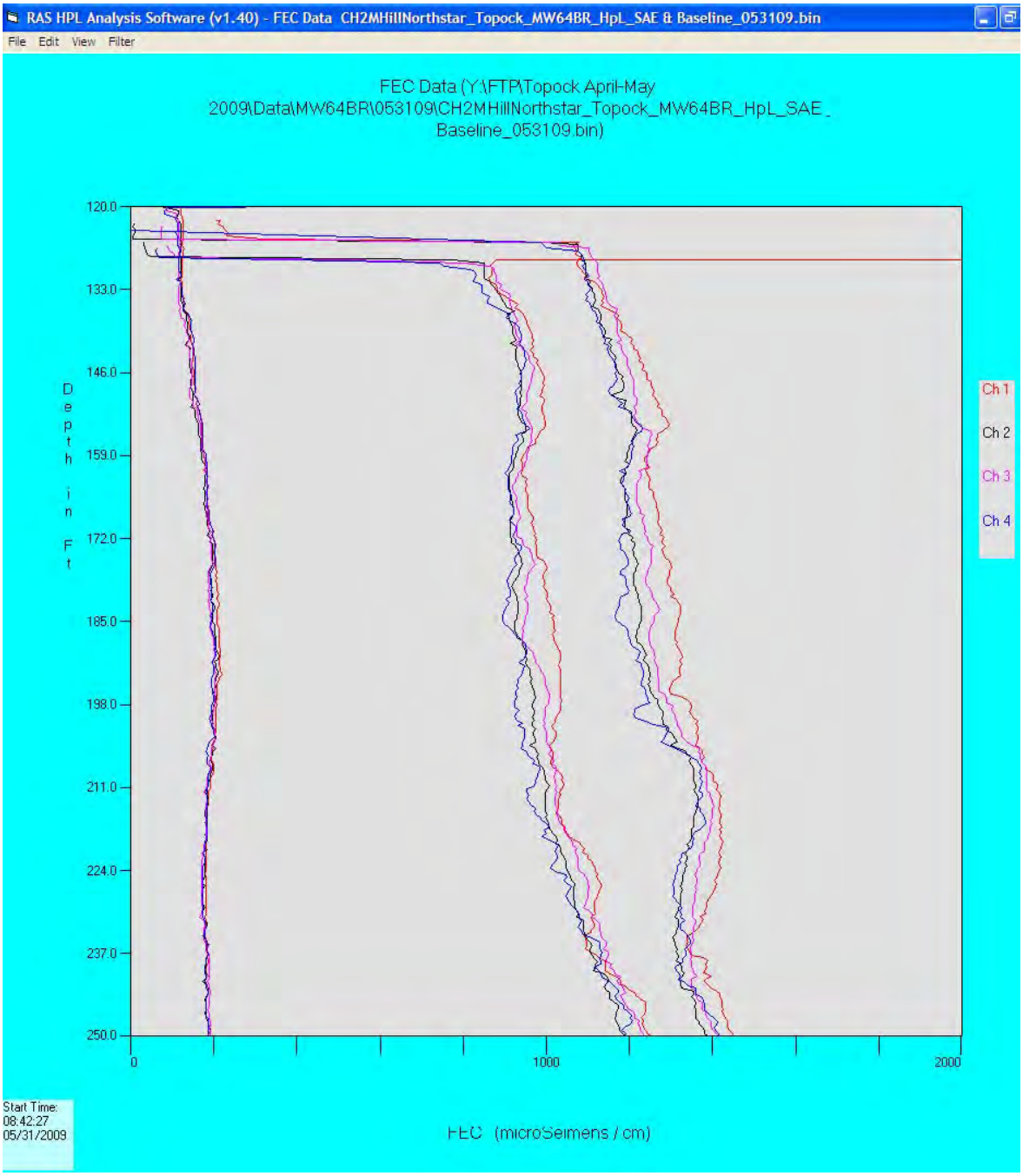


Figure 17. MW-64BR. Summary of Logs collected during SAE test. 16 foot slug removed.

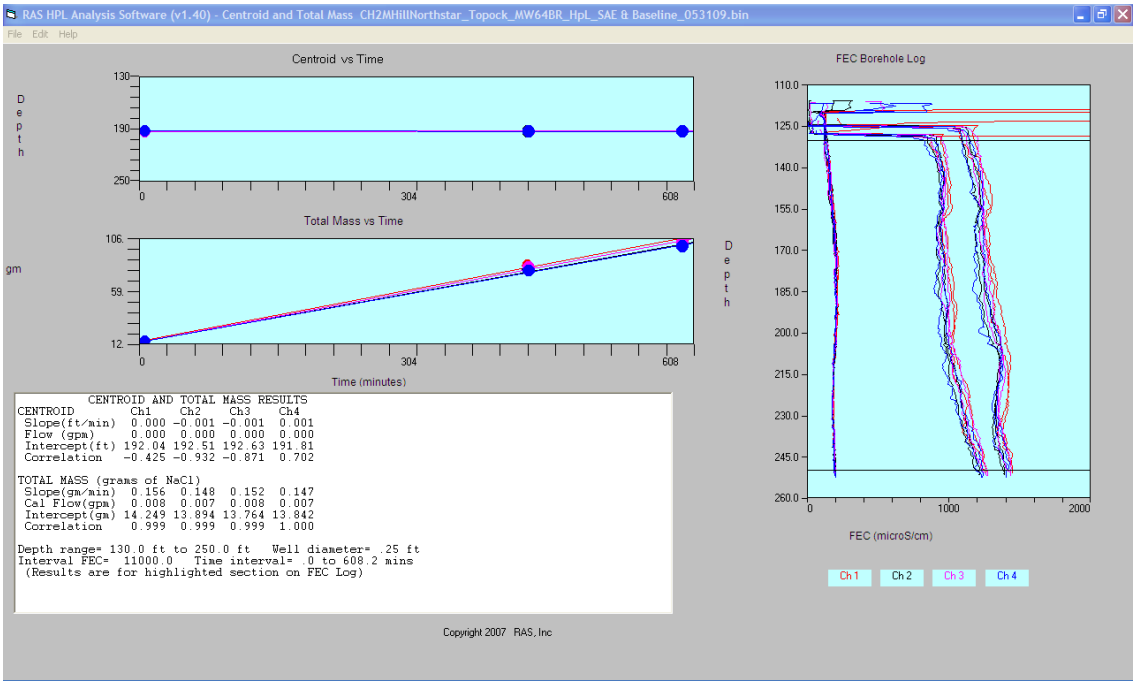


Figure 18. MW-64BR Centroid Total Mass Analysis – Total Formation Production 0.008 gpm and compares very favorably with average formation flow calculated volumetrically from rising head data (above).

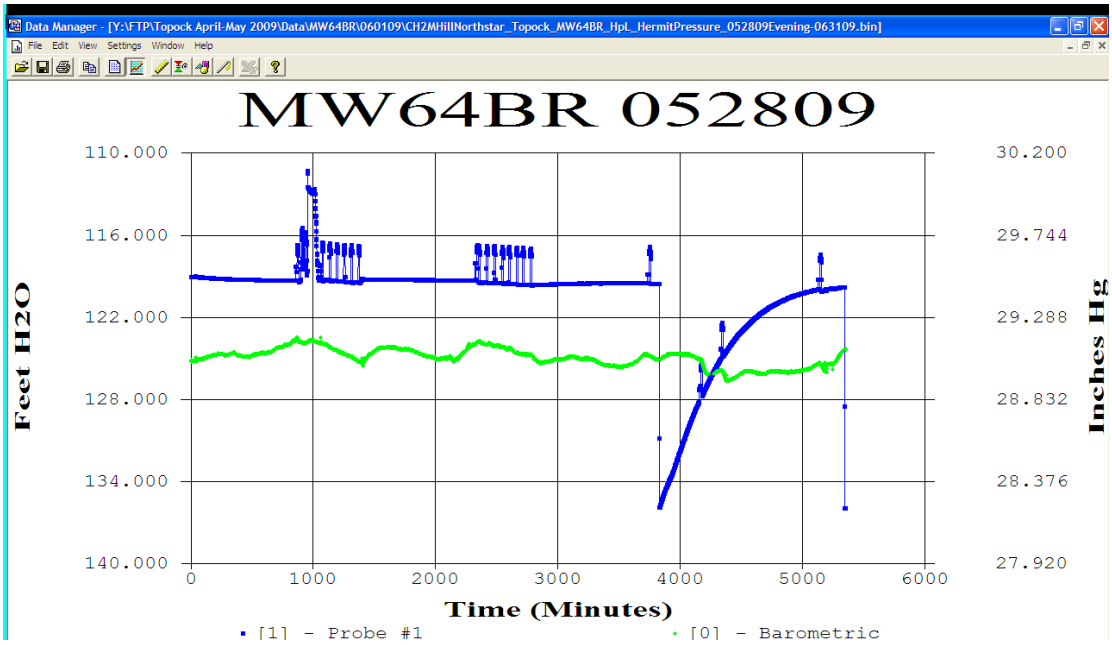


Figure 19. MW-64BR Topock MW-64BR complete pressure history. Start 5-28-09 @20:18 hours, end 6-01-09 13:34 hours.

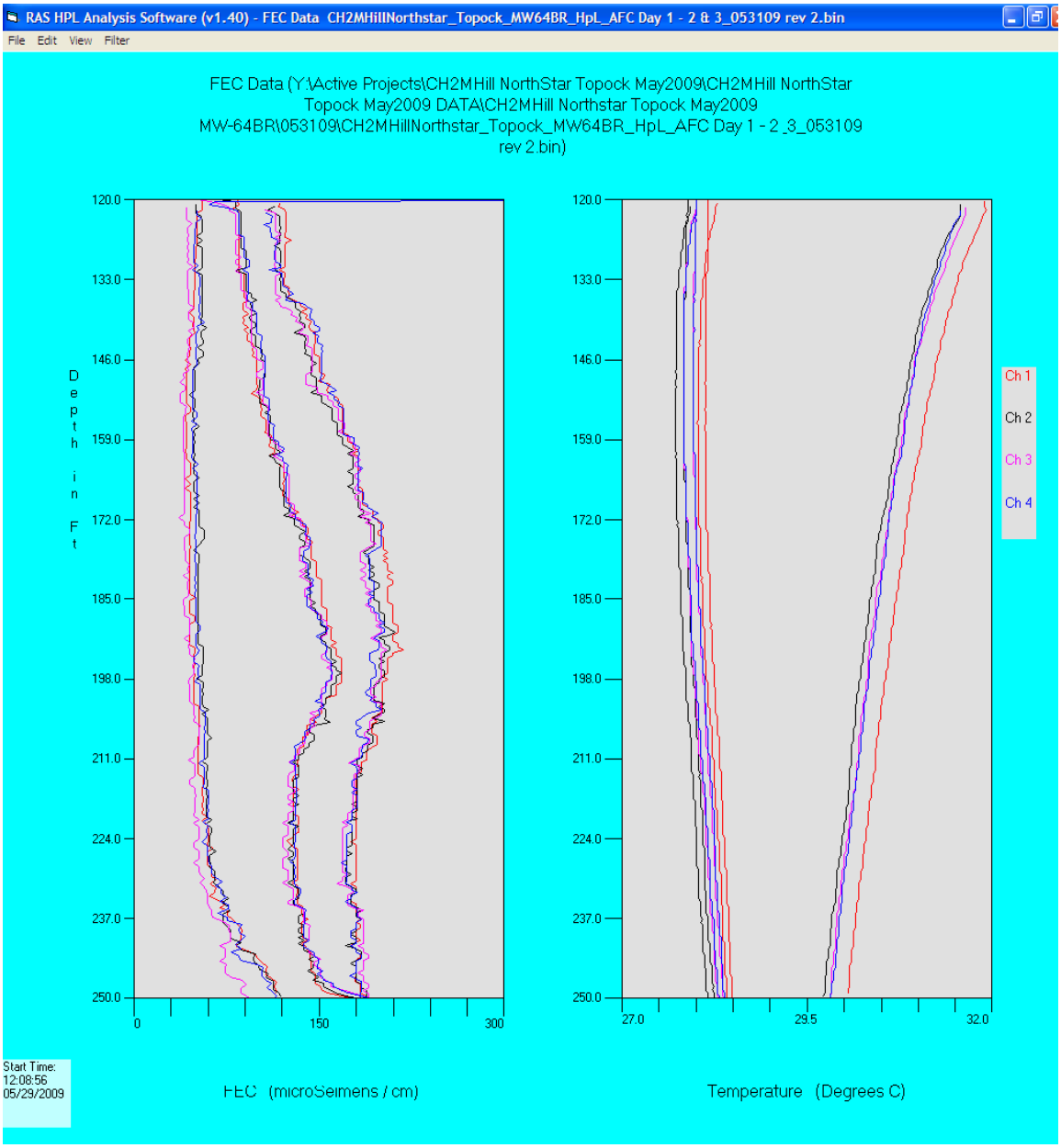


Figure 20.MW-64BR Summary of Single Daily AFC Logs. Single log collect at beginning of each day. Day 1 left, Day 2 center and Day 3 on right. 4 channel FEC and Temperature data presented.

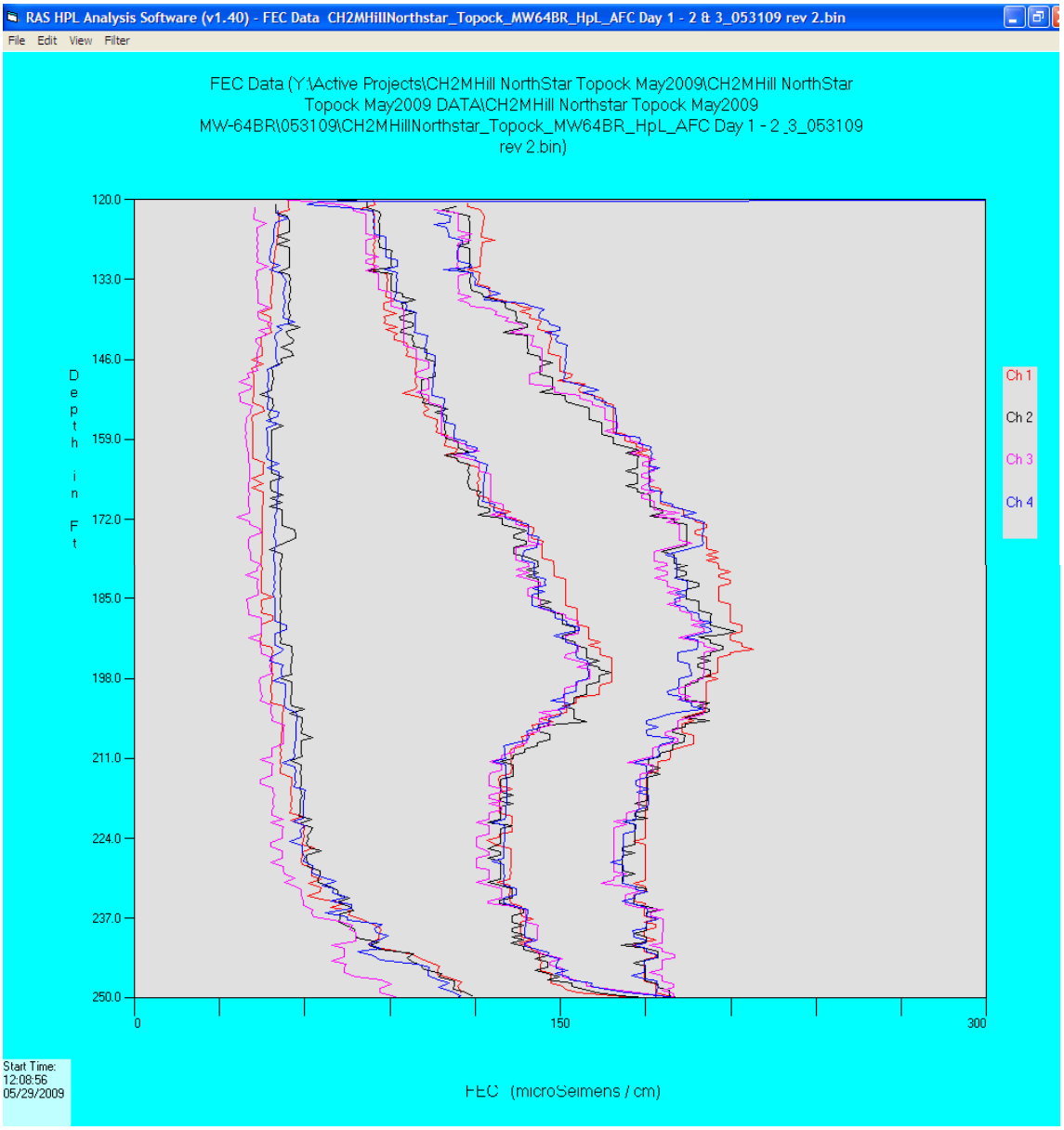


Figure 21. MW-64BR Summary of Single Daily AFC Logs. Single log collect at beginning of each day. Day 1 left, Day 2 center and Day 3 on right. 4 channel FEC presented.

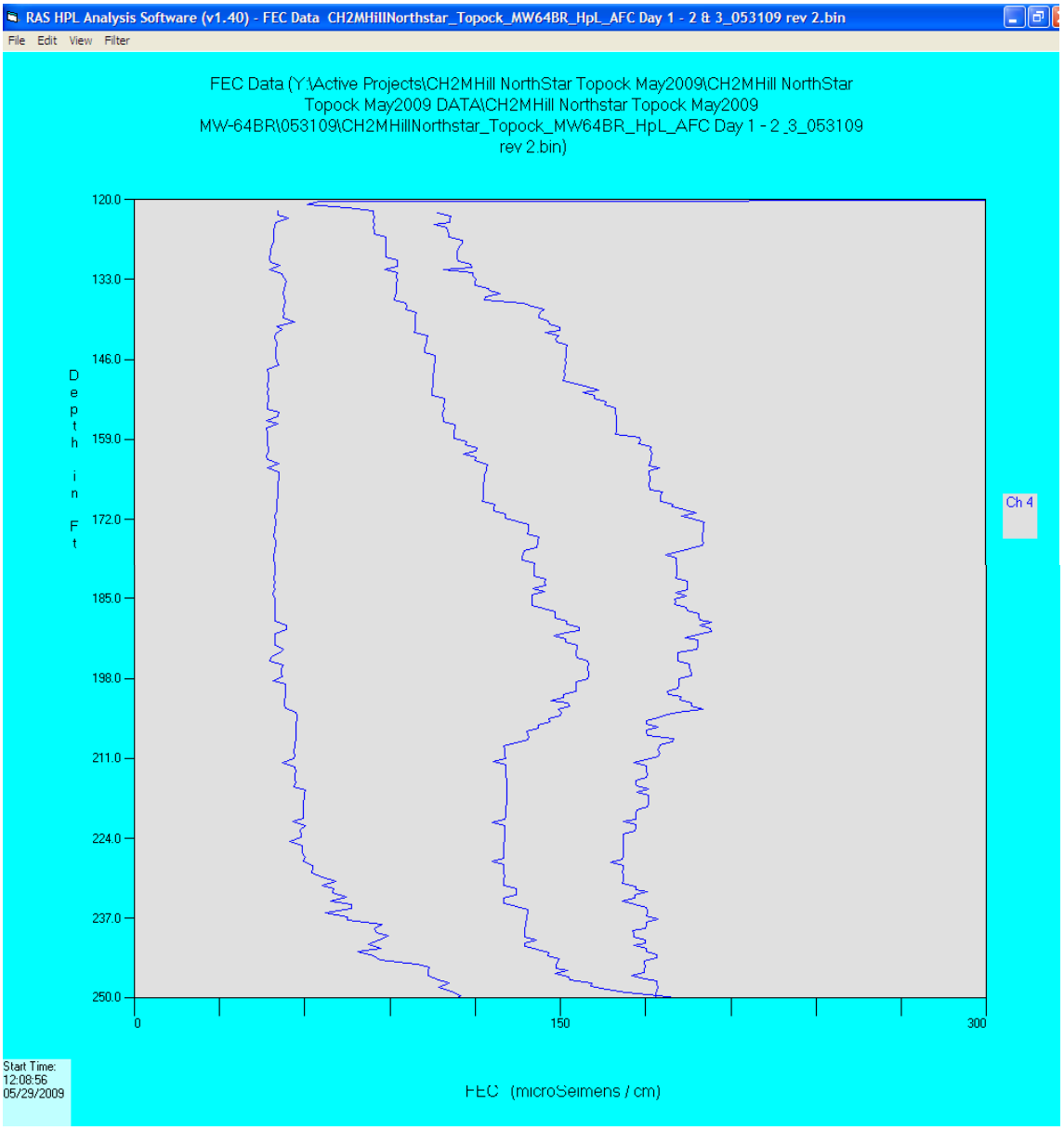


Figure 22. MW-64BR Summary of Single Daily AFC Logs. Single log collect at beginning of each day. Day 1 left, Day 2 center and Day 3 on right. Single channel (no. 4 bottommost) FEC presented.

Summary of Preliminary HPL Results Conductive Feature (CF) Depths						
			Ambient Conditions Interval Specific Flow Rate	**Pumping Conditions Interval Specific Flow Rate**	**Interval Specific Concen-tration**	**Interval Specific Hydraulic Conductivity**
	Depth (ft)		gpm (US)	gpm (US)	µS/cm	ft/day
CF	top	Bottom				
1	120	253	<0.001	0.008	11,000	6.4E-2
	Sum of Interval Specific Flowrates			0.008		
	Total observed from rising head			0.008		

Table 1. CH2MHill Topock Well MW-64BR, Summary of Results, Ambient Flow Characterization and Slug After Emplacement Tests.

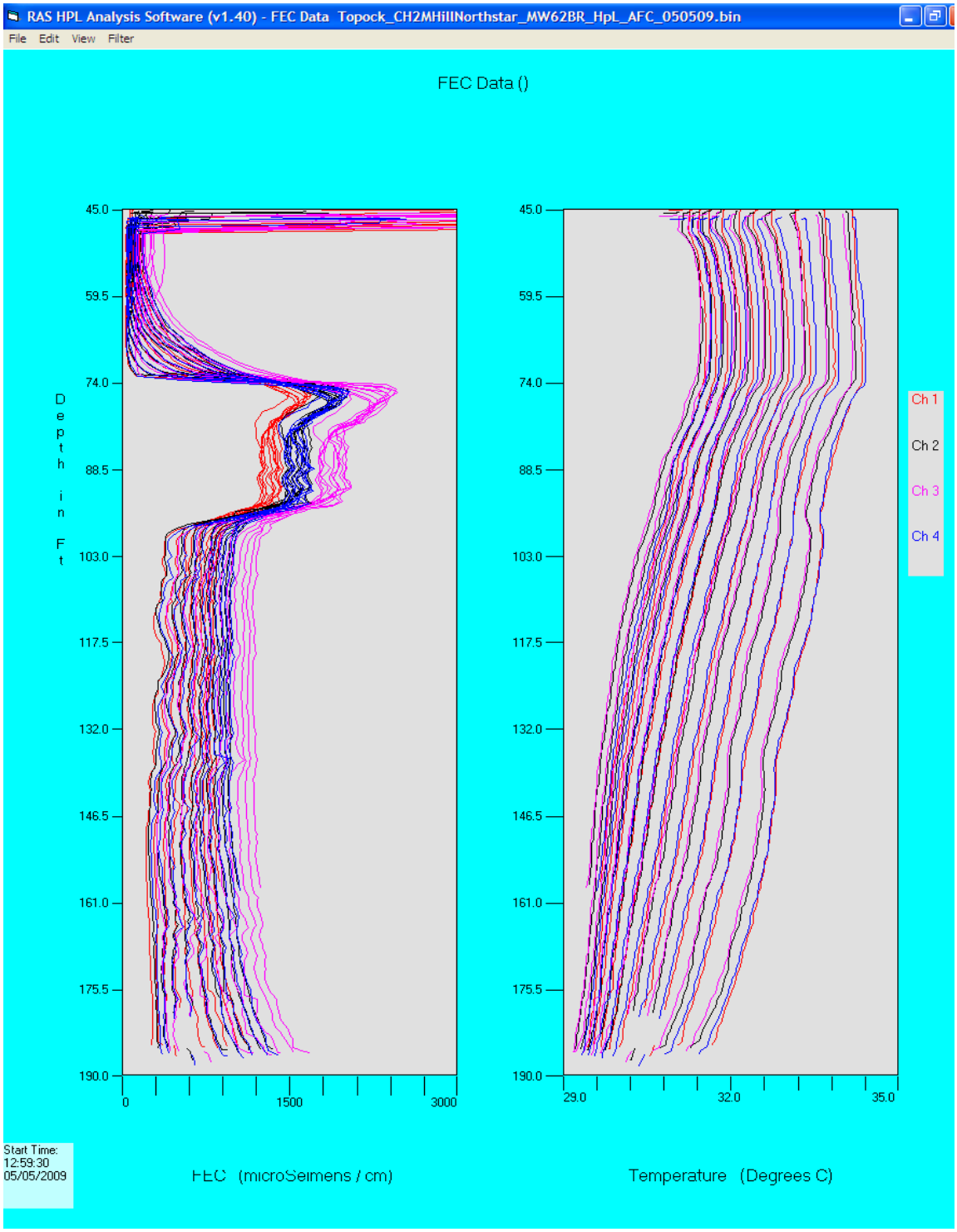


Figure 2. MW-62BR, Summary of Logs During Ambient Flow Characterization prior to pressure stabilization. Data not used in flow calculations.

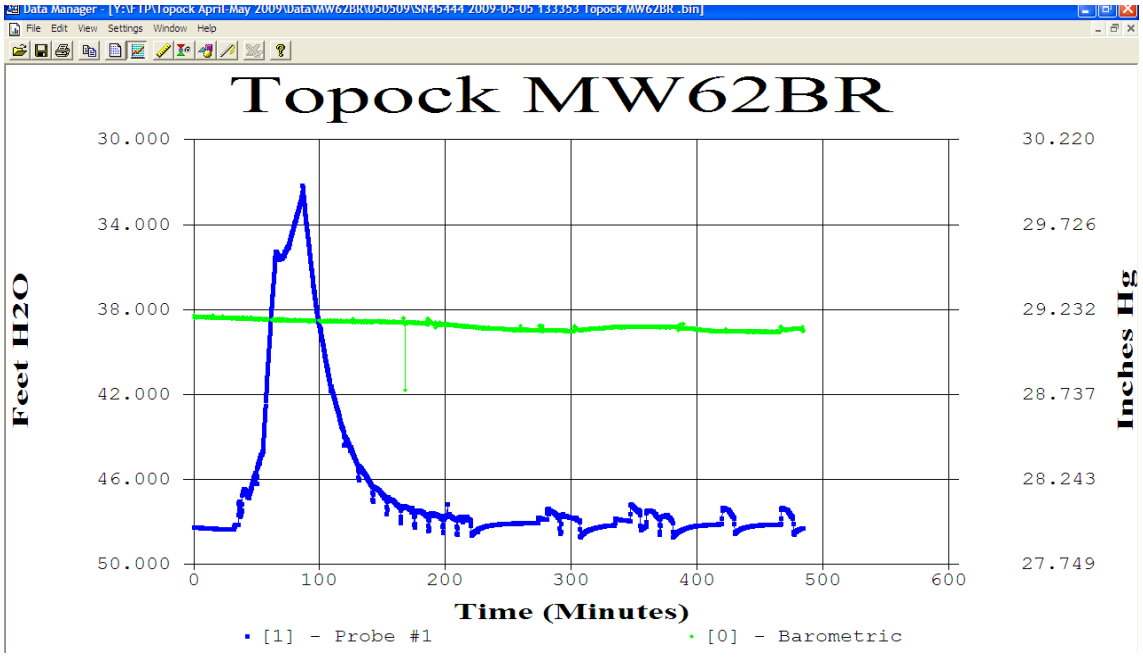


Figure 3. MW-62BR, pressure monitoring T=0 @ 5/5/09 13:34 hours, end of file at 21:38 of same day

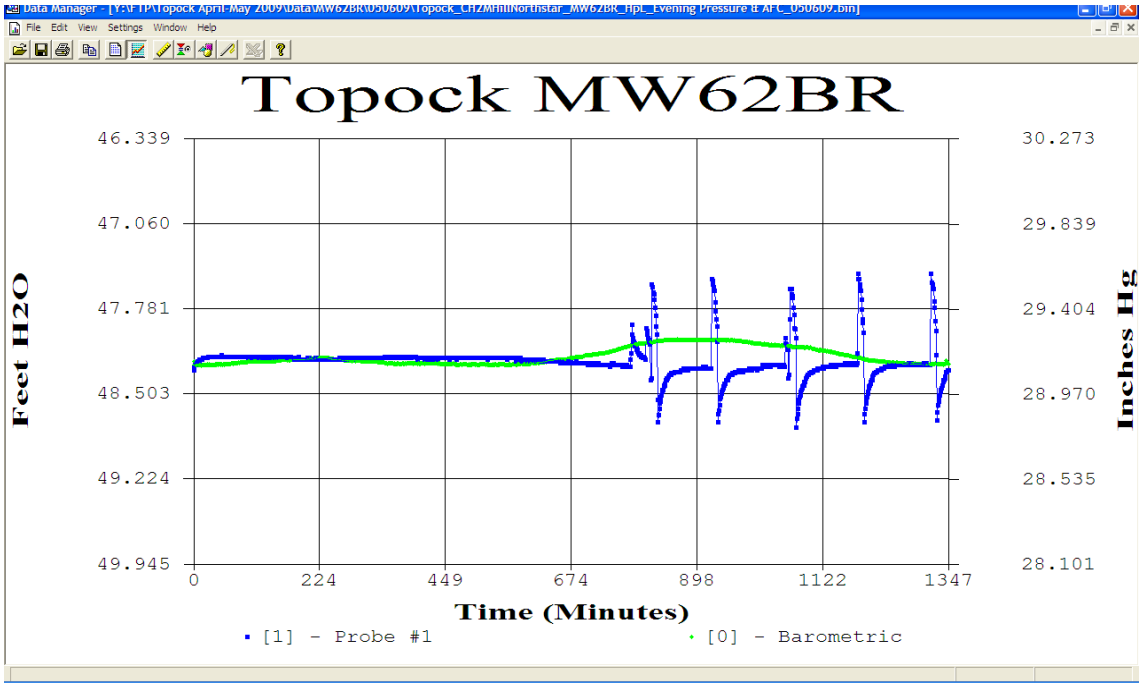


Figure 4. MW-62BR pressure monitoring T=0 @ 5/5/09 21:47 hours (Day 1 overnight and all of day 2 pressure)

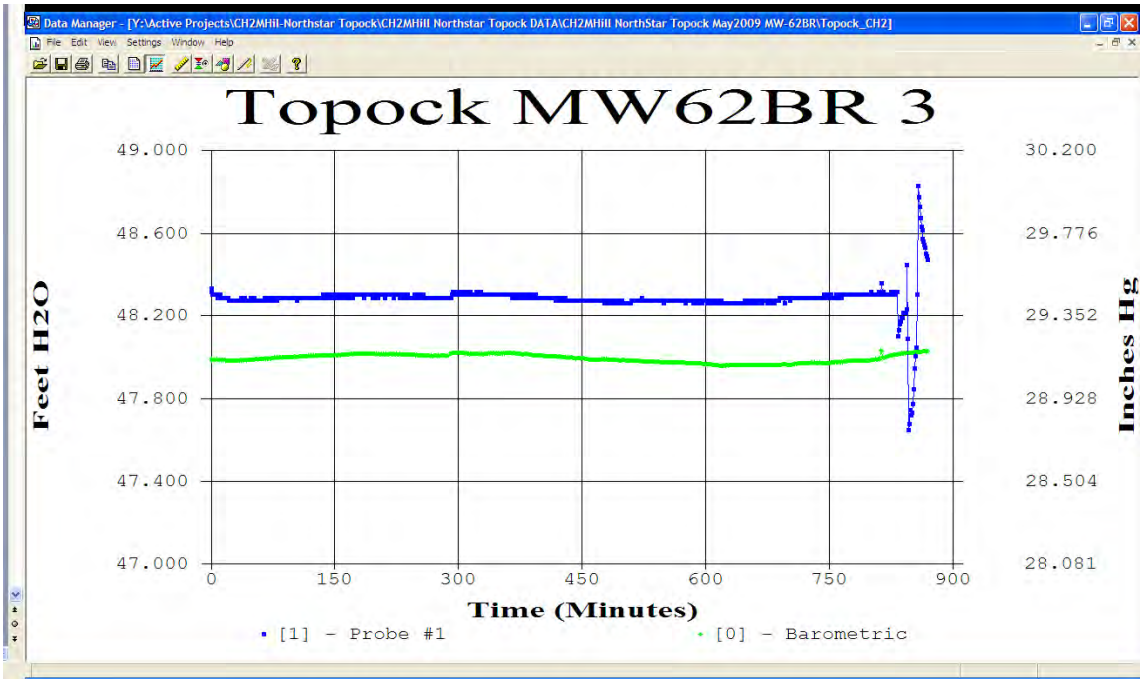


Figure 5. MW-62BR pressure monitoring T=0 @ 5/6/09 20:21 hours (Day 2 overnight and last log of day 3).

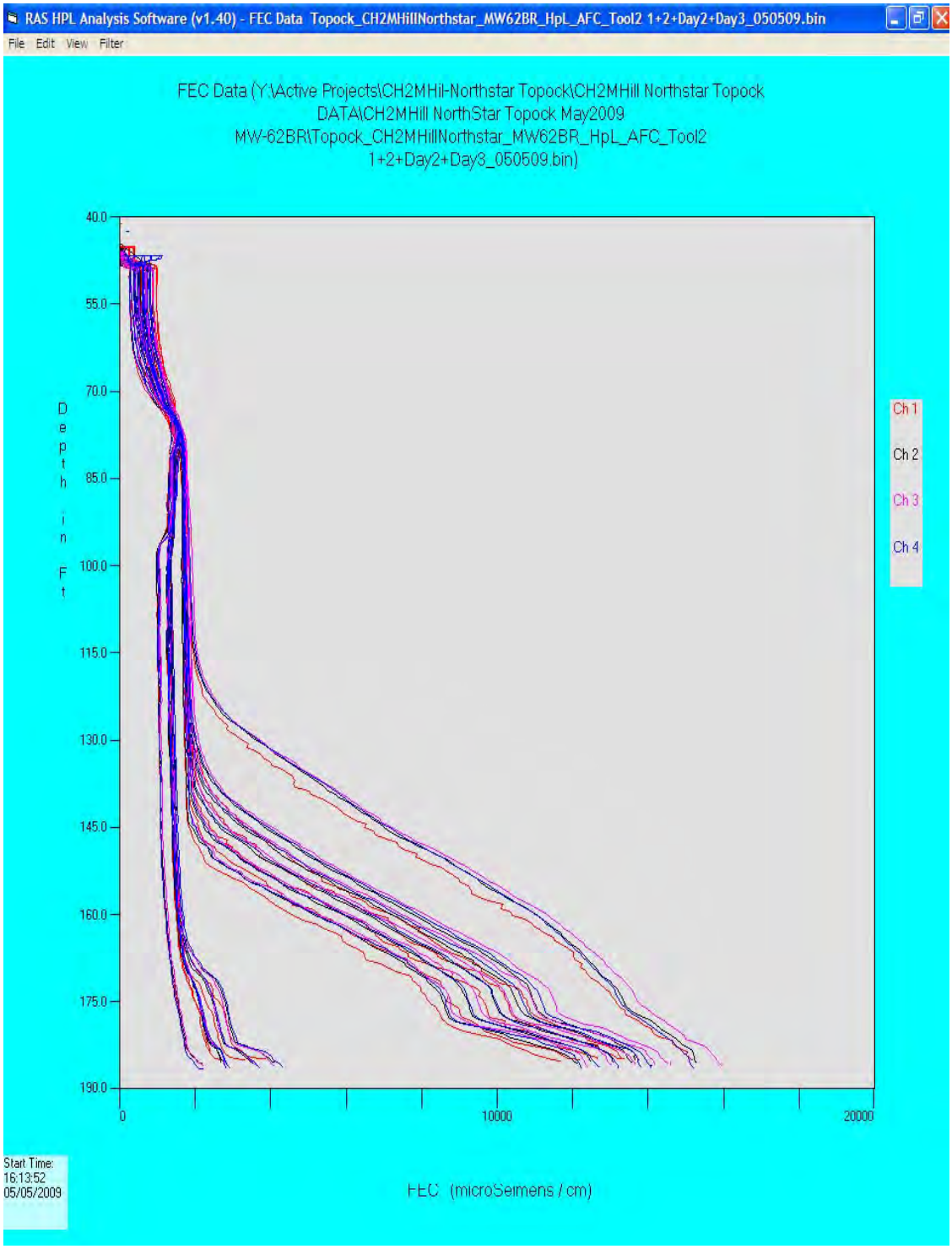


Figure 6. MW-62BR Sumary of FEC logs for AFC. Day 1, Day 2 and morning log only of Day 3 combined. All logs collected during stable pressure conditions.

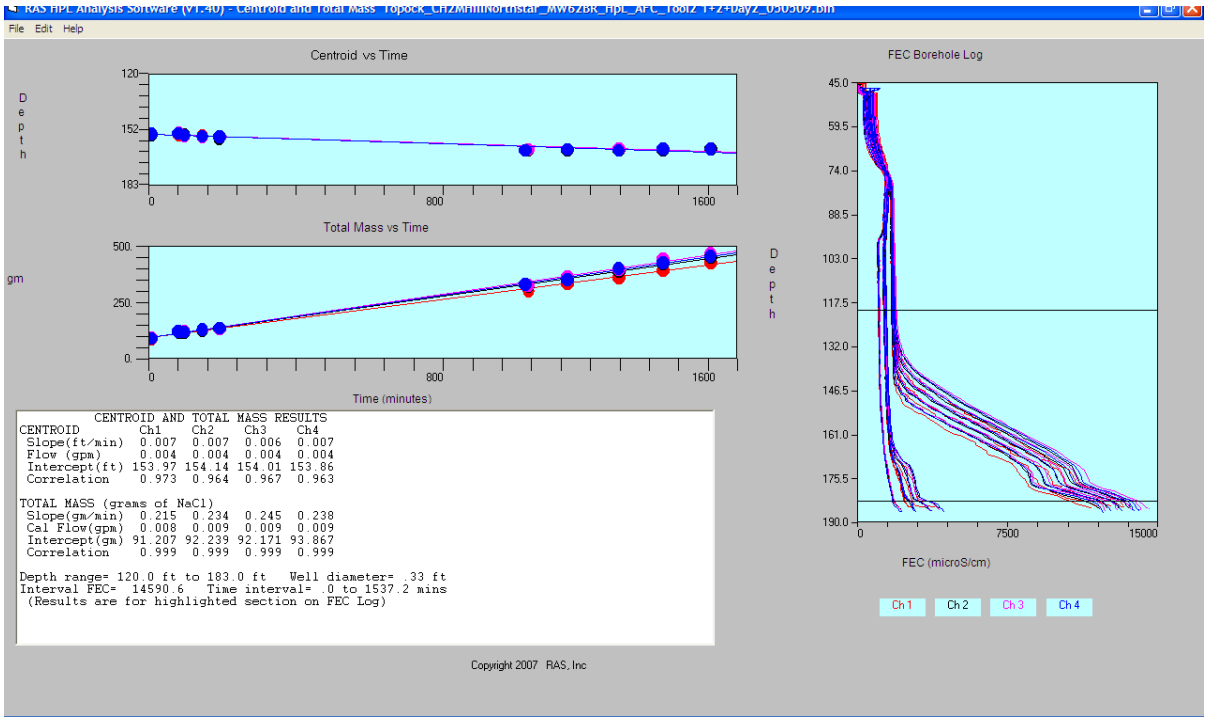


Figure 7. MW-62BR, Integral and Centroid Analysis, Ambient Flow Characterization, Day 1 and 2 compiled.

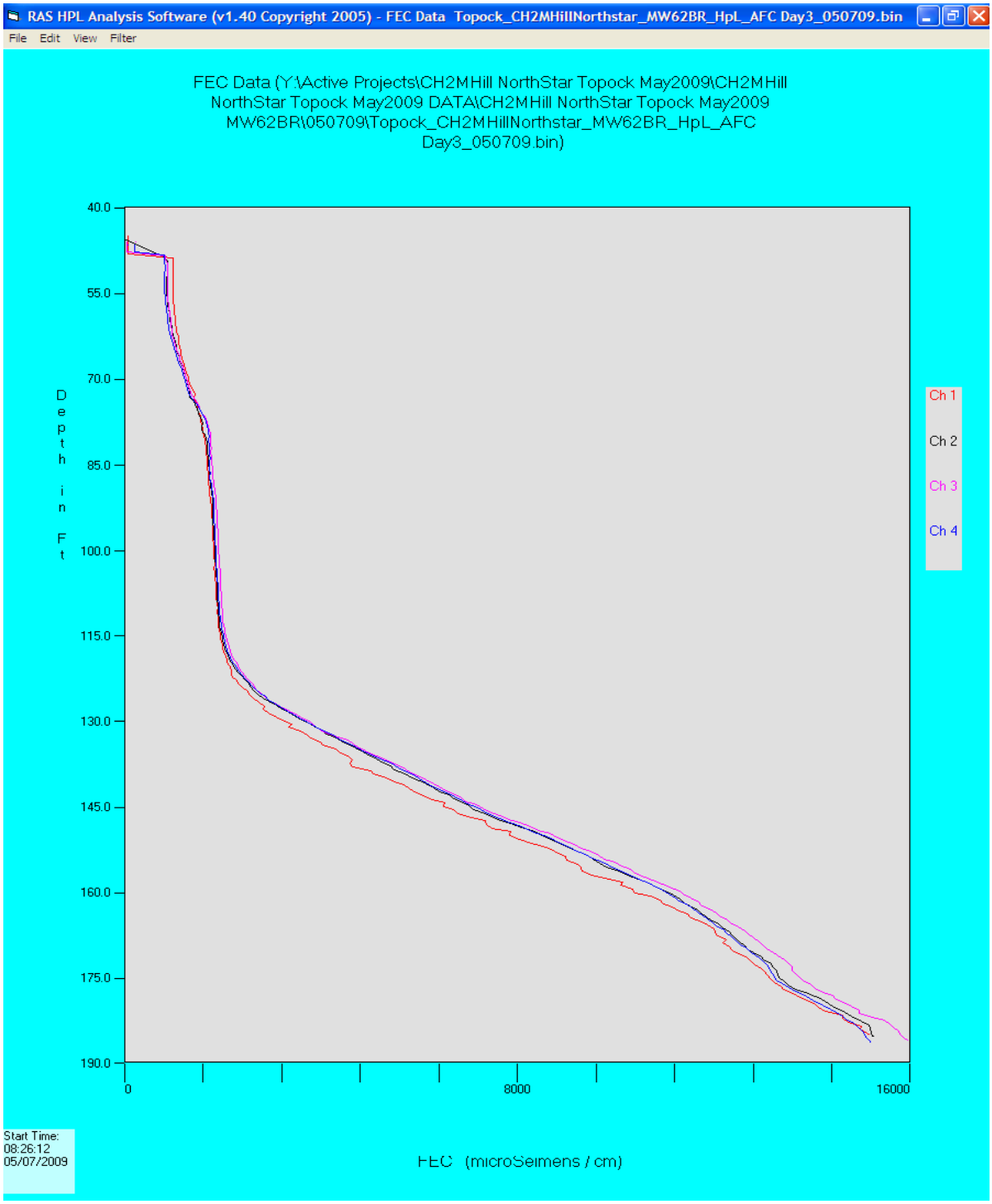


Figure 8. MW-62BR FEC log prior to Ambient Flow Condition Sample at 187 feet.

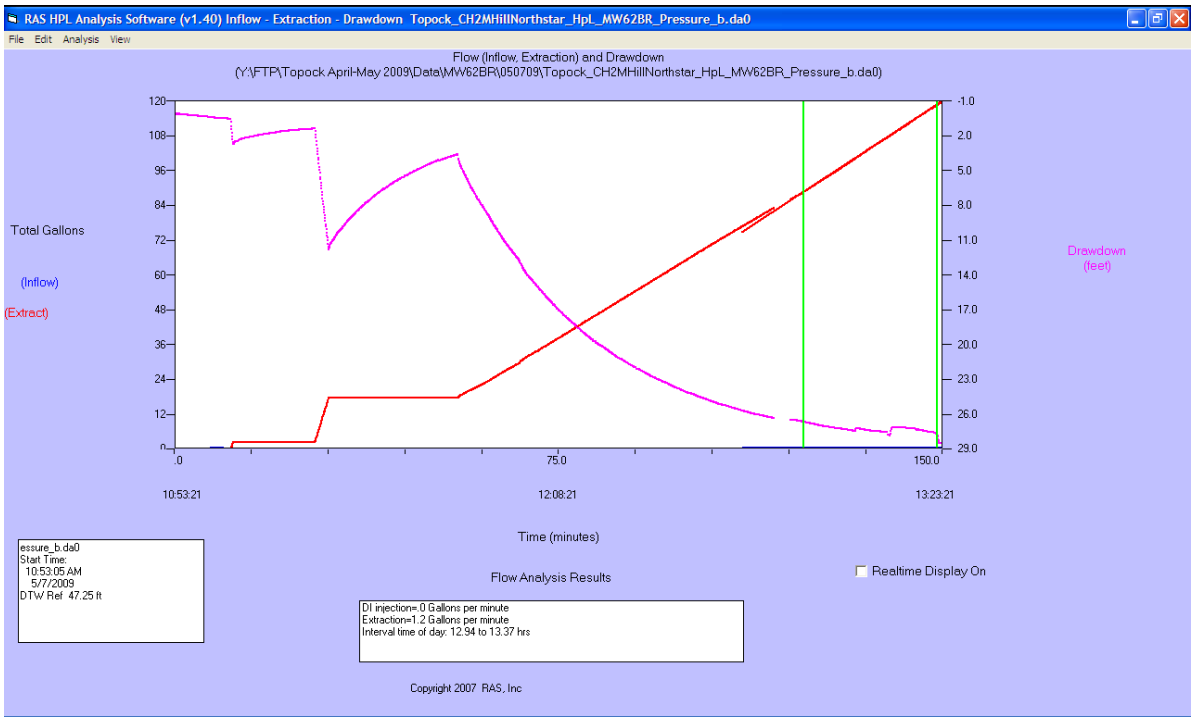


Figure 9. MW-62BR HC results (2 slug tests and short term pumping test).

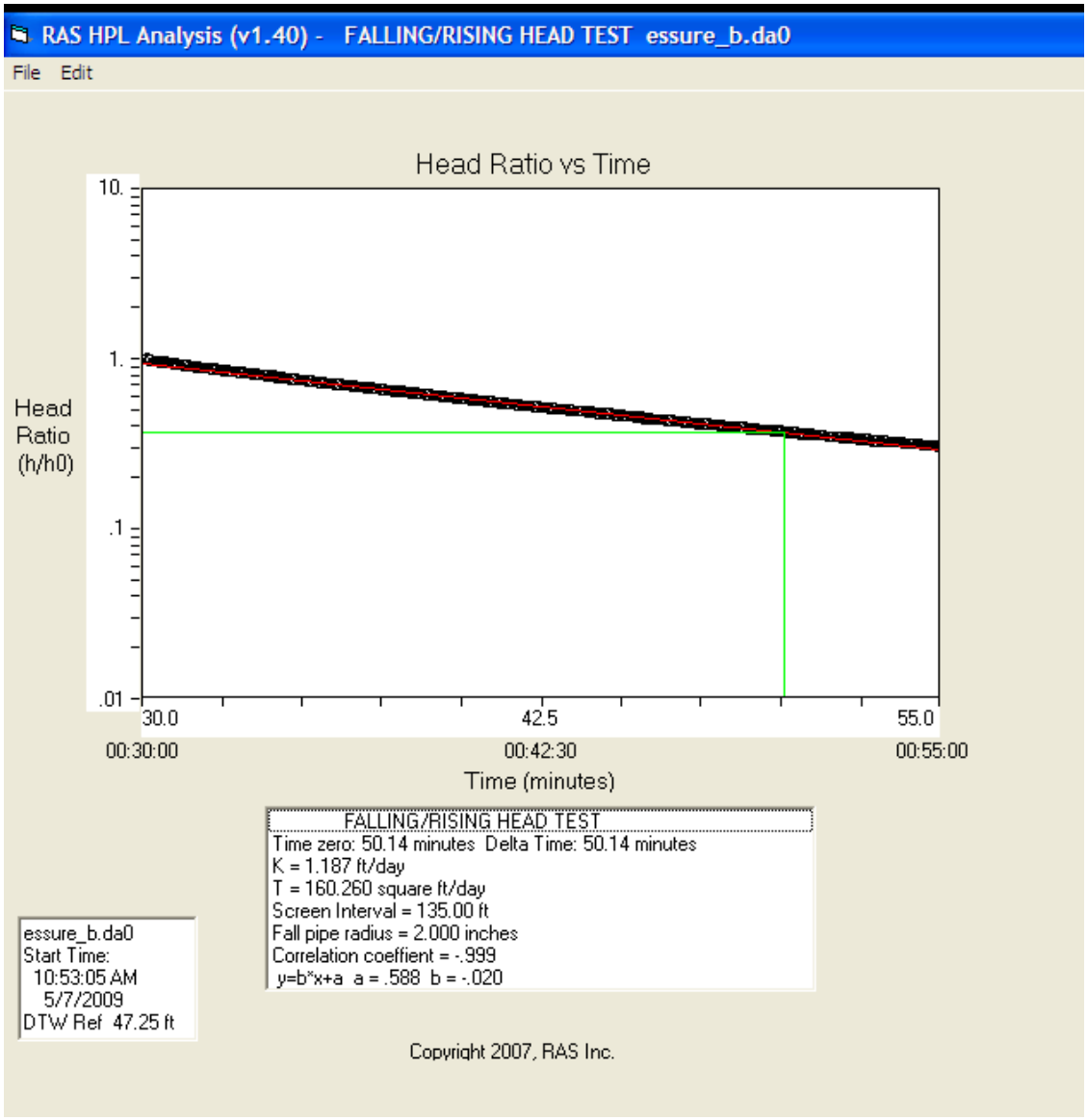


Figure 10. MW-62BR, Results of Rising Head Test Analysis.

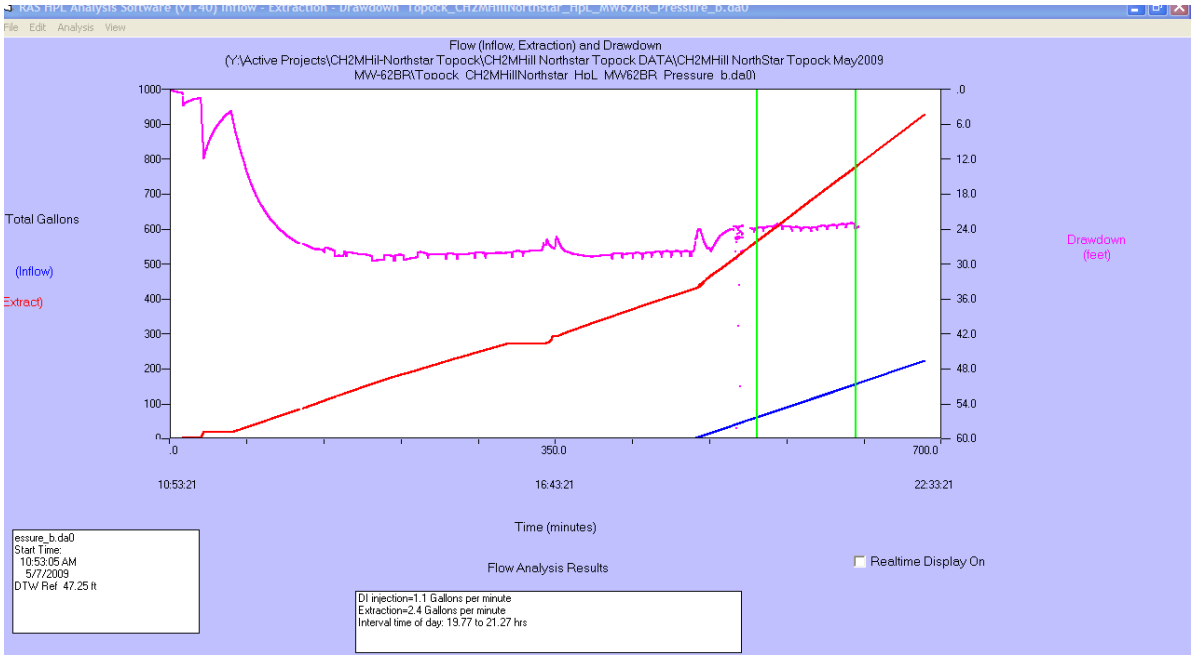


Figure 11. MW-62BR Pressure and Flow data during PDI test.

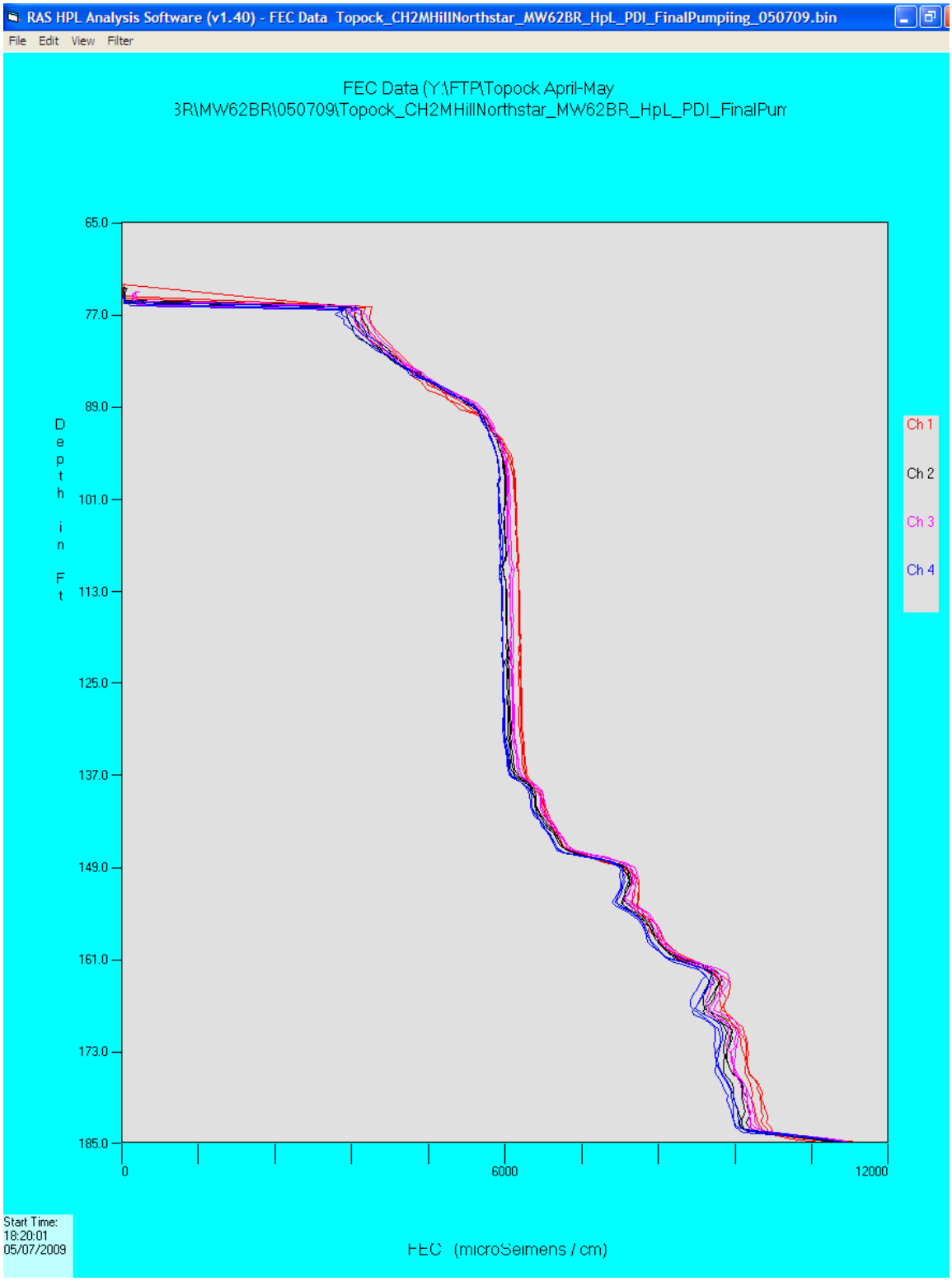


Figure 12. MW-62BR, Final Pumping Logs During PDI testing.

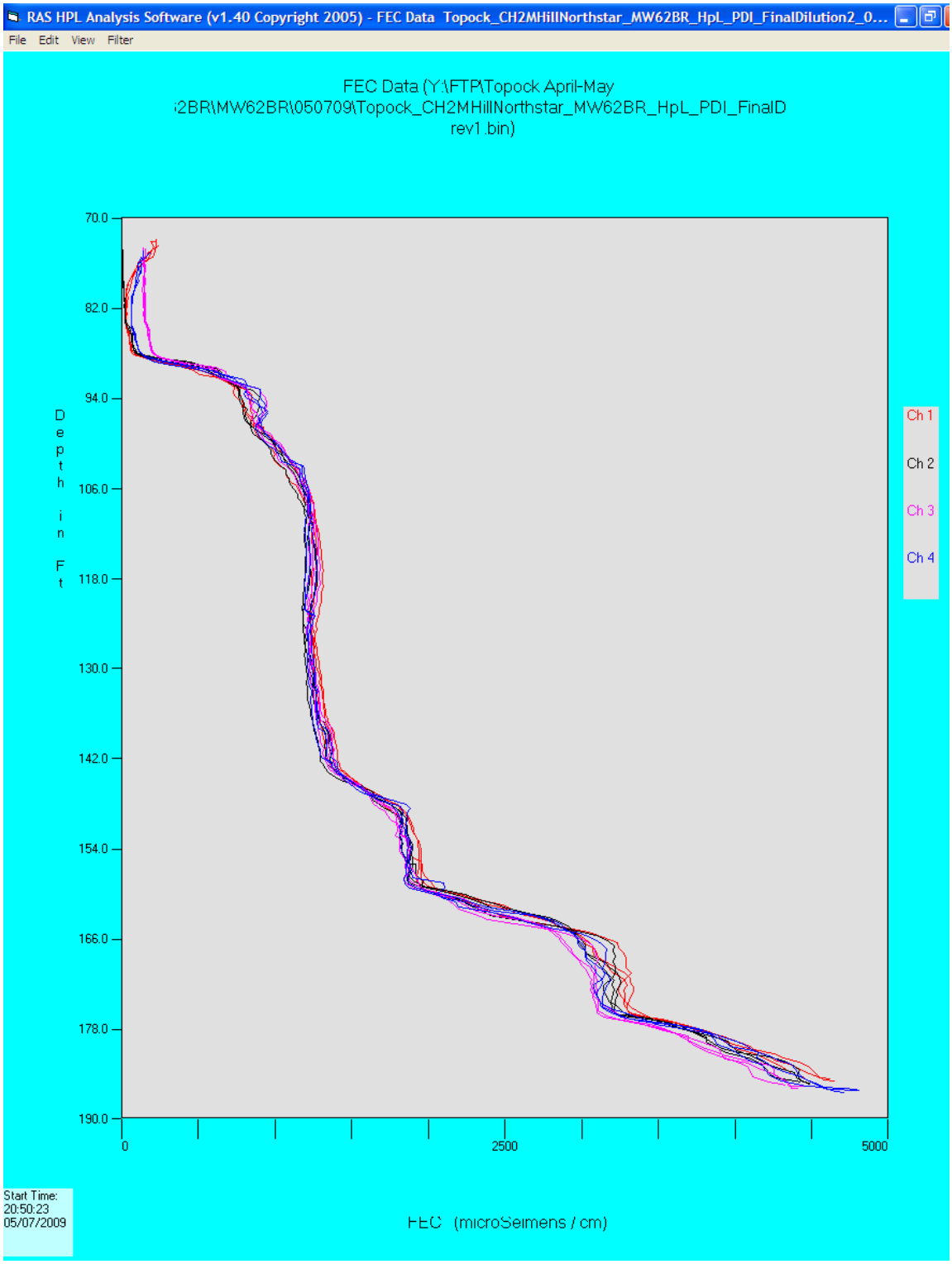


Figure 13. MW-62BR, Final Dilution Logs During PDI testing.

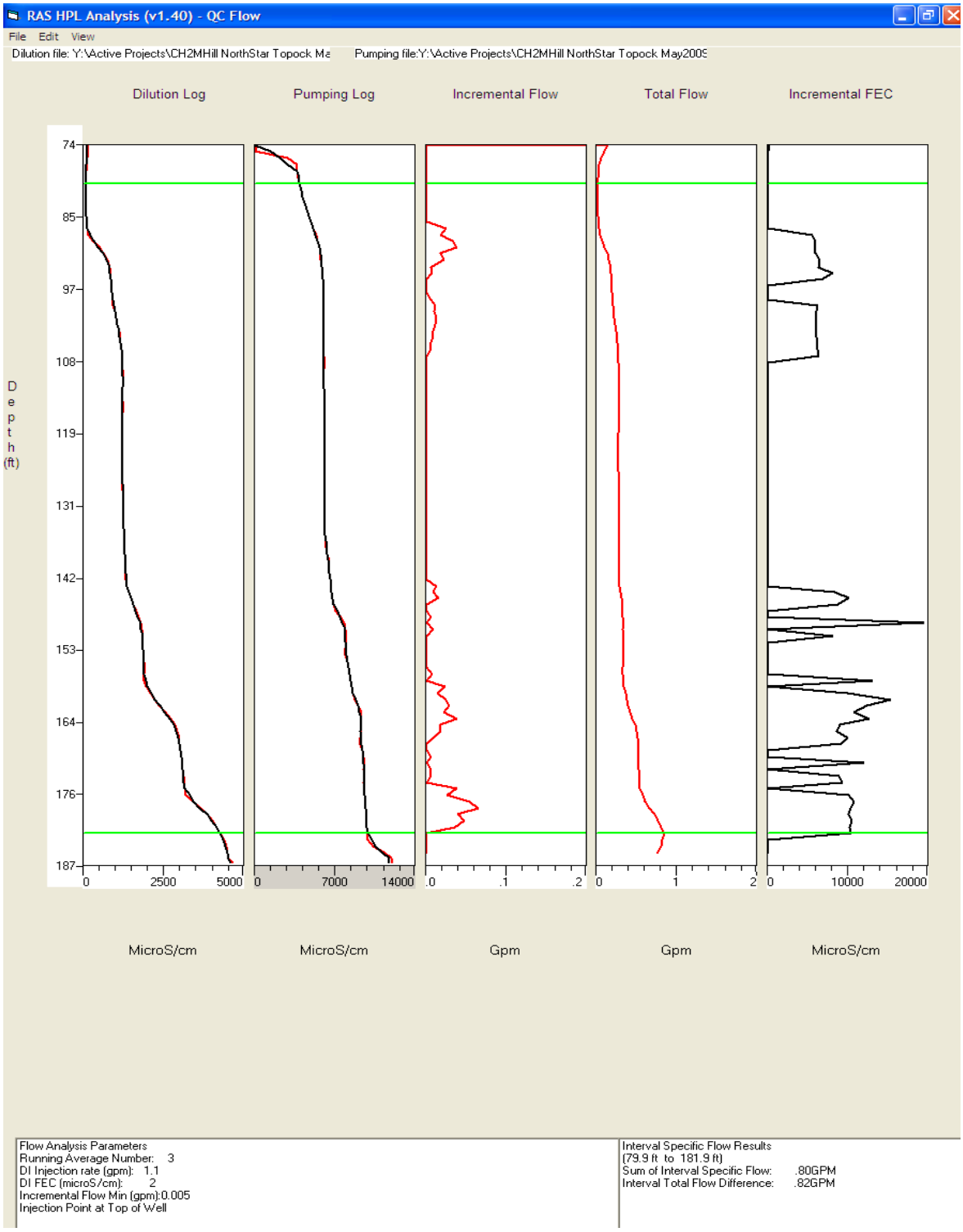


Figure 14. MW-62BR, Results of QCFLOW analysis. Total flow over interval above pump. Data suggest addition flow coming from interval below pump to TD.

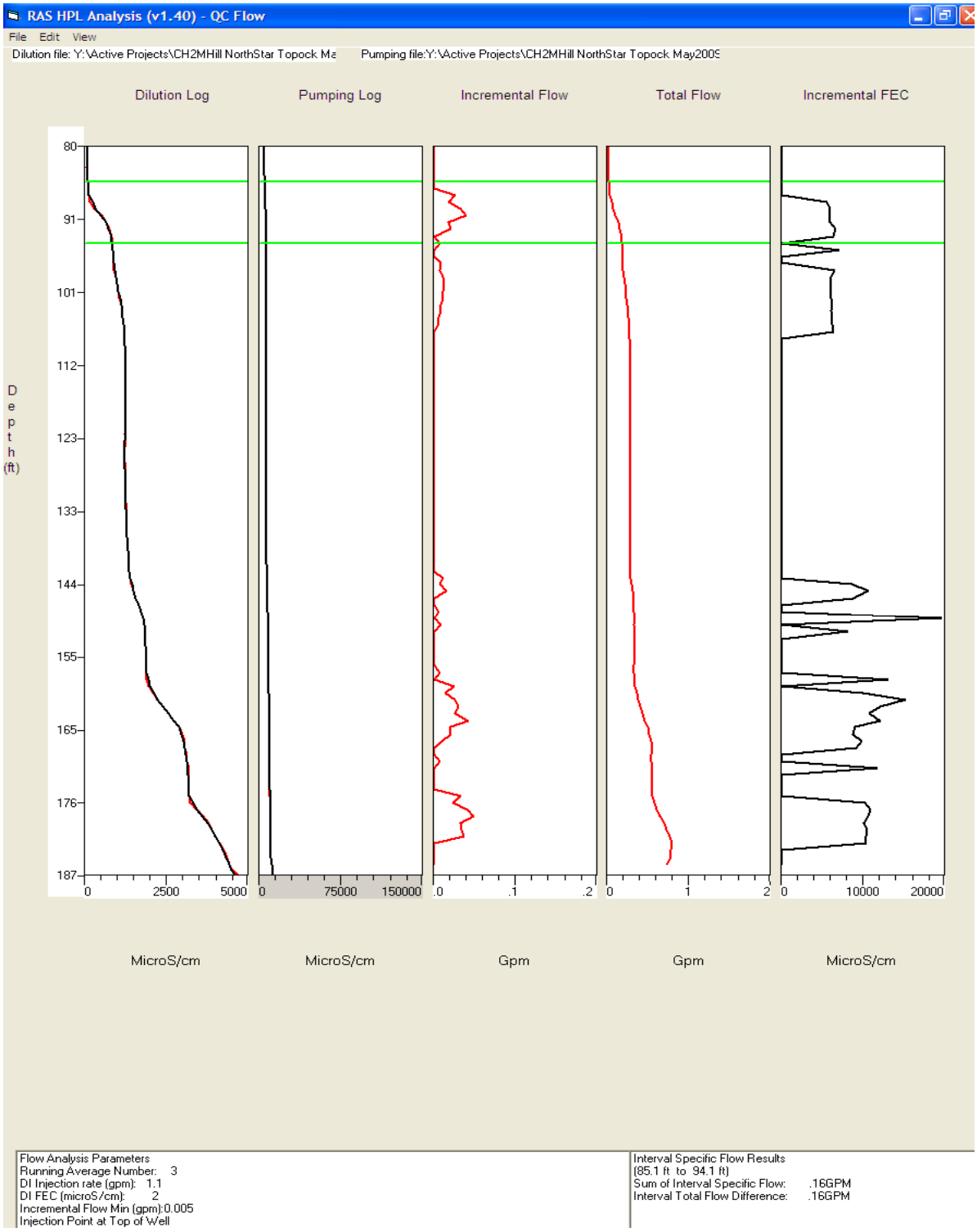


Figure 15. MW-62BR, Results of QCFLOW analysis. Total flow over interval from 85 to 94 ft.

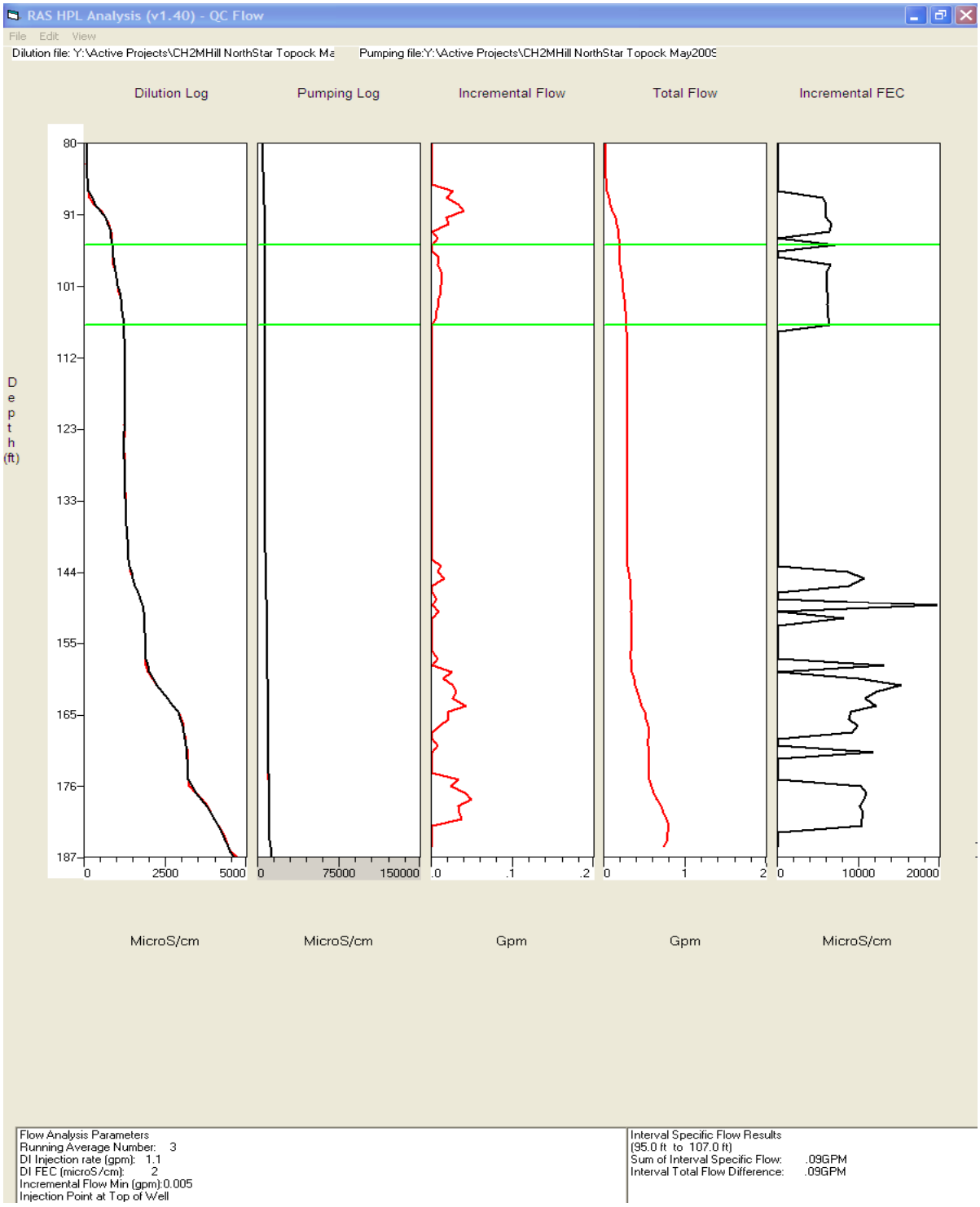


Figure 16. MW-62BR, Results of QCFLOW analysis. Total flow over interval from 95 to 107 ft.

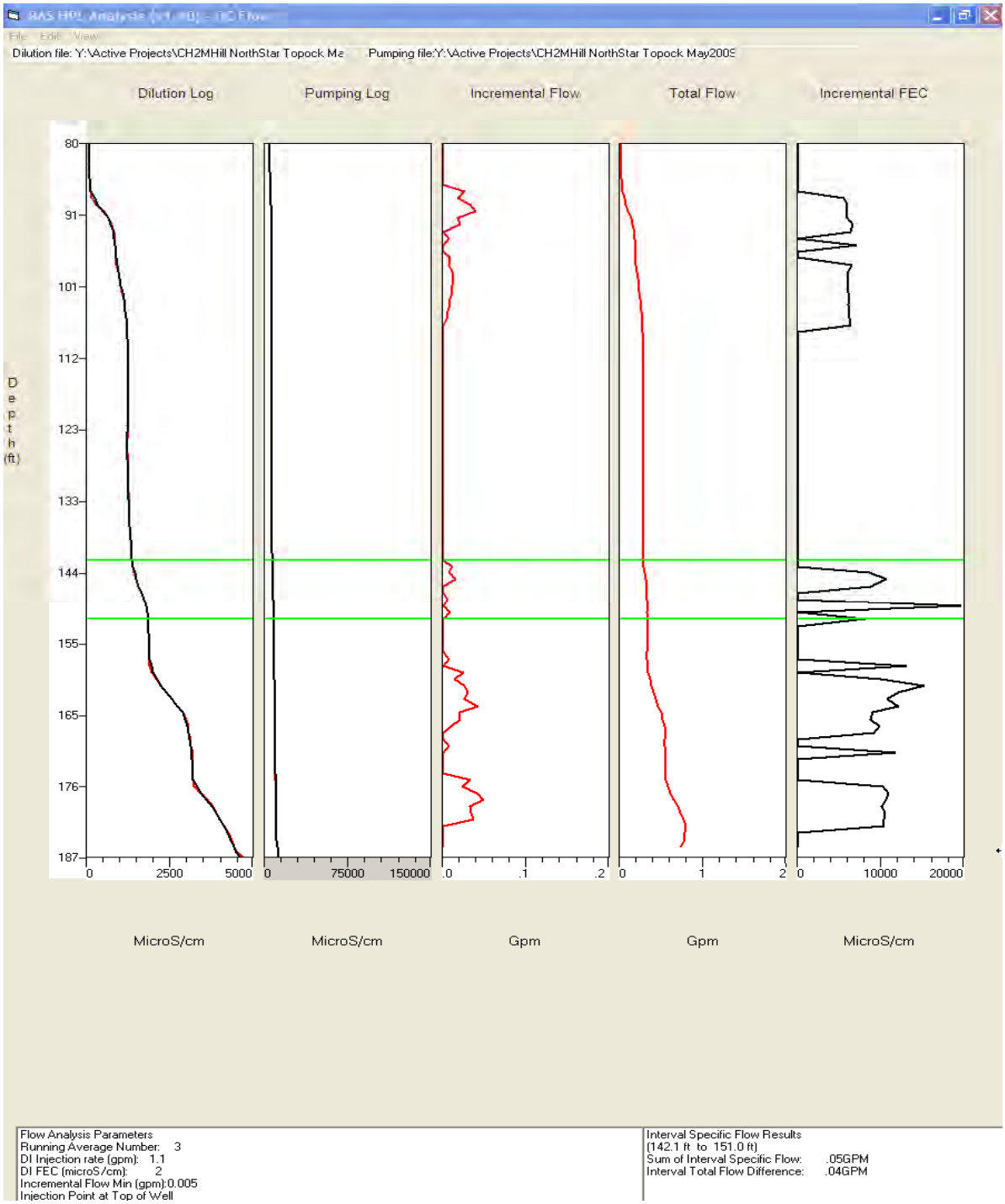


Figure 17. MW-62BR, Results of QCFLOW analysis. Total flow over interval from 142 to 151 ft.

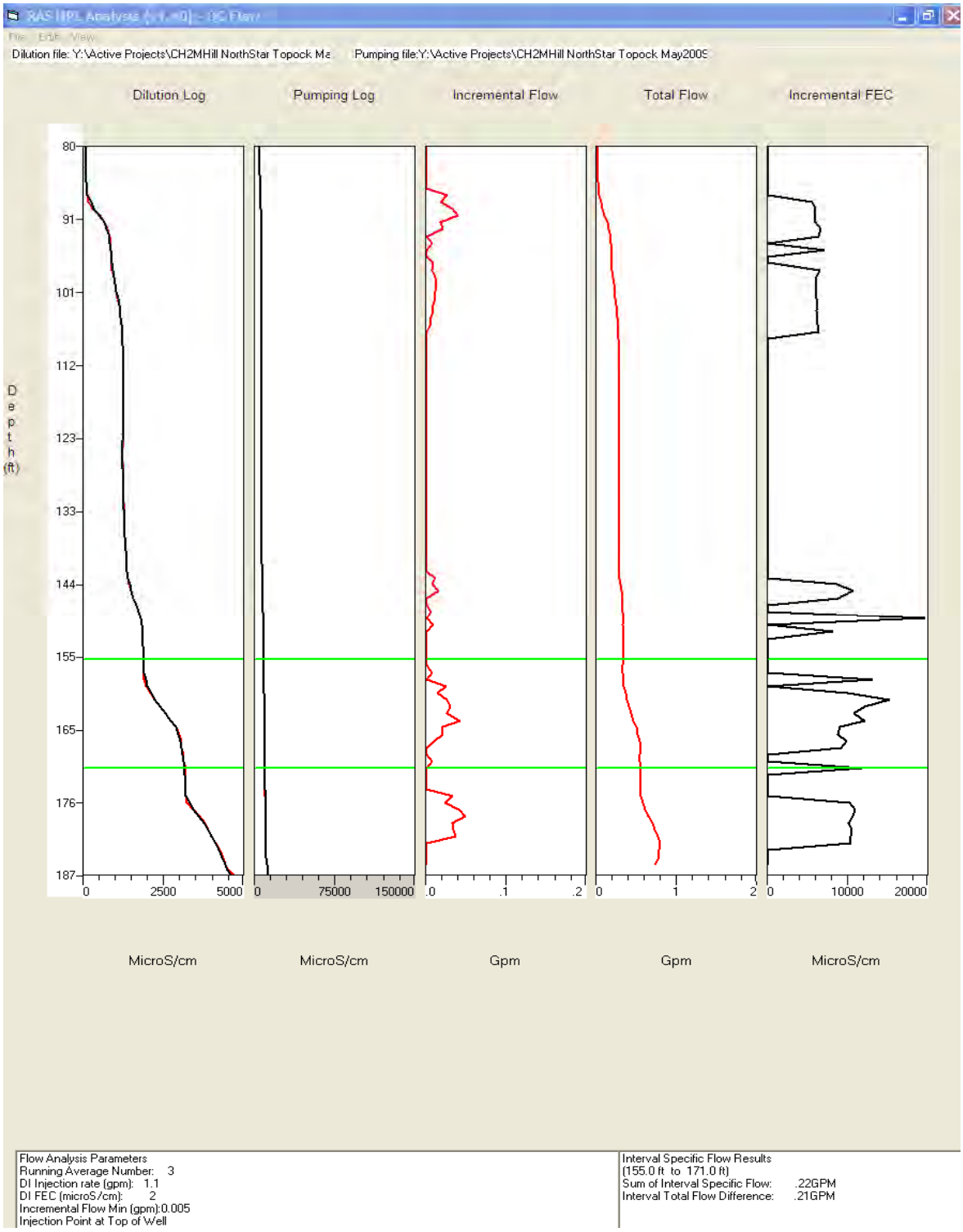


Figure 18. MW-62BR, Results of QCFLOW analysis. Total flow over interval from 155 to 171 ft.

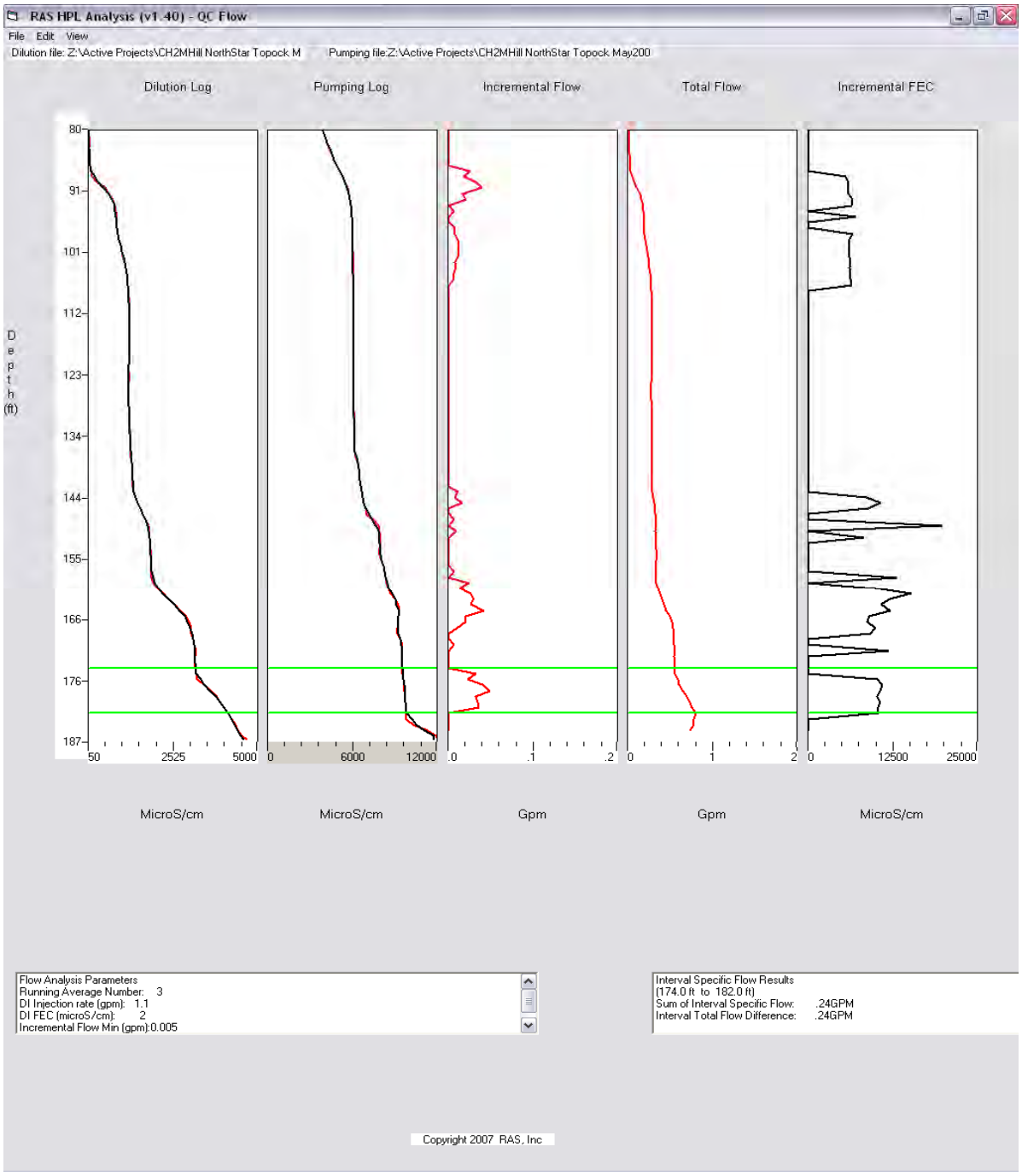


Figure 19. MW-62BR, Results of QCFLOW analysis. Total flow over interval from 174 to 182 ft.

Summary of Preliminary HPL Results Conductive Feature (CF) Depths						
			Ambient Conditions Interval Specific Flow Rate	**Pumping Conditions Interval Specific Flow Rate**	**Interval Specific Concen-tration**	**Interval Specific Hydraulic Conductivity**
	Depth (ft)		gpm (US)	gpm (US)	µS/cm	ft/day
CF	top	Bottom				
1	85.8	95.0	-0.01	0.16	6000	1.89E-01
2	95	107	0	0.09	6200	7.68E-02
3	142	151.2	0	0.04	10,200	4.45E-02
4	156	171.2	0	0.21	11,400	1.41E-01
5	173.9	182.1	0	0.24	10,600	3.00E-01
6	185	~190	0.01	0.56	12,200	2.25E-01
	Sum of Interval Specific Flowrates			1.3	$T_{totalHPL}$=1.3E+1 ft^2/day	
	Total observed at from rising head			1.3	$T_{totalSLUG}$=1.6 E+2 ft^2/day	
	ALL DEPTHS REFERENCED TO TOP OF CASING (TOC); CASING STICKUP = 27.25”					

Table 1. CH2MHill Topock Well MW-62BR, Summary of Results, Ambient Flow Characterization and Pumping During DI Injection Tests.

APPENDIX D

WELL DATA MONTAGES

WELL: MW-57BR
PROJECT: CH2M Hill - PG&E Topock Compressor Station - Needles, California

RAS Integrated Subsurface Evaluation
PH 303.526.4432 • FAX 303.526.4426
email: bpedler@rasinc.org • www.rasinc.org

LEGEND

GEOPHYSICAL LOGS

Gamma
Standard gamma ray (includes K, U, and Th)

Resistivity/Conductivity
By Dual Induction Type

Hole Size
Caliper - Drillhole diameter from three arm caliper

All Geophysical Logs conducted after borehole completion??

LITHOLOGY

- Unconsolidated Sediment
- Conglomerate Bedrock
- Metadiorite Bedrock

HYDROPHYSICAL LOGGING RESULTS:

Interval Specific Flow rate derived from Ambient Flow Characterization (AFC) and Pumping During deionized water Injection (PDI) hydrophysical data.

Dilution Fluid Electrical Conductivity (FEC) recorded while Pumping During Injection (PDI).

Horizontal flow observed during ambient conditions, inflows also evaluated during stressed (constant pumping or slug test) conditions. Horizontal flowrates based on integral method for q (Lowe, et. al., 1988).

Fluid Resistivity and Fluid temperature Logs performed during ambient conditions

Hydraulic conductivity estimates based on Hvorslev (1962), (Pedler, et al. 1988) and Theim, G. Hydrologische Methoden. Leipzig: Gebhart, 1906, p 56. Flow and velocity estimates based on hydrophysical logging results only.

Flow Zones, in percent of total fluid contribution

- >20%
- >20% and <35%
- >35% and <50%
- >50%

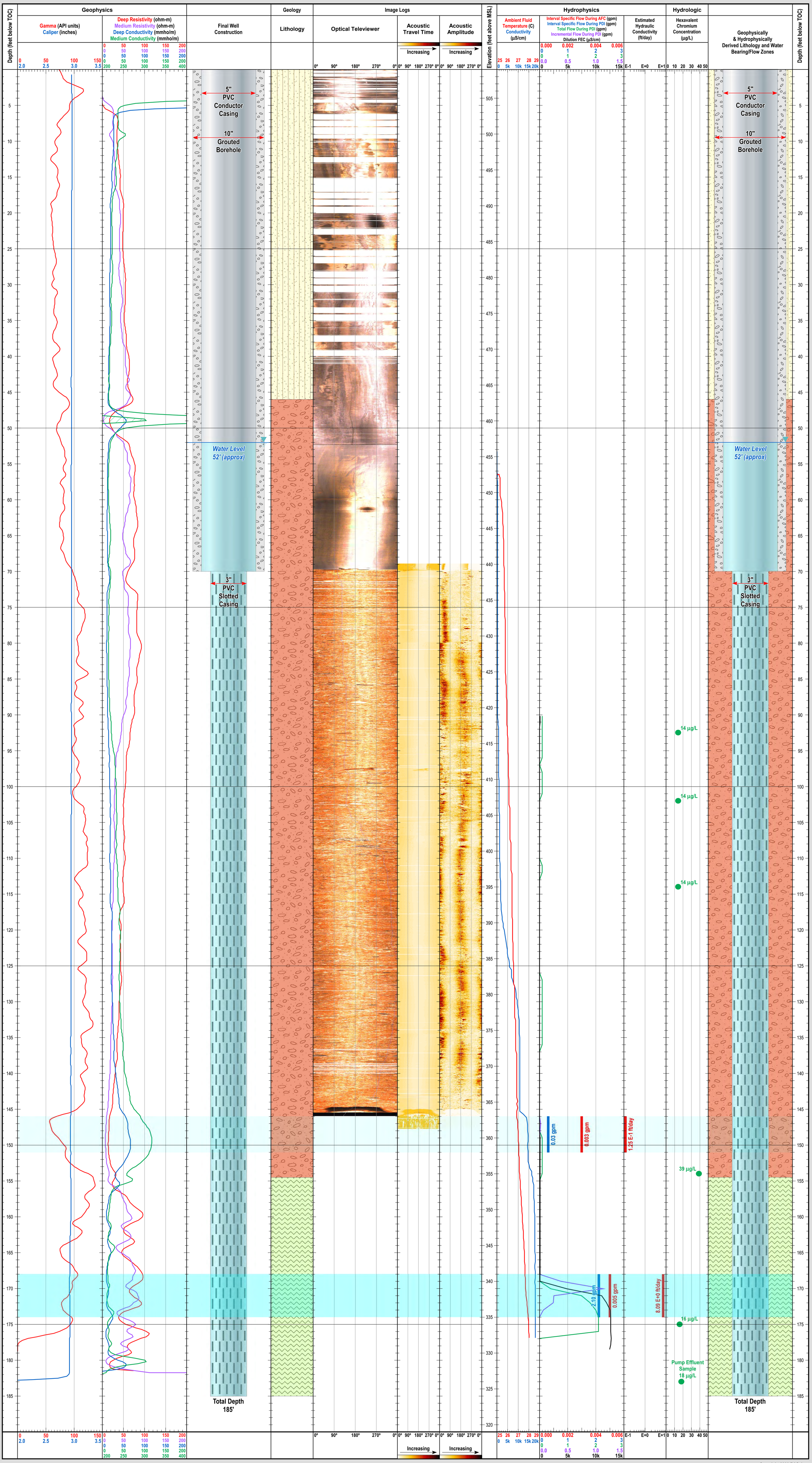
HEXAVALENT CHROMIUM EXPLANATION

- Hexavalent Chromium - Cr(VI) Validated 960 result (µg/L)

Contaminant concentrations based on samples collected in open borehole conditions.

MISCELLANEOUS NOTES:

1. Top of casing elevation: 509.0 feet (NAD83).
2. All depths referenced to top of PVC casing.
3. Coordinates of well:
   Northing: 7816369.44 Easting: 2100899.56
4. Lithology from CH2M Hill.
5. Well construction from CH2M Hill.
6. Geophysical logging conducted by Pacific Surveys on July 15, 2008 & December 2, 2008.
7. Hexavalent chromium results provided by CH2M Hill.
8. Hydrophysical logging conducted by RAS, Inc. from February 25 to March 1, 2008.



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WELL: MW-58BR
PROJECT: CH2M Hill - PG&E Topock Compressor Station - Needles, California

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email: bpedler@rasinc.org • www.rasinc.org

LEGEND

GEOPHYSICAL LOGS

Gamma
Standard gamma ray (includes K, U, and Th)

Resistivity/Conductivity
By Dual Induction Type

Hole Size
Caliper - Drillhole diameter from three arm caliper

All Geophysical Logs conducted after borehole completion??

LITHOLOGY

- Unconsolidated Sediment
- Conglomerate Bedrock
- Metadiorite Bedrock

HYDROPHYSICAL LOGGING RESULTS:

Interval Specific Flow rate derived from Ambient Flow Characterization (AFC) and Slug Test After Emplacement (SAE) hydrophysical data.

HPL FEC logs presented were collected during Slug Test After Emplacement (SAE) conditions.

FEC 1721
FEC 1731
FEC 1130

FEC XXXX where XXXX is military time at start of log.

Horizontal flow observed during ambient conditions, inflows also evaluated during stressed conditions (pumping or slug test) using Hydrophysical Logging Boundless (HLB) Version 1.0 (Lowe, et. al., 1988).

Fluid Resistivity and Fluid temperature
Logs performed during ambient conditions

Hydraulic conductivity estimates based on Hvorslev (1963), (Peditler, et al. 1988) and Theim, G. Hydrologische Methoden. Leipzig: Gebhart, 1906, p 56. Flow and velocity estimates based on hydrophysical logging results only.

Flow Zones, in percent of total fluid contribution

- <20%
- >20% and <35%
- >35% and <50%
- >50%

HEXAVALENT CHROMIUM EXPLANATION

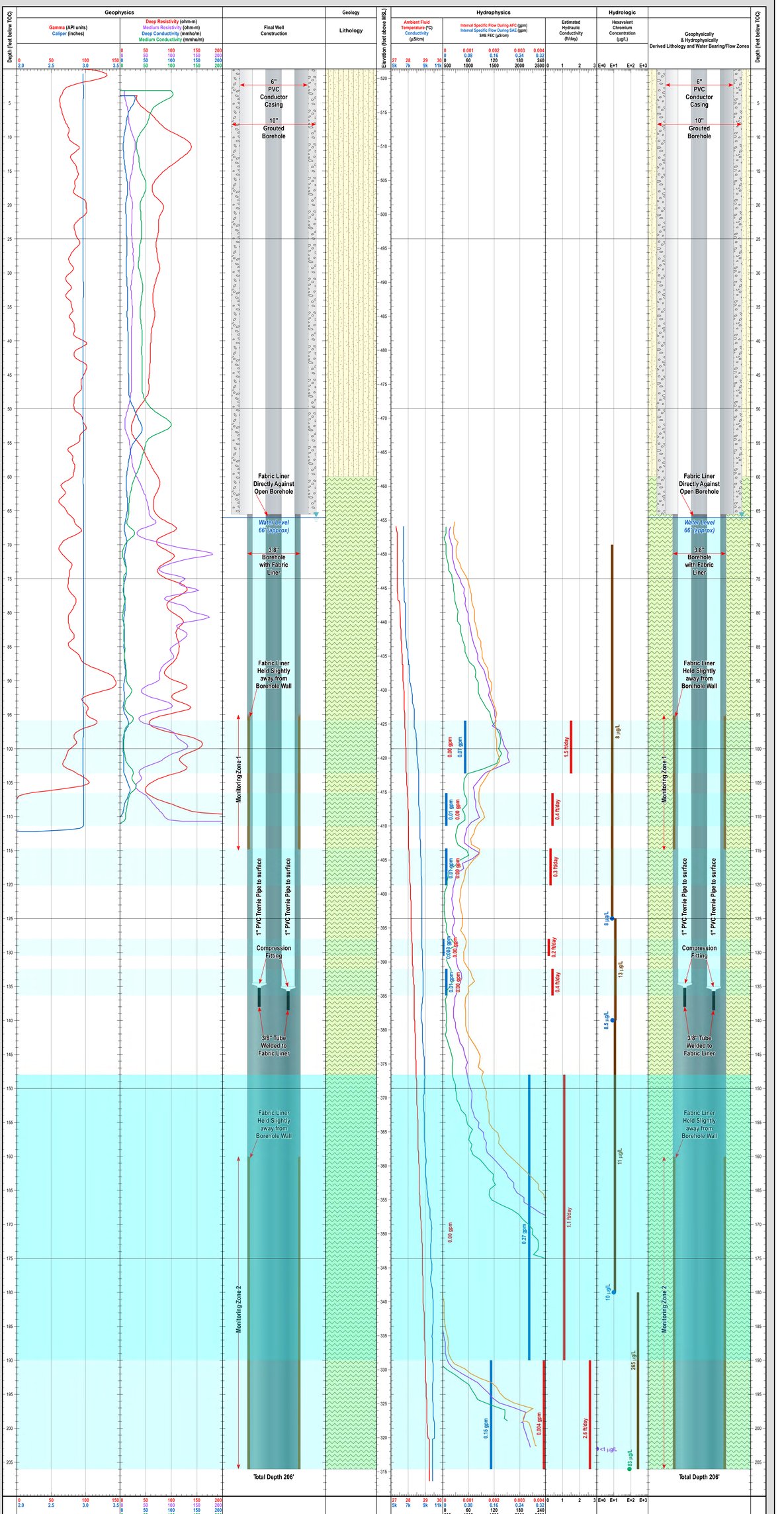
Hexavalent Chromium - Cr (VI), in micrograms per liter (µg/L)

- Calculated interval specific concentrations (intervals)
- Observed concentrations ambient conditions (point)
- Observed concentrations pumping conditions (points)
- Pump after sampling (point)

Contaminant concentrations based on samples collected in open borehole conditions.

MISCELLANEOUS NOTES:

1. Top of casing elevation: 521.4 feet (NADE83).
2. All depths referenced to top of PVC casing.
3. Coordinates of well:
   Northing: 7616137.91 Easting: 2109612.36
4. Lithology from CH2M Hill.
5. Well construction from CH2M Hill.
6. Geophysical logging conducted by Pacific Surveys on July 16, 2008 & December 2, 2008.
7. Hexavalent chromium results provided by CH2M Hill.
8. Hydrophysical logging conducted by RAS, Inc. from March 3 to March 5, 2008.



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WELL: MW-62BR

PROJECT: CH2M Hill - PG&E Topock Compressor Station - Needles, California

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email: bpedler@rasinc.org • www.rasinc.org

LEGEND

LITHOLOGY
- Unconsolidated Sediment
- Conglomerate Bedrock
- Metadiorite Bedrock

HYDROPHYSICAL LOGGING RESULTS:

Interval Specific Flow rate derived from Ambient Flow Characterization (AFC) and Pumping During deionized water injection (PDI) hydrophysical data.

Fluid Resistivity and Fluid temperature Logs performed during ambient conditions

Flow Zones, in percent of total fluid contribution
- >20%
- >10% and <20%
- >5% and <10%
- <5%

Horizontal flow observed during ambient conditions, inflows also evaluated during stressed (constant pumping or slug test) conditions. Horizontal flowrates base on integral method for q (Lowe, et. al., 1985).

Hydraulic conductivity estimates based on Hvorslev (1962), (Peckler, et al. 1988) and Thiem, G. Hydrologische Methoden. Leipzig: Gebhart, 1906, p 56. Flow and velocity estimates based on hydrophysical logging results only.

HEXAVALENT CHROMIUM EXPLANATION

Hexavalent Chromium - Cr (VI), in micrograms per liter (µg/L)
- Calculated Interval specific concentrations (Intervals)
- Observed concentrations ambient conditions (point)
- Observed concentrations pumping conditions (points)
- Pump after sampling (point)

Contaminant concentrations based on samples collected in open borehole conditions.

MISCELLANEOUS NOTES:

1. Top of casing elevation: 503.5 feet (NAD83).
2. All depths referenced to top of PVC casing.
3. Coordinates of well:
   Northing: 7616551.06 Easting: 2101068.31
4. Lithology from CH2M Hill.
5. Well construction from CH2M Hill.
6. Hexavalent chromium results provided by CH2M Hill.
7. Hydrophysical logging conducted by RAS, Inc. from May 5 to May 8, 2009.

Depth (feet below TOC)

Final Well Construction

6" PVC Conductor Casing

10" Grouted Borehole

Water Level 47' (approx)

Fabric Liner Directly Against Open Borehole

3.8" Borehole with Fabric Liner

Fabric Liner Held Slightly away from Borehole Wall

Monitoring Zone 1

1" PVC Tremie Pipe to surface

1" PVC Tremie Pipe to surface

Compression Fitting

3/8" Tube Welded to Fabric Liner

Fabric Liner Held Slightly away from Borehole Wall

Monitoring Zone 2

Total Depth 192'

Geology

Lithology

Elevation (feet above MSL)

Hydrophysics

Ambient Fluid Temperature (°C) Conductivity (µS/cm)

27 28 29
10k 15k 20k

Interval Specific Flow During AFC (gpm)
Interval Specific Flow During PDI (gpm)
Total Flow During PDI (gpm)
Incremental Flow During PDI (gpm)

-0.02 -0.01 0 +0.01 +0.02
0 0.2 0.4 0.6 0.8
0 0.02 0.04 0.06 0.08

0.16 gpm
-0.01 gpm
0 gpm
0.09 gpm
0.21 gpm
0 gpm
0.24 gpm
0 gpm
0.04 gpm
0 gpm
0.55 gpm
+0.01 gpm

Estimated Hydraulic Conductivity (ft/day)

E-2 E-1 E+0

0.189 ft/day
0.0765 ft/day
0.0443 ft/day
0.141 ft/day
0.300 ft/day
0.225 ft/day

Hydrologic

Hexavalent Chromium Concentration (µg/L)

E+2 E+3 E+4

1200 µg/L
1200 µg/L
1200 µg/L
1200 µg/L
<0 (-430) µg/L
920 µg/L
158 µg/L
600 µg/L
353 µg/L
520 µg/L
<1 µg/L
311 µg/L
430 µg/L

Hydrophysically Derived Lithology and Water Bearing/Flow Zones

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WELL: MW-64BR

PROJECT: CH2M Hill - PG&E Topock Compressor Station - Needles, California

RAS Inc. Regulatory Advocacy Solutions

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LEGEND

LITHOLOGY
- Unconsolidated Sediment
- Conglomerate Bedrock
- Metabasite Bedrock

HYDROPHYSICAL LOGGING RESULTS:
Interval Specific Flow rate derived from Ambient Flow Characterization (AFC) and Slug Test After Emplacement (SAE) hydrophysical data.
HPL-FEC logs presented were collected during Slug Test after Emplacement conditions.
- FEC 1540
- FEC 1546
- FEC 1555

FEC XXXX where XXXX is military time at start of log.
Horizontal flow observed during ambient conditions, inflows also evaluated during stressed (constant discharge pumping) conditions. Flow rates derived from base on integral method for a (Lowe, et. al., 1988).
Fluid Resistivity and Fluid temperature Log performed during ambient conditions
Hydraulic conductivity estimates based on Hvorslev (1962) (Reller, et al 1988) and Thein, G. Hydrophysical Methods: Leipzig: Gebhart, 1906, p 39. Flow and conductivity estimates based on hydrophysical logging results only.

Flow Zones, in percent of total fluid contribution
- >20%
- >20% and <35%
- >35% and <50%
- <50%

HEXAVALENT CHROMIUM EXPLANATION
Hexavalent Chromium - Cr (+3), in micrograms per liter (µg/L)
- Observed Interval specific concentrations (Intervals)
- Observed concentrations ambient conditions (point)
- Observed concentrations stressed conditions (point)
- Pump after sampling (point)

Contaminant concentrations based on samples collected in open borehole conditions.

MISCELLANEOUS NOTES:
1. Top of casing elevation 576.0 feet (NAD83).
2. All depths referenced to top of PVC casing.
3. Coordinates of well: Northing: 1816283.41 Easting: 2105520.49
4. Lithology from CH2M Hill.
5. Well construction from CH2M Hill.
6. Hexavalent chromium results provided by CH2M Hill.
7. Hydrophysical logging conducted by RAS, Inc. from May 27 to June 1, 2009.

Depth (feet below TOC) | Final Well Construction | Geology: Lithology | Elevation (feet above MSL) | Hydrophysics: Ambient Fluid Temperature (°C) Conductivity (µS/cm) | Interval Specific Flow During AFC (gpm) Interval Specific Flow During SAE (gpm) SAE FEC (µS/cm) | Estimated Hydraulic Conductivity (ft/day) | Hydrologic: Hexavalent Chromium Concentration (µg/L) | Hydrophysically Derived Lithology and Water Bearing/Flow Zones | Depth (feet below TOC)

Ambient Fluid Temperature (°C): 27 28 29
Conductivity (µS/cm): 4k 8k 12k
Interval Specific Flow During AFC (gpm): 0.000 0.004 0.008 0.012 0.016
Interval Specific Flow During SAE (gpm): 0.000 0.004 0.008 0.012 0.016
SAE FEC (µS/cm): 0 400 800 1200 1600
Estimated Hydraulic Conductivity (ft/day): E-2 E-1 E+0

PVC Conductor Casing
1" Grouted Borehole
Fabric Liner Directly Against Open Borehole
14" Borehole with Fabric Liner
Water Level 577 (approx.)
Fabric Liner Held Slightly away from Borehole Wall
Monitoring Zone 1
3/8" Tube Welded to Fabric Liner, Extends to Surface
Monitoring Zone 2
Monitoring Zone 3
<0.001 gpm
0.008 gpm
6.4 E-2 ft/day
Total Depth 257'

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REPORT, APPENDICES AND DATA

CD-ROM

Attachment C
Laboratory Analytical Results for Soil and Groundwater

Attachment C-1
Soil Analytical Data Tables

TABLE C1-1
Soil Sample Results: Metals
Inside the Compressor Station
Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation
PG&E Topock Compressor Station, Needles, California

				Metals (mg/kg)															
Commercial Screening Level [1]:				**380**	**0.24**	**63,000**	**190**	**500**	**1,400**	**37**	**300**	**38,000**	**320**	**180**	**4,800**	**16,000**	**4,800**	**4,800**	**63**	**5,200**	**100,000**
Background [2]:				**NE**	**11**	**410**	**0.672**	**1.1**	**39.8**	**0.83**	**12.7**	**16.8**	**8.39**	**NE**	**1.37**	**27.3**	**1.47**	**NE**	**NE**	**52.2**	**58**
Location	**Date**	**Depth (ft bgs)**	**Sample Type**	**Antimony**	**Arsenic [3]**	**Barium**	**Beryllium**	**Cadmium**	**Chromium**	**Chromium Hexavalent**	**Cobalt**	**Copper**	**Lead**	**Mercury**	**Molybdenum**	**Nickel**	**Selenium**	**Silver**	**Thallium**	**Vanadium**	**Zinc**
BH-65 (Site 5)	03/24/11	0 - 0.5	N	ND (0.26)	2	94	ND (0.26)	ND (0.26)	12	0.52	3.4	5.2	6.7	ND (0.1)	0.86	9.7	ND (0.26)	ND (0.26)	ND (0.26)	13	21
	03/24/11	2 - 3	N	ND (0.26)	2.8	150	0.28	ND (0.26)	17	0.79	4.3	8.1	**20**	ND (0.12)	0.57	10	ND (0.26)	ND (0.26)	ND (0.26)	17	28
	03/17/11	9 - 10	N	ND (2.1)	1.7	95	ND (1)	ND (1)	15	ND (0.41)	7.1	7.4	3.5	ND (0.1)	ND (1)	11	ND (1)	ND (1)	ND (2.1)	38	**66**
	03/17/11	14 - 15	N	ND (2.1)	1.5	140	ND (1)	ND (1)	16	ND (0.42)	9	7.5	3	ND (0.1)	ND (1)	12	ND (1)	ND (1)	ND (2.1)	35	43
	03/17/11	19 - 20	N	ND (2)	1.6	140	ND (1)	ND (1)	24	ND (0.41)	8.4	7	3	ND (0.1)	ND (1)	15	ND (1)	ND (1)	ND (2)	36	50
	03/17/11	29 - 30	N	ND (2J)	0.99	130	ND (1)	ND (1)	25	ND (0.4)	8.6	5.3	1.8 J	ND (0.1)	ND (1J)	11	ND (1J)	ND (1)	ND (2J)	36	39
	03/17/11	37 - 40	N	ND (2.1)	2.5	140	ND (1.1)	ND (1.1)	**48**	ND (0.42)	**14**	**17**	3.8	ND (0.1)	ND (1.1)	**33**	ND (1.1)	ND (1.1)	ND (2.1)	50	41
	03/17/11	49 - 50	N	ND (2.1)	2.7	90	ND (1.1)	ND (1.1)	**50**	ND (0.43)	12	**27**	4.1	ND (0.11)	ND (1.1)	**29**	ND (1.1)	ND (1.1)	ND (2.1)	50	45
	03/17/11	59 - 60	N	ND (2.1)	2.4	73	ND (1)	ND (1)	**40**	ND (0.42)	12	8	3.1	ND (0.1)	ND (1)	**28**	ND (1)	ND (1)	ND (2.1)	51	43
	03/18/11	69 - 70	N	ND (2.1)	2.4	94	ND (1.1)	ND (1.1)	23	ND (0.42)	10	14	2.9	ND (0.1)	ND (1.1)	19	ND (1.1)	ND (1.1)	ND (2.1)	44	43
	03/18/11	79 - 80	N	ND (2.1)	2.5	110	ND (1.1)	ND (1.1)	**61**	ND (0.42)	**13**	**21**	3.7	ND (0.1)	ND (1.1)	**44 J**	ND (1.1)	ND (1.1)	ND (2.1)	**57**	50
	03/18/11	79 - 80	FD	ND (2.1)	2.7	93	ND (1)	ND (1)	**53**	ND (0.42)	12	15	3.5	ND (0.1)	ND (1)	**35 J**	ND (1)	ND (1)	ND (2.1)	**54**	42
	03/18/11	89 - 90	N	ND (2.1)	2.4	49	ND (1.1)	ND (1.1)	20	ND (0.43)	8.8	12	2.8	ND (0.11)	ND (1.1)	17	ND (1.1)	ND (1.1)	ND (2.1)	36	38
	03/18/11	99 - 100	N	ND (2.1J)	3.3	**1,000**	ND (1)	ND (1J)	**66**	ND (0.42)	**16**	**18**	3.4 J	ND (0.1)	ND (1J)	**53**	ND (1J)	ND (1)	ND (2.1J)	**63**	51
	03/18/11	109 - 110	N	ND (2.1)	2.7	88	ND (1.1)	ND (1.1)	**49**	ND (0.43)	11	**20**	4.5	ND (0.11)	ND (1.1)	**34**	ND (1.1)	ND (1.1)	ND (2.1)	50	48
	03/18/11	119 - 120	N	ND (2.1)	2.9	50	ND (1)	ND (1)	**50**	ND (0.41)	**14**	13	2.8	ND (0.1)	ND (1)	**41**	ND (1)	ND (1)	ND (2.1)	**57**	46
	03/19/11	129 - 130	N	ND (2.1)	2.4	56	ND (1)	ND (1)	26	ND (0.42)	8.6	**20**	3	ND (0.11)	ND (1)	20	ND (1)	ND (1)	ND (2.1)	32	36
	03/19/11	139 - 140	N	ND (2.2)	2.6	140	ND (1.1)	ND (1.1)	25	ND (0.43)	9.7	**20**	2.6	ND (0.11)	ND (1.1)	21	ND (1.1)	ND (1.1)	ND (2.2)	38	44
BH-66 (Site 6)	03/23/11	0 - 0.5	N	ND (0.27)	1.4	70	ND (0.27)	ND (0.27)	12	ND (0.43)	4	5	**8.9**	ND (0.11)	ND (0.27)	11	ND (0.27)	ND (0.27)	ND (0.27)	14	16
	03/23/11	2 - 3	N	ND (0.27)	1.3	62	ND (0.27)	ND (0.27)	9.1	ND (0.42)	3.3	5	3.2	ND (0.11)	ND (0.27)	9.3	ND (0.27)	ND (0.27)	ND (0.27)	11	15
	03/23/11	5 - 6	N	ND (0.28)	1.8	76	0.33	ND (0.28)	14	ND (0.45)	4.9	6.2	2.6	ND (0.1)	ND (0.28)	11	ND (0.28)	ND (0.28)	ND (0.28)	19	26
	04/12/11	14 - 15	N	ND (2.1)	2.3	72 J	ND (1)	ND (1)	5.3 J	ND (0.41)	2	3.8	2.7	ND (0.1)	ND (1)	4	ND (1)	ND (1)	ND (2.1)	12 J	11 J
	04/12/11	14 - 15	FD	ND (2.1)	2.8	100 J	ND (1)	ND (1)	15 J	ND (0.42)	3.5	11	3.8	ND (0.1)	ND (1)	6.7	ND (1)	ND (1)	ND (2.1)	15 J	20 J
	04/12/11	19 - 20	N	ND (2)	2.4	86	ND (1)	ND (1)	10	ND (0.41)	2.2	3	3	ND (0.1)	ND (1)	4.1	ND (1)	ND (1)	ND (2)	12	14
	04/12/11	29 - 30	N	ND (2.1)	2.3	97	ND (1)	ND (1)	7	ND (0.41)	2.2	2.6	2.7	ND (0.1)	ND (1)	4.1	ND (1)	ND (1)	ND (2.1)	12	13
	04/12/11	39 - 40	N	ND (2.1)	2	68	ND (1)	ND (1)	28	ND (0.41)	9.7	9.3	2.7	ND (0.1)	ND (1)	23	ND (1)	ND (1)	ND (2.1)	41	38
	04/12/11	49 - 50	N	ND (2.1J)	2 J	130	ND (1)	ND (1)	28	ND (0.41)	9.9	9.5	3	ND (0.1)	ND (1J)	23	ND (1)	ND (1)	ND (2.1J)	43	41
	04/13/11	59 - 60	N	ND (2.1)	1.8	28	ND (1.1)	ND (1.1)	25	ND (0.42)	8.2	8.1	2.9	ND (0.1)	ND (1.1)	16	ND (1.1)	ND (1.1)	ND (2.1)	35	40
	04/13/11	69 - 70	N	ND (2.1)	2.2	34	ND (1.1)	ND (1.1)	18	ND (0.43)	8.8	13	3.8	ND (0.11)	ND (1.1)	16	ND (1.1)	ND (1.1)	ND (2.1)	39	44
	04/13/11	79 - 80	N	ND (2.1)	1.6	100	ND (1)	ND (1)	17	ND (0.42)	8.7	10	2.7	ND (0.1)	ND (1)	13	ND (1)	ND (1)	ND (2.1)	37	43
	04/13/11	89 - 90	N	ND (2.1)	2	29	ND (1.1)	ND (1.1)	18	ND (0.43)	8	10	3	ND (0.1)	ND (1.1)	15	ND (1.1)	ND (1.1)	ND (2.1)	32	39
	04/13/11	99 - 100	N	ND (2.1)	1.8	80	ND (1.1)	ND (1.1)	21	ND (0.43)	7.8	12	3.6	ND (0.11)	ND (1.1)	16	ND (1.1)	ND (1.1)	ND (2.1)	34	38
	04/13/11	109 - 110	N	ND (2.1)	1.6	120	ND (1.1)	ND (1.1)	22	ND (0.42)	9.1	9.7	3.4	ND (0.1)	ND (1.1)	16	ND (1.1)	ND (1.1)	ND (2.1)	38	41
	04/14/11	119 - 120	N	ND (2.1)	1.7	39 J	ND (1)	ND (1)	20	ND (0.41)	8	12	2.6	ND (0.1)	ND (1)	13	ND (1)	ND (1)	ND (2.1)	33	36
	04/14/11	119 - 120	FD	ND (2.1)	1.7	23 J	ND (1)	ND (1)	23	ND (0.42)	7.7	13	2.8	ND (0.1)	ND (1)	15	ND (1)	ND (1)	ND (2.1)	33	36
	04/14/11	129 - 130	N	ND (2.1)	2.1	51	ND (1.1)	ND (1.1)	29	ND (0.43)	8.3	12	2.7	ND (0.11)	ND (1.1)	19	ND (1.1)	ND (1.1)	ND (2.1)	36	35
BH-67 (Site 2)	03/17/11	0 - 0.5	N	ND (2.2)	3.2	120	ND (1.1)	ND (1.1)	32	ND (0.43)	10	14	5	ND (0.11)	ND (1.1)	**29**	ND (1.1)	ND (1.1)	ND (2.2)	45	43
	03/17/11	2 - 3	N	ND (2.1)	2.9	240	ND (1.1)	ND (1.1)	11	ND (0.42)	5.2	3.5	1.8	ND (0.1)	ND (1.1)	7.6	ND (1.1)	ND (1.1)	ND (2.1)	31	28
	03/17/11	5 - 6	N	ND (2)	1.9	27	ND (1)	ND (1)	2.8	ND (0.4)	1.4	ND (2)	2.2	ND (0.1)	ND (1)	2.3	ND (1)	ND (1)	ND (2)	11	6.7
	04/29/11	9 - 10	N	ND (2.1)	2.8	66	ND (1)	ND (1)	4.4	ND (0.42)	2.3	ND (2.1)	2.6	ND (0.1)	ND (1)	4	ND (1)	ND (1)	ND (2.1)	14	12
	04/29/11	14 - 15	N	ND (2)	2.1	35	ND (1)	ND (1)	2.4	ND (0.41)	ND (1)	ND (2)	1.7	ND (0.1)	ND (1)	1.4	ND (1)	ND (1)	ND (2)	7.2	5.7
	04/29/11	19 - 20	N	ND (2)	2.6	110	ND (1)	ND (1)	6.6	ND (0.41)	2.2	2.2	2.6	ND (0.1)	1.2	3.3	ND (1)	ND (1)	ND (2)	14	12

TABLE C1-1
Soil Sample Results: Metals
Inside the Compressor Station
Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation
PG&E Topock Compressor Station, Needles, California

				Metals (mg/kg)															
Commercial Screening Level [1]:				**380**	**0.24**	**63,000**	**190**	**500**	**1,400**	**37**	**300**	**38,000**	**320**	**180**	**4,800**	**16,000**	**4,800**	**4,800**	**63**	**5,200**	**100,000**
Background [2]:				**NE**	**11**	**410**	**0.672**	**1.1**	**39.8**	**0.83**	**12.7**	**16.8**	**8.39**	**NE**	**1.37**	**27.3**	**1.47**	**NE**	**NE**	**52.2**	**58**
Location	**Date**	**Depth (ft bgs)**	**Sample Type**	**Antimony**	**Arsenic [3]**	**Barium**	**Beryllium**	**Cadmium**	**Chromium**	**Chromium Hexavalent**	**Cobalt**	**Copper**	**Lead**	**Mercury**	**Molybdenum**	**Nickel**	**Selenium**	**Silver**	**Thallium**	**Vanadium**	**Zinc**
BH-67 (Site 2)	04/29/11	29 - 30	N	ND (2)	ND (1)	220	ND (1)	ND (1)	18	ND (0.41)	**14**	4.5	ND (1)	ND (0.1)	**4.6**	12	ND (1)	ND (1)	ND (2)	**56**	**69**
	04/29/11	39 - 40	N	ND (2)	1.9	15	ND (1)	ND (1)	2.4	ND (0.4)	1.1	ND (2)	2	ND (0.1)	ND (1)	1.5	ND (1)	ND (1)	ND (2)	10	5.5
	04/29/11	39 - 40	FD	ND (2)	1.6	15	ND (1)	ND (1)	2.1	ND (0.4)	ND (1)	ND (2)	1.7	ND (0.1)	ND (1)	1.2	ND (1)	ND (1)	ND (2)	8.9	4.5
	04/29/11	49 - 50	N	ND (2.1)	2.7	110	ND (1)	ND (1)	12	ND (0.42)	3.3	2.7	2.8	ND (0.1)	**2.2**	4.5	ND (1)	ND (1)	ND (2.1)	20	17
	04/29/11	59 - 60	N	ND (2.3)	8.8	190	ND (1.2)	ND (1.2)	18	ND (0.47)	4.9	12	**10**	ND (0.12)	**3.5**	13	ND (1.2)	ND (1.2)	ND (2.3)	28	50
	04/29/11	69 - 70	N	ND (2.1)	2.3	110	ND (1)	ND (1)	3.2	ND (0.41)	1.4	ND (2.1)	2.6	ND (0.1)	ND (1)	2	ND (1)	ND (1)	ND (2.1)	8.1	7.8
	04/29/11	79 - 80	N	ND (2.2)	6.9	180	ND (1.1)	ND (1.1)	13	ND (0.44)	4.5	6.3	6.9	ND (0.11)	ND (2.2)	9.3	ND (1.1)	ND (1.1)	ND (2.2)	23	34
	04/29/11	89 - 90	N	ND (2.2)	4.3	74	ND (1.1)	ND (1.1)	22	0.78	8.7	7.1	4.4	ND (0.11)	**3.2**	17	ND (1.1)	ND (1.1)	ND (2.2)	41	39
	04/29/11	99 - 100	N	ND (2.1)	3.4	46	ND (1)	ND (1)	22	ND (0.41)	9.5	7.8	2.9	ND (0.1)	**3.4**	15	ND (1)	ND (1)	ND (2.1)	43	40
	04/29/11	109 - 110	N	ND (2.1)	1.6	48	ND (1)	ND (1)	31	ND (0.41)	12	8.4	3.5	ND (0.1)	**4.9**	19	ND (1)	ND (1)	ND (2.1)	52	50
	04/29/11	119 - 120	N	ND (2.1)	3	44	ND (1)	ND (1)	20	ND (0.42)	9.7	6.6	2.9	ND (0.1)	**3.5**	14	ND (1)	ND (1)	ND (2.1)	43	44
	04/30/11	129 - 130	N	ND (2.1)	3.3	90	ND (1)	ND (1)	26	ND (0.42)	9.5	12	2.6	ND (0.11)	**4.3**	17	ND (1)	ND (1)	ND (2.1)	41	42
	04/30/11	139 - 140	N	ND (2.1)	ND (5.2)	39	ND (1)	ND (1)	15	ND (0.42)	7.8	ND (10)	ND (5.2)	ND (0.1)	**3.3**	9.8	ND (1)	ND (1)	ND (2.1)	33	36
	04/30/11	139 - 140	FD	ND (2.1)	3.1	36	ND (1.1)	ND (1.1)	19	ND (0.42)	8.9	6.5	2.6	ND (0.1)	**4.2**	13	ND (1.1)	ND (1.1)	ND (2.1)	40	43
	04/30/11	149 - 150	N	ND (2.1)	2.9	**510**	ND (1)	ND (1)	17	ND (0.41)	8.9	ND (10)	1.5	ND (0.1)	**3.3**	12	ND (1)	ND (1)	ND (2.1)	37	36
	04/30/11	159 - 160	N	ND (2.1)	2.4	35	ND (1)	ND (1)	19	ND (0.41)	10	7.3	2.3	ND (0.1)	**3.9**	13	ND (1)	ND (1)	ND (2.1)	44	41
BH-68 (Site 3)	03/17/11	0 - 0.5	N	ND (2.2)	3.8	130	ND (1.1)	ND (1.1)	17	ND (0.43)	5.7	7.4	4.2	ND (0.11)	ND (1.1)	14	ND (1.1)	ND (1.1)	ND (2.2)	30	29
	03/17/11	0 - 0.5	FD	ND (2.2)	3.5	130	ND (1.1)	ND (1.1)	22	ND (0.43)	7.4	12	5.6	ND (0.11)	ND (1.1)	19	ND (1.1)	ND (1.1)	ND (2.2)	35	33
	03/17/11	2 - 3	N	ND (2.1)	3.7	55	ND (1.1)	ND (1.1)	4.2	ND (0.42)	1.9	ND (2.1)	2.5	ND (0.11)	ND (1.1)	4.2	ND (1.1)	ND (1.1)	ND (2.1)	11	11
	03/17/11	5 - 6	N	ND (2.3)	1.8	51	ND (1.2)	ND (1.2)	4.6	ND (0.47)	1.9	2.5	3.5	ND (0.12)	ND (1.2)	3.8	ND (1.2)	ND (1.2)	ND (2.3)	12	13
	05/13/11	9 - 10	N	ND (0.26J)	4.6	130	0.61	ND (0.26)	12 J	ND (0.42)	5.8 J	8.5 J	**12 J**	ND (0.11)	1.2	13 J	ND (0.26)	ND (0.26)	ND (0.26)	27	31
	05/13/11	14 - 15	N	ND (0.25)	1.8	14	ND (0.25)	ND (0.25)	2.8	ND (0.41)	1.1	2	2	ND (0.1)	0.92	2.4	ND (0.25)	ND (0.25)	ND (0.25)	6.7	6.3
	05/13/11	19 - 20	N	ND (0.27)	3	200	0.46	ND (0.27)	31	ND (0.42)	8.8	10	3.8	ND (0.11)	0.55	21	ND (0.27)	ND (0.27)	ND (0.27)	39	38
	05/13/11	29 - 30	N	ND (0.26)	2.7	52	0.45	ND (0.26)	35	ND (0.42)	8.8	12	3.3	ND (0.1)	0.45	27	ND (0.26)	ND (0.26)	ND (0.26)	41	38
	05/13/11	39 - 40	N	ND (0.27)	2.6	55	0.51	ND (0.27)	32	ND (0.42)	8.8	16	4.5	ND (0.11)	0.47	27	ND (0.27)	ND (0.27)	ND (0.27)	42	41
	05/13/11	49 - 50	N	ND (0.26)	1.8	46	0.37	ND (0.26)	16	ND (0.41)	6.3	8.5	2.7	ND (0.1)	0.46	12	ND (0.26)	ND (0.26)	ND (0.26)	29	35
	05/13/11	59 - 60	N	ND (0.26)	2.6	100	0.5	ND (0.26)	22	ND (0.42)	7.7	12	3.8	ND (0.11)	0.45	18	ND (0.26)	ND (0.26)	ND (0.26)	35	36
	05/13/11	69 - 70	N	ND (0.26)	2.3	200	0.53	ND (0.26)	26	ND (0.42)	8.8	13	4.2	ND (0.11)	0.5	20	ND (0.26)	ND (0.26)	ND (0.26)	41	39
	05/13/11	79 - 80	N	ND (0.27)	2.5	58	0.55	ND (0.27)	36	ND (0.42)	8.6	13	4	ND (0.11)	0.49	24	ND (0.27)	ND (0.27)	ND (0.27)	40	41
	05/13/11	89 - 90	N	ND (0.27)	3.3	44	0.66	ND (0.27)	28	ND (0.43)	7.9	14	5.9	ND (0.11)	0.62	23	ND (0.27)	ND (0.27)	ND (0.27)	41	38
	05/13/11	99 - 100	N	ND (0.27)	3.2	49	0.67	ND (0.27)	37	ND (0.44)	8.3	**18**	5.3	ND (0.11)	0.62	**30**	ND (0.27)	ND (0.27)	ND (0.27)	45	44
	05/13/11	99 - 100	FD	ND (0.27)	3.1	54	0.58	ND (0.27)	38	ND (0.43)	8.6	16	5.1	ND (0.11)	0.68	**32**	ND (0.27)	ND (0.27)	ND (0.27)	44	41
	05/13/11	109 - 110	N	ND (0.26)	1.9	32	0.42	ND (0.26)	16	ND (0.42)	6.1	11	3.4	ND (0.1)	0.38	13	ND (0.26)	ND (0.26)	ND (0.26)	31	31
	05/13/11	119 - 120	N	ND (0.27)	2.4	58	0.51	ND (0.27)	25	ND (0.43)	8	16	4.2	ND (0.11)	0.49	20	ND (0.27)	ND (0.27)	ND (0.27)	41	38
	05/13/11	129 - 130	N	ND (0.26)	2.1	24	0.39	0.3	15	ND (0.42)	6.3	8.4	2.8	ND (0.11)	0.3	12	ND (0.26)	ND (0.26)	ND (0.26)	29	31
	05/14/11	139 - 140	N	ND (0.27)	3.8	120	0.61	ND (0.27)	**45**	ND (0.43)	11	**19**	6.1	ND (0.11)	0.87	**35**	ND (0.27)	ND (0.27)	ND (0.27)	48	46
	05/14/11	149 - 150	N	ND (0.26)	3.8	68	0.5	ND (0.26)	**48**	ND (0.42)	11	**19**	4.3	ND (0.11)	0.76	**39**	ND (0.26)	ND (0.26)	ND (0.26)	50	42
	05/14/11	159 - 160	N	ND (0.26)	2.9	34	0.41	ND (0.26)	22	ND (0.42)	8.8	13	3.2	ND (0.11)	0.43	19	ND (0.26)	ND (0.26)	ND (0.26)	38	38

TABLE C1-1

Soil Sample Results: Metals

Inside the Compressor Station

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

Notes:

1 Commercial screening level - commercial DTSC CHHSL. If the commercial DTSC CHHSL is not established, the USEPA regional screening level is used.

2 CH2M HILL. 2009. "Final Soil Background Technical Memorandum at Pacific Gas and Electric Company Topock Compressor Station, Needles, California." May.

3 Commercial screening level is below background values therefore arsenic results are only screened against background.

Results greater than or equal to the Background levels are bolded

NE = not established

USEPA = United States Environmental Protection Agency

DTSC = California Department of Toxic Substances Control

CHHSL = California human health screening levels

-- = not analyzed

FD = Field Duplicate

ft bgs = feet below ground surface

J = concentration or reporting limit estimated by laboratory or data validation

mg/kg = milligrams per kilogram

N = Primary Sample

ND = not detected at the listed reporting limit

TABLE C1-2
Soil Sample Results: Metals
Outside the Compressor Station
Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation
PG&E Topock Compressor Station, Needles, California

				Metals (mg/kg)																
Interim Screening Level :				**0.285**	**11**	**410**	**0.672**	**1.1**	**39.8**	**0.83**	**12.7**	**16.8**	**8.39**	**0.0125**	**1.37**	**27.3**	**1.47**	**5.15**	**2.32**	**52.2**	**58**
Residential Screening Level [1] :				**30**	**0.07**	**5,200**	**16**	**39**	**280**	**0.29**	**23**	**3,000**	**80**	**10**	**380**	**1,600**	**380**	**380**	**5**	**390**	**23,000**
Ecological Comparison Values [2] :				**0.285**	**11.4**	**330**	**23.3**	**0.0151**	**36.3**	**139.6**	**13**	**20.6**	**0.0166**	**0.0125**	**2.25**	**0.607**	**0.177**	**5.15**	**2.32**	**13.9**	**0.164**
Background [3] :				**NE**	**11**	**410**	**0.672**	**1.1**	**39.8**	**0.83**	**12.7**	**16.8**	**8.39**	**NE**	**1.37**	**27.3**	**1.47**	**NE**	**NE**	**52.2**	**58**
Location	**Date**	**Depth (ft bgs)**	**Sample Type**	**Antimony**	**Arsenic**	**Barium**	**Beryllium**	**Cadmium**	**Chromium**	**Chromium Hexavalent**	**Cobalt**	**Copper**	**Lead**	**Mercury**	**Molybdenum**	**Nickel**	**Selenium**	**Silver**	**Thallium**	**Vanadium**	**Zinc**
BH-69 (Site 4)	03/18/11	0 - 0.5	N	ND (2.1)	3.1	140	ND (1)	ND (1)	58	0.72	12	20	9.6	ND (0.1)	ND (1)	35	ND (1)	ND (1)	ND (2.1)	50	73
	03/18/11	2 - 3	N	ND (2.2)	2.7	89	ND (1.1)	ND (1.1)	49	ND (0.45)	11	14	7.4	ND (0.11)	ND (1.1)	33	ND (1.1)	ND (1.1)	ND (2.2)	45	61
	05/31/11	5 - 6	N	ND (2)	1.7	250	ND (1)	ND (1)	63	ND (0.41)	11	29	3.9	ND (0.1)	1	46	ND (1)	ND (1)	ND (2)	55	49
	05/31/11	9 - 10	N	ND (2.1)	2.2	150	ND (1)	ND (1)	57	ND (0.42)	12	25	4.3	ND (0.1)	ND (1)	45	ND (1)	ND (1)	ND (2.1)	59	53
	05/31/11	14 - 15	N	ND (2)	1.9	170	ND (1)	ND (1)	45	ND (0.41)	10	42	4	ND (0.1)	ND (1)	42	ND (1)	ND (1)	ND (2)	58	48
	05/31/11	19 - 20	N	ND (2)	1.6	280	ND (1)	ND (1)	55	ND (0.41)	12	32	4.2	ND (0.1)	ND (1)	43	ND (1)	ND (1)	ND (2)	57	49
	05/31/11	29 - 30	N	ND (2)	1.9	120	ND (1)	ND (1)	57	ND (0.4)	11	46	3.6	ND (0.1)	ND (1)	50	ND (1)	ND (1)	ND (2)	74	50
	05/31/11	39 - 40	N	ND (2.1)	2.8	170	ND (1.1)	ND (1.1)	48	ND (0.43)	8.4	21	4.1	ND (0.11)	ND (1.1)	35	ND (1.1)	ND (1.1)	ND (2.1)	59	42
BH-70 (Site H)	05/24/11	0 - 0.5	N	ND (2)	2.9	120	ND (1)	ND (1)	40	1.1	3.6	18	11	ND (0.1)	ND (1)	12	ND (1)	ND (1)	ND (2)	25	54
	05/24/11	2 - 3	N	ND (2)	2.1	150	ND (1)	ND (1)	66	1.6	4.4	44	13	ND (0.1)	ND (1)	16	ND (1)	ND (1)	ND (2)	29	99
	05/24/11	5 - 6	N	ND (2)	2.3	150	ND (1)	ND (1)	26	0.43	3.3	12	3.8	ND (0.1)	ND (1)	12	ND (1)	ND (1)	ND (2)	25	56
	05/24/11	9 - 10	N	ND (2.1)	1.9	250	ND (1)	ND (1)	34	ND (0.41)	6.6	24	2.8	ND (0.1)	ND (1)	25	ND (1)	ND (1)	ND (2.1)	45	50
	05/24/11	14 - 15	N	ND (2.1)	1.8	670	ND (1)	ND (1)	41	ND (0.42)	7.5	38	3	ND (0.1)	ND (1)	30	ND (1)	ND (1)	ND (2.1)	45	51
	05/24/11	19 - 20	N	ND (2.1)	2.1	310 J	ND (1.1)	ND (1.1)	40 J	ND (0.42)	9.5	29	3.3	ND (0.11)	ND (1.1)	31	ND (1.1)	ND (1.1)	ND (2.1)	46	56
	05/24/11	19 - 20	FD	ND (2.1)	1.7	1,400 J	ND (1.1)	ND (1.1)	32 J	ND (0.42)	7.4	23	2.6	ND (0.11)	ND (1.1)	26	ND (1.1)	ND (1.1)	ND (2.1)	40	50
	05/24/11	29 - 30	N	ND (2.2)	2.5	880	ND (1.1)	ND (1.1)	29	ND (0.44)	9.4	26	3.2	ND (0.11)	ND (1.1)	22	ND (1.1)	ND (1.1)	ND (2.2)	43	52
	05/24/11	39 - 40	N	ND (2)	3.1	280	ND (1)	ND (1)	35	ND (0.41)	11	69	5.7	ND (0.1)	ND (1)	27	ND (1)	ND (1)	ND (2)	46	54
	05/24/11	49 - 50	N	ND (2.1)	6.3	150	ND (1.1)	ND (1.1)	34	ND (0.43)	11	82	5.7	ND (0.11)	ND (1.1)	27	ND (1.1)	ND (1.1)	ND (2.1)	48	58
	05/24/11	59 - 60	N	ND (2.2)	8	190	ND (1.1)	ND (1.1)	46	ND (0.44)	14	100	6.7	ND (0.11)	ND (1.1)	32	ND (1.1)	ND (1.1)	ND (2.2)	56	69
	05/24/11	69 - 70	N	ND (10)	6.7	63	ND (5.1)	ND (5.1)	7.3	ND (0.41)	13	ND (10)	ND (5.1)	ND (0.1)	ND (5.1)	7.5	ND (5.1)	ND (5.1)	ND (10)	36	34
MW-57BR (Site B)	01/14/09	3 - 4	N	ND (2)	9.2	270	ND (2)	ND (1)	26	ND (0.16)	7.8	11	6.7	ND (0.1)	ND (2)	17	ND (1)	ND (2)	ND (4.1)	34	52
	01/14/09	8 - 9	N	ND (2.1)	8	85	ND (1)	ND (1)	20	ND (0.17)	7.9	11	2.7	ND (0.1)	1.3	16	ND (1)	ND (1)	ND (2.1)	28	46
	01/14/09	8 - 9	FD	ND (2.1)	8.4	85	ND (1)	ND (1)	22	ND (0.16)	8	11	2.9	ND (0.1)	1.3	16	ND (1)	ND (1)	ND (2.1)	27	48
	01/14/09	18 - 19	N	ND (4.1)	9.9	240	ND (2.1)	ND (2.1)	25	ND (0.16)	10	12	4.3	ND (0.1)	3	16	ND (2.1)	ND (2.1)	ND (4.1)	31	68
MW-58BR Open Borehole (Shallow) (Site A)	01/29/09	1.5 - 2	N	ND (2.1J)	ND (2.1)	410	ND (2.1)	ND (1.1)	4,000	150	8.2	300	160	0.33	3.5	24	ND (1.1)	ND (2.1)	6.1	23	300
	01/29/09	19 - 20	N	ND (2.1)	12	240	ND (2.1)	ND (1.1)	33	0.43	12	24	4	ND (0.11)	ND (2.1)	25	ND (1.1)	ND (2.1)	4.7	38	63
	01/29/09	29 - 30	N	ND (2.1)	13	110	ND (2.1)	ND (1.1)	26	ND (0.17)	11	14	3.6	ND (0.11)	ND (2.1)	19	ND (1.1)	ND (2.1)	4.8	33	64
	01/29/09	39 - 40	N	ND (2.1)	12	150	ND (2.1)	ND (1.1)	35	0.43	12	17	4.2	ND (0.11)	ND (2.1)	22	ND (1.1)	ND (2.1)	4.7	34	51
	01/29/09	49 - 50	N	ND (2.1)	8.3	180	ND (1.1)	ND (1.1)	24	ND (0.17)	8.7	17	3.7	ND (0.11)	ND (1.1)	16	ND (1.1)	ND (1.1)	ND (2.1)	28	46
	01/29/09	59 - 60	N	ND (2.2)	8.4	37	ND (1.1)	ND (1.1)	27	ND (0.18)	13	58	3.4	ND (0.11)	ND (1.1)	22	ND (1.1)	ND (1.1)	ND (2.2)	28	41
Site-1 (Site 1)	03/23/11	0 - 0.5	N	ND (0.26J)	4.2 J	320	0.33	ND (0.26)	13 J	ND (0.42)	4.4 J	7.7 J	3.3	ND (0.1)	ND (0.26)	9.5 J	ND (0.26J)	ND (0.26)	ND (0.26)	20 J	25
	03/23/11	2 - 3	N	ND (0.26)	3.2	310	ND (0.26)	ND (0.26)	8.9	ND (0.42)	5	6.1	1.9	ND (0.1)	ND (0.26)	7.9	ND (0.26)	ND (0.26)	ND (0.26)	23	27
	03/23/11	5 - 6	N	ND (0.26)	2.5	130	ND (0.26)	ND (0.26)	9.1	ND (0.42)	3.3	4.7	2.6	ND (0.11)	ND (0.26)	7.4	ND (0.26)	ND (0.26)	ND (0.26)	15	17

TABLE C1-2
Soil Sample Results: Metals
Outside the Compressor Station
Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation
PG&E Topock Compressor Station, Needles, California

Notes:

1 Residential screening level - residential DTSC CHHSL. If the residential DTSC CHHSL is not established, the USEPA regional screening level is used.
2 ARCADIS. 2008. "Technical Memorandum 3: Ecological Comparison Values for Metals and Polycyclic Aromatic Hydrocarbons in Soil."
May 28. ARCADIS. 2009. "Topock Compression Station - Final Technical Memorandum 4: Ecological Comparison Values for Additional Detected Chemicals in Soil." July 1.
3 CH2M HILL. 2009. "Final Soil Background Technical Memorandum at Pacific Gas and Electric Company Topock Compressor Station, Needles, California." May.
Results greater than or equal to the interim screening level are circled.
Results greater than or equal to the Background levels are bolded
NE = not established
USEPA = United States Environmental Protection Agency
DTSC = California Department of Toxic Substances Control
CHHSL = California human health screening levels
-- = not analyzed
FD = Field Duplicate
ft bgs = feet below ground surface
J = concentration or reporting limit estimated by laboratory or data validation
mg/kg = milligrams per kilogram
N = Primary Sample
ND = not detected at the listed reporting limit

TABLE C1-3

Soil Sample Results: Contract Laboratory Program Inorganics

Inside the Compressor Station

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

				Contract Laboratory Program (CLP) Inorganics (mg/kg)						
Commercial Screening Level [1]:				**990,000**	**NE**	**720,000**	**NE**	**23,000**	**NE**	**NE**
Background [2] :				**16,400**	**66,500**	**NE**	**12,100**	**402**	**4,400**	**2,070**
Location	**Date**	**Depth (ft bgs)**	**Sample Type**	**Aluminum**	**Calcium**	**Iron**	**Magnesium**	**Manganese**	**Potassium**	**Sodium**
BH-65 (Site 5)	03/17/11	14 - 15	N	10,000	17,000	21,000	7,000	350	4,100	650
	03/17/11	19 - 20	N	9,300	9,800	23,000	6,400	350	3,300	550
BH-67 (Site 2)	03/17/11	2 - 3	N	7,200	23,000	15,000	5,400	210	2,200	430
	03/17/11	5 - 6	N	1,100	22,000	3,600	2,900	73	400	280
BH-68 (Site 3)	03/17/11	2 - 3	N	2,000	6,900	6,700	2,600	70	540	320
	03/17/11	5 - 6	N	3,100	20,000	5,000	3,600	130	940	560

Notes:

1 Commercial screening level - commercial DTSC CHHSL. If the commercial DTSC CHHSL is not established, the USEPA regional screening level is used.

2 CH2M HILL. 2009. "Final Soil Background Technical Memorandum at Pacific Gas and Electric Company Topock Compressor Station, Needles, California." May.

NE = not established

USEPA = United States Environmental Protection Agency

DTSC = California Department of Toxic Substances Control

CHHSL = California human health screening levels

-- = not analyzed

FD = Field Duplicate

ft bgs = feet below ground surface

J = concentration or reporting limit estimated by laboratory or data validation

mg/kg = milligrams per kilogram

N = Primary Sample

ND = not detected at the listed reporting limit

TABLE C1-4

Soil Sample Results: Contract Laboratory Program Inorganics

Outside the Compressor Station

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

				Contract Laboratory Program (CLP) Inorganics (mg/kg)							
Interim Screening Level :				**16,400**	**66,500**	**0.9**	**55,000**	**12,100**	**402**	**4,400**	**2,070**
Residential Screening Levels[1] :				**77,000**	**NE**	**1,600**	**55,000**	**NE**	**1,800**	**NE**	**NE**
Ecological Comparison Values[2] :				**NE**	**NE**	**0.9**	**NE**	**NE**	**220**	**NE**	**NE**
Background[3] :				**16,400**	**66,500**	**NE**	**NE**	**12,100**	**402**	**4,400**	**2,070**
Location	**Date**	**Depth (ft bgs)**	**Sample Type**	**Aluminum**	**Calcium**	**Cyanide**	**Iron**	**Magnesium**	**Manganese**	**Potassium**	**Sodium**
BH-69 (Site 4)	03/18/11	2 - 3	N	17,000	28,000	---	23,000	12,000	360	3,800	1,700
	05/31/11	5 - 6	N	20,000	62,000	ND (0.26)	30,000	16,000	520	3,400	1,500
	05/31/11	9 - 10	N	20,000	40,000	ND (0.26)	31,000	16,000	420	4,000	1,700
	05/31/11	14 - 15	N	19,000	71,000	ND (0.26)	29,000	15,000	430	3,400	1,500
	05/31/11	19 - 20	N	20,000	67,000	ND (0.26)	31,000	15,000	440	3,600	1,500
	05/31/11	29 - 30	N	19,000	30,000	ND (0.25)	32,000	16,000	410	5,500	1,000
	05/31/11	39 - 40	N	16,000	34,000	ND (0.27)	26,000	13,000	320	4,500	1,100
BH-70 (Site H)	05/24/11	0 - 0.5	N	7,300	26,000	ND (0.25J)	14,000	6,400	220 J	1,500	430
	05/24/11	2 - 3	N	8,800	24,000	ND (0.25J)	17,000	7,500	240	2,100	440
	05/24/11	5 - 6	N	7,000	20,000	ND (0.25J)	14,000	6,400	200	1,500	400
	05/24/11	9 - 10	N	16,000	57,000	ND (0.26J)	27,000	12,000	400	2,700	1,800
	05/24/11	14 - 15	N	19,000	45,000	ND (0.26J)	30,000	13,000	380	2,700	1,700
	05/24/11	19 - 20	N	17,000	22,000	ND (0.26J)	32,000	13,000	410	2,600	730

TABLE C1-4

Soil Sample Results: Contract Laboratory Program Inorganics

Outside the Compressor Station

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

Notes:

1 Residential screening level - residential DTSC CHHSL. If the residential DTSC CHHSL is not established, the USEPA regional screening level is used.

2 ARCADIS. 2008. "Technical Memorandum 3: Ecological Comparison Values for Metals and Polycyclic Aromatic Hydrocarbons in Soil."

May 28. ARCADIS. 2009. "Topock Compression Station - Final Technical Memorandum 4: Ecological Comparison Values for Additional Detected Chemicals in Soil." July 1.

3 CH2M HILL. 2009. "Final Soil Background Technical Memorandum at Pacific Gas and Electric Company Topock Compressor Station, Needles, California." May.

Results greater than or equal to the interim screening level are circled.

NE = not established

USEPA = United States Environmental Protection Agency

DTSC = California Department of Toxic Substances Control

CHHSL = California human health screening levels

-- = not analyzed

FD = Field Duplicate

ft bgs = feet below ground surface

J = concentration or reporting limit estimated by laboratory or data validation

mg/kg = milligrams per kilogram

N = Primary Sample

ND = not detected at the listed reporting limit

TABLE C1-5
Soil Sample Results: Polycyclic Aromatic Hydrocarbons
Inside the Compressor Station
Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation
PG&E Topock Compressor Station, Needles, California

				Polycyclic Aromatic Hydrocarbons (µg/kg)																	
Commercial Screening Level [1] :				**99,000**	**4,100,000**	**33,000,000**	**17,000,000**	**170,000,000**	**1,300**	**130**	**1,300**	**17,000,000**	**1,300**	**13,000**	**380**	**22,000,000**	**22,000,000**	**1,300**	**18,000**	**17,000,000**	**17,000,000**	**130**
Background [2] :				**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Location	**Date**	**Depth (ft bgs)**	**Sample Type**	**1-Methyl naphthalene**	**2-Methyl naphthalene**	**Acena phthene**	**Acena phthylene**	**Anthracene**	**Benzo (a) anthracene**	**Benzo (a) pyrene**	**Benzo (b) fluoranthene**	**Benzo (ghi) perylene**	**Benzo (k) fluoranthene**	**Chrysene**	**Dibenzo (a,h) anthracene**	**Fluoranthene**	**Fluorene**	**Indeno (1,2,3-cd) pyrene**	**Naphthalene**	**Phen anthrene**	**Pyrene**	**B(a)P Equivalent**
BH-65 (Site 5)	03/24/11	0 - 0.5	N	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	5.5	6.5	ND (5.1)	ND (5.1)	ND (5.1)	5.5	ND (5.1)	ND (5.1)	ND (4.5)	ND (5.1)	5.5	4.8
	03/24/11	2 - 3	N	ND (5.2)	6.3	ND (5.2)	ND (5.2)	ND (5.2)	7.3	11	16	9.8	6.3	8.7	ND (5.2)	14	ND (5.2)	6.3	ND (4.5)	ND (5.2)	13	16
	03/17/11	9 - 10	N	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (4.5)
	03/17/11	14 - 15	N	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (4.5)
	03/17/11	19 - 20	N	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (4.8)	ND (5.1)	ND (5.1)	ND (4.5)
	03/17/11	29 - 30	N	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (4.8)	ND (5)	ND (5)	ND (4.4)
	03/17/11	37 - 40	N	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (4.3)	ND (5.3)	ND (5.3)	ND (4.6)
	03/17/11	49 - 50	N	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (4.6)
	03/17/11	59 - 60	N	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (4.5)
	03/18/11	69 - 70	N	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (4.6)
	03/18/11	79 - 80	N	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (4.6)
	03/18/11	79 - 80	FD	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (4.6)	ND (5.2)	ND (5.2)	ND (4.5)
	03/18/11	89 - 90	N	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (4.6)
	03/18/11	99 - 100	N	ND (5.2)	5.2	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (4.4)	ND (5.2)	ND (5.2)	4.5
	03/18/11	109 - 110	N	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5)	ND (5.4)	ND (5.4)	ND (4.7)
	03/18/11	119 - 120	N	ND (5.2)	5.2	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	4.5
	03/19/11	129 - 130	N	ND (5.2)	5.2	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5)	ND (5.2)	ND (5.2)	4.5
	03/19/11	139 - 140	N	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (4.6)	ND (5.4)	ND (5.4)	ND (4.7)
BH-66 (Site 6)	03/23/11	0 - 0.5	N	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (4.8)	ND (5.4)	ND (5.4)	ND (4.7)
	03/23/11	2 - 3	N	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (4.8)	ND (5.3)	ND (5.3)	ND (4.6)
	03/23/11	5 - 6	N	ND (5.6)	ND (5.6)	ND (5.6)	ND (5.6)	ND (5.6)	ND (5.6)	ND (5.6)	ND (5.6)	ND (5.6)	ND (5.6)	ND (5.6)	ND (5.6)	ND (5.6)	ND (5.6)	ND (5.6)	ND (4.5)	ND (5.6)	ND (5.6)	ND (4.9)
	04/12/11	14 - 15	N	ND (5.2)	ND (52)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (4.5)
	04/12/11	14 - 15	FD	ND (5.2)	ND (52)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (52)	ND (5.2)	ND (5.2)	ND (4.5)
	04/12/11	19 - 20	N	ND (5.1)	ND (51)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	6.5	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.6)	ND (5.1)	5.1	4.9
	04/12/11	29 - 30	N	ND (5.2)	ND (52)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.1)	ND (5.2)	ND (5.2)	ND (4.5)
	04/12/11	39 - 40	N	ND (5.2)	ND (52)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (4.7)	ND (5.2)	ND (5.2)	ND (4.5)
	04/12/11	49 - 50	N	ND (5.2)	ND (52)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (4.5)	ND (5.2)	ND (5.2)	ND (4.5)
	04/13/11	59 - 60	N	ND (5.3)	ND (53)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (4.3)	ND (5.3)	ND (5.3)	ND (4.6)
	04/13/11	69 - 70	N	ND (5.4)	ND (54)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (4.4)	ND (5.4)	ND (5.4)	ND (4.7)
	04/13/11	79 - 80	N	ND (5.2)	ND (52)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (6)	ND (5.2)	ND (5.2)	ND (4.5)
	04/13/11	89 - 90	N	ND (5.3)	ND (53)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.4)	ND (5.3)	ND (5.3)	ND (4.6)
	04/13/11	99 - 100	N	5.3	ND (53)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (6)	ND (5.3)	ND (5.3)	4.6
	04/13/11	109 - 110	N	ND (5.3)	ND (53)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.2)	ND (5.3)	ND (5.3)	ND (4.6)
	04/14/11	119 - 120	N	ND (5.2)	ND (52)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (4.9)	ND (5.2)	ND (5.2)	ND (4.5)
	04/14/11	119 - 120	FD	ND (5.2)	ND (52)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.3)	ND (5.2)	ND (5.2)	ND (4.5)
	04/14/11	129 - 130	N	ND (5.4)	ND (54)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (4.6)	ND (5.4)	ND (5.4)	ND (4.7)
BH-67 (Site 2)	03/17/11	0 - 0.5	N	ND (5.4)	12 J	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (4.6)	ND (5.4)	ND (5.4)	4.7
	03/17/11	2 - 3	N	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.1)	ND (5.3)	ND (5.3)	ND (4.6)
	03/17/11	5 - 6	N	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (4.4)

TABLE C1-5
Soil Sample Results: Polycyclic Aromatic Hydrocarbons
Inside the Compressor Station
Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation
PG&E Topock Compressor Station, Needles, California

				Polycyclic Aromatic Hydrocarbons (µg/kg)																	
Commercial Screening Level [1] :				99,000	4,100,000	33,000,000	17,000,000	170,000,000	1,300	130	1,300	17,000,000	1,300	13,000	380	22,000,000	22,000,000	1,300	18,000	17,000,000	17,000,000	130
Background [2] :				NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Location	**Date**	**Depth (ft bgs)**	**Sample Type**	**1-Methyl naphthalene**	**2-Methyl naphthalene**	**Acena phthene**	**Acena phthylene**	**Anthracene**	**Benzo (a) anthracene**	**Benzo (a) pyrene**	**Benzo (b) fluoranthene**	**Benzo (ghi) perylene**	**Benzo (k) fluoranthene**	**Chrysene**	**Dibenzo (a,h) anthracene**	**Fluoranthene**	**Fluorene**	**Indeno (1,2,3-cd) pyrene**	**Naphthalene**	**Phen anthrene**	**Pyrene**	**B(a)P Equivalent**
BH-67 (Site 2)	04/29/11	9 - 10	N	ND (5.2)	ND (52)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.3)	ND (5.2)	ND (5.2)	ND (4.5)
	04/29/11	14 - 15	N	ND (5.1)	ND (51)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.5)	ND (5.1)	ND (5.1)	ND (4.5)
	04/29/11	19 - 20	N	ND (5.1)	ND (51)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.4)	ND (5.1)	ND (5.1)	ND (4.5)
	04/29/11	29 - 30	N	ND (5.1)	ND (51)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (4.9)	ND (5.1)	ND (5.1)	ND (4.5)
	04/29/11	39 - 40	N	ND (5.1)	ND (51)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.7)	ND (5.1)	ND (5.1)	ND (4.5)
	04/29/11	39 - 40	FD	ND (5.1)	ND (51)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.9)	ND (5.1)	ND (5.1)	ND (4.5)
	04/29/11	49 - 50	N	ND (5.2)	ND (52)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5)	ND (5.2)	ND (5.2)	ND (4.5)
	04/29/11	59 - 60	N	ND (5.9)	ND (59)	ND (5.9)	ND (5.9)	ND (5.9)	ND (5.9)	ND (5.9)	ND (5.9)	ND (5.9)	ND (5.9)	ND (5.9)	ND (5.9)	ND (5.9)	ND (5.9)	ND (5.9)	ND (4.6)	ND (5.9)	ND (5.9)	ND (5.2)
	04/29/11	69 - 70	N	ND (5.2)	ND (52)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.8)	ND (5.2)	ND (5.2)	ND (4.5)
	04/29/11	79 - 80	N	ND (5.5)	ND (55)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.3)	ND (5.5)	ND (5.5)	ND (4.8)
	04/29/11	89 - 90	N	ND (5.5)	ND (55)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (4.5)	ND (5.5)	ND (5.5)	ND (4.8)
	04/29/11	99 - 100	N	ND (5.2)	ND (52)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (4.4)	ND (5.2)	ND (5.2)	ND (4.5)
	04/29/11	109 - 110	N	ND (5.2)	ND (52)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (6.5)	ND (5.2)	ND (5.2)	ND (4.5)
	04/29/11	119 - 120	N	ND (5.2)	ND (52)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (4.7)	ND (5.2)	ND (5.2)	ND (4.5)
	04/30/11	129 - 130	N	ND (5.2)	ND (52)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.7)	ND (5.2)	ND (5.2)	ND (4.5)
	04/30/11	139 - 140	N	ND (5.3)	ND (53)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (4.6)	ND (5.3)	ND (5.3)	ND (4.6)
	04/30/11	139 - 140	FD	ND (5.2)	ND (52)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.3)	ND (5.2)	ND (5.2)	ND (4.5)
	04/30/11	149 - 150	N	ND (5.2)	ND (52)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (4.4)	ND (5.2)	ND (5.2)	ND (4.5)
	04/30/11	159 - 160	N	ND (5.2)	ND (52)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (4.8)	ND (5.2)	ND (5.2)	ND (4.5)
BH-68 (Site 3)	03/17/11	0 - 0.5	N	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (4.7)
	03/17/11	0 - 0.5	FD	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (4.6)	ND (5.4)	ND (5.4)	ND (4.7)
	03/17/11	2 - 3	N	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (4.6)
	03/17/11	5 - 6	N	ND (5.8)	ND (5.8)	ND (5.8)	ND (5.8)	ND (5.8)	ND (5.8)	ND (5.8)	ND (5.8)	ND (5.8)	ND (5.8)	ND (5.8)	ND (5.8)	ND (5.8)	ND (5.8)	ND (5.8)	ND (5.8)	ND (5.8)	ND (5.8)	ND (5.1)
	05/13/11	9 - 10	N	ND (5.3)	ND (53)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (6.1)	ND (5.3)	ND (5.3)	ND (4.6)
	05/13/11	14 - 15	N	ND (5.1)	ND (51)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.6)	ND (5.1)	ND (5.1)	ND (4.5)
	05/13/11	19 - 20	N	ND (5.3)	ND (53)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5)	ND (5.3)	ND (5.3)	ND (4.6)
	05/13/11	29 - 30	N	ND (5.3)	ND (53)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.2)	ND (5.3)	ND (5.3)	ND (4.6)
	05/13/11	39 - 40	N	ND (5.3)	ND (53)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.2)	ND (5.3)	ND (5.3)	ND (4.6)
	05/13/11	49 - 50	N	ND (5.2)	ND (52)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (4.8)	ND (5.2)	ND (5.2)	ND (4.5)
	05/13/11	59 - 60	N	ND (5.3)	ND (53)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.1)	ND (5.3)	ND (5.3)	ND (4.6)
	05/13/11	69 - 70	N	ND (5.3)	ND (53)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (4.8)	ND (5.3)	ND (5.3)	ND (4.6)
	05/13/11	79 - 80	N	ND (5.3)	ND (53)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (4.8)	ND (5.3)	ND (5.3)	ND (4.6)
	05/13/11	89 - 90	N	ND (5.3)	ND (53)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.5)	ND (5.3)	ND (5.3)	ND (4.6)
	05/13/11	99 - 100	N	ND (5.5)	ND (55)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.4)	ND (5.5)	ND (5.5)	ND (4.8)
	05/13/11	99 - 100	FD	ND (5.4)	ND (54)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (4.4)	ND (5.4)	ND (5.4)	ND (4.7)
	05/13/11	109 - 110	N	ND (5.2)	ND (52)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.7)	ND (5.2)	ND (5.2)	ND (4.5)
	05/13/11	119 - 120	N	ND (5.4)	ND (54)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.4)	ND (5.2)	ND (5.4)	ND (5.4)	ND (4.7)
	05/13/11	129 - 130	N	ND (5.3)	ND (53)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.6)	ND (5.3)	ND (5.3)	ND (4.6)
	05/14/11	139 - 140	N	ND (5.3)	ND (53)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.2)	ND (5.3)	ND (5.3)	ND (4.6)

TABLE C1-5

Soil Sample Results: Polycyclic Aromatic Hydrocarbons

Inside the Compressor Station

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

				Polycyclic Aromatic Hydrocarbons (µg/kg)																	
Commercial Screening Level [1] :				**99,000**	**4,100,000**	**33,000,000**	**17,000,000**	**170,000,000**	**1,300**	**130**	**1,300**	**17,000,000**	**1,300**	**13,000**	**380**	**22,000,000**	**22,000,000**	**1,300**	**18,000**	**17,000,000**	**17,000,000**	**130**
Background [2] :				**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Location	**Date**	**Depth (ft bgs)**	**Sample Type**	**1-Methyl naphthalene**	**2-Methyl naphthalene**	**Acena phthene**	**Acena phthylene**	**Anthracene**	**Benzo (a) anthracene**	**Benzo (a) pyrene**	**Benzo (b) fluoranthene**	**Benzo (ghi) perylene**	**Benzo (k) fluoranthene**	**Chrysene**	**Dibenzo (a,h) anthracene**	**Fluoranthene**	**Fluorene**	**Indeno (1,2,3-cd) pyrene**	**Naphthalene**	**Phen anthrene**	**Pyrene**	**B(a)P Equivalent**
BH-68 (Site 3)	05/14/11	149 - 150	N	ND (5.3)	ND (53)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (4.9)	ND (5.3)	ND (5.3)	ND (4.6)
	05/14/11	159 - 160	N	ND (5.3)	ND (53)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.4)	ND (5.3)	ND (5.3)	ND (4.6)

Notes:

1 Commercial screening level - commercial DTSC CHHSL. If the commercial DTSC CHHSL is not established, the USEPA regional screening level is used.

2 CH2M HILL. 2009. "Final Soil Background Technical Memorandum at Pacific Gas and Electric Company Topock Compressor Station, Needles, California." May.

NE = not established

USEPA = United States Environmental Protection Agency

DTSC = California Department of Toxic Substances Control

CHHSL = California human health screening levels

Calculations:

BaP equivalent = Sum of Result x TEF, 1/2 reporting limit used for nondetects. If all PAHs are nondetect, the final qualifier code is U.

PAHLow = Sum of Result of low molecular weight PAHs, zero is used for nondetect values.

PAHHigh= Sum of Result of high molecular weight PAHs, zero is used for nondetect values.

-- = not analyzed

µg/kg = micrograms per kilogram

FD = Field Duplicate

ft bgs = feet below ground surface

J = concentration or reporting limit estimated by laboratory or data validation

N = Primary Sample

ND = not detected at the listed reporting limit

TABLE C1-6

Soil Sample Results: Polycyclic Aromatic Hydrocarbons

Outside the Compressor Station

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

				Polycyclic Aromatic Hydrocarbons (µg/kg)																			
Interim Screening Level :				22,000	310,000	3,400,000	1,700,000	17,000,000	380	38	380	1,700,000	380	3,800	110	2,300,000	2,300,000	380	3,600	1,700,000	1,700,000	38	1,160	10,000
Residential Screening Levels[1] :				22,000	310,000	3,400,000	1,700,000	17,000,000	380	38	380	1,700,000	380	3,800	110	2,300,000	2,300,000	380	3,600	1,700,000	1,700,000	38	NE	NE
Ecological Comparison Values[2] :				NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	1,160	10,000
Background[3] :				NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Location	**Date**	**Depth (ft bgs)**	**Sample Type**	**1-Methyl naphthalene**	**2-Methyl naphthalene**	**Acena phthene**	**Acena phthylene**	**Anthracene**	**Benzo (a) anthracene**	**Benzo (a) pyrene**	**Benzo (b) fluoranthene**	**Benzo (ghi) perylene**	**Benzo (k) fluoranthene**	**Chrysene**	**Dibenzo (a,h) anthracene**	**Fluoranthene**	**Fluorene**	**Indeno (1,2,3-cd) pyrene**	**Naphthalene**	**Phen anthrene**	**Pyrene**	**B(a)P Equivalent**	**PAH High molecular weight**	**PAH Low molecular weight**
BH-69 (Site 4)	03/18/11	0 - 0.5	N	ND (5.2)	6.3 J	ND (5.2)	ND (5.2)	ND (5.2)	12	17	29	17	10	19	ND (5.2)	350	ND (5.2)	15	ND (5.2)	9.4	28	25	500	16
	03/18/11	2 - 3	N	ND (5.6)	10 J	ND (5.6)	ND (5.6)	ND (5.6)	7.4	10	20	12	7.4	12	ND (5.6)	20	ND (5.6)	10	5.6	6.3	18	16	120	22
	05/31/11	5 - 6	N	ND (5.1)	ND (51)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.5)	ND (5.1)	ND (5.1)	ND (4.5)	ND	ND
	05/31/11	9 - 10	N	ND (5.3)	ND (53)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.4)	ND (5.3)	ND (5.3)	ND (4.6)	ND	ND
	05/31/11	14 - 15	N	ND (5.1)	ND (51)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.3)	ND (5.1)	ND (5.1)	ND (4.5)	ND	ND
	05/31/11	19 - 20	N	ND (5.1)	ND (51)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5)	ND (5.1)	ND (5.1)	ND (4.5)	ND	ND
	05/31/11	29 - 30	N	ND (5.1)	ND (51)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (6.4)	ND (5.1)	ND (5.1)	ND (4.5)	ND	ND
	05/31/11	39 - 40	N	ND (5.3)	ND (53)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (6)	ND (5.3)	ND (5.3)	ND (4.6)	ND	ND
BH-70 (Site H)	05/24/11	0 - 0.5	N	ND (5)	ND (50)	ND (5)	ND (5)	ND (5)	14	18	33	22	11	19	5.7	28	ND (5)	18	ND (5.9)	8	24	28	190	8
	05/24/11	2 - 3	N	ND (5.1)	ND (51)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.4)	ND (5.1)	ND (5.1)	ND (4.5)	ND	ND
	05/24/11	5 - 6	N	ND (5)	ND (50)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (4.8)	ND (5)	ND (5)	ND (4.4)	ND	ND
	05/24/11	9 - 10	N	ND (5.2)	ND (52)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (4.8)	ND (5.2)	ND (5.2)	ND (4.5)	ND	ND
	05/24/11	14 - 15	N	ND (5.2)	ND (52)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (4.5)	ND	ND
	05/24/11	19 - 20	N	ND (5.3)	ND (53)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.9)	ND (5.3)	ND (5.3)	ND (4.6)	ND	ND
	05/24/11	19 - 20	FD	ND (5.3)	ND (53)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.4)	ND (5.3)	ND (5.3)	ND (4.6)	ND	ND
	05/24/11	29 - 30	N	ND (5.5)	ND (55)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.6)	ND (5.5)	ND (5.5)	ND (4.8)	ND	ND
	05/24/11	39 - 40	N	ND (5.1)	ND (51)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.6)	ND (5.1)	ND (5.1)	ND (4.5)	ND	ND
	05/24/11	49 - 50	N	ND (5.3)	ND (53)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.9)	ND (5.3)	ND (5.3)	ND (4.6)	ND	ND
	05/24/11	59 - 60	N	ND (5.5)	ND (55)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.9)	ND (5.5)	ND (5.5)	ND (4.8)	ND	ND
	05/24/11	69 - 70	N	ND (5.1)	ND (51)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (4.4)	ND (5.1)	ND (5.1)	ND (4.5)	ND	ND
MW-57BR (Site B)	01/14/09	3 - 4	N	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (5.1)	ND (4.3)	ND (5.1)	ND (5.1)	ND (4.5)	ND	ND
	01/14/09	8 - 9	N	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (4.6)	ND (5.2)	ND (5.2)	ND (4.5)	ND	ND
	01/14/09	8 - 9	FD	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (4.5)	ND (5.2)	ND (5.2)	ND (4.5)	ND	ND
	01/14/09	18 - 19	N	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (4.2)	ND (5.2)	ND (5.2)	ND (4.5)	ND	ND
MW-58BR Open Borehole (Shallow) (Site A)	01/29/09	19 - 20	N	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (4.6)	ND (5.3)	ND (5.3)	ND (4.6)	ND	ND
	01/29/09	29 - 30	N	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (4.6)	ND	ND
	01/29/09	39 - 40	N	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (4.2)	ND (5.3)	ND (5.3)	ND (4.6)	ND	ND
	01/29/09	49 - 50	N	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (4.3)	ND (5.3)	ND (5.3)	ND (4.6)	ND	ND
	01/29/09	59 - 60	N	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (5.5)	ND (4.8)	ND (5.5)	ND (5.5)	ND (4.8)	ND	ND
Site-1 (Site 1)	03/23/11	0 - 0.5	N	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (4.6)	ND	ND
	03/23/11	2 - 3	N	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (4.8)	ND (5.3)	ND (5.3)	ND (4.6)	ND	ND
	03/23/11	5 - 6	N	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (5.3)	ND (4.7)	ND (5.3)	ND (5.3)	ND (4.6)	ND	ND

TABLE C1-6

Soil Sample Results: Polycyclic Aromatic Hydrocarbons

Outside the Compressor Station

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

Notes:

1 Residential screening level - residential DTSC CHHSL. If the residential DTSC CHHSL is not established, the USEPA regional screening level is used.

2 ARCADIS. 2008. "Technical Memorandum 3: Ecological Comparison Values for Metals and Polycyclic Aromatic Hydrocarbons in Soil."
May 28. ARCADIS. 2009. "Topock Compression Station - Final Technical Memorandum 4: Ecological Comparison Values for Additional Detected Chemicals in Soil." July 1.

3 CH2M HILL. 2009. "Final Soil Background Technical Memorandum at Pacific Gas and Electric Company Topock Compressor Station, Needles, California." May.

Results greater than or equal to the interim screening level are circled.

NE = not established

USEPA = United States Environmental Protection Agency

DTSC = California Department of Toxic Substances Control

CHHSL = California human health screening levels

Calculations:

BaP equivalent = Sum of Result x TEF, 1/2 reporting limit used for nondetects. If all PAHs are nondetect, the final qualifier code is U.

PAHLow = Sum of Result of low molecular weight PAHs, zero is used for nondetect values.

PAHHigh= Sum of Result of high molecular weight PAHs, zero is used for nondetect values.

-- = not analyzed

µg/kg = micrograms per kilogram

FD = Field Duplicate

ft bgs = feet below ground surface

J = concentration or reporting limit estimated by laboratory or data validation

N = Primary Sample

ND = not detected at the listed reporting limit

TABLE C1-7

Soil Sample Results: Polychlorinated Biphenyls

Inside the Compressor Station

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

				Polychlorinated biphenyls (µg/kg)								
Commercial Screening Level [1]:				**21,000**	**540**	**540**	**740**	**740**	**740**	**740**	**740**	**740**
Background [2]:				**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Location	**Date**	**Depth (ft bgs)**	**Sample Type**	**Aroclor 1016**	**Aroclor 1221**	**Aroclor 1232**	**Aroclor 1242**	**Aroclor 1248**	**Aroclor 1254**	**Aroclor 1260**	**Aroclor 1262**	**Aroclor 1268**
BH-65 (Site 5)	03/24/11	0 - 0.5	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	03/24/11	2 - 3	N	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	48	ND (17)	---	---
	03/17/11	9 - 10	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)
	03/17/11	14 - 15	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)
	03/17/11	19 - 20	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)
	03/17/11	29 - 30	N	ND (17)	ND (33)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)
	03/17/11	37 - 40	N	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)
	03/17/11	49 - 50	N	ND (18)	ND (35)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)
	03/17/11	59 - 60	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)
	03/18/11	69 - 70	N	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)
	03/18/11	79 - 80	N	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)
	03/18/11	79 - 80	FD	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)
	03/18/11	89 - 90	N	ND (18)	ND (35)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)
	03/18/11	99 - 100	N	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)
	03/18/11	109 - 110	N	ND (18)	ND (36)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)
	03/18/11	119 - 120	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)
	03/19/11	129 - 130	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)
	03/19/11	139 - 140	N	ND (18)	ND (36)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)
BH-66 (Site 6)	03/23/11	0 - 0.5	N	ND (18)	ND (35)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	---	---
	03/23/11	2 - 3	N	ND (18)	ND (35)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	---	---
	03/23/11	5 - 6	N	ND (18)	ND (37)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	---	---
	04/12/11	14 - 15	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	04/12/11	14 - 15	FD	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	04/12/11	19 - 20	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	38	ND (17)	---	---
	04/12/11	29 - 30	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	04/12/11	39 - 40	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	04/12/11	49 - 50	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	04/13/11	59 - 60	N	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	04/13/11	69 - 70	N	ND (18)	ND (36)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	---	---

TABLE C1-7

Soil Sample Results: Polychlorinated Biphenyls

Inside the Compressor Station

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

				Polychlorinated biphenyls (µg/kg)								
Commercial Screening Level [1]:				**21,000**	**540**	**540**	**740**	**740**	**740**	**740**	**740**	**740**
Background [2]:				**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Location	**Date**	**Depth (ft bgs)**	**Sample Type**	**Aroclor 1016**	**Aroclor 1221**	**Aroclor 1232**	**Aroclor 1242**	**Aroclor 1248**	**Aroclor 1254**	**Aroclor 1260**	**Aroclor 1262**	**Aroclor 1268**
BH-66 (Site 6)	04/13/11	79 - 80	N	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	04/13/11	89 - 90	N	ND (18)	ND (35)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	---	---
	04/13/11	99 - 100	N	ND (18)	ND (35)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	---	---
	04/13/11	109 - 110	N	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	04/14/11	119 - 120	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	04/14/11	119 - 120	FD	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	04/14/11	129 - 130	N	ND (18)	ND (35)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	---	---
BH-67 (Site 2)	03/17/11	0 - 0.5	N	ND (18)	ND (36)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)
	03/17/11	2 - 3	N	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)
	03/17/11	5 - 6	N	ND (17)	ND (33)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)
	04/29/11	9 - 10	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	04/29/11	14 - 15	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	04/29/11	19 - 20	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	04/29/11	29 - 30	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	04/29/11	39 - 40	N	ND (17)	ND (33)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	04/29/11	39 - 40	FD	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	04/29/11	49 - 50	N	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	04/29/11	59 - 60	N	ND (19)	ND (39)	ND (19)	ND (19)	ND (19)	ND (19)	ND (19)	---	---
	04/29/11	69 - 70	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	04/29/11	79 - 80	N	ND (18)	ND (36)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	---	---
	04/29/11	89 - 90	N	ND (18)	ND (36)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	---	---
	04/29/11	99 - 100	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	04/29/11	109 - 110	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	04/29/11	119 - 120	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	04/30/11	129 - 130	N	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	04/30/11	139 - 140	N	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	04/30/11	139 - 140	FD	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	04/30/11	149 - 150	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	04/30/11	159 - 160	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---

TABLE C1-7

Soil Sample Results: Polychlorinated Biphenyls

Inside the Compressor Station

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

				Polychlorinated biphenyls (µg/kg)								
Commercial Screening Level [1]:				**21,000**	**540**	**540**	**740**	**740**	**740**	**740**	**740**	**740**
Background [2]:				**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Location	**Date**	**Depth (ft bgs)**	**Sample Type**	**Aroclor 1016**	**Aroclor 1221**	**Aroclor 1232**	**Aroclor 1242**	**Aroclor 1248**	**Aroclor 1254**	**Aroclor 1260**	**Aroclor 1262**	**Aroclor 1268**
BH-68 (Site 3)	03/17/11	0 - 0.5	N	ND (18)	ND (36)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)
	03/17/11	0 - 0.5	FD	ND (18)	ND (36)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)
	03/17/11	2 - 3	N	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)
	03/17/11	5 - 6	N	ND (19)	ND (38)	ND (19)	ND (19)	ND (19)	ND (19)	ND (19)	ND (19)	ND (19)
	05/13/11	9 - 10	N	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	05/13/11	14 - 15	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	05/13/11	19 - 20	N	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	05/13/11	29 - 30	N	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	05/13/11	39 - 40	N	ND (18)	ND (35)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	---	---
	05/13/11	49 - 50	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	05/13/11	59 - 60	N	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	05/13/11	69 - 70	N	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	05/13/11	79 - 80	N	ND (18)	ND (35)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	---	---
	05/13/11	89 - 90	N	ND (18)	ND (35)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	---	---
	05/13/11	99 - 100	N	ND (18)	ND (36)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	---	---
	05/13/11	99 - 100	FD	ND (18)	ND (35)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	---	---
	05/13/11	109 - 110	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---
	05/13/11	119 - 120	N	ND (18)	ND (35)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	---	---
	05/13/11	129 - 130	N	ND (17)	ND (35)	ND (17)	31	ND (17)	ND (17)	ND (17)	---	---
	05/14/11	139 - 140	N	ND (18)	ND (35)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	---	---
	05/14/11	149 - 150	N	ND (17J)	ND (35J)	ND (17J)	ND (17J)	ND (17J)	ND (17J)	ND (17J)	---	---
	05/14/11	159 - 160	N	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---

TABLE C1-7
Soil Sample Results: Polychlorinated Biphenyls
Inside the Compressor Station
Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation
PG&E Topock Compressor Station, Needles, California

Notes:

1 Commercial screening level - commercial USEPA regional screening levels

2 CH2M HILL. 2009. "Final Soil Background Technical Memorandum at Pacific Gas and Electric Company Topock Compressor Station, Needles, California." May.

NE = not established

USEPA = United States Environmental Protection Agency

DTSC = California Department of Toxic Substances Control

CHHSL = California human health screening levels

-- = not analyzed

µg/kg = micrograms per kilogram

FD = Field Duplicate

ft bgs = feet below ground surface

J = concentration or reporting limit estimated by laboratory or data validation

N = Primary Sample

ND = not detected at the listed reporting limit

TABLE C1-8

Soil Sample Results: Polychlorinated Biphenyls

Outside the Compressor Station

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

				Polychlorinated biphenyls (µg/kg)									
Interim Screening Level :				**3,900**	**140**	**140**	**220**	**220**	**220**	**220**	**220**	**220**	**204**
Residential Screening Level [1] :				**3,900**	**140**	**140**	**220**	**220**	**220**	**220**	**220**	**220**	**NE**
Ecological Comparison Values [2] :				**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**204**
Background [3] :				**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Location	**Date**	**Depth (ft bgs)**	**Sample Type**	**Aroclor 1016**	**Aroclor 1221**	**Aroclor 1232**	**Aroclor 1242**	**Aroclor 1248**	**Aroclor 1254**	**Aroclor 1260**	**Aroclor 1262**	**Aroclor 1268**	**Total PCBs**
BH-69 (Site 4)	03/18/11	0 - 0.5	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	67	ND (17)	ND (17)	ND (17)	67
	03/18/11	2 - 3	N	ND (18)	ND (37)	ND (18)	ND (18)	ND (18)	51	ND (18)	ND (18)	ND (18)	51
	05/31/11	5 - 6	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND
	05/31/11	9 - 10	N	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND
	05/31/11	14 - 15	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND
	05/31/11	19 - 20	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND
	05/31/11	29 - 30	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND
	05/31/11	39 - 40	N	ND (18)	ND (35)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	ND
BH-70 (Site H)	05/24/11	0 - 0.5	N	ND (17)	ND (33)	ND (17)	ND (17)	ND (17)	26	ND (17)	ND (17)	ND (17)	26
	05/24/11	2 - 3	N	ND (17)	ND (33)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND
	05/24/11	5 - 6	N	ND (17)	ND (33)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND
	05/24/11	9 - 10	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND
	05/24/11	14 - 15	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND
	05/24/11	19 - 20	N	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND
	05/24/11	19 - 20	FD	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---	ND
	05/24/11	29 - 30	N	ND (18)	ND (36)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	---	---	ND
	05/24/11	39 - 40	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---	ND
	05/24/11	49 - 50	N	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---	ND
	05/24/11	59 - 60	N	ND (18)	ND (36)	ND (18)	ND (18)	ND (18)	ND (18)	ND (18)	---	---	ND
	05/24/11	69 - 70	N	ND (17)	ND (34)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---	ND
Site-1 (Site 1)	03/23/11	0 - 0.5	N	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---	ND
	03/23/11	2 - 3	N	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---	ND
	03/23/11	5 - 6	N	ND (17)	ND (35)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	---	---	ND

TABLE C1-8
Soil Sample Results: Polychlorinated Biphenyls
Outside the Compressor Station
Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation
PG&E Topock Compressor Station, Needles, California

Notes:

1 Residential screening level - residential USEPA regional screening levels

2 ARCADIS. 2008. "Technical Memorandum 3: Ecological Comparison Values for Metals and Polycyclic Aromatic Hydrocarbons in Soil."
May 28. ARCADIS. 2009. "Topock Compression Station - Final Technical Memorandum 4: Ecological Comparison Values for Additional Detected Chemicals in Soil." July 1.

3 CH2M HILL. 2009. "Final Soil Background Technical Memorandum at Pacific Gas and Electric Company Topock Compressor Station, Needles, California." May.

Results greater than or equal to the interim screening level are circled.

NE = not established

USEPA = United States Environmental Protection Agency

DTSC = California Department of Toxic Substances Control

CHHSL = California human health screening levels

Total PCBs by Area = Sum of Result of PCBs. Detected values are summed plus ½ the RL for nondetect Aroclors if the Aroclor is detected somewhere in the area.
If all aroclors in a particular sample are nondetect the PCB Total is 0.

-- = not analyzed

µg/kg = micrograms per kilogram

FD = Field Duplicate

ft bgs = feet below ground surface

J = concentration or reporting limit estimated by laboratory or data validation

N = Primary Sample

ND = not detected at the listed reporting limit

TABLE C1-9

Soil Sample Results: Total Petroleum Hydrocarbons and Detected Volatile Organic Compounds

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

				Total Petroleum Hydrocarbons (mg/kg)			Volatile Organic Compounds Detected (µg/kg)	
RWQCB Environmental Screening Level [1]:				**540**	**540**	**1,800**	**NE**	**NE**
Background [2]:				**NE**	**NE**	**NE**	**NE**	**NE**
Location	**Date**	**Depth (ft bgs)**	**Sample Type**	**TPH as diesel**	**TPH as gasoline**	**TPH as motor oil**	**4-Isopropyl toluene**	**Isopropyl benzene**
BH-65 (Site 5)	03/24/11	0 - 0.5	N	22	ND (0.89)	64	ND (4.5)	ND (4.5)
	03/24/11	2 - 3	N	32	ND (0.89)	83	ND (4.5)	ND (4.5)
	03/17/11	9 - 10	N	ND (10)	ND (1.3)	ND (10)	ND (6.9)	ND (6.9)
	03/17/11	14 - 15	N	ND (10)	ND (1.1)	ND (10)	ND (5.9)	ND (5.9)
	03/17/11	19 - 20	N	ND (10)	ND (1.2)	ND (10)	ND (4.8)	ND (4.8)
	03/17/11	29 - 30	N	ND (10)	ND (0.95)	ND (10)	ND (4.8)	ND (4.8)
	03/17/11	37 - 40	N	ND (11)	ND (1.3)	ND (11)	ND (4.3)	ND (4.3)
	03/17/11	49 - 50	N	ND (11)	ND (1.1)	ND (11)	ND (6)	ND (6)
	03/17/11	59 - 60	N	ND (10)	ND (1.1)	ND (10)	ND (6.2)	ND (6.2)
	03/18/11	69 - 70	N	ND (11)	ND (0.92)	ND (11)	ND (5.6)	ND (5.6)
	03/18/11	79 - 80	N	ND (11)	ND (1.2)	ND (11)	ND (5.3)	ND (5.3)
	03/18/11	79 - 80	FD	ND (10)	ND (0.99)	ND (10)	ND (4.6)	ND (4.6)
	03/18/11	89 - 90	N	ND (11)	ND (0.9)	ND (11)	ND (5.4)	ND (5.4)
	03/18/11	99 - 100	N	ND (10)	ND (0.92)	ND (10)	ND (4.4)	ND (4.4)
	03/18/11	109 - 110	N	ND (11)	ND (1)	ND (11)	ND (5)	ND (5)
	03/18/11	119 - 120	N	ND (10)	ND (0.91)	ND (10)	ND (5.4)	ND (5.4)
	03/19/11	129 - 130	N	ND (10)	ND (1)	ND (10)	ND (5)	ND (5)
	03/19/11	139 - 140	N	ND (11)	ND (0.91)	ND (11)	ND (4.6)	ND (4.6)
BH-66 (Site 6)	03/23/11	0 - 0.5	N	ND (11)	ND (0.95)	ND (11)	ND (4.8)	ND (4.8)
	03/23/11	2 - 3	N	ND (11)	ND (0.92)	28	ND (4.8)	ND (4.8)
	03/23/11	5 - 6	N	ND (11)	ND (0.85)	ND (11)	ND (4.5)	ND (4.5)
	04/12/11	14 - 15	N	30	ND (1)	53	ND (5.2)	ND (5.2)
	04/12/11	14 - 15	FD	29	ND (1.1)	53	ND (5.7)	ND (5.7)
	04/12/11	19 - 20	N	40	ND (1.3)	92	ND (5.6)	ND (5.6)
	04/12/11	29 - 30	N	ND (10)	ND (1)	ND (10)	ND (5.1)	ND (5.1)
	04/12/11	39 - 40	N	ND (10)	ND (0.85)	ND (10)	ND (4.7)	ND (4.7)
	04/12/11	49 - 50	N	ND (10)	ND (1.1)	ND (10)	ND (4.5)	ND (4.5)
	04/13/11	59 - 60	N	ND (11)	ND (0.99)	ND (11)	ND (4.3)	ND (4.3)
	04/13/11	69 - 70	N	ND (11)	ND (1)	ND (11)	ND (4.4)	ND (4.4)
	04/13/11	79 - 80	N	ND (10)	ND (0.98)	ND (10)	ND (6)	ND (6)
	04/13/11	89 - 90	N	ND (11)	ND (1)	ND (11)	ND (5.4)	ND (5.4)
	04/13/11	99 - 100	N	ND (11)	ND (0.99)	ND (11)	ND (6)	ND (6)
	04/13/11	109 - 110	N	ND (10)	ND (0.98)	ND (10)	ND (5.2)	ND (5.2)
	04/14/11	119 - 120	N	ND (10)	ND (1)	ND (10)	ND (4.9)	ND (4.9)
	04/14/11	119 - 120	FD	ND (10)	ND (0.93)	ND (10)	ND (5.3)	ND (5.3)
	04/14/11	129 - 130	N	ND (11)	ND (1.1)	ND (11)	ND (4.6)	ND (4.6)
BH-67 (Site 2)	03/17/11	0 - 0.5	N	12	ND (1)	22	ND (4.6)	ND (4.6)
	03/17/11	2 - 3	N	ND (11)	ND (1)	ND (11)	ND (5.1)	ND (5.1)
	03/17/11	5 - 6	N	ND (10)	ND (1.2)	ND (10)	ND (5.6)	ND (5.6)

TABLE C1-9

Soil Sample Results: Total Petroleum Hydrocarbons and Detected Volatile Organic Compounds

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

				Total Petroleum Hydrocarbons (mg/kg)			Volatile Organic Compounds Detected (µg/kg)	
RWQCB Environmental Screening Level [1]:				**540**	**540**	**1,800**	**NE**	**NE**
Background [2]:				**NE**	**NE**	**NE**	**NE**	**NE**
Location	**Date**	**Depth (ft bgs)**	**Sample Type**	**TPH as diesel**	**TPH as gasoline**	**TPH as motor oil**	**4-Isopropyl toluene**	**Isopropyl benzene**
BH-67 (Site 2)	04/29/11	9 - 10	N	ND (10)	ND (1.1)	ND (10)	ND (5.3)	ND (5.3)
	04/29/11	14 - 15	N	ND (10)	ND (1.1)	ND (10)	ND (5.5)	ND (5.5)
	04/29/11	19 - 20	N	ND (10)	ND (1.4)	15	ND (5.4)	ND (5.4)
	04/29/11	29 - 30	N	ND (10)	ND (1)	ND (10)	ND (4.9)	ND (4.9)
	04/29/11	39 - 40	N	ND (10)	ND (1.3)	ND (10)	ND (5.7)	ND (5.7)
	04/29/11	39 - 40	FD	ND (10)	ND (1.3)	ND (10)	ND (5.9)	ND (5.9)
	04/29/11	49 - 50	N	ND (10)	ND (1.1)	ND (10)	ND (5)	ND (5)
	04/29/11	59 - 60	N	ND (12)	ND (1.1)	ND (12)	ND (4.6)	6.3
	04/29/11	69 - 70	N	ND (10)	ND (1.2)	ND (10)	ND (5.8)	ND (5.8)
	04/29/11	79 - 80	N	ND (11)	ND (1.1)	ND (11)	ND (5.3)	ND (5.3)
	04/29/11	89 - 90	N	ND (11)	ND (0.99)	ND (11)	ND (4.5)	ND (4.5)
	04/29/11	99 - 100	N	ND (10)	ND (0.98)	ND (10)	ND (4.4)	ND (4.4)
	04/29/11	109 - 110	N	ND (10)	ND (1.1)	ND (10)	ND (6.5)	ND (6.5)
	04/29/11	119 - 120	N	ND (10)	ND (0.92)	ND (10)	ND (4.7)	ND (4.7)
	04/30/11	129 - 130	N	ND (10)	ND (0.99)	ND (10)	ND (5.7)	ND (5.7)
	04/30/11	139 - 140	N	ND (11)	ND (0.9)	ND (11)	ND (4.6)	ND (4.6)
	04/30/11	139 - 140	FD	ND (10)	ND (0.98)	ND (10)	ND (5.3)	ND (5.3)
	04/30/11	149 - 150	N	ND (10)	ND (1)	ND (10)	ND (4.4)	ND (4.4)
	04/30/11	159 - 160	N	ND (10)	ND (0.97)	ND (10)	ND (4.8)	ND (4.8)
BH-68 (Site 3)	03/17/11	0 - 0.5	N	ND (11)	ND (1)	12	ND (5.4)	ND (5.4)
	03/17/11	0 - 0.5	FD	ND (11)	ND (0.96)	ND (11)	ND (4.6)	ND (4.6)
	03/17/11	2 - 3	N	ND (11)	ND (1.1)	ND (11)	ND (5.7)	ND (5.7)
	03/17/11	5 - 6	N	ND (12)	ND (1.1)	ND (12)	ND (5.9)	ND (5.9)
	05/13/11	9 - 10	N	ND (11)	ND (1.2)	ND (11)	ND (6.1)	ND (6.1)
	05/13/11	14 - 15	N	ND (10)	ND (1.3)	ND (10)	ND (5.6)	ND (5.6)
	05/13/11	19 - 20	N	ND (11)	ND (1.1)	ND (11)	ND (5)	ND (5)
	05/13/11	29 - 30	N	ND (11)	ND (0.94)	ND (11)	ND (5.2)	ND (5.2)
	05/13/11	39 - 40	N	ND (11)	ND (1.2)	ND (11)	ND (5.2)	ND (5.2)
	05/13/11	49 - 50	N	ND (10)	ND (0.96)	ND (10)	ND (4.8)	ND (4.8)
	05/13/11	59 - 60	N	ND (11)	ND (1.1)	ND (11)	ND (5.1)	ND (5.1)
	05/13/11	69 - 70	N	ND (11)	ND (1.2)	ND (11)	ND (4.8)	ND (4.8)
	05/13/11	79 - 80	N	ND (11)	ND (0.94)	ND (11)	ND (4.8)	ND (4.8)
	05/13/11	89 - 90	N	ND (11)	ND (0.9)	ND (11)	ND (5.5)	ND (5.5)
	05/13/11	99 - 100	N	ND (11)	ND (1.1)	ND (11)	ND (5.4)	ND (5.4)
	05/13/11	99 - 100	FD	ND (11)	ND (1)	ND (11)	ND (4.4)	ND (4.4)
	05/13/11	109 - 110	N	ND (10)	ND (1)	ND (10)	ND (5.7)	ND (5.7)
	05/13/11	119 - 120	N	ND (11)	ND (1)	ND (11)	ND (5.2)	ND (5.2)
	05/13/11	129 - 130	N	ND (11)	ND (0.91)	ND (11)	ND (5.6)	ND (5.6)
	05/14/11	139 - 140	N	ND (11)	ND (1)	ND (11)	ND (5.2)	ND (5.2)

TABLE C1-9

Soil Sample Results: Total Petroleum Hydrocarbons and Detected Volatile Organic Compounds

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

				Total Petroleum Hydrocarbons (mg/kg)			Volatile Organic Compounds Detected (µg/kg)	
RWQCB Environmental Screening Level [1]:				**540**	**540**	**1,800**	**NE**	**NE**
Background [2]:				**NE**	**NE**	**NE**	**NE**	**NE**
Location	**Date**	**Depth (ft bgs)**	**Sample Type**	**TPH as diesel**	**TPH as gasoline**	**TPH as motor oil**	**4-Isopropyl toluene**	**Isopropyl benzene**
BH-68 (Site 3)	05/14/11	149 - 150	N	ND (11)	ND (0.97)	ND (11)	ND (4.9)	ND (4.9)
	05/14/11	159 - 160	N	ND (10)	ND (0.93)	ND (10)	ND (5.4)	ND (5.4)
BH-69 (Site 4)	03/18/11	0 - 0.5	N	83	ND (1)	150	ND (5.4)	ND (5.4)
	03/18/11	2 - 3	N	14	ND (1)	33	ND (5)	ND (5)
	05/31/11	5 - 6	N	ND (10)	ND (1)	ND (10)	ND (5.5)	ND (5.5)
	05/31/11	9 - 10	N	ND (10)	ND (1.1)	ND (10)	ND (5.4)	ND (5.4)
	05/31/11	14 - 15	N	ND (10)	ND (1.1)	ND (10)	ND (5.3)	ND (5.3)
	05/31/11	19 - 20	N	ND (10)	ND (0.91)	ND (10)	ND (5)	ND (5)
	05/31/11	29 - 30	N	ND (10)	ND (1)	ND (10)	ND (6.4)	ND (6.4)
	05/31/11	39 - 40	N	ND (11)	ND (0.9)	ND (11)	ND (6)	ND (6)
BH-70 (Site H)	05/24/11	0 - 0.5	N	ND (10)	ND (1.2)	17	6.5	ND (5.9)
	05/24/11	2 - 3	N	ND (10)	ND (1.1)	ND (10)	ND (5.4)	ND (5.4)
	05/24/11	5 - 6	N	ND (10)	ND (0.92)	ND (10)	ND (4.8)	ND (4.8)
	05/24/11	9 - 10	N	ND (10)	ND (0.87)	ND (10)	ND (4.8)	ND (4.8)
	05/24/11	14 - 15	N	ND (10)	ND (0.99)	ND (10)	ND (5.2)	ND (5.2)
	05/24/11	19 - 20	N	ND (11)	ND (1)	ND (11)	ND (5.9)	ND (5.9)
	05/24/11	19 - 20	FD	ND (11)	ND (0.97)	ND (11)	ND (5.4)	ND (5.4)
	05/24/11	29 - 30	N	ND (11)	ND (1)	ND (11)	ND (5.6)	ND (5.6)
	05/24/11	39 - 40	N	ND (10)	ND (1)	ND (10)	ND (5.6)	ND (5.6)
	05/24/11	49 - 50	N	ND (11)	ND (1.1)	ND (11)	ND (5.9)	ND (5.9)
	05/24/11	59 - 60	N	ND (11)	ND (0.94)	ND (11)	ND (5.9)	ND (5.9)
	05/24/11	69 - 70	N	ND (10)	ND (0.91)	ND (10)	ND (4.4)	ND (4.4)
MW-57BR (Site B)	01/14/09	3 - 4	N	ND (10)	ND (0.96)	ND (10)	ND (4.3)	ND (4.3)
	01/14/09	8 - 9	N	ND (10)	ND (0.89)	ND (10)	ND (4.6)	ND (4.6)
	01/14/09	8 - 9	FD	ND (10)	ND (0.92)	ND (10)	ND (4.5)	ND (4.5)
	01/14/09	18 - 19	N	ND (10)	ND (0.83)	ND (10)	ND (4.2)	ND (4.2)
MW-58BR Open Borehole (Shallow) (Site A)	01/29/09	19 - 20	N	ND (11)	ND (1.4)	ND (11)	ND (4.6)	ND (4.6)
	01/29/09	29 - 30	N	ND (11)	ND (0.84)	ND (11)	ND (5.9)	ND (5.9)
	01/29/09	39 - 40	N	ND (11)	ND (0.73)	ND (11)	ND (4.2)	ND (4.2)
	01/29/09	49 - 50	N	ND (11)	ND (0.96J)	ND (11)	ND (4.3)	ND (4.3)
	01/29/09	59 - 60	N	ND (11)	ND (1.1)	ND (11)	ND (4.8)	ND (4.8)
Site-1 (Site 1)	03/23/11	0 - 0.5	N	58	ND (1.2)	140	ND (5.6)	ND (5.6)
	03/23/11	2 - 3	N	ND (11)	ND (1)	ND (11)	ND (4.8)	ND (4.8)
	03/23/11	5 - 6	N	ND (11)	ND (0.96)	ND (11)	ND (4.7)	ND (4.7)

TABLE C1-9

Soil Sample Results: Total Petroleum Hydrocarbons and Detected Volatile Organic Compounds

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

Notes:

1 RWQCB. 2008. "Screening For Environmental Concerns at Sites With Contaminated Soil and Groundwater" (Table K-1). May 27.

2 CH2M HILL. 2009. "Final Soil Background Technical Memorandum at Pacific Gas and Electric Company Topock Compressor Station, Needles, California." May.

Results greater than or equal to the RWQCB screening level are bolded.

NE = not established

USEPA = United States Environmental Protection Agency

DTSC = California Department of Toxic Substances Control

RWQCB = Regional Water Quality Control Board

CHHSL = California human health screening levels

TPH = Total Petroleum Hydrocarbon

-- = not analyzed

FD = Field Duplicate

ft bgs = feet below ground surface

J = concentration or reporting limit estimated by laboratory or data validation

mg/kg = milligrams per kilogram

N = Primary Sample

ND = not detected at the listed reporting limit

TABLE C1-10
Soil Sample Results: Dioxin and Furans
Inside the Compressor Station
Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation
PG&E Topock Compressor Station, Needles, California

				Dioxin/Furans (ng/kg)																		
	Commercial Screening Level[1]:			**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**200**	**NE**	**NE**
	Background[2]:			**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Location	**Date**	**Depth (ft bgs)**	**Sample Type**	**1,2,3,4,6,7,8-HpCDD**	**1,2,3,4,6,7,8-HpCDF**	**1,2,3,4,7,8,9-HpCDF**	**1,2,3,4,7,8-HxCDD**	**1,2,3,4,7,8-HxCDF**	**1,2,3,6,7,8-HxCDD**	**1,2,3,6,7,8-HxCDF**	**1,2,3,7,8,9-HxCDD**	**1,2,3,7,8,9-HxCDF**	**2,3,4,6,7,8-HxCDF**	**OCDD**	**OCDF**	**1,2,3,7,8-PeCDD**	**1,2,3,7,8-PeCDF**	**2,3,4,7,8-PeCDF**	**2,3,7,8-TCDD**	**2,3,7,8-TCDF**	**TEQ**	**TEQ Avian**	**TEQ Mammals**
BH-65 (Site 5)	03/24/11	0 - 0.5	N	1,400	ND (110)	6.3 J	ND (3.3)	5.8 J	41	ND (3.6)	15	ND (2.4)	4.4 J	11,000	230	ND (1.6)	ND (1.5)	2.6 J	0.54 J	0.95 J	27	11	27
	03/24/11	2 - 3	N	510	ND (63)	3.2 J	ND (2.1)	3.4 J	13	ND (3)	4 J	1.4 J	2.7 J	6,800	80	ND (0.94)	ND (0.78)	1.2 J	ND (0.088)	ND (0.6)	11	5.1	11
BH-66 (Site 6)	03/23/11	0 - 0.5	N	39	ND (5.3)	ND (0.42)	0.31 J	ND (0.29)	ND (1.2)	ND (0.28)	ND (0.41)	ND (0.1)	0.4 J	530	12 J	ND (0.21)	ND (0.076)	ND (0.19)	ND (0.055)	0.19 J	0.95	0.66	0.95
BH-67 (Site 2)	03/17/11	0 - 0.5	N	0.66 J	ND (0.61)	ND (0.097)	ND (0.1)	ND (0.033)	ND (0.09)	ND (0.24)	ND (0.068)	ND (0.039)	0.11 J	ND (4.5)	ND (0.35)	ND (0.035)	ND (0.042)	ND (0.057)	ND (0.024)	ND (0.27)	0.1	0.23	0.1
	03/17/11	2 - 3	N	0.28 J	ND (0.26)	ND (0.082)	ND (0.099)	ND (0.1)	ND (0.13)	ND (0.15)	ND (0.13)	ND (0.19)	ND (0.036)	ND (0.9)	ND (0.22)	ND (0.18)	0.25 J	ND (0.16)	ND (0.15)	ND (0.33)	0.26	0.47	0.26
	03/17/11	5 - 6	N	0.27 J	ND (0.21)	ND (0.094)	0.15 J	ND (0.16)	ND (0.18)	ND (0.13)	0.16 J	ND (0.15)	ND (0.12)	ND (1)	ND (0.22)	ND (0.22)	0.33 J	0.27 J	ND (0.15)	ND (0.35)	0.37	0.72	0.37
BH-68 (Site 3)	03/17/11	0 - 0.5	N	0.68 J	ND (0.76)	ND (0.29)	0.63 J	ND (0.64)	ND (0.58)	ND (0.75)	0.59 J	ND (0.42)	0.73 J	ND (3.2)	ND (0.38)	ND (0.68)	0.72 J	0.91 J	ND (0.18)	ND (0.33)	1.1	1.8	1.1
	03/17/11	0 - 0.5	FD	0.73 J	0.82 J	ND (0.065)	ND (0.11)	ND (0.13)	ND (0.05)	0.46 J	0.16 J	ND (0.11)	0.35 J	7.4 J	ND (0.4)	ND (0.26)	ND (0.17)	0.56 J	ND (0.13)	ND (0.48)	0.52	1.1	0.52

Notes:

1 Commercial screening level - commercial DTSC CHHSL. If the commercial DTSC CHHSL is not established, the USEPA regional screening level is used.
2 CH2M HILL. 2009. "Final Soil Background Technical Memorandum at Pacific Gas and Electric Company Topock Compressor Station, Needles, California." May.
NE = not established
NA = not applicable
USEPA = United States Environmental Protection Agency
DTSC = California Department of Toxic Substances Control
CHHSL = California human health screening levels
Calculations:
Teq = Sum of Result x TEF, 1/2 reporting limit used for nondetects. If all Dioxins and Furans are nondetect, the final qualifier code is U.
TeqBird = Sum of Result x TEF, 1/2 reporting limit used for nondetects. If all Dioxins and Furans are nondetect, the final qualifier code is U.
TeqMammals = Sum of Result x TEF, 1/2 reporting limit used for nondetects. If all Dioxins and Furans are nondetect, the final qualifier code is U.
-- = not analyzed
FD = Field Duplicate
ft bgs = feet below ground surface
J = concentration or reporting limit estimated by laboratory or data validation
N = Primary Sample
ND = not detected at the listed reporting limit
ng/kg = nanograms per kilogram

TABLE C1-11

Soil Sample Results: Dioxin and Furans

Outside the Compressor Station

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

				Dioxin/Furans (ng/kg)																		
Interim Screening Level :				NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	4.6	NE	NE	4.6	NE	50	16	1.6
Residential Regional Screening Levels[1] :				NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	50	NE	NE
Ecological Comparison Values[2] :				NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	16	1.6
Background[3] :				NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NA	NE	NE
Location	**Date**	**Depth (ft bgs)**	**Sample Type**	**1,2,3,4,6,7,8-HpCDD**	**1,2,3,4,6,7,8-HpCDF**	**1,2,3,4,7,8,9-HpCDF**	**1,2,3,4,7,8-HxCDD**	**1,2,3,4,7,8-HxCDF**	**1,2,3,6,7,8-HxCDD**	**1,2,3,6,7,8-HxCDF**	**1,2,3,7,8,9-HxCDD**	**1,2,3,7,8,9-HxCDF**	**2,3,4,6,7,8-HxCDF**	**OCDD**	**OCDF**	**1,2,3,7,8-PeCDD**	**1,2,3,7,8-PeCDF**	**2,3,4,7,8-PeCDF**	**2,3,7,8-TCDD**	**2,3,7,8-TCDF**	**TEQ**	**TEQ Avian**	**TEQ Mammals**
BH-69 (Site 4)	03/18/11	0 - 0.5	N	1,900	ND (300)	12 J	16	12 J	55	ND (17)	27	2.7 J	12 J	16,000	270	6.6 J	ND (0.12)	3.8 J	ND (0.78)	2.4 J	47	26	47
	03/18/11	2 - 3	N	930	ND (140)	5.2 J	8.2 J	6.8 J	28	ND (9.4)	14	1.9 J	6.7 J	8,200	94	3.9 J	ND (0.053)	2.8 J	ND (0.34)	ND (1.4)	25	14	25
	05/31/11	5 - 6	N	1.5 J	1.3 J	ND (0.64)	ND (0.45)	ND (0.37)	ND (0.61)	ND (0.34)	ND (0.58)	0.88 J	0.59 J	ND (6.3J)	4.4 J	ND (0.16)	ND (0.36)	ND (0.11)	ND (0.13)	ND (0.59)	0.49	0.76	0.49
Site-1 (Site 1)	03/23/11	0 - 0.5	N	2.7 J	ND (1.6)	ND (0.15)	ND (0.09)	ND (0.32)	ND (0.074)	ND (0.29)	0.2 J	ND (0.12)	ND (0.46)	21 J	0.95 J	ND (0.13)	ND (0.18)	0.6 J	ND (0.044)	ND (0.49)	0.42	1	0.42

Notes:

1 Residential screening level - residential DTSC CHHSL. If the residential DTSC CHHSL is not established, the USEPA regional screening level is used.

2 ARCADIS. 2008. "Technical Memorandum 3: Ecological Comparison Values for Metals and Polycyclic Aromatic Hydrocarbons in Soil."

May 28. ARCADIS. 2009. "Topock Compression Station - Final Technical Memorandum 4: Ecological Comparison Values for Additional Detected Chemicals in Soil." July 1.

3 CH2M HILL. 2009. "Final Soil Background Technical Memorandum at Pacific Gas and Electric Company Topock Compressor Station, Needles, California." May.

Results greater than or equal to the interim screening level are circled.

NE = not established

NA = not applicable

USEPA = United States Environmental Protection Agency

DTSC = California Department of Toxic Substances Control

CHHSL = California human health screening levels

Calculations:

Teq = Sum of Result x TEF, 1/2 reporting limit used for nondetects. If all Dioxins and Furans are nondetect, the final qualifier code is U.

TeqBird = Sum of Result x TEF, 1/2 reporting limit used for nondetects. If all Dioxins and Furans are nondetect, the final qualifier code is U.

TeqMammals = Sum of Result x TEF, 1/2 reporting limit used for nondetects. If all Dioxins and Furans are nondetect, the final qualifier code is U.

-- = not analyzed

FD = Field Duplicate

ft bgs = feet below ground surface

J = concentration or reporting limit estimated by laboratory or data validation

N = Primary Sample

ND = not detected at the listed reporting limit

ng/kg = nanograms per kilogram

Attachment C-2
Groundwater Analytical Data Tables

TABLE C2-1

Groundwater Sample Results: Metals

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

Location	Date	Sample Type	Metals (µg/L)																	
	Background[1] :		**1.22**	**24.3**	**195**	**0.663**	**NE**	**NE**	**31.8**	**34.1**	**0.843**	**10.5**	**1.91**	**NE**	**36.3**	**10.6**	**10.3**	**2.13**	**0.908**	**59.9**	**77.7**
			Antimony, dissolved	**Arsenic, dissolved**	**Barium, dissolved**	**Beryllium, dissolved**	**Boron, dissolved**	**Cadmium, dissolved**	**Chromium Hexavalent**	**Chromium, dissolved**	**Cobalt, dissolved**	**Copper, dissolved**	**Lead, dissolved**	**Mercury, dissolved**	**Molybdenum, dissolved**	**Nickel, dissolved**	**Selenium, dissolved**	**Silver, dissolved**	**Thallium, dissolved**	**Vanadium, dissolved**	**Zinc, dissolved**
MW-23-060 (MW-23)	07/21/09	N	ND (10)	**25**	**200**	ND (2.5)	---	ND (3)	26	30	ND (3)	**67**	ND (10)	ND (0.2)	**50**	ND (5)	2.7	ND (3)	ND (0.5)	ND (3)	ND (75)
	09/24/09	N	---	**---**	**---**	---	---	---	30.5	25.6	---	**---**	---	---	**---**	---	---	---	---	---	---
	12/10/09	N	---	**---**	**---**	---	---	---	25.8	25.6	---	**---**	---	---	**---**	---	---	---	---	---	---
	03/08/10	N	---	**---**	**---**	---	---	---	19.7	17.2	---	**---**	---	---	**---**	---	---	---	---	---	---
	05/03/10	N	---	**---**	**---**	---	---	---	24.7	23.9	---	**---**	---	---	**---**	---	---	---	---	---	---
	09/29/10	N	---	**---**	**---**	---	---	---	29.6	31.1	---	**---**	---	---	**---**	---	---	---	---	---	---
	12/14/10	N	---	3	**---**	---	---	---	30.4	33.3	---	**---**	---	---	**---**	---	---	---	---	---	---
	02/09/11	N	---	---	**---**	---	---	---	31.5	30.8	---	**---**	---	---	**---**	---	---	---	---	---	---
	05/04/11	N	---	2.5	**---**	---	---	---	30.2	31.3	---	**---**	---	---	**---**	---	---	---	---	---	---
	09/29/11	N	---	2.1	**---**	---	---	---	26.8	29.8	---	**---**	---	---	**---**	---	---	---	---	---	---
	12/13/11	N	ND (20)	2.2	130	ND (2)	---	ND (6)	29.9	30.6	ND (6J)	ND (10)	ND (20)	ND (0.2)	12	ND (10J)	4.7	**15**	ND (2.5)	ND (6)	ND (20)
	02/14/12	N	ND (10)	3.3	130	ND (1)	---	ND (3)	30.2	32.1	ND (3)	**17**	ND (10)	ND (0.2)	9.6	ND (5)	4.5 J	**9.7**	ND (12)	6.9	14
	04/30/12	N	---	2.6	---	---	---	---	29.7	32.4	---	**---**	---	---	---	---	---	**---**	---	---	---
	04/30/12	FD	---	2.2	---	---	---	---	29.9	33.4	---	**---**	---	---	---	---	---	**---**	---	---	---
	09/12/12	N	---	5.9	---	---	---	---	**32.8**	**35.2**	---	**---**	---	---	---	---	---	**---**	---	---	---
	11/08/12	N	---	5.3	---	---	---	---	31.6	**35.5**	---	**---**	---	---	---	---	---	**---**	---	---	---
	02/18/13	N	---	5.5	---	---	---	---	**33.7**	**34.8**	---	**---**	---	---	---	---	---	**---**	---	---	---
MW-23-080 (MW-23)	07/21/09	N	ND (10)	24	170	ND (2.5)	---	ND (3)	**34**	**44**	ND (3)	**36**	ND (10)	ND (0.2)	**95**	ND (5)	0.82	ND (3)	ND (0.5)	12	ND (120)
	09/23/09	N	---	---	---	---	---	---	29.7	28.1	---	**---**	---	---	**---**	---	---	---	---	---	---
	12/10/09	N	---	---	---	---	---	---	21.8	22.4	---	**---**	---	---	**---**	---	---	---	---	---	---
	03/08/10	N	---	---	---	---	---	---	11.3	9.6	---	**---**	---	---	**---**	---	---	---	---	---	---
	05/04/10	N	---	---	---	---	---	---	21.8	20.5	---	**---**	---	---	**---**	---	---	---	---	---	---
	09/29/10	N	---	---	---	---	---	---	6	8	---	**---**	---	---	**---**	---	---	---	---	---	---
	12/14/10	N	---	2.6	---	---	---	---	12.2	12.8	---	**---**	---	---	**---**	---	---	---	---	---	---
	02/09/11	N	---	---	---	---	---	---	19.8	20.7	---	**---**	---	---	**---**	---	---	---	---	---	---
	05/04/11	N	---	3.3	---	---	---	---	14.1	13.3	---	**---**	---	---	**---**	---	---	---	---	---	---
	05/04/11	FD	---	3.4	---	---	---	---	14.4	12.5	---	**---**	---	---	**---**	---	---	---	---	---	---
	09/29/11	N	---	3.5	---	---	---	---	5.6	5.6	---	**---**	---	---	**---**	---	---	---	---	---	---
	12/12/11	N	ND (20)	3.3	67	ND (2)	---	ND (6J)	8.7	8.8	ND (6J)	ND (10)	ND (20J)	ND (0.2)	**41**	ND (10J)	4.8	**14**	ND (2.5)	19	ND (20)
	12/12/11	FD	ND (20)	3.3	69	ND (2)	---	ND (6J)	8.2	8.6	ND (6J)	ND (10)	ND (20J)	ND (0.2)	**41**	ND (10J)	5.3	**14**	ND (2.5)	19	ND (20)
	02/14/12	N	ND (10)	3.7	62	ND (1)	---	ND (3)	9.5	10.8	ND (3)	ND (5)	ND (10)	ND (0.2)	31	ND (5)	5.3	**9.1**	ND (12)	20	ND (10)
	04/30/12	N	---	4.1	---	---	---	---	6	8.2	---	---	---	---	---	---	---	**---**	---	---	---
	09/12/12	N	---	3.3	---	---	---	---	12.8	15.9	---	---	---	---	---	---	---	**---**	---	---	---
	09/12/12	FD	---	3	---	---	---	---	14.2	15.2	---	---	---	---	---	---	---	**---**	---	---	---
	11/08/12	N	---	2.7	---	---	---	---	19.2	21.6	---	---	---	---	---	---	---	**---**	---	---	---
	02/18/13	N	---	3.1	---	---	---	---	11.2	10.6	---	---	---	---	---	---	---	**---**	---	---	---
MW-57-050 (Site B)	02/17/10	N	---	---	---	---	---	---	**86**	**88**	---	---	---	---	---	---	---	**---**	---	---	---
MW-57-070 (Site B)	02/11/09	N	ND (0.5)	4.1	67	ND (3)	---	ND (3)	**660**	**720**	ND (3)	ND (5)	ND (10)	ND (0.2)	13	ND (5)	ND (10)	ND (3)	ND (0.5)	ND (3)	ND (10)
	07/21/09	N	ND (10)	5	110	ND (2.5)	---	ND (3)	**340**	**350**	ND (3)	9.7	ND (10)	ND (0.2)	22	ND (5)	4.4	ND (3)	ND (0.5)	ND (3)	ND (48)
	09/24/09	N	---	---	---	---	---	---	**132**	**139**	---	---	---	---	---	---	---	---	---	---	---
	12/10/09	N	---	---	---	---	---	---	**84.4**	**103**	---	---	---	---	---	---	---	---	---	---	---
	03/16/10	N	---	---	---	---	---	---	**542**	**449**	---	---	---	---	---	---	---	---	---	---	---
	05/05/10	N	---	---	---	---	---	---	**452**	**452**	---	---	---	---	---	---	---	---	---	---	---

TABLE C2-1

Groundwater Sample Results: Metals

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

Location	Date	Sample Type	Metals (µg/L)																	
Background[1] :			**1.22**	**24.3**	**195**	**0.663**	**NE**	**NE**	**31.8**	**34.1**	**0.843**	**10.5**	**1.91**	**NE**	**36.3**	**10.6**	**10.3**	**2.13**	**0.908**	**59.9**	**77.7**
			Antimony, dissolved	**Arsenic, dissolved**	**Barium, dissolved**	**Beryllium, dissolved**	**Boron, dissolved**	**Cadmium, dissolved**	**Chromium Hexavalent**	**Chromium, dissolved**	**Cobalt, dissolved**	**Copper, dissolved**	**Lead, dissolved**	**Mercury, dissolved**	**Molybdenum, dissolved**	**Nickel, dissolved**	**Selenium, dissolved**	**Silver, dissolved**	**Thallium, dissolved**	**Vanadium, dissolved**	**Zinc, dissolved**
MW-57-070 (Site B)	09/30/10	N	---	---	---	---	---	---	**856**	**733**	---	---	---	---	---	---	---	---	---	---	---
	12/15/10	N	---	1.4	---	---	130	---	**456 J**	**438**	---	---	---	---	3	---	2	---	---	---	---
	12/15/10	FD	---	1.5	---	---	130	---	**330 J**	**368**	---	---	---	---	3.1	---	1.9	---	---	---	---
	02/10/11	N	---	---	---	---	---	---	**507**	**612**	---	---	---	---	---	---	---	---	---	---	---
	05/05/11	N	---	---	---	---	---	---	**486**	**475**	---	---	---	---	---	---	---	---	---	---	---
	05/05/11	FD	---	---	---	---	---	---	**500**	**421**	---	---	---	---	---	---	---	---	---	---	---
	09/29/11	N	---	---	---	---	---	---	**309**	**352**	---	---	---	---	---	---	---	---	---	---	---
	12/15/11	N	ND (10)	ND (2.5)	150	ND (1)	---	ND (3)	**291**	**296**	ND (3)	ND (5)	ND (10)	ND (0.2)	ND (5)	ND (5J)	3	**5.8**	ND (2.5)	ND (3)	69
	02/15/12	N	ND (10)	1.2	130	ND (1)	---	ND (3J)	**454**	**520**	ND (3)	9.8 J	ND (10)	ND (0.2)	ND (5)	6.7	3.6	**6.5**	ND (0.5)	ND (3)	ND (10)
	05/03/12	N	---	1.6	---	---	---	---	**288**	**314**	---	---	---	---	4.4	---	2.7	**---**	---	---	---
	09/12/12	N	---	---	---	---	---	---	**609**	**614**	---	---	---	---	---	---	---	**---**	---	---	---
	12/13/12	N	---	1.4	---	---	---	---	**724**	**799**	---	---	---	---	2.2	---	3.5	**---**	---	---	---
	12/13/12	FD	---	1.4	---	---	---	---	**752**	**851**	---	---	---	---	2.3	---	3.4	**---**	---	---	---
	02/20/13	N	---	---	---	---	---	---	**272**	**338**	---	---	---	---	---	---	---	**---**	---	---	---
	02/20/13	FD	---	---	---	---	---	---	**268**	**376**	---	---	---	---	---	---	---	**---**	---	---	---
	03/11/13	N	---	---	---	---	---	---	**594**	**562**	---	---	---	---	---	---	---	**---**	---	---	---
MW-57BR (Site B)	03/01/09	N	---	---	---	---	---	---	**36**	**35**	---	---	---	---	---	---	---	**---**	---	---	---
MW-57-185 (Site B)	07/20/09	N	ND (10)	**30**	82	ND (2.5)	---	ND (3)	1.4	ND (4.9)	ND (3)	**11**	ND (10)	ND (0.2)	**99**	ND (5)	ND (2.5J)	ND (3)	ND (2.5)	ND (3)	ND (63)
	09/23/09	N	---	**---**	---	---	---	---	1.13	2.38	---	**---**	---	---	**---**	---	---	---	---	---	---
	12/09/09	N	---	**---**	---	---	---	---	2.09	2.62	---	**---**	---	---	**---**	---	---	---	---	---	---
	03/09/10	N	---	**---**	---	---	---	---	6.8	6.7	---	**---**	---	---	**---**	---	---	---	---	---	---
	05/05/10	N	---	**---**	---	---	---	---	3.9	4.7	---	**---**	---	---	**---**	---	---	---	---	---	---
	09/29/10	N	---	**---**	---	---	---	---	5.6	5.9	---	**---**	---	---	**---**	---	---	---	---	---	---
	12/09/10	N	---	11	---	---	2,500	---	3.7	2.4	---	**---**	---	---	**87**	---	0.52	---	---	---	---
	02/08/11	N	---	---	---	---	---	---	5.9	6.6	---	**---**	---	---	**---**	---	---	---	---	---	---
	05/03/11	N	---	12	---	---	---	---	6.3	7.2	---	**---**	---	---	**88**	---	3.3	---	---	---	---
	09/28/11	N	---	13	---	---	---	---	7	8.5	---	**---**	---	---	**88**	---	ND (2.5)	---	---	---	---
	12/13/11	N	ND (20)	12	55	ND (2)	---	ND (6)	7.4	7.3	ND (6J)	ND (10)	ND (20)	ND (0.2)	**78**	ND (10J)	ND (2.5)	ND (6)	ND (2.5)	ND (6)	ND (20)
	02/10/12	N	ND (10)	12	51	ND (1)	---	ND (3)	7.2	8.5	ND (3)	ND (5)	ND (10)	ND (0.2)	**69**	ND (5)	ND (2.5)	**4.4**	ND (2.5)	ND (3)	ND (10)
	02/10/12	FD	ND (10)	13	54	ND (1)	---	ND (3)	7.3	8.9	ND (3)	ND (5)	ND (10)	ND (0.2)	**72**	ND (5)	ND (2.5)	**4.5**	ND (12)	ND (3)	ND (10)
	04/30/12	N	---	14	---	---	---	---	7.1	8.6	---	---	---	---	**93**	---	ND (2.5)	**---**	---	---	---
	09/11/12	N	---	14	---	---	---	---	7.8	9.1	---	---	---	---	**86**	---	ND (2.5)	**---**	---	---	---
	11/08/12	N	---	13	---	---	---	---	9.5	10.7	---	---	---	---	**85**	---	ND (0.5)	**---**	---	---	---
	02/06/13	N	---	13	---	---	---	---	10.4	11.4	---	---	---	---	**77**	---	ND (0.5)	**---**	---	---	---
MW-58-065 (Site A)	02/17/10	N	---	---	---	---	---	---	ND (0.2)	8	---	---	---	---	**---**	---	---	**---**	---	---	---
MW-58BR Open Borehole (Shallow) (Site A)	03/05/09	N	---	**25 J**	---	---	---	---	**230**	**240**	---	---	---	---	**---**	---	---	**---**	---	---	---
	03/05/09	N	---	**---**	---	---	---	---	**200**	**200**	---	---	---	---	**---**	---	---	**---**	---	---	---
MW-58BR Open Borehole (Deeper) (Site A)	03/25/10	N	---	13	---	---	---	---	9.1	15	---	---	---	---	**---**	---	---	**---**	---	---	---
	02/28/13	N	---	1.1	---	---	---	---	ND (1)	ND (1)	---	---	---	---	**---**	---	---	**---**	---	---	---
MW-58BR Flute (Upper Zone) (Site A)	07/22/09	N	ND (10)	**110 R'**	190	ND (2.5)	---	ND (3)	ND (1)	3	ND (3)	ND (5)	ND (10)	ND (0.2J)	**62**	ND (5)	ND (0.5)	ND (3)	ND (0.5)	ND (3)	ND (40)

TABLE C2-1

Groundwater Sample Results: Metals

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

Location	Date	Sample Type	Metals (µg/L)																	
	Background[1] :		**1.22**	**24.3**	**195**	**0.663**	**NE**	**NE**	**31.8**	**34.1**	**0.843**	**10.5**	**1.91**	**NE**	**36.3**	**10.6**	**10.3**	**2.13**	**0.908**	**59.9**	**77.7**
			Antimony, dissolved	**Arsenic, dissolved**	**Barium, dissolved**	**Beryllium, dissolved**	**Boron, dissolved**	**Cadmium, dissolved**	**Chromium Hexavalent**	**Chromium, dissolved**	**Cobalt, dissolved**	**Copper, dissolved**	**Lead, dissolved**	**Mercury, dissolved**	**Molybdenum, dissolved**	**Nickel, dissolved**	**Selenium, dissolved**	**Silver, dissolved**	**Thallium, dissolved**	**Vanadium, dissolved**	**Zinc, dissolved**
MW-58BR Flute (Upper Zone) (Site A)	09/29/09	N	---	**---**	---	---	---	---	ND (1.05)	ND (1)	---	---	---	---	**---**	---	---	---	---	---	---
	12/16/09	N	---	18 J	---	---	---	---	ND (1.05)	1.4	---	---	---	---	**---**	---	---	---	---	---	---
MW-58BR Flute (Lower Zone) (Site A)	07/22/09	N	ND (10)	**340 R'**	120	ND (2.5)	---	ND (3)	ND (1)	6.3	ND (3)	6.8	ND (10)	ND (0.2J)	**51**	ND (5)	ND (0.5)	ND (3)	ND (0.5)	ND (3)	ND (23)
	09/29/09	N	---	**---**	---	---	---	---	4.69	9.7	---	---	---	---	**---**	---	---	---	---	---	---
	12/16/09	N	---	**41 J**	---	---	---	---	7.56	26.6	---	---	---	---	**---**	---	---	---	---	---	---
MW-58BR Packer (Shallow Set) Upper Zone (Site A)	09/14/10	N	---	5.9	---	---	---	---	3.8	3.5	---	---	---	---	**---**	---	---	---	---	---	---
	10/06/10	N	---	5.6	---	---	---	---	4.7	8.4	---	---	---	---	**---**	---	---	---	---	---	---
MW-58BR Packer (Shallow Set) Lower Zone (Site A)	09/16/10	N	---	3.2	---	---	---	---	**200**	**200**	---	---	---	---	**---**	---	---	---	---	---	---
	10/07/10	N	---	3.2	---	---	---	---	**199**	**173**	---	---	---	---	**---**	---	---	---	---	---	---
MW-58BR Packer (Deeper Set) Upper Zone (Site A)	02/01/11	N	---	1.9	---	---	---	---	ND (1)	ND (1)	---	---	---	---	**---**	---	---	---	---	---	---
	03/18/11	N	---	1.8	---	---	---	---	ND (5)	ND (1)	---	---	---	---	**---**	---	---	---	---	---	---
	07/06/11	N	---	1.2	---	---	---	---	ND (1)	ND (1)	---	---	---	---	**---**	---	---	---	---	---	---
	08/02/11	N	---	0.89	---	---	---	---	ND (5)	ND (0.5)	---	---	---	---	**---**	---	---	---	---	---	---
	08/30/11	N	---	1.1	---	---	---	---	ND (1)	2.3	---	---	---	---	**---**	---	---	---	---	---	---
	10/11/11	N	ND (10)	0.93	110	ND (1)	---	ND (3)	ND (1)	ND (0.5)	ND (3)	5.2	ND (10)	ND (0.2)	16	ND (5)	ND (2.5)	**6**	ND (12)	ND (3)	**92**
	11/08/11	N	ND (10)	0.79	85	ND (1)	---	ND (3)	ND (1)	3	ND (3)	ND (5)	ND (10)	ND (0.2)	14	ND (5)	2.6	**10**	ND (2.5)	ND (3)	14
	12/08/11	N	ND (10)	0.74	130	ND (1)	---	ND (3)	ND (1)	ND (0.5)	ND (3)	5.8	ND (10)	ND (0.2)	21	ND (5)	ND (2.5)	**13**	ND (12)	ND (3)	**130**
	02/08/12	N	ND (10)	ND (0.5)	98	ND (1)	---	ND (3J)	ND (1)	ND (1)	ND (3)	ND (5)	ND (10)	ND (0.2)	19	ND (5)	ND (2.5)	**7**	ND (2.5)	ND (3)	**130**
	05/15/12	N	---	---	---	---	---	---	ND (1)	1.4	---	---	---	---	---	---	---	**---**	---	---	**---**
	10/03/12	N	---	0.49	---	---	---	---	ND (1)	ND (1)	---	---	---	---	---	---	---	**---**	---	---	**---**
MW-58BR Packer (Deeper Set) Lower Zone (Site A)	02/10/11	N	---	1.6	---	---	---	---	**140**	**130**	---	---	---	---	---	---	---	**---**	---	---	**---**
	04/04/11	N	---	1.6	---	---	---	---	**100**	**110**	---	---	---	---	---	---	---	**---**	---	---	**---**
	07/07/11	N	---	1.9	---	---	---	---	**210**	**210**	---	---	---	---	---	---	---	**---**	---	---	**---**
	08/23/11	N	---	1.4	---	---	---	---	**150**	**150**	---	---	---	---	---	---	---	**---**	---	---	**---**
	08/31/11	N	---	2	---	---	---	---	**200**	**170**	---	---	---	---	---	---	---	**---**	---	---	**---**
	10/13/11	N	ND (10)	0.75	100	ND (1)	---	ND (3)	28	28	ND (3)	ND (5)	ND (10)	ND (0.2)	12	ND (5)	ND (2.5)	**7.1**	ND (2.5)	ND (3)	ND (10)
	11/09/11	N	ND (10)	1.8	77	ND (1)	---	ND (3)	**210**	**190**	ND (3)	ND (5)	ND (10)	ND (0.2)	14	ND (5)	2.8	**11**	ND (2.5)	ND (3)	11
	12/09/11	N	ND (10)	1.6	89	ND (1J)	---	ND (3)	**88**	**89**	ND (3)	5.9	ND (10)	ND (0.2)	18	ND (5J)	ND (2.5)	**12**	ND (2.5)	ND (3)	15
	02/09/12	N	ND (10)	1.6	70	ND (1)	---	ND (3)	**79**	**68**	ND (3)	ND (5)	ND (10)	ND (0.2)	17	ND (5)	1.9	**6.5**	ND (2.5)	ND (3)	14
	05/16/12	N	---	---	---	---	---	---	2.4	7.4	---	---	---	---	---	---	---	**---**	---	---	---
	10/04/12	N	---	0.71	---	---	---	---	2.3	10.2	---	---	---	---	---	---	---	**---**	---	---	---
MW-59-100 (Site G)	03/18/09	N	ND (2.5)	13	160	ND (6)	---	ND (3)	**4,300**	**4,800**	ND (6)	ND (10)	ND (10)	ND (0.2)	**38**	**13**	ND (10)	ND (6)	ND (2.5)	ND (6)	ND (20)
	07/22/09	N	ND (10)	18	72	ND (2.5)	---	ND (3)	**5,100**	**4,900**	ND (3)	ND (5)	ND (10)	ND (0.2J)	**38**	ND (5)	5.1	ND (3)	ND (0.5)	ND (3)	ND (20)
	07/22/09	FD	ND (10)	17	70	ND (2.5)	---	ND (3)	**5,100**	**4,800**	ND (3)	ND (5)	ND (10)	ND (0.2J)	**39**	ND (5)	ND (0.5)	ND (3)	ND (0.5)	ND (3)	ND (58)
	09/24/09	N	---	---	---	---	---	---	**4,630**	**5,300**	---	---	---	---	**---**	---	---	---	---	---	---
	12/11/09	N	---	---	---	---	---	---	**4,340**	**4,420**	---	---	---	---	**---**	---	---	---	---	---	---

TABLE C2-1

Groundwater Sample Results: Metals

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

Location	Date	Sample Type	Metals (µg/L)																	
	Background[1] :		**1.22**	**24.3**	**195**	**0.663**	**NE**	**NE**	**31.8**	**34.1**	**0.843**	**10.5**	**1.91**	**NE**	**36.3**	**10.6**	**10.3**	**2.13**	**0.908**	**59.9**	**77.7**
			Antimony, dissolved	**Arsenic, dissolved**	**Barium, dissolved**	**Beryllium, dissolved**	**Boron, dissolved**	**Cadmium, dissolved**	**Chromium Hexavalent**	**Chromium, dissolved**	**Cobalt, dissolved**	**Copper, dissolved**	**Lead, dissolved**	**Mercury, dissolved**	**Molybdenum, dissolved**	**Nickel, dissolved**	**Selenium, dissolved**	**Silver, dissolved**	**Thallium, dissolved**	**Vanadium, dissolved**	**Zinc, dissolved**
MW-59-100 (Site G)	03/17/10	N	---	---	---	---	---	---	**5,320**	**5,270**	---	---	---	---	**---**	---	---	---	---	---	---
	05/06/10	N	---	---	---	---	---	---	**4,940**	**4,850**	---	---	---	---	**---**	---	---	---	---	---	---
	09/30/10	N	---	---	---	---	---	---	**5,140**	**4,630**	---	---	---	---	**---**	---	---	---	---	---	---
	12/16/10	N	---	2.1	---	---	1,400	---	**5,660**	**4,830**	---	---	---	---	4.6	---	5	---	---	---	---
	02/10/11	N	---	---	---	---	---	---	**5,090**	**5,020**	---	---	---	---	---	---	---	---	---	---	---
	02/10/11	FD	---	---	---	---	---	---	**5,110**	**5,120**	---	---	---	---	---	---	---	---	---	---	---
	05/06/11	N	---	2	---	---	---	---	**5,240**	**4,520**	---	---	---	---	ND (12)	---	4.7	---	---	---	---
	10/04/11	N	---	2	---	---	---	---	**4,330**	**4,850**	---	---	---	---	ND (12)	---	5.6	---	---	---	---
	12/15/11	N	ND (10)	2	66	ND (1)	---	ND (3)	**4,600**	**4,950**	ND (3)	ND (5)	ND (10)	ND (0.2)	ND (5)	ND (5J)	5.3	**12**	ND (2.5)	ND (3)	ND (10)
	12/15/11	FD	ND (10)	1.5	66	ND (1)	---	ND (3)	**4,990**	**4,890**	ND (3)	ND (5)	ND (10)	ND (0.2)	ND (5)	ND (5J)	3.7	**12**	ND (2.5)	ND (3)	ND (10)
	02/22/12	N	ND (10)	2	67	ND (1)	---	ND (3)	**4,070**	**4,690**	ND (3)	ND (5)	ND (10)	ND (0.2)	ND (5)	ND (5)	3.8	**11**	ND (2.5)	ND (3)	ND (10)
	05/08/12	N	---	2.1	---	---	---	---	**4,610**	**4,690**	---	---	---	---	5.7	---	4.6	**---**	---	---	---
	10/02/12	N	---	2.9	---	---	---	---	**4,510**	**4,640**	---	---	---	---	4.9	---	ND (5)	**---**	---	---	---
	11/28/12	N	---	4.4	---	---	---	---	**3,980**	**3,970**	---	---	---	---	4.3	---	ND (5)	**---**	---	---	---
	02/27/13	N	---	2.6	---	---	---	---	**3,920**	**4,030**	---	---	---	---	3.8	---	ND (5)	**---**	---	---	---
MW-60-125 (Site F)	03/20/09	N	ND (2.5)	8.7	63	ND (3)	---	ND (3)	**810**	**840**	ND (3)	ND (5)	ND (10)	ND (0.2)	25	ND (5)	ND (10)	ND (3)	ND (2.5)	ND (3)	ND (10)
	07/21/09	N	ND (10)	11	45	ND (2.5)	---	ND (3)	**780**	**810**	ND (3)	6.7	ND (10)	ND (0.2)	**45**	ND (5)	4.2	ND (3)	**0.99**	ND (3)	ND (27)
	09/24/09	N	---	---	---	---	---	---	**570**	**619**	---	---	---	---	**---**	---	---	---	**---**	---	---
	12/10/09	N	---	---	---	---	---	---	**532**	**592**	---	---	---	---	**---**	---	---	---	**---**	---	---
	03/17/10	N	---	---	---	---	---	---	**657**	**592**	---	---	---	---	**---**	---	---	---	**---**	---	---
	05/06/10	N	---	---	---	---	---	---	**1,120**	**1,080**	---	---	---	---	**---**	---	---	---	**---**	---	---
	09/30/10	N	---	---	---	---	---	---	**806**	**795**	---	---	---	---	**---**	---	---	---	**---**	---	---
	12/16/10	N	---	1.4	---	---	810	---	**1,090**	**992**	---	---	---	---	17	---	5.2 J	---	**---**	---	---
	12/16/10	FD	---	1.5	---	---	820	---	**1,070**	**1,000**	---	---	---	---	18	---	5.3 J	---	**---**	---	---
	02/10/11	N	---	---	---	---	---	---	**1,160**	**1,170**	---	---	---	---	---	---	---	---	**---**	---	---
	05/05/11	N	---	1.8	---	---	---	---	**1,040**	**959**	---	---	---	---	32	---	**34**	---	**---**	---	---
	10/04/11	N	---	1.7	---	---	---	---	**715**	**760**	---	---	---	---	20	---	ND (12)	---	**---**	---	---
	12/14/11	N	ND (10)	1.5	41	ND (1)	---	ND (3)	**901**	**915**	ND (3)	ND (5)	ND (10)	ND (0.2)	15	ND (5J)	5.4	**7.2**	ND (2.5)	ND (3)	ND (10)
	02/15/12	N	ND (10)	1.2	42	ND (1)	---	ND (3)	**918**	**1,100**	ND (3)	ND (5)	ND (10)	ND (0.2)	14	ND (5)	5.5	**7.1**	ND (2.5)	ND (3)	12
	05/03/12	N	---	1.7	---	---	---	---	**882**	**936**	---	---	---	---	19	---	5.4	**---**	---	---	---
	09/20/12	N	---	1.7	---	---	---	---	**848**	**846**	---	---	---	---	18	---	5.2	**---**	---	---	---
	12/06/12	N	---	1.8	---	---	---	---	**867**	**804**	---	---	---	---	21	---	6.2	**---**	---	---	---
	02/20/13	N	---	1.6	---	---	---	---	**1,020**	**1,000**	---	---	---	---	19 J	---	6.1	**---**	---	---	---
MW-60BR-245 (Site F)	08/03/11	N	ND (2.5)	7	46	ND (2.5)	---	ND (2.5)	**61**	**53**	ND (0.5)	ND (5)	ND (5)	ND (0.2)	**62**	ND (5)	ND (2.5)	ND (2.5)	ND (2.5)	ND (1)	ND (50)
	08/09/11	N	ND (10)	6.9	45	ND (1)	---	ND (3)	**64**	**69**	ND (3)	6.1	ND (10)	ND (0.2)	**47**	ND (5)	ND (5)	**5.9**	ND (5)	ND (3)	ND (10)
	09/07/11	N	ND (10)	8.8	44	ND (1)	---	ND (3)	**77**	**71**	ND (3)	ND (5)	ND (10)	ND (0.2)	**46**	ND (5)	ND (2.5)	**5.2**	ND (12)	ND (3)	ND (10)
	10/16/11	N	ND (10)	6.9	47	ND (1)	---	ND (3)	**200**	**220**	ND (3)	5.7	ND (10)	ND (0.2)	**44**	ND (5)	ND (2.5)	**5.1**	ND (12)	ND (3)	**230**
	11/02/11	N	ND (2.5)	7.6	45	ND (12)	---	ND (2.5)	**78**	**70**	ND (2.5)	---	ND (25)	ND (0.2)	**54**	ND (5)	ND (12)	ND (12)	ND (12)	ND (5)	ND (50)
	11/03/11	N	ND (2.5)	4.8	58	ND (12)	---	ND (2.5)	**290**	**260**	ND (0.5)	ND (5)	ND (25)	ND (0.2)	**48**	ND (5)	ND (2.5)	ND (2.5)	ND (12)	1.3	**200**
	11/04/11	N	ND (10)	5.2	66	ND (1)	---	ND (3)	**130**	**130**	ND (3)	6.8	ND (10)	ND (0.2)	**43**	ND (5)	**17 J**	**8.7**	ND (12)	ND (3)	**340 J**
	11/16/11	N	ND (10)	8	100	ND (1)	---	ND (3)	**130**	**150**	ND (3)	**16**	ND (10)	ND (0.2)	**44**	ND (5)	ND (2.5)	**8.9**	ND (2.5)	6.9	**120**
	12/14/11	N	ND (20)	5.9	69	ND (2)	---	ND (6)	**260**	**240**	ND (6)	ND (10)	ND (20)	ND (0.2)	**46**	ND (10J)	ND (2.5)	ND (6J)	ND (2.5)	ND (6)	ND (20)
	02/16/12	N	ND (10)	4	62	ND (1)	---	ND (3)	**250**	**250**	ND (3)	8.6	ND (10)	ND (0.2)	**43**	ND (5)	ND (12J)	**7.2**	ND (12)	ND (3)	27

TABLE C2-1

Groundwater Sample Results: Metals

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

Location	Date	Sample Type	Metals (µg/L)																	
	Background[1] :		1.22	24.3	195	0.663	NE	NE	31.8	34.1	0.843	10.5	1.91	NE	36.3	10.6	10.3	2.13	0.908	59.9	77.7
			Antimony, dissolved	Arsenic, dissolved	Barium, dissolved	Beryllium, dissolved	Boron, dissolved	Cadmium, dissolved	Chromium Hexavalent	Chromium, dissolved	Cobalt, dissolved	Copper, dissolved	Lead, dissolved	Mercury, dissolved	Molybdenum, dissolved	Nickel, dissolved	Selenium, dissolved	Silver, dissolved	Thallium, dissolved	Vanadium, dissolved	Zinc, dissolved
MW-60BR-245 (Site F)	05/17/12	N	---	8.8	---	---	---	---	**74.2**	**77**	---	---	---	---	**56**	---	ND (2.5)	**---**	---	---	---
	09/19/12	N	---	8.1	---	---	---	---	**89.7**	**97.2**	---	---	---	---	**54**	---	ND (2.5)	**---**	---	---	---
	12/05/12	N	---	8.1	---	---	---	---	**61.4**	**59.2**	---	---	---	---	**62**	---	2.1	**---**	---	---	---
	03/14/13	N	---	7.5	---	---	---	---	**90.6**	**125**	---	---	---	---	**46**	---	1.7	**---**	---	---	---
	03/14/13	FD	---	7.1	---	---	---	---	**93.9**	**110**	---	---	---	---	**47**	---	1.8	**---**	---	---	---
MW-61-110 (Site C)	03/23/09	N	ND (5)	17	120	ND (6)	---	ND (3)	**620**	**670**	ND (6)	ND (10)	ND (10)	ND (0.2)	**38**	ND (5)	ND (10)	ND (6)	ND (5)	ND (6)	ND (20)
	07/21/09	N	ND (10)	22	110	ND (2.5)	---	ND (3)	**240**	**260**	ND (3)	10	ND (10)	ND (0.2)	**60**	ND (5)	ND (0.5)	ND (3)	ND (0.5)	ND (3)	ND (38)
	09/24/09	N	---	---	---	---	---	---	**360**	**363**	---	---	---	---	**---**	---	---	---	---	---	---
	12/10/09	N	---	---	---	---	---	---	**433**	**450**	---	---	---	---	**---**	---	---	---	---	---	---
	03/17/10	N	---	---	---	---	---	---	**484**	**406**	---	---	---	---	**---**	---	---	---	---	---	---
	05/06/10	N	---	---	---	---	---	---	**480**	**511**	---	---	---	---	**---**	---	---	---	---	---	---
	09/30/10	N	---	---	---	---	---	---	**512**	**507**	---	---	---	---	**---**	---	---	---	---	---	---
	12/15/10	N	---	3.2	---	---	1,700	---	**567**	**510**	---	---	---	---	27	---	1	---	---	---	---
	02/09/11	N	---	---	---	---	---	---	**684**	**653**	---	---	---	---	---	---	---	---	---	---	---
	05/05/11	N	---	3.4	---	---	---	---	**522**	**531**	---	---	---	---	23	---	ND (2.5)	---	---	---	---
	09/30/11	N	---	3.3	---	---	---	---	**611**	**698**	---	---	---	---	24	---	ND (2.5)	---	---	---	---
	12/14/11	N	ND (20)	3.2	93	ND (2)	---	ND (6J)	**682**	**722**	ND (6)	ND (10)	ND (20)	ND (0.2)	17	ND (10J)	ND (2.5)	**9.7**	ND (12)	ND (6)	ND (20)
	02/15/12	N	ND (10)	3.2	87	ND (1)	---	ND (3)	**634**	**680**	ND (3)	ND (5)	ND (10)	ND (0.2)	16	ND (5)	ND (2.5)	**9.4**	ND (2.5)	ND (3)	ND (10)
	05/03/12	N	---	3.2	---	---	---	---	**486**	**578**	---	---	---	---	22	---	ND (2.5)	**---**	---	---	---
	09/27/12	N	---	2	---	---	---	---	**656**	**714**	---	---	---	---	24.1	---	ND (5)	**---**	---	---	---
	09/27/12	FD	---	2.1	---	---	---	---	**661**	**738**	---	---	---	---	20.2	---	ND (5)	**---**	---	---	---
	11/27/12	N	---	3.2	---	---	---	---	**666**	**709**	---	---	---	---	21.9	---	ND (5)	**---**	---	---	---
	11/27/12	FD	---	3.1	---	---	---	---	**678**	**716**	---	---	---	---	20.9	---	ND (5)	**---**	---	---	---
	02/25/13	N	---	3.4	---	---	---	---	**637**	**682 J**	---	---	---	---	24	---	ND (5)	**---**	---	---	---
MW-62-065 (Site E)	03/27/09	N	ND (2.5)	6.1	45	ND (3)	---	ND (3)	**720**	**740**	ND (3)	ND (5)	ND (10)	ND (0.2)	23	ND (5)	ND (10)	ND (3)	ND (2.5)	ND (3)	ND (10)
	07/22/09	N	ND (10)	6.5	34	ND (2.5)	---	ND (3)	**290**	**300**	ND (3)	ND (5)	ND (10)	ND (0.2J)	28	ND (5)	2.7	ND (3)	ND (0.5)	ND (3)	ND (19)
	09/24/09	N	---	---	---	---	---	---	**236**	**251**	---	---	---	---	---	---	---	---	---	---	---
	12/10/09	N	---	---	---	---	---	---	**219**	**247**	---	---	---	---	---	---	---	---	---	---	---
	03/16/10	N	---	---	---	---	---	---	**397**	**372**	---	---	---	---	---	---	---	---	---	---	---
	05/06/10	N	---	---	---	---	---	---	**436**	**456**	---	---	---	---	---	---	---	---	---	---	---
	09/30/10	N	---	---	---	---	---	---	**500**	**462**	---	---	---	---	---	---	---	---	---	---	---
	12/15/10	N	---	0.99	---	---	680	---	**598**	**494**	---	---	---	---	13	---	3.1	---	---	---	---
	02/09/11	N	---	---	---	---	---	---	**481**	**475**	---	---	---	---	---	---	---	---	---	---	---
	05/05/11	N	---	---	---	---	---	---	**488**	**472**	---	---	---	---	---	---	---	---	---	---	---
	09/29/11	N	---	1.3	---	---	---	---	**457**	**500**	---	---	---	---	14	---	3	---	---	---	---
	12/13/11	N	ND (10)	0.98	39	ND (1)	---	ND (3)	**532**	**500**	ND (3)	5.2	ND (10)	ND (0.2)	12	ND (5J)	3.2	**4.4**	ND (0.5)	ND (3)	**100**
	02/17/12	N	ND (10)	1.5	35	ND (1)	---	ND (3)	**452**	**530**	ND (3)	ND (5)	ND (10)	ND (0.2)	11	ND (5)	3.1	**3.4**	ND (2.5)	ND (3)	12
	05/02/12	N	---	1.8	---	---	---	---	**443**	**433**	---	---	---	---	18	---	ND (2.5)	**---**	---	---	---
	09/12/12	N	---	---	---	---	---	---	**588**	**627**	---	---	---	---	---	---	---	**---**	---	---	---
	12/10/12	N	---	1.4	---	---	---	---	**505**	**543**	---	---	---	---	15	---	3.5	**---**	---	---	---
	02/19/13	N	---	---	---	---	---	---	**404**	**406**	---	---	---	---	---	---	---	**---**	---	---	---
MW-62-110 (Site E)	07/22/09	N	ND (10)	**430 R'**	69	ND (2.5)	---	ND (3)	**74**	**71**	ND (3)	ND (5)	ND (10)	ND (0.2J)	**110**	ND (5)	1.4	ND (3)	ND (0.5)	ND (3)	ND (12)
	09/29/09	N	---	**---**	---	---	---	---	4.4	31.3	---	---	---	---	**---**	---	---	---	---	---	---

TABLE C2-1

Groundwater Sample Results: Metals

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

Location	Date	Sample Type	Metals (µg/L)																	
Background[1] :			**1.22**	**24.3**	**195**	**0.663**	**NE**	**NE**	**31.8**	**34.1**	**0.843**	**10.5**	**1.91**	**NE**	**36.3**	**10.6**	**10.3**	**2.13**	**0.908**	**59.9**	**77.7**
			Antimony, dissolved	**Arsenic, dissolved**	**Barium, dissolved**	**Beryllium, dissolved**	**Boron, dissolved**	**Cadmium, dissolved**	**Chromium Hexavalent**	**Chromium, dissolved**	**Cobalt, dissolved**	**Copper, dissolved**	**Lead, dissolved**	**Mercury, dissolved**	**Molybdenum, dissolved**	**Nickel, dissolved**	**Selenium, dissolved**	**Silver, dissolved**	**Thallium, dissolved**	**Vanadium, dissolved**	**Zinc, dissolved**
MW-62-110 (Site E)	12/16/09	N	---	**32 J**	---	---	---	---	**381**	**460**	---	---	---	---	**---**	---	---	---	---	---	---
	03/11/10	N	---	10.3	---	---	---	---	**628**	**684**	---	---	---	---	**---**	---	---	---	---	---	---
	05/04/10	N	---	12	---	---	---	---	**579**	**569**	---	---	---	---	**---**	---	---	---	---	---	---
	09/29/10	N	---	19.5	---	---	---	---	**414**	**363**	---	---	---	---	**---**	---	---	---	---	---	---
	12/16/10	N	---	14	---	---	1,200	---	**390**	**378**	---	---	---	---	**57**	---	2.4	---	---	---	---
	02/09/11	N	---	14	---	---	---	---	**565**	**540**	---	---	---	---	**---**	---	---	---	---	---	---
	05/05/11	N	---	14	---	---	---	---	**569**	**531**	---	---	---	---	**60**	---	2.5	---	---	---	---
	09/29/11	N	---	11	---	---	---	---	**598**	**739**	---	---	---	---	**54**	---	3.2	---	---	---	---
	12/14/11	N	ND (10)	10	39	ND (1)	---	ND (3)	**1,140**	**1,300**	ND (3)	ND (5)	ND (10)	ND (0.2)	**44**	ND (5J)	ND (12)	ND (3)	ND (2.5)	ND (3)	ND (10)
	02/16/12	N	ND (10)	6.3	41	ND (1)	---	ND (3)	**842**	**880**	ND (3)	ND (5)	ND (10)	ND (0.2)	**44**	ND (5)	ND (12)	**3.2**	ND (12)	ND (3)	ND (10)
	05/10/12	N	---	8.8	---	---	---	---	**828**	**941**	---	---	---	---	**50**	---	3.4	**---**	---	---	---
	09/13/12	N	---	8.5	---	---	---	---	**894**	**923**	---	---	---	---	**45**	---	3.6	**---**	---	---	---
	12/11/12	N	---	12	---	---	---	---	**904**	**944**	---	---	---	---	**46**	---	3.4	**---**	---	---	---
	02/26/13	N	---	10	---	---	---	---	**1,050**	**969**	---	---	---	---	**47**	---	3	**---**	---	---	---
MW-62-190 (Site E)	07/22/09	N	ND (10)	**270 R'**	120	ND (2.5)	---	ND (3)	ND (1)	2	ND (3)	ND (5)	ND (10)	ND (0.2J)	**100**	ND (5)	ND (0.5)	ND (3)	ND (0.5)	ND (3)	ND (33)
	09/29/09	N	---	**---**	---	---	---	---	**147**	**50.3**	---	---	---	---	**---**	---	---	---	---	---	---
	12/16/09	N	---	**40 J**	---	---	---	---	ND (1.05)	1.6	---	---	---	---	**---**	---	---	---	---	---	---
	03/11/10	N	---	9.4	---	---	---	---	ND (1.05)	ND (1)	---	---	---	---	**---**	---	---	---	---	---	---
	05/04/10	N	---	9.4	---	---	---	---	ND (1)	ND (1)	---	---	---	---	**---**	---	---	---	---	---	---
	09/29/10	N	---	9.5	---	---	---	---	ND (1)	ND (1)	---	---	---	---	**---**	---	---	---	---	---	---
	12/16/10	N	---	8.1	---	---	2,300	---	ND (1)	1.3	---	---	---	---	**87**	---	0.51	---	---	---	---
	02/09/11	N	---	8	---	---	---	---	ND (1)	ND (1)	---	---	---	---	**---**	---	---	---	---	---	---
	05/05/11	N	---	6.5	---	---	---	---	ND (1)	ND (1)	---	---	---	---	**82**	---	ND (2.5)	---	---	---	---
	09/29/11	N	---	6.6	---	---	---	---	ND (1)	ND (1)	---	---	---	---	**85**	---	ND (12)	---	---	---	---
	12/14/11	N	ND (20)	6.7	63	ND (2)	---	ND (6)	ND (1)	ND (1)	ND (6)	ND (10)	ND (20)	ND (0.2)	**76**	ND (10J)	ND (2.5)	ND (6J)	ND (12)	ND (6)	ND (20)
	02/16/12	N	ND (10)	6.4	72	ND (1)	---	ND (3)	ND (1)	ND (1)	ND (3)	ND (5)	ND (10)	ND (0.2)	**63**	ND (5)	ND (12)	**5.4**	ND (12)	ND (3)	ND (10)
	05/10/12	N	---	5.4	---	---	---	---	ND (1)	ND (1)	---	---	---	---	**68**	---	ND (2.5)	**---**	---	---	---
	09/13/12	N	---	5.9	---	---	---	---	ND (1)	ND (1)	---	---	---	---	**76**	---	ND (2.5)	**---**	---	---	---
	12/11/12	N	---	5.8	---	---	---	---	ND (1)	ND (1)	---	---	---	---	**82**	---	3.3	**---**	---	---	---
	02/26/13	N	---	5.9	---	---	---	---	ND (1)	ND (1)	---	---	---	---	**81**	---	ND (2.5)	**---**	---	---	---
MW-63-065 (Site E-Alt2)	04/15/09	N	ND (0.5)	5.2	69	ND (3)	---	ND (3)	ND (0.2)	2.3	ND (3)	ND (5)	ND (10)	ND (0.2)	**41**	ND (5)	ND (10)	ND (3)	ND (0.5)	ND (3)	ND (10)
	07/20/09	N	ND (10)	6.7	35	ND (2.5)	---	ND (3)	0.54	ND (2.9)	ND (3)	5.5	ND (10)	ND (0.2)	**50**	ND (5)	ND (0.5)	ND (3)	**0.94**	ND (3)	ND (34)
	07/20/09	FD	ND (10)	6.6	35	ND (2.5)	---	ND (3)	0.54	ND (3)	ND (3)	7.8	ND (10)	ND (0.2)	**49**	ND (5)	ND (0.5)	ND (3)	**0.91**	ND (3)	ND (54)
	09/22/09	N	---	---	---	---	---	---	0.65	1.2	---	---	---	---	**---**	---	---	---	**---**	---	---
	09/22/09	FD	---	---	---	---	---	---	0.54	1.9	---	---	---	---	**---**	---	---	---	**---**	---	---
	12/09/09	N	---	---	---	---	---	---	0.63	1.1	---	---	---	---	**---**	---	---	---	**---**	---	---
	12/09/09	FD	---	---	---	---	---	---	ND (1.05)	ND (1)	---	---	---	---	**---**	---	---	---	**---**	---	---
	03/09/10	N	---	---	---	---	---	---	ND (1.05)	ND (1)	---	---	---	---	**---**	---	---	---	**---**	---	---
	03/09/10	FD	---	---	---	---	---	---	1.1	ND (1)	---	---	---	---	**---**	---	---	---	**---**	---	---
	05/03/10	N	---	---	---	---	---	---	1.4	2.1	---	---	---	---	**---**	---	---	---	**---**	---	---
	05/03/10	FD	---	---	---	---	---	---	1.4	2.4	---	---	---	---	**---**	---	---	---	**---**	---	---
	09/27/10	N	---	---	---	---	---	---	1.7	2.2	---	---	---	---	**---**	---	---	---	**---**	---	---
	09/27/10	FD	---	---	---	---	---	---	1.7	2.2	---	---	---	---	**---**	---	---	---	**---**	---	---

TABLE C2-1

Groundwater Sample Results: Metals

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

Location	Date	Sample Type	Metals (µg/L)																	
	Background[1] :		**1.22**	**24.3**	**195**	**0.663**	**NE**	**NE**	**31.8**	**34.1**	**0.843**	**10.5**	**1.91**	**NE**	**36.3**	**10.6**	**10.3**	**2.13**	**0.908**	**59.9**	**77.7**
			Antimony, dissolved	**Arsenic, dissolved**	**Barium, dissolved**	**Beryllium, dissolved**	**Boron, dissolved**	**Cadmium, dissolved**	**Chromium Hexavalent**	**Chromium, dissolved**	**Cobalt, dissolved**	**Copper, dissolved**	**Lead, dissolved**	**Mercury, dissolved**	**Molybdenum, dissolved**	**Nickel, dissolved**	**Selenium, dissolved**	**Silver, dissolved**	**Thallium, dissolved**	**Vanadium, dissolved**	**Zinc, dissolved**
MW-63-065 (Site E-Alt2)	12/06/10	N	---	1.6	---	---	730	---	1.2	ND (1)	---	---	---	---	28	---	0.88	---	**---**	---	---
	02/08/11	N	---	---	---	---	---	---	1.3	1.7	---	---	---	---	---	---	---	---	**---**	---	---
	05/03/11	N	---	1.6	---	---	---	---	1	1.7	---	---	---	---	27	---	1.8	---	**---**	---	---
	09/28/11	N	---	1.5	---	---	---	---	1.6	2.8	---	---	---	---	24	---	ND (2.5)	---	**---**	---	---
	12/12/11	N	ND (10)	1.5	40	ND (1)	---	ND (3)	1.2	2.1	ND (3)	**11**	ND (10)	ND (0.2)	21	ND (5J)	1.1	**3.3**	0.82	ND (3)	73
	02/13/12	N	ND (10)	1.2	28	ND (1)	---	ND (3)	ND (0.2)	1.4	ND (3)	5.6	ND (10)	ND (0.2)	21	5.2	0.83	ND (3)	0.71	ND (3)	28
	04/26/12	N	---	1.2	---	---	---	---	0.76	1.5	---	---	---	---	26	---	ND (2.5)	---	---	---	---
	09/10/12	N	---	1.7	---	---	---	---	1.5	2.3	---	---	---	---	20	---	1.8	---	---	---	---
	11/07/12	N	---	1.5	---	---	---	---	1.2	2	---	---	---	---	19	---	0.93	---	---	---	---
	02/06/13	N	---	1.6	---	---	---	---	1.2	1.5	---	---	---	---	22	---	0.81	---	---	---	---
MW-64BR Open Borehole (C-Alt)	12/20/10	N	---	5.3	---	---	---	---	**140**	**140**	---	---	---	---	---	---	---	---	---	---	---
	03/01/13	N	---	2.9	---	---	---	---	ND (1)	ND (1)	---	---	---	---	---	---	---	---	---	---	---
MW-64BR Flute (Upper Zone) (C-Alt)	07/22/09	N	ND (10)	**450 R'**	140	ND (2.5)	---	ND (3)	ND (1)	5.2	ND (3)	ND (5)	ND (10)	ND (0.2J)	**110**	ND (5)	ND (0.5)	ND (3)	ND (0.5)	ND (3)	ND (21)
	09/29/09	N	---	**---**	---	---	---	---	ND (1.05)	1.5	---	---	---	---	**---**	---	---	---	---	---	---
	10/12/09	N	---	**---**	---	---	---	---	ND (1.05)	ND (1)	---	---	---	---	**---**	---	---	---	---	---	---
	11/04/09	N	---	**---**	---	---	---	---	ND (1.05)	ND (1)	---	---	---	---	**---**	---	---	---	---	---	---
	12/16/09	N	---	**26 J**	---	---	---	---	ND (1.05)	1.84	---	---	---	---	**---**	---	---	---	---	---	---
	01/19/10	N	---	**---**	---	---	---	---	ND (1.05)	ND (1)	---	---	---	---	**---**	---	---	---	---	---	---
	02/10/10	N	---	**---**	---	---	---	---	ND (1.05)	ND (1)	---	---	---	---	**---**	---	---	---	---	---	---
	03/11/10	N	---	12.5	---	---	---	---	ND (1.05)	ND (1)	---	---	---	---	**---**	---	---	---	---	---	---
	05/04/10	N	---	12.9	---	---	---	---	ND (1)	ND (1)	---	---	---	---	**---**	---	---	---	---	---	---
	08/25/10	N	---	10.4	---	---	---	---	ND (1)	ND (1)	---	---	---	---	**---**	---	---	---	---	---	---
	09/29/10	N	---	8.2	---	---	---	---	ND (1)	ND (1)	---	---	---	---	**---**	---	---	---	---	---	---
	10/20/10	N	---	---	---	---	---	---	ND (0.2)	ND (1)	---	---	---	---	**---**	---	---	---	---	---	---
	11/11/10	N	---	---	---	---	---	---	ND (0.2)	ND (1)	---	---	---	---	**---**	---	---	---	---	---	---
MW-64BR Flute (Middle Zone) (C-Alt)	07/22/09	N	ND (10)	**550 R'**	140	ND (2.5)	---	ND (3)	5.7	17	ND (3)	**31**	ND (10)	ND (0.2J)	**93**	ND (5)	ND (0.5)	ND (3)	ND (0.5)	ND (3)	ND (41)
	09/29/09	N	---	**---**	---	---	---	---	ND (1.05)	2.5	---	**---**	---	---	**---**	---	---	---	---	---	---
	10/12/09	N	---	**---**	---	---	---	---	1.6	6	---	**---**	---	---	**---**	---	---	---	---	---	---
	11/04/09	N	---	**---**	---	---	---	---	1.4	5.6	---	**---**	---	---	**---**	---	---	---	---	---	---
	12/16/09	N	---	**26 J**	---	---	---	---	ND (1.05)	5.6	---	**---**	---	---	**---**	---	---	---	---	---	---
	01/19/10	N	---	**---**	---	---	---	---	ND (1.05)	3.2	---	**---**	---	---	**---**	---	---	---	---	---	---
	02/10/10	N	---	**---**	---	---	---	---	ND (1.05)	ND (1)	---	**---**	---	---	**---**	---	---	---	---	---	---
	03/11/10	N	---	8.5	---	---	---	---	ND (1.05)	ND (1)	---	**---**	---	---	**---**	---	---	---	---	---	---
	05/04/10	N	---	8.5	---	---	---	---	ND (1)	2.6	---	**---**	---	---	**---**	---	---	---	---	---	---
	08/25/10	N	---	6.3	---	---	---	---	ND (1)	3.9	---	**---**	---	---	**---**	---	---	---	---	---	---
	09/29/10	N	---	6.6	---	---	---	---	ND (1)	3.8	---	**---**	---	---	**---**	---	---	---	---	---	---
	10/20/10	N	---	---	---	---	---	---	ND (1)	3.6	---	**---**	---	---	**---**	---	---	---	---	---	---
	11/11/10	N	---	---	---	---	---	---	ND (1)	4	---	**---**	---	---	**---**	---	---	---	---	---	---
MW-64BR Flute (Lower Zone) (C-Alt)	07/22/09	N	ND (10)	**770 R'**	170	ND (2.5)	---	ND (3)	ND (1)	4.8	ND (3)	ND (5)	ND (10)	ND (0.2J)	**85**	ND (5)	ND (0.5)	ND (3)	ND (0.5)	ND (3)	ND (11)
	09/29/09	N	---	**---**	---	---	---	---	1.4	1.4	---	---	---	---	**---**	---	---	---	---	---	---

TABLE C2-1

Groundwater Sample Results: Metals

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

Location	Date	Sample Type	Metals (µg/L)																	
	Background[1] :		1.22	24.3	195	0.663	NE	NE	31.8	34.1	0.843	10.5	1.91	NE	36.3	10.6	10.3	2.13	0.908	59.9	77.7
			Antimony, dissolved	Arsenic, dissolved	Barium, dissolved	Beryllium, dissolved	Boron, dissolved	Cadmium, dissolved	Chromium Hexavalent	Chromium, dissolved	Cobalt, dissolved	Copper, dissolved	Lead, dissolved	Mercury, dissolved	Molybdenum, dissolved	Nickel, dissolved	Selenium, dissolved	Silver, dissolved	Thallium, dissolved	Vanadium, dissolved	Zinc, dissolved
MW-64BR Flute (Lower Zone) (C-Alt)	10/12/09	N	---	**---**	---	---	---	---	ND (1.05)	1.3	---	---	---	---	**---**	---	---	---	---	---	---
	11/04/09	N	---	**---**	---	---	---	---	1.9	1.2	---	---	---	---	**---**	---	---	---	---	---	---
	12/16/09	N	---	**33 J**	---	---	---	---	ND (1.05)	2.2	---	---	---	---	**---**	---	---	---	---	---	---
	01/19/10	N	---	**---**	---	---	---	---	ND (1.05)	ND (1)	---	---	---	---	**---**	---	---	---	---	---	---
	02/10/10	N	---	**---**	---	---	---	---	ND (1.05)	ND (1)	---	---	---	---	**---**	---	---	---	---	---	---
	03/11/10	N	---	2.9	---	---	---	---	ND (1.05)	ND (1)	---	---	---	---	**---**	---	---	---	---	---	---
	05/04/10	N	---	5.2	---	---	---	---	ND (1)	ND (1)	---	---	---	---	**---**	---	---	---	---	---	---
	08/25/10	N	---	3.4	---	---	---	---	ND (1)	ND (1)	---	---	---	---	**---**	---	---	---	---	---	---
	09/29/10	N	---	2.6	---	---	---	---	ND (1)	ND (1)	---	---	---	---	**---**	---	---	---	---	---	---
	10/20/10	N	---	---	---	---	---	---	ND (1)	ND (1)	---	---	---	---	**---**	---	---	---	---	---	---
	11/11/10	N	---	---	---	---	---	---	ND (1)	ND (1)	---	---	---	---	**---**	---	---	---	---	---	---
MW-64BR Packer (Upper Zone) (C-Alt)	01/26/11	N	---	2.8	---	---	---	---	**220**	**220**	---	---	---	---	**---**	---	---	---	---	---	---
	04/12/11	N	---	3.1	---	---	---	---	**130**	**140**	---	---	---	---	**---**	---	---	---	---	---	---
	07/11/11	N	---	2.2	---	---	---	---	20	23	---	---	---	---	**---**	---	---	---	---	---	---
	08/15/11	N	---	2.5	---	---	---	---	**60**	**57**	---	---	---	---	**---**	---	---	---	---	---	---
	09/12/11	N	---	2.5	---	---	---	---	**62**	**50**	---	---	---	---	**---**	---	---	---	---	---	---
	10/24/11	N	ND (10)	4.7	45	ND (1)	---	ND (3)	**51**	**50**	ND (3)	ND (5)	ND (10)	ND (0.2)	**40**	ND (5)	**11**	**6.9**	ND (2.5)	ND (3)	**550**
	11/14/11	N	ND (10)	2.7	68	ND (1)	---	ND (3)	1.4	0.98	ND (3)	ND (5)	ND (10)	ND (0.2)	**54**	ND (5)	8.1	**7.6**	ND (2.5)	ND (3)	**2,200**
	12/12/11	N	ND (10)	1.6	65	ND (1)	---	ND (3)	6.8	6.6	ND (3)	ND (5)	ND (10)	ND (0.2)	**53**	ND (5J)	7.6	**8.5**	ND (2.5)	ND (3)	**1,500**
	02/13/12	N	ND (10)	1.7	73	ND (1)	---	ND (3)	ND (1)	ND (1)	ND (3)	ND (5)	ND (10)	ND (0.2)	**49**	ND (5)	1.8	**5.7**	ND (2.5)	ND (3)	**95**
	04/16/12	N	---	---	---	---	---	---	ND (1)	2.1	---	---	---	---	**---**	---	---	**---**	---	---	**---**
	10/08/12	N	---	7.4	---	---	---	---	ND (1)	ND (1)	---	---	---	---	**---**	---	---	**---**	---	---	**---**
MW-64BR Packer (Lower Zone) (C-Alt)	02/24/11	N	---	4.5	---	---	---	---	**100**	**97**	---	---	---	---	**---**	---	---	**---**	---	---	**---**
	04/20/11	N	---	3.9	---	---	---	---	2.1	3.2	---	---	---	---	**---**	---	---	**---**	---	---	**---**
	07/21/11	N	---	3	---	---	---	---	**68**	**58**	---	---	---	---	**---**	---	---	**---**	---	---	**---**
	08/18/11	N	---	4.4	---	---	---	---	**100**	**100**	---	---	---	---	**---**	---	---	**---**	---	---	**---**
	09/15/11	N	---	3.5	---	---	---	---	**82**	**72**	---	---	---	---	**---**	---	---	**---**	---	---	**---**
	10/27/11	N	ND (2.5)	2.9	59	ND (12)	---	ND (2.5)	**74**	**64**	ND (2.5)	ND (5)	ND (25)	ND (0.2)	**64**	ND (5)	ND (2.5)	ND (2.5)	ND (12)	ND (5)	**450**
	11/17/11	N	ND (20)	3.4	62	ND (2)	---	ND (6)	**90**	**80**	ND (6)	ND (10)	ND (20)	ND (0.2)	**63**	ND (10)	ND (2.5)	**9.1**	ND (2.5)	ND (6)	**560**
	12/15/11	N	ND (20)	3.4	55	ND (2)	---	ND (6)	**87**	**79**	ND (6)	ND (10)	ND (20)	ND (0.2)	**59**	ND (10J)	ND (12)	ND (6J)	ND (12)	ND (6)	**530**
	02/16/12	N	ND (10)	3.6	62	ND (1)	---	ND (3)	**56**	**50**	ND (3)	ND (5)	ND (10)	ND (0.2)	**57**	ND (5)	ND (2.5)	**6.7**	ND (12)	ND (3)	**310**
	04/19/12	N	---	---	---	---	---	---	21.9	23.2	---	---	---	---	**---**	---	---	**---**	---	---	**---**
	10/10/12	N	---	1.7	---	---	---	---	ND (1)	1	---	---	---	---	**---**	---	---	**---**	---	---	**---**
MW-65-160 (Site 5)	05/14/11	N	ND (0.5)	2.6	**210**	ND (2.5)	---	ND (0.5)	**43**	**41**	0.84	ND (1)	ND (5)	ND (0.2)	31	ND (1)	6.2	ND (0.5)	ND (2.5)	1.2	ND (10)
	06/13/11	N	ND (10)	1.2	140	ND (1)	---	ND (3)	13	17	ND (3)	ND (5)	ND (10)	ND (0.2)	**42**	ND (5)	2.5	ND (3)	ND (0.5)	ND (3)	ND (10)
	07/11/11	N	ND (10)	0.97	120	ND (1)	---	ND (3)	14	18	ND (3)	ND (5)	ND (10)	ND (0.2)	**72**	ND (5)	2.1	ND (3)	ND (0.5)	ND (3)	ND (10)
	08/09/11	N	ND (10)	0.98	110	ND (1)	---	ND (3)	24	28	ND (3)	5.8	ND (10)	ND (0.2)	**38**	ND (5)	2.6	**3.5**	ND (0.5)	ND (3)	ND (10)
	08/09/11	FD	ND (10)	0.98	110	ND (1)	---	ND (3)	23	28	ND (3)	6.2	ND (10)	ND (0.2)	**38**	ND (5)	2.6	**3.7**	ND (0.5)	ND (3)	ND (10)
	09/07/11	N	ND (10)	0.82	100	ND (1)	---	ND (3)	30	31	ND (3)	ND (5)	ND (10)	ND (0.2)	**38**	ND (5)	3.5	**3.4**	ND (2.5)	ND (3)	ND (10)
	10/17/11	N	ND (10)	0.78	91	ND (1)	---	ND (3)	18	21	ND (3)	5	ND (10)	ND (0.2)	**37**	ND (5)	5	ND (3)	ND (0.5)	ND (3)	ND (10)
	11/15/11	N	ND (10)	0.9	92	ND (1)	---	ND (3)	**64**	**67**	ND (3)	5.3	ND (10)	ND (0.2)	29	ND (5)	5.2	**5**	ND (0.5)	ND (3)	ND (10)

TABLE C2-1

Groundwater Sample Results: Metals

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

Location	Date	Sample Type	Metals (µg/L)																	
	Background[1] :		**1.22**	**24.3**	**195**	**0.663**	**NE**	**NE**	**31.8**	**34.1**	**0.843**	**10.5**	**1.91**	**NE**	**36.3**	**10.6**	**10.3**	**2.13**	**0.908**	**59.9**	**77.7**
			Antimony, dissolved	**Arsenic, dissolved**	**Barium, dissolved**	**Beryllium, dissolved**	**Boron, dissolved**	**Cadmium, dissolved**	**Chromium Hexavalent**	**Chromium, dissolved**	**Cobalt, dissolved**	**Copper, dissolved**	**Lead, dissolved**	**Mercury, dissolved**	**Molybdenum, dissolved**	**Nickel, dissolved**	**Selenium, dissolved**	**Silver, dissolved**	**Thallium, dissolved**	**Vanadium, dissolved**	**Zinc, dissolved**
MW-65-160 (Site 5)	12/15/11	N	ND (10)	0.91	91	ND (1)	---	ND (3)	**45**	**48**	ND (3)	5.4	ND (10)	ND (0.2)	31	ND (5J)	5.7	**3.6**	ND (2.5)	ND (3)	ND (10)
	02/16/12	N	ND (10)	0.82	82	ND (1)	---	ND (3)	**32**	**35**	ND (3)	ND (5)	ND (10)	ND (0.2)	28	ND (5)	6.2	**4.4**	ND (2.5)	ND (3)	ND (10)
	05/01/12	N	---	0.96	---	---	---	---	**51**	**54.6**	---	---	---	---	31	---	7.1	**---**	---	---	---
	09/18/12	N	---	0.9	---	---	---	---	**75.7**	**79.6**	---	---	---	---	29	---	6.4	**---**	---	---	---
	12/04/12	N	---	0.88	---	---	---	---	**78.5**	**85.1**	---	---	---	---	29	---	8.5	**---**	---	---	---
	02/19/13	N	---	0.83	---	---	---	---	**78.8**	**77.1**	---	---	---	---	28	---	7.7	**---**	---	---	---
MW-65-225 (Site 5)	05/14/11	N	ND (2.5)	1.7	71	ND (2.5)	---	ND (2.5)	**130**	**110**	ND (0.5)	1.3	ND (25)	ND (0.2)	**38**	ND (1)	2.7	ND (2.5)	ND (12)	2.3	14
	06/13/11	N	ND (10)	1.8	77	ND (1)	---	ND (3)	**120**	**120**	ND (3)	ND (5)	ND (10)	ND (0.2)	**37**	ND (5)	1.9	ND (3)	**5.3**	ND (3)	ND (10)
	07/11/11	N	ND (10)	1.7	65	ND (1)	---	ND (3)	**210**	**210**	ND (3)	ND (5)	ND (10)	ND (0.2)	**65**	ND (5)	2.6	ND (3)	**4.2**	3.4	ND (10)
	08/09/11	N	ND (10)	1.8	62	ND (1)	---	ND (3)	**230**	**210**	ND (3)	ND (5)	ND (10)	ND (0.2)	32	ND (5)	ND (5)	**6.7**	ND (5)	ND (3)	13
	09/07/11	N	ND (10)	2	58	ND (1)	---	ND (3)	**250**	**250**	ND (3)	ND (5)	ND (10)	ND (0.2)	32	ND (5)	3.3	**5.7**	**4.6**	ND (3)	ND (10)
	10/17/11	N	ND (10)	2.1	56	ND (1)	---	ND (3)	**250**	**250**	ND (3)	5.2	ND (10)	ND (0.2)	35	ND (5)	4.1	**4.9**	**4.6**	3.3	ND (10)
	11/15/11	N	ND (10)	2	53	ND (1)	---	ND (3)	**310**	**300**	ND (3)	ND (5)	ND (10)	ND (0.2)	31	ND (5)	4.1	**7.2**	ND (12)	3.4	ND (10)
	11/15/11	FD	ND (10)	2	53	ND (1)	---	ND (3)	**310**	**320**	ND (3)	ND (5)	ND (10)	ND (0.2)	31	ND (5)	3.9	**7.4**	**4.3**	3.5	ND (10)
	12/15/11	N	ND (10)	1.8	51	ND (1)	---	ND (3)	**350**	**320**	ND (3)	ND (5)	ND (10)	ND (0.2)	32	ND (5J)	ND (12)	**5.8**	**3.8**	3.1	ND (10)
	02/16/12	N	ND (10)	2	52	ND (1)	---	ND (3)	**360**	**370**	ND (3)	ND (5)	ND (10)	ND (0.2)	31	ND (5)	5.1	**6.5**	**3.9**	4.1	ND (10)
	05/02/12	N	---	2.2	---	---	---	---	**365**	**387**	---	---	---	---	**38**	---	4.1	**---**	**---**	---	---
	09/18/12	N	---	2.3	---	---	---	---	**528**	**570**	---	---	---	---	34	---	5.8	**---**	**---**	---	---
	12/05/12	N	---	2.3	---	---	---	---	**634**	**637**	---	---	---	---	**38**	---	8.1	**---**	**---**	---	---
	02/19/13	N	---	2.4	---	---	---	---	**630**	**627**	---	---	---	---	33	---	7.2	**---**	**---**	---	---
MW-66-165 (Site 6)	05/12/11	N	ND (0.5)	1.6	85	ND (2.5)	---	ND (0.5)	**480**	**440**	ND (0.5)	ND (1)	ND (25)	ND (0.2)	14	ND (1)	**36**	ND (2.5)	ND (12)	4.2	ND (10)
	06/13/11	N	ND (10)	1.4	64	ND (1)	---	ND (3)	**560**	**570**	ND (3)	ND (5)	ND (10)	ND (0.2)	8.7	ND (5)	**40**	ND (3)	ND (0.5)	5.3	ND (10)
	07/12/11	N	ND (10)	1.3	62	ND (1)	---	ND (3)	**560**	**560**	ND (3)	ND (5)	ND (10)	ND (0.2)	**39**	ND (5)	**37**	ND (3)	ND (2.5)	5.4	ND (10)
	07/12/11	FD	ND (10)	1.2	63	ND (1)	---	ND (3)	**550**	**570**	ND (3)	ND (5)	ND (10)	ND (0.2)	**39**	ND (5)	**37**	ND (3)	ND (2.5)	5.4	ND (10)
	08/09/11	N	ND (10)	1.2	61	ND (1)	---	ND (3)	**560**	**520**	ND (3)	6.4	ND (10)	ND (0.2)	9.7	ND (5)	**37**	**3.7**	ND (5)	3.2	ND (10)
	10/18/11	N	ND (10)	1.2	65	ND (1)	---	ND (3)	**440**	**480**	ND (3)	5.4	ND (10)	ND (0.2)	10	ND (5)	**33**	**5**	ND (0.5)	3.7	ND (10)
	11/15/11	N	ND (10)	1.2	63	ND (1)	---	ND (3)	**500**	**520**	ND (3)	5.8	ND (10)	ND (0.2)	8.2	ND (5)	**35**	**5.5**	ND (2.5)	3.6	ND (10)
	12/15/11	N	ND (10)	0.97	65	ND (1)	---	ND (3)	**490**	**470**	ND (3)	5.1	ND (10)	ND (0.2)	8.3	ND (5J)	**37**	**3.6**	ND (2.5)	ND (3)	ND (10)
	02/17/12	N	ND (10)	1.3	59	ND (1)	---	ND (3)	**570**	**570**	ND (3)	ND (5)	ND (10)	ND (0.2)	6	ND (5)	**40**	**4.4**	ND (2.5)	4.1	ND (10)
	05/02/12	N	---	1.3	---	---	---	---	**651**	**682**	---	---	---	---	7.4	---	**43**	**---**	---	---	---
	09/17/12	N	---	1.8	---	---	---	---	**653**	**665**	---	---	---	---	6.4	---	**36**	**---**	---	---	---
	12/06/12	N	---	1.3	---	---	---	---	**622**	**583**	---	---	---	---	7.1	---	**37**	**---**	---	---	---
	02/20/13	N	---	1.3	---	---	---	---	**636**	**613**	---	---	---	---	6.7	---	**39**	**---**	---	---	---
MW-66-230 (Site 6)	05/12/11	N	ND (2.5)	4.7	75	ND (2.5)	---	ND (2.5)	**4,600 J**	**4,200**	ND (0.5)	ND (5)	ND (25)	ND (0.2)	**57**	ND (5)	4.9	ND (2.5)	ND (12)	1.2	72
	06/14/11	N	ND (10)	4.6	67	ND (1)	---	ND (3)	**5,100**	**4,700**	ND (3)	ND (5)	ND (10)	ND (0.2)	**43**	ND (5)	4.8	ND (3)	ND (2.5)	ND (3)	ND (10)
	07/12/11	N	**15**	4	64	ND (1)	---	ND (3)	**5,000**	**4,900**	ND (3)	ND (5)	ND (10)	ND (0.2)	**70**	ND (5)	6.3	ND (3)	ND (2.5)	ND (3)	ND (10)
	08/10/11	N	ND (10)	4	57	ND (1)	---	ND (3)	**5,100**	**4,400**	ND (3)	ND (5)	ND (10)	ND (0.2)	**47**	ND (5)	7.1	**5.7**	ND (2.5)	ND (3)	ND (10)
	10/19/11	N	ND (10)	4.5	57	ND (1)	---	ND (3)	**4,400**	**4,700**	ND (3)	ND (5)	ND (10)	ND (0.2)	**69**	ND (5)	7.3	**7**	ND (12)	ND (3)	ND (10)
	11/17/11	N	ND (10)	4.4	53	ND (1)	---	ND (3)	**4,900**	**4,700**	ND (3)	6.3	ND (10)	ND (0.2)	**69**	ND (5)	7.3	**7.4**	ND (12)	ND (3)	ND (10)
	12/15/11	N	ND (20)	3.7	51	ND (2)	---	ND (6)	**5,400**	**5,300**	ND (6)	ND (10)	ND (20)	ND (0.2)	**75**	ND (10J)	ND (12)	ND (6J)	ND (12)	ND (6)	ND (20)
	02/22/12	N	ND (10)	4.1	55	ND (1)	---	ND (3)	**5,800**	**5,600**	ND (3)	ND (5)	ND (10)	ND (0.2)	**77**	ND (5)	6.5	**7.8**	ND (2.5)	ND (3)	ND (10)
	05/10/12	N	---	4.8	---	---	---	---	**5,880**	**5,900**	---	---	---	---	**82**	---	9.6	**---**	---	---	---
	05/10/12	FD	---	5.4	---	---	---	---	**5,560**	**5,720**	---	---	---	---	**86**	---	9.9	**---**	---	---	---

TABLE C2-1

Groundwater Sample Results: Metals

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			Metals (µg/L)																	
	Background[1] :		1.22	24.3	195	0.663	NE	NE	31.8	34.1	0.843	10.5	1.91	NE	36.3	10.6	10.3	2.13	0.908	59.9	77.7
Location	Date	Sample Type	Antimony, dissolved	Arsenic, dissolved	Barium, dissolved	Beryllium, dissolved	Boron, dissolved	Cadmium, dissolved	Chromium Hexavalent	Chromium, dissolved	Cobalt, dissolved	Copper, dissolved	Lead, dissolved	Mercury, dissolved	Molybdenum, dissolved	Nickel, dissolved	Selenium, dissolved	Silver, dissolved	Thallium, dissolved	Vanadium, dissolved	Zinc, dissolved
MW-66-230 (Site 6)	09/17/12	N	---	6.9	---	---	---	---	**6,200**	**6,040**	---	---	---	---	**79**	---	10	**---**	---	---	---
	12/10/12	N	---	6.3	---	---	---	---	**6,190**	**5,910**	---	---	---	---	**84**	---	**12**	**---**	---	---	---
	02/21/13	N	---	6.6	---	---	---	---	**6,510**	**6,400**	---	---	---	---	**87**	---	**11**	**---**	---	---	---
MW-66BR-270 (Site 6)	11/03/11	N	ND (2.5)	ND (0.5)	**200**	ND (12)	---	ND (2.5)	ND (5)	ND (1)	ND (2.5)	ND (5)	ND (25)	ND (0.2)	**55**	ND (5)	ND (2.5)	ND (2.5)	ND (12)	ND (5)	ND (50)
	11/17/11	N	ND (10)	ND (2.5)	190	ND (1)	---	ND (3)	ND (1)	ND (0.5)	ND (3)	ND (5)	ND (10)	ND (0.2)	**40**	ND (5)	ND (2.5)	**5**	ND (2.5)	ND (3)	ND (10)
	01/16/12	N	ND (10)	0.32	**210**	ND (1)	---	ND (3)	ND (1)	ND (0.5)	ND (3)	ND (5)	ND (10)	ND (0.2)	**39**	ND (5J)	ND (0.5)	**3.9**	ND (2.5)	ND (3)	ND (10)
	03/07/12	N	ND (10)	ND (0.5)	**290**	ND (1)	---	ND (3)	ND (1)	ND (1)	ND (3)	ND (5)	ND (10)	ND (0.2)	19	ND (5)	ND (12)	**5.3**	ND (12)	ND (3)	ND (10)
	05/24/12	N	---	ND (0.5)	**---**	---	---	---	ND (1)	1.1	---	---	---	---	27	---	ND (2.5)	**---**	---	---	---
	10/02/12	N	---	0.32	**---**	---	---	---	ND (1)	ND (1)	---	---	---	---	28	---	7.5	**---**	---	---	---
	12/20/12	N	---	0.24	**---**	---	---	---	ND (1)	ND (1)	---	---	---	---	36	---	0.85	**---**	---	---	---
	03/12/13	N	---	0.32	**---**	---	---	---	ND (1)	ND (1)	---	---	---	---	21	---	ND (0.5)	**---**	---	---	---
MW-67-185 (Site 2)	09/24/11	N	ND (10)	1.9	55	ND (1)	---	ND (3)	**910**	**1,000**	ND (3)	**11**	ND (10)	ND (0.2)	17	ND (5)	**33**	ND (3)	ND (2.5)	ND (3)	12
	10/18/11	N	ND (10)	2.3	52	ND (1)	---	ND (3)	**1,100**	**1,300**	ND (3)	ND (5)	ND (10)	ND (0.2)	18	ND (5)	**35**	ND (3)	ND (0.5)	ND (3)	ND (10)
	10/18/11	FD	ND (10)	2.3	54	ND (1)	---	ND (3)	**1,100**	**1,300**	ND (3)	ND (5)	ND (10)	ND (0.2)	18	ND (5)	**36**	ND (3)	ND (0.5)	ND (3)	ND (10)
	11/16/11	N	ND (10)	1.8	52	ND (1)	---	ND (3)	**1,500**	**1,600**	ND (3)	8.8	ND (10)	ND (0.2)	18	ND (5)	**42**	**3.4**	ND (0.5)	ND (3)	ND (10)
	12/14/11	N	ND (10)	1.8	54	ND (1)	---	ND (3)	**1,700**	**1,700**	ND (3)	ND (5)	ND (10)	ND (0.2)	17	ND (5J)	**45**	ND (3)	ND (2.5)	ND (3)	ND (10)
	02/21/12	N	ND (10)	1.8	54	ND (1)	---	ND (3)	**2,000**	**2,000**	ND (3)	ND (5)	ND (10)	ND (0.2)	15	ND (5)	**55**	**3**	ND (2.5)	ND (3)	ND (10)
	05/03/12	N	---	1.7	---	---	---	---	**2,180**	**2,230**	---	---	---	---	16	---	**100**	**---**	---	---	---
	09/20/12	N	---	1.7	---	---	---	---	**2,370**	**2,320**	---	---	---	---	14	---	**86**	**---**	---	---	---
	12/06/12	N	---	1.8	---	---	---	---	**2,300**	**2,270**	---	---	---	---	12	---	**110**	**---**	---	---	---
	02/21/13	N	---	1.7	---	---	---	---	**2,190**	**2,100**	---	---	---	---	17	---	**110**	**---**	---	---	---
	02/21/13	FD	---	1.6	---	---	---	---	**2,180**	**2,110**	---	---	---	---	17	---	**110**	**---**	---	---	---
MW-67-225 (Site 2)	05/16/11	N	ND (0.5)	3.3	150	ND (0.5)	---	ND (0.5)	**1,800**	**1,800**	ND (0.5)	ND (1)	ND (1)	ND (0.2)	**52**	ND (1)	**60**	ND (0.5)	ND (5)	ND (3)	ND (10)
	05/16/11	FD	0.96	3.4	150	ND (0.5)	---	ND (0.5)	**1,800**	**1,700**	ND (0.5)	ND (1J)	ND (1)	ND (0.2)	**53**	ND (1)	**61**	ND (0.5)	ND (2.5)	ND (3)	ND (10)
	06/14/11	N	ND (10)	2.7	88	ND (1)	---	ND (3)	**1,900**	**1,900**	ND (3)	ND (5)	ND (10)	ND (0.2)	**37**	ND (5)	**68**	ND (3)	ND (2.5)	ND (3)	ND (10)
	07/12/11	N	ND (10)	2.3	82	ND (1)	---	ND (3)	**2,100**	**2,200**	ND (3)	ND (5)	ND (10)	ND (0.2)	**64**	ND (5)	**63**	ND (3)	ND (2.5)	ND (3)	ND (10)
	08/09/11	N	ND (10)	2	72	ND (1)	---	ND (3)	**2,400**	**2,200**	ND (3)	ND (5)	ND (10)	ND (0.2)	**37**	ND (5)	**62**	ND (3)	ND (5)	ND (3)	ND (10)
	09/08/11	N	ND (10)	2.5	61	ND (1)	---	ND (3)	**2,600**	**2,800**	ND (3)	ND (5)	ND (10)	ND (0.2)	35	ND (5)	**72**	ND (3)	ND (2.5)	ND (3)	ND (10)
	10/19/11	N	ND (10)	2.6	60	ND (1)	---	ND (3)	**2,800**	**3,100**	ND (3)	ND (5)	ND (10)	ND (0.2)	33	ND (5)	**76**	**3.4**	ND (2.5)	ND (3)	ND (10)
	11/17/11	N	ND (10)	2.7	53	ND (1)	---	ND (3)	**3,100**	**3,100**	ND (3)	ND (5)	ND (10)	ND (0.2)	31	ND (5)	**80**	**3.6**	ND (2.5)	ND (3)	ND (10)
	12/14/11	N	ND (10)	2.9	51	ND (1)	---	ND (3)	**3,200**	**3,200**	ND (3)	ND (5)	ND (10)	ND (0.2)	31	ND (5J)	**75**	ND (3)	ND (2.5)	ND (3)	ND (10)
	02/21/12	N	ND (10)	2.5	47	ND (1)	---	ND (3)	**3,200**	**3,100**	ND (3)	ND (5)	ND (10)	ND (0.2)	30	ND (5)	**63**	**3.2**	ND (2.5)	ND (3)	ND (10)
	02/21/12	FD	ND (10)	2.8	47	ND (1)	---	ND (3)	**3,100**	**3,200**	ND (3)	ND (5)	ND (10)	ND (0.2)	30	ND (5)	**75**	**3.3**	ND (2.5)	ND (3)	ND (10)
	05/07/12	N	---	2.8	---	---	---	---	**3,180**	**3,260**	---	---	---	---	33	---	**79**	**---**	---	---	---
	09/20/12	N	---	2.8	---	---	---	---	**3,200**	**3,420**	---	---	---	---	33	---	**67**	**---**	---	---	---
	12/10/12	N	---	3.2	---	---	---	---	**3,210**	**3,110**	---	---	---	---	33	---	**80**	**---**	---	---	---
	02/21/13	N	---	3.2	---	---	---	---	**3,310**	**3,110**	---	---	---	---	36	---	**75**	**---**	---	---	---
MW-67-260 (Site 2)	05/15/11	N	ND (2.5)	14	**280**	ND (2.5)	---	ND (2.5)	**2,000**	**1,900**	ND (0.5)	ND (5)	ND (25)	ND (0.2)	**78**	ND (5)	ND (2.5)	ND (2.5)	ND (12)	ND (1)	ND (50)
	06/14/11	N	ND (10)	11	130	ND (1)	---	ND (3)	**1,800**	**1,600**	ND (3)	ND (5)	ND (10)	ND (0.2)	**72**	ND (5)	ND (2.5)	ND (3)	ND (2.5)	ND (3)	ND (10)
	07/12/11	N	**10**	11	110	ND (1)	---	ND (3)	**1,900**	**1,900**	ND (3)	ND (5)	ND (10)	ND (0.2)	**88**	ND (5)	ND (2.5)	ND (3)	ND (12)	ND (3)	ND (10)
	08/09/11	N	ND (10)	9.7	93	ND (1)	---	ND (3)	**2,000**	**1,800**	ND (3)	ND (5)	ND (10)	ND (0.2)	**64**	ND (5)	ND (5)	**3.9**	ND (5)	ND (3)	ND (10)
	09/08/11	N	ND (10)	12	81	ND (1)	---	ND (3)	**2,100**	**2,100**	ND (3)	ND (5)	ND (10)	ND (0.2)	**66**	ND (5)	ND (2.5)	**3.8**	ND (12)	ND (3)	ND (10)
	10/19/11	N	ND (10)	12	79	ND (1)	---	ND (3)	**1,900**	**2,100**	ND (3)	ND (5)	ND (10)	ND (0.2)	**66**	ND (5)	3.2	**5.2**	ND (2.5)	ND (3)	ND (10)

TABLE C2-1

Groundwater Sample Results: Metals

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			Metals (µg/L)																	
	Background[1] :		1.22	24.3	195	0.663	NE	NE	31.8	34.1	0.843	10.5	1.91	NE	36.3	10.6	10.3	2.13	0.908	59.9	77.7
Location	Date	Sample Type	Antimony, dissolved	Arsenic, dissolved	Barium, dissolved	Beryllium, dissolved	Boron, dissolved	Cadmium, dissolved	Chromium Hexavalent	Chromium, dissolved	Cobalt, dissolved	Copper, dissolved	Lead, dissolved	Mercury, dissolved	Molybdenum, dissolved	Nickel, dissolved	Selenium, dissolved	Silver, dissolved	Thallium, dissolved	Vanadium, dissolved	Zinc, dissolved
MW-67-260 (Site 2)	11/17/11	N	ND (10)	11	73	ND (1)	---	ND (3)	**2,000**	**2,000**	ND (3)	ND (5)	ND (10)	ND (0.2)	**66**	ND (5)	ND (2.5)	**5.5**	ND (2.5)	ND (3)	ND (10)
	12/14/11	N	ND (20)	13	69	ND (2)	---	ND (6)	**2,300**	**2,100**	ND (6)	ND (10)	ND (20)	ND (0.2)	**70**	ND (10J)	ND (12)	ND (6J)	ND (12)	ND (6)	ND (20)
	02/21/12	N	ND (10)	8.4	77	ND (1)	---	ND (3)	**1,700**	**1,600**	ND (3)	5.6	ND (10)	ND (0.2)	**78**	ND (5)	ND (2.5)	**5.4**	ND (2.5)	ND (3)	ND (10)
	05/07/12	N	---	12	---	---	---	---	**2,130**	**2,090**	---	---	---	---	**81**	---	ND (2.5)	**---**	---	---	---
	09/20/12	N	---	11	---	---	---	---	**2,130**	**2,160**	---	---	---	---	**81**	---	1.6	**---**	---	---	---
	12/06/12	N	---	12	---	---	---	---	**2,020**	**1,930**	---	---	---	---	**85**	---	2.1	**---**	---	---	---
	02/21/13	N	---	11	---	---	---	---	**2,130**	**2,060**	---	---	---	---	**85**	---	1.6	**---**	---	---	---
MW-68-180 (Site 3)	06/11/11	N	ND (10)	5.1	62	ND (1)	---	ND (3)	**11,000**	**11,000**	ND (3)	ND (5)	ND (10)	ND (0.2)	**49**	ND (5)	9.3	ND (3)	ND (0.5)	4.8	ND (10)
	06/14/11	N	ND (10)	2.8	58	ND (1)	---	ND (3)	**2,600**	**2,300**	ND (3)	ND (5)	ND (10)	ND (0.2)	**54**	ND (5)	5.5	ND (3)	ND (0.5)	3.6	ND (10)
	06/14/11	FD	ND (10)	3.1	65	ND (1)	---	ND (3)	**2,700**	**2,400**	ND (3)	ND (5)	ND (10)	ND (0.2)	**53**	ND (5)	5.1	ND (3)	ND (0.5)	5.5	11
	07/12/11	N	ND (10)	2.5	50	ND (1)	---	ND (3)	**1,400**	**1,500**	ND (3)	ND (5)	ND (10)	ND (0.2)	**63**	ND (5)	4.3	ND (3)	ND (0.5)	4.5	ND (10)
	09/08/11	N	ND (10)	2.1	52	ND (1)	---	ND (3)	**18,000**	**19,000**	ND (3)	ND (5)	ND (10)	ND (0.2)	**43**	ND (5)	**13**	**4.7**	ND (2.5)	ND (3)	ND (10)
	10/18/11	N	ND (10)	2.2	40	ND (1)	---	ND (3)	**19,000**	**23,000**	**4**	ND (5)	ND (10)	ND (0.2)	**43**	ND (5)	**15**	**7**	ND (0.5)	ND (3)	10
	11/17/11	N	ND (10)	2.3	33	ND (1)	---	ND (3)	**20,000**	**23,000**	**5.9**	ND (5)	ND (10)	ND (0.2)	**42**	ND (5)	**16**	**7.7**	ND (0.5)	ND (3)	ND (10)
	12/15/11	N	ND (10)	2.3	29	ND (1)	---	ND (3)	**22,000**	**21,000**	**5.9**	5.9	ND (10)	ND (0.2)	**49**	ND (5J)	**16**	**7.9**	ND (2.5)	ND (3)	ND (10)
	02/22/12	N	ND (10)	2.5	28	ND (1)	---	ND (3)	**16,000**	**17,000**	**4.2**	ND (5)	ND (10)	ND (0.2)	**39**	ND (5)	**13**	**5.8**	ND (2.5)	ND (3)	ND (10)
	05/10/12	N	---	2.9	---	---	---	---	**5,970**	**5,990**	**---**	---	---	---	**37**	---	10	**---**	---	---	---
	09/20/12	N	---	2.2	---	---	---	---	**16,400**	**16,900**	**---**	---	---	---	**42**	---	**13**	**---**	---	---	---
	12/11/12	N	---	2.7	---	---	---	---	**20,200**	**21,800**	**---**	---	---	---	**47**	---	**18 J**	**---**	---	---	---
	12/11/12	FD	---	2.8	---	---	---	---	**20,400**	**21,700**	**---**	---	---	---	**47**	---	**25 J**	**---**	---	---	---
	02/21/13	N	---	2.5	---	---	---	---	**17,300**	**15,600**	**---**	---	---	---	**47**	---	**14**	**---**	---	---	---
MW-68-240 (Site 3)	06/11/11	N	ND (10)	2.7	77	ND (1)	---	ND (3)	**640**	**660**	ND (3)	ND (5)	ND (10)	ND (0.2)	22	ND (5)	3.6	ND (3)	ND (2.5)	ND (3)	19
	06/14/11	N	ND (10)	1.7	86	ND (1)	---	ND (3)	**420**	**400**	ND (3)	ND (5)	ND (10)	ND (0.2)	21	ND (5)	4	ND (3)	ND (2.5)	ND (3)	13
	07/12/11	N	ND (10)	1.7	70	ND (1)	---	ND (3)	**920**	**870**	ND (3)	ND (5)	ND (10)	ND (0.2)	**48**	ND (5)	4	ND (3)	ND (2.5)	ND (3)	ND (10)
	09/07/11	N	ND (10)	1.8	67	ND (1)	---	ND (3)	**1,100**	**1,100**	ND (3)	ND (5)	ND (10)	ND (0.2)	17	ND (5)	4.8	**6.1**	ND (12)	ND (3)	ND (10)
	09/07/11	FD	ND (10)	1.8	67	ND (1)	---	ND (3)	**1,100**	**1,100 J**	ND (3)	ND (5)	ND (10)	ND (0.2)	18	ND (5)	4.6	**6.1**	ND (2.5)	ND (3)	ND (10)
	10/18/11	N	ND (10)	1.9	62	ND (1)	---	ND (3)	**1,300**	**1,500**	ND (3)	ND (5)	ND (10)	ND (0.2)	15	ND (5)	5.3	**8.2**	ND (2.5)	ND (3)	ND (10)
	11/16/11	N	ND (10)	2	60	ND (1)	---	ND (3)	**1,500**	**1,500**	ND (3)	ND (5)	ND (10)	ND (0.2)	14	ND (5)	5.1	**8.8**	ND (2.5)	ND (3)	ND (10)
	12/14/11	N	ND (10)	ND (2.5)	60	ND (1)	---	ND (3)	**1,600**	**1,600**	ND (3)	ND (5)	ND (10)	ND (0.2)	16	ND (5J)	ND (12)	**7.8**	ND (12)	ND (3)	ND (10)
	02/17/12	N	ND (10)	1.6	53	ND (1)	---	ND (3)	**1,800**	**1,800**	ND (3)	ND (5)	ND (10)	ND (0.2)	13	ND (5)	4.9	**7.4**	ND (12)	ND (3)	ND (10)
	05/03/12	N	---	1.9	---	---	---	---	**1,820**	**1,900**	---	---	---	---	21	---	4.8	**---**	---	---	---
	09/20/12	N	---	1.7	---	---	---	---	**2,000**	**1,980**	---	---	---	---	19	---	4.1	**---**	---	---	---
	12/06/12	N	---	2	---	---	---	---	**1,990**	**1,870**	---	---	---	---	23	---	5.1	**---**	---	---	---
	02/20/13	N	---	1.9	---	---	---	---	**1,970**	**2,020**	---	---	---	---	22	---	4.6	**---**	---	---	---
MW-68BR-280 (Site 3)	09/08/11	N	ND (10)	2.7	77	ND (1)	---	ND (3)	ND (5)	ND (1)	ND (3)	ND (5)	ND (10)	ND (0.2)	**96**	ND (5)	ND (2.5)	**4.8**	ND (12)	ND (3)	ND (10)
	10/21/11	N	ND (10)	1.6	73	ND (1)	---	ND (3)	ND (5)	ND (2.5)	ND (3)	ND (5)	ND (10)	ND (0.2)	**71**	ND (5)	ND (2.5)	**6.1**	ND (2.5)	ND (3)	11
	11/16/11	N	ND (20)	2.1	60	ND (2)	---	ND (6)	ND (5)	ND (0.5)	ND (6)	ND (10)	ND (20)	ND (0.2)	**77**	ND (10)	ND (2.5)	**7.1**	ND (2.5)	ND (6)	ND (20)
	12/14/11	N	ND (20)	1.8	67	ND (2)	---	ND (6)	ND (5)	ND (2.5)	ND (6)	ND (10)	ND (20)	ND (0.2)	**77**	ND (10J)	ND (12)	ND (6J)	ND (12)	ND (6)	ND (20)
	02/14/12	N	ND (10)	1.8	59	ND (1)	---	ND (3)	ND (1)	ND (1)	ND (3)	ND (5)	ND (10)	ND (0.2)	**65**	ND (5)	ND (2.5)	**5**	ND (12)	ND (3)	ND (10)
	05/09/12	N	---	2.4	---	---	---	---	ND (1)	ND (1)	---	---	---	---	**94**	---	ND (2.5)	**---**	---	---	---
	10/03/12	N	---	2.5	---	---	---	---	ND (1)	ND (1)	---	---	---	---	**95**	---	ND (2.5)	**---**	---	---	---
	11/12/12	N	---	2.1	---	---	---	---	ND (1)	ND (1)	---	---	---	---	**90**	---	ND (2.5)	**---**	---	---	---
	02/18/13	N	---	2.3	---	---	---	---	ND (1)	ND (1)	---	---	---	---	**88**	---	ND (2.5)	**---**	---	---	---

TABLE C2-1

Groundwater Sample Results: Metals

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			Metals (µg/L)																
	Background[1] :		1.22	24.3	195	0.663	NE	NE	31.8	34.1	0.843	10.5	1.91	NE	36.3	10.6	10.3	2.13	0.908	59.9	77.7
Location	Date	Sample Type	Antimony, dissolved	Arsenic, dissolved	Barium, dissolved	Beryllium, dissolved	Boron, dissolved	Cadmium, dissolved	Chromium Hexavalent	Chromium, dissolved	Cobalt, dissolved	Copper, dissolved	Lead, dissolved	Mercury, dissolved	Molybdenum, dissolved	Nickel, dissolved	Selenium, dissolved	Silver, dissolved	Thallium, dissolved	Vanadium, dissolved	Zinc, dissolved
MW-69-195 (Site 4)	06/30/11	N	ND (10)	1.7	34	ND (1)	---	ND (3)	**120**	**120**	ND (3)	ND (5)	ND (10)	ND (0.2)	**71**	ND (5)	9	ND (3)	0.67	3.8	14
	07/11/11	N	ND (10)	1.6	37	ND (1)	---	ND (3)	**140**	**140**	ND (3)	ND (5)	ND (10)	ND (0.2)	**78**	ND (5)	10	ND (3)	0.71	3.1	ND (10)
	08/09/11	N	ND (10)	1.5	38	ND (1)	---	ND (3)	**210**	**200**	ND (3)	9.8	ND (10)	ND (0.2)	**48**	ND (5)	**11**	ND (3)	0.65	ND (3)	ND (10)
	09/07/11	N	ND (10)	1.8	31	ND (1)	---	ND (3)	**260**	**260**	ND (3)	ND (5)	ND (10)	ND (0.2)	**40**	ND (5)	**12**	ND (3)	ND (2.5)	ND (3)	ND (10)
	10/18/11	N	ND (10)	1.8	33	ND (1)	---	ND (3)	**310**	**340**	ND (3)	ND (5)	ND (10)	ND (0.2)	**38**	ND (5)	**13**	**3.5**	0.54	3.4	ND (10)
	11/15/11	N	ND (10)	1.9	31	ND (1)	---	ND (3)	**380**	**380**	ND (3)	ND (5)	ND (10)	ND (0.2)	36	ND (5)	**14**	**3.5**	ND (0.5)	3.3	ND (10)
	12/14/11	N	ND (10)	2	29	ND (1)	---	ND (3)	**360**	**360**	ND (3)	ND (5)	ND (10)	ND (0.2)	**40**	ND (5J)	**14**	ND (3)	ND (2.5)	3.8	ND (10)
	02/17/12	N	ND (10)	2.4	26	ND (1)	---	ND (3)	**280**	**290**	ND (3)	ND (5)	ND (10)	ND (0.2)	**41**	ND (5)	**12**	ND (3)	ND (2.5)	5.2	ND (10)
	05/02/12	N	---	2.1	---	---	---	---	**446**	**488**	---	---	---	---	**46**	---	**15**	---	---	---	---
	09/19/12	N	---	2.1	---	---	---	---	**789**	**840**	---	---	---	---	**50**	---	**14**	---	---	---	---
	12/05/12	N	---	2.1	---	---	---	---	**849**	**869**	---	---	---	---	**57**	---	**15**	---	---	---	---
	02/20/13	N	---	2.2	---	---	---	---	**909**	**852**	---	---	---	---	**65**	---	**13**	---	---	---	---
MW-70-105 (Site H)	06/10/11	N	ND (10)	7.5	65	ND (1)	---	ND (3)	16	19	ND (3)	ND (5)	ND (10)	ND (0.2)	**160**	ND (5)	1.5	ND (3)	ND (0.5)	ND (3)	ND (10)
	06/13/11	N	ND (10)	4.9	51	ND (1)	---	ND (3)	0.38	1.2	ND (3)	ND (5)	ND (10)	ND (0.2)	**170**	ND (5)	0.97	ND (3)	ND (0.5)	ND (3)	ND (10)
	07/11/11	N	ND (10)	4.6	63	ND (1)	---	ND (3)	3.8	7	ND (3)	ND (5)	ND (10)	ND (0.2)	**180**	ND (5)	1.3	ND (3)	ND (0.5)	ND (3)	ND (10)
	08/08/11	N	ND (10)	4.8	82	ND (1)	---	ND (3)	18	23	ND (3)	ND (5)	ND (10)	ND (0.2)	**150**	ND (5)	1.2	ND (3)	ND (0.5)	ND (3)	ND (10)
	09/06/11	N	ND (10)	3.4	67	ND (1)	---	ND (3)	13	14	ND (3)	ND (5)	ND (10)	ND (0.2)	**140**	ND (5)	0.8	ND (3)	ND (0.5)	ND (3)	ND (10)
	11/14/11	N	ND (10)	5.2	74	ND (1)	---	ND (3)	31	34	ND (3)	ND (5)	ND (10)	ND (0.2)	**140**	ND (5)	1.4	ND (3)	ND (0.5)	ND (3)	ND (10)
	12/12/11	N	ND (20)	4.8	84	ND (2)	---	ND (6)	**55**	**63**	ND (6J)	ND (10)	ND (20)	ND (0.2)	**130**	ND (10J)	1.6	ND (3)	ND (0.5)	ND (6)	ND (20)
	02/16/12	N	ND (10)	4.5	81	ND (1)	---	ND (3)	13	16	ND (3)	ND (5)	ND (10)	ND (0.2)	**130**	ND (5)	0.87	ND (3)	ND (2.5)	ND (3)	ND (10)
	05/01/12	N	---	5.4	---	---	---	---	**76.3**	**77.9**	---	---	---	---	**120**	---	2	---	---	---	---
	09/12/12	N	---	6.2	---	---	---	---	**80.8**	**85.6**	---	---	---	---	**120**	---	2.2	---	---	---	---
	12/04/12	N	---	5.2	---	---	---	---	**65.1**	**71.1**	---	---	---	---	**110**	---	2.2	---	---	---	---
	02/19/13	N	---	5.8	---	---	---	---	**93.2**	**91.7**	---	---	---	---	**110**	---	2.6	---	---	---	---
MW-70BR-225 (Site H)	10/24/11	N	ND (10)	2	36	ND (1)	---	ND (3)	**1,600**	**1,800**	ND (3)	ND (5)	ND (10)	ND (0.2)	21	ND (5)	2.8	**9.1**	ND (2.5)	ND (3)	13
	11/07/11	N	ND (10)	1.9	40	ND (1)	---	ND (3)	**2,300**	**2,400**	ND (3)	ND (5)	ND (10)	ND (0.2)	10	ND (5)	3	**13**	ND (12)	ND (3)	42
	11/16/11	N	ND (10)	2.1	46	ND (1)	---	ND (3)	**2,300**	**2,400**	ND (3)	5.7	ND (10)	0.25	13	ND (5)	2.8	**13**	ND (2.5)	ND (3)	ND (10)
	12/15/11	N	ND (10)	2.1	47	ND (1)	---	ND (3)	**2,200**	**2,400**	ND (3)	ND (5)	ND (10)	ND (0.2)	16	ND (5J)	ND (12)	**13**	ND (2.5)	ND (3)	ND (10)
	02/16/12	N	ND (10)	1.9	44	ND (1)	---	ND (3)	**2,200**	**2,300**	ND (3)	ND (5)	ND (10)	0.3	12	ND (5)	2.7	**12**	ND (2.5)	ND (3)	ND (10)
	05/17/12	N	---	2	---	---	---	---	**2,460**	**2,460**	---	---	---	---	18	---	ND (2.5)	**---**	---	---	---
	05/17/12	FD	---	2.1	---	---	---	---	**2,380**	**2,550**	---	---	---	---	18	---	2.6	**---**	---	---	---
	09/18/12	N	---	2.1	---	---	---	---	**2,410**	**2,500**	---	---	---	---	16	---	ND (5)	**---**	---	---	---
	12/13/12	N	---	1.9	---	---	---	---	**1,980**	**1,980**	---	---	---	---	19	---	3.1	**---**	---	---	---
	02/26/13	N	---	1.9	---	---	---	---	**1,960**	**1,880**	---	---	---	---	19	---	2.6	**---**	---	---	---
MW-71-035 (Site L)	11/03/11	N	0.55	1.5	130	ND (2.5)	---	ND (0.5)	ND (1)	ND (1)	ND (0.5)	ND (1)	ND (25)	ND (0.2)	**83**	ND (1)	5.2	ND (2.5)	ND (12)	ND (1)	ND (10)
	11/15/11	N	ND (10)	1.5	100	ND (1)	---	ND (3)	ND (1)	ND (0.5)	ND (3)	**13**	ND (10)	ND (0.2)	**85**	ND (5)	2.5	**5.1**	ND (2.5)	ND (3)	ND (10)
	12/14/11	N	ND (10)	ND (2.5)	120	ND (1)	---	ND (3)	ND (1)	ND (2.5)	ND (3)	5.1	ND (10)	ND (0.2)	**82**	ND (5J)	ND (12)	**5.7**	ND (2.5)	ND (3)	ND (10)
	02/15/12	N	ND (10)	1.8	92	ND (1)	---	ND (3)	ND (1)	ND (1)	ND (3)	5	ND (10)	ND (0.2)	**64**	ND (5)	2.4	**4.9**	ND (2.5)	ND (3)	ND (10)
	05/03/12	N	---	1.7	---	---	---	---	ND (1)	ND (1)	---	---	---	---	**91**	---	ND (2.5)	**---**	---	---	---
	09/19/12	N	---	1.7	---	---	---	---	ND (0.2)	ND (1)	---	---	---	---	**58**	---	2.5	**---**	---	---	---
	11/08/12	N	---	1.4	---	---	---	---	ND (0.2)	ND (1)	---	---	---	---	**65**	---	2.3	**---**	---	---	---
	02/07/13	N	---	1.5	---	---	---	---	0.78	ND (1)	---	---	---	---	**59**	---	2.2	**---**	---	---	---
MW-72-080 (Site K)	08/31/11	N	ND (10)	9.1	56	ND (1)	---	ND (3)	**40**	**44**	ND (3)	ND (5)	ND (10)	ND (0.2)	**83**	ND (5)	2.5	ND (3)	ND (2.5)	ND (3)	ND (10)

TABLE C2-1

Groundwater Sample Results: Metals

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			Metals (µg/L)																	
	Background[1] :		1.22	24.3	195	0.663	NE	NE	31.8	34.1	0.843	10.5	1.91	NE	36.3	10.6	10.3	2.13	0.908	59.9	77.7
Location	Date	Sample Type	Antimony, dissolved	Arsenic, dissolved	Barium, dissolved	Beryllium, dissolved	Boron, dissolved	Cadmium, dissolved	Chromium Hexavalent	Chromium, dissolved	Cobalt, dissolved	Copper, dissolved	Lead, dissolved	Mercury, dissolved	Molybdenum, dissolved	Nickel, dissolved	Selenium, dissolved	Silver, dissolved	Thallium, dissolved	Vanadium, dissolved	Zinc, dissolved
MW-72-080 (Site K)	09/06/11	N	ND (10)	7.5	91	ND (1)	---	ND (3)	**60**	**61**	ND (3)	ND (5)	ND (10)	ND (0.2)	**69**	ND (5)	2.4	**3.7**	ND (2.5)	ND (3)	ND (10)
	10/17/11	N	ND (10)	8.8	100	ND (1)	---	ND (3)	**95**	**91**	ND (3)	ND (5)	ND (10)	ND (0.2)	**69**	ND (5)	ND (12)	**4.2**	ND (2.5)	ND (3)	ND (10)
	11/14/11	N	ND (10)	9.4	95	ND (1)	---	ND (3)	**90**	**92**	ND (3)	ND (5)	ND (10)	ND (0.2)	**68**	ND (5)	ND (2.5)	**6.2**	ND (2.5)	ND (3)	ND (10)
	12/15/11	N	ND (20)	9.3	81	ND (2)	---	ND (6)	**130**	**130**	ND (6)	ND (10)	ND (20)	ND (0.2)	**64**	ND (10J)	ND (12)	ND (6J)	ND (12)	ND (6)	ND (20)
	02/13/12	N	ND (10)	9.4	71	ND (1)	---	ND (3)	**110**	**99**	ND (3)	ND (5)	ND (10)	ND (0.2)	**68**	ND (5)	ND (2.5)	**5.1**	ND (2.5)	ND (3)	ND (10)
	05/01/12	N	---	9.7	---	---	---	---	**87.6**	**89**	---	---	---	---	**75**	---	ND (2.5)	**---**	---	---	---
	09/19/12	N	---	11	---	---	---	---	**151**	**158**	---	---	---	---	**76**	---	2	**---**	---	---	---
	12/05/12	N	---	11	---	---	---	---	**150**	**150**	---	---	---	---	**77**	---	1.8	**---**	---	---	---
	02/19/13	N	---	11	---	---	---	---	**122**	**119**	---	---	---	---	**73**	---	ND (2.5)	**---**	---	---	---
MW-72BR-200 (Site K)	07/23/12	N	ND (2.5)	13	53	ND (1)	---	ND (3J)	2	2.2	ND (3)	ND (5)	ND (10J)	ND (0.2)	**65**	ND (5)	ND (2.5)	**5.3**	ND (2.5)	ND (3)	ND (10)
	07/24/12	N	0.59	9.2	130	ND (5)	---	ND (15)	ND (1)	ND (1)	ND (15)	ND (25)	ND (50)	ND (0.2)	**57**	ND (25)	ND (2.5)	ND (15)	ND (2.5)	ND (15)	ND (50)
	09/13/12	N	0.83	15	55	ND (2)	---	ND (6J)	3.9	4.5	ND (6)	ND (10J)	ND (20)	ND (0.2)	**63**	ND (10)	ND (2.5)	ND (6)	ND (12)	ND (6)	ND (20)
	09/13/12	FD	0.86	15	56	ND (2)	---	ND (6)	3.8	4.3	ND (6)	ND (10)	ND (20)	ND (0.2)	**63**	ND (10)	ND (2.5)	ND (6)	ND (12)	ND (6)	ND (20)
	11/14/12	N	---	15	---	---	---	---	6.4	7.3	---	---	---	---	**77**	---	ND (0.5)	---	---	---	---
	02/07/13	N	---	14	---	---	---	---	7.9	8.2	---	---	---	---	**65**	---	ND (0.5)	---	---	---	---
MW-73-080 (Site I)	10/22/11	N	ND (10)	1.1	110	ND (1)	---	ND (3)	21	20	ND (3)	ND (5)	ND (10)	ND (0.2)	26	ND (5)	6.2	**6.5**	ND (2.5)	ND (3)	18
	11/15/11	N	ND (10)	1.2	76	ND (1)	---	ND (3)	28	26	ND (3)	5.4	ND (10)	ND (0.2)	20	ND (5)	5	**15**	ND (2.5)	ND (3)	ND (10)
	12/14/11	N	ND (10)	1.7	88	ND (1)	---	ND (3)	**36**	**35**	ND (3)	7	ND (10)	ND (0.2)	21	ND (5J)	5.5	**18**	ND (12)	ND (3)	10
	02/14/12	N	ND (10)	1.3	74	ND (1)	---	ND (3)	**36**	31	ND (3)	ND (5)	ND (10)	ND (0.2)	17	ND (5)	4.7	**13**	ND (2.5)	ND (3)	ND (10)
	05/02/12	N	---	1.4	---	---	---	---	**32.9**	**38**	---	---	---	---	23	---	5.4	**---**	---	---	---
	09/13/12	N	---	1.6	---	---	---	---	**37.3**	**39.3**	---	---	---	---	23	---	6.2	**---**	---	---	---
	12/05/12	N	---	1.5	---	---	---	---	**35.6**	**36.2**	---	---	---	---	24	---	4.8	**---**	---	---	---
	02/19/13	N	---	2.1	---	---	---	---	25.1	25.8	---	---	---	---	23	---	4	**---**	---	---	---
MW-74-240 (Site J)	01/16/12	N	**45**	**58**	12	ND (1)	---	ND (3)	ND (0.2)	ND (0.5)	ND (3)	ND (5)	ND (10)	ND (0.2)	**190**	ND (5J)	3.6	ND (3)	ND (0.5)	5.3	ND (10)
	02/17/12	N	**25**	15	9	ND (1)	---	ND (3)	ND (0.2)	ND (1)	ND (3)	ND (5)	ND (10)	ND (0.2)	**150**	ND (5)	2.7	ND (3)	ND (0.5)	ND (3)	ND (10)
	05/10/12	N	**---**	15	---	---	---	---	ND (0.2)	ND (1)	---	---	---	---	**210**	---	ND (2.5)	---	---	---	---
	09/27/12	N	**---**	9.3	---	---	---	---	0.28	ND (1)	---	---	---	---	**47**	---	3.8	---	---	---	---
	12/20/12	N	**---**	15	---	---	---	---	ND (0.2)	ND (1)	---	---	---	---	**110**	---	1.4	---	---	---	---
	12/20/12	FD	**---**	16	---	---	---	---	ND (0.2)	ND (1)	---	---	---	---	**110**	---	1.1	---	---	---	---
	03/01/13	N	**---**	8.8	---	---	---	---	ND (0.2)	ND (1)	---	---	---	---	**68**	---	1.7	---	---	---	---

Notes:

1 Site background concentration is the 95% upper tolerance limit (UTL) of the elevated percentile from the Steps 3 and 4 Groundwater Background Study Report (CH2M HILL, 2008)

Results greater than or equal to the Background levels are bolded

-- = not analyzed

µg/L = micrograms per liter

J = concentration or reporting limit estimated by laboratory or data validation

ND = not detected at the listed reporting limit

R' = Due to the influence of well construction materials, the results were shown to not be representative of aquifer conditions and were considered to be unusable and rejected

TABLE C2-2

Groundwater Sample Results: Contract Laboratory Program Inorganics

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			Contract Laboratory Program (CLP) Inorganics (µg/L)						
	Background[1]:		55.8	NE	NE	NE	NE	NE	NE
Location	Date	Sample Type	Aluminum, dissolved	Calcium, dissolved	Iron, dissolved	Magnesium, dissolved	Manganese, dissolved	Potassium, dissolved	Sodium, dissolved
MW-23-060 (MW-23)	07/21/09	N	ND (200)	830,000	ND (40)	49,000	ND (10)	100,000	2,700,000
	09/24/09	N	---	830,000	41	35,000	ND (10)	---	2,800,000
	12/14/10	N	---	760,000	ND (20)	11,000	ND (10)	---	2,600,000
	05/04/11	N	---	---	---	---	0.51	---	---
	09/29/11	N	---	---	---	---	ND (2.5)	---	---
	12/13/11	N	ND (100)	830,000	ND (40)	28,000	ND (20)	57,000	2,900,000
	02/14/12	N	---	---	---	---	ND (10)	---	---
	04/30/12	N	---	---	---	---	ND (2.5)	---	---
	04/30/12	FD	---	---	---	---	ND (2.5)	---	---
	09/12/12	N	---	---	---	---	ND (0.5)	---	---
	11/08/12	N	---	860,000	ND (100)	7,900	ND (0.5)	---	3,200,000
	02/18/13	N	---	---	---	---	ND (0.5)	---	---
MW-23-080 (MW-23)	07/21/09	N	**250**	900,000	ND (40)	190	ND (10)	94,000	2,900,000
	09/23/09	N	**---**	820,000	ND (20)	ND (100)	ND (10)	---	3,200,000
	12/14/10	N	**---**	750,000	ND (20)	7,100	ND (10)	---	2,900,000
	05/04/11	N	**---**	---	---	---	ND (0.5)	---	---
	05/04/11	FD	**---**	---	---	---	ND (2.5)	---	---
	09/29/11	N	**---**	---	---	---	ND (2.5)	---	---
	12/12/11	N	ND (100)	760,000	ND (40J)	1,500	ND (20)	51,000 J	3,100,000 J
	12/12/11	FD	ND (100)	780,000	ND (40J)	1,800	ND (20)	52,000 J	3,100,000
	02/14/12	N	---	---	---	---	ND (10)	---	---
	04/30/12	N	---	---	---	---	ND (12)	---	---
	09/12/12	N	---	---	---	---	ND (0.5)	---	---
	09/12/12	FD	---	---	---	---	ND (2.5)	---	---
	11/08/12	N	---	780,000	ND (100)	15,000	ND (0.5)	---	3,200,000
	02/18/13	N	---	---	---	---	ND (0.5)	---	---
MW-57-070 (Site B)	02/11/09	N	---	340,000	ND (500)	24,000	31	11,000	110,000

TABLE C2-2

Groundwater Sample Results: Contract Laboratory Program Inorganics

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			Contract Laboratory Program (CLP) Inorganics (µg/L)						
	Background[1]:		55.8	NE	NE	NE	NE	NE	NE
Location	Date	Sample Type	Aluminum, dissolved	Calcium, dissolved	Iron, dissolved	Magnesium, dissolved	Manganese, dissolved	Potassium, dissolved	Sodium, dissolved
MW-57-070 (Site B)	07/21/09	N	ND (200)	420,000	ND (40)	28,000	86	12,000	110,000
	09/24/09	N	---	420,000	43	27,000	33	---	87,000
	12/10/09	N	---	460,000	34	29,000	17	---	110,000
	12/15/10	N	---	260,000	79	18,000	17	11,000	92,000
	12/15/10	FD	---	260,000	69	18,000	25	11,000	95,000
	12/15/11	N	ND (50J)	370,000	ND (20)	26,000	ND (10)	10,000	100,000
	05/03/12	N	---	---	---	---	6.3	---	---
	12/13/12	N	---	280,000	49	19,000	5.4	---	86,000
	12/13/12	FD	---	270,000	42	19,000	5.8	---	86,000
MW-57-185 (Site B)	07/20/09	N	ND (200)	330,000	ND (40)	3,300	1,100	66,000	3,600,000
	09/23/09	N	---	310,000	ND (20)	3,300	1,000	---	3,800,000
	12/09/09	N	---	320,000	21	3,100	850	---	3,500,000
	12/09/10	N	---	350,000	ND (20)	3,100	580	66,000	3,700,000
	05/03/11	N	---	---	---	---	540	---	---
	09/28/11	N	---	---	---	---	520	---	---
	12/13/11	N	ND (100)	330,000	ND (40)	3,600	550	56,000	3,800,000
	02/10/12	N	---	---	---	---	470	---	---
	02/10/12	FD	---	---	---	---	500	---	---
	04/30/12	N	---	---	---	---	470	---	---
	09/11/12	N	---	---	---	---	400	---	---
	11/08/12	N	---	350,000	ND (100)	4,000	400	---	4,300,000
	02/06/13	N	---	---	---	---	270	---	---
MW-58BR Flute (Upper Zone) (Site A)	07/22/09	N	ND (200)	610,000	130	33,000	2,500	47,000	1,700,000
	09/29/09	N	---	530,000	160	27,000	2,300	---	1,400,000
	12/16/09	N	---	470,000	190	22,000	1,300	---	1,200,000
MW-58BR Flute (Lower Zone) (Site A)	07/22/09	N	ND (200)	470,000	57	25,000	310	33,000	1,100,000
	09/29/09	N	---	420,000	ND (20)	22,000	200	---	1,100,000

TABLE C2-2

Groundwater Sample Results: Contract Laboratory Program Inorganics

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			Contract Laboratory Program (CLP) Inorganics (µg/L)						
	Background[1]:		55.8	NE	NE	NE	NE	NE	NE
Location	Date	Sample Type	Aluminum, dissolved	Calcium, dissolved	Iron, dissolved	Magnesium, dissolved	Manganese, dissolved	Potassium, dissolved	Sodium, dissolved
MW-58BR Flute (Lower Zone) (Site A)	12/16/09	N	---	360,000	ND (20)	18,000	130	---	920,000
MW-58BR Packer (Deeper Set) Upper Zone (Site A)	12/08/11	N	ND (50)	620,000	1,300	30,000	940	29,000	2,000,000
MW-58BR Packer (Deeper Set) Lower Zone (Site A)	12/09/11	N	ND (50)	580,000	ND (20)	29,000	160	27,000	1,400,000
MW-59-100 (Site G)	03/18/09	N	---	870,000	ND (1,000)	31,000	2,400	46,000	1,500,000
	07/22/09	N	ND (200)	830,000	ND (40)	26,000	290	55,000	1,300,000
	07/22/09	FD	ND (200)	820,000	ND (40)	25,000	290	51,000	1,300,000
	09/24/09	N	---	940,000	35	26,000	91	---	1,600,000
	12/11/09	N	---	830,000	26	22,000	51	---	1,400,000
	12/16/10	N	---	760,000	ND (20)	24,000	ND (10)	44,000	1,300,000
	05/06/11	N	---	---	---	---	3.4	---	---
	10/04/11	N	---	---	---	---	1.9	---	---
	12/15/11	N	ND (50J)	690,000	ND (20)	23,000	ND (10)	33,000	1,300,000
	12/15/11	FD	ND (50J)	690,000	ND (20)	23,000	ND (10)	31,000	1,400,000
	02/22/12	N	---	---	---	---	ND (10)	---	---
	05/08/12	N	---	---	---	---	11	---	---
	10/02/12	N	---	628,000	ND (20)	22,700	1.3	---	1,560,000
	11/28/12	N	---	691,000	ND (20)	26,100	0.78	---	1,440,000
	02/27/13	N	---	637,000	ND (20)	23,400	ND (0.5)	---	1,590,000
MW-60-125 (Site F)	03/20/09	N	---	450,000 J	ND (500)	29,000	120	39,000	1,500,000 J
	07/21/09	N	ND (200)	480,000	ND (40)	29,000	140	41,000	1,100,000
	09/24/09	N	---	470,000	57	27,000	100	---	1,200,000
	12/10/09	N	---	470,000	160	24,000	41	---	1,200,000
	12/16/10	N	---	540,000	ND (20)	29,000	29	43,000 J	1,300,000
	12/16/10	FD	---	550,000	ND (20)	29,000	35	40,000 J	1,300,000
	05/05/11	N	---	---	---	---	ND (0.5)	---	---
	10/04/11	N	---	---	---	---	14	---	---
	12/14/11	N	ND (50J)	480,000	ND (20)	25,000	13	26,000	1,300,000

TABLE C2-2

Groundwater Sample Results: Contract Laboratory Program Inorganics

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			Contract Laboratory Program (CLP) Inorganics (µg/L)						
	Background[1]:		55.8	NE	NE	NE	NE	NE	NE
Location	Date	Sample Type	Aluminum, dissolved	Calcium, dissolved	Iron, dissolved	Magnesium, dissolved	Manganese, dissolved	Potassium, dissolved	Sodium, dissolved
MW-60-125 (Site F)	02/15/12	N	---	---	---	---	15	---	---
	05/03/12	N	---	---	---	---	11	---	---
	09/20/12	N	---	---	---	---	10	---	---
	12/06/12	N	---	410,000	ND (20)	25,000	14	---	1,400,000
	02/20/13	N	---	---	---	---	ND (0.5)	---	---
MW-60BR-245 (Site F)	08/09/11	N	---	340,000	ND (20)	5,600	14	37,000	3,000,000
	09/07/11	N	---	370,000	ND (20)	5,400	17	44,000	3,500,000
	11/16/11	N	---	380,000	1,400	8,100	170	39,000	3,300,000
	12/14/11	N	ND (100J)	440,000	25	10,000	ND (20)	44,000	3,500,000
	02/16/12	N	---	---	---	---	13	---	---
	05/17/12	N	---	---	---	---	12	---	---
	09/19/12	N	---	---	---	---	5.9	---	---
	12/05/12	N	---	390,000	ND (100)	6,100	9.6	---	3,800,000
	03/14/13	N	---	---	---	---	ND (0.5)	---	---
	03/14/13	FD	---	---	---	---	ND (0.5)	---	---
MW-61-110 (Site C)	03/23/09	N	---	510,000	ND (1,000)	22,000	700	58,000	2,800,000
	07/21/09	N	ND (200)	630,000	ND (40)	23,000	820	73,000	2,700,000
	09/24/09	N	---	640,000	47	21,000	590	---	2,900,000
	12/10/09	N	---	660,000	30	20,000	500	---	3,000,000
	12/15/10	N	---	670,000	130	20,000	520	58,000	2,600,000
	05/05/11	N	---	---	---	---	360	---	---
	09/30/11	N	---	---	---	---	270	---	---
	12/14/11	N	ND (100J)	690,000 J	ND (20)	22,000	260	53,000	4,200,000
	02/15/12	N	---	---	---	---	220	---	---
	05/03/12	N	---	---	---	---	280	---	---
	09/27/12	N	---	637,000	ND (20)	23,400	172	---	2,840,000
	09/27/12	FD	---	624,000	ND (20)	22,900	165	---	2,790,000

TABLE C2-2

Groundwater Sample Results: Contract Laboratory Program Inorganics

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			Contract Laboratory Program (CLP) Inorganics (µg/L)						
	Background[1]:		55.8	NE	NE	NE	NE	NE	NE
Location	Date	Sample Type	Aluminum, dissolved	Calcium, dissolved	Iron, dissolved	Magnesium, dissolved	Manganese, dissolved	Potassium, dissolved	Sodium, dissolved
MW-61-110 (Site C)	11/27/12	N	---	604,000	ND (20)	21,600	165	---	2,750,000
	11/27/12	FD	---	637,000	ND (20)	21,800	179	---	2,860,000
	02/25/13	N	---	629,000	ND (20)	23,300	133	---	2,850,000
MW-62-065 (Site E)	03/27/09	N	---	200,000	ND (500)	24,000	37	29,000	1,400,000
	07/22/09	N	ND (200)	200,000	ND (40)	25,000	62	36,000	860,000
	09/24/09	N	---	210,000	76	25,000	39	---	1,100,000 J
	12/10/09	N	---	200,000	ND (20)	23,000	31	---	910,000
	12/15/10	N	---	220,000	ND (20)	24,000	ND (10)	28,000	980,000
	09/29/11	N	---	---	---	---	13	---	---
	12/13/11	N	ND (50J)	230,000	ND (20J)	27,000	ND (10)	25,000	1,100,000
	05/02/12	N	---	---	---	---	4.2	---	---
	12/10/12	N	---	210,000	ND (20)	24,000	1.1	---	1,100,000
MW-62-110 (Site E)	07/22/09	N	ND (200)	150,000	ND (40)	7,000	440	35,000	1,400,000
	09/29/09	N	---	170,000	27	8,000	490	---	1,700,000
	12/16/09	N	---	160,000	ND (20)	7,100	350	---	1,500,000
	12/16/10	N	---	170,000	ND (20)	8,400	230	37,000	1,600,000
	05/05/11	N	---	---	---	---	240	---	---
	09/29/11	N	---	---	---	---	210	---	---
	12/14/11	N	ND (50J)	180,000	ND (20)	8,700	160	24,000	1,700,000
	02/16/12	N	---	---	---	---	190	---	---
	05/10/12	N	---	---	---	---	180	---	---
	09/13/12	N	---	---	---	---	140	---	---
	12/11/12	N	---	170,000	ND (20)	8,200	130	---	1,600,000
	02/26/13	N	---	---	---	---	83	---	---
MW-62-190 (Site E)	07/22/09	N	ND (200)	350,000	55	14,000	2,200	62,000	3,500,000
	09/29/09	N	---	250,000	ND (20)	11,000	1,200	---	2,500,000
	12/16/09	N	---	350,000	56	13,000	1,900	---	3,500,000

TABLE C2-2

Groundwater Sample Results: Contract Laboratory Program Inorganics

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			Contract Laboratory Program (CLP) Inorganics (µg/L)						
	Background[1]:		**55.8**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Location	**Date**	**Sample Type**	**Aluminum, dissolved**	**Calcium, dissolved**	**Iron, dissolved**	**Magnesium, dissolved**	**Manganese, dissolved**	**Potassium, dissolved**	**Sodium, dissolved**
MW-62-190 (Site E)	12/16/10	N	---	370,000	49	14,000	1,300	69,000	3,300,000
	05/05/11	N	---	---	---	---	1,000	---	---
	09/29/11	N	---	---	---	---	1,100	---	---
	12/14/11	N	ND (100J)	310,000	35	13,000	920	42,000	3,500,000
	02/16/12	N	---	---	---	---	840	---	---
	05/10/12	N	---	---	---	---	760	---	---
	09/13/12	N	---	---	---	---	790	---	---
	12/11/12	N	---	320,000	46	12,000	710	---	4,200,000
	02/26/13	N	---	---	---	---	620	---	---
MW-63-065 (Site E-Alt2)	04/15/09	N	---	150,000	ND (500)	21,000	520	26,000	1,200,000
	07/20/09	N	ND (200)	200,000	ND (40)	21,000	240	33,000	1,200,000
	07/20/09	FD	ND (200)	200,000	ND (40)	21,000	230	32,000	1,200,000
	09/22/09	N	---	200,000	56	23,000	150	---	1,200,000
	09/22/09	FD	---	200,000	52	22,000	170	---	1,300,000
	12/09/09	N	---	190,000	34	20,000	110	---	1,100,000
	12/09/09	FD	---	190,000	25	20,000	91	---	1,100,000
	12/06/10	N	---	230,000	26	23,000	57	27,000	1,300,000
	05/03/11	N	---	---	---	---	43	---	---
	09/28/11	N	---	---	---	---	15	---	---
	12/12/11	N	**270 J**	180,000	510	20,000	51	17,000	1,100,000
	02/13/12	N	**---**	---	---	---	44	---	---
	04/26/12	N	**---**	---	---	---	30	---	---
	09/10/12	N	**---**	---	---	---	11	---	---
	11/07/12	N	**---**	230,000	24	23,000	140	---	1,400,000
	02/06/13	N	**---**	---	---	---	3.4	---	---
MW-64BR Flute (Upper Zone) (C-Alt)	07/22/09	N	ND (200)	230,000	50	15,000	470	36,000	1,400,000
	09/29/09	N	---	310,000	130	18,000	1,300	---	1,800,000

TABLE C2-2

Groundwater Sample Results: Contract Laboratory Program Inorganics

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			Contract Laboratory Program (CLP) Inorganics (µg/L)						
	Background[1]:		55.8	NE	NE	NE	NE	NE	NE
Location	Date	Sample Type	Aluminum, dissolved	Calcium, dissolved	Iron, dissolved	Magnesium, dissolved	Manganese, dissolved	Potassium, dissolved	Sodium, dissolved
MW-64BR Flute (Upper Zone) (C-Alt)	12/16/09	N	---	350,000	260	17,000	1,100	---	2,000,000
MW-64BR Flute (Middle Zone) (C-Alt)	07/22/09	N	ND (200)	330,000	ND (40)	15,000	270	47,000	2,100,000
	09/29/09	N	---	430,000	39	18,000	810	---	2,600,000
	12/16/09	N	---	450,000	170	16,000	710	---	3,100,000
MW-64BR Flute (Lower Zone) (C-Alt)	07/22/09	N	ND (200)	270,000	130	17,000	330	41,000	1,600,000
	09/29/09	N	---	390,000	28	19,000	1,200	---	2,300,000
	12/16/09	N	---	450,000	78	20,000	1,300	---	3,000,000
MW-64BR Packer (Upper Zone) (C-Alt)	11/14/11	N	---	---	---	---	430	---	---
	12/12/11	N	ND (50J)	440,000	ND (20J)	21,000	330	35,000	2,200,000
MW-64BR Packer (Lower Zone) (C-Alt)	11/17/11	N	---	---	---	---	77	---	---
	12/15/11	N	ND (100J)	420,000	ND (20)	12,000	67	37,000	3,400,000
MW-65-160 (Site 5)	06/13/11	N	---	210,000	46	37,000	590	23,000	510,000
	07/11/11	N	---	250,000	40	36,000	570	18,000	580,000
	08/09/11	N	---	230,000	46	35,000	490	15,000	540,000
	08/09/11	FD	---	230,000	64	35,000	500	14,000	520,000
	09/07/11	N	---	240,000	ND (20)	35,000	480	17,000	550,000
	10/17/11	N	---	220,000	ND (20)	35,000	530	11,000	550,000
	11/15/11	N	ND (50)	240,000	ND (20)	36,000	480	15,000	550,000
	12/15/11	N	ND (50J)	260,000	ND (20)	38,000	470	17,000	590,000
	02/16/12	N	---	---	---	---	250	---	---
	05/01/12	N	---	---	---	---	140	---	---
	09/18/12	N	---	---	---	---	68	---	---
	12/04/12	N	---	250,000	ND (20)	33,000	33	---	550,000
	02/19/13	N	---	---	---	---	26	---	---
MW-65-225 (Site 5)	06/13/11	N	---	430,000	ND (20)	24,000	1,100	59,000	2,800,000
	07/11/11	N	---	490,000	ND (20)	25,000	570	45,000	2,700,000
	08/09/11	N	---	420,000	ND (20)	24,000	470	32,000	2,100,000

TABLE C2-2

Groundwater Sample Results: Contract Laboratory Program Inorganics

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			Contract Laboratory Program (CLP) Inorganics (µg/L)						
	Background[1]:		55.8	NE	NE	NE	NE	NE	NE
Location	Date	Sample Type	Aluminum, dissolved	Calcium, dissolved	Iron, dissolved	Magnesium, dissolved	Manganese, dissolved	Potassium, dissolved	Sodium, dissolved
MW-65-225 (Site 5)	09/07/11	N	---	410,000	ND (20)	23,000	430	39,000	2,400,000
	10/17/11	N	---	410,000	ND (20)	25,000	370	35,000	2,600,000
	11/15/11	N	ND (50)	370,000	ND (20)	22,000	310	32,000	2,400,000
	11/15/11	FD	ND (50)	370,000	ND (20)	22,000	320	33,000	2,500,000
	12/15/11	N	ND (50J)	400,000	ND (20)	22,000	240	33,000	2,200,000
	02/16/12	N	---	---	---	---	190	---	---
	05/02/12	N	---	---	---	---	140	---	---
	09/18/12	N	---	---	---	---	91	---	---
	12/05/12	N	---	310,000	ND (100)	20,000	49	---	1,800,000
	02/19/13	N	---	---	---	---	5.8	---	---
MW-66-165 (Site 6)	06/13/11	N	---	230,000 J	ND (20)	46,000	130	21,000 J	570,000 J
	07/12/11	N	---	260,000	63	46,000	130	13,000	630,000
	07/12/11	FD	---	260,000	73	46,000	130	14,000	670,000
	08/09/11	N	---	240,000	ND (20)	45,000	100	12,000	610,000
	10/18/11	N	---	260,000	ND (20)	50,000	72	14,000	580,000
	11/15/11	N	ND (50)	250,000	ND (20)	49,000	52	14,000	600,000
	12/15/11	N	ND (50J)	290,000	ND (20)	55,000	35	16,000	620,000
	02/17/12	N	---	---	---	---	12	---	---
	05/02/12	N	---	---	---	---	ND (2.5)	---	---
	09/17/12	N	---	---	---	---	ND (2.5)	---	---
	12/06/12	N	---	270,000	ND (20)	52,000	ND (0.5)	---	550,000
	02/20/13	N	---	---	---	---	ND (0.5)	---	---
MW-66-230 (Site 6)	06/14/11	N	---	360,000	ND (20)	7,200	45	69,000	3,700,000
	07/12/11	N	---	420,000	ND (20)	7,200	45	54,000	3,900,000
	08/10/11	N	---	350,000	ND (20)	7,100	45	41,000	3,200,000
	10/19/11	N	---	400,000	ND (20)	7,400	50	47,000	3,800,000
	11/17/11	N	---	370,000	ND (20)	7,200	46	45,000	4,000,000

TABLE C2-2

Groundwater Sample Results: Contract Laboratory Program Inorganics

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			Contract Laboratory Program (CLP) Inorganics (µg/L)						
	Background[1]:		55.8	NE	NE	NE	NE	NE	NE
Location	Date	Sample Type	Aluminum, dissolved	Calcium, dissolved	Iron, dissolved	Magnesium, dissolved	Manganese, dissolved	Potassium, dissolved	Sodium, dissolved
MW-66-230 (Site 6)	12/15/11	N	ND (100J)	410,000	ND (20)	8,100	33	47,000	3,900,000
	02/22/12	N	---	---	---	---	41	---	---
	05/10/12	N	---	---	---	---	27	---	---
	05/10/12	FD	---	---	---	---	29	---	---
	09/17/12	N	---	---	---	---	26	---	---
	12/10/12	N	---	430,000	ND (20)	5,900	18	---	4,100,000
	02/21/13	N	---	---	---	---	ND (2.5)	---	---
MW-66BR-270 (Site 6)	11/17/11	N	---	230,000	32	590	ND (10)	72,000	3,700,000
	01/16/12	N	---	260,000	34	530 J	ND (10)	74,000	3,500,000
	03/07/12	N	---	---	---	---	11	---	---
	05/24/12	N	---	---	---	---	73	---	---
	10/02/12	N	---	---	---	---	ND (0.5)	---	---
	12/20/12	N	---	87,000	ND (40)	21,000	41	---	3,600,000
	03/12/13	N	---	---	---	---	ND (0.5)	---	---
MW-67-185 (Site 2)	10/18/11	N	---	130,000	ND (20)	28,000	150	12,000	570,000
	10/18/11	FD	---	140,000	27	29,000	160	12,000	580,000
	11/16/11	N	---	140,000	ND (20)	30,000	92	13,000	660,000
	12/14/11	N	ND (50J)	170,000	ND (20)	34,000	69	14,000	700,000
	02/21/12	N	---	---	---	---	31	---	---
	05/03/12	N	---	---	---	---	8.3	---	---
	09/20/12	N	---	---	---	---	5.6	---	---
	12/06/12	N	---	200,000	ND (20)	40,000	ND (0.5)	---	710,000
	02/21/13	N	---	---	---	---	ND (0.5)	---	---
	02/21/13	FD	---	---	---	---	ND (0.5)	---	---
MW-67-225 (Site 2)	05/16/11	N	ND (50)	150,000	160 J	9,200	230	28,000 J	1,200,000
	05/16/11	FD	ND (50)	150,000	ND (20J)	9,200	230	29,000	1,200,000
	06/14/11	N	---	150,000	ND (20)	10,000	240	32,000	1,400,000

TABLE C2-2

Groundwater Sample Results: Contract Laboratory Program Inorganics

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			Contract Laboratory Program (CLP) Inorganics (µg/L)						
	Background[1]:		55.8	NE	NE	NE	NE	NE	NE
Location	Date	Sample Type	Aluminum, dissolved	Calcium, dissolved	Iron, dissolved	Magnesium, dissolved	Manganese, dissolved	Potassium, dissolved	Sodium, dissolved
MW-67-225 (Site 2)	07/12/11	N	---	190,000	ND (20)	12,000	240	26,000	1,500,000
	08/09/11	N	---	160,000	ND (20)	11,000	210	21,000	1,200,000
	09/08/11	N	---	170,000	42	11,000	190	23,000	1,500,000
	10/19/11	N	---	170,000	ND (20)	11,000	180	22,000	1,500,000
	11/17/11	N	---	160,000	ND (20)	11,000	150	25,000	1,700,000
	12/14/11	N	ND (50J)	180,000	ND (20)	11,000	130	23,000	1,500,000
	02/21/12	N	---	---	---	---	110	---	---
	02/21/12	FD	---	---	---	---	110	---	---
	05/07/12	N	---	---	---	---	83	---	---
	09/20/12	N	---	---	---	---	42	---	---
	12/10/12	N	---	160,000	ND (20)	8,700	32	---	1,500,000
	02/21/13	N	---	---	---	---	ND (0.5)	---	---
MW-67-260 (Site 2)	06/14/11	N	---	250,000	ND (20)	5,100	600	62,000	3,500,000
	07/12/11	N	---	300,000	ND (20)	4,500	550	50,000	3,800,000
	08/09/11	N	---	260,000	ND (20)	4,300	430	35,000	3,100,000
	09/08/11	N	---	280,000	120	4,100	410	46,000	3,800,000
	10/19/11	N	---	280,000	ND (20)	3,900	420	44,000	3,700,000
	11/17/11	N	---	260,000	ND (20)	3,800	370	48,000	3,800,000
	12/14/11	N	ND (100J)	290,000	ND (20)	3,900	280	44,000	3,800,000
	02/21/12	N	---	---	---	---	390	---	---
	05/07/12	N	---	---	---	---	230	---	---
	09/20/12	N	---	---	---	---	190	---	---
	12/06/12	N	---	300,000	ND (100)	3,700	170	---	1,900,000
	02/21/13	N	---	---	---	---	88	---	---
MW-68-180 (Site 3)	06/14/11	N	---	100,000	310 J	14,000	130	17,000	460,000
	06/14/11	FD	---	100,000	1,800 J	14,000	150	17,000	450,000
	07/12/11	N	---	100,000	36	13,000	83	10,000	500,000

TABLE C2-2

Groundwater Sample Results: Contract Laboratory Program Inorganics

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			Contract Laboratory Program (CLP) Inorganics (µg/L)						
	Background[1]:		55.8	NE	NE	NE	NE	NE	NE
Location	Date	Sample Type	Aluminum, dissolved	Calcium, dissolved	Iron, dissolved	Magnesium, dissolved	Manganese, dissolved	Potassium, dissolved	Sodium, dissolved
MW-68-180 (Site 3)	09/08/11	N	---	320,000	ND (20)	36,000	53	15,000	530,000
	10/18/11	N	---	370,000	ND (20)	40,000	35	14,000	520,000
	11/17/11	N	---	380,000	ND (20)	37,000	27	15,000	560,000
	12/15/11	N	ND (50J)	470,000	ND (20)	47,000	18	16,000	590,000
	02/22/12	N	---	---	---	---	ND (10)	---	---
	05/10/12	N	---	---	---	---	ND (2.5)	---	---
	09/20/12	N	---	---	---	---	ND (0.5)	---	---
	12/11/12	N	---	370,000	ND (20)	39,000	ND (0.5J)	---	560,000
	12/11/12	FD	---	370,000	ND (20)	38,000	41 J	---	550,000
	02/21/13	N	---	---	---	---	ND (0.5)	---	---
MW-68-240 (Site 3)	06/14/11	N	---	330,000	260	14,000	360	55,000	2,400,000
	07/12/11	N	---	410,000	ND (20)	15,000	300	45,000	2,700,000
	09/07/11	N	---	450,000	ND (20J)	17,000	270	45,000	3,000,000
	09/07/11	FD	---	450,000	62 J	17,000	270	48,000	3,000,000
	10/18/11	N	---	460,000	ND (20)	18,000	230	39,000	2,900,000
	11/16/11	N	---	440,000	ND (20)	18,000	200	43,000	3,100,000
	12/14/11	N	ND (50J)	480,000	ND (20)	19,000	190	45,000	3,000,000
	02/17/12	N	---	---	---	---	150	---	---
	05/03/12	N	---	---	---	---	140	---	---
	09/20/12	N	---	---	---	---	100	---	---
	12/06/12	N	---	510,000	ND (100)	22,000	94	---	3,300,000
	02/20/13	N	---	---	---	---	82	---	---
MW-68BR-280 (Site 3)	09/08/11	N	---	340,000 J	230	5,400	890	39,000	4,300,000 J
	10/21/11	N	---	320,000	110	5,500 J	540	47,000	4,300,000 J
	11/16/11	N	---	350,000	120	5,300	510	51,000	4,700,000
	12/14/11	N	ND (100J)	370,000	140	6,000	730	51,000	4,500,000
	02/14/12	N	---	---	---	---	340	---	---

TABLE C2-2

Groundwater Sample Results: Contract Laboratory Program Inorganics

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			Contract Laboratory Program (CLP) Inorganics (µg/L)						
	Background[1]:		55.8	NE	NE	NE	NE	NE	NE
Location	Date	Sample Type	Aluminum, dissolved	Calcium, dissolved	Iron, dissolved	Magnesium, dissolved	Manganese, dissolved	Potassium, dissolved	Sodium, dissolved
MW-68BR-280 (Site 3)	05/09/12	N	---	---	---	---	270	---	---
	10/03/12	N	---	---	---	---	220	---	---
	11/12/12	N	---	370,000	ND (100)	5,400	300	---	4,600,000
	02/18/13	N	---	---	---	---	180	---	---
MW-69-195 (Site 4)	07/11/11	N	---	160,000	ND (20)	17,000	280	11,000	550,000
	08/09/11	N	---	160,000	33	17,000	190	11,000	460,000
	09/07/11	N	---	170,000	ND (20)	17,000	140	11,000	560,000
	10/18/11	N	---	170,000	ND (20)	19,000	79	11,000	590,000
	11/15/11	N	ND (50)	160,000	23	19,000	52	11,000	610,000
	12/14/11	N	ND (50J)	180,000	ND (20)	18,000	24	12,000	700,000
	02/17/12	N	---	---	---	---	14	---	---
	05/02/12	N	---	---	---	---	6.7	---	---
	09/19/12	N	---	---	---	---	3.9	---	---
	12/05/12	N	---	140,000	ND (20)	14,000	1.8	---	650,000
	02/20/13	N	---	---	---	---	ND (0.5)	---	---
MW-70-105 (Site H)	06/13/11	N	---	29,000	36	5,200	190	14,000	370,000
	07/11/11	N	---	40,000	40	6,100	200	9,500	420,000
	08/08/11	N	---	46,000	50	6,300	210	9,200	450,000
	09/06/11	N	---	50,000	22	6,600	200	10,000	460,000 J
	11/14/11	N	ND (50)	53,000	31	7,100	220	11,000	510,000
	12/12/11	N	ND (100)	66,000	ND (40)	7,700	230	13,000	510,000
	02/16/12	N	---	---	---	---	230	---	---
	05/01/12	N	---	---	---	---	220	---	---
	09/12/12	N	---	---	---	---	220	---	---
	12/04/12	N	---	81,000	32	8,600	210	---	580,000
	02/19/13	N	---	---	---	---	210	---	---
MW-70BR-225 (Site H)	11/16/11	N	---	600,000	ND (20)	30,000	ND (10)	33,000	2,500,000

TABLE C2-2

Groundwater Sample Results: Contract Laboratory Program Inorganics

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			Contract Laboratory Program (CLP) Inorganics (µg/L)						
	Background[1]:		55.8	NE	NE	NE	NE	NE	NE
Location	Date	Sample Type	Aluminum, dissolved	Calcium, dissolved	Iron, dissolved	Magnesium, dissolved	Manganese, dissolved	Potassium, dissolved	Sodium, dissolved
MW-70BR-225 (Site H)	12/15/11	N	ND (50J)	650,000	ND (20)	31,000	ND (10)	33,000	2,300,000
	02/16/12	N	---	---	---	---	ND (10)	---	---
	05/17/12	N	---	---	---	---	ND (0.5)	---	---
	05/17/12	FD	---	---	---	---	ND (0.5)	---	---
	09/18/12	N	---	---	---	---	ND (0.5)	---	---
	12/13/12	N	---	660,000	ND (20)	31,000	ND (0.5)	---	2,400,000
	02/26/13	N	---	---	---	---	ND (2.5)	---	---
MW-71-035 (Site L)	11/15/11	N	---	220,000	60	24,000 J	350	32,000	1,200,000
	12/14/11	N	ND (50J)	300,000	ND (20J)	27,000	400	39,000	1,300,000
	02/15/12	N	---	---	---	---	340	---	---
	05/03/12	N	---	---	---	---	65	---	---
	09/19/12	N	---	---	---	---	190	---	---
	11/08/12	N	---	300,000	ND (20)	23,000	69	---	71,000
	02/07/13	N	---	---	---	---	51	---	---
MW-72-080 (Site K)	09/06/11	N	---	250,000	100	12,000	190	30,000	2,200,000
	10/17/11	N	---	320,000	28	11,000	370	34,000	3,100,000
	11/14/11	N	ND (50)	300,000	33	10,000	340	41,000	3,100,000
	12/15/11	N	ND (100J)	360,000	ND (20)	11,000	240	35,000	3,200,000
	02/13/12	N	---	---	---	---	200	---	---
	05/01/12	N	---	---	---	---	210	---	---
	09/19/12	N	---	---	---	---	120	---	---
	12/05/12	N	---	350,000	ND (100)	9,600	100	---	3,200,000
	02/19/13	N	---	---	---	---	81	---	---
MW-72BR-200 (Site K)	09/13/12	N	---	270,000 J	ND (40)	3,100 J	28	39,000 J	3,100,000
	09/13/12	FD	---	280,000	ND (40)	3,200	30	34,000	3,100,000
	11/14/12	N	---	280,000	ND (40)	3,100	15	---	3,100,000
	02/07/13	N	---	---	---	---	9.1	---	---

TABLE C2-2

Groundwater Sample Results: Contract Laboratory Program Inorganics

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			Contract Laboratory Program (CLP) Inorganics (µg/L)						
	Background[1] :		**55.8**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Location	**Date**	**Sample Type**	**Aluminum, dissolved**	**Calcium, dissolved**	**Iron, dissolved**	**Magnesium, dissolved**	**Manganese, dissolved**	**Potassium, dissolved**	**Sodium, dissolved**
MW-73-080 (Site I)	11/15/11	N	ND (50)	340,000	ND (20)	28,000	60	21,000	1,600,000
	12/14/11	N	ND (50J)	410,000	71	31,000	53	20,000	1,700,000
	02/14/12	N	---	---	---	---	37	---	---
	05/02/12	N	---	---	---	---	33	---	---
	09/13/12	N	---	---	---	---	22	---	---
	12/05/12	N	---	440,000	ND (100)	34,000	21	---	2,000,000
	02/19/13	N	---	---	---	---	ND (0.5)	---	---
MW-74-240 (Site J)	01/16/12	N	---	3,900	86	ND (100J)	ND (10)	36,000	300,000
	02/17/12	N	---	---	---	---	ND (10)	---	---
	05/10/12	N	---	---	---	---	ND (2.5)	---	---
	09/27/12	N	---	---	---	---	4.9	---	---
	12/20/12	N	---	11,000 J	160	1,200 J	3.3	---	190,000
	12/20/12	FD	---	8,800 J	170	950 J	3.3	---	200,000
	03/01/13	N	---	---	---	---	ND (0.5)	---	---

Notes:

1 Site background concentration is the 95% upper tolerance limit (UTL) of the elevated percentile from the Steps 3 and 4 Groundwater Background Study Report (CH2M HILL, 2008)

Results greater than or equal to the Background levels are bolded

-- = not analyzed

µg/L = micrograms per liter

J = concentration or reporting limit estimated by laboratory or data validation

ND = not detected at the listed reporting limit

TABLE C2-3

Groundwater Sample Results: Detected Organics

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

Location	Date	Sample Type	Organics (µg/L)								
			Acetone	Benzene	Benzoic acid	Carbon disulfide	Chloro methane	Chloroform	m+p-Xylenes	Toluene	Xylenes, total
MW-23-060 (MW-23)	07/21/09	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
MW-23-080 (MW-23)	07/21/09	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
MW-57-050 (Site B)	02/17/10	N	ND (10J)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
MW-57-070 (Site B)	02/11/09	N	ND (10J)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	06/10/09	N	---	---	ND (50)	---	---	---	---	---	---
	07/21/09	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
MW-57-185 (Site B)	07/20/09	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
MW-58-065 (Site A)	02/17/10	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
MW-58BR Flute (Upper Zone) (Site A)	07/22/09	N	**10 R**	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	**61 R**	ND (2)
MW-58BR Flute (Lower Zone) (Site A)	07/22/09	N	**15 R**	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	**21 R**	ND (2)
MW-58BR Packer (Shallow Set) Upper Zone (Site A)	09/14/10	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	**9.4**	ND (2)
	10/06/10	N	ND (10J)	ND (1J)	---	ND (1J)	ND (1J)	ND (1J)	ND (1J)	**9.3 J**	ND (2J)
MW-58BR Packer (Shallow Set) Lower Zone (Site A)	09/16/10	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	10/07/10	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
MW-58BR Packer (Deeper Set) Upper Zone (Site A)	02/01/11	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	**57**	ND (2)
	03/18/11	N	ND (10J)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	07/06/11	N	ND (10)	**1.1**	---	ND (1)	ND (1)	ND (1)	**1.4**	**16**	ND (2)
	08/02/11	N	ND (10)	**1.2**	---	ND (1)	ND (1)	ND (1)	**2.1**	**2.9**	**3**
	08/30/11	N	ND (10)	ND (1)	---	**1.6**	ND (1)	ND (1)	**1.5**	ND (2.5)	**2.1**
	10/11/11	N	ND (10J)	ND (1)	---	ND (1)	ND (1J)	ND (1)	**1.4**	ND (2.5)	**2.1**
	11/08/11	N	ND (10)	ND (1)	---	**2.1**	ND (1)	**1.6**	**1.8**	ND (2.5)	**2.4**
	12/08/11	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	**1.3**	ND (2.5)	**2.2**
MW-58BR Packer (Deeper Set) Lower Zone (Site A)	02/10/11	N	ND (10J)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	04/04/11	N	ND (10J)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	07/07/11	N	ND (10J)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	08/23/11	N	ND (10J)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	08/31/11	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	10/13/11	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	11/09/11	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)

TABLE C2-3

Groundwater Sample Results: Detected Organics

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			Organics (µg/L)								
Location	**Date**	**Sample Type**	**Acetone**	**Benzene**	**Benzoic acid**	**Carbon disulfide**	**Chloro methane**	**Chloroform**	**m+p-Xylenes**	**Toluene**	**Xylenes, total**
MW-58BR Packer (Deeper Set) Lower Zone (Site A)	12/09/11	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
MW-59-100 (Site G)	03/18/09	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	06/10/09	N	---	---	ND (50)	---	---	---	---	---	---
	07/22/09	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	07/22/09	FD	ND (10J)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
MW-60-125 (Site F)	03/20/09	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	07/21/09	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
MW-60BR-245 (Site F)	08/09/11	N	ND (10J)	ND (1)	ND (51)	ND (1)	ND (1J)	ND (1)	ND (1)	ND (2.5)	ND (2)
	12/14/11	N	---	---	---	---	---	---	---	---	---
MW-61-110 (Site C)	03/23/09	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	07/21/09	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
MW-62-065 (Site E)	03/27/09	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	07/22/09	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
MW-62-110 (Site E)	07/22/09	N	**49 R**	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	**27 R**	ND (2)
MW-62-190 (Site E)	07/22/09	N	**25 R**	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	**8.6 R**	ND (2)
MW-63-065 (Site E-Alt2)	04/15/09	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	07/20/09	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	07/20/09	FD	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
MW-64BR Open Borehole (C-Alt)	12/20/10	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
MW-64BR Flute (Upper Zone) (C-Alt)	07/22/09	N	**39 R**	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	**14 R**	ND (2)
MW-64BR Flute (Middle Zone) (C-Alt)	07/22/09	N	**31 R**	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	**21 R**	ND (2)
MW-64BR Flute (Lower Zone) (C-Alt)	07/22/09	N	**50 R**	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	**25 R**	ND (2)
MW-64BR Packer (Upper Zone) (C-Alt)	01/26/11	N	ND (10J)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	**18**	ND (2)
	04/12/11	N	ND (10J)	ND (1)	---	**1.1**	ND (1)	ND (1)	ND (1)	**58 J**	ND (2)
	07/11/11	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	08/15/11	N	ND (10J)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	09/12/11	N	ND (10J)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	10/24/11	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	11/14/11	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)

TABLE C2-3

Groundwater Sample Results: Detected Organics

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

Location	Date	Sample Type	Organics (µg/L)								
			Acetone	Benzene	Benzoic acid	Carbon disulfide	Chloro methane	Chloroform	m+p-Xylenes	Toluene	Xylenes, total
MW-64BR Packer (Upper Zone) (C-Alt)	12/12/11	N	ND (10J)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
MW-64BR Packer (Lower Zone) (C-Alt)	02/24/11	N	ND (10J)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	04/20/11	N	**15 J**	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	**14**	ND (2)
	07/21/11	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	08/18/11	N	**11**	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	09/15/11	N	ND (10J)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	10/27/11	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	11/17/11	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	12/15/11	N	ND (10)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
MW-65-160 (Site 5)	06/13/11	N	ND (10)	ND (1)	ND (51)	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
MW-66-165 (Site 6)	06/13/11	N	ND (10J)	ND (1)	ND (51)	ND (1)	ND (1)	**1.8**	ND (1)	ND (2.5)	ND (2)
	12/15/11	N	ND (10)	ND (1)	---	ND (1)	ND (1)	**1.7**	ND (1)	ND (2.5)	ND (2)
MW-66BR-270 (Site 6)	01/16/12	N	**18 J**	ND (1)	---	ND (1)	**1.8**	ND (1)	ND (1)	ND (2.5)	ND (2)
	01/18/12	N	---	---	**250**	---	---	---	---	---	---
MW-67-185 (Site 2)	10/18/11	N	ND (10J)	ND (1)	ND (51)	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	10/18/11	FD	ND (10)	ND (1)	ND (51)	ND (1)	ND (1)	**1**	ND (1)	ND (2.5)	ND (2)
	12/14/11	N	ND (10J)	ND (1)	---	ND (1)	ND (1)	**1**	ND (1)	ND (2.5)	ND (2)
MW-67-225 (Site 2)	06/14/11	N	ND (10)	ND (1)	ND (52)	ND (1)	ND (1)	**1.3**	ND (1)	ND (2.5)	ND (2)
	12/14/11	N	ND (10)	ND (1)	---	ND (1)	ND (1)	**1.6**	ND (1)	ND (2.5)	ND (2)
MW-68-180 (Site 3)	06/14/11	N	ND (10)	ND (1)	ND (51)	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	06/14/11	FD	ND (10)	ND (1)	ND (51)	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
MW-68BR-280 (Site 3)	09/08/11	N	ND (10)	ND (1)	ND (51)	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
MW-69-195 (Site 4)	07/11/11	N	ND (10)	ND (1)	ND (52J)	ND (1)	ND (1)	**1.8**	ND (1)	ND (2.5)	ND (2)
	12/14/11	N	ND (10)	ND (1)	---	ND (1)	ND (1)	**4.1**	ND (1)	ND (2.5)	ND (2)
MW-70-105 (Site H)	06/13/11	N	ND (10)	ND (1)	ND (51)	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
MW-70BR-225 (Site H)	11/16/11	N	ND (10)	ND (1)	ND (51J)	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
MW-71-035 (Site L)	11/15/11	N	ND (10J)	ND (1)	---	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	02/20/12	N	---	---	ND (65)	---	---	---	---	---	---
MW-72-080 (Site K)	09/06/11	N	ND (10J)	ND (1)	ND (51)	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)

TABLE C2-3

Groundwater Sample Results: Detected Organics

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			Organics (µg/L)								
Location	**Date**	**Sample Type**	**Acetone**	**Benzene**	**Benzoic acid**	**Carbon disulfide**	**Chloro methane**	**Chloroform**	**m+p-Xylenes**	**Toluene**	**Xylenes, total**
MW-72BR-200 (Site K)	09/13/12	N	ND (10)	ND (1)	ND (51)	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
	09/13/12	FD	ND (10)	ND (1)	ND (51)	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
MW-73-080 (Site I)	11/15/11	N	ND (10)	ND (1)	ND (50J)	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)
MW-74-240 (Site J)	01/16/12	N	ND (10)	ND (1)	ND (64)	ND (1)	ND (1)	ND (1)	ND (1)	ND (2.5)	ND (2)

Notes:

All other parameters analyzed are not detected.

Detected results are bolded

-- = not analyzed

µg/L = micrograms per liter

J = concentration or reporting limit estimated by laboratory or data validation

ND = not detected at the listed reporting limit

R = Result rejected by laboratory or data validation; should not be used for project decision-making.

TABLE C2-4

Groundwater Sample Results: Polycyclic Aromatic Hydrocarbons

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

Location	Date	Sample Type	Polyaromatic Hydrocarbons (µg/L)																			
			1-Methyl naphthalene	2-Methyl naphthalene	Acena phthene	Acena phthylene	Anthracene	Benzo (a) anthracene	Benzo (a) pyrene	Benzo (b) fluoranthene	Benzo (ghi) perylene	Benzo (k) fluoranthene	Chrysene	Dibenzo (a,h) anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-cd) pyrene	Naphthalene	Phen anthrene	Pyrene	B(a)P Equivalent	PAH High molecular weight	PAH Low molecular weight
MW-57-070 (Site B)	06/10/09	N	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.18)	ND	ND
MW-59-100 (Site G)	06/10/09	N	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.18)	ND	ND
MW-60BR-245 (Site F)	08/09/11	N	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.18)	ND	ND
MW-65-160 (Site 5)	06/13/11	N	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.18)	ND	ND
MW-66-165 (Site 6)	06/13/11	N	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.18)	ND	ND
MW-66BR-270 (Site 6)	01/18/12	N	--	ND (14)	ND (14)	ND (14)	ND (14)	ND (14)	ND (14)	ND (14)	ND (14)	ND (14)	ND (14)	ND (14)	ND (14)	ND (14)	ND (14)	ND (14)	ND (14)	ND (14)	ND (12)	ND	ND
MW-67-185 (Site 2)	10/18/11	N	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.18)	ND	ND
	10/18/11	FD	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.18)	ND	ND
MW-67-225 (Site 2)	06/14/11	N	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.18)	ND	ND
MW-68-180 (Site 3)	06/14/11	N	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.18)	ND	ND
	06/14/11	FD	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.18)	ND	ND
MW-68BR-280 (Site 3)	09/08/11	N	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.18)	ND	ND
MW-69-195 (Site 4)	07/11/11	N	ND (0.2J)	ND (0.2J)	ND (0.2J)	ND (0.2J)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2J)	ND (0.2)	ND (0.2J)	ND (0.2)	ND (0.2)	ND (0.18)	ND	ND
MW-70-105 (Site H)	06/13/11	N	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.18)	ND	ND
MW-70BR-225 (Site H)	11/16/11	N	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.18)	ND	ND
MW-71-035 (Site L)	02/16/12	N	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.23)	ND	ND
	02/20/12	N	--	ND (13)	ND (13)	ND (13)	ND (13)	ND (13)	ND (13)	ND (13)	ND (13)	ND (13)	ND (13)	ND (13)	ND (13)	ND (13)	ND (13)	ND (13)	ND (13)	ND (13)	ND (11)	ND	ND
MW-72-080 (Site K)	09/06/11	N	ND (0.21)	**0.33**	ND (0.21)	ND (0.21J)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	**0.27**	ND (0.21)	ND (0.21)	**0.18**	ND	**0.6**
	12/15/11	N	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.18)	ND	ND
MW-72BR-200 (Site K)	09/13/12	N	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.18)	ND	ND
	09/13/12	FD	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.18)	ND	ND
MW-73-080 (Site I)	11/15/11	N	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.18)	ND	ND
MW-74-240 (Site J)	01/16/12	N	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.22)	ND	ND

Notes:

Detected results are bolded

-- = not analyzed

µg/L = micrograms per liter

J = concentration or reporting limit estimated by laboratory or data validation

ND = not detected at the listed reporting limit

TABLE C2-5

Groundwater Sample Results: Pesticides

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			Pesticides (µg/L)																		
Location	**Date**	**Sample Type**	**4,4-DDD**	**4,4-DDE**	**4,4-DDT**	**Aldrin**	**alpha-BHC**	**alpha-Chlordane**	**beta-BHC**	**delta-BHC**	**Dieldrin**	**Endo sulfan I**	**Endo sulfan II**	**Endosulfan sulfate**	**Endrin**	**Endrin aldehyde**	**gamma-BHC**	**gamma-Chlordane**	**Heptachlor**	**Heptachlor Epoxide**	**Methoxychlor**	**Toxaphene**
MW-57-070 (Site B)	06/10/09	N	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.05)	ND (0.025)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
MW-59-100 (Site G)	06/10/09	N	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.05)	ND (0.025)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
MW-60BR-245 (Site F)	08/09/11	N	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.051)	ND (0.026)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.26)	ND (2.6)
MW-65-160 (Site 5)	06/13/11	N	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.026)	ND (0.026)	ND (0.026)	**0.31**	**0.093**	ND (0.051)	ND (0.026)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.26)	ND (2.6)
	12/15/11	N	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.051)	ND (0.026)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.26)	ND (2.6)
MW-66-165 (Site 6)	06/13/11	N	ND (0.052)	ND (0.052)	ND (0.052)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.052)	ND (0.026)	ND (0.052)	ND (0.052)	ND (0.052)	ND (0.052)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.26)	ND (2.6)
MW-67-185 (Site 2)	10/18/11	N	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.051)	ND (0.025)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
	10/18/11	FD	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.05)	ND (0.025)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
MW-67-225 (Site 2)	06/14/11	N	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.051)	ND (0.025)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
MW-68-180 (Site 3)	06/14/11	N	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.051)	ND (0.026)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.26)	ND (2.6)
	06/14/11	FD	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.051)	ND (0.025)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
MW-68BR-280 (Site 3)	09/08/11	N	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.051)	ND (0.026)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.26)	ND (2.6)
MW-69-195 (Site 4)	07/11/11	N	ND (0.052)	ND (0.052)	ND (0.052)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.052)	ND (0.026)	ND (0.052)	ND (0.052)	ND (0.052)	ND (0.052)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.26)	ND (2.6)
MW-70-105 (Site H)	06/13/11	N	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.051)	ND (0.026)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.26)	ND (2.6)
MW-70BR-225 (Site H)	11/16/11	N	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.051)	ND (0.025)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
MW-71-035 (Site L)	02/16/12	N	ND (0.066)	ND (0.066)	ND (0.066)	ND (0.033)	ND (0.033)	ND (0.033)	ND (0.033)	ND (0.033)	ND (0.066)	ND (0.033)	ND (0.066)	ND (0.066)	ND (0.066)	ND (0.066)	ND (0.033)	ND (0.033)	ND (0.033)	ND (0.033)	ND (0.33)	ND (3.3)
MW-72-080 (Site K)	09/06/11	N	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.051)	ND (0.026)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.26)	ND (2.6)
MW-72BR-200 (Site K)	09/13/12	N	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.051)	ND (0.026)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.26)	ND (2.6)
	09/13/12	FD	ND (0.052)	ND (0.052)	ND (0.052)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.052)	ND (0.026)	ND (0.052)	ND (0.052)	ND (0.052)	ND (0.052)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.26)	ND (2.6)
MW-73-080 (Site I)	11/15/11	N	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.051)	ND (0.026)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.26)	ND (2.6)
MW-74-240 (Site J)	01/16/12	N	ND (0.06)	ND (0.06)	ND (0.06)	ND (0.03)	ND (0.03)	ND (0.03)	ND (0.03)	ND (0.03)	ND (0.06)	ND (0.03)	ND (0.06)	ND (0.06)	ND (0.06)	ND (0.06)	ND (0.03)	ND (0.03)	ND (0.03)	ND (0.03)	ND (0.3)	ND (3)

Notes:

Detected results are bolded

-- = not analyzed

µg/L = micrograms per liter

J = concentration or reporting limit estimated by laboratory or data validation

ND = not detected at the listed reporting limit

TABLE C2-6

Groundwater Sample Results: Herbicides

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			Herbicides (µg/L)									
Location	**Date**	**Sample Type**	**2,4,5-T**	**2,4,5-TP (Silvex)**	**2,4-D**	**2,4-DB**	**Dalapon**	**Dicamba**	**Dichlorprop**	**Dinoseb**	**MCPA**	**MCPP**
MW-60BR-245 (Site F)	08/09/11	N	ND (0.08)	ND (0.08)	ND (0.08J)	ND (0.08J)	ND (0.3J)	ND (0.08J)	ND (0.08)	ND (0.08)	ND (0.08J)	**28 J**
	12/14/11	N	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.42)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)
MW-65-160 (Site 5)	06/13/11	N	ND (0.06J)	ND (0.05J)	ND (0.04J)	ND (0.2J)	ND (0.02J)	ND (0.03J)	ND (0.04J)	ND (0.05J)	ND (10J)	ND (8J)
MW-66-165 (Site 6)	06/13/11	N	ND (0.06)	ND (0.05)	ND (0.04)	ND (0.2)	ND (0.02)	ND (0.03)	ND (0.04)	ND (0.05)	ND (10)	ND (8)
MW-67-185 (Site 2)	10/18/11	N	ND (0.08J)	ND (0.08J)	ND (0.08J)	ND (0.2J)	ND (0.3J)	ND (0.08J)	ND (0.08J)	ND (0.08J)	ND (2J)	**9.7 J**
	10/18/11	FD	ND (0.08J)	ND (0.08J)	ND (0.08J)	ND (0.2J)	ND (0.3J)	ND (0.08J)	ND (0.08J)	ND (0.08J)	ND (2J)	**7.8 J**
	12/14/11	N	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.42)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)
MW-67-225 (Site 2)	06/14/11	N	ND (0.06)	ND (0.05)	ND (0.04)	ND (0.2)	ND (0.02)	ND (0.03)	ND (0.04)	ND (0.05)	ND (10)	ND (8)
MW-68-180 (Site 3)	06/14/11	N	ND (0.06)	ND (0.05)	ND (0.04)	ND (0.2)	ND (0.02)	ND (0.03)	ND (0.04)	ND (0.05)	ND (10)	ND (8)
	06/14/11	FD	ND (0.06)	ND (0.05)	ND (0.04)	ND (0.2)	ND (0.02)	ND (0.03)	ND (0.04)	ND (0.05)	ND (10)	ND (8)
MW-68BR-280 (Site 3)	09/08/11	N	ND (0.08)	ND (0.08)	ND (0.08)	ND (0.2)	ND (1)	ND (0.08)	ND (0.08)	ND (0.08)	ND (30)	ND (30)
MW-69-195 (Site 4)	07/11/11	N	ND (0.08)	ND (0.08)	ND (0.08)	ND (0.08)	--	ND (0.08)	ND (0.08)	ND (0.08)	--	--
	12/14/11	N	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.42)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)
MW-70-105 (Site H)	06/13/11	N	ND (0.06)	ND (0.05)	ND (0.04)	ND (0.2)	ND (0.02)	ND (0.03)	ND (0.04)	ND (0.05)	ND (10)	ND (8)
MW-70BR-225 (Site H)	11/16/11	N	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27J)	ND (0.43J)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)
MW-71-035 (Site L)	02/20/12	N	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.41)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)
MW-72-080 (Site K)	09/06/11	N	ND (0.08)	ND (0.08)	ND (0.08)	ND (0.2)	ND (1)	ND (0.08)	ND (0.08)	ND (0.08)	ND (30)	ND (30)
MW-72BR-200 (Site K)	09/13/12	N	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.43)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)
	09/13/12	FD	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.42)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)
MW-73-080 (Site I)	11/15/11	N	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27J)	ND (0.43J)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)
MW-74-240 (Site J)	01/16/12	N	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.45)	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)

Notes:

Detected results are bolded

-- = not analyzed

µg/L = micrograms per liter

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ND = not detected at the listed reporting limit

TABLE C2-7

Groundwater Sample Results: Polychlorinated Biphenyls

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			Polychlorinated Biphenyls (µg/L)								
Location	**Date**	**Sample Type**	**Aroclor 1016**	**Aroclor 1221**	**Aroclor 1232**	**Aroclor 1242**	**Aroclor 1248**	**Aroclor 1254**	**Aroclor 1260**	**Aroclor 1262**	**Aroclor 1268**
MW-57-070 (Site B)	06/10/09	N	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	--	--
MW-59-100 (Site G)	06/10/09	N	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	--	--
MW-60BR-245 (Site F)	08/09/11	N	ND (0.51)	ND (1)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	--	--
MW-65-160 (Site 5)	06/13/11	N	ND (0.51)	ND (1)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)
MW-66-165 (Site 6)	06/13/11	N	ND (0.52)	ND (1)	ND (0.52)	ND (0.52)	ND (0.52)	ND (0.52)	ND (0.52)	ND (0.52)	ND (0.52)
MW-67-185 (Site 2)	10/18/11	N	ND (0.51)	ND (1)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	--	--
	10/18/11	FD	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	--	--
MW-67-225 (Site 2)	06/14/11	N	ND (0.51)	ND (1)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)
MW-68-180 (Site 3)	06/14/11	N	ND (0.51)	ND (1)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)
	06/14/11	FD	ND (0.51)	ND (1)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)
MW-68BR-280 (Site 3)	09/08/11	N	ND (0.51)	ND (1)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	--	--
MW-69-195 (Site 4)	07/11/11	N	ND (0.52)	ND (1)	ND (0.52)	ND (0.52)	ND (0.52)	ND (0.52)	ND (0.52)	ND (0.52)	ND (0.52)
MW-70-105 (Site H)	06/13/11	N	ND (0.51)	ND (1)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)
MW-70BR-225 (Site H)	11/16/11	N	ND (0.51)	ND (1)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	--	--
MW-71-035 (Site L)	02/16/12	N	ND (0.66J)	ND (1.3J)	ND (0.66J)	ND (0.66J)	ND (0.66J)	ND (0.66J)	ND (0.66J)	--	--
MW-72-080 (Site K)	09/06/11	N	ND (0.51)	ND (1)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	--	--
MW-72BR-200 (Site K)	09/13/12	N	ND (0.51)	ND (1)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	--	--
	09/13/12	FD	ND (0.52)	ND (1)	ND (0.52)	ND (0.52)	ND (0.52)	ND (0.52)	ND (0.52)	--	--
MW-73-080 (Site I)	11/15/11	N	ND (0.51)	ND (1)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	--	--
MW-74-240 (Site J)	01/16/12	N	ND (0.6J)	ND (1.2J)	ND (0.6J)	ND (0.6J)	ND (0.6J)	ND (0.6J)	ND (0.6J)	ND (0.6J)	ND (0.6J)

Notes:

Detected results are bolded

-- = not analyzed

µg/L = micrograms per liter

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ND = not detected at the listed reporting limit

TABLE C2-8

Groundwater Sample Results: Total Petroleum Hydrocarbons

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			Total Petroleum Hydrocarbons (µg/L)		
Location	**Date**	**Sample Type**	**TPH as diesel**	**TPH as gasoline**	**TPH as motor oil**
MW-57-070 (Site B)	06/10/09	N	ND (50)	---	ND (50)
MW-59-100 (Site G)	06/10/09	N	ND (50)	---	ND (50)
MW-60BR-245 (Site F)	08/09/11	N	ND (53)	ND (100)	ND (53)
MW-65-160 (Site 5)	05/14/11	N	ND (51J)	---	ND (51J)
	06/13/11	N	ND (51)	ND (100)	ND (51)
MW-65-225 (Site 5)	05/14/11	N	ND (50)	---	ND (50)
MW-66-165 (Site 6)	05/12/11	N	ND (52)	---	ND (52)
	06/13/11	N	ND (51J)	ND (100)	ND (51)
MW-66-230 (Site 6)	05/12/11	N	ND (51)	---	ND (51)
MW-66BR-270 (Site 6)	01/16/12	N	---	ND (100J)	---
MW-67-185 (Site 2)	10/18/11	N	ND (51)	ND (100)	ND (51)
	10/18/11	FD	ND (51)	ND (100)	ND (51)
MW-67-225 (Site 2)	05/16/11	N	ND (51)	---	ND (51)
	05/16/11	FD	ND (51)	---	ND (51)
	06/14/11	N	ND (51)	ND (100)	ND (51)
MW-67-260 (Site 2)	05/15/11	N	ND (51)	---	ND (51)
MW-68-180 (Site 3)	06/14/11	N	ND (51)	ND (100)	ND (51)
	06/14/11	FD	ND (51)	ND (100)	ND (51)
MW-68-240 (Site 3)	06/11/11	N	ND (50)	ND (100)	ND (50)
MW-68BR-280 (Site 3)	09/08/11	N	**100**	ND (100)	**51**
	12/14/11	N	ND (53)	---	ND (53)
MW-69-195 (Site 4)	07/11/11	N	ND (50)	ND (100)	ND (50)
MW-70-105 (Site H)	06/13/11	N	**75**	ND (100)	ND (51)
	12/12/11	N	ND (52)	---	ND (52)
MW-70BR-225 (Site H)	11/16/11	N	ND (51)	ND (100)	ND (51)
MW-71-035 (Site L)	11/15/11	N	---	ND (100)	---
	02/16/12	N	ND (65)	---	ND (65)
MW-72-080 (Site K)	09/06/11	N	ND (50)	ND (100)	ND (50)
MW-72BR-200 (Site K)	09/13/12	N	ND (51)	ND (100)	ND (51)
	09/13/12	FD	ND (52)	ND (100)	ND (52)
MW-73-080 (Site I)	11/15/11	N	**310**	ND (100)	**490**
	02/14/12	N	ND (50)	---	**82**
MW-74-240 (Site J)	01/16/12	N	**490 J**	ND (100)	**580 J**

Notes:

Detected results are bolded

-- = not analyzed

J = concentration or reporting limit estimated by laboratory or data validation

TABLE C2-9

Groundwater Sample Results: Anions and General Chemistry Parameters

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			General Chemistry (mg/L except where footnoted)																		
Location	**Date**	**Sample Type**	**Alkalinity, bicarbonate as CaCO3**	**Alkalinity, carbonate as CaCO3**	**Alkalinity, hydroxide**	**Alkalinity, total as CaCO3**	**Ammonia as nitrogen**	**Bromide**	**Chloride**	**Deuterium**	**Fluoride**	**Nitrate**	**Nitrate as Nitrogen**	**Nitrate/Nitrite as Nitrogen**	**Nitrite as Nitrogen**	**Ortho phosphate**	**Orthophosphate, dissolved**	**Oxygen 18**	**Specific conductance**	**Sulfate**	**Total dissolved solids**	**Total organic carbon**
MW-23-060 (MW-23)	07/21/09	N	**28**	ND (5)	ND (5)	**28**	ND (0.1)	--	**5,500**	**-75.32**	--	--	**3.9**	--	--	--	--	**-8.96**	--	**540**	**11,000**	**1.6**
	09/24/09	N	**28**	**8.5**	ND (5)	**36**	--	--	**5,800**	--	--	--	**4.6**	--	--	--	--	--	**16,000**	**560**	--	--
	12/10/09	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**15,400**	--	--	--
	03/08/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**10,000**	--	--	--
	05/03/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**14,000**	--	--	--
	12/14/10	N	ND (5)	**32**	**11**	**43**	ND (0.1)	--	**5,200**	--	--	--	**3.7**	--	--	--	--	--	**12,000**	**500**	--	--
	05/04/11	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**15,000**	--	--	--
	09/29/11	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**16,000**	--	--	--
	12/13/11	N	**36**	ND (5)	ND (5)	**36**	ND (0.1)	ND (2.5)	**5,700**	**-71**	ND (5)	--	**5**	--	ND (50)	ND (0.5J)	--	**-8.3**	**16,000**	**640**	**10,000**	ND (1)
	02/14/12	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**16,000**	--	--	--
	04/30/12	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**14,000**	--	--	--
	04/30/12	FD	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**14,000**	--	--	--
	09/12/12	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**16,000**	--	--	--
	11/08/12	N	ND (5)	**26**	**8.6**	**34**	**0.1**	--	**6,000**	--	--	--	--	**5.73**	--	--	--	--	**19,000**	**670**	--	--
	02/18/13	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**17,000**	--	--	--
MW-23-080 (MW-23)	07/21/09	N	ND (5)	**25**	**110**	**140**	ND (0.1)	--	**5,400**	**-73.42**	--	--	**6.3**	--	--	--	--	**-8.67**	--	**650**	**11,000**	**1.7**
	09/23/09	N	ND (5)	**23**	**94**	**120**	--	--	**5,700**	--	--	--	**5.7**	--	--	--	--	--	**16,000**	**660**	--	--
	12/10/09	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**16,500**	--	--	--
	03/08/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**16,000**	--	--	--
	05/04/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**16,600**	--	--	--
	12/14/10	N	ND (5)	**28**	**41**	**70**	**0.27**	--	**5,600**	--	--	--	**3.9**	--	--	--	--	--	**13,000**	**940**	--	--
	05/04/11	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**15,000**	--	--	--
	05/04/11	FD	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**16,000**	--	--	--
	09/29/11	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**16,000**	--	--	--
	12/12/11	N	ND (5)	**18 J**	**22 J**	**41**	**0.18**	ND (2.5)	**5,700**	**-71.8**	ND (10)	--	**4.9**	--	ND (25)	ND (0.5)	--	**-8.4**	**16,000**	**940**	**9,900**	ND (1)
	12/12/11	FD	ND (5)	**39 J**	**11 J**	**50**	**0.11**	ND (2.5)	**5,600**	**-71.8**	ND (10)	--	**4.8**	--	ND (25)	ND (0.5)	--	**-8.4**	**16,000**	**960**	**10,000**	ND (1)
	02/14/12	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**16,000**	--	--	--
	04/30/12	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**15,000**	--	--	--
	09/12/12	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**16,000**	--	--	--
	09/12/12	FD	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**16,000**	--	--	--
	11/08/12	N	ND (5)	**19**	**30**	**49**	**0.1**	--	**5,900**	--	--	--	--	**6.82**	--	--	--	--	**19,000**	**880**	--	--
	02/18/13	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**17,000**	--	--	--
MW-57-050 (Site B)	02/17/10	N	--	--	--	--	--	--	**350**	**-64.75**	--	**3.8**	--	--	--	--	--	**-8.61**	--	**220**	**1,100**	--
MW-57-070 (Site B)	02/11/09	N	**81**	ND (5J)	ND (5)	**81**	ND (0.1)	--	**710**	**-64.5**	--	--	**8**	--	--	--	--	**-8.58**	--	**130 J**	**1,700**	**1.6**
	07/21/09	N	**75**	ND (5J)	ND (5)	**75**	ND (0.1)	--	**840**	**-65.85**	--	--	**9.1**	--	--	--	--	**-9.29**	--	**100**	**2,000**	**1.3**
	09/24/09	N	**81**	ND (5)	ND (5)	**81**	--	--	**930**	--	--	--	**7.1**	--	--	--	--	--	--	**110**	--	--
	12/10/09	N	**78**	ND (5)	ND (5)	**78**	--	--	**880**	--	--	--	**7.2**	--	--	--	--	--	--	**100**	--	--
	03/16/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**1,200**	--	--	--
	05/05/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**1,700**	--	--	--
	12/15/10	N	**100**	ND (5)	ND (5)	**100**	ND (0.1)	--	**520**	--	--	--	**6.2**	--	--	--	--	--	**2,000**	**120**	**1,600**	ND (1)
	12/15/10	FD	**100**	ND (5)	ND (5)	**100**	ND (0.1)	--	**520**	--	--	--	**6.2**	--	--	--	--	--	**1,900**	**120**	**1,600**	ND (1)
	05/05/11	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**2,400**	--	--	--
	05/05/11	FD	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**2,400**	--	--	--

TABLE C2-9

Groundwater Sample Results: Anions and General Chemistry Parameters

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			General Chemistry (mg/L except where footnoted)																		
Location	**Date**	**Sample Type**	**Alkalinity, bicarbonate as CaCO3**	**Alkalinity, carbonate as CaCO3**	**Alkalinity, hydroxide**	**Alkalinity, total as CaCO3**	**Ammonia as nitrogen**	**Bromide**	**Chloride**	**Deuterium**	**Fluoride**	**Nitrate**	**Nitrate as Nitrogen**	**Nitrate/Nitrite as Nitrogen**	**Nitrite as Nitrogen**	**Ortho phosphate**	**Orthophosphate, dissolved**	**Oxygen 18**	**Specific conductance**	**Sulfate**	**Total dissolved solids**	**Total organic carbon**
MW-57-070 (Site B)	09/29/11	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2,400	--	--	--
	12/15/11	N	59	ND (5)	ND (5)	59	ND (0.1)	ND (0.5)	700	-62.7	ND (1)	--	7.4	--	ND (5)	ND (0.1)	--	-8.5	2,500	98	2,200	ND (1)
	02/15/12	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2,800	--	--	--
	05/03/12	N	--	--	--	--	--	--	--	--	--	--	5.2	--	--	--	--	--	2,600	--	--	--
	09/12/12	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2,300	--	--	--
	12/13/12	N	120	ND (5)	ND (5)	120	ND (0.1)	--	510	--	--	--	--	8.35	--	--	--	--	2,100	98 J	--	--
	12/13/12	FD	100	ND (5)	ND (5)	100	ND (0.1)	--	500	--	--	--	--	7.99	--	--	--	--	2,100	120 J	--	--
	02/20/13	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2,100	--	--	--
	02/20/13	FD	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2,100	--	--	--
	03/11/13	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2,200	--	--	--
MW-57-185 (Site B)	07/20/09	N	20	6.3	ND (5)	26	ND (0.1)	--	6,100	-79.12	--	--	ND (2.5)	--	--	--	--	-10.28	--	680	11,000	0.57
	09/23/09	N	18	ND (5)	ND (5)	22	--	--	6,000	--	--	--	ND (5)	--	--	--	--	--	--	700	--	--
	12/09/09	N	23	ND (5)	ND (5)	23	--	--	6,100	--	--	--	ND (2.5)	--	--	--	--	--	--	710	--	--
	03/09/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	17,000	--	--	--
	05/05/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	18,400	--	--	--
	12/09/10	N	20	ND (5)	ND (5)	22	ND (0.1)	--	6,400	--	--	--	ND (2.5)	--	--	--	--	--	16,000	700	11,000	ND (1)
	05/03/11	N	--	--	--	--	--	--	--	--	--	--	ND (2.5)	--	--	--	--	--	17,000	--	--	--
	09/28/11	N	--	--	--	--	--	--	--	--	--	--	ND (2.5)	--	--	--	--	--	17,000	--	--	--
	12/13/11	N	110	ND (5)	ND (5)	110	ND (0.1)	ND (2.5)	6,400	-75.6	ND (10)	--	ND (2.5)	--	ND (50)	ND (0.5)	--	-10.1	18,000	730	11,000	ND (1)
	02/10/12	N	--	--	--	--	--	--	--	--	--	--	ND (2.5)	--	--	--	--	--	17,000	--	--	--
	02/10/12	FD	--	--	--	--	--	--	--	--	--	--	ND (2.5)	--	--	--	--	--	17,000	--	--	--
	04/30/12	N	--	--	--	--	--	--	--	--	--	--	ND (2.5)	--	--	--	--	--	16,000	--	--	--
	09/11/12	N	--	--	--	--	--	--	--	--	--	--	ND (2.5)	--	--	--	--	--	18,000	--	--	--
	11/08/12	N	21	ND (5)	ND (5)	21	--	--	6,600	--	--	--	--	0.0298	--	--	--	--	21,000	740	--	--
	02/06/13	N	--	--	--	--	--	--	--	--	--	--	--	0.0119	--	--	--	--	17,000	--	--	--
MW-58-065 (Site A)	02/17/10	N	--	--	--	--	--	--	45	-77.76	--	ND (0.5)	--	--	--	--	--	-10.06	--	97	370	--
MW-58BR Open Borehole (Deeper) (Site A)	03/25/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7,800	--	--	2.1
	02/28/13	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7,300	--	--	--
MW-58BR Flute (Upper Zone) (Site A)	07/22/09	N	43	ND (5J)	ND (5)	43	ND (0.1)	--	4,000	-77.48	--	--	ND (2.5)	--	--	--	--	-10.41	--	550	7,800	17 J
	09/29/09	N	47	ND (5)	ND (5)	47	--	--	3,000	--	--	--	ND (2.5)	--	--	--	--	--	--	490	--	--
	12/16/09	N	42	ND (5)	ND (5)	42	--	--	2,400	--	--	--	ND (2.5)	--	--	--	--	--	--	420	--	35
MW-58BR Flute (Lower Zone) (Site A)	07/22/09	N	45	ND (5)	ND (5)	45	ND (0.1)	--	2,800	-76.86	--	--	ND (2.5)	--	--	--	--	-10.46	--	490	5,700	18 J
	09/29/09	N	76	ND (5)	ND (5)	76	--	--	2,100	--	--	--	ND (2.5)	--	--	--	--	--	--	370	--	--
	12/16/09	N	100	ND (5)	ND (5)	100	--	--	1,600	--	--	--	ND (1)	--	--	--	--	--	--	280	--	41
MW-58BR Packer (Shallow Set) Upper Zone (Site A)	09/14/10	N	--	--	--	--	--	--	3,600	--	--	--	ND (1)	--	--	--	--	--	--	--	--	ND (1)
	10/06/10	N	--	--	--	--	--	--	3,500	--	--	--	ND (1)	--	--	--	--	--	--	--	6,400	ND (1)
MW-58BR Packer (Shallow Set) Lower Zone (Site A)	09/16/10	N	--	--	--	--	--	--	2,900	--	--	--	1.1	--	--	--	--	--	--	--	--	ND (1)

TABLE C2-9

Groundwater Sample Results: Anions and General Chemistry Parameters

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			General Chemistry (mg/L except where footnoted)																		
Location	**Date**	**Sample Type**	**Alkalinity, bicarbonate as CaCO3**	**Alkalinity, carbonate as CaCO3**	**Alkalinity, hydroxide**	**Alkalinity, total as CaCO3**	**Ammonia as nitrogen**	**Bromide**	**Chloride**	**Deuterium**	**Fluoride**	**Nitrate**	**Nitrate as Nitrogen**	**Nitrate/Nitrite as Nitrogen**	**Nitrite as Nitrogen**	**Ortho phosphate**	**Orthophosphate, dissolved**	**Oxygen 18**	**Specific conductance**	**Sulfate**	**Total dissolved solids**	**Total organic carbon**
MW-58BR Packer (Shallow Set) Lower Zone (Site A)	10/07/10	N	--	--	--	--	--	--	**2,900**	--	--	--	**1.1**	--	--	--	--	--	--	--	**5,700**	ND (1)
MW-58BR Packer (Deeper Set) Upper Zone (Site A)	02/01/11	N	--	--	--	--	--	--	**3,870**	--	--	--	ND (1)	--	--	--	--	--	--	--	**7,100**	ND (1)
	03/18/11	N	--	--	--	--	--	--	**3,900**	--	--	--	ND (1)	--	--	--	--	--	--	--	**6,900**	ND (1)
	07/06/11	N	--	--	--	--	--	--	**3,400**	--	--	--	ND (1)	--	--	--	--	--	--	--	**6,600**	ND (1)
	08/02/11	N	--	--	--	--	--	--	**4,300**	--	--	--	ND (1)	--	--	--	--	--	--	--	**7,400**	ND (1)
	08/30/11	N	--	--	--	--	--	--	**3,100**	--	--	--	ND (2.5)	--	--	--	--	--	--	--	**7,300**	ND (1)
	10/11/11	N	--	--	--	--	--	--	**3,900**	--	--	--	ND (2.5)	--	--	--	--	--	--	--	**7,400**	ND (1)
	11/08/11	N	--	--	--	--	--	--	**2,800**	--	--	--	ND (2.5)	--	--	--	--	--	--	--	**6,200**	ND (1)
	12/08/11	N	**37**	ND (5)	ND (5)	**37**	**0.14**	ND (2.5)	**3,400**	**-76.2**	**2.8 J**	--	ND (2.5)	--	ND (25)	ND (0.5J)	--	**-9.8**	**11,000**	**550**	**6,300**	ND (1)
	02/08/12	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**1,100**	--	--	--
	05/15/12	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**11,000**	--	--	--
	10/03/12	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**10,000**	--	--	--
MW-58BR Packer (Deeper Set) Lower Zone (Site A)	02/10/11	N	--	--	--	--	--	--	**2,600**	--	--	--	**1.2**	--	--	--	--	--	--	--	**5,200**	ND (1)
	04/04/11	N	--	--	--	--	--	--	**2,900**	--	--	--	**1.1**	--	--	--	--	--	--	--	**5,600**	ND (1)
	07/07/11	N	--	--	--	--	--	--	**3,400**	--	--	--	ND (1)	--	--	--	--	--	--	--	**7,000**	ND (1)
	08/23/11	N	--	--	--	--	--	--	**3,200**	--	--	--	ND (1)	--	--	--	--	--	--	--	**5,800**	ND (1)
	08/31/11	N	--	--	--	--	--	--	**3,300**	--	--	--	ND (2.5)	--	--	--	--	--	--	--	**6,600**	ND (1)
	10/13/11	N	--	--	--	--	--	--	**3,000**	--	--	--	ND (2.5)	--	--	--	--	--	--	--	**4,800**	ND (1)
	11/09/11	N	--	--	--	--	--	--	**2,900**	--	--	--	ND (2.5)	--	--	--	--	--	--	--	**6,000**	ND (1)
	12/09/11	N	**37**	ND (5)	ND (5)	**37**	**0.19**	ND (2.5)	**2,600**	**-76.1**	**2.6**	--	ND (2.5)	--	ND (25)	ND (0.5)	--	**-9.8**	**8,400**	**510**	**5,700**	ND (1)
	02/09/12	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**8,900**	--	--	--
	05/16/12	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**11,000**	--	--	--
	10/04/12	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**9,400**	--	--	--
MW-59-100 (Site G)	03/18/09	N	**110**	ND (5)	ND (5)	**110**	ND (0.5)	--	**3,300 J**	**-62.4**	--	--	**4.2**	--	--	--	--	**-7.84**	--	**760 J**	**7,800**	**3.4**
	07/22/09	N	**110**	ND (5)	ND (5)	**110**	ND (0.1)	--	**3,500**	**-62.99**	--	--	**4.4**	--	--	--	--	**-8.4**	--	**750**	**7,500**	ND (0.6J)
	07/22/09	FD	**110**	ND (5)	ND (5)	**110**	ND (0.1)	--	**3,500**	**-62.36**	--	--	**4.5**	--	--	--	--	**-7.79**	--	**750**	**7,500**	**0.8 J**
	09/24/09	N	**100**	ND (5)	ND (5)	**100**	--	--	**3,700**	--	--	--	**4.8**	--	--	--	--	--	--	**780**	--	--
	12/11/09	N	**120**	ND (5)	ND (5)	**120**	--	--	**3,100**	--	--	--	**4.5**	--	--	--	--	--	--	**690**	--	--
	03/17/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**12,000**	--	--	--
	05/06/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**9,890**	--	--	--
	12/16/10	N	**330**	ND (5)	ND (5)	**330**	ND (0.1)	--	**2,800**	--	--	--	**5.9**	--	--	--	--	--	**8,400**	**660**	**6,700**	ND (1)
	05/06/11	N	--	--	--	--	--	--	--	--	--	--	**3.8**	--	--	--	--	--	**10,000**	--	--	--
	10/04/11	N	--	--	--	--	--	--	--	--	--	--	**4**	--	--	--	--	--	**10,000**	--	--	--
	12/15/11	N	**56 J**	ND (5)	ND (5)	**56 J**	ND (0.1)	ND (2.5)	**2,800**	**-59.8**	ND (2.5)	--	**4.3**	--	ND (25)	ND (0.5)	--	**-7.9**	**9,000**	**700**	**5,800**	ND (1)
	12/15/11	FD	**110 J**	ND (5)	ND (5)	**110 J**	ND (0.1)	ND (2.5)	**2,700**	**-60**	ND (10)	--	**4.4**	--	ND (25)	ND (0.5)	--	**-7.6**	**9,100**	**700**	**5,800**	ND (1)
	02/22/12	N	--	--	--	--	--	--	--	--	--	--	**4.1**	--	--	--	--	--	**9,100**	--	--	--
	05/08/12	N	--	--	--	--	--	--	--	--	--	--	**3.2**	--	--	--	--	--	**11,000**	--	--	--
	10/02/12	N	**120**	ND (5)	ND (5)	**120**	--	--	**2,900**	--	--	--	**3.6**	--	--	--	--	--	**9,700**	**660**	--	--
	11/28/12	N	**120**	ND (5)	ND (5)	**120**	ND (0.1)	--	**3,100**	--	--	--	--	**4.52**	--	--	--	--	**9,400**	**680**	--	--

TABLE C2-9

Groundwater Sample Results: Anions and General Chemistry Parameters

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			General Chemistry (mg/L except where footnoted)																		
Location	**Date**	**Sample Type**	**Alkalinity, bicarbonate as CaCO3**	**Alkalinity, carbonate as CaCO3**	**Alkalinity, hydroxide**	**Alkalinity, total as CaCO3**	**Ammonia as nitrogen**	**Bromide**	**Chloride**	**Deuterium**	**Fluoride**	**Nitrate**	**Nitrate as Nitrogen**	**Nitrate/Nitrite as Nitrogen**	**Nitrite as Nitrogen**	**Ortho phosphate**	**Orthophosphate, dissolved**	**Oxygen 18**	**Specific conductance**	**Sulfate**	**Total dissolved solids**	**Total organic carbon**
MW-59-100 (Site G)	02/27/13	N	**120**	ND (5)	ND (5)	**120**	--	--	**3,100**	--	--	--	--	**4.02**	--	--	--	--	**9,800**	**660**	--	--
MW-60-125 (Site F)	03/20/09	N	**58**	ND (5)	ND (5)	**58**	ND (0.5)	--	**2,500**	**-70.5**	--	--	**4.4**	--	--	--	--	**-9.28**	--	**450 J**	**5,400**	**1.2**
	07/21/09	N	**77**	ND (5)	ND (5)	**77**	ND (0.1)	--	**2,600**	**-72.73**	--	--	**3.3**	--	--	--	--	**-9.51**	--	**390**	**5,200**	**0.42**
	09/24/09	N	**62**	ND (5)	ND (5)	**62**	--	--	**2,600**	--	--	--	**3.7**	--	--	--	--	--	--	**420**	--	--
	12/10/09	N	**62**	ND (5)	ND (5)	**62**	--	--	**2,400**	--	--	--	**3.2**	--	--	--	--	--	--	**400**	--	--
	03/17/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**8,800**	--	--	--
	05/06/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**9,080**	--	--	--
	12/16/10	N	**51**	ND (5)	ND (5)	**51**	ND (0.1)	--	**2,700**	**-71.8**	--	--	**3.6**	--	--	--	--	**-9.3**	**8,000**	**450**	**6,100**	ND (1)
	12/16/10	FD	**52**	ND (5)	ND (5)	**52**	ND (0.1)	--	**2,700**	**-72.4**	--	--	**3.3**	--	--	--	--	**-8.9**	**8,000**	**440**	**5,800**	ND (1)
	05/05/11	N	--	--	--	--	--	--	--	--	--	--	**3.6**	--	--	--	--	--	**8,700**	--	--	--
	10/04/11	N	--	--	--	--	--	--	--	--	--	--	**2.6**	--	--	--	--	--	**8,200**	--	--	--
	12/14/11	N	**80**	ND (5)	ND (5)	**80**	ND (0.1)	ND (1)	**2,600**	**-70.2**	ND (2.5)	--	**3.4**	--	ND (25)	ND (0.2J)	--	**-9**	**8,100**	**440**	**5,200**	ND (1)
	02/15/12	N	--	--	--	--	--	--	--	--	--	--	**3.5**	--	--	--	--	--	**19,000**	--	--	--
	05/03/12	N	--	--	--	--	--	--	--	--	--	--	**3**	--	--	--	--	--	**8,400**	--	--	--
	09/20/12	N	--	--	--	--	--	--	--	--	--	--	**2.9**	--	--	--	--	--	**9,600**	--	--	--
	12/06/12	N	**46**	ND (5)	ND (5)	**46**	ND (0.1)	--	**2,800**	--	--	--	--	**4.26**	--	--	--	--	**8,700**	**460**	--	--
	02/20/13	N	--	--	--	--	--	--	--	--	--	--	--	**4.26**	--	--	--	--	**8,400**	--	--	--
MW-60BR-245 (Site F)	08/09/11	N	**23**	ND (5)	ND (5)	**23**	ND (0.1)	ND (2.5)	**5,600**	--	ND (10)	--	ND (2.5)	--	ND (50)	ND (0.5)	--	--	--	**740**	**4,400**	ND (1)
	09/07/11	N	**24**	ND (5)	ND (5)	**24**	ND (0.1)	ND (2.5)	**5,800**	--	**12**	--	ND (2.5)	--	ND (50)	ND (0.5)	--	--	--	**750**	**9,700**	ND (1)
	11/16/11	N	**28**	ND (5)	ND (5)	**28**	ND (0.1)	ND (2.5)	**5,700**	--	**7.6**	--	ND (2.5)	--	ND (50)	ND (0.5)	--	--	--	**780**	**10,000**	ND (1)
	12/14/11	N	**37**	ND (5)	ND (5)	**37**	ND (0.1)	ND (2.5)	**5,700**	**-75**	**6.9**	--	ND (2.5)	--	ND (50)	ND (0.5)	--	**-9.8**	**17,000**	**740**	**9,600**	ND (1)
	02/16/12	N	--	--	--	--	--	--	--	--	--	--	ND (2.5)	--	--	--	--	--	**17,000**	--	--	--
	05/17/12	N	--	--	--	--	--	--	--	--	--	--	ND (2.5)	--	--	--	--	--	**17,000**	--	--	--
	09/19/12	N	--	--	--	--	--	--	--	--	--	--	ND (2.5)	--	--	--	--	--	**18,000**	--	--	--
	12/05/12	N	**22**	ND (5)	ND (5)	**22**	ND (0.1)	--	**6,100**	--	--	--	--	**0.231**	--	--	--	--	**17,000**	**770**	--	--
	03/14/13	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**16,000**	--	--	--
	03/14/13	FD	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**16,000**	--	--	--
MW-61-110 (Site C)	03/23/09	N	**52**	ND (5J)	ND (5)	**52**	ND (0.5)	--	**4,700**	**-75.7**	--	--	ND (2.5)	--	--	--	--	**-9.86**	--	**620 J**	**9,100**	**3.3**
	07/21/09	N	**51**	ND (5)	ND (5)	**51**	**0.15**	--	**5,200**	**-76.54**	--	--	ND (2.5)	--	--	--	--	**-10.02**	--	**640**	**9,600**	**1.9**
	09/24/09	N	**46**	ND (5J)	ND (5)	**46**	--	--	**5,200**	--	--	--	ND (5)	--	--	--	--	--	--	**690**	--	--
	12/10/09	N	**42**	ND (5)	ND (5)	**42**	--	--	**4,900**	--	--	--	ND (2.5)	--	--	--	--	--	--	**660**	--	--
	03/17/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**15,000**	--	--	--
	05/06/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**15,500**	--	--	--
	12/15/10	N	**43**	ND (5)	ND (5)	**43**	**0.14**	--	**5,400**	--	--	--	ND (2.5)	--	--	--	--	--	**14,000**	**670**	**9,200**	ND (1)
	05/05/11	N	--	--	--	--	--	--	--	--	--	--	ND (2.5)	--	--	--	--	--	**15,000**	--	--	--
	09/30/11	N	--	--	--	--	--	--	--	--	--	--	ND (2.5)	--	--	--	--	--	**15,000**	--	--	--
	12/14/11	N	**13**	**14**	ND (5)	**27**	ND (0.1)	ND (2.5)	**5,300**	**-72.2**	ND (5)	--	ND (2.5)	--	ND (50)	ND (0.5)	--	**-9.4**	**15,000**	**700**	**8,700**	ND (1)
	02/15/12	N	--	--	--	--	--	--	--	--	--	--	ND (2.5)	--	--	--	--	--	**29,000**	--	--	--
	05/03/12	N	--	--	--	--	--	--	--	--	--	--	ND (2.5)	--	--	--	--	--	**16,000**	--	--	--
	09/27/12	N	**45**	ND (5)	ND (5)	**45**	--	--	**5,400**	--	--	--	ND (2.5)	--	--	--	--	--	**17,000**	**690**	--	--
	09/27/12	FD	**46**	ND (5)	ND (5)	**46**	--	--	**5,300**	--	--	--	ND (2.5)	--	--	--	--	--	**17,000**	**700**	--	--
	11/27/12	N	**46**	ND (5)	ND (5)	**46**	**0.37 J**	--	**5,500**	--	--	--	--	**0.866**	--	--	--	--	**15,000**	**680**	--	--
	11/27/12	FD	**43**	ND (5)	ND (5)	**43**	ND (0.1J)	--	**5,500**	--	--	--	--	**0.899**	--	--	--	--	**15,000**	**700**	--	--

TABLE C2-9

Groundwater Sample Results: Anions and General Chemistry Parameters

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			General Chemistry (mg/L except where footnoted)																		
Location	**Date**	**Sample Type**	**Alkalinity, bicarbonate as CaCO3**	**Alkalinity, carbonate as CaCO3**	**Alkalinity, hydroxide**	**Alkalinity, total as CaCO3**	**Ammonia as nitrogen**	**Bromide**	**Chloride**	**Deuterium**	**Fluoride**	**Nitrate**	**Nitrate as Nitrogen**	**Nitrate/Nitrite as Nitrogen**	**Nitrite as Nitrogen**	**Ortho phosphate**	**Orthophosphate, dissolved**	**Oxygen 18**	**Specific conductance**	**Sulfate**	**Total dissolved solids**	**Total organic carbon**
MW-61-110 (Site C)	02/25/13	N	**53**	ND (5)	ND (5)	**53**	--	--	**5,300**	--	--	--	--	**0.999**	--	--	--	--	**15,000**	**660**	--	--
MW-62-065 (Site E)	03/27/09	N	**110**	ND (5J)	ND (5)	**110**	ND (0.5)	--	**1,900**	**-67**	--	--	**4.8**	--	--	--	--	**-8.91**	--	**400**	**3,800**	**2.7**
	07/22/09	N	**120**	ND (5)	ND (5)	**120**	**0.12**	--	**1,600**	**-70.62**	--	--	**2.9**	--	--	--	--	**-9.75**	--	**360**	**3,600**	**0.95 J**
	09/24/09	N	**130**	ND (5J)	ND (5)	**130**	--	--	**1,600**	--	--	--	**2.5**	--	--	--	--	--	--	**370**	--	--
	12/10/09	N	**130**	ND (5)	ND (5)	**130**	--	--	**1,500**	--	--	--	**2.3**	--	--	--	--	--	--	**350**	--	--
	03/16/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**6,000**	--	--	--
	05/06/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**6,230**	--	--	--
	12/15/10	N	**110**	ND (5)	ND (5)	**110**	ND (0.1)	--	**1,700**	**-68.7**	--	--	**3.6**	--	--	--	--	**-8.7**	**5,800**	**380**	**3,400**	ND (1)
	05/05/11	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**6,000**	--	--	--
	09/29/11	N	--	--	--	--	--	--	--	--	--	--	**3.5**	--	--	--	--	--	**6,300**	--	--	--
	12/13/11	N	**100**	ND (5)	ND (5)	**100**	ND (0.1)	ND (1)	**1,800**	**-66.6**	**3.4**	--	**3.6**	--	ND (25)	ND (0.2)	--	**-8.8**	**3,900**	**400**	**2,900**	ND (1)
	02/17/12	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**6,500**	--	--	--
	05/02/12	N	--	--	--	--	--	--	--	--	--	--	**2.9**	--	--	--	--	--	**6,600**	--	--	--
	09/12/12	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**6,400**	--	--	--
	12/10/12	N	**110**	ND (5)	ND (5)	**110**	ND (0.1)	--	**1,900**	--	--	--	--	**3.7**	--	--	--	--	**6,200**	**410**	--	--
	02/19/13	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**5,400**	--	--	--
MW-62-110 (Site E)	07/22/09	N	**74**	ND (5)	ND (5)	**74**	ND (0.1)	--	**2,500**	**-70.54**	--	--	ND (1)	--	--	--	--	**-9.27**	--	**450**	**5,000**	**25 J**
	09/29/09	N	**82**	ND (5)	ND (5)	**82**	--	--	**2,600**	--	--	--	ND (2.5)	--	--	--	--	--	--	**470**	--	--
	12/16/09	N	**76**	ND (5)	ND (5)	**76**	--	--	**2,400**	--	--	--	ND (2.5)	--	--	--	--	--	--	**470**	--	**31**
	02/10/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**17**
	03/11/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**8,800**	--	--	**13**
	05/04/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**8,640**	--	--	**14**
	09/29/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**15**
	12/16/10	N	**77**	ND (5)	ND (5)	**77**	**0.27**	--	**2,500**	**-65.8**	--	--	**2.8**	--	--	--	--	**-8.1**	**7,900**	**490**	**4,800**	**17**
	02/09/11	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**6.2**
	05/05/11	N	--	--	--	--	--	--	--	--	--	--	**2.5**	--	--	--	--	--	**8,500**	--	--	--
	09/29/11	N	--	--	--	--	--	--	--	--	--	--	**3**	--	--	--	--	--	**8,700**	--	--	**9.9**
	12/14/11	N	**45**	ND (5)	ND (5)	**45**	**0.12**	ND (1)	**2,500**	**-63.8**	**4.3**	--	**3.7**	--	ND (25)	ND (0.2)	--	**-8.1**	**8,400**	**520**	**4,900**	**5.5**
	02/16/12	N	--	--	--	--	--	--	--	--	--	--	**3.2**	--	--	--	--	--	**8,700**	--	--	--
	05/10/12	N	--	--	--	--	--	--	--	--	--	--	**2.9**	--	--	--	--	--	**8,900**	--	--	--
	09/13/12	N	--	--	--	--	--	--	--	--	--	--	**4.2**	--	--	--	--	--	**9,200**	--	--	--
	12/11/12	N	**82**	ND (5)	ND (5)	**82**	ND (0.1)	--	**2,700**	--	--	--	--	**3.61**	--	--	--	--	**9,000**	**540**	--	--
	02/26/13	N	--	--	--	--	--	--	--	--	--	--	--	**4.26**	--	--	--	--	**8,400**	--	--	--
MW-62-190 (Site E)	07/22/09	N	**49**	ND (5)	ND (5)	**49**	ND (0.1)	--	**6,300**	**-79.41**	--	--	ND (2.5)	--	--	--	--	**-10.55**	--	**690**	**11,000**	**58 J**
	09/29/09	N	**54**	ND (5)	ND (5)	**54**	--	--	**4,400**	--	--	--	ND (2.5)	--	--	--	--	--	--	**590**	--	--
	12/16/09	N	**38**	ND (5)	ND (5)	**38**	--	--	**6,000**	--	--	--	ND (5)	--	--	--	--	--	--	**680**	--	**31**
	02/10/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**12**
	03/11/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**17,000**	--	--	**8.5**
	05/04/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**18,100**	--	--	**10**
	09/29/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**8.6**
	12/16/10	N	**41**	ND (5)	ND (5)	**41**	ND (0.1)	--	**6,000**	**-78.4**	--	--	ND (2.5)	--	--	--	--	**-10**	**15,000**	**710**	**10,000**	**13**
	02/09/11	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**5.4**
	05/05/11	N	--	--	--	--	--	--	--	--	--	--	ND (2.5)	--	--	--	--	--	**17,000**	--	--	--

TABLE C2-9

Groundwater Sample Results: Anions and General Chemistry Parameters

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			General Chemistry (mg/L except where footnoted)																		
Location	**Date**	**Sample Type**	**Alkalinity, bicarbonate as CaCO3**	**Alkalinity, carbonate as CaCO3**	**Alkalinity, hydroxide**	**Alkalinity, total as CaCO3**	**Ammonia as nitrogen**	**Bromide**	**Chloride**	**Deuterium**	**Fluoride**	**Nitrate**	**Nitrate as Nitrogen**	**Nitrate/Nitrite as Nitrogen**	**Nitrite as Nitrogen**	**Ortho phosphate**	**Orthophosphate, dissolved**	**Oxygen 18**	**Specific conductance**	**Sulfate**	**Total dissolved solids**	**Total organic carbon**
MW-62-190 (Site E)	09/29/11	N	--	--	--	--	--	--	--	--	--	--	ND (2.5)	--	--	--	--	--	17,000	--	--	5.9
	12/14/11	N	46	ND (5)	ND (5)	46	ND (0.1)	ND (2.5)	5,900	-75.8	6.8	--	ND (2.5)	--	ND (50)	ND (0.5)	--	-10.1	16,000	700	9,000	4.7
	02/16/12	N	--	--	--	--	--	--	--	--	--	--	ND (2.5)	--	--	--	--	--	16,000	--	--	--
	05/10/12	N	--	--	--	--	--	--	--	--	--	--	ND (2.5)	--	--	--	--	--	19,000	--	--	--
	09/13/12	N	--	--	--	--	--	--	--	--	--	--	ND (2.5)	--	--	--	--	--	19,000	--	--	--
	12/11/12	N	44	ND (5)	ND (5)	44	ND (0.1J)	--	6,300	--	--	--	--	0.0304	--	--	--	--	18,000	730	--	--
	02/26/13	N	--	--	--	--	--	--	--	--	--	--	--	ND (0.01)	--	--	--	--	17,000	--	--	--
MW-63-065 (Site E-Alt2)	04/15/09	N	200	ND (5J)	ND (5)	200	ND (0.1)	--	1,500	--	--	--	ND (1)	--	--	--	--	--	--	540 J	3,400	6.4
	07/20/09	N	210	ND (5)	ND (5)	210	ND (0.1)	--	1,800	-97.99	--	--	ND (1)	--	--	--	--	-12.04	--	570	4,100	0.69
	07/20/09	FD	210	ND (5)	ND (5)	210	ND (0.1)	--	1,700	-98.26	--	--	ND (1)	--	--	--	--	-12.44	--	560	4,100	ND (1.2)
	09/22/09	N	190	ND (5)	ND (5)	190	--	--	1,800	--	--	--	ND (1)	--	--	--	--	--	--	580	--	--
	09/22/09	FD	200	ND (5)	ND (5)	200	--	--	1,800	--	--	--	ND (1)	--	--	--	--	--	--	580	--	--
	12/09/09	N	210	ND (5)	ND (5)	210	--	--	1,800	--	--	--	ND (1)	--	--	--	--	--	--	580	--	--
	12/09/09	FD	200	ND (5)	ND (5)	200	--	--	1,800	--	--	--	ND (1)	--	--	--	--	--	--	570	--	--
	03/09/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7,200	--	--	--
	03/09/10	FD	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7,200	--	--	--
	05/03/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7,580	--	--	--
	05/03/10	FD	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7,470	--	--	--
	12/06/10	N	190	ND (5)	ND (5)	190	0.12	--	2,000	--	--	--	1.3	--	--	--	--	--	7,200	600	4,400	ND (1)
	05/03/11	N	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	7,200	--	--	--
	09/28/11	N	--	--	--	--	--	--	--	--	--	--	1.4	--	--	--	--	--	7,500	--	--	--
	12/12/11	N	210	ND (5)	ND (5)	210	ND (0.1)	ND (1)	1,800	-97.6	ND (2.5)	--	1.3	--	ND (10)	ND (0.2)	--	-12.5	4,600	580	4,000	ND (1)
	02/13/12	N	--	--	--	--	--	--	--	--	--	--	ND (1)	--	--	--	--	--	7,200	--	--	--
	04/26/12	N	--	--	--	--	--	--	--	--	--	--	1.1	--	--	--	--	--	6,900	--	--	--
	09/10/12	N	--	--	--	--	--	--	--	--	--	--	1.1	--	--	--	--	--	7,600	--	--	--
	11/07/12	N	200	ND (5)	ND (5)	200	ND (0.1)	--	2,100	--	--	--	--	1.05	--	--	--	--	8,800	640	--	--
	02/06/13	N	--	--	--	--	--	--	--	--	--	--	--	1.07	--	--	--	--	6,300	--	--	--
MW-64BR Open Borehole (C-Alt)	12/20/10	N	--	--	--	--	--	--	4,600	--	--	--	2.1	--	--	--	--	--	--	--	8,300	ND (1)
	03/01/13	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12,000	--	--	--
MW-64BR Flute (Upper Zone) (C-Alt)	07/22/09	N	57	ND (5)	ND (5)	57	0.2	--	2,600	-78.22	--	--	ND (1)	--	--	--	--	-10.22	--	450	5,100	16 J
	09/29/09	N	120	ND (5)	ND (5)	120	--	--	3,200	--	--	--	ND (2.5)	--	--	--	--	--	--	470	--	--
	12/16/09	N	74	ND (5)	ND (5)	74	--	--	3,000	--	--	--	ND (2.5)	--	--	--	--	--	--	530	--	1.1 J
	02/10/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.5
	03/11/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	11,000	--	--	2
	05/04/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10,100	--	--	2.9
	09/29/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.2
MW-64BR Flute (Middle Zone) (C-Alt)	07/22/09	N	54	ND (5)	ND (5)	54	0.14	--	4,500	-77.75	--	--	ND (2.5)	--	--	--	--	-9.73	--	580	8,000	19 J
	09/29/09	N	110	ND (5)	ND (5)	110	--	--	4,400	--	--	--	ND (5)	--	--	--	--	--	--	540	--	--
	12/16/09	N	64	ND (5)	ND (5)	64	--	--	4,700	--	--	--	ND (5)	--	--	--	--	--	--	650	--	1.8 J
	02/10/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.2
	03/11/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	15,000	--	--	3.7

TABLE C2-9

Groundwater Sample Results: Anions and General Chemistry Parameters

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			General Chemistry (mg/L except where footnoted)																		
Location	**Date**	**Sample Type**	**Alkalinity, bicarbonate as CaCO3**	**Alkalinity, carbonate as CaCO3**	**Alkalinity, hydroxide**	**Alkalinity, total as CaCO3**	**Ammonia as nitrogen**	**Bromide**	**Chloride**	**Deuterium**	**Fluoride**	**Nitrate**	**Nitrate as Nitrogen**	**Nitrate/Nitrite as Nitrogen**	**Nitrite as Nitrogen**	**Ortho phosphate**	**Orthophosphate, dissolved**	**Oxygen 18**	**Specific conductance**	**Sulfate**	**Total dissolved solids**	**Total organic carbon**
MW-64BR Flute (Middle Zone) (C-Alt)	05/04/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	15,200	--	--	5.3
	09/29/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.8
MW-64BR Flute (Lower Zone) (C-Alt)	07/22/09	N	66	ND (5)	ND (5)	66	0.18	--	3,200	-78.7	--	--	ND (1)	--	--	--	--	-9.91	--	470	6,200	25 J
	09/29/09	N	140	ND (5)	ND (5)	140	--	--	3,900	--	--	--	ND (2.5)	--	--	--	--	--	--	450	--	--
	12/16/09	N	79	ND (5)	ND (5)	79	--	--	4,700	--	--	--	ND (5)	--	--	--	--	--	--	600	--	3.7
	02/10/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	11
	03/11/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	15,000	--	--	8.4
	05/04/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	15,100	--	--	12
	09/29/10	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.5
MW-64BR Packer (Upper Zone) (C-Alt)	01/26/11	N	--	--	--	--	--	--	4,100	--	--	--	2.6	--	--	--	--	--	--	--	8,300	ND (1)
	04/12/11	N	--	--	--	--	--	--	3,500	--	--	--	3.4	--	--	--	--	--	--	--	7,800	ND (1)
	07/11/11	N	--	--	--	--	--	--	3,300	--	--	--	3.7	--	--	--	--	--	--	--	5,800	ND (1)
	08/15/11	N	--	--	--	--	--	--	3,600	--	--	--	2.9	--	--	--	--	--	--	--	7,400	ND (1)
	09/12/11	N	--	--	--	--	--	--	3,600	--	--	--	3	--	--	--	--	--	--	--	6,500	ND (1)
	10/24/11	N	--	--	--	--	--	--	3,400	--	--	--	3.2	--	--	--	--	--	--	--	6,300	ND (1)
	11/14/11	N	--	--	--	--	--	--	3,600	--	4.7	--	ND (2.5)	--	--	--	--	--	--	--	6,200	ND (1)
	12/12/11	N	70	ND (5)	ND (5)	70	0.24	ND (2.5)	3,700	-72	4.7	--	ND (2.5)	--	ND (25)	ND (0.5)	--	-9.2	11,000	600	6,900	ND (1)
	02/13/12	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12,000	--	--	--
	04/16/12	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12,000	--	--	--
	10/08/12	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12,000	--	--	--
MW-64BR Packer (Lower Zone) (C-Alt)	02/24/11	N	--	--	--	--	--	--	5,300	--	--	--	ND (2.5)	--	--	--	--	--	--	--	9,700	ND (1)
	04/20/11	N	--	--	--	--	--	--	5,500	--	--	--	ND (2.5)	--	--	--	--	--	--	--	9,600	ND (1)
	07/21/11	N	--	--	--	--	--	--	5,100	--	--	--	ND (2.5)	--	--	--	--	--	--	--	8,400	ND (1)
	08/18/11	N	--	--	--	--	--	--	5,600	--	--	--	ND (2.5)	--	--	--	--	--	--	--	9,000	ND (1)
	09/15/11	N	--	--	--	--	--	--	5,600	--	--	--	ND (2.5)	--	--	--	--	--	--	--	8,900	ND (1)
	10/27/11	N	--	--	--	--	--	--	5,400	--	--	--	ND (2.5)	--	--	--	--	--	--	--	11,000	ND (1)
	11/17/11	N	--	--	--	--	--	--	5,500	--	7	--	ND (2.5)	--	--	--	--	--	--	--	9,100	ND (1)
	12/15/11	N	88	ND (5)	ND (5)	88	0.18	ND (2.5)	5,500	-73.5	7.5	--	ND (2.5)	--	ND (50)	ND (0.5J)	--	-9.4	16,000	740	9,000	ND (1)
	02/16/12	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	16,000	--	--	--
	04/19/12	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13,000	--	--	--
	10/10/12	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	14,000	--	--	--
MW-65-160 (Site 5)	06/13/11	N	71	ND (5J)	ND (5)	71	0.54	0.91	990	--	2.6	--	2.5	--	ND (10)	ND (0.1)	--	--	--	360	2,500	ND (1)
	07/11/11	N	63	ND (5J)	ND (5)	63	0.67	0.98	1,000	--	2.5	--	2.3	--	ND (10)	ND (0.1)	--	--	--	370	2,500	ND (1)
	08/09/11	N	63	ND (5)	ND (5)	63	0.72 J	0.78	1,100	--	2.5	--	3.4	--	ND (25)	ND (0.1)	--	--	--	380	2,600	ND (1)
	08/09/11	FD	64	ND (5)	ND (5)	64	0.11 J	0.83	1,100	--	2.7	--	3.5	--	ND (10)	ND (0.1)	--	--	--	380	2,400	ND (1)
	09/07/11	N	62	ND (5)	ND (5)	62	0.84	1	1,100	--	ND (2.5)	--	3.6	--	ND (10)	ND (0.1)	--	--	--	380	2,500	ND (1)
	10/17/11	N	72	ND (5)	ND (5)	72	0.28	ND (1)	1,100	--	3	--	4.3	--	ND (10)	ND (0.2)	--	--	--	400	2,500	ND (1)
	11/15/11	N	71	ND (5)	ND (5)	71	0.44	1	1,100	--	1.5	--	5.9	--	ND (5)	ND (0.1)	--	--	--	400	2,600	ND (1)
	12/15/11	N	63	ND (5)	ND (5)	63	0.11	ND (1)	1,100	-65	1.6	--	5.9	--	ND (10)	ND (0.2)	--	-8.5	4,100	390	2,600	ND (1)
	02/16/12	N	--	--	--	--	--	--	--	--	--	--	7.6	--	--	--	--	--	4,200	--	--	--

TABLE C2-9

Groundwater Sample Results: Anions and General Chemistry Parameters

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			General Chemistry (mg/L except where footnoted)																		
Location	**Date**	**Sample Type**	**Alkalinity, bicarbonate as CaCO3**	**Alkalinity, carbonate as CaCO3**	**Alkalinity, hydroxide**	**Alkalinity, total as CaCO3**	**Ammonia as nitrogen**	**Bromide**	**Chloride**	**Deuterium**	**Fluoride**	**Nitrate**	**Nitrate as Nitrogen**	**Nitrate/Nitrite as Nitrogen**	**Nitrite as Nitrogen**	**Ortho phosphate**	**Orthophosphate, dissolved**	**Oxygen 18**	**Specific conductance**	**Sulfate**	**Total dissolved solids**	**Total organic carbon**
MW-65-160 (Site 5)	05/01/12	N	--	--	--	--	--	--	--	--	--	--	8	--	--	--	--	--	3,900	--	--	--
	09/18/12	N	--	--	--	--	--	--	--	--	--	--	8.6	--	--	--	--	--	4,300	--	--	--
	12/04/12	N	110	ND (5)	ND (5)	110	ND (0.1)	--	1,000	--	--	--	--	11.4	--	--	--	--	4,100	440	--	--
	02/19/13	N	--	--	--	--	--	--	--	--	--	--	--	10.8	--	--	--	--	4,000	--	--	--
MW-65-225 (Site 5)	06/13/11	N	56	ND (5J)	ND (5)	56	0.34	ND (1)	5,200	--	10	--	ND (1)	--	ND (50)	ND (0.2)	--	--	--	910	9,600	ND (1)
	07/11/11	N	63	ND (5J)	ND (5)	63	0.28	ND (1)	4,200	--	7.8	--	3.4	--	ND (50)	ND (0.2)	--	--	--	790	7,300	ND (1)
	08/09/11	N	70	ND (5)	ND (5)	70	0.32	ND (1)	4,300	--	ND (5)	--	3.7	--	ND (50)	ND (0.2)	--	--	--	800	7,800	ND (1)
	09/07/11	N	73	ND (5)	ND (5)	73	0.25	ND (2.5)	4,200	--	7.5	--	4.1	--	ND (50)	ND (0.5J)	--	--	--	790	7,300	ND (1)
	10/17/11	N	70	ND (5)	ND (5)	70	0.24	ND (2.5)	4,100	--	8.1	--	4	--	ND (50)	ND (0.5)	--	--	--	760	7,600	ND (1)
	11/15/11	N	73	ND (5)	ND (5)	73	0.22	ND (2.5)	3,700	--	4.4	--	5	--	ND (25)	ND (0.5)	--	--	--	740	6,600	ND (1)
	11/15/11	FD	73	ND (5)	ND (5)	73	0.12	ND (2.5)	3,700	--	5.1	--	4.9	--	ND (25)	ND (0.5)	--	--	--	750	6,800	ND (1)
	12/15/11	N	22	ND (5)	ND (5)	22	0.13	ND (2.5)	3,500	-61.9	4.3	--	6.1	--	ND (25)	ND (0.5)	--	-7.5	11,000	740	6,200	ND (1)
	02/16/12	N	--	--	--	--	--	--	--	--	--	--	5.6	--	--	--	--	--	12,000	--	--	--
	05/02/12	N	--	--	--	--	--	--	--	--	--	--	5	--	--	--	--	--	13,000	--	--	--
	09/18/12	N	--	--	--	--	--	--	--	--	--	--	8.1	--	--	--	--	--	12,000	--	--	--
	12/05/12	N	97	ND (5)	ND (5)	97	ND (0.1)	--	2,800	--	--	--	--	11.2	--	--	--	--	9,400	710	--	--
	02/19/13	N	--	--	--	--	--	--	--	--	--	--	--	9.82	--	--	--	--	10,000	--	--	--
MW-66-165 (Site 6)	06/13/11	N	94	ND (5J)	ND (5)	94	0.16	1.4	980	--	ND (5)	--	26	--	ND (10)	ND (0.1J)	--	--	--	510	2,900	ND (1)
	07/12/11	N	96	ND (5J)	ND (5)	96	0.13	1.7	1,000	--	ND (5)	--	27	--	ND (10)	ND (0.1J)	--	--	--	520	2,800	ND (1)
	07/12/11	FD	97	ND (5J)	ND (5)	97	0.19	1.4	1,000	--	ND (2.5)	--	27	--	ND (10)	ND (0.1)	--	--	--	520	2,900	ND (1)
	08/09/11	N	96	ND (5)	ND (5)	96	0.19	1.4	1,000	--	ND (1)	--	30	--	ND (10)	ND (0.1)	--	--	--	530	2,600	ND (1)
	10/18/11	N	85	ND (5)	ND (5)	85	0.14	1.2	1,000	--	ND (1)	--	28	--	ND (10)	ND (0.1)	--	--	--	520	2,600	ND (1)
	11/15/11	N	82	ND (5)	ND (5)	82	0.18	1.5	1,000	--	ND (2.5)	--	29	--	ND (5)	ND (0.1)	--	--	--	510	2,600	ND (1)
	12/15/11	N	22	ND (5)	ND (5)	22	ND (0.1)	1.5	1,000	-65.2	ND (2.5)	--	30	--	ND (10)	ND (0.2)	--	-8.5	4,400	490	2,900	ND (1)
	02/17/12	N	--	--	--	--	--	--	--	--	--	--	32	--	--	--	--	--	4,700	--	--	--
	05/02/12	N	--	--	--	--	--	--	--	--	--	--	30	--	--	--	--	--	4,600	--	--	--
	09/17/12	N	--	--	--	--	--	--	--	--	--	--	30	--	--	--	--	--	4,500	--	--	--
	12/06/12	N	87	ND (5)	ND (5)	87	ND (0.1)	--	1,100	--	--	--	--	38.4	--	--	--	--	4,300	490	--	--
	02/20/13	N	--	--	--	--	--	--	--	--	--	--	--	39.1	--	--	--	--	4,300	--	--	--
MW-66-230 (Site 6)	06/14/11	N	35	ND (5J)	ND (5)	35	ND (0.1)	ND (1)	5,900	--	ND (25)	--	5.4	--	ND (25)	ND (0.2)	--	--	--	910	10,000	ND (1)
	07/12/11	N	39	ND (5J)	ND (5)	39	0.12	ND (2.5)	5,900	--	ND (10)	--	5.6	--	ND (50)	ND (0.2)	--	--	--	870	10,000	ND (1)
	08/10/11	N	36	ND (5)	ND (5)	36	0.12	ND (2.5)	6,000	--	ND (10)	--	6.4	--	ND (50)	ND (0.2)	--	--	--	910	9,000	ND (1)
	10/19/11	N	38	ND (5)	ND (5)	38	0.15	ND (2.5)	5,900	--	ND (10)	--	5.2	--	ND (50)	ND (0.5)	--	--	--	1,000	10,000	ND (1)
	11/17/11	N	34	ND (5)	ND (5)	34	ND (0.1)	ND (2.5)	5,700	--	6.9	--	6.3	--	ND (50)	ND (0.5)	--	--	--	1,000	9,800	ND (1)
	12/15/11	N	38	ND (5)	ND (5)	38	ND (0.1)	ND (2.5)	5,900	-67.2	ND (10)	--	7.8	--	ND (50)	ND (0.5)	--	-8.3	17,000	1,100	9,600	ND (1)
	02/22/12	N	--	--	--	--	--	--	--	--	--	--	8.8	--	--	--	--	--	17,000	--	--	--
	05/10/12	N	--	--	--	--	--	--	--	--	--	--	9.5	--	--	--	--	--	19,000	--	--	--
	05/10/12	FD	--	--	--	--	--	--	--	--	--	--	9.4	--	--	--	--	--	19,000	--	--	--
	09/17/12	N	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--	19,000	--	--	--
	12/10/12	N	32	ND (5)	ND (5)	32	ND (0.1)	--	6,600	--	--	--	--	15.2	--	--	--	--	19,000	1,100	--	--
	02/21/13	N	--	--	--	--	--	--	--	--	--	--	--	14.1	--	--	--	--	18,000	--	--	--
MW-66BR-270 (Site 6)	01/16/12	N	ND (5)	36	69	110	0.25	ND (2.5)	6,000	--	ND (10)	--	ND (2.5)	--	ND (50)	ND (0.5J)	--	--	--	180	11,000	4.7
	03/07/12	N	--	--	--	--	--	--	--	--	--	--	ND (2.5)	--	--	--	--	--	17,000	--	--	--

TABLE C2-9

Groundwater Sample Results: Anions and General Chemistry Parameters

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			General Chemistry (mg/L except where footnoted)																		
Location	**Date**	**Sample Type**	**Alkalinity, bicarbonate as CaCO3**	**Alkalinity, carbonate as CaCO3**	**Alkalinity, hydroxide**	**Alkalinity, total as CaCO3**	**Ammonia as nitrogen**	**Bromide**	**Chloride**	**Deuterium**	**Fluoride**	**Nitrate**	**Nitrate as Nitrogen**	**Nitrate/Nitrite as Nitrogen**	**Nitrite as Nitrogen**	**Ortho phosphate**	**Orthophosphate, dissolved**	**Oxygen 18**	**Specific conductance**	**Sulfate**	**Total dissolved solids**	**Total organic carbon**
MW-66BR-270 (Site 6)	05/24/12	N	--	--	--	--	--	--	--	--	--	--	ND (2.5)	--	--	--	--	--	17,000	--	--	--
	10/02/12	N	--	--	--	--	--	--	--	--	--	--	ND (2.5)	--	--	--	--	--	18,000	--	--	--
	12/20/12	N	ND (5)	26	ND (5)	26	0.309	--	6,100	--	--	--	--	0.0776	--	--	--	--	19,000	210	--	--
	03/12/13	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	18,000	--	--	--
MW-67-185 (Site 2)	10/18/11	N	130	ND (5)	ND (5)	130	0.21	0.96	780	--	ND (2.5)	--	11	--	ND (10)	ND (0.1J)	--	--	--	490	2,000	ND (1)
	10/18/11	FD	130	ND (5)	ND (5)	130	ND (0.1)	1	800	--	ND (2.5)	--	9.6	--	ND (10)	ND (0.1)	--	--	--	480	2,100	ND (1)
	11/16/11	N	120	ND (5)	ND (5)	120	0.18	1.2	760	--	1.1	--	12	--	ND (5)	ND (0.1)	--	--	--	520	2,100	ND (1)
	12/14/11	N	130	ND (5)	ND (5)	130	0.19	1.4	790	-69.4	ND (2.5)	--	12	--	ND (2.5)	ND (0.1)	--	-9.1	3,900	530	2,300	ND (1)
	02/21/12	N	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--	4,000	--	--	--
	05/03/12	N	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--	4,400	--	--	--
	09/20/12	N	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--	4,700	--	--	--
	12/06/12	N	120	ND (5)	ND (5)	120	ND (0.1)	--	1,100	--	--	--	--	21.6	--	--	--	--	4,400	630	--	--
	02/21/13	N	--	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	4,300	--	--	--
	02/21/13	FD	--	--	--	--	--	--	--	--	--	--	--	22.5	--	--	--	--	4,200	--	--	--
MW-67-225 (Site 2)	06/14/11	N	120	ND (5J)	ND (5)	120	0.38	1.3	1,800	--	5.5	--	13	--	ND (10)	ND (0.2)	--	--	--	910	4,100	ND (1)
	07/12/11	N	130	ND (5J)	ND (5)	130	0.46	1.4	1,800	--	5.7	--	14	--	ND (25)	ND (0.2)	--	--	--	990	4,500	ND (1)
	08/09/11	N	130	ND (5)	ND (5)	130	0.48	1.2	1,800	--	5	--	14	--	ND (25)	ND (0.2)	--	--	--	1,000	4,200	ND (1)
	09/08/11	N	130	ND (5)	ND (5)	130	0.44	1.6	1,900	--	5.7	--	16	--	ND (25)	ND (0.2)	--	--	--	1,100	4,300	ND (1)
	10/19/11	N	120	ND (5)	ND (5)	120	0.13	1.5	1,900	--	6.3	--	16	--	ND (25)	ND (0.2)	--	--	--	1,100	4,500	ND (1)
	11/17/11	N	110	ND (5)	ND (5)	110	0.16	1.6	1,700	--	4	--	17	--	ND (10)	ND (0.2)	--	--	--	1,000	4,400	ND (1)
	12/14/11	N	120	ND (5)	ND (5)	120	0.12	1.7	1,800	-67.5	4.2	--	18	--	ND (10)	ND (0.2)	--	-8.2	7,600	1,100	4,400	ND (1)
	02/21/12	N	--	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	7,600	--	--	--
	02/21/12	FD	--	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	7,600	--	--	--
	05/07/12	N	--	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--	7,400	--	--	--
	09/20/12	N	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--	8,000	--	--	--
	12/10/12	N	140	ND (5)	ND (5)	140	ND (0.1)	--	1,800	--	--	--	--	20.6	--	--	--	--	7,500	1,100	--	--
	02/21/13	N	--	--	--	--	--	--	--	--	--	--	--	23.1	--	--	--	--	7,000	--	--	--
MW-67-260 (Site 2)	06/14/11	N	32	ND (5J)	ND (5)	32	0.17	ND (1)	5,400	--	10	--	ND (1)	--	ND (25)	ND (0.2)	--	--	--	760	8,900	ND (1)
	07/12/11	N	18	21 J	ND (5)	38	0.3	ND (2.5)	5,200	--	9.3	--	1	--	ND (50)	ND (0.2)	--	--	--	720	9,100	ND (1)
	08/09/11	N	30	ND (5)	ND (5)	30	0.1	ND (2.5)	5,800	--	ND (5)	--	1.1	--	ND (50)	ND (0.2)	--	--	--	790	9,200	ND (1)
	09/08/11	N	31	ND (5)	ND (5)	31	0.14	ND (2.5)	5,900	--	11	--	ND (2.5)	--	ND (50)	ND (0.5)	--	--	--	800	9,300	ND (1)
	10/19/11	N	25	ND (5)	ND (5)	25	0.13	ND (2.5)	6,000	--	12	--	ND (2.5)	--	ND (50)	ND (0.5)	--	--	--	880	9,300	ND (1)
	11/17/11	N	29	ND (5)	ND (5)	29	0.14	ND (2.5)	5,600	--	7.2	--	ND (2.5)	--	ND (50)	ND (0.5)	--	--	--	790	9,000	ND (1)
	12/14/11	N	43	ND (5)	ND (5)	43	0.1	ND (2.5)	5,800	-68.8	7.1	--	ND (2.5)	--	ND (50)	ND (0.5)	--	-8.8	17,000	810	9,400	ND (1)
	02/21/12	N	--	--	--	--	--	--	--	--	--	--	ND (2.5)	--	--	--	--	--	17,000	--	--	--
	05/07/12	N	--	--	--	--	--	--	--	--	--	--	ND (2.5)	--	--	--	--	--	18,000	--	--	--
	09/20/12	N	--	--	--	--	--	--	--	--	--	--	ND (5)	--	--	--	--	--	18,000	--	--	--
	12/06/12	N	29	ND (5)	ND (5)	29	0.123	--	6,100	--	--	--	--	1.56	--	--	--	--	18,000	830	--	--
	02/21/13	N	--	--	--	--	--	--	--	--	--	--	--	1.49	--	--	--	--	17,000	--	--	--
MW-68-180 (Site 3)	06/14/11	N	120	ND (5J)	ND (5)	120	0.17	ND (0.5)	480	--	2.2	--	5.2 J	--	ND (2.5)	ND (0.1)	--	--	--	400	1,600	ND (1)
	06/14/11	FD	110	ND (5J)	ND (5)	110	0.24	ND (0.5)	500	--	2.2	--	6.7 J	--	ND (2.5)	ND (0.1)	--	--	--	420	1,700	ND (1)
	07/12/11	N	110	ND (5J)	ND (5)	110	0.17	ND (0.5)	500	--	2.4	--	4.8	--	ND (5)	ND (0.1)	--	--	--	410	1,700	ND (1)
	09/08/11	N	73	ND (5)	ND (5)	73	0.19	1	740	--	2.6	--	25	--	ND (10)	ND (0.2J)	--	--	--	900	2,800	1.3

TABLE C2-9

Groundwater Sample Results: Anions and General Chemistry Parameters

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			General Chemistry (mg/L except where footnoted)																		
Location	**Date**	**Sample Type**	**Alkalinity, bicarbonate as CaCO3**	**Alkalinity, carbonate as CaCO3**	**Alkalinity, hydroxide**	**Alkalinity, total as CaCO3**	**Ammonia as nitrogen**	**Bromide**	**Chloride**	**Deuterium**	**Fluoride**	**Nitrate**	**Nitrate as Nitrogen**	**Nitrate/Nitrite as Nitrogen**	**Nitrite as Nitrogen**	**Ortho phosphate**	**Orthophosphate, dissolved**	**Oxygen 18**	**Specific conductance**	**Sulfate**	**Total dissolved solids**	**Total organic carbon**
MW-68-180 (Site 3)	10/18/11	N	**73**	ND (5)	ND (5)	**73**	**0.13**	**1.1**	**780**	**--**	ND (2.5)	**--**	**29**	**--**	ND (10)	ND (0.2)	**--**	**--**	**--**	**960**	**2,900**	**1.3**
	11/17/11	N	**73**	ND (5)	ND (5)	**73**	**0.18**	**1.3**	**790**	**--**	**1.7**	**--**	**29**	**--**	ND (5)	ND (0.2)	**--**	**--**	**--**	**970**	**2,700**	**1.5**
	12/15/11	N	**57**	**14**	ND (5)	**71**	ND (0.1)	**1.5**	**770**	**-65.2**	**1.7**	**--**	**33**	**--**	ND (5)	ND (0.2)	**--**	**-7.2**	**4,400**	**930**	**2,900**	**1.3**
	02/22/12	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**24**	**--**	**--**	**--**	**--**	**--**	**3,900**	**--**	**--**	**--**
	05/10/12	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**12**	**--**	**--**	**--**	**--**	**--**	**3,200**	**--**	**--**	**--**
	09/20/12	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**25**	**--**	**--**	**--**	**--**	**--**	**4,100**	**--**	**--**	**--**
	12/11/12	N	**75**	ND (5)	ND (5)	**75**	ND (0.1J)	**--**	**830**	**--**	**--**	**--**	**--**	**31**	**--**	**--**	**--**	**--**	**4,400**	**990**	**--**	**--**
	12/11/12	FD	**75**	ND (5)	ND (5)	**75**	ND (0.1J)	**--**	**840**	**--**	**--**	**--**	**--**	**30.5**	**--**	**--**	**--**	**--**	**4,400**	**1,000**	**--**	**--**
	02/21/13	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**27.3**	**--**	**--**	**--**	**--**	**3,700**	**--**	**--**	**--**
MW-68-240 (Site 3)	06/14/11	N	**68**	ND (5J)	ND (5)	**68**	**0.15**	ND (1)	**4,100**	**--**	**5.5**	**--**	**1.5**	**--**	ND (25)	ND (0.2)	**--**	**--**	**--**	**730**	**7,700**	ND (1)
	07/12/11	N	**66**	ND (5J)	ND (5)	**66**	**0.13**	ND (1)	**4,400**	**--**	**5.6**	**--**	**2.2**	**--**	ND (50)	ND (0.2)	**--**	**--**	**--**	**730**	**7,400**	ND (1)
	09/07/11	N	**63**	ND (5)	ND (5)	**63**	**0.16**	ND (2.5)	**5,000**	**--**	ND (2.5)	**--**	**3.1**	**--**	ND (50)	ND (0.5)	**--**	**--**	**--**	**810**	**8,700**	ND (1)
	09/07/11	FD	**62**	ND (5)	ND (5)	**62**	ND (0.1)	ND (2.5)	**5,000**	**--**	ND (2.5)	**--**	**2.9**	**--**	ND (50)	ND (0.5)	**--**	**--**	**--**	**810**	**8,900**	ND (1)
	10/18/11	N	**64**	ND (5)	ND (5)	**64**	**0.11**	ND (2.5)	**5,100**	**--**	ND (10)	**--**	**3.2**	**--**	ND (50)	ND (0.5)	**--**	**--**	**--**	**910**	**8,900**	ND (1)
	11/16/11	N	**62**	ND (5)	ND (5)	**62**	**0.14**	ND (2.5)	**4,800**	**--**	ND (5)	**--**	**3.2**	**--**	ND (50)	ND (0.5)	**--**	**--**	**--**	**840**	**8,600**	ND (1)
	12/14/11	N	**28**	ND (5)	ND (5)	**28**	ND (0.1)	ND (2.5)	**5,200**	**-69.1**	ND (5)	**--**	**3.4**	**--**	ND (50)	ND (0.5)	**--**	**-8.7**	**15,000**	**830**	**8,600**	ND (1)
	02/17/12	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**3.5**	**--**	**--**	**--**	**--**	**--**	**16,000**	**--**	**--**	**--**
	05/03/12	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**3.6**	**--**	**--**	**--**	**--**	**--**	**16,000**	**--**	**--**	**--**
	09/20/12	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	ND (5)	**--**	**--**	**--**	**--**	**--**	**17,000**	**--**	**--**	**--**
	12/06/12	N	**62**	ND (5)	ND (5)	**62**	ND (0.1)	**--**	**5,600**	**--**	**--**	**--**	**--**	**4.82**	**--**	**--**	**--**	**--**	**16,000**	**860**	**--**	**--**
	02/20/13	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**4.58**	**--**	**--**	**--**	**--**	**15,000**	**--**	**--**	**--**
MW-68BR-280 (Site 3)	09/08/11	N	**33**	ND (5)	ND (5)	**33**	ND (0.1)	ND (2.5)	**6,800**	**--**	ND (5)	**--**	ND (2.5)	**--**	ND (50)	ND (0.5)	**--**	**--**	**--**	**650**	**11,000**	ND (1)
	10/21/11	N	**48**	ND (5)	ND (5)	**48**	ND (0.1)	ND (2.5)	**6,900**	**--**	**13**	**--**	ND (2.5)	**--**	ND (100)	ND (0.5J)	**--**	**--**	**--**	**710**	**11,000**	ND (1)
	11/16/11	N	**33**	ND (5)	ND (5)	**33**	ND (0.1)	ND (2.5)	**7,200**	**--**	**7.7**	**--**	ND (2.5)	**--**	ND (50)	ND (0.5)	**--**	**--**	**--**	**720**	**12,000**	ND (1)
	12/14/11	N	**120**	ND (5)	ND (5)	**120**	ND (0.1)	ND (2.5)	**7,500**	**-76.7**	ND (5)	**--**	ND (2.5)	**--**	ND (50)	ND (0.5)	**--**	**-10.2**	**19,000**	**700**	**12,000**	ND (1)
	02/14/12	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	ND (2.5)	**--**	**--**	**--**	**--**	**--**	**19,000**	**--**	**--**	**--**
	05/09/12	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	ND (2.5)	**--**	**--**	**--**	**--**	**--**	**21,000**	**--**	**--**	**--**
	10/03/12	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	ND (2.5)	**--**	**--**	**--**	**--**	**--**	**22,000**	**--**	**--**	**--**
	11/12/12	N	**24**	ND (5)	ND (5)	**24**	ND (0.1)	**--**	**7,500**	**--**	**--**	**--**	**--**	**0.01**	**--**	**--**	**--**	**--**	**21,000**	**740**	**--**	**--**
	02/18/13	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	ND (0.01)	**--**	**--**	**--**	**--**	**21,000**	**--**	**--**	**--**
MW-69-195 (Site 4)	07/11/11	N	**140**	ND (5J)	ND (5)	**140**	**0.41**	**0.8**	**670**	**--**	**2.9**	**--**	**16**	**--**	ND (5)	ND (0.1)	**--**	**--**	**--**	**420**	**2,000**	ND (1)
	08/09/11	N	**140**	ND (5)	ND (5)	**140**	**0.22**	**0.6**	**710**	**--**	**3.3**	**--**	**19**	**--**	ND (5)	ND (0.1)	**--**	**--**	**--**	**450**	**2,000**	ND (1)
	09/07/11	N	**140**	ND (5)	ND (5)	**140**	**0.2**	**0.74**	**740**	**--**	**3**	**--**	**19**	**--**	ND (10)	ND (0.1)	**--**	**--**	**--**	**480**	**2,100**	ND (1)
	10/18/11	N	**130**	ND (5)	ND (5)	**130**	**0.16**	**0.71**	**770**	**--**	**3.3**	**--**	**21**	**--**	ND (10)	ND (0.1)	**--**	**--**	**--**	**520**	**2,100**	ND (1)
	11/15/11	N	**150**	ND (5)	ND (5)	**150**	**0.12**	**0.9**	**730**	**--**	**2.3**	**--**	**20**	**--**	ND (5)	ND (0.1)	**--**	**--**	**--**	**560**	**2,200**	**1**
	12/14/11	N	**130**	ND (5)	ND (5)	**130**	ND (0.1)	**0.82**	**680**	**-64.3**	**2.6**	**--**	**20**	**--**	ND (5)	ND (0.1)	**--**	**-7.8**	**3,700**	**570**	**2,600**	**1.3**
	02/17/12	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**17**	**--**	**--**	**--**	**--**	**--**	**3,700**	**--**	**--**	**--**
	05/02/12	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**19**	**--**	**--**	**--**	**--**	**--**	**3,800**	**--**	**--**	**--**
	09/19/12	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**22**	**--**	**--**	**--**	**--**	**--**	**3,900**	**--**	**--**	**--**
	12/05/12	N	**200**	ND (5)	ND (5)	**200**	ND (0.1)	**--**	**680**	**--**	**--**	**--**	**--**	**20.3**	**--**	**--**	**--**	**--**	**3,800**	**690**	**--**	**--**
	02/20/13	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**22.4**	**--**	**--**	**--**	**--**	**3,500**	**--**	**--**	**--**
MW-70-105 (Site H)	06/13/11	N	**86**	ND (5J)	ND (5)	**86**	ND (0.1)	ND (0.5)	**480**	**--**	**4.7**	**--**	ND (0.5)	**--**	ND (2.5)	ND (0.1)	**--**	**--**	**--**	**130**	**1,100**	**1.1**
	07/11/11	N	**74**	ND (5J)	ND (5)	**74**	**0.1**	ND (0.5)	**540**	**--**	**4.7**	**--**	**0.82**	**--**	ND (5)	ND (0.1)	**--**	**--**	**--**	**130**	**1,300**	ND (1)

TABLE C2-9

Groundwater Sample Results: Anions and General Chemistry Parameters

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			General Chemistry (mg/L except where footnoted)																		
Location	**Date**	**Sample Type**	**Alkalinity, bicarbonate as CaCO3**	**Alkalinity, carbonate as CaCO3**	**Alkalinity, hydroxide**	**Alkalinity, total as CaCO3**	**Ammonia as nitrogen**	**Bromide**	**Chloride**	**Deuterium**	**Fluoride**	**Nitrate**	**Nitrate as Nitrogen**	**Nitrate/Nitrite as Nitrogen**	**Nitrite as Nitrogen**	**Ortho phosphate**	**Orthophosphate, dissolved**	**Oxygen 18**	**Specific conductance**	**Sulfate**	**Total dissolved solids**	**Total organic carbon**
MW-70-105 (Site H)	08/08/11	N	**95**	ND (5)	ND (5)	**95**	**0.14**	ND (0.5)	**630**	**--**	**5**	**--**	**1.5**	**--**	ND (5)	ND (0.1)	**--**	**--**	**--**	**160**	**1,500**	ND (1)
	09/06/11	N	**88**	ND (5)	ND (5)	**88**	**0.1**	ND (0.5)	**670**	**--**	**4.7**	**--**	**1**	**--**	ND (10)	ND (0.1)	**--**	**--**	**--**	**170**	**1,500**	ND (1)
	11/14/11	N	**90**	ND (5)	ND (5)	**90**	ND (0.1)	ND (0.5)	**670**	**--**	**3.9**	**--**	**1.2**	**--**	ND (5)	ND (0.1)	**--**	**--**	**--**	**190**	**1,400**	ND (1)
	12/12/11	N	**91**	ND (5)	ND (5)	**91**	ND (0.1)	ND (0.5)	**780**	**-69.8**	**3.5**	**--**	**1.6**	**--**	ND (5)	ND (0.1)	**--**	**-9.2**	**2,800**	**200**	**1,500**	ND (1)
	02/16/12	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**0.88**	**--**	**--**	**--**	**--**	**--**	**3,100**	**--**	**--**	**--**
	05/01/12	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**2**	**--**	**--**	**--**	**--**	**--**	**3,000**	**--**	**--**	**--**
	09/12/12	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**2**	**--**	**--**	**--**	**--**	**--**	**3,300**	**--**	**--**	**--**
	12/04/12	N	**87**	ND (5)	ND (5)	**87**	ND (0.1)	**--**	**930**	**--**	**--**	**--**	**--**	**2.05**	**--**	**--**	**--**	**--**	**3,500**	**240**	**--**	**--**
	02/19/13	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**2.55**	**--**	**--**	**--**	**--**	**3,300**	**--**	**--**	**--**
MW-70BR-225 (Site H)	11/16/11	N	**45**	ND (5)	ND (5)	**45**	ND (0.1)	ND (2.5)	**4,000**	**--**	**4.4**	**--**	**3.6**	**--**	ND (50)	ND (0.5)	**--**	**--**	**--**	**730**	**8,000**	ND (1)
	12/15/11	N	**50**	ND (5)	ND (5)	**50**	ND (0.1)	ND (2.5)	**4,100**	**-71.1**	ND (10)	**--**	**3.6**	**--**	ND (50)	ND (0.5)	**--**	**-9**	**13,000**	**790**	**8,000**	ND (1)
	02/16/12	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**3.4**	**--**	**--**	**--**	**--**	**--**	**13,000**	**--**	**--**	**--**
	05/17/12	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**3.6**	**--**	**--**	**--**	**--**	**--**	**14,000**	**--**	**--**	**--**
	05/17/12	FD	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**3.6**	**--**	**--**	**--**	**--**	**--**	**14,000**	**--**	**--**	**--**
	09/18/12	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**3.6**	**--**	**--**	**--**	**--**	**--**	**14,000**	**--**	**--**	**--**
	12/13/12	N	**43**	ND (5)	ND (5)	**43**	ND (0.1)	**--**	**4,200**	**--**	**--**	**--**	**--**	**3.8**	**--**	**--**	**--**	**--**	**14,000**	**770**	**--**	**--**
	02/26/13	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**4.13**	**--**	**--**	**--**	**--**	**13,000**	**--**	**--**	**--**
MW-71-035 (Site L)	11/15/11	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**1.1**
	11/16/11	N	**--**	**--**	**--**	**--**	ND (0.1)	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
	11/17/11	N	**69**	ND (5)	ND (5)	**69**	**--**	ND (1)	**2,000**	**--**	**3.1**	**--**	**1.7**	**--**	ND (10)	ND (0.2)	**--**	**--**	**--**	**460**	**3,700**	**--**
	12/14/11	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**-69.7**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**-9.3**	**7,900**	**--**	**--**	**--**
	12/15/11	N	**--**	**--**	**--**	**--**	ND (0.1)	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	ND (1)
	12/16/11	N	**79**	ND (5)	ND (5)	**79**	**--**	ND (1)	**2,200**	**--**	**3.4**	**--**	**1.6**	**--**	ND (25)	ND (0.2J)	**--**	**--**	**--**	**480**	**4,300**	**--**
	02/15/12	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**2.7**	**--**	**--**	**--**	**--**	**--**	**13,000**	**--**	**--**	**--**
	05/03/12	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	ND (2.5)	**--**	**--**	**--**	**--**	**--**	**7,100**	**--**	**--**	**--**
	09/19/12	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**1.3**	**--**	**--**	**--**	**--**	**--**	**7,500**	**--**	**--**	**--**
	11/08/12	N	**77**	ND (5)	ND (5)	**77**	**0.1**	**--**	**2,500**	**--**	**--**	**--**	**--**	**1.66**	**--**	**--**	**--**	**--**	**9,300**	**540**	**--**	**--**
	02/07/13	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**1.63**	**--**	**--**	**--**	**--**	**6,800**	**--**	**--**	**--**
MW-72-080 (Site K)	09/06/11	N	**56**	ND (5)	ND (5)	**56**	**0.1**	ND (2.5)	**3,600**	**--**	**7.1**	**--**	**2.5**	**--**	ND (50)	ND (0.5)	**--**	**--**	**--**	**510**	**6,900**	ND (1)
	10/17/11	N	**49**	ND (5)	ND (5)	**49**	**0.12**	ND (2.5)	**4,700**	**--**	**9.6**	**--**	ND (2.5)	**--**	ND (50)	ND (0.5)	**--**	**--**	**--**	**630**	**7,900**	ND (1)
	11/14/11	N	**51**	ND (5)	ND (5)	**51**	**0.13**	ND (2.5)	**4,500**	**--**	**6.7**	**--**	ND (2.5)	**--**	ND (25)	ND (0.5)	**--**	**--**	**--**	**630**	**7,700**	ND (1)
	12/15/11	N	**41**	ND (5)	ND (5)	**41**	ND (0.1)	ND (2.5)	**5,000**	**-72.9**	ND (10)	**--**	ND (2.5)	**--**	ND (50)	ND (0.5)	**--**	**-9.5**	**15,000**	**690**	**8,700**	ND (1)
	02/13/12	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	ND (2.5)	**--**	**--**	**--**	**--**	**--**	**15,000**	**--**	**--**	**--**
	05/01/12	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	ND (2.5)	**--**	**--**	**--**	**--**	**--**	**16,000**	**--**	**--**	**--**
	09/19/12	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	ND (2.5)	**--**	**--**	**--**	**--**	**--**	**15,000**	**--**	**--**	**--**
	12/05/12	N	**42**	ND (5)	ND (5)	**42**	ND (0.1)	**--**	**5,400**	**--**	**--**	**--**	**--**	**1.47**	**--**	**--**	**--**	**--**	**16,000**	**700**	**--**	**--**
	02/19/13	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**1.15**	**--**	**--**	**--**	**--**	**16,000**	**--**	**--**	**--**
MW-72BR-200 (Site K)	09/13/12	N	**16**	**13**	ND (5)	**29**	ND (0.1)	ND (2.5)	**4,700**	**-77.2**	ND (10)	**--**	ND (2.5)	**--**	ND (50)	**--**	ND (0.5)	**-10**	**15,000**	**630**	**9,100**	ND (1)
	09/13/12	FD	**16**	**13**	ND (5)	**29**	ND (0.1)	ND (2.5)	**4,900**	**-78.8**	ND (10)	**--**	ND (2.5)	**--**	ND (50)	**--**	ND (0.5)	**-9.9**	**15,000**	**630**	**9,200**	ND (1)
	11/14/12	N	**25**	ND (5)	ND (5)	**25**	**0.228**	**--**	**5,300**	**--**	**--**	**--**	**--**	**0.0982**	**--**	**--**	**--**	**--**	**16,000**	**680**	**--**	**--**
	02/07/13	N	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**0.141**	**--**	**--**	**--**	**--**	**12,000**	**--**	**--**	**--**
MW-73-080 (Site I)	11/15/11	N	**90**	ND (5)	ND (5)	**90**	**0.14**	ND (1)	**3,000**	**--**	**2.8**	**--**	**5.6**	**--**	ND (10)	ND (0.2)	**--**	**--**	**--**	**390**	**6,000**	ND (1)
	12/14/11	N	**70**	ND (5)	ND (5)	**70**	ND (0.1)	ND (1)	**3,100**	**-70.2**	ND (2.5)	**--**	**5.7**	**--**	ND (25)	ND (0.2)	**--**	**-9.3**	**9,500**	**390**	**5,300**	**2.5**

TABLE C2-9

Groundwater Sample Results: Anions and General Chemistry Parameters

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			General Chemistry (mg/L except where footnoted)																		
Location	**Date**	**Sample Type**	**Alkalinity, bicarbonate as CaCO3**	**Alkalinity, carbonate as CaCO3**	**Alkalinity, hydroxide**	**Alkalinity, total as CaCO3**	**Ammonia as nitrogen**	**Bromide**	**Chloride**	**Deuterium**	**Fluoride**	**Nitrate**	**Nitrate as Nitrogen**	**Nitrate/Nitrite as Nitrogen**	**Nitrite as Nitrogen**	**Ortho phosphate**	**Orthophosphate, dissolved**	**Oxygen 18**	**Specific conductance**	**Sulfate**	**Total dissolved solids**	**Total organic carbon**
MW-73-080 (Site I)	02/14/12	N	--	--	--	--	--	--	--	--	--	--	**5.3**	--	--	--	--	--	**10,000**	--	--	--
	05/02/12	N	--	--	--	--	--	--	--	--	--	--	**4.8**	--	--	--	--	--	**11,000**	--	--	--
	09/13/12	N	--	--	--	--	--	--	--	--	--	--	**4.6**	--	--	--	--	--	**11,000**	--	--	--
	12/05/12	N	**86**	ND (5)	ND (5)	**86**	ND (0.1)	--	**3,500**	--	--	--	--	**4.98**	--	--	--	--	**11,000**	**420**	--	--
	02/19/13	N	--	--	--	--	--	--	--	--	--	--	--	**4.01**	--	--	--	--	**8,800**	--	--	--
MW-74-240 (Site J)	01/16/12	N	ND (5)	**210**	**36**	**240**	**2.5**	ND (0.5)	**270**	--	**4.7**	--	ND (0.5)	--	ND (2.5)	ND (0.1)	--	--	--	**120**	**1,100**	**15**
	02/17/12	N	--	--	--	--	--	--	--	--	--	--	ND (0.5)	--	--	--	--	--	**1,700**	--	--	--
	05/10/12	N	--	--	--	--	--	--	--	--	--	--	ND (0.5)	--	--	--	--	--	**1,300**	--	--	--
	09/27/12	N	--	--	--	--	--	--	--	--	--	--	ND (0.5)	--	--	--	--	--	**1,200**	--	--	--
	12/20/12	N	**110**	**37**	ND (5)	**150**	**0.535**	--	**160**	--	--	--	--	**0.0739 J**	--	--	--	--	**1,100**	**96**	--	--
	12/20/12	FD	**110**	**37**	ND (5)	**150**	**0.476**	--	**160**	--	--	--	--	**0.0549 J**	--	--	--	--	**1,100**	**94**	--	--
	03/01/13	N	--	--	--	--	--	--	--	--	--	--	--	**0.159**	--	--	--	--	**890**	--	--	--

Notes:

Detected results are bolded

-- = not analyzed

mg/L = milligrams per liter

J = concentration or reporting limit estimated by laboratory or data validation

Deuterium and Oxygen 18 in differences from global standards in ppt

ND = not detected at the listed reporting limit

pH in pH units

Specific conductance in microsiemens per centimeter (µS/cm)

TABLE C2-10

Groundwater Sample Results: Dioxin and Furans

Revised Addendum to the Summary or Findings Associated with the East Ravine Groundwater Investigation

PG&E Topock Compressor Station, Needles, California

			Dioxins and Furans (pg/L)																		
Location	**Date**	**Sample Type**	**1,2,3,4,6,7,8-HpCDD**	**1,2,3,4,6,7,8-HpCDF**	**1,2,3,4,7,8,9-HpCDF**	**1,2,3,4,7,8-HxCDD**	**1,2,3,4,7,8-HxCDF**	**1,2,3,6,7,8-HxCDD**	**1,2,3,6,7,8-HxCDF**	**1,2,3,7,8,9-HxCDD**	**1,2,3,7,8,9-HxCDF**	**2,3,4,6,7,8-HxCDF**	**OCDD**	**OCDF**	**1,2,3,7,8-PeCDD**	**1,2,3,7,8-PeCDF**	**2,3,4,7,8-PeCDF**	**2,3,7,8-TCDD**	**2,3,7,8-TCDF**	**TEQ**	**TEQ Avian**	**TEQ Mammals**
MW-57-070 (Site B)	05/04/09	N	ND (2.5)	ND (10)	ND (1.9)	ND (2)	ND (1.2)	ND (5.7)	ND (1.1)	ND (2)	ND (4.7)	ND (1.3)	ND (150)	ND (23)	ND (2.1)	ND (0.5)	ND (0.5)	ND (0.63)	ND (0.5)	--	--	--
MW-59-100 (Site G)	05/04/09	N	ND (1.2)	ND (0.65)	ND (0.98)	ND (1)	ND (0.53)	ND (1)	ND (0.49)	ND (1)	ND (0.72)	ND (0.56)	ND (1.3)	ND (2.4)	ND (1.2)	ND (0.34)	ND (0.34)	ND (0.53)	ND (0.34)	--	--	--
MW-60BR-245 (Site F)	08/09/11	N	ND (1.6)	ND (2.2)	ND (0.72)	ND (1.1)	ND (0.63)	ND (0.98)	ND (0.49)	ND (1.1)	ND (0.68)	ND (0.59)	ND (2.8)	ND (2.1)	ND (1.2)	ND (1.7)	ND (1)	ND (0.96)	ND (0.67)	ND (1.6)	ND (2.2)	ND (1.6)
MW-65-160 (Site 5)	06/13/11	N	ND (6.3)	ND (3.5)	ND (4.5)	ND (4.9)	ND (2.6)	ND (5.1)	ND (2.3)	ND (4.7)	ND (3.1)	ND (2.7)	ND (9.6J)	ND (9.6)	ND (3.6)	ND (2.4)	ND (2.4)	ND (4)	ND (3.4)	ND (5.7)	ND (7.8)	ND (5.7)
MW-66-165 (Site 6)	06/13/11	N	ND (4.8)	ND (3.4)	ND (4.4)	ND (3.6)	ND (2.2)	ND (3.8)	ND (2)	ND (3.5)	ND (2.6)	ND (2.3)	ND (11)	ND (8.2)	ND (4.5)	ND (2.4)	ND (2.4)	ND (4.1)	ND (4.7)	ND (6)	ND (8.8)	ND (6)
MW-67-185 (Site 2)	10/18/11	N	ND (23)	**25 J**	**17 J**	ND (4.5)	ND (5.5)	ND (5.4)	ND (7.3)	**5.1 J**	ND (11)	ND (6.5)	ND (110)	ND (32)	**5.1 J**	ND (4.7)	ND (4.3)	ND (5.8)	ND (5.5)	**12**	**16**	**12**
	10/18/11	FD	ND (27)	ND (22)	**22 J**	**7.7 J**	ND (6.3)	**11 J**	ND (32)	ND (6)	ND (15)	ND (6.6)	ND (38)	ND (19)	ND (3.4)	ND (6.7)	ND (5.6)	ND (9.6)	ND (7.2)	**13**	**17**	**13**
	02/21/12	N	ND (1)	ND (0.59)	ND (0.81)	ND (1)	ND (0.58)	ND (0.92)	ND (0.5)	ND (0.91)	ND (0.69)	ND (0.56)	**13 J**	ND (0.74)	ND (1.1)	ND (0.57)	ND (0.6)	ND (0.44)	ND (0.63)	**1.2**	**1.6**	**1.2**
MW-67-225 (Site 2)	06/14/11	N	ND (2.8)	ND (4.6)	ND (2.2)	ND (3.3)	ND (2.3)	ND (2.1)	**3.1 J**	ND (5.1)	ND (3)	ND (1.5)	ND (12)	ND (9.9)	ND (2.2)	ND (1.4)	ND (2)	ND (2.1)	ND (2.8)	**3.8**	**5.7**	**3.8**
	12/14/11	N	ND (2.6)	ND (2.3)	ND (3.3)	ND (2.3)	ND (0.89)	ND (1.7)	ND (0.66J)	ND (1.8)	ND (1)	ND (0.84)	ND (7.8)	ND (2.9)	ND (1.7)	ND (1)	ND (1.1)	ND (1)	ND (0.85)	ND (2.1)	ND (2.7)	ND (2.1)
MW-68-180 (Site 3)	06/14/11	N	ND (4.4)	ND (2.6)	ND (3.4)	ND (3.4)	ND (2)	ND (3.5)	ND (1.9)	ND (3.3)	ND (2.4)	ND (2.1)	ND (6.5)	ND (4.7)	ND (3.2)	ND (2.7)	ND (2.7)	ND (4.4)	ND (4.4)	ND (5.4)	ND (8.2)	ND (5.4)
	06/14/11	FD	ND (5.1)	ND (3.3)	ND (4.3)	ND (16)	ND (6.3)	ND (5.8)	ND (4.8)	ND (5.3)	ND (3.7)	ND (3)	ND (13)	ND (13)	ND (5.7)	ND (5.4)	ND (2.8)	ND (4.3)	ND (5.5)	ND (8.1)	ND (11)	ND (8.1)
MW-68BR-280 (Site 3)	09/08/11	N	ND (25)	ND (33)	ND (15)	**20 J**	ND (16)	ND (16)	ND (13)	ND (25)	ND (25)	ND (24)	ND (8.5)	ND (8.7)	ND (4.5)	ND (3.2)	ND (3)	ND (1.9)	ND (2.8)	**12**	**13**	**12**
	12/14/11	N	ND (4.7)	ND (6.7)	ND (3.6)	ND (6.4)	ND (1.4)	ND (4.9)	ND (1.1J)	ND (5.1)	ND (1.6)	ND (1.3)	ND (62)	ND (6.4)	ND (2.7)	ND (1.9)	ND (1.6)	ND (1.4)	ND (1.6)	ND (3.6)	ND (4.5)	ND (3.6)
MW-69-195 (Site 4)	07/11/11	N	**9.5 J**	ND (1.3)	ND (1.8)	ND (2.2)	ND (1.5)	ND (3.1J)	ND (1.2)	ND (2)	ND (10)	ND (3.9)	**310**	ND (4.1)	ND (2.2)	ND (1.1)	ND (1.5)	ND (1.3J)	ND (1.5)	**3.5**	**4.4**	**3.5**
	12/14/11	N	ND (2.6)	ND (3.6)	ND (2.2)	ND (3.3)	ND (0.92)	ND (2.5)	ND (0.68J)	ND (2.7)	ND (1.1)	ND (1.5)	ND (3.6)	ND (3.2)	ND (2.1)	ND (1.6)	ND (1.7)	ND (1.7)	ND (1.3)	ND (2.9)	ND (4)	ND (2.9)
MW-70-105 (Site H)	06/13/11	N	ND (4.1)	ND (2.9)	ND (3.8)	ND (4.9)	ND (2.5)	ND (5.2)	ND (2.3)	ND (4.8)	ND (3)	ND (2.6)	ND (19)	ND (5.2)	ND (4)	ND (2.5)	ND (2.5)	ND (4.2)	ND (4.4)	ND (6.1)	ND (8.6)	ND (6.1)
MW-70BR-225 (Site H)	11/16/11	N	ND (1.2)	ND (1.7)	ND (0.95)	ND (1.1)	ND (0.6)	ND (1.1)	ND (0.85)	ND (1.1)	ND (0.55)	ND (0.73)	**7.5 J**	ND (1.7)	ND (0.85)	ND (0.63)	ND (0.65)	ND (0.5)	ND (0.53)	**1.1**	**1.5**	**1.1**
	02/16/12	N	ND (2.1)	ND (1.2)	ND (2.9)	ND (2.5)	ND (1.6)	ND (1.6)	ND (1.2)	ND (1.6)	ND (3.3)	ND (2.3)	ND (3.1)	ND (3.2)	ND (1.6)	ND (0.82)	ND (2.2)	ND (0.87)	ND (0.76)	ND (2.4)	ND (3.3)	ND (2.4)
MW-71-035 (Site L)	02/20/12	N	ND (2.9)	ND (1.8)	ND (2.4)	ND (2.5)	ND (0.94)	ND (2.2)	ND (1.8)	ND (2.2)	ND (1.1)	ND (0.52)	**15 J**	ND (3.9)	ND (2)	ND (1.1)	ND (1.1)	ND (0.72)	ND (0.76)	**2.2**	**2.8**	**2.2**
	05/03/12	N	ND (9.6)	**6.6 J**	ND (3.5)	ND (2.9)	ND (1.5)	ND (2.7)	ND (1.3)	ND (1.6)	ND (4.7)	ND (1.5)	ND (41)	ND (9.8)	ND (3.2)	ND (1.2)	ND (1.3)	ND (1.1)	ND (0.86)	**3.4**	--	--
MW-72-080 (Site K)	09/06/11	N	ND (11)	ND (7.6)	ND (8.7)	ND (11)	ND (4.9)	ND (7.3)	ND (3.9)	ND (9.6)	ND (11)	ND (6.3)	ND (20)	ND (15)	ND (5.3)	ND (4.9)	ND (2.8)	ND (3.2)	ND (3.2)	ND (7.7)	ND (9.7)	ND (7.7)
MW-72BR-200 (Site K)	09/13/12	N	**180 J**	**40 J**	**8.7 J**	ND (2.3)	ND (1.6)	ND (4)	ND (1.5)	ND (2.1)	ND (1.9)	ND (4.3)	**2,900 J**	**300 J**	ND (5.2)	ND (0.51)	ND (0.57)	ND (0.97)	ND (0.71)	**7.3**	**5.4**	**7.3**
	09/13/12	FD	**520 J**	**100 J**	ND (6.5)	ND (3.7)	ND (2)	ND (2.6)	ND (5.8)	ND (3.5)	ND (2.4)	ND (46)	**7,500 J**	**880 J**	ND (1.7)	**3 J**	ND (1.1)	ND (1.3)	ND (0.78)	--	--	--
MW-73-080 (Site I)	11/15/11	N	**18 J**	**16 J**	**8.7 J**	ND (2.2)	ND (1.4)	ND (3.9)	**9.3 J**	ND (3.6)	**15 J**	ND (3.8)	**29 J**	ND (5.7)	**11 J**	ND (1.3)	ND (4.3)	ND (5.4)	ND (3.9)	**18**	**21**	**18**
	02/14/12	N	ND (3.6)	ND (1.9)	ND (2.8)	ND (2.4)	ND (1.4)	ND (2.3)	ND (1.3)	ND (2.3)	ND (1.8)	ND (1.5)	ND (11)	ND (8.7)	ND (2.3)	ND (1.2)	ND (1.3)	ND (1.4)	ND (1.1)	ND (2.8)	ND (3.6)	ND (2.8)
MW-74-240 (Site J)	01/16/12	N	ND (5.5)	ND (1.4)	ND (2)	ND (3.6)	ND (1.5)	ND (3.2)	ND (1.2)	ND (3.2)	ND (1.7)	ND (1.5)	ND (6.8)	ND (3.3)	ND (4.1)	ND (1.4)	ND (1.5)	ND (1.9)	ND (1.1)	ND (4.1)	ND (5)	ND (4.1)

Notes:

Detected results are bolded

Calculations:

-- = not analyzed

pg/L = picograms per liter

J = concentration or reporting limit estimated by laboratory or data validation

ND = not detected at the listed method detection limit

Teq = Sum of Result x TEF, 1/2 reporting limit used for nondetects.

TeqBird = Sum of Result x TEF, 1/2 reporting limit used for nondetects. If all Dioxins and Furans are nondetect, the final qualifier code is U.

TeqMammals = Sum of Result x TEF, 1/2 reporting limit used for nondetects. If all Dioxins and Furans are nondetect, the final qualifier code is U.

Attachment D
Site H Constant Rate Test

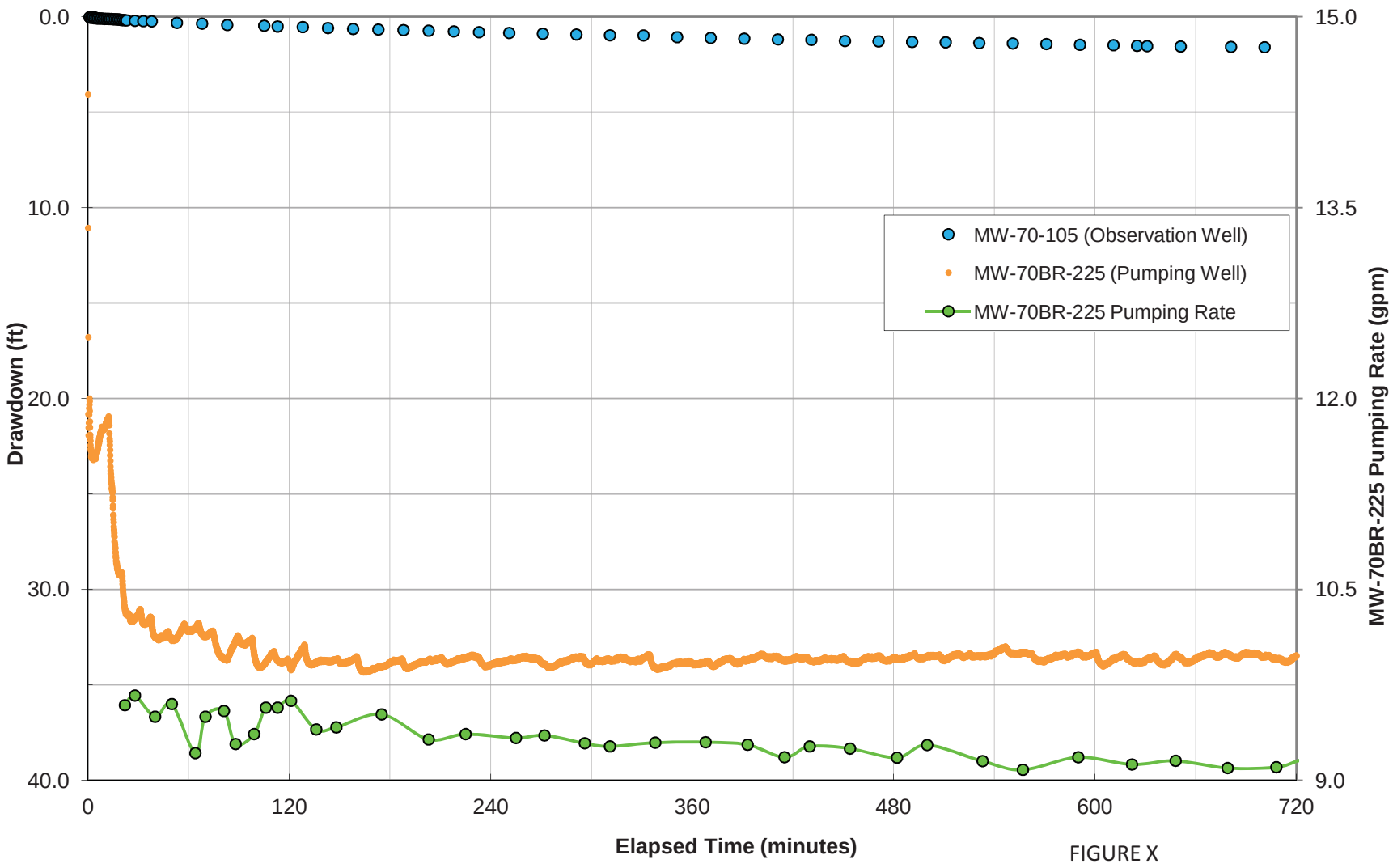

MW-70BR-225 Constant Rate Pump Test, 1/15/2012
0.0
10.0
20.0
30.0
40.0
Drawdown (ft)
15.0
13.5
12.0
10.5
9.0
MW-70BR-225 Pumping Rate (gpm)
0
120
240
360
480
600
720
Elapsed Time (minutes)
MW-70-105 (Observation Well)
MW-70BR-225 (Pumping Well)
MW-70BR-225 Pumping Rate

FIGURE X

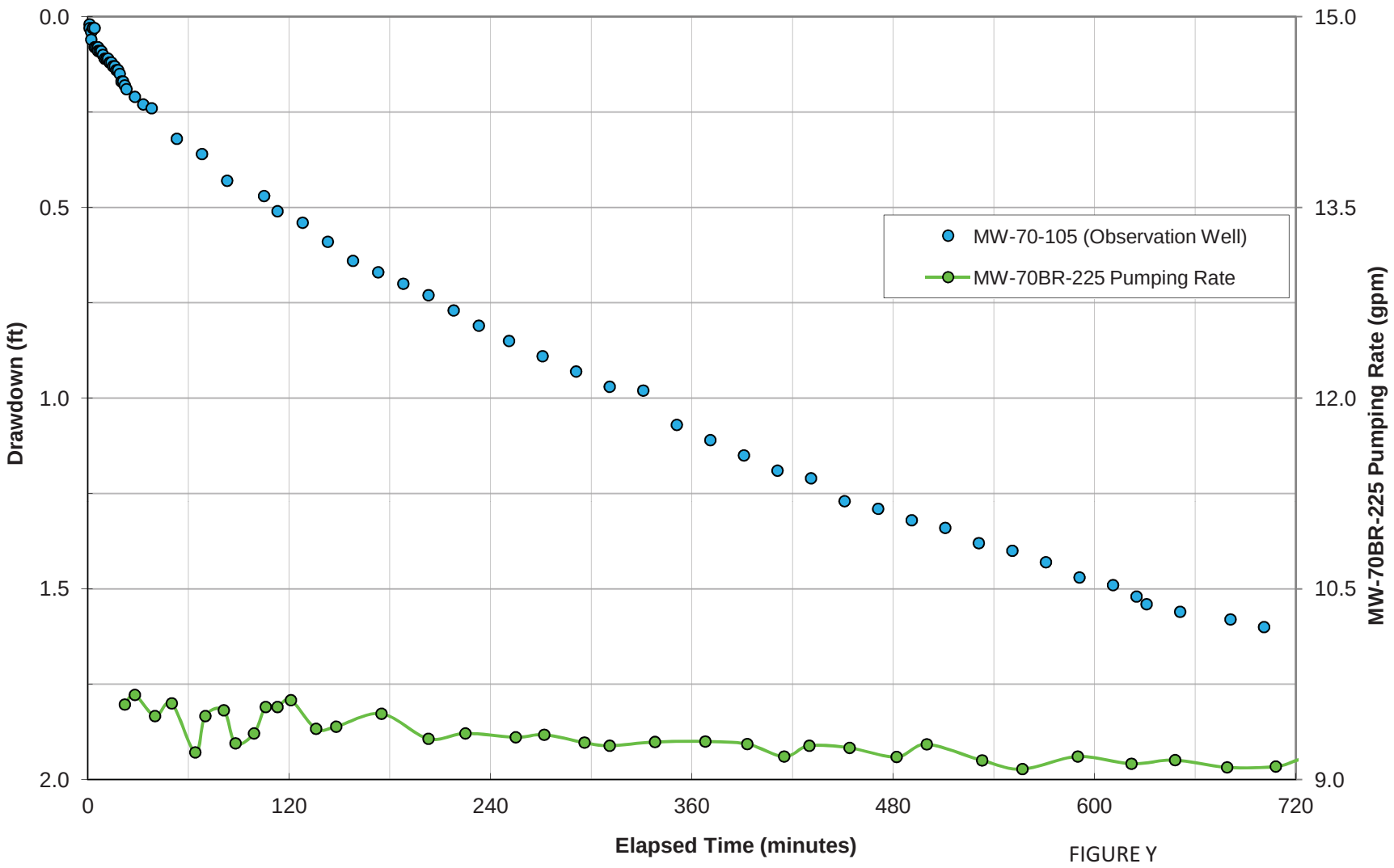
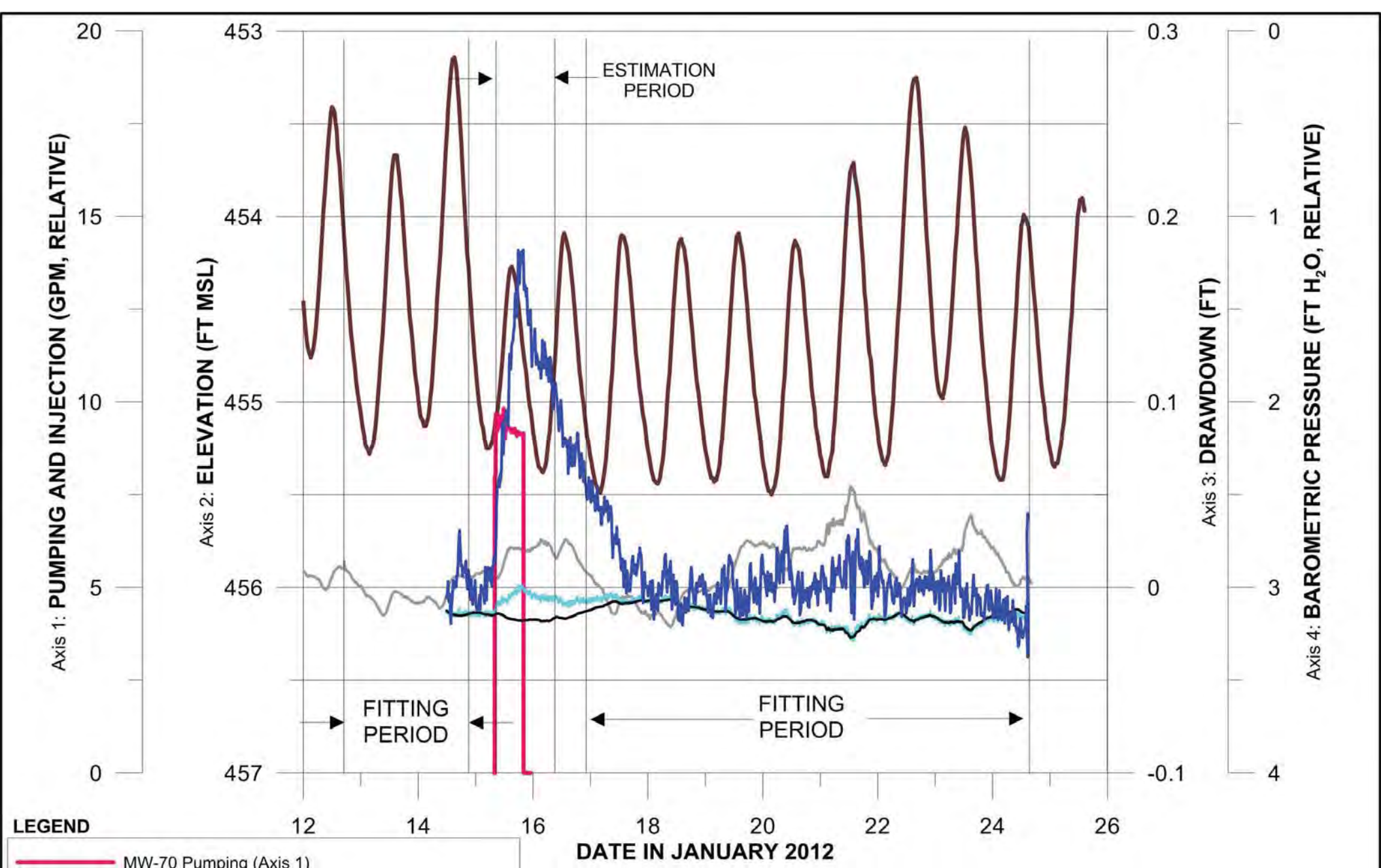

MW-70BR-225 Constant Rate Pump Test, 1/15/2012
0.0
0.5
1.0
1.5
2.0
Drawdown (ft)
15.0
13.5
12.0
10.5
9.0
MW-70BR-225 Pumping Rate (gpm)
MW-70-105 (Observation Well)
MW-70BR-225 Pumping Rate
0
120
240
360
480
600
720
Elapsed Time (minutes)

FIGURE Y



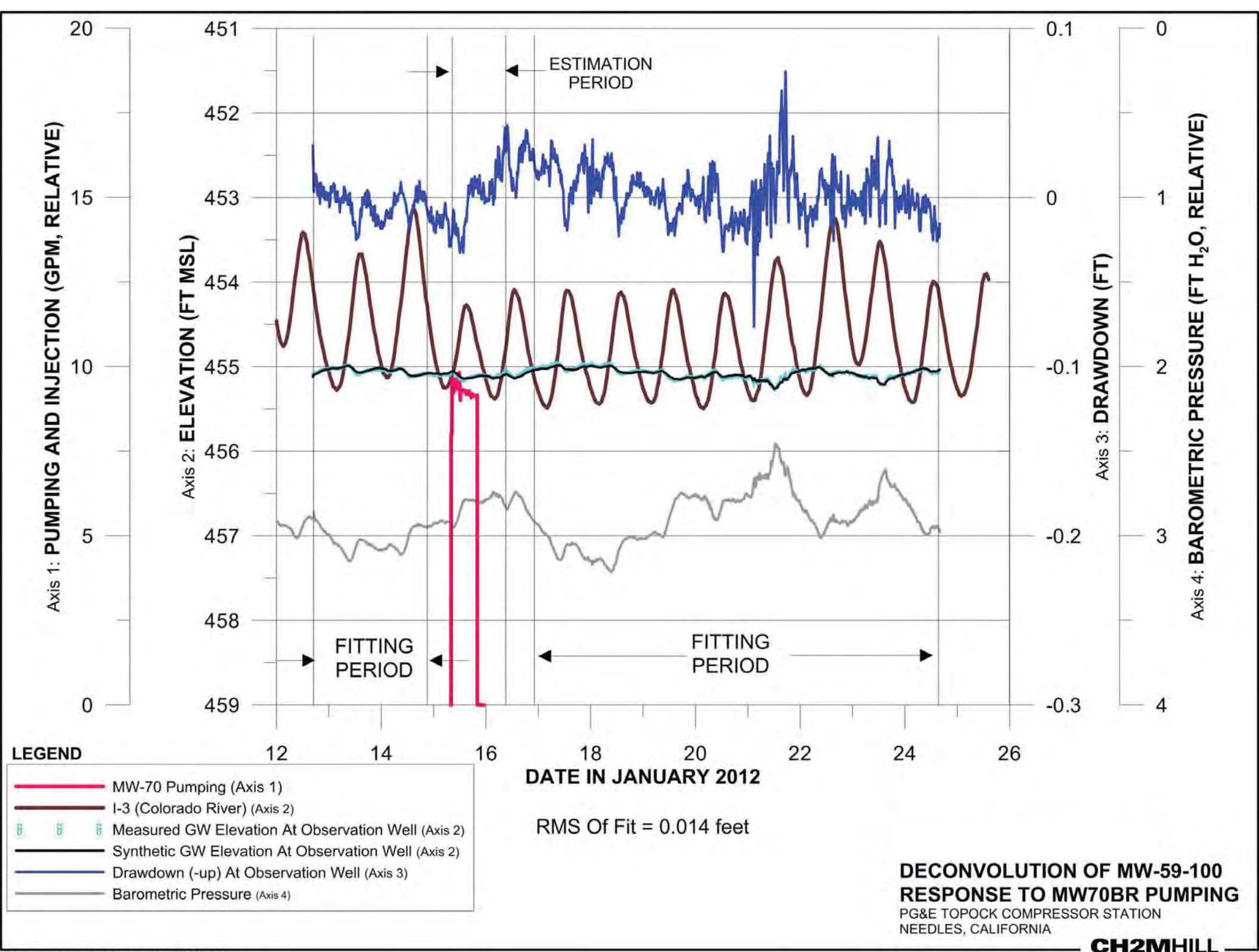
RMS Of Fit = 0.012 feet

DECONVOLUTION OF MW-58BR-185 RESPONSE TO MW70BR PUMPING

PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

CH2MHILL

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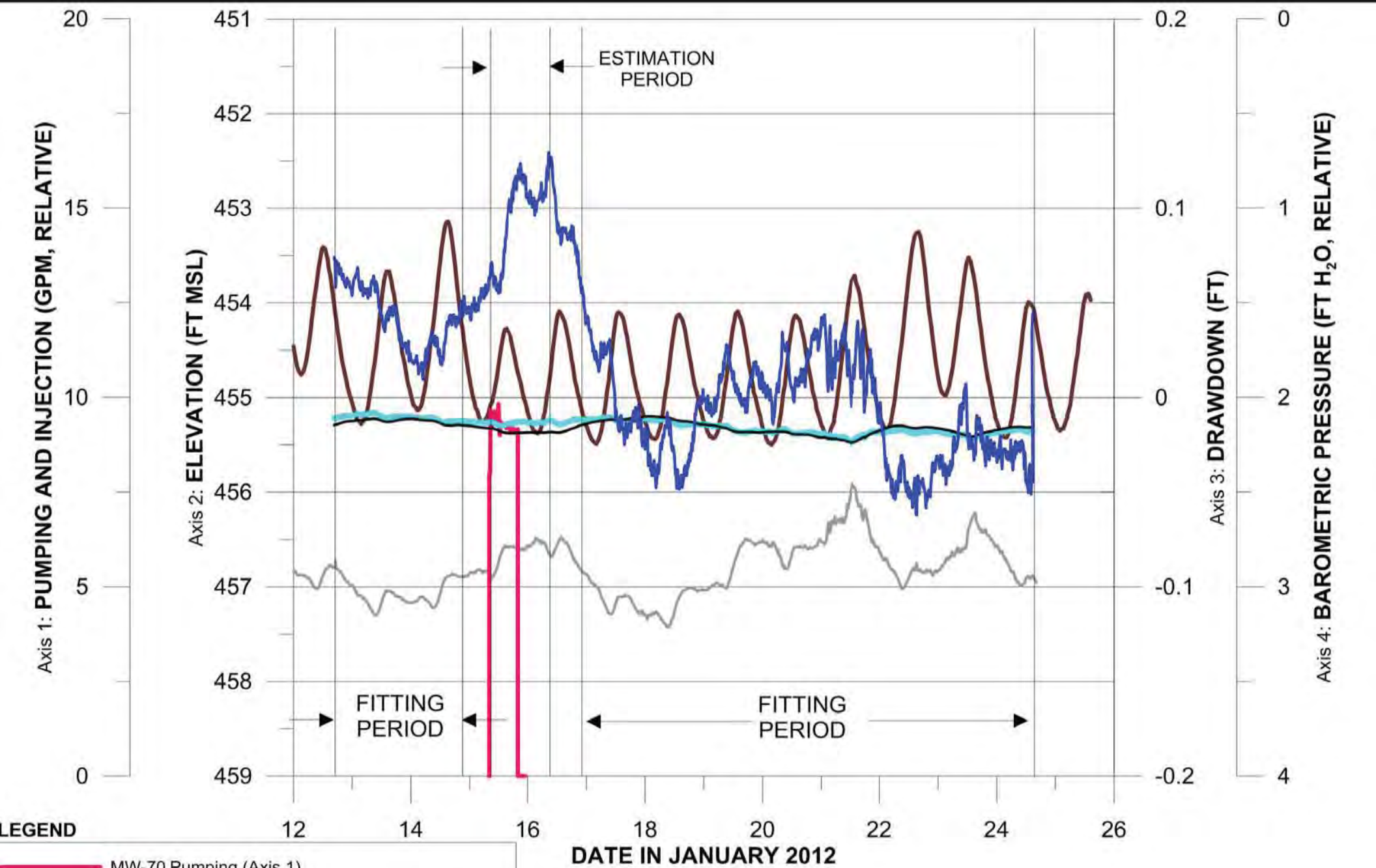


DECONVOLUTION OF MW-59-100 RESPONSE TO MW70BR PUMPING

PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

CH2MHILL

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LEGEND

- MW-70 Pumping (Axis 1)
- I-3 (Colorado River) (Axis 2)
- Measured GW Elevation At Observation Well (Axis 2)
- Synthetic GW Elevation At Observation Well (Axis 2)
- Drawdown (-up) At Observation Well (Axis 3)
- Barometric Pressure (Axis 4)

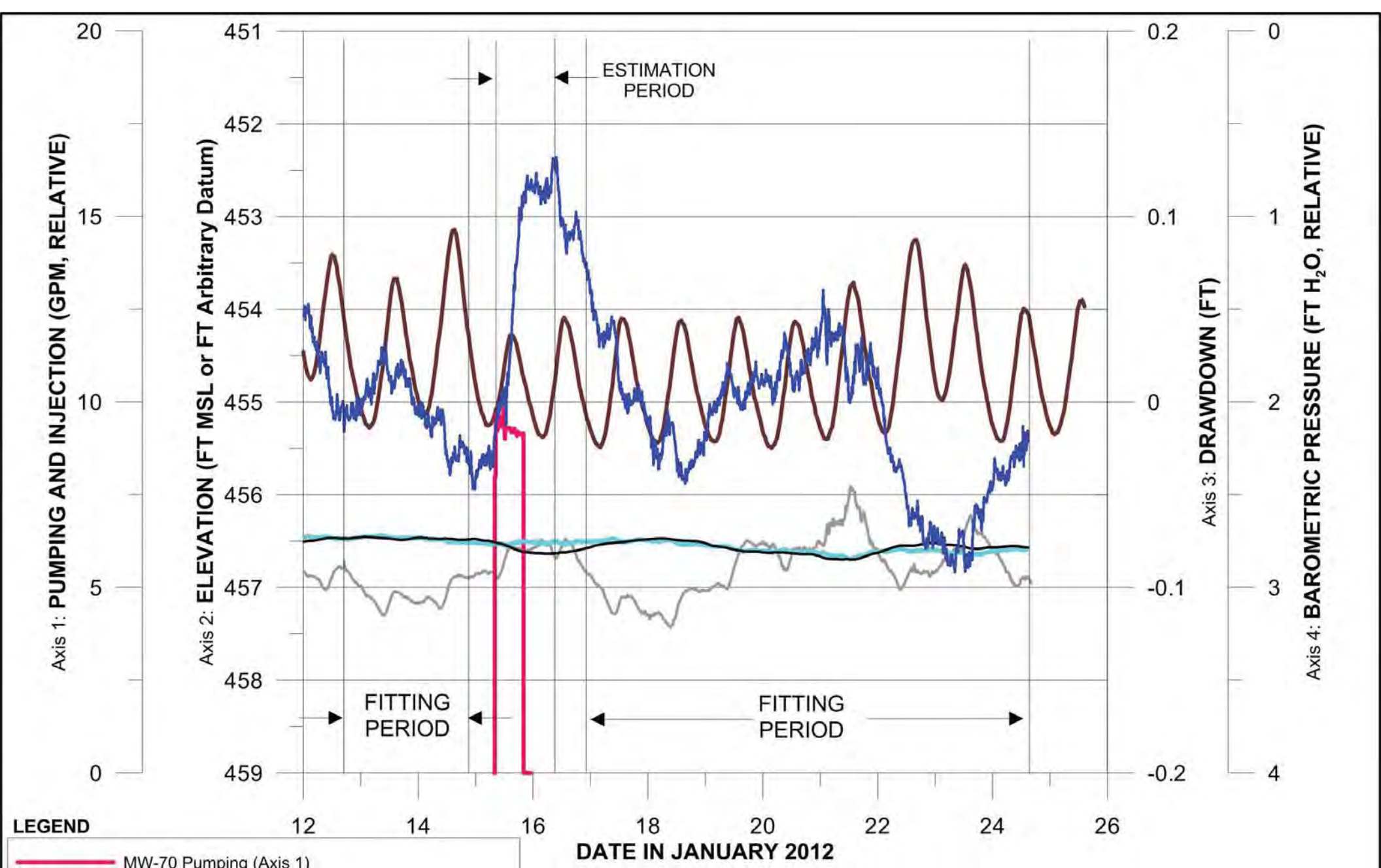
RMS Of Fit = 0.032 feet

DECONVOLUTION OF MW-60-125 RESPONSE TO MW70BR PUMPING

PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

CH2MHILL

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LEGEND

- MW-70 Pumping (Axis 1)
- I-3 (Colorado River) (Axis 2)
- Measured GW Elevation At Observation Well (Axis 2)
- Synthetic GW Elevation At Observation Well (Axis 2)
- Drawdown (-up) At Observation Well (Axis 3)
- Barometric Pressure (Axis 4)

RMS Of Fit = 0.037 feet

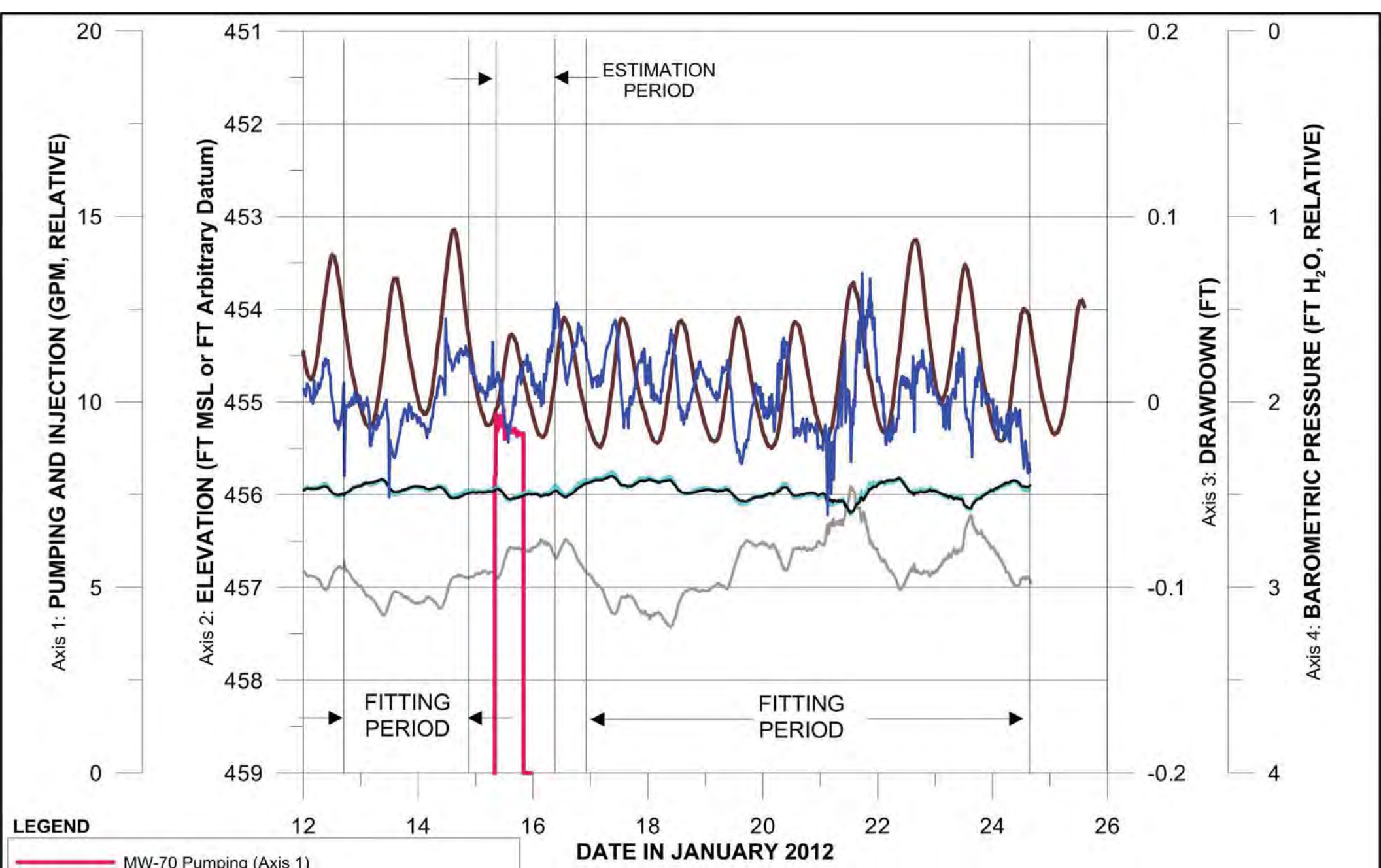
NOTE: The measured and synthetic groundwater elevations shown are referenced to an arbitrary datum.

DECONVOLUTION OF MW-60BR-245 RESPONSE TO MW70BR PUMPING

PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

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RMS Of Fit = 0.020 feet

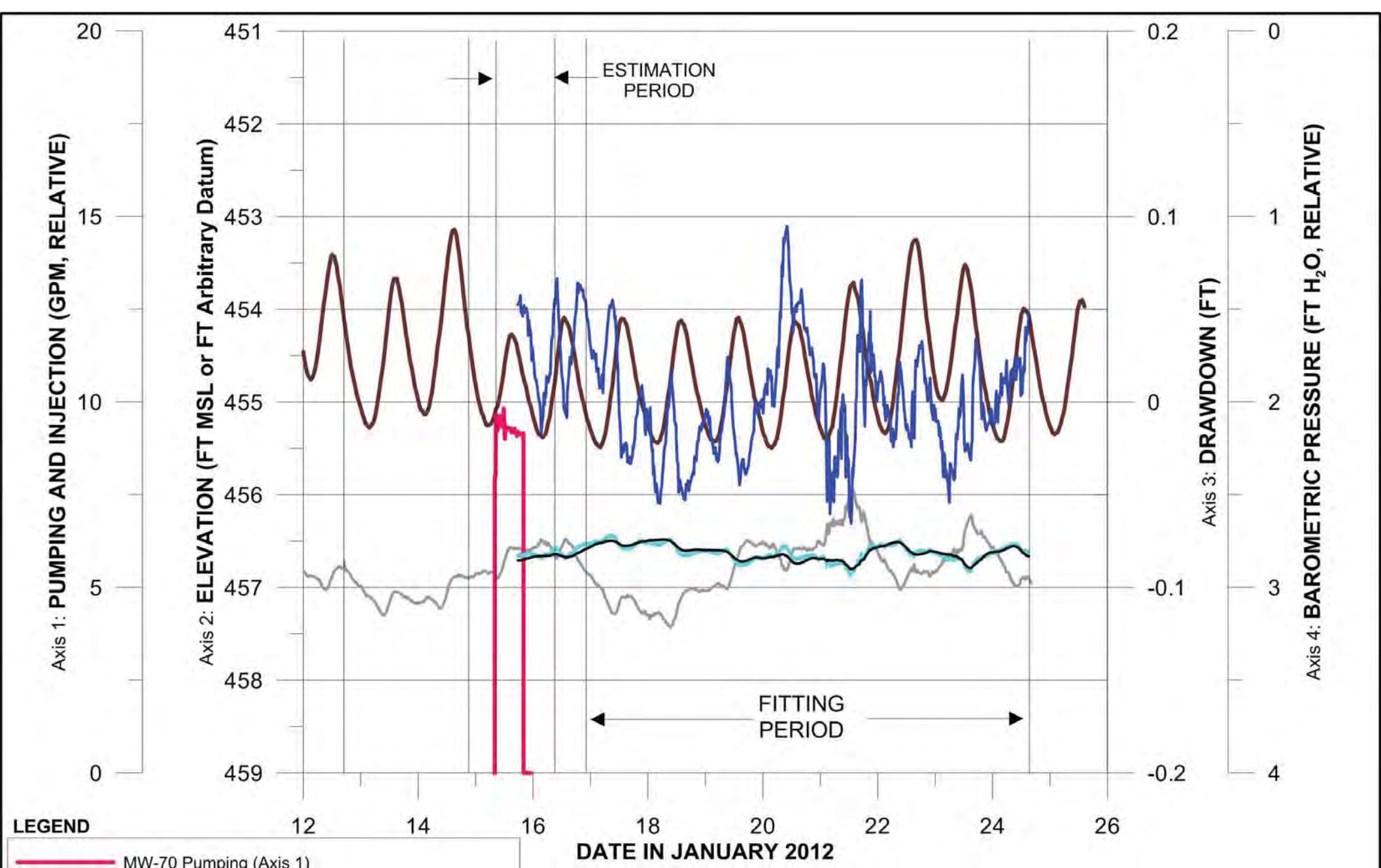
NOTE: The measured and synthetic groundwater elevations shown are referenced to an arbitrary datum.

DECONVOLUTION OF MW-68-180 RESPONSE TO MW70BR PUMPING

PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

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LEGEND

- MW-70 Pumping (Axis 1)
- I-3 (Colorado River) (Axis 2)
- Measured GW Elevation At Observation Well (Axis 2)
- Synthetic GW Elevation At Observation Well (Axis 2)
- Drawdown (-up) At Observation Well (Axis 3)
- Barometric Pressure (Axis 4)

RMS Of Fit = 0.031 feet

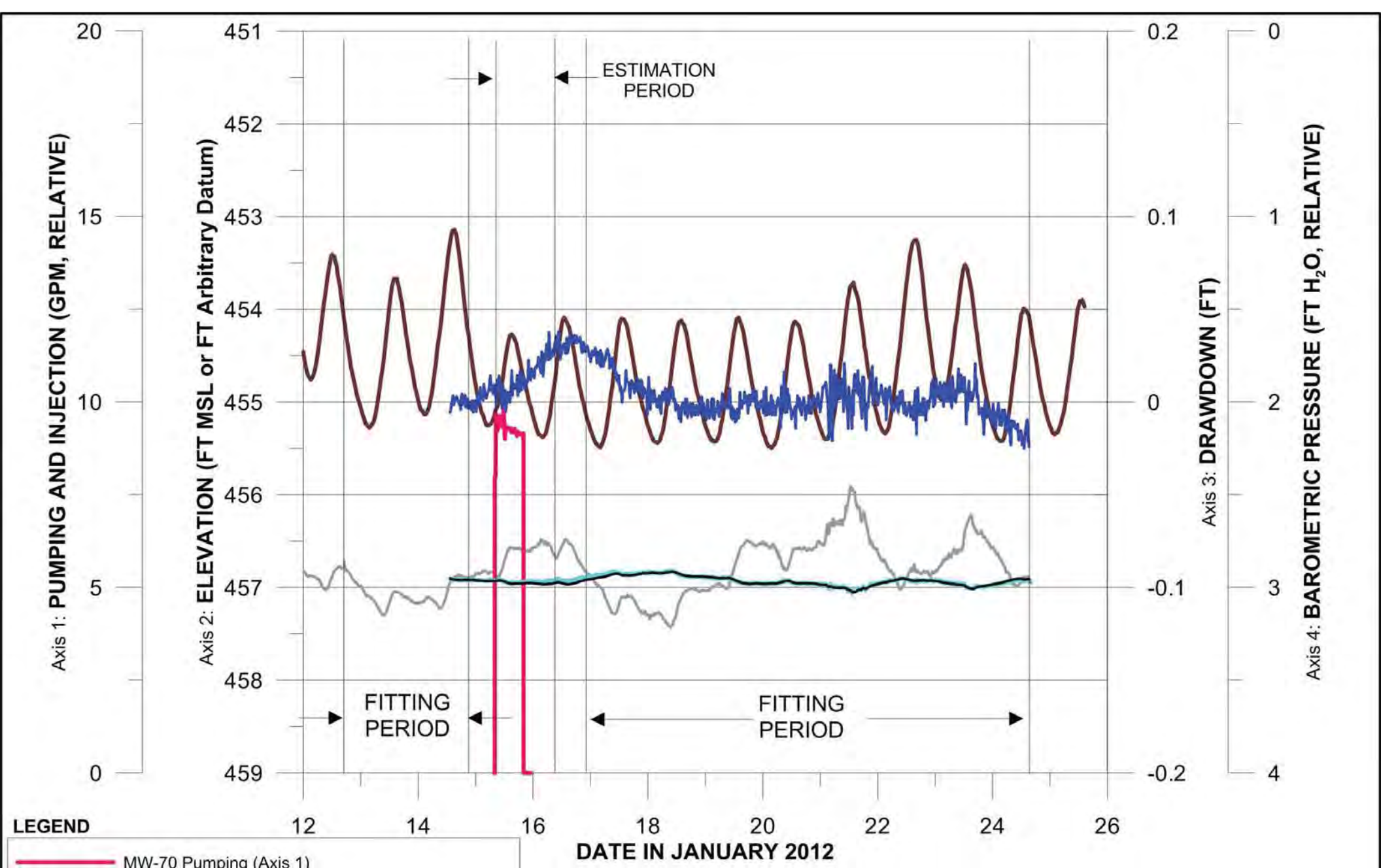
NOTE: The measured and synthetic groundwater elevations shown are referenced to an arbitrary datum.

DECONVOLUTION OF MW-68-240 RESPONSE TO MW70BR PUMPING

PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

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RMS Of Fit = 0.008 feet

NOTE: The measured and synthetic groundwater elevations shown are referenced to an arbitrary datum.

DECONVOLUTION OF MW-69-195 RESPONSE TO MW70BR PUMPING

PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

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Attachment E
Data Quality Evaluation

Attachment E-1
Data Quality Evaluation for Soil Analytical Data

Review of Soil Analytical Data for the Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation, PG&E Topock Compressor Station, Needles, California

Prepared for

Pacific Gas and Electric

November, 2012

CH2MHILL
2525 Airpark Drive
Redding, California 96001

Introduction

This Data Quality Evaluation (DQE) report assesses the data quality of soil sample analytical results for the Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation, PG&E Topock Compressor Station, Needles, California. Samples were collected and analyzed as requested by the California Department of Toxic Substance Control. The *PG&E Quality Assurance Program Plan* (QAPP) – Topock *Addendum to the PG&E Program Quality Assurance Project Plan for the RCRA Facility Investigation/Remedial Investigation for Soil*, December 2008 and subsequent updates, individual method requirements, internal laboratory quality control (QC) criteria, guidelines from the U.S. Environmental Protection Agency (EPA) Contract Laboratory National Functional Guidelines for Inorganic Data Review, July 2002, and EPA Contract Laboratory National Functional Guidelines for Organic Data Review, October 1999, were used in this assessment.

Analytical Data

Advanced Technology Laboratories (ATL) of Las Vegas, Nevada and Agriculture and Priority Pollutants Laboratories, Inc. (APPL) of Clovis, California performed the required analyses. Both laboratories are certified by the California Department of Health Service's Environmental Laboratory Accreditation Program for the analyses included in Table 2 where appropriate. Samples were analyzed for one or more of the analytes / methods provided in Table 1.

TABLE 1
Analytical Parameters

Parameter	**Method** [a]	**Laboratory**
Dioxin/Furans	SW8290	APPL
Hexavalent Chromium	SW7199	ATL
Total Organic Carbon (TOC)	SW9060	ATL
Cations	SW6010B	ATL
Metals	SW6020A	ATL
Mercury	SW7471A	ATL
Total Petroleum Hydrocarbon (TPH) – Gasoline Range	SW8015B	ATL
TPH-Diesel and Motor Oil Ranges	SW8015B	ATL
Volatile Organic Compounds (VOC)	SW8260B	ATL
Semivolatile Organic Compounds	SW8270C	ATL
Polynuclear Aromatic Hydrocarbons (PAH)	SW8270-Selected Ion Monitoring (SIM)	ATL
PCBs	SW8082	ATL

TABLE 1
Analytical Parameters

Parameter	Method [a]	Laboratory
pH	SW9045	ATL
Cyanide	SW9014	ATL

[a] SW-846 Test Methods for Evaluating Solid Waste, 3rd Edition, revision 4, 1996.

This DQE report covers 95 normal soil samples, and 8 field duplicate (FD) soil samples. These samples were reported by the laboratories in 15 sample delivery groups identified in Table 1 below:

TABLE 1
Sample Delivery Groups

64191	64322	64816	N005513
N005519	N005597	N005633	N005634
N005648	N005736	N005737	N005817
N005818	N005878	N005879	

The sample delivery groups were assessed by reviewing the following: (1) the chain-of-custody documentation; (2) holding-time compliance; (3) initial and continuing calibration criteria; (4) method blanks and field blanks; (5) laboratory control sample/laboratory control sample duplicate (LCS/LCSD) recoveries; (6) matrix spike/matrix spike duplicate (MS/MSD) recoveries; (7) laboratory duplicate precision; (8) surrogate spike recoveries; (9) internal standard recoveries; (10) FD precision; and (11) the required QC samples at the specified frequencies.

Data flags were assigned as defined in the QAPP. These flags, as well as the reason for each flag, are entered into the electronic database and can be found in Table 3 at the end of this report (sorted by validation reason and then analyte). Multiple flags are routinely applied to specific sample method/matrix/analyte combinations, but there will be only one final flag. A final flag is applied to the data and is the most conservative of the applied validation flags. The final flag also includes matrix and blank sample effects.

The data flags are listed and defined below:

- J = Analyte was present but the reported value might not be accurate or precise (estimated).
- R = Data were unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.

- U = Analyte was not detected at the specified detection limit.
- UJ = Analyte was not detected and the specified detection limit might not be accurate or precise (estimated).

Data Assessment

Data assessment includes a review of the activities described in the following sections.

Holding Times

Holding-time exceedances result in the possible loss of target analytes due to degradation or chemical reactions that usually cause a negative bias to sample results.

Six cyanide (SW9014) samples were extracted outside the EPA recommended holding-time of 14 days. The non-detected results were qualified as estimated and flagged "UJ".

All other holding times were met.

Method Blanks

Method blanks (MB) are used to monitor each preparation or analytical batch for contamination throughout the entire analytical process from sources such as glassware, reagents, instrumentation and other potential contaminant sources within the laboratory. If a target analyte is detected in the method blank, similar detections in the samples are possibly artifacts of laboratory contamination.

Three MBs for dioxins (SW8290) had analytes that were detected at a concentration between the method detection limit (MDL) and the reporting limit (RL). Associated sample results that were at concentrations between the MDL and 5x the associated MB concentration were qualified as non-detect and flagged "U". Sample results greater than 5x the associated MB concentration were qualified, but no flag was applied.

MBs were analyzed at the required frequency; no other target analytes were detected at or above the reporting limit (RL).

Field Blanks

Equipment Blanks (EB) are used to assess the effectiveness of sampling equipment decontamination procedures. Target analytes detected in EBs may indicate that field equipment was not thoroughly decontaminated and/or samples could have been cross contaminated.

Dedicated equipment was used to collect all soil samples and no EBs were required.

Calibration

Initial calibration and periodic verification are essential to generating defensible analytical data. Initial calibrations that do not meet method requirements result in data that may be either positively or negatively biased. Periodic calibration verification ensures that the instrument has not been adversely affected by the sample matrix or other instrument failures that would increase or decrease the sensitivity or accuracy of the method. The

inability to meet initial or continuing calibration analyses may result in qualifying the data as estimated or rejecting the data for project decision-making purposes.

Initial and continuing calibrations were performed as required by the methods. Calibration criteria were met with the following exceptions.

Nineteen volatile samples (SW8260) were associated with continuing calibration verification standards (CCV) that had 2,2-Dichloropropane recover at less than the lower control limit (LCL). The non-detect results were qualified as estimated and flagged "UJ".

Twenty six volatile samples (SW8260) were associated with CCV that had 2-Butanone recover at greater than the upper control limit (UCL). The non-detect results were qualified; no flags were applied.

Twelve volatile samples (SW8260) were associated with continuing CCV that had 2-Hexanone recover at greater than the UCL. The non-detect results were qualified; no flags were applied.

Thirty nine volatile samples (SW8260) were associated with CCV that had Acetone recover at greater than the UCL. The non-detect results were qualified; no flags were applied.

Nineteen volatile samples (SW8260) were associated with continuing CCV that had Acrylonitrile recover at greater than the UCL. The non-detect results were qualified; no flags were applied.

Five PAH samples (SW8270SIM) were associated CCV that had Benzo(b)fluoranthene recover at greater than the UCL. The non-detect results were qualified; no flags were applied.

Internal Standard Recoveries

Internal standards are used for organic analyses and have similar chemical characteristics to the target analytes and provide an analytical response which is distinct from the analyte and not normally subject to interference. The internal standards are added prior to analysis for the purpose of determining analyte concentrations. The internal standard's response is referenced against a relative response factor enabling the sample analyte concentration to be corrected for matrix effects. Internal standard recoveries below 10 percent result in non-detect sample results being rejected.

One volatile sample's (SW8260B) results were associated with an internal standard that recovered at less than LCL. The non-detect results were qualified, however because the bias to a non-detected result based on low recovery would be high; no flags were applied.

All other internal response factors met method acceptance criteria.

Surrogate Recoveries

Surrogates are primarily used in organic chromatography methods and are added prior to sample preparation. The surrogates are added to all samples, standards, and blanks in a preparation batch and provide a measurement to determine recovery for every sample matrix. Surrogate compounds are chosen to represent the various chemistries of the target analytes in a specific method. They are often specified by the method and are deliberately

selected for their improbability of occurring as environmental contaminants. The results are compared to the acceptance criteria as established by the method or the QAPP. Surrogate recoveries below 10 percent result in non-detect sample results being rejected.

Surrogate recoveries met the acceptance criteria with the following exception.

One PCB samples (SW8082) had surrogate recovery less than the LCL. The non-detected results were qualified as estimated and flagged "UJ".

One dioxin samples (SW8290) had a surrogate recovery less than the LCL. The associated non-detected result was qualified as estimated and flagged "UJ".

Matrix Spike Samples

Matrix spike (MS) recoveries are used to evaluate the affect of the sample matrix on the recovery of target analytes. A sample is fortified with a known quantity of a target analyte and is carried through the same preparation and analytical procedures as the unspiked sample. MS recoveries outside the QC limits may indicate that the sample's matrix is affecting the method's ability to accurately quantify the target analyte in the associated sample, or samples from similar locations. A low MS recovery generally indicates a negative bias in the sample data, while a high MS recovery indicates a potential positive bias to the associated sample data. If duplicate MS analyses are performed, a relative percent difference (RPD) greater than QC criteria may further indicate that the sample matrix is affecting the precision of the method for the target analyte that did not meet criteria. Therefore, when the MS does not meet criteria, results are usually considered estimated. MS/matrix spike duplicate (MSD) recoveries below 10 percent result in non-detect sample results being rejected.

MS/MSD acceptance criteria were met with the following exceptions.

Six samples had low biased spike recoveries for one or more of the following metal analytes: Antimony (SW6010B), Arsenic (SW6020A), Cadmium (SW6010B), Chromium (SW6020A), Cobalt (SW6020A), Copper (SW6020A), Lead (SW6010B/SW6020A), Manganese (SW6010B), Molybdenum (SW6010B), Nickel (SW6020A), Selenium (SW6010B/SW6020A), Thallium (SW6010B), and Vanadium (SW6020A). The parent sample non-detected results were qualified as estimated and flagged "UJ" and the parent sample detected results were qualified as estimated and flagged "J".

Four semivolatile samples (SW8270C) had low biased spike recoveries. The non-detected results were qualified as estimated and flagged "UJ" except where the spike recovery was less than ten percent (<10%). Analytes (Benzoic acid and 1,1´-Biphenyl) with non-detect results where the spike recovery was less than 10% were rejected and flagged "R".

One Cyanide (SW9014) sample had low biased spike recovery. The parent non-detected result was qualified as estimated and flagged "UJ".

Six TOCs (SW9060) samples had low biased spike recoveries. The parent detected results were qualified as estimated and flagged "J".

Three TOCs (SW9060) samples had high biased spike recoveries. The parent detected results were qualified as estimated and flagged "J".

One TPH Motor Oil (SW8015B) samples had high biased spike recovery. The non-detect parent sample result was qualified; no flags were applied.

The relative percent differences for one Arsenic (SW6020A) sample MS and MSD exceeded criterion. The detected parent result was qualified as estimated and flagged "J".

Two PAH samples (SW8270SIM) had MS and MSD RPDs that exceeded the criterion. The non-detected parent results were qualified; no flags were applied.

Dilution Test

Dilution Test is used in metals analysis to evaluate matrix interference. The sample concentration must be a minimum of at least 25 times greater than the RL. A fivefold (1+4) dilution is analyzed and must agree within 10 percent of the original concentration. If not, an interference effect must be suspected.

One Copper detect sample result that exceeded the 10 percent RPD criteria was qualified as estimated and flagged "J".

Field Duplicates

Field duplicates (FD) are collected and analyzed to determine if field collection activities or the sample matrix influences the precision of the analytical measurements obtained at the sample site.

All FD acceptance criteria were met with the following exceptions.

Four FD pairs had RPDs greater than the UCL for one or more of the following metals: Barium, Chromium, Nickel, Vanadium, and Zinc (SW6010B). Six FD pairs had RPDs greater than the UCL for TOCs (SW9060). Detected results were qualified as estimated and flagged "J".

Laboratory Duplicates

Laboratory duplicates measure laboratory precision. RPDs that exceed method criteria indicate imprecision in some aspect of the analytical procedure.

The laboratory analyzed duplicate aliquots of field samples at the required frequency. The QC acceptance criteria were met for all methods.

Laboratory Control Samples

A laboratory control sample (LCS) measures laboratory accuracy. Accuracy is the degree of agreement between a measured value and the expected value. The LCS is prepared from laboratory deionized or reagent-grade water and spiked with known amounts of the target analytes of interest. Recovery of analytes outside of QC limits generally indicates a problem with the analytical procedure. A low LCS recovery indicates that the target analyte in associated samples is likely biased low. Likewise, a high LCS recovery indicates that the target analyte in associated samples is likely biased high. Results associated with LCS recovery criteria exceedances are considered estimated. LCS recoveries below 10 percent result in non-detect sample results being rejected.

LCSs were analyzed at the required frequency and were recovered within QC limits with the following exceptions.

Seven semivolatile (SW8270C) samples were associated with LCSs that had recoveries for 1,1´-Biphenyl, 1,2,4,5-Tetrachlorobenzene, Benzaldehyde, Acetophenone , and Hexachlorocyclopentadiene that were between the LCL and 10%. The non-detected sample results were qualified as estimated and flagged "UJ".

Twelve semivolatile (SW8270C) samples were associated with LCSs that had recoveries for 1,1´-Biphenyl that were less than 10%. The non-detected sample results were rejected and flagged "R".

Nineteen volatile (SW8260B) samples were associated with LCSs that had recoveries for Acrylonitrile that were greater than the UCL. The non-detected sample results were qualified; no flags were applied.

Ten semivolatile (SW8270C) samples were associated with LCSs that had recoveries for 3,3´-Dichlorobenzidine that were greater than the UCL. The non-detected sample results were qualified; no flags were applied.

Twenty PAH (SW8270SIM) samples were associated with LCSs that had recoveries for 2-Methylnaphthalene that were greater than the UCL. The detected sample results were qualified as estimated and flagged "J" and the non-detected sample results were also qualified but no flags were applied.

Chain of Custody / Sample Receipt

Samples are collected under chain of custody to ensure that sample integrity is documented and known from the time of collection through receipt at the laboratory where custody is relinquished to the laboratory.

Each sample was documented in a completed chain of custody and received at the laboratory in good condition. All discrepancies identified in laboratory custody were promptly resolved.

Overall Review

The goal of this review is to demonstrate that a sufficient number of representative samples were collected and the resulting analytical data can be used to support the decision-making process. The procedures for assessing the precision, accuracy, representativeness, completeness, and comparability parameters (PARCC) are addressed in the QAPP. The following summary highlights the PARCC findings for the above-defined events:

1. The completeness objective for the PG&E program is 90 % for soil samples. The completeness objectives were met for all method/analyte combinations with the exception of 1,1´-Biphenyl (SW8270C). Although found in natural gas and used as a precursor for the production of PCB's this compound is difficult to analyze and is unlikely to be found in any significant amounts at the Topock Compressor Station. Although all of the 1,1´-Biphenyl results were non-detect, only 36.8 % of the 1,1´-Biphenyl results met the completeness objectives.

2. Samples were collected and analyzed based on approved methods/procedures and the results are reported using industry-standardized units.
3. The routinely acceptable performance of field and laboratory QC indicators (FDs, field blanks, laboratory blanks, LCS, MS/MSD, surrogate, and calibrations) generally show the accuracy and precision of the data meet the project objectives.
    - Six dioxin samples (SW8290) had results that were qualified as not detected due to MB contamination.
    - Six metals samples (SW6010B/SW6020A), four semivolatile samples (SW8270C), one Cyanide sample (SW9014), nine TOCs samples (SW9060), and one TPH Motor Oil (SW8015B) sample were qualified as estimated values due to MS/MSD exceedances.
    - One PCB (SW8082) and one dioxin (SW8290) sample were qualified due to surrogate recovery outside the method criteria.
    - Results from nineteen Volatiles (SW8260) samples were qualified as estimated values due to calibration criteria exceedances for 2,2-Dichloropropane.
4. Results from six cyanide (SW9014) samples were qualified as estimated due to holding time exceedance.
5. Analytical data as qualified meet the data quality objectives and may be used in project decision making with the exception of 1,1´-Biphenyl (SW8270C).

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SW8260B	BH-69-10403	N005879	2,2-Dichloropropane	ug/Kg	5.5	UJ	CCV<LCL
SW8260B	BH-69-10404	N005879	2,2-Dichloropropane	ug/Kg	5.4	UJ	CCV<LCL
SW8260B	BH-69-10405	N005879	2,2-Dichloropropane	ug/Kg	5.3	UJ	CCV<LCL
SW8260B	BH-69-10406	N005879	2,2-Dichloropropane	ug/Kg	5	UJ	CCV<LCL
SW8260B	BH-69-10407	N005879	2,2-Dichloropropane	ug/Kg	6.4	UJ	CCV<LCL
SW8260B	BH-69-10408	N005879	2,2-Dichloropropane	ug/Kg	6	UJ	CCV<LCL
SW8260B	BH-70-10501	N005878	2,2-Dichloropropane	ug/Kg	5.9	UJ	CCV<LCL
SW8260B	BH-70-10502	N005878	2,2-Dichloropropane	ug/Kg	5.4	UJ	CCV<LCL
SW8260B	BH-70-10503	N005878	2,2-Dichloropropane	ug/Kg	4.8	UJ	CCV<LCL
SW8260B	BH-70-10504	N005878	2,2-Dichloropropane	ug/Kg	4.8	UJ	CCV<LCL
SW8260B	BH-70-10505	N005878	2,2-Dichloropropane	ug/Kg	5.2	UJ	CCV<LCL
SW8260B	BH-70-10506	N005878	2,2-Dichloropropane	ug/Kg	5.9	UJ	CCV<LCL
SW8260B	BH-70-10507	N005878	2,2-Dichloropropane	ug/Kg	5.6	UJ	CCV<LCL
SW8260B	BH-70-10508	N005878	2,2-Dichloropropane	ug/Kg	5.6	UJ	CCV<LCL
SW8260B	BH-70-10509	N005878	2,2-Dichloropropane	ug/Kg	5.9	UJ	CCV<LCL
SW8260B	BH-70-10510	N005878	2,2-Dichloropropane	ug/Kg	5.9	UJ	CCV<LCL
SW8260B	BH-70-10511	N005878	2,2-Dichloropropane	ug/Kg	4.4	UJ	CCV<LCL
SW8260B	BH-70-50015	N005878	2,2-Dichloropropane	ug/Kg	5.4	UJ	CCV<LCL
SW8260B	TB-052411	N005878	2,2-Dichloropropane	ug/L	1	UJ	CCV<LCL
SW8260B	BH-65-10016	N005597	2-Butanone	ug/Kg	45	U	CCV>UCL
SW8260B	BH-65-10017	N005597	2-Butanone	ug/Kg	45	U	CCV>UCL
SW8260B	BH-66-10101	N005597	2-Butanone	ug/Kg	48	U	CCV>UCL
SW8260B	BH-66-10102	N005597	2-Butanone	ug/Kg	48	U	CCV>UCL
SW8260B	BH-66-10103	N005597	2-Butanone	ug/Kg	45	U	CCV>UCL
SW8260B	BH-69-10403	N005879	2-Butanone	ug/Kg	55	U	CCV>UCL
SW8260B	BH-69-10404	N005879	2-Butanone	ug/Kg	54	U	CCV>UCL
SW8260B	BH-69-10405	N005879	2-Butanone	ug/Kg	53	U	CCV>UCL
SW8260B	BH-69-10406	N005879	2-Butanone	ug/Kg	50	U	CCV>UCL
SW8260B	BH-69-10407	N005879	2-Butanone	ug/Kg	64	U	CCV>UCL
SW8260B	BH-69-10408	N005879	2-Butanone	ug/Kg	60	U	CCV>UCL
SW8260B	BH-70-10501	N005878	2-Butanone	ug/Kg	59	U	CCV>UCL
SW8260B	BH-70-10502	N005878	2-Butanone	ug/Kg	54	U	CCV>UCL
SW8260B	BH-70-10503	N005878	2-Butanone	ug/Kg	48	U	CCV>UCL
SW8260B	BH-70-10504	N005878	2-Butanone	ug/Kg	48	U	CCV>UCL
SW8260B	BH-70-10505	N005878	2-Butanone	ug/Kg	52	U	CCV>UCL
SW8260B	BH-70-10506	N005878	2-Butanone	ug/Kg	59	U	CCV>UCL
SW8260B	BH-70-10507	N005878	2-Butanone	ug/Kg	56	U	CCV>UCL
SW8260B	BH-70-10508	N005878	2-Butanone	ug/Kg	56	U	CCV>UCL

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SW8260B	BH-70-10509	N005878	2-Butanone	ug/Kg	59	U	CCV>UCL
SW8260B	BH-70-10510	N005878	2-Butanone	ug/Kg	59	U	CCV>UCL
SW8260B	BH-70-10511	N005878	2-Butanone	ug/Kg	44	U	CCV>UCL
SW8260B	BH-70-50015	N005878	2-Butanone	ug/Kg	54	U	CCV>UCL
SW8260B	Site1-10001	N005597	2-Butanone	ug/Kg	56	U	CCV>UCL
SW8260B	Site1-10002	N005597	2-Butanone	ug/Kg	48	U	CCV>UCL
SW8260B	Site1-10003	N005597	2-Butanone	ug/Kg	47	U	CCV>UCL
SW8260B	BH-69-10403	N005879	2-Hexanone	ug/Kg	55	U	CCV>UCL
SW8260B	BH-69-10404	N005879	2-Hexanone	ug/Kg	54	U	CCV>UCL
SW8260B	BH-69-10405	N005879	2-Hexanone	ug/Kg	53	U	CCV>UCL
SW8260B	BH-69-10406	N005879	2-Hexanone	ug/Kg	50	U	CCV>UCL
SW8260B	BH-69-10407	N005879	2-Hexanone	ug/Kg	64	U	CCV>UCL
SW8260B	BH-69-10408	N005879	2-Hexanone	ug/Kg	60	U	CCV>UCL
SW8260B	BH-70-10501	N005878	2-Hexanone	ug/Kg	59	U	CCV>UCL
SW8260B	BH-70-10502	N005878	2-Hexanone	ug/Kg	54	U	CCV>UCL
SW8260B	BH-70-10503	N005878	2-Hexanone	ug/Kg	48	U	CCV>UCL
SW8260B	BH-70-10504	N005878	2-Hexanone	ug/Kg	48	U	CCV>UCL
SW8260B	BH-70-10505	N005878	2-Hexanone	ug/Kg	52	U	CCV>UCL
SW8260B	BH-70-10506	N005878	2-Hexanone	ug/Kg	59	U	CCV>UCL
SW8260B	BH-65-10016	N005597	Acetone	ug/Kg	45	U	CCV>UCL
SW8260B	BH-65-10017	N005597	Acetone	ug/Kg	45	U	CCV>UCL
SW8260B	BH-66-10101	N005597	Acetone	ug/Kg	48	U	CCV>UCL
SW8260B	BH-66-10102	N005597	Acetone	ug/Kg	48	U	CCV>UCL
SW8260B	BH-66-10103	N005597	Acetone	ug/Kg	45	U	CCV>UCL
SW8260B	BH-66-10104	N005634	Acetone	ug/Kg	52	U	CCV>UCL
SW8260B	BH-66-10105	N005634	Acetone	ug/Kg	56	U	CCV>UCL
SW8260B	BH-66-10106	N005634	Acetone	ug/Kg	51	U	CCV>UCL
SW8260B	BH-66-10107	N005634	Acetone	ug/Kg	47	U	CCV>UCL
SW8260B	BH-66-10108	N005634	Acetone	ug/Kg	45	U	CCV>UCL
SW8260B	BH-66-10109	N005633	Acetone	ug/Kg	43	U	CCV>UCL
SW8260B	BH-66-10110	N005633	Acetone	ug/Kg	44	U	CCV>UCL
SW8260B	BH-66-10111	N005633	Acetone	ug/Kg	60	U	CCV>UCL
SW8260B	BH-66-10112	N005633	Acetone	ug/Kg	54	U	CCV>UCL
SW8260B	BH-66-10113	N005633	Acetone	ug/Kg	60	U	CCV>UCL
SW8260B	BH-66-10114	N005633	Acetone	ug/Kg	52	U	CCV>UCL
SW8260B	BH-66-50003	N005634	Acetone	ug/Kg	57	U	CCV>UCL
SW8260B	BH-69-10403	N005879	Acetone	ug/Kg	55	U	CCV>UCL
SW8260B	BH-69-10404	N005879	Acetone	ug/Kg	54	U	CCV>UCL

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SW8260B	BH-69-10405	N005879	Acetone	ug/Kg	53	U	CCV>UCL
SW8260B	BH-69-10406	N005879	Acetone	ug/Kg	50	U	CCV>UCL
SW8260B	BH-69-10407	N005879	Acetone	ug/Kg	64	U	CCV>UCL
SW8260B	BH-69-10408	N005879	Acetone	ug/Kg	60	U	CCV>UCL
SW8260B	BH-70-10501	N005878	Acetone	ug/Kg	59	U	CCV>UCL
SW8260B	BH-70-10502	N005878	Acetone	ug/Kg	54	U	CCV>UCL
SW8260B	BH-70-10503	N005878	Acetone	ug/Kg	48	U	CCV>UCL
SW8260B	BH-70-10504	N005878	Acetone	ug/Kg	48	U	CCV>UCL
SW8260B	BH-70-10505	N005878	Acetone	ug/Kg	52	U	CCV>UCL
SW8260B	BH-70-10506	N005878	Acetone	ug/Kg	59	U	CCV>UCL
SW8260B	BH-70-10507	N005878	Acetone	ug/Kg	56	U	CCV>UCL
SW8260B	BH-70-10508	N005878	Acetone	ug/Kg	56	U	CCV>UCL
SW8260B	BH-70-10509	N005878	Acetone	ug/Kg	59	U	CCV>UCL
SW8260B	BH-70-10510	N005878	Acetone	ug/Kg	59	U	CCV>UCL
SW8260B	BH-70-10511	N005878	Acetone	ug/Kg	44	U	CCV>UCL
SW8260B	BH-70-50015	N005878	Acetone	ug/Kg	54	U	CCV>UCL
SW8260B	Site1-10001	N005597	Acetone	ug/Kg	56	U	CCV>UCL
SW8260B	Site1-10002	N005597	Acetone	ug/Kg	48	U	CCV>UCL
SW8260B	Site1-10003	N005597	Acetone	ug/Kg	47	U	CCV>UCL
SW8260B	TB-052411	N005878	Acetone	ug/L	10	U	CCV>UCL
SW8260B	BH-69-10403	N005879	Acrylonitrile	ug/Kg	55	U	CCV>UCL
SW8260B	BH-69-10404	N005879	Acrylonitrile	ug/Kg	54	U	CCV>UCL
SW8260B	BH-69-10405	N005879	Acrylonitrile	ug/Kg	53	U	CCV>UCL
SW8260B	BH-69-10406	N005879	Acrylonitrile	ug/Kg	50	U	CCV>UCL
SW8260B	BH-69-10407	N005879	Acrylonitrile	ug/Kg	64	U	CCV>UCL
SW8260B	BH-69-10408	N005879	Acrylonitrile	ug/Kg	60	U	CCV>UCL
SW8260B	BH-70-10501	N005878	Acrylonitrile	ug/Kg	59	U	CCV>UCL
SW8260B	BH-70-10502	N005878	Acrylonitrile	ug/Kg	54	U	CCV>UCL
SW8260B	BH-70-10503	N005878	Acrylonitrile	ug/Kg	48	U	CCV>UCL
SW8260B	BH-70-10504	N005878	Acrylonitrile	ug/Kg	48	U	CCV>UCL
SW8260B	BH-70-10505	N005878	Acrylonitrile	ug/Kg	52	U	CCV>UCL
SW8260B	BH-70-10506	N005878	Acrylonitrile	ug/Kg	59	U	CCV>UCL
SW8260B	BH-70-10507	N005878	Acrylonitrile	ug/Kg	56	U	CCV>UCL
SW8260B	BH-70-10508	N005878	Acrylonitrile	ug/Kg	56	U	CCV>UCL
SW8260B	BH-70-10509	N005878	Acrylonitrile	ug/Kg	59	U	CCV>UCL
SW8260B	BH-70-10510	N005878	Acrylonitrile	ug/Kg	59	U	CCV>UCL
SW8260B	BH-70-10511	N005878	Acrylonitrile	ug/Kg	44	U	CCV>UCL
SW8260B	BH-70-50015	N005878	Acrylonitrile	ug/Kg	54	U	CCV>UCL

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SW8260B	TB-052411	N005878	Acrylonitrile	ug/L	20	U	CCV>UCL
SW8270SIM	BH-65-10011	N005513	Benzo(b)fluoranthene	ug/Kg	5.2	U	CCV>UCL
SW8270SIM	BH-65-10012	N005513	Benzo(b)fluoranthene	ug/Kg	5.4	U	CCV>UCL
SW8270SIM	BH-65-10013	N005513	Benzo(b)fluoranthene	ug/Kg	5.2	U	CCV>UCL
SW8270SIM	BH-65-10014	N005519	Benzo(b)fluoranthene	ug/Kg	5.2	U	CCV>UCL
SW8270SIM	BH-65-10015	N005519	Benzo(b)fluoranthene	ug/Kg	5.4	U	CCV>UCL
SW6010B	BH-66-10104	N005634	Barium	mg/Kg	72	J	FD>RPD
SW6010B	BH-66-10115	N005648	Barium	mg/Kg	39	J	FD>RPD
SW6010B	BH-66-50003	N005634	Barium	mg/Kg	100	J	FD>RPD
SW6010B	BH-66-50004	N005648	Barium	mg/Kg	23	J	FD>RPD
SW6010B	BH-70-10506	N005878	Barium	mg/Kg	310	J	FD>RPD
SW6010B	BH-70-50015	N005878	Barium	mg/Kg	1400	J	FD>RPD
SW6010B	BH-66-10104	N005634	Chromium	mg/Kg	5.3	J	FD>RPD
SW6010B	BH-66-50003	N005634	Chromium	mg/Kg	15	J	FD>RPD
SW6010B	BH-70-10506	N005878	Chromium	mg/Kg	40	J	FD>RPD
SW6010B	BH-70-50015	N005878	Chromium	mg/Kg	32	J	FD>RPD
SW6010B	BH-65-10009	N005513	Nickel	mg/Kg	44	J	FD>RPD
SW6010B	BH-65-50001	N005513	Nickel	mg/Kg	35	J	FD>RPD
SW9060	BH-65-10009	N005513	Total Organic Carbon	mg/Kg	5400	J	FD>RPD
SW9060	BH-65-50001	N005513	Total Organic Carbon	mg/Kg	8000	J	FD>RPD
SW9060	BH-66-10104	N005634	Total Organic Carbon	mg/Kg	2200	J	FD>RPD
SW9060	BH-66-10115	N005648	Total Organic Carbon	mg/Kg	2500	J	FD>RPD
SW9060	BH-66-50003	N005634	Total Organic Carbon	mg/Kg	2800	J	FD>RPD
SW9060	BH-66-50004	N005648	Total Organic Carbon	mg/Kg	3200	J	FD>RPD
SW9060	BH-67-10218	N005737	Total Organic Carbon	mg/Kg	7900	J	FD>RPD
SW9060	BH-67-50007	N005737	Total Organic Carbon	mg/Kg	3300	J	FD>RPD
SW9060	BH-68-10303	N005513	Total Organic Carbon	mg/Kg	8500	J	FD>RPD
SW9060	BH-68-10314	N005817	Total Organic Carbon	mg/Kg	4400	J	FD>RPD
SW9060	BH-68-50009	N005513	Total Organic Carbon	mg/Kg	4100	J	FD>RPD
SW9060	BH-68-50010	N005817	Total Organic Carbon	mg/Kg	5600	J	FD>RPD
SW6010B	BH-66-10104	N005634	Vanadium	mg/Kg	12	J	FD>RPD
SW6010B	BH-66-50003	N005634	Vanadium	mg/Kg	15	J	FD>RPD
SW6010B	BH-66-10104	N005634	Zinc	mg/Kg	11	J	FD>RPD
SW6010B	BH-66-50003	N005634	Zinc	mg/Kg	20	J	FD>RPD
SW9014	BH-70-10501	N005878	Cyanide	mg/Kg	0.25	UJ	HT>UCL
SW9014	BH-70-10502	N005878	Cyanide	mg/Kg	0.25	UJ	HT>UCL
SW9014	BH-70-10503	N005878	Cyanide	mg/Kg	0.25	UJ	HT>UCL
SW9014	BH-70-10504	N005878	Cyanide	mg/Kg	0.26	UJ	HT>UCL

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SW9014	BH-70-10505	N005878	Cyanide	mg/Kg	0.26	UJ	HT>UCL
SW9014	BH-70-10506	N005878	Cyanide	mg/Kg	0.26	UJ	HT>UCL
SW8260B	BH-66-50003	N005634	1,1,2,2-Tetrachloroethane	ug/Kg	5.7	U	IS<LCL
SW8260B	BH-66-50003	N005634	1,2,3-Trichloropropane	ug/Kg	5.7	U	IS<LCL
SW8260B	BH-66-50003	N005634	1,2,4-Trichlorobenzene	ug/Kg	5.7	U	IS<LCL
SW8260B	BH-66-50003	N005634	1,2,4-Trimethylbenzene	ug/Kg	5.7	U	IS<LCL
SW8260B	BH-66-50003	N005634	1,2-Dibromo-3-chloropropane	ug/Kg	5.7	U	IS<LCL
SW8260B	BH-66-50003	N005634	1,2-Dichlorobenzene	ug/Kg	5.7	U	IS<LCL
SW8260B	BH-66-50003	N005634	1,3,5-Trimethylbenzene	ug/Kg	5.7	U	IS<LCL
SW8260B	BH-66-50003	N005634	1,3-Dichlorobenzene	ug/Kg	5.7	U	IS<LCL
SW8260B	BH-66-50003	N005634	1,4-Dichlorobenzene	ug/Kg	5.7	U	IS<LCL
SW8260B	BH-66-50003	N005634	2-Chlorotoluene	ug/Kg	5.7	U	IS<LCL
SW8260B	BH-66-50003	N005634	Bromobenzene	ug/Kg	5.7	U	IS<LCL
SW8260B	BH-66-50003	N005634	Isopropylbenzene	ug/Kg	5.7	U	IS<LCL
SW8260B	BH-66-50003	N005634	n-Butylbenzene	ug/Kg	5.7	U	IS<LCL
SW8260B	BH-66-50003	N005634	n-Propylbenzene	ug/Kg	5.7	U	IS<LCL
SW8260B	BH-66-50003	N005634	sec-Butylbenzene	ug/Kg	5.7	U	IS<LCL
SW8260B	BH-66-50003	N005634	tert-Butylbenzene	ug/Kg	5.7	U	IS<LCL
SW8290	BH-65-10016	64322	1,2,3,4,6,7,8- HpCDF	PG/G	110	U	LB<RL
SW8290	BH-65-10017	64322	1,2,3,4,6,7,8- HpCDF	PG/G	63	U	LB<RL
SW8290	BH-66-10101	64322	1,2,3,4,6,7,8- HpCDF	PG/G	5.3	U	LB<RL
SW8290	Site1-10001	64322	1,2,3,4,6,7,8- HpCDF	PG/G	1.6	U	LB<RL
SW8290	BH-65-10016	64322	1,2,3,4,7,8,9- HpCDF	PG/G	6.3	J	LB<RL
SW8290	BH-65-10017	64322	1,2,3,4,7,8,9- HpCDF	PG/G	3.2	J	LB<RL
SW8290	BH-66-10101	64322	1,2,3,4,7,8,9- HpCDF	PG/G	0.42	U	LB<RL
SW8290	BH-69-10403	64816	1,2,3,4,7,8,9- HpCDF	PG/G	0.64	U	LB<RL
SW8290	Site1-10001	64322	1,2,3,4,7,8,9-HpCDF	PG/G	0.15	U	LB<RL
SW8290	BH-67-10201	64191	1,2,3,4,7,8- HxCDF	PG/G	0.033	U	LB<RL
SW8290	BH-67-10202	64191	1,2,3,4,7,8- HxCDF	PG/G	0.1	U	LB<RL
SW8290	BH-67-10203	64191	1,2,3,4,7,8- HxCDF	PG/G	0.16	U	LB<RL
SW8290	BH-68-10303	64191	1,2,3,4,7,8- HxCDF	PG/G	0.64	U	LB<RL
SW8290	BH-68-50009	64191	1,2,3,4,7,8- HxCDF	PG/G	0.13	U	LB<RL
SW8290	BH-69-10401	64191	1,2,3,4,7,8- HxCDF	PG/G	12	J	LB<RL
SW8290	BH-69-10402	64191	1,2,3,4,7,8- HxCDF	PG/G	6.8	J	LB<RL
SW8290	BH-65-10016	64322	1,2,3,6,7,8- HxCDF	PG/G	3.6	U	LB<RL
SW8290	BH-65-10017	64322	1,2,3,6,7,8- HxCDF	PG/G	3	U	LB<RL
SW8290	BH-66-10101	64322	1,2,3,6,7,8- HxCDF	PG/G	0.28	U	LB<RL
SW8290	Site1-10001	64322	1,2,3,6,7,8- HxCDF	PG/G	0.29	U	LB<RL

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SW8290	BH-67-10201	64191	1,2,3,6,7,8- HxCDD	PG/G	0.09	U	LB<RL
SW8290	BH-67-10202	64191	1,2,3,6,7,8- HxCDD	PG/G	0.13	U	LB<RL
SW8290	BH-67-10203	64191	1,2,3,6,7,8- HxCDD	PG/G	0.18	U	LB<RL
SW8290	BH-68-10303	64191	1,2,3,6,7,8- HxCDD	PG/G	0.58	U	LB<RL
SW8290	BH-68-50009	64191	1,2,3,6,7,8- HxCDD	PG/G	0.05	U	LB<RL
SW8290	BH-67-10201	64191	1,2,3,7,8,9- HxCDF	PG/G	0.039	U	LB<RL
SW8290	BH-67-10202	64191	1,2,3,7,8,9- HxCDF	PG/G	0.19	U	LB<RL
SW8290	BH-67-10203	64191	1,2,3,7,8,9- HxCDF	PG/G	0.15	U	LB<RL
SW8290	BH-68-10303	64191	1,2,3,7,8,9- HxCDF	PG/G	0.42	U	LB<RL
SW8290	BH-68-50009	64191	1,2,3,7,8,9- HxCDF	PG/G	0.11	U	LB<RL
SW8290	BH-69-10401	64191	1,2,3,7,8,9- HxCDF	PG/G	2.7	J	LB<RL
SW8290	BH-69-10402	64191	1,2,3,7,8,9-HxCDF	PG/G	1.9	J	LB<RL
SW8290	BH-65-10016	64322	1,2,3,7,8- PeCDF	PG/G	1.5	U	LB<RL
SW8290	BH-65-10017	64322	1,2,3,7,8- PeCDF	PG/G	0.78	U	LB<RL
SW8290	BH-66-10101	64322	1,2,3,7,8- PeCDF	PG/G	0.076	U	LB<RL
SW8290	BH-69-10403	64816	1,2,3,7,8- PeCDF	PG/G	0.36	U	LB<RL
SW8290	Site1-10001	64322	1,2,3,7,8- PeCDF	PG/G	0.18	U	LB<RL
SW8290	BH-65-10016	64322	1,2,3,7,8- PeCDD	PG/G	1.6	U	LB<RL
SW8290	BH-65-10017	64322	1,2,3,7,8- PeCDD	PG/G	0.94	U	LB<RL
SW8290	BH-66-10101	64322	1,2,3,7,8- PeCDD	PG/G	0.21	U	LB<RL
SW8290	BH-67-10201	64191	1,2,3,7,8- PeCDD	PG/G	0.035	U	LB<RL
SW8290	BH-67-10202	64191	1,2,3,7,8- PeCDD	PG/G	0.18	U	LB<RL
SW8290	BH-67-10203	64191	1,2,3,7,8- PeCDD	PG/G	0.22	U	LB<RL
SW8290	BH-68-10303	64191	1,2,3,7,8- PeCDD	PG/G	0.68	U	LB<RL
SW8290	BH-68-50009	64191	1,2,3,7,8- PeCDD	PG/G	0.26	U	LB<RL
SW8290	BH-69-10401	64191	1,2,3,7,8- PeCDD	PG/G	6.6	J	LB<RL
SW8290	BH-69-10402	64191	1,2,3,7,8- PeCDD	PG/G	3.9	J	LB<RL
SW8290	Site1-10001	64322	1,2,3,7,8-PeCDD	PG/G	0.13	U	LB<RL
SW8290	BH-67-10201	64191	2,3,7,8-TCDD	PG/G	0.024	U	LB<RL
SW8290	BH-67-10202	64191	2,3,7,8-TCDD	PG/G	0.15	U	LB<RL
SW8290	BH-67-10203	64191	2,3,7,8-TCDD	PG/G	0.15	U	LB<RL
SW8290	BH-68-10303	64191	2,3,7,8-TCDD	PG/G	0.18	U	LB<RL
SW8290	BH-68-50009	64191	2,3,7,8-TCDD	PG/G	0.13	U	LB<RL
SW8290	BH-69-10401	64191	2,3,7,8-TCDD	PG/G	0.78	U	LB<RL
SW8290	BH-69-10402	64191	2,3,7,8-TCDD	PG/G	0.34	U	LB<RL
SW8290	BH-67-10201	64191	2,3,7,8-TCDF	PG/G	0.27	U	LB<RL
SW8290	BH-67-10202	64191	2,3,7,8-TCDF	PG/G	0.33	U	LB<RL
SW8290	BH-67-10203	64191	2,3,7,8-TCDF	PG/G	0.35	U	LB<RL

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SW8290	BH-68-10303	64191	2,3,7,8-TCDF	PG/G	0.33	U	LB<RL
SW8290	BH-68-50009	64191	2,3,7,8-TCDF	PG/G	0.48	U	LB<RL
SW8290	BH-69-10401	64191	2,3,7,8-TCDF	PG/G	2.4	J	LB<RL
SW8290	BH-69-10402	64191	2,3,7,8-TCDF	PG/G	1.4	U	LB<RL
SW8290	BH-69-10403	64816	2,3,7,8-TCDF	PG/G	0.59	U	LB<RL
SW8290	BH-67-10201	64191	OCDD	PG/G	0.35	U	LB<RL
SW8290	BH-67-10202	64191	OCDD	PG/G	0.22	U	LB<RL
SW8290	BH-67-10203	64191	OCDD	PG/G	0.22	U	LB<RL
SW8290	BH-68-10303	64191	OCDD	PG/G	0.38	U	LB<RL
SW8290	BH-68-50009	64191	OCDD	PG/G	0.4	U	LB<RL
SW8290	BH-67-10201	64191	OCDD	PG/G	4.5	U	LB<RL
SW8290	BH-67-10202	64191	OCDD	PG/G	0.9	U	LB<RL
SW8290	BH-67-10203	64191	OCDD	PG/G	1	U	LB<RL
SW8290	BH-68-10303	64191	OCDD	PG/G	3.2	U	LB<RL
SW8290	BH-68-50009	64191	OCDD	PG/G	7.4	J	LB<RL
SW8290	BH-69-10403	64816	OCDD	PG/G	6.3	UJ	LB<RL
SW8270C	BH-65-10002	N005513	1,1´-Biphenyl	ug/Kg	730	UJ	LCS<LCL
SW8270C	BH-65-10003	N005513	1,1´-Biphenyl	ug/Kg	710	UJ	LCS<LCL
SW8270C	BH-67-10202	N005513	1,1´-Biphenyl	ug/Kg	740	UJ	LCS<LCL
SW8270C	BH-67-10203	N005513	1,1´-Biphenyl	ug/Kg	700	UJ	LCS<LCL
SW8270C	BH-68-10301	N005513	1,1´-Biphenyl	ug/Kg	740	UJ	LCS<LCL
SW8270C	BH-68-10302	N005513	1,1´-Biphenyl	ug/Kg	810	UJ	LCS<LCL
SW8270C	BH-69-10402	N005513	1,1´-Biphenyl	ug/Kg	780	UJ	LCS<LCL
SW8270C	BH-69-10403	N005879	1,1'-Biphenyl	ug/Kg	720	R	LCS<LCL
SW8270C	BH-69-10404	N005879	1,1'-Biphenyl	ug/Kg	730	R	LCS<LCL
SW8270C	BH-69-10405	N005879	1,1'-Biphenyl	ug/Kg	720	R	LCS<LCL
SW8270C	BH-69-10406	N005879	1,1'-Biphenyl	ug/Kg	710	R	LCS<LCL
SW8270C	BH-69-10407	N005879	1,1'-Biphenyl	ug/Kg	710	R	LCS<LCL
SW8270C	BH-69-10408	N005879	1,1'-Biphenyl	ug/Kg	740	R	LCS<LCL
SW8270C	BH-70-10501	N005878	1,1'-Biphenyl	ug/Kg	700	R	LCS<LCL
SW8270C	BH-70-10502	N005878	1,1'-Biphenyl	ug/Kg	710	R	LCS<LCL
SW8270C	BH-70-10503	N005878	1,1'-Biphenyl	ug/Kg	700	R	LCS<LCL
SW8270C	BH-70-10504	N005878	1,1'-Biphenyl	ug/Kg	730	R	LCS<LCL
SW8270C	BH-70-10505	N005878	1,1'-Biphenyl	ug/Kg	730	R	LCS<LCL
SW8270C	BH-70-10506	N005878	1,1'-Biphenyl	ug/Kg	740	R	LCS<LCL
SW8270C	BH-65-10002	N005513	1,2,4,5-Tetrachlorobenzene	ug/Kg	730	UJ	LCS<LCL
SW8270C	BH-65-10003	N005513	1,2,4,5-Tetrachlorobenzene	ug/Kg	710	UJ	LCS<LCL
SW8270C	BH-67-10202	N005513	1,2,4,5-Tetrachlorobenzene	ug/Kg	740	UJ	LCS<LCL

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SW8270C	BH-67-10203	N005513	1,2,4,5-Tetrachlorobenzene	ug/Kg	700	UJ	LCS<LCL
SW8270C	BH-68-10301	N005513	1,2,4,5-Tetrachlorobenzene	ug/Kg	740	UJ	LCS<LCL
SW8270C	BH-68-10302	N005513	1,2,4,5-Tetrachlorobenzene	ug/Kg	810	UJ	LCS<LCL
SW8270C	BH-69-10402	N005513	1,2,4,5-Tetrachlorobenzene	ug/Kg	780	UJ	LCS<LCL
SW8270C	BH-65-10002	N005513	Acetophenone	ug/Kg	730	UJ	LCS<LCL
SW8270C	BH-65-10003	N005513	Acetophenone	ug/Kg	710	UJ	LCS<LCL
SW8270C	BH-67-10202	N005513	Acetophenone	ug/Kg	740	UJ	LCS<LCL
SW8270C	BH-67-10203	N005513	Acetophenone	ug/Kg	700	UJ	LCS<LCL
SW8270C	BH-68-10301	N005513	Acetophenone	ug/Kg	740	UJ	LCS<LCL
SW8270C	BH-68-10302	N005513	Acetophenone	ug/Kg	810	UJ	LCS<LCL
SW8270C	BH-69-10402	N005513	Acetophenone	ug/Kg	780	UJ	LCS<LCL
SW8270C	BH-65-10002	N005513	Benzaldehyde	ug/Kg	730	UJ	LCS<LCL
SW8270C	BH-65-10003	N005513	Benzaldehyde	ug/Kg	710	UJ	LCS<LCL
SW8270C	BH-67-10202	N005513	Benzaldehyde	ug/Kg	740	UJ	LCS<LCL
SW8270C	BH-67-10203	N005513	Benzaldehyde	ug/Kg	700	UJ	LCS<LCL
SW8270C	BH-68-10301	N005513	Benzaldehyde	ug/Kg	740	UJ	LCS<LCL
SW8270C	BH-68-10302	N005513	Benzaldehyde	ug/Kg	810	UJ	LCS<LCL
SW8270C	BH-69-10402	N005513	Benzaldehyde	ug/Kg	780	UJ	LCS<LCL
SW8270C	BH-65-10002	N005513	Hexachlorocyclopentadiene	ug/Kg	690	UJ	LCS<LCL
SW8270C	BH-65-10003	N005513	Hexachlorocyclopentadiene	ug/Kg	670	UJ	LCS<LCL
SW8270C	BH-67-10202	N005513	Hexachlorocyclopentadiene	ug/Kg	700	UJ	LCS<LCL
SW8270C	BH-67-10203	N005513	Hexachlorocyclopentadiene	ug/Kg	660	UJ	LCS<LCL
SW8270C	BH-68-10301	N005513	Hexachlorocyclopentadiene	ug/Kg	700	UJ	LCS<LCL
SW8270C	BH-68-10302	N005513	Hexachlorocyclopentadiene	ug/Kg	770	UJ	LCS<LCL
SW8270C	BH-69-10402	N005513	Hexachlorocyclopentadiene	ug/Kg	730	UJ	LCS<LCL
SW8270SIM	BH-65-10001	N005513	2-Methylnaphthalene	ug/Kg	5.1	U	LCS>UCL
SW8270SIM	BH-65-10002	N005513	2-Methylnaphthalene	ug/Kg	5.2	U	LCS>UCL
SW8270SIM	BH-65-10003	N005513	2-Methylnaphthalene	ug/Kg	5.1	U	LCS>UCL
SW8270SIM	BH-65-10004	N005513	2-Methylnaphthalene	ug/Kg	5	U	LCS>UCL
SW8270SIM	BH-65-10005	N005513	2-Methylnaphthalene	ug/Kg	5.3	U	LCS>UCL
SW8270SIM	BH-65-10006	N005513	2-Methylnaphthalene	ug/Kg	5.3	U	LCS>UCL
SW8270SIM	BH-65-10007	N005513	2-Methylnaphthalene	ug/Kg	5.2	U	LCS>UCL
SW8270SIM	BH-65-10008	N005513	2-Methylnaphthalene	ug/Kg	5.3	U	LCS>UCL
SW8270SIM	BH-65-10009	N005513	2-Methylnaphthalene	ug/Kg	5.3	U	LCS>UCL
SW8270SIM	BH-65-10010	N005513	2-Methylnaphthalene	ug/Kg	5.3	U	LCS>UCL
SW8270SIM	BH-65-50001	N005513	2-Methylnaphthalene	ug/Kg	5.2	U	LCS>UCL
SW8270SIM	BH-67-10201	N005513	2-Methylnaphthalene	ug/Kg	12	J	LCS>UCL
SW8270SIM	BH-67-10202	N005513	2-Methylnaphthalene	ug/Kg	5.3	U	LCS>UCL

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SW8270SIM	BH-67-10203	N005513	2-Methylnaphthalene	ug/Kg	5	U	LCS>UCL
SW8270SIM	BH-68-10301	N005513	2-Methylnaphthalene	ug/Kg	5.3	U	LCS>UCL
SW8270SIM	BH-68-10302	N005513	2-Methylnaphthalene	ug/Kg	5.8	U	LCS>UCL
SW8270SIM	BH-68-10303	N005513	2-Methylnaphthalene	ug/Kg	5.4	U	LCS>UCL
SW8270SIM	BH-68-50009	N005513	2-Methylnaphthalene	ug/Kg	5.4	U	LCS>UCL
SW8270SIM	BH-69-10401	N005513	2-Methylnaphthalene	ug/Kg	6.3	J	LCS>UCL
SW8270SIM	BH-69-10402	N005513	2-Methylnaphthalene	ug/Kg	10	J	LCS>UCL
SW8270C	BH-66-10104	N005634	3,3´-Dichlorobenzidine	ug/Kg	690	U	LCS>UCL
SW8270C	BH-66-10105	N005634	3,3´-Dichlorobenzidine	ug/Kg	680	U	LCS>UCL
SW8270C	BH-66-10106	N005634	3,3´-Dichlorobenzidine	ug/Kg	690	U	LCS>UCL
SW8270C	BH-66-10108	N005634	3,3´-Dichlorobenzidine	ug/Kg	690	U	LCS>UCL
SW8270C	BH-66-10110	N005633	3,3´-Dichlorobenzidine	ug/Kg	700	U	LCS>UCL
SW8270C	BH-66-10111	N005633	3,3´-Dichlorobenzidine	ug/Kg	700	U	LCS>UCL
SW8270C	BH-66-10112	N005633	3,3´-Dichlorobenzidine	ug/Kg	700	U	LCS>UCL
SW8270C	BH-66-10113	N005633	3,3´-Dichlorobenzidine	ug/Kg	700	U	LCS>UCL
SW8270C	BH-66-10114	N005633	3,3´-Dichlorobenzidine	ug/Kg	700	U	LCS>UCL
SW8270C	BH-66-50003	N005634	3,3´-Dichlorobenzidine	ug/Kg	680	U	LCS>UCL
SW8260B	BH-67-10204	N005736	Acrylonitrile	ug/Kg	53	U	LCS>UCL
SW8260B	BH-67-10205	N005736	Acrylonitrile	ug/Kg	55	U	LCS>UCL
SW8260B	BH-67-10206	N005736	Acrylonitrile	ug/Kg	54	U	LCS>UCL
SW8260B	BH-67-10207	N005736	Acrylonitrile	ug/Kg	49	U	LCS>UCL
SW8260B	BH-67-10208	N005736	Acrylonitrile	ug/Kg	57	U	LCS>UCL
SW8260B	BH-67-10209	N005736	Acrylonitrile	ug/Kg	50	U	LCS>UCL
SW8260B	BH-67-10210	N005736	Acrylonitrile	ug/Kg	46	U	LCS>UCL
SW8260B	BH-67-10211	N005736	Acrylonitrile	ug/Kg	58	U	LCS>UCL
SW8260B	BH-67-10212	N005736	Acrylonitrile	ug/Kg	53	U	LCS>UCL
SW8260B	BH-67-10213	N005736	Acrylonitrile	ug/Kg	45	U	LCS>UCL
SW8260B	BH-67-10214	N005736	Acrylonitrile	ug/Kg	44	U	LCS>UCL
SW8260B	BH-67-10215	N005736	Acrylonitrile	ug/Kg	65	U	LCS>UCL
SW8260B	BH-67-10216	N005736	Acrylonitrile	ug/Kg	47	U	LCS>UCL
SW8260B	BH-67-10217	N005737	Acrylonitrile	ug/Kg	57	U	LCS>UCL
SW8260B	BH-67-10218	N005737	Acrylonitrile	ug/Kg	46	U	LCS>UCL
SW8260B	BH-67-10219	N005737	Acrylonitrile	ug/Kg	44	U	LCS>UCL
SW8260B	BH-67-10220	N005737	Acrylonitrile	ug/Kg	48	U	LCS>UCL
SW8260B	BH-67-50006	N005736	Acrylonitrile	ug/Kg	59	U	LCS>UCL
SW8260B	BH-67-50007	N005737	Acrylonitrile	ug/Kg	53	U	LCS>UCL
SW8270C	BH-68-10301	N005513	1,1´-Biphenyl	ug/Kg	740	UJ	MS<LCL
SW8270C	BH-70-10502	N005878	1,1'-Biphenyl	ug/Kg	710	R	MS<LCL

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SW8270C	BH-68-10301	N005513	1,2,4,5-Tetrachlorobenzene	ug/Kg	740	UJ	MS<LCL
SW8270C	BH-70-10502	N005878	1,2,4-Trichlorobenzene	ug/Kg	330	UJ	MS<LCL
SW8270C	BH-67-10208	N005736	1,2-Dichlorobenzene	ug/Kg	330	UJ	MS<LCL
SW8270C	BH-70-10502	N005878	1,2-Dichlorobenzene	ug/Kg	330	UJ	MS<LCL
SW8270C	BH-70-10502	N005878	1,3-Dichlorobenzene	ug/Kg	330	UJ	MS<LCL
SW8270C	BH-70-10502	N005878	1,4-Dichlorobenzene	ug/Kg	330	UJ	MS<LCL
SW8270C	BH-70-10502	N005878	2,4-Dichlorophenol	ug/Kg	1700	UJ	MS<LCL
SW8270C	BH-65-10004	N005513	2,4-Dinitrophenol	ug/Kg	1700	UJ	MS<LCL
SW8270C	BH-70-10502	N005878	2-Chlorophenol	ug/Kg	330	UJ	MS<LCL
SW8270C	BH-70-10502	N005878	2-Methylnaphthalene	ug/Kg	330	UJ	MS<LCL
SW8270C	BH-68-10301	N005513	Acetophenone	ug/Kg	740	UJ	MS<LCL
SW6010B	BH-65-10004	N005513	Antimony	mg/Kg	2	UJ	MS<LCL
SW6010B	BH-65-10011	N005513	Antimony	mg/Kg	2.1	UJ	MS<LCL
SW6010B	BH-66-10108	N005634	Antimony	mg/Kg	2.1	UJ	MS<LCL
SW6020A	BH-68-10304	N005817	Antimony	mg/Kg	0.26	UJ	MS<LCL
SW6020A	Site1-10001	N005597	Antimony	mg/Kg	0.26	UJ	MS<LCL
SW6020A	Site1-10001	N005597	Arsenic	mg/Kg	4.2	J	MS<LCL
SW8270C	BH-68-10301	N005513	Benzaldehyde	ug/Kg	740	UJ	MS<LCL
SW8270C	BH-65-10004	N005513	Benzoic acid	ug/Kg	1700	R	MS<LCL
SW8270C	BH-70-10502	N005878	Benzoic acid	ug/Kg	1700	UJ	MS<LCL
SW8270C	BH-70-10502	N005878	Bis(2-chloroethoxy)methane	ug/Kg	330	UJ	MS<LCL
SW6010B	BH-65-10011	N005513	Cadmium	mg/Kg	1	UJ	MS<LCL
SW6020A	BH-68-10304	N005817	Chromium	mg/Kg	12	J	MS<LCL
SW6020A	Site1-10001	N005597	Chromium	mg/Kg	13	J	MS<LCL
SW6020A	BH-68-10304	N005817	Cobalt	mg/Kg	5.8	J	MS<LCL
SW6020A	Site1-10001	N005597	Cobalt	mg/Kg	4.4	J	MS<LCL
SW6020A	BH-68-10304	N005817	Copper	mg/Kg	8.5	J	MS<LCL
SW6020A	Site1-10001	N005597	Copper	mg/Kg	7.7	J	MS<LCL
SW9014	BH-70-10501	N005878	Cyanide	mg/Kg	0.25	UJ	MS<LCL
SW8270C	BH-70-10502	N005878	Hexachlorocyclopentadiene	ug/Kg	670	UJ	MS<LCL
SW6010B	BH-65-10004	N005513	Lead	mg/Kg	1.8	J	MS<LCL
SW6010B	BH-65-10011	N005513	Lead	mg/Kg	3.4	J	MS<LCL
SW6020A	BH-68-10304	N005817	Lead	mg/Kg	12	J	MS<LCL
SW6010B	BH-70-10501	N005878	Manganese	mg/Kg	220	J	MS<LCL
SW6010B	BH-65-10004	N005513	Molybdenum	mg/Kg	1	UJ	MS<LCL
SW6010B	BH-65-10011	N005513	Molybdenum	mg/Kg	1	UJ	MS<LCL
SW6010B	BH-66-10108	N005634	Molybdenum	mg/Kg	1	UJ	MS<LCL
SW6020A	BH-68-10304	N005817	Nickel	mg/Kg	13	J	MS<LCL

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SW6020A	Site1-10001	N005597	Nickel	mg/Kg	9.5	J	MS<LCL
SW8270C	BH-70-10502	N005878	Nitrobenzene	ug/Kg	330	UJ	MS<LCL
SW6010B	BH-65-10004	N005513	Selenium	mg/Kg	1	UJ	MS<LCL
SW6010B	BH-65-10011	N005513	Selenium	mg/Kg	1	UJ	MS<LCL
SW6020A	Site1-10001	N005597	Selenium	mg/Kg	0.26	UJ	MS<LCL
SW6010B	BH-65-10004	N005513	Thallium	mg/Kg	2	UJ	MS<LCL
SW6010B	BH-65-10011	N005513	Thallium	mg/Kg	2.1	UJ	MS<LCL
SW6010B	BH-66-10108	N005634	Thallium	mg/Kg	2.1	UJ	MS<LCL
SW9060	BH-66-10104	N005634	Total Organic Carbon	mg/Kg	2200	J	MS<LCL
SW9060	BH-67-10203	N005513	Total Organic Carbon	mg/Kg	3500	J	MS<LCL
SW9060	BH-67-10204	N005736	Total Organic Carbon	mg/Kg	2000	J	MS<LCL
SW6020A	Site1-10001	N005597	Vanadium	mg/Kg	20	J	MS<LCL
SW9060	BH-65-10012	N005513	Total Organic Carbon	mg/Kg	5800	J	MS>UCL
SW9060	BH-66-10115	N005648	Total Organic Carbon	mg/Kg	2500	J	MS>UCL
SW9060	BH-70-10510	N005878	Total Organic Carbon	mg/Kg	4200	J	MS>UCL
SW8015-E	BH-65-10006	N005513	TPH-Motor Oil	mg/Kg	11	U	MS>UCL
SW8270C	BH-67-10208	N005736	1,2-Dichlorobenzene	ug/Kg	330	UJ	MSRPD
SW8270C	BH-67-10208	N005736	1,3-Dichlorobenzene	ug/Kg	330	UJ	MSRPD
SW8270C	BH-68-10307	N005817	1,3-Dichlorobenzene	ug/Kg	350	U	MSRPD
SW8270C	BH-67-10208	N005736	1,4-Dichlorobenzene	ug/Kg	330	UJ	MSRPD
SW8270C	BH-68-10307	N005817	1,4-Dichlorobenzene	ug/Kg	350	U	MSRPD
SW6020A	BH-66-10108	N005634	Arsenic	mg/Kg	2	J	MSRPD
SW8270C	BH-67-10208	N005736	Bis(2-chloroethyl)ether	ug/Kg	330	UJ	MSRPD
SW8270C	BH-67-10208	N005736	Bis(2-chloroisopropyl)ether	ug/Kg	330	U	MSRPD
SW8270C	BH-67-10208	N005736	Hexachlorobutadiene	ug/Kg	670	UJ	MSRPD
SW8270C	BH-67-10208	N005736	Hexachloroethane	ug/Kg	330	UJ	MSRPD
SW8270C	BH-68-10307	N005817	Hexachloroethane	ug/Kg	350	U	MSRPD
SW8270C	BH-67-10208	N005736	Naphthalene	ug/Kg	330	UJ	MSRPD
SW8270C	BH-68-10307	N005817	Nitrobenzene	ug/Kg	350	U	MSRPD
SW8270C	BH-70-10502	N005878	1,1'-Biphenyl	ug/Kg	710	R	SD<LCL
SW8270C	BH-67-10208	N005736	1,2,4-Trichlorobenzene	ug/Kg	330	UJ	SD<LCL
SW8270C	BH-70-10502	N005878	1,2,4-Trichlorobenzene	ug/Kg	330	UJ	SD<LCL
SW8270C	BH-67-10208	N005736	1,2-Dichlorobenzene	ug/Kg	330	UJ	SD<LCL
SW8270C	BH-70-10502	N005878	1,2-Dichlorobenzene	ug/Kg	330	UJ	SD<LCL
SW8270C	BH-67-10208	N005736	1,3-Dichlorobenzene	ug/Kg	330	UJ	SD<LCL
SW8270C	BH-70-10502	N005878	1,3-Dichlorobenzene	ug/Kg	330	UJ	SD<LCL
SW8270C	BH-67-10208	N005736	1,4-Dichlorobenzene	ug/Kg	330	UJ	SD<LCL
SW8270C	BH-65-10004	N005513	2,4-Dinitrophenol	ug/Kg	1700	UJ	SD<LCL

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SW8270C	BH-67-10208	N005736	2-Chlorophenol	ug/Kg	330	UJ	SD<LCL
SW8270C	BH-67-10208	N005736	2-Methylnaphthalene	ug/Kg	330	UJ	SD<LCL
SW8270C	BH-70-10502	N005878	2-Methylnaphthalene	ug/Kg	330	UJ	SD<LCL
SW6010B	BH-65-10004	N005513	Antimony	mg/Kg	2	UJ	SD<LCL
SW6010B	BH-65-10011	N005513	Antimony	mg/Kg	2.1	UJ	SD<LCL
SW6010B	BH-66-10108	N005634	Antimony	mg/Kg	2.1	UJ	SD<LCL
SW6020A	BH-68-10304	N005817	Antimony	mg/Kg	0.26	UJ	SD<LCL
SW6020A	Site1-10001	N005597	Antimony	mg/Kg	0.26	UJ	SD<LCL
SW6020A	BH-66-10108	N005634	Arsenic	mg/Kg	2	J	SD<LCL
SW6020A	Site1-10001	N005597	Arsenic	mg/Kg	4.2	J	SD<LCL
SW8270C	BH-68-10301	N005513	Benzaldehyde	ug/Kg	740	UJ	SD<LCL
SW8270C	BH-65-10004	N005513	Benzoic acid	ug/Kg	1700	R	SD<LCL
SW8270C	BH-70-10502	N005878	Benzoic acid	ug/Kg	1700	UJ	SD<LCL
SW8270C	BH-67-10208	N005736	Bis(2-chloroethyl)ether	ug/Kg	330	UJ	SD<LCL
SW6010B	BH-65-10011	N005513	Cadmium	mg/Kg	1	UJ	SD<LCL
SW6020A	BH-68-10304	N005817	Chromium	mg/Kg	12	J	SD<LCL
SW6020A	Site1-10001	N005597	Chromium	mg/Kg	13	J	SD<LCL
SW6020A	Site1-10001	N005597	Cobalt	mg/Kg	4.4	J	SD<LCL
SW6020A	Site1-10001	N005597	Copper	mg/Kg	7.7	J	SD<LCL
SW8270C	BH-67-10208	N005736	Hexachlorobutadiene	ug/Kg	670	UJ	SD<LCL
SW8270C	BH-70-10502	N005878	Hexachlorocyclopentadiene	ug/Kg	670	UJ	SD<LCL
SW8270C	BH-67-10208	N005736	Hexachloroethane	ug/Kg	330	UJ	SD<LCL
SW6010B	BH-65-10011	N005513	Lead	mg/Kg	3.4	J	SD<LCL
SW6020A	BH-68-10304	N005817	Lead	mg/Kg	12	J	SD<LCL
SW6010B	BH-70-10501	N005878	Manganese	mg/Kg	220	J	SD<LCL
SW6010B	BH-65-10004	N005513	Molybdenum	mg/Kg	1	UJ	SD<LCL
SW6010B	BH-65-10011	N005513	Molybdenum	mg/Kg	1	UJ	SD<LCL
SW6010B	BH-66-10108	N005634	Molybdenum	mg/Kg	1	UJ	SD<LCL
SW8270C	BH-67-10208	N005736	Naphthalene	ug/Kg	330	UJ	SD<LCL
SW6020A	BH-68-10304	N005817	Nickel	mg/Kg	13	J	SD<LCL
SW6020A	Site1-10001	N005597	Nickel	mg/Kg	9.5	J	SD<LCL
SW6010B	BH-65-10004	N005513	Selenium	mg/Kg	1	UJ	SD<LCL
SW6010B	BH-65-10011	N005513	Selenium	mg/Kg	1	UJ	SD<LCL
SW6020A	Site1-10001	N005597	Selenium	mg/Kg	0.26	UJ	SD<LCL
SW6010B	BH-65-10004	N005513	Thallium	mg/Kg	2	UJ	SD<LCL
SW6010B	BH-65-10011	N005513	Thallium	mg/Kg	2.1	UJ	SD<LCL
SW6010B	BH-66-10108	N005634	Thallium	mg/Kg	2.1	UJ	SD<LCL
SW9060	BH-65-10002	N005513	Total Organic Carbon	mg/Kg	2400	J	SD<LCL

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SW9060	BH-65-10006	N005513	Total Organic Carbon	mg/Kg	4200	J	SD<LCL
SW9060	BH-67-10207	N005736	Total Organic Carbon	mg/Kg	1600	J	SD<LCL
SW6020A	Site1-10001	N005597	Vanadium	mg/Kg	20	J	SD<LCL
SW9060	BH-65-10012	N005513	Total Organic Carbon	mg/Kg	5800	J	SD>UCL
SW6020A	Site1-10001	N005597	Copper	mg/Kg	7.7	J	SerDil
SW8082	BH-68-10319	N005818	Aroclor 1016	ug/Kg	17	UJ	Sur<LCL
SW8082	BH-68-10319	N005818	Aroclor 1221	ug/Kg	35	UJ	Sur<LCL
SW8082	BH-68-10319	N005818	Aroclor 1232	ug/Kg	17	UJ	Sur<LCL
SW8082	BH-68-10319	N005818	Aroclor 1242	ug/Kg	17	UJ	Sur<LCL
SW8082	BH-68-10319	N005818	Aroclor 1248	ug/Kg	17	UJ	Sur<LCL
SW8082	BH-68-10319	N005818	Aroclor 1254	ug/Kg	17	UJ	Sur<LCL
SW8082	BH-68-10319	N005818	Aroclor 1260	ug/Kg	17	UJ	Sur<LCL
SW8290	BH-69-10403	64816	OCDD	PG/G	6.3	UJ	Sur<LCL

[1] This is the final qualifier flag for this analyte/method combination. If more than one flag was applied, this is the most conservative.

Validation Flags:

J = Analyte was present but the reported value might not be accurate or precise (estimated).

UJ = Analyte was not detected and the specified detection limit might not be accurate or precise (estimated).

R = Data were unusable due to deficiencies in the ability to analyze the sample and meet QC criteria (rejected).

U = Analyte was not detected at the specified detection limit.

Validation Reasons:

CCV<LCL = Continuing calibration recovery less than lower control limit.

CCV<UCL = Continuing calibration recovery greater than upper control limit.

FD>RPD = Field duplicate's relative percent difference is greater than the control limit.

HTp>UCL = Sample extraction holding time exceeded the upper control limit.

IS<LCL = Internal standard recovery, less than lower control limit.

LB>RL = Laboratory blank target concentration greater than the reporting limit.

LCS<LCL = Laboratory Control Sample recovery less than the lower control limit.

LCS>UCL = Laboratory Control Sample recovery greater than the upper control limit.

MS<LCL = Matrix spike recovery less than lower control limit.

MS>UCL = Matrix spike recovery greater than upper control limit.

MSRPD = Relative percent difference between matrix spike and matrix spike duplicate greater than control limit.

SD<LCL = Matrix spike duplicate recovery less than lower control limit.

SD>UCL = Matrix spike duplicate recovery greater than upper control limit.

SerDil = Dilution test is greater than 10% RPD.

Sur<LCL = Surrogate recovery less than lower control limit.

Attachment E-2
Data Quality Evaluation for Groundwater Analytical Data

Review of Groundwater Analytical Data for the Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation, PG&E Topock Compressor Station, Needles, California

Prepared for

Pacific Gas and Electric

November, 2012

CH2MHILL
2525 Airpark Drive
Redding, California 96001

Introduction

This Data Quality Evaluation (DQE) report assesses the data quality of groundwater analytical results for the Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation, PG&E Topock Compressor Station, Needles, California, between March 20, 2011 and July 24, 2012. Samples were collected and analyzed as requested by the California Department of Toxic Substance Control. The data was assessed using internal laboratory quality control (QC) criteria; the PG&E Quality Assurance Program Plan (QAPP); the Topock Addendum (July 2008) and subsequent updates.

Analytical Data

Advanced Technology Laboratories (ATL) of Las Vegas, Nevada; Agriculture and Priority Pollutants Laboratories, Inc. (APPL) of Clovis, California; D-TEK Analytical Laboratories, Inc. of Carlsbad California; Sierra Analytical of Laguna Hills, California; TestAmerica Laboratories, Inc. (STL-SEA) of Tacoma Washington; Truesdail Laboratories, Inc. (TLI) of Tustin, California; and Zymax Forensics (Zymax) of San Luis Obispo, California performed the required analyses. All laboratories are certified by the California Department of Health Service's Environmental Laboratory Accreditation Program for the analyses included in Table 2 where appropriate. Samples were analyzed for one or more of the analytes / methods provided in Table 1.

TABLE 1
Analytical Parameters

Parameter	**Method**	**Laboratory**
Dioxin/Furans	SW8290 [b]	APPL
Stable isotopes of deuterium and oxygen	CF-IRMS	Zymax
Hexavalent Chromium	E218.6 [a]	ATL, TLI
Specific Conductivity	E120.1 [a]	ATL
Chloride, Nitrate, Sulfate	E300.0 [a]	ATL
Alkalinity (Carbonate and Bicarbonate)	SM2320 B [c]	ATL
Total Dissolved Solids	SM2540 C [c]	ATL
Suspended Solids	SM2540 D [c]	ATL
Ammonia as Nitrogen	SM4500 NH3 C [c]	ATL
Total Organic Carbon (TOC)	SM5310 C [c]	ATL
Cations	SW6010B [b]	ATL
Metals	SW6020A [b]	ATL, TLI
Mercury	SW7470A [b]	ATL

TABLE 1
Analytical Parameters

Parameter	**Method**	**Laboratory**
Total Petroleum Hydrocarbon (TPH) – Gasoline Range	SW8015B [b]	ATL
TPH-Diesel and Motor Oil Ranges	SW8015B [b]	ATL
Volatile Organic Compounds (VOC)	SW8260B [b]	ATL
Semivolatile Organic Compounds	SW8270C [b]	ATL
Polynuclear Aromatic Hydrocarbons	SW8270-Selected Ion Monitoring [b]	ATL
Pesticides	SW8081A [b]	ATL
PCBs	SW8082 [b]	ATL
Herbicides	SW8151 [b]	ATL, D-TEK, STL-SEA, Sierra

[a] EPA Methods for Chemical Analysis of Water and Wastes, Revised March 1983.
[b] SW-846 Test Methods for Evaluating Solid Waste, 3rd Edition, revision 4, 1996.
[c] Standard Methods for the Examination of Water and Wastewater 20th Edition, 1998.

This DQE report covers 178 normal groundwater and 12 field duplicate (FD) groundwater samples. These samples were reported by the laboratories in 82 sample delivery groups identified in Table 2 below:

TABLE 2
Sample Delivery Groups

42483	999089	N006374	N007016
42763	999179	N006392	N007032
64901	N005518	N006393	N007042
65107	N005527	N006408	N007165
65389	N005647	N006410	N007177
65608	N005651	N006540	N007288
65628	N005731	N006640	N007298
66074	N005732	N006641	N007307
66330	N005733	N006655	N007319
66377	N005799	N006674	N007325
66569	N005800	N006686	N007329
66728	N005815	N006687	N007337

66990	N005816	N006754	N007345
67010	N005831	N006755	N007359
67046	N005957	N006795	N007367
68733	N005959	N006834	N007445
800024	N006053	N006859	N008094
800093	N006096	N006860	N008208
800239	N006242	N006986	N008500
803809	N006261	N007001	
900181	N006269	N007014	

The sample delivery groups were assessed by reviewing the following: (1) the chain-of-custody documentation; (2) holding-time compliance; (3) initial and continuing calibration criteria; (4) method blanks and field blanks; (5) laboratory control sample/laboratory control sample duplicate (LCS/LCSD) recoveries; (6) matrix spike/matrix spike duplicate (MS/MSD) recoveries; (7) laboratory duplicate precision; (8) surrogate spike recoveries; (9) internal standard recoveries; (10) FD precision; and (11) the required QC samples at the specified frequencies.

Data flags were assigned as defined in the QAPP. These flags, as well as the reason for each flag, are entered into the electronic database and can be found in Table 3 at the end of this report (sorted by validation reason and then analyte). Multiple flags are routinely applied to specific sample method/matrix/analyte combinations, but there will be only one final flag. A final flag is applied to the data and is the most conservative of the applied validation flags. The final flag also includes matrix and blank sample effects.

The data flags used defined below:

- J = Analyte was present but the reported value might not be accurate or precise (estimated).
- R = Data were unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.
- U = Analyte was not detected at the specified detection limit.
- UJ = Analyte was not detected and the specified detection limit might not be accurate or precise (estimated).

Data Assessment

Data assessment includes a review of the activities described in the following sections.

Holding Times

Holding-time exceedances result in the possible loss of target analytes due to degradation or chemical reactions that usually cause a negative bias to sample results.

Two herbicide (SW8151) and two semivolatile (SW8270C) samples were extracted outside the EPA recommended holding-time of 7 days. The detected results were qualified as estimated and flagged "J". The non-detected results were qualified as estimated and flagged "UJ".

All other holding times were met.

Method Blanks

Method blanks (MB) are used to monitor each preparation or analytical batch for contamination throughout the entire analytical process from sources such as glassware, reagents, instrumentation and other potential contaminant sources within the laboratory. If a target analyte is detected in the method blank, similar detections in the samples are possibly artifacts of laboratory contamination.

One MB for dioxins (SW8290) had four analytes that were detected at a concentration between the method detection limit (MDL) and the reporting limit (RL) and a second MB had one analyte that was detected at a concentration between the MDL and the RL. The associated sample results were at concentrations between the MDL and 5x the associated MB concentration; those results were qualified as non-detect and flagged "U".

Two MBs for semivolatile (SW8270C) had one analyte (Diethylphthalate) that was detected at a concentration greater than the RL. The associated sample results were at concentrations between the RL and 5x the associated MB concentration; those results were qualified as non-detect and flagged "U".

MBs were analyzed at the required frequency; no other target analytes were detected at or above the reporting limit (RL).

Negative Blanks

Initial calibration blanks (ICBs), continuing calibration blanks (CCBs), and MBs with negative results where the absolute values are greater than the RL can indicate a negative bias in the sample results.

Negative blank results were reported for nickel, aluminum, silver, cobalt, iron, magnesium and beryllium:

- Thirty five associated sample results for nickel (SW6010B) were qualified as estimated. The detect result were flagged "J" the non-detect results were flagged "UJ".
- Twenty seven associated sample results for aluminum (SW6010B) were qualified as estimated. . The detect result were flagged "J" the non-detect results were flagged "UJ".

- Seven associated sample results for silver (SW6010B) were qualified as estimated. The detect result were flagged "J" the non-detect results were flagged "UJ".
- Five associated sample results for cobalt (SW6010B) were qualified as estimated. The detect result were flagged "J" the non-detect results were flagged "UJ".
- Three associated sample results for iron (SW6010B) were qualified as estimated. The detect result were flagged "J" the non-detect results were flagged "UJ".
- Two associated sample results for magnesium (SW6010B) were qualified as estimated. The detect result were flagged "J" the non-detect results were flagged "UJ".
- One associated sample results for Beryllium (SW6010B) were qualified as estimated. The detect result were flagged "J" the non-detect results were flagged "UJ".

Field Blanks

Equipment Blanks (EB) are used to assess the effectiveness of sampling equipment decontamination procedures. Target analytes detected in EBs may indicate that field equipment was not thoroughly decontaminated and/or samples could have been cross contaminated.

Eight hexavalent chromium samples (E218.6) were associated with an EB that had detects greater than the RL, all eight sample results were greater than 5x the associated EB concentration. No flags were applied.

Five chromium samples (SW6020A) were associated with an EB that had detects greater than the RL, four of the five sample results were greater than 5x the associated EB concentration and no flags were applied. One sample result was at a concentration less than 5x the associated EB concentration; that result was qualified as non-detect and flagged "U".

Three toluene samples (SW8260) were associated with an EB that had detects greater than the RL, all three results were at a concentration less than 5x the associated EB concentration; the results were qualified as non-detect and flagged "U".

No other target analytes were detected at or above the reporting limit (RL) in an EB.

Quantitation and Sensitivity

Due to a demonstrated matrix effect for the hexavalent chromium analyses, which is discussed in the "Other" section below, sample interference may require a dilution resulting in elevated RLs for method E218.6 for the non-detected sample results. No flags are applied, but the "ValAdj" reason is noted.

In addition matrix and analyte concentrations resulted in elevated RLs for method E300.0, SW6010B, and SW6020A for the non-detected sample results.

All other method/analyte combinations not mentioned in the Field Blanks or Quantitation and Sensitivity sections met the project RL objectives.

Two sample's hexavalent chromium and chromium results were qualified as estimated and the detected results were flagged "J" due to hexavalent chromium results that exceed the chromium results.

Calibration

Initial calibration and periodic verification are essential to generating defensible analytical data. Initial calibrations that do not meet method requirements result in data that may be either positively or negatively biased. Periodic calibration verification ensures that the instrument has not been adversely affected by the sample matrix or other instrument failures that would increase or decrease the sensitivity or accuracy of the method. The inability to meet initial or continuing calibration analyses may result in qualifying the data as estimated or rejecting the data for project decision-making purposes.

Initial and continuing calibrations were performed as required by the methods. Calibration criteria were met with the following exceptions.

Two herbicide samples (SW8151) were associated with an initial calibration verification standard (ICVS) that had 2,4-DB and Dalapon recover at less than the lower control limit (LCL) and three herbicide samples (SW8151) that were associated with an (ICVS) that had Pentachlorophenol recover at less than the LCL. The non-detect results were qualified as estimated and flagged "UJ".

Two herbicide samples (SW8151) were associated with continuing calibration verification standards (CCV) that had Dalapon recover at less than the LCL. The non-detect results were qualified as estimated and flagged "UJ".

Five volatile samples (SW8260) were associated with a continuing calibration verification standards (CCV) that had 1,1,1-Trichloroethane recovered at less than the LCL. The non-detect results were qualified as estimated and flagged "UJ".

Five volatile samples (SW8260) were associated with a continuing calibration verification standards (CCV) that had Bromomethane recover at less than the LCL. The non-detect results were qualified as estimated and flagged "UJ".

Two volatile samples (SW8260) were associated with a continuing calibration verification standards (CCV) that had 2,2-Dichloropropane recover at less than the LCL. The non-detect results were qualified as estimated and flagged "UJ".

One volatile sample (SW8260) was associated with a continuing calibration verification standard (CCV) that had Chloromethane recover at less than the LCL. The non-detect result was qualified as estimated and flagged "UJ".

One volatile sample (SW8260) was associated with a continuing calibration verification standard (CCV) that had Dichlorodifluoromethane recover at less than the LCL. The non-detect result was qualified as estimated and flagged "UJ".

One volatile sample (SW8260) was associated with a continuing calibration verification standard (CCV) that had Acetone recover greater than the upper control limit (UCL). The detect result was qualified as estimated and flagged "J".

Six semivolatile samples (SW8270C) were associated with a continuing calibration verification standards (CCV) that had Bis(2-chloroisopropyl)ether recover at less than the LCL. The non-detect results were qualified as estimated and flagged "UJ".

Three semivolatile samples (SW8270C) were associated with a continuing calibration verification standards (CCV) that had Benzoic acid recover at less than the LCL. The non-detect results were qualified as estimated and flagged "UJ".

Two semivolatile samples (SW8270C) were associated with a continuing calibration verification standards (CCV) that had 2,4-Dinitrophenol recover at less than the LCL. The non-detect results were qualified as estimated and flagged "UJ".

Five dioxin samples (SW8290) were associated with a continuing calibration verification standards (CCV) that had 1,2,3,6,7,8-Hexachlorodibenzofuran recover at less than the LCL. The non-detect results were qualified as estimated and flagged "UJ".

One dioxin sample (SW8290) was associated with a continuing calibration verification standard (CCV) that had Octachlorodibenzo-p-dioxin recover greater than the UCL. The detect result was qualified as estimated and flagged "J".

One set of hexavalent chromium samples had more than 10 samples between qualifying CCVs; one associated detect result was qualified as estimated and flagged "J".

Internal Standard Recoveries

Internal standards are used for organic analyses and have similar chemical characteristics to the target analytes and provide an analytical response which is distinct from the analyte and not normally subject to interference. The internal standards are added prior to analysis for the purpose of determining analyte concentrations. The internal standard's response is referenced against a relative response factor enabling the sample analyte concentration to be corrected for matrix effects. Internal standard recoveries below 10 percent result in non-detect sample results being rejected.

Three dioxin sample results (SW8290) were associated with an internal standard that recovered at less than LCL. The non-detect results were qualified as estimated and flagged "UJ".

All other internal response factors met method acceptance criteria.

Surrogate Recoveries

Surrogates are primarily used in organic chromatography methods and are added prior to sample preparation. The surrogates are added to all samples, standards, and blanks in a preparation batch and provide a measurement to determine recovery for every sample matrix. Surrogate compounds are chosen to represent the various characterisitics of the target analytes in a specific method. They are often specified by the method and are deliberately selected for their improbability of occurring as environmental contaminants. The results are compared to the acceptance criteria as established by the method or the QAPP. Surrogate recoveries below 10 percent result in non-detect sample results being rejected.

Surrogate recoveries met the acceptance criteria with the following exception.

One TPH-Diesel and TPH-Motor Oil sample (SW8015B) had surrogate recovery greater than the UCL. The detected results were qualified as estimated and flagged "J".

One TPH-Diesel and TPH-Motor Oil sample (SW8015B) had surrogate recovery less than the LCL. The non-detected results were qualified as estimated and flagged "UJ".

Two PCB samples (SW8082) had surrogate recovery less than the LCL. The non-detected results were qualified as estimated and flagged "UJ".

One Herbicide samples (SW8151) had surrogate recovery less than the LCL. The non-detected results were qualified as estimated and flagged "UJ".

One Semivolatile samples (SW8270C) had surrogate recovery less than the LCL. The non-detected results were qualified as estimated and flagged "UJ".

Matrix Spike Samples

Matrix spike (MS) recoveries are used to evaluate the affect of the sample matrix on the recovery of target analytes. A sample is fortified with a known quantity of a target analyte and is carried through the same preparation and analytical procedures as the unspiked sample. MS recoveries outside the QC limits may indicate that the sample's matrix is affecting the method's ability to accurately quantify the target analyte in the associated sample. A low MS recovery generally indicates a negative bias in the sample data, while a high MS recovery indicates a potential positive bias to the associated sample data. If duplicate MS analyses are performed, a relative percent difference (RPD) greater than QC criteria may further indicate that the sample matrix is affecting the precision of the method for the target analyte that did not meet criteria. Therefore, when the MS does not meet criteria, results are usually considered estimated. MS/ matrix spike duplicate (MSD) recoveries below 10 percent result in non-detect sample results being rejected.

MS/ MSD acceptance criteria were met with the following exceptions.

MS/MSD recoveries for twelve samples were less than the LCL for the orthophosphate (E300.0). The parent non-detected results were flagged "UJ".

One Barium (SW6010B) samples had low biased MS/MSD recoveries. The parent detected result was qualified as estimated and flagged "J".

Seven Cadmium (SW6010B) samples had low biased MS/MSD recoveries. The parent non-detected results were qualified as estimated and flagged "UJ".

Two Calcium (SW6010B) samples had low biased MS/MSD recoveries. The parent detected results were qualified as estimated and flagged "J".

Two Cobalt (SW6010B) samples had low biased MS/MSD recoveries. The parent non-detected results were qualified as estimated and flagged "UJ".

Two Copper (SW6010B) samples had low biased MS/MSD recoveries. The parent detected result was qualified as estimated and flagged "J". The parent non-detected result was qualified as estimated and flagged "UJ".

Two Iron (SW6010B) samples had low biased MSD recoveries. The parent non-detected results were qualified as estimated and flagged "UJ".

Two Lead (SW6010B) samples had low biased MS/MSD recoveries. The parent non-detected results were qualified as estimated and flagged "UJ".

One Lead (SW6010B) samples had low biased MS recoveries. The parent non-detected result was qualified as estimated and flagged "UJ".

One Magnesium (SW6010B) samples had low biased MS/MSD recoveries. The parent detected result was qualified as estimated and flagged "J".

One Molybdenum (SW6010B) samples had low biased MS/MSD recoveries. The parent detected result was qualified as estimated and flagged "J".

Two Nickel (SW6010B) samples had low biased MS/MSD recoveries. The parent non-detected results were qualified as estimated and flagged "UJ".

One Potassium (SW6010B) samples had low biased MS/MSD recoveries. The parent detected result was qualified as estimated and flagged "J".

One Chromium (SW6020A) samples had low biased MS/MSD recoveries. The parent detected result was qualified as estimated and flagged "J".

One Copper (SW6020A) samples had low biased MS/MSD recoveries. The parent detected result was qualified as estimated and flagged "J".

One Copper (SW6020A) samples had low biased MS recovery. The parent non-detected result was qualified as estimated and flagged "UJ".

One Copper (SW6020A) samples had zero percent recovery for the MS/MSD. The parent non-detected result was rejected and flagged "R".

One Selenium (SW6020A) samples had low biased MS recoveries. The parent non-detected result was qualified as estimated and flagged "UJ".

One Selenium (SW6020A) samples had low biased MS/MSD recoveries. The parent detected result was qualified as estimated and flagged "J".

One Zinc (SW6020A) samples had low biased MS/MSD recoveries. The parent non-detected result was qualified as estimated and flagged "UJ".

One TPH-Diesel sample (SW8015B) had low biased MSD recoveries. The parent non-detected result was qualified as estimated and flagged "UJ".

One TPH-Gasoline sample (SW8015B) had low biased MS recoveries. The parent non-detected result was qualified as estimated and flagged "UJ".

MS and/or MSD recoveries for 1,2,4-Trimethylbenzene, 1,2-Dibromoethane, 2-butanone, acetone, acrolein, acrylonitrile, bromoform and styrene (SW8260B) were less than the LCL. Eight non-detected parent sample results were flagged "UJ".

One Calcium (SW6010B) samples had high biased MS/MSD recoveries. The parent detected result was qualified as estimated and flagged "J".

Two Potassium (SW6010B) samples had high biased MS/MSD recoveries. The parent detected results were qualified as estimated and flagged "J".

One Sodium (SW6010B) samples had high biased MS/MSD recoveries. The parent detected result was qualified as estimated and flagged "J".

One Barium (SW6020A) samples had low biased MS/MSD recoveries. The parent detected results were qualified as estimated and flagged "J".

One Chromium (SW6020A) samples had high biased MS/MSD recoveries. The parent detected result was qualified as estimated and flagged "J".

The RPD for one Selenium (SW6020A) sample MS/MSD exceeded criterion. The detected parent result was qualified as estimated and flagged "J".

Dilution Test

Dilution Test is used in metals analysis to evaluate matrix interference. The sample concentration must be a minimum of at least 25 times greater than the RL. A fivefold (1+4) dilution is analyzed and must agree within 10 percent of the original concentration. If not, an interference effect must be suspected.

Two Magnesium, one Potassium, three Sodium, and one Zinc (SW6010B) sample had detected results that exceeded the 10 percent RPD criteria. The detected results were qualified as estimated and flagged "J".

Field Duplicates

Field duplicates (FD) are collected and analyzed to determine if field collection activities or the sample matrix influences the precision of the analytical measurements obtained at the sample site.

All FD acceptance criteria were met with the following exceptions.

One FD pair had RPDs greater than the UCL for Nitrate (E300.0). One FD pair had RPDs greater than the UCL for Ammonia (SM4500N H3 C). Two FD pairs had RPDs greater than the UCL for Alkalinity (SM2320 B). One FD pair had RPDs greater than the UCL for Chromium (SW6020A). Three FD pairs had RPDs greater than the UCL for Iron (SW6010B). And One FD pair of dioxins (SW8290) had RPDs greater than the UCL for OCDD, OCDF and 1,2,3,4,6,7,8-HpCDD.

Detected and non-detected results were qualified as estimated and were flagged "J" and "UJ."

Laboratory Duplicates

Laboratory duplicates measure laboratory precision. RPDs that exceed method criteria indicate imprecision in some aspect of the analytical procedure.

The laboratory analyzed duplicate aliquots of field samples at the required frequency. The QC acceptance criteria were met for all methods.

Laboratory Control Samples

A laboratory control sample (LCS) measures laboratory accuracy. Accuracy is the degree of agreement between a measured value and the expected value. The LCS is prepared from

laboratory deionized or reagent-grade water and spiked with known amounts of the target analytes of interest. Recovery of analytes outside of QC limits generally indicates a problem with the analytical procedure. A low LCS recovery indicates that the target analyte in associated samples is likely biased low. Likewise, a high LCS recovery indicates that the target analyte in associated samples is likely biased high. Results associated with LCS recovery criteria exceedances are considered estimated. LCS recoveries below 10 percent result in non-detect sample results being rejected.

LCSs were analyzed at the required frequency and were recovered within QC limits with the following exceptions.

Two LCSs for Carbonate Alkalinity (SM2320 B) had recoveries that were less than the LCL. Twenty associated non-detected sample results were qualified as estimated and flagged "UJ"; one associated detected sample result was qualified as estimated and flagged "J".

One LCS for 2,4,5-T and Dichlorprop (SW8151) had recoveries that were less than the LCLs. Two associated non-detected sample results were qualified as estimated and flagged "UJ".

One LCS for 2,4-Dichlorophenol (SW8270C) had a recovery that was less than the LCL. One associated non-detected sample result was qualified as estimated and flagged "UJ".

One LCS for Acenaphthylene (SW8270SIM) had a recovery that was less than the LCL. One associated non-detected sample result was qualified as estimated and flagged "UJ".

One LCS for 1,2,3,6,7,8-Hexachlorodibenzofuran (SW8290) had a recovery that was less than the LCL. Three associated non-detected sample results were qualified as estimated and flagged "UJ".

One LCS/LSCD pair had RPDs greater than the UCL for 2,4-Dimethylphenol (SW8270C). One LCS/LSCD pair had RPDs greater than the UCL for Hexachlorobutadiene and Nitrobenzene (SW8270C). One LCS/LSCD pair had RPDs greater than the UCL for 1-Methylnaphthalene, 2-Methylnaphthalene, Acenaphthene, Acenaphthylene, Fluorene, and Naphthalene (SW8270 SIM). Non-detected results were qualified as estimated and flagged "UJ".

Two herbicide (SW8151) LCSs were reported with an incomplete list of analytes; the associated detect and non-detect results were qualified as estimated and were flagged "J" and "UJ".

Chain of Custody / Sample Receipt

Samples are collected under chain of custody to ensure that sample integrity is documented and known from the time of collection through receipt at the laboratory where custody is relinquished to the laboratory.

Each sample was documented in a completed chain of custody and received at the laboratory in good condition. All discrepancies identified in laboratory custody were promptly resolved. None were an impact to the data or data quality.

Other

Matrix interference has been encountered at the Topock site, in selected monitoring wells, that affected the sensitivity for hexavalent chromium by the method E218.6. CH2M HILL directed the laboratory to perform additional quality assurance /QC analyses to aid in assessing if there is any effect on method sensitivity for each well location due to the sample matrix.

The laboratory was instructed to analyze an MS of all samples by spiking the samples with 1 µg/L of hexavalent chromium to ensure that identification is accurate for detected results. For non-detected results, the MS should verify there are not false negatives that go undetected.

If the MS is not recovered or the peak is outside of the established retention time window for either detected or non-detected results, the laboratory will make a fivefold dilution of two aliquots of the sample. The first aliquot will be analyzed without the spike, and the second will be spiked with 1 µg/L of hexavalent chromium, and the recovery and peak retention time evaluated. If this MS recovery is not within laboratory QC limits and/or the peak is not within the laboratory retention time window, the laboratory will dilute two additional aliquots of sample tenfold, spike one of the aliquots, analyze the sample/MS, and perform successively greater dilutions of 25:1, 50:1, or 100:1 until the peak identified in the post spike analysis is within the established retention time window for hexavalent chromium, and the recovery of the spike is within laboratory QC limits.

The detected result that is reported by the laboratory on the final data package is chosen from the dilution where both the peak detected in the unspiked and the spiked sample fall within the appropriate retention time and the MS is recovered with QC control limits. The RLs are raised to the level of the appropriate dilution.

For non-detected results, the dilution selected by the laboratory for reporting is taken from the smallest dilution that yields an MS recovery within QC control limits and within the appropriate retention time window.

Confirmation Analysis

When method SW8151 is used to analyze unfamiliar samples, compound identifications should be supported by at least one additional qualitative technique. Second column gas chromatograph/mass spectrometer (GC/MS) criteria appropriate for the qualitative confirmation of compound identifications. Method SW8151suggests GC/MS techniques should be judiciously employed to support qualitative identifications made with this method.

Three samples had detected results for MCPP (SW8151), however the lab did not provide any confirmation data or information. The detected sample results were qualified as estimated and flagged “J”

Overall Review

The goal of this review is to demonstrate that a sufficient number of representative samples were collected and the resulting analytical data can be used to support the decision-making process. The procedures for assessing the precision, accuracy, representativeness, completeness, and comparability parameters (PARCC) are addressed in the QAPP. The following summary highlights the PARCC findings for the above-defined events:

1. The completeness objective for the PG&E program is 95 percent (%) for groundwater samples. The completeness objective was met for all method/analyte combinations.
2. Samples were collected and analyzed based on approved methods/procedures and the results are reported using industry-standardized units.
3. The routinely acceptable performance of field and laboratory QC indicators (FDs, field blanks, laboratory blanks, LCS, MS/MSD, surrogate, and calibrations) generally show the accuracy and precision of the data meet the project objectives.
    - One chromium (SW6020A) and three toluene (SW8260) results were qualified as not detected due to EB contamination.
    - Orthophosphate (E300.0), Barium (SW6010B), Cadmium (SW6010B), Calcium (SW6010B),Cobalt (SW6010B), Copper (SW6010B), Iron (SW6010B), Lead (SW6010B), Magnesium (SW6010B), Molybdenum (SW6010B), Nickel (SW6010B), Potassium (SW6010B), Chromium (SW6020A), Copper (SW6020A), Selenium (SW6020A), Zinc (SW6020A), TPH-Diesel (SW8015B), TPH-Gasoline (SW8015B), 1,2,4-Trimethylbenzene, 1,2-Dibromoethane, 2-butanone, acetone, acrolein, acrylonitrile, bromoform and styrene (SW8260B) samples were qualified as estimated values due to MS/MSD exceedances.
    - TPH-Diesel and TPH-Motor Oil (SW8015B), PCB (SW8082), Herbicide (SW8151) and Semivolatile (SW8270C) samples were qualified due to surrogate recovery outside the method criteria.
    - Herbicide (SW8151), Volatiles (SW8260), Semivolatiles (SW8270C), Dioxin (SW8290) and Hexavalent chromium (E218.6) samples were qualified as estimated values due to calibration criteria exceedances.
4. Results from Two herbicide (SW8151) and two semivolatile (SW8270C) samples were qualified as estimated due to holding time exceedance.
5. Matrix effects were identified in eight samples for hexavalent chromium (E218.6) analyses and the RLs were raised to the concentrations where the matrix effects were overcome as indicated by acceptable MS analyses.
6. Analytical data as qualified meet the data quality objectives and may be used in project decision making.

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SW6010B	MW-66BR-270-008	N007165	Magnesium, dissolved	mg/L	0.53	J	CCB>RL
SW6010B	MW-74BR-240-008	N007165	Magnesium, dissolved	mg/L	0.1	UJ	CCB>RL
SW6010B	MW-66BR-270-008	N007165	Nickel, dissolved	ug/L	5	UJ	CCB>RL
SW6010B	MW-74BR-240-008	N007165	Nickel, dissolved	ug/L	5	UJ	CCB>RL
SW8260	MW-64BR-LWR-150-007	N007032	1,1,1-Trichloroethane	ug/L	1	UJ	CCV<LCL
SW8260	MW-66-165-007	N007032	1,1,1-Trichloroethane	ug/L	1	UJ	CCV<LCL
SW8260	MW-67-185-007	N007032	1,1,1-Trichloroethane	ug/L	1	UJ	CCV<LCL
SW8260	MW-67-225-007	N007032	1,1,1-Trichloroethane	ug/L	1	UJ	CCV<LCL
SW8260	MW-69-195-007	N007032	1,1,1-Trichloroethane	ug/L	1	UJ	CCV<LCL
SW8290	AB-60131-007	66569	1,2,3,6,7,8-HXCDF	PG/L	0.69	UJ	CCV<LCL
SW8290	MW-67-225-007	66569	1,2,3,6,7,8-HXCDF	PG/L	0.66	UJ	CCV<LCL
SW8290	MW-68BR-280-007	66569	1,2,3,6,7,8-HXCDF	PG/L	1.1	UJ	CCV<LCL
SW8290	MW-69-195-007	66569	1,2,3,6,7,8-HXCDF	PG/L	0.68	UJ	CCV<LCL
SW8290	MW-82-007	66569	1,2,3,6,7,8-HXCDF	PG/L	0.78	UJ	CCV<LCL
SW8260	MW-70BR-225-006	N006859	2,2-Dichloropropane	ug/L	1	UJ	CCV<LCL
SW8260	MW-71-035-006	N006859	2,2-Dichloropropane	ug/L	1	UJ	CCV<LCL
SW8270C	MW-70BR-225-006	N006859	2,4-Dinitrophenol	ug/L	51	UJ	CCV<LCL
SW8270C	MW-73-080-006	N006834	2,4-Dinitrophenol	ug/L	50	UJ	CCV<LCL
SW8270C	MW-69-195-002	N006096	Benzoic acid	ug/L	52	UJ	CCV<LCL
SW8270C	MW-70BR-225-006	N006859	Benzoic acid	ug/L	51	UJ	CCV<LCL
SW8270C	MW-73-080-006	N006834	Benzoic acid	ug/L	50	UJ	CCV<LCL
SW8270C	MW-65-160-001	N005957	Bis(2-chloroisopropyl)ether	ug/L	10	UJ	CCV<LCL
SW8270C	MW-66-165-001	N005957	Bis(2-chloroisopropyl)ether	ug/L	10	UJ	CCV<LCL
SW8270C	MW-67-225-001	N005957	Bis(2-chloroisopropyl)ether	ug/L	10	UJ	CCV<LCL
SW8270C	MW-68-180-001	N005957	Bis(2-chloroisopropyl)ether	ug/L	10	UJ	CCV<LCL
SW8270C	MW-70-105-001	N005957	Bis(2-chloroisopropyl)ether	ug/L	10	UJ	CCV<LCL
SW8270C	MW-99-001	N005957	Bis(2-chloroisopropyl)ether	ug/L	10	UJ	CCV<LCL
SW8260	EB-70331-001	N005957	Bromomethane	ug/L	1	UJ	CCV<LCL
SW8260	MW-65-160-001	N005957	Bromomethane	ug/L	1	UJ	CCV<LCL
SW8260	MW-66-165-001	N005957	Bromomethane	ug/L	1	UJ	CCV<LCL
SW8260	MW-67-225-001	N005957	Bromomethane	ug/L	1	UJ	CCV<LCL
SW8260	MW-68-180-001	N005957	Bromomethane	ug/L	1	UJ	CCV<LCL
SW8260	MW-70-105-001	N005957	Bromomethane	ug/L	1	UJ	CCV<LCL
SW8260	MW-99-001	N005957	Bromomethane	ug/L	1	UJ	CCV<LCL
SW8151	MW-70BR-225-006	N006859	Dalapon	ug/L	0.43	UJ	CCV<LCL
SW8151	MW-73-080-006	N006834	Dalapon	ug/L	0.43	UJ	CCV<LCL
SW8260	MW-60BR-245-003	N006261	Chloromethane	ug/L	1	UJ	CCV<LCL

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SW8260	MW-60BR-245-003	N006261	Dichlorodifluoromethane	ug/L	1	UJ	CCV<LCL
SW8260	MW-66BR-270-008	N007165	Acetone	ug/L	18	J	CCV>UCL
SW8290	AB-60131-007	66569	OCDD	PG/L	190	J	CCV>UCL
SW6010B	BH-65-20003	N005527	Chromium, dissolved	ug/L	88	J	Cr+6>Cr
SW6020A	MW-72BR-200-DEV	N008094	Chromium, dissolved	ug/L	5.7	J	Cr+6>Cr
E218.6	BH-65-20003	N005527	Hexavalent Chromium	ug/L	140	J	Cr+6>Cr
E218.6	MW-72BR-200-DEV	N008094	Hexavalent Chromium	ug/L	7.9	J	Cr+6>Cr
SM2320B	MW-102-007	N007032	Alkalinity	mg/L	110	J	FD>RPD
SM2320B	MW-59-100-007	N007032	Alkalinity	mg/L	56	J	FD>RPD
SM2320B	MW-102-007	N007032	Alkalinity, Bicarbonate	mg/L	110	J	FD>RPD
SM2320B	MW-59-100-007	N007032	Alkalinity, Bicarbonate	mg/L	56	J	FD>RPD
SM2320B	MW-101-007	N007014	Alkalinity, Carbonate	mg/L	39	J	FD>RPD
SM2320B	MW-23-080-007	N007014	Alkalinity, Carbonate	mg/L	18	J	FD>RPD
SM2320B	MW-101-007	N007014	Alkalinity, Hydroxide	mg/L	11	J	FD>RPD
SM2320B	MW-23-080-007	N007014	Alkalinity, Hydroxide	mg/L	22	J	FD>RPD
SW6010B	MW-101-004	N006410	Iron, dissolved	ug/L	62	J	FD>RPD
SW6010B	MW-67-225	N005831	Iron, dissolved	ug/L	160	J	FD>RPD
SW6010B	MW-67-225-DUP	N005831	Iron, dissolved	ug/L	20	UJ	FD>RPD
SW6010B	MW-68-180-001	N005957	Iron, dissolved	ug/L	310	J	FD>RPD
SW6010B	MW-68-240-004	N006410	Iron, dissolved	ug/L	20	UJ	FD>RPD
SW6010B	MW-99-001	N005957	Iron, dissolved	ug/L	1800	J	FD>RPD
SW6020A	MW-120-187a	N008500	Chromium, dissolved	ug/L	5	UJ	FD>RPD
SW6020A	MW-72BR-200-187a	N008500	Chromium, dissolved	ug/L	3.3	J	FD>RPD
E300.0	MW-68-180-001	N005957	Nitrate as N	mg/L	5.2	J	FD>RPD
E300.0	MW-99-001	N005957	Nitrate as N	mg/L	6.7	J	FD>RPD
SM4500NH3	MW-100-003	N006261	Nitrogen, Ammonia (As N)	mg/L	0.11	J	FD>RPD
SM4500NH3	MW-65-160-003	N006261	Nitrogen, Ammonia (As N)	mg/L	0.72	J	FD>RPD
SW8290	MW-120-187a	68773	1,2,3,4,6,7,8-HpCDD	PG/L	520	J	FD>RPD
SW8290	MW-72BR-200-187a	68773	1,2,3,4,6,7,8-HpCDD	PG/L	180	J	FD>RPD
SW8290	MW-120-187a	68773	OCDF	PG/L	880	J	FD>RPD
SW8290	MW-72BR-200-187a	68773	OCDF	PG/L	300	J	FD>RPD
SW8290	MW-120-187a	68773	OCDD	PG/L	7500	J	FD>RPD
SW8290	MW-72BR-200-187a	68773	OCDD	PG/L	2900	J	FD>RPD
SW8270C	MW-70BR-225-006	N006859	1,2,4-Trichlorobenzene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	1,2,4-Trichlorobenzene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	1,2-Dichlorobenzene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	1,2-Dichlorobenzene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	1,3-Dichlorobenzene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	1,3-Dichlorobenzene	ug/L	10	UJ	HTp>UCL

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SW8270C	MW-70BR-225-006	N006859	1,4-Dichlorobenzene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	1,4-Dichlorobenzene	ug/L	10	UJ	HTp>UCL
SW8151	MW-101-005	N006655	2,4,5-T	ug/L	0.08	UJ	HTp>UCL
SW8151	MW-67-185-005	N006655	2,4,5-T	ug/L	0.08	UJ	HTp>UCL
SW8151	MW-101-005	N006655	2,4,5-TP (Silvex)	ug/L	0.08	UJ	HTp>UCL
SW8151	MW-67-185-005	N006655	2,4,5-TP (Silvex)	ug/L	0.08	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	2,4,5-Trichlorophenol	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	2,4,5-Trichlorophenol	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	2,4,6-Trichlorophenol	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	2,4,6-Trichlorophenol	ug/L	10	UJ	HTp>UCL
SW8151	MW-101-005	N006655	2,4-D	ug/L	0.08	UJ	HTp>UCL
SW8151	MW-67-185-005	N006655	2,4-D	ug/L	0.08	UJ	HTp>UCL
SW8151	MW-101-005	N006655	2,4-DB	ug/L	0.2	UJ	HTp>UCL
SW8151	MW-67-185-005	N006655	2,4-DB	ug/L	0.2	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	2,4-Dichlorophenol	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	2,4-Dichlorophenol	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	2,4-Dimethylphenol	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	2,4-Dimethylphenol	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	2,4-Dinitrophenol	ug/L	51	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	2,4-Dinitrophenol	ug/L	50	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	2,4-Dinitrotoluene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	2,4-Dinitrotoluene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	2,6-Dinitrotoluene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	2,6-Dinitrotoluene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	2-Chloronaphthalene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	2-Chloronaphthalene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	2-Chlorophenol	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	2-Chlorophenol	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	2-Methylnaphthalene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	2-Methylnaphthalene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	2-Methylphenol	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	2-Methylphenol	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	2-Nitroaniline	ug/L	51	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	2-Nitroaniline	ug/L	50	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	2-Nitrophenol	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	2-Nitrophenol	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	3,3-┤ -Dichlorobenzidine	ug/L	20	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	3,3-Dichlorobenzidine	ug/L	20	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	3-Nitroaniline	ug/L	51	UJ	HTp>UCL

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SW8270C	MW-73-080-006	N006834	3-Nitroaniline	ug/L	50	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	4,6-Dinitro-2-methylphenol	ug/L	51	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	4,6-Dinitro-2-methylphenol	ug/L	50	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	4-Bromophenyl-phenylether	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	4-Bromophenyl-phenylether	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	4-Chloro-3-methylphenol	ug/L	51	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	4-Chloro-3-methylphenol	ug/L	50	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	4-Chloroaniline	ug/L	20	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	4-Chloroaniline	ug/L	20	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	4-Chlorophenyl-phenylether	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	4-Chlorophenyl-phenylether	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	4-Methylphenol	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	4-Methylphenol	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	4-Nitroaniline	ug/L	20	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	4-Nitroaniline	ug/L	20	UJ	HTp>UCL
SW8151	MW-101-005	N006655	4-Nitrophenol	ug/L	0.1	UJ	HTp>UCL
SW8151	MW-67-185-005	N006655	4-Nitrophenol	ug/L	0.1	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	4-Nitrophenol	ug/L	51	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	4-Nitrophenol	ug/L	50	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Acenaphthene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Acenaphthene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Acenaphthylene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Acenaphthylene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Anthracene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Anthracene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Benzo(a)anthracene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Benzo(a)anthracene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Benzo(a)pyrene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Benzo(a)pyrene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Benzo(b)fluoranthene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Benzo(b)fluoranthene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Benzo(g,h,i)perylene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Benzo(g,h,i)perylene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Benzo(k)fluoranthene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Benzo(k)fluoranthene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Benzoic acid	ug/L	51	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Benzoic acid	ug/L	50	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Benzyl alcohol	ug/L	20	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Benzyl alcohol	ug/L	20	UJ	HTp>UCL

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SW8270C	MW-70BR-225-006	N006859	Bis(2-chloroethoxy)methane	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Bis(2-chloroethoxy)methane	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Bis(2-chloroethyl)ether	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Bis(2-chloroethyl)ether	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Bis(2-chloroisopropyl)ether	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Bis(2-chloroisopropyl)ether	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Bis(2-ethylhexyl)phthalate	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Bis(2-ethylhexyl)phthalate	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Butylbenzylphthalate	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Butylbenzylphthalate	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Chrysene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Chrysene	ug/L	10	UJ	HTp>UCL
SW8151	MW-101-005	N006655	Dalapon	ug/L	0.3	UJ	HTp>UCL
SW8151	MW-67-185-005	N006655	Dalapon	ug/L	0.3	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Dibenz(a,h)anthracene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Dibenz(a,h)anthracene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Dibenzofuran	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Dibenzofuran	ug/L	10	UJ	HTp>UCL
SW8151	MW-101-005	N006655	Dicamba	ug/L	0.08	UJ	HTp>UCL
SW8151	MW-67-185-005	N006655	Dicamba	ug/L	0.08	UJ	HTp>UCL
SW8151	MW-101-005	N006655	Dichlorprop	ug/L	0.08	UJ	HTp>UCL
SW8151	MW-67-185-005	N006655	Dichlorprop	ug/L	0.08	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Diethylphthalate	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Diethylphthalate	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Dimethylphthalate	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Dimethylphthalate	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Di-n-butylphthalate	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Di-n-butylphthalate	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Di-n-octylphthalate	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Di-n-octylphthalate	ug/L	10	UJ	HTp>UCL
SW8151	MW-101-005	N006655	Dinoseb	ug/L	0.08	UJ	HTp>UCL
SW8151	MW-67-185-005	N006655	Dinoseb	ug/L	0.08	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Fluoranthene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Fluoranthene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Fluorene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Fluorene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Hexachlorobenzene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Hexachlorobenzene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Hexachlorobutadiene	ug/L	20	UJ	HTp>UCL

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SW8270C	MW-73-080-006	N006834	Hexachlorobutadiene	ug/L	20	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Hexachloroethane	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Hexachloroethane	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Indeno(1,2,3-cd)pyrene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Indeno(1,2,3-cd)pyrene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Isophorone	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Isophorone	ug/L	10	UJ	HTp>UCL
SW8151	MW-101-005	N006655	MCPA	ug/L	2	UJ	HTp>UCL
SW8151	MW-67-185-005	N006655	MCPA	ug/L	2	UJ	HTp>UCL
SW8151	MW-101-005	N006655	MCPP	ug/L	7.8	J	HTp>UCL
SW8151	MW-67-185-005	N006655	MCPP	ug/L	9.7	J	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Naphthalene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Naphthalene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Nitrobenzene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Nitrobenzene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	N-Nitrosodi-n-propylamine	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	N-Nitrosodi-n-propylamine	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	N-Nitrosodiphenylamine	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	N-Nitrosodiphenylamine	ug/L	10	UJ	HTp>UCL
SW8151	MW-101-005	N006655	Pentachlorophenol	ug/L	0.08	UJ	HTp>UCL
SW8151	MW-67-185-005	N006655	Pentachlorophenol	ug/L	0.08	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Pentachlorophenol	ug/L	51	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Pentachlorophenol	ug/L	50	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Phenanthrene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Phenanthrene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Phenol	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Phenol	ug/L	10	UJ	HTp>UCL
SW8270C	MW-70BR-225-006	N006859	Pyrene	ug/L	10	UJ	HTp>UCL
SW8270C	MW-73-080-006	N006834	Pyrene	ug/L	10	UJ	HTp>UCL
SW6010B	MW-66BR-270-008	N007165	Magnesium, dissolved	mg/L	0.53	J	ICB>RL
SW6010B	MW-74BR-240-008	N007165	Magnesium, dissolved	mg/L	0.1	UJ	ICB>RL
SW6010B	MW-66BR-270-008	N007165	Nickel, dissolved	ug/L	5	UJ	ICB>RL
SW6010B	MW-74BR-240-008	N007165	Nickel, dissolved	ug/L	5	UJ	ICB>RL
SW8151	MW-70BR-225-006	N006859	2,4-DB	ug/L	0.27	UJ	ICVS<LCL
SW8151	MW-73-080-006	N006834	2,4-DB	ug/L	0.27	UJ	ICVS<LCL
SW8151	MW-70BR-225-006	N006859	Dalapon	ug/L	0.43	UJ	ICVS<LCL
SW8151	MW-73-080-006	N006834	Dalapon	ug/L	0.43	UJ	ICVS<LCL
SW8151	MW-70BR-225-006	N006859	Pentachlorophenol	ug/L	0.27	UJ	ICVS<LCL
SW8151	MW-73-080-006	N006834	Pentachlorophenol	ug/L	0.27	UJ	ICVS<LCL

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SW8151	MW-74BR-240-008	N007165	Pentachlorophenol	ug/L	0.28	UJ	ICVS<LCL
SW8290	MW-69-195-002	65107	1,2,3,6,7,8-HXCDD	PG/L	3.1	UJ	IS<LCL
SW8290	MW-69-195-002	65107	2,3,7,8-TCDD	PG/L	1.3	UJ	IS<LCL
SW8290	MW-65-160-001	64901	OCDD	PG/L	9.6	UJ	IS<LCL
SM2320B	MW-66-165-001	N005957	Alkalinity, Carbonate	mg/L	5	UJ	LabA&P
E218.6	MW-66-230	N005800	Hexavalent Chromium	ug/L	4600	J	LabA&P
SW8290	MW-101-005	66074	1,2,3,4,6,7,8-HPCDD	PG/L	27	U	LB<RL
SW8290	MW-67-185-005	66074	1,2,3,4,7,8-HXCDF	PG/L	5.5	U	LB<RL
SW8290	MW-101-005	66074	1,2,3,6,7,8-HXCDF	PG/L	32	U	LB<RL
SW8290	MW-67-185-005	66074	2,3,4,6,7,8-HXCDF	PG/L	6.5	U	LB<RL
SW8290	MW-73-080-006	66330	2,3,7,8-TCDF	PG/L	3.9	U	LB<RL
SW8290	MW-67-185-005	66074	OCDF	PG/L	32	U	LB<RL
SW8290	MW-101-005	66074	OCDD	PG/L	38	U	LB<RL
SW8290	MW-67-185-005	66074	OCDD	PG/L	110	U	LB<RL
SW8270C	MW-66BR-270-008b	N007177	Diethylphthalate	ug/L	77	U	LB>RL
SW8270C	MW-74BR-240-008	N007165	Diethylphthalate	ug/L	71	U	LB>RL
SW8290	MW-67-225-007	66569	1,2,3,6,7,8-HXCDF	PG/L	0.66	UJ	LCS<LCL
SW8290	MW-68BR-280-007	66569	1,2,3,6,7,8-HXCDF	PG/L	1.1	UJ	LCS<LCL
SW8290	MW-69-195-007	66569	1,2,3,6,7,8-HXCDF	PG/L	0.68	UJ	LCS<LCL
SW8151	MW-101-005	N006655	2,4,5-T	ug/L	0.08	UJ	LCS<LCL
SW8151	MW-67-185-005	N006655	2,4,5-T	ug/L	0.08	UJ	LCS<LCL
SW8270C	MW-60BR-245-003	N006261	2,4-Dichlorophenol	ug/L	10	UJ	LCS<LCL
SW8270SIM	MW-72-080-004	N006393	Acenaphthylene	ug/L	0.21	UJ	LCS<LCL
SM2320B	MW-100-002	N006096	Alkalinity, Carbonate	mg/L	5	UJ	LCS<LCL
SM2320B	MW-65-160-001	N005957	Alkalinity, Carbonate	mg/L	5	UJ	LCS<LCL
SM2320B	MW-65-160-002	N006096	Alkalinity, Carbonate	mg/L	5	UJ	LCS<LCL
SM2320B	MW-65-225-001	N005957	Alkalinity, Carbonate	mg/L	5	UJ	LCS<LCL
SM2320B	MW-65-225-002	N006096	Alkalinity, Carbonate	mg/L	5	UJ	LCS<LCL
SM2320B	MW-66-165-001	N005957	Alkalinity, Carbonate	mg/L	5	UJ	LCS<LCL
SM2320B	MW-66-165-002	N006096	Alkalinity, Carbonate	mg/L	5	UJ	LCS<LCL
SM2320B	MW-66-230-001	N005957	Alkalinity, Carbonate	mg/L	5	UJ	LCS<LCL
SM2320B	MW-66-230-002	N006096	Alkalinity, Carbonate	mg/L	5	UJ	LCS<LCL
SM2320B	MW-67-225-001	N005957	Alkalinity, Carbonate	mg/L	5	UJ	LCS<LCL
SM2320B	MW-67-225-002	N006096	Alkalinity, Carbonate	mg/L	5	UJ	LCS<LCL
SM2320B	MW-67-260-001	N005957	Alkalinity, Carbonate	mg/L	5	UJ	LCS<LCL
SM2320B	MW-67-260-002	N006096	Alkalinity, Carbonate	mg/L	21	J	LCS<LCL
SM2320B	MW-68-180-001	N005957	Alkalinity, Carbonate	mg/L	5	UJ	LCS<LCL
SM2320B	MW-68-180-002	N006096	Alkalinity, Carbonate	mg/L	5	UJ	LCS<LCL
SM2320B	MW-68-240-001	N005957	Alkalinity, Carbonate	mg/L	5	UJ	LCS<LCL

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SM2320B	MW-68-240-002	N006096	Alkalinity, Carbonate	mg/L	5	UJ	LCS<LCL
SM2320B	MW-69-195-002	N006096	Alkalinity, Carbonate	mg/L	5	UJ	LCS<LCL
SM2320B	MW-70-105-001	N005957	Alkalinity, Carbonate	mg/L	5	UJ	LCS<LCL
SM2320B	MW-70-105-002	N006096	Alkalinity, Carbonate	mg/L	5	UJ	LCS<LCL
SM2320B	MW-99-001	N005957	Alkalinity, Carbonate	mg/L	5	UJ	LCS<LCL
SW8151	MW-101-005	N006655	Dichlorprop	ug/L	0.08	UJ	LCS<LCL
SW8151	MW-67-185-005	N006655	Dichlorprop	ug/L	0.08	UJ	LCS<LCL
SW8270SIM	MW-69-195-002	N006096	1-Methylnaphthalene	ug/L	0.2	UJ	LCSRPD
SW8270C	MW-69-195-002	N006096	2,4-Dimethylphenol	ug/L	10	UJ	LCSRPD
SW8270SIM	MW-69-195-002	N006096	2-Methylnaphthalene	ug/L	0.2	UJ	LCSRPD
SW8270SIM	MW-69-195-002	N006096	Acenaphthene	ug/L	0.2	UJ	LCSRPD
SW8270SIM	MW-69-195-002	N006096	Acenaphthylene	ug/L	0.2	UJ	LCSRPD
SW8270SIM	MW-69-195-002	N006096	Fluorene	ug/L	0.2	UJ	LCSRPD
SW8270C	MW-68-280-004	N006410	Hexachlorobutadiene	ug/L	20	UJ	LCSRPD
SW8270SIM	MW-69-195-002	N006096	Naphthalene	ug/L	0.2	UJ	LCSRPD
SW8270C	MW-68-280-004	N006410	Nitrobenzene	ug/L	10	UJ	LCSRPD
SW8260	MW-64BR-UPR-150-007	N007014	2-Butanone	ug/L	10	UJ	MS<LCL
SW8260	MW-66-165-001	N005957	2-Butanone	ug/L	10	UJ	MS<LCL
SW8260	MW-67-185-005	N006655	2-Butanone	ug/L	10	UJ	MS<LCL
SW8260	MW-67-185-007	N007032	2-Butanone	ug/L	10	UJ	MS<LCL
SW8260	MW-71-035-006	N006859	2-Butanone	ug/L	10	UJ	MS<LCL
SW8260	MW-72-080-004	N006393	2-Butanone	ug/L	10	UJ	MS<LCL
SW8260	MW-60BR-245-003	N006261	Acetone	ug/L	10	UJ	MS<LCL
SW8260	MW-64BR-UPR-150-007	N007014	Acetone	ug/L	10	UJ	MS<LCL
SW8260	MW-66-165-001	N005957	Acetone	ug/L	10	UJ	MS<LCL
SW8260	MW-67-185-005	N006655	Acetone	ug/L	10	UJ	MS<LCL
SW8260	MW-67-185-007	N007032	Acetone	ug/L	10	UJ	MS<LCL
SW8260	MW-72-080-004	N006393	Acetone	ug/L	10	UJ	MS<LCL
SW8260	MW-64BR-UPR-150-007	N007014	Acrolein	ug/L	20	UJ	MS<LCL
SW8260	MW-67-185-005	N006655	Acrolein	ug/L	20	UJ	MS<LCL
SW8260	MW-67-185-007	N007032	Acrolein	ug/L	20	UJ	MS<LCL
SW8260	MW-71-035-006	N006859	Acrolein	ug/L	20	UJ	MS<LCL
SW8260	MW-72-080-004	N006393	Acrolein	ug/L	20	UJ	MS<LCL
SW8260	MW-67-185-005	N006655	Acrylonitrile	ug/L	20	UJ	MS<LCL
SW8260	MW-71-035-006	N006859	Acrylonitrile	ug/L	20	UJ	MS<LCL
SW6020A	BH-66-20104	N005651	Barium, dissolved	ug/L	79	J	MS<LCL
SW6010B	MW-72BR-200-DEV	N008094	Barium, dissolved	ug/L	69	J	MS<LCL

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SW8260	MW-74BR-240-008	N007165	Bromoform	ug/L	1	UJ	MS<LCL
SW6010B	MW-101-007	N007014	Cadmium, dissolved	ug/L	6	UJ	MS<LCL
SW6010B	MW-23-080-007	N007014	Cadmium, dissolved	ug/L	6	UJ	MS<LCL
SW6010B	MW-57-070-009	N007329	Cadmium, dissolved	ug/L	3	UJ	MS<LCL
SW6010B	MW-58BR-UPR-160-009	N007288	Cadmium, dissolved	ug/L	3	UJ	MS<LCL
SW6010B	MW-61-110-007	N007032	Cadmium, dissolved	ug/L	6	UJ	MS<LCL
SW6010B	MW-72BR-200-[148-168]	N008208	Cadmium, dissolved	ug/L	3	UJ	MS<LCL
SW6010B	MW-72BR-200-187a	N008500	Cadmium, dissolved	ug/L	6	UJ	MS<LCL
SW6010B	MW-68-280-004	N006410	Calcium, dissolved	ug/L	340000	J	MS<LCL
SW6020A	BH-66-20104	N005651	Chromium, dissolved	ug/L	7200	J	MS<LCL
SW6020A	MW-23-060-009	N007325	Chromium, dissolved	ug/L	27	J	MS<LCL
SW6010B	MW-101-007	N007014	Cobalt, dissolved	ug/L	6	UJ	MS<LCL
SW6010B	MW-23-080-007	N007014	Cobalt, dissolved	ug/L	6	UJ	MS<LCL
SW6020A	BH-66-20104	N005651	Copper, dissolved	ug/L	1.7	J	MS<LCL
SW6010B	MW-57-070-009	N007329	Copper, dissolved	ug/L	9.8	J	MS<LCL
SW6020A	MW-60BR-245-Dev001_235-245	N006754	Copper, dissolved	ug/L	5	R	MS<LCL
SW6020A	MW-67-225-DUP	N005831	Copper, dissolved	ug/L	1	UJ	MS<LCL
SW6010B	MW-72BR-200-187a	N008500	Copper, dissolved	ug/L	10	UJ	MS<LCL
SW6010B	MW-101-007	N007014	Lead, dissolved	ug/L	20	UJ	MS<LCL
SW6010B	MW-23-080-007	N007014	Lead, dissolved	ug/L	20	UJ	MS<LCL
SW6010B	MW-72BR-200-[148-168]	N008208	Lead, dissolved	ug/L	10	UJ	MS<LCL
SW6010B	MW-71-035-006	N006859	Magnesium, dissolved	ug/L	24000	J	MS<LCL
SW6010B	MW-72BR-200-DEV	N008094	Molybdenum, dissolved	ug/L	77	J	MS<LCL
SW6010B	MW-101-007	N007014	Nickel, dissolved	ug/L	10	UJ	MS<LCL
SW6010B	MW-23-080-007	N007014	Nickel, dissolved	ug/L	10	UJ	MS<LCL
E300.0	MW-23-060-007	N007014	Orthophosphate as P	mg/L	0.5	UJ	MS<LCL
E300.0	MW-58BR-UPR-160-007	N006986	Orthophosphate as P	mg/L	0.5	UJ	MS<LCL
E300.0	MW-60-125-007	N007032	Orthophosphate as P	mg/L	0.2	UJ	MS<LCL
E300.0	MW-64BR-LWR-150-007	N007032	Orthophosphate as P	mg/L	0.5	UJ	MS<LCL
E300.0	MW-65-225-004	N006410	Orthophosphate as P	mg/L	0.5	UJ	MS<LCL
E300.0	MW-66-165-001	N005957	Orthophosphate as P	mg/L	0.1	UJ	MS<LCL
E300.0	MW-66-165-002	N006096	Orthophosphate as P	mg/L	0.1	UJ	MS<LCL
E300.0	MW-66BR-270-008	N007165	Orthophosphate as P	mg/L	0.5	UJ	MS<LCL
E300.0	MW-67-185-005	N006655	Orthophosphate as P	mg/L	0.1	UJ	MS<LCL
E300.0	MW-68-180-004	N006410	Orthophosphate as P	mg/L	0.2	UJ	MS<LCL
E300.0	MW-68-280-005	N006674	Orthophosphate as P	mg/L	0.5	UJ	MS<LCL

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
E300.0	MW-71-035-007_c	N007042	Orthophosphate as P	mg/L	0.2	UJ	MS<LCL
SW6010B	MW-101-007	N007014	Potassium, dissolved	mg/L	52	J	MS<LCL
SW6020A	MW-60BR-245-009	N007337	Selenium, dissolved	ug/L	12	UJ	MS<LCL
SW6020A	MW-60BR-245-Dev003	N006795	Selenium, dissolved	ug/L	17	J	MS<LCL
SW8015-P	MW-66BR-270-008	N007165	TPH-Gasoline	ug/L	100	UJ	MS<LCL
SW6020A	BH-66-20104	N005651	Zinc, dissolved	ug/L	10	UJ	MS<LCL
SW6020A	BH-66-20101	N005647	Barium, dissolved	ug/L	87	J	MS>UCL
SW6010B	MW-61-110-007	N007032	Calcium, dissolved	mg/L	690	J	MS>UCL
SW6010B	MW-72BR-200-187a	N008500	Calcium, dissolved	ug/L	270000	J	MS>UCL
SW6020A	BH-66-20101	N005647	Chromium, dissolved	ug/L	150	J	MS>UCL
SW6020A	MW-101-004	N006410	Chromium, dissolved	ug/L	1100	J	MS>UCL
SW6010B	MW-23-080-007	N007014	Potassium, dissolved	mg/L	51	J	MS>UCL
SW6010B	MW-66-165-001	N005957	Potassium, dissolved	ug/L	21000	J	MS>UCL
SW6010B	MW-67-225	N005831	Potassium, dissolved	mg/L	28	J	MS>UCL
SW6010B	MW-68-280-004	N006410	Sodium, dissolved	ug/L	4300000	J	MS>UCL
SW6020A	MW-23-060-009	N007325	Selenium, dissolved	ug/L	4.5	J	MSRPD
SW6010B	MW-102-007	N007032	Aluminum, dissolved	ug/L	50	UJ	Negative blank
SW6010B	MW-57-070-007	N007032	Aluminum, dissolved	ug/L	50	UJ	Negative blank
SW6010B	MW-59-100-007	N007032	Aluminum, dissolved	ug/L	50	UJ	Negative blank
SW6010B	MW-60-125-007	N007032	Aluminum, dissolved	ug/L	50	UJ	Negative blank
SW6010B	MW-60BR-245-007	N007032	Aluminum, dissolved	ug/L	100	UJ	Negative blank
SW6010B	MW-61-110-007	N007032	Aluminum, dissolved	ug/L	100	UJ	Negative blank
SW6010B	MW-62-065-007	N007014	Aluminum, dissolved	ug/L	50	UJ	Negative blank
SW6010B	MW-62-110-007	N007032	Aluminum, dissolved	ug/L	50	UJ	Negative blank
SW6010B	MW-62-190-007	N007032	Aluminum, dissolved	ug/L	100	UJ	Negative blank
SW6010B	MW-63-065-007	N007014	Aluminum, dissolved	ug/L	270	J	Negative blank
SW6010B	MW-64BR-LWR-150-007	N007032	Aluminum, dissolved	ug/L	100	UJ	Negative blank
SW6010B	MW-64BR-UPR-150-007	N007014	Aluminum, dissolved	ug/L	50	UJ	Negative blank
SW6010B	MW-65-160-007	N007032	Aluminum, dissolved	ug/L	50	UJ	Negative blank
SW6010B	MW-65-225-007	N007032	Aluminum, dissolved	ug/L	50	UJ	Negative blank
SW6010B	MW-66-165-007	N007032	Aluminum, dissolved	ug/L	50	UJ	Negative blank
SW6010B	MW-66-230-007	N007032	Aluminum, dissolved	ug/L	100	UJ	Negative blank
SW6010B	MW-67-185-007	N007032	Aluminum, dissolved	ug/L	50	UJ	Negative blank
SW6010B	MW-67-225-007	N007032	Aluminum, dissolved	ug/L	50	UJ	Negative blank
SW6010B	MW-67-260-007	N007032	Aluminum, dissolved	ug/L	100	UJ	Negative blank
SW6010B	MW-68-180-007	N007032	Aluminum, dissolved	ug/L	50	UJ	Negative blank
SW6010B	MW-68-240-007	N007032	Aluminum, dissolved	ug/L	50	UJ	Negative blank

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SW6010B	MW-68BR-280-007	N007032	Aluminum, dissolved	ug/L	100	UJ	Negative blank
SW6010B	MW-69-195-007	N007032	Aluminum, dissolved	ug/L	50	UJ	Negative blank
SW6010B	MW-70BR-225-007	N007032	Aluminum, dissolved	ug/L	50	UJ	Negative blank
SW6010B	MW-71-035-007_a	N007042	Aluminum, dissolved	ug/L	50	UJ	Negative blank
SW6010B	MW-72-080-007	N007032	Aluminum, dissolved	ug/L	100	UJ	Negative blank
SW6010B	MW-73-080-007	N007032	Aluminum, dissolved	ug/L	50	UJ	Negative blank
SW6010B	MW-58BR-LWR-160-007	N007001	Beryllium, dissolved	ug/L	1	UJ	Negative blank
SW6010B	MW-101-007	N007014	Cobalt, dissolved	ug/L	6	UJ	Negative blank
SW6010B	MW-23-060-007	N007014	Cobalt, dissolved	ug/L	6	UJ	Negative blank
SW6010B	MW-23-080-007	N007014	Cobalt, dissolved	ug/L	6	UJ	Negative blank
SW6010B	MW-57-185-007	N007016	Cobalt, dissolved	ug/L	6	UJ	Negative blank
SW6010B	MW-70-105-007	N007014	Cobalt, dissolved	ug/L	6	UJ	Negative blank
SW6010B	MW-62-065-007	N007014	Iron, dissolved	ug/L	20	UJ	Negative blank
SW6010B	MW-64BR-UPR-150-007	N007014	Iron, dissolved	ug/L	20	UJ	Negative blank
SW6010B	MW-71-035-007_a	N007042	Iron, dissolved	ug/L	20	UJ	Negative blank
SW6010B	MW-101-007	N007014	Nickel, dissolved	ug/L	10	UJ	Negative blank
SW6010B	MW-102-007	N007032	Nickel, dissolved	ug/L	5	UJ	Negative blank
SW6010B	MW-23-060-007	N007014	Nickel, dissolved	ug/L	10	UJ	Negative blank
SW6010B	MW-23-080-007	N007014	Nickel, dissolved	ug/L	10	UJ	Negative blank
SW6010B	MW-57-070-007	N007032	Nickel, dissolved	ug/L	5	UJ	Negative blank
SW6010B	MW-57-185-007	N007016	Nickel, dissolved	ug/L	10	UJ	Negative blank
SW6010B	MW-58BR-LWR-160-007	N007001	Nickel, dissolved	ug/L	5	UJ	Negative blank
SW6010B	MW-59-100-007	N007032	Nickel, dissolved	ug/L	5	UJ	Negative blank
SW6010B	MW-60-125-007	N007032	Nickel, dissolved	ug/L	5	UJ	Negative blank
SW6010B	MW-60BR-245-007	N007032	Nickel, dissolved	ug/L	10	UJ	Negative blank
SW6010B	MW-61-110-007	N007032	Nickel, dissolved	ug/L	10	UJ	Negative blank
SW6010B	MW-62-065-007	N007014	Nickel, dissolved	ug/L	5	UJ	Negative blank
SW6010B	MW-62-110-007	N007032	Nickel, dissolved	ug/L	5	UJ	Negative blank
SW6010B	MW-62-190-007	N007032	Nickel, dissolved	ug/L	10	UJ	Negative blank
SW6010B	MW-63-065-007	N007014	Nickel, dissolved	ug/L	5	UJ	Negative blank
SW6010B	MW-64BR-LWR-150-007	N007032	Nickel, dissolved	ug/L	10	UJ	Negative blank
SW6010B	MW-64BR-UPR-150-007	N007014	Nickel, dissolved	ug/L	5	UJ	Negative blank
SW6010B	MW-65-160-007	N007032	Nickel, dissolved	ug/L	5	UJ	Negative blank
SW6010B	MW-65-225-007	N007032	Nickel, dissolved	ug/L	5	UJ	Negative blank
SW6010B	MW-66-165-007	N007032	Nickel, dissolved	ug/L	5	UJ	Negative blank
SW6010B	MW-66-230-007	N007032	Nickel, dissolved	ug/L	10	UJ	Negative blank
SW6010B	MW-67-185-007	N007032	Nickel, dissolved	ug/L	5	UJ	Negative blank

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SW6010B	MW-67-225-007	N007032	Nickel, dissolved	ug/L	5	UJ	Negative blank
SW6010B	MW-67-260-007	N007032	Nickel, dissolved	ug/L	10	UJ	Negative blank
SW6010B	MW-68-180-007	N007032	Nickel, dissolved	ug/L	5	UJ	Negative blank
SW6010B	MW-68-240-007	N007032	Nickel, dissolved	ug/L	5	UJ	Negative blank
SW6010B	MW-68BR-280-007	N007032	Nickel, dissolved	ug/L	10	UJ	Negative blank
SW6010B	MW-69-195-007	N007032	Nickel, dissolved	ug/L	5	UJ	Negative blank
SW6010B	MW-70-105-007	N007014	Nickel, dissolved	ug/L	10	UJ	Negative blank
SW6010B	MW-70BR-225-007	N007032	Nickel, dissolved	ug/L	5	UJ	Negative blank
SW6010B	MW-71-035-007_a	N007042	Nickel, dissolved	ug/L	5	UJ	Negative blank
SW6010B	MW-72-080-007	N007032	Nickel, dissolved	ug/L	10	UJ	Negative blank
SW6010B	MW-73-080-007	N007032	Nickel, dissolved	ug/L	5	UJ	Negative blank
SW6010B	MW-60BR-245-007	N007032	Silver, dissolved	ug/L	6	UJ	Negative blank
SW6010B	MW-62-190-007	N007032	Silver, dissolved	ug/L	6	UJ	Negative blank
SW6010B	MW-64BR-LWR-150-007	N007032	Silver, dissolved	ug/L	6	UJ	Negative blank
SW6010B	MW-66-230-007	N007032	Silver, dissolved	ug/L	6	UJ	Negative blank
SW6010B	MW-67-260-007	N007032	Silver, dissolved	ug/L	6	UJ	Negative blank
SW6010B	MW-68BR-280-007	N007032	Silver, dissolved	ug/L	6	UJ	Negative blank
SW6010B	MW-72-080-007	N007032	Silver, dissolved	ug/L	6	UJ	Negative blank
SW8151	MW-101-005	N006655	MCPP	ug/L	7.8	J	No CF
SW8151	MW-60BR-245-003	N006261	MCPP	ug/L	28	J	No CF
SW8151	MW-67-185-005	N006655	MCPP	ug/L	9.7	J	No CF
SW8151	MW-101-005	N006655	2,4-D	ug/L	0.08	UJ	NoLCS
SW8151	MW-60BR-245-003	N006261	2,4-D	ug/L	0.08	UJ	NoLCS
SW8151	MW-67-185-005	N006655	2,4-D	ug/L	0.08	UJ	NoLCS
SW8151	MW-101-005	N006655	2,4-DB	ug/L	0.2	UJ	NoLCS
SW8151	MW-60BR-245-003	N006261	2,4-DB	ug/L	0.08	UJ	NoLCS
SW8151	MW-67-185-005	N006655	2,4-DB	ug/L	0.2	UJ	NoLCS
SW8151	MW-60BR-245-003	N006261	4-Nitrophenol	ug/L	0.1	UJ	NoLCS
SW8151	MW-101-005	N006655	Dalapon	ug/L	0.3	UJ	NoLCS
SW8151	MW-60BR-245-003	N006261	Dalapon	ug/L	0.3	UJ	NoLCS
SW8151	MW-67-185-005	N006655	Dalapon	ug/L	0.3	UJ	NoLCS
SW8151	MW-101-005	N006655	Dicamba	ug/L	0.08	UJ	NoLCS
SW8151	MW-60BR-245-003	N006261	Dicamba	ug/L	0.08	UJ	NoLCS
SW8151	MW-67-185-005	N006655	Dicamba	ug/L	0.08	UJ	NoLCS
SW8151	MW-101-005	N006655	MCPA	ug/L	2	UJ	NoLCS
SW8151	MW-60BR-245-003	N006261	MCPA	ug/L	0.08	UJ	NoLCS
SW8151	MW-67-185-005	N006655	MCPA	ug/L	2	UJ	NoLCS
SW8151	MW-101-005	N006655	MCPP	ug/L	7.8	J	NoLCS

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SW8151	MW-67-185-005	N006655	MCPP	ug/L	9.7	J	NoLCS
SW8151	MW-60BR-245-003	N006261	Pentachlorophenol	ug/L	0.08	UJ	NoLCS
SW8260	MW-60BR-245-003	N006261	1,2,4-Trimethylbenzene	ug/L	1	UJ	SD<LCL
SW8260	MW-71-035-006	N006859	1,2-Dibromoethane	ug/L	1	UJ	SD<LCL
SW8260	MW-64BR-UPR-150-007	N007014	2-Butanone	ug/L	10	UJ	SD<LCL
SW8260	MW-66-165-001	N005957	2-Butanone	ug/L	10	UJ	SD<LCL
SW8260	MW-67-185-005	N006655	2-Butanone	ug/L	10	UJ	SD<LCL
SW8260	MW-67-185-007	N007032	2-Butanone	ug/L	10	UJ	SD<LCL
SW8260	MW-71-035-006	N006859	2-Butanone	ug/L	10	UJ	SD<LCL
SW8260	MW-72-080-004	N006393	2-Butanone	ug/L	10	UJ	SD<LCL
SW8260	MW-60BR-245-003	N006261	Acetone	ug/L	10	UJ	SD<LCL
SW8260	MW-64BR-UPR-150-007	N007014	Acetone	ug/L	10	UJ	SD<LCL
SW8260	MW-66-165-001	N005957	Acetone	ug/L	10	UJ	SD<LCL
SW8260	MW-67-185-005	N006655	Acetone	ug/L	10	UJ	SD<LCL
SW8260	MW-67-185-007	N007032	Acetone	ug/L	10	UJ	SD<LCL
SW8260	MW-71-035-006	N006859	Acetone	ug/L	10	UJ	SD<LCL
SW8260	MW-72-080-004	N006393	Acetone	ug/L	10	UJ	SD<LCL
SW8260	MW-64BR-UPR-150-007	N007014	Acrolein	ug/L	20	UJ	SD<LCL
SW8260	MW-66-165-001	N005957	Acrolein	ug/L	20	UJ	SD<LCL
SW8260	MW-67-185-007	N007032	Acrolein	ug/L	20	UJ	SD<LCL
SW8260	MW-71-035-006	N006859	Acrolein	ug/L	20	UJ	SD<LCL
SW8260	MW-64BR-UPR-150-007	N007014	Acrylonitrile	ug/L	20	UJ	SD<LCL
SW8260	MW-71-035-006	N006859	Acrylonitrile	ug/L	20	UJ	SD<LCL
SW6020A	BH-66-20101	N005647	Barium, dissolved	ug/L	87	J	SD<LCL
SW6010B	MW-72BR-200-DEV	N008094	Barium, dissolved	ug/L	69	J	SD<LCL
SW6010B	MW-101-007	N007014	Cadmium, dissolved	ug/L	6	UJ	SD<LCL
SW6010B	MW-23-080-007	N007014	Cadmium, dissolved	ug/L	6	UJ	SD<LCL
SW6010B	MW-57-070-009	N007329	Cadmium, dissolved	ug/L	3	UJ	SD<LCL
SW6010B	MW-58BR-UPR-160-009	N007288	Cadmium, dissolved	ug/L	3	UJ	SD<LCL
SW6010B	MW-61-110-007	N007032	Cadmium, dissolved	ug/L	6	UJ	SD<LCL
SW6010B	MW-72BR-200-[148-168]	N008208	Cadmium, dissolved	ug/L	3	UJ	SD<LCL
SW6010B	MW-68-280-004	N006410	Calcium, dissolved	ug/L	340000	J	SD<LCL
SW6020A	BH-66-20104	N005651	Chromium, dissolved	ug/L	7200	J	SD<LCL
SW6020A	MW-23-060-009	N007325	Chromium, dissolved	ug/L	27	J	SD<LCL
SW6010B	MW-101-007	N007014	Cobalt, dissolved	ug/L	6	UJ	SD<LCL
SW6010B	MW-23-080-007	N007014	Cobalt, dissolved	ug/L	6	UJ	SD<LCL

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SW6020A	BH-66-20104	N005651	Copper, dissolved	ug/L	1.7	J	SD<LCL
SW6010B	MW-57-070-009	N007329	Copper, dissolved	ug/L	9.8	J	SD<LCL
SW6020A	MW-60BR-245-Dev001_235-245	N006754	Copper, dissolved	ug/L	5	R	SD<LCL
SW6010B	MW-72BR-200-187a	N008500	Copper, dissolved	ug/L	10	UJ	SD<LCL
SW6010B	MW-101-007	N007014	Iron, dissolved	ug/L	40	UJ	SD<LCL
SW6010B	MW-23-080-007	N007014	Iron, dissolved	ug/L	40	UJ	SD<LCL
SW6010B	MW-101-007	N007014	Lead, dissolved	ug/L	20	UJ	SD<LCL
SW6010B	MW-23-080-007	N007014	Lead, dissolved	ug/L	20	UJ	SD<LCL
SW6010B	MW-71-035-006	N006859	Magnesium, dissolved	ug/L	24000	J	SD<LCL
SW6010B	MW-72BR-200-DEV	N008094	Molybdenum, dissolved	ug/L	77	J	SD<LCL
SW6010B	MW-101-007	N007014	Nickel, dissolved	ug/L	10	UJ	SD<LCL
SW6010B	MW-23-080-007	N007014	Nickel, dissolved	ug/L	10	UJ	SD<LCL
E300.0	MW-23-060-007	N007014	Orthophosphate as P	mg/L	0.5	UJ	SD<LCL
E300.0	MW-58BR-UPR-160-007	N006986	Orthophosphate as P	mg/L	0.5	UJ	SD<LCL
E300.0	MW-60-125-007	N007032	Orthophosphate as P	mg/L	0.2	UJ	SD<LCL
E300.0	MW-64BR-LWR-150-007	N007032	Orthophosphate as P	mg/L	0.5	UJ	SD<LCL
E300.0	MW-65-225-004	N006410	Orthophosphate as P	mg/L	0.5	UJ	SD<LCL
E300.0	MW-66-165-001	N005957	Orthophosphate as P	mg/L	0.1	UJ	SD<LCL
E300.0	MW-66-165-002	N006096	Orthophosphate as P	mg/L	0.1	UJ	SD<LCL
E300.0	MW-66BR-270-008	N007165	Orthophosphate as P	mg/L	0.5	UJ	SD<LCL
E300.0	MW-67-185-005	N006655	Orthophosphate as P	mg/L	0.1	UJ	SD<LCL
E300.0	MW-68-180-004	N006410	Orthophosphate as P	mg/L	0.2	UJ	SD<LCL
E300.0	MW-68-280-005	N006674	Orthophosphate as P	mg/L	0.5	UJ	SD<LCL
E300.0	MW-71-035-007_c	N007042	Orthophosphate as P	mg/L	0.2	UJ	SD<LCL
SW6010B	MW-101-007	N007014	Potassium, dissolved	mg/L	52	J	SD<LCL
SW6020A	MW-60BR-245-Dev003	N006795	Selenium, dissolved	ug/L	17	J	SD<LCL
SW8260	MW-60BR-245-003	N006261	Styrene	ug/L	1	UJ	SD<LCL
SW8015-E	MW-66-165-001	N005957	TPH-Diesel	ug/L	51	UJ	SD<LCL
SW6020A	BH-66-20104	N005651	Zinc, dissolved	ug/L	10	UJ	SD<LCL
SW6010B	MW-72BR-200-187a	N008500	Calcium, dissolved	ug/L	270000	J	SD>UCL
SW6020A	BH-66-20101	N005647	Chromium, dissolved	ug/L	150	J	SD>UCL
SW6020A	MW-101-004	N006410	Chromium, dissolved	ug/L	1100	J	SD>UCL
SW6010B	MW-23-080-007	N007014	Potassium, dissolved	mg/L	51	J	SD>UCL
SW6010B	MW-66-165-001	N005957	Potassium, dissolved	ug/L	21000	J	SD>UCL
SW6010B	MW-67-225	N005831	Potassium, dissolved	mg/L	28	J	SD>UCL
SW6010B	MW-68-280-004	N006410	Sodium, dissolved	ug/L	4300000	J	SD>UCL
SW6010B	MW-68-280-005	N006674	Magnesium, dissolved	ug/L	5500	J	SerDil

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SW6010B	MW-72BR-200-187a	N008500	Magnesium, dissolved	ug/L	3100	J	SerDil
SW6010B	MW-72BR-200-187a	N008500	Potassium, dissolved	ug/L	39000	J	SerDil
SW6010B	MW-23-080-007	N007014	Sodium, dissolved	mg/L	3100	J	SerDil
SW6010B	MW-68-280-005	N006674	Sodium, dissolved	ug/L	4300000	J	SerDil
SW6010B	MW-70-105-004	N006393	Sodium, dissolved	ug/L	460000	J	SerDil
SW6010B	MW-60BR-245-Dev003	N006795	Zinc, dissolved	ug/L	340	J	SerDil
SW8270C	MW-73-080-006	N006834	1,2,4-Trichlorobenzene	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	1,2-Dichlorobenzene	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	1,3-Dichlorobenzene	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	1,4-Dichlorobenzene	ug/L	10	UJ	Sur<LCL
SW8151	MW-65-160-001	N005957	2,4,5-T	ug/L	0.06	UJ	Sur<LCL
SW8151	MW-65-160-001	N005957	2,4,5-TP (Silvex)	ug/L	0.05	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	2,4,5-Trichlorophenol	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	2,4,6-Trichlorophenol	ug/L	10	UJ	Sur<LCL
SW8151	MW-65-160-001	N005957	2,4-D	ug/L	0.04	UJ	Sur<LCL
SW8151	MW-65-160-001	N005957	2,4-DB	ug/L	0.2	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	2,4-Dichlorophenol	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	2,4-Dimethylphenol	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	2,4-Dinitrophenol	ug/L	50	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	2,4-Dinitrotoluene	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	2,6-Dinitrotoluene	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	2-Chloronaphthalene	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	2-Chlorophenol	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	2-Methylnaphthalene	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	2-Methylphenol	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	2-Nitroaniline	ug/L	50	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	2-Nitrophenol	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	3,3-┤ -Dichlorobenzidine	ug/L	20	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	3-Nitroaniline	ug/L	50	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	4,6-Dinitro-2-methylphenol	ug/L	50	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	4-Bromophenyl-phenylether	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	4-Chloro-3-methylphenol	ug/L	50	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	4-Chloroaniline	ug/L	20	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	4-Chlorophenyl-phenylether	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	4-Methylphenol	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	4-Nitroaniline	ug/L	20	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	4-Nitrophenol	ug/L	50	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Acenaphthene	ug/L	10	UJ	Sur<LCL

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SW8270C	MW-73-080-006	N006834	Acenaphthylene	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Anthracene	ug/L	10	UJ	Sur<LCL
SW8082	MW-71-035-009B	N007345	Aroclor 1016	ug/L	0.66	UJ	Sur<LCL
SW8082	MW-74BR-240-008	N007165	Aroclor 1016	ug/L	0.6	UJ	Sur<LCL
SW8082	MW-71-035-009B	N007345	Aroclor 1221	ug/L	1.3	UJ	Sur<LCL
SW8082	MW-74BR-240-008	N007165	Aroclor 1221	ug/L	1.2	UJ	Sur<LCL
SW8082	MW-71-035-009B	N007345	Aroclor 1232	ug/L	0.66	UJ	Sur<LCL
SW8082	MW-74BR-240-008	N007165	Aroclor 1232	ug/L	0.6	UJ	Sur<LCL
SW8082	MW-71-035-009B	N007345	Aroclor 1242	ug/L	0.66	UJ	Sur<LCL
SW8082	MW-74BR-240-008	N007165	Aroclor 1242	ug/L	0.6	UJ	Sur<LCL
SW8082	MW-71-035-009B	N007345	Aroclor 1248	ug/L	0.66	UJ	Sur<LCL
SW8082	MW-74BR-240-008	N007165	Aroclor 1248	ug/L	0.6	UJ	Sur<LCL
SW8082	MW-71-035-009B	N007345	Aroclor 1254	ug/L	0.66	UJ	Sur<LCL
SW8082	MW-74BR-240-008	N007165	Aroclor 1254	ug/L	0.6	UJ	Sur<LCL
SW8082	MW-71-035-009B	N007345	Aroclor 1260	ug/L	0.66	UJ	Sur<LCL
SW8082	MW-74BR-240-008	N007165	Aroclor 1260	ug/L	0.6	UJ	Sur<LCL
SW8082	MW-74BR-240-008	N007165	Aroclor 1262	ug/L	0.6	UJ	Sur<LCL
SW8082	MW-74BR-240-008	N007165	Aroclor 1268	ug/L	0.6	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Benzo(a)anthracene	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Benzo(a)pyrene	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Benzo(b)fluoranthene	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Benzo(g,h,i)perylene	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Benzo(k)fluoranthene	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Benzoic acid	ug/L	50	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Benzyl alcohol	ug/L	20	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Bis(2-chloroethoxy)methane	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Bis(2-chloroethyl)ether	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Bis(2-chloroisopropyl)ether	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Bis(2-ethylhexyl)phthalate	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Butylbenzylphthalate	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Chrysene	ug/L	10	UJ	Sur<LCL
SW8151	MW-65-160-001	N005957	Dalapon	ug/L	0.02	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Dibenz(a,h)anthracene	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Dibenzofuran	ug/L	10	UJ	Sur<LCL
SW8151	MW-65-160-001	N005957	Dicamba	ug/L	0.03	UJ	Sur<LCL
SW8151	MW-65-160-001	N005957	Dichlorprop	ug/L	0.04	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Diethylphthalate	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Dimethylphthalate	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Di-n-butylphthalate	ug/L	10	UJ	Sur<LCL

Table 3A

Data Qualification Summary

East Ravine Groundwater Monitoring Samples

Method	Sample ID	COC Number	Analyte	Units	Final Result	Final Validation Flag[1]	Validation Reason
SW8270C	MW-73-080-006	N006834	Di-n-octylphthalate	ug/L	10	UJ	Sur<LCL
SW8151	MW-65-160-001	N005957	Dinoseb	ug/L	0.05	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Fluoranthene	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Fluorene	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Hexachlorobenzene	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Hexachlorobutadiene	ug/L	20	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Hexachloroethane	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Indeno(1,2,3-cd)pyrene	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Isophorone	ug/L	10	UJ	Sur<LCL
SW8151	MW-65-160-001	N005957	MCPA	ug/L	10	UJ	Sur<LCL
SW8151	MW-65-160-001	N005957	MCPP	ug/L	8	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Naphthalene	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Nitrobenzene	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	N-Nitrosodi-n-propylamine	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	N-Nitrosodiphenylamine	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Pentachlorophenol	ug/L	50	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Phenanthrene	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Phenol	ug/L	10	UJ	Sur<LCL
SW8270C	MW-73-080-006	N006834	Pyrene	ug/L	10	UJ	Sur<LCL
SW8015-E	MW-65-160	N005815	TPH-Diesel	ug/L	51	UJ	Sur<LCL
SW8015-E	MW-65-160	N005815	TPH-Motor Oil	ug/L	51	UJ	Sur<LCL
SW8015-E	MW-74BR-240-008	N007165	TPH-Diesel	ug/L	490	J	Sur>UCL
SW8015-E	MW-74BR-240-008	N007165	TPH-Motor Oil	ug/L	580	J	Sur>UCL
E218.6	MW-66BR-270-008	N007165	Hexavalent Chromium	ug/L	1	U	ValAdj
E218.6	MW-66BR-270-009	N007445	Hexavalent Chromium	ug/L	1	U	ValAdj
E218.6	MW-66BR-270-Dev001	N006755	Hexavalent Chromium	ug/L	5	U	ValAdj
E218.6	MW-68-280-004	N006408	Hexavalent Chromium	ug/L	5	U	ValAdj
E218.6	MW-68-280-005	N006674	Hexavalent Chromium	ug/L	5	U	ValAdj
E218.6	MW-68BR-280-007	N007032	Hexavalent Chromium	ug/L	5	U	ValAdj
E218.6	MW-71-035-007_a	N007042	Hexavalent Chromium	ug/L	1	U	ValAdj
E218.6	MW-71-35-Dev001	N006755	Hexavalent Chromium	ug/L	1	U	ValAdj

[1] This is the final qualifier flag for this analyte/method combination. If more than one flag was applied, this is the most conservative.

Validation Flags:

J = Analyte was present but the reported value might not be accurate or precise (estimated).

UJ = Analyte was not detected and the specified detection limit might not be accurate or precise (estimated).

R = Data were unusable due to deficiencies in the ability to analyze the sample and meet QC criteria (rejected).

U = Analyte was not detected at the specified detection limit.

Validation Reasons:

CCB>RL = Continuing calibration blank target concentration greater than the reporting limit.

CCV<LCL = Continuing calibration recovery less than lower control limit.

CCV<UCL = Continuing calibration recovery greater than upper control limit.

Cr+6>Cr = Hexavalent Chromium concentration greater than the Chromium concentration by a relative percent difference of more than 20 percent .

FD>RPD = Field duplicate's relative percent difference is greater than the control limit.

HTp>UCL = Sample extraction holding time exceeded the upper control limit.

ICB>RL = Initial calibration blank target concentration greater than the reporting limit.

ICVS<LCL = Second source verification standard recovery, less than lower control limit.

IS<LCL = Internal standard recovery, less than lower control limit.

LabA&P = Laboratory accuracy and precision criteria not met.

LB>RL = Laboratory blank target concentration greater than the reporting limit.

LCS<LCL = Laboratory Control Sample recovery less than the lower control limit.

LCSRPD = Laboratory Control Sample duplicate's relative percent difference is greater than the control limit.

MS<LCL = Matrix spike recovery less than lower control limit.

MS>UCL = Matrix spike recovery greater than upper control limit.

MSRPD = Relative percent difference between matrix spike and matrix spike duplicate greater than control limit.

Negative Blank = Blanks with negative results where the absolute values are greater than the RL.

No CF = No confirmation results were provided

NoLCS = No Laboratory Control Sample results were provided for this sample result.

SD<LCL = Matrix spike duplicate recovery less than lower control limit.

SD>UCL = Matrix spike duplicate recovery greater than upper control limit.

SerDil = Dilution test is greater than 10% RPD.

Sur<LCL = Surrogate recovery less than lower control limit.

Sur>UCL = Surrogate recovery greater than upper control limit.

ValAdj = Value reported by laboratory adjusted due to matrix issues.

Attachment F
Agency Comments

Cavaliere, Mike/BAO

From: Innis, Pamela [pamela_innis@ios.doi.gov]
Sent: Friday, February 15, 2013 12:56 PM
To: Yvonne Meeks; Hong, Christina/LAC; Cavaliere, Mike/BAO; Sheets, Keith/PDX; Barackman, Martin/RDD
Cc: Baker, Karen@DTSC; Aaron Yue; Chris Guerre; Rick Newill
Subject: DOI/DTSC comments on the Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation
Attachments: ER-TCS Addendum DOI_DTSC comments.docx

DOI and DTSC have reviewed the *Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation* and our combined comments are attached.

--
Pamela S. Innis
DOI Topock Remedial Project Manager
U.S. Department of the Interior
Office of Environmental Policy and Compliance
P.O. Box 25007, MS D108
Denver, CO 80225-0007
Voice: 303.445.2502
Fax: 303.445.6320
Cell: 303.501.5685

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The Department of the Interior (DOI) and the Department of Toxic Substances Control (DTSC) have reviewed the *Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation, Pacific Gas and Electronic Company, Topock Compressor Station, Needles, California* submitted by PG&E on November 15, 2012. While the addendum summarizes the work performed in Phase 2 of the investigation, it was our expectation that the resulting report would expand on the original document and provide a more inclusive evaluation of the combined information from the two phases of the East Ravine - Topock Compressor Station investigation. To that end, we have developed general comments highlighting the main revisions that are expected in the document followed by several focused comments concerning the document identified during our cursory review. It is our expectation that a comprehensive review will occur after the document is revised and provided with the 60% design submittal.

General Comments:

All tables should be expanded to include data from both the Phase 1 and 2 groundwater studies. The table should distinguish between data from each phase using shading or some other format.

Figures 2-1 through 3-5 should show all of the Phase 1 and 2 well numbers and letter identifiers (Add identifiers for Sites A, B, C, C-alt, E, E-alt2, and G).

The text is inconsistent in the use of site terminology and well numbers. The well numbering was sequential with the time of installation and does not facilitate locating the wells in the discussion. The reader is left to continually be looking up well numbers on the map to find out the location of a particular discussion. It would facilitate the review if the text consistently referred to both Site names (Site A, etc) and specific well numbers throughout.

A set of three groundwater results maps are provided, showing only the most recent results and breaking the results up by upper, middle and lower intervals. The maps also depict the entire plume area, rather than focusing on the East Ravine and TCS. The presentation of separate shallow, middle and deep maps for the bedrock wells does not have the utility it did for the alluvial aquifer. Also, presenting only the last round of results masks some higher concentrations that were present in nearly as recent results. It is recommended that PG&E provide a set of groundwater results maps that are focused on the East Ravine and TCS area, provide a separate map for each round of sampling, and depict all depth results on each map.

A figure should be included that provides the results of the soil sampling.

Currently, the ER-TCS report compares only to health-based screening levels. Although this information may be used in the future as part of the Soil RI and Soil Risk Assessment, it should not be focus of the evaluation in the ER-TCS groundwater addendum. It is our expectation that PG&E use the soil work plan DQO (Decision 3 – Impacts to Groundwater) developed for determining a threat to groundwater and that the associated screening levels are used for the comparison and evaluation.

Specific comments noted from preliminary review of report:

Page 1, Summary of Key Findings, Item 1, Figures 3-1 to 3-5.

Cross-section Assessment. Include color coding or contours to depict chromium groundwater concentrations on the cross sections. This will aide in visualizing the extent of contamination and potential source areas.

Extend Cross-Section A-A' in both directions. To the northwest, add MW-24 bench/MW-11 data to extend views of bedrock/alluvial characterization. Suggest adding the MW-40 cluster as it lines up on the section as well. To the south, extend the line to the south to assist in emphasizing that the extent of contamination to the south is unknown.

Add a ross-section parallel to shoreline similar to the physical model to illustrate where contamination does and doesn't reside adjacent to the river.

Move cross-section B-B' to East Ravine proper where well data are concentrated. PG&E concludes on Page 2 that this is the axis of groundwater flow in the area. Include, at a minimum, wells MW-74, MW-70 cluster, MW-58 cluster, MW-57 cluster, and MW-62 cluster.

Figure 3-1: The Phase 2 bedrock contact is not plotted properly in the vicinity of Site 4. Please revise.

Page 1, Summary of Key Findings, Item 2, Groundwater Occurrence in Bedrock

The section concludes that groundwater in bedrock occurs in widely spaced discrete fractures and the bulk rock matrix does not transmit water. Noting this, PG&E should develop an appropriate groundwater model for fractured bedrock and transition to it as part of remedy development and long-term monitoring of the remedy. The continued use of a conventional porous medium model over the lifetime of this project is not appropriate.

Page 2, Summary of Key Findings, Item 3, Refined Extent of Cr(VI) in Groundwater

Include the chromium plume boundary ("blue line" on other PG&E site wide figures) on map views that focus on the East Ravine/Topock Compressor Station (e.g., Figure 1). PG&E should provide some discussion on the plume boundaries especially where the boundary should be dashed/queried. For instance, include text indicating that the extent of contamination south of well MW-60 is not defined. Suggest adding language why PG&E believes that additional characterization is not necessary beyond dashed/queried areas.

Figures 3-6 to 3-8 are at an inappropriate scale as they do not focus on the Compressor Station and East Ravine data. Utilize a scale similar to Figure 3-1 or 3-11 (one inch equals 400' to 500') and move the Compressor Station to near the center of the figure. Are data plotted correctly on Figures 3-6 to 3-8? (e.g., MW-70BR-225 is plotted on the shallow zone figure; MW-67-225 is plotted in the mid-depth; MW-62-110 is plotted as a deep well).

a) East Ravine Area. The section compares bedrock chromium concentration to "background". As background bedrock concentrations do not exist for the Topock site, the text throughout the document should reference the Topock chromium cleanup number of 32 ppb and should provide the rationale for use of the cleanup number as an appropriate limit for bedrock evaluation.

a) East Ravine Area. The section concludes, "The results of the soil samples collected do not suggest a contamination source in the vadose zone". PG&E should assess the source issue comprehensively and look at multiple lines of evidence (e.g., soil data, groundwater data, historic usage, aerial photo interpretations, etc.) in drawing such conclusions which must be supported by sufficient data and evaluation. Furthermore, it is uncertain if the entire AOC 10 data set was evaluated and what type of evaluation was actually conducted in the report.

b) TCS Site. This section should note that the highest chromium concentrations in the Topock area have been detected under the Compressor Station. The section concludes, "…the results of the soil samples collected do not suggest a contamination source in the vadose zone". This statement is currently unsupported as the majority of the soil borings were not well located beneath potential source areas and since the majority of the station has not been characterized for residual soil contamination that may threaten groundwater. With minimal vadose zone data, it is DTSC's position that conclusions regarding potential vadose zone sources cannot be made with any certainty at this time. It is understood that groundwater contamination may suggest a current or historic source of vadose zone contamination.

Page 6, Section 2.4, Monitoring Well Installation and Development: Describe the grout discharge that occurred at the surface away from one well (Site F?) and what was believed to have happened that caused the unusual occurrence.

Page 7, Section 2.5, Borehole Flow Testing: Include the RAS, Inc. hydrophysical testing reports as an attachment to ER/TCS Report.

Page 8, Groundwater Monitoring Well Sampling: Include additional, available groundwater data collected since the November 2012 ER/TCS Report was prepared.

Page 8, Section 2.8, Investigation-Derived Waste Management: The report should discuss the nature and source of the organics contained in the liquids that were treated at LES in Arizona.

Page 9, Section 2.8, Investigation-Derived Waste Management: The report should clarify the nature and source of the organics contained in drill cuttings that were disposed of in Nevada.

Page 13, Section 3.5.1 Distribution of Chromium and Field Measurements: The section begins by mentioning well MW-68-180 and cites the high chromium concentration of 22,000 ppb and that it had lowered in more recent sampling events. It would be important to provide a hypothesis for such changes. Could it be due to sampling method (e.g., different purge volumes or duration), well development, etc.?

Page 14, Section 3.5.2 Sample Results for Nonchromium Contaminants: Figures should be prepared to easily evaluate the distribution of molybdenum, selenium, nitrate, arsenic, and fluoride.

Page 14, Section 3.5.3 Sample Results for Additional Constituents: Evaluate all data including general minerals data. Recall that lower TDS groundwater occurs in shallow wells located within the East Ravine wash proper and may suggest that fresher, cleaner, water has infiltrated and "washed" the shallow zone in the wash area and could explain why the Site F shallow well still exhibits elevated chromium. From a remedy standpoint, this suggests that flushing (or extraction) could work in the East Ravine.

Page 17, Data Quality Evaluation Summary: Include a summary discussion in this section as it currently only references Attachment E.

Page 17, Section 4, Refinements to the Topock Conceptual Site Model: Indicate that the new groundwater data exhibit elevated nitrate under the compressor station and may suggest the station is/was a source.

Summary of March 15, 2013 Call Regarding Agency Comments on Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation, Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

Comment No.	Section	Comment	Key Clarification/Resolution Items from March 15, 2013 Call
1		All tables should be expanded to include data from both the Phase 1 and 2 groundwater studies. The table should distinguish between data from each phase using shading or some other format.	None.
2		Figures 2-1 through 3-5 should show all of the Phase 1 and 2 well numbers and letter identifiers (Add identifiers for Sites A, B, C, C-alt, E, E-alt2, and G).	None.
3		The text is inconsistent in the use of site terminology and well numbers. The well numbering was sequential with the time of installation and does not facilitate locating the wells in the discussion. The reader is left to continually be looking up well numbers on the map to find out the location of a particular discussion. It would facilitate the review if the text consistently referred to both Site names (Site A, etc) and specific well numbers throughout.	None.
4		A set of three groundwater results maps are provided, showing only the most recent results and breaking the results up by upper, middle and lower intervals. The maps also depict the entire plume area, rather than focusing on the East Ravine and TCS. The presentation of separate shallow, middle and deep maps for the bedrock wells does not have the utility it did for the alluvial aquifer. Also, presenting only the last round of results masks some higher concentrations that were present in nearly as recent results. It is recommended that PG&E provide a set of groundwater results maps that are focused on the East Ravine and TCS area, provide a separate map for each round of sampling, and depict all depth results on each map.	The group discussed and agreed that average concentrations (with reference minimum and maximum concentrations) should be used to present key water quality constituents since individual events are summarized in the various groundwater monitoring program reports.
5		A figure should be included that provides the results of the soil sampling.	The group confirmed that this figure should focus on samples collected during Phases 1 and 2 of this investigation.
6		Currently, the ER-TCS report compares only to health-based screening levels. Although this information may be used in the future as part of the Soil RI and Soil Risk Assessment, it should not be focus of the evaluation in the ER-TCS groundwater addendum. It is our expectation that PG&E use the soil work plan DQO (Decision 3 – Impacts to Groundwater) developed for determining a threat to groundwater and that the associated screening levels are used for the comparison and evaluation.	The group agreed that discussion of soil data should be kept to high level data presentation of the soil data collected during Phases 1 and 2 of this investigation.

Comment No.	Section	Comment	Key Clarification/Resolution Items from March 15, 2013 Call
7	**Page 1, Summary of Key Findings, Item 1, Figures 3-1 to 3-5**	Cross-section Assessment. Include color coding or contours to depict chromium groundwater concentrations on the cross sections. This will aide in visualizing the extent of contamination and potential source areas.	The group agreed that average concentrations should also be used on the cross-sections.
8		Extend Cross-Section A-A' in both directions. To the northwest, add MW-24 bench/MW-11 data to extend views of bedrock/alluvial characterization. Suggest adding the MW-40 cluster as it lines up on the section as well. To the south, extend the line to the south to assist in emphasizing that the extent of contamination to the south is unknown.	The agencies clarified that the main point of these edits are to show that characterization is not complete to the south.
9		Add a cross-section parallel to shoreline similar to the physical model to illustrate where contamination does and doesn't reside adjacent to the river.	The agencies indicated that the new section should extend from Site I to K to MW-63 to MW-23, and should stop near the extent of the ER-TCS area (i.e., could be ended at MW-22).
10		Move cross-section B-B' to East Ravine proper where well data are concentrated. PG&E concludes on Page 2 that this is the axis of groundwater flow in the area. Include, at a minimum, wells MW-74, MW-70 cluster, MW-58 cluster, MW-57 cluster, and MW-62 cluster.	None.
11		Figure 3-1: The Phase 2 bedrock contact is not plotted properly in the vicinity of Site 4. Please revise.	None.
12	**Page 1, Summary of Key Findings, Item 2, Groundwater Occurrence in Bedrock**	The section concludes that groundwater in bedrock occurs in widely spaced discrete fractures and the bulk rock matrix does not transmit water. Noting this, PG&E should develop an appropriate groundwater model for fractured bedrock and transition to it as part of remedy development and long-term monitoring of the remedy. The continued use of a conventional porous medium model over the lifetime of this project is not appropriate.	The agencies agreed that modifications could be made to the existing groundwater model to address this comment. Text will be added to the document that describes the changes being made to the model based on the findings of the ER-TCS investigation.
13	**Page 2, Summary of Key Findings, Item 3, Refined Extent of Cr(VI) in Groundwater**	Include the chromium plume boundary ("blue line" on other PG&E site wide figures) on map views that focus on the East Ravine/Topock Compressor Station (e.g., Figure 1). PG&E should provide some discussion on the plume boundaries especially where the boundary should be dashed/queried. For instance, include text indicating that the extent of contamination south of well MW-60 is not defined. Suggest adding language why PG&E believes that additional characterization is not necessary beyond dashed/queried areas.	None.
14		Figures 3-6 to 3-8 are at an inappropriate scale as they do not focus on the Compressor Station and East Ravine data. Utilize a scale similar to Figure 3-1 or 3-11 (one inch equals 400' to 500') and move the Compressor Station to near the center of the figure. Are data plotted correctly on Figures 3-6 to 3-8? (e.g., MW-70BR-225 is plotted on the shallow zone figure; MW-67-225 is plotted in the mid-depth; MW-62-110 is plotted as a deep well).	None.

Comment No.	Section	Comment	Key Clarification/Resolution Items from March 15, 2013 Call
15		a) East Ravine Area. The section compares bedrock chromium concentration to "background". As background bedrock concentrations do not exist for the Topock site, the text throughout the document should reference the Topock chromium cleanup number of 32 ppb and should provide the rationale for use of the cleanup number as an appropriate limit for bedrock evaluation.	None.
16		a) East Ravine Area. The section concludes, "The results of the soil samples collected do not suggest a contamination source in the vadose zone". PG&E should assess the source issue comprehensively and look at multiple lines of evidence (e.g., soil data, groundwater data, historic usage, aerial photo interpretations, etc.) in drawing such conclusions which must be supported by sufficient data and evaluation. Furthermore, it is uncertain if the entire AOC 10 data set was evaluated and what type of evaluation was actually conducted in the report.	The group agreed that the soil discussion should be focused on samples collected during Phases 1 and 2 of this investigation, and that conclusions regarding soil should be minimized in this document and left to the Soil RFI/RI.
17		b) TCS Site. This section should note that the highest chromium concentrations in the Topock area have been detected under the Compressor Station. The section concludes, "…the results of the soil samples collected do not suggest a contamination source in the vadose zone". This statement is currently unsupported as the majority of the soil borings were not well located beneath potential source areas and since the majority of the station has not been characterized for residual soil contamination that may threaten groundwater. With minimal vadose zone data, it is DTSC's position that conclusions regarding potential vadose zone sources cannot be made with any certainty at this time. It is understood that groundwater contamination may suggest a current or historic source of vadose zone contamination.	None.
18	**Page 6, Section 2.4, Monitoring Well Installation and Development**	Describe the grout discharge that occurred at the surface away from one well (Site F?) and what was believed to have happened that caused the unusual occurrence.	None.
19	**Page 7, Section 2.5, Borehole Flow Testing**	Include the RAS, Inc. hydrophysical testing reports as an attachment to ER/TCS Report.	Hydrophysical testing reports from both Phases 1 and 2 should be included.
20	**Page 8, Groundwater Monitoring Well Sampling**	Include additional, available groundwater data collected since the November 2012 ER/TCS Report was prepared.	The group agreed that the discussion in the document should be a summary of what we know about Cr, not focused on a single event. Also see Comment 4.

Comment No.	Section	Comment	Key Clarification/Resolution Items from March 15, 2013 Call
21	**Page 8, Section 2.8, Investigation-Derived Waste Management**	The report should discuss the nature and source of the organics contained in the liquids that were treated at LES in Arizona.	None.
22	**Page 9, Section 2.8, Investigation-Derived Waste Management**	The report should clarify the nature and source of the organics contained in drill cuttings that were disposed of in Nevada.	None.
23	**Page 13, Section 3.5.1 Distribution of Chromium and Field Measurements**	The section begins by mentioning well MW-68-180 and cites the high chromium concentration of 22,000 ppb and that it had lowered in more recent sampling events. It would be important to provide a hypothesis for such changes. Could it be due to sampling method (e.g., different purge volumes or duration), well development, etc.?	None.
24	**Page 14, Section 3.5.2 Sample Results for Nonchromium Contaminants**	Figures should be prepared to easily evaluate the distribution of molybdenum, selenium, nitrate, arsenic, and fluoride.	None.
25	**Page 14, Section 3.5.3 Sample Results for Additional Constituents**	Evaluate all data including general minerals data. Recall that lower TDS groundwater occurs in shallow wells located within the East Ravine wash proper and may suggest that fresher, cleaner, water has infiltrated and "washed" the shallow zone in the wash area and could explain why the Site F shallow well still exhibits elevated chromium. From a remedy standpoint, this suggests that flushing (or extraction) could work in the East Ravine.	The agencies clarified that the document should include more discussion of specific conductance data in the ER-TCS area to evaluate trends.
26	**Page 17, Data Quality Evaluation Summary**	Include a summary discussion in this section as it currently only references Attachment E.	None.
27	**Page 17, Section 4, Refinements to the Topock Conceptual Site Model**	Indicate that the new groundwater data exhibit elevated nitrate under the compressor station and may suggest the station is/was a source.	None.

TABLE F-1

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Item	Comment Number	Section/Page	Reference Text	60% Design Comment	
General Comments					
1				It is suggested that a table of abbreviations and acronyms be included for reference.	A table of abbreviations and acronyms has been included
Specific Comments – Executive Summary					
2		Executive Summary, Summary of Key Findings, Refined understanding of hydrogeology, Page 1 (Carried forward from 60% design comments.)	"The depth to bedrock beneath the TCS was found to be deeper than previously estimated, which indicates a larger area of saturated alluvium in this area than previously estimated."	Since aquifer thickness has increased, how does this impact the current groundwater remedial program (e.g., well screening zones, water volumes, capture zone, pumping rates, etc.)?	The changes in aquifer thickness as a result of the East Ravine investigation was incorporated into the 60% design. The model was updated to reflect the deeper bedrock along East Ravine and under the compressor station prior the completion of the 60% design document. The revisions to aquifer thickness resulted in only slight changes of the capture zones and pumping volumes.
3		ES, Summary of Key Findings, pg. 2, first paragraph	Based on measurements of specific capacity…	Identify the specific capacity data for the bedrock and unconsolidated materials, parenthetically in the sentence, so the reader can better understand the comparisons.	The sentence has been revised to read "Based on ~~measurements~~ estimates of specific capacity developed from measurements of drawdown during well development and routine well sampling, which provide a qualitative means of comparing the production rate of the different wells, the bedrock produces little groundwater relative to the nearby unconsolidated aquifer (See Attachment B2).
4		ES, Summary of Key Findings, pg. 2, first paragraph	Vertical gradients at well pairs within the saturated bedrock and between the bedrock and unconsolidated aquifer are all upward.	Based on elevated levels of Cr(VI) in MW-70, it appears that in areas of fracture networks that there is vertical migration of Cr(VI) from the unconsolidated to the consolidated aquifers. Thus there are exceptions to the "upward flow" statement. Suggest adding some language to this effect to better clarify the findings. Note: the hydraulic connection between the unconsolidated and consolidated aquifers is further substantiated in Figures 3-2, 3-3, and 3-5 where elevated levels of Cr(VI) are observed in bedrock.	Chromium was likely introduced into the bedrock during the times that water was discharged to East Ravine and is shown in aerial photos to be ponded in two or more places. This ponded water likely reversed the natural upward gradients, pushing chromium into the bedrock and out into the fracture network. The paragraph in question addresses the current conditions, which show persistent and widespread upward gradients from bedrock to alluvium. Hydraulic connection between bedrock and alluvium is part of the conceptual model for this site.
5		Page 3, Summary of Key Findings, Item 2	Hydraulic data collected during this investigation suggest that the groundwater occurrence in the bedrock is within relatively widely spaced, discrete fractures.	The assumption that the fractures are discrete is unsupported by the widespread dissemination of Cr (VI) in East Ravine and TCS areas.	Constituents can travel faster and farther in fractured rock than in porous media of similar permeability, so the extent of the chromium distribution in East Ravine is consistent with a sparsely fractured system, where it appears that ponding of wastewater for a relatively few years was responsible for distributing chromium over a relatively large area. Text has been added that further defines what is meant by a "discrete" fracture, and how Cr can still move throughout the system despite this.
6		Page 3, last paragraph, bulleted items		The bullets are arranged such that it is unclear that bullet 2 & 3 are for the East Ravine and 5-7 are for TCS. It is recommended that the information be reformatted.	The bullets have been reformatted so the intended hierarchy is clear.
Specific Comments – Main Body of Document					
7		Section 1.1, Page 4, 2nd bullet	DOI, Bureau of Land Management (BLM)…	After Bureau of Reclamation notation, change "Bureau" to "Reclamation"	The text has been revised as requested
8		Section 2.0, page 4, First paragraph, Last sentence	Well installation activities were not conducted at contingency Sites 1, I-Alt, or J-Alt.	The listing of site names identified on page 5 shows additional wells (D, E- Alt-1) where no wells were installed. For consistency, the text and table should contain the same information regarding wells not installed.	The text on Page 4 is specific to the Phase 2 investigation work while the table includes both Phase 1 and 2. The sentence has been revised to as follows to clarify that. "During Phase 2 investigations, well installation activities were not conducted at contingency Sites 1, I-Alt, or J-Alt"
9		Section 2.2-Drilling Methods and Lithologic Logging. ..lithologic logs provided in Attachment A-2		Upon review of the bedrock core logs found in Attachment A-2, fractures throughout the cores were characterized as having reddish stains, rust stains, iron stains. Are these stains in response to the presence of iron and is iron forming bacteria a concern with regards to fouling up well screens?	Iron is abundant throughout the alluvial aquifer at the site. The presence of iron in the aquifer materials is very beneficial to the success of in-situ remediation, because as reduced iron is oxidized, Cr(VI) is reduced to Cr(III). This is the basis of the treatment process used at IM-3 and it is expected to be an important part of the in-situ process as well. To date, iron bacteria have not been a problem in wells at the site.

TABLE F-1

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<table>
<tr><th>Item</th><th>Comment Number</th><th>Section/Page</th><th>Reference Text</th><th>60% Design Comment</th><th></th></tr>
<tr><td>10</td><td></td><td>Section 2.5, Page 9
(Carried forward from 60% design comments.)</td><td>“The depth-specific samples were collected using a wireline straddle packer tool to isolate fractures in the interval of interest.”</td><td>Please identify the intervals of interest.</td><td>The term “interval of interest” refers to the target zones were samples were collected in each well. This section describes the methods that were used in the investigation. The specific intervals sampled and the sample results are described in Section 3.2</td></tr>
<tr><td>11</td><td></td><td>Section 3.1-Lithology and Hydrostratigraphy</td><td>General Comment</td><td>It is recommended that PG&E prepare geologic cross-sections showing bedrock fractures in each borehole to ascertain if there is a pattern and the possibility of interconnectivity of fractures between boreholes. This information along with pumping test data and groundwater quality data can be utilized to ascertain to what extent fractures throughout the East Ravine are connected (e.g., contaminant pathways).</td><td>The meta-diorite bedrock is highly fractured, consistent with what might expected given the proximity of the detachment fault. However where borehole flow logging has been conducted, the degree of fracturing in the core log was not correlated with the locations of conductive fractures in the boreholes. The individual fractures in the highly fractured zones are typically filled with gouge and secondary minerals. Notations of the degree of fracturing on the core log provide little or no useful information about the permeability of the rock.
To assist with the spatial understanding of where flow zones were identified within the bedrock, these intervals have been added to the cross-sections adjacent the borehole lithology. The following note has also been added to the sections that include boreholes with flow profile information: “Flow zones identified are based on the results of flow profiling within the given borehole. Groundwater flow directions flow within the fractured bedrock cannot be inferred from borehole to borehole given the chaotic nature of the fracture network.”</td></tr>
<tr><td>12</td><td></td><td>Section 3.2-Borehole Flow Characterization Results, pg. 12</td><td>General Comment</td><td>The dominant flow zones in Boreholes MW-60BR-245, MW-70BR-255, and MW-72BR-200 appear to be at or near the same elevations. Could/are these fractures be connected? See table below
<table><tr><th>Bedrock Flow Zone Info</th><th>MW-60BR-245</th><th>MW-70BR-255</th><th>MW-72BR-200</th></tr><tr><td>Dominant Flow Zone Depth</td><td>236-240 fbg</td><td>208 & 220</td><td>148 - 168</td></tr><tr><td>Surface elevation</td><td>555.9</td><td>538.9</td><td>513.5</td></tr><tr><td>Dominant Flow Zone Elevation</td><td>315.9-319.9</td><td>330.9-318.9</td><td>345.5 - 365.5</td></tr><tr><td>Specific Conductivity (Table B-2)</td><td>16,220</td><td>13,030</td><td>17,000</td></tr></table>
Additional data in discussed Section 3.6.1, page 19 (see referenced text below) suggest fracture connections. Please verify.
Reference text:
MW-70BR-225 was pumped for 12 hours and a small drawdown was observed in MW-60BR-245, some 600 feet east of MW-70. Possibly if it was pumped longer drawdown may have been observed in MW-72BR-200.</td><td>There is undoubtedly some degree of connection through the fracture network between many of the wells in the East Ravine, however the overall low permeability of the rock and relatively wide spacing of the wells makes impractical to map the fracture network or define individual fracture connections between boreholes.</td></tr>
<tr><td>13</td><td></td><td>Section 3.2-Borehole Flow Characterization Results, pg. 12, 1st paragraph</td><td>Concentrations were 130 micrograms per liter…</td><td>It is assumed that the reference to concentrations is Cr(VI) concentrations. Please state this for clarification purposes.</td><td>Text has been revised to read: “Concentrations of Cr(VI) were 130 micrograms per liter (µg/L), 290 µg/L, and 78 µg/L in the shallow, middle, and deep samples, respectively.”</td></tr>
<tr><td>14</td><td></td><td>Section 3.2,
Page 12
(Carried forward from 60% design comments.)</td><td>“Depth-specific grab samples were collected from the two primary flow zones using packers.”</td><td>Are the two primary flow zones found at 148-168 feet and 195 feet? If so, this information should be stated parenthetically at the end of the sentence.</td><td>Text has been revised to read: “Depth-specific grab samples were collected from the two primary flow zones (148’ to 168’ and 191’ to 198.5’) using packers.</td></tr>
<tr><td>15</td><td></td><td>Section 3.4, Page 14</td><td>For the purpose of this report, where analysis of the soil data is focused on the development of the conceptual site model for the ER-</td><td>The introduction text in Section 3.4 notes that concentrations were only “compared only to BTVs”. The comparison should also include reporting limits.</td><td>The text has been revised to read: “For the purpose of this report, where analysis of the soil data is focused on the development of the conceptual site model for the ER-TCS areas, results for inorganic analytes are compared only to BTVs. For organic analytes, results inside the compressor station fence line were compared to commercial screening levels and results outside the fence line</td></tr>
</table>

TABLE F-1
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Item	Comment Number	Section/Page	Reference Text	60% Design Comment	
			TCS areas, results are compared only to BTVs.		were compared to residential screening levels. If the appropriate DTSC CHHSL was not established, the USEPA regional screening level was used." Reporting limits for all compounds are listed in the tables in Appendix C.
16		Section 3.4, Page 14	For the purpose of this report, where analysis of the soil data is focused on the development of the conceptual site model for the ER-TCS areas, results are compared only to BTVs.	The introduction text in Section 3.4 notes that concentrations were only "compared only to BTVs". One would presume that part of the conceptual site model would be defining the source and include transport of contaminants from the soil to groundwater. Were comparison values considered for impacts to groundwater and if not, when will they be considered? As stated in previous comments, it is our expectation that PG&E use the soil work plan DQO (Decision 3 – Impacts to Groundwater) developed for determining a threat to groundwater and that the associated screening levels are used for the comparison and evaluation.	The analysis of impacts to groundwater from soil contaminants will be developed in Volume 3 of the RFI.
17		Section 3.4.1, Page 15, Site 5	Barium, cobalt, copper, lead, nickel, vanadium and zinc were also detected above the BTV, and none of the detected concentrations exceeded respective commercial screening levels.	The introduction text in Section 3.4 notes that concentrations were only "compared only to BTVs". Delete the segment of the sentence "and none of the detected concentrations exceeded respective commercial screening levels".	The sentence has been revised as requested.
18		Section 3.4.1, Page 15, Site 6	Lead was also detected above the BTV but not the commercial screening levels.	The introduction text in Section 3.4 notes that concentrations were only "compared only to BTVs". Delete the reference to "commercial screening levels".	The sentence has been revised as requested.
19		Section 3.4.2, page 15		The introduction text in Section 3.4 notes that concentrations were only "compared only to BTVs" yet screening levels are discussed in this section. Please address the inconsistency.	See response to comment 15 above, which clarifies that commercial screening levels were used for organic compounds where no BTV has been established.
20		Section 3.5.1-Distribution of Chromium and Field Measurements, pg. 16, Second paragraph	…..the existing monitoring wells do not fully define the extent of the elevated Cr(VI) in bedrock to the south of the East Ravine.	MW-65-160 and 225 well cluster show elevated Cr(VI) concentrations as so does MW-66-230 and 165. This data suggests that the western boundary is also not fully defined. Further, as the "Old Well" is located between MW-10 and MW-38 and was historically used as an injection well, this could further complicate Cr(VI) plume delineation within bedrock.	The MW-65-160 and 225 and MW-66-165 and 230 wells area all completed in the alluvium and don't provide any information about the delineation of Cr(VI) in bedrock. Cr(VI) was ND in the bedrock well at MW-66 cluster (MW-66BR-270). There is no bedrock well at the MW-65 cluster. Considering that the "Old Well" was intended to provide a relatively modest water supply for the construction of the compressor station and that the alluvial aquifer in this area provides ample water of reasonable quality, there would have been no reason to extend the well to bedrock. In addition, it was likely drilled with the cable-tool drilling equipment common in that era, which would have not been able to penetrate far into competent bedrock. The total depth of the well has been verified to be 158 feet below ground surface, which is approximately where the top of bedrock is estimated for this area based on boring logs from adjacent wells. For example, the boring log for the MW-38 location, which is about 170 feet to the north was drilled to 195 feet below ground surface, where loosely consolidated bedrock was logged from approximately 178 feet bgs. Bedrock shallows to the south toward the mountain front; therefore, bedrock is estimated to be slightly shallower at the "old well" (TCS-4).
21		Section 3.5.1, Page 16, 2nd full paragraph	It is therefore unlikely that the plume extends any great distance to the south beyond the existing well network.	"Any great distance" is a relative term, depending on the circumstances and personal interpretation. It would be appropriate to reference the extent of the plume relative to estimated boundary shown in Figure 3-8.	The sentence has been revised to read: "It is therefore unlikely that the plume extends ~~any great distance to~~ the south beyond the inferred plume boundary shown on Figure 3-8.~~existing well network~~.
22		Section 3.5.2-Sample Results for Non-Chromium Contaminants of Potential Concern in the ER-TCS Wells, pg. 17	Nitrate – Average nitrate concentrations above the UTL of 5.03 mg/l were found in eleven wells, while concentrations above the California MCL of 10 mg/l were found in eight wells on the compressor station, with higher concentrations generally in shallower wells.	Does the ground water with high concentrations of nitrate require any special handling or disposal?	Nitrate is more easily reduced than Cr(VI), so it will be eliminated in the IRZ line and in any of the IRL/TCS wells where carbon is added (water extracted from the East Ravine area will be re-injected using the TCS injection wells). There is no plan to pump water from below the compressor station, so it is not anticipated that any large volumes of water with elevated concentrations of nitrate would be generated during the remedial action. The purge water from these wells (generated during sampling) is currently managed at IM-3, where the process used to reduce Cr(VI) also reduces nitrate.

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Item	Comment Number	Section/Page	Reference Text	60% Design Comment	
23		Section 3.5.2-Sample Results for Non-Chromium Contaminants of Potential Concern in the ER-TCS Wells, pg. 17	Selenium – Maximum concentrations exceeded alluvial aquifer background in both the deep and shallow wells in the MW-60 cluster and in the shallower well at the MW-64 cluster	What are the maximum concentrations and were they above the California MCL of 50 ug/l? Will groundwater containing Selenium above the California MCL of 50 ug/l require any special handling?	As shown on Figure 3-11, selenium above the MCL of 50 ug/L was detected only in wells MW-67-185 and MW-67-225. It is not anticipated that this water would require any special handling.
24		Section 3.6.1, Page 19, 1st paragraph (Carried forward from 60% design comments.)	"The drawdown caused by pumping was too small to observe directly in any but the closet well, MW-70-105 9shallower well pair to the pumping well), where the well exhibited a consistent dewatering trend and a total of 1.6 feet of drawdown . . . "	What is the distance from the pumping well to well MWE-70-105?	The distance is approximately 15 feet.
25		3.6.1-Constant Rate Extraction Testing, pg. 19, second full paragraph	General comments on paragraph	With regards to seeing no drawdown effects on alluvial well MW-59-100, given the short time period the pump test was run it may be that the test was not run long enough to have any influence on water levels at MW-59-100 The statement that "relatively high flow rates, the elevated chromium concentrations, and the stable isotope signature showing a mixture of bedrock and alluvial water at MW-70-225 are all consistent with the theory that this well may be drawing water from the alluvium well through a bedrock fracture system" suggests that there are contaminate pathways from the alluvial aquifer to the bedrock aquifer. Interconnectivity between the alluvial aquifer and the bedrock aquifer by way of bedrock fracture systems provide a window for contaminate migration. Although there is an upward flow component from the bedrock aquifer to the alluvial aquifer, mounding caused by injection wells may induce vertical flow from the alluvial aquifer into the bedrock aquifer in areas of fracture systems, possibly causing cross-contamination. The proposed locations of injection wells TCS-1 and TCS-2 are in the vicinity of the "old well" (possible source area) and MW-70BR (possible bedrock fracture zone). Possible mounding effects might result in cross-contamination. Discuss how the groundwater remedial program addresses groundwater contamination in bedrock.	Agreed. A longer pump test might have shown drawdown in the alluvium. Hydraulic connection between the alluvium and the bedrock is likely. The TCS injection wells will be injecting water amended with carbon, so if that water moves into bedrock, it will be remediating Cr(VI) as it moves. The design of the groundwater remediation systems, including those components of the system designed for the East Ravine, is provided in the 60% design report, and has been updated in the 90% design.
26		Section 3.6.2, Page 19 (Carried forward from 60% design comments.)		Please identify the range of specific capacity measurements so readers can better understand the specific capacity estimates without having to refer to data located elsewhere in the document.	The text has been revised as follows "The higher specific capacity (typically greater than 3 gpm/ft) is observed in the alluvial wells. Several of the bedrock wells pump dry, precluding measurement of specific capacity. The bedrock well with the highest specific capacity (averaging about 2.8 gpm/ft) is MW-69-195, located on the TCS. MW-69-195 is a shallow zone well with 20 feet of screen just below the water table in bedrock. The second-highest bedrock specific capacity (averaging about 0.6 gpm/ft) was observed at well MW-70BR-225, where the constant rate pumping test was conducted.
27		3.6.2-Specific Capacity Estimates, pg. 19	MW-69-195 is a shallow zone well with 20 feet of screen just below the water table in bedrock.	Could MW-69 also represent another fracture zone where water from the alluvial aquifer could be migrating into the bedrock aquifer?	Yes. Both the high specific capacity of MW-69-195 relative to other bedrock wells and the isotopic signature of the water suggest that a connection to the alluvial aquifer, however the dominance of upward gradients between bedrock and overlying alluvium would tend to limit downward migration of constituents into bedrock.
28		4.0-Refinements to the Topock Conceptual Site Model, pg. 21-22, last sentence on pg. 21	"Lithologic data collected during the installation of these wells provide better definition of the topography of the bedrock contact below the TCS and, as a result, indicate a larger area of saturated alluvium beneath the TCS that previously estimated"	Has a bedrock topographic map been generated for the site?	A contour map of the elevation of the top of bedrock was included in the RFI Volume 2 (Figure 5-9), however the contours near the compressor station do not reflect the more recent data from the East Ravine investigation.

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29		Section 4.0, Page 22, 1st partial paragraph	Based on the data from MW-66BR-270 and MW-68BR-280, concentrations of the Cr(VI) in the alluvium do not extend in to the bedrock directly beneath the TCS.	It would appear that, when considering concentrations in MW-69-195, MW 65-225, and MW-70BR-225, a more appropriate statement would be that "concentrations of the Cr(VI) in the alluvium do not extend in to the bedrock directly beneath the *northern half* of the TCS*, but may be present in the southern portion.*"	MW-65-225 is an alluvial well and MW-70BR-225 is not beneath the compressor station. The text has been revised as follows: "Based on the data from MW-66BR-270 and MW-68BR-280, concentrations of Cr(VI) in the alluvium do not extend into the bedrock directly beneath the TCS. Concentrations of Cr(VI) are observed in ~~the~~ bedrock well MW-69-195 immediately south of the TCS fence line where saturated alluvium is not present, but Cr(VI) has not been detected in the southern most bedrock well MW-74-240.
30		4.0-Refinements to the Topock Conceptual Site First full paragraph	…do not suggest any previous unknown hotspots or contaminate sources	Information from the "old well" investigation may result in additional source information. This should be considered in the conceptual site model before such a conclusion is made.	The old well is in a known source location, the former infiltration ponds. Since the old well does not extend deep into bedrock, if at all, it would make little difference to the conceptual model whether Cr(VI) was released to the ponds or to this old well.
31		4.0-Refinements to the Topock Conceptual Site Model, pg. 22, 1st paragraph	"The data suggests a localized connection to the alluvium rather that to some as yet undiscovered zone of highly fractured and more permeable bedrock".	A review of Boring Logs – BH-69 and BH-70 provide the following information with regards to fractures:	The meta-diorite bedrock is highly fractured, consistent with what might expected given the proximity of the detachment fault. However where borehole flow logging has been conducted, the degree of fracturing in the core log was not correlated with the locations of conductive fractures in the boreholes. The individual fractures in the highly fractured zones are typically filled with gouge and secondary minerals. Notations of the degree of fracturing on the core log provide little or no useful information about the permeability of the rock.

BH/MW-69-195 Boring Long	
Depth (ft. below grade)	**Comment**
42	Interface between bedrock and alluvium
42-157	Highly fractured (General note on boring log)
62	Less highly fracture
87	moderately weathered, highly fracture, presence of iron staining
117	moderately fracture, iron staining
127	Less fracturing
137	Fractured at approximately 80 degree dip, iron and black-colored staining
157	Rock Coring Begins
158-159	Highly Fractured Notations
162-164, 166-169,	Highly Fractured Notations
174, 182, 190,	Highly Fractured Notations
BH-70	
Depth (ft. below grade)	**Comment**
68.5	Interface between bedrock and alluvium
	Soil sample collected between 69-70 fbg
	Rock flour (ML)
87	Begin rock coring, highly fractured
88	Fracture Zone
88-96	Joints 30 to 60 degrees
96	Highly fractured
98	Highly fractured

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				101-108	Highly fractured
				127-130	Highly fractured
				139-140	Multiple fractures
				149-151	Highly Fractured
				157	Highly fractured
				165	Highly Fractured
				167	Highly fractured
				191-194	Highly fractured
				199	Highly fractured
				207	Multiple fractures
				216-220	Highly fractured
				225-227	Highly fractured
				BH-74	
				Depth (ft. below grade)	**Comment**
				216-218	Highly Fractured
				225-230	Highly Fractured
				232-234	Highly Fractured
				236-238	Highly Fractured
				Does the data suggest that fracturing might be more widespread then otherwise believed?	
32		Section 4.0, Page 22, 2nd paragraph	The conceptual model suggested by the hydrophysical logging is that the groundwater flow occurs in relatively widely spaced discrete fractures.	The assumption that the fractures are discrete is unsupported by the widespread dissemination of Cr (VI) in East Ravine and TCS areas.	See response to comment 5.
33		4.0-Refinements to the Topock Conceptual Site Model, pg. 22, 3rd paragraph	"In fractured crystalline rock, typical mobile porosity is 1% or less"	Based on the information collected by PG&E, mobile porosity may be more than 1% in some localized areas. Can the model take this into account?	The model can accommodate any mobile porosity value.
34		Section 4.0, Page 22, Footnote		DOI Comment 18 on the 30% design states "The statement that "bedrock in East Ravine has relatively few conductive fractures" is broad and not well supported as evidenced by the extent of the plume and conductivity of some of the wells." These two paragraphs do not address the extent of the plume found in the East Ravine area.	Constituents can travel faster and farther in fractured rock than in porous media of similar permeability, so the extent of the chromium distribution in East Ravine is consistent with a sparsely fractured system, where it appears that ponding of wastewater for a relatively few years was responsible for distributing chromium over a relatively large area.

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PG&E Topock Compressor Station, Needles, California

Item	Comment Number	Section/Page	Reference Text	60% Design Comment	
35		4.0-Refinements to the Topock Conceptual Site Model, pg. 23, top of page	"Pumping from the bedrock during the MW-7-BR-225 constant rate test did not induce discernible drawdown in the nearest wells…"	Although this was true, the test was short term and may not have run long enough for any drawdown effects to reach the nearest well cluster.	Agreed.
36	Specific Comments - Figures				
37		Figure 2-1		Please include the location of the 'hot well' referenced in Section 3.5.1 in this figure.	The "hot well" (which is actually an above ground concrete surge tank) has been added to the figure.

TABLE F-2

DTSC Comments on Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

Comment Number	Comment Number	Section/Page	Reference Text	60% Design Comment	PG&E Response to Comment
1				As the Technical Memorandum (TM) is 958 pages long, please revise it to include a Table of Contents.	Agree
2		Executive Summary, Page 1, Item 2.	"…is consistent with the existing conceptual site model for the East Ravine area."	The existing conceptual site model for the East Ravine and Compressor Station area should be included in the document (suggest Section 4). Present what PG&E believes is the conceptual model, including supporting illustrations. PG&E should also identify the uncertainties and assumptions made as part of the conceptual model.	Text has been added to Section 4 to more clearly present the current conceptual model for bedrock under the East Ravine and the TCS.
3		Executive Summary, Page 2, Item 3b.	Low levels of Cr(VI) were found where the water table occurs in bedrock at the southern edge of the TCS, but were not detected at the southernmost location (Site J, MW-74-240).	Minor edit. Need to add "the" and a comma.	Agree.
4		Executive Summary, Conclusion, Page 2, Paragraph 1.	Based on data collected during Phase 2 of this ER-TCS investigation, the refined conceptual site model confirms what was inferred based on previously available data (and described in the *2009 Summary of Findings Associated with the East Ravine Groundwater Investigation Report* [CH2M HILL, 2009a]), that assumptions associated with the anticipated design and operation of the final groundwater remedy do not need to be modified.	Revision of this sentence appears necessary as the remedy design was modified, although not significantly, based on the results of the Phase 2 investigation (e.g., extraction at the Site H area was added due to yield and depth of contamination). Similar language is found in the second to last paragraph of Section 4.	The sentence in question will be revised to read: ~~"Based on~~ Data collected during Phase 2 of this ER-TCS investigation have resulted in the addition of two alluvial aquifer injection wells near the compressor station and a bedrock extraction well near MW-70 to the remedial design. However the data from the Phase II investigation ~~the refined conceptual site model confirms what was inferred based on previously available data (and described in the 2009 *Summary of Findings Associated with the East Ravine Groundwater Investigation Report* [CH2M HILL, 2009a]),~~ that the overall ~~assumptions associated with the anticipated~~ design ~~and operation~~ of the final groundwater remedy in the East Ravine, which relies on pumping from the bedrock, does not need to be modified." Similar revision will be made to the relevant text in Section 4.
5		Executive Summary, Conclusion, Page 2, Paragraph 2.	As communicated by the Department of Toxic Substances Control (DTSC) in a May 10, 2012, email (DTSC, 2012), Phase 2 field investigation activities are complete with the exception of Site H (MW-70 well series), where the agencies have directed PG&E to conduct additional characterization to determine the vertical extent of Cr(VI) in groundwater. This work and any further well installation will be considered as part of the groundwater monitoring program to be established as part of the groundwater remedy.	DTSC does not believe that the investigation activity specified in the cited text was captured in the 60% design. PG&E needs to make sure that this item is addressed during preparation of the 90% design and address what is meant by "will be considered as part of the groundwater monitoring program?"	Additional investigation to characterize the vertical extent of contamination at the MW-70 location will be described in the 90% design document. The statement "will be considered as part of the groundwater monitoring program" was meant to confirm that this investigation is not intended to precede and thereby delay the remedial design, but rather be considered as part of the groundwater monitoring program that will be implemented in conjunction with the installation of the remedy.
6		3.1 Lithology and Hydrostratigraphy, Page 11	Saturated alluvium in the East Ravine area was only encountered at MW-71-035 (Site L), where the saturated thickness above conglomerate bedrock was relatively thin. Sediments at this location were relatively finegrained compared with areas of saturated sediments to the east.	Clarification/revision needed. The cited sentence can be interpreted to indicate that the only saturated East Ravine alluvium is located at well MW-71 and is relatively thin. Please revise to clarify that this is not the case (e.g., Site G/MW-59, MW-70).	In fact, the only place that saturated alluvium has been encountered is at well MW-71. The alluvial wells were installed just above bedrock at MW-59 and MW-70 locations have been dry except for a brief period shortly after they were installed. The water that was initially in these wells was likely introduced during drilling. The sentence is correct in stating that MW-71 is the only place that saturated alluvium has been encountered in East Ravine.

TABLE F-2

DTSC Comments on Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

Comment Number	Comment Number	Section/Page	Reference Text	60% Design Comment	PG&E Response to Comment
7		3.4.2 Summary of TPH and Organics Results, Page 15	Calculated quantities of dioxins and furans (toxicity equivalents quotient [TEQ]) were below respective screening levels at all sites where fill was encountered including Site 1, BH-67, BH-68, BH-65, BH-66, and BH-69 (dioxins and furans were not analyzed at BH-70 as fill was not encountered).	Table C1-11 indicates that some levels exceeded interim screening levels. Please revise.	The text will be revised to read: Calculated quantities of dioxins and furans (toxicity equivalents quotient [TEQ]) were below the Human-TEQ screening value of 50 ng/kg ~~respective screening levels~~ at all sites where fill was encountered including Site 1, BH-67, BH-68, BH-65, BH-66, and BH-69 (dioxins and furans were not analyzed at BH-70 as fill was not encountered). However, the 0 – 0.5 feet bgs sample from BH-69 exceeded the TEQ-Avian and TEQ-mammal ecological screening values (ECVs) and the 2 to 3 feet bgs sample from BH-69 exceeded the TEQ-Mammal ECV. No other samples exceeded the ECVs.
8		3.4.2 Summary of TPH and Organics Results, Page 15	Volatile organic compounds were not detected in any of the samples collected with the exception of the surface soil sample at BH-70 where 4-isopropyl toluene was detected below the screening level.	Table C1-9 indicates that isopropyl benzene was also detected at 60 feet bgs at BH-67. Please revise.	The sentence will be revised to read: "Volatile organic compounds were not detected in any of the samples collected with the exception of the surface soil sample at BH-70 where 4-isopropyl toluene was detected and the sample from 60 feet in BH-67 where isopropyl benzene was detected. ~~below the screening level.~~"
9		3.7.2 Soil Data Quality Evaluation Summary, Page 21	**3.7.2 Soil Data Quality Evaluation Summary**	Need to change "Soil" to "Groundwater" in 3.7.2 heading.	Heading will be changed to read: **"Groundwater Data Quality Evaluation Summary"**
10		4.0 Refinements to the Topock Conceptual Site Model, Page 22	Elevated concentrations of Cr(VI) are observed in the saturated alluvium beneath the TCS with concentrations in the parts per million on the north and east sides of the TCS; however, these data are not unlike concentrations previously observed to the north and northeast of the TCS.	This statement should probably be revised to reflect that the highest concentrations of Cr(VI) that have been detected on the site were found in the alluvial aquifer beneath the TCS (see page 2 of the document). The section should also discuss how this changes the general understanding of where the core of the plume occurs at the site. Prior to the ER/TCS investigation, the hot spot was off site at MW-20 Bench. The ER/TCS investigation changes the conceptual model in that the core/highest concentrations of the Cr(VI) plume is more extensive than previously understood.	The text will be revised to read: "The highest concentrations of Cr(VI) yet detected at the site are observed in the saturated alluvium beneath the TCS, within an area of elevated concentrations in the parts per million along the north and east sides of the TCS. Although these concentrations are not unlike concentrations previously observed to the north and northeast of the TCS, it does appear that the area of elevated concentrations around the compressor station is larger than previously understood during the 30% design. This finding has been taken into account in the subsequent phases of the design by adding two carbon amended injection wells (TCS-1 and TCS-2) to accelerate remediation of Cr(VI) in the alluvium under the TCS."
11		4.0 Refinements to the Topock Conceptual Site Model, Page 22	With the exception of concentrations detected in the parts per million at MW-70BR-225, Cr(VI) concentrations observed in the new wells are similar to the previously installed wells and do not suggest any previously unknown hotspots or contaminant sources.	Please revise the cited sentence to mesh with the text on page 15/16 of the TM that suggests a source near well MW-68-180. See also comment above.	The text will be revised to read: "With the exception of concentrations detected in the parts per million at MW-70BR-225, Cr(VI) concentrations observed in the new wells are similar to the previously installed wells and do not suggest any previously unknown hotspots or contaminant sources outside the compressor station, which was always considered a potential source location."
12		Figure 3-1	Bedrock/Alluvial Aquifer Phase 2 contact line.	Shouldn't the cited contact pass right through Site H/MW-70 and lie on the other side (east) of Site L /MW-71?	This estimated contact line has been corrected such that it is to the east of MW-71-35. Saturated alluvium was not encountered at the Site H/MW-70 location. It is acknowledged that the shallow screen, as shown on Figure 3-2 (cross-section A-A') is slightly confusing given the projection of the well screen relative the water table. The depth to rock at this location was logged at 68.5 feet below ground surface (approximately 471.5 feet above mean sea level) and the average water level that this contact is based on is 456 feet above mean sea level. Therefore, the contact should pass slightly north of MW-70, as shown. Figure 3-2 has been revised to show the shallow screen and projected alluvium/bedrock/water table contact more precisely.

TABLE F-2

DTSC Comments on Revised Addendum to the Summary of Findings Associated with the East Ravine Groundwater Investigation

Comment Number	Comment Number	Section/Page	Reference Text	60% Design Comment	PG&E Response to Comment
13		Figure 3-3		Please modify cross-section B-B' as follows: MW-62 shows alluvium occurring beneath the conglomerate.	The figure will be corrected to show conglomerate to total depth in MW-62.
14		Figure 3-6		Please modify cross-section E-E' as follows: Move the section line to pass directly through MW-21 and MW-73-80. This will bring all existing wells very close to the line. Then project wells MW-71-35, MW-62 cluster and MW-72 cluster onto the line. DTSC requested this section to illustrate where contamination approaches the river.	The cross section will be modified as requested.

Appendix M
Addendum to Freshwater Pre-Injection Treatment System Conceptual Design Basis Memorandum

Addendum to Freshwater Pre-injection Treatment System Conceptual Design Basis PG&E Topock Compressor Station, Needles, California

PREPARED FOR: Pacific Gas and Electric Company

PREPARED BY: CH2M HILL

DATE: August 28, 2014

1.0 Introduction

Since the submittal of the 60% design of the Pacific Gas and Electric Company (PG&E) Topock Compressor Station (TCS) (CH2M HILL 2013), the State Water Resources Control Board (State Board) has issued a decision letter on November 20, 2013, and the California Department of Toxic Substances Control (DTSC) has provided direction in its comment on the 60% design (#145 DTSC-50) that will include an arsenic pre-treatment contingency as part of the 90% design. In compliance with this DTSC directive, this technical memorandum (TM) presents the design basis for a potential future pre-treatment option for freshwater.

This option assumes that the primary source is groundwater from well HNWR-1A and the secondary source is groundwater from wells HNWR-1 or Site B. All three freshwater supply wells are located in Arizona. This assumption will be revisited after completion of the alternative freshwater source evaluation—the field work is currently under way. The potential future treatment system, referred to herein as the freshwater pre-injection treatment system (FWPTS), will be located in the vicinity of the planned remedy-produced water-conditioning plant. All components of the FWPTS are located on previously disturbed areas within the PG&E-owned parcel.

The treatment goals of the FWPTS are arsenic removal to concentrations less than the federal and California maximum contaminant level (MCL) of 10 micrograms per liter (µg/L) (California Department of Public Health, 2013). This TM discusses the evaluation of available treatment technologies for arsenic; the selection of technologies for bench-scale testing; the results from bench-scale testing at CH2M HILL's Applied Science Laboratory (ASL) in Corvallis, Oregon; and the design basis/design criteria for the FWPTS. This document also includes a process flow diagram, a preliminary equipment layout, and a preliminary list of key equipment.

The design information presented herein has been developed based on Topock-specific information (that is, bench-scale testing results of HNWR-1 water) and experience in designing and operating arsenic groundwater treatment systems on non-Topock projects. Because of its location, the potential future FWPTS will be designed to achieve a safe, harmonious, and sustainable operation within TCS. Engineering design details of the FWPTS are included in the 90% design.

2.0 Freshwater Water Quality, Treatment Goals, and Design Flow Rates

For the purpose of this conceptual design, it is assumed that the water quality from the future supply well (HNWR-1A) in Arizona is similar to that of the HNWR-1 well. PG&E has collected and analyzed six samples from HNWR-1 starting in November 2010. Analytical results from November 2010 through February 2014 indicate that the naturally-occurring arsenic concentrations in HNWR-1 water were 14-16 µg/L, greater than the federal and California MCL of 10 µg/L arsenic. Tables 1A and 1B summarize available analytical results for HNWR-1 (all tables and figures are presented at the end of this TM). As previously mentioned, the treatment goals for the FWPTS are to remove arsenic to concentrations less than 10 µg/L.

The total freshwater supply flow rates are based on the sum of the modeled freshwater flows into the Freshwater and Inner Recirculation Loop injection wells. The FWPTS will be designed to treat freshwater for remedy injection only. Exhibit 1 shows the FWPTS design flow rates.

EXHIBIT 1
Design Flow Rates
Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum
PG&E Topock Compressor Station, Needles, California

Element	Unit	Minimum Flow	Nominal Flow	Maximum Flow
Freshwater Pre-Injection Treatment System (FWPTS)	gpm	150	450	900

3.0 Evaluation and Selection of Treatment Technologies

For this conceptual design basis, PG&E has identified and evaluated proven treatment technologies for arsenic that are United States Environmental Protection Agency (USEPA) Best Available Technologies (USEPA 2001) and have been successfully used by municipalities and industry. Unproven technologies or technologies that have not been used in full-scale applications were not considered.

The initial list included nine technologies: anion exchange, activated alumina (AA) adsorbents, reverse osmosis (RO), electrodialysis reversal (EDR), lime softening, distillation, iron-based adsorbents, titanium-based adsorbents, and coagulation/filtration (see Exhibit 2). These technologies were evaluated and screened in a two-step process: (1) the initial screening was based on the experience of the engineering team with the individual technology, and (2) the second-level screening was based on a set of criteria - namely treatment effectiveness, reliability and flexibility[1], operational complexity, waste generation, footprint, and cost effectiveness. After completion of the technology screening and evaluation process, the AA technology with disposable and regenerable (AA) adsorptive media, coagulation filtration, and iron-based adsorbent granular ferric hydroxide (GFH) were selected for bench-scale testing. For more details of this screening and a description of the evaluation processes, see Attachment A.

EXHIBIT 2
Technologies Considered for Arsenic Removal
Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum
PG&E Topock Compressor Station, Needles, California

Technology	Evaluation Status
Anion exchange	Screened out, significant waste generation.
AA	Selected for bench-testing
Titanium-based adsorbents	Screened out, similar as other adsorbents considered, with less experience.
Reverse osmosis (RO)	Screened out, significant waste generation.
Electrodialysis reversal (EDR)	Screened out, significant waste generation.
Lime softening	Screened out, significant waste generation.
Distillation	Screened out, significant energy use and capital cost.
Coagulation filtration	Selected for bench-testing
Iron-based adsorbents	Selected for bench-testing

[1] Flexibility is defined as the ability of a system to respond to potential internal or external changes affecting its performance, in a timely and cost-effective manner. Also includes aspects such as handling changes in influent water quality and flowrates.

4.0 Summary of Bench-scale Testing Results

The objectives of bench-scale testing were to: (1) verify the effectiveness of each adsorptive media in removing arsenic from HNWR-1 water to the treatment goals, (2) understand the time to break through (critical for equipment sizing and waste management) for AA and GFH, (3) understand effectiveness of coagulation with a jar test, and (4) understand waste generation amounts. This section summarizes the testing and results to date as it relates to arsenic treatment.

To accomplish the first two objectives, CH2M HILL's ASL employs a testing procedure for evaluating adsorptive media effectiveness in removing arsenic in a small-diameter laboratory column analogous to the rapid small-scale column test method developed for assessing granular-activated carbon in a continuous flow system. This method significantly reduces the amount of time and water required for testing compared to pilot-scale and full-scale systems (USEPA 1996). A jar test was performed to evaluate the effectiveness of ferric chloride as coagulant.

A groundwater sample was continuously pumped, sampled, and collected in three 55-gallon drums from HNWR-1 well in early January 2013 and was shipped to ASL for bench-scale testing. The groundwater sample was processed continuously through the column, and the treated water was sampled and analyzed for arsenic until breakthrough (defined as at least 70 percent of the average influent concentration). After the first breakthrough, the media was regenerated, and the test was repeated. Two treatment cycles (termed Service Cycle 1 and Service Cycle 2) were conducted for regenerable AA (due to fluoride breakthrough caused by the greater affinity of fluoride versus arsenic to AA). Because of time constraints, not all media samples were able to be tested until arsenic breakthrough. In total, 133 liters of HNWR-1 well water were processed using disposable AA and 204 liters using GFH. These samples were tested for as long as time permitted in the laboratory. The rapid small-scale column test results provide information on adsorption capacity (extent of adsorption) and the rate of adsorption (adsorption kinetics), which are the two dominant factors affecting breakthrough in the media columns.

The rapid small-scale column test for arsenic removal was performed using the following media

- Regenerable AA (BASF AA-400G)
- Disposable AA (BASF AA-FS50)
- Alum-impregnated AA (AIAA)
- GFH

Prior to passing the water over the media, the groundwater was pretreated as follows: the pH was adjusted to 6.5 with hydrochloric acid and the water was injected with chlorine to maintain a residual concentration of 1 mg/L for 60 seconds (this is to oxidize any arsenite present in the water to arsenate), and was followed by inline filtration.

Column Testing Treatment Effectiveness and Time to Breakthrough

Figure 1 shows concentrations of arsenic in treated water versus the number of bed-volumes of groundwater passed through (one bed-volume is equivalent to the amount of adsorptive media in the column). During the first service cycle, the regenerable AA performs well, but in the second service cycle the effluent concentration begins to increase more rapidly indicating after the initial service cycle the media loses capacity to adsorb arsenic. Due to this fact and the difficulty in regenerating AA media which requires using strong chemicals like caustic and sulfuric acid increasing safety concerns, cost, and associated wastewater management[2], this method is eliminated from further analysis. The AIAA performed somewhat better than the regenerable AA, but not as well as the disposable AA media. The poorer performance and the additional effort to impregnate the alum onto the AA, eliminates this media from further evaluation. The disposable media performed well to more than 44,000 bed volumes, although the arsenic effluent concentration appears to have increased more than the effluent from the GFH media column.

To ascertain the relative performance of the two media, another figure was prepared (Figure 2), which shows the measured effluent concentration as a function of the amount of arsenic adsorbed on the treatment media. The amount of arsenic absorbed was calculated by multiplying the measured concentration in effluent samples by the volume of water passing through during the sampling interval and dividing by the mass of media in the column.

[2] The estimated wastewater volume ranged from 3.3 to 11 million gallons per year (CH2M HILL 2013).

The effluent concentration in the disposable AA, begins to rise rapidly when the adsorption reaches 0.4 µg/mg media where as in the GFH varies between 0.15 and 0.35 µg/mg media until the test was stopped. These results more clearly indicate GFH will perform better.

Jar Testing Results

Jar testing was performed to test arsenic removal by coagulation with ferric chloride. Water samples were pre-oxidized with free chlorine dosed to provide approximately 1 mg/L free chlorine residual for 60 seconds prior to ferric chloride addition and mixing. Ferric chloride was added to reach doses 5, 10, 15, and 20 mg/L. The mixers were run at 70 revolutions per minute (rpm) for 30 seconds followed by 25 rpm for 20 minutes. The samples were then filtered through a 0.45 micron filter and the filtered water tested for arsenic and pH.

Figure 3 shows the arsenic concentration versus ferric chloride dose applied during testing. Jar testing demonstrated that arsenic could effectively be removed to <10 µg/L with ferric chloride dosed to 5 mg/L.

Process Selection

As shown above, the GFH was effective at removing arsenic to below the treatment goals (the federal and California MCL of 10 µg/L). The effluent remained less than 1 µg/L of arsenic for over 70,000 bed-volumes. The GFH media performed better than the disposable AA offering longer running periods between media change-outs. Coagulation and filtration although effective creates a solid waste stream 5 times greater than GFH that must be transported and disposed of off-site and is more difficult to operate. Based on these reasons, GFH was selected for the FWPTS design.

Section 5 discusses the treatment and backwash process in more details and provides a summary of the sustainability factors.

5.0 Freshwater Treatment Process and System Description

As previously mentioned, GFH was selected as the treatment technology to be carried forward into the design of the FWPTS. GFH is a granular, ferric-based, non-regenerative media that adsorbs arsenic and other heavy metal ions from solution. The USEPA has identified GFH as an effective media to remove arsenic (USEPA 2003). This section describes the design philosophy, the treatment process, and the system configuration envisioned at this stage. This section also discusses the uncertainties with the ongoing design and the work that is currently underway or being planned to address these uncertainties.

5.1 Treatment System Description

Groundwater will be pumped and conveyed from the future water supply well in Arizona to the remedy freshwater storage tank. Water will be pumped from this tank and will be injected with hypochlorite for arsenic oxidation and with acid to reduce pH to 6.5; both hypochlorite and lower pH improve arsenic removal in the media vessels. After chemical injection, water will be passed through cartridge filters to remove solids that would otherwise clog the media, reducing performance and runtime. With the solids removed, the water will be divided into two or three streams (nominal or maximum flow) and each will be processed through a single treatment media vessel (configured in parallel) in a downward flow direction. Automatic valves will divert the flow to the proper vessels and will control the flow rate into each in service vessel. During nominal flow, the third and treatment media vessel will be in standby mode. During maximum flow, three treatment media vessels will be operating.

PG&E evaluated dechlorination alternatives to remove residual chlorine from the treated freshwater. The reason for this step is to prevent the dechlorination chemicals in the freshwater plume from adversely effecting microorganisms in the remediation zones. Dechlorination is often accomplished by addition of commonly used chemicals such as ascorbic acid, calcium thiosulfate, and hydrogen peroxide. The evaluation included cost-effectiveness and safety issues related with handling and storage, and the results showed calcium thiosulfate was the best. The equipment needed include chemical storage tanks or totes, metering pumps, and an inline static mixer. Due to climate condition at Topock, the equipment would be housed in an air-conditioned storage building.

5.2 Media Backwash & Replacement Process

The amount of wastewater generated is primarily a function of backwash frequency. Backwashing prevents over compaction of the media bed enabling good flow conditions. The media bed should be backwashed once a month for proper media maintenance. Backwashing occurs in an upflow mode, the reverse of normal forward down-flow operation. Once the backwash process is complete, normal forward down-flow operation may resume. Each media vessel backwash process is expected take ten minutes.

At some point during treatment operations, the media will lose its adsorptive capacity and will need to be replaced. Based on bench scale testing, this point is anticipated to be after more than 70,000 bed-volumes or about 8 months at maximum flow rates. The actual replacement frequency will be determined during full-scale operation. For the purpose of the conceptual design, it is assumed that the media will be replaced once a year. Spent media will be removed from each vessel and sent to a landfill. Prior experience operating GFH treatment process shows the spent media is not hazardous (Ela 2006). Waste characterization testing will be performed in accordance with state and federal requirements and facility waste acceptance procedures. Virgin media will be placed in the media vessel and normal forward down-flow operation may resume.

Wastewater & Solid Waste Generation

The volume of wastewater needing to be managed is estimated based on the following assumptions:

- Backwash rate is 15 gpm/sq. ft. and vessel cross section area is 50 sq. ft.
- Backwashing time is 10 minutes resulting in 7,550 gallons per backwash
- Four vessels backwashed monthly at 900 gpm and two vessels backwashed monthly at 450 gpm
- 95 percent of the backwash water is recycled to the beginning of the process

At 450 gpm – 7,550 gallons/backwash x 2 vessels per month x 12 months per year x 5% = 9,000 gallons per year

For 900 gpm – 7,550 gallons/backwash x 4 vessels per month x 12 months per year x 5% = 18,000 gallons per year

The remaining (5 percent of the) backwash water can be discharged to the TCS evaporation ponds or disposed offsite at permitted facilities. There is no need to treat or neutralize the pH of the discharged backwash water as it will be within acceptable ranges. Treated water is used for backwashing and no arsenic desorbs from the media during the backwashing process. Discharged backwash water will have more solids compared to the treated water but it will be able to be pumped to the TCS evaporation ponds or disposed offsite without treatment.

Periodic disposal of the spent GFH media would be required also as a solid waste stream. Based on the bench testing, this would be no more frequently than every 8 months, but is expected to be less frequent. For the purposes of this conceptual design, it is assumed that the media will require annual replacement. The mass of solid waste to be managed

- The media has a specific gravity of 1.1 with water density of 62.4 pounds per cubic foot
- Each vessel has 200 cubic feet of media
- Four vessels need replacement at a rate 900 gpm and 2 vessels at a rate of 450 gpm

At 450 gpm – 200 cubic feet/vessel x 2 vessels per year x 1.1 x 62.4 pounds per cubic foot / 2,000 tons/pound = 13.7 tons per year

At 900 gpm – 200 cubic feet/vessel x 4 vessels per year x 1.1 x 62.4 pounds per cubic foot / 2,000 tons/pound = 27.5 tons per year

5.3 Chemical and Media Use

Chemicals will be used in the treatment system. Chlorine in the form of calcium hypochlorite tablets is used to oxidize arsenite to arsenate. Arsenate is more readily removed by the treatment process. Acid is used in pretreatment to improve adsorption by lowering the pH to about 6.5. The estimated chemical use is shown in Exhibit 3.

EXHIBIT 3
Annual Chemical Usage Rates
Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum
PG&E Topock Compressor Station, Needles, California

Flow Case	Flowrate, gpm	Hypochlorite, pounds/year	93% Sulfuric Acid, gallons/year	Calcium Thiosulfate
Nominal	450	3,500	5,150	2,550
Maximum	900	7,000	10,300	1,275

5.4 Sustainability Summary

For each of the treatment plant operating scenarios (450 and 900 gpm), sustainability parameters such as waste generation, chemical usage, energy use, and greenhouse gas emissions were estimated for the FWPTS as shown on Exhibit 4.

EXHIBIT 4
Sustainability Summary [a]
Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum
PG&E Topock Compressor Station, Needles, California

	Operations								Construction	
Treatment Case	Chemical Truck Trips	Solid Waste Truck Trips	Electricity, kw-hr/yr	Wastewater Generation, MG/yr	Solid Waste Generated, tons/ year[b]	Chemical Use, gal/yr	Total Miles/ year	Emissions, CO2 eq, Tons/year[c]	CO2 eq, Tons [d]	Footprint, sf [e]
450 gpm	20	2	280,000	Minimal	17	21,300	7,000	180	210	2,400
900 gpm	39	~3	320,000	Minimal	33	42,500	13,000	200	250	3,900

Notes:
Units: kw-hr/year = kilowatt-hours per year; MG/yr = million gallons per year; gal = gallons; sf = square feet; gpm=gal per minute; CO2 eq – carbon dioxide equivalent
[a] Previously submitted on March 29, 2013. Additional effects for using a dechlorination agent if required will be added to this table in the 90% design submittal.
[b] Solid waste includes spent filter cartridges (500 to 1,000 per year)
[c] Operational emissions include vehicle emission and electricity generation
[d] Construction includes site work, material delivery, and workers travel
[e] Footprint based on foundations for building, process tanks, and chemical storage

5.5 Controls Philosophy

The system will be automated to reduce the need for continuous operator oversight. Electronic notifications will be sent automatically to on-site operators that notify them of system alarms, shutdown, or other issues. System automation will be controlled using a programmable logic controller that will communicate with the groundwater remedy supervisory control and data acquisition system. Pneumatic valves will be automated to control flow. Online pH, turbidity, and conductivity sensors will be incorporated to enable remote process monitoring and control. Arsenic cannot be monitored using an online analyzer. Grab samples will be collected periodically and analyzed using a bench top colorimetric instrument in the sample room (located in the Remedy Produced Water Conditioning Building) to monitor arsenic levels.

5.6 Other Related Systems and Infrastructure

Electricity will be provided from the Compressor Station. The new FWPTS location will have a heating, ventilation, and air conditioning (HVAC) system for only critical equipment such as electrical and controls equipment.

5.7 Design Philosophy/Uncertainties in Design

As previously mentioned, the FWPTS will be designed to achieve a safe, efficient, and sustainable operation within the compressor station over the anticipated decades-long life of the remedy. Most of the uncertainty in the design is related to the bed life and adsorptive capacity of the media. Based on bench testing, it is anticipated that the media will not need to be replaced before 70,000 bed volumes are processed– or every 8 months. The actual adsorptive capacity will need to be determined during full-scale operation and the result will greatly influence the amount of wastewater and solid waste generated by the process.

6.0 Design Information

Process calculations used to develop the design criteria were prepared using the conservative assumption that the treatment vessels each needed to be backwashed once a month and media replaced annually. Conceptual design information is presented in Tables 2, 3, and 4 and on Figures 4, 5, and 6.

7.0 References

California Department of Public Health. 2013. "Comparison of MCLs and PHGs for Regulated Contaminants in Drinking Water" Web page. Online: http://www.cdph.ca.gov/certlic/drinkingwater/Pages/MCLsandPHGs.aspx. Accessed March 22.

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Tables

TABLE 1A
HNWR-1 Analytical Results (November 2010 through January 2013)
Groundwater Remedy Operation and Maintenance Manual
Volume 3: Contingency Plan
PG&E Topock Compressor Station, Needles, California

	Location:	HNWR-01	HNWR-01	HNWR-01	HNWR-01	HNWR-01	HNWR-01
	Sample Date:	11/10/2010	2/23/2012	3/14/2012	4/4/2012	6/27/2012	1/22/2013
Parameter	**Units**						
Field							
Dissolved oxygen	mg/L	**5.33**	**3.52**	**3.29**	**3.72**	**---**	**---**
Oxidation reduction potential	mV	**159**	**172**	**200**	**112**	**33.5**	**---**
pH	pH units	**7.84**	**7.68**	**7.61**	**8.07**	**7.51**	**---**
Salinity	%	**0.42**	**0.0662**	**0.0537**	**0.0509**	**0.439**	**---**
Specific conductance	µS/cm	**870**	**1,024**	**830**	**787**	**6,791**	**---**
Temperature	°C	**35.9**	**38.3**	**38.1**	**38.0**	**37.9**	**---**
Turbidity	NTU	**5.10**	**5.10**	**2.50**	**---**	**8.00**	**---**
Anions							
Bromide	mg/L	**---**	**---**	**---**	**---**	**---**	**---**
Chloride	mg/L	**---**	**130**	**130**	**130**	**130**	**---**
Fluoride	mg/L	**3.80**	**---**	**---**	**---**	**4.00**	**3.90**
Nitrate (as nitrogen)	mg/L	**2.50**	**2.60**	**2.50**	**2.50**	**2.60**	**---**
Nitrite as Nitrogen	mg/L	**---**	**---**	**---**	**---**	**---**	**---**
Sulfate	mg/L	**47.0**	**45.0**	**44.0**	**45.0**	**44.0**	**---**
General Chemistry							
Alkalinity, bicarb as CaCO3	mg/L	**---**	**110**	**110**	**110**	**100**	**---**
Alkalinity, carb as CaCO3	mg/L	**---**	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	**---**
Alkalinity, hydroxide	mg/L	**---**	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	**---**
Alkalinity, total as CaCO3	mg/L	**100**	**110**	**110**	**110**	**100**	**---**
Ammonia as nitrogen	mg/L	ND (0.1)	**0.13**	**0.12**	**0.15**	ND (0.1)	**---**
Cyanide	mg/L	**---**	**---**	ND (0.01)	ND (0.01)	ND (0.01)	**---**
Deuterium	0/00	**-75.3**	**-73.8**	**---**	**---**	**-77.1**	**---**
Oxygen 18	0/00	**-10.3**	**-10.2**	**---**	**---**	**-10.2**	**---**
pH	pH units	**---**	**---**	**---**	**---**	**---**	**---**
Soluble silica	mg/L	**28.6**	**---**	**---**	**---**	**25.9**	**---**
Specific conductance	µS/cm	**740**	**---**	**---**	**---**	**---**	**---**
Total dissolved solids	mg/L	**490 J**	**480**	**510**	**430**	**440**	**---**
Total Kjeldahl Nitrogen	mg/L	ND (0.4)	**---**	**---**	**---**	**---**	**---**
Total organic carbon	mg/L	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	**---**
Total suspended solids	mg/L	**---**	**---**	ND (10)	**---**	ND (10)	**---**
Herbicides							
2,4,5-T	µg/L	**---**	**---**	ND (2.7)	ND (0.26)	**---**	**---**
2,4,5-TP (Silvex)	µg/L	**---**	**---**	ND (2.7)	ND (0.26)	**---**	**---**
2,4-D	µg/L	**---**	**---**	ND (2.7)	ND (0.26)	**---**	**---**
2,4-DB	µg/L	**---**	**---**	ND (2.7)	ND (0.26)	**---**	**---**
4-Nitrophenol	µg/L	**---**	**---**	ND (2.7)	**---**	**---**	**---**

TABLE 1A
HNWR-1 Analytical Results (November 2010 through January 2013)
Groundwater Remedy Operation and Maintenance Manual
Volume 3: Contingency Plan
PG&E Topock Compressor Station, Needles, California

Location:		HNWR-01	HNWR-01	HNWR-01	HNWR-01	HNWR-01	HNWR-01
Sample Date:		**11/10/2010**	**2/23/2012**	**3/14/2012**	**4/4/2012**	**6/27/2012**	**1/22/2013**
Parameter	**Units**						
Herbicides							
Dalapon	µg/L	---	---	ND (4.4)	ND (0.42)	---	---
Dicamba	µg/L	---	---	ND (2.7)	ND (0.26)	---	---
Dichlorprop	µg/L	---	---	ND (2.7)	ND (0.26)	---	---
Dinoseb	µg/L	---	---	ND (2.7)	ND (0.26)	---	---
MCPA	µg/L	---	---	ND (2.7)	ND (0.26)	---	---
MCPP	µg/L	---	---	ND (2.7)	ND (0.26)	---	---
Pentachlorophenol	µg/L	---	---	ND (2.7)	ND (0.26)	---	---
Metals							
Aluminum, dissolved	µg/L	ND (50)	---	ND (50)	ND (50)	ND (50)	---
Antimony, dissolved	µg/L	ND (10)	ND (10)	ND (10)	ND (0.5)	ND (0.5)	---
Arsenic	µg/L	---	---	---	---	---	**16.0**
Arsenic, dissolved	µg/L	**15.0**	**15.0**	**16.0**	**15.0**	**16.0**	**16.0**
Barium, dissolved	µg/L	**130**	**110**	**110**	**110**	**110**	---
Beryllium, dissolved	µg/L	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	---
Boron, dissolved	µg/L	**380**	---	---	---	---	---
Cadmium, dissolved	µg/L	ND (3.0)	ND (3.0)	ND (3.0)	ND (3.0)	ND (3.0)	---
Calcium, dissolved	µg/L	**23,000**	**19,000 J**	**19,000**	**20,000**	---	---
Chromium, Hexavalent	µg/L	**17.5**	**15.0**	**18.0**	**14.0**	**15.0**	---
Chromium, total dissolved	µg/L	**19.2**	**16.0**	**18.0**	**17.0**	**18.0**	---
Cobalt, dissolved	µg/L	ND (3.0)	ND (3.0)	ND (3.0)	ND (3.0)	ND (3.0)	---
Copper, dissolved	µg/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	---
Iron, dissolved	µg/L	ND (20)	**37.0**	ND (20)	**25.0**	**38.0**	---
Lead, dissolved	µg/L	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	---
Magnesium, dissolved	µg/L	**4,000**	**3,100**	**3,200 J**	**3,100 J**	---	---
Manganese, dissolved	µg/L	ND (10)	**1.90**	**0.64**	**1.70**	**1.70**	---
Mercury, dissolved	µg/L	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	---
Molybdenum, dissolved	µg/L	**11.0**	**9.40**	**10.0**	**9.00**	**9.10**	---
Nickel, dissolved	µg/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	---
Potassium, dissolved	µg/L	**5,100**	**4,400**	**4,000**	**3,700**	---	---
Selenium, dissolved	µg/L	**0.73**	**0.87**	**0.75**	**0.75**	**0.71**	---
Silver, dissolved	µg/L	ND (3.0)	ND (3.0)	ND (3.0)	ND (3.0)	ND (3.0) J	---
Sodium, dissolved	µg/L	**130,000**	**130,000**	**130,000**	**130,000**	---	---
Soluble silica	mg/L	---	---	---	---	---	---
Thallium, dissolved	µg/L	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	---
Vanadium, dissolved	µg/L	**20.0**	**21.0**	**22.0 J**	**20.0**	**20.0**	---
Zinc, dissolved	µg/L	ND (10)	ND (10)	**16.0**	ND (10)	ND (10)	---

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PG&E Topock Compressor Station, Needles, California

Location:		HNWR-01	HNWR-01	HNWR-01	HNWR-01	HNWR-01	HNWR-01
Sample Date:		**11/10/2010**	**2/23/2012**	**3/14/2012**	**4/4/2012**	**6/27/2012**	**1/22/2013**
Parameter	**Units**						
Perchlorate							
Perchlorate	µg/L	---	---	ND (2.0)	ND (2.0)	---	---
Pesticides							
4,4-DDD	µg/L	---	---	ND (0.053)	ND (0.052)	---	---
4,4-DDE	µg/L	---	---	ND (0.053)	ND (0.052)	---	---
4,4-DDT	µg/L	---	---	ND (0.053)	ND (0.052)	---	---
Aldrin	µg/L	---	---	ND (0.027)	ND (0.026)	---	---
alpha-BHC	µg/L	---	---	ND (0.027)	ND (0.026)	---	---
alpha-Chlordane	µg/L	---	---	ND (0.027)	ND (0.026)	---	---
beta-BHC	µg/L	---	---	ND (0.027)	ND (0.026)	---	---
delta-BHC	µg/L	---	---	ND (0.027)	ND (0.026)	---	---
Dieldrin	µg/L	---	---	ND (0.053)	ND (0.052)	---	---
Endo sulfan I	µg/L	---	---	ND (0.027)	ND (0.026)	---	---
Endo sulfan II	µg/L	---	---	ND (0.053)	ND (0.052)	---	---
Endosulfan sulfate	µg/L	---	---	ND (0.053)	ND (0.052)	---	---
Endrin	µg/L	---	---	ND (0.053)	ND (0.052)	---	---
Endrin aldehyde	µg/L	---	---	ND (0.053)	ND (0.052)	---	---
gamma-BHC	µg/L	---	---	ND (0.027)	ND (0.026)	---	---
gamma-Chlordane	µg/L	---	---	ND (0.027)	ND (0.026)	---	---
Heptachlor	µg/L	---	---	ND (0.027)	ND (0.026)	---	---
Heptachlor Epoxide	µg/L	---	---	ND (0.027)	ND (0.026)	---	---
Methoxy chlor	µg/L	---	---	ND (0.27)	ND (0.26)	---	---
Toxaphene	µg/L	---	---	ND (2.7) J	ND (2.6) J	---	---
Polyaromatic Hydrocarbons							
1-Methyl naphthalene	µg/L	---	---	ND (0.22)	ND (0.2)	---	---
2-Methyl naphthalene	µg/L	---	---	ND (0.22)	ND (0.2)	---	---
Acenaphthene	µg/L	---	---	ND (0.22)	ND (0.2)	---	---
Acenaphthylene	µg/L	---	---	ND (0.22)	ND (0.2)	---	---
Anthracene	µg/L	---	---	ND (0.22)	ND (0.2)	---	---
B(a)P Equivalent	µg/L	---	---	ND (0.19)	ND (0.18)	---	---
Benzo (a) anthracene	µg/L	---	---	ND (0.22)	ND (0.2)	---	---
Benzo (a) pyrene	µg/L	---	---	ND (0.22)	ND (0.2)	---	---
Benzo (b) fluoranthene	µg/L	---	---	ND (0.22)	ND (0.2)	---	---
Benzo (ghi) perylene	µg/L	---	---	ND (0.22)	ND (0.2)	---	---
Benzo (k) fluoranthene	µg/L	---	---	ND (0.22)	ND (0.2)	---	---
Chrysene	µg/L	---	---	ND (0.22)	ND (0.2)	---	---
Dibenzo (a,h) anthracene	µg/L	---	---	ND (0.22)	ND (0.2)	---	---

TABLE 1A
HNWR-1 Analytical Results (November 2010 through January 2013)
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PG&E Topock Compressor Station, Needles, California

Location:		HNWR-01	HNWR-01	HNWR-01	HNWR-01	HNWR-01	HNWR-01
Sample Date:		**11/10/2010**	**2/23/2012**	**3/14/2012**	**4/4/2012**	**6/27/2012**	**1/22/2013**
Parameter	**Units**						
Polyaromatic Hydrocarbons							
Fluoranthene	µg/L	---	---	ND (0.22)	ND (0.2)	---	---
Fluorene	µg/L	---	---	ND (0.22)	ND (0.2)	---	---
Indeno (1,2,3-cd) pyrene	µg/L	---	---	ND (0.22)	ND (0.2)	---	---
Naphthalene	µg/L	---	---	ND (0.22)	ND (0.2)	---	---
PAH High molecular weight	µg/L	---	---	ND (0.0)	ND (0.0)	---	---
PAH Low molecular weight	µg/L	---	---	ND (0.0)	ND (0.0)	---	---
Phenanthrene	µg/L	---	---	ND (0.22)	ND (0.2)	---	---
Pyrene	µg/L	---	---	ND (0.22)	ND (0.2)	---	---
Polychlorinated Biphenyls							
Aroclor 1016	µg/L	---	---	ND (0.53)	ND (0.52)	---	---
Aroclor 1221	µg/L	---	---	ND (1.1)	ND (1.0)	---	---
Aroclor 1232	µg/L	---	---	ND (0.53)	ND (0.52)	---	---
Aroclor 1242	µg/L	---	---	ND (0.53)	ND (0.52)	---	---
Aroclor 1248	µg/L	---	---	ND (0.53)	ND (0.52)	---	---
Aroclor 1254	µg/L	---	---	ND (0.53)	ND (0.52)	---	---
Aroclor 1260	µg/L	---	---	ND (0.53)	ND (0.52)	---	---
Radiochemistry							
Gross Alpha	pCi/L	---	---	---	---	---	---
Gross Beta	pCi/L	---	---	---	---	---	---
Total Petroleum Hydrocarbons							
Orthophosphate, dissolved	mg/L	---	---	---	---	---	---
TPH as diesel	µg/L	---	---	**190**	ND (51) J	---	---
TPH as gasoline	µg/L	---	---	ND (100)	ND (100)	---	---
TPH as motor oil	µg/L	---	---	ND (53)	ND (51)	---	---
Volatile Organic Compounds							
1,1,1,2-Tetrachloroethane	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
1,1,1-Trichloroethane	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
1,1,2,2-Tetrachloroethane	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
1,1,2-Trichloroethane	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
1,1-Dichloroethane	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
1,1-Dichloroethene	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
1,1-Dichloropropene	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
1,2,3-Trichlorobenzene	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
1,2,3-Trichloropropane	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
1,2,4-Trichlorobenzene	µg/L	---	---	ND (1.0)	ND (1.0)	---	---

TABLE 1A
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PG&E Topock Compressor Station, Needles, California

Location:		HNWR-01	HNWR-01	HNWR-01	HNWR-01	HNWR-01	HNWR-01
Sample Date:		**11/10/2010**	**2/23/2012**	**3/14/2012**	**4/4/2012**	**6/27/2012**	**1/22/2013**
Parameter	**Units**						
Volatile Organic Compounds							
1,2,4-Trimethylbenzene	µg/L	---	---	ND (1.0)	ND (1.0) J	---	---
1,2-Dibromo-3-chloropropane	µg/L	---	---	ND (2.0)	ND (2.0)	---	---
1,2-Dibromoethane	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
1,2-Dichlorobenzene	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
1,2-Dichloroethane	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
1,2-Dichloropropane	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
1,3,5-Trimethylbenzene	µg/L	---	---	ND (1.0)	ND (1.0) J	---	---
1,3-Dichlorobenzene	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
1,3-Dichloropropane	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
1,4-Dichlorobenzene	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
2,2-Dichloropropane	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
2-Chlorotoluene	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
4-Isopropyltoluene	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
Acetone	µg/L	---	---	ND (10)	ND (10)	---	---
Acrolein	µg/L	---	---	ND (20)	ND (20)	---	---
Acrylonitrile	µg/L	---	---	ND (20)	ND (20)	---	---
Benzene	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
Bromobenzene	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
Bromochloromethane	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
Bromodichloromethane	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
Bromoform	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
Bromomethane	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
Carbon disulfide	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
Carbon tetrachloride	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
Chloro methane	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
Chlorobenzene	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
Chloroethane	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
Chloroform	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
cis-1,2-Dichloroethene	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
cis-1,3-Dichloropropene	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
Dibromochloromethane	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
Dibromomethane	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
Dichlorodifluoromethane	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
Ethyl- benzene	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
Hexachlorobutadiene	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
Isopropylbenzene	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
Methyl ethyl ketone	µg/L	---	---	ND (10)	ND (10)	---	---

TABLE 1A
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Location:		HNWR-01	HNWR-01	HNWR-01	HNWR-01	HNWR-01	HNWR-01
Sample Date:		**11/10/2010**	**2/23/2012**	**3/14/2012**	**4/4/2012**	**6/27/2012**	**1/22/2013**
Parameter	**Units**						
Volatile Organic Compounds							
Methyl isobutyl ketone	µg/L	---	---	ND (10)	ND (10)	---	---
Methyl tert-butyl ether (MTBE)	µg/L	---	---	ND (1.0)	ND (1.0) J	---	---
Methylene chloride	µg/L	---	---	ND (5.0)	ND (5.0)	---	---
N-Butylbenzene	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
N-Propylbenzene	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
p-Chlorotoluene	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
sec-Butylbenzene	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
Styrene	µg/L	---	---	ND (1.0)	ND (1.0) J	---	---
tert-Butylbenzene	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
Tetrachloroethene	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
Toluene	µg/L	---	---	ND (2.5)	ND (2.5)	---	---
trans-1,2-Dichloroethene	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
trans-1,3-Dichloropropene	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
Trichloroethene	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
Trichlorofluoromethane (Freon 11)	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
Vinyl chloride	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
Xylene, m,p-	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
Xylene, o-	µg/L	---	---	ND (1.0)	ND (1.0)	---	---
Xylenes, total	µg/L	---	---	ND (2.0)	ND (2.0)	---	---

Notes:

---	not collected or not available.
%	percent
0/00	differences from global standards in ppt.
°C	degrees Celcius.
J	analyte was present, but reported value was estimated.
mg/L	milligrams per liter.
mV	millivolts.
ND	parameter not detected at the listed reporting limit.
NTU	nephelometric turbidity units.
µg/L	micrograms per liter.
µS/cm	microSiemens per centimeter.

TABLE 1B
HNWR-1 Analytical Results (October 2013 through February 2014)
Groundwater Remedy Operation and Maintenance Manual
Volume 3: Contingency Plan
PG&E Topock Compressor Station, Needles, California

Location:	HNWR-01	HNWR-01	HNWR-01	HNWR-01	HNWR-01	HNWR-01	HNWR-01
Sample Date:	10/22/2013	2/11/2014	2/12/2014	2/12/2014	2/12/2014	2/13/2014	2/14/2014
Time (hours):	--	1	6	12	24	48	72
Parameter / **Units**							
Anions							
Bromide mg/L	ND (0.5)	ND (0.5)	---	---	---	---	ND (0.5)
Chloride mg/L	**140**	**140**	---	---	---	---	140
Fluoride mg/L	**3.90**	**4.00**	**4.00**	**4.00**	**4.00**	**3.80**	3.90
Nitrate (as nitrogen) mg/L	**2.50**	**2.60**	**2.70**	**2.70**	**2.70**	**2.50**	2.50
Nitrite as Nitrogen mg/L	ND (2.5)	ND (1.0)	---	---	---	---	ND (1.0)
Sulfate mg/L	**45.0**	**45.0**	---	---	---	---	51.0
General Chemistry							
Deuterium 0/00	---	**-73.6**	**-73.4**	**-73.4**	**-73.4**	**-74.3**	-72.5
Oxygen 18 0/00	---	**-10.1**	**-10.4**	**-10.4**	**-10.4**	**-10.5**	-10.4
pH pH units	---	**7.90 J**	---	---	---	---	7.70 J
Total organic carbon mg/L	---	ND (1.0)	---	---	---	---	ND (1.0)
Herbicides							
2,4,5-T µg/L	---	ND (0.012)	---	---	---	---	ND (0.012)
2,4,5-TP (Silvex) µg/L	---	ND (0.016)	---	---	---	---	ND (0.016)
2,4-D µg/L	---	ND (0.065)	---	---	---	---	ND (0.065)
2,4-DB µg/L	---	ND (0.32)	---	---	---	---	ND (0.32)
Dalapon µg/L	---	ND (2.4) J	---	---	---	---	ND (2.4) J
Dicamba µg/L	---	ND (0.037)	---	---	---	---	ND (0.037)
Dichlorprop µg/L	---	ND (0.012)	---	---	---	---	ND (0.012)
Dinoseb µg/L	---	ND (0.04)	---	---	---	---	ND (0.04)
MCPA µg/L	---	ND (0.29) J	---	---	---	---	ND (0.29) J
MCPP µg/L	---	ND (0.3) J	---	---	---	---	ND (0.3) J
Metals							
Antimony, dissolved µg/L	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
Arsenic, dissolved µg/L	**14.0**	**16.0**	**16.0**	**16.0**	**16.0**	**15.0**	14.0
Barium, dissolved µg/L	**110**	**120**	**120**	**120**	**120**	**130**	120
Beryllium, dissolved µg/L	ND (1.0)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
Cadmium, dissolved µg/L	ND (3.0)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
Calcium, dissolved µg/L	---	**19,000**	---	---	---	---	23,000
Chromium, Hexavalent µg/L	**20.0**	**20.0**	**20.0**	**20.0**	**20.0**	**19.0**	19.0
Chromium, total dissolved µg/L	**17.0**	**18.0**	**19.0**	**19.0**	**19.0**	**17.0**	16.0
Cobalt, dissolved µg/L	ND (3.0)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
Copper, dissolved µg/L	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Iron, dissolved µg/L	---	ND (20)	---	---	---	---	ND (20)
Lead, dissolved µg/L	ND (10)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Magnesium, dissolved µg/L	---	**3,200**	---	---	---	---	4,200

TABLE 1B
HNWR-1 Analytical Results (October 2013 through February 2014)
Groundwater Remedy Operation and Maintenance Manual
Volume 3: Contingency Plan
PG&E Topock Compressor Station, Needles, California

	Location:	HNWR-01	HNWR-01	HNWR-01	HNWR-01	HNWR-01	HNWR-01	HNWR-01
	Sample Date:	10/22/2013	2/11/2014	2/12/2014	2/12/2014	2/12/2014	2/13/2014	2/14/2014
	Time (hours):	--	1	6	12	24	48	72
Parameter	**Units**							
Metals								
Manganese, dissolved	µg/L	---	ND (0.5)	---	---	---	---	ND (0.5)
Mercury, dissolved	µg/L	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
Molybdenum, dissolved	µg/L	**9.10**	**9.00**	**9.40**	**9.40**	**9.40**	**9.20**	8.90
Nickel, dissolved	µg/L	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Potassium, dissolved	µg/L	---	**4,100**	---	---	---	---	4,600
Selenium, dissolved	µg/L	**0.68**	**0.79**	**0.77**	**0.77**	**0.77**	**0.76**	0.75
Silver, dissolved	µg/L	ND (3.0)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
Sodium, dissolved	µg/L	---	**130,000**	---	---	---	---	140,000
Soluble silica	mg/L	**27.0**	**24.0**	**25.0 J**	**25.0 J**	**25.0 J**	**25.0**	27.0
Thallium, dissolved	µg/L	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
Vanadium, dissolved	µg/L	**20.0**	**18.0**	**19.0**	**19.0**	**19.0**	**17.0**	16.0
Zinc, dissolved	µg/L	**12.0**	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)
Perchlorate								
Perchlorate	µg/L	---	ND (2.0)	---	---	---	---	ND (2.0)
Pesticides								
4,4-DDD	µg/L	---	ND (0.05)	---	---	---	---	ND (0.052)
4,4-DDE	µg/L	---	ND (0.05)	---	---	---	---	ND (0.052)
4,4-DDT	µg/L	---	ND (0.05)	---	---	---	---	ND (0.052)
Aldrin	µg/L	---	ND (0.025)	---	---	---	---	ND (0.026)
alpha-BHC	µg/L	---	ND (0.025)	---	---	---	---	ND (0.026)
alpha-Chlordane	µg/L	---	ND (0.025)	---	---	---	---	ND (0.026)
beta-BHC	µg/L	---	ND (0.025)	---	---	---	---	ND (0.026)
delta-BHC	µg/L	---	ND (0.025)	---	---	---	---	ND (0.026)
Dieldrin	µg/L	---	ND (0.05)	---	---	---	---	ND (0.052)
Endo sulfan I	µg/L	---	ND (0.025)	---	---	---	---	ND (0.026)
Endo sulfan II	µg/L	---	ND (0.05)	---	---	---	---	ND (0.052)
Endosulfan sulfate	µg/L	---	ND (0.05)	---	---	---	---	ND (0.052)
Endrin	µg/L	---	ND (0.05)	---	---	---	---	ND (0.052)
Endrin aldehyde	µg/L	---	ND (0.05)	---	---	---	---	ND (0.052)
gamma-BHC	µg/L	---	ND (0.025)	---	---	---	---	ND (0.026)
gamma-Chlordane	µg/L	---	ND (0.025)	---	---	---	---	ND (0.026)
Heptachlor	µg/L	---	ND (0.025)	---	---	---	---	ND (0.026)
Heptachlor Epoxide	µg/L	---	ND (0.025)	---	---	---	---	ND (0.026)
Methoxy chlor	µg/L	---	ND (0.25)	---	---	---	---	ND (0.26)
Toxaphene	µg/L	---	ND (2.5)	---	---	---	---	ND (2.6)

TABLE 1B
HNWR-1 Analytical Results (October 2013 through February 2014)
Groundwater Remedy Operation and Maintenance Manual
Volume 3: Contingency Plan
PG&E Topock Compressor Station, Needles, California

Location:		HNWR-01	HNWR-01	HNWR-01	HNWR-01	HNWR-01	HNWR-01	HNWR-01
Sample Date:		10/22/2013	2/11/2014	2/12/2014	2/12/2014	2/12/2014	2/13/2014	2/14/2014
Time (hours):		--	1	6	12	24	48	72
Parameter	**Units**							
Polyaromatic Hydrocarbons								
1-Methyl naphthalene	µg/L	---	ND (0.2)	---	---	---	---	ND (0.21)
2-Methyl naphthalene	µg/L	---	ND (0.2)	---	---	---	---	ND (0.21)
Acenaphthene	µg/L	---	ND (0.2)	---	---	---	---	ND (0.21)
Acenaphthylene	µg/L	---	ND (0.2)	---	---	---	---	ND (0.21)
Anthracene	µg/L	---	ND (0.2)	---	---	---	---	ND (0.21)
Benzo (a) anthracene	µg/L	---	ND (0.2)	---	---	---	---	ND (0.21)
Benzo (a) pyrene	µg/L	---	ND (0.2)	---	---	---	---	ND (0.21)
Benzo (b) fluoranthene	µg/L	---	ND (0.2)	---	---	---	---	ND (0.21)
Benzo (ghi) perylene	µg/L	---	ND (0.2)	---	---	---	---	ND (0.21)
Benzo (k) fluoranthene	µg/L	---	ND (0.2)	---	---	---	---	ND (0.21)
Chrysene	µg/L	---	ND (0.2)	---	---	---	---	ND (0.21)
Dibenzo (a,h) anthracene	µg/L	---	ND (0.2)	---	---	---	---	ND (0.21)
Fluoranthene	µg/L	---	ND (0.2)	---	---	---	---	ND (0.21)
Fluorene	µg/L	---	ND (0.2)	---	---	---	---	ND (0.21)
Indeno (1,2,3-cd) pyrene	µg/L	---	ND (0.2)	---	---	---	---	ND (0.21)
Naphthalene	µg/L	---	ND (0.2)	---	---	---	---	ND (0.21)
Phenanthrene	µg/L	---	ND (0.2)	---	---	---	---	ND (0.21)
Pyrene	µg/L	---	ND (0.2)	---	---	---	---	ND (0.21)
Polychlorinated Biphenyls								
Aroclor 1016	µg/L	---	ND (0.5)	---	---	---	---	ND (0.52)
Aroclor 1221	µg/L	---	ND (1.0)	---	---	---	---	ND (1.0)
Aroclor 1232	µg/L	---	ND (0.5)	---	---	---	---	ND (0.52)
Aroclor 1242	µg/L	---	ND (0.5)	---	---	---	---	ND (0.52)
Aroclor 1248	µg/L	---	ND (0.5)	---	---	---	---	ND (0.52)
Aroclor 1254	µg/L	---	ND (0.5)	---	---	---	---	ND (0.52)
Aroclor 1260	µg/L	---	ND (0.5)	---	---	---	---	ND (0.52)
Radiochemistry								
Gross Alpha	pCi/L	---	**7.42**	---	---	---	---	6.34 J
Gross Beta	pCi/L	---	ND (4.0)	---	---	---	---	ND (4.0)
Total Petroleum Hydrocarbons								
Orthophosphate, dissolved	mg/L	---	ND (0.02)	---	---	---	---	ND (0.02)
TPH as diesel	µg/L	---	ND (50)	---	---	---	---	ND (50)
TPH as gasoline	µg/L	---	ND (100)	---	---	---	---	ND (100)
TPH as motor oil	µg/L	---	ND (50)	---	---	---	---	ND (50)

Notes:

---	not collected or not available.
0/00	differences from global standards in ppt.
J	analyte was present, but reported value was estimated.
mg/L	milligrams per liter.
ND	parameter not detected at the listed reporting limit.
NTU	nephelometric turbidity units.
pCi/L	picocurries per liter.
µg/L	micrograms per liter.

TABLE 2

Design Criteria for Arsenic Treatment System

Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum
PG&E Topock Compressor Station, Needles, California

Subject	Criteria	Comments/Reason
OPERATIONAL CRITERIA		
Maximum Groundwater Injection Flow Capacity	900 gpm	
Minimum Groundwater Injection Flow Capacity	150 gpm	
Average Groundwater Injection Flow Capacity	450 gpm	
SITE CIVIL		
Location	Designated freshwater treatment at PG&E Topock Compressor Station near Needles, California. Next to the Remedy Produced Water Conditioning Building, within the footprint of the planned Decontamination Pad	
Building Finish Floor Elevation	Finished first floor, Elevation 626 feet (NGVD88).	
Grading	Longitudinal Slopes: Minimum 1% away from structures (2% desirable).	
Vehicle Access	WB 50 (turning radius for semi-truck and trailer with 50-foot wheel base). HS 20 (wheel loading on access roadways and parking areas). 50-foot minimum turning radius. Designated site accommodates truck circulation. Roads will be constructed at new facility for maintenance activities.	Required for delivery of chemicals, pumps, motors, and fire vehicles.
Site Constraints	Proposed facility located within the boundary of the compressor station. Access to all critical compressor station facilities must be maintained.	No modifications to the perimeter site fence or entrance gate will be made.
Parking	No parking will be required for new facility.	
Pedestrian Traffic	Limited to paved roadways, sidewalks are not located between existing facilities.	
PROCESS EQUIPMENT, MOTORS, VALVES, AND ANCILLARIES		
Treatment Process	Pre-oxidation, influent pH adjustment, followed by ligand exchange with granular ferric hydroxide for arsenic removal. Periodic backwash of media with treated water and annual media replacement. Treated water will be dechlorinated to limit adverse effects on microorganisms and remedy performance (see Dechlorination System below).	Design criteria listed below is what is expected from planned pre-purchase bid, but not a guarantee of what equipment will be selected.

TABLE 2

Design Criteria for Arsenic Treatment System

Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum
PG&E Topock Compressor Station, Needles, California

Subject	Criteria	Comments/Reason
Granular Ferric Hydroxide (GFH) Treatment		
Treatment Objective	Arsenic removal	
Number of Vessels	Three when operating a maximum flow: Three online. Two online when operating at nominal flow;	Three vessels were included in the 90% design instead of four following a value engineering evaluation. Three vessels on-line will meet treatment requirements and have a very small effect on performance because the total downtime during backwashing (i.e., vessel is off-line) is 30 minutes per month (<0.1% of time).
Residence Time	5 minutes empty bed contact time	USEPA guidance.
Vessel Height	10.5 feet overall	
Vessel Diameter	8 feet	4 to 8 gpm/ft^2 hydraulic loading.
Materials of Construction	Low-carbon steel with epoxy lining that is NSF 61 listed.	
Media	Granular ferric hydroxide	Siemens, Severn Trent, or equal
Performance Limits		
Effluent Arsenic Concentration	< 10 µg/L	
Wastewater Volume	9,000 – 18,000 gal/year	
Chlorine Feed System		
Chemical Feed System	One calcium hypochlorite tablet feeder system—HDXLPE (with oxidation resistant liner) mix tank, feed pump, tablet hopper, controller and panel with disconnect. Sized for 0.2 to 2 lbs/hour of chlorine. Three days' minimum tablet capacity.	Feed system located in a containment area.
Safety Equipment	One eyewash and shower unit	Located in chemical storage area.
Coatings/Finishes	Chemical resistant coatings in chemical areas	
Controls	Chemical feed pump speed control	
Sulfuric Acid Feed System		
Chemical Feed System	One 1,000-gallon carbon steel with baked phenolic lining. Desiccant drier installed on vent. Sulfuric acid tank with tank pad. One chemical feed skid with two controllable chemical feed pumps (up to 2 gal/hour)	Tank will be located in a containment area. Monthly fill frequency is the design basis. Solution concentration will be 93%.
Safety Equipment	One eyewash and shower unit	Located in chemical storage area.
Coatings/Finishes	Chemical resistant coatings in chemical areas	
Controls	Chemical feed pump speed control	
Backwash Tank and Treated Water Tank		
Material	Fiberglass Reinforced Plastic (FRP)	
Number	Two	

TABLE 2

Design Criteria for Arsenic Treatment System

Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum
PG&E Topock Compressor Station, Needles, California

Subject	Criteria	Comments/Reason
Capacity	10,000-gallons tanks	Backwash is anticipated to be just over 7,000 gallons per vessel – 10 minutes of backwashing at 15 gpm/ft^2. Backwash tank will have floating decanter and cone bottom to aid in solids recovery and improve backwash recycle rate. Treated water tank will be flat-bottomed. Both tanks will be equipped with ladders and top access platforms with safety cages and railings.
Dechlorination System		Chemical selected for use in dechlorination is calcium thiosulfate.
Chemical Feed System	Drums or chemical tote compatible with calcium thiosulfate. One chemical feed skid with two controllable chemical feed pumps	Container will be located in a containment area. Monthly fill frequency is the design basis, It is assumed there is sufficient space for this equipment.
Safety Equipment	One eyewash and shower unit	Located in chemical storage area.
Coatings/Finishes	Chemical resistant coatings in chemical areas	
Controls	Chemical feed pump speed control Inline static mixer	
Flow Meters		
Type	Magnetic	
Number	Seven	
Flow Control Strategy	FWPTS will receive raw water from the primary source well (HNWR-1A) into a new freshwater storage tank (10,000 gallons). The secondary sources (HNWR-1 and Site B) may be connected to the pipeline in the future. PG&E is considering augmenting the supply with a gravity flow line from the existing TCS storage tanks only when required.) A booster pump with variable frequency drive will vary the flow through the treatment plant to maintain set point water levels in the treated water tank and prevent pump operating when the remedy freshwater storage tank water levels are below the setpoint. Media vessel inlet control valves equalize flows through each vessel based on flowmeters located downstream of each media vessel.	
Pressure Transmitters	Furnished before/after media vessels.	
Static Mixer		
Number	Two (at the inlet and outlet)	
Diameter	10-inch	
Type	Wafer style with integral injection ports	

TABLE 2

Design Criteria for Arsenic Treatment System

Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum
PG&E Topock Compressor Station, Needles, California

Subject	Criteria	Comments/Reason
Piping Materials		
Process	HDPE SDR 11 or CPVC Schedule 80, per ASTM D1784, ASTM D1785, and NSF/ANSI 14 and NSF 61 listed	
Treatment Media Vessel Manifold	HDPE SDR 11 or CPVC Schedule 80, per ASTM D178, ASTM D1785, NSF/ANSI 14 and NSF-61 listed	
Potable Water	Buried: Copper, Type K, per ASTM B88 Exposed: Copper, Type L, per ASTM B88 or CPVC Sch. 80	
Process Piping Installation	Major process piping headers will be installed in pipe trenches inside the treatment building and buried outside the building. Media vessel piping will be aboveground. Actuated valves will be installed above grade whenever possible.	
Remedy freshwater storage tank Interface	Inlet from Remedy freshwater storage tank	
YARD PIPING		
Design Criteria	Appendix C, Basis of Design Report (CH2M HILL 2014)	
CORROSION CONTROL		
Design Criteria	Appendix C, Basis of Design Report (CH2M HIL, 2014)	
ARCHITECTURAL/STRUCTURAL		
Building Code	Appendix C, Basis of Design Report (CH2M HILL 2014)	
Building Design Concept	Single building adjacent to Remedy Produced Water Conditioning System	
Building Construction Materials	Appendix C, Basis of Design Report (CH2M HILL 2014)	
Loads	Appendix C, Basis of Design Report (CH2M HILL 2014)	
HVAC		
Codes/Standards	Appendix C, Basis of Design Report (CH2M HILL 2014)	
Design Conditions		
Site Elevation	See Section C.2 Civil, Appendix C, Basis of Design Report (CH2M HILL 2014)	
Cooling Load Basis	Building envelope heat gain and internal heat gains from equipment.	
System Type		
Process Building	A free standing electrical and controls equipment panel will be installed. The panel will have dedicated cooling system.	
PLUMBING		
Lavatory/Toilet Room	No facilities provided.	
Potable Water	Emergency shower/eye wash stations.	Per 2010 California Plumbing Code, and ANSI Z358.1.

TABLE 2

Design Criteria for Arsenic Treatment System

Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum
PG&E Topock Compressor Station, Needles, California

Subject	Criteria	Comments/Reason
Non-potable Water	The non-potable water supply will have a reduced pressure backflow preventer. Non-potable water will be supplied for wash down water. Wash down hose valves, hoses and hose racks will be furnished in the area as required.	Per 2010 California Plumbing Code.
ELECTRICAL		
Electrical Load	The electrical load will consist of process pumps, motor operated valves, filter system, control panel and instrumentation, building HVAC, convenience receptacles and interior and exterior lighting. Power distribution will be sized in accordance with NFPA 70 (National Electric Code) to operate process and facility loads. Short-circuit current interrupting capacity of power distribution equipment will be coordinated with existing power distribution system.	.
Service Voltage	480V, 3-phase, 3-wire power will be supplied from XFMR 099	
Utilization Voltage	Appendix C, Basis of Design Report (CH2M HILL 2014)	
Redundancy Requirements	Power distribution system redundancy will be limited to equipment supporting the operation of back-up process and facility equipment (i.e. motor control combination starters, and breakers,). Power distribution system for FWPTS will incorporate spare breakers and fuses. Supporting quick replacement of failed components. Backup power when needed by portable diesel generator located near Remedy Produced Conditioning Building.	.
Manufacturers of Electrical Equipment, Grounding, Lightning Protection, Illumination, Emergency Lights, Stand-by/Backup Power, Raceways, and Duct Banks	Appendix C, Basis of Design Report (CH2M HILL 2014)	
SECURITY		
Security	None	All security covered through TCS main facility
CONTROL AND TELEMETRY		
Control and Telemetry Design Criteria	The treatment vessels will be a packaged system with the equipment manufacturer providing a fully configured programmable logic controller based system control panel with panel-mounted operator interface terminal. The control panel will be specified with an uninterruptible power supply to provide true online conditioned power sized to operate the connected load for 30 minutes.	

TABLE 2

Design Criteria for Arsenic Treatment System

Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum
PG&E Topock Compressor Station, Needles, California

Subject	Criteria	Comments/Reason
Communications, Other Networks, Supervisory Control and Data Acquisition, Instrumentation	Appendix C, Basis of Design Report (CH2M HILL 2014)	
Environmental Requirements	Equipment and instrumentation will be suitable for the following conditions: Air-conditioned Spaces: 10°C to 35°C and a relative humidity of 10 to 80 percent. Non-air-conditioned Spaces: 0°C to 50°C and a relative humidity of 10 to 95 percent. Outdoors: 0°C to 60°C and a relative humidity of 5 to 100 percent.	Environmental controls, such as heaters, fans, and air conditioning will be provided to maintain equipment within the operating conditions recommended by the manufacturer.
Standards/References	Appendix C, Basis of Design Report (CH2M HILL 2014)	

TABLE 3
Major Equipment List
Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum
PG&E Topock Compressor Station, Needles, California

Quantity	Name	Description
3	Treatment Media Vessels	8-feet-diameter low-carbon steel with epoxy lining (4 - 8 gpm/ft^2 hydraulic loading rate)
1	Hypochlorite Feeder	Calcium hypochlorite tablet feeder: HDXLPE (with oxidation-resistant liner) mix tank, feed pump, tablet hopper, controller, and panel with disconnect
1	Sulfuric Acid Tank	1,000-gallon, (93% sulfuric acid), desiccant drier installed on vent. Baked phenolic lining on steel.
1	Acid Feed System	Pre-engineered skid with two chemical metering pumps for 93% sulfuric acid (0.5 to 2 gph)
1	Dechlorination System	Pre-engineered chemical feed skid to pump calcium thiosulfate, storage tote(s) or tanks, and static mixer. Air-conditioned chemical storage shed will be provided to maintain chemical quality.
2	Pre-and post-treatment Wafer-Style Static Mixers	With integral injection ports
2	Booster Pumps	Centrifugal pump with variable frequency drive
2	Filters skids with replaceable elements	Package unit with differential pressure indication and alarm and flow control valves to divert water to the online filter. Cartridge type
2	Backwash Recycle Pumps	Multistage centrifugal pump
2	Backwash Pumps	Centrifugal pump 755 gpm (15 gpm/ft^2 hydraulic loading rate)

TABLE 4

Mass Balance Table

Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum
PG&E Topock Compressor Station, Needles, California

Stream # (see Figure 4)	1	2	3	4	5	6	7
Waste Stream	Downstream of the Booster Pumps	To the Media Filters	To the Treated Water Tank	To the Injection Wells	Backwash	Recycle	Liquid Phase Separators in Remedy Produced Water Conditioning Building
Maximum Flow (gpm)	900	900	900	900			
Maximum Flow (ac-ft/Year)	1,452	1,452	1,452	1,452			
Arsenic (mg/L)	0.015	0.015	0.001	0.001	0.001		
Arsenic (lbs/yr)	59.1	59.1					
pH	8.0	6.5	6.5	6.5	6.5		
Chlorine (mg/L)	0	1.15	1.15	1.15	1.15		
Calcium Hypochlorite (lb/year)		6,969					
Sulfuric Acid (mg/L)		40					
Acid (gal/year)		10,297					
Dechlorination Agent (mg/L)					74		
Dechlorination Agent (gal/yr)					2,550		
Wastewater Volume (MG/yr)					0.36	0.344	0.018
Wastewater Volume (ac-ft/yr)					1.11	1.055	0.056
Nominal Flow (gpm)	450	450	450	450			
Nominal Flow (ac-ft/Year)	726	726	726	726			
Arsenic (mg/L)	0.015	0.015	0.001	0.001	0.001		
Arsenic (lbs/yr)	29.5	29.5					
pH	8.0	6.5	6.5	6.5	6.5		
Chlorine (mg/L)	0	1.15	1.15	1.15	1.15		
Calcium Hypochlorite (lb/year)		3,485					
Sulfuric Acid (mg/L)		40					
Acid (gal/year)		5,148					
Dechlorination Agent (mg/L)					74		
Dechlorination Agent (gal/yr)					1275		
Wastewater Volume (MG/yr)					0.18	0.172	0.009
Waste Volume (ac-ft/yr)					0.56	0.528	0.028

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GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CA

PROCESS

FRESHWATER PRE-INJECTION TREATMENT SYSTEM – MASS BALANCE

SHEET	
DWG NO.	
DATE	8/21/2014 01:35
REV	1

PRINTED AUGUST 9, 2014 06:39

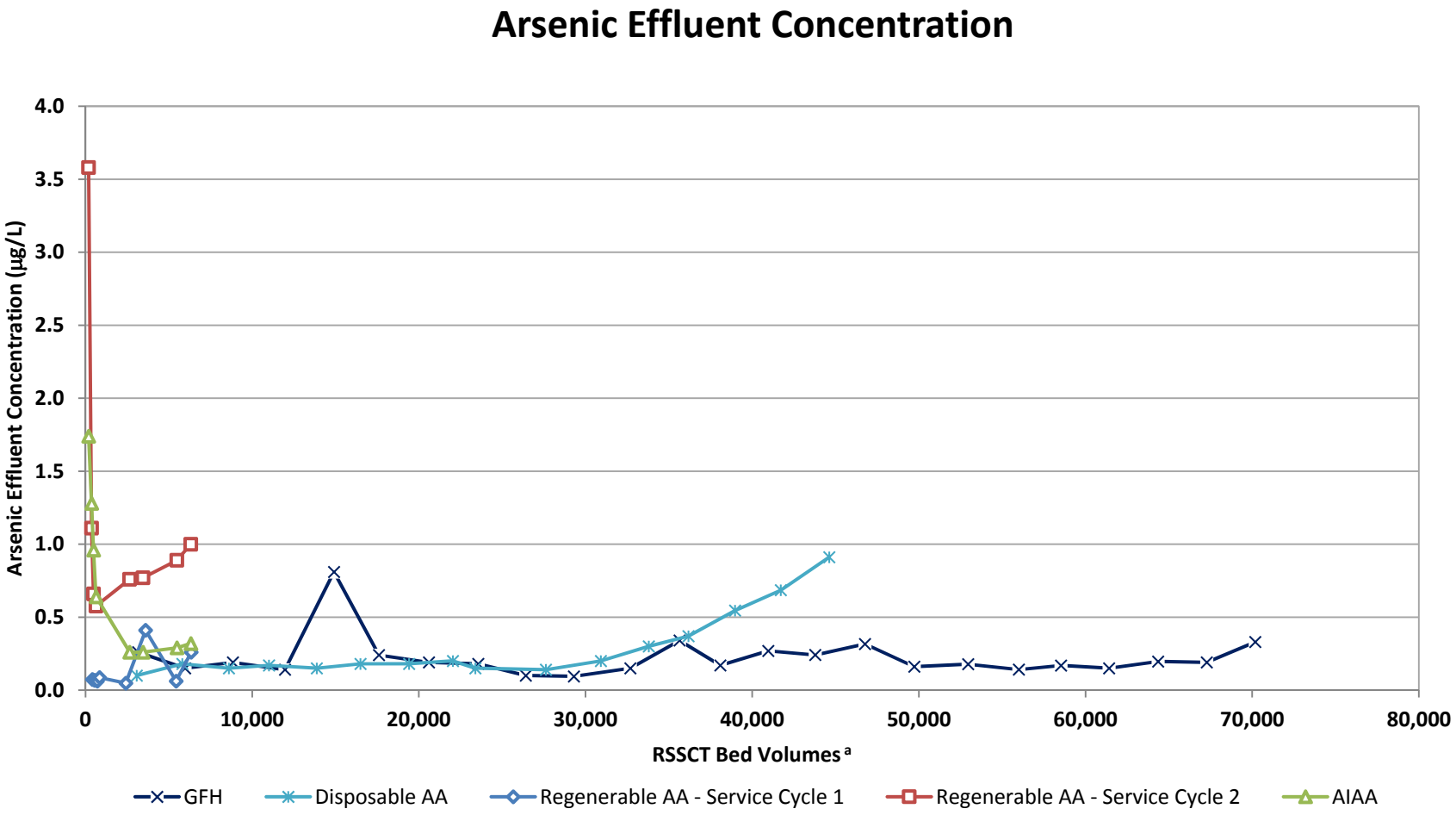
Figures

FIGURE 1

Arsenic Effluent Concentration versus Bed Volumes

Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum

PG&E Topock Compressor Station, Needles, California



Notes:

a. One bed-volume is equivalent to the amount of adsorptive media in the column. At maximum flow, this equates to about 289 bed volumes per day.

FIGURE 2

Arsenic Effluent and Adsorption Rate

Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum
PG&E Topock Compressor Station, Needles, California

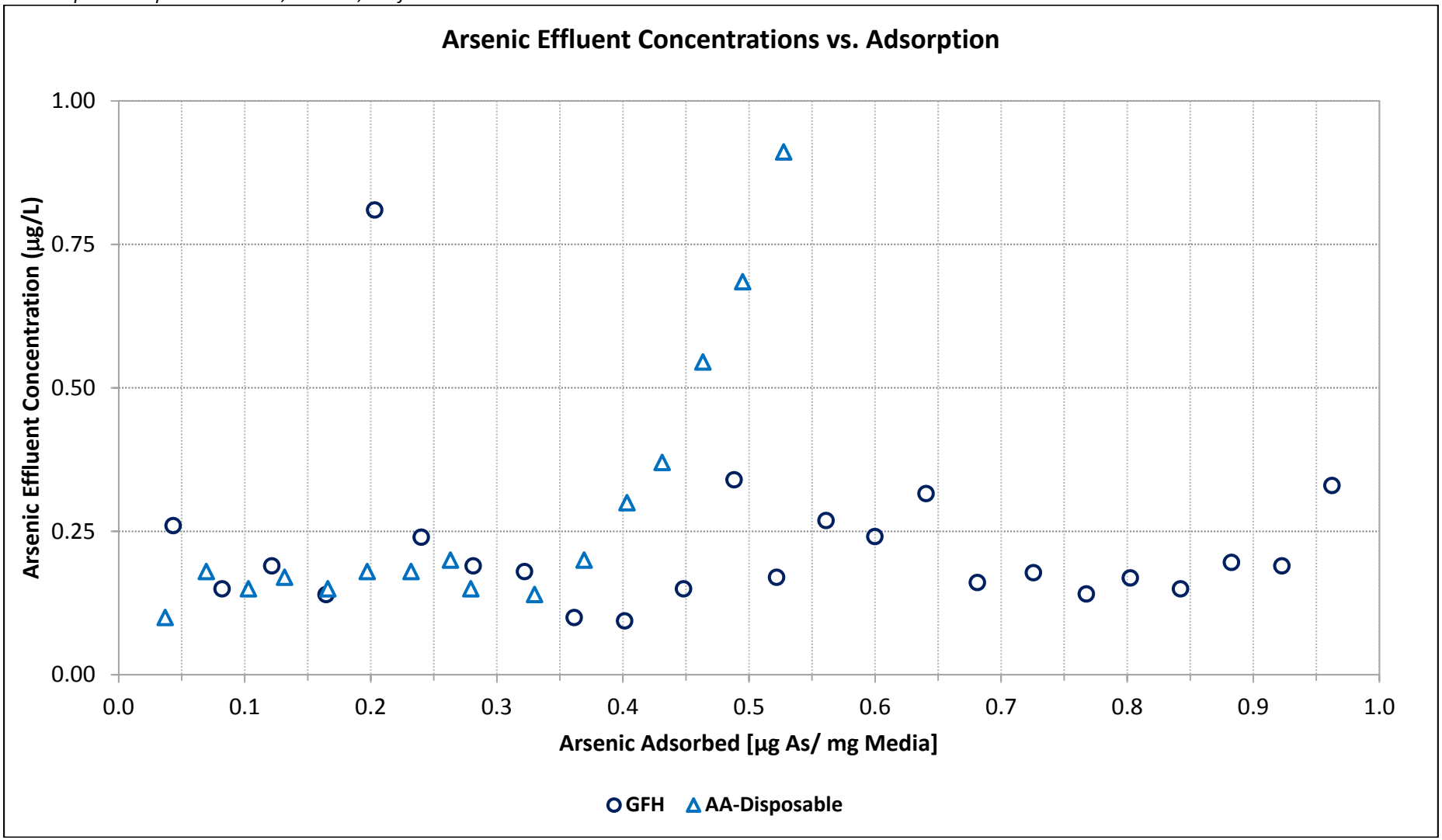


FIGURE 3

Jar Test Results

Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum
PG&E Topock Compressor Station, Needles, California

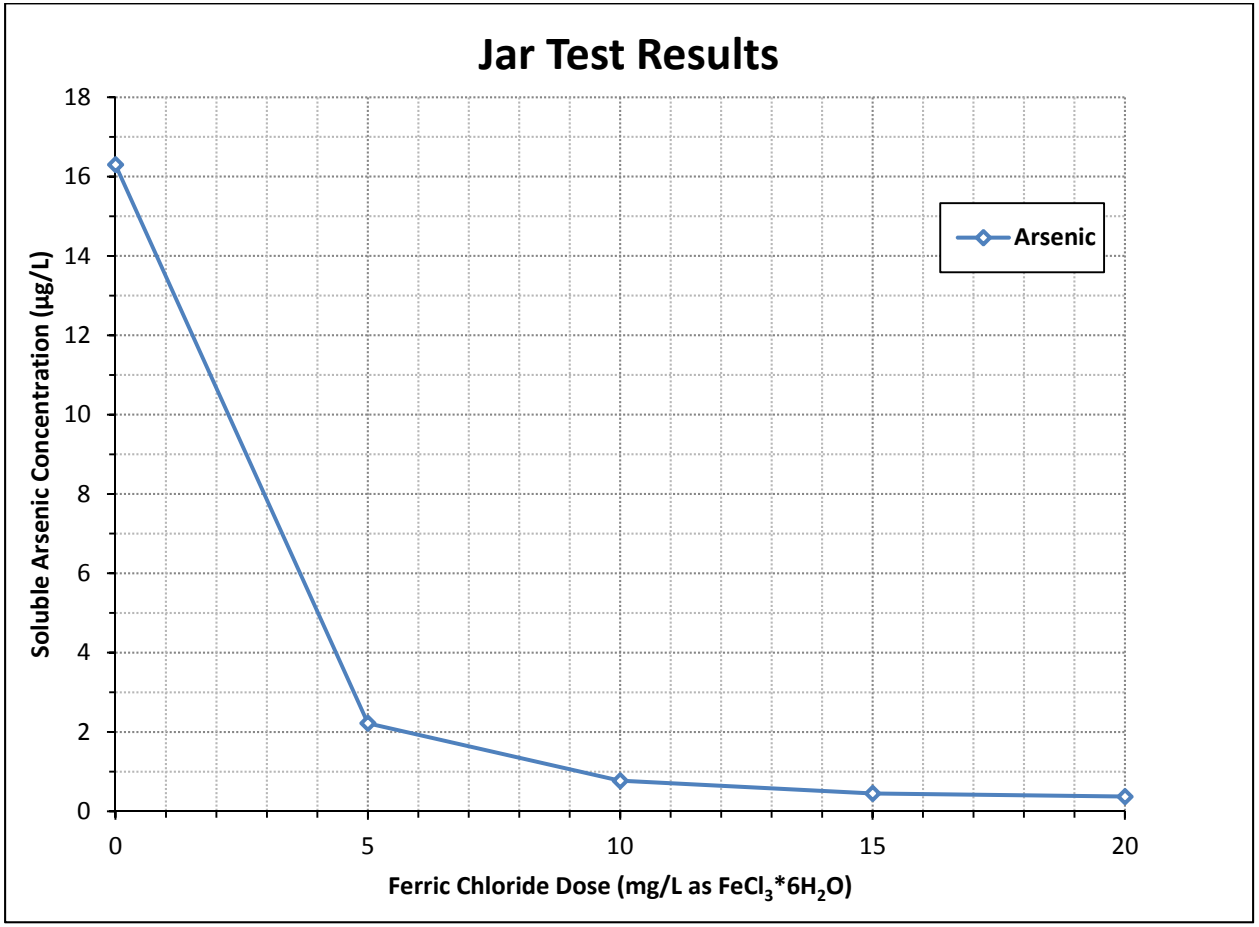
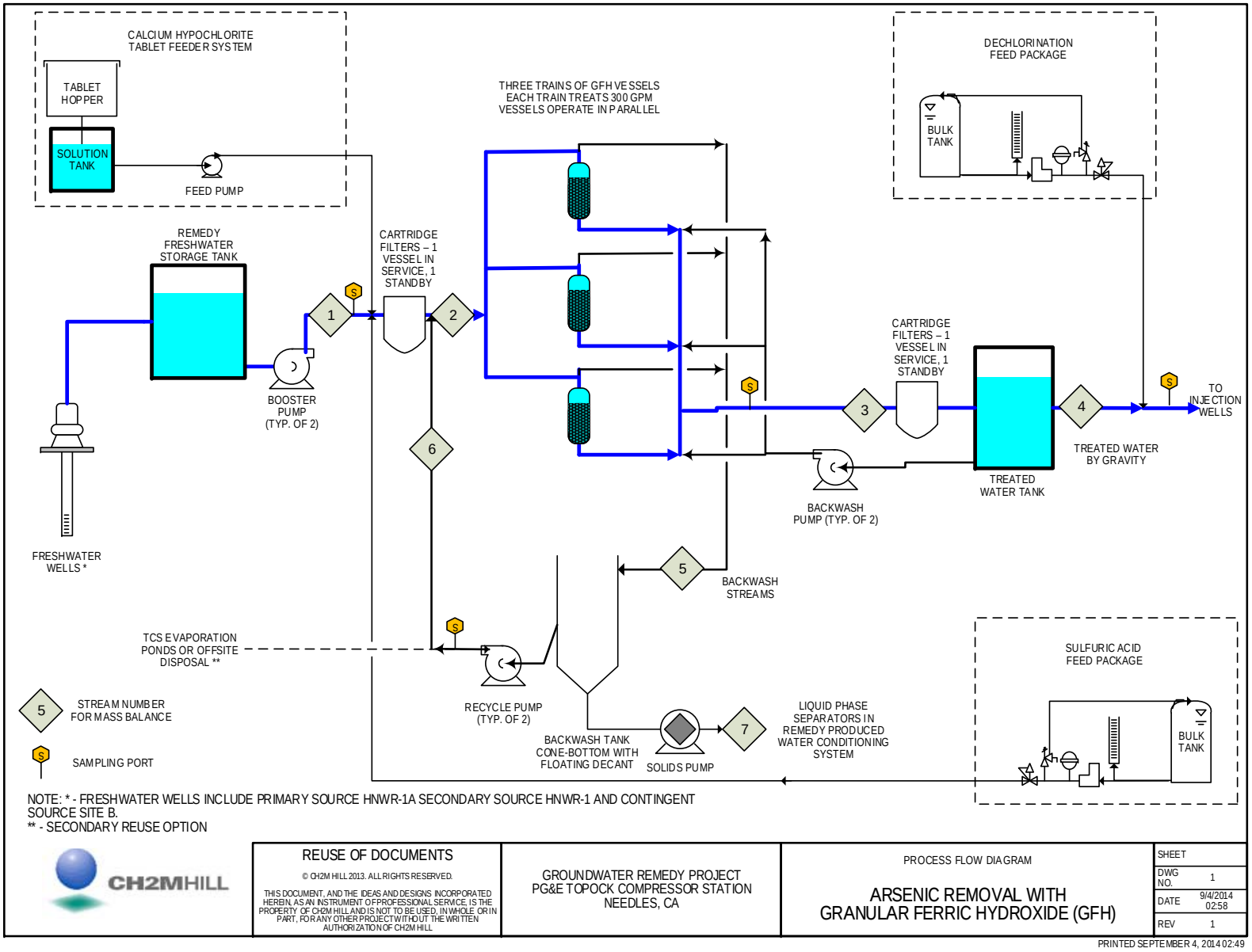


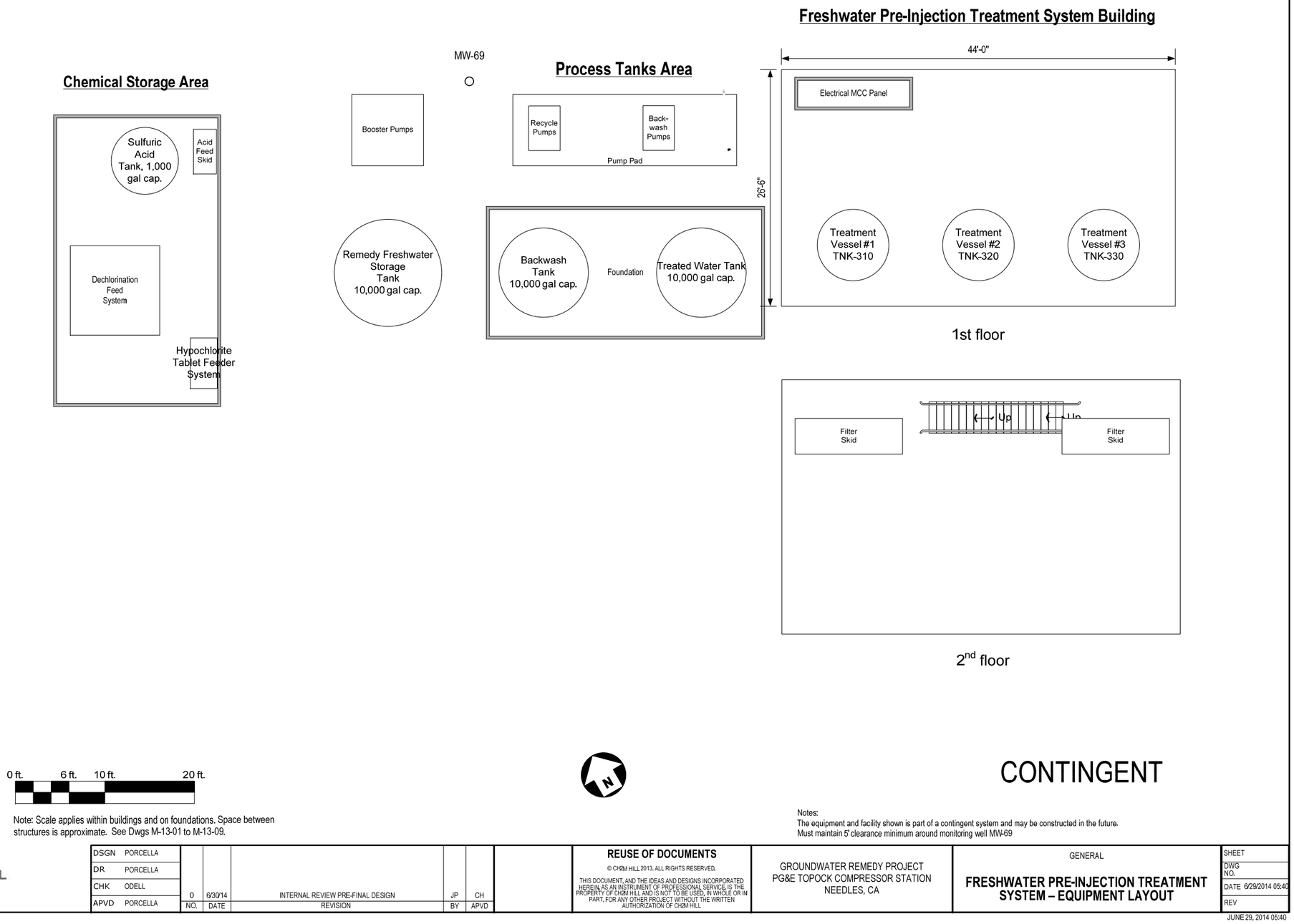
FIGURE 4

Process Flow Diagram

Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum

PG&E Topock Compressor Station, Needles, California





DSGN	PORCELLA						
DR	PORCELLA						
CHK	ODELL						
APVD	PORCELLA	0	6/30/14	INTERNAL REVIEW PRE-FINAL DESIGN	JP	CH	
		NO.	DATE	REVISION	BY	APVD	

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GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CA

GENERAL

FRESHWATER PRE-INJECTION TREATMENT SYSTEM – EQUIPMENT LAYOUT

SHEET
DWG NO.
DATE 6/29/2014 05:40
REV

JUNE 29, 2014 05:40

FIGURE 5
Equipment Layout
Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum
PG&E Topock Compressor Station, Needles, California

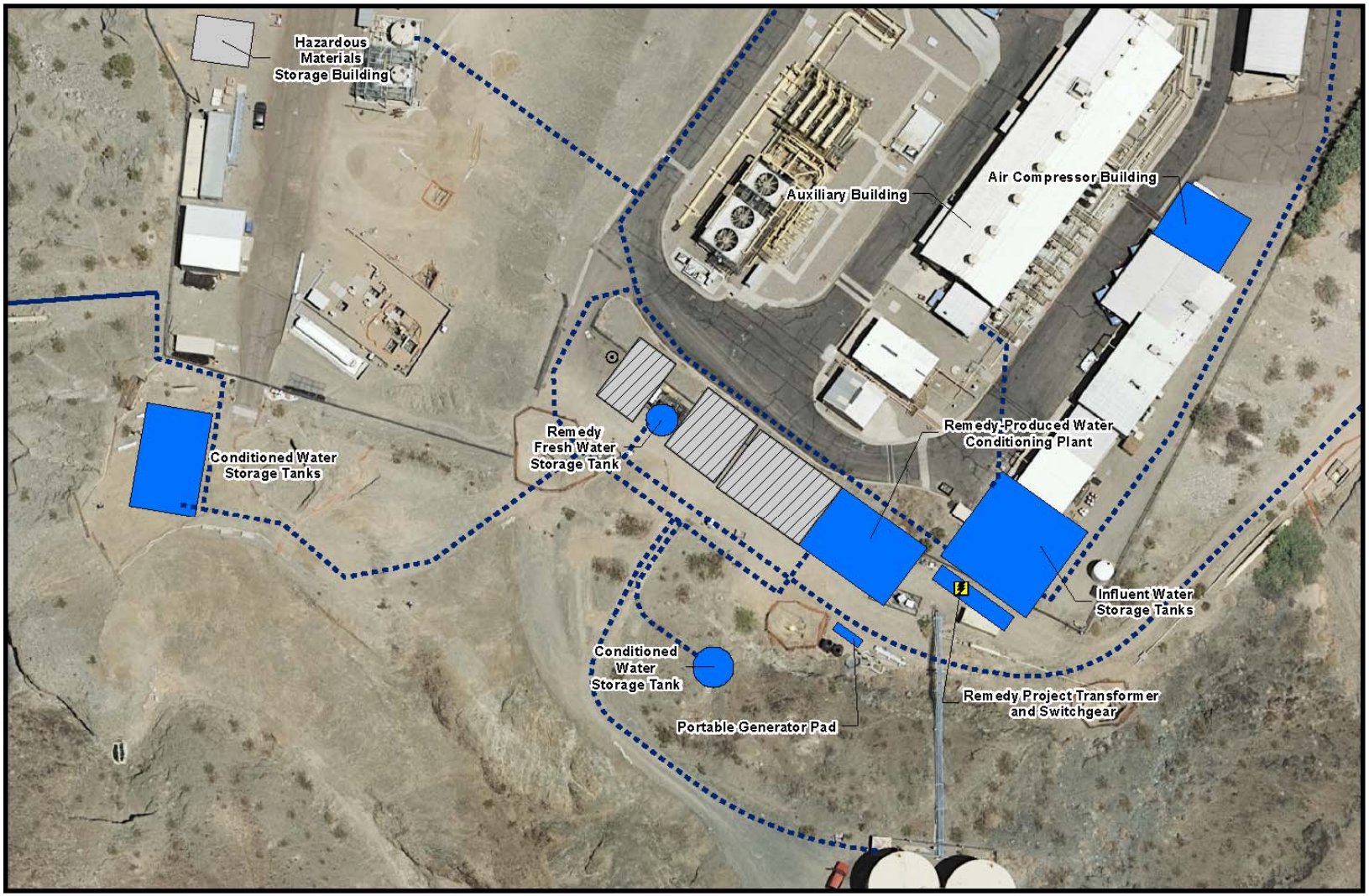


FIGURE 6

Site Layout

Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum
PG&E Topock Compressor Station, Needles, California

Attachment A
Arsenic and Fluoride Treatment Technology Screening

ATTACHMENT A

Arsenic and Fluoride Treatment Technology Screening

As part of the pre-conceptual design work, several treatment technologies were identified and screened to help select an effective and efficient treatment process for two removal processes -- arsenic/fluoride removal and arsenic only removal. After technology identification, the list was screened qualitatively with a more detailed screening was completed on a short list of five technologies. Bench-scale testing was then performed to select the technology to carry forward into design.

A.1 Initial Screening

The United States Environmental Protection Agency, water and wastewater utilities, industrial concerns, research universities and centers, and industry groups have published numerous case studies and reports on testing and performance of these technologies in treating arsenic and fluoride in water (American Water Works Association, 1999; Odell, 2010). The initial list of technologies evaluated for the Topock freshwater pre-injection treatment system was developed from those technologies that have been successfully used by municipalities and industry. Unproven technologies or technologies that have not been used in full-scale applications were not considered in the screening. The initial list included anion exchange, activated alumina (AA), reverse osmosis (RO), electrodialysis reversal (EDR), lime softening, distillation, iron-based adsorbents, titanium-based adsorbents, and coagulation/filtration. The status of selection is summarized in Table A-1.

TABLE A-1
Technologies Considered for Arsenic and Fluoride Removal
Addendum to Freshwater Pre-injection Treatment System Design Basis Memorandum
PG&E Topock Compressor Station, Needles, California

Technology	Status
Anion exchange	Screened out, significant waste generation.
Activated Alumina (AA)	Selected for bench-testing. Primary treatment option is regenerable AA if arsenic and fluoride treatment required.
Titanium-based adsorbents	Screened out, similar as other adsorbents considered, with less experience.
Reverse Osmosis (RO)	Screened out, significant waste generation.
Electrodialysis Reversal (EDR)	Screened out, significant waste generation.
Lime Softening	Screened out, significant waste generation.
Distillation	Screened out, significant energy use and capital cost.
Coagulation Filtration	Screened out, this process does not treat fluoride. If arsenic-only treatment is required, this technology would be screened out due to more residuals are generated, additional chemicals are used, and the process is more complex than iron-based adsorbents. However, it will be retained for bench-scale testing for data collection due to the quick and simple test.
Iron-based Adsorbents	Screened out, this process does not treat fluoride. If arsenic-only treatment required, this process may be used.

A brief process description is provided below.

Anion Exchange. Anions such as fluoride, nitrate, arsenate, selenate, and chromate can be removed from water by using ion exchange with resin. This physical-chemical process involves an easily displaceable ion on the solid phase, exchanging with an unwanted ion in the water that adsorbs to the solid phase. To accomplish the exchange reaction, a packed bed of ion-exchange resin beads is used. Source water is continually passed through the bed in a downflow or upflow mode until the adsorbent is exhausted, as evidenced by the appearance (breakthrough) of the unwanted contaminant at an unacceptable concentration in the effluent.

The most useful ion-exchange reactions are reversible. In the simplest cases, the exhausted bed is regenerated using an excess of the displaceable ion in the form of salt brine. Ideally, no permanent media structural change occurs during the exhaustion/regeneration cycle. This is a proven technology, is widely used, and is easy to automate, but it generates considerable wastewater.

Activated Alumina*.* AA is a semi-crystalline porous inorganic adsorbent, is a proven technology for fluoride removal, and effectively removes arsenic. The removal mechanism, which is one of exchange of contaminant anions for surface hydroxides on the alumina, is generally called adsorption, although ligand exchange is a more appropriate term for the highly specific surface reactions involved. Packed beds of AA are used in water treatment plants in a similar manner to anion exchange. Regeneration is accomplished using a basic solution like sodium hydroxide (caustic). The adsorbent media can be purchased in a disposable form as well. In this case, the spent media is disposed in an offsite facility. This is a proven technology, is widely used, is easy to automate, but it generates considerable wastewater.

Titanium-based adsorbents*.* These are porous adsorbents made with titanium that work similarly to AA in that surface hydroxides exchange with fluoride in the water stream. Similarly, caustic is used to regenerate the adsorbent in the packed beds. This is a newer process with fewer systems in service.

Reverse Osmosis. RO is a membrane water treatment system in which water is pressurized to more than 100 pounds per square inch and is directed through small pores in a synthetic membrane. Treated water is produced through the other side of the small pores while larger particulates are retained on the inlet side of the membrane. RO is effective in removing uranium, radium, arsenic, fluoride, nitrates, microbial contaminants, and many chemicals. Because of the high pressure required for the process, RO systems typically are energy-intensive and have high initial costs. Furthermore, these systems can require more operator attention and can require membrane integrity testing. RO systems also risk fouling and scaling from hard water, colloids, and bacteria. The fouling and scaling increase the pressure drop and result in a shorter lifetime for the membrane or frequent chemical cleaning. In addition, this process generates considerable volumes of wastewater.

Electrodialysis Reversal. EDR is a membrane water treatment process that relies on polarizing electrodes to remove contaminants. The ions in the water are attracted to the membrane by a cathode or anode. Once attracted to the membrane, the ion is transported electrically through the membrane. EDR systems reverse the polarity of the electrodes every 15 to 20 minutes. This process releases accumulated ions and has the following advantages:

- Breaks up scale and reduces the potential for scaling.
- Reduces microbiological growth on the membrane.
- Reduces membrane cleaning frequency.

EDR systems operate at higher pressures than most water treatment systems but not as high as RO systems. They are maintenance intensive and generate considerable volumes of wastewater.

Lime Softening. Hardness in water is characterized by elevated levels of magnesium and calcium. Lime softening removes the hardness by mixing lime (slaked or hydrated) during the treatment process. The lime addition increases the pH of the water and causes the magnesium and calcium to precipitate out. Flocculation and sedimentation units are employed to provide a sufficient time and space to accumulate solids. Magnesium requires a higher pH than calcium to cause precipitation and results in water with a pH as high as 11. Carbon dioxide is used commonly to reduce the pH back to desired levels. This process, although used often, requires

careful chemical dosing and process monitoring, requires large amounts of chemicals, and generates large amounts of waste sludge.

Distillation. To distill water, water is heated until boiling and vaporized. The resulting steam is collected and condensed in a clean storage tank. Distillation is effective in removing metals, hardness, and particulates because they do not vaporize with the water. The boiling process also kills bacteria and some viruses. Distillation is ineffective in removing contaminants with a lower boiling point than water, such as benzene. These contaminants must be removed before condensation or recontamination will occur. This process is straightforward to operate but uses high amounts of energy and requires costly metal alloys for construction.

Coagulation Filtration. Coagulation is a process in which smaller particles in suspension attach to one another through electrostatic forces. As the particles attach to one another, larger particles start to form. Aluminum and ferric salts are the most commonly used compounds to enhance coagulation because aluminum or iron hydroxide is formed. Once finished with the coagulation process, the water is filtered through a media filter or microfilter to remove the aggregated particles. Coagulation filtration has been found very effective in removing arsenic from water. While often some form of pretreatment is needed (usually chlorine oxidation), coagulation filtration systems can achieve over a 90 percent reduction in arsenic. However, this process does not treat fluoride. The process is relatively easy to operate.

Iron-based Adsorbents. Contaminated water is passed through a pressure vessel that contains iron based adsorbents that remove arsenic. Granular ferric hydroxide is a common example that is in an amorphous crystalline form. Iron-based adsorbents have been shown effective in removing arsenic (not fluoride) at pH levels normally found in drinking water; however, best performance happens at lower pH levels. Lower pH levels may result in the need for more operator attention and the possibility of handling hazardous chemicals. Once the media has been lost its adsorbent capacity, the spent media is replaced.

A.1.1 Initial Screening Results

As a result of the screening, four technologies were retained for further evaluation:

- AA adsorption – disposal media and regenerable media
- Iron-based adsorbents
- Coagulation/filtration

The following technologies were rejected based on the reasons listed below.

- **Anion exchange, EDR, and RO:** processes generate large residual wastewater streams that must be disposed of.
- **Lime softening:** generates large volume of waste sludge that is difficult and costly to dispose of.
- **Titanium-based adsorbents:** effective at very low pH or with expensive rare earth metals and has the fewest number of operating systems.
- **Distillation:** high cost for energy use.

A.2 Second-level Screening

The two remaining technologies were screened at a second level with AA divided into regenerable and disposable forms. The screening criteria were as follows:

1. Treatment Effectiveness
   - Ability to achieve treatment goals
2. Reliability and Flexibility
   - Ability to allow variation in influent water
   - Expandability

3. Operational Complexity
   - Ease of operation
   - Safety
4. Waste Generation
   - Quantity and quality
5. Footprint
6. Cost Effectiveness

As a result of the screening, anion exchange was not carried forward and was dropped from further consideration because of its lower effectiveness, greater operational complexity, the wastewater volumes generated, and its higher operating cost. The four processes— regenerable AA and disposable AA, iron-based adsorbents, and coagulation/filtration —were advanced to bench-scale testing.

A.3 Bench-scale Testing

As described in the body of the Design Basis Technical Memorandum, bench-scale testing was performed after the technology screening. Testing showed that regenerable AA and iron-based adsorbent were the technologies that best met design needs if both arsenic and fluoride removal, or arsenic removal alone is required Disposable AA was eliminated from further evaluation.

A.4 References

American Water Works Association. 1999. *Water Quality and Treatment - A Handbook of Community Water Supplies*, 5th Edition. Ed. by R.D. Letterman.

Odell, Lee H. 2010. *Treatment Technologies for Groundwater*. American Water Works Association.

Appendix N
Summary of Findings from Implementation of Alternative Freshwater Sources Evaluation

Topock Project Executive Abstract

Document Title: *Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Area, Pacific Gas and Electric Company, Topock Compressor Station, Needles, California*

Submitting Agency: DTSC, DOI

Final Document? ☒ Yes ☐ No

Date of Document: 4/2/2014

Who Created this Document?: (i.e. PG&E, DTSC, DOI, Other)

PG&E

Priority Status: ☒ HIGH ☐ MED ☐ LOW

Is this time critical? ☒ Yes ☐ No

Action Required:

☐ Information Only ☒ Review & Input

☐ Other / Explain:

Type of Document:

☐ Draft ☐ Report ☐ Letter ☒ Memo

☐ Other / Explain:

What does this information pertain to?

☐ Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA)/Preliminary Assessment (PA)

☐ RCRA Facility Investigation (RFI)/Remedial Investigation (RI) (including Risk Assessment)

☐ Corrective Measures Study (CMS)/Feasibility Study (FS)

☒ Corrective Measures Implementation (CMI)/Remedial Action (RA)

☐ California Environmental Quality Act (CEQA)/Environmental Impact Report (EIR)

☐ Interim Measures

☐ Other / Explain:

Is this a Regulatory Requirement?

☒ Yes

☐ No

If no, why is the document needed?

What is the consequence of NOT doing this item? What is the consequence of DOING this item?

This technical memorandum is required to communicate the findings of the Evaluation of Alternative Freshwater Sources for the groundwater remedy as directed with DTSC's September 4, 2013, letter, DOI's September 4, 2013, letter, and DTSC and DOI's joint email on November 6, 2013. Feedback received on this document will be considered for a subsequent draft, as necessary, which will be included as an appendix to the forthcoming Groundwater Remedy Pre-final (90%) Basis of Design document. This report is in compliance with the RFI/RI process.

Other Justification/s:

☐ Permit ☐ Other / Explain:

Brief Summary of attached document:

As an element of the final groundwater remedy design, freshwater sources, including groundwater supply wells and the Colorado River, have been considered for use during remedy operation. The average and maximum volume of freshwater required for remedy operation is estimated to be 450 and 900 gallons per minute (gpm), respectively, based on groundwater modeling. In the Basis of Design Report/Intermediate (60%) Design for the Final Groundwater Remedy, PG&E presented a plan to obtain freshwater from a well on the Havasu National Wildlife Refuge (HNWR)—well HNWR-1. This evaluation was conducted based on concern raised by DTSC in their August 8, 2012 letter regarding water quality from the proposed remedy freshwater source.

This technical memorandum summarizes the activities conducted and associated findings for the evaluation of alterative freshwater sources as defined in the Final Implementation Plan for Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Areas, Pacific Gas and Electric Company, Topock Compressor Station, Needles, California (Work Plan).

Written by: Pacific Gas and Electric Company

Recommendations:

Provide input to the regulatory agencies.

How is this information related to the Final Remedy or Regulatory Requirements:

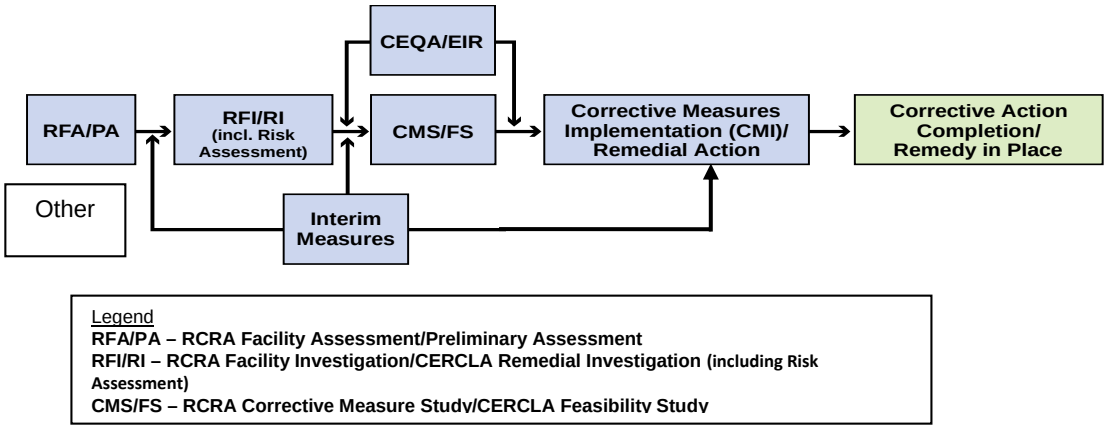
This technical memorandum communicates the conclusions and associated recommendations for the Evaluation of Alternate Freshwater Sources for the groundwater remedy.

Other requirements of this information?

None.

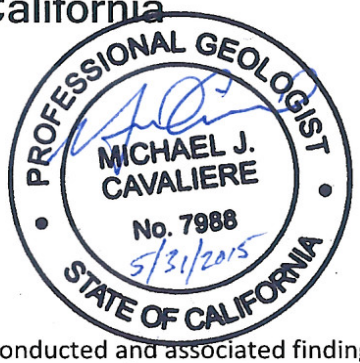
Related Reports and Documents:

Click any boxes in the Regulatory Road Map (below) to be linked to the Documents Library on the DTSC Topock Web Site (www.dtsc-topock.com).



Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Area, Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

DOCUMENT ID:	PGE20140402A
PREPARED FOR:	Pacific Gas and Electric Company
PREPARED BY:	CH2M HILL
DATE:	April 2, 2014



Summary

This technical memorandum summarizes the activities conducted and associated findings for the evaluation of alterative freshwater sources as defined in the *Final Implementation Plan for Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Areas, Pacific Gas and Electric Company, Topock Compressor Station, Needles, California* (Work Plan) (CH2M HILL, 2013b). The following primary activities were conducted at the two freshwater source evaluation locations (Site B and the area of the existing Havasu National Wildlife Refuge (HNWR) well, referred to herein as the HNWR-1 Site) (see Figure 1) during the implementation of the Work Plan, which was conducted in phases from October 2013 to February 2014:

- Installed exploratory boreholes at Site B and the HNWR-1 Site to a depth of 400 feet below ground surface (bgs) to facilitate collecting lithologic and zone-specific groundwater samples.
- Constructed a new well at Site B using the exploratory borehole as a pilot hole.
- Conducted an in-well video survey of the existing HNWR-1 well to confirm well construction details and evaluate the general well condition.
- Performed well and aquifer testing, including step-rate extraction tests and 72-hour constant rate extraction tests, at the existing HNWR-1 well and the new Site B well to evaluate well performance and estimate aquifer properties.
- Irrigated water pumped during Site B well development and all well testing activities at the HNWR future re-vegetation plot, as indicated in the Work Plan (CH2M HILL, 2013b).
- Conducted pre-construction surveys for biological, paleontological, and cultural resources (post-construction biological survey is pending).
- Conducted monitoring for biological, paleontological, and cultural resources during all fieldwork.

In addition to discussion during routine project meetings, three conference calls with the Technical Working Group (TWG) were held to provide updates on project activities and provide preliminary summaries of the data collected. These calls were held on November 4, 2013, January 29, 2014, and February 28, 2014. In addition to these calls, options for freshwater supply for the remedy and conceptual pipeline routing and infrastructure that would be associated with the freshwater supply well(s) were discussed during the March 19, 2014, TWG meeting.

Following is a summary of key findings from this evaluation:

- **Refined understanding of the unconsolidated aquifer in Arizona.** Data collected from the exploratory boreholes indicate that the unconsolidated aquifer at both locations is comprised largely of well-graded gravels with sand. Grab water quality samples at both locations indicate a stratified aquifer with higher

specific conductance (saltier) water occurring deeper in the borehole, and a more fresh (less salty) water occurring in the shallower intervals. The fresh (less salty) water at Site B is approximately 100 feet thicker than at the HNWR-1 Site. Both the Site B and HNWR-1 Site exploratory locations are located within the large fluvial plain of the pre-dam era Colorado River, and the detailed drilling logs describe these clean fluvial deposits at a greater frequency and thickness than the fluvial deposits on the California side of the River, which represents the thin western edge of the fluvial plain.

- **Refined understanding of the current condition of HNWR-1.** HNWR-1 will currently supply enough water of sufficient quality to supply the groundwater remedy at the nominal design flow rate of 450 gallons per minute (gpm), but not the maximum flow rate of 900 gpm. While the construction of the well was sufficient for its original intent (irrigation), it is not sufficient for long-term daily operation as a reliable element of the groundwater remedy. Due to the design and construction of the well the options for aggressive and effective well maintenance are limited. Further, operational flexibility to lower the pump and generate more flow is limited by the smaller diameter of the lower portion of the well.
- **Aquifer quality and well performance at Site B.** The Site B well will supply enough water to support the maximum designed remedy flow rate and the well construction allows optimal flexibility for operation (i.e., pump depth) and maintenance options; however, based on current well construction and operation during testing, the water quality is currently not optimal.
- **EIR Mitigation Measures WATER-1.** Constant-rate extraction tests conducted for a duration of 72 hours at both HNWR-1 and the Site B well suggest that neither will substantially adversely affect the production rates of existing nearby wells (see EIR Mitigation Measure WATER-1, Addendum No. 1).

Following is the recommended path forward for establishing a reliable freshwater supply for the groundwater remedy:

1. Conduct a depth-specific characterization of the Site B well to evaluate the potential for well modifications to improve water quality.
2. Install a new well at the HNWR-1 Site to provide the primary source of freshwater for use as part of the groundwater remedy.
3. Design the infrastructure required to plumb and operate both the new well at the HNWR-1 Site and the Site B well in order to provide maximum flexibility and reliability in the remedy freshwater supply.

1.0 Introduction

Pacific Gas and Electric Company (PG&E) is implementing the selected groundwater remedy for chromium in groundwater at the PG&E Topock Compressor Station (TCS, or the Compressor Station) in San Bernardino County, California. Remedial activities at the Topock site are being performed in conformance with the requirements of the Resource Conservation and Recovery Act (RCRA) Corrective Action pursuant to a Corrective Action Consent Agreement (CACA) entered into by PG&E and the California Department of Toxic Substances Control (DTSC) in 1996, as well as the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) pursuant to pursuant to a Remedial Design/Remedial Action Consent Decree between the United States and PG&E, entered by the United States District Court for the Central District of California on November 21, 2013.

As an element of the final groundwater remedy design, freshwater sources, including groundwater supply wells and the Colorado River, have been considered for use during remedy operation. The average and maximum volume of freshwater required for remedy operation is estimated to be 450 and 900 gpm, respectively, based on groundwater modeling. In the *Basis of Design Report/Intermediate (60%) Design for the Final Groundwater Remedy* (CH2M HILL, 2013b), PG&E presented a plan to obtain freshwater from a well on HNWR—well HNWR-1. This evaluation was conducted based on concern raised by DTSC in their August 8, 2012 (DTSC, 2012) letter regarding water quality from the proposed remedy freshwater source.

This technical memorandum summarizes the activities conducted and associated findings for the evaluation of alterative freshwater sources as defined in the Work Plan (CH2M HILL, 2013b).

1.1 Approvals and Authorizations

The Topock Alternative Freshwater Source Evaluation was executed in conformance with the following approvals and authorizations:

- DTSC acceptance of the Work Plan (CH2M HILL, 2013b) and approval for implementation subject to conditions set forth in the letter (DTSC, 2012), which included Mitigation Measures adopted by the certified Final Environmental Impact Report (DTSC, 2011) as specified in the EIR Addendum (No. 1) for the Alternative Freshwater Source Evaluation.
- U.S. Department of Interior [DOI], Bureau of Land Management [BLM], U.S. Fish and Wildlife Service [USFWS], and Bureau of Reclamation [Reclamation] acceptance of the Work Plan (CH2M HILL, 2013b) and approval for implementation subject to the conditions set forth in the letter (DOI, 2013).
- HNWR acceptance of the Work Plan (CH2M HILL, 2013b) and approval for implementation subject to the conditions set forth in the email to Yvonne Meeks of PG&E (HNWR, 2012).

1.2 Coordination with Agencies and Tribes

Immediately prior to conducting any ground disturbing activities, a project initiation meeting was held at the Topock Compressor Station on October 2, 2013. During this meeting, representatives from PG&E, the regulatory agencies and Tribes discussed the details of the planned fieldwork, biological, paleontological, cultural, and historical sensitivities associated with the project area, and conducted a walk of the fieldwork sites. During work, in addition to discussion during routine project meetings, three conference calls with the TWG were held to provide updates on project activities and provide preliminary summaries of the data collected. These calls were held on November 4, 2013, January 29, 2014, and February 28, 2014. In addition to these calls, options for freshwater supply for the remedy and conceptual pipeline routing and infrastructure that would be associated with the potential freshwater supply well(s) was discussed during the March 19, 2014, TWG meeting. Tribal monitors participated throughout the fieldwork and were provided with routine field schedule updates.

1.3 Technical Memorandum Organization

The remainder of this technical memorandum is organized in the following manner:

- **Section 2.0** summarizes the field activities conducted throughout the evaluation.
- **Section 3.0** present the analysis of the data collected during the evaluation, including the results of laboratory analysis of groundwater samples, and analysis of hydraulic testing data.
- **Section 4.0** summarizes the PG&E recommended path forward for establishing a freshwater supply for the groundwater remedy.
- **Section 5.0** provides a list of works cited in this technical memorandum.

2.0 Summary of Field Activities

Field activities were conducted in three general phases including exploratory drilling and data collection, well construction and development, and well and aquifer testing. All project activities were performed under the supervision of both a California and Arizona Professional Geologist. This section describes the details of each element of work conducted.

2.1 Site Access, Preparation, Compliance Monitoring, and Security

An onsite biologist conducted a pre-construction survey before work began. Biological monitoring was conducted daily throughout fieldwork by a field contact representative (FCR) that was trained by the biologist prior to the beginning of work. The post-construction surveys for each investigation site is pending and will be completed following fence installation at Site B (scheduled for April 2014) or after any additional

fieldwork (see Section 4). After complete, the pre- and post-construction survey data will be used to assess and document compliance with the Programmatic Biological Assessment (PBA) (CH2M HILL, 2007). The results of these surveys will be provided a biological resources completion report, which is scheduled for submittal to BLM and the Havasu National Wildlife Refuge (HNWR) 60 days after the completion of fieldwork.

An onsite archaeologist and an onsite paleontologist conducted a pre-construction survey before work began for cultural and paleontological resources, respectively. All site activities were monitored daily by an onsite archaeologist. Tribal monitors, which were invited to observe all site activities, did monitor many of the activities. In addition, a paleontologist was present at the beginning of ground-disturbing activities and provided paleontological awareness training for all site personnel. The paleontologist was on-call throughout the fieldwork, but was not contacted by the field team as paleontological resources were not observed during drilling.

Access for drilling and associated equipment was established at both the HNWR-1 Site and Site B along access routes identified in the Work Plan (CH2M HILL, 2013b) by importing gravel from local quarries. The existing land surface at the work sites was not graded. Prior to work, both sites consisted of flat, sandy areas that were previously disturbed by HNWR activities as part of an ongoing re-vegetation effort. Site B was devoid of vegetation. The HNWR-1 Site was sparsely vegetated with Russian thistle, which is viewed by HNWR as an invasive, nuisance species. The Russian thistle in the HNWR-1 Site work area was removed at the direction of the HNWR and as directed in the field by the onsite biologist. No listed species or nesting birds were observed during the pre-activity or post-activity surveys.

After the work areas were established, temporary fencing was installed to control site access. Onsite security was utilized to monitor the work areas during non-working hours. No incidences of unauthorized site access were detected during any of the work phases.

Each drilling location was surveyed for underground utilities prior to work. The surveys included participating in the Arizona Blue Stake mark-and-locate program and using surface geophysical techniques typically used for utility location (e.g., radio frequency line location tool).

Project activities were conducted in compliance with the items identified in Attachment B of the Work Plan (CH2M HILL, 2013a), which includes compliance with Applicable and Relevant or Appropriate Requirements, the PBA (CH2M HILL, 2007), the Programmatic Agreement (BLM, 2010), and the Cultural and Historic Properties Management Plan (BLM, 2012). Compliance monitoring activities associated with the EIR Addendum No. 1 Mitigation Measures Reporting Program (MMRP), which is also included in Attachment B to the Work Plan (CH2M HILL, 2013a), were conducted continuously during fieldwork associated with the Work Plan (CH2M HILL, 2013b) and are documented in the quarterly compliance reports, which are available on the DTSC website for the Topock Project Site. While discussing Site B well construction activities during the February 12, 2014, Consultative Working Group (CWG) meeting, representatives from the Tribes raised a question whether the disturbance associated with filling a shallow slump around the conductor casing (see Section 2.3) was addressed by the MMRP for EIR Addendum No. 1. While the slump was an unplanned result of drilling, the total volume of the subsurface Site B well disturbance is still less than that provided for in the EIR Addendum. Based on the depth and diameter assumptions in the Work Plan (CH2M HILL, 2013b), the total “planned volume” of the well is approximately 316 cubic yards. Based on final well construction, including the estimated dimension of the slump that was filled, the total subsurface volume disturbed by Site B drilling and well installation activities is approximately 262 cubic yards.

2.2 Exploratory Drilling, Data Collection, and Borehole Decommissioning

At each Site B and the HNWR-1 Site, one exploratory borehole was installed to a depth of 400 feet bgs to facilitate collecting lithologic and zone-specific groundwater samples. Each borehole was drilled using the dual-rotary method (using a Foremost DR-24 drill rig), which rotates both an outer, primary casing and the drill string (attached to the drill bit), independently. This method injects compressed air down the drill string, and out the bit, to return drill cuttings from the bottom of the borehole to the ground surface within the

inside of the primary casing. The primary casing remains in place as the borehole is drilled to maintain borehole stability. An 8-inch (nominal diameter) primary casing was used to drill both exploratory boreholes. No chemical additives were used during drilling. Freshwater was introduced to the borehole at various times during drilling at both sites to counteract heaving conditions (i.e., the water was used to provide hydraulic head within the drill casing to counteract formation materials moving up into the drill casing). Freshwater used during drilling was obtained from the Golden Shores Water Company. Drill cuttings recovered during drilling were logged in accordance with the methods and procedures identified in the Work Plan (CH2M HILL, 2013b). The lithologic logs for both boreholes are provided in Attachment A.

After the water table was reached, zone-specific groundwater samples were collected from the borehole approximately every 50 feet to assess changes in water quality with depth and qualitative changes in borehole capacity. Eight zone-specific groundwater samples were collected from each of the exploratory boreholes for laboratory analysis as defined in the Work Plan (CH2M HILL, 2013b). With the exception of the sample collected from 400 feet in the HNWR-1 Site borehole, which was collected using a bailer because the zone did not produce enough water to be pumped, each sample was collected by removing the drill string from within the primary casing and operating a submersible pump within the borehole (i.e., inside the primary casing). Water quality measurements were monitored at the surface (e.g., specific conductance, pH, oxidation-reduction potential) throughout purging for sample collection. Dissolved oxygen was not measured during the collection of groundwater samples from the borehole because the drilling method injects large volumes of air while drilling, which aerates the groundwater and obscures the natural distribution of dissolved oxygen in the groundwater. All groundwater samples were analyzed in accordance with the Work Plan, with all samples being analyzed for Title 22 (CAM 17) metals, silica, fluoride, and nitrate. A subset of samples (approximately half of those collected) were analyzed for the list of water quality parameters that were used to previously characterize the existing HNWR-1 well, including CAM 17 metals, perchlorate, petroleum hydrocarbons, pesticides, polyaromatic hydrocarbons, polychlorinated biphenyls, herbicides, chloride, sulfate, nitrate, nitrite, fluoride, bromide, phosphate, general minerals, total organic carbon, pH, gross alpha and beta, and stable isotopes of hydrogen and oxygen. Specifically, this included the samples from 100, 200, and 300 feet bgs in both the HNWR-1 Site borehole and Site B, and at 400 feet bgs in the Site B borehole only. While a sample for the “longer list” laboratory analysis was planned for the 400 feet bgs sample in the HNWR-1 Site borehole, this sample was only analyzed for the “shorter list” due to sample volume constraints. Even though the zone specific samples were analyzed by a certified laboratory, the data are considered screening level quality because of the method of sample collection (i.e., pumping or bailing from an open borehole during construction).

After each of the exploratory boreholes were drilled to total depth and the final zone-specific groundwater sample was collected, the 8-inch primary casing (exploratory casing) was left in place pending discussion of the exploratory data with the TWG and decision on the next steps for the evaluation. During this time, each casing was secured at the surface by welding a cap over the top and placing hydrated bentonite clay around casing where it interfaced with the surface soils. This approach to temporarily securing the exploratory casing was discussed with and approved by ADWR. Following discussion of the exploratory data with the TWG on November 4, 2013, the exploratory casing at Site B was removed and the borehole was subsequently reamed for the installation of the Site B well (see Section 2.3). Subsequent to the installation of the Site B well, the exploratory casing at the HWNR-1 Site was removed and the borehole was decommissioned in accordance with the Work Plan (CH2M HILL, 2013b). Specifically, the borehole was decommissioned in accordance with variance option “Alternative 4” of ADWR’s *Well Abandonment Handbook* (ADWR, 2008). The borehole was decommissioned by backfilling from total depth (400 feet) to 22 feet bgs with pea gravel. The interval from 2 to 22 feet bgs was sealed using cement bentonite grout (installed via positive pressure tremie), and the upper most 2 feet was backfilled with granular material from the existing site area (i.e., drill cuttings from the borehole and surface soil adjacent to the borehole).

2.3 Site B Well Construction and Development

Following joint direction received from DTSC and DOI (DTSC, 2013b) the exploratory boring at Site B was reamed for the installation of a new well. Well design was based on evaluation of lithologic data from recovered drill cuttings, and the results of field measurement and laboratory analysis of zone-specific groundwater samples. Borehole drilling, well construction, and well development activities were conducted from November 2013 to February 2014. The materials and methods used for constructing and developing the Site B well are presented in this section. A well construction diagram is provided in Attachment A-1. Although drilling and well installation activities conducted as part of the Work Plan (CH2M HILL, 2013b) are exempt from the requirement to obtain well installation permits from the ADWR pursuant to the CERCLA Section 121(e)(1) permitting exemption, NOI to install wells at both the HNWR-1 Site (used only for the exploratory borehole at this time) and Site B were filed (provided in Attachment A) and the substantive requirements associated with the approved NOIs were followed.

The Site B well was drilled and constructed using the dual-rotary drilling method (using a Foremost DR-40 drill rig) as follows:

1. **Removed the exploratory casing.** The 8-inch exploratory casing was pulled from total depth (400 feet bgs) using the drill rig. The portion of the exploratory borehole from 400 to 320 feet bgs was sealed using cement bentonite grout (installed via positive pressure tremie). The remainder of the borehole was left open and allowed to collapse since this portion would be subsequently reamed for well construction.

2. **Installed the conductor casing.** A conductor casing was installed to stabilize the upper portion of the borehole, provide a primary surface seal (per ADWR well standards), and isolate the completed well from shallower groundwater. A 31-inch-diameter (nominal) borehole was drilled to 77 feet bgs, and a 24-inch (nominal) mild-steel conductor casing was installed (all joints were welded). The annulus between the conductor casing and the borehole wall from 77 feet bgs to ground surface was sealed using cement bentonite grout (installed via positive pressure tremie).

3. **Drilled the borehole for well construction.** After the seal for the conductor casing had cured, a 21-inch-diameter (nominal) borehole was drilled out the bottom of the conductor casing to a total depth of 325 feet bgs, which is 5 feet into the top of the sealed portion of the exploratory borehole. As previously discussed, a shallow surface slumping event occurred around the outside of the conductor casing during drilling. While not desirable, this is not uncommon when drilling with compressed air. The slump resulted in a shallow void around the outside of the conductor casing in the vadose zone (the bottom of the void was confirmed near the interface of the water table at approximately 19 feet bgs using a tag line). The diameter of the void at the ground surface was approximately 5 to 7 feet. It is estimated that the slump was caused by zones of weakness created in the early stages of borehole drilling for conductor casing installation (a condition exacerbated by the fine-grained nature of the shallow vadose zone). These zones of weakness were bridged during sealing of the conductor casing, and continued to settle during the drilling of the 21-inch borehole until the slumping event occurred. The slump was stabilized using cement bentonite grout that was poured from the ground surface.

4. **Installing the well casing and annular materials.** After the 21-inch borehole was drilled to total depth, the well casing was installed within the primary drill casing. The well casing and screen are 14 inches in diameter and composed of 316L stainless steel (all joints were welded). All well screen is wire wrapped with 0.090-inch open spacing between wires. Filter pack material was installed through the primary casing, and all sealing materials were installed via tremie within the primary drill casing, which was removed from the borehole in stages as annular materials were installed around the well casing. All filter pack annular material is composed of Tacna 4x10 gradation sand. The well was constructed with the following casing and screen intervals (described from the bottom of the well to the ground surface):

    - 320 to 305 feet bgs – cased with a welded cap on the bottom and filter sand in the annular space (this section comprises the sump).

- 305 to 265 feet bgs – screened with filter sand in the annular space.
- 265 to 245 feet bgs – cased with an intermediate annular seal composed of hydrated bentonite pellets from 260-250 feet bgs. This section provides operational flexibility in the event the lower screened section needs to be isolated, or sealed, and can also be used as a lower pump chamber.
- 245 to 195 feet bgs – screened with filter sand in the annular space.
- 195 to 185 feet bgs – cased with filter sand in the annular space. This section provides operational flexibility in the event an intermediate pump chamber is determined beneficial to operation.
- 185 to 145 feet bgs – screened with filter sand in the annular space.
- 145 feet bgs to ground surface – cased with the annular space sealed from 120 feet bgs to the ground surface with cement bentonite grout. The section is the primary pump chamber and also provide a secondary surface seal. A 2-inch-diameter, 304L stainless steel gravel feed tube was installed in the annular space from 130 feet bgs to the ground surface.

5. **Completed the well head.** The stainless steel well casing (i.e., production casing) was completed approximately 3 feet above ground surface, and sealed with a blank flange plate (bolted with gasket). The gravel feed tube was also completed above grade and sealed with a 2-inch compression cap. The mild steel conductor casing was extended above the production casing with a hinged cap that is secured with a padlock, which is similar to other wells associated with the Topock Remediation Project.

A well construction diagram summarizing this information is provided in Attachment A-1.

After the secondary seal installed between the conductor casing and the production casing had cured, development of the well began. Development was initially conducted using the drill rig using a dual-swab air lift tool. This high-energy development method uses compressed air to extract groundwater from the well. The dual-swab tool uses a steel casing with openings along a 20-foot interval and rubber gaskets (swabs) at the top and bottom of the 20 foot section to focus the pumping energy along specific intervals of well screen. Following air lift development, a line-shaft pump was installed in the well and used to surge the well at multiple flow rates. Sand production and water quality measurements (e.g., specific conductance, pH, oxidation-reduction potential, and dissolved oxygen) were monitored on the effluent water at the surface during well development. Approximately 385,000 gallons were removed during initial air-lift development, and approximately 2,270,200 gallons were removed during pump development.

Following construction, development, and testing (see Section 2.5), in-well video and plumbness surveys were conducted to verify well details and condition on February 20, 2014. The video survey confirmed the well construction details outlined above and that the well screen, casing, and welded joints were in good condition (a summary of the Site B video survey is provided in Attachment A-1). The video log also confirmed that some sand and silt had settled in the sump during final development and testing activities. A portion of the material was subsequently removed by bailer, but some of the more densely compacted material will need to be removed by air-lift at a later date (i.e., at the time the well is put into operation). An in-well gyroscope was used to verify that the well casing was plumb.

2.4 HNWR-1 Well Construction and Condition

A video survey of the existing HNWR-1 well was conducted on October 21, 2013, to verify well construction details and condition (a summary of the HNWR-1 video survey is provided in Attachment A-2). The existing submersible pump was temporarily removed from the well to provide access for the down-hole camera, and was re-installed immediately following the survey. The video survey in combination with well installation notes previously provided by the HNWR confirms that the well was constructed with a 10-inch-diameter, mild steel well casing from 2.75 feet above ground surface to approximately 118.5 feet bgs. The 10-inch casing shows moderate to heavy scaling below the water table and has been perforated (apparently post-installation using a roller perforator) from approximately 90.5 feet bgs to 118.5 feet bgs, where the well reduces to 8 inches in diameter (based on visual estimation, a caliper survey was not conducted) and the

material changes to stainless steel, wire-wrap screen. An adapter section of the reduced diameter is in place from approximately 118.5 to 119.5 feet bgs, and the stainless steel, wire-wrap screen was observed to a depth of approximately 156 feet bgs where soft fill prevented further video confirmation; however, the camera was lowered to a total depth of approximately 165 feet bgs before being refused (this depth was difficult to verify given the fill in the bottom of the well). The well screen is noted to be partially plugged based on the video survey.

Interpretation of this video survey in combination with available well installation notes suggests that the 10-inch well casing was installed by drilling with a casing advance method to a total depth of 160 feet bgs. A 40-foot-long screen section was then fabricated (two 20-foot screen sections welded together, and presumably with a cap welded to the bottom) with a 6-inch K-packer (i.e., a series of rubber rings mounted onto a section of steel pipe) welded to the top of the screen section. The screen assembly was then landed on the bottom of the borehole at 157 feet bgs (it is inferred that there was approximately 3 feet of heaved formation within the 10-inch casing). With the screen assembly in the bottom of the borehole, the 10-inch casing was retracted with the drill rig to expose the screen assembly, leaving approximately 2.3 feet of 10-inch casing below the K-packer. The installation of filter sand or gravel is not noted in the installation notes, and it would not be possible to have installed filter pack material given this construction method. Given the casing advance drilling method, the perforations in the 10-inch must have been cut with the casing in situ, otherwise the casing would have failed during drilling. The driller's notes indicated that a temporary surface casing (i.e., conductor casing) was used then pulled after the 10-inch casing was in its final position (with the screen exposed), and "grouted up." A conceptual well construction diagram for HNWR-1 that summarizes this inferred construction is provided in Attachment A-2.

While this well was adequate for the irrigation purpose for which it was designed, it is not adequate for long-term operation as part of the groundwater remedy freshwater supply. The well construction severely limits the options available for future well rehabilitation, and the effectiveness of rehabilitation overall. The lack of filter pack and the relatively large aperture perforations in the 10-inch casing are especially problematic as formation material will move readily into the well when surged. The construction details for the surface seal, which protects the well for infiltration of fluids from the surface, are not completely known.

2.5 Well and Aquifer Testing

Hydraulic testing was performed at both the existing HNWR-1 well and the Site B well to assess well performance and estimate aquifer properties. Step-rate tests were conducted in both wells to estimate the upper end of flow that could be sustained during the subsequent constant-rate tests conducted in each well. All groundwater discharged during the well tests was surface irrigated to the area designated in the Work Plan (CH2M HILL, 2013b) (see Section 2.6). The duration of both constant-rate extraction tests was constrained to 72-hours so that the irrigation area could be managed with zero run-off.

Effluent water quality measurements (e.g., specific conductance, pH, oxidation-reduction potential, and dissolved oxygen) were monitored in the field during all well tests. Dissolved oxygen was not measured during the HNWR-1 step-rate test due to a malfunctioning sensor. Water quality samples for laboratory analysis were collected from the pump effluent during both constant-rate tests to assess if water quality changed over time. Samples were collected during the tests at 1 hour, 6 hours, 12 hours, 24 hours, 48 hours, and 72 hours after the start of the test. All samples were analyzed in accordance with the Work Plan (CH2M HILL, 2013b). In addition to field parameters, groundwater samples were analyzed for CAM 17 metals, silica, fluoride, and nitrate. In addition, as requested by the TRC during the January 29, 2014, conference call with the TWG, all groundwater samples were analyzed for stable isotopes of hydrogen and oxygen. Samples from the beginning and end of the test (1 hour and 72 hours) were analyzed for a longer list of analytes, including CAM 17 metals, perchlorate, petroleum hydrocarbons, pesticides, polyaromatic hydrocarbons, polychlorinated biphenyls, herbicides, chloride, sulfate, nitrate, nitrite, fluoride, bromide, phosphate, general minerals, total organic carbon, pH, and gross alpha and beta.

Pressure transducers were utilized in several observation wells in the project area to observe potential effects of pumping at each of the wells during the constant-rate tests. In addition to the pumping wells (the Site B well and HNWR-1), monitoring the level of the Colorado River (I-3 gauging station) and barometric pressure, the following observation wells and surface water bodies were instrumented during testing (listed roughly from east to west): monitoring well near the Serrano supply well, Topock-2 (operated by Southwest Water Company), Topock-3 (operated by Southwest Water Company), GSRV-2, Topock-66 (test well for fire water supply), MW-55-120, MW-55-45, Catfish Paradise (surface water body north of South Dike), Lost Lake (surface water body south of South Dike), MW-54-85, MW-54-140, MW-54-195, and MW-49-195 (on the California side of the Colorado River). The location of these wells and surface water bodies are presented on Figure 1.

Testing details specific to each well are summarized in the following subsections.

HNWR-1. A step-rate extraction test was conducted at HNWR-1 on October 16, 2013, and a 72-hour constant-rate extraction test was conducted from February 11 to 14, 2014. Both tests were conducted using the existing electric submersible pump (Grundfos 800S750-3 pump with a 75-horsepower motor), which was installed with the intake at approximately 88 feet bgs (approximately 3 feet above the top of the well casing perforations). The step-rate test consisted of six 90-minute steps with the following average flow rates: 278 gpm, 382 gpm, 472 gpm, 557 gpm, 658 gpm, and 767 gpm. A seventh step was attempted at 875 gpm (maximum pump flow) but the pump began to cavitate after approximately 30 minutes, indicating that water level drawdown in the well had dropped below the minimum operating head required above the pump. Based on analysis of the step-rate extraction test, a flow of 700 gpm was chosen for the constant-rate test. A plot of the drawdown data collected during the HWNR-1 step-rate test is provided in Figure B-1 in Attachment B. HNWR-1 is located approximately 750 feet from the operational Topock-2 and -3 supply wells, which are operated by Southwest Water Company to provide freshwater to the Topock Compressor Station, Topock-66 restaurant, and nearby residences. Prior to the beginning of the HNWR-1 constant-rate test, project staff coordinated with the Southwest Water Company to fill available storage on the compressor station and for the residences/Topock-66 restaurant so that well operation could be minimized during the HNWR-1 testing period.

Site B. A step-rate extraction test was conducted at the Site B well on February 7, 2014, and a 72-hour constant-rate extraction test was conducted from February 7 to 10, 2014. Both tests were conducted using a line-shaft turbine pump that was temporarily installed for well development and testing. The intake of the test pump was located at approximately 138 feet bgs (approximately 7 feet above the top of the well screen). The step-rate test consisted of six 80-minute steps with the following average flow rates: 507 gpm, 694 gpm, 911 gpm, 1,101 gpm, 1,292 gpm, and 1,494 gpm. A plot of the drawdown data collected during the Site B step-rate test is provided in Figure B-2 in Attachment B. Based on analysis of the step-rate extraction test and projecting the amount of water could be applied over time to the irrigation area (based on irrigation that had been conducted to date), a flow of 1,000 gpm was chosen for the constant-rate test.

2.6 Management of Material Generated during Evaluation

Three types of materials were generated during fieldwork: drill cuttings, purged groundwater, and trash, all of which were managed in accordance with the Work Plan (CH2M HILL, 2013b). Drill cuttings and purged groundwater were managed in accordance with site-specific and regulatory practice for groundwater supply well drilling. Because this work was conducted as part of a CERCLA response action, implementation plan activities conducted onsite were covered under the permit exemption codified in Section 121(e)(1) of CERCLA. While the permit exemption applies to the administrative or procedural elements (e.g., preparing and submitting permit applications and obtaining permits), the substantive requirements of the applicable laws remain. Groundwater discharge and drill cuttings were managed in compliance with the substantive requirements of Aquifer Protection General Permit 1.04, as authorized by Arizona Administrative Code Section R18-9-B301(D).

Drill cuttings were diverted from the cuttings return pipe on the rig using a cyclone that was staged over the top of a roll-off bin. From the roll-off bin all drill cuttings were spread to the ground surface adjacent to the borehole. Chemical additives were not used during drilling, therefore cuttings sampling was not necessary to determine suitability for discharge to the ground surface. Drill cuttings were not discharged to any jurisdictional areas. Clay was recovered in the drill cuttings from both boreholes. In accordance with the Work Plan (CH2M HILL, 2013b), the clay material was gathered and separated from the other drill cuttings for storage on dye-free cotton muslin fabric and labeled. The material was recovered from the cuttings bin as many small clay balls, which were subsequently aggregated into a larger ball that was approximately the size of a soccer ball. The material was securely stored at the work site, and the agencies and Tribes were informed of the clay. The material was subsequently managed by the project archaeologist in coordination with the Tribes.

Purged groundwater was generated during drilling, well development, and well testing. Water generated during drilling and air-lift development (see Section 2.3) was discharged to the ground surface in the same area as the drill cuttings. Water was generated at a higher rate during pump development and well testing. This water was surface irrigated to the area designated in the Work Plan (CH2M HILL, 2013b). The water was pumped through a temporary, aboveground conveyance pipeline to as many as 12 sprinklers in the irrigation area (see Figure 2). During key development activities, discharge was irrigated directly to the ground without the use of a sprinkler to avoid discharge pressure limitations associated with the sprinkler equipment; however, all discharge activities were conducted in a manner that did not promote scouring or erosion of the irrigation area. A total volume of approximately 10.5 million gallons was discharged to the irrigation area during pump development at Site B and all well testing activities at both wells. Purged groundwater was neither discharged nor allowed to run-off to jurisdictional areas, the Colorado River, nor Arizona County Highway 10.

Incidental trash was removed from the work area daily and was transferred to a standard trash bin at the TCS for offsite disposal.

3.0 Results of the Evaluation

This section presents the analysis of data collected during the activities detailed in Section 2. Section 4 discusses the integration of all available data from this evaluation, and associated recommendations for the path forward in establishing a freshwater supply for the groundwater remedy.

3.1 Exploratory Data

This section presents the analysis of lithologic data collected during drilling, and the results of screening level groundwater samples collected from the initial exploratory boreholes.

Lithology and Hydrostratigraphy. Based on data collected from the exploratory boreholes, a single unconsolidated aquifer was drilled at both locations that is comprised largely of well graded gravels with sand. A combination of finer-grained sands and slits and gravel is observed in the upper 40 feet of the HNWR-1 Site and the upper 100 feet of Site B. Within this interval, a layer of lean clay was encountered at Site B between 70 and 80 feet bgs. This finer-grained material is likely a combination of overbank deposits from the Colorado River and alluvial material sourced from Sacramento Wash. Below these finer-grained intervals, the lithology encountered was predominantly comprised of fluvial river gravels with sand. Both boreholes are located within the large fluvial plain of the pre-dam era Colorado River, and the detailed drilling logs describe these clean fluvial deposits at a greater frequency and thickness than the fluvial deposits on the California side of the River, which represents the thin western edge of the fluvial plain. Bedrock was not encountered at either the HNWR-1 Site or Site B; however, low penetration rates during drilling the deeper portion of the HNWR-1 Site exploratory borehole might be an indication that the total depth of this borehole was closer to bedrock that the Site B borehole (see also specific conductance data from the deeper portion of the HNWR-1 Site borehole, and the limited groundwater recovery at the bottom of the borehole). The additional lithologic data collected during this evaluation has been added to the conceptual cross-section that was included in the Work Plan (CH2M HILL, 2013b) (see Figure 3).

The water table was encountered at approximately 9 and 19 feet bgs at the HNWR-1 Site and Site B, respectively (based on water level data collected from the HNWR-1 and Site B wells), and the ground surface at Site B is approximately 8 feet higher than at the HNWR-1 Site. The HNWR-1 well has been surveyed for elevation, but the survey for the Site B well is pending; therefore, detailed comparison of groundwater elevation between the two sites (accounting for river level influence) cannot be completed at this time. Regardless, the groundwater elevation at the two sites appears to be very similar.

Screening-level Groundwater Samples. This section presents the results of field water quality measurements (Table 1) and laboratory analysis of the 8 screening level, zone-specific groundwater samples collected from the HWNR-1 Site and Site B exploratory boreholes (Tables 2 through 9).

Field Measurements. Field water quality measurements monitoring during sample collection, included specific conductance, temperature, pH, oxidation-reduction potential, and turbidity, as well as depth to water within the primary drill casing during purging. Specific conductance measurements indicate a change in water type in both boreholes with higher specific conductance (saltier) water occurring deeper in the borehole, and a lower specific conductance (less salty) water occurring in the shallower intervals. This transition was observed between the 350- and 400-foot-bgs samples at Site B, and between the 250- and 300-foot-bgs samples at the HNWR-1 Site. Therefore, the thickness of fresh (less salty) water at Site B is approximately 100 feet greater than at the HNWR-1 Site. Based on measurement of ORP, the deeper, saltier water in each borehole tends to be reduced while the shallower, fresher water is aerobic (i.e., positive oxygen-reduction potential). This is consistent with the conceptual site model of shallower groundwater being a combination of river water and infiltration from Sacramento Wash, with the older, saltier water along the bottom of the basin. This trend is observed in both alluvial and bedrock wells and is consistent with the theory that in this lower portion of the Mohave basin, older connate water is upwelling from the deeper portions of basin. During the eons that it could take for groundwater to move through the basin, the salts are leached from the rocks, increasing specific conductance, and dissolved oxygen is lost through reactions with reduced mineral species.

The temperature of the groundwater in both boreholes ranged from approximately 32 to 42 degrees Celsius (approximately 90 to 107 degrees Fahrenheit). Measurements collected from shallow to deeper within each borehole indicate increasing temperature with depth. The measurement collected from the deepest sample in the HWNR-1 Site borehole was lower than would be expected based on the trend of measurements from shallower samples. This is because this sample was collected with a bailer, while all the other samples were collected using a submersible pump. Variations in temperature measurements can be an artifact of submersible pump operation to purge the groundwater. In general, pumping with less hydraulic head above the pump (i.e., more drawdown) will result in a temperature measurement that is biased higher. For example, the majority of temperature measurements from the HNWR-1 Site borehole are approximately 36 degrees Celsius while pumping with approximately 80 feet of drawdown. In the Site B borehole, similar pumping conditions resulted in a similar temperature measurement, while lower temperature measurements were observed when pumping with less drawdown. Heat from the drilling tools can also create variations in temperature from one measurement interval to the next. Section 3.1 discusses the temperature measurements taken while pumping within the wells, which removes some of this variability.

Measurements of pH were consistent between both boreholes, ranging from approximately 7.5 to 8.5, which is consistent with measurements throughout the project area.

Metals. In general, concentrations of metals observed in zone-specific samples were similar between the two boreholes. Dissolved arsenic concentrations ranged from non-detect to 12 micrograms per liter (μg/L) at the HNWR-1 Site, and from 0.97 to 13 μg/L at Site B. The detected ranges of chromium were also similar between the two boreholes with a range of non-detect to 11 μg/L at the HNWR-1 Site, and non-detect to 16 μg/L at Site B. Samples from the zones that correspond to the deeper, saltier water have very low to non-detect concentrations of hexavalent chromium, which is consistent with the reducing conditions discussed in

the field measurements above. Similarly, dissolved arsenic concentrations are also very low to non-detect in these samples suggesting a different water type.

Organics. Organic analyses included perchlorate, total petroleum hydrocarbon (TPH), pesticides, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and herbicides. All results for perchlorate, pesticides, PAHs, PCBs, and herbicides were non-detect. TPH as diesel was detected at concentrations slightly above the reporting limit in the 100- and 200-foot-bgs samples from the Site B borehole (58 and μg/L, respectively), and TPH as motor oil was detected slightly above the reporting limit in the 400-foot-bgs sample from the same borehole (53 μg/L). These TPH detections are believed to be associated with the lubricants used in the air compressor or on the drilling tools, and would not be expected to persist.

Other Constituents. Review of the results of other analyses including contract laboratory program (CLP) inorganics and general chemistry indicates that the samples from the depths that correspond to the deeper, saltier water have higher concentrations of calcium, iron, magnesium, potassium, sodium, chloride, and sulfate. The concentration of nitrate as nitrogen was particularly elevated (200 milligrams per liter (mg/L)) in the shallowest sample collected from the Site B borehole. This concentration is attributed to nitrogen released from the decay of the dense vegetation that covered this area for many years but was burned prior to the initiation of the HNWR Re-vegetation Project.

Analyses of the zone-specific samples for stable isotopes of hydrogen and oxygen indicate a consistent isotopic signature within each borehole, and across the two boreholes. In the *Final RCRA Facility Investigation/Remedial Investigation Report* (Final RFI/RI Report) (CH2M HILL, 2009), stable isotopes of oxygen and hydrogen were used to generally identify three water groups: 1) river water and river-influenced groundwater, 2) local alluvial groundwater, and 3) industrial water from historical facility discharges. The groups are intermixed to varying degrees. When compared with the isotopic signature of other wells in the project area, the samples from the exploratory boreholes correspond with alluvial and fluvial non-plume wells, which is consistent with the conceptual model of the aquifer for this area.

3.2 Aquifer Testing Data

The constant-rate extraction tests at HNWR-1 and Site B were each conducted for 72 hours. Drawdown at HNWR-1 and Site-B is shown in Figures B-3 and B-4 in Attachment B. The HNWR-1 test was conducted at flow rate of 700 gpm, which maintained approximately 44 feet of water level drawdown in the well. Similarly, the Site B test was conducted at flow rate of 1,000 gpm, which maintained approximately 60 feet of drawdown in the well. During the Site B test, the drawdown in the well recovered approximately 2 feet throughout most of the test duration; however, the water level stabilized during the final hours of the test. Because the recovery trend eventually stabilized, this recovery is attributed to increased well efficiency over most of the testing period and not recharge associated with the infiltration of surface irrigated test water, which would be expected to show an exponential recovery curve. This slight draw-up of the water level in Site B during testing did not have an adverse effect on analysis of the data.

The water level data collected during the HNWR-1 and Site B constant-rate extraction tests were downloaded from the transducers and compiled following completion of the tests. Pumping at HNWR-1 produced measurable drawdown and recovery in the Topock-2 and Topock-3 wells (less than 1 foot) (Figure B-5 in Attachment B). Pumping from the Site B well produced measurable drawdown in the HNWR-1, Topock-2, and Topock-3 wells. The Topock-2 well began pumping approximately 7 hours before the conclusion of the 72-hour Site B test and remained pumping until several hours after the conclusion of the test. This prevented the Topock-2 and Topock-3 well data from being used for aquifer test analysis after this time, but usable data were collected over the majority of the test period.

Data from monitoring well clusters MW-54 and MW-55, MW-49-135, and data from the Topock-66, and Serrano wells were corrected using the U.S. Geological Survey deconvolution software (Halford, et al, 2012) to filter out the influence of river and barometric fluctuations on these wells. Inspection of deconvoluted data from these wells indicated no measurable drawdown from either the Site B or HNWR-1 test.

Hydrographs with raw (uncorrected) data and corrected data from these wells are presented in Figures B-6 through B-10 in Attachment B. Initial review of the uncorrected data at MW-55 and Topock-66, as discussed during the February 28 conference call with the TWG, indicated potential drawdown of up to 0.2 feet, though final data corrected for the influence of the river indicated no measureable drawdown from either the Site B or HNWR-1 test. The Site B well data recorded during the HNWR-1 test were also deconvoluted, and these data did not exhibit measurable drawdown (Figure B-4 in Attachment B). Any drawdown that may have occurred at these wells would be less than the post-deconvolution "noise" level of about 0.05 feet (0.6 inches).

The pumping well and observation well data from both of these tests were analyzed to estimate aquifer properties using the aquifer test software MLU (Hemker and Post, 2014; Hemker, 1999). For each test, the drawdown at pumping and observation wells was plotted and representative points on the drawdown curves were selected to define the drawdown input to MLU. A simple five-layer system was set-up in MLU, consistent with the layout of the numerical model. Layers 1-4 in the MLU analysis were each set to be 150 feet thick at HNWR-1, and 300 feet thick at Site-B, which reflects field observations of increasing aquifer thickness in the vicinity of Site B. Layer 5 at both sites was set to 300 feet.

The modeled fits to the observed drawdown data are shown in Figures B-11 and B-12. The estimated hydraulic conductivity (K) of the aquifer in this area is about 200 feet/day (ft/day), based on the results of the tests and the estimated thickness of the zone affected by the tests. These results were compared to the parameters in the numerical model, which is currently calibrated to a range of K-values from 30 – 200 ft/day, with typical K-values at 30 ft/day. Results from these aquifer tests represent a higher K than most areas of the Topock site on the California side of the Colorado River, where the typical K is about 30 ft/day. However, given the nature of the material encountered during drilling (sand and gravel), the estimated K from these tests corresponds well with the highest permeability materials found in the floodplain within the Topock project area on the California side, which have an estimated K of about 200 ft/day. The aquifer test area is within the large fluvial plain of the pre-dam era Colorado River, and the detailed drilling logs describe these clean fluvial deposits at a greater frequency and thickness than the fluvial deposits on the California side, which represents the thin western edge of the fluvial plain.

As a result of the test analysis, the transmissivity estimated for the aquifer is greater than that in the current flow model. When the flow model was last calibrated, there were no hydraulic data available in the area of these tests, and only regional indications of the aquifer thickness. The exploratory borehole at the HNWR-1 Site was drilled to a depth of 400 feet without encountering bedrock, which is double the assigned depth in the current model. Both the thickness and transmissivity of the fluvial deposits in this area will be increased in the model from the Topock Marina eastward to the edge of the regional model domain. The effects of these changes on the modeled site remedy effectiveness are expected to be minor, but there will be less regional influence of the freshwater pumping well(s) due to the higher permeability assigned to this area of the model.

Analysis of Water Quality Data. This section presents the results of field water quality measurement (Table 1) and laboratory analysis of the 12 groundwater samples collected from the HWNR-1 and Site B wells during constant-rate testing (Tables 2 through 9). In addition, these tables include the results from one sample collected from the HNWR-1 well on October 22, 2013, which was a "one-off" sample collected per the standard operating procedure for the Topock Groundwater Monitoring Program. Compared to the zone-specific samples collected from the exploratory boreholes, the samples collected during well testing are representative of a combined condition across the entire screened interval. HNWR-1 is effectively screened across the interval from 90.5 to 156 feet bgs and the Site B well is effectively screened across the interval from approximately 140 to 305 feet bgs.

Field Measurements. Field water quality measurements, including specific conductance, temperature, pH, oxidation-reduction potential, turbidity, and dissolved oxygen, were monitored during all testing activities (with the exception of dissolved oxygen during the HNWR-1 step test, which was not measured due to a

malfunctioning sensor). The water quality measurements collected during the step-rate and constant-rate tests were consistent at each well, which suggests that the water type entering the well screens does not vary significantly when each well is pumped across the range of flows utilized during step-rate testing, or throughout the duration of the constant-rate tests. The average specific conductance measurement collected during the constant-rate tests for HNWR-1 and Site B were 833 and 1,291 microSiemens per centimeter (μS/cm), respectively, which is consistent with the measurements collected from the corresponding depths in the respective exploratory boreholes. Oxidation-reduction potential and dissolved oxygen measurements also remained consistent during the respective tests, and are representative of the oxidizing water observed at these depths in the exploratory boreholes. Measurement of pH was consistent during both tests at approximately 7.9.

Temperature measurements were consistent throughout the constant-rate tests and consistent with measurements collected during the exploratory sampling. The average temperature during the constant-rate tests were approximately 37.6 and 35.8 degrees Celsius (approximately 99.7 and 96.4 degrees Fahrenheit) at HNWR-1 and Site B, respectively. The difference in temperature between the two wells could be attributed to the different pumps used for each test. The HNWR-1 test was conducted with a submersible pump, which has a motor (i.e., heat source) in the well, while the Site B test was conducted with a line-shaft pump that does not have a motor in the well. Comparing this temperature data to that from the groundwater on the California side of the Colorado River, the average temperature in the monitoring wells within the planned injection zone for the groundwater remedy is 29.6 degrees C, calculated among the means at each well. The overall range in temperature measurements is 23.2 to 34.7 degrees C. The density at 37.6 degrees, which was the average measurement at HNWR-1 (and the higher of the two sites), is approximately 0.003 kilograms per liter (kg/L) lower than that at 29.6 degrees, assuming equal TDS. This slight difference is not expected to cause a significant separation between injected and receiving waters, especially given the inherent heterogeneity of the alluvial aquifer. Also, the 8-degree difference in temperature is not significant enough for the warmer water to cause greater leaching of matrix minerals, since the solubility of the various oxides, hydroxides, and silicate minerals is virtually identical at these two temperatures.

Metals. The concentrations of metals detected in samples collected during constant-rate testing were consistent throughout each respective test. Detected concentrations of dissolved arsenic ranged from 14 to 16 and 17 to 18 μg/L in the HNWR-1 and Site B wells, respectively. These concentrations are consistent with those detected previously in HNWR-1. Detected concentrations of chromium ranged from 19 to 20 and 33 to 34 μg/L in the HNWR-1 and Site B wells, respectively. While the concentration in HNWR-1 is consistent with those detected previously in HNWR-1, the concentrations at Site B are higher. These higher concentrations likely occur because Site B is further north than HNWR-1, and therefore closer to the higher background concentrations of chromium that enter the basin from the Black Mountains, which are composed of ultra-mafic rocks that contain naturally occurring chromium and other metals.

Organics. Organic analyses included perchlorate, TPH, pesticides, PAHs, PCBs, and herbicides. All results for perchlorate, pesticides, PAHs, PCBs, and herbicides were non-detect. TPH as diesel and TPH as motor oil were detected at concentrations of 92 (estimated) and 130 μg/L, respectively in the sample collected from the Site B well immediately before the constant-rate test was ended. These TPH detections are believed to be associated with the pump tools and lubrication oil (a highly refined mineral oil) used along the shaft of the pump that operates within the well. These detections are not expected to persist.

Other Constituents. Other analyses including CLP inorganics, bromide, chloride, fluoride, nitrate/nitrite as nitrogen, soluble silica, sulfate, and total organic carbon were all consistent with the concentrations detected in samples from the exploratory boreholes of the corresponding depths. All results for gross alpha and gross beta were either non-detect or below the respective California maximum contaminant levels for drinking water, which are 15 and 50 picocuries per liter, respectively.

The results for stable isotopes of hydrogen and oxygen from samples collected during the constant-rate tests are consistent with the results discussed for the exploratory samples (see Section 3.1).

4.0 Recommendations for Design of the Groundwater Remedy

The following conclusions about the HNWR-1 and Site B wells are based on review of hydraulic and water quality data collected during this evaluation:

- HNWR-1 will currently supply enough water of sufficient quality to supply the groundwater remedy at the nominal design flow rate of 450 gpm, but not the maximum flow rate of 900 gpm. While the construction of the well was sufficient for its original intent (irrigation), it is not sufficient for long-term daily operation as reliable element of the groundwater remedy. Due to the design, construction, and condition of the well, as the well performance declines over time, the options for well maintenance are limited. Further, operational flexibility to lower the pump and generate more flow is limited by the diameter of the lower portion of the well.
- The Site B well will supply enough water to support the maximum designed remedy flow rate and the well construction allows optimal flexibility for operation (i.e., pump depth) and maintenance options; however, based on the current well construction and operation during well testing, the water quality is currently not optimal.
- Constant-rate extraction tests conducted for a duration of 72 hours at both HNWR-1 and the Site B well suggest that neither will substantially adversely affect the production rates of existing nearby wells (see EIR Mitigation Measure WATER-1, Addendum No. 1).

Based on these conclusions, the recommended path forward for establishing a reliable freshwater supply for the groundwater remedy includes:

1. **Depth-specific characterization of the Site B well.** While the current water quality from the Site B well is not optimal for the groundwater remedy (in and of itself), based on the analysis of well testing data, the well represents a viable freshwater source that can be used as a contingency option for the remedy water supply or to supplement another freshwater supply well[1]. It is recommended that depth-specific flow and water quality data be collected to support future decisions related to well operation for the groundwater remedy. For example, if depth-specific data suggests chromium is entering the well at a specific interval, the well operation or construction could potentially be modified to lower the chromium concentration in freshwater supplied by the well.
2. **Install a new well at the HNWR-1 Site.** A well that is designed and constructed for use as part of the groundwater remedy at the HNWR-1 Site could be expected to produce adequate quality and quantity of groundwater (i.e., the maximum designed remedy flow rate). A properly designed and constructed well would allow for the full range of well maintenance options for reliable, long-term operation. The new well would be installed by over-drilling/reaming the backfilled HNWR-1 Site exploratory borehole such that an additional borehole is not required.
3. **Design the infrastructure** that would be required to plumb and operate the Site B well as part of the groundwater remedy to support future contingency actions, as necessary. Conceptual pipeline routing and associated infrastructure is included as Attachment D. In addition, design infrastructure to service the new well at the HNWR-1 site.

The implementation of these steps should occur in parallel with the development of the 90 Percent Basis of Design Report so that the conclusions of the additional work can be included in the document.

[1] Additional wells that could be used to supplement Site B include well(s) at the HWNR-1 site, Topock-2, and Topock-3. At the request of the TRC during the March 19, 2014 TWG meeting, a water quality report from Southwest Water, Inc. is provided in Attachment C.

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Tables

TABLE-1

Summary of Field Measurements

Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Area

PG&E Topock Compressor Station, Needles, California

				Field Water Quality Measurements						Hydraulic Measurements				
Location	Date	Step or Elapsed Time	Approximate Sample Depth (feet)	ORP (mV)	Spec. Conduct. (uS/cm)	Temp. (°C)	pH	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Volume Purged (gallons)	Average Pumping Rate (gpm)	Approximate Static Water Level*	Approximate Pumping Water Level*	Drawdown (feet)
Site B (Exploratory)	6-Oct-13	--	58	219	636	32.3	8.18	--	84	50	1	19	not stable	--
	7-Oct-13	--	100	107	996	34.1	8.40	--	44	1,538	13	23	30	7
	7-Oct-13	--	150	161	1,519	33.6	8.22	--	47	976	18	24	25	2
	8-Oct-13	--	200	172	1,328	35.2	8.20	--	49	823	16	24	36	12
	9-Oct-13	--	250	115	929	36.0	8.15	--	16	621	17	26	84	59
	9-Oct-13	--	300	108	1,471	36.3	7.93	--	36	1,769	19	24	28	4
	10-Oct-13	--	350	77	1,182	37.0	8.21	--	30	1,668	12	24	56	32
	15-Oct-13	--	400	-99	10,313	38.1	7.46	--	45	1,253	12	24	37	13
Site B (Step-rate Test)	7-Feb-14	Step 1	--	195	1,280	32.3	8.07	4.8	5	--	507	19	46	27
	7-Feb-14	Step 2	--	196	1,275	32.2	8.05	6.5	3	--	694	19	57	38
	7-Feb-14	Step 3	--	190	1,257	33.3	8.03	5.9	1	--	911	19	73	54
	7-Feb-14	Step 4	--	186	1,275	34.2	8.02	5.7	2	--	1,101	19	86	67
	7-Feb-14	Step 5	--	197	1,243	33.4	8.05	5.6	2	--	1,292	19	102	83
	7-Feb-14	Step 6	--	201	1,251	34.5	8.01	4.8	2	--	1,494	19	120	101
Site B (Constant-rate Test)	7-Feb-14	1 hour	--	154	1,278	35.9	7.98	5.3	2	--	1,000	19	78	59
	8-Feb-14	6 hours	--	123	1,279	35.8	7.97	5.3	1	--	1,000	19	80	61
	8-Feb-14	12 hours	--	147	1,285	35.3	7.96	4.8	1	--	1,000	19	80	61
	8-Feb-14	24 hours	--	127	1,293	35.9	7.94	4.4	1	--	1,000	19	79	60
	9-Feb-14	48 hours	--	102	1,301	35.8	7.93	4.1	1	--	1,000	19	78	59
	10-Feb-14	72 hours	--	109	1,311	35.8	7.93	3.9	1	--	1,000	19	78	59
HNWR-1 Site (Exploratory)	16-Oct-13	--	50	134	972	34.5	7.96	--	43	319	17	11	13	2
	17-Oct-13	--	100	183	875	34.9	8.08	--	11	1,990	20	11	11	0
	17-Oct-13	--	150	184	892	38.9	8.19	--	47	645	17	11	31	21
	17-Oct-13	--	200	175	1,018	39.7	8.30	--	34	464	12	11	27	16
	18-Oct-13	--	250	170	1,405	41.0	8.12	--	34	749	16	12	28	17
	19-Oct-13	--	300	-290	26,300	40.2	8.33	--	27	781	16	13	not stable	--
	19-Oct-13	--	350	-224	47,192	42.4	7.97	--	50	921	19	13	not stable	--
	20-Oct-13	--	400	123	25,830	35.1	7.98	--	135	1	bailer	--	--	--
HNWR-1 (Step-rate Test)	16-Oct-13	Step 1	--	89	867	35.8	8.06	--	8	--	278	9	22	13
	16-Oct-13	Step 2	--	102	859	35.7	8.16	--	4	--	382	9	30	21
	16-Oct-13	Step 3	--	109	858	35.6	8.15	--	3	--	472	9	36	27
	16-Oct-13	Step 4	--	116	860	35.3	8.13	--	2	--	557	9	43	34
	16-Oct-13	Step 5	--	119	860	36.1	8.12	--	2	--	658	9	51	42
	16-Oct-13	Step 6	--	128	862	36.1	8.14	--	3	--	757	9	60	51
	16-Oct-13	Step 7	--	130	863	36.2	8.11	--	2	--	875	9	66	57
HNWR-1 (Constant-rate Test)	11-Feb-14	1 hour	--	129	811	37.7	8.00	3.1	1	--	700	9	52	43
	11-Feb-14	6 hours	--	107	815	37.5	7.99	3.4	1	--	700	9	52	43
	11-Feb-14	12 hours	--	98	828	37.4	7.98	3.3	1	--	700	9	52	43
	12-Feb-14	24 hours	--	91	843	37.3	7.97	3.3	1	--	700	9	52	43
	13-Feb-14	48 hours	--	81	850	37.2	7.96	3.4	0	--	700	9	52	43
	14-Feb-14	72 hours	--	84	851	37.1	7.95	3.2	2	--	700	9	52	43

Notes:

uS/cm - MicroSiemens per centimeter

mg/L - Milligrams per liter

mV - Millivolts

°C - degrees Celsius

NTU - Nephelometric Turbidity Units

gpm - gallons per minute

Field water quality measurements collected using a field meter equipped with a flow cell (unless a bailer was used)

* Approximate water level measurements are expressed as feet below ground surface.

TABLE-2

Groundwater Sample Results: Metals

Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Area

Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

				Metals (µg/L)																
Location	**Phase**	**Date**	**Depth/ Time**	**Antimony, dissolved**	**Arsenic, dissolved**	**Barium, dissolved**	**Beryllium, dissolved**	**Cadmium, dissolved**	**Chromium, dissolved**	**Cobalt, dissolved**	**Copper, dissolved**	**Hexavalent Chromium**	**Lead, dissolved**	**Mercury, dissolved**	**Molybdenum, dissolved**	**Nickel, dissolved**	**Selenium, dissolved**	**Silver, dissolved**	**Thallium, dissolved**	**Vanadium, dissolved**	**Zinc, dissolved**
HNWR-1	GW Sampling	10/22/13	92 - 156 ft	ND (0.5)	**14**	**110**	ND (1)	ND (3)	**17**	ND (3)	ND (5)	**20**	ND (10)	ND (0.2)	**9.1**	ND (5)	**0.68**	ND (3)	ND (0.5)	**20**	**12**
	Constant-rate test	02/11/14	1 hrs	ND (0.5)	**16**	**120**	ND (0.5)	ND (0.5)	**18**	ND (0.5)	ND (1)	**20**	ND (1)	ND (0.2)	**9**	ND (1)	**0.79**	ND (0.5)	ND (0.5)	**18**	ND (10)
	Constant-rate test	02/12/14	6 hrs	ND (0.5)	**16**	**110**	ND (0.5)	ND (0.5)	**19**	ND (0.5)	ND (1)	**20**	ND (1)	ND (0.2)	**9.4**	ND (1)	**0.75**	ND (0.5)	ND (0.5)	**19**	ND (10)
	Constant-rate test	02/12/14	12 hrs	ND (0.5)	**16**	**110**	ND (0.5)	ND (0.5)	**18**	ND (0.5)	ND (1)	**20**	ND (1)	ND (0.2)	**9**	ND (1)	**0.73**	ND (0.5)	ND (0.5)	**18**	ND (10)
	Constant-rate test	02/12/14	24 hrs	ND (0.5)	**15**	**120**	ND (0.5)	ND (0.5)	**18**	ND (0.5)	ND (1)	**19**	ND (1)	ND (0.2)	**9.1**	ND (1)	**0.77**	ND (0.5)	ND (0.5)	**17**	ND (10)
	Constant-rate test	02/13/14	48 hrs	ND (0.5)	**15**	**130**	ND (0.5)	ND (0.5)	**17**	ND (0.5)	ND (1)	**19**	ND (1)	ND (0.2)	**9.2**	ND (1)	**0.76**	ND (0.5)	ND (0.5)	**17**	ND (10)
	Constant-rate test	02/14/14	72 hrs	ND (0.5)	**14**	**120**	ND (0.5)	ND (0.5)	**16**	ND (0.5)	ND (1)	**19**	ND (1)	ND (0.2)	**8.9**	ND (1)	**0.75**	ND (0.5)	ND (0.5)	**16**	ND (10)
HNWR-1 Site	Exploratory	10/16/13	50 ft	ND (0.5)	**6**	**87**	ND (1)	ND (3)	**6.1**	ND (3)	ND (5)	**6**	ND (10)	ND (0.2)	**9.5**	ND (5)	**0.96**	ND (3)	ND (0.5)	**16**	**14**
	Exploratory	10/17/13	100 ft	ND (0.5)	**10**	**110**	ND (1)	ND (3)	**12**	ND (3)	ND (5)	**11**	ND (10)	ND (0.2)	**8.7**	ND (5)	**0.83**	ND (3)	ND (0.5)	**18**	ND (10)
	Exploratory	10/17/13	150 ft	ND (0.5)	**6.9**	**78**	ND (1)	ND (3)	**8.8**	ND (3)	ND (5)	**9**	ND (10)	ND (0.2)	**10**	ND (5)	**0.52**	ND (3)	ND (0.5)	**13**	ND (10)
	Exploratory	10/17/13	200 ft	ND (0.5)	**11**	**100**	ND (1)	ND (3)	**11**	ND (3)	ND (5)	**9**	ND (10)	ND (0.2)	**8.9**	ND (5)	**0.57**	ND (3)	ND (0.5)	**16**	ND (10)
	Exploratory	10/18/13	250 ft	ND (0.5)	**12**	**580**	ND (1)	ND (3)	**3.3**	ND (3)	ND (5)	**1**	ND (10)	ND (0.2)	**15**	ND (5)	**0.57**	**5.7**	ND (0.5)	ND (3)	ND (10)
	Exploratory	10/19/13	300 ft	ND (2.5)	**0.8**	**91**	ND (1)	ND (3)	ND (1)	ND (3)	**14**	ND (1)	ND (10)	ND (0.2)	**120**	ND (5)	ND (2.5)	ND (3)	ND (2.5)	**11**	ND (10)
	Exploratory	10/19/13	350 ft	ND (2.5)	**3**	**240**	ND (5)	ND (15)	ND (1)	ND (15)	**26**	ND (1)	ND (50)	ND (0.2)	**160**	ND (25)	ND (2.5)	ND (15)	ND (12)	ND (15)	ND (50)
	Exploratory	10/20/13	400 ft	ND (2.5)	ND (0.5)	**150**	**1.3**	ND (3J)	ND (1)	ND (3)	**8.1**	ND (1)	ND (10)	ND (0.2)	**39**	**6.9**	ND (2.5)	**12**	ND (12)	ND (3)	**11**
Site B	Exploratory	10/06/13	58 ft	ND (0.5)	**1.3**	**110**	ND (1)	ND (3)	ND (1)	ND (3)	ND (5)	ND (0.2)	ND (10)	ND (0.2)	**11**	ND (5)	**1.6**	ND (3)	ND (0.5)	**9.2**	ND (10)
	Exploratory	10/07/13	100 ft	ND (0.5)	**13**	**130**	ND (1)	ND (3)	**2.3**	ND (3)	ND (5)	**2.1**	ND (10)	ND (0.2)	**17**	ND (5)	**0.78**	ND (3)	ND (0.5)	**11**	ND (10)
	Exploratory	10/07/13	150 ft	ND (0.5)	**13**	**140**	ND (1)	ND (3)	**16**	ND (3)	**5.9**	**16**	ND (10)	ND (0.2)	**17**	ND (5)	**0.99**	ND (3)	ND (0.5)	**12**	ND (10)
	Exploratory	10/08/13	200 ft	ND (0.5)	**13**	**130**	ND (1)	ND (3)	**7.7**	ND (3)	**7.8**	**5.2**	ND (10)	ND (0.2)	**13**	ND (5)	**0.89**	ND (3)	ND (0.5)	**13**	ND (10)
	Exploratory	10/09/13	250 ft	ND (0.5)	**10**	**140**	ND (1)	ND (3)	**3.2**	ND (3)	ND (5)	**2.8**	ND (10)	ND (0.2)	**8.6**	ND (5)	**0.78**	ND (3)	ND (0.5)	**12**	ND (10)
	Exploratory	10/09/13	300 ft	ND (0.5)	**4.5**	**140**	ND (1)	ND (3)	ND (1)	ND (3)	ND (5)	ND (0.2)	ND (10)	ND (0.2)	**8.5**	ND (5)	**0.88**	ND (3)	ND (0.5)	**7**	ND (10)
	Exploratory	10/10/13	350 ft	ND (0.5)	**12**	**94**	ND (1)	ND (3)	**5.7**	ND (3)	ND (5)	**4.6**	ND (10)	ND (0.2)	**8.8**	ND (5)	**0.69**	ND (3)	ND (0.5)	**16**	ND (10)
	Exploratory	10/15/13	400 ft	ND (0.5)	**0.97**	**120**	ND (1)	ND (3)	ND (1)	ND (3)	**11**	ND (0.2)	ND (10)	ND (0.2)	**6.9**	ND (5)	**0.81**	**6.7**	ND (2.5)	ND (3)	**26**
	Constant-rate test	02/07/14	1 hrs	ND (0.5)	**17**	**170**	ND (0.5)	ND (0.5)	**31**	ND (0.5)	ND (1)	**33**	ND (1)	ND (0.2)	**12**	ND (1)	**0.86**	ND (0.5)	ND (0.5)	**17**	ND (10)
	Constant-rate test	02/08/14	6 hrs	ND (0.5)	**17**	**150**	ND (0.5)	ND (0.5)	**31**	ND (0.5)	ND (1)	**33**	ND (1)	ND (0.2)	**11**	ND (1)	**0.92**	ND (0.5)	ND (0.5)	**16**	ND (10)
	Constant-rate test	02/08/14	12 hrs	ND (0.5)	**18**	**160**	ND (0.5)	ND (0.5)	**31**	ND (0.5)	ND (1)	**33**	ND (1)	ND (0.2)	**12**	ND (1)	**0.9**	ND (0.5)	ND (0.5)	**17**	ND (10)
	Constant-rate test	02/08/14	24 hrs	ND (0.5)	**17**	**160**	ND (0.5)	ND (0.5)	**32**	ND (0.5)	ND (1)	**34**	ND (1)	ND (0.2)	**12**	ND (1)	**0.89**	ND (0.5)	ND (0.5)	**17**	ND (10)
	Constant-rate test	02/09/14	48 hrs	ND (0.5)	**18**	**160**	ND (0.5)	ND (0.5)	**31**	ND (0.5)	ND (1)	**34**	ND (1)	ND (0.2)	**12**	ND (1)	**0.94**	ND (0.5)	ND (0.5)	**16**	ND (10)
	Constant-rate test	02/10/14	72 hrs	ND (0.5)	**18**	**170**	ND (0.5)	ND (0.5)	**33**	ND (0.5)	ND (1)	**34**	ND (1)	ND (0.2)	**12**	ND (1)	**0.92**	ND (0.5)	ND (0.5)	**17 J**	ND (10)

Notes:

Detected results are bolded

-- = not analyzed

ft = feet below ground surface

GW = Groundwater

hrs = hours

J = concentration or reporting limit estimated by laboratory or data validation

ND = not detected at the listed reporting limit

µg/L = micrograms per liter

TABLE-3

Groundwater Sample Results: Contract Laboratory Program Inorganics

Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Area

Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

				Contract Laboratory Program (CLP) Inorganics (µg/L)					
Location	**Phase**	**Date**	**Depth/ Time**	**Calcium, dissolved**	**Iron, dissolved**	**Magnesium, dissolved**	**Manganese, dissolved**	**Potassium, dissolved**	**Sodium, dissolved**
HNWR-1	Constant-rate test	02/11/14	1 hrs	**19,000**	ND (20)	**3,200**	ND (0.5)	**4,100**	**130,000**
	Constant-rate test	02/14/14	72 hrs	**23,000**	ND (20)	**4,200**	ND (0.5)	**4,600**	**140,000**
HNWR-1 Site	Exploratory	10/17/13	100 ft	**26,000**	**42**	**5,100**	---	**5,100**	**140,000**
	Exploratory	10/17/13	200 ft	**17,000**	**110**	**2,000**	---	**4,900**	**180,000**
	Exploratory	10/19/13	300 ft	**27,000**	**880**	**1,800**	---	**5,800**	**230,000**
Site B	Constant-rate test	02/07/14	1 hrs	**32,000 J**	**22**	**5,600**	ND (0.5)	**5,000**	**230,000**
	Constant-rate test	02/10/14	72 hrs	**37,000**	ND (20)	**6,400**	ND (0.5)	**5,200**	**240,000**
	Exploratory	10/07/13	100 ft	**20,000**	**26**	**4,400**	---	**4,700**	**160,000**
	Exploratory	10/08/13	200 ft	**28,000**	**200**	**5,200**	---	**5,200**	**200,000**
	Exploratory	10/09/13	300 ft	**34,000**	**76**	**6,800**	---	**5,800**	**220,000**
	Exploratory	10/15/13	400 ft	**360,000**	**550**	**27,000**	---	**16,000**	**1,900,000**

Notes:

Detected results are bolded

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hrs = hours

J = concentration or reporting limit estimated by laboratory or data validation

ND = not detected at the listed reporting limit

µg/L = micrograms per liter

TABLE-4

Groundwater Sample Results: Polycyclic Aromatic Hydrocarbons

Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Area

Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

				Polyaromatic Hydrocarbons (µg/L)																
Location	**Phase**	**Date**	**Depth/ Time**	**1-Methyl naphthalene**	**2-Methyl naphthalene**	**Acenaph-thene**	**Acenaph-thylene**	**Anthracene**	**Benzo-(ghi)-perylene**	**Benzo(a)-anthracene**	**Benzo(a)-pyrene**	**Benzo(b)-fluor anthene**	**Benzo(k)-fluor anthene**	**Chrysene**	**Dibenzo- (a,h)-anthracene**	**Fluoranthene**	**Fluorene**	**Indeno(1,2,3-cd)pyrene**	**Naph-thalene**	**Phen-anthrene**	**Pyrene**
HNWR-1	Constant-rate test	02/11/14	1 hrs	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
	Constant-rate test	02/14/14	72 hrs	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)
HNWR-1 Site	Exploratory	10/17/13	100 ft	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
	Exploratory	10/17/13	200 ft	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
	Exploratory	10/19/13	300 ft	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
Site B	Exploratory	10/07/13	100 ft	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
	Exploratory	10/08/13	200 ft	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
	Exploratory	10/09/13	300 ft	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
	Exploratory	10/15/13	400 ft	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
	Constant-rate test	02/07/14	1 hrs	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
	Constant-rate test	02/10/14	72 hrs	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)

Notes:

Detected results are bolded

-- = not analyzed

ft = feet below ground surface

GW = Groundwater

hrs = hours

ND = not detected at the listed reporting limit

µg/L = micrograms per liter

TABLE-5

Groundwater Sample Results: Pesticides

Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Area

Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

				Pesticides (µg/L)																		
Location	**Phase**	**Date**	**Depth/ Time**	**4,4-DDD**	**4,4-DDE**	**4,4-DDT**	**Aldrin**	**alpha-BHC**	**alpha-Chlordane**	**beta-BHC**	**delta-BHC**	**Dieldrin**	**Endo sulfan I**	**Endo sulfan II**	**Endosulfan sulfate**	**Endrin**	**Endrin aldehyde**	**gamma-BHC**	**gamma-Chlordane**	**Heptachlor**	**Heptachlor Epoxide**	**Methoxy chlor**	**Toxaphene**
HNWR-1	Constant-rate test	02/11/14	1 hrs	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.05)	ND (0.025)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
	Constant-rate test	02/14/14	72 hrs	ND (0.052)	ND (0.052)	ND (0.052)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.052)	ND (0.026)	ND (0.052)	ND (0.052)	ND (0.052)	ND (0.052)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.26)	ND (2.6)
HNWR-1 Site	Exploratory	10/17/13	100 ft	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.05)	ND (0.025)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
	Exploratory	10/17/13	200 ft	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.05)	ND (0.025)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
	Exploratory	10/19/13	300 ft	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.05)	ND (0.025)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
Site B	Exploratory	10/07/13	100 ft	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.051)	ND (0.025)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
	Exploratory	10/08/13	200 ft	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.05)	ND (0.025)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
	Exploratory	10/09/13	300 ft	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.051)	ND (0.025)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
	Exploratory	10/15/13	400 ft	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.05)	ND (0.025)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
	Constant-rate test	02/07/14	1 hrs	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.05)	ND (0.025)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
	Constant-rate test	02/10/14	72 hrs	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.05)	ND (0.025)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)

Notes:

Detected results are bolded

-- = not analyzed

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hrs = hours

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µg/L = micrograms per liter

TABLE-6

Groundwater Sample Results: Polychlorinated Biphenyls

Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Area

Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

				Polychlorinated Biphenyls (µg/L)						
Location	**Phase**	**Date**	**Depth/ Time**	**Aroclor 1016**	**Aroclor 1221**	**Aroclor 1232**	**Aroclor 1242**	**Aroclor 1248**	**Aroclor 1254**	**Aroclor 1260**
HNWR-1	Constant-rate test	02/11/14	1 hrs	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
	Constant-rate test	02/14/14	72 hrs	ND (0.52)	ND (1)	ND (0.52)	ND (0.52)	ND (0.52)	ND (0.52)	ND (0.52)
HNWR-1 Site	Exploratory	10/17/13	100 ft	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
	Exploratory	10/17/13	200 ft	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
	Exploratory	10/19/13	300 ft	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
Site B	Exploratory	10/07/13	100 ft	ND (0.51J)	ND (1J)	ND (0.51J)	ND (0.51J)	ND (0.51J)	ND (0.51J)	ND (0.51J)
	Exploratory	10/08/13	200 ft	ND (0.5J)	ND (1J)	ND (0.5J)	ND (0.5J)	ND (0.5J)	ND (0.5J)	ND (0.5J)
	Exploratory	10/09/13	300 ft	ND (0.51)	ND (1)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)
	Exploratory	10/15/13	400 ft	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
	Constant-rate test	02/07/14	1 hrs	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
	Constant-rate test	02/10/14	72 hrs	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)

Notes:

Detected results are bolded

-- = not analyzed

ft = feet below ground surface

GW = Groundwater

hrs = hours

ND = not detected at the listed reporting limit

µg/L = micrograms per liter

TABLE-7

Groundwater Sample Results: Total Petroleum Hydrocarbons

Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Area
Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

Location	Phase	Date	Depth/ Time	Total Petroleum Hydrocarbons (µg/L)		
				TPH-d	TPH-g	TPH-mo
HNWR-1	Constant-rate test	02/11/14	1 hrs	ND (50)	ND (100)	ND (50)
	Constant-rate test	02/14/14	72 hrs	ND (50)	ND (100)	ND (50)
HNWR-1 Site	Exploratory	10/17/13	100 ft	ND (50)	ND (100)	ND (50)
	Exploratory	10/17/13	200 ft	ND (50)	ND (100)	ND (50)
	Exploratory	10/19/13	300 ft	ND (50)	ND (100)	ND (50)
Site B	Constant-rate test	02/07/14	1 hrs	ND (50J)	ND (100)	ND (50)
	Constant-rate test	02/10/14	72 hrs	**92 J**	ND (100)	**130**
	Exploratory	10/07/13	100 ft	**58**	ND (100)	ND (51)
	Exploratory	10/08/13	200 ft	**62**	ND (100)	ND (50)
	Exploratory	10/09/13	300 ft	ND (51)	ND (100)	ND (51)
	Exploratory	10/15/13	400 ft	ND (50)	ND (100)	**53**

Notes:

-- = not analyzed

ft = feet below ground surface

GW = Groundwater

hrs = hours

J = concentration or reporting limit estimated by laboratory or data validation

TABLE-8

Groundwater Sample Results: Anions, General and Radiochemistry Parameters

Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Area

Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

				General Chemistry and Radiochemistry (mg/L except where footnoted)														
Location	**Phase**	**Date**	**Depth/ Time**	**Bromide**	**Chloride**	**Deuterium***	**Fluoride**	**Gross Alpha***	**Gross Beta***	**Nitrate as Nitrogen**	**Nitrite as Nitrogen**	**Orthophosphate, dissolved**	**Oxygen 18***	**Perchlorate***	**pH***	**Soluble silica**	**Sulfate**	**Total organic carbon**
HNWR-1	GW Sampling	10/22/13	92 - 156 ft	ND (0.5)	**140**	--	**3.9**	--	--	**2.5**	ND (2.5)	--	--	--	--	**27**	**45**	--
	Constant-rate test	02/11/14	1 hrs	ND (0.5)	**140**	**-73.63**	**4**	**7.42**	ND (4)	**2.6**	ND (1)	ND (0.02)	**-10.11**	ND (2)	**7.9 J**	**24**	**45**	ND (1)
	Constant-rate test	02/12/14	6 hrs	--	--	**-73.42**	**4**	--	--	**2.7**	--	--	**-10.11**	--	--	**25 J**	--	--
	Constant-rate test	02/12/14	12 hrs	--	--	**-73.16**	**3.9**	--	--	**2.6**	--	--	**-10.4**	--	--	**25**	--	--
	Constant-rate test	02/12/14	24 hrs	--	--	**-72.92**	**3.9**	--	--	**2.7**	--	--	**-10.04**	--	--	**25**	--	--
	Constant-rate test	02/13/14	48 hrs	--	--	**-74.32**	**3.8**	--	--	**2.5**	--	--	**-10.52**	--	--	**25**	--	--
	Constant-rate test	02/14/14	72 hrs	ND (0.5)	**140**	**-72.54**	**3.9**	**6.34 J**	ND (4)	**2.5**	ND (1)	ND (0.02)	**-10.44**	ND (2)	**7.7 J**	**27**	**51**	ND (1)
HNWR-1 Site	Exploratory	10/16/13	50 ft	--	--	--	**3.8**	--	--	**2.5**	--	--	--	--	--	**26**	--	--
	Exploratory	10/17/13	100 ft	ND (0.5)	**140**	**-72.9**	**3.8**	**3.49**	**5.17**	**2.5**	ND (2.5)	ND (0.02)	**-10.1**	ND (2)	**8 J**	--	**51**	ND (1)
	Exploratory	10/17/13	150 ft	--	--	--	**4.5**	--	--	**2.4**	--	--	--	--	--	**20**	--	--
	Exploratory	10/17/13	200 ft	ND (0.5)	**180**	**-72.8**	**4.3**	ND (3)	**4.14**	**2.3**	ND (2.5)	ND (0.02)	**-9.7**	ND (2)	**8 J**	--	**53**	ND (1)
	Exploratory	10/18/13	250 ft	--	--	--	**5.6**	--	--	**2.1**	--	--	--	--	--	**21**	--	--
	Exploratory	10/19/13	300 ft	ND (10)	**11,000**	**-78**	**8.1**	ND (3)	ND (131)	ND (10)	ND (50)	ND (0.02)	**-10.2**	ND (20)	**7.8 J**	--	**670**	ND (1)
	Exploratory	10/19/13	350 ft	--	--	--	**8.4**	--	--	ND (10)	--	--	--	--	--	**20**	--	--
	Exploratory	10/20/13	400 ft	--	--	--	--	--	--	--	--	--	--	--	--	**3.7**	--	--
Site B	Exploratory	10/06/13	58 ft	--	--	--	**2**	--	--	**200**	--	--	--	--	--	**31**	--	--
	Exploratory	10/07/13	100 ft	ND (0.5)	**170**	**-75.9**	**5**	**4.71 J**	ND (4)	**2.5**	ND (2.5)	ND (0.02)	**-11**	ND (2)	**7.8 J**	--	**58**	ND (1)
	Exploratory	10/07/13	150 ft	--	--	--	**4.8**	--	--	**2.4**	--	--	--	--	--	**22**	--	--
	Exploratory	10/08/13	200 ft	ND (0.5)	**250**	**-75.9**	**4.2**	**5.9 J**	**8.05**	**2.5**	ND (2.5)	ND (0.02)	**-10.8**	ND (2)	**7.8 J**	--	**71**	ND (1)
	Exploratory	10/09/13	250 ft	--	--	--	**3.9**	--	--	**2.6**	--	--	--	--	--	**21**	--	--
	Exploratory	10/09/13	300 ft	ND (0.5)	**310**	**-76.5**	**4.1**	**3.6 J**	**4.53**	**2.6**	ND (2.5)	ND (0.02)	**-10.5**	ND (2)	**7.6 J**	--	**78**	ND (1)
	Exploratory	10/10/13	350 ft	--	--	--	**4.7**	--	--	**2.5**	--	--	--	--	--	**19**	--	--
	Exploratory	10/15/13	400 ft	ND (2.5)	**3,100**	**-78.8**	**4.1 J**	**3.66**	ND (21.9)	ND (2.5)	ND (10)	ND (0.02)	**-10.9**	ND (10)	**7.3 J**	--	**330**	ND (1)
	Constant-rate test	02/07/14	1 hrs	ND (0.5)	**270**	**-75.45**	**4.3**	**5.51**	ND (4)	**2.4**	ND (2.5)	ND (0.02)	**-10.15**	ND (2)	**7.8 J**	**23**	**70**	ND (1)
	Constant-rate test	02/08/14	6 hrs	--	--	**-75.84**	**4.3**	--	--	**2.5**	--	--	**-10.27**	--	--	**22**	--	--
	Constant-rate test	02/08/14	12 hrs	--	--	**-77.46**	**4.4**	--	--	**2.5**	--	--	**-10.42**	--	--	**23**	--	--
	Constant-rate test	02/08/14	24 hrs	--	--	**-75.52**	**4.2**	--	--	**2.4**	--	--	**-10.32**	--	--	**19 J**	--	--
	Constant-rate test	02/09/14	48 hrs	--	--	**-76.74**	**4.1**	--	--	**2.4**	--	--	**-10.4**	--	--	**23**	--	--
	Constant-rate test	02/10/14	72 hrs	ND (0.5)	**270**	**-74.54**	**4.3**	**4.38**	ND (4)	**2.5**	ND (2.5)	ND (0.02)	**-10.07**	ND (2)	**7.9 J**	**24**	**71**	ND (1)

Notes:

Detected results are bolded

* Oxygen-18 and Deuterium in differences from global standards in parts per thousand

* Gross alpha and beta in picocuries per liter

* Perchlorate in micrograms per liter (µg/L)

* pH in pH units

All other parameters in milligrams per liter (mg/L)

-- = not analyzed

ft = feet below ground surface

GW = Groundwater

hrs = hours

J = concentration or reporting limit estimated by laboratory or data validation

ND = not detected at the listed reporting limit

TABLE-9

Groundwater Sample Results: Herbicides

Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Area

Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

				Herbicides (µg/L)									
Location	**Phase**	**Date**	**Depth/ Time**	**2,4,5-T**	**2,4,5-TP (Silvex)**	**2,4-D**	**2,4-DB**	**Dalapon**	**Dicamba**	**Dichlorprop**	**Dinoseb**	**MCPA**	**MCPP**
HNWR-1	Constant-rate test	02/11/14	1 hrs	ND (0.012)	ND (0.016)	ND (0.065)	ND (0.32)	ND (2.4J)	ND (0.037)	ND (0.012)	ND (0.04)	ND (0.29J)	ND (0.3J)
	Constant-rate test	02/14/14	72 hrs	ND (0.012)	ND (0.016)	ND (0.065)	ND (0.32)	ND (2.4J)	ND (0.037)	ND (0.012)	ND (0.04)	ND (0.29J)	ND (0.3J)
HNWR-1 Site	Exploratory	10/17/13	100 ft	ND (0.09)	ND (0.07)	ND (0.4)	ND (3)	ND (10J)	ND (0.08)	ND (0.5)	ND (0.2)	ND (10J)	ND (10J)
	Exploratory	10/17/13	200 ft	ND (0.09)	ND (0.07)	ND (0.4)	ND (3)	ND (10)	ND (0.08)	ND (0.5)	ND (0.2)	ND (10)	ND (10)
	Exploratory	10/19/13	300 ft	ND (0.09)	ND (0.07)	ND (0.4)	ND (3)	ND (10J)	ND (0.08)	ND (0.5)	ND (0.2)	ND (10J)	ND (10J)
Site B	Exploratory	10/07/13	100 ft	ND (0.09)	ND (0.07)	ND (0.4)	ND (3)	ND (10J)	ND (0.08J)	ND (0.5J)	ND (0.2)	ND (10J)	ND (10J)
	Exploratory	10/08/13	200 ft	ND (0.09)	ND (0.07)	ND (0.4)	ND (3)	ND (10)	ND (0.08J)	ND (0.5J)	ND (0.2)	ND (10)	ND (10)
	Exploratory	10/09/13	300 ft	ND (0.09J)	ND (0.07)	ND (0.4)	ND (3)	ND (10)	ND (0.08)	ND (0.5)	ND (0.2)	ND (10J)	ND (10J)
	Exploratory	10/15/13	400 ft	ND (0.09)	ND (0.07)	ND (0.4)	ND (3)	ND (10J)	ND (0.08)	ND (0.5)	ND (0.2)	ND (10J)	ND (10J)
	Constant-rate test	02/07/14	1 hrs	ND (0.09)	ND (0.07)	ND (0.4)	ND (3)	ND (10J)	ND (0.08)	ND (0.5)	ND (0.2)	ND (10J)	ND (10J)
	Constant-rate test	02/10/14	72 hrs	ND (0.09)	ND (0.07)	ND (0.4)	ND (3)	ND (10J)	ND (0.08)	ND (0.5)	ND (0.2)	ND (10J)	ND (10J)

Notes:

Detected results are bolded

-- = not analyzed

ft = feet below ground surface

GW = Groundwater

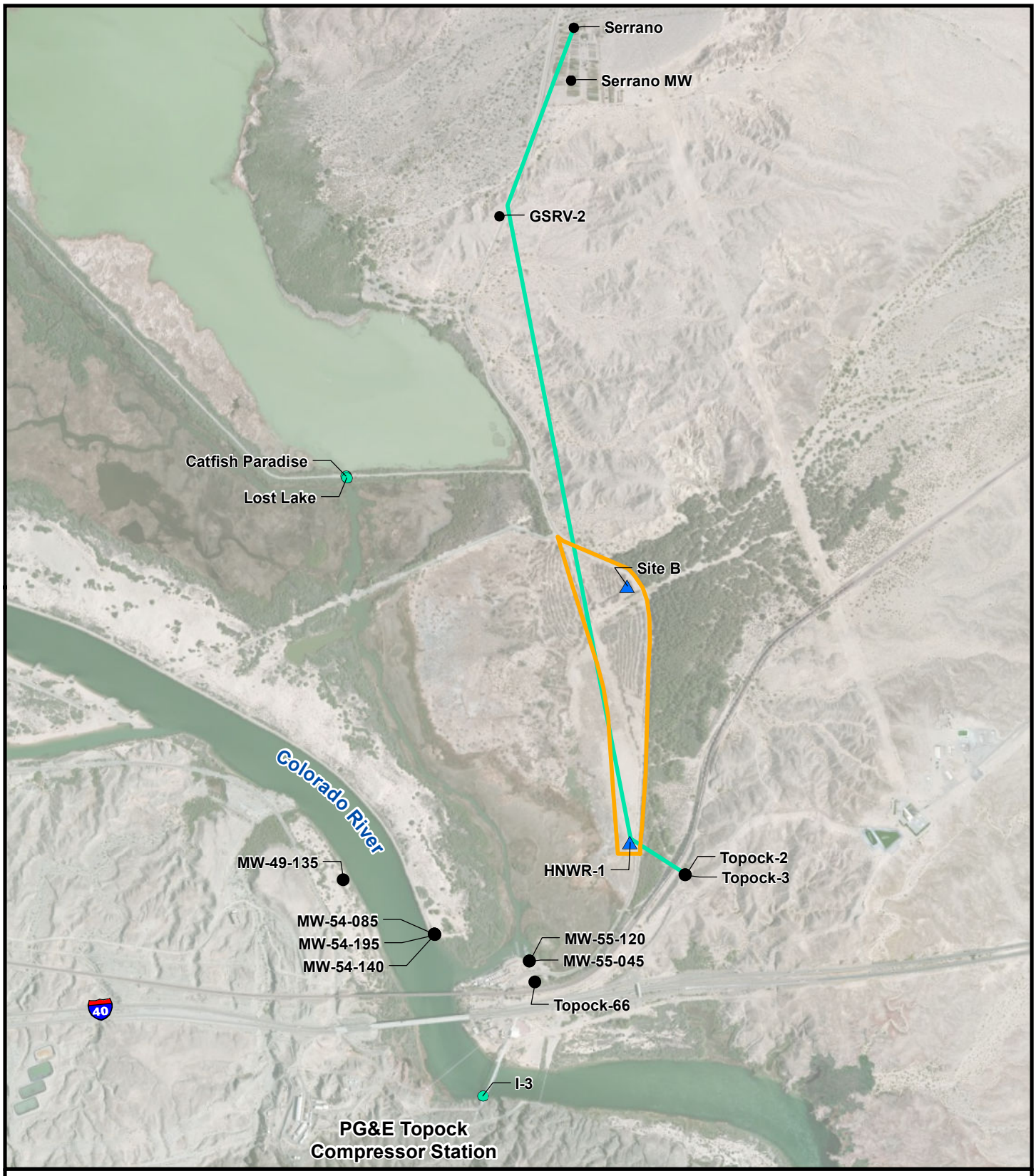
hrs = hours

J = concentration or reporting limit estimated by laboratory or data validation

ND = not detected at the listed reporting limit

µg/L = micrograms per liter

Figures



LEGEND

- Pumping Well/Observation Well
- Observation Well
- Surface Water Body
- Conceptual Geologic Cross Section
- Boundary of Work Area

N

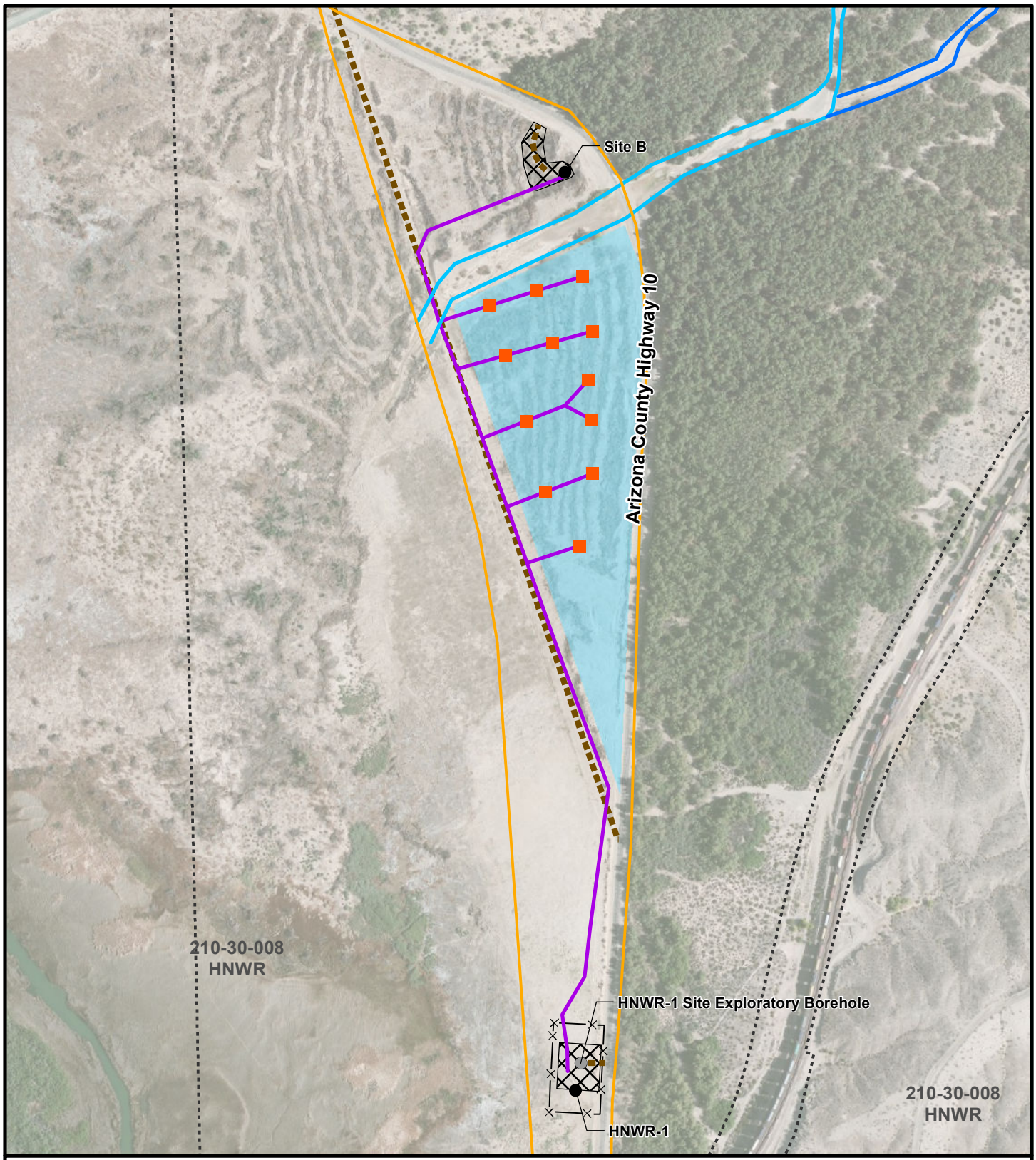
0 600 1,200 2,400 Feet

FIGURE 1
SITE MAP

SUMMARY OF FINDINGS ASSOCIATED WITH THE EVALUATION OF ALTERNATIVE FRESHWATER SOURCES IN THE TOPOCK REMEDIATION PROJECT AREA
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

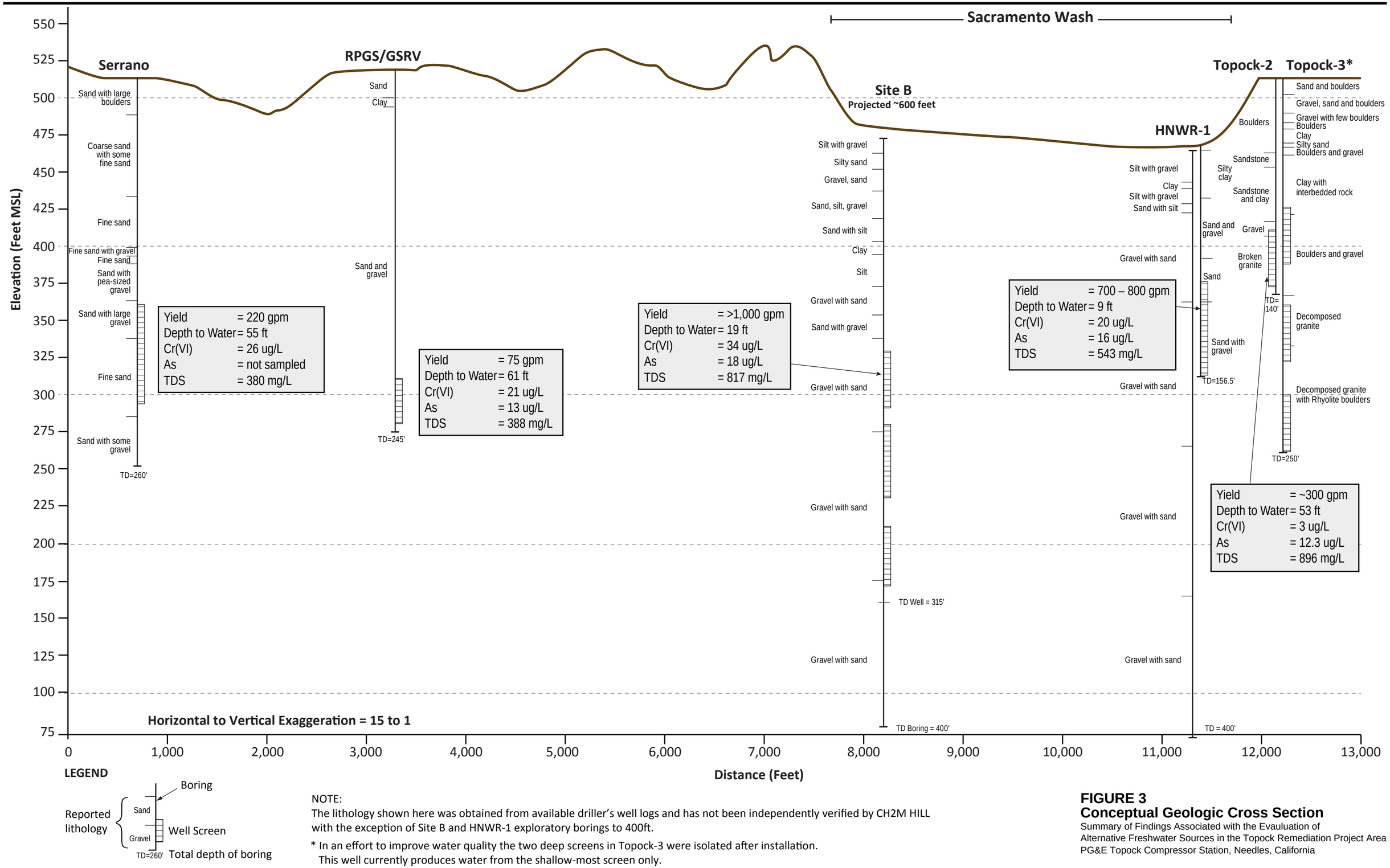
Path: \\Zinfandel\proj\PacificGasElectricCo\TopockProgram\GIS\MapFiles\2014\FWIP\FIG1_SiteMap.mxd Date Saved: 3/25/2014 10:41:59 AM

CH2MHILL



Note: Fence line for Site B is pending discussion with HNWR. Estimated installation date is April 2014.

FIGURE 2
SITE B AND HNWR-1 SITE WORK AREAS
SUMMARY OF FINDINGS ASSOCIATED WITH THE EVALUATION OF ALTERNATIVE FRESHWATER SOURCES IN THE TOPOCK REMEDIATION PROJECT AREA
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA



LEGEND

NOTE:
The lithology shown here was obtained from available driller's well logs and has not been independently verified by CH2M HILL with the exception of Site B and HNWR-1 exploratory borings to 400ft.

* In an effort to improve water quality the two deep screens in Topock-3 were isolated after installation. This well currently produces water from the shallow-most screen only.

FIGURE 3
Conceptual Geologic Cross Section
Summary of Findings Associated with the Evauluation of Alternative Freshwater Sources in the Topock Remediation Project Area
PG&E Topock Compressor Station, Needles, California

Attachment A
Well Construction Information

Attachment A-1
Site B Well

Arizona Department of Water Resources
Water Management Division
P.O. Box 36020 Phoenix, Arizona 85067-6020
(602) 771-8500 • (602) 771-8690 fax
• www.azwater.gov •

Notice of Intent to Drill, Deepen, Replace or Modify a Well
(except a Non-Exempt Well in an Active Management Area)

$150 or $100 FEE

- Review instructions prior to completing form in black or blue ink.
- You must include with your Notice:
  - Check or money order in the amount of the appropriate filing fee.
  - For a well located within an AMA or INA, the fee is $150.00.
  - For a well not located within an AMA or INA, the fee is $100.00 if the well will be used solely for domestic purposes (see page 2 and instructions) and will have a pump with a maximum capacity of not more than 35 gallons per minute. Otherwise, the fee is $150.00.
- Authority for fee: A.R.S. § 45-596 and A.A.C. R12-15-104.

AMA / INA	B	SB
RECEIVED DATE	WS	
ISSUED DATE	WQARF	CERCLA
LEGAL REVIEW IF APP	REASONING	

FILE NUMBER

WELL REGISTRATION NUMBER
55 -

SECTION 1. COUNTY OR LOCAL HEALTH AUTHORITY APPROVAL (if applicable)

If water from the proposed well will be used for domestic purposes on a parcel of land of 5 or fewer acres, the applicable county or local health authority must endorse all items in Section 1 within one year before submission to the Department of Water Resources. You must also attach a site plan (pg. 3).

CHECK ONE

☐ County or Local Health Authority Recommends Approval (pursuant to A.R.S. § 45-596 (G) and (F))
- ☐ Field Inspection Performed
- ☐ Site Plan Review Only

☐ Insufficient Information to Make a Determination

Official County or Local Seal or Stamp

COUNTY OR LOCAL AUTHORITY NAME AND TITLE

TELEPHONE NUMBER | DATE | COUNTY OR LOCAL AUTHORITY SIGNATURE

SECTION 2. REGISTRY INFORMATION

Well Type

CHECK ONE

☐ Exempt
(Pump has a maximum capacity of not more than 35 gpm and water is not used for irrigation purposes inside an AMA.) *(See instructions.)*

☒ Non-Exempt
(Pump has a maximum capacity of more than 35 gpm and the well is located outside an AMA.) *(See instructions.)*

DESIGN PUMP CAPACITY
1,000 Gallons Per Minute

Proposed Action

CHECK ONE

☒ Drill New Well
☐ Deepen
☐ Replace
☐ Modify

If Deepening, Replacing or Modifying:

ORIGINAL WELL REGISTRATION NUMBER
55 - NA

MAXIMUM CAPACITY OF ORIGINAL WELL
NA Gallons Per Minute

DISTANCE & DIRECTION FROM ORIGINAL WELL
NA Feet

Location of Well

WELL LOCATION ADDRESS (IF ANY): NA

COUNTY WHERE WELL IS LOCATED: Mohave

TOWNSHIP (N/S)	RANGE (E/W)	SECTION	160 ACRE	40 ACRE	10 ACRE
T16N	R21W	35	NW ¼	NE ¼	SW ¼

COUNTY ASSESSOR'S PARCEL ID NUMBER			# OF ACRES
BOOK	MAP	PARCEL	
210	30	008	365

Place of Water Use *(Mandatory Information, see instructions.)*

Is the groundwater basin where the well will be drilled the same as the place where the water will be used?	Yes	No
		☒

TOWNSHIP (N/S)	RANGE (E/W)	SECTION	160 ACRE	40 ACRE	10 ACRE
Used as part of the Topock Comp. Station's remediation.					

SECTION 3. OWNER INFORMATION

Well Owner

FULL NAME OF COMPANY, ORGANIZATION, OR INDIVIDUAL
Pacific Gas & Electric Company

MAILING ADDRESS
PG&E Topock Compressor Station PO Box 337

CITY / STATE / ZIP CODE
Needles CA 92363

CONTACT PERSON NAME AND TITLE
Curt Russell Topock Site Manager

TELEPHONE NUMBER: 760-791-5884 FAX: 760-326-5542

Landowner (if different from Well Owner)

FULL NAME OF COMPANY, GOVERNMENT AGENCY, OR INDIVIDUAL
Havasu National Wildlife Refuge

MAILING ADDRESS
317 Mesquite Ave

CITY / STATE / ZIP CODE
Needles, CA 92363

CONTACT PERSON NAME AND TITLE
Linda L. Miller, Refuge Manager

TELEPHONE NUMBER: 760-326-3853 *22 FAX: 760-326-5745

SECTION 4.

Questions	Yes	No	If Yes:
1. Is the proposed well site within 100 feet of a septic tank system, sewer disposal area, landfill, hazardous materials or petroleum storage area or tank?		☒	You must also request a variance (A.A.C. R12-15-818).
2. Is there another well name or identification number associated with this well (e.g., Lot 35 Well, Smith Well, etc.)?		☒	PLEASE STATE
3. Is the proposed well a NEW well to be located within an Active Management Area? *(See instructions.)*		☒	Unless the well is a replacement well and the total number of operable exempt wells on the land is not increasing, you must also file a supplemental form A.R.S. § 45-454(C) & (D).
4. Is the proposed well the second exempt well on this parcel for the same use?		☒	If the proposed well is in an Active Management Area, you must also file a supplemental form A.R.S. § 45-454(I).

(Site B)

Notice of Intent to Drill, Deepen, Replace or Modify a Well

WELL REGISTRATION NUMBER: 55-

SECTION 5. DRILLING AUTHORIZATION

Drilling Firm

NAME: Layne Christensen Company, LLC

DWR LICENSE NUMBER: #7

ROC LICENSE NUMBER: 071734

TELEPHONE NUMBER: 480-267-8416

FAX: 480-895-8699

MAILING ADDRESS: 12030 East Riggs Road

CITY / STATE / ZIP CODE: Chandler AZ 85249

DATE CONSTRUCTION IS SCHEDULED TO BEGIN: October 2, 2013

SECTION 6. WATER / SITE INFORMATION

Principal Use of Water (CHECK ONE)	Other Uses of Water (CHECK ALL THAT APPLY)
☐ Irrigation	☒ Irrigation
☐ Commercial	☒ Commercial
☐ Domestic	☐ Domestic
☐ Municipal	☐ Municipal
☐ Industrial	☒ Industrial
☐ Stock	☐ Stock
☒ Remediation	☐ Remediation
☐ Dewatering	☐ Dewatering
☐ Other* (please specify):	☐ Other* (please specify):

NOTE: If this is a Notice of Intent to construct a new well that will be used for the purpose of withdrawing groundwater for transportation to an Active Management Area (AMA) pursuant to A.R.S. § 45-552, 45-553, 45-554 or 45-555(A), the authorization to drill the well issued in association with this Notice **shall not be considered the approval to transport groundwater to an AMA.** *(see instructions.)*

SECTION 7. PROPOSED WELL CONSTRUCTION DESIGN (attach separate sheet if needed)

Borehole: DEPTH FROM SURFACE FROM (feet)	Borehole: DEPTH FROM SURFACE TO (feet)	Borehole: BOREHOLE DIAMETER (inches)	Casing: DEPTH FROM SURFACE FROM (feet)	Casing: DEPTH FROM SURFACE TO (feet)	Casing: OUTER DIAMETER (inches)	Casing: MATERIAL TYPE (T): STEEL	PVC	ABS	IF OTHER TYPE, DESCRIBE	Casing: PERFORATION TYPE (T): BLANK OR NONE	WIRE WRAP	SHUTTER SCREEN	MILLS KNIFE	SLOTTED	IF OTHER TYPE, DESCRIBE	GROUTING MATERIAL
0	480	24	0	100	14.625	X*				X						Cement
			100	400	14.625	X					X					

* ADWR well construction standards require a surface seal consisting of a minimum of 20 feet of steel casing. Cement grout must be used to fill the annular space between the surface casing and the borehole. (A.A.C. R12-15-811(B))

The Department's issuance of an authorization to drill a well is not a determination of whether water withdrawn from the well is legally surface water or groundwater. The legal nature of the water withdrawn from the well may be the subject of court action in the future as part of a determination of surface water rights in your area. If there are court proceedings that could affect your well, you will be notified and be given the opportunity to participate. If you have questions regarding the legal nature of the water to be withdrawn from your proposed well, please consult with an experienced civil engineer, hydrologist or water rights attorney.

For the purposes of determining appropriate fees outside AMAs or INAs, "domestic purposes" is defined as "uses related to the supply, service and activities of households and private residences and includes the application of water to less than 2 acres of land to produce plants or parts of plants for sale or human consumption, or for use as feed for livestock, range livestock or poultry, as such terms are defined in A.R.S. § 3-1201."

SECTION 8. OPTIONAL BY PROPERTY OWNER AND WELL OWNER ONLY

☐ By checking this box, I hereby provide ADWR permission to enter the property for the purpose of taking water level measurements at this well. *(See instructions.)*

SECTION 9. WELL OWNER AND PROPERTY OWNER SIGNATURE

I state that this notice is filed in compliance with A.R.S. § 45-596 and is complete and correct to the best of my knowledge and belief.

TYPE OR PRINT NAME AND TITLE: Curt Russell (PG&E Topock Project Site Manager), Linda Miller (Refuge Manager)

SIGNATURE OF WELL OWNER: C Russell — DATE: 9-26-2013

SIGNATURE OF LANDOWNER, IF APPLICABLE (SEE INSTRUCTIONS): Refuge Manager — DATE: 09/26/13

(Site B)

Notice of Intent to Drill, Deepen, Replace or Modify a Well

WELL REGISTRATION NUMBER
55 -

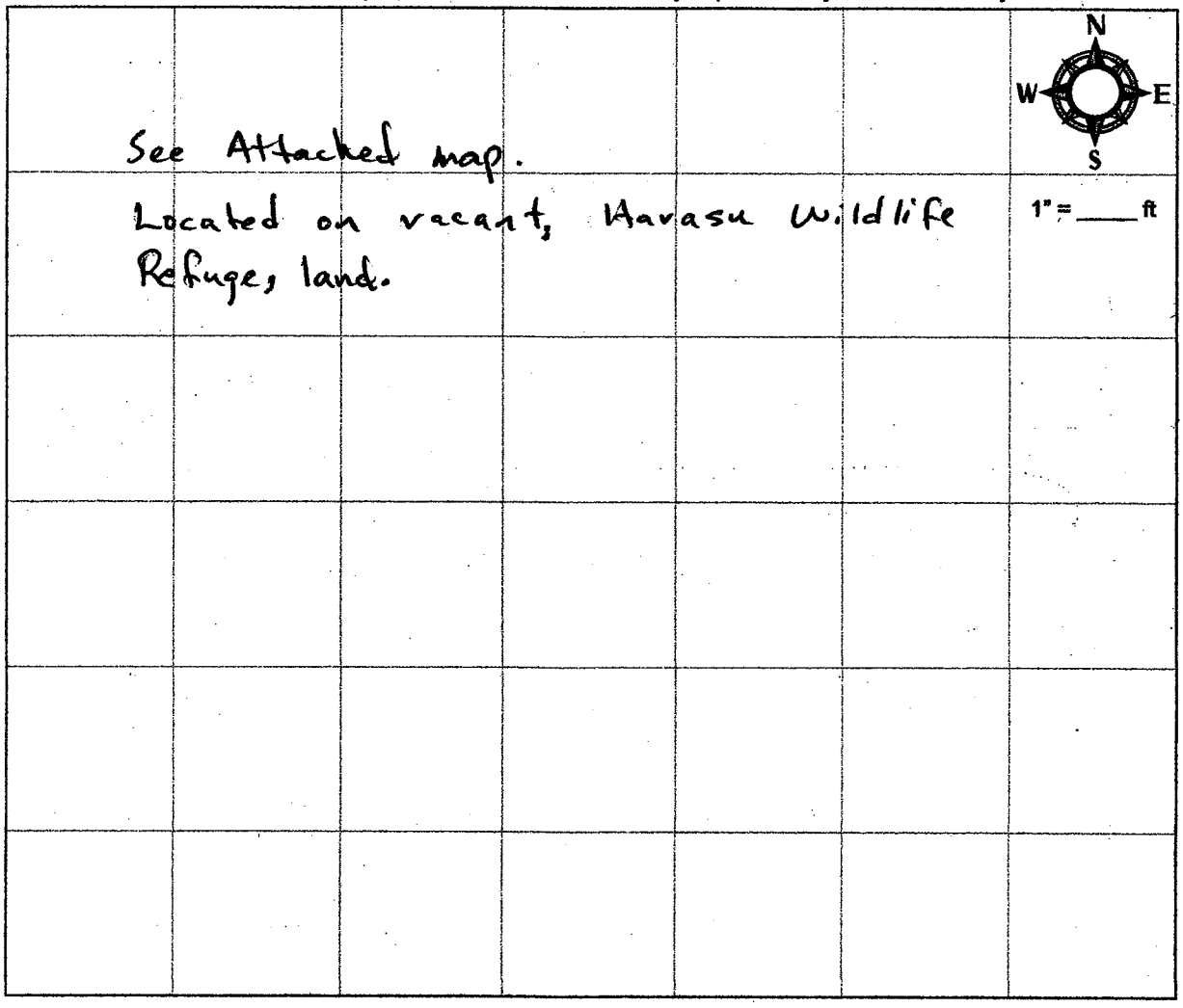
CHECK ONE: ☒ FILING MANUALLY
☐ FILING ELECTRONICALLY* *DRILLER'S E-MAIL ADDRESS:

*COUNTY OR LOCAL HEALTH AUTHORITY APPROVAL CODE	COUNTY APPROVAL CODE
If applicant is filing this NOI electronically via the ADWR website and County approval is required, please indicate approval by providing a County Approval Code.	NA

WELL SITE PLAN

NAME OF WELL OWNER	COUNTY ASSESSOR'S PARCEL ID NUMBER		
	BOOK	MAP	PARCEL
Pacific Gas & Electric Company	210	30	008

- If this well will be a domestic well on 5 acres or less, please draw the following: (1) the boundaries of your property; (2) the proposed well location; (3) the locations of all septic tank systems and sewer systems on the property or within 100 feet of the well location, even if on neighboring properties; and (4) any permanent structures on the property that may aid in locating the well. If the parcel is vacant land or lacks a septic tank or sewer system, please indicate this.
- Indicate the distance between the proposed well location and any septic tank system or sewer system.



COUNTY OR LOCAL AUTHORITY NAME AND TITLE	*Official County or Local Seal or Stamp*
COUNTY OR LOCAL AUTHORITY SIGNATURE	
TELEPHONE NUMBER / DATE	

(Site B)

GROUNDWATER PARTNERS

PROJECT NUMBER:	WELL ID:	SHEET:	OF:
428373.FS.06	***SITE B***	***1***	***14***

SOIL BORING LOG

PROJECT:	*Topock Alternative Freshwater Source Evaluation*	LOCATION:	*Site B: 1.5 miles north of I-40 and HWY 10, Golden Shores, AZ*
DRILLING METHOD AND EQUIPMENT:	*Pilot borehole drilled with dual rotary, DR-24, 8-inch diameter drive casing. Reamed borehole with DR-40, 20-inch diameter drive casing.*		
GROUND SURFACE ELEVATION (FT):	*473*	DRILLING CONTRACTOR:	*Layne Christensen; Driller: S. Walker*
LATITUDE:	*34° 43' 57.19"*	START: *10/4/13*	WELL INFO: *14" SS Steel, 0.090", Screen: CWW*
LONGITUDE:	*114°28' 41.07"*	FINISH: *10/15/13*	LOGGER: *E. Ludwig P.G., Garrett Frey*
WATER LEVEL (FT BGS):	*21*		
TOTAL DEPTH (FT BGS):	*400*		

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
0	10.3 SAND SACK SLURRY CEMENT GROUT (WITHIN 24 INCH CONDUCTOR CASING) 14" DIAMETER BLANK, STAINLESS STEEL TYPE 316 L CASING	ML	**SILT WITH GRAVEL (ML)** - Dark grayish brown (10YR 4/2), 90% non-plastic silt, 10% gravel, gravel is coarse to fine, subangular, dry	Soil samples were collected using a 5-gallon bucket and/or shovel from the cyclone.
5				
10		SM	**SILTY SAND (SM)** - Dark grayish brown (10YR 4/2), 70% fine to medium poorly graded sand, 30% non-plastic silt, subangular, dry	Increase in gravel at 15' Slightly moist
15				
20				1446 10/04/2013
		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Reddish brown (5YR 4/4), 70% gravel, 25% coarse sand, 5% fine sand, subangular, loose, moist	1540 10/04/2013
25				
30				

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: SITE B	SHEET: 2 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	Site B: 1.5 miles north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Pilot borehole drilled with dual rotary, DR-24, 8-inch diameter drive casing. Reamed borehole with DR-40, 20-inch diameter drive casing.		
GROUND SURFACE ELEVATION (FT):	473	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 57.19"	START: 10/4/13	WELL INFO: 14" SS Steel, 0.090", Screen: CWW
LONGITUDE:	114°28' 41.07"	FINISH: 10/15/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	21		
TOTAL DEPTH (FT BGS):	400		

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
30	10.3 SAND SACK SLURRY CEMENT GROUT (WITHIN 24 INCH CONDUCTOR CASING) 14" DIAMETER BLANK, STAINLESS STEEL TYPE 316 L CASING	GW	**WELL GRADED SAND WITH GRAVEL (GW)** - Reddish brown (5YR 4/4), 70% gravel, 25% coarse sand, 5% fine sand, subangular, loose, moist	Hose plugged (1530) Hose unplugged (1700)
35		SP-SM	**POORLY GRADED SAND WITH SILT (SP-SM) -** Dark yellowish-brown (10YR 4/4) 90% very fine to fine sands, 10% silt, subangular, wet	All sample are saturated below 35 ft 1717 10/04/2013
40		GW	**WELL GRADED GRAVEL (GW) -** 95% subangular gravel up to 3/4", 5% coarse sand	0800 10/05/2013 0750 Tagged static at 20 ft
45		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - 85% subangular gravel, 15% coarse subangular sand, 5% fine sand, subangular, loose, moist	
50				
55		SP	**POORLY GRADED SAND WITH SILT (SP)** - 95% subangular medium to coarse sands, 5% gravel up to 1/8"	
60				

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: SITE B	SHEET: 3 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	Site B: 1.5 miles north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Pilot borehole drilled with dual rotary, DR-24, 8-inch diameter drive casing. Reamed borehole with DR-40, 20-inch diameter drive casing.		
GROUND SURFACE ELEVATION (FT):	473	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 57.19"	START: 10/4/13	WELL INFO: 14" SS Steel, 0.090", Screen: CWW
LONGITUDE:	114°28' 41.07"	FINISH: 10/15/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	21	TOTAL DEPTH (FT BGS):	400

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
60	10.3 SAND SACK SLURRY CEMENT GROUT (BOTTOM OF CONDUCTOR CASING AT 75 FEET) 14" DIAMETER BLANK, STAINLESS STEEL TYPE 316 L CASING	SP	**POORLY GRADED SAND WITH SILT (SP)** - 95% subangular medium to coarse sands, 5% gravel up to 1/8"	
65		GW	**WELL GRADED GRAVEL (GW) -** 95% subangular gravel up to 1", 5% coarse sand	
70				
75		CL	**LEAN CLAY (CL)** - Dark grayish brown (10YR 4/2), medium plasticity, stiff, 95% clay, 5% silt	
80				
85		ML	**SILT (ML)** - Dark grayish brown (10YR 4/2), poorly graded, low plasticity, silt is coarse	
90				

GROUNDWATER PARTNERS

PROJECT NUMBER:	WELL ID:	SHEET:	OF:
428373.FS.06	***SITE B***	***4***	***14***

SOIL BORING LOG

PROJECT:	*Topock Alternative Freshwater Source Evaluation*	LOCATION:	*Site B: 1.5 miles north of I-40 and HWY 10, Golden Shores, AZ*
DRILLING METHOD AND EQUIPMENT:	*Pilot borehole drilled with dual rotary, DR-24, 8-inch diameter drive casing. Reamed borehole with DR-40, 20-inch diameter drive casing.*		
GROUND SURFACE ELEVATION (FT):	*473*	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	*34° 43' 57.19"*	START: *10/4/13*	WELL INFO: *14" SS Steel, 0.090", Screen: CWW*
LONGITUDE:	*114°28' 41.07"*	FINISH: *10/15/13*	LOGGER: *E. Ludwig P.G., Garrett Frey*
WATER LEVEL (FT BGS):	*21*		
TOTAL DEPTH (FT BGS):	*400*		

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
90	BENTONITE AQUAGUARD GROUT (BOREHOLE DIAMETER: 20 INCHES FROM 75 TO 320 FEET) 14" DIAMETER BLANK, STAINLESS STEEL TYPE 316 L CASING			
95		ML	**SILT (ML)** - Dark grayish brown (10YR 4/2), poorly graded, low plasticity, silt is coarse	
100				1200 10/6/2013
105				
110		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - 70% rounded to subrounded gravel up to 2", 30% fine to very fine sand	
115				
120		MH	**ELASTIC SILT (MH)** - Brown (7.5YR 4/4), low to medium elasticity	

GROUNDWATER PARTNERS

PROJECT NUMBER:	WELL ID:	SHEET:	OF:
428373.FS.06	*SITE B*	*5*	*14*

SOIL BORING LOG

PROJECT:	*Topock Alternative Freshwater Source Evaluation*	LOCATION:	*Site B: 1.5 miles north of I-40 and HWY 10, Golden Shores, AZ*
DRILLING METHOD AND EQUIPMENT:	*Pilot borehole drilled with dual rotary, DR-24, 8-inch diameter drive casing. Reamed borehole with DR-40, 20-inch diameter drive casing.*		
GROUND SURFACE ELEVATION (FT):	*473*	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	*34° 43' 57.19"*	START: *10/4/13*	WELL INFO: *14" SS Steel, 0.090", Screen: CWW*
LONGITUDE:	*114°28' 41.07"*	FINISH: *10/15/13*	LOGGER: *E. Ludwig P.G., Garrett Frey*
WATER LEVEL (FT BGS):	*21*		
TOTAL DEPTH (FT BGS):	*400*		

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
120				
125				1218 10/7/2013 1250 10/7/2013
130	14" DIAMETER BLANK, STAINLESS STEEL TYPE 316 L CASING TAGNA-AX10 FILTER PACK	SP	**POORLY GRADED SAND WITH GRAVEL (SP)** - 60% fine to medium sand, 40% well graded rounded to subrounded gravel up to 2"	
135				
140		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 70-90% rounded to subangular gravel up to 2", 10-30% poorly graded subangular medium sand	
145				
150				

GROUNDWATER PARTNERS

PROJECT NUMBER:	WELL ID:	SHEET:	OF:
428373.FS.06	*SITE B*	*6*	*14*

SOIL BORING LOG

PROJECT:	*Topock Alternative Freshwater Source Evaluation*	LOCATION:	*Site B: 1.5 miles north of I-40 and HWY 10, Golden Shores, AZ*
DRILLING METHOD AND EQUIPMENT:	*Pilot borehole drilled with dual rotary, DR-24, 8-inch diameter drive casing. Reamed borehole with DR-40, 20-inch diameter drive casing.*		
GROUND SURFACE ELEVATION (FT):	*473*	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	*34° 43' 57.19"*	START: *10/4/13*	WELL INFO: *14" SS Steel, 0.090", Screen: CWW*
LONGITUDE:	*114°28' 41.07"*	FINISH: *10/15/13*	LOGGER: *E. Ludwig P.G., Garrett Frey*
WATER LEVEL (FT BGS):	*21*		
TOTAL DEPTH (FT BGS):	*400*		

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
150				
155				
160	14" DIAMETER 0.090" SLOT STAINLESS STEEL TYPE 316 WIRE WRAP ROCKFORD MOSS WELL SCREEN TAGNAAX10 FILTER PACK			
165		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 70-90% rounded to subangular gravel up to 2", 10-30% poorly graded subangular medium sand	1700 10/7/2013 0836 10/8/2013
170				
175				
180				

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: SITE B	SHEET: 7 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	Site B: 1.5 miles north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Pilot borehole drilled with dual rotary, DR-24, 8-inch diameter drive casing. Reamed borehole with DR-40, 20-inch diameter drive casing.		
GROUND SURFACE ELEVATION (FT):	473	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 57.19"	START: 10/4/13	WELL INFO: 14" SS Steel, 0.090", Screen: CWW
LONGITUDE:	114°28' 41.07"	FINISH: 10/15/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	21	TOTAL DEPTH (FT BGS):	400

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
180				
185				
190	14" DIAMETER BLANK, STAINLESS STEEL TYPE 316 L CASING			0856 10/8/2013 1038 10/8/2013
195	JACNA-AX10 FILTER PACK	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 70-90% rounded to subangular gravel up to 2", 10-30% poorly graded subangular medium sand	
200	14" DIAMETER (0.250") SLOT, STAINLESS STEEL TYPE 316 L WIRE WRAP ROSCO MODEL WELL SCREEN			1047 10/8/2013 1525 10/8/2013
205				
210				

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: SITE B	SHEET: 8 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	Site B: 1.5 miles north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Pilot borehole drilled with dual rotary, DR-24, 8-inch diameter drive casing. Reamed borehole with DR-40, 20-inch diameter drive casing.		
GROUND SURFACE ELEVATION (FT):	473	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 57.19"	START: 10/4/13	WELL INFO: 14" SS Steel, 0.090", Screen: CWW
LONGITUDE:	114°28' 41.07"	FINISH: 10/15/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	21		
TOTAL DEPTH (FT BGS):	400		

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
210				
215				
220	14" DIAMETER 0.250" SLOT, 316 STAINLESS STEEL TYMEN 316 WIRE WRAP FORCE MAIN SCREEN TAGNAAX10 FILTER PACK			1542 10/8/2013 1625 10/8/2013
225		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 70-90% rounded to subangular gravel up to 2", 10-30% poorly graded subangular medium sand	
230				
235				
240				1645 10/8/2013

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: SITE B	SHEET: 9 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	Site B: 1.5 miles north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Pilot borehole drilled with dual rotary, DR-24, 8-inch diameter drive casing. Reamed borehole with DR-40, 20-inch diameter drive casing.		
GROUND SURFACE ELEVATION (FT):	473	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 57.19"	START: 10/4/13	WELL INFO: 14" SS Steel, 0.090", Screen: CWW
LONGITUDE:	114°28' 41.07"	FINISH: 10/15/13	LOGGER: E. Ludwig P.G., Garrett Frey

WATER LEVEL (FT BGS): 21

TOTAL DEPTH (FT BGS): 400

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
240				
245				
250	COATED BENTONITE PELLETS 1/4			1542 10/8/2013
				1200 10/9/2013
255	14" DIAMETER BLANK, STAINLESS STEEL TYPE 316 L CASING	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 70-90% rounded to subangular gravel up to 2", 10-30% poorly graded subangular medium sand	
260				
265				
270				1235 10/9/2013

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: SITE B	SHEET: 10 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	Site B: 1.5 miles north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Pilot borehole drilled with dual rotary, DR-24, 8-inch diameter drive casing. Reamed borehole with DR-40, 20-inch diameter drive casing.		
GROUND SURFACE ELEVATION (FT):	473	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 57.19"	START: 10/4/13	WELL INFO: 14" SS Steel, 0.090", Screen: CWW
LONGITUDE:	114°28' 41.07"	FINISH: 10/15/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	21	TOTAL DEPTH (FT BGS):	400

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
270				Drilling is very slow
275				
280	14" DIAMETER 0.090" SLOT STAINLESS STEEL TYPE 316 WIRE WRAP ROCKFORD MOSS WELL SCREEN #3 SAND PACK X 10 FILTER PACK			1456 10/9/2013 1530 10/9/2013
285		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 70-90% rounded to subangular gravel up to 2", 10-30% poorly graded subangular medium sand	
290				
295				
300				1608 10/9/2013

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: SITE B	SHEET: 11 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	Site B: 1.5 miles north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Pilot borehole drilled with dual rotary, DR-24, 8-inch diameter drive casing. Reamed borehole with DR-40, 20-inch diameter drive casing.		
GROUND SURFACE ELEVATION (FT):	473	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 57.19"	START: 10/4/13	WELL INFO: 14" SS Steel, 0.090", Screen: CWW
LONGITUDE:	114°28' 41.07"	FINISH: 10/15/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	21		
TOTAL DEPTH (FT BGS):	400		

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
300				0910 10/10/2013
305				
310				
315		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 70-90% rounded to subangular gravel up to 2", 10-30% poorly graded subangular medium sand	
320				0928 10/10/2013 0949 10/10/2013
325				
330				

TACNA 4X10 FILTER PACK

14" DIAMETER BLANK, STAINLESS STEEL TYPE 316 L CASING

NEAT CEMENT GROUT (BOREHOLE DIAMETER FROM 320 TO 400 FEET IS 8.5 INCHES)

GROUNDWATER PARTNERS

.	WELL ID:	SHEET:	OF:
428373.FS.06	*SITE B*	*12*	*14*

SOIL BORING LOG

PROJECT: *Topock Alternative Freshwater Source Evaluation*		LOCATION: *Site B: 1.5 miles north of I-40 and HWY 10, Golden Shores, AZ*	
DRILLING METHOD AND EQUIPMENT: *Pilot borehole drilled with dual rotary, DR-24, 8-inch diameter drive casing. Reamed borehole with DR-40, 20-inch diameter drive casing.*			
GROUND SURFACE ELEVATION (FT): *473*	DRILLING CONTRACTOR: Layne Christensen; Driller: S. Walker		
LATITUDE: *34° 43' 57.19"*	START: *10/4/13*	WELL INFO: *14" SS Steel, 0.090", Screen: CWW*	WATER LEVEL (FT BGS): *21*
LONGITUDE: *114°28' 41.07"*	FINISH: *10/15/13*	LOGGER: *E. Ludwig P.G., Garrett Frey*	TOTAL DEPTH (FT BGS): *400*

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
330	NEAT CEMENT GROUT (BOREHOLE DIAMETER FROM 320 TO 400 FEET IS 8.5 INCHES)			
335				
340				1016 10/10/2013 1055 10/10/2013
345		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 70-90% rounded to subangular gravel up to 2", 10-30% poorly graded subangular medium sand	
350				1102 10/10/2013 0710 10/15/2013
355				
360				

GROUNDWATER PARTNERS

.	WELL ID:	SHEET:	OF:
428373.FS.06	*SITE B*	*13*	*14*

SOIL BORING LOG

PROJECT: *Topock Alternative Freshwater Source Evaluation*		LOCATION: *Site B: 1.5 miles north of I-40 and HWY 10, Golden Shores, AZ*	
DRILLING METHOD AND EQUIPMENT: *Pilot borehole drilled with dual rotary, DR-24, 8-inch diameter drive casing. Reamed borehole with DR-40, 20-inch diameter drive casing.*			
GROUND SURFACE ELEVATION (FT): *473*	DRILLING CONTRACTOR: Layne Christensen; Driller: S. Walker		
LATITUDE: *34° 43' 57.19"*	START: *10/4/13*	WELL INFO: *14" SS Steel, 0.090", Screen: CWW*	WATER LEVEL (FT BGS): *21*
LONGITUDE: *114°28' 41.07"*	FINISH: *10/15/13*	LOGGER: *E. Ludwig P.G., Garrett Frey*	TOTAL DEPTH (FT BGS): *400*

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
360	NEAT CEMENT GROUT (BOREHOLE DIAMETER FROM 320 TO 400 FEET IS 8.5 INCHES)			
365				
370				0740 10/15/2013 0815 10/15/2013
375		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 70-90% rounded to subangular gravel up to 2", 10-30% poorly graded subangular medium sand	
380				
385				
390				0920 10/15/2013

GROUNDWATER PARTNERS

.	WELL ID:	SHEET:	OF:
428373.FS.06	***SITE B***	***14***	***14***

SOIL BORING LOG

PROJECT:	*Topock Alternative Freshwater Source Evaluation*	LOCATION:	*Site B: 1.5 miles north of I-40 and HWY 10, Golden Shores, AZ*
DRILLING METHOD AND EQUIPMENT:	*Pilot borehole drilled with dual rotary, DR-24, 8-inch diameter drive casing. Reamed borehole with DR-40, 20-inch diameter drive casing.*		
GROUND SURFACE ELEVATION (FT):	*473*	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	*34° 43' 57.19"*	START: *10/4/13*	WELL INFO: *14" SS Steel, 0.090", Screen: CWW*
LONGITUDE:	*114°28' 41.07"*	FINISH: *10/15/13*	LOGGER: *E. Ludwig P.G., Garrett Frey*
WATER LEVEL (FT BGS):	*21*		
TOTAL DEPTH (FT BGS):	*400*		

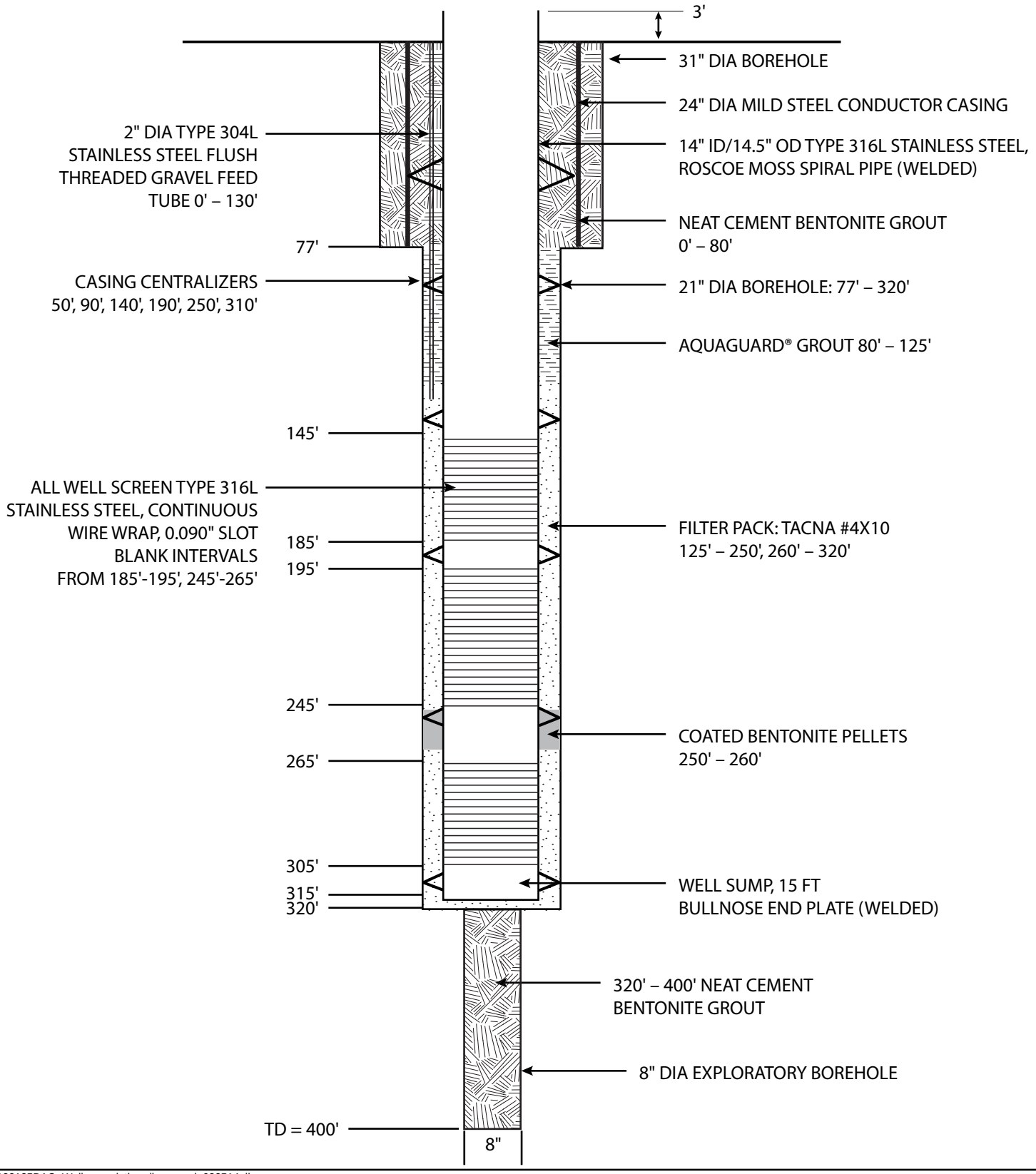
DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
390 395 400	NEAT CEMENT GROUT (BOREHOLE DIAMETER FROM 320 TO 400 FEET IS 8.5 INCHES)	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 70-90% rounded to subangular gravel up to 2", 10-30% poorly graded subangular medium sand	Total depth of pilot borehole: 400 ft. 0928 10/15/2013

CH2MHILL®	PROJECT NUMBER: 428373.FS.06	WELL NUMBER: SITE B
	WELL COMPLETION DIAGRAM	

PROJECT: Topock Alternative Freshwater Source Evaluation	LOCATION: 1 mi north I-40 & HWY 10, Golden Shores, AZ

DRILLING METHOD/EQUIPMENT: Exploratory boring dual air rotary, Foster DR-24, 8" dia; reamed to construct well, Foster DR-40

DRILLING CONTRACTOR: Layne Christensen	START: 11/20/2013 END: 1/23/2014	LOGGER: E. Ludwig, G. Frey (Groundwater Partners, Inc.)
34° 43' 57.19", 114° 28' 41.07"	SURFACE ELEVATION (FT): 473	DEPTH TO WATER (FT BGS): 21



ES110712123135BAO_Well_completion-diagram.ai_032514_lho

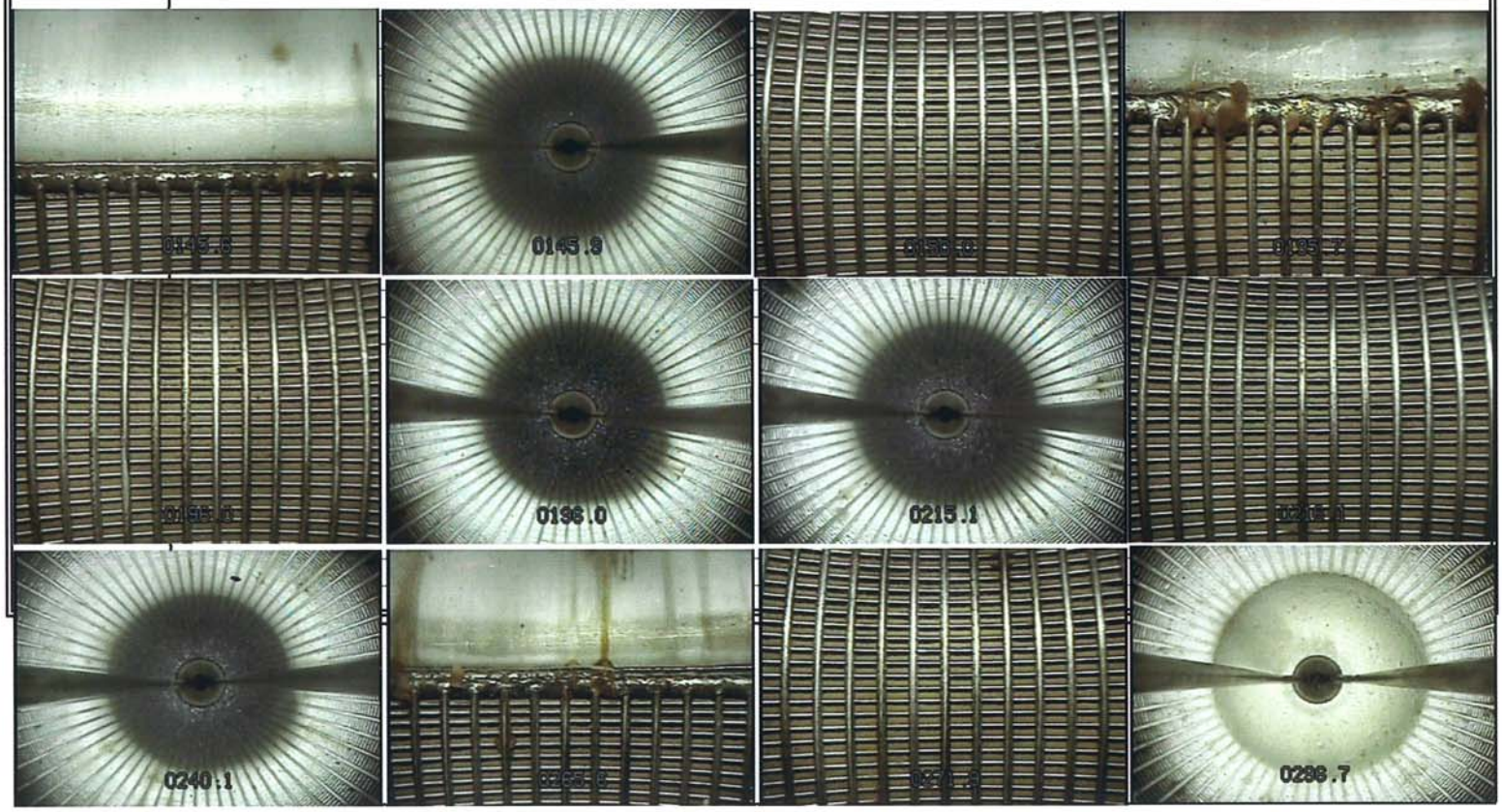
Pacific Surveys

a full service geophysical well logging company

Video Survey Report

Company:	Groundwater Partners Inc.	**Date:**	20-Feb-14		
Well:	Site B	**Run No.**	One	**Truck**	PS-5
Field:	Topock	**Job Ticket:**	18047		
State:	Nevada	**Total Depth:**	302 ft		
		Water Level:	19 ft	SWL	
Location:	2 miles North of Golden Shores	**Oil on Water:**	No	**Amount:**	0 ft
	GPS: N34o43.955' W114o28.687'	**Operator:**	Abreau		
Zero Datum:	Ground Level **Tool Zero:**	Side-Scan		**Dead Space**	1.75 ft
Reason for Survey:	New Well Construction	**Guides Set @**	14.00"		

Depth	Observations		
0.0 ft	Begin survey at ground surface.	**Perforation:**	**As-Built**
18.5 ft	SWL; Water slightly turbid with light suspended bio-material; Visibility good.	Wire-Wrap	145.00 ft to 185.00ft
50.0 ft	Casing appears clean and in good condition.		195.00 ft to 245.00ft
100.0 ft	Casing appears clean and in good condition.		265.00 ft to 305.00ft
145.6 ft	Top of perforations; Perforations appear open and in good condition.		
185.1 ft	Bottom of perforated interval; all perforations appear open and in good condition.		
195.7 ft	Top of perforations; Perforations appear open and in good condition.		
204.0 ft	Perforations appear twisted slightly; All perforations appear intact with no separations,		
205.0 ft	Bottom of twisted perforations.		
245.0 ft	Bottom of perforated interval; all perforations appear open and in good condition.		
265.6 ft	Top of perforations; Perforations appear open and in good condition.		
298.4 ft	Top of settled bio-material; camera descends easily into material.	**Casing Size**	**As-Built**
302.4 ft	Hard fill; Camera stops; end survey.	14.00	0.00 ft to 315.00ft
		CSG Material	SST
		Screen Material	SST



800.919.7555
909.625.6262

4456 via st. ambrose
claremont ca 91711
www.pacificsurveys.com

fax: 909.399.3180

Attachment A-2
HNWR-1 Well

Arizona Department of Water Resources
Water Management Division
P.O. Box 36020 Phoenix, Arizona 85067-6020
(602) 771-8500 • (602) 771-8690 fax
• www.azwater.gov •

Notice of Intent to Drill, Deepen, Replace or Modify a Well

(except a Non-Exempt Well in an Active Management Area)

$150 or $100 FEE

- Review instructions prior to completing form in black or blue ink.
- You must include with your Notice:
  - Check or money order in the amount of the appropriate filing fee.
  - For a well located within an AMA or INA, the fee is $150.00.
  - For a well not located within an AMA or INA, the fee is $100.00 if the well will be used solely for domestic purposes (see page 2 and instructions) and will have a pump with a maximum capacity of not more than 35 gallons per minute. Otherwise, the fee is $150.00.
- Authority for fee: A.R.S. § 45-596 and A.A.C. R12-15-104.

AMA / INA	B	BB
RECEIVED DATE	WB	
ISSUED DATE	MGMT	CERCLA
LEGAL REVIEW IF APP	REASONING	

FILE NUMBER

WELL REGISTRATION NUMBER
55 -

SECTION 1. COUNTY OR LOCAL HEALTH AUTHORITY APPROVAL (if applicable)

If water from the proposed well will be used for domestic purposes on a parcel of land of 5 or fewer acres, the applicable county or local health authority must endorse all items in Section 1 within one year before submission to the Department of Water Resources. You must also attach a site plan (pg. 3).

CHECK ONE

☐ County or Local Health Authority Recommends Approval (pursuant to A.R.S. § 45-596 (G) and (F))
- ☐ Field Inspection Performed
- ☐ Site Plan Review Only

☐ Insufficient Information to Make a Determination

Official County or Local Seal or Stamp

COUNTY OR LOCAL AUTHORITY NAME AND TITLE

TELEPHONE NUMBER | DATE | COUNTY OR LOCAL AUTHORITY SIGNATURE

SECTION 2. REGISTRY INFORMATION

Well Type

CHECK ONE

☐ Exempt
(Pump has a maximum capacity of not more than 35 gpm and water is not used for irrigation purposes inside an AMA.)
(See instructions.)

☒ Non-Exempt
(Pump has a maximum capacity of more than 35 gpm and the well is located outside an AMA.)
(See instructions.)

DESIGN PUMP CAPACITY: 1,000 Gallons Per Minute

Proposed Action

CHECK ONE

☒ Drill New Well
☐ Deepen
☐ Replace
☐ Modify

If Deepening, Replacing or Modifying:

ORIGINAL WELL REGISTRATION NUMBER: 55 - NA

MAXIMUM CAPACITY OF ORIGINAL WELL: NA Gallons Per Minute

DISTANCE & DIRECTION FROM ORIGINAL WELL: NA Feet

Location of Well

WELL LOCATION ADDRESS (IF ANY): NA

COUNTY WHERE WELL IS LOCATED: Mohave

TOWNSHIP (N/S)	RANGE (E/W)	SECTION	160 ACRE	40 ACRE	10 ACRE
T16N	R21W	35	SW ¼	SE ¼	NW ¼

COUNTY ASSESSOR'S PARCEL ID NUMBER

BOOK	MAP	PARCEL	# OF ACRES
210	30	008	365

Place of Water Use *(Mandatory information, see instructions.)*

Is the groundwater basin where the well will be drilled the same as the place where the water will be used?	Yes	No
		☒

TOWNSHIP (N/S)	RANGE (E/W)	SECTION	160 ACRE	40 ACRE	10 ACRE
Used as part of the Topock Comp. Station's remediation.					

SECTION 3. OWNER INFORMATION

Well Owner

FULL NAME OF COMPANY, ORGANIZATION, OR INDIVIDUAL: Pacific Gas & Electric Company

MAILING ADDRESS: PG&E Topock Compressor Station PO Box 337

CITY / STATE / ZIP CODE: Needles CA 92363

CONTACT PERSON NAME AND TITLE: Curt Russell Topock Site Manager

TELEPHONE NUMBER: 760-791-5884 FAX: 760-326-5542

Landowner *(if different from Well Owner)*

FULL NAME OF COMPANY, GOVERNMENT AGENCY, OR INDIVIDUAL: Havasu National Wildlife Refuge

MAILING ADDRESS: 317 Mesquite Ave

CITY / STATE / ZIP CODE: Needles, CA 92363

CONTACT PERSON NAME AND TITLE: Linda L. Miller Refuge Manager

TELEPHONE NUMBER: 760-326-3853 x22 FAX: 760-326-5745

SECTION 4.

Questions	Yes	No	If Yes:
1. Is the proposed well site within 100 feet of a septic tank system, sewer disposal area, landfill, hazardous materials or petroleum storage area or tank?		☒	You must also request a variance (A.A.C. R12-15-818).
2. Is there another well name or identification number associated with this well (e.g., Lot 35 Well, Smith Well, etc.)?		☒	PLEASE STATE
3. Is the proposed well a NEW well to be located within an Active Management Area? *(See instructions.)*		☒	Unless the well is a replacement well and the total number of operable exempt wells on the land is not increasing, you must also file a supplemental form A.R.S. § 45-464(C) & (D).
4. Is the proposed well the second exempt well on this parcel for the same use?		☒	If the proposed well is in an Active Management Area, you must also file a supplemental form A.R.S. § 45-454(I).

(Near HNWR-1)

Notice of Intent to Drill, Deepen, Replace or Modify a Well

WELL REGISTRATION NUMBER
55-

SECTION 5. DRILLING AUTHORIZATION

Drilling Firm

NAME: Layne Christensen Company, LLC

DWR LICENSE NUMBER	ROC LICENSE NUMBER
#7	071734

TELEPHONE NUMBER	FAX
480-267-8416	480-895-8699

MAILING ADDRESS: 12030 East Riggs Road

CITY / STATE / ZIP CODE: Chandler AZ 85249

DATE CONSTRUCTION IS SCHEDULED TO BEGIN: October 2, 2013

SECTION 6. WATER / SITE INFORMATION

Principal Use of Water (CHECK ONE)	Other Uses of Water (CHECK ALL THAT APPLY)
☐ Irrigation	☒ Irrigation
☐ Commercial	☒ Commercial
☐ Domestic	☐ Domestic
☐ Municipal	☐ Municipal
☐ Industrial	☒ Industrial
☐ Stock	☐ Stock
☒ Remediation	☐ Remediation
☐ Dewatering	☐ Dewatering
☐ Other* (please specify):	☐ Other* (please specify):

NOTE: If this is a Notice of Intent to construct a new well that will be used for the purpose of withdrawing groundwater for transportation to an Active Management Area (AMA) pursuant to A.R.S. § 45-552, 45-553, 45-554 or 45-555(A), the authorization to drill the well issued in association with this Notice shall not be considered the approval to transport groundwater to an AMA. *(see instructions.)*

SECTION 7. PROPOSED WELL CONSTRUCTION DESIGN (attach separate sheet if needed)

Borehole			Casing													
DEPTH FROM SURFACE			DEPTH FROM SURFACE			MATERIAL TYPE (T)				PERFORATION TYPE (T)						
FROM (feet)	TO (feet)	BOREHOLE DIAMETER (inches)	FROM (feet)	TO (feet)	OUTER DIAMETER (inches)	STEEL	PVC	ABS	IF OTHER TYPE, DESCRIBE	BLANK OR NONE	WIRE WRAP	SHUTTER SCREEN	MILLS KNIFE	SLOTTED	IF OTHER TYPE, DESCRIBE	GROUTING MATERIAL
0	480	26	0	100	14.625	X*				X						Cement
			100	400	14.625	X					X					

* ADWR well construction standards require a surface seal consisting of a minimum of 20 feet of steel casing. Cement grout must be used to fill the annular space between the surface casing and the borehole. (A.A.C. R12-15-811(B))

The Department's issuance of an authorization to drill a well is not a determination of whether water withdrawn from the well is legally surface water or groundwater. The legal nature of the water withdrawn from the well may be the subject of court action in the future as part of a determination of surface water rights in your area. If there are court proceedings that could affect your well, you will be notified and be given the opportunity to participate. If you have questions regarding the legal nature of the water to be withdrawn from your proposed well, please consult with an experienced civil engineer, hydrologist or water rights attorney.

For the purpose of determining appropriate fees outside AMAs or INAs, "domestic purposes" is defined as "uses related to the supply, service and activities of households and private residences and includes the application of water to less than 2 acres of land to produce plants or parts of plants for sale or human consumption, or for use as feed for livestock, range livestock or poultry, as such terms are defined in A.R.S. § 3-1201."

SECTION 8. OPTIONAL BY PROPERTY OWNER AND WELL OWNER ONLY

☐ By checking this box, I hereby provide ADWR permission to enter the property for the purpose of taking water level measurements at this well. *(See instructions.)*

SECTION 9. WELL OWNER AND PROPERTY OWNER SIGNATURE

I state that this notice is filed in compliance with A.R.S. § 45-596 and is complete and correct to the best of my knowledge and belief.

TYPE OR PRINT NAME AND TITLE: Curt Russell (PG&E Topock Project Site Manager), Linda Miller (Refuge Manager)

SIGNATURE OF WELL OWNER: [signature] — DATE: 9-26-2013

SIGNATURE OF LANDOWNER, IF APPLICABLE (SEE INSTRUCTIONS): [signature] Refuge Manager — DATE: 09/26/13

(Near HNWR-1)

Notice of Intent to Drill, Deepen, Replace or Modify a Well

WELL REGISTRATION NUMBER
55 -

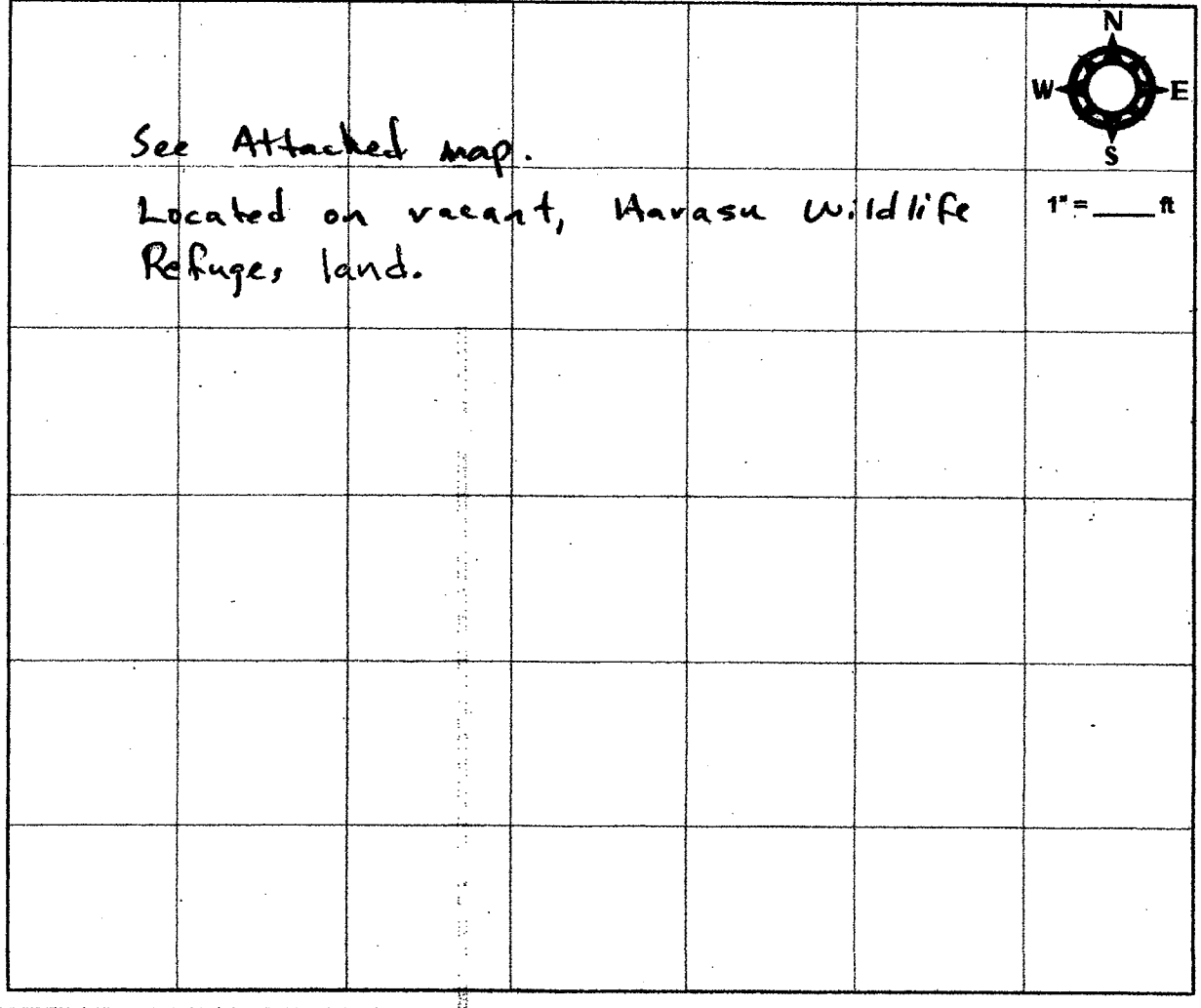
CHECK ONE: ☒ FILING MANUALLY ☐ FILING ELECTRONICALLY* *DRILLER'S E-MAIL ADDRESS:

*COUNTY OR LOCAL HEALTH AUTHORITY APPROVAL CODE *If applicant is filing this NOI electronically via the ADWR website and County approval is required, please indicate approval by providing a County Approval Code.*	COUNTY APPROVAL CODE
	NA

WELL SITE PLAN

NAME OF WELL OWNER	COUNTY ASSESSOR'S PARCEL ID NUMBER		
	BOOK	MAP	PARCEL
Pacific Gas & Electric Company	210	30	008

- If this well will be a domestic well on 5 acres or less, please draw the following: (1) the boundaries of your property; (2) the proposed well location; (3) the locations of all septic tank systems and sewer systems on the property or within 100 feet of the well location, even if on neighboring properties; and (4) any permanent structures on the property that may aid in locating the well. If the parcel is vacant land or lacks a septic tank or sewer system, please indicate this.
- Indicate the distance between the proposed well location and any septic tank system or sewer system.



COUNTY OR LOCAL AUTHORITY NAME AND TITLE	*Official County or Local Seal or Stamp*
COUNTY OR LOCAL AUTHORITY SIGNATURE	
TELEPHONE NUMBER / DATE	

 (Near HNWR-1)

GROUNDWATER PARTNERS	PROJECT NUMBER: ***428373.FS.06***	WELL ID: ***HNWR-1/PGE-BH-02***	SHEET: ***1*** OF: ***14***

SOIL BORING LOG

PROJECT: *Topock Alternative Freshwater Source Evaluation*		LOCATION: *HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ*	
DRILLING METHOD AND EQUIPMENT: *Dual Rotary, DR-24, 8-inch diameter drive casing*			
GROUND SURFACE ELEVATION (FT): *465*	DRILLING CONTRACTOR: *Layne Christensen; Driller: S. Walker*		
LATITUDE: *34° 43' 24.55"*	START: *10/16/13*	WELL INFO: *No Well Installed*	WATER LEVEL (FT BGS): *NA*
LONGITUDE: *114° 28' 42.22"*	FINISH: *10/20/13*	LOGGER: *E. Ludwig P.G., Garrett Frey*	TOTAL DEPTH (FT BGS): *400*

DEPTH (FT) BELOW SURFACE	MONITORING WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
0	NEAT CEMENT GROUT	ML	**SILT WITH GRAVEL (ML)** - Dark grayish brown (10YR 4/2), 95% non-plastic silt, 5% gravel, gravel is coarse to fine, subangular	1145 16/16/2013 Soil samples were collected using a 5-gallon bucket from the cyclone.
5				Dry Slightly moist
10				Moist
15				Wet All sample are saturated below 15 ft
20				1200 10/16/2013
		CL	**LEAN CLAY (CL) -** Dark grayish brown (10YR 4/2), medium plasticity, 95% clay, 5% silt	1228 10/16/2013
25		ML	**SILT WITH GRAVEL (ML)** - Dark grayish brown (10YR 4/2), 95% non-plastic silt, 5% gravel, gravel is coarse to fine, subangular	
30				

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1/PGE-BH-02	SHEET: 2 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter drive casing		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: No Well Installed
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	NA		
TOTAL DEPTH (FT BGS):	400		

DEPTH (FT) BELOW SURFACE	MONITORING WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
30		ML	**SILT WITH GRAVEL (ML)** - Dark grayish brown (10YR 4/2), 95% non-plastic silt, 5% gravel, gravel is coarse to fine, subangular	
35		SP-SM	**POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM) -** Brown (10YR 5/3) 70% very fine to fine sands, 10% silt, 20% subangular well graded gravel up to 1/2"	
40				1236 10/16/2013
45	PEA GRAVEL	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	1311 10/16/2013 Slow penetration rates 45-55'
50				
55				
60				1335 10/16/2013

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1/PGE-BH-02	SHEET: 3 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter drive casing		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: No Well Installed
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	NA		
TOTAL DEPTH (FT BGS):	400		

DEPTH (FT) BELOW SURFACE	MONITORING WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
60				
65				
70				
75	PEA GRAVEL	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
80				1559 10/16/2013 1634 10/16/2013
85				
90				

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1/PGE-BH-02	SHEET: 4 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter drive casing		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: No Well Installed
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	NA		
TOTAL DEPTH (FT BGS):	400		

DEPTH (FT) BELOW SURFACE	MONITORING WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
90				
95				
100				1647 13/16/2013 0834 13/17/2013
105	PGAGRAVEL	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
110				
115				
120				0848 10/17/2013

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1/PGE-BH-02	SHEET: 5 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter drive casing		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: No Well Installed
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	NA		
TOTAL DEPTH (FT BGS):	400		

DEPTH (FT) BELOW SURFACE	MONITORING WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
120				
125				1218 10/17/2013 1250 10/17/2013
130				
135	PEA-GRAVEL	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
140				0935 10/17/2013 1016 10/17/2013
145				
150				1018 10/17/2013

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1/PGE-BH-02	SHEET: 6 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter drive casing		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: No Well Installed
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	NA		
TOTAL DEPTH (FT BGS):	400		

DEPTH (FT) BELOW SURFACE	MONITORING WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
150				1350 10/17/2013
155				
160				
165	PEA-GRAVEL	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
170				1410 10/17/2013 1442 10/17/2013
175				
180				

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1/PGE-BH-02	SHEET: 7 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter drive casing		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: No Well Installed
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	NA		
TOTAL DEPTH (FT BGS):	400		

DEPTH (FT) BELOW SURFACE	MONITORING WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
180				
185				
190				1457 10/17/2013 1537 10/17/2013
195	PEA-GRAVEL	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
200				1545 10/17/2013 0818 10/18/2013
205				
210				

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1/PGE-BH-02	SHEET: 8 OF: 14

SOIL BORING LOG

PROJECT:	*Topock Alternative Freshwater Source Evaluation*	LOCATION:	*HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ*		
DRILLING METHOD AND EQUIPMENT:	*Dual Rotary, DR-24, 8-inch diameter drive casing*				
GROUND SURFACE ELEVATION (FT):	*465*	DRILLING CONTRACTOR: Layne Christensen; Driller: S. Walker			
LATITUDE:	*34° 43' 24.55"*	START: *10/16/13*	WELL INFO: *No Well Installed*	WATER LEVEL (FT BGS):	*NA*
LONGITUDE:	*114° 28' 42.22"*	FINISH: *10/20/13*	LOGGER: *E. Ludwig P.G., Garrett Frey*	TOTAL DEPTH (FT BGS):	*400*

DEPTH (FT) BELOW SURFACE	MONITORING WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
210				
215				
220				0834 10/18/2013
				0900 10/18/2013
225	PEA GRAVEL	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
230				
235				
240				0913 10/18/2013

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1/PGE-BH-02	SHEET: 9 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter drive casing		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: No Well Installed
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	NA		
TOTAL DEPTH (FT BGS):	400		

DEPTH (FT) BELOW SURFACE	MONITORING WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
240				0943 10/18/2013
245				
250				
255	PEA/GRAVEL	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	0950 10/18/2013 1328 10/18/2013
260				1337 10/18/2013 1453 10/18/2013
265				
270				

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1/PGE-BH-02	SHEET: 10 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter drive casing		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: No Well Installed
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	NA		
TOTAL DEPTH (FT BGS):	400		

DEPTH (FT) BELOW SURFACE	MONITORING WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
270				
275				
280				1424 10/18/2013
				1458 10/18/2013
285	PEA GRAVEL	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	Slow penetration rates
290				
295				
300				1523 10/18/2013

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1/PGE-BH-02	SHEET: 11 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter drive casing		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: No Well Installed
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	NA		
TOTAL DEPTH (FT BGS):	400		

DEPTH (FT) BELOW SURFACE	MONITORING WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
300				1035 10/19/2013
305				
310				
315	-PEA GRAVEL	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
320				1058 10/19/2013 1131 10/19/2013
325				
330				

GROUNDWATER PARTNERS

. 428373.FS.06	WELL ID: HNWR-1/PGE-BH-02	SHEET: 12	OF: 14

SOIL BORING LOG

PROJECT: *Topock Alternative Freshwater Source Evaluation*		LOCATION: *HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ*	
DRILLING METHOD AND EQUIPMENT: *Dual Rotary, DR-24, 8-inch diameter drive casing*			
GROUND SURFACE ELEVATION (FT): *465*	DRILLING CONTRACTOR: Layne Christensen; Driller: S. Walker		
LATITUDE: *34° 43' 24.55"*	START: *10/16/13*	WELL INFO: *No Well Installed*	WATER LEVEL (FT BGS): *NA*
LONGITUDE: *114° 28' 42.22"*	FINISH: *10/20/13*	LOGGER: *E. Ludwig P.G., Garrett Frey*	TOTAL DEPTH (FT BGS): *400*

DEPTH (FT) BELOW SURFACE	MONITORING WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
330				
335				
340				1151 10/19/2013
				1234 10/19/2013
345	-PEA GRAVEL-	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
350				1243 10/19/2013
				1720 10/19/2013
355				
360				1730 10/19/2013

GROUNDWATER PARTNERS

.	WELL ID:	SHEET:	OF:
428373.FS.06	HNWR-1/PGE-BH-02	13	14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter drive casing		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen; Driller: S. Walker
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: No Well Installed
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	NA		
TOTAL DEPTH (FT BGS):	400		

DEPTH (FT) BELOW SURFACE	MONITORING WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
360				0745 10/20/13
365				
370				
375	-PEA-GRAVEL	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
380				0815 10/20/2013 0920 10/20/2013
385				
390				

GROUNDWATER PARTNERS

.	WELL ID:	SHEET:	OF:
428373.FS.06	*HNWR-1/PGE-BH-02*	*14*	*14*

SOIL BORING LOG

PROJECT: *Topock Alternative Freshwater Source Evaluation*		LOCATION: *HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ*	
DRILLING METHOD AND EQUIPMENT: *Dual Rotary, DR-24, 8-inch diameter drive casing*			
GROUND SURFACE ELEVATION (FT): *465*	DRILLING CONTRACTOR: Layne Christensen; Driller: S. Walker		
LATITUDE: *34° 43' 24.55"*	START: *10/16/13*	WELL INFO: *No Well Installed*	WATER LEVEL (FT BGS): *NA*
LONGITUDE: *114° 28' 42.22"*	FINISH: *10/20/13*	LOGGER: *E. Ludwig P.G., Garrett Frey*	TOTAL DEPTH (FT BGS): *400*

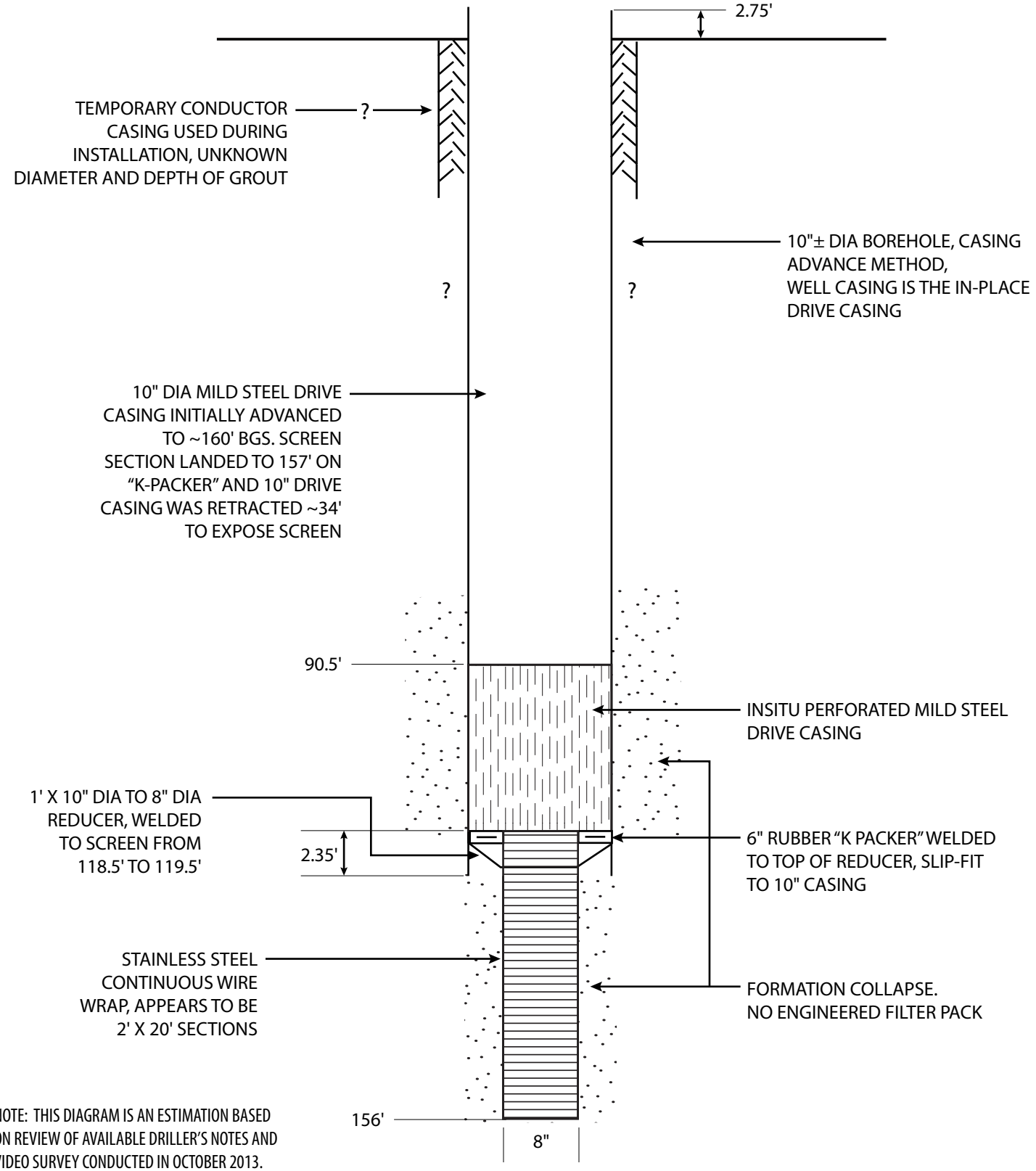
DEPTH (FT) BELOW SURFACE	MONITORING WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
390				
395		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
400				Total depth of pilot borehole: 400 ft. 0955 10/20/2013

CH2MHILL®	PROJECT NUMBER: 428373.FS.06	WELL NUMBER: HNWR-1
	WELL COMPLETION DIAGRAM	

PROJECT: Topock Alternative Freshwater Source Evaluation	LOCATION: 0.3 mi north I-40 & HWY 10, Golden Shores, AZ

DRILLING METHOD/EQUIPMENT: Casing advance (unknown) - *see note below*

DRILLING CONTRACTOR: ADT Drilling	START: 10/25/2010 END: 11/4/2010	LOGGER: R. Firasch (driller)
34° 43' 24", 114° 28' 42"	SURFACE ELEVATION (FT): 465	DEPTH TO WATER (FT): 9



NOTE: THIS DIAGRAM IS AN ESTIMATION BASED ON REVIEW OF AVAILABLE DRILLER'S NOTES AND VIDEO SURVEY CONDUCTED IN OCTOBER 2013.

ES110712123135BAO_Well_completion-diagram.ai_032514_lho

Layne Christensen Co.
12030 E. Riggs Rd.
Chandler, AZ. 85249
Phone: (480) 895-9404

Well Inspection Report

CLIENT: CH2M HILL
ADDRESS:
CONTACT: ELI LUDWIG
JOB LOCATION: TOPOCK AZ

WELL NUMBER: HNWR-1 **JOB NUMBER:** 27178

SURVEYED BY: G SQUIRES **DATE:** OCT21/13

REVIEWED BY: **WATER LEVEL:** 7'10"

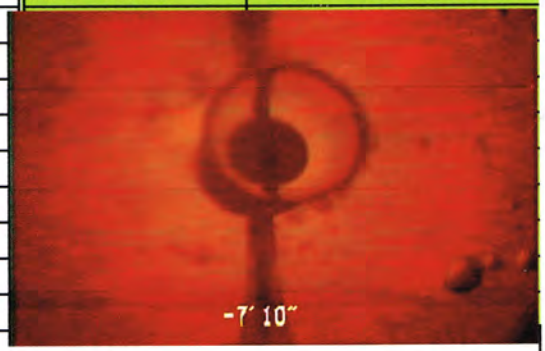
WATER CONDITION: MOSTLY CLEAR **TOTAL DEPTH:** Unknown

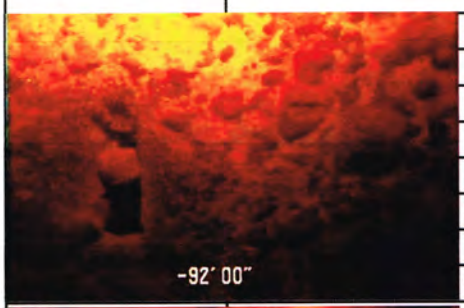
CASING DIAMETER: 10" REDUCES TO 8" AT 118'6" **SURVEY DEPTH:** 156'2"

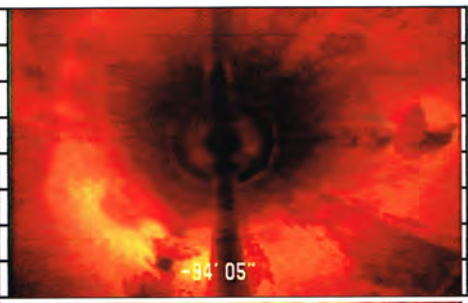
NOTES:

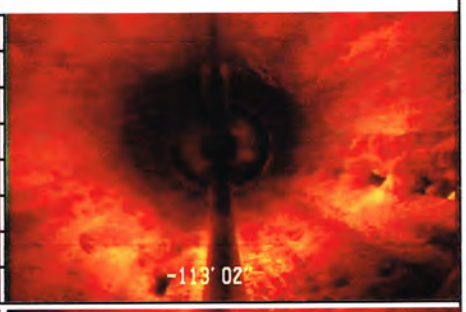
DEPTH	REMARKS
0-	TOP OF FLANGE SIDE VIEW
7'10"	STATIC WATER LEVEL (CLOUDY)
50'	WATER STARTS TO CLEAR
85'	SLIGHTLY HEAVIER SCALE
90'7	START PERFS ROLLER PERFS
118'6"	REDUCTION TO 8"
119'4"	TRANSITION TO WIRE WRAP SCREEN
121'2"	PARTIALLY PLUGGED SCREEN
156'2"	TOP OF SOFT FILL PAPER DEBRIS IN WELL

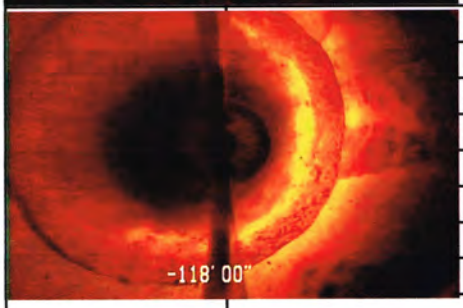
Perforation:	ROLLER PERFS
90'7"-156'2"	WIRE WRAP SCREEN

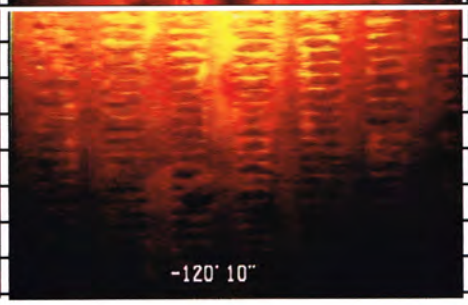


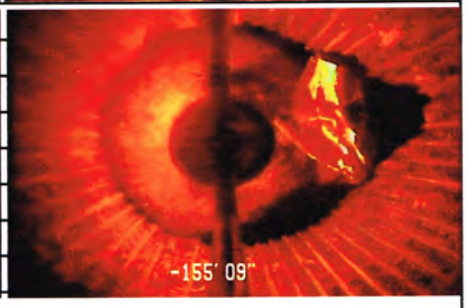












Attachment B
Well and Aquifer Testing Data

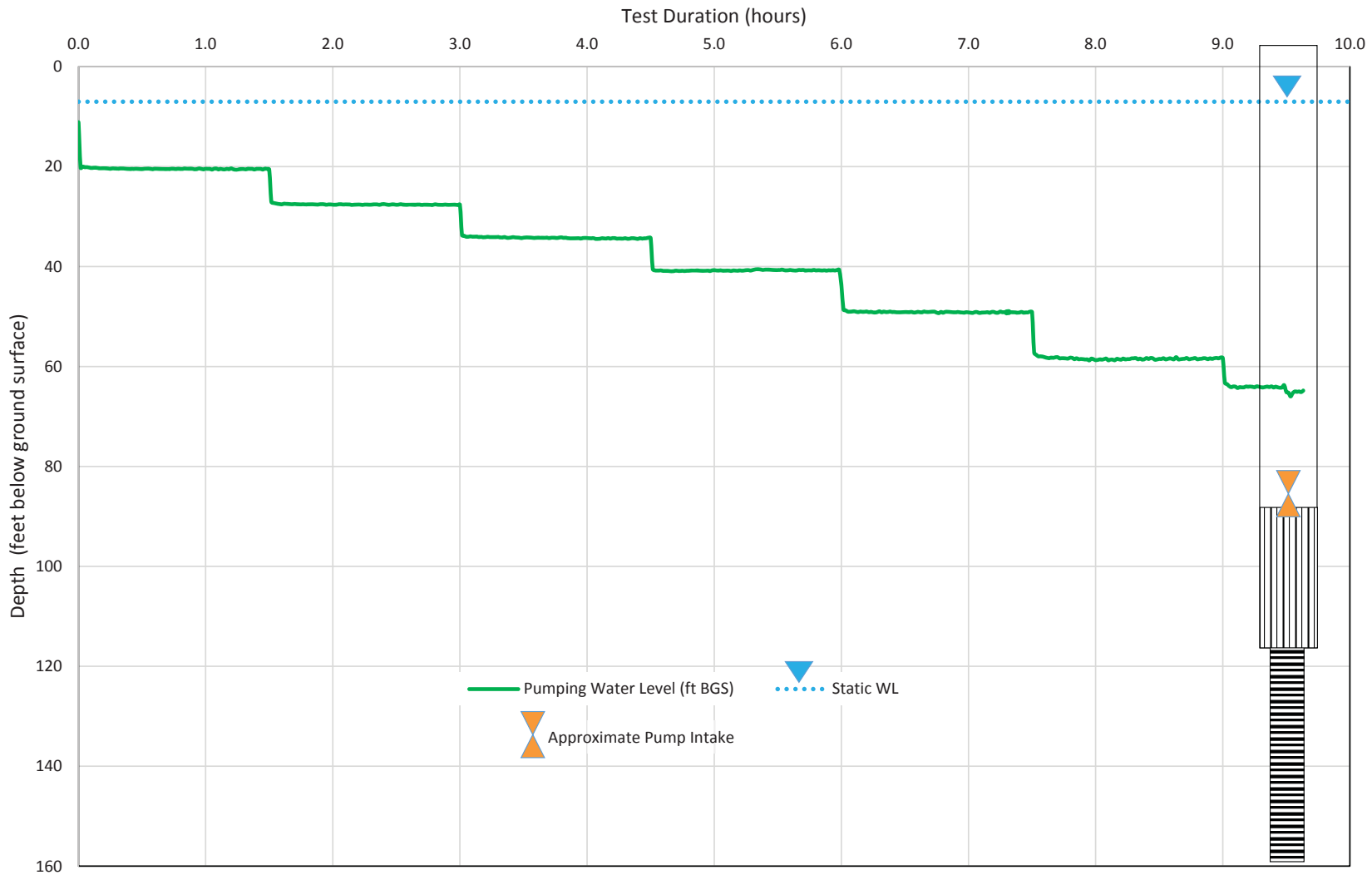


FIGURE B-1
Attachment B – Well and Aquifer Testing Data
Summary of Findings Associated with the Evaluation of
Alternative Freshwater Sources in the Topock Remediation Project Area
Pacific Gas and Electric Company
Topock Compressor Station, Needles, California

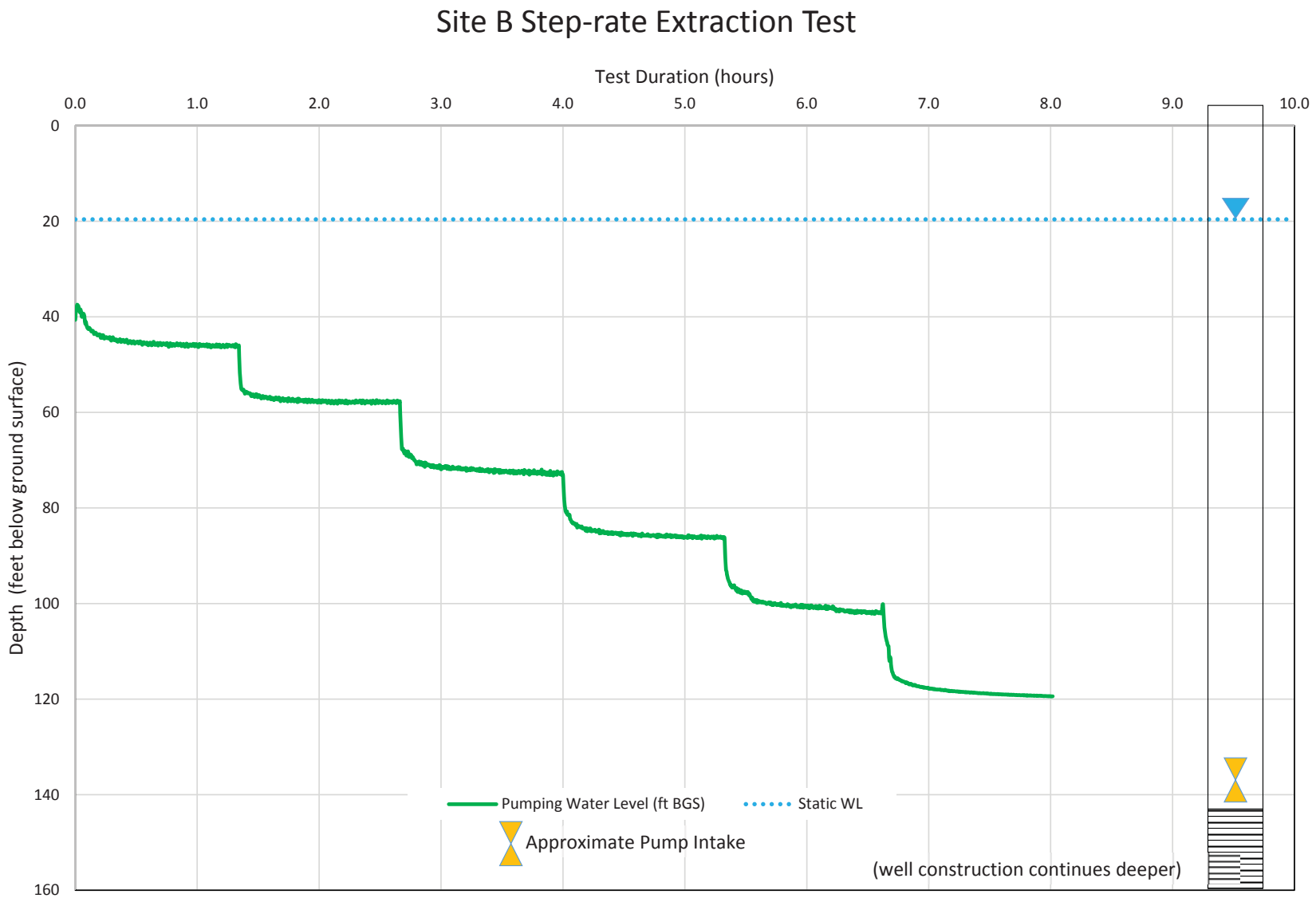


FIGURE B-2
Attachment B – Well and Aquifer Testing Data
Summary of Findings Associated with the Evaluation of
Alternative Freshwater Sources in the Topock Remediation Project Area
Pacific Gas and Electric Company
Topock Compressor Station, Needles, California

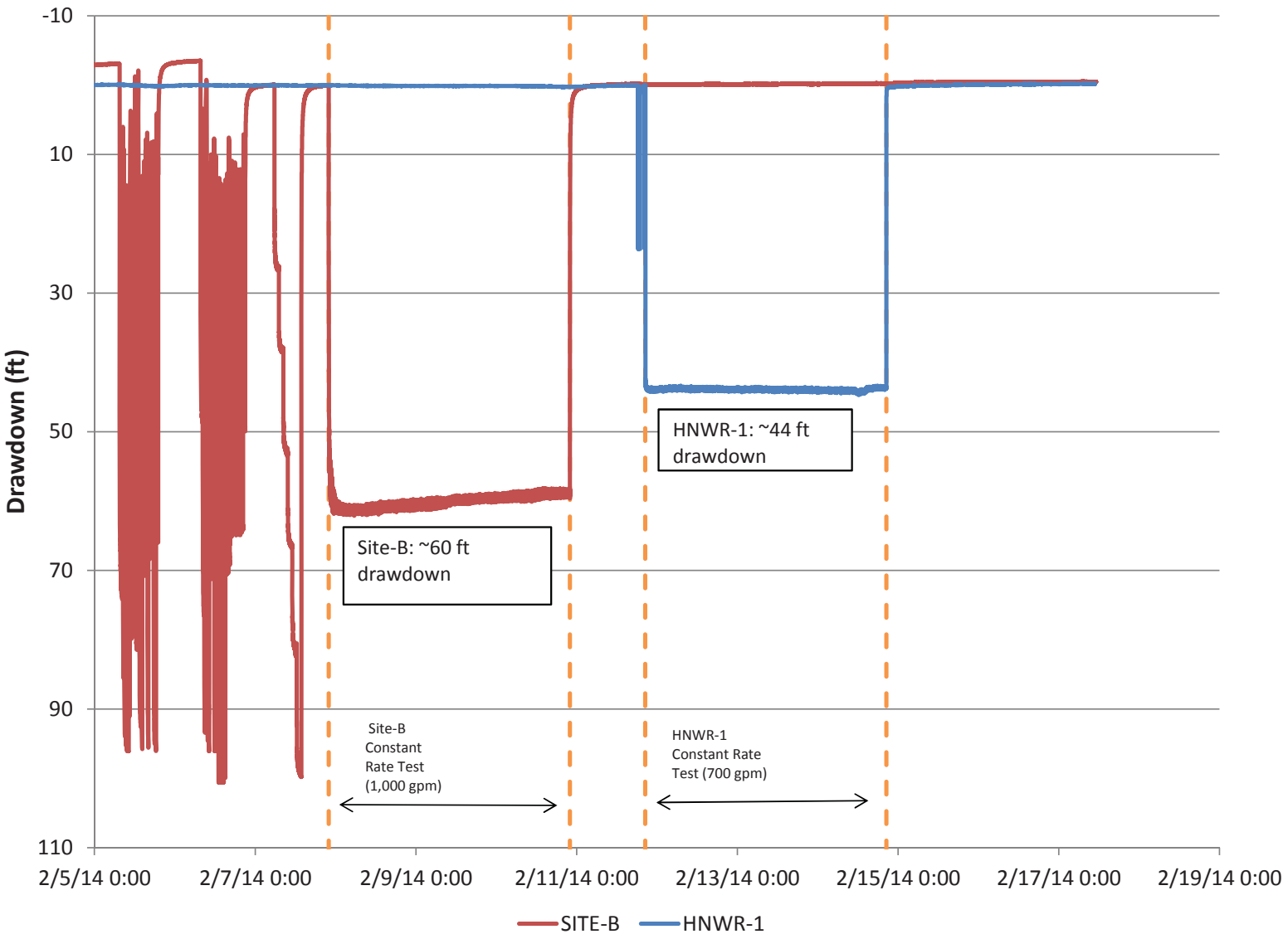


FIGURE B-3
Attachment B – Well and Aquifer Testing Data
Summary of Findings Associated with the Evaluation of
Alternative Freshwater Sources in the Topock Remediation Project Area
Pacific Gas and Electric Company
Topock Compressor Station, Needles, California

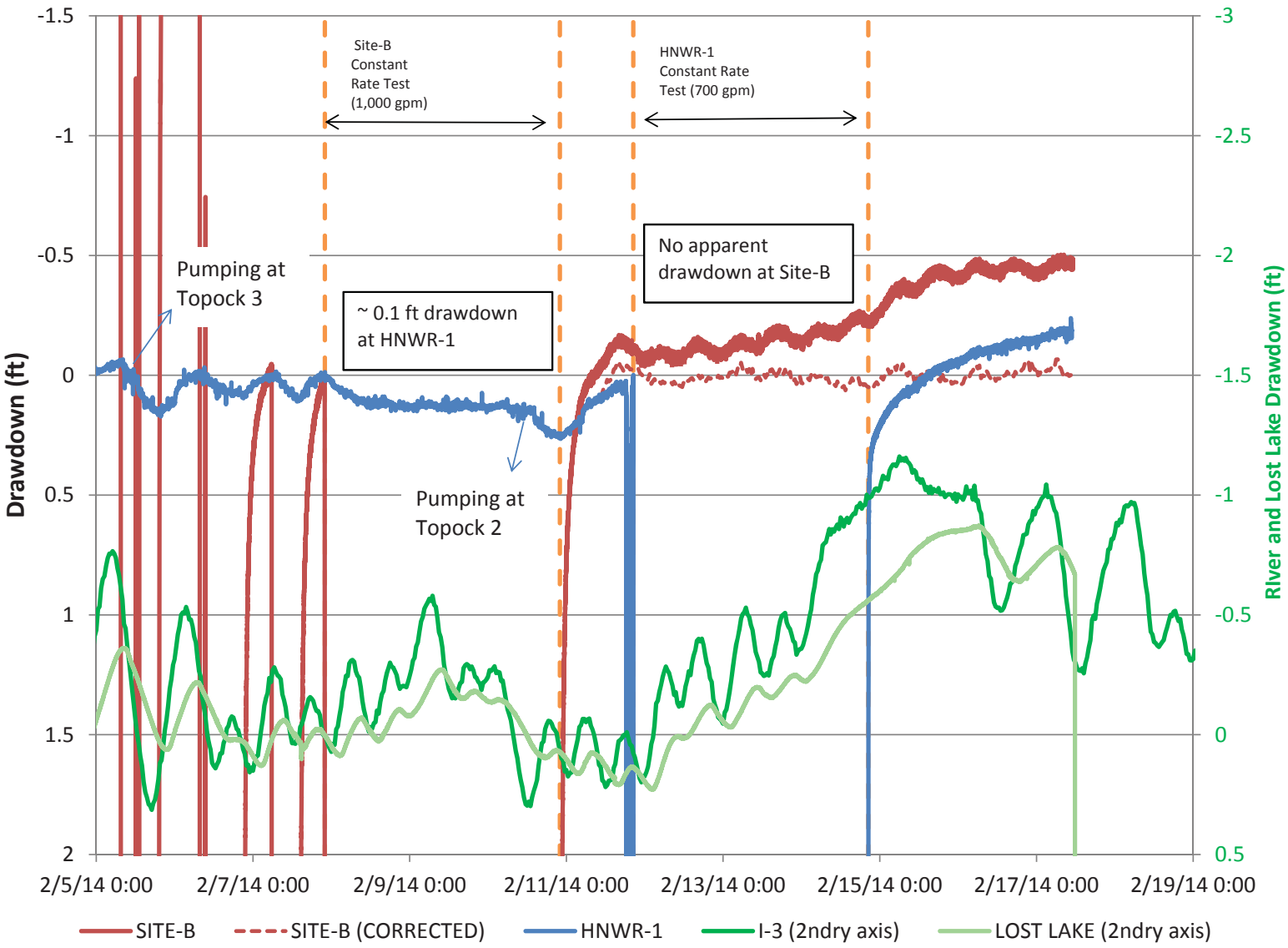


FIGURE B-4
Attachment B – Well and Aquifer Testing Data
Summary of Findings Associated with the Evaluation of
Alternative Freshwater Sources in the Topock Remediation Project Area
Pacific Gas and Electric Company
Topock Compressor Station, Needles, California

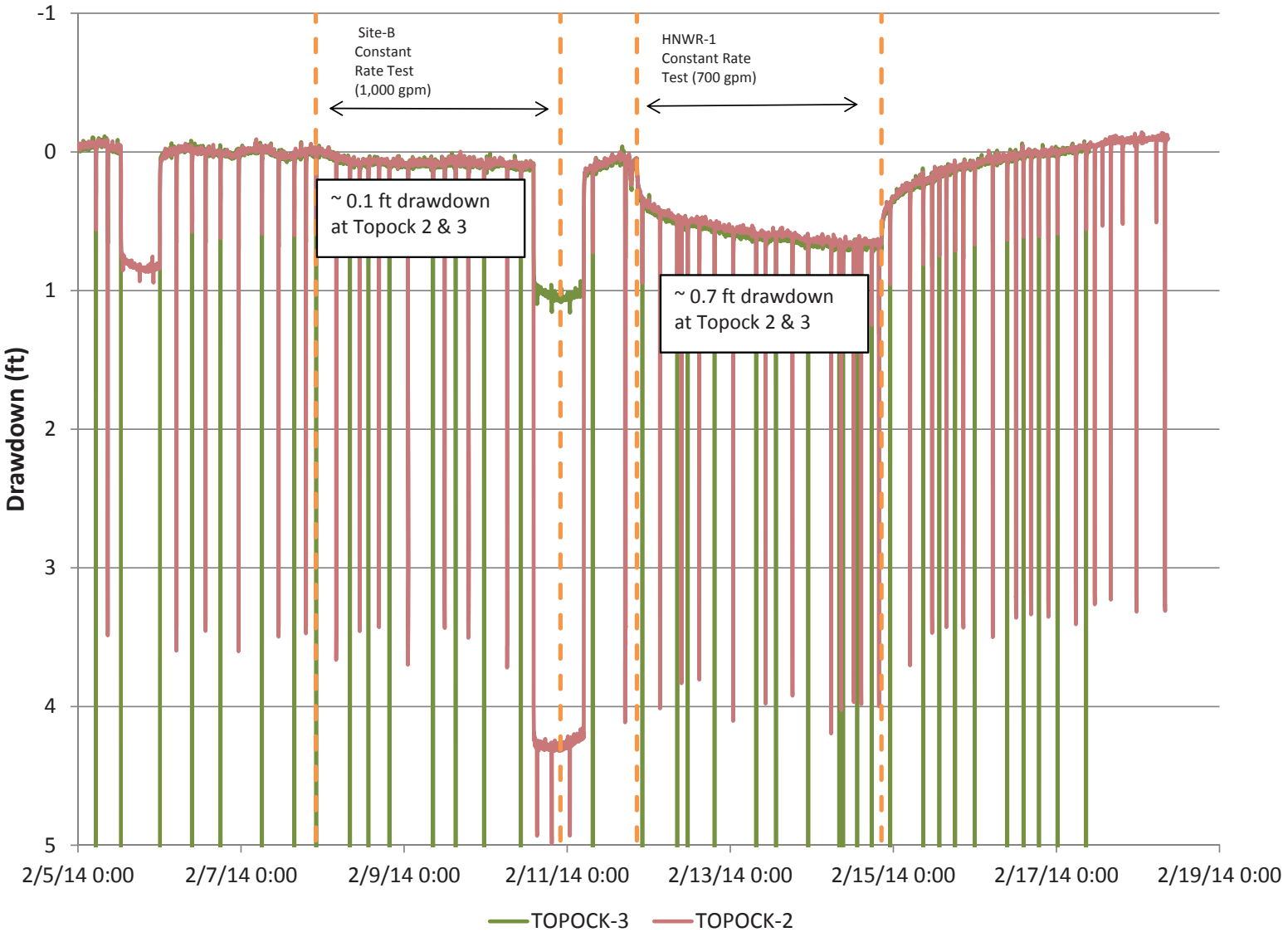


FIGURE B-5
Attachment B – Well and Aquifer Testing Data
Summary of Findings Associated with the Evaluation of
Alternative Freshwater Sources in the Topock Remediation Project Area
Pacific Gas and Electric Company
Topock Compressor Station, Needles, California

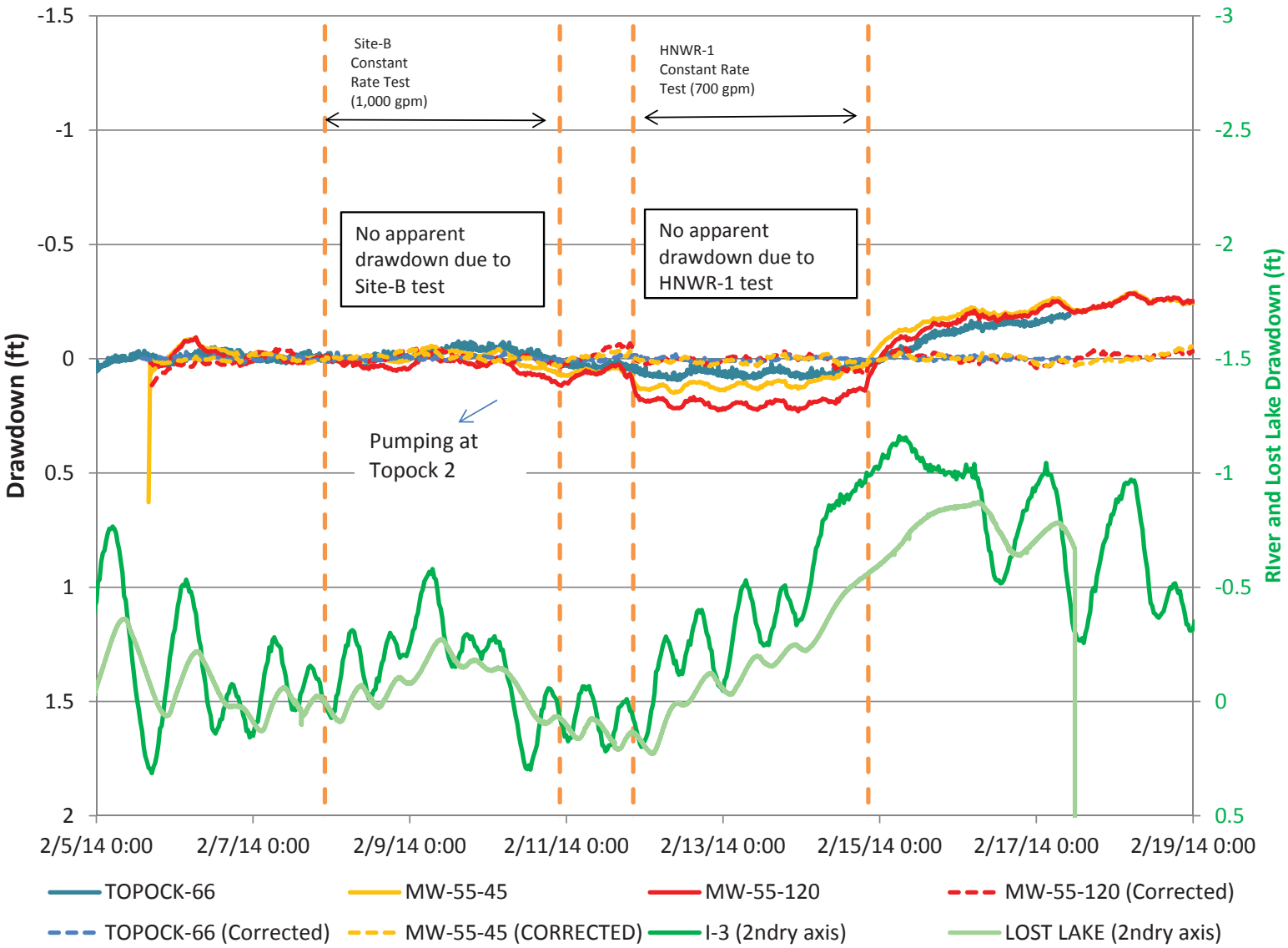


FIGURE B-6
Attachment B – Well and Aquifer Testing Data
Summary of Findings Associated with the Evaluation of
Alternative Freshwater Sources in the Topock Remediation Project Area
Pacific Gas and Electric Company
Topock Compressor Station, Needles, California

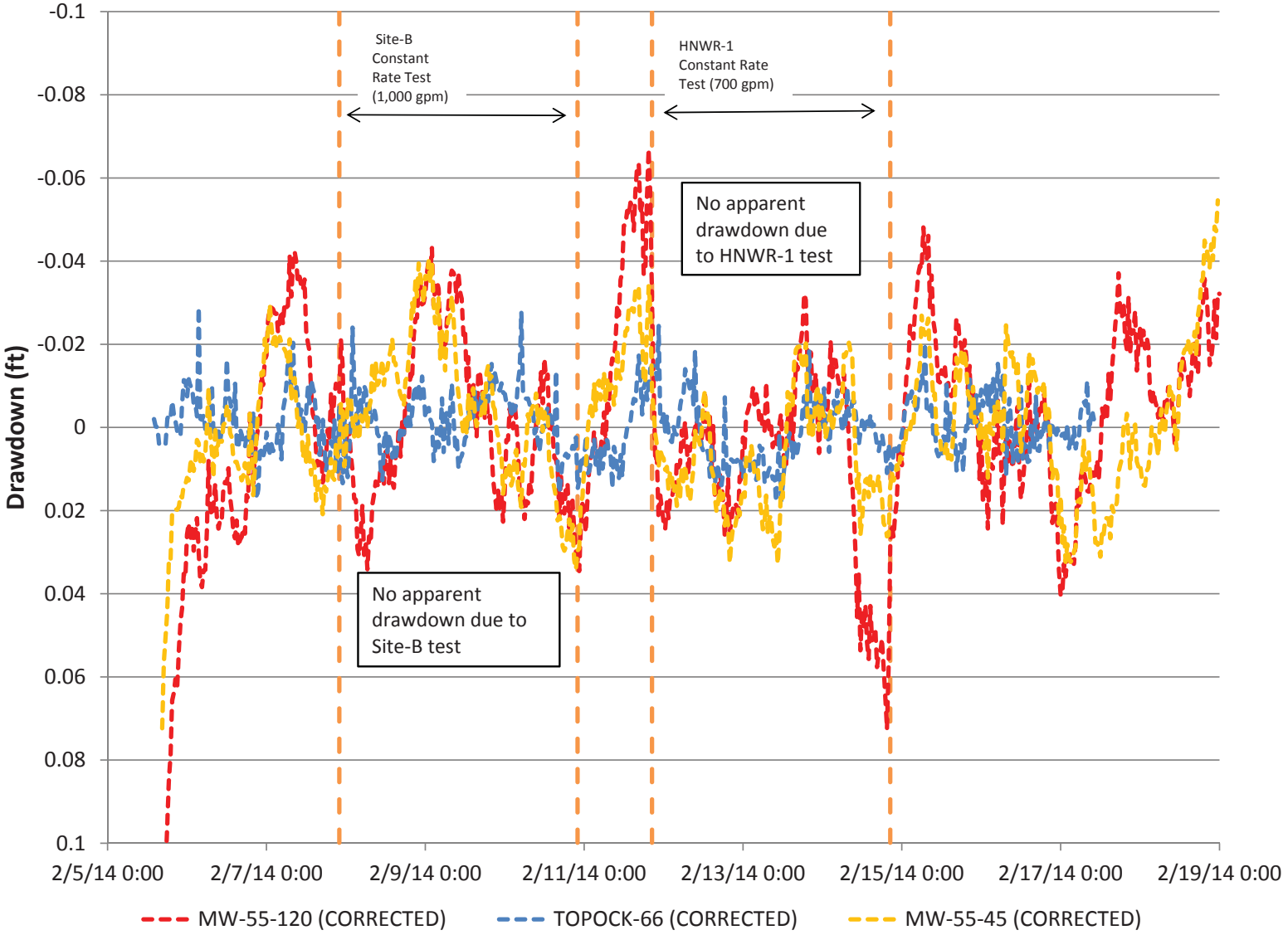


FIGURE B-7
Attachment B – Well and Aquifer Testing Data
Summary of Findings Associated with the Evaluation of
Alternative Freshwater Sources in the Topock Remediation Project Area
Pacific Gas and Electric Company
Topock Compressor Station, Needles, California

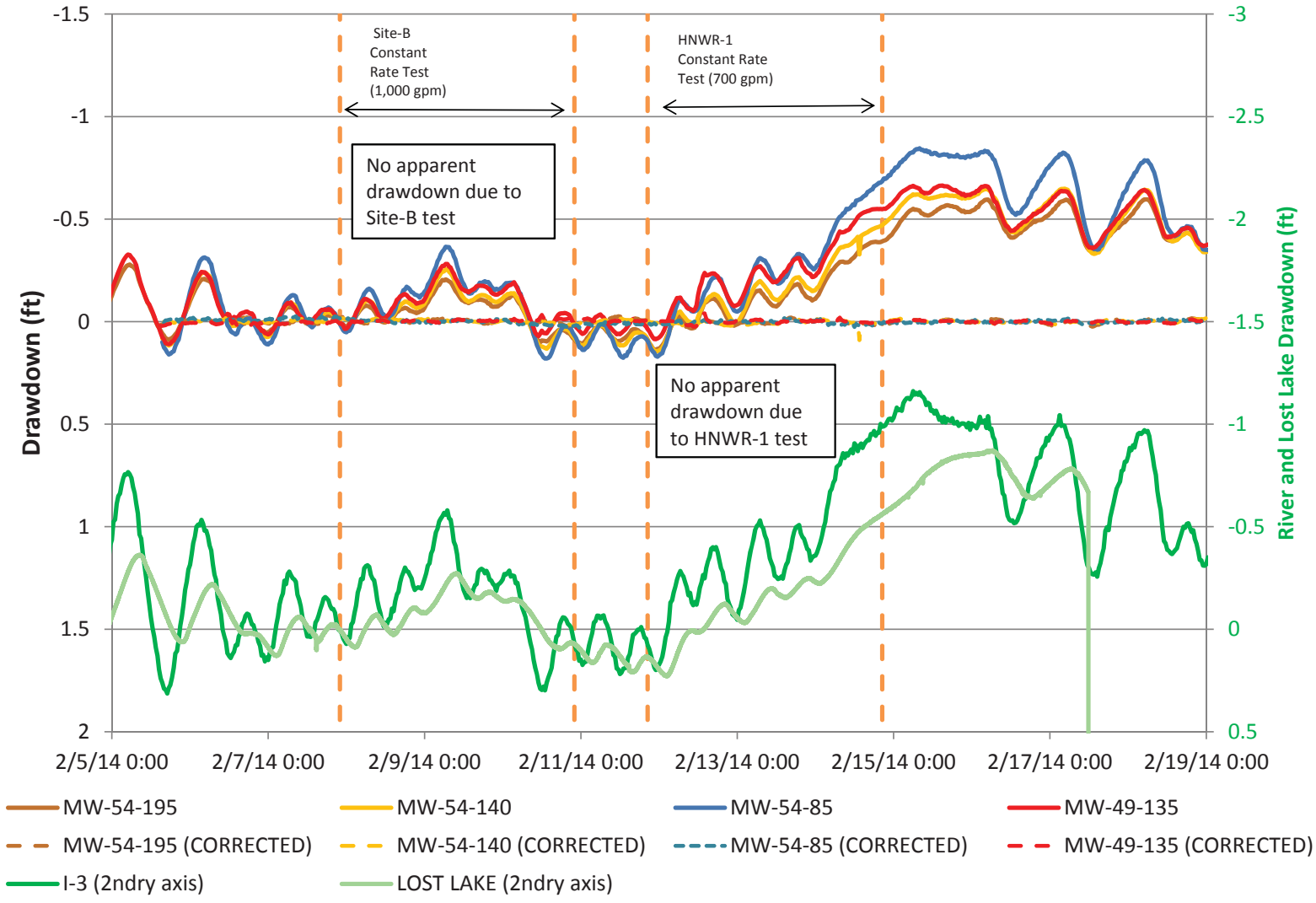


FIGURE B-8
Attachment B – Well and Aquifer Testing Data
Summary of Findings Associated with the Evaluation of
Alternative Freshwater Sources in the Topock Remediation Project Area
Pacific Gas and Electric Company
Topock Compressor Station, Needles, California

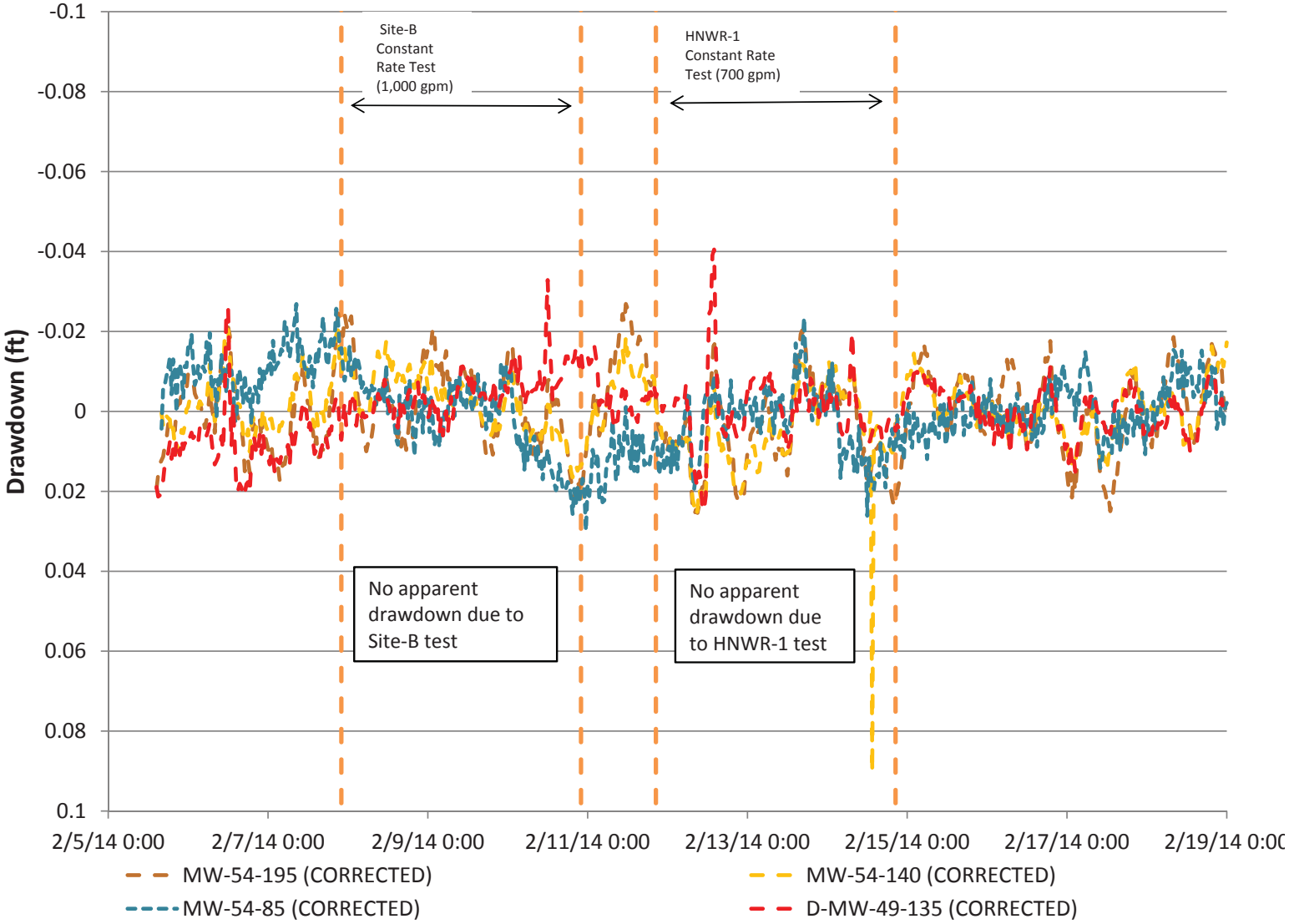


FIGURE B-9
Attachment B – Well and Aquifer Testing Data
Summary of Findings Associated with the Evaluation of
Alternative Freshwater Sources in the Topock Remediation Project Area
Pacific Gas and Electric Company
Topock Compressor Station, Needles, California

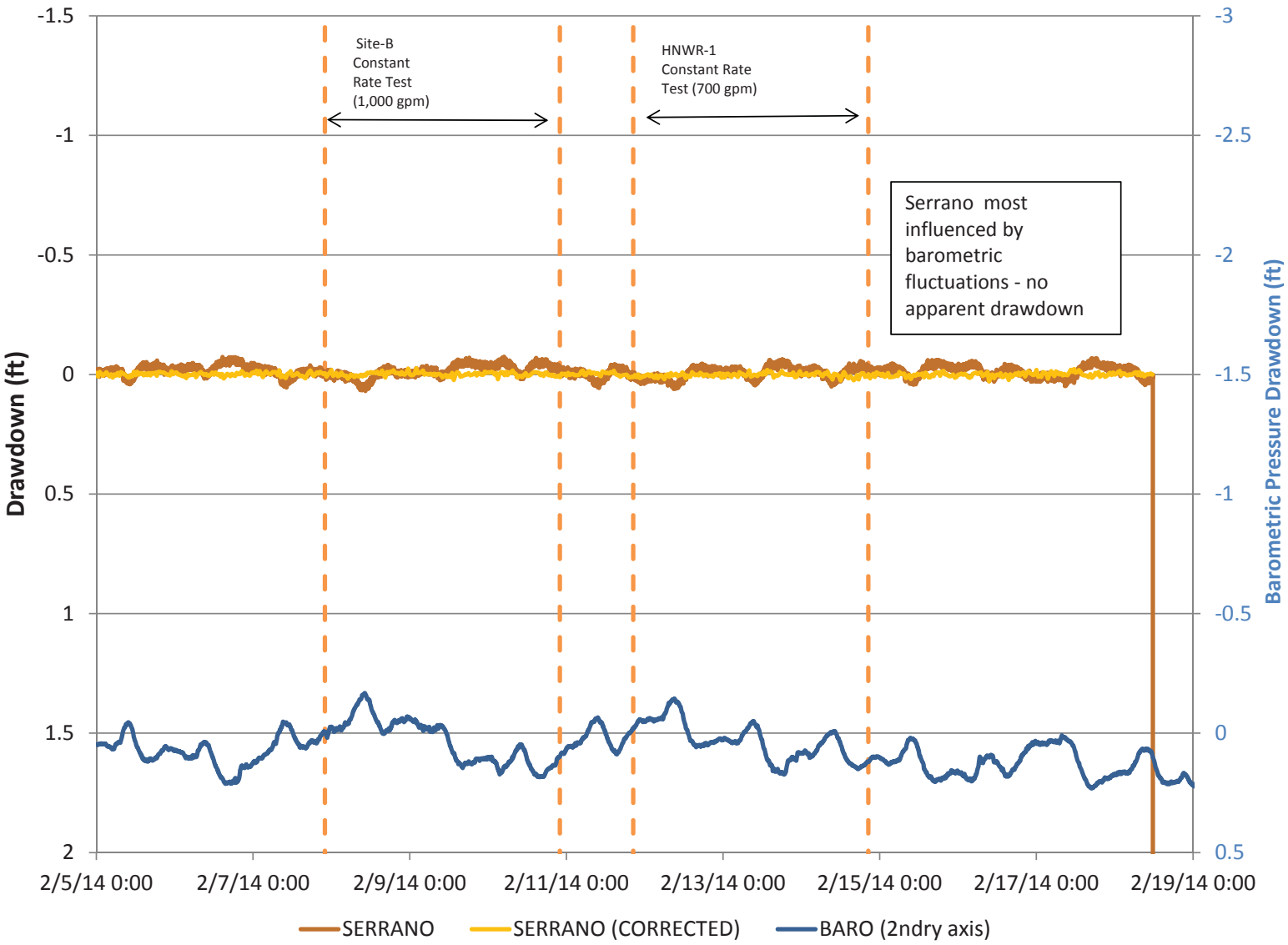


FIGURE B-10
Attachment B – Well and Aquifer Testing Data
Summary of Findings Associated with the Evaluation of
Alternative Freshwater Sources in the Topock Remediation Project Area
Pacific Gas and Electric Company
Topock Compressor Station, Needles, California

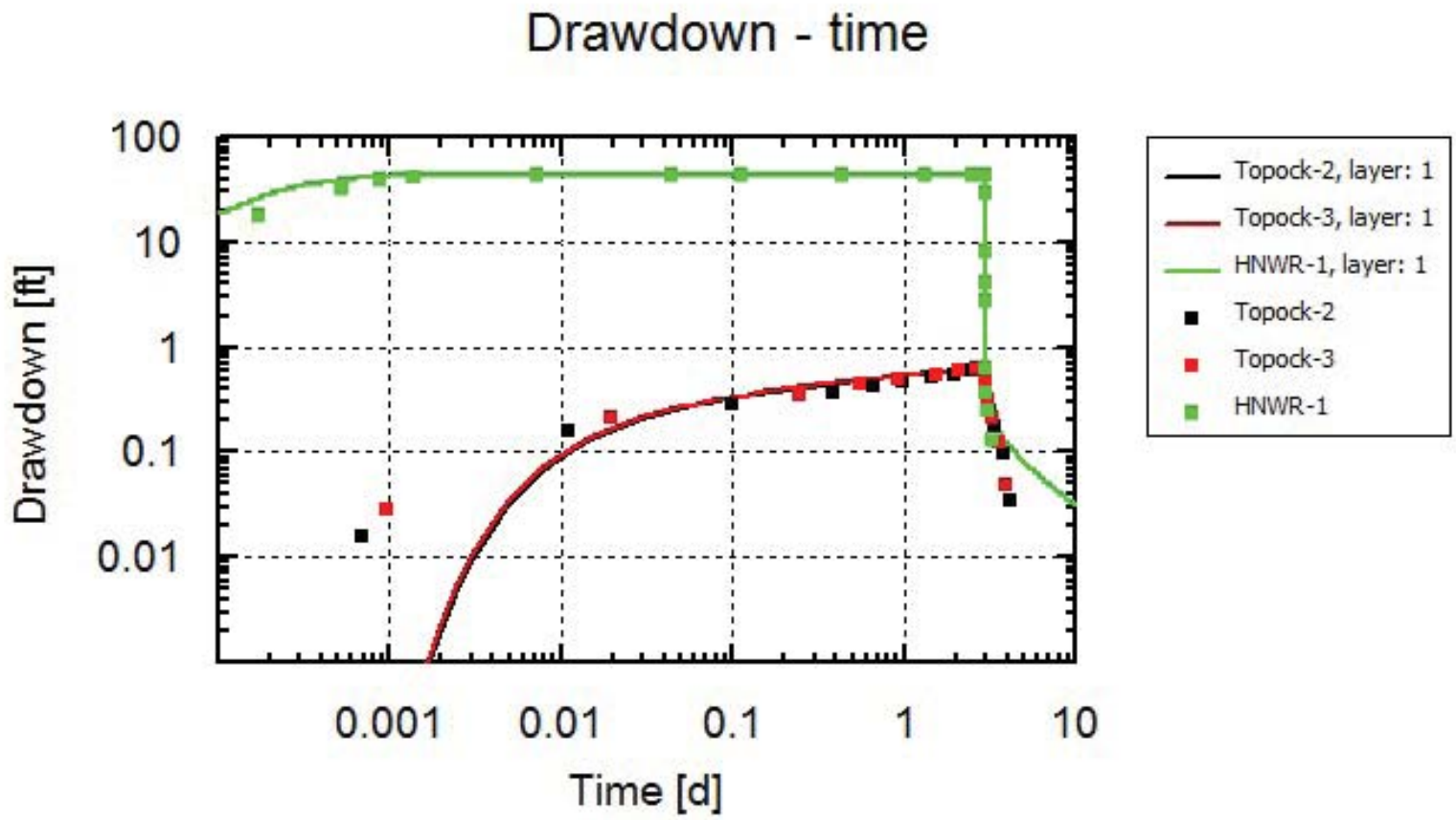


FIGURE B-11
Attachment B – Well and Aquifer Testing Data
Summary of Findings Associated with the Evaluation of
Alternative Freshwater Sources in the Topock Remediation Project Area
Pacific Gas and Electric Company
Topock Compressor Station, Needles, California

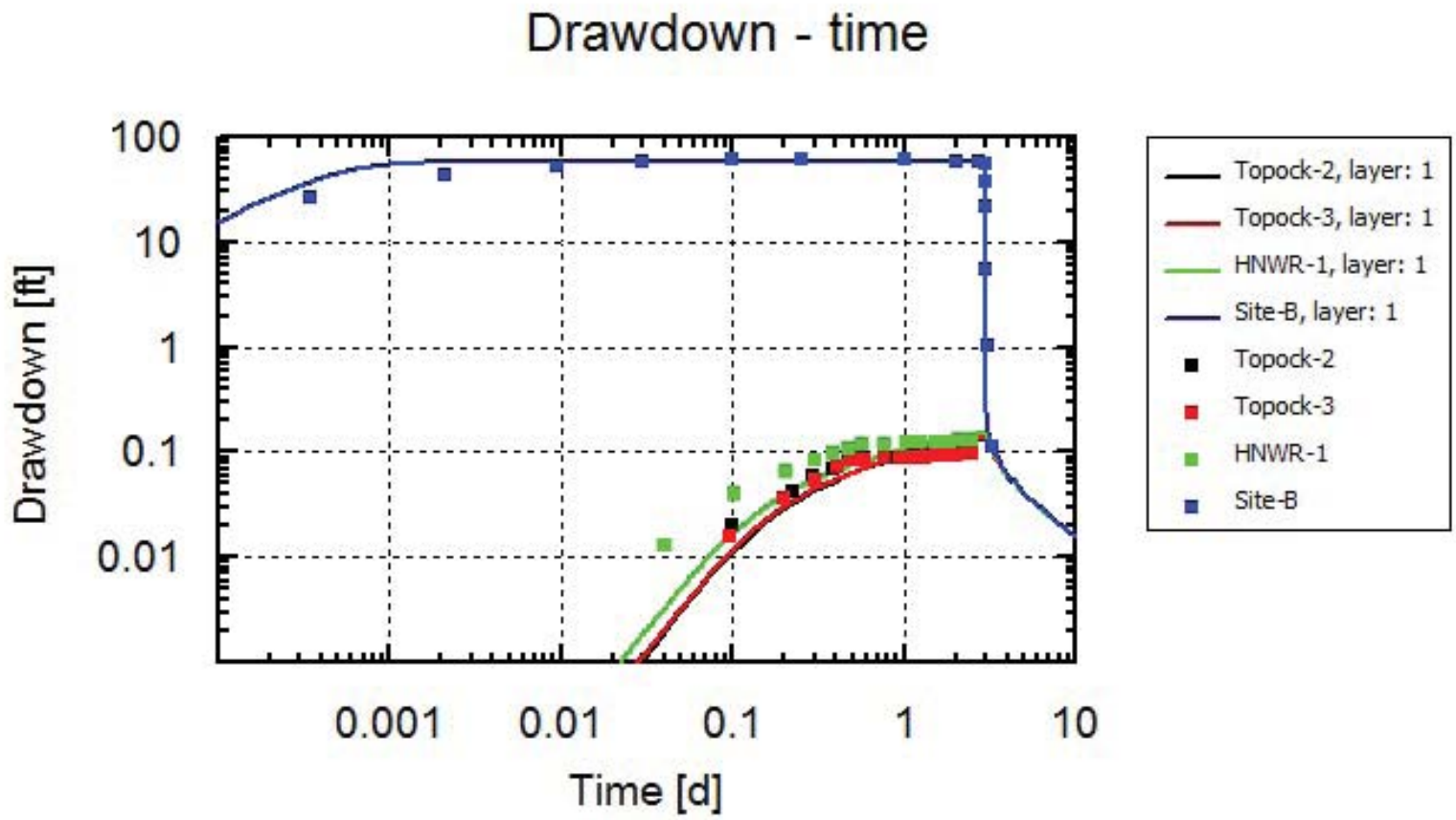


FIGURE B-12
Attachment B – Well and Aquifer Testing Data
Summary of Findings Associated with the Evaluation of
Alternative Freshwater Sources in the Topock Remediation Project Area
Pacific Gas and Electric Company
Topock Compressor Station, Needles, California

Attachment C
Water Quality Report for Topock-2 and Topock-3

Mohave
ENVIRONMENTAL LABORATORY
License No. AZ0037

Customer Name: Southwest Water
Lab ID: 30646
Sample Type: Drinking Water
Sampled By: V. Hewlett

Date Received: 01/11/12 11:35
Date Reported: 01/16/12

Analytical Results

Parameter	Method	Result	Units	Detect Limit	Date	Analyst
30646-01						
Sample Date: 01/11/12 10:00						
Wellhead						
08-033						
Metals						
Chromium VI	SM3500Cr-D	<0.005	mg/L	0.005	1/11/2012	JP
Wet Chemistry						
Specific Conductance	SM2510-B	1,500	umhos/cm	10	1/12/2012	JP

Samples received in laboratory @ 20.2 degrees C.

Sheila Poff
Authorized Signature

Variances & Exemptions {V&E} – State or EPA permission not to meet an MCL or a treatment technique under certain conditions.

Action Level – The concentration of a contaminant which, if exceeded, triggers treatment or other requirements which a water system must follow.

Treatment Technique {TT} – {Mandatory language} a treatment technique is a required process intended to reduce the level of a contaminant in drinking water.

Maximum Contaminant level – {Mandatory language} The "Maximum Allowed" {MCL} is the highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.

Maximum Contaminant Level Goal – {Mandatory language} The "Goal" {MCLG} is the level of a contaminant in drinking water below which there is no known or expected or expected risk to health. MCLGs allow for a margin of safety.

As you can see by the table, our system had no violations. We are proud that your drinking water meets or exceeds all Federal and State requirements. We have learned through our monitoring and testing that some constituents have been detected. The EPA has determined that your water **IS SAFE** at these levels.

All sources of drinking water are subject to potential contamination by substances that are naturally occurring or man made. These substances can be microbes, inorganic or organic chemicals and radioactive substances. All drinking water, including bottled water, may reasonably be expected to contain at least a small of some contaminants. The presents of contaminates does not necessarily indicate that the water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the Environmental Protection Agency's Safe Drinking Water Hotline at 1-800-426-4791

MCLs are set very stringent levels. To understand the possible health effects described for many regulated constituents, a person would have to drink 2 liters of water every day at the MCL level for a lifetime to have a one-in-a-million chance of having the described health effect.

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV?AIDS or other immune system disorders, some elderly and infants can particularly at risk from infections. These people should seek advice about drinking water from their health providers. EPA/CDC guidelines on appropriate means to lessen the risk of infection by cryptosporidium and other microbiological contaminants are available from the Safe Water Hotline 1-800-426-4791.

We at SOUTHWEST WATER INC. work hard to provide top quality water to every tap. We ask that all our customers help us protect our water sources, which are the heart of our community, our way of life and our children's future. Please call our office if you have any questions: 928-219-9358.

SOUTHWEST WATER INC.

ANNUAL CONSUMER CONFIDENCE REPORT

08-033 **Date: July 2011**

Reporting Period For 2010

SOUTHWEST WATER INC. is pleased to present to you this year's Annual Quality Water Report. This report is designed to inform you about the quality of water and services we deliver to you every day. Our constant goal is to provide you with a safe end dependable supply of drinking water. We want you to understand the efforts we make to continually improve the water treatment process and protect our water resources. We are committed to ensuring the quality of your water. Our water source is in the Warm Springs Aquifer.

SOUTHWEST WATER INC. routinely monitors for constituents in your drinking water according to Federal and State laws. As water travels over the land or underground, it can pick up substances or contaminates such as microbes, inorganic and organic chemicals and radioactive substances. All drinking water, including bottled drinking water may be reasonably expected to contain at least small amounts of some constituents. It is very important to remember that the presence of these constituents does not necessarily pose a health risk.

In this table you will find many terms and abbreviations you might not be familiar with. To help you better understand these terms we have provided the following definitions:

Non-detects {ND} - Laboratory analysis indicates that constituent is not present.

Parts per million {ppm} or Milligrams per liter – {mg/l} – One part per million corresponds to one minute in two years or a single penny in $10,000.

Parts per billion {ppb} or Micrograms per liter – One part per billion corresponds to one minute in 2,000 years, or a single penny $10,000,000.

Parts per trillion {ppq} or nanograms per liter {nanograms/l} – One part per quadrillion corresponds to one minute in 2,000,000 years, or one penny in $10,000,000,000.

Parts per quadrillion {ppq} or pictograms per liter {pictogram/l} – one part per quadrillion corresponds to one minute in 2,000,00,000 years or one penny in $10,000,000,000,000.

Picocuries per liter {pCiL} – Picocuries per liter is a measure of the radioactivity in water.

Millirems per year {mrem/yr} – Measure of radiation absorbed by the body.

Million fibers per liter {MFL} – million fibers per liter is a measure of the asbestos fibers that are longer than 10 micrometers.

SOUTHWEST WATER INC.

ANNUAL CONSUMER CONFIDENCE REPORT

08-033 **Date: June ..2012**

Reporting Period For 2011

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Millirems per year {mrem/yr} – Measure of radiation absorbed by the body.

Million fibers per liter {MFL} – million fibers per liter is a measure of the asbestos fibers that are longer than 10 micrometers.

Variances & Exemptions {V&E} – State or EPA permission not to meet an MCL or a treatment technique under certain conditions.

Action Level – The concentration of a contaminant which, if exceeded, triggers treatment or other requirements which a water system must follow.

Treatment Technique {TT} – {Mandatory language} a treatment technique is a required process intended to reduce the level of a contaminant in drinking water.

Maximum Contaminant level – {Mandatory language} The "Maximum Allowed" {MCL} is the highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.

Maximum Contaminant Level Goal – {Mandatory language} The "Goal" {MCLG} is the level of a contaminant in drinking water below which there is no known or expected or expected risk to health. MCLGs allow for a margin of safety.

As you can see by the table, our system had no violations. We are proud that your drinking water meets or exceeds all Federal and State requirements. We have learned through our monitoring and testing that some constituents have been detected. The EPA has determined that your water **IS SAFE** at these levels.

All sources of drinking water are subject to potential contamination by substances that are naturally occurring or man made. These substances can be microbes, inorganic or organic chemicals and radioactive substances. All drinking water, including bottled water, may reasonably be expected to contain at least a small of some contaminants. The presents of contaminates does not necessarily indicate that the water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the Environmental Protection Agency's Safe Drinking Water Hotline at 1-800-426-4791

MCLs are set very stringent levels. To understand the possible health effects described for many regulated constituents, a person would have to drink 2 liters of water every day at the MCL level for a lifetime to have a one-in-a-million chance of having the described health effect.

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV?AIDS or other immune system disorders, some elderly and infants can particularly at risk from infections. These people should seek advice about drinking water from their health providers. EPA/CDC guidelines on appropriate means to lessen the risk of infection by cryptosporidium and other microbiological contaminants are available from the Safe Water Hotline 1-800-426-4791.

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Arizona Department of Environmental Quality

Drinking Water Inorganic Chemical Analysis Reporting Form

Entry Point to the Distribution System (EPDS) Only

PWS ID#: AZ0408-033

PWS Name: Southwest Water

4/7/2011 Sample Date

06:00 (24 hr clock) Sample time

V. Hewlett
Owner/Contact Person Name

Owner/Contact Fax Number

928-715-8100
Owner/Contact Person Phone Number

Sample Type
[X] Compliance Monitoring

Sample Collection Point
[x] EPDS # 001

Sampling Site ID

For MCL or Composite Level Exceedance

_____ Original Violation Specimen Number

Sample Type
[ ] Confirmation
[ ] Confirmation Composite

INORGANIC CHEMICAL ANALYSIS

>>> To be completed by laboratory personnel <<<

Analysis Method	MCL	Reporting Limit	Contaminant Name	Cont Code	Analysis Run Date	Result	Exceeds MCL	Exceeds Reporting Limit
EPA 200.9	0.010	0.005	Arsenic	1005			[ ]	
SM 3111D	2	1	Barium	1010			[ ]	
EPA 200.9	0.005	0.0025	Cadmium	1015			[ ]	
EPA 200.9	0.1	0.05	Chromium	1020			[ ]	
SM4500-F-C	4	0.5	Fluoride	1025			[ ]	
EPA 245.1	0.002	0.001	Mercury	1035			[ ]	
EPA 300.0	10	2.5	Nitrate (as N)	1040	4/7/11	2.2	[ ]	[ ]
EPA 300.0	1	0.25	Nitrite (as N)	1041			[ ]	[ ]
EPA 200.0	0.05	0.025	Selenium	1045			[ ]	
EPA 200.9	0.006	0.003	Antimony	1074			[ ]	
EPA 200.9	0.004	0.002	Beryllium	1075			[ ]	
EPA 335.4	0.2	0.1	Cyanide	1024			[ ]	
EPA 200.9	No MCL	0.05	Nickel*	1036			[ ]	
EPA 200.9	0.002	0.001	Thallium	1085			[ ]	
SM 3111B	No MCL	10	Sodium*	1052			[ ]	

>>>>> LABORATORY INFORMATION <<<<<

To be completed by laboratory personnel

Lab ID Number: AZ0037

Specimen Number: 28295-01

Name: Mohave Environmental Laboratory 2580 Landon Dr. Ste. A Bullhead City, AZ 86429

Printed Name and Phone Number of Lab Contact: Sheila Poff 928-754-8101

Authorized Signature: Sheila Poff

Date Public Water System Notified:

Comments:

All units must be reported in milligrams per liter (mg/l)

*Contaminants without an MCL

DWAR 2IN: Revised 7/2009

Microbiological Contaminants

Contaminant	MCL	MCLG	Unit	Result	Violation (Yes or No)	Sample Date	Likely Source of Contamination
Total Coliform Bacteria for Systems that collects>40 samples per month	No more than 5% of monthly samples can be positive	0	Absent or Present	a	N	2011	Naturally present in the environment
Total Coliform Bacteria for Systems that collects<40 samples per month	No more than 1 positive monthly sample	0	Absent or Present	a	N	2011	Naturally present in the environment
Fecal coliform and E. Coli	A routine sample & a repeat sample are total coliform positive, & one is also fecal coliform or *E. coli positive*	0	Absent or Present	a	N	2011	Human and animal fecal waste

Lead and Copper

Contaminant	AL	ALG	Units	90th Percentile	Number of Sites over AL	Violation (Yes or No)	Sample Date/Year	
Copper	1.3	0	ppm	.018	5	N	07-11	
Lead	15	0	ppb	0184	5	N	07-11	

Inorganic Contaminants

Contaminate	MCL	UN	Units	Level Detected/ Range	Violation	Sample Date	
Nitrate (as Nitrogen) Poe#1	10	10	ppm	2.2	N	04-11	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits

Secondary Contaminants

Secondary standards are non-enforceable guidelines for contaminants that may cause cosmetic effects or aesthetic effects in drinking water. EPA recommends these standards but does not require water systems to comply.

Contaminant	Secondary Standard	MCLG	Units	Level detected/ Range	Violation		

Violations

The following violations were received by our water system or were ongoing in the calendar year 2011

Type/Description	Compliance Period
NONE	

Please contact **Victor Hewlett** at SouthWest Water inc. 928.219.9358 to learn more about what you can do to help protect your drinking water sources, any questions about the annual drinking water quality report, to learn more about our system, or to attend scheduled public meetings. We want you, our valued customers, to be informed about the services we provide and the quality water we deliver to you every day.

Health Effects Information About the Above Tables

Nitrate in drinking water at levels above 10 ppm is a health risk for infants of than six months of age. High nitrate levels in drinking water can cause blue baby syndrome. Nitrate levels may rise quickly for short periods-of-time because of rainfall or agricultural activity. If you are caring for an infant, and detected nitrate levels are above 5 ppm, you should ask advice from your health care provider.

Report for 2012

Microbiological Contaminants

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Fecal coliform and E. Coli	A routine sample & a repeat sample are total coliform positive, & one is also fecal coliform or *E. coli positive*	0	Absent or Present	a	N	2010	Human and animal fecal waste

Lead and Copper

Contaminant	AL	ALG	Units	90th Percentile	Number of Sites over AL	Violation (Yes or No)	Sample Date/Year	
Copper	1.3	0	ppm	.020	5	N	07-10	
Lead	15	0	ppb	0195	5	N	07-10	

Inorganic Contaminants

Contaminate	MCL	UN	Units	Level Detected/ Range	Violation	Sample Date	
Nitrate (as Nitrogen) Poe#1	10	10	ppm	2.1	N	04-10	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits

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Secondary standards are non-enforceable guidelines for contaminants that may cause cosmetic effects or aesthetic effects in drinking water. EPA recommends these standards but does not require water systems to comply.

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Report for 2011

Attachment D
Conceptual Infrastructure and Pipeline Alignment (Presentation from March 19, 2014 TWG Meeting)



FIGURE 1
HNWR-1 WELL SITE FACING WEST–EXISTING CONDITIONS
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL

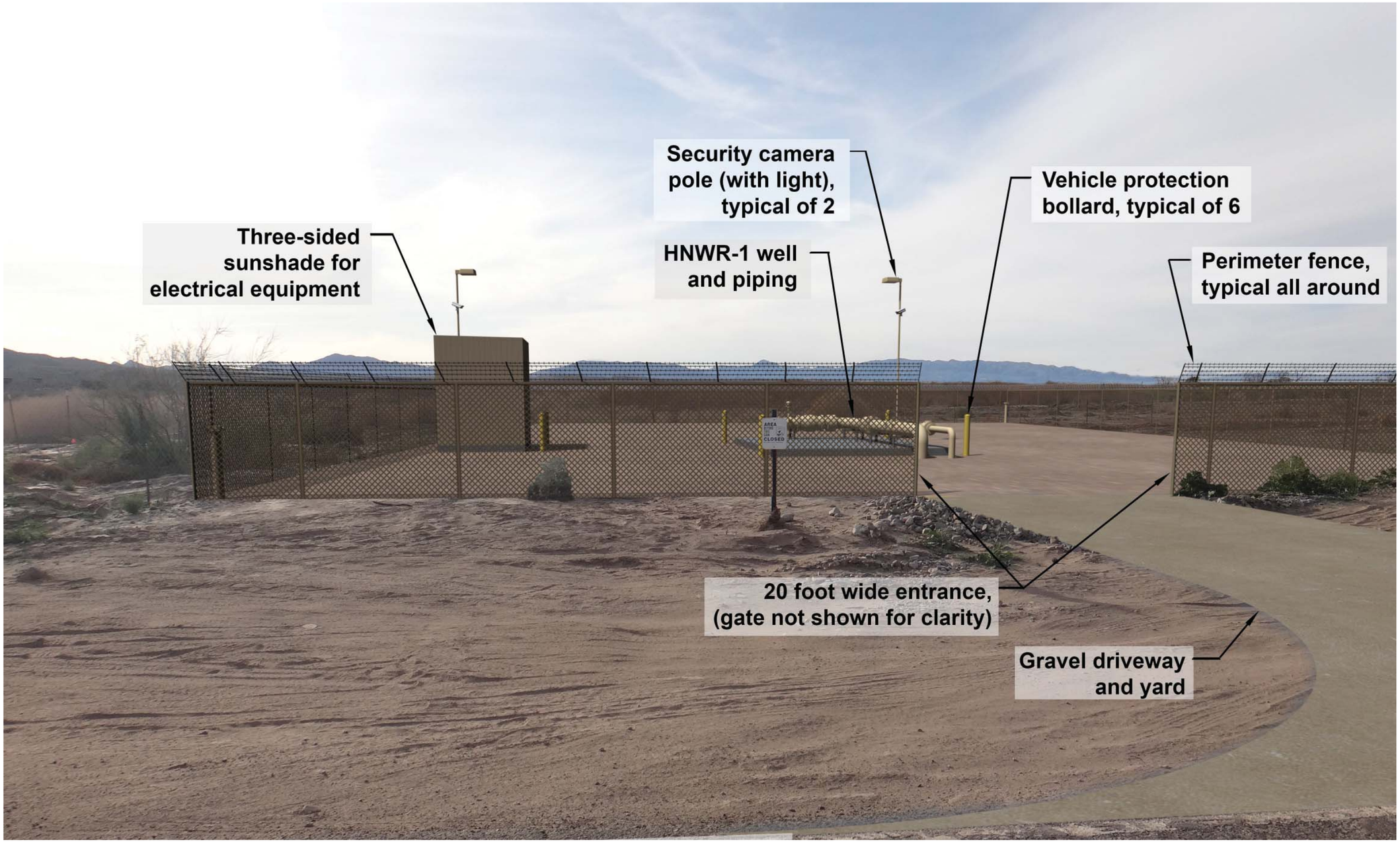


FIGURE 2
HNWR-1 WELL SITE FACING WEST – PROPOSED INFRASTRUCTURE PER 60% DESIGN
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

Notes:
Conceptual Visualization - This is for illustration purposes only.

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LEGEND

- Pipeline B per 60% design – above ground
- Pipeline B per 60% design – underground
- Conceptual portion of Pipeline B – underground
- Existing utilities
- Construction staging areas
- Wells (at well sites)

FIGURE 3
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 1 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

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LEGEND

- Pipeline B per 60% design – above ground
- Pipeline B per 60% design – underground
- Existing utilities
- Construction staging areas

FIGURE 4
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 2 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

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LEGEND

- Pipeline B per 60% design – underground
- Existing utilities
- Underground electrical
- Construction staging areas

FIGURE 5
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 3 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

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LEGEND

- Pipeline B per 60% design – above ground
- Pipeline B per 60% design – underground
- Existing utilities

FIGURE 6
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 4 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

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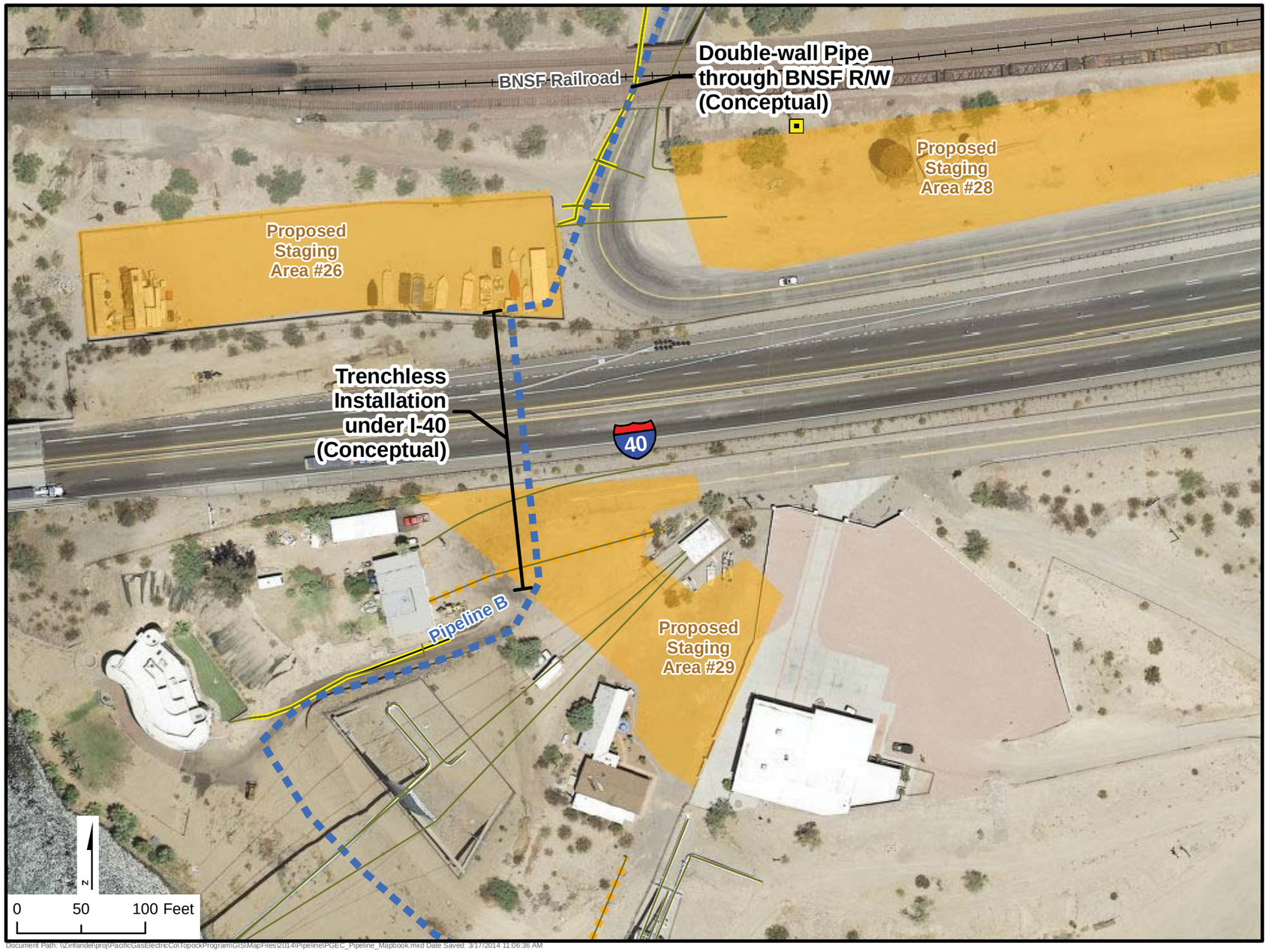
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LEGEND

- Pipeline B per 60% design – above ground
- Pipeline B per 60% design – underground
- Existing utilities

FIGURE 7
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 5 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL

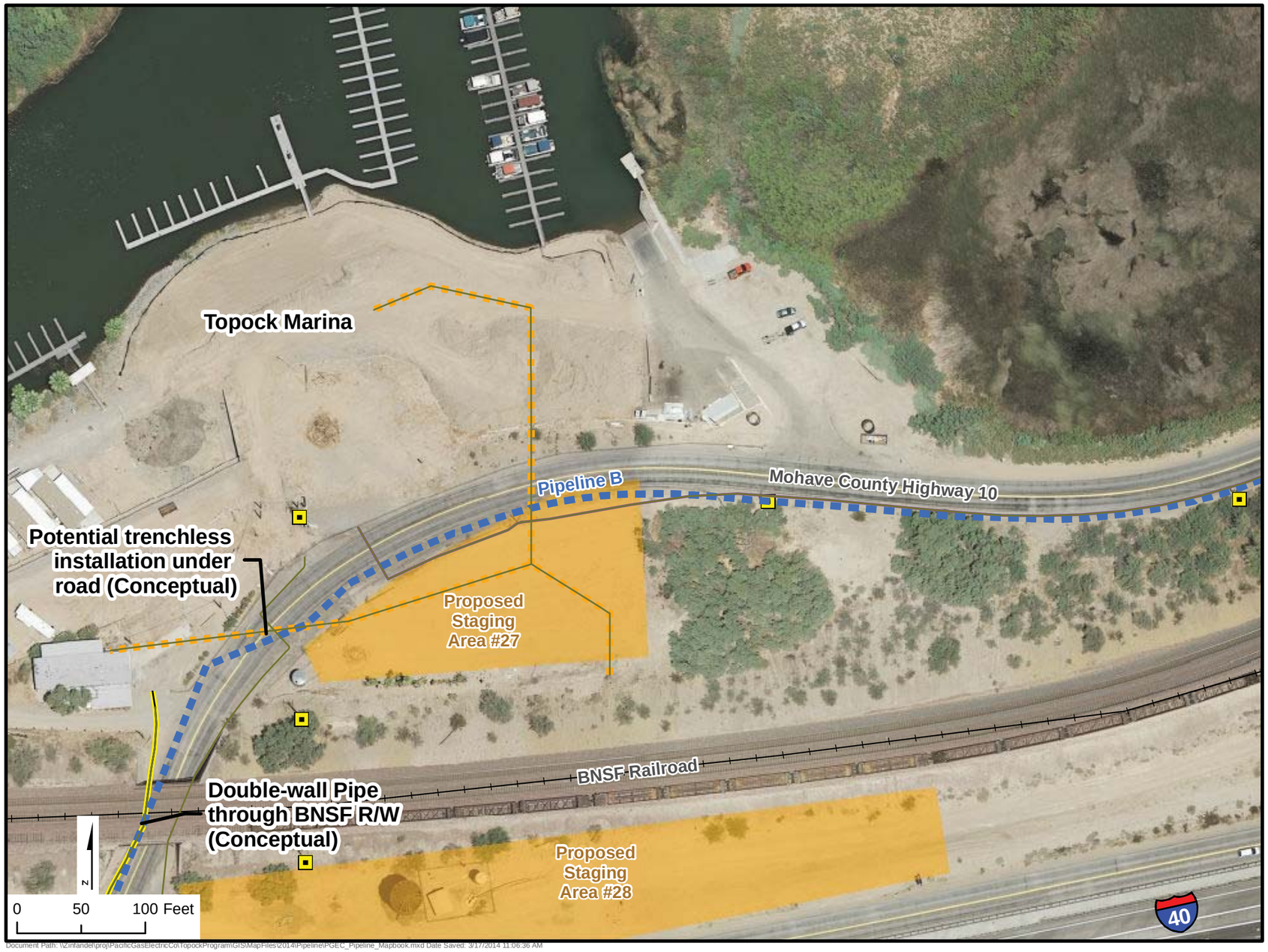


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LEGEND

- Pipeline B per 60% design – underground
- Existing utilities
- Overhead electrical poles
- Unknown/private utility
- Construction staging areas

FIGURE 8
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 6 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA



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LEGEND

- Pipeline B per 60% design – underground
- Existing utilities
- Overhead electrical poles
- Unknown/private utility
- Underground electric
- Construction staging areas

FIGURE 9
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 7 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

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LEGEND

- Pipeline B per 60% design – underground
- Existing utilities
- Overhead electrical poles

FIGURE 10
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 8 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL



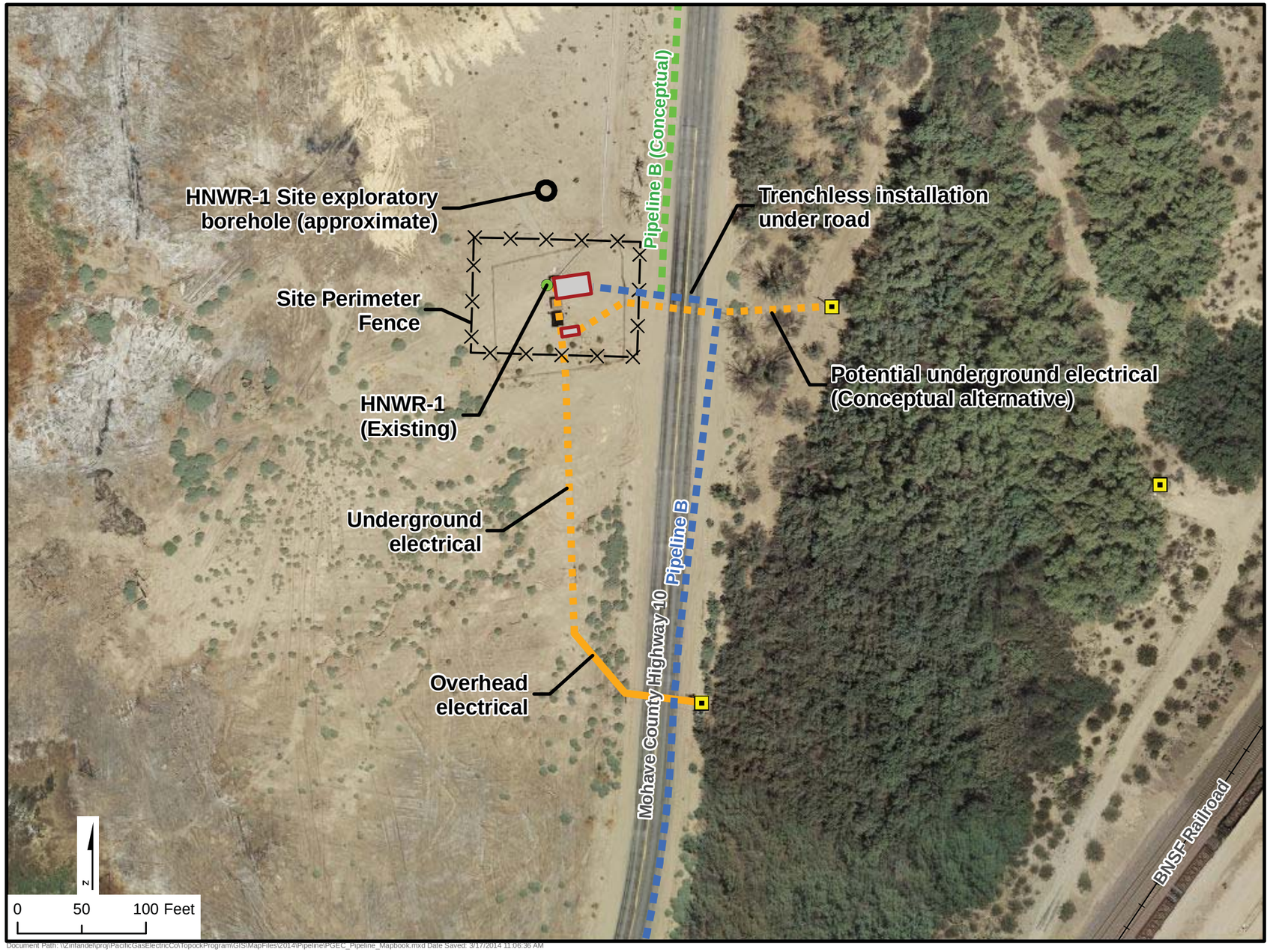
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LEGEND

- Pipeline B per 60% design – underground
- Existing utilities
- Overhead electrical poles

FIGURE 11
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 9 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

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LEGEND

- Conceptual portion of Pipeline B – underground
- Pipeline B per 60% design – underground
- Overhead electrical
- Underground electrical
- Overhead electrical poles
- Wells (at well sites)
- Concrete pads or structures (at well sites)
- – X – Fences

FIGURE 12
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 10 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

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LEGEND

- Conceptual portion of Pipeline B – underground
- Overhead electrical poles

FIGURE 13
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 11 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

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LEGEND

- Conceptual portion of Pipeline B – underground

FIGURE 14
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 12 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

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LEGEND

- Conceptual portion of Pipeline B – underground

FIGURE 15
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 13 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

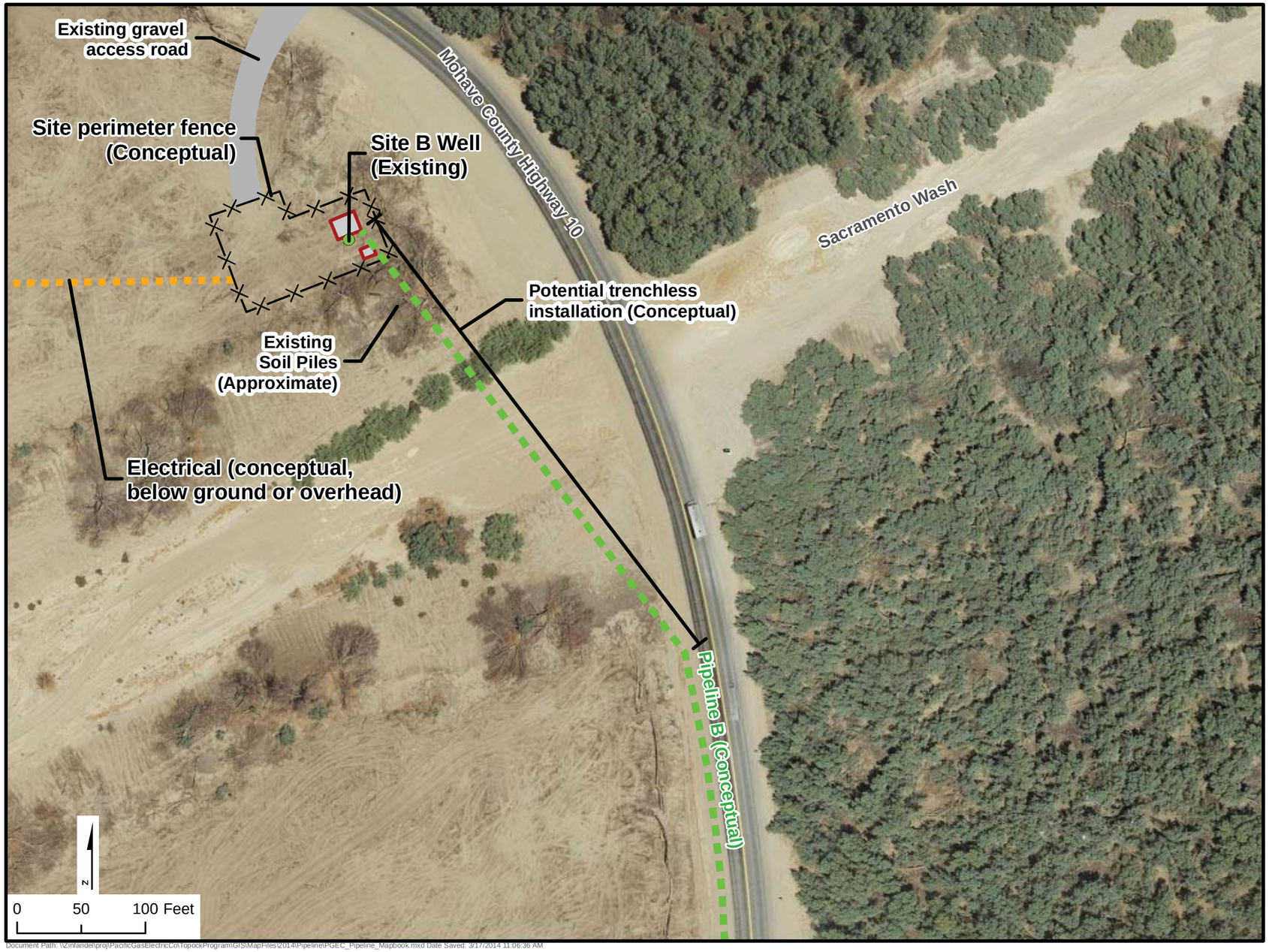


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LEGEND

- Conceptual portion of Pipeline B – underground

FIGURE 16
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 14 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA



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LEGEND

- Conceptual portion of Pipeline B – underground
- Electrical - below ground or overhead
- Wells (at well sites)
- Concrete pads or structures (at well sites)
- – X – Fences

FIGURE 17
CONCEPTUAL PIPELINE B ALIGNMENT
PAGE 15 OF 15
GROUNDWATER REMEDY PROJECT
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

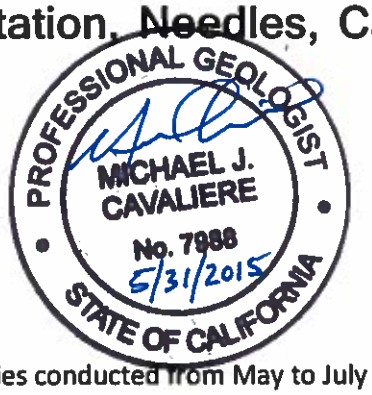
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Addendum to the Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Area, Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

PREPARED FOR: Pacific Gas and Electric Company

PREPARED BY: CH2M HILL

DATE: September 8, 2014



Summary

This technical memorandum summarizes additional activities conducted from May to July 2014 (referred to herein as Phase 2) and associated findings for the evaluation of alterative freshwater sources as defined in the *Final Implementation Plan for Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Areas, Pacific Gas and Electric Company, Topock Compressor Station, Needles, California* (Work Plan) (CH2M HILL, 2013b). Initial activities conducted from October 2013 to February 2014 (referred to herein as Phase 1) and associated findings are summarized in the technical memorandum titled *Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Area, Pacific Gas and Electric Company, Topock Compressor Station, Needles, California (referred to herein as the Phase 1 Report)* (CH2M HILL, 2014). Phase 2 activities were conducted in accordance with the April 4, 2014 joint direction letter from United States Department of the Interior (DOI) and California Department of Toxic Substances Control (DTSC) regarding the freshwater well location for the Topock groundwater remedy (DOI, 2014).

The following primary activities were conducted during the implementation of Phase 2 at the two freshwater source evaluation locations (Site B and the HNWR-1 Site, which includes the area of the existing Havasu National Wildlife Refuge (HNWR) well HNWR-1 and new well HNWR-1A) (see Figure 1):

- Performed flow profile testing and associated zone-specific groundwater sampling at the Site B well.
- Constructed and developed a new well at the HNWR-1 Site using the exploratory borehole installed during Phase 1 as a pilot hole. This new well is referred to as HNWR-1A.
- Following well development, a step-rate extraction test was conducted at the new HNWR-1A well to evaluate well performance.
- Irrigated water that was pumped during Site B well flow profile testing and HNWR-1A well development and well testing activities at the HNWR future re-vegetation plot, as indicated in the Work Plan (CH2M HILL, 2013b).
- Conducted pre-construction surveys for biological, paleontological, and cultural resources (the post-construction biological survey is complete and the associated report is in progress).
- Conducted monitoring for biological, paleontological, and cultural resources during all field work.

In addition to discussion during routine project meetings, updates on Phase 2 field work were provided during the June and July, 2014 Technical Working Group (TWG) meetings.

The following conclusions about the freshwater supply for the groundwater remedy are based on review of hydraulic and water quality data collected during both phases of this evaluation:

- **HNWR-1 water quality and well performance.** Based on data collected during Phase 1, HNWR-1 will currently supply enough water of sufficient quality to supply the groundwater remedy at the nominal design flow rate of 450 gallons per minute (gpm), but not the maximum flow rate of 900 gpm. While the construction of the well was sufficient for its original intent (irrigation), it is not sufficient for long-term daily operation as a reliable element of the groundwater remedy. Due to the design and construction of the well the options for aggressive and effective well maintenance are limited. Further, operational flexibility to lower the pump and generate more flow is limited by the smaller diameter of the lower portion of the well.
- **Site B water quality and well performance.** Based on data collected during Phase 1, the Site B well will supply enough water to support the maximum designed remedy flow rate and the well construction allows optimal flexibility for operation (i.e., pump depth) and maintenance options; however, based on current well construction and operation during testing, the water quality is currently not optimal. The Site B well flow profile testing and associated zone-specific groundwater sampling conducted during Phase 2 suggests that the well currently has little water quality stratification; therefore, it is unlikely that modification to the well construction will result in a change in the water quality produced from the well.
- **HNWR-1A water quality and well performance.** Like nearby well HNWR-1, water quality from the HNWR-1A well is adequate to supply the groundwater remedy; however, unlike HNWR-1, the quantity of water that the well will produce exceeds the maximum estimated demand for remedy operation. Further, the well construction is sufficient for long-term daily operation as a reliable element of the groundwater remedy and is suitable for a range of well maintenance options, as determined necessary during remedy operation.
- **EIR Mitigation Measures WATER-1.** 72-hour constant-rate extraction tests conducted during Phase 1 at both HNWR-1 and the Site B well suggest that neither will substantially adversely affect the production rates of existing nearby wells (see EIR Mitigation Measure WATER-1, Addendum No. 1). Data collected during these tests were used to update the groundwater flow model for the Arizona side of the Colorado River. The updated model was re-run to simulate drawdown in nearby well Topock-2 with the operation of HNWR-1A, which has a slightly different construction than HNWR-1, at the nominal flow design flow rate of 450 gpm. This simulated pumping in HNWR-1A results in an additional 0.1 feet of drawdown compared to HNWR-1; therefore, pumping at HNWR-1A also will not substantially adversely affect the production rates of existing nearby wells.

Based on this information the recommended path forward for establishing a freshwater supply for the groundwater remedy that provides the maximum flexibility and reliability includes:

1. Utilization of HNWR-1A as the primary freshwater supply for the groundwater remedy.
2. Designing the infrastructure required to plumb and operate the HNWR-1 well as a secondary freshwater supply.
3. Designing the infrastructure required to plumb and operate the Site B well as a contingency freshwater supply. While the Site B well will provide an adequate quantity of water, blending with another supply will likely be required to lower the naturally occurring hexavalent chromium concentration below 32 μg/L.

1.0 Introduction

Pacific Gas and Electric Company (PG&E) is implementing the selected groundwater remedy for chromium in groundwater at the PG&E Topock Compressor Station (TCS, or the Compressor Station) in San Bernardino County, California. Remedial activities at the Topock site are being performed in conformance with the requirements of the Resource Conservation and Recovery Act (RCRA) Corrective Action pursuant to a Corrective Action Consent Agreement (CACA) entered into by PG&E and the California Department of Toxic

Substances Control (DTSC) in 1996, as well as the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) pursuant to pursuant to a Remedial Design/Remedial Action Consent Decree between the United States and PG&E, entered by the United States District Court for the Central District of California on November 21, 2013.

As an element of the final groundwater remedy design, freshwater sources, including groundwater supply wells and the Colorado River, have been considered for use during remedy operation. The average and maximum volume of freshwater required for remedy operation is estimated to be 450 and 900 gpm, respectively, based on groundwater modeling. In the *Basis of Design Report/Intermediate (60%) Design for the Final Groundwater Remedy* (CH2M HILL, 2013b), PG&E presented a plan to obtain freshwater from a well on HNWR—well HNWR-1.

This technical memorandum summarizes the activities conducted and associated findings for Phase 2 of the evaluation of alterative freshwater sources as defined in the Work Plan (CH2M HILL, 2013b).

1.1 Approvals and Authorizations

Phase 2 of the Topock Alternative Freshwater Source Evaluation was executed in conformance with the following approvals and authorizations:

- DTSC acceptance of the Work Plan (DTSC, 2013b) and approval for implementation subject to conditions set forth in the letter (DTSC, 2012), which included Mitigation Measures adopted by the certified Final Environmental Impact Report (DTSC, 2011) as specified in the EIR Addendum (No. 1) for the Alternative Freshwater Source Evaluation.
- U.S. Department of Interior [DOI], Bureau of Land Management [BLM], U.S. Fish and Wildlife Service [USFWS], and Bureau of Reclamation [Reclamation] acceptance of the Work Plan (DTSC, 2013b) and approval for implementation subject to the conditions set forth in the letter (DOI, 2013).
- HNWR acceptance of the Work Plan (CH2M HILL, 2013b) and approval for implementation subject to the conditions set forth in the email to Yvonne Meeks of PG&E (HNWR, 2012).
- The April 4, 2014 joint direction letter from DOI and DTSC regarding the freshwater well location for the Topock groundwater remedy (DOI, 2014).

1.2 Coordination with Agencies and Tribes

Immediately prior to conducting any ground disturbing activities, a project initiation tailboard meeting was held at the HNWR-1 Site on May 30, 2014. During this meeting, representatives from PG&E and Tribes discussed the details of the planned fieldwork, biological, paleontological, cultural, and historical sensitivities associated with the project area, and conducted a walk of the fieldwork site. During work, in addition to discussion during routine project meetings, updates on Phase 2 field work were provided during the June and July, 2014 Technical Working Group (TWG) meetings. Tribal monitors participated throughout the fieldwork and were provided with routine field schedule updates.

1.3 Technical Memorandum Organization

The remainder of this technical memorandum is organized in the following manner:

- **Section 2.0** summarizes the field activities conducted throughout the evaluation.
- **Section 3.0** presents the analysis of the data collected during Phase 2 of the evaluation, including the results of laboratory analysis of groundwater samples, and analysis of well testing data.
- **Section 4.0** summarizes the PG&E recommended path forward for establishing a freshwater supply for the groundwater remedy.
- **Section 5.0** provides a list of works cited in this technical memorandum.

2.0 Summary of Field Activities

Primary field activities conducted during Phase 2 included well construction, development, and testing of the HNWR-1A well, and testing of the Site B well. All project activities were performed under the supervision of both a California and Arizona Professional Geologist. This section describes the details of each element of work conducted.

2.1 Site Access, Preparation, Compliance Monitoring, and Security

An onsite biologist conducted a pre-construction survey before work began. Biological monitoring was conducted daily throughout fieldwork by a field contact representative (FCR) that was trained by the biologist prior to the beginning of work. The post-construction survey for the site was completed on July 24, 2014. The pre- and post-construction survey data will be used to assess and document compliance with the Programmatic Biological Assessment (PBA) (CH2M HILL, 2007). The results of the surveys will be provided in a biological resources completion report, which is scheduled for submittal to BLM and the Havasu National Wildlife Refuge (HNWR) 60 days after the completion of fieldwork.

An onsite archaeologist/paleontologist conducted a pre-construction survey before work began for cultural and paleontological resources. All site activities were monitored daily by an onsite archaeologist. Tribal monitors, who were invited to observe all site activities, monitored many of the activities. The paleontologist was on-call throughout the fieldwork, but was not contacted by the field team, as paleontological resources were not observed during drilling.

Access for HNWR-1A drilling, Site B well flow profile testing and irrigation equipment deployment was accomplished using previous routes developed during work conducted in 2013 (Phase 1) that are identified in the Work Plan (CH2M HILL, 2013b). The existing land surfaces at the work sites were not graded or changed from the conditions established during Phase 1. No listed species or nesting birds were observed during the pre-activity or post-activity surveys.

Existing temporary fencing was utilized to control site access. Onsite security was utilized to monitor the work areas during non-working hours. No incidences of unauthorized site access were detected during work.

The HNWR-1A drilling location was initially surveyed for underground utilities prior to Phase 1 field work in 2013. The Arizona Blue Stake mark-and-locate program was utilized at HNWR-1A immediately prior to mobilization and drilling for Phase 2.

Project activities were conducted in compliance with the items identified in Attachment B of the Work Plan (CH2M HILL, 2013a), which includes compliance with Applicable and Relevant or Appropriate Requirements, the PBA (CH2M HILL, 2007), the Programmatic Agreement (BLM, 2010), and the Cultural and Historic Properties Management Plan (BLM, 2012). Compliance monitoring activities associated with the EIR Addendum No. 1 Mitigation Measures Reporting Program (MMRP), which is also included in Attachment B to the Work Plan (CH2M HILL, 2013a), were conducted continuously during fieldwork associated with the Work Plan (CH2M HILL, 2013b) and are documented in the quarterly compliance reports, which are available on the DTSC website for the Topock Project Site.

2.2 Previous Work at the HNWR-1 Site

During October 2013, one 8-inch diameter exploratory borehole was installed to a depth of 400 feet below ground surface (bgs) at location HNWR-1A (previously referred to as the “HNWR-1 Site exploratory borehole”) to facilitate collection of lithologic and zone-specific groundwater samples. The exploratory borehole was drilled using the dual-rotary method (using a Foremost DR-24 drill rig), which rotates both an outer primary casing and the drill string (attached to the drill bit), independently as described in the Phase 1 Report. Drill cuttings collected during HNWR-1A exploratory drilling were logged in accordance with the methods and procedures identified in the Work Plan (CH2M HILL, 2013b). The lithologic log for HNWR-1A is included in Attachment A. Zone-specific groundwater samples were collected from the HNWR-1A

exploratory borehole approximately every 50 feet to assess changes in water quality with depth. Groundwater quality field measurements and laboratory results from the zone-specific sampling are included in Tables 1 through 9.

Data from the HNWR-1A exploratory borehole indicated that the unconsolidated aquifer is comprised largely of well-graded gravels and sand. Zone-specific water quality samples indicated a stratified aquifer with higher specific conductance (saltier) water occurring deeper in the borehole, and more fresh (less salty) water occurring in the shallower interval. The transition from fresh (less salty) water to saltier water is between 250 and 300 feet bgs, where the specific conductance of zone-specific groundwater samples increased from approximately 1,405 □S/cm to 26,300 □S/cm. The HNWR-1 Site is located within the large fluvial plain of the pre-dam era Colorado River, and the detailed logs describe these clean fluvial deposits at a greater frequency and thickness than the fluvial deposits on the California side of the River, which represents the thin western edge of the fluvial plain.

After HNWR-1A exploratory drilling and sampling was complete, the exploratory casing was removed and the borehole was decommissioned on February 2, 2014 in accordance with the Work Plan (CH2M HILL, 2013b) as discussed in the Phase 1 Report (CH2M HILL, 2014a). The borehole was decommissioned by backfilling from total depth (400 feet) to 22 feet bgs with pea gravel. The interval from 2 to 22 feet bgs was sealed using cement bentonite grout (installed via tremie) and the upper most 2 feet was backfilled with granular material from the existing site area (i.e., drill cuttings from the borehole and surface soil adjacent to the borehole).

Hydraulic testing was performed at the HNWR-1 well (prior to the installation of HNWR-1A, which is now located approximately 60 feet from HNWR-1A) to assess well performance and estimate aquifer properties. A step-rate extraction test was conducted at the HNWR-1 well on October 16, 2013, and a 72-hour constant-rate extraction test was conducted from February 11 to 14, 2014. The step-rate test consisted of six 90-minute steps with the following average flow rates: 278 gpm, 382 gpm, 472 gpm, 557 gpm, 658 gpm, and 767 gpm. A seventh step was attempted at 875 gpm (maximum pump flow) but the pump began to cavitate after approximately 30 minutes, indicating that water level drawdown in the well had dropped below the minimum operating head required above the pump. Based on analysis of the step-rate extraction test, a flow of 700 gpm was chosen for the constant-rate test. HNWR-1 is located approximately 750 feet from the Topock-2 and -3 supply wells, which are operated by Southwest Water Company to provide freshwater to the Topock Compressor Station, Topock-66 restaurant, and nearby residences. Prior to the beginning of the HNWR-1 constant-rate test, project staff coordinated with the Southwest Water Company to fill available storage on the compressor station and for the residences/Topock-66 restaurant so that well operation could be minimized during the HNWR-1 testing period. As summarized in the Phase 1 report (CH2M HILL, 2014), the results of the HNWR-1 constant-rate extraction test suggests that operation of the HNWR-1 well will not substantially adversely affect the production rate of existing nearby wells (see EIR Mitigation Measure WATER-1, Addendum No. 1).

2.3 HNWR-1A Well Drilling, Construction and Development

Following joint direction received from DTSC and DOI (DOI, 2014) a drill rig and field crew re-mobilized to the site and the existing HNWR-1A exploratory boring was reamed/over drilled for the installation of a new well. Well design was based on evaluation of lithologic data from recovered drill cuttings, and the results of field measurement and laboratory analysis of zone-specific groundwater samples collected during Phase 1. Borehole drilling, well construction, and well development activities were conducted from May 30, 2014 to June 29, 2014. The materials and methods used for constructing and developing the HNWR-1A well are presented in this section. Although drilling and well installation activities conducted as part of the Work Plan (CH2M HILL, 2013b) are exempt from the requirement to obtain well installation permits from the ADWR pursuant to the CERCLA Section 121(e)(1) permitting exemption, a notice of intent (NOI) to install a well at the HNWR-1 Site previously existed since it had only been used for the exploratory borehole and was still

valid for a well drilled in the same borehole (see Attachment A). The substantive requirements associated with the approved NOI were followed.

The HNWR-1A well was drilled and constructed using the dual-rotary drilling method (using a Foremost DR-24 drill rig) as follows:

1. **Drilled the borehole for well construction.** Once the drill rig was set up over the existing exploratory borehole, a 20-inch-diameter (nominal) borehole was drilled to a total depth of 205 feet bgs.
2. **Installed the well casing and annular materials.** After the 20-inch diameter borehole was drilled to total depth, the well casing was installed within the primary drill casing. The well casing and screen are 14-inch diameter, 316L stainless steel (all joints were welded). Well screen is wire wrapped with 0.090-inch open spacing between wires. Filter pack material was installed through the primary casing, and seal materials were installed via tremie within the primary drill casing, which was removed from the borehole in stages as annular materials were installed around the well casing. Filter pack annular material is composed of Premier Silica 6x9 gradation sand. The well was constructed with the following casing and screen intervals:
   - Ground surface to 63 feet bgs – blank cased with the annular space sealed from 51 feet bgs to the ground surface with cement bentonite grout.
   - 63 to 133 feet bgs – screened with filter sand in the annular space.
   - 133 to 154 feet bgs – blank cased with an intermediate annular seal composed of hydrated bentonite pellets from 136 to 146 feet bgs. This section could be used as the pump chamber or could provide a place to set a packer in the event the lower screened section needed to be isolated to exclude poorer quality water.
   - 154 to 194 feet bgs – screened with filter sand in the annular space.
   - 194 to 204 feet bgs – blank cased with a welded plate on the bottom and filter sand in the annular space (this section comprises the sump).

   Figure 2 presents an update of the conceptual geologic cross-section that was included in the Work Plan (CH2M HILL, 2013b). The updated cross-section reflects additional data collected during both Phase 1 and Phase 2, including well construction and water quality data for HNWR-1A.
3. **Completed the wellhead.** The stainless steel well casing was completed approximately 5 feet above ground surface, and sealed with stainless steel cap. Like the Site B well that was installed during Phase 1, the HNWR-1A well will be finished with a flange welded to the well casing and sealed with a blank flange plate (bolted with gasket) so that it can be easily accessed and plumbed into the groundwater remedy pipeline. A mild steel protective casing will be installed around and above the production casing with a hinged cap that is secured with a padlock, which is similar to other wells associated with the Topock Remediation Project. These well head modifications will be completed in September 2014.

A well construction diagram summarizing this information is provided in Attachment A.

Well development was initially conducted using the drill rig with a dual-swab airlift tool. This high-energy development method used compressed air to extract groundwater from the well. The dual-swab tool was made of steel pipe with openings along a 5-foot interval and rubber gaskets (swabs) at the top and bottom of the 5-foot section to focus the pumping energy along specific intervals of well screen. Following airlift development, a submersible pump was installed in the well and used to surge the well at multiple flow rates. Sand production and water quality measurements (e.g., temperature, specific conductance, pH, oxidation-reduction potential, and dissolved oxygen) were monitored on the effluent water at the surface during well development. Approximately 360,000 gallons were removed during initial airlift development, and 1,570,600 gallons were removed during pump development.

Following construction, development, and testing (see Section 2.5), a video survey and a gyroscope survey were conducted in the well to verify the as-built well details and condition on July 9, 2014. The video survey confirmed the well construction details outlined above and that the well screen, casing, and welded joints were in good condition (a summary of the video survey is provided in Attachment A). The gyroscope survey was used to verify that the well casing was plumb and straight.

2.5 HNWR-1A Step-Rate Discharge Testing

On June 24, 2014, a 12-hour step-rate discharge test was conducted at the HNWR-1A well to assess well performance and to estimate the upper operational flow that could be sustained. The test was conducted using a submersible electric pump installed with the intake at approximately 145 feet bgs. The step-rate test consisted of six 120-minute steps with the following average flow rates: 481 gpm, 704 gpm, 881 gpm, 1,095 gpm, 1,298 gpm, and 1,483 gpm. A plot of the drawdown data collected during the HNWR-1A step-rate test is provided in Figure B-1 in Attachment B.

Effluent water quality measurements (e.g., temperature, specific conductance, pH, oxidation-reduction potential, and dissolved oxygen) were monitored during the test. Water quality samples for laboratory analysis were collected from the pump effluent during each step to qualify changes over pumping rates. The samples collected at each step were analyzed for Title 22 metals, hexavalent chromium, total chromium, silica, fluoride, and nitrate. A sample was collected during the third step (881 gpm) and was analyzed for a longer list of analytes including CAM 17 metals, deuterium, oxygen 18, perchlorate, petroleum hydrocarbons, pesticides, polyaromatic hydrocarbons, polychlorinated biphenyls, herbicides, chloride, sulfate, silica, nitrate, nitrite, fluoride, bromide, phosphate, general minerals, total organic carbon, pH, and gross alpha and beta. The third step was selected for a longer list of analytes because the flow rate was closest to the maximum design flow rate of 900 gpm.

Pressure transducers were utilized in HNWR-1 and Site B to observe potential effects of HNWR-1A pumping during the step-rate test. All groundwater discharged during the test (715,900 gallons) was surface irrigated to the area designated in the Work Plan (CH2M HILL, 2013b) (see Section 2.7) and was managed with zero run-off from the designated irrigation area.

2.6 Site B Well Flow Profile Testing

Dynamic (i.e., the pumping head condition) flow profile testing and associated water quality profile sampling were conducted to assess flow contribution and associated water quality concentrations under operational conditions for all Site B well screened intervals. Specifically, the flow contribution of each 10-ft section of well screen was evaluated and zone-specific groundwater samples were collected at 8 points along the well screen (plus one sample of pumping effluent at the well head) to evaluate the contribution of arsenic, hexavalent chromium, fluoride, and TDS concentrations to the well (a longer list of metals was analyzed, but the analysis focused on these four). Fieldwork related to flow profile testing at the Site B well was completed over two days with the dynamic flow profile test conducted on June 11, 2014 and zone-specific groundwater sampling completed on June 12, 2014. Prior to the initiation of data collection for the flow profile and water quality sampling, the well was pumped at a constant flow rate of 986 gpm for approximately 24 hours to establish a steady-state flow condition.

Dynamic Flow Profile Testing. Flow contribution in the Site B well was measured by injecting dye at 13 discrete depths from 140 to 310 ft bgs while pumping at 986 gpm. The dynamic flow profile was performed using the USGS Tracer Pulse Dynamic Flow Profile method (USGS white papers are provided in Attachment B) to measure flow contribution along the length of the well, which is accomplished by injecting low concentrations of biodegradable, food grade dye at different depths in the well during pumping. The dynamic flow profile was evaluated by maintaining a constant flow rate of 986 gpm with the pump installed in the cased section of the well above all screened intervals during the flow profile testing activities. The flow profile is calculated based on dye travel time from the injection point within the well to the wellhead at ground surface where the dye is detected in the discharge water. Results from flow profile testing were used

to determine the depths of the groundwater samples that would be used to evaluate the water quality profile.

Water Quality Sampling. While maintaining a constant flow rate of 986 gpm at Site B well, water quality samples for laboratory analysis were collected on June 12, 2014 at the following nine depths: 0 (pump effluent), 140, 165, 175, 190, 205, 215, 235, and 255 ft bgs.

The samples collected at each depth were analyzed for Title 22 metals, hexavalent chromium, fluoride, and TDS; however, the analysis of the flow profile testing data focused on total chromium, hexavalent chromium, fluoride, and TDS. Effluent water quality measurements (e.g., temperature, specific conductance, pH and oxidation-reduction potential) were monitored in the field during the water quality sampling.

2.7 Management of Material Generated During Evaluation

Three types of materials were generated during fieldwork: drill cuttings, purged groundwater, and trash, all of which were managed in accordance with the Work Plan (CH2M HILL, 2013b). Drill cuttings and purged groundwater were managed in accordance with site-specific and regulatory practice for groundwater supply well drilling. Because this work was conducted as part of a CERCLA response action, implementation plan activities conducted onsite were covered under the permit exemption codified in Section 121(e)(1) of CERCLA. While the permit exemption applies to the administrative or procedural elements (e.g., preparing and submitting permit applications and obtaining permits), the substantive requirements of the applicable laws remain. Groundwater discharge and drill cuttings were managed in compliance with the substantive requirements of Aquifer Protection General Permit 1.04, as authorized by Arizona Administrative Code Section R18-9-B301(D).

Drill cuttings were diverted from the cuttings return pipe on the rig using a cyclone that was staged over the top of a tank. From the tank all drill cuttings were spread to the ground surface adjacent to the borehole. Chemical additives were not used during drilling, therefore cuttings sampling was not necessary to determine suitability for discharge to the ground surface. Drill cuttings were not discharged to any jurisdictional areas. Clay was recovered in the drill cuttings from the borehole. In accordance with the Work Plan (CH2M HILL, 2013b), the clay material was gathered and separated from the other drill cuttings for storage on dye-free cotton muslin fabric and labeled. The material was recovered from the cuttings bin as many small clay balls, which were subsequently aggregated into a larger ball that was approximately the size of a medium beach ball. The material was securely stored at the work site, and the agencies and Tribes were informed of the clay. The project archaeologist, in coordination with the Tribes, subsequently managed the material.

Purged groundwater was generated during drilling, well development, and well testing at HNWR-1A, and flow profile testing at the Site B well. Water generated during drilling (see Section 2.3) was discharged to the ground surface in the same area as the drill cuttings. Water was generated at a higher rate during development well testing and flow profile testing and was surface irrigated to the area designated in the Work Plan (CH2M HILL, 2013b). The water was pumped through a temporary, aboveground conveyance pipeline to as many as 12 sprinklers in the irrigation area (see Figure 3). During key development activities, discharge was irrigated directly to the ground without the use of a sprinkler to avoid discharge pressure limitations associated with the sprinkler equipment; however, all discharge activities were conducted in a manner that did not promote scouring or erosion of the irrigation area. A total volume of approximately 5.26 million gallons was discharged to the irrigation area during development and testing at HNWR-1A and flow profile testing at Site B. Purged groundwater was neither discharged nor allowed to run-off to jurisdictional areas, the Colorado River, nor Arizona County Highway 10.

Incidental trash was removed from the work area daily and was transferred to a standard trash bin at the TCS for offsite disposal.

3.0 Results of the Evaluation

This section presents the analysis of data collected during the activities detailed in Section 2. Section 4 discusses the integration of all available data from this evaluation, and associated recommendations for the recommended path forward in establishing a freshwater supply for the groundwater remedy.

3.1 Aquifer Testing Data

The step-rate extraction test at HNWR-1A was conducted for 12 hours. Drawdown at HNWR-1A is shown in Figure B-1 in Attachment B. The HNWR-1A step-rate test was conducted at a maximum average flow rate of 1,483 gpm, which maintained approximately 40 feet of water level drawdown in the well.

Pumping at HNWR-1A during the step-rate extraction test produced measurable drawdown in the HNWR-1 well (approximately 8 feet) but there was no apparent drawdown at the Site B well. The water levels and pumping rates/times were not monitored in the Topock-2, Topock-3 or Marina wells during the HNWR-1A step-rate extraction test as they were during the HNWR-1 constant rate extraction test (conducted during Phase 1).

Analysis of Water Quality Data. This section presents the results of field water quality measurement (Table 1) and laboratory analysis of the six groundwater samples collected during the HWNR-1A step-rate test (Tables 2 through 9) on June 24, 2014. The samples collected during each step are representative of a combined condition across the entire screened interval for each flow rate.

Field Measurements. Field water quality measurements, including specific conductance, temperature, pH, oxidation-reduction potential, turbidity, and dissolved oxygen, were monitored during testing activities. The water quality measurements collected during the step-rate test were consistent with the HNWR-1 well and the HNWR-1A exploratory data, which suggests that the water type entering the well screens does not vary significantly when each well is pumped across the range of flows utilized during step-rate testing. The average specific conductance measurement collected during the step-rate test for HNWR-1A was 999 microSiemens per centimeter (μS/cm), which is consistent with the measurements collected from the corresponding depths in the respective exploratory borehole. Oxidation-reduction potential and dissolved oxygen measurements also remained consistent during the respective tests, and are representative of the aerobic water observed at these depths in the exploratory boreholes. Measurement of pH was consistent with HNWR-1 well and the exploratory borehole at approximately 8.2.

Temperature measurements were consistent throughout the step-rate test and consistent with measurements collected during the exploratory sampling. The average temperature during the step-rate test was approximately 36.2 degrees Celsius (approximately 97.2 degrees Fahrenheit) at HNWR-1A. Comparing this temperature data to that from the groundwater on the California side of the Colorado River, the average temperature in the monitoring wells within the planned injection zone for the groundwater remedy is 29.6 degrees C, calculated among the means at each well. The overall range in temperature measurements is 23.2 to 34.7 degrees C. The density at 36.2 degrees, which was the average measurement at HNWR-1A, is approximately 0.003 kilograms per liter (kg/L) lower than that at 29.6 degrees, assuming equal TDS. This slight difference is not expected to cause a significant separation between injected and receiving waters, especially given the inherent heterogeneity of the alluvial aquifer. Also, the 7-degree difference in temperature is not significant enough for the warmer water to cause greater leaching of matrix minerals, since the solubility of the various oxides, hydroxides, and silicate minerals are virtually identical at these two temperatures.

Metals. The concentrations of metals detected in samples collected during the step-rate test were consistent throughout each respective step. Detected concentrations of dissolved arsenic ranged from 12 to 14 μg/L, total chromium ranged from 15 to 16 μg/L and dissolved hexavalent chromium ranged from 17 to 18 μg/L. Arsenic and chromium (total and hexavalent) concentrations are lower than those detected previously in the HNWR-1 and Site B Wells.

Organics. Organic analyses included perchlorate, TPH, pesticides, PAHs, PCBs, and herbicides. All results for the organic analysis were non-detect.

Other Constituents. Other analyses including bromide, chloride, fluoride, nitrate/nitrite as nitrogen, soluble silica, sulfate, and total organic carbon were all consistent with the concentrations detected in samples from the exploratory borehole and HNWR-1 well. Results for gross alpha and gross beta were below the respective California maximum contaminant levels for drinking water, which are 15 and 50 picocuries per liter, respectively.

The results for stable isotopes of hydrogen and oxygen from samples collected during the step-rate test are consistent with the results of other samples collected during the evaluation from the HNWR-1 Site and Site B (see Table 8).

3.2 Site B Well Flow Profile Testing

The groundwater samples associated with the Site B well flow profile test were collected on June 12, 2014 at the Site B well.

Dynamic Flow Profile Testing. Based on the 13 discrete depth dye injection points from 140 to 310 ft bgs, the flow contribution along the length of the well (flow profile) was evaluated (see Attachment B, Table B-1). The Site B well was constructed with 3-screened zones and the percent flow contribution for each screened zone is as follows:

- Upper Screen, 145-185 ft bgs: 27%
- Middle Screen, 195-245 ft bgs: 58%
- Lower Screen, 265-305 ft bgs: 15%

The individual portions of the well that contributed the greatest flow were 25 percent from 175-185 ft bgs and 45 percent from 205-225 ft bgs.

Analysis of Water Quality Data. This section presents the results of field water quality measurements (Table 1) and laboratory analysis of the nine groundwater samples collected during the Site B well flow profile testing event (Tables 2 and 8). The nine samples collected during flow profile testing within the Site B well at various depths are representative of a cumulative or combined condition across the entire screened interval below the specific listed sample depth (the samples are collected while pumping with the pump intake positioned above the screen); therefore, the sample collected at the Site B wellhead (0 ft sample) is representative of a combined condition across the entire screened interval of the well. These results are then evaluated with the results of the profile of flow contribution to calculate a flow-weighted concentration. The next three subsections discuss the results of these samples empirically, and the last subsection presents the calculated flow-weighted concentration profile.

Field Measurements. Field water quality measurements, including specific conductance, temperature, pH, oxidation-reduction potential and turbidity, were monitored during flow profile sampling activities. The water quality measurements collected during the Site B flow profile test were consistent with the Site B constant-rate, step-rate test results and the Site B exploratory data, which suggests that the water type entering the well screens does not vary significantly with depth. The average specific conductance measurement collected during the Site B flow profile test was 1,320 microSiemens per centimeter (μS/cm). Temperature measurements were also consistent for the various depths during flow profile testing and compared to temperature measured during constant-rate and step-rate testing at the Site B well (conducted during February 2014, Phase 1). The average temperature during Site B flow profile testing was approximately 35.2 degrees Celsius (approximately 95.4 degrees Fahrenheit). Measurement of pH was consistent with previous Site B tests and the average pH of all sample depths was approximately 8.07. Oxidation-reduction potential measurements also remained consistent during the flow profile sampling and were representative of the oxidizing water observed at these depths in the exploratory boreholes and

measured during constant-rate and step-rate testing. Turbidity remained below 2.0 for all samples collected during flow profile testing.

Metals. The reported concentration of metals detected in the 0-ft sample collected during flow profile testing was consistent with sampling conducted during the Site B well constant-rate test. Detected concentrations of dissolved arsenic for the 0-ft sample was 17 μg/L and for the 8 depth specific samples results ranged from 16 to 18 μg/L. Detected concentrations of dissolved hexavalent chromium for the 0-ft sample was 34 μg/L and for the 8 depth specific samples results ranged from 36 to 38 μg/L. Hexavalent chromium concentrations were slightly higher than those detected previously during the Site B well constant-rate test.

Other Constituents. Other analyses including fluoride and TDS were consistent with the results from samples collected during the Site B well constant-rate test. The concentration of fluoride detected in the 0-ft flow profile sample was 4.2 μg/L. The concentration of fluoride detected in the 140 ft to 255 ft samples ranged from 4.0 to 4.3 μg/L. TDS concentrations ranged from 610 to 800 mg/L for samples collected during flow profile testing with the greatest concentration measured in the deepest sample.

Calculated Flow-weighted Concentration Profile. The laboratory analytical results for the zone-specific and the 0-ft (pump effluent) samples were evaluated with the results of the profile of flow contribution to calculate a flow-weighted concentration profile using the principles of conservation of mass. Based on this calculated profile, zones of relatively higher flow in the Site B well (approximately 175 to 285 feet bgs) have little water quality stratification. The flow contribution of the shallowest screened interval (approximately 145 to 175 feet bgs) was too low to allow for accurate calculation of a flow-weighted concentration.

4.0 Recommendations for Design of the Groundwater Remedy

The following conclusions about the freshwater supply for the groundwater remedy are based on review of hydraulic and water quality data collected during both phases of this evaluation:

- **HNWR-1 water quality and well performance.** Based on data collected during Phase 1, HNWR-1 will currently supply enough water of sufficient quality to supply the groundwater remedy at the nominal design flow rate of 450 gallons per minute (gpm), but not the maximum flow rate of 900 gpm. While the construction of the well was sufficient for its original intent (irrigation), it is not sufficient for long-term daily operation as a reliable element of the groundwater remedy. Due to the design and construction of the well the options for aggressive and effective well maintenance are limited. Further, operational flexibility to lower the pump and generate more flow is limited by the smaller diameter of the lower portion of the well.
- **Site B water quality and well performance.** Based on data collected during Phase 1, the Site B well will supply enough water to support the maximum designed remedy flow rate and the well construction allows optimal flexibility for operation (i.e., pump depth) and maintenance options; however, based on current well construction and operation during testing, the water quality is currently not optimal. The Site B well flow profile testing and associated zone-specific groundwater sampling conducted during Phase 2 suggests that the well currently has little water quality stratification; therefore, it is unlikely that modification to the well construction will result in a change in the water quality produced from the well.
- **HNWR-1A water quality and well performance.** Like nearby well HNWR-1, water quality from the HNWR-1A well is adequate to supply the groundwater remedy; however, unlike HNWR-1, the quantity of water that the well will produce exceeds the maximum estimated demand for remedy operation. Further, the well construction is sufficient for long-term daily operation as a reliable element of the groundwater remedy and is suitable for a range of well maintenance options, as determined necessary during remedy operation.

- **EIR Mitigation Measures WATER-1.** 72-hour constant-rate extraction tests conducted during Phase 1 at both HNWR-1 and the Site B well suggest that neither will substantially adversely affect the production rates of existing nearby wells (see EIR Mitigation Measure WATER-1, Addendum No. 1). Data collected during these tests were used to update the groundwater flow model for the Arizona side of the Colorado River. The updated model was re-run to simulate drawdown in nearby well Topock-2 with the operation of HNWR-1A, which has a slightly different construction than HNWR-1, at the nominal flow design flow rate of 450 gpm. This simulated pumping in HNWR-1A results in an additional 0.1 feet of drawdown compared to HNWR-1; therefore, pumping at HNWR-1A also will not substantially adversely affect the production rates of existing nearby wells.

Based on this information the recommended path forward for establishing a freshwater supply for the groundwater remedy that provides the maximum flexibility and reliability includes:

1. Utilization of HNWR-1A as the primary freshwater supply for the groundwater remedy.
2. Designing the infrastructure required to plumb and operate the HNWR-1 well as a secondary freshwater supply.
3. Designing the infrastructure required to plumb and operate the Site B well as a contingency freshwater supply. While the Site B well will provide an adequate quantity of water, blending with another supply will likely be required to lower the naturally occurring hexavalent chromium concentration below 32 μg/L.

5.0 References

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Tables

TABLE-1

Summary of Field Measurements

Addendum to the Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Area

PG&E Topock Compressor Station, Needles, California

				Field Water Quality Measurements						Hydraulic Measurements				
Location	Date	Step or Elapsed Time	Approximate Sample Depth (feet)	ORP (mV)	Spec. Conduct. (uS/cm)	Temp. (°C)	pH	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Volume Purged (gallons)	Average Pumping Rate (gpm)	Approximate Static Water Level*	Approximate Pumping Water Level*	Drawdown (feet)
Site B (Exploratory)	6-Oct-13	--	58	219	636	32.3	8.18	--	84	50	1	19	not stable	--
	7-Oct-13	--	100	107	996	34.1	8.40	--	44	1,538	13	23	30	7
	7-Oct-13	--	150	161	1,519	33.6	8.22	--	47	976	18	24	25	2
	8-Oct-13	--	200	172	1,328	35.2	8.20	--	49	823	16	24	36	12
	9-Oct-13	--	250	115	929	36.0	8.15	--	16	621	17	26	84	59
	9-Oct-13	--	300	108	1,471	36.3	7.93	--	36	1,769	19	24	28	4
	10-Oct-13	--	350	77	1,182	37.0	8.21	--	30	1,668	12	24	56	32
	15-Oct-13	--	400	-99	10,313	38.1	7.46	--	45	1,253	12	24	37	13
Site B (Step-rate Test)	7-Feb-14	Step 1	--	195	1,280	32.3	8.07	4.8	5	--	507	19	46	27
	7-Feb-14	Step 2	--	196	1,275	32.2	8.05	6.5	3	--	694	19	57	38
	7-Feb-14	Step 3	--	190	1,257	33.3	8.03	5.9	1	--	911	19	73	54
	7-Feb-14	Step 4	--	186	1,275	34.2	8.02	5.7	2	--	1,101	19	86	67
	7-Feb-14	Step 5	--	197	1,243	33.4	8.05	5.6	2	--	1,292	19	102	83
	7-Feb-14	Step 6	--	201	1,251	34.5	8.01	4.8	2	--	1,494	19	120	101
Site B (Constant-rate Test)	7-Feb-14	1 hour	--	154	1,278	35.9	7.98	5.3	2	--	1,000	19	78	59
	8-Feb-14	6 hours	--	123	1,279	35.8	7.97	5.3	1	--	1,000	19	80	61
	8-Feb-14	12 hours	--	147	1,285	35.3	7.96	4.8	1	--	1,000	19	80	61
	8-Feb-14	24 hours	--	127	1,293	35.9	7.94	4.4	1	--	1,000	19	79	60
	9-Feb-14	48 hours	--	102	1,301	35.8	7.93	4.1	1	--	1,000	19	78	59
	10-Feb-14	72 hours	--	109	1,311	35.8	7.93	3.9	1	--	1,000	19	78	59
Site B (Flow-profile test)	12-Jun-14	--	0	147	1,280	36.1	7.99	--	2	--	986	20	78	58
	12-Jun-14	--	145	151	1,490	34.1	8.00	--	1	--	986	20	78	58
	12-Jun-14	--	165	134	1,352	34.3	8.05	--	2	--	986	20	78	58
	12-Jun-14	--	175	155	1,403	34.6	8.12	--	**1**	--	986	20	78	58
	12-Jun-14	--	190	149	1,370	34.5	8.01	--	**1**	--	986	20	78	58
	12-Jun-14	--	205	169	1,341	35.3	8.20	--	2	--	986	20	78	58
	12-Jun-14	--	215	168	1,290	35.8	8.10	--	1	--	986	20	78	58
	12-Jun-14	--	235	135	1,305	35.8	8.07	--	1	--	986	20	78	58
	12-Jun-14	--	255	39	1,052	36.2	8.05	--	1	--	986	20	78	58
HNWR-1 Site (Exploratory)	16-Oct-13	--	50	134	972	34.5	7.96	--	43	319	17	11	13	2
	17-Oct-13	--	100	183	875	34.9	8.08	--	11	1,990	20	11	11	0
	17-Oct-13	--	150	184	892	38.9	8.19	--	47	645	17	11	31	21
	17-Oct-13	--	200	175	1,018	39.7	8.30	--	34	464	12	11	27	16
	18-Oct-13	--	250	170	1,405	41.0	8.12	--	34	749	16	12	28	17
	19-Oct-13	--	300	-290	26,300	40.2	8.33	--	27	781	16	13	not stable	--
	19-Oct-13	--	350	-224	47,192	42.4	7.97	--	50	921	19	13	not stable	--
	20-Oct-13	--	400	123	25,830	35.1	7.98	--	135	1	bailer	--	--	--
HNWR-1 (Step-rate Test)	16-Oct-13	Step 1	--	89	867	35.8	8.06	--	8	--	278	9	22	13
	16-Oct-13	Step 2	--	102	859	35.7	8.16	--	4	--	382	9	30	21
	16-Oct-13	Step 3	--	109	858	35.6	8.15	--	3	--	472	9	36	27
	16-Oct-13	Step 4	--	116	860	35.3	8.13	--	2	--	557	9	43	34
	16-Oct-13	Step 5	--	119	860	36.1	8.12	--	2	--	658	9	51	42
	16-Oct-13	Step 6	--	128	862	36.1	8.14	--	3	--	757	9	60	51
	16-Oct-13	Step 7	--	130	863	36.2	8.11	--	2	--	875	9	66	57
HNWR-1 (Constant-rate Test)	11-Feb-14	1 hour	--	129	811	37.7	8.00	3.1	1	--	700	9	52	43
	11-Feb-14	6 hours	--	107	815	37.5	7.99	3.4	1	--	700	9	52	43
	11-Feb-14	12 hours	--	98	828	37.4	7.98	3.3	1	--	700	9	52	43
	12-Feb-14	24 hours	--	91	843	37.3	7.97	3.3	1	--	700	9	52	43
	13-Feb-14	48 hours	--	81	850	37.2	7.96	3.4	0	--	700	9	52	43
	14-Feb-14	72 hours	--	84	851	37.1	7.95	3.2	2	--	700	9	52	43
HNWR-1A (Step-rate Test)	24-Jun-14	Step 1	--	85	1,017	35.9	8.04	3.2	1	--	481	8	15	8
	24-Jun-14	Step 2	--	72	1,003	35.9	8.03	3.2	0	--	704	8	21	13
	24-Jun-14	Step 3	--	73	999	36.1	8.02	3.2	1	--	881	8	26	18
	24-Jun-14	Step 4	--	80	995	36.3	8.01	3.0	1	--	1,095	8	33	25
	24-Jun-14	Step 5	--	91	993	36.3	8.00	2.9	2	--	1,298	8	40	32
	24-Jun-14	Step 6	--	80	984	36.6	7.99	3.0	1	--	1,483	8	48	40

Notes:

uS/cm - MicroSiemens per centimeter

mg/L - Milligrams per liter

mV - Millivolts

°C - degrees Celsius

NTU - Nephelometric Turbidity Units

gpm - gallons per minute

Field water quality measurements collected using a field meter equipped with a flow cell (unless a bailer was used)

* Approximate water level measurements are expressed as feet below ground surface.

TABLE-2

Groundwater Sample Results: Metals

Addendum to the Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Areas

Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

				Metals (µg/L)																
Location	**Phase**	**Date**	**Depth/ Time/ Rate**	**Antimony, dissolved**	**Arsenic, dissolved**	**Barium, dissolved**	**Beryllium, dissolved**	**Cadmium, dissolved**	**Chromium, dissolved**	**Cobalt, dissolved**	**Copper, dissolved**	**Hexavalent Chromium**	**Lead, dissolved**	**Mercury, dissolved**	**Molybdenum, dissolved**	**Nickel, dissolved**	**Selenium, dissolved**	**Silver, dissolved**	**Thallium, dissolved**	**Vanadium, dissolved**	**Zinc, dissolved**
HNWR-1	GW Sampling	10/22/13	92 - 156 ft	ND (0.5)	**14**	**110**	ND (1)	ND (3)	**17**	ND (3)	ND (5)	**20**	ND (10)	ND (0.2)	**9.1**	ND (5)	**0.68**	ND (3)	ND (0.5)	**20**	**12**
	Constant-rate test	02/11/14	1 hrs	ND (0.5)	**16**	**120**	ND (0.5)	ND (0.5)	**18**	ND (0.5)	ND (1)	**20**	ND (1)	ND (0.2)	**9**	ND (1)	**0.79**	ND (0.5)	ND (0.5)	**18**	ND (10)
	Constant-rate test	02/12/14	6 hrs	ND (0.5)	**16**	**110**	ND (0.5)	ND (0.5)	**19**	ND (0.5)	ND (1)	**20**	ND (1)	ND (0.2)	**9.4**	ND (1)	**0.75**	ND (0.5)	ND (0.5)	**19**	ND (10)
	Constant-rate test	02/12/14	12 hrs	ND (0.5)	**16**	**110**	ND (0.5)	ND (0.5)	**18**	ND (0.5)	ND (1)	**20**	ND (1)	ND (0.2)	**9**	ND (1)	**0.73**	ND (0.5)	ND (0.5)	**18**	ND (10)
	Constant-rate test	02/12/14	24 hrs	ND (0.5)	**15**	**120**	ND (0.5)	ND (0.5)	**18**	ND (0.5)	ND (1)	**19**	ND (1)	ND (0.2)	**9.1**	ND (1)	**0.77**	ND (0.5)	ND (0.5)	**17**	ND (10)
	Constant-rate test	02/13/14	48 hrs	ND (0.5)	**15**	**130**	ND (0.5)	ND (0.5)	**17**	ND (0.5)	ND (1)	**19**	ND (1)	ND (0.2)	**9.2**	ND (1)	**0.76**	ND (0.5)	ND (0.5)	**17**	ND (10)
	Constant-rate test	02/14/14	72 hrs	ND (0.5)	**14**	**120**	ND (0.5)	ND (0.5)	**16**	ND (0.5)	ND (1)	**19**	ND (1)	ND (0.2)	**8.9**	ND (1)	**0.75**	ND (0.5)	ND (0.5)	**16**	ND (10)
HNWR-1 Site	Exploratory	10/16/13	50 ft	ND (0.5)	**6**	**87**	ND (1)	ND (3)	**6.1**	ND (3)	ND (5)	**6**	ND (10)	ND (0.2)	**9.5**	ND (5)	**0.96**	ND (3)	ND (0.5)	**16**	**14**
	Exploratory	10/17/13	100 ft	ND (0.5)	**10**	**110**	ND (1)	ND (3)	**12**	ND (3)	ND (5)	**11**	ND (10)	ND (0.2)	**8.7**	ND (5)	**0.83**	ND (3)	ND (0.5)	**18**	ND (10)
	Exploratory	10/17/13	150 ft	ND (0.5)	**6.9**	**78**	ND (1)	ND (3)	**8.8**	ND (3)	ND (5)	**9**	ND (10)	ND (0.2)	**10**	ND (5)	**0.52**	ND (3)	ND (0.5)	**13**	ND (10)
	Exploratory	10/17/13	200 ft	ND (0.5)	**11**	**100**	ND (1)	ND (3)	**11**	ND (3)	ND (5)	**9**	ND (10)	ND (0.2)	**8.9**	ND (5)	**0.57**	ND (3)	ND (0.5)	**16**	ND (10)
	Exploratory	10/18/13	250 ft	ND (0.5)	**12**	**580**	ND (1)	ND (3)	**3.3**	ND (3)	ND (5)	**1**	ND (10)	ND (0.2)	**15**	ND (5)	**0.57**	**5.7**	ND (0.5)	ND (3)	ND (10)
	Exploratory	10/19/13	300 ft	ND (2.5)	**0.8**	**91**	ND (1)	ND (3)	ND (1)	ND (3)	**14**	ND (1)	ND (10)	ND (0.2)	**120**	ND (5)	ND (2.5)	ND (3)	ND (2.5)	**11**	ND (10)
	Exploratory	10/19/13	350 ft	ND (2.5)	**3**	**240**	ND (5)	ND (15)	ND (1)	ND (15)	**26**	ND (1)	ND (50)	ND (0.2)	**160**	ND (25)	ND (2.5)	ND (15)	ND (12)	ND (15)	ND (50)
	Exploratory	10/20/13	400 ft	ND (2.5)	ND (0.5)	**150**	**1.3**	ND (3J)	ND (1)	ND (3)	**8.1**	ND (1)	ND (10)	ND (0.2)	**39**	**6.9**	ND (2.5)	**12**	ND (12)	ND (3)	**11**
HNWR-1A	Step-rate test	06/24/14	500 gpm	ND (0.5)	**12**	**110**	ND (0.5)	ND (0.5)	**16**	ND (0.5)	ND (1)	**17**	ND (1)	ND (0.2)	**9.8**	ND (1)	**0.97**	ND (0.5)	ND (0.5)	**18**	**30**
	Step-rate test	06/24/14	700 gpm	ND (0.5)	**12**	**110**	ND (0.5)	ND (0.5)	**15**	ND (0.5)	ND (1)	**17**	ND (1)	ND (0.2)	**9.3**	ND (1)	**0.88**	ND (0.5)	ND (0.5)	**17**	**22**
	Step-rate test	06/24/14	900 gpm	ND (0.5)	**12**	**110**	ND (0.5)	ND (0.5)	**16**	ND (0.5)	ND (1)	**17**	ND (1)	ND (0.2)	**9.5**	ND (1)	**1**	ND (0.5)	ND (0.5)	**18**	**19**
	Step-rate test	06/24/14	1100 gpm	ND (0.5)	**12**	**110**	ND (0.5)	ND (0.5)	**16**	ND (0.5)	ND (1)	**17**	ND (1)	ND (0.2)	**9.5**	ND (1)	**0.95**	ND (0.5)	ND (0.5)	**18**	**16**
	Step-rate test	06/24/14	1300 gpm	ND (0.5)	**13**	**110**	ND (0.5)	ND (0.5)	**16**	ND (0.5)	ND (1)	**17**	ND (1)	ND (0.2)	**9.7**	ND (1)	**0.99**	ND (0.5)	ND (0.5)	**18**	**14**
	Step-rate test	06/24/14	1500 gpm	ND (0.5)	**12**	**110**	ND (0.5)	ND (0.5)	**16**	ND (0.5)	ND (1)	**18**	ND (1)	ND (0.2)	**9.5**	ND (1)	**0.98**	ND (0.5)	ND (0.5)	**18**	**16**
Site B	Exploratory	10/06/13	58 ft	ND (0.5)	**1.3**	**110**	ND (1)	ND (3)	ND (1)	ND (3)	ND (5)	ND (0.2)	ND (10)	ND (0.2)	**11**	ND (5)	**1.6**	ND (3)	ND (0.5)	**9.2**	ND (10)
	Exploratory	10/07/13	100 ft	ND (0.5)	**13**	**130**	ND (1)	ND (3)	**2.3**	ND (3)	ND (5)	**2.1**	ND (10)	ND (0.2)	**17**	ND (5)	**0.78**	ND (3)	ND (0.5)	**11**	ND (10)
	Exploratory	10/07/13	150 ft	ND (0.5)	**13**	**140**	ND (1)	ND (3)	**16**	ND (3)	**5.9**	**16**	ND (10)	ND (0.2)	**17**	ND (5)	**0.99**	ND (3)	ND (0.5)	**12**	ND (10)
	Exploratory	10/08/13	200 ft	ND (0.5)	**13**	**130**	ND (1)	ND (3)	**7.7**	ND (3)	**7.8**	**5.2**	ND (10)	ND (0.2)	**13**	ND (5)	**0.89**	ND (3)	ND (0.5)	**13**	ND (10)
	Exploratory	10/09/13	250 ft	ND (0.5)	**10**	**140**	ND (1)	ND (3)	**3.2**	ND (3)	ND (5)	**2.8**	ND (10)	ND (0.2)	**8.6**	ND (5)	**0.78**	ND (3)	ND (0.5)	**12**	ND (10)
	Exploratory	10/09/13	300 ft	ND (0.5)	**4.5**	**140**	ND (1)	ND (3)	ND (1)	ND (3)	ND (5)	ND (0.2)	ND (10)	ND (0.2)	**8.5**	ND (5)	**0.88**	ND (3)	ND (0.5)	**7**	ND (10)
	Exploratory	10/10/13	350 ft	ND (0.5)	**12**	**94**	ND (1)	ND (3)	**5.7**	ND (3)	ND (5)	**4.6**	ND (10)	ND (0.2)	**8.8**	ND (5)	**0.69**	ND (3)	ND (0.5)	**16**	ND (10)
	Exploratory	10/15/13	400 ft	ND (0.5)	**0.97**	**120**	ND (1)	ND (3)	ND (1)	ND (3)	**11**	ND (0.2)	ND (10)	ND (0.2)	**6.9**	ND (5)	**0.81**	**6.7**	ND (2.5)	ND (3)	**26**
	Constant-rate test	02/07/14	1 hrs	ND (0.5)	**17**	**170**	ND (0.5)	ND (0.5)	**31**	ND (0.5)	ND (1)	**33**	ND (1)	ND (0.2)	**12**	ND (1)	**0.86**	ND (0.5)	ND (0.5)	**17**	ND (10)
	Constant-rate test	02/08/14	6 hrs	ND (0.5)	**17**	**150**	ND (0.5)	ND (0.5)	**31**	ND (0.5)	ND (1)	**33**	ND (1)	ND (0.2)	**11**	ND (1)	**0.92**	ND (0.5)	ND (0.5)	**16**	ND (10)
	Constant-rate test	02/08/14	12 hrs	ND (0.5)	**18**	**160**	ND (0.5)	ND (0.5)	**31**	ND (0.5)	ND (1)	**33**	ND (1)	ND (0.2)	**12**	ND (1)	**0.9**	ND (0.5)	ND (0.5)	**17**	ND (10)
	Constant-rate test	02/08/14	24 hrs	ND (0.5)	**17**	**160**	ND (0.5)	ND (0.5)	**32**	ND (0.5)	ND (1)	**34**	ND (1)	ND (0.2)	**12**	ND (1)	**0.89**	ND (0.5)	ND (0.5)	**17**	ND (10)
	Constant-rate test	02/09/14	48 hrs	ND (0.5)	**18**	**160**	ND (0.5)	ND (0.5)	**31**	ND (0.5)	ND (1)	**34**	ND (1)	ND (0.2)	**12**	ND (1)	**0.94**	ND (0.5)	ND (0.5)	**16**	ND (10)
	Constant-rate test	02/10/14	72 hrs	ND (0.5)	**18**	**170**	ND (0.5)	ND (0.5)	**33**	ND (0.5)	ND (1)	**34**	ND (1)	ND (0.2)	**12**	ND (1)	**0.92**	ND (0.5)	ND (0.5)	**17 J**	ND (10)
	Flow-profile test	06/12/14	0 ft	ND (0.5)	**17**	**160**	ND (0.5)	ND (0.5)	**31**	ND (0.5)	ND (1)	**34**	ND (1)	ND (0.2)	**11**	ND (1)	**0.82**	ND (0.5)	ND (0.5)	**16**	ND (10)
	Flow-profile test	06/12/14	145 ft	ND (0.5)	**18**	**170**	ND (0.5)	ND (0.5)	**32**	ND (0.5)	ND (1)	**36**	ND (1)	ND (0.2)	**13**	ND (1)	**0.9**	ND (0.5)	ND (0.5)	**16**	ND (10)
	Flow-profile test	06/12/14	165 ft	ND (0.5)	**17**	**180**	ND (0.5)	ND (0.5)	**32**	ND (0.5)	ND (1)	**36**	ND (1)	ND (0.2)	**13**	ND (1)	**0.93**	ND (0.5)	ND (0.5)	**16**	ND (10)
	Flow-profile test	06/12/14	175 ft	ND (0.5)	**17**	**200**	ND (0.5)	ND (0.5)	**32 J**	ND (0.5)	ND (1)	**36**	ND (1)	ND (0.2)	**11**	ND (1)	**1**	ND (0.5)	ND (0.5)	**16**	ND (10)
	Flow-profile test	06/12/14	190 ft	ND (0.5)	**17**	**170**	ND (0.5)	ND (0.5)	**32**	ND (0.5)	ND (1)	**36**	ND (1)	ND (0.2)	**8.6**	ND (1)	**0.96**	ND (0.5)	ND (0.5)	**16**	ND (10)
	Flow-profile test	06/12/14	205 ft	ND (0.5)	**17**	**180**	ND (0.5)	ND (0.5)	**33**	ND (0.5)	ND (1)	**36**	ND (1)	ND (0.2)	**8.9**	ND (1)	**0.93**	ND (0.5)	ND (0.5)	**16**	ND (10)
	Flow-profile test	06/12/14	215 ft	ND (0.5)	**17**	**170**	ND (0.5)	ND (0.5)	**32**	ND (0.5)	ND (1)	**36**	ND (1)	ND (0.2)	**8.5**	ND (1)	**0.92**	ND (0.5)	ND (0.5)	**15**	ND (10)
	Flow-profile test	06/12/14	235 ft	ND (0.5)	**17**	**150**	ND (0.5)	ND (0.5)	**34**	ND (0.5)	ND (1)	**38**	ND (1)	ND (0.2)	**9.2**	ND (1)	**0.97**	ND (0.5)	ND (0.5)	**16**	ND (10)

TABLE-2

Groundwater Sample Results: Metals

Addendum to the Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Areas

Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

				Metals (µg/L)																
Location	**Phase**	**Date**	**Depth/ Time/ Rate**	**Antimony, dissolved**	**Arsenic, dissolved**	**Barium, dissolved**	**Beryllium, dissolved**	**Cadmium, dissolved**	**Chromium, dissolved**	**Cobalt, dissolved**	**Copper, dissolved**	**Hexavalent Chromium**	**Lead, dissolved**	**Mercury, dissolved**	**Molybdenum, dissolved**	**Nickel, dissolved**	**Selenium, dissolved**	**Silver, dissolved**	**Thallium, dissolved**	**Vanadium, dissolved**	**Zinc, dissolved**
Site B	Flow-profile test	06/12/14	255 ft	ND (0.5)	**16**	**150**	ND (0.5)	ND (0.5)	**35**	ND (0.5)	ND (1)	**38**	ND (1)	ND (0.2)	**9.8**	**1.1**	**1**	ND (0.5)	ND (0.5)	**16**	ND (10)

Notes:

Detected results are bolded

-- = not analyzed

ft = feet below ground surface

gpm = gallons per minute

GW = Groundwater

hrs = hours

J = concentration or reporting limit estimated by laboratory or data validation

ND = not detected at the listed reporting limit

µg/L = micrograms per liter

TABLE-3

Groundwater Sample Results: Contract Laboratory Program Inorganics

Addendum to the Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Areas

Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

				Contract Laboratory Program (CLP) Inorganics (µg/L)					
Location	**Phase**	**Date**	**Depth/ Time/ Rate**	**Calcium, dissolved**	**Iron, dissolved**	**Magnesium, dissolved**	**Manganese, dissolved**	**Potassium, dissolved**	**Sodium, dissolved**
HNWR-1	Constant-rate test	02/11/14	1 hrs	**19,000**	ND (20)	**3,200**	ND (0.5)	**4,100**	**130,000**
	Constant-rate test	02/14/14	72 hrs	**23,000**	ND (20)	**4,200**	ND (0.5)	**4,600**	**140,000**
HNWR-1 Site	Exploratory	10/17/13	100 ft	**26,000**	**42**	**5,100**	---	**5,100**	**140,000**
	Exploratory	10/17/13	200 ft	**17,000**	**110**	**2,000**	---	**4,900**	**180,000**
	Exploratory	10/19/13	300 ft	**27,000**	**880**	**1,800**	---	**5,800**	**230,000**
Site B	Constant-rate test	02/07/14	1 hrs	**32,000 J**	**22**	**5,600**	ND (0.5)	**5,000**	**230,000**
	Constant-rate test	02/10/14	72 hrs	**37,000**	ND (20)	**6,400**	ND (0.5)	**5,200**	**240,000**
	Exploratory	10/07/13	100 ft	**20,000**	**26**	**4,400**	---	**4,700**	**160,000**
	Exploratory	10/08/13	200 ft	**28,000**	**200**	**5,200**	---	**5,200**	**200,000**
	Exploratory	10/09/13	300 ft	**34,000**	**76**	**6,800**	---	**5,800**	**220,000**
	Exploratory	10/15/13	400 ft	**360,000**	**550**	**27,000**	---	**16,000**	**1,900,000**

Notes:

Detected results are bolded

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gpm = gallons per minute

GW = Groundwater

hrs = hours

J = concentration or reporting limit estimated by laboratory or data validation

ND = not detected at the listed reporting limit

µg/L = micrograms per liter

TABLE-4

Groundwater Sample Results: Polycyclic Aromatic Hydrocarbons

Addendum to the Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Areas

Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

				Polyaromatic Hydrocarbons (µg/L)																	
Location	**Phase**	**Date**	**Depth/ Time/ Rate**	**1-Methyl naphthalene**	**2-Methyl naphthalene**	**Acenaph-thene**	**Acenaph-thylene**	**Anthracene**	**Benzo-(ghi)-perylene**	**Benzo(a)-anthracene**	**Benzo(a)-pyrene**	**Benzo(b)-fluor anthene**	**Benzo(k)-fluor anthene**	**Chrysene**	**Dibenzo- (a,h)-anthracene**	**Fluoranthene**	**Fluorene**	**Indeno(1,2,3-cd)pyrene**	**Naph-thalene**	**Phen-anthrene**	**Pyrene**
HNWR-1	Constant-rate test	02/11/14	1 hrs	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
	Constant-rate test	02/14/14	72 hrs	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)
HNWR-1 Site	Exploratory	10/17/13	100 ft	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
	Exploratory	10/17/13	200 ft	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
	Exploratory	10/19/13	300 ft	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
HNWR-1A	Step-rate test	06/24/14	900 gpm	--	ND (10J)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (1)	ND (10)	ND (10)
Site B	Exploratory	10/07/13	100 ft	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
	Exploratory	10/08/13	200 ft	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
	Exploratory	10/09/13	300 ft	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
	Exploratory	10/15/13	400 ft	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
	Constant-rate test	02/07/14	1 hrs	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
	Constant-rate test	02/10/14	72 hrs	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)

Notes:

Detected results are bolded

-- = not analyzed

ft = feet below ground surface

gpm = gallons per minute

GW = Groundwater

hrs = hours

ND = not detected at the listed reporting limit

µg/L = micrograms per liter

TABLE-5

Groundwater Sample Results: Pesticides

Addendum to the Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Areas

Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

				Pesticides (µg/L)																		
Location	**Phase**	**Date**	**Depth/ Time/ Rate**	**4,4-DDD**	**4,4-DDE**	**4,4-DDT**	**Aldrin**	**alpha-BHC**	**alpha-Chlordane**	**beta-BHC**	**delta-BHC**	**Dieldrin**	**Endo sulfan I**	**Endo sulfan II**	**Endosulfan sulfate**	**Endrin**	**Endrin aldehyde**	**gamma-BHC**	**gamma-Chlordane**	**Heptachlor**	**Heptachlor Epoxide**	**Methoxychlor**	**Toxaphene**
HNWR-1	Constant-rate test	02/11/14	1 hrs	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.05)	ND (0.025)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
	Constant-rate test	02/14/14	72 hrs	ND (0.052)	ND (0.052)	ND (0.052)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.052)	ND (0.026)	ND (0.052)	ND (0.052)	ND (0.052)	ND (0.052)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.26)	ND (2.6)
HNWR-1 Site	Exploratory	10/17/13	100 ft	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.05)	ND (0.025)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
	Exploratory	10/17/13	200 ft	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.05)	ND (0.025)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
	Exploratory	10/19/13	300 ft	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.05)	ND (0.025)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
HNWR-1A	Step-rate test	06/24/14	900 gpm	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.051)	ND (0.026)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.26)	ND (2.6)
Site B	Exploratory	10/07/13	100 ft	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.051)	ND (0.025)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
	Exploratory	10/08/13	200 ft	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.05)	ND (0.025)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
	Exploratory	10/09/13	300 ft	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.051)	ND (0.025)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.051)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
	Exploratory	10/15/13	400 ft	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.05)	ND (0.025)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
	Constant-rate test	02/07/14	1 hrs	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.05)	ND (0.025)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)
	Constant-rate test	02/10/14	72 hrs	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.05)	ND (0.025)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.25)	ND (2.5)

Notes:

Detected results are bolded

-- = not analyzed

ft = feet below ground surface

gpm = gallons per minute

GW = Groundwater

hrs = hours

ND = not detected at the listed reporting limit

µg/L = micrograms per liter

TABLE-6

Groundwater Sample Results: Polychlorinated Biphenyls

Addendum to the Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Areas

Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

				Polychlorinated Biphenyls (µg/L)						
Location	**Phase**	**Date**	**Depth/ Time/ Rate**	**Aroclor 1016**	**Aroclor 1221**	**Aroclor 1232**	**Aroclor 1242**	**Aroclor 1248**	**Aroclor 1254**	**Aroclor 1260**
HNWR-1	Constant-rate test	02/11/14	1 hrs	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
	Constant-rate test	02/14/14	72 hrs	ND (0.52)	ND (1)	ND (0.52)	ND (0.52)	ND (0.52)	ND (0.52)	ND (0.52)
HNWR-1 Site	Exploratory	10/17/13	100 ft	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
	Exploratory	10/17/13	200 ft	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
	Exploratory	10/19/13	300 ft	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
HNWR-1A	Step-rate test	06/24/14	900 gpm	ND (0.51)	ND (1)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)
Site B	Exploratory	10/07/13	100 ft	ND (0.51J)	ND (1J)	ND (0.51J)	ND (0.51J)	ND (0.51J)	ND (0.51J)	ND (0.51J)
	Exploratory	10/08/13	200 ft	ND (0.5J)	ND (1J)	ND (0.5J)	ND (0.5J)	ND (0.5J)	ND (0.5J)	ND (0.5J)
	Exploratory	10/09/13	300 ft	ND (0.51)	ND (1)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)
	Exploratory	10/15/13	400 ft	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
	Constant-rate test	02/07/14	1 hrs	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
	Constant-rate test	02/10/14	72 hrs	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)

Notes:

Detected results are bolded

-- = not analyzed

ft = feet below ground surface

gpm = gallons per minute

GW = Groundwater

hrs = hours

ND = not detected at the listed reporting limit

µg/L = micrograms per liter

TABLE-7

Groundwater Sample Results: Total Petroleum Hydrocarbons

Addendum to the Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Proje

Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

				Total Petroleum Hydrocarbons (µg/L)		
Location	**Phase**	**Date**	**Depth/ Time/ Rate**	**TPH-d**	**TPH-g**	**TPH-mo**
HNWR-1	Constant-rate test	02/11/14	1 hrs	ND (50)	ND (100)	ND (50)
	Constant-rate test	02/14/14	72 hrs	ND (50)	ND (100)	ND (50)
HNWR-1 Site	Exploratory	10/17/13	100 ft	ND (50)	ND (100)	ND (50)
	Exploratory	10/17/13	200 ft	ND (50)	ND (100)	ND (50)
	Exploratory	10/19/13	300 ft	ND (50)	ND (100)	ND (50)
HNWR-1A	Step-rate test	06/24/14	900 gpm	ND (52)	ND (100)	ND (52)
Site B	Constant-rate test	02/07/14	1 hrs	ND (50J)	ND (100)	ND (50)
	Constant-rate test	02/10/14	72 hrs	**92 J**	ND (100)	**130**
	Exploratory	10/07/13	100 ft	**58**	ND (100)	ND (51)
	Exploratory	10/08/13	200 ft	**62**	ND (100)	ND (50)
	Exploratory	10/09/13	300 ft	ND (51)	ND (100)	ND (51)
	Exploratory	10/15/13	400 ft	ND (50)	ND (100)	**53**

Notes:

-- = not analyzed

ft = feet below ground surface

gpm = gallons per minute

GW = Groundwater

hrs = hours

J = concentration or reporting limit estimated by laboratory or data validation

TABLE-8

Groundwater Sample Results: Anions, General and Radiochemistry Parameters

Addendum to the Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Areas

Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

				General Chemistry and Radiochemistry (mg/L except where footnoted)															
Location	**Phase**	**Date**	**Depth/ Time/ Rate**	**Bromide**	**Chloride**	**Deuterium** *	**Fluoride**	**Gross Alpha** *	**Gross Beta** *	**Nitrate as Nitrogen**	**Nitrite as Nitrogen**	**Orthophosphate, dissolved**	**Oxygen 18** *	**Perchlorate** *	**pH** *	**Soluble silica**	**Sulfate**	**Total dissolved solids**	**Total organic carbon**
HNWR-1	GW Sampling	10/22/13	92 - 156 ft	ND (0.5)	**140**	--	**3.9**	--	--	**2.5**	ND (2.5)	--	--	--	--	**27**	**45**	--	--
	Constant-rate test	02/11/14	1 hrs	ND (0.5)	**140**	**-73.63**	**4**	**7.42**	ND (4)	**2.6**	ND (1)	ND (0.02)	**-10.11**	ND (2)	**7.9 J**	**24**	**45**	--	ND (1)
	Constant-rate test	02/12/14	6 hrs	--	--	**-73.42**	**4**	--	--	**2.7**	--	--	**-10.11**	--	--	**25 J**	--	--	--
	Constant-rate test	02/12/14	12 hrs	--	--	**-73.16**	**3.9**	--	--	**2.6**	--	--	**-10.4**	--	--	**25**	--	--	--
	Constant-rate test	02/12/14	24 hrs	--	--	**-72.92**	**3.9**	--	--	**2.7**	--	--	**-10.04**	--	--	**25**	--	--	--
	Constant-rate test	02/13/14	48 hrs	--	--	**-74.32**	**3.8**	--	--	**2.5**	--	--	**-10.52**	--	--	**25**	--	--	--
	Constant-rate test	02/14/14	72 hrs	ND (0.5)	**140**	**-72.54**	**3.9**	**6.34 J**	ND (4)	**2.5**	ND (1)	ND (0.02)	**-10.44**	ND (2)	**7.7 J**	**27**	**51**	--	ND (1)
HNWR-1 Site	Exploratory	10/16/13	50 ft	--	--	--	**3.8**	--	--	**2.5**	--	--	--	--	--	**26**	--	--	--
	Exploratory	10/17/13	100 ft	ND (0.5)	**140**	**-72.9**	**3.8**	**3.49**	**5.17**	**2.5**	ND (2.5)	ND (0.02)	**-10.1**	ND (2)	**8 J**	--	**51**	--	ND (1)
	Exploratory	10/17/13	150 ft	--	--	--	**4.5**	--	--	**2.4**	--	--	--	--	--	**20**	--	--	--
	Exploratory	10/17/13	200 ft	ND (0.5)	**180**	**-72.8**	**4.3**	ND (3)	**4.14**	**2.3**	ND (2.5)	ND (0.02)	**-9.7**	ND (2)	**8 J**	--	**53**	--	ND (1)
	Exploratory	10/18/13	250 ft	--	--	--	**5.6**	--	--	**2.1**	--	--	--	--	--	**21**	--	--	--
	Exploratory	10/19/13	300 ft	ND (10)	**11,000**	**-78**	**8.1**	ND (3)	ND (131)	ND (10)	ND (50)	ND (0.02)	**-10.2**	ND (20)	**7.8 J**	--	**670**	--	ND (1)
	Exploratory	10/19/13	350 ft	--	--	--	**8.4**	--	--	ND (10)	--	--	--	--	--	**20**	--	--	--
	Exploratory	10/20/13	400 ft	--	--	--	--	--	--	--	--	--	--	--	--	**3.7**	--	--	--
HNWR-1A	Step-rate test	06/24/14	500 gpm	--	--	--	--	--	--	--	--	--	--	--	--	**24**	--	--	--
	Step-rate test	06/24/14	700 gpm	--	--	--	--	--	--	--	--	--	--	--	--	**24**	--	--	--
	Step-rate test	06/24/14	900 gpm	ND (0.5)	**180**	**-73.11**	**3.9**	**4.57**	**5.52**	**2.6**	ND (1)	ND (0.02)	**-10.06**	ND (2)	**7.7 J**	**29 J**	**56**	--	ND (1)
	Step-rate test	06/24/14	1100 gpm	--	--	--	--	--	--	--	--	--	--	--	--	**24**	--	--	--
	Step-rate test	06/24/14	1300 gpm	--	--	--	--	--	--	--	--	--	--	--	--	**24**	--	--	--
	Step-rate test	06/24/14	1500 gpm	--	--	--	--	--	--	--	--	--	--	--	--	**24**	--	--	--
Site B	Exploratory	10/06/13	58 ft	--	--	--	**2**	--	--	**200**	--	--	--	--	--	**31**	--	--	--
	Exploratory	10/07/13	100 ft	ND (0.5)	**170**	**-75.9**	**5**	**4.71 J**	ND (4)	**2.5**	ND (2.5)	ND (0.02)	**-11**	ND (2)	**7.8 J**	--	**58**	--	ND (1)
	Exploratory	10/07/13	150 ft	--	--	--	**4.8**	--	--	**2.4**	--	--	--	--	--	**22**	--	--	--
	Exploratory	10/08/13	200 ft	ND (0.5)	**250**	**-75.9**	**4.2**	**5.9 J**	**8.05**	**2.5**	ND (2.5)	ND (0.02)	**-10.8**	ND (2)	**7.8 J**	--	**71**	--	ND (1)
	Exploratory	10/09/13	250 ft	--	--	--	**3.9**	--	--	**2.6**	--	--	--	--	--	**21**	--	--	--
	Exploratory	10/09/13	300 ft	ND (0.5)	**310**	**-76.5**	**4.1**	**3.6 J**	**4.53**	**2.6**	ND (2.5)	ND (0.02)	**-10.5**	ND (2)	**7.6 J**	--	**78**	--	ND (1)
	Exploratory	10/10/13	350 ft	--	--	--	**4.7**	--	--	**2.5**	--	--	--	--	--	**19**	--	--	--
	Exploratory	10/15/13	400 ft	ND (2.5)	**3,100**	**-78.8**	**4.1 J**	**3.66**	ND (21.9)	ND (2.5)	ND (10)	ND (0.02)	**-10.9**	ND (10)	**7.3 J**	--	**330**	--	ND (1)
	Constant-rate test	02/07/14	1 hrs	ND (0.5)	**270**	**-75.45**	**4.3**	**5.51**	ND (4)	**2.4**	ND (2.5)	ND (0.02)	**-10.15**	ND (2)	**7.8 J**	**23**	**70**	--	ND (1)
	Constant-rate test	02/08/14	6 hrs	--	--	**-75.84**	**4.3**	--	--	**2.5**	--	--	**-10.27**	--	--	**22**	--	--	--
	Constant-rate test	02/08/14	12 hrs	--	--	**-77.46**	**4.4**	--	--	**2.5**	--	--	**-10.42**	--	--	**23**	--	--	--
	Constant-rate test	02/08/14	24 hrs	--	--	**-75.52**	**4.2**	--	--	**2.4**	--	--	**-10.32**	--	--	**19 J**	--	--	--
	Constant-rate test	02/09/14	48 hrs	--	--	**-76.74**	**4.1**	--	--	**2.4**	--	--	**-10.4**	--	--	**23**	--	--	--
	Constant-rate test	02/10/14	72 hrs	ND (0.5)	**270**	**-74.54**	**4.3**	**4.38**	ND (4)	**2.5**	ND (2.5)	ND (0.02)	**-10.07**	ND (2)	**7.9 J**	**24**	**71**	--	ND (1)
	Flow-profile test	06/12/14	0 ft	--	--	--	**4.2**	--	--	--	--	--	--	--	--	--	--	**680**	--
	Flow-profile test	06/12/14	145 ft	--	--	--	**4.3**	--	--	--	--	--	--	--	--	--	--	**760**	--
	Flow-profile test	06/12/14	165 ft	--	--	--	**4.3**	--	--	--	--	--	--	--	--	--	--	**770**	--
	Flow-profile test	06/12/14	175 ft	--	--	--	**4.1**	--	--	--	--	--	--	--	--	--	--	**710**	--
	Flow-profile test	06/12/14	190 ft	--	--	--	**4**	--	--	--	--	--	--	--	--	--	--	**610**	--
	Flow-profile test	06/12/14	205 ft	--	--	--	**4**	--	--	--	--	--	--	--	--	--	--	**620**	--
	Flow-profile test	06/12/14	215 ft	--	--	--	**4.1**	--	--	--	--	--	--	--	--	--	--	**630**	--
	Flow-profile test	06/12/14	235 ft	--	--	--	**4.2**	--	--	--	--	--	--	--	--	--	--	**730**	--

TABLE-8

Groundwater Sample Results: Anions, General and Radiochemistry Parameters

Addendum to the Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Areas

Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

				General Chemistry and Radiochemistry (mg/L except where footnoted)															
Location	**Phase**	**Date**	**Depth/ Time/ Rate**	**Bromide**	**Chloride**	**Deuterium** *	**Fluoride**	**Gross Alpha**	**Gross Beta** *	**Nitrate as Nitrogen**	**Nitrite as Nitrogen**	**Orthophosphate, dissolved**	**Oxygen 18** *	**Perchlorate** *	**pH** *	**Soluble silica**	**Sulfate**	**Total dissolved solids**	**Total organic carbon**
Site B	Flow-profile test	06/12/14	255 ft	--	--	--	**4.3**	--	--	--	--	--	--	--	--	--	--	**800**	--

Notes:

Detected results are bolded

* Oxygen-18 and Deuterium in differences from global standards in parts per thousand

* Gross alpha and beta in picocuries per liter

* Perchlorate in micrograms per liter (µg/L)

* pH in pH units

All other parameters in milligrams per liter (mg/L)

-- = not analyzed

ft = feet below ground surface

gpm = gallons per minute

GW = Groundwater

hrs = hours

J = concentration or reporting limit estimated by laboratory or data validation

ND = not detected at the listed reporting limit

TABLE-9

Groundwater Sample Results: Herbicides

Addendum to the Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Areas

Pacific Gas and Electric Company, Topock Compressor Station, Needles, California

				Herbicides (µg/L)									
Location	**Phase**	**Date**	**Depth/ Time/ Rate**	**2,4,5-T**	**2,4,5-TP (Silvex)**	**2,4-D**	**2,4-DB**	**Dalapon**	**Dicamba**	**Dichlorprop**	**Dinoseb**	**MCPA**	**MCPP**
HNWR-1	Constant-rate test	02/11/14	1 hrs	ND (0.012)	ND (0.016)	ND (0.065)	ND (0.32)	ND (2.4J)	ND (0.037)	ND (0.012)	ND (0.04)	ND (0.29J)	ND (0.3J)
	Constant-rate test	02/14/14	72 hrs	ND (0.012)	ND (0.016)	ND (0.065)	ND (0.32)	ND (2.4J)	ND (0.037)	ND (0.012)	ND (0.04)	ND (0.29J)	ND (0.3J)
HNWR-1 Site	Exploratory	10/17/13	100 ft	ND (0.09)	ND (0.07)	ND (0.4)	ND (3)	ND (10J)	ND (0.08)	ND (0.5)	ND (0.2)	ND (10J)	ND (10J)
	Exploratory	10/17/13	200 ft	ND (0.09)	ND (0.07)	ND (0.4)	ND (3)	ND (10)	ND (0.08)	ND (0.5)	ND (0.2)	ND (10)	ND (10)
	Exploratory	10/19/13	300 ft	ND (0.09)	ND (0.07)	ND (0.4)	ND (3)	ND (10J)	ND (0.08)	ND (0.5)	ND (0.2)	ND (10J)	ND (10J)
HNWR-1A	Step-rate test	06/24/14	900 gpm	ND (0.09J)	ND (0.07J)	ND (0.4J)	ND (3J)	ND (10J)	ND (0.08J)	ND (0.5J)	ND (0.2J)	ND (10J)	ND (10J)
Site B	Exploratory	10/07/13	100 ft	ND (0.09)	ND (0.07)	ND (0.4)	ND (3)	ND (10J)	ND (0.08J)	ND (0.5J)	ND (0.2)	ND (10J)	ND (10J)
	Exploratory	10/08/13	200 ft	ND (0.09)	ND (0.07)	ND (0.4)	ND (3)	ND (10)	ND (0.08J)	ND (0.5J)	ND (0.2)	ND (10)	ND (10)
	Exploratory	10/09/13	300 ft	ND (0.09J)	ND (0.07)	ND (0.4)	ND (3)	ND (10)	ND (0.08)	ND (0.5)	ND (0.2)	ND (10J)	ND (10J)
	Exploratory	10/15/13	400 ft	ND (0.09)	ND (0.07)	ND (0.4)	ND (3)	ND (10J)	ND (0.08)	ND (0.5)	ND (0.2)	ND (10J)	ND (10J)
	Constant-rate test	02/07/14	1 hrs	ND (0.09)	ND (0.07)	ND (0.4)	ND (3)	ND (10J)	ND (0.08)	ND (0.5)	ND (0.2)	ND (10J)	ND (10J)
	Constant-rate test	02/10/14	72 hrs	ND (0.09)	ND (0.07)	ND (0.4)	ND (3)	ND (10J)	ND (0.08)	ND (0.5)	ND (0.2)	ND (10J)	ND (10J)

Notes:

Detected results are bolded

-- = not analyzed

ft = feet below ground surface

gpm = gallons per minute

GW = Groundwater

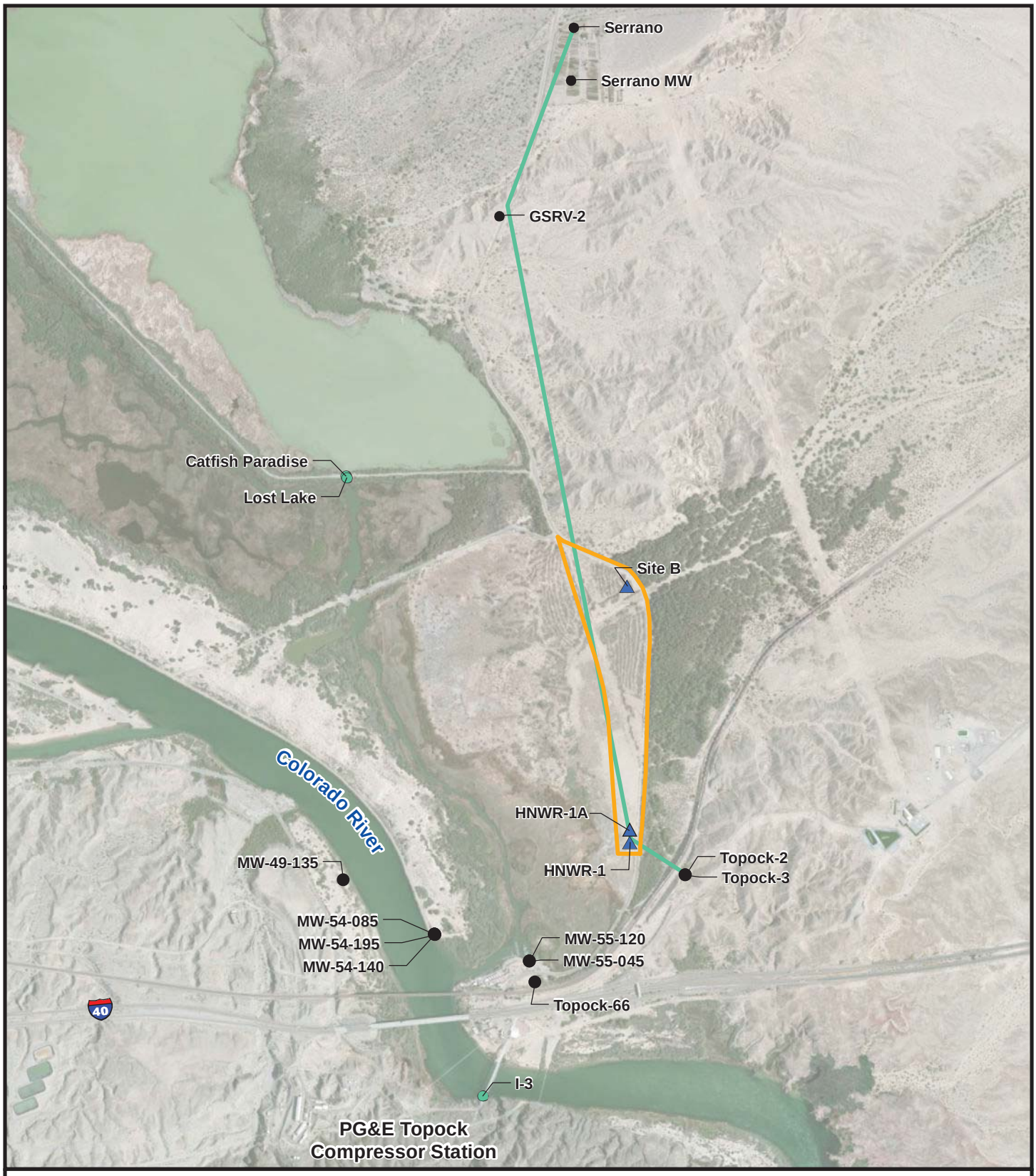
hrs = hours

J = concentration or reporting limit estimated by laboratory or data validation

ND = not detected at the listed reporting limit

µg/L = micrograms per liter

Figures



LEGEND

- Pumping Well/Observation Well
- Observation Well
- Surface Water Body
- Conceptual Geologic Cross Section
- Boundary of Work Area

N

0 600 1,200 2,400 Feet

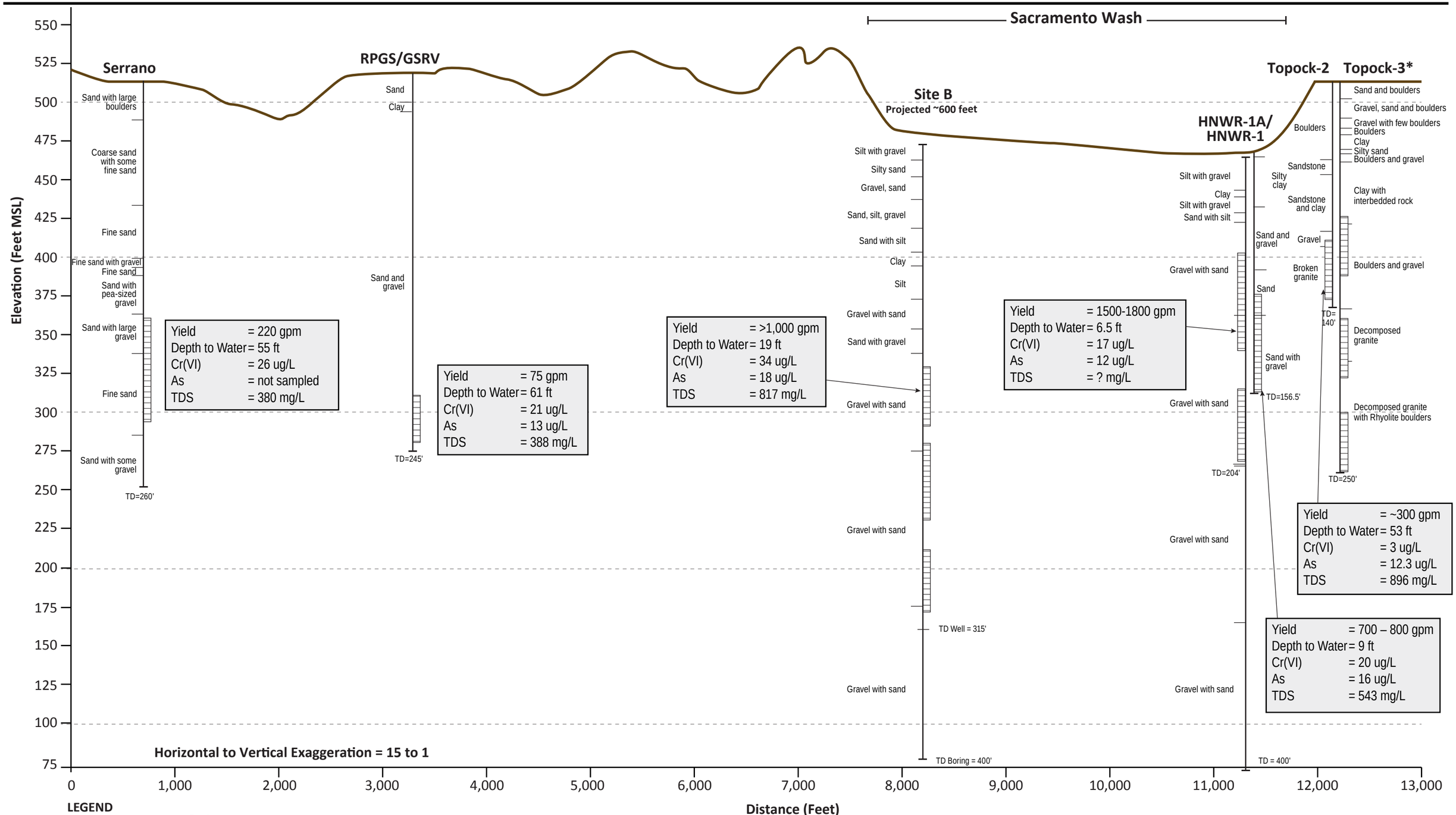
FIGURE 1

SITE MAP

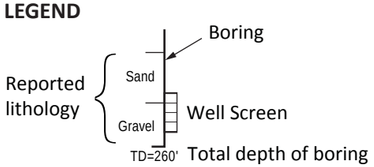
ADDENDUM TO THE SUMMARY OF FINDINGS ASSOCIATED WITH THE EVALUATION OF ALTERNATIVE FRESHWATER SOURCES IN THE TOPOCK REMEDIATION PROJECT AREA
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

CH2MHILL

Path: \\Zinfandel\proj\PacificGasElectricCo\TopockProgram\GIS\MapFiles\2014\FWIP\FIG1_SiteMap.mxd Date Saved: 3/25/2014 10:41:59 AM



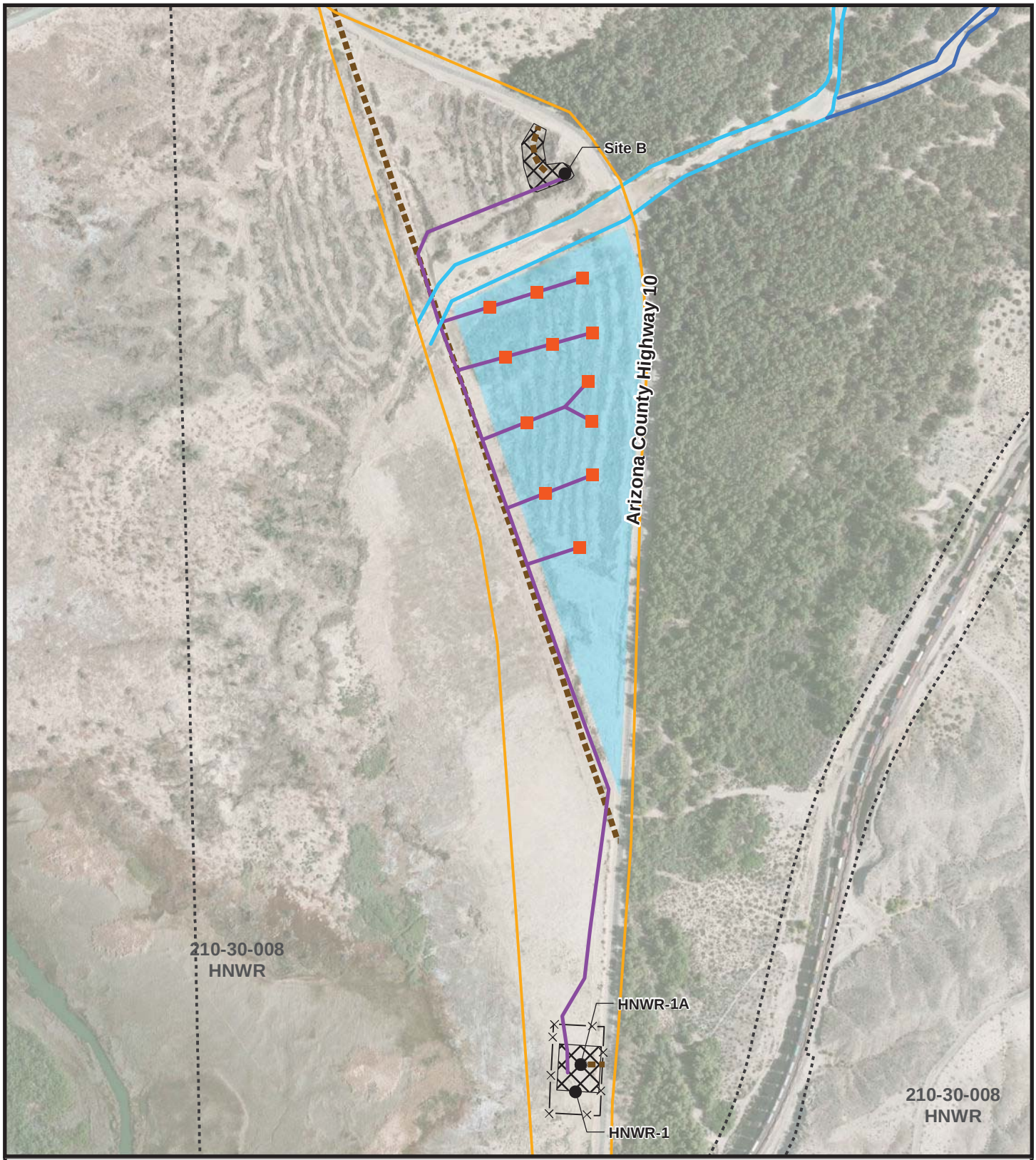
LEGEND



NOTE:
The lithology shown here was obtained from available driller's well logs and has not been independently verified by CH2M HILL with the exception of Site B and HNWR-1A exploratory borings to 400ft.

* In an effort to improve water quality the two deep screens in Topock-3 were isolated after installation. This well currently produces water from the shallow-most screen only.

FIGURE 2
Conceptual Geologic Cross Section
Addendum to the Summary of Findings Associated with the Evauluation of Alternative Freshwater Sources in the Topock Remediation Project Area
PG&E Topock Compressor Station, Needles, California



Note: Fence line for Site B is pending discussion with HNWR. Estimated installation date is April 2014.

FIGURE 3

SITE B AND HNWR-1 SITE WORK AREAS

ADDENDUM TO THE SUMMARY OF FINDINGS ASSOCIATED WITH THE EVALUATION OF ALTERNATIVE FRESHWATER SOURCES IN THE TOPOCK REMEDIATION PROJECT AREA
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

Attachment A
HNWR-1A Well Construction Information

Arizona Department of Water Resources
Water Management Division
P.O. Box 36020 Phoenix, Arizona 85067-6020
(602) 771-8500 • (602) 771-8690 fax
• www.azwater.gov •

Notice of Intent to Drill, Deepen, Replace or Modify a Well

(except a Non-Exempt Well in an Active Management Area)

$150 or $100 FEE

- Review instructions prior to completing form in black or blue ink.
- You must include with your Notice:
  - Check or money order in the amount of the appropriate filing fee.
  - For a well located within an AMA or INA, the fee is $150.00.
  - For a well not located within an AMA or INA, the fee is $100.00 if the well will be used solely for domestic purposes (see page 2 and instructions) and will have a pump with a maximum capacity of not more than 35 gallons per minute. Otherwise, the fee is $150.00.
- Authority for fee: A.R.S. § 45-596 and A.A.C. R12-15-104.

AMA / INA	B	BB
RECEIVED DATE	WB	
ISSUED DATE	MGMT	CERCLA
LEGAL REVIEW IF APP	REASONING	

FILE NUMBER

WELL REGISTRATION NUMBER
55 -

SECTION 1. COUNTY OR LOCAL HEALTH AUTHORITY APPROVAL (if applicable)

If water from the proposed well will be used for domestic purposes on a parcel of land of 5 or fewer acres, the applicable county or local health authority must endorse all items in Section 1 within one year before submission to the Department of Water Resources. You must also attach a site plan (pg. 3).

CHECK ONE

☐ County or Local Health Authority Recommends Approval (pursuant to A.R.S. § 45-596 (G) and (F))
- ☐ Field Inspection Performed
- ☐ Site Plan Review Only

☐ Insufficient Information to Make a Determination

Official County or Local Seal or Stamp

COUNTY OR LOCAL AUTHORITY NAME AND TITLE

TELEPHONE NUMBER | DATE | COUNTY OR LOCAL AUTHORITY SIGNATURE

SECTION 2. REGISTRY INFORMATION

Well Type

CHECK ONE

☐ Exempt
(Pump has a maximum capacity of not more than 35 gpm and water is not used for irrigation purposes inside an AMA.)
(See instructions.)

☒ Non-Exempt
(Pump has a maximum capacity of more than 35 gpm and the well is located outside an AMA.)
(See instructions.)

DESIGN PUMP CAPACITY: 1,000 Gallons Per Minute

Proposed Action

CHECK ONE

☒ Drill New Well
☐ Deepen
☐ Replace
☐ Modify

If Deepening, Replacing or Modifying:

ORIGINAL WELL REGISTRATION NUMBER: 55 - NA

MAXIMUM CAPACITY OF ORIGINAL WELL: NA Gallons Per Minute

DISTANCE & DIRECTION FROM ORIGINAL WELL: NA Feet

Location of Well

WELL LOCATION ADDRESS (IF ANY): NA

COUNTY WHERE WELL IS LOCATED: Mohave

TOWNSHIP (N/S)	RANGE (E/W)	SECTION	160 ACRE	40 ACRE	10 ACRE
T16N	R21W	35	SW ¼	SE ¼	NW ¼

COUNTY ASSESSOR'S PARCEL ID NUMBER

BOOK	MAP	PARCEL	# OF ACRES
210	30	008	365

Place of Water Use *(Mandatory information, see instructions.)*

Is the groundwater basin where the well will be drilled the same as the place where the water will be used?	Yes	No
		☒

TOWNSHIP (N/S)	RANGE (E/W)	SECTION	160 ACRE	40 ACRE	10 ACRE
Used as part of the Topock Comp. Station's remediation.					

SECTION 3. OWNER INFORMATION

Well Owner

FULL NAME OF COMPANY, ORGANIZATION, OR INDIVIDUAL: Pacific Gas & Electric Company

MAILING ADDRESS: PG&E Topock Compressor Station PO Box 337

CITY / STATE / ZIP CODE: Needles CA 92363

CONTACT PERSON NAME AND TITLE: Curt Russell Topock Site Manager

TELEPHONE NUMBER: 760-791-5884 FAX: 760-326-5542

Landowner *(if different from Well Owner)*

FULL NAME OF COMPANY, GOVERNMENT AGENCY, OR INDIVIDUAL: Havasu National Wildlife Refuge

MAILING ADDRESS: 317 Mesquite Ave

CITY / STATE / ZIP CODE: Needles, CA 92363

CONTACT PERSON NAME AND TITLE: Linda L. Miller Refuge Manager

TELEPHONE NUMBER: 760-326-3853 x22 FAX: 760-326-5745

SECTION 4.

Questions	Yes	No	If Yes:
1. Is the proposed well site within 100 feet of a septic tank system, sewer disposal area, landfill, hazardous materials or petroleum storage area or tank?		☒	You must also request a variance (A.A.C. R12-15-818).
2. Is there another well name or identification number associated with this well (e.g., Lot 35 Well, Smith Well, etc.)?		☒	PLEASE STATE
3. Is the proposed well a NEW well to be located within an Active Management Area? *(See instructions.)*		☒	Unless the well is a replacement well and the total number of operable exempt wells on the land is not increasing, you must also file a supplemental form A.R.S. § 45-464(C) & (D).
4. Is the proposed well the second exempt well on this parcel for the same use?		☒	If the proposed well is in an Active Management Area, you must also file a supplemental form A.R.S. § 45-454(I).

(Near HNWR-1)

Arizona Department of Water Resources
Water Management Division
P.O. Box 36020 Phoenix, Arizona 85067-6020
(602) 771-8527 • www.azwater.gov

Request to Change Well Information

- Review instructions prior to completing form in black or blue ink.
- You must include with your Notice:
  - check or money order for any required fee(s)
- Authority for fee: A.R.S. § 45-113 and A.A.C. R12-15-104

** PLEASE PRINT CLEARLY **

FILE NUMBER: B(16-21)35CDB
WELL REGISTRATION NUMBER: 55-222635

SECTION 1. REGISTRY INFORMATION

Well Owner

FULL NAME OF COMPANY, ORGANIZATION, OR INDIVIDUAL: Pacific Gas & Electric Company
MAILING ADDRESS: PO Box 337
CITY / STATE / ZIP CODE: Needles CA 92363
CONTACT PERSON NAME AND TITLE: Curt Russell Topock Site Manager
TELEPHONE NUMBER: 760-791-5884
FAX: 760-326-5542

Location of Well

WELL LOCATION ADDRESS (IF ANY): NA

TOWNSHIP (N/S)	RANGE (E/W)	SECTION	160 ACRE	40 ACRE	10 ACRE
T16N	R21W	35	SW ¼	SE ¼	NW ¼

LATITUDE			LONGITUDE		
34° Degrees	39' Minutes	44.00" N Seconds	121° Degrees	45' Minutes	56.5" W Seconds

METHOD OF LATITUDE/LONGITUDE (CHECK ONE): ☒ *GPS: Hand-Held ☐ USGS Quad Map ☐ Conventional Survey ☐ *GPS: Survey-Grade
*IF GPS WAS USED, GEOGRAPHIC COORDINATE DATUM (CHECK ONE): ☒ NAD-83 ☐ Other (please specify):

COUNTY ASSESSOR'S PARCEL ID NUMBER			COUNTY WHERE WELL IS LOCATED
BOOK	MAP	PARCEL	
210	30	008	36S

Type of Request (CHECK ONE)
☒ Change of Well Drilling Contractor *(Fill out Section 2)* ☐ Change of Well Ownership *(Fill out Section 3)* ☐ Change of Well Information (location, use, etc.) *(Fill out Section 4)*

SECTION 2. REQUEST TO CHANGE WELL DRILLING CONTRACTOR

FEE $120 per Well

- If drilling or abandoning a well, the Department must receive this request and issue authorization to the new drilling firm prior to the commencement of well drilling or abandonment.

Current Well Drilling Contractor

FULL NAME OF COMPANY, ORGANIZATION, OR INDIVIDUAL: Layne Christensen Company, LLC
DWR LICENSE NUMBER: 7
TELEPHONE NUMBER: 480-267-8416
FAX: 480-895-8699

New Well Drilling Contractor

FULL NAME OF COMPANY, ORGANIZATION, OR INDIVIDUAL: Boart Longyear Company
DWR LICENSE NUMBER: 83
ROC LICENSE CATEGORY: 073446
TELEPHONE NUMBER: 775-738-1980
FAX: 385-234-3033

SECTION 3. STATEMENT OF CHANGE OF WELL OWNERSHIP

FEE $30 per Well

Previous Well Owner	New Well Owner
FULL NAME OF COMPANY, ORGANIZATION, OR INDIVIDUAL	FULL NAME OF COMPANY, ORGANIZATION, OR INDIVIDUAL
MAILING ADDRESS	MAILING ADDRESS
CITY / STATE / ZIP CODE	CITY / STATE / ZIP CODE
CONTACT PERSON NAME AND TITLE	CONTACT PERSON NAME AND TITLE
TELEPHONE NUMBER / FAX	TELEPHONE NUMBER / FAX

SECTION 4. CHANGE OF WELL INFORMATION (No Fee Required)

NOTE: Applies only to wells that have already been drilled. For proposed wells, an amended Notice of Intent to Drill a Well must be filed.

EXPLAIN

SECTION 5. OPTIONAL BY PROPERTY OWNER AND WELL OWNER ONLY

☐ By checking this box, I hereby provide ADWR permission to enter the property for the purpose of taking water level measurements at this well. *(See instructions.)*

SECTION 6. WELL OWNER SIGNATURE

I HEREBY CERTIFY that the above statements are true to the best of my knowledge and belief.

TYPE OR PRINT NAME AND TITLE: Curt Russell, Topock Site Manager
SIGNATURE OF WELL OWNER: Curt Russell
DATE: 5-28-14

Notice of Intent to Drill, Deepen, Replace or Modify a Well

WELL REGISTRATION NUMBER
55-

SECTION 5. DRILLING AUTHORIZATION

Drilling Firm

NAME: Layne Christensen Company, LLC

DWR LICENSE NUMBER	ROC LICENSE NUMBER
#7	071734

TELEPHONE NUMBER	FAX
480-267-8416	480-895-8699

MAILING ADDRESS: 12030 East Riggs Road

CITY / STATE / ZIP CODE: Chandler AZ 85249

DATE CONSTRUCTION IS SCHEDULED TO BEGIN: October 2, 2013

SECTION 6. WATER / SITE INFORMATION

Principal Use of Water (CHECK ONE)	Other Uses of Water (CHECK ALL THAT APPLY)
☐ Irrigation	☒ Irrigation
☐ Commercial	☒ Commercial
☐ Domestic	☐ Domestic
☐ Municipal	☐ Municipal
☐ Industrial	☒ Industrial
☐ Stock	☐ Stock
☒ Remediation	☐ Remediation
☐ Dewatering	☐ Dewatering
☐ Other* (please specify):	☐ Other* (please specify):

NOTE: If this is a Notice of Intent to construct a new well that will be used for the purpose of withdrawing groundwater for transportation to an Active Management Area (AMA) pursuant to A.R.S. § 45-552, 45-553, 45-554 or 45-555(A), the authorization to drill the well issued in association with this Notice shall not be considered the approval to transport groundwater to an AMA. *(see instructions.)*

SECTION 7. PROPOSED WELL CONSTRUCTION DESIGN (attach separate sheet if needed)

Borehole			Casing													
DEPTH FROM SURFACE			DEPTH FROM SURFACE			MATERIAL TYPE (T)				PERFORATION TYPE (T)						
FROM (feet)	TO (feet)	BOREHOLE DIAMETER (inches)	FROM (feet)	TO (feet)	OUTER DIAMETER (inches)	STEEL	PVC	ABS	IF OTHER TYPE, DESCRIBE	BLANK OR NONE	WIRE WRAP	SHUTTER SCREEN	MILLS KNIFE	SLOTTED	IF OTHER TYPE, DESCRIBE	GROUTING MATERIAL
0	480	26	0	100	14.625	X*				X						Cement
			100	400	14.625	X					X					

* ADWR well construction standards require a surface seal consisting of a minimum of 20 feet of steel casing. Cement grout must be used to fill the annular space between the surface casing and the borehole. (A.A.C. R12-15-811(B))

The Department's issuance of an authorization to drill a well is not a determination of whether water withdrawn from the well is legally surface water or groundwater. The legal nature of the water withdrawn from the well may be the subject of court action in the future as part of a determination of surface water rights in your area. If there are court proceedings that could affect your well, you will be notified and be given the opportunity to participate. If you have questions regarding the legal nature of the water to be withdrawn from your proposed well, please consult with an experienced civil engineer, hydrologist or water rights attorney.

For the purpose of determining appropriate fees outside AMAs or INAs, "domestic purposes" is defined as "uses related to the supply, service and activities of households and private residences and includes the application of water to less than 2 acres of land to produce plants or parts of plants for sale or human consumption, or for use as feed for livestock, range livestock or poultry, as such terms are defined in A.R.S. § 3-1201."

SECTION 8. OPTIONAL BY PROPERTY OWNER AND WELL OWNER ONLY

☐ By checking this box, I hereby provide ADWR permission to enter the property for the purpose of taking water level measurements at this well. *(See instructions.)*

SECTION 9. WELL OWNER AND PROPERTY OWNER SIGNATURE

I state that this notice is filed in compliance with A.R.S. § 45-596 and is complete and correct to the best of my knowledge and belief.

TYPE OR PRINT NAME AND TITLE: Curt Russell (PG&E Topock Project Site Manager), Linda Miller (Refuge Manager)

SIGNATURE OF WELL OWNER: [signature] — DATE: 9-26-2013

SIGNATURE OF LANDOWNER, IF APPLICABLE (SEE INSTRUCTIONS): [signature] Refuge Manager — DATE: 09/26/13

(Near HNWR-1)

Notice of Intent to Drill, Deepen, Replace or Modify a Well

WELL REGISTRATION NUMBER
55 -

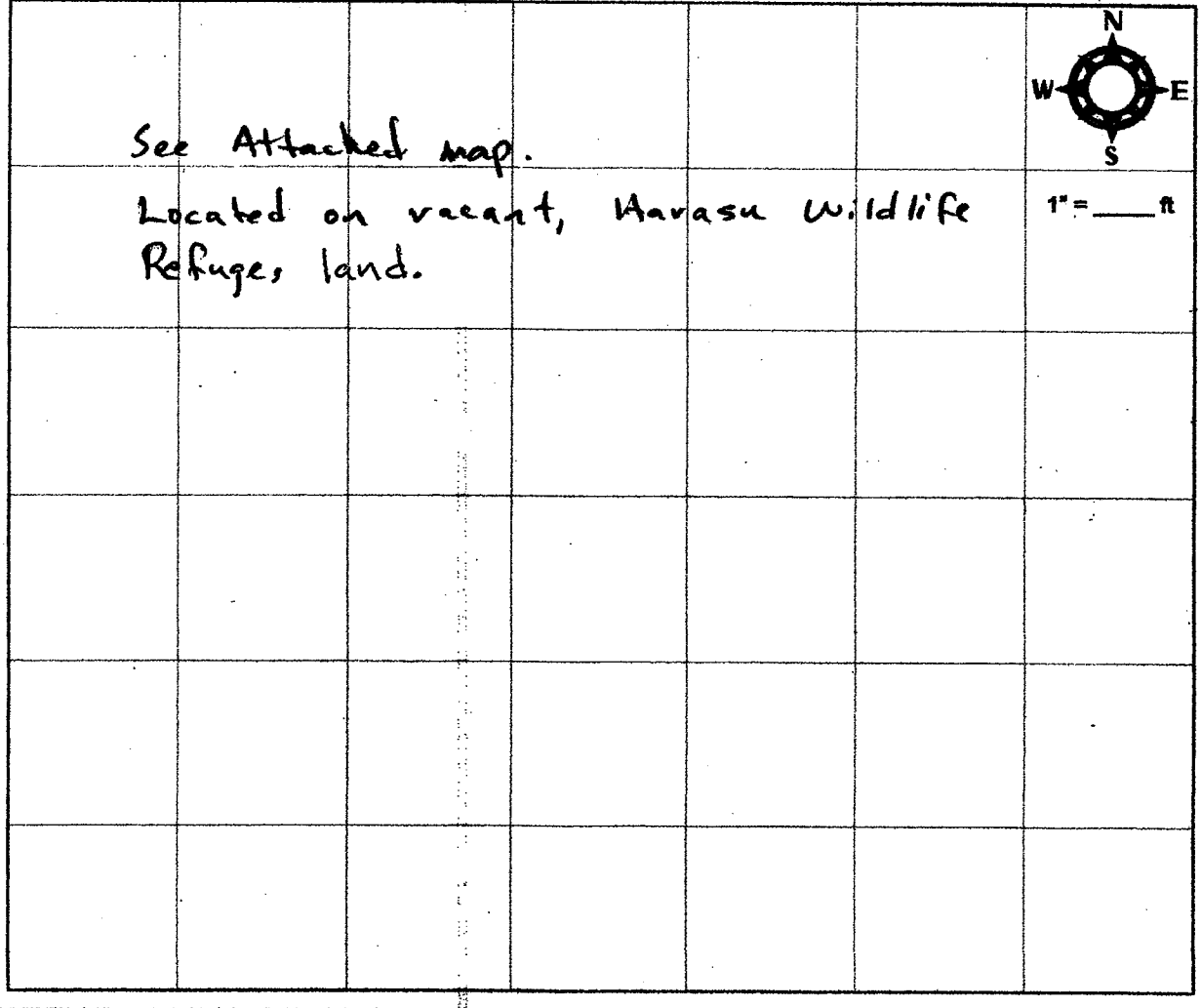
CHECK ONE: ☒ FILING MANUALLY ☐ FILING ELECTRONICALLY* *DRILLER'S E-MAIL ADDRESS:

*COUNTY OR LOCAL HEALTH AUTHORITY APPROVAL CODE *If applicant is filing this NOI electronically via the ADWR website and County approval is required, please indicate approval by providing a County Approval Code.*	COUNTY APPROVAL CODE
	NA

WELL SITE PLAN

NAME OF WELL OWNER	COUNTY ASSESSOR'S PARCEL ID NUMBER		
	BOOK	MAP	PARCEL
Pacific Gas & Electric Company	210	30	008

- If this well will be a domestic well on 5 acres or less, please draw the following: (1) the boundaries of your property; (2) the proposed well location; (3) the locations of all septic tank systems and sewer systems on the property or within 100 feet of the well location, even if on neighboring properties; and (4) any permanent structures on the property that may aid in locating the well. If the parcel is vacant land or lacks a septic tank or sewer system, please indicate this.
- Indicate the distance between the proposed well location and any septic tank system or sewer system.



COUNTY OR LOCAL AUTHORITY NAME AND TITLE	*Official County or Local Seal or Stamp*
COUNTY OR LOCAL AUTHORITY SIGNATURE	
TELEPHONE NUMBER / DATE	

 (Near HNWR-1)

GROUNDWATER PARTNERS

PROJECT NUMBER:	WELL ID:	SHEET:	OF:
428373.FS.06	***HNWR-1A***	***1***	***14***

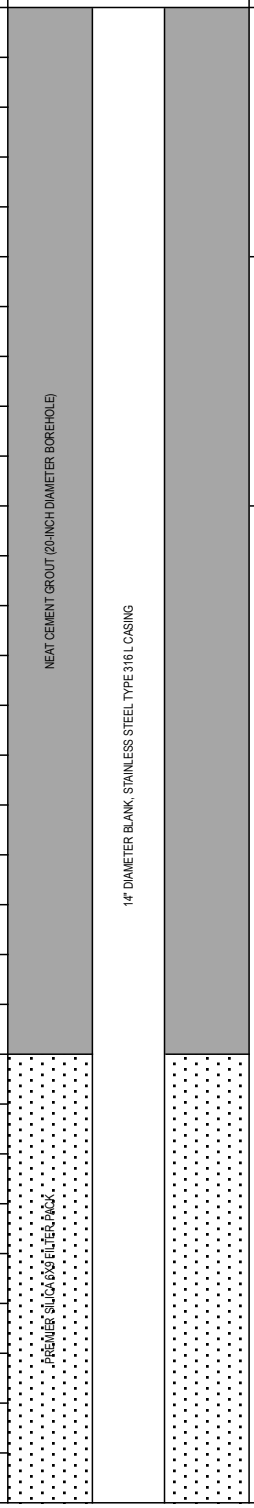
SOIL BORING LOG

PROJECT:	*Topock Alternative Freshwater Source Evaluation*	LOCATION:	*HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ*
DRILLING METHOD AND EQUIPMENT:	*Dual Rotary, DR-24, 8-inch diameter exploratory borehole, 20-inch diameter ream*		
GROUND SURFACE ELEVATION (FT):	*465*	DRILLING CONTRACTOR:	*Layne Christensen (Exploration Borehole: 10/2013), Boart Longyear (Ream and Well Install 6/2014)*
LATITUDE:	*34° 43' 24.55"*	START: *10/16/13*	WELL INFO: *14" SS Steel, 0.090", Screen: CWW*
LONGITUDE:	*114° 28' 42.22"*	FINISH: *10/20/13*	LOGGER: *E. Ludwig P.G., Garrett Frey*
WATER LEVEL (FT BGS):	*6.5*		
TOTAL DEPTH (FT BGS):	*400*		

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
0	NEAT CEMENT GROUT (20-INCH DIAMETER BOREHOLE) 14" DIAMETER BLANK, STAINLESS STEEL TYPE 316 L CASING	ML	**SILT WITH GRAVEL (ML)** - Dark grayish brown (10YR 4/2), 95% non-plastic silt, 5% gravel, gravel is coarse to fine, subangular	1145 16/16/2013 Soil samples were collected using a 5-gallon bucket from the cyclone.
5				Dry Slightly moist
10				Moist
15				Wet All sample are saturated below 15 ft
20				1200 10/16/2013
		CL	**LEAN CLAY (CL) -** Dark grayish brown (10YR 4/2), medium plasticity, 95% clay, 5% silt	1228 10/16/2013
25		ML	**SILT WITH GRAVEL (ML)** - Dark grayish brown (10YR 4/2), 95% non-plastic silt, 5% gravel, gravel is coarse to fine, subangular	
30				

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1A	SHEET: 2 OF: 14
	SOIL BORING LOG		

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ		
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter exploratory borehole, 20-inch diameter ream				
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen (Exploration Borehole: 10/2013), Boart Longyear (Ream and Well Install 6/2014)		
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO:	14" SS Steel, 0.090", Screen: CWW	WATER LEVEL (FT BGS): 6.5
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER:	E. Ludwig P.G., Garrett Frey	TOTAL DEPTH (FT BGS): 400

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
30		ML	**SILT WITH GRAVEL (ML)** - Dark grayish brown (10YR 4/2), 95% non-plastic silt, 5% gravel, gravel is coarse to fine, subangular	
35		SP-SM	**POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM) -** Brown (10YR 5/3) 70% very fine to fine sands, 10% silt, 20% subangular well graded gravel up to 1/2"	
40				1236 10/16/2013
		GW		1311 10/16/2013
45				Slow penetration rates 45-55'
50			**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
55				
60				1335 10/16/2013

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1A	SHEET: 3 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter exploratory borehole, 20-inch diameter ream		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen (Exploration Borehole: 10/2013), Boart Longyear (Ream and Well Install 6/2014)
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: 14" SS Steel, 0.090", Screen: CWW
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	6.5		
TOTAL DEPTH (FT BGS):	400		

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
60	14" BLANK CASING			
65				
70				
75	PREMIER SILICA 6X9 FILTER PACK 14" DIAMETER 0.090" SLOT SPAN INSA STEEL TYPE 316L WIRE WRAP KOSKOE MODS WELL SCREEN	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
80				1559 10/16/2013 1634 10/16/2013
85				
90				

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1A	SHEET: 4 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter exploratory borehole, 20-inch diameter ream		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen (Exploration Borehole: 10/2013), Boart Longyear (Ream and Well Install 6/2014)
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: 14" SS Steel, 0.090", Screen: CWW
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	6.5		
TOTAL DEPTH (FT BGS):	400		

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
90				
95				
100	BRAIDED SILICA SAND FILTER PACK 14" DIAMETER 0.090" SLOT STAINLESS STEEL TYPE 316 WIRE WRAP FOXCOR MODEL WELL SCREEN			1647 13/16/2013 0834 13/17/2013
105		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
110				
115				
120				0848 10/17/2013

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1A	SHEET: 5 OF: 14

SOIL BORING LOG

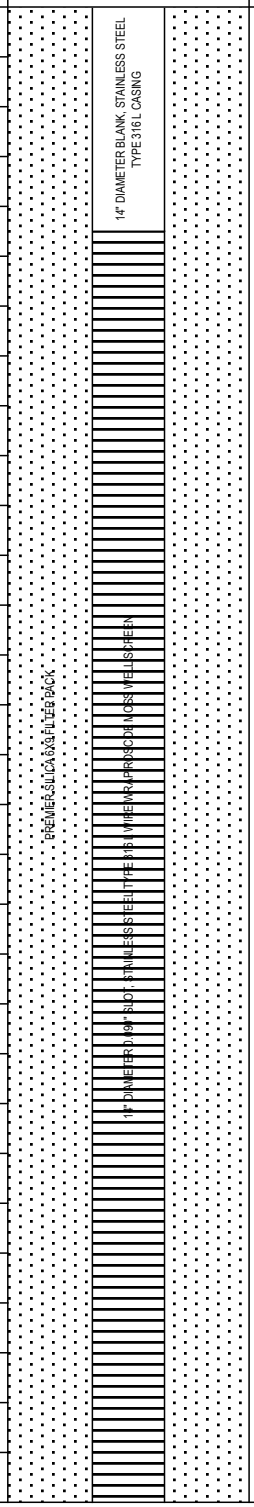
PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter exploratory borehole, 20-inch diameter ream		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen (Exploration Borehole: 10/2013), Boart Longyear (Ream and Well Install 6/2014)
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: 14" SS Steel, 0.090", Screen: CWW
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	6.5		
TOTAL DEPTH (FT BGS):	400		

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
120				
125				1218 10/17/2013
				1250 10/17/2013
130	PREMIER SILICA #3 FILTER PACK 14" DIAMETER 0.090" SLOT, STAINLESS STEEL TYPE 316 L WIRE WRAP ROSEMEAD WELL SCREEN			
135		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
140	COATED BENTONITE PELLETS 1/4 14" DIAMETER BLANK, STAINLESS STEEL TYPE 316 L CASING			0935 10/17/2013
				1016 10/17/2013
145				
150				1018 10/17/2013

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1A	SHEET: 6 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter exploratory borehole, 20-inch diameter ream		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen (Exploration Borehole: 10/2013), Boart Longyear (Ream and Well Install 6/2014)
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: 14" SS Steel, 0.090", Screen: CWW
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	6.5		
TOTAL DEPTH (FT BGS):	400		

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
150				1350 10/17/2013
155				
160				
165		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
170				1410 10/17/2013 1442 10/17/2013
175				
180				

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1A	SHEET: 7 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter exploratory borehole, 20-inch diameter ream		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen (Exploration Borehole: 10/2013), Boart Longyear (Ream and Well Install 6/2014)
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: 14" SS Steel, 0.090", Screen: CWW
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	6.5		
TOTAL DEPTH (FT BGS):	400		

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
180				
185				
190	4" DIAMETER 0.090" SLOT, STAINLESS STEEL TYPE 316L WIRE WRAP ROSCOE MOSS WELL SCREEN PREMIER SILICA G99 FILTER PACK			1457 10/17/2013 1537 10/17/2013
195		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
200	14" DIAMETER BLANK, STAINLESS STEEL TYPE 316 L CASING			1545 10/17/2013 0818 10/18/2013
205	PEA GRAVEL			
210				

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1A	SHEET: 8 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter exploratory borehole, 20-inch diameter ream		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen (Exploration Borehole: 10/2013), Boart Longyear (Ream and Well Install 6/2014)
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: 14" SS Steel, 0.090", Screen: CWW
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	6.5		
TOTAL DEPTH (FT BGS):	400		

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
210				
215				
220				0834 10/18/2013
				0900 10/18/2013
225	PEA GRAVEL	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
230				
235				
240				0913 10/18/2013

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1A	SHEET: 9 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter exploratory borehole, 20-inch diameter ream		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen (Exploration Borehole: 10/2013), Boart Longyear (Ream and Well Install 6/2014)
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: 14" SS Steel, 0.090", Screen: CWW
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	6.5		
TOTAL DEPTH (FT BGS):	400		

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
240				0943 10/18/2013
245				
250				
255	PEA-GRAVEL	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	0950 10/18/2013 1328 10/18/2013
260				1337 10/18/2013 1453 10/18/2013
265				
270				

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1A	SHEET: 10 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter exploratory borehole, 20-inch diameter ream		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen (Exploration Borehole: 10/2013), Boart Longyear (Ream and Well Install 6/2014)
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: 14" SS Steel, 0.090", Screen: CWW
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	6.5		
TOTAL DEPTH (FT BGS):	400		

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
270				
275				
280				1424 10/18/2013
				1458 10/18/2013
285	PEA GRAVEL	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	Slow penetration rates
290				
295				
300				1523 10/18/2013

GROUNDWATER PARTNERS	PROJECT NUMBER: 428373.FS.06	WELL ID: HNWR-1A	SHEET: 11 OF: 14

SOIL BORING LOG

PROJECT:	Topock Alternative Freshwater Source Evaluation	LOCATION:	HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ
DRILLING METHOD AND EQUIPMENT:	Dual Rotary, DR-24, 8-inch diameter exploratory borehole, 20-inch diameter ream		
GROUND SURFACE ELEVATION (FT):	465	DRILLING CONTRACTOR:	Layne Christensen (Exploration Borehole: 10/2013), Boart Longyear (Ream and Well Install 6/2014)
LATITUDE:	34° 43' 24.55"	START: 10/16/13	WELL INFO: 14" SS Steel, 0.090", Screen: CWW
LONGITUDE:	114° 28' 42.22"	FINISH: 10/20/13	LOGGER: E. Ludwig P.G., Garrett Frey
WATER LEVEL (FT BGS):	6.5		
TOTAL DEPTH (FT BGS):	400		

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
300				1035 10/19/2013
305				
310				
315	-PEA GRAVEL	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
320				1058 10/19/2013 1131 10/19/2013
325				
330				

GROUNDWATER PARTNERS	428373.FS.06	WELL ID: HNWR-1A	SHEET: 12 OF: 14

SOIL BORING LOG

PROJECT:	*Topock Alternative Freshwater Source Evaluation*	LOCATION:	*HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ*
DRILLING METHOD AND EQUIPMENT:	*Dual Rotary, DR-24, 8-inch diameter exploratory borehole, 20-inch diameter ream*		
GROUND SURFACE ELEVATION (FT):	*465*	DRILLING CONTRACTOR:	Layne Christensen (Exploration Borehole: 10/2013), Boart Longyear (Ream and Well Install 6/2014)
LATITUDE:	*34° 43' 24.55"*	START: *10/16/13*	WELL INFO: *14" SS Steel, 0.090", Screen: CWW*
LONGITUDE:	*114° 28' 42.22"*	FINISH: *10/20/13*	LOGGER: *E. Ludwig P.G., Garrett Frey*
WATER LEVEL (FT BGS):	*6.5*		
TOTAL DEPTH (FT BGS):	*400*		

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
330				
335				
340				1151 10/19/2013
				1234 10/19/2013
345	-PEA-GRAVEL	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
350				1243 10/19/2013
				1720 10/19/2013
355				
360				1730 10/19/2013

GROUNDWATER PARTNERS

.	WELL ID:	SHEET:	OF:
428373.FS.06	*HNWR-1A*	*13*	*14*

SOIL BORING LOG

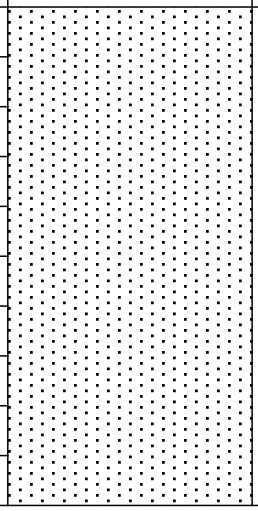
PROJECT:	*Topock Alternative Freshwater Source Evaluation*	LOCATION:	*HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ*
DRILLING METHOD AND EQUIPMENT:	*Dual Rotary, DR-24, 8-inch diameter exploratory borehole, 20-inch diameter ream*		
GROUND SURFACE ELEVATION (FT):	*465*	DRILLING CONTRACTOR:	Layne Christensen (Exploration Borehole: 10/2013), Boart Longyear (Ream and Well Install 6/2014)
LATITUDE:	*34° 43' 24.55"*	START: *10/16/13*	WELL INFO: *14" SS Steel, 0.090", Screen: CWW*
LONGITUDE:	*114° 28' 42.22"*	FINISH: *10/20/13*	LOGGER: *E. Ludwig P.G., Garrett Frey*
WATER LEVEL (FT BGS):	*6.5*		
TOTAL DEPTH (FT BGS):	*400*		

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
360				0745 10/20/13
365				
370				
375	-PEA-GRAVEL	GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	
380				0815 10/20/2013 0920 10/20/2013
385				
390				

GROUNDWATER PARTNERS	428373.FS.06	WELL ID: HNWR-1A	SHEET: 14 OF: 14

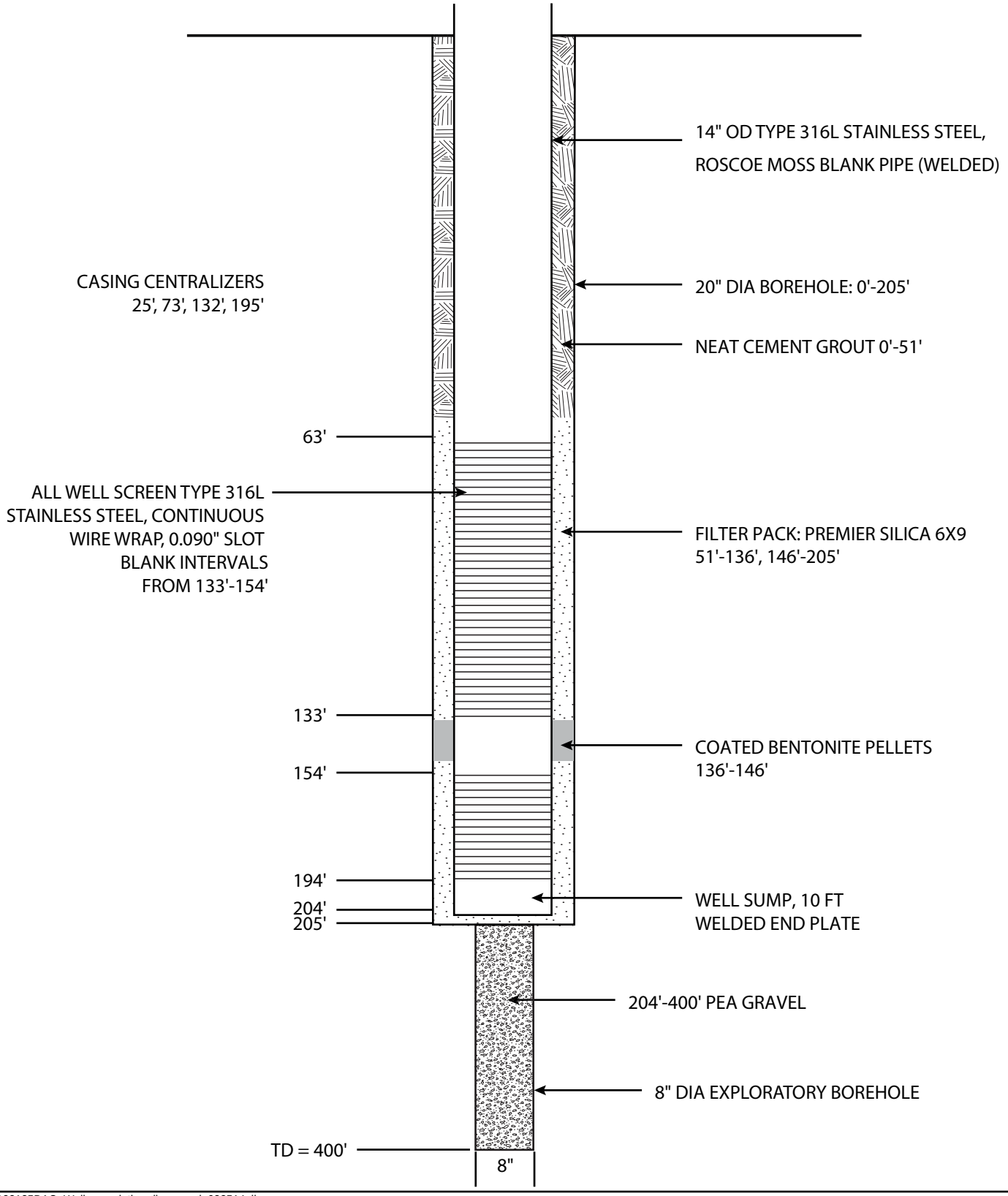
SOIL BORING LOG

PROJECT:	*Topock Alternative Freshwater Source Evaluation*	LOCATION:	*HNWR-1 Site: 1.0 mile north of I-40 and HWY 10, Golden Shores, AZ*
DRILLING METHOD AND EQUIPMENT:	*Dual Rotary, DR-24, 8-inch diameter exploratory borehole, 20-inch diameter ream*		
GROUND SURFACE ELEVATION (FT):	*465*	DRILLING CONTRACTOR:	Layne Christensen (Exploration Borehole: 10/2013), Boart Longyear (Ream and Well Install 6/2014)
LATITUDE:	*34° 43' 24.55"*	START: *10/16/13*	WELL INFO: *14" SS Steel, 0.090", Screen: CWW* — WATER LEVEL (FT BGS): *6.5*
LONGITUDE:	*114° 28' 42.22"*	FINISH: *10/20/13*	LOGGER: *E. Ludwig P.G., Garrett Frey* — TOTAL DEPTH (FT BGS): *400*

DEPTH (FT) BELOW SURFACE	WELL CONSTRUCTION	USCS GROUP SYMBOL	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, RELATIVE DENSITY, CONSISTENCY, GRAIN SIZE, GRAIN SHAPE, PLASTICITY	COMMENTS DEPTH OF CASING, PENETRATION RATE, DATE AND TIME
390 395 400		GW	**WELL GRADED GRAVEL WITH SAND (GW)** - Dark reddish gray (2.5YR 4/1) and dark greenish gray (GLEY 2 4/1), 60-90% rounded to subangular gravel up to 2", 10-40% poorly graded subangular medium sand	Total depth of pilot borehole: 400 ft. 0955 10/20/2013

CH2MHILL®	PROJECT NUMBER: 428373.FS.06	WELL NUMBER: HNWR-1A
	WELL COMPLETION DIAGRAM	

PROJECT: Topock Alternative Freshwater Source Evaluation		LOCATION: 1 mi north I-40 & HWY 10, Golden Shores, AZ
DRILLING METHOD/EQUIPMENT: Exploratory boring dual air rotary, Foster DR-24, 8" dia; reamed to construct well		
DRILLING CONTRACTOR: BOART LONGYEAR	START: 6/1/2014 END: 6/20/2014	LOGGER: E. Ludwig, G. Frey (Groundwater Partners, Inc.)
34° 43' 24.55", 114° 28' 42.22"	SURFACE ELEVATION (FT): 465	DEPTH TO WATER (FT BGS): 6.5



ES110712123135BAO_Well_completion-diagram.ai_032514_lho

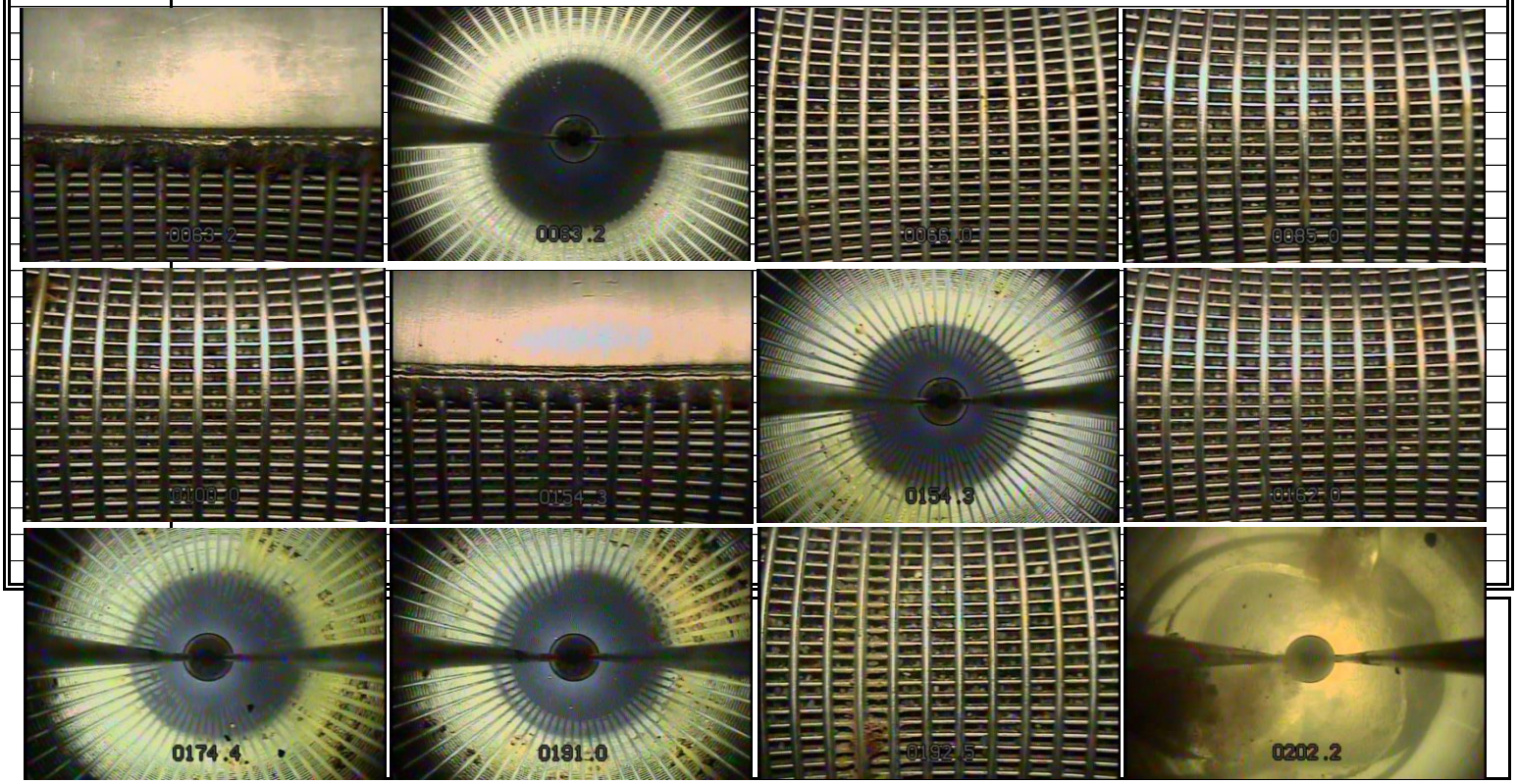
Pacific Surveys

a full service geophysical well logging company

Video Survey Report

Company:	Groundwater Partners Inc.	**Date:**	09-Jul-14		
Well:	HNWR-1A	**Run No.**	One	**Truck**	PS-5
Field:	Topock	**Job Ticket:**	18287		
State:	Arizona	**Total Depth:**	204 ft		
		Water Level:	6 ft	SWL	
Location:	1.5 miles north of Golden Shores	**Oil on Water:**	No	**Amount:**	0 ft
	GPS: N34o43.405' W114o28.699'	**Operator:**	Abreau		
Zero Datum:	Ground Level **Tool Zero:**	Side-Scan		**Dead Space**	1.75 ft
Reason for Survey:	New Well Construction	**Guides Set @**	13.0 in		

Depth	Observations		
0.0 ft	Begin survey from ground level.	**Perforation:**	**From Survey**
6.1 ft	SWL; Water clear, visibility good.	Wire-Wrap	63.20 ft to 132.60ft
20.0 ft	Casing appears normal and in good condition.		154.30 ft to 193.70ft
63.2 ft	Top of perforations, perforations appear open and in good condition.		
66.0 ft	Perforations appear open, with visible gravel pack.		
85.0 ft	Perforations appear open, with visible gravel pack.		
132.6 ft	Bottom of perforations, perforations appear open within interval.		
140.0 ft	Casing appears normal and in good condition.		
154.3 ft	Top of perforations, perforations appear open and in good condition.		
162.0 ft	Perforations appear open, with visible gravel pack.		
191.0 ft	Perforations appear open, with visible gravel pack.		
193.7 ft	Bottom of perforations, perforations appear open with few localized small bio-growth patches.	**Casing Size**	**From Survey**
203.8 ft	Fill; End Survey.	14.0 in	0.00 ft to 203.80ft
		CSG Material	SST
		Screen Material	SST



800.919.7555
909.625.6262

4456 via st. ambrose
claremont ca 91711
www.pacificsurveys.com

fax: 909.399.3180

Attachment B
Well and Aquifer Testing Data

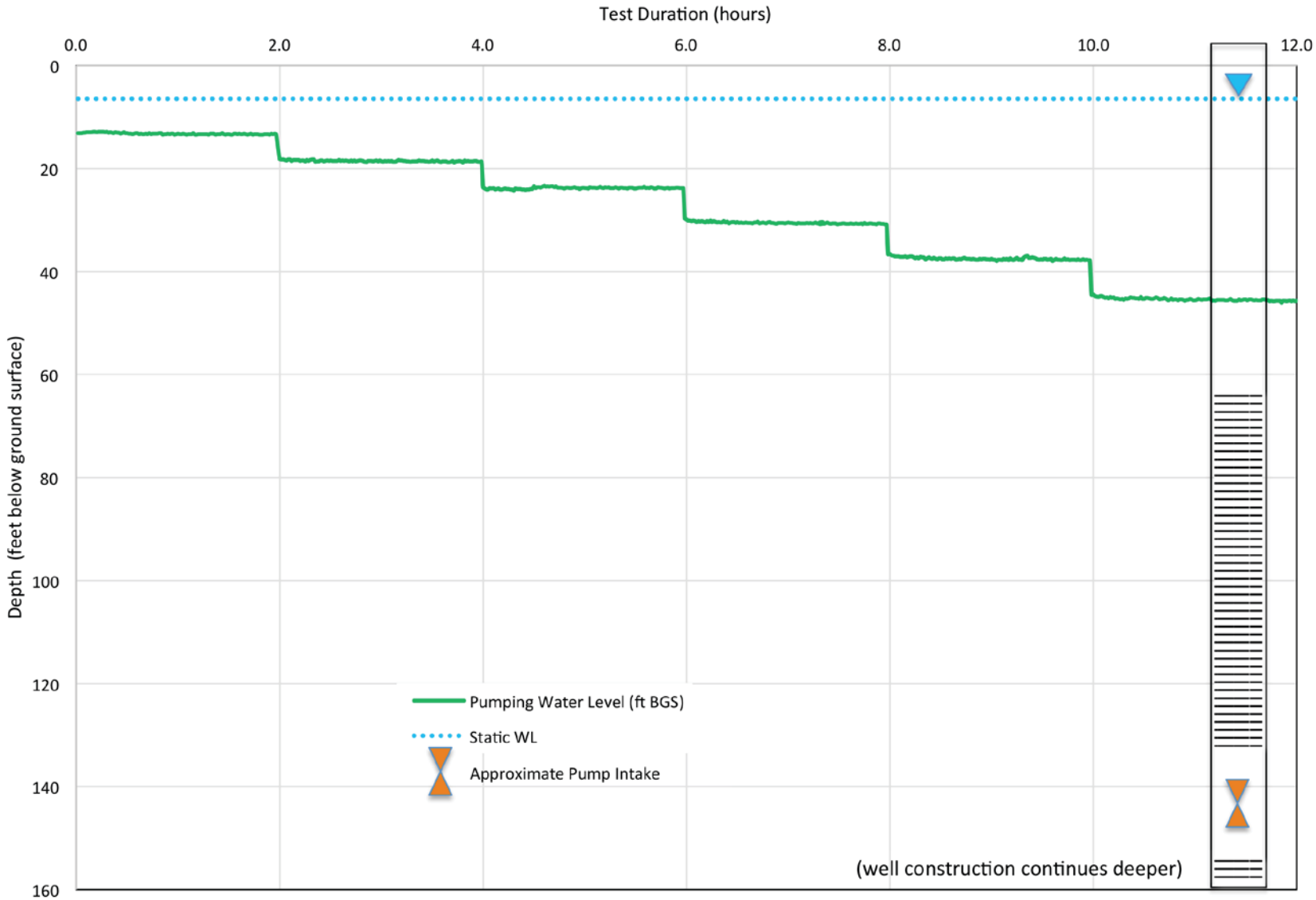


FIGURE B-1
Attachment B – HNWR-1A Well Testing Data
Addendum to the Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Area
Pacific Gas and Electric Company
Topock Compressor Station, Needles, California

TABLE B-1

Results of Site B Well Flow Profile Testing

Addendum to the Summary of Findings Associated with the Evaluation of Alternative Freshwater Sources in the Topock Remediation Project Area

PG&E Topock Compressor Station, Needles, California

Depth Interval					Lab Results				Calculated Flow Weighted Concentration				
Top Depth (feet)	Bottom Depth (feet)	Casing Type Graphic	Flow Contribution (gpm)	Flow Contribution (%)	Arsenic (ug/L)	Hexavalent Chromium (ug/L)	Fluoride (mg/L)	TDS (mg/L)	Arsenic (ug/L)	Hexavalent Chromium (ug/L)	Fluoride (mg/L)	TDS (mg/L)	Sampler Depth (feet)
Ground Surface			-986	0	17	34	4.2	680	NA	NA	NA	NA	Pump Effluent
145	150												
150	155		5	0.5%	18	36	4.3	760	-- [5]	-- [5]	-- [5]	-- [5]	145
155	160												
160	165												
165	170		13	1.3%	17	36	4.3	770	-- [5]	-- [5]	-- [5]	-- [5]	165
170	175												
175	180		246	25%	17	36	4.1	710	17	36	4.4	1,004	175
180	185												
185	190		1	0%									
190	195				17	36	4.0	610	17	36	4.0	374	190
195	200		28	3%									
200	205												
205	210		203	21%	17	36	4.0	620	17	36	3.9	615	205
210	215												
215	220												
220	225		239	24%	17	36	4.1	630	17	34	4.0	552	215
225	230												
230	235												
235	240		105	11%									
240	245				17	38	4.2	730	17	38	4.2	718	235
245	250		0	0%									
250	255												
255	260		16	2%									
260	265												
265	270		66	7%									
270	275												
275	280		64	6.6%	16	38	4.3	800	16	38	4.3	800	255
280	285												
285	290		0	0%									
290	295												
295	300		0	0%									
300	305												
305	310												
310	315												

Notes:

1 All sampling was conducted at Site B Well on June 12, 2014.

2 The purge rate during sampling (and 24 hours prior to sampling) was 986 gpm.

3 Reported analytical results are dissolved

4 All data analysis including calculation of flow contribution and flow weighted concentrations performed by BESST, Inc.

5 The flow contribution of this zone is too small to allow for accurate calculation of a flow-weighted concentration.

6 Flow data from the intervals 215'-225' and 225'-235' flow results were inconclusive due to equipment mechanical issues at the time of injection. Therefore the flow data from 215' to 235' was calculated at 239 gpm over a 20' interval instead of two 10' intervals. The same is true for the interval 145'-165', which had a total flow contribution of 5 gpm.

ug/L - Micrograms per liter

mg/L - Milligrams per liter

feet - feet below ground surface

gpm - gallons per minute

TDS - total dissolved solids

NA - Not Aplicable

Blank casing

Well screen

Relative Low — Relative High

(Flow Contribution Graphic Scale)

U.S. Geological Survey Combined Well-Bore Flow and Depth-Dependent Water Sampler

The U.S. Geological Survey has developed a combined well-bore flow and depth-dependent sample collection tool. It is suitable for use in existing production wells having limited access and clearances as small as 1 inch. The combination of well-bore flow and depth-dependent water-quality data is especially effective in assessing changes in aquifer properties and water quality with depth. These are direct measures of changes in well yield and ground-water quality with depth under actual operating conditions. Combinations of other geophysical tools capable of making these measurements, such as vertical-axis current meters used with wire-line samplers, are commercially available but these tools are large and can not easily enter existing production wells.

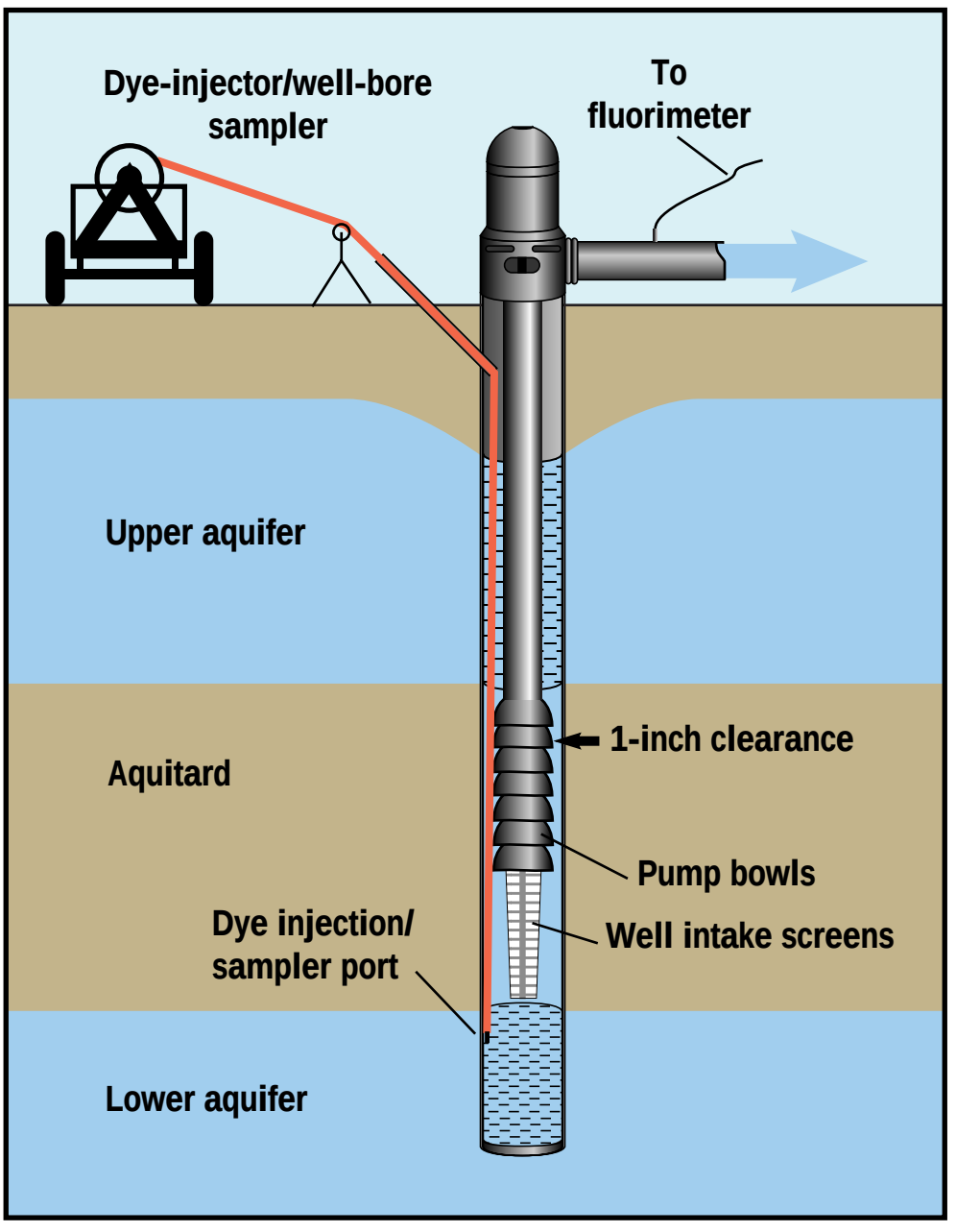


Figure 1. Example of typical deployment in a deep-turbine production well.

BASIC OPERATING PRINCIPLES

The U.S. Geological Survey device is a high-pressure hose equipped with valves for dye injection and sample collection. The hose is mounted on a reel for deployment, retrieval, and storage (fig. 1). The hose can be used to collect velocity-log data and, after cleaning and decontamination, the same hose can be used to collect depth-dependent water-quality data. Accessories, such as a Teflon® hose extension, are available for collection of organic compounds.

Velocity-Log Data

The equipment is used to obtain flow data within the well bore under pumping conditions using a technique we named the 'tracer-pulse method.' When operated in this mode, the hose is filled with fluid containing an easily measured tracer, such as water colored with Rhodamine dye. The hose is lowered to a known depth in the well (d_1) and a pulse of the tracer is injected into the water column. The travel-time of the tracer to a detector on the surface is measured (t_1). If Rhodamine dye is used, a commercially available fluorimeter is used to measure the arrival of the dye at the surface. The hose is then lowered to the next depth (d_2), another pulse of dye is released, and the travel-time is measured (t_2). The velocity is calculated as the difference in the travel-times. Assuming piston flow, the flow rate (Q), given a known well radius (r), is calculated using the following equation:

$$Q = (V\pi r^2) \quad \text{where: } V = (d_2-d_1)/(t_2-t_1)$$

A series of injections at different depths is done to construct a velocity profile for the well. The velocity profile can then be used to guide the collection and interpretation of depth-dependent water-quality data.

Depth-Dependent Water-Quality Data

To collect a water-quality sample from a given depth in the well, the hose is pressurized to greater than the hydrostatic pressure at that depth and lowered into the well. When the sample depth is reached, the hose is vented at the surface and water from the well at the sample depth enters the hose. The hose is retrieved and the sample expelled from the hose under pressure. The process is repeated at several depths to complete a water-quality profile within the well. If the concentrations of a constituent at the first sample depth (C_1) and the second sample depth (C_2) are known, the concentration in water entering the well from the intervening water-bearing zone (C_a) can be calculated from the water-quality profile and the velocity-log data:

$$[(C_1Q_1-C_2Q_2)/Q_a] = C_a$$
$$\text{where } Q_a = (Q_1 - Q_2)$$

This calculation assumes conservative mixing and conservation of mass.

APPLICATIONS

The data shown in figure 2 are from a deep production well in a complex multiple-aquifer system. These data illustrate changes with time in the chloride concentration of water entering the well at depth and changes with time in the distribution of flow into the well. Because changes in well yield and water quality measured at the surface were small, these changes would not have been detected using conventional sample collection methods which are a composite of all the water flowing into the well. A comparison of data from a velocity log using a conventional spinner tool and a velocity log using the tracer-pulse method also is shown in figure 2. The tracer-pulse method correctly identified the most important water-yielding zone and the depth below which almost no water enters the well. Neither of these important hydrologic features could have been identified on the basis of indirect data, such as a resistivity log (fig. 2).

The combination of velocity-log data and depth-dependent water-quality data is an especially effective data set for hydrologic interpretations. Specific applications for data collected using this approach include:

(1) Identification of changes in ground-water quality and well yield with time.
(2) Identification of different water-bearing units with depth.

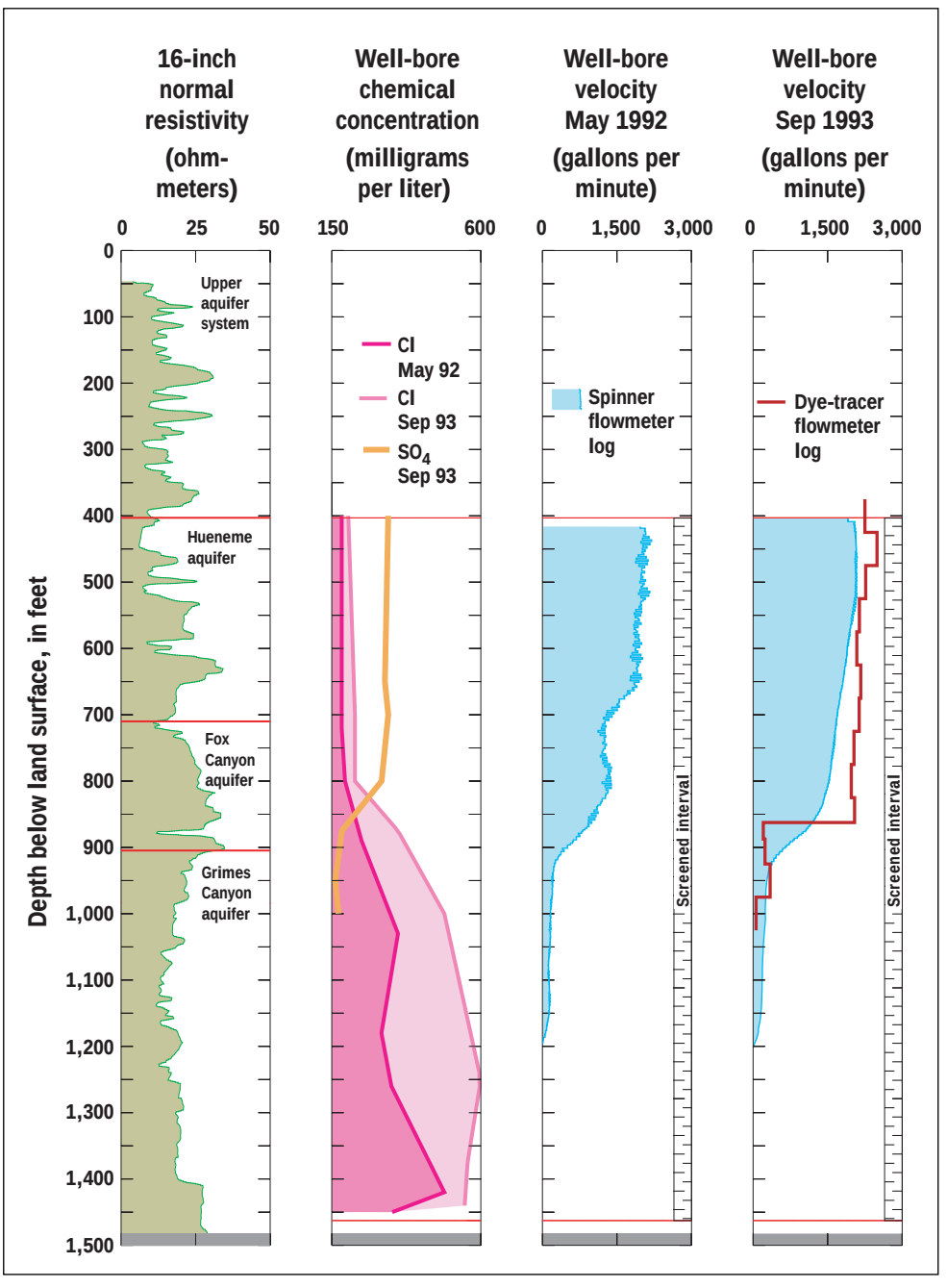


Figure 2. Example of depth-dependent flow and chemical data sampled from a deep production well.

(3) Identification of changes in natural ground-water chemistry with depth.
(4) Identification of man-made or natural contaminants with depth.

Although the applications described here are primarily for production wells, the approach also can be applied to observation wells. This approach may be especially useful to assess the performance of wells used for remediation if contaminants are stratified within the aquifer.

TECHNICAL CONTACT
John Izbicki, Allen Christensen, Randy Hanson
U.S. Geological Survey
Water Resources Division
5735 Kearny Villa Road, Suite O
San Diego, CA 92123-1135
Voice: (858) 637-9005
Fax: (858) 637-9201
Web: http://water/wr/usgs.gov
e-mail: jaizbick@usgs.gov, ahchrist@usgs.gov, rthanson@usgs.gov

LICENSING CONTACT
Julia Giller, Neal Mark
U.S.G.S. Technology Enterprise Office
12201 Sunrise Valley Drive, MS-211
Reston, VA 20192
Voice: (703) 648-4450, (703) 648-5068
e-mail: tto@usgs.gov

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A SMALL-DIAMETER SAMPLE PUMP FOR COLLECTION OF DEPTH-DEPENDENT SAMPLES FROM PRODUCTION WELLS UNDER PUMPING CONDITIONS

By John A. Izbicki

The U.S. Geological Survey, in cooperation with the manufacturer ([1]Besst In$_2$c. http://www.besstinc.com), has modified a commercially available gas-displacement sample pump to collect water at selected depths within production wells under pumping conditions. The modified pump is about 6 inches long, less than 1 inch in diameter, and is operated through repeated application and release of compressed gas. The pump is intended for use in production wells having limited access that prevents the use of traditional geophysical tools, such as wire-line bailers, used to collect depth-dependent water samples. In most cases, the production pump does not have to be removed or the well modified for insertion of the sample pump. Data collected at different depths within the production well reflect water quality at those depths under actual pumping conditions. If well-bore flow velocities are known, the quality of water in the aquifer between sample depths can be estimated.

DESIGN AND BASIC OPERATING PRINCIPLES OF THE SAMPLE PUMP

The modified sample pump consists of a series of one-way flow valves connected to the surface by two 1/8-inch-diameter Teflon tubes bonded together into a single hose. One tube serves as a pressure line, and the other serves as the sample line (fig. 1). After the pump is lowered into the well to the sample depth, water enters the pump, filling both Teflon tubes to the water level in the well (Initial conditions, fig. 1). The pressure line is pressurized using compressed gas, and water is displaced from this tube into the sample line (Pressure cycle, fig. 1). A one-way flow valve at the pump intake prevents the displaced water from flowing back into the well. Once the water is in the sample line, another one-way valve prevents the water from flowing back toward the sample pump after pressure is released (Release cycle, fig. 1).

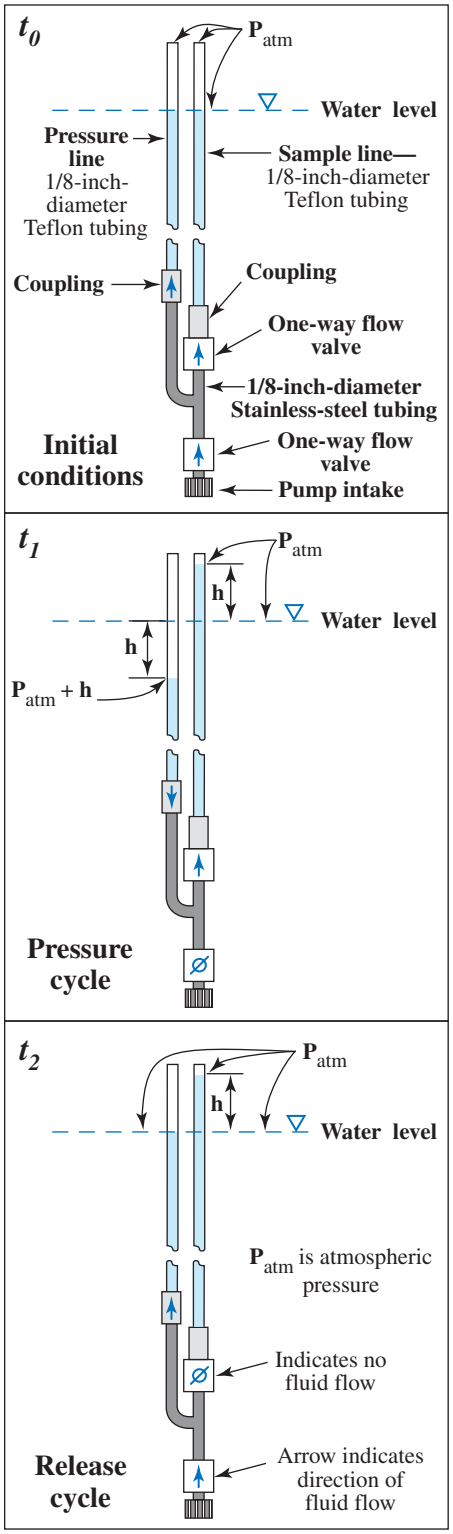


Figure 1. Diagram showing schematic of small-diameter pump and basic operating principles.

To force additional water into the sample line, pressure is alternately applied and released on the pressure line at the surface using compressed gas regulated through a control panel built by the U.S. Geological Survey. The column of water in the sample line can be forced upward to the surface through the sequential application and release of pressure. Alternately, when sufficient volume is accumulated, water in the sample line can be forced to the surface using compressed gas. With proper use, water from the pump is suitable for analysis for a wide variety of constituents, including volatile organic carbon and dissolved gasses. The pump is capable of lifting water from depths as great as 1,200 feet. The pump and hose are mounted on a motorized reel (fig. 2).

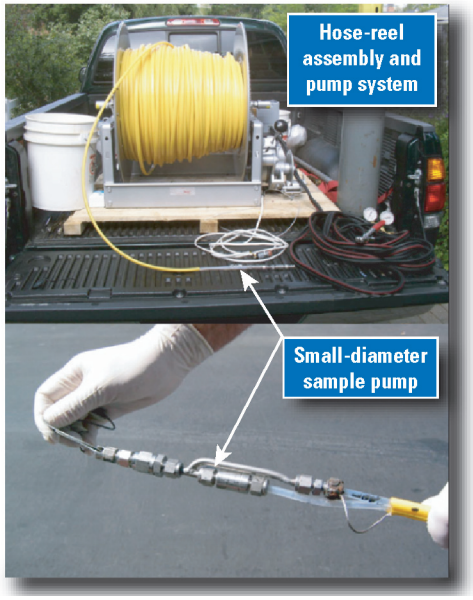


Figure 2. Photograph showing a) hose-reel assembly and b) small-diameter sample pump.

Samples from different depths within production wells can be collected by sequentially moving the pump to a different sample-collection depth without retrieving the pump from the well after each sample is collected. The pump pro-

vides an alternative to traditional sample-collection methods using wire-line bailers or sample-collection methods developed by Izbicki and others (1999), both of which require sample equipment to be pulled from the well to bring each depth-dependent sample to land surface.

DATA INTERPRETATION

Depth-dependent water-quality data collected within production wells under pumping conditions can be used to estimate the quality of water yielded to a well from a selected depth interval using the following equation:

$$C_a = (C_i Q_i - C_{i+1} Q_{i+1})/Q_a , \quad \text{(eq. 1)}$$

where:

C is the concentration of a given constituent,

Q is the flow of water within the well (either as volume per unit time, as velocity, or as percent of total discharge),

i is the first sample collection and flow measurement depth,

$i+1$ is the second sample collection and flow measurement depth, and

a is the interval between i and $i+1$.

(In this example, flow in the well is presumed to be upward toward the pump intake and the first sample-collection depth is shallower than the second sample-collection depth.)

Depth-dependent water-quality data collected from production well 4N/5W-2H1 near Victorville, California, using this small-diameter sample pump are shown in figure 3. The well is screened between 600 and 836 feet below land surface, and the pump intake is at 685 feet. The well was pumped at 1,000 gallons per minute. Flow was upward from the bottom of the well screen toward the pump intake. The deepest sample collected from the well is presumed to be representative of water in the aquifer at that depth. The next deepest sample is a mixture of water already in the well and water that entered the well between the two sample depths. The combination of velocity-log and depth-dependent water-quality data can be used to resolve the mixture within the well and estimate the concentration of a constituent in water contributed from the aquifer to the well at selected sample depths below the pump intake during pumping (fig. 3). Results of calculations show that, in general, arsenic concentrations increased with depth below the pump intake but remained below the U.S. Environmental Protection Agency proposed Maximum Contaminant Level for arsenic of 10 micrograms per liter (µg/L).

Flow was downward in the well from the top of the screened interval to the pump intake (fig. 3). No samples were collected above the pump intake and the arsenic concentration of water yielded from the aquifer to the well above the pump intake was not calculated.

DISCUSSION

The small-diameter pump provides a means to collect depth-dependent water-quality data from specific intervals in long-screened production wells under pumped conditions. Coupled depth-dependent water-quality and velocity-log data have application to a wide range of hydrologic problems including seawater intrusion, brine invasion, naturally occurring trace-elements, and anthropogenic contamination. The small-diameter sample pump described in this fact sheet enables more efficient collection of depth-dependent samples from production wells having limited access by increasing the ease with which water samples are collected (thereby reducing the time and cost) through eliminating the need to retrieve the sample pump from the well after each sample is collected.

REFERENCES CITED Izbicki, J.A., Christensen, A.H., and Hanson, R.T., 1999, U.S. Geological Survey combined well-bore flow and depth-dependent water sampler; U.S. Geological Survey Fact Sheet FS 196-99.

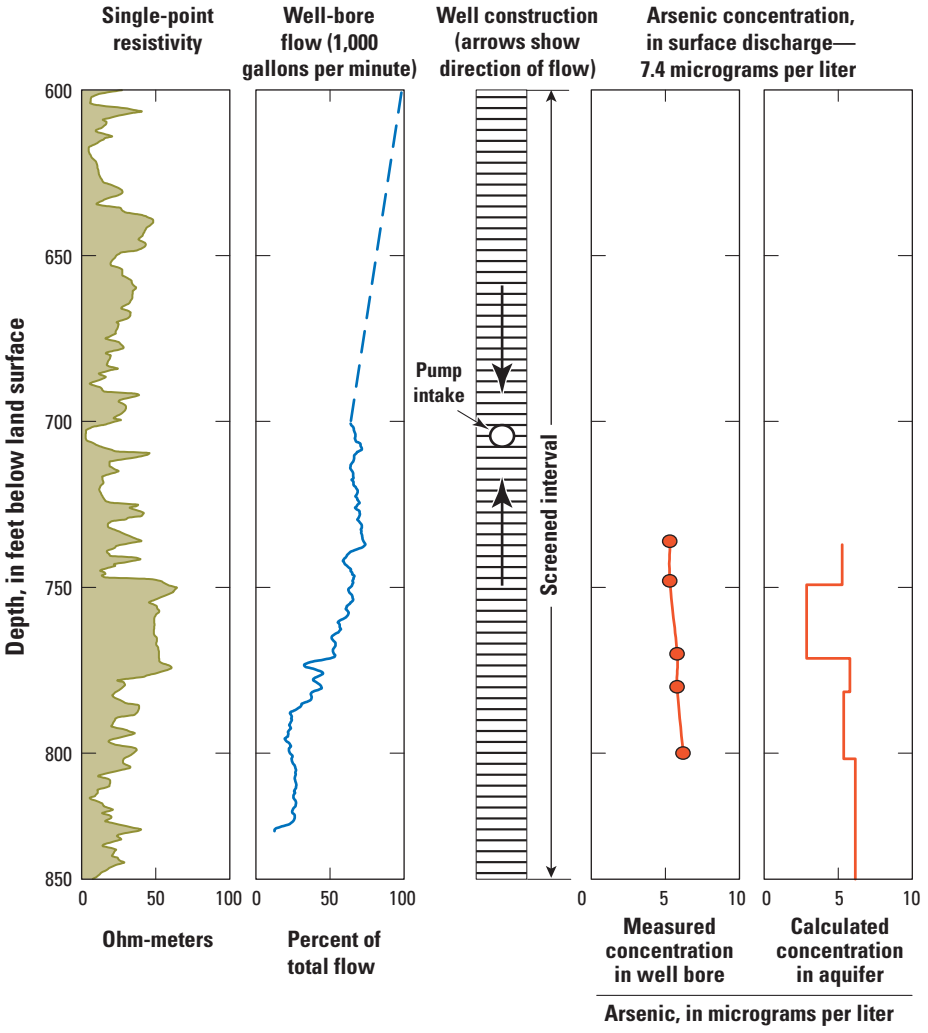


Figure 3. Depth-dependent water-quality data collected from production well 4N/5W-2H1 near Victorville, California.

1. The use of trade names in this fact sheet is for identification purposes only and does not constitute endorsement by the U.S. Geological Survey.