-----Original Message-----
From: Aaron Yue [mailto:ayue@dtsc.ca.gov]
Sent: Friday, December 03, 2010 5:39 PM
To: Hong, Christina/LAC; YJM1@pge.com
Cc: Anne Hoagland, EDAW; Jamie Cleland, EDAW, SD; Mark Capps; Steve Heipel, EDAW, Sac; Courtney Ann Coyle, Attorney for FMIT; Arlene Kingery, Fort Yuma Quechan Indian Tribe; Janis Lutrick, ARCADIS; Lisa Kellogg, Arcadis; Marshall Cheung, Twenty Nine Palms; William Anderson, Twenty-Nine Palms; Julie Riemenschneider, ADEQ; Amanda E. Stone, ADEQ; Thomas Di Domizio, ADEQ; Rebecca Heick, BLM; Craig J. Johnson, BLM; cwolff@blm.gov; George Shannon, BLM; Mark Calamia, BLM; Michael Johnson, BLM; Mike_Henderson@blm.gov; Ramone McCoy, BLM; bob.lucas@calobby.com; Steve Bigley, CBWD (e-mail only, not on CWG); Schroth, Brian/SAC; Carlson, Fritz/RDD; Vogt, Gerald/RDD; Piper, Jay/LAS; Eakins, Julie/BAO; Piper, Jay/LAS; Sheets, Keith/BAO; Barackman, Martin/RDD; Cavaliere, Mike/BAO; Bertucci, Paul/BAO; Lee, Serena/SDO; Jack Ehrhardt, Hulapai Indian Tribe; Patty@co.mohave.az.us; Rachel Patterson, Mohave Co DPH; Sherry Cordova, Cocopah Indian Tribe; Jill McCormick, Cocopah; Edmund Domingues, Cocopah; Paul Soto, Cocopah; Rick Newill, BOR; Abbas Amirteymoor, CRB; jcchen@crb.ca.gov; Lindia Liu, CRB; Richard Armstrong, CRITs; Douglas Bonamici, CRITs; Eric Shepard, Colorado Indian Tribe; Charley Land, CRIT Env. Prot. Off.; Michael Sullivan, FMIT Rep; Stefan Awender, DFG; Aaron Yue; Christina Fu; Christopher Guerre; Carolyn Yee; Guenther Moskat; Greg Neal; James Eichelberger; Jose Marcos; Karen Baker; Lori Hare; Mona Bontty; Nancy Long; Nancy Ritter; Shukla Roy-Semmen; kabei.arlene@epa.gov; kaplan.mitch@epa.gov; Steve Armann, US EPA; Christine Medley, FMIT; Linda Otero, Fort Mohave; Luke Johnson, FMIT; Nora McDowell-Antone, FMIT; Timothy Williams, Chairman, FMIT; Win Wright, Hualapai; Loretta Jackson, Hualapai Tribe; Shan Lewis, Fort Mohave; Carrie Marr, USFWS; Dick Gilbert, USFWS; Jean Calhoun, USFWS; Linda L. Miller, USFWS; Robb Pilkington, FWS; eric_fordham@geopentech.com; john_barneich@geopentech.com; tom_freeman@geopentech.com; Dawn Hubbs, Hualapai; Leo S. Leonhart, Hargis & Associates; Toni Sekunda, HSG for DOI; William Hirt, Quechan Indian Tribe, Ft. Yuma; LTJG Isabel Espinosa; Vincent Slayton-Garcia, IHS; Pamela_Innis@ios.doi.gov; drew@jdp-law.com; Mark Slaughter, BOR; Bart Koch, MWD; Mickey Chaudhuri, MWD; Stewart, Mic/EXT; Peter von Haam, MWD; sliang@mwdh2o.com; tfreeman@mwdh2o.com; Dwight A. Dutschke, Office of Historic Preservation; Curt Russell, PG&E; Glenn Caruso, PG&E; Juan Jayo, PG&E; Kevin Sullivan, Contract Engineer (for PG&E); rldl@pge.com; Gary Hansen, CRIT; Dave Fogerson, SDCWA; Casey Padgett, DOI; Melissa Derwart, US DOI; Steve McDonald; Brad Guay, Havasu NWR; Brian Farmer, USBOR; Jeff Smith; Valerie Thomas, USBOR; jaizbick@usgs.gov ; kgstolle@usgs.gov; pmmartin@usgs.gov; Jose Cortez, CRWQCB; Tom Vandenberg, SWRCB; Charles Wood, Chairman, Chemehuevi Tribe; Dennis Fagundes, Chemehuevi; Gilbert Parra, Chemehuevi Tribe; Eddie Williams, Fort Yuma-Quechan Tribe; Amanda Leivas-Sharpe, CRIT; Robb Pilkington, HNR; Shirley Smith, Chemehuevi Tribe
Subject: PG&E: East Ravine and TCS Work Plan Addendum

Greetings,

DTSC is formally transmitting comments on the East Ravine and Topock Compressor Station Work Plan Addendum that was prepared by CH2M Hill on August 27, 2010. On September 13, 2010, DTSC forwarded the Work Plan Addendum to the CWG, TWG and interested Tribes for a 30 day review and comment period. As a result, DTSC received written comments from the FMIT and the Hualapai. MWD also determined

that they do not have any specific comments. DTSC notes that the comments from FMIT and Hualapai Indian Tribe were carbon copied to PG&E when they were submitted to DTSC. However, to complete the administrative record, DTSC is formally transmitting these comments and DTSC's comments on the Work Plan Addendum to PG&E for response. DTSC understands that within the comment letters, there are non-technical comments by the Tribes that will require DTSC's input for resolution. DTSC requests that PG&E begin the response to comment process and work with DTSC on the responses to procedural comments.

Please note, in addition to the attached comments, there are conditions that we request PG&E to incorporate into the final workplan. These conditions and comments are as follows:

1. Pursuant to our July 28, 2010 direction letter to continue the groundwater characterization in East Ravine: "Once a well is installed, PG&E should conduct monthly sampling until further notice by DTSC. Validated analytical laboratory results from each monthly sampling event shall be submitted to DTSC no later than five weeks after the event. A Well installation Report shall be submitted to DTSC and DOI within 60 days after the last well is installed."

2. Footnote 1 of Table 1 attached to our July 28, 2010 direction letter specified: "Site K: At a minimum, a shallow water table well shll be constructed as per Figure 5 (Shallow Zone Monitoring Well) of the July 11, 2008 Work Plan."

3. As part of the work plan addendum, DTSC requests that PG&E add discussion in the work plan regarding repatriation of any clean soil removed during well installation process. Repatriation of uncontaminated site soil shall be conducted after discussion with interested Native American Tribes.

4. As part of the work plan addendum, DTSC requests that PG&E add discussion regarding site restoration after completion of investigation and remediation.

It is DTSC's goal to complete the responses and finalize the East Ravine and Topock Compressor Station Work Plan prior to the end of December 2010. DTSC requests that PG&E review the current project schedule and make all necessary adjustments to ensure the completion of the Work Plan in this timeframe.

If you have any questions concerning this matter, please feel free to contact me

Sincerely,

Aaron Yue
Senior Hazardous Substances Engineer
Geology, Permitting and Corrective Action Branch Cypress, California

Topock Project Executive Abstract

Document Title: Addendum to the Revised Work Plan for East Ravine Groundwater Investigation, PG&E Topock Compressor Station, Needles, California

Submitting Agency: California Department of Toxic Substances Control (DTSC), Department of the Interior (DOI)

Final Document? ☒ Yes ☐ No

Date of Document: 8/27/2010

Who Created this Document?: (i.e. PG&E, DTSC, DOI, Other)

PG&E

Priority Status: ☒ **HIGH** ☐ **MED** ☐ **LOW**
Is this time critical? ☒ Yes ☐ No

Type of Document:
☐ Draft ☐ Report ☐ Letter ☐ Memo

☒ Other / Explain: Work Plan Addendum

Action Required:
☐ Information Only ☒ Review & Comment
Return to: DTSC and DOI

By Date: per DTSC and DOI instruction
☐ 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
☐ 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?
Work Plan Addendum is required to be in compliance with DTSC's July 28, 2010 direction letter, and DOI's February 25, 2010 direction letter.

Other Justification/s:
☐ Permit ☐ Other / Explain:

Brief Summary of attached document:

This Addendum to the Revised Work Plan for East Ravine Groundwater Investigation (CH2M HILL, 2008) is submitted in conformance with DTSC's July 28, 2010 direction letter, and DOI's February 25, 2010 direction letter. The Plan presents the proposed approach for groundwater investigation in the East Ravine and Topock Compressor Station areas.

Written by: PG&E

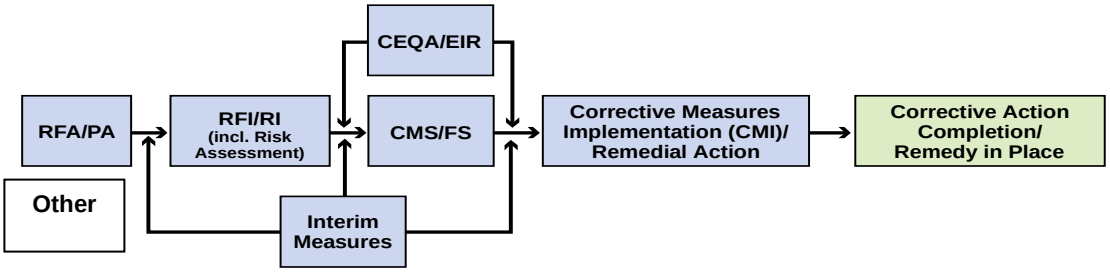
Recommendations:

How is this information related to the Final Remedy or Regulatory Requirements:
This Work Plan Addendum is required by DTSC's July 28, 2010 direction letter, and DOI's February 25, 2010 direction letter. The additional investigation will be conducted to collect information to enhance the understanding of the groundwater contamination in the East Rave area and evaluate the nature and extent of potential groundwater contamination beneath the Topock Compressor Station.

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).



Legend
RFA/PA – RCRA Facility Assessment/Preliminary Assessment
RFI/RI – RCRA Facility Investigation/CERCLA Remedial Investigation (including Risk Assessment)
CMS/FS – RCRA Corrective Measure Study/CERCLA Feasibility Study
CEQA/EIR – California Environmental Quality Act/Environmental Impact Report

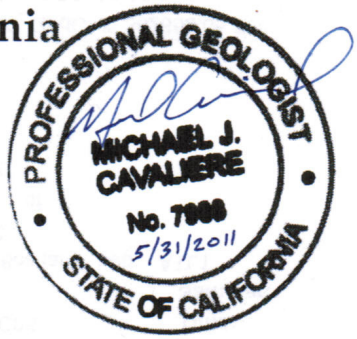
Addendum to the Revised Work Plan for East Ravine Groundwater Investigation, PG&E Topock Compressor Station, Needles, California

PREPARED FOR: Pacific Gas & Electric Company

PREPAR

DATE: August 27, 2010

DOI letter is joint DOI/DTSC letter. Make edits to note this including references.



Background

On February 24, 2010, the U.S. Department of the Interior (DOI) issued a letter entitled *PG&E Topock Compressor Station Remediation Site – Groundwater Characterization Requirements for the East Ravine and Compressor StationAreas* (DOI, 2010). This letter required that PG&E combine groundwater characterization activities for the Topock Compressor Station (TCS) site proposed in the *RCRA Facility Investigation/Remedial Investigation Soil Investigation Work Plan Part B* (Soil Inv 2007b) with additional characterization act East Ravine area of the site. Potential investigation locations and their rationales were discussed during the March 16 and April 15, 2010, Technical Working Group (TWG) meetings.

Include DTSC letter in reference list.

On July 28, 2010, the Department of Toxic Substances (DTSC) issued a letter to PG&E entitled *East Ravine and Compressor Station Well Installation, Pacific Gas and Electric Company, Topock Compressor Station, California (EPA ID NO. CAT080011729)* (DTSC, 2010). This letter directed PG&E to submit an addendum to the *Revised Work Plan for East Ravine Groundwater Investigation* (Work Plan) (CH2M HILL, 2008b) for approval by DTSC and DOI. The addendum to the 2008 Work Plan (Addendum) will be use groundwater characterization of the East Ravine area of th groundwater underneath the TCS.

Please include both direction letters as attachments to this Addendum as there are directives contained in the letters that are not explicitly discussed in the Addendum.

The 2008 Work Plan describes the objectives, technical app investigative methods, administrative approvals, implemer plans for the East Ravine Groundwater Investigation (ERGI), which was implemented in 2009. This Addendum describes the objectives for the combined ERGI/TCS investigation, the rationale for investigation locations, additional implementation items not included in the Work Plan, and a proposed schedule. Therefore, additional information related to the rationale for, and implementation of, the scope of work as directed in the July 28, 2010 letter from DTSC is provided as a supplement to the existing Work Plan. This Addendum is organized such that sections below directly correlate to the Work Plan.

1.0 Introduction

Background information for the TCS remediation project and the ERGI, including a detailed presentation of the conceptual model of East Ravine area groundwater conditions, is

presented in Section 1 of the Work Plan. Evaluation of the data collected during the implementation of the Work Plan in 2009, and the additional characterization data required based on the evaluation, was summarized in Appendix A of the *Final Corrective Measures Study/Feasibility Study Report for SWMU 1/AOC 1 and AOC 10 at the Pacific Gas and Electric Company Topock Compressor Station* (CMS/FS) (CH2M HILL, 2009).

Detailed information on the physical characteristics and setting of the Compressor Station, and the TCS site specifically, is presented in the Soil Investigation Work Plan, Part B (CH2M HILL, 2007b).

The TCS is situated on a topographic ridge that is divided into two terraces separated by approximately 30 to 50 feet in elevation – the upper and lower yards. The TCS is topographically lower than the Chemehuevi Mountains, which bound the area to the south. However, the TCS is bordered by steep slopes down to lower topographic areas on the north, east, and west. Bat Cave Wash, which is approximately 60 to 80 feet lower than the lower yard, bounds the site to the west. To the east, the East Ravine area and other topographically low areas bound the site approximately 70 to 100 feet lower in elevation. The steeply northward-sloping bedrock of the Chemehuevi Mountains extends beneath the TCS site and is overlain by unconsolidated sediments that are alluvial, and potentially fluvial, in origin. Miocene conglomerate bedrock is sporadically observed beneath portions of the site as down-thrown blocks in contact with the underlying metadiorite bedrock of the Chemehuevi Mountains.

Based on a limited number of data points, the depth to bedrock in the area varies from surface outcrops to the south to approximately 270 feet below ground surface (bgs) in the north at TW-1 (see Figure 1 of the Addendum). The estimated bedrock structure contour based on surface outcrops and borehole data collected through July 2009 is presented on Figure 1 of the Addendum. Based on projection of the approximate elevation to the groundwater table across the site (456 feet mean sea level [MSL]), saturated alluvium is expected to be present beneath the northern portion of the TCS site, while the top of bedrock is projected to rise above the groundwater table in the southern portion (toward the Chemehuevi Mountains). The monitoring network at the site is insufficient to determine the localized groundwater gradient beneath the TCS ridge. Based on water level data from the East Ravine area, horizontal gradients are expected to be consistent northeasterly, away from the mountain front (CH2M HILL, 2009c).

Constituents known to have been released from the TCS were released primarily as liquids (spills or discharges). Some constituents may also have been released as dust on the station (i.e., from sand blasting) and would have been deposited onto the ground surface. Released liquids would have preferentially infiltrated in areas of unpaved soils. Runoff would have been transported from the upper yard into the lower yard and/or could have been released to the low-lying areas surrounding the compressor station, including Bat Cave Wash, the Debris Ravine, the East Ravine, and the topographic low areas. Due to the relative lack of natural infiltration at the site (approximately 5 inches of rainfall per year) and the extremely high evapotranspiration rate of 70 to 80 inches per year, combined with the depth to groundwater of approximately 165 to 175 feet bgs, there is little potential for migration of COPCs from vadose zone soils to groundwater except in areas where there was ongoing release of liquids or in areas where runoff may have collected (CH2M HILL, 2007b). Liquids would be expected to infiltrate downward until they reach the water table, where they

Perched water has been identified in East Ravine area.

would move with the natural groundwater gradient. Perched groundwater conditions have ~~not~~ previously been observed at the Topock site~~; however,~~ if low-permeability perching layers or sloping bedrock surfaces ~~were~~ present in the unsaturated zone, infiltrating water could move down-dip along the sloping surface prior to merging with the regional aquifer. Chromium concentrations have been detected in groundwater monitoring wells screened in both the alluvium and the bedrock adjacent to the TCS ridge. These chromium concentrations are attributed to a known source in Bat Cave Wash; however, potential sources, if they exist, on the TCS or in the East Ravine could be a contributing factor.

As stated in the DOI's February 24 letter (DOI, 2010), the objectives for this investigation are as follows:

- East Ravine Area
  - Define the nature and extent of groundwater contamination within the bedrock and/or alluvium.
  - Identify the source(s) of bedrock groundwater contamination.
- TCS Site
  - Define the nature and extent of potential 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.

The TCS area represents a portion of the site for which only minimal characterization data has been collected to date. Therefore, with the coordination of DTSC and DOI, data quality objectives (DQOs) have been developed to guide the collection and use of data for the TCS site. The DQO analysis for the TCS investigation is presented in Attachment A.

During implementation of the Addendum, PG&E will continue to coordinate with stakeholders regarding field procedures to best preserve potentially affected environmental, cultural, and spiritual resources. PG&E also intends to conduct this work in a manner consistent with the conservation and mitigation measures discussed within the Programmatic Biological Assessment (CH2M HILL, 2007a).

2.0 Field Investigation and Drilling Activities

Section 2 of the Work Plan presented implementation topics including investigation overview; selection and rationale for the drilling sites; site preparation and access; and description of the drilling, well installation, groundwater characterization and sampling activities proposed or considered potentially applicable. This section of the Addendum includes supplemental information as it relates to the current scope of work.

2.1 Investigation Overview

A phased groundwater characterization and well installation program has been developed to address DTSC's July 28 directive (DTSC, 2010) for groundwater investigation in the East Ravine and TCS areas. Figure 2 shows the potential locations of monitoring wells. The area actually affected by field activities at each location will be smaller than that indicated on Figure 2 pending the results of surveys for utility, cultural, and biological resources. Per agency direction, wells will initially be installed at the nine primary drilling sites designated Sites 2 through 6 in the TCS area, and F, H, K, and L in the East Ravine area. The investigation rationale and specific information for each of the investigation locations is provided in Table 1. Based on this rationale, Sites 1, I, and J are included as contingent sites, where investigation may be required by the agencies pending the collection of data from other sites. Investigation at contingent sites will only be conducted as directed by DTSC and DOI.

TABLE 1
Drilling and Well Installation Plan
Addendum to the Revised Work Plan for East Ravine Groundwater Investigation
PG&E Topock Compressor Station, Needles, California

LOCATION INFORMATION				SITE DETAIL		
Site ID	**Site Priority**	**Rationale[1]**	**Contingency Rationale[1]**	**Est. Ground Surface Elevation (feet msl)**	**Est. Bedrock Depth (feet bgs)**	**Anticipate Saturated Alluvium?**
EAST RAVINE AREA INVESTIGATION SITES						
Site F	**Primary**	Monitor for vertical extent of contamination as per 2009 CMS Report	--	556	5	No
Site H	**Primary**	Assess upper reaches of wash east of Site A and monitor for migration from potential sources on the TCS.	--	525	65	Possibly
Site K	**Primary**	Monitor eastward extent of the plume.	--	510	10	No
Site L	**Primary**	Monitor eastward extent of the plume.	--	510	15	No
Site I (-Alt)	**Secondary**	Assess eastern extent of the plume, if needed.	Results from Site K or MW-64	520 (Alt = 560)	5 (Alt = 5)	No
TCS INVESTIGATION SITES						
Site 2	**Primary**	Monitor for eastward migration from potential source: Cooling Tower B (AOC 6). Monitor northward migration from TCS.	--	620	200	Yes
Site 3	**Primary**	Monitor for eastward migration from potential source: Cooling Liquid Mixing Area/Hot Well (AOC 19).	--	620	165	Possibly
Site 4	**Primary**	Monitor for southward migration from potential sources including Cooling Tower A (AOC 5).	--	620	30	No
Site 5	**Primary**	Monitor for migration from potential sources: Sludge Drying Beds (SWMU 5) and Chromate Reduction Tank (SWMU 6), and westward component from TCS.	--	595	140	Possibly

TABLE 1
Drilling and Well Installation Plan
Addendum to the Revised Work Plan for East Ravine Groundwater Investigation
PG&E Topock Compressor Station, Needles, California

LOCATION INFORMATION				SITE DETAIL		
Site ID	**Site Priority**	**Rationale[1]**	**Contingency Rationale[1]**	**Est. Ground Surface Elevation (feet msl)**	**Est. Bedrock Depth (feet bgs)**	**Anticipate Saturated Alluvium?**
Site 6	**Primary**	Monitor for westward migration from potential sources on the TCS.	--	595	200	Yes
Site 1	**Secondary**	Monitor for northward migration from potential TCS sources including Cooling Tower B (AOC 6). Selenium is a concern in this area (elevated at well TW-1 with long screen), but may be answered by Sites 2 and/or 6.	Results from Sites 2 and 6	620	220	Yes
Site J	**Secondary**	Monitor southern extent of the plume, if needed.	Results from Sites 4, 5, and H	673	5	No

Notes:
[1] Rationale provided by DTSC in July 28, 2010 direction letter.
TCS = Topock Compressor Station
bgs = below ground surface
msl = mean sea level

This is per the 2008 Workplan.

~~Per agency direction,~~ up to three separate boreholes are proposed at each investigation site to address the investigation objectives. For project planning purposes, borehole/well installation will be conducted according to the logic steps provided below. In accordance with the procedure used during the 2009 implementation of the Work Plan, PG&E will organize conference calls with the agencies and other interested stakeholders and tribes at key milestones during the investigation in order to reach consensus on the appropriate next steps. In general, the investigation will proceed as follows:

- The initial borehole at each location will be installed to characterize subsurface conditions based on one of the following scenarios:
  - **Top of bedrock is below the water table.** The borehole will be used to collect soil samples from the vadose zone, collect screening-level groundwater samples in the saturated alluvium, and determine the depth to bedrock. Monitoring well(s) will be installed within the borehole, as determined appropriate.
  - **Top of bedrock is below ground surface, but above the top of groundwater.** The borehole will be used to collect soil samples from the vadose zone and determine the top of bedrock. A monitoring well may be installed across the unsaturated contact of the bedrock and alluvium, as determined necessary. If a well is not installed across this contact, then the borehole will be used to characterize the upper 20 feet of saturated bedrock through the direct installation of a monitoring well.

  - **Bedrock is present at the ground surface.** The borehole will be used to characterize the upper 20 feet of saturated bedrock through the direct installation of a monitoring well.

- The second borehole, as determined necessary, will be installed to characterize groundwater conditions depending on the purpose of the initial borehole.
  - If the initial borehole was used for installation of monitoring well(s) in the saturated alluvium or across the unsaturated contact between the bedrock and alluvium, then the second borehole will be used to characterize the upper 20 feet of saturated bedrock through the direct installation of a monitoring well.
  - If the initial borehole was used for installation of monitoring well(s) to characterize the upper 20 feet of saturated bedrock, then the second borehole will be used to characterize deeper bedrock conditions, as determined appropriate.
- The third borehole will [illegible] collected from the initi[illegible]ation cannot be accomplished [illegible]

Is the decon. area by the route 66 sign necessary? Why not have it all at the staging area?

2.2 Site Preparation, Access, and Equipment Staging

The preparation and maintenance of each investigation site before and during investigation activities will be conducted as defined in the Work Plan. Proposed access routes for sites included in this Addendum, and equipment staging and decontamination areas, are shown on Figure 2. The specific drilling locations within the areas indicated on Figure 2 will be based on the results of utility, biological, and cultural resource surveys to ensure safe working distances from all hazards, as well as biological and culturally sensitive areas.

2.3 Borehole Drilling and Requirements

Drilling, core/borehole logging, and well construction will be performed under the supervision of a California Professional Geologist. The drilling, core/borehole logging, soil sample collection, and well construction activities will be conducted in accordance with the Work Plan and modified methods and standard operating procedures (SOPs) from the *Topock Program Sampling, Analysis, and Field Procedures Manual* (CH2M HILL, 2005).

As discussed in Section 2.1, up to three vertical boreholes will be drilled at each investigation location. The deeper borehole(s) will extend into the bedrock through a conductor casing installed through the alluvial interval, and potentially a portion of the bedrock interval, to isolate the borehole/well from shallower groundwater. The depth of the conductor casing, as determined necessary, will be based on data collected from shallower borehole(s) and well(s).

As discussed in the Work Plan, the drilling method used may vary depending on the conditions encountered. Rotosonic is the preferred method for drilling through unconsolidated sediments and, for limited applications, in consolidated bedrock. Rotosonic drilling has been effective in consolidated bedrock in the East Ravine area; however, the method may prove to be inadequate to reach deeper target intervals in bedrock beneath the TCS area. The wireline, diamond-bit core drilling method is preferred for drilling through bedrock, especially when obtaining relatively undisturbed core is necessary. For this

investigation, collection of relatively undisturbed bedrock core is anticipated for all bedrock intervals of interest, as practical. If the collection of bedrock core is determined impractical, the application of borehole geophysical testing, as detailed in Section 2.4.1 of the Work Plan, may provide adequate characterization data in place of the core log. If field conditions are such that rotosonic or wireline core drilling methods are not efficient or adequate to achieve the objectives of a given borehole, then other drilling methods listed in the Work Plan (e.g., mud rotary, hollow stem auger, etc.) may be employed.

Soil samples will be collected from the vadose zone of each of the TCS boreholes for laboratory analysis. Samples will be collected from the recovered rotosonic core at the depths of 0.5-1, 3, 6, 10, 15, and 20 feet bgs, and every 10 feet deeper until the water table or bedrock is encountered. Soil samples will be collected directly above bedrock, as practical. Soil samples will be analyzed in the laboratory for COPCs identified for the TCS area in the Soil Investigation Work Plan, Part B (CH2M HILL, 2007b) and subsequent response to comments correspondence with the agencies (CH2M HILL, 2008a). The analytical list for soil samples is presented in Table 2.

Once the water table is reached in the unconsolidated portion of the borehole, screening-level groundwater samples will be collected from discrete depths. The results of screening-level groundwater samples will be used to assist with field decisions related to this investigation; however, only groundwater samples collected from properly installed and developed monitoring wells will be included in final evaluation of nature and extent. The Isoflow® sampler or equivalent will be used for groundwater sample collection in the unconsolidated portion of the borehole.[1] This method allows relatively undisturbed groundwater samples to be collected at regular intervals so that a vertical profile of screening-level water quality data can be constructed. Samples will be collected from a 10-foot portion of the borehole at 20-foot intervals. The shallowest sample will be collected from an interval approximately 10 to 20 feet below the water table. Where feasible, a sample also will be collected from the zone just above the bedrock. The Isoflow® sampling system will be configured such that the water levels can be measured during pumping for Isoflow® sample collection. Recording the drawdown response for each zone purged may allow for qualitatively distinguishing low-, medium-, and higher-permeability zones within the boreholes tested. Attempts will be made to measure drawdown during pumping for Isoflow® sample collection.

[1] The Isoflow® sampling system is not appropriate for the collection of discrete interval groundwater samples from the consolidated portion of the borehole. The consolidated nature of the borehole prevents the formation from sealing against the outside of the drill casing, which will allow shallower water to enter the sample interval.

TABLE 2
Groundwater and Soil Sample Analysis Plan
Addendum to the Revised Work Plan for East Ravine Groundwater Investigation
PG&E Topock Compressor Station, Needles, California

Analyte	Analytical Method	Borehole Screening Samples	Post Well Development Samples	Monthly GW Sampling Events	Final GW Sampling Event	Soil
Field Analysis						
Specific conductance	field instrument	X[1]	X	X	X	
Oxidation reduction potential	field instrument	X[1]	X	X	X	
Dissolved oxygen	field instrument	X[1]	X	X	X	
pH	field instrument	X[1]	X	X	X	
Turbidity	field instrument	X[1]	X	X	X	
Temperature	field instrument	X[1]	X	X	X	
Laboratory Analysis						
Chemical Parameters						
Hexavalent chromium	Method EPA-218.6	X	X	X	X	
Hexavalent chromium	SW7199/ 3060A					X
Title 22 Metals	Methods SW6010B,SW6020A, SW7470A	X	X	X	X	X
Mercury	SW7471A					X
Mercury	SW7470A			X[2]	X[3]	
VOC	Method SW8260B			X[2]	X[3]	X
SVOC	Method SW8270C			X[2]	X[3]	
PAH	Method SW8270C-SIM			X[2]	X[3]	X
DRO, GRO, RRO	SW8015B			X[2]	X[3]	X
PCB	SW8082			X[2]	X[3]	X
Organochrlorine Pesticide	SW8081A			X[2]	X[3]	
Organochrlorine Herbicide	SW8151A			X[2]	X[3]	
TAL/TCL Compounds	various					X[4]
Dioxins/Furans	SW8290			X[2]	X[3]	X
General Chemistry Parameters						
Total dissolved solids	SM2540C			X	X[3]	
Total suspended solids	SM2540D			X	X[3]	
Chloride, Sulfate, Nitrate, Nitrite, Fluoride, Bromide, Phosphate	EPA 300.0			X	X[3]	
Alkalinity	SM2320B			X	X[3]	
Ammonia	EPA 350.2			X	X[3]	
General minerals (Ca, Mg, K, Na) (dissolved)	Method SW6010B			X	X[3]	
Iron (dissolved)	Method SW6010B			X	X[3]	
Manganese (dissolved)	Method SW6010B			X	X[3]	
Total Organic Carbon (TOC)	SW9060					X
Total Organic Carbon (TOC)	SM5310			X	X[3]	
pH	SW9045					X
Oxygen 18	CF-IRMS				X	
Deuterium	CF-IRMS				X	

Include nitrate for soils.

Notes:
[1] Field measurements will be made as practical
[2] Analyses will only be run during the initial monthly event associated with the shallowest well at each location.
[3] Analyses may be run pending review of initial sample results and discussion with DTSC and DOI.
[4] Soil samples will be analyzed for TAL/TCL compounds at a frequency of 10 percent. Samples analyzed with Method SW6010B may also be analyzed with Methods SW6020A, EPA 200.7 and EPA 200.8. Continuous flow isotope ratio mass spectrometry (CF-IRMS)

2.4 Bedrock Characterization

Deeper bedrock boreholes, which will be separated from the unconsolidated, and potentially shallower consolidated, portion(s) of the borehole by a grouted conductor casing, will be characterized using the methods detailed in Section 2.4 of the Work Plan, as determined appropriate.

2.5 Monitoring Well Installation

Well construction methods, materials, and design will vary depending on the conditions encountered and the associated objectives. Conventional, single-screen monitoring wells will be installed as detailed in Section 2.5.1 of the Work Plan, as determined appropriate. Unlike the conditions encountered in the East Ravine area, the thickness of the saturated, unconsolidated portion of the borehole may require the installation of a nested monitoring well such that two separate screened zones are established in one borehole. Well casing, screen, and borehole completion materials for nested wells are the same as those defined for conventional, single-screen monitoring wells. A design schematic for nested monitoring wells is provided on Figure 3.

As detailed in Section 2.5.2 of the Work Plan, the design of bedrock monitoring wells will also be determined based on the conditions encountered and the associated objectives. Potential well designs may include, but are not limited to, the use of equipment such as Solinst® CMT (Continuous Multilevel Tubing), FLUTe™ systems, inflatable packer systems, BarCad® systems, or equivalent. Factors that must be evaluated prior to selection of a well design include the number of zones to be monitored, the length of the monitored and sealed zones, the chemical constituents to be monitored, and the type of water level data required. Final well design will be chosen in consultation with the agencies prior to implementation, as was conducted during the 2009 implementation of the 2008 Work Plan, to ensure that future water quality and water level data collected at these locations are appropriate to meet the objectives of this Addendum.

As detailed in Section 2.5.3 of the Work Plan, surface completion for constructed wells will consist of a subsurface well vault, unless access and siting conditions allow for the installation of an above-ground steel, locking wellhead monument. Well development, and well survey and completion diagram activities, will be conducted as detailed in Sections 2.5.4 and 2.5.5 of the Work Plan, respectively.

2.6 Groundwater Sample Collection

Groundwater sample collection will be conducted using the methods and procedures detailed in the Work Plan. The approach to the frequency of groundwater sample collection from wells installed as part of this Addendum has been revised from that in the Work Plan. A revised groundwater sample analysis plan is presented in Table 2.

Immediately following development of a newly installed well, a sample will be collected for laboratory analyses of Cr(VI) and Title 22 metals. Once the well has reached hydraulic equilibrium following initial groundwater characterization, testing, and development, a groundwater sample will be collected per the SOP used for the Topock Groundwater Monitoring Program (GMP) as part of a recurring, monthly sampling event. As additional wells are installed, developed, and reach hydraulic equilibrium, they will be incorporated into the monthly sampling event. The initial monthly samples collected from the shallowest

well at each location will be analyzed in the laboratory for the full analytical list, as detailed in Table 2. The initial monthly samples from deeper wells at each location will be analyzed for Cr(VI) and Title 22 metals, as will subsequent monthly samples collected from all wells. Once all wells required as part of this Addendum are installed, one contemporaneous sampling event will be conducted for all groundwater monitoring wells installed as part of the original Work Plan and as part of this Addendum. As indicated in Table 2, the analytical list to be used for this contemporaneous sampling event will be determined after review of laboratory results from initial sampling events, and in consultation with DTSC and DOI. Following the contemporaneous sampling event, the wells installed as part of this Addendum will be incorporated, as appropriate, in the Topock GMP.

2.7 Site Restoration Activities

Investigation Sites I, I-Alt, K, and L are located on Havasu Nation Wildlife Refuge (HNWR) property managed by the U.S. Fish and Wildlife Service (USFWS). Site H is on PG&E property, but must be accessed using existing roadways on HNWR property. Sites 1 though 6, J, and J-Alt are located on PG&E property. With the exception of Site H, all areas have been previously disturbed and contain sparse to no vegetation. Site H is located in a previously undisturbed portion of the East Ravine wash, which contains sparse vegetation. Given the sparse vegetation in the proposed work areas, no formal site restoration and re-vegetation plan is anticipated. Temporary signage or other effects that may be erected during well construction will be removed upon completion of drilling and well installation activities. After well installation at the sites located on HNWR/USRWS property, PG&E will work with the agencies to implement potential restoration at the drilling sites (if required) and to minimize future disturbance from post-installation groundwater monitoring activities.

3.0 Waste Management and Decontamination

Investigation-derived wastes (IDW) will include liquids (groundwater, drilling fluids, and decontamination rinsate), drill cuttings, and incidental trash. All IDW will be collected as detailed in Section 3.1 of the Work Plan and will be stored at the staging areas shown on Figure 2. Liquids generated during well drilling, well development, and sampling activities will be processed at the IM No. 3 treatment plant or transported to a PG&E-contracted offsite disposal facility, as appropriate, based on the results of characterization samples. Drill cuttings and incidental trash will be processed as detailed in the Work Plan.

Equipment decontamination will be conducted as detailed in Section 3.2 of the Work Plan. However, all decontamination activities will be conducted on the engineered decontamination pad (see Figure 2), which has been constructed since the development of the Work Plan.

4.0 Approvals and Authorizations

Section 4 of the 2008 Work Plan presents the anticipated approvals required to implement this Addendum, as well as details pertaining to the various biological and cultural considerations. Although the anticipated approvals and various biological and cultural considerations do not differ largely from those included in the Work Plan, for the sake of

completeness, this information is presented in the following subsections in detail in the context of the Addendum to the Work Plan.

4.1 Anticipated Approvals

Implementation of this Addendum will require prior approval from DTSC and DOI pursuant to their authority under the Resource Conservation and Recovery Act (RCRA) and Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), respectively. Anticipated approvals and authorizations for implementation of the groundwater investigation outlined in this Addendum are listed in Table 3.

TABLE 3
Approvals and Authorizations for Drilling and Well Installation
Addendum to the Revised Work Plan for East Ravine Groundwater Investigation
PG&E Topock Compressor Station, Needles, California

Agency/Organization	Approvals and Authorizations
U. S. Department of Interior (DOI)/Havasu National Wildlife Refuge (HNWR)	Approval letter from DOI/HNWR anticipated. Approval subject to National Historic Preservation Act (NHPA) Section 106 and Endangered Species Act (ESA) Section 7 consultations (see below).
California Department of Toxic Substances Control (DTSC)	As state lead agency, approval letter from DTSC is required. California Environmental Quality Act (CEQA) compliance anticipated to occur via a Categorical Exemption.
California Department of Fish and Game (CDFG)	Project activities have been previously authorized by Streambed Alteration Agreement No. 1600-2005-0140-R6.
California Department of Transportation (Caltrans)	Project activities within I-40 right-of-way (Site L) will require an update to existing Caltrans encroachment permit number 08-10-6-SV-0430.
U S. Bureau of Land Management	DOI lead with Section 7 ESA requirements. Guides work plan compliance within the scope of the Programmatic Biological Assessment (CH2M HILL, 2007a) and conducts associated Section 7 consultation.
State Historic Preservation Office (SHPO)	U. S. Fish and Wildlife Service HNWR approval subject to NHPA Section 106 process involving a minimum 30-day Tribal consultation followed by a minimum 30-day SHPO consultation.
San Bernardino County	Compliance with substantive well drilling permit requirements. Administrative requirements (such as obtaining well permits) are exempt under CERCLA permit exemption (DOI memorandum dated November 16, 2007)
Private Pipeline Companies	As needed, activities located in the right-of-way of any pipelines will be subject to prior coordination with the owner/manager of the associated facilities.

Portions of the proposed activities are located on the HNWR, which is managed by the USFWS. The DOI is the parent agency of the USFWS, and the anticipated approval mechanism is an approval letter from the DOI. It is expected that the DOI's approval letter will address CERCLA approval, as well as conditions imposed to comply with Section 7 of the Endangered Species Act (ESA) and Section 106 of the National Historic Preservation Act (NHPA).

As discussed further in Section 4.2, Biological Evaluation, the proposed Addendum activities will be conducted in a manner consistent with the Programmatic Biological Assessment (CH2M HILL, 2007a), and therefore in compliance with ESA requirements.

Compliance with Section 106 of the NHPA is expected to involve a minimum 30-day consultation with local Native American tribes, followed by a minimum 30-day consultation with the State Historic Preservation Office (SHPO).

Approval from the DTSC is subject to compliance with the California Environmental Quality Act (CEQA). It is anticipated that the subject activities qualify for an exemption from CEQA, pursuant to Section 15061 of the CEQA Guidelines.

Portions of the work plan activities are within the jurisdiction of the California Department of Fish and Game (CDFG), pursuant to Section 1600 *et seq.* of the Fish and Game Code. Compliance with Section 1600 requirements is provided via the existing CDFG Streambed Alteration Agreement No. 1600-2005—0140-R6, as amended in January 2007.

Investigation Site L is located within of the right-of-way (ROW) maintained by the California Department of Transportation (Caltrans). Therefore, it is anticipated that an update to existing Caltrans encroachment permit number 08-10-6-SV-0430 will be required.

Pipeline infrastructure that is owned and/or maintained by private entities is located at and near the project site; approximate locations are shown on Figure 2. Before field work, the precise ROW of any nearby pipelines will be determined, and coordination will occur as needed with the affected pipeline company to obtain prior approval and comply with applicable requirements. In addition, before implementation of the subject activities, Underground Service Alert notifications will be made so that utility companies can locate and mark the locations of their underground facilities.

CERCLA exemption to the well permitting administrative requirements of the County of San Bernardino will be verified before any drilling activities.

4.2 Biological Evaluation

The approved PBA (CH2M HILL, 2007a) and associated ESA Section 7 consultation addressed a variety of PG&E Topock remedial and investigative actions at the project site, including those identified in this work plan. The PBA provides programmatic coverage of remedial and investigative actions up to the final remedy (expected by 2012) and avoids the need for project-specific consultations under the federal ESA. Groundwater characterization activities, such as those proposed at the East Ravine and TCS areas, are addressed in Section 3.3.1 of the PBA (CH2M HILL, 2007a) as a Category 1 activity (i.e., well installation, maintenance, and operation). Applicable, measures are identified in the PBA to offset potential impacts resulting from this category of activity.

The purpose of this biological evaluation is to outline the proposed groundwater characterization activities at the East Ravine and TCS areas as they relate to federally listed species and to determine if the actions are within the context and boundaries of the PBA, as requested by the DOI Bureau of Land Management (BLM). To achieve this purpose, this section discusses project timing, project location and habitat sensitivity, habitat loss, conservation measures, listed species determinations, and conclusions.

The federally listed species being considered and evaluated include the southwestern willow flycatcher (SWFL—*Empidonax traillii extimus*), Yuma clapper rail (*Rallus longirostris yumanensis*), Mojave desert tortoise (*Gopherus agassizii*), bonytail chub (*Gila elegans*), and razorback sucker (*Xyrauchen texanus*).

4.2.1 Project Timing

The proposed work plan activities are estimated to commence in the first half of 2011. The precise start date is contingent upon receipt of necessary approvals and authorizations as discussed in Section 4.1. Because of the proximity of investigation Sites I, K, and L to riparian habitat, nesting migratory birds may be in the area during the bird nesting season, defined as March 15 to September 30 in the PBA. During these periods, a biological monitor would be in the field to conduct preconstruction surveys for nesting birds upon equipment setup at each location. Construction activity at these sites may be allowed to occur during this time period, subject to appropriate conservation measures described below in Section 4.2.4 of this work plan (e.g., nesting bird surveys and establishment of sufficient buffers).

Investigation Sites 1 through 6, H, J, and J-Alt are located within PG&E's compressor station property, and are sufficiently upland from the sensitive riparian habitat along the Colorado River such that no direct or indirect effects to avian species would result. Similarly, Sites F, I, and I-Alt are located over 200 feet from sensitive riparian habitat identified in the PBA and therefore are not expected to be subject to the nesting bird restrictions established in the PBA.

4.2.2 Project Location and Habitat Sensitivity

Investigation Sites 1 through 6, J, and J-Alt are located within the property boundary of the PG&E compressor station. This industrialized area is located upland from the Colorado River floodplain and does not include sensitive biological habitat. Investigation Sites F, I, I-Alt, and K are located on the HNWR and Site L is located within a Caltrans right-of-way on HNWR property, which are several hundred feet upland of the Colorado River floodplain. Project activity at these sites will be limited to the existing roadways and immediately adjacent areas. Site H is located on a non-industrialized portion of PG&E property several hundred feet upland of the Colorado River floodplain.

4.2.3 Habitat Loss

Habitat loss is not anticipated to occur during well installation activities; these sites are primarily within or adjacent to existing access roads. Well installation activities at Site H may require limited crushing of vegetation (non-sensitive species). Crushed vegetation is expected to recover after the drilling activity is done. Therefore, the proposed work plan activities described herein would conform to the cumulative limits of 2.5 acres of floodplain habitat loss and 3.0 acres of upland habitat loss prescribed in the PBA. Additional conservation measures applicable to the work plan activities are described below.

4.2.4 Conservation Measures

The work plan activities related to investigation Sites I, K, and L would conform to the applicable conservation measures specified for nesting migratory birds, including minimizing habitat loss. Per the PBA, the proposed work areas are outside of the defined SWFL and Avian habitats, but in the vicinity of riparian habitat which may support nesting birds during the nesting season. Construction activity at these sites is contingent may be conducted outside of the bird nesting season to minimize impacts to potentially sensitive riparian habitat. If construction activity at these sites occurs during the bird nesting season, a preconstruction survey for nesting birds will be conducted and construction activity

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within 200 feet of active nesting areas would be prohibited in accordance with the measures established in the PBA. All other investigation sites are located sufficiently upland from the Colorado River floodplain (i.e., over 200 feet) to avoid potential impacts to riparian areas.

Groundwater sampling at the investigation Sites I, L, and K, and other well operation and maintenance activities subsequent to construction may be subject to the modified floodplain sampling procedures referenced in the PBA. These procedures are in effect during the SWFL nesting season (defined as May 1 through September 30 in the PBA) and may be applicable to access and sampling at investigation Sites I, K, and L. Due to the distance from sensitive riparian habitat on the Colorado River floodplain, all other investigation sites would not be subject to these modified procedures.

Implementation of the work plan activities will also be subject to the applicable general management measures provided for in the PBA. This is expected to include designation of a field contact representative (FCR) responsible for overseeing compliance with applicable mitigation measures, construction awareness training, and preparation of a construction completion report that includes a quantification of impacted habitat.

4.2.5 Listed Species Determinations

Southwestern willow flycatcher. Through application of the conservation and management measures referenced above and described in detail in the PBA, the potential direct or indirect effects of the proposed work plan activities to the SWFL are expected to be either insignificant or discountable. A determination of "may affect, but not likely to adversely affect" is concluded for this species. This determination is within the context of the PBA.

Yuma clapper rail. Prior surveys conducted at the project site and documented by the PBA have not indicated the presence of Yuma clapper rail in the vicinity of the proposed work plan activities. The application of conservation and management measures referenced above would serve to further limit the potential direct or indirect effects to the Yuma clapper rail, which are expected to be either insignificant or discountable. A determination of "may affect, but not likely to adversely affect" is concluded for this species. This determination is within the context of the PBA.

Mojave desert tortoise. This action will have no direct effect upon this species. The USFWS protocol surveys that were performed in 2004, 2005, 2006, and 2007 resulted in no recent evidence of species presence within the Area of Potential Effect (APE). Therefore, any potential direct effects will be avoided. This determination is within the context of the PBA.

Razorback sucker. This action will have no effect upon this species. The project will not occur within the Colorado River or 100-year floodplain as delineated in the PBA. Therefore, potential direct and indirect effects to this species will be avoided. This determination is within the context of the PBA.

Bonytail chub. This action will have no effect upon this species. The work plan activities will be proximate to, but will not occur within the designated critical habitat for this species, which is coincident with the Colorado River 100-year floodplain. No direct or indirect impacts to critical habitat or the bonytail chub would result from implementation of the work plan activities. This determination is within the context of the PBA.

4.2.6 Conclusion

The activities proposed in this work plan are within the context and boundaries outlined in the PBA, including the general management measures, mitigation measures, and BLM Lake Havasu Field Office. Therefore, this action will be compliant with the federal ESA provided that applicable mitigation measures identified in the PBA are implemented. Additional consultation with the USFWS is not required.

4.3 Archaeological Surveys, Reviews, and Consultations

The area subject to activities described in this Addendum was included in an archaeological survey of the Area of Potential Effect (APE) (Applied Earthworks, 2007). AE reexamined all work areas and access routes in July 2010. Only one significant archaeological resource was found in this area; a small portion of historic Route 66 (CA-SBR-2910H) is located along existing gas pipeline (Lines 300A and 300B) routes and road alignments in this area. Investigation Sites K and I are in proximity to this section of Route 66. This portion of Route 66 has been greatly disturbed by the construction of Line 300B. Examination of this area as part of the 2009 implementation of the Work Plan and subsequent site walks indicated that only a very small portion of the original Route 66 pavement appears intact. Although deteriorated, the original Route 66 guardrail is still in place at a majority of this location. The narrow roadbed and guardrail at this portion of Route 66 provides this NRHP property with integrity of location and feel. The general configuration and historic guardrail at this section of Route 66 will be protected so as to not impact the integrity of location and feel of this NRHP historic property.

Activities at drilling Sites 1 through 6, F, H, I-Alt, J, J-Alt, and L present no potential to impact the historic pavement and guardrail noted above. Both of the historic sites will be protected from work activities at Sites I and K and will be monitored at the beginning, and periodically during, the course of the work. The PG&E Field Contact Representative (FCR) will be responsible for providing archaeological resources sensitivity training to the workers implementing this Addendum and for ensuring compliance with all applicable archaeological resources protective measures during drilling activities.

The TCS site and adjacent lands are contained within a larger geographic area that is considered sacred by the Fort Mojave Indian Tribe and by other Native American tribes. In recognition of this, work activities will be conducted in a manner that recognizes and respects these resources and the spiritual values of the surrounding lands. PG&E understands that the environmental, cultural, and spiritual resources may not be physically perceptible. To this end, worker site orientation will stress that all site activities must be conducted in a respectful manner that is conscious of this context. In addition, PG&E will contact the tribes which have in the past expressed a desire for tribal monitors. In the event there is a desire to monitor this work, PG&E will make arrangements for monitoring of field activities, if acceptable to the landowner and if consistent with security and health and safety considerations.

5.0 Schedule and Reporting

The estimated project implementation schedule is presented on Figure 4. As illustrated, field investigation at all nine primary locations, not including contingency locations, is estimated to require 6 to 8 months, depending on the extent of characterization required at each

location. The date and schedule for conducting the primary drilling, investigation, and reporting activities are subject to obtaining approvals and authorizations from DTSC, DOI, HNWR, and other agencies, as described in Section 4. Once all approvals and authorizations are obtained, a more detailed implementation schedule that includes conference calls to discuss field data as it becomes available will be provided to DTSC and DOI.

The results of all investigation activities conducted as part of this Addendum will be included in a summary report for submittal to DTSC and DOI. This report will include a summary of investigation activities conducted; evaluation of the data collected as part of the investigation; and associated conclusions and recommendations as they relate to the project objectives. The summary report will be submitted to the agencies approximately 9 weeks after the receipt of validated groundwater analytical data collected during the contemporaneous groundwater sampling event.

References

Applied Earthworks. 2007. *Archaeological and Historical Investigations, Third Addendum: Survey of the Original and Expanded APTE: Topock Compressor Station Site Vicinity, San Bernardino County, California.* Report prepared for Pacific Gas and Electric Company, San Francisco.

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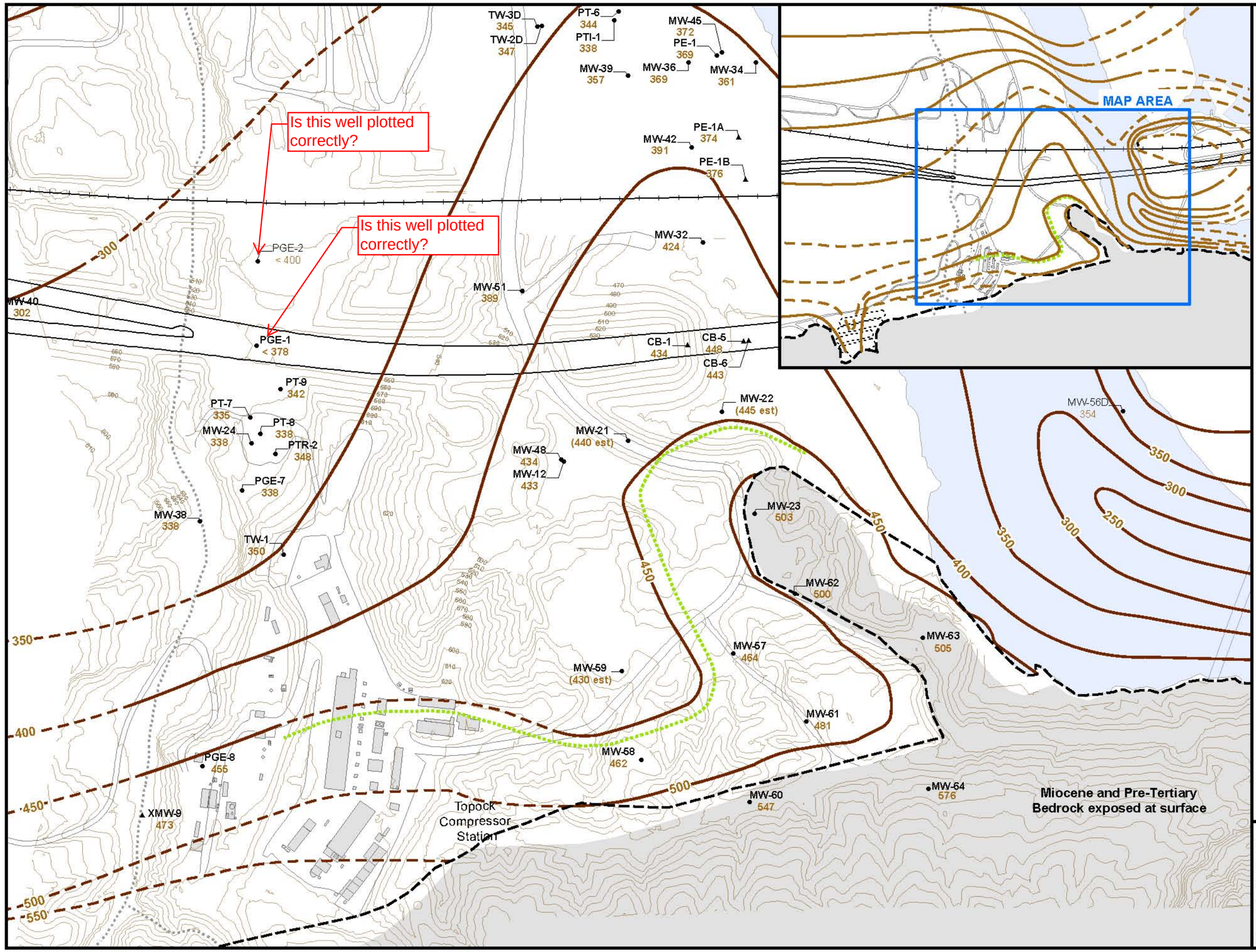
U.S. Department of Interior (DOI). 2010. *PG&E Topock Compressor Station Remediation Site – Groundwater Characterization Requirements for the East Ravine and Compressor Station Areas.* February 24.

Figures



N

0 150 300 450 Feet

LEGEND

MW-41 ● 177 — Elevation of Bedrock in feet above mean sea level (MSL)

(326 est) — Bedrock elevation estimated from cross-section

< 240 — Bedrock elevation deeper than elevation of total depth of boring (data posted for selected locations)

Bedrock elevation contour (feet MSL)

350 — Contours are dashed where inferred from USGS seismic surveys and extended beyond drilling locations.

Ground Surface Elevation Contours 10-foot Interval

Approximate bedrock / Alluvial Aquifer contact at elevation 456 ft MSL.

Notes:

The bedrock structure map has been updated July 2009 with drilling data from 2009 East Ravine groundwater investigation.

FIGURE 1
BEDROCK STRUCTURE CONTOUR MAP

ADDENDUM TO THE REVISED WORK PLAN FOR THE EAST RAVINE GROUNDWATER INVESTIGATION
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

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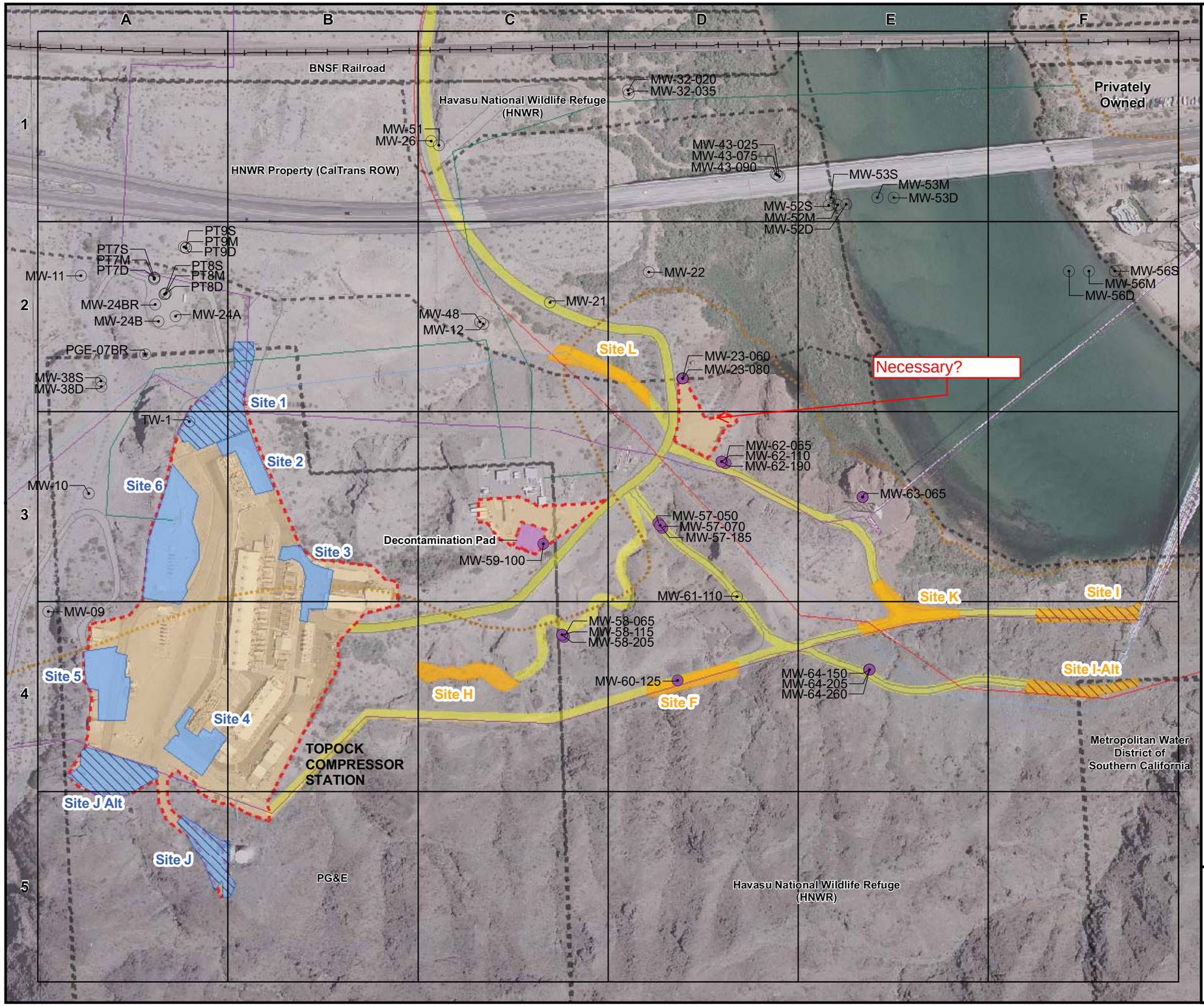

LEGEND

- Monitoring Well
- Monitoring Well - ERGI
- Transwestern Pipeline
- Mojave Pipeline
- PG&E Pipeline
- SoCal Gas Pipeline
- Equipment Decontamination Area
- Contigency Site
- Proposed TCS Drilling Location
- Proposed ERGI Area Drilling Location
- Equipment Staging Area
- Approximate bedrock / Alluvial Aquifer contact at elevation 456 ft MSL.
- Access Route
- Property Line

N

0 250 500 Feet

FIGURE 2
SITE PLAN FOR EAST RAVINE AND COMPRESSOR STATION GROUNDWATER INVESTIGATION

ADDENDUM TO THE REVISED WORK PLAN FOR THE
EAST RAVINE GROUNDWATER INVESTIGATION
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

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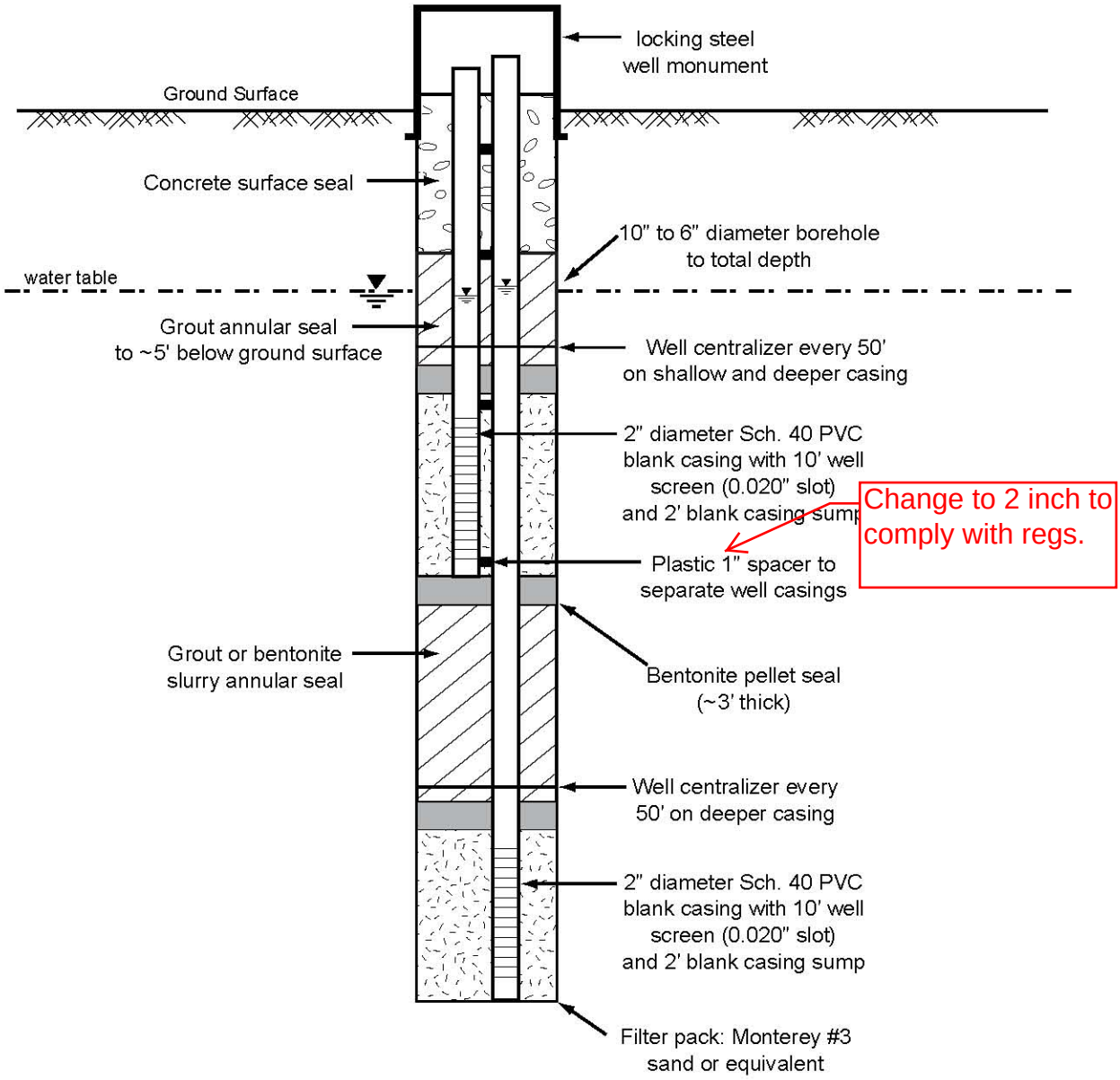

FIGURE 3
SCHEMATIC OF
NESTED WELL CONSTRUCTION
ADDENDUM TO THE REVISED WORK PLAN
FOR EAST RAVINE GROUNDWATER INVESTIGATION
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

DIAGRAM NOT TO SCALE
All depths in feet below ground surface (bgs)
are approximate and will be determined based
on drilling log and Isoflow(™) sampling.

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ES081210104015BAO_Fig3_Schematic_NestedWellConstr.ai_081710_lho

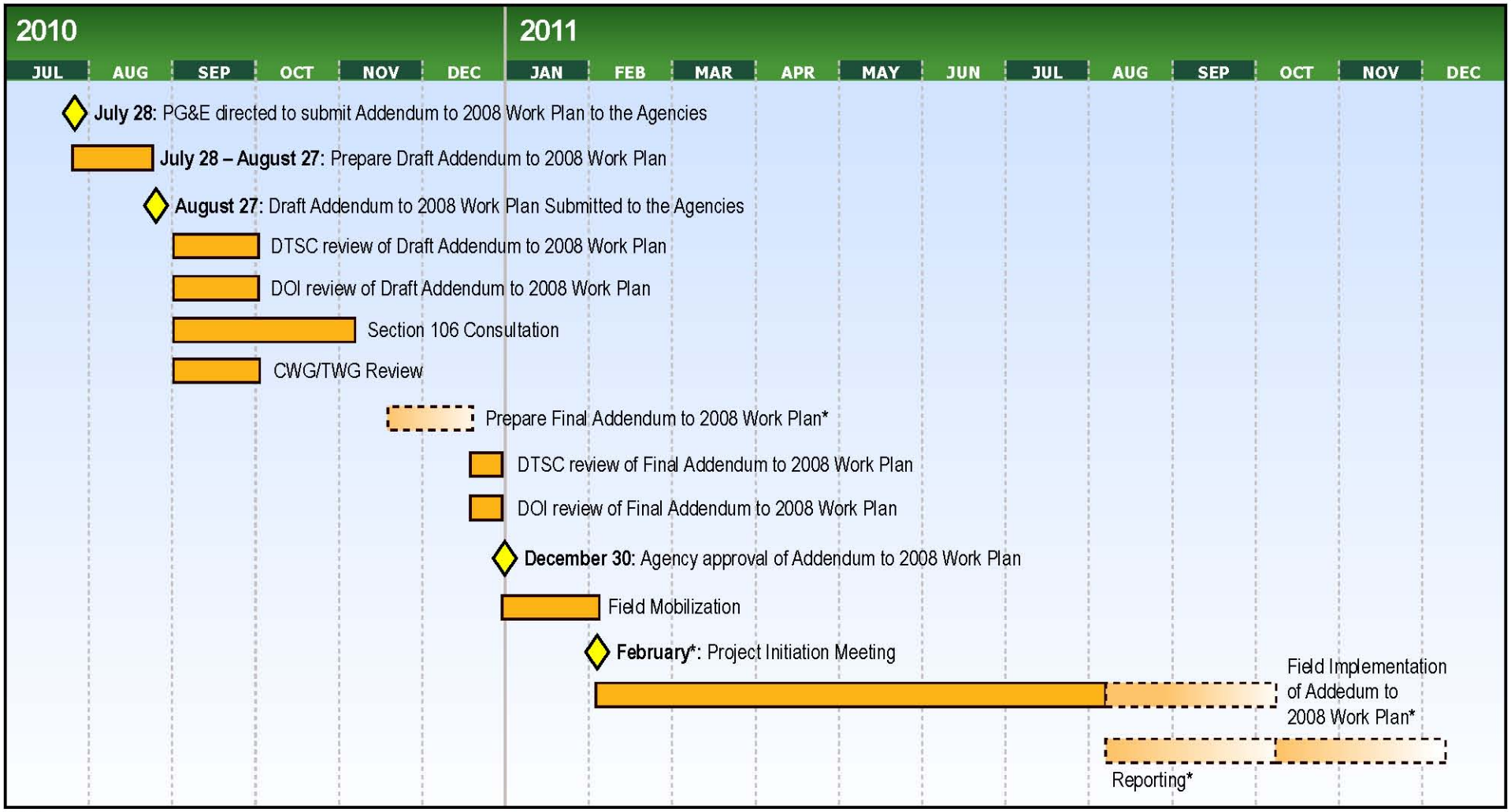

FIGURE 4
Estimated Implemenation Schedule
Addendum to the Revised Work Plan for
East Ravine Groundwater
PG&E Topock Compressor Station
Needles, California

ATTACHMENT A

Data Quality Objectives

ATTACHMENT A

Data Quality Objectives

This Attachment to the Addendum provides Data Quality Objectives (DQOs) for groundwater investigation on the Topock Compressor Station (TCS) site.

The DQOs for the TCS Groundwater Investigation are provided in Table A-1, and the associated decision flow chart is provided in Figure A-1. This section provides a corresponding detailed description of the assumptions for each step and the process for implementing each step.

Step 1: Problem Statement

Step 1 consists of defining the problem and includes review of existing information; development of a conceptual site model (CSM) of the environmental hazard to be investigated; summary of release, migration, and exposure pathways; identification of the planning team; identification of available resources, and constraints. These components are described in detail below.

Problem Definition

The overall problem statement for the TCS Groundwater Investigation is:

Historical practices within the TCS fence line, which is located on a topographic ridge, may have contributed to the contamination of groundwater immediately below the TCS. The nature and direction of potentially contaminated groundwater flow beneath the TCS ridge-top is not well understood on the local scale, and is potentially complicated by a northward-sloping configuration of the contact between the unconsolidated alluvium and consolidated bedrock interface beneath the TCS. The potential presence and migration behavior of contaminated groundwater should be assessed to support engineering design of the groundwater remedy.

Site-specific information is needed to:

- Determine the nature and extent of potentially contaminated groundwater beneath the TCS.
- Estimate migration direction and pathways for contaminated groundwater in support of the remedial design.

The nature and extent of groundwater chemicals of potential concern (COPCs) below the TCS topographic ridge top must be defined to assist in the design of the groundwater remedy to address potential contamination beneath the station. As part of understanding the nature and extent of potential contamination, the migration direction and pathways for potential contaminated groundwater must be understood in sufficient detail laterally and vertically to support remedial design.

The data collected as part of the TCS Groundwater Investigation is essential to understanding whether residual soil concentrations resulting from historic TCS activities are a source of groundwater contamination. However, it is not possible to definitively make this determination based on groundwater data alone. The data collected as part of the TCS groundwater investigation will be evaluated with data collected during the future Soil Part B investigation (TCS soil investigation) to assess whether residual soil concentrations resulting from historic TCS activities are a source of groundwater contamination. Separate DQOs are being developed for the TCS soil investigation. Therefore, these DQOs are focused on the evaluation of the nature and extent of groundwater contamination in the context of main plume remedy design as opposed to source determination.

Conceptual Site Model

A CSM is a schematic representation of how constituents released from a source may be transported to the surrounding environmental media and ultimately may come into contact with human or ecological receptors. A CSM includes known and suspected sources of contamination, types of constituents and affected media, known and potential routes of migration, and known or potential human and environmental receptors.

The CSM developed for the groundwater underneath the TCS provides the framework for evaluating where and to what depths investigations should occur and the factors that must be considered in installing the proposed monitoring wells. Information on contaminant transport and migration mechanisms and potentially exposed receptors helps guide the necessary investigation of the lateral and vertical extent of contamination. A CSM for the groundwater underneath the TCS is presented in Section 1 of the *Addendum to the Revised Work Plan for East Ravine Groundwater Investigation* (Addendum), to which this DQO analysis is attached. The focus of the CSM is on the occurrence and movement of groundwater beneath the TCS.

The CSM relies on the detailed information regarding the physical characteristics and setting of the study area – including surface features, meteorology, site geology, surface water hydrology, and site hydrogeology – presented in Appendix A of the Draft Soil Part B Work Plan and Appendix A of the Final Corrective Measures Study/Feasibility Study (CMS/FS) (CH2M HILL, 2009c).

Constituent Release, Migration, and Potential Exposure Pathways

The TCS is situated on a topographic ridge that is divided into two terraces separated by approximately 30 to 50 feet in elevation – the upper and lower yards. The TCS is topographically lower than the Chemehuevi Mountains, which bound the area to the south. However, the TCS is bordered by steep slopes down to lower topographic areas on the north, east, and west. Bat Cave Wash, which is approximately 60 to 80 feet lower than the lower yard, bounds the site to the west. To the east, the East Ravine area and other topographically low areas bound the site approximately 70 to 100 feet lower in elevation. The steeply northward-sloping bedrock of the Chemehuevi Mountains extends beneath the TCS site and is overlain by unconsolidated sediments that are alluvial, and potentially fluvial, in origin. Miocene conglomerate bedrock is sporadically observed beneath portions of the site as down-thrown blocks in contact with the underlying metadiorite bedrock of the Chemehuevi Mountains.

Based on a limited number of data points, the depth to bedrock in the area varies from surface outcrops to the south to approximately 270 feet below ground surface (bgs) in the north at TW-1 (see Figure 1 of the Addendum). The estimated bedrock structure contour based on surface outcrops and borehole data collected through July 2009 is presented on Figure 1 of the Addendum. Based on projection of the approximate elevation to the groundwater table across the site (456 feet mean sea level [MSL]), saturated alluvium is expected to be present beneath the northern portion of the TCS site, while the top of bedrock is projected to rise above the groundwater table in the southern portion (toward the Chemehuevi Mountains). The monitoring network at the site is insufficient to determine the localized groundwater gradient beneath the TCS ridge. Based on water level data from the East Ravine area, horizontal gradients are expected to be consistent northeasterly, away from the mountain front (CH2M HILL, 2009c).

Constituents known to have been released from the TCS were released primarily as liquids (spills or discharges). Some constituents may also have been released as dust on the station (i.e., from sand blasting) and would have been deposited onto the ground surface. Released liquids would have preferentially infiltrated in areas of unpaved soils. Runoff would have been transported from the upper yard into the lower yard and/or could have been released to the low-lying areas surrounding the compressor station, including Bat Cave Wash, the Debris Ravine, the East Ravine, and the topographic low areas. Due to the relative lack of natural infiltration at the site (approximately 5 inches of rainfall per year) and the extremely high evapotranspiration rate of 70 to 80 inches per year, combined with the depth to groundwater of approximately 165 to 175 feet bgs, there is little potential for migration of COPCs from vadose zone soils to groundwater except in areas where there was ongoing release of ere runoff may have collected (CH2M HILL, 2007b). Liquids would be lownward until they reach the water table, where they would move with the natural groundwater gradient. Perched groundwater conditions have not previously been observed at the Topock site; however, if low-permeability perching layers or sloping bedrock surfaces were present in the unsaturated zone, infiltrating water could move down-dip along the sloping surface prior to merging with the regional aquifer. Chromium concentrations have been detected in groundwater monitoring wells screened in both the alluvium and the bedrock adjacent to the TCS ridge. These chromium concentrations are attributed to a known source in Bat Cave Wash; however, potential sources, if they exist, on the TCS or in the East Ravine could be a contributing factor.

Revise. See previous edit.

Planning Team

The planning team for the TCS Groundwater Investigation consists of PG&E, the California Department of Toxic Substances Control (DTSC), the U.S. Department of the Interior (DOI), interested stakeholders, and the Tribes. Designated representatives from these organizations met prior to the development of these DQOs to determine the appropriate number of wells and the approach to well installation sequencing for Step 7.

Resources, Constraints, and Deadlines

Resources available to complete the TCS Groundwater Investigation and subsequent steps in the Resource Conservation and Recovery Act (RCRA) and Corrective Action and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) programs consist of PG&E staff and consultants, DTSC and DOI staff and consultants,

interested stakeholders, and Tribal staff and consultants. Resources are limited in terms of available knowledgeable staff and project deadlines (as outlined in the project "rainbow" schedule).

There are substantial constraints on the groundwater investigation effort. Physical constraints within the TCS include buildings in active use, aboveground pipelines set at heights ranging from several inches to more than 8 feet above ground, and subsurface high-pressure gas lines and other utilities. The remote location of the TCS also makes certain investigation activities more difficult.

The site is located in an area rich in cultural and historical resources. Several federally recognized Tribes have identified the larger TCS site area, which encompasses the TCS topographic ridge, as being of traditional, religious, and cultural importance. As a result, the number of boreholes permitted for installation ~~as part of~~ the groundwater investigation ~~is very limited, which may constrain the amount of data collected in evaluation of the nature and extent of groundwater contamination or the technologies used to collect the data~~.

The physical constraints and the types of COPCs released limit the potential migration control and groundwater remediation actions that could be employed to address constituents in groundwater potentially posing an unacceptable risk to human health and the environment.

Step 2: Identify the Decisions

Step 2 consists of identifying the decisions to be made in the TCS Groundwater Investigation. Activities completed in this step consist of identifying the principal study questions, defining the alternative actions that may be taken based on the range of possible outcomes, and combining the alternative actions and the principal study questions into decision statements.

Two related decisions have been established to guide the collection of chemical and physical groundwater data and ultimately support the engineering design of the groundwater remedy.

Decision 1. Determine the nature and extent of potential groundwater contamination beneath the TCS and determine whether a revision of the groundwater remedy is necessary to address the contamination, if found. If a revision is necessary, conduct necessary technical and administrative assessments and revise the remedy and documentation. If a revision is not necessary, incorporate additional nature and extent data in the groundwater remedy design to address the groundwater conditions beneath the TCS.

Decision 2. Determine the nature of groundwater occurrence and movement beneath the TCS.

The alternative outcomes of data collection and evaluation include:

1. The occurrence, migration direction, and pathways of groundwater beneath the TCS, and nature and extent of potential contamination of the groundwater, are sufficiently understood and can be used to evaluate whether revision to the groundwater remedy is required.

2. The occurrence, migration direction, and pathways of groundwater beneath the TCS, and nature and extent of potential contamination of the groundwater, are not sufficiently understood to evaluate whether a revision to the groundwater remedy is required, and additional data must be collected.

Step 3: Inputs to the Decision

Once the necessary decisions have been determined, the next step is to identify the inputs required to make the decisions. The inputs for each decision are defined separately to ensure all required inputs have been identified. Inputs for each decision are also listed in Table A-1.

Inputs to Decision 1 – TCS Groundwater Contamination

Five types of information need to be available and considered when assessing whether the nature and extent of contamination are adequately understood:

1. Comparison of COPC concentration data for various monitoring sites/intervals
2. Potential contaminant fate and transport mechanisms
3. Screening and comparison values
4. Constraints on investigation (e.g., cultural resources and infrastructure occurrence)

COPC concentration data must meet data quality criteria (including reporting limits and other criteria) set forth in the *Draft PG&E Program Quality Assurance Project Plan* (QAPP) (CH2M HILL, 2008a) and the *Addendum to the PG&E Program QAPP for Topock Groundwater Monitoring and Investigation Projects* (CH2M HILL, 2008b) to be considered usable. The COPC concentration data must be compared to background and other applicable screening levels (i.e., maximum contaminant levels [MCLs] and groundwater action levels) to assess whether the characterization of nature and extent is adequate to support Decision 1 assessments.

COPC concentration data must be compared between monitoring locations to evaluate vertical and horizontal concentration gradients. These comparisons, when combined with a complete soil data set, will be useful in the determination of potential source areas.

The CSM is an input to Decision 1 because it describes the potential transport mechanisms and fate of COPC(s) potentially released into the environm groundwater data are collected in the appropriate location

Include note that background for bedrock groundwater has not been defined.

Comparison/screening levels identified for Decision 1 include:

- Background groundwater concentrations for metals and select inorganic compounds (CH2M HILL 2008c, 2009a).
- Chemical-specific applicable or relevant and appropriate requirements (ARARs) for COPCs in groundwater (DOI, 2009).

Screening levels will be used to assess the extent of contamination and do not necessarily indicate the presence of unacceptable risk. As noted in the discussion for Step 1, physical,

cultural, and biological constraints may limit the feasibility of investigation in certain site areas or depth intervals.

Inputs to Decision 2 – Groundwater Flow Directions and Pathways

The inputs required for Decision 2 include soil and rock physical property information, and geologic, hydrologic, hydrogeologic, and topographic information. Existing data, as well as new site data, will provide information on depth to groundwater; and geotechnical, geochemical, and hydraulic characteristics of the soil in the vadose and saturated zones, and in the bedrock.

Step 4: Study Boundaries

Study boundaries include spatial (lateral and vertical), analytical, and temporal boundaries, as appropriate. Boundaries must be defined for each decision individually, as the scale at which data will be evaluated and the data populations of interest may vary for each decision. Study boundaries, especially the lateral and vertical study boundaries, are subject to change as additional data are collected. Temporal boundaries are required because a given medium may change over time. The study boundaries associated with the decisions are summarized in Table A-1.

Decision 1 Study Boundaries – TCS Groundwater Contamination

Spatial, analytical, and temporal boundaries for Decision 1 are detailed in the following subsections.

Lateral Boundaries

The lateral boundary for Decision 1 consists of the entire area comprising the TCS topographic ridge.

Vertical Boundaries

The vertical boundary of the soil investigation for Decision 1 extends from the water table to the vertical extent of contamination. Special emphasis is given to intervals of saturated alluvium, the shallowest interval of saturated bedrock, and the contact between the unconsolidated alluvium and consolidated bedrock where bedrock is present above the water table.

Analytical Boundaries

Analytical boundaries for Decision 1 consist of chemical parameters (COPCs and general chemistry). Chemical parameters were defined based on the site use and release history described in the Revised Final RCRA Facility Investigation/Remedial Investigation (RFI/RI) Report, Volume 1 (CH2M HILL, 2007a) and fate and transport mechanisms as documented in the CSM. The approach to groundwater sample collection and analysis is provided in Table 2 of the Addendum. Following two or more rounds of contemporaneous sample collection and analysis, the suites of compounds selected for analysis will be refined, as determined appropriate based on the prior results and discussion with DTSC and DOI.

Temporal Boundaries

A minimum of two sets of contemporaneous groundwater chemical data will be collected and analyzed.

Decision 2 Study Boundaries – Groundwater Flow Directions and Pathways

Spatial, analytical, and temporal boundaries for Decision 2 are provided below.

Lateral Boundaries

The lateral study boundaries for Decision 2 are the same as for Decision 1.

Vertical Boundaries

The vertical study boundaries for Decision 2 are the same as for Decision 1.

Analytical Boundaries

The analytical boundaries for Decision 2 consist of various types of hydrogeologic and hydrologic data, including hydrostratigraphic unit and bedrock interval elevations and groundwater elevations/potential.

Temporal Boundaries

Groundwater elevation data will be collected during contemporaneous measurement events.

Step 5: Decision Rule

Decision rules are "if…, then…" statements that describe the actions to be taken depending on the site-specific findings. A decision flow chart was developed for the two decisions identified in these DQOs. The decision process depicted in Figure 2 of the Addendum is described below.

Decision 1 – TCS Groundwater Contamination

Refer to Figure A-1 for the following discussion of the decision rule for Decision 1.

Box 1

The first step in the groundwater investigation is to collect and analyze groundwater samples, and validate the groundwater chemical data from installed and developed monitoring wells as determined appropriate during the implementation TCS Groundwater Investigation (i.e., implementation of the Addendum). The validated chemical data will be compiled with other pertinent data (e.g., from the East Ravine Groundwater Investigation). Non-validated screening-level groundwater chemical data collected during field implementation of the Addendum, or other investigations, will be used for information only, and will not be used to determine the nature and extent of COPC distributions.

The data collected during the groundwater investigation will be validated as described in the QAPP (CH2M HILL, 2008a) and the Addendum to the QAPP (CH2M HILL, 2008b). A minimum of two rounds of contemporaneous groundwater chemical data will be collected before the Decision 1 data evaluation is conducted.

Box 2

Once the new and existing data sets have been combined and reviewed, the combined data set will be compared to screening criteria. The combined data tables will flag each occurrence of a COPC exceeding one or more of the screening criteria. The following sets of screening values will be used:

- Background groundwater concentrations of dissolved metals and select inorganic compounds (CH2M HILL 2008c, 2009a).
- Chemical-specific ARARs for COPCs in groundwater (DOI, 2009).

The initial comparison will be on a sample-by-sample basis. The detected concentrations will first be compared to either the background concentrations (for metals and select inorganic compounds) or chemical-specific ARARs for COPCs in groundwater for which a background value has not been established.

The data from the TCS Groundwater Investigation will then be compared to the data for the main plume. The initial comparison will assess whether new compounds that are not present at elevated concentrations in the main plume have been detected at elevated concentrations underneath the compressor station. The presence of elevated concentrations of a new compound when compared to data from the main plume may be indicative of a separate, TCS-related source.

Box 3

Where possible, isoconcentation maps will be developed from the TCS Groundwater Investigation data and data from any relevant near-by wells to assess the distribution of chemical concentrations in groundwater underneath and in the vicinity of the TCS. Contours will be developed for all water-bearing units encountered in the investigation, as appropriate, based on the analysis of data collected in Decision 2. In addition, the vertical contaminant profile will be evaluated to determine whether chemicals present at elevated concentrations in shallower water-bearing units are present at elevated concentrations in deeper water-bearing units. If additional data collection is desirable and feasible to complete this evaluation, then the investigation and/or sampling will be conducted and the new data will be validated (Box 1). After the new data are validated, they will be combined with the existing data, and the evaluation will begin again starting with Box 2.

Box 4

Following the assessment of the nature and extent of any contamination detected beneath the TCS, the data will be used to assess if the groundwater remedy can adequately address any new and/or higher-concentration compounds in previously characterized hydrogeologic units, and/or the occurrence of elevated concentrations of compounds in previously uncharacterized hydrogeologic units.

Box 5

If it is determined that a revision to the remedy is required, a technical evaluation will be conducted to develop the appropriate revisions, and related administrative documentation will be prepared.

Decision 2 – Groundwater Flow Directions and Pathways

Refer to Figure A-1 for the following discussion of the decision rule for Decision 2.

Box 1

The first step in addressing Decision 2 is to collect hydrogeologic data from the new wells as determined appropriate during implementation of the TCS Groundwater Investigation (i.e., implementation of the Addendum).

Box 2

The second step is to integrate the new hydrogeologic data into the CSM.

Boxes 3 and 4

In Box 3, the new hydrogeologic data are evaluated in combination with relevant existing data from nearby locations to determine whether they are sufficient to evaluate the occurrence and behavior of groundwater. The evaluation will be conducted for all water-bearing units investigated and will assess the sufficiency of the data to estimate flow directions, pathways, and flow rates. If there are sufficient data to characterize the hydrogeologic parameters of interest, the path leads to Box 4, and the updated the CSM will be used to help define the need for any remedy revision pursuant to Decision 1.

Boxes 5 through 7

If there are insufficient data to characterize the hydrogeologic parameters of interest to the degree desired, additional data collection will be considered. The first step is to evaluate whether additional data collection is necessary to support Decision 1 and whether that data collection is feasible (Box 5). The primary consideration for the decision of whether additional data are necessary is the residual uncertainty in the CSM (i.e., would the refined CSM more clearly explain the nature and extent of contamination to the point that a previously ambiguous conclusion regarding the adequacy of the selected groundwater remedy becomes more definite). Feasibility of data collection will consider the same cultural and biological resources and physical constraints described earlier. In addition, field experience during the initial well installation effort may provide added insight into the feasibility of further data collection.

If the desired supplemental data collection is feasible, the next step (Box 6) is to design the supplemental data collection program, and the flow chart leads from there back to Box 1 for collection of additional data. Considerations for Box 6 are the types of data that need to be collected and the physical environment in which they would be collected. It should be noted that additional data collection may also include further literature research regarding physical and chemical characteristics or more detailed modeling of the area of interest (e.g., smaller "cells" for the groundwater flow model).

If supplemental data collection is not feasible, the remaining uncertainty will be addressed in Decision 1 during the evaluation of the remedy and may result in revisions to the remedy design (Box 7).

Steps 6 and 7: Acceptable Limits on Decision Error and Optimized Sampling Design

Step 6 is intended to define acceptable limits on decision errors. A decision error would occur if, based on the available data, the project team chooses the wrong response action in the sense that a different response action would have been chosen if the project team had access to "perfect data" or absolute truth. Decision errors will be controlled by implementing appropriate quality control measures as outlined in the QAPP, constructing monitoring wells to sample key depth intervals, sampling for a relatively wide range of compounds, and collecting the appropriate hydrogeologic and hydrologic data, as described in Step 4 (analytical boundaries). Data collection will be focused on key depth intervals, such as the water table, unconsolidated intervals, the contact between the unconsolidated alluvium and the consolidated bedrock, and shallow and deeper bedrock intervals. The determination of key hydrogeologic intervals will vary by location based on subsurface lithology. Decision error is further limited by the placement of investigation sites at 5 to 7 locations around the TCS perimeter and by biasing the locations toward suspect areas (i.e., areas of concern and/or areas with known releases to soil), where feasible. Decision errors related to excess data collection (i.e., cultural boundaries) and cross-contamination of deeper intervals due to elevated concentrations of COPCs at shallower depths will be minimized by implementing a "step-down" approach to investigation where shallower key depth intervals are characterized prior to a decision to initiate deeper investigation.

The purpose of Step 7 is to "*identify a resource-effective data collection design for generating data that are expected to satisfy the DQOs*" (USEPA, 2000). Step 7 seeks to integrate the desired investigation effort, as well as any practical constraints that exist. The optimized investigation design consists of 5 to 7 monitoring well locations selected based on the assessment of the data needs and site constraints. Well locations are shown in Figure 2 of the Addendum.

References

CH2M HILL. 2009a. *RCRA Facility Investigation/Remedial Investigation Report, Revised Final, Volume 2, PG&E Topock Compressor Station, Needles, California*. February 11.

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U.S. Environmental Protection Agency (USEPA). 2006a. *Guidance on Systematic Planning Using the Data Quality Objectives Process (EPA QA/G-4).* February.

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_____. 2000. *Data Quality Objectives Process for Hazardous waste Site Investigations* (EPA *QA/G-4HW).* Final. January.

TABLE A-1
Data Quality Objectives for the Topock Compressor Station Groundwater Investigation

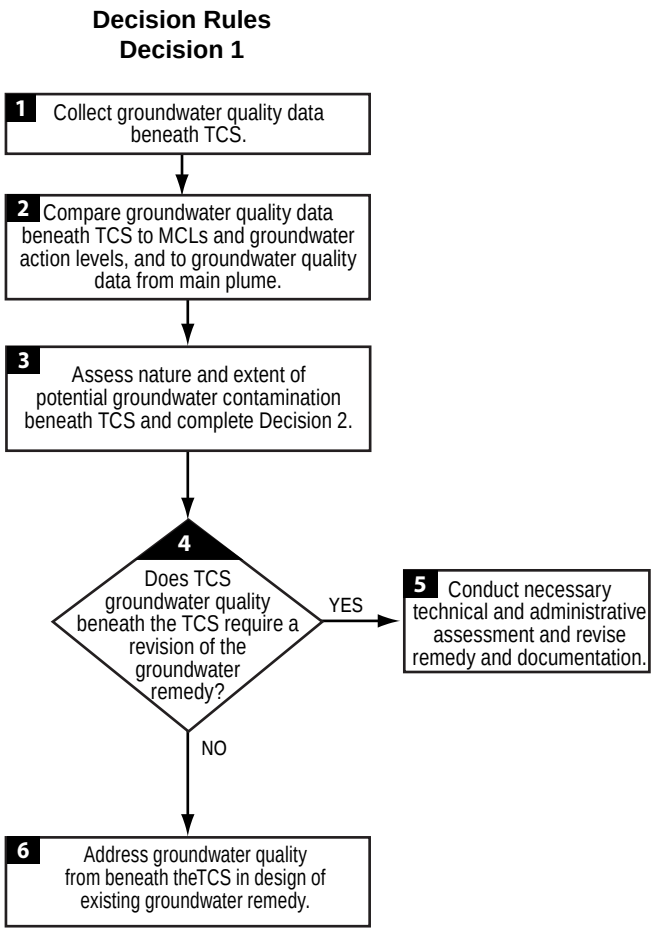
STEP 1 Problem Statement	STEP 2 Decision Statement	STEP 3 Inputs to the Decision	STEP 4 Study Area Boundaries	STEP 5 Decision Rules	STEP 6 Limits of Decision Errors	STEP 7 Optimize the Design for Data Collection
Historical practices within the Topock Compressor Station (TCS) fence line, which is located on a topographic ridge, may have contributed to the contamination of groundwater immediately below the TCS. The nature and direction of potentially contaminated groundwater flow beneath the ridge-top TCS is not well understood and is potentially complicated by a northward-sloping configuration of the contact between the unconsolidated alluvium and consolidated bedrock interface beneath the TCS. The potential presence and migration behavior of contaminated groundwater must be assessed to support engineering design of the groundwater remedy. Site-specific information is needed to: • Determine the nature and extent of potentially contaminated groundwater beneath the TCS. • Estimate migration direction and pathways for contaminated groundwater in support of the remedial design.	**Decision 1:** Determine the nature and extent of potential groundwater contamination beneath the TCS and determine whether a revision of the groundwater remedy is necessary to address the contamination. If a revision is necessary, conduct necessary technical and administrative assessments and revise the remedy and documentation. If a revision is not necessary, incorporate additional nature and extent data in the groundwater remedy design to address the groundwater conditions beneath the TCS. **Decision 2:** Determine nature of groundwater occurrence and movement beneath the TCS.	**Decision 1:** • COPCs associated with the historic TCS operations • TCS groundwater COPC data • Comparison/screening values (regional background and regulatory screening values for groundwater) • Groundwater conceptual site model for the TCS • Geologic/hydrogeologic/hydrologic information (Decision 2 results) • Topographic information • Soil and rock physical and chemical property information • TCS SWMU/AOC/UA location and use history information • Cultural and historic information for the TCS • Infrastructure information for the TCS **Decision 2:** • Geologic/hydrogeologic/hydrologic information • Topographic information • Soil and rock physical property information	**Decision 1:** • Lateral Extent – The entire footprint of the TCS topographic ridge top. • Vertical Extent – From the water table to the vertical extent of contamination, with special emphasis on: – Saturated alluvium – The shallowest saturated interval of bedrock – The contact between the unconsolidated alluvium and consolidated bedrock where bedrock is present above the water table • Analytical Parameters – Chemical parameters, including: – Hexavalent Chromium: Method EPA-218.6 – Title 22 Metals: Methods SW6010B,SW6020A, SW7470A – Mercury: Method SW7470A – VOC: Method SW8260B – SVOC: Method SW8270C – PAH: Method SW8270C-SIM – DRO, GRO, RRO: Method SW8015B – PCB: Method SW8082 – Organochrlorine Pesticide: Method SW8081A – Organochrlorine Herbicide: Method SW8151A – Dioxins/Furans: Method SW8290 – Total Dissolved Solids: Method SM2540C – Total Suspended Solids: Method SM2540D – Chloride, Sulfate, Nitrate, Nitrite, Fluoride, Bromide, Phosphate: Method EPA 300.0 – Alkalinity: Method SM2320B – Ammonia: Method EPA 350.2 – General Minerals (Ca, Mg, K, Na) (dissolved): Method SW6010B – Iron (dissolved): Method SW6010B – Manganese (dissolved): Method SW6010B – Total Organic Carbon (TOC): Method SM5310 • Temporal Boundaries – Groundwater chemical data collected during two or more contemporaneous sampling events following well installation. **Decision 2:** • Lateral Extent – Same as for Decision 1. • Vertical Extent – Same as for Decision 1.	See Figure A-1 for Decision 1 and Decision 2 decision rules.	**Decision 1:** Limit decision error through: • Place monitoring wells at multiple locations along the TCS ridge top perimeter. Placement locations will be potentially down-gradient of identified potential TCS source areas (SWMU/AOCs/UAs). • Conduct multiple sampling events and analyze groundwater samples for a wide range of potential contaminants. • Construct monitoring wells for sample collection from key hydrogeologic intervals, such as the water table, unconsolidated intervals, the contact between the unconsolidated alluvium and the consolidated bedrock, and shallow and deeper bedrock intervals. The determination of key hydrogeologic intervals will vary by location based on subsurface lithology. **Decision 2:** Limit decision error through: • Place monitoring wells at multiple locations within the TCS (same locations as for Decision 1). • Construct monitoring wells to measure groundwater elevations/potential at key depth intervals, such as the water table, unconsolidated intervals, the contact between the unconsolidated alluvium and the consolidated bedrock, and shallow and deeper bedrock intervals. The determination of key hydrogeologic intervals will vary by location based on subsurface lithology.	See Figure A-1 for Decision 1 and Decision 2 decision rules.

TABLE A-1
Data Quality Objectives for the Topock Compressor Station Groundwater Investigation

STEP 1 Problem Statement	STEP 2 Decision Statement	STEP 3 Inputs to the Decision	STEP 4 Study Area Boundaries	STEP 5 Decision Rules	STEP 6 Limits of Decision Errors	STEP 7 Optimize the Design for Data Collection
			• Analytical Parameters – Hydrogeologic and hydrologic parameters, including: – Hydrostratigraphic unit and bedrock interval elevations – Groundwater elevations/potential • Temporal Boundaries – Groundwater elevation data collected during contemporaneous measurement events.			

Note: The list of analytical parameters is based on Conceptual Site Model (CSM) and will be refined after each round of investigation/data evaluation. Chemicals of Concern (COCs) will be selected based on the risk assessment.

AOC = Area of Contamination
COPC = Chemical of Potential Concern
DQO = Data Quality Objective
SWMU = Solid Waste Management Unit
TCS = Topock Compressor Station
UA = Uninvestigated Area



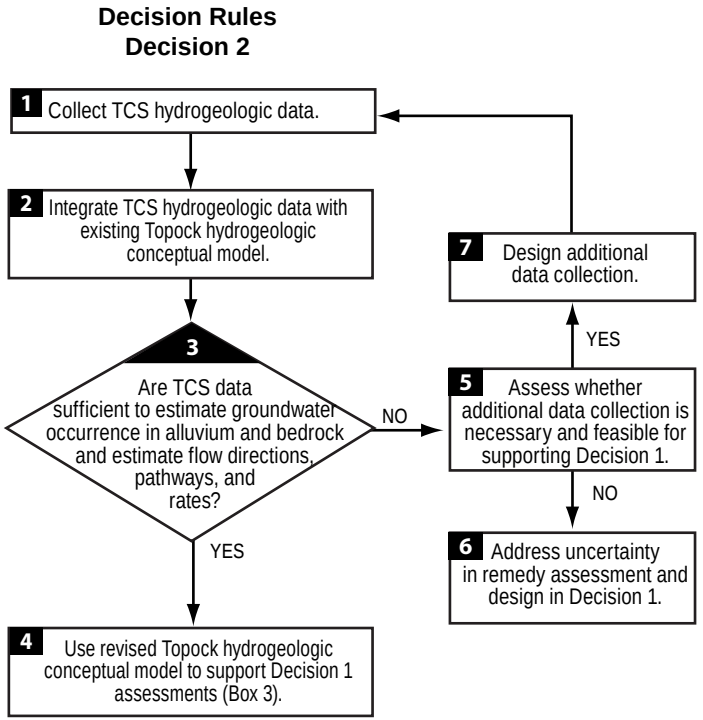


FIGURE A-1
Decision 1 & 2 Rules
Addendum to the Revised Work Plan for
East Ravine Groundwater Investigation
PG&E Topock Compressor Station
Needles, California

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October 14, 2010

VIA ELECRONIC MAIL

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Re: FMIT comments on PG&E's August 27, 2010, document titled "Addendum to the Revised Work Plan for East Ravine Groundwater Investigation, PG&E Topock Compressor Station, Needles, California"

Dear Mr. Yue and Ms. Innis:

Hargis + Associates, Inc. (H+A) is in receipt of your email dated September 13, 2010, requesting comments of the above-referenced Pacific Gas & Electric Company (PG&E) document (the Addendum). On behalf of our client, the Fort Mojave Indian Tribe (the Tribe or FMIT), and with review from its legal counsel, I am hereby providing the following comments.

As you are aware, H+A previously submitted comments to the Department of Toxic Substances Control (DTSC) on August 4, 2010, in response to DTSC's July 28, 2010, letter on the subject of the East Ravine Groundwater Investigation (ERGI). The Tribe also submitted comments on Phase I of the ERGI in December 2007 (copy attached). It seems that many concerns identified at that time still apply to the investigation as currently proposed.

The Tribe's August 4, 2010, comment letter addressed two primary issues:

1. An understanding that the ERGI is intended to resolve issues pertinent to the site groundwater remedy. In particular, the question of the relevance of the discovery of groundwater contamination in the East Ravine, which thereby extended the area and volume of groundwater contamination to be addressed by the remedy, as well as the potential complication of the presence of hexavalent chromium within the bedrock groundwater in that area.

On this point, the Tribe understands that there is a tradeoff in terms of the degree of characterization that occurs now versus the degree of conservatism that may be incorporated in the remedial design. Specifically, the Tribe is hoping that this second phase of the ERGI and will lead to a *less intrusive design* than was proposed for the final remedy in the Proposed Plan and Statement of Basis.

2. The Tribe insisted that proper survey of the cultural resource present within the areas of the investigation be performed to identify culturally sensitive areas (including but not limited to archaeological resources). Moreover, the Tribe insisted on participation of the Tribal Monitors during such surveys.

These points are re-emphasized as the Phase II investigation approaches implementation. However, a review of this draft does not indicate that the Tribe's views have been adequately incorporated into the action to date, and the Tribe considers it mandatory that they are substantively addressed.

While the Tribe appreciates the opportunity to be involved at an early juncture in the decision process, there are many aspects of the Addendum that are of great concern to the Tribe. The following comments are offered in that regard.

Expanded Work Scope

The Tribe understands that Phase II of the ERGI has been greatly expanded at the direction of DTSC to incorporate investigation of the PG&E Topock Compressor Station (TCS) area. To date, the remedial investigation has not included areas within the TCS footprint, thereby presenting a potential data gap across the overall Site. The Tribe understands that an objective of this approach is to determine whether there are contaminant source areas within the TCS fence line that need to be considered in the design of the groundwater remedy. The Tribe expects that the scope of the investigation as presented in this document as well as its predecessor documents will eliminate this data gap with regard to the groundwater remedy and therefore the need for further investigation.

As you are aware, remedial soils investigations for both Part A and Part B are in planning. Both of these soils investigations are relevant to the ERGI and TCS groundwater investigations. The soils investigations will also serve to eliminate certain data gaps and resolve issues related to the groundwater remedy. The Tribe encourages that the information derived from these separate, but related, investigations be evaluated comprehensively and in a complementary manner that will minimize the need for redundancy and the cumulative impacts of both drilling wells and sampling soil.

CSM Data Gaps

The conceptual site model (CSM) is perhaps the primary tool in evaluating the significance of data gaps. In considering the need for additional data, the CSM is the key for determining whether additional data will make a difference in project decisions such as the identification and/or nature of risk pathways, and ultimately the need for and/or design of remedial measures

to reduce risk. The CSM is more than a “schematic representation” as suggested in the Attachment A (p. A-2). The CSM represents the actual level of conceptual understanding that forms the basis for such key decisions. The CSM will always have some residual level of uncertainty, but decisions related to the program for reducing uncertainties must represent a realistic balance among the impacts of further data collection against the level of reduction in the uncertainty and, of course, the ability to improve the remedy. Information, such as that assembled in Table 1, is potentially helpful in understanding how each particular disturbance fulfills a perceived data need. But while this table provides a site-by-site “rationale,” it is not really clear how critical this information is in terms of refining or completing the CSM. Therefore there is no basis for weighing the informational value of these installations against their respective impacts. PG&E must clearly justify each disturbance in terms of how the information gained will advance remedy decisions. If the information gained by an action is marginal, then the impact should be avoided.

Site Restoration

Section 2.7 (Site Restoration Activities) contains errors, is vague, and provides no mitigation or restoration standards. For example, it states that location “I-Alt” is on the Havasu National Wildlife Refuge property; however, Figure 2 shows it located, at least in part, on Metropolitan Water District (MWD) property. Has MWD signed off on this use of their land? This section also delays restoration discussions and requirements until "after well installation." Criteria for site restoration must be developed, reviewed, and approved as part of the work plan. The Tribe expects to participate in these discussions during work plan preparation and prior to its approval.

The fact that a location may have experienced prior disturbance does not mean that the agencies cannot require PG&E to leave the location better off than they found it as a condition of project approval and in recognition of cumulative impacts. Moreover, there may be other than biological resource reasons for requiring reasonable restoration or revegetation such as erosion, aesthetic, and cultural factors.

Previously Disturbed Areas

In past forums, the Tribe has commented on the general notion that further disturbances in areas that are previously disturbed is more acceptable than in areas where disturbances have not yet occurred. However, the Tribe objects to the implication in Section 2.7 that land that is somehow "previously disturbed" does not require survey, consideration, restoration or mitigation. The criteria used to determine “previous disturbance” as well as a process for applying the criteria must be detailed in the work plan and then reviewed with the Tribe prior to approval. The activities proposed in the addendum are taking place within the Tribe's sacred area. They may have individual adverse impacts as well as indirect and cumulative impacts.

Unsupported application of a "previously disturbed" label to lands is what resulted in the litigation over the IM3 environmental exemption. The Tribe is alarmed that DTSC may be considering approving this activity through a categorical exemption (Section 4.1, Table 3, p.12). While not wanting to build delay into the process, the Tribe disagrees that this activity qualifies

for exemption under Section 15061 of the California Environmental Quality Act (CEQA) Guidelines.[1] Caution must be exercised here in order not to trigger unnecessary project delays.

Cultural Resource Surveys

The Tribe is very troubled by Section 4.3 (Archaeological Surveys, Reviews, and Consultations). An important factor in the Tribe's ability to offer relevant and meaningful input to these planning discussions is participation in cultural resources surveys. There are, unfortunately, many instances in which Tribal Monitor participation is not happening (such as the recently added areas to the Project APE, the MW-38 investigation, etc.).

In regard to the ERGI-TCS, were FMIT tribal monitors present for **all** the cultural surveys including those in both 2007 and July 2010? Was a report prepared for the July 2010 archeological survey? Were any potential locations eliminated from the Project due to the discovery of previously unrecorded tribal cultural resources? If so, that should be stated in the archaeological report and work plan so that there is a record of such finds and project revisions. Similarly, were any such finds recorded on State of California Department of Recreation forms and filed with the California Historical Information System? The Tribe requests copies of any such records. The Tribe must be a party to the recording of cultural resource finds.

In regard to the TCS, the Tribe inquired in its 2010 letter as to whether a cultural resource survey ever had been performed on the TCS property. This question was posed pursuant to information provided by the U.S. Department of the Interior that the TCS had **not** been surveyed.[2] The Tribe believes that there is a strong possibility that the TCS does overlie a potentially rich area in terms of archaeological and tribal cultural resources. This is based, in part, on the relative position and topography of the area in relation to the Topock Maze.

Without tribal participation on project surveys, the agencies cannot conclude that there will be no impacts to archaeology or other resources of concern to the tribes. Also, apart from archaeology, the agencies already have been told that these activities will impact a sacred area of great concern to the Tribe. Yet, it appears the agency is once again, as was the case with the Arizona well, poised to assert there will be no adverse effects to the Tribe and no mitigation required. Consultation must also occur prior to project approval on Section 3.0 (Waste Management and Decontamination), to ensure that materials are being handled in a manner as culturally-appropriate as possible and that "dirty and clean" soils are not being inappropriately comingled.

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[1] FMIT legal counsel advises that exceptions to categorical exemptions pursuant to Section 15300.2 of the CEQA Guidelines applies here including: its sensitive location, cumulative impacts, significant effect and historical resources being adversely changed. The expansion of this work plan also raises the CEQA issue of segmentation and whether these expanded activities are more properly part of the final remedy for groundwater and should have been included in the Environmental Impact Report (EIR).

[2] See May 3, 2010, letter from Pamela Innis, DOI, to Leo S. Leonhart, H+A, re "Cultural Resource Surveys."

As requested in all previous field incursions, the Tribe requires that:

(1) A cultural resource survey be performed within the proposed area of disturbance (including across the TCS area) prior to approval of the project;

(2) Tribal Monitors have the opportunity to participate in this survey; and

(3) Tribal Monitors have the opportunity to observe any ground disturbing project work as it is performed and have the right to ask for temporary work stoppage in the event of a significant find.

Mitigation measures may also be required and should be developed through consultation with affected tribes, including FMIT.

Cultural Sensitivity Training

The Tribe is concerned with the statement that, "The PG&E Field Contact representative (FCR) will be responsible for providing archaeological resources sensitivity training ..." This must include tribal cultural sensitivity training with tribal involvement.

Standards of Performance

Tribal concerns are limited to one paragraph (less than that provided for impacts to Route 66) Page 15 states that:

> *"The TCS site and adjacent lands are contained within a larger geographic area that is considered sacred by the Fort Mojave Indian Tribe and by other Native American tribes. In recognition of this, work activities will be conducted in a manner that recognizes and respects these resources and the spiritual values of the surrounding lands. PG&E understands that the environmental, cultural, and spiritual resources may not be physically perceptible. To this end, worker site orientation will stress that all site activities must be conducted in a respectful manner that is conscious of this context. In addition, PG&E will contact the tribes which have in the past expressed a desire for tribal monitors. In the event there is a desire to monitor this work, PG&E will make arrangements for monitoring of field activities, if acceptable to the landowner and if consistent with security and health and safety considerations."*

Specifically, what does it mean to conduct all site activities in a respectful manner … does DTSC, BLM, or PG&E have standards for achieving such a vague goal? Current standards and practices that are will be imposed should be specifically enumerated in the work plan or be embodied in an agreement directing the work and workers. All this needs to go into a National Historic Preservation Act (NHPA) Section 106 Memorandum of Agreement (MOA), because from the Tribe's point of view, the project will have adverse effects, and compliance with Section 106 is listed as a required approval in Section 4.1, Table 3. The Tribe again reminds DTSC and

DOI that this activity is just part of the ongoing pattern of cumulative effects for which no resolution or mitigation has been reached with the Tribe.

Section 106 Consultation

A related matter is the block for Section 106 consultation on the associated schedule (Figure 4). Do the agencies believe they have started this consultation? How do the agencies propose to finish it? Has a determination of adverse effect been made? Have they actually initiated consultation? Has anybody started negotiating toward a memorandum of agreement? These, again, are matters of major concern to the Tribe at this juncture and moving forward.

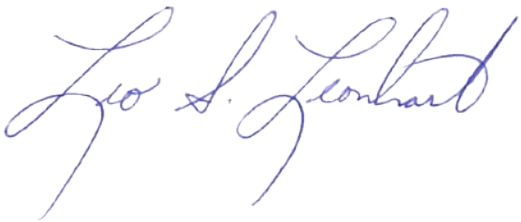
Land Ownership

The Tribe is concerned about the statement that PG&E will make arrangements for monitoring of field activities only if "acceptable to the landowner" and consistent with "security" and "health and safety considerations." Our understanding is that agencies can require monitoring as a condition of project approval and that landowners cannot dictate the manner in which work is performed. In any case, here, the landowners are federal and state agencies and PG&E. This limitation should be struck. Similarly, PG&E and the agencies must consult with the tribes on the parameters for the latter two categories, instead of allowing such an undefined, blanket statement in a work plan.

The Tribe looks forward to a written response and having a dialog with the agencies on these activities prior to their approval and implementation.

Sincerely,

HARGIS + ASSOCIATES, INC.



Leo S. Leonhart, PhD, PG, CHg
Principal Hydrogeologist

Attachment: Dec. 28, 2007, letter

cc w/encl: N. Brown, ACHP
C. Coyle
M. Donaldson, CA SHPO
J. Garrison, AZ SHPO
T. King
S. McDonald
N. McDowell-Antone
Y. Meeks, PG&E
L. Otero, FMIT Council
C. Pease, USFWS
M. Sullivan
T. Williams, FMIT Chairman

839.07 ERGI-TCS Addendum

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December 28, 2007

VIA ELECTRONIC MAIL

Mr. Aaron Yue
CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL
5796 Corporate Avenue
Cypress, California 90630

Mr. Steve Politsch, Field Manager
BUREAU OF LAND MANAGEMENT
2610 Sweetwater Avenue
Lake Havasu City, AZ 86406

Re: Fort Mojave Indian Tribe Comments on Pacific Gas & Electric Co. December 11, 2007, document titled *Work Plan for East Ravine Groundwater Investigation PG&E Compressor Station, Needles, California*

Dear Messrs. Yue and Politsch:

Pursuant to Dr. Christopher Guerre's December 13, 2007, solicitation for comments on the above-referenced work plan, the Fort Mojave Indian Tribe (the Tribe) is hereby providing its comments. The Tribe's understanding of the background, purpose, and nature of this project comes from participation in the Technical Working Group (TWG) meeting held at the Topock Compressor Station on October 16, 2007, a recent site visit by Chairperson Linda Otero and Mr. Felton Bricker, and the reading of the work plan itself.

First and foremost, the Tribe asserts that it is opposed to the drilling of the new monitor wells proposed in the work plan. Specifically, the plan calls for the drilling of groundwater monitor wells at two new "primary" sites identified as "A" and "B," with the possibility of subsequent drilling and well construction at three other "contingency" sites ("C," "D." and "E"). As the Tribe has expressed many times in the past, each of these wells is an intrusion within the larger geographic area PG&E acknowledges as "sacred" to the Tribe.[1] Each time the Tribe has expressed such concerns in the past, both PG&E and DTSC have accepted the Tribe's concerns and pledged to do whatever possible to avoid or otherwise minimize future drilling. On at least one occasion, the Tribe was told that once the drilling of wells on the Arizona side of the Colorado River was completed, there would be no further need for drilling for characterization purposes. Yet it seems like this was never the intention of DTSC, and that the prospect for continued intrusion is virtually open-ended.

[1] See p. 1-2, 1st sentence in Section 1.2.1 of the Work Plan.

Other Offices:
Mesa, AZ
San Diego, CA

Another concern is the apparent perception that the location of such intrusions can mitigate such concerns. For example, on numerous occasions it has been suggested that if drilling (or other types of intrusions such as borings, soil excavations, etc.) were limited to areas of previous disturbance, the Tribe's concerns would be lessened. The Tribe wishes to emphasize that this is not the case. **Every intrusion into this sacred area poses a concern, and taken together, pose adverse, cumulative impacts to the sacred area.** Moreover, the Tribe understands that part of the project area is potentially within the Havasu National Wildlife Refuge, and feels that, in addition to minimizing impacts to the sacred area, every effort should be made to avoid impacts to refuge areas.

With this said, the Tribe is fully aware of both the nature of the technical investigation as well as the requirements of the regulatory process that forms the template for activities at this site. That is why, in commenting on past work plans, the Tribe has endeavored to offer potential technical alternatives and at times suggested refocusing priorities and needs of certain actions (such as the proposed drilling at Arizona Site 1). It seems that in many instances, such suggestions/comments by the Tribe have been rather summarily dismissed on grounds that appear to reflect convenience as opposed to serious reflection on the underlying technical merit. This leads to the Tribe to conclude that when there is a potential for conflict between technical curiosity and cultural or religious values the former is more often than not accorded the greater weight.

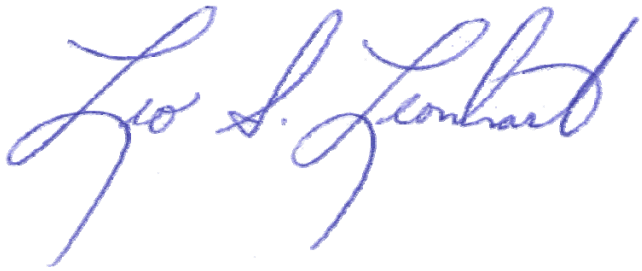
With specific reference to this study, it was rigorously argued in the October TWG meeting that, while there may be some justification for examining groundwater quality in view of shallow soil results in the East Ravine as well as inexplicable and temporary water quality anomalies indicated in groundwater sampled at MW-23, the need to do further characterization at this time (as opposed to some time in the future that may indicate the need for a separate remedy component) is not fully justifiable. Indeed this position was argued strongly by PG&E staff as well as others, and the ensuing discussion was mostly related to "if you are going to go ahead with this, this is the way you should do it …" Fundamentally, in light of the apparent remedial action objective of protecting the water in the Colorado River while restoring the groundwater, it is unlikely that, with or without this information, the site groundwater remedy will be affected in the near term. This point was asserted by PG&E's engineers at the meeting. To the contrary, they suggested that the need to design a specific remedy component to address the East Ravine might be better decided after the remedial action is underway.

The Tribe has also questioned why such large areas are called out for each of the primary sites and contingency sites as indicated on Figure 2. It would seem that the actual drilling and construction activities would only disturb much smaller areas. While these large delineations were possibly intended to represent general locations areas within which much smaller disturbances would occur, this is not explained in the workplan.

In summary, the Tribe reasserts its opposition to this action fundamentally because it violates its sacred grounds. Please contact me if you have further questions.

Sincerely,

HARGIS + ASSOCIATES, INC.



LEO S. LEONHART, PHD, RG, CHG
Principal Hydrogeologist

cc: C. Coyle
W. Donaldson
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M. Gorsen
L. Johnson
S. McDonald
L. Otero
M. Sullivan
T. Williams

83907AOC10

Hualapai Department of Cultural Resources
P.O. Box 310
Peach Springs, Arizona 86434
Office: 928.769.2223 FAX: 928.769.2235

Date: October 14, 2010 File: **HDCR 10-156**

Department of Toxic Substances Control
Attention: Mr. Aaron Yue
P.O. Box 5796
Corporate Ave.
Cypress, CA 90630-4732

Subject: East Ravine, Addendum to the Revised Work Plan

Dear Mr. Yue,

The Hualapai Tribe would like to offer comments regarding technical memorandum *"Addendum to the Revised Work Plan for East Ravine Groundwater Investigation, PG&E Topock Compressor Station, Needles, California,"* by CH2M HILL, August 27, 2010. The report proposes additional work in the East Ravine area, and initiates new work within the boundaries of the Topock Compressor Station (TCS). The work plan indicates the drilling and installation of 27 or more new wells. The wells will be located along the ridgeline and to the east of the ridge for what might have been a southern extension of the Maze Locus B. The Hualapai Tribe views all wells as desecrations to the earth, especially near the Topock Maze.

The work plan addendum indicates that approvals and authorizations will be sought according to Section 106 of the National Historic Preservation Act (NHPA). This is welcome information, and the Hualapai Tribe looks forward to providing input to the S106 process. However, according to the California Environmental Quality Act (CEQA) and California Public Resources Code 21083.2, the Department of Toxic Substances Control (DTSC) should be following similar procedures to consult with Native American Tribes. On page 12 of the subject report, it says that DTSC qualifies for exemption of these rules. We would appreciate an explanation as to why DTSC is exempt as this does not reflect good stewardship of archaeological and historical resources of the State of California.

The East Ravine and TCS areas need to have full archaeological clearances before the work begins. During a field tour of the East Ravine on October 6, 2010, a historical feature was noted that looked like an old explosives cache, which might have been related to Route 66. However, this feature is not described in the Applied Earthworks report of November 2006. The ravine is a dynamic system where features could be uncovered during rainfall events. Since there was a large rainfall event in January 2010, we feel that the whole area needs to be re-surveyed, and the survey should be done by a team of independent Tribal and third-party archaeological experts.

Other technical comments are as follows:

- At the nine new drilling sites, up to three wells could be installed at each site. One of these wells might be installed at the interface of the alluvium and bedrock in the unsaturated zone. While this might help with decisions regarding soil contamination and leaching, there is not a need for nine wells at the alluvium/bedrock interface. If there is a research component to study

the bedrock/alluvium interface, then this should be a separate objective (page 3), and the study should include the bedrock/alluvium interface in the saturated and unsaturated zones.

- From the water level data, there is a groundwater mound under the East Ravine. The ravine acts as a funnel for groundwater recharge during rainfall run-off events, and check dams, in the ravine, retain the recharge water. However, this mounding might have pushed the chromium contamination to the south of the ravine, as shown by elevated chromium concentrations in wells MW-60 and MW-61. The terrain may be too steep to allow drilling at surface locations to the south of the ravine; therefore, angled or directional drilling could be used to explore the contamination to the south. Existing drill pads could be used, and damage to possible cultural artifacts could be spared.

- High concentrations of total organic carbon (TOC) from 25 to 58 mg/L, were noted in wells MW-62 and MW-64. What are the possible sources for these high TOC concentrations? Carbon isotopes could be used to trace the carbon types. If these are natural TOC concentrations, then natural attenuation of chromium could be enhanced by the presence of these organics. In this regard, the oxidation-reduction state of the aquifer needs to be monitored more closely using analytical redox couples (for example, As^{V}/As^{III}, Fe^{III}/Fe^{II}, CH_4/CO_2, and $^{13}C/^{12}C$).

- As part of earlier drilling in the East Ravine, screening wells were drilled as open holes in bedrock. Monitoring well MW-58BR-D is 208 feet deep, with as much as 142 feet of saturated bedrock exposed within the open borehole. Regardless of the possible upward groundwater flow in bedrock, these screening wells could provide pathways for vertical contaminant migration, and the wells should be sealed to prevent vertical migration using packers, or the boreholes should be sealed with bentonite and abandoned properly.

- The work plan says that the wells will be completed with flush-mount casing and below-ground vaults. Site H is located in the bottom of the East Ravine. Rainfall runoff could seep into the well vault; therefore, this type of installation is not recommended for this site.

- Aquifer tests should be conducted using slug-test methods only. Pumping tests could cause the contamination to migrate, thereby confusing the source-area questions.

- To the east of the ravine at the Colorado River, the interface between bedrock and the river need to be studied to characterize the possible presence of an organic layer. If there is an organic layer at the river, then natural attenuation may play an important role in the remediation decision.

The Hualapai Department of Cultural Resources and the Hualapai Tribe appreciates the efforts by all parties to address our concerns. If you have any questions, please do not hesitate to contact myself, or Dawn Hubbs, Program Manager at (928) 769-2223.

Sincerely,

Loretta Jackson-Kelly, Director
Tribal Historic Preservation Officer
Hualapai Department of Cultural Resources