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September 30, 2005

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Subject: Pore Water and Seepage Study Work Plan
PG&E Topock Compressor Station, Needles, California

Dear Mr. Shopay:

Enclosed is the *Pore Water and Seepage Study Work Plan*, prepared in compliance with the Department of Toxic Substances Control's (DTSC) letter dated September 6, 2005. This work plan describes the proposed study approach, planning, methodologies, execution, and reporting for the pore water and seepage investigation. A revised Topock Health and Safety Plan is also included in the appendices.

Please contact me at (805) 546-5243 if you have any questions or if you need additional information.

Sincerely,

Julie Eakins for Yvonne Meeks

Enclosure

Pore Water and Seepage Study Work Plan

PG&E Topock Compressor Station
Needles, California

September 30, 2005

Prepared for

California Department of Toxic Substances Control

On behalf of

Pacific Gas and Electric Company

CH2MHILL
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Acronyms and Abbreviations

BLM	United States Bureau of Land Management
BN&SF	Burlington Northern & Santa Fe
BOR	United States Bureau of Reclamation
Cr(VI)	hexavalent chromium
Cr(T)	total dissolved chromium
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm	centimeter
CWG	Consultative Workgroup
DQO	Data Quality Objective
DTSC	California Department of Toxic Substances Control
E&E	Ecology and Environment, Incorporated
ESA	Endangered Species Act
FT/SEC	feet per second
GPS	Global Positioning System
HNWR	Havasu National Wildlife Refuge
HSP	Health and Safety Plan
ID	identification
IDW	investigation derived waste
IM	Interim Measure
IW	injection well
NEPA	National Environmental Policy Act
NPT	national pipe taper
ORP	oxidation-reduction potential
QAPP	Quality Assurance Project Plan
PG&E	Pacific Gas and Electric Company
PWSS	Pore Water and Seepage Study

RFI	Resource Conservation and Recovery Act Facility Investigation
SAFPM	Sampling, Analysis, and Field Procedures Manual
SAP	Sampling and Analysis Plan
SETAC	Society of Environmental Toxicology
SOP	Standard Operating Procedure
TWG	Technical Working Group
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

1.0 Introduction

Pacific Gas and Electric Company (PG&E) is addressing chromium in groundwater at the Topock Compressor Station in Needles, California, under the oversight of the California Environmental Protection Agency, Department of Toxic Substances Control (DTSC). On June 9, 2005, DTSC issued a letter entitled "Requirement for Submittal of Pore Water and Seepage Workplan, Pacific Gas and Electric Company, Topock Compressor Station, Needles, California (United States Environmental Protection Agency [EPA])" to PG&E (DTSC 2005a). In that letter, DTSC required that PG&E begin planning for pore water sampling and seepage measurements in the Colorado River.

Figure 1-1 shows the location of the Topock Compressor Station, site features, and the approximate study area for the proposed Pore Water and Seepage Study (PWSS).

1.1 Investigation Background

Per DTSC's June 9 letter, PG&E submitted a technical memorandum entitled *Conceptual Approach for a Pore Water Sampling and Seepage Study* on June 27, 2005 (CH2M HILL 2005a). The technical memorandum presented an approach and focused on a set of pore water sampling methods that may be applicable to the site. In a letter dated June 30, 2005, DTSC provided comments and further recommendations for the PWSS (DTSC 2005b).

PG&E submitted a *Pore Water and Seepage Study Overview* (CH2M HILL 2005b) on July 13, 2005 in compliance with DTSC's letters of June 9, 2005 and June 30, 2005 and following consultation with DTSC during conference calls on June 29 and July 6, 2005. DTSC summarized comments and input by the Technical Working Group (TWG) in an August 9 memorandum (DTSC 2005c). This submittal, the *Draft Pore Water and Seepage Study Work Plan*, has been developed in accordance with DTSC's September 6 letter (DTSC 2005d), discussions during the TWG meeting on July 20, 2005, and subsequent conference calls.

1.1.1 Overview of Current Site Characterization and Monitoring

In July 2004, PG&E submitted a *Sampling and Analysis Plan, Groundwater and Surface Water Monitoring* (SAP) (CH2M HILL 2004a) that describes the scope, schedule, and sampling and analysis procedures for the ongoing Groundwater and Surface Water Monitoring Program. The SAP, approved by DTSC, establishes specific objectives for surface water monitoring at the Topock site, including routine monitoring of near-shore Colorado River locations both upgradient and downgradient of the Topock site. This program has been augmented by ongoing collection of depth-specific surface water samples in the river channel, which commenced in July 2005 (DTSC 2005e). The depth-specific river channel sampling stations are located approximately one-third of the river width from the corresponding shoreline stations, on the California side (see Figure 1-2). Samples are collected 1 foot from the bottom of the river channel, halfway through the water column, and within 1 foot of the water surface (Revised SAP) (CH2M HILL 2005e). This pore water sampling and seepage study

was developed to yield results that can be used in conjunction with those of the surface water sampling program.

1.1.2 Previous Pore Water Sampling

Two studies of shallow sediment pore water quality have been conducted previously, each using a different method. In both studies, samples were obtained from the edge of the Colorado River in the immediate vicinity of the Topock site and at various upstream reference locations. Samples were collected in 2003 by Ecology and Environment, Inc. (E&E), and the results were reported as part of the Draft and Final Resource Conservation and Recovery Act Facility Investigation reports (RFI) (E&E 2004; CH2M HILL 2005c). In 2001, the United States Geological Survey (USGS) collected and analyzed river sediment samples (May et al. 2002) for the United States Fish and Wildlife Service (USFWS), and reported the results in a report dated March 2004 (Ingersoll et al. 2004).

In their June 9 letter (DTSC 2005a), DTSC concluded that the data set presented in the RFI was inadequate to assess the fate and transport of chromium in site groundwater. Additional discussion of both the 2003 E&E results and the 2004 USGS results, including a discussion of the limitations of that data, is provided in detail in the *Pore Water and Seepage Study Overview* (CH2M HILL 2005b).

1.2 Site Conceptual Model

The Topock site is located at the extreme southern end of the Mohave Valley, just above where the river enters the Topock Gorge. Bedrock outcrops to the south and west of the site create barriers to groundwater flow (Figure 1-1). In contrast to the overall trend of southerly groundwater flow throughout most of the Mohave Valley, groundwater flow directions at the Topock site are predominantly north to northeasterly. Groundwater at the Topock site is recharged primarily from local precipitation rather than from the Colorado River. Consequently, due to the limited amount of local recharge, the groundwater gradients at the Topock site are very slight.

Interaction of groundwater with the Colorado River is complex. The daily fluctuations in river stage, typically several feet each day, cause the surface water-groundwater interaction at this site to be very dynamic. Water levels in wells located several hundred feet from the river fluctuate on the order of feet due to fluctuations in river stage. In this way, the Colorado River can switch between a gaining stream and a losing stream daily.

The stage of the Colorado River also varies seasonally in response to upstream dam discharge for resource management and electricity production. During spring and summer months, the river stage is higher than surrounding groundwater levels, and groundwater gradients indicate recharge to the aquifer occurs. During the fall and winter, river levels drop several feet and groundwater gradients are generally towards the river. Metzger and Loeltz (1973) reported that the Colorado River is by far the principal source of recharge to groundwater in the Mohave Valley. However, this does not appear to be true across most of the Topock site, where the geochemistry indicates that the groundwater system is recharged from precipitation on the nearby mountains and infiltration from the intermittent flows in the desert washes.

The Colorado River affects groundwater levels at the Topock site. Wells completed in the fluvial sediments near the river often show substantial influence due to river stage fluctuations, caused by Davis Dam release patterns. For a 1 foot change in river level, some wells, such as the MW-34 wells, respond with a corresponding head change of over 0.6 foot. The magnitude of head change observed at a well is in some cases clearly a function of distance from the river. Due to these river fluctuations, groundwater gradient shifts direction daily as well as seasonally in the floodplain area. The alluvial wells are also affected; seasonal river influences on groundwater hydraulic head have been observed as far away as well MW-16, located southwest of the evaporation ponds and more than 4,500 feet from the Colorado River.

1.3 Primary Study Objectives

The primary objectives of this study, as outlined in the August 9 DTSC memorandum (DTSC 2005c), are to:

1. Assess chromium concentrations in pore water at multiple locations within the zone that has been historically downgradient of the chromium plume observed in the floodplain, during the next seasonal low river stand.
2. Assess chromium concentrations in pore water at multiple locations that are historically upgradient of Bat Cave Wash, during the next seasonal low river stand.
3. Assess whether geochemical conditions in shallow sediments below the Colorado River favor chromium reduction.

1.4 Secondary Study Objectives

The secondary objectives of this study, as outlined in the August 9 DTSC memorandum, are to:

1. Conduct a pilot study to assist in selecting certain sampling design elements of the Pore Water and Seepage Study. The pilot study should determine the following:
   a. Depth of influence from diurnal river level fluctuation. The results will be used to select pore water sampling depths with DTSC consultation.
   b. Real-time exchange parameters that can be used to identify zones of groundwater-surface water exchange. The results will be used to determine whether a full scale seepage study should be conducted.
   c. Expected penetration depth capabilities of selected seepage and pore water sampling method(s) in the Colorado River sediments. The results will be used to select the appropriate sampling method.
2. Collect data that will allow estimates of the mixing ratio between surface water and groundwater within the zone of this investigation.

1.5 Data Interpretation and Considerations

Pore water sampling is generally performed as part of an ecological risk assessment on the benthic community, where microbial, meiofaunal, and macrofaunal receptors are the subject of analysis (SETAC 2001). These studies primarily focus on toxicity testing. The term “pore

water" has a specific meaning to toxicologists; it refers to interstitial water in the uppermost 10 centimeters (cm) of sediment where the benthic organisms live. However, for the purposes of this PWSS, pore water is characterized as water in pore spaces immediately beneath the river.

The presence of constituents of concern in pore water does not provide direct indication of any impact to the overlying surface water. To evaluate the surface water impact, it is necessary to quantify the concentrations of constituents of concern, the magnitude of pore water flux to the overlying surface water, and the geochemical environment in the river substrate. At the Topock site, a pump-and-haul remediation system operated from March 2004 until August 2005. A pump-and-treat on-site remediation system has been operating since August 2005. The extraction wells have been effective at controlling groundwater gradients in the floodplain near the river and for some distance under the river. Within the zone of influence of TW-2D pumping, located about 600 feet from the Colorado River, constituents in pore water (if present) would tend to migrate downward, away from the river.

Hexavalent chromium [Cr(VI)] is also naturally occurring in aerobic groundwater in the Mohave Basin. Studies are currently underway to evaluate the concentrations of natural background Cr(VI) in the vicinity of the Topock site. Thus, Cr(VI) in pore water could be associated with naturally-occurring Cr(VI). A detection of Cr(VI) in pore water could indicate:

- There is naturally-occurring Cr(VI) in pore water.
- There is naturally-occurring Cr(VI) in nearby groundwater.
- The surface water contains Cr(VI).
- A sampling error occurred (many of the potential pore water sampling techniques are untested or could introduce interference).
- A laboratory error occurred or the limits of the laboratory precision methods were exceeded (as was the case with the USFWS sampling).
- The Cr(VI) is associated with the Topock site.

2.0 Study Approach and Rationale

2.1 Overview of Study/Work Plan Design

In their letter dated August 26 (DTSC 2005d), DTSC directed PG&E to submit a *Draft Pore Water and Seepage Study Work Plan* and to begin the process of obtaining permits, agreements and contractors for implementation. The following activities are proposed to plan, permit, and execute the seepage and pore water study:

- Submittal of a Draft Work Plan to DTSC on September 30, 2005.
- Review the Draft Work Plan by DTSC and, if necessary, the TWG.
- Preparation and submittal of a Final Work Plan.
- Securing of permits, approvals, and certifications.
- Procurement of specialty subcontractors and equipment (which may require significant lead times).
- Performance of a pilot study to deploy and retrieve temperature sensors, and to evaluate proposed pore water sampling methodologies (see Section 2.3).
- Performance of a seepage investigation to determine the locations on the river bottom where groundwater may be upwelling into the river (see Section 3.0).
- Pore water sampling to determine if Cr(VI) is in the pore water below the river - both upgradient and downgradient of the Bat Cave Wash outlet (see Section 4.0).

This Work Plan details the conceptual approach for the seepage evaluation and pore water sampling study based on the June 30 DTSC memorandum (DTSC 2005b). It presents the background, study approach, methods review, permitting, procurement, implementation plan, reporting, and schedule for the PWSS. The preferred and alternative methods for the seepage assessment and the pore water sampling are discussed. The appendices contain additional technical information on the proposed sampling methods, standard operating procedures, and the Health and Safety Plan (HSP).

2.2 Study Design Considerations

The physical location of the sediment, its particle size distribution and level of compaction, and the final use of the data typically dictate the type of sampler used and the collection methodology that is chosen (USEPA 2001, SETAC 2001). Site conditions of particular importance include the depth of the water body overlying the sediment and the strength of the river current.

The potential sampling locations at the Topock site will be subject to water turbulence and high water velocities (2 to 3 feet per second [ft/sec]), resulting in conditions where it may be difficult for a boat to maintain a fixed position. The Colorado River level at the Topock site

varies almost continuously in response to the variable release of water from Davis Dam, and to a lesser degree in response to changes in the water level of Lake Havasu. Seasonally, the average river level at the I-3 gauge varies by about 5 feet. Daily variations at I-3 can exceed 4 feet in the summer and 1 foot in the winter.

As part of interim measures (IM) directed by DTSC direction, PG&E has operated groundwater extraction well(s) at the MW-20 bench in the floodplain area of the site since March 2004. The purpose of extraction is to maintain a landward groundwater gradient of at least 0.001 feet/foot, to prevent the Cr (VI) plume beneath the site from migrating towards the Colorado River. From March 2004 through July 2005, extracted groundwater was shipped off-site in trucks for treatment and disposal at a third-party facility. Beginning in July 2005, extracted groundwater has been pumped from the extraction wells to the IM-3 treatment facility. Treated groundwater is re-injected through injection wells IW-2 and IW-3. Currently, the IM extraction well TW-2D is pumping at approximately 90 gallons per minute. During the week of August 29, 2005, the extraction and treatment system was tested at up to 135 gallons per minute, without problems. It is anticipated that an average landward gradient of at least 0.001 feet/foot will be maintained within the TW-2D capture zone throughout the period during which pore water sampling takes place.

2.3 Pilot Study/Phase I to Support Sampling Design

To determine the effectiveness and feasibility of the proposed methods for the pore water sampling and the seepage assessment, a pilot study (Phase I) will be conducted. This study will involve the deployment of TidbiT® temperature sensors and testing of the pore water sampling methods. The TidbiT® sensors will be placed at 5 locations in the river, at 1-foot 3-feet, and 6-feet depth intervals below the river bottom. The results would ideally provide an estimate of the depth of temperature fluctuation caused by diurnal river level changes. The depth of investigation for the seepage and pore water sampling would be selected based the results of the pilot study. The TidbiT® sensors will be deployed by pumping river water down an installing pipe from a stationary boat. After emplacement of the sensors, the pipe will be removed, leaving the sensors buried in the river bottom. A cable will be attached to the sensors and will extend above the river bottom. After approximately 1 week of exposure time, the sensors will be retrieved using the attached cable and the data will be downloaded. During the same mobilization as the TidbiT® sensors deployment, two drive-point methods (the Harpoon™ sampler and the drive-point piezometer) will be tested to determine the depths below the river bottom to which each method can penetrate, evaluate the proposed sampling methodology, and test the disturbance to the bottom sediments and noise levels. These methods are described in detail in Section 4.0. A test pore water sample will be collected and sent to the laboratory to determine if there is matrix interference but the sample will not be analyzed for chromium. The TidbiT® deployment and the pore water sampling method testing will be conducted from an anchored boat. Details of the pilot study design were presented in a September 16, 2005 technical memorandum that has been shared with some of the potential permitting agencies (included in Appendix A).

3.0 Groundwater/Surface Water Seepage Assessment

3.1 Review of Methods

A review of the potential methods for identifying areas of groundwater/surface water seepage was presented in the *Pore Water and Seepage Study Overview* submitted in July to DTSC (CH2M HILL 2005b). Table 3-1 provides a list of potential seepage investigation methods that were discussed and evaluated.

3.2 Rationale for Preferred Method

In DTSC's August 9 memorandum, the TidbiT® sensor deployment was identified as being the most viable for initially evaluating vertical temperature trends beneath the river bottom. This device will be utilized in the pilot study to determine if zones of groundwater/surface water exchange can be detected by temperature. These sensors are self-contained, consisting of a temperature probe, battery, and data logger. The TidbiT® sensors will log temperatures at several depths below the river bottom. This method was selected because it will provide information on diurnal fluctuations in temperatures at the river bottom, which would not be possible with real-time probes. PG&E's groundwater sampling program at Topock has established that groundwater is several degrees warmer than river water, so warmer or more consistent pore water temperatures may be indicative of the presence of groundwater discharge. The depth of investigation for the seepage and pore water sampling would be selected based the results of the pilot study (see Section 2.3).

The seepage investigation will involve measuring real time temperature and specific conductance in the pore water by advancing small (less than 1") diameter drive-point probes into the river bottom from an anchored boat. This method will allow a large number of samples to be surveyed at a rapid rate, which is necessary to cover the study area in a sufficiently dense sample grid in a timely manner. In the event the pilot study demonstrates that temperature alone is not sufficient to delineate locations of groundwater seepage, measuring specific conductance might provide additional insight. Groundwater exhibits higher specific conductance than river water, so higher conductivity measurements could be indicative of groundwater seepage.

3.3 Locations and Sample Timing

An aerial photograph of the Topock Compressor Station, Colorado River, and the downstream area of the PWSS is provided in Figure 3-1. The Colorado River in this area ranges from approximately 600 feet wide (north of Burlington Northern & Santa Fe [BN&SF] railroad bridge) to approximately 450 feet wide south of the I-3 gas transmission crossing. Based on 3 depth transects measured in July 2005, the depth of the river is

approximately 12 feet in most study areas, with a maximum recorded depth of 22 feet near the southern portion of I-3. The locations of the three depth transects on the river are also presented in Figure 3-1. Figure 3-2 presents the cross sections of the depth transects.

If the pilot study identifies the areas in which groundwater-surface water exchange occurs, the areas will be selected for the seepage investigation (DTSC 2005c). Figure 3-3 presents the proposed seepage investigation area, which begins downgradient from the outlet of Bat Wash Cave and ends just past surface water sampling location C-TAZ, and is approximately 6,000 feet long. The seepage investigation would consist of a series of transects with 3 measurement locations each, spaced about 200 feet apart. This would involve an approximate total of 90 investigation points, requiring an estimated 6 working days to complete. The number and the spacing between points may be revised following the pilot study, further investigation, or discussions with DTSC or the Consultative Workgroup (CWG).

To minimize the effects of surface water recharge on pore water characteristics, the seepage investigation and pore water sampling should be conducted during times of seasonally low river levels, which current United States Bureau of Reclamation (BOR) projections indicate will occur in the months of November through January.

The seepage investigation is currently scheduled for middle or late November 2005, pending agency approval and permissions, during the seasonal low river stand and shortly before the initiation of the pore water sampling. Fieldwork and data collection may last a week or more, followed by a week of data processing and interpretation. All work will be conducted during daylight hours to minimize health and safety risks on the river.

4.0 Pore Water Sampling

4.1 Review of Methods

A review of the potential methods for pore water sampling was presented in the *Pore Water and Seepage Study Overview* submitted in July 2005 to DTSC (CH2M HILL 2005b). Table 4-1 provides a list of pore water sampling methods that were discussed and evaluated.

4.2 Rationale for Preferred Method

As specified by DTSC's August 9 memorandum, drive-point samplers are to be used to conduct the pore water sampling (Phase III). With this methodology, drive-point samplers are advanced into river sediments for collection of pore water samples via a purge pump (i.e., a peristaltic pump). The objective is to penetrate to depths below the zone of influence from diurnal river level fluctuation, if possible. Drive-point sampling should prove effective for the following reasons:

1. Divers are not required for drive-point sampling. The section of the Colorado River near Topock has fairly heavy boat traffic and a fast current, posing a significant health risk to divers.
2. Diffusion sampling would require two diver mobilizations, one to deploy the samplers, the other to retrieve the samplers a week later.
3. Diffusion samplers are unproven for chromium studies and would require a separate pilot study to evaluate their effectiveness.
4. Drive-point samplers will allow sampling of a wider area and multiple depths over a shorter period of time compared to diffusion samplers.
5. Drive-point sampling should be effective under conditions of moving currents and during various river level stages.
6. Drive-point sampling will not cause excessive disturbance to the river bottom.
7. Drive-point sampling will enable the collection of field water quality parameters.
8. Drive-point samplers are a demonstrated technology.

Disadvantages of drive-point sampling include: (1) limitations of discrete sampling events that do not capture average conditions, (2) potential difficulty in completely sealing the drive points from river water infiltration, and (3) potential difficulty in advancing drive points in coarse river bottom material.

Two specific types of drive-point sampling methods will be tested during the pilot study: the Pushpoint Harpoon™ sampler and drive-point piezometers. Below are descriptions of

these two methods, with more detailed technical specifications and photographs included in Appendix B.

Harpoon™ Sampler: Consists of a ¼" diameter stainless steel drive point that is 22" long. It is attached to a $^{7}/_{8}$" diameter coupler that is connected to ½" diameter metal tubing which extends to the surface. The sampler is advanced by hand up to 22" deep into sediment. Pore water is pumped to the surface with a peristaltic pump through $^{3}/_{8}$" diameter polyethylene or Tygon® tubing inside the sampler piping.

Drive-Point Piezometers: Consists of ¾" diameter stainless steel drive point attached to steel pipe of same diameter. It can be advanced by hand or with a manual or vibrating power hammer. Similar to the Harpoon™ sampler, water is pumped to the surface through polyethylene or Tygon® tubing for sampling.

Of the two drive-point sampling methods presented, the Harpoon™ sampler is the preferred method. Although the depth of sample collection is limited, it will have less impact on the river bottom than the drive-point piezometer. The pilot study will determine the effective sampling depths of these methods. If the Harpoon™ proves incapable of reaching the desired sampling depths then the drive-point piezometer will be used to collect samples at the desired depth.

4.3 Locations and Sample Timing

The locations of the pore water sampling will be determined by the results of the pilot study and the seepage investigation, at areas where groundwater seepage is indicated. A depth-discrete sample will be collected at each station, with the appropriate depth of investigation to be determined by the results of the pilot study. In response to the daily river level fluctuations, the hydraulic head in the shallow sediments beneath the river is expected to shift daily. The objective therefore will be to sample at a depth that is below the zone of diurnal surface water influence in the river bottom, as indicated by consistent temperature measurements over a daily cycle.

Pore water sampling is planned as a one-time event in mid-December, pending agency approvals and permissions. The duration of the event will be determined based on the results of the pilot study and seepage investigation. PG&E is planning to request that BOR temporarily stabilize the river levels before and during the sampling period to minimize the effects of daily river fluctuations on pore water characteristics. Low water levels will enable sampling in shallower water from a watercraft. CH2M HILL will coordinate the sampling dates with the BOR. To minimize the risk of accident or injury to sampling personnel and the boating public, the pore water sampling will be conducted during daylight hours, when visibility on the water is greatest.

4.4 Analytical Parameters

All pore water samples will be analyzed for the following analytes: Cr(VI), total dissolved chromium [Cr(T)], specific conductance, and pH. Samples collected for Cr(VI) and Cr(T) will be filtered and preserved at the time of collection in the field, similar to the depth-discrete river channel water sampling procedures. The water quality field parameters that

will be measured at each of the sampling locations with a flow-through cell include: specific conductance, temperature, pH, oxidation-reduction potential (ORP), and dissolved oxygen. Analytical methods and reporting limits for both the laboratory and field parameters are presented in Table 4-1. Quality control procedures for both field and laboratory work are discussed in Section 7.0.

Stable isotopes (Oxygen 18 and deuterium) were considered for inclusion in the pore water analyte set. If there was a distinct difference between stable isotope ratios in pore water and river water, comparison of stable isotope ratios between river and pore water could provide an estimate of the degree of mixing between river water and groundwater. A review of the existing stable isotope data was undertaken to determine if the pore water might have a stable isotope signature distinct from the river. Shallow floodplain wells near the river provide the closest analog to pore water. These wells include MW-27-20, MW-28-25, MW-29, and MW-43-25. The stable isotope data from this set of shallow wells is plotted along with the stable isotope data from river samples in Figure 4-1. There is no distinguishable difference in the stable isotope data from the shallow wells and the river. Pore water represents a mixture of river water and shallow groundwater and would be expected to have an isotopic signature between river water and shallow groundwater. Because the two end members that make up pore water (river and shallow groundwater) are isotopically indistinguishable, pore water would also be expected to be isotopically indistinguishable from either river water or shallow groundwater. Stable isotope analysis was therefore not included in the pore water study analyte set.

5.0 Permitting and Procurement Activities

5.1 Permitting Agencies and Preliminary Permit Requirements

The majority of the study area is managed by the USFWS Havasu National Wildlife Refuge (HNWR). The HNWR encompasses the entire Colorado River south of the BN&SF railway, and the Arizona portion of the river north of the railway. The United States Bureau of Land Management (BLM) manages the California portion of the Colorado River north of the BN&SF railway, on behalf of the BOR. PG&E will seek approval to perform the PWSS pursuant to the February 2005 Consent Agreement, which was entered into by PG&E and the USFWS, BLM, and BOR.

Based on discussions with the USFWS HNWR staff, approval to implement the PWSS will involve review of the PWSS work plan and consultation with the ecological services section of the USFWS, to ensure compliance with the federal Endangered Species Act (ESA). This consultation process may be completed within a 30- to 45-day period following submittal of the final PWSS work plan. It is expected that final approval by the USFWS HNWR will include stipulations related to ecological resources. A similar process will apply to obtain approval from the BLM Lake Havasu field office, to implement the PWSS north of the BN&SF railway in the California portion of the river.

It is anticipated that the federal agencies will conduct formal government-to-government consultation with potentially affected Native American tribes, during which the tribes will have the opportunity to provide input on the proposed PWSS.

Activities that involve dredge and fill activities in the Colorado River are subject to Sections 401 and 404 of the federal Clean Water Act. The United States Army Corps of Engineers (USACE) administers Section 404 of the Clean Water Act, and have previously indicated that actions undertaken pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) are considered exempt. A similar exemption has been provided by the California Regional Water Quality Control Board, which administers Section 401 of the Clean Water Act. Because the PWSS is considered a CERCLA activity, it is expected that this exemption would apply.

Other agencies with jurisdiction over the proposed PWSS activities include the California Department of Fish and Game, and the Arizona Department of Game and Fish. It is expected that the USFWS consultation process will satisfy any state requirements, such that a separate consultation with these agencies will not be required.

Final approval to implement the PWSS will come from the DTSC. Because this approval is considered a discretionary action, approval of the PWSS is subject to the provisions of the California Environmental Quality Act (CEQA). The DTSC has not yet determined the appropriate mechanism for compliance with CEQA.

5.2 Subcontractors and Procurement

Preliminary work scoping and scheduling has been conducted with subcontractors to ensure that work can proceed according to the schedule outlined in Section 9.0. Anticipated subcontractors include: California-certified analytical laboratories, one boat for the pilot study, up to three boats for the pore water sampling event, and a seepage investigation subcontractor. Other subcontractors will be procured as the investigation progresses. Materials and supplies will also be procured as needed.

6.0 Study Implementation Plan

This section outlines the necessary procedures to implement the PWSS. Deployment, investigation and sampling techniques, contingency plans and health and safety issues are discussed.

6.1 Field Activity Procedures

6.1.1 Sampling Deployment

All three phases of the project (pilot study, seepage investigation, and pore water sampling) will be conducted from one or more boats in the Colorado River channel. During sampling procedures, the boat will be held stationary by deploying anchors upstream if it is to remain at the location for a relatively long period. For quick measurements, the boat may remain stationary by utilizing the engine.

6.1.2 Sampling and Analysis Procedures

Sampling procedures for the three phases of the Pore Water and Seepage Study are discussed below. Detailed procedures are included as Standard Operating Procedures (SOPs) in Appendix C.

Pilot Study

TidbiT® temperature sensors will be deployed for an initial temperature survey during the pilot study. The TidbiT® is a self-contained unit approximately 1.5 inches in diameter. A metal pipe 0.75 to 1.5 inches in diameter, deployed from a stationary boat, will be used to install the TidbiT™ sensors in the river bottom by 'jetting'. River water will be pumped down the pipe and out a nozzle at the end. The water jet emanating from the nozzle of the pipe will loosen and temporarily displace the sediments in the immediate vicinity, allowing advancement of the pipe into the river bottom. Depending on the characteristics of the sediment, temporary increases in river turbidity may occur near the river bottom in the immediate vicinity of the pipe during the jetting process. Each hole is expected to take approximately 10 minutes to complete.

A TidbiT® sensor will be attached to the jet pipe as it advances, and will be released when the jet pipe is pulled back. Alternatively, a TidbiT® sensor may be inserted through the center of the jetting pipe after it has been inserted into the river bottom. The TidbiT® sensors will be left behind in the river bottom as the pipe is extracted. The surrounding sediments are expected to collapse around the sensor upon removal of the jet pipe. Each TidbiT® will be attached to a stainless steel wire or small diameter cable that extends to the river bottom surface and is marked with brightly-colored nylon rope. The rope will be weighted so that it does not float up off the river bottom and into the path of passing boats. Global Positioning System (GPS) coordinates will be logged to enable recovery. After approximately 1 week, a crew in a boat will use a winch to retrieve the TidbiT® sensors.

Seepage Investigation

The seepage investigation will involve a temperature and conductivity survey. During the survey, a team of one or more boats will advance a small diameter (1" or less) drive point into the river bottom across selected transect lines, from the mouth of Bat Cave Wash downstream to the I-3 gas transmission line in the south (Figure 4-1). No pore water will be collected during this process. A real-time GPS unit will be connected to the computer onboard the boat to log the locations of all measurement points. The sensor in the drive point will collect data continuously and relay it to the computer on the boat, so that a temperature and resistivity profile can be generated at each sampling location. The sensor will be driven by hand or with a vibrating power hammer to depths of up to 6 feet below the river bottom, or to refusal, if 6 feet is not reached. The sensor will be pulled back to the surface after field measurements stabilize at the maximum depth and nothing will be left in the river bottom.

Pore Water Sampling

The pore water sampling method (Harpoon™ or drive-point piezometer) will be determined by the outcome of the pilot test and with regulatory approval. A drive-point sampler will be driven by hand or a power hammer to the desired sampling depth. Once the sampling depth has been reached, pore water will be pumped to the surface through a $^3/_8$"diameter polyethylene or Tygon® tube. Pumped water will be diverted to a flow-through cell that measures basic water quality parameters (temperature, specific conductance, dissolved oxygen, salinity, oxidation-reduction potential, etc.). Approximately three sampler volumes will be pumped to purge the drive-point sampler and a water sample will be collected. No more than 10 liters of water will be pumped from each sample location. Pumped water will be collected on the boat and stored in ice coolers. The sampling device will be pulled back to the surface and the hole will collapse behind it. Nothing will be left on the river bottom. Very little sediment disturbance is anticipated with this method. At the end of the day, or when water storage on the boat reaches capacity, the purge water will be transferred to the investigation derived waste (IDW) tank on the Topock site. This tank is used to store all purge water from groundwater sampling at the site. A PG&E subcontractor is responsible for analyzing and disposing of the water in the IDW tank.

6.1.3 Health and Safety

The *Topock Health and Safety Plan* (Revision 8) covers the work described in this Work Plan and is presented in Appendix D. The reach of Colorado River near the Topock site is subject to a significant amount of boat traffic. The sampling procedures must address the health and safety of personnel during sampling, potential hazards to navigation or recreational users, and the security of any dedicated equipment deployed on the river bottom. In the past year, boat collisions have resulted in fatalities near Topock.

All of the proposed methods will require boats to be anchored in the river channel, which would be much a greater navigation hazard at night when anchor cables would not be visible. To minimize the risk to sampling personnel and the boating public, all parts of the study will be conducted during daylight hours when visibility on the water is greatest.

6.2 Contingency for Alternative Study Methods

6.2.1 Seepage Assessment

If the TidbiT® survey indicates that the depth where diurnal fluctuations in temperature is greater than could be reached with the temperature probes, the seepage survey will not be conducted. Pore water samples would then be obtained from the 10 transects shown on Figure 6-1.

6.2.2 Pore Water Sampling

If the results of the seepage investigation do not indicate groundwater seepage locations, the pore water sampling will be conducted on five upstream transects and five downstream transects (Figure 6-1). Seven of these transects comply with DTSC June 30 letter recommendations (DTSC 2005b) and approximately correspond to the July 2005 surface water monitoring locations. Three upstream transects were added, to allow for collection of a robust background data set. DTSC also recommended that each upgradient transect have three to four sampling locations and each downgradient transect have four to five sampling locations (DTSC 2005b). To effectively characterize pore water conditions, 5 sampling locations will be attempted for each transect, for a maximum of 50 potential sampling locations in the study area. The final locations may be revised based on the actual channel depth, morphology, and river sediment at each location (e.g., sandy and silty sediments). Subsurface conditions may prevent pore water sampling at all proposed locations. The sample depth will be determined from the results of the Phase I TidbiT® temperature survey. Otherwise, samples will be collected from the maximum achievable depth for the selected pore water sampling method. The Harpoon™ sampler is anticipated to penetrate up to 50 cm while the drive-point piezometer is expected to penetrate 3 to 6 feet below the river bottom.

7.0 Quality Control and Data Management

Quality control procedures will be implemented for both field activities and laboratory work associated with the PWSS. Detailed descriptions of quality control procedures at the Topock site are provided in the Quality Assurance Project Plan for Water Quality Sampling and Analysis (QAPP), which is found in Appendix D of the *Sampling, Analysis, and Field Procedures Manual* (SAFPM) (CH2M HILL 2005d). This plan ensures that data quality objectives (DQOs) are achieved and that validated results may be used for project decision-making purposes.

7.1 Field Quality Control

The QAPP presents requirements for quality control sampling and sample handling and custody procedures to be implemented in the field. Due to the importance of attaining good ORP and other field data, careful measures will be taken to ensure that all field instruments are calibrated and that routine maintenance is performed. In addition, field duplicates and equipment blanks will be collected as specified in the QAPP. Proper decontamination procedures and handling investigation derived waste from the river are described in the SAFPM.

7.2 Laboratory Quality Control

The QAPP outlines quality control requirements for laboratory analyses to be conducted for all PG&E Topock projects. The QAPP addresses data quality objectives; method detection limits, reporting limits, and instrument calibration requirements; laboratory quality control samples; laboratory data management procedures; performance evaluations; preventive maintenance; corrective action; and quality assurance reports. The laboratory analytical data generated from the pore water sampling will be independently reviewed by project chemists to assess data quality and identify deviations from analytical requirements.

7.3 Data Validation

The analytical results of groundwater and surface water samples will be evaluated to verify whether the data are sufficiently accurate, precise, and representative of site conditions for decision-making purposes in support of ongoing site investigation and remediation activities. Details regarding data validation for the Topock PWSS are provided in the QAPP.

7.4 Data Management

Management of data generated from the Topock PWSS will be conducted in accordance with the *PG&E Program Data Management Plan* (CH2M HILL 2004b). The Data Management Plan outlines standardized procedures for field data collection and review, analytical data loading into the information system (environmental database), verification of the uploaded

data, quality assurance/quality control procedures associated with data management, and reporting formats.

8.0 Contingency Plan and Reporting

8.1 Contingency Plan

In the event that Cr(VI) is detected in pore water in the downgradient sampling locations, the PWSS Contingency Plan will go into effect. Figure 8-1 presents the events that would occur in the event of a Cr(VI) detection in pore water downstream of the Topock site. The necessity for additional sampling will be determined by a statistical comparison between data from downstream locations and data from background locations. If a Cr(VI) detection at a downstream location is demonstrated to be significantly greater than background detection, the appropriate regulatory agencies will be notified immediately. Additional sampling will then be performed to confirm the detection and further define the distribution of Cr(VI) in the pore water of the river bottom. The contingency sampling would involve the following steps:

a. Re-sampling pore water at location(s) where there was a significant Cr(VI) detection.

b. Sampling pore water 20 feet from the location of the significant detection in four directions. Samples will be collected at the depth of the original detection.

c. Collecting a surface water sample above the pore water detection to determine if Cr(VI) is present in the river channel. Surface water samples will be collected in accordance with the *Revised Sampling Sample and Standard Operating Procedure for Depth-Specific Surface Water Sampling* (CH2M HILL 2005e).

8.2 Data Reporting

The results of the pilot study will be submitted in a technical memorandum approximately 10 days after the recovery and data download of the Tidbit® sensors. Preliminary results from the seepage investigation will be submitted approximately 10 days following the conclusion of data collection. As specified in the DTSC June 30 memorandum (DTSC 2005b), pore water sampling results will be submitted in a tabular format within 7 days of data validation completion.

8.3 Pore Water and Seepage Study Report

A PWSS report with interpretation of findings will be submitted to DTSC 45 days after validation of the pore water sampling data. The report will summarize the findings of the pilot study, the seepage investigation, and the pore water sampling study. Results will be presented in tabular and graphical formats. Distribution and trends of pore water seepage and detects and non-detects of Cr(VI) will be discussed.

9.0 Schedule

Table 9-1 presents the proposed PWSS schedule, with estimated sampling dates for the pilot study, the seepage investigation, and the pore water sampling. The start of each field event is dependent on obtaining all required agency approvals and permissions. The table does not include contingency events and follow-up sampling if required. All days presented are working days.

10.0 References

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Tables

Table 3-1

Summary of Seepage Investigation Methods

Pore Water and Seepage Investigation

PG&E Topock Compressor Station, Needles, California

Method	Installation	Sampling Depth Below River Bottom	Advantages	Disadvantages or Limitations	Proven Applications / References
Real - time temperature probe survey	Small-diameter probes driven into bottom from a boat	Up to 4 ft	Rapid collection of data allows for relatively large numbers of locations to be surveyed.	Diurnal fluctuations of river may limit working time to a few hours per day unless probes can be driven to depths below the zone where diurnal flow is dominant	Has been developed and successfully applied at similar sites by GSi/Water
Trident probe survey	Combined temp / conductivity / sampling probes driven into bottom from a boat	Up to 2 ft	Probe is able to measure both temperature and conductivity in-situ plus collect groundwater samples.	Diurnal fluctuations of river may limit working time to a few hours per day unless probes can be driven to depths below the zone where diurnal flow is dominant. Triple probe may encounter more cobbles than a single, thermal probe. Technology only available through subcontract with Coastal Monitoring or Groundwater Seepage, Incorporated.	Developed by Space and Naval Warfare Systems Command (SPAWAR); has been used at numerous coastal, lake, stream, and river sites.
Temperature logging on river bottom	Strings of TidbiT's laid on river bottom using divers or boats	0 ft	Temperature loggers provide more information on diurnal fluctuations than real-time probes and could be deployed without regard to river stage. Could provide an efficient method for preliminary survey to determine if temperature signal is detectable above river bottom.	Temperature signal would be muted by mixing with river water. Method would likely be less sensitive than methods that measure sub-bottom temperature. Strings of instruments on river bottom could be damaged by boat anchors or buried by moving sandbars.	Method suggested by USGS
Temperature logging in shallow sub-bottom	Divers bury TidbiT's in river bottom, either directly or inside temporary plastic casings.	Up to 2 ft	Buried temperature sensors more likely to see signal from GW seepage. Could be coupled with passive diffusion samplers to provide both temp and water quality measurements.	Need for deployment by divers would limit number of sites that could be surveyed. It may be difficult find and retrieve TidbiT's if sandbars shift.	None found
Bathymetric Survey	Boat-mounted equipment moving along survey lines	NA	Identification of coarse-grained zones where GW seepage is most likely. Knowledge of depth and bottom configuration could be used to help focus other investigation techniques.	Does not provide any direct measurement of seepage. Would need to be followed up by other methods.	Well proven technology widely used.
Aerial Thermal Infrared Survey	Super-cooled detector mounted in small aircraft	NA	Can cover large areas efficiently	Only detects temperature differences in near surface waters. Unlikely to work well in deep, fast flowing river	

Table 4-1
Summary of Pore Water Sampling Methods
Pore Water and Seepage Investigation
PG&E Topock Compressor Station, Needles, California

Sampler Type	Description	Sampling Depth Below River Bottom	Sample Volume	Advantages	Disadvantages or Limitations	Proven Applications / References
Discrete Sampling Methods				Provides the most representative sample of pore water at the time of sampling. Much faster and easier to deploy than either diffusion or seepage sampling methods.	Influence of diurnal fluctuations in river level may require sampling only during low water times and limit working hours per day.	
Drive-point piezometers	1.5 to 2-inch diameter pipes driven by hand into river bottom from a boat	Up to 6 ft	Only limited by soil type	- no sample volume limitations - field parameters (e.g., such as DO, ORP, etc.) can be measured with flow-thru cell; limited to suction lift; - could allow for repeat sampling at same locations if drive points were left in place	- Difficult to install in deep water or in swift currents - could not be installed in hard bottom sediments - large diameter of drive points may provide more chance of downward leakage of surface water	Drive points commonly used for Sampling shallow groundwater and have been previously used for pore water sampling at Topock
Harpoon Sampler	1/4-inch diameter probes driven by hand into river bottom from a boat.	Up to 2 ft	Only limited by soil type	- simple and low-cost sample tool - no sample volume limitations - field parameters (e.g., such as DO, ORP, etc.) can be measured with flow-thru cell; limited to suction lift; - could allow for repeat sampling at same locations if Harpoons were left in place - could allow for shore based sampling by routing tubing to river bank	- relatively new and unproven sampler design	None found
Trident® Probe (temperature/ conductivity/pore water probe)	Installed from boat; may require diver assist	Up to 2 ft	50-ml (syringe) or greater in sample bottle	- Can be used manually near the shore or from a boat - provides real-time readout and profiling of temp and SC - can be used to estimate the location of the groundwater/ surface water interface by looking at temperature gradients - air hammer allows installation in harder sediments	- limited to 2 ft sample depth - probe subject to damage if cobbles are encountered	Developed by Space and Naval Warfare Systems Command (SPAWAR); has been used at numerous coastal, lake, stream, and river sites.
Diffusion Sampling Methods				Diffusion sampling methods would provide integrated samples over a long period of time and could provide the most representative samples of the average concentrations present in pore water.	Diffusion samplers have not been widely used for metals. Because equilibration time is likely to be several days, the 24 hour holding time for Cr(VI) analysis could not be met.	
Drive Point Piezometer with LDPE diffusion bottles and temperature loggers (Tidbit)	Boat and/or diver-installed	Up to 6 ft with samples collected at multiple depths	Up to 0.4 L in 10 vials	- easy to construct 1.5-inch diameter drive point piezometers that can be stacked with multiple diffusion bottles and temperature loggers. - can be installed by hand in shallow water or by boat in deeper water (may need diver assist). - samples are time-integrated and can be at multiple depths. - temperature can be logged for the period of installation. for evaluation vertical groundwater flow conditions.	- may require diver assist for installation and will require diver assist for removal. - could allow for resampling at exact same location - not a commercially available product - permitting may be more difficult because pipes are left in river bottom	PDB Demonstration at Grissom ARB, Indiana
LDPE Diffusion bottles buried with temperature loggers (Tidbit)	Diver-installed	Up to 2 ft	Up to 0.3 L in 3 x 100 ml plastic bottles	- bottles may be placed at multiple depths depending on sediment type - temperature loggers can be placed with samplers for evaluation of vertical groundwater flow conditions	- divers required for installation and retrieval - doesn't allow for resampling at exact same spot	Naval Industrial Reserve Ordnance Plant (NIROP), Naval Air Station, Fridley, MN; Fort Worth Joint Reserve Base (NAS Fort Worth JRB), Texas.

Table 4-1
Summary of Pore Water Sampling Methods
Pore Water and Seepage Investigation
PG&E Topock Compressor Station, Needles, California

Sampler Type	Description	Sampling Depth Below River Bottom	Sample Volume	Advantages	Disadvantages or Limitations	Proven Applications / References
Seepage Sampling Methods				Sampling bottom seepage provides a better measure of what is entering the river rather than just what is present in pore water. Seepage samplers can provide measurements of seepage rate.	If no groundwater seepage is occurring at the location where the sampler is deployed, no samples would be obtained. The effects of currents may disrupt the samplers ability to accurately measure and collect seepage samples.	
UltraSeep® (multi-sample seepage meter)	Boat and diver-installed	0 ft	Up to 3 L Dependent on seepage rate	- direct measurement of groundwater and contaminant discharges at the sediment/surface water interface. - unit stores data and controls sampling events based on seepage rate, which is continuously monitored. - up to six samples can be collected for chemical analysis -can be programmed to sample when discharge rate or conductivity reaches a threshold value	- difficult to use and install in high currents - proprietary technology only available through U.S. Navy - sampler cost significantly greater than other methods - would require 24 - 48 deployment hours for each sample location - would only provide samples at locations where groundwater was discharging	U.S. Navy (numerous sites) Currently undergoing further technical evaluation under the DOD's ESTCP program http://www.estcp.org/projects/cleanup/cu-0422.cfm
Benthic Flux Sampler	Diver-installed	0 ft	Dependent on seepage rate	- can operate unattended from a few days to months depending upon size and design - can operate in deep water - some are equipped with coring capabilities, advective flow volume measurement (from sediment to surface water), and current measurement instrumentation	- difficult to use and install in high currents - not able to program sample times to coincide with indications of groundwater discharge - would require 24 - 48 deployment hours for each sample location - would only provide samples at locations where groundwater was discharging - may not be commercially available	Developed by U. S. Navy and tested in several sites Certified by CalEPA.
Lee-type Seepage Sampler	Diver-installed	0 ft	Dependent on seepage rate	- low cost and light weight -low profile less likely to be tipped by current	- may not be usable in current velocity at Topock dynamic pressure on exposed sample bag - would require 24 - 48 deployment hours for each sample location - would only provide samples at locations where groundwater was discharging	Developed in 1970's and has been widely used

TABLE 4-2
Site Analytical Parameters, Test Methods, and Reporting Limits
Pore Water and Seepage Study
PG&E Topock Compressor Station, Needles, California

Analytical Parameter	Units	PoreWater	
		Analytical Method	Minimum Reporting Limit [1]
Laboratory Measurements			
Hexavalent Chromium	µg/L	SW 7199	0.2
Total Chromium, dissolved	µg/L	SW 6010B	1
pH	pH units	EPA 150.1	---
Specific conductance	µS/cm	EPA 120.1	2
Field Measurements			
Temperature	ºC	Field Instrumentation	---
Specific Conductance	µS/cm	Field Instrumentation	---
Dissolved Oxygen	mg/L	Field Instrumentation	---
Oxidation-Reduction Potential	mV	Field Instrumentation	---
pH	pH units	Field Instrumentation	---
Turbidity	NTU	Field Instrumentation	---

Notes:

[1] Minimum reporting limit for undiluted samples. Reporting limits are increased when sample dilution is required.

TABLE 9-1
PWSS Schedule
Pore Water and Seepage Investigation
PG&E Topock Compressor Station

Event	Event Timing	Estimated Duration	Notes
Pilot Study (Phase I)	October 2005	2 to3 Days (Deployment) 1 Day (Recovery)	To occur after all permits have been obtained.
Seepage Investigation (Phase II)	November 2005 (middle-late)	6 Days	Preceding the pore water sampling.
Pore Water Sampling (Phase III)	December 2005 (middle)	1 Week or 2 Days	Duration to be determined after pilot study.

Figures

N

0 2,000 4,000 Feet

1 inch equals 2,000 feet

Map Source: USGS 7.5 minute quads Topock AZ, and Whale Mountain CA.

Upstream Study Area

Downstream Study Area

PG&E Topock Compressor Station

FIGURE 1-1
SITE LOCATION AND STUDY AREA

PORE WATER AND SEEPAGE INVESTIGATION
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

CH2MHILL

N

0 1,000 2,000 Feet

1 inch equals 1,000 feet

LEGEND

River channel surface water sampling location

Shoreline surface water sampling location

C-NR4

NR-3

C-NR3

NR-2

C-NR1

NR-1

CON

C-CON

A-Dock

Park Moabi

PG&E Parcel No. 650-151-08

RRB

Colorado River

Topock Marsh

R-28

MW-34 Cluster

C-MAR

Topock Marina

R-27

C-R27

BN & SF RAILROAD

BAT CAVE WASH

INTERSTATE 40

R-22

C-R22

C-I3

I-3

C-TAZ

NEW EVAPORATION PONDS

TOPOCK COMPRESSOR STATION

PG&E

DEBRIS RAVINE

FORMER EVAPORATION POND SITE

FIGURE 1-2
GMP SURFACE WATER MONITORING LOCATIONS SEPTEMBER 2005

PORE WATER AND SEEPAGE INVESTIGATION
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

CH2MHILL

0 500 1,000 Feet

1 inch equals 500 feet

LEGEND

- River Depth/Transect Sample points (depths in Feet)
- Monitoring Well
- Extraction Well
- Planned River Channel Depth Profile Line
- Approximate limits of hexavalent chromium greater than 50 ppb in Alluvial Aquifer March 2005

Colorado River

Topock Marsh

50 ppb

TW-2D

MW-34 Cluster

A

4 11 13 4 11 6 11 12 12 12

Topock Marina

B

4 13 10 12 4 13 11 12 10 9

5 8 7 10 9 13 13 C 11 22

TOPOCK COMPRESSOR STATION

PG&E

DEBRIS RAVINE

FIGURE 3-1
DOWNGRADIENT PWSS AREA AND DEPTH TRANSECTS
JULY 2005

PORE WATER AND SEEPAGE INVESTIGATION
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

CH2MHILL

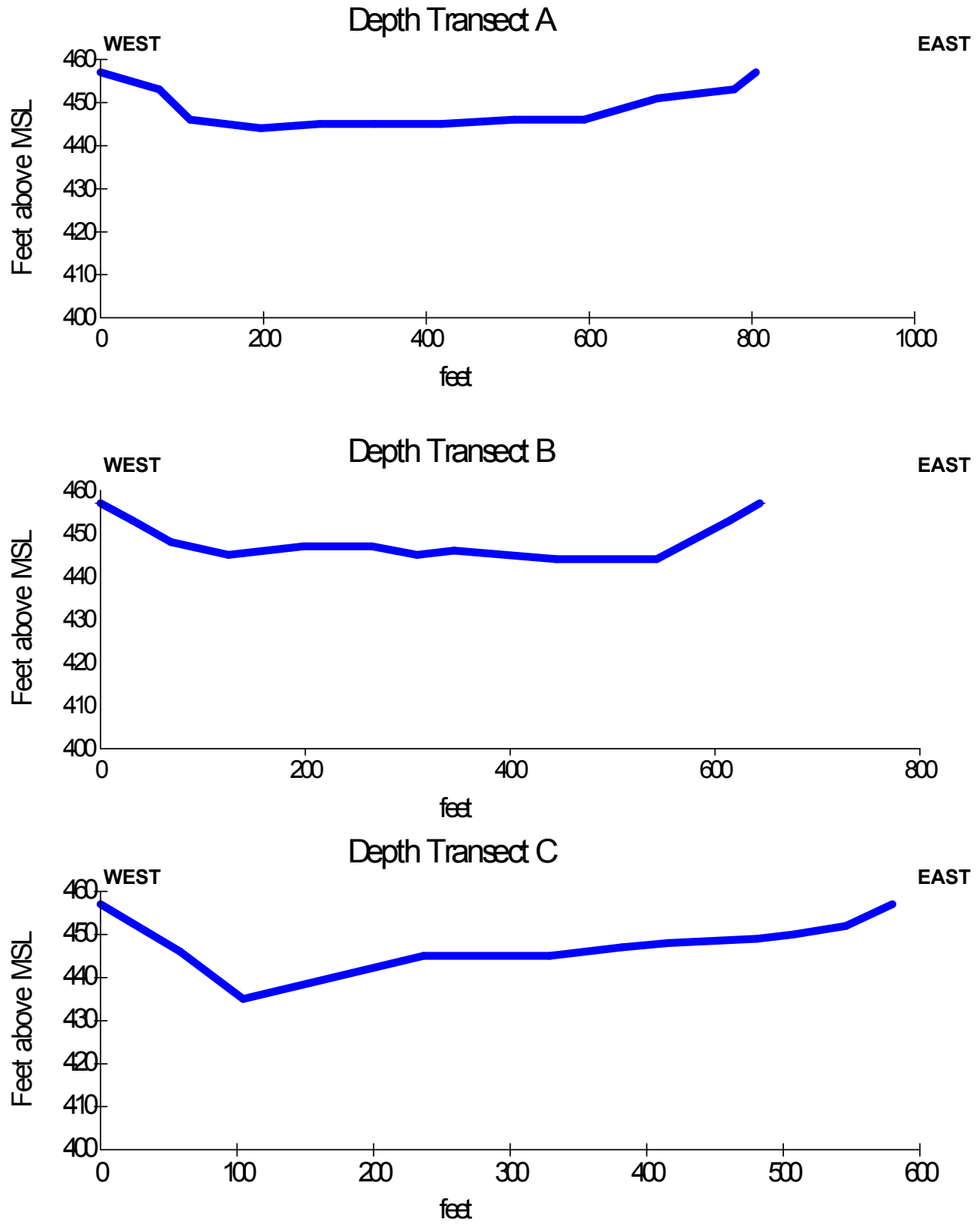


FIGURE 3-2
COLORADO RIVER DEPTH CROSS SECTIONS
JULY 2005

PORE WATER AND SEEPAGE INVESTIGATION
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

CH2MHILL

N

0 1,000 2,000 Feet

LEGEND

- Approximate limits of hexavalent chromium greater than 50 ppb in Alluvial Aquifer, March 2005
- Pilot Study and Seepage Investigation
- Seepage Study Sample Location

Colorado River

Park Moabi

PG&E Parcel No. 650-151-08

66

50 ppb

Topock Marsh

MW-34 Cluster

Topock Marina

BN & SF RAILROAD

INTERSTATE 40

BAT CAVE WASH

NEW EVAPORATION PONDS

TOPOCK COMPRESSOR STATION

PG&E

FORMER EVAPORATION POND SITE

DEBRIS RAVINE

FIGURE 3-3
PROPOSED LOCATIONS OF SEEPAGE INVESTIGATION
PORE WATER AND SEEPAGE INVESTIGATION
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

CH2MHILL

BAO \\ZINFANDEL\PROJ\PACIFICGASELECTRICCO\TOPOCKPROGRAM\GIS\MXD\2005\PWS_DTSC_PWLOCS.MXD PWS_DTSC_PWLOCS.PDF 7/13/2005 09:51:32

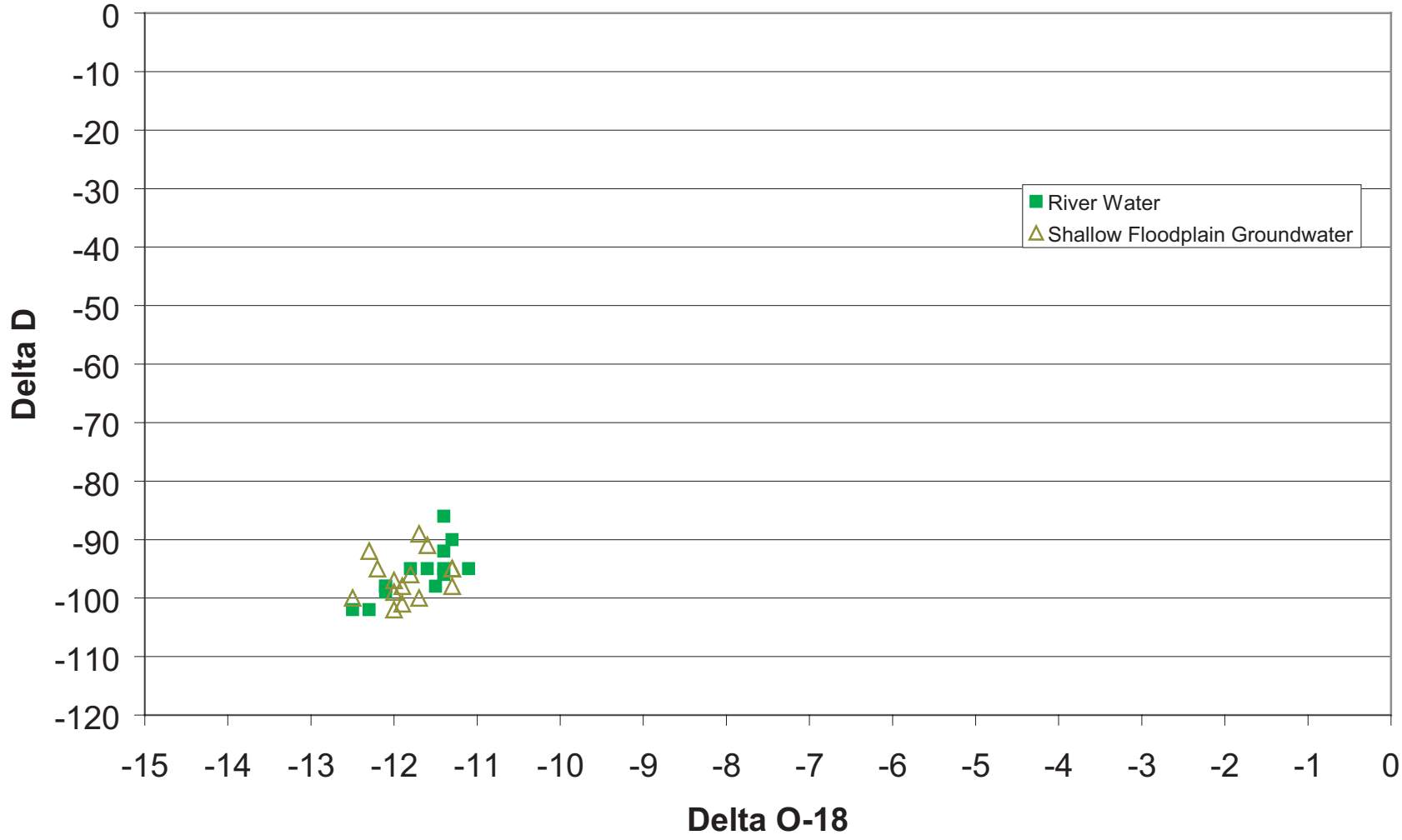


FIGURE 4-1
COMPARISON OF STABLE ISOTOPE RATIOS BETWEEN RIVER WATER AND SHALLOW WELLS NEAR RIVER
PORE WATER AND SEEPAGE INVESTIGATION
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

CH2MHILL

332663.A1.05.02_Fig 4-1_9/29/05_ccc_sfo

N

0 1,000 2,000 Feet

LEGEND

- Approximate limits of hexavalent chromium greater than 50 ppb in Alluvial Aquifer, March 2005
- Generalized area for pore water sampling transects proposed by DTSC
- Additional upstream sampling transects proposed by PG&E

Park Moabi

PG&E Parcel No. 650-151-08

Colorado River

Topock Marsh

66

50 ppb

MW-34 Cluster

Topock Marina

BN & SF RAILROAD

INTERSTATE 40

BAT CAVE WASH

NEW EVAPORATION PONDS

TOPOCK COMPRESSOR STATION

PG&E

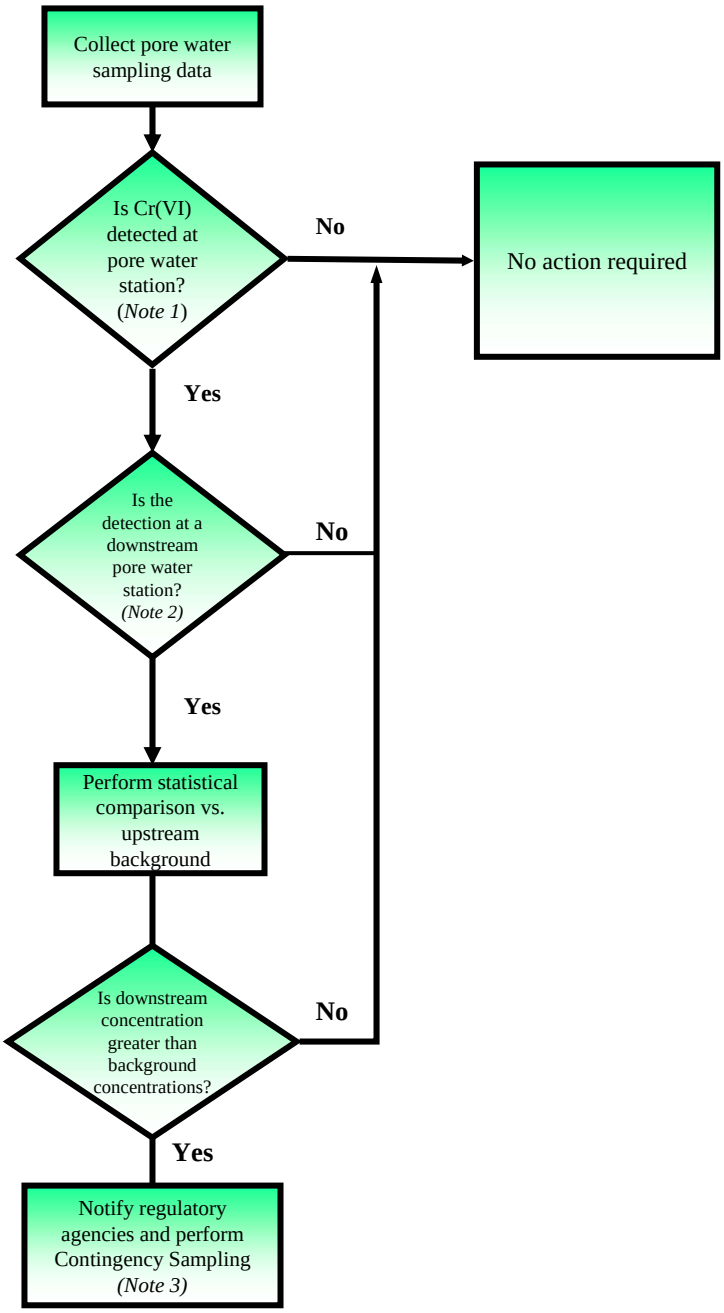
FORMER EVAPORATION POND SITE

DEBRIS RAVINE

FIGURE 6-1
PROPOSED LOCATIONS OF PORE WATER SAMPLING TRANSECTS
PORE WATER AND SEEPAGE INVESTIGATION
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

CH2MHILL

Contingency Planning for Pore Water Sampling
September 2005
Draft Revision 0



NOTES:

1. The trigger concentration is assumed to be any concentration greater than ND (above the reporting limit using USEPA Method 7199).
2. Downstream locations are those located to the south of the Bat Cave Wash outlet (Figure 1-1).
3. Contingency sampling as outlined in Section 8.1 of this Work Plan.

FIGURE 8-1
CONTINGENCY PLAN
PORE WATER AND SEEPAGE INVESTIGATION
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

Appendix A
Phase 1 Technical Memorandum

Colorado River Pore Water Sampling Project Overview

PG&E Topock Site

September 16, 2005

Cal EPA's Department of Toxic Substance Control has ordered Pacific Gas and Electric Company to perform a seepage evaluation and pore water sampling survey (PWSS) in the sediments beneath the Colorado River, near Park Moabi, California. The purpose of the required work is to better understand the dynamic interaction of surface water and groundwater at the river/aquifer interface.

The preliminary sampling locations identified for a seepage evaluation and pore water sampling investigation would include a set of appropriate background stations, located upstream of Bat Cave Wash, and a suitable set of downstream stations, located between the BN&SF railroad bridge and downstream (east) of the I-3 gas-transmission crossing. The general location of the study area and the initial locations of transects along which samples will be collected are provided in Figure 1.

The field work for this study will proceed in three phases, as outlined below.

Phase I – Background Temperature Data Collection and Testing Pore Water Sampling Methods

a) Deployment of TidbiT ™ temperature sensors. The purpose of the Phase I temperature study is to evaluate the temperature of pore water at various depths beneath the river to determine the depth below which the daily temperature fluctuations due to changing river levels are effectivelydamped out (*i.e.* no longer detectable at the sensitivity of the instrumentation). Pre water temperatures are proposed to be measured using TidbiT™ temperature sensors. These sensors are a self-contained unit, consisting of a temperature probe, battery, and data logger in a package about 1.5 inches in diameter (see picture below).

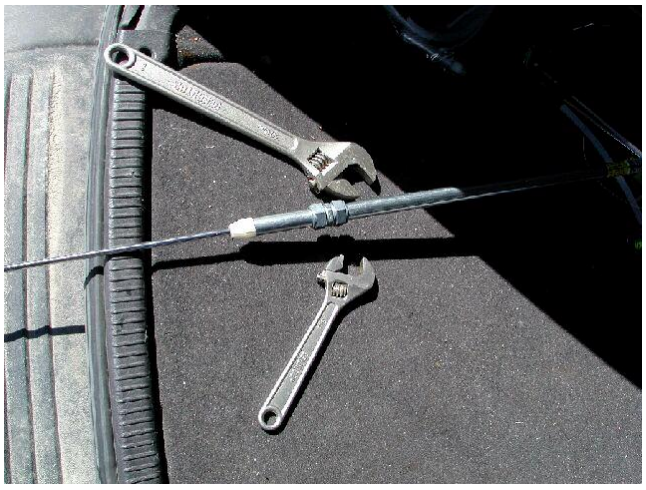
The TidbiTs™ will ideally be deployed at depths of approximately two, four, and six feet below the riverbed. A metal pipe approximately 0.75 to 1.5 inches in diameter, deployed from a stationary boat, will be used to install the TidbiTs™ in the river bottom by 'jetting'. River water will be pumped down the pipe and out a nozzle at the end. The water jet emanating from the nozzle on end of the pipe will loosen and temporarily displace the sediments in the immediate vicinity, allowing advancement of the pipe into the river bottom. Depending on the characteristics of the sediment, temporary increases in river turbidity may occur near the river bottom in the immediate vicinity of the pipe during the jetting process. Each hole is expected to take between 1 and 10 minutes to complete.

A TidbiT™ will be attached to the jet pipe as it advances, and will be released when the jet pipe is pulled back. The surrounding sediments are expected to collapse around the sensor upon removal of the jet pipe. Each TidbiT™ will be attached to a stainless steel wire that runs to the river bottom surface and is marked with brightly-colored nylon rope. The rope will be weighted so that it does not float into the river channel and into the path of passing boats. Three TidbiT™ sensors will be deployed at each of five locations along the west side of the River, in water that is approximately six feet deep. This will result in at least 15 holes being jetted into the river bottom. The sampling locations will be logged with GPS. After approximately one week, a crew in a boat will use a winch to retrieve the TidbiT™ sensors.

TidbiT temperature sensor (1.5″diameter)

b) Testing pore water sampling methods. Actual pore water sampling will occur in Phase III of the PWSS, which is scheduled to occur in December 2005. In Phase I, to be performed as soon as possible, two pore water sampling methods will be tested for the efficacy of the sampling method itself (*i.e.*, ease of advancement, total depth achievable) and the quality of data derived from the sample. Both methods are boat-deployed, involving driving a metal probe into the river bottom (without jetting) and pumping small volumes of pore water to the surface with a peristaltic pump. The boat will either be anchored in place or will be kept stationary in the current using the motor. Testing will occur in up to 10 locations in water that is approximately six to twelve feet deep.

The first method to be tested is the trademarked Harpoon™ equipment, distributed by MHE Products. The Harpoon™ (see photo below) consists of a stainless steel drive point that is 0.25″ in diameter and 22″ long. The drive point is attached to 0.5″-diameter steel electrical conduit sections, which extend above the river surface. The sampler is advanced by hand-pushing only. It is anticipated that the Harpoon™ sampler will be able to collect samples up to 22″ below the river bottom. Once the desired sampling depth has been reached, pore water will be pumped to the surface through a small-diameter polyethylene tube. Pumped water will be diverted to a flow-through cell that measures basic water quality parameters (temperature, electrical conductivity, dissolved oxygen, salinity, oxidation/reduction potential, etc.) to determine the time and volumes necessary to reach stabilization of these parameters. No more than 10 liters of water will be pumped from each sample location. Pumped water will be collected on the boat and stored. The device will be pulled back to the surface and the hole will collapse behind it. Nothing will be left in the river bottom. Very little sediment disturbance is anticipated with this method. At the end of the day, or when water storage on the boat reaches capacity, the purge water will be poured into the IDW tank near the MW-20 bench. This tank is used to store all purge water from groundwater sampling at the site. A PG&E subcontractor is responsible for analyzing and disposing of the water in the IDW tank.


Harpoon™ sampler

The second pore water sampling method to be evaluated is the drive-point piezometer, which is available from a number of vendors (see picture below). The drive-point piezometer is similar in many ways to the Harpoon™, except that it has a stronger, larger (0.75″) diameter, allowing it to be advanced either manually or with a vibrating power hammer. Because the drive-point can be advanced with a power hammer, it has no depth limitations based on the probe length, and it is able to collect samples from greater depths than the Harpoon™ sampler. The larger diameter pipe will displace a slightly larger volume of sediments during advancement, and the vibration caused by the hammer will further agitate sediments. Depending on subsurface conditions, the drive point could be advanced to as much as six feet below the river bottom. Pore water will be pumped to the surface with a peristaltic pump and diverted through a flow-through cell to measure water quality parameters and to determine time and volumes required for parameter stabilization. Pumped water will be managed in the same manner as described above. The drive point will then be pulled back out of the sediments and the hole will collapse behind it. Nothing will be left in the river bottom.


Installing a drive-point piezometer with a manual hammer.

Phase II – Seepage Study Measuring Temperature and Conductivity

If the Phase 1 survey indicates that temperature monitoring is likely to provide useful information, a Phase II survey will be implemented. The Phase II survey will investigate a much larger area of the river than that of Phase I. Phase II will be performed immediately prior to Phase III pore water sampling. During Phase II, a team of one or more boats will advance a 1″ drive point into the river bottom across approximately 30 transect lines, from the mouth of Bat Cave Wash in the north to downstream of the I-3 gas transmission line in the south. Three samples will be collected along each transect. No pore water will be collected during this process. A real-time GPS unit will be connected to the computer on the boat to log the locations of all samples. The sensor in the drive point collects data continuously and relays it to the computer on the boat, so that a temperature and resistivity profile is generated at each sampling location. The sensor will be driven by hand or with a vibrating power hammer to depths of up to six feet below the river bottom or to refusal, if six feet is not reached. The vibration and displacement of sediments may increase turbidity in the river for a brief time in the immediate vicinity of each sample location during advancement. The sensor will be pulled back to the surface after stabilizing at maximum depth and nothing will be left in the river bottom.

Phase III – Pore water Sampling

Pore water sampling will be conducted along transects chosen by DTSC and PG&E to intersect likely groundwater discharge locations. Additional pore water samples will be collected from any discrete groundwater discharge locations identified in the Phase II seepage survey. If the Phase II survey is not successful in identifying discrete zones of discharge, sampling will be confined to the ten transects. The pore water sampling method (Harpoon™ or drive-point piezometer) will be determined by the outcome of Phase I testing, and contingent on regulatory approval. The selected method will be employed as outlined in the Phase I discussion. A total of up to 60 pore water sample locations will be chosen. The drive-point sampler will be advanced three to six feet below the river bottom, depending on the results of Phase I and II. Approximately three casing volumes (less than two liters) will be pumped to purge the drive point, and a water sample will be collected. Purge water will be managed in the same manner as described in the Phase I discussion. After sampling, the drive-point assembly will be pulled back to the surface. Nothing will be left in the river bottom.

N

0 1,000 2,000 Feet

1 inch equals 1,000 feet

LEGEND

- Generalized area for pore water sampling transects proposed by DTSC
- Additional upstream pore water sampling transects proposed by PG&E
- Phase 1A Proposed Area: TidbiT® deployment (site conditions will dictate placement)
- Phase 1B Proposed Area: 1 drive-point piezometer and 1 Harpoon sampler test at each location
- Depth-specific river channel surface water sampling location
- Shoreline surface water sampling location
- Approximate limits of hexavalent chromium greater than 50 ppb in Alluvial Aquifer, March 2005

Note: Locations are approximate and will not be situated in vegetation areas

C-NR4
Arizona
California
NR-3
C-NR3
NR-2
C-NR1
NR-1
C-CON
CON
A-Dock
Park Moabi
PG&E Parcel No. 650-151-08
RRB
Colorado River
Topock Marsh
50 ppb
R-28
MW-34 Cluster
R-27
C-R27
Topock Marina
BN & SF RAILROAD
INTERSTATE 40
BAT CAVE WASH
R-22
C-R22
C-I3
I-3
C-TAZ
NEW EVAPORATION PONDS
TOPOCK COMPRESSOR STATION
PG&E
FORMER EVAPORATION POND SITE
DEBRIS RAVINE

FIGURE 1
PHASE 1 STUDY AREAS AND PORE WATER SAMPLING TRANSECTS
PORE WATER AND SEEPAGE INVESTIGATION
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

CH2MHILL

BAO \\ZINFANDEL\PROJ\PACIFICGASELECTRICCO\TOPOCKPROGRAM\GIS\MXD\2005\PWS_PHASE1_LOCS.MXD PWS_PHASE1_LOCS.PDF 9/27/2005 14:10:33

Appendix B
Technical Information on Seepage and Pore Water Methods

Drive-Point Piezometer

Stainless Steel

Stainless Steel Drive-Point Piezometers

The Model 615 Drive-Point Piezometers are designed to give field personnel a truly inexpensive method to monitor groundwater in suitable conditions.

Solinst 615 Drive-Point Piezometers attach to inexpensive 3/4" NPT steel drive pipe which is widely available through local plumbing and hardware stores.

Solinst Drive-Point Piezometers are most often installed permanently as wells, for short-term or long-term monitoring of groundwater level and quality. They can also be used once and removed. Drive-point, tubing and pipe alternatives are available to suit almost every situation.

High quality samples can be obtained as polyethylene or Teflon® lined tubing is attached to the stainless steel drive point piezometers. A shielded version is available which avoids clogging or smearing of the screen during installation. Sampling and head measurements are taken within the tubing with small diameter equipment.

Solinst Drive-Point Piezometers can be driven into the ground, or the soil at the bottom of a borehole with any direct push or drilling technology, including a vibrating power hammer or the manual slide hammer shown at right.

High Quality Samples

Model 615 Piezometers are composed of a stainless steel cylindrical filter screen protected within a 3/4" (20 mm) stainless steel drive-point body with an internal filter support and a barbed fitting for attachment of sample tubing.

The inner barbed fitting allows connection of 5/8" x 1/2" (16 mm x 12 mm) LDPE or Teflon® sample tubing. This prevents sample water from contacting the steel extension casing, and maintains high sample integrity even when inexpensive carbon steel extensions are used.

615S shielded drive-point piezometers have a single use, optional filter shield to avoid smearing and plugging of the filter during driving. The strengthened connector at the top of the drive-point acts as an annular seal which avoids contamination from higher levels in the hole. Optional heavy duty extension couplings strengthened to create a more rugged piezometer are also available.

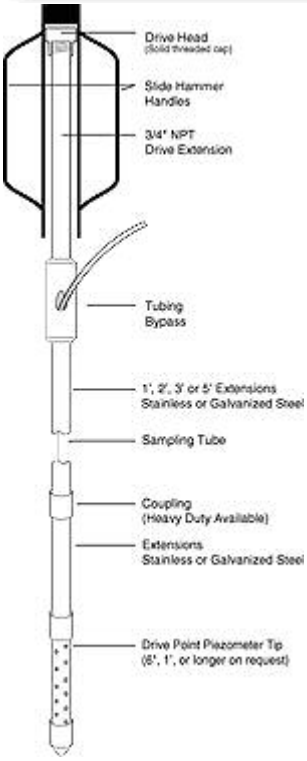
615N Drive-Point Piezometers are designed for hydraulic head measurements with no barb for tubing. This saves money and frees up more space for easier use of a water level meters.

High Quality Groundwater & Surface Water Instrumentation

Drive-Point Piezometer

Model 615 Drive-Point Piezometers

Manual Slide Hammer



For the most inexpensive wellpoint installations, the Manual Slide Hammer can be used to install the Solinst Drive-Point Piezometers without the need for any expensive equipment on site. The slide hammer and all other equipment can easily be transported in a car or truck to most sites.

A heavy duty drive head is used, on which the slide hammer impacts, and a tubing by-pass ensures that the tubing does not get damaged during installation.

A vibrating power hammer can also be used for installation of drive-points.

Applications

Model 615 Drive-Points are suitable for the following uses:

- groundwater sampling, including VOCs
- water level monitoring
- contaminant plume delineations
- sparge points
- soil gas sampling
- UST monitoring
- low cost and minimal disturbance site assessment

High Quality Groundwater & Surface Water Instrumentation

Drive-Point Piezometer

Model 615 Drive-Point Piezometers

|Quote |Drive-

Sample in Narrow Dia.

Sampling Within Narrow Diameters

Direct push sampling has quickly become a popular way to obtain groundwater samples; however, sampling within drive-points requires a narrow diameter sampler. Solinst offers several options for this specific sampling application.

Single Valve Pump

To sample from within Solinst Model 615 Drive-Point Piezometers, the integral tubing can be converted easily into a Solinst Single Valve Pump. This inexpensive modification creates a dedicated compressed air or nitrogen drive pump out of 5/8" x 1/2" (12 mm x 16 mm) tubing. Suitable for sampling to depths of 150 ft. (45 m).

Miniature Point Source Bailer

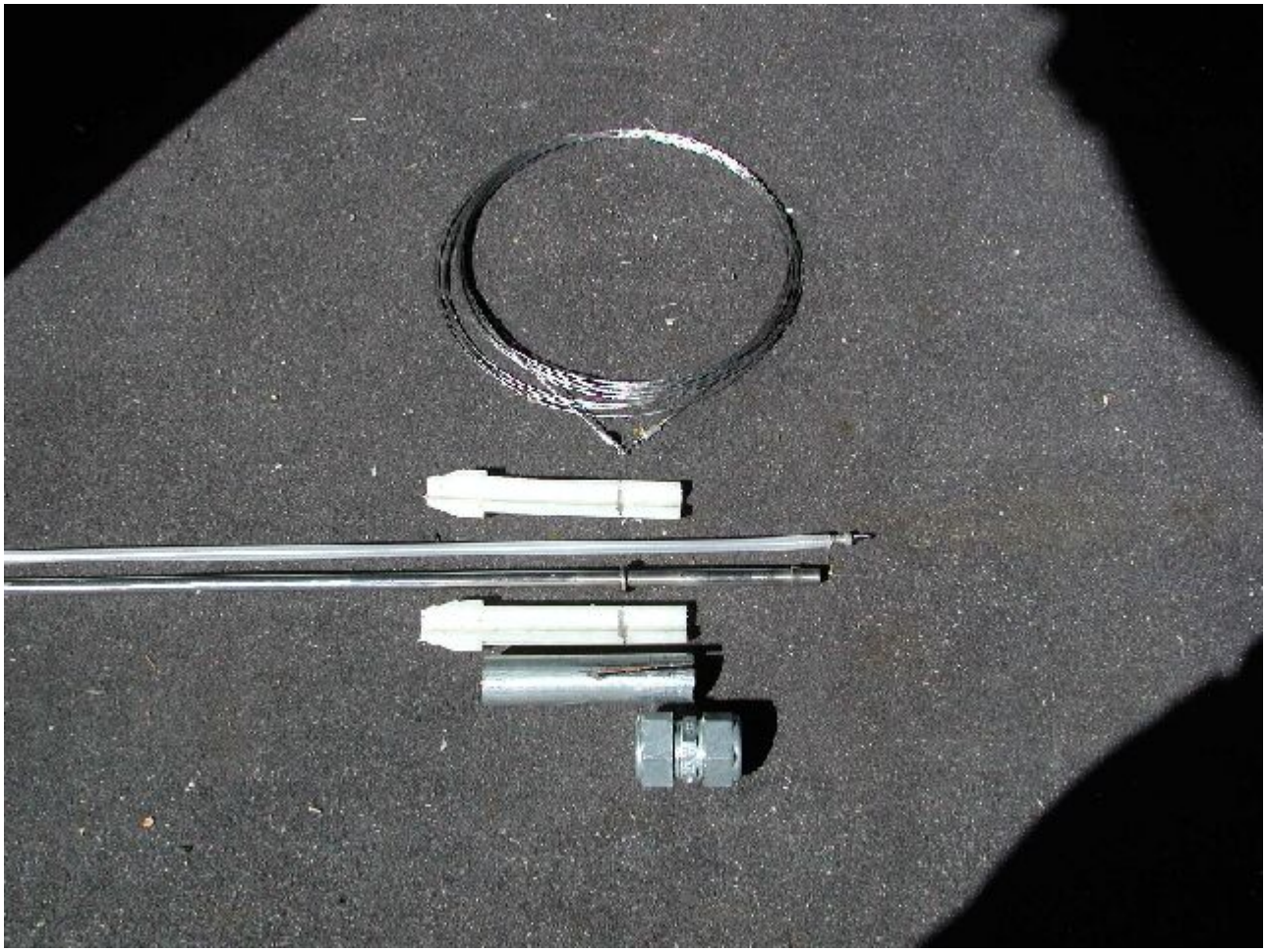
The 1/2" (12 mm) dia. stainless steel bailer works very well in 615N Drive-Point Piezometers. The bottom emptying device permits a regulated, steady flow.

MHE Products - PushPoint Harpoon Instructions Ver 1.01 7/23/03 www.MHEproducts.com

The Harpoon is the newest in the line of PushPoint sediment pore-water sampling tools.
This tool incorporates the function of a PushPoint Extreme sampler into a device that can be used from a boat or through the ice in 20+ feet of water to sample sediment pore water. If the bottom is composed of loose sediment, the sampler can be pushed 15+ feet into sediments to gather pore water samples. One of the advantages of the tool is that the investigator can purchase commonly available materials to custom configure the sampler to meet their sampling depth requirements. The extendable body of the sampler is made of ½" EMT conduit (~$2/10 foot), and the sampling tubing is 3/8" OD polyethylene tubing. Multiple lengths of 3/8" polyethylene tubing inside lengths of ½" EMT may be connected together as needed to form a very long, remotely-operated PushPoint sampler that can be connected to a peristaltic pump to collect sediment pore water.

MHE PushPoint Harpoon installed in the Harpoon Holder, clamped together by EMT compression coupler nut.
This is the MHE Harpoon assembly ready to go.
Attach the Shuttle Cable, 3/8" poly tubing and ½" EMT conduit and you're ready to sample.
Pore water sampling is possible from a boat or through the ice at depths of 20+ feet of water and through 20+ feet of loose sediments..

Caution: the tip of the Harpoon is very sharp to facilitate penetrating sediments. When you are working with the Harpoon, especially when disassembling the Harpoon Holder, be careful not to poke anything (or anyone) with the point of the Harpoon. During disassembly, when pulling off the compression sleeve from the Harpoon Holder,
it can suddenly pull free from the nylon jaws as you are pulling the assembly apart, and the tip of the Harpoon has been known to stick into things like car seats, etc.



EXPLODED VIEW

The MHE Harpoon system:
1) stainless steel Shuttle Cable with clasp on one end and loop on the other
2) top jaw of nylon Harpoon Holder assembly
3) 3/16': OD polyethylene Shuttle with stainless steel support inside and Cable Attachment Screw on top
4) 316 SS body of the 24" MHE Harpoon
5) bottom jaw of nylon Harpoon Holder assembly
6) split compression sleeve is the outer sleeve of Harpoon Holder

7) ½” EMT conduit compression-type coupler

This is how the Harpoon Holder attaches to the EMT compression coupler. Note that the Shuttle has been installed in the Harpoon body (only a small amount of the Shuttle poly tubing is visible) and the loop of the Shuttle the ready for attachment to the Shuttle Cable.

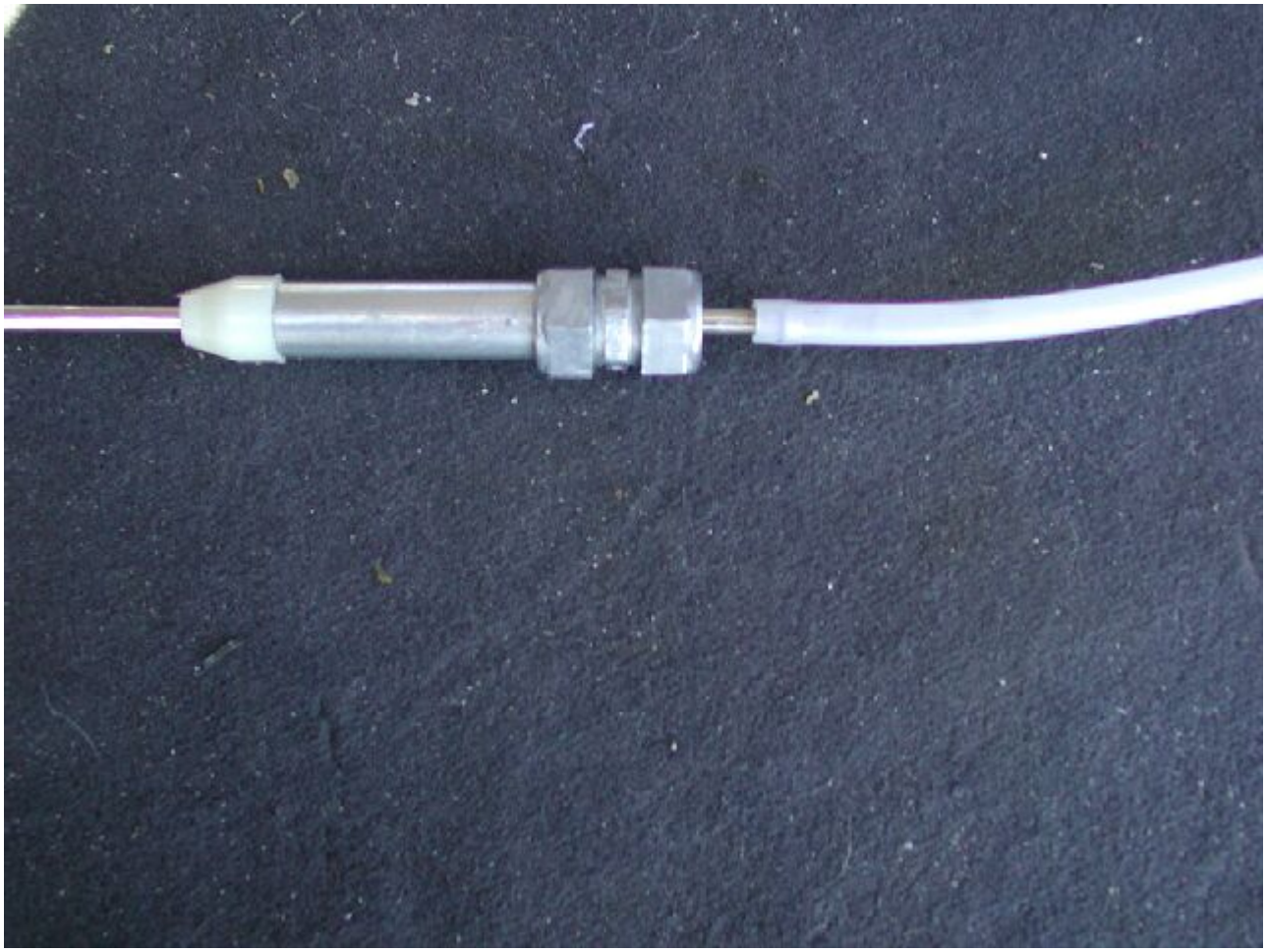
Tighten the EMT coupler to the MHE Harpoon, leaving the other EMT coupler nut that will connect to the long length of EMT loose.

Before you attach the Shuttle Cable and the poly tubing to the Harpoon you will need to feed the looped end of the Shuttle Cable through your 3/8" poly tubing until only the clasp of the Shuttle Cable sticks out of poly tubing.

It is far easier to feed the Shuttle Cable through the poly if the poly tubing is straight rather than coiled. Shuttle Cable lengths of up to 30' are available.

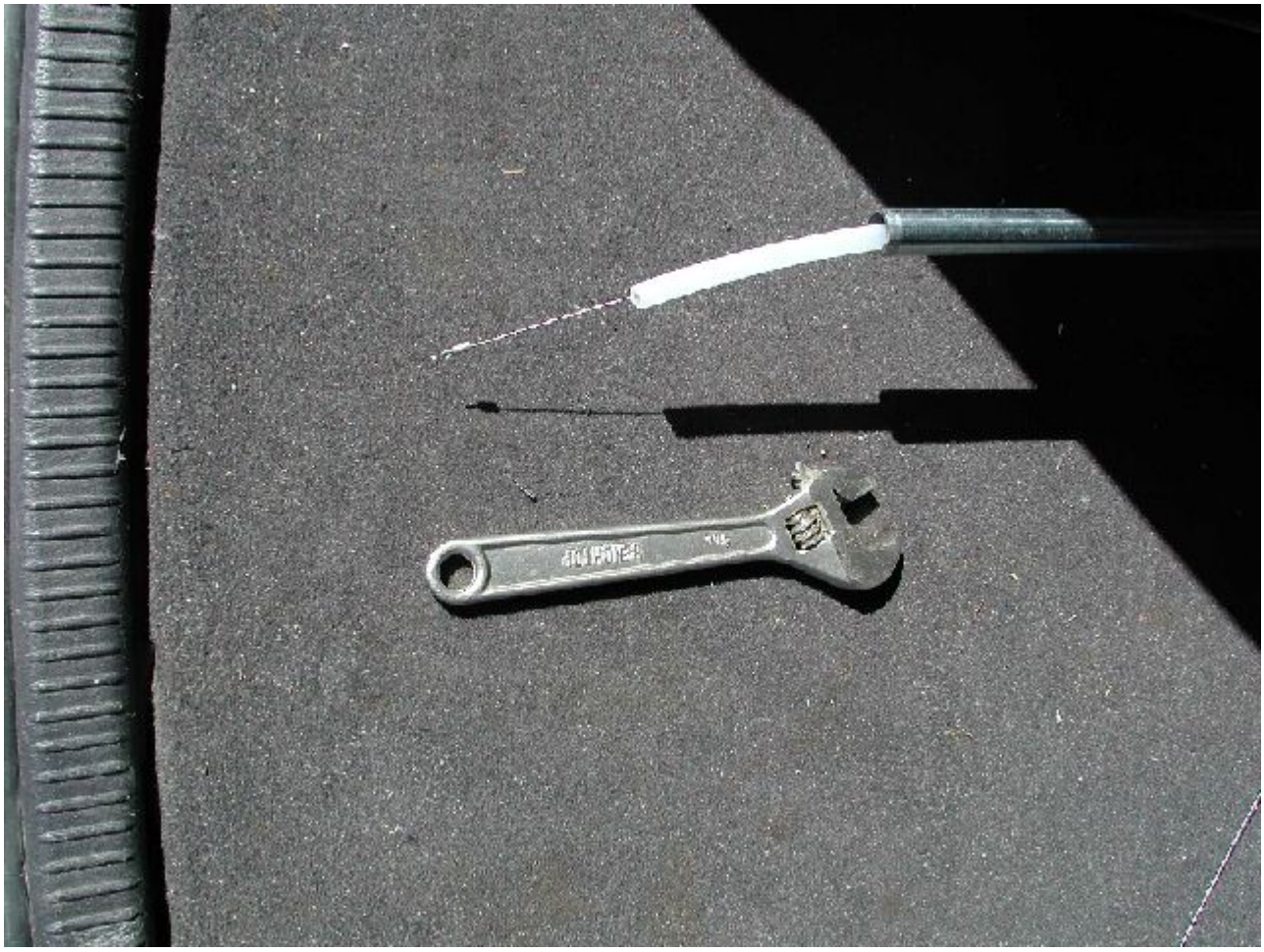
Sometimes it's helpful to just have a bunch of Shuttle Cables already strung inside poly tubing for quick and easy attachment to a single Harpoon. I recommend leaving as little of the clasp of the Shuttle Cable exposed as you need to attach to the Shuttle Screw; this will reduce the effort needed to push the poly tubing over the barbed fitting at the sampling port of the Harpoon.

Make sure that the poly Shuttle is fully inserted into the Harpoon body.
Only friction holds the Shuttle in place within the Harpoon body.
Attach the clasp end of the Shuttle Cable to the loop of the Shuttle Cable Screw.
Do not disturb the Shuttle position in the Harpoon or pull the Shuttle Cable attached to the Shuttle until you have deployed the sampler and you are ready to sample as you may pull the Shuttle from the Harpoon and expose the inside of the screened-zone of the Harpoon to the sediments during insertion - this may clog the sampler.



Push the 3/8” OD poly tubing past the barb at the sampling port of the Harpoon, at least ¼” (6mm).
It is nearly impossible to pull the poly tubing off after it has been pushed much past the barb.
After that, it will be necessary to cut the poly off to remove it (more on this later).
Slide the loose end of the poly through a length of ½” EMT conduit and connect to the EMT coupler on the Harpoon Holder.
If you are having a lot of trouble pushing the poly past the barb, try heating ½” of the end of the poly in the flame of a butane lighter for 1 or 2 seconds to soften the polyethylene a little.

MHE Harpoon attached to a 10’ piece of EMT and ready to go into the water.
You can add additional lengths of EMT, poly tubing and Shuttle Cable as needed to reach the desired depth. Shuttle Cables have a loop at the end so that they may be joined end-to-end to achieve longer lengths.
We recommend using a 1.25 inch piece of 3/8”ID clear vinyl or Tygon tubing to connect successive lengths of 3/8”
poly together if a longer sampler is needed to push through deeper water or deeper into the sediments than originally anticipated. Use a nylon wire-tie (zip-tie) or other means to clamp both connections to the poly.



Push the Harpoon straight down into sediments to the desired depth.
Once the sampling system is inserted into the sediments, I usually cut off the EMT at a convenient height and then slip
the excess EMT off the poly.
Cut the poly so that approximately 3 inches of the poly extend past the top of the EMT. This reduces the amount of curve that
the will be in the poly. The Shuttle Cable likes straight poly tubing to travel through – each curve adds quite a bit of friction.
Be careful to not cut the Shuttle Cable when you cut off the excess poly tubing.
To sample the sediment pore water, have a peristaltic pump ready with enough tubing on it to allow for movement of the boat during sampling without pulling the sampler sideways.
Hold the end of the EMT and then pull the Shuttle Cable with the attached Shuttle completely out of the 3/8" poly.
Immediately attach the peristaltic pump tubing to the end of the 3/8" poly and pump the pore water – don't waste any
time getting the development water out of the system.
Do your sampling as you would with any PushPoint sampler.

To easily remove the poly tubing from the Harpoon, take a sharp knife and cut the poly tubing until you reach the flat back-end of the barb. Do the same on the other side of the sampler. The tubing should come off easily.

If you have several Harpoon bodies and several Shuttles and Shuttle Cables, you can pre-assemble the cores of the Harpoon sampling systems to lengths of poly tubing, and have them ready (locked-and-loaded) for easy deployment.

In this way, all you need is one Harpoon Holder which would be interchangeable to all the preassembled Harpoon cores.

MHE has developed a “screen-sok: constructed of polyethylene and a 52TPI polypropylene fabric for use in highly organic, “mucky” sediments. This allows the sampler to extract pore water under conditions that one would think impossible. The Screen-Sok can be taped (electrical tape or the tape of your choice) to the sampler if you want to reuse it ; if not taped, it will probably stay in the sediments as the sampler is withdrawn. The Screen-Sok can also be used effectively on all the other PPX PushPoint samplers.

If you have questions about these instructions or applications, the fastest way to contact us is by e-mail at sales@MHEproducts.com

We can also be reached at: phone/voice 989 362 5179
Phone/voice/fax 517 393 0948

underwater

StowAway® TidbiT®

$119

Small size: approx.
3.0 x 4.1 x 1.7 cm thick
(1.2 x 1.6 x 0.65"); 23 gm (0.8 oz)

The StowAway TidbiT is Onset's smallest data logger and is widely used for monitoring temperatures in streams, lakes and oceans. Small size, rugged case and alarm indication also make this a popular choice for monitoring conditions during shipment.

Key Specifications

Ideal for underwater applications up to 30° C

StowAway TidbiT: -5°to 37°C model:

Range†: -4° to 37°C (24° to 99°F)
Accuracy: ±0.2° at 20°C (±0.4° at 70°F)
Resolution: 0.16° at 20°C (0.29° at 70°F)

StowAway TidbiT: -20°to 50°C model:

Range†: -20° to 50°C (-4° to 122°F)
Accuracy: ±0.4°at 20°C (±0.8° at 70°F)
Resolution: 0.3°C at 20°C (0.6° at 70°F)

Capacity: 32,520 measurements

† *Specified range is narrower than nominal range due to precision calibration process. Using TidbiT Temp loggers in wet environments (>90% RH) over 86°F (30°C) for extended periods of more than 8 weeks cumulative may lead to premature failure. For applications over 30°C, use the HOBO Water Temp Pro (pg 14).*
Note: For Onset's lowest cost underwater temperature monitoring solutions, use the HOBO H8 Temp (pg. 4) in combination with a waterproof submersible subcase (pg. 20) or see Water Temp Pro (pg. 14)

Features and Specifications

Waterproof to 300 m (1000 feet)
IR communications and Optic Shuttle for readout when wet—even underwater!
Programmable start time/date or triggered start on location with Optic Coupler or magnet
Small Size and Alarm Indication
5-year, non-replaceable battery (typical use*)
NIST-traceable temperature accuracy certificate available
Multiple sampling with minimum, maximum or averaging
Mounting tab
Time accuracy: ±1 minute per week at 20°C (68°F)
Memory modes: Stop when full, Wrap-around when full
Response time in water: 5 minutes (typical to 90%)
Response time in air moving 1m/second: 20 minutes

** 16 three-month deployments in water (35° to 80°F) with 4 minute or longer intervals (no multiple sampling)*

Optic Shuttle™

Size/Weight: 132 x 20 x 25 mm
(5.2 long x 0.8 tall x 1.0" thick)
without coupler; 28.35 g (1 oz)

$199

The pocket-sized Optic Shuttle provides a convenient way to readout and relaunch TidbiT data loggers and bring the data back to your host PC.

Features and Specifications

Waterproof to 15 psi (30 feet)
128K capacity enough for 4 full 32K loggers
Data offload time from logger: 6 minutes typical from 32K logger
Data readout time to PC: 3 minutes typical for complete offload
TidbiT Coupler and Optic Coupler included
Uploads the same data to a PC as if the data were read out directly from the logger
6 year factory-replaceable battery (typical)

Optic Base Station™

$80 to $120

Size/Weight: 132 x 20 x 25 mm
(5.25 long x 0.8 tall x .95" thick)
without coupler; 56.7 g (2 oz)

The Optic Base Station is used to communicate between the host computer** and either a StowAway TidbiT data logger or an Optic Shuttle. An Optic Coupler and TidbiT Coupler for connecting the base station to loggers are also included.

*** A battery-powered version of the Optic Base Station is available (part #DSB) for palmtop and portable computers.*

StowAway TidbiT Ordering

Description	Part No.	Qty. 1-9	10-99	100+
32K StowAway TidbiT				
(-5° to 37°C)	TBI32-05+37	$119	$110	$101
(-20° to 50°C)	TBI32-20+50	$119	$110	$101
Optic Base Station for TidbiT	DSA	$80	$74	$68
Battery-powered Optic Base Station	DSB	$120	$111	$102
Optic Shuttle for TidbiT	DTA128B	$199	$183	$169
Software				
BoxCar Pro 4.3 Starter Kit (Windows)	BCP4.3-ON	$95	$88	$81
BoxCar 3.7 Starter Kit (Windows)	BC3.7-ON	$14	$13	$12

Note: A BoxCar Pro 4.3 or BoxCar 3.7 starter kit and an Optic Base Station are required to operate the TidbiT loggers. Each starter kit includes software, computer interface cable and software manual. The Optic Base Station includes an Optic Base Station, Optic Coupler and TidbiT Coupler. See pages 31-33 for software information. Use with USB port requires USB-Serial Adapter (pg 33) and BoxCar Pro 4.3+.

CE Compliant with all relevant directives in the European Union (EU)

Appendix C
Field Investigation Methods and Standard Operating Procedures

SOP-A14

Pore Water Sampling
Standard Operating Procedures for PG&E Topock Program

This standard operating procedure (SOP) addresses the procedures and equipment to be used for pore water sampling at the Topock site. This SOP should be used for pore water sampling stations on the Colorado River.

REQUIRED DOCUMENTS

1) Event-specific sampling and analysis plan (SAP).
2) Pore Water and Seepage Study Work Plan. Refer to Topock Program Sampling, Analysis, and Field Procedures Manual and QAPP (Field Procedures Manual), as required.
3) Topock Program Health and Safety Plan (HSP).
4) Blank sampling logs and field notebook.

PREPARATION & SETUP

1) Review event-specific SAP or event-specific field instructions, Work Plan, and HSP.
2) Initiate field logbook for sampling activity.
3) Inspect all equipment and calibrate field water quality (WQ) meters according to SOP-A9, *Calibration of Field Instruments*.
4) Inventory sample bottles, required analyses, and confirm the lab courier schedule.
5) Field-check and set up sampling equipment: drive point sampler, WQ meters, health and safety apparatuses (life vest, rescue rope, life preserver), water depth meter or depth-finder, weighted tape, peristaltic pump, filters, sufficient tygon and silicone tubing, sampling equipment, etc.
6) Conduct tailgate meeting to discuss health and safety issues and event objectives.

SAMPLING PROCEDURES

1) Prepare pore water sampling log (use attached form).
2) The sampling team will travel to each pore water sampling station in a motorized boat. A safety inspection of the boat will be performed by the field crew prior to boarding (check for fire extinguisher, etc.). Samples will be collected from selected stations along transects across the river.
3) An industry standard (Trimble or similar) resource grade handheld DGPS unit (GeoXT or similar) will be used with real-time correction (wide area augmentation system) to locate the sampling stations within a 1 meter radius (68% of the time, commonly referred to 1 sigma accuracy). At each location, two anchors should be positioned upstream at

least 10 feet from each other (refer to SOP A-12 Attachment A). Record the GPS coordinates on the sampling log. In the event a sampling station is too shallow to safely approach by boat, the next closest location with adequate depth will be sampled and a remark noted on the sampling log with the new GPS coordinates.

4) Record the depth of the river at each sampling station using the depth-finder or a weighted tape. If a weighted tape is used, read the tape at the river water surface when the weight touches the river floor. Record river depth on the sample log.

5) Samples will be collected at a depth below the river bottom determined from the pilot study.

6) Samples are to be collected using a drive point sampler and variable-speed peristaltic pump with ¾-inch tygon tubing. Dedicated tubing will be used for each sample. Once the sampling depths have been calculated for each station, pre-cut two pieces of tygon tubing and attach them to the drive point sampler. Lower the sampler and tubing until the tip of the sampler touches the river bottom. Then hand-drive the sampler into the river sediment until desired depth is achieved. Attach the discharge end of the sample tubing to the flow cell of the water quality meter. Start the peristaltic pump and purge 3 sampler volumes. Record the time, pH, conductivity, turbidity, dissolved oxygen, temperature, salinity, TDS, and ORP on the field log. Note and provide qualifying remarks if parameter readings are anomalous or unstable due to an instrument problem. Turn off the peristaltic pump, remove tubing from the flow cell, and restart the pump. Attach a 0.45 micron filter when sampling for Cr(T) by USEPA Method 6010B or for Cr(VI) by USEPA Method 7199. Refer to SOP-A6 in the Field Procedures Manual for filtration procedures. Pump approximately 500 ml through the system and begin filling the applicable sample bottles. Remove the filter prior to filling sample bottles for the other analyses, which do not require filtration. Record all sample information on the field log.

7) Collect remaining samples for analyses according to the event-specific SAP. Use a new piece of tygon tubing and change out the flexible silicone tubing in the peristaltic pump at each location.

8) Follow the Field Procedures Manual for sample handling and management, equipment decontamination, and investigation-derived waste (IDW) management.

9) Decontaminate the sampling apparatus after each sample is collected. The decontamination will be a triple rinse with 5-gallon buckets containing soapy water, potable water, and deionized (DI) water, respectively. First, the apparatus will be placed in the soapy water and the outside scrubbed. Then pump approximately 3 sampler volumes through the apparatus using the peristaltic pump and dedicated tubing used. Re-circulate the water back into the 5-gallon bucket. Repeat the rinse with the potable and deionized water.

10) Collect an equipment rinse blank after the first decontamination of the day. Collect the sample by attaching the decontaminated sampling apparatus to a length of clean peristaltic tubing. Run deionized water through the sampler and collect a sample to be shipped to the analytic laboratory for hexavalent chromium analysis.

Project Name Pore Water and Seepage Study
Job Number ____________
Field Team ____________
Field Conditions ____________

Sampling Event ____________
Date ____________
Page ____ of ____

Sample ID [ ] Sample Time ________ GPS Coordinates (measured): ________
Depth to Sample Below River Bottom: _______ Time: ______ Measure Point: ________
QC Sample No. and Type [ ] QC Sample Time ________
Water Quality Meter Serial Number: Sampling Method:

Sample Location	Time		pH	Conductivity uS/cm	Turbidity NTU	Diss. Oxygen mg/L	Temp. °C	Salinity %	TDS g/L	Eh / ORP mv	Comments (See descriptors below)

Observations: (i.e. low water level, sand bank present, etc..) ________
Remarks ________

Color: clear, grey, yellow, brown, black, cloudy, green **Odor**: none, sulphur, organic, other **Solids**: Trace, Small Qu, Med Qu, Large Qu, Particulate, Silt, Sand

Sample ID [ ] Sample Time ________ GPS Coordinates (measured): ________
Depth to Sample Below River Bottom: _______ Time: ______ Measure Point: ________
QC Sample No. and Type [ ] QC Sample Time ________
Water Quality Meter Serial Number: Sampling Method:

Sample Location	Time		pH	Conductivity uS/cm	Turbidity NTU	Diss. Oxygen mg/L	Temp. °C	Salinity %	TDS g/L	Eh / ORP mv	Comments (See descriptors below)

Observations: (i.e. low water level, sand bank present, etc..) ________
Remarks ________

Color: clear, grey, yellow, brown, black, cloudy, green **Odor**: none, sulphur, organic, other **Solids**: Trace, Small Qu, Med Qu, Large Qu, Particulate, Silt, Sand

Sample ID [ ] Sample Time ________ GPS Coordinates (measured): ________
Depth to Sample Below River Bottom: _______ Time: ______ Measure Point: ________
QC Sample No. and Type [ ] QC Sample Time ________
Water Quality Meter Serial Number: Sampling Method:

Sample Location	Time		pH	Conductivity uS/cm	Turbidity NTU	Diss. Oxygen mg/L	Temp. °C	Salinity %	TDS g/L	Eh / ORP mv	Comments (See descriptors below)

Observations: (i.e. low water level, sand bank present, etc..) ________
Remarks ________

Color: clear, grey, yellow, brown, black, cloudy, green **Odor**: none, sulphur, organic, other **Solids**: Trace, Small Qu, Med Qu, Large Qu, Particulate, Silt, Sand

SOP-A15

TidbiT® Deployment and Retrieval
Standard Operating Procedures for PG&E Topock Program

This standard operating procedure (SOP) addresses the procedures and equipment to be used for TidbiT® deployment and retrieval at the Topock site. This SOP should be used for TidbiT® deployment and retrieval on the Colorado River.

REQUIRED DOCUMENTS

1) Pore Water and Seepage Study Work Plan.
2) Topock Program Health and Safety Plan (HSP).
3) Field notebook.

PREPARATION & SETUP

1) Review event-specific SAP or event-specific field instructions, Work Plan, and HSP.
2) Initiate field logbook for field activity.
3) Inspect all equipment.
4) Field-check and set up sampling equipment: trash pump, TidbiT® sensors and retrieval cable, health and safety apparatuses (life vest, rescue rope, life preserver), water depth meter or depth-finder, weighted tape, 20 feet of 1.5" PVC pipe, etc.
5) Conduct tailgate meeting to discuss health and safety issues and event objectives.

DEPLOYMENT PROCEDURES

1) The team will travel to each TidbiT® station in a motorized boat. A safety inspection of the boat will be performed by the field crew prior to boarding (check for fire extinguisher, etc.). TidbiT® sensors will be deployed at five locations at depths of 1, 3 and 6 feet below the river bottom.
2) An industry standard (Trimble or similar) resource grade handheld DGPS unit (GeoXT or similar) will be used with real-time correction (wide area augmentation system) to locate the TidBiT® stations within a 1 meter radius (68% of the time, commonly referred to 1 sigma accuracy). At each location, two anchors should be positioned upstream at least 10 feet from each other to ensure the boat remains stationary (refer to SOP A-12 Attachment A). Record the GPS coordinates in the log book.
3) Record the depth of the river at each sampling station using the depth-finder or a weighted tape. If a weighted tape is used, read the tape at the river water surface when the weight touches the river floor. Record river depth on the sample log.
4) At each location TidbiT® devices will be deployed at a depth of 1, 3 and 6 feet below the river bottom. String three TidbiT® sensors together with 2' of cable in between each

sensor. Attach 3′ of cable with a 1′ looped end at the top sensor to a small floatation piece that will be at the surface of the river bottom after deployment.

5) Connect appropriate length of PVC pipe to trash pump hose (depth of river + 6′ deployment depth). Leave enough length above river surface to manipulate pipe.

6) Lower pipe end to river bottom at designated location for TidbiT® deployment. Turn on trash pump. Slowly jet and lower the pipe into river bottom to the desired depth. Surging pipe up and down may be required to achieve desired depth.

7) Confirm depth with a weighted tape down the pipe.

8) When appropriate depth is achieved, lower the TidbiT® sensors and retrieval cable down the pipe.

9) Extract the pipe by pulling back to the surface. Additional water jetting may be required to loosen sediments around the pipe.

RETRIEVAL PROCEDURES

1) Navigate to TidbiT® location using a GPS unit.

2) Use a 15′ hooked-end pole to catch the looped end for the TidbiT® string. Several passes maybe required.

3) Once the loop has been hooked, pull the TidbiT® string out of the river bottom. An onboard pulley maybe required to extract the TidbiTs®. If the TidbiT® string cannot be pulled to the surface, it may be necessary to jet a pipe along the string to the required depth to facilitate removal.

4) Label the TidbiTs® with location and depth upon bringing onboard. Return to the office trailer and download the data from TidbiTs® onto the computer.

Appendix D
Health and Safety Plan

CH2M HILL HEALTH AND SAFETY PLAN

This Health and Safety Plan (HSP) will be kept on the site during field activities and will be reviewed as necessary. The plan will be amended or revised as project activities or conditions change or when supplemental information becomes available. The plan adopts, by reference, the Standards of Practice (SOPs) in the CH2M HILL *Corporate Health and Safety Program, Program and Training Manual*, as appropriate. In addition, this plan adopts proceduresprovided in project-specific Work Plans. The Site Safety Coordinator (SSC) is to be familiar with these SOPs and the contents of this plan. CH2M HILL's personnel and subcontractors must sign Attachment 1.

Project Information and Description

PROJECT NO(s): Initial Project #168525.TP GW Monitoring # 328225.GM.02.00 Interim Corrective Measures & Drilling testing #184004.PS. Background Study 316538.TC.02.00. Tracer Testing 332959.CM.FW.03 Pore Water Seepage Testing # 332663.A1

CLIENT: Pacific Gas & Electric Co.

PROJECT/SITE NAME: Topock Site Remediation, PG&E Topock Gas Compressor Station

SITE ADDRESS: 15 miles southeast of Needles, California (eastern San Bernardino County)

CH2M HILL PROJECT MANAGER(S): Julie Eakins/SFO (Project Manager)
Ellen Hedfield/RDD (groundwater monitoring task)
Mathew Johns/DEN & Paul Bertucci/SFO (Floodplain monitoring)
Jay Piper/LAS (drilling/testing task)
Brett Roberts/DEN (Background Study)
Terry DeBiase/SFO (Pore Water and Seepage Study)

TASK MANAGER(S): Serena Lee/SFO & Matt Ringier/SFO (GMP)
John Dallapiazzo/DEN (Background Study)
David Thomas/SFO (Transducer O&M)

CH2M HILL OFFICE: Oakland (San Francisco), California Office

DATE HEALTH AND SAFETY PLAN PREPARED: rev1 - 11/20/2001, rev2 - 10/28/2003, rev3 – 02/19/2004, rev4- 04/02/2004, rev5-08/20/2004, rev6-04-26-2005, rev 8 09-19-2005.

DATE(S) OF SITE WORK: Project startup in November 2001 (site visit/observe other samplers); ongoing groundwater and surface water sampling; drilling of exploratory boring/well in November 2003; interim corrective measures scheduled for 2004 ; Numerous work tasks, including water sampling, remediation work and such will continue through 2006

SITE ACCESS: Active PG&E gas compressor facility, requires sign-in & safety orientation: most sampling locations and wells are on federal (BLM) land.

SITE SIZE: approximately 1/2-mile square study area

SITE TOPOGRAPHY: high desert, hills & dry wash/alluvial terrain

PREVAILING WEATHER: dry; very hot during summer

SITE DESCRIPTION AND HISTORY: Active natural gas compressor facility which was subject of a RCRA Facility Investigation (RFI) in 1997-99 to investigate extent of chromium-impacts to soil and groundwater resulting from past wastewater disposal. The RFI Report and ongoing groundwater monitoring will be used to define correction measures and remediation alternatives. Interim corrective measures are planned in 2004 to collect

additional site data and initiate hydraulic control of the groundwater plume. Current surface conditions pose no critical or immediate risk to human health or environment.

DESCRIPTION OF SPECIFIC TASKS TO BE PERFORMED:
Field activities scheduled for 2005-6 include the following tasks:

1. Groundwater Monitoring Program: Includes water level monitoring and groundwater and surface water sample collection, shipment for analysis of water samples, sampling equipment and decontamination, purge water handling and management for PG&E disposal. July 2005 initiation of depth-specific river channel sampling from boats.
2. New task added in Sept 2005 is Pore Water Seepage studies using boats for access to the river bottoms.
3. Interim Corrective Measures (site investigation activities): Includes drilling, monitoring well and extraction well installation, geophysics, and hydraulic testing.
4. Interim Corrective Measures (groundwater extraction system): Includes installation and operation and maintenance (O&M) of a groundwater extraction system at the MW-20 bench. Installation activities include siting equipment (e.g. tanks, secondary containment, piping, and temporary power) provided by PG&E subcontractor. O&M activities include system monitoring, water sampling (for mass removal and waste profiling), coordinating truck filling operations, and routine system maintenance. Extracted groundwater is scheduled for offsite treatment and disposal until onsite treatment and disposal facilities are permitted and/or installed.
5. Development and testing of further monitoring wells.
6. Tracer testing for determination of groundwater flow paths, velocities, mixing and dispersion.

Site Map

This page is reserved for a Site Map.

Note locations of Support, Decontamination, and Exclusion Zones; site telephone; first aid station; evacuation routes; and assembly areas.

Table of Contents

1 Tasks to be Performed Under this Plan

1.1 Description of Tasks

(Reference Field Project Start-up Form)

Refer to project documents (i.e., Work Plan) for detailed task information. A health and safety risk analysis (Section 1.2) has been performed for each task and is incorporated in this plan through task-specific hazard controls and requirements for monitoring and protection. Tasks other than those listed below require an approved amendment or revision to this plan before tasks begin. Refer to Section 8.2 for procedures related to "clean" tasks that do not involve hazardous waste operations and emergency response (Hazwoper).

1.1.1 Hazwoper-Regulated Tasks

- **Groundwater monitoring**
- **Surface water sampling**
- **Monitoring well drilling/installation**
- **Investigation-derived waste (drum) sampling and disposal**
- **O&M of groundwater extraction system at MW-20 bench**

1.1.2 Non-Hazwoper-Regulated Tasks

Under specific circumstances, the training and medical monitoring requirements of federal or state Hazwoper regulations are not applicable. It must be demonstrated that the tasks can be performed without the possibility of exposure in order to use non-Hazwoper-trained personnel. **Prior approval from the Health and Safety Manager (HSM) is required before these tasks are conducted on regulated hazardous waste sites.**

TASKS	CONTROLS
• Installation of groundwater extraction system at MW-20 bench (e.g., siting tanks, piping, instrumentation and controls, and temporary power..	• Brief on hazards, limits of access, and emergency procedures
• Background sampling study	• Post contaminant areas as appropriate (refer to Section 8.2 for details)
• Pore water Seepage sampling and study, using boats to access the river.	• Sample and monitor as appropriate (refer to Section 5.0)
• Tracer injection well study using dyes	

1.2 Task Hazard Analysis

(Refer to Section 2 for hazard controls)

POTENTIAL HAZARDS	TASKS				
	Mud-Rotary Drilling	Groundwater monitoring, aquifer testing, tracer study	O&M of pumping system	Surface water and sediment sampling from the shore or water	IDW drum sampling and disposal
Flying debris/objects	X	X		X	X
Noise > 85dBA	X	X	X		
Electrical	X		X		
Suspended loads	X				
Buried utilities, drums, tanks	X				
Slip, trip, fall	X	X	X	X	X
Back injury	X	X	X	X	X
Confined space entry					
Trenches / excavations					
Visible lightning	X	X	X	X	X
Vehicle traffic	X	X	X		
Elevated work areas/falls			X	X	
Fires			X	X	X
Entanglement	X				
Drilling	X				
Heavy equipment			X		
Working near water				X	
Working from boat				X	
IDW Drum Sampling					X

2 Hazard Controls

This section provides safe work practices and control measures used to reduce or eliminate potential hazards. These practices and controls are to be implemented by the party in control of either the site or the particular hazard. CH2M HILL employees and subcontractors must remain aware of the hazards affecting them regardless of who is responsible for controlling the hazards. CH2M HILL employees and subcontractors who do not understand any of these provisions should contact the SSC for clarification.

In addition to the controls specified in this section, Project-Activity Self-Assessment Checklists are contained in Attachment 5. These checklists are to be used to assess the adequacy of CH2M HILL and subcontractor site-specific safety requirements. The objective of the self-assessment process is to identify gaps in project safety performance, and prompt for corrective actions in addressing these gaps. Self-assessment checklists should be completed early in the project, when tasks or conditions change, or when otherwise specified by the HSM. The self-assessment checklists, including documented corrective actions, should be made part of the permanent project records, and be promptly submitted to the HSM.

Project-specific frequency for completing self-assessments

- complete self assessment checklist every two weeks for drilling activities.
- complete self assessment checklist every week for groundwater extraction system activities

2.1 Project-Specific Hazards

2.1.1 Lockout/Tagout

- Do not work on equipment when the unexpected operation could result in injury, unless lockout/tagout procedures are implemented.
- Staff working under a lockout/tagout procedure must complete the CH2M HILL Lockout/Tagout training course. Project-specific training may also be required on site-specific lockout/tagout procedures.
- Standard lockout/tagout procedures include the following six steps:
  - notify all personnel in the affected area of the lockout/tagout,
  - shut down the equipment using normal operating controls,
  - isolate all energy sources,
  - apply individual lock and tag to each energy isolating device,
  - relieve or restrain all potentially hazardous stored or residual energy, and
  - verify that isolation and de-energization of the equipment has been accomplished. Once verified that the equipment is at the zero energy state, work may begin.
- All safe guards must be put back in place, all affected personnel notified that lockout/tagout has been removed, and controls positioned in the safe mode prior to lockout/tagout removal.
- Do not remove another person’s lock or tag.

2.1.2 Working Above or Near Water

- Fall protection should be provided to prevent personnel from falling into water. Where fall protection systems are not provided and the danger of drowning exists, U.S. Coast Guard-approved personal flotation devices (PDFs), or life jacket, shall be worn.
- Inspect PFDs prior to use. Do not use defective PFDs.
- A life-saving skiff must be provided for emergency rescue.
- A minimum of one ring buoy with 90 feet of 3/8-inch solid-braid polypropylene (or equal) rope must be provided for emergency rescue.
- Use sampling and other equipment according to the manufacturers' instructions.

2.1.3 Drilling

(Reference CH2M HILL SOP HS-35, *Drilling*)

- Only authorized personnel are permitted to operate drill rigs.
- Stay clear of areas surrounding drill rigs during every startup.
- Stay clear of the rotating augers and other rotating components of drill rigs.
- Stay as clear as possible of all hoisting operations. Loads shall not be hoisted overhead of personnel.
- Do not wear loose-fitting clothing or other items such as rings or watches that could get caught in moving parts. Long hair should have it restrained.
- If equipment becomes electrically energized, personnel shall be instructed not to touch any part of the equipment or attempt to touch any person who may be in contact with the electrical current. The utility company or appropriate party shall be contacted to have line de-energized prior to approaching the equipment.
- Smoking around drilling operations is prohibited.

2.1.4 Exposure to Public Vehicular Traffic

The following precautions must be taken when working around traffic, and in or near an area where traffic controls have been established by a contractor.

- Exercise caution when exiting traveled way or parking along street – avoid sudden stops, use flashers, etc.
- Park in a manner that will allow for safe exit from vehicle, and where practicable, park vehicle so that it can serve as a barrier.
- All staff working adjacent to traveled way or within work area must wear reflective/high-visibility safety vests.
- Eye protection should be worn to protect from flying debris.
- Remain aware of factors that influence traffic related hazards and required controls – sun glare, rain, wind, flash flooding, limited sight-distance, hills, curves, guardrails, width of shoulder (i.e., breakdown lane), etc.
- Always remain aware of an escape route -- behind an established barrier, parked vehicle, guardrail, etc.
- Always pay attention to moving traffic – never assume drivers are looking out for you
- Work as far from traveled way as possible to avoid creating confusion for drivers.
- When workers must face away from traffic, a “buddy system” should be used, where one worker is looking towards traffic.
- When working on highway projects, obtain a copy of the contractor’s traffic control plan.
- Work area should be protected by a physical barrier – such as a K-rail or Jersey barrier.
- Review traffic control devices to ensure that they are adequate to protect your work area. Traffic control devices should: 1) convey a clear meaning, 2) command respect of road users, and 3) give adequate time for proper traffic response. The adequacy of these devices are dependent on limited sight distance, proximity to ramps or intersections, restrictive width, duration of job, and traffic volume, speed, and proximity.
- Either a barrier or shadow vehicle should be positioned a considerable distance ahead of the work area. The vehicle should be equipped with a flashing arrow sign and truck-mounted crash cushion (TMCC). All vehicles within 40 feet of traffic should have an orange flashing hazard light atop the vehicle.
- Except on highways, flaggers should be used when 1) two-way traffic is reduced to using one common lane, 2) driver visibility is impaired or limited, 3) project vehicles enter or exit traffic in an unexpected manner, or 4) the use of a flagger enhances established traffic warning systems.
- Lookouts should be used when physical barriers are not available or practical. The lookout continually watches approaching traffic for signs of erratic driver behavior and warns workers. Vehicles should be parked at least 40 feet away from the work zone and traffic. Minimize the amount of time that you will have your back to oncoming traffic.

2.1.5 IDW Drum Sampling

Personnel are permitted to handle and/or sample drums containing investigation-derived waste (IDW) only; handling or sampling other drums requires a plan revision or amendment approved by the CH2M HILL HSM. The following control measures will be taken when sampling drums containing IDW:

- Minimize transportation of drums.

- Sample only labeled drums or drums known to contain IDW.
- Use caution when sampling bulging or swollen drums. Relieve pressure slowly.
- If drums contain, or potentially contain, flammable materials, use non-sparking tools to open.
- Picks, chisels, and firearms may not be used to open drums.
- Reseal bung holes or plugs whenever possible.
- Avoid mixing incompatible drum contents.
- Sample drums without leaning over the drum opening.
- Transfer the content of drums using a method that minimizes contact with material.
- PPE and air monitoring requirements specified in Sections 4 and 5 must address IDW drum sampling.
- Spill-containment procedures specified in Section 7 must be appropriate for the material to be handled.

2.1.6 Sunburn Prevention

Most people enjoy spending time outdoors, but too much time in the sun can cause problems later. Excessive sun exposure can cause your skin to age prematurely, become "leathery," wrinkled, and in some cases, may cause skin cancer. People with fair skin, freckles and red or blond hair are most at risk but even those who tan easily need to be careful. Avoid being outside from 10 a.m. to 3 p.m. when the sun's rays are the strongest. When this is not possible, wear protective clothing such as long sleeves and a full rim hard hat to cover your neck, ears and face.. Use a sun screen with a sun protection factor of at least 15, and reapply it often since perspiration can dilute it's protective effects.. Also take precautions on cloudy days because even though the sun intensity seems diminished, 70 to 80% of the suns rays are still coming through the clouds.. Some medications can also make you more sun sensitive so check with your doctor.

2.1.7 ATV Safety

- Use of ATV's is a high hazard risk and only approved staff may operate.
- All staff will be required to review Attachment 7 and receive basic use training.
- ATV's shall be used in accordance of manufacturers specifications.
- Required PPE shall be worn at all times.

2.1.8 Field Vehicle Safety

- Parking at pullouts must be done with care. Leave room for vehicles belonging to contractors to easily pullout in case of emergency. Do not block any vehicles in. If this is necessary, leave keys in ignition.
- Right of Way on site roads. Those traveling uphill always have the right of way if there is no room to pass. Vehicle traveling downhill, must backup to the nearest pullout.
- Field vehicles are to carry emergency equipment as specified in section 9.2.
- Correct PPE should be available for each person riding in a field vehicle.
- WD is required for site access in certain areas. Only those familiar with use of OFF Highway 4WD vehicles should drive during site access.
- Do not park or drive over dry brush, as this may be ignited by a hot exhaust system.
- Do not attempt to drive on pitched steeply angled roadways or trails.
- Do not attempt to cross fast flowing stream beds or flash flood channels without knowing weather conditions or storm warnings.
- Seatbelts are to be worn at all times.
- Only rented 4WD vehicles with extra damage waiver insurance shall be used. Enterprise Rental provides this, check with contracts about other CH2MHILL preferred rental agencies. Special rate codes must be used to rent.

2.1.9 Earthmoving Equipment (Reference CH2M HILL SOP HS-27, *Earthmoving Equipment*)

- Only authorized personnel are permitted to operate earthmoving equipment.
- Maintain safe distance from operating equipment and stay alert of equipment movement. Avoid positioning between fixed objects and operating equipment and equipment pinch points, remain outside of the equipment

swing and turning radius. Pay attention to backup alarms, but not rely on them for protection. Never turn your back on operating equipment.

- Approach operating equipment only after receiving the operator's attention. The operator shall acknowledge your presence and stop movement of the equipment. Caution shall be used when standing next to idle equipment; when equipment is placed in gear it can lurch forward or backward. Never approach operating equipment from the side or rear where the operator's vision is compromised.
- When required to work in proximity to operating equipment, wear high-visibility vests to increase visibility to equipment operators. For work performed after daylight hours, vests shall be made of reflective material or include a reflective stripe or panel.
- Do not ride on earthmoving equipment unless it is specifically designed to accommodate passengers. Only ride in seats that are provided for transportation and that are equipped with seat belts.
- Stay as clear as possible of all hoisting operations. Loads shall not be hoisted overhead of personnel.
- Earthmoving equipment shall not be used to lift or lower personnel.
- If equipment becomes electrically energized, personnel shall be instructed not to touch any part of the equipment or attempt to touch any person who may be in contact with the electrical current. The utility company or appropriate party shall be contacted to have line de-energized prior to approaching the equipment.

2.1.10 Fall Protection (Reference CH2M HILL SOP HS-31, *Fall Protection*)

- Fall protection systems must be used to eliminate fall hazards when performing construction activities at a height of 6 feet or greater and when performing general industry activities at a height of 4 feet or greater.
- Staff exposed to fall hazards must complete the CH2M HILL Fall Protection training course and receive project-specific fall protection training. Do not use fall protection systems on which you have not been trained.
- The SSC/DSC must complete the Project Fall Protection Evaluation Form and provide project-specific fall protection training to all staff exposed to fall hazards. The Project Fall Protection Evaluation Form is provided in Attachment 4 of this plan.
- The SSC/DSC shall act as competent person and shall inspect and oversee the use of fall protection systems. Follow all requirements established by the competent person for the use and limitation of fall protection systems.
- A registered professional engineer shall oversee the use of horizontal lifelines.
- Only one person shall be simultaneously attached to a vertical lifeline.
- Remain within the guardrail system when provided. Leaning over or stepping across a guardrail system is not permitted.
- Do not stand on objects (boxes, buckets, bricks, blocks, etc.) or ladders to increase working height on top of platforms protected by guardrails.
- Inspect personal fall arrest systems prior to each use. Do not use damaged fall protection systems at any time, or for any reason.
- Set-up personal fall arrest systems so that you can neither free-fall more than 6 feet nor contact any lower level.
- Only attach personal fall arrest systems to anchorage points capable of supporting at least 5,000 pounds.
- Use fall protection equipment for fall protection only and not to hoist materials. Do not use personal fall arrest systems that have been subjected to impact loading.

2.1.11 Chemical Laboratory Activities

- Personnel must complete the computer-based Laboratory Safety training module.
- Personnel must complete the general laboratory medical monitoring protocol and be approved for such activities.
- Personnel must receive chemical-specific hazard communication training on the chemicals to which they are exposed.
- Personnel who are exposed to methylene chloride must complete the computer-based Methylene Chloride training module.
- Personnel must read and follow the requirements of the Chemical Hygiene Plan.

2.1.12 Lightning and Thunderstorms

- Avoid working during thunderstorms.
- If caught in one, seek shelter in low lying areas, nearby buildings or your car. Do not touch anything metal.
- Avoid lone trees as shelter.
- Avoid open, elevated, bare areas.
- Do not cross bodies of water.
- If caught in open area, place feet close together and crouch down as small as possible, without lying on the ground.
- Ground strikes are known to be initiated by "leaders", or charges, from the earth making a connection to the charge in the clouds. This may make your hair stand up, and since you do not want to be part of a leader that makes the connection to form a cloud-to-ground strike, immediately crouch as described above.
- Avoid working in flood channels due to flash flood hazards. Rain in the mountains can create a flashflood hazard, even if no rain is falling in your area.

2.1.13 Working On Water

- Safe means of boarding or leaving the boat or platform must be provided to prevent slipping and falling.
- Boat/barge must be equipped with adequate railing.
- Boat/barge must be operated according to U.S. Coast Guard regulations (speed, lightning, right-of-way, etc.).
- Staff should be instructed on safe use and operation of boat prior to use.
- Work requiring the use of a boat will not take place at night or during inclement weather.
- Shut off engine before refueling. Do not smoke while refueling.

Before getting underway:

- Vessels should not be operated alone.
- Personnel Floatation Devices (PFD) are required for all personnel, and are available to check out when filing float plan.
- Cellular telephone equipment may be checked out when filing float plan.
- Jackets and other protection against the weather should be a consideration when planning your operation.
- Basic Personal Protective Equipment (PPE) such as hats, safety glasses, etc., are required in addition to PFD's.

Communication:

- A serviceable cellular telephone must be onboard with the operator. Cellular telephones may be obtained when filing float plan.
- A list of emergency telephone contact numbers will be provided when filing float plan.
- Marine radio, inquire if one is available and test for operation

- If your destination includes boarding any of the dredging or floating equipment, you must first contact the operator to schedule the visit to ensure safe operations.

At the dock:

- USCG approved Personal Floatation Device (PFD) must be worn at all times by all personnel in and around small craft or when the potential for drowning exists.
- Check inventory, which should at a minimum include; PFDs for all personnel, cellular telephone, marine radio, charged fire extinguisher, first aid kit, emergency signaling device, fuel, paddle, anchoring system, and running lights (if night operations occur).
- Never jump into a small boat, always board by stepping into the center of the bottom.
- Be careful no to exceed the maximum weight capacity of the vessel.
- Make careful inspection of the vessel and the immediate surroundings.

- Check visibility, conditions such as heavy fog may preclude operations.
- Make note of the direction and strength of the wind and current.
- Ensure that all lines are secure before getting underway to prevent fouling the propeller.
- Smoking is not permitted onboard.

Returning:

- Make certain that the vessel is secure at the dock, all dock lines secure, radio and other electrical equipment is turned off, etc.
- Replace or report equipment the needs service or repair when closing out the float plan.
- Return any equipment, which may have been issued, to you or your passengers for the operation.

Be ALERT! The principal cause of a vessel colliding with another vessel or with a fixed object is failure of the operator to maintain an efficient forward lookout.

2.1.14 Hand Augering

Muscle strains can occur with hand augering. To minimize the occurrence of injury, the following should be observed:

- Keep augers sharp - a dull auger requires more work to advance through the soil.
- Before beginning work, stretch or warm up the body as you would prior to exercising.
- Try to avoid excessive twisting or wrenching motions when using the auger.

2.1.15 Tracer Injection Well Study

A tracer test using fluorescent dyes will be used and added to existing injection wells. Tracer dyes are shipped in powder form to the jobsite in carboys, inside protective coolers.

Guidelines outlines in Section 2.2.2, 2.2.3, and 2.2.4 of this safety plan, must followed for use of this Tracer dye.

2.2 General Hazards

2.2.1 General Practices and Housekeeping

(Reference CH2M HILL SOP HS-20, *General Practices*)

- Site work should be performed during daylight hours whenever possible. Work conducted during hours of darkness require enough illumination intensity to read a newspaper without difficulty.
- Good housekeeping must be maintained at all times in all project work areas.
- Common paths of travel should be established and kept free from the accumulation of materials.
- Keep access to aisles, exits, ladders, stairways, scaffolding, and emergency equipment free from obstructions.
- Provide slip-resistant surfaces, ropes, and/or other devices to be used.
- Specific areas should be designated for the proper storage of materials.
- Tools, equipment, materials, and supplies shall be stored in an orderly manner.
- As work progresses, scrap and unessential materials must be neatly stored or removed from the work area.
- Containers should be provided for collecting trash and other debris and shall be removed at regular intervals.
- All spills shall be quickly cleaned up. Oil and grease shall be cleaned from walking and working surfaces.

2.2.2 Hazard Communication

(Reference CH2M HILL SOP HS-05, *Hazard Communication)*

The SSC is to perform the following:

- Complete an inventory of chemicals brought on site by CH2M HILL using Attachment 2.
- Confirm that an inventory of chemicals brought on site by CH2M HILL subcontractors is available.
- Request or confirm locations of Material Safety Data Sheets (MSDSs) from the client, contractors, and subcontractors for chemicals to which CH2M HILL employees potentially are exposed.

- Before or as the chemicals arrive on site, obtain an MSDS for each hazardous chemical.
- Label chemical containers with the identity of the chemical and with hazard warnings, and store properly.
- Give employees required chemical-specific HAZCOM training using Attachment 3.
- Store all materials properly, giving consideration to compatibility, quantity limits, secondary containment, fire prevention, and environmental conditions.

2.2.3 Shipping and Transportation of Chemical Products

(Reference CH2M HILL's *Procedures for Shipping and Transporting Dangerous Goods)*

Chemicals brought to the site might be defined as hazardous materials by the U.S. Department of Transportation (DOT). All staff who ship the materials or transport them by road must receive CH2M HILL training in shipping dangerous goods. All hazardous materials that are shipped (e.g., via Federal Express) or are transported by road must be properly identified, labeled, packed, and documented by trained staff. Contact the HSM or the Equipment Coordinator for additional information.

2.2.4 Lifting

(Reference CH2M HILL SOP HS-112, *Lifting*)

- Proper lifting techniques must be used when lifting any object.
  - Plan storage and staging to minimize lifting or carrying distances.
  - Split heavy loads into smaller loads.
  - Use mechanical lifting aids whenever possible.
  - Have someone assist with the lift -- especially for heavy or awkward loads.
  - Make sure the path of travel is clear prior to the lift.
  - CH2M HILL's lifting limit per person is 40lbs. All lifts over this weight must be done with assistance.

2.2.5 Fire Prevention

(Reference CH2M HILL SOP HS-22, *Fire Prevention*)

- Fire extinguishers shall be provided so that the travel distance from any work area to the nearest extinguisher is less than 100 feet. When 5 gallons or more of a flammable or combustible liquid is being used, an extinguisher must be within 50 feet. Extinguishers must:
  - be maintained in a fully charged and operable condition,
  - be visually inspected each month, and
  - undergo a maintenance check each year.
- The area in front of extinguishers must be kept clear.
- Post "Exit" signs over exiting doors, and post "Fire Extinguisher" signs over extinguisher locations.
- Combustible materials stored outside should be at least 10 feet from any building.
- Solvent waste and oily rags must be kept in a fire resistant, covered container until removed from the site.
- Flammable/combustible liquids must be kept in approved containers, and must be stored in an approved storage cabinet.

2.2.6 Electrical

(Reference CH2M HILL SOP HS-23, *Electrical*)

- Only qualified personnel are permitted to work on unprotected energized electrical systems.
- Only authorized personnel are permitted to enter high-voltage areas.
- Do not tamper with electrical wiring and equipment unless qualified to do so. All electrical wiring and equipment must be considered energized until lockout/tagout procedures are implemented.
- Inspect electrical equipment, power tools, and extension cords for damage prior to use. Do not use defective electrical equipment, remove from service.
- All temporary wiring, including extension cords and electrical power tools, must have ground fault circuit interrupters (GFCIs) installed.
- Extension cords must be:
  - equipped with third-wire grounding.

  - covered, elevated, or protected from damage when passing through work areas.
  - protected from pinching if routed through doorways.
  - not fastened with staples, hung from nails, or suspended with wire.
- Electrical power tools and equipment must be effectively grounded or double-insulated UL approved.
- Operate and maintain electric power tools and equipment according to manufacturers' instructions.
- Maintain safe clearance distances between overhead power lines and any electrical conducting material unless the power lines have been de-energized and grounded, or where insulating barriers have been installed to prevent physical contact. Maintain at least 10 feet from overhead power lines for voltages of 50 kV or less, and 10 feet plus ½ inch for every 1 kV over 50 kV.
- Temporary lights shall not be suspended by their electric cord unless designed for suspension. Lights shall be protected from accidental contact or breakage.
- Protect all electrical equipment, tools, switches, and outlets from environmental elements.

2.2.7 Heat Stress

(Reference CH2M HILL SOP HS-09, *Heat and Cold Stress*)

- Drink 16 ounces of water before beginning work. Disposable cups and water maintained at 50°F to 60°F should be available. Under severe conditions, drink 1 to 2 cups every 20 minutes, for a total of 1 to 2 gallons per day. Do not use alcohol in place of water or other nonalcoholic fluids. Decrease your intake of coffee and caffeinated soft drinks during working hours.
- Acclimate yourself by slowly increasing workloads (e.g., do not begin with extremely demanding activities).
- Use cooling devices, such as cooling vests, to aid natural body ventilation. These devices add weight, so their use should be balanced against efficiency.
- Use mobile showers or hose-down facilities to reduce body temperature and cool protective clothing.
- Conduct field activities in the early morning or evening and rotate shifts of workers, if possible.
- Avoid direct sun whenever possible, which can decrease physical efficiency and increase the probability of heat stress. Take regular breaks in a cool, shaded area. Use a wide-brim hat or an umbrella when working under direct sun for extended periods.
- Provide adequate shelter/shade to protect personnel against radiant heat (sun, flames, hot metal).
- Maintain good hygiene standards by frequently changing clothing and showering.
- Observe one another for signs of heat stress. Persons who experience signs of heat syncope, heat rash, or heat cramps should consult the SSC/DSC to avoid progression of heat-related illness.

SYMPTOMS AND TREATMENT OF HEAT STRESS

	Heat Syncope	Heat Rash	Heat Cramps	Heat Exhaustion	Heat Stroke
Signs and Symptoms	Sluggishness or fainting while standing erect or immobile in heat.	Profuse tiny raised red blister-like vesicles on affected areas, along with prickling sensations during heat exposure.	Painful spasms in muscles used during work (arms, legs, or abdomen); onset during or after work hours.	Fatigue, nausea, headache, giddiness; skin clammy and moist; complexion pale, muddy, or flushed; may faint on standing; rapid thready pulse and low blood pressure; oral temperature normal or low	Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high oral temperature.
Treatment	Remove to cooler area. Rest lying down. Increase fluid intake. Recovery usually is prompt and complete.	Use mild drying lotions and powders, and keep skin clean for drying skin and preventing infection.	Remove to cooler area. Rest lying down. Increase fluid intake.	Remove to cooler area. Rest lying down, with head in low position. Administer fluids by mouth. Seek medical attention.	Cool rapidly by soaking in cool– but not cold– water. Call ambulance, and get medical attention immediately!

Monitoring Heat Stress

These procedures should be considered when the ambient air temperature exceeds 70°F, the relative humidity is high (>50 percent), or when workers exhibit symptoms of heat stress.
The heart rate (HR) should be measured by the radial pulse for 30 seconds, as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 100 beats/minute, or 20 beats/minute above resting pulse. If the HR is higher, the next work period should be shortened by 33 percent, while the length of the rest period stays the same. If the pulse rate still exceeds 100 beats/minute at the beginning of the next rest period, the work cycle should be further shortened by 33 percent. The procedure is continued until the rate is maintained below 100 beats/minute, or 20 beats/minute above resting pulse.

A new Heat Stress Monitoring log has been implemented. See attachments or Rick Cavil for a copy.

2.2.8 Cold Stress

(Reference CH2M HILL SOP HS-09, *Heat and Cold Stress*)

- Be aware of the symptoms of cold-related disorders, and wear proper, layered clothing for the anticipated fieldwork. Appropriate rain gear is a must in cool weather.
- Consider monitoring the work conditions and adjusting the work schedule using guidelines developed by the U.S. Army (wind-chill index) and the National Safety Council (NSC).
- Wind-Chill Index is used to estimate the combined effect of wind and low air temperatures on exposed skin. The wind-chill index does not take into account the body part that is exposed, the level of activity, or the amount or type of clothing worn. For those reasons, it should only be used as a guideline to warn workers when they are in a situation that can cause cold-related illnesses.
- NSC Guidelines for Work and Warm-Up Schedules can be used with the wind-chill index to estimate work and warm-up schedules for fieldwork. The guidelines are not absolute; workers should be monitored for symptoms of cold-related illnesses. If symptoms are not observed, the work duration can be increased.
- Persons who experience initial signs of immersion foot, frostbite, hypothermia should consult the SSC/DSC to avoid progression of cold-related illness.
- Observe one another for initial signs of cold-related disorders.
- Obtain and review weather forecast – be aware of predicted weather systems along with sudden drops in temperature, increase in winds, and precipitation.

SYMPTOMS AND TREATMENT OF COLD STRESS			
	Immersion (Trench) Foot	**Frostbite**	**Hypothermia**
Signs and Symptoms	Feet discolored and painful; infection and swelling present.	Blanched, white, waxy skin, but tissue resilient; tissue cold and pale.	Shivering, apathy, sleepiness; rapid drop in body temperature; glassy stare; slow pulse; slow respiration.
Treatment	Seek medical treatment immediately.	Remove victim to a warm place. Re-warm area quickly in warm–but **not** hot–water. Have victim drink warm fluids, but **not** coffee or alcohol. Do not break blisters. Elevate the injured area, and get medical attention.	Remove victim to a warm place. Have victim drink warm fluids, but **not** coffee or alcohol. Get medical attention.

2.2.9 Compressed Gas Cylinders

- Valve caps must be in place when cylinders are transported, moved, or stored.
- Cylinder valves must be closed when cylinders are not being used and when cylinders are being moved.
- Cylinders must be secured in an upright position at all times.
- Cylinders must be shielded from welding and cutting operations and positioned to avoid being struck or knocked over; contacting electrical circuits; or exposed to extreme heat sources.
- Cylinders must be secured on a cradle, basket, or pallet when hoisted; they may not be hoisted by choker slings.

2.2.10 Confined Space Entry

(Reference CH2M HILL SOP HS-17, *Confined Space Entry*)

No confined space entry will be permitted. Confined space entry requires additional health and safety procedures, training, and a permit. If conditions change such that confined-space entry is necessary, contact the HSM to develop the required entry permit.
When planned activities will not include confined-space entry, permit-required confined spaces accessible to CH2M HILL personnel are to be identified before the task begins. The SSC is to confirm that permit spaces are properly posted or that employees are informed of their locations and hazards.

2.3 Biological Hazards and Controls

2.3.1 Snakes

Snakes typically are found in underbrush and tall grassy areas. If you encounter a snake, stay calm and look around; there may be other snakes. Turn around and walk away on the same path you used to approach the area. If a person is bitten by a snake, wash and immobilize the injured area, keeping it lower than the heart if possible. Seek medical attention immediately. **DO NOT** apply ice, cut the wound, or apply a tourniquet. Try to identify the type of snake: note color, size, patterns, and markings.

2.3.2 Bees and Other Stinging Insects

Bee and other stinging insects may be encountered almost anywhere and may present a serious hazard, particularly to people who are allergic. Watch for and avoid nests. Keep exposed skin to a minimum. Carry a kit if you have had allergic reactions in the past, and inform the SSC and/or buddy. If a stinger is present, remove it carefully with tweezers. Wash and disinfect the wound, cover it, and apply ice. Watch for allergic reaction; seek medical attention if a reaction develops.

2.3.3 Bloodborne Pathogens

(Reference CH2M HILL SOP HS-36, *Bloodborne Pathogens*)

Exposure to bloodborne pathogens may occur when rendering first aid or CPR, or when coming into contact with landfill waste or waste streams containing potentially infectious material. Exposure controls and personal protective equipment (PPE) are required as specified in CH2M HILL SOP HS-36, *Bloodborne Pathogens*. Hepatitis B vaccination must be offered before the person participates in a task where exposure is a possibility.

2.3.4 Scorpion Weed

Scorpion weed has been found to be located on the project site and needs to be avoided by project personnel. Scorpion week has purple flowers has the potential to cause a skin rash when contacted. The following text provides information to project personnel about this plant species.

GENERAL MORPHOLOGY: This plant is an herbaceous plant species that has a cyme raceme (curled flower stem with multiple flowers) and alternate leaves.

FLOWER COLOR: Purple

LOCATION WHERE PLANTS MAY OCCUR: Predominantly along the side of a wash or along the Colorado River bank.

REQUIRED COORDINATION: As is may be difficult to identify the plants present on the project site, they will need to be identified on the project site to all field personnel prior to site work.

IF SKIN IS CONTACTED WITH PLANT:

When skin is directly contacted by *Phacelia sp*., sap or hairs from the plant will attached to the skin. Once affected, you will begin to feel a tingling sensation and your skin may develop red bumps or turn brown. Do not touch this

area of your skin because you may spread the hairs/sap of the plant to new areas on your skin. This would cause other areas to be infected. You have two types of methods to assist in removing the hairs. In all cases, please consult the appropriate medical attention.

1. **Where water is available**: Place area of skin under large volume of flowing water. You can look to see if hairs are removed from the water flow. When confident that the hairs/sap have been removed you can wash area with soap. I would suggest that you place soap directly on area without touching it first, and keep under flowing water until removed. You can repeat as often as necessary. When confident that hairs have been removed from the area, you can rub the area with soap with a paper towel or rag.

2. **Where water is not available**: If you are in an are where water is not available, you can place tape over the area contacted an pull off quickly. This will assist in removing the hairs. Repeat as often as necessary. An additional method would be to cover area with hand cream or other viscous liquid and shave. This will remove the plant hairs as well as your natural hair from your skin. A razor is usually included in a snake bite kit. Please dispose of razor after use. You can rinse the area with any type of liquid (soda, juice) if water is not available if sap is present on your skin. Follow #1 above when water is available.

WHEN CLOTHING/GEAR IS CONTACTED WITH PLANT:

Remove clothing without touching area that was contacted with plant. Store in a plastic bag until you can wash them. When washing, do not include other clothing items in the load. If a large area is affected in the clothing, you may want to wash it more than once to ensure that all plant materials have been removed.

Wash all gear with soap and water if contacted plant. Electronic equipment will have to be wiped with a dry towel, as water will damage the equipment. Be careful to ensure that all field equipment is clean, as people using the equipment on a later date could become infected.

2.3.5 Dog Safety

- In areas known to be frequented by feral dogs, equip each field team with dog repellant (e.g., Shock Dog Repellent or other capsaicin-based spray).
  - Read manufactures instructions.
  - Position yourself up-wind if possible before using.
  - Only use if attacked-- not just threatened.
- Avoid all dogs – both leashed and stray.
- Don't disturb a dog while it is sleeping, eating or caring for puppies.
- If a dog approaches to sniff you - stay still.
- An aggressive dog has a tight mouth, flattened ears and a direct stare.
- If you're threatened by a dog, remain calm – don't scream and avoid eye contact.
- If you say anything, speak calmly and firmly.
- Don't turn and run – try to stay still until the dog leaves, or back away slowly until the dog is out of sight or you have reached safety (e.g., vehicle).
- If attacked, retreat to vehicle or attempt to place something between you and the dog.
- If you fall or are knocked to the ground, curl into a ball with your hands over your head and neck, and protect your face.
- If bitten, immediately scrub the bite site vigorously with soap and water.
- Report the incident to the local authorities.

- Seek medical attention as soon as possible.

2.5 Contaminants of Concern

(Refer to Project Files for more detailed contaminant information)

Contaminant	Location and Maximum[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Chromium (as Cr(II) & Cr(III))	GW: 13.2 (MW-20/70) SB: 74.9 (4', RR Debris site) SS: 2,100 (disposal area) SW: not detected	0.5 mg/m^3	25	Irritated eyes, sensitization dermatitis, histologic fibrosis of lungs	NA
Chromium (hexavalent)	GW: 12.9 (MW-20/70) SB: 15.4 (4, RR Debris site) SS: 53.0 (disposal area) SW: not detected	0.01 mg/m^3	15 Ca	Irritated respiratory system, nasal septum perforation, liver and kidney damage, leucytosis, leupen, monocytosis, eosinophilla, eye injury, conjunctivitis, skin ulcer, sensitization dermatitis	NA

Footnotes:

[a] Specify sample-designation and media: SB (Soil Boring), A (Air), D (Drums), GW (Groundwater), L (Lagoon), TK (Tank), SS (Surface Soil), SL (Sludge), SW (Surface Water).

[b] Appropriate value of PEL, REL, or TLV listed.

[c] IDLH = immediately dangerous to life and health (units are the same as specified "Exposure Limit" units for that contaminant); NL = No limit found in reference materials; CA = Potential occupational carcinogen.

[d] PIP = photoionization potential; NA = Not applicable; UK = Unknown.

2.6 Potential Routes of Exposure

Dermal: Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in Section 4.	**Inhalation:** Vapors and contaminated particulates. This route of exposure is minimized through proper respiratory protection and monitoring, as specified in Sections 4 and 5, respectively.	**Other:** Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smoking).

3 Project Organization and Personnel

3.1 CH2M HILL Employee Medical Surveillance and Training

(Reference CH2M HILL SOPs HS-01, *Medical Surveillance*, and HS-02, *Health and Safety Training)*

The employees listed below are enrolled in the CH2M HILL Comprehensive Health and Safety Program and meet state and federal hazardous waste operations requirements for 40-hour initial training, 3-day on-the-job experience, and 8-hour annual refresher training. Employees designated "SSC" have completed a 12-hour site safety coordinator course, and have documented requisite field experience. An SSC with a level designation (D, C, B) equal to or greater than the level of protection being used must be present during all tasks performed in exclusion or decontamination zones. Employees designated "FA-CPR" are currently certified by the American Red Cross, or equivalent, in first aid and CPR. At least one FA-CPR designated employee must be present during all tasks performed in exclusion or decontamination zones. The employees listed below are currently active in a medical surveillance program that meets state and federal regulatory requirements for hazardous waste operations. Certain tasks (e.g., confined-space entry) and contaminants (e.g., lead) may require additional training and medical monitoring.

Pregnant employees are to be informed of and are to follow the procedures in CH2M HILL's SOP HS-04, *Reproduction Protection*, including obtaining a physician's statement of the employee's ability to perform hazardous activities before being assigned fieldwork.

Employee Name	Office	Responsibility	SSC/FA-CPR
David Thomas	BAO	Task/Field Manager (Drilling);	Level D,
Matt Ringier	BAO	Team Lead, SSC	Level D, ISC,
Gary Bissonnette	BAO	Field member	Level D,
Serena Lee	BAO	Team Lead, SSC	Level D, FA/CPR, SSC
Martin Barackman	RDD	Field team	Level D,
Zach Miller	SDO	Field team	Level C, SSC, FA/CPR
Matt Johns	DEN	PM (Floodplain)	Level C, SC-HW, FA/CPR
Jennifer Bradtmueller	DEN	GMP Team	Level C, SC-HW, FA/CPR
Bob Trebble	ANC	GMP team	Level D, FA/CPR
John Dallapiazza	DEN	Team lead, SSC	Level C, SC-HW, FA/CPR
Kathryn Brown	RDD	GMP Team	Level C, SC-HW, FA/CPR
Brad Shearer	RDD	Field team	Level C, SC-HW, FA/CPR
Jay Piper	PHX	Field Task Mgr.	Level C, FA, SC-HW
Paul Bertucci	BAO	Project Manager (Floodplain)	Expired
Dan Cichy	DEN	GMP Team, Bkgd Study	Level D, FA/CPR
Ken Dorman	SAC	GMP Team	Level C, SC-HW, FA
Shawn Duffy	RDD	GMP Team	Level D
Kate Ebel	BAO	GMP Team	Level D, SC-HW, FA/CPR
Mike Ladeau	SCO	GMP Team	Level C, FA/CPR, SC
John Lueck	RDD	GMP Team	Level C, SC-HW, FA
Audie Martin	RDD	GMP Team	Level C, ISC, FA/CPR
Victor Martinez	DFW	GMP Team	Level C, SC-C, FA/CPR

Erica Matthews	LAS	GMP Team	Level D, SC-HW
Ryan McClellan	DEN	GMP Team	Level C
Ben Moayyad	SAC	GMP Team	Level D, SC-HW, FA/CPR
Jim Sarabia	PHX	GMP Team	Level C, SC-HW, FA/CPR
Allan Erickson	PHX	Transducer Team	Level D, SC-C, FA/CPR
Isaac Wood	BAO	Transducer Team	Level C

3.2 Field Team Chain of Command and Communication Procedures

3.2.1 Client

Contact Name: Yvonne Meeks, PG&E Project Manager
Phone: (805)-546-5243
Facility Contact Name: Margie Fergerson, Topock Facility Site Environ. Manager
Phone: (760) 326-5524

3.2.2 CH2M HILL

Project Manager: Julie Eakins/BAO
Task Manager/SSC (Drilling): David Thomas/BAO
Task Manager (soil sampling): Rick Sturm/BAO
Task Manager (groundwater program): Matt Ringier/ BAO and Serena Lee/BAO
Task Manager (interim corrective measures: Mathew Johns/DEN
Health and Safety Manager: Rick Cavil/BAO
Field Team Leader/SSC (GMP): Matt Ringier and Serena Lee/BAO (groundwater program) David Thomas/BAO (interim corrective measures and system operation),
Site Safety Coordinator: Jay Piper/ PHX, David Thomas/BAO, Matt Ringier/BAO, John Dallapiazza/DEN, Allan Erickson/PHX
The SSC is responsible for contacting the Field Team Leader and Project Manager. In general, the Project Manager will contact the client. The Health and Safety Manager should be contacted as appropriate.

3.2.3 CH2M HILL Subcontractors

(Reference CH2M HILL SOP HS-55, *Subcontractor, Contractor, and Owner*)

Strongarm Environmental Field Services, Norwalk, CA. 562-404-6656(Scott or Casey) Will provide two field sampling technicians and field vehicles/equipment to perform quarterly groundwater sampling in 2002 under the direction of CH2M HILL.

WDC Exploration and Wells, Montclair, CA, will conduct drilling and well construction/development tasks.

Randy Wallis Well Service, Barstow, CA will provide on-call services including well and pump maintenance and repair of the existing groundwater monitoring and extraction wells at the Topock site.

Prosonic Corp., 2475 Cerritos Ave., Signal Hill CA 90755. 562-424-9992 or 800-996-4949 (Corp. office) Provide specialized drill rig and crew.

GSI Water, 520 Mission St. South Pasadena, CA 91030. 626/441-0039 Seepage Study

Captain Doyle River Excursions, Topock Marina**.** Boat charter service and captains for boat tasks.

The subcontractors listed above are covered by this HSP and must be provided a copy of this plan. However, this plan does not address hazards associated with the tasks and equipment that the subcontractor has expertise in (e.g., drilling, excavation work, electrical). Subcontractors are responsible for the health and safety procedures specific to their work, and are required to submit these procedures to CH2M HILL for review before the start of field work. Subcontractors must comply with the established health and safety plan(s). The CH2M HILL SSC should verify that subcontractor employee training, medical clearance, and fit test records are current and must monitor and enforce compliance with the

established plan(s). CH2M HILL's oversight does not relieve subcontractors of their responsibility for effective implementation and compliance with the established plan(s).

CH2M HILL should continuously endeavor to observe subcontractors' safety performance. This endeavor should be reasonable, and include observing for hazards or unsafe practices that are both readily observable and occur in common work areas. CH2M HILL is not responsible for exhaustive observation for hazards and unsafe practices. In addition to this level of observation, the SSC is responsible for confirming CH2M HILL subcontractor performance against both the subcontractor's safety plan and applicable self-assessment checklists. Self-assessment checklists contained in Attachment 5 are to be used by the SSC to review subcontractor performance.

Health and safety related communications with CH2M HILL subcontractors should be conducted as follows:

- Brief subcontractors on the provisions of this plan, and require them to sign the Employee Signoff Form included in Attachment 1.
- Request subcontractor(s) to brief the project team on the hazards and precautions related to their work.
- When apparent non-compliance/unsafe conditions or practices are observed, notify the subcontractor safety representative and require corrective action – the subcontractor is responsible for determining and implementing necessary controls and corrective actions.
- When repeat non-compliance/unsafe conditions are observed, notify the subcontractor safety representative and stop affected work until adequate corrective measures are implemented.
- When an apparent imminent danger exists, immediately remove all affected CH2M HILL employees and subcontractors, notify subcontractor safety representative, and stop affected work until adequate corrective measures are implemented. Notify the Project Manager and HSM as appropriate.
- Document all oral health and safety related communications in project field logbook, daily reports, or other records.

4 Personal Protective Equipment (PPE)

(Reference CH2M HILL SOP HS-07, *Personal Protective Equipment*, HS-08, *Respiratory Protection*)

PPE Specifications [a]

Tasks	Level	Body	Head	Respirator [b]
General site entry Surveying Observation of material loading for offsite disposal Oversight of remediation and construction	D	Work clothes; steel-toe, leather work boots; work glove.	Hardhat [c] Safety glasses Ear protection [d]	None required
Surface water sampling Aquifer testing Sediment sampling Drilling new wells, soil sampling.	Modified D	Work clothes or cotton coveralls **Boots:** Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [c] Safety glasses Ear protection [d]	None required
Groundwater sampling Investigation-derived waste (drum) sampling and disposal	Modified D	**Coveralls:** Long Work pants **Boots:** Steel-toe, leather work boots **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hat [c] Splash shield [c] Safety glasses Ear protection [d]	None required.
River work from a boat	Modified D	**Work clothes:** long pants, t-shirt with sleeves, leather work boots, USCG approved flotation device. Upgrade to steel toed may be required if carrying heavy objects. **Gloves:** Nitrile gloves may be necessary for sampling.	Hat Safety Glasses	None required
Groundwater extraction system site set-up and general inspections	D	Work clothes; steel-toe, leather work boots; work glove.	Hardhat [c] Safety glasses Ear protection [d]	None required
Groundwater extraction system O&M	Modified D	**Coveralls:** Uncoated Tyvek® **Boots:** Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [c] Splash shield [c] Safety glasses Ear protection [d]	None required.

Reasons for Upgrading or Downgrading Level of Protection

Upgrade[f]	Downgrade
• Request from individual performing tasks. • Change in work tasks that will increase contact or potential contact with hazardous materials. • Occurrence or likely occurrence of gas or vapor emission. • Known or suspected presence of dermal hazards. • Instrument action levels (Section 5) exceeded.	• New information indicating that situation is less hazardous than originally thought. • Change in site conditions that decreases the hazard. • Change in work task that will reduce contact with hazardous materials.

[a] Modifications are as indicated. CH2M HILL will provide PPE only to CH2M HILL employees.

[b] No facial hair that would interfere with respirator fit is permitted.

[c] Hardhat and splash-shield areas are to be determined by the SSC.

[d] Ear protection should be worn when conversations cannot be held at distances of 3 feet or less without shouting.

[e] Cartridge change-out schedule is at least every 8 hours (or one work day), except if relative humidity is > 85%, or if organic vapor measurements are > midpoint of Level C range (refer to Section 5)--then at least every 4 hours. If encountered conditions are different than those anticipated in this HSP, contact the HSM.

[f] Performing a task that requires an upgrade to a higher level of protection (e.g., Level D to Level C) is permitted only when the PPE requirements have been approved by the HSM, and an SSC qualified at that level is present.

5 Air Monitoring/Sampling

(Reference CH2M HILL SOP HS-06, *Air Monitoring)*

5.1 Air Monitoring Specifications

Air monitoring is not required since there is a very low potential for personal exposure during planned site activities. The primary pathway for exposure to chromium is via inhalation of chromium-containing dust, so as long as dust is controlled, there should be no exposure problems. If work changes or if dust is generated during work activities, then the HSM must be notified so that air monitoring and PPE can be further evaluated.

6 Decontamination

(Reference CH2M HILL SOP HS-13, *Decontamination*)

The SSC must establish and monitor the decontamination procedures and their effectiveness. Decontamination procedures found to be ineffective will be modified by the SSC. The SSC must ensure that procedures are established for disposing of materials generated on the site.

6.1 Decontamination Specifications

Personnel

- Boot wash/rinse
- Glove wash/rinse
- Outer-glove removal
- Body-suit removal
- Inner-glove removal
- Respirator removal
- Hand wash/rinse
- Face wash/rinse
- Shower ASAP
- Dispose of PPE in municipal trash, or contain for disposal
- Dispose of personnel rinse water to facility or sanitary sewer, or contain for offsite disposal

Sample Equipment

- Wash/rinse equipment
- Solvent-rinse equipment
- Contain solvent waste for offsite disposal

Heavy Equipment

- Power wash
- Steam clean
- Dispose of equipment rinse water to facility or sanitary sewer, or contain for offsite disposal

6.2 Diagram of Personnel-Decontamination Line

No eating, drinking, or smoking is permitted in contaminated areas and in exclusion or decontamination zones. The SSC should establish areas for eating, drinking, and smoking. Contact lenses are not permitted in exclusion or decontamination zones.

Figure 6-1 illustrates a conceptual establishment of work zones, including the decontamination line. Work zones are to be modified by the SSC to accommodate task-specific requirements.

7 Spill-Containment Procedures

Sorbent material will be maintained in the support zone. Incidental spills will be contained with sorbent and disposed of properly. Additional spill-containment procedures are provided in project-specific work plans.

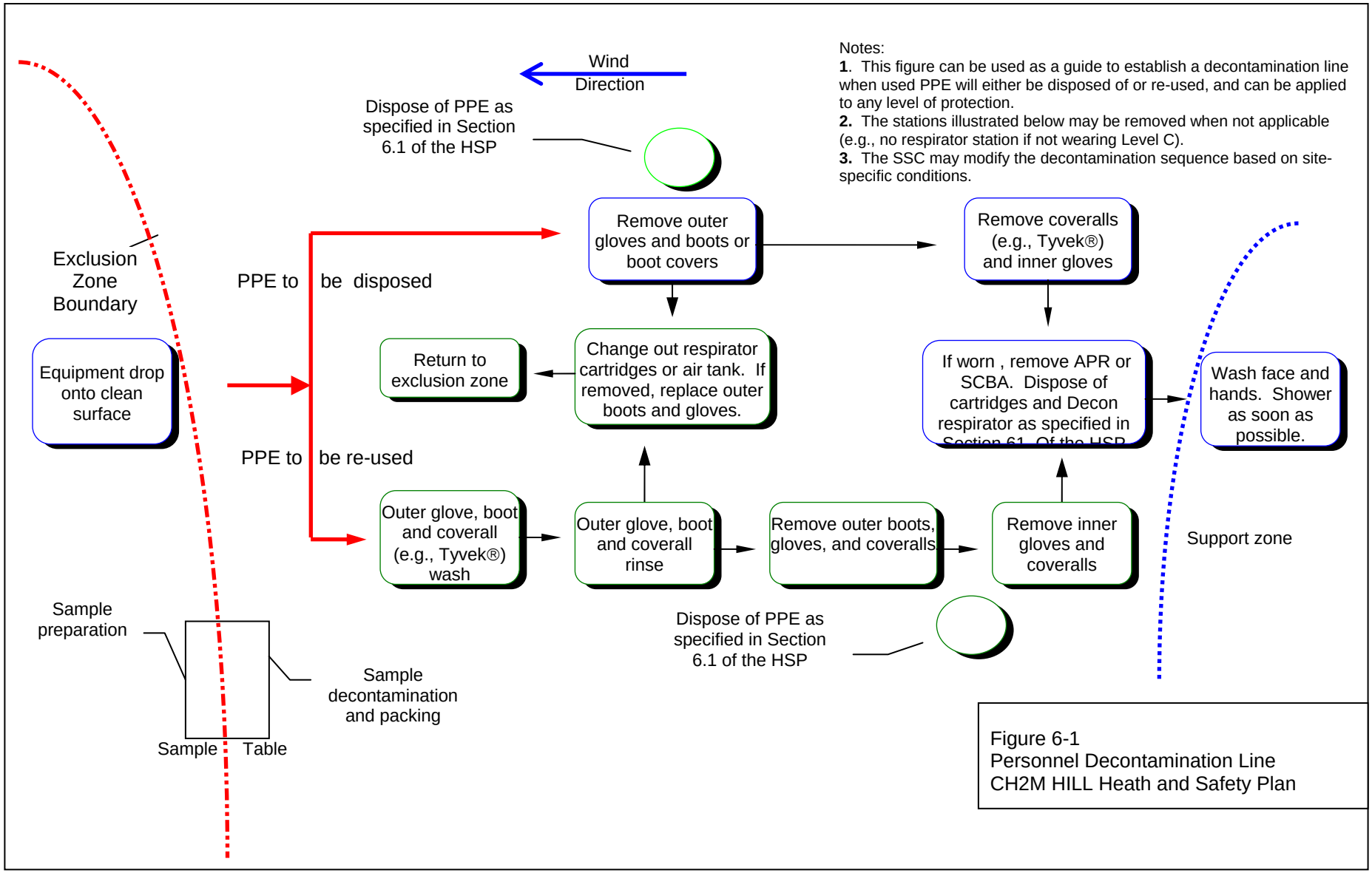


Figure 6-1
Personnel Decontamination Line
CH2M HILL Heath and Safety Plan

8 Site-Control Plan

8.1 Site-Control Procedures

(Reference CH2M HILL SOP HS-11, *Site Control)*

- The SSC will conduct a site safety briefing (see below) before starting field activities or as tasks and site conditions change.
- Topics for briefing on site safety: general discussion of Health and Safety Plan, site-specific hazards, locations of work zones, PPE requirements, equipment, special procedures, emergencies.
- The SSC records attendance at safety briefings in a logbook and documents the topics discussed.
- Post the OSHA job-site poster in a central and conspicuous location in accordance with CH2M HILL SOP HS-71, *OSHA Postings*.
- Establish support, decontamination, and exclusion zones. Delineate with flags or cones as appropriate. Support zone should be upwind of the site. Use access control at entry and exit from each work zone.
- Establish onsite communication consisting of the following:
  - Line-of-sight and hand signals
  - Air horn
  - Two-way radio or cellular telephone if available
- Establish offsite communication.
- Establish and maintain the "buddy system."
- Initial air monitoring is conducted by the SSC in appropriate level of protection.
- The SCC is to conduct periodic inspections of work practices to determine the effectiveness of this plan – refer to Sections 2 and 3. Deficiencies are to be noted, reported to the HSM, and corrected.

8.2 Hazwoper Compliance Plan

(Reference CH2M HILL SOP HS-19, *Site-Specific Written Safety Plans)*

Certain parts of the site work are covered by state or federal Hazwoper standards and therefore require training and medical monitoring. Anticipated Hazwoper tasks (Section 1.1.1) might occur consecutively or concurrently with respect to non-Hazwoper tasks. This section outlines procedures to be followed when approved activities specified in Section 1.1.2 do not require 24- or 40-hour training. Non-Hazwoper-trained personnel also must be trained in accordance with all other state and federal OSHA requirements.

- In many cases, air sampling, in addition to real-time monitoring, must confirm that there is no exposure to gases or vapors before non-Hazwoper-trained personnel are allowed on the site, or while non-Hazwoper-trained staff are working in proximity to Hazwoper activities. Other data (e.g., soil) also must document that there is no potential for exposure. The HSM must approve the interpretation of these data. Refer to subsections 2.5 and 5.3 for contaminant data and air sampling requirements, respectively.
- When non-Hazwoper-trained personnel are at risk of exposure, the SSC must post the exclusion zone and inform non-Hazwoper-trained personnel of the:
  - nature of the existing contamination and its locations
  - limitations of their access
  - emergency action plan for the site
- Periodic air monitoring with direct-reading instruments conducted during regulated tasks also should be used to ensure that non-Hazwoper-trained personnel (e.g., in an adjacent area) are not exposed to airborne contaminants.
- When exposure is possible, non-Hazwoper-trained personnel must be removed from the site until it can be demonstrated that there is no longer a potential for exposure to health and safety hazards.
- Remediation treatment system start-ups: Once a treatment system begins to pump and treat contaminated media, the site is, for the purposes of applying the Hazwoper standard, considered a treatment, storage, and disposal facility (TSDF). Therefore, once the system begins operation, only Hazwoper-trained personnel (minimum of 24 hour of training) will be permitted to enter the site. All non-Hazwoper-trained personnel must not enter the TSDF area of the site.

9 Emergency Response Plan

(Reference CH2M HILL, SOP HS-12, *Emergency Response*)

This emergency response plan covers the planned sampling, drilling, and investigation activities for the site. A project-specific Emergency Response Plan has been prepared for operation of the groundwater extraction system.

9.1 Pre-Emergency Planning

The SSC performs the applicable pre-emergency planning tasks before starting field activities and coordinates emergency response with CH2M HILL onsite parties, the facility, and local emergency-service providers as appropriate.

- Review the facility emergency and contingency plans where applicable.
- Determine what onsite communication equipment is available (e.g., two-way radio, air horn).
- Determine what offsite communication equipment is needed (e.g., nearest telephone, cell phone).
- Confirm and post emergency telephone numbers, evacuation routes, assembly areas, and route to hospital; communicate the information to onsite personnel.
- Field Trailers: Post "Exit" signs above exit doors, and post "Fire Extinguisher" signs above locations of extinguishers. Keep areas near exits and extinguishers clear.
- Review changed site conditions, onsite operations, and personnel availability in relation to emergency response procedures.
- Where appropriate and acceptable to the client, inform emergency room and ambulance and emergency response teams of anticipated types of site emergencies.
- Designate one vehicle as the emergency vehicle; place hospital directions and map inside; keep keys in ignition during field activities.
- Inventory and check site emergency equipment, supplies, and potable water.
- Communicate emergency procedures for personnel injury, exposures, fires, explosions, and releases.
- Rehearse the emergency response plan before site activities begin, including driving route to hospital.
- Brief new workers on the emergency response plan.

The SSC will evaluate emergency response actions and initiate appropriate follow-up actions.

9.2 Emergency Equipment and Supplies

The SSC should mark the locations of emergency equipment on the site map and post the map.

Emergency Equipment and Supplies	Location
20 LB (or two 10-lb) fire extinguisher (A, B, and C classes)	Support Zone/Heavy Equipment
First aid kit	Support Zone/Field Vehicle
Eye Wash	Support & Decon Zone/Field Vehicle
Potable water	Support & Decon Zone/Field Vehicle
Bloodborne-pathogen kit	Support Zone/Field Vehicle
Additional equipment (specify):	Cell phone or radio

9.3 Incident Response

In fires, explosions, or chemical releases, actions to be taken include the following:

- Shut down CH2M HILL operations and evacuate the immediate work area.
- Notify appropriate response personnel.
- Account for personnel at the designated assembly area(s).
- Assess the need for site evacuation, and evacuate the site as warranted.

Instead of implementing a work-area evacuation, note that small fires or spills posing minimal safety or health hazards may be controlled.

9.4 Emergency Medical Treatment

The procedures listed below may also be applied to non-emergency incidents. Injuries and illnesses (including overexposure to contaminants) must be reported to Human Resources. If there is doubt about whether medical treatment is necessary, or if the injured person is reluctant to accept medical treatment, contact the CH2M HILL medical consultant. During non-emergencies, follow these procedures as appropriate.

- Notify appropriate emergency response authorities listed in Section 9.8 (e.g., 911).
- The SCC will assume charge during a medical emergency until the ambulance arrives or until the injured person is admitted to the emergency room.
- Prevent further injury.
- Initiate first aid and CPR where feasible.
- Get medical attention immediately.
- Perform decontamination where feasible; lifesaving and first aid or medical treatment take priority.
- Make certain that the injured person is accompanied to the emergency room.
- When contacting the medical consultant, state that the situation is a CH2M HILL matter, and give your name and telephone number, the name of the injured person, the extent of the injury or exposure, and the name and location of the medical facility where the injured person was taken.
- Report incident as outlined in Section 9.7.

9.5 Evacuation

- Evacuation routes and assembly areas (and alternative routes and assembly areas) are specified on the site map.
- Evacuation route(s) and assembly area(s) will be designated by the SSC before work begins.
- Personnel will assemble at the assembly area(s) upon hearing the emergency signal for evacuation.
- The SSC and a "buddy" will remain on the site after the site has been evacuated (if safe) to assist local responders and advise them of the nature and location of the incident.
- The SSC will account for all personnel in the onsite assembly area.
- A designated person will account for personnel at alternate assembly area(s).
- The SSC will write up the incident as soon as possible after it occurs and submit a report to the Corporate Director of Health and Safety.

9.6 Evacuation Signals

Signal	Meaning
Grasping throat with hand	Emergency-help me.
Thumbs up	OK; understood.
Grasping buddy's wrist	Leave area now.
Continuous sounding of horn	Emergency; leave site now.

9.7 Incident Notification and Reporting

- Upon any project incident (fire, spill, injury, near miss, death, etc.), immediately notify the PM and HSM. Call emergency beeper number if HSM is unavailable.
- For CH2M HILL work-related injuries or illnesses, contact and help Human Resources administrator complete an Incident Report Form (IRF). IRF must be completed within 24 hours of incident.
- For CH2M HILL subcontractor incidents, complete the Subcontractor Accident/Illness Report Form and submit to the HSM.
- Notify and submit reports to client as required in contract.

10 Approval

This site-specific Health and Safety Plan has been written for use by CH2M HILL only. CH2M HILL claims no responsibility for its use by others unless that use has been specified and defined in project or contract documents. The plan is written for the specific site conditions, purposes, dates, and personnel specified and must be amended if those conditions change.

10.1 Original Plan

Written By: Paul Bertucci **Date: 11/20/2001**

Approved By: Trish Danby/SAC **Date: November 20, 2001**

10.2 Revisions

Revisions Made By:	**Rick Cavil/SJC**	**Date:**	**Feb. 20, 2004**
Revisions Made By:	**Rick Cavil/SJC**	**Date:**	**04/02/04**
Revisions Made By:	**Rick Cavil/SFO**	**Date:**	**08/20/04**
Revisions Made By:	**Rick Cavil/SFO**	**Date:**	**04/20/05**
Revisions Made By:	**Rick Cavil/BAO**	**Date:**	**07/06/05**
Revisions Made By:	**Rick Cavil/BAO**	**Date:**	**09/19/05**

Revisions to Plan: Hazards updates, section 2.1.15, PPE sections, new task orders, new subs, MSDS,

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Revisions Approved By: Rick Cavil/SJC	**Date: 02/24/2004**
Revisions Approved By: Rick Cavil/SJC	**Date: 04/02/2004**
Revisions Approved By: Rick Cavil/SFO	**Date: 08/20/2004**
Revisions Approved By: Rick Cavil/SFO	**Date: 04/26/2005**
Revisions Approved By: Rick Cavil/BAO	**Date: 07/07/2005**
Revisions Approved By: Rick Cavil/BAO	**Date: 09/19/2005**

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11 Attachments

Attachment 1: **Employee Signoff Form – Field Safety Instructions**
Attachment 2: **Project-Specific Chemical Product Hazard Communication Form**
Attachment 3: **Chemical-Specific Training Form**
Attachment 4: **Emergency Contacts**
Attachment 5: **Project Activity Self-Assessment Checklists**
Attachment 6: **Applicable Material Safety Data Sheets**
Attachment 7: **ATV Safety**
Attachment 8: **Heat Stress Monitoring Log**

EMPLOYEE SIGNOFF FORM

Health and Safety Plan

- The CH2M HILL project employees and subcontractors listed below have been provided with a copy of this HSP, have read and understood it, and agree to abide by its provisions.

Project Name: Topock Groundwater Monitoring and Drilling **Project Number:** varies by task

EMPLOYEE NAME (Please print)	EMPLOYEE SIGNATURE	COMPANY	DATE

Project-Specific Chemical Product Hazard Communication Form

This form must be completed prior to performing activities that expose personnel to hazardous chemicals products. Upon completion of this form, the SSC shall verify that training is provided on the hazards associated with these chemicals and the control measures to be used to prevent exposure to CH2M HILL and subcontractor personnel. Labeling and MSDS systems will also be explained.

Project Name: Topock Groundwater Monitoring and Drilling **Project Number:** 184004.PS.02

MSDSs will be maintained at the following location(s):

Hazardous Chemical Products Inventory

Chemical	Quantity	Location	MSDS Available	Container labels	
				Identity	Hazard
Methane	1 liter, compressed	Support Zone			
Isobutylene	1 liter, compressed	Support Zone			
Pentane	1 liter, compressed	Support Zone			
Hydrochloric acid	< 500 ml	Support Zone / sample bottles			
Nitric acid	< 500 ml	Support Zone / sample bottles			
Sulfuric Acid	< 500 ml	Support Zone / sample bottles			
Sodium hydroxide	< 500 ml	Support Zone / sample bottles			
Methanol	< 1 Gallon	Support/Decon Zones			
Hexane	< 1 Gallon	Support/Decon Zones			
pH buffers	< 500 ml	Support Zone			
MSA Sanitizer	< 1 liter	Support/Decon Zones			
Alconox/Liquinox	< 1liter	Support/Decon Zones			
Tracer dyes	30 lbs.				

Refer to SOP HS-05 *Hazard Communication* for more detailed information.

CH2MHILL

CHEMICAL-SPECIFIC TRAINING FORM

Location:	Project # : 184004.PS.02
HCC:	Trainer:

TRAINING PARTICIPANTS:

NAME	SIGNATURE	NAME	SIGNATURE

REGULATED PRODUCTS/TASKS COVERED BY THIS TRAINING:

The HCC shall use the product MSDS to provide the following information concerning each of the products listed above.

☐ Physical and health hazards

☐ Control measures that can be used to provide protection (including appropriate work practices, emergency procedures, and personal protective equipment to be used)

☐ Methods and observations used to detect the presence or release of the regulated product in the workplace (including periodic monitoring, continuous monitoring devices, visual appearance or odor of regulated product when being released, etc.)

Training participants shall have the opportunity to ask questions concerning these products and, upon completion of this training, will understand the product hazards and appropriate control measures available for their protection.

Copies of MSDSs, chemical inventories, and CH2M HILL's written hazard communication program shall be made available for employee review in the facility/project hazard communication file.

Emergency Contacts – Attachment 4

24-hour CH2M HILL Emergency Beeper – 888/444-1226

Medical Emergency – 911
Colorado River Medical Center
1401 Bailey Ave.
Needles, CA 92363
(760) 326-4531
Ambulance (760) 326-5299

CH2M HILL Medical Consultant
Health Resources
Dr. Jerry H. Berke, M.D., M.P.H.
600 West Cummings Park, Suite 3400
Woburn, MA 01801-6350
1-781-938-4653 1-800-350-4511
(After hours calls will be returned within 20 minutes)

Fire/Spill Emergency – 911
Fire Dept. Emergency (760) 326-2211
Needles Fire Department (760) 326-2833

Corporate Director Health and Safety
Name: Jerry Lyle/BOI
Phone: 208-345-5310 x6244
24-hour emergency beeper: 888-444-1226

Security & Police – 911
Highway Patrol (760) 326-9200
Needles Sheriff (760) 326-9200
Park Moabi Regional Park Ranger (760) 326-3831

Regional Health and Safety Program Manager (RHSPM)
Name: Rick Cavil/BAO
Phone: 510-587-7502 Cell: 408-896-0140

Designated Safety Coordinators (DSC)
Name: John Dallapiazza/DEN 303-771-0900 x65342
Matt Ringier/BAO 510-587-7510
Name: Dave Thomas/BAO 510-587-7529
Name: Jay Piper/LAS cell: 702-525-1137
Name: Allan Erickson/PHX cell:602-312-5895

Regional Human Resources Department
Name: Lisa Covey/SAC
Phone: 916/920-0212 ext. 253

Project Manager
Name: Julie Eakins /BAO
Phone: (510) 587-7647

Corporate Human Resources Department
Name: Pete Hannan/COR
Phone: 303/771-0900

Federal Express Dangerous Goods Shipping
Phone: 800/238-5355
CH2M HILL Emergency Number for Shipping Dangerous Goods
Phone: 800/255-3924

Worker's Compensation:
Contact Regional HR dept. to have form completed or contact Julie Zimmerman after hours: 303/664-3304

Automobile Accidents:
Rental: Carol Dietz/COR 303/713-2757
CH2M HILL owned vehicle:
Zurich Insurance Co. 800/987-3373

Contact the Project Manager. Generally, the Project Manager will contact relevant government agencies.

Facility Alarms: per PG&E facility safety program

Evacuation Assembly Area(s): per PG&E facility manager

Facility/Site Evacuation Route(s): per PG&E facility safety program

Hospital Name/Address:
Colorado River Medical Center
1401 Bailey Avenue, Needles , CA

Hospital Phone #: (760) 326-4531

Directions to Hospital

Include written directions here, and attach or post a highlighted map if needed.
Exit facility & drive northwest approximately 10 miles on Highway 40 west to Needles.
Take the "J" Street exit & turn left onto "J Street.
Go several blocks & turn left onto Bailey Ave.
The Hospital is on the left after the park.

CH2M HILL HEALTH AND SAFETY PLAN

Attachment 5

Project Activity Self-Assessment Checklists

CH2MHILL

H&S Self-Assessment Checklist - DRILLING

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's HSP/FSI.

This checklist is to be used at locations where: 1) CH2M HILL employees are potentially exposed to hazards associated with drilling operations (complete Sections 1 and 3), and/or 2) CH2M HILL oversight of a drilling subcontractor is required (complete entire checklist).

SSC/DSC may consult with drilling subcontractors when completing this checklist, but shall not direct the means and methods of drilling operations nor direct the details of corrective actions. Drilling subcontractors shall determine how to correct deficiencies and we must carefully rely on their expertise. Items considered to be imminently dangerous (possibility of serious injury or death) shall be corrected immediately or all exposed personnel shall be removed from the hazard until corrected.

Completed checklists shall be sent to the health and safety manager for review.

Project Name: _____ Project No.: _____

Location: _____ PM: _____

Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposures to drilling hazards
☐ Evaluate a CH2M HILL subcontractor's compliance with drilling H&S requirements
Subcontractors Name: _____

- Check "Yes" if an assessment item is complete/correct.
- Check "No" if an item is incomplete/deficient. Deficiencies shall be brought to the immediate attention of the drilling subcontractor. Section 3 must be completed for all items checked "No."
- Check "N/A" if an item is not applicable.
- Check "N/O" if an item is applicable but was not observed during the assessment.

Numbers in parentheses indicate where a description of this assessment item can be found in Standard of Practice HS-35.

SECTION 1	Yes	No	N/A	N/O
PERSONNEL SAFE WORK PRACTICES (3.1)				
1. Only authorized personnel operating drill rig	☐	☐	☐	☐
2. Personnel cleared during rig startup	☐	☐	☐	☐
3. Personnel clear of rotating parts	☐	☐	☐	☐
4. Personnel not positioned under hoisted loads	☐	☐	☐	☐
5. Loose clothing and jewelry removed	☐	☐	☐	☐
6. Personnel instructed not to approach equipment that has become electrically energized	☐	☐	☐	☐
7. Smoking is prohibited around drilling operation	☐	☐	☐	☐
8. Personnel wearing appropriate PPE, per HSP/FSI	☐	☐	☐	☐

SECTION 2	Yes	No	N/A	N/O
GENERAL (3.2.1)				
9. Daily safety briefing/meeting conducted with crew	☐	☐	☐	☐
10. Daily inspection of drill rig and equipment conducted before use	☐	☐	☐	☐
DRILL RIG PLACEMENT (3.2.2)				
11. Location of underground utilities identified	☐	☐	☐	☐
12. Safe clearance distance maintained from overhead powerlines	☐	☐	☐	☐
13. Drilling pad established, when necessary	☐	☐	☐	☐
14. Drill rig leveled and stabilized	☐	☐	☐	☐
DRILL RIG TRAVEL (3.2.3)				
15. Rig shut down and mast lowered and secured prior to rig movement	☐	☐	☐	☐
16. Tools and equipment secured prior to rig movement	☐	☐	☐	☐
17. Only personnel seated in cab are riding on rig during movement	☐	☐	☐	☐
18. Safe clearance distance maintained while traveling under overhead powerlines	☐	☐	☐	☐
19. Backup alarm or spotter used when backing rig	☐	☐	☐	☐
DRILL RIG OPERATION (3.2.4)				
20. Kill switch clearly identified and operational	☐	☐	☐	☐
21. All machine guards are in place	☐	☐	☐	☐
22. Rig ropes not wrapped around body parts	☐	☐	☐	☐
23. Pressurized lines and hoses secured from whipping hazards	☐	☐	☐	☐
24. Drill operation stopped during inclement weather	☐	☐	☐	☐
25. Air monitoring conducted per HSP/FSI for hazardous atmospheres	☐	☐	☐	☐
26. Rig placed in neutral when operator not at controls	☐	☐	☐	☐
DRILL RIG MAINTENANCE (3.2.5)				
27. Defective components repaired immediately	☐	☐	☐	☐
28. Lockout/tagout procedures used prior to maintenance	☐	☐	☐	☐
29. Cathead in clean, sound condition	☐	☐	☐	☐
30. Drill rig ropes in clean, sound condition	☐	☐	☐	☐
31. Fall protection used for fall exposures of 6 feet or greater	☐	☐	☐	☐
32. Rig in neutral and augers stopped rotating before cleaning	☐	☐	☐	☐
33. Good housekeeping maintained on and around rig	☐	☐	☐	☐
DRILLING AT HAZARDOUS WASTE SITES (3.2.6)				
34. Waste disposed of according to HSP	☐	☐	☐	☐
35. Appropriate decontamination procedures being followed, per HSP	☐	☐	☐	☐

<u>SECTION 3</u>

Complete this section for all items checked “No” in Sections 1 or 2. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

CH2M HILL HEALTH AND SAFETY PLAN

Attachment 6

Applicable Material Safety Data Sheets

ATV SAFETY

ATVs

All terrain vehicles (ATVs) will generally be operated in accordance with the Contractor's requirements.

- ATVs are special use vehicles with a light engine or electric motor, other than construction equipment, not intended and/or allowed for highway use. ATVs ***do not*** have seat belts or ***do not*** have substantial roll protection (i.e., ROPS, FOPS, steel roll-cage, etc.)

Procedures for ATVs:

ATVs shall not be operated on site unless their use has been justified and approved by the Health and Safety Manager (HSM) and the onsite Designated Safety Coordinator (DSC).

ATVs with fewer than four wheels are not allowed on site.

Operators shall be trained by a competent person or certified by the manufacture prior to receiving revocable authorization to operating ATVs on site. ATVs shall be operated in accordance with the operating manual.

Training will consist of these instructions, audio-visual aids, hands-on training by a competent person, and a demonstration of basic skills. All individuals are required meet all training aspects before ATV use.

ATVs shall remain on flat surfaces at all times and shall not be operated on slopes steeper than a 20% grade.

Daily inspections of vehicles for safety and maintenance will be required. See the onsite DSC for further guidance or use checklists provided.

Operators and passengers on ATVs shall wear:

- wear safety glasses, goggles, or face-shield at all times when moving
- leather boots or shoes
- a ***PROPERLY FITTED*** DOT/ANSI/SNELL approved helmet

ATV Safety

- Speed ***is not*** to exceed 20 mph.
- Make sure the engine is turned OFF before dismounting the vehicle. (tip: put vehicle into neutral before turning engine off).
- Avoid driving over any extremely obstacles (i.e. wood/logs, fences, boulders, etc).
- Remember to shift weight, to inside when turning, forward when going uphill, and back when going down hill. Reduce speed when necessary.
- Watch for pedestrians and other vehicles.
- Only drive during daylight hours.
- Do not carry passengers.
- Do not exceed recommend payload.
- When using trailers, watch your turning radius.
- Slow down before coming to a stop.
- Shut engine down prior to refueling.
- Each driver will have a valid drivers license.
- ATV's must have adequate wheel guarding.

- Absolutely no horseplay or stunting will be tolerated while operating ATV's.
- Stay seated at all times while ATV is in motion.
- Avoid changes gears when throttle is depressed completely. It's best to quickly let up on the throttle before changing gears, and then going back after the gear has switched.
- Report any damage or injuries immediately, and report any hazardous condition that could cause these, including horseplay.
- Keep both hands on the bars when in motion.

CH2M HILL requires that riders read this information as part of the training before using ATVs on this project, and sign-off on the Health and Safety Plan/IIPP (Attachment 1) to show they understand and will comply. All questions should be posed to the Health and Safety Manager and onsite DSC.

Gators

Gators are another vehicle which is used on this site for field access along the river sands and such. All staff are required to review manufacturers operating guidelines and wear seatbelts at all times.

- There is no riding allowed in the back.
- All riders will have a seat with a seatbelt.
- Safety glasses are to be worn when operating.
- Gators are not ATV's and should not be used on steep terrains.