Topock Project Executive Abstract

Document Title: Groundwater Corrective Measure Implementation/Remedial Design (CMI/RD) Work Plan for SWMU 1/AOC 1 and AOC 10, PG&E Topock Compressor Station, Needles, California

Submitting Agency: DTSC, DOI

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PG&E

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☐ Draft ☒ Report ☐ Letter ☐ Memo

☐ Other / Explain:

Action Required:

☐ Information Only ☒ Review & Comment

Return to: DTSC and DOI

By Date: As specified by DTSC and DOI

☐ Other / Explain:

What does this information pertain to?

☐ Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA)/Preliminary Assessment (PA)
☐ RCRA Facility Investigation (RFI)/Remedial Investigation (RI) (including Risk Assessment)
☐ Corrective Measures Study (CMS)/Feasibility Study (FS)
☒ Corrective Measures Implementation (CMI)/Remedial Action
☐ California Environmental Quality Act (CEQA)/Environmental Impact Report (EIR)
☐ Interim Measures
☐ Other / Explain:

Is this a Regulatory Requirement?

☒ Yes
☐ No

If no, why is the document needed?

What is the consequence of NOT doing this item? What is the consequence of DOING this item?

Report is required to be in compliance with the 1996 Corrective Action Consent Agreement

Other Justification/s:

☐ Permit ☐ Other / Explain:

Brief Summary of attached document:

This Corrective Measures Implementation/Remedial Design (CMI/RD) Work Plan presents the framework and schedule for implementation of the selected groundwater remedy for chromium in groundwater at the Pacific Gas and Electric Company (PG&E) Topock Compressor Station (the Compressor Station), Needles, California. The existing chromium contamination in groundwater near the Compressor Station is largely attributable to the historical wastewater discharge from compressor station operations to Bat Cave Wash, designated as Solid Waste Management Unit (SWMU) 1/Area of Concern (AOC) 1, and within the East Ravine, designated as AOC 10. Other cleanup actions that may be required due to other historical operations at the Compressor Station are not within the scope of this document and will be addressed in subsequent documents as appropriate.

This CMI/RD Work Plan presents the framework for implementation of the groundwater remedy and is intended to satisfy both RCRA Corrective Action and CERCLA requirements. After the CMI/RD Work Plan is approved by DTSC and DOI, the remedy design will commence. Construction and start-up of the remedy will occur following completion of the remedy design. Operation and maintenance of the groundwater remedy will continue until the Remedial Action Objectives (RAOs) are achieved. Following attainment of the RAOs, closure and post-closure activities will take place.

Written by: Pacific Gas and Electric Company

Recommendations:

Review the CMI/RD Work Plan and provide comments to DTSC and DOI.

How is this information related to the Final Remedy or Regulatory Requirements:

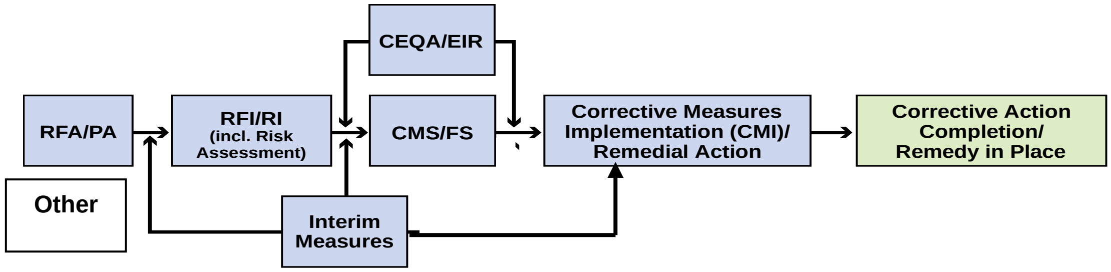
This Work Plan presents the framework and schedule for implementation of the groundwater remedy selected by DTSC and DOI to address chromium contamination in groundwater at SWMU 1/AOC 1 and AOC 10.

Other requirements of this information?

None.

Related Reports and Documents:

Click any boxes in the Regulatory Road Map (below) to be linked to the Documents Library on the DTSC Topock Web Site (www.dtsc-topock.com).



Legend

RFA/PA – RCRA Facility Assessment/Preliminary Assessment

RFI/RI – RCRA Facility Investigation/CERCLA Remedial Investigation (including Risk Assessment)

CMS/FS – RCRA Corrective Measure Study/CERCLA Feasibility Study

CEQA/EIR – California Environmental Quality Act/Environmental Impact Report

Version 9

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May 2, 2011

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Subject: Groundwater Corrective Measure Implementation/Remedial Design Work Plan for SWMU1/AOC1 and AOC10, PG&E Topock Compressor Station, Needles, California *(Document ID: PGE20110502A)*

Dear Mr. Yue and Ms. Innis:

In compliance with the 1996 Corrective Action Consent Agreement between the California Department of Toxic Substances Control (DTSC) and Pacific Gas and Electric Company (PG&E), this letter transmits the *Groundwater Corrective Measure Implementation/Remedial Design Work Plan for SWMU1/AOC1 and AOC10 at PG&E Topock Compressor Station, Needles, California* (CMI/RD Work Plan). This Work Plan presents the framework and schedule for implementation of the groundwater remedy selected by DTSC and the U.S. Department of the Interior (DOI) to address chromium contamination in groundwater at the PG&E Topock Compressor Station.

The 1996 Corrective Action Consent Agreement (Article F, Item 3) also states that "Concurrent with the submission of a CMI Work Plan, Respondent shall submit to the DTSC a Public Involvement Plan in accordance with Attachment 3". Based on DTSC direction, PG&E is not required to submit a separate Public Involvement Plan concurrent with the submission of this CMI/RD Work Plan. It is PG&E's understanding that DTSC will be conducting a review of the agency's public participation information and will determine whether the information meets its current need or an update is required. If DTSC determines that an update to the Public Participation Plan is needed, DTSC will lead the update effort.

Please contact me at (805) 234-2257 if you have any questions or comments regarding this Work Plan.

Sincerely,

Yvonne Meeks

Yvonne Meeks
Topock Project Manager

cc: Karen Baker/DTSC

Groundwater Corrective Measures Implementation/ Remedial Design Work Plan for SWMU 1/AOC 1 and AOC 10

PG&E Topock Compressor Station Needles, California

Prepared for

Pacific Gas and Electric Company

May 2011

Prepared by

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Certification

Groundwater Corrective Measures Implementation/
Remedial Design Work Plan for
SWMU 1/AOC 1 and AOC 10
PG&E Topock Compressor Station
Needles, California

Prepared for
California Department of Toxic Substances Control and
United States Department of the Interior

On behalf of
Pacific Gas and Electric Company

May 2011

This report was prepared under supervision of a California Professional Engineer.

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Acronyms and Abbreviations

μg/L	micrograms per liter
AOC	Area of Concern
APE	Area of Potential Effects
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
BLM	United States Bureau of Land Management
BMP	Best Management Practice
BNSF	Burlington Northern Santa Fe Railroad
BOR	United States Bureau of Reclamation
CACA	Corrective Action Consent Agreement
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
cfs	cubic feet per second
CHPMP	Cultural Historic Property Management Plan
CIMP	Cultural Impact Mitigation Program
CMI	Corrective Measures Implementation
CMP	Compliance Monitoring Program
CMS/FS	corrective measures study/feasibility study
COC	constituent of concern
COPC	constituent of potential concern
Cr(III)	trivalent chromium
Cr(T)	total chromium
Cr(VI)	hexavalent chromium
CRMP	Cultural Resources Management Plan

CTF	Clearinghouse Task Force
DOI	United States Department of Interior
DTSC	California Environmental Protection Agency, Department of Toxic Substances Control
E&E	Ecology and Environment, Inc.
EIR	environmental impact report
ft/ft	feet per foot
gpm	gallons per minute
GWRA	groundwater human health and ecological risk assessment
HMBP	Hazardous Material Business Plan
HNWR	Havasu National Wildlife Refuge
HSP	Health and Safety Plan
HSU	hydrostratigraphic unit
I&C	instrumentation and controls
I-40	Interstate 40
IM	Interim Measure
IRZ	In-situ Reactive Zone
mg/kg	milligrams per kilogram
MMRP	Mitigation Monitoring and Reporting Program
MNA	monitored natural attenuation
NHPA	National Historic Preservation Act
NTH	National Trails Highway
O&M	operation and maintenance
PA	Programmatic Agreement
PAH	polycyclic aromatic hydrocarbon
PBA	Programmatic Biological Agreement
PG&E	Pacific Gas and Electric Company
PMP	Performance Monitoring Program
PP	Proposed Plan
ppb	parts per billion

QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RFA	RCRA Facility Assessment
RFI/RI	RCRA Facility Investigation/Remedial Investigation
ROD	Record of Decision
ROW	right-of-way
SHPO	State Historic Preservation Officer
SOB	Statement of Basis
SOP	standard operating procedure
SWFL	southwestern willow flycatcher
SWMU	Solid Waste Management Unit
SWPPP	Storm Water Pollution Prevention Plan
TDS	total dissolved solids
TLP	Topock Leadership Partnership
TMR	telescopic mesh refinement
TOC	total organic carbon
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
UTL	upper tolerance limit
Water Board	California Regional Water Quality Control Board
WDR	Waste Discharge Requirement

1.0 Introduction

This Corrective Measures Implementation/Remedial Design (CMI/RD) Work Plan presents the framework and schedule for implementation of the selected groundwater remedy for chromium in groundwater at the Pacific Gas and Electric Company (PG&E) Topock Compressor Station (the Compressor Station) in San Bernardino County, California. The existing chromium contamination in groundwater near the Compressor Station is largely attributable to the historical wastewater discharge from Compressor Station operations to Bat Cave Wash, designated as Solid Waste Management Unit (SWMU) 1/Area of Concern (AOC) 1, and within the East Ravine, designated as AOC 10. Other cleanup actions that may be required due to other historical operations at the Compressor Station are not within the scope of this document and will be addressed in subsequent documents as appropriate.

PG&E is implementing the groundwater remedy at the Compressor Station in conformance with the requirements of the Resource Conservation and Recovery Act (RCRA) Corrective Action and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The California Environmental Protection Agency, Department of Toxic Substances Control (DTSC) is the state lead agency overseeing corrective actions at the Compressor Station in accordance with the RCRA Corrective Action. In February 1996, PG&E and DTSC entered into a Corrective Action Consent Agreement (CACA) pursuant to Section 25187 of the California Health and Safety Code (DTSC, 1996). The United States Department of the Interior (DOI) is the lead federal agency overseeing response actions on or emanating from land under its jurisdiction, custody, or control near the Compressor Station pursuant to CERCLA. In July 2005, PG&E and the federal agencies entered into an Administrative Consent Agreement (DOI, 2005).

In a coordinated effort, DOI and the DTSC selected the groundwater remedy to address chromium in groundwater at SWMU 1/AOC 1 and AOC 10. The DOI decision is presented in the Record of Decision (ROD) (DOI, 2010a), and the DTSC decision is presented in a decision package that includes the certification of the Final Environmental Impact Report (EIR), the Final Statement of Basis (SOB), the Statement of Decision, and the Resolution of Approval (DTSC, 2011a).

The action being taken by PG&E to address chromium in groundwater near the Compressor Station is referred to in this work plan as the "remedy," which is intended to be equivalent to the RCRA Corrective Action and CERCLA terminology of "corrective measure," "corrective action," remedial action" or "response action." Furthermore, the action is more specifically defined as the "groundwater remedy" to distinguish it from other future actions that may be selected for the soil media at the Compressor Station.

This work plan describes the framework for activities to be conducted through design, construction, startup, operation, maintenance, monitoring, closure, and post-closure of the groundwater remedy. The following subsections provide project background information, describe the selected remedy and the remedial action objectives (RAOs), and outline the content and organization of this work plan.

1.1 Project Background

The Compressor Station is located adjacent to the Colorado River in eastern San Bernardino County, California, approximately 12 miles southeast of Needles, California, south of Interstate 40 (I-40), in the north end of the Chemehuevi Mountains (Figure 1-1) (all figures are located at the end of this document).

Exhibit 1-1 below illustrates the site cleanup process and the various project phases for the groundwater remedy. Investigative and remedial activities at the Compressor Station date back to the 1980s with the identification of SWMUs through a RCRA Facility Assessment (RFA). To date, major portions of the site RCRA Facility Investigation/Remedial Investigation (RFI/RI) have been completed, an Interim Measure (IM) is being implemented, and a corrective measures study/feasibility study (CMS/FS) for SWMU 1/AOC 1 and AOC 10 has been completed. The status and findings of these activities may be reviewed at the DTSC Topock web site: http://www.dtsc-topock.com.

Key technical documents and other project background information for the various phases of the site cleanup process of the groundwater remedy are described below. Extensive information about the site background, environmental characteristics, and facility infrastructure and performance are provided in the referenced documents. These documents can be accessed and reviewed at http://www.dtsc-topock.com. Relevant information from each of these documents will be used during implementation of the groundwater remedy.

RFI/RI Volume 1—Volume 1 of the RFI/RI Report (CH2M HILL, 2007c) compiled and evaluated information on the Compressor Station operations and history, and included identification and descriptions of the SWMUs, AOCs, and other undesignated areas. Volume 1 of the RFI/RI Report was completed in 2007 and approved later that year by both DTSC and DOI; it identified SWMU 1/AOC 1 (Bat Cave Wash) and AOC 10 (East Ravine) associated with past discharge of wastewater from the Compressor Station. Volume I represented the completion of the RFA/CERCLA Preliminary Assessment project phase.

RFI/RI Volume 2—Volume 2 of the RFI/RI Report (CH2M HILL, 2009a and 2009b) contained information on the hydrogeologic characterization and results of groundwater, surface water, pore water, and river sediment investigations to evaluate and characterize the nature and extent of groundwater contamination resulting from past discharge of wastewater from the Compressor Station. The Volume 2 Report and its addendum were completed in February and June 2009, respectively, and were approved by both DTSC and DOI later in the same year.

Groundwater Risk Assessment (GWRA)—In November 2009, PG&E completed a groundwater risk assessment that evaluated potential risks to human health and ecological receptors associated with groundwater affected by past discharge of wastewater from the Compressor Station (ARCADIS, 2009). The GWRA provided information to assist risk management decision-making about the constituents of concern (COCs) in groundwater and risk-based concentrations of those constituents. Both DTSC and DOI approved the GWRA in December 2009.

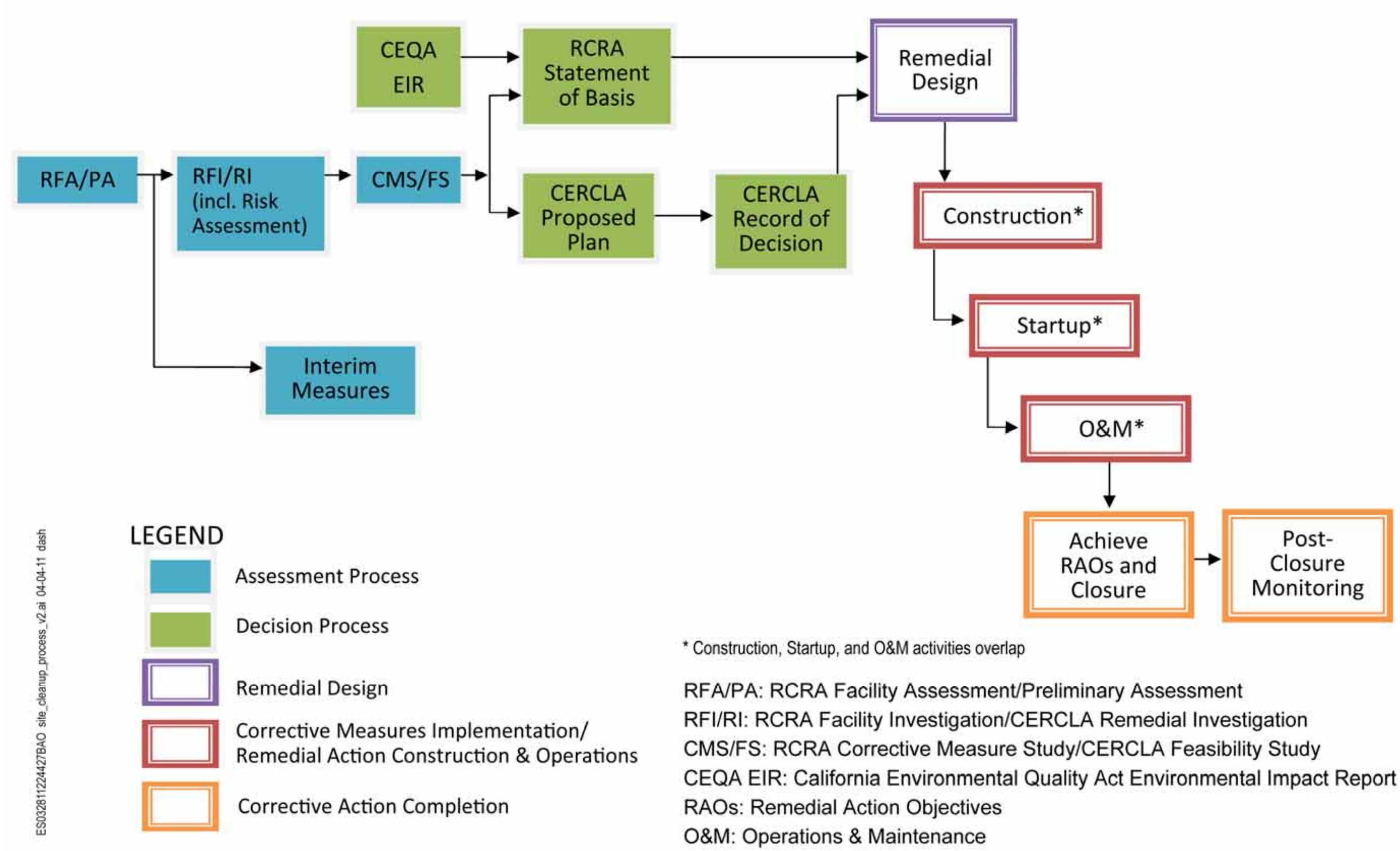

EXHIBIT 1-1
Site Cleanup Process

Corrective Measure Study/Feasibility Study—A CMS/FS for SWMU 1/AOC 1 and AOC 10 was completed in 2009 (CH2M HILL, 2009c). The CMS/FS identified the RAOs for the groundwater remedial action, identified nine remedial alternatives to address the RAOs, and evaluated each of the alternatives against RCRA Corrective Action and CERCLA-defined criteria. As part of the CMS/FS, the DOI identified the Applicable or Relevant and Appropriate Requirements (ARARs) for the action. Based on the evaluation of the alternatives against the criteria, Alternative E, "In-situ Treatment with Fresh Water Flushing," was recommended as the alternative that provided the best balance of advantages and tradeoffs for the remedial action. Both DTSC and DOI approved the CMS/FS in December 2009.

Remedy Decision—The decision process steps identified on Exhibit 1-1 include the California Environmental Quality Act (CEQA) EIR, the RCRA SOB, the CERCLA Proposed Plan (PP), and the CERCLA ROD. The CEQA EIR was completed in January 2011 (AECOM, 2011); it described the existing conditions in the project area, analyzed the potential environmental impacts associated with project implementation, and identified mitigation measures to reduce the level of significance of impacts, where feasible. The SOB, which identified the State's preferred alternative, was published by the DTSC in January 2011 (DTSC, 2011a). The DOI published the PP on June 4, 2010, which presented the DOI's recommendation for the preferred alternative (DOI, 2010b). In January 2011, DOI issued the ROD for the site, which selected the groundwater remedy (DOI, 2010a).

Interim Measure—PG&E has been implementing an IM at the site since March 2004. The purpose of the IM has been to stabilize the groundwater contamination during the time period in which the site characterization, risk assessment, and alternative definition and evaluation steps are completed. The current IM consists of pumping from extraction wells on the Colorado River floodplain, and management of extracted groundwater via treatment in an aboveground treatment plant and onsite injection. Treatment consists of a continuous, multi-step process that involves reduction of hexavalent chromium (Cr[VI]) to trivalent chromium (Cr[III]), precipitation and removal of precipitate solids by clarification and microfiltration, and lowering of naturally occurring total dissolved solids (TDS) using reverse osmosis. Treated groundwater is transported via an aboveground pipeline to an injection well field located approximately 2,000 feet west of the treatment plant and injected into the alluvial aquifer. The IM will be terminated upon the determination by the agencies that it is no longer required.

This CMI/RD Work Plan is intended to satisfy both RCRA Corrective Action and CERCLA requirements (refer to Exhibit 1-1). Construction and start-up of the remedy will occur following completion of the remedy design. Operation and maintenance (O&M) of the groundwater remedy will continue until the RAOs are achieved. Following attainment of the RAOs, closure and post-closure activities will take place. Each of these phases, including the types of activities and required submittals, is discussed in more detail in Chapter 4 of this work plan.

1.2 Selected Groundwater Remedy and Requirements for Implementation

The selected groundwater remedy, as well as key regulatory conditions, goals and requirements for implementation, are described below.

1.2.1 Selected Groundwater Remedy

The selected remedy for chromium in groundwater at SWMU 1/AOC 1 and AOC 10 near the Compressor Station is "Alternative E—In-situ Treatment with Fresh Water Flushing." The groundwater remedy includes:

- Construction of an In-situ Reactive Zone (IRZ) along National Trails Highway (NTH) using a line of wells that may be used as both injection and extraction wells to circulate groundwater and distribute an organic carbon source to promote bacteriological reduction of the Cr(VI) to Cr(III).
- Flushing accomplished through a combination of fresh water injection and injection of carbon-amended water in wells upgradient of the plume.
- Extraction wells near the Colorado River to provide hydraulic capture of the plume, accelerate cleanup of the floodplain, and enhance the flow of contaminated groundwater through the IRZ line.
- Bedrock extraction wells in the eastern (downgradient) end of the East Ravine to provide hydraulic capture of contaminated groundwater in bedrock. Extracted water will be treated and managed using the same active treatment system that will be used to treat and manage contaminated groundwater extracted from the alluvial aquifer.
- Institutional controls to restrict surface land uses and prevent the use of groundwater.
- Monitored natural attenuation (MNA) as a long-term component to address residual Cr(VI) that may remain in recalcitrant portions of the aquifer after in-situ treatment.

As discussed previously, this action will henceforth be referred to as the groundwater remedy, intended to be equivalent to other RCRA Corrective Action and CERCLA terminology of "corrective measure," "corrective action," remedial action," or "response action." The terminology "Alternative E" or "selected remedy" will no longer be used in this document. Additional details of the groundwater remedy are provided in Chapter 2 of this work plan.

Implementation of the groundwater remedy is anticipated to require several decades, the actual time required for implementation depending on a number of factors. The level of project definition will increase during the remedial design phase and will continue to increase during the construction and operation and maintenance phases. This concept of increasing project definition after remedy selection is referenced in U.S. Environmental Protection Agency (USEPA) guidance documents (USEPA, 2000) and illustrated in Exhibit 1-2. The definition of the groundwater remedy presented in Chapter 2 is conceptual (comparable to the level of project definition in the CMS/FS Report). The level of project definition will be further refined in the remedial design documents, and then refined still further during operation and system optimization.

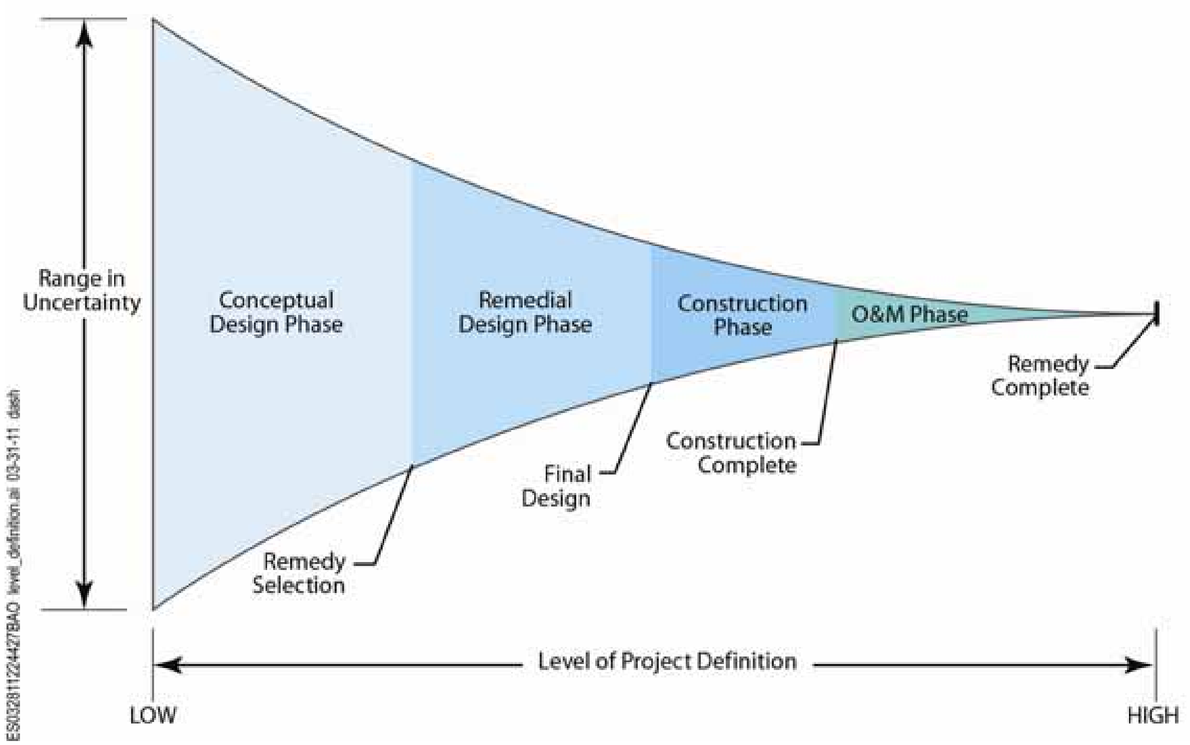

EXHIBIT 1-2
Level of Project Definition Over Time

1.2.2 Remedial Action Objectives

The objectives of the groundwater remedy, or RAOs, are defined based on the conclusions of the GWRA and ARARs identification. The RAOs for the groundwater remedy are to:

1. Prevent ingestion of groundwater as a potable water source having Cr(VI) in excess of the regional background concentration of 32 micrograms per liter (µg/L).
2. Prevent or minimize migration of total chromium (Cr[T]) and Cr(VI) in groundwater to ensure concentrations in surface water do not exceed water quality standards that support the designated beneficial uses of the Colorado River (11 µg/L Cr[VI]).
3. Reduce the mass of Cr(T) and Cr(VI) in groundwater at the site to achieve compliance with ARARs in groundwater. This RAO will be achieved through the cleanup goal of the regional background concentration of 32 µg/L of Cr(VI).
4. Ensure that the geographic location of the target remediation area does not permanently expand following completion of the remedial action.

1.2.3 ARARs

CERCLA remedial actions are required to comply with the substantive requirements of identified ARARs. The DOI identified the ARARs for the groundwater remedy, documented in the ROD (DOI, 2010a). The ARARs include chemical-specific, location-specific, and action-specific ARARs of federal, California, and Arizona laws and regulations. As the RAOs were developed based on the identified chemical-specific ARARs, attaining the RAOs will therefore result in compliance with the chemical-specific ARARs. Until the RAOs are attained, institutional controls to prohibit development of drinking water supply wells within the plume will be maintained. Plans and procedures to comply with the identified location- and action-specific ARARs during construction, operation, monitoring, closure, and post-closure phases of the groundwater remedy will be developed, as discussed in Chapter 4.

In conformance with one of the identified location-specific ARARs, the National Historic Preservation Act (NHPA), the U.S. Bureau of Land Management (BLM), Arizona State Historic Preservation Officer (SHPO), California SHPO, and the Advisory Council on Historic Preservation have completed a Programmatic Agreement (PA) (BLM, 2010) that includes policies and procedures to help guide BLM's planning and decision-making as it affects cultural and historic properties specific to the remedial investigations and groundwater and soil removal and response actions. The Area of Potential Effect (APE) as defined by the PA is shown on Figure 1-2.

1.2.4 CEQA Mitigation Measures

In conformance with CEQA, DTSC prepared an EIR to evaluate the potential environmental effects of actions associated with cleanup of groundwater contamination at the Compressor Station and to identify mitigation measures to reduce the level of significance of impacts, where feasible (AECOM, 2011). The project area as defined by the EIR for evaluation of impacts and assessment of remedy implementation is shown on Figure 1-2. The EIR concluded that implementation of the groundwater remedy would generate significant adverse environmental impacts, and for most potential impacts, the EIR prescribes mitigation capable of reducing these impacts to less-than-significant levels. The EIR included a Mitigation Monitoring and Reporting Program (MMRP) for the groundwater remedy. The mitigation measures were identified for impacts associated with various resources, including aesthetics, air, cultural, biological, geology and soils, hazardous materials, hydrology and water quality, noise, and water supply resources (AECOM, 2011). Plans and procedures to comply with the identified CEQA mitigation measures during construction, operation, monitoring, closure, and post-closure phases of the groundwater remedy will be developed, as discussed in Chapter 4.

1.3 Organization and Content of Work Plan

This work plan presents the framework and schedule for implementation of the groundwater remedy at the Compressor Station. The content of this work plan is guided by the requirements of the RCRA CACA (DTSC, 1996) and CERCLA (40 CFR 300), as well as USEPA guidance for remedial design and remedial action (USEPA, 1995a; 1995b).

Exhibit 1-3 illustrates the specific requirements for this CMI/RD Work Plan as outlined in the CACA and identifies where in this document each of the CACA work plan requirements are included.

EXHIBIT 1-3
CACA Requirements for this CMI/RD Work Plan
Corrective Measures Implementation/Remedial Design Work Plan
PG&E Topock Compressor Station, Needles, California

CMI/RD Work Plan Requirements from the CACA (DTSC, 1996)	Chapter of this CMI/RD Work Plan Where Requirement is Met
Introduction/Purpose	Chapter 1
Media Cleanup Standards	Chapter 1
Conceptual Model of Contaminant Migration	Chapter 3
Description of Corrective Measures	Chapter 2
Data Sufficiency	Chapter 3
Project Management	Chapter 7
Project Schedule	Chapter 4
Design Criteria	Will be provided in future design submittals
Design Basis	Will be provided in future design submittals
Conceptual Process/Schematic Diagrams	Chapter 2
Site Plan Showing Preliminary Plant Layout and/or Treatment Area	Chapter 2
Tables listing number and type of major components with approximate dimensions	Will be provided in future design submittals
Tables giving preliminary mass balances	Will be provided in future design submittals
Site safety and security provisions	Will be provided in future design submittals
Waste management practices	Will be provided in future submittals (O&M Plan, Construction-related Plans)
Required permits	Will be provided in future submittals
Long-lead procurement considerations	Will be provided in future design submittals
Appendices including design data, equations, sample calculations, laboratory or field test results	Will be provided in future design submittals

Source:
California Department of Toxic Substances Control (DTSC). 1996. *Corrective Action Consent Agreement (Revised), Pacific Gas and Electric Company's Topock Compressor Station, Needles, California.* EPA ID No. CAT080011729. February 2.

This CMI/RD Work Plan is organized into the following chapters:

- Chapter 1 provides project background information; introduces the groundwater remedy, as well as key regulatory conditions, goals and requirements for implementation; and provides the organization and content of the work plan.
- Chapter 2 describes the main elements of the remedial action including a description of the main system components and other features, and also includes a discussion of the Corrective Measure/Remedial Action Monitoring Program.
- Chapter 3 provides a summary of existing site conditions and drivers for collection of additional site characteristic information during design, construction, and operation of the groundwater remedy.
- Chapter 4 provides a schedule for the implementation of the groundwater remedy and a list and schedule dates of future submittals required by the regulatory process, including the protocol for review of these documents.
- Chapter 5 describes the existing IM components and discusses considerations for transitioning from the IM to the groundwater remedy, including a potential decision process for the transition.
- Chapter 6 identifies short-term design activities for the groundwater remedy, including a data collection plan for 2011 and groundwater modeling activities.
- Chapter 7 summarizes project organization and management approach for the groundwater remedy.
- Chapter 8 provides reference information for the works cited in this report.

2.0 Groundwater Remedy Components

The groundwater remedy consists of five main components (see Exhibit 2-1). This section describes each of the components and presents a framework for their design and implementation. The design basis and criteria will be provided in future design packages.

This section also describes the supporting facilities and infrastructures for the five main remedy components, to ensure their proper operation. In addition, this section presents the framework for the Corrective Measure/Remedial Action Monitoring Program that will be implemented to evaluate the performance of the groundwater remedy to attain the RAOs and to comply with ARARs.

2.1 Description of Groundwater Remedy Main Components

The following section describes the main components of the groundwater remedy, including the in-situ reduction, fresh water injection, and groundwater extraction systems. Figures 2-1a and 2-1b show the conceptual remedy site plan. Figure 2-2 shows an overall conceptual process flow schematic diagram for the remedy.

Implementation of the groundwater remedy is anticipated to require several decades, the actual time required for implementation depending on a number of factors. The level of project definition will increase during the remedial design phase and will continue to increase during the construction and operation and maintenance phases. Numbers and locations of remedy facilities and operational elements are largely assumptions at this point. It is fully expected that changes to the numbers, locations, methods, and configuration of remedy components will change as the remedy moves through the design, construction, and operational phases. Changes will be made during design, construction, and operation to optimize the remedy to enhance performance to attain the RAOs, provide for adjustments due to field conditions, and comply with location-

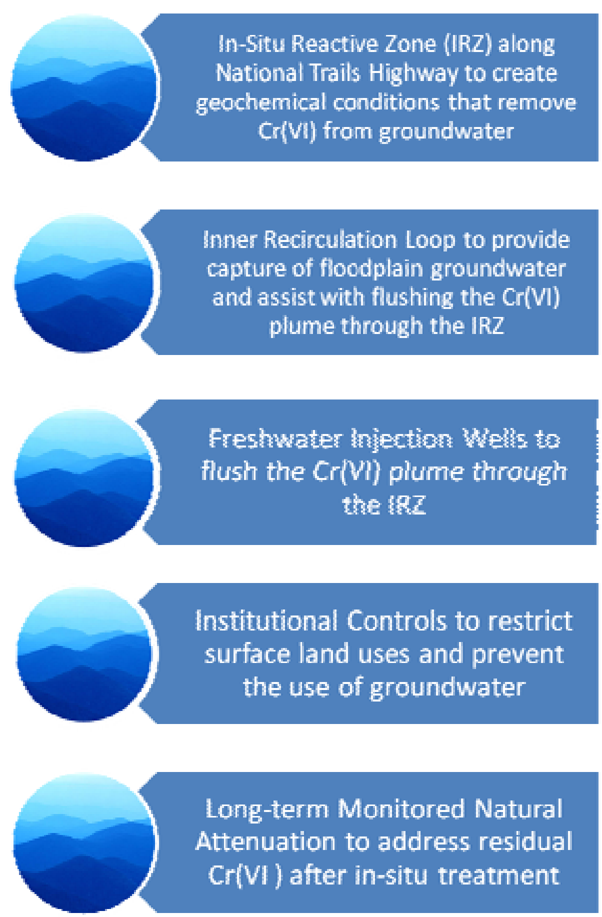

EXHIBIT 2-1
Main Remedy Components

and action-specific ARARs, EIR mitigation measures, and landowner and leaseholder requirements.

2.1.1 In-situ Reactive Zone (IRZ)

The IRZ consists of a line of wells installed along National Trails Highway (NTH) that will be used to create and maintain a permeable barrier in the aquifer where Cr(VI) will be removed from groundwater by conversion to insoluble Cr(III). The IRZ will be established by injecting water containing a degradable source of organic carbon (e.g., ethanol, sodium lactate, or other food-grade carbon compounds) through a line of wells to create a continuous zone of reduced geochemical conditions along NTH. The IRZ wells will operate as either injection or extraction wells to circulate groundwater and distribute the organic carbon source throughout the target treatment zone.

Effective distribution of organic carbon (as measured by total organic carbon [TOC]) is one of the key design criteria for the establishment of the IRZ. Effective distribution of TOC is a function of the following aspects:

- Site geology (including lithology, hydraulic characteristics, structure, and geochemical make-up)
- Groundwater injection volumes and rates
- TOC concentrations
- Groundwater chemistry
- Groundwater flow patterns in the vicinity of the injection well

These aspects will control the radius of influence of an individual IRZ injection well and the resultant number of wells and their relative spacing required to achieve the treatment objectives. Individual IRZ well design is based on the lateral and vertical extents of the contaminant plume. The thickness of the aquifer in the area of the plume ranges from less than 50 feet near the bedrock interface to over 150 feet near NTH (CH2M HILL, 2009c). To adequately distribute TOC through a 100-ft vertical "slice" of the plume requires multiple wells positioned in a nest. Alternatively, an individual well can contain two to three discrete screened intervals separated by blank sections. In either case, injected groundwater may be delivered in alternating depth sequences, or potentially in more than one interval simultaneously.

Solute transport modeling will support the design of the IRZ. The model will establish the number of IRZ wells, the spacing between those wells, injection flow rates, carbon dose rates, as well as the location and flow rates of extraction wells within the line of IRZ wells. The plan for developing the model and modeling efforts is discussed in Section 6.2.

Another important consideration in the IRZ design involves the fate and transport of secondary treatment byproducts (e.g., iron, arsenic, and manganese). Byproduct formation, along with the microbial growth associated with the in-situ process, can negatively influence the performance of the extraction wells and injection wells. Solute transport and geochemical modeling will be used to develop strategies for minimizing generation and migration of byproducts.

IRZ System Footprint

The IRZ line will be located along a portion of NTH, covering a distance approximately 3,000 feet in length. Wells will be installed on one or both sides of the road (possibly extending into the floodplain or areas adjacent to natural gas pipeline corridors northeast of the Topock Compressor Station). Wells and appurtenant infrastructure (e.g., foundations, concrete aprons/skirts, piping, electrical ducts/conduits, etc.) will be installed, to the extent practicable, in areas that have previously been disturbed. Piping will convey groundwater from extraction wells to carbon amendment facilities and back to injection wells. Piping and conduits to provide instrumentation and controls (I&C) and electrical power to the extraction and injection well pumps will be located along NTH. Piping and conduit will be placed into excavated trenches that are backfilled, or will be routed above ground. Spare pipes and conduits may be placed in trenches to minimize the need for excavation in the future.

The IRZ will employ above grade structures with foundations to house major equipment items such as pumps, storage tanks, valves and instrumentation, control panels, and electrical switchgear. In addition, the above grade structures will include a bulk carbon storage tank (or multiple tanks). Tanker truck loading and unloading pads with concrete spill containment will also be constructed. These structures could be located at the MW-20 Bench as this area is easily accessible and is next to the IRZ, minimizing the required distance for piping to and from the extraction and injection wells and operational logistics. In addition, a secondary structure may be installed to the north of the MW-20 Bench to house electrical power and I&C circuits for the northernmost IRZ wells.

IRZ System Details

A conceptual IRZ process flow schematic is illustrated in Figure 2-2. The number of wells, spacing, materials of construction, and design details will be provided in the upcoming design submittals. Well depth will be determined primarily by the depth to bedrock. It is anticipated that the well depths will vary from up to 300 feet below ground surface (bgs) at the north end of the IRZ line (along NTH) to less than 100 feet bgs at the south end. The IRZ wells can be designed with one to three discrete screen intervals targeting specific zones of the water-bearing unit for treatment by the IRZ. The length of each well screen may range from 5 to 50 feet, as a function of the geology and target zone thickness. Specific site geology and groundwater modeling will be used to determine actual well design specifications. The IRZ wells may contain some or all of the following down-hole components:

- Pneumatic packers (location dependent)
- Injection piping
- Valves
- Control and monitoring instrumentation
- Equipment to facilitate batch addition of well maintenance compounds at the well head
- Backflush pump (submersible pump or ejector pump) to facilitate removal of excess biomass, aquifer solids, and/or mineral precipitates and extend the duration of the injection well operation between redevelopment
- Extraction pumps and associated equipment installed in select IRZ wells

Each wellhead will be contained in a vault which is mainly below grade, but may have a portion which is above grade at some locations. The vault will house wellhead piping, fittings, and valves (e.g., control valves, isolation valves, air release valves, vacuum relief valves, etc.). The vaults may also contain I&C devices, including pressure switches, level switches, flow meters and transmitters, level transmitters (for down-hole pressure transducers), and other related devices and support infrastructure. Each well may be connected to a carbon-amended groundwater conveyance header, a spare header, backflush piping, and/or a backflush return header. IRZ wells configured as extraction wells will be connected to a groundwater conveyance header. Each of these headers will run the entire length of the IRZ and will be routed to the IRZ carbon amendment and well maintenance facilities likely located at the MW-20 Bench.

IRZ Carbon Amendment

As indicated above, a series of groundwater pipes will convey groundwater from the extraction well networks to the IRZ carbon amendment system, likely to be located on the MW-20 Bench. Carbon substrate (e.g., ethanol, sodium lactate, or other food-grade carbon source) will be dosed into the extracted groundwater, combined into amended groundwater pipes, and conveyed to the IRZ wells and the carbon amendment injection wells.

Buildings may be used to house the primary carbon dosing, metering, and control equipment; including valves, flow meters, pumps, and ancillary equipment. Carbon substrate dosing pumps will be monitored with metering instruments and controlled to provide target TOC concentrations to the groundwater stream. Pulsing carbon injections, rather than continuous injections, may be employed to distribute the carbon amendment throughout the treatment zone and mitigate excessive localized bio-fouling of the injection well screens. Building design details will be provided in the future design submittals.

The carbon substrate will be maintained onsite in properly sized, secured, and protected storage tanks. A secure and contained loading area will be designed to accommodate transfer of substrate from transportation containers (e.g., semi-trailer tankers) to the storage tanks. Design details of storage tanks and off-loading pads will be provided in the future design submittals.

Well Maintenance

Groundwater injection is expected to be nearly continuous initially; however, injection flow rates may decline as wells clog, increasing injection levels, and reducing the available head for injection. To maintain the performance of the injection wells, the IRZ will be equipped with facilities to provide routine and preventive in-well maintenance, including back-flushing pumps, and chemical addition access piping. The design may incorporate either a submersible pump or a jet ejector pump to facilitate well maintenance activities. Additional conveyance pipes will be included to route the water generated during the maintenance cycle to the MW-20 Bench and/or a separate treatment facility for treatment and removal of solids (see Section 2.2.3).

Buildings may be used to house the well maintenance equipment, including the back-flush recirculation system and a clean-in-place system for the IRZ carbon-amended groundwater pipe (using spare pipes to create a recirculation loop). These buildings may be placed on the

MW-20 Bench near the carbon amendment facilities or at another site. Maintenance system equipment and sizing will be determined during the design process.

IRZ Operation

Injection and extraction rates at each well will vary depending on the aquifer characteristics, biomass, geochemistry, and other factors, but will typically be less than 50 gallons per minute (gpm) per well. Injection at specific wells may be adjusted or discontinued to optimize the IRZ system's operation. Injection and extraction to specific target screen intervals may also be discontinued to optimize the IRZ system's operation. Similarly, the pumping rates from each extraction well will be controllable in order to optimize IRZ system operation. As previously indicated, the number, specifications, and locations of the extraction and injection wells in the IRZ will be determined during the design.

O&M activities for the IRZ line include, but are not limited to, pulsing with carbon amendment, refining the injection and extraction well recirculation system, collecting and analyzing groundwater samples, inspecting equipment, and periodically maintaining or replacing wells when necessary.

2.1.2 Inner Recirculation Loop

The Inner Recirculation Loop system is composed of extraction wells along the bank of the Colorado River (the River Bank extraction wells), extraction wells in the East Ravine area, extraction wells in the Embayment Area, and injection wells in the Upland Area. Extraction downgradient of the IRZ line will serve the purpose of capturing Cr(VI) that was already downgradient of the IRZ line prior to IRZ operation. It will also help draw the chromium plume through the IRZ and draw carbon-amended water from the IRZ line into the floodplain to expand the extent of treatment in the floodplain. Additionally, these extraction wells will provide secondary protection for the Colorado River by controlling the migration of byproducts generated by the IRZ.

River Bank Extraction Wells

The River Bank extraction well network is expected to consist of five or more groundwater extraction wells. Well design details, including materials of construction, will be provided in the upcoming engineering design submittals. Site geology and groundwater modeling will be used to determine actual well design specifications and groundwater yields. Each extraction well may contain some or all of the following down-hole components:

- Electric submersible pump
- Pump discharge piping (e.g., drop tube)
- Valve/fittings to facilitate batch addition of well maintenance reagents at the well head
- Control and monitoring instrumentation

Each wellhead will be contained in a vault which is mainly below grade, but may have a portion which is above grade at some locations. The vault will house wellhead equipment and instruments. Each well will be connected to a groundwater conveyance header that will be routed to the IRZ carbon amendment system, likely located at the MW-20 Bench.

Embayment Extraction Wells

The Embayment Area lies east of the Topock Compressor Station where the alluvial aquifer extends southward following a depression in the bedrock. The Embayment Area will have approximately four groundwater extraction wells. Well design details, including materials of construction, will be provided in the upcoming design submittals. Site geology and groundwater modeling will be used to specify actual well designs, construction, locations, and estimated groundwater yields. Each extraction well may contain some or all of the following down-hole components:

- Electric submersible pump
- Pump discharge piping (e.g., drop tube)
- Valve/fittings to facilitate batch addition of well maintenance reagents at the well head
- Control and monitoring instrumentation

Each wellhead will be contained in a vault which is mainly below grade, but may have a portion which is above grade at some locations. The vault will house wellhead piping, fittings, valves, flow meters and transmitters, and pressure transducers/level transmitters. Each well will be connected to a groundwater conveyance header that will be routed to the IRZ carbon amendment system, likely located at the MW-20 Bench.

East Ravine Extraction Wells

The East Ravine extraction well network is expected to consist of a series of groundwater extraction wells installed in bedrock along the lower (eastern) end of the East Ravine. Site geology and groundwater modeling, coupled with the East Ravine groundwater investigation effort, will be used to determine actual well design specifications and groundwater yields. Each extraction well may contain some or all of the following down-hole components:

- Electric submersible pump
- Pump discharge piping (e.g., drop tube)
- Valve/fittings to facilitate batch addition of well maintenance reagents at the well head
- Control and monitoring instrumentation

Each wellhead will be contained in a vault which is mainly below grade, but may have a portion which is above grade at some locations. The vault will house wellhead piping, fittings, valves, flow meters and transmitters, and pressure transducers/level transmitters. Each well will be connected to a groundwater conveyance header that will be connected to the Embayment extraction well network header.

Carbon-Amended Injection Wells

The Inner Recirculation Loop injection well network is anticipated to consist of four or more wells installed near the western margin of the plume north of I-40. Well design details, including materials of construction, will be provided in the future design packages. Wells may be designed with multiple discrete screened intervals to target specific zones of the water-bearing unit. Site geology and groundwater modeling will be used to determine actual well design specifications. The injection wells may contain some or all of the following down-hole components:

- Pneumatic packer
- Injection piping
- Valves
- Control and monitoring instrumentation
- Valve/ fittings to facilitate batch addition of well maintenance reagent at the well head
- Backflush pump (submersible pump or ejector pump)
- Extraction pumps and associated equipment may be installed in select Inner Loop wells

Each wellhead will be contained in a vault which is mainly below grade, but may have a portion which is above grade at some locations. The vault will house wellhead piping, fittings, and valves. The vaults may also contain I&C devices to optimize well operations. Submersible pumps intended for backflushing may require modification involving removal of their check valves. The modification allows flow back into the well upon turning the pump off, creating a surging action beneficial for well development. Each well will be connected to more than one carbon-amended groundwater conveyance headers. Each of the headers will run the entire length of the Inner Loop and will be routed to the IRZ carbon amendment system, likely located at the MW-20 Bench. The purpose of the spare header is to provide redundancy and flexibility of operation. In addition, the spare header can be employed to facilitate well or pipe cleaning of biological and/or mineral fouling within the primary carbon-amended groundwater header. As described previously, to the extent practicable, this infrastructure will be routed through areas that have been previously disturbed.

O&M activities associated with the Inner Recirculation Loop system include management and adjustment of injection and extraction system flow rates, periodic well maintenance, groundwater sample collection and analysis, management of carbon amendment systems, equipment inspections, and periodic replacement of wells and other structures as needed.

Inner Recirculation Loop Footprint

The locations of the carbon-amended injection wells and River Bank extraction wells are shown in Figure 2-1a. The River Bank extraction wells will be located along the bank of the Colorado River. Carbon-amended groundwater would be injected into a series of wells located west of Bat Cave Wash and north of the Burlington Northern Santa Fe (BNSF) railroad tracks, covering a distance approximately 1,300 feet in length. These injection wells will be located along existing roads and utility corridors, minimizing the disturbance associated with remedial activities.

Recirculation System Details

A conceptual process flow schematic is illustrated in Figure 2-2. Well construction details will be similar to the injection and extraction wells used in the IRZ system, with multiple screens and the potential to target specific vertical intervals for injection and extraction. Well vaults and controls may be similar to those described previously for the IRZ line wells. Groundwater recovered from the River Bank extraction well network will be dosed with carbon at the IRZ carbon amendment system (as described above).

2.1.3 Fresh Water Injection System

Fresh water will be extracted from offsite production well (s) and then injected at several locations beyond the western and northern periphery of the groundwater plume. The primary purpose of the fresh water injection is to assist with flushing the chromium plume through the NTH IRZ and to constrain westward spread of carbon-amended water and in-situ byproducts from the Inner Recirculation Loop.

The fresh water injection system is anticipated to consist of fresh water production well(s), injection wells (four shown in the CMS/FS [CH2M HILL, 2009c]) and piping connecting the production well area to the injection wells. The anticipated capacity of the fresh water injection system is at least 500 gpm. The actual volume of injection water required to accelerate plume movement may be larger or smaller than the currently estimated total of 500 gpm. Groundwater modeling will be used to support the design of the fresh water injection system. The model will verify the number and location of the injection wells, as well as the extraction and injection flow rates. The plan for modeling efforts is discussed in Section 6.2. It is important to note that as the remedy implementation progress, certain components of the fresh water injection system (e.g., sources of fresh water, number and location of injection wells) may need to be adjusted with changing conditions.

Fresh Water Production Well(s)

The CMS/FS considered multiple potential sources of fresh water (production wells in Arizona, production wells in California, and the Colorado River), and multiple conceptual locations were considered for the potential production wells. For the purpose of the forthcoming remedial design, it is proposed that the source of fresh water will be from production well(s) in Arizona. Alternative well locations will be evaluated during the design.

In compliance with EIR mitigation measure CUL-1a-9, in order to minimize environmental impacts and disturbances, priority will be given to previously disturbed areas and to reuse of existing physical improvements when locating new infrastructure including production well(s). To that end, if the use of already existing production well(s) with suitable characteristics (in terms of quality and quantity and infrastructure) is proposed outside of the project area or the APE, an analysis will first be conducted to assess the environmental impacts associated with using the existing wells and whether they would be adequately addressed by the existing EIR mitigation measures, including mitigation measure CUL-1a-9. Additional analyses may be required depending on the results of the first analysis, and before any decision is made on the use of existing production wells outside of the project area or the APE.

Fresh Water Injection Well(s)

There are four conceptual injection well locations as shown on Figure 2-1a. If the injection rates and aquifer properties at any of these locations prove to be different than anticipated, it is possible that more than one injection well may be installed at a single location or additional injection well may be needed at different locations. Each injection well will be similar except for capacity, piping size, and location. Each injection well will consist of a well casing containing a drop pipe, aboveground or submersible pump, backflush discharge pipe, and associated sounding tubes or bubbler lines for measuring water levels. The top of the well casing and associated valves and piping may be contained in a vault which is mainly below grade, but may have a portion which is above grade at some locations. Alternatively, the wells may be completed entirely above ground located inside a structure or fence. A local control panel shaded by a sunscreen will be located nearby.

Fresh Water Injection System Routing

Figures 2-1a and 2-1b present the conceptual routing of the fresh water injection system. Assuming that the fresh water supply is obtained from a well or wells in Arizona, fresh water piping from the production well and instrumentation conduits may follow the alignment of the existing source water piping for the Compressor Station, running parallel to the BNSF railroad track, then crossing underneath the railroad track and under I-40. The pipeline would continue onto the existing arched pipeline bridge (co-owned by El Paso Natural Gas and PG&E) to cross the river. During the design, an evaluation will be conducted to verify/ confirm the feasibility of the river crossing on the arched bridge. A backup option is to install the fresh water pipe under the Colorado River, along the alignment of the existing natural gas pipeline (owned by Transwestern Pipeline) between the railroad bridge and I-40, or to utilize other existing bridges.

After crossing the Colorado River into California, the water pipeline may follow PG&E's natural gas pipeline right-of-way (ROW) along a portion of old Route 66 and PG&E's pipeline ROW road to the existing water tank area of the Compressor Station. Midway along this route, it is likely that the water pipeline would branch to the north to connect to the piping corridor located within NTH and the Topock Compressor Station access road to allow the fresh water system to form a loop. This northern branch would head north on NTH and continue up to the intersection with the IM No. 3 access road, after crossing under I-40 and the BNSF railroad tracks. The line would branch north to serve the northernmost injection well. The main trunk of this northern branch would continue west on the IM No. 3 access road to serve the westernmost well located near the IM No. 3 injection wells. Along this route, another branch will go to the south and west to an injection well located within the I-40 median. Two potential routes have been identified to reach the I-40 median well: both will require directional boring. This branch would also continue south through Bat Cave Wash to connect to the southernmost injection well. The final leg of this loop is a pipeline segment that goes up the existing Bat Cave Wash access road into the Compressor Station. The pipeline would follow the western Compressor Station fence line and then proceed to the east to the water tank area.

Along the pipe route, booster stations may be required to meet the operational requirements. The need for and locations of the booster stations will be evaluated during the design.

Fresh Water Injection System Operation

The fresh water injection system is intended to operate with occasional downtime for maintenance and rehabilitation. The production well or wells is anticipated to operate to supply the necessary injection capacity, with the possibility of connecting to the existing fresh water storage tanks above the Compressor Station. The production well pump could operate less than full time as long as it has sufficient capacity to deliver the needed amount of fresh water during intermittent operation. The production well pump would turn on when the tanks drop to a pre-set level. This level would be above the level required for minimum emergency storage or other Compressor Station requirements. The well(s) would continue pumping until the tanks reached a pre-set level that would correspond to a full tank, just slightly below the emergency tank overflow level. The well(s) will need to be taken out of service for rehabilitation periodically.

Fresh water would flow into the injection wells through a flow control valve, which would maintain a pre-set water level measured in the aquifer. Flow rate, pressure and water level in the well would be monitored locally and transmitted back to the control building. The injection wells would be back-flushed frequently (potentially up to four times per month) to clear well screens and restore permeability. Periodically, the injection wells may go through more extensive cleaning. Valves will be closed to enable the back-flushing to occur without interrupting injection to the other wells. The back-flushed water will be conveyed from the injection wells to a central system by a separate pipeline. Piping design will focus on independent maintenance at each well, covering routine actions like back-flushing, periodic chemical addition and agitation, or more prolonged invasive rehabilitation techniques. Using this approach, other system wells can remain in service during maintenance activities involving individual wells or groups of wells.

Valves will be installed at key locations in the pipe so that pipeline maintenance on the main trunk loop can be conducted while the system remains in service. Pipeline maintenance on some pipe segments may preclude service to just one well during maintenance activities.

The well network will be monitored remotely at one or more control facilities as well as having instruments with local readouts. Potential location for such control facility or facilities include the MW-20 Bench (co-locate with the IRZ control system), the Compressor Station, or a location near the Transwestern Metering Station. Pressure, well level, pump status, and flow data from production and injection wells would be transmitted back to the control facility. Alarms would be triggered by a loss of pressure (potential main break or control valve failure) or a pump failure. In compliance with the EIR mitigation measures, alarms will not be routed through PG&E's existing Compressor Station alarm system.

The water quality of the production well(s) in Arizona may require pH adjustment to prevent potential scaling on injection wells. In that case, a water conditioning facility may be required.

Well Maintenance, Rehabilitation, and Replacement

Over time, well maintenance will be required to prevent progressive loss in specific injectivity and specific capacity. Routine back-flushing will be the primary method of maintaining well performance, but it is anticipated that more extensive redevelopment may be required periodically. Progressive clogging could be related to air entrainment, suspended solids, bacterial growth, or geochemical reactions. In addition to these specific clogging mechanisms, all injection wells remain susceptible to clogging by suspended solids accumulation. Thus, invasive rehabilitation methods will focus on the specific sources of well clogging, along with suspended solids.

Typically rehabilitation consists of superchlorination; acid treatment; swabbing and air lifting; and development pumping. Rehabilitation programs vary and will be tailored to the given well conditions. Some well rehabilitation methods potentially involve the addition of chemicals to a well. Chemicals that are added will be pumped back up to the surface if necessary, followed by treatment and proper management of the removed wastewater. The management of this wastewater stream is discussed in Section 2.2.3.

Older wells may require decommissioning or replacement. Wells will be decommissioned in accordance with the California Department of Water Resources standards. Different well designs may require different approaches to decommissioning. Wells must be properly decommissioned to ensure the protection of groundwater quality by preventing the borehole from being a conduit for (a) the infiltration of surface water to the aquifer or (b) the migration of contaminated groundwater to uncontaminated portions of the aquifer. In addition, wells must be properly decommissioned to eliminate a possible physical hazard to humans and animals.

Wells may also be damaged during flooding or storm events. Wellheads in flood-prone areas will be designed to minimize the possibility of damage due to flooding. Care will be taken to ensure that any damaged wells are properly rehabilitated or replaced in a timely manner to ensure continued operation of the remedy, ensure protection of the groundwater quality, and eliminate hazards to humans and animals.

2.1.4 Institutional Controls (ICs)

Institutional controls are legal and administrative mechanisms used to limit activities on specified property that could interfere with the remedy or the protection of human health and the environment. The ROD stated that the ICs adopted by the selected groundwater remedy for the Topock site are specified in the *BLM Lake Havasu Field Office Resource Management Plan* issued in May 2007 (BLM, 2007) and in the *1994 Lower Colorado River National Wildlife Refuges Comprehensive Management Plan* (U.S. Fish and Wildlife Service [USFWS] and U.S. Bureau of Reclamation [BOR], 1994). These plans restrict surface uses and use of the groundwater. In addition, land use covenants or deed restrictions to prevent groundwater use within the plume until cleanup goals are attained are common ICs that could also be used for the Topock site. Similar ICs or their equivalents could effectively manage risk of exposure by restricting direct human contact with the groundwater plume. However, a restriction on groundwater use alone would not meet long-term cleanup goals. Therefore, an IC is considered a component of the remedial action for risk management in addition to the remedial technologies that comprise the project. It is anticipated that if ICs are implemented in a specific area, most of these controls would remain in place for the duration of the remedy; that is, until the RAOs are achieved.

Where available, the ICs or their equivalents could provide control by: (1) preventing the use of contaminated groundwater within the plume; (2) prohibiting the installation of new large-capacity water supply wells within a specified area; (3) restricting the development/use of the land such that the planned (i.e., build in 2013-2014) remedial structures (wells, pipelines, tanks, etc.) are protected and that PG&E can access, operate and maintain them; and (4) restricting the use/development of the land such that future (i.e., to be built beyond 2014) remedial structures can be built and that PG&E will be allowed to access, operate and maintain them.

Key parameters needed to set up ICs include definition of the area over which the ICs should be applied (e.g., area within which offsite pumping could be a concern), location of remedial facilities, and implementation timing.

2.1.5 Monitored Natural Attenuation (MNA)

MNA is included as a long-term component of the groundwater remedy. MNA relies on natural processes to reduce chemical concentrations and could be utilized in the O&M phase after sufficient data are available to evaluate the effectiveness of the in-situ treatment and the hydraulic containment components.

At the Topock site, attenuation occurs naturally in the fluvial sediments near the Colorado River, where reducing materials in the aquifer chemically and biochemically convert Cr(VI) to low-solubility Cr(III) that precipitates out of solution and binds to the aquifer formation. Reducing conditions have been documented in shallow to mid-depth fluvial wells and sediments near and underlying the river. South of the railroad tracks, these reducing conditions are also encountered in deep wells near and beneath the river. The observed natural reducing conditions are characterized by the presence of organic carbon, dissolved iron, dissolved manganese, and ammonia in groundwater samples. The available data indicate that the fluvial sediments adjacent to and beneath the river have sufficient reducing capacity to reduce all or at least a significant portion of the Cr(VI) plume (CH2M HILL, 2008c; 2009e). The presence of this reducing zone adds an extra layer of protection for the river during the active operation of the remedy, as well as afterwards, in addition to the protections afforded by the final remedy.

2.2 Description of Groundwater Remedy Supporting Features

This section describes additional features of the groundwater remedy that are not aimed specifically at attaining RAOs, but that represent features within the footprint and are needed to ensure proper operation. Further details will be provided in future design packages or documents.

2.2.1 Security and Site Access

In general, the security for remedial facilities located inside the Compressor Station will be provided for by the Compressor Station security system. Remedial facilities located outside of the Compressor Station will be equipped with security features/systems that are consistent with PG&E's current security standards. Such features, as determined necessary and in compliance with project and landowners' requirements, could include, but are not limited to, fencing to protect the equipment and provide safety for personnel and the public; locks to prevent authorized access; security devices and instrumentation; security communication systems; alarms to notify PG&E's security operations; and security cameras. As required by the EIR mitigation measure CUL-1a-3b, a Site Security Plan will be developed as part of the final design with the goal to provide increased observation and reporting of potential intrusions into the project area that may impact significant cultural resources during construction and operation of the final remedy.

To protect the health and safety of personnel, the public, and animals in the surrounding environment, and to ensure non-interference with remedy operations, engineering controls will be used to restrict access to remedial facilities located outside of the Compressor Station. Access to remedial facilities located inside the Compressor Station will be in accordance with established protocols for the facility. Besides consideration for health and safety and remedy operations, another aspect of access is related to preserving Tribal members' access to, and use of, the project area for religious, spiritual, or other cultural purposes. To address this aspect of access, an Access Plan will be developed in the future in coordination with the federal agencies with land management responsibilities in the project area, as required by EIR mitigation measure CUL-1a-2.

In addition, as required by EIR mitigation measures CUL-1a-3c and 3d, an informational kiosk will be installed within Park Moabi that will inform visitors of work activities being done at the project site and specify which parts of the project will be off limits to off-road vehicle usage due to health and safety concerns, and for protection of cultural and biological resources. Signage could also be posted to indicate those parts of the project area that are off limits to off-road vehicle usage to reduce potential damage to environmental resources.

2.2.2 Utilities and Support Facilities

The groundwater remedy will include utility and support facilities necessary to make the remedy effective and safe. Utilities include primarily electrical power, communications systems, I&C systems, and fresh water. For this project, it is anticipated that the City of Needles electric system will supply primary electrical service, and this will be taken from the existing electrical power system, if possible. As the design develops, the required service load will be better defined. Emergency backup generation will be provided to supply power in the event of a service outage. The backup generation may be provided by a stand-alone generator or by tying into the Compressor Station electric system, if excess power is available for this purpose.

Support facilities may include operator's facilities, equipment and materials storage, equipment maintenance and testing areas, office space, bathrooms, waste or refuse containers, and an onsite laboratory.

2.2.3 Management of Remedy Wastewater

The groundwater remedy includes wells that will require maintenance such as back-flushing and rehabilitation. Such maintenance activities will create a wastewater stream that must be managed. Other types of wastewater (smaller volume) will also need to be managed, such as monitoring well sampling purge water, equipment decontamination wastewater, and rainfall that collects in secondary containment. Collectively, these types of wastewater are called remedy wastewater.

It is estimated that 3 to 16 million gallons per year of remedy wastewater will be generated. Well back-flushing is projected to be the largest source of wastewater, followed by well rehabilitation, monitoring well sampling, rainfall, and other sources. The management methods for the remedy wastewater considered in the EIR include onsite management and offsite disposal. Additional information regarding onsite management options is presented below:

- **Transport of Wastewater** – use a combination of trucking and piping. The preferred option is to transport by piping from wells requiring frequent maintenance (injection and IRZ wells) and by trucks from wells that require less frequent maintenance (extraction and monitoring wells) or wells for which transport by pipeline would be problematic. It is envisioned that all piping for remedy wastewater will be laid in parallel, or in a common trench, to the extent practicable, with other piping and conduits.

- **Treatment of Wastewater -** store and treat the wastewater (using fixed and/or mobile units) prior to disposal/reuse. Mobile treatment equipment may be used during well maintenance periodically for filtration, but not for full treatment. The primary reason is that the amount of equipment required for full treatment would exceed the available space in the areas where wells are likely to be installed. Furthermore, using mobile equipment for full treatment could increase the potential for leaks and spills. A fixed treatment system could be in a building shared with other functions required by the remedy, such as onsite laboratory, remedy control center, fresh water conditioning/ treatment, and/or carbon-amendment controls. The treatment of remedy wastewater could involve removal of particulate material, solids dewatering, filtration, and neutralization. Some remedy wastewater could also contain dissolved constituents, such as chromium, iron, manganese, arsenic, and organic carbon. It is not anticipated that these will require removal as disposal/reuse options exist that can receive such water – including water from the carbon-amended injection wells in the plume and the existing Compressor Station evaporation ponds. The fixed treatment system could operate in a continuous or batch mode – this will be determined during detailed design. A conceptual process flow schematic for the remedy wastewater treatment system is shown in Figure 2-3.

- **Disposal/Reuse of Treated Wastewater.** Multiple potential disposal or reuse options are considered so as to provide operational flexibility and avoid hampering operation of the remedy. These options will be further developed during the design process and include:

  1. <u>Reuse by blending with fresh water and use in Compressor Station cooling towers</u>. The cooling towers use fresh water to cool the compressed natural gas. The water is re-circulated in the tower and the volume is reduced through evaporation. Make-up water is added so the cooling demand is met. Water is blown down or discharged from the system to control concentration of salts or other impurities in the circulating water. The blowdown discharges to the existing evaporation ponds through an existing pipeline. This reuse option will require a pipeline to supply treated remedy wastewater to the cooling tower. Treated wastewater with low dissolved and suspended solids concentrations is likely to be desired to prevent scaling or plugging. In addition, as the circulating water is currently treated to prevent fouling and corrosion in the cooling towers, this reuse option will be evaluated/designed to ensure a similar level of protectiveness. The cooling tower water usage between January 2009 and March 2011 ranged from 11 to 110 gpm (using monthly water volumes converted to instantaneous rates).

  2. <u>Discharge to the Compressor Station evaporation ponds, especially for wastewater that contains high TDS or has a high well-plugging potential</u>. The Compressor Station's lined evaporation ponds receive cooling tower blowdown water and evaporate it as part of normal Compressor Station operations. Solids are removed from the ponds periodically. For this option, a pipe supplying treated remedy wastewater would be connected to the cooling tower blowdown discharge system and would be pumped to the ponds through the existing pipeline. The ponds operate under Waste Discharge Requirements (WDRs) issued by the California Regional Water Quality Control Board (Water Board). Excess capacity of the ponds will be evaluated during the design.

3. Discharge to Moabi Regional Park wastewater ponds. The Moabi Regional Park sewage treatment system ponds receive the wastewater from the Moabi Regional Park facilities and Pirate's Cove resort. Four ponds have been constructed, although only one pond appears to be in service at any one time, suggesting that there is significant excess capacity in this system. In this option, treated wastewater would be pumped in a pipeline running along NTH to an outfall directly at the ponds or be connected to another portion of the sewage treatment system. PG&E has not yet evaluated the regulatory or permit requirements of the Moabi Regional Park sewage treatment system, nor is it known at this time if San Bernardino County would accept the wastewater.

4. Reuse by blending with carbon-amended water and injection into amended water injection wells. The carbon-amended injection wells could take remedy wastewater with minimal treatment except for solids removal. This may benefit the remedy in further accelerating the plume movement toward the IRZ line on NTH. However, it is not known how much excess capacity the wells could take without affecting the plume movement. The groundwater modeling being performed will be used as a tool to understand the relative difference in the allowable fresh water and carbon-amended injection rates so that flow ranges can be defined for effective operation. For this option, a pipeline would be constructed to convey treated remedy wastewater to the carbon-amended injection wells.

5. Discharge to an infiltration gallery built in Bat Cave Wash near the Compressor Station. An injection gallery in Bat Cave Wash is another potential method to dispose of treated water. This also has the advantage of accelerating the plume movement toward the IRZ line along NTH. The groundwater modeling being performed will be used to verify the maximum flow to avoid unwanted effects on the plume.

These five options will be further evaluated and additional details on the remedy wastewater management system will be included in the design. The design may include one or more the options listed above.

2.3 Corrective Measure/Remedial Action Monitoring Program

This section provides a discussion of the preliminary framework of the monitoring program for the groundwater remedy. Many of the details of this monitoring program, such as the monitoring well network (i.e., the location, the number, and the design of monitoring wells), will be determined during the design and included in future design submittals and the O&M Plan.

In general, the monitoring program is anticipated to include the following concepts:

- Data will be collected from various media, including groundwater, surface water, and process samples,
- Monitoring wells incorporated into the monitoring program will be a combination of existing monitoring wells and new monitoring wells, and
- The monitoring program will be re-evaluated throughout implementation of the remedy and adjusted as necessary to evaluate expected changes in site conditions.

2.3.1 Monitoring Goals and Objectives

During the RFI/RI stage of the project, groundwater monitoring has been conducted primarily for site characterization to define the nature and extent of contaminants in groundwater. In addition, existing monitoring programs are conducted to evaluate the performance of the IM. With the completion of the RFI/RI and the IM phases of the project, the objectives of the existing monitoring programs at the site will be complete. When the groundwater remedy is implemented, the current groundwater monitoring programs will be replaced by a new Corrective Measure/Remedial Action Monitoring Program with the focus of evaluating the performance of the remedy to attain the RAOs and to comply with ARARs.

Compliance Monitoring During Remedy Implementation

The RAOs for the groundwater remedy, as stated in Section 1.2.2, are:

1. Prevent ingestion of groundwater as a potable water source having Cr(VI) in excess of the regional background concentration of 32 µg/L.
2. Prevent or minimize migration of Cr(T) and Cr(VI) in groundwater to ensure concentrations in surface water do not exceed water quality standards that support the designated beneficial uses of the Colorado River (11 µg/L Cr[VI]).
3. Reduce the mass of Cr(T) and Cr(VI) in groundwater at the site to achieve compliance with ARARs in groundwater. This RAO will be achieved through cleanup goal of regional background of 32 µg/L of Cr(VI).
4. Ensure that the geographic location of the target remediation area does not permanently expand following completion of the remedial action.

Compliance monitoring will focus on confirming that the groundwater remedy is achieving these RAOs. The first RAO, relating to prevention of ingestion of contaminated groundwater, will be met primarily through ICs. Compliance monitoring will primarily be designed to ensure that the groundwater remedy is meeting RAOs 2, 3, and 4, relating to controlling migration and reducing mass to an adequate degree. Compliance monitoring will involve water quality monitoring. While RFI/RI characterization at the site has been focused on both Cr(T) and Cr(VI), future monitoring during the remediation will be focused on Cr(VI).

Outside the perimeter of the plume, water quality monitoring will be implemented to ensure that the target remediation area is not expanding and that in-situ byproducts are being adequately controlled. Water quality monitoring in groundwater outside the plume will focus on analysis for Cr(VI), as well as in-situ byproducts (arsenic and manganese). Concentrations in groundwater outside the plume will be evaluated against background concentrations (32 parts per billion [ppb] for Cr[VI] and 24 ppb for arsenic). Elevated concentrations at established compliance wells will result in contingency activities, such as system modifications. River monitoring may also be conducted to ensure that concentrations remain below numeric surface water quality criteria. Concentrations above water quality criteria attributable to contributions from the Topock site will result in contingency activities, such as system modifications. Most compliance monitoring would likely occur in wells around the perimeter of the plume, particularly along the western and northern margins where the fresh water injection wells are located. Over the expected decades-long O&M period, it is expected that the plume will change in size and shape, and therefore the compliance monitoring program surrounding the plume will be modified accordingly.

Inside the perimeter of the plume, monitoring will be performed to assess the success of the remedy in attaining the RAOs and to update the shape and location of the target remediation area over the O&M period. Inside the plume, the monitoring program is focused on measuring progress towards attainment of RAOs, and therefore will primarily be measuring changes in Cr(VI) concentrations. Because an IC will be in place during the O&M period to prohibit ingestion of groundwater and therefore control risks, it is expected that compliance monitoring inside the perimeter of the plume will be less frequent than monitoring outside the perimeter of the plume, likely on an annual or bi-annual basis. Unlike the areas outside the plume, increases in concentrations inside the plume will not result in contingency activities because of the ICs. The ICs within the area of the plume boundary will remain in place until concentrations in groundwater are shown to have attained the RAOs.

Process Control Monitoring During Remedy Implementation

Process control monitoring is conducted to ensure that the groundwater remedy is functioning as designed. In the vicinity of the IRZ and the carbon-amended injection wells, the geochemistry of the aquifer will be altered to create the reducing conditions that will remove the Cr(VI) from groundwater. The process control monitoring will focus on issues such as ensuring that carbon dosing is sufficient to establish and maintain an effective IRZ, that the production and attenuation of in-situ by-products is occurring as anticipated, and that Cr(VI) is being removed to the extent necessary to meet RAOs.

Much of the process control monitoring for the in-situ remediation systems will involve sampling from wells associated with the IRZ and the carbon-amended water injection wells. Samples would be collected from nearby monitoring wells and possibly from IRZ and carbon-amended water injection wells. In above-ground support systems, process control monitoring mostly involves sampling from pipes and tanks. Tanks, pipes, and pumps are needed to mix the carbon amendment into the water being pumped from the River Bank extraction wells. It is anticipated that some process control sampling would be conducted in the mixing facility to monitor for changes in the quality of the influent water and ensure proper carbon dosing. Other process control monitoring will be performed for influent and/or effluent from a conditioning/treatment facility for fresh water (if any), and influent/effluent from a system to manage wastewater produced by maintenance activities associated with the remedy such as injection well maintenance.

Constituents for process control monitoring will vary depending on design criteria, and results will be evaluated to assess the need for and type of system modifications or adjustments. Frequency of process control monitoring will depend on the system being evaluated; it is expected that more frequent monitoring will be needed during start-up of systems, and frequency of process control monitoring will be reduced or eliminated when the systems are optimized and steady-state conditions result.

Process control monitoring is often implemented using less rigorous analytical methods than compliance monitoring. For example, at the current IM No. 3 treatment plant, process control samples are analyzed in an onsite laboratory. This laboratory provides data of sufficient quality to make the day-to-day decisions needed for process control, but it is not state certified, so most of the data are not useful for compliance purposes. It is anticipated that non-certified lab analysis will also be a component of process control monitoring during the groundwater remedy.

In addition, water level monitoring will also be conducted to confirm adequate gradient control. Although gradient control is not an RAO in itself, maintaining groundwater gradients in certain areas, such as the fresh water injection barrier and the East Ravine extraction wells, will be necessary in order to prevent spreading of the plume and to ultimately achieve RAOs for groundwater quality.

2.3.2 Constituents to be Monitored and Monitoring Frequency

Table 2-1 presents preliminary information about the constituents that would be monitored and the monitoring frequency for different types of monitoring purposes (all tables are presented at the end of this report). Additional details of the monitoring program will be provided in future design submittals and the O&M Plan.

2.3.3 Evolution of Monitoring Programs Over Time

As the groundwater remedy implementation progresses, the chromium plume will diminish and change shape. This will typically result in changes in the monitoring program. Wells that were formerly within the plume boundary may become perimeter wells. Former perimeter wells may be far from the plume and therefore no longer be needed as part of the regular monitoring network. Once the floodplain is clean, it may be possible to turn off the pumping wells near the river and the carbon-amended injection wells. Changes such as this would result in changes in the monitoring program. Eventually, it will be determined that the active part of the remedial action is no longer needed. This may come about when RAOs have been met, or it may be determined that monitored natural attenuation is an appropriate alternative for a small remaining portion of the plume. At this time, the monitoring program would be reconfigured to focus on the areas where the plume remained and the natural attenuation processes that would eventually lead to reaching RAOs.

3.0 Baseline Site Conditions and Plan for Additional Data Collection

This section provides information about site characteristics, sources of information, and additional data and information that may be collected to update and refine the site understanding during groundwater remedy implementation. The additional information will be collected for various reasons such as to further document baseline conditions prior to remedy implementation, provide information as needed for design and construction planning, and provide information to evaluate remedy performance during future operational and closure phases. Additional data collection discussed in this section will be described in more detail in Section 4 and Section 6. Section 4 describes documents to be developed with additional details on the plan and schedule for collection and reporting of additional site condition information. Section 6 discusses plans for short-term data collection activities.

3.1 Hydrogeology and Plume Dimensions

Site hydrogeologic characterization and chromium distribution are discussed below, as well as objectives for collection of supplemental information to refine or update this information during the groundwater remedy design, construction, operation, and post-closure phases.

3.1.1 Site Characteristics

The geologic and hydrogeologic conditions at the site have been characterized through data collected over an approximately 14-year period since the initiation of RFI activities in 1997. The geologic and hydrogeologic conditions of the site described below are discussed in greater detail in the RFI/RI Volume 2 Report (CH2M HILL, 2009a), the Volume 2 Addendum (CH2M HILL, 2009b), the Summary of Findings Associated with the East Ravine Groundwater Investigation included in Appendix A of the CMS/FS (CH2M HILL, 2009c), and ongoing monitoring reports. The following sections summarize information from these reports.

Hydrogeologic Setting

The Topock site is situated in a basin-and-range geologic environment in the Mohave Valley. The Colorado River is the main source of water to this groundwater basin, but at the southern end where the site is located, groundwater is fed by a modest amount of local recharge from mountain runoff. The most prominent geologic structural feature in the study area is a Miocene-age, low-angle normal fault (referred to as a detachment fault) that forms the northern boundary of the Chemehuevi Mountains (Figure 3-1) found to the southeast of the study area. The surface expression of the Chemehuevi detachment fault is evident as a pronounced northeast-southwest lineament that can be traced along the northern boundary of the Chemehuevi Mountains, terminating at the abrupt bend in the Colorado River east of the Compressor Station (Figure 3-1).

The site is located at the southern (downstream) end of the Mohave Valley groundwater basin. On a regional scale, groundwater in the northern and central area of the valley is recharged primarily by the Colorado River, while groundwater discharges back to the river in the southern area, above where the alluvial aquifer thins near the entrance to Topock Gorge. The groundwater directly beneath the Topock site is derived mostly from the relatively small recharge from the nearby mountains. Under natural conditions, groundwater flows from west/southwest to east/northeast across the site. The Colorado River, Topock Marsh, floodplain and other surface features at the Topock site are shown on a 2009 aerial photograph on Figure 3-1. This figure also shows the locations of the PG&E Topock Compressor Station, the current IM groundwater extraction area (MW-20 bench and adjacent floodplain), and the IM No. 3 groundwater treatment facility and associated injection area. Subsurface features including stratigraphy, aquifer dynamics, and river-floodplain communication are presented in a block diagram depicting the central portion of the study area on Figure 3-2.

The Colorado River flows along the eastern and northern boundary of the site and is very dynamic, fluctuating seasonally and daily largely due to upstream flow regulation of water releases primarily at Davis Dam, approximately 33 miles upstream. River levels at the site fluctuate by 2 to 3 feet per day, and flows vary anywhere from 4,000 to 25,000 cubic feet per second (cfs) according to the dam releases, producing a sinusoidal hydrograph each day. Locally, a floodplain borders both sides of the Colorado River, though the river no longer experiences regular spring floods due to flow regulation from upstream dams.

Hydrogeologic Properties

Groundwater occurs in the Tertiary and younger alluvial fan and fluvial deposits. The unconsolidated alluvial and fluvial deposits are underlain by the Miocene Conglomerate and pre-Tertiary metamorphic and igneous bedrock. The bedrock typically has lower permeability; therefore groundwater movement occurs primarily in the overlying unconsolidated deposits. In the Mohave groundwater basin, water-bearing zones may occur locally where bedrock formations are weathered or fractured, although no areas have been identified where saturated bedrock formations are capable of yielding significant quantities of groundwater.

The alluvial aquifer consists of (1) alluvial sands and gravels shed from local mountain chains that ring the valley, and (2) fluvial material deposited by the Colorado River over time. Groundwater occurs under unconfined to semi-confined conditions within the alluvial fan and fluvial sediments beneath most of the site. The alluvial sediments consist primarily of clayey/silty sand and clayey gravel deposits interfingered with more permeable sand and gravel deposits. The alluvial deposits exhibit considerable variability in hydraulic conductivity between fine- and coarse-grained sequences. The fluvial sediments similarly consist of interbedded sand, sandy gravel, and silt/clay.

The water table in the alluvial aquifer is nearly flat and typically equilibrates to an elevation within 2 to 3 feet of the river level. On the basis of the variable topography, the depth to groundwater ranges from as shallow as 5 feet below ground surface (bgs) in floodplain wells next to the river to approximately 170 feet bgs at the upland alluvial terrace areas. The saturated thickness of the alluvial aquifer is about 100 feet in the floodplain and thins to the south, pinching out along the Miocene Conglomerate and bedrock outcrops. In the western and northern portions of the site, where the depth to bedrock increases, the saturated alluvial aquifer is over 200 feet thick.

Hydrogeologic features of the site are summarized below:

- Under ambient conditions in the vicinity of the site, the river recharges groundwater during the higher-flow stages in the spring and summer months, and groundwater discharges to the river during the months of lower river stages in fall and winter. Since 2004, the IM groundwater extraction and treatment system has maintained a consistent, year-round landward gradient in the area where the plume is present in the floodplain.
- Under natural conditions, groundwater flows from west-southwest to east-northeast across the site. Localized areas of northward flow likely occur along the mountain front to the south of the Compressor Station. Gradients are very small due to the limited recharge, with a typical value of 0.0005 foot/foot in the alluvial area. Under average conditions, groundwater velocity in the alluvial aquifer ranges from about 25 to 46 feet/year, according to numerical model estimates. Gradients are upward between bedrock and the overlying alluvial aquifer and typically, but not universally, upward within the alluvial aquifer.
- Investigation and monitoring in the East Ravine area (see Figure 3-1) shows that the groundwater in fractured bedrock is in hydraulic communication with the alluvial aquifer and equilibrates to an approximate elevation similar to the water table in the alluvial aquifer. Compared to the alluvial aquifer, the fractured rock permeabilities are very low, based on well tests in this area.

Chromium Plume Dimensions, December 2010

From the former percolation area in Bat Cave Wash, the wastewater infiltrated into the coarse sand and gravel of the wash bed and infiltrated approximately 75 feet downward through the unsaturated zone to reach groundwater (Figure 3-2). The chromium plume extends from the former percolation bed in Bat Cave Wash approximately 3,000 feet north/northeast to the Colorado River floodplain, along the general direction of groundwater flow. Chromium is present at all depth intervals of the alluvial portion of the aquifer but is generally not present in shallow and middle-depth fluvial wells near the Colorado River where natural reducing conditions predominate and geochemically remove the chromium from groundwater. Elevated concentrations of chromium are also present in wells completed within the shallow portion of the bedrock formations in the East Ravine to the southeast of the Compressor Station.

The chromium plume is defined as that part of the aquifer where Cr(VI) concentrations exceed natural background levels. The calculated statistical upper tolerance limit (UTL) of natural background levels for Cr(VI) in alluvial groundwater, obtained from sampling monitoring and water supply wells surrounding the Topock site, is 31.8 μg/L (CH2M HILL, 2008a), which has been rounded to 32 μg/L for discussion of the extent of impacted groundwater below. The majority of the plume is located in the alluvial aquifer.

Figures 3-3a, 3-3b, and 3-3c illustrate the extent of Cr(VI) contamination in the alluvial aquifer and bedrock formations based on groundwater sample results for 125 wells sampled during the fourth quarter of 2010. The fourth quarter 2010 sampling event is the largest event conducted on an annual frequency.

In each of the alluvial aquifer depth monitoring zones,[1] the location of Cr(VI) concentrations for groundwater greater than or equal to 32 µg/L follows Bat Cave Wash northward approximately 3,000 feet from the Compressor Station. For the shallow and mid-depth zones, the 32 µg/L concentration limit extends west of Bat Cave Wash and into the western portion of the floodplain. In the deep zone of the alluvial aquifer, the 32 µg/L concentration limit extends further west of Bat Cave Wash and further eastward into the floodplain in the area between monitoring wells MW-27 and MW-28. Since startup of the IM groundwater extraction in 2004, concentration trends in floodplain wells have been generally stable or decreasing (CH2M HILL, 2011a).

During the 2009 East Ravine Groundwater Investigation, Cr(VI) was also found within the Miocene conglomerate and pre-Tertiary metadiorite bedrock formations east and southeast of the Topock Compressor Station. Additional investigations are being conducted in 2011 to determine the extent of Cr(VI) in bedrock. Due to the low porosity of the bedrock formations, the mass of Cr(VI) in bedrock represents a very small fraction of the total plume mass.

Based on current site characterization data, the existing dimensions of the plume exceeding natural background levels underlie an area that is approximately 175 acres, including alluvium and bedrock. The depth to groundwater in the area of the plume ranges from approximately 28 to over 135 feet bgs, and the thickness of the aquifer in the area of the plume ranges from less than 50 feet near the bedrock interface to over 150 feet near National Trails Highway. The volume of contaminated groundwater in the alluvial aquifer is currently estimated to be approximately 1.50 billion gallons (approximately 4,600 acre-feet).This estimate was calculated by interpolating the Cr(VI) concentration contours over the model grid, integrating the concentration intervals over the depth of each zone (shallow, middle, and deep), and applying a total porosity of 35 percent for the alluvial/fluvial portion of the plume (from measurements of site materials presented in Ecology and Environment, Inc. [E&E], 2004). Although the effective porosity of the bedrock formations is uncertain, it will be low compared to that of the alluvial/fluvial aquifer; therefore, the volume of the plume within the East Ravine bedrock formations is believed to represent less than 1 percent of the total plume and is not included in this volume estimate.

3.1.2 Additional Data During Groundwater Remedy Design

Characterization of the alluvial aquifer is generally considered sufficient for remedy design; however, the bedrock aquifer is not as well characterized as the alluvial aquifer, so additional groundwater monitoring and investigation of the bedrock is being conducted in 2011. The current groundwater monitoring program will continue through the remedy design phase and until the Corrective Measure/Remedial Action Monitoring Program begins. Data for the monitoring programs listed below will be used to update the baseline December 2010 chromium plume maps presented in Figures 3-3a through c, and to establish baseline levels of in-situ byproducts (arsenic and manganese) and constituents of potential concern (COPCs) (selenium, nitrate, and molybdenum) prior to remedy implementation.

[1] The depth zones are primarily defined based on the relative depth and position of screen intervals within the Alluvial Aquifer; however, there are no aquitards separating the zones.

The results of the investigation in the bedrock formations of the East Ravine will be used during the remedial design for chromium present in bedrock formations in this area. Data for the investigation beneath the Topock Compressor Station will be incorporated into remedy design for source area remediation. These programs are summarized in the following subsections.

Current Groundwater, Surface Water, Compliance and Performance Monitoring Programs

The current groundwater and surface water monitoring programs will continue through the remedy design phase and/or until the Corrective Measure/ Remedial Action Monitoring Program for the groundwater remedy is initiated. The current groundwater and surface water monitoring programs are defined in the Fourth Quarter 2010 and Annual IM Performance Monitoring and Site-Wide Groundwater and Surface Monitoring Report (CH2M HILL, 2011a) and the Second Half 2010 Semiannual Groundwater Monitoring Report for the Compliance Monitoring Program (CH2M HILL, 2011b).

The current groundwater and surface water monitoring programs are used to evaluate changes to site conditions as defined in the RFI/RI, and to evaluate performance of the Interim Measure. Data collected in the current groundwater and surface water monitoring programs which may be used in remedy design include:

- Water level data collection with pressure transducers for gradient analysis.
- Surface and groundwater sample collection for Cr(T) and Cr(VI).
- Groundwater sample collection for general water quality (alkalinity, TDS, sulfate, and chloride); stable isotopes of oxygen; in-situ byproducts (arsenic and manganese); and selenium, molybdenum and nitrate, which were identified as COPCs during the RFI/RI investigation.

Data for the monitoring programs listed below will be used to update the baseline December 2010 chromium plume maps presented in Figures 3-3a through c, and to establish baseline levels of in-situ byproducts (arsenic and manganese), and COPCs (selenium, nitrate, and molybdenum) prior to remedy implementation.

Current East Ravine and Topock Compressor Station Groundwater Investigation

A Work Plan Addendum describing the planned additional investigation activities and estimated timeline to collect information to enhance the understanding of groundwater contamination in the East Ravine bedrock area and to evaluate the nature and extent of potential groundwater contamination beneath the Topock Compressor Station was submitted to DTSC on December 31, 2010 (CH2M HILL, 2010a). East Ravine investigation activities in 2011 will include well construction, hydraulic testing, and soil and groundwater sample collection and analysis. Data collected during the East Ravine investigation in 2011 will be used to update the hydrogeologic site characteristics and plume dimensions described in Section 3.1.1 and will be incorporated into the groundwater remedy design, as appropriate.

3.1.3 Additional Data During Groundwater Remedy Construction

During the initial construction of the groundwater remedy, wells will be installed in some areas where there are currently few or no existing wells. The hydrogeologic characterization and plume dimensions described in Section 3.1.1 are based on the data set as of December 2010; installation of wells in areas of the site where there are few or no existing wells, such as to the north and west of the interpreted plume boundary, will be used to confirm and/or update the hydrogeologic site characterization following their construction. Information to be collected from these wells will include geologic logging, depth to groundwater, analytical constituent concentrations, and possibly aquifer properties. Depending on actual measured results from wells installed during construction, modifications may be made to groundwater remedy component design to maximize the remedy effectiveness.

3.1.4 Additional Data During Groundwater Remedy Operation and Closure

Following groundwater remedy construction and start-up, additional site characterization information will be collected on an ongoing basis through the operation and maintenance phase, and during post-closure monitoring. The plume dimensions described in Section 3.1.1 are expected to change and diminish during the operation of the groundwater remedy, and data will be collected to evaluate trends and monitor plume characteristics over time. Additional data during the operation phase will be obtained through the following:

- Implementation of the Corrective Measure/Remedial Action Monitoring Program. Data collected from monitoring wells for RAO attainment during operation will be for Cr(VI) concentrations. In addition, measurements of groundwater quality for in-situ treatment byproducts and hydraulic measurements will be collected in select areas of the site. DTSC and DOI have also directed that nitrate, molybdenum, and selenium concentrations in groundwater be monitored periodically throughout the remediation process. The Corrective Measure/Remedial Action Monitoring Program will be reviewed on a periodic basis (e.g., annually) and modified over the anticipated decades-long operation and maintenance period as appropriate.

- Installation of additional groundwater monitoring wells and remediation wells during operations, closure, and post-closure phases of the groundwater remedy. Additional site characterization information from wells installed during operation, closure, and post-closure phases will include geologic logging, depth to groundwater, analytical constituent concentrations, and possibly aquifer properties. The additional characterization information to be collected from these wells will be used to confirm and/or update site characterization information to evaluate performance of the groundwater remedy to attain RAOs, and optimize system performance.

Following attainment of RAOs, system operations will cease and a long-term monitoring program will be implemented. Additional characterization information to be collected during the post-closure long term monitoring will focus on groundwater quality through sampling of monitoring wells.

3.2 Other Existing Site Conditions Affecting Design, Construction, Operation

Existing site conditions anticipated to affect design, construction, and operation of the groundwater remedy are discussed below, as well as objectives for collection of supplemental information to refine or update the site condition information in the short term or long term. Additional data needs may be identified during the design and during the step of securing access and approvals; for example, site-specific geotechnical data may be required for securing encroachment permits. Section 4 describes documents to be developed with additional details on the plan and schedule for collection and reporting of additional site condition information. Section 6 discusses plans for short-term data collection activities.

3.2.1 Land Ownership, Disturbance, and Development

Land in most areas where groundwater remedial facilities will be constructed is not owned or leased by PG&E, and there are existing land uses and infrastructure in the project area that will be important factors influencing the design, construction, operation and closure of the groundwater remedy. The groundwater remedy will be developed in coordination with landowners and to minimize effects on existing structures such as roads, pipelines, and rail lines. PG&E will focus construction in previously disturbed areas, so further definition of those areas will occur early in the design phase. In addition, the groundwater remedy will use power, water, and other infrastructure that will be coordinated with existing development in the area.

Existing Information

Land overlying and near the plume is owned and/or managed by a number of government and private entities including PG&E, BOR (managed by BLM), USFWS (managing the Havasu National Wildlife Refuge [HNWR]), San Bernardino County, BNSF Railroad, Fort Mojave Indian Tribe, and the Southern California Metropolitan Water District. In addition, several other entities have easements and/or rights-of-way including the California Department of Transportation, Southern California Gas Company, Transwestern Pipeline Company, Mojave Pipeline Company, PG&E, City of Needles Electric, Southwest Gas Corporation, and Frontier Communications. Landowners/leaseholders in Arizona where pipelines for fresh water may be located include El Paso National Gas Company, BNSF Railroad, Arizona Department of Transportation, Mohave County, and private property owners. Ownership of land beneath the Colorado River includes the California State Lands Commission and the Arizona State Lands Department.

Sources of information on site development, disturbance, and existing above-ground infrastructure include aerial photographic surveys, Compressor Station information, and visual surveys of above-ground infrastructure. Existing infrastructure at the site includes the Topock Compressor Station and its associated ponds; Interstate 40; the BNSF Railroad; subsurface utilities including six natural gas transmission pipelines and potable water pipelines; overhead electric lines; railroad, pipeline and freeway bridges over the Colorado River; the Moabi Regional Park and its associated ponds; PG&E’s remedial infrastructure including IM facilities and monitoring facilities; NTH, Route 66, and other county roads and various unnamed access roads; the Topock Marina; and other nearby houses, mobile homes, and commercial structures.

Additional Land Ownership, Disturbance and Development Information During Design

Additional information will be collected during groundwater remedy design to refine existing information. Activities during design include preparation of a disturbance map, conduct of aerial photographic surveys, and preparation of an inventory of existing infrastructure.

Land owners and leaseholders will have to grant permission to access their property for construction and operation of groundwater remedy facilities or equipment. Each entity will establish its own process, whether it be an encroachment permit, easement, right-of-way, or other type of access. PG&E will contact affected entities to establish the requirements and complete the appropriate process. Depending on the specific requirements of the agreements, there may be the need for additional information such as title searches or property boundary surveying and staking.

In conformance with EIR mitigation measure CUL-1a-9, an aerial map of disturbed areas will be prepared to guide project design; this map will also document pre-construction baseline site conditions. The map will be prepared using aerial photographs supplemented by visual surveys to identify areas outside of documented archaeological site boundaries that have experienced ground disturbance in the last 50 years.

It is anticipated that groundwater remedy infrastructure, primarily pipeline corridors, will cross existing natural gas pipelines, I-40 and other existing roads, and the railroad line, among others. To more precisely define existing infrastructure, and to define pre-construction site conditions, an aerial photographic survey of the site will also be performed during the design phase. Additionally, the identification of underground utilities will be performed during design. Information on the aerial survey and underground utilities locating work is included in Section 6. The underground utilities locating work will involve non-intrusive methods using geophysical instruments such as magnetometers or ground-penetrating radar.

In addition to identifying ownership, location, and depth of existing infrastructure, additional information will be collected about its usability relative to the infrastructure for the groundwater remedy. This information will be gathered through meetings, document review, and site visits. It will include information about the existing Compressor Station fresh water supply system, cooling water system, evaporation ponds, electrical power supply, and existing utilities or infrastructure, including those owned by other entities. Existing infrastructure that could interact with the groundwater remedy construction or operation will be investigated to an extent such that it can be incorporated into the design. Examples of the existing infrastructure evaluation are as follows:

- PG&E will evaluate the ability (structural and physical space capacity) of the arched pipeline bridge to accommodate a pipe to bring fresh water from water supply well(s) in Arizona. If the bridge does not have sufficient capacity, then an alternate route crossing the Colorado River would be designed. This decision could potentially trigger additional data needs to support design.

- The groundwater remedy will require electrical power during construction and operation. The amount necessary for construction will be calculated as part of the design. Then, an appropriate source for electrical power will be selected and the supplier contacted to enable a power service to be established. For this project, it is anticipated that the City of Needles electric system will supply primary electrical service, and this will be taken from the existing electrical power system, if possible. As the design develops, the required service load will be better defined. Emergency backup generation will be provided to supply power in the event of a service outage. The backup generation may be provided by a stand-alone generator or by tying into the Compressor Station electric system, if excess power is available for this use.

- Water will be required during groundwater remedy construction for activities such as dust suppression. This water will be supplied by the Compressor Station fresh water storage tanks, and details regarding connection to these tanks will be explored during the design.
- Wastewater will be generated by the groundwater remedy, such as by maintenance of various types of wells. Additional information will be gathered during the design phase on capacities of various disposal/reuse options for treated wastewater, such as capacity of existing evaporation ponds on an average basis and annual basis, to determine if the ponds have adequate capacity for some or all of the wastewater generated. Section 2.2.3 describes the options to be evaluated during the design.

3.2.2 Topography and Surface Geology

Surface conditions and topography have a significant effect on project implementation. For example, variation in surface elevations will require installing air release valves from pipes and may require grading for storm water drainage in select areas. Infrastructure locations may be adjusted to avoid steep areas.

Existing Information

Existing topography and surface geology information is contained in the RFI/RI Volume 2 report and its Addendum (CH2M HILL, 2009a and 2009b) and CMS/FS (CH2M HILL, 2009c) reports. Existing topography information is based on data and contours from topographic surveys of monitoring wells and select infrastructure and property boundaries within the site area, published data from the U.S. Geological Survey (USGS), and aerial surveys. The generalized surface geologic map in the RFI/RI was compiled from literature sources including Metzger and Loetz (1973), John (1987), Howard et al. (1997), and PG&E historic reports.

The site is located in the southern portion of the Mohave Valley, north of the Chemehuevi Mountains, and south and west of the Colorado River floodplain. Overlying the plume, topography ranges from approximately 455 feet above mean sea level at the Colorado River floodplain to approximately 600 to 650 feet above mean sea level at the Compressor Station.

The site consists of a series of terraces divided by dry desert washes. The terraces are considerably eroded with very steep slopes. The Compressor Station is located on a prominent alluvial terrace. Overlying the plume, the largest incised channel is Bat Cave Wash, a north-south dry wash that bisects the plume. Bat Cave Wash flows on the surface only intermittently (as an ephemeral stream) following intense rainfall events and extends to the Colorado River.

Additional Topographic Information During Design

For the purposes of the remedial design, 1-foot topographic contours are required. Data at this level of detail exist in some portions of the site; however, much of the existing topographic information is 5- or 10-foot contours.

Additional topographic survey data will be collected during the design phase in areas of the site anticipated for remedial facilities. The planned area for the topographic survey is presented in Chapter 6 (Figure 6-1). Topographic surveying will be accomplished by aerial photogrammetry supplemented by ground surveying. The ground surveying will be used to locate existing features such as roads and utilities, well heads, manholes, utility poles, valves, pipe inverts, drainage flowlines, drain inlets, edge of pavement, etc.

The survey will be incorporated into the drawings, so these details can be incorporated into design items such as pipe networks, utility connections, utility crossings, earthworks quantities, grading, and drainage. An additional outcome of the survey is an updated aerial photo that can also be used for the ongoing investigation, site reconnaissance, and reporting activities being conducted through the remedial design phase.

Additional information on surface geology is not expected to be required for remedial design. The primary remedial design interface with the surface geologic mapping is the intersection of proposed subsurface infrastructure (pipeline trenches) in areas of surface bedrock (Miocene Conglomerate or Pre-Tertiary). Construction of pipeline trenches through this material will require procedures to be documented in the Construction/Remedial Action Work Plan, or alternatively relocating pipeline corridors to avoid bedrock outcrops or construct the pipelines aboveground similar to existing gas and fresh water pipes.

3.2.3 Background Soil Concentrations

Background concentrations of inorganics and polycyclic aromatic hydrocarbons (PAHs) in soil near planned groundwater remedial infrastructure have been defined through the RFI/FI soil investigations, as well as other baseline studies. Background concentrations in soils established through these efforts will be considered baseline conditions for areas near groundwater remedy infrastructure at the time of construction.

Background concentrations of inorganics and PAHs in soil for geologic units near the Topock Compressor Station are defined in the Topock Revised Final Soil Background Investigation report (CH2M HILL, 2009d) and the Soil Investigation Part A Phase 1 Data Gaps Evaluation Report (CH2M HILL, 2010b). Baseline concentrations of metals in floodplain deposits are defined in the Baseline Soil Sampling report for the PE-1 Pipeline, IM No. 3 (CH2M HILL, 2008b). A total chromium value of 31 milligrams per kilogram (mg/kg) in soil has been used for guiding remedial facility closure on the MW-20 bench (PG&E, 2005).

No additional investigations are planned to determine naturally-occurring background concentrations of metals and other inorganic compounds in soil in the immediate vicinity of groundwater remedy infrastructure (such as tanks or pipelines for contaminated groundwater or treatment chemicals) at the time of construction. Background concentrations of metals in soil near remedial infrastructure in Arizona have not been defined through site-specific studies, because groundwater remedial infrastructure in Arizona is anticipated to be limited to wells and pipelines for fresh water. As some infrastructure for the groundwater remedy will likely be located within or near soils investigation areas within the Topock Compressor Station, Bat Cave Wash, or the East Ravine, additional soil samples will be collected from those areas as part of the RFI/RI and, potentially, soil remediation activities. Future soil restoration in those areas associated with closure of groundwater facilities (e.g., pipelines) would meet any future soil cleanup concentrations that may be established for those areas.

3.2.4 Soil Contamination Areas

PG&E is performing an RFI/RI for soil in areas near the Compressor Station. Investigations are being performed to collect data to meet defined data quality objectives to complete the soil RFI/RI, soil risk assessment, and soil CMS/FS. Groundwater remedy infrastructure, such as pipeline corridors, is likely to be constructed within or near soil investigation areas inside the fenceline of the Compressor Station, and within or near soil investigation areas outside the fenceline of the Compressor Station such as Bat Cave Wash, East Ravine, and in the vicinity of AOC 11 and AOC 12.

Existing Information

Existing information on soil investigation areas is contained in documents including the Draft RFI/RI Soil Investigation Work Plan Part A (CH2M HILL, 2006), Draft RFI/RI Soil Investigation Work Plan Part B (CH2M HILL, 2007a), Soil Investigation Part A Phase 1 Data Gaps Evaluation Report (CH2M HILL, 2010), and the Implementation Report for the Time-Critical Removal Action at AOC 4 (CH2M HILL, 2011d). Existing information includes sample locations, sample depths, and analytical concentrations of organic and inorganic constituents, as well as descriptions of previous soil removal activities.

Coordination of RFI/RI Soil Investigation with Remedy Design and Construction

Additional soil investigation is planned to supplement the existing information to complete the RFI/RI Volume 3. Additional soil investigation is planned at seven investigation areas outside the Compressor Station fenceline, and at twenty-five investigation areas inside the Compressor Station fenceline. The planned additional investigation activities primarily involve collection of soil samples for laboratory analysis of inorganic and organic constituents.

The additional soil investigations are independent of design activities for the groundwater remedy; however, as soil investigation data become available they will be used to guide and inform groundwater remedy design and construction in the vicinity of these areas. Where appropriate—considering timing, efficiency and protectiveness—construction of groundwater remedy facilities will be coordinated with soil investigation and remediation activities. For example:

- Groundwater remedy infrastructure may be relocated to avoid the soil contaminated areas.
- Where groundwater remedy facilities will intersect with soil contamination areas, the Construction/Remedial Action Work Plan will describe appropriate procedures to address health and safety, soils management, erosion and dust control during groundwater remedy construction.
- Where appropriate, timing and scope of soil investigation activities will be coordinated to minimize interference with remedy implementation.

- Access restrictions established to protect groundwater remedy infrastructure will consider the need to access soil investigation areas for additional investigation or remediation.
- Removal actions for soil contamination, if any, may be combined with groundwater remedy construction to minimize multiple soil disturbances for both groundwater remedy construction and soil remediation.

3.2.5 Surface Water and Wetlands

Surface water and wetlands occur in areas near the groundwater remedy infrastructure and will affect design, construction, and implementation.

Existing Information

Existing information on surface water and wetlands has been obtained through various studies and surveys as documented in the RFI/RI Volume 2 Report (CH2M HILL, 2009a and 2009b), the Biological Resources Survey Report for the APE (CH2M HILL, 2005), the Reconnaissance Biological Resources Survey in Three Areas Outside of the APE (CH2M HILL, 2010c), and the Biological Survey in Three Areas Outside of the APE (CH2M HILL, 2010d).

The primary surface water feature is the Colorado River. The flow of the Colorado River is dynamic and fluctuates daily and seasonally as a result of BOR's power and water delivery schedule. The flow of the Colorado River at Topock is regulated by BOR, primarily by the controlled release of water from Davis Dam on Lake Mohave approximately 33 miles upstream. River levels at the site fluctuate by 2 to 3 feet per day, and flows vary anywhere from 4,000 to 25,000 cubic feet per second according to the dam releases. The Colorado River channel ranges from approximately 600 to 700 feet wide in the area upstream of the railroad bridge crossing at Topock. In 2005, the river depths ranged from 4 to 12 feet on two cross-river transects measured at and north of the I-40 bridge.

The Colorado River is a major source of water for irrigation, drinking, and other uses by humans and wildlife. The closest downstream supply intake is located approximately 21 river miles downstream of the railroad bridge over the Colorado River. The Colorado River also supports recreational uses of swimming, boating, and fishing, and serves as an aquatic habitat that supports various plant and wildlife species, including threatened or endangered species. Extensive monitoring of Colorado River surface water quality has been performed in the vicinity of the site. Surface water samples collected within the river near the site, both before and after implementation of the IM, show concentrations less than the federal water quality criteria for Cr(VI) (CH2M HILL, 2009a); the Final Human and Ecological Risk Assessment of Groundwater Impacted by Activities at SWMU 1/ AOC 1 and SWMU 2 concluded that the potential transport of constituents in groundwater to the Colorado River represents an insignificant transport pathway (ARCADIS, 2009). Routine surface water monitoring has continued since completion of the RFI/RI.

Bat Cave Wash is a north-south incised channel bisecting the plume that flows only infrequently (as an ephemeral stream) following intense rainfall events. The wash is dry throughout most of the year. Other surface water features near the site include the Park Moabi inlet/slough, the Topock Marsh, and several other dry wash drainages.

Groundwater remedy infrastructure is anticipated to be constructed near or intersecting with waters of the U.S. or identified wetlands at the pipeline crossing over the Colorado River, the pipelines in Bat Cave Wash, and the River Bank extraction wells.

Additional Information During Design, Construction, and Operation

Additional information will be collected during the design phase of the groundwater remedy to more specifically define the ordinary high water mark of the Colorado River and the location of jurisdictional waters and wetlands. Also, throughout the design, construction, and operation period, PG&E will continue to monitor surface water quality in the Colorado River.

A map of the ordinary high water mark along the bank of the Colorado River will be prepared during design to update the 2005 identification, and to the extent necessary, the 2010 identification. EIR mitigation measure AES-2 requires a minimum setback of 20 feet from the ordinary high water mark for construction of remedial facilities. The map of the ordinary high water mark will be used to guide the remedial design in these areas.

In addition, field verification of the jurisdictional waters and wetlands will be conducted by a qualified wetlands biologist during the design phase to update the 2005 identification and to the extent necessary, the 2010 identification of waters of United States in the areas where remedial facilities will be located. Verification of the jurisdictional waters and wetlands will be performed to guide remedial infrastructure design and construction to comply with EIR mitigation measure BIO-1 and the substantive requirements of the Clean Water Act that prohibit discharge of dredged or fill material in the defined waterways unless there is no practicable alternative that would have less adverse impact.

Additionally, PG&E will continue routine monitoring of surface water quality for chromium and potentially other analytical parameters in the Colorado River throughout the design, construction, and operation periods of the groundwater remedy.

3.2.6 Vegetation Conditions

Construction of groundwater remedy infrastructure may remove or displace vegetation in some areas. Certain EIR mitigation measures require preservation of mature and/or indigenous plants, and additional information is needed to identify these plants. In addition, following construction of wells in the floodplain, floodplain areas disturbed for construction will be revegetated, and additional information on existing floodplain vegetation will be used to guide the scope of the floodplain revegetation efforts.

Existing Information

Plant communities at the site have been identified through surveys as documented in the Biological Resources Survey Report for the APE (CH2M HILL, 2005), the PBA for Remedial and Investigative Actions at Topock (CH2M HILL, 2007b), the Reconnaissance Biological Resources Survey in Three Areas Outside of the APE (CH2M HILL, 2010c), and the Biological Survey in Three Areas Outside of the APE (CH2M, HILL, 2010d). Plant communities include creosote bush scrub in most upland terrestrial areas of the site, arrow weed and salt cedar in floodplain areas (both east and west) of the Colorado River, wetland areas within the Colorado River floodplain near the I-40 bridge and the Topock Marsh, and mesquite/palo verde in Bat Cave Wash and other washes.

Additional Information During Design

Additional vegetation community identification will be performed to guide design activities, in conformance with EIR mitigation measures.

EIR mitigation measure CUL-1a-5 requires that PG&E avoid, protect, and encourage the natural regeneration of identified indigenous plants of traditional cultural significance. To guide the design, construction and operation of the groundwater remedy, a qualified botanist will survey the areas where remedial facilities could be located to identify whether the identified plants may be present.

EIR mitigation measures AES-1a and AES-2b requires the protection of mature plant specimens in select locations (EIR Key Views 5 and 11) (AECOM, 2011) during construction, operation, and decommissioning of the groundwater remedy. To guide the design and construction, a qualified ecologist or biologist will identify and map existing mature plants in the areas where remedial facilities could be constructed in these EIR Key Views.

EIR mitigation measures AES 1b and AES-2c require the revegetation of disturbed areas within the riparian vegetation along the Colorado River, concurrent with construction. Additional information on existing floodplain vegetation will be collected during preparation of the revegetation plans to guide the scope of the floodplain revegetation efforts.

3.2.7 Listed and Protected Species

Federally-listed wildlife species have the potential to be located in the project area. These species include the desert tortoise (*Gopherus agassizii*) that may occur in creosote bush scrub habitat; the southwestern willow flycatcher (SWFL) (*Empidonax traillii extimus*) that has been documented as nesting in tamarisk thickets near watercourses, including the Colorado River; and fish species that may occur within the Colorado River near the site, including bonytail chub *(Gila elegans)*, Colorado pikeminnow *(Ptychocheilus lucius)*, and the razorback sucker *(Xyrauchen texanus)*. Designated critical habitat for the bonytail chub is the Colorado River and the 100-year floodplain.

Existing Information

Information on listed and protected species has been collected through literature searches and reconnaissance surveys; information is contained in the Biological Resources Survey Report for the APE (CH2M HILL, 2005), the PBA for Remedial and Investigative Actions (CH2M HILL, 2007b), the Reconnaissance Biological Resources Survey in Three Areas Outside of the APE (CH2M HILL, 2010c), and the Biological Survey in Three Areas Outside of the APE (CH2M, HILL, 2010d). In addition, PG&E has performed surveys for desert tortoise and flycatcher since 2005. Five years of annual protocol surveys for the desert tortoise completed between 2005 and 2009 resulted in an absence of tortoise sightings (PG&E, 2010); six years of annual protocol surveys for the SWFL surveys have identified no nesting pairs and only occasional transient SWFL sightings (PG&E, 2010; Garcia and Associates, 2010).

Additional Information During Construction

Pre-construction surveys for listed and protected species will be conducted in order to comply with requirements of the Federal Endangered Species Act and the Migratory Bird

Treaty Act, as well as EIR mitigation measures Bio-2a and Bio-2b. These surveys will determine if listed or protected species are present in the project area and whether additional protective measures (e.g., avoidance buffers) will be required during construction.

3.2.8 Cultural Resources

Cultural resources occur in areas near the groundwater remedy infrastructure and will affect design, construction, and implementation.

Existing Information

Cultural resources surveys of the project area are summarized in the reports *Archaeological and Historical Investigations, Third Addendum: Survey of the Original and Expanded APE for Topock Compressor Station Site Vicinity* (Applied Earthworks, 2007), *Archaeological and Historical Investigations for the PG&E Compressor Station, Addendum 8: Survey of Additional Areas Outside the Expanded Area of Potential Effects* (Applied Earthworks, 2010a), and *Archaeological and Historical Investigations for the PG&E Compressor Station, Addendum 9: Survey Within the Fence Line of the Topock Compressor Station* (Applied Earthworks, 2010b). National Register of Historic Places-eligible and listed sites within or immediately adjacent to the project area include CA-SBR-219: Topock Maze Loci A–C; CA-SBR-2910H: Historic Route 66 and portions of the National Old Trails Road; CA-SBR-6693H: Atlantic and Pacific Railroad Company rail line; and CA-SBR-1170: consisting of numerous lithic artifacts, stone tools, and features such as an aboriginal trail.

Additional Information During Design and Construction

Additional information will be collected during the design and construction phases of the groundwater remedy in accordance with EIR mitigation measures, including the following:

- The EIR mitigation measure CUL-3 requires that a paleontological investigation be conducted to refine the potential impacts on unique paleontological resources within the final design area.
- The EIR mitigation measure CUL-1b/c2 requires that a cultural resources study be conducted that may include a geoarchaeological investigation and/or non-destructive remote-sensing surveys of potentially disturbed areas to determine if a potential exists for buried historical and archaeological resources.
- The EIR mitigation measure CUL-1a-3a requires inspections of identified historical resources.

Information collected during these studies, investigations and inspections, in conjunction with existing information, will be used to guide design and construction of the groundwater remedy and will be incorporated into cultural resource documents discussed in Chapter 4. In addition, information may need to be collected to support or satisfy the PA reporting requirements. Also, depending on the design, additional supporting data may be needed.

4.0 Schedule and Future Documents

The implementation of the groundwater remedy consists of several phases, including design, construction, O&M, closure, post-closure, and decommissioning of remedial facilities. Exhibit 4-1 illustrates the project implementation phases. Multiple activities and documents will occur during each phase of the project and any one phase may overlap with other phases of the project; for example, some parts of the remedy may be in start-up while other parts are under construction. Implementation of the groundwater remedy is anticipated to require several decades, the actual time required for implementation depending on a number of factors. Figure 4-1 shows the current implementation schedule for the initial design and construction phases of the groundwater remedy. Construction of the final groundwater remedy is currently scheduled to take place from January 2013 through June 2014. Initial start-up of the system is expected to occur in November 2013. At this early stage of project implementation, a timeline for the latter phases of the project is not meaningful. As work progresses, the implementation schedule will be updated, expanded, and incorporated into future submittals.

A number of different requirements (driven by the CACA, CERCLA, EIR mitigation measures, ARARs, and PG&E's Settlement Agreement with the Fort Mojave Indian Tribe [Settlement Agreement] [PG&E, 2006]) govern the implementation of this complex project, which mandates documents to be produced in various phases of implementation. Tables 4-1 and 4-2 summarize the documents and their contents, as required by the CACA and CERCLA, respectively. The EIR MMRP (Table 5-1 of the EIR) and the PA also both mandate various documents be prepared and implemented (see Table 4-3). Compliance with substantive requirements of other ARARs will be addressed through similar documentation.

Coordination between these requirements would be beneficial to ensure clarity, harmony, and unification in implementation, while fulfilling all requirements. There are overlaps between these requirements and discrepancies in the reporting timing. Opportunity exists for a document strategy that maximizes efficiency via combining and packaging information together where it makes sense to avoid duplication and/or to facilitate tracking of information and requirements by stakeholders, interested tribes, and regulatory agencies (e.g., package information so as to reduce the number of stand-alone supporting documents that would require separate tracking). The following sections present a proposed document "road map" to accomplish the above.

4.1 Overview of Document Road Map

Table 4-3 presents the overall road map of key documents to be produced in various implementation phases, from design through decommissioning (*note that at this early stage in the project, future documents that are related to approvals, access, substantive requirements that are normally contained in permits are not yet known with specificity).*

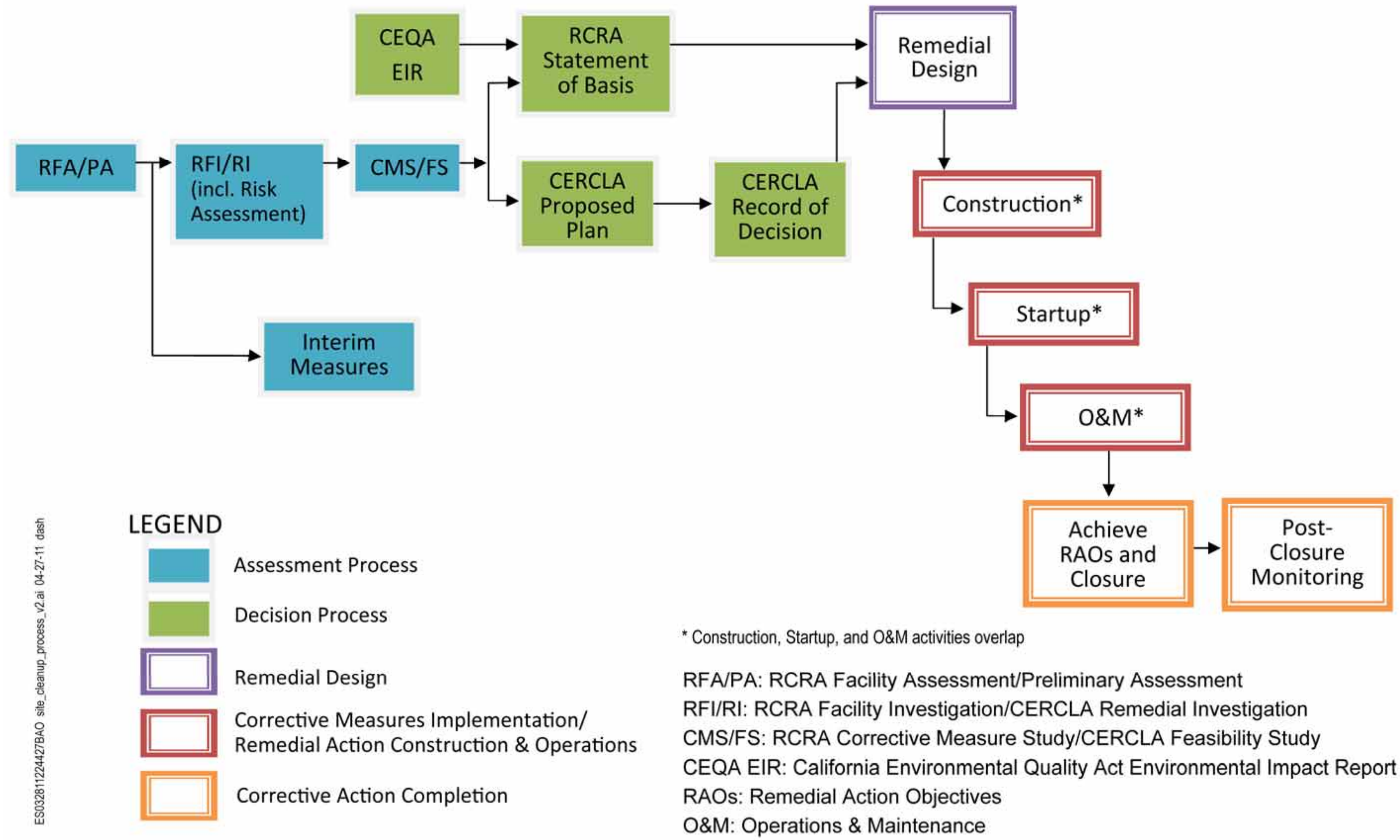

EXHIBIT 4-1
Site Cleanup Process

Where documents are proposed to be combined or packaged together, a footnote is provided in Table 4-3 to indicate the original documents. The following guidelines were used in packaging information:

- When documents have a similar mission and have enough similarity in contents, and are on a similar timeline, they represent good candidates for a combined/unified document. Examples include: (1) the CACA-required Construction Work Plan and the CERCLA-required Remedial Action Work Plan, and (2) the EIR-required Plan for Decommissioning and Removal of IM No. 3 facility and Site Restoration and the PA-required Plan for Decommissioning, Removal, and Restoration of IM No. 3.
- When documents appear to have a similar mission and enough similarity in contents, but the timeline is uncertain, they represent good candidates for coordination. An example is the EIR-required Access Plan and the PA-required Tribal Access Plan. The schedule for the Access Plan will be available after coordination with BLM.
- To the extent practicable and sensible, supporting documents will be packaged with the documents that rely upon the supporting conclusions. For example, various EIR-required documents for design (e.g., aerial map of disturbance, map of mature plant species, etc.) will be packaged with the design submittals, where possible. Likewise, the EIR-required documents for construction will be packaged with the Construction/ Remedial Action Work Plan.
- Since the groundwater remedy is a CERCLA response action, activities conducted onsite are covered under the permit exemption codified in Section 121(e)(1) of CERCLA. While the permit exemption applies to the administrative or procedural elements (e.g., preparing and submitting permit applications), the substantive requirements of ARARs remain. Substantive information that might otherwise be included in a permit application to a state or local agency will instead be incorporated into design, construction, and operating plans submitted to DTSC and DOI. For example, best management practices (BMPs) for control of storm water pollutants during construction would be incorporated into the Construction/Remedial Action Work Plan submitted to DTSC and DOI in lieu of preparing a separate Construction Storm Water Pollution Prevention Plan (SWPPP) for compliance with the Clean Water Act and general permitting requirements of the State Water Resources Control Board.
- When there is a discrepancy in the reporting timing, an efficient path forward is proposed. For example, the EIR MMRP requires that the Security Plan, the Access Plan, the Communications Log, and the Workers Cultural Sensitivity Education Training be developed as part of this CMI/RD Work Plan. It was later clarified by the agency that the CMI/RD Work Plan will provide a framework and schedule for development of these future plans. A proposed path forward for each plan is described below.

A discussion of contents for select documents is provided in the sections below.

Due to the large number of requirements driven by the EIR MMRP, Table 4-4 was prepared to ensure completeness and fulfillment of all requirements. Table 4-4 maps each mitigation measure to a future document which is intended to satisfy the measure. A mapping of substantive requirements of ARARs to a future document will be prepared during the design, as identified.

4.2 Schedule of Key Documents During Design Phase

Table 4-3 lists the key documents to be produced during each phase of the project from design to decommissioning. Table 4-5 presents a more detailed view of the contents of selected key technical documents to be produced during the design phase, which includes:

- Design submittals (Preliminary, Intermediate, and Final)
- O&M Plan
- Construction/Remedial Action Work Plan

To make information/requirements tracking efficient, several supporting or EIR-required documents are planned to be either submitted concurrently with the key documents identified above or included in the key documents. The current schedule for these documents is shown in Figure 4-1. As work progresses from preliminary design to final design to construction, the level of remedy details increases and the level of uncertainty decreases. Below is a description of other required key documents.

4.2.1 Cultural and Historical Resources Related Documents

1. Cultural Impact Mitigation Program (CIMP) — The EIR mitigation measure CUL-1a-8 requires that a CIMP be developed in coordination with Interested Tribes and the federal agencies with land management responsibilities in the project area (e.g., BLM and USFWS) in accordance with the PA. The CIMP will be submitted with the final design for DTSC's review and approval. The CIMP will include an appendix that contains the Plan for Decommissioning, Removal, and Restoration of the IM No. 3 Facility. The plan will address which parts of the IM No. 3 infrastructure will be re-used by the groundwater remedy as well as the decommissioning of the IM No. 3 treatment plant and other infrastructure. The IM No. 3 treatment plant and any other IM No. 3 infrastructure that is not incorporated into the remedial action are expected to be decommissioned following determination that the facilities are not needed to meet RAOs.

2. Access Plan — As required by the EIR mitigation measure CUL-1a-2, the goal of the Access Plan is to preserve Tribal members' access to, and use of, the project area for religious, spiritual, or other cultural purposes. A similar Tribal Access Plan is required by the PA (Stipulation IC). BLM and PG&E are coordinating on the preparation of a combined plan that satisfies both requirements. A schedule will be established as part of the coordination.

3. Aerial Map of Disturbed Areas — The EIR mitigation measure CUL-1a-9 requires that during selection of the design and specific locations for physical remediation facilities, PG&E will, in communication with the Interested Tribes (and subject to their review), and to the maximum extent feasible, as determined by DTSC, give: (1) priority to previously disturbed areas for the placement of new physical improvements; and (2) priority to re-use of existing physical improvements, such as (but not limited to) wells and pipelines, but not including IM No. 3 facilities. "Disturbed" areas in this context means those areas outside of documented archaeological site boundaries that have experienced ground disturbance in the last 50 years. An aerial map of these disturbed areas will be prepared to guide project design.

4. EIR Mitigation Measures Compliance Report — Communications and outreach are key elements in all phases of project implementation. The EIR MMRP mandates various outreach efforts and periodic reporting of specific items (such as human-caused disturbance to project facilities and activities under the grant program). To make information and requirements tracking efficient, one quarterly report will be prepared to comply with all reporting requirements, including:

   - CUL-1a-8a (protocols for continued communication, quarterly and annual)
   - CUL-1a-2 (communication log)
   - CUL-1a-3b (report of human caused disturbance to project facilities)
   - CUL-1a-11 (annual report of activities under the grant program)

   Exhibit 4-2 presents a report template. The report will be submitted to DTSC quarterly during design and construction, and annually during project operations. The report will also document the project's compliance with other EIR mitigation measures during the reporting period, such as issues, if any, and resolutions noted by the designated Disturbance Coordinators for noise and vibration (NOISE-1b and NOISE-2d).

5. Annual Cultural Resources Monitoring Report — The EIR mitigation measure CUL-1a-3a requires yearly inspections (or less frequently upon approval by DTSC) of identified historical resources, including inspections of the Topock Cultural Area, to determine if substantial adverse changes have occurred relative to the condition of the historical resources during the past year or prior to the implementation of the project. Information from the inspections will be incorporated into the Annual Cultural Resources Monitoring Reports, required by the Cultural Resources Management Plan (CRMP) (until the Cultural Historic Property Management Plan (CHPMP) is in place).

6. Cultural Resources Study/Geoarchaeological Investigation Report — The EIR mitigation measure CUL-1b/c2 requires that a cultural resources study be conducted to assess the potential for the construction, operation, or decommissioning of specific proposed improvements to result in significant impacts on identified historically significant resources. This may include a geoarchaeological investigation and/or non-destructive remote-sensing surveys of potentially disturbed areas to determine if a potential exists for buried historical and archaeological resources. The study report will be submitted to DTSC for review and evaluation to determine if existing mitigation measures are appropriate.

7. Cultural Resources Treatment Plan (if needed) — In compliance with the EIR mitigation measure CUL-1b/c-3, if the cultural resources study determines that the construction of physical improvements would result in significant impacts on identified historically significant resources, and avoidance of the resource is not feasible, a treatment plan will be prepared, in communication with Interested Tribes, that identifies measures to reduce these impacts.

PG&E Topock Compressor Station Groundwater Remediation Project
EIR Mitigation Measures Compliance Report
[Indicate Reporting Period]

1. Introduction

In compliance with the EIR mitigation measures CUL-1a-8a (protocols for continued communication), CUL-1a-2 (communication logs), CUL-1a-3b (report of human caused disturbances), and CUL-1a-11 (annual report of activities under grant program), this quarterly report summarizes the outreach efforts/communications between PG&E and the Tribes during the design and construction of the groundwater remedy. This quarterly report also documents the project's compliance with other EIR mitigation measures during the reporting period, including issues and resolutions, if any, noted by the designated Disturbance Coordinators (Curt Russell and Chris Smith of PG&E) for noise and vibration.

2. Project Status/Outreach Activities between PG&E and Tribes

Provide a brief overview of key project milestones achieved and outreach activities conducted during the reporting period. To the extent practicable and available, discuss outreach activities/milestones anticipated for next reporting period.

Log of Outreach/Communication with Tribes				
ID	**Date/Time**	**Party Initiated Contact**	**Party Received Contact**	**Summary of Outreach/Communication**

3. Summary of Compliance with EIR Mitigation Measures

Provide a summary of compliance with EIR mitigation measures during the reporting period. Information may be presented in a table or a narrative as long as all the pertinent information is included.

4. Summary of Noise/Vibration Issues (if any) and Resolutions Noted by Disturbance Coordinators *(per EIR Mitigation Measure NOISE-1b and NOISE-2d)*

Information may be presented in a table or a narrative as long as all the pertinent information is included. If information is cumulative, a table format may be a better option.

Log of Noise/Vibration Issues (if any)					
ID	**Date/Time**	**Party Initiated Contact**	**Party Received Contact**	**Summary of Issues**	**Resolution**

5. **Outstanding Items/Issues Identified as Needing Clarification -** *If applicable, list items needing clarification or further discussion, e.g., seek clarification of application of an EIR mitigation measures.*

6. **Project Photographs -** *If applicable, insert photographs with captions that depict key activities/events during the reporting period.*

EXHIBIT 4-2
EIR Mitigation Measures Compliance Report Template

8. Paleontological Investigation Report — The EIR mitigation measure CUL-3 requires a paleontological investigation, including a survey of the project area by a qualified paleontologist, be conducted to refine the potential impacts on unique paleontological resources within the final design area and to determine whether preconstruction recovery of sensitive resources and/or construction monitoring would be warranted. A report will be submitted after the investigation.

9. Training/education manual for cultural resources, historical resources, and the identification of human remains — Cultural and historical resources sensitivity education has been a central part of the Topock remediation project to date. The existing education on cultural/historical resources sensitivity for Topock occurs via periodic training and project initiation meetings. Sensitivity training classes are conducted at least annually, and are attended by all workers available to participate. Sensitivity training/education is also provided at project initiation meetings, typically held at the site and prior to field work. The training is provided by the Site Operations Manager, the Project Archaeologist, and Interested Tribal members who attend the meetings. Many EIR mitigation measures associated with the groundwater remedy (e.g., CUL-1a-13, CUL-1b/c-4, CUL-4) are related to continued training of workers on cultural resources, historical resources, and the identification of human remains. To comply with the EIR requirement, a training/education manual will be prepared using existing and new material, as available.

4.2.2 Biological Resources Related Documents

1. Programmatic Biological Agreement Addendum — An addendum to the 2007 PBA will be prepared in consultation with USFWS, BLM, and DOI to include activities associated with implementation of the groundwater remedy, in conformance with the requirements of the federal Endangered Species Act, the Fish and Wildlife Coordination Act, and the Migratory Bird Treaty Act.

2. Avoidance and Minimization Plan for Special-Status Birds — The EIR mitigation measure BIO-2a requires that an avoidance and minimization plan for special-status bird species, as defined in Table 4.3-3 of the EIR and those species protected under the federal Migratory Bird Treaty Act, including the Yuma clapper rail, be developed and implemented in consultation with USFWS, and agreed upon by DTSC. Avoidance and impact minimization measures, such as prohibiting construction near or in sensitive bird habitat, limiting construction during breeding seasons, and requiring an onsite biological monitor, will be included in the design plan and implemented to the extent necessary to avoid significant impacts on sensitive bird species. The avoidance and minimization plan can be combined with the PBA Addendum for efficiency in scoping/planning of the document and agency consultation.

3. Map of Mature Plant Species/Survey of Indigenous Plants of Traditional Cultural Significance (listed in Appendix PLA of the EIR) — The EIR mitigation measures AES-1a and AES-2b require that plant specimens in select locations (EIR Key Views 5 and 11) (AECOM, 2011) determined to be mature and that must be retained, will be mapped/identified by a qualified plant ecologist or biologist and integrated into the final design and project implementation. A map will be prepared and incorporated into the design. For

efficiency, field work may be coordinated between this mapping and the survey of indigenous plant species required by EIR mitigation measure CUL-1a in the project area.

4. Plant Transplantation/Monitoring Plan (if needed) — If an indigenous plant(s) of traditional cultural significance as listed in the EIR is identified within the project area, measures will be taken to avoid, protect, and encourage the natural regeneration of the identified plant(s) when developing the remediation design, final restoration plan, and IM No. 3 decommissioning plan as required by EIR mitigation measure CUL-1a. In the event that impacts on the identified plant(s) cannot be avoided and such plant(s) will be displaced, a plant transplantation/monitoring plan will be prepared by a qualified botanist.

5. Revegetation Plan — The EIR mitigation measures AES-1b and AES-2c require that plans and specifications for revegetation of disturbed areas within the riparian vegetation along the Colorado River be developed. The revegetation plan will include specification of maintenance and monitoring requirements, which will be implemented for a period of five years after project construction or after the vegetation has successfully established, as determined by the qualified plant ecologist or biologist.

6. Delineation of Waters and Wetlands Field Survey Addendum — In 2005, field surveys of surface waters and wetlands within and near the Topock site were conducted and documented (CH2M HILL, 2005). In 2010, surveys of three additional areas outside of the APE were conducted (CH2M HILL, 2010c and 2010d). In compliance with EIR mitigation measure BIO-1, a field verification of wetlands will be conducted and documented in an addendum to the 2005 survey and, to the extent necessary, the 2010 surveys.

7. Map of Ordinary High Water Mark — The EIR mitigation measure AES-2a requires that a minimum setback requirement of 20 feet from the water (ordinary high water mark) will be incorporated in the design, except with regard to any required river intake facilities, to prevent substantial vegetation removal along the river bank. A map of the ordinary high water mark along the river bank will be prepared and incorporated into the design.

8. Habitat Restoration Plan for Sensitive Habitats and Special-Status Species— The EIR mitigation measures BIO-1 and BIO-2c require that a habitat restoration plan be prepared to address potential impacts on (a) sensitive habitats, and (b) special-status species during decommissioning activities. The plan will be prepared in consultation with CDFG, BLM, and USFWS, and will include a revegetation seed mix or plantings design, a site grading concept plan, success criteria for restoration, a monitoring plan, and an adaptive management plan.

9. Fish Rescue Plan/In-stream Habitat Typing Report — The fish rescue plan and the in-stream habitat typing report (mitigation measure BIO-3) will not be prepared at this time since for the near-term, the forthcoming design will focus on a fresh water source from Arizona (not water from the Colorado River).

10. Hydrologic Analysis — The EIR mitigation measure WATER-1 requires that computer simulations or other appropriate hydrologic analysis be used before the installation of any new fresh water extraction wells to demonstrate that production rates of existing nearby wells will not be substantially affected. A hydrologic analysis will be prepared for inclusion in the design submittals.

4.2.3 Other Key Documents During Design

1. Site Security Plan — The Site Security Plan will be prepared and submitted concurrently with or included in the future Corrective Measure Construction/Remedial Action Work Plan. As required by the EIR mitigation measure CUL-1a-3b, the goal is to provide increased observation of potential intrusions into the project area during construction and operation of the final remedy that may impact significant cultural resources. The general framework for the Site Security Plan is as follows:

    - The security for remedial facilities located inside the Compressor Station will be provided for by the existing station security system.
    - Remedial facilities located outside of the Compressor Station will be equipped with security features/systems that are consistent with current PG&E security standards. Such features, as determined necessary and in compliance with project and landowners requirements, could include, but are not limited to, fencing to protect the equipment and provide safety for personnel and the public; locks to prevent authorized access; security devices and instrumentation; security communication systems; alarms to notify PG&E's security operations; and security cameras.

2. Grading and Erosion Control Plan — EIR mitigation measure GEO-1a-a requires that a grading and erosion control plan be prepared by a California Registered Civil Engineer for DTSC approval prior to implementation of any grading in areas of the site where there is a potential for substantial erosion or loss of topsoils. The plan will outline specific procedures for controlling erosion or loss of topsoil during construction, operation and maintenance, and decommissioning.

3. Storm Water Pollution Prevention Plan (SWPPP)/BMP plans and Monitoring & Reporting — EIR mitigation measure HYDRO-1 requires that a SWPPP and BMP plans/monitoring and reporting program be developed to control storm water runoff, erosion, and sediment during construction, consistent with the substantive requirements of the San Bernardino County Building and Land Use Services Department for erosion control.

4. Project-specific Hazardous Materials Business Plan (HMBP) — EIR mitigation measure HAZ-1a-c requires a project-specific HMBP, chemical standard operating procedure (SOP) protocols, and contingency plans. The project-specific HMBP will be prepared in accordance with substantive San Bernardino County requirements (www.sbcfire.org). Chemical standard operating procedures (SOPs) and contingency plans will be developed. The HMBP and SOPs will describe the procedures for properly storing and handling hazardous materials and hazardous wastes onsite, the required equipment and procedures for spill containment, required personal protective equipment, and the measures to be used to reduce the likelihood of releases or spills during fueling or vehicle and equipment maintenance activities.

5. Fueling SOPs and Contingency Plans — EIR mitigation measure HAZ-1b-b requires that fueling SOP protocols and a contingency plan be developed for implementation at all fueling areas onsite. Existing protocols will be reviewed and updated as needed.

6. Health and Safety Plan/Soil Management Plan — The EIR mitigation measures HAZ-2 and HAZ-2f require that a health and safety plan and a soil management plan, respectively,

be developed for DTSC approval in the event that evidence of contaminated soil is identified during ground disturbing activities (e.g., noxious odors, discolored soil). To comply with EIR mitigation measure HAZ-2c, Health and Safety Plans (or addendums or revisions, as appropriate) will be prepared for future ground-disturbing field activities. Examples include, but are not limited to, data collection to support design, construction, and O&M of the groundwater remedy.

4.3 Key Documents During the Construction Phase

Construction of the final groundwater remedy is expected to take place from January 2013 through June 2014. Initial start-up of the system is expected to occur in November 2013. After construction and operational tests are complete, a Corrective Measure/Remedial Action Construction Completion Report will be prepared and submitted to DTSC and DOI. The construction completion report documents how the completed project is consistent with the final design plans and specifications. The Corrective Measure/Remedial Action Construction Completion Report may include the following elements:

- Purpose
- Synopsis of the final groundwater remedy, design criteria, and certification that the final groundwater remedy was constructed in accordance with the final design plans and specifications
- Explanation and description of substantive modifications to the final design plans and specifications and why the modifications were necessary
- Results of any operational testing and/or monitoring which may indicate how initial operation of the final groundwater remedy compares to the design criteria
- Summary of significant activities that occurred during construction
- Summary of any inspection findings
- As-built drawings
- A schedule indicating when treatment systems will begin full scale operations

4.4 Key Documents During Operations

During remedy operations, performance monitoring reports will be submitted to DTSC and DOI at a frequency determined appropriate by the agencies. Report content will be presented in the O&M Plan.

The SOB (DTSC, 2011a) requires five-year remedy performance evaluation reports to evaluate the long-term effectiveness and reliability of the groundwater remedy. The ROD (DOI, 2010a) requires that a statutory review be conducted within five years after initiation of the remedial action and every five years thereafter until attainment of the RAOs to ensure that the remedy is, or will be, protective of human health and the environment. The contents of the five-year reviews will generally follow the USEPA Comprehensive Five-Year Review Guidance (USEPA, 2001) and could include the following main elements:

- Site chronology, including a list of all important site events and relevant dates.
- Site background, including a general site description; former, current, and future land uses of the site and surrounding areas; history of contamination; initial response; and basis for taking remedial action.
- Remedial actions, including regulatory actions; RAOs; remedy description; remedy implementation; O&M requirements, operational summary, and operational costs of system; and O&M effectiveness.
- Progress since the last five-year review (if applicable), including protectiveness statements from last review; status of recommendations and follow-up actions from last review; results of implemented actions; and status of any prior actions.
- Five-year review process, including:
  - Administrative components
  - Outline of components and schedule for the five-year review
  - Community involvement
  - Document review
  - Data review
  - Site inspections
  - Interviews
- Technical assessment:
  - Question A: Is the remedy functioning as intended by the decision documents?
  - Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?
  - Question C: Has any other information come to light that could call into question the protectiveness of the remedy?
  - Technical assessment summary
- Issues
- Recommendations and follow-up actions
- Protectiveness statement
- Next review

Operation of the groundwater remedy is expected to require several decades, the actual time required for implementation depending on a number of factors. It is fully expected that changes to the remedial systems will be made during the operation phase to optimize the remedy, address maintenance issues, and respond to changes in site conditions. Based on the results of the 5-year reviews described above, there may be construction of new infrastructure, closure of infrastructure determined unnecessary for future operations, and/or partial closure of those portions of the plume that attain RAOs earlier or are appropriate for ceasing of active operations.

4.5 Key Documents During Closure

Once cleanup goals and RAOs are achieved and/or the agency issues a decision that monitored natural attenuation is appropriate to address residual Cr(VI) in portions of the plume, a Corrective Measure/Remedial Action Completion Report will be prepared. The completion report will demonstrate how the criteria for the completion of the groundwater remedy have been satisfied and outline the criteria for when operations and maintenance may cease. The Corrective Measure/Remedial Action Completion Report may contain the following elements:

- Purpose
- Synopsis
- Corrective measure completion criteria, including a description of the process and criteria for determining when corrective measures, maintenance, and monitoring may cease.
- Demonstration that the completion criteria have been met, including results of testing and monitoring
- Summary of work accomplishments
- Summary of significant activities that occurred during operations
- Summary of inspection findings
- Summary of total O&M costs

A Closure Plan will also be prepared for the agencies' review and approval following remedial action completion and/or determination that remedial infrastructure is no longer needed to support the active operation. The Closure Plan will detail the decommissioning of the final groundwater remedy; removal of infrastructure, including monitoring wells and the treatment facilities; and site restoration activities. Depending on performance of the remedial systems, schedules for closure and decommissioning may be phased, as some portions of the site may be appropriate for closure while other portions of the site remain in active operation.

4.6 Key Documents During Post-Closure

Following agencies' approval of the Corrective Measure/Remedial Action Completion Report, PG&E will perform post-closure monitoring. Post-closure monitoring reports will be prepared to document the continued effectiveness achieved by the remedy.

4.7 Key Documents During Decommissioning of Remedial Facilities

Following agencies' approval of the Closure Plan, PG&E will perform the decommissioning of the remedial facilities and site restoration activities. A Completion Report will be prepared after the decommissioning for submittal to agencies.

4.8 Protocols for Review of Future Submittals of Cultural Resources and Design Documents

This section presents the protocols for review of future cultural resources and design documents:

- Review protocols for cultural resources-related documents throughout the design, construction, and operational phases (CUL-1a-8c)
  - PG&E proposes to follow the current document review protocol being implemented under the CRMP until the future CHPMP is in place. After the CHPMP becomes effective, PG&E proposes that the document review protocol under the CHPMP be followed.
- Review protocols for project design documents before the beginning of construction (CUL-1a-8d)
  - PG&E proposes to follow the current document review process presented in the Project Schedule (the Rainbow schedule). The process is as follows:
    1. The review period for the design submittals (including all documents submitted concurrently with the design submittals) is 30 calendar days. At the end of the review period, the reviewer will submit his or her comments to DTSC and/or DOI. For the final design submittals, there is a 55 calendar day Tribal consultation period.
    2. After review of comments received, DTSC and DOI will direct PG&E to address or incorporate a subset or all comments.
    3. After reviews of the agencies' direction and comments, if needed, PG&E will organize a comment resolution meeting to discuss and resolve comments needing resolution. Per past project experience, the comment resolution meetings are more efficient than the traditional comment response process.

5.0 IM Termination/Coordination with Groundwater Remedy Implementation

PG&E has been implementing an interim measure at the Topock site since March 2004. The purpose of the IM has been to stabilize the groundwater contamination during the time period in which the site characterization, risk assessment, and remedial alternative definition and evaluation steps are completed. This chapter describes the existing IM system and discusses the considerations for transitioning to the final groundwater remedial system and the potential decision process for transitioning between the IM and groundwater remedy. Decommissioning and restoration of the IM system is also discussed.

The IM has different goals and objectives from the groundwater remedy, as highlighted below:

Interim Measure Objectives	Groundwater Remedy Objectives
• Establish hydraulic control of the plume boundaries near the Colorado River to maintain a net landward groundwater gradient in a westward direction from the Colorado River.	• Prevent ingestion of groundwater as a potable water source having Cr(VI) in excess of the regional background concentration of 32 µg/L. • Prevent or minimize migration of Cr(T) and Cr(VI) in groundwater to ensure concentrations in surface water do not exceed water quality standards that support the designated beneficial uses of the Colorado River (11 µg/L Cr[VI]). • Reduce the mass of Cr(T) and Cr(VI) in groundwater at the site to achieve compliance with ARARs in groundwater. This RAO will be achieved through the cleanup goal of the regional background concentration of 32 µg/L Cr(VI). • Ensure that the geographic location of the target remediation area does not permanently expand following completion of the remedial action.

The goals of the IM are different from the RAOs because the RAOs were developed based on the conclusions of the RFI/RI, risk assessment, and ARARs identification, which were not complete at the time the IM objectives were defined in 2004. The IM has served the purpose of stabilizing the groundwater contamination during the time period in which the site characterization, risk assessment, and remedial alternative definition and evaluation steps have been completed. Based on the conclusions of the RI/RFI, risk assessment, and ARARs identification, the RAOs for the groundwater remedy focus on reducing the mass of Cr(VI), which was not a defined objective of the IM.

5.1 IM System Description

The IM consists of groundwater extraction for hydraulic control of the plume boundaries in the Colorado River floodplain and management of extracted groundwater. The existing components associated with the IM include the following:

- Groundwater extraction by extraction wells in the floodplain area of the site. There are four extraction wells (TW-2S, TW-2D, TW-3D, and PE-1).
- Transport of extracted groundwater to an aboveground treatment plant via underground pipelines.
- Treatment of groundwater in the aboveground treatment plant. The groundwater treatment system is a continuous, multi-step process that involves reduction of Cr(VI) to Cr(III); precipitation and removal of Cr(III) precipitate solids by clarification and microfiltration; and lowering the naturally-occurring TDS using reverse osmosis.
- Transport of treated groundwater to an injection well field via aboveground pipeline.
- Injection of treated groundwater into the alluvial aquifer. There are currently two injection wells (IW-02 and IW-03).
- Brine storage tanks and other facilities on the MW-20 bench, including truck access and loading areas, containment structures, parking areas, fencing, piping, pumps, motors, valves, electrical power and control panels, instrumentation, security system, lighting, and other ancillary equipment.
- Monitoring wells from which data are required, and identified well pairs to evaluate the performance of the IM.

Figure 5-1 illustrates the locations of existing (as-built) infrastructure associated with the IM in relation to the conceptual locations of new infrastructure associated with the groundwater remedy. Figure 5-2 provides additional detail on the locations of existing (as-built) infrastructure associated with the IM in the floodplain in relation to the conceptual locations of new groundwater remedy infrastructure. As illustrated, particularly in the floodplain, many of the features of the groundwater remedy, such as the line of extraction wells near the Colorado River and the line of IRZ wells along NTH, are located in the same general area as existing infrastructure for IM operation and performance measurement.

5.1.1 IM Extraction System

The groundwater gradient objectives of the IM are met through the operation of the IM extraction system, currently utilizing well TW-3D located on the MW-20 bench just adjacent to NTH, and well PE-1 located on the Colorado River floodplain. Based on DTSC directives, groundwater is extracted from PE-1 at its maximum sustainable rate (approximately 30 gpm) and groundwater is extracted from TW-3D at a rate (approximately 105 gpm) such that the combined rate from the two wells is 135 gpm— except during periods of scheduled and unscheduled maintenance.

The requirements for IM monitoring and reporting are outlined in various DTSC directives (DTSC, 2005; 2006; 2007; 2008a-b). Performance of the IM to meet the defined objectives is assessed through collection and reporting of water levels (which are measured by recording instruments on a continuous basis) from specified monitoring wells, and reporting gradients between specified well pairs on an average monthly basis. The magnitude of the landward gradient is required to be at least 0.001 feet per foot (ft/ft) at each of these well pairs. The IM Performance Monitoring Program (PMP) has been a routine monitoring and reporting program since 2005; the recent PMP monitoring report is the *Fourth Quarter 2010 and Annual Interim Measures Performance Monitoring and Site-wide Groundwater and Surface Water Monitoring Report* (CH2M HILL, 2011a). The PMP will be terminated upon the determination by the agencies that the IM is no longer required. The focus of the Corrective Measure/Remedial Action Monitoring Program associated with the groundwater remedy will be on monitoring and measuring the effectiveness of the remedy to attain the RAOs, rather than the objectives of the IM. If the IM PMP and the Corrective Measure/Remedial Action Monitoring Program are both in effect during a transition period, the Corrective Measure/Remedial Action Monitoring Program will efficiently plan for any overlap between the two monitoring programs.

5.1.2 Management of Extracted Groundwater

The existing IM treatment and injection systems have been established and approved as a means of effectively managing the water that is generated by the required extraction system, in compliance with waste management regulations. The treatment and injection systems are currently regulated by various approvals or permits issued by agencies including the DTSC, BLM, Water Board, San Bernardino County, and Mojave Desert Air Quality Management District.

In compliance with the Monitoring and Reporting Program under Order R7-2006-0060, PG&E currently collects influent, effluent, and other data from within the treatment plant, and the results of these analyses are reported quarterly to the Water Board, along with other required information and a summary of operations. The aquifer near the treated water injection wells is monitored via a Compliance Monitoring Program (CMP), consistent with the requirements of the Monitoring and Reporting Program under Order R7-2006-0060 and directions received from DTSC since 2005. The CMP has been a routine monitoring and reporting program since 2005; the recent CMP monitoring report is an appendix to the *Performance Assessment Report*, *Interim Measure No. 3 Injection Well Field* (CH2M HILL, 2011c). Similar to the PMP discussed above, the CMP will be terminated upon determination by the agencies that the IM is no longer required. In addition, the various regulatory approvals and permits for the treatment and injection system will be closed upon completion of the IM. If the IM CMP and the Corrective Measure/Remedial Action Monitoring Program are both in effect during a transition period, the Corrective Measure/Remedial Action Monitoring Program will efficiently plan for any overlap between the two monitoring programs.

5.2 Considerations for Transitioning from the IM to the Final Groundwater Remedy

The DTSC has established performance criteria for the operation of the IM. In addition to the gradient control metrics (maintaining a landward gradient away from the Colorado River), DTSC approval letters for the IM dictate that PG&E must maintain a target pumping rate of 135 gpm from two specific wells, TW-3D and PE-1 (Figure 5-2). These metrics are consistent with the purpose of the IM, and the IM has been successful in achieving them. However, at some point during the construction and start-up of the groundwater remedy, it will no longer be possible to operate the IM in a manner that meets the current IM metrics. This section outlines example areas where the IM gradient control/pumping rate metrics or the operation of the IM wells or treatment plant may be incompatible with the construction and start-up of the groundwater remedy.

There are several ways in which the IM gradient control/pumping rate metrics or the operation of the IM wells or treatment plant may be incompatible with the construction and start-up of the groundwater remedy. Examples of those incompatibilities include:

1) During the startup of the groundwater remedy, it will be necessary to pump from the River Bank extraction wells to test the wells, the piping, and the control system. It will likely not be possible to continuously maintain the prescribed 0.001 ft/ft gradients in the three designated well pairs during the testing of the new River Bank extraction wells.

2) There will be significant quantities of water, along with carbon amendments, injected into wells along the NTH to construct the IRZ barrier. During this period of IRZ construction, which will likely extend over many months, it may not be possible to continuously maintain the required gradient control metrics in all of the IM well pairs. There would still be landward gradients across most of the floodplain, but injection or extraction in the IRZ recirculation wells may affect water levels in one or more of the designated gradient measurement well pairs.

3) The groundwater remedy facilitates mass removal of Cr(VI) from floodplain groundwater by injecting reductant along NTH and pumping from wells near the Colorado River. Once pumping from these River Bank extraction wells is fully implemented, gradients across the floodplain will no longer be landward. With the groundwater remedy in place, the IM gradient control metrics will no longer be appropriate.

4) Construction of the IRZ barrier requires relatively uniform distribution of carbon substrates across the entire length and thickness of the aquifer along NTH. The pumping from TW-3D, which is located within about 50 feet of the IRZ barrier, creates a cone of depression that extends along much of the length of the IRZ line. Near the ends of the IRZ line, the gradients associated with TW-3D pumping are parallel to the IRZ line, which could be beneficial for distributing the carbon along the line. However, near the middle of the IRZ line, pumping from TW-3D creates very strong gradients that are nearly perpendicular to the IRZ line. The pumping from TW-3D will make it very difficult, if not impossible, to achieve even distribution of carbon substrate between the IRZ wells in the center of the IRZ line.

5) Once carbon has been distributed along the IRZ, it will be necessary to allow some time for the microbes to digest the carbon and create the geochemical reducing conditions needed to remove the chromium. During this time, it is desirable to have a minimal flow of groundwater across the IRZ so that the carbon substrate remains in the target treatment zone rather than being pulled away downgradient. The period of time required for complete development of the IRZ following carbon injection may be weeks to months. During this time, pumping from TW-3D would adversely affect the development of the IRZ by pulling un-amended water through the target treatment zone, particularly in the center portion of the IRZ line. This could result in incomplete distribution of carbon, and therefore only partial treatment, in the central portion of the IRZ, where some of the highest concentrations of Cr(VI) are found in groundwater.

6) If TW-3D remains pumping during the construction of the IRZ barrier, carbon compounds and in-situ byproducts (reduced species of iron, arsenic, and manganese) will eventually be drawn into the treatment plant. The IM treatment process is not designed to remove carbon compounds in the extracted water. Carbon compounds in the IM water could increase fouling of the IM extraction and injection wells, potentially reducing the effectiveness and capacity of the IM system. In addition, some carbon compounds can act as chelating agents and could decrease the effectiveness of the plant in removing chromium. Some of the in-situ byproducts would be removed by the treatment plant, but the plant was not designed to remove these metals and its treatment efficiency for arsenic and manganese in influent water has not been quantified. If the treatment plant is not able to adequately treat all the constituents in the influent water, concentrations in the treatment plant effluent may exceed effluent limits and/or the injection wells may be at risk of plugging. Therefore, in addition to the adverse hydraulic affects that pumping TW-3D would have on the ability to build the IRZ barrier, the construction of the IRZ barrier near TW-3D will have adverse effects on the operation of the IM treatment plant and injection wells. If PG&E is required to operate the treatment plant beyond a certain point during construction and startup of the groundwater remedy, and to meet the current discharge requirements in spite of the changing influent water chemistry, as described above, modifications to the treatment plant may be necessary and could require additional construction, and/or could require changes to approved authorizations of the treatment and injection system.

7) There may be portions of the IM infrastructure (wells, pipelines, etc.) that become incorporated into the groundwater remedy; for example, PE-1 may be incorporated into the line of River Bank extraction wells. If IM infrastructure is used as part of the groundwater remedy for a different purpose, it may reduce the amount of construction activities required, but would prevent simultaneous operation of that feature for both the IM and the groundwater remedy.

5.3 Decision Process for Transition to Groundwater Remedy Operation

A series of potential transition scenarios between the operation of the IM and the groundwater remedy is being developed as part of the remedial design process. An implementation plan for each scenario that defines the specific order and goal of each step, potential consequences of each, and critical milestones will be developed. Potential criteria for evaluating the transition scenarios will be developed and will take into account items such as the timely shutdown of the treatment plant, continued protection of the floodplain and river from contaminants, technical operational criteria, and general IM compliance issues and metrics. Once this evaluation is complete, PG&E will consult with stakeholders regarding the best transition option that provides continued safeguards for the floodplain and Colorado River while ensuring the integrity of the construction and operation of the groundwater remedy.

5.4 Transition of Regulatory Requirements Between IM and Groundwater Remedy

Once an appropriate transition scenario is selected, a schedule for the transition between regulatory approvals and programs currently required for the IM to those required for the groundwater remedy will be defined. As the transition between IM and the groundwater remedy progresses, PG&E will likely request that some existing regulatory requirements (permits, action memorandum requirements, etc.) are updated, eliminated and/or replaced, as necessary, with those required for the groundwater remedy. Other IM monitoring programs (e.g., PMP, CMP) will be terminated when the agencies determine that the IM, and therefore the IM monitoring programs, is no longer required; similarly, existing contingency plans for the injection well field area, the floodplain area and the Colorado River initiated during the IM will be terminated and replaced by contingency plans appropriate for the groundwater remedy. Chapter 4 presents a list of future anticipated deliverables for the groundwater remedy.

5.5 IM Decommissioning and Restoration

The treatment plant and other IM infrastructure that are not incorporated into the groundwater remedy are expected to be decommissioned following determination by DOI and DTSC that the facilities are not needed to meet the RAOs. In conformance with the Programmatic Agreement Stipulation V(E), EIR mitigation measure CUL-1a-8(f), and PG&E's Settlement Agreement (PG&E, 2006), a decommissioning plan will be prepared as described in Chapter 4 of this work plan. The decommissioning plan will also be consistent with other requirements such as the basis for the closure cost estimate that is submitted to the Certified Unified Program Agency every year as part of the Conditional Authorization renewal.

5.5.1 IM No. 3 Treatment Plant Decommissioning

No aboveground component of the existing IM infrastructure that is located within the footprint of the existing treatment plant building will be re-used (in its current location) as part of the groundwater remedy. Decommissioning of the existing treatment plant building will include removing the exterior structure, interior treatment equipment, and associated tanks and facilities from the treatment plant building location. Related process piping, conduit, lights, electrical trays, concrete, road surfacing, and sunshade will be removed and either reused elsewhere as part of the groundwater remedy or transported to an appropriate disposal facility. Other components such as the control trailer, sunshade steel supports, tanks, pumps, polymer system, microfilter system, reverse osmosis system, mixers, control panels, switchgears, panels, and generators are expected to be removed and either sold for salvage value or stored at the Compressor Station as shelf spares.

The decommissioning of the treatment plant will generate solid and liquid waste. Waste streams will be identified and evaluated prior to decommissioning. This effort will involve reviewing equipment use and historical spills or leaks to identify potential waste disposal or salvage options. If foundation material beneath the treatment plant is to be removed, fill or other appropriate materials will likely be placed over the area after removal of the foundation. The fill will be graded and stabilized per the erosion control plan. Sampling of the foundation to assess whether contamination is present would typically be by wipe or core sampling if determined to be necessary. If the concrete foundation is found to be contaminated, it will be managed and disposed of in accordance with applicable regulations. Equipment within the treatment building such as process pipe and tanks will be decommissioned as appropriate, such as by power washing, and reused or disposed of. Wipe or chip sampling of the equipment will be conducted to verify the effectiveness of the washing. If the equipment cannot be adequately cleaned, it will be managed and disposed of in accordance with applicable regulations. Decontamination wash water will be treated onsite if not a hazardous waste, or disposed of offsite as appropriate. The volume of wash water to be disposed of depends on the volume of water generated and the availability of onsite use or disposal. Treatment can be accomplished with portable equipment (e.g., filters, pumps, tanks). If limited onsite use is available, offsite disposal or treatment options will need to be employed.

Solid waste generated will consist of incidental trash, such as pallets, empty drink and food containers, plastic sheeting, and other disposables associated with construction work. Incidental trash will typically be collected at the end of each shift and either hauled off at the end of the day or placed in dumpsters or roll-off bins that will be hauled offsite periodically by truck to an appropriate disposal or recycling facility. The amount of materials that may be generated during the treatment plant decommissioning is estimated to be up to 5,000 cubic yards of solid waste and up to 2,000,000 gallons of water.

Typical equipment that may be used for decommissioning of the treatment plant may include cranes, forklifts, standard and high reach demolition equipment, cutting equipment (e.g., torches, reciprocating saws), jackhammers, backhoes, graders, excavators, bulldozers, water trucks, and dump trucks.

5.5.2 Other IM Infrastructure Decommissioning

If not incorporated into the groundwater remedy, other IM infrastructure will be decommissioned following the determination that the facilities are not needed to meet the RAOs. The two IM injection wells (IW-02 and IW-03) and four extraction wells (PE-1, TW-2D, TW-2S, and TW-3D) will be decommissioned using procedures required by San Bernardino County and the California Department of Water Resources. Demolition of brine storage and loading facilities on the MW-20 bench will involve procedures similar to tank demolition at the treatment plant building. Pipelines will be decontaminated as appropriate. Aboveground piping from the treatment plant to the injection well field may be reused in place or would be removed and either reused elsewhere or disposed of offsite as scrap material. Subsurface pipelines from the extraction wells to the treatment plant will likely be abandoned in place following decontamination unless the regulatory agencies or landowner requires removal. Decontamination wash water will be treated onsite or disposed of offsite as appropriate. Electrical utilities will be disconnected from their service points and underground conduit left in place. Aboveground conduit will be removed with the piping. Electrical cables will be pulled from the underground and aboveground conduit and sold for salvage value. Existing pipeline and conduit vaults that have no continuing use by the groundwater remedy system will be removed and backfilled.

5.5.3 IM Restoration

Following decommissioning of IM infrastructure, the site of the existing treatment plant and related facilities will be restored to the conditions existing prior to the construction of the investigation and remediation related appurtenances and facilities, to the extent practicable and in conformance with Programmatic Agreement Stipulation I(D) and Stipulation III(B)(3)(c), and the Settlement Agreement (PG&E, 2006). Also, in conformance with Programmatic Agreement Stipulation V(E), EIR mitigation measure CUL-1a-8(f), and the Settlement Agreement, a plan for decommissioning, removal and restoration of the IM facility will be prepared as part of the design documents for the groundwater remedy, as described in Chapter 4.

6.0 Planned Short-Term Activities to Support Remedial Design

Short-term activities to support the remedial design and/or to comply with ARARs and mitigation measures are presented in this chapter. The level of planning presented in this work plan is conceptual and based on the currently anticipated information needs for completing the preliminary design submittals. It is anticipated that most of these activities will be conducted in 2011. As the design effort progresses from the preliminary design through intermediate and final design and the level of detail increases, new information/ data needs may be identified or other requirements triggered (for example, an Instream Habitat Typing survey is not currently planned because river intake structures are not being considered in the design at this time). If necessary, additional information/data needs will be filled through subsequent investigations or studies in accordance with separate supplemental work plans or reports (e.g., bench scale treatability studies).

The efforts to update and refine the groundwater flow model, and to use this to help develop a new in-situ model of the groundwater flow, geochemistry, and fate and transport, are discussed in Sections 6.2 and 6.3, respectively. These models are analytical design tools that will be used to determine critical design parameters such as well locations, pumping and injection rates, and hydraulic capture zones, and to assist with development of contingency plans. The groundwater flow model will be updated with data and information collected subsequent to the CMS/FS.

6.1 Plan for Data Collection in 2011

The following activities are ongoing or planned for 2011:

- East Ravine and Topock Compressor Station Groundwater Investigation
- Continuation of existing groundwater, surface water, compliance and performance monitoring programs
- Mapping of disturbed areas as defined in EIR mitigation measure CUL-1a-9
- Inventory of existing infrastructure (in areas relevant to the project)
- Pump tests
- Topographic survey (Figure 6-1 shows the planned survey areas)
- Underground utility identification
- Mapping of ordinary high water mark
- Field verification of jurisdictional waters and wetlands (with the project area)
- Mapping of mature plant species (in areas where new remedial facilities are likely to be located)

- Field survey of indigenous plant species (in areas where new remedial facilities are likely to be located)

Table 6-1 identifies the scope and schedule for each of the above activities.

6.2 Groundwater Flow Model Update

The model used in the CMS/FS was calibrated in 2009 prior to installation of a number of monitoring wells, both on the site and in Arizona. These monitoring wells have provided additional data on the lithology that is not yet incorporated in the model. In addition, there are hydraulic data from the installation and testing of a large capacity irrigation well on the Havasu National Wildlife Refuge across the river in Arizona from the Topock site. A river bathymetry survey has also been conducted since the groundwater model used in the CMS/FS was constructed. The model is being updated to incorporate these recent data, and to provide a more realistic representation of the hydraulic influence of Topock Marsh.

In addition, the model grid spacing will be refined to support more detailed simulations in the area where the final groundwater remedy is to be implemented and monitored. Although the model will be updated and refined, the original hydraulic parameters will be kept intact for the floodplain and other areas where sufficient data were available at the time of the original calibration. Parameters will only be changed in areas where little or no data were available previously (e.g., the Arizona side of the river).

Once updated, this groundwater flow model will be used to support remedial design on a macro scale level (i.e., well locations and pumping/injection rates/capture zones). Through a process of Telescopic Mesh Refinement (TMR), the aquifer properties and hydraulic fluxes will be exported from the flow model to provide the basis for a much finer-grid in-situ model. The in-situ model will be used to support design of IRZ reaction zones and evaluate options for in-situ byproduct management. The in-situ model task is described in Section 6.3.

The technical tasks associated with the groundwater flow modeling activities will include the following:

1. Produce Baseline Model for In-situ Design Tool: This task will employ the use of TMR to create an in-situ model grid based on the USGS MODFLOW modeling code. The in-situ model domain will constitute a portion of the flow model domain, focusing on the chromium plume and immediately surrounding area. In order to simulate smaller-scale processes, the in-situ model will have finer grid spacing and more vertical layers than the flow model.

2. Refine Model Grid: Finer grid spacing will be applied to the entire plume area to accommodate better simulation of final groundwater remedy detail. The finer grid will extend into the East Ravine and Compressor Station areas to incorporate data collected in more recent field programs. The number of model layers will remain the same as the previous version: five total layers. In most areas of the model, four of the layers will represent unconsolidated materials and the bottom layer will be assigned bedrock properties. The exception will be the East Ravine area, where the saturated alluvium is very thin or not present. In these areas, bedrock properties will be assigned to multiple model layers.

3. Redefine Hydrostratigraphic Unit (HSU) Distribution and Bedrock Surface: The bedrock surface and HSU thicknesses will be updated on the basis of stratigraphy defined by well data collected since the original calibration. It is anticipated that additional stratigraphic data will become available during the ongoing East Ravine/Topock Compressor Station investigations, and adjustments to the model will be made as appropriate to accommodate these new data.

4. Redefine Topock Marsh Area: To better account for the influence of Topock Marsh on groundwater in Arizona, constant heads will be added to the model in the area of the Topock Marsh. Heads in these nodes will be assigned based on published average water levels maintained by USFWS. The assignment of marsh water elevations will be based on currently available information and no new data will be collected.

5. Incorporate Arizona Pumping: Extraction rates from wells in Arizona will be updated with any available data that can be obtained from public sources. In addition, the anticipated future pumping rates of the HNWR-1 well will be incorporated into the model.

6. Refine River Parameters: The river channel bottom will be refined using bathymetry survey data collected by the USGS in 2006. River depth estimates will be redefined and river bottom resistance will be recalculated to match the previous calibration.

7. Refine Aquifer Property Estimates: Transducers were installed in selected monitoring wells during a 24-hour pumping test at the HNWR-1 well. The data from these transducers will be used to refine model aquifer properties in Arizona. On the basis of previous USGS comments on the model, conductivity estimates in the area between the Old Evaporation Ponds and the IM No. 3 injection wells will be reexamined and adjusted where necessary. The aquifer properties in the floodplain area were previously calibrated based on pumping tests at TW-3D and PE-1. These properties will be maintained to preserve the original model calibration.

8. Refine Design of the Final Groundwater Remedy: Following the model update tasks identified above, the simulations conducted in the CMS/FS will be rerun as a check on the effects of the model revisions. As needed, the design of the final groundwater remedy will be adjusted, adding wells and adjusting extraction rates where necessary to optimize the performance and reliability of the groundwater remedy. The estimated time to cleanup will also be recalculated, based on the updated design and groundwater plume configuration.

6.3 In-situ Model Development

6.3.1 Groundwater Flow Evaluation

As described in Section 6.2, a TMR process will be used to export the aquifer properties and hydraulic fluxes from the groundwater flow model to provide the basis for a much finer-grid in-situ model. The in-situ model will be used to support design of IRZ reaction zones and evaluate options for in-situ byproduct management. The in-situ model will have greater resolution in the area of the chromium plume while honoring the regional flow conditions established by the groundwater flow model. Additional vertical refinement will be added to the in-situ model to improve the resolution and understanding of local hydraulic flow patterns. Boundary conditions for the in-situ model will be based on the groundwater flow patterns computed using the groundwater flow model. The hydraulic flow patterns of the refined in-situ model will be compared to those of the groundwater flow model to ensure that the two models are hydraulically consistent before proceeding.

6.3.2 Geochemical Evaluation

Dissolved metals are temporarily liberated from soils as by-products of IRZ technology by redox-driven dissolution of minerals in a reducing environment. For full-scale implementation of the IRZ remedy, a numerical model (reaction, transport, and multi-component) will be used to evaluate transient water quality effects and the timeframe required to restore groundwater to background concentrations. The focus for this analysis will be within and downgradient of the IRZ. The input parameters will be developed from the in-situ pilot test data set collected in the floodplain.

The variables affecting by-product attenuation will be identified through numerical modeling to permit incorporating geochemical reactions into the groundwater transport analysis. The multi-component reactive transport model will use the PHREEQC model developed by the USGS (Parkhurst and Appelo, 1999). The geochemical model will be calibrated against the existing floodplain data set. It will be used to evaluate the floodplain treatment scenarios and will be adjusted as appropriate using up to five different input parameter sets. These parameters determined from the geochemical model will be used as input parameters for the fate and transport model.

6.3.3 Fate and Transport Evaluation

A fate and transport model will be developed to evaluate the potential migration of the chromium plume, injected carbon, and potential IRZ by-products under various in-situ remedial scenarios. The groundwater flow model will be used to establish the initial flow conditions for each potential remedial scenario. The solute transport of the chromium and injected carbon will be performed using the modular three-dimensional transport model referred to as MT3DMS. The MT3DMS code uses the flows computed by MODFLOW in its transport calculations. MT3DMS can be utilized to simultaneously simulate the degradation of injected carbon and precipitation of chromium.

The model domain will then be prepared to evaluate IRZ by-product transport and attenuation downgradient from the IRZ under various injection and extraction scenarios for the full-scale system. The public domain code PHT3D is a multicomponent transport model for three-dimensional reactive transport in saturated porous media. PHT3D integrates MODFLOW, MT3DMS, and PHREEQC-2, enabling the assessment of flow, mass transport, and geochemical reactions (aqueous chemical speciation, distribution coefficients, kinetic rate parameters for reactions, and/or surface complexation reactions) at the site. This is a robust means to evaluate IRZ by-product transport. The model output will provide detailed information to guide the engineering design task while serving as a platform to evaluate the effects of design decisions on the by-product footprint. The model will be sufficiently detailed to enable incorporation of the current understanding of the floodplain aquifer as well as the variations in groundwater flow and geochemical reactions across the aquifer. This modeling will utilize the results of the work conducted under the geochemical modeling, both in terms of suitable input parameters as well as integration of the PHREEQC model into the flow model.

7.0 Project Organization and Management

As required by the CACA, this section describes the management approach for this project, including levels of authority and responsibility, lines of communication, and qualifications of key personnel. In addition, this section describes the general approach to health and safety, compliance, quality, and outreach throughout the design and implementation of the remedial action.

7.1 Project Commitment

PG&E is committed to implementing the design and remedial action in an effective manner that is safe, sustainable, and respectful to the sacredness and sensitivity of the cultural, historical, and biological resources at or near the Topock site, while complying fully with all regulatory mandates.

PG&E has chartered an implementation team (Section 7.2) with the accountability to ensure that the above commitment is fulfilled. General approaches to implementation in areas from health and safety, to compliance, to respect for sensitive cultural and biological resources are outlined in Section 7.3.

7.2 Project Organization

Figure 7-1 presents the overall PG&E Topock Groundwater Remedy Implementation Project Team organization chart. This project organization is intended to be a “living” element throughout the remedy implementation, meaning that it can be updated as new information becomes available as the design proceeds or as site circumstances change.

Exhibit 7-1 summarizes the qualifications and project roles of key personnel, their levels of authority and responsibility, and lines of communication.

The primary remedial design contractors (CH2M HILL and ARCADIS) report to Ms. Yvonne Meeks, the PG&E Project Manager, and are responsible for preparation of the design documents as required by the CACA and CERCLA, as well as the O&M Plan and the Construction/ Remedial Action Work Plan. Again, this is intended to be a living element of the remedy implementation that can be updated as project circumstances change. Note that in addition to CH2M HILL and ARCADIS, other qualified contractors may also be utilized to prepare select documents to comply with ARARs and mitigation measures (see Chapter 4 for a list of submittals and schedule).

At the time of this Work Plan, contractor(s) for the construction, the O&M of the groundwater remedy, and the preparation of required documents associated with these activities have not been identified.

EXHIBIT 7-1
Key Project Personnel, Qualifications, Levels of Authority and Responsibility, and Lines of Communication
Corrective Measures Implementation/Remedial Design Work Plan
PG&E Topock Compressor Station, Needles, California

Key Personnel	Summary of Qualifications, Project Role and Lines of Communication
Jane Yura	**PG&E Vice President of Gas Transmission and Distribution** Ms. Yura is the executive sponsor of the project and represents PG&E at the executive level on the Topock Leadership Partnership (TLP). Ms. Yura has served in this role since 2011.
Dave Gilbert	**PG&E Director of Chromium Remediation Program Office** Mr. Gilbert reports to Ms. Yura; he has the overall responsibility for the project direction and implementation, and represents PG&E at the executive level on the Clearinghouse Task Force (CTF). Mr. Gilbert has served in this role since 2006.
Juan Jayo	**Legal** Mr. Jayo reports to Mr. Gilbert; he has the overall responsibility for the legal aspects of the project. Mr. Jayo has served in this role since 2005.
Yvonne Meeks, P.G.	**PG&E Project Manager** Ms. Meeks reports to Mr. Gilbert; she is responsible for the technical direction and the day-to-day execution of the project. Ms. Meeks has served in this role since 2004.
Bob Doss, P.E.	**PG&E Project Engineer** Mr. Doss reports to Mr. Gilbert; he is responsible for assisting Ms. Meeks in the various aspects of execution of the project. Mr. Doss has served in this role since 2004
Curt Russell	**PG&E Topock Site Operations Manager** Mr. Russell reports to Mr. Gilbert; he is responsible for all aspects of Topock site/local operations related to the project. Mr. Russell has served in this role since 2005. For the groundwater remedy implementation, Mr. Russell is also a designated disturbance coordinator for noise/vibration.
Glenn Caruso	**PG&E Project Archaeologist** Mr. Caruso reports to Mr. Gilbert; he is the project liaison for issues related to cultural resources and historic properties. Mr. Caruso has served in this role since 2004.
Wes Rhodehamal	**PG&E Project Biologist** Mr. Rhodehamal reports to Ms. Meeks; he is the project liaison for issues related to biological resources. Mr. Rhodehamal has served in this role since 2011.
Chris Smith	**PG&E Site Compliance Management** Mr. Smith reports to Mr. Gilbert; he is responsible for the overall site compliance management activities. Mr. Smith has served in this role since 2005. For the groundwater remedy implementation, Mr. Smith is also a designated disturbance coordinator for noise/ vibration.
PG&E In-House Quality Assurance Team	**PG&E in-house subject matter experts** report to Ms. Meeks and will perform review/quality assurance of the remedial design documents prepared by the remedial design contractors. The engineering discipline reviewers will include, but not be limited to, structural, geotechnical, electrical, and instrumentation and controls.

7.3 General Implementation Approaches

7.3.1 Ensuring Protection of Human Health and the Environment

The PG&E Topock project team is committed to executing this project with zero safety incidents. Project protocols have been and will continue to be implemented and enforced to ensure safety for the project team members as well as site visitors, including Tribal Monitors, regulatory agencies, and interested stakeholders.

As the remedial design and the implementation of the remedial action progress, Health and Safety Plans (or addendums or revisions, as appropriate) will be prepared for future ground-disturbing field activities including, but not limited to, data collection to support design, construction, and O&M of the groundwater remedy. Each contractor performing field work will be responsible for preparing and complying with the standards and procedures in its project-specific health and safety plan. As required by the EIR mitigation measure HAZ-2c, project-specific health and safety plan(s) will be submitted to DTSC prior to beginning any ground disturbing activities. For protection of sensitive habitats and the environment, PG&E will implement protocols consistent with EIR mitigation measures and ARARs.

7.3.2 Ensuring Respect of the Sacredness and Sensitivity of the Cultural, Historical, and Biological Resources

PG&E is committed to implementing the design and remedial action in a manner that is respectful of the sacredness and sensitivity of the resources at and near the project area. To that end, PG&E and its contractors will fully comply with the mitigation measures set forth to minimize impacts to the sensitive resources as well as protocols and/or provisions that are forthcoming in the future Cultural Impact Minimization Plan and the Cultural Historic Properties Management Plan. For example, the EIR mitigation measures mandate that PG&E conduct specific outreach activities with Tribes and nearby communities, and report back to DTSC (via quarterly or annual reports). PG&E has included a template of the compliance report in Chapter 4 of this Work Plan for review and comment (see Exhibit 4-2).

7.3.3 Ensuring Opportunities for Inputs

The processes for remedial design and remedial action have incorporated steps for inputs from Tribes and stakeholders (Consultative Work Group and Technical Work Group). For example, input will be solicited on every work plan and design submittal. Comments/inputs received on these project documents will be reviewed by agencies, who will then direct PG&E to respond or incorporate the comments. As applicable, comment resolution meetings will be held to obtain clarification on the comments to ensure inputs are understood and accurately reflected.

In addition, both the state (DTSC) and federal (DOI) lead agencies have established programs related to Topock Community Outreach/Public Participation (DTSC, 2009; DOI, 2010c) to ensure that input from the community is reflected in remedial activities at Topock. PG&E will continue to provide support, as requested, by the agencies in their implementation of these programs.

7.3.4 Ensuring Compliance with ARARs, Mitigation Measures, and Other Agreements

The groundwater remedy is being implemented as required by RCRA Corrective Action and CERCLA. The groundwater remedy will be constructed, operated, monitored, and optimized to attain the RAOs. DTSC and DOI, as the lead agencies under the RCRA Corrective Action and CERCLA, have also identified additional requirements such as those contained in the CACA and the DTSC letter dated January 31, 2011 (DTSC, 2011b).

In addition to the requirements of the RCRA Corrective Action and CERCLA, implementation of the groundwater remedy will be guided by and held to standards required by the following main categories of requirements:

- ARARs specified in the Record of Decision (DOI, 2010a), including the Programmatic Agreement developed in compliance with the National Historic Preservation Act (BLM, 2010).
- CEQA mitigation measures defined by DTSC in the Final EIR (AECOM, 2011).
- Requirements of landowners and leaseholders of property and rights-of-way affected by groundwater remedy construction, operation and closure.

PG&E is committed to maintaining compliance with the identified requirements. Compliance will be demonstrated through submittal of information in design, operation, and closure plans; through implementation of defined field procedures; and through monitoring of activities and reporting of collected information.

Since the groundwater remedy is a CERCLA response action, activities conducted onsite are covered under the permit exemption codified in Section 121(e)(1) of CERCLA. While the permit exception applies to the administrative or procedural elements (e.g., preparing the submitting permit applications), the substantive requirements of ARARs remain. As described in Chapter 4, substantive information that might otherwise be included in a permit application to a local or state agency will instead be incorporated into design, construction, and operating plans submitted to DTSC and DOI. Offsite activities, such as transportation and disposal of waste in a permitted offsite facility, will comply with both substantive and administrative requirements of ARARs.

As part of the Final EIR, DTSC adopted a mitigation monitoring and reporting program to ensure that mitigation measures identified in the EIR are implemented and that implementation is documented (AECOM, 2011). PG&E will provide information to DTSC to document implementation and completion of identified mitigation measures.

PG&E will work directly with surrounding landowners and leaseholders of property and rights-of-way affected by groundwater remedy construction, operation, and closure, and will comply with conditions of agreements with these entities.

7.3.5 Ensuring Quality

Each contractor is responsible for performing quality control (QC) of its contracted work to manage, control, and document compliance with the requirements for remedy implementation. PG&E in-house subject matter experts will perform quality assurance (QA) during project implementation to ensure that the remedial design and remedial action meet project requirements. Quality Assurance Project Plans (QAPPs) will be prepared and included in the Construction/Remedial Action Work Plan and O&M Plan. For the long-term O&M of the groundwater remedy, an addendum to the current Topock Project QAPP or a separate QAPP will be prepared for use during this period.

7.3.6 Incorporation of Sustainability

Consistent with its existing corporate environmental policy framework, the PG&E team will work to integrate sustainability principles into the design and implementation of remedial action. The objectives are to evaluate benefits and costs of various sustainable strategies on the project and to document the results associated with application of sustainability practices (e.g., the amount of greenhouse gas reduced through the use of renewable energy like solar panels or through the specification of sustainable building materials).

7.3.7 Continuous Optimization of Processes and Resources

Implementation of the project through efficient use of processes and resources will save time and enable actual cleanup activities to begin sooner. Examples of specific approaches and tools that will be considered and implemented, as applicable, include the following:

- <u>Optimizing the remedial design/design review process</u> – e.g., implementation of a facilitated comment resolution process such as has been used successfully on previous Topock reports (e.g., the CMS/FS), as opposed to the traditional comment-response process, will save time.

- <u>Use of pre-qualified contractors, where appropriate</u> – e.g., use of pre-qualified contractors who have prior experience working at Topock will save time on procurement and reduce time spent on the learning curve. The disadvantage of this approach is lack of competition.

- <u>Consideration of detailed design specifications vs. performance-based specifications</u> – e.g., the advantage of using detailed design specifications is that a construction firm without design capabilities can bid on the construction of the project, thereby expanding competition. The disadvantage is that additional design effort and detail is required to prepare the specifications and drawings. The advantage of using performance-based specifications is the time savings at the front end for preparation of the specifications; however, additional time would most likely be required on construction procurement at the back end with this approach.

- <u>Phasing of construction and component startup</u> – e.g., it is not necessary to complete construction of all system components before start of cleanup. With careful planning, a phased approach to construction and system startup can save time and optimize the use of field resources.

8.0 References

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Tables

TABLE 2-1
Preliminary Framework for Corrective Measure/Remedial Action Monitoring Program
Corrective Measures Implementation/Remedial Design Work Plan
PG&E Topock Compressor Station, Needles, California

Monitoring Program	Primary Locations	Monitoring Objectives	Primary Constituents[1]	Frequency	Notes
Compliance Monitoring *(Outside the Plume)*	Monitoring wells west and north of fresh water injection wells	Evaluate performance to attain RAOs	Cr(VI) Redox-sensitive species	Monthly during initial phases of startup, reducing to quarterly or less frequent with time	
	Monitoring wells in East Ravine	Evaluate performance to attain RAOs	Cr(VI)	Quarterly or less frequently	
	Samples from Colorado River	Evaluate performance to attain RAOs	Cr(VI)	Quarterly	
Compliance Monitoring *(Inside the Plume)*	Monitoring wells	Evaluate progress towards attainment of RAOs	Cr(VI)	Annual or less frequently	
Process Control Monitoring	Monitoring wells west and north of fresh water injection wells	Confirm gradient control	NA	Monthly during initial phases of startup, reducing to quarterly or less frequent with time	Water level monitoring will be implemented in some of these wells. After the remedy is proven to be operating properly, the need for confirmation of gradient control ceases and water level monitoring will be discontinued.
	Monitoring wells in East Ravine	Confirm gradient control	NA	Quarterly or less frequently	Water level monitoring will be implemented in some of the East Ravine wells. After the remedy is proven to be operating properly, the need for confirmation of gradient control ceases and water level monitoring will be discontinued.
	Monitoring wells in floodplain	Confirm that carbon dosage is adequate, that Cr(VI) treatment is occurring, and that by-product behavior is as expected Confirm gradient control	Cr(VI) Redox-sensitive species TOC	Quarterly or more frequently	Water level monitoring will be implemented in some floodplain wells. After the remedy is proven to be operating properly, the need for confirmation of gradient control ceases and water level monitoring will be discontinued.
	Monitoring wells near carbon-amended injection wells	Confirm that carbon dosage is adequate, that Cr(VI) treatment is occurring, and that by-product behavior is as expected	Cr(VI) Redox-sensitive species TOC	Quarterly or more frequently	
	Water from River Bank and East Ravine extraction wells	Confirm that water is suitable for injection	Cr(VI) Redox-sensitive species TOC, TDS, Common ions Alkalinity	Quarterly or more frequently	
	Fresh water source	Confirm that water is suitable for injection	To be determined	To be determined	Constituents and frequency would be different depending on whether water is from wells in Arizona or from the Colorado river
	Process samples from carbon amendment mixing system	Confirm that carbon mixing system is properly functioning	TOC	Monthly during initial phases of startup, reducing to quarterly or less frequent with time	
	Monitoring wells between carbon-amended injection wells and the National Trails Highway IRZ	Monitor water quality upgradient of IRZ line and effects of carbon injection on water quality	Cr(VI) Redox-sensitive species TOC	Quarterly to semi-annual	Frequency variable based on location of monitoring well relative to carbon-amended water injection wells
	Process samples from remedy wastewater treatment system	Confirm quality of untreated and treated water	To be determined	To be determined	

Notes:
[1] Redox-sensitive species = dissolved iron, manganese, arsenic, nitrate, and sulfate.
Common ions = calcium, magnesium, sodium, potassium, chloride, carbonate, bicarbonate, sulfate, and phosphorus.

Cr(VI) = hexavalent chromium
IRZ = In-situ Reactive Zone
NA = not applicable
RAO = remedial action objective
TDS = total dissolved solids
TOC = total organic carbon

TABLE 4-1
Summary of 1996 CACA Requirements
Corrective Measures Implementation/Remedial Design Work Plan
PG&E Topock Compressor Station, Needles, California

Corrective Measures Implementation (CMI) Work Plan *Describes the size, shape, form, and content of the corrective measure, key components or elements needed, procedures and schedule for implementation*	**Draft Plans and Specs** *Info based on CMI Work Plan but include additional design detail, and drawings/specs needed to implement the CMI*	**Final Plans and Specs** *Info sufficient to be included in a contract document and be advertised for bid*	**Construction Completion Report** *Describes how the completed project is consistent with the final design plans and specifications*	**Corrective Measure Completion Report** *Describes how the criteria for the completion of the final groundwater remedy have been fully satisfied and to justify why the final groundwater remedy and/or monitoring may cease*
• Introduction/Purpose • Media cleanup standards • Conceptual model of contaminant migration • Description of Corrective Measures • Data sufficiency • Project management • Project schedule • Design criteria • Design basis • Conceptual process/schematic diagrams • Site plan showing preliminary plant layout and/or treatment area • Tables listing number and type of major components with approximately dimensions • Tables giving preliminary mass balances • Site safety and security provisions • Waste management practices • Required permits • Long-lead procurement considerations • Appendices including design data, equations, sample calculations, laboratory or field test results **Requirements for submittal concurrent with the CMI Work Plan** • *Health and Safety Plan (Attachment 2)*[1]	• General site plans • Process flow diagrams • Mechanical/electrical/structural drawings • Piping and instrumentation diagrams • Excavation and earthwork drawings • Equipment list • Site preparation and field work standards • Preliminary specs for equipment and materials **Requirements for submittal concurrent with the Draft Plans and Specs** • Draft O&M Plan - Project management - System description - Personnel training - Startup procedures - O&M procedures - Equipment replacement schedule - Waste management practices - Sampling and monitoring - Corrective measure completion criteria - O&M contingency procedures - Data management and documentation requirements • Draft Construction Work Plan - Project management - Project schedule - Construction QA/QC program - Waste management procedures - Sampling and monitoring - Construction contingency procedures - Data management and documentation requirements - Cost estimates (if financial assurance is required)	• General site plans • Process flow diagrams • Mechanical/electrical/structural drawings • Piping and instrumentation diagrams • Excavation and earthwork drawings • Equipment list • Site preparation and field work standards • Construction drawings • Installation drawings • Detailed specs for equipment and materials **Requirements for submittal concurrent with the Final Plans and Specs** • Final O&M Plan - Project management - System description - Personnel training - Startup procedures - O&M procedures - Equipment replacement schedule - Waste management practices - Sampling and monitoring - Corrective measure completion criteria - O&M contingency procedures - Data management and documentation requirements • Final Construction Work Plan - Project management - Project schedule - Construction QA/QC program - Waste management procedures - Sampling and monitoring - Construction contingency procedures - Data management and documentation requirements - Cost estimates (if financial assurance is required)	• Purpose • Synopsis of the final corrective measure, design criteria, and certification that the final corrective measure was constructed in accordance with the final design plans and specifications • Explanation and description of any modifications to the final design plans and specifications and why the modifications were necessary • Results of any operational testing and/or monitoring which may indicate how initial operation of the final groundwater remedy compares to the design criteria • Summary of significant activities that occurred during construction • Summary of any inspection findings • As-built drawings • A schedule indicating when treatment systems will begin full scale operations	• Purpose • Synopsis • Corrective measure completion criteria, including a description of the process and criteria for determining when corrective measures, maintenance, and monitoring may cease. • Demonstration that the completion criteria have been met including results of testing and monitoring • Summary of work accomplishments • Summary of significant activities that occurred during operations • Summary of inspection findings • Summary of total O&M costs

Note:
Source = Attachment 6 (Statement of Work for Corrective Measure Implementation) to the Corrective Action Consent Agreement, Pacific Gas and Electric Company's Topock Compressor Station, Needles, California (DTSC, 1996).
[1] Clarifications on the timing of the Health and Safety plan was obtained from DTSC -- Consistent with the EIR mitigation measure HAZ-2c, Health and Safety Plans (or addendums or revisions, as appropriate) will be prepared for future ground-disturbing field activities including, but not limited to, data collection to support design, construction, and O&M of the groundwater remedy.

TABLE 4-2
Summary of 2009 CERCLA Model Remedial Design/Remedial Action Consent Decree Requirements
Corrective Measures Implementation/Remedial Design Work Plan
PG&E Topock Compressor Station, Needles, California

Remedial Design Work Plan *Describes the design of the remedy and achievement of the Performance Standards and other requirements set forth in the ROD and the Consent Decree. (Includes a Health and Safety Plan [HSP])*	**Preliminary Design (30%)** *Provides plans and specifications for construction of the remedial action (RA)*	**Intermediate Design (60%)** *Continuation and expansion of the preliminary design*	**Pre Final (90%) and Final Design (100%)** *Final plans and specifications for construction of the RA*
• Includes plans and schedules for implementation of all remedial design and pre-design tasks identified in the SOW, including but not limited to, plans and schedules for the completion of a list based on site-specific factors including: • Design sampling and analysis plan (including but not limited to, a RD QAPP) • Construction Quality Assurance Plan • Treatability study • Pre-design work plan • Preliminary design submission • Intermediate design submission • Pre-final/final design submission • Schedule for completion of the RAWP	• Design Criteria • Basis of Design (design assumptions, permit plans, prelim easements/access requirements, prelim process & instrumentation diagrams [P&IDs]) • Results of treatability studies • Results of additional field sampling and pre-design work • Project delivery strategy • Preliminary plans, drawings and sketches • Required specifications in outline form • Results of value engineering screen • Prelim construction schedule/cost estimates	• Basis of Design (design assumptions, permit plans, prelim easements/access requirements, P&IDs) • Drawings/specs (incl. O&M requirements) • RA schedule/cost estimates	• Final Basis of Design • Final plans and specifications • RA schedule • Refined cost estimates **Requirements for submittal concurrent with the Pre Final Design** • O&M Plan • Field Sampling Plan (directed at measuring progress towards meeting performance standards) • Contingency Plan • HSP • Construction Quality Assurance and Control (CQA/QC) plan - Construction quality assurance objectives, specific quality control requirements and performance standards to be followed during implementation of remedial actions - Identification of responsibilities and authorities of all organizations and key personnel involved in the design and construction of the site remediation - Description of the construction quality assurance personnel qualifications - Description of inspection activities, observation and tests to be conducted, schedules, and scope

Remedial Action Work Plan (RAWP) *Describes the plans and schedules for construction and implementation of the remedy set forth in the remedial design plans and specifications*	**Progress Reports** *Describes actions that have been taken toward achieving compliance with the Consent Decree*	**RA Construction Completion Report** *Describes how the criteria for the completion of the final groundwater remedy have been fully satisfied and to justify why the final groundwater remedy and/or monitoring may cease*	**Certification of Completion of RA** *Requests certification from Lead Federal Agency upon conclusion that the RA has been fully performed and the Performance Standards have been achieved.*
• Revised HSP • Schedule for completion of RA tasks • Method for selecting contractor • Schedule for submitting other RA-required plans • Groundwater monitoring plan • Method for implementing CQAPP/O&M Plan/Contingency Plan • Methods for satisfying permit requirements • Tentative formulation of the remedial action team • Contractor construction quality assurance plan • Decontamination procedures and disposal of materials • Requirements for project closeout	• Include a summary of all results of sampling and tests and all other data received or generated since the last progress report • Identify all plans, reports, and other deliverables required by the Consent Decree that were completed since the last progress report. • Describe all actions, including but not limited to, data collection and implementation of work plans, which are scheduled before the next progress report is due and provide other information related to the progress of construction, including, but not limited to critical path diagrams, Gantt charts, and Pert charts • Include information regarding percentage of completion, unresolved delays encountered or anticipated that may affect the future schedule for implementation, and a description of the efforts made to mitigate those delays. • Include any modifications to the work plans or other schedules that have been proposed or approved. • Describe all activities undertaken in support of the Community Relations Plan since the last progress report and upcoming activities.	• Purpose • Synopsis • Corrective measure completion criteria, including a description of the process and criteria for determining when corrective measures, maintenance, and monitoring may cease. • Demonstration that the completion criteria have been met including results of testing and monitoring • Summary of work accomplishments • Summary of significant activities that occurred during operations • Summary of inspection findings • Summary of total O&M costs **Requirements for submittal concurrent with the Construction Completion Report** • Post-Achievement O&M Plan: - Activities needed to maintain Performance Standards after they have been achieved.	• Documentation of pre- certification inspection and completion of all work. • Statement that the remedial action has been completed in full satisfaction of the requirements of the Consent Decree. • As built drawings

Note:
Source = Model RD/RA Consent Decree (October 2009) from USEPA's Remedial Action/Remedial Design web page: http://www.epa.gov/superfund/cleanup/rdra.htm

TABLE 4-3
"Road Map" of Key Future Documents
Corrective Measures Implementation/Remedial Design Work Plan
PG&E Topock Compressor Station, Needles, California

Remedial Design	Pre-Construction	Construction	Operation	Closure	Post-Closure	Decommissioning of Remedial Facilities
Key Documents Required by Corrective Action Consent Agreement (CACA)/Record of Decision (ROD)/ 2009 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Model Consent Decree/Settlement Agreement [1]						
• Preliminary Design Submittals • Intermediate Design Submittals • Final Design Submittals (includes Cultural Impact Mitigation Plan [CIMP] [2] which contains the plan for decommissioning and removal of IM No. 3 facility and site restoration [3]) • Health and Safety Plan • O&M Plan • Construction/Remedial Action Work Plan [4] • Documents required to establish institutional control(s)	• Health and Safety Plan • Documents required for access (e.g., easements, rights-of-way [ROWs])/approvals)	• Corrective Measure/ Remedial Action Construction Completion Report • Documents required for access (e.g., easements, ROWs)/approvals	• Performance monitoring reports • Five-year review reports • Documents required by access agreements/ approvals	• Corrective Measure/ Remedial Action Completion Report • Closure plan for decommissioning of remedial facilities and restoration • Closure documents required by access agreements/ approvals	• Post-closure monitoring reports • Post closure documents required by access agreements/ approvals	• Completion report
Key Documents Required by Environmental Impact Report (EIR) Mitigation Measures [5]						
• CIMP [2] (include plan for decommissioning and removal of IM No. 3 facility and site restoration [3], plant transplantation/ monitoring plan [if needed]) • Site Security Plan [6, 7] • Grading and Erosion Control Plan [6] • Storm Water Pollution Prevention Plan (SWPPP)/Best Management Practice (BMP) plans and Monitoring & Reporting [6] • Fueling SOPs and Contingency Plan for Onsite Fueling Areas [6] • Soil Management Plan [6] • Hazardous materials business plan • Access plan [7, 8] • Aerial map of disturbed areas • Map of existing mature plant species/indigenous plant species • Map of ordinary high water mark • Hydrologic analysis • Cultural resources study/Geoarchaeological investigation report • Cultural resources treatment plan (if needed) • Revegetation plans and specifications • Delineation of waters and wetlands field survey addendum • Avoidance and minimization plan for special-status birds [9] • Habitat restoration plan for sensitive habitats and special-status species • Quarterly EIR mitigation measures compliance reports • Annual cultural resources monitoring reports [10] • Training/education manual for cultural resources, historical resources, and the identification of human remains	• Paleontological investigation report [6] • Worker cultural sensitivity education program [7] • Training/education manual for cultural resources, historical resources, and the identification of human remains • Health and Safety Plan [6] • Quarterly EIR mitigation measures compliance reports • Annual cultural resources monitoring reports [10]	• Quarterly EIR mitigation measures compliance reports • Annual cultural resources monitoring reports [10]	• Annual EIR mitigation measures compliance reports • Annual cultural resources monitoring reports [10]	• Annual EIR mitigation measures compliance reports • Annual cultural resources monitoring reports [10]	• Annual EIR mitigation measures compliance reports • Annual cultural resources monitoring reports [10]	• Annual EIR mitigation measures compliance reports • Annual cultural resources monitoring reports [10]
Key Documents Required by Applicable or Relevant and Appropriate Requirements (ARARs)						
• Programmatic Biological Agreement (PBA) Addendum in conformance with the substantive requirements of the federal Endangered Species Act • Other documents with substantive information normally contained in permit applications (e.g., Report of Waste Discharge) or plans (e.g., SWPPP).	• Documents with substantive information normally contained in permit applications (e.g., Report of Waste Discharge) or plans (e.g., SWPPP)	• Documents with substantive information normally required by permits	• Documents with substantive information normally required by permits	• Documents with substantive information normally required by permits	• Documents with substantive information normally required by permits	• Documents with substantive information normally required by permits

TABLE 4-3
"Road Map" of Key Future Documents
Corrective Measures Implementation/Remedial Design Work Plan
PG&E Topock Compressor Station, Needles, California

Remedial Design	Pre-Construction	Construction	Operation	Closure	Post-Closure	Decommissioning of Remedial Facilities
Key Documents Required by Programmatic Agreement (PA)						
• Documents related to Ongoing Consultation [11] • Tribal Access Plan [8,11] • Cultural Historic Property Management Plan (CHPMP) (include Plan of Action for discoveries and Treatment Plan) [11] • Plan for decommissioning, removal, and restoration of IM No. 3 facility [3] • Brochure [7, 11] • Annual Report [11]	• Documents related to ongoing consultation [11] • Annual Report [11]	• Documents related to ongoing consultation [11] • Annual Report [11]	• Documents related to Ongoing Consultation [11] • Annual Report [11]	• Documents related to ongoing consultation [11] • Annual Report [11] • Closure plan for decommissioning of remedial facilities and restoration (prior to decommissioning of any remedial facility)	• Documents related to ongoing consultation [11] • Annual Report [11]	• Documents related to ongoing consultation [11] • Annual Report [11]

Notes:

1 At any phase of project implementation (after final design), agencies could determine that the Interim Measure (IM) is no longer required and that decommissioning of IM No. 3 facility can occur. After the decommissioning and site restoration is complete, a closure report for the IM will be prepared and submitted for approval.

2 EIR Mitigation Monitoring and Program (MMRP) CUL-1a-8 requires that the CIMP be submitted as part of the final remedial design, and that the plan for decommissioning and removal of IM No. 3 facility, and site restoration be included as an appendix to the CIMP.

3 In conformance with the EIR MMRP CUL-1a-8f, Stipulation V(E) of the PA, and PG&E's Settlement Agreement with the Fort Mojave Indian Tribe, a plan for decommissioning, removal and restoration of IM No. 3 facility will be prepared.

4 Combined Construction Work Plan (CACA required) and Remedial Action Work Plan (CERCLA required).

5 Documents related to EIR mitigation measure BIO-3 (e.g., fish rescue plan, in-stream habitat typing survey report) will not be prepared at this time as the current design focuses on production well(s) in Arizona, and not river water, as a source for fresh water.

6 EIR-required construction related plans to be included as part of the Corrective Measure Construction/Remedial Action Work Plan, the Plan for decommissioning, removal, and restoration for IM No. 3 facility, and Closure Plan for decommissioning of remedial facilities and restoration.

7 There is a discrepancy in the reporting timing required by the EIR MMRP for the Communication Log with Tribes, Security Plan, Access Plan, and Worker Cultural Sensitivity Training. This Corrective Measures Implementation/Remedial Design Work Plan will provide the framework and schedule for development of these documents.

8 EIR-required Access Plan and PA-required Tribal Plan could be combined. Schedule for the Access Plan will be available after coordination with the U.S. Bureau of Land Management (BLM).

9 Combine with Programmatic Biological Agreement Addendum.

10 EIR MMRP CUL-1a-3a requires yearly inspections (or less frequently upon approval by DTSC) of identified historical resources, including inspections of the Topock Cultural Area. Information obtained from the required inspections will be incorporated into the Annual Monitoring Reports required under the Cultural Resources Management Plan.

11 Documents to be prepared by BLM.

TABLE 4-4
Correlation of EIR Mitigation Measures and Future Documents
Corrective Measures Implementation/Remedial Design Work Plan
PG&E Topock Compressor Station, Needles, California

Resources	Mitigation Number	Timing/Schedule	Which Future Document(s) Will Contain or Satisfy This Measure?
Aesthetics	AES-1a	During design and before construction	Map of mature plant species; design submittals
	AES-1b	During design and before construction	Revegetation Plan
	AES-1c	During design and before construction	Revegetation Plan
	AES-1d	During design and before construction	Design submittals
	AES-1e	During design and before construction	Revegetation Plan
	AES-2a	During design and before construction	Map of ordinary high water mark; design submittals
	AES-2b	During design and before construction	Design submittals
	AES-2c	During design and before construction	Revegetation Plan
	AES-2d	During design and before construction	Revegetation Plan
	AES-2e	During design and before construction	Design submittals
	AES-2f	During design and before construction	Revegetation Plan
	AES-3	During design and before construction	Design submittals
Air Quality	AIR-1a	During construction and demolition	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of Cultural Impact Mitigation Plan [CIMP]); Closure Plan for Decommissioning of Remedy Facilities and Restoration
	AIR-1b	During construction and demolition	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
	AIR-1c	During construction and demolition	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
	AIR-1d	During construction and demolition	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
	AIR-1e	During construction and demolition	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration

TABLE 4-4
Correlation of EIR Mitigation Measures and Future Documents
Corrective Measures Implementation/Remedial Design Work Plan
PG&E Topock Compressor Station, Needles, California

Resources	Mitigation Number	Timing/Schedule	Which Future Document(s) Will Contain or Satisfy This Measure?
Biological Resources	BIO-1	During design and before construction (not including East Ravine under the December 2010 East Ravine Revised Addendum, Groundwater Investigation)	Delineation of Waters and Wetlands Field Survey Addendum; Habitat Restoration Plan
	BIO-2a	Before and during construction	Avoidance and Minimization Plan; Construction/ Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
	BIO-2b	Before and during construction activities (except within the East Ravine for which potential effects to the tortoise have been considered per the Programmatic Biological Agreement (PBA) and those areas that are no longer considered suitable habitat for desert tortoise per previous biological surveys)	Construction/ Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
	BIO-2c	During the design and planning of decommissioning activities and before decommissioning activities that have the potential to result in ground disturbance	Avoidance and Minimization Plan; Habitat Restoration Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
	BIO-3a	During construction activities	NA – design will focus on fresh water source from production well(s) in Arizona
	BIO-3b	Before operation of the intake structure	NA – design will focus on fresh water source from production well(s) in Arizona
	BIO-3b	Before operation of the intake structure	NA – design will focus on fresh water source from production well(s) in Arizona
	BIO-3c	During design and operation of the intake structure	NA – design will focus on fresh water source from production well(s) in Arizona
Cultural Resources	CUL-1a-1	During the design, construction, O&M, and decommissioning phases	Training manual for cultural resources
	CUL-1a-2	During the design, construction, O&M, and decommissioning phases	Access Plan; Communication Log with Tribes (part of the EIR mitigation measure compliance reports)
	CUL-1a-3a	During the design, construction, O&M, and decommissioning phases	Annual cultural resources monitoring report
	CUL-1a-3b	During the design, construction, O&M, and decommissioning phases	Site security plan; reporting of human-caused disturbances (part of the EIR mitigation measure compliance reports)
	CUL-1a-3c	During the design, construction, O&M, and decommissioning phases	Design submittals
	CUL-1a-3d	During the design, construction, O&M, and decommissioning phases	Design submittals

TABLE 4-4
Correlation of EIR Mitigation Measures and Future Documents
Corrective Measures Implementation/Remedial Design Work Plan
PG&E Topock Compressor Station, Needles, California

Resources	Mitigation Number	Timing/Schedule	Which Future Document(s) Will Contain or Satisfy This Measure?
	CUL-1a-4	During the design, construction, O&M, and decommissioning phases	EIR mitigation measures compliance reports (quarterly during design /construction, annual during project operation)
	CUL-1a-5	During the design, construction, O&M, and decommissioning phases	Survey of indigenous plant species; Plant transplantation/ monitoring plan (if needed) (part of CIMP)
	CUL-1a-6	During the design, construction, O&M, and decommissioning phases	Design submittals
	CUL-1a-7	During the design, construction, O&M, and decommissioning phases	Design submittals
	CUL-1a-8a	During the design, construction, O&M, and decommissioning phases	EIR mitigation measures compliance reports (quarterly during design /construction, annual during project operation)
	CUL-1a-8b	During the design, construction, O&M, and decommissioning phases	CIMP
	CUL-1a-8c	During the design, construction, O&M, and decommissioning phases	CIMP
	CUL-1a-8d	During the design, construction, O&M, and decommissioning phases	CIMP
	CUL-1a-8e	During the design, construction, O&M, and decommissioning phases	CIMP
	CUL-1a-8f	During the design, construction, O&M, and decommissioning phases	Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (appendix to the CIMP)
	CUL-1a-8g	During the design, construction, O&M, and decommissioning phases	CIMP
	CUL-1a-8h	During the design, construction, O&M, and decommissioning phases	CIMP
	CUL-1a-8i	During the design, construction, O&M, and decommissioning phases	CIMP
	CUL-1a-8j	During the design, construction, O&M, and decommissioning phases	CIMP
	CUL-1a-8k	During the design, construction, O&M, and decommissioning phases	CIMP
	CUL-1a-8l	During the design, construction, O&M, and decommissioning phases	CIMP
	CUL-1a-8m	During the design, construction, O&M, and decommissioning phases	CIMP
	CUL-1a-8n	During the design, construction, O&M, and decommissioning phases	CIMP
	CUL-1a-8o	During the design, construction, O&M, and decommissioning phases	CIMP
	CUL-1a-8p	During the design, construction, O&M, and decommissioning phases	CIMP

TABLE 4-4
Correlation of EIR Mitigation Measures and Future Documents
Corrective Measures Implementation/Remedial Design Work Plan
PG&E Topock Compressor Station, Needles, California

Resources	Mitigation Number	Timing/Schedule	Which Future Document(s) Will Contain or Satisfy This Measure?
	CUL-1a-9	During the design phase	Aerial map of disturbed areas
	CUL-1a-10	During the design phase	Design submittals
	CUL-1a-11	During the design and construction phases	Annual reporting of activities under grant program (part of the EIR mitigation measure compliance reports)
	CUL-1a-12	During the construction phase	Construction/ Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
	CUL-1a-13	During the construction and operations/ maintenance phase	Worker Cultural Sensitivity Education Program
	CUL-1b and 1c	During the design phase	Design submittals
	CUL-1b/c-1	During the design phase	Design submittals
	CUL-1b/c-2	During the design phase	Cultural resources study/Geoarchaelogical investigation report
	CUL-1b/c-3	During the design phase	Cultural resources treatment plan (if needed)
	CUL-1b/c-4	During the construction phase	Training material for historic resources
	CUL-2	Before completion of the final project design, during design of the proposed project and prior to ground- disturbing activities	Cultural resources study/Geoarchaelogical investigation report; cultural resources treatment plan (if needed)
	CUL-3	Before and during construction	Paleontological investigation report
	CUL-4	In concert with ground- disturbing activities throughout the remediation process	Training material for the identification of human remains
	CUL-4f	In concert with ground- disturbing activities throughout the remediation process	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
	CUL-4g	In concert with ground- disturbing activities throughout the remediation process	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
	CUL-4h	In concert with ground- disturbing activities throughout the remediation process	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
	CUL-4i	In concert with ground- disturbing activities throughout the remediation process	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration

TABLE 4-4
Correlation of EIR Mitigation Measures and Future Documents
Corrective Measures Implementation/Remedial Design Work Plan
PG&E Topock Compressor Station, Needles, California

Resources	Mitigation Number	Timing/Schedule	Which Future Document(s) Will Contain or Satisfy This Measure?
	CUL-4j	In concert with ground- disturbing activities throughout the remediation process	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
	CUL-4k	In concert with ground- disturbing activities throughout the remediation process	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
	CUL-4l	In concert with ground- disturbing activities throughout the remediation process	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
Geology & Soils	GEO-1a-a	Before any ground disturbing activities begin and during project-related ground disturbing activities, except activities included as part of the East Ravine Revised Addendum, Groundwater Investigation	Grading and Erosion Control Plan; Corrective Measure Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
	GEO-1a-b	Before any ground disturbing activities begin and during project-related ground disturbing activities, except activities included as part of the East Ravine Revised Addendum, Groundwater Investigation	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
	GEO-1a-c	Before any ground disturbing activities begin and during project-related ground disturbing activities, except activities included as part of the East Ravine Revised Addendum, Groundwater Investigation	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
	GEO-1a-d	Before any ground disturbing activities begin and during project-related ground disturbing activities, except activities included as part of the East Ravine Revised Addendum, Groundwater Investigation	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
	GEO-1b-a	During the construction, operation and maintenance, and decommissioning activities	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
	GEO-1b-b	During the construction, operation and maintenance, and decommissioning activities	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration

TABLE 4-4
Correlation of EIR Mitigation Measures and Future Documents
Corrective Measures Implementation/Remedial Design Work Plan
PG&E Topock Compressor Station, Needles, California

Resources	Mitigation Number	Timing/Schedule	Which Future Document(s) Will Contain or Satisfy This Measure?
	GEO-1b-c	During the construction, operation and maintenance, and decommissioning activities	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
Hazardous Materials	HAZ-1a-a	During operation and maintenance activities	O&M Plan
	HAZ-1a-b	During operation and maintenance activities	O&M Plan
	HAZ-1a-c	During operation and maintenance activities	Project-specific hazardous material business plan; O&M Plan
	HAZ-1b-a	During construction and decommissioning activities	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
	HAZ-1b-b	During construction and decommissioning activities	Fueling SOPs and Contingency Plan for Onsite Fueling Areas; Corrective Measure Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
	HAZ-1b-c	During construction and decommissioning activities	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
	HAZ-2	Before commencement of any ground disturbing activities and during construction, operation and maintenance, and decommissioning activities that could have potential to disturb the ground surface	Health and Safety Plan
	HAZ-2a	Before commencement of any ground disturbing activities and during construction, operation and maintenance, and decommissioning activities that could have potential to disturb the ground surface	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan
	HAZ-2b	Before commencement of any ground disturbing activities and during construction, operation and maintenance, and decommissioning activities that could have potential to disturb the ground surface	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration

TABLE 4-4
Correlation of EIR Mitigation Measures and Future Documents
Corrective Measures Implementation/Remedial Design Work Plan
PG&E Topock Compressor Station, Needles, California

Resources	Mitigation Number	Timing/Schedule	Which Future Document(s) Will Contain or Satisfy This Measure?
	HAZ-2c	Before commencement of any ground disturbing activities and during construction, operation and maintenance, and decommissioning activities that could have potential to disturb the ground surface	Health and Safety Plan; Soil Management Plan
	HAZ-2d	Before commencement of any ground disturbing activities and during construction, operation and maintenance, and decommissioning activities that could have potential to disturb the ground surface	Health and Safety Plan
	HAZ-2e	Before commencement of any ground disturbing activities and during construction, operation and maintenance, and decommissioning activities that could have potential to disturb the ground surface	Health and Safety Plan
	HAZ-2f	Before commencement of any ground disturbing activities and during construction, operation and maintenance, and decommissioning activities that could have potential to disturb the ground surface	Soil Management Plan
Hydrology and Water Quality	HYDRO-1	Before and during activities in the project area	O&M Plan; Storm Water Pollution Prevention Plan (SWPPP)/ Best Management Practices (BMP) Plan and Monitoring and Reporting
	HYDRO-2	During construction, operation and maintenance, and decommissioning	SWPPP/BMP Plan and Monitoring and Reporting
	HYDRO-3	During construction, operation and maintenance, and decommissioning	SWPPP/BMP Plan and Monitoring and Reporting
Noise	NOISE-1a	Upon commencement of construction activities being performed in proximity to vibration-sensitive receptors	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
	NOISE-1b	Upon commencement of construction activities being performed in proximity to vibration-sensitive receptors	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
	NOISE-2a	Upon commencement of construction activities being performed in proximity to vibration-sensitive receptors	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
	NOISE-2b	Upon commencement of construction activities being performed in proximity to vibration-sensitive receptors	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration

TABLE 4-4
Correlation of EIR Mitigation Measures and Future Documents
Corrective Measures Implementation/Remedial Design Work Plan
PG&E Topock Compressor Station, Needles, California

Resources	Mitigation Number	Timing/Schedule	Which Future Document(s) Will Contain or Satisfy This Measure?
	NOISE-2c	Upon commencement of construction activities being performed in proximity to vibration-sensitive receptors	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
	NOISE-2d	Upon commencement of construction activities being performed in proximity to vibration-sensitive receptors	Corrective Measure Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
	NOISE-3a	Prior to the commencement of construction activities being performed and on at least an annual basis	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
	NOISE-3b	Prior to the commencement of construction activities being performed and on at least an annual basis	Construction/Remedial Action Work Plan; Plan for Decommissioning and Removal of IM No. 3 Facility and Site Restoration (part of CIMP); Closure Plan for Decommissioning of Remedy Facilities and Restoration
Water Supply	WATER-1	During final project design and before final approval of the design of this project component	Hydrologic Analysis; Design submittals

TABLE 4-5
Content of Selected Key Documents During Design
Corrective Measures Implementation/Remedial Design Work Plan
PG&E Topock Compressor Station, Needles, California

Design Submittals			**Operation and Maintenance (O&M) Plan**	**Construction/Remedial Action Work Plan**
Preliminary	**Intermediate**	**Final**	**Key Elements**	**Key Elements**
• **Prelim Basis of Design Report** - Design assumptions, calculations - Design criteria - O&M provisions - Additional design data mapped, surveyed, or collected post Corrective Measures Study/Feasibility Study (CMS/FS) - Equipment list - Long-lead procurement considerations - Updated schedule and cost estimates • **Prelim Plans** - Site plans - Engineering/architectural drawings - Process flow diagrams (PFDs) - Process and instrumentation diagrams (P&IDs) • **Prelim Specifications** - List of specifications	• **Intermediate Basis of Design Report** - Design assumptions, calculations - Design criteria - Additional design data mapped, surveyed, or collected post CMS/FS - Equipment list - Long-lead procurement considerations - Updated schedule and cost estimates • **Intermediate Plans** - Site plans - Engineering/architectural drawings - Excavation/earthwork drawings - PFDs - P&IDs • **Intermediate Specifications** - Draft specifications	• **Final Basis of Design Report** - Design assumptions, calculations - Design criteria - Additional design data mapped, surveyed, or collected post CMS/FS - Equipment list - Long-lead procurement considerations - Updated schedule and cost estimates • **Final Plans** - Site plans - Engineering/architectural drawings - Excavation/earthwork drawings - Construction/installation drawings - PFDs - P&IDs • **Final Specifications** - Detailed specifications	• Project management and organization • Communication procedures and protocols • System description • Personnel training • Start-up procedures • O&M procedures - description of tasks for operation and maintenance, description of prescribed treatment or operation conditions, O&M schedule • Equipment replacement schedule • Waste management practices, including types of wastes to be generated and how each type of waste will be managed • Sampling and monitoring plan during system operation (including data quality objectives, Quality Assurance Project Plan) • O&M QA/QC Plan • Corrective measure completion criteria • O&M contingency plans to address potential failure modes, e.g., - Related to attainment of RAOs and ARARs compliance - Related to system breakdowns and operational problems - Related to major operational problems and is not performing to design specifications - Related to unforeseen events that prevent the operation of the groundwater remedy (e.g., acts of God like earthquakes, flooding, fires) • Data management and documentation requirements, including a description of how analytical data and results will be evaluated, documented, and managed • Details for the collection/maintenance of information • Summary of access, approvals, and substantive requirements of ARARs associated with operation	• Project management and organization • Communication procedures and protocols • Project schedule, including timing of key elements for bidding purposes, timing of the initiation and completion of all major tasks, and when the construction completion report will be submitted • Construction QA/QC Program which is intended to ensure that the groundwater remedy will meet all design criteria, plans, and specifications • Waste management procedures, including wastes to be generated during construction and how they will be managed • Site preparation and field work standards • Sampling and monitoring plan during construction • Construction contingency plans to address potential failure modes, e.g., - Related to changes to the design and/or specifications due to issues that may arise during construction - Related to unforeseen events that prevent the construction of the groundwater remedy (e.g., acts of God like earthquakes, flooding, fires) • Data management and documentation requirements, including a description of how analytical data and results will be evaluated, documented, and managed • Details for the collection/maintenance of information • Summary of access, approvals, and substantive requirements of ARARs associated with construction
Other Submittals Concurrent with or Included in Design Submittals			**Other Submittals Concurrent with or Included in the O&M Plan**	**Other Submittals Concurrent with or Included in the Construction/ Remedial Action Work Plan**
• Aerial map of disturbed areas • Map of mature plant species and indigenous species listed in Appendix PLA of the EIR • Map of ordinary high water mark • Delineation of waters and wetlands field survey addendum	• O&M Plan • Corrective Measure Construction/Remedial Action Work Plan • Programmatic Biological Agreement (PBA) Addendum/Avoidance and minimization plan • Habitat restoration plan for sensitive habitats and special-status species • Revegetation plan • Cultural resources study/ Geoarchaeological investigation report • Cultural resources treatment plan (if needed) • Hydrologic analysis	• O&M Plan • Corrective Measure Construction/Remedial Action Work Plan • CIMP (include plan for decommissioning and removal of IM No. 3 facility and site restoration, plant transplantation/ monitoring plan (if needed))	• Health and Safety Plan for O&M • Hazardous materials business plan (HAZ-1a-c)	• Health and Safety Plan for Construction (HAZ-2) • Site Security Plan (CUL-1a-3b) • Grading and Erosion Control Plan (GEO-1a-a) • Storm Water Pollution Prevention Plan (SWPPP)/BMP plans and Monitoring & Reporting (HYDRO-1) • Fueling SOPs and Contingency Plan for Onsite Fueling Areas (HAZ-1b-b) • Soil Management Plan (HAZ-2c) • Paleontological investigation report (CUL-3)

TABLE 6-1
Design Data Collection Activities in 2011
Corrective Measures Implementation/Remedial Design Work Plan
PG&E Topock Compressor Station, Needles, California

Activity	Scope	Expected Schedule
East Ravine and Topock Compressor Station Groundwater Investigation	Conduct additional groundwater characterization to evaluate data gaps in the East Ravine area and to collect groundwater data from under the Compressor Station, where minimal characterization data have been collected to date.	Ongoing through the Fall of 2011
Mapping of Disturbed Areas (as defined in EIR mitigation measure CUL-1a-9)	The project area will be mapped to identify the disturbed areas. "Disturbed" areas in this context means those areas outside of documented archaeological site boundaries that have experienced ground disturbance in the last 50 years. A set of aerial maps showing these disturbed areas will be prepared to guide project design.	Ongoing through Summer of 2011
Inventory of Existing Infrastructure (in areas relevant to the project) and Usability Evaluation	Obtain detailed information on many aspects of the Compressor Station facilities and nearby site features. This information will be gathered through meetings, document review and site visits. It will include information about the existing fresh water supply system, cooling water system, evaporation ponds, electrical power supply, and existing utilities or infrastructure, including those owned by other entities. Any feature that could interact with the groundwater remedy construction or operation will be investigated to an extent such that it can be incorporated into the design. Before the preliminary design begins, PG&E will evaluate the ability (structural and physical space capacity) of the arched pipeline bridge to accommodate a pipe bringing the fresh water source from a water supply well in Arizona. If the bridge does not have sufficient capacity, then an alternate route crossing the Colorado River would be designed. This decision would potentially trigger additional design data needs.	Summer 2011
Pump Tests	Perform pumping tests on select monitoring, extraction, or supply wells and use transducers or tracers to monitor response in pumping well and observation wells.	Summer 2011
Topographic Survey (in areas where new remedial facilities could be located)	Topographic surveying will be accomplished by aerial photogrammetry supplemented by ground surveying. Figure 6-1 shows the planned survey areas. The topographic survey will be completed prior to the preliminary design.	Summer 2011

TABLE 6-1
Design Data Collection Activities in 2011
Corrective Measures Implementation/Remedial Design Work Plan
PG&E Topock Compressor Station, Needles, California

Activity	Scope	Expected Schedule
Underground Utility Identification and Location (in areas along project utility corridors)	Underground utility location will be accomplished by non-intrusive geophysical surveying methods.	Summer 2011
Mapping of Ordinary High Water Mark (along the river bank)	A map of the ordinary high water mark along the river bank will be prepared and incorporated into the design.	Summer 2011
Field Verification of Jurisdictional Waters and Wetlands (within the project area)	A qualified wetlands biologist will conduct field verification of potential wetland areas located within the project area. An addendum to the 2005 report (CH2M HILL, 2005) and to the extent necessary, the 2010 surveys (CH2M HILL, 2010c and 2010d), will be prepared for submittal to the U.S. Army Corps of Engineers (USACE) and California Department of Toxic Substances Control (DTSC).	Summer 2011
Mapping of Mature Plant Species (in areas where new remedial facilities are likely to be located)	A qualified plant ecologist or biologist will identify and map existing mature plants to be considered in the design.	Summer 2011
Field Survey of Indigenous Plant Species (in areas where new remedial facilities could be located)	A qualified botanist will survey the areas where new remedial facilities could be located for indigenous plant species identified in Appendix PLA of the EIR.	Summer 2011

Figures

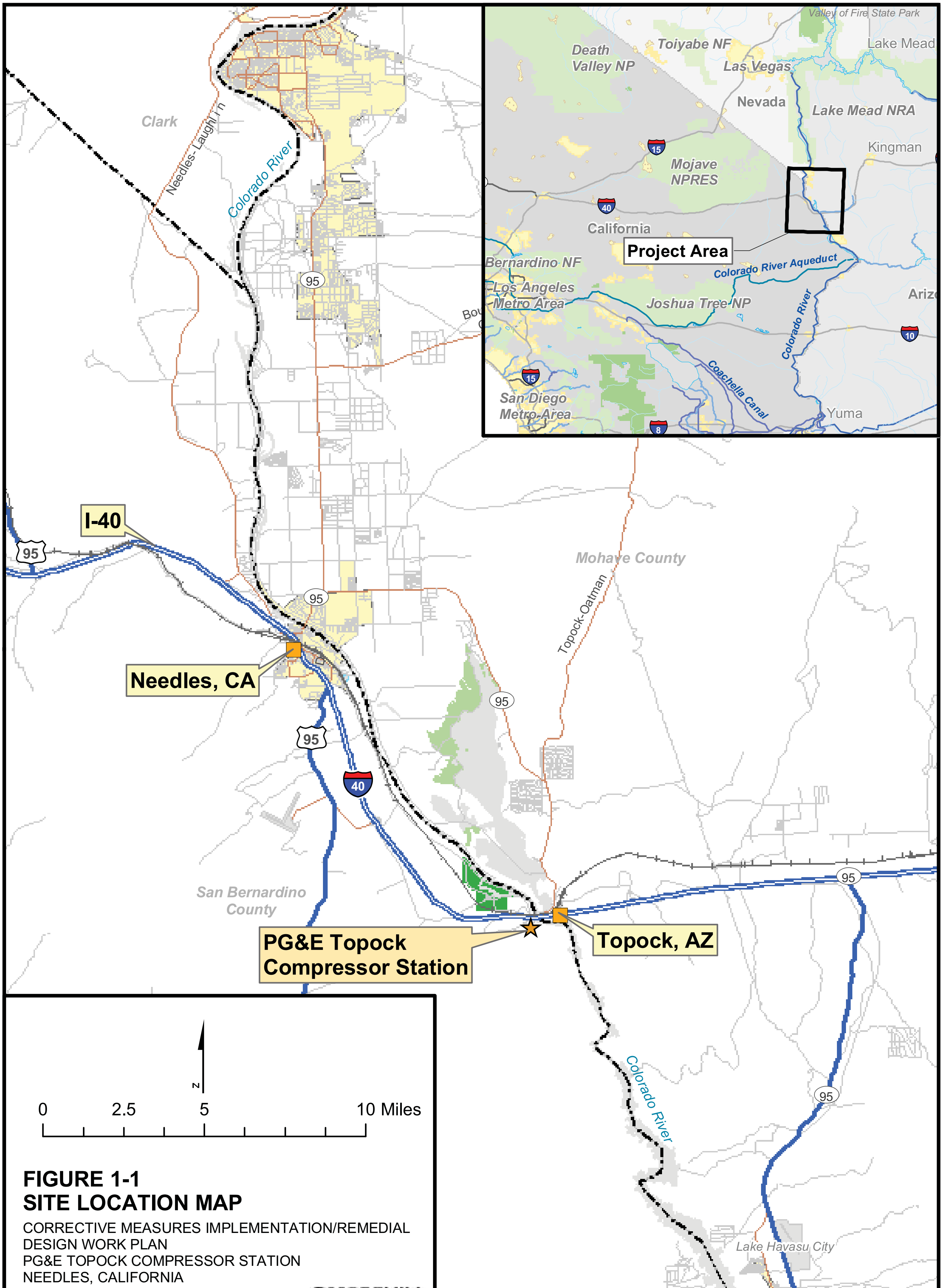

FIGURE 1-1
SITE LOCATION MAP
CORRECTIVE MEASURES IMPLEMENTATION/REMEDIAL DESIGN WORK PLAN
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

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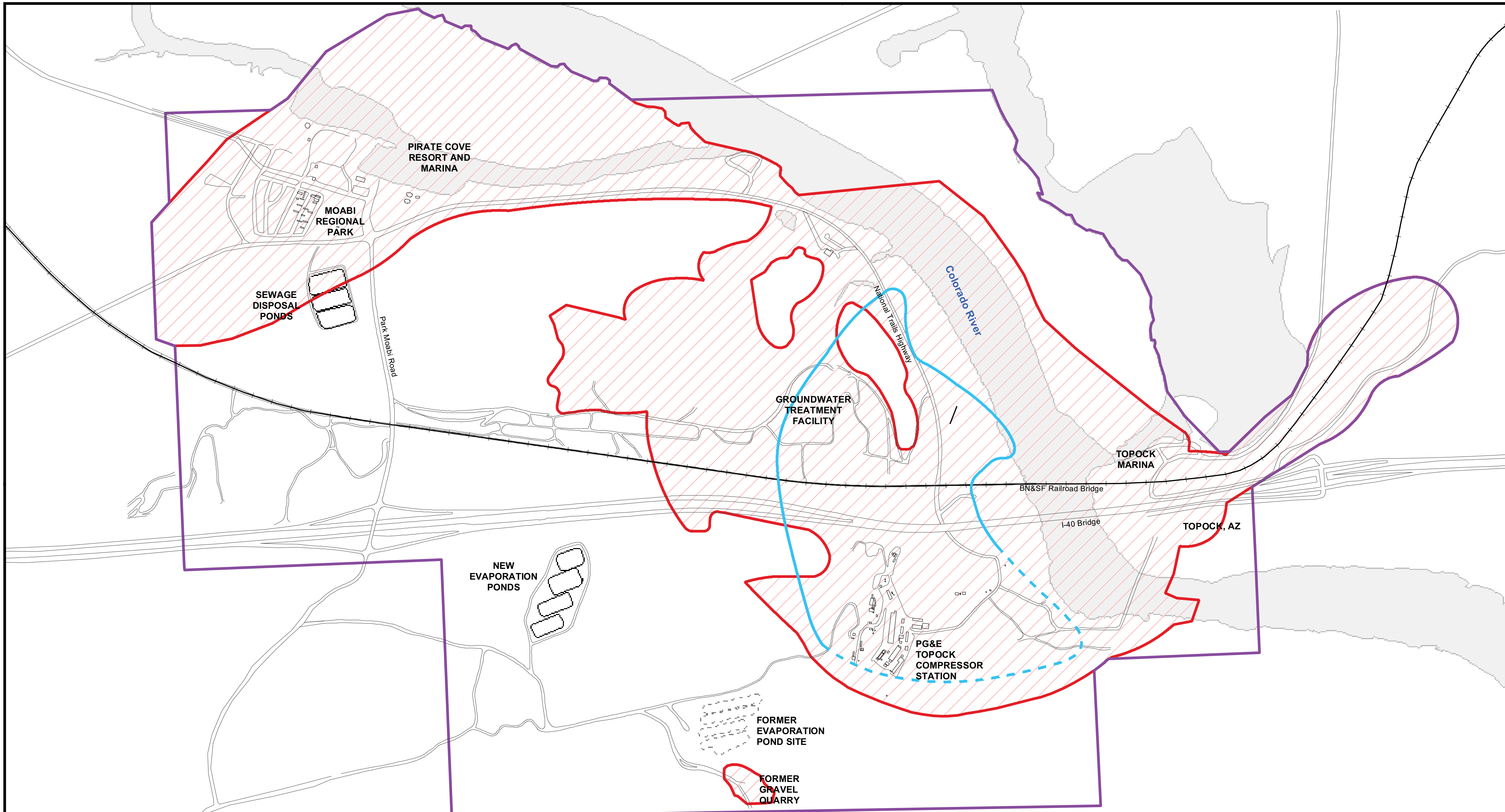

LEGEND

Area of Potential Effects (APE)

EIR Project Area

Approximate extent of hexavalent chromium [Cr(VI)] concentrations exceeding 32 micrograms per liter (µg/L) at any depth in groundwater based on fourth quarter 2010 sampling events. Dashed where based on limited data.The outline of Cr(VI) depicted as greater than 32 µg/L near or under the Colorado River is 80 feet below the bottom elevation of the Colorado River.

Note:
The locations of pipelines and existing infrastructure are approximate. The figure is not intended to be a comprehensive depiction of all existing infrastructure in the APE.

N

0 400 800 1,600 Feet

FIGURE 1-2
GROUNDWATER REMEDY PROJECT AREA

CORRECTIVE MEASURES IMPLEMENTATION/REMEDIAL DESIGN WORK PLAN
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

CH2MHILL

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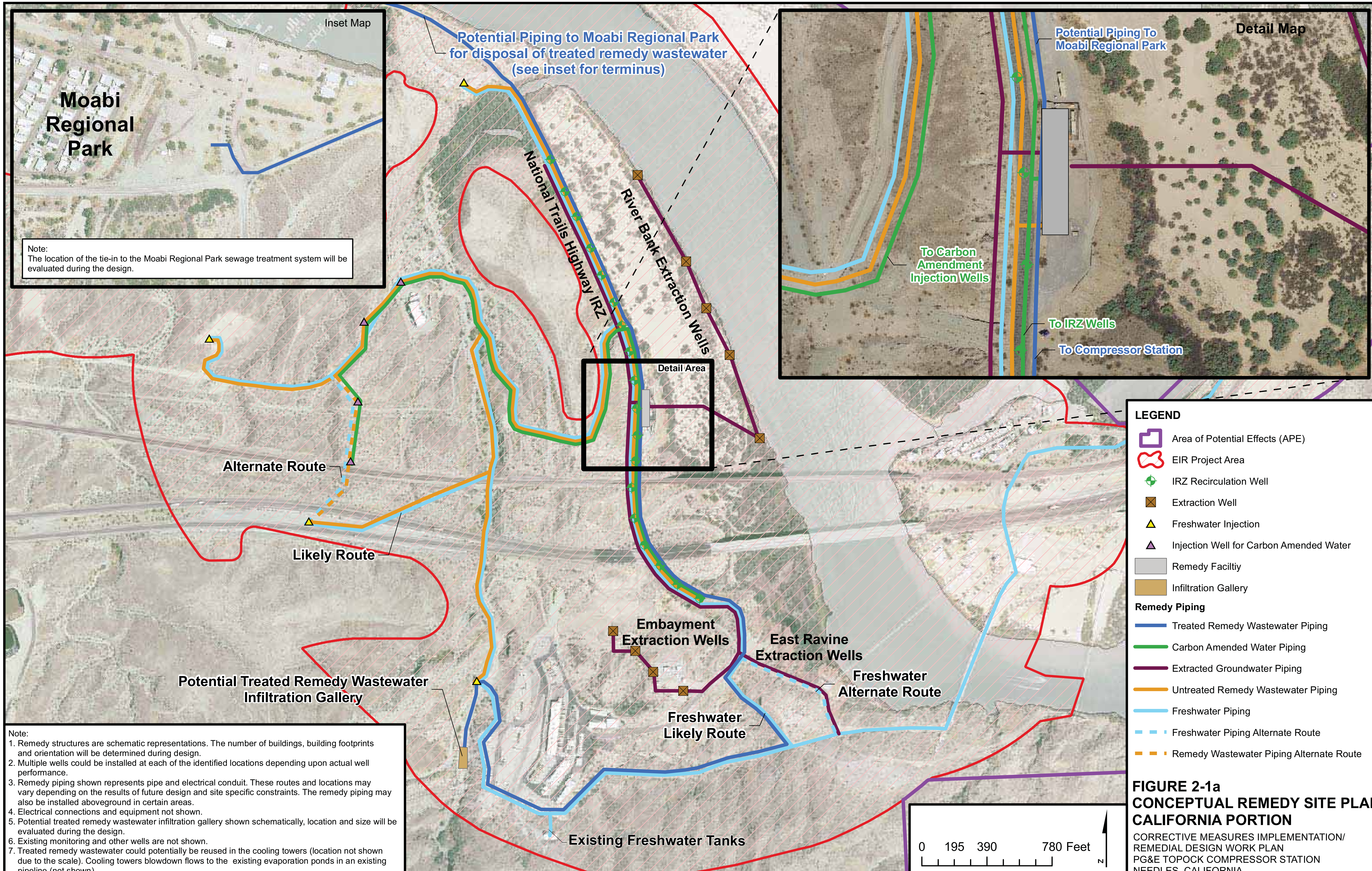

Note:
1. Remedy structures are schematic representations. The number of buildings, building footprints and orientation will be determined during design.
2. Multiple wells could be installed at each of the identified locations depending upon actual well performance.
3. Remedy piping shown represents pipe and electrical conduit. These routes and locations may vary depending on the results of future design and site specific constraints. The remedy piping may also be installed aboveground in certain areas.
4. Electrical connections and equipment not shown.
5. Potential treated remedy wastewater infiltration gallery shown schematically, location and size will be evaluated during the design.
6. Existing monitoring and other wells are not shown.
7. Treated remedy wastewater could potentially be reused in the cooling towers (location not shown due to the scale). Cooling towers blowdown flows to the existing evaporation ponds in an existing pipeline (not shown).

FIGURE 2-1a
CONCEPTUAL REMEDY SITE PLAN
CALIFORNIA PORTION

CORRECTIVE MEASURES IMPLEMENTATION/
REMEDIAL DESIGN WORK PLAN
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

CH2MHILL

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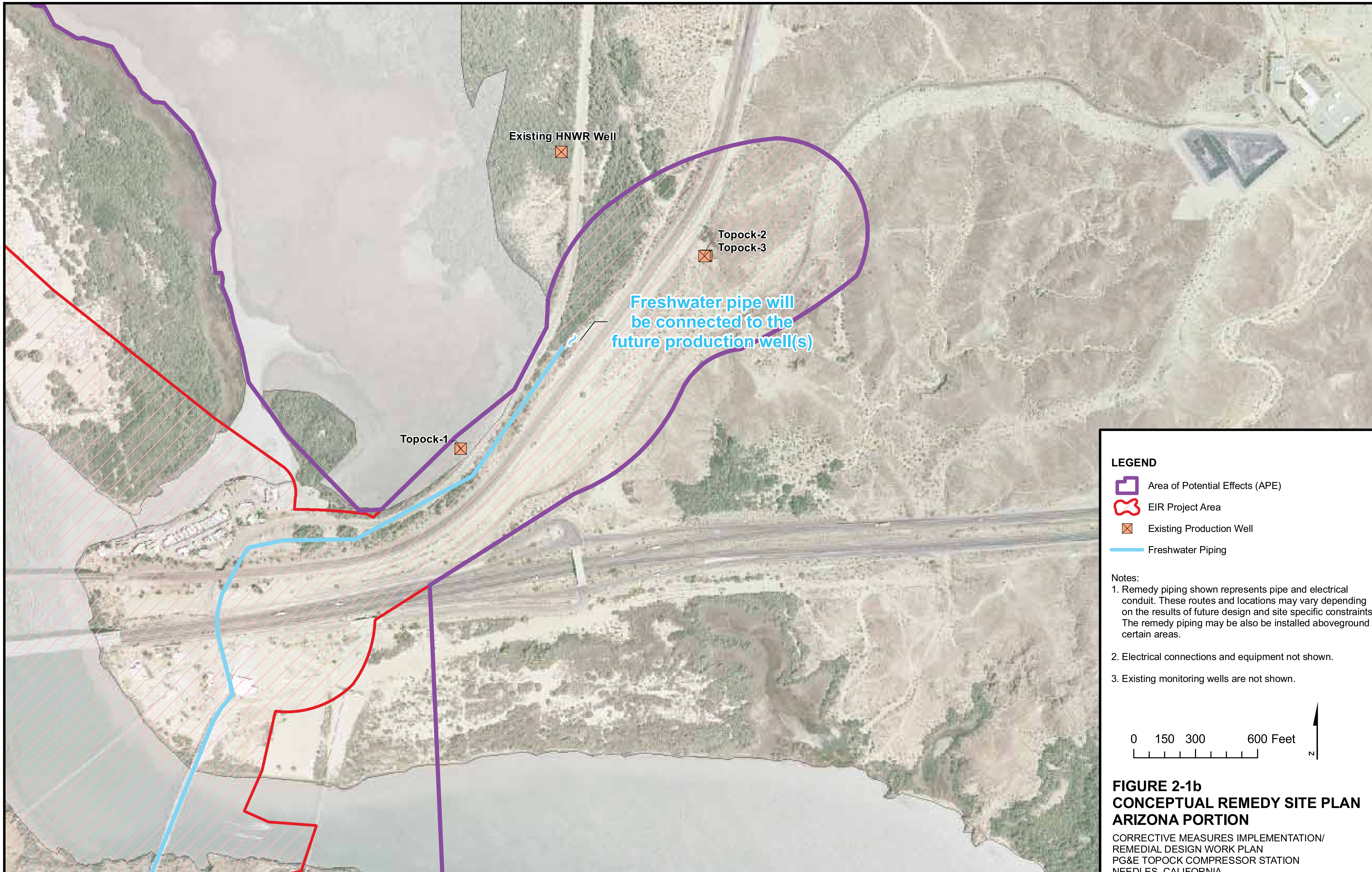

Notes:

1. Remedy piping shown represents pipe and electrical conduit. These routes and locations may vary depending on the results of future design and site specific constraints. The remedy piping may be also be installed aboveground in certain areas.
2. Electrical connections and equipment not shown.
3. Existing monitoring wells are not shown.

FIGURE 2-1b
CONCEPTUAL REMEDY SITE PLAN
ARIZONA PORTION

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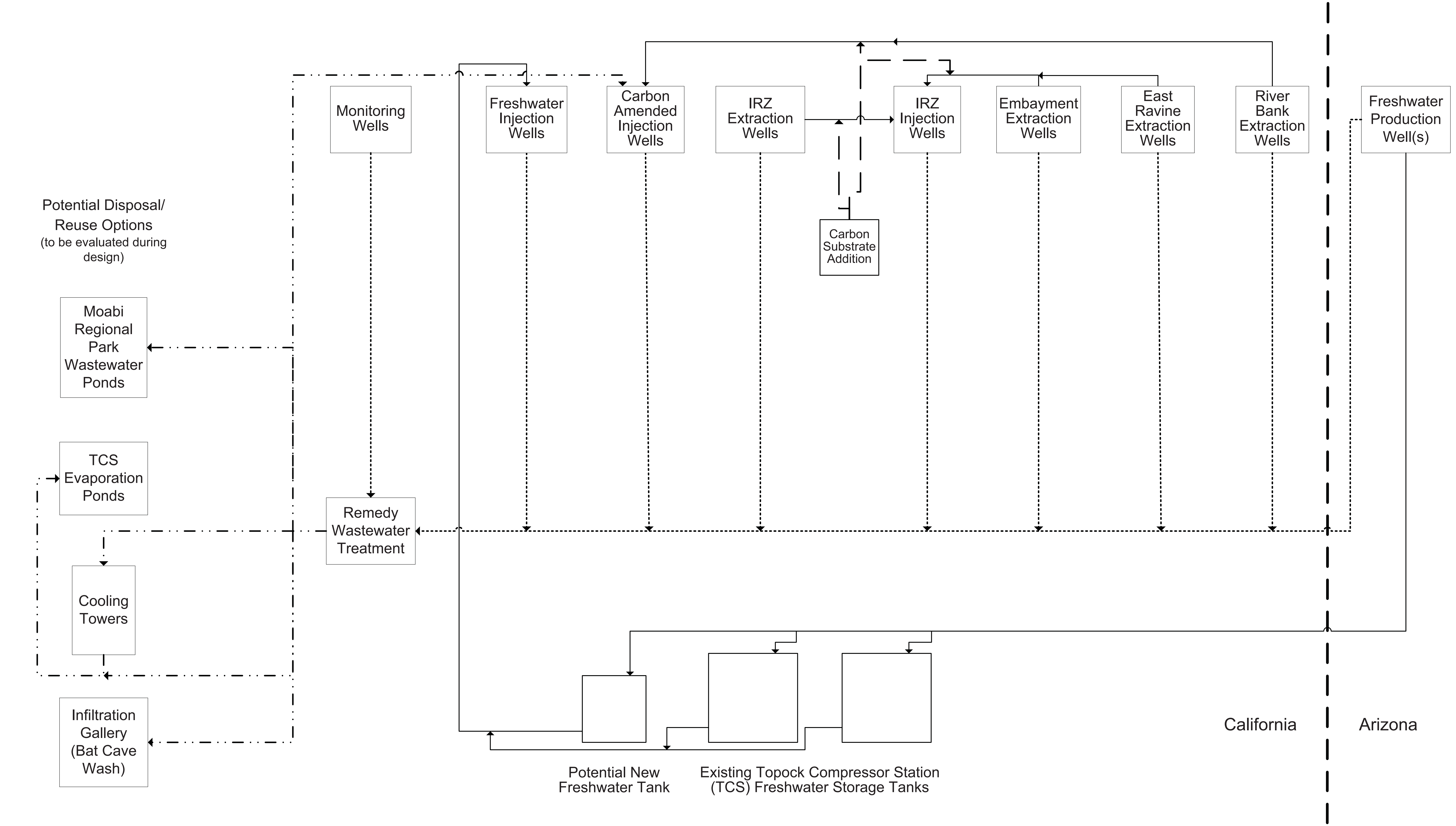

LEGEND
Extracted Groundwater:
Carbon Substrate:
Untreated Remedy Wastewater:
Treated Remedy Wastewater:

NOTES
1. Remedy wastewater is defined as wastewater generated from well maintenance activities (e.g., backflushing, rehabilitation) and other remedy-related activities (e.g., purge water from sampling of monitoring wells, equipment decontamination, rainfall that collects in secondary containment).
2. Depending upon the water quality of the Arizona production well(s), water conditioning may be required to meet operational needs of the remedy and the Compressor Station. The exact components will be determined during design. It is not shown on this conceptual diagram.

FIGURE 2-2
CONCEPTUAL REMEDY PROCESS SCHEMATIC DIAGRAM
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PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

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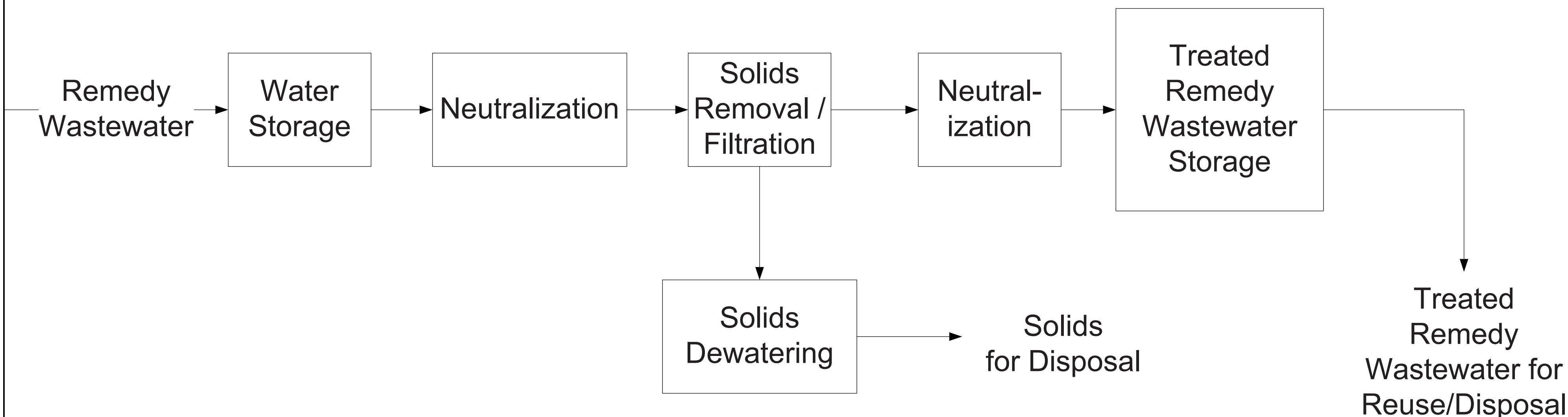

NOTES:
1. Remedy wastewater is defined as wastewater generated from well maintenance activities (e.g., backflushing, rehabilitation) and other remedy-related activities (e.g., purge water from sampling of monitoring wells, equipment decontamination, rainfall that collects in secondary containment).
2. The schematic diagram shown assumes that solids removal is the primary unit process with neutralization required to make the process more effective and adjust the treated wastewater to suit the reuse/disposal option requirements. Additional processes may be added during the design process or operations to treat dissolved constituents.

FIGURE 2-3
CONCEPTUAL REMEDY WASTEWATER TREATMENT SCHEMATIC DIAGRAM
CORRECTIVE MEASURES IMPLEMENTATION / REMEDIAL DESIGN WORK PLAN
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

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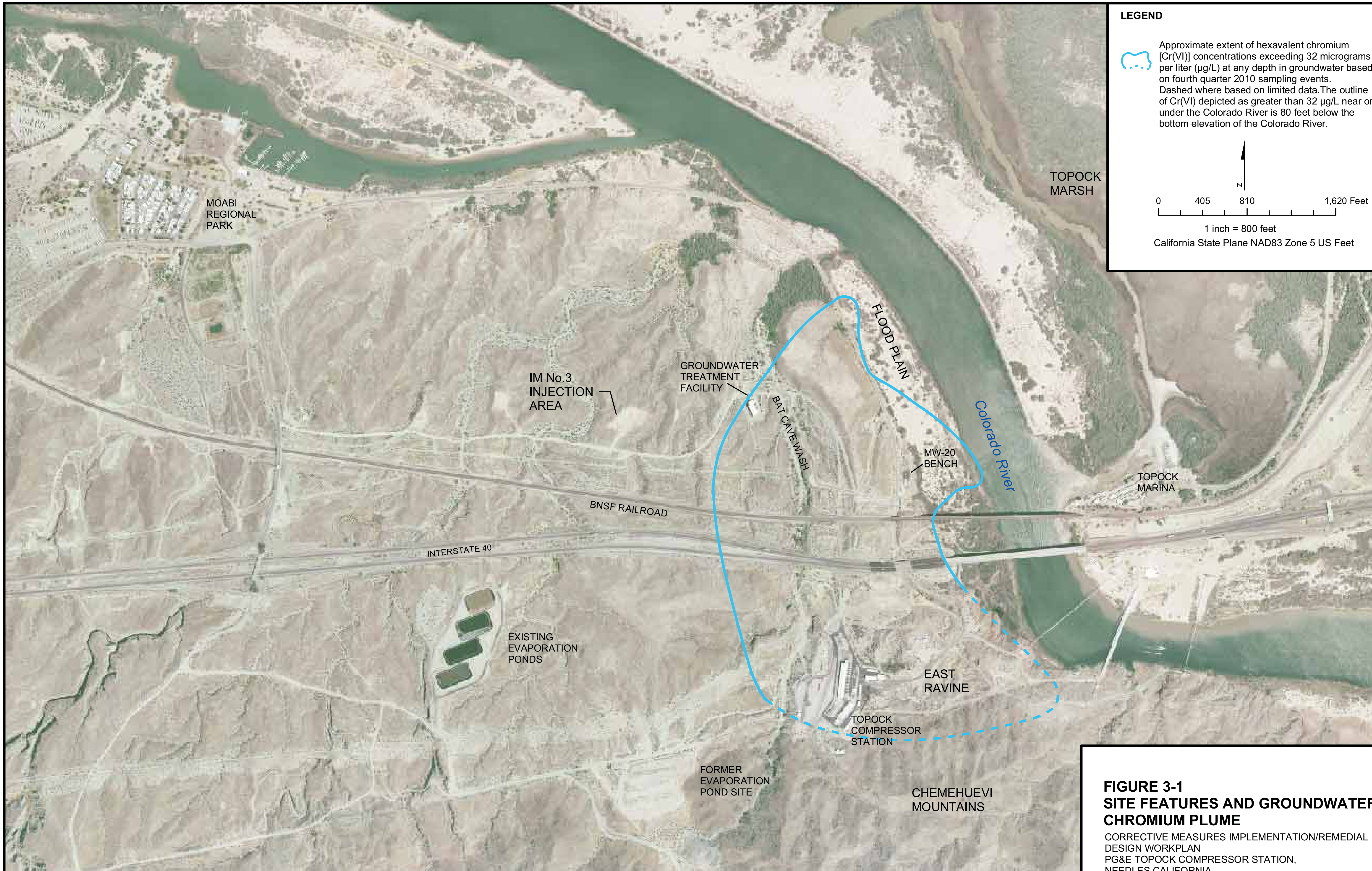

FIGURE 3-1
SITE FEATURES AND GROUNDWATER CHROMIUM PLUME
CORRECTIVE MEASURES IMPLEMENTATION/REMEDIAL DESIGN WORKPLAN
PG&E TOPOCK COMPRESSOR STATION, NEEDLES, CALIFORNIA

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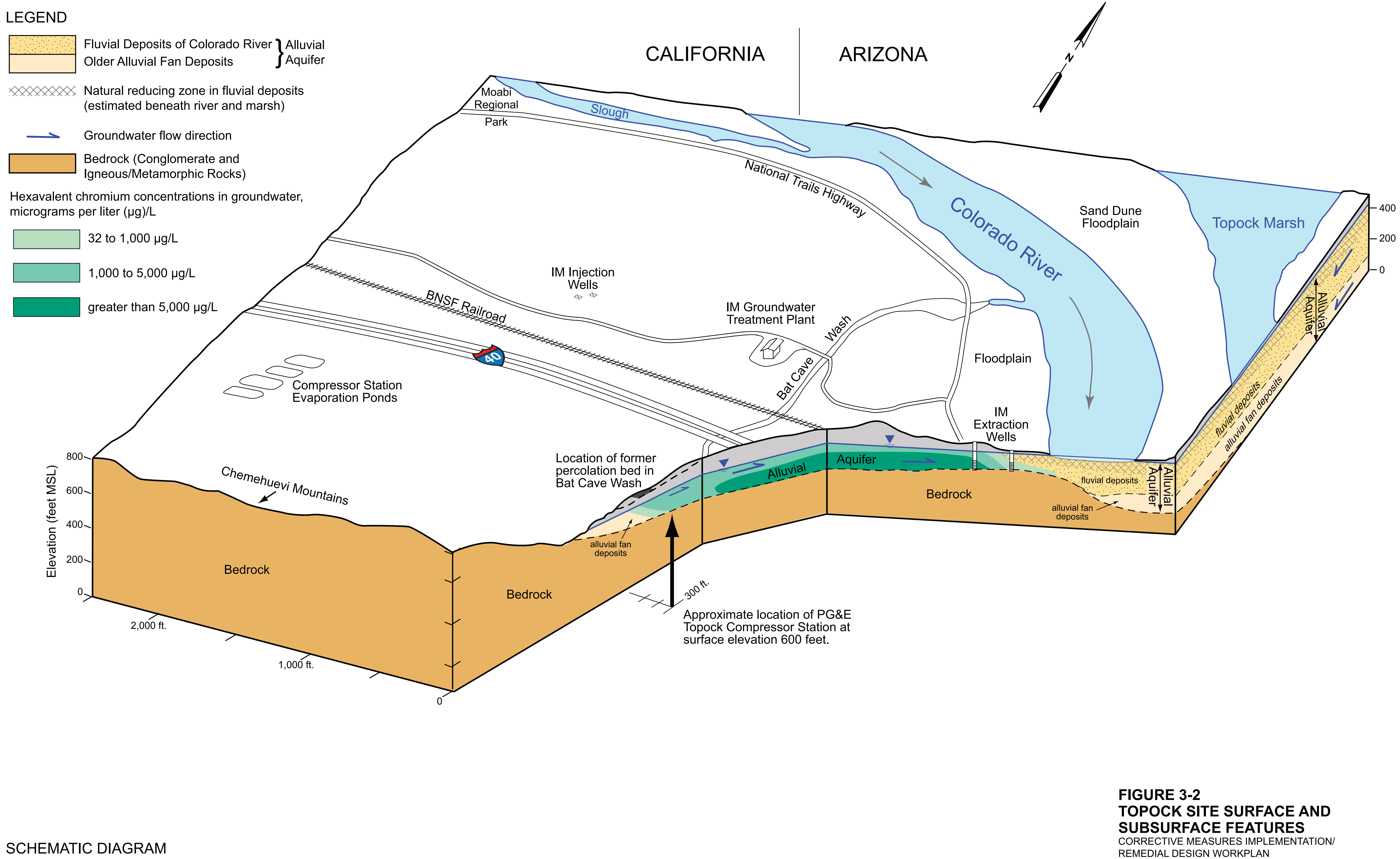
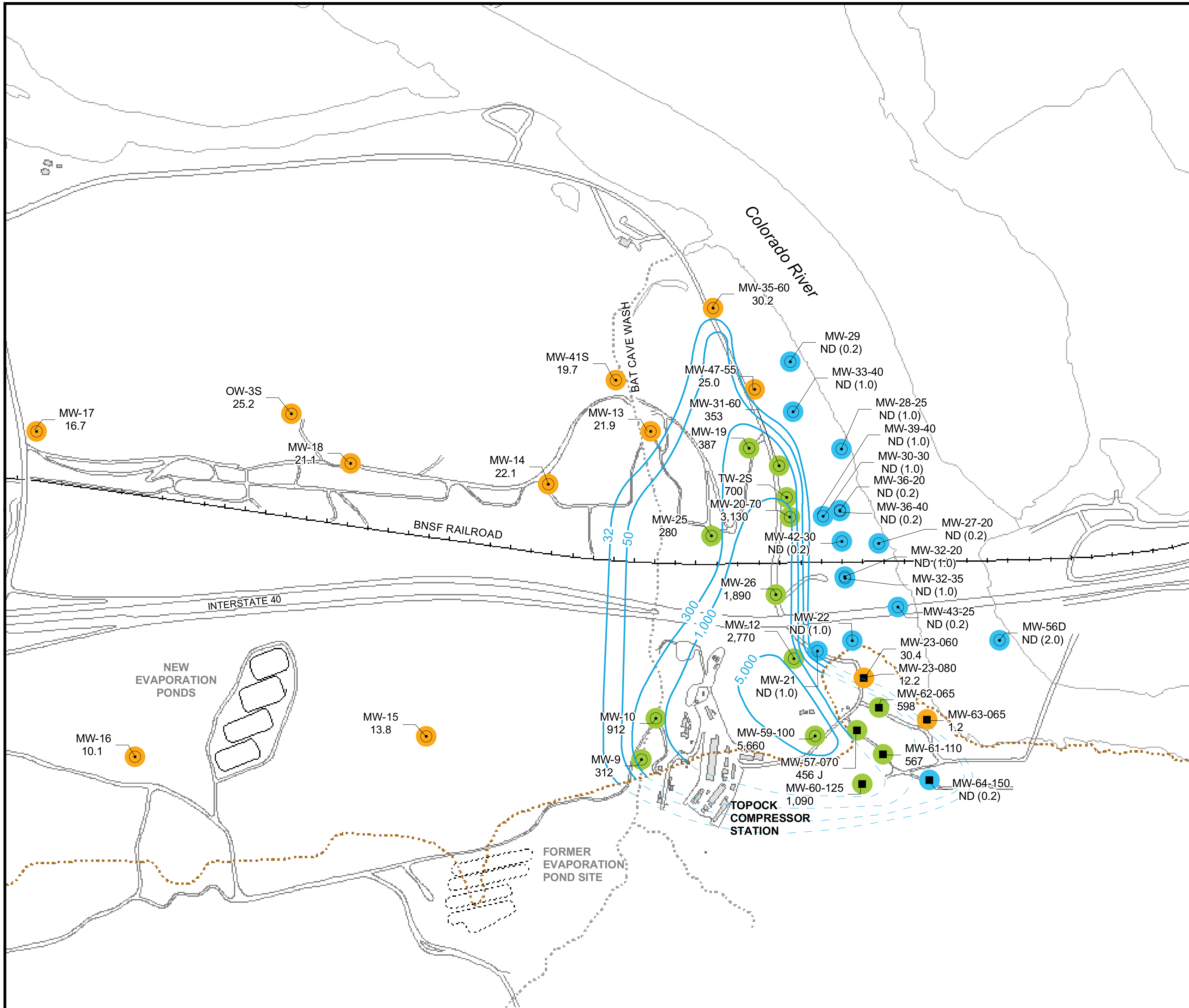


FIGURE 3-2
TOPOCK SITE SURFACE AND SUBSURFACE FEATURES
CORRECTIVE MEASURES IMPLEMENTATION/
REMEDIAL DESIGN WORKPLAN
PG&E TOPOCK COMPRESSOR STATION
NEEDLES CALIFORNIA



LEGEND

- ⊙ Alluvial aquifer well sampled during sampling event
- ■ Bedrock well sampled during sampling event

6.48 Concentration of hexavalent chromium [Cr(VI)] in groundwater, micrograms per liter (µg/L)

Results shown are maximum concentrations in primary and duplicate samples from wells completed in **Shallow zone** of alluvial aquifer and bedrock.

ND (0.2) Cr(VI) not detected at listed reporting limit (RL)

Cr(VI) Concentrations - Fourth Quarter 2010

- Not detected at analytical reporting limit
- Concentration between reporting limit and 32 µg/L
- Concentration ≥ 32 µg/L
- 32 Approximate outline of Cr(VI) concentrations of 32, 50, 300, 1,000 and 5,000 µg/L in the alluvial aquifer based on Fourth Quarter 2010 groundwater sampling.
- 32 Approximate outline of Cr(VI) concentrations of 32, 50, 300, 1,000 and 5,000 µg/L in shallow bedrock based on Fourth Quarter 2010 groundwater sampling.
- Approximate bedrock contact at 455 feet above mean sea level.

Notes:
Results plotted are maximum concentration from primary and duplicate samples.

J= Concentration or RL estimated by laboratory or data validation

FIGURE 3-3a
Cr(VI) SAMPLING RESULTS, SHALLOW WELLS IN ALLUVIAL AQUIFER AND BEDROCK, FOURTH QUARTER 2010

CORRECTIVE MEASURES IMPLEMENTATION/REMEDIAL DESIGN WORKPLAN
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

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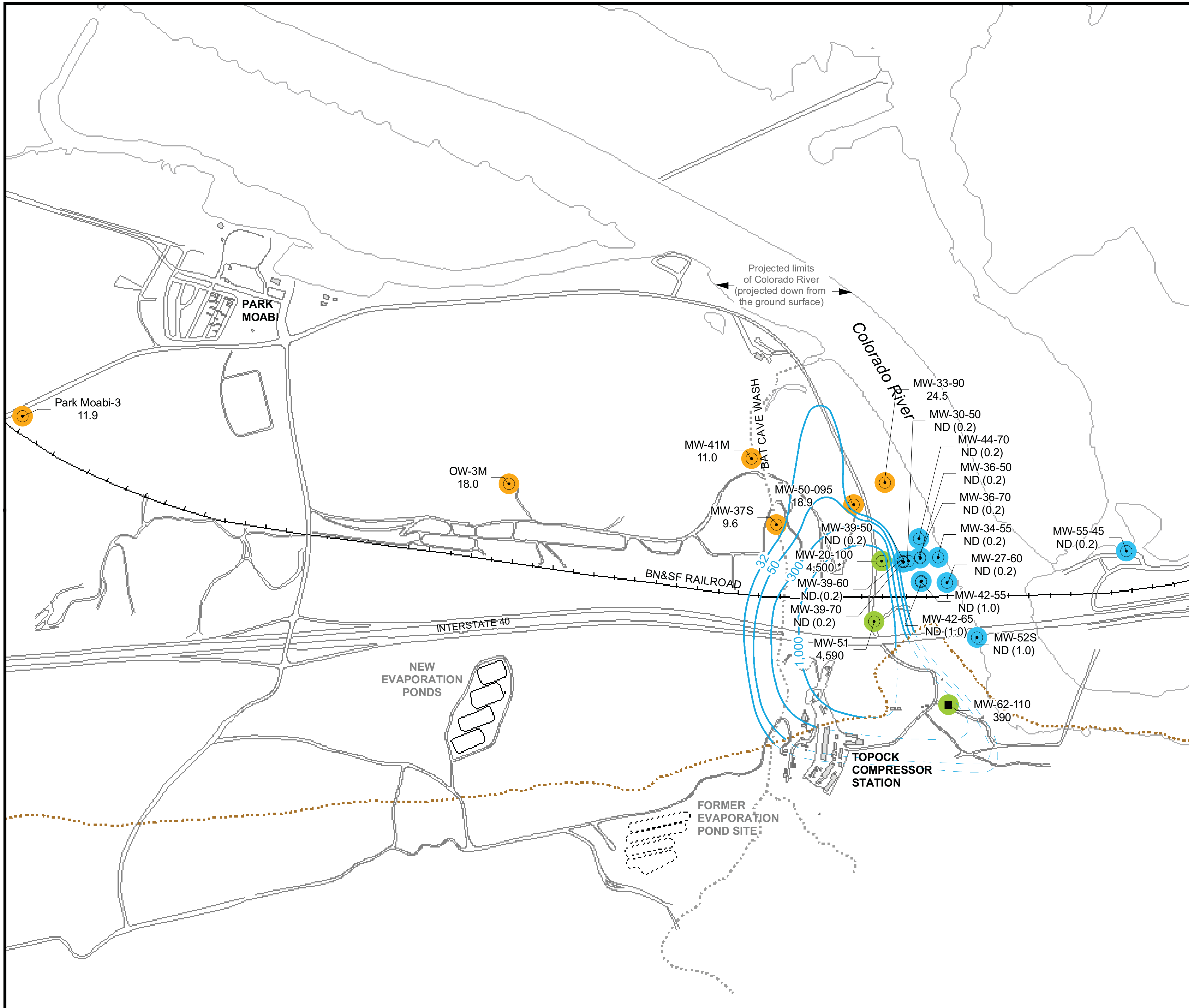

LEGEND

- ⊙ Alluvial aquifer well sampled during sampling event
- ■ Bedrock well sampled during sampling event

6.48 Concentration of hexavalent chromium [Cr(VI)] in groundwater, micrograms per liter (µg/L)

Results shown are maximum concentrations in primary and duplicate samples from wells completed in **Mid-Depth zone** of alluvial aquifer and bedrock.

ND (0.2) Cr(VI) not detected at listed reporting limit (RL)

Cr(VI) Concentrations - Fourth Quarter 2010

- Not detected at analytical reporting limit
- Concentration between reporting limit and 32 µg/L
- Concentration ≥ 32 µg/L

Approximate outline of Cr(VI) concentrations of 32, 50, 300, 1,000 and 5,000 µg/L in the alluvial aquifer based on Fourth Quarter 2010 groundwater sampling.

Approximate outline of Cr(VI) concentrations of 32, 50, 300, 1,000 and 5,000 µg/L in shallow bedrock based on Fourth Quarter 2010 groundwater sampling.

Approximate bedrock contact at 425 feet above mean sea level.

Notes:

1. Results plotted are maximum concentration from primary and duplicate samples.
2. * = Data collected February 2011 due to field logistical issues.

N

0 500 1,000 2,000 Feet

FIGURE 3-3b
Cr(VI) SAMPLING RESULTS MID-DEPTH WELLS IN ALLUVIAL AQUIFER AND BEDROCK, FOURTH QUARTER 2010

CORRECTIVE MEASURES IMPLEMENTATION/REMEDIAL DESIGN WORKPLAN
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

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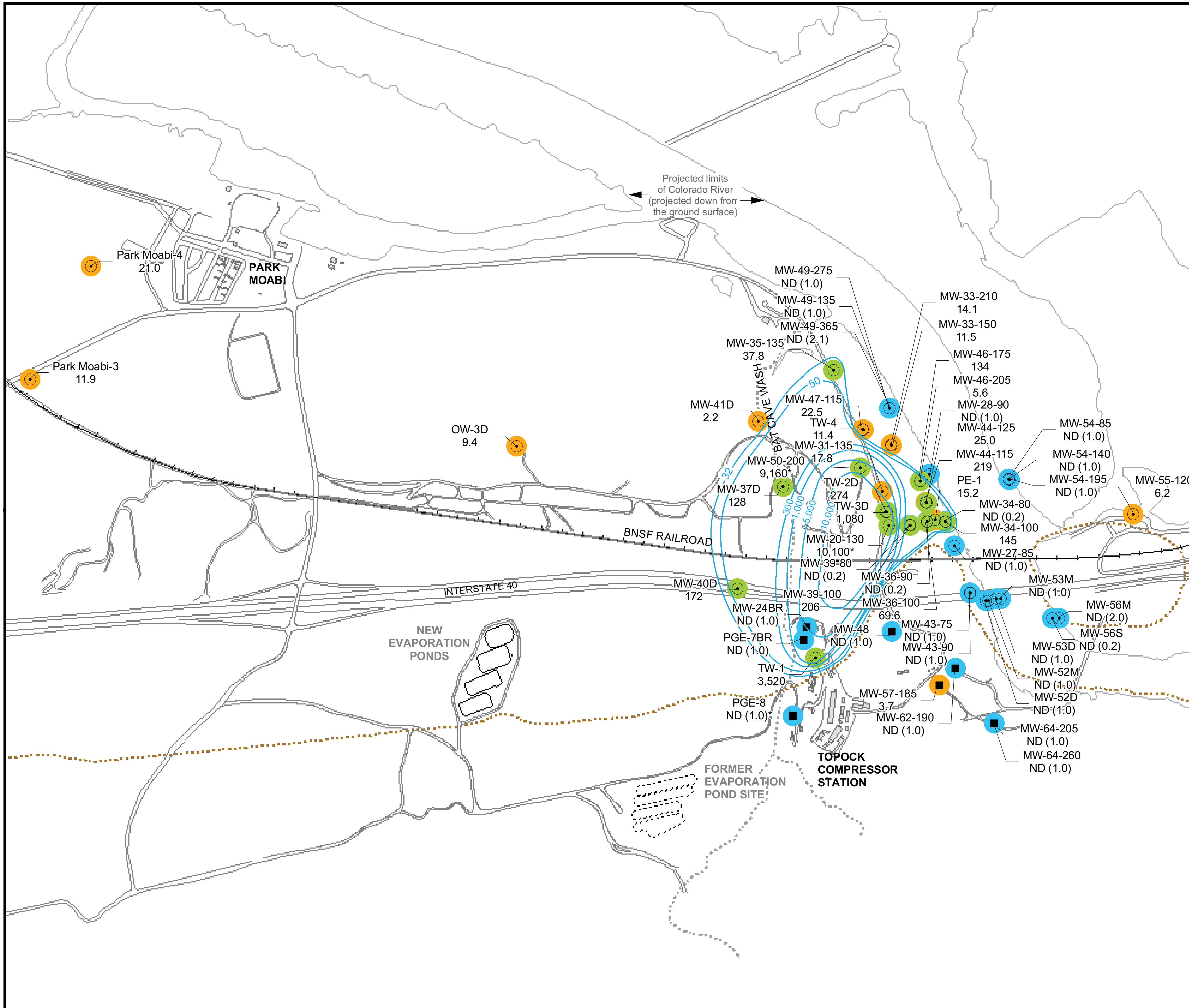

LEGEND

⊙ Alluvial aquifer well sampled during sampling event

■ Bedrock well sampled during sampling event

6.48 Concentration of hexavalent chromium [Cr(VI)] in groundwater, micrograms per liter (µg/L)

Results shown are maximum concentrations in primary and duplicate samples from wells completed in **Deep zone** of alluvial aquifer and bedrock.

ND (0.2) Cr(VI) not detected at listed reporting limit (RL)

Cr(VI) Concentrations - Fourth Quarter 2010

- Not detected at analytical reporting limit
- Concentration between reporting limit and 32 µg/L
- Concentration ≥ 32 µg/L

32 Approximate outline of Cr(VI) concentrations of 32, 50, 300, 1,000 and 5,000 µg/L in the alluvial aquifer based on Fourth Quarter 2010 groundwater sampling.

Approximate bedrock contact at 395 feet above mean sea level.

Notes:

1. Results plotted are maximum concentration from primary and duplicate samples.
2. In the floodplain area, the 32 µg/L line for Cr(VI) in deep zone (80-90 feet below Colorado River) is estimated based on available groundwater sampling, hydrogeologic and geochemical data. There are no data confirming the existence of Cr(VI) under the Colorado River.
3. * = Data collected February 2011 due to field logistical issues

N

0 500 1,000 2,000 Feet

FIGURE 3-3c
Cr(VI) SAMPLING RESULTS, DEEP WELLS IN ALLUVIAL AQUIFER AND BEDROCK, FOURTH QUARTER 2010

CORRECTIVE MEASURES IMPLEMENTATION/REMEDIAL DESIGN WORKPLAN
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

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Topock Remediation Project Groundwater Remedy Design and Construction (2011-2013)

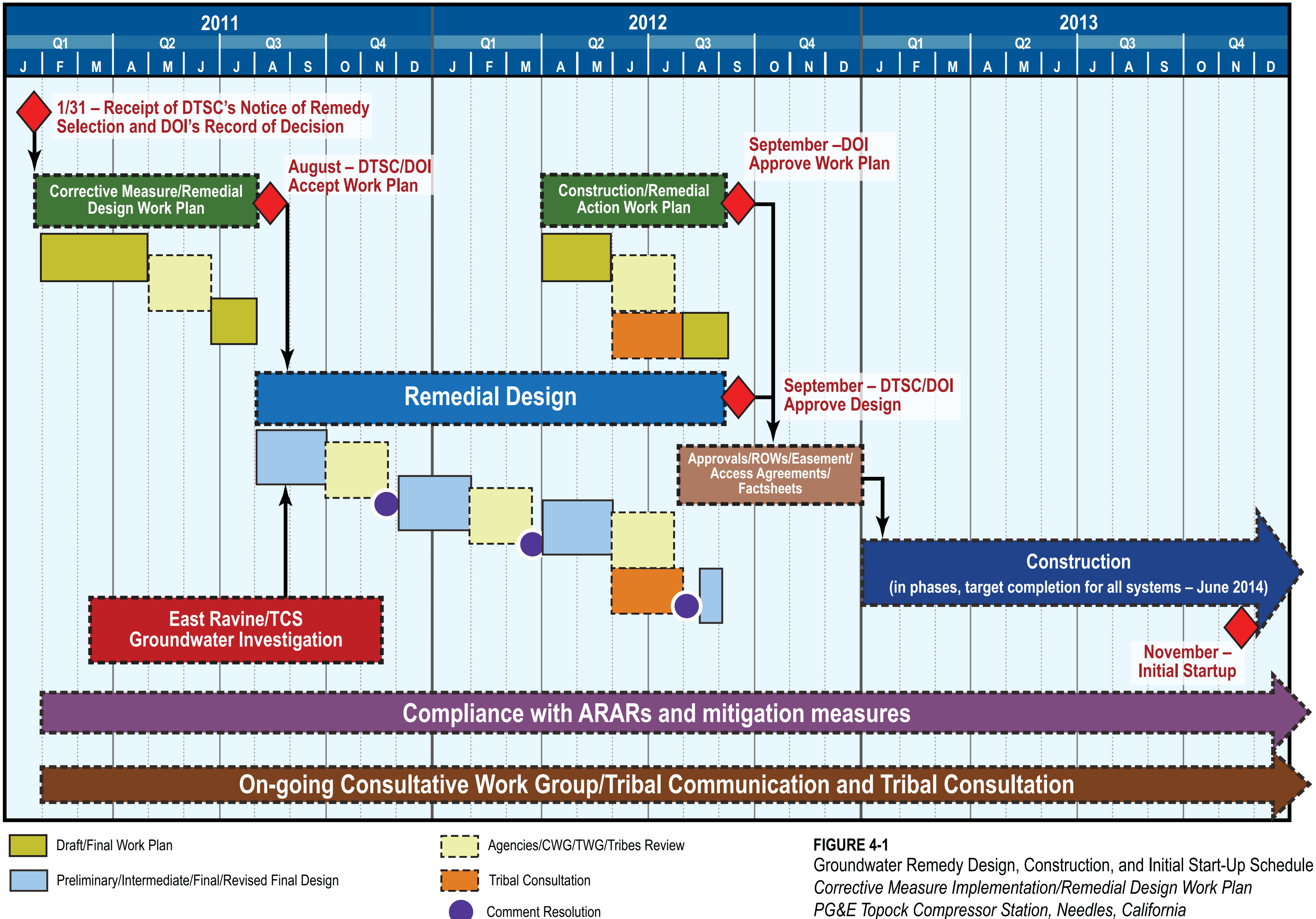
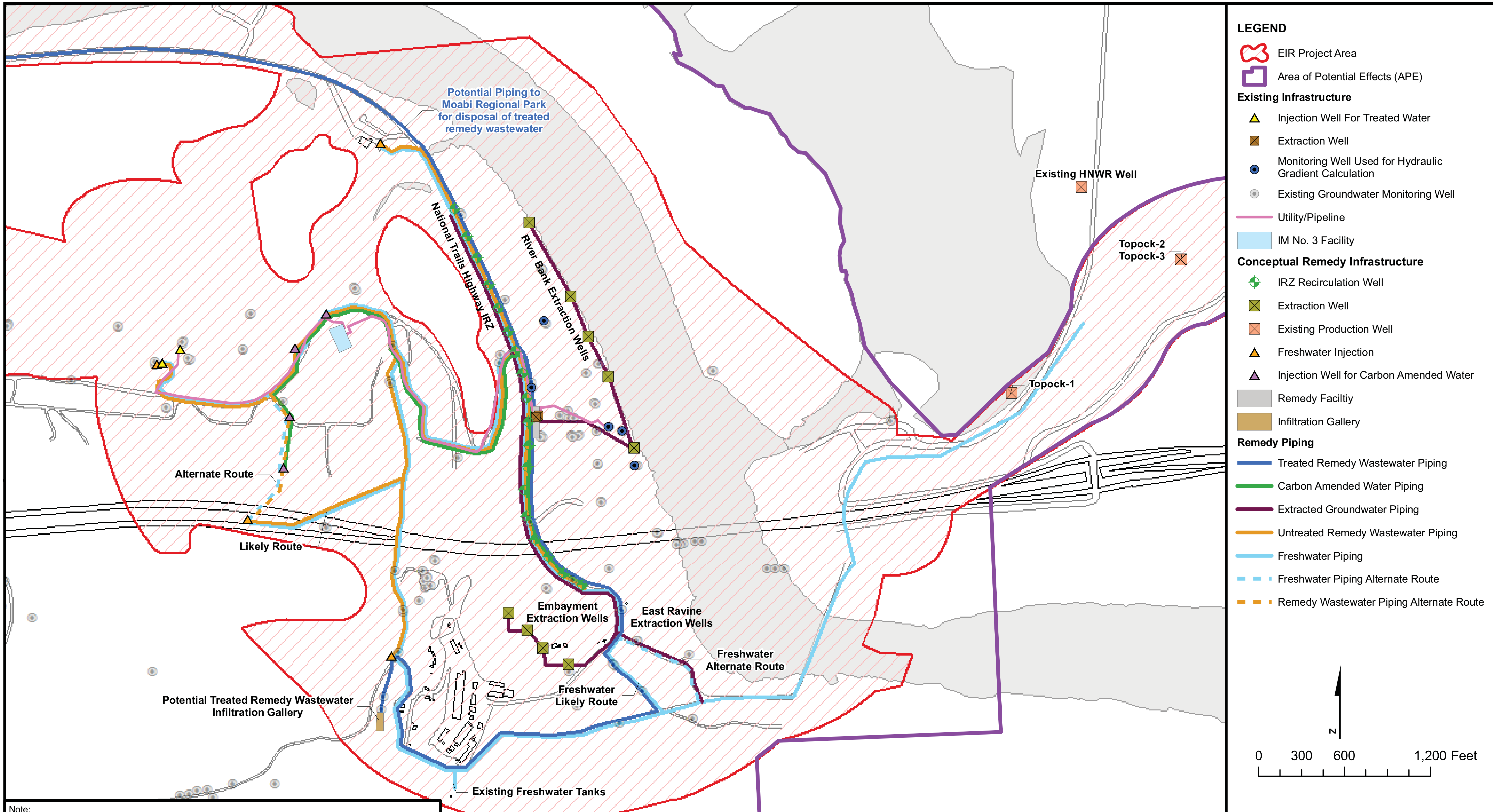


FIGURE 4-1
Groundwater Remedy Design, Construction, and Initial Start-Up Schedule
Corrective Measure Implementation/Remedial Design Work Plan
PG&E Topock Compressor Station, Needles, California



Note:
1. Remedy structures are schematic representations. The number of buildings, building footprints and orientation will be determined during design.
2. Multiple wells could be installed at each of the identified locations depending upon actual well performance.
3. Remedy piping shown represents pipe and electrical conduit. These routes and locations may vary depending on the results of future design and site specific constraints. The remedy piping may also be installed aboveground in certain areas.
4. Electrical connections and equipment not shown.
5. Potential treated remedy wastewater infiltration gallery shown schematically, location and size will be evaluated during the design.
6. Treated remedy wastewater could potentially be reused in the cooling towers (location not shown due to the scale). Cooling towers blowdown flow to the existing evaporation ponds in an existing pipeline (not shown).

FIGURE 5-1
EXISTING IM INFRASTRUCTURE AND CONCEPTUAL REMEDY INFRASTRUCTURE LOCATIONS

CORRECTIVE MEASURES IMPLEMENTATION/
REMEDIAL DESIGN WORK PLAN
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

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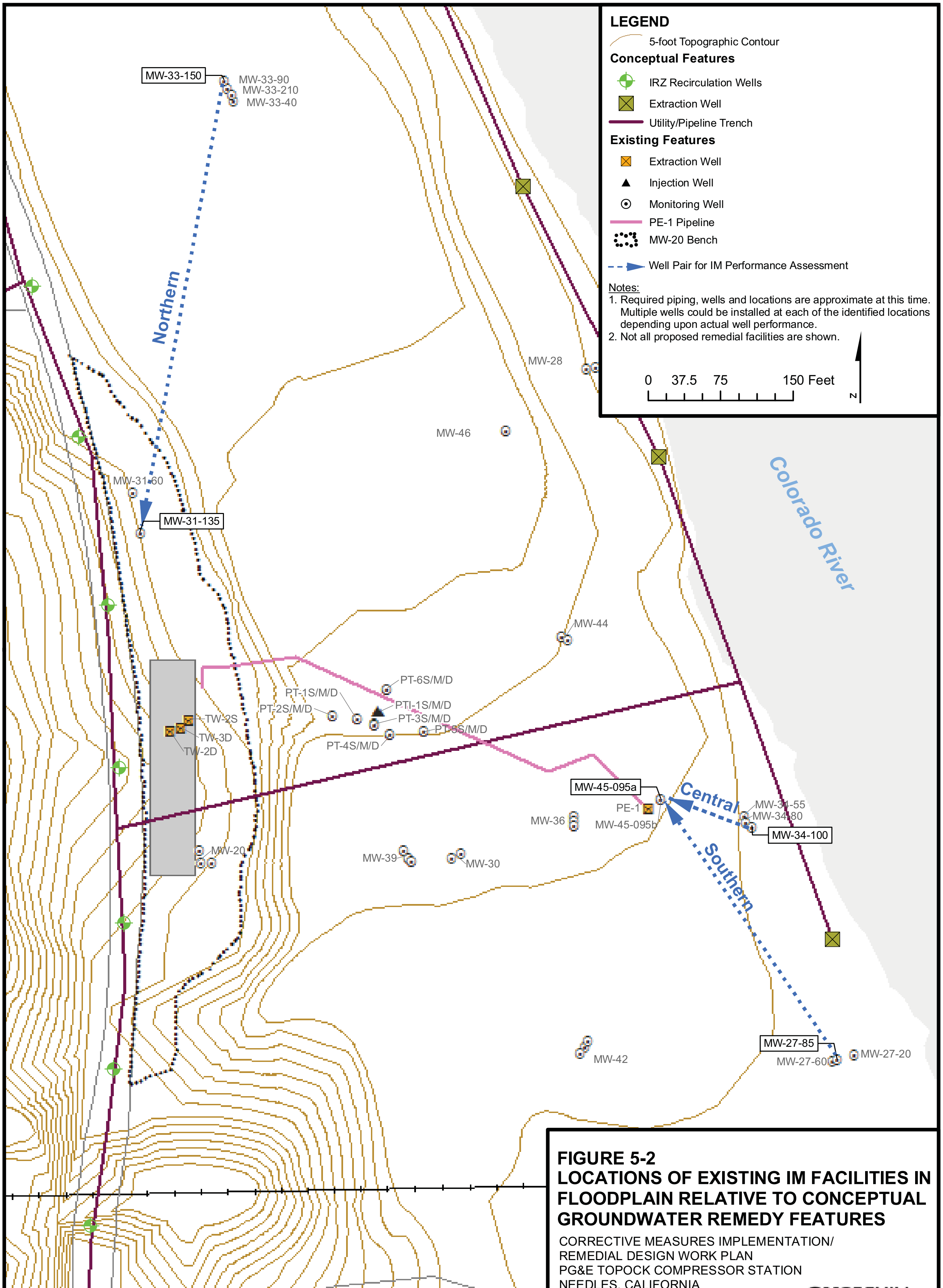

FIGURE 5-2
LOCATIONS OF EXISTING IM FACILITIES IN FLOODPLAIN RELATIVE TO CONCEPTUAL GROUNDWATER REMEDY FEATURES

CORRECTIVE MEASURES IMPLEMENTATION/
REMEDIAL DESIGN WORK PLAN
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NEEDLES, CALIFORNIA

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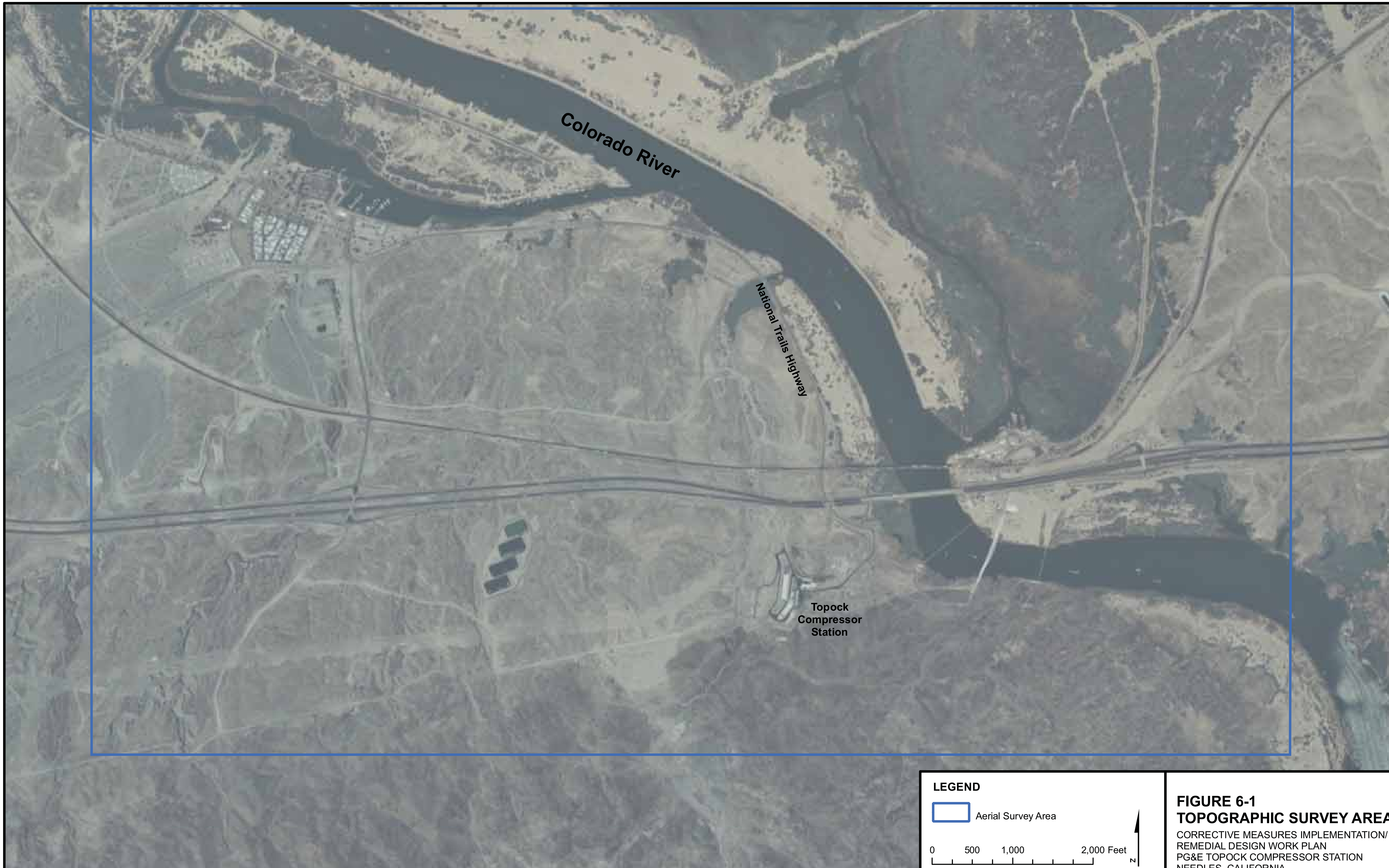

FIGURE 6-1
TOPOGRAPHIC SURVEY AREA
CORRECTIVE MEASURES IMPLEMENTATION/
REMEDIAL DESIGN WORK PLAN
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

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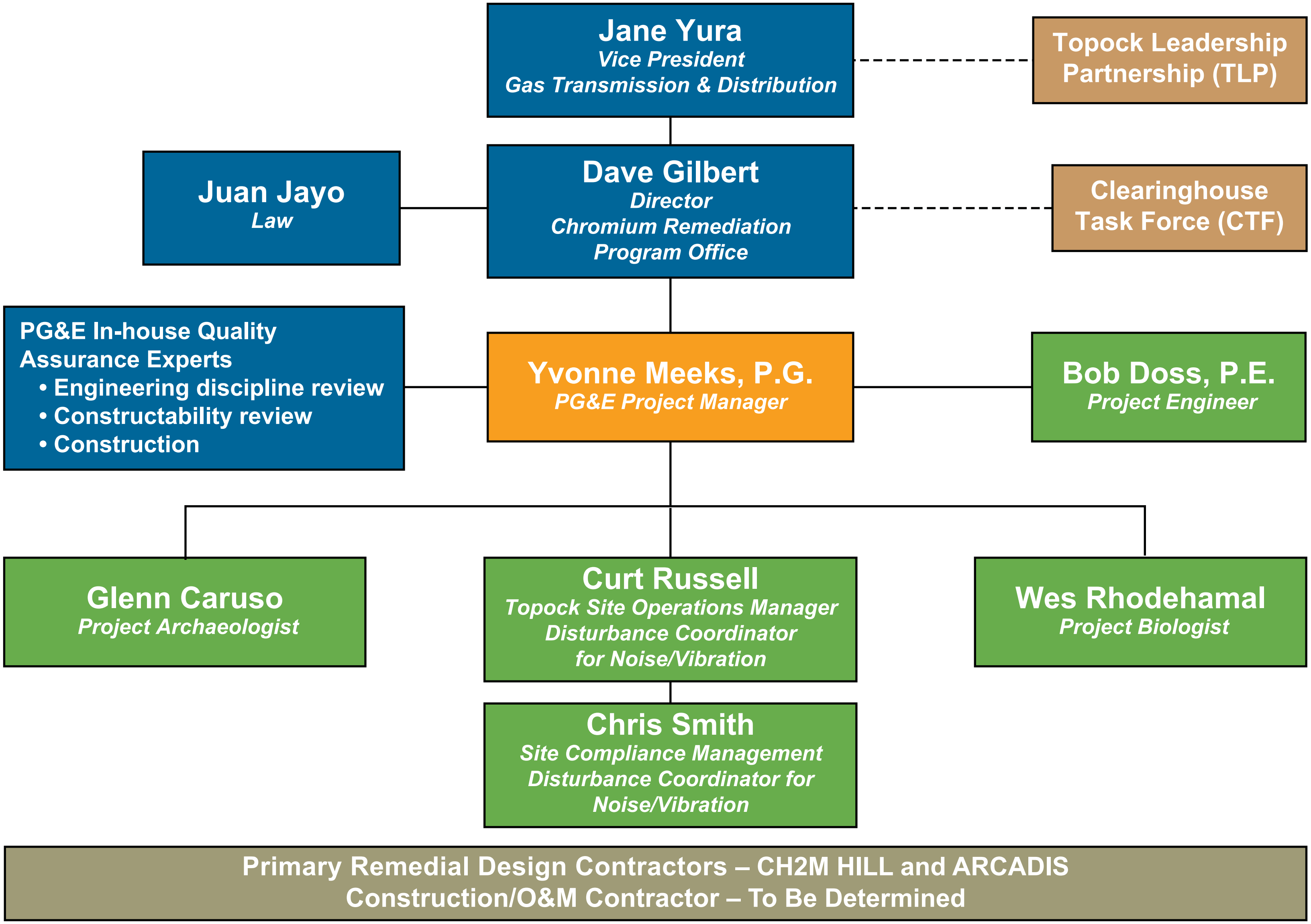

FIGURE 7-1
Project Team Organization Chart
Corrective Measure Implementation/Remedial Design Work Plan
PG&E Topock Compressor Station, Needles, California