Pacific Gas and Electric Company

Yvonne J. Meeks
Manager
Environmental Remediation

Mailing Address
4325 South Higuera Street
San Luis Obispo, CA 93401

Location
6588 Ontario Road
San Luis Obispo, CA 93405

805.234.2257
Fax: 805.546.5232
E-Mail: yjm1@pge.com

September 8, 2014

Mr. Aaron Yue
California Department of Toxic Substances Control
5796 Corporate Avenue
Cypress, CA 90630

Ms. Pamela Innis
U.S. Department of the Interior, Office of Environmental Policy and Compliance
P.O. Box 25007 (D-108)
Denver Federal Facility Building 56
Denver, Colorado 80225-0007

Subject: Basis of Design Report/Pre-Final (90%) Design Submittal and Construction/ Remedial Action Work Plan for the Final Groundwater Remedy, PG&E Topock Compressor Station, Needles, California

Dear Mr. Yue and Ms. Innis:

In compliance with the 1996 Corrective Action Consent Agreement (CACA) between the California Department of Toxic Substances Control (DTSC) and Pacific Gas and Electric Company (PG&E) and with the CERCLA Remedial Design/Remedial Action Consent Decree (CD), this letter transmits the *Basis of Design Report/Pre-Final (90%) Design for the Final Groundwater Remedy, PG&E Topock Compressor Station, Needles, California* (90% BOD Report).

Other requirements of the CACA and CD, including the plans and schedules for construction and implementation of the remedy set forth in the design plans and specifications, are addressed in the *Construction/Remedial Action Work Plan for the Final Groundwater Remedy, PG&E Topock Compressor Station, Needles, California* (C/RAWP). This letter also transmits the C/RAWP, which is presented under separate cover and is intended to be a companion document to the 90% BOD Report.

PG&E looks forward to the opportunity to walk through the 90% design documents with the Agencies, interested Tribes, and Stakeholders during the September 17, 2014 Technical Work Group Meeting.

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

Sincerely,

Yvonne Meeks

Yvonne Meeks
Topock Project Manager

cc: Kevin Sullivan/PG&E, Karen Baker/DTSC

Topock Project Executive Abstract

Document Title: *Construction/Remedial Action Work Plan for the Final Groundwater Remedy, PG&E Topock Compressor Station, Needles, California* Submitting Agency: DTSC, DOI Final Document? ☐ Yes ☒ No	Date of Document: 09/08/2014 Who Created this Document?: (i.e. PG&E, DTSC, DOI, Other) PG&E
Priority Status: ☒ HIGH ☐ MED ☐ LOW Is this time critical? ☒ Yes ☐ No Type of Document: ☐ Draft ☒ Report ☐ Letter ☐ Memo ☐ Other / Explain:	Action Required: ☐ Information Only ☒ Review & Comment Return to: N/A 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 (RA) ☐ California Environmental Quality Act (CEQA)/Environmental Impact Report (EIR) ☐ Interim Measures ☐ Other / Explain:	Is this a Regulatory Requirement? ☒ Yes ☐ No If no, why is the document needed?
What is the consequence of NOT doing this item? What is the consequence of DOING this item? This submittal is required for compliance with the 1996 Corrective Action Consent Agreement (CACA), the CERCLA Remedial Design/Remedial Action Consent Decree (CD), and the Corrective Measure Implementation/Remedial Design (CMI/RD) Work Plan.	Other Justification/s: ☐ Permit ☐ Other / Explain:

Brief Summary of attached document:

This Construction/Remedial Action Work Plan (C/RAWP) presents the plans and schedules for construction and implementation of the remedy set forth in the design plans and specifications in the *Basis of Design/Pre-Final (90%) Design Report for the Final Groundwater Remedy, PG&E Topock Compressor Station, Needles, California* (90% BOD Report).

The 90% BOD Report is submitted under a separate cover and is intended to be a companion document to this C/RAWP.

Written by: Pacific Gas and Electric Company

Recommendations:

Provide review comments to DTSC and DOI.

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

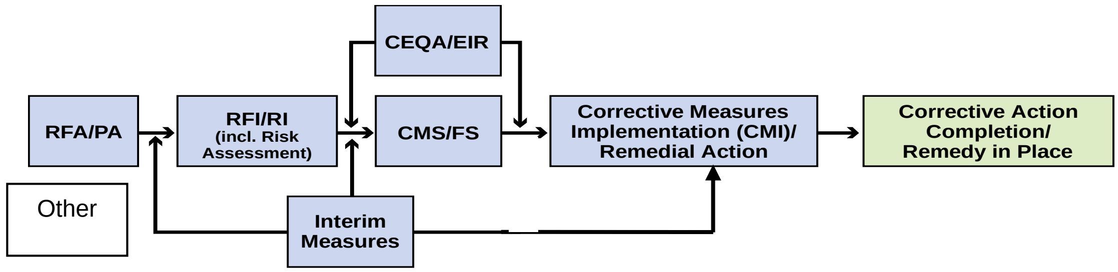
This submittal presents the plans and schedules for construction and implementation of the remedy set forth in the design plans and specifications in the 90% BOD Report.

Other requirements of this information?

None.

Related Reports and Documents:

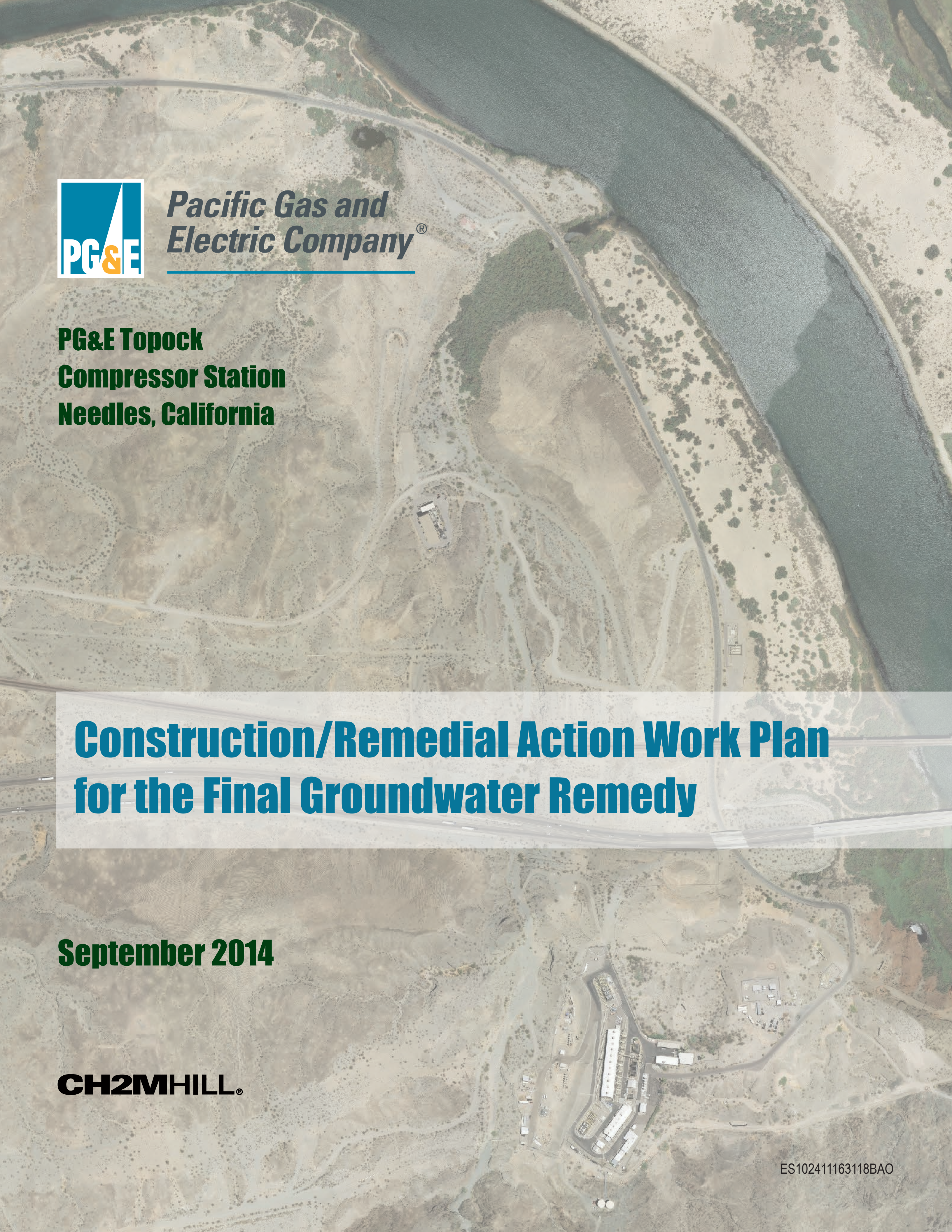
Click any boxes in the Regulatory Road Map (below) to be linked to the Documents Library on the DTSC Topock Web Site (www.dtsc-topock.com).



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

Version 9



Pacific Gas and Electric Company®

PG&E Topock Compressor Station
Needles, California

Construction/Remedial Action Work Plan for the Final Groundwater Remedy

September 2014

CH2MHILL®

ES102411163118BAO

Construction/Remedial Action Work Plan for the Final Groundwater Remedy

PG&E Topock Compressor Station Needles, California

Prepared for

Pacific Gas & Electric Company

September 2014

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155 Grand Avenue
Suite 800
Oakland, CA 94612

Certification Page

The certification page will be provided with the Final Construction/Remedial Action Work Plan.

Contents

Exhibits

Tables (located at the end of each section)

Figures (located at the end of each section)

Appendices

Acronyms and Abbreviations

µg/L	micrograms per liter
30% BOD	Draft Basis of Design Report/Preliminary (30%) Design
60% BOD	Basis of Design Report/Intermediate (60%) Design
90% BOD	Basis of Design Report/Pre-Final (90%) Design
ACEC	Area of Critical Environmental Concern
ACP	asphalt concrete pavement
ADOT	Arizona Department of Transportation
AMM	Avoidance and Minimization Measure
ANSI	American National Standards Institute
AOC	Area of Concern
APE	Area of Potential Effect
ARAR	applicable or relevant and appropriate requirement
ATSM	ATSM International
bgs	below ground surface
BLM	U.S. Bureau of Land Management
BMP	Best Management Practice
BNSF	Burlington Northern Santa Fe
BOD	Basis of Design
BOR	U.S. Bureau of Reclamation
C/RAWP	Construction/Remedial Action Work Plan
CACA	Corrective Action Consent Agreement
Caltrans	California Department of Transportation
CCR	California Code of Regulations
CD	Consent Decree
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHPMP	Cultural and Historic Properties Management Plan
CHQ	Construction Headquarters
CIMP	Cultural Impact Mitigation Plan
CMI	Corrective Measures Implementation
CQAPP	Construction Quality Assurance Project Plan

CQCP	Contractor Quality Control Plan
Cr(III)	trivalent chromium
Cr(T)	total chromium
Cr(VI)	hexavalent chromium
CWA	Clean Water Act
DOI	United States Department of the Interior
DTSC	California Environmental Protection Agency, Department of Toxic Substances Control
EIR	Environmental Impact Report
ER	East Ravine
ESA	federal Endangered Species Act
FCR	Field Contact Representative
FMIT	Fort Mojave Indian Tribe
HAZWOPER	Hazardous Waste Operations and Emergency Response
HDD	horizontal directional drilling
HMBP	Hazardous Materials Business Plan
HNWR	Havasu National Wildlife Refuge
HVAC	heating, ventilation, and air conditioning
I-40	Interstate 40
IM	Interim Measure
IM-3	Interim Measure No. 3
IRL	inner recirculation loop
IRZ	In-situ Reactive Zone
MMRP	Mitigation Monitoring and Reporting Program
MNA	monitored natural attenuation
NSF	National Science Foundation
NTH	National Trails Highway (also called National Old Trails Highway)
O&M	operation and maintenance
PA	Programmatic Agreement
PBA	Programmatic Biological Assessment
PG&E	Pacific Gas and Electric Company
PLC	programmable logic controller
PMO	Program Management Office (PG&E)
PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan

QC	quality control
RAO	remedial action objective
RB	River Bank
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RFI	RCRA Facility Investigation
RI	Remedial Investigation
ROD	Record of Decision
ROW	right-of-way
RTC	Response to Comment
RWQCB	Regional Water Quality Control Board
SCADA	Supervisory Control and Data Acquisition
SOP	standard operating procedure
SOW	Scope of Work
STLC	soluble threshold limit concentration
SWMU	Solid Waste Management Unit
TBM	tunnel boring machine
TC	toxicity characteristic
TCLP	toxicity characteristic leaching procedure
TCS	Topock Compressor Station
TDS	total dissolved solids
TW Bench	Transwestern Bench
TWB	Transwestern Bench (in reference to wells)
U.S.C.	United States Code
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Services
WBS	Work Breakdown Structure
WET	Waste Extraction Test

SECTION 1

Introduction

This Construction/Remedial Action Work Plan (C/RAWP) presents the strategy and procedures for construction and startup of the groundwater remedy system at the Pacific Gas and Electric Company (PG&E) Topock Compressor Station (TCS or Compressor Station) in Needles, California. This C/RAWP is packaged with the Basis of Design (BOD) Report/Pre-Final (90%) Design Submittal for the Final Groundwater Remedy (90% BOD Report). This C/RAWP is a companion document to the 90% BOD submittal and is focused on the strategy for constructing and starting up the groundwater remedy.

PG&E is implementing the groundwater remedy at the Topock site 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 1996, PG&E and DTSC entered into a Corrective Action Consent Agreement (CACA) pursuant to Section 25187 of the California Health and Safety Code. The U.S. Department of the Interior (DOI) is the lead federal agency overseeing response actions for land under its jurisdiction, custody, or control near the Compressor Station pursuant to CERCLA. PG&E and the United States executed a Remedial Design/Remedial Action Consent Decree (CD), on behalf of the DOI, under CERCLA in 2012, which was approved by with the U.S. District Court for the Central District of California in November 2013.

This C/RAWP has been prepared as required by the CACA and the CD. The CACA requires that this C/RAWP be prepared to document the overall management strategy, construction quality assurance procedures, and schedule for constructing the remedy. The CD requires that this C/RAWP be submitted concurrently with the pre-final/final design package. Detailed requirements of the CACA and the CD pertaining to this C/RAWP are included in Section 1.3 of this report.

1.1 Purpose and Overview

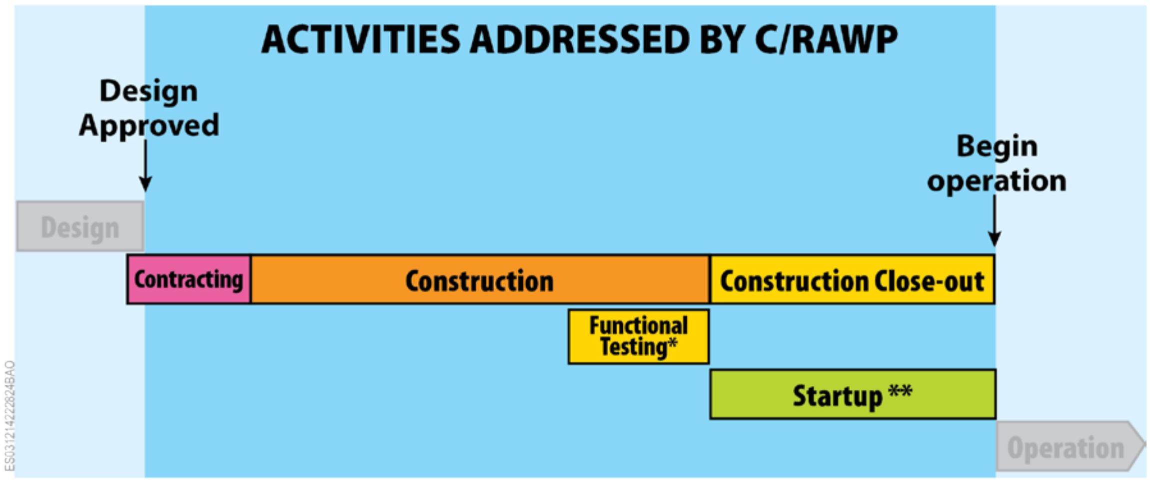
The purpose of this C/RAWP is to be a standalone document that details the strategy and procedures for constructing and starting up the final groundwater remedy. This C/RAWP is being prepared in conjunction with and is intended to be a companion document of the 90% BOD Report. The 90% BOD submittal includes:

1. The BOD report, including engineering plans, providing the design basis, design criteria, drawings, and specifications for the groundwater remedy.
2. The operations and maintenance manual (O&M Manual), outlining strategies and procedures for performing O&M of the groundwater remedy during the expected decades-long remedy operation phase, including long-term monitoring to evaluate attainment of cleanup goals.
3. This C/RAWP, outlining strategies and procedures for constructing and starting up the groundwater remedy. It also includes a plan for the shutdown, layup, and decommissioning of the existing Interim Measure (IM), as well as post-construction revegetation.

Following completion and approval of the design for the final groundwater remedy and after execution of the appropriate institutional controls, approvals, permits, and agreements, this C/RAWP will be implemented and construction will begin on the remedy.

The construction of the groundwater remedy is expected to be a multiyear process, including contracting, mobilization, site preparation and establishment of construction support facilities, construction of the groundwater remedy facilities, functional testing, shutdown and layup of the existing IM, and groundwater remedy startup. Following functional testing and startup of the groundwater remedy, O&M of the remedy will begin. Exhibit 1.1-1 shows a simplified timeline of the activities covered by the C/RAWP, starting at the approval of the Final Design and ending with initiation of the operational phase of the remedy. Throughout this work plan, the term "construction" or "construction and startup" are typically implied to mean all activities addressed by this C/RAWP, following completion and acceptance of the design and prior to the operation and maintenance phase of the project.

EXHIBIT 1.1-1
C/RAWP and Construction Timeline
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California



* This period is often referred to as "commissioning" or "shakedown", which is the period when the construction contractors make minor adjustment as necessary to ensure the system or components is operating and functioning as designed.
** The IM system will be turned off when the groundwater remedy equipment are ready to begin start-up.

1.2 Background and Setting

As shown on Figure 1.2-1, the TCS is adjacent to the Colorado River in eastern San Bernardino County, California, approximately 12 miles southeast of Needles, California, south of Interstate 40 (I-40), near the north end of the Chemehuevi Mountains. The selected groundwater remedy addresses existing chromium contamination in groundwater resulting from past TCS operations. The groundwater remedy includes:

- Construction of an In-situ Reactive Zone (IRZ) along National Trails Highway (NTH; also called National Old Trails Highway) 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 reduction of the hexavalent chromium (Cr[VI]) to trivalent chromium (Cr[III]).
- Flushing accomplished through a combination of freshwater injection and injection of carbon-amended water in wells upgradient of the plume.
- Extraction wells near the Colorado River (referred to as the River Bank Extraction Wells) to provide hydraulic capture of the plume, accelerate cleanup of the floodplain, and enhance the flow of contaminated groundwater through the IRZ line.
- East Ravine 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 as a long-term component to address residual chromium that may remain in recalcitrant portions of the aquifer after enhanced in-situ treatment and optimized system performance.

Figure 1.2-2 shows planned locations of the groundwater remedy facilities, as represented in the 90% BOD submittal.

Information on the history of the groundwater remedy project, objectives of the groundwater remedy, selection of the groundwater remedy, and regulatory setting are included in the Revised *Groundwater Corrective Measure Implementation/Remedial Design* [CMI/RD] *Work Plan for Solid Waste Management Unit 1/Area of Concern 1* [SWMU 1/AOC 1] *and Area of Concern 10, Pacific Gas and Electric Company, Topock Compressor Station, Needles, California* (CH2M HILL 2011). The CMI/RD Work Plan provides the framework for implementation of the selected groundwater remedy through design, construction, startup, operation, maintenance, decommissioning, restoration, and long-term monitoring following completion of the active treatment. The BOD 90% Report provides background information on the site and groundwater remedy, baseline site conditions, and design basis and assumptions, design criteria, design drawings and specifications and other supporting information. The BOD 90% Report also describes the existing IM that has been operating to contain the chromium contamination in groundwater since 2004 and the transition from the IM to the groundwater remedy.

The Area of Potential Effects (APE) for the Topock site is contained within what the Fort Mojave Indian Tribe (FMIT) and other Native American Tribes have identified as a larger area of traditional and cultural importance. The Tribes believe that the environmental, cultural, and spiritual resources may not be physically perceptible.

Portions of the Topock site are also located in a Riparian and Cultural Area of Critical Environmental Concern (ACEC), designated under the U.S. Bureau of Land Management (BLM) Resource Management Plan (BLM 2007), and a large portion of the site and surrounding area is the Havasu National Wildlife Refuge (HNWR). In recognition of the cultural, historical, and ecological resources, all construction and remedial activities at TCS are planned in such a way as to minimize impact to the APE. Specifically, impacts to cultural resources will be minimized by implementing the mitigation measures required by the Mitigation Monitoring and Reporting Program (MMRP; DTSC 2011a), adopted by DTSC in 2011 as part of the certified EIR (DTSC 2011b). In addition, mitigation measures have been and will continue to be implemented in accordance with the Programmatic Agreement (PA; BLM 2010); the Cultural and Historic Properties Management Plan (CHPMP; BLM 2012); the Cultural Impact Minimization Program (CIMP; PG&E 2014); and in consultation with the Tribes throughout the construction and startup process. The work will be conducted in a manner that recognizes and respects these resources and the spiritual values of the area.

1.3 Requirements and Organization of the Construction/ Remedial Action Work Plan

In conformance with the requirements of the 1996 CACA and the 2013 CD, this C/RAWP includes specific information related to the construction and start-up of the final groundwater remedy. Those requirements are organized into the sections listed below.

- **Executive Summary** provides a brief summary of the RAWP.
- **Section 1** provides the purpose and overview of the RAWP, introduces the final groundwater remedy as well as background information and setting information, and describes the requirements, content and organization of the RAWP.
- **Section 2** is the Project Management Plan and describes the project team organization responsibilities, project management approach, communication procedures, method for selecting remedial action contractors, worker training/education, regulatory compliance data management, recordkeeping, and reporting.

- **Section 3** describes procedures for construction of the groundwater remedy and outlines the schedule and sequencing considerations for construction of remedial components such as wells, pipelines, aboveground support facilities, and other remedial facilities.
- **Section 4** is the Site Management Plan describing requirements for construction and startup of the groundwater remedy such as worker health and safety, site preparation, site security, decontamination, waste management, best management practices, and other site and coordination procedures.
- **Section 5** summarizes the construction contingency plans and procedures.
- **Section 6** describes construction completion activities, including construction closeout, revegetation, functional testing, and remedy startup.
- **Section 7** provides reference information for the works cited in this report.

The C/RAWP has been prepared to meet the requirements of the CACA and the CD and will be used by PG&E and its contractors as a guide throughout the construction and startup process. Table 1.3-1 provides a cross-reference between the C/RAWP content and the CACA and the CD requirements. The content of this work plan is also guided by other agency requirements such as mitigation measures required by the Mitigation Monitoring and Reporting Program (MMRP; DTSC 2011a), and applicable or relevant and appropriate requirements as discussed throughout this work plan.

TABLE 1.3-1

Corrective Action Consent Agreement and Consent Decree Compliance Checklist for C/RAWP Requirements

Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles California

CACA Attachment 6 Requirements Part E – Construction Work Plan (DTSC 1996)	Consent Decree Requirements CD Paragraph 13b, SOW Sections 2.2.5, 2.2.6, 2.2.7, 3 (DOI 2013)	Section of the C/RAWP where the Requirement is Met
E.1 Introduction/purpose		Section 1 – Introduction
E.2 Project management, including construction management approach, levels of authority and responsibility, lines of communication and construction QA/QC responsibilities	Project Management Plan: • Identification of PG&E's remedial action project team, levels of authority, and responsibility • Project management and organization • Communication procedures and protocols • Method for selection of the contractor • Protocol for documenting ARARs compliance	Section 2.1 – Project Team Organization Section 2.3.1 – Communication Procedures and Protocols Section 2.3.2 – Method for Selecting Remedial Action Contractors Section 2.4.3 – Protocol for Documenting ARARs Compliance
E.3 Project schedule, including timing for key element of the bidding process, timing for initiation and completion of major construction tasks, and when the Construction Completion Report will be submitted	Schedule for completion of the Remedial Action: • Schedule for implementing Remedial Action tasks identified in the final design submission • Project schedule, including timing of key elements for bidding purposes, timing of the initiation and completion of major tasks, and when the construction completion report will be submitted	Section 3.3 – Construction Sequencing
E.4 Construction QA/QC Program	Final CQA Plan: • Methodology for overseeing and implementing the CQA Plan • CQA objectives, requirements, and performance standards • Identification of QA official • Identification of responsibilities and authorities • CQA personnel qualification • Inspection activities, schedules, and scope	Section 2.3.4 – Methodology for Overseeing and Implementing the CQA Project Plan Appendix A – CQAPP
	Schedule for developing and submitting other required remedial action plans	Section 4.1 – Coordination with Other Project or Site Activities

TABLE 1.3-1

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Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles California

CACA Attachment 6 Requirements Part E – Construction Work Plan (DTSC 1996)	Consent Decree Requirements CD Paragraph 13b, SOW Sections 2.2.5, 2.2.6, 2.2.7, 3 (DOI 2013)	Section of the C/RAWP where the Requirement is Met
	Site Management Plan: • Site access • Site security • Protocols for site workers, visitors, and monitors	Section 4.3.1 – Site Access and Security Section 4.3.2 – Protocols for Visitors and Monitors
	Decontamination Plan: Procedures and plans for the decontamination of equipment and the disposal of contaminated materials	Section 4.4.3 – Equipment Decontamination
E.5 Waste Management Practices	Waste Management Plan: • Procedures addressing how wastes generated during construction will be managed • Compliance with offsite shipment of waste material requirements in CD Paragraph 17	Section 4.5 – Waste Management Plan
E.6 Sampling and Monitoring • Description and purpose of monitoring tasks • Data quality objectives • Analytical test methods and detection limits • Name of analytical laboratory • Laboratory QC • Sample collection procedures and equipment • Field quality control procedures • Criteria for data acceptance and rejection • Schedule of monitoring frequency	Sampling and monitoring during construction: • Compliance with QA, sampling, and data analysis in CD Paragraph 23	Section 3.2.1.2 – Data Collection during Well Construction Appendix B – Standard Operating Procedures Appendix C – Data Quality Assurance Project Plan and Addendum
	Methodology for implementing the O&M Manual	Section 6.2– Functional Testing, Startup, and Transition to Operation and Maintenance

TABLE 1.3-1
Corrective Action Consent Agreement and Consent Decree Compliance Checklist for C/RAWP Requirements
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles California

CACA Attachment 6 Requirements Part E – Construction Work Plan (DTSC 1996)	Consent Decree Requirements CD Paragraph 13b, SOW Sections 2.2.5, 2.2.6, 2.2.7, 3 (DOI 2013)	Section of the C/RAWP where the Requirement is Met
E.7 Construction Contingency Procedures • Design changes due to field conditions • Communications during emergency • Unforeseen events	Contingency plans during construction: • Methodology for implementing the Contingency Plan • Contingencies to address design changes during construction • Contingencies due to unforeseen events • Contingencies to address potential failure modes	Section 5 – Construction Contingency Plan/ Procedures
E.8 Construction Safety Procedures	Health and Safety Plan	Section 4.4.1 – Health and Safety Appendix D – Construction Health and Safety Plan
E.9 Data Management and Documentation Requirements • Progress reporting • Monitoring and laboratory data • Records of construction costs • Personnel, maintenance, and inspection records	Data management and documentation requirements: • Details for the collection/maintenance of information • Compliance with reporting requirements in CD paragraph 32 (SOW Section 5); written monthly progress reports during remedy construction	Section 2.6 - Data Management, Documentation, Recordkeeping, and Reporting Procedures
E.10 Cost Estimate		Appendix E – Cost Estimate
	IM-3 Decommissioning Plan	Appendix F – IM-3 Decommissioning, Removal, and Restoration Work Plan
	Habitat Restoration Plan	Appendix G – Havasu National Wildlife Refuge Habitat Restoration Plan

Acronyms:

ARAR = applicable or relevant and appropriate requirement
CQA = construction quality assurance
IM-3 = Interim Measure No. 3
QA/QC = quality assurance/quality control
SOW = Statement of Work

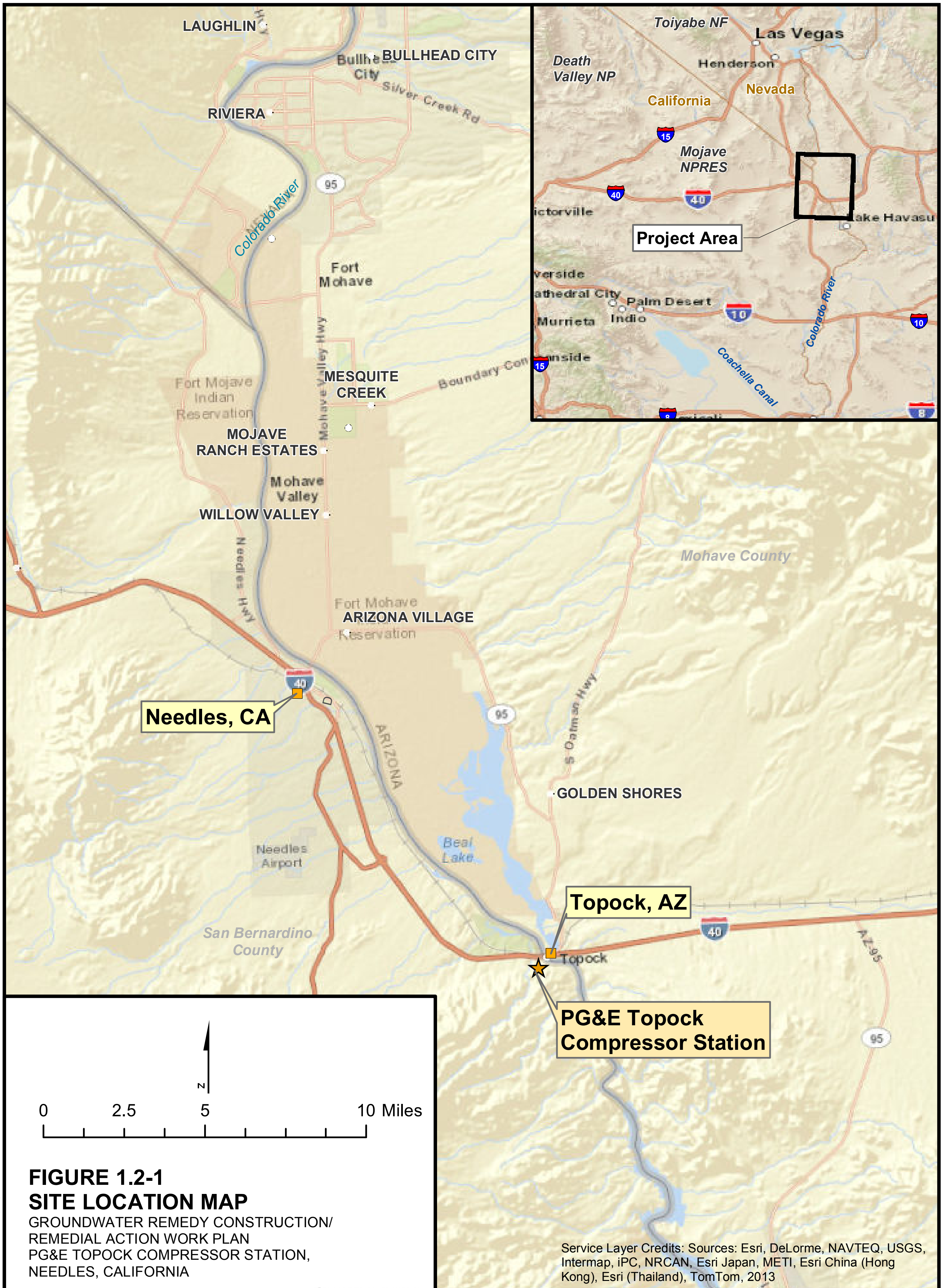

FIGURE 1.2-1
SITE LOCATION MAP
GROUNDWATER REMEDY CONSTRUCTION/
REMEDIAL ACTION WORK PLAN
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

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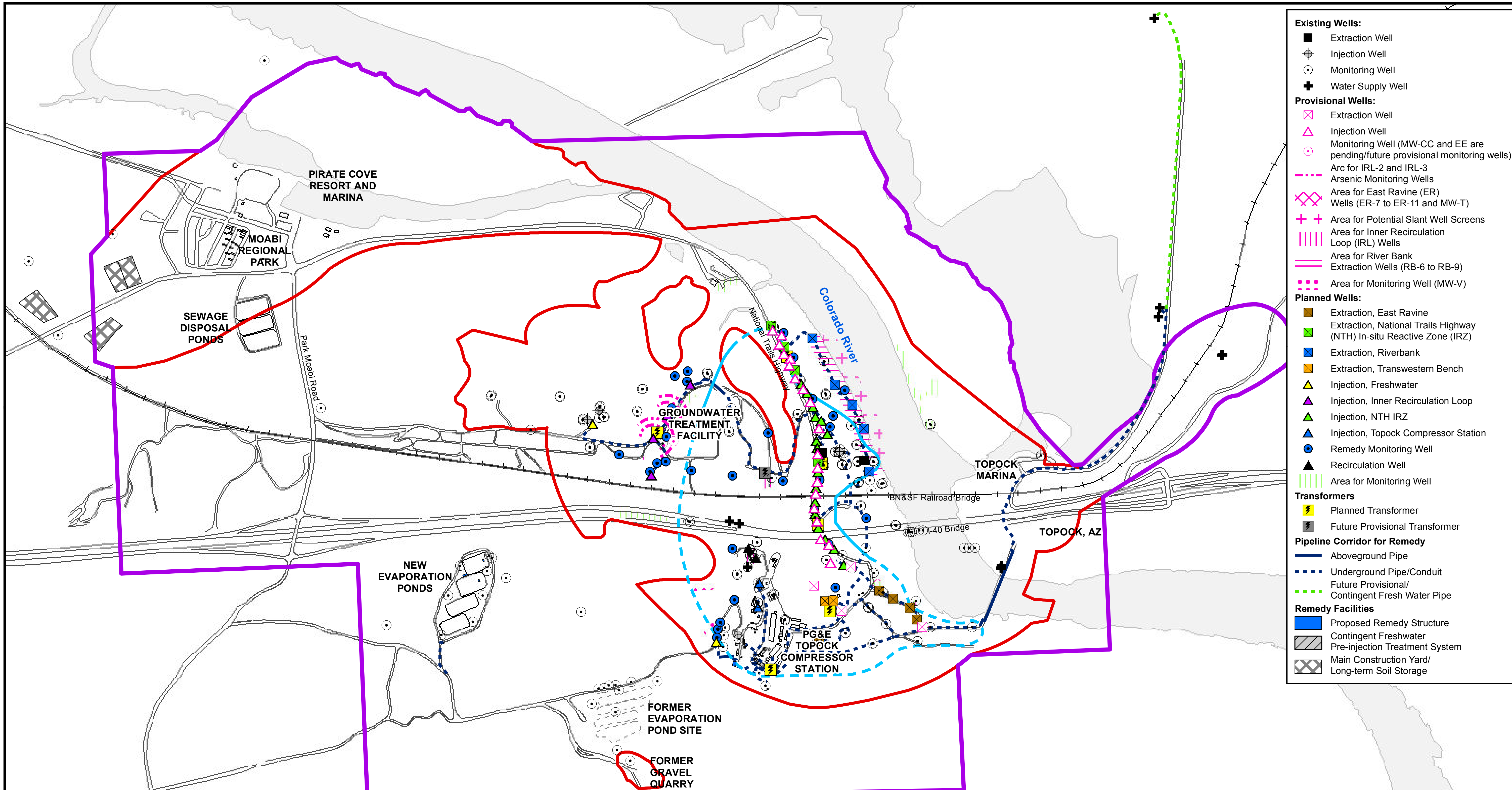

LEGEND

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 2011 sampling events. Dashed where based on limited data.

Notes:

1. 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.

2. Note that in compliance with EIR mitigation measure CUL-1a-9 as well as PA and CHPMP mitigation measures, the pipeline along the dirt road west of National Trails Highway is located in an existing, previously disturbed, access road. In addition, the location of the road and the pipeline was field verified and does not create any direct physical impact or effect on the Topock Maze, as it is manifested archaeologically, in compliance with EIR mitigation measure CUL-1a-10 and PA and CHPMP mitigation measures.

N

0 375 750 1,500 Feet

FIGURE 1.2-2
GROUNDWATER REMEDY PROJECT AREA AND SYSTEM LAYOUT
GROUNDWATER REMEDY CONSTRUCTION/ REMEDIAL ACTION WORK PLAN
PG&E TOPOCK COMPRESSOR STATION, NEEDLES, CALIFORNIA

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SECTION 2

Project Organization and Management/Project Management Plan

This section presents the project organization and management plan for the construction and startup of the groundwater remedy. This section describes PG&E's management approach, including organization, levels of authority and responsibility, lines of communication, and a summary of the communication procedures and protocols. Similar information for implementing the O&M phase of the groundwater remedy is presented in the main text of the O&M Manual.

In support of the administrative management of the groundwater remedy construction and startup, this section also presents: (1) worker training education requirements; (2) methods for overseeing quality assurance programs; (3) methods for ensuring compliance with the EIR mitigation measures, applicable or relevant and appropriate requirement (ARARs), and other agreements and programs (for example, the PA, CHPMP, and CIMP); and (4) procedures for data/records management, documentation, and reporting.

2.1 Project Team Organization

PG&E has chartered an implementation team with the accountability to ensure that the project goals and management principles are fulfilled. Table 2.1-1 summarizes the organization and roles of key personnel for the groundwater remedy construction and startup, as well as levels of authority, responsibility, and lines of communication. Exhibit 2.1-1 presents the project team organization chart for the construction and startup phase. The project organization is intended to be a "living" element throughout the construction and startup, meaning that it can be updated as new information becomes available as the project proceeds or as site circumstances change.

2.2 Project Management Approach

The PG&E Topock project team is committed to effectively implementing the construction and startup of the groundwater remedy in a safe and sustainable manner that is respectful to the sensitivity of the cultural, historical, and biological resources at or near the Topock site while complying fully with regulatory mandates. These principles as described briefly, followed by management approaches and administrative activities to be followed during groundwater remedy construction and startup.

2.2.1 Ensuring Protection of Human Health and the Environment

The PG&E Topock project team is committed to executing the groundwater remedy construction and startup 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. Section 4 and Appendix D describe health and safety protocols for the groundwater remedy construction.

The PG&E Topock project team is also committed to executing the groundwater remedy construction and startup in a manner that protects sensitive habitats and the environment. Project protocols have been and will be enforced to minimize impacts to environmental resources including aesthetic, biological, air quality, cultural, geology and soils, hazardous materials, hydrology and water quality, noise, and water supply. Section 2.4 contains a detailed assessment of compliance with ARARs and mitigation measures to minimize impacts to these resources.

2.2.2 Ensuring Respect of the Sensitivity of the Cultural, Historical, and Biological Resources

The PG&E Topock project team is committed to constructing the final groundwater remedy in a manner that is respectful of the sensitivity of the resources at and near the project area. 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 in the CIMP (provided as Appendix H to this C/RAWP) and the CHPMP (provided as Appendix I to this C/RAWP). 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). Section 2.4 describes action to be taken to ensure compliance with mitigation measures, ARARs, and other agreements, including those associated with reducing impacts to sensitive resources. Section 2.3.3 describes cultural and historic resource sensitivity training and biological resource sensitivity education for site workers.

2.2.3 Ensuring Opportunities for Inputs

The PG&E Topock project team is committed to supporting the established programs of the state (DTSC) and federal (DOI) lead agencies related to Topock community outreach/public participation (DTSC 2009; DOI 2010) to ensure that input from agencies, stakeholders, Tribes, and the local community is reflected in remedial activities at Topock. PG&E will continue to provide support to the agencies, as requested, with implementation of these programs.

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

The groundwater remedy is being implemented as required by RCRA Corrective Action and CERCLA. Additionally, implementation of the groundwater remedy is guided by and held to standards required by the following main categories of requirements:

- ARARs specified in the Record of Decision (ROD) (DOI 2010)
- California Environmental Quality Act (CEQA) mitigation measures defined by DTSC in the Final EIR (DTSC 2011b)
- PA and the CHPMP developed in compliance with the National Historic Preservation Act (BLM 2010, 2012)
- Requirements of landowners and leaseholders of property and rights-of-way (ROWs) affected by groundwater remedy construction, operation, and monitoring.

PG&E is committed to maintaining compliance with the identified requirements. Anticipated approvals/ authorizations, as well as compliance with mitigation measures, ARARs, and other agreements, are described in Section 2.4.

2.2.5 Ensuring Quality

The PG&E Topock Team will manage the groundwater remedy construction and startup in conformance with its quality assurance/quality control (QA/QC) programs. A Construction Quality Assurance Project Plan (CQAPP) for the groundwater remedy construction is included in Appendix A to this C/RAWP. The CQAPP details the systems and controls that PG&E has established to ensure that the construction will meet or exceed the design criteria, plans, and specifications. The CQAPP includes inspections and verification activities, QC testing, QA testing, construction audits, construction surveillance, construction deficiency identification and control and correction, and methods and processes for continuous improvement during construction of the groundwater remedy.

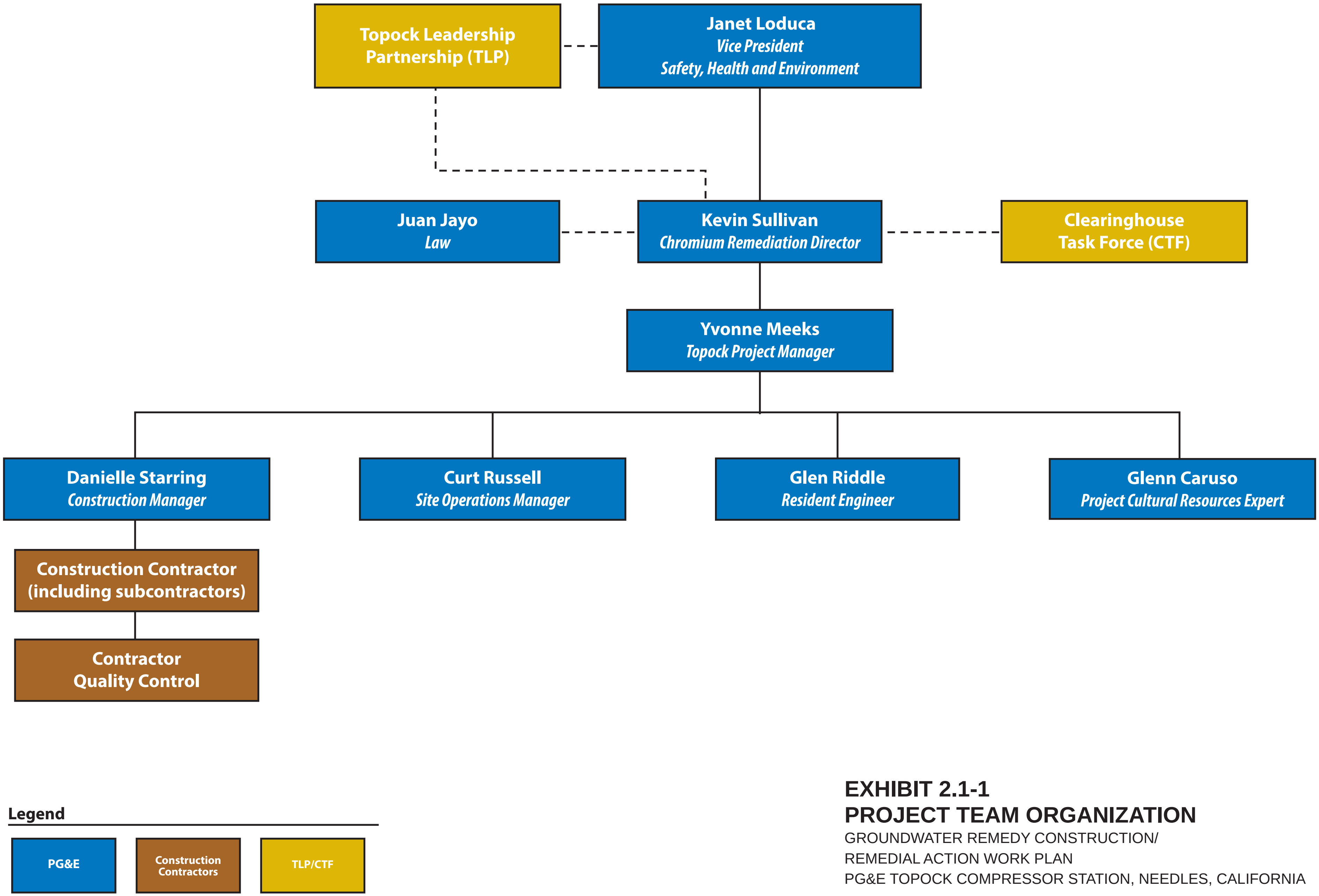

EXHIBIT 2.1-1
PROJECT TEAM ORGANIZATION
GROUNDWATER REMEDY CONSTRUCTION/
REMEDIAL ACTION WORK PLAN
PG&E TOPOCK COMPRESSOR STATION, NEEDLES, CALIFORNIA

CH2MHILL.

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In addition, QA and QC requirements for environmental data collected during groundwater remedy construction and startup are contained in the project Quality Assurance Project Plan (QAPP) and QAPP Addendum, included as Appendix C to this C/RAWP. The QAPP and QAPP Addendum outline the procedures to ensure that environmental data collected during the groundwater remedy construction and startup will be of appropriate quality to achieve the project objectives and consistent with the U.S. Environmental Protection Agency (USEPA) requirements for QAPPs. PG&E will ensure that laboratories for the analysis of site samples adhere to accepted USEPA methods, participate in an USEPA-equivalent QA/QC program, and have a documented quality system. Standard operating procedures (SOPs) for data collection and field measurements provide consistency for QA and QC and are provided as Appendix B to this C/RAWP.

Each contractor is responsible for performing QC of its contracted work to manage, control, and document compliance with these requirements. PG&E and/or its designated subject matter experts will perform QA during project implementation to ensure that the groundwater remedy construction and start-up meet project requirements.

2.2.6 Incorporation of Sustainability

Consistent with its Programmatic Sustainable Remediation Guidance (PG&E 2011), the PG&E Topock project team will work to integrate sustainability principles into the groundwater remedy construction and startup. During design, sustainability focus has been on reducing the overall remedial timeframe and reducing O&M requirements for water use, materials use, waste generation, energy use air emissions generated, health and safety, and hazardous and potential impacts on biological resources. During the construction and startup phases, key sustainability metrics will be identified, along with relevant sustainable best management practices (BMPs), to reduce overall remedy impacts. It is expected that the sustainability practices will focus on reducing emissions from heavy equipment and maximizing onsite injection or reuse of disturbed soil and extracted groundwater, as allowed by waste management regulations. Sustainability practices and recordkeeping will be included in the documentation and recordkeeping requirements in Section 2.6.2.

2.2.7 Ensuring Efficient Integration with Other Activities

The PG&E Topock project team will manage the groundwater remedy construction and startup in a manner that allows efficient integration with other PG&E activities including operation of the TCS, operation of the IM, eventual shutdown and layup of the IM, and soil RCRA Facility Investigation/Remedial Investigation (RFI/RI) activities.

The PG&E Topock team will also implement the groundwater remedy construction and startup in a manner that respects the operations and use of neighboring landowners and facilities, such as roads, pipelines, businesses, homes, and designated uses of public land.

2.3 Project Management Elements

In support of the principles outlined in Section 2.2, the following subsection describes administrative activities to be implemented during groundwater remedy construction and startup.

2.3.1 Summary of Communication Procedures and Protocols

Communication and outreach are key elements of all phases of project implementation. This section presents a summary of communication procedures and protocols to be used during the construction and startup of the groundwater remedy. The communication procedures and protocols are intended to be used by the PG&E Topock project team to inform and/or seek input from agencies, stakeholders, and Tribes in support of community outreach and public participation efforts; to seek approvals from agencies; to resolve issues; and to comply with certain requirements. This summary is a compilation of the communication procedures and protocols specified in various project directives and agreements (for example, the CACA, CD, EIR mitigation measures, PA, Programmatic Biological Assessment (PBA), CHPMP, CIMP, Hazardous

Materials Business Plan (HMBP), and Section 1600 Avoidance and Minimization Measures) and relevant state and federal requirements (for example, those related to reporting of releases of fuels or hazardous materials). This communication framework is intended to be a dynamic “living” element throughout the remedy implementation, meaning that it can be updated as new information becomes available as the project proceeds or as site circumstances change.

In general, communications occur in two forms: routine (regular periodic communication) and nonroutine (communication when the project experiences unexpected changes during construction and startup). Communication could be verbal, written, or both. Examples of routine communication include quarterly Consultative Working Group meetings and progress reports. Examples of nonroutine communication include notification of a release of U.S. Department of Transportation (USDOT)-regulated hazardous material during transportation or discovery of human-caused disturbance to remedy facilities.

Table 2.3-1 identifies triggering events, party or parties initiating communication, party or parties receiving communication, and a description of the communication protocols and procedures to be followed for routine and non-routine communications during construction and startup of the groundwater remedy.

2.3.2 Method for Selecting Remedial Action Contractors

The PG&E Chromium Project Management Office (PMO) has been established to implement PG&E’s chromium remediation program, including construction of the Topock groundwater remedy. Although the specific contracting approach for construction of the groundwater remedy has not been finalized, the PMO will select the remedial action contractors for construction and startup of the groundwater remedy in conformance with PG&E purchasing and procurement requirements and considering factors such as cost; qualifications; ability to meet PG&E requirements for health and safety, insurance, and the CQAPP; as well as the ability to support PG&E’s efforts in sustainability and compliance. PG&E plans to use pre-qualified contractors, where appropriate and available, including those who have prior experience working at Topock, to save time on procurement, to reduce time spent on the learning curve, and to reduce the potential for delays/conflicts during implementation. Preference will also be extended to contractors that are certified as disadvantaged businesses through the California Public Utilities Commission.

2.3.3 Worker Training and Education

In support of PG&E’s management principles, worker education and training programs for the groundwater remedy construction include cultural and historic resource sensitivity training, biological resource sensitivity education, health and safety, and other and training necessary to comply with regulatory requirements and the CQAPP.

2.3.3.1 Cultural and Historical Resources

Cultural and historical resources sensitivity education has been a central part of the Topock remediation project to date. Consistent with its obligations under PA monitoring protocol, existing PG&E standard practice, and the EIR MMRP requirements, cultural sensitivity training is required of staff, workers, and contractors engaged in activities within the EIR project area/APE to familiarize them with the sacred nature and cultural significance of the area so that they will perform their jobs in a respectful manner. The training occurs before field work and design submittal. This training includes discussion of appropriate behavior, activities that are to be avoided, and consequences for noncompliance. Consistent with these obligations, PG&E will not tolerate disrespectful behavior in the field and will remove staff, workers, or contractors who do not comply with this section.

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. Site orientation will stress that site activities will be conducted in a respectful manner. New site workers will be required to receive the training before they can work on ground-disturbing activities. Sensitivity training will be provided by PG&E's Site Operations Manager and Cultural Resources Specialist their designees, and supporting contractors. PG&E will invite participation from the Tribes, archaeological monitors, and agency staff, as appropriate.

Several EIR mitigation measures associated with the groundwater remedy (for example, CUL-1a-13, CUL-1b/c-4, and CUL-4) are related to continued training of workers regarding cultural resources, historical resources, and the identification of human remains. PG&E will continue communications with Tribes on development of a worker cultural sensitivity education program per CUL-1a-13, which will be implemented before construction, during construction, and during operation of the remedial facility.

2.3.3.2 Biological Resources

As with cultural and historical resources, biological resources sensitivity education has also been a central part of the Topock project. PG&E's education program covering threatened and endangered species, wetland awareness, the general project management measures specified under the PBA and other requirements and agreements is provided at project initiation meetings, typically held at the site and prior to field work. The training is provided by the PG&E Topock Site Operations Manager, the PG&E Project Biologist, and supporting contract biologists. Staff, workers, and contractors will receive training prior to working onsite.

In accordance with the PBA, PG&E-designated Field Contact Representatives (FCRs) will be responsible for overseeing compliance with the PBA and EIR mitigation measures. The FCR(s) has the authority to halt activities that pose a danger to listed species and/or are in violation with the mitigation measures. A qualified biologist will conduct a preconstruction survey for special-status wildlife species immediately prior to initiation of ground-disturbing activities. Within 60 days of completion of construction activities, the FCR and the qualified biologist will prepare a report for submittal to BLM.

2.3.3.3 Other Worker Training and Education

The CQAPP provides typical qualifications for QA/QC positions and for performing QA functions. PG&E recognizes the need to maintain a high-quality, well-trained, and competent construction management and inspection team. PG&E personnel will receive ongoing training to maintain and improve their technical skills and levels of competence to perform the work in their assigned roles. PG&E managers and staff will regularly review and assess training needs to maintain efficiency in existing job functions and to provide additional skills, knowledge, or competence required to adequately adapt to changes in technology, methods, or job functions. Prior to the start of construction—and periodically during the construction period—PG&E Topock project team will assess the project-specific staffing needs and implement training, as necessary.

Paleontological awareness training is also required for project personnel involved with ground-disturbing activities (for example, grading, trenching, drilling) in conformance with the Paleontological Resources Management Plan (Appendix J).

Construction workers and field personnel will be required to comply with the training requirements specified in the overall Construction Health and Safety Plan (Appendix D) and their own site-specific Health and Safety Plan specific to their definable feature of work. In addition, field personnel that manage hazardous or potentially hazardous waste will be required to comply with the training requirements of hazardous waste regulatory requirements. Other training may be required for specific job activities such as USDOT hazardous material training.

2.3.4 Methodology for Overseeing and Implementing the Construction Quality Assurance Project Plan

A CQAPP for the groundwater remedy construction is included in Appendix A to this C/RAWP in conformance with the CACA (Section Attachment 6, Part E.4) and the CD (Section VI.13.b and Appendix C, Sections 2.5, 3.1). The PG&E Topock team will implement the CQAPP to ensure that the groundwater remedy construction will meet or exceed the design criteria, plans, and specifications. PG&E's approach to implementing the CQAPP includes a combination of QC performed by the construction contractor and QA performed by PG&E. Each contractor is responsible for performing QC of its contracted work to manage, control, and document compliance with these requirements. PG&E will specify a QA official, independent of the construction contractors, to monitor and verify implementation of the CQAPP during construction and startup of the groundwater remedy. Additional detail on quality assurance/quality control (QA/QC) responsibilities and authorities of key personnel involved in the construction of the groundwater remedy is provided in the Construction Quality Assurance Project Plan (CQAPP).The continuous improvement strives to continually improve the effectiveness of the quality management system through the use of quality policy, quality objectives, audit results, analysis of data, corrective and preventive actions, and management review. In support of the process improvement, the PG&E management team will schedule meetings to review and assess plans and progress, document lessons learned, and conduct formal and informal audits of the construction process to measure the success of QA/QC plan and procedures. Documents of lessons learned and best practices are imperative to PG&E's performance and to providing confidence that the construction process has achieved its quality goals.

2.4 Anticipated Approvals and Authorizations and Compliance with Mitigation Measures, ARARs, and other Agreements

2.4.1 Compliance with Mitigation Measures, ARARs, and Other Agreements

This section provides a summary of actions taken or to be taken by PG&E in compliance with the EIR mitigation measures and the identified ARARs, the PA, the CHPMP, and the CIMP at this stage in the design and during the construction and startup of the groundwater remedy.

2.4.1.1 Summary of Compliance with EIR Mitigation Measures

There are 154 mitigation measures (counting subparts) set forth in the EIR and the adopted MMRP that address 12 resource areas, including aesthetic, biological resources, air quality, cultural resources, geology and soils, hazardous materials, hydrology and water quality, land use and planning, noise, transportation, utilities and service systems, and water supply. A summary of actions taken or to be taken in compliance with the EIR mitigation measures is presented in Appendix K. Identification and demonstration of how the identified ARARs and EIR mitigation measures are being incorporated into the groundwater remedy are summarized and discussed in tables presented in Section 6 of the 90% BOD Report; copies of these tables are presented in Appendix K to this C/RAWP (for the reader's convenience).[1] In addition, a summary of compliance with applicable CIMP protocols, PA stipulations, and the CHPMP provisions are also included in Appendix K.

In compliance with EIR mitigation measure CUL-1a-8, PG&E has developed the CIMP in coordination with the Tribes and has included the plan in Appendix H of this work plan. Compliance with the CIMP protocols are described in Appendix K. Additional protocols developed to comply with EIR mitigation measures for cultural resources are included in Appendix P.

2.4.1.2 Summary of Compliance with Identified ARARs

There are 57 ARARs addressing several resource areas, including biological, air quality, cultural, hazardous materials, and waterways (six chemical-specific, 38 action-specific, and 13 location-specific). Because the remedial action objectives (RAOs) were developed based on identified chemical-specific ARARs, attaining

[1] The compliance tables in Appendix K to this C/RAWP are copied directly from Section 6 of the 90% BOD Report. The table numbers and reference citations are unchanged; the reference citations correspond to the References List (Section 9) of the 90% BOD Report, not the References List in this C/RAWP. Please refer to Section 9 of the 90% BOD Report to identify the sources cited in Appendix K to this C/RAWP.

the RAOs will result in compliance with the chemical-specific ARARs. Until the RAOs are attained, institutional controls will be maintained to prohibit development of drinking water supply wells within the plume and additional areas outside of the plume footprint where control of groundwater flow directions and gradients is necessary to contain and remediate the chromium plume. One specific RAO is to reduce the mass of total chromium (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 regional background of 32 micrograms per liter (μg/L) of Cr(VI).

Because the final 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 (for example, preparing and submitting permit applications), the substantive requirements of the ARARs remain. A summary of the actions taken or that will be taken to comply with the identified ARARs is presented in Appendix K.

As provided in Appendix K to this C/RAWP, PG&E has prepared a draft protocol to identify procedures to be taken to ensure compliance with ARAR #32, CWA Section 404. Additionally, mitigation measure BIO-1 of the EIR contains applicable mitigation requirements related to Clean Water Act (CWA) Section 404. The draft protocol and proposed procedures for compliance with ARAR #32 and the portion of BIO-1 related to CWA Section 404 are presented in Appendix K.

In addition, in compliance with ARAR #40, the federal Endangered Species Act (ESA), PG&E, the U.S. Fish and Wildlife Service (USFWS), BLM and DOI coordinated on the PBA for the final groundwater remedy to address potential effects on federal listed species. This ESA Section 7 consultation was concluded with receipt of USFWS concurrency letter on July 7, 2014. Measures outlined in the PBA and associated USFWS determination letter will be implemented before and during construction activities. The PBA is included in this C/RAWP as Appendix U.

2.4.1.3 Summary of Compliance with PA and CHPMP

In addition, a summary of actions taken or that will be taken to comply with applicable stipulations in the PA (BLM 2010) and a summary of actions taken or that will be taken to comply with applicable requirements in the CHPMP (BLM 2012) are presented in Appendix K.

2.4.2 Anticipated Approvals, Authorizations, and Permits

Implementation of the groundwater remedy will require approvals of the final design and this C/RAWP from DTSC and DOI, pursuant to their authority under RCRA and CERCLA, respectively.

2.4.2.1 Access to Federal Lands

Remedial infrastructure are planned on federal lands, including lands administered by U.S. Bureau of Reclamation (BOR) (managed by BLM) and HNWR (managed by USFWS). It is PG&E’s understanding that the ROD, the CD, and the DOI’s approval of this C/RAWP constitute permission to implement the groundwater remedy and authorization to access federal property for purposes related to implementation of this C/RAWP. No other permit applications or approvals for access to federal lands will be required before field implementation. In addition, the process required for compliance with ARARs is addressed and documented in the above section, and there is not a separate process for compliance required for access to federal lands.

2.4.2.2 Access to Non-federal Lands

Remedial infrastructure is planned on non-federal lands, including lands owned by Burlington Northern Santa Fe (BNSF) Railway, Kinder Morgan, FMIT, and private property owners in the Topock Marine area. In addition, infrastructure is planned on county roadways or their ROWs (San Bernardino County, Mojave County), as well as roadways/ROWs of state transportation agencies (California Department of Transportation [Caltrans], Arizona Department of Transportation [ADOT]). Where remedial infrastructure crosses or travels along utility easements, a consent to common use agreement or other notification process will be implemented, as appropriate.

Pursuant to CERCLA Section 121(e), activities conducted onsite are exempt from obtaining federal, state, or local permits or complying with other procedural requirements. However, PG&E is still required to comply with the substantive requirements of the identified location- and action-specific ARARs. Below is a list of anticipated approvals/permits/agreements that PG&E anticipates obtaining for the project:

- Encroachment permits from ADOT and Caltrans for pipeline segment under I-40
- Easement(s) from BNSF for pipeline segments and access roads under BNSF ROW
- Encroachment permits from the San Bernardino and Mojave counties for infrastructure in the county roadways and ROWs
- Any necessary approvals from California and Arizona State Lands for the crossing of the Colorado River on the Arched Bridge
- Consent to common use agreements or other appropriate notification requirements with utility companies for remedial infrastructure on their lands or within their easements and ROWs
- Access agreements with private property owners for remedial structures on their lands, where such agreements do not otherwise exist.
- Land Use Covenant for PG&E’s TCS parcel

It should be noted that under the Settlement Agreement between PG&E and the FMIT, PG&E has access to the land owned by the FMIT to implement the selected final groundwater remedy. More specifically, the 2006 Easement Agreement between the FMIT and PG&E covers access, as well as activities such as facility O&M. The FMIT’s preference to limit such activity to the extent practicable and to have as little remedial infrastructure placed on its property as possible is recognized; this preference has been, and will continue to be, considered during the development of the design, consistent with the provisions of the Easement Agreement and the 2006 Settlement Agreement.

2.4.2.3 Other Anticipated Approvals, Permits, and Agreements

In addition to the above, PG&E has and will continue to coordinate with the California Regional Water Quality Board (RWQCB) regarding the substantive requirements applicable to the use of the evaporation ponds at the TCS for disposal of certain remedy-produced water streams.

2.4.3 Protocol for Documenting ARARs Compliance and EIR Mitigation Measures Compliance

In compliance with CD requirement (¶13[b][10] and SOW Section 3.4), PG&E proposes the following protocol to document attainment of the ARARs identified in the ROD during construction and startup of the groundwater remedy:

1. Continue to document compliance with ARARs in a table similar to the ARARs compliance table in Appendix K and submit quarterly to DOI. PG&E welcomes DOI’s input as to how DOI would like to receive this information (for example, as a standalone submittal, as an attachment to the progress reports, etc.).
2. Where continued ARARs compliance will be via actions taken to implement other project documents, (for example, implementation of the BMP Plan, the Waste Management Plan, etc.), PG&E will prepare and submit to DOI the required submittals (as with current practices, where there are overlapping requirements between state and federal processes, one submittal will be prepared to satisfy both processes). .

In addition, PG&E proposes to continue to document compliance with EIR Mitigation Measures. As described in the CMI/RD Work Plan (CH2M HILL 2011), EIR Mitigation Measures Compliance Reports will be submitted to DTSC quarterly during design and construction phases of the project, and annually during O&M. The quarterly reports submitted to DTSC document the project's compliance with EIR mitigation measures during the reporting period. In addition, the quarterly reports are used to report on specific events during the reporting period, such as resolutions noted by the designated Disturbance Coordinators for noise and vibration required by NOISE-1b and NOISE-2d), or reports of human-caused disturbance to project facilities required by CUL-1a-3b.

2.5 Compliance Milestones

As required by the CD ¶71b(4), compliance milestones proposed for the groundwater remedy construction are below:

1. Quarterly reports documenting ARARs compliance during the construction period, as described in Section 2.4.3 above. Quarterly ARARs compliance reports are proposed to be submitted to DOI 20 calendar days after the end of each quarter (January 20, April 20, July 20 and October 20), for the duration of the remedy construction. For purposes of this milestone, the duration of remedy construction will begin with DOI approval of the 100 percent design, and will end with PG&E's submittal of the Construction Completion Report.
2. Annual monitoring reports for specified archaeological and historic properties pursuant to Section 6.6.5 of the CHPMP. Annual monitoring reports are proposed to be submitted to BLM by December 31 of each year for the duration of remedy construction. For purposes of this milestone, the duration of remedy construction will begin with DOI approval of the 100 percent design, and will end with PG&E's submittal of the Construction Completion Report.
3. Submittal of the report required by the PBA, general Mitigation Measure #24. The report will be submitted to the BLM and will document the effectiveness and practicality of the mitigation measure and make recommendations for modifying the measures to enhance species protection, as appropriate. The report will also provide information on survey and monitoring activities, observed listed species if encountered, and the actual acreage disturbed by the activities, if any. The report will be submitted within 60 days of completion of construction activities. PG&E and DOI will agree on a specific date for submittal of this report at the time of construction completion and prior to the start of the 60-day report period.

2.6 Data Management, Documentation, Recordkeeping, and Reporting Procedures

This section describes the overall management and documentation of data, records, and information anticipated to be collected during construction and startup of the final groundwater remedy and the reporting and maintenance of the records.

2.6.1 Field Measurements and Laboratory Data

Three types of environmental data are expected to be collected during construction and startup of the final groundwater remedy: field measurement/ process monitoring data, onsite laboratory data, and offsite laboratory data. As required by the CACA (Attachment 6, Part E.9) and the CD (Appendix C, Section 3), the following addresses procedures describing how environmental data and results will be evaluated, documented and managed. The management of each type of data is described below. Exhibit 2.6-1 presents a simplified data management process for the project.

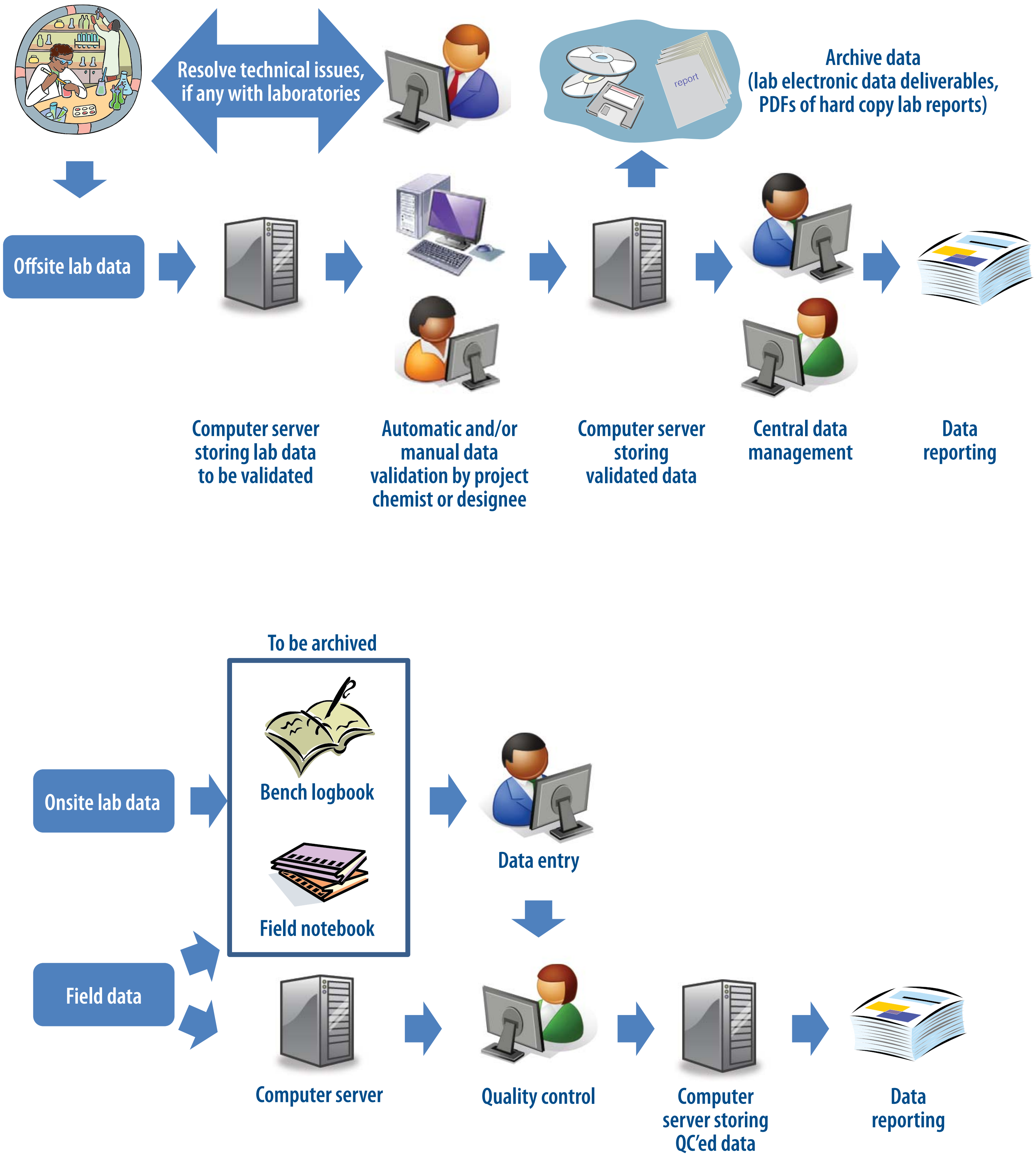


EXHIBIT 2.6-1
Simplified Data Management Process
Groundwater Remedy Construction/Remedial Action Work Plan
PG&E Topock Compressor Station, Needles, California

QA and QC requirements designed to ensure that environmental data collected during groundwater remedy construction and startup will be of appropriate quality to achieve the project objectives. The project QAPP and QAPP Addendum are included in Appendix C to this C/RAWP, consistent with the USEPA requirements for QAPPs. PG&E, or its designee, will ensure that laboratories for the analysis of site samples adhere to accepted USEPA methods, participate in an USEPA-equivalent QA/QC program, and have a documented quality system. SOPs for data collection and field measurements provide consistency for QA and QC (Appendix A).

2.6.1.1 Field Measurement/Process Monitoring Data

Field measurements will be collected during construction of the monitoring and remediation well network and during functional testing and startup of the groundwater remedy, including the well network, the carbon amendment facilities, the remedy-produced water conditioning plant, and the freshwater supply system. Measurements will be conducted in accordance with the SOPs included in Appendix B to this C/RAWP and are recorded manually in a field logbook, field sampling form, tablet computer, and/or process monitoring checklist or are recorded automatically by stationary or handheld data loggers and transmitted to a database using a telemetry system. Periodic field audits by experienced staff will be conducted to verify that SOPs are being followed. Equipment calibration will follow manufacturers' recommendation to ensure data quality. Manually recorded data will be entered and/or transferred into a database. In addition, process monitoring and control data generated in facilities/plants may be automatically recorded into a data historian that resides in the plant control system, if in place. The data will be maintained in a database and will be reviewed by experienced field staff or chemist. Historic trends, water quality data, and well construction details will also be made available to the field crew so that anomalous data (compared to historical values) can be identified in a timely manner and field-verified and -corrected after consulting with experienced scientist or chemist, as appropriate.

2.6.1.2 Onsite Laboratory Data

Certain testing for process control monitoring will be performed at an onsite laboratory in accordance with site-specific SOPs, provided as Appendix B to this C/RAWP. Onsite lab measurements during construction may include Cr(VI), Cr(T), ferrous iron, conductivity, turbidity, pH, nitrate, sulfate, alkalinity, total organic carbon, orthophosphate, manganese, and total dissolved solids. Additional measurements could be added in the future.

The onsite lab data will be recorded in a bench log book and entered into a spreadsheet and/or database periodically. Although the onsite data will not be validated using the same procedures as the offsite lab data, they will be reviewed, anomalous results will be identified and, if needed, reanalyzed at the direction of the Project Chemist.

Onsite laboratory samples will periodically be analyzed in conjunction with offsite analysis, and the data will be reviewed/compared for quality and accuracy.

2.6.1.3 Offsite Laboratory Data

Offsite data reduction, validation, and management are outlined in the Project QAPP and QAPP Addendum (Appendix C to this C/RAWP). The data flow (electronic and hard copy) from offsite laboratory to the Project Chemist is tracked to ensure that the data are reviewed and validated in a timely manner. The Project Chemist will discuss and resolve technical issues, if any, with the laboratory. The laboratory will maintain electronic and hardcopy records sufficient to recreate each analytical event. At a minimum, the laboratory will maintain the following records:

- Raw data, including instrument printouts, bench worksheets, and chromatograms, with compound identification and quantitation reports
- Laboratory-specific, written SOPs for each analytical method and QA/QC function implemented during the analysis of project samples

Hardcopy and electronic versions of analytical data will be archived in project files, on electronic archive tapes, and/or on other electronic storage media for the duration of remedy operation as specified in Section 2.6.2 of this C/RAWP. Electronic laboratory data will be subject to routine backup until it is archived for long-term retention.

2.6.2 Recordkeeping

Records will be collected for a variety of efforts during construction and startup of the groundwater remedy, such as for documenting compliance with regulatory requirements; and inspections for QA/QC activities. The following describe some of the key recordkeeping activities associated with groundwater remedy construction and startup.

2.6.2.1 Construction Quality Assurance Records

Recordkeeping and documentation are important elements of the CQAPP (provided as Appendix A to this C/RAWP). Examples of records include contractor submittals, daily construction reports, QA logs and records, inspection checklists and reports, surveillance reports, audit reports, material receiving reports, and monitoring and test data.

The CQAPP outlines a process for management of design changes during construction. The original design drawings will be marked up by the construction contractor as the work progresses to indicate as-built conditions. These “red-line” drawings are maintained throughout the construction process. Upon completion of construction, the contractor submits the red-line markup drawings for review. Following review and approval, the Resident Engineer and/or Engineer(s) of Record incorporates the markups and issues the final as-built drawings.

The CQAPP also outlines requirements for recordkeeping, construction reports, inspection reports, and test reports. Project documents are managed through a combination of a secure document filing and storage system and a computerized document tracking system. Sufficient records will be prepared and maintained as work is performed to document evidence of the quality of construction and laboratory analysis of activities affecting quality. Examples of inspection forms are provided in the CQAPP. The completed forms are routed to the project QC/QA files and are maintained as part of the project record.

2.6.2.2 Records of Soil, Water, and Waste Materials Generated during Construction

The Soil Management Plan (Appendix L to this C/RAWP) provides procedures for handling and management of soil disturbed during construction of the groundwater remedy. As outlined in the Soil Management Plan and the Management Protocol for Handling and Disposition of Displaced Site Material in the CIMP, PG&E will maintain a Displaced Material Inventory for displaced soil, which will include origin of the material, description of the material, dates of displacement or accumulation, generated activity, approximate volume, storage location and mode, characterization status, and final disposition information. Soil accumulation areas will be inspected routinely, and inspection reports will also be retained.

In addition, PG&E will comply with the recordkeeping requirements of 22 California Code of Regulations (CCR) 66262.4 for soil or groundwater generated during construction of the remedy characterized as hazardous, including transportation and offsite disposal records, profiles and associated characterization data, manifests, offsite facility waste receipts, trucking logs, and training records. Characterization will be documented on a waste profile form provided by the offsite treatment or disposal facility as part of the waste acceptance process. An approved copy of the waste profile will be received prior to offsite transportation of the material.

In addition, an inventory of water generated during well construction and testing will be maintained, including date, location, quantity of generation, and ultimate disposal location, such as the IM-3 treatment plant or the compressor station ponds.

Best efforts will be made to separate recyclable materials (for example, plastic water bottles) from municipal waste streams and to estimate the percentage of materials diverted from municipal solid waste landfill disposal.

2.6.2.3 Other Recordkeeping during Construction

Additional recordkeeping and tracking efforts during construction, consistent with CD Sections 94 and 97, may include:

- Health and safety training records, incident information, and audit findings
- Information to track sustainability metrics such as greenhouse gas emissions, nitrogen oxides and sulfur oxides and offsite waste disposal. Information that may be recorded includes vehicle counts, vehicle types, mileage of shipments and deliveries, and materials and waste inventories
- Sampling and laboratory analysis documentation, chain of custody records
- Well installation characterization data and construction records
- Visual inspection reports of storm water BMP effectiveness and information on qualifying storm events
- Annual stormwater compliance reports
- Construction costs and schedules
- Pre- and post-construction photo documentation
- Inspections by FCRs
- Worker training records
- Environmental compliance tracking, inspection, and records
- Other reports, correspondence, documents, information, or data related to construction

Records from above activities may be hardcopy or may be incorporated in an electronic database system. Hardcopy field records and/or inspection forms will be scanned for electronic storage.

2.6.2.4 Retention and Reporting

In compliance with the CACA (Section XII) and the CD (Section XXV), PG&E will maintain records for 10 years following receipt of certification of completion. At the conclusion of the record retention period, PG&E will notify DOI and DTSC in writing at least 90 days prior to the destruction of records and will provide DOI and DTSC with the opportunity to take possession of records. Deliverables during the groundwater construction and startup, such as the monthly progress reports and the construction completion report, will be submitted to DTSC and DOI in electronic format, with hardcopies available upon request. Deliverables will also be posted to the project SharePoint site for DTSC, DOI, and/or stakeholder review.

During the construction phase of the groundwater remedy, a construction headquarters will be established that will house the centralized repository of the master drawings, specifications, contracts, lease agreements, agency approvals, plans, inspection records and construction personnel records.

2.6.3 Reporting

2.6.3.1 Progress Reporting

As required by the CACA (Attachment 7) and the CD (Appendix C, Section 5), PG&E will prepare and submit monthly progress reports during construction and startup of the groundwater remedy. Exhibit 2.6-2 presents a monthly progress report template to be completed throughout the construction process.

EXHIBIT 2.6-2

Monthly Progress Report Template

Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

PG&E Topock Compressor Station Groundwater Remediation Project

Monthly Progress Report for Final Groundwater Remedy Construction and Startup

[Indicate Reporting Period]

Table of Contents

1. Introduction

In compliance with the 1996 CACA (Attachment 6, Part E, Section 9a and Attachment 7) and the 2013 RD/RA CD (¶32 and Appendix C, Section 5), this monthly report describes activities taken during the prior reporting period and activities planned for the next six weeks, presents available results from sampling and testing since last reporting period, summarizes progress in the construction of the final groundwater remedy, issues encountered and actions to rectify the issues, and deviations from the design documents and/or the Construction/Remedial Action Work Plan that PG&E have proposed to DTSC/DOI or that have been approved by the Agencies. In addition, this report discusses personnel changes and summarizes activities performed and activities planned in support of the Community Relation Plan and contacts with local community, representatives of the press, and/or public interest groups.

2. Description of Activities and Work Completed

Describe completed construction activities; data collected, generated or received; nature and volume of waste generated; waste handling/disposal; issues encountered; actions taken to rectify problems/issues; personnel changes; and deviations from the design documents; the Construction/Remedial Action Work Plan or other approved work plans.

3. Communication

Summary of all contacts with representatives of the press, local community or public interest groups during the reporting period. Summary of other activities provided to assist DTSC and or DOI in support of the Community Involvement/Relations Plan.

4. Planned Activities for Next Six Weeks

Provide planned activities of next six weeks (construction activities, sampling and monitoring events, activities in support of the Community Involvement/Relations Plan, etc.).

5. Construction Schedule Review

Provide information relating to the construction schedule progress, sequencing of activities, information regarding percentage of completion, unresolved delays encountered or anticipated that may affect the future schedule, and a description of efforts made to mitigate those delays or anticipated delays.

6. Attachments/Appendices including Relevant Project Photos as appropriate

One electronic copy of each written monthly progress report will be submitted to DTSC and DOI by the tenth day of the following month. Hardcopies will be provided to DTSC and DOI upon request. If requested, PG&E will also provide briefings for DTSC and DOI to discuss progress of the construction activities.

PG&E will use the monthly progress report to communicate progress related to the construction schedule, and will notify DTSC and DOI of changes in the schedule. PG&E will notify DTSC and DOI of a change in the schedule for the performance of any activity no later than 7 days prior to the performance of the activity, or as otherwise agreed to by PG&E, DTSC, and DOI.

Following completion of construction and startup activities, progress reporting and monitoring will be as described in the O&M Manual.

2.6.3.2 Construction Completion Report

As required by the CACA (Attachment 6, Part F) and the CD (Appendix C, Section 4), PG&E will prepare a Construction Completion Report after construction and operational tests are complete. The Construction Completion Report will be prepared by a registered professional engineer, will be submitted to DTSC and DOI, and will include:

- Purpose
- Synopsis of the constructed groundwater remedy, design criteria, and certification that the final corrective measure was constructed in accordance with the final design plans and specifications
- Explanation and description of modifications to the final design plans and specifications and why the modifications were necessary
- Results of operational testing and/or monitoring that may indicate how initial operation of the final groundwater remedy compares to the design criteria
- Summary of significant activities that occurred during construction, including problems and how addressed
- Summary of inspection findings
- Summary of significant deviations (for example, technical field changes, revised assumptions) from the ROD or approved work plans made during construction
- As-built drawings
- A schedule indicating when treatment systems will begin full-scale operations
- Certification by a responsible corporate official from PG&E or PG&E’s Project Manager that the information in the report is true, accurate, and complete.

2.6.3.3 Additional Reporting During Remedy Construction

Additional reporting during the remedy construction will include:

- Annual stormwater compliance reporting, as described in Appendix K.
- Post-construction biological completion report required by PBA general Mitigation Measure 24 and the protocol and proposed procedures for compliance with ARAR #32 and the portion of BIO-1 related to CWA Section 404
- Post-construction revegetation efforts monitoring reports as described in Appendices N and O
- Final report, following conclusion of earthmoving activities, as described in the Paleontological Resources Management Plan, in Appendix J.

PG&E may elect to combine any of the above with the monthly progress reports or Construction Completion Report, as appropriate.

TABLE 2.1-1

Key Project Personnel, Qualifications, Levels of Authority and Responsibility, and Lines of Communication

Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Key Personnel	Project Role, Summary of Qualifications, and Lines of Communication
Janet Loduca	**PG&E Vice President Safety, Health, and the Environment** Ms. Loduca is the executive sponsor of the project and represents PG&E (the Owner) at the executive level on the Topock Leadership Partnership.
Kevin Sullivan	**PG&E Chromium Remediation Director** Mr. Sullivan has the overall responsibility for the project direction and implementation and represents PG&E at the executive level on the Clearinghouse Task Force.
Juan Jayo	**Legal** Mr. Jayo has the overall responsibility for the legal aspects of the project and reports to the General Counsel of PG&E.
Yvonne Meeks	**PG&E Topock Project Manager** Ms. Meeks reports to Mr. Sullivan and is responsible for giving technical and strategic direction to the PG&E Project Team and for execution of the project as a whole. Ms. Meeks also serves as the primary PG&E Topock project team point of contact for external project stakeholders, including regulatory agencies, tribes, and the community.
Danielle Starring	**PG&E Construction Manager** Ms. Starring is responsible for the construction of the Remedy facilities. Ms. Starring is responsible for the overall management of activities related to the construction program.
Curt Russell	**PG&E Site Operations Manager** Mr. Russell reports to Ms. Meeks; he is responsible for overall site management and compliance. As such, he acts as the liaison with PG&E Gas Operations staff and coordinates activities and processes for site visitors and observers. For the groundwater remedy implementation, Mr. Russell is also a designated disturbance coordinator for noise/vibration.
Glen Riddle	**Resident Engineer** Mr. Riddle is responsible for the overall engineering design activities, and is responsible for approving changes to the design during construction. During construction of the groundwater remedy, Mr. Riddle will works with the QA Manager on QA/QC activities in accordance with this C/RAWP and the CQAPP.
Glenn Caruso	**PG&E Project Cultural Resources Expert** Mr. Caruso reports to Ms. Meeks; he is the project liaison for issues related to cultural resources and historic properties. He also directs the activities of PG&E's cultural resources staff.
TBD	**Construction Contractor(s)** The construction contractor(s) provides the labor, materials, and equipment required for remedy construction. The construction contractor and its subcontractors are responsible for quality control of constructed work products.

TABLE 2.3-1

Communication Framework during Construction and Startup

Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Type	Triggering Event	Required By[a]	Party Initiating Communi-cation	Party Communication is Addressed to[b]	General Communication Procedures/Protocols
Routine Communication	Notification of planned construction/field activities (including sampling)	CIMP and EIR MMRP measures CUL-1a-8a, CUL-1a-8j, CUL-1a-8l, CUL-1a-8h EIR MMRP measures Noise-1b, 2d, and 3b CD ¶24 PA Appendix C Monitoring Protocol Section 1600 AMM #34	PG&E Site Operations Manager or designee	DTSC, DOI, HNWR, Tribes, CDFW Project stakeholders	Notify agencies and Tribes monthly of scheduled field activities. During periods of extensive construction activity, these notifications will be issued more frequently – weekly and/or daily (CUL-1a-8j/CUL-1a-8h). After issuing these notifications, PG&E will notify the nearby noise-sensitive receptors and Tribes of any schedule changes. Nearby noise-sensitive receptors, including residents at Moabi Regional Park and the Topock Marina area, will be notified of the schedule of construction activities and any subsequent changes when construction activities are conducted within 1,850 feet and 5,830 feet from California receptors and 330 feet and 735 feet from Arizona receptors for daytime and nighttime noise, respectively. Other means of notifications could also include: (1) formal presentations and announcements at meetings, including Consultative Work Group, Technical Work Group, Clearinghouse Task Force, etc.; (2) daily information sheets for site visitors during times of intensive activity (e.g., construction); and (3) posting project activity schedules and other information on a project website (CUL-1a-8j). For Tribal monitoring/observation of ground-disturbing activities, notify Tribes as early as possible, but at least 3 business days in advance of the initiation of the identified project work, whenever possible per the PA's monitoring protocol and not less than one week in advance of the initiation of planned activities and other scientific surveying that is conducted in anticipation of construction activities (CUL-1a-8l). When activity is imminent and

TABLE 2.3-1
Communication Framework during Construction and Startup
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Type	Triggering Event	Required By[a]	Party Initiating Communi-cation	Party Communication is Addressed to[b]	General Communication Procedures/Protocols
					advance notification was not possible, PG&E will place telephone calls to key tribal representatives (CUL-1a-8j). Notify DOI 28 days in advance of sample collection activities, unless shorter notice is agreed to by DOI (CD ¶24). In the event short-order sampling/field activity needs occur, PG&E will call DTSC and DOI (prior to proceeding with the activity), and then follow up by email. In the event that email or voice mail is not available to PG&E, a text message will be sent to DTSC and DOI prior to proceeding with the activity and then a follow up by email. Notify CDFW at least 5 days prior to initiation of construction activities and at least 5 days prior to completion of construction activities.
	Progress reporting	CACA Attachments 6 and 7 CD ¶32	PG&E PM or designee	DTSC, DOI	Monthly reports via email during construction and start-up. Figure 2.3-1 presents a template for the Monthly Progress Reports.
	EIR mitigation measure compliance reporting ARAR compliance reporting	EIR MMRP measures CUL-1a-2, CUL-1a-3b, CUL-1a-11 CD ¶32.b(10)	PG&E PM or designee	DTSC DOI	Quarterly reports via email during construction and startup.
	Tribal-specific outreach activities	2006 Settlement Agreement between PG&E and FMIT (Section VIII[A]); PG&E Memoranda of Agreement with various Tribes; EIR mitigation measure CUL-1a-8a	PG&E PM or designee	Tribes and Agencies (on request)	Frequent communications with Tribes to address current issues and provide a forecast of upcoming activities (e.g., PG&E currently holds monthly updates with Tribes) (CUL-1a-8a). Other communications make take place depending on purpose of the communication and type of information to be exchanged.

TABLE 2.3-1
Communication Framework during Construction and Startup
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Type	Triggering Event	Required By[a]	Party Initiating Communi-cation	Party Communication is Addressed to[b]	General Communication Procedures/Protocols
	Request for Variance/Notification of Changes				
Non-routine Communication	Material Deviation[e] from Work Plan and design documents, MMRP, action-specific and location-specific ARARs.	This C/RAWP	PG&E PM, PG&E Site Operation Manager, or designee	DTSC, DOI	Notify the agencies orally within 3 days of when PG&E first knows of potential deviations. Submit a Work Variance Request Form (exhibit 2.3-3 to agencies for approval 5 calendar days before the anticipated work occurs or unless agreed to otherwise with agencies. See also RAWP Chapter 5 (Construction Contingency Plan/Procedures).
	Review of data collected during construction of the groundwater remedy well network	This C/RAWP	PG&E PM, PG&E Site Operations Manager, or designee	DTSC, DOI	Review of data collected at predetermined well locations to finalize well design concurrent with field work, as defined in Section 3.1 of this C/RAWP. The anticipated timing of these events will be forecasted monthly based on the actual construction schedule (through routine communication defined above in this table), and email confirmation will be provided within days of the anticipated event. Review of data collected at key well locations that are not pre-determined in this work plan to finalize well design. If data collected during construction of wells indicate that key design assumptions used in the basis of design are incorrect, PG&E will organize a real-time conference call (i.e., concurrent with field work) with DTSC and DOI representatives. The purpose of the call will be to review the data collected and reach consensus on the appropriate next steps at the given location and examine the potential effects these data might have on the sting of other nearby wells.
	Discovery of event that occurs or has occurred that causes delay in the performance of any obligation under the CD for which PG&E intends to assert a claim of *force majeure*	CD ¶61	PG&E PM or designee	DOI	Orally within 3 working days of when PG&E first knew the event might cause a delay and written notification within 7 days thereafter.

TABLE 2.3-1
Communication Framework during Construction and Startup
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Type	Triggering Event	Required By[a]	Party Initiating Communi-cation	Party Communication is Addressed to[b]	General Communication Procedures/Protocols
	Discovery of changes to the schedule described in the progress reports (i.e., change in schedule described in the monthly progress report for the performance of any activity including, but not limited to data collection and implementation of work plans)	CD ¶33	PG&E PM, PG&E Site Operations Manager, or designee	DOI	No later than 7 days prior to the performance of the activities, or as otherwise agreed to by DOI and PG&E.
	Notification when Contingency Triggers				
	Major breakdown includes emergency situations such as fires, incidents that result in hospitalization or death, acts of god (e.g., earthquake, flood), etc.	CACA Attachment 6, Item 7b CD ¶52 PBA #19 and #22	PG&E PM, PG&E Site Operations Manager, or designee	DTSC, DOI, Affected Land Owners/Managers (FMIT, BOR, BLM, HNWR/ USFWS) If there is a potential threat to the river, notify MWD and immediate downstream users such as the Chemehuevi Indian Tribe as soon as possible	Call 911 if there is an impact to human health that requires immediate medical attention by emergency response/health care professionals. Within 48 hours to BLM (PBA #19 and #22). Immediate notification to DOI's Project Manager, or, if the PM is unavailable, DOI's Alternate PM. To comply with this specific CD requirement, PG&E interprets immediate to be "within 24 hours." Within 24 hours to DTSC orally; within 72 hours in writing; include incident in next progress report. Additional notifications may be required (e.g., spills)
	Releases[d] of EPCRA-listed extremely hazardous substances and CERCLA-listed hazardous substances to the environment that are subject to reporting under EPCRA Section 304.	CACA IV(A)(3) CD ¶34 and ¶35 PBA #19 and #22 Project-specific HMBP CERCLA Section 103(a)	PG&E Site Operations Manager, or designee	NRC, EMA, CUPA, DTSC, DOI, Affected Land Owners/ Managers (FMIT, BOR, BLM, HNWR/ USFWS) If there is a potential threat to the river, notify MWD and immediate downstream users such as the Chemehuevi Indian Tribe as soon as possible	Call 911 if there is an impact to human health that requires immediate medical attention by emergency response/health care professionals. Within 15 minutes verbally to the NRC, EMA and the CUPA. Written follow-up report to EMA and CUPA within 30 days. Within 24 hours to DOI PM or if DOI PM is not available, to one of the Bureau (BLM, USFWS, or BOR) PM. Written reports to DOI within 30 days of onset of event and again, within 45 days after conclusion of event (latter report detailing actions taken in response). Within 48 hours to BLM (PBA #19 and #22). Within 48 hours orally and within 10 days in writing to DTSC; include incident in next progress report

TABLE 2.3-1
Communication Framework during Construction and Startup
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Type	Triggering Event	Required By[a]	Party Initiating Communi-cation	Party Communication is Addressed to[b]	General Communication Procedures/Protocols
	Releases[d] of CERCLA-listed hazardous substances to the environment that are reportable under CERCLA Section 103.	CACA IV(A)(3) CD ¶34 and ¶35 PBA #19 and #22 HMBP CERCLA Section 103(a)	PG&E PM, PG&E Site Operations Manager, or designee	NRC, EMA, CUPA, DTSC, DOI, Affected Land Owners/Managers (FMIT, BOR, BLM, HNWR/ USFWS) If there is a potential threat to the river, notify MWD and immediate downstream users such as the Chemehuevi Indian Tribe as soon as possible	Call 911 if there is an impact to human health that requires immediate medical attention by emergency response/health care professionals. Within 15 minutes verbally to the NRC, EMA and the CUPA. Written follow-up report to EMA and CUPA within 30 days. Within 24 hrs to DOI PM or if DOI PM is not available, to one of the Bureau (BLM, FWS, or BOR) PM. Written reports to DOI within 30 days of onset of event and again, within 45 days after conclusion of event (latter report detailing actions taken in response). Within 48 hours to BLM (PBA #19 and #22). Within 48 hours orally and within 10 days in writing to DTSC; include incident in next progress report.
	Releases[d] of hazardous materials to the environment reportable under CHSC Section 25501 and 19 CCR 2703	CACA IV(A)(3) HMBP PBA #19 and #22 CHSC Section 25501, 19 CCR 2703	PG&E PM, PG&E Site Operations Manager, or designee	NRC if over reportable quantity, EMA, CUPA, DTSC, DOI, Affected Land Owners/ Managers (FMIT, BOR, BLM, HNWR/ USFWS) If there is a potential threat to the river, notify MWD and immediate downstream users such as the Chemehuevi Indian Tribe as soon as possible	Call 911 if there is an impact to human health that requires immediate medical attention by emergency response/health care professionals. Immediate verbal report to EMA and CUPA. Written follow-up report within 30 days. Include incident in next progress report. Within 48 hours to BLM (PBA #19 and #22). Within 48 hours orally and within 10 days in writing to DTSC; include incident in next progress report

TABLE 2.3-1
Communication Framework during Construction and Startup
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Type	Triggering Event	Required By[a]	Party Initiating Communi-cation	Party Communication is Addressed to[b]	General Communication Procedures/Protocols
	Release of oil to navigable waters of the US or adjacent shorelines in quantity that causes a sheen on the water or a violation of applicable water quality standards. Release of any quantity of oil to waters of the state, or release of 1 barrel (42 gallons) or more to a location on land where it could potentially enter waters of the State.	33 U.S.C. 1321 CWC Section 13272 Calif. State Oil Spill Contingency Plan Fuel SOPs (EIR MMRP HAZ-1b)	PG&E PM, PG&E Site Operations Manager, or designee	NRC (for spills to waters of the US), EMA, DTSC, DOI, Affected Land Owners/ Managers (FMIT, BOR, BLM, HNWR/ USFWS) If there is a potential threat to the river, notify MWD and immediate downstream users such as the Chemehuevi Indian Tribe as soon as possible	Within 15 minutes to NRC and EMA.
	Release of hazardous waste or hazardous waste constituents that could threaten human health or the environment outside the facility.	CACA IV(A)(3) and Attachment 6, Item 7b CD ¶52 HMBP PBA #19 and #22 22 CCR 66265.56	PG&E PM, PG&E Site Operations Manager, or designee	EMA, DTSC, DOI, Affected Land Owners/ Managers (FMIT, BOR, BLM, HNWR/ USFWS) If there is a potential threat to the river, notify MWD and immediate downstream users such as the Chemehuevi Indian Tribe as soon as possible	Immediate verbal report to EMA. Written follow-up report within 15 days to DTSC. Within 48 hours to BLM (PBA #19 and #22). Within 24 hours orally; within 72 hours in writing to DTSC; include incident in next progress report.
	Release of USDOT-regulated hazardous material during transportation[c] reportable under 49 CFR 171.15(b)	49 CFR 171.15	PG&E PM, PG&E Site Operations Manager, or designee	NRC Affected Land Owners/ Managers (FMIT, BOR, BLM, HNWR/ USFWS If there is a potential threat to the river, notify MWD and immediate downstream users such as the Chemehuevi Indian Tribe as soon as possible	Call 911 if there is an impact to human health that requires immediate medical attention by emergency response/health care professionals. Immediate verbal report to NRC. Written follow-up report within 30 days.

TABLE 2.3-1
Communication Framework during Construction and Startup
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Type	Triggering Event	Required By[a]	Party Initiating Communi-cation	Party Communication is Addressed to[b]	General Communication Procedures/Protocols
	Discovery of human-caused disturbance/human remains or burials/previously unidentified potentially significant cultural, historic, or paleontological resources/active dead or injured listed species				
	Discovery of human-caused disturbance to remedy facilities	EIR MMRP measure CUL-1a-3b Site Security Plan	PG&E Site Operations Manager, PG&E Remediation Resources Specialist or designee	DTSC, Landowners involved in the incursion (BLM, USFWS, or FMIT)	Notification protocols per Site Security Plan; summarized in quarterly compliance report. Additional notifications may be required (e.g., spills).
	Discovery of human remains or burials	EIR mitigation measure CUL-4 PA Section IX CHPMP (Section 8.2 and Appendix D, Plan of Action)	PG&E Site Operations Manager, PG&E Remediation Resources Specialist, Qualified Cultural Resources Consultant, or designee	PG&E's initial communication is to the San Bernardino County Coroner, and PG&E's and DTSC's project managers. The qualified cultural resources consultant will coordinate the interaction between Interested Tribes, PG&E, the County, and DTSC to determine proper treatment and disposition of any remains. Human remains found on federal land would require notification of BLM. BLM will then notify the Advisory Council on Historic Preservation, California and Arizona State Historic Preservation Officers, BOR, USFWS, DTSC, relevant County Coroner, and Interested Tribes, The County Coroner will contact the Native American Heritage Commission if it determines the	Suspend work in the immediate vicinity of the discovery (not less than 5 meters and not to exceed 50 meters from the discovered remains), and if the discovery is on federal land, notify BLM as soon as possible, but no later than 24 hours of the discovery by telephone, followed by written confirmation within three business days. If the remains are found in California, BLM will notify the County Coroner. If the discovery is on non-federal/non-tribal lands in Arizona, then BLM in consultation with PG&E will report the discovery to the Arizona State Museum. If the discovery is on non-federal/non-tribal lands in California, then PG&E will notify the County Coroner. Additional notifications and communications are described in the CHPMP, Appendix D, Plan of Action.

TABLE 2.3-1
Communication Framework during Construction and Startup
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Type	Triggering Event	Required By[a]	Party Initiating Communi-cation	Party Communication is Addressed to[b]	General Communication Procedures/Protocols
				remains are Native American and not related to a crime.	
	Discovery of previously unidentified potentially significant cultural, historical, and/or paleontological resources	PBA #29 EIR MMRP measures CUL-1b/c-4 and CUL-1a-8b/o CIMP PA Section IX CHPMP (Section 8.1 and Appendix C, Discovery Plan)	PG&E Site Operations Manager, PG&E Remediation Resources Specialist, Qualified Cultural Resources Consultant, or designee	PG&E's initial communication is to BLM and the Tribes, if the resource is Native American in nature. BLM will then notify the Advisory Council on Historic Preservation, California and Arizona State Historic Preservation Officers, BOR, USFWS, the Tribes (if not already notified) and DTSC.	Suspend work in the immediate vicinity of the discovery (not less than 5 meters and not to exceed 50 meters from the discovered remains), notify BLM and the Tribes, if the resource is Native American in nature, immediately. Qualified archaeologists will inspect and evaluate any new sites that may be discovered during construction and will notify Tribal Monitors of the discovery. Tribal Monitors will then inspect and evaluate the new site(s) (CIMP, Subsection 14.6); EIR MMRP measures CUL-1a-8b and 8o).
	Locate dead or injured listed species	PBA #28	PG&E Site Operations Manager, PG&E Project Biologist or designee	BLM, USFWS	Notify Agencies within 3 working days of its finding.

Notes:

[a] EIR MMRP (DTSC 2011), PA (BLM 2010), CD, PBA, CHPMP (BLM 2012), CACA, HMBP, AMM, CIMP

[b] Agencies: ADEQ = Arizona Department of Environmental Quality; BLM = U.S. Bureau of Land Management; BOR = U.S. Bureau of Reclamation; DOI = U.S. Department of the Interior; DTSC = California Department of Toxic Substances Control; HNWR = Havasu National Wildlife Refuge; MWD = Metropolitan Water District; RWQCB = Regional Water Quality Control Board; USFWS = U.S. Fish and Wildlife Service; NRC = National Response Center, California Emergency Management Agency = EMA, CUPA = California Unified Permitting Agency, CDFW = California Department of Fish and Wildlife.

[c] Transportation includes loading, offloading, and storage of USDOT-regulated vehicle/trailer. Notify the NRC in the event of a transportation incident involving death, hospitalization, damage greater than $50,000, roadway shutdown or public evacuation exceeding 1 hour, fire, breakage or spillage.

[d] Excludes permitted discharge of materials and release of hazardous materials/waste into secondary containment areas that is not released to the environment.

[e] Material deviation means a change that would (1) render the approved design non-compliant with codes, regulations, and/or engineering standard of practices, (2) render planned well locations and/or constructions fail to meet the project objectives, (3) cause significant schedule delay, and/or (4) cause a significant increase in costs.

FIGURE 2.3-1
Work Variance Request Form
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

PG&E TOPOCK GROUNDWATER REMEDIATION PROJECT
Work Variance Request Form *

Request Prepared By: | Request Approval From:

Date Submitted: | Date Approval Required:

Variance Request No.: | Map Area:

Location:

Landowner: | Landowner Parcel Number(s):

Current Vegetative Cover/Land Use:

Existing Sensitive Resource? ☐ No ☐ Yes Specify:

Variance From: ☐ Mitigation Measure ☐ Work Plan/Procedure ☐ Response to Comments
☐ Drawing ☐ Permit Condition ☐ Other

Detailed Description of Variance and Justification (Attach additional information if necessary):

Attachments: ☐ Photo ☐ Construction Drawing ☐ Aerial Photo Mark-Up ☐ Correspondence ☐ Other

Potential Impacts of Variance:

☐ Air Quality	☐ Hazardous Materials	☐ Aesthetic
☐ Biological Resources	☐ Noise	☐ Water Resources
☐ Geology and Soils	☐ Paleo Resources	
☐ Cultural Resources	☐ Hydrology and Water Quality	

Description and Justification:

* This form is associated with material deviations from the Work Plan and design documents, MMRP, action-specific and location-specific ARARs for which DTSC and DOI are notified during construction. A material deviation means a change that would (1) render the approved design non-compliant with codes, regulations, and/or engineering standard of practices, (2) render planned well locations and/or constructions fail to meet the project objectives, (3) cause significant schedule delay, and/or (4) cause a significant increase in costs.

SECTION 3

Construction Methods and Sequencing

This section outlines PG&E's current thinking and strategies for constructing the groundwater remedy. This section describes the construction means and methods that could be used to build the remedy, presents a preliminary sequence of those construction activities, and contains a preliminary construction schedule.

It is anticipated that as construction planning progresses and the contracting/procurement process begins, additional details will emerge that will be used to further refine the construction sequencing and schedule. PG&E will develop a detailed construction schedule, including identification of the project's critical path after the approval of the 100% design and selection of contractors. For this reason, this section has been written with the intent of providing enough detail to facilitate review and comment by agencies, Tribes, and other stakeholders, while still allowing for the uncertainty inherent in construction planning at this stage.

3.1 Key Remedy Features for Construction

As outlined in the 90% BOD Report, the groundwater remedy includes the following key features:

- An IRZ along the 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 reduction of the Cr(VI) to Cr(III).
- An inner recirculation loop (IRL) comprising:
  - Extraction wells near the Colorado River (referred to as the River Bank [RB] extraction wells) to provide hydraulic capture of Cr(VI) groundwater concentrations, accelerate cleanup of the floodplain, enhance the flow of contaminated groundwater through the IRZ line, and control migration of IRZ-generated byproducts toward the Colorado River.
  - Injection wells to re-inject groundwater extracted from the RB extraction wells, which may be amended with an organic carbon source, and/or freshwater in the upgradient portion of the Cr(VI) plume to flush the plume through the IRZ.
- A TCS recirculation loop comprising:
  - East Ravine extraction wells in the eastern (downgradient) end of the East Ravine to provide hydraulic capture of contaminated groundwater in bedrock.
  - TCS injection wells located upgradient of the TCS for the re-injection of groundwater extracted from the East Ravine extraction wells and Transwestern (TW) Bench extraction wells, which will be amended with an organic carbon source to promote reduction of the Cr(VI) to Cr(III) and remove elevated Cr(VI) groundwater concentrations from the alluvial aquifer in the vicinity of the TCS.
- Injection of freshwater 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 IRL.
- A monitoring well network consisting of existing site wells and new monitoring wells.

The groundwater remedy also includes supporting features within the project footprint that are not aimed specifically at attaining RAOs but are needed to make the remedy effective and safe over its projected decades-long operation. The key supporting features include a remedy-produced water conditioning system to manage wastewater produced from O&M of the remedy (for example, maintenance of wells and piping, sampling and monitoring of wells, etc.); utilities (for example, power supply for the remedy and distribution conduits, communication and data network, fire water, etc.); site safety and security (for example, alarms, gates/fences, security cameras, etc.); access roads for installation and long-term O&M needs, an operations facility to house site operation and field staff, as well as essential O&M functions (for example, remote control and monitoring equipment/telecom/information technology, Supervisory Control and Data Acquisition [SCADA] system); and a maintenance/storage facility at Moabi Regional Park that will house a laboratory, a document repository center, a training/conference room, equipment storage, and soil storage areas.

Exhibit 3.1-1 provides a summary of the remedy design parameters/key remedy features at this pre-final (90%) design stage. Figures 3.1-1 through 3.1-4 show the locations of remedy features in California, at the TCS evaporation ponds, at the Moabi Regional Park, and in Arizona. Exhibit 3.1-2A and B provides summary of borehole count for well construction.

EXHIBIT 3.1-1
Summary of Engineering Design Parameters and Key Remedy Features
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Remedy Feature	Design Parameters/Quantity	Location
NTH IRZ	– Twenty-four IRZ injection wells (plus 30 future provisional wells) spaced along the NTH IRZ line – Four IRZ extraction wells (plus one future provisional well) located at the ends and in the central portion of the NTH IRZ line	See Figure 3.1-1 for general locations
IRL	– Five RB extraction wells (plus up to four future provisional wells) along the Colorado River – Four IRL injection wells (plus three future provisional wells) near the western margin (upgradient) of the groundwater plume north of I-40	See Figure 3.1-1 for general locations
TCS recirculation loop	– Five East Ravine extraction wells (plus up to six future provisional wells) downgradient of the TCS in the southeast portion of the plume existing in bedrock – Two TW bench extraction wells (plus two future provisional wells) in the area northeast of the TCS – Two TCS injection wells in the area of the TCS	See Figure 3.1-1 for general locations
Freshwater injection	– Two freshwater injection wells located upgradient of the groundwater plume	See Figure 3.1-1 for general locations
Monitoring wells	• Thirty-six new monitoring well locations (plus four identified future provisional wells) • Up to 10 additional, unidentified future provisional monitoring wells.	See Figure 3.1-1 for general locations
Carbon amendment and carbon storage facilities	• One 3,000-gallon aboveground carbon storage tank and carbon amendment facility at the TW Bench • One 15,000-gallon aboveground carbon storage tank and carbon amendment facility at the MW-20 Bench	See Figure 3.1-1 for general locations of the two bench areas
Freshwater source/supply well/storage	• Freshwater supply will be primarily from the existing well HNWR-1A, located on the HNWR in Arizona. Freshwater can also be supplied form the existing nearby well HNWR-1 as a secondary source and from the existing Site B well approximately 0.9 mile north of the HNWR-1 as a contingent source. • One 10,000-gallon freshwater storage tank for use by the remedy	See Figures 3.1-1 and 3.1-3 for general locations
Piping corridor (water pipes, electrical conduits, fibers, etc.)	• Approximately 110,000 feet (ft) of water/liquid/utility pipes and approximately 61,000 ft of electrical conduits and cables. Over 95% of conveyance pipes/conduits will be belowground.	See Figures 3.1-1 and 3.1-3 for general piping layout

EXHIBIT 3.1-1

Summary of Engineering Design Parameters and Key Remedy Features

Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Remedy Feature	Design Parameters/Quantity	Location
Supporting facilities during remedy O&M	• Conduits and associated equipment connecting to the power supply systems in the existing Auxiliary Building at the TCS A new air compressor building that will house the existing air compressors and air dryer. • Connection panel and pad for a portable, rental backup generator of similar make and model to the existing generator (Isuzu Model 6WG1X). Note that backup generator will be mobilized onsite as needed during project implementation to provide power • Secondary power supply from small photovoltaic solar panels at various locations such as at the Operations Building at the TW Bench and at select remote well locations • A SCADA system for controlling and monitoring the remedy; the remedy SCADA equipment will be located inside the Operations Building at the TW Bench • One remedy-produced water conditioning system and associated tanks at the TCS • One Operations Building (approx. 1,480 square feet) to house essential functions for long-term O&M (SCADA system, programmable logic controllers, uninterruptible power supply, communications, etc.) at the TW Bench. Space is reserved in the Operations Building for a small, packaged drinking/potable water system. Shared use of existing TW Bench with Transwestern. • One long-term remedy support area (approx. 1.3 acres) and two soil storage/ management areas (approx. 1.55 acres each) in Moabi Regional Park • Shared use of the Compressor Station Hazardous Material Storage Building with TCS. • Improvements at the TCS evaporation ponds to improve evaporation rate and to minimize trucking offsite; in the event that trucking offsite is necessary during remedy operations, improvements to the existing truck loading station to enhance the ability to pump pond water to tanker trucks	See Figures 3.1-1 through 3.1-3 for general location
Access pathways and roadways for remedy O&M	• Two new graded access roads in the upland area to allow for installation and maintenance of wells IRL-2 and IRL-4 • One new access road east of the TW Bench for access to Transwestern's gas transmission equipment • A new road in the floodplain for the construction and maintenance of the IRZ/RB wells, future provisional wells, and associated piping • Access pathways/roads to remedy infrastructure on private properties in California and Arizona to access the remedy features	See Section 4 for access pathways and roads
Other ancillary facilities for use during remedy O&M	• Two aboveground pipe bridges for aerial crossing of Bat Cave Wash—one pipe bridge crosses the southern portion of the wash near the TCS and the other pipe bridge crosses the northern portion of the wash in the uplands • Small photovoltaic solar panels at various locations such as at the Operations Building at the TW Bench and at select remote well locations; small communication radios at remote monitoring well locations, freshwater supply well in Arizona, and equipment at the TCS ponds to allow for remote data collection • Security equipment (gate, security cameras) for remote facilities	See Figure 3.1-1 for general locations of the two pipe bridges

Note:

See Basis of Design Report/Pre-Final (90%) Design Submittal for design assumptions and details for key remedy features.

EXHIBIT 3.1-2A
Estimated Borehole Count Associated with Well Construction: Summary
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Well Type	EIR Limit (by Well Type)	Installed	Planned	Future Provisional	Total (by Well Type)
Monitoring Well Boreholes	60	16	53	24	93
Remediation Well Boreholes	110	2	47	46	95
Total (by Status)	**170**	**18**	**100**	**70**	**188**

EXHIBIT 3.1-2B
Estimated Borehole Count Associated with Well Construction: Count Details
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Item	Location Name	Well Type	Added in 90% BOD	Status	Est. # of Well Screen Intervals	Calculated # of Boreholes	Number of Boreholes Installed	Est. # of Planned Boreholes	Est. # of Future Provisional Boreholes
1	ER-TCS GW Investigation	Monitoring	No	Installed	--	--	16	--	--
2	MW-10D	Monitoring	Yes	Planned	1	1	--	1	0
3	MW-11D	Monitoring	Yes	Planned	1	1	--	1	0
4	MW-70BR-D	Monitoring	Yes	Planned	1	1	--	1	0
5	MW-A	Monitoring	No	Planned	4	2	--	2	0
6	MW-B	Monitoring	No	Planned	4	2	--	2	0
7	MW-C	Monitoring	No	Planned	4	2	--	2	0
8	MW-D	Monitoring	No	Planned	3	2	--	2	0
9	MW-E	Monitoring	No	Planned	2	1	--	1	0
10	MW-F	Monitoring	No	Planned	2	1	--	1	0
11	MW-G	Monitoring	No	Planned	1	1	--	1	0
12	MW-H	Monitoring	No	Planned	4	2	--	2	0
13	MW-I	Monitoring	No	Planned	4	2	--	2	0
14	MW-J	Monitoring	No	Planned	4	2	--	2	0
15	MW-K	Monitoring	No	Planned	1	1	--	1	0
16	MW-L	Monitoring	No	Planned	4	2	--	2	0
17	MW-M	Monitoring	No	Planned	4	2	--	2	0
18	MW-N	Monitoring	No	Planned	3	2	--	2	0
19	MW-O	Monitoring	No	Planned	4	2	--	2	0

EXHIBIT 3.1-2B

Estimated Borehole Count Associated with Well Construction: Count Details

Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Item	Location Name	Well Type	Added in 90% BOD	Status	Est. # of Well Screen Intervals	Calculated # of Boreholes	Number of Boreholes Installed	Est. # of Planned Boreholes	Est. # of Future Provisional Boreholes
20	MW-P	Monitoring	No	Planned	4	2	--	2	0
21	MW-Q	Monitoring	No	Planned	4	2	--	2	0
22	MW-R	Monitoring	No	Planned	4	2	--	2	0
23	MW-S	Monitoring	No	Planned	2	1	--	1	0
24	MW-T	Monitoring	Yes	Planned	TBD	1	--	1	0
25	MW-U	Monitoring	Yes	Planned	2	1	--	1	0
26	MW-V	Monitoring	Yes	Future Provisional	2	1	--	0	1
27	MW-W	Monitoring	Yes	Planned	2	1	--	1	0
28	MW-X	Monitoring	Yes	Planned	4	2	--	2	0
29	MW-Y	Monitoring	Yes	Planned	4	2	--	2	0
30	MW-Z	Monitoring	Yes	Planned	4	2	--	2	0
31	MW-AA	Monitoring	Yes	Planned	2	1	--	1	0
32	MW-BB	Monitoring	Yes	Planned	2	1	--	1	0
33	MW-CC	Monitoring	Yes	Planned	2	1	--	1	0
34	MW-DD	Monitoring	Yes	Planned	2	1	--	1	0
35	MW-EE	Monitoring	Yes	Pending/Future Provisional	2	1	--	0	1
36	MW-FF	Monitoring	Yes	Planned	2	1	--	1	0
37	MW-GG	Monitoring	Yes	Planned	2	1	--	1	0
38	MW-HH	Monitoring	Yes	Planned	2	1	--	1	0
39	MW-II	Monitoring	Yes	Planned	2	1	--	1	0
40	Slant Wells Under River	Monitoring	Yes	Future Provisional	TBD	2	--	0	2
41	10 Unidentified MW Locations	Monitoring	Yes	Future Provisional	4 (per location)	20	--	0	20
42	Site B	Remediation	Yes	Installed	--	--	1	--	--
43	HWNR-1A	Remediation	Yes	Installed	--	--	1	--	--
44	ER-1	Remediation	No	Planned	1	1	--	1	0
45	ER-2	Remediation	No	Planned	1	1	--	1	0
46	ER-3	Remediation	No	Planned	1	1	--	1	0
47	ER-4	Remediation	No	Planned	1	1	--	1	0

EXHIBIT 3.1-2B

Estimated Borehole Count Associated with Well Construction: Count Details

Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Item	Location Name	Well Type	Added in 90% BOD	Status	Est. # of Well Screen Intervals	Calculated # of Boreholes	Number of Boreholes Installed	Est. # of Planned Boreholes	Est. # of Future Provisional Boreholes
48	ER-5	Remediation	No	Future Provisional	1	1	--	0	1
49	ER-6	Remediation	No	Installed	0	0	(Included in Item 1)	0	0
50	ER-7	Remediation	Yes	Future Provisional	1	1	--	0	1
51	ER-8	Remediation	Yes	Future Provisional	1	1	--	0	1
52	ER-9	Remediation	Yes	Future Provisional	1	1	--	0	1
53	ER-10	Remediation	Yes	Future Provisional	1	1	--	0	1
54	ER-11	Remediation	Yes	Future Provisional	1	1	--	0	1
55	FW-1	Remediation	No	Planned	1	1	--	1	0
56	FW-2	Remediation	No	Planned	1	1	--	1	0
57	IRL-1	Remediation	No	Planned	1	1	--	1	0
58	IRL-2	Remediation	No	Planned	1	1	--	1	0
59	IRL-3	Remediation	No	Planned	1	1	--	1	0
60	IRL-4	Remediation	No	Planned	1	1	--	1	0
61	IRL-5	Remediation	No	Future Provisional	1	1	--	0	1
62	IRL-6	Remediation	No	Future Provisional	1	1	--	0	1
63	IRL-7	Remediation	No	Future Provisional	1	1	--	0	1
64	IRZ-01	Remediation	No	Planned	1	1	--	1	0
65	IRZ-02	Remediation	No	Future Provisional	4	2	--	0	2
66	IRZ-03	Remediation	No	Future Provisional	4	2	--	0	2
67	IRZ-04	Remediation	No	Future Provisional	4	2	--	0	2
68	IRZ-05	Remediation	No	Planned	2	1	--	1	0
69	IRZ-06	Remediation	No	Future Provisional	4	2	--	0	2
70	IRZ-07	Remediation	No	Future Provisional	4	2	--	0	2
71	IRZ-08	Remediation	No	Future Provisional	4	2	--	0	2
72	IRZ-09	Remediation	No	Planned	2	1	--	1	0
73	IRZ-10	Remediation	No	Future Provisional	4	2	--	0	2
74	IRZ-11	Remediation	No	Planned	4	2	--	2	0
75	IRZ-12	Remediation	No	Future Provisional	4	2	--	0	2

EXHIBIT 3.1-2B

Estimated Borehole Count Associated with Well Construction: Count Details

Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Item	Location Name	Well Type	Added in 90% BOD	Status	Est. # of Well Screen Intervals	Calculated # of Boreholes	Number of Boreholes Installed	Est. # of Planned Boreholes	Est. # of Future Provisional Boreholes
76	IRZ-13	Remediation	No	Planned	4	2	--	2	0
77	IRZ-14	Remediation	No	Future Provisional	4	2	--	0	2
78	IRZ-15	Remediation	No	Planned	4	2	--	2	0
79	IRZ-16	Remediation	No	Planned	4	2	--	2	0
80	IRZ-17	Remediation	No	Planned	4	2	--	2	0
81	IRZ-18	Remediation	No	Future Provisional	4	2	--	0	2
82	IRZ-19	Remediation	No	Planned	4	2	--	2	0
83	IRZ-20	Remediation	No	Planned	4	2	--	2	0
84	IRZ-21	Remediation	No	Planned	4	2	--	2	0
85	IRZ-22	Remediation	No	Future Provisional	4	2	--	0	2
86	IRZ-23	Remediation	No	Planned	1	1	--	1	0
87	IRZ-24	Remediation	No	Future Provisional	2	1	--	0	1
88	IRZ-25	Remediation	No	Planned	2	1	--	1	0
89	IRZ-26	Remediation	No	Future Provisional	2	1	--	0	1
90	IRZ-27	Remediation	No	Planned	2	1	--	1	0
91	IRZ-28	Remediation	No	Future Provisional	2	1	--	0	1
92	IRZ-29	Remediation	No	Planned	2	1	--	1	0
93	IRZ-30	Remediation	No	Future Provisional	2	1	--	0	1
94	IRZ-31	Remediation	No	Planned	2	1	--	1	0
95	IRZ-32	Remediation	No	Future Provisional	2	1	--	0	1
96	IRZ-33	Remediation	No	Planned	2	1	--	1	0
97	IRZ-34	Remediation	No	Future Provisional	1	1	--	0	1
98	IRZ-35	Remediation	No	Planned	1	1	--	1	0
99	IRZ-36	Remediation	No	Future Provisional	1	1	--	0	1
100	IRZ-37	Remediation	No	Planned	1	1	--	1	0
101	IRZ-38	Remediation	No	Future Provisional	1	1	--	0	1
102	IRZ-39	Remediation	No	Planned	1	1	--	1	0
103	IRZ-40	Remediation	No	Future Provisional	1	1	--	0	1
104	RB-1	Remediation	No	Planned	2	1	--	1	0

EXHIBIT 3.1-2B

Estimated Borehole Count Associated with Well Construction: Count Details

Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Item	Location Name	Well Type	Added in 90% BOD	Status	Est. # of Well Screen Intervals	Calculated # of Boreholes	Number of Boreholes Installed	Est. # of Planned Boreholes	Est. # of Future Provisional Boreholes
105	RB-2	Remediation	No	Planned	2	1	--	1	0
106	RB-3	Remediation	No	Planned	2	1	--	1	0
107	RB-4	Remediation	No	Planned	2	1	--	1	0
108	RB-5	Remediation	No	Planned	2	1	--	1	0
109	RB-6	Remediation	Yes	Future Provisional	2	1	--	0	1
110	RB-7	Remediation	Yes	Future Provisional	2	1	--	0	1
111	RB-8	Remediation	Yes	Future Provisional	2	1	--	0	1
112	RB-9	Remediation	Yes	Future Provisional	2	1	--	0	1
113	TCS-1	Remediation	No	Planned	2	1	--	1	0
114	TCS-2	Remediation	No	Planned	2	1	--	1	0
115	TWB-1	Remediation	No	Planned	1	1	--	1	0
116	TWB-2	Remediation	No	Planned	1	1	--	1	0
117	TWB-3	Remediation	No	Future Provisional	1	1	--	0	1
118	TWB-4	Remediation	No	Future Provisional	1	1	--	0	1

Key Assumptions:

1. Up to 2 well casings (screens) will be nested in each borehole at MW locations where there are multiple screens. The estimated number of screened intervals could change based on actual field conditions.

2. Remediation wells will be constructed with one well per borehole (this includes dual screen wells along the IRZ, for which some have up to 2 separate dual screen wells per location).

3.2 Construction Methods

This section describes the typical methods and equipment that will be used to construct the groundwater remedy. These tools and techniques are grouped and presented according to the type of infrastructure with which they are associated; that is, wells, piping and utilities, vertical infrastructure (buildings and other aboveground facilities), and access routes.

The construction methods and equipment described herein are typical and feasible for similar projects constructed in similar site conditions. However, the exact methods and equipment that will be used in the field will be selected by the construction contractor(s) to provide the safest and most efficient construction processes to meet project requirements. It is unlikely that all of the tools and techniques described herein will be brought to bear, and even less likely that all of them would be used simultaneously. It is impractical to predict exactly which methods, equipment, or even numbers of equipment will be chosen or used at any point in the future because selection will depend on variable factors that cannot be known with certainty at this time. Some of these factors are equipment availability, market rates, employee skillsets, construction schedule, the size/structure/scope of the construction contract(s), and site conditions encountered in the field. For that reason, this section has been written with the intent of providing enough detail for regulatory review and approval while still providing flexibility for construction contractors to meet the project requirements in the safest and most efficient manner possible. Preliminary construction activities such as mobilization, utility survey, site preparation, and demarcation are discussed in Section 4 of the C/RAWP.

3.2.1 Wells

This section presents the approach to construction of new wells associated with the groundwater remedy, including extraction, injection, and monitoring wells. While the specific design and function of each well or well type will vary, the approach to construction for each will use similar methods, tools, and procedures. For many wells, the approach to finalizing the design and/or siting will depend on the information collected during location-specific well construction and/or information collected during the construction and testing of other nearby wells. Therefore, to minimize the total disturbance associated with well network construction (the number of individual boreholes required), the construction approach has been developed using the entirety of the well network.

Section 3.2.1.1 details the methods, tools, and general procedures planned to be used to drill and decommission the boreholes, which will be used for data collection (pilot boreholes) and for well construction. The types of data that will be collected during well drilling and the collection methods are further detailed in Section 3.2.1.2. The approach to using the information collected during well drilling to finalize well design and/or siting is presented in Section 3.2.1.3. Construction and development methods and procedures, and key design considerations for each well type are presented in Section 3.2.1.4. Finally, details for well testing and the use of well testing data are presented in Section 3.2.1.5.

Operational fieldwork methods and procedures that are not specific to designing, constructing, developing, and testing wells, such as waste management and site access, are presented in Section 4 of this C/RAWP.

3.2.1.1 Borehole Drilling and Decommissioning

The method used to drill each borehole will vary depending on the required borehole depth and diameter, data collection requirements, and the subsurface conditions encountered. In some cases, a borehole might initially be drilled with one method and subsequently reamed, or over-drilled, with another method. This section presents a description of the typical drilling equipment and specific drilling methods that are planned for remedy well network construction, as well as the approach to borehole stabilization and decommissioning.

Drilling Equipment. The equipment that will be present in the work zone for drilling and well construction activities is generally similar regardless of the specific drilling method. This equipment will include, but is not limited to:

- **Drill Rig.** Drill rigs will be mounted on either a tracked vehicle or highway-rated truck/trailer. In general, the footprint of the drill rig will be approximately 10 feet wide by 50 feet long or less. The height of the derrick when vertical will be approximately 40 feet tall or less. Specific dimensions will vary by rig.
- **Primary Service Truck or Trailer.** A drill rig will be supported by a truck or trailer used to deliver and manage larger drilling tools like the drilling pipe or well casing. In some cases, this will be the same truck that delivers water to the drill rig. This vehicle is usually positioned adjacent to the drill rig and often end-to-end. The dimension of this piece of equipment is typically similar to or smaller than the drill rig.
- **Secondary Support Equipment.** This smaller equipment will vary from rig to rig and is primarily dependent on the drilling method or given task. Examples of secondary support equipment that might be required include, but are not limited to, the following:
  - Auxiliary compressors, pumps, and generators
  - Material management equipment (backhoe or forklift)
  - Solids control unit for management of drill cuttings when drilling fluids are recirculated
  - General equipment trailer(s) to store smaller tools and materials
- **Bins and Tanks.** Drill cuttings and fluids generated during drilling will be temporarily stored in the work zone using tanks and bins. It is estimated that tanks will range in size from fixed-axle tanks that are approximately 9 feet wide by 50 feet long by 12 feet high to those that are smaller and mounted on a skid or trailer. The dimension of a typical bin (20 cubic yard capacity) is approximately 25 feet long by 8 feet wide by 5 feet high; however, smaller bins might also be used. The amount of storage capacity required at each drilling site will vary significantly depending on variables like the production rate of groundwater from the formation and the drilling method; however, it is estimated that up to three tanks and three bins could be required to support the drilling of a borehole at a given time.
- **Crew Vehicles and Facilities.** Vehicles used by the crew to access the work zone will range from standard highway vehicles to smaller off-highway vehicles. The exact number of vehicles will change depending on location and crew size at a given time but would typically be less than five. Temporary bathroom facilities will typically be in the work zone unless the work zone is within a jurisdictional area such as drainage and washes.

Throughout work, the crew will continuously assess what specific equipment is needed for a given task. Effort will be made to minimize the amount of equipment in the work zone. For example, if storage tanks were initially needed but are no longer required for a given task, then they could be removed. Similarly, if several drilling sites are located in the same general area, then a central tank staging area could be used to minimize the number of physical locations where the tanks are staged, thereby minimizing total footprint.

Drilling Methods. During the construction of the groundwater remedy well network, boreholes will be drilled for a variety of objectives that require a range of borehole diameters, depths, and data collection capabilities. To meet the different objectives, several drilling methods are considered in this work plan. The construction of the network will be completed most efficiently and with the least amount of total disturbance (for example, minimizing the total number of boreholes, or the duration of field time required to meet the project objectives) by continuously assessing the chosen drilling methods and maintaining flexibility to change methods.

Rotosonic Drilling. Rotosonic is the preferred method for drilling through unconsolidated materials above bedrock when continuous core is required, but a large borehole diameter is not required. Boreholes drilled with this method are generally between 6 and 12 inches in diameter; however, subsurface conditions can limit the depths to which larger-diameter boreholes can be drilled using rotosonic methods. According to past experience at Topock, the estimated maximum depth for smaller-diameter rotosonic boreholes is approximately 300 to 400 feet below ground surface (bgs). This method involves advancing a rotating and vibrating outer drive casing and inner core barrel through the subsurface. Rotosonic drilling can produce a continuous core from the land surface to the target drilling depth and results in a temporarily cased borehole for well construction. Boreholes drilled with the rotosonic method can be drilled without adding water or other additives (for example, drilling mud); however, past experience using this method at Topock indicates that injecting water while drilling is required when drilling larger-diameter and/or deeper boreholes to manage borehole pressures (heaving conditions) and tooling temperatures. In general, an advantage of rotosonic drilling is that it generates minimal drilling wastes (that is, drill cuttings and purged groundwater) relative to other comparable methods and typically can drill through the lithology at Topock. Rotosonic methods have been used at Topock for limited applications when drilling in the conglomerate and crystalline metadiorite bedrock.

During the construction of the groundwater remedy well network, it is anticipated that the rotosonic method will be most useful when installing pilot boreholes for data collection or installing smaller-diameter wells (for example, monitoring wells with two or less nested, 2-inch-diameter well casings).

Rotary Drilling with Casing Advance. This method is representative of a category of specific types of tooling (for example, dual rotary, and dual-tube methods, such as Stratex or Odex). This is the preferred method for drilling through unconsolidated materials above bedrock when continuous core is not required and borehole diameters are larger. A primary advantage of these methods is that they are capable of drilling boreholes to the largest diameters and depths required for construction of the groundwater remedy well network; therefore, these methods are particularly important when methods like rotosonic or hollow-stem auger are not sufficient. This method involves advancing an outer drive casing while removing the cuttings from within that drive casing using air and/or water, drilling mud, or other additives as the drilling fluid. The determination regarding how the drilling fluid is engineered, be it simply air and water or another method, is made in the field based on direct observations of the formation and drilling tools during drilling.

During the construction of the groundwater remedy well network, it is anticipated that this method will be most useful when installing pilot boreholes for data collection at depths greater than what can be achieved with the rotosonic method or for installing larger-diameter wells (for example, injection and extraction wells).

Rotary Drilling (Conventional). Rotary drilling is included as a category that includes specific types of tooling (for example, tri-cone roller bit or percussion hammer) used to install boreholes within both unconsolidated and bedrock formations. A wide range of borehole diameters can be drilled to depths larger than what is required for construction of the groundwater remedy well network. With this method, the drill bit is rotated on hollow drill pipes that are used to either inject the drilling fluid (air or drilling mud) and return the cuttings to the surface through the annulus or return the drill cuttings to the surface (in the case of reverse circulation). Conventional rotary drilling does not advance an outer drive casing to stabilize the borehole, so drilling mud is typically used.

During the construction of the groundwater remedy well network, it is anticipated that air rotary (with a downhole percussion hammer) will be used to install the extraction wells at the east end of the East Ravine area. Mud rotary is not currently planned for use, but is included as a potential drilling technology to install larger-diameter, deeper wells (for example, injection wells in the uplands) should the preferred rotary drilling with casing advance method prove unsuccessful or inefficient.

Wireline Core Drilling. Wireline, diamond-bit core drilling methods are preferred for drilling through consolidated bedrock when relatively undisturbed bedrock core is beneficial for well design. This method uses a rotating, dual-barreled drill casing with a diamond-impregnated bit to collect relatively undisturbed core. Additionally, as determined necessary, a triple-tube core barrel, which uses the same tools as the dual-barreled system, but includes an inner sleeve to maximize core recovery in especially fractured rock, can be used. Drilling fluid, typically water with no additives (though a polymer is sometimes needed) is used to move drill cuttings out of the borehole. Coring activities are typically initiated using water with no additives; however, the determination to add an additive to the drilling fluid to facilitate the removal of cuttings from the borehole or inhibit the loss of drilling fluids to the formation is made in the field based on direct observations of the formation and drilling tools during drilling.

During the construction of the groundwater remedy well network, it is anticipated that wireline core drilling will only be used to drill the portion of monitoring well MW-70BR-D in the East Ravine, which is deeper than the existing MW-70BR-225 borehole. Continuous core has been collected from the shallower bedrock at this location, and core is not necessary for designing the extraction wells that will be installed at the eastern end of the East Ravine area, as discussed in Section 3.2.1.4.

Bucket Auger. A bucket auger is used to drill large-diameter boreholes (that is, 24 to 48 inches, though the upper end of this range is not anticipated to be needed) in unconsolidated material when the primary drilling method would either be less efficient or not capable of installing the borehole. This method is typically used to install large-diameter conductor casings to predesigned, generally shallow (less than 100 feet) depths. The method uses a "bucket" with a cutting edge on the bottom rotated by the drill rig. Cuttings are removed from the borehole by bringing the bucket back to the surface and emptying it. When drilling, it may be determined necessary to stabilize the borehole wall by installing a temporary casing or by using fluid, such as water or drilling mud. The determination regarding whether the drilling fluid is needed and how it is engineered, be it simply water or drilling mud, is made in the field based on direct observations of the formation and drilling tools during drilling. With this method, even if drilling mud is needed, the cuttings will typically remain primarily separated from the mud.

During the construction of the groundwater remedy well network, it is anticipated that a bucket auger will only be used if large-diameter conductor casings are required to maintain borehole integrity when installing deeper, large-diameter wells.

Hollow-stem Auger. Hollow-stem auger drilling is typically used to install smaller-diameter boreholes (up to approximately 12 to 14 inches) in unconsolidated material that is finer-grained (minimal concentrations of cobble and boulder-sized material). The method is typically used to install single-cased, smaller-diameter (2- to 4-inch-diameter casing) wells to shallow depths (fewer than 100 to 150 feet). Drilling is conducted by driving and rotating a spiral-flighted casing (auger) into the ground, whereby cuttings are moved up the borehole along the auger flights. When it has reached the appropriate depth, a well can be constructed through the inside of the auger. Typically, fluids are not added to the borehole unless required to manage borehole pressure (heaving conditions).

This method is typically not used at Topock because of the rocky lithology throughout the site and heaving conditions that have been encountered in the past; however, it is possible that the method might prove useful for the installation of some wells such as the shallower wells near the southern end of the NTH IRZ, where the thickness of the unconsolidated material above bedrock is relatively thin and the depth to water is shallow.

Drilling Fluid. Drilling fluid, which can consist of liquids (for example, water or drilling mud) and/or gas (compressed air), will be required for the majority of drilling methods that will be used to construct the remedy well network. Drilling fluids are critical for removing cuttings from the borehole, controlling borehole pressure, and cooling the drilling tools. The primary drilling fluids used during construction will be compressed air and/or water; however, while not preferred for drilling at Topock, drilling fluid additives might be required based on field conditions. Drilling additives used will be commercially available products typically used in the water supply and environmental drilling industry and will be compliant with National Science Foundation (NSF)/ American National Standards Institute (ANSI) *Standard 60: Drinking Water Treatment Chemicals – Health Effects*. Examples of potential additives include foaming agents (Baroid Quik Foam), bentonite-based products, and fluid control additives (soda ash, Baroid Quik Gel, Quik-Trol, EZ-Mud, Penetrol, and N-Seal). The function of some example drilling additives and the example ingredients are included in Exhibit 3.2-1.

EXHIBIT 3.2-1
Example Drilling Fluid Additives
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Additive Function	Example Ingredients	Ingredient Percent/Weight	Example Trade Name
Foaming agent (cuttings removal)	Ethanol, Isopropanol	5-10% each	Quik-Foam
Filtrate control and borehole stability	Polysaccharide	60-100%	Quick-Trol
Filtrate control and clay inhibitor	Light petroleum distillate	10-30%	EZ-Mud
Viscosifier and fluid loss control	Sodium bentonite with trace silica	100%	Quik-Gel
Lost circulation material (acid soluble)	Slag wool fiber	60-100%	N-Seal

When compressed air and/or water are used as the primary drilling fluid, the total amount of additive used is typically a small percentage of the total volume of water purged or generated during the drilling process. For example, it is estimated that the average borehole could generate approximately 85,000 gallons of water when drilled at Topock using compressed air as the primary drilling fluid, of which the total volume of additive ingredient used is estimated to be less than 10 gallons. In this example, which assumes Quik-Foam will be needed, the additive ingredients represent less than 0.001 percent of the total water generated during drilling. When drilling mud is required, which uses solids like bentonite and liquid additives like those previously listed, this percentage would be higher because the total volume of water generated would be less (drilling mud is engineered to limit the volume of water that enters/exits the borehole during drilling); however, the percentage of additive relative to total volume of water generated would still be small.

Borehole Stabilization. During drilling, field conditions might require that a borehole be stabilized to prevent an unsafe working condition or limit the amount of formation material that is removed during drilling. This is typically addressed by using the drill rig to install a temporary or permanent conductor casing in the shallower portion of the borehole, or by filling the borehole with drilling fluid (as described in the previous section) to control borehole pressure. Temporary conductor casings, which could simply be larger-diameter sections of drilling pipe, are removed when drilling is complete, whereas permanent casings are incorporated into the design of a given well construction.

Borehole Decommissioning. The majority of boreholes drilled will be used to construct well(s), though some field conditions might require a borehole to be decommissioned (backfilled) without constructing a well. For example, if a smaller-diameter pilot borehole is drilled to collect borehole data, and the well will not be constructed until a later date (for example, the drill rig that will be used to ream the borehole to a sufficient diameter is not immediately available), the borehole will be decommissioned albeit only temporarily. In another case, borehole data might determine that a well should not be constructed at a given location and that the borehole should be decommissioned permanently.

When a borehole is to be permanently decommissioned, the methods and procedures detailed for exploratory boreholes in the SOP for well and borehole decommissioning (see Well-SOP-01 in Appendix B to this C/RAWP) will be followed. For example, in accordance with the minimum standards for decommissioning a borehole in the State of California, as established by the California Department of Water Resources in the California Well Standards, because these boreholes will be drilled in areas of known or potential soil and groundwater contamination, sealing material (for example, neat cement with up to 6 percent bentonite) is required throughout the entirety of the borehole; however, PG&E will seek a variance to this approach when a borehole is only to be temporarily backfilled. For pilot boreholes that will be subsequently overdrilled for well construction, PG&E will propose to temporarily backfill the boreholes by allowing it to either naturally collapse or with the placement of clean granular material (sand). After the pilot borehole is drilled to total depth, the drilling tools (bit and casing) will be removed from the borehole in 10- to 20-foot sections (as determined by the length of drill casing joints). As each section is removed, the total depth of the borehole will be verified to determine whether it has naturally collapsed (as is typically the case in the saturated portion of the borehole); if not, the borehole will be backfilled with clean material before the next section of drill casing is removed. By temporarily backfilling boreholes that will be subsequently overdrilled for well construction, the risk of compromising the hydraulic integrity of the borehole and adjacent formation is minimized. If sealing material is used to backfill these boreholes, there is risk that a new borehole would be needed for the planned well to function properly. It is assumed that temporarily backfilled boreholes will be overdrilled within 3 to 4 months for well construction. If it is determined that a temporarily backfilled borehole will not be used for well installation, it will be overdrilled and sealed in accordance with the applicable well standards.

In accordance with the Well-SOP-01, filler and sealing materials will be installed using a tremie pipe, which may include the drill casing depending on the drilling method. As determined necessary, an additional tremie pipe installed within the drill casing will be used to install fluid materials used for backfilling and sealing (grout) so that the material is introduced near the bottom of the borehole and standing water is displaced upward. Anticipated sealing and filler materials are defined in Well-SOP-01 in Appendix B to this C/RAWP.

3.2.1.2 Data Collection during Well Construction

The boreholes drilled during the construction of the remedy well network will be used to collect a variety of data, which will be used to refine the Topock conceptual site model and finalize well design details. The need for location-specific data collection will vary from one location to another (see Section 3.2.1.3 of this C/RAWP). In general, there are two primary data needs:

1. Collecting lithologic information to determine the grain size, sorting, and stratigraphy of the geologic formation. Specifically, this information will be used to design the optimal filter-pack material and screen aperture size for the wells, as well as to select the appropriate well screen intervals within the aquifer given the purpose of an individual well (for example, selection of the intervals for injection of water with/without carbon amendment, groundwater extraction, or for groundwater monitoring).
2. Collecting borehole groundwater samples to refine understanding of local changes in water quality throughout the aquifer (for example, the distribution of Cr(VI) concentrations). Specifically, this information will be used to select the appropriate well screen intervals within the aquifer given the purpose of an individual well.

The type of data needed from a given borehole will, in part, determine what drilling method is required. For example, if lithologic information from core is needed to finalize well design details, but a borehole diameter larger than what a rotosonic rig is capable of drilling is required for well construction, a pilot borehole might initially be installed with a rotosonic drill rig, and that pilot borehole would subsequently be overdrilled with a method capable of installing a larger-diameter borehole. As data are collected from the boreholes during construction or from testing of the constructed wells (see Section 3.2.1.5 of this C/RAWP), the results will be compared to existing data comprising the conceptual site model to determine the appropriate amount of additional data required to finalize individual well designs and construct the larger remedy well network. This section details the types of data that will be collected and the collection methods. A preliminary plan for how additional data will be collected and used to finalize well design at each scheduled well location is described in Section 3.2.1.3 to this C/RAWP. This plan will be assessed on an ongoing basis to determine if more, or less, data are required.

Lithologic Logging and Soil Sample Collection. Lithologic descriptions will be logged from each borehole based on visual inspection of the retrieved core or the drill cuttings under the supervision of a California Professional Geologist. Lithologic information will be collected from continuous core (that is, unconsolidated material and/or bedrock) at well locations where understanding the stratigraphy in detail is required to finalize well design details. Lithologic information may be collected from the drill cuttings at other locations.

Unconsolidated sediments will be logged in accordance with the SOP-B3 in Appendix B to this C/RAWP. The field log will document the following information for each soil boring:

- Unique soil boring or well identification
- Purpose of the soil boring (monitoring well)
- Location in relation to an easily identifiable landmark
- Names of the drilling subcontractor and logger
- Start and finish dates and times
- Drilling method
- If applicable, types of drilling fluids, volume, and depths at which they were used
- Diameters of surface casing, casing type, and methods of installation
- Depth at which saturated conditions were first encountered
- Lithologic descriptions (based on the Unified Soil Classification System)
- Sampling-interval depths
- Zones of caving or heaving
- Depth at which drilling fluid was lost and the volume lost
- Changes in drilling fluid properties
- Drilling rate
- Drilling rig reactions, such as chatter, rod drops, and bouncing

Cored bedrock boreholes will be logged with the same procedure used for previous boreholes drilled at the site (for example, the East Ravine area). At a minimum, the lithologic log for cored bedrock boreholes will include the following information:

- Depth at which drilling fluid was lost and the volume lost
- Changes in drilling fluid properties
- Drilling rate
- Fractures per foot
- Lithologic descriptions (including structures, texture, foliations, bedding, grain size, and hardness)
- Alteration and weathering
- Percent core recovery
- Core discontinuity description
- Rock quality designation

At select locations, soil samples will be collected from the unconsolidated core or drill cuttings to analyze physical properties (for example, grain size distribution), and the results of analysis will be used to finalize well design details (for example, screen slot size and filter pack material). As they are collected, soil and bedrock core will be photo-documented in the field.

Borehole Groundwater Sample Collection. Groundwater samples will be collected from the borehole during the drilling process at select locations. The results of laboratory analysis of the samples will be used to evaluate water quality at multiple intervals within the aquifer at a given location, which will be used to finalize well design for select wells. For example, borehole groundwater samples (combined with borehole lithology data) will be used to select the appropriate screen intervals at a given monitoring well location. Similarly, these data can be used to identify intervals with elevated Cr(VI) concentrations that might be targeted by a screened interval for a carbon substrate injection well along the NTH IRZ.

Borehole groundwater samples will be collected from specific intervals of select boreholes drilled within the unconsolidated aquifer. When the water table is reached, samples will be collected from the borehole approximately every 30 to 50 feet, or as significant hydrogeologic changes are identified during drilling (for example, if bedrock is encountered, a sample might be collected directly above bedrock), to assess changes in water quality with depth and qualitative changes in borehole capacity[1]. One exception to this frequency is when borehole groundwater samples are being collected to support the design of a well that will supplement an existing well. For example, if a well is being installed to evaluate deeper water quality where a water table well already exists, samples will typically only be collected from depths deeper than the existing well screen interval(s). Alternatively, only shallower borehole groundwater samples might be collected to support the design of a well supplementing an existing deeper well.

The specific method that will be used to collect these samples will depend on the drilling method being used; however, the general approach will be similar. The borehole will be drilled to the bottom depth of the sample interval, then the drill casing will be retracted to the top depth of the interval, and the sample zone will be isolated. For example, the preferred method when drilling with a casing advance drilling method (for example, rotosonic, or rotary with casing advance) is placing a temporary well screen in the bottom of the borehole and retracting the drive casing to expose the temporary well screen. A packer attached to the temporary well casing will be used to isolate the screen from the water column in the cased borehole above. After the sampling interval is established, the sample will be collected by purging the temporary well with an electric submersible pump or equivalent that minimizes disturbance of the purged water and maximizes data quality (airlift will be the least preferred groundwater purging method for sample collection). If it is determined that this method is not practical, based on subsurface conditions (for example, heaving conditions), then the sample could be collected by simply pumping from within the drill casing using an electric submersible pump. Water quality measurements will be monitored on the pump effluent at the surface (for example, specific conductance, pH, and oxidation-reduction potential), and the temporary screen will be considered developed (ready for sample collection) once measurements are indicative of estimated aquifer conditions as compared to the water used for drilling (for example, elevated specific conductance when compared to lower specific conductance drilling water). Like past data collection efforts conducted during drilling to support well design, collected borehole groundwater samples will be analyzed onsite for Cr(VI) and Cr(T) in accordance with SOP-L01 and SOP-L03, respectively, and duplicate samples will be submitted to a certified offsite laboratory for confirmation at a frequency of approximately 10 percent (in accordance with the QAPP). Analysis for other constituents, either using the onsite or offsite laboratories, will be added as needed.

Borehole groundwater samples will not be collected during the drilling process in bedrock. Section 3.2.1.4 contains more information regarding the approach to the characterization of deeper bedrock at the MW-70 cluster location.

Borehole Geophysical Logging. Borehole geophysical logging provides information about formation mineralogy and aquifer characteristics; however, the effectiveness of geophysical logging is limited in steel-cased boreholes (boreholes drilled with rotosonic and rotary with casing advance). The determination to conduct borehole geophysical logging will be made in the field when drilling conditions are appropriate and as needed to finalize design details for the remedy well network. Examples of the types of geophysical logs that might be performed include:

- Caliper log
- Natural gamma ray log
- Electric logs (spontaneous potential, short and long normal)
- Acoustic televiewer log
- Video log

Borehole geophysical logging involves lowering equipment (for example, electronic sensors and cameras) into the borehole (or well) on a cable. The equipment passively collects data while being lowered from

[1] Borehole capacity is a qualitative measurement of aquifer yield (observing drawdown in the borehole for a given extraction rate during drilling or pumping of the open borehole), but cannot be used as a measure of permeability or transmissivity.

ground surface to total depth. At the surface, the equipment in the work zone typically only includes a van or truck containing the winch and electronics required to lower the sensors and process the data.

Well Sampling. Groundwater samples will be collected from select wells to guide decisions during construction of the well network. For example, as detailed in Section 3.2.1.3, water quality samples will be collected and analyzed from key wells (referred to as Category 1) to determine proper siting of key extraction, injection, and monitoring wells. The methods and procedures for the collection of groundwater samples from wells will follow those identified in Volume 2 of the O&M Manual. Groundwater samples collected from wells will be analyzed at a certified offsite laboratory for Cr(T), Cr(VI), or other constituents, as needed.

The equipment required for well sampling will be the same as that currently used for the Topock groundwater monitoring program, and as detailed in Volume 2 of the O&M Manual. Typically, this includes one vehicle (a truck or off-highway vehicle) equipped to conduct all sampling tasks, including purge water storage. Additional vehicles are sometimes used to support the sampling.

3.2.1.3 Approach to Finalizing Well Design and/or Siting

Preliminary well designs for each remediation and monitoring well are provided in Tables 3.2-1 through 3.2-5 and include the number of screened intervals for each well location, the depth intervals to be screened, and the total depths of the wells (these tables, as well as additional well design basis information is provided in Section 3 of the 90% BOD Report). This preliminary design information is based on general assumptions about the aquifer and the current conceptual site model. The final determination of the well design details will be made based on information collected in the field during construction and testing of the well network. Well design and/or siting will follow a structured, iterative, timely, and adaptive approach so that uncertainties inherent within the hydrogeological setting at Topock can be minimized and inform the decisions required to construct the wells to meet remedy objectives. This section presents the framework for the collection, interpretation, and communication of the data collected during well network construction and the resulting well construction decisions.

As summarized in Section 3.2.1.2, additional data will be collected during construction of the groundwater remedy well network to finalize well design and, in some cases, well siting. Based on a review of the key information required to construct the well network, each new well has been assigned to one of three categories differentiated by the types of decisions that will be made based on observations and analysis during construction. The three categories are summarized in Exhibit 3.2-2. New well locations comprising the groundwater remedy well network have been color-coded on Figure 3.2-1 to indicate the estimated category assignment. It is anticipated that the well category designations, especially for those in categories 2 and 3, will be continually assessed throughout construction of the remedy well network and will be re-designated as appropriate based on findings in the field. PG&E will update the agencies of re-designated wells via monthly progress reports as defined in Section 2 of this C/RAWP.

EXHIBIT 3.2-2
Summary of Well Categories
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

	Is Location-specific Data Needed to Finalize Well Location(s)?	Is Location-specific Data Needed to Finalize Design?
Category 1	Yes	Yes
Category 2	No	Yes
Category 3	No	Potentially

The detailed approach to drilling, data collection, and construction of wells for each category is presented in the following subsections.

Approach to Category 1 Locations. Category 1 wells have been designated in areas where existing uncertainties in the current conceptual site model may drive final well siting and/or design, as well as the other associated remedy infrastructure (pipelines). These areas include the northern area of the NTH IRZ, the IRL injection area in the uplands, the southern freshwater injection well (FW-2) area, and the East Ravine area. In each of these areas, an already planned monitoring well has been designated as the Category 1 well location. Data collection at these locations will be scheduled early in the construction schedule to confirm the assumptions in the basis of design for these areas prior to moving forward with the construction of other wells and remedy infrastructure. This approach will minimize the potential for uncertainties in the conceptual site model to cause unnecessary disturbance (that is, avoid constructing unnecessary infrastructure). A summary of Category 1 well locations, key design assumptions that will be confirmed at each, and dependent wells associated with each is provided in Table 3.2-6. The process for data collection, communication, and associated decision making at Category 1 locations will be iterative, and more than one pilot boring and/or monitoring well may be required to confirm the location and design of adjacent remediation/monitoring wells. The process is as follows:

1. Install a pilot borehole generally through the entire thickness of the unconsolidated aquifer. This borehole will be used to collect lithologic data and borehole groundwater samples and, pending Step 2, to construct the Category 1 monitoring well.
2. Analyze pilot borehole data. Use the lithologic and water quality data to confirm the designed well location and determine what intervals of the aquifer should be screened.
   a. If the data collected from the pilot borehole indicate that key design assumptions used in the basis of design are incorrect, PG&E will organize a real-time conference call (concurrent with fieldwork) with the agencies prior to the construction of the Category 1 well. The purposes of the call will be to review the data collected, reach consensus on the appropriate next steps at the given location, and examine the potential effects these data might have on the siting of other nearby wells (potentially pending the results of Step 4). Changes in a Category 1 well location, design, or function may result from Cr(VI) concentrations in the borehole samples that deviate significantly from those projected in the basis of design or if it is determined the lithologic and/or water quality data indicate a hydrogeologic condition that deviates substantially from the site conceptual model. Alternatively, it could be determined that a well is not necessary at the Category 1 location and that the pilot borehole should be permanently decommissioned (see Step 3).
   b. If the borehole data collected confirm the key assumptions used in the basis of design, the Category 1 monitoring well will be constructed consistent with the design detailed in Table 3.2-6 as a design basis and as appropriate based on the borehole data collected. A summary of the lithologic and water quality data collected will be communicated to the agencies via monthly progress reports as defined in Section 2 of this C/RAWP.
3. Construct and develop the Category 1 well(s), or decommission the pilot borehole in accordance with the procedures detailed in Section 3.2.1.1, and implement new path forward as agreed upon with the agencies in Step 2a. A summary of final well construction information will be communicated to the agencies via monthly progress reports as defined in Section 2 of this C/RAWP.
4. Collect groundwater sample(s), as needed, from the constructed Category 1 well(s) to confirm the data collected from the pilot borehole and verify whether nearby wells are properly sited, should be moved to meet their defined objective, or potentially whether other wells should be added or deleted to meet remedy objectives.
   a. If the data collected from constructed Category 1 well(s) indicate that key design assumptions used in the basis of design are incorrect, PG&E will organize a real-time conference call (concurrent with

fieldwork) with the agencies prior to constructing dependent wells and associated well infrastructure. The purpose of the call will be to review the data collected and reach consensus on the appropriate next steps for the given area.

b. If the data collected from constructed Category 1 well(s) confirm the key assumptions used in the basis of design, construction of dependent wells and associated infrastructure in the given area will move forward. A summary of the water quality data collected will be communicated to the agencies via monthly progress reports as defined in Section 2 of this C/RAWP.

5. Proceed with design and construction of nearby Category 2 and/or Category 3 wells or, if alternate siting is required, proceed with the installation of the new Category 1 pilot borehole/well for the given area.

1. **Approach to Category 2 Locations.** Category 2 wells require borehole-specific data collection to finalize well design (selection of screened intervals), but unlike Category 1, the location of the well is not anticipated to change based on the results. Category 2 wells include monitoring wells located outside of the plume where existing subsurface data is more sparse, wells that are part of the arsenic monitoring network, and the river bank extraction wells (RB-1 through RB-5), where the selection of screened intervals will be dependent on borehole-specific observations (see Section 3.2.1.4, river bank extraction wells). The process for data collection, communication, and associated decision making at Category 2 locations is as follows: Install a pilot borehole generally through the entire thickness of the unconsolidated aquifer. This borehole will be used to collect lithologic data and borehole groundwater samples and, ultimately, to construct the Category 2 well.

2. Analyze pilot borehole data. Use the lithologic and water quality data to determine what intervals of the aquifer should be screened. PG&E will organize a real-time conference call (concurrent with fieldwork) with the agencies, as available, prior to construction of the Category 2 well. If the agency representatives are unavailable to discuss the data in a reasonable amount of time, PG&E will proceed with well construction. A summary of the lithologic and water quality data collected for the given Category 2 well will be communicated to the agencies via monthly progress reports as defined in Section 2 of this C/RAWP.

3. Construct and develop the Category 2 well(s). A summary of final well construction information will be communicated to the agencies via monthly progress reports as defined in Section 2 of this C/RAWP.

Approach to Category 3 Locations. Category 3 wells are located in areas where the conceptual site model is reasonably defined and/or will become more defined given the density of new wells that will be constructed. Category 3 wells will require a blend of borehole-specific data and/or supplemental data from adjacent boreholes and wells to finalize well design, but unlike Category 1, the location of the well is not anticipated to change. For example, due to the relatively close spacing of the IRZ wells, only certain wells may require pilot boreholes to finalize well design, particularly to the south where the aquifer is thin and the distribution of Cr(VI) is generally throughout the entire aquifer. Borehole data will be collected from pilot boreholes at an initial group of Category 3 well locations to finalize well design at these locations: IRZ-1, -5, -9, -13, -15, -20, -27, and -35. The design of subsequent wells will be finalized using the data collected from these locations, other predecessor locations, and/or additional pilot boreholes, as determined necessary. Similarly, freshwater injection well FW-2 and injection wells IRL-1 though IRL-4 are located in areas that will be characterized during the construction of Category 1 wells, so additional borehole-specific data (other than grain-size information for finalizing the design well screen and gravel pack specifications) is not anticipated to be critical to finalize well design. Upon analysis of the data collected from the initial pilot boreholes (and other existing data), the need for additional pilot borings and data collection to support Category 3 well design will be evaluated based on the proximity, uniformity, and conformity of the pilot borehole data already collected.

The process for data collection, communication, and associated decision making at Category 3 wells is as follows:

1. Install Category 3 pilot borehole(s) in a given focus area (for example, pilot boreholes along the NTH IRZ), generally through the entire thickness of the unconsolidated aquifer. These borehole(s) will be used to collect lithologic data and borehole groundwater samples and, ultimately, to construct the Category 3 well. Once data collection is complete, temporarily decommission the pilot borehole in accordance with the procedures detailed in Section 3.2.1.1..
2. Evaluate data collected from the pilot borehole(s) and adjacent pilot boreholes and wells and determine whether supplemental data are needed to finalize Category 3 well design details for a given area. Install additional pilot borehole(s) at planned Category 3 locations as determined necessary.
3. Finalize Category 3 well design for a given well or group of wells. Analyze pilot borehole data and data from nearby wells for a given area to determine what intervals of the aquifer should be screened, and the design of well screen and gravel pack specifications for the Category 3 well(s) in that area. A summary of the lithologic and water quality data collected for the given Category 3 well/area will be communicated to the agencies via monthly progress reports as defined in Section 2 of this C/RAWP.
4. Install/overdrill the borehole for Category 3 well construction. For locations where a pilot borehole was installed, the pilot borehole will be overdrilled for well construction. If a pilot borehole was not installed, then drill cuttings will be used to confirm the lithologic assumptions and screen interval determinations that were finalized in Step 3 (and adjusted as necessary). A summary of final well construction information will be communicated to the agencies via monthly progress reports as defined in Section 2 of this C/RAWP.

3.2.1.4 Well Construction and Development

This section summarizes the types of wells that comprise the remedy well network, preliminary well design, key data required to finalize well design, well construction methods and materials, well development, and well surface completion and instrumentation. Additional details related to well design and purpose during remedy operation are included in Sections 3.2 and 3.6 of the 90% BOD Report.

Well Types and Preliminary Design. This section provides a summary of the number, types, and design basis for remedy wells, as included in Sections 3.2 and 3.6 of the 90% BOD Report. The preliminary estimates for remediation and monitoring well screen lengths and depths are summarized Tables 3.2-1 through 3.2-5, which are also included in Section 3 of the 90% BOD Report. Generalized well design drawings are included in Appendix D of the 90% BOD Report. Preliminary well design details including screened intervals, screen lengths, number of screens, screen/filter pack specifications, and in-well infrastructure will be finalized concurrent with construction pending the evaluation of data collected during drilling and well testing, as discussed in Section 3.2.1.3.

NTH IRZ Wells. The NTH IRZ, which is composed of 28 wells (divided among 20 locations), will act as a recirculating system in which water extracted via the four NTH IRZ extraction wells will be amended with carbon substrate and re-injected into the NTH IRZ line via the 24 NTH IRZ injection wells. Each of the wells will be constructed using up to 12-inch-nominal-diameter well casing with one or two screened intervals to target specific intervals of the unconsolidated sediments. Final determination of the screened intervals will be made based on information collected in the field during borehole installation, and it is possible that the final determination of screened intervals could result in a change to the designed number of screen intervals at a given NTH IRZ well location. In turn, a change in the number of screened intervals could result in a change in the total number of wells required at that location to accomplish the objectives of the NTH IRZ, in the associated wellhead (for example, vault design), or to down-well piping and equipment. For example, an increase in the number of screen intervals at a given location that requires discrete control of injected carbon-amended water could result in the need to construct an additional well at that location (that is, next to the initial well) because a single well can accommodate, at most, two discrete screened intervals separated by a pneumatic packer. Alternatively, if fewer screened intervals are required, a well that was initially planned for construction may be reserved as a future provisional well. Key information that will be evaluated to finalize the design of the NTH IRZ network include the following:

- **Saturated thickness of the unconsolidated aquifer.** The design currently assumes that more screened intervals are required for wells in the northern portion of the NTH IRZ and fewer screened intervals are required in the southern portion, based on the assumption that saturated thickness of the unconsolidated aquifer thins to the south. As saturated thickness is confirmed through the installation of pilot boreholes and boreholes for well construction, the number of required screen intervals (and length of each) will be finalized.
- **Water quality within the unconsolidated aquifer.** The NTH IRZ wells are designed to inject carbon-amended water into discrete portions of the aquifer. The results of groundwater samples collected from the pilot boreholes and water quality data from the existing groundwater monitoring network (including planned Category 1 monitoring well location MW-A) will be evaluated to identify portions of the aquifer with elevated Cr(VI) concentrations relative to other intervals (qualitative changes in borehole capacity observed during borehole groundwater sample collection will also be considered, see Section 3.2.1.2). These data will be considered when selecting the screened intervals for these wells. Additionally, the northernmost extent of the NTH IRZ well network is based on the current understanding of the extent of the Cr(VI) plume in this area. The results of groundwater samples collected from the MW-A location and water quality data from the existing groundwater monitoring network in this area will be evaluated to identify whether additional wells north of IRZ-1 and MW-35 may be needed.
- **Well performance.** Following the development of a given well, the specific capacity/injectivity will be compared to assumptions used in the design. Lower-than-predicted flow or injection rates will not necessarily indicate that additional wells are required. Sustainable flow rates will be considered in the context of the conceptual site model, which will be continually updated as needed during remedy implementation and will be used to assess the potential need to replace or add wells to the NTH IRZ well network.

Thirty-one future provisional NTH IRZ wells (divided among 20 locations) are identified in the 90% BOD Report.

River Bank Extraction Wells. Five extraction wells (RB-1 through RB-5) will be constructed along the bank of the Colorado River as the downgradient component of the Inner Recirculation Loop. The river bank extraction wells will be constructed using up to 12-inch-nominal-diameter well casing with two screened intervals. Each well will be constructed with one screened interval to target the deeper portions of the aquifer, as well as a second shallow screen interval should extraction from both intervals be required in the future. Initially, groundwater will only be extracted from the lower screen, which will be isolated from the shallower screen interval with a pneumatic packer. Key information that will be evaluated to finalize the design of the river bank extraction well network include:

- **Saturated thickness of the unconsolidated aquifer.** The design currently estimates lengths for two screened intervals for each of the RB extraction wells based on model layer thickness assumptions. As total saturated thickness is confirmed through the installation of pilot boreholes and boreholes for well construction, the length of the individual screened intervals will be finalized.
- **Water quality within the unconsolidated aquifer.** The RB extraction wells are designed such that the lower screen is constructed beneath the reducing rind of the Colorado River to minimize both negative hydraulic impacts to this zone and the potential for well fouling. The results of groundwater samples collected from the pilot boreholes and water quality data from the existing groundwater monitoring network will be evaluated to identify changes in water quality with depth indicative of the naturally reduced groundwater. These changes will be considered when selecting the screened intervals for these wells.

- **Well performance.** Following the development of a given well, the specific capacity will be compared to assumptions used in the design. Lower-than-predicted flow rates will not necessarily indicate that additional wells are required. Sustainable flow rates will be considered in the context of the conceptual site model, which will be continually updated as needed during remedy implementation and used to assess the potential need to replace or add wells to the river bank extraction well network.

Four future provisional RB extraction well locations (RB-6 through RB-9) are identified in the 90% BOD Report.

Inner Recirculation Loop Injection Wells. Four injection wells (IRL-1 through IRL-4) will be constructed in the upland area of the site, near the western margin of the groundwater plume north of I-40, as the upgradient component of the IRL. Each of the wells will be constructed using up to 12-inch-nominal-diameter well casing with two screened intervals. Each well will be constructed with one screened interval to target the shallower portions of the aquifer, as well as a second deeper screen interval The two screened intervals will be isolated from each other with a section of blank casing and annular well seal (see Well Construction Methods and Materials below) with a pneumatic packer, as necessary. The screened intervals for wells IRL-1 and IRL-2 will be located such that the shallow screen spans approximately the upper one-third of the saturated aquifer thickness and the deep screen spans the lower two-thirds of the saturated aquifer thickness. The screened intervals for wells IRL-3 and IRL-4 will be located such that the shallow screen spans approximately the upper two-thirds of the saturated aquifer thickness and the deep screen spans the lower one-third of the saturated aquifer thickness. In each case, a blank casing section approximately 20 feet long will be installed between the shallow and deep screens so that the borehole annulus between the two screens can be sealed. The placement of the upper and lower screened intervals for wells IRL-1 through -4 are approximate and may be adjusted based on field data (that is, the blank casing section could be moved up or down to isolate a finer-grained portion of the unconsolidated aquifer, as encountered). Key information that will be evaluated to finalize the design of the IRL injection well network includes the following:

- **Saturated thickness of the unconsolidated aquifer.** The design currently estimates lengths for two screened intervals for each of the IRL injection wells based on model layer thickness assumptions. As total thickness is confirmed through the installation of pilot boreholes and boreholes for well construction, the length of the individual screened intervals will be finalized.
- **Water quality within the unconsolidated aquifer.** The IRL injection wells are designed such that they are located near the western margin of the groundwater plume north of I-40. Further, the upper and lower screened intervals will be constructed at depths that generally correspond with changes in naturally occurring total dissolved solids (TDS) concentrations with depth (lower TDS water is typically observed shallower in the unconsolidated aquifer in the upland area). Water quality data from the existing groundwater monitoring network will be evaluated to identify changes in water quality, with depth indicative of the naturally occurring TDS concentrations. These changes will be considered when selecting the screened intervals for these wells.
- **Well performance.** Following the development of a given well, the specific injectivity will be compared to assumptions used in the design. Lower-than-predicted injection rates will not necessarily indicate that additional wells are required. Sustainable flow rates will be considered in the context of the conceptual site model, which will be continually updated as needed during remedy implementation and used to assess the potential need to replace or add wells to the IRL injection well network.

Three future provisional IRL injection wells (IRL-5 through IRL-7) are identified in the 90% BOD Report.

Transwestern Bench (TWB) Extraction Wells. Two extraction wells (TWB-1 and TWB-2) will be constructed northeast of the TCS where the unconsolidated aquifer extends southward following a depression in the bedrock to capture Cr(VI)-impacted groundwater. These wells are a downgradient component of the TCS recirculation loop. Each of the wells will be constructed using up to 12-inch-nominal-diameter well casing with one or two screened intervals to target specific intervals of the unconsolidated aquifer. Key information that will be evaluated to finalize the design of the TWB extraction well network includes the following:

- **Unconsolidated aquifer thickness and composition.** The design currently estimates a length for one screened interval for each of the TWB extraction wells based on model layer thickness assumptions. As is typical for extraction well design, the screened interval is placed in the lower portion of the aquifer to account for water-level drawdown during operation. As total thickness and the geologic composition of the aquifer is confirmed through the installation of pilot boreholes and boreholes for well construction, the length and depths of the individual screened interval(s) will be finalized.
- **Water quality within the unconsolidated aquifer.** The TWB extraction wells are designed to remove Cr(VI)-impacted groundwater from the unconsolidated aquifer. Therefore, the results of groundwater samples collected from pilot boreholes and the existing groundwater monitoring network will be evaluated to confirm elevated Cr(VI) concentrations with depth. The total depth of Cr(VI)-impacted groundwater will be considered when selecting the screened interval(s) for these wells such that extraction is focused at the appropriate depth.
- **Well performance.** Following the development of a given well, the specific capacity will be compared to assumptions used in the design. Lower-than-predicted flow rates will not necessarily indicate that additional wells are required. Sustainable flow rates will be considered in the context of the conceptual site model, which will be continually updated as needed during remedy implementation and used to assess the potential need to replace or add wells to the TWB extraction well network.

Two provisional TWB extraction wells are identified in the 90% BOD Report (TWB-3 and TWB-4).

East Ravine (ER) Extraction Wells. Four extraction wells (ER-1 through ER-4) will be constructed at the eastern end of the East Ravine area to provide hydraulic capture of Cr(VI)-impacted groundwater in bedrock. In addition, an existing monitoring well (MW-70BR-225) will be converted to function as a fifth extraction well in the East Ravine bedrock (ER-6). Like the TWB extraction wells, these wells are a downgradient component of the TCS recirculation loop. Each of the wells will be constructed using up to a 6-inch-nominal-diameter conductor casing to the top of competent bedrock or a minimum of 20 feet bgs. This conductor casing will be cemented in place. Up to a 5-inch-diameter borehole will be drilled out of the bottom of the conductor casing to total borehole depth. Depending on the condition of the bedrock encountered during drilling, a sleeve casing composed of slotted polyvinyl chloride (PVC) well screen might be placed into the borehole to prevent borehole collapse during well operation. The design of East Ravine extraction well network will be finalized pending the evaluation of the following key information:

- **Water quality within the bedrock.** The East Ravine extraction wells (ER-1 through ER-4) are designed to extract groundwater such that they hydraulically capture Cr(VI)-impacted groundwater in East Ravine area bedrock. While water quality data from the extraction well boreholes is not critical for proper well design, the vertical characterization data collected from planned monitoring well MW-70BR-D and the existing monitoring well network will be considered prior to finalizing extraction well design.
- **Well performance.** Following the development of a given well, the specific capacity will be compared to assumptions used in the design. Lower-than-predicted flow will not necessarily indicate that additional wells are required. Sustainable flow rates will be considered in the context of the conceptual site model, which will be continually updated as needed during remedy implementation and used to assess the potential need to replace, deepen, or add wells to the East Ravine extraction well network.

Six provisional East Ravine extraction wells are identified in the 90% BOD Report (ER-5 and ER-7 through ER-11).

TCS Injection Wells. Two injection wells will be constructed on the TCS to deliver carbon-amended groundwater from the TWB and ER extraction wells to the unconsolidated aquifer. These wells are the upgradient component of the TCS recirculation loop. Each of the wells will be constructed using up to

12-inch-nominal-diameter well casing with one or two discrete screened intervals of the unconsolidated alluvial sediments. Key information that will be evaluated to finalize the design of the TCS injection well network includes the following:

- **Unconsolidated aquifer thickness and composition.** The design currently estimates a dual-screen design for the TCS injection wells, and the screened intervals will be selected based on the thickness and composition of the unconsolidated aquifer. While both these parameters are reasonably well-defined by characterization work conducted for the installation of existing nearby monitoring wells, this information will be confirmed during the installation of the boreholes for these wells, and the individual screened interval(s) will be finalized.
- **Water quality within the unconsolidated aquifer.** The water quality of the unconsolidated aquifer in the area of the TCS injection wells is well characterized by the existing monitoring well network; however, because the TCS injection wells are designed to inject carbon-amended groundwater to unconsolidated aquifer, in general, water quality data are not critical for proper well design. Regardless, the existing water quality data will be considered when finalizing well design.
- **Well performance.** Following the development of a given well, the specific injectivity will be compared to assumptions used in the design. Lower-than-predicted injection rates will not necessarily indicate that additional wells are required. Sustainable flow rates will be considered in the context of the conceptual site model, which will be continually updated as needed during remedy implementation and used to assess the potential need to replace or add wells to the TCS injection well network.

Freshwater Injection Wells. Two freshwater injection wells, one in the upland area (FW-1) and another west of the TCS on the west side of Bat Cave Wash (FW-2) will be constructed outside of the plume to deliver freshwater to the aquifer and increase the hydraulic gradient across the site. Each of the wells will be constructed using up to 12-inch-nominal-diameter well casing with a single well screen interval across the majority of the unconsolidated aquifer. Key information that will be evaluated to finalize the design of the freshwater injection well network includes the following:

- **Unconsolidated aquifer thickness and composition.** The design currently estimates the length for one screened interval for each of the freshwater injection well based on model layer thickness assumptions. As total thickness is confirmed through the installation of pilot boreholes and boreholes for well construction, the length of the individual screened intervals will be finalized. While the saturated thickness in the FW-1 area is reasonably well characterized, it is less so in the FW-2 area. If sufficient saturated thickness above the bedrock surface is not present at the planned FW-2 location, an alternate location may need to be identified.
- **Water quality within the unconsolidated aquifer.** The freshwater injection wells are designed to be located outside of the Cr(VI) plume. The results of groundwater samples collected from pilot boreholes and/or planned Category 1 monitoring well MW-S will be considered prior to the installation of FW-2. The water quality of the unconsolidated aquifer in the area of FW-1 is well-characterized, and IM-3 injection of treated water has been conducted in this area for many years. While the final location of FW-2 is subject to additional data collection, the location for FW-1 is unlikely to change based on additional data from nearby wells.
- **Well performance.** Following the development of a given well, the specific injectivity will be compared to assumptions used in the design. Lower-than-predicted injection rates will not necessarily indicate that additional wells are required. Sustainable flow rates will be considered in the context of the conceptual site model, which will be continually updated, as needed, during remedy implementation and used to assess the potential need to replace or add wells to the freshwater injection well network.

Monitoring Wells. The existing monitoring well network will be augmented by an additional 35 monitoring well locations. The number of screened intervals that will be required at each new location is estimated in Table 3.2-5, based on the assumption for thickness of the unconsolidated aquifer in the model, or as determined by location-specific objectives (for example, MW-10D, where only one screened interval will be added above bedrock to supplement existing well MW-10). These monitoring wells will serve a variety of purposes related to monitoring the effects and progress of groundwater remedy operation. The final design of each monitoring well will depend on variables evaluated during construction, including the hydrogeologic condition at each location, well utility requirements, and constructability (see Section 3.6 of the 90% BOD Report). While multiple screen intervals will be required at most new monitoring well locations, effort will be made to optimize final monitoring well designs so that the total number of boreholes required is minimized. It is estimated that monitoring wells will be constructed with 2-inch-nominal-diameter PVC casing and screen and that these casings will be nested in as few boreholes as practicable at each location (this is estimated to be one or two boreholes per location, but could potentially be more depending on final monitoring requirements and subsurface conditions). Key information that will be evaluated to finalize the design of the additional wells includes the following:

- **Saturated thickness of the unconsolidated aquifer.** In general, the design currently assumes that more screen intervals are required for monitoring well locations in the northern portion of the remediation project area and fewer screened intervals in the southern portion based on the assumption that saturated thickness of the unconsolidated aquifer thins to the south. As saturated thickness is confirmed through installing pilot boreholes and boreholes for well construction, the number of required screen intervals (and length of each) will be finalized.
- **Water quality within the unconsolidated aquifer.** The monitoring wells are designed to provide water quality data from discrete portions of the aquifer. For monitoring wells located within the Cr(VI) plume, the results of groundwater samples collected from the pilot boreholes and water quality data from the existing groundwater monitoring network will be evaluated to identify portions of the aquifer with elevated Cr(VI) concentrations relative to other intervals. The intervals with the elevated Cr(VI) concentrations will be considered when selecting the screened intervals for these wells. Wells designed to monitor byproducts in IRL injection areas (MW-I and MW-J) and wells designed to monitor dose response (MW-P and MW-Q) are located outside the Cr(VI) plume and do not have a chemical-specific monitoring objective. Therefore, water quality data are not critical to finalize design the design of these monitoring wells.
- **Water quality within the bedrock in the East Ravine area.** Monitoring well MW-70BR-D is designed to provide vertical characterization of Cr(VI) in bedrock at existing well location MW-70BR-225. This borehole will be drilled to evaluate approximately 60 feet deeper than the bottom of MW-70BR-225 (approximately 10 feet of separation with 50 feet of open borehole). The open portion of the MW-70BR-D borehole will initially be sampled to assess water quality. If depth-specific concentration data are determined necessary, a flow profile of the open potion of the borehole will be conducted to identify the depth(s) of water-producing fracture(s), and depth-specific samples will be collected from those depths, as appropriate.
- **Well performance.** Following the development of a given monitoring well, field water quality measurements will be evaluated to confirm that data are within the expected ranges. For example, elevated pH is an indicator of potential grout intrusion and might present the need to replace the given monitoring well.

Four provisional monitoring well locations (MW-V, MW-EE, and an area for two potential slant well locations) are identified in the 90% BOD Report; however, it is understood that the effectiveness of the monitoring network will be continuously assessed over the course of remediation and that additional wells will be installed, as needed. It is assumed that an additional 10 monitoring well locations, which might require multiple boreholes at each, could be required to supplement the monitoring well network during remedy operation as aquifer conditions change.

Well Construction Methods and Materials. The process for drilling the boreholes that will be used for well construction are detailed in Section 3.2.1.2. This section summarizes the methods and materials that will be used to construct the wells within the boreholes. Wells will be constructed in accordance with the California or Arizona well standards, as appropriate. Following construction and development of each injection and extraction well (excluding the East Ravine extraction wells unless determined necessary during construction), a video survey will be conducted to verify well construction details and the as-built condition of well screen, casing, and welded joints. A gyroscope survey will be conducted to verify that the well casing is plumb and straight, as determined necessary. Key elements of well construction include borehole diameter, well casing and screen installation, filter pack, and annular seal installation.

Borehole Diameter. The diameter of borehole required for extraction and injection well construction will ultimately depend on the diameter of the well casing that is selected. These wells are designed with casing up to 12 inches in nominal diameter (this does not apply to extraction wells constructed in the bedrock, which will be smaller in diameter); therefore, it is estimated that the borehole will need to be approximately 18 to 24 inches in diameter so that annular materials can be properly installed. During construction, the drilling methods and details will be continuously evaluated to minimize the diameter of the boreholes so that field efficiency is maximized and the volume of disturbed material generated is minimized.

The diameter of boreholes drilled for monitoring wells will depend on the number of casings nested in each borehole. For example, if two casings are nested in one borehole, then the borehole diameter will be up to 12 inches in diameter. If three or four casings are nested, then the borehole will be up to 24 inches in diameter; however, nesting more than two casings in one borehole presents complications for construction that will be evaluated for practicability in the field. “Telescoping” the diameter of monitoring well boreholes (that is, decreasing the borehole diameter at specific depths) might be a way to overcome the difficulties inherent in nesting multiple well casings to deeper depths and will be evaluated for applicability during construction.

As discussed in Section 3.2.1.2, borehole stabilization is a key variable for field safety and well design. If temporary or permanent conductor casings are required to stabilize the borehole or construct an effective sanitary well seal, then the borehole diameter in the uppermost part of the borehole where the conductor casing will be set could be larger than the diameter required for well casing installation alone. It is estimated that boreholes up to 32 inches in diameter could be required to install these shallow conductor casings; however, the installation of these casings will be the exception and not the rule for final well design.

Well Casing and Screen. Well casing and screen for all wells will be prefabricated offsite and installed using the drill rig. For installation, the well casing and screen assembly will be suspended at a distance above the bottom of the borehole so that none of the weight of the casing is supported from the bottom of the borehole.

Casing material for the remediation wells deeper than 150 feet will be 316L stainless steel below saturation and either 304 stainless or carbon steel above saturation to provide the required tensile strength and collapse pressure resistance for the expected installation depths (typically, the transition depth for casing material will be tens of feet above the water table). If a mix of stainless-steel and carbon-steel casings are used, it may be necessary to install a dielectric coupling between the two casing types to inhibit corrosion. Schedule 80 PVC might be selected for casing material for remediation wells shallower than 150 feet, or the same casing material used for the deeper wells might be maintained. The screened intervals for remediation wells will be comprised of continuous wire wrap 316L stainless steel. Centralizers will be installed at regular intervals along the well casing and screen assembly, approximately every 40 to 60 feet (as a minimum frequency) to allow for the proper installation of annular materials (sand pack and sealing material). In general, centralizers installed along screened sections will be located at the joints to avoid blocking portions of the screen.

Monitoring well casing and screen will be composed of flush-threaded PVC, and screen sections will be machine-slotted. Centralizers will be installed at regular intervals along the well casing and screen assembly, approximately every 40 to 60 feet (as a minimum frequency), starting from approximately 5 to 10 feet from the bottom to ensure proper installation of annular materials and, in the case of nested monitoring wells, proper separation between casings and the borehole wall.

Filter Pack. The filter pack material that is installed in the annular space adjacent the screen intervals will consist of clean, engineered granular material. The size and gradation of this material will be chosen based on review of lithologic data and will be designed in combination with the "slot" aperture of the well screen. The filter pack material will be placed using a tremie pipe, which may include the drill casing depending on the drilling method. In general, the filter pack material will begin below the screen and extend several feet above the screen to allow for settlement over time. The top of the filter pack will be measured to verify depth during emplacement and the volume of material installed will be tracked for comparison against the calculated volume of the borehole annuls. The screened interval will be surged with a surge block during filter pack emplacement to aid with settlement.

Annular Seals. Sealing material will be placed in the annulus between the well casing and the borehole wall and between well casings for nested wells to create a sanitary seal between the well screen and the ground surface (minimum thickness of 20 feet).[2] In some cases (for example, dual-screened wells where the well screens will be operated independently), annular seals might also need to be placed between well screens. Fluid sealing material will be emplaced using a tremie pipe installed within the drill casing so that the material is introduced near the bottom of the interval to be sealed and standing water is displaced upward. Like installing the filter pack, granular sealing material will be placed using a tremie pipe, which may include the drill casing depending on the drilling method. Following is a list of sealing materials that may be used at the Topock site:

- **Neat cement**. Composed entirely of Type II/V Portland cement grout with up to 6 percent bentonite powder.
- **Sand-cement grout.** Composed of Portland cement with no more than two parts sand to one part cement by weight of sand.
- **Concrete.** Composed of Portland cement and aggregated mixed at a ratio of at least 564 pounds of cement per cubic yard of aggregate. Aggregate used must be smaller than one-fifth of the radial thickness of the annular seal and is typically reserved for large volume/diameter borehole or well decommissioning.
- **Bentonite clay.** Composed of commercially prepared, powdered, granulated, pelletized, or chipped/crushed sodium montmorillonite clay with the largest dimension of pellet or chip being less than one-fifth the radial thickness of the annular seal. Bentonite cannot be used as a sealing material opposite zones of fractured rock, unless otherwise approved by lead agencies. Because bentonite seals may have a tendency to dry, shrink, and crack in arid and semi-arid areas where subsurface moisture levels can be low, they are not recommended for sealing the vadose zone at the Topock site. Bentonite is not a preferred material for sealing injection well screens because high injection pressures could cause the material to migrate within the borehole. Bentonite is additionally not recommended for application in high TDS environments (>5,000 parts per million) because of the adverse effects on its ability to properly swell and seal in these conditions.

According to California well standards, drilling mud or cuttings are not acceptable sealing materials.

Water used to prepare sealing materials should generally be of potable quality, compatible with the type of sealing material used, and free of contaminants and suspended matter. Manufacturers' specifications for mixture volumes and curing times will be strictly followed (typically, ASTM International [ASTM] C150,

[2] If a well is designed so that the screened interval is exceptionally shallow and 20 feet of surface seal is not technically practicable, the surface seal depth will be maximized given the depth of the screen.

Standard Specification for Portland cement). Further, the use of any additives must comply with the requirements of ASTM C494 (Standard Specification for Chemical Admixtures for Concrete).

During installation of seal material, verification of the volume of the material placed in the well or borehole will be compared to the calculated volume of the borehole annulus, which should be at least equal to the calculated volume of void space to be sealed.

Well Development. Following construction, each well will be developed using a combination of bailing, surging, and pumping to remove fluids introduced during drilling and sediment that accumulates in the well during installation and to develop the hydraulic connection between the well screen, filter pack, and the formation. Generally, extraction and injection wells will be developed using a combination of dual-swab airlift and pumping. During select stages of pumping, purged water will be allowed to surge back into the well such that the filter pack is stressed with positive and negative hydraulic head conditions. Monitoring well development will be conducted using a combination of bailing, surging (for example, with a surge block) and pumping. Water storage tanks will be used during development, as detailed in Section 3.2.1.

Typically, development of extraction/injection wells will initially be conducted using the drill rig to airlift the well (though this is dependent on the drilling method used to construct the well). The purpose of this initial development step is to remove the majority of drilling fluid and fines from the filter pack and adjacent formation, and to settle the filter pack material prior to setting the upper well seals. Sand content, turbidity, and level of filter pack material, are the primary field measurements collected during the initial development. When stability is reached, initial development is ended and the well seal is set. After extraction/injection well construction is complete, a well service rig (“pump rig”) is used to finish development using a combination of surging and/or jetting, bailing and pumping. The purpose of this phase of development is to organize the filter pack material, further remove fines, and establish efficient hydraulic connection between the well screen, filter pack, and the formation. This phase of development is iterative, and the recharge rates between these steps, sand content in the effluent during each step, and trends in the specific capacity of the well during pumping are monitored as primary indications of well development progress. Field water quality measurements will be monitored on the pump effluent at the surface (for example, specific conductance, pH, oxidation-reduction potential, etc.) during pumping. The well will be considered developed (that is, ready for subsequent hydraulic testing and/or sample collection) when turbidity measurements are low and stable (typically 50 nephelometric turbidity units or less), specific capacity is stable, and the well is yielding groundwater that exhibits water quality measurements indicative of aquifer conditions as compared to the water used for drilling.

Overall, the process for monitoring well development is simpler than for the remediation wells, primarily because of the difference in the type of screen (slotted PVC vs. wire-wrapped stainless steel) and is typically performed using a well service rig; however, some monitoring well pump development might be conducted using electric submersible pumps installed by hand. As previously detailed for the extraction and injection wells, field water quality measurements will be monitored to determine when development is complete.

Commercially available, dilute chemical additives that are typically used in constructing or rehabilitating potable water wells that might be used during well development to enhance well performance. Well development additives used will be compliant with NSF/ANSI *Standard 60: Drinking Water Treatment Chemicals – Health Effects*. The function of some example well development additives and the example ingredients are included in Exhibit 3.2-3.

EXHIBIT 3.2-3
Example Additives that Might be Used During Well Development
Groundwater Remedy Construction/Remedial Action Work Plan
PG&E Topock Compressor Station, Needles, California

Additive Function	Example Ingredients	Ingredient Percent/Weight	Example Trade Name
Acids to remove mineral deposits	Phosphoric acid	60-85%	NuWell 120
Oxidizing agent to disinfect/degrade biofilms	Hydrogen peroxide, bleach	--	--
Dispersants	Anionic polyacrylamide	60-100%	Aqua-clear PFD, NuWell 220
Biocides to inhibit bio growth	Acetic acid	--	--
Physical agitation	Carbon dioxide, nitrogen	--	--
Chelating agents to aid acid/disinfectant penetration	Citric acid	--	--

Well Surface Completion and Instrumentation. Surface completions for constructed wells are detailed in the generalized well design drawings included in Appendix D of the 90% BOD Report and will generally consist of subsurface well vaults, unless siting conditions require an aboveground, steel, locking wellhead monument (for example, wells installed in the channel of an active wash). Excavation to facilitate installation of the well vaults will be conducted with either hand tools or mechanical equipment (backhoe), depending on the required size of the excavation and the type of material being excavated. The subsurface well vault will be set in a concrete pad that is sized proportionally to the given well vault, and each vault will be equipped with an appropriate cover or lid. Wells inside the vault will be equipped with water-tight well seals to prevent surface water from entering the wells if the vaults fill with water. For aboveground completions, the wellhead monument completion will be placed over the casing and cap and seated in a concrete collar that extends 5 to 10 feet bgs so that the well is anchored during flow events in the wash channel.

Following construction, development, and testing (as conducted, see Section 3.2.1.5), downhole instrumentation and equipment required for a given well will be installed. For extraction and injection wells, this will include equipment such as pumps, access pipes, well maintenance infrastructure, and packers, which will be installed with a well service rig or similar equipment. The downhole equipment that will be installed in monitoring wells will only include pressure transducers or small-diameter pumps, as determined necessary, which are installed by hand.

3.2.1.5 Well Testing

Extraction and injection wells will be tested following construction and development to evaluate baseline well performance, which is necessary for tracking and troubleshooting performance degradation during remedy operation. The types of testing that will be conducted include in-well surveys (for example, video, flow logging, etc.), specific capacity/injectivity testing, water quality testing, and constant-rate extraction tests at select locations to confirm actual aquifer properties relative to the assumptions used in the groundwater model. As with data collected from the pilot boreholes to support well construction, well testing data will be collected following well construction to support decisions regarding whether adding or reducing wells is needed to properly construct the remedy well network. The results of well testing will continuously be compared to existing data that comprise the conceptual site model. Consistent with Section 4.1.1 of the O&M Manual (Volume 1) for the groundwater remedy, this section details the types of data that will be collected and the collection methods.

Following development, specific capacity and injectivity testing will be conducted at extraction and injection wells so that baseline specific capacity/injectivity can be evaluated. Typically, the testing will include evaluation of specific capacity/injectivity at flow increments of approximately 50, 100, and 150 percent of the design extraction or injection rate. These tests will typically be conducted over a 2- to 12-hour period depending on the performance of the well, and the water level in the pumping well will be monitored using pressure transducers. Field water quality measurements will be monitored on the pump effluent at the surface (for example, specific conductance, pH, and oxidation-reduction potential) during testing. Equipment for these tests will be similar to that identified for well development and include a well service rig and water storage tanks. In most cases, these tests will be conducted immediately after well development is complete, using the same equipment. Water that is purged and stored in tanks during well testing will be used for injection testing, as practicable, and this water will be pumped through a filter to remove particulate matter prior to reinjection.

Constant-rate extraction tests will be conducted to evaluate well performance and to refine the understanding of aquifer hydraulics in areas where these types of data are limited (the northern end of the floodplain, TWB, freshwater injection well FW-2, and uplands wells IRL-1 and IRL-4). In addition to constant-rate tests in these areas, data collected during well construction/development and specific capacity/injectivity testing might indicate that additional constant-rate tests would be beneficial in the context of estimating remedy performance. For example, if specific capacity testing indicate a significantly lower flow than that currently estimated at an extraction well, a constant-rate test might be conducted to understand if a lower extraction rate will still achieve well objectives. At the other extreme, if well capacity is much higher than that currently estimated, then data from a constant-rate test would be used to determine whether additional extraction is required to achieve well objectives. These constant-rate test data are not as important for injection wells, for which the objective is to inject a specific volume of water or carbon substrate and there is no capture metric. While excess injection capacity is not problematic for remedy operation, if injection capacity is low or marginal, then an additional well might need to be installed.

The duration of constant-rate tests are estimated to range from 6 to 12 hours when assessing well performance and up to 48 to 72 hours for tests designed to determine larger-scale aquifer hydraulics (i.e., transmissivity, specific yield, and hydraulic conductivity). Constant-rate aquifer tests will generally require the same equipment as tests detailed for the specific capacity and injectivity, but water levels several adjacent observation wells will be monitored using pressure transducers (typically, this will include wells within an approximate 500-foot radius of the pumping well, but could include wells further away, depending on the test flow rate). For this reason, to obtain the most complete data set, constant-rate tests will typically be conducted after all of the planned wells for a given area are constructed and developed. Field water quality measurements will be monitored on the pump effluent at the surface (for example, specific conductance, pH, and oxidation-reduction potential) during constant-rate testing. Hydraulic data collected during constant-rate tests might require correction using the U.S. Geological Survey deconvolution software (Halford, et al. 2012) to filter out the influence of river and barometric fluctuations.

In addition to the constant-rate testing, flow logging can be a useful element of the baseline evaluation for wells that are constructed with screen intervals greater than approximately 75 feet long. Spinner logging, the most common method of flow logging, measures the contribution of groundwater flow into the well from various depth intervals of screen. Measurements of vertical flow velocities are collected under dynamic (pumping/injection) conditions and analyzed to develop a flow profile. Other methods of flow logging that have been conducted as part of the Topock Remediation Project and that will be considered for use during well testing include hydrophysics and dye-pulse logging. Each of these methods require primary equipment similar to methods identified for well development and include a well service rig and water storage tanks.

3.2.2 Piping and Utilities

This section describes the typical methods that are anticipated for construction of the remedy piping, stormwater drainage piping, electrical distribution systems, and communications systems. These piping and conduit systems will connect together different components of the remedy system such as wells and building. The design contains five typical configurations for these systems:

- **Direct burial.** Pipes, conduits, and/or wires are placed in an excavated trench so they are in direct contact with the ground, earthen backfill, and/or concrete encasement.
- **Concrete trenches.** Typically made of precast concrete, box-like concrete trenches are placed in an excavated trench and joined to make a continuous trench, and then the pipes, conduits, and/or wires are placed in the concrete trenches. Alternatively, concrete trenches may also be cast-in-place.
- **Trenchless technologies.** An underground hole is created to install a carrier pipe under the ground and then pipes, conduits, and/or wires pulled through the carrier pipe.
- **Installed above ground.** In this instance pipes, conduits, and/or wires are installed close to or above the ground surface and are often attached to other structures for support.
- **Installed on pipe bridges.** Also an aboveground option, the pipes, conduits, and/or wires are installed high above the ground on bridges.

Piping and utility systems are often installed sequentially from one end of the pipe to the other. However, the number and location of work sites and crews for a given pipeline will vary over time based on site-specific factors. Some of these factors are equipment availability, market rates, employee skillsets, construction schedule, the size/structure/scope of the construction contract(s), and site conditions encountered in the field. The typical methods and equipment associated with each configuration are discussed in the following sections.

3.2.2.1 Direct Burial

The steps to install this configuration include excavating a trench, installing materials in the trench, and backfilling the trench with earthen materials and/or concrete.

Excavation. The trenches will be excavated primarily with construction equipment. Soil removed from the trench, known as spoils, will be placed alongside the trench (on the ground and/or in bins) and/or loaded directly into haul vehicles. Haul vehicles may include pickup trucks, flatbed trucks, bin transport trucks, scrapers, bucket loaders, or dump trucks, all of which are typically used for this type of work. When placed next to the trench the spoil will be far enough away from the edge so as not to cause cave-in of the excavation. Where space is limited and/or spoil requires processing, spoil will be loaded into haul vehicles and transported to one or more soil storage sites. If applicable and where required, topsoil will be segregated from other soil and saved. Excavated soil that can be reused as backfill material will be segregated and stored/stockpiled onsite until backfilling. Similarly, any pavement will be segregated from the soil as required and managed. Refer for the Soil Management Plan in Appendix L of this C/RAWP for more detailed information about soil management.

Methods such as sloping, benching, and/or shoring may be required to prevent the trench walls from caving in and allow construction to proceed in a safe manner and to comply with governmental regulations. Steps to prevent trench walls from collapsing are most often employed on trenches with depth greater than 4 feet. With sloping, the angle of the trench side walls are reduced from 90 degrees to near 45 degrees or flatter while benching involves cutting one or more horizontal steps into the trench walls. Shoring involves installing metal or wooden structures in the trench to support the trench walls. Shoring is usually moved as the excavation progresses. The contractor(s) will select and implement the method used to prevent trench cave-ins and that selection will meet regulatory construction safety requirements.

Handwork, that is workers using hand tools, may be required to shape or groom the trench. Hand work, as well as soft dig methods, may also be required when trenching near existing underground utilities. Soft dig techniques include hydrovacuum excavation, and air lancing. With hydrovacuuming the soil is loosened by spraying the ground with high-pressure water. The loose soil and water is then vacuumed into a truck for transport and disposal. The hydrovacuum spoils are generally placed in a containment area, allowed to dry, and moved to designated soil management areas. Air-lancing is similar to hydrovacuuming, except that high-pressure air is used to loosen the soil.

Install System Components. Construction material will be hauled to the work area, staged alongside the trenches, and installed in the trench using construction equipment and handwork. The trench bottom will be covered with a compacted bedding material, typically sand, to provide a firm rock-free layer on which to install piping and conduit. If the trench bottom itself is too soft, wet, and/or unstable to allow construction, the trench will be over-excavated and backfilled with stabilization material before placing the bedding material. Stabilization material is typically gravel, rock, crushed rock, or other gravelly soil. An alternative to stabilization is to redesign the pipe.

Lengths of pipe and conduit will be joined together, lowered into the trench, and placed on the bedding material. The lengths of pipe and conduit may be connected together either before or after being placed in the trench. Joining methods depend on the material specified and could include pushing together bell-and-spigot-type pipe ends, solvent welding, fusion welding, metal welding, mechanically restrained connections, valves, or pipe penetrations. Piping and conduits may also be placed on cradles, blocks, or other temporary supports in the trench. The joining methods will generally be in accordance with the pipe/conduit manufacturer's installation recommendations. The piping and conduit will then be covered with pipe zone material, usually concrete or compacted sand, which is designed to protect the piping/conduits from damage during backfilling. A locating wire may be attached to the top of nonmetallic pipes or conduit before placing pipe zone material. Marking materials, such as tape, tracer wire, and/or concrete, are placed on the pipe zone fill. Concrete used to encase or mark electrical conduit is generally dyed red in accordance with standard industry safety practices and project design criteria.

Pipes will be leak-tested before being placed into service. The testing will generally involve flushing the pipe, filling the pipe with water, pressurizing the pipe in one or more stages, and then measuring pressure loss over time. The testing procedures will comply with standard industry guidelines. The pipelines may be tested before, during, and/or after backfilling, and pipelines may be tested in sections and/or over the full pipe length. Water used for flushing and testing will be disposed of in accordance with applicable permits, laws, and regulations. Potential water disposal locations include IM-3, TCS evaporation ponds, and/or offsite disposal. Refer to Section 4 for water management. Electrical and communication conduits will be tested by running a mandrel between some or all manholes. The wires and conductors pulled through the conduits will be tested for continuity.

Backfill and Finish Grading. After installing the system components, the trench will be backfilled and compacted using construction equipment. Typical backfill materials are compacted select fill or concrete. Select fill is a general fill soil whose gradation meets a specified maximum particle size. Wherever the spoils stockpiled alongside the trench and/or in bins meets requirements it will be placed directly back in the trench as backfill. Or the select fill will be created by processing the spoils or other on-site soil, or importing soil. The backfill will be placed in lifts and compacted with equipment to meet project requirements. Compaction will be periodically tested as specified. The backfill is placed to create a surface that matches or is mounded slightly higher than the adjacent ground surface. The backfill soil will be graded to blend into the adjacent ground surface and stabilized. Trenches through asphalt concrete pavement (ACP) are typically topped with the same ACP.

Vaults, Valves, and Other Components. Vaults, hand holes, pull boxes, valves, anodes, and other components associated with the pipelines and conduits are typically installed as part of the backfill operation. Generally located below ground, these components are installed by excavating a hole and placing the component in the hole on bedding and/or stabilization materials. The excavation may be created by widening the trench where the component will be installed in-line with piping or conduit). Backfill is then placed around the component as described in the previous paragraph. Although these components are discussed in the direct burial section, the may be used for other methods and facilities described in this section.

Additional Measures to Operate in Constrained Work Zones. Additional construction measures may be required to operate in locations where the primary work zones and/or access routes are of limited size due to existing facilities or other constraints. When size is limited by existing facilities, including utilities, temporary structures such as wood cribbing, underpinning, and/or shoring may be installed to temporarily reinforce or support the existing facilities. In some locations, such as the uplands, temporary "jumper" pipes, or conduits, may be installed during construction to temporarily reroute existing utilities (to include IM-3 piping). Rerouting may be needed to protect existing utilities from nearby construction activities or to clear an area into which new facilities can be installed. The jumper pipes and/or conduits will generally tie into the existing utilities at two locations, be installed on the ground surface, and be placed in a location that avoids construction activities and is protective of cultural and natural resources.

In areas such as the uplands and the flood plain, the work zones may be very narrow to protect adjacent cultural and biological resources. This may result in very little working space in which to operate equipment, stage materials, and place spoils. Measures to cope with this may include reducing trench widths to provide more usable space or prohibiting equipment/vehicles from passing through the work zone or beside the trench. If the latter measure is employed, excavation equipment would load spoils directly into a nearby haul vehicle for transport to a soil management area. A material haling vehicle would then move into the space vacated by the spoil-hauling vehicle. The excavator would then offload backfill and/or piping materials from the vehicle and install them in the trench. After competing installation, the excavation equipment could then forward along the pipe alignment, excavate more trench, and start the cycle again. Although these additional measures are discussed here in the direct burial section, the measures may be used for any of the construction methods described in this section.

Construction Equipment. The types and anticipated numbers of equipment typically used to construct this configuration are listed below in Exhibit 3.2-4. The activities in which each piece of equipment is typically involved is designated by an "X" in the column for a given activity.

EXHIBIT 3.2-4
Typical Construction Equipment for Trench and Backfill[a]
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Equipment	Excavate Trench	Install System	Backfill and F. Grading	Typical Make/Model	Estimated Number
Excavator (w/hoe-ram)	X	X	X	CAT 330	~2 per trench
Backhoe	X	X	X	CAT 430	~2 per trench
Trenching machine	X			Ditchwitch RT120	~1 per trench
Scraper (standard push)	X		X	CAT 621	~2 per trench
Scraper (twin engine)	X		X	CAT 627	~1 per trench
Bulldozer (w/rippers)	X		X	CAT D8	~1 per trench
Vacuum/soft dig truck	X			Presvac Hydrovac	~1 per trench
Dump/haul truck	X	X	X	CAT CT660	~3 per trench
Dump trailer (w/tractor truck)	X	X	X	DynaHauler	~3 per trench
Water truck	X	X	X	1,000 to 4,000 gal	~3 per trench
Articulated dump/haul truck	X	X	X	CAT 730	~2 per trench
Front end loader	X	X	X	CAT 966	~1 per trench
Walk-behind soil compactor			X	Wacker DPU 130 or DS 70	~2 per trench
Soil compactor			X	CAT 815	~1 per trench

EXHIBIT 3.2-4
Typical Construction Equipment for Trench and Backfill[a]
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Equipment	Excavate Trench	Install System	Backfill and F. Grading	Typical Make/Model	Estimated Number
Rough terrain/telescopic fork lift		X		SkyTrak 4290	~2 per trench
Concrete truck		X	X	McNeilus Standard Mixer	~2 per trench
Concrete pump truck w/boom		X	X	Putzmeister 28Z	~1 per trench
Boom/crane truck		X		National Crane 1400H	~1 per trench
Road grader			X	CAT 120	~1 per trench
Pipe laying machine		X		CAT PL61	~1 per trench
Pipe welding machine		X		McElroy 412 or 618	~1 per pipe material
Fuel/grease truck	X	X	X	Oilmen's AL44	~1 per trench
Mechanics truck	X	X	X	Knapheide KMT2	~1 per trench
Pickup and support trucks	X	X	X	Ford 250	~3 per trench

Note:

[a] The equipment listed in this table are typical. The equipment actually used during construction will be selected by the construction contractor based on project-specific factors.

3.2.2.2 Concrete Trench

The steps to install this configuration include excavating a trench, placing prefabricated sections of concrete trench in the excavated trench on bedding materials, backfilling around the concrete, installing piping, conduits, and/or wires in the concrete trenches, and covering the trenches with lids. Alternatively, the concrete trenches may be cast-in-place. Certain pipelines will make side-by-side use of both the prefabricated concrete trench and direct bury methods.

Excavation. The trenches will be excavated in largely the same manner as described in Section 3.2.2.1.

Install Concrete Trenches. Box-like sections of concrete trench will be placed into the excavation using construction equipment. The sections will likely be precast at an offsite location and delivered to the site. Before placing the sections, the trench bottom will bedded and stabilized largely as described in Section 3.2.2.1. Construction equipment will be used to lift the concrete pieces and set them down in the trenches. Smaller sections will be picked and placed as a single unit. Larger sections may require that pieces be placed in trench and assembled by hand. The concrete sections and pieces maybe joined mechanically, welded, and/or with sealants. The sections may be stored onsite, staged near the trench, and/or offloaded directly from haul vehicles.

The construction method will be slightly different when the concrete trenches are cast-in-place. After completing, excavation wood or metal forms will be installed in the trench to form the edges of the concrete trenches. Reinforcing steel may also be placed in the trenches. Concrete will be placed into trenches and forms using concrete trucks or pumped using concrete pumps. The concrete will be vibrated into place, finished per specified requirements, and allowed to cure.

Install System Components. System components will be transported to and installed in the concrete trenches primarily using construction equipment and handwork. The pipes and conduits will be installed and tested in largely the same manner as described in Section 3.2.2.1. However, no pipe zone materials will be required in this method because the concrete trenches will protect the piping.

Backfill and Finish Grading. Before, during, and/or after component installation, the gap between the concrete trench and the excavation will be backfilled and compacted with construction equipment. The backfilling and finish grading will be performed in largely the same manner as described in Section 3.2.2.1. Prefabricated lids will be placed over the concrete trenches using construction equipment. The lids may be left exposed or covered with backfill.

Construction Equipment. The types and anticipated numbers of equipment typically used to construct this configuration are listed in Exhibit 3.2-5. The activities in which each piece of equipment is typically involved is designated by an "X" in the column for a given activity.

EXHIBIT 3.2-5
Typical Construction Equipment for Concrete Trench[a]
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Equipment	Excavate Trench	Install Concrete Trench	Install System	Backfill and F. Grading	Typical Make/Model	Estimated Number
Excavator (w/hoe-ram)	X	X	X	X	CAT 330	~2 per trench
Backhoe	X	X	X	X	CAT 430	~2 per trench
Trenching machine	X				Ditchwitch RT120	~1 per trench
Scraper (standard push)	X			X	CAT 621	~2 per trench
Scraper (twin engine)	X			X	CAT 627	~1 per trench
Bulldozer (w/rippers)	X			X	CAT D8	~1 per trench
Vacuum/soft dig truck	X				Presvac Hydrovac	~1 per trench
Dump/haul truck	X	X	X	X	CAT CT660	~3 per trench
Water truck	X		X	X	1,000 to 4,000 gal	~3 per trench
Articulated dump/haul truck	X	X	X	X	CAT 730	~2 per trench
Front end loader	X	X	X	X	CAT 966	~1 per trench
Concrete truck		X			McNeilus Standard Mixer	~1-2 per trench
Concrete truck pump w/ boom		X			Putzmeister 28Z	~1 per trench
Walk-behind soil compactors		X		X	Wacker DPU 130 or DS 70	~2 per trench
Rough terrain/telescopic fork lift		X	X		SkyTrak 4290	~2 per trench
Boom/crane truck		X	X		National Crane 1400 H	~1 per trench
Crane		X			Manitowoc Grove GMK4114L	~1 per trench
Road grader				X	CAT 120	~1 per trench
Pipe laying machine			X		CAT PL61	~1 per trench
Pipe welding machine			X		McElroy 412 or 618	~1 per pipe material
Fuel/grease truck	X	X	X	X	Oilmen's AL44	~1 per trench
Mechanics truck	X	X	X	X	Knapheide KMT2	~1 per trench
Pickup and support trucks	X	X	X	X	Ford 250	~3 per trench

Note:
[a] The equipment listed in this table are typical. The equipment actually used during construction will be selected by the construction contractor based on project-specific factors.

3.2.2.3 Trenchless Technology

Trenchless technologies such as horizontal directional drilling (HDD), horizontal-auger boring, microtunneling, and conventional tunneling may also be used to construct the remedy. Methods will be chosen based on the type of system being installed and the anticipated ground conditions. These construction techniques achieve very similar results, which is to construct a hole under the ground, install a carrier pipe in the hole, and pull the system components through the carrier pipe.

Horizontal Directional Drilling. This method consists of preparing launching and receiving sites, drilling a pilot hole, reaming, installing the pipes and utilities, and stabilizing the site.

Site Preparation. The launching and receiving sites will be prepared with construction equipment before starting drilling operations. At the launch site, a pit or an earthen platform may be constructed to provide a stable working platform for the drill rig and facilitate future pipe connections. Shoring, sloping, and or benching may be required to maintain stability of the earthen walls that form the pit. The launch pit will contain drilling mud that exits the borehole, provide work space to change bits, and facilitate future pipe connections. The ground around the launch site may be cleared and/or graded to provide adequate room to lay out materials, setup support vehicles, and perform the work. Materials that may be staged at the site include bags of (dry) drilling mud, drill steel, tools, piping, and spoil.

A pit will also be dug at the receiving site. The receiving pit will contain drilling mud that may exit the borehole, provide work space to change bits, and facilitate future pipe connections. Piping may be staged at either the launching or receiving pits. Temporary fencing and signs may be installed around the launching and receiving areas.

Drilling. A relatively small-diameter pilot hole will be drilled along the design alignment using mud rotary methods. A drilling mud slurry will be pumped into the hole as the drill bit cuts into the soil. Predominantly a mix of water, bentonite, and other drilling admixtures, this mud will carry spoil cuttings out of the hole and ultimately into a mud recycling system. The mud will also form a cake around the borehole walls that will help prevent the hole from collapsing. The recycling system will remove cuttings from the mud so the mud may be pumped back into the hole for reuse. The cuttings would be drained by the HDD contractor and managed in accordance with the Soil Management Plan presented in Appendix L to this C/RAWP. The recycling system may be truck- and/or trailer-mounted and may be augmented with pits dug into the ground. The drilling contractor will monitor progress using instrumentation in the drill rig and drill bit. The contractor will also measure mud quantity during the operation and observe the surface to look for signs that the mud is percolating upward through the soil and emerging at the ground surface.

Reaming. After reaching the receiving pit, the borehole will be enlarged by reaming. In the receiving pit, the drill bit will be swapped out for a reaming bit. The reaming bit will enlarge the borehole as it is pulled back through the pilot hole. This may require more than one pass and/or more than one bit to reach the required diameter.

Install Carrier Pipe and System Components. After the reaming is completed, a pipe will be attached to the drill pipe and pulled through the borehole by the drill rig. This may be done from either side of the hole based on site conditions. This pulled pipe may be the remedy pipe/conduit itself or it may be a carrier pipe. If the latter, the drill rig and ropes/cables will be used to pull the remedy pipes/conduits through the carrier pipe, and other equipment may assist. Eventually, the pipes/conduit ends sticking out of the hole will be connected to the rest of the pipeline on either side of the hole. These connections may be completed quite some time after the trenchless installation is complete. The connections will be made and tested in accordance with manufacturer’s recommendations as described in Section 3.2.2.1.

Backfill and Finish Grading. After completing installation, the site will be left in a stable condition to support future construction operations. Drilling mud, spoil, and other materials will be removed, and the ground surface will be left in a condition that does not promote the release of fugitive dust. If the piping and conduit connections are made immediately after completing drilling, the launch and receiving pits will be backfilled. If, however, the piping/conduit connections are made an extended time after drilling, the pits may be left open or partially backfilled and the end of the pipe marked to avoid the need to backfill an area only to re-excavate it in the future. In that case, fences, signs, regular inspections, and other measures would be considered to address any potential safety concerns.

Construction Equipment. The types and anticipated numbers of equipment typically used to implement this method are listed in Exhibit 3.2-6. The activities in which each piece of equipment is typically involved is designated by an "X" in the column for a given activity.

EXHIBIT 3.2-6
Typical Construction Equipment for Horizontal Directional Drilling[a]
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Equipment	Site Preparation	Drilling - Reaming	Install System	Backfill and F. Grading	Typical Make/Model	Estimated Number
Excavator (w/hoe-ram)	X		X	X	CAT 330	~1 per pipe
Backhoe	X		X	X	CAT 430	~1 per pipe
Vacuum/soft dig truck	X				Prevac Hydrovac	~1 per pipe
Dump/haul truck	X			X	CAT CT660	~1 per pipe
Water truck	X	X	X	X	1,00 to 3,000 gal	~1 per pipe
Front end loader	X	X	X	X	CAT 966	~1 per pipe
Rough terrain/telescopic fork lift	X	X	X	X	SkyTrak 4290	~1 per pipe
Boom/crane truck	X	X	X	X	National Crane 1400H	~1 per pipe
Drill rig		X	X		DitchWitch JT100 Mach 1	~1 per pipe
Drill rig transport vehicle		X		X	Tractor trailers	~1 per rig
Mud recycling truck/trailer		X			American Augers MCM-4000	~1 per rig
Pipe welding machine			X		McElroy 412 or 618	~1 per pipe material
Fuel/grease truck	X	X	X	X	Oilmen's AL44	~1 per trench
Mechanics truck	X	X	X	X	Knapheide KMT2	~1 per trench
Pickup and support trucks	X	X	X	X	Ford 250	~3 per trench

Note:

[a] The equipment listed in this table are typical. The equipment actually used during construction will be selected by the construction contractor based on project-specific factors.

Horizontal Auger Boring. This method, also called jack-and-bore, consists of preparing driving and receiving sites, boring while simultaneously advancing a casing pipe, and installing pipes and utilities in the casing/carrier pipe.

Site Preparation. The driving and receiving sites will be built with construction equipment before starting boring operations. A driving pit will be dug to allow installation of the pipe and conduit at the correct elevation and to provide a reaction surface against which the boring machine can push. The boring machine will be lifted from a haul vehicle, placed into the pit, and braced against the back wall of the drive pit. Shoring, sloping, and or benching may be required to maintain earthen wall stability in the pit. The ground around the launch pit may be cleared and/or graded to provide adequate room to layout materials, setup support vehicles, and perform the work. Materials that may be staged at the site include auger flights, tools, piping, and spoil. A pit will also be dug at the receiving site. The receiving pit will provide work space to facilitate future pipe connections. Piping may be staged at either the launching or receiving pits. Temporary fencing and signs may be installed around the launching and receiving areas.

Boring and Casing Installation. The boring machine will advance auger flights and a steel casing pipe into the ground along the proposed pipe alignment. As the bit cuts into the ground, spoil will be removed from the hole by the auger flights. The augers and casing pipe will be advanced simultaneously into the ground as a single unit. Soil will be removed from the casing by the helical auger flights and will be removed from the drive pit using construction equipment and stockpiled. Additional lengths of pipe will be lowered into the driving pit and welded onto the carrier pipe as needed to advance the bore.

Install System Components. After boring is complete, the ends of the casing pipe will be cut and will serve as a carrier pipe for the remedy pipe/conduit. The boring machine and other equipment will use ropes, cables, or drill steel to pull the remedy pipes/conduits through the carrier pipe. Eventually, the pipes and conduit ends sticking out of the hole will be connected to the rest of the pipelines and conduit will run on either side of the hole. These connections may be made an extended period of time after the trenchless installation is complete. The connections will be made and testing performed in accordance with manufacturer’s recommendations as described in Section 3.2.2.1.

Backfill and Finish Grading. After completing installation, the site will be left in a stable condition to support future construction operations. Spoil and other materials will be removed, and the ground surface will be left in a condition that does not promote the release of fugitive dust. If the piping and conduit connections are made immediately after completing boring, the drive and receiving pits will be backfilled. If, however, the piping and conduit connections are made an extended period of time after boring, the pits may be left open or partially backfilled and the end of the pipe marked to avoid the need to backfill an area only to re-excavate it in the future. In that case, fences, signs, regular inspections, and other measures would be considered to address any potential safety concerns.

Construction Equipment. The types and anticipated numbers of equipment typically used to implement this method are listed in Exhibit 3.2-7 The activities in which each piece of equipment is typically involved is designated by an “X” in the column for a given activity.

EXHIBIT 3.2-7
Typical Construction Equipment for Horizontal Auger Boring[a]
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Equipment	Site Preparation	Boring	Install System	Backfill and F. Grading	Typical Make/Model	Estimated Number
Excavator (w/hoe-ram)	X	X	X	X	CAT 330	~1 per pipe
Backhoe	X	X	X	X	CAT 430	~1 per pipe
Vacuum/soft dig truck	X				Prevac Hydrovac	~1 per pipe
Dump/haul truck	X	X		X	CAT CT660	~1 per pipe
Water truck	X	X	X	X	1,00 to 3,000 gal	~1 per pipe
Front end loader	X	X	X	X	CAT 966	~1 per pipe
Rough terrain/extendable fork lift	X	X	X	X	SkyTrak 4290	~1 per pipe
Boom/crane truck	X	X	X	X	National Crane 1400H	~1 per pipe
Auger boring machine		X	X		Robbinx ABM 72-1500	~1 per pipe
Auger boring machine transport vehicle		X		X	Tractor Trailer	~1 per rig
Crane	X	X		X	Manitowoc Grove GMK4114L	~1 per rig
Pipe welding machine			X		McElroy 412 or 618	~1 per pipe material
Fuel/grease truck	X	X	X	X	Oilmen’s AL44	~1 per trench
Mechanics truck	X	X	X	X	Knapheide KMT2	~1 per trench
Pickup and support trucks	X	X	X	X	Ford 250	~3 per trench

EXHIBIT 3.2-7

Typical Construction Equipment for Horizontal Auger Boring[a]

Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Equipment	Site Preparation	Boring	Install System	Backfill and F. Grading	Typical Make/Model	Estimated Number

Note:

[a] The equipment listed in this table are typical. The equipment actually used during construction will be selected by the construction contractor based on project-specific factors.

Microtunneling. Generally, this method would be used when ground conditions are not suitable for HDD or horizontal auger boring. The primary difference between this method and horizontal-auger boring is that microtunneling requires the use of a small remote-controlled tunnel boring machine (TBM) instead of an auger boring machine. Microtunneling consists of preparing launch and receiving sites, tunneling while installing a casing pipe behind the TBM, and installing pipes and utilities in the casing. The casing pipe is installed in sections and may be steel and/or precast concrete. Spoil is removed from the hole by a mud system or a conveyor belt system. Once the casing is in place, the system components are pulled through in the same manner as that for horizontal-auger boring. Except for the TBM substitution, the equipment used for this method is largely the same as discussed for horizontal auger boring.

Conventional Tunneling. Generally, this method would be used when ground conditions are not suitable for HDD, horizontal auger boring, or micro tunneling. The primary difference between this method and microtunneling is that in conventional tunneling, excavation is done by personnel in the hole using hand tools, power tools, and/or heavy equipment. Conventional tunneling consists of preparing the launch and receiving sites, tunneling while installing a casing pipe behind the excavation face, and installing pipes and utilities in the casing. A larger-diameter hole is required to allow workers to enter the hole and access the excavation face. Spoil is removed from the hole using heavy equipment, a conveyor belt system, and/or carts mounted on a light gauge rail system. The hole is supported by a continuous steel or concrete liner as the tunnel is advanced. Once the casing is in place, the system components are pulled through in the same manner as that for prefabricated utility ducts. The equipment used for this method is largely the same as discussed for horizontal auger boring except that a tunneling machine is used in place for a boring machine.

3.2.2.4 Aboveground Piping and Utilities

Methods for installing the system components in this configuration consist of installing pipe support structures, installing the pipes, and coating and labeling the pipes. This configuration is commonly employed when pipes are routed on or inside structures.

Support Structures. Pipe supports will be attached to concrete structures such as floors, footings, pads, walls, and ceilings, or metal features such as columns, beams, or walls. Typical pipe supports will include stanchions, hanger rods, saddles, brackets, clamps, pipe racks/trays, and metal frames (for example, unistrut). Although pipe supports may be embedded in wet concrete, they will generally be installed after the concrete has cured to a sufficient strength. The supports will be attached to anchors and/or bolts that will be drilled into the concrete. When supports, such as stanchions, are placed on concrete pads or floors, a grout pad will usually be provided to level the base plate. Supports attached to metal may be attached using screws, welds, brackets, clamps, and/or bolts. Supports installed at high elevations will require the use of fall protection measures and/or equipment such as manlifts to meet regulatory safety requirements

Pipe/Conduit Installation. The piping and conduit will be connected and installed on the pipe supports. The pieces may be linked together either before, after, or while being placed in the pipe support. Joining methods could include pushing together bell-and-spigot-type pipe ends, solvent welding, fusion welding, metal welding, mechanically restrained connections, valves, or pipe penetrations. The joining methods will be in accordance with the pipe/conduit manufacturer’s installation recommendations.

Pipes will be tested for leakage. The testing will involve flushing the pipe, filling the pipe with water, pressurizing the pipe in one or more stages, and measuring pressure loss over time. The pipelines may be tested before, during, and/or after installation and coating, and pipes may be tested in sections and/or over the full pipe length. Water used for flushing and testing will be disposed of in accordance with applicable permits, laws, and regulations. Electrical and communication conduits may be tested by running a mandrel between some or all manholes. The wires and conductors pulled through the conduits will be tested for continuity.

The installation of Pipeline B, which conveys freshwater, on the L300A (Arched) Bridge over the Colorado River is a special case. Customized roller-type pipe supports will be bolted to the bridge deck. A temporary elevated working platform will be installed to the existing deck beams to allow installation. The 12-inch-diameter pipe will be delivered to the Arizona side or the river, welded together to create 160-foot-long segments (approximate length), and hydrostatically tested. After successful testing, each segment will be lifted onto the pipe supports and welded to the other pipe segments already on the bridge. The pipe will then be pulled west towards California until there is enough room to place another segment onto the bridge and the process repeats itself. This pipeline pulling and welding process will continue until all the pipe is placed on the L300A Bridge. Fabrication, welding, and erection of the piping shall be per ASME B31.3 Code.

Coating and Labeling. Before, during, and/or after installation the piping will be painted or coated to resist corrosion, meet esthetic or architectural standards, and meet process requirements. The piping, conduit, and accessories, such as valves, will be labeled. Labelling will typically identify the purpose of the contents of the pipe, such as potable water, and the direction of flow.

Construction Equipment. The types and anticipated numbers of equipment typically used to implement this method are listed in Exhibit 3.2-8. The activities in which each piece of equipment is typically involved is designated by an “X” in the column for a given activity.

EXHIBIT 3.2-8
Typical Construction Equipment for Above-Ground Piping[a]
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Equipment	Pipe Supports	Pipe and Conduit Installation	Coating and Labeling	Typical Make/Model	Estimated Number
Scaffolding	X	X	X	Not Applicable	~1 per pipe
Man lift/basket	X	X	X	JLG 800AJ or 3394RT	~1 per pipe
Rough terrain/extendable fork lift	X	X	X	SkyTrak 4290	~1 per pipe
Boom/crane truck	X	X	X	National Crane 4290	~1 per pipe
Pipe welding machine		X		McElroy 412 or 618	~1 per pipe
Metal welding machine	X	X		Truck-mounted	~1 per pipe
Pickup and support trucks	X	X	X	Ford 250	~3 per pipe

Note:

[a] The equipment listed in this table are typical. The equipment actually used during construction will be selected by the construction contractor based on project-specific factors.

3.2.2.5 Pipe Bridges

Construction methods for this configuration consist of installing abutment footings, fabricating and assembling the bridge, lifting and installing the bridge, and installing piping and conduit. This configuration is commonly employed over short spans where vertical clearance over the ground, roads, or other utilities is required, and underground configurations are impractical.

Abutment Footings. The bridge abutments will be built by excavating a hole in in the ground and constructing cast-in-place reinforced concrete footings. Construction equipment will be used to dig the hole, and the spoil will be loaded directly into haul vehicles and/or temporarily stockpiled near the excavation. The excavation bottom subgrade will be compacted and may be covered with a compacted layer of coarse-grained soil such as aggregate base, gravel, and/or crushed rock. Reinforcing steel, also known as rebar, will be lowered into the hole and assembled by hand. Metal and/or wood forms will be installed around the excavation to contain concrete in the above-grade portions of the footings. False work and other temporary structures may also be needed to support the concrete until it sets. Ready-mix concrete will be delivered to the site and placed the forms in one or more pours. Concrete pumping equipment may be used to place the concrete in the forms. The concrete will be vibrated into place, finished by hand, and allowed to cure. Curing could take one month or more and may require application of burlap bags, water, and/or sealant sprays. Steel embedment plates and/or bolts may be placed into the concrete to provide points at which to anchor the bridge.

Assembly. The structural steel bridge components will be fabricated at an offsite location and brought to the site for assembly. Fabricating the structural steel at an offsite location will allow the work to occur in a more controlled shop environment. The bridge components and subassemblies will be delivered to the site and placed next to the bridge location for assembly. The components and subassemblies will be linked together by welds, rivets, and/or bolts. Assembly may require grinding, torch cutting, and other miscellaneous tasks.

Lift and Install. Once the entire bridge has been assembled, it will be lifted into place with a crane and attached to the bridge abutments. The bridge will not be lifted until it has been determined that the abutment footings are strong enough to bear the bridge weight, and the bridge itself has been fully assembled and inspected. In addition, the crane must be placed in a location with a firm, stable ground surface that allows ample reach to move and manipulate the bridge. Grading and/or wood cribbing may be required to make the crane level and stable. Tag lines will be attached to the bridges to allow manipulation during the lift. Additional cranes and/or construction equipment may be used to provide more control during the lift. The bridge will be moved into position, lowered onto the abutment footings, and attached to the foundations. Typical anchoring methods include bolting and/or welding the bridge onto bolts or plates that are embedded in the concrete. The grating, handrails, ladders, and other nonstructural portions of the bridge will be installed after the structure is attached.

Pipe Installation. The pipes and conduits that run across the bridges will be installed, coated, labeled, and tested in largely the same manner as described in Section 3.2.2.4.

Construction Equipment. The types and anticipated numbers of equipment typically used to implement this method are listed in Exhibit 3.2-9. The activities in which each piece of equipment is typically involved is designated by an “X” in the column for a given activity.

EXHIBIT 3.2-9
Typical Construction Equipment for Pipe Bridges[a]
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Equipment	Abutment Footings	Assembly	Lift and Install	Pipe and Conduit Installation	Typical Make/Model	Estimated Number
Excavator (w/hoe-ram)	X	X	X		CAT 330	~2 per trench
Backhoe	X	X	X		CAT 430	~2 per trench
Bulldozer (w/rippers)	X		X		CAT D8	~1 per trench
Dump/haul truck	X	X	X		CAT CT660	~3 per trench
Water truck	X	X	X		1,000 to 3,000 gal	~3 per trench

EXHIBIT 3.2-9

Typical Construction Equipment for Pipe Bridges[a]

Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Equipment	Abutment Footings	Assembly	Lift and Install	Pipe and Conduit Installation	Typical Make/Model	Estimated Number
Articulated dump/haul truck	X	X	X		CAT 730	~2 per trench
Front end loader	X	X	X		CAT 966	~1 per trench
Walk-behind soil compactor			X		Wacker DPU 120 or DS 70	~2 per trench
Soil compactor			X		CAT 815	~1 per trench
Rough terrain/telescopic fork lift	X	X			SkyTrak 4290	~2 per trench
Concrete truck	X		X		McNeiulus Standard Mixer	~1 per trench
Concrete pump truck w/boom	X		X		Putzmeister 28Z	~1 per trench
Pipe welding machine		X			McElroy 412 or 618	~1 per pipe material
Fuel/grease truck	X	X	X		Oilmen's AL44	~1 per trench
Mechanics truck	X	X	X		Knapheide KMT2	~1 per trench
Scaffolding	X			X	Not Applicable	~1 per bridge
Man lift/basket	X		X	X	JLG 800AJ or 3394RT	~2 per bridge
Boom/crane truck	X	X	X	X	National Crane 1400H	~2 per bridge
Crane			X		Manitowoc Grove GMK4114L	~1 per bridge
Metal welding machine		X	X	X	Truck-mounted	~1 per bridge
Conduit heater				X	Truck-mounted	~1 per bridge
Pickup and support trucks	X	X	X		Ford 250	~3 per trench

Note:

[a] The equipment listed in this table are typical. The equipment actually used during construction will be selected by the construction contractor based on project-specific factors.

3.2.3 Vertical Infrastructure

This section describes the typical methods and equipment that will be used to construct different elements of the vertical infrastructure associated with the remedy, which includes buildings and other aboveground facilities. Although most of the vertical infrastructure will be at the TCS, TW Bench, MW-20 Bench, or evaporation ponds, there will be some small miscellaneous vertical infrastructure at other locations such as well sites. Vertical infrastructure associated with the Construction HQ is discussed in Section 4 of this C/RAWP.

The infrastructure located inside TCS includes concrete foundations and pads, metal buildings and shade structures, concrete buildings, retaining walls, tanks (both permanent and temporary), pumps and process equipment, transformers and electrical equipment, and heating, ventilation, and air conditioning (HVAC) systems. Construction activities inside TCS will be coordinated with station personnel and will comply with TCS work rules so as to not interfere with station operations.

The infrastructure at the TW Bench includes a septic system with leach field, trenches, concrete masonry unit buildings, fencing, a tank, a retaining wall, and asphalt concrete pavement.

The infrastructure at the MW-20 Bench includes a storage tank with associated concrete pad; a truck-unloading concrete containment pad; a pre-engineered metal building; and associated equipment such as electrical, process, mechanical, etc.

The infrastructure at the existing evaporation ponds includes a small building, new instrumentation and control systems, and modifying pond inlet pipes. The techniques and equipment used for construction will likely be similar to those described for ground piping and vertical infrastructure.

Concrete Foundations and Pads. These elements will be built by excavating holes and trenches in the ground and using cast-in-place reinforced concrete footings. Construction equipment will be used to excavate, and the spoil will be loaded directly into haul vehicles and/or temporarily stockpiled near the excavations. Excavation in hard soil or rock may require special excavation techniques such as road mining, grinding, and/or hoe-ramming. The excavation bottom subgrade will be compacted and may be covered with a compacted layer of coarse-grained soil such as aggregate base, gravel, and/or crushed rock. Reinforcing steel, also known as rebar, will be lowered into the hole and assembled by hand. Metal and/or wood forms will be installed around the excavation to contain concrete in the above-grade portions of the footings. Concrete will be delivered to the site and placed the forms in one or more pours. Concrete pumping equipment may be used to place concrete in forms. The concrete will be vibrated into place, finished by hand, and allowed to cure. Curing could take one month or more and may require application of burlap bags, water, and/or sealant sprays. Steel components, bolts, and/or rebar may protrude from the concrete surface to provide points at which to anchor buildings.

Metal Buildings and Shade Structures. Generally, the structural framing and outer skin of the metal buildings will be prefabricated then assembled onsite. Assembly will begin with the structural framing being attached to the concrete foundations. Structural members can be welded and/or mechanically fastened together (bolted, screwed or riveted). Wall and roof skins will be attached next using mechanical fasteners or, in some case, welding the components. Electrical, plumbing, and HVAC systems will be installed concurrently as erection of the structure progresses. Equipment and piping for the remedy process systems will also be installed concurrently as the various areas are ready for the different components. Finishes, such as paint, hardware, electrical and plumbing fixtures, are generally accomplished later in the process to avoid damages to the exposed components.

Concrete Buildings. These buildings differ from the metal buildings because the structure will be built using concrete rather than steel. Construction of the concrete structure will take place by first installing forms to the shape of the finished structure, placing false work to support the concrete until it sets, and installing the reinforcing steel. Ready mix concrete will be delivered to the site and placed in the forms either by dumping directly out of the truck, or by using a concrete pump in cases where the concrete delivery truck cannot reach the forms with its chutes. Multiple setups and pours will be necessary for the concrete buildings. Once the structure is in place, electrical, plumbing, HVAC, equipment, piping and finishes will be installed in a manner similar to that for the metal buildings. Cranes will also be mounted in the ceiling of the remedy produced water conditioning plant.

Concrete Masonry Unit Buildings. These structures will be built by installing a concrete foundation, after which, walls will be built by stacking and grouting together concrete blocks having open cells or holes. Reinforcing steel will be installed in the cells, and the voids will be filled with concrete or concrete grout. At some locations, building walls may also act as retaining walls against adjacent hillsides. The roof and other systems will be installed after installing the walls in the same manner as described for concrete buildings.

Retaining Walls. Soil retention structures, such as walls, are installed to support steep soil slopes. The slopes are made steep to create more usable space and allow for larger buildings and other structures. When providing space for buildings, the retaining walls may be incorporated into building walls. The retaining walls also may be constructed using cast-in-place concrete with the same methods of layout, excavation, forming, reinforcing, and concrete placement as described for concrete buildings and foundations, or the walls may be constructed of concrete block. Soil will be backfilled behind the retaining walls once the concrete has cured for a specified time.

Steel Tanks. Depending on size, the steel tanks may be completely prefabricated offsite and placed on the foundations as a complete unit, or the tanks may be erected in place from prefabricated or raw components. The tanks are generally cylindrical and will usually be placed on a ring-shaped cast-in-place reinforced concrete footing.

Temporary Tanks. Rectangular portable tanks, commonly known as frac tanks, will also be used. These will be placed on reinforced, cast-in-place concrete foundations designed to provide drainage and secondary containment.

Pumps and Process Equipment. Pumps and other process equipment will be installed on concrete pads. Generally, the equipment and its supports will be attached to the concrete with anchor bolts and grout pads provided to help level the equipment. Piping and electrical wiring connected to the equipment may be aboveground or buried.

Septic System. This system, consisting of a septic tank and leach field, will be installed under the parking lot of the TW Bench. The tanks will be installed by excavating below the ground surface and placing the tanks in the excavation. The leach field will be created by excavating trenches, placing filter geotextile in the trench, and backfilling the trenches with perforated pipe surrounded by gravel.

Transformers and Electrical, Instrumentation, and Communication Equipment. Transformers, cabinets, and other equipment will be installed on concrete pads. Generally, the equipment and/or its supports will be attached to the concrete with anchor bolts and grout pads provided to help level the equipment.

Conduits and raceways will be provided in the structures to carry electrical systems. The insulated electrical wiring will be pulled through conduits and raceways, whether above- or belowground, using hand holes and cable-pulling machines. The pull tension will be monitored while pulling to avoid damage to insulated wires. The wires will be tested to confirm acceptability after installation.

HVAC Equipment. In some cases, the HVAC equipment will be installed on concrete pads adjacent buildings, with pipes and ductwork penetrating the building shell.

Other Vertical Infrastructure. This category includes other miscellaneous vertical infrastructure installed at the site, such as transformers, electrical and communication panels, antennas, lighting, security devices, fencing, and a construction water tank. The techniques and equipment used for construction would be similar to those described in the sections for aboveground piping and vertical infrastructure.

Construction Equipment. The types and anticipated numbers of equipment typically used for vertical construction are listed in Exhibit 3.2-10. The activities in which each piece of equipment is typically involved is designated by an “X” in the column for a given activity.

EXHIBIT 3.2-10
Typical Construction Equipment for Vertical Construction[a]
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Equipment	Concrete Foundations	Metal Buildings	Concrete Buildings	Retaining Walls	Tanks	Install Equipment	Typical Make/Model	Estimated Number
Excavator (w/hoe-ram)	X			X			CAT 330	~2 per bldg.
Backhoe	X			X			CAT 430	~2 per bldg
Bulldozer w/rippers	X			X			CAT D10	~2 per bldg
Vacuum/soft-dig truck	X			X			Presvac Hydrovac	~1 per bldg
Dump/haul truck	X	X	X	X	X	X	CAT CT660	~2 per bldg

EXHIBIT 3.2-10
Typical Construction Equipment for Vertical Construction[a]
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Equipment	Concrete Foundations	Metal Buildings	Concrete Buildings	Retaining Walls	Tanks	Install Equipment	Typical Make/Model	Estimated Number
Water truck	X		X	X			1,000 to 3,000 gal	~2 per bldg
Articulated dump/haul truck	X	X	X	X	X	X	CAT 730	~2 per bldg
Front-end loader	X	X	X	X	X	X	CAT 966	~1 per bldg
Walk-behind soil compactor	X			X			Wacker DPU 130 or DS 70	~2 per bldg
Soil compactor	X			X			CAT 815	~1 per bldg
Rough terrain/telescopic fork lift	X	X	X	X	X	X	SkyTrak 4290	~1 per bldg
Concrete truck	X		X	X			McNeilus Standard Mixer	~5 per bldg
Concrete pump truck w/boom	X		X	X			Putzmeister 28Z	~1 per bldg
Boom/crane truck	X	X	X	X	X	X	National Crane 1400H	~1 per bldg
Crane		X	X		X	X	Manitowoc Grove GMK4114L	~1 per bldg
Man lift/basket		X	X	X	X	X	JLG 800AJ or 3394RT	~2-3 per bldg
Scaffolding		X	X		X	X	Not Applicable	~1-2 per bldg
Pipe welding machine		X	X		X	X	McElroy 412 or 618	~1 per bldg
Fuel/grease truck	X	X	X	X	X	X	Oilmen's AL44	~1 per bldg
Mechanics truck	X	X	X	X	X	X	Knapheide KMT2	~1 per bldg
Metal welding machine		X			X	X	Truck-mounted	~2 per bldg
Pickup and support trucks	X	X	X	X	X	X	Ford 250	~3 per bldg

Note:

[a] The equipment listed in this table are typical. The equipment actually used during construction will be selected by the construction contractor based on project-specific factors.

3.2.4 Site Access Pathways

This section describes the two types of access roads that will be installed as part of the remedy: temporary access roads used for construction and long-term access roads used to regularly operate and maintain the remedy.

3.2.4.1 Temporary Access

Temporary access roads will be provided to allow construction and startup of the remedy system. Generally, the roads will use existing paths or be constructed by clearing a new path to provide a smooth driving surface. Large rocks will be removed from the road alignment and, if necessary, vegetation will be trimmed, cut, and/or cleared. If the existing subgrade soil is soft or loose, it may be reinforced, removed and replaced, or both. Geotextiles, geogrids, steel mats, plastic mats, sand grid, and/or soil stabilizers may be used to reinforce soil. If the soil is removed and replaced, the excavated subgrade soil may be loaded directly into haul vehicles or stockpiled near the excavation for reuse. The replacement soil will generally be a coarse-grained material such as gravel, crushed rock, and/or aggregate base, built and maintained to carry the construction equipment expected on that route. The road surfacing will typically be coarse-grained soil and/or compacted native soil. In certain instances, these temporary access roads may become long-term access roads to allow operation of the remedy.

3.2.4.2 Long-term Access

Long-term access roads will be provided to allow regular O&M of remedy system components. In some locations, access roads and pipelines may share the same alignment, with the pipeline being installed adjacent to or underneath the access road.

Typically, there will be at least one way to access each well, but there will not be a dedicated route to each well. For example, the access road in the floodplain may be constructed in a loop or ring-shape configuration to allow access to/from the well from two directions. Where possible, the temporary access roads will also serve as the long-term access road to reduce the amount of disturbed area. The number of roads will be minimized to the extent practical, while still providing access to all parts of the remedy infrastructure.

Pipeline I/FW-2 Road. Improvements will be made to the road that leads into Bat Cave Wash from the west (to the west of TCS). The improvements will consist of installing new drainage structures, raising the road elevation, and providing a new road surface. This work will be accomplished with heavy construction equipment. New drainage structures, such as ditches, inlets, and pipes, will be installed by excavating below the ground surface and placing the structures in the excavation. The road will be raised by placing fill on the existing surface, cutting soil from higher portions of the road, and placing it on lower portions to create more uniform surface. The fill will likely be borrow from other excavations at the project site. The road surface will be created by spreading and compacting imported gravel on the road surface.

Floodplain Road. A new ring-shape road will be constructed in the floodplain to support construction and provide long-term access to the wells. The road maybe be founded on granular stabilization rock depending on the stiffness of the existing subgrade soil. The structural layers in the road will consist of gravel, aggregate base (essentially a processed mixture of sand and gravel), and geosynthetic such as geotextiles. The road materials will be placed and compacted in lifts or layers after preparing the subgrade. Depending on location, the road may be built before, during, and/or after pipeline construction.

TW Bench Area. The parking lot will be covered with ACP. The ground surface will be cut to grade, compacted, and covered with a layer of gravelly soil called aggregate base. The ACP will be placed as a hot mix on the base and allowed to cure.

In addition, a new road will be installed to provide access to the existing TW Gas Metering Station yard from the north. The footprint of the new road route will be cleared and graded, and the remaining subgrade will be compacted. The fill soil will be built up in lifts, which are loose layers of soil. Each lift will be placed, graded, moisture conditioned, and compacted. The road will be surfaced with gravel or aggregate base.

Pipeline H/IRL-4 Road. A new road will be constructed to provide access to Pipeline H. It will be installed in the same manner described above for TW Bench access road.

Construction Equipment. The types and anticipated numbers of equipment typically used to construct this configuration are listed in Exhibit 3.2-11. The activities in which each piece of equipment is typically involved is designated by an “X” in the column for a given activity.

3.2.5 Commissioning

Commissioning will include functional testing and other activities are required to verify that installed equipment and other individual components are functioning as designed. The specific activities are discussed in Section 6 of this C/RAWP.

3.2.6 Construction Closeout

Construction closeout activities include the final tasks that, along with commissioning, are required for the construction contractor(s) to fulfill their contracts. It includes generating as-built documents, making final submittals, training (to be provided by vendor[s]), surveying, soil stabilization, and demobilization. Generating as-built documents includes creating record drawings that show what was actually built and surveying as-built facilities and topography. In addition to as-built documents, end-of-project submittals include the test records, quality records, final reports, lien releases, warranties and guarantees, spare parts/materials, and other documents and materials required by contract. The contractor may bring manufacturer's representatives to the site to observe construction and/or commissioning and train personnel to operate equipment.

Areas where the ground surface was disturbed by construction activities will be stabilized to reduce the chances of producing fugitive dust. Stabilization may consist of moisture conditioning and compacting the soil, and applying a layer of dust palliative/tackifier, such as SoilTrac® and/or coarse-grained soil, such as gravel, to the ground surface. The contractor will make a final site survey to verify that conditions at the end of construction are keeping with requirements to match preconstruction conditions. As major field work is completed, equipment, personnel, and materials will be demobilized by removal from site. Also, following construction completion, designated biological monitors will return to the site to document the post-construction conditions. Eventually, the CHQ at Moabi Regional Park will be deconstructed and the area will transition to support the long-term O&M of the remedy. It is anticipated that certain equipment or infrastructure used during construction will be reused for long-term O&M, for example, utilities, security fence, onsite laboratory, equipment storage, crew shop, decontamination pad, office trailers, etc. Details are being developed and will be presented to agencies and stakeholders shortly after submittal of the 90% design.

EXHIBIT 3.2-11
Typical Construction Equipment for Access Construction[a]
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Equipment	Access Construction	Typical Make/Model	Estimated Number
Excavator (w/hoe-ram)	X	CAT 330	~1 per road
Backhoe	X	CAT 430	~1 per road
Scraper (standard push)	X	CAT 621	~2 per road
Scraper (twin engine)	X	CAT 627	~2 per road
Bulldozer (w/rippers)	X	CAT D10	~1 per road
Vacuum/soft dig truck	X	Presvac Hydrovac	~1 per road
Dump/haul truck	X	CAT CT660	~3 per road
Water truck	X	1,000 to 3,000 gal	~2 per road
Articulated dump/haul truck	X	CAT 730	~2 per road
Front-end loader	X	CAT 966	~1 per road
Soil compactor	X	CAT 815	~1 per road

EXHIBIT 3.2-11

Typical Construction Equipment for Access Construction[a]

Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Equipment	Access Construction	Typical Make/Model	Estimated Number
Road grader	X	CAT 120	~1 per road
Fuel/grease truck	X	Oilmen's AL44	~1 per road
Mechanics truck	X	Knapheide KMT2	~1 per road
Pickup and support trucks	X	Ford 250	~1 per road

Note:

[a] The equipment listed in this table are typical. The equipment actually used during construction will be selected by the construction contractor based on project-specific factors.

3.2.7 Startup

After functional testing is complete, remedy startup will be initiated for transition into remedy operation and maintenance. Remedy startup, including shutdown and layup of the IM, is discussed in Section 6.

3.3 Construction Sequencing

This section provides an overview of the estimated durations and logic used to develop the preliminary sequence of construction. Section 3.3.1 provides an overview of key considerations and assumptions made in developing the sequence. Sections 3.3.2 through 3.3.6 discuss construction schedule considerations for pre-construction activities, wells, piping and utilities, vertical infrastructure, and end of construction activities.

The preliminary construction sequence was developed to meet the requirements of the RCRA CACA and the CERCLA CD. Exhibit 3.3-1 illustrates the preliminary construction schedule for the groundwater remedy. A more detailed construction schedule will be prepared following approval of the 100% design and selection of contractors. The schedule will be regularly updated during project implementation. As described in Section 2.5.3, PG&E will use the monthly progress reports to communicate progress related to the schedule and PG&E will notify DTSC and DOI of a change to the schedule for performance of any activity prior to the performance of the activity, or as otherwise agreed to by PG&E, DTSC, and DOI. The following describes the sequencing development and schedule duration and constraints for key remedial infrastructure at this preliminary stage in the planning.

3.3.1 Sequencing Overview

3.3.1.1 General

The preliminary construction sequence presented herein was based on estimated construction durations and sequencing logic typical and feasible for similar projects constructed in similar site conditions. However, the exact durations and logic that will actually be used for planning and executing field activities will be based on the structure of construction contracts selected by PG&E and contractors to provide the safest and most efficient operation that meets project requirements. It is unlikely that all of the construction elements will be sequenced as described herein. It is impractical at this stage to predict exactly which elements will be constructed at any point in the future because that will depend on many variable and uncertain factors. Examples of such variables include but are not limited to equipment and personnel availability, the size/structure/scope of the construction contract(s), constraints imposed by operations at the TCS, and site conditions encountered in the field. For that reason, this section has been written with the intent of providing enough detail to facilitate review and comment by agencies, Tribes, and other stakeholders, while still allowing for the uncertainty inherent in a construction sequencing developed at this stage in the design/construction process.

3.3.1.2 Sequencing Development

The construction sequencing shown in Exhibit 3.3-1 was developed using a process typically used for construction projects. After dividing the project into major construction activities, each activity was given a unique alphanumeric identifier. For example, preconstruction mobilization was designated TC.PC.01, and construction of Pipeline A was designated TC.PL.A. These activities were organized in a hierarchical framework known as a Work Breakdown Structure (WBS). Higher-level tasks are more general, and lower-level tasks are more detailed. For example, the higher-level task TC.PC, preconstruction, comprises two lower-level tasks, TC.PC.01 (mobilization) and TC.PC.02 (site prep). Relationships, known as sequencing logic, were then used to connect the different tasks. For example, the construction of Pipeline A, TC.PL.A, cannot begin until mobilization is largely complete under task TC.PC.01 because TC.PC.01 is a predecessor to TC.PL.A. Finally, construction durations were developed for each element in the WBS based on the expected level of effort for each task, site constraints, and reasonable and typical production rates. These durations are shown as green and blue bars on Exhibit 3.3-1. This work was done using Primavera, the industry-standard software for scheduling and controlling construction projects.

3.3.1.3 Overall Project Starting Conditions

This construction sequence shown in the preliminary construction schedule starts when the groundwater remedy design is ready to construct. For purposes of sequencing, the design is considered ready to construct when the activities listed below are completed:

- Regulatory agencies have approved the 100 percent Professional Engineer-stamped design, including the C/RAWP.
- DTSC’s environmental review (EIR) on the design is complete.
- Construction requirements in the C/RAWP have been put in construction and procurement documents (for example, Division 1 specifications, scopes of work, and requests for proposal)
- Site access agreements are in place (for example, easements, ROWs, and encroachment permits), to include lease agreements for the construction headquarters and soil handling area.

Duration and Calendar. The preliminary construction schedule on Exhibit 3.3-1 shows the project lasting approximately 17 to 18 quarters. This duration includes time for contracting, startup, and construction closeout activities that, strictly speaking, are not composed entirely of field construction activities. The estimated duration of field construction activities is projected to be approximately 11 to 12 quarters. Time on Exhibit 3.3-1 is shown in sequentially numbered quarters, as opposed to months and years, due to the uncertainty inherent in construction planning at this stage.

Early Starts and Concurrent Work. The preliminary construction schedule on Exhibit 3.3-1 is known as an early-start schedule because it shows the earliest possible start date for each activity based on the sequencing logic and estimated durations. As a result, Exhibit 3.3-1 shows a large number of construction activities starting at nearly the same time in the middle of the second quarter (construction of Pipelines A, B, and C [TC.PL.A through TC.PL.C] and the TCS vertical infrastructure [TCS.ST.11 through TCS.ST.16]). At first glance, this implies that a large number of field activities will commence simultaneously, and while that could in fact happen, it might not. PG&E may choose to phase the start of certain construction activities on a case-by-case basis to provide the safest and most efficient operation possible. For example, PG&E may need to stagger the start of certain tasks at the TCS to avoid interfering with critical TCS operations. This could have a ripple effect on the schedule because of the sequencing logic, but at this this stage of construction planning, it is difficult to determine exactly what the effect might be. PG&E will develop a detailed construction schedule with more solid start dates after the approval of the 100% design and selection of contractors.

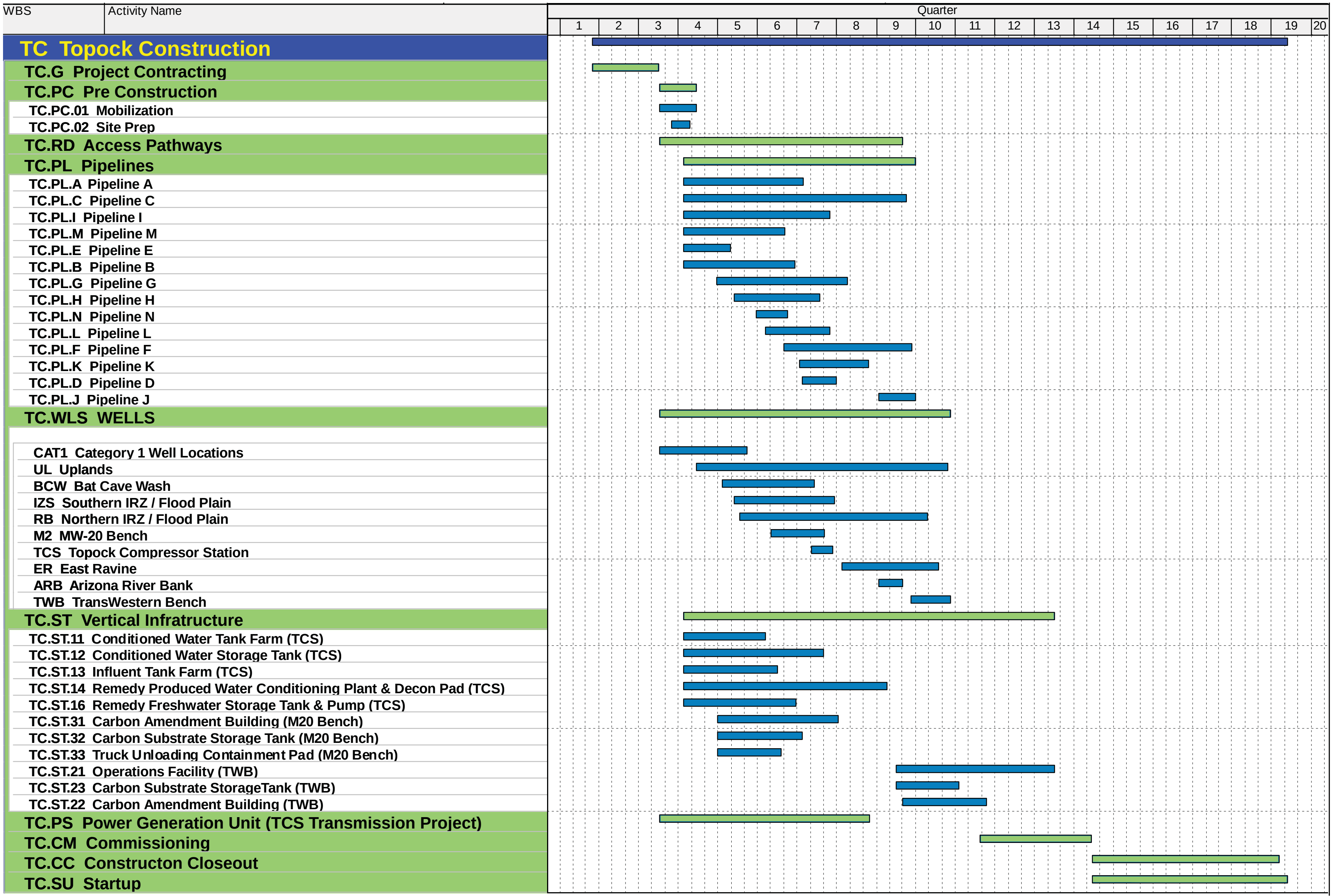


EXHIBIT 3.3-1
PRELIMINARY CONSTRUCTION SCHEDULE FOR THE GROUNDWATER REMEDY

CONSTRUCTION/REMEDIAL ACTION WORK PLAN
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

Timeline dated: September 4, 2014; 13:14

3.3.2 Contracting and Preconstruction Activities (WBS Codes TC.G, TC.PC.01, and TC.PC.02)

The first activities in the sequence include procurement/contracting, mobilization, and site preparation. These activities are early in the sequence because they are necessary to start field construction activities. These activities will overlap, and the total duration is expected to be approximately 8 months.

Construction cannot occur until qualified contractors, vendors, and suppliers are under contract to perform the work. Procuring and contracting is expected to begin once the design is 100 percent complete and is estimated to have a total duration of approximately 5 months (WBS code TC.G). It will include staffing and/or procuring a field management team, sourcing qualified construction contractors, awarding construction contracts, and procuring other services and materials. Procurement and contracting are a phased activity—contracts may be awarded at different times during this period and may even be awarded after this period, as needed, to support implementation. A phased approach will allow some construction to begin before the completion of all preconstruction activities. Procurement and contracting are discussed in greater detail in Section 2.3.2.

Mobilization (WBS code TC.PC.01) is expected to last approximately 3 months and will include moving personnel and equipment to the site, building the construction headquarters, and establishing associated utilities and services for the headquarters (PG&E is currently working with the BLM to obtain the use of this portion of the Moabi Regional Park). Section 4 describes mobilization in greater detail.

Site preparation (TC.PC.02) will begin as mobilization is winding down and is anticipated to last approximately 1 to 2 months. It will include preparing temporary staging and work areas, including the construction water-filling station; the soil processing and storage areas at Moabi Regional Park; installing temporary site controls (fencing, erosion control, etc.); conducting geophysical surveys to locate utilities; and demarcating sensitive areas. Site-specific sensitivity training and orientation will also occur during site preparation activities. Section 4 describes site preparation in greater detail.

Site access pathways and roads will be constructed throughout the project timeline as needed to provide access to primary work zones and support zones. The construction durations for individual pathways are included in the duration for the associated construction element. For example, the time needed to construct a road leading to the primary work zone for a well or pipeline is included in the duration for that well or pipeline.

3.3.3 Wells (WBS Code TC.WL)

Well construction and testing will be conducted throughout the project duration and are expected to have a total duration of approximately 22 months. This duration is based on preliminary work sequencing assumptions and the assumption that a range of up to five drill rigs will be operating concurrently at any time over the given duration. In general, borehole drilling and well construction activities will begin with the Category 1 well locations and progress to Category 2 and 3 well locations across the site (see Section 3.2.1.3), and well-testing activities will be conducted following the completion of well construction and development in a given testing area (see Section 3.2.1.5). Some wells require installation of the respective pipeline to provide access to the well and for management of water generated during well development and testing. Exhibit 3.3-2 presents some of the unique schedule constraints and sequencing requirements for drilling and well construction to occur in specific areas of the site. Factors to be considered to optimize the well construction and testing schedule duration, which could result in an increase or decrease to the total estimated duration, include but are not limited to: availability of equipment; inclement weather effects; refinement to the well construction and testing scope of work based on actual field conditions; other concurrent construction activities; waste management capacity; and agency communication requirements.

EXHIBIT 3.3-2
Key Well Schedule Constraints[a]
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Structure	Approx. Duration (months)	Schedule Constraints
Category 1 Wells	7	Constructing access roads to MW-S and MW-BB.
NTH IRZ Area (Northern and Southern) and Floodplain Wells	15	Completing well installation and initial data collection at Category 1 well location MW-A (to confirm key design assumptions) prior to the installation of other northern NTH IRZ area and floodplain wells. The access road on the floodplain and associated pipelines will be constructed before Category 2 and 3 wells on the floodplain to facilitate drill rig access. Further, advance construction of the pipelines will provide for the ability to convey water generated during well construction, development, and testing; thus limiting the associated equipment footprint. Biological surveys may identify specific locations where road construction and well drilling activities may be restricted on the floodplain for a designated time period (e.g., construction buffers around any active bird nests that may be found).[b]
Upland Area Wells	19	Completing well installation and initial data collection at Category 1 well locations MW-P, MW-BB, MW-DD, and MW-FF (to confirm key design assumptions) prior to installing associated IRL Injection Wells 1 through 4, and associated monitoring wells. Once the IRL-4 location is confirmed, the access road and Pipeline H will be constructed before installing IRL-4, MW-Q, and MW-GG. Temporary IM-3 injection piping may be constructed before IRL-3 and FW-1 so the drilling work does not interfere with IM-3 injection activities.
Bat Cave Wash Area Wells	7	Completing well installation and initial data collection at Category 1 well location MW-S (to confirm key design assumptions) prior to installing FW-2 and associated monitoring wells. Once the FW-2 location is confirmed, the access road will be constructed before installing FW-2, MW-S, MW-HH, and MW-II. Avoiding storm events (i.e., flow in Bat Cave Wash channel) for MW-10D and MW-11D.
Topock Compressor Station Wells	2	Coordinating with the TCS such that construction of TCS-1 and TCS-2 does not interfere with their operations.
TW Bench Wells	3	Installation of TWB-1 and TWB-2 will occur after the construction of the road to the north side of the TW yard and the planned grading of the bench area associated with the construction of other remedy infrastructure. Coordinating with TW such that construction of TWB-1, TWB-2, and MW-K do not interfere with TW operations.
East Ravine Area Wells	7	Maintaining vehicle access to pipeline bridges during the construction of ER-1 through ER-4 and MW-T.
Arizona River Bank Wells	2	None

Note:

[a] The constraints shown in this table are preliminary and could change based on variable factors.

[b] While the possibility of active bird nests is greatest within the dense vegetation of the historical and current Colorado River floodplain, it is recognized that there could also be active bird nests within the desert washes or uplands that would dictate a similar response.

3.3.4 Piping and Utilities (WBS Code TC.PL)

The total anticipated duration for pipeline construction is approximately 18 months. The estimated construction durations for the pipelines are shown on Exhibit 3.3-1.

Construction of several pipelines could begin soon after completion of the relevant preconstruction activities. As shown on Exhibit 3.3-1, this includes Pipelines A, B, C, I, and E. These could be constructed early simply because there are no or few conflicting activities that could constrain the start date. However, PG&E may choose to phase their start on a case-by-case basis to sequence construction in the safest and most efficient manner possible and as required to coordinate with TCS operations.

The other pipelines are shown to start at later dates because there are activities constraining their start times. For example, Pipeline G cannot start construction until a portion of Pipeline C has been constructed in the floodplain. For purposes of estimating construction durations, the sequencing assumes that, to the extent practical, pipelines are constructed from one end to the other, pausing only when required. However, contractors could choose to construct simultaneously at several locations along the same pipeline or skip sections of pipeline. The pipeline construction durations also include time for site improvements at the well sites to include vertical infrastructure. Some of the key schedule constraints and sequencing requirements for pipelines are listed in Exhibit 3.3-3. The listed constraints are those that uniquely affect the construction sequencing and scheduling of certain work activities (for example, the requirement for maintaining one lane of the entrance road to TCS always open affects the sequencing of Pipeline F construction).

EXHIBIT 3.3-3
Key Pipeline Schedule Constraints
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Pipeline	Approx. Duration (months)	Schedule Constraint [a]
All	18	Generally, site improvements will be made at well sites after the pipeline leading to that site has been installed. Site improvements include concrete pads, fences, gravel surfacing, shade structures, and final pipe/wire connections. The time needed to complete site improvements is included in the pipeline construction duration.
A	10	Construction of Pipeline A will be sequenced to maintain vehicle access to the IM-3 treatment plant (IM-3). Access to IM-3 facilities must be maintained at all times; thus, either the west access road to IM-3 or the east access road to IM-3 must be open at all times.
B	9	For planning purposes, the portion of Pipeline B within 200 feet of the Topock Marsh, between the Topock 66 Marina and HNWR-1, may not be constructed between mid-March and October 1 because that is the nesting season of the Yuma clapper rail.[b]
C	17	Construction of Pipeline C in the IRZ North/River Bank area may begin after completion of monitoring well MW-A.
		Construction of Pipeline C in the East Ravine area may begin after completion of monitoring well MW-70BR-D.
		Construction of Pipeline C on the MW-20 Bench may begin after construction support yards are established and water management structures, such as frac tanks, are installed and connected to IM-3.
		Biological surveys may identify specific locations on the floodplain where pipeline and road construction activities will be restricted for a designated time period.[c]
D	3	Construction of Pipeline D may begin after completion of Pipeline L because D ties into L.
E	4	Construction of Pipeline E may begin after a new road has been built to provide access to the north side of the existing gas metering station yard owned by the TW Pipeline Company.
F	10	Construction of Pipeline F may begin after installing Pipeline D and completing much of the site civil work on the TW Bench. The latter constraint maintains vehicle access to the TCS (1 lane minimum).
		In addition, construction of Pipeline F on/near the TW Bench may begin after completion of Pipeline E.
G	10	Pipeline G construction may begin after completing much of Pipeline C in the IRZ North/River Bank area.
		Biological surveys may identify specific locations on the floodplain where pipeline and road construction activities will be restricted for a designated time period. [c]

EXHIBIT 3.3-3
Key Pipeline Schedule Constraints
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Pipeline	Approx. Duration (months)	Schedule Constraint [a]
H	7	Construction of the southern portion of Pipeline H may begin after a new access road has been built and before the IRL-4 well has been installed.
		The northern portion of Pipeline H may begin construction after completion of the western half of Pipeline A has been completed.
I	11	Construction of the Pipeline I bridge will require personnel and equipment to be in Bat Cave Wash. To the extent practical, work in the wash should limited to times when precipitation is less likely to occur.
J	3	Pipeline J connects Pipelines F and B. Construction of Pipeline J may begin after completion of the portions of Pipelines F and B to which it connects.
K	5	Construction of Pipeline K may begin after completion of the remedy-produced water conditioning plant and associated decontamination pad, Pipeline L, and Pipeline M.
L	5	Construction of Pipeline L may begin after completion of the influent tank farm, conditioned water storage tank, and foundations/piping for the conditioned water tank farm.
M	8	None identified but will coordinate with TCS in future.
N	2 to 3	Construction of Pipeline N may begin after completion of Pipeline M.

Note:

[a] The constraints shown in this table are preliminary and could change based on variable factors.

[b] However, from June 1 to October 1 (i.e., the remainder of the breeding season), activities within this area may occur in a single window up to 10 days long with prior approval from BLM and USFWS.

[c] While the possibility of active bird nests is greatest within the dense vegetation of the historical and current Colorado River floodplain, it is recognized that there could also be active bird nests within the desert washes or uplands that would dictate a similar response.

3.3.5 Vertical Infrastructure (WBS Code TC.ST)

Construction of the vertical structures on TCS could begin soon after completion of the preconstruction activities. These could be constructed early simply because at this time, no activities have been identified that could constrain the start date. However, PG&E may choose to phase their start on a case-by-case basis to sequence construction in the safest and most efficient manner possible and as required to coordinate with TCS operations. The total anticipated duration for TCS vertical infrastructure construction is approximately 15 to 16 months. The anticipated construction durations for each structure are shown in Exhibit 3.3-4. In addition, it is expected that TCS construction projects may be active at the same general time as the remedy construction (for example, power generation [WBS code TC.PS]). PG&E will coordinate with TCS operations and sequence remedy construction to avoid conflict with the TCS construction projects.

Construction of the vertical structures on the MW-20 Bench will likely begin after completion of Pipeline C in the MW-20 Bench area. This will be done largely to avoid congestion on the MW-20 Bench. The total anticipated duration for MW-20 Bench structure construction is approximately 9 months. The anticipated construction durations for each structure are shown in Exhibit 3.3-3.

Construction of the structures on the TW Bench will likely begin over a year after the start of field construction activities to avoid congestion created by monitoring well installation. In addition, vertical construction on the TW Bench will not start until a new road has been built to access the north side of the existing Transwestern gas pipeline metering yard. The total anticipated duration for the TW Bench vertical structure construction is approximately 12 months. The anticipated construction durations for each structure are shown in Exhibit 3.3-4.

EXHIBIT 3.3-4
Key Vertical Infrastructure Schedule Constraints
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Structure	Location	Approx. Duration (months)	Schedule Constraint [a]
Remedy-produced Water Conditioning Plant, Decontamination Pad, and Retaining Walls	TCS	15	None identified but will coordinate with TCS in future.
Conditioned Water Tank Farm	TCS	6	None identified but will coordinate with TCS in future.[b]
Conditioned Water Storage Tank	TCS	11	None identified but will coordinate with TCS in future. [b]
Influent Water Tank Farm	TCS	7	None identified but will coordinate with TCS in future. [b]
Remedy Freshwater Storage Tank	TCS	9	None identified but will coordinate with TCS in future. [b]
Carbon Substrate Storage Tank	MW-20 Bench	7	Cannot start until nearby portions of Pipeline C are built and there is more space available on the MW-20 Bench.
Carbon Amendment Building	MW-20 Bench	9	Cannot start until nearby portions of Pipeline C are built and there is more space available on the MW-20 Bench.
Truck Unloading Containment Pad	MW-20 Bench	5	Cannot start until nearby portions of Pipeline C are built and there is more space available on the MW-20 Bench.
Operations Building	TW Bench	12	Cannot start until TWB-02 well installed, access provided to existing TW gas yard, and more space is available on the TW Bench.
Carbon Amendment Building	TW Bench	6	Cannot start until TWB-02 well installed, access provided to existing TW gas yard and more space is available on the TW Bench.
Carbon Substrate Storage Tank	TW Bench	5	Cannot start until TWB-02 well installed, access provided to existing TW gas yard, and more space is available on the TW Bench.

Note:

[a] The constraints shown in this table are preliminary and could change based on variable factors.

[b] Separate TCS construction/operations efforts may constrain sequence of work at the TCS.

3.3.6 End-of-construction Activities (WBS Codes TC.CC, TC.CM, and TC.SU)

Commissioning activities (WBS code TC.CM, also known as functional testing or shakedown) are expected to last approximately 9 months and start while the TW Bench operations building is being constructed. However, some commissioning activities could begin earlier once installation of an individual system or component is completed. This group of activities, also called functional testing, is described in more detail in Section 6.

Construction closeout activities (WBS code TC.CC) will occur after completion of field construction activities and are expected to last approximately 14 months. This group of activities includes producing record drawings and other as-built information, submitting and obtaining approval for construction completion report, soil stabilization, and demobilization. This group of activities is described in more detail in Section 3.2.6.

Revegetation of areas affected by construction is not included in the construction schedule on Exhibit 3.3-1; a schedule for implementation of the revegetation activities will be developed separately. Revegetation will typically begin after remedy construction is complete, although may occur in specific locations after remedial construction is complete in that location. Post-construction revegetation is described in Section 6.

Startup activities (WBS code TC.SU) will be generally concurrent with closeout activities and are expected to last approximately 15 months, but could possibly last 1 to 2 years. These activities are detailed in Section 6.2; in general, they include those activities required to start the remedy system and fine-tune remedy operations based on performance monitoring. These activities can generally start once commissioning activities are complete and the permanent remedy power supply has been established. Startup will occur concurrently with construction closeout activities.

TABLE 3.2-1
Pre-Final Remediation Well Design Parameter Summary: National Trails Highway IRZ Wells
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

	Pre-Final Injection/Extraction Rate per Model Layer (gpm)								Pre-Final Well Coordinates	
Well Location ID[a]	Nominal	Minimum	Maximum	Pre-Final Well Screen Length (feet)	Model Layer Saturated Thickness (feet)	Pre-Final Well Depiction	Pre-Final Well Count	Pre-Final Future Provisional Well Count	X	Y
IRZ-1 (Extraction)[b]									7615297.081	2104063.768
Layer 1	20	20	80	120	65	Dual Screen Well	1	0		
Layer 2					93					
Layer 3	20	20	80	180	124					
Layer 4					79					
IRZ-2									*7615314.733*	*2104010.323*
Layer 1	*0*	*0*	*6*	*50*	*71*	*Dual Screen Well*	*0*	*1*		
Layer 2	*0*	*0*	*6*	*70*	*93*					
Layer 3	*0*	*0*	*6*	*100*	*119*	*Dual Screen Well*	*0*	*1*		
Layer 4	*0*	*0*	*6*	*50*	*72*					
IRZ-3									*7615415.553*	*2103957.160*
Layer 1	*0*	*0*	*6*	*70*	*86*	*Dual Screen Well*	*0*	*1*		
Layer 2	*0*	*0*	*6*	*80*	*96*					
Layer 3	*0*	*0*	*6*	*90*	*109*	*Dual Screen Well*	*0*	*1*		
Layer 4	*0*	*0*	*6*	*40*	*63*					
IRZ-4									*7615392.091*	*2103849.460*
Layer 1	*0*	*0*	*6*	*70*	*90*	*Dual Screen Well*	*0*	*1*		
Layer 2	*0*	*0*	*6*	*70*	*93*					
Layer 3	*0*	*0*	*6*	*80*	*100*	*Dual Screen Well*	*0*	*1*		
Layer 4	*0*	*0*	*6*	*40*	*57*					
IRZ-5 (Extraction)[b]									7615445.427	2103825.736
Layer 1	40	20	80	150	93	Dual Screen Well	1	0		
Layer 2					93					
Layer 3	40	20	80	140	99					
Layer 4					56					
IRZ-6									*7615440.751*	*2103744.711*
Layer 1	*0*	*0*	*6*	*70*	*91*	*Dual Screen Well*	*0*	*1*		
Layer 2	*0*	*0*	*6*	*70*	*90*					
Layer 3	*0*	*0*	*6*	*70*	*94*	*Dual Screen Well*	*0*	*1*		
Layer 4	*0*	*0*	*6*	*40*	*54*					
IRZ-7									*7615514.912*	*2103691.892*
Layer 1	*0*	*0*	*6*	*70*	*92*	*Dual Screen Well*	*0*	*1*		
Layer 2	*0*	*0*	*6*	*60*	*87*					
Layer 3	*0*	*0*	*6*	*70*	*93*	*Dual Screen Well*	*0*	*1*		
Layer 4	*0*	*0*	*6*	*40*	*52*					
IRZ-8									*7615501.889*	*2103615.023*
Layer 1	*0*	*0*	*6*	*60*	*84*	*Dual Screen Well*	*0*	*1*		

TABLE 3.2-1
Pre-Final Remediation Well Design Parameter Summary: National Trails Highway IRZ Wells
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Well Location ID[a]	Pre-Final Injection/Extraction Rate per Model Layer (gpm)			Pre-Final Well Screen Length (feet)	Model Layer Saturated Thickness (feet)	Pre-Final Well Depiction	Pre-Final Well Count	Pre-Final Future Provisional Well Count	Pre-Final Well Coordinates	
	Nominal	Minimum	Maximum						X	Y
Layer 2	*0*	*0*	*6*	*60*	*81*					
Layer 3	*0*	*0*	*6*	*60*	*84*	*Dual Screen Well*	*0*	*1*		
Layer 4	*0*	*0*	*6*	*40*	*51*					
IRZ-9 (Extraction)[b]									7615566.330	2103560.751
Layer 1	40	20	80	130	81	Dual Screen Well	1	0		
Layer 2					75					
Layer 3	40	20	80	120	80					
Layer 4					50					
IRZ-10									*7615569.264*	*2103470.371*
Layer 1	*0*	*0*	*6*	*40*	*69*	*Dual Screen Well*	*0*	*1*		
Layer 2	*0*	*0*	*6*	*40*	*65*					
Layer 3	*0*	*0*	*6*	*40*	*68*	*Dual Screen Well*	*0*	*1*		
Layer 4	*0*	*0*	*6*	*40*	*49*					
IRZ-11									7615636.156	2103409.075
Layer 1	10	0	20	40	65	Dual Screen Well	1	0		
Layer 2	10	0	20	40	62					
Layer 3	10	0	20	40	66	Dual Screen Well	1	0		
Layer 4	10	0	20	40	51					
IRZ-12									*7615660.246*	*2103350.817*
Layer 1	*0*	*0*	*6*	*40*	*60*	*Dual Screen Well*	*0*	*1*		
Layer 2	*0*	*0*	*6*	*40*	*57*					
Layer 3	*0*	*0*	*6*	*40*	*59*	*Dual Screen Well*	*0*	*1*		
Layer 4	*0*	*0*	*6*	*40*	*51*					
IRZ-13									7615701.692	2103307.059
Layer 1	9	0	20	40	54	Dual Screen Well	1	0		
Layer 2	9	0	20	40	52					
Layer 3	9	0	20	40	59	Dual Screen Well	1	0		
Layer 4	9	0	20	40	53					
IRZ-14									*7615736.699*	*2103202.539*
Layer 1	*0*	*0*	*6*	*40*	*55*	*Dual Screen Well*	*0*	*1*		
Layer 2	*0*	*0*	*6*	*40*	*53*					
Layer 3	*0*	*0*	*6*	*40*	*50*	*Dual Screen Well*	*0*	*1*		
Layer 4	*0*	*0*	*6*	*30*	*44*					
IRZ-15									7615766.310	2103145.565
Layer 1	7	0	15	40	49	Dual Screen Well	1	0		
Layer 2	7	0	15	40	48					
Layer 3	7	0	15	40	48	Dual Screen Well	1	0		

TABLE 3.2-1
Pre-Final Remediation Well Design Parameter Summary: National Trails Highway IRZ Wells
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Well Location ID[a]	Pre-Final Injection/Extraction Rate per Model Layer (gpm) Nominal	Minimum	Maximum	Pre-Final Well Screen Length (feet)	Model Layer Saturated Thickness (feet)	Pre-Final Well Depiction	Pre-Final Well Count	Pre-Final Future Provisional Well Count	Pre-Final Well Coordinates X	Y
Layer 4	7	0	15	30	43					
IRZ-16									7615794.469	2103038.226
Layer 1	6	0	15	40	51	Dual Screen Well	1	0		
Layer 2	6	0	15	40	49					
Layer 3	6	0	15	30	42	Dual Screen Well	1	0		
Layer 4	6	0	15	20	36					
IRZ-17									7615861.49	2102994.285
Layer 1	7	0	15	40	51	Dual Screen Well	1	0		
Layer 2	7	0	15	40	49					
Layer 3	7	0	15	30	39	Dual Screen Well	1	0		
Layer 4	7	0	15	20	33					
IRZ-18									*7615834.113*	*2102912.441*
Layer 1	*0*	*0*	*6*	*40*	*51*	*Dual Screen Well*	*0*	*1*		
Layer 2	*0*	*0*	*6*	*40*	*49*					
Layer 3	*0*	*0*	*6*	*20*	*30*	*Dual Screen Well*	*0*	*1*		
Layer 4	*0*	*0*	*6*	*15*	*23*					
IRZ-19									7615930.424	2102846.991
Layer 1	7	0	13	35	44	Dual Screen Well	1	0		
Layer 2	7	0	13	30	41					
Layer 3	7	0	13	20	28	Dual Screen Well	1	0		
Layer 4	7	0	13	15	24					
IRZ-20									7615807.564	2102769.249
Layer 1	4	0	13	35	47	Dual Screen Well	1	0		
Layer 2	4	0	13	30	42					
Layer 3	4	0	13	15	24	Dual Screen Well	1	0		
Layer 4	4	0	13	10	20					
IRZ-21									7615815.994	2102691.507
Layer 1	5	0	10	40	48	Dual Screen Well	1	0		
Layer 2	5	0	10	20	29					
Layer 3	5	0	10	10	18	Dual Screen Well	1	0		
Layer 4	5	0	10	15	26					
IRZ-22									*7615819.972*	*2102619.334*
Layer 1	*0*	*0*	*6*	*35*	*44*	*Dual Screen Well*	*0*	*1*		
Layer 2	*0*	*0*	*6*	*15*	*27*					
Layer 3	*0*	*0*	*6*	*10*	*19*	*Dual Screen Well*	*0*	*1*		
Layer 4	*0*	*0*	*6*	*15*	*27*					

TABLE 3.2-1
Pre-Final Remediation Well Design Parameter Summary: National Trails Highway IRZ Wells
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

	Pre-Final Injection/Extraction Rate per Model Layer (gpm)			Pre-Final Well Screen Length (feet)	Model Layer Saturated Thickness (feet)	Pre-Final Well Depiction	Pre-Final Well Count	Pre-Final Future Provisional Well Count	Pre-Final Well Coordinates	
Well Location ID[a]	**Nominal**	**Minimum**	**Maximum**						**X**	**Y**
IRZ-23 (Extraction)[b]									7615824.866	2102534.901
Layer 1					33					
Layer 2					28					
Layer 3	100	40	160	70	24	Single Screen Well (Layers 2, 3, & 4)[d]	1	0		
Layer 4					24					
IRZ-24									*7615822.168*	*2102468.274*
Layer 1	*0*	*0*	*13*	*40*	*31*					
Layer 2					*28*	*Dual Screen Well*	*0*	*1*		
Layer 3	*0*	*0*	*13*	*40*	*26*					
Layer 4					*25*					
IRZ-25									7615826.121	2102415.641
Layer 1	8	0	18	40	29					
Layer 2					27	Dual Screen Well	1	0		
Layer 3	8	0	18	40	26					
Layer 4					24					
IRZ-26									*7615818.538*	*2102313.742*
Layer 1	*0*	*0*	*13*	*40*	*28*					
Layer 2					*26*	*Dual Screen Well*	*0*	*1*		
Layer 3	*0*	*0*	*13*	*40*	*24*					
Layer 4					*24*					
IRZ-27									7615801.341	2102238.870
Layer 1	8	0	18	40	27					
Layer 2					25	Dual Screen Well	1	0		
Layer 3	8	0	18	40	23					
Layer 4					24					
IRZ-28									*7615797.904*	*2102180.167*
Layer 1	*0*	*0*	*13*	*40*	*26*					
Layer 2					*24*	*Dual Screen Well*	*0*	*1*		
Layer 3	*0*	*0*	*13*	*40*	*23*					
Layer 4					*22*					
IRZ-29									7615792.463	2102082.530
Layer 1	7	0	15	40	25					
Layer 2					22	Dual Screen Well	1	0		
Layer 3	7	0	15	35	21					
Layer 4					20					
IRZ-30									*7615780.610*	*2102010.804*
Layer 1	*0*	*0*	*13*	*40*	*26*	*Dual Screen Well*	*0*	*1*		

TABLE 3.2-1
Pre-Final Remediation Well Design Parameter Summary: National Trails Highway IRZ Wells
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Well Location ID[a]	Pre-Final Injection/Extraction Rate per Model Layer (gpm) Nominal	Minimum	Maximum	Pre-Final Well Screen Length (feet)	Model Layer Saturated Thickness (feet)	Pre-Final Well Depiction	Pre-Final Well Count	Pre-Final Future Provisional Well Count	Pre-Final Well Coordinates X	Y
Layer 2					*20*					
Layer 3	*0*	*0*	*13*	*30*	*19*					
Layer 4					*18*					
IRZ-31									7615790.562	2101946.996
Layer 1	6	0	13	35	26	Dual Screen Well	1	0		
Layer 2					16					
Layer 3	6	0	13	25	16					
Layer 4					16					
IRZ-32									*7615812.857*	*2101863.292*
Layer 1	*0*	*0*	*13*	*30*	*21*	*Dual Screen Well*	*0*	*1*		
Layer 2					*14*					
Layer 3	*0*	*0*	*13*	*20*	*14*					
Layer 4					*13*					
IRZ-33									7615828.110	2101792.506
Layer 1	4	0	13	25	17	Dual Screen Well	1	0		
Layer 2					14					
Layer 3	4	0	13	20	14					
Layer 4					11					
IRZ-34									*7615853.907*	*2101666.998*
Layer 1	*0*	*0*	*26*	*35*	*13*	*Single Screen Well (All Layers)*	*0*	*1*		
Layer 2					*12*					
Layer 3					*12*					
Layer 4					*10*					
IRZ-35									7615903.592	2101664.688
Layer 1	6	0	15	30	10	Single Screen Well (All Layers)	1	0		
Layer 2					10					
Layer 3					10					
Layer 4					10					
IRZ-36									*7615948.819*	*2101605.697*
Layer 1	*0*	*0*	*25*	*25*	*7.4*	*Single Screen Well (All Layers)*	*0*	*1*		
Layer 2					*7.6*					
Layer 3					*7.6*					
Layer 4					*7.6*					
IRZ-37									7616003.877	2101554.571
Layer 1	4	0	10	20	5.7	Single Screen Well (All Layers)	1	0		
Layer 2					5.9					
Layer 3					5.9					

TABLE 3.2-1
Pre-Final Remediation Well Design Parameter Summary: National Trails Highway IRZ Wells
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

	Pre-Final Injection/Extraction Rate per Model Layer (gpm)			Pre-Final Well Screen Length (feet)	Model Layer Saturated Thickness (feet)	Pre-Final Well Depiction	Pre-Final Well Count	Pre-Final Future Provisional Well Count	Pre-Final Well Coordinates	
Well Location ID[a]	**Nominal**	**Minimum**	**Maximum**						**X**	**Y**
Layer 4					5.9					
IRZ-38									*7615965.222*	*2101400.445*
Layer 1	*0*	*0*	*25*	*15*	*5.0*	*Single Screen Well (All Layers)*	*0*	*1*		
Layer 2					*5.3*					
Layer 3					*5.3*					
Layer 4					*5.3*					
IRZ-39										
Layer 1	4	0	5	10	2.8	Single Screen Well (All Layers)	1	0	7616112.476	2101375.588
Layer 2					3.1					
Layer 3					3.1					
Layer 4					3.1					
IRZ-40 (Extraction)									*7616191.542*	*2101358.005*
Layer 1	*0*	*0*	*25*	*5*	*1.7*	*Single Screen Well (All Layers)*	*0*	*1*		
Layer 2					*2.0*					
Layer 3					*2.0*					
Layer 4					*2.0*					
Extraction Total:	**300**	**200[c]**	**400[c]**	---	---	---	**4**	**1**	---	---
Injection Total:	**300**	**200[c]**	**400[c]**	---	---	---	**24**	**30**	---	---

Notes:

Gray Italics denote future provisional wells.

gpm = gallons per minute

[a] Number of wells, total screen intervals, and screen depth placement at each well location ID are for purposes of the pre-final (90%) design submittal and are continuing to be evaluated. One well location ID may consist of multiple wells or screens, and one well screen interval may include more than one model layer. A maximum of two discrete screen intervals will be included per individual well. Dual screen wells will consist of one well with two discreet screen intervals separated by a packer. Some well location IDs include two dual screen wells which will be installed in separate boreholes.

[b] Wells are constructed with a dedicated pump for each well screen with the intervals separated using a pneumatic packer.

[c] Individual well minimum and maximum flow rates are provided herein. However, the total aggregate extraction/injection flow rates are limited to 200 gpm at minimum flows and 400 gpm at maximum flows.

[d] Extraction well design and operation will target extraction of groundwater from all four model layers without being screened across all layers.

TABLE 3.2-2
Pre-Final Remediation Well Design Parameter Summary: Inner Recirculation Loop Wells
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

	Pre-Final Injection/Extraction Rate per Model Layer (gpm)								Pre-Final Well Coordinates	
Well Location ID[a]	**Nominal**	**Minimum**	**Maximum**	**Pre-Final Well Screen Length (feet)**	**Model Layer Saturated Thickness (feet)**	**Pre-Final Well Depiction**	**Pre-Final Well Count**	**Pre-Final Future Provisional Well Count**	**X**	**Y**
River Bank Extraction Wells										
RB-1									7615763.621	2103917.990
Layer 1				160[g]	106					
Layer 2					99					
Layer 3	25	25	170	150	104	Single Screen Well (Layers 3 & 4)[g]	1	0		
Layer 4					56					
RB-2									7616012.005	2103398.007
Layer 1				70[g]	58					
Layer 2					56					
Layer 3	0	25	170	125	73	Single Screen Well (Layers 3 & 4)[g]	1	0		
Layer 4					60					
RB-3									7616210.553	2103172.847
Layer 1				70[g]	56					
Layer 2					58					
Layer 3	50	25	170	100	51	Single Screen Well (Layers 3 & 4)[g]	1	0		
Layer 4					50					
RB-4									7616337.509	2102908.528
Layer 1				70[g]	50					
Layer 2					55					
Layer 3	50	25	170	100	37	Single Screen Well (Layers 3 & 4)[g]	1	0		
Layer 4					50					
RB-5									7616397.623	2102423.944
Layer 1				15[g]	24					
Layer 2					24					
Layer 3	25	25	170	25	16	Single Screen Well (Layers 3 & 4)[g]	1	0		
Layer 4					16					
RB-6									*TBD*	*TBD*
Layer 1				*TBD[g]*	*TBD*					
Layer 2					*TBD*					
Layer 3	*0*	*25*	*170*	*TBD*	*TBD*	*Single Screen Well (Layers 3 & 4)[g]*	*0*	*1*		
Layer 4					*TBD*					
RB-7									*TBD*	*TBD*
Layer 1				*TBD[g]*	*TBD*					
Layer 2					*TBD*					
Layer 3	*0*	*25*	*170*	*TBD*	*TBD*	*Single Screen Well (Layers 3 & 4)[g]*	*0*	*1*		
Layer 4					*TBD*					

TABLE 3.2-2

Pre-Final Remediation Well Design Parameter Summary: Inner Recirculation Loop Wells

Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Well Location ID[a]	Pre-Final Injection/Extraction Rate per Model Layer (gpm) Nominal	Minimum	Maximum	Pre-Final Well Screen Length (feet)	Model Layer Saturated Thickness (feet)	Pre-Final Well Depiction	Pre-Final Well Count	Pre-Final Future Provisional Well Count	Pre-Final Well Coordinates X	Y
RB-8									*TBD*	*TBD*
Layer 1				*TBD*[g]	*TBD*					
Layer 2					*TBD*					
Layer 3	*0*	*25*	*170*	*TBD*	*TBD*	*Single Screen Well (Layers 3 & 4)*[g]	*0*	*1*		
Layer 4					*TBD*					
RB-9									*TBD*	*TBD*
Layer 1				*TBD*[g]	*TBD*					
Layer 2					*TBD*					
Layer 3	*0*	*25*	*170*	*TBD*	*TBD*	*Single Screen Well (Layers 3 & 4)*[g]	*0*	*1*		
Layer 4					*TBD*					
Inner Recirculation Loop Injection Wells[b]										
IRL-1									7614392.08	2103402.91
Layer 1	0	35	200	80	62	Dual Screen Well	1	0		
Layer 2	75			170	71					
Layer 3					74					
Layer 4					64					
IRL-2									7614133.272	2103058.411
Layer 1	0	35	200	74	62	Dual Screen Well	1	0		
Layer 2	75			160	63					
Layer 3					65					
Layer 4					64					
IRL-3									7613976.088	2102799.301
Layer 1	100	35	200	140	55	Dual Screen Well	1	0		
Layer 2					55					
Layer 3					59					
Layer 4				71	61					
IRL-4									7613953.827	2102380.665
Layer 1	200	35	200	115	46	Dual Screen Well	1	0		
Layer 2					46					
Layer 3					49					
Layer 4				56	51					
IRL-5									*TBD*	*TBD*
Layer 1	*0*	*35*	*200*	*TBD*	*TBD*	*TBD*	*0*	*1*		
Layer 2					*TBD*					
Layer 3					*TBD*					
Layer 4					*TBD*					

TABLE 3.2-2

Pre-Final Remediation Well Design Parameter Summary: Inner Recirculation Loop Wells

Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Well Location ID[a]	Pre-Final Injection/Extraction Rate per Model Layer (gpm) Nominal	Minimum	Maximum	Pre-Final Well Screen Length (feet)	Model Layer Saturated Thickness (feet)	Pre-Final Well Depiction	Pre-Final Well Count	Pre-Final Future Provisional Well Count	Pre-Final Well Coordinates X	Y
IRL-6[f]									*TBD*	*TBD*
Layer 1					*TBD*					
Layer 2	*0*	*35*	*200*	*TBD*	*TBD*	*TBD*	*0*	*1*		
Layer 3					*TBD*					
Layer 4					*TBD*					
IRL-7[f]									*TBD*	*TBD*
Layer 1					*TBD*					
Layer 2	*0*	*35*	*200*	*TBD*	*TBD*	*TBD*	*0*	*1*		
Layer 3					*TBD*					
Layer 4					*TBD*					
Extraction Total:	**150**	**0[c]**	**500[c]**	**---**	**---**		**5**	**4**	**---**	**---**
Injection Total:	**450[d]**	**150[d,e]**	**900[d,e]**	**---**	**---**		**4**	**3**	**---**	**---**

Notes:

Gray Italics denote future provisional wells.

gpm = gallons per minute

[a] Number of wells, total screen intervals, and screen depth placement at each well location ID are for purposes of the pre-final (90%) design submittal and are continuing to be evaluated.

[b] The pre-final nominal scenario assumes IRL-1 and IRL-2 will receive River Bank Extraction Well water (carbon-amended if Cr[VI] concentrations in the River Bank Extraction Wells exceed the clean-up goal); and IRL-3 and IRL-4 will receive fresh water. However, injection wells IRL-1 through IRL-4 (and future provisional wells IRL-5 through IRL-7, if constructed) will be constructed for flexibility to inject either/both fresh water or/and River Bank Extraction Well water during the lifetime of the remedy. IRL-1 and IRL-2 will be installed as dual-screen wells with the shallow screen (upper one-third of the saturated interval) separated from the deep screen (lower two-thirds of the saturated interval) with a pneumatic packer. The pre-final nominal scenario assumes injection of River Bank Extraction Well water into the deep screen only at IRL-1 and IRL-2. IRL-3 and IRL-4 will be installed with both a shallow screen (upper two-thirds of the saturated interval) and deep screen (lower one-third of the saturated interval). IRL-3 and IRL-4 will be designed to accommodate a pneumatic packer for potential future isolation of the shallow and deep screened intervals; however, under the pre-final nominal scenario, only fresh water will be injected into IRL-3 and IRL-4 and the shallow and deep screens in these wells will not be isolated.

[c] Individual extraction well minimum and maximum flow rates are provided herein. However, the minimum and maximum aggregate flow rates from the entire extraction well network are estimated to be 0 gpm and 500 gpm, respectively.

[d] Injection flow rate includes 300 gpm of fresh water for the nominal flow, up to 150 gpm of fresh water for the minimum flow, and up to 900 gpm of fresh water for the maximum flow, as needed.

[e] Individual injection well minimum and maximum flow rates are provided herein. However, the minimum and maximum aggregate flow rates for the entire injection well network are estimated to be 150 gpm and 900 gpm, respectively.

[f] Future provisional well IRL-6 or IRL-7 may alternatively be considered as an extraction well with extracted groundwater re-injected into other IRL Injection Wells.

[g] River Bank Extraction Wells will be installed with a second shallow screen interval for potential future use which will be isolated from the deeper screen interval with a pneumatic packer.

TABLE 3.2-3

Pre-Final Remediation Well Design Parameter Summary: TCS Recirculation Loop Wells

Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Well Location ID[a]	Pre-Final Injection/Extraction Rate per Model Layer (gpm) Nominal	Minimum	Maximum	Pre-Final Well Screen Length (feet)	Model Layer Saturated Thickness (feet)	Pre-Final Well Depiction	Pre-Final Well Count	Pre-Final Future Provisional Well Count	Pre-Final Well Coordinates X	Y
Transwestern Bench Extraction Wells										
TWB-1									7615903.03	2100962.45
Layer 1					11					
Layer 2					11					
Layer 3					11					
Layer 4	13	1	15	20	11	Single Screen Well (Layers 3 & 4)[e]	1	0		
TWB-2									7615993.88	2100972.00
Layer 1					8.3					
Layer 2					8.7					
Layer 3					8.7					
Layer 4	9	1	15	15	8.7	Single Screen Well (Layers 3 & 4)[e]	1	0		
TWB-3									*7615776.618*	*2101143.378*
Layer 1					*12*					
Layer 2					*13*					
Layer 3					*13*					
Layer 4	*0*	*1*	*15*	*25*	*13*	*Single Screen Well (Layers 3 & 4)e*	*0*	*1*		
TWB-4									*7616088.146*	*2100858.533*
Layer 1					*5.5*					
Layer 2					*5.9*					
Layer 3					*5.9*					
Layer 4	*0*	*1*	*15*	*20*	*5.9*	*Single Screen Well (Layers 3 & 4)[e]*	*0*	*1*		

TABLE 3.2-3

Pre-Final Remediation Well Design Parameter Summary: TCS Recirculation Loop Wells

Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Well Location ID[a]	Pre-Final Injection/Extraction Rate per Model Layer (gpm) Nominal	Minimum	Maximum	Pre-Final Well Screen Length (feet)	Model Layer Saturated Thickness (feet)	Pre-Final Well Depiction	Pre-Final Well Count	Pre-Final Future Provisional Well Count	Pre-Final Well Coordinates X	Y
East Ravine Extraction Wells[b]										
ER-1		2 Total	4 Total						7616510.976	2101089.290
Layer 1	0.5			90	30	Single Screen Well or Open Bore	1	0		
Layer 2					20					
Layer 3					20					
Layer 4					20					
ER-2									7616666.277	2100998.762
Layer 1	0.5			90	30	Single Screen Well or Open Bore	1	0		
Layer 2					20					
Layer 3					20					
Layer 4					20					
ER-3									7616855.469	2100897.942
Layer 1	0.5			90	30	Single Screen Well or Open Bore	1	0		
Layer 2					20					
Layer 3					20					
Layer 4					20					
ER-4									7616934.556	2100761.269
Layer 1	0.5			90	30	Single Screen Well or Open Bore	1	0		
Layer 2					20					
Layer 3					20					
Layer 4					20					
ER-5									*7616995.304*	*2100677.912*
Layer 1	*0*	*0.5*	*1*	*90*	*30*	*Single Screen Well or Open Bore*	*0*	*1*		
Layer 2					*20*					
Layer 3					*20*					
Layer 4					*20*					
ER-6									7615840.000	2100512.000
Layer 1	3	1	5	90	29	Single Screen Well or Open Bore	1	0		
Layer 2					20					
Layer 3					20					
Layer 4					20					
ER-7									*TBD*	*TBD*
Layer 1	*0*	*0.5*	*1*	*TBD*	*TBD*	*Single Screen Well or Open Bore*	*0*	*1*		
Layer 2					*TBD*					
Layer 3					*TBD*					
Layer 4					*TBD*					
ER-8									*TBD*	*TBD*

TABLE 3.2-3

Pre-Final Remediation Well Design Parameter Summary: TCS Recirculation Loop Wells

Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Well Location ID[a]	Pre-Final Injection/Extraction Rate per Model Layer (gpm)			Pre-Final Well Screen Length (feet)	Model Layer Saturated Thickness (feet)	Pre-Final Well Depiction	Pre-Final Well Count	Pre-Final Future Provisional Well Count	Pre-Final Well Coordinates	
	Nominal	Minimum	Maximum						X	Y
Layer 1	*0*	*0.5*	*1*	*TBD*	*TBD*	*Single Screen Well or Open Bore*	*0*	*1*		
Layer 2					*TBD*					
Layer 3					*TBD*					
Layer 4					*TBD*					
ER-9									*TBD*	*TBD*
Layer 1	*0*	*0.5*	*1*	*TBD*	*TBD*	*Single Screen Well or Open Bore*	*0*	*1*		
Layer 2					*TBD*					
Layer 3					*TBD*					
Layer 4					*TBD*					
ER-10									*TBD*	*TBD*
Layer 1	*0*	*0.5*	*1*	*TBD*	*TBD*	*Single Screen Well or Open Bore*	*0*	*1*		
Layer 2					*TBD*					
Layer 3					*TBD*					
Layer 4					*TBD*					
ER-11									*TBD*	*TBD*
Layer 1	*0*	*0.5*	*1*	*TBD*	*TBD*	*Single Screen Well or Open Bore*	*0*	*1*		
Layer 2					*TBD*					
Layer 3					*TBD*					
Layer 4					*TBD*					
TCS Injection Wells										
TCS-1									7615167.690	2101171.376
Layer 1	6.75	2	20	50	37	Dual Screen Well	1	0		
Layer 2					21					
Layer 3	6.75	2	20	40	21					
Layer 4					25					
TCS-2									7615149.128	2100899.663
Layer 1	6.75	2	20	40	27	Dual Screen Well	1	0		
Layer 2					26					
Layer 3	6.75	2	20	40	27					
Layer 4					17					
Extraction Total:	**27**	**10[c]**	**75[c]**	**---**	**---**	**---**	**7**	**8**	**---**	**---**
Injection Total:	**27**	**10[c]**	**75[c,d]**	**---**	**---**	**---**	**2**	**0**	**---**	**---**

Notes:

Gray Italics denote future provisional wells.

gpm = gallons per minute

[a] Number of wells, total screen intervals, and screen depth placement at each well location ID are for purposes of the pre-final (90%) design submittal and are continuing to be evaluated. One well location ID may consist of multiple screens, and one well screen interval may include more than one model layer. A maximum of two discrete screen intervals will be included per individual well. Dual screen wells will consist of one well with two discrete screen intervals separated by a packer.

[b] East Ravine Extraction Wells are not expected to produce significant water, and automated pump cycling will be required.

[c] Individual well minimum and maximum flow rates are provided herein. However, the total aggregate minimum and maximum extraction/injection flow rates are limited to 10 gpm and 75 gpm, respectively.

[d] Injection flow rate includes up to 75 gpm of freshwater.

[e] Extraction well design and operation will target extraction of groundwater from all four model layers without being screened across all layers.

TABLE 3.2-4
Pre-Final Remediation Well Design Parameter Summary: Freshwater Injection Wells
Groundwater Remedy Construction/Remedial Action Work Plan,
PG&E Topock Compressor Station, Needles, California

Well Location ID[a]	Pre-Final Injection/Extraction Rate per Model Layer (gpm)[b]			Pre-Final Well Screen Length (feet)	Model Layer Saturated Thickness (feet)	Pre-Final Well Depiction	Pre-Final Well Count	Pre-Final Future Provisional Well Count	Pre-Final Well Coordinates	
	Nominal	Minimum	Maximum						X	Y
FW-1									7613297.30	2102955.36
Layer 1	100	50	200	250	57	Single Screen Well (All Layers)	1			
Layer 2					57					
Layer 3					56					
Layer 4					78					
FW-2									7614682.700	2100511.512
Layer 1	50	25	100	60	15	Single Screen Well (All Layers)	1			
Layer 2					15					
Layer 3					15					
Layer 4					15					
Total:	**150**	**75**	**300**	---	---	---	**2**		---	---

Notes:

gpm = gallons per minute

[a] Number of wells, total screen intervals, and screen depth placement at each well location ID are for purposes of pre-final (90%) design submittal and are continuing to be evaluated. One well screen interval may include more than one model layer. A maximum of two discrete screen intervals will be included per individual well.

[b] Well testing will be conducted to assess specific injectivity per Section 4 of the O&M Plan (Appendix L, O&M Manual, Volume 1).

TABLE 3.2-5

Estimated Construction of Proposed Groundwater Monitoring Wells

Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Monitoring Category/ Location ID	Projected Depth to Groundwater (ft bgs)	Projected Saturated Thickness Above Bedrock (ft)	Projected Depth to Bedrock (ft bgs)	Number of Intervals to be Monitored[a]	Length of Interval(s) to be Monitored (ft)[a]	Estimated Depths to be Monitored (ft bgs)[a]			
Northern NTH IRZ Extraction Monitoring Well									
MW-A	13	357	370	4	40	40 to 80	140 to 180	230 to 270	310 to 350
MW-B	17	327	344	4	40	40 to 80	130 to 170	220 to 260	290 to 330
NTH IRZ Dose Response Monitoring Well									
MW-C	22	197	219	4	20	30 to 50	80 to 100	130 to 150	180 to 200
MW-D	18	157	175	3	20	40 to 60	90 to 110	140 to 160	
MW-E	36	100	136	2	20	50 to 70	105 to 125		
MW-F	54	81	135	2	20	70 to 90	105 to 125		
MW-G	57	30	87	1	20	65 to 85			
NTH IRZ Downgradient Well and Riverbank Extraction Monitoring Well									
MW-H	14	183	197	4	20	30 to 50	80 to 100	120 to 140	170 to 190
MW-W	16	27	43	1	20	20 to 40			
NTH IRZ Riverbank Extraction Monitoring Well									
MW-O	1	253	254	4	40	20 to 60	80 to 120	140 to 180	200 to 240
MW-X	1	325	326	4	40	20 to 60	100 to 140	180 to 220	260 to 300
MW-Y	1	325	326	4	40	20 to 60	100 to 140	180 to 220	260 to 300
Slant wells	0	262	262	2	40	150 to 190	210 to 250		
IRL Downgradient Monitoring Well									
MW-M	59	169	228	4	20	70 to 90	110 to 130	155 to 175	195 to 215
MW-R	100	185	285	4	20	115 to 135	160 to 180	205 to 225	250 to 270
IRL Dose Response Monitoring Well									
MW-P	51	275	326	4	30	75 to 105	140 to 170	210 to 240	285 to 315
MW-Q	105	195	300	4	30	110 to 140	160 to 190	210 to 240	260 to 290
IRL Byproduct Monitoring Well									
MW-I	67	278	345	4	30	85 to 115	55 to 185	220 to 250	300 to 330
MW-J	118	218	336	4	30	130 to 160	180 to 210	230 to 260	290 to 320
TCS Loop Transwestern Bench Extraction Monitoring Well									
MW-K	94	24	117	1	20	95 to 115			
East Ravine Extraction Monitoring Well									
MW-T	51	TBD	TBD	2	TBD	TBD			
MW-70BR-D	99	0	69	1	50	235 to 285			

TABLE 3.2-5

Estimated Construction of Proposed Groundwater Monitoring Wells

Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Monitoring Category/ Location ID	Projected Depth to Groundwater (ft bgs)	Projected Saturated Thickness Above Bedrock (ft)	Projected Depth to Bedrock (ft bgs)	Number of Intervals to be Monitored[a]	Length of Interval(s) to be Monitored (ft)[a]	Estimated Depths to be Monitored (ft bgs)[a]			
Freshwater Injection Observation Well									
MW-S	13	149	162	2	40	30 to 70	100 to 140		
Compliance Monitoring Well - Inside Plume									
MW-L	76	177	253	4	20	90 to 110	140 to 160	180 to 200	220 to 240
MW-N	109	131	240	3	20	130 to 150	170 to 190	210 to 230	
MW-10D	95	105	200	1	20	170 to 190			
MW-11D	66	126	192	1	20	150 to 170			
Compliance Monitoring Well - Outside Plume									
MW-U	144	164	308	2	40	150 to 190	230 to 270		
MW-V *	96	89	185	1	40	120 to 160			
MW-Z	24	388	412	4	40	50 to 90	150 to 190	250 to 290	350 to 390
Arsenic Monitoring Well									
MW-AA	41	282	323	2	50	70 to 120	220 to 270		
MW-BB	73	261	334	2	50	90 to 140	220 to 270		
MW-CC *	65	260	325	2	50	90 to 140	220 to 270		
MW-DD	105	230	335	2	50	120 to 170	220 to 270		
MW-EE *	105	228	333	2	50	120 to 170	220 to 270		
MW-FF	105	201	306	2	50	120 to 170	220 to 270		
MW-GG	111	199	310	2	50	120 to 170	220 to 270		
MW-HH	86	90	176	1	50	100 to 150			
MW-II	83	93	176	1	50	100 to 150			

Notes:

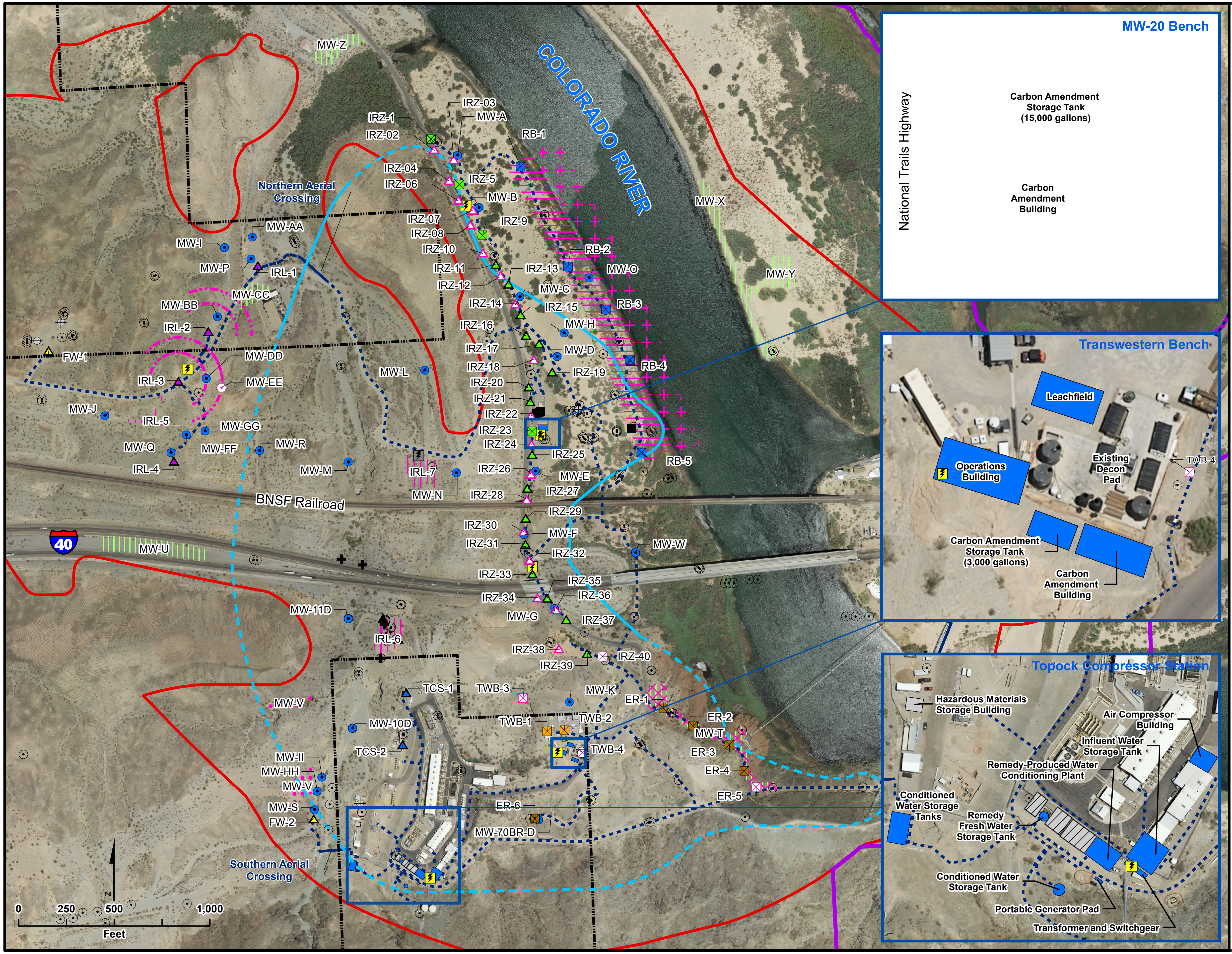
[a] The screened intervals as shown are preliminary, and are based on assumptions in the current site conceptual model (primarily the total projected thickness of the unconsolidated aquifer) as well as the specific purpose of the proposed monitoring location. The number, length, and depths of the monitoring intervals for each location will be finalized concurrent with fieldwork. These decisions will be based on additional information collected during construction of the remedy well network.

Abbreviations:

TBD = To Be Determined
* = Provisional monitoring well

TABLE 3.2-6
Summary of Category 1 Well Information
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Category 1 Well Location	Key Design Assumption Being Confirmed at Category 1 Well Locations	Dependent Well Locations
MW-A	Northern margin of the groundwater plume is defined and the northern extent of the NTH IRZ and RB extraction wells are adequate	Northern IRZ and River Bank Extraction Wells
MW-P	Near the western margin of the groundwater plume	IRL-1, MW-I, MW-AA
MW-S	Outside the western margin of the groundwater plume Saturated thickness above bedrock is adequate for injection well operation	FW-2, MW-HH, MW-II
MW-BB	Near the western margin of the groundwater plume	IRL-2
MW-DD	Near the western margin of the groundwater plume	IRL-3 and MW-EE
MW-FF	Near the western margin of the groundwater plume	IRL-4, MW-Q, MW-J, MW-GG,
MW-70BR-D	East Ravine extraction wells will function properly at the designed total depth; this will not affect East Ravine extraction well siting but could affect design (i.e., depth)	ER-1 through ER-4, ER-6 (potentially), MW-T



LEGEND

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

Existing Wells:

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

Provisional Wells:

(Items in Pink are Provisional)

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

Planned Wells:

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

Pipeline Corridor for Remedy

- Aboveground Pipe
- Underground Pipe/Conduit

Remedy Facilities

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

Note:

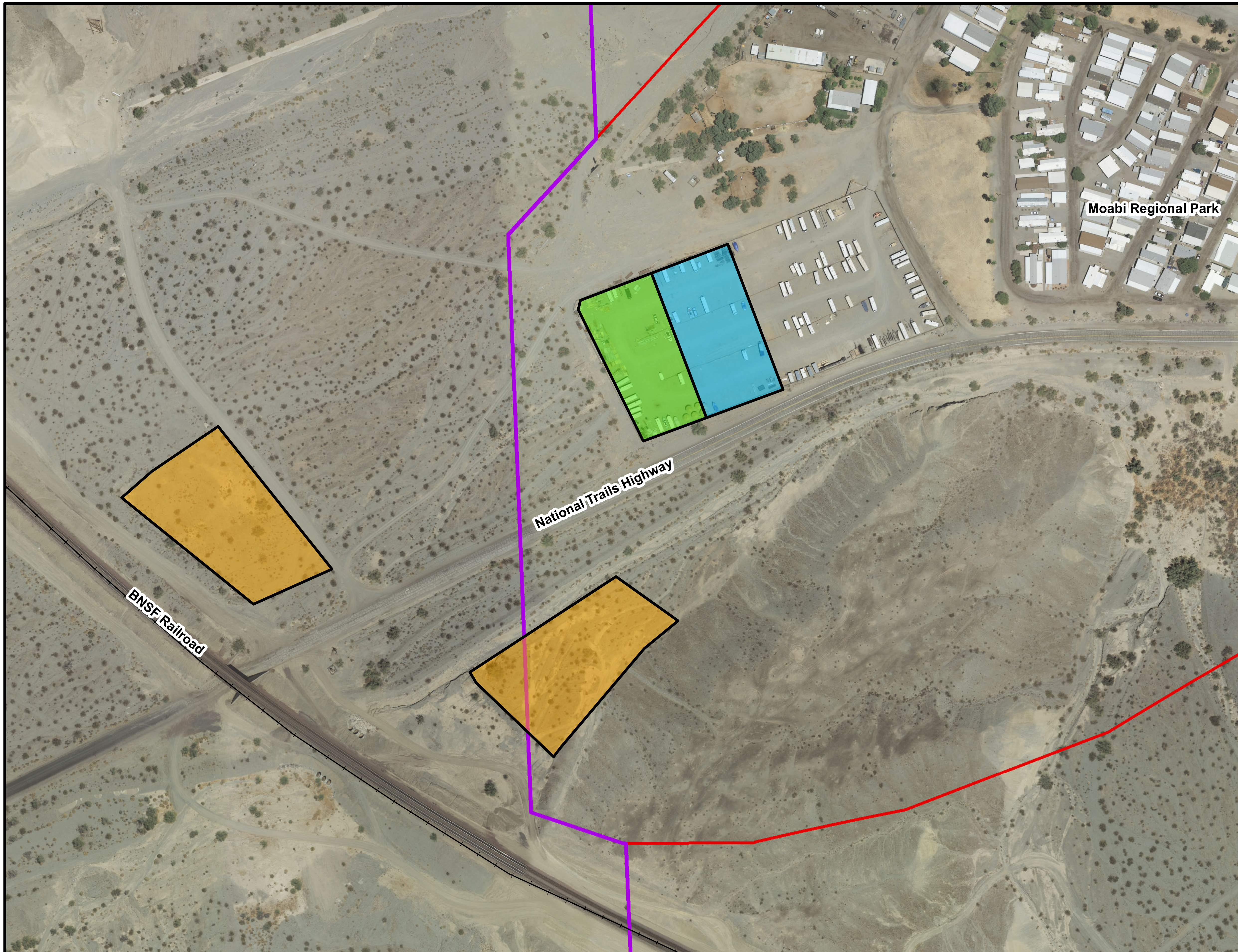
1. Note that in compliance with EIR mitigation measure CUL-1a-9, as well as PA and CHPMP mitigation measures, the pipeline along the dirt road west of National Trails Hwy is located in an existing, previously disturbed, access road. In addition, the location of the road and pipeline was field verified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

FIGURE 3.1-1
GENERAL REMEDY SYSTEM LAYOUT - CALIFORNIA

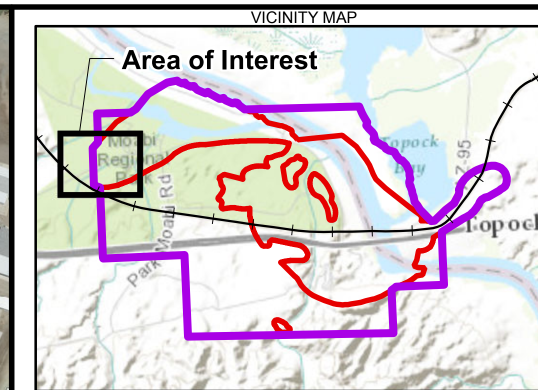
GROUNDWATER REMEDY CONSTRUCTION/ REMEDIAL ACTION WORK PLAN
PG&E TOPOCK COMPRESSOR STATION, NEEDLES, CALIFORNIA

CH2MHILL

Path: \\Zinfandel\proj\PacificGasElectricCo\TopockProgram\GIS\MapFiles\2014\CRAWP\FIG1-2_PM_StagingRemedy_11x17.mxd



VICINITY MAP



LEGEND

- Long Term Remedy Support Area (1.2 acres approx.)
- Soil Storage Area (Each 1.5 acres approx.)
- Temporary Construction Laydown Area (1.3 acres approx.)
- Area of Potential Effects (APE)
- EIR Project Area

Notes:
1. This is a conceptual layout. Locations are approximate.
2. Descriptions of activities/functions anticipated for the construction support areas are included in the Construction/Remedial Action Work Plan.
3. Descriptions of activities/functions anticipated for the long-term remedy support areas are included in Section 3.5 of this BOD, and the O&M Manual.

N

0 95 190 380 Feet

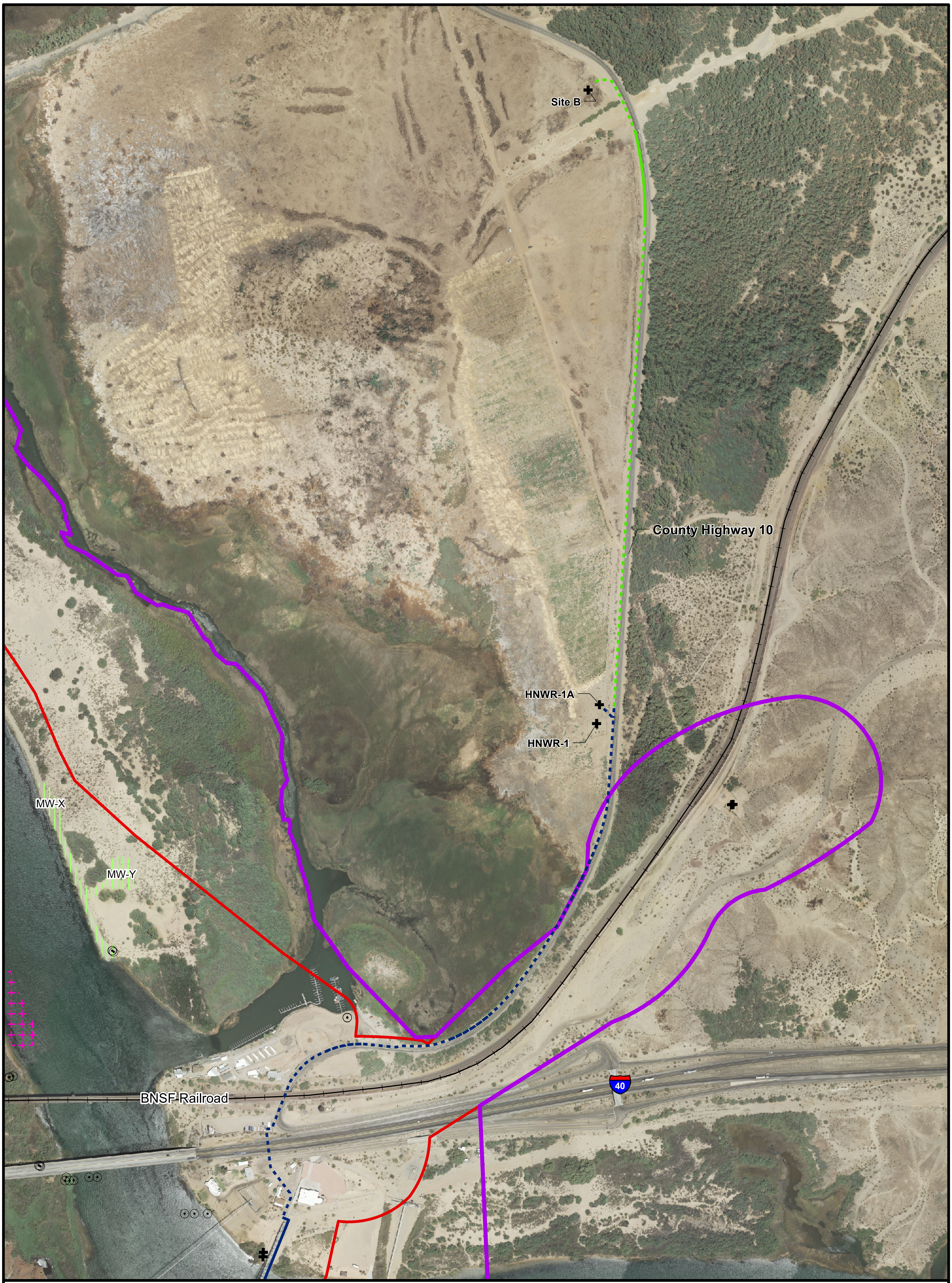
Service Layer Credits: Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community

FIGURE 3.1-2
GENERAL REMEDY SYSTEM LAYOUT - MOABI REGIONAL PARK

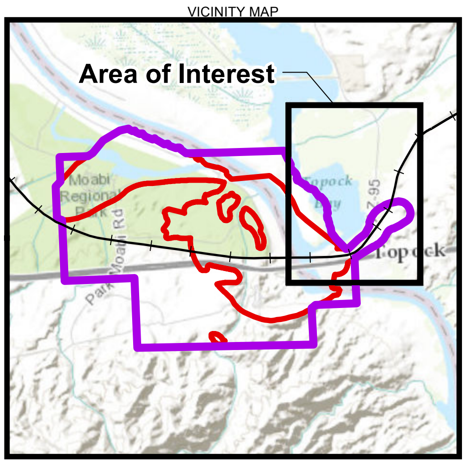
GROUNDWATER REMEDY CONSTRUCTION/
REMEDIAL ACTION WORK PLAN
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL

Path: \\Zinfandel\proj\PacificGasElectricCo\TopockProgram\GIS\MapFiles\2014\CRAWP\FIG312_PM_StagingRemedy_11x17.mxd



VICINITY MAP



LEGEND

Existing Wells:
- Monitoring Well
- Water Supply Well

Planned Wells:
- Area for Monitoring Well (Applies to MW-X and MW-Y)

Provisional Wells:
- Area for Potential Slant Well Screens

Pipeline Corridor for Remedy
- Aboveground Freshwater Pipe
- Underground Freshwater Pipe
- Future Provisional/Contingent Fresh Water Pipe

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

Note:
All wells and remedy structure locations are approximate.

Service Layer Credits: Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community

N

0 200 400 800 Feet

FIGURE 3.1-3
GENERAL REMEDY SYSTEM LAYOUT - ARIZONA
GROUNDWATER REMEDY CONSTRUCTION/
REMEDIAL ACTION WORK PLAN
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL

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LEGEND

Underground Gas Supply Pipe

Proposed Remedy Structure

Notes:

1. All remedy structure locations are approximate.
2. An alternate method of supplying power to the pumps and agitators is by direct connection to the compressor station power system. With this alternative, the new electrical conductors will be installed along the right-of-way that currently contains the discharge pipeline that carries water from the compressor station to the ponds. A small control building or panel would be installed to house the pond controls and communications equipment. PG&E is evaluating this option and will include the selected power supply method in the final (100%) design.

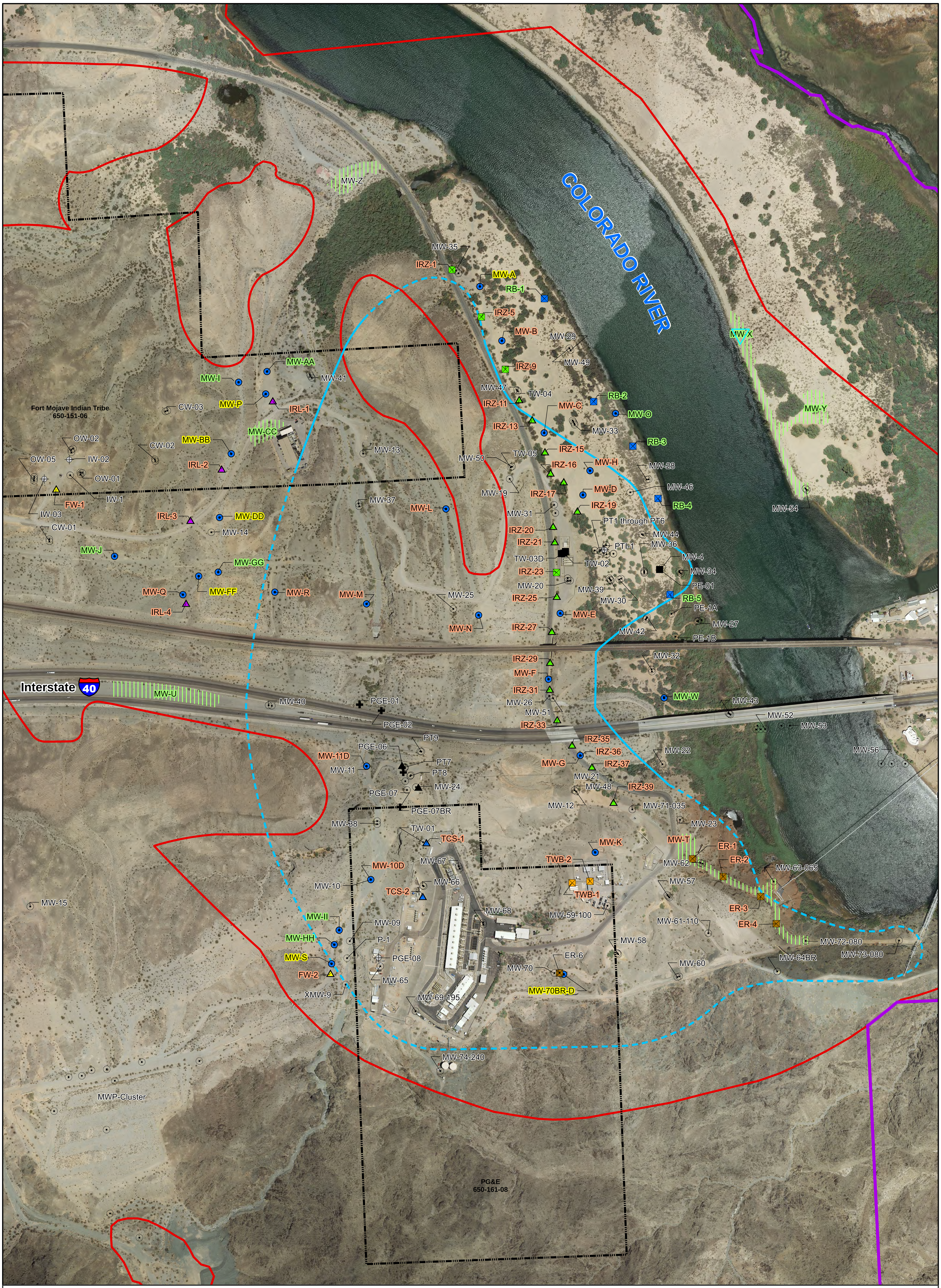
N

0 75 150 300 Feet

FIGURE 3.1-4
GENERAL REMEDY SYSTEM LAYOUT - TCS EVAPORATION PONDS
GROUNDWATER REMEDY CONSTRUCTION/ REMEDIAL ACTION WORK PLAN
PG&E TOPOCK COMPRESSOR STATION, NEEDLES, CALIFORNIA

CH2MHILL

BAO \\ZINFANDEL\PROJ\PACIFICGASELECTRICCO\TOPOCKPROGRAM\GIS\MAPFILES\2014\CRAWP\FIG314_POND_PHOTO.MXD ECLARK1 9/5/2014 11:12:50 AM



LEGEND

Property Boundaries

Area of Potential Effects (APE)

EIR Project Area

Existing Wells:

Extraction Well

Injection Well

Monitoring Well

Water Supply Well

Approximate extent of hexavalent chromium [Cr(VI)] concentrations exceeding 32 micrograms per liter (µg/L) at any depth ingroundwater based on fourth quarter 2013 sampling events. Dashed where based on limited data.

Planned Wells:

Extraction, East Ravine

Extraction, National Trails Highway (NTH) In-situ Reactive Zone (IRZ)

Extraction, Riverbank

Extraction, Transwestern Bench

Injection, Freshwater

Injection, Inner Recirculation Loop

Injection, NTH IRZ

Injection, Topock Compressor Station

Remedy Monitoring Well

Recirculation Well

Area for Monitoring Well

Well Category Highlighting:
Yellow Highlighting for Well Category 1
Green Highlighting for Well Category 2
Orange Highlighting for Well Category 3

Note:

1. Note that in compliance with EIR mitigation measure CUL-1a-9, as well as PA and CHPMP mitigation measures, the pipeline along the dirt road west of National Trails Hwy is located in an existing, previously disturbed, access road. In addition, the location of the road and pipeline was field verified and does not create any direct physical impact or effect on the Topock Maze, as it is manifested archaeologically, in compliance with EIR mitigation measure CUL-1a-10, PA, and CHPMP mitigation measures.
2. All well and structure locations are approximate.

N

0 170 340 680 Feet

FIGURE 3.2-1
ESTIMATED APPROACH TO WELL NETWORK CONSTRUCTION
CONSTRUCTION/REMEDIAL ACTION WORK PLAN
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL

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SECTION 4

Site Management Plan

This section contains the site management plan required by CD SOW Section 3.2 and describes overall procedures and practices to be followed during construction and startup of the groundwater remedy. Procedures and practices described herein include coordination with other project or site activities; mobilization and site preparation; site access and security; protocols for visitors and monitors; waste management, environmental controls, and BMPs during construction to manage waste materials, construction footprint, dust, and erosion.

4.1 Coordination with Other Project or Site Activities

Construction of the groundwater remedy will occur over an approximately 2- to 3-year period, followed by approximately 1 year of construction closeout, and the remedy will be constructed within an approximately 35-acre area owned by a variety of land owners in both California and Arizona. Remedial infrastructure is planned on federal lands, as well as non-federal lands, including lands owned by BNSF Railway, Kinder Morgan, the FMIT, and private property owners in the Topock Marina area. In addition, infrastructure is planned on county roadways or their ROWs (San Bernardino County, Mohave County), as well as roadways/ROWs of Caltrans and ADOT. Remedy pipelines will also cross other foreign utilities' ROWs (for example, Southwest Gas, Kinder Morgan, SoCal Gas, Transwestern Pipeline, Frontier Communications, Mohave Electric Coop, Needles Electric, and Southwest Water). As such, it is important that construction of the groundwater remedy be well-coordinated with other neighboring project or site activities.

As described in the 90% BOD Report, PG&E is in the process of obtaining access agreements and/or other approvals, permits, and agreements with the appropriate entities that own the land where groundwater remedial infrastructure will be constructed or temporary support facilities will be located. It is anticipated that those agreements, approvals, and permits will outline specific requirements for coordinating construction with existing transportation and utility entities and landowners, and PG&E will comply with the terms of those agreements. PG&E will also obtain necessary permits and approvals for lane closure of public roads or construction within state or county ROWs and road and railway crossings or crossing of the Colorado River on the Arch Bridge. Access agreement, permits, and approvals are expected to include provisions regarding communications, coordinating schedules for construction with landowners, minimizing disturbance, ensuring safety, and performing restoration following construction.

Coordination of construction activities with other PG&E operations and activities will be performed throughout the construction. Key components of the coordination will be associated with TCS operations, IM operations, and Soil RFI/RI activities. The discussion of coordination with other project or site activities in this section meets the requirement of CD Paragraph 13.b.3: Schedule for developing and submitting other required remedial action plans.

4.1.1 Coordination with TCS Operations

The TCS compresses natural gas for transportation through pipelines to PG&E's customers in northern and central California. TCS facilities include natural gas pipelines; TCS fenced operational structures, including the compressor building, cooling towers, offices, warehouse, vehicle garage, maintenance buildings, storage buildings, and aboveground tanks; four evaporation ponds connected to the TCS via a wastewater pipeline; and supporting roads, water, and power. Pipeline facilities include two 34-inch pipelines, two pipeline bridges across the Colorado River, valves, and cathodic protection.

Groundwater remedial facilities to be constructed on the TCS parcel include structures, pipelines, and wells. Structures to be located on the TCS parcel include:

- Remedy-produced Water Conditioning Plant
- Conditioned Water Storage Tanks and Secondary Containment
- Influent Water Storage Tanks and Secondary Containment
- Freshwater Storage Tank
- Decontamination Pad (occupies the same footprint as the Contingent Freshwater Pre-injection Treatment Building)
- TW Bench Carbon Amendment building
- TW Bench Carbon Tank
- TW Bench Operations Building

In addition to the groundwater remedy infrastructure to be built on the TCS parcel, construction will occur along the access road to the TCS, in areas immediately surrounding the TCS parcel (including the Arched Bridge over the Colorado River), and at the TCS evaporation ponds.

Key coordination issues with the TCS staff will include scheduling construction activities to minimize disturbance to TCS operations, communications, space considerations, safety, coordination of shared utilities (water, power, wastewater), and design compatibility. Construction activities that occur in PG&E's gas pipeline ROWs will be coordinated with PG&E Gas Operations. Many of these issues were considered during design but will also require coordination during construction.

4.1.2 Coordination with Ongoing IM-3 Activities

PG&E has been implementing an interim measure at the Topock site since March 2004 for the purpose of stabilizing the groundwater contamination until implementation of the groundwater remedy. The IM, currently designated as IM No. 3 or IM-3, consists of groundwater extraction for hydraulic control of the plume boundaries in the Colorado River floodplain and management of extracted groundwater. The location of existing primary IM-3 components, including facilities, pipelines, and extraction, injection, and monitoring wells, are shown on Figure 4.1-1 and 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 involving 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.

During most of the period under which the groundwater remedy will be constructed, the IM-3 system will be operational, and the groundwater remedy construction must minimize interference with the existing IM-3 wells, pipelines, treatment plant, and MW-20 Bench facilities and access to those facilities. For example, portions of the remedy piping corridor and the construction area for remediation wells FW-1, IRL-1 and IRL-3 will occupy the same corridor as the IM-3 piping; therefore, the construction must be done with care so as to not damage the IM infrastructure in the corridor. The construction project will coordinate with IM-3 to install temporary or jumper piping around planned remedy infrastructure during construction to allow for continued IM-3 operation, as necessary.

The IM-3 treatment and injection system will be used during the construction period as one of several methods to manage water generated from construction and for testing of new wells and pipelines.

After the DTSC has determined that PG&E may cease IM-3 operations, the IM-3 treatment plant will be placed in standby mode. The layout of the IM-3 system is described in Appendix F to this C/RAWP. IM-3 decommissioning activities will be implemented after receipt of approval for IM-3 decommissioning by DTSC, with concurrence from the DOI, in accordance with Exhibit A to the 2012 Settlement Agreement between DTSC and the FMIT.

4.1.3 Coordination with Soil RCRA Facility Investigation/Remedial Action Activities

PG&E is planning and implementing site investigation and remediation activities associated with identified soil investigation areas under both RCRA and CERCLA. Currently, there are 35 identified soil investigation areas within and surrounding the TCS associated with past TCS operations. PG&E is planning additional investigation activities at the soil investigation areas that may occur simultaneously with construction of the groundwater remedy (CH2M HILL 2013). Soil investigation activities are expected to include drilling and soil sampling, potential plant or other biota sampling, pilot testing, equipment staging and decontamination, and investigation-derived waste management.[3] As such, groundwater remedy construction will be coordinated with soil investigation activities, to the extent practical, to minimize disruption to the schedule of either project’s activities, ensure safety, minimize footprint, and share resources and facilities.

In addition to coordinating schedules and activities with the soil investigation program, the construction of the groundwater remedy will be managed to control exposure to and control of potential contaminants at the soil investigation areas. Section 4.4 presents site controls and procedures for health and safety, personnel air monitoring, soil management, and decontamination for areas where groundwater remedy facilities will intersect with soil contamination areas. The Soil Management Plan in Appendix L to this C/RAWP includes existing information on locations of soil investigation areas, as well as known or potential contaminants in those areas. Additional characterization data collected during the soil investigation program and the baseline soil sampling program will be used during groundwater remedy construction to inform and adjust controls and procedures as needed. Figure 4.1-2 and Exhibit 4.1-1 identify the overlap between groundwater remedial infrastructure and soil investigation areas.

[3] At this time, it is not anticipated that the soil investigation areas will move through the site characterization and remedy selection process such that remedial action will occur at the soil investigation areas at roughly the same time as groundwater remedy construction.

EXHIBIT 4.1-1

Soil RCRA Facility Investigation/Remedial Investigation SWMUs, AOCs, and Undesignated Areas

Construction/Remedial Action Work Plan for the Final Groundwater Remedy, PG&E Topock Compressor Station, Needles, California

Soil Investigation Areas		Overlaps or Is within 20 feet of Groundwater Remedy Infrastructure? (Y/N)—List type of infrastructure
Located Outside the Topock Compressor Station Fence Line		
SWMU 1	Former Percolation Bed	No
AOC 1	Area Around Former Percolation Bed	Yes – wells, pipes
AOC 4	Debris Ravine	Yes – pipes
AOC 9	Southeast Fence Line (Outside Visitor Parking Area)	Yes – pipes
AOC 10	East Ravine	Yes – pipes, wells
AOC 11	Topographic Low Areas	Yes – pipes, wells, building
AOC 12	Fill Area	Yes – pipe, wells
AOC 14	Railroad Debris Site	No
AOC 27	MW 24 Bench	Yes – well
AOC 28	Pipeline Drip legs	Yes – pipes, wells
AOC 29	IM-3 Treatment Plant	No
AOC 30	MW 20 Bench	Yes – pipes, wells, building, tanks
AOC 31	Former Teapot Dome Oil Pit	No
UA 1	Potential Pipe Disposal Area	No
UA 2	Former 300B Pipeline Liquids Tank	No
Located Inside the Topock Compressor Station Fence Line		
SWMU 5	Sludge-Drying Beds	No
SWMU 6	Chromate Reduction Tank	No
SWMU 8	Process Pump Tank	No
SWMU 9	Transfer Sump	No
SWMU 11	Former Sulfuric Acid Tanks	No
AOC 5	Cooling Tower A	No
AOC 6	Cooling Tower B	No
AOC 7	Hazardous Materials Storage Area	Yes – pipes, tanks
AOC 8	Paint Locker	Yes – pipes, tanks
AOC 13	Unpaved Areas within the Compressor Station	Yes – pipes, wells, buildings
AOC 15	Auxiliary Jacket Water Cooling Pumps	No
AOC 16	Sandblast Shelter	No
AOC 17	Onsite Septic System	Yes – pipes, building
AOC 18	Combined Hazardous Waste Transference Pipelines	Yes – pipes
AOC 19	Former Cooling Liquid Mixing Area and Former Hotwell	No
AOC 20	Industrial Floor Drains	No
AOC 21	Round Depression near Sludge-drying Bed	No
AOC 22	Unidentified Three-sided Structure	Yes – pipes
AOC 23	Former Water Conditioning Building	No
AOC 24	Stained Area and Former American Petroleum Institute Oil/Water Separator	No
AOC 25	Compressor and Generator Engine Basements	No
AOC 26	Former Scrubber Oil Sump	No

EXHIBIT 4.1-1
Soil RCRA Facility Investigation/Remedial Investigation SWMUs, AOCs, and Undesignated Areas
Construction/Remedial Action Work Plan for the Final Groundwater Remedy, PG&E Topock Compressor Station, Needles, California

Soil Investigation Areas		Overlaps or Is within 20 feet of Groundwater Remedy Infrastructure? (Y/N)—List type of infrastructure
AOC 32	Oil Storage Tanks and Waste Oil Sump	No
AOC 33	Potential Former Burn Area near AOC 17	Yes – pipes
Unit 4.3	Oil/Water Holding Tank	No
Unit 4.4	Oil Water Separator	No
Unit 4.5	Portable Waste Oil Storage Tank	No
Perimeter Area		Yes – pipes, wells
Storm Drain System		Yes – pipes

4.2 Preconstruction Activities

This section presents the preparation activities that will be conducted prior to the beginning of construction, including project initiation with the agencies and stakeholders (including Tribes), mobilization of construction facilities and staff, work area preparation and demarcation, and documentation of preconstruction work area conditions. In addition, this section presents plans for establishing the water source and power supply to support construction.

4.2.1 Project Initiation Meeting

Consistent with other phases of work conducted at the Topock site, PG&E will invite agency representatives and other stakeholders (including representatives of Tribes involved with the Topock project) to the site for a project initiation meeting. This meeting will be scheduled to occur prior to the start of primary construction activities. During the meeting, PG&E will present an overview of the activities that will be conducted as part of this C/RAWP, discuss various cultural and biological sensitivities associated with the project, introduce key project team members (including subcontractors), identify requirements for site visitors, describe applicable site safety and communication protocols, and review plans for project communications with the agency and stakeholders during work.

4.2.2 Mobilization

Mobilization of people and equipment to the site will include the setup of three primary yard areas located in the western area of Moabi Regional Park to support the remedy construction for approximately 2 to 3-year period, followed by approximately 1 year of construction closeout,:

- **The main construction yard (also known as the Construction Headquarters [CHQ]).** The CHQ will serve as the central work/meeting space for all site workers/contractors and visitors, and will be a primary area for the staging of equipment (drill rigs, excavators, backhoes, cranes, etc.) and supplies (pipes, valves, transformers, well materials, etc.). Supporting activities at the CHQ include establishing required utilities, restroom facilities, safety and security measures, and office space.
- **The soil staging/processing area**. This area is where soil and material displaced during construction activities will be brought for staging, processing and potential reuse at the project site. Imported material for use in construction may also be temporarily staged here.
- **The soil container storage area.** This area will serve as the primary storage and management area for containerized soil displaced from the site during construction that is pending final disposition in accordance with the Soil Management Plan (see Appendix L).

The location of these areas is shown on Figure 4.2-1. As shown on this figure and as further detailed on Figure 4.2-2, the CHQ comprises two areas: the temporary construction laydown area and the long-term remedy support area. After construction is complete, PG&E proposes to reduce the CHQ area to the smaller long-term remedy support area, which will serve as the primary yard supporting a smaller team during the O&M of the remedy, which is expected to last for approximately 30 years, followed by approximately 10 years of long-term monitoring and up to 20 years of additional arsenic monitoring. Additional notes regarding the proposed conceptual layout and use of these support areas are listed below:

- The footprint for the CHQ has been designed to simultaneously support multiple contractors and their respective employees, equipment, tools, materials, and supplies.
- The portion of the CHQ identified as the temporary construction laydown area includes features that will be removed after the construction is completed. These features will include portable office trailers, tool storage containers, construction materials, and construction equipment.
- The active equipment in the soil staging/processing area is expected to only be needed during the construction of the remedy. After the construction is complete, this area may be used as a location for storage of stockpiles of clean soils. Clean soils may also be used in this location as fill material at the landowner's request.
- The soil storage area will be needed until final disposition of containerized soil has been determined.
- Utility features for the CHQ will include the use of power, water, and sewer services. After the layout and features becomes firm, PG&E will work with the City of Needles to determine the power supply details and with the BLM and San Bernardino County for water supply and sewer management details.

4.2.3 Site Preparation and Demarcation

Site preparation and demarcation activities include demarcating work area limits, identifying biologically and/or culturally sensitive areas, identifying subsurface utilities and other existing constraints, documenting preconstruction site conditions, and establishing access routes and work areas that will minimize impacts to these features to the extent possible. This work will be conducted in accordance with EIR Mitigation Measure CUL-1a-8n, as presented in Section 2.14 of the CIMP, Protocols for Protective Measures for Archaeological/Historical Sites during Construction; Section 6.6.3 of the CHPMP, Avoidance Measures/Management Thresholds; Section 3.4 of the PBA, General Project Management Measures CDFW avoidance and mitigation measures, and the protocol for compliance with EIR MM BIO-1 and ARAR #32.

Site preparation and demarcation activities will be conducted for areas where construction-related activities occur and include the following types:

- **Primary Work Zones.** These zones are defined as the immediate area where actual construction will occur for a given component of remedy infrastructure. For example, the primary work zone for the construction of a well will consist of a defined area around the well location, while the zone for the construction of a pipeline will consist of an area on one or both sides along the length of the pipeline. To the extent feasible, primary work zones will be limited to previously disturbed areas (that is, minimizing use of undisturbed areas and those potentially exposed to differential compaction).
- **Support Zones (Staging Areas).** Most of the staging areas will be located adjacent to or near primary work zones to support construction. Staging areas are existing open areas (that is, minimizing use of undisturbed areas and those potentially exposed to differential compaction) that can be used to minimize the size of the primary work zones by centrally placing temporary facilities, such as portable toilets and breaks areas, and for laydown of construction equipment, materials, supplies, and tools. Displaced soil, material (asphalt), and water generated in the primary work zones might also be temporarily staged in a staging areas en route to the designed storage or disposition area so that the size of the primary work zones can be minimized. Staging area will also be used to coordinate

transportation activities—for example, a staging area for the management of wastewater generated during well construction and development on the flood plain—will be set up at the centrally located MW-20 Bench. This central wastewater management area will include a series of portable frac tanks for temporary storage of wastewater, a truck haul station for hauling of wastewater, and pumping facilities to pump the wastewater to the IM-3 treatment plant, as appropriate, thereby limiting the need for these activities in the primary work zones on the flood plain.

- **Access Routes.** These pathways consist of existing and new routes that are required for workers, equipment, and materials to access the primary work zones and staging areas.

The location of access routes and staging areas are depicted on Figure 4.2-3. Primary work zones will be co-located with planned remedy infrastructure and are not specifically indicated on Figure 4.2-3. The precise boundaries of primary work zones, staging areas, and access routes will be identified and demarcated in the field prior to construction, with participation from qualified archaeological monitor(s) and biologist(s) to exclude the locations and boundaries of known biological resources, archaeological and historical resources, and other cultural sites requiring protective measures to the maximum extent practicable. These demarcations are temporary by nature and will be precisely demarcated in the field to minimize the total area needed to support a given construction activity. The demarcation process for each of these areas will be implemented as needed as field work is conducted in a given area.

Tribal monitors will be invited to participate in/or observe the demarcation of work areas. If warranted, protective measures may be employed on or around archaeological or historical sites to protect the resource from disturbance. These measures may include, but are not limited to, protective coverings of soil or riprap, onsite personnel to prevent access to sensitive areas, use of flagging, blaze-orange mesh fencing secured to steel posts, bollards, natural barriers of rocks or piled brush, cables suspended between secure posts, K-rails, and/or signage (for example, “This Area Closed” or “Exclusion Zone: Keep Out”). Such measures will be temporary (only as needed during construction) and will, to the extent practicable, not call undue attention to the nature of the resource being protected.

In accordance with Occupational Safety and Health Administration requirements and the Health and Safety Plan, exclusion zones, contaminant reduction zones, and support zones will be established for primary work zones in potentially contaminated areas. BMPs will be implemented as appropriate within the primary work zones or staging areas, including the placement of plastic sheeting or other covering on the ground to minimize potential impacts from construction materials and equipment (both active and idle). Other site preparation activities will include construction staking, installing erosion and sedimentation controls and other temporary environmental controls in accordance with the BMP Plan (see Appendix M to this C/RAWP), delineating access/haul routes between primary work areas and staging areas posting of signage, planning and setup of work observation locations, site orientation, setting up health and safety equipment, and similar activities.

4.2.4 Documentation of Preconstruction Site Conditions

Site preparation will include documentation of preconstruction site conditions, including utility surveys, photographic documentation, and baseline soil sampling. In addition, PG&E may, at its discretion, perform a pre-construction aerial survey of the construction area. Also, in conformance the PBA, the BIAMP, and other requirements, a qualified biologist will conduct pre-construction surveys for special status wildlife species and nesting birds.

4.2.4.1 Aboveground and Underground Utility Survey

A survey of aboveground and underground utilities will be conducted within all work areas prior to beginning site preparation and construction activities. These surveys, which may be conducted at different times during construction as work in a given area is initiated, will include the following activities at a minimum:

- Site-specific reconnaissance, which will include a visual inspection of work areas and review of available site utility plans and as-built documentation.
- Notification to the one-call notification center that supports the Southern California area (Underground Service Alert or "Dig Alert") and Arizona (Blue Stake or "Arizona 811") to identify utilities that operate within the respective work areas. These notifications will also be used to notify a given utility owner of planned field work to determine if a stand-by field representative is required for field oversight.
- Surface geophysical survey of the work areas to supplement and confirm the information obtained from the one-call notification. These surveys will utilize various remote sensing tools to identify underground features. The geophysical methods that may be used, as determined appropriate in the field, include electromagnetic locators, radio frequency locators, magnetic locators, metal detection, and ground-penetrating radar.

In addition, proposed locations of field work will be reviewed with PG&E and landowners, leaseholders, and/or utility companies with personnel knowledgeable regarding the locations of the existing utilities, and in conformance with land use agreements. Prior to field work and as determined necessary by the utility owner, all known or suspected utilities that are identified through the activities above will be exposed by hand or with soft excavation equipment (for example, hydrovacuum excavation). The appropriate exposure method will be selected in consultation with the owner of the feature (as appropriate) and may be dependent upon the type of feature being investigated. Those utility services that will require lockout/tagout, shut off, or relocation to carry out the work will be identified in cooperation with the utility owner. Lockout/tagout will be performed only by qualified personnel.

4.2.4.2 Photograph Documentation

Photographs will be taken to document the preconstruction site conditions of the work areas and will be referenced when assessing requirements for post-construction site conditions, and biological restoration. See photo documentation requirements in the CIMP (CUL-1a-8e), the PBA, HNWR Habitat Restoration Plan (Appendix G), the Aesthetics and Visual Resources Protection and Revegetation Plan (Appendix N), and the Habitat Restoration Plan for Riparian Vegetation and Other Sensitive Habitats (Appendix O).

4.2.4.3 Baseline Soil Sampling

To document baseline soil conditions prior to groundwater remedy implementation, soil samples will be collected and analyzed in accordance with the Baseline Soil Sampling and Analysis Plan. The Sampling and Analysis Plan also includes the collection of data to assist with the management of materials displaced during construction activities in accordance with the Displaced Material Management Protocols. The Sampling and Analysis Plan is included in Appendix A of the Soil Management Plan (see Appendix L of this C/RAWP).

4.2.5 Construction Water Supply

A construction water supply will be established to support field work. Example uses for construction water include dust control, equipment decontamination, process water for well construction and development, hydrostatic testing of constructed pipelines, and other activities. Potential sources of water include:

- **Existing TCS water supply system.** This supply will be accessed by a temporary storage and distribution system so interference with TCS operations is minimized. The existing water supply pipe will be tapped and a temporary aboveground pipe (1- to 2-inch-diameter high-density polyethylene pipe) will convey water from the tap to a temporary freshwater storage tank staged in the vicinity of the turnout area outside east of the PG&E TCS entry gate.
- **Existing freshwater supply well in Arizona (HNWR-1A).** This supply will be accessed either at the wellhead (typically, to support construction in Arizona) or through Pipeline B once constructed. Water

will be pumped from the well using either a temporary pump/power supply (generator) or using the remedy equipment and power supply once constructed.

- **Treated water from IM-3.** Excess treated water from IM-3 will be accessed by the existing IM-3 storage and distribution system, or utilizing a temporary storage and supply system.
- **Existing water supply for Park Moabi.** This water supply is included as a contingency and will only be accessed as determined necessary and as authorized by the landowner. A water supply station will be established in the CHQ area using a temporary storage and distribution system.
- **Other commercially available supplies.** Water will be obtained, as necessary, from commercially available supplies including, but not limited to, Golden Shores Water Company and City of Needles. Water will be transported to the site via water truck.

Primary construction water supply tanks (typically 12,000-gallon overhead fill tank) will be staged near the given water source. Typically, water trucks will be used to convey water from the water sources to the work areas to support field work and wetdown vehicle traffic routes, as determined necessary to suppress dust; however, a temporary network of aboveground distribution pipes (1- to 2-inch-diameter high-density polyethylene pipe) may be employed to convey water to the appropriate work areas, where feasible, to minimize the disturbance associated with water truck traffic. Secondary construction water tanks will be placed in the primary work zones or adjacent staging areas in California and Arizona to support construction in a given work area, as determined necessary, and will be removed once work in that area is complete.

4.2.6 Construction Power and Lighting

In general, construction power will be supplied by portable generators, whenever utility power is not readily available near the point of use. With the exception of security lighting at Park Moabi in the CHQ area, which might be supplemented for the CHQ, temporary lighting will be supplied by portable generators and light plants, as needed. While night work is not planned as part of routine construction activities, it may be determined that limited circumstances require the continuation of work into the nighttime because it cannot be disrupted or suspended (for example, special conditions during drilling or concrete pouring). For these special circumstances, nighttime construction lighting will be used in accordance with EIR Mitigation Measure CUL-1a-7, which includes protocols for nighttime lighting, as discussed in Section 4.6 of this C/RAWP.

4.3 Site Management Practices

This section provides details related to general site management including site access and security, site visitation protocols, and transportation routes and protocols.

4.3.1 Site Access and Security

Site access and security provisions during construction include preserving access to the project area, engineering controls for safeguarding equipment and constructed facilities, inspections, and notification and reporting. Land management and ownership considerations affect site access and security. A portion of the groundwater remedy will be constructed on land owned by PG&E. However, most of the land in the project area is owned by the United States and managed by federal agencies. Portions of these federal lands are also used by other entities, such as the Caltrans, ADOT, San Bernardino County, Mohave County, and various utility companies through leases, easements, and ROWs. The rest of the land in the project area is owned by private or governmental parties, including BNSF, the FMIT, and other owners of smaller parcels in Arizona. Provisions for site access and security of the groundwater remediation system will be coordinated with these entities, as necessary. Details of site access and security will be defined in the final agreements with land owners, lease holders, and utility companies.

In conformance with EIR Mitigation Measure CUL-1a-2 and the PA, protocols have been developed to preserve Tribal members' access to, and use of, the project area for religious, spiritual, or other cultural purposes, to the extent that PG&E has the authority to facilitate such access. The protocols are contained in the Access Plan, provided as Appendix P to this C/RAWP. Tribal access issues and procedures vary according to land ownership: federal property, private parcels not owned by PG&E, and PG&E-owned property. PG&E is committed to accommodate Tribal access requests in accordance with these procedures, in consideration of landowner requirements, health and safety concerns, and to ensure noninterference with approved remediation activities and TCS operations. On PG&E-owned property, for safety and security purposes, a PG&E escort is required for Tribal representatives, and Tribal access must be consistent with PG&E safety requirements and must not interfere with approved remediation activities or TCS operations.

In addition, site visitors (including federal and state agency personnel and interested stakeholders) will be accommodated throughout the duration of the construction phase. Procedures for visitors associated with the project—such as regulators, landowners, and leaseholders of land or facilities entering work areas (access routes, primary work zones, and staging areas), utility companies, stakeholders, and Tribal monitors—are described in Section 4.3.2.

In conformance with EIR Mitigation Measure CUL-1a-3b and for protection of the groundwater remedy infrastructure and facilities, a Site Security Plan has been developed and is provided as Appendix Q. The Site Security Plan outlines PG&E security plans and protocols, including physical security measures, inspections, notification, and reporting. Security for remedial facilities inside the compressor station will be provided for by the existing TCS security system. Construction contractors will establish and enforce their own separate security measures for safeguarding their equipment, materials, and constructed facilities. The Health and Safety Plan also outlines security measures that will be followed for all work activities, including hazardous materials and waste storage (as necessary).

Engineering controls are anticipated to be established to safeguard equipment, materials, and constructed remedial facilities and to protect the health and safety of personnel, the public, and the surrounding environment in accordance with the Site Security Plan. During construction, PG&E will establish a fenced CHQ area with controlled access, cameras, and a security system consistent with PG&E's current security standards. Separately, satellite staging areas will be established for use by construction contractors, in areas approved by PG&E, for storage of equipment and supplies. Some of the satellite staging areas may be fenced and locked and may also include cameras and alarms. A subset of the staging areas discussed during the 60% comment resolution process will be used during construction; the proposed areas are presented in Figure 4.2-3 (the numbering scheme used during 60% comment resolution was retained on this figure for ease of referencing).

The contractor/contractors may elect to install additional security measures; these measures will be coordinated with and approved by PG&E or their responsible representative. Lighting for security of construction equipment and materials will be temporary and will be minimized to the extent feasible in conformance with Mitigation Measure CUL-1a-7.

Protocols for protective measures for archaeological/historic sites during construction are provided in the CIMP and CHPMP. Protective measures may include, but are not limited to, protective coverings of soil or riprap, onsite personnel to prevent access to sensitive areas, use of flagging, blaze-orange mesh fencing secured to steel posts, bollards, natural barriers of rocks or piled brush, cables suspended between secure posts, and/or signage (for example, "This Area Closed" or "Exclusion Zone: Keep Out"). These measures will be temporary (only as needed during construction) and will, to the extent practicable, not call undue attention to the nature of the resource being protected. In accordance with the Site Security Plan, inspections will be performed to increase observation of potential intrusions during construction other impact significant cultural resources. Should a designated inspector observe disturbance to the environment, notification will be provided to DTSC and the corresponding landowner.

4.3.2 Protocols for Visitors and Monitors

Safety for visitors and monitors is a high priority for this project; therefore, prior to entering the construction site, visitors and monitors associated with the active construction must check in at the CHQ, which serves as the point of contact location, and must be properly attired for safety. At the CHQ, visitors will sign the visitors' log and meet the designated PG&E representative for the site visit. First-time visitors will be provided with cultural resources awareness and site safety orientation and, if appropriate, biological resources awareness training, prior to further work at the site. Visitors will complete a signoff form before entering the site for the first time acknowledging understanding of the site access requirements. Repeat visitors will be asked to renew their understanding of the site access requirements annually. A master list of companies and utilities and their employees and individuals who have signed the signoff form will be kept at the construction office and will be verified when each person arrives at the site.

Visitors to the site will meet the designated PG&E representative to verify that he/she is aware of the visit and obtain instructions on access restrictions or considerations related to the purpose of the visit. To ensure safety for vehicular traffic on NTH during the busy construction period, PG&E may arrange for transportation of visitors and monitors to the construction site or might otherwise organize consolidation of travel vehicles associated with the purpose of the visit. Visitors will not travel around the site without an escort unless the Site Operations Manager or his designee permits otherwise. Visitors will be told not to enter restricted areas unless an archaeological or biological monitor is present. Because PG&E anticipates that Tribal monitors and agency observers are likely to be onsite to observe much of the construction work, PG&E will arrange appropriate safe viewing locations for site observers. Upon arrival to the site, PG&E will establish a protocol for observers to communicate and check in with PG&E's construction team.

To minimize interference with ongoing TCS operations during remedy construction, access to the TCS will be limited to essential construction personnel and visitors/monitors needing to observe the construction work.

Consistent with EIR Mitigation Measure CUL-1a-8l, as formulated in Section 2.12 of the CIMP, Protocols for Tribal Monitors to Observe Ground Disturbing Activities; and in the sections "Tribal and Archaeological Monitoring Protocol" in the PA and CHPMP, PG&E will notify the Interested Tribes of planned ground-disturbing activities and other scientific surveying being conducted in anticipation of construction activities. This provides the opportunity for Tribes to send Tribal monitors to the site to observe these activities, if they wish. While onsite, Tribal monitors will have the opportunity to discuss concerns directly with the PG&E project team while the activities are proceeding, as well as reporting their observations and any issues of concern directly to the Tribe(s) that they represent.

After a schedule for field activities has been established and communicated, each Tribal monitor can choose their arrival and departure times at the work site. Scheduled project activities will not be delayed if a notified monitor does not arrive at the time that the work is scheduled. If the field activity schedule changes, the Tribes will be notified as soon as practicable. It is the responsibility of monitors to report to and maintain ongoing communication with their respective Tribe(s). Each Tribal monitor will prepare a Daily Monitoring Log, which will be signed by the monitor and the designated site supervisor and/or PG&E's onsite project manager (or designee), and will be submitted to PG&E at the end of each day. PG&E will provide a copy to the Tribe(s) upon request. Monitoring of ground-disturbing activities will be in accordance with this protocol, as well as with the "Tribal and Archaeological Monitoring Protocol" of the PA (BLM et al. 2010).

The safety requirements identified in the "Tribal and Archaeological Monitoring Protocol" of the PA will apply at all times, as well as the requirement for all monitors to check in to the CHQ or designated location at the start of work each day. Monitors will be expected to actively participate to enhance the safety of themselves and the other workers onsite by communicating with PG&E's site supervisor if any safety concerns are identified. Due to safety considerations at the construction site, monitors will be prohibited from conducting any monitoring within designated construction exclusion areas inside the primary work zones, unless otherwise authorized by PG&E. Such zones will be clearly delineated to the Tribal and archaeological monitors by PG&E's Site Supervisor. In these situations, PG&E will provide alternative methods for accommodating monitors including, but not limited to, high-powered binoculars, spotting scopes, or other vision enhancement tools or alternative viewing platforms will occur.

4.3.3 Transportation Routes and Traffic Control

Figure 4.2-3 illustrates the proposed traffic routes, along with the primary truck inspection station, and check-in points for trucks. Traffic routes will be updated as needed throughout the construction planning process and, where possible, existing unpaved access roads will be used and maintained for different stages of construction to limit the potential for differential compaction of undisturbed areas. Day-to-day routine construction vehicle and heavy equipment traffic will typically be routed between the CHQ (Area 3 on Figure 4.2-3) and a given construction area using the routes shown on Figure 4.2-3. Nonroutine traffic entering the project site will check in at a designated check-in location prior to entering the site. The check-in location will typically be the CHQ but may, at times, be another location including the turnout north of the I-40 freeway ramps (staging area 9), MW-20 Bench along the NTH (staging area 18), the TW Bench near the TCS entrance gate (staging area 23), or other locations that have been identified as staging areas. Depending on level of activity, there may be a separate check-in location established for work in Arizona at one of the staging areas near County Highway 10 or I-40. At the truck check-in/inspection station, trucks will undergo a cursory mechanical inspection to identify readily apparent potential safety concerns and confirm that documentation is complete. In addition, prior to entering work areas, trucks will be visually inspected for fuel or oil leaks, appropriate sound suppression devices, as well as inspection of load (for example, empty containers will be inspected for cleanliness and haul vehicles will be verified covered). Construction traffic will be routed in and out of primary work zones and staging areas through stabilized construction entrances/exits to reduce the potential for tracking of mud and dirt onto private or public roads.

After check in, arrangements will be made for meeting the specific contact person for the specific load at the designated work area. To control onsite traffic and minimize disruptions to existing operations—depending on the quantity and type of equipment/materials—designated onsite trucks may be used to shuttle materials from the check-in point to individual staging areas/construction zones. This approach of using designated vehicles may also apply to transporting personnel to and from the construction zones. Personnel vehicles will typically be parked at the CHQ.

Within the TCS, vehicles are required to maintain appropriate speeds for safety and dust control. While on public roads (including NTH and IM-3 access road), project-related vehicles will follow the posted speed limits and apply defensive driving techniques for traffic safety.

It is anticipated that lane closures will be required for portions of the following activities, at a minimum:

- The construction of some portions of the freshwater pipe in Arizona will require temporary single-lane closures along Arizona County Highway 10.
- The construction of portions of the NTH IRZ will require single-lane closures along NTH near the MW-20 Bench.
- Portions of the unpaved IM-3 access road will be temporarily closed for the construction of the remedy infrastructure in the uplands area of the site.

Traffic control plans, which will include the plan for use of temporary signage and delineators, will be prepared by the individual construction contractors for their work and reviewed by PG&E’s construction management team. Traffic control plans will be prepared for submittal to San Bernardino and Mohave Counties as part of the encroachment permitting process, and traffic control measures will be designed in accordance with applicable state and federal highway temporary traffic control guidelines.

4.4 Safety, Air Monitoring, and Decontamination

Consistent with PG&E commitment to worker safety and minimizing migration of contaminants due to construction activities, the following address health and safety, air monitoring, and decontamination procedures for construction of the groundwater remedy, focused primarily on those locations at the site where construction activities may encounter contaminated soil or groundwater.

4.4.1 Health and Safety

A Construction Health and Safety Plan is included in Appendix D, for construction activities specifying how workers will be protected during the construction activities, and includes training requirements, establishment of work zones, hazard control, exposure monitoring and protection, medical surveillance, and emergency planning, in conformance with EIR Mitigation Measure HAZ-2, as well as applicable requirement of the California Occupational Safety and Health Administration Hazardous Waste Operations and Emergency Response (HAZWOPER) regulations of Title 8 of the California Code of Regulations (CCR) Section 5192, as well as the U.S. Occupational Safety and Health Administration requirements in 29 Code of Federal Regulations (CFR)1910 and 1926.

4.4.2 Air and Meteorological Monitoring

Construction of the groundwater remedy will include construction activities within the boundaries of soil investigation areas, both inside and outside of the TCS fence line. During construction activities within soil investigation areas, air monitoring may be conducted to assess air quality within and adjacent to work areas and work perimeters. Air monitoring for construction activities within soil investigation areas may be performed to assess worker exposure to airborne contaminants and to document that construction activities do not result in the migration of soil contaminants by air beyond the work area boundaries. Results of air monitoring will be used to evaluate and adjust engineering control measures to prevent airborne contaminants from migrating outside the work area and to evaluate levels of personal protective equipment.

Air and meteorological monitoring will be performed for construction activities within the boundaries of soil investigation areas that overlap with or are located within 20 feet of groundwater remedy infrastructure, as identified in Exhibit 4.4-1.

The air and meteorological monitoring program for construction activities within the boundaries of the soil investigation areas may include baseline monitoring, perimeter air monitoring, and meteorological monitoring. Personal monitoring within the construction areas will is not described below, but will be performed in conformance with the Construction Health and Safety Plan (Appendix D). Monitoring parameters will depend on the location for construction and the contaminants of concern from available soil data at that location, including data that may be available at the time of groundwater remedy construction from implementation of the Soil RCRA Facility Investigation/Remedial Investigation Work Plan (CH2M HILL 2013).

4.4.2.1 Perimeter Air Monitoring

Perimeter air monitoring will be used to evaluate the ongoing effectiveness of the dust control program, to guide modifications to field activities and engineering control measures, if necessary, and to document that construction activities do not result in the migration of soil contaminants by air beyond the work area boundaries. Both direct-read, real-time dust monitoring and air sampling may be conducted during construction activities within soil investigation areas. Portable battery-operated dust monitors and air sampling pumps would be set up at the perimeter of the construction zones based on wind direction and location of site work. The monitors would be installed if activities have the potential to create significant visible dust or if extensive trenching or other soil disturbance is performed. The monitors would be removed immediately after activities are completed.

The results of the perimeter air monitoring, in consideration of baseline monitoring performed prior to construction activities within soil investigation areas or other risk-based action levels, will be used to adjust work activities such as the use of dust suppression, altering the pace of excavation or work activities, modifying work practices to minimize dust or other emissions, or temporarily halting work activities until conditions are more favorable.

4.4.2.2 Meteorological Monitoring

Weather conditions can play an important role when determining potential dust migration pathways. The meteorological monitoring program will consist of an anemometer capable of reading wind speed and direction, a thermometer, a hygrometer, and a rain gauge interfaced with a data logger. Meteorological weather stations that may be used would be temporary, portable, battery-operated units, and set up on tripods. Meteorological monitoring parameters to evaluate upwind, downwind, and crosswind ambient air monitoring locations may include:

- **Wind Direction:** The wind direction indicates the direction from which the wind is blowing and which direction dust will migrate. The observed wind directions will be used to designate samples as upwind, downwind, or crosswind relative to the construction zone.
- **Wind Speed:** The wind speed is a major determinant of the travel distance and travel time of dust.
- **Maximum Observed Wind Speed:** The maximum observable wind speed will be recorded and an action level will be set, at which, work will cease at the construction zones.
- **Rainfall:** The amount of precipitation can affect the concentration of dust suspended in the air surrounding the construction zones.
- **Temperature (daily high and low):** The temperature at the construction zones can affect the concentration of dust suspended in the air surrounding these areas.
- **Humidity:** The humidity level can affect the concentration of dust remaining suspended in the air surrounding the construction zones.

4.4.3 Equipment Decontamination

Construction vehicles, equipment, and drill rigs will be cleaned before mobilization to the site, between work areas as necessary and before leaving site. BMPs will be implemented to keep materials, vehicles, equipment, and rigs clean to minimize potential impact to the ground surface and the tracking of mud and dirt out of the primary work zones and onto public or private roads. Such measures may include, but are not limited to, dry brush methods to remove mud or dirt and air dry, and/or wet methods such as steam cleaning or pressure washing with water/detergents (see Standard Operating Procedure [SOP]-B5 in Appendix B for additional information on decontamination procedures).

Decontamination operations will occur within the given primary work zone and/or at one of three designated decontamination pads designated for remedy use, which are (1) within the TCS fence line next to the remedy-produced water conditioning plant (to be constructed); (2) at the TW Bench (existing); and (3) at the CHQ in Moabi Regional Park (to be constructed). Where a designated decontamination pad is not available and/or not conveniently located, a temporary equipment decontamination facility will be constructed to properly decontaminate equipment by mechanical means as well as with the use of high-pressure, low-volume hot water when necessary. Decontamination rinse water will be captured and routed to temporary storage tanks and will be managed in accordance with the Waste Management Plan, provided as Appendix R to this C/RAWP. Sediments collected from the decontamination facility will be transferred to the designated waste management areas.

Equipment that comes into contact with contaminated groundwater (for example, downhole drilling tools or water sampling equipment) will be decontaminated between drilling and sampling locations, as appropriate, to prevent cross contamination.

Some construction activities will occur in areas with potential soil contamination such as an AOC or a SWMU. Vehicles, equipment, and rigs that enter an AOC or a SWMU will be decontaminated before exiting and entering uncontaminated areas. In this case, temporary equipment decontamination facilities (also known as contaminant reduction zones) will be within the primary work zone; the location will be selected to prevent equipment from being exposed to additional or other contamination. This area will be demarcated to limit access to essential personnel involved with the decontamination process. Decontamination of personnel, as necessary, is addressed in the Health and Safety Plan, provided as Appendix D to this C/RAWP.

4.5 Waste Management Plan

The Waste Management Plan, provided as Appendix R to this C/RAWP, discusses expected wastes to be generated during startup and construction of the final groundwater remedy at the site. The Waste Management Plan presents procedures for the characterization, storage, onsite management, transportation, and disposal of waste. Wastes generated from construction and startup activities will be managed onsite in compliance with the EIR mitigation measures, as adopted in the MMRP, and the ARARs established in the ROD (DOI 2010) and will be disposed of offsite in a manner consistent with applicable local, state, and federal laws and regulations.

Wastes to be generated from decommissioning of the interim measure are addressed in the IM-3 Decommissioning Plan (Appendix F), and wastes generated during O&M of the groundwater remedy are addressed in the O&M Manual (CH2M HILL 2014).

4.5.1 Expected Waste Streams

Expected waste streams from remedy construction and startup activities and their estimated quantities are described in this section.

4.5.1.1 Wastewater

Expected wastewater streams include:

- **Wastewater generated from well installation, development, and testing/sampling.** The current estimated total volume of wastewater generated over the entire construction period is 25 million gallons. It is expected that some of this wastewater stream will be conveyed to temporary staging areas (for example, the MW-20 Bench) and subsequently disposed onsite at the existing IM-3 treatment plant and TCS evaporation ponds or injected into an appropriate well subject to availability and in accordance with the substantive requirements. Excess or hazardous wastewater will be transported offsite for treatment/disposal.
- **Remedy-produced water generated during remedy startup such as backwashing of wells.** This wastewater stream will be transported onsite via piping or trucking to the remedy-produced water conditioning plant (inside the TCS), conditioned by removing solids and pH adjustment, and transported via piping to the IRZ wells for re-injection. The estimated total volume of remedy-produced water is 7.6 million gallons per year (see 90% BOD Report, Section 3.4, Remedy-produced Water Management). No offsite transportation is anticipated for this waste stream.
- **Miscellaneous wastewater streams (for example, equipment decontamination, rainfall that collects in secondary containment areas).** These waste streams will be managed onsite via IM-3 and/or TCS evaporation ponds. During startup, these waste streams may be managed by piping or trucking to the remedy-produced water conditioning plant (inside the TCS), the IRZ wells. Excess wastewater will be transported offsite for disposal.

- **Water from hydrotesting of conveyance piping system.** It is anticipated that this water will be generally clean and therefore suitable for reuse in testing, dust control, backfill moisture control, and other similar onsite uses.
- **Displaced soil (for example, well drilling, installation of pipe trenches/access roads).** Displaced soil will be managed in accordance with the Soil Management Plan, provided as Appendix L to this C/RAWP. After accounting for onsite processing and reuse of soils, approximately 4,000 cubic yards of non-hazardous soil and 11,000 cubic yards of clean soil will remain onsite. The non-hazardous soil will include approximately 3,000 cubic yards of drill cuttings and 1,000 cubic yards generated by other construction activities. The clean soil will include approximately 3,000 cubic yards of drill cuttings and 8,000 cubic yards of soil generated by other construction activities. In addition, approximately 800 cubic yards of excavated bedrock is expected to be removed for the construction of remedial facilities inside the TCS. Excavated bedrock will be managed in a manner similar to oversized rocks in displaced soil. Based on contaminant concentrations at soil investigation areas near TCS, soil to be generated from construction activities is not expected to be characterized as hazardous waste.
- **Precipitated solids/sludge and spent filters generated from the remedy-produced water conditioning process**. The amount of precipitated solids and sludge is estimated to be 1.6 tons (dry weight) per year, based on 7.6 million gallons per year of remedy-produced water, using 25 percent caustic to neutralize the first flush of well rehabilitation water. The amount of spent filters is estimated to be 0.45 tons (dry weight) per year. These waste streams will be transported offsite for disposal.
- **General construction waste**. These general construction waste streams will be transported offsite for recycling or disposal.
  - Concrete and asphalt pavement rubble (from construction within roads, TCS)
  - Construction and demolition debris (lumber, gypsum wallboard, glass, metal, roofing material, carpeting, plastic pipe, etc.)
  - Used personal protective equipment
  - Miscellaneous waste (trash, paper bags, cardboard boxes, office debris, etc.)
  - Empty drums/cans, unused chemicals/paints, used oil, used solvents, oily solids, and used fuel filters/parts from equipment maintenance, etc.
  - Universal waste (batteries, electronic devices, lamps, aerosol cans, and mercury-containing equipment)
  - Sampling equipment such as calibration gas cylinders
- **Sanitary waste**. This waste stream will be handled by portable toilets, with the exception of the temporary facilities that may be able to tie into existing sanitary systems such as the TCS and the planned construction yard at Moabi Regional Park.

4.5.2 Waste Characterization and Classification

Waste material with the potential to be hazardous wastes will be characterized per the procedures outlined below. Once the characteristics or profile of a waste stream is established, PG&E will continue to use the same waste profile unless a process change indicates that the waste stream should be recharacterized.

4.5.2.1 Liquid Wastes

Liquids will be classified as hazardous waste if they exhibit hazardous waste characteristics. Characterization will be conducted as appropriate as defined in the following sections. Three expected liquid wastes at the site include liquid with a pH of 2.0 or below or 12.5 or above; dissolved chromium concentration equal to or greater than 5 parts per million; and/or dissolved arsenic concentration equal to or greater than 5 parts per million. Liquids will be evaluated for the presence of metals having hazardous waste toxicity characteristic levels specified in 22 CCR 66261.24 using the following approach:

- Liquid wastes containing less than 0.5 percent filterable solids will be analyzed for total metals and the results compared with the RCRA toxicity characteristic (TC) limits in 22 CCR 66261.24(a)(1) and the soluble threshold limit concentrations (STLC) in 22 CCR 66261.24(a)(2). If a constituent exceeds the RCRA TC limit, the waste will be classified as RCRA hazardous. If no constituents exceed the RCRA TC limit, but one or more constituents exceed the STLC, the waste will be classified as non-RCRA hazardous. If neither limit is exceeded, the waste will be classified as non-hazardous.
- Liquid wastes containing 0.5 percent or more filterable solids will be analyzed using the toxicity characteristic leaching procedure (TCLP), and the results compared with the RCRA TC limits. If a TC limit is exceeded, the waste will be classified as RCRA hazardous. If no TC limits are exceeded, the waste will be analyzed using the California Waste Extraction Test (WET), and the results will be compared with the STLCs. If one or more STLCs is exceeded, the waste will be classified as non-RCRA hazardous. If neither limit is exceeded, the waste will be classified as non-hazardous.

4.5.2.2 Solid Wastes

Solid wastes will be analyzed for total metals expressed in milligrams per kilogram, and the results will be evaluated as follows:

1. If the total constituent concentration exceeds the total threshold limit concentration in 22 CCR 66261.24(a)(2), material will be classified as a non-RCRA hazardous waste. Additional evaluation of the STLC, as described in Step 3, will not be performed.
2. If the total constituent concentration exceeds the numeric value of the RCRA TC level by 20 times or more, the TCLP will be performed. If the constituent concentration in the TCLP leachate exceeds the TC level, the material will be classified as a RCRA hazardous waste. Additional evaluation of the STLC, as described in Step 3, will not be performed.
3. If the material has not been classified as hazardous waste in Steps 1 or 2, the total constituent concentration will be compared to the STLC. If the total constituent concentration exceeds the numeric value of the STLC by 10 times or more, the WET will be performed. If the constituent concentration in the WET exceeds the STLC, the material will be classified as a non-RCRA hazardous waste.

If the material has not been classified as a hazardous waste in Steps 1, 2, or 3, it will be classified as non-hazardous waste.

4.5.2.3 Miscellaneous Wastes

Miscellaneous waste such as trash, paper bags, and cardboard boxes will be disposed of as non-hazardous solid waste unless affected by potentially contaminated material or water. Potentially contaminated miscellaneous waste will be combined with other hazardous waste. Empty, used 55-gallon drums that formerly contained hazardous materials will be labeled with the word “empty” and the date emptied and will be returned to the original chemical supplier or turned over to a drum reconditioner. Drums being reconditioned will be removed from the site within 1 year.

Characterization and classification of additional, miscellaneous construction waste streams is provided in the Waste Management Plan in Appendix R to this C/RAWP.

4.5.3 Management of Waste

4.5.3.1 General Waste Management Procedures

Waste materials will be managed onsite in demarcated waste management areas. Waste management areas are identified in Figure 4.5-1. Within the waste management areas, hazardous wastes will be segregated from non-hazardous wastes. Additionally, incompatible hazardous wastes (for example, flammable and corrosives wastes) will be segregated. Wastes of the same matrix, contamination, and source may be aggregated to facilitate accumulation and disposal. Lined roll-off boxes will be used to contain solid wastes. Liquid wastes will be contained in drums, totes, or portable tanks. Cleaning and decontamination wastewater will be contained in portable tanks within secondary containment near the point of origin while the water is characterized for onsite management or offsite disposal. Incidental trash, such as wooden pallets and food and beverage containers, will be contained in dumpsters located in staging areas near temporary facilities. Universal waste will be stored in containers or packages that will remain closed; are structurally sound; are adequate to prevent breakage; are compatible with contents of batteries, lamps, or thermostats; and lack evidence of leakage, spillage, or damage that could cause leakage under reasonably foreseeable conditions. When possible, containerized wastes will be direct-loaded onto a truck and removed from the site from the point of generation (for example, potentially during rehabilitation event at well site).

Non-RCRA and RCRA hazardous wastes will be removed from the site within 90 days from the date of generation. The date of generation is the day that a waste is first placed in a container or stockpiled. The accumulation start date for containers is documented on the hazardous waste label. A log or other record will be used to document the accumulation start date for stockpiles and tanks. Labeling of waste containers (tanks) will be in accordance with 22 CCR Division 4.5 Chapter 12 and 49 CFR 172, 173, and 178. Universal waste will be labeled as universal waste plus the type of universal waste (for example, “Universal Waste – Batteries”); it will be accumulated onsite up to 1 year, and not more than 5,000 kilograms will be accumulated at one time. Universal waste will be sent to a permitted recycling facility. Waste accumulation and equipment storage areas will be inspected daily for labeling, malfunctions, deterioration, discharges, and leaks that could result in a release. Deficiencies observed or noted during inspection will be corrected immediately, and corrective measures will be documented and maintained onsite.

4.5.3.2 Onsite Management of Construction Water

Wastewater will be generated during construction activities from well installation, development, and testing/sampling. Other miscellaneous wastewater streams will be generated from equipment and vehicle decontamination, as well as water from hydrotesting of conveyance piping and rainfall collected in secondary containment areas. Consistent with water conservation and sustainability practices, onsite reuse and disposal of wastewater generated during construction will be maximized. Onsite options are described below. Water that is not managed onsite will be transported offsite to a permitted facility.

Management at IM-3 and the TCS Ponds. ARARs for the operation of IM-3 (treatment and injection facilities) authorize the disposal of groundwater generated during well installation, well development, and aquifer testing, as well as purged groundwater and water generated while rinsing field equipment during sampling events for the area-wide groundwater monitoring program.

The lined evaporation ponds receive cooling tower blowdown water and evaporate it as part of normal TCS operations. Solids are removed from the ponds periodically. The ponds operate under Waste Discharge Requirements issued by the California Regional Water Quality Control Board. Discharge of construction water to the ponds will require coordinating capacity with the TCS operations and authorization by the Regional Water Quality Control Board.

Onsite Reuse. Water from hydrostatic testing of conveyance piping may be reused onsite in a manner that complies with the State Water Resources Control Board Water Quality Order No. 2003-003-DWQ, Statewide General Waste Discharge Requirements for Discharges To Land With A Low Threat To Water Quality. The permit states that *“The discharge of water main, water storage tank, water hydrant pipeline flushing, or hydrostatic testing water from tanks or pipelines that have been used to store or convey any medium other than potable water is prohibited, unless the Discharger has demonstrated to the Regional Board that all residual pollutant concentrations have been reduced to levels below Regional Board Basin Plan groundwater quality objectives.”*(Paragraph 7 on page 4). The water generated from hydrostatic testing will be low-volume discharges with minimal pollutant concentrations and will not be reused in a manner that results in a discharge to waters of the United States or waters of the state. The volume and date of each reuse event will be recorded.

Injection at Individual Wells during Well Testing. Following well installation and development, wells may be tested to evaluate its maximum injection flow rate. This hydraulic testing involves extracting water from the well, storing the water in portable tanks, then injecting the water back into the aquifer at the same or nearby well through a filter to remove particulate matter. Because chemical additives will not be used during these well testing activities, the water will be injected without additional characterization.

4.5.4 Waste Transportation and Offsite Disposal

After the wastes are containerized and labeled, those wastes ready for offsite disposal will be loaded onto trucks for transport to preapproved disposal facilities. A designated transportation and disposal coordinator will be onsite during transportation and disposal activities. This individual will be responsible for coordinating and overseeing these activities.

As truck loading is completed, the containers and trucks will be inspected and brushed as necessary to remove loose materials if the truck is transporting hazardous waste. Each load on a truck will be inspected by the driver to ensure that the load is secure. Hazardous waste labels on non-bulk containers will be verified to be accurate and complete, and non-bulk containers will be labeled with the appropriate USDOT hazard class label. Appropriate documentation to include waste manifests or shipping papers will be completed, checked, and kept onsite. A truck log with loading and transportation information will be maintained. Transport vehicles will proceed to the designated disposal facilities in accordance with local, state, and federal transportation requirements.

4.5.4.1 Disposal Facilities

Disposal facilities that receive CERCLA waste (wastes that contain CERCLA hazardous substances, pollutants, or contaminants) will be in compliance with the CERCLA Off-Site Rule (42 United States Code [U.S.C.] 9621(d)(3) and 40 CFR 300.440).Wastes designated as RCRA or Non-RCRA hazardous wastes will be transported to and disposed of at an appropriately permitted facility. In accordance with the requirements of the Remedial Design/Remedial Action Consent Decree (DOI 2013), prior to the first shipment of waste material offsite, and annually thereafter, PG&E will demonstrate to DOI's satisfaction that USEPA has determined that the proposed receiving facility is operating in compliance with 42 U.S.C. 9621(d)(3) and 40 CFR 300.440. If PG&E knows or has reason to know the facility no longer meets the criteria of 40 CFR 300.440(b), PG&E will inform DOI, propose an alternate receiving facility prior to any subsequent shipments, and demonstrate to DOI's satisfaction that USEPA has determined that the alternate receiving facility is operating in compliance with 42 U.S.C. 9621(d)(3) and 40 CFR 300.440. The waste material will be stored onsite in accordance with the Waste Management Plan until approval is received and the waste material is transported offsite. If the waste management facility is out of state, prior to the first shipment of waste material, PG&E will provide written notice for disposal of waste material at the listed facilities to the appropriate state environmental official in each receiving facility's state and the DOI Project Manager.

PG&E proposes use of the following potential disposal facilities for the project as well as others, subject to the communication and approval processes under the CD outlined above:

PSC Rancho Cordova – TSDF
11855 White Rock Road
Rancho Cordova, CA 95742

Chemical Waste Management – Kettleman Hills Facility – Landfill
35251 Old Skyline Road
Kettleman City, CA 93239

US Ecology Inc. - Landfill

Highway 95 (12 miles South of Beatty, NV)
Beatty, NV 89003

Clean Harbors Button Willow – Landfill
2500 West Lokern Road
Button Willow, CA 9320

4.6 Best Management Practices Plan

The following describes BMPs for the construction of the groundwater remedy.

4.6.1 Stormwater-related BMPs

A BMP plan, prepared to meet the substantive requirements of applicable federal, state, and local permit and regulatory requirements for stormwater discharges associated with construction and land disturbance activities, as well as EIR Mitigation Measure HYDRO-1, is provided as Appendix M. Appendix M includes BMPs, as well as requirements for visual inspection, monitoring, reporting, working training and education, and recordkeeping. BMPs will be used for varying activities and varying locations and durations depending on specific activities

Storm water related BMPs addressed in Appendix M include:

- Erosion control BMPs, including preservation of existing vegetation, geotextiles and road maintenance
- Sediment control BMPs, including silt fences, gravel bag berms and straw bale barriers
- Waste and Materials Management Control, including stockpile management, and waste management
- Non-stormwater BMPs, including vehicle and equipment fueling and maintenance
- Good housekeeping BMPs.

4.6.2 Other Site Controls and Avoidance, Mitigation, and Management Measures

4.6.2.1 Dust Control

To comply with EIR Mitigation Measures AIR-1a, AIR-1b, AIR-1c and AIR-1e, fugitive dust emission control measures will be used during construction: wind erosion control will be applied as necessary to prevent nuisance dust and minimize the movement of sediment disturbed during construction.

- Use periodical watering for short-term stabilization of disturbed surface areas, including haul roads, to minimize visible fugitive dust emissions during dust episodes. A water truck also will be used to control dust on disturbed surfaces during visible dusting episodes. Water application rates will be optimized to the greatest practical extent while still maintaining dust control but controlling runoff from affected material. Water may be applied as a pre-wetting step in addition to use during construction activities.
- Cover loaded haul vehicles while operating on publicly maintained roads.
- Stabilize graded site surfaces using soil binders, as necessary, upon completion of grading when subsequent development is delayed or expected to be delayed more than 30 days, except when such delay is caused by precipitation that dampens the disturbed surface sufficiently to eliminate visible fugitive dust emissions. Commercial dust control and soil stabilization products are typically polymer- or plant-based slurries such as Soiltac or similar products.
- Cleanup project-related track out or spills on publicly maintained paved surfaces within 24 hours.

- Curtail or reduce nonessential earthmoving activity under high-wind conditions (greater than 25 miles per hour), or develop a plan to control dust during high-wind conditions.

4.6.2.2 Control Measures in Soil Investigation Areas

To comply with EIR Mitigation Measures HAZ-2a, HAZ-2b, and HAZ-2c, the following procedures will be followed for construction activities in soil investigation areas:

- Vehicle movement will be controlled to avoid traveling in areas where contaminated soils are known to be present, and speeds will be limited to 15 miles per hour or slower to limit generation of dust. Measures such as wetting of surfaces will be employed to prevent dust generation by vehicular traffic or other dust-generating work activities.
- Pre-mobilization planning will be used to review the likelihood of encountering contaminated soils, and procedures in the Hazardous Materials Business Plan, Construction Health and Safety Plan, the Soil Management Plan, SOPs, and the Waste Management Plan will be followed. The pre-mobilization planning will ensure that the contingencies for handling contaminated soils are in place prior to implementing the field operations.
- Should evidence of contaminated soil be identified during ground-disturbing activities (for example, noxious odors, discolored soil), work the area will immediately cease until soil samples can be collected and analyzed for the presence of contaminants. Potentially contaminated soils encountered in situ will be isolated—and appropriate dust and erosion control measures will be applied—to minimize the potential for migration until laboratory results are received. Contaminated soil will be managed and disposed of in accordance with the Construction Health and Safety Plan and the Soil Management Plan.

4.6.3 Noise and Vibration

Compliance measures and protocols related to noise and vibration are included in the EIR MMRP and the CIMP. For convenience and brevity, the compliance measures and protocols to be implemented before, during, and after construction through the start of O&M are compiled in Exhibit 4.6-1.

EXHIBIT 4.6-1
Protocols to Reduce Auditory and Vibration Impacts from Construction Activities
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

Noise Protocols	Timing/Schedule
1. PG&E will designate disturbance coordinators for noise concerns arising from construction.	Before construction
2. Verify location of planned construction activities that may occur within the noise buffers (i.e., 1,850 feet and 5,830 feet from the mobile home park at Moabi Regional Park, and 330 feet and 735 feet from the mobile home park at the Topock Marina in Arizona and private residences in Topock Marina area for daytime and nighttime noise, respectively), and determine through-noise measurements if temporary noise barriers must be erected, as required by NOISE-2c.	Before construction
3. If noise monitoring during construction is required by the CIMP, noise monitoring locations will be selected in the field by a qualified acoustical consultant (INCE Board Certified or Professional Engineer in Acoustics) in coordination with the Tribes. The EIR MMRP requires that noise measurements be conducted at the nearest noise-sensitive land use relative to the construction activities. Noise measurements will be in accordance with the Topock Sound Measurement Protocol in the 90% BOD Report. The qualified acoustical consultant will use a sound level meter for the noise measurements that meets the standards of ANSI (Section S14 1979, Type 1 of Type 2).	Before construction
4. PG&E disturbance coordinators will post contact information in a conspicuous location near construction areas so that it is clearly visible to nearby noise sensitive receptors (i.e., mobile home parks at Moabi Regional Park and the Topock Marina, and private residences in Topock Marina area) most likely to be disturbed. In addition, mailing of the same information will be sent to nearby noise sensitive receptors and Interested Tribes. The disturbance coordinator will contact nearby noise-sensitive receptors, advising them of the construction schedule. The disturbance coordinators also will	Before and during construction

EXHIBIT 4.6-1
Protocols to Reduce Auditory and Vibration Impacts from Construction Activities
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California

alert Interested Tribes to project activities that would generate new noise in the Topock Cultural Area at least annually.	
5. If the qualified acoustical consultant, after taking noise measurements at the nearest noise-sensitive land use relative to the construction activities, finds that the relevant noise thresholds are exceeded, temporary noise barriers will be erected.	During construction
6. Maintain construction equipment according to manufacturer guidelines. Equipment will be fitted with the best available noise-suppression devices. Applicable impact tools will be shrouded or shielded, and intake or exhaust ports on power equipment will be muffled or shielded.	During construction
7. Construction equipment will not be allowed to idle for extended periods of time (more than 15 minutes) when not being used for construction.	During construction
8. Should a concern about the actual noise generated by remedy construction arise, the PG&E disturbance coordinator will thoroughly investigate and resolve the issue appropriately. A qualified acoustical consultant will evaluate reoccurring disturbances for compliance with applicable standards. Noise measurements will be in accordance with sound measurement protocol in the 90% BOD Report. Noise complaints and resolutions will be recorded, tracked, and reported to DTSC in quarterly compliance reports.	Before, during, and after construction
Vibration Protocols	**Timing/Schedule**
1. PG&E will designate disturbance coordinators for vibration concerns arising from construction.	Before construction
2. PG&E disturbance coordinators will post contact information in a conspicuous location near construction areas so that it is clearly visible to nearby vibration sensitive receptors (i.e., mobile home parks at Moabi Regional Park and the Topock Marina, and private residences in Topock Marina area). The coordinator will manage complaints resulting from the construction noise. Reoccurring disturbances will be evaluated by a qualified acoustical consultant to ensure compliance with applicable standards. The disturbance coordinator will contact nearby vibration-sensitive receptors, advising them of the construction schedule. Vibration complaints and their resolutions will be recorded, tracked, and reported to DTSC in the quarterly compliance reports.	Before, during, and after construction
3. Construct new wells a minimum of 45 feet from vibration-sensitive receptors (i.e., mobile home parks at Moabi Regional Park and the Topock Marina, and private residences in Topock Marina area). Avoid constructing wells within 30 feet of vibration- sensitive land uses located in California and 275 feet of vibration- sensitive land uses located in Arizona (i.e., mobile home parks at Moabi Regional Park and the Topock Marina, and private residences in Topock Marina area).	During construction

Sources: EIR MMRP, CIMP

Figures 4.6-1 and 4.6-2 show identified noise-sensitive receptors at the project site in California and Arizona, respectively, as well as noise monitoring buffer zones for daytime and nighttime noise. Construction activities occurring within these buffer zones will plan for monitoring and mitigation in accordance with the EIR MMRP and the CIMP.

As mentioned in Item 5 of Exhibit 4.6-1, temporary noise barriers will be erected if the relevant noise thresholds are exceeded breaking the line of sight between the source and receptor where noise levels exceed applicable standards. Typical noise barriers that could be used during construction to mitigate noise concerns are dumpsters, bins, tanks, soil berms, and/or soil stockpiles. In the unlikely event that engineered acoustical barriers such as temporary panels or blankets are required during construction, they will comply with requirements of the EIR Mitigation Measure NOISE-2c. Placement, orientation, size, and density of acoustical barriers will be specified by a qualified acoustical consultant.

4.6.4 Lighting

4.6.4.1 Nighttime Construction Lighting

The protocol for nighttime lighting, in conformance with EIR Mitigation Measure CUL-1a-7 is provided in Appendix P, Cultural Resources Protocols, to this C/RAWP. The first step will be to determine whether nighttime construction work is required. Nighttime construction-related activities will be limited to work that cannot be disrupted or suspended until the following day, such as, but not limited to, well drilling and development or decommissioning activities. If nighttime construction is required, the following principles will be applied:

- Identify the active area for construction and the applicable lighting standards. Only areas of active construction may be illuminated.
- Obtain portable lighting (including solar-powered). Lights must include shielding/shrouding (for example, downward-facing fixtures with cutoff shields to reduce light diffusion). No permanent poles will be installed for nighttime lighting.
- Install the minimum lighting feasible to maintain adequate night lighting for safety at the lowest allowable height. Orient the lights such that offsite visibility of light sources, glare, and construction activities is limited.
- Assign a responsible member of the construction crew, such as foreman or crew boss, to extinguish the lighting as soon as the nighttime construction work is completed.

4.6.4.2 Emergency Lighting System

The emergency lighting system will:

- Provide emergency illumination in appropriate spaces, as required by code to provide life safety, property, and equipment protection.
- Provide adequate lighting levels to maintain safe building egress and critical process/plant functions.

4.6.4.3 Explosion-proof Luminaires

A room or space listed as a hazardous atmosphere area will have explosion-proof-type luminaires UL-listed for installation in the hazardous area classifications, as required by Article 500 of the National Electric Code.

4.6.4.4 Lighting Standards

The following lighting standards will apply during remedy construction through the start of O&M, as discussed in the 90% BOD Report:

- Construction Industry 29 CFR 1926.56 (lighting safety requirements)
- General Industry 29 CFR 1910.120 (HAZWOPER) (lighting safety requirements)
- San Bernardino County Code Title 8, 83.07.040 Glare and Outdoor Lighting - Mountain and Desert Regions
- Mohave County Outdoor Light Control Ordinance 87-1

4.6.5 Aesthetic/Biological Resource-related Site Management and Compliance Measures

Compliance measures and BMPs related to aesthetic and biological resources are included in numerous preexisting documents and directives, including:

- PBA for the TCS final groundwater remedy, (CH2M HILL 2014) containing:
  - General project management measures

- Management measures for potential southwestern willow flycatcher habitat
- Management measures for potential western yellow-billed cuckoo habitat
- Management measures for potential Agassiz's desert tortoise habitat
- Management measures for potential Morafkai's desert tortoise habitat
- Management measures for Potential Yuma clapper rail habitat
- Management measures for work in or near the mainstem Colorado River, as well as the backwater areas of Park Moabi and the Topock Marina

- Final Bird Impact Avoidance and Minimization Plan, provided as Appendix S to this C/RAWP, which contains general avoidance and minimization measures, as well as species-specific mitigation measures for southwestern willow flycatcher and Yuma clapper rail similar to those in the PBA.
- The MMRP for the TCS groundwater remediation project (DTSC 2011a), containing mitigation measures (EIR Mitigation Measures BIO-2a and BIO-2b) for special-status birds and desert tortoise, as well as mitigation measures for vegetation removal, preservation, and revegetation (BIO-1, AES-1, and AES-2) during construction.
- The protocol for PG&E compliance with EIR MMRP BIO-1 and ARAR #32 for work activities near or within jurisdictional wetland and waters containing wetlands avoidance measures and management practices before, during, and after construction.
- Avoidance and Minimization Measures for California Department of Fish and Wildlife (CDFW) Jurisdictional Washes as documented in correspondence with CDFW: Attachment to Letter from Chris Hayes/CDFW to Yvonne Meeks/PG&E, Confirmation of Application of the CERCLA 121(e)(1) Permit Exemption to Pacific Gas and Electric Company's Soil and Groundwater Investigation and Remediation Project, dated March 6, 2013

Collectively, these documents and directives provide procedures and avoidance measures to be followed before, during, and after construction. Reporting and communications associated with these compliance measures are included in Section 2 of this C/RAWP. Habitat restoration for HNWR lands, riparian habitats, and aesthetics and visual resources is discussed in Section 6, and the restoration plans that will govern restoration of the project area are included as Appendices G, N, and O to this C/RAWP.

4.6.6 Cultural/Archaeological/Historical Resource-related Site Management and Compliance Measures

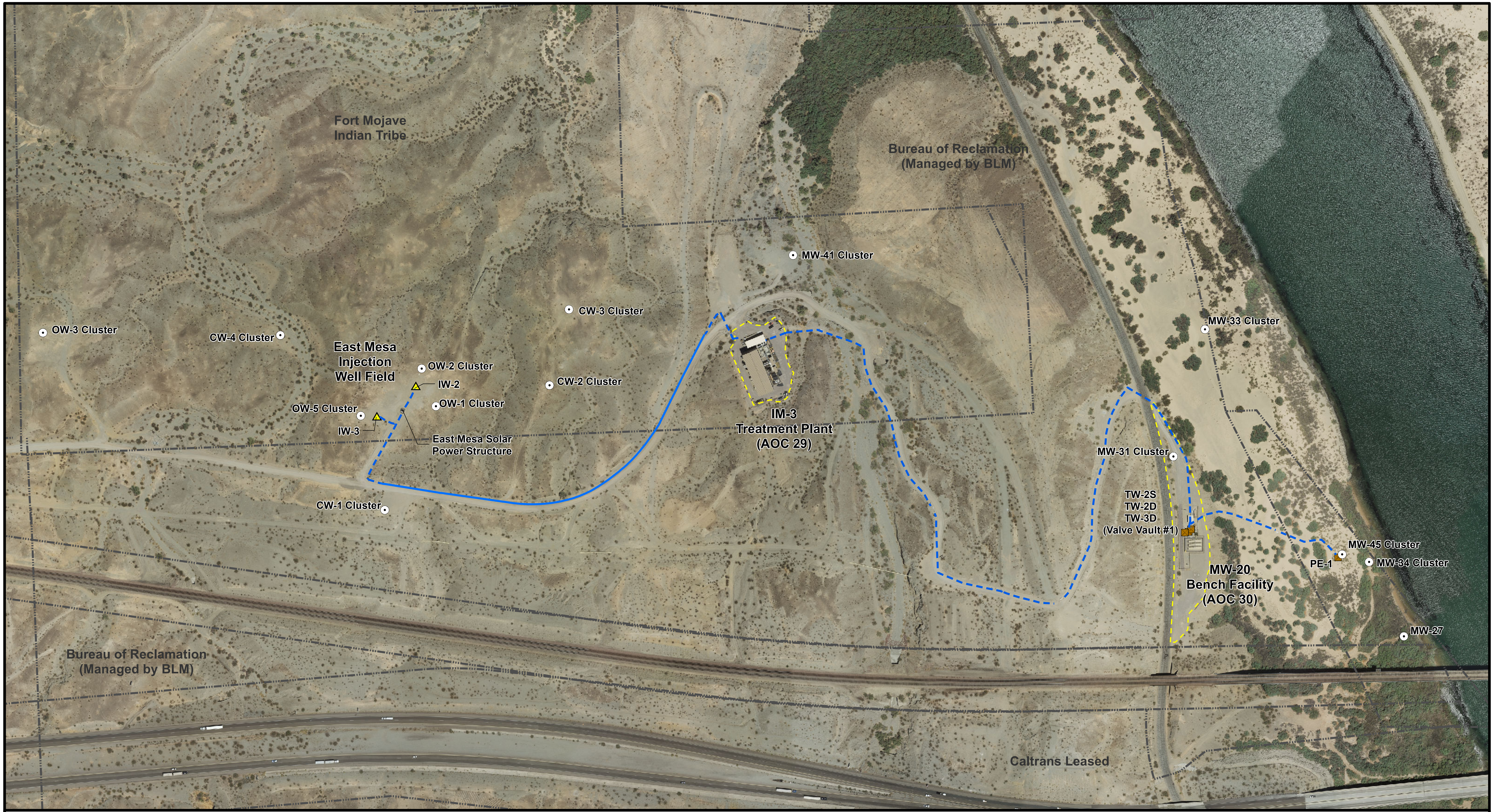
Compliance measures and BMPs related to cultural and archaeological/historical resources are included in numerous existing documents and directives, including:

- The PA Among the Bureau of Land Management, Arizona State Historic Preservation Officer, California State Historic Preservation Officer and the Advisory Council on Historic Preservation for the Topock Remediation Project in San Bernardino County, California and Mohave County, Arizona (BLM 2010), with provisions applicable during construction and associated with avoidance measures; construction monitoring; accommodations of Tribal activities; treatment of cultural, historical, and archaeological properties; and procedures for discoveries.
- The CHPMP (BLM 2012), provided as Appendix I to this C/RAWP, with provisions applicable during construction and associated with avoidance measures; site controls; construction monitoring; accommodations of Tribal activities; treatment of cultural, historical, and archaeological properties; and procedures for discoveries.
- CIMP, provided as Appendix H, to this C/RAWP, with protocols applicable before, during, and after construction and associated with Tribal communications; treatment of archaeological materials;

repatriation of clean soils; accommodation of Tribal ceremonies; Tribal monitoring; protective measures for archaeological/historical sites; and inspection of remediation facilities and/or staging areas; and reporting discoveries of cultural importance.

- The certified EIR and adopted MMRP (DTSC 2011a-b), with provisions applicable during construction associated with mitigation measures to minimize impacts to cultural, archaeological, and historical resources to the extent feasible.
- Management Measures for Geoarchaeological Resources, provided as Appendix T to this C/RAWP, with procedures for monitoring and avoidance of excavations in defined areas.
- Management Measures for the Paleontological Resources, provided as Appendix J to this C/RAWP), with requirements for training, monitoring, and surveying of paleontological resources during ground-disturbing activities, as well as recovery, documentation, preparation, and repository for fossils recovered during the project.

Collectively, these documents and directives provide procedures and avoidance measures to be followed before, during, and after construction. Reporting and communications associated with these compliance measures are included in Section 2.



LEGEND

- Monitoring Well
- Extraction Well
- Injection Well
- IM-3 Pipeline (underground where dashed)
- Area of Concern (AOC) Boundary
- Property Boundary

FIGURE 4.1-1
LOCATION OF IM-3 COMPONENTS
GROUNDWATER REMEDY CONSTRUCTION/
REMEDIAL ACTION WORK PLAN
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

CH2MHILL

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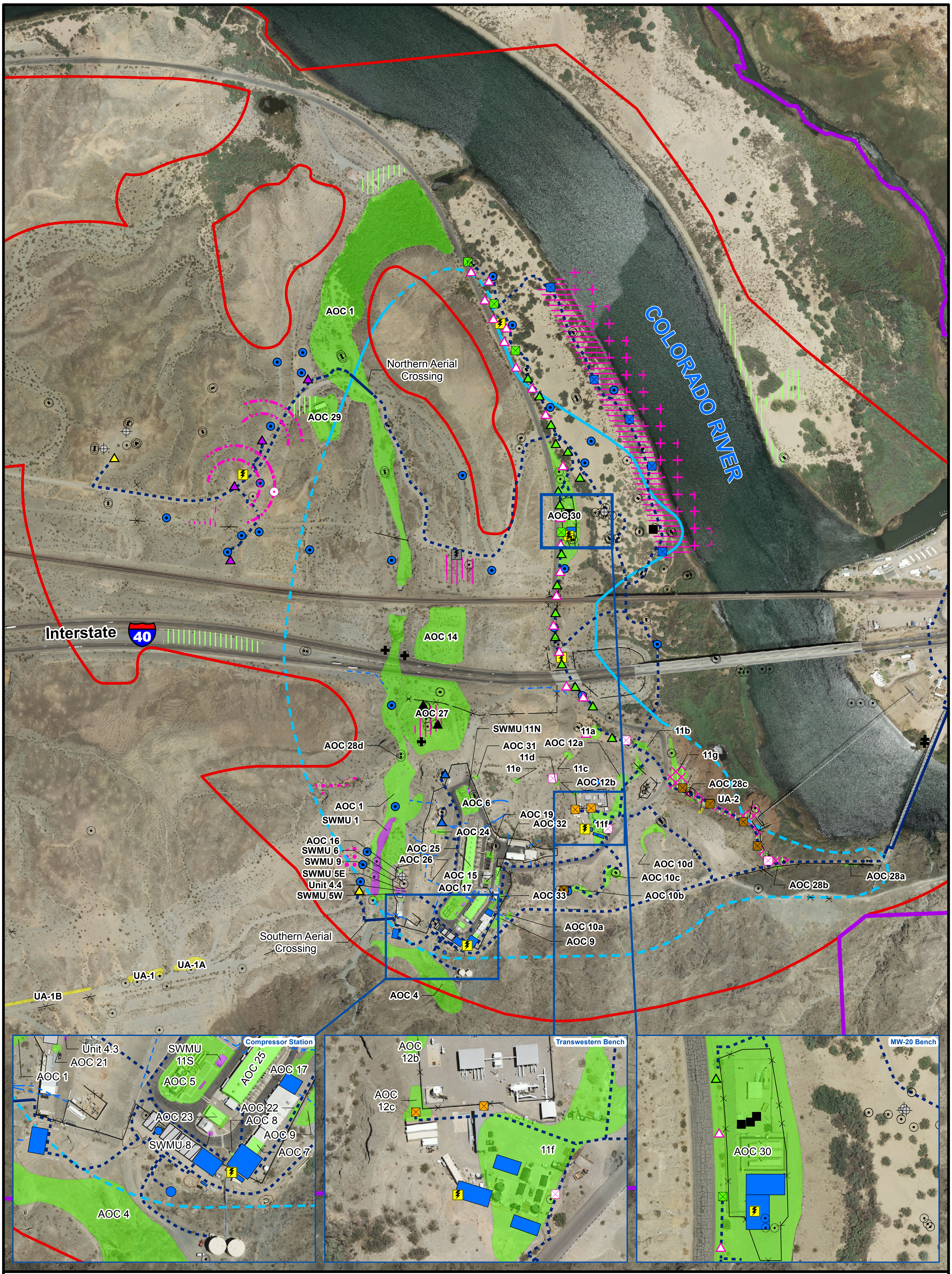

Notes:
1. All wells and remedy structure locations are approximate.
2. AOC 13 consists of the current and former unpaved areas within the fence line. AOC 18 consists of the current and former unpaved areas within the fence line. AOC 18 consists of the hazardous waste transference pipelines and cooling tower blowdown pipelines.

FIGURE 4.1-2
MAP OF SOLID WASTE MANAGMENT UNITS (SWMUS) AND AREAS OF CONCERN (AOCS)
GROUNDWATER REMEDY CONSTRUCTION/ REMEDIAL ACTION WORK PLAN
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

CH2MHILL

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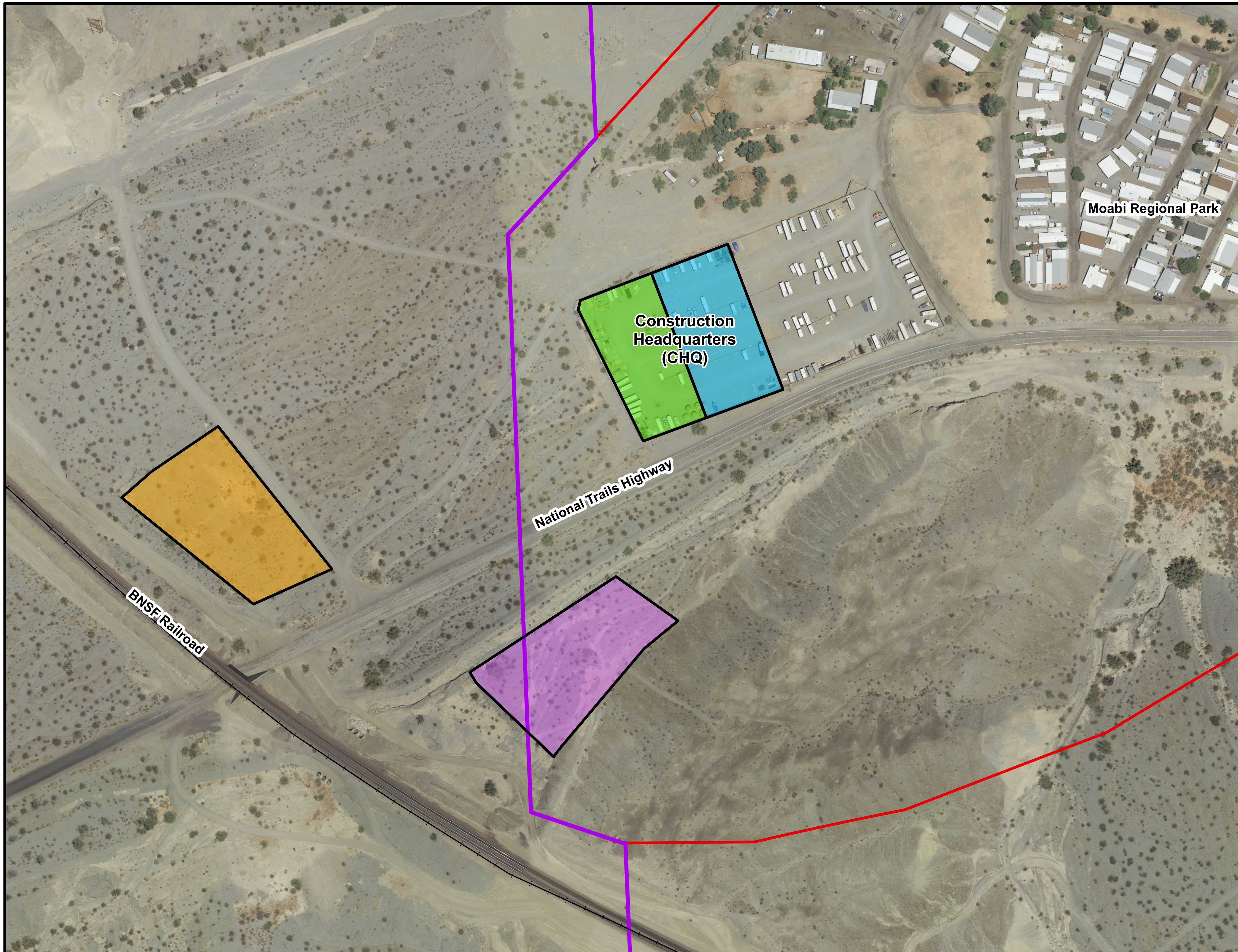
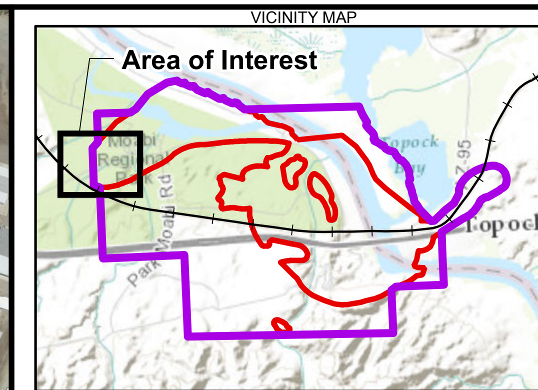


VICINITY MAP



LEGEND

- Container Storage Area (1.5 acres approx.)
- Long Term Remedy Support Area (1.2 acres approx.)
- Soil Storage/Processing Area (1.5 acres approx.)
- Temporary Construction Laydown Area (1.3 acres approx.)
- Area of Potential Effects (APE)
- EIR Project Area

Notes:
1. This is a conceptual layout. Locations are approximate.
2. Descriptions of activities/functions anticipated for the construction support areas are included in the Construction/Remedial Action Work Plan.
3. Descriptions of activities/functions anticipated for the long-term remedy support areas are included in Section 3.5 of this BOD, and the O&M Manual.

N

0 95 190 380 Feet

Service Layer Credits: Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community

FIGURE 4-.2-1
LOCATIONS OF CONSTRUCTION FACILITIES IN MOABI REGIONAL PARK

GROUNDWATER REMEDY CONSTRUCTION/
REMEDIAL ACTION WORK PLAN
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

CH2MHILL

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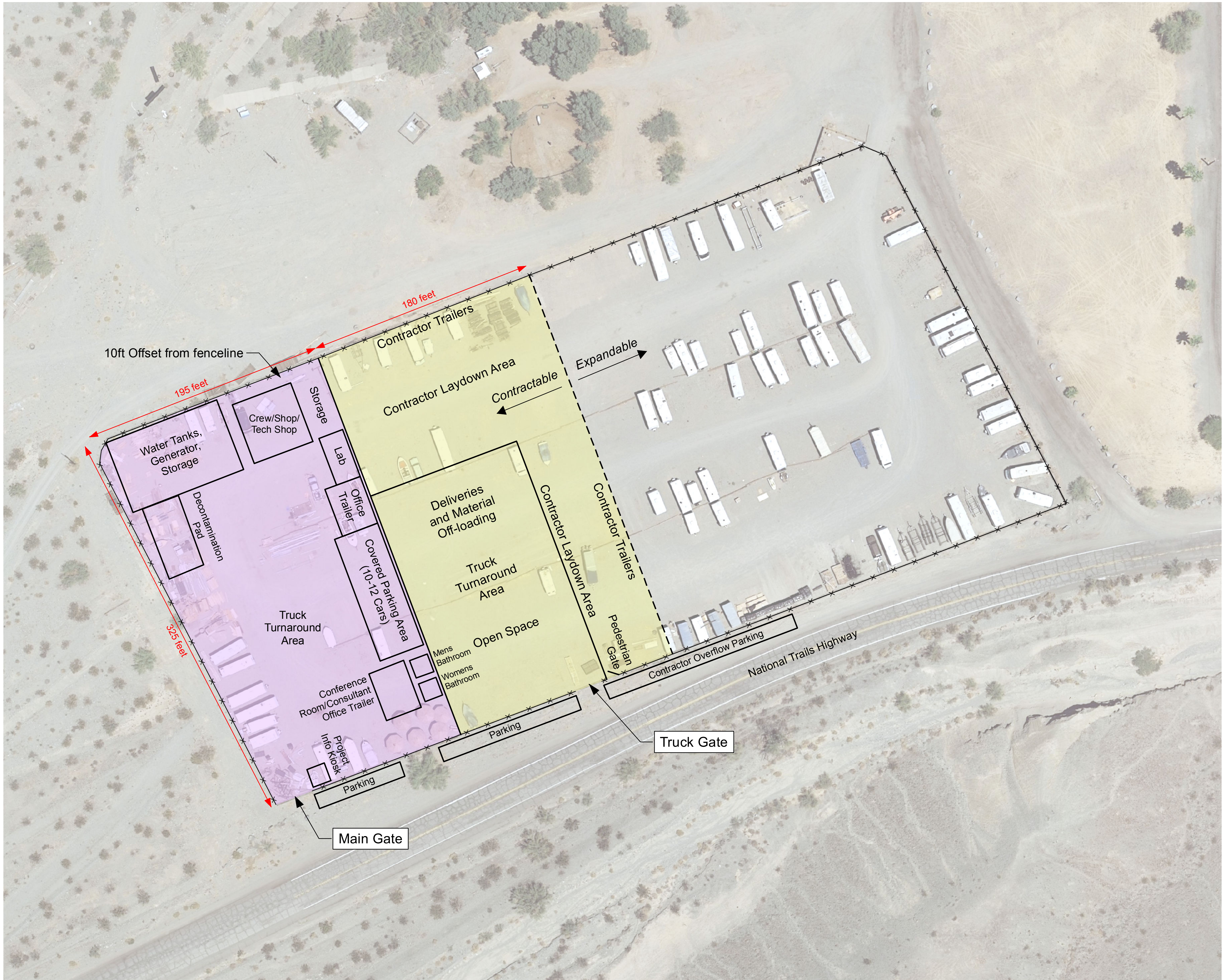

Legend

- Temporary Construction Laydown Area (~1.35 AC.)
- Long Term Remedy Support Area (~1.30 AC.)
- Existing Fenceline (Buildings offset 10' from fenceline)

Notes:
1. This is a conceptual layout. Locations are approximate.
2. Descriptions of activities/functions anticipated for the construction support areas are included in the Construction/Remedial Action Work Plan.
3. Descriptions of activities/functions anticipated for the long-term remedy support areas are included in Section 3.5 of this BOD, and the O&M Manual.

PACIFIC GAS AND ELECTRIC COMPANY
TOPOCK COMPRESSOR STATION, NEEDLES, CALIFORNIA
GROUNDWATER REMEDY CONSTRUCTION/REMEDIAL ACTION WORK PLAN

CONSTRUCTION HEADQUARTERS SPATIAL PLANNING

ARCADIS

FIGURE
4.2-2

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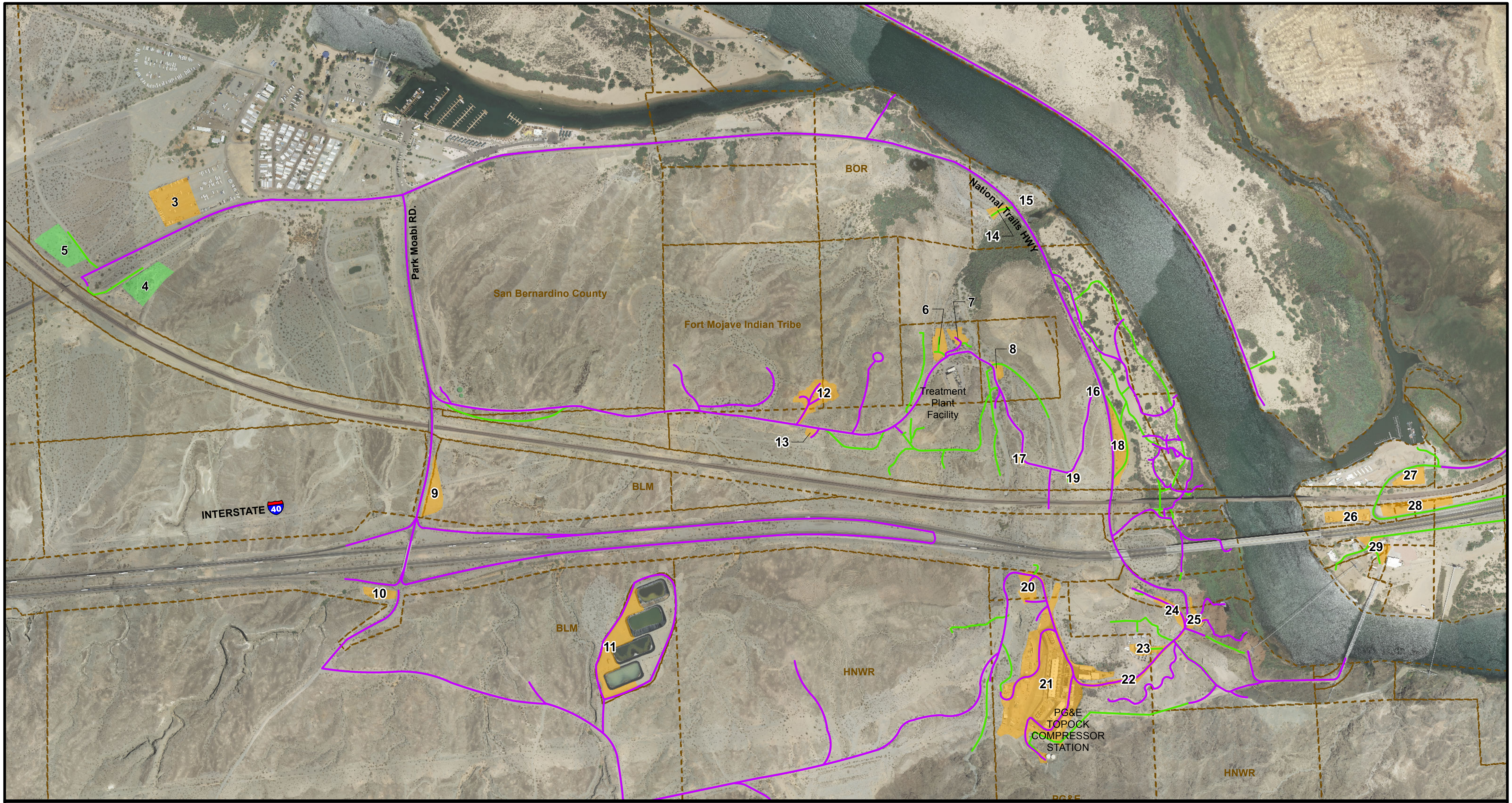

LEGEND

- Existing Access Route
- New Remedy Access Route
- Potential Soil Processing and Storage Areas for Remediation Project
- Proposed Staging Areas for Remediation Project

Notes:
1. Area 3 (CHQ) will be used as the primary truck inspection area. Areas #9, #18, and #23 or other staging areas might also be used depending on the specific construction activity.
2. Decontamination pads will be located in Area #3 (Construction Headquarters), Area #21 (Topock Compressor Station), and Area #23 (Transwestern Bench).
3. Areas #15, 16, 17, and 19 will not be used as staging areas. Areas #16, 17, and 19 may be part of the primary work zones for remedy infrastructure along the access road.

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Feet

FIGURE 4.2-3
CONSTRUCTION SITE PLAN AND ACCESS ROUTES
GROUNDWATER REMEDY CONSTRUCTION/ REMEDIAL ACTION WORK PLAN
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

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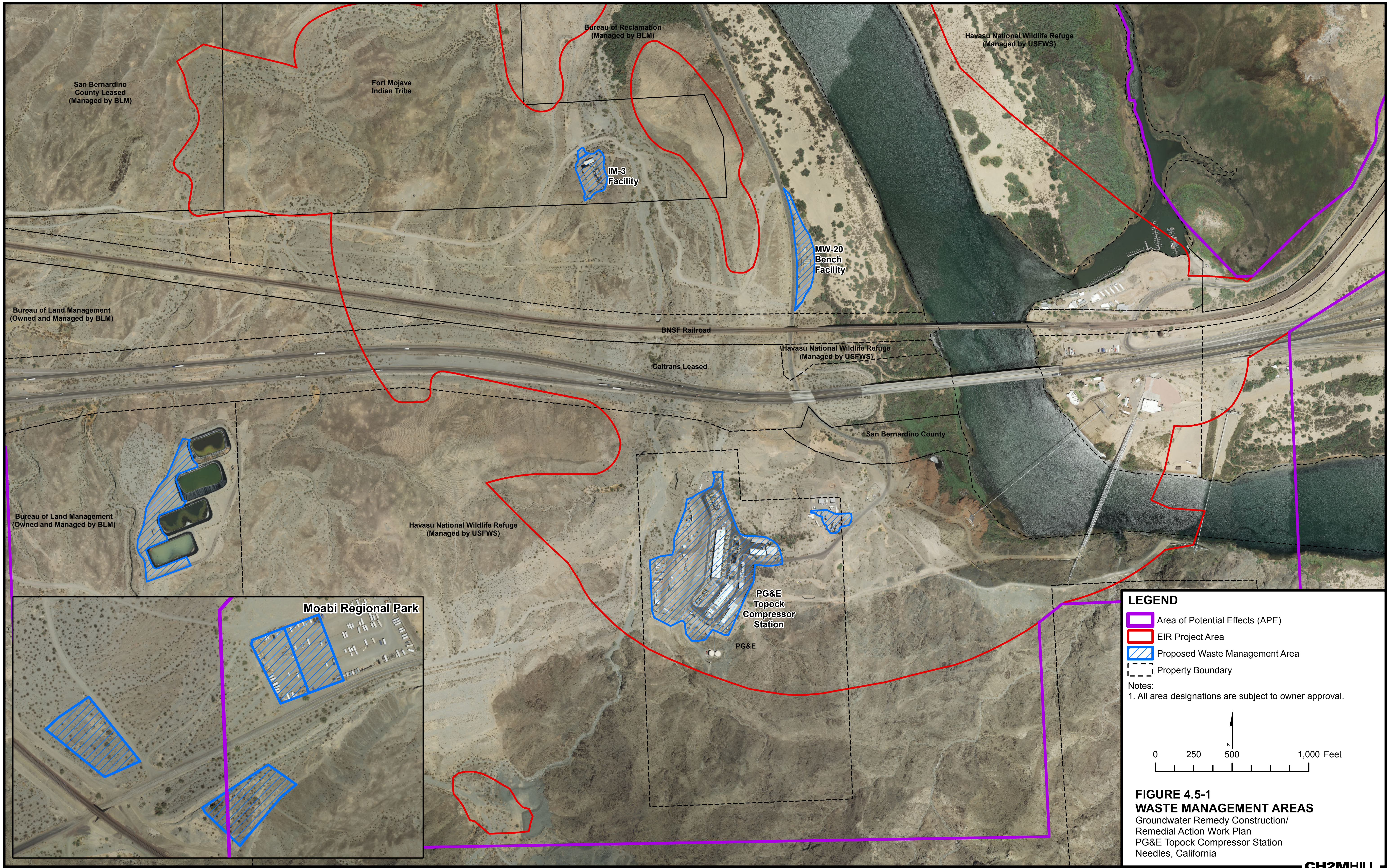
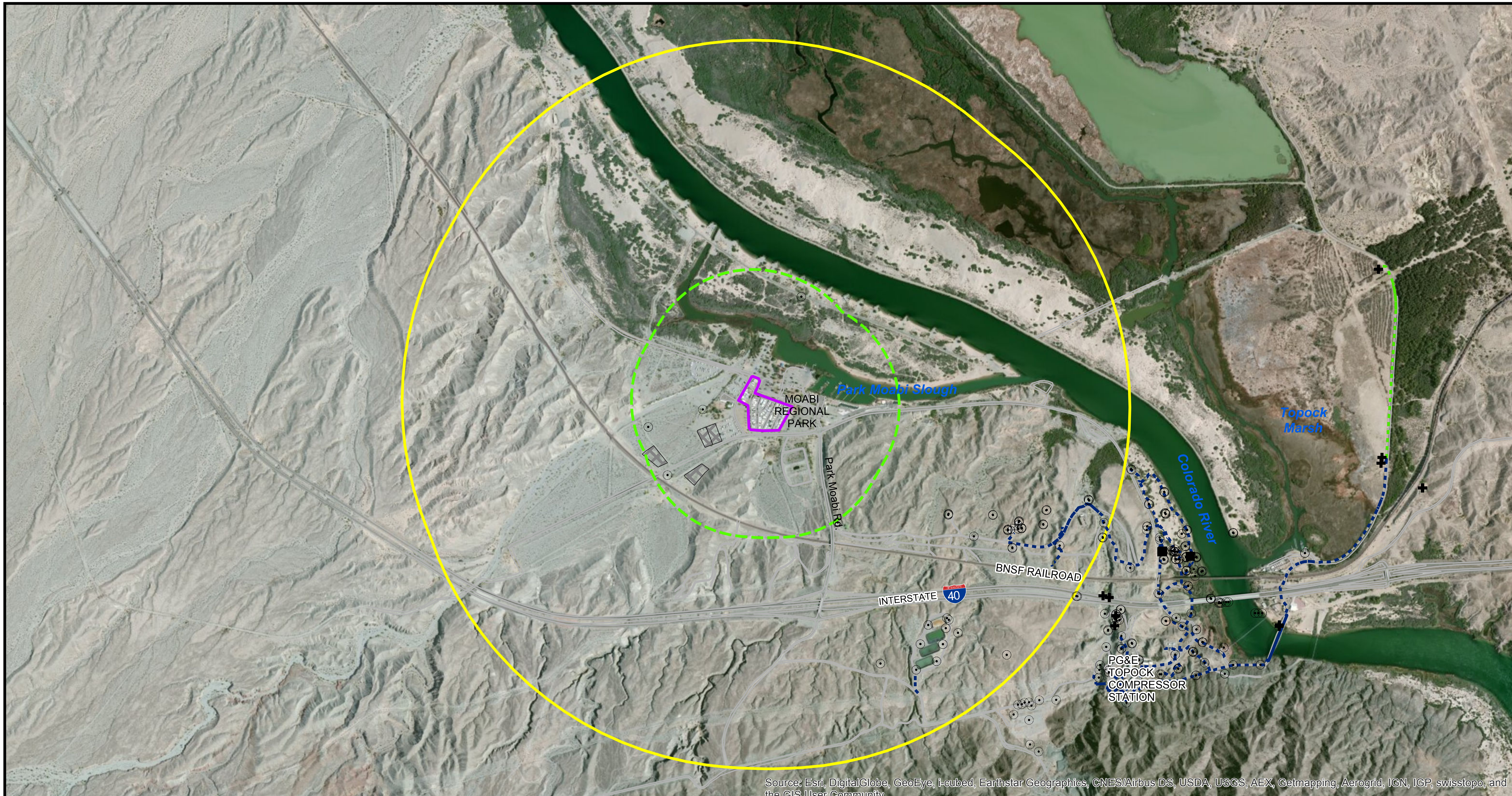


FIGURE 4.5-1
WASTE MANAGEMENT AREAS
Groundwater Remedy Construction/
Remedial Action Work Plan
PG&E Topock Compressor Station
Needles, California



LEGEND

- Extraction Well
- Injection Well
- Monitoring Well
- Water Supply Well
- Aboveground Pipe
- Underground Pipe/Conduit
- Future Provisional/Contingent Fresh Water Pipe
- 5,830' Noise Monitoring Buffer for Construction Activities between 10PM and 7AM
- 1,850' Noise Monitoring Buffer for Construction Activities conducted between 7AM and 10PM
- Noise Sensitive Receptor
- Proposed Main Construction Yard/ Soil Management/ Soil Storage Areas for Remedy

Note:
Proposed noise monitoring locations will be the boundary of the noise receptors facing the project-related construction activities. The precise monitoring locations will be determined in the field by a qualified acoustical consultant. In accordance with the CIMP protocol CUL-1a-8h, noise monitoring locations will be selected in coordination with the Tribes prior to construction.

N

0 750 1,500 3,000
Feet

FIGURE 4.6-1
PROPOSED NOISE MONITORING LOCATIONS RELATED TO PROJECT-RELATED CONSTRUCTION ACTIVITIES IN CALIFORNIA
EIR MITIGATION MEASURE NOISE-2C
GROUNDWATER REMEDY CONSTRUCTION/
REMEDIAL ACTION WORK PLAN
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

CH2MHILL

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LEGEND

- Extraction Well
- Injection Well
- Monitoring Well
- Water Supply Well
- Aboveground Pipe
- Underground Pipe/Conduit
- RailRoad
- 735' Noise Monitoring Buffer for Construction Activities between 10PM and 7AM
- 330' Noise Monitoring Buffer for Construction Activities conducted between 7AM and 10PM
- Noise Monitoring Station
- Proposed Staging Areas

Note:
Proposed noise monitoring locations will be the boundary of the noise receptors facing the project-related construction activities. The precise monitoring locations will be determined in the field by a qualified acoustical consultant. In accordance with the CIMP protocol CUL-1a-8h, noise monitoring locations will be selected in coordination with the Tribes prior to construction.

N

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Feet

FIGURE 4.6-2
PROPOSED NOISE MONITORING LOCATIONS RELATED TO PROJECT-RELATED CONSTRUCTION IN ARIZONA EIR MITIGATION MEASURE NOISE-2C
GROUNDWATER REMEDY CONSTRUCTION/ REMEDIAL ACTION WORK PLAN
PG&E TOPOCK COMPRESSOR STATION, NEEDLES, CALIFORNIA

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SECTION 5

Construction Contingency Plan/Procedures

This section presents the contingency plan and procedures to implement the plan during the construction and startup of the groundwater remedy, as required by the CACA (Attachment C, Item E7) (DTSC 1996) and the CD (Paragraph 13.b.6, and Appendix C, Sections 2.2.6 and 3) (DOI 2013). Contingency planning is being conducted as a part of the construction planning process to anticipate potential risks, organize plans, and develop methods/procedures to mitigate these risks.

5.1 Contingency Plans Required by the CACA and the CD

Pursuant to the CACA and CD requirements, this C/RAWP identifies and addresses potential failure modes related to (1) changes to the design and/or specifications due to issues that may arise during construction, and (2) unforeseen events that prevent the construction of the groundwater remedy (e.g., earthquakes, flooding, and fires).

The objective of the contingency planning process is to outline possible failures that could cause unacceptable conditions if not mitigated during the construction and startup of the groundwater remedy. Mitigation measures are focused on these issues first and foremost. The planning process also identified conditions that, while not unacceptable, are issues that PG&E will strive to avoid or minimize (e.g., releases of hazardous substances).

The following types of unacceptable conditions have been identified if failures are not mitigated:

- Approved design rendered noncompliant with codes, regulations, and/or engineering standard of practice.
- Noncompliant with the EIR, ARARs, PA, CHPMP, PBA, etc.
- Significant delay in schedule
- Significant increase in cost

The mitigation measures described in this section are taken to minimize or eliminate the likelihood of these unacceptable conditions or to lessen their effects. In general, causes of potential failures during construction are mitigated through: (1) chartering a team committed to implementing the project in an effective manner that is safe, sustainable, and respectful, (2) establishing site procedures and BMPs, including workers' education programs to ensure that the work is implemented properly, as discussed in Section 4 of this C/RAWP, and (3) implementing an approach to groundwater remedy well network construction (detailed in Section 3.2.1.3) that is designed to minimize or lessen the effects of the risk associated with discovery of groundwater or hydrogeologic conditions that differ from those assumed for design. Causes of potential failures during startup are mitigated through the design and the O&M planning phases. The mitigations are documented in the O&M Contingency Plan (O&M Manual, Volume 3).

Tables 5.1-1 and 5.1-2 summarizes the contingency plans for changes to the design and/or specifications due to issues that may arise during construction, and unforeseen events that could prevent the construction of the groundwater remedy (e.g., earthquakes, flooding, and fires). In addition, several tables from the O&M Contingency Plan addressing contingency plans during startup are included herein for convenience.

5.2 Contingency Plan Required by DTSC

Per DTSC direction (Response to Comment [RTC] #21 DTSC-2 on the 60% BOD Report), a contingent arsenic treatment system is included in the 90% design as part of the O&M Contingency Plan (Volume 3 of the O&M Manual, Section 2.3 and Appendix B). If the contingent system were to be constructed, the construction activities would be addressed under this C/RAWP. Construction approaches for this contingent system are anticipated to be similar to that of the remedy-produced water conditioning plant discussed in Section 3.2.

5.3 Contingency Plan from Comment Resolution at 60% Design

In response to comments on the 60% design documents (RTC #757 DTSC-239, RTC #341), a contingent system is included in the 90% design (O&M Contingency Plan, Section 2.2 and Appendix A) to remove scale-forming ions from remedy-produced water prior to injecting. If the contingent system were to be constructed, the construction activities would be addressed under this C/RAWP. Construction approaches for this contingent system are anticipated to be similar to that of tanks and process systems discussed in Section 3.2 of this C/RAWP.

TABLE 5.1-1
Failure Mode Effect Analysis Matrix – Contingencies to Address Changes to the Design/Specifications due to Issues that May Arise during Construction and Startup
Groundwater Remedy Construction/Remedial Action Work Plan Contingency Plan, PG&E Topock Compressor Station, Needles, California

	Failure Mode	Likely Causes for Failure	Effects of Failure If Not Mitigated	Mitigation after Failures Had Occurred to Lessen Their Effects
Failure Modes Associated with Construction	Discovery of site conditions that differ from those assumed for design	• Lack of site-specific subsurface data during design (e.g., certain groundwater quality data, certain hydrogeologic data, supplemental geotechnical data, soil conditions)	• Approved design rendered noncompliant with codes/ regulations and/ or engineering standard of practice • Planned well locations and/or constructions fail to meet the project objectives • Schedule delay • Increase cost	• Implement communication protocol outlined in Table 2.3-1 to obtain approval for design changes. • Implement approved design changes as appropriate.
	Discovery of soil contamination at or near target depth of pipe trench(es)	N/A	• Potential damage to remedy infrastructure during potential future soil remediation • Potential negative effects on potential future soil remediation efforts (e.g., delay due to lack of access to the contamination)	• Conduct additional soil sampling and potentially remediation within the footprint of the pipe trench(es). Discussions with agencies, stakeholders, and Tribes will occur prior to any remediation activities.
	Discovery of human remains or burials	N/A	• Noncompliant with PA, CHPMP, CIMP, EIR, and ARARs if work activities were to continue without implementing the identified mitigations • Schedule delay • Increase cost	• Suspend work in the immediate vicinity of the discovery (not less than 5 meters and not to exceed 50 meters from the discovered remains). • Implement communication protocol outlined in Table 2.3-1.
	Discovery of previously unidentified potentially significant cultural, historical, and/or paleontological resources	N/A	• Noncompliant with PA, CHPMP, CIMP, EIR, and ARARs if work activities were to continue without implementing the identified mitigations • Schedule delay • Increase cost	• Suspend work in the immediate vicinity of the discovery (not less than 5 meters and not to exceed 50 meters from the discovered remains). • Implement communication protocol outlined in Table 2.3-1.
	Discovery of active bird nests in work zones	• Nontransient, protected species moving into the project area	• Noncompliant with PBA and Bird Avoidance Plan if work activities were to continue without implementing the identified mitigations • Schedule delay • Increase cost	• Suspend work in the immediate vicinity of the discovery at recommended distance as described in Table 6-1 or 6-2 of the Bird Avoidance Plan
	Discovery of active desert tortoise burrows in work zones	• Desert tortoise moving into the project area	• Noncompliant with PBA if work activities were to continue without implementing the identified mitigations • Schedule delay • Increase cost	• Suspend work in the immediate vicinity of the discovery. • Consult with Agencies.

TABLE 5.1-1

Failure Mode Effect Analysis Matrix – Contingencies to Address Changes to the Design/Specifications due to Issues that May Arise during Construction and Startup

Groundwater Remedy Construction/Remedial Action Work Plan Contingency Plan, PG&E Topock Compressor Station, Needles, California

	Failure Mode	Likely Causes for Failure	Effects of Failure If Not Mitigated	Mitigation after Failures Had Occurred to Lessen Their Effects
Failure Modes Associated with Startup	Failure mode effect analyses for the startup of the in situ remediation system, the remedy-produced water conditioning system, the remedy SCADA, and the power distribution system have been conducted as part of contingencies planning for O&M and have been documented in the O&M Contingency Plan (Volume 3 of the O&M Manual). The failure mode effect analyses tables from the O&M Contingency Plan are included in this section for the convenience of the reader.			

TABLE 5.1-2

Failure Mode Effect Analysis Matrix – Contingencies to Address Potential Failure Modes Related to Unforeseen Events during Construction and Startup

Groundwater Remedy Construction/Remedial Action Work Plan Contingency Plan, PG&E Topock Compressor Station, Needles, California

	Failure Mode	Likely Causes for Failure	Effects of Failure If Not Mitigated	Mitigation taken or to be taken to Minimize or Eliminate the Likelihood of Failures, or lessen Their Effects	Mitigation after Failures Had Occurred to lessen Their Effects
Failure Modes Associated with Construction and Start-up	Major breakdown includes emergency situations such as fires, incidents that result in hospitalization or death, acts of God (e.g., earthquake, flood), etc.	• Acts of God	• Construction cannot proceed • Schedule delay • Increase cost	• Establish emergency response plan(s) • See failure mode effect analyses from the O&M Contingency Plan (included in this section for the convenience of the reader).	• Implement communication protocol outlined in Table 2.3-1. • Implement emergency response plan(s).
	Releases[a] of EPCRA-listed extremely hazardous substances and CERCLA-listed hazardous substances to the environment that are subject to reporting under EPCRA Section 304.	• Various construction and startup activities	• Noncompliant with various federal and state regulations	• Implement BMPs specified in the Site Management Plan to eliminate or minimize opportunity for releases.	• Implement communication protocol outlined in Table 2.3-1.
	Releases[a] of CERCLA-listed hazardous substances to the environment that are reportable under CERCLA Section 103.	• Various construction and startup activities	• Noncompliant with various federal and state regulations	• Implement BMPs specified in the Site Management Plan to eliminate or minimize opportunity for releases.	• Implement communication protocol outlined in Table 2.3-1.
	Releases[a] of hazardous materials to the environment reportable under CHSC 25501 and 19 CCR 2703.	• Various construction and startup activities	• Noncompliant with various federal and state regulations	• Implement BMPs specified in the Site Management Plan to eliminate or minimize opportunity for releases.	• Implement communication protocol outlined in Table 2.3-1.
	Release of oil to navigable waters of the US or adjacent shorelines in quantity that causes a sheen on the water or a violation of applicable water quality standards. Release of a quantity of oil to waters of the State, or release of 1 barrel (42 gallons) or more to a location on land where it could potentially enter waters of the State.	• Various construction and startup activities	• Noncompliant with various federal and state regulations	• Implement BMPs specified in the Site Management Plan to eliminate or minimize opportunity for releases.	• Implement communication protocol outlined in Table 2.3-1.
	Release of hazardous waste or hazardous waste constituents that could threaten human health or the environment outside the facility.	• Various construction and startup activities	• Noncompliant with various federal and state regulations	• Implement BMPs specified in the Site Management Plan to eliminate or minimize opportunity for releases.	• Implement communication protocol outlined in Table 2.3-1.

TABLE 5.1-2

Failure Mode Effect Analysis Matrix – Contingencies to Address Potential Failure Modes Related to Unforeseen Events during Construction and Startup

Groundwater Remedy Construction/Remedial Action Work Plan Contingency Plan, PG&E Topock Compressor Station, Needles, California

	Failure Mode	Likely Causes for Failure	Effects of Failure If Not Mitigated	Mitigation taken or to be taken to Minimize or Eliminate the Likelihood of Failures, or lessen Their Effects	Mitigation after Failures Had Occurred to lessen Their Effects
	Release of USDOT-regulated hazardous material during transportation[b] reportable under 49 CFR 171.15(b).	• Various construction and startup activities	• Noncompliant with various federal and state regulations	• Implement BMPs specified in the Site Management Plan to eliminate or minimize opportunity for releases.	• Implement communication protocol outlined in Table 2.3-1.

[a] Excludes permitted discharge of materials and release of hazardous materials/waste into secondary containment areas that is not released to the environment.

[b] Transportation includes loading, offloading, and storage of a USDOT-regulated vehicle/trailer.

Failure mode effect analyses for the startup of the in situ remediation system, the remedy-produced water conditioning system, the remedy SCADA, and the power distribution system have been conducted as part of contingencies planning for O&M and have been documented in the O&M Contingency Plan (Volume 3 of the O&M Manual). The failure mode effect analyses tables from the O&M Contingency Plan are included in this section for the convenience of the reader.

Failure Mode Effect Analysis Tables from O&M Manual Volume 3, Contingency Plan

TABLE 2.1-1

Failure Mode Effect Analysis Matrix - In-Situ Remediation System

Groundwater Remedy Operation and Maintenance Manual

Volume 3: Contingency Plan

PG&E Topock Compressor Station, Needles, California

Potential Failure and Effect without Mitigation	Potential Cause	Mitigation - Design	Mitigation - Operations				Severity (1 Low - 5 High)	Likelihood (1 Low - 5 High)	Severity x Likelihood	Type of Unacceptable Condition					Notes
			Mitigation	Observable Condition		Action if Cause Occurs				A. Unacceptable Remedy Performance	B. Significant Schedule Increase	C. Significant Cost Increase	D. Change to Impact	E. H&S or Compliance NOV (other than related to remedy performance)	
				PLC	Human										
Conveyance (General)															
Release from conveyance pipeline. <u>Effect Without Mitigation:</u> Potential release of water with Cr(VI), carbon substrate, and/or well/pipeline maintenance chemicals.	Differential thermal expansion or settlement, deterioration, vandalism, puncture; pressure exceedance; fabrication failure.	Overall pipeline design for durability over project lifetime; secondary containment (double-wall pipe or concrete trench box) with appropriately-designed leak detection systems (see Appendix C - Design Criteria, Section C.5.1 - Piping); redundant/spare pipe installed (or spare space provided for additional pipe); pipe installed within concrete trench box or direct buried without stacking to facilitate access.	Flow monitoring	Alarm conditions - secondary containment sump alarms; out-of-range process alarms (i.e., pipeline flows or pressures)	Observe leak	Stop pipeline operation, switch to spare pipeline and/or repair /replace pipeline, resume operation.	4	1	4					X	Type E unacceptable condition associated with potential environmental release.
Conveyance fouling/clogging. <u>Effect without Mitigation:</u> Potentially insufficient capacity to support remedy.	Solids buildup (i.e., scaling, biofouling).	Overall system/pipeline design to minimize solids buildup; clean-in-place system and cleanouts for pipeline maintenance (see Operations and Maintenance Plan, Section 5 - Pipeline Maintenance); redundant/spare pipe installed (or spare space provided for additional pipe); pipe installed within concrete trench box or direct buried without stacking to facilitate access.	Pipeline pressure/flow monitoring	Pipeline pressure/flow monitoring and data-logging	Significant increase in pipeline pressure or decrease in flow; observed clogging	Stop pipeline operation, switch to spare pipeline and/or clean/repair /replace pipeline, resume operation.	2	3	6						
Pipeline maintenance chemical/fluid release to wells. <u>Effect without Mitigation:</u> Release of chemicals, solids, etc. into wells and groundwater.	Valving between wells and conveyance not closed during pipeline maintenance.	Clean-in-place system programmed to require automated wellhead valves to be closed prior to operation.	Operator training; wellhead/pipeline inspection during maintenance	Well pressure/flow monitoring and data-logging; wellhead valve position monitoring	Loss of pipeline maintenance solution; observed well flows during pipeline maintenance	Well rehab (Operations and Maintenance Plan, Section 4 - Well Maintenance)	2	2	4						

TABLE 2.1-1
Failure Mode Effect Analysis Matrix - In-Situ Remediation System
Groundwater Remedy Operation and Maintenance Manual
Volume 3: Contingency Plan
PG&E Topock Compressor Station, Needles, California

Potential Failure and Effect without Mitigation	Potential Cause	Mitigation - Design	Mitigation - Operations				Severity (1 Low - 5 High)	Likelihood (1 Low - 5 High)	Severity x Likelihood	Type of Unacceptable Condition					Notes
			Mitigation	Observable Condition		Action if Cause Occurs				A. Unacceptable Remedy Performance	B. Significant Schedule Increase	C. Significant Cost Increase	D. Change to Impact	E. H&S or Compliance NOV (other than related to remedy performance)	
				PLC	Human										
Remediation Wells (General) - see also Table 2.2-1, Failure Mode Effect Analysis Matrix - Remedy-produced Water Management System															
Extraction well failure. Effect without Mitigation: The well will not be able to contribute to meeting extraction rate/remedy goals.	Capacity declines over time due to fouling or other well issues.	See Appendix C - Design Criteria (Remediation Well Design and Field Construction Approach) and Operations and Maintenance Plan, Section 4 - Well Maintenance - Extraction wells designed to optimize performance - Extraction wells designed to facilitate periodic well rehab - Remedy operations to minimize substrate and remedial by-product concentrations at extraction wells to minimize fouling	Remediation/monitoring well performance monitoring; periodic well rehab (Operations and Maintenance Plan, Section 4 - Well Maintenance)	Well water level/flow monitoring and data-logging	Insufficient capacity of produced water based on remediation/ monitoring well performance monitoring and evaluation	If well maintenance efforts ineffective - stop well operation, repair or replace, resume operation.	2	3	6						
	Well collapse or casing/screen failure (from deterioration, corrosion, etc.), vandalism, accidental damage, etc.	See Appendix C - Design Criteria (Remediation Well Design and Field Construction Approach) - Overall well design for durability over project lifetime - materials selection for resistance against corrosion, deterioration, and damage during routine operation and well rehab - Wells secured within vaults for protection	Visual well inspections	Alarm condition - out-of-range well operation	Observe damage	Stop well operation, repair or replace, resume operation.	2	1	2						
Injection well failure. Effect without Mitigation: The well will not be able to contribute to meeting injection rate/remedy goals.	Capacity declines over time.	See Appendix C - Design Criteria (Remediation Well Design and Field Construction Approach) and Operations and Maintenance Plan, Section 4 - Well Maintenance - Injection wells designed to optimize performance - drop tubes to minimize air entrainment - Injection wells designed to facilitate routine backwashing and periodic well rehab	Remediation/monitoring well performance monitoring; periodic well backwashing and rehab (Operations and Maintenance Plan, Section 4 - Well Maintenance)	Well water level/pressure/flow monitoring and data-logging	Insufficient capacity of injected water based on remediation/ monitoring well performance monitoring and evaluation	If well maintenance efforts ineffective - stop well operation, repair or replace, resume operation.	2	3	6						
	Well collapse or casing/screen failure (from deterioration, corrosion, etc.), vandalism, accidental damage, etc.	See Appendix C - Design Criteria (Remediation Well Design and Field Construction Approach) - Overall well design for durability over project lifetime - materials selection for resistance against corrosion, deterioration, and damage during routine operation and well rehab - Wells secured within vaults for protection	Visual well inspections	Alarm condition - out-of-range well operation	Observe damage	Stop well operation, repair or replace, resume operation.	2	1	2						
Release from wellhead, piping, or vault. Effect Without Mitigation: Potential release of water with Cr(VI), carbon substrate, and/or well/pipeline maintenance chemicals.	Differential thermal expansion, deterioration, vandalism, puncture; pressure exceedance; fabrication failure.	Overall wellhead design for durability over project lifetime; wells secured within vaults for protection; leak detection level switch in vault sump to alarm/stop well operation	Visual well/vault inspections	Alarm condition - well vault sump level switch; out-of-range well operation	Observe leak	Stop well operation, repair, resume operation.	4	1	4					X	Type E unacceptable condition associated with potential environmental release.
	Injection well overflows.	Downwell pressure transducer to shut off well if excessive water level/pressure increase; leak detection level switch in vault sump to alarm/stop well operation; overall injection system designed for flow/pressure balancing across network to minimize potential for well overflow	Visual well/vault inspections; preventative well maintenance (Operations and Maintenance Plan, Section 4 - Well Maintenance)	Alarm condition - well vault sump level switch; out-of-range well operation	Observe leak	Stop well operation, make repairs (as necessary), troubleshoot injection well capacity issues, as necessary - rehab/redevelop well (Operations and Maintenance Plan, Section 4 - Well Maintenance)	4	1	4					X	
Remediation well equipment, valving, instrumentation failure (other than above). Effect without Mitigation: Potential well damage or undesired operation.	Mechanical or electrical failure; general wear and tear; temperature.	Valves/instruments designed to fail in safest position; redundant controls/alarms; well casing relief valves to protect injection wells in case of excess pressure; common equipment/onsite spares for wells to facilitate troubleshooting	Preventative maintenance schedule; visual well/vault inspections	Alarm condition - well vault sump level switch; out-of-range well operation	Observe leak or out-of-range well operation	Stop well operation, repair, resume operation.	2	2	4						

TABLE 2.1-1

Failure Mode Effect Analysis Matrix - In-Situ Remediation System

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PG&E Topock Compressor Station, Needles, California

Potential Failure and Effect without Mitigation	Potential Cause	Mitigation - Design	Mitigation - Operations				Severity (1 Low - 5 High)	Likelihood (1 Low - 5 High)	Severity x Likelihood	Type of Unacceptable Condition					Notes
			Mitigation	Observable Condition		Action if Cause Occurs				A. Unacceptable Remedy Performance	B. Significant Schedule Increase	C. Significant Cost Increase	D. Change to Impact	E. H&S or Compliance NOV (other than related to remedy performance)	
				PLC	Human										
Carbon Amendment Systems (MW-20 and TW Benches)															
General carbon amendment system failure. <u>Effect without Mitigation:</u> Unable to operate parts or all of groundwater recirculation and carbon amendment systems to support remedy.	Equipment, valving, instrumentation failure	Valves/instruments that can result in a release if a fail-safe return is not provided are designed to fail in safest position; redundant controls/alarms; common equipment/onsite spares to facilitate troubleshooting; secondary containment at bench systems.	Visual inspections and preventative maintenance schedule	Alarm condition - out-of-range system operation; sump level alarm	Observed failure condition	Stop system operation, repair, resume operation.	3	2	6						
Carbon substrate storage and/or feed system failure. <u>Effect without Mitigation</u>: Potential release of flammable liquid; unable to amend recirculated groundwater with carbon substrate; potential over-dosing of carbon substrate to injection wells.	Human error Physical impact from vehicles Equipment, valving, instrument failure Corrosion, puncture, deterioration, accidental damage Vandalism	See Appendix C - Design Criteria, C.5.7 - Fire Protection Equipment and Draft Basis of Design Report, Section 3.2.1.1 - Description - NTH IRZ (Organic Carbon Substrate Amendment System [MW-20 Bench]) and Section 3.2.3.1 - Description - TCS Recirculation Loop (Organic Carbon Substrate Amendment System [Transwestern Meter Station]) - System designed in accordance with all applicable codes for flammable liquids - Overall system design for durability over project lifetime, including materials selection for compatibility, corrosion control, impact/damage protection - Storage tank has impact-resistant construction and double-wall construction with integral interstitial zone for leak detection monitoring - Instrumentation to include: tank interstitial space fluid level sensors, primary tank level transmitter with manual gauging port for operator verification, primary tank fluid temperature sensor, visible beacon/audible alarm within bench areas to notify operators of high level during tank filling, pipeline secondary containment leak detection system - Double-wall tank and piping systems with additional secondary containment in process/filling area - Valves/instruments designed to fail in safest position - Redundant controls/alarms - Fire extinguishers to be located at bench systems in accordance with applicable codes - Security fencing/traffic bollards	Visual inspections and preventative maintenance schedule; operator training	Alarm condition - leak detection/ secondary containment alarm; tank overfill alarm; out-of-range system operation (i.e., over- or under-dosing)	Observe failure condition	Stop system operation, repair, replace, or otherwise resolve failure, resume system operation; manual carbon substrate dosing at system or individual wells, if necessary	5	2	10			X		X	Type C/E unacceptable conditions associated with potential cost/H&S issues with flammable liquid storage and handling.

TABLE 2.1-1
Failure Mode Effect Analysis Matrix - In-Situ Remediation System
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Potential Failure and Effect without Mitigation	Potential Cause	Mitigation - Design	Mitigation - Operations: Mitigation	Mitigation - Operations: Observable Condition: PLC	Mitigation - Operations: Observable Condition: Human	Mitigation - Operations: Action if Cause Occurs	Severity (1 Low - 5 High)	Likelihood (1 Low - 5 High)	Severity x Likelihood	Type of Unacceptable Condition: A. Unacceptable Remedy Performance	B. Significant Schedule Increase	C. Significant Cost Increase	D. Change to Impact	E. H&S or Compliance NOV (other than related to remedy performance)	Notes
NTH IRZ															
IRZ is not effective at removing Cr(VI) from groundwater as designed. <u>Effect without Mitigation:</u> Potential schedule/cost increase or other issues with achieving RAOs as designed.	More rapid utilization of carbon substrate after injection than anticipated.	Design included pilot testing, predictive simulations/modeling, and additional design efforts; system designed with flexibility for range of operating flow rates and carbon substrate types and dosing strategies; future provisional wells have been included in the design, if needed; flexibility retained in the design to adjust locations of provisional wells; manual carbon substrate dosing can target individual wells if needed to supplement IRZ-wide dosing; River Bank extraction wells are designed to capture downgradient Cr(VI), TOC, and/or byproducts, as needed; system designed with flexibility to re-direct extracted water from TCS Recirculation Loop to NTH IRZ (if system is flow limited)	See Sampling and Monitoring Plan, Decision Rules/Operational Framework (Figures 2.2-2 and 2.2-3) for IRZ performance troubleshooting and operational adaptability philosophy to be conducted based on remedial performance monitoring/evaluation and using the designed system flexibility - operational adjustments may include flow rates, carbon substrate type and dosing strategy, number and location of operating wells, injection of water from the TCS Recirculation Loop into the NTH IRZ (if system is flow limited), etc. River Bank extraction, Inner Recirculation Loop extraction, and Freshwater injection wells may be slowed or shut down to slow groundwater flow rate during NTH IRZ troubleshooting.		See Sampling and Monitoring Plan and Operations and Maintenance Plan for summary of remedy monitoring and how data will be evaluated/applied to remedy system optimization	If operational adjustments outlined in Sampling and Monitoring Plan, Decision Rules/Operational Framework (Figures 2.2-2 and 2.2-3) are not successful in establishing IRZ effectiveness - additional extraction/injection wells or water sources (if system is flow limited) will be considered	4	2	8	X	X	X	X		Unacceptable conditions associated with potential increased level of effort required to achieve remedy performance objectives.
	Well spacing or screen placement is inadequate.						4	2	8	X	X	X	X		
	Recalcitrant mass in immobile porespace.						4	2	8	X	X	X	X		
	Unexpected hydrogeologic conditions (e.g., preferential flow paths allow water to pass through IRZ without adequate treatment).						4	3	12	X	X	X	X		
	Extraction/injection flow limited.						4	2	8	X	X	X	X		
Extraction of organic carbon and/or significant byproducts. <u>Effect without Mitigation:</u> Potential to increase well/pipeline maintenance required to meet remedy goals.	Carbon substrate dosing greater than required.					If operational adjustments outlined in Sampling and Monitoring Plan, Decision Rules/Operational Framework (Figures 2.2-2 and 2.2-3) are not successful in managing organic carbon or by-product concentrations at extraction wells - additional wells or water sources (if system is flow limited) will be considered; treatment of River Bank extracted groundwater prior to re-injection will be considered.	4	2	8			X			
	By-product generation greater than expected/attenuation slower than expected						4	2	8			X			

TABLE 2.1-1

Failure Mode Effect Analysis Matrix - In-Situ Remediation System

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Potential Failure and Effect without Mitigation	Potential Cause	Mitigation - Design	Mitigation - Operations				Severity (1 Low - 5 High)	Likelihood (1 Low - 5 High)	Severity x Likelihood	Type of Unacceptable Condition					Notes
			Mitigation	Observable Condition		Action if Cause Occurs				A. Unacceptable Remedy Performance	B. Significant Schedule Increase	C. Significant Cost Increase	D. Change to Impact	E. H&S or Compliance NOV (other than related to remedy performance)	
				PLC	Human										
Inner Recirculation Loop - see also Table 2.3-1, Failure Mode Effect Analysis Matrix - Freshwater Supply															
Unacceptable migration of Cr(VI) or byproducts. <u>Effect without Mitigation</u>: Potential for Cr(VI) or byproducts to enter the Colorado River; potential plume expansion.	Unexpected hydrogeologic conditions.	Design included pilot testing, predictive simulations/modeling, and additional design efforts; system designed with flexibility for range of operating flow rates and carbon substrate type and dosing strategy; IRL injection wells designed for flexibility to inject freshwater and/or River Bank extracted groundwater[1]; future provisional wells have been included in the design, if needed; flexibility retained in the design to adjust locations of provisional wells	See Sampling and Monitoring Plan, Decision Rules/Operational Framework (Figures 2.2-4 and 2.2-5) for IRL performance troubleshooting and operational adaptability philosophy to be conducted based on remedial performance monitoring/evaluation and using the designed system flexibility - operational adjustments may include flow rates, carbon substrate type and dosing strategy, number and location of operating wells, injection of freshwater and/or River Bank extracted groundwater into IRL injection wells[1], etc.		See Sampling and Monitoring Plan and Operations and Maintenance Plan for summary of remedy monitoring and how data will be evaluated/applied to remedy system optimization	If operational adjustments outlined in Sampling and Monitoring Plan, Decision Rules/Operational Framework (Figures 2.2-4 and 2.2-5) are not successful in establishing adequate plume control or plume flushing - additional extraction/injection wells (including wells to the south of RB-5), River Bank extraction well pumping from shallow zones, or additional water sources (if system is flow limited) will be considered; institutional controls will be considered, as needed, to limit new large-capacity extraction wells; additional mitigation measures, including potential treatment of River Bank extracted groundwater prior to re-injection, will be considered	4	3	12	X		X	X		Unacceptable conditions associated with potential increased level of effort required to achieve remedy performance objectives.
	Well spacing or screen placement is inadequate.						4	2	8	X		X	X		
	New large-capacity wells (e.g., water supply wells) are installed near the site (e.g., at Park Moabi or elsewhere along the Colorado River).						4	2	8	X		X	X		
Flushing of plume through NTH IRZ not as effective as designed. <u>Effect without Mitigation:</u> Potential schedule delay.	Unexpected hydrogeologic conditions.						4	3	12		X	X	X		
	Well spacing or screen placement is inadequate.						4	2	8	X		X	X		
	Lack of adequate supply of injection water (e.g., River Bank Extraction Well produced water contains unacceptably high concentrations of byproducts/other constituents).						4	2	8		X	X	X		
Natural reducing rind near river is negatively-impacted by pumping resulting in inadequate reducing buffer in floodplain. <u>Effect without Mitigation:</u> Could affect ability to rely on MNA for residual contamination when active remediation ends.	Oxic water from the river being pulled into floodplain by extraction wells near the river	Design included pilot testing, predictive simulations/modeling, and additional design efforts; system designed with flexibility for range of operating flow rates; River Bank extraction well pumping planned for deeper zones only				If operational adjustments are not successful in adequately maintaining the natural reducing rind - assess potentially required remedy modifications	2	2	4						

TABLE 2.1-1

Failure Mode Effect Analysis Matrix - In-Situ Remediation System

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Potential Failure and Effect without Mitigation	Potential Cause	Mitigation - Design	Mitigation - Operations				Severity (1 Low - 5 High)	Likelihood (1 Low - 5 High)	Severity x Likelihood	Type of Unacceptable Condition					Notes
			Mitigation	Observable Condition		Action if Cause Occurs				A. Unacceptable Remedy Performance	B. Significant Schedule Increase	C. Significant Cost Increase	D. Change to Impact	E. H&S or Compliance NOV (other than related to remedy performance)	
				PLC	Human										
TCS Recirculation Loop															
TW Bench extraction well network does not provide adequate volume or mass removal. Effect without Mitigation: Potential schedule delay as impacted water near TCS not treated as rapidly as planned.	Unexpected hydrogeologic conditions.	Design included pilot testing, predictive simulations/modeling, and additional design efforts; system designed with flexibility for range of operating flow rates and carbon substrate type and dosing strategy; TCS injection wells designed for flexibility to inject freshwater and/or extracted groundwater; future provisional wells have been included in the design, if needed; flexibility retained in the design to adjust locations of provisional wells; River Bank extraction wells are designed to capture downgradient Cr(VI), TOC, and/or byproducts, as needed; system designed with flexibility to re-direct extracted water from TCS Recirculation Loop to NTH IRZ (if system is limited by ability to inject into TCS injection wells)	See Sampling and Monitoring Plan, Decision Rules/Operational Framework (Figures 2.2-6 to 2.2-8) for TCS Recirculation Loop performance troubleshooting and operational adaptability philosophy to be conducted based on remedial performance monitoring/evaluation and using the designed system flexibility - operational adjustments may include flow rates, carbon substrate type and dosing strategy, number and location of operating wells, etc.; TW Bench and East Ravine extracted groundwater may be injected into NTH IRZ (if system is limited by ability to inject into TCS injection wells).		See Sampling and Monitoring Plan and Operations and Maintenance Plan for summary of remedy monitoring and how data will be evaluated/applied to remedy system optimization	If operational adjustments outlined in Sampling and Monitoring Plan, Decision Rules/Operational Framework (Figures 2.2-6 to 2.2-8) are not successful in achieving design objectives - additional extraction/injection wells or water sources (if system is flow limited) will be considered.	4	3	12		X	X	X		Unacceptable conditions associated with potential increased level of effort required to achieve remedy performance objectives.
	Well spacing or screen placement is inadequate.						4	2	8		X	X	X		
	Extraction/injection flow limited.						4	2	8		X	X	X		
East Ravine extraction well network does not provide capture of targeted groundwater, as designed. Effect without Mitigation: Potential expansion of plume or Cr(VI) release to Colorado River.	Unexpected hydrogeologic conditions.						4	3	12	X	X	X	X		
	Well spacing or screen placement is inadequate.						4	2	8	X	X	X	X		
	Extraction/injection flow limited.						4	2	8	X	X	X	X		
Cr(VI) treatment by TCS injection well network not as effective as designed. Effect without Mitigation: Potential schedule delay.	Unexpected hydrogeologic conditions.						4	3	12		X	X	X		
	More rapid utilization of carbon substrate after injection than anticipated.						4	2	8		X	X	X		
	Well spacing or screen placement is inadequate.						4	2	8		X	X	X		
	Extraction/injection flow limited.						4	2	8		X	X	X		

TABLE 2.1-1
Failure Mode Effect Analysis Matrix - In-Situ Remediation System
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Potential Failure and Effect without Mitigation	Potential Cause	Mitigation - Design	Mitigation - Operations: Mitigation	Mitigation - Operations: Observable Condition: PLC	Mitigation - Operations: Observable Condition: Human	Mitigation - Operations: Action if Cause Occurs	Severity (1 Low - 5 High)	Likelihood (1 Low - 5 High)	Severity x Likelihood	Type of Unacceptable Condition: A. Unacceptable Remedy Performance	B. Significant Schedule Increase	C. Significant Cost Increase	D. Change to Impact	E. H&S or Compliance NOV (other than related to remedy performance)	Notes
Freshwater Injection System - see also Table 2.3-1, Failure Mode Effect Analysis Matrix - Freshwater Supply															
Flushing of plume through NTH IRZ not as effective as designed. <u>Effect without Mitigation:</u> Potential schedule delay.	Unexpected hydrogeologic conditions.	Design included pilot testing, predictive simulations/modeling, and additional design efforts; system designed with flexibility for range of operating flow rates	See Sampling and Monitoring Plan, Figure 2.2-9 Freshwater Injection System Decision Rules/Operational Framework for freshwater injection performance troubleshooting and operational adaptability philosophy to be conducted based on remedial performance monitoring/evaluation and using the designed system flexibility - operational adjustments may include flow rates, number and location of operating wells, etc.; TCS injections may be adjusted or shut down if FW-02 is not operating as intended		See Sampling and Monitoring Plan and Operations and Maintenance Plan for summary of remedy monitoring and how data will be evaluated/applied to remedy system optimization	If operational adjustments outlined in Sampling and Monitoring Plan, Figure 2.2-9 Freshwater Injection System Decision Rules/Operational Framework are not successful in achieving design objectives - additional injection wells will be considered	4	3	12		X	X	X		Unacceptable conditions associated with potential increased level of effort required to achieve remedy performance objectives.
	Well or screen placement is inadequate.						4	2	8		X	X	X		
	Lack of adequate supply of injection water.						4	2	8		X	X	X		
Insufficient FW-02 performance to maintain control of southwestern plume margin. <u>Effect without Mitigation</u>: Potential plume expansion.	Unexpected hydrogeologic conditions.						4	3	12	X					
	Well or screen placement is inadequate.						4	2	8	X					
	Lack of adequate supply of injection water.						4	2	8	X					
Analytical data collected from freshwater arsenic monitoring wells located 225 feet from freshwater injection locations indicate arrival of arsenic plume above the water quality objective. <u>Effect without Mitigation:</u> Per the California State Water Resources Control Board (SWRCB) letter to DTSC (SWRCB 2013), PG&E is required to cease injection of untreated water and either 1) add pre-treatment or 2) use a freshwater source without arsenic if data collected from freshwater arsenic monitoring wells located 225 feet from freshwater injection locations indicate arrival of arsenic plume above the water quality objective. Modeling calculations will be re-assessed and these or other actions may also be considered for implementation if data collected from freshwater arsenic monitoring wells located 150 feet from freshwater injection locations indicate arrival of the leading edge of the arsenic plume, defined as arsenic concentrations at the concentration in the injected freshwater.	Unexpected hydrogeologic/ geochemical conditions.	Design included pilot testing, predictive simulations/modeling and additional design efforts; system designed with flexibility for range of operating flow rates	Sampling of freshwater arsenic monitoring wells located 150 feet from freshwater injection locations. If data from these wells indicate arrival of the leading edge of the arsenic plume, defined as arsenic concentrations at the concentration in the injected freshwater, modeling calculations will be re-assessed and operational adjustments may include flow rates, number and location of IRL injection wells operating with freshwater versus River Bank extracted groundwater[1], aeration of freshwater prior to injection to reduce arsenic mobility, etc. (see Sampling and Monitoring Plan, Section 2.2.4)		See Sampling and Monitoring Plan and Operations and Maintenance Plan for summary of remedy monitoring and how data will be evaluated/applied to remedy system optimization	If operational adjustments/interim actions discussed in Sampling and Monitoring Plan, Section 2.2.4 are not successful in achieving design objectives - implementation of the freshwater pre-injection treatment system (see also Section 2.3) for freshwater arsenic treatment and/or additional/alternative freshwater sources will be implemented per the SWRCB letter to DTSC (SWRCB 2013).	4	2	8		X	X			Type B/C unacceptable condition associated with potential schedule/cost increases.

TABLE 2.1-1

Failure Mode Effect Analysis Matrix - In-Situ Remediation System

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Potential Failure and Effect without Mitigation	Potential Cause	Mitigation - Design	Mitigation - Operations: Mitigation	Mitigation - Operations: Observable Condition: PLC	Mitigation - Operations: Observable Condition: Human	Mitigation - Operations: Action if Cause Occurs	Severity (1 Low - 5 High)	Likelihood (1 Low - 5 High)	Severity x Likelihood	Type of Unacceptable Condition: A. Unacceptable Remedy Performance	Type of Unacceptable Condition: B. Significant Schedule Increase	Type of Unacceptable Condition: C. Significant Cost Increase	Type of Unacceptable Condition: D. Change to Impact	Type of Unacceptable Condition: E. H&S or Compliance NOV (other than related to remedy performance)	Notes
In-Situ Remediation System (General)															
Aerial or vertical extent of Cr(VI) plume greater than currently defined. <u>Effect without Mitigation</u>: Potential expansion of remedy footprint.	Inadequate characterization of Cr(VI) in groundwater	Groundwater characterization efforts to date indicate it is unlikely that significant Cr(VI) concentrations exist outside of currently-defined plume footprint. Remedy system design includes some flexibility to expand outside of planned footprint, if needed. See Chapter 5 of the Construction/Remedial Action Work Plan for the Construction Contingency Plan/Procedures.	Installation of remediation and monitoring wells will be conducted in a step-wise manner with a focus on first gathering lithologic data, then water quality data, before finalizing well locations/well screen intervals and installing wells. Well construction will also consider previous well data to ensure the latest data is used in the well installation process.		See Sampling and Monitoring Plan and Operations and Maintenance Plan for summary of remedy monitoring and how data will be evaluated/applied to remedy system optimization	Assess potentially required remedy modifications, including system expansion	4	2	8			X	X		Unacceptable conditions associated with potential cost increase/additional CEQA analysis required due to expansion of remedy footprint.
Cr(III) re-oxidation to Cr(VI) after in-situ treatment. <u>Effect without Mitigation:</u> Potential issues with achieving RAOs as designed.	Unexpected high availability of reactive MnO_2 surfaces along groundwater flow path.	Design included pilot testing, predictive simulations/modeling, and additional design efforts that indicated significant re-oxidation of Cr(III) to Cr(VI) is unlikely	See Sampling and Monitoring Plan, Decision Rules/Operational Framework (Figures 2.2-2 to 2.2-9) for remedy performance troubleshooting and operational adaptability philosophy to be conducted based on remedial performance monitoring/evaluation and using the designed system flexibility such as adjusting operational flow rates, organic carbon dosing strategy, etc.			Assess potentially required remedy modifications	1 to 4	1	1 to 4	X	X	X	X		Unacceptable conditions associated with potential increased level of effort required to achieve remedy performance objectives.
Changes in aquifer pH not adequately buffered. <u>Effect without Mitigation:</u> Potential issues with achieving RAOs as designed.	Inadequate groundwater and/or biogeochemical characterization	Design included pilot testing and predictive simulations/modeling that indicated significant change in pH is unlikely				Assess potentially required remedy modifications	1 to 3	1	1 to 3						
In-situ remedy byproduct (arsenic) concentrations do not sufficiently attenuate. <u>Effect without Mitigation</u>: Potential issues with achieving RAOs as designed.		Design included pilot testing, predictive simulations/modeling, and additional design efforts that indicate sufficient byproduct attenuation following remedy operation				Assess potentially required remedy modifications, including potential treatment of extracted River Bank groundwater prior to re-injection	1 to 3	1	1 to 3						
In-situ remedy byproduct (manganese) concentrations do not sufficiently attenuate. <u>Effect without Mitigation</u>: Potential issues with achieving RAOs as designed.							1 to 3	1	1 to 3						
In-situ remedy byproduct (iron) concentrations do not sufficiently attenuate. <u>Effect without Mitigation</u>: Potential issues with achieving RAOs as designed.							1 to 3	1	1 to 3						

TABLE 2.1-1

Failure Mode Effect Analysis Matrix - In-Situ Remediation System

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Potential Failure and Effect without Mitigation	Potential Cause	Mitigation - Design	Mitigation - Operations				Severity (1 Low - 5 High)	Likelihood (1 Low - 5 High)	Severity x Likelihood	Type of Unacceptable Condition					Notes
			Mitigation	Observable Condition		Action if Cause Occurs				A. Unacceptable Remedy Performance	B. Significant Schedule Increase	C. Significant Cost Increase	D. Change to Impact	E. H&S or Compliance NOV (other than related to remedy performance)	
				PLC	Human										
Natural Disaster															
Seismic damage. Effect without Mitigation: Damage to remedy infrastructure may cause shutdown of parts or all of remedy.	Earthquake	See Appendix C - Design Criteria, C.3.5 - Seismic Loads - Structures will be designed in accordance with applicable seismic codes		Alarm conditions will shut system down if significant damage	Observed failure condition	Stop system operation, inspect system, repair/replace system infrastructure (as needed), resume system operation	varies	1	varies		X	X			Type B/C unacceptable condition associated with potential schedule/cost increases.
Flooding. Effect without Mitigation: Damage to remedy infrastructure may cause shutdown of parts or all of remedy; potential loss of access.	Rising water levels in Colorado River	Remedy infrastructure located outside of ordinary high water mark and 100-year floodplain to the extent possible; system can be operated/shutdown remotely if access limited	Preventative system shutdown or other action if flood conditions predicted	Alarm conditions will shut system down if significant flooding (sump levels)/ damage	Observed failure condition		varies	1	varies		X	X			Type B/C unacceptable condition associated with potential schedule/cost increases.
Fire damage. Effect without Mitigation: Damage to remedy infrastructure may cause shutdown of parts or all of remedy.	Wildfires/vegetation fires; Compressor station or gas pipeline explosion	System can be operated/shutdown remotely if access limited	Routine vegetation clearing/housekeeping in remedy facility areas; preventative system shutdown or other actions if fires in area	Alarm conditions will shut system down if significant damage	Observed failure condition		varies	1	varies		X	X			Type B/C unacceptable condition associated with potential schedule/cost increases.
Freezing conditions. Effect without Mitigation: Potential damage to remedy infrastructure may cause shutdown of parts or all of remedy.	Cold temperatures	Site conditions/temperatures unlikely to be cold enough to cause issues.	Preventative system shutdown and system/pipeline draining if freezing temperatures predicted	Alarm conditions will shut system down if significant freezing/ damage	Observed failure condition		1	1	1						
Wind-blow dust damage. Effect without Mitigation: Potential damage to remedy infrastructure may cause shutdown of parts or all of remedy.	Dust, sands, etc. blown by high desert winds	Most remedy infrastructure located within enclosed buildings or vaults.	Preventative maintenance and visual inspection schedule to observe damage	Alarm conditions will shut system down if equipment failure due to dust damage	Observed damage or failure condition		1	2	2						

Abbreviations:

PLC - process logic controller
DOI - United States Department of the Interior
DTSC - Department of Toxic Substances Control
EIR - environmental impact report
H&S - health and safety
NOV - notice of violation
RAO - remedial action objective
TW - Transwestern
IRZ - In-Situ Reactive Zone
NTH - National Trails Highway
TCS - Topock Compressor Station
IRL - Inner Recirculation Loop
MNA - monitored natural attenuation
Cr(VI) - hexavalent chromium
Cr(III) - trivalent chromium
MnO_2 - manganese dioxide
P/V - pressure/vacuum
SWRCB - State Water Resources Control Board
TOC - total organic carbon

Notes:

1. Under the nominal operational scenario, River Bank extracted groundwater will be injected into the lower two-thirds of the saturated interval at IRL-1 and IRL-2. Changes in the wells and/or intervals into which River Bank extracted groundwater is injected will first be discussed with the DTSC and DOI.

TABLE 2.2-1
Failure Mode Effect Analysis Matrix — Remedy-produced Water Management System
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PG&E Topock Compressor Station, Needles, California

Potential Failure and Effect without Mitigation	Potential Cause	Mitigation - Design	Mitigation - Operations: Mitigation	Observable Condition: Remedy SCADA	Observable Condition: Human	Action if Cause Occurs	Severity (1 Low - 5 High)	Likelihood (1 Low - 5 High)	Severity x Likelihood	A. Unacceptable Remedy Performance	B. Significant Schedule Increase	C. Significant Cost Increase	D. Significant Change to Impacts (Additional CEQA Analysis)	E. H&S or Compliance NOV (other than related to remedy performance)	Notes
1. Conditioning System Capacity Insufficient [2,3] Effect without Mitigation: Some water will not be able to be conditioned or re-used/ disposed on-site.	a. Generate more water that must be managed in a single backwash event – Short- term capacity condition	Plant designed for 35 gpm capacity and safety factor applied in sizing storage tanks	Temporarily decrease backwash frequency which would cause an increase in water level in the injection well	Influent flow measurements	N/A	Adjust operations to reduce backwash Investigate root cause and re-evaluate well O&M procedures	1	1	1						In cases resulting in loss of well performance, see the SOPs in the O&M Manual for diagnostic and maintenance procedures.[4]
	b. Wells need more maintenance then anticipated – Long-term capacity condition	Plant designed for 35 gpm capacity and safety factor applied in sizing storage tanks. Process is divided into 2 sides (Remedy A-side and Freshwater B-side) to allow for flexibility in managing conditioned water.	Investigate root cause, re-evaluate well operations, and maintenance procedures (see Section 4). If needed, evaluate the need and methods to increase plant capacity.	Flow transmitters, High well operating level	N/A	Adjust operations to reduce backwash Investigate root cause and re-evaluate well O&M procedures	3	2	6						See Note [1]. Severity depends on downtime and cost.
	c. Excessive load of solids on filters. Frequent filter change-outs	Install tanks to settle solids and turbidity analyzers on conditioned water tanks. Design coarse, then fine filter and standby filters on each train and instrumentation to measure pressure across the filters.	Conduct jar testing for alternative coagulants, to improve settling in tanks. Normal operation is flow through 2-stage filters. Standby filters put into service if operating filter is fouled. Stock spare filters on site	Quick increase in differential pressure across cartridge filters Alarms	Scheduled inspections, check water chemistry for scaling conditions	Well sampling to evaluate influent solids concentrations; Replace cartridges. If scaling, change pH target or add antiscalant	2	1	2						In cases resulting in loss of well performance, see the O&M Manual, Volume 1, Section 4 for diagnostic and maintenance procedures.[4]
	d. Grit build-up in tank	Design capability to pump solids from these tanks to phase separators. Design capability to use vac truck to remove solids.	Operators to monitor solids level	N/A	Operators to monitor solids level	Operators to hose down solids so they'll pump out, or remove by vac truck	1	1	1						
	e. Phase separator bins cannot be removed due to problems with hauling contractor and solids fill up in system. Plant capacity limited or stopped.	N/A	Have backup destination for disposal planned	N/A	N/A	Store full bins on site or at other PG&E facilities	1	1	1						

TABLE 2.2-1
Failure Mode Effect Analysis Matrix — Remedy-produced Water Management System
Groundwater Remedy Operation and Maintenance Manual
Volume 3: Contingency Plan
PG&E Topock Compressor Station, Needles, California

Potential Failure and Effect without Mitigation	Potential Cause	Mitigation - Design	Mitigation - Operations: Mitigation	Mitigation - Operations: Observable Condition: Remedy SCADA	Mitigation - Operations: Observable Condition: Human	Mitigation - Operations: Action if Cause Occurs	Severity (1 Low - 5 High)	Likelihood (1 Low - 5 High)	Severity x Likelihood	Type of Unacceptable Condition: A. Unacceptable Remedy Performance	B. Significant Schedule Increase	C. Significant Cost Increase	D. Significant Change to Impacts (Additional CEQA Analysis)	E. H&S or Compliance NOV (other than related to remedy performance)	Notes
	f. IRZ and other on-site reuse/disposal options do not have the capacity to take all treated water – Short term condition	N/A	Storage	N/A	N/A	Adjust operations	2	1	2						
	g. IRZ and other on-site reuse/disposal options do not have the capacity to take all treated water – Long term condition	N/A	Evaluate alternative re-use options	N/A	N/A	Trucking	3	1	3						.
	h. More wells or higher flow rates are needed to achieve RAOs, which produces more water to manage	Reserve space for additional storage and/or conditioning equipment	N/A	N/A	N/A	N/A	2	1	2						See Note 3.
2. Poor Quality Water to Wells: High or low pH Effect without Mitigation: Out of Spec Water may cause increased well or formation fouling or geochemical changes releasing minerals which could affect IRZ performance or plume composition. Excessive pH either high or low could reduce or change microorganism populations, which in turn could also reduce IRZ performance.	a. Tank eductor failure, and poor mixing of conditioning chemicals	Install redundant tank eductors	N/A	N/A	If chemical addition loses effectiveness at altering pH. Will do periodic visual inspections of educators	Repair or replace	1	1	1						
	b. pH Analyzer Failure	Install analyzers on influent and conditioned water tanks	Periodic calibration and system inspections	High and low alarm	Scheduled inspections and monitoring with handheld meter	N/A	1	1	1						
3. Poor Quality Water to Wells: High Suspended Solids Effect without Mitigation: Increase potential for well fouling which could result in increased well maintenance	Cartridge filter rupture or operator not install cartridge	Install turbidity analyzers on conditioned water tanks	Injection well performance monitoring SOP and RPWC System SOPs.[4] Normal operation is flow through 2-stage filters. Standby filter put into service if operating filter is fouled	Alarms on analyzers	Equipment inspections	Follow well maintenance procedures (Section 4), replace cartridges	2	1	2						

TABLE 2.2-1
Failure Mode Effect Analysis Matrix — Remedy-produced Water Management System
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Volume 3: Contingency Plan
PG&E Topock Compressor Station, Needles, California

Potential Failure and Effect without Mitigation	Potential Cause	Mitigation - Design	Mitigation - Operations: Mitigation	Observable Condition: Remedy SCADA	Observable Condition: Human	Action if Cause Occurs	Severity (1 Low - 5 High)	Likelihood (1 Low - 5 High)	Severity x Likelihood	A. Unacceptable Remedy Performance	B. Significant Schedule Increase	C. Significant Cost Increase	D. Significant Change to Impacts (Additional CEQA Analysis)	E. H&S or Compliance NOV (other than related to remedy performance)	Notes
4. Poor Quality Water to Wells: Presence of scaling ions: (Ca, Mg, Mn, Fe, etc.) or high pH water Effect without Mitigation: Scaling in pipelines and wells	Presence of ions in well water	Reserve space to add conditioning units, if needed. These contingent units are described in Section 2.2 of this Contingency Plan. Pipe blowoffs and cleanouts are included in the pipelines. May need to add anti-scalants continuously or use other chemical cleaners.	Monitor effluent quality and injection well performance (see additional information in the Notes column).	N/A	N/A	Follow well maintenance procedures (Section 4)	2	2	4						System is not designed for removing dissolved metals. Modify conditioning process if dissolved ions and metals pose or are causing declining well performance. Addition of conditioning methods may be required if pH increase is not effective in removing constituents. More frequent rehabs or backwash at wells that are fouling due to poor effluent water quality.
5. Equipment Failure Effect Without Mitigation: Leak, contamination, personnel exposure	a. Pipe rupture	Select piping material that is appropriate for the liquid being conveyed and is rated for the anticipated operating pressure.	N/A	N/A	Visual	Follow SOPs,[4] and perform repair	2	1	2						
	b. Tank Failure	Install tank vents, barriers to prevent vehicle impact, seismic supports, coatings, corrosion protection system, and secondary containment for tanks	Preventive maintenance	N/A	Visual	Follow SOPs,[4] and perform repair	2	1	2						
	c. Pump Failure	Mech. seals, drainage for leaks and drips, evaluate seal flush system destination, evaluate cavitation potential on low suction head pumps.	Preventive maintenance	Run fail indication	N/A	Follow SOPs[4] for pump and seals, and perform repair	1	1	1						
	d. Filter failure	Install instrumentation to measure pressure across the filters and alarm. Install 2-stage filters (coarse and fine). Set vessel pressure rating to contain "deadhead" pump condition.	Preventive maintenance	Increased pressure across filters	N/A	Follow SOPs,[4] and perform repair/ replace cartridges	1	1	1						
	e. Eductor failure	Install multiple tank eductors. Monitor vacuum on educator to evaluate erosion or fouling.	Preventive maintenance and inspection. Do routine maintenance and adjust procedures and equipment accordingly.	N/A	Visual inspections/ maintenance	Follow SOPs[4] and perform repair/ replace educators.	1	1	1						

TABLE 2.2-1
Failure Mode Effect Analysis Matrix — Remedy-produced Water Management System
Groundwater Remedy Operation and Maintenance Manual
Volume 3: Contingency Plan
PG&E Topock Compressor Station, Needles, California

			Mitigation - Operations							Type of Unacceptable Condition					
				Observable Condition											
Potential Failure and Effect without Mitigation	**Potential Cause**	**Mitigation - Design**	**Mitigation**	**Remedy SCADA**	**Human**	**Action if Cause Occurs**	**Severity (1 Low - 5 High)**	**Likelihood (1 Low - 5 High)**	**Severity x Likelihood**	**A. Unacceptable Remedy Performance**	**B. Significant Schedule Increase**	**C. Significant Cost Increase**	**D. Significant Change to Impacts (Additional CEQA Analysis)**	**E. H&S or Compliance NOV (other than related to remedy performance)**	**Notes**
6. Freezing Effect without mitigation: No fluid flow	Low ambient temperature	Install heat trace for some chemical piping and storage tanks.	Drain system. Other responses include heat tape, wrapping lines with cloth or rags, or placing heat lamps.	N/A	Weather forecast and anticipated outage schedule.	Upgrade freeze protection or change chemical strength or type	2	1	2						Not been a problem historically at TCS or IM-3
7. Spills Effect without Mitigation: Exposure and contamination of soil	Equipment or pipe failure	Provide adequate secondary containment	SOP[4] and training and alarms (also in HMBP, BMPs, SWPPP)	Alarm for pump running and no flow. Secondary containment level alarms	Visual inspections	Drain system, pump to influent storage tanks. Repair leak.	2	1	2						
8. Unexpected constituents/ material by-product in conditioned water Effect without Mitigation: Carry over contaminant to cooling tower or injection wells	a. Not following RPWC SOPs[4]	N/A	Follow the Operation and Maintenance Manual and SOPs	N/A	N/A	Reinforce/training	1	1	1						Examples include, iron, manganese, silica, calcium, magnesium, and biological materials
	b. Unexpected material enters system	N/A	Investigate root cause, re-evaluate well operations, and maintenance procedures (see Section 4)	N/A	N/A	Revise SOPs[4] or process as needed, could modify monitoring procedures.	2	1	2						
9. Lightning Strike Effect without mitigation: Damage to plant may cause shutdown of system. May cause release of produced water or conditioning chemicals	Lightning	Provide lightning protection and adequate secondary containment for tanks and equipment	Maintain appropriate spare parts to minimize downtime. If necessary, can truck offsite or stop backwashing to mitigate downtime of conditioning system.	N/A	Add inspections into SOPs[4] to watch for leaks or overfilling after a strike	Inspect and assess site for damage / mechanical integrity or repair. If necessary, can truck offsite or stop backwashing until repair is done.	2	1	2						
10. Seismic Damage Effect without Mitigation: Damage to plant may cause shutdown of system	Earthquake	Design in accordance with structural design criteria in 90% Basis of Design Report, Appendix C. Provide adequate secondary containment for tanks and equipment	If necessary, can truck offsite or stop backwashing to mitigate downtime of conditioning system.	N/A	N/A	Inspect and assess site for damage / mechanical integrity or repair. If necessary, can truck offsite or stop backwashing until repair is done.	3	1	3						
11. Fire Effect without Mitigation: Damage to plant may cause shutdown of system	Fire	Fire hydrant in proximity of building. Provide adequate secondary containment for equipment and tanks.	Fire water/pumps at station. If necessary, can truck offsite or stop backwashing to mitigate downtime of conditioning system.	N/A	N/A	Contact Fire Dept. Inspect, assess damage, begin repairs, startup. If necessary, can truck offsite or stop backwashing until repair is done.	2	1	2						

TABLE 2.2-1
Failure Mode Effect Analysis Matrix — Remedy-produced Water Management System
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Volume 3: Contingency Plan
PG&E Topock Compressor Station, Needles, California

Potential Failure and Effect without Mitigation	Potential Cause	Mitigation - Design	Mitigation - Operations: Mitigation	Observable Condition: Remedy SCADA	Observable Condition: Human	Action if Cause Occurs	Severity (1 Low - 5 High)	Likelihood (1 Low - 5 High)	Severity x Likelihood	A. Unacceptable Remedy Performance	B. Significant Schedule Increase	C. Significant Cost Increase	D. Significant Change to Impacts (Additional CEQA Analysis)	E. H&S or Compliance NOV (other than related to remedy performance)	Notes
12. System is damaged due to vandalism Effect without Mitigation: Damage to wells could result in increased trucking or well repair/ replacement. Plant is off-line for weeks to months while being re-built.	Vandalism	Facilities within the TCS will be secured by current TCS security system. Controls built into the system (alarms, containment, automatic cutoffs and shutdowns) are designed to help mitigate uncontrolled releases or discharges following several types of due to vandalism	Periodic inspections of all equipment inside and outside conditioning system and wells. TCS access control and security will help protect plant.	N/A	N/A	Inspect and assess site for damage / mechanical integrity or repair.	2	1	2						

Notes:

[1] Anticipated annual remedy-produced water volume is 7.6 million gallons (MG) per year. With provisional wells this volume could increase to 10 MG per year. The automated backwashing and conditioning system has been designed to accommodate this range of anticipated volume of wastewater. If the system functions as designed, the amount of trucking needed during O&M would be minimal, and within the range analyzed in the certified EIR (DTSC 2011; see Section 3.5.3, page 3-26).

[2] Current estimated annual flow is 7.6 MG; with provisional wells could be 10 MG/yr. Peak design flow is 35 gpm (18.4 MG/yr).

[3] Space is reserved to allow for increase storage and system conditioning capacity if needed.

[4] Standard Operating Procedures are presented in O&M Manual Volume 1, Operation and Maintenance Plan, Appendix C.

Acronyms and Abbreviations:

ARAR = Applicable or Relevant and Appropriate Requirements
BMP = Best Management Practices
EIR = Environmental Impact Report
H&S = Health & Safety
HMBP = Hazardous Materials Business Plan
IM-3 = Interim Measure No. 3
NOV = Notice of Violation
N/A = Not Applicable
O&M = Operation and Maintenance
RAO = Remedial Action Objective
RPWC = Remedy-Produced Water Conditioning
SCADA = Supervisory Control and Data Acquisition
SOP = Standard Operating Procedure
SWPPP = Storm Water Pollution Prevention Plan
TCS = Topock Compressor Station

TABLE 2.4-1
Failure Mode Effect Analysis Matrix—Power Supply
Groundwater Remedy Operation and Maintenance Manual
Volume 3: Contingency Plan
PG&E Topock Compressor Station, Needles, California

			Mitigation - Operations							Type of Unacceptable Condition					
				Observable Condition											
Potential Failure and Effect without Mitigation	**Potential Cause**	**Mitigation – Design**	**Mitigation**	**Remedy SCADA**	**Human**	**Action if Cause Occurs**	**Severity (1 Low - 5 High)**	**Likelihood (1 Low - 5 High)**	**Severity x Likelihood**	**A. Unacceptable Remedy Performance**	**B. Significant Schedule Increase**	**C. Significant Cost Increase**	**D. Significant Change to Impacts (e.g., Additional CEQA Analysis)**	**E. H&S or Compliance NOV (other than related to remedy performance)**	**Notes**
1. Utility or generated power supply failure Effect Without Mitigation: Loss of equipment function and eventual loss of control system functionality. May prohibit systematic shutdown of processes	Raptor entanglement, lightning strike on line, high wind, post insulator destroyed by gunshot, traffic collision with pole, or external customer causes distribution circuit trip	Uninterruptible Power Supplies (UPS) for control circuits	Maintain site security.	N/A	N/A	Repair, replace	1	2	2						
	Generator mechanical, electrical, or controller failure	Interconnection to other source(s) of generated electrical power, connection point for dedicated portable generator (note that a portable, rental backup generator of similar make and model of the existing generator [Isuzu Model 6WG1X] will be mobilized onsite as needed during project implementation to provide power).	N/A	N/A	N/A	Repair, replace	2	1	2						
2. Electrical distribution equipment failure Effect Without Mitigation: Loss of power downstream of failed equipment. May prohibit systematic shutdown of processes	Manufacturing defects, age, and heat exposure, or ingress of dirt/sand into electrical equipment	Use utility-grade equipment, rated for installation environment. Utilize common equipment styles for quick replacement	Periodic electrical testing, including transformer dissolved gas analysis	N/A	N/A	Repair, replace	3	1	3						
3. Damage from direct or nearby lightning strikes Effect Without Mitigation: Loss of power downstream of failed equipment. May prohibit systematic shutdown of processes	If power is from utility: Connection to utility overhead lines which attract lightning	Use of Surge Protective Devices	Periodic inspection of SPD indicators	N/A	N/A	Repair, replace	3	1	3						
	Direct strike on equipment	None	None	Loss of Power Detected	Charred Enclosure	Repair, replace	3	2	6						
4. Cable damage/fault/failure Effect Without Mitigation: Loss of power downstream of failed equipment. May prohibit systematic shutdown of processes	Digging near underground lines, rodents in termination cabinets, over temperature leading to insulation failure	Protect power cabling in raceway and enclosures. Minimize sun exposure to insulation systems and size circuits conservatively	Keep enclosure doors closed, use proper bolt torques	Loss of Power Detected	N/A	Repair, replace	3	1	3						
5. Externally caused equipment failure Effect Without Mitigation: Loss of power downstream of failed equipment. May prohibit systematic shutdown of processes	Vandalism, theft, force majeure	Provide secure, robust, and lockable system enclosures	Inspect accessible equipment for damage	N/A	Inspect accessible equipment for damage	Repair, replace	3	1	3						

TABLE 2.4-1
Failure Mode Effect Analysis Matrix—Power Supply
Groundwater Remedy Operation and Maintenance Manual
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PG&E Topock Compressor Station, Needles, California

			Mitigation - Operations							Type of Unacceptable Condition					
				Observable Condition											
Potential Failure and Effect without Mitigation	Potential Cause	Mitigation – Design	Mitigation	Remedy SCADA	Human	Action if Cause Occurs	Severity (1 Low - 5 High)	Likelihood (1 Low - 5 High)	Severity x Likelihood	A. Unacceptable Remedy Performance	B. Significant Schedule Increase	C. Significant Cost Increase	D. Significant Change to Impacts (e.g., Additional CEQA Analysis)	E. H&S or Compliance NOV (other than related to remedy performance)	Notes

Notes:
ARAR = applicable or relevant and appropriate requirement
H&S = health and safety
N/A = not applicable
NOV = Notice of Violation
PLC = programmable logic controller

TABLE 2.5-1
Failure Mode Effect Analysis Matrix—Remedy SCADA, Control Systems, and Instruments
Groundwater Remedy Operation and Maintenance Manual
Volume 3: Contingency Plan
PG&E Topock Compressor Station, Needles, California

Potential Failure and Effect without Mitigation	Potential Cause	Mitigation - Design	Mitigation - Operations: Mitigation	Mitigation - Operations: Observable Condition: Remedy SCADA	Mitigation - Operations: Observable Condition: Human	Mitigation - Operations: Action if Cause Occurs	Severity (1 Low – 5 High)	Likelihood (1 Low – 5 High)	Severity x Likelihood	Type of Unacceptable Condition: A. Unacceptable Remedy Performance	B. Significant Schedule Increase	C. Significant Cost Increase	D. Significant Change to Impacts (e.g., Additional CEQA Analysis etc.)	E. H&S or Compliance NOV (other than related to remedy performance)	Notes
1. PLC hardware failure Effect Without Mitigation: Lose ability to send/ receive control signals from control room. Lose ability to collect data.	a. Over-temperature	Keep cooled, design includes shade or active cooling where required for equipment longevity.	Keep spares on-site in stock	Remedy SCADA monitors communication and PLC health, and alarms in failure event	Failure may result in unchanged or frozen process variable	Repair, replace	1	3	3						Would be fixed before would cause RAO or schedule issues
	b. Dust/Rainfall/Spray from washdown or pipe break	Design utilizes industrial-grade equipment, housing in National Electrical Manufacturers Association (NEMA)-rated enclosures appropriate for environment. For open enclosures include filters.													Would be fixed before would cause RAO or schedule issues
	c. Power supply irregularity (lightning, shifting generator power, utility's overvoltage, harmonics, temporary power loss)	UPS provided for each PLC.													Would be fixed before would cause RAO or schedule issues
2. Cabling or termination damage/failure Effect Without Mitigation: Lose ability to send/ receive control signals from control room. Lose ability to collect data.	Mechanical damage by backhoe or shovel for underground circuits, traffic or vandalism for above-ground circuits, or temperature changes loosen terminations	Provide conduit for mechanical protection of circuits, route fiber optic cables in protected areas of panels, monitor communications, detection tape, rigid conduit, concrete cap, pipe markers.	Use proper torque on cable terminations	Remedy SCADA monitors communications network, alarms in failure event	Routine patrols of utility corridors and facilities	Repair, replace	1	2	2						

TABLE 2.5-1
Failure Mode Effect Analysis Matrix—Remedy SCADA, Control Systems, and Instruments
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PG&E Topock Compressor Station, Needles, California

Potential Failure and Effect without Mitigation	Potential Cause	Mitigation - Design	Mitigation - Operations: Mitigation	Mitigation - Operations: Observable Condition: Remedy SCADA	Mitigation - Operations: Observable Condition: Human	Mitigation - Operations: Action if Cause Occurs	Severity (1 Low – 5 High)	Likelihood (1 Low – 5 High)	Severity x Likelihood	Type of Unacceptable Condition: A. Unacceptable Remedy Performance	B. Significant Schedule Increase	C. Significant Cost Increase	D. Significant Change to Impacts (e.g., Additional CEQA Analysis etc.)	E. H&S or Compliance NOV (other than related to remedy performance)	Notes
3. Field instrumentation damage/failure Effect Without Mitigation: Lose ability to receive accurate control signals from control room or at local controllers. Diminished process data accuracy.	a. Thermal or physical damage to instrument or aging of internal parts or circuits, drifting of instrument output signal(s)	Provide sun protection and mechanical protection where instruments are vulnerable to damage	Calibrate instruments according to manufacturer's recommended schedules	Reduced control system and process performance	Test critical alarms as part of O&M procedure and field verification (e.g., water levels)	Adjust, repair, replace	1	1	1						For severities upon loss of critical instrumentation, see Process FMEAs.
	b. Power supply irregularity (lightning, shifting generator power, utility's overvoltage, harmonics, temporary power loss)	Connect externally powered instruments to UPS-fed circuits	Routine testing of battery capacity or regular replacement	Erroneous alarms, reduced control system and process performance	N/A	Repair, replace	1	1	1						
4. SCADA controls software failure: Effect without Mitigation: Control system commands lock themselves into last state	Software bug, OS or applications software	Use HMI software suited for size of system, rigorous testing of applications software prior to and during startup	Keep backup files onsite and offsite for all OS and application software programs	N/A	Loss of real-time monitoring and/or control	Reboot system, potential reload of software	2	2	4						
5. Valve fails in non-safe state. Effect without Mitigation: Water or chemical may flow not per design.	a. Power failure	Valves that are important to fail in safe position will be designed or configured with a fail safe mode or passive valves (checks), alarm at PLC	N/A	Detection of undesirable process condition	N/A	Repair, replace	2	2	4						
	b. Electrically actuated valves - power loss at valve	Program to fail to safe position	N/A	Objectionable flow condition	N/A	Repair, replace	2	2	4						

TABLE 2.5-1
Failure Mode Effect Analysis Matrix—Remedy SCADA, Control Systems, and Instruments
Groundwater Remedy Operation and Maintenance Manual
Volume 3: Contingency Plan
PG&E Topock Compressor Station, Needles, California

			Mitigation - Operations							Type of Unacceptable Condition					
				Observable Condition											
Potential Failure and Effect without Mitigation	**Potential Cause**	**Mitigation - Design**	**Mitigation**	**Remedy SCADA**	**Human**	**Action if Cause Occurs**	**Severity (1 Low – 5 High)**	**Likelihood (1 Low – 5 High)**	**Severity x Likelihood**	**A. Unacceptable Remedy Performance**	**B. Significant Schedule Increase**	**C. Significant Cost Increase**	**D. Significant Change to Impacts (e.g., Additional CEQA Analysis etc.)**	**E. H&S or Compliance NOV (other than related to remedy performance)**	**Notes**
6. Radio Communication interruption Effect Without Mitigation: Lose ability to send/ receive control signals from control room. Lose ability to collect data.	Vegetation or other obstruction in radio path	Antennas on towers with clear line of sight, use appropriate carrier frequency for link, program communications heartbeat	Vegetation management	Communication loss for radio link	N/A	Clear obstruction	1	2	2						
7. Externally caused SCADA equipment failure Effect Without Mitigation: Lose ability to send/ receive control signals from control room. Lose ability to collect data.	Vandalism, theft, force majeure	Provide secure and robust system enclosures, bollards where required, installations above flood plain	Periodic inspections of all equipment inside and outside conditioning system and wells. TCS access control will help protect plant.	Loss of equipment functionality	Visibly damaged or missing equipment	Repair, replace	1	1	1						
8. pH probe or other analytical probe/device fouling Effect Without Mitigation: Lose ability to monitor pH/parameter. Lose ability to collect data.	Contact with process liquid over time	Make pH probes or other devices accessible to operators	Routine inspection of cleaning of pH probes or devices	N/A	Rapid loss of calibration, visual fouling	Clean and re-calibrate	1	1	1						

TABLE 2.5-1
Failure Mode Effect Analysis Matrix—Remedy SCADA, Control Systems, and Instruments
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PG&E Topock Compressor Station, Needles, California

Potential Failure and Effect without Mitigation	Potential Cause	Mitigation - Design	Mitigation - Operations				Severity (1 Low – 5 High)	Likelihood (1 Low – 5 High)	Severity x Likelihood	Type of Unacceptable Condition					Notes
			Mitigation	Observable Condition: Remedy SCADA	Observable Condition: Human	Action if Cause Occurs				A. Unacceptable Remedy Performance	B. Significant Schedule Increase	C. Significant Cost Increase	D. Significant Change to Impacts (e.g., Additional CEQA Analysis etc.)	E. H&S or Compliance NOV (other than related to remedy performance)	
9. Cyber-security: Software security, remote access security, or operating system update errors. <u>Effect Without Mitigation:</u> Lose ability to send/ receive control signals from control room. Lose ability to collect data.	Not keeping software up to date, remote hack	Design in site access security, and remote access security, password protected access	Maintain software license, password protection	N/A	N/A		2	1	2						
10. Remedy SCADA does not get alarms <u>Effect Without Mitigation</u>: Systems are shut down	Loss of communications which results in loss of status, control, and alarms.	Design includes layers of protection against such consequences. Such a failure would result in an alarm indicating loss of communication. See control scheme for the PLC in Appendix E of the 90% BOD Report, Section Number 26 79 15.	Periodic verification of SCADA/PLC communications	No communication	No communication		3	1	3						

Notes:
ARAR = applicable or relevant and appropriate requirement
BOD = Basis of Design
CEQA = California Environmental Quality Act
H&S = health and safety
FMEA = Failure Mode Effects Analysis
N/A = not applicable
NOV = Notice of Violation
O&M = operation and maintenance
OS = operating system
PLC = programmable logic controller
RAO = remedial action objective
SCADA = supervisory control and data acquisition
TCS = Topock Compressor Station
UPS = uninterruptible power supply

SECTION 6

Post-construction and Startup Activities

Construction of the groundwater remedy will end with functional testing, construction closeout, post-construction revegetation, and transition to operation and maintenance. As described in Section 3, construction closeout will include record drawings, final submittals and reports from construction contractors (including site photos), site cleanup, vendor training, demobilization, and stabilizing areas of soil disturbance. The remaining end of construction activities—namely functional testing, post-construction revegetation, and commissioning and startup of the remedial systems—are described herein.

6.1 Post-construction Revegetation

After the remedy construction is complete, the revegetation of the areas affected by construction will begin. Revegetation efforts for the Topock Program will be conducted at two specific periods related to the final groundwater remedy. The first period will be immediately after completion of the remedy construction. The second period will be in future, after the groundwater remedy has achieved the groundwater RAOs, and the system has been decommissioned and removed. The activities discussed in this section will begin immediately following remedy construction, and the intent will be to offset loss of habitat incurred during construction, as represented by the loss of mature plants and trees. The revegetation efforts related to the future final decommissioning and removal of remedy system will be provided at a future date when adequate information related to the site conditions is known.

In general, the revegetation approach will be informed by the preconstruction condition, as documented through ground photographic records, topographic/aerial maps, disturbed area map, archaeological surveys, historical resource surveys, and biological surveys. The goal is to restore the areas affected by construction as close as possible to preconstruction conditions.

6.1.1 Revegetation Activities Concurrent with Construction

The revegetation activities summarized here are based upon the different plans that have been prepared to address different sensitive habitats or areas and that are provided in various appendices of this C/RAWP. These plans include the HNWR Habitat Restoration Plan (Appendix G to this C/RAWP), the Habitat Restoration Plan for Riparian Vegetation and Other Sensitive Habitats (Appendix O), the Aesthetics and Visual Resources Protection and Revegetation Plan (Appendix N), and the Mitigation and Monitoring Plan for Culturally Significant Plants (Appendix P).

These various plans describe the overall program restoration and revegetation approach for the period that begins with the completion of the remedy construction and extends through the operation phase of the remedy project up to the decommissioning and removal phases. Specific information related to the actual project impacts, as well as generalized locations for restoration activities, are presented in the restoration plans for the HNWR, riparian vegetation, and other sensitive habitats. However, the specific information related to precisely how the plantings will occur within each restoration area will be provided to the agencies for review in a separate Planting Plan prior to implementation. For each restoration area to be used, the Planting Plan would include information about the number of replacement plants by species, plant size and container type, planting locations, and irrigation system design.

It should be recognized that much of the actual remedy construction footprint will be required for continued access to allow for ongoing system O&M and for sampling of the final groundwater remedy system. For this reason, revegetation activities to offset construction impacts will need to occur on adjacent or nearby habitats to the construction footprint. This will avoid having to disturb restoration plantings when future removal and restoration activities are needed.

6.1.1.1 Avoidance and Minimization of Plant Impacts during Design and Construction

Throughout the design process, efforts have been made to locate remedy facilities along roadways, pipeline ROWs, and other previously disturbed areas to avoid impacts to vegetation. Construction areas, as well as staging and storage areas, also have been located in previously disturbed and/or developed areas to minimize and avoid impacts to vegetation and other sensitive resources. To further minimize impacts, a biologist will conduct preconstruction surveys, and areas of native vegetation and sensitive habitats in the immediate vicinity of the construction areas will be identified and clearly marked with flagging, fencing, and/or signage. Construction workers also will be provided with environmental awareness training regarding biological resources, including sensitive species and habitats.

Implementation of the project will not be able to avoid impacts to all mature plants and trees. However, the field implementation and approach will be first to avoid mature vegetation or to preserve them in place, wherever feasible. Where the impact cannot be avoided, design and construction implementation will preferentially seek to avoid impacts to woody perennial native trees, such as blue palo verde and honey mesquite, because these species are considered more valuable in terms of aesthetics and habitat for local wildlife species.

Impacts to mature vegetation will include both temporary and permanent impacts. Temporary impacts would occur in areas where some vegetation clearing is needed to provide work space for construction activities that are associated with installation Remedy facilities. In these areas, plants such as arrow weed, salt cedar and, to a limited extent, creosote bush, will either be trimmed or flattened, but the root systems of the plants will be left intact whenever feasible. Both arrow weed and salt cedar are adapted to frequent disturbance and will readily resprout if the root systems remain intact. Creosote bush will also naturally recover as long as the root system is not significantly disturbed. Trimming of trees is another temporary impact that may occur during construction; however, trimming alone is not considered as habitat loss.

Permanent impacts to mature plants will occur in areas where the root systems of the plants are significantly disturbed as a result of installation of remedy facilities. Permanent impacts may also occur at those locations where vegetation will be removed to create access roadways that will be used throughout the operation phase of the project for routine monitoring, inspection, and maintenance activities. With the exception of some of the creosote bushes common throughout the project area, the majority of the vegetation impacts will occur to arrow weed and salt cedar on the historical floodplain lying above the 100-year flood elevation below the NTH and the MW-20 Bench.

An inventory of the habitat losses at the 90% design stage is part of the HNWR and riparian restoration plans and is presented in maps and in tabular format within each plan.

6.1.1.2 Approaches for Restoration and Revegetation

The various restoration plans provide information on the different options that will be employed for mitigating plant impacts that cannot be otherwise avoided. These plans include techniques to save plants by salvaging plants, when feasible, and replanting them in a pre-designated location. When the trees are too large to be reliably transplanted, the lost trees will be replaced with new trees of the same species grown in containers within a commercial plant nursery from locally collected seeds, if available. The revegetation plans in this C/RAWP do not; however, include techniques for establishment of herbaceous vegetation because those approaches would not mirror existing conditions in this arid ecosystem and were considered unlikely to be successful.

6.1.1.3 Success Criteria, Monitoring, and Adaptive Management

Due to the fact that replacement saplings do not provide the same habitat value as mature trees, a mitigation ratio of 3:1 will be used to offset impacts to riparian trees. Replacement trees will be propagated from locally collected seeds and grown in a nursery for one year prior to planting in selected mitigation sites, if available. The success criteria for mitigation plantings will be a final minimum plant replacement ratio of

2.25:1 (75 percent overall survival rate) of mitigation plantings at the end of a minimum 5-year monitoring period.

Monitoring will continue for a minimum of 5 years following mitigation plantings. In the event that mortality rates or trends in declining vigor of the mitigation plantings result in less than a minimum of a final 2.25:1 mitigation ratio, additional saplings will be planted. Replacement plantings will be monitored for 5 years from the time of the initial planting to ensure that the mitigation success criteria have been met.

To account for anticipated mortality rates that may be as high as 50 percent for desert mitigation plantings, the initial replanting will include twice as many saplings as required by the mitigation ratios. This initial higher planting ratio is intended to compensate for expected sapling mortality over time and ensure that the final mitigation ratios are obtained. For example, if three palo verde trees will be removed during construction they would be replaced at a 3:1 ratio with seedlings grown from locally sourced seeds. The initial mitigation would therefore require nine replacement plantings. The success criteria would be 75 percent overall survival of these plantings after 5 years, resulting in a final mitigation ratio of 2.25:1 or survival of 6.75 (rounds to 7) out of nine initial plantings.

Adaptive management involves learning from experience and modifying subsequent behavior in light of that experience. Data may be collected and analyzed throughout the monitoring period, and the results can be used to modify (adapt) restoration approaches, as appropriate, to ensure successful establishment of transplanted species and the desired density and cover of plants. Maintenance and adaptive management will focus on weed control, irrigation modification, herbivory protection, and mortality rates.

6.1.1.4 Weed Control

Weedy species, such as Russian thistle (*Salsola tragus*), Sahara mustard *(Brassica tournefortii*), and salt cedar (*Tamarix ramosissima*), can significantly affect growth and survival of transplants. Transplant and seed sites will be relatively weed-free and will be monitored regularly for weed infestations. It is much easier to prevent the establishment of weeds in an area than it is to eradicate weed populations once they have become established. Monitoring for weed seedlings of Russian thistle, Sahara mustard, and salt cedar will be done early in the growing season (March to April) to allow for treatment and removal of weedy species before flowering and seed dispersal. In addition, young weed seedlings can be removed by hand, thereby avoiding the need for more intensive mechanical or chemical treatments.

6.1.1.5 Irrigation Modification

The objective is to obtain the maximum survival rate of transplanted trees and shrubs; therefore, it may be necessary to modify the irrigation schedule and/or amount of water during the revegetation period. While irrigation will only be used during the initial establishment period, the condition of the plants will be monitored throughout the monitoring period of 5 years. If after the initial watering, plants show a notable decline in vigor, it may be necessary to increase the amount and/or timing of irrigation to prevent mortality and increase vigor. Care will be taken not to overwater the plants.

6.1.1.6 Herbivory Protection

Tree and shrub protectors will be maintained until the plants are large enough to withstand herbivory or before the growth of the plant being impacted by the barrier. PG&E will be responsible for removing the tree and shrub protectors.

6.1.1.7 Photo-monitoring

Photo-monitoring stations will be established by a qualified vegetation ecologist or landscape architect in areas where vegetation impacts will occur to document preconstruction conditions. Photo points also will be used to monitor the natural recovery of plant species and to monitor the mitigation areas. The methods and procedures to be used are adapted from the U.S. Department of Agriculture's Photo Point Monitoring Handbook (Hall 2002).

6.2 Functional Testing, Startup, and Transition to Operation and Maintenance

This section discusses activities from the functional testing to the end of construction to the start of remedy O&M and the methodologies proposed to be used for functional testing, remedy startup (including shutdown and layup of the IM), and the transition from startup to O&M. This section is intended to meet the requirements of CD Paragraph 13(b)(5) (Methodology for Implementing the Operations and Maintenance Plan).

6.2.1 Functional Testing

Pursuant to CERCLA 40 CFR 300.435(f)(2), the groundwater remedy becomes operational and functional either 1 year after construction is complete, or when the groundwater remedy is determined concurrently by DOI and DTSC to be functioning properly and performing as designed—whichever is earlier. The "functional testing" period is often referred to as "commissioning" or "shakedown," which is the period when the construction team makes minor adjustments as necessary to ensure the system or components are operating and functioning as designed. For the purposes of this C/RAWP, the term "functional testing" will be used. DOI may grant extensions to the 1-year period, as appropriate. Criteria for assessments of are being developed in coordination with DTSC and DOI.

The following provides a general overview of functional testing activities. These activities are grouped and presented below according to the type of infrastructure/system with which they are associated (e.g., remediation wells, remedy water conveyance systems, process systems, and monitoring wells). Additional testing procedures will typically be provided by vendors or construction contractors as part of their submittals to PG&E for review and acceptance. Where applicable, requirements for these testing procedures are included in the technical specifications (Appendix E of the 90% BOD).

The types of activities and associated footprint (areas of activity, resources, etc.) anticipated for functional testing will be similar to that for construction. However, while most of the functional testing activities will occur onsite, certain remedy components will also be tested prior to being delivered to the site (e.g., specialty weld joints, motors, pumps, etc.)

6.2.1.1 Remediation Wells

Functional testing for remediation wells will be implemented both during development (following construction) and post-development. During development, wells will be evaluated for potential construction and/or efficiency issues by monitoring parameters such as turbidity and specific capacity. In general, trends in specific capacity observed during well development (i.e., during pumping) can be an early indicator of sustainable well capacity and refinement of local hydrogeologic conditions. Post-development functional testing will include downhole video surveys and specific capacity/injectivity testing. Additional detail on these types of testing is provided in Section 3.2.1.5 of this C/RAWP and in Section 4.1 of Volume 1 of the O&M Manual. The remediation wells also include down-well components (e.g., submersible pumps, check valves, etc.) that should be tested per the technical specifications, provided in Appendix E of the 90% BOD, and the manufacturer's recommendations.

6.2.1.2 Remedy Water Conveyance Systems

Functional testing for remedy water conveyance systems will include leakage testing. Before being placed into service, piping will be hydostatically leak-tested according to the procedures summarized in Section 3.2.2 of this C/RAWP and detailed in the technical specifications (Appendix E of the 90% BOD, Section 40 80 01 – Process Piping Leakage Testing). Valves may be tested during pipeline testing or as a separate step (Appendix E of the 90% BOD, Section 40 27 02 – Process Valves and Operators). Prior to final acceptance, following assembly and testing, pipelines will also be flushed with water to remove accumulated construction debris/other foreign matter to the extent practicable per the technical specifications (Appendix E of the 90% BOD, Section 22 10 01 – Plumbing Piping and Accessories).

Remedy water conveyance systems also include instrumentation and control components installed at the well vaults/well meter vaults and, in some cases, water transfer/recirculation pumps and/or water storage tanks. These components will be tested per the technical specifications, provided in Appendix E of the 90% BOD, and the manufacturer's recommendations. Relevant technical specifications are listed below:

- Section 40 90 00 – Instrumentation and Control for Process Systems
- Section 44 42 56.10 – Horizontal End Suction Centrifugal Pumps
- Section 33 16 13.14 – Frac Tanks
- Section 43 40 13 – Steel Storage Tank

Certain components (e.g., tanks, pumps, etc.) may be tested prior to being delivered to the site.

6.2.1.3 Process Systems

Process systems include vertical infrastructure—aboveground process piping, pumps, tanks, and other process equipment—installed at the TCS, TW Bench, and MW-20 Bench. Functional testing for aboveground process piping will include pressure/leakage testing. Before being placed into service, piping will be leak-tested using hydrostatic or pneumatic methods according to the procedures detailed in the technical specifications (Appendix E of the 90% BOD, Section 40 80 01 – Process Piping Leakage Testing and Section 40 50 20 – Aboveground Piping). Valves may be tested during pipe testing or as a separate step (see also Appendix E of the 90% BOD, Section 40 27 02 – Process Valves and Operators).

Functional testing for process system equipment, including pumps (e.g., alignment/vibration testing), tanks (e.g., leak testing), filters, and instrumentation and control components, will be conducted per the technical specifications, provided in Appendix E of the 90% BOD, and the manufacturer's recommendations. Relevant technical specifications are listed below:

- Section 44 44 13.01 – Chemical Metering Pumps
- Section 44 42 56.15 – Air-Operated Diaphragm Pumps
- Section 43 40 13 – Steel Storage Tank
- Section 43 40 02 – High Density Polyethylene Tank
- Section 33 16 13.14 – Frac Tanks
- Section 44 43 13.16 – Cartridge Filters
- Section 40 90 00 – Instrumentation and Control for Process Systems)

Certain components (e.g., tanks, pumps, etc.) may be tested prior to being delivered to the site.

To assist the reader with understanding and visualization of functional testing activities, an example of how the remedy-produced water conditioning plant may be functionally tested is described below:

- First, freshwater will be used to test the functionality of mechanical, electrical, and controls equipment by subsystem. No remedy-produced water or treatment chemicals will be introduced in this phase. Subsystems will include the Influent Tank Farm, A-side Filter System, B-side Filter System, Acid System, Caustic System, Coagulant System, Seal Water System, A-Side Conditioned Water Tank Farm, B-Side Conditioned Water Storage Tank, and TCS Truck Fill Station. Equipment (duty and standby) within each subsystem will be tested. This phase will include completing loop checks of instrumentation and control equipment, ensuring that a signal is properly sent to field instrumentation for each programmable logic controller (PLC) output designed, and ensuring that a signal is received at the PLC for each PLC input designed.

- After subsystems are functioning as intended, the entire system will be tested with freshwater. No remedy-produced water or treatment chemicals will be introduced in this phase. The primary objective of this step is to ensure all subsystems function together for the batch and conditioning processing modes. Functional testing of the batch processing mode will be conducted on the A-side process equipment, and functional testing of the continuous processing mode will be conducted on the A-side and B-side process equipment. Equipment (duty and standby) within each subsystem will be tested. Set points will be temporarily adjusted during clean water startup of the batch processing mode to test functionality of the chemical feed systems with the influent tanks. The system will be tested using the process design nominal and maximum flow rates. Process alarms and alarm actions will be simulated for their proper annunciation, process interaction, resetting, and process restarting.
- After freshwater startup of the full entire system is complete, the system will be functionally tested using remedy-produced water and treatment chemicals. This phase initially will consist of testing items that could not be simulated with freshwater, such as the liquid-phase separators and chemical feed systems (with true set points). Functional testing will continue with testing of the batch processing mode on the A-side process equipment and the continuous processing mode on the A-side and B-side process equipment. Equipment (duty and standby) within each subsystem will be tested. Process samples will be collected at various sample ports built into the system during this phase. Samples will be collected and in accordance with the Sampling and Monitoring Plan in Volume 1 of the O&M Manual.

6.2.1.4 Monitoring Wells

Monitoring wells will not be subject to the same functional testing procedures as the remediation wells due to their differing performance objectives (i.e., ability to yield representative water quality data [monitoring wells] versus sustain a design flow rate [remediation wells]). In general, representative groundwater samples can still be collected from low-flowing wells and, because the flow metric is less essential for monitoring wells, rigorous specific capacity testing has not been specified.

Functional testing for newly installed monitoring wells will occur primarily following construction and development. Monitoring wells will be sounded to verify total depth and to determine whether there are obstructions that could prevent successful sample collection. In addition, as described previously in Section 3.2.1.4, field water parameter measurements (e.g., turbidity and pH) collected post-development will be evaluated for indications that the well screen or casing might be compromised by collapse or grout intrusion. If there is evidence of downhole issues, video surveying may be performed as a second resort to evaluate well casing and screen integrity. In addition, well protection features (e.g., well seal, well vault/ protective monument casing, and concrete pad/collar) will be inspected to ensure that they are in place and adequate to prevent damage or contamination.

6.2.2 Remedy Startup, Including Shutdown and Layup of IM

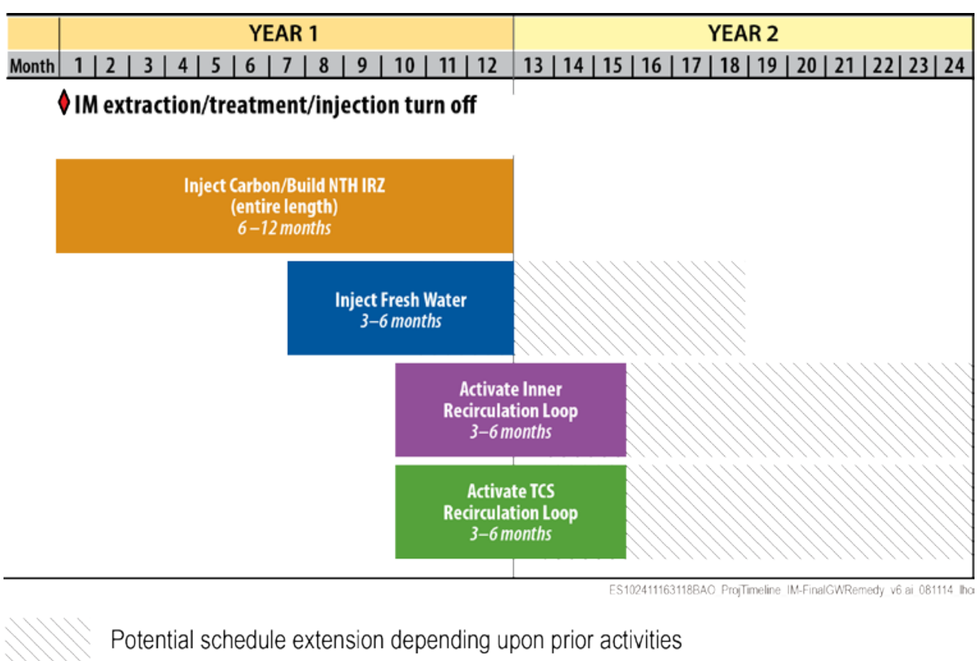
After functional testing is completed, the following steps will be conducted (these are consistent with Article V(B) of the Settlement Agreement between DTSC and FMIT [DTSC 2012] and Article 9(a) of the Settlement Agreement between PG&E and FMIT [PG&E 2012]):

- The IM-3 system will be turned off when the groundwater remedy equipment and facilities are in place and ready for startup. The remedy equipment and facilities may include the wells for the IRZ along the NTH, the RB wells, the freshwater wells, monitoring wells, the East Ravine/TCS wells, and the pipelines, controls, and electrical and mechanical systems needed to operate these wells. PG&E will notify DTSC and the Tribe when the IM-3 system is ready to be turned off per the above-stated conditions. Upon DTSC concurrence that the system is ready to be turned off, PG&E will turn off the IM-3 system, and this date will be the “startup date.”
  - Procedures for shutting down IM-3 are included in the existing IM-3 Treatment and Extraction System O&M Plan (CH2M HILL 2006). Procedures for preparing IM-3 for layup and activities during

layup are presented in the IM-3 Decommissioning, Removal, and Restoration Work Plan, included in Appendix F of this C/RAWP.

- Once the IM-3 system is shut down, PG&E will implement the following remedy startup steps as presented in the 90% BOD Report (the rationale for this step-wise startup strategy is discussed in detail in Section 7.3 of the 90% BOD) (see also Exhibit 6.2-1 in this C/RAWP):
  - The NTH IRZ carbon substrate injections will begin, and the NTH IRZ cutoff line will be established. This step could be completed 6 to 12 months after startup to allow for incremental startup of the injection wells, water level measurements, flow balancing, and system adjustments, as necessary.
  - Once the NTH IRZ is established, the carbon substrate injections will be turned off and the freshwater injection system[4] will be brought online to begin enhancing the riverward gradient to enhance migration of the Cr(VI)-impacted groundwater toward the IRZ wall. This step could take 3 to 6 months to allow for incremental startup of the injection wells, water level measurements, flow balancing, and system adjustments, as necessary.
  - Subsequently, the IRL will next be initiated (i.e., startup of RB extraction wells and IRL injection wells). This step could take 3 to 6 months to allow for incremental startup of the extraction and injection wells, flow balancing, and system adjustments, as necessary. In addition, if groundwater captured by the RB extraction wells requires carbon amendment before re-injection, operation of the carbon substrate amendment system components will also be required.
  - Simultaneously to the startup of the IRL, the startup of the TCS recirculation loop (i.e., the East Ravine extraction wells, TW Bench extraction wells, and TCS injection wells) will be initiated. This step could take 3 to 6 months to allow for incremental startup of the injection wells, water level measurements, flow balancing, and system adjustments, as necessary.

EXHIBIT 6.2-1
Projected Timeline for Implementation of Proposed Transition Plan
Groundwater Remedy Construction/Remedial Action Work Plan, PG&E Topock Compressor Station, Needles, California



[4] The pre-final (90% design) nominal scenario assumes IRL-1 and IRL-2 (northern IRL Injection Wells) will receive RB extraction well water (amended with carbon if Cr(VI) concentrations in the RB extraction wells exceed the cleanup goal) to the lower two-thirds of the saturated interval; and IRL-3 and IRL-4 (southern IRL injection wells) will receive fresh water.

Startup and O&M activities for the different remedy components are detailed in Volume 1 of the O&M Manual. The types of activities and associated footprint (areas of activity, resources, etc.) anticipated for system startup will be similar to that described in the O&M Manual (Volumes 1 and 2) for routine O&M and remedy monitoring. However, in general, site visits are anticipated to occur slightly more frequently during initial startup as remediation wells and systems are brought online incrementally to facilitate flow balancing and the optimization of injection/extraction rates across the system.

During initial startup, carbon substrate dosing may also be adjusted incrementally until the target nominal injection concentration, or otherwise optimal concentration, is achieved to establish a microbial population and evaluate substrate distribution in an incremental fashion. Additionally, there may be a greater need for troubleshooting and operational adjustments at this phase. Aquifer conditions—e.g., flow/hydraulic gradients and geochemistry—are also anticipated to change most rapidly during startup (i.e., the first one to 2 years of remedy operation). The Sampling and Monitoring Program (Volume 2 of the O&M Manual) accounts for this, and higher monitoring/sampling frequencies are typically specified for the first year or two of operation or until system operations are verified.

Detailed SOPs for conducting start-up activities for individual remedy components are presented in an appendix of the Construction/Remedial Action Work Plan. These SOPs include:

- IRZ-SOP-01 – MW-20 Bench system startup (NTH IRZ and IRL)
- IRZ-SOP-03 – TW Bench system startup (TCS Recirculation Loop)
- FWS-SOP-01 for the freshwater supply conveyance and storage operations – System startup and shutdown
- RTP-SOP-01 for Remedy-produced Water Conditioning Plant operations – System "hot" startup and shutdown

6.2.2.1 Remedy Operation and Maintenance

Pursuant to Article 9(a) of the Settlement Agreement between DTSC and FMIT (DTSC 2012), and Exhibit A to that agreement ("Additional Settlement Terms – Criteria for Decommissioning of IM-3"), the groundwater remedy will have reached full operational status when the start-up steps have been completed. At that point, PG&E will perform the following steps:

- Provide DTSC, DOI, and the Tribes with written notice that the remedy has reached full operational status. The date of this notice will be the "full operational status date."
- At the end of each calendar quarter following the full operational status date, prepare and submit to DTSC and DOI quarterly progress reports on the extent to which the data regarding remedy performance are adequate to make a determination of Plume Control, for the purpose of making a determination that IM-3 may be decommissioned (for criteria for approval of IM-3 Decommissioning, see the IM-3 Decommissioning, Removal, and Restoration Work Plan, included in an appendix of this Construction/Remedial Action Work Plan or Section 7.4 of the BOD).

In addition, pursuant to Exhibit A to the Settlement Agreement between DTSC and the FMIT (DTSC 2012), DTSC's determination of Plume Control will be consistent with the ability to achieve the criteria for DTSC's determination that the overall groundwater remedy is operating properly and successfully (OPS), and must be made concurrent with or after DTSC's OPS determination, unless DTSC in its lawful discretion, decides that decommissioning of IM-3 can occur prior to DTSC's OPS determination; and DOI must concur with DTSC's decision to decommission IM-3.

Exhibit A of the Settlement Agreement between DTSC and the FMIT (DTSC 2012) also defines "Operating Properly and Successfully" for purposes of the overall groundwater remedy is defined as follows: (1) the remedy is operating as designed, (2) the information obtained from remedy operation indicates that the remedy is protective of human health and the environment, and c) the remedy is likely to be able to achieve the cleanup levels or performance goals delineated in the DTSC (DTSC 2011) and the ROD (DOI 2010) for the groundwater remedy at the PG&E Topock Site. Criteria for assessments of OPS are being developed in coordination with DTSC and DOI.

Procedures for the operation of various remedy components and supporting facilities included in the O&M Plan, Volume 1 of the O&M Manual, and for the collection of data regarding remedy performance included in the Sampling and Monitoring Plan, Volume 2 of the O&M Manual will be implemented. In addition, the Contingency Plan (Volume 3), the Soil Management Plan (Volume 4), and the Health and Safety Plan (Volume 5) will also be followed.

SECTION 7

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