



Alan C. Lloyd, Ph.D.
Agency Secretary
Cal/EPA



Department of Toxic Substances Control

700 Heinz Avenue, Suite 100
Berkeley, California 94710-2721



Arnold Schwarzenegger
Governor

January 6, 2006

Ms. Yvonne Meeks
Portfolio Manager - Site Remediation
Pacific Gas and Electric Company
4325 South Higuera Street
San Luis Obispo, CA 93401

CONDITIONAL APPROVAL OF THE DRAFT WELL INSTALLATION WORK PLAN FOR INTERIM MEASURES PERFORMANCE MONITORING PROGRAM, DATED NOVEMBER 30, 2005, PACIFIC GAS AND ELECTRIC COMPANY, TOPOCK COMPRESSOR STATION, NEEDLES, CALIFORNIA (EPA ID NO. CAT080011729)

Dear Ms. Meeks:

The Department of Toxic Substances Control (DTSC) has completed our review of the Draft Work Plan for Interim Measures Performance Monitoring Program (Workplan) dated November 30, 2005. The DTSC Northern California Geological Services Unit (GSU) has reviewed and provided technical comments on the Workplan in a memorandum dated December 23, 2005. A copy of the GSU memorandum is included as Enclosure 1 and was previously provided to Pacific Gas and Electric Company (PG&E) and the Consultative Workgroup (CWG) on December 23, 2005.

DTSC has reviewed our obligations under the California Environmental Quality Act (CEQA) and has considered comments provided by stakeholders. DTSC has determined that the scope of work and activities proposed are consistent with the previous Interim Measures No. 2 Notice of Exemption (NOE) dated February 10, 2004, Interim Measures No. 3 NOE dated June 30, 2004, and the DTSC Interim Measures No. 3 Conditional Approval letter dated June 30, 2004.

In addition to the scope of work identified in the Workplan, DTSC is also requiring PG&E to install wells at up to five additional locations. These locations are shown on a figure included in Enclosure 1 and consist of four locations and one contingent location. The objective of the additional locations is to acquire data that will:

- a) evaluate the reduction or reversal of the flow of contaminated groundwater toward the river;

- b) evaluate the reversal of groundwater gradient away from the river;
- c) analyze the influence of wells that may be used for longer term flow reversal or containment;
- d) evaluate hydraulic control of the plume boundary near the river to achieve a net reversal of groundwater gradient away from the river;
- e) evaluate additional extraction well locations and their sphere of influence; and
- f) evaluate the influence of extraction on the existing groundwater plume for evaluating the interim measure performance.

GSU described the rationale for each location in Enclosure 1 and has provided a summary of the rationale for each location as Enclosure 2 of this letter. Upon completion of the installation and sampling of all wells DTSC will consider establishing an appropriate data cut-off date for information to be included in the revised RCRA Facility Investigation (RFI) report.

DTSC is providing conditional approval of the scope of work identified in the Workplan and for up to five additional well locations as follows:

1. PG&E shall install two wells at Site C rather than the single proposed well. See Comment 2 of Enclosure 1 for further discussion.
2. PG&E is prohibited from using the secondary access route shown on Figure 3-2 of the Workplan as a contingency access route to Site A and Site B drilling locations.
3. As feasible, PG&E shall sample wells installed at Sites A and C at least two times prior to March 30, 2006. Thereafter, the wells shall be sampled on a monthly basis for at least three months as part of the Interim Measures Performance Monitoring Program.
4. PG&E shall install at least two new monitoring wells at Location 1, adjacent to existing well MW-19. At least one well shall be installed with a larger diameter casing that is capable of supporting hydraulic testing.
5. PG&E shall install at least three new monitoring wells at Location 2, along Park Moabi Road and approximately midway between the existing MW-31 and MW-35 well clusters. The design of this well cluster shall be capable of support hydraulic testing.
6. If determined to be necessary by DTSC, upon reviewing field results observed at Location 2 or Site C, PG&E shall be prepared to install a well cluster at Location 3 to augment or replace existing well MW-29.
7. At Location 4, PG&E shall advance a boring adjacent to existing well MW-26 to verify the depth of the fanglomerate bedrock and shall use the same investigation

techniques as described in the Workplan (i.e., drilling method, continuous logging, Isoflow® sampling). If a sufficient thickness of saturated Alluvial Aquifer is determined to be present above the top of the fanglomerate and below the MW-26 screen interval (i.e., five to ten feet), as determined by DTSC, PG&E shall be prepared to install a new monitoring well to monitor that zone. If an appropriate thickness of sediments is present, as determined by DTSC, PG&E shall design the well to support aquifer testing. As feasible, the borehole shall penetrate several feet into the fanglomerate unit to determine whether a water-bearing zone is present. If determined to be present, PG&E shall plan to include installation of a bedrock well at this location in the future as a data collection activity in the Groundwater Corrective Measures Study Workplan.

8. At Location 5, PG&E shall drill adjacent to existing well MW-12 to verify the depth of the fanglomerate bedrock and shall use the same investigation techniques as described in the Workplan (i.e., drilling method, continuous logging, Isoflow® sampling). If a sufficient thickness of saturated Alluvial Aquifer and fanglomerate is encountered below the MW-12 screen interval (i.e., five to ten feet), PG&E shall be prepared to install a new monitoring well to monitor that zone. As feasible, the borehole shall penetrate several feet into the fanglomerate unit to determine whether a water-bearing zone is present. If determined to be present, PG&E shall include installation of a bedrock well at this location as a future data collection activity in the Groundwater Corrective Measures Study Workplan.
9. No later than January 27, 2006, PG&E shall submit Technical Addendum 1 to the Workplan that describes the approach for installing the wells at Locations 1, 2, 3, 4, and 5, the anticipated well completion details, an anticipated schedule for installing, developing, and sampling wells and an anticipated schedule for installing transducers in the new wells. Technical Addendum 1 shall include the proposed access route for contingent Location 3. The preparation and submission of this technical addendum is not required prior to commencement of drilling at locations A, B and C. Drilling at these locations can occur upon receipt of necessary approvals (Condition 11), notification (Condition 12), staging area description (Condition 16), and kick-off meeting (Condition 17) as described below.
10. No later than February 7, 2006, PG&E shall submit Technical Addendum 2 to the Workplan that describes the approach for hydraulic testing of wells at Locations 1, 2, and 4 (if installed and DTSC determines to be appropriate). Technical Addendum 2 shall include the proposed methods, logistical considerations, and an anticipated schedule for conducting the aquifer testing. The schedule should consider the closure date for data collection for the groundwater portion of the RCRA Facility Investigation and Remedial Investigation Report.

For the activities conditionally approved and required by this letter,

11. PG&E shall obtain all necessary approvals and/or authorizations from applicable federal, state, county, and local agencies as required. Prior to commencing any field activities, PG&E shall provide written notification to DTSC listing all applicable permits and/or approvals that have been obtained.
12. PG&E shall provide a minimum of seven (7) days notice prior to commencing any field activities.
13. As feasible, PG&E shall prioritize the sequence of well installation as follows:
 - i. Sites A, B, and C;
 - ii. Location 2;
 - iii. Location 3 (if determined to be necessary);
 - iv. Location 4;
 - v. Location 5; and
 - vi. Location 1.
14. PG&E shall adjust the grout mixtures to be used for well construction as discussed in Comment 5 of the Enclosure 1.
15. PG&E shall conduct geophysical logging of the deep borings at Sites A and C and Locations 1, 2, and 3. These activities are not required to support selection of the shallower screened intervals at these sites and the geophysical logging can be conducted shortly after the wells are completed.
16. Prior to the commencement of drilling activities, PG&E shall provide a more detailed description of the short-term and longer-term staging areas that considers the scope of work identified in the Workplan and the additional well installation identified by DTSC in this letter.
17. Prior to the start of field activities, PG&E shall schedule and host an onsite pre-construction kick-off meeting. PG&E shall provide DTSC a minimum of seven (7) notice of the meeting date.
18. A biological and cultural resource monitor shall be onsite prior to and during the movement and setup of drilling equipment.

DTSC is also requiring the following three (3) additional tasks related to inactive water supply wells PGE-06, PGE-07 and painting of well monuments and bollards.

19. PG&E shall evaluate the potential vertical migration pathway from the Alluvial Aquifer to bedrock units that is enabled by the design of well PGE-07. No later than February 17, 2006, PG&E shall submit a technical memorandum providing recommendations whether this well should be reconstructed or decommissioned. If

Ms. Yvonne Meeks
January 6, 2006
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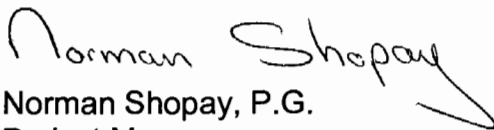
the recommendation is for well reconstruction or decommissioning, DTSC will require PG&E to provide a workplan for well PGE-07 at the same time.

20. No later than February 28, 2006, PG&E shall submit a technical memorandum that evaluates the usefulness of well PGE-06 for the site monitoring program and as part of the groundwater remedy. The technical memorandum should provide a recommendation as to whether this well should be decommissioned. If the recommendation is for well decommissioning, DTSC will require PG&E to provide a well decommissioning workplan for well PGE-06 at the same time.

21. As previously stated in DTSC's letter dated May 3, 2005 "*Well monuments and bollards shall be painted Desert Tan except in areas adjacent to roads where the monuments and bollards shall be painted yellow for safety visibility*". PG&E was to submit a schedule for these activities. However, since the May 3, 2005 DTSC letter there has been some additional discussions regarding paint colors to lessen the visual impacts. As a test, MW-25 was painted Desert Tan. Based on the results of this test DTSC has determined that PG&E shall complete the painting of well monuments and bollards by March 15, 2006. Monitoring wells and bollards in the floodplain and upland areas shall be painted Desert Tan. Monitoring wells and bollards in areas adjacent to roads shall be painted yellow for safety visibility.

If you have questions, please contact me at (510) 540-3943.

Sincerely,



Norman Shopay, P.G.
Project Manager
Geology, Permitting and Corrective Action Branch

nts/193c

Enclosure 1: GSU Technical Memorandum, Well Installation Work Plan for Interim Measures Performance Monitoring Program, Dated December 23, 2005

Enclosure 2 Summary of Rationale for Additional Well Locations

cc: PG&E Topock Consultative Workgroup Members – Via e-mail



Alan C. Lloyd, Ph.D.
Agency Secretary
Cal/EPA



Department of Toxic Substances Control

8800 Cal Center Drive
Sacramento, California 95826-3200



Arnold Schwarzenegger
Governor

MEMORANDUM

TO: Norman Shopay, P.G.
Project Manager
Hazardous Waste Management Program, Berkeley Regional Office

FROM: Kate Burger, Ph.D., P.G. *Norman Shopay For K.B.*
Engineering Geologist, Northern California Geological Services Unit
Hazardous Waste Management Program, Sacramento Regional Office

DATE: December 23, 2005

SUBJECT: Well Installation Workplan, Floodplain Interim Measure Performance
Monitoring Program, PG&E Topock Compressor Station, Needles,
San Bernardino County, Project No. 22120/540015-48/36-HWMP

DOCUMENT REVIEWED

Draft Well Installation Work Plan for Interim Measures Performance Monitoring Program, PG&E Topock Compressor Station, Needles, California. Prepared by CH2M Hill. Dated November 30, 2005.

INTRODUCTION

The Northern California Geological Services Unit (GSU) of the Department of Toxic Substances Control (DTSC) has reviewed the above-referenced well installation workplan (Workplan). Pacific Gas and Electric Company (PG&E) is submitting the workplan as required by the October 17, 2005 DTSC letter providing conditional approval of extraction well TW-3D. The work described in the Workplan will provide additional wells that are needed to assess hydraulic gradients associated with the expanded groundwater extraction system and to provide better definition of the plume position to the north and northwest of the MW-34 well cluster. Both of these objectives must be addressed in order to assess the floodplain interim measure (IM) performance. DTSC provided the Workplan to the Consultative Workgroup (CWG) on December 1, 2005 and discussed the Workplan with CWG members in a December 2, 2005 conference call. DTSC received written comments from the Fort Mojave Indian Tribe on December 9, 2005 and GSU has reviewed and considered these comments.

As you requested, in addition to reviewing the scope of work identified in the Workplan, GSU is providing options for additional well locations for your consideration in the approval of this workplan. Also, GSU is recommending the decommissioning of well PGE-07 and an evaluation of the continued usefulness of well PGE-06 for the project.

This memorandum provides the GSU comments and recommendations. If you have questions, please contact me at (916) 255-6537.

SCOPE OF WORK PROPOSED IN WORKPLAN

DTSC identified the performance monitoring requirements for the IM in a February 14, 2005 letter. The three gradient well pairs established in the performance monitoring requirements were based on a single groundwater pumping center on the MW-20 bench. Groundwater extraction from well PE-1 will create another pumping center in the floodplain area. This second pumping center requires additional wells that can be used to assess the performance of the IM.

PG&E proposes to install wells at the following three locations:

Site A (170 feet north of well PE-1). Three wells will be installed at this location to form well cluster MW-44. The wells will be screened in the middle and lower depth intervals of the Alluvial Aquifer. One of the lower depth interval wells will be used as part of a gradient well pair in the vicinity of extraction well PE-1. This well cluster may also provide delineation of the chromium plume in the area north to northwest of well MW-34-100. The Site A location was selected based on the groundwater flow model projections of flow conditions under groundwater extraction from both the MW-20 bench and well PE-1. The location has been adjusted to prevent damage to vegetated areas in the vicinity. Because of this adjustment and the possibility that actual groundwater flow conditions may differ from the groundwater flow model projections, well cluster MW-44 may not be optimally located to assess gradients induced by extraction well PE-1.

Site B (15 feet east of well PE-1). A single well (well MW-45) will be installed in the lower depth interval of the Alluvial Aquifer to serve as the central well in gradient well pairs used to assess gradients induced by extraction well PE-1.

Site C (90 feet west of the MW-28 well cluster). One or two wells will be installed at this location (well or well cluster MW-46) to provide better control on gradient mapping in the lower depth interval of the Alluvial Aquifer. PG&E proposes to install a second well only if permeable zones are identified in the oldest alluvium unit (Toa1). Depending on the findings at well cluster MW-44, an additional well or additional wells at this location may also provide further chromium plume delineation. This well or well cluster is intended to augment the data from well cluster MW-28. The location is adjusted westward because of the soft sand conditions encountered near the MW-28 well cluster and to avoid disturbance of nearby vegetation.

Comments and Recommendations

GSU recommends approval of the Workplan, provided that the following Comments 2, 3, 4, and 5 are addressed during implementation of the proposed activities. GSU considers the scope of work outlined in the Workplan to be the most crucial locations to be installed during this investigation.

1. With the activation of extraction wells TW-3D and PE-1, DTSC will need to reevaluate the performance monitoring requirements established in the February 14, 2005 DTSC letter. The reassessment should consider: the use of extraction well TW-2D (in lieu of well MW-20-130 or MW-31-135) as a central well for gradient well pairs used to assess pumping at the MW-20 bench; new well pairs established to evaluate extraction well PE-1; use of a well at Site C as part of a gradient well pair; and the target gradient to be maintained by each gradient well pair. GSU suggests that the reevaluation be deferred until several months of water level data are available from existing and proposed floodplain wells while the pumping from wells TW-3D/TW-2D, TW-3D/TW-2D/PE-1, or TW-3D/PE-1.
2. The Workplan proposes to install one well at Site C with a second well contingent upon identification of "a substantial thickness of permeable alluvium". Given the thickness of the lower depth interval of the Alluvial Aquifer in this area and the concern that the chromium plume may be migrating along the top of the hard fanglomerate surface, GSU believes that two wells will be needed at this location. The lower part of the Alluvial Aquifer observed in the MW-28 borehole is described as a wet, well-graded, sandy gravel which suggests that a transmissive unit is present. Elsewhere at the site, PG&E has installed wells in apparently low permeability alluvium, which yield groundwater with significant chromium concentrations (e.g., MW-37D screens a moist sandy gravel). Ultimately, the screened intervals selected for this location should consider the groundwater Isoflow sampling results and the geophysical logging to be performed at the time of drilling activities. GSU recommends that a DTSC representative be present to observe drilling at this location to provide input regarding the selected screened intervals.
3. The Workplan indicates that cased-well geophysical logging (natural gamma ray and induction) will be conducted in the deepest well at Sites A and C. The Workplan does not clearly indicate the timing for the geophysical logging. From a discussion with CH2M Hill on December 1, 2005, GSU understands that the geophysical logging will be conducted in a timeframe that will support selection of the shallower screened intervals at Site A and Site C.
4. The Workplan indicates that either a 30 percent solids bentonite grout or a cement mixture will be used as the annular grout. The bentonite grout should be mixed in accordance with manufacturer specifications. The cement mixture should be mixed with no more than 6.5 gallons of water (rather than the 8 gallons cited in the Workplan) for the cement and bentonite powder ratio stated in the Workplan.
5. PG&E should monitor wells installed at Sites A and C at least two times prior to March 30, 2006. Thereafter, as part of the IM performance monitoring program, PG&E should monitor wells installed at Sites A and C at a monthly frequency for three months. A decision regarding appropriate sampling frequency for these wells should be made after reviewing the monthly data.

ADDITIONAL WELL LOCATIONS FOR CONSIDERATION

GSU understands that as part of this field mobilization, DTSC is also interested in acquiring data that would provide:

- a. further basis for evaluating the IM performance;
- b. further basis for evaluating groundwater remedial alternatives in the Groundwater Corrective Measures Study; and
- c. a means of expediting the groundwater remedy selection.

GSU has identified the following rationale for additional well locations to support this data acquisition.

- A. Additional measurement points to allow assessment of the hydraulic gradients induced by groundwater extraction and injection. Additional measurement points in some areas will allow groundwater flow conditions to be assessed empirically rather than relying on groundwater flow model predictions.
- B. Better delineation of the mapped groundwater plume extent (i.e., the 20 and 50 parts per billion (ppb) contour positions). Improved interpretation of the plume extent will allow refinement of the area that will need to be addressed by the groundwater remedy.
- C. Better vertical characterization of the chromium plume distribution and geochemical conditions (i.e., oxidation/reduction potential, dissolved oxygen, total dissolved solids). The additional vertical characterization will assist with the assessment of *in situ* treatment feasibility and target screen positions for a pump-and-treat system. For some areas north of the MW-20 bench, the existing data set may rely too heavily on chromium and geochemical distributions observed at certain wells (e.g., MW-31 well cluster).
- D. Hydraulic testing locations to allow assessment of hydrogeologic conditions where limited data is available and at locations that could be considered as potential pump-and-treat centers. Geo/Hydro Technical Workgroup (TWG) members have had repeated discussions about the need for additional hydraulic data to the north of the MW-20 bench.
- E. Better definition of the nature and depth of the bedrock surface, especially north of the MW-20 bench. Better bedrock definition is needed for understanding the groundwater flow conditions and for considering the design depth of any physical barriers that might be considered as part of the groundwater remedy.
- F. Monitoring points that would enable further assessment of potential plume migration pathways that would need to be considered as part of the evaluation of the groundwater remedy.

Recommended Locations

GSU is recommending up to five additional well locations as (1) deeper wells adjacent to an existing shallow well or (2) a new well cluster or well nest. As shown on the attached figure, with the exception of contingent Location 3, the recommended locations lie along Park Moabi Road or are readily accessible from Park Moabi Road. GSU believes that the suggested locations will support important, multiple technical functions (as identified in the above-noted rationale and in the discussion of each location below), without additional disturbance to sensitive upland areas. GSU is making these recommendations without consideration of whether all suggested locations are feasible for this field mobilization. Hence, some locations may need to be deferred as a data collection activity during the Groundwater Corrective Measures Study.

Location 1. Augment existing shallow well location MW-19 by installing middle and deep depth interval wells in the Alluvial Aquifer. This location lies just west of Park Moabi Road and along the road leading to the existing treatment plant. The purpose of this well cluster would be to collect data to address Rationale A, C, D, E, and F (see above).

Over the past several years, CWG members have discussed this location as a desirable for both a monitoring well cluster (or nested well pair) and as a potential extraction well location (e.g., PE-3). GSU notes that the alternative to this location is to drill further west in the upland area. However, GSU believes that the stated technical objectives can be met at this location and thus avoid disturbance of the upland area.

With regards to Rationale F, GSU believes that this location is needed to provide additional assessment of the hexavalent chromium concentrations observed at well MW-37D within Bat Cave Wash. The October 2005 hexavalent chromium concentration for this well is 1,800 micrograms per liter ($\mu\text{g/L}$) the highest concentration reported to-date. Based on the groundwater flow field predicted by recent groundwater flow model simulations, GSU does not consider the next well cluster to the north of MW-37D (well cluster MW-41) to provide an adequate assessment of the plume migration pathway from this well. Additional wells at this location would allow assessment of the direction of chromium plume migration (eastward from MW-37D) that is predicted by the groundwater flow model.

Location 2. Install a three well cluster or nest along Park Moabi Road, approximately halfway between the MW-31 and MW-35 well clusters. The purpose of this well cluster or nest would be to collect data to address Rationale A, B, C, D, E, and F (see above).

GSU notes that the alternative to this location is to drill further west in the upland area. However, GSU believes that the stated technical objectives can be met at this location and thus avoid disturbance of the upland area.

With regards to Rationale F, GSU believes that this location is also needed to provide additional assessment of the hexavalent chromium concentrations observed at well MW-37D within Bat Cave Wash. Wells at this location would allow further refinement of the chromium plume migration (generally eastward from Bat Cave Wash) that is predicted by the groundwater flow model.

- Location 3. Contingent location. Replace or augment existing well MW-29 (shallow depth interval well in Alluvial Aquifer) with a well cluster or nest that screens multiple zones in the Alluvial Aquifer. A decision as to whether this location is needed should be contingent upon the findings at the Location 2 and potentially Site C. The purpose of this well cluster would be to collect data to address Rationale A, B, C, and E (see above).
- Location 4. Augment existing well location MW-26 (screens shallow depth interval of Alluvial Aquifer) with one or two additional wells screened in the lower portion of the Alluvial Aquifer and upper bedrock (if permeable zones are determined to be present). This location is on Havasu National Wildlife Refuge property and lies along Park Moabi Road. Over the past several years, CWG members have discussed this location as a desirable for both a monitoring well cluster (or nested well pair) and as a potential extraction well location (e.g., PE-2). The purpose of this well cluster would be to collect data to address Rationale A, B, C, and D (see above).
- Location 5. Install a shallow bedrock well adjacent to monitoring well MW-12 which screens the saturated portion of the Alluvial Aquifer (approximately 25 to 47 feet below ground surface) and the reported top of the red fanglomerate (approximately 47 to 50 feet below ground surface). This location lies in a low-lying area immediately west of Park Moabi Road and is on Havasu National Wildlife Refuge property. The purpose of this additional well would be to collect data to address Rationale A, B, C, E and F (see above).

With regards to Rationale F, GSU review of the RCRA Facility Investigation/Remedial Investigation Report (RFI/RI Report) has identified concerns with Area of Concern (AOC) 11 in which well MW-12 is located. These concerns include:

- (a) Elevated arsenic, molybdenum, and pH concentrations are observed in well MW-12 groundwater which suggest some impact.
- (b) This is a low-lying area that has received long-term runoff from compressor station operations.
- (c) The investigation efforts to-date have not fully evaluated this AOC.
- (d) The log for well MW-12 indicates that the red fanglomerate is a wet silty sand. Hence, the depth of permeable materials containing chromium and other metals has not been identified.
- (e) Other wells in the vicinity of MW-12 may not be adequate to fully characterize the nature of the bedrock in this area. The fanglomerate at

well MW-21 is described as a poorly-graded gravelly sand (no moisture description provided, but low recharge well during sampling efforts). The conglomerate at well MW-22 was encountered via hand auger and a description of the unit is not available.

(f) GSU does not believe that this is an area that is currently being considered as a potential location to be addressed by the groundwater remedy.

WELLS RECOMMENDED FOR DECOMMISSIONING

In reviewing the site-wide groundwater monitoring program and the RFI/RI Report, GSU has identified concerns with the well completion for inactive water supply well PGE-07. This well is located on the MW-24 bench immediately north of the compressor station. As illustrated by Figure 2-11 of the RFI/RI Report, well PGE-07 screens across the base of the Alluvial Aquifer, through the Miocene conglomerate, and into the top of the pre-Tertiary bedrock. Monitoring at nearby well MW-24B (screens near base of the Alluvial Aquifer) indicates hexavalent chromium concentrations range from 4,790 to 5,640 $\mu\text{g/L}$. By screening across the base of the impacted Alluvial Aquifer and through the bedrock units, the design of well PGE-07 potentially allows downward migration of the chromium plume. GSU urges that this well is decommissioned to remove this vertical pathway. Data lost from the well can be replaced by the existing MW-24 well cluster (i.e., MW-24A, MW-24B, MW-24BR).

GSU recommends that PG&E evaluate the continued necessity of inactive water supply well PGE-06, which is also located in the MW-24 bench. Well PGE-06 is screened in the shallow and middle depth intervals of the Alluvial Aquifer (110 to 180 feet below ground surface) and reports hexavalent chromium concentrations on the order of 1,630 to 2,070 $\mu\text{g/L}$. The PGE-06 well screen interval overlaps the screen interval for nearby well MW-24A (104 to 124 feet below ground surface, hexavalent chromium concentrations of 2,960 to 3,390 $\mu\text{g/L}$). Based on the water quality and hydraulic data that can be obtained from the MW-24 well cluster, GSU does not believe that there is a compelling need for well PGE-06 as part of the site-wide groundwater monitoring program. However, another factor to consider in the decision to decommission this well is whether the well would have some use during the groundwater remedy, whether as a pump-and-treat center or as part of an *in situ* treatment effort. Hence, the GSU recommendation is for PG&E to evaluate the continued usefulness of this well for the project, whether as part of the site-wide monitoring program or as part of the groundwater remedy.

Peer reviewed by: Alfredo Zanoria, CEG, CHG

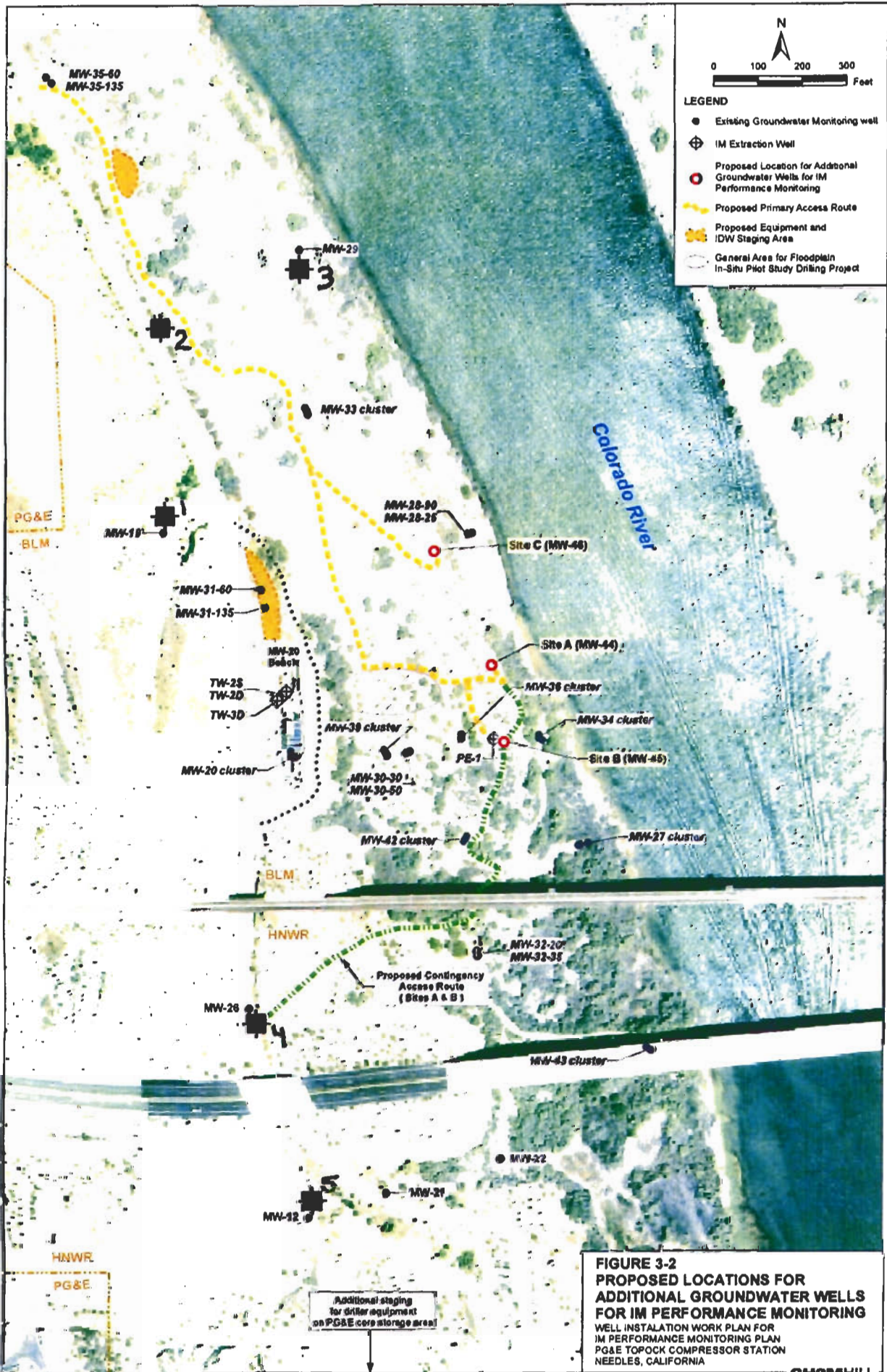


FIGURE 3-2
PROPOSED LOCATIONS FOR
ADDITIONAL GROUNDWATER WELLS
FOR IM PERFORMANCE MONITORING
 WELL INSTALLATION WORK PLAN FOR
 IM PERFORMANCE MONITORING PLAN
 PG&E TOPOCK COMPRESSOR STATION
 NEEDLES, CALIFORNIA

ENCLOSURE NO. 2 – SUMMARY OF RATIONALE FOR ADDITIONAL WELL LOCATIONS¹
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Location ²	Location Description	General Rationale ³	DTSC Rationale ⁴	Geo/Hydro Technical Workgroup (TWG) Input ⁵	Stakeholder Comments on RFI/RI Report That Support Well Locations
1	<p>Adjacent to MW-19, just off Park Moabi Road.</p> <p>2 new wells: screening middle and lower depth interval of Alluvial Aquifer as well cluster/ nest.</p>	ACDEF	<p>-Eastern control on hexavalent chromium (Cr(VI)) concentrations observed at MW-37D in Bat Cave Wash (BCW) (1,800 parts per billion (ppb) in October 2005). The alternative is to drill on the upland area to west, which DTSC does not consider to be a viable option.</p> <p>-Allows better vertical characterization of chromium (Cr) plume and geochemical conditions as transition from upland to floodplain. Data will be useful for <i>in situ</i> treatment, pump-and-treat system, and physical barrier design.</p> <p>-With proper design of new wells, location will provide a hydraulic testing point to assess aquifer conditions north of the MW-20 bench. Will provide data to consider for <i>in situ</i> treatment, pump-and-treat, and physical barrier design.</p> <p>-Gradient measurement point in relative close proximity to MW-20 bench and floodplain <i>in situ</i> pilot test. Also allows assessment of effects on injection on groundwater flow and plume movement.</p>	<p>-The TWG selected this as a potential extraction well location, PE-3.</p> <p>-TWG members strongly advocated this location for further characterization for the following reasons: *more hydraulic characterization is needed to assess aquifer thickness and conditions before designing a pumping well at this location; *members had reservations regarding incomplete characterization of plume in this area such that they would not want to put in a pumping well that potentially draws the Cr plume northward; *additional characterization in northern portion of floodplain is needed to support final remedy selection.</p> <p>-Location supports U.S. Geological Survey (USGS) and GSU recommendation for drilling in northern floodplain area to assess vertical plume distribution and lateral migration pathways from BCW toward floodplain. USGS believes that existing interpretation of vertical plume configuration and geochemical conditions relies too heavily on MW-31 cluster.</p> <p>-RWQCB advocates largest possible influence on the plume (mass removal and hydraulic containment), such as a pumping well would provide at this location.</p>	<p>The following U.S. Department of Interior (DOI) comments support additional well installation at Location 1: 28, 32, 33, 41, 47, 137, 140, 133, and 168. For your reference, portions of these comments are included as Note 6 of this enclosure.</p> <p>The following Arizona Department of Environmental Quality (ADEQ) comments support additional well installation at Location 1: General Comment, 1.2.1, 9.1.5, and 13.5. For your reference, portions of these comments are included as Note 7 of this enclosure.</p>

Location ²	Location Description	General Rationale ³	DTSC Rationale ⁴	TWG Input ⁵	Stakeholder Comments on RFI/RI Report That Support Well Locations
2	<p>Along Park Moabi Road, midway between MW-31 and MW-35 well clusters</p> <p>New 3 well cluster/nest screening upper, middle, and lower depth intervals of Alluvial Aquifer</p>	ABCDEF	<p>-A bedrock control point is needed to assess Alluvial Aquifer thickness. Latest top of Miocene bedrock elevation contour map indicates that <u>all</u> bedrock depths along Park Moabi Road and north of the MW-20 bench are estimates. Need to know top of bedrock to evaluate whether a physical barrier is feasible, particularly if the barrier would be constructed along the road.</p> <p>-Eastern control on Cr(VI) concentrations observed at MW-37D in Bat Cave Wash (1,800 ppb). The alternative is to drill on the upland area to west, which DTSC does not consider to be a viable option.</p> <p>-Allow better vertical characterization of Cr plume and geochemical conditions as transition from upland to floodplain.</p> <p>-Allow better resolution of plume position to be addressed by groundwater remedy. Position of contours on current plume maps are estimated using MW-31 and MW-35 well clusters (~1300 feet apart)</p> <p>-With proper design of new wells, location will provide a hydraulic testing point to assess aquifer conditions north of the MW-20 bench. Will provide data to consider for <i>in situ</i> treatment, pump-and-treat, and physical barrier design.</p> <p>-Gradient measurement point where can observe effects of extraction, injection, and floodplain, in situ pilot study.</p>	<p>-MW-35 well cluster was originally to be installed at this location.</p> <p>-Members advocated this location for the following reasons: *more hydraulic characterization is needed to assess aquifer thickness and conditions in northern floodplain area; *additional characterization in northern floodplain area is needed to support final remedy selection.</p> <p>-Location supports USGS/GSU recommendation for drilling in north floodplain area to assess vertical plume distribution and lateral migration pathways from Bat Cave Wash (MW-37) toward floodplain (MW-31)</p>	<p>The following DOI comments support well installation at Location 2: 28, 32, 33, 41, 47, 137, 140, 133, and 168. For your reference, portions of these comments are included as Note 6 of this enclosure.</p> <p>The following ADEQ comments support additional well installation at Location 2: General Comment, 1.2.1, 9.1.5, and 13.5. For your reference, portions of these comments are included as Note 7 of this enclosure.</p>

Location ²	Location Description	General Rationale ³	DTSC Rationale ⁴	TWG Input ⁵	Stakeholder Comments on RFI/RI Report That Support Well Locations
3	<p>Contingent location, adjacent to MW-29, northern part of floodplain</p> <p>New 2 to 3 well cluster/nest screening upper, middle, and lower depth intervals of Alluvial Aquifer. The number of new wells is uncertain because well MW-29 screens shallowest portion of Alluvial Aquifer and does not really provide useful data.</p> <p>(Note: Contingent because only would install if encountered unexpected plume conditions at Location 2 or Site C.)</p>	ABCE	<p>-If installed, this would be a key gradient measurement point in northern portion of floodplain area.</p> <p>-If installed, would be a plume assessment point adjacent to river.</p> <p>-If installed, would allow vertical characterization of Cr plume and geochemical conditions near river.</p> <p>-If installed, the well will provide an additional bedrock control point to be considered by the remedial design.</p>		<p>The following DOI comments support additional well installation at Location 3: 28, 32, 33, 41, 47, 137, 140, 133, and 168. For your reference, portions of these comments are included as Note 6 of this enclosure.</p> <p>The following ADEQ comments support additional well installation at Location 3: General Comment, 1.2.1, 9.1.5, and 13.5. For your reference, portions of these comments are included as Note 7 of this enclosure.</p>

Location ²	Location Description	General Rationale ³	DTSC Rationale ⁴	TWG Input ⁵	Stakeholder Comments on RFI/RI Report That Support Well Locations
4	<p>Adjacent to MW-26, along Park Moabi Rd, on HNWR</p> <p>New well screening saturated sediments below MW-26 (if sufficient thickness present)</p> <p>Depending on nature of bedrock, DTSC may also request additional well as a <u>data collection activity under the Groundwater Corrective Measures Study Workplan.</u></p>	ABCD	<p>-Cr(VI) concentrations in MW-26 range from 3000-3800 ppb. MW-26 screens the shallow Alluvial Aquifer (although it is likely thin here). The concern that there is deeper contamination than what is monitored by well MW-26. The latest structural contour map indicates that the top of the fanglomerate is estimated at this location. Hence, there is a need to verify nature and position of the bedrock.</p> <p>-Drilling at this location will verify the bedrock position and the thickness of saturated sediments beneath the zone screened by well MW-26. (Note: DTSC does not consider it necessary to mobilize a different type of drilling rig for this location during this field mobilization. DTSC is interested in a demonstration that the top of the fanglomerate is accurately identified and whether permeable, wet zones are present below the MW-26 screen interval.)</p> <p>-If a deeper monitoring well is installed below MW-26, the well would allow vertical plume definition.</p> <p>-If an additional well is installed and appropriately designed, it will provide a useful hydraulic testing location with which to assess aquifer properties and the location potential as a pumping center. (Note: Location coincides with potential extraction well location PE-2.)</p> <p>-If an additional well is installed, it will provide a useful gradient measurement location.</p>	-The TWG selected this as a potential extraction well location, PE-2.	<p>The following DOI comments support additional investigation and well installation at Location 4: 28, 32, 33, 41, 47, 137, 140, 133, and 168. For your reference, portions of these comments are included as Note 6 of this enclosure.</p> <p>The following ADEQ comments support additional well installation at Location 4: General Comment, 1.2.1, 9.1.5, and 13.5. For your reference, portions of these comments are included as Note 7 of this enclosure.</p>

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Location ²	Location Description	General Rationale ³	DTSC Rationale ⁴	TWG Input ⁵	Stakeholder Comments on RFI/RI Report That Support Well Locations
5	<p>Adjacent to MW-12, HNWR</p> <p>New well screening saturated sediments below MW-12 (if sufficient thickness present)</p> <p>Depending on nature of bedrock, DTSC may also request additional well <u>as a data collection activity under the part of Groundwater Corrective Measures Study Workplan.</u></p>	ABCEF	<p>-AOC 11 is a low-lying area that has received long-term compressor station runoff, but remains uninvestigated by the RFI/RI. Unusual groundwater chemistry is observed in at MW-12 (As, Mo, pH), which is located within this AOC. The MW-12 log indicates that the fanglomerate is a wet silty sand. There is concern that there is additional groundwater contamination in this area. Need to answer this question very soon so that the additional groundwater pathway is identified (if present) and incorporated into the spatial scope of the groundwater remedy.</p> <p>-If a well is installed, it will provide the plume characterization (nature and extent) needed to support the CMS and remedy selection.</p> <p>-The additional investigation will provide a better understanding of the bedrock in this area. (Note: DTSC does not consider it necessary to mobilize a different type of drilling rig for this location during this field mobilization. DTSC is interested in a demonstration that the top of the fanglomerate has been accurately identified and whether permeable, wet zones are present below the MW-12 screen interval.)</p>		<p>The following DOI comments support additional investigation and well installation at Location 5: 28, 32, 33, 41, 47, 101, 121, 133, 137, 140, and 168. For your reference, portions of these comments are included as Note 6 of this enclosure.</p> <p>The following ADEQ comments support additional well installation at Location 5: General Comment, 1.2.1, 9.1.5, 12.3.3, and 13.5. For your reference, portions of these comments are included as Note 7 of this enclosure.</p>

Notes:

1. This table was prepared by the DTSC Geological Services Unit (GSU).
2. Well locations are shown on figure included as last page of Enclosure 1, GSU Technical Memorandum, Well Installation Work Plan for Interim Measures Performance Monitoring Program, Dated December 23, 2005.

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Notes (Continued):

3. General rationale as presented in Enclosure 1.
 - A. Additional measurement points to allow assessment of the hydraulic gradients induced by groundwater extraction and injection. Additional measurement points in some areas will allow groundwater flow conditions to be assessed empirically rather than relying on groundwater flow model predictions.
 - B. Better delineation of the mapped groundwater plume extent (i.e., the 20 and 50 ppb contour positions). Improved interpretation of the plume extent will allow refinement of the area that will need to be addressed by the groundwater remedy.
 - C. Better vertical characterization of the chromium plume distribution and geochemical conditions (i.e., oxidation/reduction potential, dissolved oxygen, total dissolved solids). The additional vertical characterization will assist with the assessment of *in situ* treatment feasibility and target screen positions for a pump-and-treat system. For some areas north of the MW-20 bench, the existing data set may rely too heavily on chromium and geochemical distributions observed at certain wells (e.g., MW-31 well cluster).
 - D. Hydraulic testing locations to allow assessment of hydrogeologic conditions where limited data is available and at locations that could be considered as potential pump-and-treat centers. TWG members have had repeated discussions about the need for additional hydraulic data to the north of the MW-20 bench.
 - E. Better definition of the nature and depth of the bedrock surface, especially north of the MW-20 bench. Better bedrock definition is needed for understanding the groundwater flow conditions and for considering the design depth of any physical barriers that might be considered as part of the groundwater remedy.
 - F. Monitoring points that would enable further assessment of potential plume migration pathways that would need to be considered as part of the evaluation of the groundwater remedy.
4. DTSC rationale expands upon what is presented in Enclosure 1.
5. As documented in meeting minutes from the August 16, 2005 TWG meeting.
6. Selected DOI comments (dated July 1, 2005), entitled "Document Review and Comment Resolution Sheet, PG&E Topock Compressor Station Draft RCRA Facility Investigation and Remediation Investigation Report (dated February 2005)". [Note: Portions of the comments are particularly relevant to the additional well locations are underlined for emphasis.]
 - 28) Report Reference: Page 2-7, Section 2.3.4. Comment: "...The RFI should avoid oversimplifying statements such as these and provide more detailed discussions of its data. For example, the thickness of the alluvial aquifer in the floodplain is as much as 130 ft (MW-28-90) and this to the south to as thin as 5 ft in MW-22...Because the bedrock surface is a significant hydraulic boundary and controls the flow of groundwater, it needs to be discussed in detail within the RFI. A top of bedrock map and/or an isopach of the Alluvial Aquifer need to be presented in the RFI. This would easily present the location of potential hydrologic boundary relevant to containment of the plume, particularly where the Miocene conglomerate pinches out within the site. Such a map further highlights possible data gaps in the current distribution of monitoring wells..."
 - 32) Report Reference: Page 2-10, Section 2.5.2.2. Comment: "...To better represent the data collected, and the spatial distribution of monitoring wells, separate maps of wells completed in the various hydrostratigraphic units (upper, middle, lower) should be provided as well as for the bedrock information...The RFI needs to generate separate maps for each unit, e.g., the upper, middle, lower Alluvial Aquifer, as well as the bedrock zones. A basis for separation of these units should be provided. This will provide a better understanding and potentially identify data gaps..."
 - 33) Report Reference: Page 2-11, Section 2.5.2.2. Comment: "...The last sentence mentions that a buried bedrock ridge (paleoridge or fault block) extends northward from the Chemehuevi Mountains. A contour map depicting the bedrock surface (the surface of the Tmc) needs to be incorporated into this RFI. This map would provide useful information regarding the location and depths to this important hydraulic boundary and where potential data gaps exist. In addition, an isopach of the saturated zone of the Alluvial Aquifer needs to be incorporated into the RFI. The RFI needs to discuss the deepening of the bedrock surface to the west (MW-40D)..."
 - 41) Report Reference: Page 2-12, Section 2.5.3. Comment: "...The RFI needs to explain what these greater pumping rates are possible in these two wells (TW-1 and TW-2), otherwise it can be inferred that these locations are not representative of the Alluvial Aquifer..."
 - 47) Report Reference: Page 2-14, Section 2.5.3.2. Comment: "...The RFI needs to accurately represent the spatial distribution of TDS results as well as other indicator parameters that will assist in evaluating the lateral extent of groundwater impacts and the overall dynamics of the groundwater flow regime. TDS and other parameters are useful indicators and therefore should be mapped in detail per the relative aquifer depths or well completions in order to accurately assess a parameters spatial distribution. Isopleths of various groundwater quality parameters need to be incorporated into the RFI, and be constrained to specific zones of the aquifer, e.g., shallow, middle, deep, and bedrock as needed..."
 - 101) Report Reference: Page 11-1, Section 11.0. Comment: "*For AOCs that don't identify the groundwater as a complete exposure pathway:* The groundwater is known to have been impacted by the activities and releases from the facility but the actual sources are only speculative. Why wouldn't all the identified AOCs or SWMUs be considered potential sources of groundwater contamination until the data supports elimination of this pathway?..."
 - 101) Report Reference: Page 11-5, Section 11.7. Comment: "The East Ravine is located along the detachment fault which is known to be fractured. Though the depth to bedrock beneath this AOC is not provided in the RFI, it could be assumed to be relatively shallow (see Figure 2-4) as the bedrock (Tmc) surface rises to the south and is exposed...Several aerial photographs show standing water within these impoundments (1964 and 1967) and the USGS topographic map shows them as water bodies. Based upon the available evidence, including the limited number of sediment samples, there is a potential groundwater pathway associated to these impoundments. This pathway needs to be characterized..."
 - 121) Report Reference: Page 12-19, Section 12.7.4. Comment: "*Conclusions:* This section states that the groundwater pathway is incomplete. How do the impoundments that exist in the ravine affect the infiltration of surface water or precipitation? In the other ravines where waste was disposed, the groundwater pathway is considered complete. Why is this ravine different from the Bat Cave Wash? This material may be contributing to or have contributed to the past groundwater contamination. Are there data that show the vertical extent of contamination?"

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Notes (Continued):

- 133) Report Reference: Section 13. Comment: "The RFI must provide a comprehensive understanding of the groundwater plume and the processes controlling its migration. Moreover, inadequate delineation of the plume and these processes may lead to inadequate IM and CMS/FS designs. To simply define the plume by the spatial distribution of Cr is oversimplifying the potential problem(s). Indicator parameters provide valuable information regarding the transport processes at any site, and mapping and understanding these processes is of high priority. Though many of these indicator parameters are non-toxic, when detected from a known source, they add confidence that a monitoring network (surface water and/or ground water) is properly assessing a pathway..."
- 137) Report Reference: Page 13-2. Comment: "...Potentiometric surface maps and isopach maps of the Alluvial Aquifer are needed to assist this discussion, particularly to show where the effects of bedrock occurs and the effects of the River on the flow direction..."
- 140) Report Reference: Page 13-3, Section 13.1.2.2. Comment: "The highest concentrations of Cr(VI) in groundwater seem to be beneath areas where previous discussion suggested that the groundwater is not impacted. Is it believed that the plume, that is expected to have originated from the Bat Cave Wash discharges, has migrated this far [floodplain area]?"
- 168) Report Reference: Page 13-16, Section 13.5. Comment: "Though focusing on information in the area of the IM is important, delineation of the total extent of the plume is essential for a successful remediation design. The RFI needs to delineate the entire plume and focus some attention on the East Ravine... Not only estimating the depth to bedrock, but its 3-dimensional characteristics is extremely important to a successful groundwater remediation design. This should include areas in the western portion of the study area, where the bedrock is assumed to deepen..."
7. Selected ADEQ comments (dated June 28, 2005), entitled "Comments on PG&E Topock Compressor Station DRAFT RCRA Facility Investigation (RFI), Vol. 1-3, prepared by CH2MHill, dated February 2005". [Note: Portions of the comments are particularly relevant to the additional well locations are underlined for emphasis.]
- General Comment (Page 2 of ADEQ Memorandum). Comment: "Concentration contouring – Concentration contouring would be very helpful for depicting vertical and horizontal distribution. It would be helpful if the RFI contained concentration contouring for chromium and TDS to depict the vertical and horizontal extent of contamination and to facilitate discussion and the next steps in the Resource Conservation and Recovery Act (RCRA) remedial processes. Concentration contours are very useful in examining the spatial behavior of the plume."
- Section 1.2.1 (Interim Measures). Comment: "...From an outside perspective, creating and maintaining landward gradients were the primary objectives for the interim measures implemented to date, since plume boundaries were and still are being defined and additional investigation may be needed... The term 'hydraulic control' used here and in Section 9.1.5 is broad. It should be clear that capture is a 3-dimensional goal. The goals should be more clearly stated – hydraulic control in both the horizontal and vertical directions in all layers of the site (possibly including bedrock if a connection is found between California and Arizona)..."
- Section 9.1.5 (Interim Measures). Comment: "...It would be helpful to iterate here and elsewhere that more work will be required in the future to control plume boundaries...additional investigation may be required towards the east...Without additional data regarding the edge of the plume...it is hard to prove or disprove whether the plume boundary is being controlled..."
- Section 12.3.3 (East Ravine). Comment: "...ADEQ concurs that additional sampling is warranted in this area, especially to determine the vertical extent of elevated concentrations. Even though there are impoundments present to catch runoff, this area topographically drains toward the Colorado River and is located at the interface with bedrock outcrops. Data suggest the need for additional study."
- Section 13.5 (Data Needs for Groundwater Characterization). Comment: "ADEQ suggests the following additions to this list: ...additional wells for improved water level contouring/equipotential maps, including the deeper portion of the aquifer at the bedrock surface...concentration contouring of Cr(VI) and TDS..."