

**CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION**

**CLEANUP AND ABATEMENT ORDER
NO. R6V-2015-0068**

WDID NO. 6B369107001

**REQUIRING PACIFIC GAS AND ELECTRIC COMPANY
TO CLEAN UP AND ABATE WASTE DISCHARGES
OF TOTAL AND HEXAVALENT CHROMIUM TO THE
GROUNDWATERS OF THE MOJAVE HYDROLOGIC UNIT**

_____ San Bernardino County _____

The California Regional Water Quality Control Board, Lahontan Region (Water Board), finds:

Discharger

1. The Pacific Gas and Electric Company (PG&E) owns and operates the Hinkley Compressor Station (hereafter the "Facility"), located at 35863 Fairview Road, Hinkley in San Bernardino County. For the purposes of this Order, PG&E is the Discharger.
2. This is a new order issued to PG&E to cleanup and abate the effects of the discharge of chromium waste or threatened pollution or nuisance. For the purposes of this Order, references to "chromium" include both total (Cr(T)) and hexavalent (Cr(VI)) forms, unless otherwise specified. This Order combines outstanding requirements in previous orders, adds new requirements and deadlines for future cleanup and abatement actions, and replaces previous orders with requirements now incorporated into this Order. Previous orders replaced by this Order are listed in Attachment 1, "CAO and Investigative Orders Replaced by CAO No. R6V-2015-0068."

Source of Groundwater Contamination

3. The Facility began operating in 1952 and discharged untreated cooling tower wastewater containing hexavalent chromium, used as a corrosion inhibitor, to unlined ponds until 1964. Wastewater percolated through soil to the water table, approximately 80 feet below, creating chromium contamination in groundwater. The area beneath the former unlined ponds is also referred to as the "source area" in this Order. A different corrosion inhibitor was used between 1966 and 1972, with the latter date being when the unlined ponds were replaced with lined ponds. Chromium has not been used to control corrosion at the Facility since 1965.

Hydrogeology

4. In general, the groundwater flow in the Hinkley Valley is primarily to the north, towards the Harper Dry Lake Valley, located about 8 miles north and west (downgradient) of the Facility. The groundwater gradient along the north-south axis of the chromium plume ranges from 0.002 to 0.007 feet per foot (vertical drop over horizontal length), with an average rate of 0.004 feet per foot. The Mojave River, located approximately 1 mile south

of the Facility, contributes more than 80 percent of the natural groundwater recharge to the Hinkley Valley.

5. The hydrogeology at the Facility and north to the vicinity of Thompson Road consists of an upper, unconfined aquifer and a lower, confined aquifer separated by a clay layer that forms a regional aquitard. Within the upper aquifer, two water bearing zones are recognized as the shallow and deep zones. The hydrogeology in the western and northernmost areas consists of just the upper, unconfined aquifer, as the lower aquifer and clay aquitard pinch out (terminate against the upward sloping bedrock). Depth to groundwater in the Hinkley Valley ranges from 75 to 95 feet below ground surface.

Extent Chromium Contamination

6. On April 30, 2015, the Water Board received PG&E's "First Quarter 2015_Groundwater Monitoring Report and Domestic Well Sampling Results" (2015 1st Quarter Report). Data and information in the 2015 1st Quarter Report show monitoring and extraction well locations where hexavalent and total chromium concentrations exceed interim maximum background levels of 3.1 µg/l or parts per billion (ppb) Cr(VI) and 3.2 ppb Cr(T)(discussed in Findings 8b, 14, and 15) in groundwater. Well SA-MW-05D, located at the Facility, shows the highest reported concentrations as:

- Hexavalent Chromium Cr(VI) 3,600 ppb (parts per billion)
- Total Chromium Cr(T) 3,700 ppb

7. In the upper aquifer, PG&E's 2014 3rd Quarter Groundwater Monitoring Report (see Figure 5-5 in 2014 3rd Quarter Report) shows chromium in groundwater at concentrations exceeding interim maximum background levels as a plume in the southern area and two "disputed plumes" (see Finding 8.b.) in the northern area. The total area is approximately 8 miles in length and approximately 2 miles in width, throughout the Hinkley Valley and into Harper Dry Lake Valley.
8. In the lower aquifer, chromium is detected up to levels exceeding the hexavalent chromium drinking water standard of 10 ppb (see Finding 28) in a localized area east of Mountain View Road and near Santa Fe Road. For example, the 2015 2nd Quarter Report shows lower aquifer monitoring well MW-92C containing 26 ppb Cr(VI). The water quality in the lower aquifer water for chromium is generally at low (e.g. less than 1 ppb) or non-detectable levels, per monitoring wells MW-11C and MW-14C, between the Facility and east of Mountain View Road near Santa Fe Road. "Non-detect" refers to the lowest concentration that a laboratory analytical instrument can detect while minimizing uncertainty. According to PG&E's November 23, 2010, Work Plan for Evaluation of the Lower Aquifer, the chromium detected in this vicinity in the lower aquifer appears to be the result of contaminated upper aquifer water migrating into the lower aquifer in a localized area at the western edge of an aquitard (referred to as, 'the blue clay'). The downward migration appears to be a result of the observed downward gradient in the area, which likely extends beyond the edge of the aquitard. Consequently, contaminated water likely flowed from the upper aquifer to the lower aquifer in the localized area east of mountain View Road and near Santa Fe Road. Later investigation and proposed remedial reports suggested the chromium migration pathway was via pathways within the thinning blue clay and/or around the blue clay edge near Mountain View Road (PG&E's August 1, 2011 Delineation of Chromium in Lower Aquifer; November 7, 2014 Plan for Enhancement of Lower Aquifer Remedy).

The lower aquifer is subject to different hydrogeological chemistry and is not expected to have the same Cr(VI) background concentrations as upper aquifer zones. Monitoring wells sampled during early investigations of the lower aquifer indicated non-detect concentrations of Cr(VI) upgradient of a localized area east of Mountain View Road and near Santa Fe Road (also referred to as the transition zone at the western edge of the lower aquifer). This information suggests the natural background concentrations of Cr(VI) in the lower aquifer upgradient of the “localized area” may be non-detect. The area upgradient of the “localized area” does not have direct hydraulic connection to the upper aquifer whereas the transition zone does. The “localized area” is in a hydrogeological transition zone between the lower aquifer and the overlying upper aquifer. Consequently, Cr(VI) background concentrations in the “localized area” are likely influenced by both the lower aquifer and upper aquifer hydrogeological chemistry. The United States Geological Survey (USGS) Background Study does not include an evaluation of the lower aquifer or “localized area” transition zone Cr(VI) background concentrations; therefore, before cleanup levels for the lower aquifer are established, the development of a site conceptual model and background concentrations are necessary.

9. The locations of the upper aquifer plumes are based on Figure 5-5 of the 2014 3rd Quarter Report, and are shown in Attachment 2, “Location of Chromium Plumes (Third Quarter 2014)”. PG&E has mapped the plumes, following specific requirements in CAO R6V-2008-0002A4, issued January 8, 2013, to connect any monitoring wells located within 2,600 feet of each other if their chromium concentrations exceed interim background levels. Although that specific mapping requirement is being removed, the requirement in this order for PG&E to map chromium isoconcentration contour lines is expected to produce a map that is substantially similar to the quarterly report plume maps that have been generated since 2013.
 - a) The southern plume is contiguous to the original source of waste chromium discharged at the Facility. The southern plume extends northward from the Facility property to just north of Thompson Road, generally following the northerly direction of groundwater flow. The southern plume includes the currently contiguous “western finger” of the chromium plume in the upper aquifer, west of Serra Road, between Highway 58 to the south and Acacia Street to the north.
 - b) Chromium in the northern area has been mapped since 2013 as two discontinuous (i.e., non-contiguous) areas of Cr(VI) above the interim maximum background concentration and separate from the southern plume and from each other. The southern-most northern area, extends from just south of Sonoma Street to just south of a topographic high feature known as Red Hill at the Hinkley Gap. The north-most northern area, extends from northwest of Red Hill up to just south of Brown Ranch Road. These areas have been mapped with closed isoconcentration lines depicting zones equal to or greater than 3.1 ppb Cr(VI) within these northern areas. The zones that contain greater than 3.1 ppb Cr(VI) are hereafter referred to as the northern “disputed plumes” because whether the chromium is linked to PG&E’s discharge or naturally-occurring has been disputed among the parties. PG&E has submitted evidence disputing the assertion that the Cr(VI) is conclusively linked to its discharge or remedial activities and claiming that there is Cr(VI) naturally occurring in the northern area. Because the USGS is conducting a background study in this area and the results of that study will be used to establish what Cr(VI) is linked to PG&E’s historic discharge and remediation activities, it is not necessary for the Water Board to

establish at this time whether the Cr(VI) in the northern area is in whole, or in part, or no part from PG&E.

- c) In general, lesser chromium concentrations (mostly in the single digits) occur in the two northern disputed plumes, with the exception a hot spot of higher chromium concentrations at MW-193S3, compared to chromium concentrations in the southern plume. At MW-193S3, chromium concentrations have been reported at greater than 100 ppb since 2013, but are now at 65 ppb Cr(VI) as of the 2015 1st Quarter Report. Domestic wells also exist within 1,500 feet of MW-193S3. Chromium detected in domestic well 16N-01, located in the northeast corner of the Harper Dry Lake Valley and 12 miles from the Facility, is not believed to be from PG&E's release because domestic well 16N-01 is located 2.6 miles further downgradient than the 7.3 mile calculated distance of potential groundwater flow from the source at the PG&E compressor station. (See Finding 10, below, describing potential migration distance of leading edge of chromium plume in upper aquifer.)
- d) Data from about 100 groundwater monitoring wells is used to interpret the approximate location of the 3.1 Cr(VI) isoconcentration lines in the northern disputed plumes. About seven private supply wells are located in either downgradient or cross gradient locations from the northern disputed plumes and each of those private supply wells, except for Well 33N-01, have sufficient monitoring wells in the upgradient locations to serve as sentry wells for protection of public health. This Order identifies more subsurface information is needed for sufficient resolution of the areas south and east of Well 33N-01 and to understand the chromium in the groundwater in this area, and requires PG&E to submit a workplan proposing additional wells or a technical justification for why additional wells are not necessary.
10. Finding 12 in Amended R6V-2008-0002A4 (discussed below in Findings 18, 19 and 20) provides a theoretical calculation for the potential length of a chromium plume, assuming the initial discharge began in 1952, as 7.32 miles¹. This value represents the potential migration distance of the leading edge of a plume in the upper aquifer. This estimate is based on a groundwater flow velocity estimate of 2 feet per day, provided by PG&E and supported by data from the USGS and the Mojave Water Agency. The value is a conservative average value from a range of measurements. Using the estimated rate of 2 feet per day groundwater flow velocity, a chromium plume has the potential to migrate at least an additional 1,460 feet or 0.28 miles since Order R6V-2008-002A4 was issued January 8, 2013. Added to the original calculation provided, there is a total potential migration distance of at least 7.6 miles, putting the plume potentially into the Harper Dry Lake Valley which is hydraulically downgradient of the Facility. The 7.6-mile estimated calculation is consistent with the approximately 8-mile distance shown on plume maps in the 2014 3rd Quarter Report described in Finding 7.

As stated in a March 13, 2015, Technical Memo from PG&E's Principal Geologist consultant from Stantec, PG&E believes the estimated calculation above does not consider the historic and current groundwater pumping in the Hinkley Valley that would limit groundwater movement to the north. Additionally, PG&E asserts the groundwater

¹ The calculation is: (2 feet/day x 365 days/year x 53 years) / 5,280 feet/mile = 7.32 miles of potential migration of the leading edge of the plume. 53 years assumes the time between issuance of CAO No. R6V-2008-0002A4 and the waste discharge is 60 years, minus 7 years for waste chromium to percolate to groundwater.

gradients and hydraulic conductivity assumed for the groundwater flow calculation are less for the northern area resulting in groundwater flow velocity less than 2 feet per day.

11. The release from PG&E's Facility is the only known source of anthropogenic chromium in groundwater in the Hinkley upper and lower aquifers.

Regulatory History

12. Discharges from the Facility were first regulated by the Water Board in 1972 under Board Order No. 6-72-44. In late 1987, PG&E reported to the State that total chromium and hexavalent chromium concentrations exceeding the California drinking water standard of 50 ppb total chromium were found in groundwater beneath and downgradient of the Facility (see Finding 3 of Cleanup and Abatement Order No. 6-87-160).
13. On December 29, 1987, the Water Board issued Cleanup and Abatement Order (CAO) No. 6-87-160 to PG&E, requiring a site investigation and initiation of soil and groundwater cleanup actions. Amendments to the 1987 CAO were issued in 1994 and 1998, requiring PG&E to conduct further site assessments, cleanup actions and reporting.
14. On August 6, 2008, the Water Board Executive Officer issued CAO No. R6V-2008-0002 to PG&E, ordering further cleanup of chromium and abatement of the effects of chromium in soil and groundwater from historical discharges at the Facility. CAO No. R6V-2008-0002 also required PG&E to submit a Feasibility Study evaluating cleanup options to hydraulically contain and remediate the known extent of the chromium plume in groundwater to background concentrations.
15. The Water Board Executive Officer amended CAO No. R6V-2008-0002 on November 12, 2008. CAO No. R6V-2008-0002A1 set the following average and maximum background levels for Cr(VI) and Cr(T) in groundwater based on a 2007 study conducted by PG&E:
 - 1.2 ppb Cr(VI), average background level
 - 1.5 ppb Cr(T), average background level
 - 3.1 ppb Cr(VI), maximum background level
 - 3.2 ppb Cr(T), maximum background level
16. The maximum background levels of 3.1 ppb Cr(VI) and 3.2 ppb Cr(T) have been used to determine the effectiveness of remediation actions and to determine if the chromium plume has migrated into areas previously unaffected by the discharge of waste.

In 2011, the approach PG&E used to develop these background values underwent scientific peer review. The reviewers were critical of several aspects of the study approach. Further, PG&E's 2007 background study did not investigate potential background values in the North Hinkley or Harper Dry Lake/Water Valleys. Therefore, it is acknowledged that the accuracy of the currently adopted background values, particularly for the northern area, is uncertain. A revised background study, conducted by the USGS, is underway, expected to be completed within five years. The USGS is scheduled to produce a Background Study Preliminary Results Report no later than September 2017 and a Final Background Study no later than June 2019. The USGS background study is investigating natural chromium occurrences throughout the Hinkley Valley, including in the North Hinkley and Harper Dry Lake/Water Valleys. Following study completion, the

Water Board may consider updating chromium background levels and setting final cleanup levels. In the interim, the levels stated in Finding 14 will continue to be used as background values, and will be referred to as “interim” maximum background concentrations to distinguish these values from other values that may be adopted at a later date based on the results from the USGS Background Study.

17. The Water Board Executive Officer issued a second amendment to CAO No. R6V-2008-0002 on April 7, 2009 allowing for the lateral migration of the 4 ppb Cr(VI) eastern plume boundary during implementation of remedial actions (4 ppb Cr(VI) was the level formerly used to define the chromium plume in CAO No. R6V-2008-0002). Accordingly, this Order allows for migration of the 4 ppb chromium plume boundary to accommodate remediation goals under the conditions specified in Order section V.H. A map showing the location of allowed plume migration area is included as Attachment 3, “Area of Allowed Plume Expansion.”
18. The Water Board approved and the Executive Officer issued a third amendment to CAO No. R6V-2008-0002 on March 14, 2012, CAO No. R6V-2008-0002A3, replacing plume containment requirements in CAO No. R6V-2008-0002. The Water Board Executive Officer issued a fourth amendment to CAO No. R6V-2008-0002 on January 8, 2013, CAO No. R6V-2008-0002A4, requiring PG&E to conduct further investigations to fully define the chromium boundary in groundwater to the 3.1 ppb Cr(VI) and 3.2 ppb Cr(T) levels.
19. The Water Board Assistant Executive Officer issued Investigative Order R6V-2011-0079 on September 29, 2011, requiring PG&E to, among other things, draw plume boundary lines of 3.1 ppb Cr(VI) and 3.2 ppb Cr(T) to connect any monitoring well located within 2,000 feet of any other monitoring well having chromium concentrations of 3.1 ppb Cr(VI) or 3.2 ppb CR(T) or greater.
20. Orders in CAO No. R6V-2008-0002A4, which were issued prior to the State of California setting the Cr(VI) drinking water standard at 10 ppb, required PG&E to define the extent of chromium in the upper aquifer using the interim maximum background levels. Order provision A.2.a required that monitoring well locations were not to exceed one-quarter mile distance (1,320 feet) from other monitoring wells in accessible areas. Order provision C.2 required that maps include chromium plume boundary lines drawn to connect any monitoring well located within one-half mile (2,600 feet) of any other monitoring well having chromium concentrations exceeding background levels. PG&E used this plume boundary to define who received offers for replacement water and property buyout. With the drinking water maximum contaminant level now set at 10 ppb for Cr(VI), prescriptive plume definition and mapping requirements are no longer needed, as the plume map is not being used to determine who gets replacement water (See Findings 22, 42-45; note PG&E has terminated its property purchase program). Instead, this Order requires ongoing investigation of groundwater, including retaining the requirement for a minimum well spacing of 1,320 feet or less for the southern plume area, to provide sufficient resolution of chromium concentrations, to determine plume migration and to judge successful remediation, and it requires plume boundary mapping consistent with the industry standard of best professional judgment by a California licensed Professional Geologist or Civil Engineer.

However, because the community has expressed concerns that changing the mapping requirements may result in substantially different maps than it has become accustomed to, the requirement for a minimum well spacing of 1,320 feet or less for the southern

plume area is retained and the requirement to draw 3.1 ppb Cr(VI) and 3.2 ppb Cr(T) isoconcentration contour lines is included, which will result in the chromium concentrations being identified in ways that are substantially similar to what has been required in the past. This mapping requirement is consistent with other mapping requirements issued by the Water Board, such as in CAO R6V-2013-0045 which requires the City of Barstow to map the isoconcentration contour lines of nitrate in the groundwater. The mapping requirements in this order allow the community and the Water Board to be able to continue to track the northern chromium concentrations, while not identifying those northern chromium concentrations as being from PG&E's historic discharge during the pendency of the USGS Background Study.

21. In response to requirements in CAO No. R6V-2008-0002A4, PG&E submitted the April 24, 2014 document, "Status Report for the Northern Areas." The document proposed to investigate chromium in groundwater in seven areas in the northern disputed plumes. Through 1st Quarter 2015, two areas had been investigated and a third area had two monitoring wells (MW-212S1 and MW-212S2) installed near Red Hill to support chromium plume boundary investigations. PG&E has claimed an inability to gain access to private properties and presence of endangered species habitat has prevented investigative activities in certain areas. However, as PG&E continues to buy properties and/or Department of Fish and Wildlife issues permits within endangered species habitat (expected in 2017), access status may change in the future, allowing further investigations where domestic wells are threatened.
22. In compliance with CAO No. R6V-2008-0002, PG&E submitted a Feasibility Study and addenda in 2010 and 2011, identifying strategies for implementing final site cleanup for achieving background conditions of chromium, including timeframe estimates for reaching various cleanup milestones. In the June 30, 2014 document, "Remedial Timeframe Assessment", PG&E updated the estimates from the 2010 Feasibility Study to reflect current conditions and knowledge regarding site cleanup. The updated estimates range from six to 23 years to remediate 99 percent of the 50 ppb southern plume east of Serra Road; and 11 to 50 years to remediate 99 percent of the 10 ppb southern plume east of Serra Road. The ranges reflect remediation times for different modeled hydrologic layers of the upper aquifer (finer-grained versus coarser-grained model layers) and different assumptions of in-situ remediation modeling. These estimates inform the basis for the cleanup goals in this Order. The timeframe estimates are uncertain given underlying, simplified assumptions in the modeling, uncertainty in conditions throughout the modeled aquifer, operational and construction uncertainties and assumptions made on the timing and continuation of permitting for the project.
23. On January 7, 2011, CAO No. R6V-2011-0005 was issued to PG&E requiring interim continuous drinking water (bottled water) for residents having Cr(VI) or Cr(T) in domestic wells above the interim maximum background levels. The Order also established a quarterly domestic well sampling program in Hinkley. Amended CAO No. R6V-2011-0005A1, issued on October 11, 2011, required permanent continuous drinking water (whole house water or WHW) that met drinking water standards for residents having chromium in domestic wells above the interim maximum background levels. A second amended Order, CAO No. R6V-2011-0005A2, was issued on June 7, 2012, incorporating PG&E's expanded WHW program for all Hinkley residents within the affected area having detectable chromium in domestic wells. A third amendment, CAO No. R6V-2011-0005A3, issued February 18, 2014, set bottled water quality requirements at the average

background value for hexavalent chromium. These Orders are listed in Attachment 1, "CAO and Investigative Orders Replaced by CAO No. R6V-2015-0068."

24. On April 9, 2008, the Water Board issued general waste discharge requirements (WDRs), Order No. R6V-2008-0014, that allows PG&E to implement various remediation projects to provide chromium plume containment and to clean up chromium pollution in groundwater. To date, the Water Board has issued multiple Notices of Applicability permitting PG&E to conduct in-situ (below ground) remediation in the southern plume, inject freshwater into wells along Serra Road to prevent western plume migration, and implement tracer tests and pilot studies.
25. Since 1991, the Water Board has issued individual WDRs to PG&E to apply extracted chromium-contaminated groundwater to crop fields as a means of converting Cr(VI) to trivalent chromium (Cr3). On March 12, 2014, the Water Board issued WDRs, Board Order No. R6V-2014-0023 allowing the discharge of extracted groundwater on up to 500 acres of agricultural fields in the Hinkley Valley to be used to facilitate cleanup of groundwater contamination in the southern plume. Attachment 4, "Active Water Board Orders and Notices Authorizing Cleanup Actions" lists active WDRs and Notices of Applicability issued to PG&E since 2008.
26. In compliance with CAO No. R6V-2008-0002A3, PG&E has been operating a groundwater extraction system to maintain hydraulic containment of the southern chromium plume south of Thompson Road. Hydraulic containment is determined by comparing hydraulic gradients or flow direction vectors calculated from specific monitoring well pairs and triplets within the mandated capture zone. Since 2nd Quarter 2014, monitoring data indicate remedial actions have reduced the area in the capture zone where chromium concentrations exist greater than 10 ppb and 50 ppb. That is, as groundwater extraction in the southern plume continues, the leading (northern) edge of the southern chromium plume is being pulled to the south (the plume area is decreasing), and the chromium concentrations within the capture area are decreasing. Therefore, the existing capture metrics are now too far north to verify containment of the chromium plume. The existing capture metrics adopted in CAO No. R6V-2008-0002A3 are shown in Attachments 5 through 7 "Hydraulic Capture Metrics," "Hydraulic Capture Monitoring Plan, Shallow Zone of Upper Aquifer," and "Hydraulic Capture Monitoring Plan, Deep Zone of Upper Aquifer."
27. On October 3, 2014, PG&E submitted the "Work Plan to Conduct Hydraulic Testing and Capture Analysis, Winter 2014-2015", proposing to conduct hydraulic testing activities in the northern area of the southern chromium plume. The purpose of the testing is to evaluate an alternate and more southerly capture zone configuration for the chromium plume. The Assistant Executive Officer approved PG&E's work plan on December 19, 2014. The December 19, 2014, approval letter temporarily amended CAO No. R6V-2008-0002A3 to require monitoring and reporting to determine if during the testing, chromium concentrations are increasing in nearby wells; to require contingency plan implementation if such increases are noted; and to set notification requirements. This Order incorporates the requirements and corresponding deadlines of the December 19, 2014 letter as if set forth fully herein. As of August 2015, Water Board staff is reviewing PG&E's report on the completed hydraulic testing and capture analysis. The Water Board's Executive Officer may amend this Order at any time to incorporate alternate capture metrics.

Exceedances of Water Quality Objectives and Impairment of Beneficial Uses

28. The 1995 Water Quality Control Plan for the Lahontan Region (Basin Plan) established water quality objectives for the protection of beneficial uses. The beneficial uses of the groundwater in the Mojave Hydrologic Unit designated in the Basin Plan include municipal and domestic supply, agricultural supply, fresh water replenishment, and industrial service supply.
29. Basin Plan water quality objectives to protect the municipal and domestic supply beneficial use include the following Maximum Contaminant Levels (MCLs), referred to as the drinking water standards, that have been established by the California Department of Public Health (now the California Division of Drinking Water):
- | | |
|---------------------|---------------------------------|
| Hexavalent Chromium | 10 ppb (effective July 1, 2014) |
| Total Chromium | 50 ppb |
30. The concentrations of hexavalent chromium and total chromium detected in groundwater samples taken from wells on and off the Facility of up to 3,900 and 4,100 ppb Cr(VI) and Cr(T), respectively, exceed water quality objectives specified in the Basin Plan to protect drinking water supplies. These concentrations adversely affect the groundwater in the Mojave Hydrologic Unit for its beneficial uses.
31. The level of waste chromium in groundwater on and off the Facility constitutes a pollution as defined in Water Code section 13050, subdivision (I):
- “Pollution” means an alteration of the quality of waters of the state by waste to a degree which unreasonably affects either of the following:*
- (A) The waters for beneficial uses.*
- (B) Facilities which serve these beneficial uses.*
32. California Water Code section 13304, subdivision (a) states in part:
- A person...who has caused or permitted, causes or permits, or threatens to cause or permit any waste to be discharged or deposited where it is, or probably will be, discharged to waters of the state and creates, or threatens to create, a condition of pollution or nuisance, shall, upon order of the regional board, clean up or abate the effects of the waste, or, in the case of threatened pollution or nuisance, take other necessary remedial action, including but not limited to, overseeing cleanup and abatement efforts. A cleanup and abatement order issued by the state board or a regional board may require the provision of, or payment for, uninterrupted replacement water service, which may include wellhead treatment, to each affected public water supplier or private well owner.*
33. Findings in this Order identify where chromium wastes have been discharged or deposited into waters of the state in groundwater in violation of the water quality objectives in the Basin Plan, or where PG&E has caused or permitted, or threatens to cause or permit waste to be discharged or deposited where it is or probably will be

discharged into waters of the state, creating or threatening to create a condition of pollution or nuisance. PG&E is therefore subject to Water Code section 13304(a), requiring cleanup and abatement of waste discharges.

Need for Requirements in this Order

34. Soil and groundwater remediation actions have taken place since 1988. Although progress has been made, chromium in groundwater in both the upper and lower aquifers continues to exist at levels greater than interim maximum background values, and at levels that adversely affect or threaten to affect beneficial uses. The chromium plume in the upper aquifer is at concentrations significantly above the drinking water standards. The characteristics of the upper and lower aquifers differ greatly, and within the upper aquifer the southern plume characteristics differ greatly from those of the northern disputed plumes, and the amount of data available differs greatly for each area:
- a) For the southern plume, data from about 400 monitoring wells is used to understand the extent of chromium in excess of the interim maximum background levels. Because this monitoring network provides a significant amount of data that links chromium contamination to PG&E's historical discharge from its compressor station, sufficient evidence exists for the Water Board to require PG&E to cleanup and abate its discharge pursuant to California Water Code section 13304. The relatively dense monitoring network is also used to evaluate the effectiveness of PG&E's containment and cleanup activities for the southern plume.
 - b) For the northern disputed plumes, data from nearly 100 monitoring wells is used to define the extent of chromium in excess of the interim maximum background levels. There is insufficient evidence for the Water Board to link the chromium to PG&E's historical discharge at this time. However, because the standard for requiring dischargers to submit technical or monitoring program reports as part of investigations of water quality under Water Code section 13267 is much less stringent than requirements for requiring clean up under Water Code section 13304, sufficient evidence exists for the Water Board to require PG&E to conduct investigations and monitoring of the northern disputed plumes. The USGS Background Study is intended to provide sufficient evidence that can be used to determine if the chromium in the northern disputed plumes is linked to PG&E's historical discharge or if it is naturally-occurring. Though the extent of chromium in excess of the interim maximum background levels is not as well defined in all areas of the northern disputed plumes, as compared to the southern plume, the highest chromium concentration in the north is roughly one-tenth of that in the south. As of 3rd Quarter 2014 monitoring results, there are six domestic wells in the north having chromium concentrations in excess of the interim maximum background concentrations. According to PG&E, these domestic well owners have been provided reverse osmosis systems or refused such systems.
 - c) For the lower aquifer, data from approximately 20 monitoring wells is used to define the extent of chromium that is directly linked to PG&E's historical discharge. Those monitoring wells indicate that Cr(VI) linked to PG&E's discharge has migrated into portions of the lower aquifer which have been shown to previously not contain Cr(VI) above a detection limit of 0.2 ppb. However, limited data exists to characterize the transition zone from the upper aquifer to the lower aquifer and there is insufficient data to conclude whether naturally-occurring Cr(VI) occurs in other parts of the lower

aquifer. An evaluation of the remediation feasibility, and additional geochemical and hydrogeological data from the transition zone between the upper and lower aquifer is needed before a cleanup level can be set for the lower aquifer.

Therefore, this Order requires PG&E to: continue southern plume containment, continue and enhance corrective actions in both upper and lower aquifers; conduct corrective actions in the northern disputed plumes area, when applicable, and, to the extent required, continue to refine the extent of chromium in excess of the interim maximum background concentrations in the upper aquifer. To ensure progress toward protection and restoration of beneficial uses of the groundwater, this Order sets deadlines for PG&E to reach and maintain specific concentrations of chromium in groundwater, including interim targets such as 50 ppb and 10 ppb.

35. Monitoring and reporting are required under this Order, pursuant to Water Code section 13267, which authorizes a regional board to require persons who have discharged, discharges or is suspected of having discharged, or who proposes to discharge waste within its region to furnish technical or monitoring reports. The burden, including costs of these reports shall bear a reasonable relationship to the need for the report and the benefits to be obtained from the report. The required technical reports are necessary to evaluate PG&E's compliance with the terms and conditions of this Order, and to assure protection of waters of the state and restoration of beneficial uses. Consistent with Water Code section 13267, this Order requires implementation of a monitoring and reporting program that is intended to verify the effectiveness of remediation, track progress toward meeting remediation targets, evaluate threats to and monitor water quality in private supply wells. The burden of the monitoring and reporting is outweighed by the need for information gained by the monitoring and reporting requirements because the monitoring is necessary to verify the effectiveness of the remediation, track progress towards meeting remediation targets, and evaluate threats to and monitor water quality in private supply wells. Monitoring requirements for this Order are specified in Attachment 8, "Groundwater Monitoring and Reporting Program, CAO No. R6V-2015-0068."
36. This Order requires PG&E to clean up and abate the effects of historical chromium discharges from the Facility. Several different cleanup methods are being implemented by PG&E to meet the requirements of past enforcement actions, including groundwater extraction and management; in-situ (subsurface) remediation, and freshwater injection. Cleanup methods are currently conducted under Board Orders (waste discharge requirements, WDRs) or Notices of Applicability of General Orders, which contain specific monitoring for remediation effectiveness, plume boundary control, plume containment, remediation byproducts, and private supply well protection. This Order does not alter or revise the mitigation and monitoring required by current Board Orders, but instead prescribes monitoring and reporting in addition to what is required in those Board Orders (see Attachment 4, "Active Water Board Orders and Notices Authorizing Cleanup Actions").
37. On December 19, 2014, PG&E submitted a document titled "Draft Groundwater Monitoring and Reporting Program, PG&E Hinkley Compressor Station" (Draft MRP), proposing a number of changes to existing monitoring and reporting programs for the Hinkley groundwater cleanup project. The Draft MRP proposed reducing the number and frequency of monitoring well sampling for the contiguous southern plume area and the non-contiguous northern disputed plumes area north of Salinas Road; consolidating all requirements for monitoring into one site-wide plan; streamlining the current chromium

monitoring well network to eliminate redundant monitoring. The Draft MRP also proposed modifying the domestic well monitoring program by reducing the sampling frequency of certain wells and eliminating other wells.

38. Water Board staff has reviewed PG&E's Draft MRP. The following conclusions from that evaluation form the basis of the MRP in this CAO:

- a) The program presented in PG&E's Draft MRP for southern plume monitoring meets the monitoring objectives to track remediation effectiveness, chromium plume tracking and domestic well protection, with several additions incorporated into the "Groundwater Monitoring and Reporting Program, CAO No. R6V-2015-0068", Attachment 8.
- b) Remediation system expansion is still ongoing in the southern plume area. For example, expansion of the Ranch agricultural treatment unit (ATU) was completed in third quarter 2014; construction of new ATUs in the southern portion of the southern contiguous plume are planned and under construction. In-situ remediation zones may be expanded over current operations. Expansion of remediation system will result in increased groundwater extraction, infiltration, and treated water injections over what has occurred in the past. For this reason, quarterly sampling at domestic wells is required until expanded systems have been operating for a length of time to detect and react to any unforeseen changes to water quality, as specified in the Mitigation Monitoring and Reporting Program (MMRP) in the ATU WDRs referenced in the Groundwater Monitoring and Reporting Program, CAO No. R6V-2015-0068.
- c) The "Groundwater Monitoring and Reporting Program, CAO No. R6V-2015-0068", shown in Attachment 8, allows sampling frequency modifications over time under certain conditions. Such conditions include when statistical trends indicate changes in sampling frequency are warranted as described in the "Groundwater Monitoring and Reporting Program, CAO No. R6V-2015-0068".

39. Certain monitoring wells may be eliminated from the sampling program, or their sampling frequency reduced based on well "redundancy" (i.e., monitoring wells within 200 feet of each other installed in the same aquifer layer). Over the more than 25 years of site investigation and cleanup, numerous monitoring wells have been installed for different investigations. Where the density of wells is such that duplicate wells are monitoring the same aquifer zone, removing such wells will not compromise monitoring objectives.

Replacement Water for Affected Private Supply Wells

40. The groundwater aquifer in the Hinkley Valley is the sole source of water supply for domestic and community supply wells in the area. The 2015 1st Quarter Report indicates 99 private water supply wells were sampled for hexavalent chromium. Of these, nine wells contained hexavalent chromium greater than interim maximum background levels. The highest hexavalent chromium concentration measured in a private supply well in 1st Quarter 2015 was 4.2 ppb. No private supply wells sampled contained hexavalent chromium greater than the 10 ppb drinking water standard. However, as shown in Figure 5-5 of the 2015 1st Quarter Report, private supply wells are located near and downgradient of monitoring wells containing Cr(VI) concentrations at or above the drinking water standard.

41. California Water Code section 13304, subdivision (f) states:

Replacement water provided pursuant to subdivision (a) shall meet all applicable federal, state, and local drinking water standards, and shall have comparable quality to that pumped by the public water system or private well owner before the discharge of waste.

42. In State Water Board Water Quality Order 2005-007 (*Olin Order*), the State Water Board clarified that an “affected well,” for which regional water boards have discretion to require replacement water pursuant to Water Code 13304(a), was one that did not meet the federal, state and local drinking water standards. The *Olin Order* also held that the Regional Water Boards may require dischargers to submit water replacement plans prior to documentation of contaminant levels exceeding the relevant standard. The *Olin Order* held that where water quality data exhibit trends indicating the likelihood of future exceedances, it is prudent and appropriate for regional water boards to take such action before actual well exceedances occur (*Olin Order* at p. 7).

Replacement Water Service

43. From 2011 to 2014, in response to CAO No. R6V-2011-0005 and amendments, PG&E provided bottled water and/or whole-house water (WHW) to residences or businesses within the affected area and having detectable chromium in well water. On July 1, 2014, the State Water Board Division of Drinking Water's adoption of the 10 ppb Cr(VI) drinking water standard became effective. PG&E ceased providing bottled water and/or WHW on October 31, 2014, because no residence or business had hexavalent chromium above the new standard. However, this Order requires PG&E to submit a workplan outlining long-term replacement water supply options for affected wells (defined in Finding 46), should any active private supply well later exceed the drinking water standard and become an affected well. The long-term replacement water workplan is required within 45 days of this Order being issued.
44. On August 17, 2011, the Office of Environmental Health Hazard Assessment issued a response to the Lahontan Regional Water Quality Control Board regarding whether there was a risk of inhalation of chromium from showering or from the use in evaporative coolers. That letter stated that the Public Health Goal (PHG) for drinking water was based on exposure via ingestion and inhalation during showering, and that since so little Cr VI is inhaled during showering, “the PHG based only on ingestion is identical (after rounding) to that based on ingestion plus inhalation during showering: 0.02 ug/L.” Therefore, the fractional cancer risk due to inhalation is very small, and that inhalation exposure during showering could not be used as a basis for establishing the PHG. Similarly, OEHAA agreed with conclusions that “swamp coolers do not increase the concentration of airborne Cr VI,” and that “swamp coolers do not constitute an inhalation risk.” Therefore, the replacement water must be provided for drinking and cooking purposes, and is not necessary for other uses such as showering or use in swamp coolers.
45. Accordingly, this Order requires that PG&E submit a plan that can be implemented to provide a long-term replacement water supply for drinking and cooking purposes for affected wells and where private supply well concentrations exhibit increasing trends indicating the likelihood that wells will be affected within the next year.
46. **Affected wells** are defined as domestic or community wells in the domestic well sampling area defined in the “Groundwater Monitoring and Reporting Program,

CAO No. R6V-2015-0068”, Attachment 8, containing chromium in concentrations (measured at any time by PG&E or by local, state or federal agencies) that are above the primary drinking water standards of 10 ppb Cr(VI) or 50 ppb Cr(T) and where the chromium detections are linked to PG&E’s historical releases.

47. Currently, there are no systems for removing Cr (VI) that have been registered by the State Water Board’s Division of Drinking Water.

Independent Consultant

48. The Water Board recognizes the significant community interest in the site and the challenges community members may have in evaluating and understanding the technical aspects of this site and cleanup actions. The Hinkley community is in a rural setting in the unincorporated area of San Bernardino County. Community members are made up of different income levels and ethnicities. The Water Board is committed to principles of environmental justice. This means providing fair treatment of people of all races, cultures and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies. (Gov. Code § 65040.12(e).) Fair treatment means that “no group of people should bear a disproportionate share of the negative environmental consequences resulting from industrial, governmental and commercial operations or policies.” (U.S. EPA <http://www.epa.gov/environmentaljustice/basics/index.html>.) The goal of environmental justice is “for everyone to enjoy the same degree of protection from environmental and health hazards and equal access to the decision-making process to have a healthy environment in which to live, learn, and work.” (*Id.*)
49. Therefore, it is important to the Water Board that environmental justice is promoted by ensuring that the cleanup and abatement of chromium contamination of this area promotes equity and affords fair treatment, accessibility and protection for all members of the community. To effectively participate in evaluating and understanding the technical aspects of cleanup actions, the Water Board finds it is essential that the community have access to independent consultants. The cost of this effort shall be borne by PG&E pursuant to Water Code section 13304.

Legal and Regulatory Authorities

50. This Order conforms to and implements policies and requirements of the Porter-Cologne Water Quality Control Act (Division 7, commencing with Water Code section 13000) including (1) sections 13267 and 13304; (2) applicable state and federal regulations; (3) all applicable provisions of statewide Water Quality Control Plans adopted by the State Water Resources Control Board (State Water Board) and the Water Quality Control Plan for the Lahontan Region (Basin Plan) adopted by the Water Board including beneficial uses, water quality objectives, and implementation plans; (4) State Water Board policies and regulations, including State Water Board Resolution No. 68-16, Statement of Policy with Respect to Maintaining High Quality of Waters in California; Resolution No. 88-63, Sources of Drinking Water; Resolution No. 92-49, Policies and Procedures for Investigation, and Cleanup and Abatement of Discharges under Water Code Section 13304; California Code of Regulations (CCR) Title 23, Chapter 16, Article 11; CCR Title 23, section 3890 et. seq.; and (5) relevant standards, criteria, and advisories adopted by other state and federal agencies.

Consideration of California Water Code section 106.3

51. Water Code section 106.3 establishes a state policy that every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes, and directs state agencies to consider this policy when adopting regulations pertinent to water uses described in the section, including the use of water for domestic purposes. This Order promotes that policy by requiring PG&E, in accordance with time schedules, to clean up its past hexavalent chromium discharges to reach, at a minimum, maximum contaminant levels designed to protect human health and ensure that water is safe for domestic use. This Order also requires replacement drinking water where PG&E has affected individual domestic water supplies to the point where maximum contaminant levels (drinking water standards) are exceeded, and replacement water plans when there is a threat of exceedance.

California Environmental Quality Act

52. This Order is a project for purposes of the California Environmental Quality Act (CEQA) and is subject to the provisions of CEQA (Public Resources Code, section 21000 et seq.). The Water Board is the lead agency for this Project, and certified an Environmental Impact Report (EIR) at a public meeting on July 17, 2013 (Resolution R6V-2013-0060). The EIR analyzed the impacts of foreseeable cleanup activities, including those that may be implemented under this Order, such as groundwater extraction and application to agricultural treatment units, in-situ remediation, and freshwater injection.

53. The EIR describes potentially significant environmental impacts that may occur as a result of implementing cleanup activities. Potentially significant and unavoidable impacts were identified for the following water quality and biological resources:

- a. Impacts to water quality in the Hinkley Valley aquifer due to remedial actions:
 - Temporary chromium plume bulging;
 - Temporary increase in remedial byproducts, including those related to agricultural treatment units:
 - Total dissolved solids
 - Uranium and other radionuclides
- b. Impacts to biological resources due to construction of agricultural units:
 - Conflicts with wildlife movement (i.e., desert tortoise migration corridors could be lost due to new agricultural fields for remediation purposes)

54. This Order requires cleanup of chromium-contaminated groundwater to interim remediation targets, including background conditions, which may result in one or more significant and unavoidable impacts described above. Findings required by CEQA sections 15091 through 15093, regarding any significant environmental effect of the project, including a statement of overriding considerations, were adopted by the Water Board in Board Order No. R6V-2014-0023 and are incorporated herein by reference.

Public Workshops on Draft CAO and Consensus Points

55. The Water Board's Prosecution Team sent a draft CAO on January 21, 2015, to PG&E and posted that draft on the Water Board's public webpage for public accessibility.

Subsequently on February 4, 2015, the Water Board's Advisory Team issued a public notice requesting review and comment on the Prosecution Team's draft CAO by March 13, 2015. The Water Board received six comment letters by the due date.

56. Because the significance of the comments received, the Water Board held a public workshop on May 28, 2015, in Barstow to bring the various parties together, and through a facilitated discussion, reach consensus on some main policy issues in the draft CAO.
57. After the May 28, 2015, public workshop, the Water Board's Prosecution Team met with PG&E on several occasions to discuss and draft consensus points. On July 8, 2015, the Water Board's Prosecution Team submitted consensus points that it had worked out with PG&E. The submitted consensus points suggested many revisions to language in the draft CAO, including significant revisions to Attachment 8 (the Monitoring and Reporting Program).
58. On September 1, 2015, the Water Board's Advisory Team released a draft CAO for a 30-day public comment period. That draft CAO incorporated all the consensus points the Water Board received on July 8, 2015.
59. On September 16, 2015, at its regular meeting in Barstow, the Water Board held a public workshop on the September 1, 2015 draft CAO to receive input.
60. On September 30, 2015, the Water Board received eleven comment letters on the September 1, 2015, draft CAO.
61. On October 16, 2015, the Water Board's Advisory Team released the Proposed CAO for public review showing recommended changes from the September 1, 2015, draft CAO version.

IT IS HEREBY ORDERED that, pursuant to the Water Code sections 13267 and 13304, PG&E shall clean up and abate the effects of the discharge and threatened discharge of chromium to waters of the state, and shall comply with the provisions of this Order:

- I. PG&E shall implement on-going corrective actions, including but not limited to agricultural treatment units (ATUs), in-situ remediation, and freshwater injections. Corrective actions shall be conducted in accordance with approved workplans, WDRs, Notices of Applicability (see Attachment 4, "Active Water Board Orders and Notices Authorizing Clean Up Actions"), monitoring programs, or as modified with the Water Board's or its Executive Officer's approval.
- II. PG&E shall not cause or permit any additional waste chromium to be discharged or deposited where it is, or probably will be, discharged into waters of the State.
- III. PG&E shall upload all technical documents, such as workplans, reports, letters, memorandums, etc., to the State Water Resources Control Board's Geotracker database, within **one** business day of the document date, so that they can be viewed by the public at the link:
https://geotracker.waterboards.ca.gov/profile_report.asp?global_id=SL0607111288

IV. Chromium Plume Definition in the Upper Aquifer

- A. PG&E shall define, with sufficient resolution using the industry standard of best professional judgment (as defined in IV. A. 1 through 3, below), the extent of total and hexavalent chromium in the upper aquifer from the source area at the compressor station into the Harper Dry Lake Valley where chromium discharge threatens beneficial uses.
1. For the southern plume, “sufficient resolution” means monitoring wells to define the southern plume must be spaced no more than 1,320 feet apart. If areas exceeding the 1,320-foot requirement are constrained by inaccessibility or other issues, then PG&E must submit a technical justification to explain the issues, describe the steps that are being taken to expeditiously resolve the issues, and contain a technical justification explaining the reasons data from those areas is or is not needed for sufficient plume resolution. The technical justification will be reviewed according to the protocol set forth in Order provision XIX, under the heading “General Provisions.”
 2. As of the date this Order is issued, certain areas exist in and around the northern disputed plumes where there is little to no subsurface information about chromium concentrations in the groundwater and these areas exhibit insufficient resolution to fully understand the occurrence of chromium in the groundwater. These areas include: eastern boundary for the Hinkley Valley northern disputed plume; northwest of MW-154S1, south and east of Well 33N-01, north and west of MW-196; and east and west of Hinkley Road starting at MW-161 and north to Grasshopper Road.
 3. Best professional judgment means the California licensed Professional Geologist or Civil Engineer must consider, at a minimum, these factors when interpreting or extrapolating the existing data to define the chromium plume boundaries:
 - i. Geology - pertinent subsurface features such as location and depth to bedrock, influences of structure (e.g. folding and faulting), and stratigraphy.
 - ii. Hydrogeology – location and hydraulic properties of the hydrostratigraphic units including, as appropriate, hydraulic conductivity, hydraulic gradients (e.g. horizontal and vertical, regional and localized due to groundwater extraction or injection), saturated aquifer thickness, groundwater flow velocities and directions, characteristics of confined, unconfined, and vadose zones.
 - iii. Geochemistry – nature and extent of chromium concentrations, pertinent groundwater chemistry, historical data from monitoring wells, and appropriate trend analyses. Location of, depth to, and hydrogeologic influences of bedrock.

- iv. USGS Background Study – written technical information provided by the USGS such as the preliminary results report, or final report or other technical documentation containing analysis, interpretations and conclusions of chromium concentrations and sources of chromium.
- B. To achieve sufficient resolution to track movement of the chromium concentrations and protect public health in those areas listed in sections IV.A.1 and IV.A.2 of this Order until the USGS Background Study is available, PG&E shall conduct the following actions in areas where access is currently allowed:

Within 30 days of the date this Order is issued, either submit a workplan proposing multi-depth monitoring well locations, or submit a technical justification based on best professional judgment explaining the reasons why additional subsurface information is not needed for sufficient resolution in these area(s). The technical justification must also consider the protection of public health.

If submitting the workplan, then it must include proposed well designs and describe the method and manner of installation. If locations were considered but not chosen because they are inaccessible, explain why the area is inaccessible, and what PG&E has done to try to gain access. As access is gained over time, PG&E shall submit a workplan to install monitoring wells (for further plume definition) to the Water Board within 30 days of any change in land access status. Changes in land access status include, but are not limited to, being provided access to private property by the owner, acquisition of private property, and approval from agencies, such as Department of Fish and Wildlife, to lands that may be considered endangered species habitat or threatened species habitat. PG&E must use best professional judgment to assess if additional wells within those areas are necessary to define the plume boundary.

- C. Unless otherwise ordered, all monitoring wells required by the Water Board shall be installed, developed, and sampled **within 6 months of the date of approval** when access to land is allowed.
- D. All monitoring wells installed under requirements in this Order shall be added to the Groundwater Monitoring and Reporting Program (MRP) (see Requirement VIII, Attachment 8) upon the first sampling event. Monitoring well designs and boring logs shall be included as attachments in quarterly groundwater monitoring reports. All new wells shall be sampled at a **quarterly frequency**.

V. Southern Plume Containment

PG&E shall take all actions necessary to contain the southern chromium plume from migrating to other locations.

- A. For the purposes of this Order, southern plume containment is defined as:

1. No further migration or expansion of the chromium plume to locations where hexavalent chromium and total chromium is below interim maximum background levels, or
 2. No further migration or expansion of the 50 ppb Cr(VI)/Cr(T) or 10 ppb Cr(VI)/Cr(T) boundaries to outside the area(s) of hydraulic capture. Hydraulic capture is determined by comparing hydraulic gradients or flow direction vectors calculated from specific monitoring well pairs and triplets within the most recent mandated capture zone accepted by the Water Board.
- B. **Beginning January 15, 2016**, and every three months thereafter, PG&E shall submit quarterly hydraulic capture metric reports containing **monthly** capture metric information to verify containment of the southern plume from migration. Report information shall include groundwater elevation data, groundwater extraction rates, capture metrics, and maps showing the location for all referenced wells and monitoring data and chromium plume boundaries. The report shall provide a conclusion as to whether the 50 ppb Cr(VI)/Cr(T) or 10 ppb Cr(VI)/Cr(T) boundary line has migrated or expanded to outside the area(s) of hydraulic capture established as of the date this Order is issued.
- C. Compliance with containment requirements will be determined by (1) comparing hydraulic gradients or groundwater flow direction vectors calculated from groundwater elevation data from select well pairs/triplets and piezometers (2012 capture metrics), as outlined in Attachments 5-7, and (2) comparing the 50 ppb Cr(VI)/Cr(T) and 10 ppb Cr(VI)/Cr(T) boundaries to plume maps as of the date this Order is issued. The Water Board may find PG&E out of compliance with these requirements if at any time any of the following conditions occurs:
1. The third consecutive month of data (e.g., January, February, and March) indicates that the well pair/triplet capture metrics are still not being met; or
 2. If approved capture metrics are not met 3 out of 12 months during the course of one year (e.g. July 2015 through July 2016); or
 3. If the 50 ppb Cr(VI)/Cr(T) or 10 ppb Cr(VI)/Cr(T) boundaries migrate or expand to outside the area(s) of hydraulic capture during any monitoring event.
- D. Should any of the above conditions occur, then by the 15th of the month following the quarterly report submittal, PG&E shall submit a contingency plan to re-establish capture as soon as practical. The contingency plan shall propose contingency monitoring wells located downgradient and cross gradient to the original capture zone boundary set in 2012 and a monitoring program for verifying plume capture. Upon approval by the Executive Officer, PG&E shall implement the contingency plan according to the schedule that has been approved or issued. All contingency assessments and subsequent corrective actions shall be described in **monthly** capture metric reports due by the 15th of each month. Reports shall provide data and information to demonstrate progress towards resuming plume capture. Reports shall also include maps that show the location of all referenced wells, monitoring data, original plume boundary lines, and water supply wells within one-half mile of the original capture zone boundary lines.

- E. PG&E shall notify the Water Board **within one week** when contingency actions are taken. The notice shall identify the date or instance leading to the contingency action, what the action is, and monitoring actions to be undertaken for verifying the contingency action is effective. A map shall accompany all data showing referenced wells, monitoring data, plume boundary lines, and water supply wells within one-half mile of the capture zone boundary lines.
- F. As remediation continues with time, it is expected that chromium concentrations will decrease and plume lines will constrict inward and southward. In such an instance, it may not be prudent or optimal to continue operating an extraction well network and waste groundwater for the sole purpose of hydraulic containment for low chromium concentrations. As described in Finding 26, PG&E may propose a more optimal alternate hydraulic capture zone than the current one in place. An alternate proposal shall consist of the following information: groundwater elevation and chromium monitoring data, maps showing change in chromium plume configuration over time, proposed alternate capture zone and capture metrics, and a contingency plan proposing corrective actions and contingency monitoring wells cross and downgradient of the alternate hydraulic capture zone for monitoring chromium concentrations. The alternate hydraulic capture zone and metrics shall be implemented upon approval by the Executive Officer.
- G. Should an approved alternate hydraulic capture zone be implemented, it is expected that some rebounding chromium concentrations may occur in groundwater in the original hydraulic capture zone. The Water Board will not find PG&E out of compliance with this Order if the approved contingency plan, including corrective actions and monitoring program, is implemented and the 50 ppb Cr(VI)/Cr(T) or 10 ppb Cr(VI)/Cr(T) boundaries do not expand more than 1,000 feet during any monitoring event from capture boundaries established prior to the alternate hydraulic capture boundaries.
- H. This Order allows for the lateral migration of the 4 ppb hexavalent chromium eastern plume boundary in the southern plume to no more than 1,000 feet (see Attachment 3, "Area of Allowed Plume Expansion") during implementation of remedial actions, provided PG&E contains chromium from migrating to the north. The 4 ppb hexavalent chromium boundary is intended for plume containment evaluation and is not a cleanup goal. If PG&E is unable to provide data and information that clearly indicates chromium in this expanded area is being captured in the downgradient flow direction, it will constitute a violation of Requirement V for southern plume containment.

VI. Cleanup Requirements

- A. As of the date this Order is issued, PG&E shall continuously² implement previously accepted on-going corrective actions, including but not limited to, agricultural treatment units (ATUs), in-situ remediation, and freshwater injections (see Finding Nos. 24 and 25). Corrective actions shall be conducted in accordance with accepted current and future workplans, WDRs, Notices of Applicability, monitoring programs, or as modified with the Executive Officer's approval.

² The term "continuously" as used in section VI.A does not apply to emergency interruptions or routine maintenance.

- B. PG&E shall submit an annual operational plan in conjunction with the Annual Cleanup Status and Effectiveness Reports, as required in Groundwater Monitoring and Reporting Program, CAO No. R6V-2015-0068, Attachment 8. Corrective actions will also be conducted at a level specified in the annual operational plan. Reductions in corrective actions of more than 10 percent on a monthly basis as compared to the annual operational plan shall require notification to Water Board staff prior to implementation.
- C. Corrective actions may be needed in the areas listed below based on monitoring results.

1. Southern Plume

a) "Western Finger"

PG&E shall cleanup and abate chromium concentrations greater than interim maximum background levels west of Serra Road between Highway 58 and Acacia Street. During 2014, greater than interim maximum background levels existed at monitoring well locations MW-121, MW-153, and MW-169.

- i. PG&E shall continue on-going remedial activities in accordance with accepted current and future workplans and proposals. Corrective actions implemented in the western area must be fully discussed and described in quarterly monitoring reports for the Northwest Freshwater Injection (NWF1) area and In-Situ Remediation Zone (IRZ). PG&E shall collect groundwater samples from monitoring wells in the area of the western finger consistent with the Groundwater Monitoring and Reporting Program, CAO No. R6V-2015-0068, Attachment 8.
- ii. If Cr(VI) concentrations equal or exceed 10 ppb at one or more of the monitoring wells set forth in Table 1 for two consecutive sampling events, PG&E shall submit a technical report within 60 calendar days from submittal of the quarterly site-wide groundwater monitoring report proposing additional actions to remediate the observed exceedances.

Table 1. Western Area Sentry Wells
MW-57D
MW-57S
MW-58
MW-59
MW-118S
MW-147D
MW-147S
MW-148S
MW-164S

MW-168D
MW-168S
MW-201D
MW-201S
MW-202D
MW-202S

- iii. No later than 60 days following acceptance of the USGS Background Study Preliminary Results Report by the Water Board, PG&E shall submit a technical report to the Water Board Executive Officer regarding the feasibility of achieving USGS background concentrations in the area of the western finger using the existing remedial activities, including an estimated cleanup timeframe if applicable. If additional remedial actions are required to achieve USGS background levels, the technical report shall include a proposal to implement such activities. If at any time USGS provides written technical background study information such as the preliminary results report, final report or other technical document containing analysis, interpretation and conclusions demonstrating the chromium in the western finger is predominantly naturally occurring, no further remedial activities will be required in this area upon approval from the Water Board Executive Officer.

b) Lower Aquifer

PG&E shall clean up and abate chromium concentrations in the lower aquifer that are linked to PG&E's historical discharge or remedial actions and must perform the following additional actions:

- i. To remediate chromium in the lower aquifer groundwater, PG&E must implement action east of Mountain View Road. PG&E may continue to implement its November 7, 2014 "Plan for Enhancement of Lower Aquifer Remedy", provided it is performed in accordance with the Water Board's conditional acceptance dated December 22, 2014.
- ii. Submit a technical report within 180 days of this order presenting an evaluation of the updated conceptual site model and background concentrations for the lower aquifer and transition zone at the western edge of the lower aquifer.
- iii. Submit a feasibility assessment for the remediation and cleanup to background concentrations in the lower aquifer and the transition zone at the western edge of the lower aquifer within 90 days of Water Board acceptance of the conceptual site model and background report required under item ii, above.

c) For all remaining areas of the southern plume, reach the following cleanup goals in the upper aquifer by the listed timeframes:

- i. Reach and maintain 50 ppb Cr(VI) and Cr(T) in 90% of the 50 ppb Cr(VI) and Cr(T) plume as of the date this Order is issued, by

December 31, 2025, as reported in the fourth quarter 2025 groundwater monitoring report. The 90th percentile shall be based on the number of monitoring well locations where chromium concentrations exceed 50 ppb Cr(VI) and Cr(T) as of the date this Order is issued, as shown in Table 8.1 of Attachment 8.

- ii. Reach and maintain 10 ppb Cr(VI) and Cr(T) in 80% of the 10 ppb Cr(VI) and Cr(T) and 50 ppb Cr(VI) and Cr(T) plumes as defined on the date this Order is issued, by **December 31, 2032**, as reported in the fourth quarter 2032 groundwater monitoring report. The 80th percentile shall be based on the number of monitoring well locations where chromium concentrations exceed 10 ppb Cr(VI) and Cr(T) as of the date this Order is issued, as shown in Table 8.1 of Attachment 8.
- iii. Reach and maintain background levels of Cr(VI) and Cr(T).
- iv. At a minimum every four years, PG&E will evaluate chromium cleanup actions to reach the cleanup goals and submit a four-year comprehensive cleanup status and effectiveness report, per the requirements of Attachment 8, CAO MRP. If actions are not achieving expected reductions in chromium concentrations, a workplan outlining recommendations and an implementation schedule to increase effectiveness will be submitted by the deadlines listed in Attachment 8, CAO MRP. PG&E may request an extension of the cleanup goals and timelines which will be subject to Water Board review and approval.

2. Northern Disputed Plumes Area

- a) PG&E shall cleanup and abate chromium “hot spots” in the northern disputed plumes area. “Hot spots” are defined as:
 - i. any domestic well having Cr(VI) equal to or exceeding 10 ppb during any one sampling event; or
 - ii. any monitoring, extraction, remediation well or piezometer having hexavalent chromium concentrations greater than 10 ppb within one half mile upgradient of any active domestic well and meeting any of the following conditions (triggers):
 1. Fifty percent (50%) or more increase above Cr(VI) concentrations reported in second quarter 2015 that persist for two consecutive sampling events;
 2. Increasing statistical trend (using Mann-Kendall) over four sampling events.
- b) **Within 30 days** of receiving laboratory reports containing data indicating one or more of these triggers are met, submit a workplan and implementation schedule proposing the method and manner to remediate chromium “hot spots” in groundwater. Identify all wells that trigger this action and describe their general

location. The workplan shall propose a cleanup action to begin within 45 days of the date of the workplan. Describe remedial equipment needed and expected operational actions to return Cr(VI) concentrations back to second quarter 2015 levels or less. Provide an estimated cleanup time and basis for the estimate if possible.

- c) If at any time USGS provides written technical background study information such as the preliminary results report, final report or other technical document containing analysis, interpretation and conclusions demonstrating the chromium in the Northern Disputed Plumes Area or in specific Northern Disputed Plumes Area hot spots is predominantly naturally occurring, no further remedial activities will be required in this area upon approval from the Water Board Executive Officer.
- d) If at any time USGS provides written technical background study information such as the preliminary results report, final report or other technical document containing analysis, interpretation and conclusions demonstrating the chromium in the Northern Disputed Plumes Area is predominantly from PG&E's historical discharge, then PG&E must submit a technical report, within 180 days of Water Board acceptance of the USGS information, presenting a feasibility assessment for the remediation and cleanup to the USGS background concentrations.

VII. Replacement Water Supply

- A. **Beginning with 1st Quarter 2016**, within each quarterly groundwater monitoring report required in section X below, provide an analysis whether any domestic well within the domestic well sampling area defined in the "Groundwater Monitoring and Reporting Program, CAO No. R6V-2015-0068", Attachment 8, contains hexavalent chromium concentrations exhibiting an increasing trend indicating likely future exceedances of the hexavalent chromium drinking water standard within one year.

1. Interim Replacement Water Supply

- a) Within 10 business days of receipt of a laboratory report identifying an affected well as defined by Finding 46 (i.e., an active domestic or community well containing chromium linked to PG&E's historical releases in concentrations that are above the primary drinking water standards of 10 ppb Cr(VI) or 50 ppb Cr(T)), supply interim uninterrupted replacement water (i.e., bottled water or equivalent) to users of such affected wells.
- b) Within 7 days of the submittal of each quarterly report, provide a report to the Water Board listing all properties that have been provided interim uninterrupted water service. The report shall include the well number and describe the general area in Hinkley or the Harper Dry Lake Valley the well is located, such as the southern plume, the Hinkley Valley northern disputed plume, or Harper Dry Lake Valley northern disputed plume. If bottled water is provided, PG&E shall also list the bottled water service being used and the water volume being delivered. Furthermore, if other

than commercially available bottled water is being provided, the report shall include documentation to show that interim water supply meets state primary and secondary drinking water standards.

2. Long-term Replacement Water Supply

- a) Within 45 days of this Order being issued, PG&E must submit for the Water Board Executive Officer's acceptance a workplan outlining long-term replacement water supply for all drinking and cooking uses. Pursuant to California Water Code section 13304(f), replacement water "shall meet all applicable federal, state, and local drinking water standards, and shall have comparable water quality to that pumped by the public water system or private well owner before the discharge of waste." The workplan must include a plan for providing replacement water for any active private supply well identified pursuant to VII.A., above, should any such well later exceed the drinking water standard and become an Affected Well, as defined in Finding 46. The workplan shall include the following:
- i. An evaluation of at least three different methods to provide **long-term** replacement water supply.
 - ii. A discussion on the feasibility and timing to implement each method including the needs for permits, approvals, and environmental analysis.
 - iii. An evaluation of the quantity of water (gallons per minute) that can be provided by each method compared with typical individual household supply needs for drinking and cooking.
 - iv. An evaluation of the quality of water that can be provided by each method in comparison to California primary and secondary drinking water standards.
 - v. An analysis of wastes that may be generated by each method, disposal options, costs, and an analysis of potential byproducts in groundwater created by each method. For example, reverse osmosis generates salts and potentially others compounds that are typically sent to septic systems.
 - vi. An operation, maintenance, and, replacement plan, such as for filters, equipment, etc., of each evaluated method.
 - vii. A water quality monitoring and reporting plan to verify quality and performance of each evaluated method.
 - viii. A complete cost analysis including construction, operations, maintenance, and replacement plan of each evaluated method.
 - ix. A contingency plan to ensure uninterrupted replacement water supply.
 - x. State how the workplan and recommended method will be presented to the owner(s) and users of the affected well(s).
- b) Within 21 days of identifying an affected well, PG&E must consult with the Division of Drinking Water to determine if it has registered any technologies as being able to address Cr(VI) in drinking water and

determine if there are any new technologies available that were not previously considered in their long-term plan and assess, after consultation with the well owner, which method for long-term replacement water would best fit the individual circumstances of the well owner(s), and submit that information to the Water Board's Executive Officer. **Within 30 days** of that submittal and written authorization from the well owner for the installation of a long-term replacement drinking and cooking water supply, PG&E shall implement the workplan to provide a long-term replacement drinking and cooking water supply for all affected wells, as defined in Finding 46.

- c) Within each groundwater monitoring report required as part of PG&E's domestic well monitoring and reporting program and during which long-term replacement drinking water is supplied, PG&E shall provide a report to the Water Board listing all properties that have been provided long-term uninterrupted replacement water supply. The report shall include: the affected well number and general area location, the method used to provide replacement water supply, and evidence provided water supply meets state primary and secondary drinking water standards. Describe all actions completed during the quarter, such as operation and maintenance. Describe any problems that may have occurred and how and when they were corrected or remedied. For instance, if sampling indicates that alternate water supply does not meet federal and state drinking water standards, describe what corrective actions were implemented to fix the problem. If the well owner did not respond or provide permission to access and install long-term water supply, provide evidence of such, including actual date and time and manner of communication. Provide proof that monitoring data has been sent to the owner of the affected well(s).

VIII. Independent Consultant

- A. PG&E shall continue to fund an independent consultant(s) that can provide technical information, education, and advice to community members on matters subject to regulation by the Water Board related to the chromium groundwater pollution in Hinkley. The independent consultant(s) shall not be involved in any aspect of this site (consulting for PG&E or involved in any litigation, and be willing to sign such a document stating such) and be accepted by PG&E and the Water Board or the Executive Officer.
- B. **Annually, on February 1 starting in 2016**, PG&E must submit a report to the Water Board including the scope of work and budget for the previous year and the next twelve month period. This report must provide evidence that adequate funds were made available in the past twelve months and are being made available for the next twelve months to complete the following at a minimum (or submit an alternative plan of equivalent effort and effectiveness in meeting the community's needs):
1. An annual report and presentation to the Water Board on the independent consultant's efforts within the Hinkley community.
 2. A minimum of six community newsletters each year to disseminate information to Hinkley residents.

3. A minimum of four public meetings held in the Hinkley community.
 4. Availability for one on one communications with individual or groups of Hinkley residents (at least 100 hours of availability).
 5. Production of technical reviews, written comments and presentations to respond to Water Board orders, PG&E reports, USGS reports and other technical materials related to the chromium remediation (e.g. new cleanup technology).
 6. Outside expert on matter(s) of greatest concern to the community.
- C. The annual workplan is subject to Water Board Executive Officer approval. Every four years, the Water Board's Executive Officer will review and may revise the annual requirements listed above under item B.

General Provisions

IX. Plan Approval and Implementation

All plans required by this Order require the Water Board's approval, and shall be incorporated and implemented as part of this Order whether expressly stated above or not. Any violation of an approved plan required by this Order shall be considered a violation of this Order. The Water Board's Executive Officer is hereby delegated the authority to approve, conditionally approve, or reject plans submitted in accordance with this Order. In addition, the Water Board's Executive Officer may grant deadline extensions if good cause has been demonstrated.

X. Groundwater Monitoring and Reporting Program

California Water Code section 13267 authorizes the Regional Water Quality Control Board (Water Board) to require technical and monitoring reports. The Monitoring and Reporting Program (MRP) is incorporated as Attachment 8 in this Order. The MRP establishes monitoring requirements consistent with the California Water Code to evaluate compliance with the terms and conditions of this Order, and to assure protection of waters of the state and restoration of beneficial uses.

XI. Laboratory Analysis

All water sample analyses shall utilize the most recent testing methods. Testing for Total Chromium analysis shall be done using United State Environmental Protection Agency (US EPA) Methods 6010B or 6020A to a reporting limit of 1 ppb. Testing for hexavalent chromium shall be conducted in accordance with US EPA Method SW 218.6 with a reporting limit of 0.2 ppb. A part per billion is equivalent to micrograms per liter or µg/L also reported by laboratories. The laboratory used shall be certified by the California Environmental Laboratory Accreditation Program. If best available technology in the future allows for better testing methods adopted by the State of California or lower detection levels, PG&E shall implement the better method or detection level.

XII. Certifications for all Plans and Reports

All technical and monitoring plans and reports required in conjunction with this Order are required pursuant to Water Code section 13267 and shall include a statement by PG&E, or an authorized representative of PG&E, certifying under penalty of perjury in conformance with the laws of the State of California that the workplan and/or report is

true, complete, and accurate. Maps, hydrogeologic reports and engineered plans shall be prepared or directly supervised by, and signed and stamped by a Professional Geologist or Civil Engineer, respectively, registered in California. It is expected that all interpretations and conclusions of data in these documents will be truthful, supported with evidence, and there will be no attempts to mislead by false statements, exaggerations, deceptive presentation, or failure to include essential information.

All maps larger than 11" X 17" must be submitted in hardcopy to the South Lake Tahoe and Victorville offices of the Lahontan Regional Water Quality Control Board:

South Lake Tahoe main office
2501 Lake Tahoe Blvd.
South Lake Tahoe, CA 96150

Victorville office
14440 Civic Drive, Suite 200
Victorville, CA 92392

XIII. Duty to Submit Other Information

When the Discharger becomes aware that it has failed to submit any relevant facts in any report required under this CAO, or submitted incorrect information in any such report, the Discharger shall promptly submit such facts or information to the Water Board.

XIV. Liability for Oversight Costs Incurred by the Water Board

PG&E shall be liable, pursuant to Water Code 13304, to the Water Board for all reasonable costs incurred by the Water Board to investigate unauthorized discharges of waste, or to oversee cleanup of such waste, abatement of the effects thereof, or other remedial action, pursuant to this Order. PG&E shall reimburse the Water Board for all reasonable costs associated with site investigation, oversight, and cleanup. Failure to pay any invoice for the Water Board's investigation and oversight costs within the time stated in the invoice (or within thirty days after the date of invoice, if the invoice does not set forth a due date) shall be considered a violation of this Order. If this site is enrolled in a State Water Board-managed reimbursement program, reimbursement shall be made pursuant to this Order and according to the procedures established in that program.

XV. No Limitation of Water Board Authority

This Order in no way limits the authority of this Water Board to institute additional enforcement actions or to require additional investigation and cleanup of the site consistent with the Water Code. This Order may be revised by the Water Board's Executive Officer as additional information becomes available.

XVI. Enforcement

Failure to comply with the requirements, terms, or conditions of this Order will result in additional enforcement action that may include the imposition of administrative civil liability pursuant to California Water Code sections 13268 and 13350, or referral to the

Attorney General of the State of California for civil liability or injunctive relief. The Water Board reserves its rights to take any enforcement action authorized by law.

XVII. Permits or Approvals

This Order does not alleviate the responsibility of PG&E to obtain necessary local, state, and/or federal permits to construct or operate facilities or take actions necessary for compliance with this Order. This Order does not prevent imposition of additional standards, requirements, or conditions by any other regulatory agency. This Order does not authorize any act that results in the taking of a threatened or endangered species or any act that is now prohibited, or becomes prohibited in the future, under either the California Endangered Species Act (Fish and Game Code sections 2050 to 2097) or the federal Endangered Species Act (16 U.S.C.A. sections 1531 to 1544). If a “take” will result from any act required by this Order, PG&E shall obtain authorization for an incidental take from appropriate authorities prior to taking action. PG&E is responsible for meeting all requirements of the Endangered Species Acts for any acts required by this Order.

XVIII. Replacement of Prior Orders

This Order replaces all requirements of Orders and Directives listed in Attachment 1 including CAO No. R6V-2008-0002 and amendments, and CAO No. R6V-2011-0005 and amendments. In addition, this Order replaces requirements in Investigative Order Nos. R6V-2011-0079 and R6V-2013-0051; and Executive Officer letter directives dated October 4, 2013, December 12, 2013, and February 26, 2014. See Attachment 1 for descriptions of these Orders and Directives. This Order shall not preclude enforcement against PG&E for failure to comply with any requirement in any other Order issued by the Water Board. The Water Board reserves its rights to take any enforcement action authorized by law.

XIX. Dispute Resolution Process

All technical justifications submitted to the Water Board must use best professional judgment, as defined above in IV. A. 3, and will be reviewed for acceptance. If the Water Board disagrees with one or more interpretations or conclusions in a technical justification, then the Water Board’s Executive Officer or the Water Board, as appropriate, will provide final determination of the issue, after considering all relevant information.

XX. Attachments Incorporated Herein

The eight attachments referenced in this Order are hereby incorporated herein:


- 1) CAO and Investigative Orders Replaced by CAO No. R6V-2015-0068
- 2) Location of Chromium Plumes (Third Quarter 2014)
- 3) Area of Allowed Plume Expansion
- 4) Active Water Board Orders and Notices Authorizing Clean up Actions
- 5) Hydraulic Capture Metrics
- 6) Hydraulic Capture Monitoring Plan, Shallow Zone of Upper Aquifer
- 7) Hydraulic Capture Monitoring Plan, Deep Zone of Upper Aquifer

- 8) Groundwater Monitoring and Reporting Program, CAO No. R6V-2015-0068
- 9) Summary of Performance and Submittal Requirements

XXI. Right to Petition

Any person aggrieved by this action of the Lahontan Water Board may petition the State Water Resources Control Board (State Water Board) to review the action in accordance with Water Code section 13320 and California Code of Regulations, title 23, section 2050 and following. The State Water Board shall receive the petition by 5:00 p.m., 30 days after the date this Order is issued, except that if the thirtieth day following the date of this Order falls on a Saturday, Sunday, or state holiday, the petition shall be received by the State Water Board by 5:00 p.m. on the next business day. Copies of the law and regulations applicable to filing petitions may be found on the Internet at: http://www.waterboards.ca.gov/public_notices/petitions/water_quality or will be provided upon request.


PATTY Z. KOUYOUMDJIAN
EXECUTIVE OFFICER


Date

Attachment 1. CAO and Investigative Orders Replaced by CAO No. R6V-2015-0068

Board Order, Date Issued	Summary of Key Requirements	Status
REPLACED CLEANUP AND ABATEMENT ORDERS (CAOs)		
CAO R6V-2008-0002 August 6, 2008	1. Requires: a) No further migration of plume b) Achieve plume containment by Dec 31, 2008 c) Develop and implement final cleanup strategy (Feasibility Study or FS) 2. Establishes quarterly and semiannual reporting	1 a) and b). Ongoing. Requirement for ongoing and improved plume containment for southern plume retained in 2015 CAO. See CAO sections II and V. 1 c) FS completed, implementation in progress. Interim remedial targets contained in 2015 CAO. See CAO section VI. 2. Ongoing. 2015 CAO contains monitoring and reporting requirements. See CAO Attachment 8.
CAO R6V-2008-0002A1 November 12, 2008	1. Establishes background levels of chromium (Cr) to assess remediation strategies	1. Background levels retained in 2015 CAO, including acknowledgement of USGS background study and potential future revision of background values. See findings 14 and 15.
CAO R6V-2008-0002A2 April 7, 2009	1. Allows up to 1,000 feet migration of 4 parts per billion (ppb) plume line on eastern boundary to implement South Central injection area	1. Ongoing. Retained in 2015 CAO, see Attachment 2 and section V.I.
CAO R6V-2008-0002A3 March 14, 2012	1. Sets hydraulic containment metrics south of Thompson road 2. Requires plume containment north of Thompson road 3. Sets monthly monitoring and reporting	1. Ongoing. Retained in 2015 CAO, with provisions to allow for adaptive management (plume shrinkage/rebound). See section V. 2. Southern contiguous plume north of Thompson Road is contained as required. For northern plumes, 2015 CAO requires hotspot remediation. See section VI. B.2. 3. Ongoing. 2015 CAO sets monitoring and reporting requirements for hydraulic capture. See section V. C.
CAO R6V-2008-0002A4 January 8, 2013	1. Requires full definition of chromium plume 2. Sets mapping, lab analysis, reporting and submittal requirements	1. Ongoing. Retained in 2015 CAO, see section IV. 2. Ongoing. Retained in 2015 CAO, see section IX, X and Attachment 8.
CAO R6V-2011-0005	1. Requires bottled water to all well users	1. 2015 CAO requires bottled water for wells users with Cr6 at

Attachment 1. CAO and Investigative Orders Replaced by CAO No. R6V-2015-0068

Board Order, Date Issued	Summary of Key Requirements	Status
REPLACED CLEANUP AND ABATEMENT ORDERS (CAOs)		
January 7, 2011	with water exceeding background levels within 3,000 feet of defined chromium plume 2. Quarterly reporting	or above MCL within 2 days of first detection. 2. Retained in 2015 CAO for wells with Cr6 at or above MCL.
CAO R6V-2011-0005A1 October 11, 2011	1. Affected well definition refined: a) If well has chromium 6 (Cr6) at Public Health Goal (PHG) or greater and increasing trend is present b) If well has greater than background levels c) Notes that CAO may be amended to use future Cr6 Maximum Contaminant Level (MCL) for affected wells 2. Affected area defined as one mile down or cross gradient of defined Cr plume 3. Replacement water quality requirement of 0.06 ppb 4. Requires feasibility study for whole house replacement water and implementation of such 5. Recognizes Community Advisory Committee and need for independent consultant paid for by discharger	1 a). 2015 CAO requires replacement water plan if increasing trend in domestic wells, or within 20 percent of Cr6 MCL. 1 b) and c). Cr6 MCL now in effect for affected well definition. 2015 CAO reflects Cr6 MCL for affected well definition. 2. Retained in 2015 CAO. See findings 43 and 44. 3. Replacement water must meet MCLs. 4. Complete. 2015 CAO contains requirements for replacement water plans when private supply well contains hexavalent chromium concentrations exhibiting an increasing trend indicating likely future exceedances of the Cr6 MCL, or any private supply well with hexavalent chromium concentrations within 20 percent of the Cr6 MCL (i.e., 8 µg/L Cr6). 5. Ongoing. Requirement for independent consultant retained in 2015 CAO. See section VI and finding 45.

Attachment 1. CAO and Investigative Orders Replaced by CAO No. R6V-2015-0068

Board Order, Date Issued	Summary of Key Requirements	Status
REPLACED CLEANUP AND ABATEMENT ORDERS (CAOs)		
	6. Quarterly reporting	6. Ongoing. 2015 CAO contains modified requirements for monitoring and reporting. See section VII.2iii.
CAO R6V-2011-0005A2 June 7, 2012	1. Requires implementation of PG&E's expanded whole house water program: <ul style="list-style-type: none"> a) Affected wells are those with detectable (>0.06 ppb) Cr6 within one mile of Cr plume b) Water quality must meet at CA MCLs, and Cr6 PHG, or Cr6 MCL once adopted c) Once Cr6 MCL is adopted, MCL defines affected well 2. Suspends requirement for trend analysis to determine affected wells	1 a) and c). 2015 CAO reflects Cr6 MCL for affected well definition. See section VII.A.2 and findings 43 and 44. 1 b). Replacement water must meet Cr6 MCL. See section VII.A.2. 1 c). Cr6 MCL defines affected well in 2015 CAO. See finding 44. 2. 2015 CAO requires Discharger submit replacement water plans where private supply well concentrations exhibit increasing trends indicating the likelihood of future exceedances of the hexavalent chromium MCL, or if a private supply well has chromium reaching within 20 percent of the hexavalent chromium MCL.
CAO R6V-2011-0005A3 February 18, 2014	1. Revises replacement bottled water quality to allow up to 1.2 ppb Cr6.	1. 2015 CAO requires bottled water to meet Cr6 MCL. See section VII.1.ii.

Investigative Order or Directive, Date Issued	Summary of Key Requirements	Status
REPLACED INVESTIGATIVE ORDERS (IOs) AND LETTER DIRECTIVES		
Investigative Order (IO) R6V-2011-0079	1. Sets mapping information and content requirements. 2. Sets report content requirements.	1 and 2 retained in 2015 CAO. See Attachment 8.

Attachment 1. CAO and Investigative Orders Replaced by CAO No. R6V-2015-0068

Investigative Order or Directive, Date Issued	Summary of Key Requirements	Status
REPLACED INVESTIGATIVE ORDERS (IOs) AND LETTER DIRECTIVES		
September 29, 2011		
IO R6V-2013-0051 June 26, 2013	<ol style="list-style-type: none"> 1. Approves criteria for removal of domestic wells from sampling program 2. Accepts recommendation to abandon inactive wells screened across water both aquifers 3. Outlines reporting requirements for inactive domestic wells 	1, 2 and 3 retained in 2015 CAO. See Attachment 8 section IV.
IO R6V-2013-0087 October 30, 2013	1. Conditionally approves Action Plan for Western Area to reduce chromium concentrations in groundwater west of the freshwater injection area.	1. Requirement for continued operation contained in 2015 CAO. See section VI. B.1.a.i.
Prosecution Team Letter August 2, 2013	<ol style="list-style-type: none"> 1. Requests action plan for western area and supplemental information 2. Request for additional information in semi-annual reports related to western area: <ol style="list-style-type: none"> a) Changes in Cr concentrations between reporting periods b) Changes in remedial operations between reporting periods c) Changes in remedial effectiveness between reporting periods 	<ol style="list-style-type: none"> 1. Complete. 2. Replaced with requirement to reach background levels in western area by 2016, see section VI.B.1a.ii.
Executive Officer Letter October 4, 2013	1. Clarifies use of historical data in Cr plume boundary.	1. Complete.
Prosecution Team Letter November 7, 2013	1. Requests a byproduct monitoring report.	1. Complete.

Attachment 1. CAO and Investigative Orders Replaced by CAO No. R6V-2015-0068

Investigative Order or Directive, Date Issued	Summary of Key Requirements	Status
REPLACED INVESTIGATIVE ORDERS (IOs) AND LETTER DIRECTIVES		
Executive Officer Letter December 12, 2013	1. Review of compliance versus interpreted plume maps, 3 rd Quarter 2013: a) Cr detections on and east of Dixie Road no longer need to be drawn on compressor station plume maps b) Cr detections at MWs 159, 160, and 163 no longer need to be drawn on plume maps c) Cr detections at MWs 169S2, 121S and 153 are to be drawn connected to contiguous plume d) Cr detections north of Thompson Road above background are to be drawn on plume maps	1 a) through d) Ongoing interpretation, retained in 2015 CAO. <ul style="list-style-type: none"> • See attachment 8, section 1.G for 1 a) and b). • See CAO section IV. for requirements to install MWs in northern area.
Prosecution Team Letter February 25, 2014	1. Status report of chromium in western area	1. Complete.
Executive Officer Letter February 26, 2014	1. Accepts Northern area investigation 2. Notify Water Board within 10 days if increasing concentrations (change of 30% or more) to the north or northwest of MW-193S3 are detected 3. Sample domestic wells in eastern area of Harper Dry Lake valley each quarter 4. Include domestic wells north of Grasshopper road in plume contouring if above background	1. See CAO section IV. For requirements to install MWs in northern area. 2. 2015 CAO requires hotspot remediation in northern area. 3. Ongoing, modified requirements in 2015 CAO. See attachment 8. 4. Ongoing, retained requirements in 2015 CAO. See attachment 8.

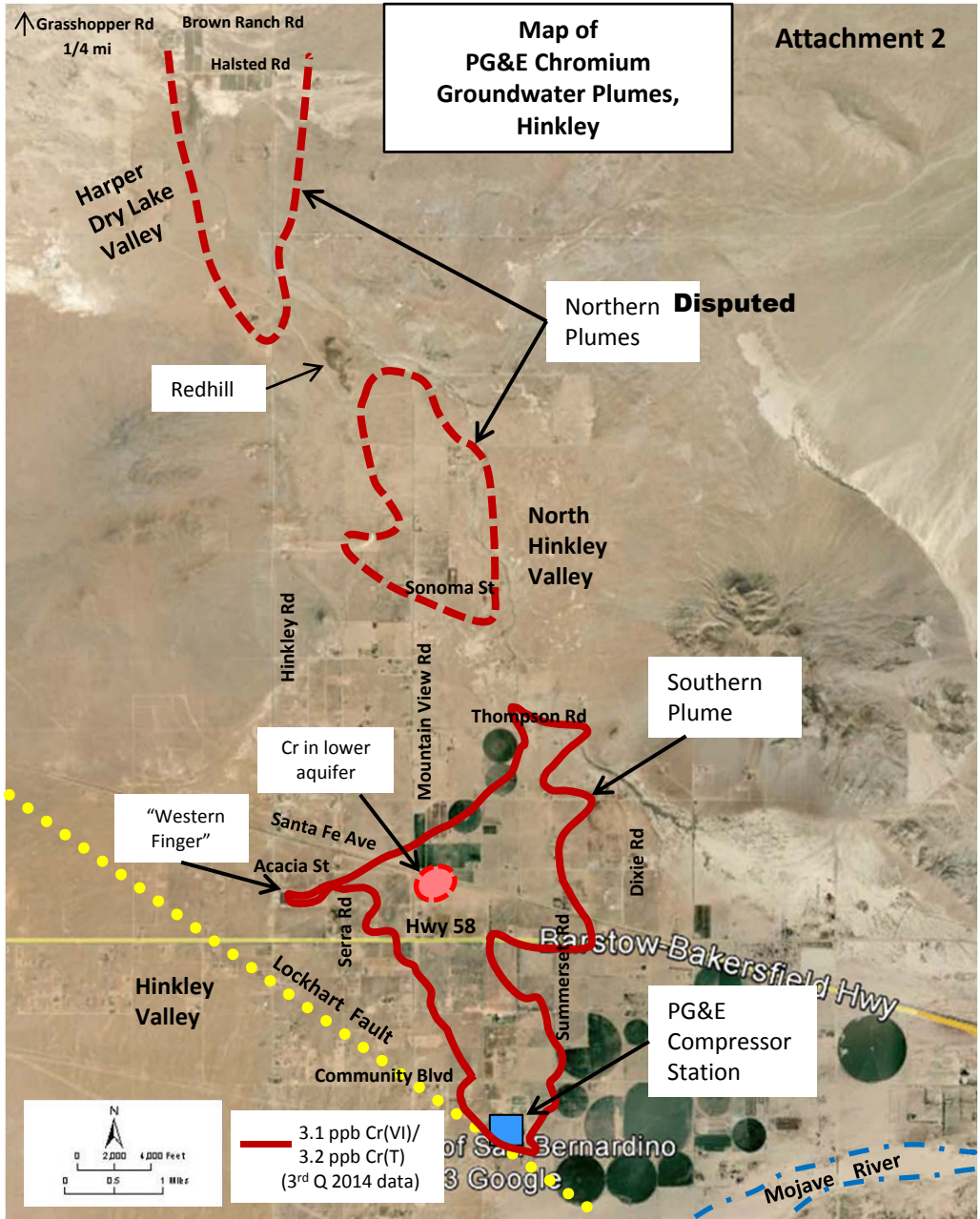
Notes:

1. CAO R6V-2008-0034 (as amended) contains replacement water provisions and other requirements regarding nitrate pollution related to Desert View Dairy animal operations. Mr. Paul Ryken is the primary responsible party for the purposes of those CAO requirements; PG&E has secondary responsibility. That CAO is not included in this table and will not be affected by new CAO requirements.

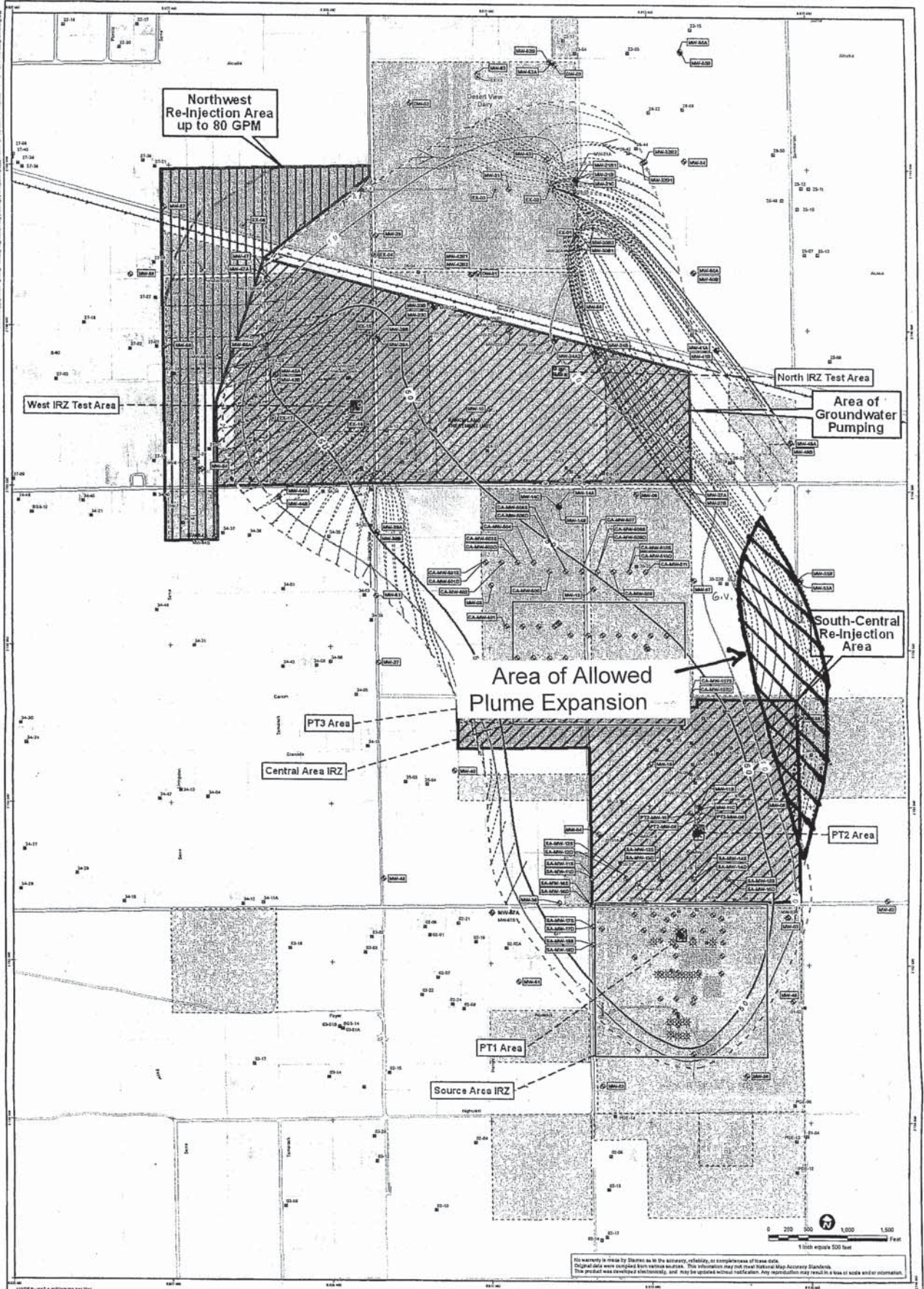
Attachment 1. CAO and Investigative Orders Replaced by CAO No. R6V-2015-0068

2. Replacement water requirements for increases of chromium or remediation byproducts, and decreases in groundwater levels in domestic wells due to agricultural treatment unit operations are contained in Waste Discharge Requirements R6V-2014-0023, issued to PG&E in March 2014. Those requirements will not be affected by 2015 CAO requirements for replacement water.

Map of
PG&E Chromium
Groundwater Plumes,
Hinkley



Attachment 3. Area of Allowed Plume Expansion



NOTES: mg/l = milligrams per liter
 gpd = gallons per day; cu ft = cubic feet per day
 Projection: CA State Plane MAG27 Feet Zone V
 Coordinate System: ANSRS and CIGM27, December 2007 / July 2008

<p>Proposed Injection and Extraction Areas</p> <ul style="list-style-type: none"> Area for Re-injection of Clean Water Area for Re-injection of Groundwater Pumped from Outside the Plume Area of Groundwater Pumping 	<p>Wells by Well Type</p> <ul style="list-style-type: none"> Monitoring Wells Bedrock Aquifer Test Wells Extractor Wells Existing Re-injection Wells Other Wells 	<p>Predicted Groundwater Flow</p> <ul style="list-style-type: none"> Predicted Groundwater Flow Direction Predicted Paths for Groundwater Flow 	<p>Chromium Plume (June 2008)</p> <ul style="list-style-type: none"> Concentration of Hexavalent Chromium (µg/l) 50 µg/l 10 µg/l 4 µg/l 	<p>FOR: Pacific Gas & Electric NOI for Coverage Under a General Permit Groundwater Remediation Project Hinkley, California</p>	<p>Predicted Groundwater Flow Patterns - Plume Boundary Cr(VI) = 4 µg/l</p>	<p>FIGURE 2</p>
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Stantec
 57 Lafayette Circle, 2nd Floor
 Lafayette, California
 PHONE: (925) 291-3000/291-3322 (FAX)

JOB NUMBER: 0007-00004-00
 DRAWN BY: R. Edwards
 CHECKED BY: G. Green
 APPROVED BY: C. Maxwell
 DATE: 05/05/08

Attachment 4. Active Water Board Orders and Notices Authorizing Clean up Actions

Document Type; Date	Title	Description
In-situ Remediation Waste Discharge Requirements and Notices of Applicability		
Board Order R6V-2008-0014; April 9, 2008	General Waste Discharge Requirements for PG&E General Site-wide Groundwater Remediation Project	<ul style="list-style-type: none"> • Authorizes extraction, management and re-injection of groundwater, included freshwater and treated water. In-situ actions consisting of injection of chemical or biological reductant directly to groundwater. • Well rehabilitation and groundwater flow tracing.
Notice of Applicability; April 7, 2009	Notice of Applicability of General Waste Discharge Requirements for the General Site-wide Groundwater Remediation Project (WDID 6B369107001, Board Order No. R6V-2008-0014)	<ul style="list-style-type: none"> • Authorizes South Central Re-injection area project. • Allows up to 80 gallons per minute freshwater injection near Serra Road (Northwest Freshwater Injection area). • Sets receiving water limits for TDS. • Sets monitoring and reporting requirements.
Notice of Applicability; August 17, 2009	Notice of Applicability of General Waste Discharge Requirements for the General Site-wide Groundwater Remediation Project (WDID 6B369107001, Board Order No. R6V-2008-0014)	<ul style="list-style-type: none"> • Authorizes increased ethanol volumes for the Source Area In-situ remediation project.
Notice of Applicability; July 7, 2010	Notice of Applicability of General Waste Discharge Requirements for the General Site-wide Groundwater Remediation Project (WDID 6B369107001, Board Order No. R6V-2008-0014) and Rescission of Monitoring and Reporting programs Nos. R6V-2006-0054A1 and R6V-2008-0032.	<ul style="list-style-type: none"> • Combines three ongoing in-situ remediation projects (Source area, Central area, and South Central re-injection area) into one project (called IRZ, in-situ remediation zone) for monitoring and reporting purposes. • Sets monitoring and reporting for IRZ project. • Sets contingency plan requirements and threshold limits for byproducts migration and concentrations.

<p>Notice of Applicability; December 5, 2014</p>	<p>Notice of Applicability to Conduct Bioreactor Pilot Test, PG&E Compressor Station (WDID 6B369107001, Board Order No. R6V-2008-0014)</p>	<ul style="list-style-type: none"> • Authorizes 14-month testing of 2-stage bioreactor (above-ground treatment system). Effluent from testing to be treated and re-injected at the South Central IRZ • Set additional monitoring and reporting requirements.
<p>Agricultural Treatment Unit WDRs and Notice of Applicability</p>		
<p>Board Order R6V-2014-0023; March 12, 2014</p>	<p>Waste Discharge Requirements for PG&E Groundwater Remediation Project, Agricultural Treatment Units, WDID 6B361403002</p>	<ul style="list-style-type: none"> • Authorizes groundwater extraction and application to irrigate up to 500 acres of agricultural fields. • Sets monitoring and reporting requirements, including Environmental Impact Report mitigation measure implementation.
<p>Notice of Applicability; August 1, 2014</p>	<p>Notice of Applicability of Waste Discharge Requirements for Agricultural Treatment Units, (WDID 6B361403002, Board Order No. R6V-2014-0023)</p>	<ul style="list-style-type: none"> • Describes location and acreage of agricultural fields authorized. • Sets reporting due dates. • Describes minor change to monitoring program.

Revised
Attachment 5

Appendix A - Shallow Zone Hydraulic Capture Metrics

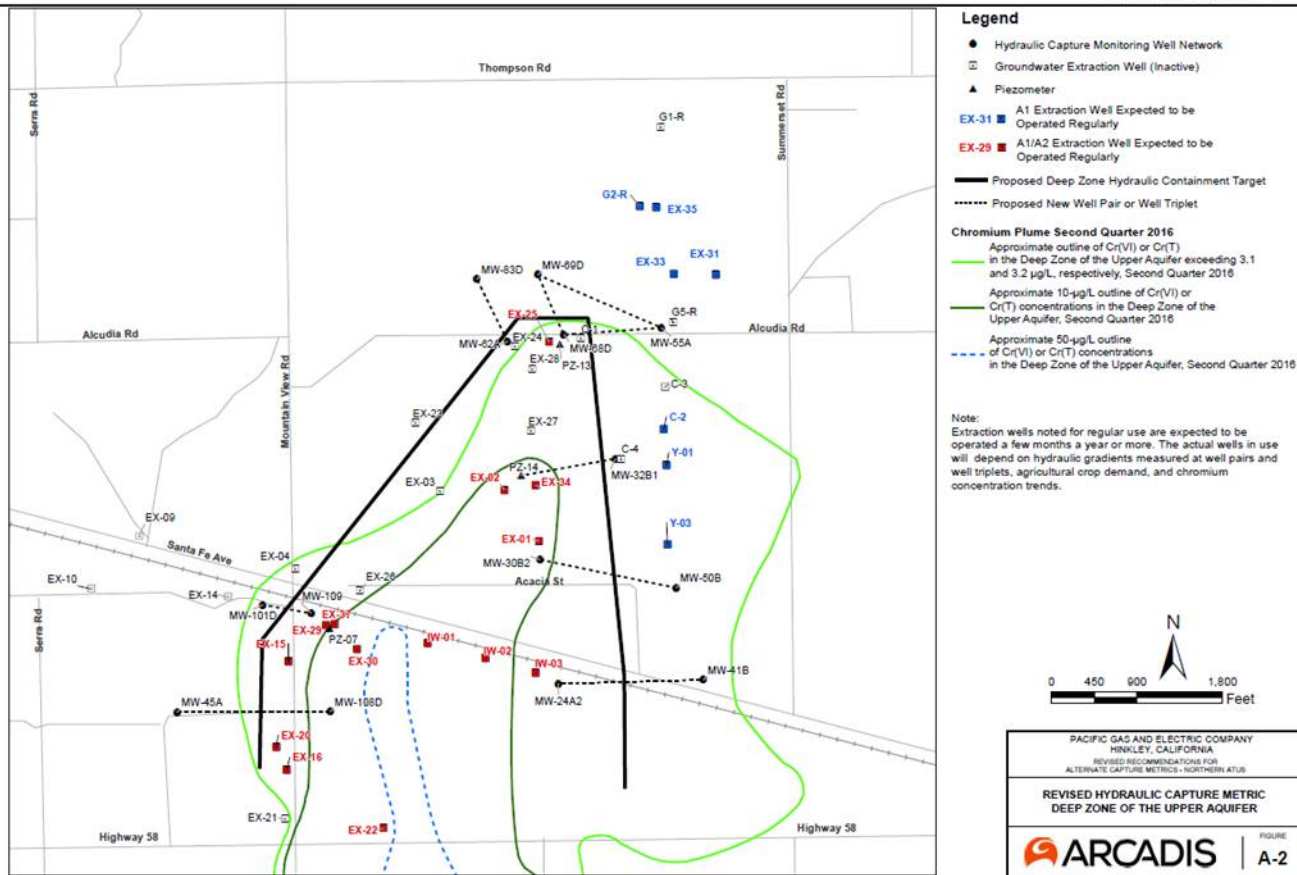
Hydraulic capture shall be demonstrated through analysis of potentiometric surfaces in the A1 and A2 layers of the upper aquifer measured at least monthly. Hydraulic capture shall be demonstrated using those monitoring wells or piezometers identified in Table A-1 or other wells accepted by Water Board staff. For well pairs, the inner well must have a potentiometric surface lower than the outer well. For well triplets, the vector described by the potentiometric surfaces at the three wells must show a gradient directed inward of the capture boundary line shown on Figures A-1 and A-2 for the A1 and A2 depth layers, respectively.

Table A-1 Hydraulic Capture Monitoring Plan

Depth Interval	Well Pairs		Well Triplets
A1 Interval	Outer Well	Inner Well	
	PZ-04	MW-71S	
	MW-79S	MW-71S	
			MW-80S, MW-72S, MW-71S
			MW-112S, MW-86S, MW-72S
			MW-69S, MW-70S, MW-71S
	PZ-03	MW-21A	
	MW-29	MW-109 (or PZ-08 if EX-29 is not operating)	
			MW-76S, MW-45A, MW-108D
			MW-47, MW-45A, MW-19
			MW-88S, MW-41S, MW-50S
			MW-49S, MW-88S, MW-41S
A2 Interval	Outer Well	Inner Well	
	MW-45A	MW-108D	
	MW-101D	MW-109 (or PZ-07 if EX-29 is not operating)	
	MW-83D	MW-62A	
			MW-69D, MW-55A, MW-68D
	MW-32B1	PZ-14	
	MW-50B	MW-30B2	
	MW-41A	MW-24A2	

Revised
Attachment 6

Revised
Attachment 7



Attachment 8

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD LAHONTAN REGION

CLEANUP AND ABATEMENT ORDER NO. R6V-2015-0068 WDID NO. 6B369107001

REQUIRING PACIFIC GAS AND ELECTRIC COMPANY TO CLEAN UP AND ABATE WASTE DISCHARGES OF TOTAL AND HEXAVALENT CHROMIUM TO THE GROUNDWATERS OF THE MOJAVE HYDROLOGIC UNIT

Groundwater Monitoring and Reporting Program

San Bernardino County

California Water Code section 13267 authorizes the Regional Water Quality Control Board (Water Board) to require technical and monitoring reports. This Monitoring and Reporting Program (MRP) establishes requirements consistent with the California Water Code. Pursuant to Water California Water Code section 13223, this MRP may be amended by the Water Board Executive Officer.

This MRP requires Pacific Gas & Electric Company (hereinafter referred to as either "PG&E" or "Discharger") to collect water samples, conduct monitoring actions, and submit technical reports to evaluate compliance with the terms and conditions of this Order, and to assure protection of waters of the state and restoration of beneficial uses. Consistent with Water Code section 13267, this Order requires implementation of a MRP that is intended to verify the effectiveness of remediation, track progress toward meeting remediation targets, and evaluate threats to and monitor water quality in private supply wells.

As cleanup progresses and conditions change, it may be necessary to modify the requirements to best accommodate changing conditions. The Water Board's Executive Officer has the ability to modify the requirements of this Order, as necessary.

I. GROUNDWATER MONITORING REQUIREMENTS

- A. **Beginning 1st Quarter 2016, and every quarter (three months) thereafter,** PG&E shall implement a site-wide monitoring well and domestic well sampling and monitoring program. Monitoring well and domestic/community well sampling shall be conducted at the frequency and using the criteria prescribed in this "Groundwater Monitoring and Reporting Program."

B. PG&E shall:

1. Collect groundwater elevation data to the nearest 0.01 foot from all monitoring wells required for that quarter.
2. Collect groundwater samples from monitoring wells and active domestic/community wells required for that quarter. Active is defined as any water supply well used during that quarter or planned for use within the next six months. Active wells include those wells on PG&E-owned property and used that quarter for any purpose. Inactive wells are defined as any water supply well not used that quarter or not planned for use within the next six months.
3. Water samples shall be analyzed for Cr(VI) using Environmental Protection Agency (EPA) Method 218.6 with a reporting limit of 0.2 parts per billion (ppb) and Cr(T) using EPA Method 6020A or 6010B with a reporting limit of 1 ppb.

C. Southern Plume Area, including "Western Finger" and Lower Aquifer

This area is defined as the southern plume area connected to the source area at the Facility, shown in CAO Attachment 2. Within this area, the Discharger shall conduct sampling to meet the following objectives:

1. To track remediation effectiveness, sampling will be conducted in accordance with the monitoring and reporting programs specified for the Agricultural Treatment Units (ATUs) and In-Situ Reactive Zones (IRZs) in the permits for those systems, as summarized in Attachment A to this MRP. The ATU monitoring program is currently established in the ATU WDRs (Order No. R6V-2014-0023, discussed in Finding 25) and associated documents. The IRZ program was proposed by the Water Board staff in a letter dated February 19, 2014 and will be included in a revised IRZ monitoring program that will be circulated for public comment along with revised/combined Notice of Applicability for the general Waste Discharge Requirements for In-situ Activities (Order No. R6V-2008-0014, discussed in Finding 24).
2. To track the chromium plume, to protect domestic wells, and for general monitoring, sampling will be conducted according to the chromium monitoring program listed in MRP Attachment A.

Once every year in the Annual Cleanup Status and Effectiveness Reports, the monitoring frequency of monitoring wells used to contour the plume boundary will be reviewed to determine whether the sampling frequency for an individual well should be changed. The decision tree shown in Figure 8.1 (MRP Attachment B) will be used to determine if a change in monitoring frequency is warranted.

- Quarterly Branch: For quarterly monitoring wells, if the Cr(VI) concentration is less than 3.1 µg/L for a period of four consecutive sampling events, the monitoring frequency will be reduced to semi-annual. If there are 12 consecutive sampling events of data in which the Cr(VI) concentrations are less than 10 µg/L then the sampling frequency will be changed to semiannual if either of the two following conditions are met: 1) Cr(VI) concentration is greater than 3.1 µg/L and there is a decreasing Mann-Kendall statistical trend based on 12 consecutive sampling events of data or 2) no trend based on 12 consecutive sampling events of data. If these conditions are not met, the sampling frequency will remain quarterly.
- Semi-Annual Branch: For semiannual monitoring wells, if the Cr(VI) concentration is greater than or equal to 3.1 µg/L for four consecutive sampling events and there is an increasing Mann-Kendall trend, then the sampling frequency will be changed to quarterly. If the Cr(VI) concentration is less than 3.1 µg/L for four consecutive sampling events, then the frequency will stay at semi- annual. If the Cr(VI) concentration is greater than 3.1 µg/L and there is not an increasing Mann Kendall statistical trend, then the sampling frequency will stay semi- annual.
- The few wells that are monitored on an annual sampling frequency, as specified in MRP Attachment A will continue on an annual sampling frequency. If changes to sampling frequency for these wells are needed, the evaluation will occur separately.
- This process will not apply to ATU and IRZ program wells which are under separate monitoring programs.

MRP Attachment A presents the initial sampling program. This program will be updated in the Annual Cleanup Status and Effectiveness Reports (Required in section II.B, below) each year to reflect any changes made in the annual program evaluation or other changes made during the year.

D. Northern Disputed Plumes Area

This area is defined as north of Thompson Road and into the Harper Dry Lake Valley, shown on CAO Attachment 2. The Discharger shall conduct the following sampling:

1. Quarterly sampling at all **single** monitoring wells and at **multi-depth** monitoring wells showing the **highest** hexavalent or total chromium detections greater than the interim maximum background levels as of 4th Quarter 2014.
2. Semi-annual sampling in the second and fourth quarter of each year at **multi-depth** monitoring wells showing the **second highest** hexavalent or total chromium detections as of 4th Quarter 2014.

3. Annual sampling in the 4th Quarter of each year for all **multi-depth** monitoring wells showing the third highest hexavalent or total chromium detections as of 4th Quarter 2014.
4. Once every year in the Annual Cleanup Status and Effectiveness Reports, the sampling frequency of monitoring wells used to draw the location of the chromium isoconcentration contour lines will be reviewed to determine whether the sampling frequency for an individual well should be changed. The decision tree shown in Figure 8.2 (MRP Attachment C) will be used to determine changes to the monitoring frequencies.
 - a) Quarterly Branch: For quarterly monitoring wells, if the Cr(VI) concentration is less than 3.1 ppb for a period of four consecutive sampling events, the monitoring frequency will be reduced to semi-annual. If the Cr(VI) concentration is greater than 3.1 ppb and there is a decreasing Mann-Kendall statistical trend based on 12 consecutive quarters of data and there are 12 consecutive quarters of data in which the Cr(VI) concentrations are less than 10 ppb or no trend based on 12 consecutive quarters of data and there are 12 consecutive quarters of data in which the Cr(VI) concentrations are less than 10 ppb, then the sampling frequency will be changed to semiannual. For the remaining quarterly wells, the sampling frequency will remain quarterly.
 - b) Semi-Annual Branch: For semiannual monitoring wells, if the Cr(VI) concentration is greater than or equal to 3.1 ppb for four consecutive sampling events and there is an increasing Mann-Kendall trend, then the sampling frequency will be changed to quarterly. If the Cr(VI) concentration is less than 3.1 ppb for four consecutive sampling events, then the frequency will be changed to annual. If the Cr(VI) concentration is greater than 3.1 ppb and there is not an increasing Mann Kendall statistical trend, then the sampling frequency will be decreased to annual. If all of the wells in the cluster meet the criteria for annual sampling, the well with the highest Cr(VI) concentration will be retained for semi-annual sampling.
 - c) Annual Branch: For annual monitoring wells, if the Cr(VI) concentration is non-detect for four consecutive sampling events, the sampling frequency will be reduced to biennial. If the Cr(VI) concentration is detected within four consecutive sampling events and there is an increasing Mann-Kendall statistical trend, then the sampling frequency will be increased to semi-annual. If the Cr(VI) concentration is detected within four consecutive sampling events and there is not an increasing Mann-Kendall statistical trend, then the sampling frequency will remain annual.

E. Domestic/Community Water Supply Wells, Northern Disputed Plume¹

For the northern area where the plume is disputed, the following sampling requirements apply to all active drinking water supply wells one-half mile downgradient and cross gradient of any northern area monitoring well showing detections of total or hexavalent chromium above the maximum contaminant levels established for drinking water.

1. Quarterly sampling at all domestic and community wells having hexavalent or total chromium detections at or above drinking water standards following any sampling event.
2. Semi-annual sampling in the second and fourth quarter of each year at all domestic and community wells having hexavalent or total chromium detections at or above the interim maximum background levels.
3. Requests to modify the quarterly or semi-annual sampling frequency must follow the decision tree process specified in Attachment C of this MRP.

F. No Monitoring or Domestic Well Sampling is Required for the Following Locations:

1. Southwest (i.e., upgradient) of the Lockhart Fault
2. On or east of Dixie Road
3. Redundant monitoring wells (defined as being less than 200 feet from other monitoring wells except those screened across different depths) having the lower of chromium detections compared to the other nearby well may be removed from all sampling events.

II. REPORTING TYPES

A. Quarterly Groundwater Monitoring Reports

Quarterly groundwater monitoring reports for site-wide monitoring well and domestic/community well monitoring are due every quarter (three months) on February 10th, May 10th, August 10th, and November 10th of each year. The quarterly reports shall include required information for maps and reports as described below in Requirements III.B.1., B.2., and B.3.

B. Annual Cleanup Status and Effectiveness Reports, and Operational Plans

Beginning February 28, 2016, submit annual cleanup effectiveness reports to reach target concentrations listed in CAO Requirement VI. The reports shall describe all clean up actions planned and/or implemented during the previous calendar year. PG&E shall explain why any planned cleanup actions were not

¹ Domestic supply well monitoring in the southern plume area is required as part of Board Order R6V-2014-0023 (Waste Discharge Requirements for Agricultural Treatment Units).

implemented. Each report shall discuss the actual effectiveness of the final cleanup remedy compared to the prior year's data and expected effectiveness showing the fourth quarter chromium plume boundary for the year before versus that year's fourth quarter chromium plume boundary map on the same figure. Provide a calculation for chromium mass removed over the year and the cumulative mass removed since initial remedial actions were implemented in 1992. If current actions are not achieving expected reductions in chromium concentrations, the report shall propose recommendations and an implementation schedule to increase effectiveness. **Within 30 days of the annual report due date**, implement the recommended actions that do not require Water Board approval.

Each annual report shall also include operational plans for the upcoming year. Operational plans shall be specific to each remediation system (e.g., ATUs, IRZs, and freshwater injection areas), and shall describe minimum planned flow rates, injection rates, reagent volumes, or other pertinent measures of operational effort to maintain plume capture, and demonstrate progress toward meeting remediation goals. Subsequent annual status reports shall be submitted by February 28 of each calendar year, starting with the year 2017. In the fourth year, the annual report shall be replaced by a four-year Comprehensive Cleanup Status and Effectiveness Report, as described in the next section.

C. **Four-Year Comprehensive Cleanup Status and Effectiveness Reports**

Beginning March 30, 2020, and every four years thereafter in lieu of the annual report, submit a report containing a comprehensive evaluation of chromium cleanup actions to reach target concentrations listed in CAO Requirement VI. These four-year comprehensive reports shall summarize the information listed above in the annual reports, II.B, during the previous four years of remedial action. Each report shall contain a figure showing the fourth quarter chromium plume boundary map for each of the four years. Using this figure and other information, each report shall compare the fourth year data to data from the previous three years to discuss remediation effectiveness. The fourth year data shall also be compared to data from the year this Order is issued, and all intermittent four-year reports. Data collected over the four-year period shall be used to update groundwater models for predicting chromium cleanup to target concentrations. The report shall also provide research of best available technologies that may be available to remediate chromium in groundwater sooner than target deadlines in this Order. Using the groundwater model results, evaluate the progress to reach target chromium concentrations by the associated deadlines. Describe whether current actions are or are not achieving expected reductions in chromium concentrations. If cleanup actions are not achieving expected reductions, submit a workplan **within 30 days of the date of the 4-year report due date** proposing recommendations and an implementation schedule to increase effectiveness. If best available technology is not recommended, the report

and workplan shall state why and provide supporting information. The four-year reports can consider, evaluate, and include corrective actions previously approved by the Water Board. Subsequent four-year comprehensive reports shall be submitted by March 30 every four years, starting with the year 2024.

III. GROUNDWATER MONITORING REPORTS

- A. Quarterly groundwater monitoring reports shall include all monitoring data, laboratory reports, related maps, tables of historical data, calculations, statistical test results for that quarter, and recommendations, such as locations for the installation of additional monitoring wells, as required by section IV.B of the Order to provide subsurface information for sufficient resolution of the chromium isoconcentration contour lines in the areas identified in IV.A.2.
- B. Using data from the monitoring wells, quarterly reports shall define the full lateral and vertical extent of chromium in groundwater, based on the monitoring information gathered pursuant to the MRP, for hexavalent and total chromium to at least the interim maximum background levels of 3.1 ppb and 3.2 ppb, respectively, in the upper aquifer, and to 0.2 ppb Cr(VI) the lower aquifer, and determine the direction of groundwater flow. At a minimum, quarterly monitoring reports shall contain the information listed below.

1. Map Types

- a. Show the concentrations of total and hexavalent chromium in groundwater in the upper and lower aquifers. Each quarterly report shall contain two maps:
 - i. A map showing the concentrations of total and hexavalent chromium throughout the uppermost saturated zone as isoconcentration contour lines identifying the maximum extent of 3.1 Cr (VI)/ 3.2 Cr (T). Chromium concentrations shall be shown next to each monitoring well sampled. Include the location of domestic wells sampled; however, data from domestic wells shall not be used to draw the chromium isoconcentration contour lines, except in the northern area where no monitoring well is located within one-half mile of domestic wells. For those areas where insufficient monitoring wells exist to define the chromium isoconcentration contour lines in the northern area, data from the domestic wells must be considered and the differences between monitoring wells and supply wells must be factored into a technical explanation of the data.

- ii. A separate map showing the maximum extent of concentrations of total and hexavalent chromium at 3.1 Cr (VI)/3.2 Cr (T) that quarter compared to the prior quarter.

- b. Potentiometric map for the upper aquifer showing the groundwater flow directions, estimated flow velocity, and calculated gradients, along the length of the map and areas where PG&E collected water table data.
- c. Potentiometric map for the lower aquifer showing the groundwater flow directions, estimated flow velocity, and calculated gradients, along the length of the map where water table data exist.
- d. Map showing all active and inactive domestic/community supply wells, including those wells on PG&E-owned property and used that quarter for any purpose. Chromium concentrations shall be shown next to each water supply well sampled.
- e. Maps of chromium isoconcentrations shall be submitted to the Water Board in digitized form (such as a pdf document). At least one of the submitted maps shall contain monitoring data and chromium isoconcentration contour lines and be printable by the public on 8-1/2 inch by 11 inch and 11 inch by 17 inch paper. Another submitted map shall contain only chromium isoconcentration contour lines and be printable by the public on 8-1/2 inch by 11 inch paper.

2. Map Content

- a. Map contents shall be consistent between each map, including data, color, symbols, etc.
- b. Text font size on maps shall be 9 points or greater.
- c. Street names shall be shown in black color to be easily legible.
- d. Location of all active supply wells used for remedial actions and the compressor station operations.
- e. Approximate location of the Lockhart Fault.
- f. Chromium isoconcentration contour lines on maps shall reflect the groundwater physical and chemical characteristics as interpreted from data reported in monitoring wells and extraction wells at all locations for that quarter. Chromium isoconcentration contour lines shall show monitoring and extraction well concentration contours representing the maximum extent of the following: 1,000 ppb Cr(VI) or Cr(T), 50 ppb Cr(T), 10 ppb Cr(VI), 3.1 ppb Cr(VI) or 3.2 ppb Cr(T).
- g. Chromium isoconcentration contour lines shall be drawn by a California licensed Professional Geologist or Civil Engineer by evaluating and reporting the site specific conditions using best professional judgment considering the following factors, at a minimum:

- i. Geology – pertinent subsurface features such as location and depth to bedrock, influences of structure (e.g. folding and faulting), and stratigraphy.
 - ii. Hydrogeology – location and hydraulic properties of the hydrostratigraphic units including, as appropriate, hydraulic conductivity, hydraulic gradients (e.g. horizontal and vertical, regional and localized due to groundwater extraction or injection), saturated aquifer thickness, groundwater flow velocities and directions, characteristics of confined, unconfined, and vadose zones.
 - iii. Geochemistry – nature and extent of chromium concentrations, pertinent groundwater chemistry, historical data from monitoring wells, and appropriate trend analyses.
 - iv. USGS background study – written technical information provided by the USGS such as the preliminary results report, or final report or other technical documentation containing analysis, interpretations and conclusions of concentrations and sources of chromium.
- h. The dashed line representing the inferred chromium isoconcentration contour line of 3.1 ppb Cr(VI) or 3.2 ppb Cr(T) shall be a dark color so as to stand out in contrast to other markings on the map.
- i. Domestic wells having chromium concentrations exceeding interim maximum background levels and which become inactive in the prior quarter can be removed from maps only if a monitoring well exists and is monitored within one-quarter mile distance of that domestic well.

3. Report Content

- a. Describe depth to groundwater, changes from prior quarter, and calculated gradients and flow direction.
- b. Table of groundwater elevation data for all monitoring and remediation wells sampled over prior 12 months,
- c. Potentiometric map showing the groundwater flow direction and the calculated flow gradient,
- d. Laboratory results:
 - i. If sample results show a relative percent difference of 25percent or greater between Cr(VI) and Cr(T) concentrations and if both concentrations are less than 10 ppb and Cr(VI) is greater than 3.1 ppb and Cr(T) is greater than 3.2 ppb, then the samples must be re-analyzed within the same quarter and the ensuing results described. In addition, if sample results have Cr(VI)/Cr(T) difference greater than 1.0 ppb at concentrations below 4 ppb, then the sample must be re-analyzed within the same quarter and the ensuing results described.

- ii. Tabulate laboratory results for monitoring wells, remediation wells, domestic/community supply wells, and include data over the prior 12-months of sampling for each well.
- e. Describe all required monitoring wells or water supply wells not sampled during quarter and provide an explanation why.
- f. Interpret chromium isoconcentration contour lines in the upper and lower aquifers compared to contour lines in prior quarter. State if this quarter's contour lines are stable or have migrated. If migration occurred, explain why it migrated (if due to PG&E's actions, natural groundwater movement, or actions by others).
- g. Describe methods and actions for installing wells, as needed.
- h. The domestic well sampling and monitoring requirements shall be included in the main body of the report (not as an appendix) and include:
 - i. Total number and sampling results for wells that quarter, including number of wells exceeding interim maximum background levels and chromium drinking water standards.
 - ii. An analysis of whether any domestic well within the domestic well sampling area contains Cr(VI) exhibiting an increasing trend, indicating likely future exceedances of the Cr(VI) drinking water standards within one year.
 - iii. Required water supply wells not sampled that quarter with an explanation of why not.
 - iv. Map showing all active domestic wells in sampling program and detected chromium concentrations for each monitoring event.
 - v. Table of inactive water supply wells.
- i. Include appendices for boring logs and well designs for any wells installed during the quarter.
- j. Include appendix with description explaining the difference between monitoring well labels, such as A, B, C versus S and D, etc.
- k. Include appendix of Standard Operating Procedures for sampling procedures of monitoring wells and domestic wells.
- l. Include appendix of laboratory reports and field notes.
- m. Discuss calculated groundwater flow direction and velocity based on groundwater elevation data and not surface topography.

C. Submittal of Maps of Isoconcentration Contour Lines

Maps of chromium isoconcentration contour lines shall be submitted to the Water Board in digitized form (such as a pdf document) within **one** business day of the report due date. At least one of the submitted maps shall contain monitoring data and isoconcentration contour lines and be printable by the public on 8-1/2 inch by 11 inch and 11 inch by 17 inch paper. Another

submitted map shall contain only isoconcentration contour lines and be printable by the public on 8-1/2 inch by 11 inch paper.

D. Geotracker Submittals

Reports shall be uploaded to the State Water Resources Control Board’s Geotracker database, within **one** business day of the report due date, so that reports can be viewed by the public at the link: https://geotracker.waterboards.ca.gov/profile_report.asp?global_id=SL0607111288. If report appendices are uploaded as separate files, the appendix number or letter shall be included in the file name.

E. Other Monitoring Requirements Not Superseded

Requirements for site-wide groundwater monitoring and domestic well sampling and monitoring do not supersede sampling requirements in Water Board orders R6V-2008-0014 and R6V-2014-0023 and related Notices of Applicability.

IV. MONITORING FOR COMPLIANCE WITH CAO CLEANUP REQUIREMENTS FOR SOUTHERN PLUME

The monitoring and remediation wells listed in Table 8.1 shall be evaluated in four-year comprehensive reports required above by Requirement II.C. All wells in Table 8.1 shall be monitored at the frequency specified in MRP Attachment A for total and hexavalent chromium to assess progress toward and compliance with cleanup requirements specified in CAO Requirement VI.B. The concentrations of chromium listed in Table 8.1 are of third quarter 2014.

Table 8.1. Monitoring Wells for Evaluating Compliance with CAO Cleanup Requirements for Southern Plume.

Compliance MWs for 50 ppb Target	Cr(VI) (ppb)	CrT (ppb)	Compliance MWs for 10 ppb Target	Cr(VI) (ppb)	CrT (ppb)
CA-MW-107D	150		PMW-01	42	
CA-MW-108S	76		CA-MW-204D	29	
CA-MW302D	99	99	CA-MW-312D	28	29
CA-MW-315D	75	76	CA-MW-402S	40	39
CA-MW-405D	74	75	CA-MW-404S	19	19
PMW-03	320	360	CA-MW-411S	25	25
MW-01	550	610	CA-MW-412D	28	29
MW-11B	1400	1400	CA-MW-506D	13	14
MW-15	1700	1800	CA-MW-508D	32	32
MW-17	110	99	EX-02	20	18
MW-178D	290		EX-15	11	11
MW-178S	220		EX-20	13	13
MW-18	53		EX-26	22	

Compliance MWs for 50 ppb Target	Cr(VI) (ppb)	CrT (ppb)	Compliance MWs for 10 ppb Target	Cr(VI) (ppb)	CrT (ppb)
MW-180RD	95		EX-30	41	43
MW-180RS	92		EX-34	21	
			IW-01	26	28
MW-20	700	720	IW-02	15	17
MW-36	84	87	MW-03	13	12
PT2-MW-10	510		MW-04	33	34
SA-MW-01S	400	450	MW-10	22	23
SA-MW-02D	150	160	MW-108D	35	35
SA-MW-04S	220	250	MW-108S	41	39
SA-MW-05D	3900	4100	MW-109	13	12
SA-MW-06S	520	570	MW-12B	12	13
SA-MW-07D	880		MW-13	22	23
SA-MW-09S	470		MW-14B	35	32
SA-MW-10D	400	430	MW-14S	29	29
SA-MW-11S	430				
SA-MW-11D	120		MW-179D	26	
SA-MW-15D	90		MW-182D	39	
SA-MW-16S	340	390	MW-182S	30	
SA-MW-17S	190	210	MW-183D	22	
SA-MW-18D	64	69	MW-183S	33	
SA-MW-20D	830	910	MW-22B	29	29
SA-MW-26S	360	380	MW-23B	44	47
SA-SM-01S	740		MW-27A	12	11
SA-SM-02D	1800		MW-28B	14	15
SA-SM-08D	290	310	MW-30B2	12	13
SA-SM-11D	95	100	MW-38B	28	27
SC-MW-03D	320	350	MW-39D	23	
SC-MW-12S	330	340	MW-41S	11	14
SC-MW-13S	110	120	MW-42B1	33	33
SC-MW-21S	440		MW-42B2	45	48
SC-MW-26D	1000		MW-43	10	11
SC-MW-38D	55	52	MW-50S	14	14
# OF WELLS	44		MW-68D	12	11
90 % OF TOTAL (compliance target)	40		SA-SM-10D	22	
Minimum Cr value (3Q 2014, ppb)	52		X-16	15	
Maximum Cr value (3Q 2014, ppb)	4100		Y-01	12	
			Y-03	11	

Compliance MWs for 50 ppb Target	Cr(VI) (ppb)	CrT (ppb)	Compliance MWs for 10 ppb Target	Cr(VI) (ppb)	CrT (ppb)
			# OF WELLS	49	
			80% OF TOTAL (compliance target)	39	
			Minimum Cr value (3Q 2014, ppb)	10	
			Maximum Cr value (3Q 2014, ppb)	48	

V. CRITERIA FOR REMOVAL OR ABANDONMENT OF PG&E-OWNED INACTIVE DOMESTIC WELLS FROM SAMPLING PROGRAM

- A. The Discharger may remove inactive wells from the domestic well sampling requirements specified above in Requirement I.B.2, if such wells meet the following criteria:
 - 1. The domestic well is located within 2,000 feet of a multi-depth monitoring well, or
 - 2. The domestic well does not contain hexavalent or total chromium concentrations of 2.0 ppb or greater since September 2011.
 - 3. Prior to removing domestic wells from the sampling program, the Discharger shall provide the Water Board with a list of inactive domestic wells and the rationale for removal from the sampling program within each quarterly report.
 - 4. Domestic wells removed from the sampling program shall be left in place and secured (capped in place) until they become active or a decision is made to abandon them under IV.B, below.

- B. The Discharger may abandon inactive domestic wells, for example, those which are screened across both the upper and lower aquifers.
 - 1. Prior to abandonment, the Discharger will provide the Water Board with a list of inactive domestic wells proposed for abandonment at least 14 days before initiating abandonment actions.
 - 2. Upon Water Board acceptance of the list, the Discharger will abandon inactive domestic wells in accordance with state Well Standards and county ordinances.

Attachments:

- Attachment A: Southern Plume Area Monitoring Program
- Attachment B: Figure 8.1, Decision Tree for Monitoring Frequency, Southern Plume Area
- Attachment C: Figure 8.2, Decision Tree for Monitoring Frequency, Northern Disputed Plume Area

MRP Attachment A: Southern Plume Area Monitoring
Program

Attachment A
Southern Plume Area Monitoring Program

Well ID	Aquifer Zone	Remediation Effectiveness Monitoring			Chromium Monitoring		
		ATU Monitoring Plan ^a	IRZ Monitoring Plan ^b	Hydraulic Control Monitoring Plan (water levels only) ^{c d}	Used for contouring plume boundary	Downgradient of main contiguous plume	Domestic well protection
BW-01D	LUA				Q		
BW-01S	UUA				Q		
C-01	UA				Q		
C-02	UUA				Q		
C-04	UA				Q		
CA-MW-101D	LUA		Q				
CA-MW-102D	LUA		SA				
CA-MW-103D	LUA		SA				
CA-MW-104D	LUA		SA				
CA-MW-104S	UUA		SA				
CA-MW-105	UA		SA				
CA-MW-105D	LUA		SA				
CA-MW-106D	LUA		SA				
CA-MW-107D	LUA		Q				
CA-MW-108D	LUA		Q				
CA-MW-108S	UUA		SA				
CA-MW-109D	LUA		Q				
CA-MW-109S	UUA		A				
CA-MW-110	UUA	Q					
CA-MW-201	UUA		A				
CA-MW-202	UUA		A				
CA-MW-203	UA		A				
CA-MW-204D	LUA		SA				
CA-MW-204S	UUA		A				
CA-MW-301	UUA		Q				
CA-MW-302D	LUA		SA				
CA-MW-302S	UUA		SA				
CA-MW-303D	LUA		SA				
CA-MW-303S	UUA		SA				
CA-MW-304	UUA		SA				
CA-MW-305	UUA		A				
CA-MW-306D	LUA		SA				
CA-MW-306S	UUA		A				
CA-MW-307D	LUA		A				
CA-MW-307S	UUA		A				
CA-MW-308	UUA		A				
CA-MW-309	UUA		A				
CA-MW-310D	LUA		SA				
CA-MW-310S	UUA		SA				
CA-MW-311	UUA		A				
CA-MW-312D	LUA		Q				
CA-MW-313	UUA		Q				
CA-MW-314	UUA		A				

Attachment A
Southern Plume Area Monitoring Program

		Remediation Effectiveness Monitoring			Chromium Monitoring		
Well ID	Aquifer Zone	ATU Monitoring Plan ^a	IRZ Monitoring Plan ^b	Hydraulic Control Monitoring Plan (water levels only) ^{c d}	Used for contouring plume boundary	Downgradient of main contiguous plume	Domestic well protection
CA-MW-315D	LUA		SA				
CA-MW-315S	UUA		A				
CA-MW-316	UUA		A				
CA-MW-317D	LUA		SA				
CA-MW-317S	UUA		A				
CA-MW-401	UUA		SA				
CA-MW-402D	LUA		A				
CA-MW-402S	UUA		SA				
CA-MW-403D	LUA		A				
CA-MW-403S	UUA		A				
CA-MW-404D	LUA		A				
CA-MW-404S	UUA		SA				
CA-MW-405D	LUA		SA				
CA-MW-405S	UUA		A				
CA-MW-406	UUA		SA				
CA-MW-407	UUA		A				
CA-MW-408	UUA		SA				
CA-MW-409D	LUA		SA				
CA-MW-409S	UUA		A				
CA-MW-410	UUA		SA				
CA-MW-411D	LUA		A				
CA-MW-411S	UUA		SA				
CA-MW-412D	LUA		Q				
CA-MW-412S	UUA		Q				
CA-MW-501D	LUA		Q				
CA-MW-501S	UUA		Q				
CA-MW-502	UUA		SA				
CA-MW-503D	LUA		A				
CA-MW-503S	UUA		SA				
CA-MW-504	UUA		SA				
CA-MW-505	UUA		SA				
CA-MW-506D	LUA		SA				
CA-MW-506S	UUA		Q				
CA-MW-507	UUA		SA				
CA-MW-508D	LUA		SA				
CA-MW-508S	UUA		A				
CA-MW-509	UUA		A				
CA-MW-510D	LUA		Q				
CA-MW-510S	UUA		A				
CA-MW-511	UUA		Q				
CA-MW-601	UUA		Q				
CA-MW-602	UUA		Q				
CA-MW-603	UUA		Q				

Attachment A
Southern Plume Area Monitoring Program

Well ID	Aquifer Zone	Remediation Effectiveness Monitoring			Chromium Monitoring		
		ATU Monitoring Plan ^a	IRZ Monitoring Plan ^b	Hydraulic Control Monitoring Plan (water levels only) ^{c d}	Used for contouring plume boundary	Downgradient of main contiguous plume	Domestic well protection
CPVT	UNK	Q					
DVD-BS-01	UNK	Q					
DW-02	UUA	Q		X			
DW-03	UUA			X	Q		
EX-02	UA				Q		
EX-03	UA				Q		
EX-04	LUA				Q		
EX-05	UUA				Q		
EX-15	UA				Q		
EX-16	UA				Q		
EX-17	UUA				Q		
EX-20	UA				Q		
EX-21	UA				Q		
EX-23	UA				Q		
EX-31	UUA				Q		
EX-32	UUA				Q		
EX-33	UUA				Q		
EX-35	UUA				Q		
EX-36	UA				Q		
G-1R	UA				Q		
G-2R	UUA				Q		
GPVTN	UNK	Q					
GPVTS	UNK	Q					
IW-01	UA				Q		
IW-02	UA				Q		
IW-03	UA				Q		
MW-01	UUA		A				
MW-03	LUA				Q		
MW-03A	UA		Q				
MW-04	UUA		SA				
MW-05	UUA				Q		
MW-06	UUA		A				
MW-09	LUA				Q		
MW-100C	LA				Q		
MW-101D	LUA				Q		
MW-102D	LUA				Q		
MW-105D	LUA	Q					
MW-105S	UUA	Q					
MW-107S	UUA				Q		
MW-108S	UUA				Q		
MW-109	UUA				Q		
MW-110S	UUA				Q		
MW-112S	UUA				Q		

Attachment A
Southern Plume Area Monitoring Program

Well ID	Aquifer Zone	Remediation Effectiveness Monitoring			Chromium Monitoring		
		ATU Monitoring Plan ^a	IRZ Monitoring Plan ^b	Hydraulic Control Monitoring Plan (water levels only) ^{c,d}	Used for contouring plume boundary	Downgradient of main contiguous plume	Domestic well protection
MW-116D1	LUA				Q		
MW-118S	UUA						Q
MW-11A	UUA		A				
MW-11B	LUA		Q				
MW-11C	LA				A		
MW-121D	LUA				Q		
MW-121S	UUA				SA		
MW-122D	LUA				Q		
MW-124S1	UUA				Q		
MW-124S2	UUA				Q		
MW-126S1	UUA				Q		
MW-126S2	UUA				Q		
MW-127S1	UUA	Q					
MW-127S2	UUA	Q					
MW-128S1	UUA				Q		
MW-12B	LUA		A				
MW-13	LUA		A				
MW-147D	LUA					SA	
MW-147S	UUA				Q		
MW-148S	UUA					SA	
MW-14A	UUA		SA				
MW-14B	LUA	SA					
MW-14C	LA				A		
MW-14S	UUA	SA					
MW-153S	LUA				Q		
MW-155D	LUA		Q				
MW-155S	UUA		Q				
MW-158CR	LA				A		
MW-16	UUA	Q					
MW-164D	LUA				SA		
MW-164S	UUA				SA		
MW-168D	LUA					A	
MW-168S	UUA					SA	
MW-169S2	UUA				Q		
MW-17	UUA		Q				
MW-170S	UUA	Q		X			
MW-172S1	UUA				Q		
MW-172S2	UUA				Q		
MW-177D	LUA		Q				
MW-177S	UUA		SA				
MW-178D	LUA		Q				
MW-178S	UUA	Q					
MW-179D	LUA		Q				

Attachment A
Southern Plume Area Monitoring Program

Well ID	Aquifer Zone	Remediation Effectiveness Monitoring			Chromium Monitoring		
		ATU Monitoring Plan ^a	IRZ Monitoring Plan ^b	Hydraulic Control Monitoring Plan (water levels only) ^{c d}	Used for contouring plume boundary	Downgradient of main contiguous plume	Domestic well protection
MW-179S	UUA		SA				
MW-17D	LUA		SA				
MW-18	UA		SA				
MW-180RD	LUA		Q				
MW-180RS	UUA		Q				
MW-181D	LUA		SA				
MW-181S	UUA		SA				
MW-182D	LUA		Q				
MW-182S	UUA		Q				
MW-183D	LUA		Q				
MW-183S	UUA		Q				
MW-20	UUA		Q				
MW-201D	LUA						A
MW-201S	UUA						SA
MW-202S	UUA				Q		
MW-203D	LUA				Q		
MW-206S	UUA	Q					
MW-208S	UUA	Q					
MW-209S	UUA	Q					
MW-210S	UUA	SA					
MW-211S	UUA	Q					
MW-21A	UA	Q		X			
MW-21B	LUA			X			
MW-21B1	LUA	Q					
MW-21C	LA				SA		
MW-22A1	UA	SA					
MW-22B	LUA	SA					
MW-23B	LUA				Q		
MW-23C	LA				Q		
MW-27A	UUA	SA					
MW-27B	LUA	SA					
MW-28A	UUA	SA					
MW-28B	LUA	SA					
MW-28C	LA				Q		
MW-29	UUA	SA		X			
MW-30B2	LUA			X			
MW-31	LUA	Q					
MW-31C	LA				Q		
MW-32B1	LUA	Q					
MW-32S	UUA	Q		X			
MW-34	LA				SA		
MW-36	UUA		Q				
MW-37	UUA				Q		

Attachment A
Southern Plume Area Monitoring Program

Well ID	Aquifer Zone	Remediation Effectiveness Monitoring			Chromium Monitoring		
		ATU Monitoring Plan ^a	IRZ Monitoring Plan ^b	Hydraulic Control Monitoring Plan (water levels only) ^{c,d}	Used for contouring plume boundary	Downgradient of main contiguous plume	Domestic well protection
MW-38A	UUA		SA				
MW-38B	LUA		Q				
MW-39	UUA		SA				
MW-39D	LUA		Q				
MW-41B	LUA			X			
MW-41S	UUA			X	Q		
MW-42B1	LUA	SA					
MW-42B2	LUA	SA		X			
MW-42C	LA				Q		
MW-43	LUA				Q		
MW-44A	UUA				Q		
MW-44B	LUA				Q		
MW-45A	UUA			X	Q		
MW-45B	LUA				Q		
MW-46	UUA		SA				
MW-47	UA			X	Q		
MW-47A	UUA			X			
MW-49A	LUA	SA					
MW-49B	LUA	SA					
MW-49S	UUA				Q		
MW-50B	LUA			X	Q		
MW-50S	UUA			X	Q		
MW-54	UUA			X	Q		
MW-55A	LUA	Q					
MW-55B	LUA			X			
MW-55C	LA				SA		
MW-55S	UUA	Q		X			
MW-56	LUA	SA					
MW-57	UUA					SA	
MW-57D	LUA					SA	
MW-58	UUA			X	Q		
MW-59	UUA				A		
MW-61	UUA		SA				
MW-62A	LUA			X	Q		
MW-62C	LA				SA		
MW-63	UUA	Q					
MW-66A	UUA				Q		
MW-67A	UUA		Q				
MW-67B	LUA		Q				
MW-68C	LA				SA		
MW-68D	LUA	Q		X			
MW-68S	UUA	Q		X			
MW-69D	LUA			X	Q		

Attachment A
Southern Plume Area Monitoring Program

Well ID	Aquifer Zone	Remediation Effectiveness Monitoring			Chromium Monitoring		
		ATU Monitoring Plan ^a	IRZ Monitoring Plan ^b	Hydraulic Control Monitoring Plan (water levels only) ^{c,d}	Used for contouring plume boundary	Downgradient of main contiguous plume	Domestic well protection
MW-69S	UUA			X	Q		
MW-70D	LUA	Q					
MW-70S	UUA	Q		X			
MW-71D	LUA	Q					
MW-71S	UUA	Q		X			
MW-72S	UUA			X	Q		
MW-73D	LUA		Q				
MW-73S	UUA		Q				
MW-74D	UUA		Q				
MW-74S	UUA		Q				
MW-75D	LUA		Q				
MW-76S	UUA			X	Q		
MW-78D	LUA		SA				
MW-78S	UUA		Q				
MW-79S	UUA			X	Q		
MW-80S	UUA			X	Q		
MW-82S	UUA			X			
MW-83D	UUA	Q		X			
MW-83S	UUA	Q					
MW-84D	LUA	Q					
MW-84S	UUA	Q					
MW-85D	LUA	Q					
MW-85S	UUA	Q					
MW-86D	LUA	SA					
MW-86S	UUA	SA		X			
MW-87D	LUA				Q		
MW-87S	UUA			X	Q		
MW-88D	LUA	SA					
MW-88S	UUA	SA		X			
MW-89D	LUA	Q					
MW-89S	UUA	Q					
MW-90C	LA				Q		
MW-91C	LA				Q		
MW-92C	LA				Q		
MW-93C	LA				SA		
MW-94S	UUA				Q		
MW-95S	UUA				Q		
MW-96S	UUA				Q		
MW-97S	UUA				Q		
MW-98C	LA				Q		
MW-99C	LA				SA		
PMW-02	UUA	SA					
PMW-03	LUA		Q				

Attachment A
Southern Plume Area Monitoring Program

Well ID	Aquifer Zone	Remediation Effectiveness Monitoring			Chromium Monitoring		
		ATU Monitoring Plan ^a	IRZ Monitoring Plan ^b	Hydraulic Control Monitoring Plan (water levels only) ^{c d}	Used for contouring plume boundary	Downgradient of main contiguous plume	Domestic well protection
PMW-04	UA		SA				
PMW-05	UA		Q				
PMW-06	UA		A				
PT1-MW-01	UA		SA				
PT1-MW-04	UA		Q				
PT2-MW-08	UA		A				
PT2-MW-09	UA		SA				
PT2-MW-10	LUA		Q				
PT2-MW-11	UA		SA				
PZ-04	UUA			X			
PZ-05	UUA			X			
PZ-06	UUA			X			
PZ-08	UUA			X			
RPVT	UNK	Q					
SA-MW-01D	LUA		SA				
SA-MW-01S	UUA		Q				
SA-MW-02D	LUA		A				
SA-MW-02S	UUA		Q				
SA-MW-03D	LUA		A				
SA-MW-03S	UUA		A				
SA-MW-04D	LUA		SA				
SA-MW-04S	UUA		SA				
SA-MW-05D	LUA		Q				
SA-MW-05S	UUA		A				
SA-MW-06D	LUA		SA				
SA-MW-06S	UUA		Q				
SA-MW-07D	LUA		Q				
SA-MW-07S	UUA		Q				
SA-MW-08D	LUA		Q				
SA-MW-08S	UUA		SA				
SA-MW-09D	LUA		A				
SA-MW-09S	UUA		Q				
SA-MW-10D	LUA		Q				
SA-MW-10S	UUA		SA				
SA-MW-11D	LUA		SA				
SA-MW-11S	UUA		Q				
SA-MW-12D	LUA		SA				
SA-MW-12S	UUA		Q				
SA-MW-13D	LUA		A				
SA-MW-13S	UUA		Q				
SA-MW-14D	LUA		SA				
SA-MW-14S	UUA		SA				
SA-MW-15D	LUA		SA				

Attachment A
Southern Plume Area Monitoring Program

Well ID	Aquifer Zone	Remediation Effectiveness Monitoring			Chromium Monitoring		
		ATU Monitoring Plan ^a	IRZ Monitoring Plan ^b	Hydraulic Control Monitoring Plan (water levels only) ^{c d}	Used for contouring plume boundary	Downgradient of main contiguous plume	Domestic well protection
SA-MW-15S	UUA	Q					
SA-MW-16D	LUA		Q				
SA-MW-16S	UUA		Q				
SA-MW-17D	LUA		SA				
SA-MW-17S	UUA		Q				
SA-MW-18D	LUA		SA				
SA-MW-18S	UUA		Q				
SA-MW-20D	LUA		Q				
SA-MW-20S	UUA		SA				
SA-MW-21D	LUA		SA				
SA-MW-21S	UUA		A				
SA-MW-22D	LUA		A				
SA-MW-22S	UUA		A				
SA-MW-24D	LUA		SA				
SA-MW-24S	UUA		SA				
SA-MW-25D	LUA		Q				
SA-MW-25S	UUA		Q				
SA-MW-26D	LUA		Q				
SA-MW-26S	UUA		Q				
SA-MW-27D	LUA		Q				
SA-MW-27S	UUA		Q				
SA-SM-01D	LUA		Q				
SA-SM-01S	UUA		Q				
SA-SM-02D	LUA		A				
SA-SM-02S	UUA		Q				
SA-SM-03D	LUA		A				
SA-SM-03S	UUA		A				
SA-SM-04S	UUA		A				
SA-SM-05S	UUA		A				
SA-SM-06D	LUA		A				
SA-SM-06S	UUA		SA				
SA-SM-07D	LUA		A				
SA-SM-07S	UUA		A				
SA-SM-08D	LUA		Q				
SA-SM-08S	UUA		A				
SA-SM-09D	LUA		A				
SA-SM-09S	UUA		SA				
SA-SM-10D	LUA		A				
SA-SM-10S	UUA		A				
SA-SM-11D	LUA		SA				
SA-SM-11S	UUA		A				
SC-MW-01D	LUA		Q				
SC-MW-01S	UUA		Q				

Attachment A
Southern Plume Area Monitoring Program

Well ID	Aquifer Zone	Remediation Effectiveness Monitoring			Chromium Monitoring		
		ATU Monitoring Plan ^a	IRZ Monitoring Plan ^b	Hydraulic Control Monitoring Plan (water levels only) ^{c d}	Used for contouring plume boundary	Downgradient of main contiguous plume	Domestic well protection
SC-MW-02D	LUA		Q				
SC-MW-02S	UUA		Q				
SC-MW-03D	LUA		Q				
SC-MW-03S	UUA		Q				
SC-MW-04D	LUA		Q				
SC-MW-04S	UUA		Q				
SC-MW-05D	LUA		Q				
SC-MW-05S	UUA		SA				
SC-MW-06D	LUA		Q				
SC-MW-06S	UUA		Q				
SC-MW-07D	LUA		SA				
SC-MW-07S	UUA		Q				
SC-MW-08D	LUA		SA				
SC-MW-08S	UUA		SA				
SC-MW-09D	LUA		Q				
SC-MW-09S	UUA		SA				
SC-MW-10D	LUA		Q				
SC-MW-10S	UUA		Q				
SC-MW-11D	LUA		Q				
SC-MW-11S	UUA		Q				
SC-MW-12D	LUA		Q				
SC-MW-12S	UUA		Q				
SC-MW-13D	LUA		Q				
SC-MW-13S	UUA	Q					
SC-MW-14D	LUA		Q				
SC-MW-14S	UUA	SA					
SC-MW-15D	LUA		Q				
SC-MW-15S	UUA		SA				
SC-MW-16C	LA				A		
SC-MW-16D	LUA		Q				
SC-MW-16S	UUA		SA				
SC-MW-21D	LUA		A				
SC-MW-21S	UUA	Q					
SC-MW-22D	LUA		A				
SC-MW-22S	UUA		A				
SC-MW-23D	LUA		A				
SC-MW-23S	UUA		A				
SC-MW-26D	LUA		Q				
SC-MW-26S	UUA		A				
SC-MW-32D	LUA		SA				
SC-MW-32S	UUA		A				
SC-MW-38D	LUA		SA				
SC-MW-38S	UUA		A				

**Attachment A
Southern Plume Area Monitoring Program**

Well ID	Aquifer Zone	Remediation Effectiveness Monitoring			Chromium Monitoring		
		ATU Monitoring Plan ^a	IRZ Monitoring Plan ^b	Hydraulic Control Monitoring Plan (water levels only) ^{c d}	Used for contouring plume boundary	Downgradient of main contiguous plume	Domestic well protection
X-10	UA		SA				
X-11	LUA		A				
X-12	UA	Q					
X-16	LUA		A				
YAU	UNK	Q					
TOTAL NUMBER OF WELLS:		434					

^a WDRs set forth in Water Board Order No. R6V 2014-0023 (Water Board 2014a)

^b Water Board Letter "Comments on Manganese Investigation Technical Report, Pacific Gas and Electric (PG&E), Hinkley Compressor Station, San Bernardino County" (Water Board 2014b)

^c Water Board Order No. R6V 2008 0002A3 (Water Board 2012). A proposed revision to the hydraulic control monitoring program was submitted to the Water Board on June 2, 2015

^d Monitoring wells in Hydraulic Capture Monitoring Program have pressure transducers installed and record nearly continuous water level measurements (every 30 minutes). Manual water levels are also collected at these monitoring locations periodically

B = biennial monitoring frequency (sampled every two years)

Q = quarterly monitoring frequency

SA = semiannual monitoring frequency (sampled twice per year)

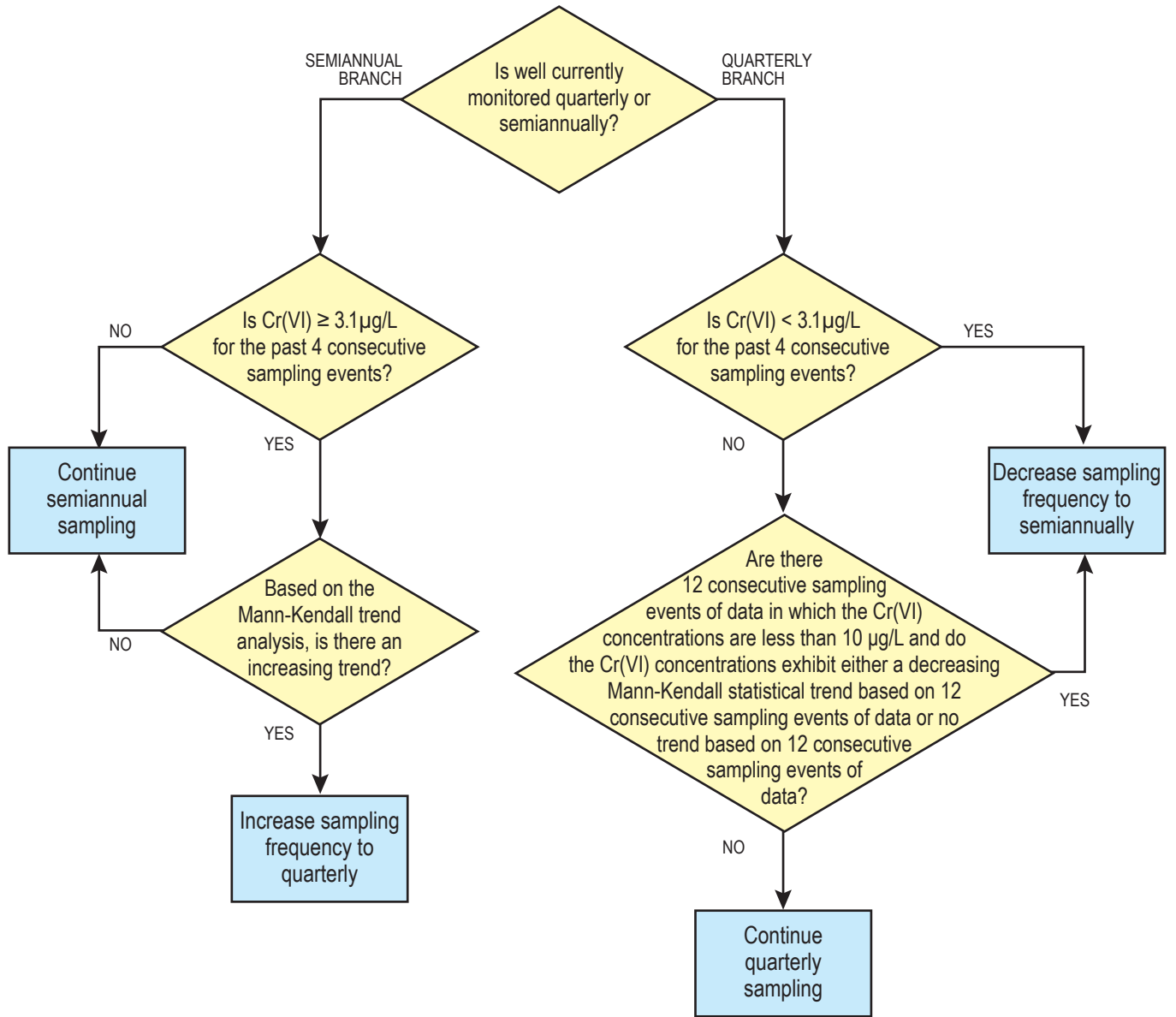
LA = lower aquifer

LUA = deep zone of the upper aquifer

UUA = shallow zone of the upper aquifer

MRP Attachment B: Figure 8.1, Decision Tree for Monitoring Frequency, Southern Plume Area

EVERY YEAR



Note:

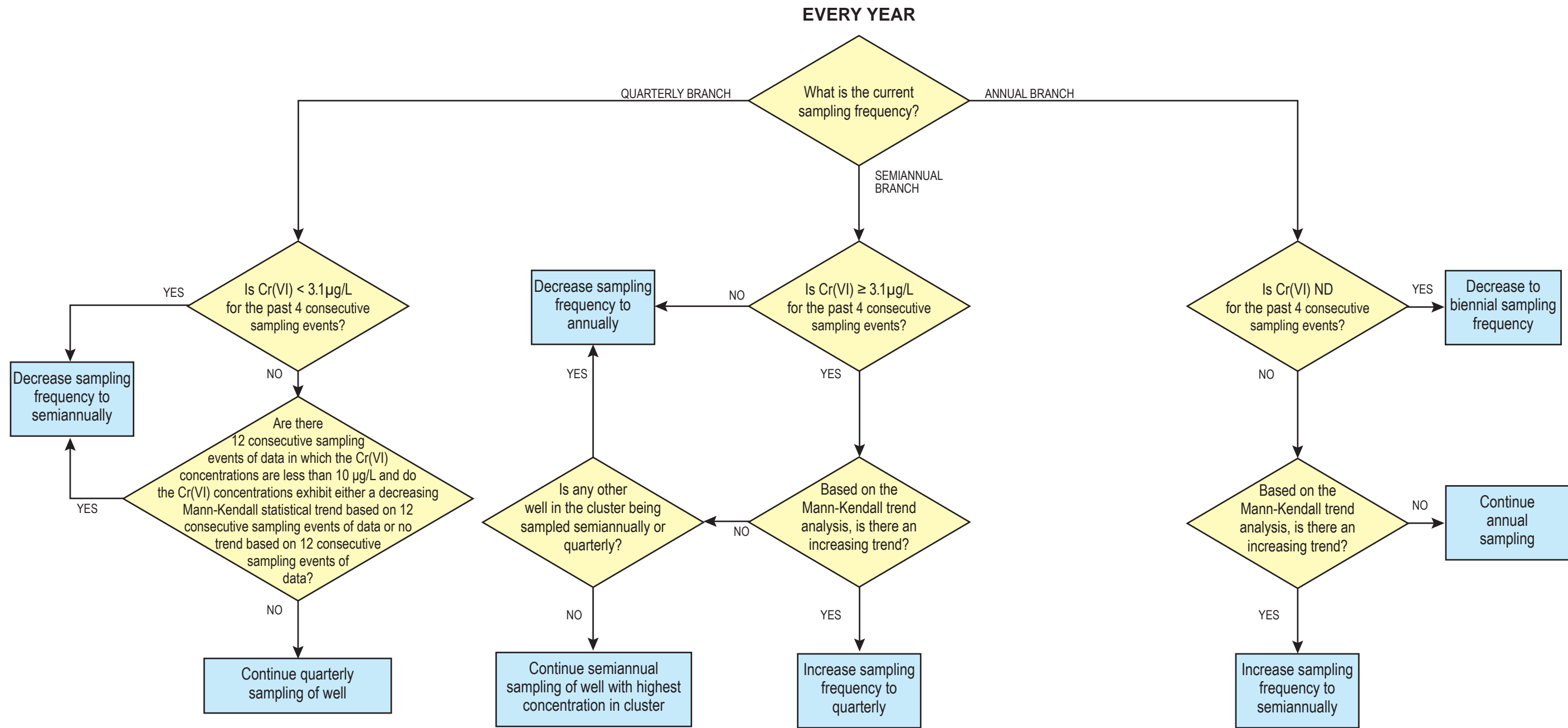
The few wells in this area that are monitored in the Southern Plume Area on an annual sampling frequency will continue on an annual sampling frequency. If changes to sampling frequency for these wells is needed, the evaluation will occur separately.

Legend

- Cr(VI) hexavalent chromium
- µg/L micrograms per liter
- Semiannual Sampled twice per year

FIGURE 8-1
Decision Tree for Monitoring Frequency, Southern Plume Area

MRP Attachment C: Decision Tree for Monitoring Frequency, Northern Area



Note: Sampling frequency for wells sampled biennially will be evaluated on a case-by-case basis using similar logic as shown above.

- Legend
- Cr(VI) hexavalent chromium
 - µg/L micrograms per liter
 - ND Not detected
 - Semiannual Sampled twice per year
 - Biennial Sampled every two years

FIGURE 8-2
Decision Tree for Monitoring Frequency, Northern Area

Attachment 9

PG&E Hinkley - Cleanup and Abatement Order

Summary of Performance Requirements

General

I	Implement on-going corrective actions. [“Continue to implement”]	Ongoing.
II	Shall not cause additional waste chromium to be discharged or deposited where it is, or probably will be, discharged into waters of the State.	Ongoing.

Chromium Plume Definition in the Upper Aquifer

IV.A.	Define extent with sufficient resolution	Ongoing.
IV.C. (Contingent)	Develop and sample new MWs installed in Order IV.A. and report results in Groundwater Monitoring Program (Attachment 8).	Within 60 days of EO approval.
IV.D. (Contingent)	Add any MWs installed under requirements in this Order to the Groundwater Monitoring Program (Attachment 8).	Upon first sampling event.
IV.D. (Contingent)	Sample new MWs quarterly.	Quarterly.

Southern Plume Containment

V.C.a. though V.C.c.	Compliance requirements and violation specifics for Southern Plume Hydraulic Capture Metrics.	Duration.
V.D. (Contingent)	Implement contingency plan to re-establish Southern Plume capture, if necessary.	According to approved schedule.
V.G.	If alternative hydraulic capture zone implemented (Order V.F.), 50 ppb Cr(VI)/Cr(T) or 10 ppb Cr(VI)/Cr(T) boundaries may not expand more than 1,000 feet.	Ongoing, if contingency implemented.
V.H.	Maintain 4 ppb boundary to within 1,000 feet in eastern boundary of Southern Plume.	Ongoing.

Summary of Performance Requirements (continued)

Cleanup Requirements

VI.A.	Implement previously accepted corrective actions.	Continuously.
VI.C.	Conduct corrective actions at specified level.	Ongoing.
VI.C.1.a. (Western Area)	Cleanup and abate chromium above background in Western Area. (Continue ongoing remedial activities.)	Ongoing.
VI.C.1.b.i. (Lower Aquifer)	Cleanup and abate chromium in Lower Aquifer linked to PG&E.	Ongoing.
VI.C.1.c.i.	Reach and maintain 50 ppb Cr(VI)/Cr(T) in 90% of the 50 ppb CrVI/CrT plume.	December 31, 2025.
VI.C.1.c.ii.	Reach and maintain 10 ppb Cr(VI)/Cr(T) in 80% of the 10 ppb Cr(VI)/Cr(T) and 50 ppb Cr(VI)/Cr(T) plumes.	December 31, 2032.
V.C.1.c.iii	Reach and maintain background levels of Cr(VI) and Cr(T).	No date specified. Dependent on USGS BGS.
VI.C.2.b. (Contingent)	Cleanup and abate any "hot spots" in the Northern Area.	Within 45 days of accepted workplan.
VI.C.2.c. (Contingent)	If USGS BGS indicates, no further remedial action required in the Northern Area.	-

Replacement Water Supply

VII.A.1.a. (Contingent)	Supply interim water supply if a domestic well exceeds the MCL.	Within 10 days of lab report.
VII.A.2.b. (Contingent)	Supply long-term water supply if a domestic well qualifies.	Within 45 days of EO approval of workplan.

Independent Consultant

VIII.A.	Continue to fund an independent consultant.	Ongoing.
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Monitoring and Reporting Program (See Attachment 8)

I.B.1. & 2.	Collect groundwater elevation data and samples.	Quarterly (or less).
I.B.3.	Analyze groundwater samples.	Quarterly.
I.C.1.	Sample MWs as specified in the monitoring programs for the ATU and IRZ permits.	As specified in ATU and IRZ permits.
I.D.	Collect groundwater elevation data and samples from MWs in the Northern Areas.	Quarterly (or less).
I.E. (Contingent)	Sample domestic wells in the north with MCL exceedances.	Quarterly and semi-annually.
II.B. (Contingent)	Implement recommended cleanup actions not requiring Water Board approval.	Within 30 days of the Annual Report due date.

PG&E Hinkley CAO

Summary of Submittal Requirements

General

III	Upload documents to Geotracker	Within one business day of the document date.
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Chromium Plume Definition in the Upper Aquifer

IV.B.	Either submit a workplan to install MWs if change in land access status occurs or submit a technical justification explaining why additional wells are not necessary.	Within 30 days of the date this Order is adopted.
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Southern Plume Containment

V.B.	Submit Hydraulic Capture Metric Reports	Quarterly, beginning January 15, 2016.
V.D. (Contingent)	Submit contingency plan to re-establish capture, if necessary.	15 th of the month following quarterly report submittal.
V.D. (Contingent)	Submit Hydraulic Capture Metric contingency assessments and subsequent corrective actions, if necessary.	Monthly, by the 15th of the month.
V.E. (Contingent)	Notify Water Board when hydraulic capture contingency actions are taken, if necessary.	Within one week.
V.F. (Optional)	PG&E may propose more optimal alternative hydraulic capture zone.	Upon EO approval.

Summary of Submittal Requirements (continued)

Cleanup Requirements

VI.B.	Submit "Annual Cleanup Status and Effectiveness" report and an "Operations Plan"	Annually, beginning February 28, 2016 until February 2020 (when the Operations Plan will be replaced by a Four-Year report).
VI.B.	Notify the Water Board if reductions of more than 10 percent in corrective actions are necessary.	Prior to implementing the corrective actions.
VI.C.1.a.ii. (Contingent)	Submit technical report if CrVI exceeds 10 ppb in Western Area sentry MWs.	Within 60 days from submittal of quarterly site-wide groundwater monitoring report.
VI.C.1.a.iii.	Submit technical report regarding feasibility of achieving background based on USGS Preliminary BGS.	Within 60 days of acceptance of USGS Preliminary BGS (scheduled for release by September 2017).
VI.C.1.b.ii	Submit technical report evaluating background concentrations in lower aquifer.	Within 180 days of this Order.
VI.C.1.b.iii	Submit feasibility assessment to cleanup to background concentrations.	Within 90 days of Water Board acceptance of VI.C.1.b.ii.
VI.C.1.c.iv.	Submit a four-year cleanup status and effectiveness report.	Beginning March 30, 2020, and every four years thereafter (in lieu of the Annual Report required in MRP Order VI.B.).
VI.C.1.c.iv. (Contingent)	Submit workplan if cleanup actions are not achieving expected results.	Within 30 days of the Four-Year Report due date.
VI.C.2.b. (Contingent)	Submit a workplan if a "hot spot" trigger is met.	Within 30 days of receiving lab report.
VI.C.2.d (Contingent)	Submit a feasibility assessment.	Within 180 days of USGS submittal.

Summary of Submittal Requirements (continued)

Replacement Water Supply

VII.A. (Contingent)	Provide an analysis whether a domestic well water is subject to increasing trend likely to exceed CrVI MCL within a year.	In each quarterly monitoring report, beginning first quarter 2016.
VII.A.1.b. (Contingent)	Submit a report of properties being provided with interim replacement water.	Within 7 days of each quarterly report.
VII.A.2.a. (Contingent)	Submit a workplan outlining long-term replacement water supply for all drinking and cooking uses.	Within 45 days of this Order being issued.
VII.A.2.b.	Submit a “new technology” evaluation.	Within 21 days of identifying an affected well.
VII.A.2.c. (contingent)	Submit a report of properties being supplied long-term water supply.	Quarterly.

Independent Consultant

VIII.B.	Submit a report that includes the scope of work and budget for 12-month past and 12-month future, for the independent consultant.	Annually.
VIII.C.	The annual workplan for the independent consultant is subject to EO approval.	Annually.

Monitoring and Reporting Program (Attachment 8)

II.A.	Submit groundwater monitoring reports	Quarterly, on Jan 30 th , April 30 th , July 30 th , and Oct 30 th .
II.B.	Submit Annual Cleanup Status and Effectiveness and Operational Plan report (“Annual Report”)	February 28, 2016 February 28, 2017 February 28, 2018 February 28, 2019
II.C.	Submit Four-Year Comprehensive Cleanup Status and Effectiveness reports (“Four-Year Report”)	March 30, 2020, and every four years thereafter.
II.C. (Contingent)	Submit workplan if cleanup actions are not achieving expected results.	Within 30 days of the Four-Year Report due date.
III.D.	Upload documents to Geotracker	Within one business day of the document date.

Abbreviations:

ATU – Agricultural Treatment Unit
BGS – Background Study
EO – Executive Officer

IRZ – In-Situ Reactive Zone
MCL – Maximum Contaminant Level
MW – monitoring well

USGS – United States Geological Survey