



# California Regional Water Quality Control Board Central Valley Region

**Karl E. Longley, ScD, P.E., Chair**

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Secretary for  
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**Edmund G. Brown Jr.**  
Governor

20 March 2012

Mr. Kent Hawley  
9 CES/CEVR  
6601 B Street  
Beale Air Force Base, CA 95903-1708

**NOTICE OF APPLICABILITY OF GENERAL ORDER NO. R5-2008-0149-037  
UNITED STATES AIR FORCE – BEALE AIR FORCE BASE IN-SITU GROUNDWATER  
REMEDICATION OF VOLATILE ORGANIC COMPOUNDS USING IN-SITU CHEMICAL  
OXIDATION AT SWMU 34, YUBA COUNTY**

The United States Air Force – Beale Air Force Base (Discharger) submitted a Notice of Intent, dated 13 September 2011, requesting coverage under General Order No. R5-2008-0149, General Waste Discharge Requirements for In-situ Groundwater Remediation at Sites with Volatile Organic Compounds, Nitrogen Compounds, Perchlorate, Pesticides, Semi-Volatile Compounds and/or Petroleum Compounds. Based on information in your submittal, it is our determination that this project meets the required conditions to be approved under Order No. 2008-0149. All of the requirements contained in the general order are applicable to your project. You are assigned Order No. R5-2008-0149-037.

**Project Location:**

The project is at Beale Air Force Base in Yuba County,  
Township/Range/Section: T 15N R5E S9 Mount Diablo B&M

**Project Description:**

Operations at Solid Waste Management Unit (SWMU) 34 at Beale Air Force Base caused pollution of the soil and groundwater. The primary pollutants of concern are petroleum hydrocarbons. The petroleum hydrocarbons detected in groundwater at SWMU 34 are as follows: total petroleum hydrocarbon as diesel (TPH-G), total petroleum hydrocarbons as gasoline (TPH-G); and, benzene, toluene, ethylbenzene and xylene (BTEX). The source of groundwater contamination at SWMU 34 is an oil water separator N (OWS N), which was removed between 1996 and 1998. The removal of OWS N was included in the excavation of approximately 1400 yards of contaminated soil. Confirmation soil samples were collected after excavation activities and revealed concentrations of TPH-D (from waste extraction test) ranging from 0.045 to 207 milligrams per liter (mg/L). BTEX concentrations ranged from 0.0051 to 2.8 milligram per kilogram (mg/kg). Soil gas probes were installed in the former location of OWS N in 2008. Soil gas samples did not detect volatile organic compounds (VOCs), which are associated with other sites such as SWMU 23 and Site 23 in proximity to

***California Environmental Protection Agency***

OWS N. Soil samples collected during drilling activities did not detect TPH contamination and only detected toluene at concentrations of 0.08 micrograms per liter ( $\mu\text{g/L}$ ). Additional investigations were performed between 2008 and 2010 to determine the extent of groundwater contamination associated with OWS N, and these investigations provided the basis for conducting groundwater cleanup at SWMU 34. Groundwater samples collected between 2008 and 2011 near the former location of OWS N detected TPH-D ranging from 656 to 23,600  $\mu\text{g/L}$  and TPH-G ranging from 232 to 1320  $\mu\text{g/L}$ . Xylene was detected at a maximum concentration of 43.1  $\mu\text{g/L}$ .

The targeted treatment area for this project is an area adjacent to the former location of OWS N, which is estimated to have concentrations of TPH-D in groundwater ranging from 1000  $\mu\text{g/L}$  to 10,000  $\mu\text{g/L}$ . The Discharger proposes to inject a combination of RegenOx and ORC-A solution into the saturated zone extending from 27 to 37 feet below ground surface. RegenOX is a formulation consisting of an oxidizer composed of sodium percarbonate and sodium carbonate. These oxidizers treat the petroleum constituents and generate hydrogen and oxygen as an end product. ORC-A is a proprietary formulation of food-grade, calcium oxy-hydroxide that produces a controlled-release of molecular oxygen for a period of up to 12 months upon hydration. The injection will occur at 56 locations within a 1,800 square foot area. A total of 8,370 pounds of RegenOx and ORC-A will be injected into the subsurface to provide treatment of the groundwater plume. The injection will occur in four events spaced one to two weeks apart.

The Discharger will conduct analytical sampling and reporting, which is described in the attached Groundwater Monitoring and Reporting Program. If the Discharger desires to conduct longer-term in-situ remediation of the groundwater, a revised Notice of Intent must be submitted and a new Notice of Applicability received prior to proceeding with the additional remediation.

**General Information:**

1. The project will be operated in accordance with the requirements contained in the General Order and in accordance with the information submitted in the Notice of Intent.
2. The Discharger shall comply with the General Order No. R5-2008-0149.
3. Injection of materials other than those specified in the Notice of Intent into the subsurface is prohibited, unless analysis, as specified in the Order No. R5-2008-0149, of the injectant is provided and approval is given by Board staff.
4. Failure to abide by the conditions of the General Order could result in an enforcement action as authorized by provisions of the California Water Code.
5. The Discharger shall comply with the attached Monitoring and Reporting Order No. R5-2008-0149-037, and any revisions thereto as ordered by the Executive Officer.

6. The Discharger has provided a Contingency Plan that would be implemented if dissolved chromium or any other dissolved metals included in the monitoring program are detected above the baseline concentration or the maximum contaminant level (MCL) in downgradient compliance monitoring wells.
7. The injection of RegenOx and ORC-A solution and other strongly oxidizing agents has the potential, in some geologic settings, to convert naturally occurring chromium to a soluble form of chromium known as chromium VI. The California Office of Environmental and Human Health Assessment has determined that chromium VI is a toxic substance, and has issued a public health goal for chromium VI of 0.02 parts per billion in drinking water. General Order R5-2008-0149 prohibits the creation of conditions of pollution, contamination, or nuisance. Treatment technologies that covert naturally occurring chromium to chromium VI and may be deemed in violation of this prohibition. If chromium VI byproducts are created during treatment, the Board may require the cleanup and abatement attributable to those byproducts.

If you have any questions regarding this matter, please contact Robert Reeves at (916) 464-4651 or by email him at [reeves@waterboards.ca.gov](mailto:reeves@waterboards.ca.gov).

PAMELA C. CREEDON  
Executive Officer  
Attachments

Monitoring and Reporting Order R5-2008-0149-037  
General Order No. R5-2008-0149

cc:

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CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
CENTRAL VALLEY REGION

TENTATIVE MONITORING AND REPORTING ORDER NO. R5-2008-0149-037  
FOR  
UNITED STATES AIR FORCE  
BEALE AIR FORCE BASE  
IN-SITU GROUNDWATER REMEDIATION OF VOLATILE ORGANIC COMPOUNDS  
USING IN-SITU CHEMICAL OXIDATION AT SWMU 34  
YUBA COUNTY

This Monitoring and Reporting Order (MRP) describes requirements for providing groundwater monitoring of an enhanced in-situ bioremediation (Bioremediation) system at Beale Air Force Base. This MRP is necessary to evaluate and determine whether the in-situ treatment of groundwater pollutants is effective. This MRP is issued pursuant to Water Code Section 13267. The United States Air Force (Discharger) shall not implement any changes to this MRP unless and until a revised MRP is issued by the Executive Officer. As appropriate, Central Valley Water Board staff shall approve specific sample station locations prior to implementation of sampling activities.

Prior to construction of any new groundwater monitoring or injection wells, and prior to destruction of any groundwater monitoring or injection wells, the Discharger shall submit plans and specifications to the Central Valley Water Board staff for review and approval. Once installed, any new groundwater monitoring wells or injection wells added to the monitoring program shall be sampled semi-annually according to Table 2 of this Order.

All samples should be representative of the volume and nature of the discharge or matrix of material sampled. The time, date, and location of each grab sample shall be recorded on the sample chain of custody form.

### **GROUNDWATER MONITORING**

As shown on Figure 1, the monitoring and reporting for Solid Waste Management Unit (SWMU) 34 consists of 56 injection locations. The monitoring network for this treatability study will consist of five treatment zone monitoring wells, five compliance monitoring wells and one background well. The injection locations will provide a treatment area covering approximately 1800 square feet. The injection depth will extend from 27 to 37 feet below ground surface. Monitoring wells with free phase petroleum product or visible sheen, if present, shall be monitored, at a minimum, for product thickness and depth to water. Sample collection and analysis shall follow standard USEPA protocol.

The monitoring wells shall be sampled according to the schedule in Table 1, and the samples analyzed by the methods in Table 2, as follows:

**Table 1: Sampling Frequency and Constituent Suite**

Well Number <sup>1</sup>	Frequency	Constituent Suite(s) <sup>2</sup>	Monitoring Objective
23L002MW	Quarterly	A, B, C	Background Well
SWMU34008MW <sup>3</sup>	Quarterly	A,B,C	Treatment Zone Well
SWMU34009MW <sup>3</sup>	Quarterly	A,B,C	Treatment Zone Well
SWMU34U005MW	Semi-Annually	A,B,C	Transition Zone Well
SWMU34U006MW	Semi-Annually	A,B,C	Transition Zone Well
SWMU34U003MW	Semi-Annually	A,B, C	Compliance Well
23L003MW	Semi-Annually	A, B,C	Transition Zone Well
23U002AMW	Semi- Annually	A, B, C	Compliance Well
23U002BMW	Annually	A, B, C	Compliance Well
23U005AMW	Annually	A, B, C	Compliance Well
23U005BMW	Bi-Annually	A, B, C	Compliance Well
23U003AMW	Annually	A, B, C	Compliance Well
23U003BMW	Bi-Annually	A, B. C	Compliance Well
23U004AMW	Annually	A, B, C	Compliance Well
23U004BMW	Bi-Annually	A, B, C	Compliance Well
SMWU34U004MW	Quarterly	A, B. C	Treatment Zone Well

<sup>1</sup> Well numbers as shown on Figure 1

<sup>2</sup> Constituent suite components (see Table 2)

<sup>3</sup> Compliance monitoring wells to evaluate source area remedy to be constructed in 2012 and prior to start of injection.

**Table 2: Analytical Methods**

Constituent	Method <sup>1</sup>	Maximum Practical Quantitation Limit (µg/L) <sup>2</sup>
<b>Suite A</b>		
TPH-G, TPH-D, BTEX, MTBE	various	various
<b>Suite B</b>		
Dissolved Metals (sodium, vanadium, copper, arsenic, iron, manganese, zinc and total chromium)	EPA Method 6010B	various
<b>Suite C</b>		
Total Dissolved Solids <sup>3</sup>	EPA 160.1	10,000

<sup>1</sup> Or an equivalent USEPA Method that achieves the maximum Practical Quantitation Limit

<sup>2</sup> All concentrations between the Method Detection Limit and the Practical Quantitation Limit shall be reported as trace levels.

<sup>3</sup> Total Dissolved Solids (TDS) data should be correlated with electrical conductivity data. Conduct TDS analysis on 10 percent of samples to confirm correlation

### FIELD SAMPLING

In addition to the above sampling and analysis, field sampling and analysis shall be conducted each time a monitoring well or extraction well is sampled. The sampling and analysis of field parameters shall be as specified in Table 3.

**Table 3: Field Sampling Requirements**

Parameters	Units	Type of Sample
Groundwater Elevation	Feet, Mean Sea Level	Measurement
Oxidation-reduction potential	Millivolts	Grab
Electrical Conductivity	uhmos/cm	Grab
Dissolved Oxygen	mg/L	Grab
pH	pH Units (to 0.1 units)	Grab

Field Test instruments (such as those used to test pH and dissolved oxygen) may be used provided that:

- a. The operators are trained in proper use and maintenance of the instruments;
- b. The instruments are calibrated prior to each monitoring event; and
- c. Instruments are serviced and/or calibrated by the manufacturer at the recommended frequency

### DISCHARGE MONITORING

The Discharger shall monitor daily the discharge of water and amendments that are injected into the groundwater according to the requirements specified in Table 4. Each

amendment addition shall be recorded individually, along with information regarding the time period over which the amendment was injected into the aquifer.

**Table 4: Discharge Monitoring Requirements**

<b>Parameters</b>	<b>Units</b>	<b>Type of Sample</b>
Injected Volume	gallons per day	Meter
Amendment(s) Added	kilograms per day	Measured

### **ESTABLISHMENT OF BACKGROUND CONCENTRATION VALUES**

The Discharger shall develop background values for concentrations of sulfide, sulfate, carbon dioxide, methane, ethane, dissolved organic carbon (filtered), Total Dissolved Solids and dissolved metals (sodium, vanadium, copper, arsenic, iron, manganese, zinc and total chromium) background values in groundwater should be developed by averaging the respective concentrations reported in background well 23L002MW. Alternatively, the Discharger shall develop background values for respective concentrations reported in monitoring wells listed in Table 1.

### **REPORTING**

When reporting the data, the Discharger shall arrange the information in tabular form so that the date, the constituents, and the concentrations are readily discernible. The data shall be summarized in such a manner as to illustrate clearly the compliance with this Order. In addition, the Discharger shall notify the Central Valley Water Board within 48 hours of any unscheduled shutdown of groundwater extraction wells associated with the bioreactor.

As required by the California Business and Professions Code Sections 6735, 7835, and 7835.1, all reports shall be prepared by a registered professional or their subordinate and signed by the registered professional.

The Discharger shall submit semi-annual and annual electronic data reports, which conform to the requirements of the California Code of Regulations, Title 23, Division 3, Chapter 30. The semi-annual report and annual report shall be submitted electronically over the internet to the Geotracker database system by **1 June and 1 December**, respectively, of each calendar year until such time as the Executive Officer determines that the reports are no longer necessary. Hard copies of semi-annual and annual reports shall be submitted to the Central Valley Water Board by **1 June and 1 December** of each year, respectively, until such time as the Executive Officer determines that the reports are no longer necessary.

Semi-annual reports shall include the following minimum information:

- (a) A description and discussion of the groundwater sampling event and results, including trends in the concentrations of pollutants and groundwater elevations in the wells, how and when samples were collected, and whether the pollutant plume(s) is delineated;
- (b) Field logs that contain, at a minimum, water quality parameters measured before, during, and after purging, method of purging, depth of water, volume of water purged, etc;
- (c) Groundwater contour maps for all groundwater zones, if applicable;
- (d) Isocontour pollutant concentration maps for all groundwater zones and all major constituents of concern, if applicable;
- (e) A table showing well construction details such as well number, groundwater zone being monitored, coordinates (longitude and latitude), ground surface elevation, reference elevation, elevation of screen, elevation of bentonite, elevation of filter pack, and elevation of well bottom;
- (f) A table showing historical lateral and vertical (if applicable) flow directions and gradients;
- (g) Cumulative data tables for all major constituents of concern containing the water quality analytical results and depth to groundwater for all monitoring wells for the past five years, if applicable. Raw laboratory data shall be provided on CD or DVD and included in the report. The Central Valley Water Board may request additional data as necessary;
- (h) A copy of the laboratory analytical data report;
- (i) If applicable, the status of any ongoing remediation, including cumulative information on the mass of pollutant removed from the subsurface, system operating time, the effectiveness of the remediation system, and any field notes pertaining to the operation and maintenance of the system; and
- (j) If applicable, the reasons for and duration of all interruptions in the operation of any remediation system, and actions planned or taken to correct and prevent interruptions.

Annual Reports shall contain an evaluation of the effectiveness and progress of the investigation and remediation. Annual Reports shall contain the following minimum information:

- (a) Both tabular and graphical summaries of all data obtained during the year;
- (b) Groundwater contour maps and pollutant concentration maps containing all data obtained during the previous year;
- (c) A discussion of the long-term trends in the concentrations of the pollutants in the groundwater monitoring wells;
- (d) An analysis of whether the pollutant plume is being captured by an extraction system or is continuing to spread;
- (e) A description of all remedial activities conducted during the year, an analysis of their effectiveness in removing the pollutants, and plans to improve remediation system effectiveness;
- (f) An identification of any data gaps and potential deficiencies/redundancies in the monitoring system or reporting program; and
- (g) If desired, a proposal and rationale for any revisions to the groundwater sampling plan frequency and/or list of analytes.

The results of any monitoring done more frequently than required at the locations specified in the MRP shall also be reported to the Central Valley Water Board. The Discharger shall implement the above monitoring program as of the date of the Order.

Ordered by:

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PAMELA C. CREEDON, Executive Officer

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(Date)