

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

MONITORING AND REPORTING PROGRAM NO. R5-2015-0012-072

FOR
IN-SITU GROUNDWATER REMEDIATION
AND DISCHARGE OF TREATED GROUNDWATER TO LAND

SACRAMENTO MUNICIPAL UTILITY DISTRICT
FORMER COMMUNITY LINEN SITE
1824 AND 1826 61ST STREET
SACRAMENTO, CALIFORNIA
SACRAMENTO COUNTY

This Monitoring and Reporting Program (MRP) is issued to the Sacramento Municipal Utility District (SMUD) (Discharger) and describes requirements for monitoring of a full-scale in-situ groundwater remediation program for treatment of chlorinated volatile organic compounds (CVOCs) in groundwater using enhanced in-situ bioremediation at the Former Community Linen Site in Sacramento, California (the "Site"). The project will consist of injection of amendments including EHC-L amendment mixed with clean anaerobic water, sodium bicarbonate (pH buffer), and bioaugmentation DHC culture (KB-1) including dehalococcoides bacteria into the groundwater to create conditions for anaerobic degradation of tetrachloroethene (PCE) and trichloroethene (TCE) to ethene and ethane. Pilot testing was conducted for the proposed amendments and additional bench-scale laboratory testing was conducted to test treatability compared to other amendment types. The groundwater treatment will consist of four permeable reactive zones (PRZ-1 through PRZ-4) each with two rows of borings for injection of the amendments at multiple depths below the groundwater table in each boring at the locations shown on Figure 5-5 of this MRP. Details for the in-situ groundwater remediation program design are provided in the 19 July 2021 Remedial Design and Implementation Plan (RDIP).

This MRP is issued pursuant to Water Code Section 13267. The Discharger shall not implement any changes to this MRP unless and until a revised MRP is issued by the Executive Officer. As appropriate, California Regional Water Quality Control Board, Central Valley Region (Central Valley Water Board) staff shall approve specific sample station locations prior to implementation of sampling activities.

All samples shall 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

The groundwater monitoring well network consists of background wells, treatment zone wells, transition zone wells, compliance wells, and downgradient wells, shown on Figure 5-5 and Table 1 of this MRP. Sample collection and analysis shall follow standard United States Environmental Protection Agency (USEPA) protocols and sample analyses shall be completed

by a California state-certified laboratory. Groundwater monitoring wells shall be sampled and analyzed according to Table 1 through Table 4.

**Table 1: Sampling Frequency and Constituent Suites
 (see Tables 2 and 3 for Suite and Frequency Descriptions)**

Well	Well Type	Suite A	Suite B	Suite C	Suite D	Suite E	Suite F	Suite G	Suite H	Suite I
MWS-2	Background	1, 2, 3, 4, 5	1, 3, 5	1, 3, 5	1, 3, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	2, 4	1, 2, 3, 4, 5	1, 3, 5
MWS-5	Compliance	1, 2, 3, 4, 5	1, 3, 5	1, 3, 5	1, 3, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	2, 4	1, 2, 3, 4, 5	-
MWS-6	Source and Treatment Zone	1, 2, 3, 4, 5	1, 3, 5	1, 3, 5	1, 3, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	2, 4	1, 2, 3, 4, 5	1, 3, 5
PRZ-3-MW-1	Treatment Zone	1, 2, 3, 4, 5	1, 3, 5	1, 3, 5	1, 3, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	2, 4	1, 2, 3, 4, 5	1, 3, 5
PRZ-3-MW-2	Treatment Zone	1, 2, 3, 4, 5	1, 3, 5	1, 3, 5	1, 3, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	2, 4	1, 2, 3, 4, 5	-
GMW-2	Treatment Zone	1, 2, 3, 4, 5	1, 3, 5	1, 3, 5	1, 3, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	2, 4	1, 2, 3, 4, 5	-
GMW-4	Treatment Zone	1, 2, 3, 4, 5	1, 3, 5	1, 3, 5	1, 3, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	-
PRZ-3-MW-3	Transition Zone	1, 2, 3, 4, 5	1, 3, 5	1, 3, 5	1, 3, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	2, 4	1, 2, 3, 4, 5	1, 3, 5
PRZ-3-MW-4	Transition Zone	1, 2, 3, 4, 5	1, 3, 5	1, 3, 5	1, 3, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	-
CWS-1	Transition Zone	1, 2, 3, 4, 5	1, 3, 5	1, 3, 5	1, 3, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	2, 4	1, 2, 3, 4, 5	-
CWS-2	Transition Zone	1, 2, 3, 4, 5	1, 3, 5	1, 3, 5	1, 3, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	-
CWS-3	Compliance	1, 2, 3, 4, 5	1, 3, 5	1, 3, 5	1, 3, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	2, 4	1, 2, 3, 4, 5	-
MWS-7	Compliance	1, 2, 3, 4, 5	1, 3, 5	1, 3, 5	1, 3, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	2, 4	1, 2, 3, 4, 5	-

**Table 1 - Continued: Sampling Frequency and Constituent Suites
 (see Tables 2 and 3 for Suite and Frequency Descriptions)**

Well	Well Type	Suite A	Suite B	Suite C	Suite D	Suite E	Suite F	Suite G	Suite H	Suite I
MWS-8	Compliance	1, 2, 3, 4, 5	1, 3, 5	1, 3, 5	1, 3, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	2, 4	1, 2, 3, 4, 5	-
MWS-9	Treatment Zone	1, 2, 3, 4, 5	1, 3, 5	1, 3, 5	1, 3, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	2, 4	1, 2, 3, 4, 5	1, 3, 5
PRZ-4-MW-1	Treatment Zone	1, 2, 3, 4, 5	1, 3, 5	1, 3, 5	1, 3, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	-
PRZ-4-MW-2	Transition Zone	1, 2, 3, 4, 5	1, 3, 5	1, 3, 5	1, 3, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	2, 4	1, 2, 3, 4, 5	1, 3, 5
PRZ-4-MW-3	Transition Zone	1, 2, 3, 4, 5	1, 3, 5	1, 3, 5	1, 3, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	-
CWS-4	Compliance	1, 2, 3, 4, 5	1, 3, 5	1, 3, 5	1, 3, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	2, 4	1, 2, 3, 4, 5	-
MWS-10	Down gradient	1, 2, 3, 4, 5	-	-	-	1, 2, 3, 4, 5	1, 2, 3, 4, 5	1, 2, 3, 5	1, 2, 3, 4, 5	-
MWS-11	Down gradient	1, 2, 3, 4, 5	-	-	-	1, 2, 3, 4, 5	1, 2, 3, 4, 5	1, 2, 3, 5	1, 2, 3, 4, 5	-
MWS-12	Down gradient	1, 2, 3, 4, 5	-	-	-	1, 2, 3, 4, 5	1, 2, 3, 4, 5	1, 2, 3, 5	1, 2, 3, 4, 5	-
MWS-13	Down gradient	1, 2, 3, 4, 5	-	-	-	1, 2, 3, 4, 5	1, 2, 3, 4, 5	1, 2, 3, 5	1, 2, 3, 4, 5	-
MWS-14C	Down gradient	1, 2, 3, 4, 5	-	-	-	1, 2, 3, 4, 5	1, 2, 3, 4, 5	1, 2, 3, 5	1, 2, 3, 4, 5	-

Table 2: Analytical Suites A through I for Table 1

Suite	Constituent Class	Purpose
A	Site COCS (PCE, TCE, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, vinyl chloride)	Site contaminants and daughter products and monitoring of secondary water quality standards
B	General minerals (alkalinity, bicarbonate, chloride, sulfate, total hardness, nitrate, nitrite, and ammonia)	Laboratory geochemical characterization (monitoring of secondary water quality standards)
C	Total dissolved solids (TDS)	Monitoring of secondary water quality standards
D	Total and dissolved metals (arsenic, barium, cadmium, calcium, total chromium, copper, iron, lead, manganese, magnesium, mercury, molybdenum, nickel, selenium, and silica)	Monitoring of secondary water quality standards
E	Field parameters (pH, dissolved oxygen, ORP, temperature, specific conductivity, ferrous iron, and sulfide)	Field geochemical characterization and monitoring of secondary water quality standards
F	Total organic carbon	Measure of amendment distribution and longevity
G	Geochemical (alkalinity, sulfate, nitrate, total iron, dissolved iron)	Laboratory geochemical characterization to measure amendment performance
H	Dissolved gases (methane, ethane, and ethene)	Products of degradation
I	Microbial (Dehalococcoides sp. and functional genes)	Presence of dechlorinating bacteria

Table 3: Groundwater Monitoring Event Schedule for Table 1

Sampling Event	Event Purpose	Time of Completion
1	Measure baseline pre-amendment conditions	Prior to amendment injections
2	Performance monitoring	Three months post-injections
3	Performance monitoring	Six months post-injections
4	Performance monitoring	Nine months post-injections
5	Performance monitoring	Twelve months post-injections

Table 4: Analytical Methods

Constituent	Analytical Method ¹	Maximum Practical Quantitation Limit ²
Volatile Organic Compounds	EPA 8260B	0.5 µg/L
Alkalinity	EPA 300	5 mg/L
Bicarbonate	EPA 300	5 mg/L
Chloride	EPA 300	0.5 mg/L
Sulfate	EPA 300	2.5 mg/L
Total Hardness	EPA 300	0.5 mg/L
Nitrate	EPA 300	0.3 mg/L
Total Dissolved Solids	EPA 160.1	10 mg/L
Arsenic	EPA 6010/6020	5 µg/L
Calcium	EPA 300	0.1 mg/L
Dissolved Iron	EPA 6010/6020	100 µg/L
Dissolved Manganese	EPA 6010/6020	20 µg/L
Manganese	EPA 6010/6020	20 µg/L
Magnesium	EPA 300	50 µg/L
Sodium	EPA 300	1 mg/L
Potassium	EPA 300	0.02 mg/L
Total Organic Carbon	EPA 415.2	0.3 mg/L
Methane	RSK 175	1 µg/L
Ethane	RSK 175	1 µg/L
Ethene	RSK 175	1 µg/L
Volatile Fatty Acids	EPA 5560	3 mg/L
Dehalococcoides Bacteria	CENSUS	3.7 cells/ml

¹ Or an equivalent method that achieves the maximum Practical Quantitation Limit.

² All concentrations between the Method Detection Limit and the Practical Quantitation Limit shall be reported as an estimated value.

FIELD SAMPLING

In addition to the above sampling and analysis, field sampling and analysis shall be conducted each time a well is sampled. The sampling and analysis of field parameters shall be as specified in Table 5.

Table 5: Field Sampling Requirements

Parameters	Units	Type of Sample
Groundwater Elevation	feet, mean sea level (ft msl)	Measurement
Oxidation-Reduction Potential (ORP)	millivolts (mV)	Grab
Electrical Conductivity (EC)	micromhos per centimeter (umhos/cm)	Grab
Dissolved Oxygen	milligrams per liter (mg/L)	Grab
Temperature	degrees Fahrenheit (°F)	Grab
pH	pH units	Grab

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

1. The operator is trained in proper use and maintenance of the instruments;
2. The instruments are calibrated prior to each monitoring event;
3. Instruments are serviced and/or calibrated by the manufacturer at the recommended frequency; and
4. Field calibration reports are submitted as described in item (b) of the "Reporting" section of this MRP.

IN-SITU DISCHARGE MONITORING

The Discharger shall monitor daily the discharge of water and amendments that are injected into the groundwater during the pilot test, according to the requirements specified in Table 6.

Table 6: Discharge Monitoring Requirements

Parameters	Units	Type of Sample
Injected Volume	gallons per day	Meter
Amendment(s) Added	pounds per day	Measured

ESTABLISHMENT OF BACKGROUND CONCENTRATION VALUES

The Discharger shall determine the background concentration values of arsenic, chromium, iron, manganese, magnesium, potassium, and total dissolved solids in groundwater following the procedures found in California Code of Regulations, Title 27, Section 20415(e)(10). The Discharger shall collect samples from the compliance wells (CWS-3, CWS-4, MWS-5, MWS-7, and MWS-8) and analyzed for the above constituents. Background concentration values for each of the above constituents will then be established (on an individual, well-by-well basis) using the calculated 95% upper confidence limit. Groundwater concentrations at Compliance wells may not exceed the respective background concentration values by more than 20 percent.

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 clearly illustrate compliance with this Order. In addition, the Discharger shall notify the Central Valley Water Board staff within 48 hours of any unscheduled shutdown of the groundwater extraction system that results in system non-operation for seven consecutive days or more. The results of any monitoring done more frequently than required at the locations specified in the Monitoring and Reporting Program shall also be reported to the Central Valley Water Board.

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

The Discharger shall submit semiannual electronic data reports, which conform to the requirements of the California Code of Regulations, Title 23, Division 3, Chapter 30. The semiannual reports shall be submitted electronically over the internet to the Geotracker database system by **1 August and 1 February** until such time as the Executive Officer determines that the reports are no longer necessary.

Each semiannual report 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) a discussion of groundwater quality at compliance wells, with respect to the applicable groundwater limitations;
- (c) a discussion of groundwater quality at sentinel wells, with respect to the applicable baseline conditions;
- (d) 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, field instrument calibration reports, etc.;
- (e) groundwater contour maps for all groundwater zones, if applicable;
- (f) pollutant concentration maps for all groundwater zones, if applicable;
- (g) 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;
- (h) a table showing historical lateral and vertical (if applicable) flow directions and gradients;
- (i) cumulative data tables containing the water quality analytical results and depth to groundwater;
- (j) a copy of the laboratory analytical data report(s);
- (k) the status of any ongoing remediation, including an estimate of the cumulative 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
- (l) 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.

An Annual Report shall be submitted to the Central Valley Water Board by **1 February** of each year. This report shall contain an evaluation of the effectiveness and progress of the investigation and remediation. The Annual Report may be substituted for the second semi-annual monitoring report as long as it contains all of the information required for that report plus that required for the Annual Report. The Annual Report 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 effectively treated;
- (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.

A letter transmitting the monitoring reports shall accompany each report. Such a letter shall include a discussion of requirement violations found during the reporting period, and actions taken or planned for correcting noted violations, such as operation or facility modifications. If the Discharger has previously submitted a report describing corrective actions and/or a time schedule for implementing the corrective actions, reference to the previous correspondence will be satisfactory. The transmittal letter shall contain the penalty of perjury statement by the Discharger, or the Discharger's authorized agent, as described in the Standard Provisions General Reporting Requirements Section B.3.

The Discharger shall implement the above monitoring program on the first day of the month following adoption of this Order.

Ordered by:

Original Digitally Signed by John J. Baum on
Date: 2021.11.08 12:04:04 -08'00'

For PATRICK PULUPA, Executive Officer

11/8/2021

(Date)