

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
CENTRAL VALLEY REGION

MONITORING AND REPORTING PROGRAM NO. R5-2015-0012-013

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

LINCOLN CENTER ENVIRONMENTAL REMEDIATION TRUST  
STOCKTON, CALIFORNIA  
SAN JOAQUIN COUNTY

This Monitoring and Reporting Program (MRP) is issued to the Lincoln Center Environmental Remediation Trust (Discharger) and describes requirements for monitoring the progress of the in situ chemical oxidation (ISCO) groundwater remediation program (ISCO Program) at the Lincoln Village Shopping Center in Stockton, California (the "Site"). The primary objective of the ISCO Program is to treat tetrachloroethene, trichloroethene, and cis-1,2-dichloroethene groundwater impacts in the site vicinity. This full-scale ISCO Program was designed based, in part, on the results of an ISCO pilot test conducted during 2013. The design for the full-scale ISCO Program was included in the 9 October 2015 *Final Revised Remedial Design/Remedial Action Work Plan* (RD/RA Work Plan) submitted as part of the Notice of Intent for coverage under General Order R5-2015-0012. The ISCO Program covered by this MRP will be implemented in three sequential phases. During Phases 1 and 2, the ISCO Program involves the delivery of a chemical oxidant, potassium permanganate, into groundwater using a recirculation approach for both shallow (A-Zone) and deep (B-Zone) groundwater. Phase 1 and Phase 2 consist of ISCO recirculation using injection transects located on-Site and off-Site, respectively, as shown on Figures 1 through 4 of this MRP. During Phase 3, extracted groundwater will be treated and recirculated through the A-Zone and B-Zone treatment areas. During Phase 3, no oxidant will be injected.

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**

This section presents the groundwater monitoring programs for the Phase 1 and Phase 2 ISCO Programs. 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.

**PHASE 1 GROUNDWATER MONITORING PROGRAM**

The expected duration of Phase 1 is approximately 18 months. The locations of the A-Zone and B-Zone wells included in the Phase 1 groundwater monitoring program are shown on Figures 1 and 2, respectively. The Phase 1 groundwater monitoring wells shall be sampled according to the schedule in Table 1A and the samples analyzed by the methods in Table 2.

**Table 1A: Phase 1 Sampling Frequency and Constituent Suites**

<b>Well Number<sup>1</sup></b>	<b>Frequency</b>	<b>Constituent Suite(s)<sup>2,3</sup></b>	<b>Monitoring Objective<sup>4</sup></b>
<i>A-Zone:</i> A1-U/L (proposed), A2-U/L (proposed), MW-108A, MW-121A-U, MW-122-A-U, MW-123A-L, MW-124-A-L, MW-128A  <i>B-Zone:</i> MW-205B, MW-214B, MW-215B	Baseline (prior to injection), then Quarterly	Suite A and Field Sampling	Treatment Zone <sup>5</sup>
<i>A-Zone:</i> A1-U/L (proposed), A2-U/L (proposed), MW-108A, MW-121A-U, MW-122-A-U, MW-123A-L, MW-124-A-L, MW-128A  <i>B-Zone:</i> MW-205B, MW-214B, MW-215B	Baseline (prior to injection), then Annually	Suite B and Field Sampling	Treatment Zone <sup>5</sup>
<i>A-Zone:</i> MW-117A, MW-125A, MW-127A, MW-129A  <i>B-Zone:</i> MW-206B, MW-216B, MW-218B	Quarterly (during Background Study), then Annually	Suites A, B and Field Sampling	Background <sup>6</sup> & Compliance <sup>7</sup>

<sup>1</sup> Well numbers and locations as shown on Figures 1 and 2.

<sup>2</sup> Constituent suite components are listed in Table 2.

<sup>3</sup> Field sampling components are listed in Table 3.

<sup>4</sup> Because the ISCO Program is being applied with a recirculation system, a transition zone does not exist and, therefore, there are no proposed transition zone wells.

<sup>5</sup> Wells sampled to evaluate remediation progress inside the treatment zone.

<sup>6</sup> Wells used to develop background concentrations.

<sup>7</sup> Wells used to determine compliance with water groundwater limitations.

Monitoring wells MW-121A-U, MW-123-A-L, MW-128A, and MW-215B in the treatment zone will also function as “sentinel wells” during Phase 1. The sentinel wells are existing wells that are downgradient of the Phase 1 injection wells, yet upgradient of extraction wells and within the hydraulic capture zone. The purpose of the sentinel wells is to provide information on the proximity of hexavalent chromium to the extraction wells and to determine the appropriate time to install and operate ion exchange at the groundwater treatment system.

A baseline concentration for hexavalent chromium and other inorganic constituents will be established in the sentinel wells prior to starting Phase 1 recirculation, as described in the “Establishment of Background Concentration Values” section of this MRP. A trigger concentration (defined as 20 percent greater than baseline) will be established for each well. If a trigger concentration is exceeded in a well, the Central Valley Water Board will be notified and a confirmation sample will be collected from the sentinel well, the nearest downgradient extraction well and Compliance Well, and the groundwater treatment system influent and effluent monthly, for at least one quarter. If the hexavalent chromium concentration in the groundwater treatment system monthly influent sample exceeds 7.0 micrograms per liter (ug/L), the Discharger shall collect a confirmation sample within 24 hours and with a turnaround time of no more than 5 days. If the confirmation sample exceeds 7.0 ug/L, the Discharger shall bring the ion exchange system on-line to remove hexavalent chromium as proposed in the RD/RA Work Plan. The established NPDES permit average monthly effluent limit is currently 7.8 ug/L with in instantaneous maximum of 16.0 ug/L. The typical range of hexavalent chromium in the effluent is 3.6 to 4.9 ug/L based on 2014 data.

**PHASE 2 GROUNDWATER MONITORING PROGRAM**

Phase 2 will commence following the completion of Phase 1. The expected duration for Phase 2 is approximately 18 months. The locations of the A-Zone and B-Zone wells included in the Phase 2 groundwater monitoring program are shown on Figures 3 and 4, respectively. The Phase 2 groundwater monitoring wells shall be sampled according to the schedule in Table 1B and the samples analyzed by the methods in Table 2.

**Table 1B: Phase 2 Sampling Frequency and Constituent Suites**

Well Number <sup>1</sup>	Frequency	Constituent Suite(s) <sup>2,3</sup>	Monitoring Objective <sup>4</sup>
A-Zone: A3U/L (proposed), A4U/L (proposed), A5U/L (proposed)  B-Zone: B1U/L (proposed), B2U/L (proposed)	Baseline (prior to injection), then Quarterly	Suite A and Field Sampling	Treatment Zone <sup>5</sup>

<p><i>A-Zone:</i>                  A3U/L (proposed),                  A4U/L (proposed),                  A5U/L (proposed)</p> <p><i>B-Zone:</i>                  B1U/L (proposed),                  B2U/L (proposed)</p>	<p>Baseline (prior to injection), then Annually</p>	<p>Suite B and Field Sampling</p>	<p>Treatment Zone<sup>5</sup></p>
<p><i>A-Zone:</i>                  MW-117A, MW-125A,                  MW-127A, MW-129A</p> <p><i>B-Zone:</i>                  MW-206B, MW-216B,                  MW-218B</p>	<p>Quarterly (during Background Study), then Annually</p>	<p>Suites A, B and Field Sampling</p>	<p>Background<sup>6</sup> &amp; Compliance<sup>7</sup></p>

- 1 Well numbers and locations as shown on Figures 3 and 4.
- 2 Constituent suite components are listed in Table 2.
- 3 Field sampling components are listed in Table 3.
- 4 Because the ISCO Program is being applied with a recirculation system, a transition zone does not exist and, therefore, there are no proposed transition zone wells.
- 5 Wells sampled to evaluate remediation progress inside the treatment zone.
- 6 Wells used to develop background concentrations.
- 7 Wells used to determine compliance with water groundwater limitations.

Proposed wells A3U/L, A4U/L, A5U/L, B1U/L, and B2U/L in the treatment zone will also function as sentinel wells during Phase 2. The sentinel wells will be installed downgradient of the Phase 2 injection wells, yet upgradient of the extraction wells and within the hydraulic capture zone. As with Phase 1, the purpose of the sentinel wells is to provide information on the proximity of hexavalent chromium to the extraction wells and to determine the appropriate time to install and operate ion exchange at the groundwater treatment system if it was not already installed during Phase 1.

A baseline concentration for hexavalent chromium and other inorganic constituents will be established in the sentinel wells following well installation and development and prior to starting Phase 2 recirculation. A trigger concentration (defined as 20 percent greater than baseline) will be established for each well. If a trigger concentration is exceeded in a well, the Central Valley Water Board will be notified and a confirmation sample will be collected from the sentinel well, the nearest downgradient extraction well and Compliance well, and the groundwater treatment system influent and effluent monthly, for at least one quarter. If the hexavalent chromium concentration in the groundwater treatment system monthly influent sample exceeds 7.0 ug/L, the Discharger shall collect a confirmation sample within 24 hours and with a turnaround time of no more than 5 days. If the confirmation sample exceeds 7.0 ug/L, the Discharger shall bring the ion exchange system on-line to remove hexavalent chromium as proposed in the RD/RA Work Plan. The established NPDES permit average monthly effluent limit is currently 7.8 ug/L with in instantaneous maximum of 16.0 ug/L. The typical range of hexavalent chromium in the effluent is 3.6 to 4.9 ug/L based on 2014 data.

Phase 3 will commence immediately following the completion of Phase 2 and will include recirculating (extracted and treated) groundwater through the A-Zone and B-Zone treatment

areas. During Phase 3, no oxidant will be injected. Phase 3 recirculation is expected to operate for approximately five years. The groundwater monitoring program for Phase 3 will initially follow the same scope and schedule as the Phase 2 groundwater monitoring program and may later be adjusted, as appropriate.

**Table 2: Analytical Methods**

Constituent	Analytical Method <sup>1</sup>	Maximum Practical Quantitation Limit <sup>2</sup>
<b>Suite A</b>		
Volatile Organic Compounds	EPA 8260B	0.5 µg/L
Hexavalent Chromium <sup>3</sup>	EPA 7196, 7199	5 µg/L
Permanganate <sup>4</sup>	SM 4500- KMnO <sub>4</sub>	5 mg/L
<b>Suite B</b>		
Dissolved Iron	EPA 6020/200.8	100 µg/L
Dissolved Manganese	EPA 6020/200.8	20 µg/L
Total Chromium	EPA 6020/200.8	5 µg/L
Total Potassium	EPA 6020/200.8	1 mg/L
Total Dissolved Solids	EPA 160.1	10 mg/L

- <sup>1</sup> Or an equivalent 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 an estimated value.
- <sup>3</sup> If the samples have visual evidence (i.e. pink or purple color) or residual permanganate, hexavalent chromium will instead be analyzed using EPA 7199 due to interference with EPA 7196.
- <sup>4</sup> If hexavalent chromium (EPA 7196, 7199) and total chromium (EPA 6020/200.8) analytical results are shown to be approximately equal, the Discharger may elect to substitute the latter method for any required hexavalent chromium analysis.

**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 3.

**Table 3: 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 Celsius (°C)	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.

### TREATMENT PLANT EFFLUENT MONITORING

The effluent (after treatment and prior to oxidant amendment) from the groundwater treatment system will be sampled for volatile organic compounds (VOCs) during the ISCO Program on a monthly basis. A maximum effluent limitation of 0.5 µg/L applies to each VOC for which the Discharger is responsible for (i.e. tetrachloroethene, trichloroethene, and cis-1,2-dichloroethene, trans-1,2-dichloroethene, and vinyl chloride).

It should be noted that the groundwater treatment system is concurrently governed by National Pollutant Discharge Elimination System (NPDES) No. CA0084255. The NPDES Permit requires monthly effluent monitoring for constituents including VOCs, hexavalent chromium, and other inorganic constituents of concern for the ISCO Program.

### IN-SITU DISCHARGE MONITORING

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

**Table 4: Discharge Monitoring Requirements**

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

### AMENDMENT ANALYSIS

As part of previous ISCO pilot-testing activities under General Order R5-2008-0149, the Discharger completed an amendment analysis on a mixture of Carus®-brand potassium permanganate and deionized water. The concentration of permanganate in the mixture was 2 g/L, which is approximately equal to the target injection concentration (2.3 g/L) to be used during the Phase 1 and Phase 2 ISCO Programs. The results of the previously-submitted amendment analysis were submitted with the Notice of Intent for General Order R5-2015-0012 and will be used to satisfy this requirement. The Discharger has also provided the Central Valley Water Board with the manufacturer's certificate of analysis for the oxidant.

## **ESTABLISHMENT OF BACKGROUND CONCENTRATION VALUES**

The Discharger shall conduct a Background Study to determine the background concentration values of hexavalent chromium, dissolved iron, dissolved manganese, total chromium, total potassium, total dissolved solids, pH, and electrical conductivity in groundwater following the procedures found in California Code of Regulations, Title 27, Section 20415(e)(10). The Discharger shall conduct at least eight sampling events (i.e., quarterly for two years) as part of this study. During each background sampling event, samples will be collected from MW-117A, MW-125A, MW-127A, MW-129A, MW-206B, MW-216B, and MW-218B 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 of the mean. Groundwater concentrations at Compliance wells may not exceed the respective background concentration values by more than 20 percent.

Changes in background groundwater quality may occur over time due to environmental factors. For example, over the past decade an increasing trend in background groundwater electrical conductivity has been observed in the site vicinity. In consultation with the Central Valley Water Board staff, the Discharger may propose future studies to determine any changes in background groundwater quality conditions. The Discharger may propose updates to background values for certain constituents based on the results of such studies.

## **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 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 the 1st day of the second month following the end of each calendar quarter 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 signed by Andrew Altevoqt for  
PAMELA C. CREEDON Executive Officer

22 August 2016

(Date)