

Los Angeles Regional Water Quality Control Board

February 11, 2015

Mr. Michael Bower
Project Coordinator
The Boeing Company
5800 Woolsey Canyon Road
MC T-487
Canoga Park, CA 91304

REVISED MONITORING AND REPORTING PROGRAM – IN SITU CHEMICAL OXIDATION PILOT TESTING FOR GROUNDWATER REMEDIATION AT SANTA SUSANA FIELD LABORATORY PROPERTY, 5800 WOOLSEY CANYON ROAD, CANOGA PARK, CALIFORNIA 93063 (FILE NO. 12-147, ORDER NO. R4-2007-0019, SERIES NO. 232, CI-9974, GLOBAL ID WDR100009654, EPA ID NO. CAN 000 908 498)

Dear Mr. Bower:

On September 5, 2013, The Boeing Company (hereinafter Discharger) was enrolled under the Los Angeles Regional Water Quality Control Board (Regional Board) Order No. R4-2007-0019, "General Waste Discharge Requirements for Groundwater Remediation at Petroleum Hydrocarbon Fuel, Volatile Organic Compound And/Or Hexavalent Chromium Impacted Sites," adopted by the Regional Board on March 1, 2007 for the injection of potassium permanganate (KMnO_4) into a single injection well as part of an *in-situ* chemical oxidation (ISCO) pilot test at the Santa Susana Field Laboratory (SSFL) in Ventura County, California. Upon enrollment of the Waste Discharge Requirements (WDRs), the Discharger was required to implement Monitoring and Reporting Program (MRP) No. CI-9974.

On November 20, 2014, the Discharger submitted a letter to the California Department of Toxic Substances Control (DTSC) requesting approval of modifications to the injection and monitoring program. DTSC approved the proposed modifications on December 19, 2014.

The following modifications to the injection and monitoring programs were approved by DTSC:

Injection-Related Modifications:

1. Postpone the December 2014 injection event to January 2015 to allow sufficient time to order additional KMnO_4 from the supplier and increase KMnO_4 dosage to potentially increase its effectiveness.
2. Reduce the total number of injections from 10 to 7 and decrease the time between injections to approximately 2 weeks apart beginning in mid-late January 2015. Additional injections may be conducted if supported by the data collected following the higher dose injections.
3. Increase the KMnO_4 dosing from 2% (20 g/L) to 3% (30 g/L), in an effort to increase its effectiveness.

Monitoring-Related Modifications:

1. Reduce frequency of weekly field parameter monitoring events to bi-weekly for primary wells. DTSC agreed that the bi-weekly monitoring events will allow for sufficient monitoring of trends over time through the remainder of the project.
2. Revise schedule for remaining monthly, quarterly, and semi-annual monitoring events, following completion of injection activities by early February 2015.
3. Reduce sampling frequency for three selected primary wells C-1, RD-73, and RD-35B, which are located outside the influence of the ISCO injections, from monthly to bi-monthly. The rationale for this change is based on monthly analytical data collected from June 2014 to October 2014 which demonstrate little to no change attributable to the ISCO injections. These wells will still be sampled bi-weekly for field parameters.
4. Collect samples from uppermost three sample ports only at multi-port wells RD-31 and RD-35C. There are a total of eight multi-port wells in the monitoring program, but wells RD-31 and RD-35C are located outside the influence of the ISCO injections. The rationale for this modification is based on quarterly analytical data from all RD-31 and RD-35C sample ports from June 2014 to September 2014 which demonstrate little to no change attributable to the ISCO injections. Sampling from the uppermost three ports is necessary to monitor ISCO influence. Deeper ports from these wells will be sampled if the uppermost three ports show potential influence from ISCO injections.

Regional Board staff concurs with the monitoring-related modifications approved by DTSC, and MRP No. CI-9974 is therefore modified as follows:

1. Change the minimum frequency for analysis of field parameters (dissolved oxygen, oxygen reduction potential, specific conductivity, pH, temperature, and color) in primary wells from weekly to bi-weekly for the remaining monitoring events.
2. Change the minimum frequency for laboratory analysis of volatile organic compounds, dissolved metals, anions, boron, and total dissolved solids from monthly to bi-monthly for primary wells C-1, RD-73, and RD-35B.
3. Collect samples from the uppermost three ports only at secondary wells RD-31 and RD-35C. All deeper ports shall be sampled if any of the uppermost ports shows potential influence from the higher dosage ISCO injections.

The Discharger shall comply with the Electronic Submittal of Information (ESI) requirements by submitting all reports and correspondence required under the MRP, including groundwater monitoring data, discharge location data, and pdf monitoring reports to the State Water Resources Control Board GeoTracker database under Global ID WDR100009654. ESI training video is available at:

<https://waterboards.webex.com/waterboards/ldr.php?AT=pb&SP=MC&rID=44145287&rKey=7dad4352c990334b>

Please see Paperless Office Notice for GeoTracker Users, dated December 12, 2011 at:

<http://www.waterboards.ca.gov/losangeles/resources/Paperless/Paperless%20Office%20for%20GT%20Users.pdf>

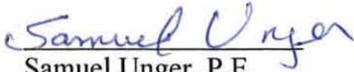
Mr. Michael Bower
The Boeing Company

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February 11, 2015

If you have any additional questions, please contact the Project Manager, Mr. David Koo at (213) 620-6155 (dkoo@waterboards.ca.gov) or the Unit Chief, Dr. Eric Wu at (213) 576-6683 (ewu@waterboards.ca.gov) regarding this matter.

Sincerely,


Samuel Unger, P.E.
Executive Officer

Enclosure: Monitoring and Reporting Program No. CI-9974 revised on February 11, 2015

cc: Mr. Roger Paulson, Department of Toxic Substances Control
Mr. Kevin Murdock, CH2M HILL

STATE OF CALIFORNIA
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LOS ANGELES REGION

REVISED MONITORING AND REPORTING PROGRAM NO. CI-9974
FOR
THE BOEING SANTA SUSANA FIELD LABORATORY IN-SITU CHEMICAL OXIDATION
FIELD EXPERIMENT PROJECT
INSTRUMENT AND EQUIPMENT LABORATORIES AREA
CANOGA PARK, CA 93063

ENROLLMENT UNDER REGIONAL BOARD
ORDER NO. R4-2007-0019 (SERIES NO. 232)
FILE NO. 12-147

I. REPORTING REQUIREMENTS

- A. The Boeing Company (hereinafter Discharger) shall implement this Monitoring and Reporting Program (MRP) at the Santa Susana Field Laboratory (SSFL), Instrument and Equipment Laboratories (IEL) Area, Canoga Park, California, the location of which is shown on Figure 1, on the effective date of this revision (February 11, 2015) under Regional Board Order No. R4-2007-0019. The first monitoring report under this monitoring program is due by July 30, 2015.

Monitoring reports shall be received by the dates in the following schedule:

<u>Reporting Period</u>	<u>Report Due</u>
January – March	April 30
April – June	July 30
July – September	October 30
October – December	January 30

- B. If there is no discharge or injection during any reporting period, the report shall so state.
- C. By January 15th of each year, beginning January 15, 2014, the Discharger shall submit an annual summary report to the Regional Board. The report shall contain both tabular and graphical summaries of the monitoring data obtained during the previous calendar year. In addition, the Discharger shall discuss the compliance record and the corrective actions taken, or planned, which may be needed to bring the discharge into full compliance with the waste discharge requirements.
- D. Laboratory analyses – all chemical, bacteriological, and toxicity analyses shall be conducted at a laboratory certified for such analyses by the California Department of Public Health Environmental Laboratory Accreditation Program (ELAP). A copy of the laboratory certifications shall be provided each time a new and/or renewal is obtained from ELAP.

- E. The method limits (MLs) employed for effluent analyses shall be lower than the permit limits established for a given parameter, unless the Discharger can demonstrate that a particular ML is not attainable and obtains approval for a higher ML from the Executive Officer. At least once a year, the Discharger shall submit a list of the analytical methods employed for each test and the associated laboratory quality assurance/quality control (QA/QC) procedures.
- F. All QA/QC samples must be run on the same dates when samples were actually analyzed. The Discharger shall make available for inspection and/or submit the QA/QC documentation upon request by Regional Board staff. Proper chain of custody procedures must be followed and a copy of the chain of custody documentation shall be submitted with the report.
- G. Each monitoring report must affirm in writing that "All base scope analyses were conducted at a laboratory certified for such analyses by the California Department of Health Services, and in accordance with current United States Environmental Protection Agency (USEPA) guideline procedures or as specified in this Monitoring Program." Proper chain of custody procedures must be followed and a copy of the completed chain of custody form shall be submitted with the report.
- H. For every item where the requirements are not met, the Discharger shall submit a statement of the cause(s), and actions undertaken or proposed which will bring the discharge into full compliance with waste discharge requirements at the earliest possible time, including a timetable for implementation of those actions.
- I. The Discharger shall maintain all sampling and analytical results, including strip charts, date, exact place, and time of sampling, dates analyses were performed, analyst's name, analytical techniques used, and results of all analyses. Such records shall be retained for a minimum of three years. This period of retention shall be extended during the course of any unresolved litigation regarding this discharge, or when requested by the Regional Board.
- J. In reporting the monitoring data, the Discharger shall arrange the data in tabular form so that the date, the constituents, and the concentrations are readily discernible. The data shall be summarized to demonstrate compliance with the requirements and, where applicable, shall include results of receiving water observations.
- K. Any mitigation/remedial activity including any pre-discharge treatment conducted at the site must be reported in the quarterly monitoring report.
- L. Each monitoring report shall contain a separate section titled "Summary of Non-Compliance" which discusses the compliance record and the corrective actions taken or planned that may be needed to bring the discharge into full compliance with WDRs. This section shall be located at the front of the report and shall

clearly list all non-compliance with discharge requirements, as well as all excursions of effluent limitations.

- M. The Discharger shall comply with requirements contained in Section G of Order No. R4-2007-0019 "*Monitoring and Reporting Requirements*" in addition to the aforementioned requirements.

II. INJECTION MONITORING REQUIREMENTS

Reagent Injections - An injection test (field pilot test) shall be performed at the site per the "*Work Plan Addendum #1, In-Situ Chemical Oxidation Field Experiment*" (Work Plan Addendum). The injection utilizes potassium permanganate solution mixed with potable water. The injection flow rates, potassium permanganate concentrations, and durations may vary from specific values included in the Work Plan Addendum based on observed head and water quality conditions, and these changes shall be based on advance California Department of Toxic Substances Control (DTSC) approval.

Prior to the first In-Situ Chemical Oxidation (ISCO) injection event, a potassium bromide tracer test shall be conducted. The tracer test shall consist of 2 to 5 days of potassium bromide addition, followed by several weeks of field parameter monitoring from the monitoring well network.

The quarterly reports shall contain the following information regarding the injection activities. If there is no injection during any reporting period, the report shall so state.

1. Location map showing injection wells for the oxidant or tracer solution.
2. Written summary defining:
 - Depth of injection;
 - Total volume and concentration of the reagent solution injected;
 - Reagent injection flow rate; and
 - Reagent injection pressures.

III. GROUNDWATER MONITORING PROGRAM FOR THE REMEDIATION PROJECT

A groundwater monitoring program shall be designed to detect and evaluate impacts associated with the injection activities. A tracer test shall be conducted first, followed by the ISCO injection events, and both will be conducted at well RD-35A. The tracer test shall include 2-5 days of tracer solution injection, followed by 4 to 6 weeks of monitoring at groundwater monitoring wells RD-105, RD-106, RD-107, C-1, C-10, C-18, RD-35B, and RD-73. The tracer shall include potassium bromide, mixed to a target injection concentration of approximately 200 to 2,000 milligrams per liter (mg/L).

After the tracer test monitoring period is complete, the ISCO injection shall be conducted. Tables 1 and Table 2, below, identify the constituents that shall be analyzed during the baseline sampling event (about one month prior to the tracer or ISCO injection

date) and subsequent groundwater monitoring events during the monitoring period for the purpose of evaluating the effectiveness of the tracer and the injection.

For the tracer test, the Monitoring and Reporting Program shall include eight (8) *primary* groundwater monitoring wells which are located closest to the injection well - RD-105, RD-106, RD-107, C-1, C-10, C-18, RD-35B, and RD-73. For the ISCO injection, the same primary wells shall be monitored (both “routine” and “non-routine” wells), with the addition of four (4) *secondary* monitoring wells (located further from or deeper than the injection well - RD-31, RD-35C, RD-37, and RD-72), and three *tertiary* monitoring wells (located furthest from the injection well - HAR-24, HAR-25, and WS-14). The locations of the monitoring wells are shown on Figure 2 (attached). These sampling stations shall not be changed and any proposed change of monitoring locations shall be identified and approved by the Regional Board Executive Officer (Executive Officer) prior to their use.

TABLE 1. BROMIDE TRACER TEST SAMPLING SCHEDULE

Parameter	Analytical Method	Sampling Frequency		
		Baseline	During Tracer Addition to First Arrival, Every 1-10 Days	Post-Tracer Arrival (Every 3-21 Days)
PRIMARY WELLS ONLY (RD-105, RD-106, RD-107, C-1, C-10, C-18, RD-35B, RD-73)				
DO, ORP, specific conductance, pH, temperature	Field measured using flow-through cell	X	X	X
Bromide	Hach [®] Field Test Kit, ion-specific electrode, and/or EPA 300.0	X	X	X

- NOTES: (1) Sampling frequency above is estimated minimum monitoring required; additional monitoring may be conducted as needed. Samples will be submitted for laboratory confirmation of field-measured bromide at a frequency of 10%.
 (2) Baseline sampling consists of single sampling event about one month prior to the start of the tracer study.
 (3) During tracer addition, frequent monitoring shall be conducted to monitor “first arrival.” It is expected that more frequent sampling shall be needed at wells closer to the injection well or along flow pathways from the injection well, whereas more distant wells or those that may not be located along flow pathways shall be monitored less frequently.
 (4) After tracer addition is complete, less frequent monitoring shall be conducted to monitor “tail” of the breakthrough curve. Similar to the tracer addition period, it is expected that more frequent sampling shall be needed at wells closer to the injection well or along flow pathways from the injection well, whereas more distant wells or those that may not be located along flow pathways shall be monitored less frequently.
 (5) Some of the individual ports in the multi-port wells may not show response from the tracer test, and the monitoring frequency may be reduced for these ports upon the approval of the Regional Board Executive Officer.
 (6) Some secondary wells (identified in Table 2) may be monitored if breakthrough is observed at the primary wells.
 (7) Due to uncertainty in predicting the duration of a tracer study, the monitoring shall continue until the Regional Board is notified that the tracer study is complete.
 X Test for parameter

The water quality results collected during the ISCO performance monitoring program, as presented in Table 2, will be used to evaluate the total distance that the potassium permanganate solution has traveled, and the associated timeframe. The travel distance and time will depend on many factors, including the natural oxidant demand of the formation and the degree to which there are interconnected fractures between the injection well and the

monitoring well ports. The arrival of potassium permanganate may be observed within days in the nearby primary wells, and within weeks, or not at all, in the more distant primary wells and secondary/tertiary wells. Potassium permanganate can persist and remain reactive for several weeks in the subsurface. The purpose of the multiple injections is to create a sustained concentration gradient that will provide for diffusion of oxidant from the fractures into the adjacent rock matrix blocks, where a majority of the contaminant mass is expected to be present.

TABLE 2. ISCO PILOT TEST SAMPLING SCHEDULE

Parameter	Analytical Method	Sampling Frequency ^{1, 2, 5}		
		Baseline ⁴	Weekly or Bi-Weekly Monitoring (X or C) ²	Monthly (M), Bi-Monthly (B), Quarterly (Q) ³ , or Semi-Annual (S) Analytical Sampling
PRIMARY "ROUTINE" WELLS (RD-105, RD-106, RD-107, C-18, C-10)				
DO, ORP, spec. cond., pH, temp.	Field measured, flow-through cell	X	X*	
Permanganate	Field Colorimeter	X	X*	
VOCs	EPA Method 8260B	X	X*	M
Dissolved metals (includes K and Mn)	EPA Methods 6010B and/or 6020	X		M
Anions (bromide, chloride, nitrate, sulfate, bicarbonate)	EPA Method 300.0 (SM 2320B for bicarbonate)	X		M
Boron	EPA Method 200.7	X		M
TDS	SM 2540C	X		M
PRIMARY "NON-ROUTINE" WELLS (RD-35B, RD-73, C-1)				
DO, ORP, spec. cond., pH, temp.	Field measured, flow-through cell	X	X*	
Permanganate	Field Colorimeter	X	X*	
VOCs	EPA Method 8260B	X	X*	B
Dissolved metals (includes K and Mn)	EPA Methods 6010B and/or 6020	X		B
Anions (bromide, chloride, nitrate, sulfate, bicarbonate)	EPA Method 300.0 (SM 2320B for bicarbonate)	X		B
Boron	EPA Method 200.7	X		B
TDS	SM 2540C	X		B

SECONDARY WELLS (RD-31, RD-35C, RD-37, RD-72) ⁶				
DO, ORP, spec. cond, pH, temp	Field measured, flow-through cell	X	C	Q
Permanganate	Field Colorimeter	X	C	Q
VOCs	EPA Method 8260B	X		Q
Dissolved metals (includes K and Mn)	EPA Methods 6010B and/or 6020	X		Q
Anions (bromide, chloride, nitrate, sulfate, bicarbonate)	EPA Method 300.0 (SM 2320B for bicarbonate)	X		Q
Boron	EPA Method 200.7	X		Q
TDS	SM 2540C	X		Q
TERTIARY WELLS (HAR-24, HAR-25, WS-14)				
DO, ORP, spec. cond, pH, temp	Field measured, flow-through cell	X	C	S
Permanganate	Field Colorimeter	X	C	S
VOCs	EPA Method 8260B	X		S
Dissolved metals (includes K and Mn)	EPA Methods 6010B and/or 6020	X		S
Anions (bromide, chloride, nitrate, sulfate, bicarbonate)	EPA Method 300.0 (SM 2320B for bicarbonate)	X		S
Boron	EPA Method 200.7	X		S
TDS	SM 2540C	X		S

- NOTES: (1) Sampling frequency above is the minimum monitoring required; additional monitoring may be conducted as needed.
 (2) If some ports in the primary multi-port monitoring wells do not show response from the ISCO test after 3-4 months of weekly/monthly monitoring, then the frequency may be reduced (from weekly to bi-weekly for field parameter measurements, and from monthly to bi-monthly for the laboratory analytical parameters) – pending Regional Board's approval. If there is no response from some ports after 6 months of monitoring, then the sampling frequency may be further reduced from bi-weekly to monthly for field parameter measurements, and from bi-monthly to quarterly for the laboratory analytical parameters – pending Regional Board's approval.
 (3) The quarterly samples from the secondary wells shall be collected at baseline, 3, and 6 months during injection, and approximately 3 and 6 months post-injection (6 events). The semi-annual samples from the tertiary wells shall be collected at baseline, 6 months after the start of injection, and approximately 6 months after the stop of injection (3 events). The frequency of sampling may be increased to quarterly (for the tertiary wells) or bi-monthly or monthly (for the secondary wells) if there are influences from the ISCO injection based on the laboratory analytical data.
 (4) Baseline sampling consists of a single sampling event about one month prior to the start of injection.
 (5) Post-injection sampling shall consist of a maximum of 6 months after the final ISCO injection event, or until the Regional Board is notified that the respective pilot test for permanganate is complete.
 (6) Beginning with the December 2014 quarterly sampling event, only the top 3 ports of Westbay wells RD-31 and RD-35C will be sampled, based on DTSC verbal approval on December 5, 2014 and email approval on December 19, 2014. Deeper ports from these wells will be sampled if the uppermost ports show potential influence from the higher dosage ISCO injections planned for early 2015.
 * Weekly sampling for field parameters (DO, ORP, specific conductivity, pH, temperature, and permanganate/color) will be conducted throughout the monitoring period unless a reduction in frequency is approved by the Regional Board, per Note (2) above. Weekly monitoring for VOCs in the primary wells will be conducted for the first 8 weeks (2 months) to allow more frequent evaluation of contaminant concentrations; after the 8 week period, monthly monitoring for VOCs will be conducted for the remaining portion of the monitoring period. Weekly sampling events will be conducted into early 2015, and then bi-weekly sampling events will be conducted through the remainder of the monitoring program following MRP

revision.

X Test for parameter

C Testing is contingent and shall only be conducted if there are influences from the ISCO injection in the nearest primary well (RD-31 sampling contingent on C-1 results; RD-35C contingent on RD-35B results; RD-37 contingent on C-10 and RD-106 results; RD-72 contingent on RD-106 results; HAR-24 and HAR-25 contingent on RD-73 results, and; WS-14 contingent on C-10 results).

All groundwater monitoring reports must include, at minimum, the following:

- a. Well identification, date and time of sampling;
- b. Sampler identification, and laboratory identification;
- c. Quarterly observation of groundwater levels, recorded to 0.01 feet mean sea level and groundwater flow direction.

IV. MONITORING FREQUENCIES

Specifications in this monitoring program are subject to periodic revisions. Monitoring requirements may be modified or revised by the Executive Officer based on review of monitoring data submitted pursuant to this Order. Monitoring frequencies may be adjusted to a less frequent basis or parameters and locations dropped by the Executive Officer if the Discharger makes a request and the request is backed by statistical trends of monitoring data submitted.

V. CERTIFICATION STATEMENT

Each report shall contain the following completed declaration:

"I certify under penalty of law that this document, including all attachments and supplemental information, was prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of a fine and imprisonment.

Executed on the ____ day of _____ at _____

_____ (Signature)

_____ (Title)"

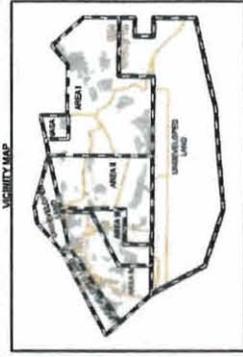
VI. ELECTRONIC SUBMITTAL OF INFORMATION (ESI) TO GEOTRACKER

The Discharger shall comply with the Electronic Submittal of information (ESI) requirements by submitting all reports required under the MRP, including groundwater monitoring data, discharge location data, correspondence, and pdf monitoring reports to the State Water Resources Control Board GeoTracker database under Global ID WDR100009654.

All records and reports submitted in compliance with this Order are public documents and will be made available for inspection during business hours at the office of the California Regional Water Quality Control Board, Los Angeles Region, upon request by interested parties. Only proprietary information, and only at the request of the Discharger, will be treated as confidential.

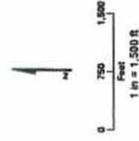
Ordered by: Samuel Unger
Samuel Unger, P.E.
Executive Officer

Date: February 11, 2015



- LEGEND**
- DIRT ROAD
 - PAVED ROAD
 - ADMINISTRATIVE AREA

Reference: USGS Topographic 7.5 Minute
 Quadrangle: Calabasas, 1987. Contour Interval: 25 ft



**WORKING
 DRAFT**

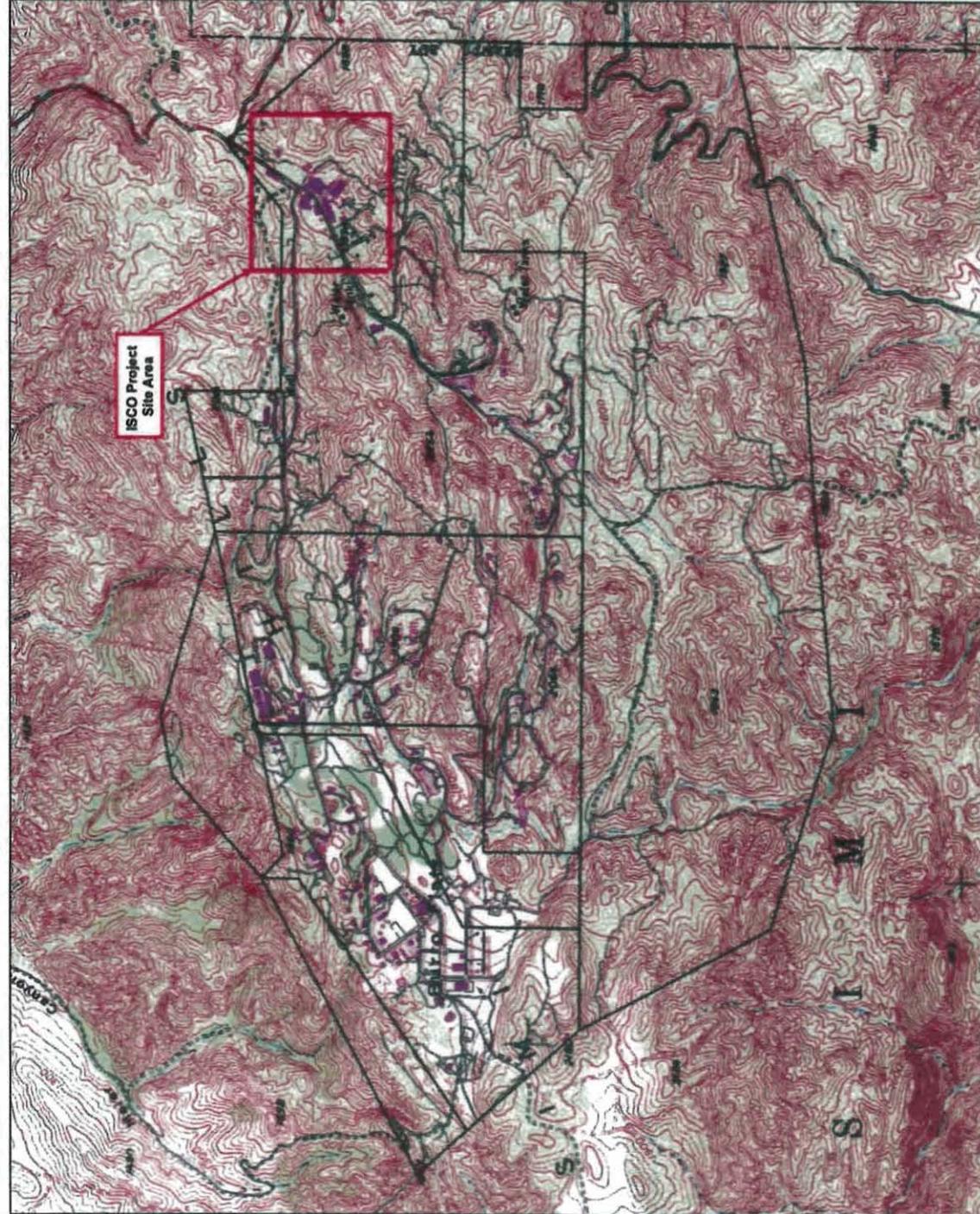
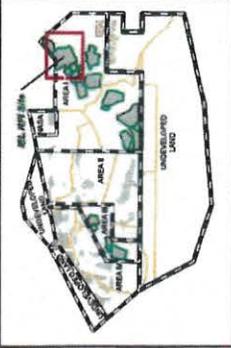


FIGURE 1
 Topographic Map with
 Project Site Location

San Joaquin Field Laboratory, Ventura County, California
 CHERRY-HILL

VICINITY MAP



- LEGEND**
- ISCO Injection Well
 - ◆ Primary Monitoring Well
 - ◆ Secondary Monitoring Well
 - ◆ Tertiary Monitoring Well
 - Locations Not Included in Monitoring Well Network
 - RFI Group Boundary
 - Existing RFI Site
 - Administrative Boundary
 - Dirt Road
 - Paved Road
 - Structure - Existing
 - Structure - Removed
 - Existing Concrete Slab
 - Removed Concrete Slab
 - Concrete Slab



WORKING DRAFT

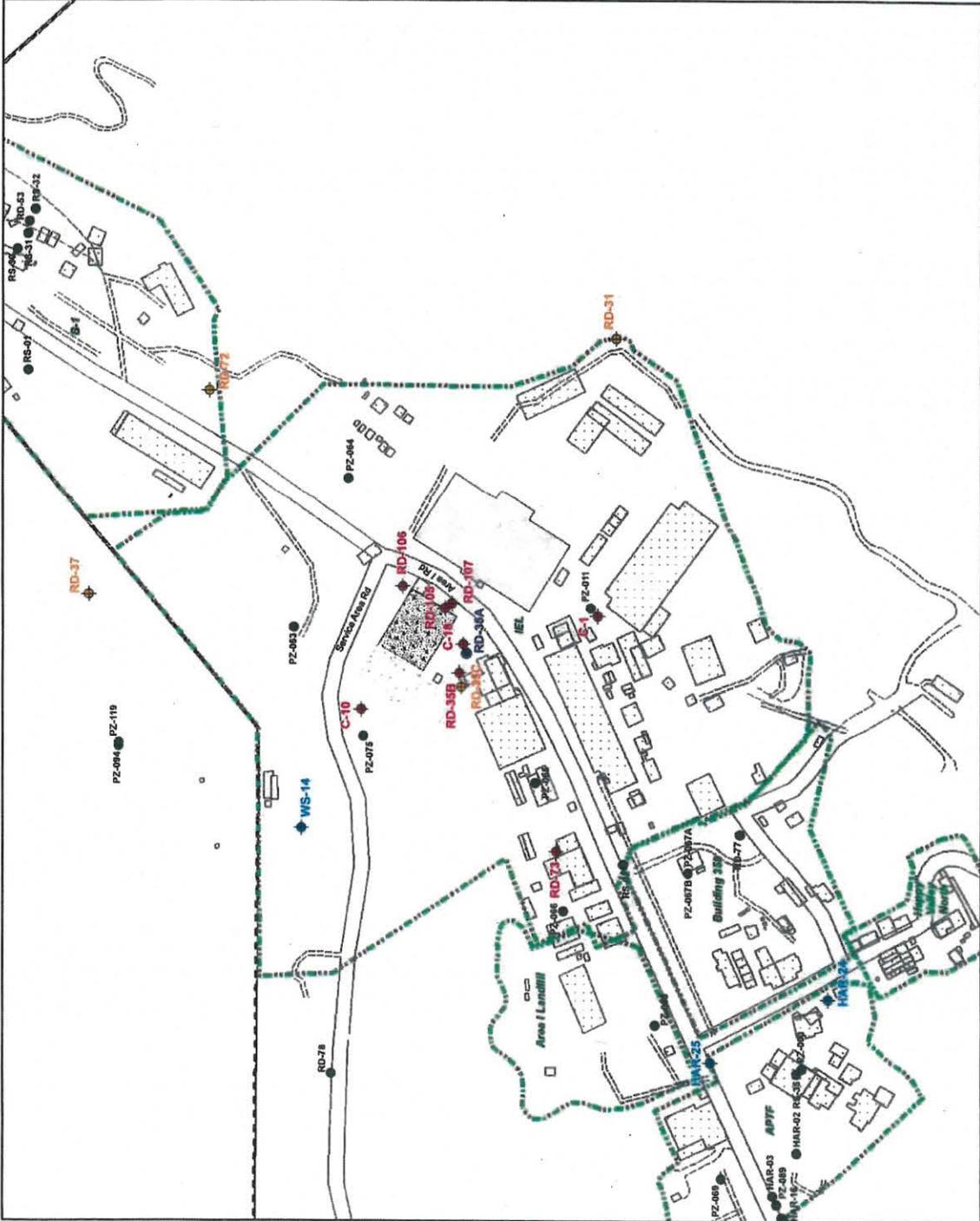


FIGURE 2
Performance Monitoring Well Layout
ISCO Field Experiment
 Santa Susana Field Laboratory, Ventura County, California
 CH22008-HLL