

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
CENTRAL VALLEY REGION

ORDER NO. R5-2004-0038

WASTE DISCHARGE REQUIREMENTS

FOR  
AIR FORCE REAL PROPERTY AGENCY  
FORMER MCCLELLAN AIR FORCE BASE  
ENHANCED ANAEROBIC BIORMEDIATION PILOT TEST AT IC-42  
SACRAMENTO COUNTY

The California Regional Water Quality Control Board, Central Valley Region, (hereafter Regional Board) finds that:

1. On 12 January 2004, the Air Force Real Property Agency (hereafter Discharger) submitted the *Draft-Final Work Plan for An Enhanced Anaerobic Bioremediation Pilot Study at Former McClellan Air Force Base, California* (Work Plan). This Work Plan describes a bioremediation pilot project to evaluate the potential for in-situ treatment of groundwater containing chlorinated aliphatic hydrocarbons (CAHs) within Investigation Cluster 42 (IC-42) in Operable Unit A. The Discharger will be constructing and operating the pilot project. The Work Plan provides the information necessary for preparation of waste discharge requirements. The Discharger is cleaning up polluted groundwater pursuant to the federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 U.S.C. 9601-9675) and also must comply with state requirements.
2. The Discharger did not submit a Report of Waste Discharge and has asserted that it is not required to obtain a permit based on CERCLA Section 121(e). CERCLA Section 121(e) states that “[n]o Federal, State, or local permit shall be required for the portion of any removal or remedial action conducted entirely onsite, where such remedial action is selected and carried out in compliance with” Section 121. The Discharger has not complied with Section 121 with respect to the action proposed in the workplan. There is no decision document prepared and selected in compliance with CERCLA Section 121 that identifies the substantive requirements that apply to the action proposed to be taken, including state “applicable or relevant requirements” that apply to protection of groundwater. An appendix to a work plan may not constitute a remedy selected under CERCLA Section 121 and the process for developing the work plan has not been subject to the requirements of CERCLA section 121. Therefore, the CERCLA permit “exemption” does not apply and the Regional Board may issue these waste discharge requirements.
3. The Discharger has stated that the substantive requirements in this Order will be incorporated into Appendix H of the Final Work Plan (in preparation). The project site location is shown on Attachment A, which is attached hereto and made part of this Order by reference.
4. The project is located near the southeastern edge of the former McClellan Air Force Base (hereafter McClellan) in Sacramento. Light industrial and commercial activities border the project location. The project site plan is shown on Attachment B, which is attached hereto and made part of this Order by reference.

5. The primary objectives of the pilot project are to assess the ability of indigenous bacteria in soil and groundwater beneath McClellan to biodegrade CAHs through injection of an organic substrate into two test cells at IC-42 and determine if application of a bioaugmentation product to one of the test cells will significantly increase rates of biodegradation. Other secondary objectives of the pilot test are to 1) determine short-term impacts to water quality resulting from substrate injection, 2) determine changes in dechlorination rates, 3) determine if the substrate mass becomes depleted within one year of injection, and 4) perform a cost-benefit analysis of substrate addition based on the test results.

### **Pilot Project Layout and Operation**

6. Groundwater beneath McClellan contains CAHs, primarily trichloroethene (TCE) and its degradation products. TCE is a solvent used primarily in cleaning operations and has a Maximum Contaminant Level (MCL), or Primary Drinking Water Standard, of 5 micrograms per liter ( $\mu\text{g/L}$ ). In addition, the California Office of Environmental Health Hazard Assessment has established a Public Health Goal for TCE in water of  $0.8 \mu\text{g/L}$ . The maximum historical concentration of TCE in the groundwater beneath IC-42 is  $1,570 \mu\text{g/L}$ .
7. The pilot project will be targeting groundwater in the uppermost water bearing zone. This semi-confined to unconfined water bearing zone consists of sands and silty sands extending from approximately 105 to 126 feet below ground surface. Groundwater movement beneath IC-42 is affected by nearby extraction well EW-302 (see Attachment C) and generally flows toward the south and southwest. The estimated groundwater seepage velocity is 29 to 88 feet per year.
8. The pilot test will involve injection of organic substrate in Test Cells A and C at IC-42 (see Attachment C). The selected organic substrate is food-grade soybean oil. The soybean oil will be mixed with a food-grade lecithin emulsifier at a ratio of 10 pounds of soybean oil to 1 pound lecithin. The soybean/lecithin mixture will be prepared off-site by a commercial supplier and shipped to McClellan. Groundwater will be extracted from injection wells prior to substrate injection and will be used as makeup water for the emulsion. Extracted water from each test cell will be containerized separately for emulsion preparation. To monitor groundwater movement away from the injection wells, a sodium bromide tracer will be added to the extracted groundwater prior to emulsification with the soybean oil/lecithin. The target concentration for the tracer will be approximately  $500 \text{ mg/L}$  in the injected substrate.

After the tracer has been added to the water, the soybean oil/lecithin mixture will be emulsified with the extracted groundwater at a ratio of approximately 5% soybean oil/lecithin to 95% groundwater by volume. Approximately 580 gallons of the emulsion will be injected into each test cell.

9. The injected substrate is expected to stimulate the growth of microorganisms in a small portion of saturated subsurface, which will consume the available dissolved oxygen and create anaerobic conditions. After the dissolved oxygen is consumed, indigenous anaerobic microorganisms should proliferate and drive reductive dechlorination. During reductive dechlorination, TCE is used as an electron acceptor and a chloride atom is removed and replaced with a hydrogen atom. Under ideal conditions, the dechlorination process will progress from TCE to dichloroethene to vinyl chloride

to ethene. Ethene is a viable food source (or carbon source) for the microorganisms and should be consumed quickly.

10. Three or four months after injection of the substrate, the Discharger will inject a commercially available bioaugmentation product into Test Cell A. The bioaugmentation product will be a proprietary natural, stable, and non-pathogenic microbial consortia that contains the known dechlorinating bacteria *Dehalococcoides Ethenogenes*. Approximately 4.5 liters of the bioaugmentation product will be injected into Test Cell A.
11. Groundwater in the test cells will be monitored to assess biodegradation of TCE and changes in hydrochemistry for a minimum of 12 months after injection as required by attached Monitoring and Reporting Program No. R5-2004-0038. Soil vapor monitoring will also be conducted to assess changes in microbial activity related to substrate injection. Monitoring may be extended beyond 12 months if the substrate is still present.

The analytes targeted by the monitoring program will include the tracer sodium bromide. Detection of sodium bromide outside the test cells will trigger additional monitoring requirements.

12. Slug testing will be performed to determine potential impacts to the hydrogeologic characteristics of the aquifer resulting from substrate injection.
13. There are no receptors in the immediate vicinity of the test cells. Potential adverse byproducts created by injection of the substrate are expected to be transient.
14. The Discharger will continue to operate extraction well EW-302, located approximately 50 feet down gradient from the test cells. This well will operate throughout the pilot test and provide containment of the substrate and any persistent adverse byproducts created by the pilot test.

### **Basin Plan, Beneficial Uses, and Regulatory Considerations**

15. The *Water Quality Control Plan for the Sacramento River and San Joaquin River Basins, Fourth Edition*, (hereafter Basin Plan) designates beneficial uses, establishes water quality objectives, contains implementation plans and policies for protecting waters of the basin, and incorporates by reference plans and policies adopted by the State Water Resources Control Board (State Board). Pursuant to §13263(a) of the California Water Code (CWC), waste discharge requirements must implement the Basin Plan.
16. Surface water drains to Magpie Creek and Don Julio Creek within the boundaries of McClellan. Off the Base and west of Raley Boulevard, Magpie Creek and Don Julio Creek flow into the Magpie Creek Diversion which empties into Robla (Rio Linda) Creek. Robla Creek, in turn, empties into the Natomas East Main Drainage Canal (NEMDC), which is tributary to the Sacramento River just upstream from the confluence with the American River.

The beneficial uses of the Sacramento River, from the Colusa Basin Drain to the I Street Bridge are: municipal and domestic supply, agricultural irrigation, body contact water recreation, other non-body contact water recreation, warm freshwater aquatic habitat, cold freshwater aquatic habitat,

warm fish migration habitat, cold fish migration habitat, warm spawning habitat, cold spawning habitat, wildlife habitat, and navigation.

17. The Basin Plan identifies the beneficial uses of the underlying groundwater as municipal and domestic supply, agricultural supply, industrial service supply, and industrial process supply.
18. State Board Resolution No. 68-16 – “Statement of Policy with Respect to Maintaining High Quality of Waters in California” (hereafter Resolution 68-16) requires the Regional Board in regulating discharges to maintain high quality waters of the state until it is demonstrated that any change in quality will be consistent with maximum benefit to the people of the State, will not unreasonably affect beneficial uses, and will not result in water quality less than that described in plans and policies (e.g., quality that exceeds water quality objectives). Any activity which produces a or may produce a waste or increased volume or concentration of waste must be required to meet waste discharge requirements which will result in best practicable treatment or control of the discharge necessary to assure that pollution or nuisance will not occur and the highest water quality consistent with maximum benefit to the people of the state will be maintained. Temporal degradation of groundwater at this site due to the substrate injection may occur. The temporary degradation allowed by this Order is consistent with Resolution 68-16 since (1) the purpose is to accelerate and enhance remediation of unacceptable concentrations of several waste constituents and such remediation is consistent with maximum benefit to the people of the state; (2) the discharge facilitates a pilot project to evaluate the effectiveness of cleanup technology in accord with State Board Resolution 92-49 and is limited in scope and duration; (3) best practicable treatment, including adequate monitoring and contingency plans to assure protection of water quality, are required; and (4) the injection will not cause water quality objectives to be exceeded beyond the project target area.
19. Section 13267(b) of California Water Code provides that:

“In conducting an investigation specified in subdivision (a), the Regional Board may require that any person who has discharged, discharges, or is suspected of having discharged or discharging, or who proposes to discharge within its region, or any citizen or domiciliary, or political agency or entity of this state who has discharged, discharges, or is suspected of having discharged or discharging, or who proposes to discharge waste outside of its region that could affect the quality of the waters of the state within its region shall furnish, under penalty of perjury, technical or monitoring program reports which the Regional Board requires. The burden, including costs of these reports, shall bear a reasonable relationship to the need for the reports and the benefits to be obtained from the reports. In requiring those reports, the Regional Board shall provide the person with a written explanation with regard to the need for the reports, and shall identify the evidence that supports requiring that person to provide the reports.”

The technical reports required by this Order and the attached MRP No. R5-2004-0038 are necessary to assure compliance with these waste discharge requirements. The Discharger operates the facility that discharges the waste subject to this Order.
20. The California Department of Water Resources sets standards for the construction and destruction of groundwater wells, as described in *California Well Standards Bulletin 74-90* (June 1991) and

*Water Well Standards: State of California Bulletin 94-81* (December 1981). These standards, and any more stringent standards adopted by the State or county pursuant to California Water Code Section 13801, apply to all monitoring wells that may be installed to perform the Pilot Test.

21. Issuance of this Order is an action to assure the restoration of the environment and is, therefore, exempt from the provisions of the California Environmental Quality Act (Public Resources Code, Section 21000, et seq.), in accordance with Title 14 California Code of Regulations (CCR) Section 15308 and 15330.
22. This discharge is exempt from the requirements of *Consolidated Regulations for Treatment, Storage, Processing, or Disposal of Solid Waste*, as set forth in Title 27, CCR, Section 20005, et seq., (hereafter Title 27). The exemption pursuant to Section 20090(b), is based on the following:
  - a. The Regional Board is issuing waste discharge requirements,
  - b. The discharge complies with the Basin Plan, and
  - c. The wastewater does not need to be managed according to Title 22 CCR, Division 4.5, and Chapter 11, as a hazardous waste.
23. Pursuant to California Water Code Section 13263(g), discharge is a privilege, not a right, and adoption of this Order does not create a vested right to continue the discharge.
24. All the above and the supplemental data and information and details in the attached Information Sheet, which is incorporated by reference herein, were considered in establishing the following conditions of discharge.
25. The Discharger and interested agencies and persons were notified of intent to prescribe waste discharge requirements for this discharge and provided with an opportunity for a public hearing and an opportunity to submit written views and recommendations.
26. In a public meeting, all comments pertaining to the discharge were heard and considered.

**IT IS HEREBY ORDERED** that pursuant to Sections 13263 and 13267 of the California Water Code, the Air Force Real Property Agency, its agents, successors, and assigns, in order to meet the provisions contained in Division 7 of the California Water Code and regulations adopted thereunder, shall comply with the following while conducting the above-described pilot study:

*[Note: Other prohibitions, conditions, definitions, and some methods of determining compliance are contained in the attached "Standard Provisions and Reporting Requirements for Waste Discharge Requirements" dated 1 March 1991, incorporated herein.]*

**A. Discharge Prohibitions**

1. Discharge of wastes to surface waters or surface water drainage courses is prohibited.
2. Discharge of waste classified as 'hazardous' under Title 23 CCR Section 2521 or 'designated', as defined in California Water Code Section 13173 is prohibited.

3. The discharge/injection of soybean oil, lecithin, commercially available bioaugmentation product, and sodium bromide by the Discharger at a location or in a manner different from that described in Findings 8 and 10, is prohibited.

## **B. Discharge Specifications**

1. The Discharger shall provide hydraulic control and complete containment within the treatment zone of any groundwater pollutants, amendments, and breakdown products either injected or created by the pilot test. The Discharger shall provide hydraulic control throughout the pilot test and until the aquifer has recovered to pre-injection conditions, or until the Discharger can demonstrate that any adverse impacts to water quality caused by the pilot test are hydraulically contained and parameters that exceed water quality objectives as a result of substrate injection show a decreasing trend.
2. The groundwater shall not be amended with materials other than soybean oil, lecithin, or a commercially available bioaugmentation product.
3. The Discharger shall not cause the permeability of the aquifer, either inside or outside of the test cells, to be affected to such a degree that the Discharger is unable to effectively operate extraction wells for the purpose of containing the substrate and or its byproducts.
4. Objectionable odor originating at the test cells shall not be perceivable beyond the limits of IC-42.
5. The discharge shall not cause pollution or nuisance as defined by the California Water Code.
6. The Discharger shall not add more than twenty times the stoichiometric-derived demand for organic substrate.

## **C. Groundwater Limitations**

1. The Discharger shall not cause the groundwater to contain persistent waste constituents statistically greater than ambient concentrations. Temporary increases of TDS, chlorides, methane, bromide, and some metals are expected and permitted in the pilot test area, but these constituents shall not migrate outside the capture zone of the existing groundwater extraction system.

## **D. Provisions**

1. The Discharger shall provide certified laboratory test results for inorganic substances that may be present in the soybean oil and lecithin at least two weeks prior to injection of the emulsion. The Discharger shall only inject food-grade soybean oil and lecithin.

The Discharger shall provide the product name, manufacturer name, and composition of the substrate and bioaugmentation products to the Regional Board at least two weeks before injection.

2. The Discharger shall notify Regional Board staff a minimum of two weeks prior to the initial start date for injection of the substrate.
3. Prior to any modifications that would result in material change in the quality or quantity of substrate discharge, or any material change in the character, location, or volume of the discharge, the Discharger shall submit information describing the modifications to the Regional Board for review. The attached Monitoring and Reporting Program (MRP) and/or this Order may be revised prior to implementation of any modifications.
4. The Discharger shall provide an alternate water supply source to any affected well owner if the Pilot Test adversely affects any water supply wells.
5. Reports shall be submitted pursuant to Section 13267 of the California Water Code. In accordance with California Business and Professions Code sections 6735, 7835, and 7835.1, engineering and geologic evaluations and judgments shall be performed by or under the direction of registered professionals competent and proficient in the fields pertinent to the required activities. All technical reports specified herein that contain work plans for, that describe the conduct of investigations and studies, or that contain technical conclusions and recommendations concerning engineering and geology shall be prepared by or under the direction of appropriately qualified professional(s), even if not explicitly stated. Each technical report submitted by the Discharger shall contain a statement of qualifications of the responsible licensed professional(s) as well as the professional's signature and/or stamp of the seal.
6. The Discharger shall submit a Technology Application Analysis Report summarizing the results of the pilot test and addressing the objectives outlined in Finding 5. The report will be submitted to the Regional Board for review within 16 months after substrate injection.
7. The Discharger shall comply with the attached MRP No. R5-2004-0038, which is part of this Order, and any revisions thereto as ordered by the Executive Officer. Modifications to MRP No. R5-2004-0038 may be made to continue process monitoring if any parameter does not return to pre-injection conditions.
8. The Discharger shall comply with the "Standard Provisions and Reporting Requirements for Waste Discharge Requirements," dated 1 March 1991, which are by reference, a part of this Order. This attachment and its individual paragraphs are commonly referenced as "Standard Provision(s)."
9. The Discharger must comply with all conditions of this Order, including timely submittal of technical and monitoring reports as directed by the Executive Officer. Violations may result in enforcement action, including a Regional Board or court order requiring corrective action or imposing civil monetary liability, or in revision or rescission of this Order.

10. Should evaluation of the pilot test data reveal adverse effects on groundwater quality that were not anticipated, the Discharger shall notify the Regional Board within 24 hours of detection of the adverse effect, followed by a written summary within two weeks. The Discharger shall clean up and abate these effects, including extraction of any byproducts. The Discharger shall provide a status summary report within two months detailing activities to implement the abatement plan.
11. The Discharger shall at all times properly operate and maintain all facilities and systems of treatment and control that are installed or used by the Discharger to achieve compliance with this Order. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems which are to be installed by the Discharger only when necessary to achieve compliance with the conditions of this Order.
12. The Discharger shall maintain records of all monitoring information including all calibration and maintenance records, copies of all reports required by this Order, and records of all data used to complete the application for this Order. Records shall be maintained for a minimum of three years from the date of the sample, measurement, or report. This period may be extended during the course of any unresolved litigation regarding this discharge or when requested by the Executive Officer.
13. A copy of this Order shall be kept at the discharge facility for reference by operating personnel. Key operating personnel shall be familiar with its contents.

I, THOMAS R. PINKOS, Executive Officer, do hereby certify the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, Central Valley Region, on 19 March 2004.

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THOMAS R. PINKOS, Executive Officer



CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
CENTRAL VALLEY REGION

MONITORING AND REPORTING PROGRAM NO. R5-2004-0038  
FOR  
AIR FORCE REAL PROPERTY AGENCY  
FORMER MCCLELLAN AIR FORCE BASE  
ENHANCED ANAEROBIC BIORMEDIATION PILOT TEST AT IC-42  
SACRAMENTO COUNTY

This Monitoring and Reporting Program (MRP) describes requirements for monitoring during the Enhanced Anaerobic Bioremediation Pilot Test at IC-42. This MRP is issued pursuant to Water Code Section 13267. The Regional Board recognizes that some changes to this monitoring program may be warranted after review of the initial post-injection monitoring data; therefore, the Discharger may request changes to the Regional Board to modify this MRP. However, the Discharger shall not implement any changes to this MRP unless and until a revised MRP is issued by the Executive Officer.

### **GROUNDWATER MONITORING**

Groundwater samples shall be collected prior to injection of the substrate to assess baseline conditions. In addition, monitoring shall be conducted at three, four, six, nine, and twelve months following injection to track changes in hydrochemistry and contaminant concentrations. If the monitored constituents (excluding VOCs) have not recovered to pre-injection levels twelve months after injection, then monitoring will continue until baseline levels have been reestablished or until the Discharger can demonstrate that any adverse impacts to water quality caused by the pilot test are hydraulically contained and parameters that exceed water quality objectives as a result of substrate injection show a decreasing trend. Wells shall be monitored in accordance with the analytical program specified in Table 1.

Monitoring of the pilot study will include measurement of field parameters during each scheduled event. These parameters include water levels, dissolved oxygen, oxidation-reduction potential, pH, temperature, electrical conductivity, and turbidity (Table 1). Field testing instruments (such as those used to test oxidation-reduction potential 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 field 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 provided with the appropriate monitoring report.

Wells MW243, MW244, and EW302 are the nearest shallow down-gradient wells from the test cells. While it is considered a remote possibility that these wells will be affected by the substrate injection, these wells shall be monitored for the tracer (sodium bromide) in the substrate during each scheduled event. If the tracer is detected in these wells, these wells shall be monitored for additional analytes in Table 1 and additional downgradient wells may be added to the monitoring program.

## QUALITY CONTROL

For quality control purposes, the Discharger shall conduct all sampling and analysis in accordance with the latest version of *Basewide Quality Assurance Project Plan, McClellan AFB*. All samples shall be representative of the volume and nature of the discharge and matrix of the sampled media.

## REPORTING

Within 60 days after completion of the six-month monitoring event, the Discharger shall submit a Pilot Study Status Report to the Regional Board. At a minimum, the Pilot Study Site Status Report shall include:

1. Summary of work performed during the six months following substrate injection.
2. Tabulated analytical data for each monitoring event.
3. Site map with all monitoring wells, groundwater flow direction, and other pertinent site features.
4. Discussion of compliance record with Waste Discharge Order R5-2004-0038 and any corrective actions taken or planned.
5. Copies of all laboratory analytical report(s).

The Discharger shall submit a Technology Application Analysis Report to the Regional Board no later than 16 months after substrate injection. The report shall contain both tabular and graphical summaries of all monitoring data obtained during the pilot study, including the evaluations described in Provision D6 of Order R5-2004-0038. The results of any monitoring done more frequently than required at the locations specified in the Monitoring and Report Program shall also be reported to the Regional Board. 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 these waste discharge requirements. The report shall include:

1. Results of groundwater monitoring and slug testing;
2. A narrative description of all preparatory, monitoring, sampling, and analytical testing activities for the groundwater monitoring. The narrative shall be sufficiently detailed to verify compliance with the WDR, this MRP, and the Standard Provisions and Reporting Requirements. The narrative shall be supported by field logs for each well documenting depth to groundwater; parameters measured before, during, and after purging; method of purging; calculation of casing volume; and total volume of water purged;

WASTE DISCHARGE REQUIREMENTS ORDER NO. R5-2004-0038  
AIR FORCE REAL PROPERTY AGENCY  
FORMER MCCLELLAN AFB  
ENHANCED ANAEROBIC BIOREMEDIATION PILOT TEST AT IC-42  
SACRAMENTO COUNTY

3

3. Calculation of groundwater elevations, an assessment of groundwater flow direction and gradient on the date of measurement, comparison of previous flow direction and gradient data, and discussion of seasonal trends if any;
4. A narrative discussion of the analytical results for all groundwater locations monitored including spatial and temporal trends, with reference to summary data tables, graphs, and appended analytical reports (as applicable);
5. A comparison of monitoring data to applicable groundwater limitations;
6. Summary data tables of historical and current water table elevations and analytical results;
7. A scaled map showing relevant structures and features of the facility, the locations of monitoring wells and any other sampling stations, and groundwater elevation contours referenced to mean sea level datum; and
8. Copies of laboratory analytical report(s) for groundwater monitoring.

A letter of transmittal shall accompany the 6-Month Status Report and Technical Application Analysis 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 a statement by the discharger, or the discharger's authorized agent, under penalty of perjury, that to the best of the signer's knowledge the report is true, accurate and complete.

Ordered by: \_\_\_\_\_  
THOMAS R. PINKOS, Executive Officer

\_\_\_\_\_  
(Date)

3/25/04 MLP/JDT

## INFORMATION SHEET

ORDER NO. R5-2004-0038  
AIR FORCE REAL PROPERTY AGENCY  
FORMER MCCLELLAN AIR FORCE BASE  
ENHANCED IN-SITU BIORMEDIATION PILOT TEST AT IC-42  
SACRAMENTO COUNTY

The Air Force Real Property Agency (hereafter Discharger) owns and operates an extensive groundwater extraction and treatment system at the former McClellan Air Force Base in the City of Sacramento. This system is being utilized to contain and remove numerous large-scale chlorinated solvent (primarily tetrachloroethene and trichloroethene) plumes present in the groundwater. The Discharger is evaluating potential alternative technologies that may supplement the existing groundwater extraction and treatment system and reduce the time required to reach applicable water quality standards.

The Discharger proposes to conduct a bioremediation pilot project to evaluate the potential for in-situ treatment of groundwater containing chlorinated solvents within Investigation Cluster 42 (IC-42) at the former McClellan Air Force Base. IC-42 is located on the southern end of the former McClellan Air Force Base and includes a historical burn pit/landfill. Contaminants associated with IC-42 include fuels, oils, solvents, and metals. The pilot test will involve injection of substrate containing food-grade soybean oil, a lecithin emulsifier, and groundwater extracted from beneath IC-42 into two test cells. To monitor groundwater movement away from the injection wells, a sodium bromide tracer will be added to the extracted groundwater prior to emulsification with the soybean oil and lecithin.

The injected substrate is expected to stimulate the growth of microorganisms in a small portion of saturated subsurface, which will consume the available dissolved oxygen and create anaerobic conditions in the two test cells. After the dissolved oxygen is consumed, indigenous anaerobic microorganisms should proliferate and degrade the solvents. Three months after injection of the substrate, a commercially available bioaugmentation product known as KB-1 will be injected into one of the test cells to further increase biodegradation rates. Under ideal conditions, the solvents will completely degrade to carbon dioxide and water.

Biodegradation of chlorinated solvents may increase the total dissolved solids (TDS) and chloride concentrations or produce more toxic trichloroethene daughter products like vinyl chloride within the treatment zone. The substrate will also temporarily increase the biomass (microbes) in the treatment zone well above ambient levels. These adverse byproducts created by injection of the substrate are expected to be transient. Any persistent adverse byproducts created by the pilot test should be captured by the existing groundwater extraction system.

3/25/04 MLP/JDT



0 1 2 MILES

FIGURE 2.1

**LOCATION OF FORMER  
McCLELLAN AIR FORCE BASE**

Organic Substrate Addition  
Pilot Test IC-42  
Former McClellan AFB, California

**PARSONS**

Denver, Colorado

Source: Radlan

Draw1741435 McClellan Location Map.odr ma 2/13/03

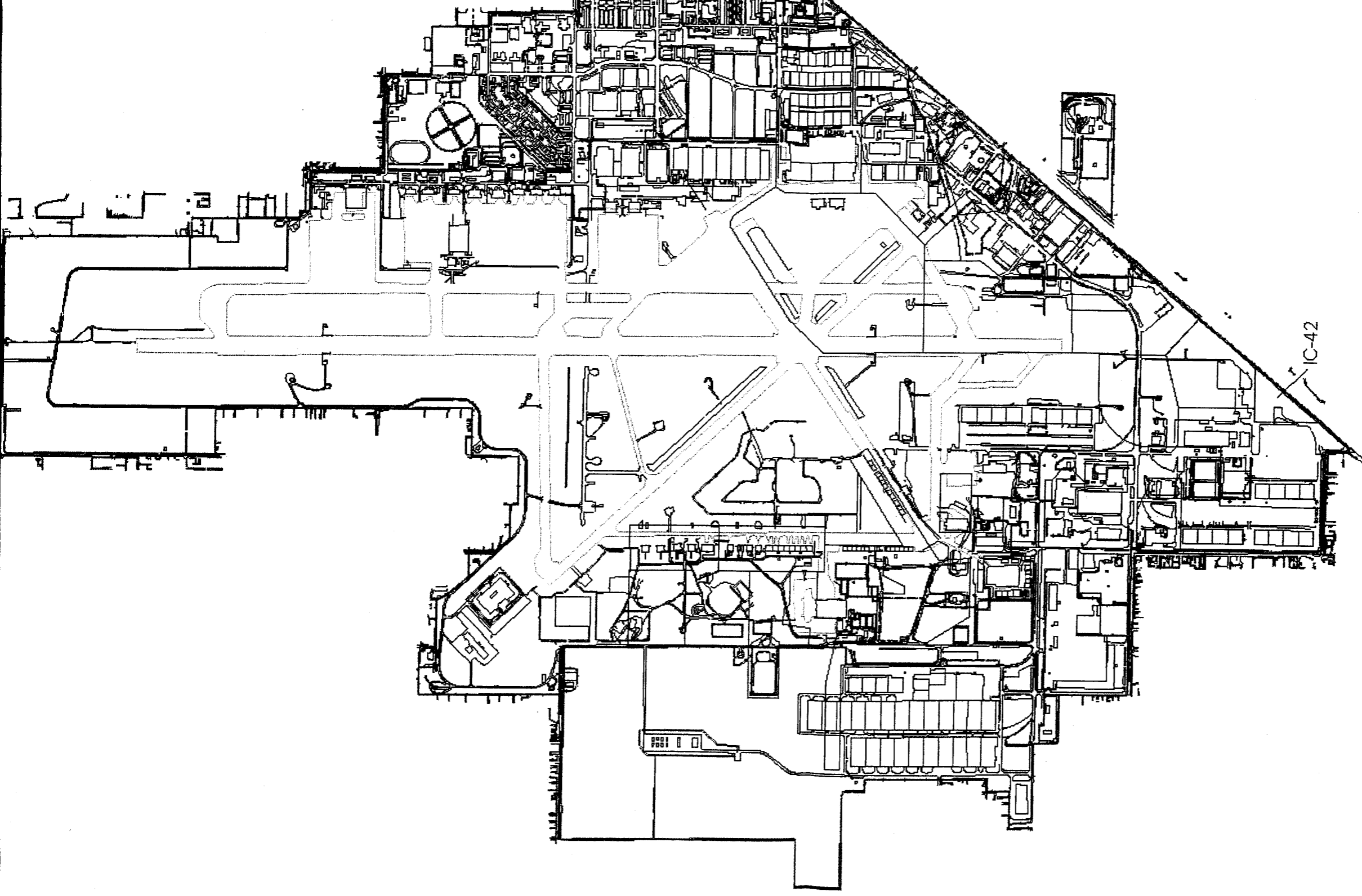
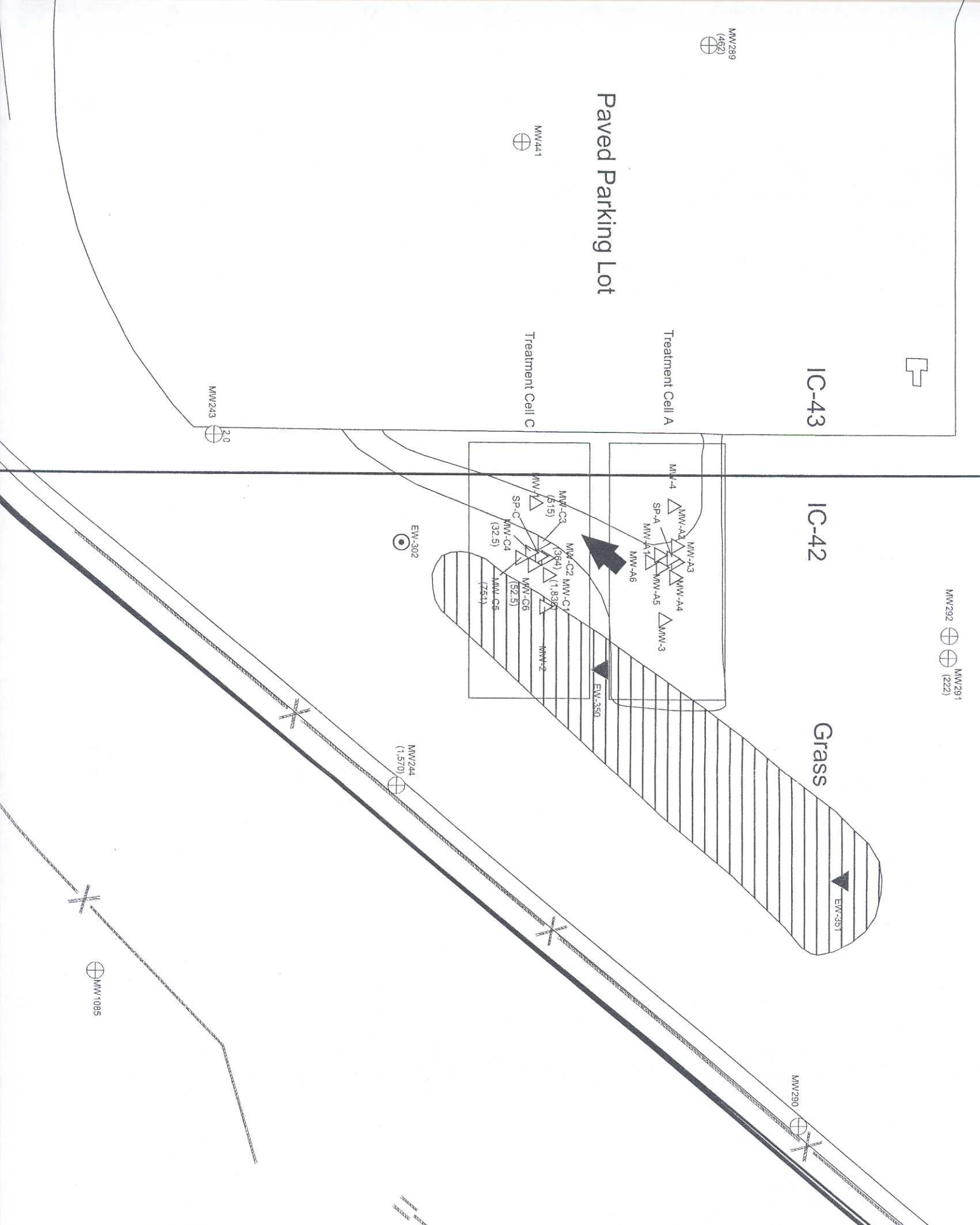


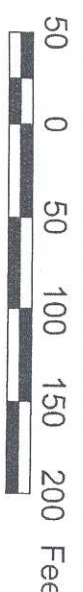
FIGURE 2.2  
LOCATION OF SITE

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**Legend**

- ▼ Base Soil Vapor Extraction Well
- ⊙ Base Groundwater Extraction Well
- ⊕ Base Groundwater Monitoring Well
- △ (TCE Concentration in August 2001, [ug/L])
- △ (TCE Concentration in 2000, [ug/L])
- △ (SP Indicates Sparge Well)
- △ Battelle Pilot Test Well
- △ (TCE Concentration in 2000, [ug/L])
- △ (SP Indicates Sparge Well)
- ▭ Former McClellan AFB Fences
- ▭ McClellan AFB Roads
- ▭ Former McClellan AFB Investigative Clusters
- ▭ Buildings
- ▭ AFB Boundary
- ▭ CS-24 (Approximate Area of Former Burn Pit/Landfill)
- ▭ Regional Groundwater
- ▲ Flow Direction



1:1,200

**FIGURE 2.3**  
**DISSOLVED TRICHLOROETHEN**  
**CONCENTRATIONS**  
**IN MONITORING ZONE A**

2000/2001  
 Organic Substrate Addition Pilot Test  
 IC-42  
 Former McClellan AFB, California

**PARSONS**

Denver, CO

**TABLE 1**  
**GROUNDWATER AND SUBSTRATE MONITORING PROGRAM**  
**ENHANCED ANAEROBIC BIORMEDIATION PILOT TEST AT IC-42**  
**FORMER MCCLELLAN AIR FORCE BASE, SACRAMENTO COUNTY**

Method	Slug Test	Water Level Measurement	Groundwater Analysis										Substrate Analysis
			VOCs	Methane, Ethane, & Ethene	Anions (a)	Manganese	Dissolved Organic Carbon	Dissolved Hydrogen	Volatile Fatty Acids	Phospholipid Fatty Acids	Well Head Parameters (b)	Test Kit Parameters (c)	VOCs
			SW8260B	AM20-GAX	E300.1	SW6010	SW9060M	AM20-GAX	(d)	(d)	(e)	(f)	SW8260B

**Test Cell A Wells**

MW-A1-113		X											
MW-A1-117	X	X	X	X	X	X	X	X	X		X	X	
MW-A2-113		X											
MW-A2-117		X											
MW-A3-113		X	X	X	X	X	X				X	X	
MW-A3-117		X											
MW-A4-113		X											
MW-A4-117		X											
MW-A5-113		X											
MW-A5-117	X	X	X	X	X	X	X		X	X	X	X	X
MW-A6-113		X	X	X	X	X	X	X	X		X	X	
MW-A6-117		X											
MW-3		X	X	X	X	X	X		X	X	X	X	
MW-4		X											

**Test Cell C Wells**

MW-C1-113		X											
MW-C1-117		X											
MW-C2-113		X	X	X	X	X	X				X	X	
MW-C2-117		X											
MW-C3-113		X											
MW-C3-117		X											
MW-C4-113		X	X	X	X	X	X	X	X		X	X	
MW-C4-117	X	X											
MW-C5-113		X											
MW-C5-117		X	X	X	X	X	X	X	X		X	X	
MW-C6-113	X	X	X	X	X	X	X		X	X	X	X	X
MW-C6-117		X											
MW-1		X											
MW-2		X	X	X	X	X	X		X	X	X	X	



**TABLE 1**  
**GROUNDWATER AND SUBSTRATE MONITORING PROGRAM**  
**ENHANCED ANAEROBIC BIORMEDIATION PILOT TEST AT IC-42**  
**FORMER MCCLELLAN AIR FORCE BASE, SACRAMENTO COUNTY**

		Groundwater Analysis										Substrate Analysis	
	Slug Test	Water Level Measurement	VOCs	Methane, Ethane, & Ethene	Anions (a)	Manganese	Dissolved Organic Carbon	Dissolved Hydrogen	Volatile Fatty Acids	Phospholipid Fatty Acids	Well Head Parameters (b)	Test Kit Parameters (c)	VOCs
<b>Method</b>			SW8260B	AM20-GAX	E300.1	SW6010	SW9060M	AM20-GAX	(d)	(d)	(e)	(f)	SW8260B

**Downgradient Wells**

MW-243		X			X								
MW-244		X			X								
EW-302		X			X								

Notes:

- (a) Anions include chloride, sulfate, bromide, nitrate, and nitrite.
- (b) Well head parameters include dissolved oxygen, oxidation-reduction potential, pH, temperature, electrical conductivity, and turbidity measured in flow-through cell.
- (c) Test kit parameters include carbon dioxide, alkalinity, sulfide, ferrous iron, and manganese.
- (d) Analyzed using Microbial Insights, Inc. internal standard operating procedures.
- (e) Well head parameters measured with field instruments.
- (f) Colorimetric: Hach Methods 8205, 8203, 8131, 8146, 8034, or equivalent.