AEROJET

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October 28, 2010

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RE: Final Boundary Operable Unit (OU-6) Remedial Investigation and Risk Assessment, Aerojet Superfund Site, Sacramento County, California

Dear Mr. Riley, Mr. MacDonald, and Mr. Cargile:

Aerojet General Corporation (Aerojet) is pleased to submit the subject report for your review and comment. This document consists of two volumes, Volume I - Remedial Investigation (RI) Report (3 binders [Part A, Part B, and Part C], and Volume II - Human Health and Ecological Risk Assessment (5 binders [Parts A-E]). The appendices for each Volume are contained on a CD-ROM, which is included within the Table of Contents located in Part A of each Volume. We have also included CD-ROMs that include a .pdf version of each document in the Table of Contents.

We appreciate the work your respective teams put into the resolution of comments on the draft version of this document Responses to all of your comments are included as Appendix N to Volume 1, Remedial Investigation. Some of the major revisions included:

- Additional details describing how the nature and extent evaluation was conducted for each chemical of potential concern in each area
- Additional feature call outs on the Physical Features figures
- Identification of all sampling locations on hits maps rather than just the locations where screening levels were exceeded.
- Development of a Protection of Groundwater risk evaluation
- Discussions in the HHRA that describe how the data was tabulated and used in the evaluation.
- Refinement of the background soils evaluation
- Use of the Edwards Air Force Base soil vapor screening values

If you have any specific questions or comments regarding this submittal, please contact Chris Fennessy at (916) 355-3341 (e-mail Christopher.Fennessy@Aerojet.com).

Sincerely,

Cindy Caulk
Program Coordinator

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Final Remedial Investigation Report for the Boundary Area Operable Unit (OU-6)

Aerojet Superfund Site
Sacramento County, California

October 2010
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Aerojet-General Corporation

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LIST OF ACRONYMS

°F	Degrees Fahrenheit
$\mu g/m^3$	Micrograms per cubic meter
1,1-DCA	1,1-Dichloroethane
1,2-DCA	1,2-Dichloroethane
1,1-DCE	1,1-Dichloroethene
1,2-DCE	1,2-Dichloroethene
AF	Attenuation factor
ARAR	Applicable or Relevant and Appropriate Requirement
ATL	Air Toxics, Limited
AWRA	Auburn-White Rock-Argonaut
bgs	Below ground surface
BOU	Boundary Operable Unit
BTEX	Benzene, toluene, ethylbenzene, and xylenes
BTV	Background threshold value
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHHSL	California Human Health Screening Level
cis-1,2-DCE	cis-1,2-Dichloroethene
COPC	Chemicals of potential concern
CSM	Conceptual Site Model
DNAPL	Dense nonaqueous-phase liquid
DQI	Data quality indicator
DTSC	California Department of Toxic Substances Control
EAS	Environmental Analytical Service, Inc.
Eco	Ecological
ERM	ERM-West, Inc.
ESL	Ecological screening level
FS	Feasibility Study
FSP	Field Sampling Plan

FWBZ	First Water-Bearing Zone
HHERA	Human and Ecological Risk Assessment
HHRA	Human Health Risk Assessment
K_ds	Single parameter distribution coefficient
LF	Leachability factor
LNAPL	Light nonaqueous-phase liquid
LUFT	Leaking Underground Fuel Tank
mg/kg	Milligrams per kilogram
NAPL	Nonaqueous-phase liquid
NDMA	N-nitrosodimethylamine
NOAA	National Oceanic and Atmospheric
OEHHA	California Office of Environmental Health Hazard Assessment
OU	Operable Unit
OU-6	Operable Unit 6
PAH	polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PCD	Partial Consent Decree
PCE	Tetrachloroethene
PGW	Protection of groundwater
PQL	Practical quantitation limit
PRG	Preliminary remediation goal
RCR	Redding-Corning-Redbluff
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RISL	Remedial investigation screening level
RSL	Regional Screening Level
RWQCB	California Regional Water Quality Control Board
SLERA	Screening-Level Ecological Risk Assessment
SSL	Soil screening level
SVOC	Semivolatile organic compound

SVSL	Soil vapor screening level
SWSL	Surface water screening level
TCE	Trichloroethene
TPH	Total petroleum hydrocarbons
TPH-D	Total petroleum hydrocarbons as diesel
trans-1,2-DCE	trans-1,2-Dichloroethene
TVOC	Total volatile organic compound
USEPA	United States Environmental Protection Agency
VOC	Volatile organic compound

1.0 INTRODUCTION

On behalf of Aerojet-General Corporation (Aerojet), ERM-West, Inc. (ERM), with the support of Central Valley Environmental, Inc., prepared this *Final Remedial Investigation* (RI) *Report* for the Boundary Operable Unit (BOU), Operable Unit 6 (OU-6) at the Aerojet Superfund Site in Sacramento, California. This RI Report for the BOU was prepared for submittal to the United States Environmental Protection Agency (USEPA) Region IX; California Environmental Protection Agency, Department of Toxic Substances Control (DTSC); and the California Regional Water Quality Control Board (RWQCB), collectively referred to hereafter as the Agencies. The Final Feasibility Study (FS) will be submitted under separate cover following Agency review and comment of this Final RI Report.

This Final RI Report, including the *Human Health and Ecological Risk Assessment* (HHERA), incorporates comments from the Agencies on the Draft BOU RI/FS Report provided in the documents listed below. The Agency comments, along with ERM's and Aerojet's responses to those comments, have been consolidated into one document included as Appendix N.

- RWQCB. 2009. *Comments on the Draft Remedial Investigation/Feasibility Study for the Boundary Operable Unit (OU-6) Aerojet-General Corporation*. 17 April 2009;
- USEPA. 2009. *Draft Boundary Operable Unit Remedial Investigation/Feasibility Study Report for the Aerojet General Corp. Site*, dated November 2008. 5 May 2009;
- DTSC. 2009a. *Review of Draft Human Health and Ecological Risk Assessment for Boundary Area Operable Unit (OU-6), Rancho Cordova, California*. 26 August 2009;
- DTSC. 2009b. *Review of the Human Health Risk Assessment for the Aerojet Administration Area of the Boundary Area Operable Unit*. 15 October 2009; and
- USEPA. 2010. *BOU RI/FS Replacement Comments from EPA* (e-mail correspondence). 12 January 2010.

This RI Report and the activities described herein were conducted in accordance with the modified Partial Consent Decree (PCD, 2002), the

Source Area Remedial Investigation/Feasibility Study Work Plan (Source Area RI/FS Work Plan, Aerojet, 2005c) and the *Final Remedial Investigation/ Feasibility Study Field Sampling Plan for Boundary Operable Unit* (BOU FSP, Aerojet, 2006b). Additionally, this RI Report is organized in general conformance with the formatting and content outlined in *Guidance for Conducting RI/FSs under CERCLA* (USEPA, 1988).

This section describes the general background of the Aerojet Facility, the purpose of this report, and document organization.

1.1 SITE AND REGULATORY BACKGROUND

The Aerojet Facility consists of approximately 8,500 acres located in eastern Sacramento County, California, about 15 miles east of Sacramento, California (Figure 1.1-1). Aerojet has utilized the site since the 1950s to develop rocket propulsion systems in support of national defense, space exploration, and satellite deployment. Industrial activities that supported, and continue to support, this work include the manufacture and testing of solid rocket motors; the removal of old propellant from solid rocket motors (hogout); manufacture and testing of liquid rocket engines; and the manufacture of chemicals. During the development of rocket propulsion systems, a variety of chemicals were manufactured and/or used at the Aerojet Superfund Site, including solvents, propellants, fuels, oxidizers, plasticizers, and metals (ICF Technology, Inc., 1989). Other chemicals manufactured at the two Aerojet chemical plants included various herbicides, pesticides, and pharmaceutical-related compounds.

Historical operations at the Aerojet Superfund Site have resulted in the discharge of some of these chemicals to the vadose zone and percolation into the underlying groundwater. Although numerous chemicals were used on the Aerojet Superfund Site, trichloroethene (TCE), tetrachloroethene (PCE), perchlorate, and N-nitrosodimethylamine (NDMA) are the most prevalent chemicals encountered. Since 1979, Aerojet has investigated the site to determine the nature and extent of the chemicals present, and to identify and implement mitigation measures to protect public health and the environment.

In 1989, Aerojet entered into a PCD, which established specified procedures and obligations toward achieving the goals delineated in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 (referred to as Superfund) and the *National Oil and Hazardous Substances Pollution Contingency Plan*. Exhibit II of the PCD

outlines the Operable Unit (OU) RI/FS Program Plan. This exhibit contained a plan for completing a facility-wide RI/FS in three phases; Scoping Phase, Phase I RI/FS, and Phase II RI/FS. Prior to 2002, Aerojet had completed the Scoping Phase and a majority of the Phase I RI/FS.

Exhibit II of the PCD was modified in 2002 (USEPA, 2002a) to allow the completion of the RI/FS through an operable unit approach and the exclusion of 2,600 acres from the boundaries of the Aerojet Superfund Site. The 2,600 acres were removed (carved out) from the Superfund Site following the completion of an exhaustive review that indicated the lands were buffer lands and not used for industrial purposes.

Exhibit III of the PCD identified five initial OUs and 317 potential source areas that are described as "location[s] above the water table where soils or other materials potentially contain hazardous substances of such character and quantity as to warrant evaluation in a Remedial Investigation [RI]." Initial investigations identified 14 additional potential source areas for a total of 331 potential source area sites. Thirty-eight of the potential source areas are addressed under the five initial OUs identified in Exhibit III.

In 2004, Aerojet prepared a *Program Plan Modification Report* (Aerojet, 2004c) in accordance with the PCD, which grouped the remaining 293 potential source areas into the following four OUs:

- OU-6 (BOU);
- OU-7 (Island OU);
- OU-8 (Eastern OU); and
- OU-9 (Central OU).

Aerojet maintains a Resource Conservation and Recovery Act (RCRA) permit, which provides requirements for closure of RCRA units, some of which are encompassed by CERCLA source areas. Corrective action at some of the RCRA units has been, with approval from DTSC, deferred to the CERCLA program. Additionally, septic tanks identified during the RI are included in the investigation of the source area in which they are located.

1.2 *PURPOSE*

This RI Report presents the results of previous (prior to 2005) and recent (2005 through 2007) RIs conducted at BOU (OU-6) source areas within the following eight Management Areas:

- Administration (Admin) Area:
  - Administration Area East (Admin East): Source Areas 3D, 4D, 11D, 50D, and 51D. Building 20034. RCRA Units B, C, and X. All associated septic systems; and
  - Administration Area West (Admin West): Source Areas 5D, 6D, 8D, 9D, 12D, 52D, D(b), and D(d). The Former Sewage Treatment Plant (FSTP), including Source Areas 8D and D(c). RCRA Units W and Y. All associated septic systems.
- Line 2 Region: Source Areas DSA, 28E, 29E, 59E, E(d), E(e), E(m), and E(n) and associated septic systems and Open Space Area 5.
- Line 5 North: Source Areas 51E, 52E, and E(l) and Open Space Area 7.
- Westlakes Area: Westlakes and Open Space Area 6.
- Buffalo Creek: Southern portion of Buffalo Creek downstream of Line 2.
- Chemical Plant 2 Area: Source Areas 25F (Dredge Pit and Eastern Basin), 59F, 60F, 61F, 62F, CP2, and F(c) and associated septic systems and Open Space Areas 1, 2, 3, and 4.
- Magazine Area (Area 48): Septic systems and Open Space Area 3.
- Area 39: Source Areas 29B, 30B, 31B, 32B, 33B, 34B, and 35B.

The locations of the eight Management Areas and Open Space Areas are shown in Figure 1.2-1.

The purpose of this Final RI Report is to determine if the development of propulsion systems and chemical manufacturing resulted in the release of chemicals at concentrations that pose, or could pose, an unacceptable risk to human and ecological receptors under current or future use scenarios.

The following information is provided in this report to justify the evaluation of remedial technologies and process and the development of remedial alternatives.

- Summary of the results of previous investigations conducted at the source areas and features encompassed within the BOU.

- Summary of the scope and results of the BOU RI performed between August 2005 and May 2007.
- An evaluation of the data for each source area with respect to the identification and distribution of chemicals of potential concern (COPCs) in soil, soil vapor, surface water, and groundwater and completeness of the characterization for those chemicals. The identification of COPCs and completeness of characterization was based on concentrations of compounds that exceed characterization screening levels presented in the BOU FSP (Aerojet, 2006b). Screening levels and their use in identifying COPCs and determining the need for additional sampling during the BOU RI are presented and discussed in Section 3.0 of this RI/FS Report.
- A Human Health Risk Assessment (HHRA) that evaluates the potential risk to human receptors posed by the presence of chemicals in soil, soil vapor, surface water, and groundwater within the BOU.
- A Screening-Level Ecological Risk Assessment (SLERA) that evaluates potential risk to ecological receptors posed by the chemicals identified in soil, sediment, soil vapor, surface water, and groundwater within the BOU during the RI.
- A detailed evaluation o the potential risk to groundwater and surface water posed by the chemicals identified in soil and soil vapor with the BOU during the RI.

1.3 REPORT ORGANIZATION

This Final RI Report for the BOU consists of two key components that, as per the request of the Agencies and to facilitate review, are each published as separate volumes complete with figures, tables, and appendices. The two components/volumes are:

- Volume I: RI Report for the BOU; and
- Volume II: *Human Health and Ecological Risk Assessment* (HHERA) for the BOU.

As previous indicated, Volume III (FS for the BOU) will be submitted under separate cover following receipt and resolution of agency comments on Volumes I and II.

This Final RI Report for the BOU is organized as follows:

Volume I: Remedial Investigation Report for the Boundary Operable Unit

The RI Report for the BOU is composed of eight sections as outlined below:

- Section 1 provides an introduction and presents a brief history of the site and regulatory background.
- Section 2 briefly summarizes the history of operations and chemical use in the BOU management areas, land use, geology, soils, and hydrogeology relevant to the areas addressed by this report. Previous investigations relevant to the BOU RI/FS are also summarized in this section.
- Section 3 describes the activities and sample analyses conducted during previous field investigation activities and the recent RI, describes the data validation and data management process, presents and discusses the screening levels used to guide the RI and evaluate the need for additional sampling, summarizes the fate and transport of the classes of chemicals identified at source areas within the BOU, and presents the Conceptual Site Models (CSMs).
- Section 4 presents the scope and results of the RI of source areas and features within the Admin Area and provides a summary of the HHERA and FS.
- Section 5 presents the scope and results of the RI of source areas and features within the Westlakes, Line 2, Line 5, Buffalo Creek, and Open Space Areas 5, 6, and 7 and provides a summary of the HHERA and FS.
- Section 6 presents the scope and results of the RI for source areas and features at Chemical Plant 2, the Magazine Area, the Dredge Pit and Eastern Basin, and Open Space Areas 1, 2, 3, and 4 and provides a summary of the HHERA and FS
- Section 7 presents the scope and results of the RI for source areas within Area 39 and provides a summary of the HHERA and FS.
- Section 8 lists references cited in this RI Report.

Figures and tables follow the report text. Appendices are presented as follows:

- Appendix A — VLEACH Modeling Discussion and Results;

- Appendix B — Analytical Data Supporting Evaluation of the Detection and Occurrence of 1,3-Butadiene in Soil Vapor;
- Appendix C — Statistical Evaluation of Background Metals and Comparison of Background to Site Metals Data;
- Appendix D —Borehole Logs for Soil Borings and Monitoring Wells;
- Appendix E — Historical Sampling Locations and Chemical Groups above Screening Levels;
- Appendix F — Analytical Results for BOU RI Soil Vapor Samples;
- Appendix G — Analytical Results for BOU RI Soil and Sediment Samples;
- Appendix H —Analytical Results for BOU RI Surface Water Samples;
- Appendix I — Profiles Showing Relative Placement of Well Screens and Grab Groundwater Samples;
- Appendix J — Water Level Hydrographs – Perched Groundwater;
- Appendix K — Water Level Hydrographs – First Water Bearing Zone;
- Appendix L — Results of Aquifer Tests and Data Analysis;
- Appendix M — Analytical Results for Groundwater Samples Collected during BOU RI Sampling Period; and
- Appendix N — Consolidated Agency Comments on Draft BOU RI/FS and Responses to Agency Comments.

Volume II: Human Health and Ecological Risk Assessment for the Boundary Operable Unit

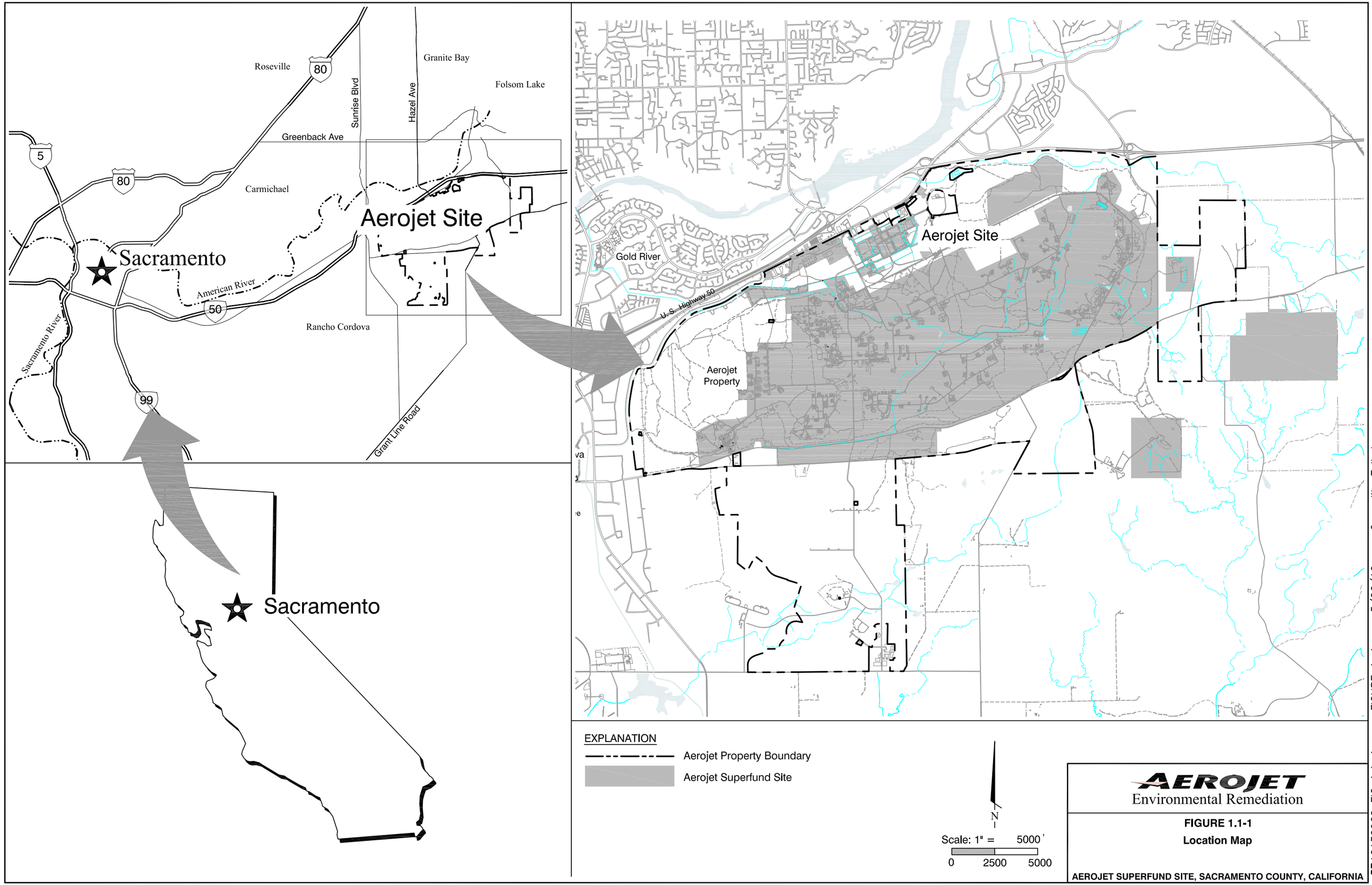
The HHERA for the BOU is composed of eight sections as outlined below:

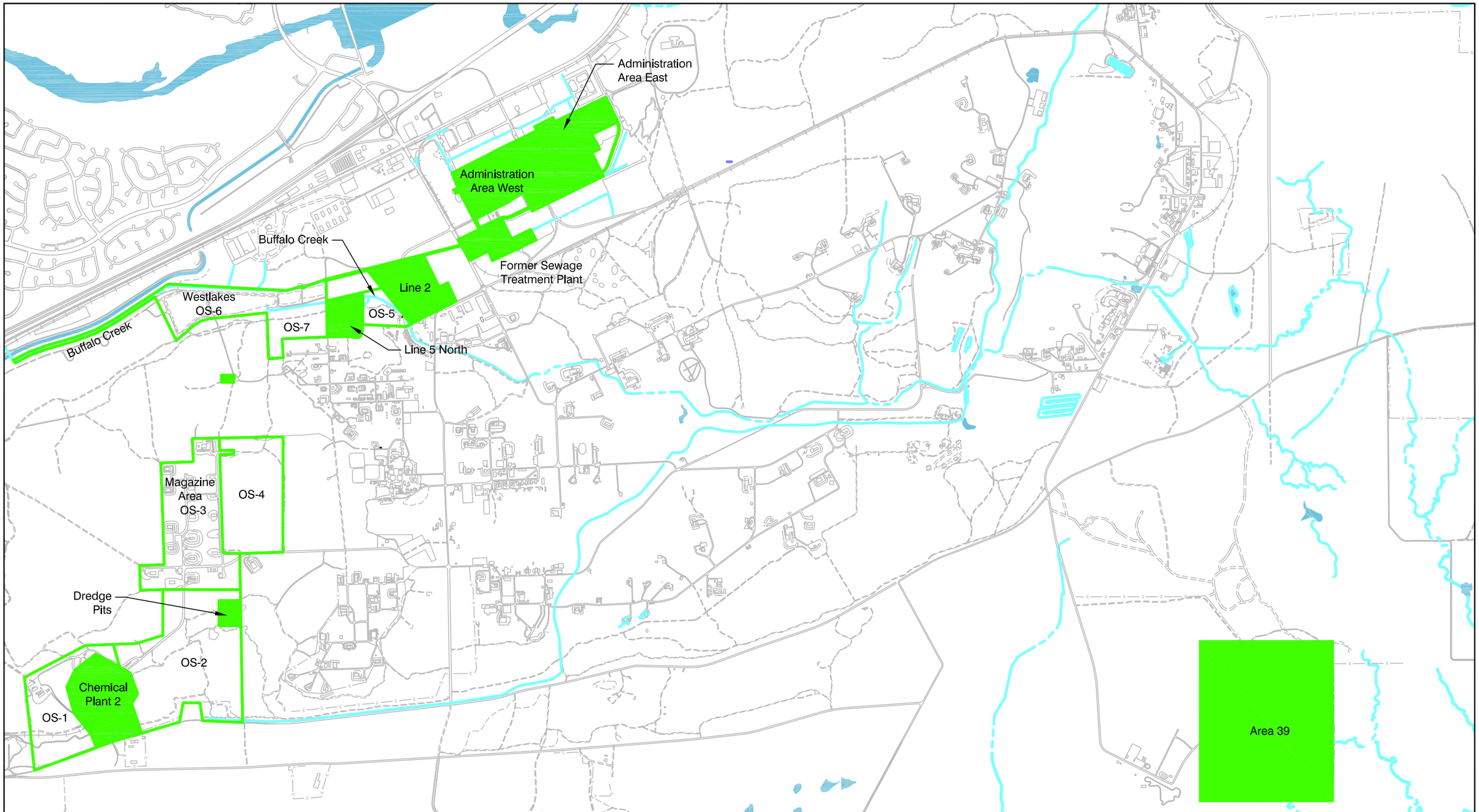
- Section 1 provides an introduction and presents the purpose of the HHERA.
- Section 2 presents background on the site, describes the environmental setting, and identifies areas of potential concern.
- Section 3 provides a summary of previous investigations.
- Section 4 presents the data evaluation procedures used, including determination of background metal concentrations, and the methods used for selection of COPCs.
- Section 5 presents the HHRA.

- Section 6 presents the SLERA.
- Section 7 discusses the uncertainties associated with the HHERA as a result of the limitations of the exposure and toxicity information, the modeling approaches, and the data used to conduct the evaluation.
- Section 8 presents a detailed evaluation of the potential for chemicals in soil vapor and soil to adversely impact groundwater and surface water.
- Section 9 presents a graphical summary of the results of the HHRA, SLERA, and groundwater/surface water impact evaluation.
- Section 10 provides a list of references cited in the HHERA.

Figures and tables follow the report text. Appendices are presented as follows:

- Appendix A — Risk Assessment White Papers;
- Appendix B — Data Used In The Risk Assessment;
- Appendix C — Statistical Evaluation of Background Metals Data Set and Comparison of Background Metals to Site Metals Data;
- Appendix D — Fate and Transport Modeling Calculations;
- Appendix E — USEPA RAGS Table D;
- Appendix F — Unit Risk Calculations and Child and Adult Blood Lead Calculations;
- Appendix G — May 2006 Site Visit Photographs;
- Appendix H — Summary of SLERA Fate Mechanisms;
- Appendix I — Buildings 20002 and 20004 Specific Human Health Risk Assessment;
- Appendix J – Review of Detection Limits versus Ecological Screening Levels; and
- Appendix K – Screening-Level Vapor Transport Modeling.


Roseville
80
Sunrise Blvd
Hazel Ave
Granite Bay
Folsom Lake
Greenback Ave
5
80
Carmichael
Aerojet Site
Sacramento
American River
50
Rancho Cordova
Sacramento River
99
Grant Line Road
Sacramento
Gold River
U. S. Highway 50
Aerojet Site
Aerojet Property
EXPLANATION
Aerojet Property Boundary
Aerojet Superfund Site
N
Scale: 1" = 5000'
0 2500 5000
AEROJET
Environmental Remediation
FIGURE 1.1-1
Location Map
AEROJET SUPERFUND SITE, SACRAMENTO COUNTY, CALIFORNIA
SR10130960 FIG 1.1-1 FIGURE 1-1 5/26/10 Carmelita Tallada



EXPLANATION

Operable Unit Containing Source Sites

Open Space (OS) Area

N

Scale: 1" = 2000'

0 1000 2000

AEROJET
Environmental Remediation

FIGURE 1.2-1

Potential Source Area Operable Units Boundary Operable Unit

10/20/08 pr SR10130961

2.0 BOUNDARY OPERABLE UNIT BACKGROUND

This section summarizes the Aerojet site history, land use, topography, BOU geology and soils, and BOU hydrology presented in the BOU FSP (Aerojet, 2006b). Previous investigations relevant to this RI/FS are summarized at the end of this section. The local topography, surface water hydrology, geology, hydrogeology, and ecological habitat for each management area are described in their individual sections in this document.

2.1 SITE HISTORY

Since the 1950s, the 8,500-acre Aerojet facility in Sacramento has primarily been used for the design, development, and testing of solid and liquid fuel rocket propulsion systems. Industrial activities conducted in support of this work included solid rocket motor manufacturing, testing, and rehabilitation; liquid rocket engine manufacturing and testing; and chemical development and manufacturing. Chemicals used at the site included solvents, propellants, fuels, lubricants, oxidizers, and metals.

2.2 TOPOGRAPHY

The Aerojet site is characterized by a relatively flat topographic surface gently sloping to the west. Most of the on-site topography is dominated by rows of dredge tailings left from gold mining operations that began in the early 1900s. The dredge tailings consist of alternating rows of cobble piles separated by low areas filled with silt and clay (slickens). The depth of dredging ranged from approximately 10 to 90 feet below ground surface (bgs). Figure 2.1-1 is a topographic map of the Administration Area within the Aerojet facility.

2.3 CLIMATE

The Sacramento area has a mild, subtropical climate with abundant sunshine most of the year. Climatic information for the area was originally obtained from *Monthly Normals of Temperature, Precipitation, and Heating and Cooling Degree Days 1951-1980, California* (National Oceanic and Atmospheric Administration [NOAA], 1982), and *Local Climatological Data 1992,*

Annual/Monthly Summary (NOAA, 1993), but has been updated based on data obtained from the Western Regional Climate Center (www.wrcc.dri.edu).

The mean annual temperature in Sacramento is a relatively mild 62.2 degrees Fahrenheit (°F). Maximum average temperatures during the summer range from 87.1 to 93.1°F. Temperatures may occasionally exceed 100°F during hot spells. Winter temperature maximums vary from 54.5 to 60.6°F. Average lows in the winter are 40.2 to 43.7°F. Temperatures in the winter rarely drop below freezing.

Average annual precipitation is 18.33 inches, with about 80 percent of the total rainfall occurring from November through March. The highest rainfall generally occurs in January, which averages 3.80 inches of precipitation. The driest month is August, averaging only 0.03 inch of rain.

2.4 *LAND USE*

Except for three off-site areas (Areas 39, 40, and 41), the Aerojet-owned property within the Superfund boundary is zoned for industrial use. The facilities that support industrial operations are grouped into manufacturing areas composed of multiple buildings. Large areas of undeveloped land are located within and between the manufacturing areas, and between the property boundaries. The majority of land between active manufacturing areas and the property boundary served as "buffer space" between operations and neighboring properties. Approximately 2,600 acres of buffer lands located along the northern and northwestern property boundaries were removed from the Aerojet Superfund Site in 2000 and may be developed with a wide variety of land uses, including residential, commercial/industrial, and recreational. Aerojet has submitted development plans to the County of Sacramento for approval (Aerojet 2005a and 2005b).

The Aerojet property was designated as a "Special Planning Area" by Sacramento County Ordinance, Title V, Chapter 8, Article 3 of the Zoning Code of Sacramento County (County of Sacramento, 1993). This ordinance identifies existing permitted uses and "provides a regulatory mechanism for making land use decisions that maintain a safe environment in which the subject property can be used, given the special requirements of the property owner."

Land uses around the Aerojet property include residential, commercial, industrial, agricultural, and recreational. The largest developed areas are located west, north, and northeast of Aerojet and include the cities of Rancho Cordova and Folsom, and the community of Gold River. These areas have a combined population of approximately 109,000 people.

Current and anticipated future land uses for Aerojet are described below:

- **Current Land Uses:** Currently, Aerojet uses some portions of the facility for ongoing industrial operations. In addition, some portions of the facility are leased for use as rangeland where sheep and other livestock may graze. However, much of the facility is currently vacant and provides habitat for a wide variety of plant and wildlife species. Properties surrounding Aerojet have been developed for mixed purposes, and include residential, commercial/industrial, and recreational land uses.
- **Future Land Uses:** Development of the Aerojet facility will include residential, commercial/industrial and recreational properties. In addition, a portion of the facility will continue to be used by Aerojet for commercial operations. Figure 2.1-2 presents the current land use plan for the Aerojet facility.

2.5 BOUNDARY OPERABLE UNIT GEOLOGY AND SOILS

The Aerojet Superfund Site is located in eastern Sacramento County near the transition zone between the Great Valley and Sierra Nevada geomorphic provinces.

The geology of the Great Valley, as summarized by Hackel (1966), can be described as a large elongated northwest-trending asymmetric trough. This trough is filled with a very thick sequence (up to 60,000 feet) of sediments of primarily marine origin ranging in age from Jurassic to Recent. The sediments that compose the eastern flank of the Great Valley (where the Aerojet site is situated) thin dramatically as they approach the foothills of the Sierra Nevada and eventually thin out completely, exposing the underlying crystalline basement rocks of pre-Tertiary age igneous and metamorphic rocks that make up the Sierra Nevada Mountain Range.

The Aerojet site is underlain by fluvial and marine sedimentary deposits ranging in age from Cretaceous to Recent. These sedimentary deposits unconformably overlie Jurassic-aged metamorphic basement rocks that

dip to the west. These sediments form a wedge, which thickens from east to west, across the Aerojet site. The easternmost sediments at the Aerojet site are about 60-feet thick; while at its western boundary (a distance of 6 miles), the sediments are nearly 2,000-feet thick. Table 2.5-1 presents the site stratigraphy beginning from oldest to youngest geologic formations:

The single most dominant surface feature at the Aerojet facility is the dredge tailings that cover approximately 80 percent of the land surface. The Aerojet facility and surrounding areas have been subjected to historical gold dredging operations beginning in the early 1900s and continuing into the 1960s. The fluvial gold-bearing sediments of the Laguna Formation were the target for the dredges, and areas within the site have been dredged to depths of up to 100 feet (from ground surface).

Soils that are found within the investigation sphere of the BOU include the following units as described in the 1993 United States Department of Agriculture Soil Conservation Service, Soil Survey of Sacramento County:

- **Xerorthents –** Excessively drained and somewhat excessively drained soils. These soil types are found in areas of dredge tailings near the American River. The soils formed in material that has a high content of gravels and cobbles derived from mixed rock sources. The material was deposited as tailings during mining activities with slopes ranging from 0 to 50 percent. Xerorthents are very deep. These soils are extremely gravelly and in some areas have strata of loose gravels or cobbles. Xerorthents underlie the majority of the BOU investigation area, which includes Chemical Plant 2, Magazine Area, Line 05, Westlakes Area, and the Open Spaces.
- **Redding-Corning-Red Bluff –** Moderately well drained soils that are moderately deep over a cemented hard pan. This soil unit is found on intermediate and high terraces, terrace remnants, and the side slopes of terraces in the eastern part of Sacramento County. The soils form in alluvium that is derived from mixed rock sources. The Redding soils are typically a surface layer of gravelly loam with a subsoil comprising a gravelly claypan, which is in turn underlain by a hardpan at a depth of 20 to 40 inches. The Corning-Red Bluff soils are typically a loam with a subsoil of clay loam, gravelly loam, and gravelly clay loam. The Redding-Corning-Red Bluff soil unit underlies a small portion of the eastern Administration Area (Area 20) and Chemical Plant 2, large portions of Line 2, and the western portion of Area 39.
- **Pentz-Hadselville -** This soil unit underlies the southeastern portion of Area 39. The soils formed in material weathered from weakly

consolidated volcaniclastic sediments composed of andesitic tuff. Slopes range from 2 to 50 percent. Typically these soils are composed of a surface layer of fine sandy loam underlain by weakly consolidated tuffaceous sediments to a depth of 10 to 20 inches. The Pentz soils are more fine sandy loams while the Hadselville soils are coarser sandy loams.

- **Urban Lands - Americanos – Natomas -** This soil unit underlies most of the Administration Area (Area 20) and is found on low stream terraces of the American River and on other low terraces adjacent to the river. These soils formed in alluvium derived dominantly from mixed rock sources. Slopes range from 0 to 2 percent. Urban land consists of areas covered by impervious surfaces such as asphalt, concrete, and buildings. Americanos soils are found on low stream terraces. They are deep or very deep with a typical surface layer and subsoil composed of silt loam. Sandy loam is also present in some areas and is discontinuously cemented with silica to a depth of 50 to 72 inches. Natomas soils are also found on low terraces. They are very deep and typically the surface layer is loam with subsoil composed of clay loam. The substratum for this soil is typically a sandy loam.

2.6 BOUNDARY OPERABLE UNIT HYDROGEOLOGY

As a consequence of the historical dredge mining activities, the Aerojet site has become a significant groundwater recharge zone for the underlying groundwater-bearing zones. The Laguna and Mehrten Formations contain the most productive aquifers underlying the Aerojet site and serve as the principal source of water for private and public water supply wells in the area. Six individual layers (A through F) have been defined beneath the Aerojet site with A being the shallowest and F being the deepest. The first groundwater occurs as either Perched Groundwater or as the unconfined First Water-Bearing Zone (FWBZ). The Perched and FWBZ groundwater are generally present in Hydrostratigraphic Layers A, B, or C.

Discontinuous lenses of shallow perched groundwater are commonly found across the Aerojet site. Perched groundwater is most often encountered within dredge tailings at depths ranging from 10 to 50 feet bgs. Perched groundwater is affected by seasonal recharge and periods of drought and commonly disappears during long drought periods and rebounds quickly when normal rainfall patterns return.

The direction and magnitude of the hydraulic gradient in perched groundwater beneath the various areas of the Aerojet site are uncertain. Contoured water level elevations of the perched groundwater indicate highly variable gradients. Water quality data suggest that perched groundwater does not travel very far laterally, and there are large downward head potentials from the perched to the FWBZ. These data suggest that the majority of perched groundwater migrates vertically downwards into the FWBZ or that it is relatively immobile.

Groundwater present in the FWBZ and deeper generally flows radially away from the center of the Aerojet site. Consequently, there are different groundwater flow directions in the various BOU management areas. Shallow groundwater beneath the Administration Area typically flows towards the west-northwest. Shallow groundwater beneath Lines 02, 05, Chemical Plant 2, the Magazine Area, and the Westlakes Areas flows to the west-southwest. In Area 39, the perched groundwater typically appears to flow towards the north, while the FWBZ has a flow direction to the west-southwest.

Hydraulic conductivities for the various aquifers range from 1 to 446 feet per day with an average of about 70 feet per day. Hydraulic gradients range from 0.005 to 0.02 feet per feet. Vertical hydraulic gradients vary across the Aerojet site due to the various groundwater extraction and treatment facilities located along most of the site perimeters.

The depths to perched groundwater and the FWBZ were reviewed with respect to the potential for groundwater to be discharged to the ground surface and surface water. Based on the review, groundwater from perched layers and the FWBZ does not discharge to the land or surface water within the BOU. Additionally, no seeps or springs indicative of the discharge of groundwater to surface have been identified within the BOU.

2.7 *SUMMARY OF RELEVANT PREVIOUS INVESTIGATIONS*

Soil and groundwater characterization at the Aerojet site has been ongoing since 1979. Since that time, numerous investigations have been conducted in accordance with USEPA guidance and the PCD to identify potential sources, characterize the nature and extent of chemicals in soil and groundwater, define exposure pathways, and evaluate potential risks to human health and the environment. Documents summarizing the scope and results of investigations that have been conducted at the sites addressed in this report are listed below.

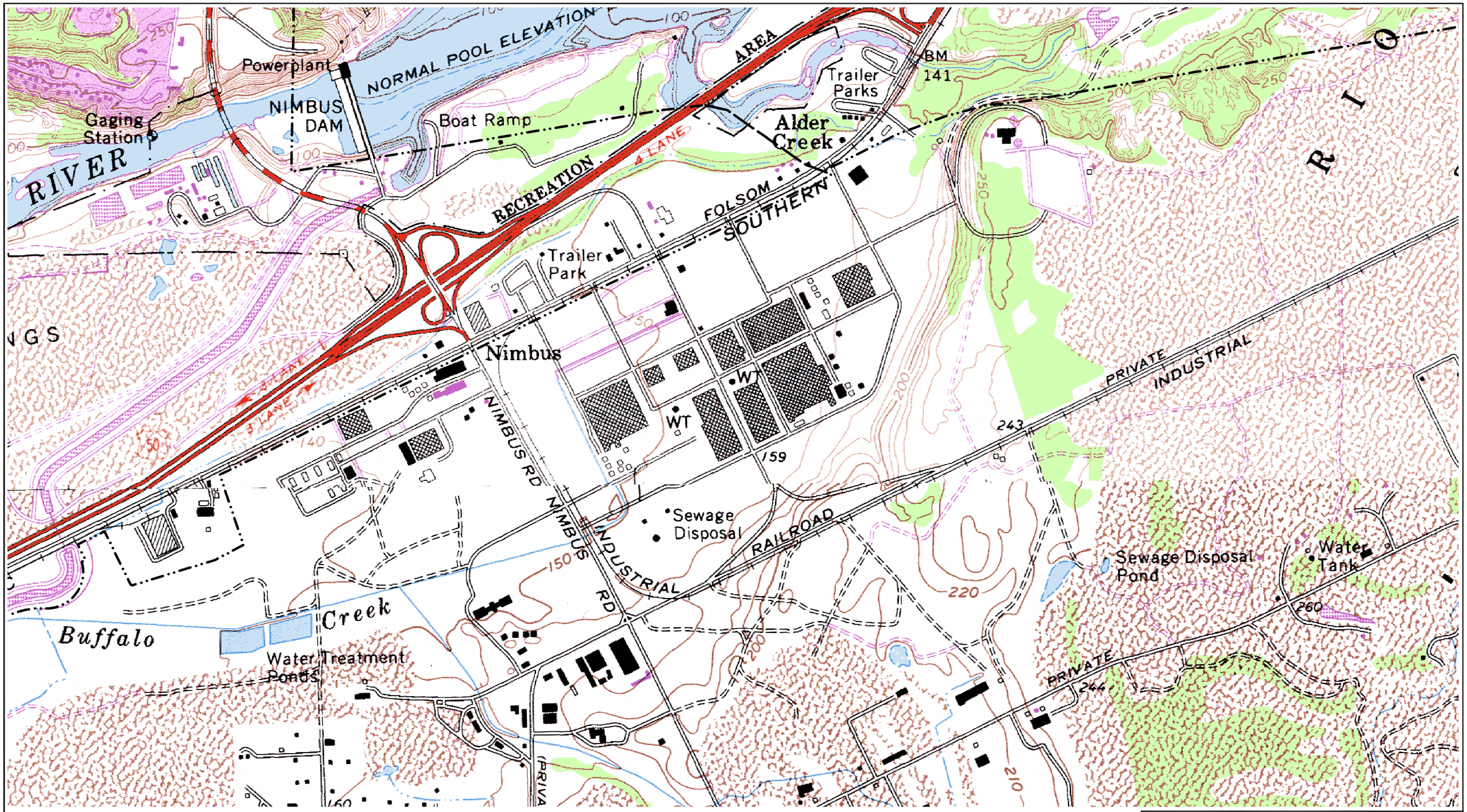
- *Background Metals in Xerorthents and Redding-Corning-Red Bluff Surface Soils at the Aerojet Superfund Site Main Plant, Sacramento, California* (Aerojet, 2007) – documents the revised results of the original background geochemistry study conducted in 1994 (Borch, 1994). The new study was meant to provide background samples that were analyzed by similar methods as the RI/FS samples. The revised study provided background levels that were generally lower than those provided in the 1994 background report but still concluded that naturally occurring concentrations of several metals at the Aerojet facility were above regulatory action levels.
- *Remedial Investigation/Feasibility Study Field Sampling Plan for the Boundary Operable Unit* (BOU FSP, Aerojet and others, 2006b) – provides a description and history for each potential source site, separated into management areas, within the BOU and summarizes the investigation history for the potential source sites. The field sampling plan also identifies data needs and data quality objectives and provides a sampling design for each management area.
- *Evaluation of the Occurrence and Detection of 1,3-Butadiene in Soil Vapor at the Aerojet Superfund Site, Rancho Cordova, California* (ERM, 2005) – summarizes the results of evaluations and investigations related to the occurrence and detection of the volatile organic compound (VOC) 1,3-butadiene in soil vapor samples. This study was conducted to track sporadic occurrences of 1,3-butadiene in Aerojet soil vapor samples and to address the possibility that these detections were false positives. The study concluded that detections of 1,3-butadiene were, indeed, false positives and should be removed from consideration as a COPC at the Aerojet Superfund Site.
- *Revised Phase I RI/FS Stage 2 Sampling Plan – Zones 1, 2, 3, and 4* (Aerojet, 1999b) – this sampling plan was written based on recommendations from the Aerojet Stage 1 Report. Within each management area, it identifies locations and analytes where further investigation is necessary. This sampling plan was later incorporated into the Field Sampling Plans for each Operable Unit.
- Aerojet Background Geochemistry Study (Borch, 1994) – documents the results of a previous study on background levels for metals at the Aerojet site and associated off-site areas.
- *Aerojet Site; Stage 1 Report - Zones 1 through 4* (Stage 1 RI Report, ICF Kaiser Engineers, Inc. 1993) – provides a description and history for each potential source site, summarizes the results of investigations

conducted prior to 1991, and provides the results of Stage 1 of the RI/FS conducted between 1991 and 1993 at each zone.

As previously indicated, numerous investigations have been conducted at the Aerojet site since 1979. Between 1979 and 1984, investigation of the source areas at the Aerojet site focused primarily on determining whether a release of VOCs had occurred and if the release may have migrated into and contributed to VOCs identified in the groundwater.

In 1985 and 1986, investigation of the source areas was expanded to evaluate the potential presence of metals, semivolatile organic compounds (SVOCs), and other chemicals other than VOCs in soil attributable to historical operations. At source areas where these compounds were detected above regulatory standards established at the time, the investigations were expanded to provide a preliminary evaluation of the extent. These investigations were conducted in areas where releases were likely to have occurred (i.e., unlined sumps and ponds, lined sumps with cracks) or where indications (staining) of a release were observed.

In 1989, Aerojet entered into a PCD which included a plan for completing a facility-wide RI/FS in three phases; Scoping Phase, Phase I RI/FS, and Phase II RI/FS. The Scoping Phase was completed in 1989 and the Phase I RI was performed between 1991 and 1993. The purpose of the Scoping Phase was to review all available data to identify what chemicals had been used at the site and how those chemicals were handled, stored, and disposed of; and identify, based on research and reconnaissance, all locations where chemicals could have potentially been discharged to the environment. The purpose of the Phase I RI was to characterize the nature and extent of all chemicals in soil, surface water, and groundwater at each of the 317 potential source areas identified during the Scoping Phase, obtain sufficient data on which to assess the risk to human and ecological receptors, and evaluate potential remedial alternatives.



Source: USGS 7.5° Topographic Quadrangle(s): Buffalo Creek, Carmichael, Citrus Heights, Folsom; 1967; from RealTopo ™, copyright by Gecko Software

LEGEND

Dredge Tailings

N

Scale: 1" = 1000'

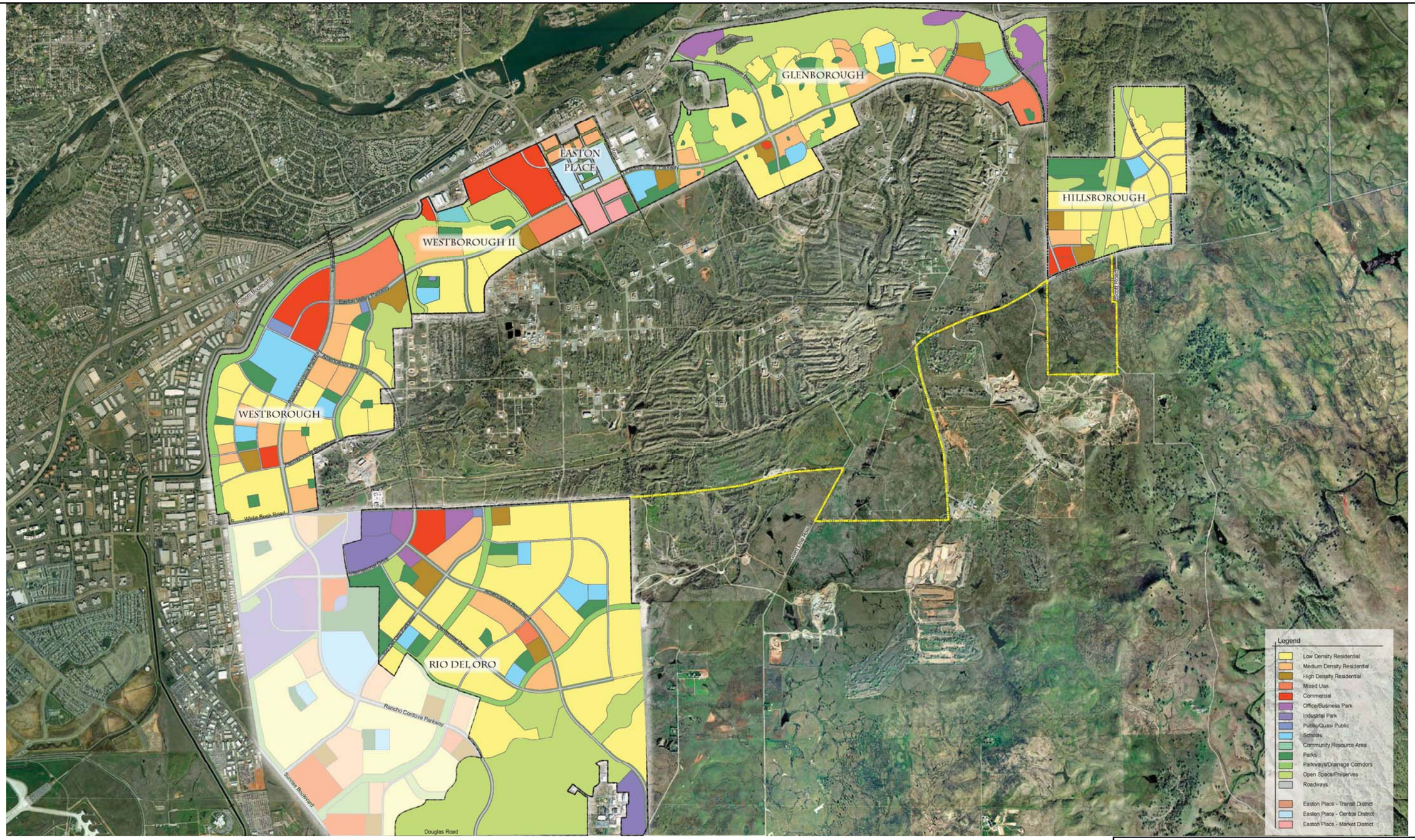
0 500 1000

AEROJET
Environmental Remediation

FIGURE 2.1-1

Surface Topography and Spatial Extent of Dredged Areas
Admin Area Boundary Operable Unit (OU-6)

12/11/07 ah SR10112232



N

Scale: 1" = 3200'

0 1600 3200

12/11/07 ah SR10130963

AEROJET
Environmental Remediation

FIGURE 2.1-2

Superfund Site Boundaries and Current Planned Land Use

Table 2.5-1 General Site Stratigraphy
Boundary Operable Units RI/FS
Aerojet Superfund Site
Sacramento County, California

Formation Name	Age	Thickness (feet)	Characteristics
Basement Rocks	Jurassic	unknown	Primarily metamorphic dominated by slates and meta-volcanic rocks.
Chico Formation	Cretaceous	200-400	Chico Formation encountered at – 1,180 feet. Composed of marine sandstone and shale with small amounts of saline water.
Ione Formation	Tertiary middle Eocene	100-400	Ione Formation encountered at – 830 feet. Composed of marine or transitional quartz sandstone and thick beds of clay.
Valley Springs Formation	Tertiary Oligocene-Miocene	75-300	Valley Springs Formation encountered at – 530 feet. Composed of volcaniclastic ash, tuff, quartz sand, pebble conglomerates and clay beds. Generally low water yielding aquifer.
Mehrten Formation	Tertiary Miocene-Pliocene	200-400	Mehrten encountered at – 190 feet. Fluvial volcaniclastic sediments composed of black sands, gravels, and interbedded clays. This Formation contains the deepest fresh water aquifer.
Laguna Formation	Tertiary Pliocene-Pleistocene	100-200	Laguna Formation is encountered at surface. Fluvial sediments derived mainly from silica-rich granitic rocks. Composed of silica-rich sands, gravels intermixed with clays, and silts. Most of the surface deposits of the Laguna have been disturbed by dredging operations. High yield aquifers are found in the Laguna.
Dredged Tailings and Undifferentiated Fluvial Deposits	Pleistocene to Recent	0-100	Dredge Tailings are unconsolidated heterogeneous mixture of sand, silt, clay, and gravels. Undifferentiated Fluvial Deposits are unconsolidated clay, silt, sand, and gravel. May contain discontinuous zones of perched groundwater.

3.0 SUMMARY OF SCREENING LEVEL DEVELOPMENT AND USE, FATE AND TRANSPORT, AND DATA VALIDATION

This section summarizes the development and use of screening levels for evaluating the nature and extent of chemicals during the BOU RI, the fate and transport of chemicals identified during the BOU RI, development of conceptual site models, and validation of the data used in this RI/FS.

3.1 DEVELOPMENT OF SCREENING LEVELS AND USE IN COMPARISON TO SITE DATA

Remedial investigation screening levels (RISLs), ecological screening levels (ESLs), and protection of groundwater (PGW) soil screening levels (SSLs) were developed for each chemical by media (soil, soil vapor, surface water, and groundwater) during preparation of the BOU FSP.

The purpose of the screening levels was to provide a way to evaluate the analytical results as they were received from the laboratory and determine the need for additional "step-out" sampling to complete the characterization. These characterization screening levels were developed from applicable or relevant and appropriate requirements and requirements "to be considered." Because an Agency-approved background dataset for metals had not been completed at the time the BOU FSP was prepared, the screening levels for metals were developed using only regulatory levels. To ensure that sampling performed during the RI was sufficient to characterize the nature and extent of chemicals and support the development of the risk assessments and FS, the screening levels were developed using the lowest, most conservative screening levels identified in regulatory guidance documents.

The comparison of the data to screening levels in this RI is made to assist the reader in the identification of those constituents that may potentially be of concern and determine if characterization has been completed to the extent possible. Because potential risks to human and ecological receptors are cumulative rather than dependent on a single constituent, no constituents were eliminated from further evaluation of potential migration or risk based on the comparison. The potential migration of all constituents and their potential risk to groundwater is addressed in Volume I (RI Report) of this document. The potential risk posed by

chemicals detected in soil, soil vapor, surface water, and groundwater to human and ecological receptors is addressed in Volume II (HHERA).

As previously discussed, screening levels for all chemicals in all media (soil, sediment, soil vapor, surface water, and groundwater) were developed as part of the BOU FSP. The development of those screening levels and their use in the RI Report (Volume I) for comparison to site-specific data to identify COPCs and evaluate the completeness of sampling is described below.

3.1.1 Development and Use of Screening Levels for Volatile Organic Compounds in Soil Vapor

RISLs were developed for VOCs in soil vapor based on potential risk to human and ecological receptors. Additionally, PGW soil vapor screening levels (SVSLs) were developed for VOCs based on their potential migration to groundwater. The procedure used to develop RISLs, ESLs, and PGW SVSLs for each VOC, and comparison of site data to those screening levels in this RI Report, are described below. RISLs and PGW SVSLs are presented on Tables 3.1-1 and 3.1-2, respectively.

3.1.1.1 Development of Remedial Investigation Screening Levels for Soil Vapor

RISLs were developed for VOCs in soil vapor during preparation of the BOU FSP (Aerojet, 2005c) using the following methodology.

- RISLs were developed using the lowest concentration of either the ambient air Preliminary Remediation Goal (PRG) established by USEPA Region IX or California Human Health Screening Levels (CHHSLs) for indoor air. Development of the RISLs for the BOU was performed in 2005, before publication of the *Regional Screening Levels* (RSLs) by USEPA in February 2009.
- The ambient air PRG or CHHSL for indoor air was adjusted based on the carcinogenicity of the VOC. The lower of the ambient air PRG for carcinogenic VOCs or one-tenth of the ambient air PRG for noncarcinogenic VOCs was used. One-tenth of the ambient air PRG or CHHSL was used to compensate for exposure to multiple constituents.
- The selected RISL is the lower of either the adjusted ambient air PRG or the CHHSL multiplied by an attention factor of 0.001 or 1/1000.

Following the receipt of soil vapor analytical data from the laboratories, Aerojet ascertained that the RISLs for many of the VOCs were so

conservative, an inordinate number of samples would be required to completely characterize the extent of every VOC to levels below their respective RISLs. Aerojet developed a revised characterization strategy that established a RISL based on the ratio between the total concentrations for those VOCs detected in the sample and the sum of the RISLs for each of those VOCs. Aerojet and the Agencies agreed that soil vapor would be characterized during the BOU RI to the extent where the sum of the ratio of the concentration for each detected VOC in the sample divided by its RISL is greater than or equal to 10. For example, if PCE at 320 micrograms per cubic meter ($\mu g/m^3$) and TCE at 961 $\mu g/m^3$ were the only VOCs detected in the samples, then the sum of their respective concentrations divided by their respective RISLs of 320 and 961 $\mu g/m^3$ (total VOC ratio), would be 2, or:

$$PCE = \frac{320\,\mu g/m^3}{320\,\mu g/m^3} = 1$$

$$TCE = \frac{961\,\mu g/m^3}{961\,\mu g/m^3} = 1$$

$$TVOC\ Ratio = 2$$

If it is assumed that the RISL for each VOC roughly represents a one-in-one million (1×10^{-6}) cancer risk, then the revised soil vapor characterization strategy would ensure the characterization of VOC concentrations in soil vapor to levels that would roughly estimate a cumulative risk of one in one hundred thousand (1×10^{-5}).

In this document, the total volatile organic compound (TVOC) ratios calculated using the RISLs published in the BOU FSP are presented in figures to allow the reader to quickly determine whether characterization was performed to below the TVOC ratio of 10 agreed upon with the Agencies.

Concentrations for selected VOCs such as TCE, PCE, 1,2-dichloroethane (1,2-DCA), chloroform, and vinyl chloride were also directly compared to their individual RISLs and those exceedances are shown in figures in this document. However, because comparison of individual non-carcinogenic VOCs to their RISLs calculated using one-tenth of their ambient air PRG or CHHSL would be inconsistent with the approach utilized for the TVOC ratios, the RISLs for those compounds were re-calculated in the same

manner as the carcinogenic VOCs. Specifically, the selected RISLs for all VOCs are either the lower of the ambient air PRG or the CHHSL multiplied by an attention factor of 0.001 or 1/1000. RISLs for VOCs are presented on Table 3.1-1.

3.1.1.2 *Development of Protection of Groundwater Screening Levels for Soil Vapor*

PGW SVSLs were developed for 14 selected VOCs in soil vapor. The 14 compounds were selected because they were the most frequently detected VOCs and/or have high toxicity values. The selected VOCs are listed below and on Table 3.1-2.

- Benzene;
- Carbon tetrachloride;
- Chloroform;
- 1,1-Dichloroethene (1,1-DCE);
- 1,1,1-Trichloroethane;
- 1,1-Dichloroethane (1,1-DCA);
- 1,2-DCA;
- cis-1,2-Dichloroethene (cis-1,2-DCE);
- trans-1,2-Dichloroethene (trans-1,2-DCE);
- Ethylbenzene;
- Methylene Chloride;
- TCE;
- PCE; and
- Vinyl Chloride.

The PGW SVSL for each of the 14 VOCs was developed using VLEACH (Version 2.2a) to model a soil concentration that would potentially exceed the selected groundwater Applicable or Relevant and Appropriate Requirements (ARARs) over the next 30 years. The ARARs selected were:

1) The lower of either the Public Health Goal (PHG) established by the California Office of Environmental Health Hazard Assessment (OEHHA) PHG or the 2008 tapwater values published in the RSL (USEPA, 2008); or

2) If PHGs or RSLs were not available, the 2004 tapwater PRG (USEPA, 2004).

VLEACH is a one-dimensional model that describes the movement of contaminants between three phases: (1) as solute dissolved in liquid phase; (2) as a gas in vapor phase; and (3) as an adsorbed chemical in the solid phase. VLEACH estimates liquid phase advection and gaseous diffusion in the vapor phase to simulate vertical transport of chemicals through the vadose zone. The VLEACH Model predicts a mass flux of the chemical from the vadose zone to groundwater over time using the following assumptions:

- Contaminant partitioning between phases follows linear relationships;
- Liquid, vapor, sorbed phases are in a state of equilibrium in each cell;
- Each chemical acts independently (i.e. chemical mixtures do not affect equilibrium concentrations);
- Soil moisture content profile is constant and the vadose zone is in a steady state with respect to downward water flux or recharge rate;
- Liquid-phase dispersion is neglected;
- No mobile nonaqueous-phase liquid (NAPL) is present in the vadose zone;
- Soil column from surface to the groundwater table is homogeneous with uniform soil properties; and
- Chemical concentration is not subject to natural degradation in soils.

The use of VLEACH to determine a PGW SVSL is a conservative approach, as laboratory column studies indicate that VLEACH may overestimate the mass leached from soil to groundwater (Rong, 1999).

The model was iteratively run in "reverse" to obtain the minimum soil concentration that would cause exceedances of the selected groundwater ARAR in the modeled cell. After the soil concentration was output by the model in milligrams per kilogram (mg/kg), it was converted to a soil vapor concentration in µg/m^3 using the following formula from the VLEACH Version 2.2a manual (Ravi, 1997):

$$Cg = \frac{KHMT}{[q + (f - q)KH + Kdrb}$$

where,

Cg = Vapor concentration of VOC in gas phase in $\mu g/m^3$;
KH = Henry's Law Constant (dimensionless);
MT = Total mass of contaminant in soil in micrograms per kilogram;
q = Volumetric water content (percent);
f = Soil porosity (percent);
Kd = Distribution coefficient in liters per kilogram; and
rb = Bulk density of soil in grams per milliliter.

A VLEACH modeling discussion including tables of inputs and results are included in Appendix A. Tables presenting the calculations performed to convert soil concentrations in mg/kg to soil vapor concentrations in $\mu g/m^3$ are presented in Appendix A.

3.1.1.3 *Development of Ecological Screening Levels for Soil Vapor*

Currently, there is no widely recognized or regulatory agency-approved source of ESLs to support screening of soil vapor data. Following discussions with the Agencies, the Edwards Air Force Base benchmarks were utilized in the SLERA (Section 6 of the HHERA; Volume II) to evaluate potential risks to burrowing small mammals due to exposures to VOCs in soil vapor. The characterization of VOCs during the BOU RI was based only on the potential risk to human health.

3.1.1.4 *Use of the Screening Levels for Soil Vapor in the Remedial Investigation*

In this RI Report (Volume I), TVOC ratios are presented on figures to allow the reader to quickly determine whether characterization was performed to below the TVOC ratio of 10 agreed upon with the Agencies. During sample collection for evaluation of the extent of chemical impacts, Aerojet and the Agencies agreed that delineation of chemical impacts to a concentration of 10x the FISL would be sufficient to evaluate risk and determine if the area requires further evaluation in the FS.

Concentrations for each VOC detected in the soil vapor samples, with the exception of 1,3-butadiene, are compared to their respective RISL and PGW SSL to assist in the identification of potential sources and areas where VOCs are present in soil vapor at concentrations that could potentially pose a risk to human receptors or migrate into groundwater. The exclusion of 1,3-butadiene from the comparison is discussed in Section 3.1.2.

While VOCs detected at concentrations exceeding their respective PGW SVSLs are identified in the text and figures in the RI, it should be noted that the PGW SVSLs do not account for the depth at which the sample was

collected. Because sample depth, or more accurately the distance of the sample from groundwater, is a crucial factor in evaluating the potential for a chemical to migrate into groundwater, an exceedance of the PGW SSL does not conclusively prove that the compound has, or will, migrate into groundwater. Therefore, a detailed evaluation of the potential for those VOCs detected above their PGW SVSLs to have migrated, or will migrate, into groundwater based on other lines of evidence such as the presence of the chemical in groundwater, physical properties such as solubility, and distance of the concentrations from groundwater is presented in Section 8 of the HHERA, Volume II of this RI/FS Report.

Because of the complexities associated with the evaluation of potential risk to ecological receptors posed by VOCs in soil vapor, a comparison of concentrations for VOCs in soil vapor to Ecological (Eco) RISLs is not provided in this RI Report. The potential risk to ecological receptors posed by VOCs in soil vapor is addressed in the SLERA provided in Section 6 of the HHERA, Volume II of this RI/FS Report.

3.1.2 *Evaluation of the Occurrence and Detection of 1,3-Butadiene in Soil Vapor*

Because of its volatility and rapid biodegradation, and the state (gas) in which this compound is used in manufacturing, 1,3-butadiene is not a compound expected to be identified in soil vapor. However, 1,3-butadiene has been commonly, but sporadically, detected (i.e., detected at 10 feet and not at 5 feet at the same location and at 10 feet at one location, but not at 10 feet at several other proximal locations) in soil vapor samples collected at various locations on the Aerojet site.

The presence and detection of 1,3-butadiene in the soil vapor at the Aerojet site has been the subject of evaluations by Aerojet and USEPA with the expert assistance of Air Toxics, Limited (ATL) and Laboratory Data Consultants. ATL specializes in the analysis of gas and vapor samples and Laboratory Data Consultants specializes in the review and validation of analytical data and procedures. Because of its toxicity, low concentrations of 1,3-butadiene may be harmful to humans; therefore, additional information was needed to determine the presence of that chemical in soil vapor and its potential to migrate into indoor air.

ERM conducted experiments between June 2005 and September 2006 to 1) verify the presence of 1,3-butadiene in the soil vapor samples; 2) identify potential sources of that compound in soil vapor or the soil vapor samples; and 3) assess the reproducibility of the detection of that

compound in soil vapor at the Aerojet site. Additionally, soil vapor sampling conducted during the BOU RI also provided information related to the reproducibility of the analytical results for 1,3-butadiene. The scope and results of the experiments, the results of soil vapor sampling conducted during the BOU RI, and conclusions based on those results are summarized below.

3.1.2.1 *Presence of 1,3-Butadiene in Soil Vapor Samples*

Split soil vapor samples were collected at multiple locations in one area of the Aerojet site in March 2005 and sent to ATL in Folsom, California, and to Environmental Analytical Service, Inc. (EAS) in San Luis Obispo, California. ATL had performed the analysis of all previous soil vapor samples collected at the site that had detections of 1,3-butadiene. Split soil vapor samples were sent to EAS because their analysis of 1,3-butadiene in vapor samples was based on the identification of two ions, as opposed to the one ion identification method used by ATL.

The split soil vapor samples were collected at a depth of 10 feet bgs using standard direct-push soil vapor sampling techniques and following guidance published by DTSC. The soil vapor samples were collected in batch certified summa canisters using a vapor stream splitter provided by ATL that evenly divided the extracted soil vapor into the two canisters. Due to concerns that leak check gas could potentially be a source of 1,3-butadiene, a leak check was not performed during sampling.

The analytical results for the soil vapor samples from the two laboratories included variations in concentrations for individual VOCs, but 1,3-butadiene was detected in the soil vapor samples analyzed by both laboratories.

3.1.2.2 *Reproducibility of 1,3-Butadiene Detections*

Although the analytical data indicated that 1,3-butadiene was present in the soil vapor samples, the source of the 1,3-butadiene had not been identified. Potential sources of 1,3-butadiene in the samples were either soil vapor from the pore space in the soil or contamination from outside sources. Contamination from outside sources included exhaust from motor vehicles, introduction during analysis by the laboratory, or off-gassing from materials used during collection of the soil vapor samples. ERM conducted experiments between June 2005 and September 2006 to 1) identify the source of the 1,3-butadiene detected in the soil vapor samples; and 2) evaluate the reproducibility of 1,3-butadiene detections in soil vapor. The results of the

experiments conducted in June and July 2005 were presented in the *Evaluation of the Occurrence and Detection of 1,3-Butadiene in Soil Vapor at the Aerojet Superfund Site* (ERM, 2005). The scope and results of these experiments and conclusions based on those results are presented below. The analytical data for soil vapor samples collected during the 1,3-butadiene evaluations are presented in Appendix B.

Scope

- Collection of soil vapor samples in June and July 2005 at four previous locations and at depths where 1,3-butadiene had previously been detected. Nested temporary soil vapor sampling probes (stainless-steel rods) were installed at 5, 10, and 15 feet bgs at two locations and nested semi-permanent vapor ports at 5, 10, and 15 feet bgs were installed at two locations. The semi-permanent vapor ports were constructed of tubing that was placed at the desired depth and the annular space surrounding the tubing was backfilled with bentonite grout. Teflon tubing was used at one location and polyethylene tubing was used at the other location.
- The collection of soil vapor samples from the temporary probes and semi-permanent ports on three separate occasions in June and July 2005. The first samples were collected after allowing 30 minutes for the probes/ports to equilibrate. Second samples were collected 2 to 3 days after installation and the third samples were collected 33 days after installation.
- Primary and duplicate soil vapor samples from the probes and ports were collected in a combination of batch and individually certified Summa canisters. Duplicate samples were collected at each soil vapor sampling location during each sampling event, but at a different depth. Vehicles were present near the locations during the first sampling event, but vehicles and other potential sources of hydrocarbons that could include 1,3-butadiene were prohibited within 500 feet of the locations during the second and third sampling events. 1,1-difluoroethane was used as a leak check gas during the collection of all samples.
- The collection of soil vapor samples between 31 August and 6 September 2006 from the ports/probes at three of the nested locations and at nine other locations on the site where 1,3-butadiene had previously been detected.
- Analysis of all soil vapor samples for VOCs by ATL using modified USEPA Method TO-14A; and

- Testing of all materials (sand, bentonite, tubing, etc.) used in construction of the probes/ports for potential off-gassing of 1,3-butadiene. The materials were placed into a sealed container, heated to induce volatilization, a vapor sample was collected from the headspace of the container, and analyzed using USEPA Method TO-15.

Results

- 1,3-Butadiene was detected at concentrations ranging from 12 to 95 $\mu g/m^3$ in every initial soil vapor sample collected from the nested probes/ports, except one. The one soil vapor sample that did not have a detected concentration of 1,3-butadiene had elevated practical quantitation limits (PQLs) resulting from the presence of the leak check gas in the sample.
- 1,3-Butadiene was not detected above the PQL (2.4 to 99 $\mu g/m^3$) in any of the soil vapor samples collected from the ports/probes 2 to 3 days after installation.
- 1,3-Butadiene was not detected above the PQL (2.5 to 19 $\mu g/m^3$) in any of the soil vapor samples collected from the ports/probes 33 days after installation.
- 1,3-Butadiene was not detected above the PQL (2.2 to 15 $\mu g/m^3$) in any of the soil vapor samples collected from the ports/probes over a year after installation.
- 1,3-Butadiene was not detected above the PQL (2.2 to 1,200 $\mu g/m^3$) in any of the soil vapor samples collected in August and September 2006 at locations where it had previously been detected.
- 1,3-Butadiene was not detected in headspace vapor samples collected.

3.1.2.3 *Conclusions Regarding the Occurrence and Detection of 1,3-Butadiene in Soil Vapor*

Conclusions concerning the occurrence and reproducibility of 1,3-butadiene in soil vapor samples at the Aerojet site based on the results of the experiments conducted to date are presented below:

- The analytical results for soil vapor samples performed by two laboratories using different methods indicate that 1,3-butadiene is actually present in the samples and the detections are not false positives. However, it has not been conclusively established if the 1,3-butadiene in the samples originates from the soil or is a contaminant introduced during sampling and/or analysis. Testing did

not identify the potential off-gassing of 1,3-butadiene from any of the materials used in the construction of the probes/ports.

- The results of the experiments performed by ERM indicate that the detections of 1,3-butadiene is not reproducible. Repeat soil vapor sampling performed as part of the BOU RI also confirmed the irreproducibility of 1,3-butadiene detections.

In addition to the results of the experiments and sampling described above, 1,3-butadiene was not detected in flux chamber samples collected in July 2003 in an area where 1,3-butadiene had been detected in soil vapor samples.

If 1,3-butadiene is indeed present in soil vapor, the fact that the detections cannot be reproduced indicates that the compound quickly degrades and, as indicated by the results of the flux chamber samples, appears unlikely to migrate into outdoor or indoor air. Because the data indicate that 1,3-butadiene may not be present in soil vapor and is unlikely to migrate into outdoor and indoor air even if it were present, 1,3-butadiene was not included as a COPC in this RI/FS Report. Therefore, a RISL or PGW SSL was not developed to evaluate completeness of characterization for this compound. Additionally, the sporadic nature of the detections makes it impossible to accurately characterize the potential nature and extent or develop a remedial alternative.

It should also be noted that the detection of 1,3-butadiene in soil vapor is not restricted to the Aerojet site. ATL said that they had received numerous enquiries from other consulting firms at various locations in the United States about 1,3-butadiene in soil vapor samples. ERM and Aerojet, along with several consulting firms that had encountered the presence of 1,3-butadiene in soil vapor samples, participated in a teleconference hosted by ATL. The other consultants also observed the same characteristics for 1,3-butadiene in the soil vapor samples noted at the Aerojet site. 1,3-Butadiene has been detected in samples at sites where no historical activities had been reported and documented and chemicals were not present in groundwater. Additionally, 1,3-butadiene was sometimes the only compound detected in soil vapor samples, and the detections could not be reproduced. To date, ERM is not aware of a conclusive resolution regarding the detection of 1,3-butadiene in soil vapor samples.

3.1.3 *Development and Use of Background Levels for Metals and Screening Levels for Metals and Non-Volatile Organic Compounds in Soil*

Remedial investigation screening levels for metals and other non-VOCs in soil, based on potential risk to human health and protection of groundwater SSLs and on migration to groundwater and surface water, were developed in the BOU FSP to guide the characterization of those compounds in soil. Additionally, Aerojet performed a study to determine naturally occurring background concentrations for metals in soil.

Following the receipt of soil analytical data from the laboratories and prior to approval of a background metals dataset, Aerojet ascertained that the RISLs developed for many of the metals and non-VOCs were so conservative, an inordinate number of samples would be required to completely characterize the extent of those compounds to levels below their respective RISLs. Therefore, similar to the approach used for VOC soil vapor data, characterization of metals and non-VOCs was based on the ratio between the total concentration for each metal/non-VOC and the sum of the RISLs for each of those compounds. Aerojet and the Agencies agreed that characterization during the BOU RI would be performed to the extent where the sum of the ratio of the concentration for each detected non-VOC in the sample divided by its RISL is greater than or equal to 10. With respect to potential risks to ecological receptors, ERM reviewed the analytical results for samples collected during the BOU RI and presented the results along with recommendations for additional characterization to the Agencies on 24 April 2007. Additional characterization sampling was performed in spring 2007 and the results were presented to, and discussed with, the Agencies on 11 February 2008.

The methods and procedures used to develop background concentrations for metals and RISLs and PGW SSLs for metals and other non-VOCs are described below. Additionally, comparison of the site soils data to those levels in this RI Report to identify COPCs and evaluate the completeness of characterization is also described below. RISLs and PGW SSLs for metals and other non-VOCs are presented on Tables 3.1-3 and 3.1-4, respectively.

3.1.3.1 *Development of Background Concentrations for Metals*

Aerojet performed a detailed study of background concentrations of metals in surface (0 to 1 foot bgs) soil at the Aerojet site in 2006. The scope of this study, including the number of samples and sampling locations, were selected and agreed upon with the Agencies. The results of the study and statistical evaluation of the data were presented in *Background*

Metals in Xerorthents and Redding-Corning-Red Bluff Surface Soils at the Aerojet Superfund Site, Main Plant, Sacramento, California (Aerojet, revised January 2007), hereafter referred to as the 2007 Background Report. Background data reported in the 2007 Background Report have been reviewed and approved by the Agencies. A summary of the study is provided below.

- A total of 156 soil samples were collected within the boundaries of the Aerojet site to evaluate naturally occurring background concentrations of metals in soil. Samples were collected from the three major soil types present at the site: Xerorthents, Redding-Corning-Redbluff (RCR) complex, and the Auburn-White Rock-Argonaut (AWRA) complex.
- Thirty-nine samples were collected from Xerorthents and 38 were collected from the RCR complex, the two major soil types found in the areas encompassed by the BOU.
- Samples were initially analyzed using USEPA Methods 6010 and re-analyzed using USEPA Method 6020 to achieve lower detection limits for the following nine metals: antimony, arsenic, cadmium, chromium, lead, molybdenum, selenium, silver, and thallium. In addition to achieving a lower detection limit, the purpose of analyzing the samples for those nine metals using USEPA Method 6020 was to reduce or eliminate false-positive detections for those metals common in USEPA Method 6010.
- Data outliers were removed from the dataset based on the presence of inflection points in probability plots.
- Background metal concentrations were established for each of the three major soil types for both analytical methods resulting in the following six background data sets:
  - Xerorthents 6010 data;
  - Xerorthents 6020 data (nine metals only);
  - RCR soil 6010 data;
  - RCR soil 6020 data (nine metals only);
  - AWRA 6010 data; and
  - AWRA 6020 data (nine metals only).

During preparation of this RI, ERM concluded that use of the four data sets representing the Xerorthents and RCR soil types found within the BOU to identify metals having "elevated" concentrations would result in a

complicated and confusing application and interpretation of background comparisons. For example, there are instances where metal concentrations in site soil samples are comparable to background using USEPA Method 6010, but "elevated" compared to background based on USEPA Method 6020.

To promote a straightforward establishment of background metals data, ERM developed an approach consistent with USEPA guidance and field duplicate protocols currently being used at Aerojet. The results from background soil samples analyzed using both analytical methods were considered to be "duplicate" results and the following decision rule was applied to the data:

1. When both duplicates are nondetects, the lesser of the detection limits is used;
2. When one of two duplicates is a nondetect, the detected value is used;
3. When both duplicates are detects, the greater of the detected values is used; and
4. Duplicates include field duplicates, as well as method-related duplicates.

Using this approach, ERM was able to combine the 6010 and 6020 background data sets for each soil type into a single data set specific to the soil type that could then be statistically compared to the site data to identify "elevated" metal concentrations. Details on the methods used to establish the background concentration data set for metals are presented in Appendix C.

For the RI Report (Volume I), concentrations of metals detected in soils collected from all source areas having the same soil type (Xerorthents or RCR) within each separate management area were statistically compared to the Aerojet background concentrations for that soil type using both the Gehan and Quantile tests. Comparisons to background using these statistical tests are consistent with USEPA's (2002c) *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites* and were performed using USEPA's ProUCL Version 4.0.1 software. If either the Gehan or the Quantile test found that the concentrations of a particular metal were greater than background, that metal was identified as a COPC and all detected concentrations for that metal were compared to its RISL and PGW SSLs. Metals having concentrations above background and their respective RISLs and PGW SSLs are identified in the RI and

discussed with respect to the location of the exceedance and completeness of characterization. Details concerning the statistical comparison of site data to background are presented in Appendix C. The development of human health and Eco RISLs and PGW SSLs for metals and other non-VOCs are described below.

3.1.3.2 *Development of Remedial Investigation Screening Levels for Metals and Other Non-Volatile Organic Compounds in Soil*

RISLs for metals and other non-VOCs in soil, except total petroleum hydrocarbons (TPH), were established using the lowest of either the USEPA Region IX residential PRG or CHHSL, if available. PRGs and CHHSLs for each metal and non-VOC and the selected RISL are presented on Table 3.1-3.

Because TPH extractable (diesel and motor oil) and purgeable (gasoline) are comprised of numerous chemicals with varying degrees of toxicity, a RISL was not established for TPH. However, RISLs were established for the individual volatile constituents (i.e., benzene and toluene) and non-volatile constituents (SVOCs and polynuclear aromatic hydrocarbons [PAHs]) present in TPH. RISLs for the volatile constituents in TPH are provided on Table 3.1-1.

3.1.3.3 *Development of Protection of Groundwater Screening Levels for Metals and Other Non-Volatile Organic Compounds in Soil*

Screening levels for metals and other inorganic compounds other than TPH in soil protective of groundwater were developed in the following procedure outlined in the *Designated Level Methodology for Waste Classification and Cleanup Level Determination* (RWQCB, 1989), which is:

Protection of Groundwater Soil Screening Level (PGW SSL) =
(Water Quality Goal) x (Leachability Factor) x (Attenuation Factor)

The water quality goal selected for each compound was the lower of the following:

- The OEHHA PHG;
- The tapwater RSL (USEPA, 2008); or
- The tapwater PRG (USEPA, 2004) if a PHG or RSL was not available).

An attenuation factor (AF) of 100 and leachability factor (LF) of 100 were used for inorganic compounds and an AF of 100 and LF of 10 were used

for organic compounds, except for perchlorate and NDMA. Because of their high solubility, an AF of 1 and a LF of 10 was used for perchlorate and NDMA.

The non-VOC compound 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) was selected for VLEACH modeling because it has high toxicity, but low solubility and mobility. Based on these criteria, the designated level methodology resulted in an overly conservative PGW SSL for 2,3,7,8-TCDD. Section 3.1.1.1 and Appendix A present information on the VLEACH methodology.

Water quality goals, AFs, LFs, and the calculated PGW SSL for inorganic and organic compounds are presented on Table 3.1-4. For metals, if the calculated PGW SSL was less than the background threshold value (BTV), the BTV was used as the PGW SSL. Calculation of the BTV for metals is described in Appendix C.

A PGW SSL of 100 mg/kg was established for TPH as diesel (TPH-D) and 500 mg/kg for TPH as motor oil (TPH-Mo) based on the recommendations presented in the California Leaking Underground Fuel Tank (LUFT) Manual (State Water Resources Control Board [SWRCB], 1989). The values represent the highest concentrations of those compounds that are protective of groundwater, assuming the most conservative conditions listed on Table 2-1 of the LUFT Manual.

3.1.3.4 *Development of Ecological Screening Levels for Metals and Other Non-Volatile Organic Compounds in Soil*

ESLs for metals and other inorganic compounds in soil protective of ecological receptors (plants, soil invertebrates, birds, and mammals) were developed based on the following hierarchy:

- USEPA Eco Soil Screening Levels (Eco-SSLs) – lowest available;
- Calculated Eco-SSLs based on USEPA Eco-SSL models and equations – using lowest available toxicity reference values from USEPA Region 9, USEPA Region 6, or Oak Ridge National Laboratory, in that order; or
- Oak Ridge National Laboratory PRGs (Effroymson et al., 1997) for those constituents where required input information to calculate an Eco-SSL was not available.

3.1.3.5 *Use of Soil Screening Levels for Metals and Other Non-Volatile Organic Compounds in Soil*

In this RI Report (Volume I), concentrations for each metal that was identified as being statistically above background based on the evaluation presented in Section 3.1.3.1 and all other non-VOCs detected in the soil samples are compared to their respective RISLs and PGW SSLs to assist in the identification of potential sources and areas where those chemicals are present at concentrations that could potentially pose a risk to human receptors or migrate into surface water and/or groundwater. While metals and other non-VOCs at concentrations exceeding their respective PGW SSLs are identified in the text and figures in the RI, it should be noted that the PGW SSLs do not account for the depth at which the sample was collected. Because sample depth, or more accurately the distance of the sample from groundwater, is a crucial factor in evaluating the potential for a chemical to migrate into groundwater, an exceedance of the PGW SSL does not conclusively prove that the compound has, or will, migrate into groundwater. Therefore, a detailed evaluation of the potential for those metals or other non-VOCs to have migrated, or will migrate, into groundwater based on the results of the comparison to PGW SSLs along with other lines of evidence such as the presence of the chemical in groundwater, physical properties such as solubility, and distance of the concentrations from groundwater is presented in Section 8 of the HHERA, Volume II of this RI/FS Report.

Due to the complexities associated with the evaluation of the potential risk posed by metals and other non-VOCs to ecological receptors consisting of multiple species, a comparison of concentrations for metals and non-VOCs to Eco RISLs are not presented in this RI Report. Potential risks to ecological receptors are addressed in Section 6 of the HHERA, Volume II of this RI/FS Report.

3.1.4 *Development and Use of Screening Levels for Compounds in Surface Water*

Surface water screening levels (SWSLs) were developed for VOCs and non-VOCs in surface water based on potential risk to human health (Table 3.1-5). The selected SWSL for each compound was the lowest of the following:

- The tapwater PRG (USEPA, 2004);
- The federal maximum contaminant level (MCL);

- The California MCL; or
- Dissolved concentration limits cited in the *Revised Waste Discharge Requirements for Aerojet-General Corporation and Aerojet Fine Chemicals* (NPDES Permit No. CA0004111) (RWQCB Order No. R5-1999-0016-R01, revised 2002).

In this RI Report (Volume I), concentrations for each compound detected in surface water were compared to their respective SWSL to assist in evaluating the potential migration of those compounds from source areas within the BOU. Storm water discharges from the Westlakes to lower Buffalo Creek and the American River are regulated through the *Revised Waste Discharge Requirements* (RWQCB, 2002)

3.2 FATE AND TRANSPORT AND CONCEPTUAL SITE MODELS

A chemical only poses a potential threat to human and ecological receptors if it comes into contact with the receptors at a concentration that could cause an adverse effect. An understanding of the fate and transport of a chemical is crucial in the evaluation of the potential for a chemical released to the environment to migrate to areas where human and ecological receptors could come into contact with it and how naturally occurring processes (physical, chemical, and biological) effect the toxicity, mobility, and volume of that chemical.

General fate and transport processes for chemicals in soil and groundwater, and specific fate and transport processes for chemicals identified in soil at source areas within the BOU are described below. Specific fate and transport processes for chemicals identified in groundwater beneath the BOU and the effect of those processes on migration are discussed in the groundwater sections of this RI Report.

3.2.1 General Fate and Transport Processes

The fate and transport processes of concern with respect to the Aerojet site are those that govern the migration of chemicals that have been released to the environment to other media such as soil, sediment, surface water, and groundwater. After chemicals have entered into a media, other fate and transport mechanisms occur that may cause further chemical migration or transformation. The general fate and transport of chemicals in soil and groundwater are discussed below to provide the basis for

understanding the migration and fate of those chemicals identified at source areas within the BOU.

3.2.1.1 *General Fate and Transport Processes of Chemicals in Soil*

A variety of processes occur that may cause organic and inorganic chemicals in soil to become immobilized, degraded, or to mobilize to another environmental medium. Some of these processes are described below.

Open Channel Flow - Open channel flow is the flow of a liquid in a conduit in which the upper surface of the liquid (i.e. the free surface) is in contact with the atmosphere. Examples of open channel flow include flow in sewer and other waste discharge lines, storm drains, and drain pipes. This transportation pathway can be available to solids moved by mechanical means, as well as for liquids entering these systems through accidental or purposeful releases.

Runoff/Fugitive Dust – Chemicals that become adsorbed (bonded) to soil particles because of the soil or chemical characteristics may still be mobilized from areas containing chemicals to other media. Storm water runoff can result in surficial particulate transport when soil is suspended in storm water during and after heavy precipitation events, and, in the case of more water-soluble substances, transport of constituents dissolved in storm water. Chemicals in soil that are exposed may be subject to erosion and transport via fugitive dust generation.

Leaching – Chemicals may be mobilized and transported downward through the soil strata by rain water, snowmelt, or other liquids that infiltrate through the soils. The leaching of chemicals from soils and the subsequent mobilization are controlled by soil properties (i.e., cation and anion exchange capacity, organic carbon content, clay content, or specific surface area) and by chemical properties (i.e., solubility and ability to partition to other phases).

Entrapment – Chemicals released to the ground surface may become bound to soil or other particles by advective forces or by adsorption. These bonding forces can be strong or weak, depending on the soils and the chemical constituents. In the example of a fuel oil release, some of the oil will remain trapped within the soil as it passes through the vadose zone to the groundwater table. A large release will pass through the soil and into the groundwater, leaving a smear zone on the soil column in the

release area. A small release may only result in stained soils on the ground surface.

Chemicals that do not dissolve in the groundwater will likely remain bound within the soil matrix until released by a physical or chemical interruption. Small soil particles in the saturated zone may be transported slowly with groundwater flow, depending on the size of the surrounding soils in the formation, but are more likely to remain static.

Nonaqueous-Phase Liquid Migration – NAPLs are nonpolar organic compounds that will not dissolve in water. Light nonaqueous-phase liquids (LNAPLs) are organic liquids, such as diesel and gasoline, which have densities less than water. Dense nonaqueous-phase liquids (DNAPLs) have densities greater than water and include chlorinated solvents. The transport of NAPLs in subsurface environments is a complex process that is strongly influenced by the geology of the system. When a NAPL is spilled on the ground surface or released beneath it, the NAPL will migrate downward through the unsaturated zone toward the water table, primarily by gravity-driven flow. The presence of low permeability layers will inhibit downward migration and force the NAPL to move laterally. If the low permeability layer is continuous, downward movement may cease. If the layer is discontinuous, the NAPL will eventually spill over its edge and continue to migrate downward toward the water table.

As the NAPL moves downward, the quantity trapped within soil pores in liquid (residual product) and vapor phase (soil vapor) increases and the quantity of mobile free product decreases. Depending on the volume of NAPL released, it may or may not reach the water table.

Volatilization – Chemicals (VOCs) having high Henry's Law coefficients or vapor pressures will readily partition (volatilize) and will remain in the open pore spaces of the soil and/or migrate to the ambient air rather than remain associated with solid or liquid phases. Once in the air, the chemicals may undergo physical transport by advection or diffusion, or they may be transformed through chemical processes such as hydrolysis or photolysis. VOCs include chlorinated aliphatic and aromatic hydrocarbons. The partitioning of these compounds depends not only on volatility and solubility, but on temperature, soil moisture content, and the presence of organic matter.

3.2.1.2 *General Fate and Transport Processes of Chemicals in Groundwater*

Chemicals are present in groundwater in two principal phases: dissolved compounds (disassociated molecules) and suspended solids (molecules adsorbed to mobile particles). These physical phases dictate how chemicals generally migrate with groundwater movement.

For chemicals that have migrated downward into groundwater from the unsaturated soils through precipitation infiltration and leaching, additional natural processes affect the chemicals' fate and transport in the subsurface environment. Geologic conditions greatly influence chemical migration, providing physical pathways or barriers that could increase or retard migration.

Advection, dispersion, and molecular diffusion are the major chemical transport processes in groundwater. The bulk movement of groundwater through advection is the principal mechanism for chemical transportation in an aquifer. Dispersion and diffusion are secondary processes for dissolved chemical transport. Degradation and retardation are the two most important transformation processes that determine the ultimate fate of chemicals in groundwater. Each of the transport and transformation processes is briefly described below.

Advection – The dominant transport process in aquifers consists of the movement of dissolved or suspended phase chemicals with the bulk flow of the water. Advective transport results from the entrainment of chemicals in a flow field, and it is driven by a potential gradient, such as pressure or hydraulic head. Advection of dissolved chemicals in an isotropic, homogenous, porous medium results in the chemicals being transported with and migrating at the same velocity as groundwater.

Dispersion – Dispersion is a mixing process that results from velocity variations within bodies of moving fluids. In groundwater environments, variable velocity regimes are caused by variations in the media, and these variations exist at a variety of scales. For example, velocity variations at the microscopic scale arise from 1) fluids moving faster through the centers of pores than along the edges; 2) fluids moving faster through large pore spaces than through narrow ones; and 3) some fluid particles following more tortuous flow paths than others as they travel around individual soil particles. At the macroscopic scale, velocity variations result from the presence of layers or lenses of materials having contrasting hydraulic conductivities or the leaching of groundwater through permeable and impermeable layers.

The mixing due to dispersion increases as aquifer heterogeneity increases, and it results in dilution of the solute body as anthropogenic chemicals in water mix with natural water along the margins of the plume. Dispersion also results in the spreading of a chemical plume over a larger area (both parallel and perpendicular to the direction of flow) than would be expected by advection alone.

Molecular Diffusion – Diffusion is movement in response to a concentration gradient. Dissolved chemicals will move from areas of high concentration to areas of low concentration within an aquifer, even at low groundwater flow rates, because the process is driven by the random thermal motion of the chemical molecules. Because this transport process occurs on the molecular scale, its impact is usually small compared to the more rapid processes of advection and dispersion. Diffusion is the dominant transport mechanism in low-permeability environments.

Retardation – In groundwater, adsorption-desorption reactions lead to retardation of the rates at which chemicals migrate with advective groundwater flow. During chemical migration through an aquifer, an organic molecule may adsorb to stationary soil particles, iron oxyhydroxide, or organic coatings on the particles, thus slowing the chemical's transport with the groundwater flow. Only after desorption will a chemical rejoin the groundwater flow. The retardation factor (R) is governed by the partition coefficient (Kp) of organic compounds or by the distribution coefficient (Kd) of metals between the sorbed state and the dissolved state. These coefficients are available in reference books or may be measured in the laboratory using site-specific samples.

Single parameter distribution coefficients (K_ds) are often used to quantify the tendency for a solute to sorb to media surfaces. These distribution coefficients are based on a linear model of adsorption (i.e., it is assumed the mass of solute sorbed increases in a linear fashion as the dissolved concentration of the solute increases). This assumption is reasonable for nonionic organic solutes; however, ionic solutes tend to display nonlinear adsorption behavior at high concentrations because the number of charged adsorption sites on a surface is limited. Therefore, single parameter distribution coefficients often are not adequate in describing the adsorption of ionic solutes in all, but dilute, solutions.

Nonionic organic solutes such as benzene, toluene, ethylbenzene, and xylenes (BTEX) and PAHs adsorb primarily to organic coatings on mineral surfaces. Nonionic organic solute K_ds can be estimated from the fraction of organic carbon in the soil and the octanol-water partition coefficient

(K_{ow}) of the solute. As a result, the octanol-water partition coefficient can be used as an index for evaluating the relative tendencies for different organic solutes to adsorb to the same surface.

Preferential Flow – In aquifer systems, preferential pathways for groundwater flow occur due to heterogeneities in the subsurface soils and the bedrock matrix. Geologic materials that are more permeable (soils or bedrock fractures) allow the preferential flow of groundwater and chemicals through those geologic units.

Nonaqueous-Phase Liquid Migration – If an LNAPL reaches the water table, it will remain in pockets at the top of the water column. If a DNAPL reaches the water table, it will continue to move downward through the water column under the influence of gravity, migrating laterally along the top of any low permeability units it encounters. Once again, downward migration may cease if the low permeability stratum is continuous; otherwise, downward migration of DNAPLs will resume when it encounters the end of the stratum or near vertical preferential flow paths within the stratum. The direction of DNAPL transport in aquifers is driven primarily by gravity and the occurrence of relatively high and low permeability features; as a result, the direction of DNAPL transport may or may not coincide with the direction of groundwater flow. DNAPL zones in aquifers may be located upgradient or downgradient from their point of release, and in stratified media they likely consist of multiple horizontal pools that are resting on top of low permeability layers. The horizontal pools are typically connected to one another and to a pool at the base of the aquifer by vertical DNAPL stringers.

As water moves through LNAPL or DNAPL pools, soluble constituents partition into the water to generate a plume of dissolved chemicals and the more volatile constituents partition to the vapor phase. Depending on the local hydrogeology and the composition of the NAPL, the rate of dissolution may be so slow that the NAPL decreases the beneficial uses of groundwater for centuries.

Degradation – Transformation and degradation of VOCs occur at many sites by biological or non-biological processes in the subsurface. These processes transform original VOC compounds to byproducts.

Understanding degradation can be important to assessing plume migration and attenuation at sites where degradation rates are significantly high. In some cases, more harmful substances are created, such as the transformation of 1,2-dichloroethene (1,2-DCE) to vinyl

chloride. In other cases, complete destruction occurs and toxic chemicals are reduced to innocuous substances, such as the mineralization of vinyl chloride to carbon dioxide and water.

Organic constituents may be degraded by biological or non-biological means. Degradation decreases the concentration of a solute in a plume, but it does not necessarily slow the rate of plume movement.

Abiotic Degradation – Mechanisms of abiotic degradation include hydrolysis, oxidation, and reduction. Hydrolysis is the process where a chemical molecule and a water molecule are both split and recombine to form new chemicals. Oxidation consists of the loss of electrons by an organic compound or by a metal ion. Reduction is the chemical reaction whereby an organic compound or a metal gains electrons. Contaminants in the subsurface may be degraded or transformed by these abiotic processes that occur naturally. The dominance or effectiveness of these transformation processes are governed by factors such as temperature, pH, solubility, etc.

Biological Degradation – In biological degradation (biodegradation), microorganisms utilize available chemicals to obtain needed energy and nutrients through reduction-oxidation reactions (electron transfer reactions). Microorganisms either utilize chemicals for growth and energy purposes or through accidental uptake and transformation (co-metabolism). Depending on the microorganisms and chemicals present, biodegradation can occur in groundwater under either aerobic or anaerobic conditions.

Under aerobic conditions, carbon (as naturally occurring or anthropogenic organic compounds) is oxidized by microorganisms to provide a net energy gain that is necessary for growth and reproduction. Typically, low-molecular weight and soluble organic compounds are readily degraded by bacteria and fungi. Aromatic hydrocarbons (i.e., BTEX compounds) are used by microorganisms as a primary substrate (electron donor). Dissolved oxygen is used as the primary electron acceptor (chemical reduction) by the aerobic microorganisms.

Once the oxygen is depleted, anaerobic microorganisms (bacteria and archaea) use other available electron acceptors and cause those chemicals to be reduced. Nitrate is converted to nitrogen gas or ammonia, ferric iron (Fe[III]) to ferrous iron (Fe[II]), manganese (Mn[IV]) to manganese (Mn[II]), sulfate to sulfide ion, chlorinated solvents to compounds with one less chlorine atom, and carbon dioxide to methane.

The most common degradation process that influences chlorinated ethene plumes is reductive dechlorination. Through sequential reductive dechlorination of chlorinated ethenes, tetrachloroethene may be degraded to ethane through the following sequence:

- PCE → TCE →1,1-dichloroethene (1,1-DCE); cis- or trans-1,2-DCE; →vinyl chloride→ ethene → ethane; → CO_2, H_20, and Cl^-

Through degradation processes, chemicals that were not originally present at the site may be produced. In some cases, these daughter products may be more toxic than the original compounds released at the site. In many cases, the complete degradation sequence does not occur.

3.2.2 *Site and Chemical-Specific Fate and Transport Processes*

A qualitative evaluation of the fate and transport of chemicals identified as COPCs in soil, soil vapor, surface water, and groundwater at the source sites within the BOU is presented below. The evaluation is based on existing site conditions, interpretations of chemicals present in the environmental media, physical state of the soil constituents, general fate and transport mechanisms, and the interpretation of the geologic and hydrogeologic conditions at the Aerojet site. As previously discussed, the fate and transport of chemicals in groundwater are affected by factors such as flow rates, permeability, reductive dechlorination, and biodegradation. Because these factors vary within each aquifer, as well as in different flow regimes at the Aerojet site, fate and transport processes specific to the chemicals present in groundwater within the BOU are discussed in the groundwater sections of this RI Report.

3.2.2.1 *Volatile Organic Compounds*

VOCs are the most commonly detected chemicals in soil at the source areas within the BOU. TCE, PCE, 1,2-DCA, chloroform, and vinyl chloride were the most commonly detected VOCs and those detected at concentrations above their respective RISLs and PGW SSLs. Typical ways in which VOCs were released to the environment at the Aerojet site include:

- Discharges to surface soil and drainages resulting from spills, leaks from equipment, or during transfer;
- Discharges to subsurface soil via leaks in the bottom of lined and unlined sumps and basins; and
- Discharges to subsurface soil via underground septic systems.

When released to the environment, VOCs will leach into the soil and partition into the liquid and vapor phases. The degree of partitioning depends upon the relative volatility and solubility of the VOC. The depth to which VOCs migrate into the soil column depends on several factors, including the volume and method of release, the lithology, and amount of water that infiltrates into the soil. If a large quantity of VOCs were released, it will behave as DNAPL as previously described and continue to migrate downward until it has been completely entrapped or partitioned to vapor phase or dissolved into groundwater. Additionally, VOCs released from the bottom of a sump may migrate to a greater depth than a release at the ground surface. The vertical migration of VOCs may also be impeded or even halted by the presence of relatively impermeable materials such as silts and clays. If released in sufficient volume, VOCs will move laterally along a layer of impermeable material and continue to do so until all of the product has become entrapped or portioned into the vapor phase or reaches the end of the impermeable layer, at which time it will continue its vertical migration. The infiltration of surface water will also contribute to vertical migration (flushing) of VOCs, particularly the more soluble VOCs.

The presence of DNAPL, or residual product, in soil and groundwater is difficult to determine with any accuracy and attempts to collect samples of DNAPL have met little success. In general, and in this RI Report, the potential presence of DNAPL in soil and groundwater is evaluated by comparing the soil vapor concentration of a particular VOC to 1 percent of its vapor saturation for soil and 1 percent of its solubility limit for groundwater. The vapor saturation and solubility limits for the most commonly detected VOCs are presented later in this RI Report.

Degradation daughter products (i.e., 1,1-DCE; cis/trans-1,2-DCE; or vinyl chloride) of PCE and TCE were not detected at significantly elevated concentrations in soil vapor or groundwater during the BOU RI. The relatively low detections of those compounds indicate that soil and groundwater conditions at the Aerojet site are generally not conducive to the biodegradation and reductive chlorination of VOCs to a substantial degree.

3.2.2.2 *Metals*

Aluminum, antimony, arsenic, cadmium, total chromium, hexavalent chromium, copper, lead, manganese, mercury, molybdenum, nickel, silver, thallium, vanadium, and zinc were detected in at least one soil

sample collected at a source area within the BOU at a concentration statistically above background and above its RISL and/or PGW SSL.

The data obtained during the BOU indicated that metals above background and their RISL and/or PGW SSLs were typically detected in surface and/or near-surface (0 to 2.5 feet bgs) near the location where the release occurred or in ditches. Because metals naturally accumulate in ditches and low-lying areas where they are deposited as a result of the reduced velocity of water flow, it is not unexpected that elevated metal concentrations were detected in those areas. Additionally, many metals bind to clay particles and higher concentrations of those metals are associated with the presence of fine silts. Historical mining (dredging) activities at the Aerojet site has disturbed the natural setting and produced tailings that may be artificially enriched with metals. For example, deposits composed mostly of clays and silts known as "slickens" were formed as the result of the discharge of water loaded with silt and clay back into the pond in which the dredger floated. These clays and silts were produced as a result of the refinement and segregation of the dredge material for the extraction of gold. Background studies conducted at the Aerojet site (Borch, 1994) have shown that concentrations of metals in the "slickens" areas are typically higher than in the surrounding cobble piles.

Metals are generally immobile, but may leach into the soil column with the infiltration of precipitation. The discharge of metals in the form of plating fluids, or suspended/dissolved in water or solvents may also contribute to the depth to which metals may migrate into the soil column. The BOU RI data indicate that while most metals are apparently confined to surface and near-surface soils, metals above background and their RISLs and/or PGW SSLs were also present at source areas where plating fluids or water containing metals were likely discharged to soil.

3.2.2.3 *Semivolatile Organic Compounds and Polynuclear Aromatic Hydrocarbons*

SVOCs, including PAHs, are relatively non-volatile and generally insoluble in water. SVOCs and PAHs have high affinities for organic carbon-rich soils. The primary mechanism of transport for SVOCs and PAHs is the entrainment of particles of those compounds or soil with those compounds attached in surface water or fugitive dust. SVOCs may migrate into drainages and low-lying areas that receive surface water discharges containing those compounds. Due to their low solubility and affinity to sorb to soil, SVOCs and PAHs are expected to be relatively persistent, but immobile in subsurface soils and unlikely to migrate vertically into the soil column. However, the discharge of these

compounds with fuels and oils or dissolved in solvents may increase its mobility and potential to migrate vertically into soil.

Benzo(a)pyrene, benzo(b&k)fluoranthene, and benzo(a)anthracene were the only SVOCs/PAHs detected in soil at source areas within the BOU at concentrations above their RISLs and/or PGW SSLs. The detection of these compounds is generally limited to the upper 3 feet of soil and within drainages. The presence of PAHs is attributed to surface discharges/ deposits resulting from the burning of hydrocarbons (vehicle exhaust, waste burning) or from electrical transformers.

3.2.2.4 *N-Nitrosodimethylamine*

The presence of NDMA at the Aerojet site is attributed to either being present as an impurity in 1,1-dimethylhydrazine, a liquid rocket fuel, or produced during the combustion of that fuel. NDMA also appears to be associated with chlorine/chloramine disinfection of water and wastewater and is found in various food products and tobacco (San Francisco Public Utilities Commission, 2007). At the Aerojet site, NDMA is thought to have been released to the environment in deluge water used for cooling and shock suppression during the testing of liquid rocket engines.

NDMA is highly soluble, but is sensitive to light and rapidly degrades when exposed to ultraviolet light. Due to its high solubility, NDMA is quickly flushed into the groundwater and has rarely been detected in soil at the Aerojet site, except for those soils that are saturated or have high moisture content. NDMA was detected in only three soil samples collected within the BOU that were analyzed for that constituent. As a result of its high solubility and low sorption and degradation rates, NDMA is expected to be very persistent in groundwater.

3.2.2.5 *Polychlorinated Biphenyls*

Polychlorinated biphenyls (PCBs) are typically added to oils used in transformers and other equipment/machinery that operate under high temperatures. PCBs provide a bond between the oil molecules that keeps the oil from breaking down under high temperatures.

PCBs are relatively insoluble in water, but may migrate into ditches and drainages as a result of the entrainment of PCB particles or soil with attached PCBs. Where discharged along with, or dissolved in, solvents, PCBs may migrate vertically into the soil column to depths greater than if discharged as PCB oil directly to soil. Biodegradation of PCBs does occur,

but usually the degradation rate is very low and, as a result, PCBs are expected to be persistent in soil.

During the BOU, PCBs at concentrations above their RISL and/or PGW SSLs were generally detected in surface and/or near-surface soils in source areas close to the point of discharge (i.e., near transformers and storage areas) or within drainages. PCBs were detected in subsurface soil and perched groundwater in two areas of the BOU. The presence of PCBs in subsurface soil at those locations is attributed to the release of significant quantities of oil containing PCBs.

3.2.2.6 *Perchlorate*

Ammonium perchlorate is used at the Aerojet site as an oxidizer in solid rocket motor propellant. Ammonium perchlorate is purchased in crystal form and then ground to specific dimensions prior to being mixed with the fuel (aluminum) and plasticizer to form the propellant. The ingredients are mixed in much the same way as cake batter, the propellant is poured into the rocket casing, and the excess propellant is trimmed. To prevent accidental ignitions, all residual propellant must be removed from the equipment used in the grinding and mixing. This cleaning is typically performed using water and solvents. Additionally, solid rocket propellant has a shelf life. When the shelf life is reached, the propellant is removed from the rocket casing using high-pressure jets of water that dissolve and cut the propellant without risk of ignition. This process, known as "hog out or hogging out" generates chunks of waste propellant and wastewater containing propellant. Wastewater containing perchlorate was typically discharged to unlined and concrete-lined troughs that conveyed the fluids to unlined or concrete/gunite-lined basins and sumps. Historically, waste propellant generated at the Aerojet site was burned.

Means by which ammonium perchlorate may have been released to the environment at the site include the following:

- Discharges of wastewater containing perchlorate to unlined troughs, basins, and sumps;
- Discharges of wastewater containing perchlorate through cracks or joints in the concrete/gunite-lined troughs, basins, and sumps;
- Discharge of perchlorate to soil during the burning of waste propellants; and
- Discharge of perchlorate to soil during handling or storage.

Upon release to the environment, ammonium quickly degrades and perchlorate (ClO^{-4}) remains. Perchlorate is inert, stable, persistent, and highly soluble (20.2 grams per 100 grams solution). Its mobility in soil is dependant on the amount of water present. Perchlorate readily migrates downward into the soil column along with infiltration of precipitation and dissolved in surface water runoff. Perchlorate will continue to migrate vertically through the soil column as long as there is sufficient water available to flow under the force of gravity. When there is no longer enough water to allow gravity flow, perchlorate will remain in the water within the pore space. When water is no longer present in the pore space and the soil becomes dry, perchlorate will bind to other salts such as sodium to form sodium perchlorate. This bond will remain until water again becomes present. Studies conducted by Aerojet (Aerojet, 1999a) found that perchlorate on the ground surface will migrate downward into the soil column during precipitation events and then migrate back towards the surface as a result of wicking action produced by the drying of soils. This action results in the persistence of perchlorate in surface soils despite it high solubility.

Upon entering groundwater, perchlorate remains in solution, and due to its low sorption and degradation rates, will likely result in widespread and persistent plumes of groundwater containing perchlorate.

Perchlorate was detected in soil at concentrations above its RISL and/or PGW SSL at several source areas within the BOU.

3.2.2.7 *Diesel and Motor Oil*

Diesel, motor oil, and other petroleum products were used at the Aerojet site for a variety of purposes. Fuel oil was historically used in boilers to generate steam to heat buildings, run equipment, and dry propellant. Additionally, diesel was used as liquid rocket fuel and in vehicles operated at the facility. Motor oil was used in vehicles, and derivates of motor oil were used as lubricants in machinery and other equipment.

When a petroleum-based fuel is spilled on the ground surface or released to the subsurface, the organic liquid will percolate downward under the force of gravity toward the water table. If a sufficient volume of material is released, it will reach the water table where it forms a layer of NAPL either on the surface of the groundwater or within it and becomes dissolved in the groundwater. The residual material trapped within the pore spaces of the soil above the water table can serve as a continuing source, as it may be available to move slowly out of the soil pores as

dissolved-phase liquid. The extent of this secondary chemical migration will vary depending on the NAPL, the degree of degradation, the soil matrix itself, and the mass already transported.

TPH-D and TPH-Mo were detected in soil samples at numerous locations and source areas within the BOU. Because PCBs are included in oils and PAHs are associated with the combustion of fuels, detections of TPH at source areas within the BOU often correspond to the detection of those compounds. TPH was also detected at the source areas within the BOU in proximity to former locations of aboveground storage tanks and underground storage tanks historically used for the storage of fuel oil and waste oils. Historical releases of fuel oil from underground storage tanks in the Administration Area have resulted in the presence of hydrocarbons in soil and perched groundwater around and beneath several of the buildings.

Data obtained during the BOU indicate that the biodegradation rate of hydrocarbons in soil and groundwater at the Aerojet site are relatively slow. The data also suggest that in areas where VOCs in vapor encounter these hydrocarbons, the hydrocarbons provide a carbon source that promotes the reductive chlorination of TCE and PCE and the formation of degradation daughter products such as 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, or vinyl chloride.

3.3 DEVELOPMENT OF CONCEPTUAL SITE MODELS

The CSM uses the fate and transport information presented above to describe relationships between chemicals and potentially exposed human and ecological receptors, thereby delineating the relationships between the suspected sources of chemicals identified at the site, the mechanisms by which the chemicals might be released and transported in the environment, and the means by which the receptors could come in contact with the chemicals. The CSM is used during preparation of the sampling plan to develop data quality objectives and during preparation of the risk assessments to develop exposure scenarios. Use of the CSM in the development of human and ecological receptor exposure scenarios is described in detail in Volume II of this RI/FS Report.

Human and ecological receptor CSMs are provided in Figures 3.3-1a through 3.3-1d. The human receptor CSM considers all current and potential future land-use conditions for the site. Because it is not feasible to individually evaluate every species that may occur on the Aerojet site,

ecological receptors are grouped into taxonomic and trophic guilds in the ecological receptor CSM. Representative receptors from each guild were identified in the Final RI/FS Work Plan (Aerojet, 2005c).

3.4 *DATA VALIDATION*

A comprehensive review of all historical data, as well as existing and newly acquired RI data, was conducted to identify valid results to be used for each analyte, each sample, and each method run. The analytical data were reviewed for applicability and usability following procedures in the *Guidance for Data Usability in Risk Assessment (Part A)* (USEPA, 1992b and USEPA, 1989). According to the USEPA Data Usability Guidance, there are six principal evaluation criteria by which data are judged for usability in risk assessment. The six criteria are:

- Availability of information associated with site data;
- Documentation;
- Data sources;
- Analytical methods and detection limits;
- Data review; and
- Data quality indicators (DQIs), including precision, accuracy, representativeness, comparability, and completeness.

A summary of these six criteria for determining data usability is provided below. These criteria are evaluated as a function of the standard operating procedure for the data validation process applied to data for the BOU RI/FS, as outlined in the *Quality Assurance Project Plan* (Aerojet, 2006a).

3.4.1 *Criterion I – Availability of Information Associated with Site Data*

The usability analysis of the site characterization data requires the availability of sufficient data for review. The required information is available from documentation associated with the site data and data collection efforts. The following lists the information sources and the availability of such information for the data usability process:

- Site descriptions provided in the BOU RI Report (Volume I) to identify the locations and features of the source areas and site-specific characteristics;

- Site maps with sample locations presented in the BOU RI Report; and
- Analytical results and detection limits provided in Appendix D of the BOU RI Report.

3.4.2 *Criterion II – Documentation Review*

The objective of the documentation review is to confirm that the analytical results provided are associated with a specific sample location and collection procedure, using available documentation. As part of the data validation process, the chain-of-custody forms prepared in the field were reviewed and compared to the analytical data results provided by the laboratory to 1) ensure completeness of the data set, and 2) that all samples analyzed by the laboratory were correlated to the correct geographic location at the site(s). Sample collection forms were also reviewed to ensure field procedures included documentation of sample times, dates, and locations; and other sample-specific information such as depth bgs were also recorded. Information from field forms generated during sample collection activities was imported into the project database.

3.4.3 *Criterion III – Data Sources*

As part of the data validation process, the review of data sources was performed to determine whether the analytical techniques used in the site characterization process are appropriate to identify the COPCs in the HHRA and SLERA.

3.4.4 *Criterion IV – Analytical Methods and Detection Limits*

In addition to the appropriateness of the analytical techniques evaluated as part of Criterion III, it is necessary to evaluate whether the analytical methods used appropriately identify COPCs and whether the detection limits are low enough to allow adequate characterization of risks. At a minimum, this data usability criterion can be met through the determination that routine USEPA reference analytical methods were used in analyzing samples collected from the site.

3.4.5 *Criterion V – Data Review*

The data review portion of the data usability process focuses primarily on the quality of the analytical data received from the laboratory. All site data that are used in the HHRA must be evaluated on the basis of completeness, precision (based on duplicates), and accuracy (based on

laboratory spikes). In addition, the laboratory results data are reviewed for blank contamination.

3.4.6 *Criterion VI – Data Quality Indicators*

DQIs are used to verify that sampling and analytical systems used in support of project activities are in control and the quality of the data generated for this project is appropriate for making decisions affecting future activities. The DQIs address the field and analytical data quality aspects as they affect uncertainties in the data collected for site characterization and the HHERA. The DQIs include precision, accuracy, representativeness, comparability, and completeness. Each of these factors is described below.

3.4.6.1 *Precision*

Precision is a measure of the degree of agreement between replicate measurements of the same source or sample. Precision is expressed by the relative percent difference between replicate measurements. Replicate measurements can be made on the same sample or on two samples from the same source. Precision is generally assessed using a subset of the measurements made.

3.4.6.2 *Accuracy*

Accuracy measures the level of bias that an analytical method or measurement exhibits. To measure accuracy, a standard or reference material containing a known concentration is analyzed or measured and the result is compared to the known value. The following quality control parameters are used to evaluate the accuracy of reported analytical results:

- Holding times and sample temperatures;
- Laboratory control spike percent recovery;
- Matrix spike/matrix spike duplicate percent recovery (organics);
- Spike sample recovery (inorganics);
- Surrogate spike recovery; and
- Blank sample results.

3.4.6.3 *Representativeness*

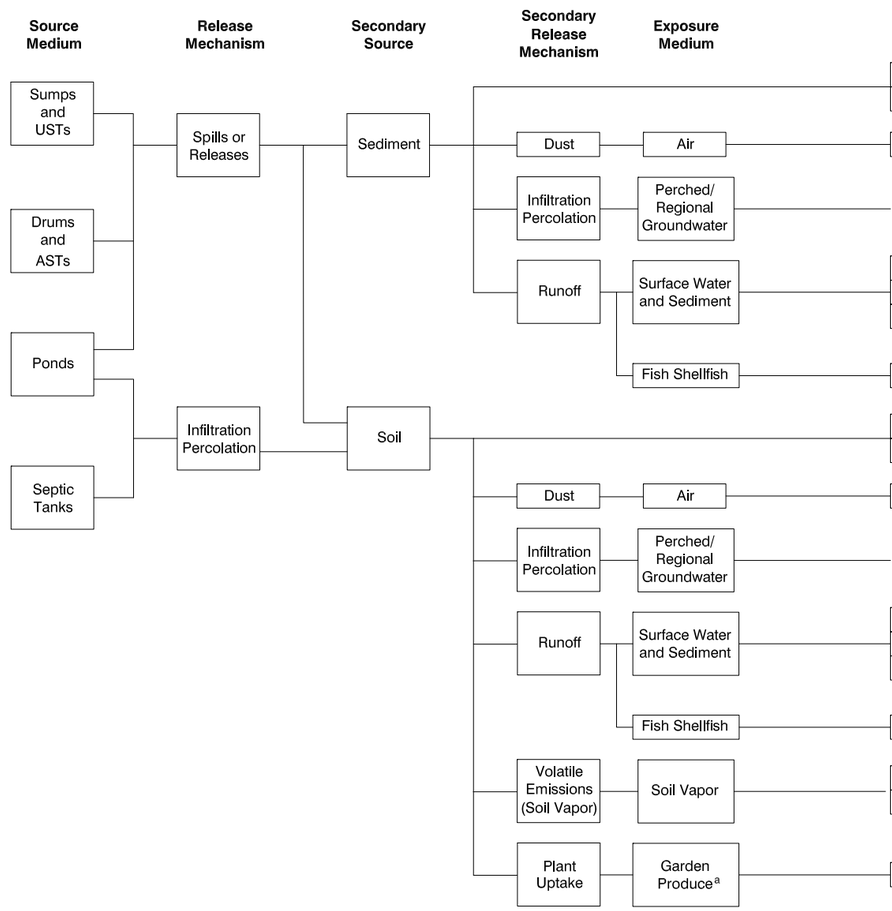
Representativeness is the degree to which data accurately and precisely represent a characteristic of the population at a sampling point or an environmental condition. There is no standard method or formula for evaluating representativeness, which is a qualitative term. Representativeness is achieved through selection of sampling locations that are appropriate relative to the objective of the specific sampling task, and by collection of an adequate number of samples from the relevant types of locations. As discussed in Section 2, the site characterization was developed to allow collection of samples that are representative of the media to which the receptors may be exposed at the site.

3.4.6.4 *Completeness*

Completeness is commonly expressed as a percentage of measurements that are valid and usable relative to the total number of measurements made. Analytical completeness is a measure of the number of overall accepted analytical results, including estimated values, compared to the total number of analytical results requested on samples submitted for analysis after review of the analytical data. All of the analytical data collected were used in the HHERA.

3.4.6.5 *Comparability*

Comparability is a qualitative characteristic expressing the confidence with which one data set can be compared with another. The analytical methods are generally consistent with those used in previous investigations of the site. The comparability goal is achieved through using standard techniques to collect and analyze representative samples and reporting analytical results in appropriate units.



Exposure Route	Human Receptor: Future Onsite Resident	Current/ Future Offsite Resident	Current/ Future Onsite Comm Ind Worker	Current/ Future Onsite Visitor Recreator[b]	Current/ Onsite Construction Worker	Future Onsite Construction Worker
Ingestion	I	I	I	I	I	I
Dermal Contact	I	I	I	I	I	I
Inhalation	I	I	I	I	I	I
See Figure 3.3-1b for Human Health Exposure Routes Related to Treated and Untreated Groundwater						
Ingestion	I	I	I	I	I	I
Inhalation	I	I	I	I	I	I
Dermal Contact	I	I	I	I	I	I
Ingestion	I	I	I	I	I	I
Ingestion	C	I	C	Q	C	C
Dermal Contact	C	I	C	Q	C	C
Inhalation	C	Q	C	Q	C	C
See Figure 3.3-1b for Human Health Exposure Routes Related to Treated and Untreated Groundwater						
Ingestion	I	I	I	I	I	I
Inhalation	I	I	I	I	I	I
Dermal Contact	I	I	I	I	I	I
Ingestion	I	I	I	I	I	I
Inhalation (Indoor)	C	I	C	I	I	I
Inhalation (Outdoor)	C	Q	C	Q	C	C
Ingestion	Q	I	I	I	I	I

Notes and Key:

a Projected residential redevelopment at Aerojet is not likely to include land-intensive pathways, such as in-situ gardening. The naturally occurring soil at Aerojet is not suited for this type of activity. Significant land preparation activities (i.e/. addition of topsoil and nutrients) would be required prior to growing fruits or vegetables.

b Since a residential and/or commercial/industrial soil exposure will be evaluated for all the source sites, there is no need to quantify a separate visitor/recreational exposure for all areas. However, a recreational exposure scenario will be evaluated for Area 39 and Buffalo Creek. Exposures to fish on the Aerojet property are highly unlikely, and are dependent upon the presence of edible species that are of large enough size to be filleted.

ASTs Above-ground Storage Tank

C Complete exposure pathway evaluated quantitatively

Comm Ind Commercial Industrial

I Incomplete exposure pathway

USTs Underground Storage Tank

Q Qualitative (not quantitative) evaluation conducted for this potentially complete exposure pathway

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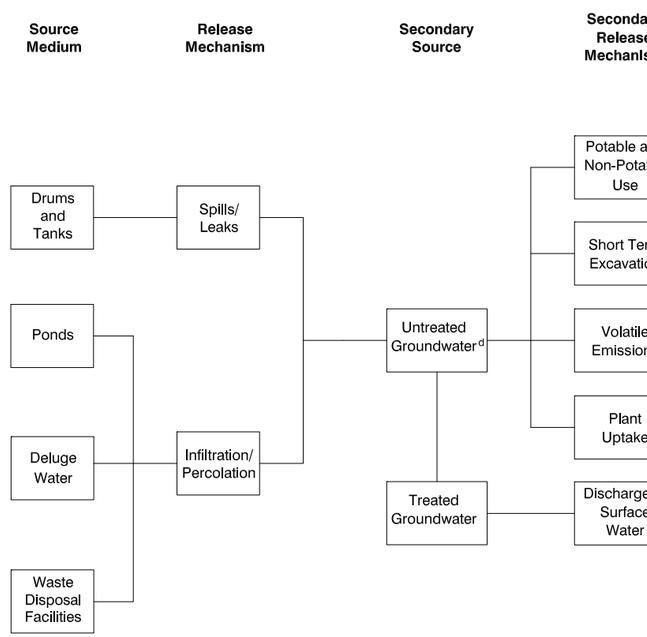
FIGURE 3.3-1a

Conceptual Site Model for the Boundary Operable Unit Soil Exposure Pathways for Human Receptors

12\2\08 PR SR10130965



Exposure Route	Human Receptor: Future Onsite Resident	Current/ Future Offsite Resident	Current/ Future Onsite Comm Ind Worker	Current/ Future Onsite Visitor Recreator[c]	Current/ Onsite Construction Worker	Future Onsite Construction Worker
Ingestion	H	H	I	I	I	I
Inhalation	H	H	I	I	I	I
Dermal Contact	H	H	I	I	I	I
Ingestion	I	I	I	I	Q	Q
Inhalation	I	I	I	I	Q	Q
Dermal Contact	I	I	I	I	Q	Q
Inhalation (Indoor)	C	C	C	I	I	I
Inhalation (Outdoor)	Q	Q	Q	Q	Q	Q
Ingestion	Q	Q	I	I	I	I
Ingestion	Q	I	Q	Q	Q	Q
Inhalation	I	I	I	I	I	I
Dermal Contact	Q	I	Q	C	Q	Q
Ingestion	Q	I	Q	Q	Q	Q

Notes and Key:

a Projected residential redevelopment at Aerojet is not likely to include land-intensive pathways, such as in-situ gardening. The naturally occurring soil at Aerojet is not suited for this type of activity. Significant land preparation activities (i.e., addition of topsoil and nutrients) would be required prior to growing fruits or vegetables.

b Although construction workers may briefly encounter the shallow water table in some OUs, construction activities in saturated trench conditions are generally avoided and dewatering is performed to avoid work in a wet and slippery trench. Dermal exposures to contaminants in trench water would be incomplete as steady state absorption and penetration of the skin is unlikely, given short exposure times.

c Recreational exposure will be evaluated on a site-specific basis; if a residential and/or commercial/industrial soil exposure has already been evaluated, there is no need to quantifya separate recreational exposure to soil unless the property may be transferred solely for recreational use. Exposures to fish on the Aerojet property are highly unlikely, and are dependent upon the presence of edible species that are of large enough size to be filleted.

d No discharge of untreated groundwater to surface water bodies identified in Boundary Operable Unit.

C Complete exposure pathway evaluated quantitatively

Comm Ind Commercial Industrial

H Hypothetically complete in absence of institutional controls

I Incomplete exposure pathway

Q Qualitative (not quantitative) evaluation conducted for this potentially complete exposure pathway

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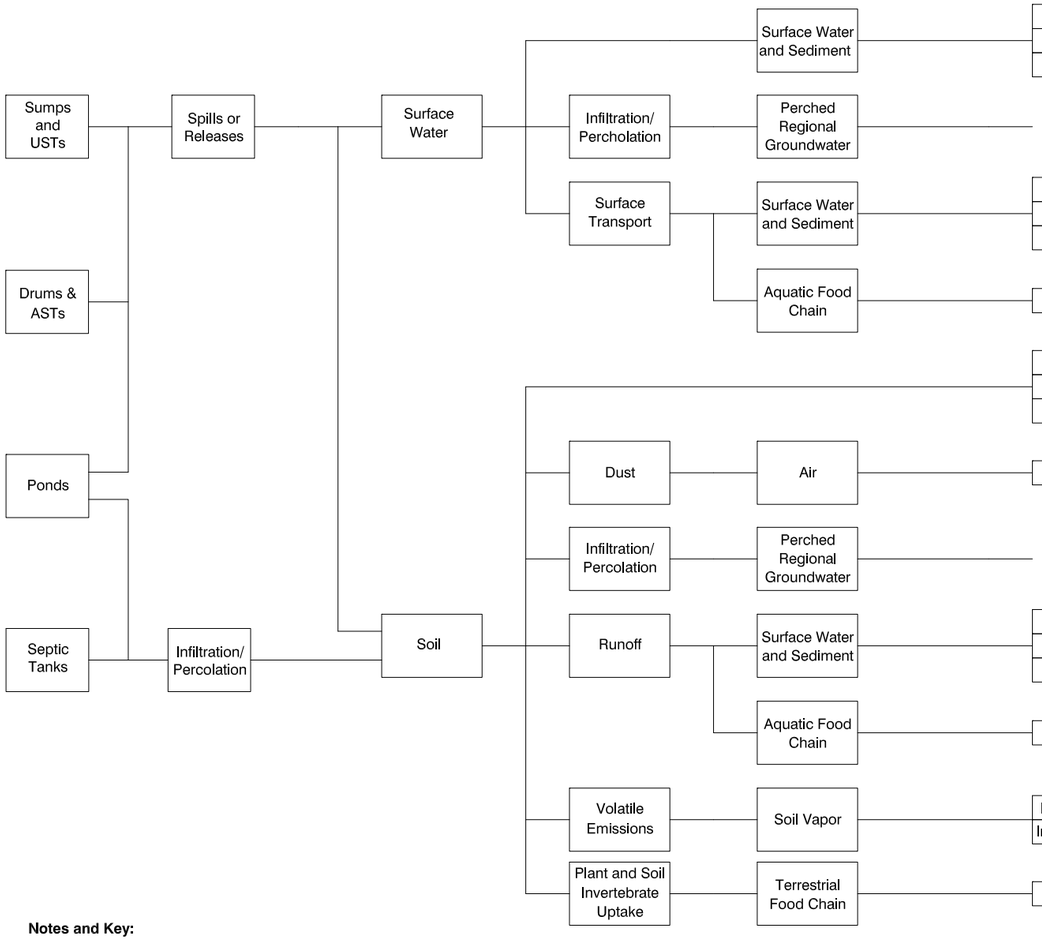
FIGURE 3.3-1b
Conceptual Site Model for the Boundary Operable Unit Groundwater and Surface Water Exposure Pathways for Human Receptors

12\12\08 PR SR10130966



Trophic Level	Ecological Receptors																	
	Producers			Primary Consumers				Secondary Consumer							Tertiary Consumers			
Functional Group/Feeding Guild / Exposure Route	Aquatic Vegetation	Trees/ Shrubs	Forbs/ Grasses	Soil Invertibrates/ Herbaceous Insects	Benthic and Aquatic Invertibrates	Herbaceous Mammals	Herbivorous/ Granivorous Birds	Snakes & Lizards	Turtles	Amphibians	Fish	Omnivorous/ Insectivorous Mammals	Omnivorous/ Insectivorous Birds	Water Fowl	Raptors	Piscivorous Mammals	Carnivorous Mammals	Piscivorous Birds
Surface Water and Sediment: Ingestion	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Surface Water and Sediment: Dermal Contact	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Surface Water and Sediment: Uptake [d]	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Perched Regional Groundwater	See Figure 3.3-1d for Ecological Exposure Routes related to Treated and Untreated Groundwater																	
Surface Water and Sediment: Ingestion	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Surface Water and Sediment: Dermal Contact	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Surface Water and Sediment: Uptake [a]	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Aquatic Food Chain: Ingestion	NE	-	-	-	NE	-	-	I	I	I	NE	I	I	I	I	I	-	I
Air: Ingestion	I	NE	NE	NE	I	C	C	Q	Q	Q	I	C	C	I	C	I	C	I
Air: Dermal Contact	I	NE	NE	NE	I	C	C	N	N	N	I	C	C	I	C	I	C	I
Air: Uptake [a]	I	C	C	C	I	-	-	-	-	-	-	-	-	-	-	-	-	-
Air: Inhalation	-	NE	NE	NE	I	N	N	N	N	N	I	N	N	N	N	N	N	N
Perched Regional Groundwater	See Figure 3.3-1d for Ecological Exposure Routes related to Treated and Untreated Groundwater																	
Surface Water and Sediment: Ingestion	NE	I	I	I	NE	C	C	Q	Q	Q	NE	C	C	C	C	C	I	C
Surface Water and Sediment: Dermal Contact	NE	I	I	I	NE	N	N	N	N	N	NE	N	N	C	N	C	N	C
Surface Water and Sediment: Uptake [a]	C	I	I	I	C	-	-	-	-	-	C	-	-	-	-	-	-	-
Aquatic Food Chain: Ingestion	NE	-	-	-	NE	-	-	I	I	I	NE	I	I	I	I	I	-	I
Soil Vapor: Inhalation[b] (Indoor)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soil Vapor: Inhalation[b] (Outdoor)	-	N	N	N	I	Q	I	Q	I	Q	I	Q	I	I	Q	I	Q	I
Terrestrial Food Chain: Ingestion	-	NE	NE	NE	-	C	C	Q	I	Q	-	C	C	I	C	I	C	I

Notes and Key:

a	Uptake applies only to plants, invertebrates, and fish and includes respiration, dermal uptake, and ingestion by these receptors.
b	Inhalation includes vapor uptake by plants and respiration by invertebrates
ASTs	Above-ground Storage Tank
USTs	Underground Storage Tank
C	Complete exposure pathway evaluated quantitatively
I	Incomplete exposure pathway
N	Negligible or insignificant (though hypothetically potentially complete) pathway that will not be evaluated
NE	Exposure route is evaluated as part of the uptake pathway
Q	Qualitative (not quantitative) evaluation conducted for this potentially complete exposure pathway
-	Not applicable

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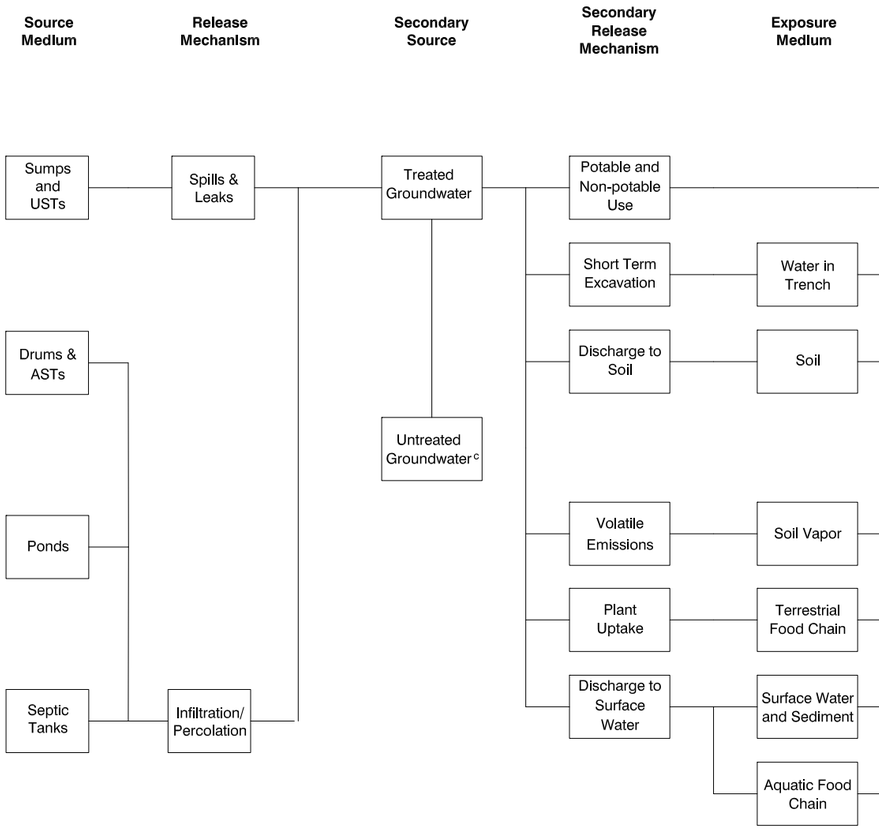
FIGURE 3.3-1c
Conceptual Site Model for the Boundary Operable Unit Soil Exposure Pathways for Ecological Receptors

12\29\08 PR SR10130967



Trophic Level	Ecological Receptors																	
	Producers			Primary Consumers				Secondary Consumer							Tertiary Consumers			
Functional Group/Feeding Guild	Aquatic Vegetation	Trees/ Shrubs	Forbs/ Grasses	Soil Invertibrates/ Herbaceous Insects	Benthic and Aquatic Invertibrates	Herbaceous Mammals	Herbivorous/ Granivorous Birds	Snakes & Lizards	Turtles	Amphibians	Fish	Omnivorous/ Insectivorous Mammals	Omnivorous/ Insectivorous Birds	Water Fowl	Raptors	Piscivorous Mammals	Carnivorous Mammals	Piscivorous Birds
Exposure Route																		
Ingestion	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Dermal Contact	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Uptake [d]	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Ingestion	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Dermal Contact	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Uptake [a]	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Ingestion	I	NE	NE	NE	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Dermal Contact	I	NE	NE	NE	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Uptake [a]	I	I	I	I	I	-	-	-	-	-	-	-	-	-	-	-	-	-
Inhalation[b] (Indoor)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Inhalation[b] (Outdoor)	-	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Ingestion	-	NE	NE	I	-	I	I	I	I	I	-	I	I	I	I	I	I	I
Ingestion	NE	I	I	I	NE	N	N	N	N	N	NE	N	N	N	N	N	N	N
Dermal Contact	NE	I	I	I	NE	N	N	N	N	N	NE	N	N	N	N	N	N	N
Uptake [a]	C	I	I	I	C	-	-	-	-	-	C	-	-	-	-	-	-	-
Ingestion	NE	-	-	-	NE	-	-	I	Q	Q	NE	N	N	N	N	N	-	N

Notes and Key:

a	Uptake applies only to plants, invertebrates, and fish and includes respiration, dermal uptake, and ingestion by these receptors.
b	Inhalation includes vapor uptake by plants and respiration by invertebrates.
c	Untreated groundwater does not discharge to surface water within the Boundary Operable Unit.
C	Complete exposure pathway evaluated quantitatively
I	Incomplete exposure pathway
N	Negligible or insignificant (though hypothetically potentially complete) pathway that will not be evaluated
NE	Exposure route is evaluated as part of the uptake pathway
Q	Qualitative (not quantitative) evaluation conducted for this potentially complete exposure pathway
-	Not applicable

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FIGURE 3.3-1d
Conceptual Site Model for the Boundary Operable Unit Groundwater and Surface Water Exposure Pathways for Ecological

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Table 3.1-1 Remedial Investigation Screening Levels (RISLs) for Soil Vapor
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

CAS NO.	Chemical	Ambient Air PRG ($\mu g/m^3$)	CHHSL for Indoor Air ($\mu g/m^3$)	CHHSL for Shallow Soil Vapor ($\mu g/m^3$)	Indoor Air Screening Level ($\mu g/m^3$)	Soil Vapor RISL ($\mu g/m^3$) [c]
67-64-1	Acetone	3,285			328.50	328,500
71-43-2	Benzene	0.25	0.084	36.20	0.084	84
75-27-4	Bromodichloromethane	0.11			0.11	108
75-15-0	Carbon disulfide	730			73.00	73,000
56-23-5	Carbon tetrachloride	0.13	0.06	25.10	0.06	58
75-45-6	Chlorodifluoromethane	51,100			5,110.00	5,110,000
75-00-3	Chloroethane	2.32			2.32	2,319
67-66-3	Chloroform	0.08			0.08	83
74-87-3	Chloromethane (methyl chloride)	94.9			9.49	9,490
110-82-7	Cyclohexane	6,205			620.50	620,500
124-48-1	Dibromochloromethane	0.08			0.08	80
95-50-1	1,2-Dichlorobenzene	209			20.86	20,857
541-73-1	1,3-Dichlorobenzene	110			10.95	10,950
106-46-7	1,4-Dichlorobenzene	0.31			0.31	306
75-71-8	Dichlorodifluoromethane (Freon 12)	208.6			20.86	20,857
75-34-3	1,1-Dichloroethane	1.18			1.18	1,180
107-06-2	1,2-Dichloroethane (EDC)	0.07	0.12	49.60	0.07	73.9
75-35-4	1,1-Dichloroethylene (1,1-DCE)	208.1			20.81	20,805
156-59-2	1,2-Dichloroethylene (cis)	36.5	36.50	15,900.00	3.65	3,650
156-60-5	1,2-Dichloroethylene (trans)	73.0	73.00	31,900.00	7.30	7,300
78-87-5	1,2-Dichloropropane	0.10			0.10	99
142-28-9	1,3-Dichloropropane	73.0			7.30	7,300
542-75-6	1,3-Dichloropropene	0.48			0.48	480
75-37-6	1,1-Difluoroethane	41,610			4,161.00	4,161,000
76-13-1	Freon 113	31,280.5			3,128.05	3.13.E+06
110-54-3	n-Hexane	208.6			20.86	20,857
75-09-2	Methylene chloride	4.09			4.09	4,087
100-42-5	Styrene	1,058.5			105.85	105,850
630-20-6	1,1,1,2-Tetrachloroethane	0.26			0.26	260
79-34-5	1,1,2,2-Tetrachloroethane	0.03			0.03	33
127-18-4	Tetrachloroethylene (PCE)	0.32	0.41	180.00	0.32	320
109-99-9	Tetrahydrofuran	0.99			0.99	989
108-88-3	Toluene	401.5	313.00	135,000.00	40.15	40,150
120-82-1	1,2,4-Trichlorobenzene	3.65			0.37	365
71-55-6	1,1,1-Trichloroethane	2,299.5	2,290.00	991,000.00	229.95	229,950
79-00-5	1,1,2-Trichloroethane	0.12			0.12	120
79-01-6	Trichloroethylene (TCE)	0.96	1.22	528.00	0.96	961
75-69-4	Trichlorofluoromethane	730			73.00	73,000
95-63-6	1,2,4-Trimethylbenzene	6.21			0.62	621
108-67-8	1,3,5-Trimethylbenzene	6.21			0.62	621
75-01-4	Vinyl chloride (child/adult)	0.11	0.03	13.30	0.03	31
1330-20-7	Xylenes	105.9	730.00	315,000.00	10.59	10,585

Notes and Key:
RISL is equal to the lower of the CHHSL or ambient air PRG times an attenuation factor of 0.001 or 1/1000.
No attenuation of soil gas within the soil column was assumed.
CHHSL = California Human Health Screening Level
$\mu g/m^3$ = Micrograms per cubic meter
PRG = Preliminary Remediation Goal
RISL = Remedial investigation screening level

Table 3.1-1 Remedial Investigation Screening Levels (RISLs) for Soil Vapor
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

CAS NO.	Chemical	Ambient Air PRG ($\mu g/m^3$)	CHHSL for Indoor Air ($\mu g/m^3$)	CHHSL for Shallow Soil Vapor ($\mu g/m^3$)	Indoor Air Screening Level ($\mu g/m^3$)	Soil Vapor RISL ($\mu g/m^3$) [c]

Sources:
PRG TABLE
Version 9
October 2004
Stanford J. Smucker Ph.D., EPA Region IX
Technical Support Section (SFD-8-4)
75 Hawthorne Street, San Francisco, CA 94105-3901

CHHSLs
Human-Exposure-Based Screening Numbers Developed to Aid Estimation of Cleanup Costs for Contaminated Soil
November 2004; January 2005 Revision
California Environmental Protection Agency
Office of Environmental Health Hazard Assessment
Integrated Risk Assessment Section

Table 3.1-2 Protection of Groundwater Soil Vapor Screening Levels (PGW SVSLs)
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

CAS Number	Chemical	Groundwater ARAR (ug/L)	Source		19 Ft DTW Total Soil Concentration (µg/kg)	30 Ft DTW Total Soil Concentration (µg/kg)	Koc (ml/g)	Henry's Law Constant (Dimensionless)	Conversion Factor *	PGW SVSL 19 Ft DTW (µg/m3)	PGW SVSL 30 Ft DTW (µg/m3)
71-55-6	1,1,1-Trichloroethane	200	Fed MCL	5.7E-03	330	160	48.64	0.7	1660.51	547,968	265,681
75-34-3	1,1-Dichloroethane	3	PHG	8.5E-05	2.2	1.71	35.04	0.23	749.89	1,650	1,282
75-35-4	1,1-Dichloroethylene	6	CA MCL	1.7E-04	55	8	35.04	1.1	2272.46	124,986	18,180
107-06-2	1,2-Dichloroethane	0.4	PHG	1.1E-05	0.115	0.121	43.79	0.048	170.30	20	21
71-43-2	Benzene	0.15	PHG	4.2E-06	0.083	0.0748	165.5	0.23	470.01	39	35
56-23-5	carbon tetrachloride	0.1	PHG	2.8E-06	0.23	0.089	48.64	1.1	2186.46	503	195
67-66-3	Chloroform	80	Fed MCL	2.3E-03	41	36	35.04	0.15	516.53	21,178	18,595
156-59-2	cis-1,2-dichloroethylene	6	CA MCL	1.7E-04	3.5	2.96	43.79	0.17	554.24	1,940	1,641
100-41-4	Ethylbenzene	300	CA MCL	8.5E-03	157	163	517.8	0.32	319.71	50,194	52,112
75-09-2	Methylene Chloride	4	PHG	1.1E-04	2.2	1.88	23.74	0.13	480.58	1,057	903
127-18-4	Tetrachloroethylene	0.06	PHG	1.7E-06	0.054	0.04	106.8	0.72	1419.95	77	57
156-60-5	trans-1,2-dichloroethylene	10	CA MCL	2.8E-04	12.4	7.25	43.79	0.38	1087.15	13,481	7,882
79-01-6	Trichloroethylene	0.8	PHG	2.3E-05	0.69	0.51	67.7	0.4	1033.36	713	527
75-01-4	Vinyl Chloride	0.05	PHG	1.4E-06	1.64	0.1	23.74	1.1	2349.24	3,853	235

Sand		
porosity	0.539	
water content	0.274	
bulk density	1.3	g/ml
foc	0.0014	

Formula:

* Conversion Factor based on Equation: $C_g = K_H M_T / [q+(f-q)K_H + K_d r_b]$ where,

C_g = Vapor concentration of VOC in gas phase in $\mu g/m^3$;

K_H = Henry's Law Constant (dimensionless);

M_T = total mass of contaminant in soil (µg/kg);

q = volumetric water content (percent);

f = soil porosity (percent);

Kd = Distribution coefficient in liters per kilogram; and

r_b = bulk density of soil (g/ml)

Notes and Key:

g/ml = Grams per milliliter

µg/kg = Micrograms per kilogram

µg/L = Micrograms per liter

$\mu g/m^3$ = Micrograms per cubic meter

CA = California

DTW = Depth to water

Fed = Federal

FOC = Fractional organic content

Ft = Feet

MCL = Maximum contaminant level

PHG = Public health goal

Table 3.1-3 Remedial Investigation Screening Levels (RISLs) for Compounds Detected in Soil
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

CAS No.	Chemical	Residential PRG for Soil (mg/kg)	CHHSL for Soil (mg/kg)	Remedial Investigation Screening Level (RISL) (mg/kg)	(µg/kg)
Metals					
7429-90-5	Aluminum	76,140		76,140	76,140,195
7440-36-0	Antimony and compounds	31.00	30.00	30.0	30,000
7440-38-2	Arsenic [a]	0.39	0.07	0.07	70
7440-39-3	Barium and compounds	5,370	5,200	5,200	5,200,000
7440-41-7	Beryllium and compounds	150	150	150	150,437
7440-42-8	Boron	16,000		16,000	16,000,000
7440-43-9	Cadmium and compounds	37.0	1.7	1.70	1,700
75-15-0	Carbon disulfide	361		361	360,534
	Total Chromium (1:6 ratio Cr VI:Cr III)	211		211	210,675
16065-83-1	Chromium III	100,000	100,000	100,000	100,000,000
18540-29-9	Chromium VI	30.1	17.0	17.0	17,000
7440-48-4	Cobalt	903	660	660	660,000
7440-50-8	Copper and compounds	3,101	3,000	3,000	3,000,000
7439-89-6	Iron	23,463		23,463	23,463,185
7439-92-1	Lead [a]	400	150	150	150,000
7439-93-2	Lithium	1,600		1,600	1,600,000
7439-96-5	Manganese and compounds	1,762		1,762	1,762,353
7487-94-7	Mercury and compounds	23.5	18.0	18.0	18,000
7439-98-7	Molybdenum	391	380	380	380,000
7440-02-0	Nickel (soluble salts)	1,564	1,600	1,564	1,564,281
7782-49-2	Selenium	390	380	380	380,000
7440-22-4	Silver and compounds	390	380	380	380,000
7440-24-6	Strontium, stable	46,924		46,924	46,924,167
7440-28-0	Thallium and compounds	5.20	5.0	5.0	5,000
7440-31-5	Tin (inorganic, also see tributyltin oxide)	46,924		46,924	46,924,167
7440-32-6	Titanium	100,000		100,000	100,000,000
7440-62-2	Vanadium and compounds	78	5.3	5.3	5,300
7440-66-6	Zinc	23,463	23,000	23,000	23,000,000
Other					
309-00-2	Aldrin	0.029	0.033	0.029	29
75-15-0	Carbon disulfide	361		361	360,534
72-54-8	DDD	2.40	2.3	2.30	2,300
72-55-9	DDE	1.70	1.6	1.60	1,600
50-29-3	DDT	1.70	1.6	1.60	1,600
60-57-1	Dieldrin	0.03	0.04	0.03	30.4
84-66-2	Diethyl phthalate	48,882		48,882	48,882,478
122-66-7	1,2-Diphenylhydrazine	0.61		0.61	608
1746-01-6	2,3,7,8-TCDD (dioxin)	0.0000039	0.0000046	0.0000039	0.0039
72-20-8	Endrin	18.3	21.0	18.3	18,331
76-44-8	Heptachlor	0.11	0.13	0.11	108
1024-57-3	Heptachlor epoxide	0.05		0.05	53.4
58-89-9	HCH (gamma) Lindane	0.44	0.50	0.44	437
67-72-1	Hexachloroethane	34.7		34.7	34,741
62-75-9	N-Nitrosodimethylamine (NDMA)	0.01		0.01	9.5
40487-42-1	Pendimethalin	2,444		2,444	2,444,124
7601-90-3	Perchlorate	7.80		7.8	7,800
108-95-2	Phenol	18,331		18,331	18,330,929
	Polychlorinated biphenyls (PCBs, see IRIS)	0.22	0.089	0.22	222
12674-11-2	PCBs - Aroclor 1016	3.90	0.089	3.90	3,900
11097-69-1	PCBs - Aroclors 1221, 1232, 1242, 1248, 1254 & 1260)	0.22	0.089	0.22	220
83-32-9	Acenaphthene	3,682		3,682	3,681,706
120-12-7	Anthracene	21,896		21,896	21,896,121
56-55-3	Benz[a]anthracene	0.62		0.62	620
205-99-2	Benzo[b]fluoranthene	0.62		0.62	620
207-08-9	Benzo[k]fluoranthene [a]	6.20	0.04	0.04	38
50-32-8	Benzo[a]pyrene	0.06	0.04	0.04	38
218-01-9	Chrysene [a]	3.8		3.78	3,781
53-70-3	Dibenz[ah]anthracene	0.06		0.06	62.1

Table 3.1-3 Remedial Investigation Screening Levels (RISLs) for Compounds Detected in Soil
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

CAS No.	Chemical	Residential PRG for Soil (mg/kg)	CHHSL for Soil (mg/kg)	Remedial Investigation Screening Level (RISL) (mg/kg)	(µg/kg)
206-44-0	Fluoranthene	2,294		2,294	2,293,610
86-73-7	Fluorene	2,747		2,747	2,747,107
193-39-5	Indeno[1,2,3-cd]pyrene	0.62		0.62	621
91-20-3	Naphthalene [a]	560	1.70	1.70	1,700
129-00-0	Pyrene	2,316		2,316	2,315,951

Notes and Key:
Screening levels are the lower of either the PRG or CHHSL.
a = Indicates the California Modified PRG was used to develop the screening value.
mg/kg = Milligrams per kilogram
µg/kg = Micrograms per kilogram
CHHSL = California Human Health Screening Level
PRG = Preliminary Remediation Goal

Sources:
PRG TABLE
Version 9
October 2004
Stanford J. Smucker Ph.D., EPA Region IX
Technical Support Section (SFD-8-4)
75 Hawthorne Street, San Francisco, CA 94105-3901

CHHSLs
Human-Exposure-Based Screening Numbers Developed to Aid Estimation of Cleanup Costs for Contaminated Soil
November 2004; January 2005 Revision
California Environmental Protection Agency
Office of Environmental Health Hazard Assessment
Integrated Risk Assessment Section

Table 3.1-4 Protection of Groundwater Screening Levels (PGW SSLs) for Soil
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

CAS Number	Chemical	Organic or Inorganic	Background Threshold Value (ug/kg)	PHG (ug/L)	April 2009 Tapwater RSL (ug/l)	Other ARAR (ug/L)	Source	Attenuation Factor	Leachability Factor	PGW SSL (ug/kg)	PGW SSL (mg/kg)
Metals											
7429-90-5	Aluminum (RCRB soils)	I	43,000,000	600	37,000	1,000	CA MCL	NA	NA	43,000,000	43,000
7429-90-5	Aluminum (Xerorthent soils)	I	54,000,000	600	37,000	1,000	CA MCL	NA	NA	54,000,000	54,000
7440-36-0	Antimony (RCRB soils)	I	1,300	20.0	15.0	6.0	CA MCL	100	100	60,000	60
7440-36-0	Antimony (Xerorthent soils)	I	460	20.0	15.0	6.0	CA MCL	100	100	60,000	60
7440-38-2	Arsenic (RCRB soils)	I	11,000	0.004	0.05	10.0	Fed MCL	NA	NA	11,000	11
7440-38-2	Arsenic (Xerorthent soils)	I	37,000	0.004	0.05	10.0	Fed MCL	NA	NA	37,000	37
7440-39-3	Barium (RCRB soils)	I	274,000	2,000	7,300	1,000	CA MCL	100	100	10,000,000	10,000
7440-39-3	Barium (Xerorthent soils)	I	320,000	2,000	7,300	1,000	CA MCL	100	100	10,000,000	10,000
7440-41-7	Beryllium (RCRB soils)	I	1,000	1.0	73.0	4.0	CA MCL	100	100	10,000	10.0
7440-41-7	Beryllium (Xerorthent soils)	I	1,100	1.0	73.0	4.0	CA MCL	100	100	10,000	10.0
7440-42-8	Boron	I	16,000		7,300	1,000	DPH NL	100	100	10,000,000	10,000.0
7440-43-9	Cadmium (RCRB soils)	I	720	0.04	18.0	5.0	CA MCL	NA	NA	720	0.72
7440-43-9	Cadmium (Xerorthent soils)	I	1,200	0.04	18.0	5.0	CA MCL	NA	NA	1,200	1.20
7440-47-3	Chromium (Total) (RCRB soils)	I	110,000			50	CA MCL	100	100	500,000	500
7440-47-3	Chromium (Total) (Xerorthent soils)	I	118,000			50	CA MCL	100	100	500,000	500
7440-48-4	Cobalt (RCRB soils)	I	24,000		11.0			100	100	110,000	110
7440-48-4	Cobalt (Xerorthent soils)	I	33,000		11.0			100	100	110,000	110
7440-50-8	Copper (RCRB soils)	I	63,000	300	1,500	1,300	CA MCL	100	100	3,000,000	3,000
7440-50-8	Copper (Xerorthent soils)	I	76,000	300	1,500	1,300	CA MCL	100	100	3,000,000	3,000
18540-29-9	Hexavalent Chromium	I		10.9	730	21	2004 TW PRG	100	100	109,000	109
7439-89-6	Iron	I	42,000,000		26,000	300	NSDWR	NA	NA	42,000,000	42,000
7439-92-1	Lead (RCRB soils)	I	42,000	2.0		15	CA MCL	NA	NA	42,000	42
7439-92-1	Lead (Xerorthent soils)	I	23,000	2.0		15	CA MCL	NA	NA	23,000	23
7439-96-5	Manganese (RCRB soils)	I	1,100,000		880	50	NSDWR	NA	NA	1,100,000	1,100
7439-96-5	Manganese (Xerorthent soils)	I	1,500,000		880	50	NSDWR	NA	NA	1,500,000	1,500
7439-97-6	Mercury (elemental RCRB soils)	I	870	1.2	0.57	2.0	CA MCL	NA	NA	5,700	5.70
7439-97-6	Mercury (elemental Xerorthent soils)	I	130	1.2	0.57	2.0	CA MCL	100	100	5,700	5.70
7439-98-7	Molybdenum (RCRB soils)	I	520		180			100	100	1,800,000	1,800
7439-98-7	Molybdenum (Xerorthent soils)	I	630		180			100	100	1,800,000	1,800
7440-02-0	Nickel (soluble salts RCRB soils)	I	75,000	12	730	100	CA MCL	100	100	120,000	120
7440-02-0	Nickel (soluble salts Xerorthent soils)	I	140,000	12	730	100	CA MCL	NA	NA	140,000	140
7782-49-2	Selenium (RCRB soils)	I	1,100		180	50	CA MCL	100	100	500,000	500
7782-49-2	Selenium (Xerorthent soils)	I	26,000		180	50	CA MCL	100	100	500,000	500
7440-22-4	Silver (RCRB soils)	I	130		180	100	NSDWR	100	100	1,000,000	1,000
7440-22-4	Silver (Xerorthent soils)	I	2,400		180	100	NSDWR	100	100	1,000,000	1,000
7440-28-0	Thallium (RCRB soils)	I	2,500	0.1	2.4	2.0	CA MCL	NA	NA	2,500	2.50
7440-28-0	Thallium (Xerorthent soils)	I	3,300	0.1	2.4	2.0	CA MCL	NA	NA	3,300	3.30
7440-31-5	Tin	I			22,000			100	100	220,000,000	220,000
7440-62-2	Vanadium (RCRB soils)	I	119,000		260	50	DPH NL	NA	NA	500,000	500
7440-62-2	Vanadium (Xerorthent soils)	I	130,000		260	50	DPH NL	NA	NA	500,000	500
7440-66-6	Zinc (RCRB soils)	I	100,000		11,000	5,000	NSDWR	100	100	50,000,000	50,000
7440-66-6	Zinc (Xerorthent soils)	I	89,000		11,000	5,000	NSDWR	100	100	50,000,000	50,000

Table 3.1-4 Protection of Groundwater Screening Levels (PGW SSLs) for Soil
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

CAS Number	Chemical	Organic or Inorganic	Background Threshold Value (ug/kg)	PHG (ug/L)	April 2009 Tapwater RSL (ug/l)	Other ARAR (ug/L)	Source	Attenuation Factor	Leachability Factor	PGW SSL (ug/kg)	PGW SSL (mg/kg)
Others											
309-00-2	Aldrin	O			0			100	10	4.0	0.004
12674-11-2	Aroclor 1016	O		0.09	1.0	0.5	CA MCL	100	10	90	0.090
11104-28-2	Aroclor 1221	O		0.09	0.0068	0.5	CA MCL	100	10	6.8	0.007
11141-16-5	Aroclor 1232	O		0.09	0.0068	0.5	CA MCL	100	10	6.8	0.007
53469-21-9	Aroclor 1242	O		0.09	0.034	0.5	CA MCL	100	10	34.0	0.034
12672-29-6	Aroclor 1248	O		0.09	0.034	0.5	CA MCL	100	10	34.0	0.034
11097-69-1	Aroclor 1254	O		0.09	0.034	0.5	CA MCL	100	10	34.0	0.034
11096-82-5	Aroclor 1260	O		0.09	0.034	0.5	CA MCL	100	10	34.0	0.034
83-32-9	Acenaphthene	O			2,200			100	10	2,200,000	2,200
120-12-7	Anthracene	O			11,000			100	10	11,000,000	11,000
56-55-3	Benz[a]anthracene	O			0.029	0.10	Fed MCL	100	10	29.0	0.03
50-32-8	Benzo[a]pyrene	O		0.004	0.0029	0.20	Fed MCL	100	10	2.9	0.0029
205-99-2	Benzo[b]fluoranthene	O			0.029			100	10	29.0	0.0290
207-08-9	Benzo[k]fluoranthene	O			0.29			100	10	290	0.2900
65-85-0	Benzoic acid	O			150,000			100	10	150,000,000	150,000
100-51-6	Benzyl alcohol	O			18,000			100	10	18,000,000	18,000
117-81-7	Bis(2-ethylhexyl)phthalate (BEHP)	O		12	4.8	4.0	CA MCL	100	10	4,000	4.0
85-68-7	Butyl benzyl phthalate	O			35			100	10	35,000	35.0
218-01-9	Chrysene	O			2.9			100	10	2,900	2.9
53-70-3	Dibenz[ah]anthracene	O			0.0029			100	10	2.9	0.003
72-54-8	4,4-DDD	O			0.28			100	10	280	0.280
50-29-3	4,4-DDT	O			0.20			100	10	200	0.200
60-57-1	Dieldrin	O			0.0042			100	10	4.2	0.004
84-66-2	Diethyl phthalate	O			29,000			100	10	29,000,000	29,000
131-11-3	Dimethyl phthalate	O				364,867	2004 TW PRG	100	10	364,866,800	364,867
84-74-2	Di-n-butyl phthalate	O			3,700			100	10	3,700,000	3,700
123-91-1	1,4-Dioxane	O			6.1	3.0	DPH NL	100	10	3,000	3.0
1746-01-6	2,3,7,8-TCDD TEQ	O			0.00000052					0.059	0.000059
206-44-0	Fluoranthene	O			1,500			100	10	1,500,000	1,500
86-73-7	Fluorene	O			1,500			100	10	1,500,000	1,500
16984-48-8	Fluoride	I		1,000		2,000	CA MCL	100	100	10,000,000	10,000
1024-57-3	Heptachlor Epoxide	O		0.006	0.0074			100	10	6.0	0.006
118-74-1	Hexachlorobenzene	O		0.03	0.042	1.0	CA MCL	100	10	30.0	0.03
87-68-3	Hexachlorobutadiene	O			0.86			100	10	860	0.9
77-47-4	Hexachlorocyclopentadiene	O		50	220	50	CA MCL	100	10	50,000	50.0
67-72-1	Hexachloroethane	O			4.8			100	10	4,800	4.8
193-39-5	Indeno[1,2,3-cd]pyrene	O			0.029			100	10	29.0	0.029
78-59-1	Isophorone	O			71			100	10	71,000	71.0
90-12-0	1-Methyl Naphthalene	O			2.3			100	10	2,300	2.3
91-57-6	2-Methylnaphthalene	O			150			100	10	150,000	150
91-20-3	Naphthalene	O			0.14	17.0	DPH NL	100	10	140	0.14
14797-55-8	Nitrate (as N)	I		10,000	58,000	10,000	Fed MCL	100	100	100,000,000	100,000
14797-65-0	Nitrite (as N)	I		1,000	3,700	1,000	CA MCL	100	100	10,000,000	10,000
88-74-4	o-Nitroaniline	O			110			100	10	110,000	110
556-88-7	Nitroguanidine	O			3,700			100	10	3,700,000	3,700
62-75-9	N-Nitrosodimethylamine (NDMA)	O		0.003	0.00042	0.01	DPH NL	1	10	0.03	0.00003

Table 3.1-4 Protection of Groundwater Screening Levels (PGW SSLs) for Soil
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

CAS Number	Chemical	Organic or Inorganic	Background Threshold Value (ug/kg)	PHG (ug/L)	April 2009 Tapwater RSL (ug/l)	Other ARAR (ug/L)	Source	Attenuation Factor	Leachability Factor	PGW SSL (ug/kg)	PGW SSL (mg/kg)
40487-42-1	Pendimethalin (Prowl)	O			1,500			100	10	1,500,000	1,500
87-86-5	Pentachlorophenol	O		0.4	0.56	1.00	CA MCL	100	10	400	0.40
14797-73-0	Perchlorate and Perchlorate Salts	I		6.0	26.0	6.0	CA MCL	1	10	60.0	0.06
85-01-8	Phenanthrene	O			1,100		(1)	100	10	1,100,000	1,100
108-95-2	Phenol	O			11,000	4,200	DPH NL	100	10	4,200,000	4,200
129-00-0	Pyrene	O			1,100			100	10	1,100,000	1,100
120-82-1	1,2,4-Trichlorobenzene	O		5.0	8.2	5.0	CA MCL	100	10	5,000	5.0
95-95-4	2,4,5-Trichlorophenol	O			3,700			100	10	3,700,000	3,700
88-06-2	2,4,6-Trichlorophenol	O			6.1			100	10	6,100	6.1
99-35-4	1,3,5-Trinitrobenzene	O			1,100			100	10	1,100,000	1,100
	TPH as Diesel	O								100,000	100
	TPH as Motor Oil	O								500,000	500

Notes and Key:

Soil screening levels protective of groundwater for all were developed using methodology described in the *Designated Level Methodology for Waste Classification and Cleanup Level Determination* (RWQCB 1989).

An attenuation factor of 100 and a leachability factor of 100 was used for inorganics, excpet perchlorate.

An attenuation factor of 100 and a leachability factor of 10 was used for organics, except NDMA.

An attenuation factor of 1 and a leachability factor of 10 was used for perchlorate and NDMA due to their high solubility.

PGW SSL for metals is higher of either screening level developed using DLM or background threshold value.

(1) = Pyrene used as surrogate

µg/L = micrograms per liter
µg/kg = Micrograms per kilogram
mg/kg = milligrams per kilogram
ARAR = Applicable or Relevant and Appropriate Requirements
CA MCL = State of California Maximum Contaminant Level
DLM = Designated level methodology
DPH NL = State of California Department of Public Health Notification Level
Fed MCL = Federal Maximum Contaminat Level
NA = DLM methodology not applicable to background
NSDWR = National Secondary Drinking Water Regulation
PHG = Public Health Goal, California Office of Environmental Health Hazard Assessment, 2009
PRG = Preliminary remediation goal
RSL = Regional Screening Levels, Oak Ridge National Laboratory (ORNL), 2008.
RSL = tap water risk screening level (USEPA Region 9)
TPH = Total petroleum hydrocarbons
TW = Tap water
USEPA = United States Environmental Protection Agency

Table 3.1-5 Surface Water Screening Levels (SWSLs)
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

CAS No.	Chemical	Tap Water PRG (µg/L)	USEPA Primary MCL (µg/L)	California Primary MCL (µg/L)	Lower of PRG or MCL (µg/L)	NPDES Permit Limit (µg/L)	Selected Surface Water Screening Level (µg/L)
Metals							
7429-90-5	Aluminum	3,650	NV	NV	3,650		3,650
7440-36-0	Antimony and compounds	1.46	6.0	6.0	1.46		1.46
7440-38-2	Arsenic [a]	0.01	10	50	0.007	0.01	0.01
7440-39-3	Barium and compounds	255	2,000.0	1,000.0	255	0.10	0.10
7440-41-7	Beryllium and compounds	7.30	4.0	4.0	4.0		4.0
7440-42-8	Boron	730	NV	NV	730		730
7440-43-9	Cadmium and compounds	1.82	5.0	5.0	1.82		1.82
67-66-3	Chloroform	0.17	80	80	0.17		0.17
16065-83-1	Chromium III	5,475	100	50.0	50.0		50
18540-29-9	Chromium VI	10.9	NV	NV	10.9		10.9
7440-48-4	Cobalt	73.0	NV	NV	73.0		73.0
7440-50-8	Copper and compounds	146	1,300	1,300	146	0.01	146
57-12-5	Cyanide (free)	73.0	200	150	73.0		73.0
7439-89-6	Iron	1,095	NV	NV	1,095	0.30	1,095
7439-92-1	Lead	NV	15.0	15.0	15.0		15.0
7439-96-5	Manganese and compounds	87.6	NV	NV	87.6		87.6
7487-94-7	Mercury and compounds	1.09	2.0	2.0	1.09		1.09
7439-98-7	Molybdenum	18.2	NV	NV	18.2		18.2
7440-02-0	Nickel (soluble salts)	73.0	NV	NV	73.0		73.0
7782-49-2	Selenium	18.2	50	50	18.2		18.2
7440-22-4	Silver and compounds	18.2	NV	NV	18.2	0.01	18.2
7440-24-6	Strontium, stable	2,190	NV	NV	2,190		2,190
7440-28-0	Thallium and compounds	0.24	2.0	2.0	0.24		0.24
7440-32-6	Titanium	14,598	NV	NV	14,598		14,598
7440-62-2	Vanadium and compounds	3.65	NV	NV	3.65		3.65
7440-66-6	Zinc	1,095	NV	NV	1,095	0.10	1,095
Other							
309-00-2	Aldrin	0.004	NV	NV	0.004		0.004
117-81-7	Bis(2-ethylhexyl)phthalate (DEHP)	4.80	6.0	4.0	4.0		4.0
75-27-4	Bromodichloromethane	0.18	80	80	0.18		0.18
75-25-2	Bromoform (tribromomethane)	8.51	NV	NV	8.51		8.51
124-48-1	Dibromochloromethane	0.13	80	80	0.13		0.13
72-20-8	Endrin	1.09	2.0	2.0	1.09		1.09
76-44-8	Heptachlor	0.015	0.40	0.01	0.01		0.01
1024-57-3	Heptachlor epoxide	0.007	0.20	0.01	0.007		0.007
72-43-5	Methoxychlor	18.2	40	30	18.2		18.2
106-44-5	4-Methylphenol	18.2	NV	NV	18.2		18.2
14797-55-8	Nitrate	1,000	10,000	10,000	1,000		1,000
14797-65-0	Nitrite	100	1,000	1,000	100		100
556-88-7	Nitroguanidine	365	NV	NV	365		365
62-75-9	N-Nitrosodimethylamine (NDMA)	0.0013	NV	NV	0.0013		0.0013
40487-42-1	Pendimethalin (PROWL)	146	NV	NV	146		146
7601-90-3	Perchlorate	0.36	NV	NV	0.36		0.36
12674-11-2	PCBs (unspeciated mixture, low risk)	0.96	0.50	0.50	0.50		0.50
11097-69-1	PCBs (unspeciated mixture, high risk)	0.03	0.50	0.50	0.03		0.03
127-18-4	Tetrachloroethylene (PCE)	0.10	5.0	5.0	0.10		0.10
108-88-3	Toluene	72.3	1,000	150	72.3		72.3
	TPH-D						100
	TPH-Mo						100
71-55-6	1,1,1-Trichloroethane	317	200	200	200		200
79-01-6	Trichloroethylene (TCE)	0.03	5.0	5.0	0.03		0.03
75-69-4	Trichlorofluoromethane	129	NV	150	129		129

Notes and Key:

Selected surface water screening level is either the NPDES Permit Limit or the lower of either the MCL or PRG.
a = Indicates the California Modified PRG was used to develop the screening value.
µg/L = Micrograms per liter
MCL = Maximum contaminant level
PRG = Preliminary Remediation Goal
USEPA = United States Environmental Protection Agency
NPDES = National Pollution Discharge Elimination System

Sources:

PRG TABLE
Version 9
October 2004
Stanford J. Smucker Ph.D., EPA Region IX
Technical Support Section (SFD-8-4)
75 Hawthorne Street, San Francisco, CA 94105-3901

4.0 SUMMARY AND RESULTS OF REMEDIAL INVESTIGATION – ADMINISTRATION AREA

The Administration Area is the historical liquid rocket manufacturing area and historical and current administration area at the Aerojet propulsion facility. Potential source areas within the Administration Area are associated with liquid rocket manufacturing and the drainage system extending from the manufacturing buildings within the Administration Area to the Westlakes Area (Figure 4.1-1). Locations where piping discharged to ditches were identified as potential source areas. The primary chemicals associated with liquid rocket manufacturing were chlorinated solvents and metals.

Source areas identified within the Administration Area, as presented in the *Final Remedial Investigation/Feasibility Study Field Sampling Plan for Boundary Operable Unit* (BOU FSP) (Aerojet et al, 2006b), are listed on Table 4.0-1. Classes of chemicals identified in soil, soil vapor, and groundwater within the Administration Area include the following:

- **Soil -** Volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH), pesticides, polychlorinated biphenyls (PCBs), and metals.
- **Soil Vapor –** VOCs.
- **Groundwater –** VOCs, SVOCs, TPH, pesticides/PCBs, perchlorate, N-nitrosodimethylamine (NDMA), and metals.

Based on review of the available data and for the purposes of this BOU Remedial Investigation (RI)/Feasibility Study (FS) Report, the Administration Area has been divided into two management areas: Administration Area East and Administration Area West (Figure 4.1-1). Source areas and Resource Conservation and Recovery Act (RCRA) units within Administration Area East and Administration Area West are listed below. Figures showing the locations of the source areas and RCRA Units are presented in Sections 4.2 and 4.3. Septic tank and leach lines within the Administration Area are discussed within the source area they are associated.

- **Administration Area East:**
  - Source Sites 3D, 11D, 50D, and 51D associated with the rocket engine manufacturing facilities (Buildings 20001, 20002, and 20004);

- A radiographic facility (Building 20034);
- RCRA Units B, C , and X; and
- Septic tanks A20-ST01, A20-ST02, A20-ST05, A20-ST06, A20-ST14, A20-ST20, and A20-ST22.

- **Administration Area West:**
  - All or portions of five drainage ditches and catch basins identified as Source Sites 5D, 9D, 12D, D(b), and D(d);
  - Two Source Sites (6D and 52D), including a former waste oil tank and treatment basin in and around Building 20009;
  - Two Source Sites (8D and D(c)) associated with the former Aerojet sewage treatment plant; and
  - RCRA Units W and Y.

This section provides a description of the Administration Area, including geology and hydrogeology, and a discussion regarding the presence and distribution of chemicals in both the vadose zone and groundwater. Additionally, the following information is presented for each of the sites:

- A summary of background information, including historical operations and activities;
- A summary of the scope and results of previous (prior to 2005) investigations;
- A summary of the scope and results of recent (2005-2007) investigations for VOCs, metals, and other non-VOCs in soil, soil vapor, and groundwater; and
- A discussion of the investigation results.

4.1 ENVIRONMENTAL SETTING – ADMINISTRATION AREA

The topography, geology, soils, surface water hydrology, general hydrogeology, and ecological habitat of the Administration Area are described below.

4.1.1 Topography

The majority of the Administration Area has been graded and paved, and is relatively flat with a gentle slope towards the north and west. The primary topographic relief is provided by the presence of a northeast-

southwest trending ancestral American River terrace along the southern and southeastern portion of the area.

4.1.2 *Geology*

Based on the descriptions from borehole logs for perched and unconfined groundwater wells and borings (Appendix D), the lithologies underlying the Administration Area are comprised of interbedded gravel, sand, silt, and clays. Indurated silt (siltstone), clay (claystone), and sand (sandstone) were encountered in several wells at varying depths.

The surface and near surface lithologies in the central and northern portions of the Administration Area are primarily comprised of reworked Quaternary-aged fluvial deposits of cobbles, sand, silt, and clay to a depth of approximately 30 feet. The approximate extent of dredging in the Administration Area is shown in Figure 4.1-2. Historical information indicates that a smaller dredger performed the dredging. In the vicinity of the Administration Area, the soils were dredged to a depth of approximately 30 feet, compared to depths up to 90 feet elsewhere on the site. Much of the Administration Area has been graded and paved; therefore, it is difficult to assess the areal extent of the dredge tailings.

The shallow subsurface lithologies described in the well logs and most of the borehole logs are consistent with those observed in dredged areas elsewhere on site. However, auger refusal has been encountered in several borings drilled in the Administration Area, suggesting the presence of indurated lithologies unlikely to have been dredged. The absence of evidence of dredging, such as remnant windrows of cobbles in areas where grading is not apparent, suggests that the Administration Area was not entirely dredged. A slight change from interbedded layers consisting primarily of silt, clay, and sands to thicker sections of interbedded sands and silty sands was noted at a depth of approximately 40 feet in a few wells in the central portion of the Administration Area. The change in lithology is evidence of the depth at which dredging was accomplished. The general subsurface lithologies for the Administration Area are shown in hydrostratigraphic cross-sections B-B′ and C-C′ (Figures 4.1-3 and 4.1-4, respectively).

4.1.3 *Soils*

The Administration Area is urban land consisting of large areas covered by impervious surfaces or structures, such as roads, driveways, sidewalks,

buildings, and parking lots. In most places, 90 percent or more of the area is covered by impervious surfaces.

Soils found within the Administration Area include the following units as mapped and described in the 1993 United State Department of Agriculture (USDA) Soil Conservation Service, Soil Survey of Sacramento County:

Xerorthents – Excessively drained and somewhat excessively drained soils. These soil types are found in areas of dredge tailings near the American River. The soils formed in material that has a high content of gravels and cobbles derived from mixed rock sources. The material was deposited as tailings during mining activities with slopes ranging from 0 to 50 percent. Xerorthents are very deep. These soils are extremely gravelly and in some areas have strata of loose gravels or cobbles.

Redding-Corning-Red Bluff – Moderately well-drained soils that are moderately deep over a cemented hard pan. This soil unit is found on intermediate and high terraces, terrace remnants, and the side slopes of terraces in the eastern part of Sacramento County. The soils form in alluvium that is derived from mixed rock sources. The Redding soils are typically a surface layer of gravelly loam with subsoil comprised of a gravelly claypan, which is in turn underlain by a hardpan at a depth of 20 to 40 inches. The Corning-Red Bluff soils are typically a loam with a subsoil of clay loam, gravelly loam, and gravelly clay loam. The Redding-Corning-Red Bluff soil unit underlies a small portion of the eastern Administration Area (Area 20).

Urban Lands–Americanos–Natomas – This soil unit underlies most of the Administration Area (Area 20) and is found on low stream terraces of the American River and on other low terraces adjacent to the river. These soils formed in alluvium-derived dominantly form mixed rock sources. Slopes range from 0 to 2 percent. Urban land consists of areas covered by impervious surfaces such as asphalt, concrete, and buildings. Americanos soils are found on low stream terraces. They are deep or very deep with a typical surface layer and subsoil composed of silt loam. Sandy loam is also present in some areas and is discontinuously cemented with silica to a depth of 50 to 72 inches. Natomas soils are also found on low terraces. They are very deep and typically the surface layer is loam with subsoil composed of clay loam. The substratum for this soil is typically a sandy loam.

4.1.4 *Surface Water Hydrology*

Local surface water features within the Administration Area include the Administration Ditch and other man-made ditches, culverts, catch basins, and storm drains (Figure 4.1-1). Most of these features are used to divert and control seasonal storm water runoff from the Aerojet site.

Most storm water runoff originating in the Administration Area of the Aerojet site flows through a series of man-made ditches that empty into the main Administration Ditch, which in turn discharges to the West Lakes Storm Water Retention Ponds. Storm water runoff is staged in the Westlakes Ponds where it is allowed to infiltrate or, when the Westlakes become full, is discharged to Buffalo Creek and ultimately to the American River. Storm water discharges to Buffalo Creek/American River are regulated through the National Pollution Discharge Elimination System (NPDES) (RWQCB, 2002).

4.1.5 *Local Hydrogeology*

The first saturated sediments encountered beneath the Administration Area are either part of perched groundwater or within the first water-bearing zone (FWBZ). For the purposes of this RI, FWBZ is defined as the upper 20 to 30 feet of saturated sediments that are laterally continuous across the Administration Area.

The general hydrogeology of the perched groundwater and FWBZ beneath the Administration Area is discussed below. Details regarding the occurrence of groundwater within the Administration Area and distribution of chemicals in the groundwater are presented in Section 4.5.

4.1.5.1 *Perched Groundwater*

Perched groundwater is the shallowest saturated unit and typically occurs in ancestral American River sediments that have been reworked by historical gold-dredging activities. Dredging activities disturbed the natural stratigraphy and the resulting spoils were deposited as unconsolidated and somewhat stratified sediments. As a result, the dredged materials are very permeable and are underlain by sediments that are typically less permeable. The base of perched groundwater often coincides with the interface between dredged and undredged materials.

The highest perched groundwater elevations on record in the Administration Area since the start of monitoring in 1982 were in 1983,

following a year of above-average precipitation. The lowest perched groundwater levels generally occurred between 1988 and 1992 during a period of below-average precipitation.

In 1983 and 1984, the FWBZ was present at elevations nearly equal to the perched groundwater elevations. During this period, the perched groundwater was in hydraulic continuity with the FWBZ and it technically did not exist.

During the BOU RI, perched groundwater was commonly encountered in the eastern portion of the Administration Area East near Buildings 20002 and 20004 and in Administration Area West near Building 20009. The perched groundwater in these two areas may be hydraulically connected, based on similar water level elevations and the relatively uniform hydraulic gradient between the two areas. In April 2006, the depth to perched groundwater within the Administration Area ranged from 7.2 to 25.1 feet below ground surface (bgs) and the median depth was 14 feet bgs. The base of perched groundwater ranges from approximately 4 to 13 feet above the top of the FWBZ.

The direction of flow in the perched groundwater in the eastern portion of the Administration Area is variable and has the steepest hydraulic gradient (approximately 0.07 feet per foot [ft/ft]). The direction of flow in the perched groundwater in the western portion of the Administration Area appears to be towards the west-northwest with a hydraulic gradient of approximately 0.01 ft/ft.

4.1.5.2 *First Water-Bearing Zone*

The FWBZ occurs in the upper portion of a sand and gravel unit containing variable amounts of silt ranging from approximately 50- to 75-feet thick, and that thins to the east. This sand and gravel unit generally corresponds to Layer C of the *Western Groundwater Operable Unit Groundwater Flow Model* (Aerojet, 2004d).

The depth to the top of the FWBZ ranges from 25 to 45 feet bgs, typically increasing in depth from east to west across the Administration Area. The FWBZ is deeper (50 to 75 feet bgs) south of the Administration Area due to the increased ground surface elevations associated with the ancestral American River terrace described in Section 4.1.1.

Since the start of monitoring in 1982, the highest water levels were recorded in 1983. The FWBZ water levels decreased an average of

approximately 30 feet between 1983 and 1990, when the lowest water levels were recorded. Between October 2004 and April 2006, the water table elevation increased approximately 6 feet.

Based on data from April 2006, flow direction in the FWBZ across the Administration Area appears to be relatively uniform towards the west-northwest. The average hydraulic gradient for the FWBZ across the Administration Area is approximately 0.01 ft/ft. The gradient is steeper (0.03 ft/ft) in the southeastern portion of the Administration Area and flattens (0.009 ft/ft) to the northwest.

4.1.6 *Ecological Habitat*

The Administration Area is mainly comprised of buildings, landscaped areas, ruderal/disturbed habitat, and paved surfaces; which are all highly disturbed vegetation communities. Flora typically includes herbaceous weeds, non-native invasive species, and ornamental landscape species. Fauna species common to the Administration Area are habitat generalists such as the rock pigeon, mourning dove, western fence lizard, European starling, house mouse, and deer mouse; or species that may venture in from adjacent vegetation communities. A *Biological Assessment Report* (ECORP Consulting, Inc., 2005), including a habitat and vegetation map for the Administration Area, was presented in Appendix B of the BOU FSP (Aerojet et al., 2006b).

Annual grassland habitat is also located within the Administration Area around Source Areas 9D, 8D, 12D, D(c), 5D, and 6D. Non-native, naturalized Mediterranean grasses represent the predominant flora species within this type of habitat. Typical fauna species include western fence lizard, common king snake, white-tailed kite, red-tailed hawk, western harvest mouse, California ground squirrel, and coyote.

Blue elderberry shrubs were observed near Source Area 5D and in the open space near the east side of the Administration Area. Blue elderberry shrubs provide potential habitat for the valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) (VELB). The VELB is fully protected under the Endangered Species Act of 1973, as amended (16 United States Code 1531 et seq.).

4.2 *SUMMARY AND RESULTS OF VADOSE ZONE REMEDIAL INVESTIGATIONS - ADMINISTRATION AREA EAST*

Administration Area East encompasses four source areas, three RCRA units, and various other features, including septic tanks, investigated during the BOU RI. To simplify the discussions and presentation of data, Administration Area East is divided into two areas that encompass source sites and other investigated features that are related or in proximity to one another. The two investigation areas in Administration Area East are:

- **Buildings 20002/20004 Area:** Includes all of Source Areas 3D, 50D, and 51D; portions of Source Area 4D not addressed in the Perimeter Groundwater Operable Unit (PGOU); and various features such as septic systems, floor drains, collection systems, sumps, storage and holding tanks, and conveyance pipelines associated with the rocket engine manufacturing facilities located in Buildings 20002 and 20004. The Buildings 20002/20004 Area also includes various other features, including septic tanks and leachfields, identified during the previous (pre-2005) and current investigations.
- **Building 20022 Area:** Includes portions of Source Area 11D not addressed in the PGOU; RCRA Units B, C, and X; a radiographic facility (Building 20034); a septic system, and other features associated with Building 20022; and various chemical handling or storage areas in the eastern portion of the Administration Area.

The location of source sites and other pertinent features in Administration Area East are shown in Figure 4.2-1.

This section provides the following information for each of the two areas of investigation in Administration Area East:

- Describes the area of investigation;
- Describes each source area and other features, including septic tanks, investigated during the previous (prior to 2005) investigations and the BOU RI;
- Summarizes previous vadose zone investigations and the results of those investigations;
- Identifies chemicals of potential concern (COPCs) identified during the previous investigations;
- Presents the data needs identified in the BOU FSP;

- Summarizes the sampling activities performed during the BOU RI and deviations from the sampling proposed in the BOU FSP;
- Presents the analytical results for samples collected during the BOU RI and historical data, where appropriate; and
- Provides a discussion of the investigation results that includes the identification of COPCs; lateral and vertical characterization of COPCs; fate and transport of the COPCs; and the potential for those COPCs to pose a risk to human health, surface water, and groundwater.

The information presented below regarding the description of source areas and previous investigations was compiled from one or more of the following sources: *Stage 1 Sampling Plan-Zone 1* (Aerojet, 1993a); *Stage 1 Sampling Plan-Zones 3 and 4* (Aerojet, 1993b); *Stage 1 Sampling Plan-Zone 2* (Aerojet, 1993c); *Aerojet Superfund Site – Scoping Report, Volumes 1 through 6* (ICF Technology, Inc., 1989); *Aerojet Site; Stage 1 Report - Zones 1 through 4* (ICF Kaiser Engineers, Inc., 1993); or BOU FSP (Aerojet et al., 2006).

4.2.1 *Buildings 20002/20004 Area – Administration Area East*

The Buildings 20002/20004 Area consists of Source Area 3D, portions of Source Area 4D, and Source Areas 50D and 51D located in and around the rocket engine manufacturing facilities associated with Buildings 20002 and 20004 (Figure 4.2-1). Additionally, the Buildings 20002/20004 Area also includes various features such as sumps, drains, tanks, septic tanks associated with the source areas, and/or historical or current manufacturing process conducted in Buildings 20002 and 20004.

4.2.1.1 *Description of Source Areas – Buildings 20002/20004 Area*

The source areas in the Buildings 20002/20004 Area and various site features that may have contributed chemicals to soil and/or groundwater are described below and shown in Figure 4.2-1. Site features were identified based on historical soil, soil vapor, and groundwater analytical data and/or visual inspection and limited data coverage.

Source Area 3D

Source Area 3D includes the rocket engine manufacturing facilities associated with Buildings 20002 and 20004. Manufacturing and construction of liquid rocket engines involved a variety of industrial applications including metalworking, X-ray facilities, equipment cleaning and degreasing, photo etching, painting, and various laboratories.

Features in the Buildings 20002 and 20004 Area that may have contributed chemicals to source areas include floor drains, collection systems, sumps, storage and holding tanks, degreasers, boiler blowdown areas, above and below ground storage tanks, paint booths, transformers, laboratories, conveyance pipelines, and septic tanks. Many of the historical features associated with potential discharges (i.e., sumps, tanks, etc.) have been removed, filled and covered, or upgraded to comply with current environmental regulations. As both buildings are still active, some of these features are still in use as part of the current operations using detergents or other non-organic materials for the cleaning of metal parts.

Source Area 3D also includes eight septic tanks and leach fields associated with Buildings 20001, 20002, 20005, 20006, 20014, and 20020 identified during the Demonstration Project Record Search. The eight septic tanks and their current status are identified and described below.

- A20-ST01-1: Northeast of Building 20001 – abandoned.
- A20-ST01-2: Southwest side of Building 20001 – abandoned.
- A20-ST01-3: Northwest side of Building 20001 – abandoned.
- A20-ST02: North of Building 20002 – services the building.
- A20-ST05-1: West side of Building 20005 – serviced restroom inside Building 20005. First septic system installed to service Building 20005 restroom. It was abandoned (pumped out, filled, and covered) and a new septic system (A20-ST05-2) was installed south of the building.
- A20-ST05-2: South of Building 20005 – 1,000-gallon underground distribution box (septic tank) and two infiltration pits (potholes).
- A20-ST06: Identified in the BOU FSP as leach pits south of Building 20006.
- A20-ST14 : A 1,000-gallon septic tank and passive infiltration well (pothole) located east of the former company store (Building 20014).
- A20-ST20: Former septic tank located northwest of Building 20001.

Source Area 4D

Source Area 4D is a drainage system consisting of interconnected open ditches, underground culverts, and catch basins south of Buildings 20004, 20005, and 20019 (Figure 4.2-1). The Source Area 4D drainage system receives surface runoff from parking lots south of those buildings and possibly discharges from the drainage system connected to buildings in

Administration Area East. The Source Area 4D drainage system discharges to Source Areas 5D and 9D, which are part of the Administration Area West open ditch system.

Source Area 50D

Source Area 50D is a diesel fuel underground storage tank (UST) located west of Building 20001. The single-walled steel tank was installed in 1982 and had a capacity of 4,000 gallons.

Source Area 51D

Source Area 51D is a former fuel oil UST located north of Building 20002. The tank is a 3,000-gallon, unlined steel tank. The date of installation is unknown. The tank passed leak tests performed in 1986, 1987, and 1988 and was removed on 18 May 1989, according to Aerojet Sacramento Environmental Operations files.

4.2.2 *Summary and Results of Previous (Pre-2005) Vadose Zone Investigations – Buildings 20002/20004 Area*

The following subsections summarize the scope and results of previous (prior to 2005) vadose zone investigations of the four source areas and septic systems that comprise the Buildings 20002/20004 Area, identify COPCs based on the previous investigations, and discuss the data quality objectives (DQOs) and sampling proposed in the BOU FSP.

4.2.2.1 *Summary of Previous (Pre-2005) Vadose Zone Investigations – Buildings 20002/20004 Area*

Soil samples from 41 soil borings and 86 soil vapor samples were collected in the vicinity of Source Areas 3D, 4D, 50D, and 51D between 1979 and 2003. Soil vapor samples were analyzed for VOCs and soil samples were analyzed for VOCs, SVOCs, metals, PCBs, and/or NDMA. Previous investigations of those source areas conducted between 1979 and 1993 are described below:

- 1979 – Soil samples were collected from eight borings and analyzed for VOCs and metals.
- 1980 – Soil samples were collected from three borings to depths between 5 and 20 feet bgs and analyzed for VOCs.

- 1982 – Soil samples were collected from four borings to depths between 5 and 20 feet bgs and analyzed for VOCs.
- 1983 – Soil samples were collected from three borings to depths between 1 and 13.5 feet bgs and analyzed for VOCs.
- 1986 – Soil samples were collected from five borings to depths between 1.5 and 29 feet bgs and analyzed for VOCs and/or metals.
- 1992 – Soil samples were collected from two borings to depths between 1 and 3 feet bgs and analyzed for SVOCs and metals. Additionally, 45 soil vapor samples were collected between 1 and 20 feet bgs and analyzed for selected VOCs.
- 1993 – Soil samples were collected from 16 borings to depths between 1 and 13.5 feet bgs and analyzed for SVOCs, metals, and/or PCBs/pesticides. Additionally, 41 soil vapor samples were collected between 10 and 20 feet bgs and analyzed for VOCs.

At Source Area 50D, soils saturated with diesel fuel were noted between 10.5 feet bgs and the top of perched groundwater during the 1983 investigation and strong hydrocarbon odors were noted from 15 feet bgs to the refusal depth in each boring during the 1993 investigation.

4.2.2.2 *Results of Previous (Pre-2005) Vadose Zone Investigations – Buildings 20002/20004 Area*

The results of the previous (prior to 2005) investigations of Source Areas 3D, 4D, 50D, and 51D, as presented in the BOU FSP (Aerojet et al., 2006b), are summarized below.

Review of the previous data identified the following COPCs in soil and/or soil vapor within the source areas within the Buildings 20002/20004 Area:

- **Soil –** VOCs, SVOCs, NDMA, PCBs, TPH, pesticides, and metals.
- **Soil Vapor –** VOCs, including light hydrocarbons.

Figures showing previous sampling locations at the source areas within Administration Area East and chemical groups detected in soil vapor and soil samples collected between 1991 and 2005 above human health and ecological screening levels were presented in the BOU FSP (Aerojet et al., 2006b) and are included in Appendix E. The BOU FSP also presented a summary of statistics and the sample results for chemicals detected in soil,

soil vapor, and groundwater that exceed human health and ecological screening levels in the Administration Area.

4.2.2.3 *Summary of Data Needs – Buildings 20002/20004 Area*

Based on a review of the previous vadose zone investigation data, extensive aerial photograph research and review, and exhaustive research of historical documents, Aerojet determined that additional soil and soil vapor sampling was needed in the Buildings 20002/20004 Area to:

- Characterize the present lateral and vertical extent of VOCs, SVOCs, PCBs, perchlorate, TPH, pH, and metals (including hexavalent chromium) in the vadose zone at the majority of the source areas and site features that may have contributed chemicals at concentrations that could potentially pose a risk to human and ecological receptors;
- Evaluate the potential for chemicals in soil to degrade surface or groundwater quality; and
- Obtain sufficient data to support fate and transport modeling, evaluation of risk to human and ecological receptors, and evaluation of potential remedial alternatives.

It should be noted that due to the time lapse (12 years) since the Stage 1 RI was performed and the elevated laboratory reporting limits for VOCs during that investigation, the investigation of VOCs performed during the BOU RI was designed to supersede all previous soil vapor and soil VOC investigation results.

4.2.3 *Summary and Results of Boundary Operable Unit Vadose Zone Investigation – Buildings 20002/20004 Area*

The following subsections summarize the BOU investigation (2005 to 2007) of the four source areas and various features within the Buildings 20002/20004 Area, describe deviations from the sampling proposed in the BOU FSP, describe the site-specific geology and hydrogeology, and present the results of the BOU RI. The results of the sampling with respect to the completeness of the characterization and identification of potential sources are discussed in Section 4.2.4.

4.2.3.1 *Summary of Boundary Operable Unit Vadose Zone Investigation – Buildings 20002/20004 Area*

The BOU RI of the vadose zone at the source areas (3D, 4D, 50D, and 51D) that comprise the Buildings 20002/20004 Area included the following activities:

Soil Vapor Investigation

- A total of 166 primary and 11 duplicate soil vapor samples were collected at the four source areas within the Buildings 20002/20004 Area and analyzed for VOCs. The VOC analysis included an evaluation of the presence of tentatively identified compounds (TICs). Soil vapor sampling locations in Administration Area East are shown in Figure 4.2-2.
- The number of soil vapor samples (including quality assurance/quality control [QA/QC] samples) collected at each of the four source areas, along with the analytical method, are provided on Table 4.2-1.
- A cross-reference between soil vapor sampling locations within the Buildings 20002/20004 Area and the specific features they were sited to investigate are provided on Table 4.2-2.

Surface and Subsurface Soil Investigation

- A total of 39 primary and 10 duplicate surface and/or near-surface (0 to 2.5 feet bgs) soil samples and 196 primary and 17 duplicate subsurface (2.6 to 35 feet bgs) soil samples were collected at the four source areas and various features and septic tanks in the Buildings 20002/20004 Area. Surface and subsurface soil sampling locations are shown in Figures 4.2-3 and 4.2-4, respectively.
- Surface and/or near-surface soil samples were analyzed for SVOCs, metals (including hexavalent chromium), NDMA, PCBs, perchlorate, cyanide, TPH as diesel (TPH-D), TPH as motor oil (TPH-Mo), pH, total organic carbon (TOC), cation exchange capacity (CEC), and/or geotechnical parameters. The SVOC analysis of soil samples also included an evaluation of the presence of TICs. In accordance with the BOU FSP, sample analysis was based on the analytical results from previous investigations and therefore every sample was not analyzed for the full suite of constituents.
- Subsurface soil samples were analyzed for SVOCs, metals, total cyanide, NDMA, PCBs, perchlorate, TPH-D, TPH-Mo, pH, TOC, CEC,

and/or geotechnical parameters. The SVOC analysis of soil samples also included an evaluation of the presence of TICs. In accordance with the BOU FSP, sample analysis was based on the analytical results from previous investigations and therefore every sample was not analyzed for the full suite of constituents.

- The numbers of surface/near-surface and subsurface soil samples collected for each analysis (including QA/QC samples) at each of the four source areas along with the corresponding methods are provided on Table 4.2-3.
- A cross-reference between surface/near-surface and subsurface soil sampling locations within the Buildings 20002/20004 Area and the specific features they were sited to investigate are provided on Table 4.2-2.

4.2.3.2 *Deviations from Boundary Operable Unit Data Quality Objectives and Sampling Design – Buildings 20002/20004 Area*

Sampling activities at the source areas (3D, 4D, 50D, and 51D) in the Buildings 20002/20004 Area during the BOU RI were generally consistent with those proposed in the BOU FSP, with the exceptions listed on Tables 4.2-4 and 4.2-5. Sampling was performed at locations proposed in the BOU FSP and step-out sampling was performed in accordance with the procedures agreed upon with the Agencies. A comparison of proposed and actual sampling activities, including sampling rationale, sample depth, and analyses, is also provided on Tables 4.2-4 and 4.2-5. Soil and soil vapor sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.2-2.

4.2.3.3 *Site-Specific Geology and Hydrogeology – Buildings 20002/20004 Area*

The geology and hydrogeology of the Buildings 20002/20004 Area are described below. The descriptions are based on information presented on field logs of borings drilled during previous investigations and the BOU RI.

<u>*Geology*</u>

As shown in Figure 4.1-2, dredging in the Building 20002/20004 Area was generally performed north of Baltimore Street. However, extensive grading during construction of the buildings makes it difficult to accurately determine the true extent of dredging. However, dredging was not performed in the south and southeast portion of the Administration

Area due to the presence of hard, indurated material associated with an ancestral American River terrace along the southern and southeastern portion of the area.

In dredged areas, the lithology is comprised of sand with gravel and cobbles with some fines. A layer of sandy lean clay and clayey sand is commonly observed near the base of the dredge tailings. Occasionally, when dredgers were turning, were dredging parallel to a previous dredge furrow, or when material that could not be dredged was encountered, small sections of land may have been left undredged. Borehole logs (Appendix D) indicate that Source Area 51D may be situated in such an area because the lithologic material in that area appears to be undisturbed.

Hydrogeology

Perched groundwater was encountered primary along Baltimore Street, between Buildings 20002 and 20004 at depths ranging from 8 to 14 feet bgs. Perched groundwater was also encountered at depths ranging from 12 to 28 feet bgs along the western side of Building 20002. Perched groundwater is often present within dredged areas.

The FWBZ zone was generally encountered in the Buildings 20002/20004 Area at depths ranging from 32 to 42 feet bgs.

4.2.3.4 *Results of Boundary Operable Unit Vadose Zone Investigation – Buildings 20002/20004 Area*

The results of the VOC, metals, SVOC, PCB, perchlorate, TPH-D and TPH-Mo, total cyanide, NDMA, pH, TOC, CEC, Waste Extraction Test using deionized water (DI-WET), and geotechnical analyses of samples collected during the BOU RI are summarized below. The analytical results for all soil vapor and soil samples are provided in Appendices F and G, respectively.

Summary of Investigation and Results - Volatile Organic Compounds

Based on evaluation of the existing data for the source areas comprising the Buildings 20002/20004 Area, the BOU FSP concluded that additional soil vapor sampling was needed to sufficiently characterize the nature and extent of VOCs. As indicated on Table 4.2-1 and below, 166 primary soil vapor samples were collected at Source Areas 3D, 4D, 50D, and 51D in the Buildings 20002/20004 Area and analyzed for VOCs. Additionally, the presence of TICs was evaluated as part of the VOC analysis.

Source Area	Depth (ft bgs)	No. of Primary Samples	No. of Locations
3D & 4D	0-10	67	67
	11-20	60	60
	21-30	29	28
	>30	0	0
50D	0-10	4	4
	11-20	4	4
	21-30	0	0
	>30	0	0
51D	0-10	1	1
	11-20	1	1
	21-30	0	0
	>30	0	0

The analytical results for the soil vapor samples collected from the shallow (0 to 10 feet bgs), intermediate (11 to 20 feet bgs), and deep (21 to 30 feet bgs) intervals at Source Areas 3D, 4D, 50D, and 51D are presented in Appendix F and summarized below. Soil vapor sampling locations in Administration Area East are shown in Figure 4.2-2. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 4.2-2.

Trichloroethene (TCE), tetrachloroethene (PCE), vinyl chloride, and total VOC (TVOC) concentrations above their respective remedial investigation screening levels (RISLs) in the shallow, intermediate, and deep intervals in the Buildings 20002/20004 Area are shown in Figure 4.2-5a. Additionally, TVOC concentrations above RISLs are shown in Figure 4.2-5b. TCE, PCE, and vinyl chloride concentrations above their protection of groundwater (PGW) soil screening levels (SSLs) are shown in Figure 4.2-6.

The TVOC concentrations illustrated in Figures 4.2-5a and 4.2-5b represent the sum of the ratio of the concentration for each detected VOC in the sample divided by its RISL. For example, if PCE at a concentration of 320 micrograms per cubic meter ($\mu g/m^3$) and TCE at a concentration of 961 $\mu g/m^3$ were the only VOCs detected in the samples, then the sum of their respective concentrations divided by their respective RISLs of 320 and 961 $\mu g/m^3$ would be 2, or:

$$PCE = \frac{320\,\mu g/m^3}{320\,\mu g/m^3} = 1$$

$$TCE = \frac{961\,\mu g/m^3}{961\,\mu g/m^3} = 1$$

$$TVOC\ Ratio = 2$$

As agreed upon with the Agencies, soil vapor would be characterized during the BOU RI to the point where the TVOC concentration ratio was less than or equal to 10.

Cross sections presenting generalized vadose zone lithology and soil vapor sampling results in Administration Area East are presented in Figures 4.2-7 and 4.2-8. Additional discussion of soil vapor investigation results for the Building 20002/20004 Area is presented in Section 4.2.4.

Shallow Soil Vapor (0 to 10 feet bgs) – VOCs:

- Seventy-two primary and seven duplicate soil vapor samples were collected from the shallow layer at 72 locations in the source areas (3D, 4D, 50D, and 51D) within the Buildings 20002/20004 Area and analyzed for VOCs, including TICs. Shallow soil vapor sampling locations are shown in Figure 4.2-2. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 4.2-2.
- Chloroform, PCE, TCE, and vinyl chloride were the only VOCs detected in the shallow soil vapor at concentrations above their respective RISLs. Shallow soil vapor samples having concentrations of those VOCs above their respective RISLs are listed on the table below. PCE, TCE, vinyl chloride, and TVOC concentrations above their RISLs in the shallow interval are illustrated in Figure 4.2-5a. TVOC concentrations greater than the RISLs are shown in Figure 4.2-5b.
- Benzene, cis-1,2-dichloroethene (cis-1,2-DCE), PCE, TCE, and vinyl chloride were the only VOCs detected in shallow soil vapor at concentrations above their respective PGW SSLs. Shallow soil vapor samples having concentrations of those VOCs above their respective PGW SSLs are listed on the table below. PCE, TCE, and vinyl chloride concentrations above their respective PGW SSLs are illustrated in Figure 4.2-6.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
3D-SP96	10	Benzene	84	35	36	N	Y
3D-SP125	10				57	N	Y
3D-SP90	10	Chloroform	83	18,595	260	Y	N
3D-SP96	10				1,200	Y	N
3D-SP103	10				500	Y	N
3D-SP113	10				340	Y	N
3D-SP115	10				890	Y	N
3D-SP116	10				400	Y	N
3D-SP135	10				480	Y	N
3D-SP137	10				670	Y	N
3D-SP143	10				340	Y	N
3D-SP145	10				500	Y	N
3D-SP147	10				390	Y	N
3D-SP105	10	cis-1,2-DCE	3,650	1,641	2,000	N	Y
3D-SP88	10	PCE	320	57	580	Y	Y
3D-SP89	10				33,000	Y	Y
3D-SP90	10				270	N	Y
3D-SP92	10				140	N	Y
3D-SP95	10				150,000	Y	Y
3D-SP96	10				95	N	Y
3D-SP99	10				280,000	Y	Y
50D-SP01	10				140	N	Y
51D-SP04	10				110	N	Y
3D-SP100	10				430,000	Y	Y
3D-SP102	10				30,000,000	Y	Y
3D-SP103	10				830,000	Y	Y
3D-SP104	10				640,000	Y	Y
3D-SP105	10				580,000	Y	Y
3D-SP107	10				98,000	Y	Y
3D-SP108	10				9,500	Y	Y
3D-SP109	10				18,000	Y	Y
3D-SP110	10				11,000	Y	Y
3D-SP111	10				56,000	Y	Y
3D-SP112	10				240	N	Y
3D-SP113	10				270	N	Y
3D-SP115	10				650	Y	Y
3D-SP116	10				150	N	Y
3D-SP117	10				1,000	Y	Y
3D-SP118	10				14,000	Y	Y
3D-SP119	10				10,000	Y	Y
3D-SP120	10				180	N	Y
3D-SP122	10				10,000	Y	Y
3D-SP123	10				180	N	Y

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
3D-SP126	10				59	N	Y
3D-SP127	10				190	N	Y
3D-SP131	10				350	Y	Y
3D-SP132	10				170	N	Y
3D-SP135	10				8,600	Y	Y
3D-SP137	10				740	Y	Y
3D-SP138	10				60	N	Y
3D-SP142	10				790	Y	Y
3D-SP143	10				1,000	Y	Y
3D-SP144	10				1,100	Y	Y
3D-SP145	10				98	N	Y
3D-SP146	10				6,400	Y	Y
3D-SP147	10				1,300	Y	Y
A20-B34-SP01	10				63	N	Y
A20-B34-SP03	10				870	Y	Y
A20-RB37-SP01	10				69,000	Y	Y
A20-RB37-SP02	10				7,100	Y	Y
A20-RC29-SP01	10				270	N	Y
A20-ST01-2-SP01	10				380	Y	Y
A20-ST01-3-SP01	10				64	N	Y
A20-ST01-SP01	10				200	N	Y
A20-ST02-SP02	10				76	N	Y
A20-ST05-SP02	10				120	N	Y
A20-ST05-SP03	10				320	N	Y
A20-ST06-SP01	10				900	Y	Y
A20-ST14-SP01	10				840	Y	Y
A20-ST14-SP02	10				760	Y	Y
3D-SP90	10	TCE	961	527	560	N	Y
3D-SP95	10				5,700	Y	Y
3D-SP99	10				940	N	Y
3D-SP100	10				580	N	Y
3D-SP103	10				1,700	Y	Y
3D-SP104	10				14,000	Y	Y
3D-SP105	10				16,000	Y	Y
3D-SP107	10				86,000	Y	Y
3D-SP109	10				2,300	Y	Y
3D-SP110	10				930	N	Y
3D-SP119	10				6,400	Y	Y
3D-SP138	10				3,400	Y	Y
3D-SP146	10				4,100	Y	Y
3D-SP147	10				140,000	Y	Y
A20-RB37-SP01	10				6,300	Y	Y

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
3D-SP90	10	Vinyl Chloride	31	235	250	Y	Y
3D-SP92	10				190	Y	N
3D-SP95	10				1,500	Y	Y
3D-SP108	10				51	Y	N
3D-SP109	10				550	Y	Y
3D-SP122	10				240	Y	N
3D-SP135	10				76	Y	N

Intermediate Soil Vapor (11 to 20 feet bgs) – VOCs:

- Sixty-five primary and three duplicate soil vapor samples were collected from the intermediate layer at 65 locations in the source areas (3D, 4D, 50D, and 51D) within the Buildings 20002/20004 Area and analyzed for VOCs, including TICs. Intermediate soil vapor sampling locations in the Buildings 20002/20004 Area are shown in Figure 4.2-2. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 4.2-2.
- Benzene, chloroform, 1,1-dichloroethane (1,1-DCA), 1,1-dichloroethene (1,1-DCE), cis-1,2-DCE, trans-1,2-dichloroethene (trans-1,2-DCE), Freon 113, hexane, PCE, TCE, and vinyl chloride were detected in the intermediate soil vapor samples at concentrations above their respective RISLs. Intermediate soil vapor samples having concentrations of those VOCs exceeding their respective RISLs are listed on the table below. PCE, TCE, vinyl chloride, and TVOC concentrations above their RISLs in the intermediate interval are shown in Figure 4.2-5a. TVOC concentrations above RISLs in the intermediate interval are shown in Figure 4.2-5b.
- Benzene, 1,1-DCA, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, PCE, TCE, and vinyl chloride were detected in intermediate soil vapor samples at concentrations above their respective PGW SSLs. Intermediate soil vapor samples having concentrations of those VOCs exceeding their respective PGW SSLs are listed below. PCE, TCE, and vinyl chloride concentrations above their PGW SSLs are shown in Figure 4.2-6.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
3D-SP93	15	Benzene	84	35	210	Y	Y
3D-SP118	20				110	Y	Y
3D-SP119	20				46	N	Y
3D-SP120	20				200	Y	Y
3D-SP125	20				51	N	Y

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
3D-SP125	20	Benzene			45	N	Y
3D-SP134	20				400	Y	Y
3D-SP141	20				57	N	Y
3D-SP142	20				49	N	Y
3D-SP149	20				93	Y	Y
A20-ST01-2-SP01	20				41	N	Y
A20-ST01-3-SP01	20				77	N	Y
A20-ST02-SP01	20				160	Y	Y
3D-SP90	20	Chloroform	83	18,595	120	Y	N
3D-SP91	20				150	Y	N
3D-SP92	20				310	Y	N
3D-SP96	17				1,600	Y	N
3D-SP125	20				110	Y	N
3D-SP128	20				140	Y	N
3D-SP143	20				380	Y	N
A20-ST05-SP01	20				1,700	Y	N
3D-SP122	20	1,1-DCA	1,180	1,282	8,100	Y	Y
A20-ST05-SP01	20				2,900	Y	Y
3D-SP109	20	1,1-DCE	20,805	18,180	54,000	Y	Y
3D-SP122	20				19,000	N	Y
3D-SP119	20	cis-1,2-DCE	3,650	1,641	9,100	Y	Y
3D-SP121	15				2,300	N	Y
3D-SP122	20				2,800	N	Y
A20-ST05-SP01	20				27,000	Y	Y
3D-SP119	20	trans-1,2-DCE	7,300	7,882	16,000	Y	Y
3D-SP109	20	Freon 113	3,130,000	NE	17,000,000	Y	N
3D-SP113	20				4,600,000	Y	N
3D-SP121	15				3,800,000	Y	N
3D-SP122	20				3,400,000	Y	N
3D-SP135	20	Hexane	20,857	NE	24,000	Y	N
3D-SP84	15	PCE	320	57	77	N	Y
3D-SP88	20				590	Y	Y
3D-SP90	20				270	N	Y
3D-SP91	20				190	N	Y
3D-SP92	20				1,000	Y	Y
3D-SP93	15				290	N	Y
3D-SP94	15				7,100	Y	Y
3D-SP95	18				130,000	Y	Y
3D-SP96	17				68	N	Y
3D-SP100	20				41,000	Y	Y
3D-SP103	20				130,000	Y	Y
3D-SP104	20				1,600,000	Y	Y
3D-SP106	15				7,200	Y	Y
3D-SP107	20				13,000	Y	Y
3D-SP109	20				530,000	Y	Y
3D-SP110	20				2,900	Y	Y
3D-SP111	20				1,300	Y	Y
3D-SP112	20				190	N	Y
3D-SP113	20				2,500	Y	Y

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
3D-SP118	20	PCE			4,500	Y	Y
3D-SP119	20				10,000	Y	Y
3D-SP120	20				160	N	Y
3D-SP121	15				320,000	Y	Y
3D-SP122	20				8,200	Y	Y
3D-SP123	20				190	N	Y
3D-SP124	20				58	N	Y
3D-SP125	20				150	N	Y
3D-SP127	20				170	N	Y
3D-SP128	20				99	N	Y
3D-SP131	20				160	N	Y
3D-SP135	20				950	Y	Y
3D-SP138	19				140	N	Y
3D-SP139	20				80	N	Y
3D-SP142	20				510	Y	Y
3D-SP143	20				720	Y	Y
3D-SP144	20				1,600	Y	Y
3D-SP146	20				4,800	Y	Y
3D-SP147	20				120	N	Y
A20-B34-SP03	20				860	Y	Y
A20-RB37-SP01	20				73,000	Y	Y
A20-RC29-SP01	20				350	Y	Y
A20-ST01-2-SP01	20				95	N	Y
A20-ST01-3-SP01	20				71	N	Y
A20-ST02-SP02	20				75	N	Y
A20-ST05-SP01	20				470	Y	Y
A20-ST05-SP01	20				85	N	Y
A20-ST05-SP02	20				170	N	Y
A20-ST06-SP01	20				850	Y	Y
A20-ST14-SP01	20				150	N	Y
A20-ST14-SP02	20				1,100	Y	Y
3D-SP92	20	TCE	961	527	660	N	Y
3D-SP95	18				7,700	Y	Y
3D-SP104	20				57,000	Y	Y
3D-SP107	20				12,000	Y	Y
3D-SP109	20				110,000	Y	Y
3D-SP119	20				46,000	Y	Y
3D-SP121	15				10,000	Y	Y
3D-SP122	20				1,700	Y	Y
3D-SP125	20				15,000	Y	Y
3D-SP128	20				60,000	Y	Y
3D-SP138	19				16,000	Y	Y
3D-SP146	20				5,800	Y	Y
3D-SP147	20				10,000	Y	Y
A20-RB37-SP01	20				6,500	Y	Y
A20-ST05-SP01	20				700,000	Y	Y
3D-SP84	15	Vinyl Chloride	31	235	420	Y	Y
3D-SP90	20				87	Y	N
3D-SP91	20				94	Y	N

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
3D-SP92	20	Vinyl			300	Y	Y
3D-SP95	18	Chloride			2,200	Y	Y
3D-SP106	15				250	Y	Y
3D-SP109	20				26,000	Y	Y
3D-SP113	20				940	Y	Y
3D-SP119	20				89	Y	N
3D-SP121	15				2,500	Y	Y
3D-SP122	20				1,600	Y	Y
3D-SP126	20				60	Y	N
3D-SP134	20				40	Y	N
3D-SP135	20				22,000	Y	Y

Deep Soil Vapor (21 to 30 feet bgs) – VOCs:

- Twenty-nine primary and one duplicate deep soil vapor samples were collected at 28 locations in the source areas (3D, 4D, 50D, and 51D) within the Buildings 20002/20004 Area and analyzed for VOCs, including TICs. Deep soil vapor sampling locations in the Buildings 20002/20004 Area are shown in Figure 4.2-2. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 4.2-2.
- Benzene, chloroform, 1,1-DCA, 1,2-dichloroethane (1,2-DCA), 1,1-DCE, cis-1,2-DCE, Freon 12, Freon 113, hexane, PCE, TCE, and vinyl chloride were detected in deep soil vapor samples at concentrations above their respective RISLs. Deep soil vapor samples having concentrations of those VOCs exceeding their respective RISLs are listed on the table below. PCE, TCE, vinyl chloride, and TVOC concentrations above their RISLs are illustrated in Figure 4.2-5a. TVOC concentrations above RISLs are illustrated in Figure 4.2-5b.
- Benzene, 1,1-DCA, 1,2-DCA, 1,1-DCE, cis-1,2-DCE, methylene chloride, PCE, TCE, and vinyl chloride were detected in deep soil vapor samples at concentrations above their respective PGW SSLs. Deep soil vapor samples having concentrations of those VOCs exceeding their respective PGW SSL are listed below. PCE, TCE, and vinyl chloride concentrations above their PGW SSLs are illustrated in Figure 4.2-6.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
3D-SP85	25	Benzene	84	35	2,300	Y	N
3D-SP85	30				66	N	Y
3D-SP132	30				150	Y	N

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
3D-SP138	30	Benzene			61	N	Y
3D-SP139	28				160	Y	N
3D-SP143	30				120	Y	N
3D-SP144	30				41	N	Y
A20-ST02-SP01	30				200	Y	N
A20-ST02-SP02	30				57	N	Y
A20-ST02-SP04	30				41	N	Y
3D-SP128	30	Chloroform	83	18,595	750	Y	N
3D-SP147	27				440	Y	N
A20-ST05-SP01	30				1,600	Y	N
3D-SP85	25	1,1-DCA	1,180	1,282	2,600	Y	Y
3D-SP106	25				120,000	Y	Y
3D-SP106	30				1,500	Y	Y
3D-SP122	30				9,800	Y	Y
3D-SP128	30				1,400	Y	Y
3D-SP144	30				4,500	Y	Y
A20-ST05-SP01	30				4,500	Y	Y
3D-SP128	30	1,2-DCA	74	21	54	N	Y
A20-ST05-SP01	30				100	Y	Y
3D-SP106	25	1,1-DCE	20,805	18,180	120,000	Y	Y
3D-SP122	30				31,000	Y	Y
3D-SP85	25	cis-1,2-DCE	3,650	1,641	74,000	Y	Y
3D-SP106	30				11,000	Y	Y
3D-SP119	29				5,700	Y	Y
3D-SP122	30				2,200	N	Y
3D-SP128	30				18,000	Y	Y
3D-SP129	25				8,600	Y	Y
3D-SP142	30				1,700	N	Y
3D-SP147	27				3,700	Y	Y
A20-ST05-SP01	30				37,000	Y	Y
3D-SP106	25	Freon 113	3,130,000	NE	64,000,000	Y	NA
3D-SP119	29				13,000,000	Y	NA
3D-SP121	25				15,000,000	Y	NA
3D-SP122	30				3,400,000	Y	NA
3D-SP119	29	Freon 12	20,857	NE	30,000	Y	NA
3D-SP85	25	Hexane	20,857	NE	64,000	Y	NA
3D-SP119	29	Methylene Chloride	4,087	903	23,000	N	Y
3D-SP84	25	PCE	320	57	71	N	Y
3D-SP85	25				70,000	Y	Y
3D-SP85	30				140	N	Y
3D-SP94	25				3,300	Y	Y
3D-SP102	28				5,900,000	Y	Y
3D-SP106	25				540,000	Y	Y
3D-SP106	30				270,000	Y	Y
3D-SP107	29				340,000	Y	Y
3D-SP109	30				2,400	Y	Y
3D-SP119	29				310,000	Y	Y
3D-SP121	25				89,000	Y	Y
3D-SP128	30	PCE			170	N	Y

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
3D-SP129	25				710	Y	Y
3D-SP132	30				160	N	Y
3D-SP138	30				15,000	Y	Y
3D-SP139	28				860	Y	Y
3D-SP142	30				4,100	Y	Y
3D-SP143	30				1,100	Y	Y
3D-SP144	30				1,500	Y	Y
3D-SP146	27				2,300	Y	Y
3D-SP147	27				760	Y	Y
A20-B34-SP03	29				1,000	Y	Y
A20-RB37-SP01	30				4,000	Y	Y
A20-ST02-SP01	30				62	N	Y
A20-ST05-SP01	30				190	N	Y
3D-SP85	25	TCE	961	527	10,000	Y	Y
3D-SP102	28				12,000	Y	Y
3D-SP106	25				190,000	Y	Y
3D-SP106	30				140,000	Y	Y
3D-SP107	29				260,000	Y	Y
3D-SP119	29				170,000	Y	Y
3D-SP122	30				7,400	Y	Y
3D-SP128	30				210,000	Y	Y
3D-SP129	25				620,000	Y	Y
3D-SP138	30				9,700	Y	Y
3D-SP139	28				660	N	Y
3D-SP142	30				37,000	Y	Y
3D-SP143	30				1,300	Y	Y
3D-SP146	27				18,000	Y	Y
3D-SP147	27				230,000	Y	Y
A20-RB37-SP01	30				1,500	Y	Y
A20-ST05-SP01	30				34,000	Y	Y
3D-SP84	25	Vinyl Chloride	31	235	48	Y	N
3D-SP85	25				170,000	Y	Y
3D-SP106	25				120,000	Y	Y
3D-SP106	30				8,400	Y	Y
3D-SP109	30				40	Y	N
3D-SP144	30				14,000	Y	Y
A20-ST05-SP01	30				160	Y	N

Summary of Investigation and Results – Metals

A total of 227 primary and 26 duplicate soil samples were collected at Source Areas 3D, 4D, 50D, and 51D in the Buildings 20002/20004 Area and analyzed for metals (including mercury) and/or hexavalent chromium during the BOU RI. The number of primary soil samples and sampling locations at Source Areas 3D, 4D, 50D, and 51D are summarized on Table 4.2-3 and below. Summary statistics for the samples are also presented on Table 4.2-3.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
3D & 4D	Metals	35	30	158	62
	Mercury	35	30	147	61
	Hex Chrome	35	30	136	62
50D	Metals	2	2	7	3
	Mercury	2	2	6	3
	Hex Chrome	2	2	7	3
51D	Metals	0	0	25	6
	Mercury	0	0	24	6
	Hex Chrome	0	0	24	6

The results of the metals analysis of surface/near-surface and subsurface soil samples collected at the source areas (3D, 4D, 50D, and 51D) within the Buildings 20002/20004 Area are presented in Appendix G and summarized below.

Metals detected in soil within Administration Area East at concentrations statistically different from background and subsequently compared to screening levels were antimony, cadmium, lead, mercury, molybdenum, and zinc (Section 3.1.3.1). Because boron, hexavalent chromium, lithium, strontium, and titanium were not included in the background evaluation, concentrations of these metals were also compared to screening levels.

Surface and subsurface soil sampling locations are shown in Figures 4.2-3 and 4.2-4, respectively. Metals detected at concentrations above background and their RISLs and PGW SSLs in soil at Source Areas 3D and 4D are shown in Figures 4.2-9 and 4.2-10, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 4.2-2. Cross sections showing the generalized lithology of the vadose zone within Administration Area East are provided in Figures 4.2-7 and 4.2-8.

Surface and Near-Surface Soil – Metals:

- Thirty-seven primary and nine duplicate surface/near-surface soil samples were collected at 32 locations (Figures 4.2-3, 4.2-9, and 4.2-10) in the source areas (3D, 4D, 50D, and 51D) within the Buildings 20002/20004 Area and analyzed for all metals, including mercury and hexavalent chromium.
- Cadmium and lead were the only metals detected in the surface/near-surface soil samples collected in the source areas within the

Buildings 20002/20004 Area above their respective RISL and/or PGW SSL.

- Cadmium and lead detected in surface and/or near-surface soil above their RISLs and/or PGW SSLs are listed on the table below. Cadmium and/or lead detected above its RISL or PGW SSL in the surface soil samples are shown in Figures 4.2-9 and 4.2-10, respectively.

Sample Location	Depth (ft bgs)	Metal	RISL (mg/kg)	PGW SSL (mg/kg)	Conc. (mg/kg)	> RISL	> PGW SSL
3D-SNS34	0.25	Cadmium	1.7	1.2	3.5	Y	Y
		Lead	150	23	110	N	Y
3D-SNS35	0.25	Cadmium	1.7	1.2	1.4	N	Y
		Lead	150	23	10	N	N
A20-RB37-SB01	1.0	Cadmium	1.7	1.2	1.6	N	Y
		Lead	150	23	210	Y	Y

mg/kg = Milligrams per kilogram

Subsurface Soil – Metals:

- One hundred ninety primary and 17 duplicate subsurface soil samples were collected at 71 locations in the source areas (3D, 4D, 50D, and 51D) within the Buildings 20002/20004 Area and analyzed for metals. One-hundred seventy-eight of the 190 samples were analyzed for mercury and 167 were analyzed for hexavalent chromium (Figures 4.2-4, 4.2-9, and 4.2-10).
- Cadmium was the only metal detected in subsurface soil samples collected at the source areas within the Buildings 20002/20004 Area at concentrations above its RISL and/or PGW SSL.
- As indicated on the table below, cadmium above its RISL and PGW SSL was detected in one soil sample collected at 51D-SB06 at a depth of 9 feet bgs. Cadmium above its RISL and PGW SSL was not, however, detected in samples collected at 5, 13, and 17 feet bgs at the same location. Cadmium detected above its RISL and PGW SSL in the subsurface soil sample collected in the Buildings 20002/20004 Area is shown in Figures 4.2-9 and 4.2-10, respectively.

Sample Location	Depth (ft bgs)	Metal	RISL (mg/kg)	PGW SSL (mg/kg)	Conc. (mg/kg)	> RISL	> PGW SSL
51D-SB06	5	Cadmium	1.7	1.2	<0.44	N	N
	9	Cadmium	1.7	1.2	2.2	Y	Y
	13	Cadmium	1.7	1.2	<0.46	N	N
	17	Cadmium	1.7	1.2	<0.47	N	N

Summary of Investigation and Results - Semivolatile Organic Compounds

A total of 184 primary and 22 duplicate soil samples were collected at Source Areas 3D, 4D, 50D, and 51D in the Buildings 20002/20004 Area and analyzed for SVOCs, including TICs, during the BOU RI. The number of primary soil samples and sampling locations at Source Areas 3D, 4D, 50D, and 51D for SVOCs are summarized on Table 4.2-3 and below. Summary statistics for the samples are also presented on Table 4.2-3.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
3D & 4D	SVOCs	24	24	130	62
50D	SVOCs	2	2	4	3
51D	SVOCs	0	0	24	6

The results of the SVOC and SVOC TIC analyses of surface/near-surface and subsurface soil samples collected at the source areas (3D, 4D, 50D, and 51D) within the Buildings 20002/20004 Area are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations are shown in Figures 4.2-3 and 4.2-4, respectively. Benzo(a)anthracene [B(a)A], benzo(a)pyrene [B(a)P], and benzo(b&k)fluoranthene [B(b&k)F] detected in soil at concentrations above their RISLs and PGW SSLs at Source Areas 3D and 4D are shown in Figures 4.2-11 and 4.2-12, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 4.2-2.

SVOC TICs were not identified in the surface or subsurface soil samples collected in the Building 20002/20004 Area.

Surface and Near-Surface Soil – SVOCs:

- A total of 26 primary and 6 duplicate surface and/or near-surface soil samples were collected at 26 locations in the source areas (3D, 4D, 50D, and 51D) within the Buildings 20002/20004 Area and analyzed for SVOCs, including TICs (Figures 4.2-3, 4.2-11, and 4.2-12).

- SVOCs detected in surface and/or near-surface soil above their RISLs and/or PGW SSLs are listed on the table below. B(b&k)F detected in soil above its RISL is shown in Figure 4.2-11. B(a)A, B(a)P, and B(b&k)F detected in soil above their respective PGW SSLs is shown in Figure 4.2-12.

Sample Location	Depth (ft bgs)	SVOC	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	> RISL	> PGW SSL
3D-SNS34	0.25	Benzo(a)anthracene	620	29	42	N	Y
		Benzo(a)pyrene	38	2.9	38	N	Y
		Benzo(b&k)fluoranthene	38	29	88	Y	Y
3D-SB17	1.0	Benzo(a)anthracene	620	29	130	N	Y
3D-SB36	1.0	Benzo(a)anthracene	620	29	42	N	Y

µg/kg = Micrograms per kilogram

Subsurface Soil – SVOCs:

- A total of 158 primary and 16 duplicate subsurface soil samples were collected at 71 locations in the source areas (3D, 4D, 50D, and 51D) included in the Buildings 20002/20004 Area and analyzed for SVOCs, including TICs (Figures 4.2-4, 4.2-11, and 4.2-12).
- SVOCs detected in subsurface soil above their respective RISLs and/or PGW SSLs in the source areas (3D, 4D, 50D, and 51D) within the Buildings 20002/20004 Area are listed on the table below. B(a)A detected at concentrations above its PGW SSL is shown in Figure 4.2-12. Naphthalene above its RISL and PGW SSL is not shown on the figures.
- B(a)A above its PGW SSL was not detected in subsurface soil samples collected from boring 3D-SB17 and 3D-SB36 where that compound was detected in surface soil.

Sample Location	Depth (ft bgs)	SVOC	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	> RISL	> PGW SSL
3D-SB12	5.0	Benzo(a)anthracene	620	29	24	N	N
	11	Benzo(a)anthracene	620	29	45	N	Y
3D-SB36	11	Benzo(b&k)fluoranthene	38	29	11	N	N
3D-SB46	5.0	Naphthalene	1,700	140	1,900	Y	Y
	11	Naphthalene	1,700	140	90	N	N
	15	Naphthalene	1,700	140	<260	N	N
51D-SB09	5.0	Naphthalene	1,700	140	<7.2	N	N
	9.0	Naphthalene	1,700	140	<8.4	N	N
	13	Naphthalene	1,700	140	1,800	Y	Y
	17	Naphthalene	1,700	140	5,300	Y	Y
51D-SB10	5.0	Naphthalene	1,700	140	<220	N	N
	9.0	Naphthalene	1,700	140	<230	N	N

Sample Location	Depth (ft bgs)	SVOC	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	> RISL	> PGW SSL
3D-SB12	5.0	Benzo(a)anthracene	620	29	24	N	N
	11	Benzo(a)anthracene	620	29	45	N	Y
3D-SB36	11	Benzo(b&k)fluoranthene	38	29	11	N	N
	13	Naphthalene	1,700	140	270	N	Y
	17	Naphthalene	1,700	140	2,100	Y	Y

NE = Not established

Summary of Investigation and Results – Polychlorinated Biphenyls

A total of 203 primary and 23 duplicate soil samples were collected at Source Areas 3D, 4D, 50D, and 51D in the Buildings 20002/20004 Area during the BOU RI and analyzed for PCBs. The number of primary soil samples and sampling locations at Source Areas 3D, 4D, 50D, and 51D for PCBs are summarized on Table 4.2-3 and below. Summary statistics for the samples are also presented on Table 4.2-3.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
3D & 4D	PCBs	26	26	152	67
50D	PCBs	0	0	2	1
51D	PCBs	0	0	23	6

The results of the PCB analysis of surface/near-surface and subsurface soil samples collected at the source areas (3D, 4D, 50D, and 51D) within the Buildings 20002/20004 Area are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations are shown in Figures 4.2-3 and 4.2-4, respectively. PCB Aroclors 1254 and 1260 detected at concentrations above their respective RISLs and PGW SSLs are shown in Figures 4.2-13 and 4.2-14. Soil sampling locations and the features being investigated are cross-referenced on Table 4.2-2.

Surface and Near-Surface Soil – PCBs:

- Twenty-six primary and six duplicate surface and/or near-surface soil samples were collected at 26 locations in the source areas (3D, 4D, 50D, and 51D) included in the Buildings 20002/20004 Area and analyzed for PCBs (Figures 4.2-3, 4.2-13, and 4.2-14).
- Only two PCBs (Aroclor 1254 and Aroclor 1260) were detected at concentrations exceeding their respective RISLs or PGW SSLs in surface and/or near-surface soil samples. The PCB Aroclor detected above its screening level, the detected concentration, and the depth

and location of the sample are identified below. Locations where Aroclor 1254 and/or 1260 were detected in soil at concentrations above their RISLs and PGW SSLs are shown in Figures 4.2-13 and 4.2-14, respectively.

Sample Location	Depth (ft bgs)	PCB	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	> RISL	> PGW SSL
3D-SNS34	0.25	Aroclor 1254	220	34	420	Y	Y
		Aroclor 1260	220	34	1,500	Y	Y
3D-SB11	1.0	Aroclor 1254	220	34	37	N	Y
3D-SB50	1.0	Aroclor 1260	220	34	65	N	Y
3D-SB52	1.0	Aroclor 1254	220	34	48	N	Y
3D-SB64	1.0	Aroclor 1254	220	34	50	N	Y
3D-SB67	1.0	Aroclor 1254	220	34	510	Y	Y
3D-SB68	1.0	Aroclor 1254	220	34	1,700	Y	Y
3D-SB69	1.0	Aroclor 1254	220	34	370	Y	Y
A20-ST01-SB03	1.0	Aroclor 1254	220	34	130	N	Y

Subsurface Soil – PCBs:

- A total of 177 primary and 17 duplicate subsurface soil samples were collected at 74 locations in the source areas (3D, 4D, 50D, and 51D) within the Buildings 20002/20004 Area and analyzed for PCBs (Figures 4.2-4, 4.2-13, and 4.2-14).
- Two PCBs (Aroclors 1248 and 1254) were detected at concentrations exceeding their respective RISLs and/or PGW SSLs in subsurface soil samples collected at the source areas (3D, 4D, 50D, and 51D) within the Buildings 20002/20004 Area. The PCB Aroclor detected above its screening level, the detected concentrations, and the depths and locations of the samples are identified on the table below. Aroclors 1248 and 1254 detected at concentrations above their RISLs and PGW SSLs are shown in Figures 4.2-13 and 4.2-14, respectively.
- PCBs were not detected in subsurface soil samples collected from borings 3D-SB11, 3D-SB50, 3D-SB52, or A20-ST01-SB03 above their RISLs or PGW SSLs.

Sample Location	Depth (f bgs)	PCB	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	> RISL	> PGW SSL
3D-SB20	5.0	Aroclor 1254	220	34	<21	N	N
	11	Aroclor 1254	220	34	430	Y	Y

Sample Location	Depth (f bgs)	PCB	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	> RISL	> PGW SSL
3D-SB22	7.75	Aroclor 1248	220	34	260	Y	Y
	11	Aroclor 1248	220	34	<23	N	N
3D-SB33	5.0	Aroclor 1254	220	34	47,000	Y	Y
	11	Aroclor 1254	220	34	98	N	Y
	23	Aroclor 1254	220	34	<21	N	N
	35	Aroclor 1254	220	34	11 J	N	N
3D-SB37	5.0	Aroclor 1254	220	34	140	N	Y
	11	Aroclor 1254	220	34	<25	N	N
	23	Aroclor 1254	220	34	<25	N	N
	32	Aroclor 1254	220	34	<23	N	N
3D-SB43	5.0	Aroclor 1254	220	34	110	N	Y
	11	Aroclor 1254	220	34	37	N	Y
	23	Aroclor 1254	220	34	<25	N	N
	35	Aroclor 1254	220	34	<21	N	N
3D-SB46	5.0	Aroclor 1254	220	34	<22	N	N
	11	Aroclor 1254	220	34	11,000	Y	Y
	15	Aroclor 1254	220	34	20 J	N	N
3D-SB63	5.0	Aroclor 1254	220	34	<24	N	Y
	10	Aroclor 1254	220	34	46	N	Y
	15	Aroclor 1254	220	34	63	N	Y
3D-SB64	5.0	Aroclor 1254	220	34	47	N	Y
	10	Aroclor 1254	220	34	19 J	N	N
	15	Aroclor 1254	220	34	<23	N	N
3D-SB65	5.0	Aroclor 1254	220	34	<23	N	N
	12	Aroclor 1254	220	34	55	N	Y
	17	Aroclor 1254	220	34	20 J	N	N
3D-SB66	5	Aroclor 1254	220	34	<29	N	N
	10	Aroclor 1254	220	34	<26	N	N
	D	Aroclor 1254	220	34	51	N	Y
	15	Aroclor 1254	220	34	100	N	Y
3D-SB67	5.0	Aroclor 1254	220	34	<27	N	N
	10	Aroclor 1254	220	34	140	N	Y
	15	Aroclor 1254	220	34	8,700	Y	Y
3D-SB68	5.0	Aroclor 1254	220	34	86	N	Y
	10	Aroclor 1254	220	34	320	Y	N
	15	Aroclor 1254	220	34	78	N	Y
3D-SB69	5.0	Aroclor 1254	220	34	21 J	N	N
	10	Aroclor 1254	220	34	<24	N	N
	15	Aroclor 1254	220	34	16,000	Y	Y

D = Duplicate

Summary of Investigation and Results - Perchlorate

A total of 142 primary and 17 duplicate soil samples were collected at Source Areas 3D, 4D, 50D, and 51D in the Buildings 20002/20004 Area

during the BOU RI and analyzed for perchlorate. The number of primary soil samples and sampling locations at Source Areas 3D, 4D, 50D, and 51D for perchlorate are summarized on Table 4.2-3 and below. Summary statistics for the samples are also presented on Table 4.2-3.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
3D & 4D	Perchlorate	15	15	103	49
50D	Perchlorate	0	0	0	0
51D	Perchlorate	0	0	24	6

The results of the perchlorate analysis of surface/near-surface and subsurface soil samples collected at the source areas (3D, 4D, 50D, and 51D) within the Buildings 20002/20004 Area are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations and perchlorate detected at concentrations above its RISL and/or PGW SSL are shown in Figures 4.2-3, 4.2-4, 4.2-13, and 4.2-14. Soil sampling locations and the features being investigated are cross-referenced on Table 4.2-2.

Surface and Near-Surface Soil – Perchlorate:

- Fifteen primary and four duplicate surface and/or near-surface soil samples were collected at 15 locations in the source areas (3D, 4D, 50D, and 51D) within the Buildings 20002/20004 Area and analyzed for perchlorate (Figures 4.2-3, 4.2-13, and 4.2-14).
- Perchlorate was not detected above its practical quantitation limit (PQL), RISL, and/or PGW SSL in any of the surface or near-surface soil samples collected at Source Areas 3D and 4D within the Buildings 20002/20004 Area.

Subsurface – Perchlorate:

- One hundred twenty-seven primary and 13 duplicate subsurface soil samples were collected at 55 locations in the source areas (3D, 4D, 50D, and 51D) within the Buildings 20002/20004 Area and analyzed for perchlorate (Figures 4.2-4, 4.2-13, and 4.2-14).
- Perchlorate was not detected above its RISL or PGW SSL in the subsurface soil samples collected at Source Area 3D.

Summary of Investigation and Results – Total Petroleum Hydrocarbons

A total of 186 primary and 22 duplicate soil samples were collected at Source Areas 3D, 4D, 50D, and 51D in the Buildings 20002/20004 Area and analyzed for TPH-D and TPH-Mo during the BOU RI. The number of primary soil samples and sampling locations for TPH at Source Areas 3D, 4D, 50D, and 51D are summarized on Table 4.2-3 and below. Summary statistics for the samples are also presented on Table 4.2-3.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
3D & 4D	TPH-D & Mo	21	21	135	63
50D	TPH-D & Mo	2	2	4	3
51D	TPH-D & Mo	0	0	24	6

The results of TPH analysis (TPH-D and TPH-Mo) of surface/near-surface and subsurface soil samples collected at the source areas (3D, 4D, 50D, and 51D) within the Buildings 20002/20004 Area are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations are shown in Figures 4.2-3 and 4.2-4, respectively. TPH-D and TPH-Mo detected at concentrations above their respective PGW SSLs are shown in Figure 4.2-13. Soil sampling locations and the features being investigated are cross-referenced on Table 4.2-2.

Surface/Near-Surface Soil – TPH:

- Twenty-three primary and six duplicate surface/near-surface soil samples were collected at 23 locations in the source areas (3D, 4D, 50D, and 51D) within the Buildings 20002/20004 Area and analyzed for TPH-D and TPH-Mo (Figure 4.2-3).
- TPH-D and/or TPH-Mo were detected above their PGW SSL in ten surface or near-surface soil samples collected at only four of the 23 locations at Source Areas 3D and 51D. Hydrocarbons detected at concentrations above their screening levels and the locations and depths of the samples having the detected concentrations are summarized on the table below. TPH-D and TPH-Mo concentrations above their respective PGW SSLs are shown in Figure 4.2-14.

Sample Location	Depth (ft bgs)	Compound	PGW SSL (mg/kg)	Conc. (mg/kg)	> PGW SSL
3D-SB11	1.0	TPH-D	100	120	Y
		TPH-Mo	500	620	Y
3D-SB17	1.0	TPH-D	100	850 J	Y
		TPH-Mo	500	4,300 J	Y
3D-SB25	1.0	TPH-D	100	120	Y
		TPH-Mo	500	520	Y
3D-SB27	1.0	TPH-D	100	170	Y
		TPH-Mo	500	600	Y

Subsurface Soil – TPH:

- One hundred sixty-three primary and 16 duplicate subsurface soil samples were collected at 72 locations in the source areas (3D, 4D, 50D, and 51D) within the Buildings 20002/20004 Area and analyzed for TPH-D and TPH-Mo (Figure 4.2-4).
- TPH-D and/or TPH-Mo were detected above their PGW SSLs in 12 subsurface soil samples collected at 8 locations at Source Areas 3D and/or 51D within the Buildings 20002/20004 Area. TPH-D and/or TPH-Mo above their respective PGW SSLs were not detected in subsurface soil samples collected at Source Area 50D.
- TPH-D and TPH-Mo detected at concentrations above their respective PGW SSLs in subsurface soil and the locations of the detections at those source areas are identified below. TPH-D and TPH-Mo concentrations above their respective PGW SSLs are shown in Figure 4.2-14.
- Of the locations where hydrocarbons were detected above their PGW SSLs in surface/near-surface soil samples, hydrocarbons were not detected in subsurface soil samples above their PGW SSLs collected from borings 3D-SB11, 3D-SB17, 3D-SB25, and 3D-SB27.

Sample Location	Depth (ft bgs)	Compound	PGW SSL (mg/kg)	Conc. (mg/kg)	> PGW SSL
3D-SB12	5	TPH-D	100	180	Y
		TPH-Mo	500	1,100	Y
	11	TPH-D	100	350	Y
		TPH-Mo	500	2,100	Y
	23	TPH-D	100	2.7	N
		TPH-Mo	500	7.5	N
	35	TPH-D	100	970	Y
		TPH-Mo	500	750	Y

Sample Location	Depth (ft bgs)	Compound	PGW SSL (mg/kg)	Conc. (mg/kg)	> PGW SSL
3D-SB20	5.0	TPH-D	100	1.1 J	N
		TPH-Mo	500	3.3 J	N
	11	TPH-D	100	6,000	Y
		TPH-Mo	500	1,000	Y
3D-SB36	5.0	TPH-D	100	8.7 J	N
		TPH-Mo	500	30 J	N
	11	TPH-D	100	120	Y
		TPH-Mo	500	460	N
3D-SB46	5.0	TPH-D	100	20	N
		TPH-Mo	500	78	N
	11	TPH-D	100	9,100	Y
		TPH-Mo	500	12,000	Y
	15	TPH-D	100	2.2 J	N
		TPH-Mo	500	3.7 J	N
3D-SB52	5.0	TPH-D	100	110	Y
		TPH-Mo	50	660	Y
51D-SB05	5.0	TPH-D	100	<2.1	N
		TPH-Mo	500	<4.2	N
	9.0	TPH-D	100	0.95	N
		TPH-Mo	500	2.4	N
	13	TPH-D	100	99	N
		TPH-Mo	500	150	N
	17	TPH-D	100	440	Y
		TPH-Mo	500	330	N
51D-SB09	5.0	TPH-D	100	5.0	N
		TPH-Mo	500	6.1	N
	9.0	TPH-D	100	2.6	N
		TPH-Mo	500	5.3	N
	13	TPH-D	100	5,300	Y
		TPH-Mo	500	3,600	Y
	17	TPH-D	100	8,100	Y
		TPH-Mo	500	5,500	Y
51D-SB10	5.0	TPH-D	100	77	N
		TPH-Mo	500	150	N
	9.0	TPH-D	100	1.6 J	N
		TPH-Mo	500	4.0 J	N
	13	TPH-D	100	1,200	Y
		TPH-Mo	500	790	Y
	17	TPH-D	100	6,500	Y
		TPH-Mo	500	3,600	Y

Summary of Investigation and Results – Miscellaneous Compounds

Miscellaneous analyses performed on soil samples collected at the source areas (3D, 4D, 50D, and 51D) within the Buildings 20002/20004 Area were

total cyanide, NDMA, pH, TOC, CEC, and/or DI-WET. The number of primary surface/near-surface and subsurface soil samples collected at each source area for each analysis, and the number of locations is summarized on the table below.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
3D & 4D	Total Cyanide	16	16	96	46
	NDMA	14	14	92	45
	pH	20	20	145	56
	TOC	0	0	36	9
	CEC	0	0	36	9
	DI-WET	0	0	1	1
50D	Total Cyanide	0	0	0	0
	NDMA	0	0	0	0
	pH	2	2	4	2
	TOC	0	0	0	0
	CEC	0	0	0	0
51D	Total Cyanide	0	0	0	0
	NDMA	0	0	24	6
	pH	0	0	24	6
	TOC	0	0	0	0
	CEC	0	0	0	0

The analytical results for the miscellaneous analyses of surface/near-surface and subsurface soil samples are presented in Appendix G and summarized below. The analytical data for pH, TOC, and CEC are used in the risk assessments to evaluate the bioavailability of some chemicals with respect to human and ecological receptors. The TOC, CEC, and DI-WET data are used in the FS to evaluate chemical and physical remedial actions, assess the potential for metals in soil to migrate into groundwater, and develop cleanup goals protective of groundwater.

Total Cyanide: Surface and subsurface soil sampling locations in the Buildings 20002/20004 Area are shown in Figures 4.2-3 and 4.2-4, respectively.

Total cyanide was not detected above its PQL, RISL, or PGW SSL in any of the surface/near-surface and subsurface soil samples collected at the source areas (3D, 4D, 50D, and 51D) and other features within the Buildings 20002/20004 Area.

N-Nitrosodimethylamine: Surface and subsurface soil sampling locations for NDMA in the source areas (3D, 4D, 50D, and 51D) within the

Buildings 20002/20004 Area are shown in Figures 4.2-13 and 4.2-14, respectively.

- NDMA was not detected at concentrations above its RISL of 9.5 µg/kg in surface, near-surface, or subsurface soil samples collected at Source Areas 3D and 51D in the Buildings 20002/20004 Area.
- NDMA was detected in one soil sample at a concentration above its PGW SSL of 0.03 µg/kg. NDMA at 3.2 µg/kg was detected in a soil sample collected from boring 3D-SB35 at 5 feet bgs. However, NDMA not detected above its PQL in samples collected from that boring at 11, 23, and 35 feet bgs.

pH: The results of pH analysis of surface/near-surface and subsurface soil samples, including duplicates, collected at the source areas (3D, 4D, 50D, and 51D) within the Buildings 20002/20004 Area are presented below. The pH of the soil was generally within the normal range (5 to 9) for mineral soils (Brady, 1974).

Source Area	Surface/ Near-Surface Soil	Subsurface Soil
3D & 4D	6.48 – 8.98	5.53 – 9.53
50D	8.03 – 8.29	7.48 – 7.59
51D	NA	4.6 – 8.27

Total Organic Carbon: TOC was not detected in the 40 subsurface soil samples, including duplicates, collected at the source areas (3D, 4D, 50D, and 51D) within the Buildings 20002/20004 Area.

Cation Exchange Capacity: CEC in the 40 subsurface soil samples, including duplicates, collected at the source areas in the Buildings 20002/20004 Area ranged from 84 to 460 milliequivalents per kilogram (meq/K).

Deionized Water - Waste Extraction Test: A DI-WET was performed on one sample (3D-SB13) collected at Source Area 3D at a depth of 22.5 feet bgs. The sample extract was analyzed for thallium. The thallium concentration detected in the soil sample and the sample extract are presented on the table below. The detected concentration of thallium is slightly above its PGW SSL of 2.41 mg/kg.

Sample ID	Sample Depth (ft bgs)	Compound	Soil Conc. (mg/kg)	Extract Conc. (mg/L)
3D-SB13	22.5	Thallium	2.6	<0.01

mg/L = Milligrams per liter

Summary of Investigation and Results – Geotechnical Parameters

A total of 63 soil samples were collected from within Administration Area East, including the source areas in the Building 20002/20004 Area, for geotechnical analyses. The results of the geotechnical analyses for moisture content, wet density, dry density, specific gravity, porosity, sieve analysis, and/or permeability are summarized on Table 4.2-6.

The geotechnical data will be used in the risk assessment to develop site-specific soil input parameters (moisture content, water-filled porosity, air-filled porosity, etc.) for fate and transport models and in the feasibility study to assess potential remedial actions such as vapor extraction. Fate and transport models are used in risk assessment to quantitatively evaluate the migration of volatile organics into outdoor and indoor air and the potential leaching of chemicals through soil and into groundwater.

4.2.4 *Discussion of Investigation Results with Respect to Data Quality Objectives – Buildings 20002/20004 Area*

The analytical results presented in the previous sections identified the following chemical constituents in soil vapor and soil at the source areas within the Buildings 20002/20004 Area at concentrations above their respective RISLs and/or PGW SSLs:

Soil vapor: Benzene, chloroform, 1,1-DCA, 1,2-DCA, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, Freon 12, Freon 113, hexane, PCE, TCE, and vinyl chloride.

Soil: Cadmium, lead, B(a)A, B(a)P, B(b&k)F, NAP, PCB Aroclor 1248, PCB Aroclor 1254, PCB Aroclor 1260, TPH-D, and TPH-Mo.

The presence of these COPCs in each source area is discussed below with respect to the data needs described in Section 4.2.2.3. Specifically,

- Has the investigation resulted in the sufficient characterization of the lateral and vertical distribution of each COPC in the vadose zone and identified a potential source for those COPCs?

- Has the investigation resulted in sufficient data to evaluate the potential for COPCs in soil to migrate into and degrade surface water and groundwater quality?
- Has the investigation resulted in data sufficient to support human health and ecological risk assessments and fate and transport modeling?
- Has the investigation resulted in sufficient data to evaluate the feasibility of remediating the identified compounds and concentrations to levels that do not pose a risk to human and ecological receptors or degrade surface water and groundwater quality?

For the purpose of this discussion, it is assumed that chemicals detected at concentrations above their RISL could potentially pose a risk to human health and chemicals detected above their PGW SSL could potentially migrate into groundwater or surface water. Sampling locations where VOCs, metals, and other non-VOCs (SVOCs, PCBs, perchlorate, NDMA, TPH-D, and TPH-Mo) were detected in surface and/or subsurface soil at concentrations above their respective PGW SSLs are shown in Figures 4.2-6, 4.2-10, 4.2-12, and 4.2-14. The analytical results for surface water and groundwater within the Administration Area are discussed in Section 4.4 and 4.5 respectively and discussed with respect to potential soil and soil vapor sources in the Buildings 20002/20004 Area. Additionally, the potential for chemicals in soil and soil vapor to migrate into surface water and groundwater is further evaluated in Section 8 of the *Human Health Ecological Risk Assessment* (HHERA) (Volume II).

4.2.4.1 *Volatile Organic Compounds*

VOCs detected in soil vapor samples collected at the source areas comprising the Buildings 20002/20004 Area are summarized in Section 4.2.3.4. TCE, PCE, vinyl chloride, and TVOC concentrations above their RISLs in the shallow, intermediate, and deep intervals are illustrated in Figure 4.2-5a. Additionally, TVOC concentrations above the RISL are also shown in Figure 4.2-5b. TCE, PCE, and vinyl chloride concentrations above their PGW SSLs in the shallow, intermediate, and deep intervals are illustrated in Figure 4.2-6. Soil vapor sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2.

Benzene, chloroform, 1,1-DCA, 1,2-DCA, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, Freon 12, Freon 113, hexane, PCE, TCE, and vinyl chloride were detected in at least one soil vapor sample collected in the Buildings 20002/20004 area at concentrations above their RISL and/or

PGW SSL. The presence of PCE, TCE, benzene, chloroform, Freon 12, Freon 13, and vinyl chloride in soil vapor with respect to potential sources, and the completeness of the characterization of VOCs, in the Buildings 20002/20004 Area are discussed below. VOCs are discussed in the order of their prevalence and concentrations in soil vapor. VOCs associated with the degradation of PCE and TCE (1,1-DCE, cis-1,2-DCE, and trans-1,2-DCE) and compounds detected at only one or two locations (1,1-DCA, 1,2-DCA, hexane) are not included in the discussion. The potential risk to groundwater posed by VOCs in soil vapor is further evaluated in Section 8 of the HHERA (Volume II).

Tetrachloroethene and Trichloroethene

As illustrated in Figures 4.2-5a and 4.2-6, soil vapor plumes of PCE and TCE above their RISL and/or PGW SSL are commingled in the shallow, intermediate, and deep soil vapor intervals beneath an area encompassing approximately 40 acres centered between Buildings 20002/20004.

- As illustrated in Figure 4.2-5a, the extent of TCE and PCE in soil vapor above their RISLs in the shallow and intermediate layers remains relatively the same, but becomes more laterally extensive and diffuse in the deep layer. As further discussed in Section 4.5.6, the observed increase in the areal extent of TCE and PCE in the deep layer is attributed to the presence of those VOCs in the groundwater.
- The highest concentrations of PCE and TCE in the Buildings 20002/20004 Area were detected in many of the same areas, but not at the same specific locations. Although the historical point of release of those two VOCs may have been separate, the figures indicate that the PCE and TCE plumes, along with plumes of other VOCs, have commingled. Potential sources of PCE and TCE above their RISL and/or PGW SSL to the vadose zone, based on the data presented on the table and figures, are listed below.
  - ***Decontamination and hydrosump areas, southern end of Building 20002:*** Concentrations of PCE and TCE were detected above their RISLs and/or PGW SSLs in shallow, intermediate, and deep soil vapor samples (3D-SP95, 3D-SP99, 3D-SP100, 3D-SP102, 3D-SP103, 3D-SP104, 3D-SP105) collected in proximity to the decontamination area and hydrosump area in the south and southwest portions of Building 20002 (Figures 4.2-5a and 4.2-6). PCE at concentrations above its 1 percent vapor saturation concentration (1,656,000 $\mu g/m^3$) and potentially indicative of the presence of residual product was detected in the shallow,

intermediate, and/or deep intervals at two locations (3D-SP102 and 3D-SP104). Investigation of the potential presence of residual product using a Ribbon Nonaqueous-Phase Liquid Sampler was performed in this area during the BOU RI. Definitive results indicating the presence of residual product were not obtained using the device and a shallow groundwater monitoring well (3729) was installed at that location. As discussed in Section 4.5.3.3, PCE at a concentration of 75 micrograms per liter (µg/L), well below the concentration (2,000 µg/L) potentially indicative of residual product, was detected in the groundwater sample collected from Well 3729. Potential sources of TCE and PCE to soil in the decontamination area and hydrosump area include below grade hazardous waste drainage trenches, a below ground hazardous waste collection sump/lift station, and degreasers.

- ***Utility corridor between Buildings 20002/20004 and Buildings 20001 and 20002:*** PCE and TCE above their RISLs and/or PGW SSL are present in shallow soil vapor along Baltimore Avenue between Buildings 20002 and 20004 and along Boston Avenue between Buildings 20001 and 20002. The presence of PCE and TCE in soil vapor along these streets is attributed to the migration of solvents along utility corridors consisting of drain pipes and sewer, water, and power lines.
- ***Waste storage tanks and degreasers, south-central portion of Building 20004:*** Concentrations of TCE greater than 100,000 µg/m^3 were detected in a shallow soil vapor sample (3D-SP147) located in proximity to waste storage tanks and multiple degreasers in the south-central portion of Building 20004. The detections indicate that these features are likely sources of TCE to the vadose zone.
- ***Septic tank A20-ST05, southeast corner of Building 20004:*** Concentrations of PCE greater than its PGW SSL and TCE greater than 100,000 µg/m^3 were detected in an intermediate soil vapor sample (A20-ST05-SP01) adjacent to septic tank A20-ST05 near the southeast corner of Building 20004. As described in Section 4.2.1.1, the initial septic tank serviced restrooms in Building 20005. Potential sources of TCE to the vadose zone in this area may be associated to the septic system or the drainage ditch (Source Area 4D) south of Building 20004.
- ***Beneath Building 20004:*** PCE and TCE were detected above their RISLs and/or PGW SSLs in soil vapor samples collected from the intermediate and deep intervals beneath Building 20004 at seven locations (3D-SP119, 3D-SP125, 3D-SP128, 3D-SP138, 3D-SP146, and

3D-SP147). The presence of PCE and TCE above their screening levels in those samples is attributed to the presence of TCE in groundwater potentially originating from the septic tank at Building 20005 or Source Area 4D ditch.

- ***Waste collection tank and trench drains, northwest corner of Building 20004:*** TCE and/or PCE were detected in the shallow, intermediate, and deep intervals at location 3D-SP121 near a former waste collection tank connected to trench drains at the northwest corner of Building 20004 (Figures 4.2-5a and 4.2-6). The waste collection tank and trench drains are a likely source of PCE and TCE at this location.
- ***Southwest corner of Baltimore Street and Boston Avenue, south of Building 20001:*** PCE and TCE above their RISLs and/or PGW SSLs were detected in soil vapor samples (3D-SP107, 3D-SP142, and 3D-SP143) collected from the shallow, intermediate, and deep layers in the southwest corner of Baltimore Street and Boston Avenue (Figures 4.2-5a and 4.2-6). The data suggest that the presence of PCE and TCE in this area may be due to the migration of VOCs along the utility corridors between the buildings or from releases associated with the waste collection tank/trench drains at the northwest corner of Building 20004.
- ***Boston Avenue near northwest corner of Building 20002:*** Concentrations of PCE above its RISL and PGW SSL was detected in a shallow soil vapor sample (3D-SP89) collected at Boston Avenue near the northwest corner of Building 20002. PCE was not, however, detected in the intermediate and deep intervals at that location. The presence of PCE in the shallow soil vapor is attributed to releases associated with a former oil/water sump (Figure 4.2-2).
- ***Underground chemical laboratory sump near northwest corner of Building 20002:*** TCE and PCE above their RISLs and/or PGW SSLs were detected in a soil vapor sample collected from the deep layer adjacent to the underground chemical laboratory sump in Akron Street near the northwest corner of Building 20002. The presence of TCE and PCE in the deep layer, and not in the intermediate and shallow layer, suggests that these compounds may be due to leakage through cracks or joints in the bottom of the sump or the migration of VOCs from groundwater.

Vinyl Chloride

As indicated on the table in Section 4.2.3.4, vinyl chloride was detected in the shallow interval at seven locations, in the intermediate interval at 14 locations, and the deep interval at 7 locations. Review of the soil vapor sampling locations indicates that vinyl chloride in soil vapor in the Buildings 20002/20004 Area is associated with the presence of other compounds, such as hydrocarbons or septic tank discharges, in the vadose zone. As discussed in Section 3.2, the presence of hydrocarbons and septic discharges can produce an environment beneficial to microorganisms that would degrade TCE and PCE to vinyl chloride through reductive dechlorination.

As shown in Figures 4.2-5a and 4.2-6, the lateral and vertical extent of vinyl chloride in the shallow, intermediate, and deep intervals within the Building 20002/20004 Area has been characterized to concentrations below its RISL and PGW SSLs.

Benzene and Chloroform

Benzene was detected above its RISL and/or PGW SSLs in soil vapor samples collected from the shallow layer at two locations, the intermediate interval at 13 locations, and the deep interval at 10 locations. Chloroform was detected above its RISL in soil vapor samples collected from the shallow interval at 11 locations, the intermediate interval at 8 locations, and the deep interval at 3 locations. Review of the soil vapor sampling locations found that benzene and chloroform were detected at scattered locations and varying depths within Administration Area East. The data did not indicate a specific or significant source of benzene and chloroform to the vadose zone, nor did the data suggest that the presence of those compounds was primarily due to migration from groundwater.

Freon 113 and Freon 12

Freon 113 was detected above its RISL in soil vapor samples collected only from the intermediate interval at four locations and the deep interval at four locations. Freon 12 was detected above its RISL in one soil vapor sample (3D-SP119) collected from the deep interval. Those locations also contained the highest detected concentrations of Freon 113 and Freon 12 in soil vapor and may be indicative of a potential source.

Freon 113 and/or Freon 12 were detected in the intermediate and deep intervals near a former waste collection tank with trench drains at the

northwest corner of Building 20004, and at locations along Boston Avenue and Baltimore Street. Additionally, Freon 113 and Freon 12 were also detected at one location (3D-SP119) in the northwest corner of Building 20004. The data suggest that the Freon 113 and Freon 12 concentrations at this location are due to activities in the various laboratories situated in the northwest corner of Building 20004 and the discharge of wastes from those laboratories to the waste collection tank via a trench drain.

As indicated by the TVOC symbols shown in Figures 4.2-5a and 4.2-5b, the lateral extent of VOCs, including TCE, PCE, vinyl chloride, benzene, chloroform, Freon 113, and Freon 12, in the vadose zone beneath and around Buildings 20002 and 20004 has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

4.2.4.2 Metals

Cadmium, lead, and mercury were the only metals detected in soil at the source areas within the Buildings 20002/20004 Area at concentrations different than background and above their respective RISLs and/or PGW SSLs. Concentrations of those metals above their RISLs and/or PGW SSLs are summarized in Section 4.2.3.4 and shown in Figures 4.2-9 and 4.2-10, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 4.2-2. Conclusions regarding the characterization of cadmium, lead, and mercury based on the data presented on the table and figures are summarized below.

Cadmium

Cadmium above its RISL and/or PGW SSL was detected in soil samples collected at four locations at the source areas within the Buildings 20002/20004 Area. The characterization of cadmium at each of those locations is discussed below.

3D-SNS34 and 3D-SNS35:

Cadmium above its RISL and/or PGW SSL was detected in two (3D-SNS34 and 3D-SNS35) samples of soil that had accumulated at the bottom of drop inlet basins along an underground drainage culvert between Buildings 20004/20005 and 20024 (Figures 4.2-9 and 4.2-10).

- The absence of cadmium above the RISL in the sample (3D-SNS35) downstream of 3D-SNS34 indicates that the lateral extent of cadmium

above the RISL is limited to the northern 50 feet of the drainage culvert. The vertical extent of cadmium at those locations would be limited by the presence of the culvert.

- Although concentrations of cadmium in both samples (3D-SNS34 and 3D-SNS35) were above its PGW SSL, the lateral and vertical extent of cadmium above the PGW SSL would be constrained by the presence of the drainage culvert.

A20-RB37-SB01:

Cadmium below its RISL, but above its PGW SSL, was detected in a near-surface (1 foot bgs) soil sample collected at one location (A20-RB37-SB01) in the ditch north of Building 20037 (Figure 4.2-10).

- Although cadmium was detected in the primary sample collected at 1 foot bgs at A20-RB37-SB01, cadmium was not detected in the duplicate sample at a concentration above the PQL of 0.91 mg/kg. The difference in concentrations between the primary and duplicate sample indicates that the presence of cadmium is not homogenously distributed in the soil.
- The vertical extent of cadmium is defined by the absence of cadmium above the PQL in soil samples collected at 5 and 11 feet bgs from boring A20-RB37-SB01.
- The lateral extent of cadmium at A20-RB37-SB01 is defined by the absence of cadmium above the PQL in soil samples collected at 1, 5, and 11 feet bgs from boring A20-RB37-SB02. Boring A20-RB37-SB02 is in the ditch north of Building 20037 and downstream of boring A20-RB37-SB01.

51D-SB06:

Cadmium above its RISL and PGW SSL was detected in a soil sample collected at 9 feet bgs from boring 51D-SB06 near the former chemical lab sump (Figures 4.2-9 and 4.2-10).

- Cadmium was not detected at concentrations above the PQL in soil samples collected at 5, 13, and 17 feet bgs from boring 51D-SB06.
- The detected concentration of cadmium in the sample collected at 9 feet bgs may represent a naturally occurring outlier, but could also be associated with historical activities associated with the former chemical laboratory sump. However, cadmium was detected in only

one subsurface soil sample collected from nearby borings 3D-SB09 at a concentration (0.9 mg/kg) below the RISL and PGW SSL.

- The lateral extent of cadmium is defined by the absence of that metal above its PQL in surface and subsurface soil samples collected from borings A20-ST01-SB01, 3D-SB10, 51D-SB08, and 51D-SB10.

Lead

Lead above its RISL and/or PGW SSL was detected in soil samples collected at only two locations at the source areas within the Buildings 20002/20004 Area. The characterization of lead at each of those locations is discussed below.

3D-SNS34:

Lead above its PGW SSL, but below its RISL, was detected in a surface soil sample (3D-SNS34) collected from a drop inlet basin along a subsurface drainage culvert between Buildings 20004/20005 and 20024 (Figures 4.2-9 and 4.2-10).

- The absence of lead above its PGW SSL and RISL in the sample (3D-SNS35) collected from the drop inlet basin downstream of 3D-SNS34 indicates that the lateral extent of lead is limited to the northern 50 feet of the culvert.
- The vertical extent of lead at location 3D-SNS34 would be limited by the presence of the drainage culvert.

A20-RB37-SB01:

Lead above its RISL and PGW SSL was detected in a near-surface (1 foot bgs) soil sample collected at one location (A20-RB37-SB01) in the ditch north of Building 20037 (Figure 4.2-10).

- Although lead at 210 mg/kg was detected in the primary sample collected at 1 foot bgs at A20-RB37-SB01, lead was detected at only 12 mg/kg in the duplicate sample. The difference in concentrations between the primary and duplicate sample indicates that the presence of lead is not homogenously distributed in the soil.
- The vertical extent of lead is defined by the absence of lead at concentrations above its RISL and PGW SSL in the samples collected at 5 and 11 feet bgs from boring A20-RB37-SB01.

- The lateral extent of lead at A20-RB37-SB01 is defined by the absence of lead at concentrations above its RISL and PGW SSL in soil samples collected at 1, 5, and 11 feet bgs from boring A20-RB37-SB02. Boring A20-RB37-SB02 is in the ditch north of Building 20037 and downstream of boring A20-RB37-SB01.

Based on the information presented above, Aerojet believes that the lateral and vertical extent of cadmium and lead at Source Areas 3D and 51D has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives. Additional evaluation of the potential risk to groundwater posed by those metals in soil is presented in Section 8 of the HHERA (Volume II).

4.2.4.3 *Semivolatile Organic Compounds*

B(a)A, B(a)P, B(b&k)F, and naphthalene (NAP) were the only SVOCs detected in soil at the source areas within the Buildings 20002/20004 Area at concentrations above their respective RISLs and/or PGW SSLs. Details regarding the depth and location of soil samples containing concentrations of those SVOCs above their RISLs and/or PGW SSLs are provided in Section 4.2.3.4. Soil sampling locations and the features being investigated are cross-referenced on Table 4.2-2. The presence of each of those compounds in soil with respect to the completeness of characterization, both laterally and vertically, are discussed below.

Benzo(a)anthracene

B(a)A was not detected in soil at the source areas within the Buildings 20002/20004 Area at concentrations above its RISL. B(a)A was, however, detected at concentrations above its PGW SSL in surface/near-surface soil samples at three locations (3D-SNS34, 3D-SB17, and 3D-SB36) and in subsurface soils at one location (3D-SB12). Conclusions regarding the characterization of B(a)A at each location based on the data are summarized below.

3D-SNS34:

B(a)A was detected at a concentration above its PGW SSL in a soil sample collected at location 3D-SNS34. Sampling location 3D-SNS34 is a drop inlet basin along a drainage culvert between Buildings 20004/20005 and 20024 (Figures 4.2-3 and 4.2-12).

- The absence of B(a)A above the PQL in the sample (3D-SNS35) collected from the drop inlet basin downstream of 3D-SNS34 indicates that the lateral extent of this compound is limited to the northern 50 feet of the culvert.
- The vertical extent of B(a)A at location 3D-SNS34 would be limited by the presence of the drainage culvert.

3D-SB17:

B(a)A was detected at a concentration above its PGW SSL in a near-surface (1 foot bgs) soil sample collected from boring 3D-SB17. Boring 3D-SB17 is along the west side of Building 20002 (Figures 4.2-3 and 4.2-12).

- The vertical extent of B(a)A at this location is defined by the absence of that compound above the PQL in the sample collected at 5 feet bgs from boring 3D-SB17.
- The lateral extent of B(a)A at boring 3D-SB17 is defined to the north, south, and east by the absence of that compound at concentrations above its PGW SSL in samples collected from borings 3D-SB11, 3D-SB13, 3D-SB16, and 3D-SB18. Although the lateral extent of B(a)A to the west has not been completely characterized, the presence of that compound in only the surface soil sample collected from boring 3D-SB17 suggests that the lateral extent is unlikely to be extensive.

3D-SB36:

B(a)A was detected at a concentration above its PGW SSL in a near-surface (1 foot bgs) soil sample collected from boring 3D-SB36. Boring 3D-SB36 is located adjacent to a former sump along the north side of Building 20004 (Figures 4.2-3 and 4.2-12).

- The vertical extent of B(a)A at this location is defined by the absence of that compound above the PQL in the samples collected at 5 and 11 feet bgs from boring 3D-SB36.
- The lateral extent of B(a)A at boring 3D-SB36 is defined by the absence of that compound at concentrations above its PGW SSL in surface and subsurface samples collected from borings 3D-SB27, 3D-SB35, 3D-SB37, and 3D-SB44.

3D-SB12:

B(a)A was detected at concentrations above its PGW SSL in subsurface soil samples collected at 5 and 11 feet bgs from boring 3D-SB12. Boring 3D-SB12 is adjacent to a former sump along the west side of Building 20002 (Figures 4.2-3 and 4.2-12).

- The vertical extent of B(a)A at this location is defined by the absence of that compound above the PQL in the samples collected at 23 and 35 feet bgs from boring 3D-SB12.
- The lateral extent of B(a)A at boring 3D-SB12 is defined by the absence of that compound at concentrations above its PGW SSL in surface and subsurface samples collected from borings 3D-SB09, 3D-SB11, and 3D-SB13.

Based on the information presented above, the lateral and vertical extent of B(a)A above its PGW SSL at the source areas within the Buildings 20002/20004 Area has been sufficiently characterized to evaluate potential risks to surface water and groundwater and, if necessary, develop remedial alternatives.

Benzo(a)pyrene

B(a)P was not detected in soil at the source areas within the Buildings 20002/20004 Area at concentrations above its RISL. B(a)P was, however, detected at a concentration above its PGW SSL in a surface (0.25 foot bgs) soil sample collected at one location (3D-SNS34). Sampling location 3D-SNS34 is a drop inlet basin along an underground drainage culvert between Buildings 20004/20005 and 20024 (Figures 4.2-3 and 4.2-12).

- The absence of B(a)P above the PQL in the sample (3D-SNS35) collected from the drop inlet basin downstream of 3D-SNS34 indicates that the lateral extent of this compound is limited to the northern 50 feet of the culvert.
- The vertical extent of B(a)P at that location 3D-SNS34 would be limited by the presence of the culvert.

Based on the information presented above, the lateral and vertical extent of B(a)P at source areas in the Buildings 20002/20004 Area has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

Benzo(b&k)fluoranthene

B(b&k)F at a concentration above its RISL and PGW SSL was detected in a surface (0.25 foot bgs) soil sample collected at only one location (3D-SNS34) within the Buildings 20002/20004 Area. Sampling location 3D-SNS34 is a drop inlet basin along an underground drainage culvert between Buildings 20004/20005 and 20024 (Figures 4.2-3 and 4.2-12).

- The absence of B(b&k)F above the PQL in the sample (3D-SNS35) collected from the drop inlet basin downstream of 3D-SNS34 indicates that the lateral extent of this compound is limited to the northern 50 feet of the culvert.
- The vertical extent of B(b&k)F at location 3D-SNS34 would be limited by the presence of the culvert.

Based on the information presented above, the lateral and vertical extent of B(b&k)F at source areas in the Buildings 20002/20004 Area has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

Naphthalene

NAP was detected at concentrations above its RISL of 1,700 µg/kg in four subsurface soil samples collected at three (3D-SB46, 51D-SB09 and 51D-SB10) locations at the source areas within the Buildings 20002/20004 Area. A PGW SSL was not established for NAP. Conclusions regarding the characterization of NAP at each location based on the data are summarized below.

3D-SB46:

NAP was detected at a concentration above its RISL in one subsurface soil sample collected at 5 feet bgs from boring 3D-SB46. Boring 3D-SB46 is adjacent to a former waste oil UST along the west side of Building 20004 (Figure 4.2-3). NAP detected at 3D-SB46 is likely associated with releases of hydrocarbons to surface soil from the former waste oil UST.

- The vertical extent of NAP at this location is defined by the absence of that compound above its RISL in the sample collected at 11 feet bgs from boring 3D-SB46.
- The lateral extent of NAP at boring 3D-SB46 has not been completely characterized to concentrations below its RISL. However, it is

generally defined by the presence of PCBs in soil above their respective screening levels in the area (see discussion below on PCBs).

51D-SB09 and 51D-SB10:

NAP was detected at concentrations above its RISL in subsurface soil samples collected between 13 and 17 feet bgs from two borings (51D-SB09 and 51D-SB10). Borings 51D-SB09 and 51D-SB10 are in a parking lot north of Building 20002 (Figure 4.2-3). The NAP concentrations detected at Source Area 51D are most likely associated with releases of diesel and fuel oil from a UST formerly located in the street north of Building 20002. During the 1980s, a remediation system was installed to extract perched groundwater containing hydrocarbons stemming from those releases. The extraction of groundwater containing hydrocarbons continued until the perched groundwater layer became dry. In April 2006, the depth to perched groundwater in the Administration Area ranged from 7.2 to 25.1 feet bgs, with a median depth of 14 feet bgs.

- Borings 51D-SB09 and 51D-SB10 were terminated at 18 feet bgs. Based on the depth at which NAP is detected at Source Area 51D and the absence of that compound above its PQL in shallower samples collected from those borings, it appears likely that the soil samples may have been collected from a layer formerly containing perched groundwater. The vertical extent of NAP at these locations is likely to extend to the top of first groundwater. It should be noted that the detections of NAP above its RISL occur in soil collected below the depth (12 feet bgs) at which human contact would potentially occur.
- The lateral extent of NAP in soil at Source Area 51D is defined by the absence of that compound above its RISL and PGW SSL in several borings, including 51D-SB07, 51D-SB06, 51D-SB10, and A20-ST02-SB02 (Figures 4.2-3 and 4.2-4). The extent of NAP in subsurface soil likely corresponds to the former extent of perched groundwater in this area.

Based on the information presented above, the lateral and vertical extent of NAP at source areas in the Buildings 20002/20004 Area has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

4.2.4.4 *Polychlorinated Biphenyls*

Aroclors 1248, 1254, and 1260 were the only PCBs detected in soil at the source areas within the Buildings 20002/20004 Area at concentrations

above their respective RISL and/or PGW SSL (Section 4.2.3.4). Soil sampling locations and the features being investigated are cross-referenced on Table 4.2-2. The presence of each of those compounds in soil with respect to the completeness of characterization, both laterally and vertically, and potential sources are discussed below.

Aroclor 1248

PCB Aroclor 1248 was detected above its RISL and PGW SSL in only one soil sample collected at a depth of 7.75 feet bgs at one (3D-SB22) location at Source Area 3D. Boring 3D-SB22 is near the former location of a former 5-Axis mill sump (Figures 4.2-1, 4.2-4, 4.2-13, and 4.2-14). Review of the data indicates that Aroclor 1248 was not associated with the detection of Aroclors 1254 and 1260 in soil at the source areas in the Buildings 20002/20004 Area.

- The absence of Aroclor 1248 in soil at 11 feet bgs from boring 3D-SB22 indicates that the vertical extent of that compound is limited to a depth of less than 11 feet bgs.
- As shown in Figures 4.2-13 and 4.2-14, the lateral extent of Aroclor 1248 in soil has not been completely characterized due to limitations in space and obstructions inherent to drilling inside the building.

Based on the information presented above, the lateral and vertical extent of Aroclor 1248 at source areas in the Buildings 20002/20004 Area has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

Aroclor 1254

PCB Aroclor 1254 concentrations above its RISL and PGW SSL are summarized in Section 4.2.3.4 and shown in Figures 4.2-13 and 4.2-14. Conclusions regarding potential sources of Aroclor 1254 to soil and the characterization of that compound based on the data presented on the table and figures, are summarized below.

- Aroclor 1254 was detected at concentrations above its RISL and/or PGW SSL in surface/near-surface or subsurface soil samples collected at 16 locations in the Buildings 20002/20004 Area. Aroclor 1254 is the most commonly detected PCB in the Buildings 20002/20004 Area.

- Review of the data indicates that Aroclor 1254 does not appear to be associated with detections of Aroclor 1248. The data also indicate while Aroclor 1260 was detected above its RISL and/or PGW SSL at two locations having Aroclor 1254 in soil, there is not a definite association with those two PCBs.
- As shown in Figures 4.2-13 and 4.2-14, Aroclor 1254 is present in soil above its RISL and/or PGW SSL at the following seven areas in the Buildings 20002/20004 Area:
  - ***Intersection of Baltimore Street and Boston Avenue at the southwest corner of Building 20002:*** Aroclor 1254 was detected above its RISL in two samples and above its PGW SSL in 11 samples collected from this area at depths ranging from 5 to 15 feet bgs. The highest concentration (47,000 µg/kg) was detected at 5 feet bgs from boring 3D-SB33, located near the center of the intersection. The most likely source of Aroclor 1254 to soil at this location is from a waste collection tank formerly located at the northwest corner of Building 20004.
    - The vertical extent of Aroclor 1254 in borings 3D-SB33, 3D-SB63, and 3D-SB64 is defined by the presence of perched groundwater at a depth of approximately 15 feet bgs.
    - The lateral extent of Aroclor 1254 in those borings has not been completely characterized to the PGW SSL of 34 µg/kg. However, due to restrictions posed by the presence of underground utilities, the extent of Aroclor 1254 has been characterized to the extent possible.

  Based on the data, the potential exists for soil containing PCBs to be present beneath Baltimore Street between Buildings 20002 and 20004.

  - ***Former oil tank west of Building 20004:*** Aroclor 1254 was detected above its RISL and/or PGW SSL in soil from borings 3D-SB20, 3D-SB46, 3D-SB68, and 3D-SB69 near the former location of the waste oil UST along the west side of Building 20004 at concentrations up to 16,000 µg/kg and to a depth of 15 feet bgs, just above perched groundwater (Figures 4.2-3, 4.2-13, and 4.2-14). NAP was also detected above its RISL and PGW SSL in soil collected from boring 3D-SB46. Releases associated with the historical use of the former oil tank are the most likely source of Aroclor 1254 to soil.
    - The vertical extent of Aroclor 1254 in the borings is defined by the presence of shallow perched groundwater at a depth of approximately 15 feet bgs.

  - The lateral extent of Aroclor 1254 in borings 3D-SB20, 3D-SB46, 3D-B67, 3D-SB68, and 3D-SB69 has not been completely characterized to levels below its RISL and PGW SSL. However, due to the presence of structures and underground utilities, the extent of Aroclor 1254 in the area of the former waste oil UST has been characterized to the extent possible.

- ***Boston Avenue near the northwest corner of Building 20002:*** Aroclor 1254 was detected at 37 µg/kg, below its RISL, but above its PGW SSL, in a near-surface (1 foot bgs) soil sample collected at sampling location 3D-SB11 along the west side of Building 20002 (Figures 4.2-3 and 4.2-14). The vertical extent of Aroclor 1254 is defined by the absence of that compound above the PQL in the sample collected at 5 feet bgs from boring 3D-SB11.
  - The lateral extent of Aroclor 1254 in boring 3D-SB11 is defined by the absence of that compound in soil samples collected from boring 3D-SB12.
  - The detection of this PCB only in the surface soil suggests that it is potentially due to a surface spill of PCB oil at this location.

- ***Boston Avenue near southwest corner of Building 20004:*** Aroclor 1254 was detected at 48 µg/kg, below its RISL, but above its PGW SSL, in soil at a depth of 1 foot bgs in boring 3D-SB52 adjacent to a former paint booth along the west side of Building 20004 (Figures 4.2-3 and 4.2-14).
  - The vertical extent of Aroclor 1254 is defined by the absence of that compound above the PQL in the sample collected at 5 feet bgs from boring 3D-SB52.
  - The lateral extent of Aroclor 1254 in boring 3D-SB52 is not well defined, but the data indicate that it is likely limited to the soil immediately adjacent to the booth.
  - The detection of this PCB only in the surface soil indicates that it is potentially due to a surface spill of PCB oil at this location.

- ***Northeast corner of Building 20004:*** Aroclor 1254 was detected at 140 µg/kg, below its RISL, but above its PGW SSL, in one subsurface soil sample collected at 5 feet bgs from boring 3D-SB37 within a photo etching and plating area in the northeast portion of Building 20004 (Figures 4.2-3 and 4.2-14).
  - The vertical extent of Aroclor 1254 at that location is defined by the absence of that compound above the PQL in the samples collected at 11, 23, and 32 feet bgs from boring 3D-SB43.

  - The lateral extent of Aroclor 1254 is characterized by the absence of that compound at concentrations above the PQL in soil samples collected from borings 3D-SB36 and 3D-SB38
  - The detection of this PCB in only surface soil suggests that is potentially due to a historical surface spill of PCB oil at this location.
- ***Septic Tank A20-ST01:*** Aroclor 1254 was detected at a concentration below its RISL, but above its PGW SSL, in a surface soil sample collected from boring A20-ST01-SB03, adjacent to septic tank A20-ST01-02, west of Building 20001 (Figures 4.2-3 and 4.2-14).
  - The vertical extent of Aroclor 1254 is defined by the absence of that compound at a concentration above the PQL in the sample collected from boring A20-ST01-SB03 at a depth of 5 feet bgs.
  - The lateral extent of Aroclor 1254 in soil at boring A20-ST01-02 has not been completely characterized to levels below its PGW SSL. However, due to the presence of structures and underground utilities, the extent of Aroclor 1254 at that location has been characterized to the extent possible.
- ***Plastic lab sump on north side of Building 20004:*** Aroclor 1254 was detected at a concentration below its RISL, but above its PGW SSL, in subsurface soil samples collected at 5 and 11 feet bgs from boring 3D-SB43. Boring 3D-SB43 is adjacent to a sump near the plastic laboratory on the north side of Building 20004 (Figures 4.2-3 and 4.2-14).
  - The vertical extent of Aroclor 1254 is defined by the absence of that compound above the PQL in the sample collected at 23 and 35 feet bgs from boring 3D-SB43.
  - The lateral extent of Aroclor 1254 detected in boring 3D-SB43 has not been completely characterized to the PGW SSL of 34 µg/kg. However, due to the presence of structures and underground utilities, the extent of Aroclor 1254 was characterized to the extent possible.
- ***Underground Drainage Culvert between Buildings 20004/20005 and 20024:*** Aroclor 1254 was detected at a concentration above its RISL and PGW SSL in sample collected at location 3D-SNS34. Sampling location 3D-SNS34 is a drop inlet basin along an underground drainage culvert between Buildings 20004/20005 and 20024 (Figures 4.2-3, 4.2-13, and 4.2-14).

- The sample (3D-SNS35) collected from the drop inlet basin downstream of 3D-SNS34 was not analyzed for PCBs. Therefore, the lateral extent of this compound could potentially extend the length of the drainage swale. The vertical extent of Aroclor 1254 at location 3D-SNS34 would be limited by the presence of the culvert.

Based on the information presented above, the lateral and vertical extent of Aroclor 1254 at source areas in the Buildings 20002/20004 Area has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

Aroclor 1260

The PCB Aroclor 1260 at concentrations above its RISL and/or PGW SSL was detected in only two soil samples collected at two (3D-SNS34 and 3D-SB50) locations with the Building 20002/20004 Area. Detections of Aroclor 1260 above its screening levels are summarized in Section 4.2.3.4 and shown in Figures 4.2-13 and 4.2-14. Conclusions regarding the characterization and potential sources of Aroclor 1260 at both locations, based on the data presented on the table and figures, are summarized below.

3D-SNS34:

Aroclor 1260 was detected at a concentration above its RISL and PGW SSL in a surface (0.25 foot bgs) soil sample collected at location 3D-SNS34. Sampling location 3D-SNS34 is a drop inlet basin along an underground drainage culvert between Buildings 20004/20005 and 20024 (Figures 4.2-3, 4.2-13, and 4.2-14).

- The sample (3D-SNS35) collected from a drop inlet basin downstream of 3D-SNS34 was not analyzed for PCBs. Therefore, the lateral extent of this compound could potentially extend the length of the drainage culvert.
- The vertical extent of Aroclor 1260 at location 3D-SNS34 would be limited by the presence of the culvert.

3D-SB50:

Aroclor 1260 was detected at a concentration above its PGW SSL, but below its RISL, in a near-surface (1 foot bgs) soil sample collected from

boring 3D-SB50. Boring 3D-SB50 is adjacent to a drain sump in Boston Avenue west of Building 20004 (Figures 4.2-3 and 4.2-14).

- The vertical extent of Aroclor 1260 is defined by the absence of that compound at concentrations above the PQL in samples collected at 5 and 11 feet bgs from boring 3D-SB50.
- The lateral extent of Aroclor 1260 at concentrations above its PGW SSL at that location has not been completely characterized. However, due to the presence of structures and underground utilities, the lateral extent has been characterized to the extent possible.

Based on the information presented above, the lateral and vertical extent of Aroclor 1260 at source areas in the Buildings 20002/20004 Area has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

4.2.4.5 *Total Petroleum Hydrocarbons*

TPH-D and TPH-Mo were detected in soil at concentrations above their PGW SSLs at the source areas within the Buildings 20002/20004 Area. The presence of each of those compounds in soil with respect to potential sources is discussed below. TPH-D and TPH-Mo were not characterized laterally and vertically to their PGW SSLs during the BOU RI. Decisions regarding the need for additional characterizations during the field effort were based on the presence of SVOCs above their screening levels.

TPH-D

TPH-D detected at concentrations above its PGW SSL are summarized in Section 4.2.3.4 and shown in Figure 4.2-14. Soil sampling locations and the features being investigated are cross-referenced on Table 4.2-2. Conclusions regarding the presence of TPH-D in soil based on the data presented on the table and figure are summarized below.

- TPH-D was detected above its PGW SSL in surface, near-surface, and/or subsurface soil samples collected at 10 locations at Source Area 3D and three locations at Source Area 51D.
- As shown in Figure 4.2-14, TPH-D was generally detected above its PGW SSL in soil at Source Area 3D in proximity to underground storm drains and catch basins between Buildings 20002 and 20004 and along Boston Avenue on the west side of Building 20002. The detections are likely related to releases of fuel oil from former USTs that serviced

boilers and heaters in the buildings and surface water runoff from parking areas.

- Figure 4.2-14 also shows that TPH-D was detected in soil above its PGW SSL at Source Area 51D, north of Building 20002. The presence of TPH-D in this area is associated with the release of fuel oil from former USTs north of Building 20002. As previously discussed, perched groundwater containing hydrocarbons was extracted from this area during the 1980s. Based on the previously presented SVOC data, NAP was also detected in several of the soil samples having TPH-D and is likely associated with the same release.

Based on the information presented above, the lateral and vertical extent of TPH-D in the source areas within the Buildings 20002/20004 Area has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

TPH-Mo

TPH-Mo detected at concentrations above its PGW SSL are summarized in Section 4.2.3.4 and shown in Figure 4.2-14. Soil sampling locations and the features being investigated are cross-referenced on Table 4.2-2. Conclusions regarding the presence of TPH-Mo in soil based on the data presented in the previous section are summarized below:

- TPH-Mo was detected above its PGW SSL in surface, near-surface, and/or subsurface soil samples collected at 9 locations at Source Area 3D and two locations at Source Area 51D.
- TPH-Mo was generally detected above its PGW SSL in soil in the same areas having TPH-D, primarily in proximity to underground storm drains and catch basins between Buildings 20002 and 20004 and along Boston Avenue on the west side of Building 20002. The detections are likely related to releases of fuel oil from former USTs that serviced boilers and heaters in the buildings, and surface water runoff from parking areas.
- The data indicate that TPH-Mo was also detected above its PGW SSL in soil in proximity to three septic tanks (A20-ST01, A20-ST05, and A20-ST06 (Figure 4.2-14).
- The presence of TPH-Mo in soil adjacent to the septic tanks suggests that hydrocarbons in the motor oil range may have been discharged to

the septic tanks or surface water containing motor oil migrated into the soil around the surface access ports to the septic tanks.

Based on the information presented above, the lateral and vertical extent of TPH-Mo in the source areas within the Buildings 20002/20004 Area has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

4.2.4.6 *N-Nitrosodimethylamine*

NDMA was not detected at concentrations above its RISL of 9.5 µg/kg in surface, near-surface, or subsurface soil samples collected at Source Areas 3D and 51D in the Buildings 20002/20004 Area (Figure 4.2-13).

NDMA was detected in one soil sample at a concentration above its PGW SSL of 0.03 µg/kg. NDMA at 3.2 µg/kg was detected in a soil sample collected from boring 3D-SB35 at 5 feet bgs (Figure 4.2-14). Boring 3D-SB35 is adjacent to a former photo-etch sump north of Building 20004.

- The vertical extent of NDMA is defined by the absence of that compound above the PQL in samples collected from boring 3D-SB35 at 11, 23, and 35 feet bgs.
- The lateral extent of NDMA identified in boring 3D-SB35 is generally characterized by the absence of that compound above the PQL in samples collected from borings 3D-SB38 and 3D-SB44. Therefore, Aerojet believes that the extent has been sufficiently characterized to evaluate potential risks and, if necessary, develop remedial alternatives.

4.2.5 *Building 20022 Area – Administration Area East*

The Building 20022 Area consists of Source Area 11D, three former RCRA Units, a former radiographic facility (Building 20034), septic tanks, and various other features associated with Building 20022. Additionally, the Building 20022 Area also includes other facilities and structures in the eastern portion of the Administration Area (Area 20).

4.2.5.1 *Description of Source Areas – Building 20022 Area*

Source Area 11D, the RCRA Units, buildings, and other features in the Building 20022 Area that may have contributed chemicals to soil and investigated during the BOU RI are described below and shown in

Figure 4.2-1. Site features were identified based on historic soil, soil vapor, and groundwater analytical data and/or visual inspection and limited data coverage.

Source Area 11D

Source Area 11D is the drainage system associated with Building 20022 and the eastern portion of the Administration Area. An underground drain originating from Building 20022 was potentially connected to the open ditch north of Building 20022. The open ditch extends around the building and received surface runoff from the building area.

The Source Area 11D drainage system was divided between the PGOU and the BOU. The drainage ditches north, east, and south of Building 20022 were addressed as part of the PGOU. The drainage ditches east of Building 20022 were investigated as part of the BOU. During the BOU RI, samples (11D-SNS18, 11D-SNS19, 11D-SNS20, and 11D-SNS23) were collected from those sections of the ditch included in the PGOU. The analytical data for those samples was evaluated in the PGOU RI/FS and are therefore not discussed in this report.

Building 20022

Building 20022 may have been used as a warehouse in the late 1950s to mid-1960s. Later, the building was used for dye penetrating operations and degreasing operations. A TCE degreaser and an underground acid storage tank were formerly located on the east side of Building 20022. The underground acid storage tank was removed in 1993 and samples were collected from the base and sidewalls of the excavation under the oversight of the County of Sacramento Department of Environmental Health. Materials that may have been handled at the building were dye-penetrating chemicals and degreasing solvents. The *Industrial and Domestic Waste Control Report* (Aerojet, 1961) states that 200 gallons per day of caustic were potentially trapped, neutralized, and discharged from Building 20022 to the Former Sewage Treatment Plant (FSTP). The BOU RI for the FSTP is discussed in Section 4.3.

Building 20022 also includes a septic system (A20-ST22) identified during the Demonstration Project Record Search. The septic system consists of four passive infiltration wells (potholes) at the northeast corner of the building. The septic system services restrooms in the building.

Building 20034

Building 20034 is a radiographic facility where ultrasonic and x-ray inspections of liquid rockets were conducted. The facility was identified by the Agencies as a potential source area after the Stage 1 RI was completed. Building 20034 is located about 150 feet east of Building 20004. Features associated with Building 20034 that may have contributed chemicals to the source areas include a ditch adjacent to Baltimore Street on the north, two X-ray bays, a film development processor room, the magnaflux/dye pen area, an aboveground storage tank (AST), and a compressor blowdown area.

RCRA Units

Three RCRA Units within the Building 20022 Area are described below:

- RCRA B: Building 20037, a chemical and hazardous waste storage building northwest of Building 20034, a former X-ray facility. Solvent sumps were located on the north and south sides of Building 20034.
- RCRA C, Building 20029 Treatment Unit: a former decontamination area northwest of Building 20022.
- RCRA X: Building 20B73, former hazardous waste storage and transfer area west of Building 20022.

Other Features and Structures

The Building 20022 Area also includes a number of various storage areas and features as described below:

- A former aboveground waste oil tank;
- Materials and equipment storage yards and associated former structures east and west of the western north-south branch of the 11D drainage ditch;
- Building 20030, a drum storage area;
- Materials and drum storage areas associated with former structures east and south of former Building 20031; and
- A vehicle maintenance shop in the northwest portion of Building 20022.

4.2.6 *Summary and Results of Previous (Pre-2005) Vadose Zone Investigations – Building 20022 Area*

The following subsections summarize the scope and results of previous (prior to 2005) vadose zone investigations of Source Area 11D, RCRA Units, Buildings 20022 and 20034 and features within the Building 20022 Area, identify COPCs based on the previous investigations, and discuss the DQOs and sampling proposed in the BOU FSP.

4.2.6.1 *Summary of Previous (Pre-2005) Vadose Zone Investigations – Building 20022 Area*

Soil samples from borings and soil vapor samples were collected in the vicinity of Source Area 11D, RCRA Units, Buildings 20022 and 20034, and features within the Building 20022 Area between 1980 and 2003. Soil vapor samples were analyzed for VOCs and soil samples were analyzed for VOCs, PCBs, and/or metals. Previous investigations of those source areas conducted between 1979 and 1993 are described below:

- 1980 – Twelve soil samples were collected from a single soil boring between 1 and 41 feet bgs and analyzed for VOCs.
- 1986 – Forty-five soil samples were collected from three soil borings at depths ranging from surface to 24.5 feet bgs and analyzed for VOCs, PCBs, and/or metals.
- 1992/1993 – Seventeen soil vapor samples were collected at depths of up to 10 feet bgs and analyzed for selected VOCs. Additionally, soil samples were collected between surface and 3 feet bgs from seven borings and analyzed for selected metals.
- 2003 – Eight soil vapor samples were collected along the Source 11D ditch north and east of Building 20022 at depths up to 10 feet bgs and analyzed for VOCs. The soil vapor sampling was conducted as part of the PGOU investigation of those portions of the Source 11D ditch.

4.2.6.2 *Results of Previous (Pre-2005) Vadose Zone Investigations – Building 20022 Area*

The results of the previous (prior to 2005) investigations of Source Area 11D and other features within the Building 20022 Area, as presented in the BOU FSP (Aerojet et al., 2006b), are summarized below.

Review of the previous data identified the following COPCs in soil and/or soil vapor within the source areas and features in the Building 20022 Area:

- **Soil –** VOCs and PCBs.
- **Soil Vapor –** VOCs.

Figures showing previous sampling locations at the source areas within Administration Area East and chemical groups detected in soil samples collected between 1991 and 2005 above human health and ecological screening levels were presented in the BOU FSP (Aerojet et al., 2006b) and are included in Appendix E. The BOU FSP also presented a summary of statistics and the sample results for chemicals detected in soil, soil vapor, and groundwater that exceed human health and ecological screening levels in the Administration Area.

4.2.6.3 *Summary of Data Needs – Building 20022 Area*

Based on a review of the previous vadose zone investigation data, extensive aerial photograph research and review, and exhaustive research of historical documents, Aerojet determined that additional soil and soil vapor sampling was needed in the Buildings 20022/20004 Area to:

- Characterize the present lateral and vertical extent of VOCs, SVOCs, PCBs, perchlorate, TPH, pH, and metals (including hexavalent chromium) in the vadose zone at the majority of the source areas and site features that may have contributed chemicals at concentrations that could potentially pose a risk to human and ecological receptors;
- Evaluate the potential presence of hexavalent chromium, NDMA, and cyanide at some locations;
- Evaluate the potential for chemicals in soil to degrade surface or groundwater quality; and
- Obtain sufficient data to support fate and transport modeling, evaluation of risk to human and ecological receptors, and evaluation of potential remedial alternatives.

It should be noted that due to the time lapse (12 years) since the Stage 1 RI was performed and the elevated laboratory reporting limits for VOCs during that investigation, the investigation of VOCs performed during the BOU RI was designed to supersede all previous soil vapor and soil VOC investigation results.

4.2.7 *Summary and Results of Boundary Operable Unit Vadose Zone Investigation – Building 20022 Area*

The following subsections summarize the recent (2005 to 2007) BOU investigation of the four source areas within the Buildings 20022 Area, describe deviations from the sampling proposed in the BOU FSP, describe the site-specific geology and hydrogeology, and present the results of the BOU RI. Results of the sampling with respect to the completeness of the characterization and identification of potential sources are discussed in Section 4.2.8.

4.2.7.1 *Summary of Boundary Operable Unit Vadose Zone Investigation – Building 20022 Area*

The BOU RI of the vadose zone at Source Area 11D and other features in the Building 20022 Area included the following activities.

Soil Vapor Investigation

- A total of 31 primary and 3 duplicate soil vapor samples were collected at Source Area 11D and other features in the Building 20022 Area during the BOU RI and analyzed for VOCs, including TICs. Soil vapor sampling locations are shown in Figure 4.2-2.
- The total number of soil vapor samples collected within each potential source site (including QA/QC samples) and analyzed for VOCs are provided on Table 4.2-1.
- A cross-reference between soil vapor sampling locations within the Building 20022 Area and the specific features they were sited to investigate are provided on Table 4.2-2.

Surface and Subsurface Soil Investigation (0 to 2.5 feet bgs)

- A total of 39 primary and 10 duplicate surface and/or near-surface (0 to 2.5 feet bgs) and 32 primary and one duplicate subsurface (2.6 to 35 feet bgs) soil samples were collected at Source Area 11D and other features in the Building 20022 Area during the BOU RI. Surface and subsurface soil sampling locations are shown in Figures 4.2-3 and 4.2-4.
- Surface and subsurface soil samples were analyzed for SVOCs, metals (including hexavalent chromium), NDMA, PCBs, perchlorate, cyanide, TPH-D, TPH-Mo, pH, TOC, CEC, and/or geotechnical parameters. The SVOC analysis of soil included an evaluation of the presence of

TICs. In accordance with the BOU FSP, sample analyses were based on the analytical results from previous investigations and therefore every sample was not analyzed for the full suite of constituents.

- The number of surface soil samples collected for each analysis (including QA/QC samples) at each of the five source areas, along with the corresponding methods, is provided on Table 4.2-7.
- A cross-reference between soil sampling locations within the Building 20022 Area and the specific features they were sited to investigate are provided on Table 4.2-2.

4.2.7.2 *Deviations from Boundary Operable Unit Data Quality Objectives and Sampling Design – Building 20022 Area*

Sampling activities at Source Area 11D, the RCRA Units, and other features in the Building 20022 Area during the BOU RI were generally consistent with those proposed by the BOU FSP. Sampling was performed at locations proposed in the BOU FSP and step-out sampling was performed in accordance with the procedures agreed upon with the Agencies. A comparison of proposed and actual sampling activities, including sampling rationale, sample depth, and analyses, is provided on Tables 4.2-4 and 4.2-5. Soil and soil vapor sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.2-2.

4.2.7.3 *Site-Specific Geology and Hydrogeology – Building 20022 Area*

The geology and hydrogeology of the Building 20022 Area are described below. The descriptions are based on information presented on field logs of borings drilled during previous investigations and the BOU RI.

Geology

Dredging was performed in the northwest corner of the Building 20022 Area, north of Buildings 20B73 and 20030 and east of Building 20022. Native, undredged material in the Building 20022 Area consisted of sands and gravels with clay grading to sands and gravels with silt to the east of Building 20022. Dredging was not performed in the south and southeast portion of the Administration Area due to the presence of hard, indurated material associated with an ancestral American River terrace along the southern and southeastern portion of the area. The depth of dredging in the Building 20022 Area may have varied based on the depth at which hard indurated material was encountered.

Hydrogeology

Perched groundwater was encountered in borings drilled in the Building 20022 Area during the BOU RI. The FWBZ was encountered in three boreholes at depths ranging from 31 to 42 feet bgs.

4.2.7.4 *Results of Boundary Operable Unit Vadose Zone Investigation – Building 20022 Area*

The results of the VOC, metals, SVOC, PCB, perchlorate, TPH-D and TPH-Mo, total cyanide, NDMA, pH, TOC, CEC, DI-WET, and geotechnical analyses of the BOU RI samples are summarized below. The analytical results for all soil vapor and soil samples are provided in Appendices F and G, respectively.

Summary of Investigation and Results - Volatile Organic Compounds

Based on evaluation of the existing data for the source areas comprising the Building 20022 Area, the BOU FSP concluded that additional soil vapor sampling was needed to sufficiently characterize the nature and extent of VOCs. As indicated on the table below and Table 4.2-1, 31 primary and 3 duplicate soil vapor samples were collected at 31 locations at Source Area 11D and in the vicinity of Building 20034 and analyzed for VOCs, including TICs.

Source Area	Depth (feet bgs)	No. of Primary Samples	No. of Locations
11D	0-10	11	11
	11-20	10	10
	21-30	3	3
Bldg 20034	0-10	3	3
	11-20	3	3
	21-30	1	1

The analytical results for the soil vapor samples collected from the shallow (0 to 10 feet bgs), intermediate (11 to 20 feet bgs), and deep (21 to 30 feet bgs) intervals at Source Area 11D and other features in the Building 20022 Area are presented in Appendix F and summarized below. Soil vapor sampling locations in Administration Area East are shown in Figure 4.2-2. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 4.2-2.

TCE, PCE, vinyl chloride, and TVOC concentrations above their RISLs in the shallow, intermediate, and deep intervals in the Building 20022 Area

are shown in Figure 4.2-5a. Additionally, TVOC concentrations above their RISLs are shown in Figure 4.2-5b. TCE, PCE, and vinyl chloride concentrations above PGW SSLs in the shallow, intermediate, and deep intervals are shown in Figure 4.2-6.

The TVOC concentrations illustrated in Figures 4.2-5a and 4.2-5b represent the sum of the ratio of the concentration for each detected VOC in the sample divided by its RISL. For example, if PCE at a concentration of 320 µg/m^3 and TCE at a concentration of 961 µg/m^3 were the only VOCs detected in the samples, then the sum of their respective concentrations divided by their respective RISLs of 320 and 961 µg/m^3 would be 2, or:

$$PCE = \frac{320\,\mu g/m^3}{320\,\mu g/m^3} = 1$$

$$TCE = \frac{961\,\mu g/m^3}{961\,\mu g/m^3} = 1$$

$$TVOC\ Ratio = 2$$

As agreed upon with the Agencies, soil vapor would be characterized during the BOU RI to the point where the TVOC concentration ratio was less than or equal to 10.

Cross-sections presenting generalized vadose zone lithology and soil vapor sampling results in the Building 20022 Area are presented in Figures 4.2-7 and 4.2-8. Additional discussion of soil vapor investigation results is presented in Section 4.2.8.1.

Shallow Soil Vapor (0 to 10 feet bgs) – VOCs:

- Fourteen primary and three duplicate soil vapor samples were collected from the shallow layer at 14 locations at Source Area 11D, Building 20034, and other features in the Building 20022 Area and analyzed for VOCs, including TICs. Shallow soil vapor sampling locations are shown in Figure 4.2-2. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 4.2-2.
- Volatile organic TICs were not detected in the shallow soil vapor samples.
- Chloroform, PCE, and TCE were the only VOCs detected in the shallow soil vapor samples at concentrations above their respective

RISLs. Shallow soil vapor samples having concentrations of those VOCs exceeding their respective RISLs and/or PGW SSLs are listed on the table below. TCE, PCE, vinyl chloride, and TVOC concentrations above their RISLs in the shallow interval are illustrated in Figure 4.2-5a. TVOC concentrations above the RISLs are also illustrated in Figure 4.2-5b.

- PCE and TCE were the only VOCs detected in shallow soil vapor samples at concentrations above its PGW SSL. Shallow soil vapor samples having concentrations of those VOCs exceeding their respective PGW SSLs are listed on the table below and shown in Figure 4.2-6.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
A20-RX73-SP01	10	Chloroform	83	18,595	450	Y	N
11D-SP27	10	PCE	320	57	130	N	Y
A20-B34-SP01	10				63	N	Y
A20-B34-SP03	10				870	Y	Y
A20-RB37-SP01	10				55,000	Y	Y
A20-RB37-SP02	10				7,000	Y	Y
A20-RC29-SP01	10				270	N	Y
A20-RX73-SP01	10				100	N	Y
A20-RB37-SP01	10	TCE	961	527	5,500	Y	Y
A20-RB37-SP02	10				930	N	Y

Intermediate Soil Vapor (11 to 20 feet bgs) – VOCs:

- Thirteen primary soil vapor samples were collected from the intermediate layer at 13 locations at Source Area 11D, Building 20034, and other features in the Building 20022 Area and analyzed for VOCs, including TICs. Soil vapor sampling locations are shown in Figure 4.2-2. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 4.2-2.
- Volatile organic TICs were not detected in the intermediate soil vapor samples.
- Chloroform, PCE, and TCE were the only VOCs detected in the intermediate soil vapor samples at concentrations above their respective RISLs. Intermediate soil vapor samples having concentrations of those VOCs exceeding their respective RISLs and/or PGW SSLs are listed on the table below. TCE, PCE, vinyl chloride, and TVOC concentrations above their RISLs in the intermediate interval are illustrated in Figure 4.2-5a. TVOC concentrations above the RISLs are also illustrated in Figure 4.2-5b.

- Benzene, PCE, and TCE were detected in intermediate soil vapor samples at concentrations above their respective PGW SSLs. Intermediate soil vapor samples having concentrations of those VOCs exceeding their respective PGW SSLs are listed on the table below. TCE and PCE concentrations above their PGW SSLs in the intermediate interval are illustrated in Figure 4.2-6.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
A20-B34-SP03	20	Benzene	84	35	44	N	Y
11D-SP28	20	Chloroform	83	18,595	120	Y	N
A20-RX73-SP01	20				300	Y	N
A20-B34-SP03	20	PCE	320	57	860	Y	Y
A20-RB37-SP01	20				73,000	Y	Y
A20-RB37-SP02	20				160	N	Y
A20-RC29-SP01	20				350	Y	Y
A20-RX73-SP01	20				170	N	Y
A20-RB37-SP01	20	TCE	961	527	6,500	Y	Y

Deep Soil Vapor (21 to 30 feet bgs) – VOCs:

- Four primary soil vapor samples were collected from the deep layer at four locations at Source Area 11D, Building 20034, and other features in the Building 20022 Area and analyzed for VOCs, including TICs. Soil vapor sampling locations are shown in Figure 4.2-2. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 4.2-2.
- Volatile organic TICs were not detected in the deep soil vapor samples
- PCE and TCE were the only VOCs detected in the deep soil vapor samples at concentrations above their respective RISLs. Deep soil vapor samples having concentrations of PCE and TCE exceeding their RISLs and/or PGW SSLs are listed on the table below. TCE, PCE, and TVOC concentrations above their RISLs are illustrated in Figure 4.2-5a. TVOC concentrations above the RISLs are also illustrated in Figure 4.2-5b.
- PCE and TCE were the only VOCs detected in the deep soil vapor samples at concentrations above their respective PGW SSLs. Deep soil vapor samples having concentrations of PCE and TCE exceeding their PGW SSLs are listed on the table below and shown in Figure 4.2-6.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
A20-B34-SP03	29	PCE	320	57	1,000	Y	Y
A20-RB37-SP01	30				3,100	Y	Y
A20-RB37-SP01	30	TCE	961	527	1,500	Y	Y

Summary of Investigation and Results – Metals

A total of 71 primary and 16 duplicate surface and/or near-surface soil samples were collected at Source Area 11D and other features in the Building 20022 Area and analyzed for metals and/or hexavalent chromium during the BOU RI. The number of primary soil samples and sampling locations are summarized on Table 4.2-7 and below. Summary statistics for the samples are also presented on Table 4.2-7.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
11D	Metals	40	24	24	8
	Mercury	32	20	24	8
	Hex Chrome	32	20	25	9
Bldg 20034	Metals	3	2	4	2
	Mercury	2	2	4	2
	Hex Chrome	2	2	4	2

The results of the metals analysis of surface/near-surface and subsurface soil samples collected at Source Area 11D, Building 20034, and other features in the Building 20022 Area are presented in Appendix G and summarized below.

Metals detected in soil within Administration Area East at concentrations statistically different from background and subsequently compared to screening levels were antimony, cadmium, lead, mercury, molybdenum, and zinc (Section 3.1.3.1). Because boron, hexavalent chromium, lithium, strontium, and titanium were not included in the background evaluation, concentrations of these metals were also compared to screening levels.

Surface and subsurface soil sampling locations are shown in Figures 4.2-3 and 4.2-4, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 4.2-2. Cross sections showing the generalized lithology of the vadose zone within the Building 20022 Area are provided in Figures 4.2-7 and 4.2-8.

Surface and Near-Surface Soil – Metals:

- Forty-three primary and 15 duplicate surface/near-surface soil samples were collected at 26 locations at Source Area 11D and around other features in the Building 20022 Area and analyzed for metals. Thirty-five of the 43 primary samples were also analyzed for mercury and hexavalent chromium.
- Cadmium and lead were the only metals detected in at least one surface/near-surface sample at a concentration greater than background and their respective RISLs and/or PGW SSLs. Cadmium and lead detected above their screening levels, the detected concentrations, and location and depth of the samples are identified on the table below and shown in Figures 4.2-9 and 4.2-10.

Sample Location	Depth (ft bgs)	Metal	RISL (mg/kg)	PGW SSL (mg/kg)	Conc. (mg/kg)	> RISL	> PGW SSL
11D-SNS12	0.5	Lead	150	23	36	N	Y
	2.5	Lead	150	23	45	N	Y
11D-SNS14	0.5	Cadmium	1.7	1.2	1.4	N	Y
	2.5	Cadmium	1.7	1.2	<0.59	N	N
11D-SNS15	0.5	Cadmium	1.7	1.2	2.7	Y	Y
		Lead	150	23	150	N	Y
	2.5	Cadmium	1.7	1.2	0.97	N	N
		Lead	150	23	11	N	N
11D-SNS16	0.5	Cadmium	1.7	1.2	2.0	Y	Y
		Lead	150	23	17	N	N
	2.5	Cadmium	1.7	1.2	2.4	Y	Y
		Lead	150	23	28	N	Y
11D-SNS22	0.5	Cadmium	1.7	1.2	3.7	Y	Y
	2.5	Cadmium	1.7	1.2	0.77	N	N
A20-RB37-SB01	1.0	Cadmium	1.7	1.2	1.6	N	Y
		Lead	150	23	210	Y	Y
	5.0	Cadmium	1.7	1.2	<0.45	N	N
		Lead	150	23	9.7	N	N

Subsurface Soil - Metals:

- Twenty-eight primary and one duplicate subsurface soil samples were collected at 10 locations at Source Area 11D, Building 20034, and other features in the Building 20022 Area and analyzed for metals, including mercury. Twenty-nine primary and one duplicate subsurface soil samples were also collected at 11 locations and analyzed for hexavalent chromium.

- Metals were not detected at concentrations above background and their respective RISLs and PGW SSLs in subsurface soil samples collected at Source Area 11D, Building 200034, and other features in the Building 20022 Area.

Summary of Investigation and Results – Semivolatile Organic Compounds

A total of 64 primary and 18 duplicate soil samples were collected at Source Area 11D and other features in the Building 20022 Area during the BOU RI and analyzed for SVOCs, including TICs. The number of primary soil samples and sampling locations are summarized on Table 4.2-7 and below. Summary statistics for the samples are also presented on Table 4.2-7.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
11D	SVOCs	43	31	19	8
Bldg 20034	SVOCs	2	2	0	0

The results of the SVOC analysis of surface/near-surface and subsurface soil samples collected at Source Area 11D and other features in the Building 20022 Area are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations are shown in Figures 4.2-3 and 4.2-4, respectively. B(a)P and B(b&k)F detected in soil at concentrations above their RISLs and PGW SSLs are shown in Figures 4.2-11 and 4.2-12, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 4.2-2.

Surface and Near-Surface Soil - SVOCs:

- Forty-five primary and 17 duplicate surface and/or near-surface soil samples were collected at 33 locations at Source Area 11D, Building 20034, and other features in the Building 20022 Area during the BOU RI and analyzed for SVOCs, including TICs.
- TICs were not detected in the SVOC analysis of the surface and/or near-surface soil samples.
- SVOCs detected in surface and near-surface soil above their respective RISLs and/or PGW SSLs are listed on the table below. B(a)P and B(b&k)F detected at concentrations above their RISLs and PGW SSLs are shown in Figures 4.2-11 and 4.2-12, respectively.

Sample Location	Depth (ft bgs)	SVOC	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	> RISL	> PGW SSL
11D-SNS17	0.5	Benzo(a)pyrene	38	2.9	41	Y	Y
		Benzo(b&k)fluoranthene	38	29	64	Y	Y
	2.5	Benzo(a)pyrene	38	2.9	<7.6	N	N
		Benzo(b&k)fluoranthene	38	29	<15	N	N
11D-SNS22	0.5	Benzo(a)pyrene	38	2.9	8.5 J	N	Y
		Benzo(b&k)fluoranthene	38	29	19 J	N	N
	2.5	Benzo(a)pyrene	38	2.9	15	N	Y
		Benzo(b&k)fluoranthene	38	29	30	N	Y

Subsurface Soil - SVOCs

- Nineteen primary and one duplicate subsurface soil samples were collected at 8 locations at Source Area 11D, Building 20034, and other features in the Building 20022 Area during the BOU RI and analyzed for SVOCs, including TICs.
- TICs were not detected in the SVOC analysis of the subsurface soil samples.
- SVOCs were not detected at concentrations above their respective RISLs or PGW SSLs in subsurface soil collected at Source Area 11D, Building 20034 and other features in the Building 20022 Area (Figures 4.2-11 and 4.2-12).

Summary of Investigation and Results – Polychlorinated Biphenyls

A total of 59 primary and 19 duplicate soil samples were collected at Source Area 11D and other features in the Building 20022 Area during the BOU RI and analyzed for PCBs. The number of primary soil samples and sampling locations for PCBs are summarized on Table 4.2-7 and below. Summary statistics for the samples are also presented on Table 4.2-7.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
11D	PCBs	41	29	18	9
Bldg 20034	PCBs	0	0	0	0

The results of the PCB analysis of surface/near-surface and subsurface soil samples collected at Source Area 11D and other features in the Building 20022 Area are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations and concentrations of PCB Aroclors 1248 and 1254 above their respective RISLs and/or PGW

SSLs are shown in Figures 4.2-13 and 4.2-14, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 4.2-2.

Surface and Near-Surface Soil – PCBs:

- Forty-one primary and 18 duplicate surface and/or near-surface soil samples were collected at 29 locations at Source Area 11D and other features in the Building 20022 Area and analyzed for PCBs.
- Two PCBs (Aroclors 1254 and 1260) were detected at concentrations exceeding their respective RISLs and/or PGW SSLs in surface and/or near-surface soil samples at Source Area 11D, Building 20034, and other features in the Building 20022 Area. Reported concentrations for all other PCB Aroclors in surface/near-surface soils were below their respective RISLs and PGW SSLs. PCB Aroclors 1254 and 1260 detected above their RISLs and/or PGW SSLs, the detected concentration, and the depth and location of the samples are identified below and shown in Figures 4.2-13 and 4.2-14.

Sample Location	Depth (ft bgs)	PCB	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	> RISL	> PGW SSL
11D-SNS12	0.5	Aroclor 1254	220	34	160 J	N	Y
		Aroclor 1260	220	34	330 J	Y	Y
	2.5	Aroclor 1254	220	34	160 J	N	Y
		Aroclor 1260	220	34	340 J	Y	Y
11D-SNS13	0.5	Aroclor 1254	220	34	120 J	N	Y
		Aroclor 1260	220	34	310 J	Y	Y
	2.5	Aroclor 1254	220	34	<22	N	N
		Aroclor 1260	220	34	<22	N	N
11D-SNS14	0.5	Aroclor 1254	220	34	150 J	N	Y
	2.5	Aroclor 1254	220	34	<24 UJ	N	N
11D-SNS15	0.5	Aroclor 1254	220	34	220 J	Y	Y
	D	Aroclor 1254	220	34	10,000 J	Y	Y
	2.5	Aroclor 1254	220	34	29 J	N	N
11D-SNS16	0.5	Aroclor 1260	220	34	49 J	N	Y
	D	Aroclor 1260	220	34	1,100 J	Y	Y
	2.5	Aroclor 1260	220	34	41 J	N	Y
11D-SNS17	0.5	Aroclor 1260	220	34	150	N	Y
	2.5	Aroclor 1260	220	34	15 J	N	N
11D-SNS22	0.5	Aroclor 1260	220	34	1300 J	Y	Y
	D	Aroclor 1260	220	34	34 J	N	N
	2.5	Aroclor 1260	220	34	<24 J	N	N
11D-SB06	1.0	Aroclor 1260	220	34	1,600	Y	Y

Sample Location	Depth (ft bgs)	PCB	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	> RISL	> PGW SSL
A20-RB37-SB01	1.0	Aroclor 1254	220	34	3,100	Y	Y
	D	Aroclor 1254	220	34	68	N	Y
A20-RB37-SB02	1.0	Aroclor 1254	220	34	<24	N	N
	D	Aroclor 1254	220	34	2,000 J	Y	Y
A20-RB37-SB03	1.0	Aroclor 1254	220	34	210 J	N	Y
A20-RC29-SB01	1.0	Aroclor 1254	220	34	59 J	N	Y

D = Duplicate

Subsurface Soil – PCBs:

- Eighteen primary and one duplicate subsurface soil samples were collected at 9 locations at Source Area 11D and other features in the Building 20022 Area and analyzed for PCBs.
- PCBs were not detected at concentrations above their respective RISLs or PGW SSLs in the subsurface soil samples.

Summary of Investigation and Results - Perchlorate

A total of 50 primary and 19 duplicate soil samples were collected at Source Area 11D and other features in the Building 20022 Area during the BOU RI and analyzed for perchlorate. The number of primary soil samples and sampling locations are summarized on Table 4.2-7 and below. Summary statistics for the samples are also presented on Table 4.2-7.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
11D	Perchlorate	39	27	11	5
Bldg 20034	Perchlorate	0	0	0	0

The results of the perchlorate analysis of surface/near-surface and subsurface soil samples collected at Source Area 11D and other features in the Building 20022 Area are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations for perchlorate are shown in Figures 4.2-13 and 4.2-14, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 4.2-2.

Surface and Near-Surface Soil – Perchlorate:

- Thirty-nine primary and 18 duplicate surface and/or near-surface soil samples were collected at 27 locations at Source Area 11D and other features in the Building 20022 Area and analyzed for perchlorate.
- Perchlorate was not detected above its RISL or PGW SSL in the surface/near-surface soil samples collected at Source Area 11D and other features in the Building 20022 Area.

Subsurface Soil – Perchlorate:

- Eleven primary and one duplicate subsurface soil samples were collected at 5 locations at Source Area 11D and other features in the Building 20022 Area and analyzed for perchlorate.
- Perchlorate was not detected above the PQL or its RISL and/or PGW SSL in any of the subsurface soil samples collected at Source Area 11D and other features in the Building 20022 Area.

Summary of Investigation and Results - Total Petroleum Hydrocarbons

A total of 53 primary and 17 duplicate soil samples were collected at Source Area 11D and other features in the Building 20022 Area during the BOU RI and analyzed for TPH-D and TPH-Mo. The number of primary soil samples and sampling locations for TPH-D and TPH-Mo are summarized on Table 4.2-7 and below. Summary statistics for the samples are also presented on Table 4.2-7.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
11D	TPH-D & Mo	36	29	15	7
Bldg 20034	TPH-D & Mo	2	2	0	0

The results of TPH analysis (TPH-D and TPH-Mo) of surface/near-surface and subsurface soil samples collected at Source Area 11D and other features in the Building 20022 Area are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations and TPH-D and/or TPH-Mo detected at concentrations above their PGW SSLs are shown in Figure 4.2-14. Soil sampling locations and the features being investigated are cross-referenced on Table 4.2-2.

Surface/Near-Surface Soil – TPH:

- Thirty-eight primary and 16 duplicate surface/near-surface soil samples were collected at 31 locations at Source Area 11D and other features in the Building 20022 Area and analyzed for TPH-D and TPH-Mo. Surface/near-surface soil sampling locations in the Building 20022 Area are shown in Figure 4.2-3.
- TPH-D and/or TPH-Mo were detected above their respective PGW SSLs in four surface and/or near-surface soil samples collected at four locations at Source Area 11D and other features in the Building 20022 Area. TPH-D and TPH-Mo detected above their PGW SSLs and the location of the detections are summarized on the table below. TPH-D and TPH-Mo concentrations above their PGW SSLs are shown in Figure 4.2-14.

Sample Location	Depth (ft bgs)	Compound	PGW SSL (mg/kg)	Conc. (mg/kg)	> PGW SSL
11D-SB04	1.0	TPH-D	100	140	Y
		TPH-Mo	500	490	N
11D-SB05	1.0	TPH-D	100	1,400	Y
		TPH-Mo	500	4,200	Y
A20-RB37-SB01	1.0	TPH-D	100	270	Y
		TPH-Mo	500	430	N
A20-RX73-SB03	1.0	TPH-D	100	250	Y
		TPH-Mo	500	940	Y

Subsurface Soil – TPH:

- Fifteen primary and one duplicate subsurface soil samples were collected at seven locations at Source Area 11D, Building 20034, and other features in the Building 20022 Area and analyzed for TPH-D and TPH-Mo. Subsurface soil sampling locations for TPH in the Building 20022 Area are shown in Figures 4.2-4 and 4.2-14.
- TPH-D was not detected at concentrations above its PGW SSL of 100 mg/kg in the subsurface soil samples collected at Source Area 11D and other features in the Building 20022 Area.
- As presented on the table below, TPH-Mo above its PGW SSL of 500 mg/kg was detected in only one subsurface soil sample collected at one location at Source Area 11D and the Building 20022 Area (Figures 4.2-4 and 4.2-14). TPH-Mo was not detected above the PGW SSL in subsurface soil samples collected from the following borings where TPH-Mo was detected in surface soil: 11D-SB05, A20-RB37-SB01, and A20-RX73-SB03.

Sample Location	Depth (ft bgs)	Compound	PGW SSL (mg/kg)	Conc. (mg/kg)	> PGW SSL
A20-RC29-SB01	5.0	TPH-D	100	6.3	N
		TPH-Mo	500	620	Y
	11	TPH-D	100	27	N
		TPH-Mo	500	180	N
	18	TPH-D	100	1.1 J	N
		TPH-Mo	500	2.4 J	N
	23	TPH-D	100	1.0 J	N
		TPH-Mo	500	2.3 J	N
	28	TPH-D	100	1.8 J	N
		TPH-Mo	500	6.2	N
	33	TPH-D	100	1.6	N
		TPH-Mo	500	4.7	N

Summary of Investigation and Results - Miscellaneous Compounds

Miscellaneous analyses performed on soil samples collected at Source Area 11D and other features in the Building 20022 Area were total cyanide, NDMA, pH, TOC, CEC, and/or DI-WET. The number of primary surface/near-surface and subsurface soil samples collected at each source area for each analysis and the numbers of locations are summarized on the table below.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
11D & Bldg 20034	Total Cyanide	37	25	10	3
	NDMA	39	27	11	5
	pH	31	31	32	12
	TOC	3	3	18	3
	CEC	3	3	18	3
	DI-WET	0	0	1	1

The analytical results for the miscellaneous analysis of surface/near-surface and subsurface soil samples are presented in Appendix G and summarized below.

Total Cyanide: Total cyanide was not detected above its RISL or PGW SSL in the surface/near-surface or subsurface soil samples collected at Source Area 11D and other features in the Building 20022 Area.

N-Nitrosodimethylamine: NDMA was not detected at concentrations above the PQL or its RISL and PGW SSL in surface/near-surface and

subsurface soil samples collected at Source Area 11D and other features in the Building 20022 Area (Figures 4.2-11 and 4.2-14).

pH: The results of pH analysis of 31 surface/near-surface and 32 subsurface soil samples, including duplicates, collected at Source Area 11D and other features in the Building 20022 Area are presented below. The pH of the soil was generally within the normal range (5 to 9) for mineral soils (Brady, 1974).

Source Area	Surface/ Near-Surface Soil	Subsurface Soil
11D	6.02 – 8.63	6.70 - 9.23
Bldg 20034	6.48 – 8.40	7.03 – 9.20

Total Organic Carbon: TOC was detected in only one soil sample collected at Source Area 11D in the Building 20022 Area. TOC at 15,000 mg/kg was detected in a soil sample collected from boring 11D-SB04 at 1 foot bgs.

Cation Exchange Capacity: CEC in the three near-surface soil samples collected at Source Area 11D and other features in the Building 20022 Area were 31, 320, and 350 meq/K. CEC in the subsurface soil samples collected at Source Area 11D and other features in the Building 20022 Area ranged from 100 to 550 meq/K.

Deionized Water - Waste Extraction Test: A DI-WET was performed on one (11D-SB08) sample collected at Source Area 11D at a depth of 5 feet bgs. The sample extract was analyzed for arsenic. The arsenic concentration detected in the soil sample and the sample extract are presented on the table below. The detected concentration of arsenic is below background.

Sample ID	Sample Depth (ft bgs)	Compound	Soil Concentration (mg/kg)	Extract Concentration (mg/L)
11D-SB08	5.0	Arsenic	10.0	0.0017

Summary of Investigation and Results – Geotechnical Parameters

A total of 63 soil samples were collected at the source areas within Administration Area East for geotechnical parameters. The results of the geotechnical analyses of the soil samples for moisture content, wet

density, dry density, specific gravity, porosity, sieve analysis, and/or permeability are summarized on Table 4.2-6.

The geotechnical data will be used in the risk assessment to develop site-specific soil input parameters (moisture content, water-filled porosity, air-filled porosity, etc.) for fate and transport models and in the feasibility study to assess potential remedial actions such as vapor extraction. Fate and transport models are used in risk assessment to quantitatively evaluate the migration of volatile organics into outdoor and indoor air and the potential leaching of chemicals through soil and into groundwater.

4.2.8 Discussion of Investigation Results with Respect to Data Quality Objectives – Building 20022 Area

The analytical results presented in the previous section identified the following chemical constituents in soil vapor or soil at Source Area 11D and other features in the Building 20022 Area at concentrations above their respective RISLs and/or PGW SSLs.

Soil vapor: Benzene, chloroform, PCE, and TCE.

Soil: Cadmium, lead, mercury, B(a)P, B(b&k)F, PCB Aroclor 1254, PCB Aroclor 1260, TPH-D, and TPH-Mo.

The presence of these COPCs in each source area is discussed below with respect to the data needs described in Section 4.2.6.3. Specifically,

- Has the investigation resulted in the sufficient characterization of the lateral and vertical distribution of each COPC in the vadose zone and identified a potential source for those COPCs?
- Has the investigation resulted in sufficient data to evaluate the potential for COPCs in soil to migrate into and degrade surface water and groundwater quality?
- Has the investigation resulted in data sufficient to support human health and ecological risk assessments and fate and transport modeling?
- Has the investigation resulted in sufficient data to evaluate the feasibility of remediating the identified compounds and concentrations to levels that do not pose a risk to human and ecological receptors or degrade surface water and groundwater quality?

For the purpose of this discussion, it is assumed that chemicals detected at concentrations above their RISL could potentially pose a risk to human health and chemicals detected above their PGW SSL could potentially migrate into groundwater or surface water. Sampling locations where VOCs, metals, and other non-VOCs (SVOCs, PCBs, perchlorate, NDMA, TPH-D, and TPH-Mo) were detected in surface and/or subsurface soil at concentrations above their respective PGW SSLs are shown in Figures 4.2-6, 4.2-10, 4.2-12, and 4.2-14.

The analytical results for surface water and groundwater within the Administration Area are discussed in Section 4.4 and 4.5 respectively and discussed with respect to potential soil and soil vapor sources at Source Area 11D and other features in the Building 20022 Area. Additionally, the potential for chemicals in soil and soil vapor to migrate into surface water and groundwater is further evaluated in Section 8 of the HHERA (Volume II).

4.2.8.1 *Volatile Organic Compounds*

VOCs detected in soil vapor samples collected at Source Area 11D and other features in the Building 20022 Area above their RISLs and/or PGW SSLs are summarized in Section 4.2.7.4. Soil vapor sampling locations are shown in Figure 4.2-2. TCE, PCE, and TVOC concentrations in the shallow, intermediate, and deep intervals above their RISLs are shown in Figure 4.2-5a. TVOC concentrations are also shown in Figure 4.2-5b. TCE, PCE, and vinyl chloride concentrations in soil vapor above their PGW SSLs are shown in Figure 4.2-6. Conclusions regarding the lateral and vertical characterization of VOCs and potential sources based on the data are summarized below:

- Chloroform, PCE, and TCE above their RISLs and PGW SSLs were detected in at least one soil vapor sample collected in the Building 20022 Area.
- Concentrations of PCE and TCE greater than their respective RISLs and PGW SSLs were detected in a shallow soil vapor sample (A20-RB37-SP01) collected adjacent to the ditch near the northwest corner of Building 20037, a chemical storage building. The most likely source of PCE and TCE at this location is the former solvent sump along the north side of Building 20037 (Figure 4.2-6).
- PCE was also detected above its RISL in an intermediate soil vapor sample collected at one (A20-RC29-SP01) location near RCRA C, a former decontamination area. The detection of PCE in the shallow

layer, although at a lower concentration, indicates that the PCE detected at this location may be due to a historical surface release to the Site 11D ditch.

As indicated by the TVOC symbols presented in Figures 4.2-5a and 4.2-5b, the lateral extent of TCE and PCE in the vadose zone in the Building 20022 Area has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

4.2.8.2 *Metals*

Cadmium and lead were the only metals detected in soil at Source Area 11D and other features in the Building 20022 Area at concentrations above background and their respective RISLs and/or PGW SSLs (Section 4.2.3.4). Concentrations of those metals above their RISLs and PGW SSLs are shown in Figures 4.2-9 and 4.2-10, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 4.2-2. The presence of each of those metals in soil with respect to the completeness of characterization, both laterally and vertically, and potential sources are discussed below.

Cadmium

Cadmium was detected at concentrations above its RISL and/or PGW SSL in seven surface/near-surface soil samples collected at six (11D-SNS14, 11D-SNS15, 11D-SNS16, 11D-SNS19, 11D-SNS22, and A20-RB37-SB01) locations at Source Area 11D and other features in the Building 20022 Area. Detections of cadmium above its RISL and/or PGW SSL are summarized in Section 4.2.7.4 and shown in Figures 4.2-9 and 4.2-10, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 4.2-2. Conclusions regarding the characterization of cadmium and potential sources of that metal to soil based on the data presented on the table and figures are summarized below.

11D-SNS14, 11D-SNS15, 11D-SNS16, 11D-SNS19, 11D-SNS22, and A20-RB37-SB01:

- All six sampling locations having concentrations of cadmium above its RISL and/or PGW SSLs are located along drainages in the eastern portion of the Administration Area (Figures 4.2-3, 4.2-9, and 4.2-10).

The presence of cadmium is attributed to surface water runoff from the various facilities.

- The detections of cadmium in samples collected along the ditch is variable, with samples containing cadmium above its RISL and/or PGW SSL situated between samples that do not have cadmium above its RISL and/or PGW SSL. The data indicate that cadmium is not homogenously distributed in soil along the ditch. However, the upstream extent of cadmium in soil in the ditch is defined by the absence of cadmium above its RISL and/or PGW SSL in soil samples A20-RB37-SB03 and 11D-SNS21. The extent of cadmium in the downstream portion of the Source Area 11D ditch was defined as part of the PGOU RI.
- Soil in the downstream extent of the Site 11D ditch (between sample locations 11D-SNS13 and 11D-SNS22) was removed in 2009 as part of the remedial effort associated with the PGOU. The soil from the southern portion of the Site 11D ditch was removed to prevent the migration of PCBs into downstream ditches (11D and 10D) within the PGOU.

Lead

Lead was detected at concentrations above its RISL and/or PGW SSL in five surface/near-surface soil samples collected at six (11D-SNS12, 11D-SNS14, 11D-SNS15, 11D-SNS16, and A20-RB37-SB01) locations at Source Area 11D and other features in the Building 20022 Area. Detections of lead above its RISL and/or PGW SSL are summarized in Section 4.2.7.4 and shown in Figures 4.2-9 and 4.2-10, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 4.2-2. Conclusions regarding the characterization of lead and potential sources of that metal to soil based on the data presented on the table and figures are summarized below.

- All five sampling locations having concentrations of lead above its RISL and/or PGW SSLs are located along drainages in the eastern portion of the Administration Area (Figures 4.2-3, 4.2-9, and 4.2-10). The presence of lead is attributed to surface water runoff from the various facilities and parking areas.
- Four (11D-SNS12, 11D-SNS14, 11D-SNS15, and 11D-SNS16) of the five samples containing lead above its RISL and/or PGW SSL was detected in the BOU portion of the Source Area 11D ditch west of Building 20022. The upstream extent of lead in soil in that portion of the ditch is defined by the absence of lead above its RISL and/or PGW SSL in soil

samples A20-RB37-SB02 and 11D-SNS21. The downstream extent of lead in that portion of the ditch is defined by the absence of that metal in soil samples collected at location 11D-SNS22.

- Soil was removed from the BOU portion of the Site 11D ditch system from Baltimore Street to Atlanta Street in 2009 as part of the remedial effort associated with the PGOU. The soil from the southern portion of the Site 11D ditch was removed to prevent the migration of PCBs into downstream ditches (11D and 10D) within the PGOU.
- The detection of lead in the near-surface soil sample collected at location A20-RB37-SB01 appears to be an isolated occurrence. The lateral extent of lead in soil at this location is defined by the absence of that metal above its RISL and PGW SSL in soil samples collected at locations A20-RB37-SB02 and A20-RB37-SB03. The vertical extent of lead is defined by the absence of that metal above its RISL and PGW SSL in the soil sample collected at 5 feet bgs from boring A20-RB37-SB01.

Based on the information presented above, the lateral and vertical extent of cadmium and lead at Source Area 11D and the Building 20022 Area have been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives. Additional evaluation of the potential risk to groundwater posed by those metals in soil is presented in Section 8 of the HHERA (Volume II).

4.2.8.3 *Semivolatile Organic Compounds*

B(a)P and B(b&k)F were the only SVOCs detected in soil at Source Area 11D and other features in the Building 20022 Area at concentrations above their respective RISLs and/or PGW SSLs. The presence of each of those compounds in soil with respect to the completeness of characterization, both laterally and vertically, and potential sources of those compounds to soil are discussed below.

Benzo(a)pyrene and Benzo(b&k)fluoranthene

B(a)P and B(b&k)F detected at concentrations above their RISLs and/or PGW SSLs are summarized in Section 4.2.7.4. B(a)P concentrations above its RISL are shown in Figure 4.2-11. B(a)P and B(b&k)F concentrations above their PGW SSLs are shown in Figure 4.2-12. Soil sampling locations and the features being investigated are cross-referenced on Table 4.2-2. Conclusions regarding the characterization of B(a)P and B(b&k)F and

sources of those compounds, based on the data presented on the table and figures, are summarized below.

11D-SNS17 and 11D-SNS22:

B(a)P and B(b&k)F were detected above their RISLs and/or PGW SSLs in near-surface (0.5 and 2.5 feet bgs) soil samples collected at locations 11D-SNS17 and 11D-SNS22. Locations 11D-SNS17 and 11D-SNS22 are in the ditch west of Building 20030 (drum storage area) (Figures 4.2-11 and 4.2-12). The downstream extent of these compounds was defined as part of the PGOU. The upstream extent of B(a)P and B(b&k)F is defined by the absence of those compounds above their RISLs and PGW SSLs in soil samples collected at location 11D-SNS16. Soil containing PCBs and any other constituents was removed from this section of the ditch in 2009 as part of the remedial action associated with the PGOU.

4.2.8.4 *Polychlorinated Biphenyls*

PCB Aroclors 1254 and 1260 were detected in soil at Source Area 11D and other features in the Building 20022 Area at concentrations above their respective RISLs and/or PGW SSLs. The presence of each of those compounds in soil with respect to the completeness of characterization, both laterally and vertically, are discussed below.

Aroclor 1254

Aroclor 1254 detected at concentrations above its RISL and PGW SSL are summarized in Section 4.2.7.4 and shown in Figures 4.2-13 and 4.2-14. Soil sampling locations and the features being investigated are cross-referenced on Table 4.2-2. Conclusions regarding the characterization of Aroclor 1254 and potential sources of that PCB to soil, based on the data presented on the table and figures, are summarized below:

- Aroclor 1254 was detected at concentrations above its RISL and/or PGW SSL in surface soil in two sections of the drainage in the Building 20022 Area:
  - Five locations (11D-SNS12 through 11D-SNS15, and A20-RC29) along the Source Area 11D drainage west of Building 20022; and
  - Three locations (A20-RB37-SB01 through A20-RB37-SB03) in the drainage surrounding Building 20037, a chemical storage building.
- The most likely source of PCBs to the Source Area 11D ditch is a former aboveground waste oil tank near the location of

A20-RC29-SB01. The RI for the PGOU identified PCBs in the ditch (Source Area 10D) downstream of Source Area 11D, indicating that PCBs originating from this area had migrated through the drainage system.

Soil containing PCBs and any other constituents was removed from these sections of the ditch in 2009 as part of the remedial action associated with the PGOU. The removal of soil from the ditch was performed to prevent the migration of PCBs into downstream ditches within the PGOU.

Aroclor 1260

The PCB Aroclor 1260 detected at concentrations above its RISL and PGW SSL are summarized in Section 4.2.7.4 and shown in Figures 4.2-13 and 4.2-14, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 4.2-2. Conclusions regarding the characterization of Aroclor 1260 and potential sources of that compound to soil, based on the data presented on the table and figures, are summarized below.

- Aroclor 1260 was detected above its RISL and/or PGW SSL in surface and/or near-surface soil samples collected at seven locations in the drainage ditch comprising Source Area 11D (Figures 4.2-13 and 4.2-14).
- Except for two locations (11D-SNS12 and 11D-SNS13), Aroclor 1260 was not detected above its RISL and/or PGW SSL at the same locations as those having Aroclor 1254. This indicates that while Aroclor 1260 may have combined with Aroclor 1254 in some locations, the sources of those two PCBs are different.
- The most likely source of Aroclor 1260 to the surface soil in the Source Area 11D drainages is discharges to the ditch from the various buildings or in surface water runoff from storage and handling areas.

Soil containing PCBs and any other constituents was removed from these sections of the ditch in 2009 as part of the remedial action associated with the PGOU. The removal of soil from the ditch was performed to prevent the migration of PCBs into downstream ditches within the PGOU.

4.2.8.5 *Total Petroleum Hydrocarbons*

TPH-D and TPH-Mo were detected in soil at Source Area 11D and other features in the Building 20022 Area at concentrations above their PGW SSLs. The presence of those compounds in soil is discussed below.

TPH-D and TPH-Mo were not characterized laterally and vertically to their PGW SSLs during the BOU RI. Decisions regarding the need for additional characterizations during the field effort were based on the presence of SVOCs above their screening levels.

TPH-D

TPH-D detected at concentrations above its PGW SSL are summarized in Section 4.2.7.4 and shown in Figure 4.2-14. Soil sampling locations and the features being investigated are cross-referenced on Table 4.2-2. The presence of TPH-D in soil based on the data presented on the table and figures is summarized below.

- TPH-D was detected at concentrations above its PGW SSL only in near-surface soil samples collected at four locations in the Building 20022 Area.
- As shown in Figure 4.2-14, TPH-D was detected above its PGW SSL in surface soil samples at 1 foot bgs at the following four locations:
  - Borings 11D-SB04 and 11D-SB05, east of Building 20030;
  - One location (A20-RB37-SB01) in the ditch north of Building 20037, a chemical storage building; and
  - One location (A20-RX73-SB03) near Building 20B73 (RCRA X).
- The vertical extent of TPH-D in borings 11D-SB04, 11D-SB05, A20-RB37-SB01, and A20-RX73-SB03 is defined by the absence of that compound above its PGW SSL in soil samples collected at 5 feet bgs from each of those borings.
- The lateral extent of TPH-D around borings 11D-SB04 and 11D-SB05 is not well characterized, but is generally defined by the absence of that compound above its PGW SSL in soil samples collected at locations 11D-SB01, 11D-SB02, A20-RX73-SB01, and A20-RX73-SB02.
- The upstream extent of TPH-D detected in boring A20-RX73-SB01 is defined by the drainage swale and the absence of that compound above its PGW SSL in soil samples collected at location A20-RB37-SB03. The downstream extent is defined by the absence of that compound above its PGW SSL in soil samples collected at location A20-RB37-SB02.

Based on the information presented above, the lateral and vertical extent of TPH-D at Source Area 11D and the Building 20022 Area has been sufficiently characterized to evaluate potential risks to human health,

surface water, and groundwater and, if necessary, develop remedial alternatives.

TPH-Mo

TPH-Mo detected at concentrations above its PGW SSL is summarized in Section 4.2.7.4 and shown in Figure 4.2-14. Soil sampling locations and the features being investigated are cross-referenced on Table 4.2-2. Conclusions regarding the presence of TPH-Mo in soil based on the data are summarized below.

- As shown in Figure 4.2-14, TPH-Mo was detected above its PGW SSL in surface and/or near-surface (1 foot bgs) soil samples collected at the following two locations in the Building 20022 Area:
  - Boring 11D-SB05, east of Building 20030; and
  - Boring A20-RX73-SB03 near Building 20B73 (RCRA X).
- Figure 4.2-14 also shows that TPH-Mo was detected above its PGW SSL in only one subsurface soil sample collected from one boring (A20-RC29-SB01). Boring A20-RC29-SB01 is near the former location of a waste oil AST.

The characterization of TPH-Mo at the seven locations listed above is discussed below.

Borings 11D-SB05 and A20-RX73-SB03:

- The vertical extent of TPH-Mo in these borings is defined by the absence of that compound above its PGW SSL in soil samples collected at 5 feet bgs.
- The lateral extent of TPH-Mo above its PGW in surface soil around each of the two borings has not been completely characterized. As previously indicated, TPH-Mo was not characterized laterally and vertically to its PGW SSL during the BOU RI. Decisions regarding the need for additional characterizations during the field effort were based on the presence of SVOCs above their screening levels.

A20-RC29-SB01:

TPH-Mo was detected above its PGW SSL in a soil sample collected at 5 feet bgs in boring A20-RC29-SB01.

- The vertical extent of TPH-Mo is limited to the upper 11 feet of soil, as defined by the absence of that compound above its PGW SSL in samples collected at 11, 18, 23, 28, and 33 feet bgs.
- The lateral extent of TPH-Mo in the vicinity of A20-RC29-SB01 is not well characterized. As previously indicated, TPH-Mo was not characterized laterally and vertically to its PGW SSLs during the BOU RI. Decisions regarding the need for additional characterizations during the field effort were based on the presence of SVOCs above their screening levels.
- Soil was removed from the BOU portion of the Site 11D ditch system from Baltimore Street to Atlanta Street in 2009 as part of the remedial effort associated with the PGOU. The soil from the southern portion of the Site 11D ditch was removed to prevent the migration of PCBs into downstream ditches (11D and 10D) within the PGOU.

Based on the information presented above, the lateral and vertical extent of TPH-Mo at Source Area 11D and the Building 20022 Area has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

4.3 SUMMARY AND RESULTS OF VADOSE ZONE REMEDIAL INVESTIGATIONS – ADMINISTRATION AREA WEST

Administration Area West encompasses nine source sites and various other features investigated during the BOU RI (Figures 4.1-1 and 4.3-1). To simplify the discussions and presentation of data, the Administration Area West has been divided into three zones that encompass source sites and other investigated features that are related or in proximity to one another. The three investigation zones in Administration Area West are:

- **Administration Area West Open Ditch System –** All or portions of five drainage ditches and catch basins identified as Source Sites 5D, 9D, 12D, D(b), and D(d);
- **Building 20009 Area –** Two Source Sites (6D and 52D), including a former waste oil tank and treatment basin in and around Building 20009; and
- **Former Sewage Treatment Plant Area –** Two Source Sites [8D and D(c)] associated with the Aerojet FSTP, and former RCRA Units W and Y.

This section provides the following information for each of the three areas of investigation in Administration Area West:

- Describes the area of investigation;
- Describes each of the source areas and other features, including septic tanks, investigated during the previous (prior to 2005) investigations and the BOU RI;
- Summarizes previous vadose zone investigations and the results of those investigations;
- Identifies COPCs identified during the previous investigations;
- Presents the data needs identified in the BOU FSP;
- Summarizes the sampling activities performed during the BOU RI and deviations from the sampling proposed in the BOU FSP;
- Presents the analytical results for samples collected during the BOU RI and historical data, where appropriate; and
- Provides a discussion of the investigation results, which includes the identification of COPCs, lateral and vertical characterization of COPCs, fate and transport of the COPCs, and the potential for those COPCs to pose a potential risk to human health or degrade surface water and groundwater quality.

The information presented below regarding the description of source areas and previous investigations was compiled from one or more of the following sources*: Stage 1 Sampling Plan-Zone 1* (Aerojet, 1993a); *Stage 1 Sampling Plan-Zones 3 and 4* (Aerojet, 1993b); *Stage 1 Sampling Plan-Zone 2* (Aerojet, 1993c); *Aerojet Superfund Site – Scoping Report, Volumes 1 through 6* (ICF Technology, Inc., 1989); *Aerojet Site; Stage 1 Report - Zones 1 through 4* (ICF Kaiser Engineers, Inc., 1993); or BOU FSP (Aerojet et al., 2006b).

4.3.1 *Administration Area West Open Ditch System – Administration Area West*

The Administration Area West Open Ditch System consists of Source Areas 5D, 9D, 12D, D(b) and D(d), as shown in Figure 4.3-1. The Administration Area West Open Ditch System receives surface runoff and discharge from the drainage system, which is comprised of underground pipes and drains and open drains connected to buildings in the Administration Area West.

The Administration Area West Open Ditch System empties into the main Administration Ditch, which discharges to the Westlakes Storm Water Retention Ponds. Storm water runoff is staged in the Westlakes Ponds where it is allowed to infiltrate or, when the Westlakes become full, is discharged to Buffalo Creek and ultimately to the American River. Storm water discharges to Buffalo Creek/American River are regulated through the NPDES (RWQCB, 2002).

4.3.1.1 *Description of Source Areas – Administration Area West Open Ditch System*

The five source areas [5D, 9D, 12D, D(b), and D(d)] that comprise the Administration Area West Open Ditch System are described below. Additionally, various site features associated with those sources that may have contributed chemicals to soil in those source areas and Administration Area groundwater are also described. The source areas and associated site features are shown in Figure 4.3-1.

<u>Source Area 5D</u>

Source Area 5D includes the north-south trending ditch west of Building 20009 and the east-west trending ditch south of Building 20009. The Source Area 5D ditches are downstream of Source Area ditches 7D, 10D, 11D, and D(d) and received drainage from those source areas. Source Area 5D may have also received drainage from Building 20009, the west side of Building 20015, the Sacramento Municipal Utility District (SMUD) substation, and from drop inlets or catch basins between these buildings and the open ditch. Underground drains originating from Buildings 20009 and 20015 may have also been connected to the ditches. Building 20009 was previously owned by the United States Air Force (USAF) and has been identified as a manufacturing building that generated waste material, including dilute chemicals, oils, used solvents, PCB/mercury antifouling agents, and miscellaneous chemicals. Drainage from Buildings 20015/20025 potentially included dilute-treated plating chemicals and photo-rinse water. Industrial activities at other buildings potentially associated with the 5D open ditch may have included liquid rocket engine manufacturing, sewage treatment and waste, and fuel oil storage. The *Industrial and Domestic Waste Control Report* (Aerojet, 1961) indicated that 40 gallons per day of dilute-plating chemicals were neutralized, reduced, and discharged to a surface drain. The report also indicates that 4,000 gallons per day of photo-rinse water were discharged to a surface drain.

Features associated with Source Area 5D that could have contributed to chemicals include the 5D drainage ditch, the drainage ditch downstream of Building 20027, a former waste-oil UST west of Building 20009, and various surface water runoff collection areas within the source area.

Source Area 9D

Source Area 9D is the ditch along Alabama Avenue, approximately 300 feet north of the FSTP. The ditch is downstream of Source Areas 4D, 5D, 7D, 10D, and 11D and may have received drainage from those source areas. Additionally, the ditch likely received surface runoff from Alabama Avenue, the parking lot south of Alabama Avenue, the areas around Buildings 20012 and 20018 (part of the FSTP), and Buildings 20019 and 20025 (former engineering buildings). Building activities included sewage treatment and office and engineering work. Sewage treatment plant effluent and cooling water were discharged to the Source Area 9D ditch. *The Industrial and Domestic Waste Control Report* (Aerojet, 1961) indicated that 375,000 gallons per day of sewage treatment plant effluent were discharged to a surface drain from Building 20018. The report also indicated that 6,000 gallons per day of cooling water were discharged to a surface drain from Building 20004, a liquid rocket engine manufacturing building.

Features associated with Source Area 9D that could have contributed chemicals include the 9D drainage ditch and various surface water runoff collection areas at the source area.

Source Area 12D

Source Area 12D is the ditch located southeast of the Nimbus-Alabama intersection approximately 1,600 feet west of Building 20025. Source Area 12D is downstream of Source Areas 4D, 5D, 6D, 7D, 8D, 9D, 10D, 11D, 52D, D(b), and D(c) and could have potentially received discharge from these source areas and from the sewage treatment plant and Building 20095 (large covered holding tank). The *Industrial and Domestic Waste Control Report* (Aerojet, 1961) indicated that 375,000 gallons per day of sewage treatment plant effluent were discharged to a surface drain from Building 20012.

Features associated with Source Area 12D that could have contributed to chemicals include the western portion of the 12D east-west drainage ditch and various runoff collection areas at the source area.

Source Area D(b)

Source Area D(b) consists of trenches that extend from the southwest corner of Building 20009 in the western portion of the area. Building 20009 was previously owned by the USAF and was a manufacturing building that generated waste materials including diluted chemicals, oils, used solvents, and miscellaneous chemicals. Several of the operations within and around Building 20009 are associated with Source Area 52D discussed later in this report. The Source Area D(b) trenches may have received drainage from a storage area on the south side of Building 20009. Source Area D(b) discharges to the adjacent Source Area 5D ditch.

Features associated with Source Area D(b) that could have contributed chemicals include the shallow drainage trench receiving discharge from the hazardous waste storage area, dye pen sump, film developing lab, sandblast area, and floor drains in the southwest corner of Building 20009; a second shallow drainage trench receiving storm water runoff from the roof and areas adjacent to Building 20009; the concrete culvert draining the southwest corner of Building 20009; and the dye pen sump located in the southwest corner of Building 20009.

Source Area D(d)

Source Area D(d) is identified as a drop inlet/catch basin 100 feet west of Building 20015/20025 and 100 feet south of the SMUD Substation fence line. The catch basin is part of the storm drain system used to control surface water run off. The catch basin was not part of any waste drainage system; only surface water flowed into the catch basin.

Features associated with Source Area D(d) that could have contributed chemicals include the grated drop inlet receiving storm water runoff from Bridgeport Avenue and the adjacent parking lot.

4.3.2 *Summary and Results of Previous (Pre-2005) Vadose Zone Investigations – Administration Area West Open Ditch System*

The following subsections summarize the scope and results of previous (prior to 2005) vadose zone investigations of the five source areas that comprise the Administration Area West Open Ditch System, identify COPCs based on the previous investigations, and discuss the DQOs and sampling proposed in the BOU FSP.

4.3.2.1 *Summary of Previous (Pre-2005) Vadose Zone Investigations – Administration Area West Open Ditch System*

Soil samples from 44 soil borings and 40 soil vapor samples were collected in the vicinity of Source Areas 5D, 9D, 12D, D(b), and D(d) between 1979 and 1993. Soil vapor samples were analyzed for VOCs and soil samples were analyzed for VOCs, SVOCs, and/or metals. Previous investigations of those source areas conducted between 1979 and 1993 are described below.

Source Area 5D

Previous vadose zone investigations were conducted at Source Area 5D in November 1979, May and July 1980, 1983, May 1986, December 1992, and March 1993. The scope of those investigations is outlined below:

- November 1979 – Two surface and near-surface (SNS) soil samples were collected and analyzed for selected VOCs.
- May 1980 – One soil boring was completed to a depth of 18 feet bgs. Soil samples were collected and analyzed for selected VOCs.
- January 1983 – Two surface soil samples were collected in 1983 and analyzed for selected VOCs.
- May 1986 – Shallow soil samples were collected at 11 locations and analyzed for selected VOCs and metals.
- 1992 – Two soil borings were advanced to collect samples between 5 and 15 feet bgs that were analyzed for selected VOCs and metals.
- March 1993 – Seven soil borings were advanced to collect samples between surface and 2.5 feet bgs that were analyzed for selected metals. Five soil vapor extraction wells were advanced to collect samples that were analyzed for selected VOCs.

Source Area 9D

Previous vadose zone investigations were conducted at Source Area 9D in 1980 and 1983. The scope of those investigations is outlined below:

- 1980 – One soil boring was advanced to collect soil samples. Refusal was encountered at 5 feet bgs on cobbles, so only a surface soil sample was analyzed for VOCs.
- 1983 – Two surface soil samples were collected and analyzed for VOCs.

Source Area 12D

Previous vadose zone investigations were conducted at Source Area 12D in 1980, 1983, 1992, and 1993. The scope of those investigations is outlined below:

- 1980 – One soil boring was completed and nine soil samples were collected at depths ranging from 5 to 46 feet bgs. The soil samples were analyzed for selected VOCs.
- 1983 – Two surface samples were collected adjacent to the 1980 soil boring and analyzed for VOCs to complete the VOC profile.
- 1992/1993 – Nine soil borings were advanced to collect samples between surface and 3 feet bgs. Soil samples were analyzed for selected metals. Six soil vapor extraction wells were advanced to recorded depths of up to 16 feet bgs, and samples were collected and analyzed for selected VOCs.

Source Area D(b)

Source Area D(b) was investigated in 1993. Two soil vapor extraction wells were advanced to recorded depths of 10 to 15 feet bgs, and samples were collected and analyzed for selected VOCs.

Source Area D(d)

Source Area D(d) was investigated in 1992. Two soil vapor extraction wells were advanced to depths of up to 10 feet bgs, and samples were collected and analyzed for selected VOCs.

4.3.2.2 *Results of Previous (Pre-2005) Vadose Zone Investigations – Administration Area West Open Ditch System*

The results of the previous (prior to 2005) investigations of Source Areas 5D, 9D, 12D, D(b), and D(d), as presented in the BOU FSP (Aerojet et al., 2006), are summarized below.

Review of the previous data identified the following COPCs in soil and/or soil vapor within the source areas that comprise the Administration Area West Open Ditch System:

- **Soil -** VOCs, SVOCs, NDMA, PCBs, and metals.
- **Soil Vapor –**VOCs.

Figures showing previous sampling locations at the source areas within Administration Area West and chemical groups detected in soil samples collected between 1991 and 2005 above human health and ecological screening levels were presented in the BOU FSP (Aerojet et al., 2006b) and are included in Appendix E. The BOU FSP also presented a summary of statistics and the sample results for chemicals detected in soil, soil vapor, and groundwater that exceed human health and ecological screening levels in the Administration Area.

4.3.2.3 *Summary of Data Needs – Administration Area West Open Ditch System*

Based on a review of the previous vadose zone investigation data, extensive aerial photograph research and review, and exhaustive research of historical documents, Aerojet determined that additional soil and soil vapor sampling was needed to:

- Characterize the present lateral and vertical extent of VOCs, SVOCs, PCBs, perchlorate, TPH, pH, and metals in the vadose zone at the majority of the source areas and site features that may have contributed chemicals at concentrations that could potentially pose a risk to human and ecological receptors;
- Evaluate the potential for chemicals in soil to degrade surface or groundwater quality; and
- Obtain sufficient data to support fate and transport modeling, evaluation of risk to human and ecological receptors, and evaluation of potential remedial alternatives.

It should be noted that due to the time lapse (12 years) since the Stage 1 RI was performed and the elevated laboratory reporting limits for VOCs during that investigation, the investigation of VOCs performed during the BOU RI was designed to supersede all previous soil vapor and soil VOC investigation results.

4.3.3 *Summary and Results of Boundary Operable Unit Vadose Zone Investigation – Administration Area West Open Ditch System*

The following subsections summarize the recent (2005 to 2007) BOU investigation of the five source areas comprising the Administration Area West Open Ditch System, describe the site-specific geology and hydrogeology, describe deviations from sampling proposed in the approved BOU FSP, and summarize the results of the investigation. Conclusions regarding the completeness of characterization and potential

sources of constituents identified in the vadose zone are presented in Section 4.3.4.

4.3.3.1 *Summary of Boundary Operable Unit Vadose Zone Investigation – Administration Area West Open Ditch System*

The BOU RI of the vadose zone at the source areas [5D, 9D, 12D, D(b), and D(d)] that comprise the Administration Area West Open Ditch System is summarized below.

Soil Vapor Investigation

- Ten primary soil vapor samples were collected along the Administration West Open Ditch System and analyzed for VOCs, including an evaluation of the presence of TICs. Soil vapor sampling locations are shown in Figure 4.3-2.
- The total number of soil vapor samples collected within each potential source site (including QA/QC samples) and analyzed for VOCs are provided on Table 4.3-1.
- A cross-reference between soil vapor sampling locations along the Administration West Open Ditch System and the specific features they were sited to investigate are provided on Table 4.3-2.

Surface and Subsurface Soil Investigation

- A total of 72 primary and 12 duplicate surface and/or near-surface (0 to 2.5 feet bgs) and 44 primary and 4 duplicate subsurface (2.6 to 59 feet bgs) soil samples were collected within the five source areas comprising the Administration Area West Open Ditch System. Surface and subsurface soil sampling locations are shown in Figures 4.3-3 and 4.3-4, respectively.
- Surface soil samples were analyzed for SVOCs, metals (including hexavalent chromium), total cyanide, NDMA, PCBs, TPH-D, TPH-Mo, pH, TOC, CEC, and/or geotechnical parameters. The SVOC analysis of soil included an evaluation of the presence of TICs. In accordance with the BOU FSP, sample analysis was based on the analytical results from previous investigations and therefore every sample was not analyzed for the full suite of constituents.
- Subsurface soil samples were analyzed for SVOCs, metals, total cyanide, NDMA, PCBs, perchlorate, TPH-D, TPH-Mo, pH, TOC, CEC, and/or geotechnical parameters. The SVOC analysis of soil included an evaluation of the presence of TICs. In accordance with the BOU

FSP, sample analysis was based on the analytical results from previous investigations and therefore every sample was not analyzed for the full suite of constituents.

- The numbers of surface/near-surface and subsurface soil samples collected for each analysis (including QA/QC samples) at each of the five source areas along with the corresponding methods are provided on Tables 4.3-3 and 4.3-4.
- A cross-reference between surface/near-surface and subsurface soil sampling locations along the Administration West Open Ditch System and the specific features they were sited to investigate are provided on Table 4.3-2.

4.3.3.2 *Deviations from Data Quality Objectives and Sampling Design – Administration Area West Open Ditch System*

Sampling activities at Source Areas 5D, 9D, 12D, D(b), and D(d) during the RI were generally consistent with those proposed by the BOU FSP, with the exceptions listed on Tables 4.3-5, and 4.3-6. Sampling was performed at locations proposed in the BOU FSP and step-out sampling was performed in accordance with the procedures agreed upon with the Agencies. A comparison of proposed and actual soil and soil vapor sampling activities, including sampling rationale, sample depth, and analyses, is provided on Tables 4.3-5 and 4.3-6. Soil and soil vapor sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2.

4.3.3.3 *Site-Specific Geology and Hydrogeology – Administration Area West Open Ditch System*

The geology and hydrogeology of the area within and surrounding the Administration Area West Open Ditch System are described below. The descriptions are based on information presented on field logs of borings drilled during previous investigations and the BOU RI.

Geology

In general, the northern two-thirds of the Administration Area West were dredged to a depth of approximately 30 feet bgs while the southern one-third of the area remained undredged. While the actual reason that the southern portion of the area was not dredged is unknown; it is likely due to the presence of hard, indurated material or that assaying indicated that sufficient gold was not present in those areas.

The source area ditches comprising the Administration Area West Open Ditch System are constructed in both dredged and undredged areas of the Administration Area. The western portion of the Source Area 5D ditch and the lined drainage trenches that make up Source Area D(b) are within the dredged areas. The southern section of the Source Area 5D ditch, and Source Areas 9D, 12, and D(d) were constructed in undredged material.

Dredged materials typically consist of a mixture of sands, gravels, and cobbles in a silty, sandy, or clayey matrix. Because of the settlement of fines in the dredge ponds during dredging, the bottom of the dredge tailings is often identified as a layer of lean clays, clayey or sandy silts, with some sand and gravel.

Hydrogeology

Perched groundwater was encountered at depths ranging from 4 to 16 feet bgs along the western portion of the Source Area 5D ditch and at a depth of roughly 18 to 19 feet bgs in the Building 20009 Area. The extent of perched groundwater and the number of perched groundwater layers that may be present beneath the open ditch system has not been completely characterized. Due to the heterogeneity of the dredged material, thin localized layers of perched groundwater may be present throughout the dredged area. Perched groundwater was observed in two borings (5D-SNS15 and 52D-SP34) along the Source Area 5D ditch.

The FWBZ was encountered in the area close to Source Area 6D, adjacent to the western portion of the Source Area 5D ditch, at a depth of approximately 36 feet bgs. However, FWBZ was not encountered in other borings drilled to a depth of 36 feet bgs or greater in the same general area.

4.3.3.4 *Results of Boundary Operable Unit Vadose Zone Investigation – Administration Area West Open Ditch System*

The results of the VOC, metals, SVOC, PCB, perchlorate, TPH-D and TPH-Mo, total cyanide, NDMA, pH, TOC, CEC, DI-WET, and geotechnical analysis of the soil vapor and soil samples collected during the BOU RI are summarized below. The analytical data for soil vapor and soil samples are presented in Appendices F and G, respectively. A discussion of the results with respect to the completeness of the characterization of constituents identified above RISLs or PGW SSLs and potential sources is presented in Section 4.3.4.

Summary of Investigation and Results - Volatile Organic Compounds

Based on evaluation of the existing data for the Administration Area West Open Ditch System (Source Areas 5D, 9D, 12D, D[b], and D[d]), the BOU FSP concluded that additional soil vapor sampling was needed at one location at Source Areas 5D and D(b) to sufficiently characterize the nature and extent of VOCs. As indicated on the table below, 10 primary soil vapor samples were collected at 10 locations at source areas 5D and D(b) and analyzed for VOCs. The number of primary soil vapor samples analyzed for VOCs and sampling locations at Source Areas 5D, 9D, 12D, D(b), and D(d) are summarized on Table 4.3-1 and below. Summary statistics for the samples are also presented on Table 4.3-1.

Source Area	Interval Depth (feet bgs)	No. of Primary Samples	No. of Locations
5D	Shallow: 0-10	0	0
	Intermediate: 11-20	1	1
	Deep: 21-30	0	0
D(b)	Shallow: 0-10	5	5
	Intermediate: 11-20	3	3
	Deep: 21-30	1	1

The analytical results for the soil vapor samples collected from the shallow (0 to 10 feet bgs), intermediate (11 to 20 feet bgs), and deep (21 to 30 feet bgs) intervals at source areas 5D and D(b) are presented in Appendix F and summarized below. Soil vapor sampling locations in Administration Area West are shown in Figure 4.3-2. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 4.3-2.

TCE, PCE, vinyl chloride, and TVOC concentrations above their respective RISLs in the shallow, intermediate, and deep intervals at Sites 5D and D(b) are shown in Figure 4.2-5a. TVOC concentrations above RISLs are also illustrated in Figure 4.2-5b. TCE, PCE, and vinyl chloride concentrations in the soil vapor intervals above their PGW SSLs are shown in Figure 4.2-6.

The TVOC concentrations illustrated in Figures 4.2-5a and 4.2-5b represent the sum of the ratio of the concentration for each detected VOC in the sample divided by its RISL. For example, if PCE at a concentration of 320 $\mu g/m^3$ and TCE at a concentration of 961 $\mu g/m^3$ were the only VOCs detected in the samples, then the sum of their respective

concentrations divided by their respective RISLs of 320 and 961 µg/m^3 would be 2, or:

$$PCE = \frac{320\,\mu g/m^3}{320\,\mu g/m^3} = 1$$

$$TCE = \frac{961\,\mu g/m^3}{961\,\mu g/m^3} = 1$$

$$TVOC\ Ratio = 2$$

As agreed upon with the Agencies, soil vapor would be characterized during the BOU RI to the point where the TVOC concentration ratio was less than or equal to 10.

Cross sections presenting generalized vadose zone lithology and soil vapor sampling results in Administration Area West are presented in Figures 4.3-5 and 4.3-6.

Shallow Soil Vapor (0 to 10 feet bgs) – VOCs:

Five primary soil vapor samples were collected from the shallow layer at five locations at Source Area D(b) and analyzed for VOCs, including TICs. Soil vapor sampling locations in Administration Area West are shown in Figure 4.3-2. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 4.3-2.

- Volatile organic TICs were not detected in the shallow soil vapor samples.
- TCE was the only VOC detected at concentrations above its RISL of 961 µg/m^3. TCE at 1,100 µg/m^3 was detected in shallow soil vapor sample D(b)-SP03. Shallow soil vapor sampling locations and concentrations of TCE and TVOCs above RISLs are shown in Figure 4.2-5a. TVOC concentrations above RISLs are also shown in Figures 4.2-5b.
- PCE was the only VOC detected at concentrations at concentrations above its PGW SSL of 57 µg/m^3. PCE was detected in shallow soil vapor samples D(b)-SP03, D(b)-SP04, and D(b)-SP06 at 130, 120, and 68 µg/m^3, respectively (Figure 4.2-6).

Intermediate Soil Vapor (11 to 20 feet bgs) – VOCs:

Four primary soil vapor samples were collected from the intermediate layer at four locations at Source Areas 5D and D(b) along the Administration Area West Open Ditch System and analyzed for VOCs, including TICs. Soil vapor sampling locations in Administration Area West are shown in Figure 4.3-2. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 4.3-2.

- Volatile organic TICs were not detected in the intermediate soil vapor samples.
- VOCs were not detected in the intermediate soil vapor samples at concentrations above their respective RISLs.
- PCE was detected above its PGW SSL of 57 $\mu g/m^3$ in one sample. PCE at 200 $\mu g/m^3$ was detected in the intermediate sample collected at D(b)-SP06 (Figure 4.2-6).

Deep Soil Vapor (21 to 30 feet bgs) – VOCs:

In accordance with the approved step-out criteria, one soil vapor sample [D(b)-SP05] was collected from the deep (30 feet bgs) interval at Source Area D(b) and analyzed for VOCs, including TICs. Sampling location D(b)-SP05 is shown in Figure 4.3-2.

- Volatile organic TICs were not detected in the deep soil vapor sample.
- VOCs were not detected in the sample at concentrations above their respective RISLs and PGW SSLs.

Summary of Investigation and Results - Metals

A total of 95 primary and 14 duplicate soil samples were collected at the Source Areas 5D, 9D, 12D, D(b), and D(d) comprising the Administration Area West Open Ditch System during the BOU RI and analyzed for metals, including mercury. Additionally, 70 of the primary samples and 13 duplicates were analyzed for hexavalent chromium. The number of primary soil samples for metals and sampling locations at Source Areas 5D, 9D, 12D, D(b), and D(d) are summarized on Tables 4.3-3 and 4.3-4 and below. Summary statistics for the samples are also presented on Tables 4.3-3 and 4.3-4.

Source Area	Compound	Surface/Near-Surface No. of Samples	Surface/Near-Surface No. of Locations	Subsurface No. of Samples	Subsurface No. of Locations
5D	Metals	30	17	24	10
	Mercury	30	17	24	10
	Hex Chrome	25	14	18	6
9D	Metals	6	3	1	1
	Mercury	6	3	1	1
	Hex Chrome	6	3	1	1
12D	Metals	4	2	0	0
	Mercury	4	2	0	0
	Hex Chrome	4	2	0	0
D(b)	Metals	8	8	15	7
	Mercury	8	8	14	7
	Hex Chrome	7	7	8	3
D(d)	Metals	3	3	4	2
	Mercury	3	3	4	2
	Hex Chrome	1	1	0	0

The results of the metals analysis of surface/near-surface and subsurface soil samples collected at the source areas comprising the Administration Area West Open Ditch System are presented in Appendix G and summarized below.

Metals detected in soil within Administration Area West at concentrations statistically different from background and subsequently compared to screening levels were antimony, cadmium, chromium, copper, lead, mercury, molybdenum, silver, and zinc (Section 3.1.3.1). Because boron, hexavalent chromium, lithium, strontium, and titanium were not included in the background evaluation, concentrations of these metals were also compared to screening levels.

Surface/near-surface and subsurface soil sampling locations are shown in Figures 4.3-3 and 4.3-4, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 4.3-2. Cross sections showing the generalized lithology of the vadose zone within Administration Area West are provided in Figures 4.3-5 and 4.3-6.

Surface and Near-Surface Soil – Metals:

- Fifty-one primary surface/near-surface soil samples and 10 duplicates were collected at 33 locations (Figures 4.3-3, 4.3-7, and 4.3-8) along the Administration Area West Open Ditch System and analyzed for all metals (including mercury) with the exception of hexavalent chromium. Forty-three primary and 10 duplicate samples collected at 27 locations were also analyzed for hexavalent chromium.

- Cadmium, chromium, and lead were detected in 31 surface and/or near-surface soil samples collected at 21 locations at concentrations greater than their respective RISLs and/or PGW SSLs.
- The number of locations/soil samples having a metal at a concentration above its screening level within each source area, the metals detected above their SSL, and the maximum detected concentration of those metals are listed on the table below. Metals detected in surface and near-surface soil samples above their respective RISLs are shown in Figure 4.3-7. Metals detected in surface and near-surface soil samples above their respective PGW SSLs are shown in Figure 4.3-8.

Sample Location	Depth (ft bgs)	Metal	RISL (mg/kg)	PGW SSL (mg/kg)	Conc. (mg/kg)	> RISL	> PGW SSL
5D-SNS08	0.5	Cadmium	1.7	1.2	1.5	N	Y
		Lead	150	23	70	N	Y
	2.5	Cadmium	1.7	1.2	1.5	N	Y
		Lead	150	23	67	N	Y
5D-SNS09	0.5	Cadmium	1.7	1.2	1.6	N	Y
5D-SNS10	0.5	Cadmium	1.7	1.2	5.8	Y	Y
		Lead	150	23	100	N	Y
5D-SNS11	0.5	Cadmium	1.7	1.2	3.9	Y	Y
	2.5	Cadmium	1.7	1.2	6.4	Y	Y
5D-SNS12	0.5	Cadmium	1.7	1.2	42	Y	Y
		Chromium	211	500	160	N	N
		Lead	150	23	34	N	Y
	2.5	Cadmium	1.7	1.2	4.1	Y	Y
		Chromium	211	500	960	Y	Y
		Lead	150	23	76	N	Y
5D-SNS13	0.5	Cadmium	1.7	1.2	54	Y	Y
		Chromium	211	500	1,800	Y	Y
		Lead	150	23	140	N	Y
		Cadmium	1.7	1.2	15	Y	Y
	2.5	Chromium	211	500	380	Y	N
		Lead	150	23	29	N	Y
5D-SNS14	0.5	Cadmium	1.7	1.2	2.5	Y	Y
		Chromium	211	500	130	N	N
		Lead	150	23	50	N	Y
	2.5	Cadmium	1.7	1.2	9.4	Y	Y
		Chromium	211	500	1,800	Y	Y
		Lead	150	23	120	N	Y

Sample Location	Depth (ft bgs)	Metal	RISL (mg/kg)	PGW SSL (mg/kg)	Conc. (mg/kg)	> RISL	> PGW SSL
5D-SNS15	0.5	Cadmium	1.7	1.2	16	Y	Y
		Chromium	211	500	2,300	Y	Y
		Lead	150	23	260	Y	Y
	2.5	Cadmium	1.7	1.2	6.3	Y	Y
		Lead	150	23	110	N	Y
5D-SNS16	0.5	Cadmium	1.7	1.2	4.6	Y	Y
		Lead	150	23	65	N	Y
	2.5	Cadmium	1.7	1.2	3.9	Y	Y
		Lead	150	23	76	N	Y
5D-SNS17	0.5	Cadmium	1.7	1.2	5.6	Y	Y
		Chromium	211	500	460	Y	N
		Lead	150	23	130	N	Y
	2.5	Cadmium	1.7	1.2	2.3	Y	Y
		Lead	150	23	48	N	Y
5D-SNS18	0.5	Cadmium	1.7	1.2	1.7	Y	Y
		Lead	150	23	48	N	Y
	2.5	Lead	150	23	62	N	Y
5D-SNS19	0.5	Lead	150	23	41	N	Y
5D-SNS20	0.5	Cadmium	1.7	1.2	1.8	Y	Y
		Chromium	211	500	140	N	N
		Lead	150	23	150	N	Y
5D-SB03	1.0	Cadmium	1.7	1.2	190	Y	Y
		Chromium	211	500	5,300	Y	Y
		Lead	150	23	330	Y	Y
5D-SB04	1.0	Cadmium	1.7	1.2	1.7	N	Y
5D-SB06	1.0	Cadmium	1.7	1.2	9.6	Y	Y
		Chromium	211	500	670	Y	Y
		Lead	150	23	30.1	N	Y
5D-SB07	1.0	Cadmium	1.7	1.2	2.6	Y	Y
9D-SNS05	0.5	Cadmium	1.7	1.2	2.5	Y	Y
		Lead	150	23	24	N	Y
	2.5	Cadmium	1.7	1.2	1.7	N	Y
12D-SNS08	2.5	Cadmium	1.7	1.2	1.7	N	Y
D(b)-SD01	0	Cadmium	1.7	1.2	9.3	Y	Y
		Lead	150	23	29	N	Y
D(d)-SD01	0	Lead	150	23	120	N	Y

Subsurface Soil – Metals:

- Forty-four primary subsurface soil samples and four duplicates were collected at 20 locations within the Administration Area West Open Ditch System and analyzed for metals (Figures 4.3-4, 4.3-7, and 4.3-8). Forty-three of the 44 primary subsurface soil samples were also analyzed for mercury and 27 were analyzed for hexavalent chromium.

- Cadmium, chromium, and/or lead were detected above their respective RISLs or PGW SSLs in six subsurface soil samples collected at five locations.
- The metals detected above their screening levels, the depth at which the sample was collected, and the sampling locations are identified on the table below. Metals detected above their RISLs and/or PGW SSLs in subsurface soil samples at the source areas comprising the Administration Area West Open Ditch System are shown in Figures 4.3-7 and 4.3-8, respectively.

Sample Location	Depth (ft bgs)	Metal	RISL (mg/kg)	PGW SSL (mg/kg)	Conc. (mg/kg)	> RISL	> PGW SSL
5D-SNS13	10	Cadmium	1.7	1.2	4.7	Y	Y
5D-SNS14	10	Cadmium	1.7	1.2	4.7 160	Y	Y
5D-SNS15	5	Cadmium	1.7	1.2	4.0	Y	Y
	10	Cadmium	1.7	1.2	6.5	Y	Y
5D-SNS16	5	Cadmium	1.7	1.2	2.0	Y	Y
5D-SB02	5	Cadmium	1.7	1.2	25	Y	Y
		Chromium	211	500	1,100	Y	Y
		Lead	150	23	74	N	Y

Summary of Investigation and Results – Semivolatile Organic Compounds

A total of 59 primary soil samples and 7 duplicates were collected at the source areas [5D, 9D, 12D, D(b), and D(d)] comprising the Administration Area West Open Ditch System during the BOU RI and analyzed for SVOCs, including TICs. The number of primary soil samples and sampling locations for SVOCs at Source Areas 5D, 9D, 12D, D(b), and D(d) are summarized on Tables 4.3-3 and 4.3-4 and below. Summary statistics for the samples are also presented on Tables 4.3-3 and 4.3-4.

		Surface/Near-Surface		Subsurface	
Source Area	Compound	No. of Samples	No. of Locations	No. of Samples	No. of Locations
5D	SVOCs	26	14	9	2
9D	SVOCs	6	3	1	1
12D	SVOCs	4	2	0	0
D(b)	SVOCs	6	6	5	2
D(d)	SVOCs	2	2	0	0

The results of the SVOC analysis of surface/near-surface and subsurface soil samples collected at Source Areas 5D, 9D, 12D, and D(b) comprising the Administration Area West Open Ditch System are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations and B(a)P detected at concentrations above its RISL are shown in Figure 4.3-9. SVOCs detected at concentrations above their PGW SSLs are shown in Figure 4.3-10. Soil sampling locations and the features being investigated are cross-referenced on Table 4.3-2.

Surface and Near-Surface Soil – SVOCs:

- Forty-four primary and 7 duplicate surface and/or near-surface soil samples were collected at 27 locations in the source areas comprising the Administration Area West Open Ditch System during the BOU RI and analyzed for SVOCs, including TICs.
- TICs were not detected in the SVOC analysis of the surface and/or near-surface soil samples.
- SVOCs detected in surface and/or near-surface soil above their respective RISLs and/or PGW SSLs are listed on the table below. B(a)P detected at concentrations above its RISL is shown in Figure 4.3-9. B(a)A, B(a)P, B(b&k)F, and dibenz(a,h)anthracene [D(a,h)A] detected at concentrations above their respective PGW SSLs are shown in Figure 4.3-10.

Sample Location	Depth (ft bgs)	SVOC	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	> RISL	> PGW SSL
5D-SNS09	0.5	Benzo(a)anthracene	620	29	68	N	Y
		Benzo (a) pyrene	38	2.9	89	Y	Y
		Benzo (b&k) fluoranthene	38	29	230	N	Y
		Dibenz(a,h)anthracene	62	2.9	6.8	N	Y
	2.5	Benzo(a)anthracene	620	29	<7.7	N	N
		Benzo (a) pyrene	38	2.9	<7.7	N	N
		Benzo (b&k) fluoranthene	38	29	<15	N	N
		Dibenz(a,h)anthracene	62	2.9	<7.7	N	N
5D-SNS13	0.5	Benzo (a) pyrene	38	2.9	26	N	Y
		Benzo (b&k) fluoranthene	38	29	97	Y	Y
	2.5	Benzo (a) pyrene	38	2.9	<7.3	N	N
		Benzo (b&k) fluoranthene	38	29	19	N	N
5D-SNS14	0.5	Benzo (a) pyrene	38	2.9	32	N	Y
		Benzo (b&k) fluoranthene	38	29	96	Y	Y
	2.5	Benzo (a) pyrene	38	2.9	<75	?	?
		Benzo (b&k) fluoranthene	38	29	<150	?	?
5D-SNS15	0.5	Benzo (a) pyrene	38	2.9	41	Y	Y
		Benzo (b&k) fluoranthene	38	29	160	Y	Y
		Benzo (b) fluoranthene	620	29	130	N	Y

Sample Location	Depth (ft bgs)	SVOC	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	> RISL	> PGW SSL
	2.5	Benzo (a) pyrene	38	2.9	<7.3	N	?
		Benzo (b&k) fluoranthene	38	29	<15	N	N
		Benzo (b) fluoranthene	620	29	NA	?	?
5D-SNS16	0.5	Benzo(a)anthracene	620	29	47	N	Y
		Benzo (b&k) fluoranthene	38	29	260	Y	Y
	2.5	Benzo(a)anthracene	38	2.9	4.9	N	Y
		Benzo(a)pyrene	38	2.9	7.0	N	Y
		Benzo (b&k) fluoranthene	38	29	30	N	Y
5D-SNS18	0.5	Benzo (a) pyrene	38	2.9	14	N	Y
		Benzo (b&k) fluoranthene	38	29	38	N	Y
	2.5	Benzo (a) pyrene	38	2.9	<8.0	N	?
		Benzo (b&k) fluoranthene	38	29	<16	N	N
D(b)-SB04	1.0	Benzo(a)anthracene	620	2.9	49	N	Y
		Benzo (a) pyrene	38	2.9	59	Y	Y
		Benzo (b&k) fluoranthene	38	29	120	Y	Y
D(b)-SD01	0.0	Benzo (a) pyrene	39	2.9	21	N	Y
		Benzo (b&k) fluoranthene	38	29	75	Y	Y

Subsurface Soil – SVOCs:

- Fifteen primary subsurface soil samples were collected at five locations in the source areas comprising the Administration Area West Open Ditch System during the BOU RI and analyzed for SVOCs, including TICs.
- TICs were not detected in the SVOC analysis of the subsurface soil samples.
- SVOCs were not detected in the subsurface soil samples at concentrations above their respective RISLs.
- B(a)P was detected in one subsurface soil above its PGW SSL of 2.9 µg/kg. B(a)P at 7.2 µg/kg was detected in a soil sample collected from boring D(b)-SBO4 at a depth of 5 feet bgs (Figure 4.3-10).

Summary of Investigation and Results – Polychlorinated Biphenyls

A total of 13 primary and 4 duplicate soil samples were collected from the Administration Area West Open Ditch System during the BOU RI and analyzed for PCBs. The number of primary soil samples and sampling locations for PCBs at Source Areas 5D, 9D, 12D, and D(b) are summarized on Tables 4.3-3 and 4.3-4 and below. Summary statistics for the samples are also presented on Tables 4.3-3 and 4.3-4.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
5D	PCBs	5	3	5	1
9D	PCBs	0	0	0	0
12D	PCBs	0	0	0	0
D(b)	PCBs	1	1	0	0
D(d)	PCBs	2	2	0	0

The results of PCB analysis of surface and subsurface soil samples collected from the Administration Area West Open Ditch System are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations and PCBs 1254 and 1260 detected at Source Areas 5D, 9D, 12D, and D(b) at concentrations above their RISLs and PGW SSLs are shown in Figures 4.3-11 and 4.3-12, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 4.3-2.

Surface and Near-Surface Soil – PCBs:

- Eight primary and four duplicate surface/near-surface soil samples were collected at six locations in the Administration Area West Open Ditch System and analyzed for PCBs.
- Only two PCBs (Aroclor 1254 and Aroclor 1260) were detected at concentrations exceeding their respective RISLs and PGW SSLs in surface and/or near-surface soil samples from the Open Ditch System.
- The PCB Aroclors detected above their screening levels, the detected concentrations, and the depths and locations of the samples are identified on the table below and shown in Figures 4.3-11 and 4.3-12.

Sample Location	Depth (ft bgs)	PCB	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	> RISL	> PGW SSL
5D-SNS18	0.5	Aroclor 1260	220	34	100	N	Y
	2.5	Aroclor 1260	220	34	65	N	Y
5D-SB01	1.0	Aroclor 1254	220	34	76	N	Y
5D-SB06	1.0	Aroclor 1254	220	34	2,500	Y	Y
5D-SB07	1.0	Aroclor 1260	220	34	800	Y	Y
5D-SB09	1.0	Aroclor 1254	220	34	610	Y	Y
5D-SB10	1.0	Aroclor 1254	220	34	46	N	Y
D(b)-SD01	0.0	Aroclor 1260	220	34	170	N	Y

Subsurface Soil – PCBs:

- Five primary subsurface soil samples were collected at one location (5D-SB01) at Source Area 5D and analyzed for PCBs.
- PCBs were not detected at concentrations greater than their respective RISLs or PGW SSLs in subsurface soil samples collected at Source Area 5D.

Summary of Investigation and Results – Perchlorate

A total of 34 primary and 6 duplicate soil samples were collected at Source Areas 5D, 9D, 12D, and D(b) comprising the Administration Area West Open Ditch System during the BOU RI and analyzed for perchlorate. The number of primary soil samples and sampling locations at Source Areas 5D, 9D, 12D, and D(b) for perchlorate are summarized on Tables 4.3-3 and 4.3-4 and below. Summary statistics for the samples are also presented on Tables 4.3-3 and 4.3-4.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
5D	Perchlorate	21	11	4	1
9D	Perchlorate	0	0	0	0
12D	Perchlorate	0	0	0	0
D(b)	Perchlorate	5	5	2	1
D(d)	Perchlorate	2	2	0	0

The results of the perchlorate analysis of surface/near-surface and subsurface soil samples collected at Source Areas 5D, 9D, 12D, and D(b) comprising the Administration Area West Open Ditch System are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations and perchlorate detected at concentrations above its RISL and/or PGW SSL are shown in Figures 4.3-11 and 4.3-12, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 4.3-2.

Surface and Near-Surface Soil – Perchlorate:

- Twenty-eight primary and 6 duplicate surface and/or near-surface soil samples were collected at 18 locations in the source areas comprising the Administration Area West Open Ditch System and analyzed for perchlorate.

- Perchlorate was not detected in the surface and near-surface soil samples at concentrations exceeding its PQL, RISL, or PGW SSL.

Subsurface Soil – Perchlorate:

- Six primary subsurface soil samples were collected at two locations in the Administration Area West Open Ditch System and analyzed for perchlorate.
- Perchlorate was not detected in the subsurface soil samples at concentrations above its PQL, RISL, or PGW SSL.

Summary of Investigation and Results – Total Petroleum Hydrocarbons

A total of 42 primary and 10 duplicate soil samples for TPH were collected at the source areas comprising the Administration Area West Open Ditch System during the BOU RI. The number of primary soil samples and sampling locations at Source Areas 5D, 9D, 12D, and D(b) for TPH are summarized on Tables 4.3-3 and 4.3-4 and below. Summary statistics for the samples are also presented on Tables 4.3-3 and 4.3-4.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
5D	TPH-D	22	12	9	2
	TPH-Mo	22	12	9	2
9D	TPH-D	0	0	0	0
	TPH-Mo	0	0	0	0
12D	TPH-D	0	0	0	0
	TPH-Mo	0	0	0	0
D(b)	TPH-D	6	6	4	1
	TPH-Mo	6	6	4	1
D(d)	TPH-D	1	1	0	0
	TPH-Mo	1	1	0	0

The results of TPH-D and TPH-Mo analysis of surface/near-surface and subsurface soil samples collected from the Administration Area West Open Ditch System are presented in Appendix G and summarized below. Surface/near-surface sampling locations at Source Areas 5D, 9D, 12D, and D(b) and TPH-D detected at concentrations above its PGW SSL are shown in Figure 4.3-12. Soil sampling locations and the features being investigated are cross-referenced on Table 4.3-2.

Surface/Near-Surface Soil – TPH:

- Twenty-nine surface/near-surface soil samples were collected at 19 locations within the Administration Area West Open Ditch System and analyzed for TPH-D and TPH-Mo (Tables 4.3-3 and 4.3-4).
- Hydrocarbons detected at concentrations above their SSL, the locations, and the depths of the samples with the detected concentrations are summarized on the table below. TPH-D and TPH-Mo detected at concentrations above their PGW SSLs and the locations of the detections are shown in Figure 4.3-12.

Sample Location	Depth (ft bgs)	Compound	PGW SSL (mg/kg)	Conc. (mg/kg)	> PGW SSL
5D-SNS14	0.5	TPH-D	100	36	N
		TPH-Mo	500	91	N
	2.5	TPH-D	100	230	Y
		TPH-Mo	500	640	N
5D-SNS16	0.5	TPH-D	100	250	Y
		TPH-Mo	500	850	Y
	2.5	TPH-D	100	52	N
		TPH-Mo	500	180	N
D(b)-SB03	1	TPH-D	100	240	Y
		TPH-Mo	500	730	Y
D(d)-SD01	0.25	TPH-D	100	130	Y
		TPH-Mo	500	370	N

Subsurface Soil – TPH:

- Thirteen primary subsurface soil samples were collected at three locations within the Administration Area West Open Ditch System and analyzed for TPH-D and TPH-Mo. Subsurface soil sampling locations for TPH at Source Areas 5D and D(b) are shown in Figures 4.3-4 and 4.3-12.
- TPH-D and TPH-Mo were not detected in the subsurface soil samples at concentrations above their PGW SSLs.

Summary of Investigation and Results – Miscellaneous Compounds

Miscellaneous analyses performed on soil samples collected from the Administration Area West Open Ditch System [Source Areas 5D, 9D, 12D, and D(b)] were CEC, total cyanide, NDMA, pH, TOC, and/or DI-WET. The number of primary surface/near-surface and subsurface soil samples collected at each source area and the numbers of locations are summarized on the table below.

Source Area	Compound	Surface/Near-Surface No. of Samples	Surface/Near-Surface No. of Locations	Subsurface No. of Samples	Subsurface No. of Locations
5D	Total Cyanide	21	11	1	1
	NDMA	1	1	1	1
	pH	25	13	5	1
	TOC	1	1	0	0
	CEC	0	0	0	0
9D	Total Cyanide	0	0	0	0
	NDMA	0	0	0	0
	pH	6	3	1	1
	TOC	2	1	1	1
	CEC	2	1	1	1
12D	Total Cyanide	0	0	0	0
	NDMA	0	0	0	0
	pH	4	2	0	0
	TOC	0	0	0	0
	CEC	0	0	0	0
D(b)	Total Cyanide	4	4	2	1
	NDMA	0	0	0	0
	pH	9	9	17	8
	TOC	0	0	2	1
	CEC	0	0	2	1
D(d)	Total Cyanide	0	0	0	0
	NDMA	0	0	0	0
	pH	0	0	0	0
	TOC	0	0	0	0
	CEC	0	0	0	0
	DI-WET	0	0	1	1

The analytical results for the miscellaneous analysis of surface/near-surface and subsurface soil samples are presented in Appendix G and summarized below.

Total Cyanide: Total cyanide at concentrations above its RISL or PGW SSL was not detected in the surface/near-surface soil samples.

N-Nitrosodimethylamine: Surface and subsurface soil sampling locations for NDMA at Source Areas 5D, 9D, 12D, and D(b) are shown in Figures 4.3-11 and 4.3-12. NDMA was not detected in the surface/near-surface or subsurface soil samples above its PQL, RISL, or PGW SSL.

pH: The results of pH analysis of 51 surface/near-surface and 24 subsurface soil samples, including duplicates, collected from the Administration Area West Open Ditch System are presented below. The pH of the soil was within the normal range (5 to 9) expected for mineral soils (Brady, 1974).

Source Area	Surface/ Near-Surface Soil	Subsurface Soil
5D	5.27 – 8.68	7.91 – 7.97
9D	5.44 – 7.3	7.57
12D	5.81 – 6.52	NA
D(b)	6.81 – 8.3	7 – 8.02
D(d)	NA	NA

Total Organic Carbon: TOC in the surface/near-surface soil samples collected at Administration Area West Open Ditch System Source Areas 5D and 9D ranged from 5,800 to 20,300 mg/kg. TOC in the subsurface soil sample collected at Administration Area West Open Ditch System Source Area 9D was 6,200 mg/kg.

Cation Exchange Capacity: CEC in the surface/near-surface soil samples collected at Administration Area West Open Ditch System source areas ranged from 180 to 500 meq/K. CEC in the subsurface soil samples collected at Administration Area West Open Ditch System Source Areas 9D and D(b) ranged from 310 to 500 meq/K.

Deionized Water - Waste Extraction Test: A DI-WET was performed on one sample (AW-AF1-SB03) collected at Source Area D(b) at a depth of 11 feet bgs. The sample extract was analyzed for arsenic. The arsenic concentration detected in the soil sample and the sample extract are presented on the table below. The detected concentration of arsenic in the sample is not statistically above background.

Sample ID	Depth (ft bgs)	Compound	Soil Concentration (mg/kg)	Extract Concentration (mg/L)
AW-AF1-SB03	11	Arsenic	7.0	0.0042

Summary of Investigation and Results – Geotechnical Parameters

A total of 58 soil samples were collected from the Administration Area West, including the Source Areas [5D, 9D, 12D, and D(b)] comprising the Administration Area West Open Ditch System, for geotechnical parameters during the BOU RI. Additionally, 17 soil samples for geotechnical parameters were collected from portions of Administration Area West between 2005 and 2007 as part of the Johnson and Ettinger (J&E) Model Calibration Study (Geosyntec, 2008). The results of the geotechnical analyses of soil samples for moisture content, wet density,

dry density, specific gravity, porosity, sieve analysis, and/or permeability are summarized on Table 4.3-7.

The geotechnical data will be used in the risk assessment to develop site-specific soil input parameters (moisture content, water-filled porosity, air-filled porosity, etc.) for fate and transport models and in the feasibility study to assess potential remedial actions such as vapor extraction. Fate and transport models are used in risk assessment to quantitatively evaluate the migration of volatile organics into outdoor and indoor air and the potential leaching of chemicals through soil and into groundwater.

4.3.4 *Discussion of Investigation Results with Respect to Data Quality Objectives – Administration Area West Open Ditch System*

The analytical results presented in the previous sections identified the following chemical constituents in soil vapor and soil at the source areas comprising the Administration Area West Open Ditch System at concentrations above their respective at concentrations above their respective RISLs and/or PGW SSLs.

Soil vapor: PCE and TCE.

Soil: Cadmium, chromium, lead, B(a)A, B(a)P, B(b&k)F, B(b)F, D(a,h)A, PCB Aroclor 1254, PCB Aroclor 1260, TPH-D, and TPH-Mo.

The presence of these COPCs in each source area is discussed below with respect to the data needs described in Section 4.3.2.3. Specifically,

- Has the investigation resulted in the sufficient characterization of the lateral and vertical distribution of each COPC in the vadose zone and identified a potential source for those COPCs?
- Has the investigation resulted in sufficient data to evaluate the potential for COPCs in soil to migrate into and degrade surface water and groundwater quality?
- Has the investigation resulted in data sufficient to support human health and ecological risk assessments and fate and transport modeling?
- Has the investigation resulted in sufficient data to evaluate the feasibility of remediating the identified compounds and concentrations to levels that do not pose a risk to human and ecological receptors or degrade surface water and groundwater quality?

For the purpose of this discussion, it is assumed that chemicals detected at concentrations above their RISL could potentially pose a risk to human health and chemicals detected above their PGW SSL could potentially migrate into groundwater or surface water. Sampling locations where VOCs, metals, and other non-VOCs (SVOCs, PCBs, perchlorate, NDMA, TPH-D, and TPH-Mo) were detected in surface and/or subsurface soil at concentrations above their respective PGW SSLs are shown in Figures 4.2-6, 4.3-8, 4.3-10, and 4.3-12.

The analytical results for surface water and groundwater within the Administration Area are discussed in Section 4.4 and 4.5, respectively, and discussed with respect to potential soil and soil vapor sources in the Administration Area West Open Ditch System. Additionally, the potential for chemicals in soil and soil vapor to migrate into surface water and groundwater is further evaluated in Section 8 of the HHERA (Volume II).

4.3.4.1 *Volatile Organic Compounds*

VOCs detected in soil vapor samples collected at the source areas comprising the Administration Area West Open Ditch System are summarized in Section 4.3.3.4. TCE was the only VOC detected at a concentrations above its RISL and PCE was the only VOC detected at a concentrations above its PGW SSL. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 4.3-2. Conclusions regarding the characterization of TCE, both laterally and vertically, based on the data, are summarized below:

<u>Trichloroethene</u>

- TCE was detected at a concentration above its RISL in shallow (10 feet bgs) soil vapor at only one location [D(b)-SP03]. TCE and TVOC concentrations above their RISLs are shown in Figure 4.2-5a.
- TCE concentrations attenuate with depth and TCE concentrations at 20 feet bgs at location D(b)-SP03 were below its RISL.
- The lateral extent of TCE is defined by the absence of that compound above its RISL in soil vapor samples collected at locations D(b)-SP04, 52D-SP08, and AW-AF1-SP01.
- The concentration (of TCE detected in the soil vapor sample are less than 1 percent of the vapor saturation concentration for that compound. The detected concentrations are therefore not indicative of the presence of nonaqueous-phase liquid (NAPL).

Tetrachloroethene

- PCE was detected at concentrations above its PGW SSL in shallow (10 feet bgs) soil vapor samples collected at two [D(b)-SP03 and D(b)-SP04] and in shallow and intermediate (11 to 20 feet bgs) soil vapor samples collected at one location [D(b)-SP06] (Figure 4.2-6). PCE concentrations above its PGW SSL are shown in Figure 4.2-6. The characterization of PCE in soil vapor at those locations is discussed below.
- PCE concentrations in soil vapor at locations [D(b)-SP03 and D(b)-SP04] attenuate with depth. PCE was not detected above its PGW SSL in soil vapor samples collected from the intermediate (11 to 20 feet bgs) interval at either location.
- PCE concentrations above its PGW SSL in soil vapor at location D(b)-SP06 above its PGW SSL may extend to first groundwater.
- The lateral extent of PCE in soil vapor at concentrations above its PGW SSL in the vicinity of the Administration Area West Open Ditch System is shown in Figure 4.2-6.

Based on the information presented above, the lateral and vertical extent of VOCs at source areas within the Administration Area West Open Ditch System has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

4.3.4.2 *Metals*

Cadmium, chromium, and lead were the only metals detected in soil at the source areas comprising the Administration Area West Open Ditch System at concentrations above background and their respective RISLs and/or PGW SSLs. The presence of each of those metals in soil with respect to the completeness of characterization, both laterally and vertically, are discussed below.

Cadmium

Cadmium detected at concentrations above its RISL and PGW SSL are summarized in Section 4.3.3.4 and shown in Figures 4.3-7 and 4.3-8, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 4.3-2. Conclusions regarding the characterization of cadmium based on the data presented on the table and figures are summarized below.

- Cadmium above its RISL was detected in 22 surface and/or near-surface (0 to 2.5 feet bgs) soil samples collected at 16 locations (Figure 4.3-7).
  - The upstream extent of cadmium above its RISL in the north-south trending ditch west of Building 20009 is defined by the absence of that metal above its RISL in the surface and near-surface soil samples collected at location 5D-SNS08 (Figure 4.3-7).
  - The upstream extent of cadmium above its RISL in the east-west section of the 5D ditch south of Building 20009 is defined by the absence of that metal above its RISL in the surface and near-surface samples collected at location 5D-SNS19.
  - The detection of cadmium above its RISL in a near-surface soil sample collected at location 12D-SNS08 indicates that cadmium has migrated downstream and into the Western Administration Ditch. The extent of cadmium beyond location 12D-SNS08 is evaluated in Section 5.4.1 of this report.
  - Cadmium was detected above its RISL in soil samples collected at depths greater than 2.5 feet bgs at only five (5D-SN13 through 5D-SNS16 and 5D-SB02) locations and at depths greater than 5 feet at only three (5D-SNS13, 5D-SNS14, and 5D-SNS15) locations. As shown in Figure 4.3-7, these four locations are all located downstream of drain lines originating from Building 20022.
  - The most likely source of cadmium above its RISL in surface/near-surface soil from the 5D ditch are the drain lines and trenches [Source Area D(b)] originating from Building 20009.
- Cadmium above its PGW SSL was detected in 28 surface and/or near-surface (0 to 2.5 feet bgs) soil samples collected at 19 locations (Figure 4.3-8).
  - The presence of cadmium above its PGW SSL at location 5D-SNS08 indicates that cadmium was likely transported to the Administration Area West Open Ditch System from ditches addressed as part of the PGOU. The increased concentrations of cadmium observed in samples collected at locations 5D-SNS12 and 5D-SNS13 indicate that discharges of fluids from activities in Building 20009 were also a source of cadmium to the open ditches.
  - The detection of cadmium above its PGW SSL in a near-surface soil sample collected at location 12D-SNS08 indicates that cadmium has migrated downstream and into the Western Administration Ditch.

The extent of cadmium beyond location 12D-SNS08 is evaluated in Section 5.4.1 of this report.

- Cadmium was detected above its PGW SSL in soil samples collected at depths greater than 2.5 feet bgs at five (5D-SN13 through 5D-SNS16 and 5D-SB02) locations (Figure 4.3-8). As shown in Figure 4.3-8, these five locations are all located downstream of drain lines originating from Building 20022.
- The vertical extent of cadmium has not been completely characterized to the revised PGW SSL of 1.2 mg/kg. However, the vertical extent was characterized to the PGW SSL of 18 mg/kg proposed in the agency-approved BOU FSP (Aerojet et al., 2006b).

Chromium

Chromium detected at concentrations above its RISL and PGW SSL are summarized in Section 4.3.3.4 and shown in Figures 4.3-7 and 4.3-8, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 4.3-2. Conclusions regarding the characterization of chromium based on the data presented on the table and figures are summarized below:

- Chromium was detected at concentrations above its RISL in eight surface/near-surface soil samples collected at seven locations and above its PGW SSL in six surface/near-surface soil samples collected at six locations at source areas within the Administration Area West Open Ditch System (Figures 4.3-7 and 4.3-8).
  - The upstream extent of chromium above its RISL and PGW SSL is defined by the absence of that metal at concentrations above its screening levels in surface/near-surface soil samples collected at locations 5D-SNS08 and 5D-SNS09 (Figures 4.3-7 and 4.3-8).
  - The downstream extent of chromium above its RISL and PGW SSL is defined by the absence of that metal at concentrations above its screening levels in surface/near-surface soil samples collected at locations 12D-SNS09 and 12D-SNS08.
- Chromium above its RISL was detected in only one subsurface soil sample (Figure 4.3-7). Chromium at 1,100 mg/kg was detected in a soil sample collected at 5 feet bgs from boring 5D-SB02. The vertical extent of chromium above its RISL is defined by the absence of that metal above its RISL in soil samples collected at 11, 23, 35, and 39 feet bgs from boring 5D-SB02.

- Chromium above its PGW SSL was detected in only one subsurface soil sample collected from one boring (5D-SB02). The vertical extent of chromium in boring 5D-SB02 is defined by the absence of that metal above its PGW SSL in soil samples collected at 11, 23, 35, and 39 feet bgs from boring 5D-SB02.

The distribution of chromium in the samples indicates that, as with cadmium, the most likely source of that metal to the 5D ditch are the drain lines originating from Building 20009 and from a historical discharge involving pickling, plating, or anodizing solutions containing metals to the bermed pond (Source Area 6D).

Lead

Lead detected at concentrations above its RISL and/or PGW SSL are summarized in Section 4.3.3.4 and shown in Figures 4.3-7 and 4.3-8, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 4.3-2. Conclusions regarding the characterization of lead based on the data presented on the table and figures are summarized below:

- Lead was not detected at concentrations above its RISL in the surface/near-surface or subsurface soil samples collected at source areas within the Administration Area West Open Ditch System.
- Lead was detected at concentrations above its PGW SSL in 24 surface/near-surface soil samples collected at 16 locations within the Administration Area West Open Ditch System (Figure 4.3-8).
- The presence of lead above its PGW SSL in the sample collected at location 5D-SNS08 suggests that concentrations of lead detected in the soil in the bottom of the source area 5D ditch may in part be attributed to the migration of lead in sediments from ditches upstream and within the PGOU.
- Lead concentrations detected in soil within source areas 5D and 9D are variable, but decrease in samples (5D-SNS16 and 9D-SNS05) collected in the southern, downstream portion of the ditches. The downstream extent of lead above its PGW SSL is defined by the absence of lead concentrations above the screening level in samples collected at locations 12D-SNS09 and 12D-SNS08 (Figure 4.3-8).
- Lead above its PGW SSL was detected in one only one subsurface soil sample. Lead at 74 mg/kg was detected in a soil sample collected at 5 feet bgs from boring 5D-SB02 (Figure 4.3-8). However,

concentrations of lead in soil samples collected above and below that depth were less than the PGW SSL.

Based on the information presented above, the lateral and vertical extent of cadmium, chromium, and lead at concentrations above their RISLs and PGW SSLs at source areas within the Administration Area West Open Ditch System has been sufficiently characterized to evaluate potential risks to human health and, if necessary, develop remedial alternatives. Additional evaluation of the potential risk to groundwater posed by those metals in soil is presented in Section 8 of the HHERA (Volume II).

4.3.4.3 *Semivolatile Organic Compounds*

B(a)A, B(a)P, B(b&k)F, benzo(b)fluoranthene [B(b)F], and D(a,h)A were the only SVOCs in soil at the source areas comprising the Administration Area West Open Ditch System at concentrations above their respective RISLs and/or PGW SSLs. The presence of each of those compounds in soil with respect to the completeness of characterization, both laterally and vertically, are discussed below.

Benzo(a)anthracene

B(a)A detected at concentrations above its RISL and PGW SSL are summarized in Section 4.3.3.4. B(a)A detected at concentrations above its PGW SSL is shown in Figure 4.3-10. Soil sampling locations and the features being investigated are cross-referenced on Table 4.3-2. Conclusions regarding the characterization of B(a)A based on the data presented on the table and figure are summarized below:

- B(a)A was not detected at concentrations above its RISL in surface, near-surface, and subsurface soil samples collected at the source areas within the Administration Area West Open Ditch System.
- B(a)A was detected at concentrations above its PGW SSL in four surface/near-surface soil samples collected at three [5D-SNS09, 5D-SNS16, and D(b)-SB04] locations (Figure 4.3-10). As shown in the figure, the detections of B(a)A above its PGW SSL appear to be isolated to the three locations.
- B(a)A at concentrations above its PGW SSL was not detected in samples collected at depths greater than 2.5 feet bgs at the three locations.

- The most likely source of B(a)A in soil in the Source Area 5D ditch and Source Area D(b) is from discharges associated with historical activities in Building 20009.

Based on the information presented above, the lateral and vertical extent of B(a)A at source areas within the Administration Area West Open Ditch System has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

Benzo(a)pyrene

B(a)P detected at concentrations above its RISL and PGW SSL are summarized in Section 4.3.3.4 and shown in Figures 4.3-9 and 4.3-10, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 4.3-2. Conclusions regarding the characterization of B(a)P based on the data presented on the table and figure are summarized below:

- B(a)P at concentrations above its RISL was detected in only three surface/near-surface soil samples collected at three (5D-SNS09, 5D-SNS15, and D(b)-SB04) locations in the source areas within the Administration Area West Open Ditch System (Figure 4.3-9). As shown in Figure 4.3-9, B(a)A above its RISL appears to be isolated to those three locations.
- B(a)P at concentrations above its PGW SSL was detected in eight surface/near-surface soil samples collected at eight locations in the source areas within the Administration Area West Open Ditch System (Figure 4.3-10). As shown in Figure 4.3-10, concentrations of B(a)P above its PGW SSL appear to be confined to surface/near-surface soil at four locations:
  - In proximity to location 5D-SNS09;
  - Along an approximately 350-foot section of the source area 5D ditch extending from location 5D-SNS13 to 5D-SNS16;
  - In proximity to location 5D-SNS18; and
  - Along a lined trench drain and catch basin [Source Area D(b)] associated with Building 20009 as defined by locations D(b)-SB04 and D(b)-SD01.
- B(a)P above its PGW SSL was detected in only one subsurface soil sample. B(a)P at 7.2 µg/kg was detected in a soil sample collected from boring D(b)-SB04 at a depth of 5 feet bgs (Figure 4.3-10). B(a)P

above its PGW SSL was not, however, detected in the soil sample collected at 11 feet bgs from boring D(b)-SB04.

- The most likely source of B(a)P in soil in the Source Area 5D ditch and Source Area D(b) is from discharges associated with historical activities in Building 20009.

Based on the information presented above, the lateral and vertical extent of B(a)P at source areas within the Administration Area West Open Ditch System has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

Benzo(b&k)fluoranthene

B(b&k)F detected at concentrations above its RISL and/or PGW SSL are summarized in Section 4.3.3.4. B(b&k)F detected at concentrations above its RISL and PGW SSL is shown in Figures 4.3-9 and 4.3-10, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 4.3-2. Conclusions regarding the characterization of B(b&k)F based on the data are summarized below:

- B(b&k)F was detected above its RISL in six surface/near-surface soil samples collected at six [5D-SNS13, 5D-SNS14, 5D-SNS15, 5D-SNS16, D(b)-SB04, and D(b)-SD01] locations at the source areas within the Administration Area West Open Ditch System (Figure 4.3-9).
  - B(b&k)F was not detected above its RISL at depths greater than 1 foot bgs at the six locations.
  - B(b&k)F at concentrations above its RISL in shallow soil within the source area 5D ditch appears to be limited to the following two areas:
    - A 300-foot section of the ditch between locations 5D-SNS13 and 5D-SNS16; and
    - Along a lined trench drain and catch basin [Source Area D(b)] associated with Building 20009 as defined by locations D(b)-SB04 and D(b)-SD01.
- B(b&k)F was detected above its PGW SSL in eight surface/near-surface soil samples collected at eight [5D-SNS09, 5D-SNS13, 5D-SNS14, 5D-SNS15, 5D-SNS16, 5D-SNS18, D(b)-SB04, and D(b)-SD01] locations at the source areas within the Administration Area West Open Ditch System.

- B(b&k)F was not detected above its PGW SSL at depths greater than 1 foot bgs at the eight locations.
- B(b&k)F at concentrations above its PGW SSL in shallow soil within the source area 5D ditch appears to be limited to the following four locations:
  - In proximity to location 5D-SNS09;
  - Along an approximately 350-foot section of the source area 5D ditch extending from location 5D-SNS13 to 5D-SNS16;
  - In proximity to location 5D-SNS18; and
  - Along a lined trench drain and catch basin [Source Area D(b)] associated with Building 20009 as defined by locations D(b)-SB04 and D(b)-SD01.

Based on the information presented above, the lateral and vertical extent of B(b&k)F at source areas within the Administration Area West Open Ditch System has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

Benzo(b)fluoranthene

B(b)F detected at concentrations above its RISL and/or PGW SSL are summarized in Section 4.3.3.4. Soil sampling locations and the features being investigated are cross-referenced on Table 4.3-2. Conclusions regarding the characterization of B(b)F based on the data are summarized below:

- B(b)F was not detected above its RISL in soil samples collected at the source areas within the Administration Area West Open Ditch System.
- B(b)F was detected above its PGW SSL in only one surface (0.5 foot bgs) soil sample collected at one (5D-SNS15) location in the ditch immediately west of Building 20009.
- Potential sources of SVOCs to the 5D ditch are discharges of those compounds during historical activities associated with Building 20009.

Based on the information presented above, the lateral and vertical extent of B(b)F at source areas within the Administration Area West Open Ditch System has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

Dibenz(a,h)anthracene

D(a,h)A detected at concentrations above its RISL and/or PGW SSL is summarized in Section 4.3.3.4. D(a,h)A detected at concentrations above its PGW SSL is shown in Figure 4.3-10. Soil sampling locations and the features being investigated are cross-referenced on Table 4.3-2. Conclusions regarding the characterization of D(a,h)A based on the data are summarized below:

- D(a,h)A was not detected above its RISL in soil samples collected at the source areas within the Administration Area West Open Ditch System.
- D(a,h)A was detected above its PGW SSL only in a surface (0.5 foot bgs) soil sample collected at one (5D-SNS09) location in the ditch immediately west of Building 20009.
- Potential sources of SVOCs to the 5D ditch are discharges of those compounds during historical activities associated with Building 20009.

Based on the information presented above, the lateral and vertical extent of D(a,h)A at source areas within the Administration Area West Open Ditch System has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

4.3.4.4 *Polychlorinated Biphenyls*

Aroclors 1254 and 1260 were the only PCBs detected in soil at the source areas comprising the Administration Area West Open Ditch System at concentrations above their respective RISLs and/or PGW SSLs. The presence of each of those compounds in soil with respect to the completeness of characterization, both laterally and vertically, are discussed below.

Aroclor 1254

The PCB Aroclor 1254 detected at concentrations above its RISL and PGW SSL are summarized in Section 4.3.3.4 and shown in Figures 4.3-11 and 4.3-12, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 4.3-2. Conclusions regarding the characterization of Aroclor 1254, based on the data presented on the table and figures, are summarized below:

- Aroclor 1254 was detected above its RISL only in near-surface (1 foot bgs) soil samples collected at two (5D-SB06 and 5D-SB09) locations at

Source Area 5D (Figure 4.3-11). The lateral and vertical extent of Aroclor 1254 above its RISL detected at those two locations has not been completely characterized and the source of Aroclor 1254 in those samples is unknown.

- Aroclor 1254 was detected above its PGW SSL in four near-surface (1 foot bgs) soil samples collected at four (5D-SB01, 5D-SB06, 5D-SB09, and 5D-SB10) locations within the Administration West Open Ditch System.
  - As shown in Figure 4.3-12, three (5D-SB06, 5D-SB09, and 5D-SB10) of the four locations are in the open field west of Building 20009 and the 5D ditch. The lateral and vertical extent of Aroclor 1254 at those three locations has not been characterized to levels below its PGW SSL.
  - Boring 5D-SB01 is adjacent to the former waste oil tank west of Building 20009 (Figure 4.3-12). The vertical extent of Aroclor 1254 at that location (5D-SB01) is defined by the absence of that compound at concentrations above the PQL in soil samples collected at 5 and 11 feet bgs. The lateral extent of Aroclor 1254 is defined by the absence of that compound at concentrations above its PGW SSL in samples collected at locations 5D-SNS09 and 5D-SNS20. The most likely source of Aroclor 1254 in soil at location 5D-SB01 is from discharges associated with the former waste oil tank.

Based on the information presented above, the lateral and vertical extent of Aroclor 1254 at source areas within the Administration Area West Open Ditch System has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

Aroclor 1260

The PCB Aroclor 1260 detected at concentrations above its RISL and PGW SSL are summarized in Section 4.3.3.4 and shown in Figures 4.3-11 and 4.3-12, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 4.3-2. Conclusions regarding the characterization of Aroclor 1260 based on the data presented on the table and figures are summarized below:

- Aroclor 1260 was detected above its RISL in only one near-surface (1 foot bgs) soil sample collected at one (5D-SB07) location at Source

Area 5D. As shown in Figure 4.3-11, location 5D-SB07 is in the field west of Building.

  - The vertical extent of Aroclor 1260 above its RISL at that location has not been completely characterized. The lateral extent of Aroclor 1260 is defined by the absence of that compound above its RISL in soil samples collected at the five (5D-SB05, 5D-SB06, 5D-SB08, 5D-SB09, and 5D-SB10) other locations in the field.
  - The absence of Aroclor 1254 at those locations having Aroclor 1260 above its RISL indicates that the two PCBs did not originate from the same source.

- Aroclor 1260 was detected above its PGW SSL in four surface/near-surface soil samples collected at three (5D-SNS18, 5D-SB07, and D(b)-SD01) locations at the source areas within the Administration Area West Open Ditch System (Figure 4.3-12).
  - The lateral and vertical extent of Aroclor 1260 at location 5D-SB07 was discussed in the previous paragraph discussing concentrations of that compound above its RISL.
  - The vertical extent of Aroclor 1260 above its PGW SSL at location 5D-SNS18 was not characterized to a depth greater than 2.5 feet bgs. However, PCBs are generally insoluble and not anticipated to migrate vertically through the soil horizon. The lateral extent of Aroclor 1260 at that location is defined by the absence of that compound above its PGW SSL in soil samples collected from 5D-SNS17 and 5D-SNS19. The absence of Aroclor 1260 in upstream sample 5D-SNS19 indicates that the source of that PCB is located between those two sampling locations. Potential sources of Aroclor 1260 include the SMUD Substation or from historical activities associated with Building 20009.
  - Location D(b)-SD01 is a sediment sample collected from the lined trench [Source Area D(b)] associated with Building 20009. The lateral and vertical extent of Aroclor 1260 is limited to the trench.

Based on the information presented above, the lateral and vertical extent of Aroclor 1260 at source areas within the Administration Area West Open Ditch System has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

4.3.4.5 *Perchlorate*

Perchlorate was not detected above its RISL or PGW SSL in surface, near-surface, or subsurface soil samples collected at the source areas within the Administration Area Open Ditch System (Section 4.3.3.4, Figures 4.3-11 and 4.3-12). Therefore, additional characterization for perchlorate does not appear warranted.

4.3.4.6 *Total Petroleum Hydrocarbons*

TPH-D and TPH-Mo were detected in soil at the source areas comprising the Administration Area West Open Ditch System at concentrations above their PGW SSLs. TPH-D and TPH-Mo were not characterized laterally and vertically to their PGW SSLs during the BOU RI. Decisions regarding the need for additional characterizations during the field effort were based on the presence of SVOCs above their screening levels. The presence of those compounds in soil is discussed below.

TPH-D

TPH-D detected at concentrations above its PGW SSL are summarized in Section 4.3.3.4 and shown in Figure 4.3-12. Soil sampling locations and the features being investigated are cross-referenced on Table 4.3-2. Conclusions regarding the characterization of TPH-D based on the data presented on the table and figure are summarized below:

- TPH-D was detected above its PGW SSL in surface and/or near-surface soil samples collected at two (5D-SNS14 and 5D-SNS16) locations at Source Area 5D, one [D(b)-SB03] location at Source Area D(b), and the sediment sample [D(d)-SD01] collected from the catch basin D(d).
- TPH-D was not detected above its PGW SSL in subsurface (greater than 2.5 feet bgs) soil samples.
- In the source area 5D ditch, the upstream and downstream extent of diesel is defined by the absence of that compound in samples 5D-SNS11 through 5D-SNS13 and samples 5D-SNS17 and 9D-SNS05. The vertical extent of TPH-D at location 5D-SNS14 was not completely characterized. However, the absence of diesel in soil at 5D-SNS15 and at 2.5 feet bgs at 5D-SNS16 indicates that the vertical extent is likely limited to the upper 3 to 4 feet.
- At location D(b)-SB03, the lateral extent of TPH-D is defined by the absence of that compound in soil borings D(b)-SB01 and D(b)-SB02

also placed along the lined trench. The vertical extent is defined by the absence of TPH-D above its PGW SSL in duplicate soil samples collected at 1 foot bgs from boring D(b)-SB03.

- The presence of TPH-D in the sediment sample [D(d)-SD01) collected from the concrete drop inlet basin is defined by the absence of that compound in samples collected at 5D-SNS19. Location 5D-SNS19 is located downstream of the outfall for the catch basin.
- The presence of TPH-D in the Source Area 5D ditch and Source Area D(b) trenches may be attributed to former activities at Building 20009 or drainage from parking areas. The presence of TPH-D in the Source Area D(d) drop inlet basin is attributed to drainage from parking areas.

Based on the information presented above, the lateral and vertical extent of TPH-D at source areas within the Administration Area West Open Ditch System has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

TPH-Mo

TPH-Mo detected at concentrations above its PGW SSL are summarized in Section 4.3.3.4. Soil sampling locations and the features being investigated are cross-referenced on Table 4.3-2. Conclusions regarding the characterization of TPH-Mo based on the data are summarized below:

- TPH-Mo was detected above its PGW SSL in surface and/or near-surface soil samples collected at only one (5D-SNS16) location at Source Area 5D and one [D(b)-SB03) location at Source Area D(b).
- TPH-Mo was not detected in the subsurface soil samples at concentrations above its PGW SSL.
- The presence of TPH-Mo in the soil samples is attributed to historical activities at the Building 20009 Area and drainage from parking areas.

Based on the information presented above, the lateral and vertical extent of TPH-Mo at source areas within the Administration Area West Open Ditch System has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

4.3.4.7 *Total Cyanide*

Total cyanide was not detected above its RISL or PGW SSL in surface, near-surface, or subsurface soil samples collected from the Administration Area West Open Ditch System (Section 4.3.3.4). Therefore, the lateral and vertical extent of total cyanide has been sufficiently characterized.

4.3.4.8 *N-Nitrosodimethylamine*

NDMA was not detected above its PQL, RISL, or PGW SSL in surface, near-surface, or subsurface soil samples collected from the Administration Area West Open Ditch System (Section 4.3.3.4, Figures 4.3-11 and 4.3-12). Therefore, the lateral and vertical extent of NDMA has been sufficiently characterized.

4.3.5 ***Building 20009 Area – Administration Area West***

The Building 20009 Area is comprised of Source Areas 6D and 52D and other features in and around Building 20009 (Figure 4.3-1). Building 20009 was formerly owned by the USAF and was a manufacturing building that generated waste materials, including diluted chemicals, oils, used solvents, PCB/mercury antifouling agents, and miscellaneous chemicals.

4.3.5.1 *Description of Source Areas – Building 20009 Area*

The two source areas (6D and 52D) in and around Building 20009 are described below. Additionally, site features associated with those source areas that may have contributed chemicals to soil in those source areas and Administration Area groundwater are also described. Site features were identified based on historical soil, soil vapor, and groundwater analytical data and/or visual inspection and limited data coverage. The source areas and associated features are shown in Figures 4.1-1 and 4.3-1.

<u>Source Area 6D</u>

Source Area 6D is a bermed pond west of Building 20009 (Figure 4.3-1). An open drainage ditch (Source Area 5D) lies between Building 20009 and the pond. Piping may have extended from Building 20009 to the pond at one time. The pond was reportedly used on a single occasion to contain a process accident involving pickling, plating, or anodizing solutions containing metals. The area was bermed to contain the released materials, which were later treated and removed.

Source Area 52D

Source Area 52D includes the features within Building 20009 such as the plating Area, TCE Degreaser, Hydro Sump, open interior drain lines, and paint spray booths; and features along the west side of Building 20009, including a former waste oil UST and two former treatment basins. The *Industrial and Domestic Waste Control Report* (Aerojet, 1961) indicated that a contractor removed solvents and miscellaneous chemicals, and the waste oil was burned. Source Area 52D also includes a PCB transformer oil release area previously investigated and partially remediated by the USAF (Figure 4.3-1). Additional information regarding the former waste oil UST, treatment basins, and PCB transformer oil release area is presented below.

Other site features that may have contributed chemicals include grated trenches in concrete pads along the west side of Building 20009, the hazardous materials storage areas on the exterior west side of Building 20009, and a deep sump near the southeast corner of Building 20009.

Former Waste Oil UST

A former waste oil UST was formerly located near the fenceline approximately 80 feet west of Building 20009 (Figure 4.3-1). The UST, removed on 26 June 1985, was approximately 29 years old and had a capacity of 2,000 gallons. At the time of removal, the tank was observed to have holes on the sides and one hole on the end. During removal, approximately 50 gallons of waste oil spilled from the tank. The waste oil stored in the tank potentially contained PCBs. Beginning on 10 July 1985, an iterative sidewall excavation was conducted. Over the course of 8 days between July and October 1985, 10 to 36 cubic yards of soil per day were removed. Multiple sidewall samples were collected from the excavation and the excavation was backfilled on 16 October 1985.

Former Treatment Basins

Two concrete-filled structures appearing to be gunite-lined ponds, and which may have been used as treatment basins, are located directly west of Building 20009 (Figure 4.3-1) near the open ditch (Source Area 5D). Wastes, including sulfuric acid and hydroxide from metal plating operations in Building 20009, may have been transferred to the ponds for treatment. Sulfur dioxide treatment also may have been performed. The *Industrial and Domestic Waste Control Report* (Aerojet, 1961) indicated that

plating wastes were treated and discharged to a surface drain in Building 20009. Metals associated with plating activities included chromium and nickel.

Former PCB Transformer Oil Spill Release Area

The investigation at Source Area 52D also included the evaluation of PCBs remaining in soil after a previous remedial action performed by the USAF. The focus of the previous remedial action was to excavate soil containing PCBs at concentrations above the industrial remediation goal. The PCBs in soil were the result of releases from a transformer at the southwest corner of Building 20009.

4.3.6 *Summary and Results of Previous (Pre-2005) Vadose Zone Investigations – Building 20009 Area*

The following subsections summarize the scope and results of previous (prior to 2005) vadose zone investigations of the four source areas and various features in the Building 20009 Area, identify COPCs based on the previous investigations, and discuss the DQOs and sampling proposed in the BOU FSP.

4.3.6.1 *Summary of Previous (Pre-2005) Vadose Zone Investigations – Building 20009 Area*

Soil samples from 29 soil borings and 20 soil vapor samples were collected in the vicinity of Source Areas 6D and 52D between 1992 and 2003. Soil vapor samples were analyzed for VOCs and soil samples were analyzed for VOCs, SVOCs, metals, and/or NDMA. Previous investigations of those source areas are summarized below.

<u>Source Area 6D</u>

Previous vadose zone investigations were conducted at Source Area 6D in 1979, 1986, 1992, and 1993. The scope of those investigations is outlined below:

- 1979 – Two surface soil samples were collected and analyzed for VOCs and metals.
- May 1986 – Seven soil borings were advanced up to 28.3 feet bgs; the associated soil samples were analyzed for metals and VOCs.

- 1992 Investigation – One soil boring was advanced to 4 feet bgs and four soil vapor extraction wells were advanced to 10 feet bgs. The soil boring was analyzed for selected metals and the soil vapor samples were analyzed for selected VOCs.
- 1993 Investigation – Six soil borings were advanced to a maximum depth of 6 feet bgs, and samples were collected and analyzed for selected metals.

Source Area 52D

Previous vadose zone investigations were conducted at the former waste oil UST at Source Area 52D in 1985 and 1986. The scope of those investigations included the following:

- 1985 – Five sidewall samples were collected in 1985 following removal of the waste oil tank at Source Area 52D.
- 1986 – Four soil borings were advanced to depths between 18 and 37.5 feet bgs to assess the lateral extent of PCBs at Source Area 52D former waste oil tank.

Additional vadose zone investigations were conducted at Source Area 52D, including the former waste oil UST and treatment basins, in 1992 and 1993. The scope of those investigations is outlined below:

- 1992 – Four soil borings ranging from 1 to 10 feet bgs were advanced to assess metals and SVOCs at Source Area 52D. Sixteen soil vapor samples were collected to assess VOCs in soil vapor.
- 1993 – Three soil borings ranging from 1 to 10 feet bgs were advanced to assess metals and SVOCs in soil at Source Area 52D. Three soil vapor samples were advanced to assess VOCs in soil vapor. Additionally, two soil borings were completed at the north and south ends of the gunite-lined waste treatment basins located west of Building 20009. Selected samples from those borings were analyzed for SVOCs and metals.

4.3.6.2 *Results of Previous Vadose Zone Investigations – Building 20009 Area*

The results of the previous investigations of Source Areas 6D and 52D, as presented in the BOU FSP (Aerojet et al., 2006b), are summarized below.

Review of the previous data identified the following COPCs in soil and/or soil vapor within the source areas in the Building 20009 Area:

- **Soil –** VOCs, SVOCs, metals (including hexavalent chromium), PCBs, perchlorate, and cyanide.
- **Soil Vapor –** VOCs.

Figures showing previous sampling locations at the source areas within the Building 20009 Area and chemical groups detected in soil samples collected between 1991 and 2005 above human health and ecological screening levels were presented in the BOU FSP (Aerojet et al., 2006b) and are included in Appendix E. The BOU FSP also presented a summary of statistics and the sample results for chemicals detected in soil, soil vapor, and groundwater that exceed human health and ecological screening levels in the Building 20009 source areas.

4.3.6.3 *Summary of Data Needs – Building 20009 Area*

Based on a review of the previous vadose zone investigation data, extensive aerial photograph research and review, and exhaustive research of historical documents, Aerojet determined that additional soil and soil vapor sampling was needed to:

- Confirm the presence of VOCs at source area soils;
- Characterize the present lateral and vertical extent of VOCs, SVOCs, perchlorate, TPH, pH, cyanide, and metals (including hexavalent chromium) in the vadose zone at concentrations that could potentially pose a risk to human and ecological receptors;
- Evaluate the potential for chemicals in soil to degrade surface or groundwater quality; and
- Obtain sufficient data to support fate and transport modeling, evaluation of risk to human and ecological receptors, and evaluation of potential remedial alternatives.

It should be noted that due to the time lapse (12 years) since the Stage 1 RI was performed and the elevated laboratory reporting limits for VOCs during that investigation, the investigation of VOCs performed during the BOU RI was designed to supersede all previous soil vapor and soil VOC investigation results.

4.3.7 *Summary and Results of Boundary Operable Unit Vadose Zone Investigations – Building 20009 Area*

The following subsections summarize the recent (2005 to 2007) BOU investigation of the four source areas and associated features within the Building 20009 Area, describe deviations from sampling proposed in the approved BOU FSP, describe site-specific geology and hydrogeology, and present the results of the BOU RI. The results of the sampling with respect to completeness of the characterization and identification of potential sources are discussed in Section 4.3.8.

4.3.7.1 *Summary of Boundary Operable Unit Vadose Zone Investigation – Building 20009 Area*

The BOU RI of the vadose zone at the source areas (6D and 52D) that comprise the Building 20009 Area included the following activities.

Soil Vapor Investigation

- Forty-eight primary and four duplicate soil vapor samples were collected at 21 locations in the Building 20009 Area at depths ranging from 10 to 40 feet bgs and analyzed for VOCs, including TICs. Soil vapor sampling locations are shown in Figure 4.3-2.
- The total number of soil vapor samples collected within each potential source site (including QA/QC samples) and analyzed for VOCs are provided on Table 4.3-1.
- A cross-reference between soil vapor sampling locations in the Building 20009 Area and the specific features they were sited to investigate are provided on Table 4.3-2.

Surface and Subsurface Soil Investigation

- A total of 45 primary and 8 duplicate surface and/or near-surface (0 to 2.5 feet bgs) and 71 primary and 4 duplicate subsurface (2.6 to 59 feet bgs) soil samples were collected within the four source areas and associated features in the Building 20009 Area. Surface and subsurface soil sampling locations are shown in Figures 4.3-3 and 4.3-4, respectively.
- Surface soil samples were analyzed for SVOCs, metals (including hexavalent chromium), total cyanide, perchlorate, TPH-D, TPH-Mo, pH, TOC, CEC, and/or geotechnical parameters. The SVOC analysis of soil included an evaluation of the presence of TICs. In accordance

with the BOU FSP, sample analysis was based on the analytical results from previous investigations and therefore every sample was not analyzed for the full suite of constituents.

- Subsurface soil samples were analyzed for SVOCs, metals (including hexavalent chromium), total cyanide, PCBs, perchlorate, TPH-D, TPH-Mo, pH, TOC, CEC, and/or geotechnical parameters. The SVOCs analysis of soil included an evaluation of the presence of TICs. In accordance with the BOU FSP, sample analysis was based on the analytical results from previous investigations and therefore every sample was not analyzed for the full suite of constituents.
- The numbers of surface/near-surface and subsurface soil samples collected for each analysis (including QA/QC samples) at each of the four source areas, along with the corresponding methods, are provided on Table 4.3-8.
- A cross-reference between surface/near-surface and subsurface soil sampling locations in the Buildings 20009 Area and the specific features they were sited to investigate are provided on Table 4.2-2.

4.3.7.2 *Deviations from Boundary Operable Unit Data Quality Objectives and Sampling Design – Building 20009 Area*

Sampling activities at Source Areas 6D and 52D during the BOU RI were generally consistent with those proposed by the BOU FSP, with the exceptions listed on Tables 4.3-5 and 4.3-6. Sampling was performed at locations proposed in the BOU FSP and step-out sampling was performed in accordance with the procedures agreed upon with the Agencies. A comparison of proposed and actual sampling activities, including sampling rationale, sample depth, and analyses, is provided on Tables 4.3-5 and 4.3-6. Soil and soil vapor sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2.

4.3.7.3 *Site Specific Geology and Hydrogeology – Building 20009 Area*

The geology and hydrogeology in the Building 20009 Area are described below. The descriptions are based on information presented on field logs of borings drilled during the BOU RI.

Geology

The majority of the area underlying Building 20009 and towards the north, west, and east was dredged to a depth of approximately 30 feet bgs. The area immediately south of Building 20009 where the hazardous materials storage and the dye pen sump are located appears to have not been dredged.

Dredged materials typically consist of a mixture of sands, gravels, and cobbles in a silty, sandy, or clayey matrix. Because of the settlement of fines in the dredge ponds during dredging, the bottom of the dredge tailings is often identified as a layer of lean clays, clayey or sandy silts, with some sand and gravel. Undredged native materials encountered south of Building 20009 generally consist of indurated sands and gravels with some silt.

Hydrogeology

Perched groundwater was observed at sporadic locations and at varying depths throughout the Building 20009 Area. Perched groundwater was noted in six (52D-SB13, 52D-SB18, 52D-SP26, 52D-SP29, 52D-SP34, and 52D-SP38) of eight borings at depths ranging from 16 to 20 feet bgs. In borings AW-AF1-SB01 and 05D-SNS15, however, perched groundwater was encountered at 11.5 and 4 feet bgs, respectively. Due to the heterogeneity of the dredged material, thin localized layers of perched groundwater may be present at various depths throughout the dredged area.

FWBZ was encountered in borings D(b)-SP04 and 06D-SB02 in the Building 20009 Area at 46 and 36 feet bgs, respectively. FWBZ was not, however, encountered in 11 other borings drilled in the Building 20009 Area to a depth of 36 feet bgs or greater.

4.3.7.4 *Results of Boundary Operable Unit Vadose Zone Investigation – Building 20009 Area*

The results of the VOC, metals, SVOC, PCB, perchlorate, TPH-D and TPH-Mo, total cyanide, pH, TOC, CEC, DI-WET, and geotechnical analysis of samples collected during the BOU RI (2005 to 2007) at Source Areas 6D and 52D are summarized below. The analytical data for soil vapor and soil samples are provided in Appendices F and G, respectively. The results with respect to the completeness of the characterization of

constituents identified above RISLs and/or PGW SSLs and potential sources are discussed in Section 4.3.8.

Summary of Investigation and Results – Volatile Organic Compounds

Based on evaluation of the existing data for the Building 20009 Source Areas (6D and 52D), the BOU FSP concluded that additional soil vapor sampling was needed to sufficiently characterize the nature and extent of VOCs. As indicated on Table 4.3-1 and the table below, 48 primary soil vapor samples were collected in the Building 20009 Area and analyzed for VOCs.

Source Area	Interval Depth (feet bgs)	No. of Primary Samples	No. of Locations
52D	Shallow: 0-10	18	18
	Intermediate: 11-20	16	16
	Deep: 21-30	13	13
	Very Deep: >30	1	1

The analytical results for the soil vapor samples collected from the shallow (0 to 10 feet bgs), intermediate (11 to 20 feet bgs), deep (21 to 30 feet bgs), and very deep (greater than 30 feet bgs) intervals at source areas in the Building 20009 Area are presented in Appendix F and summarized below. Soil vapor sampling locations in Administration Area West are shown in Figure 4.3-2. Soil vapor sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2.

TCE, PCE, vinyl chloride, and TVOC concentrations above their respective RISLs in the shallow, intermediate, and deep intervals at Source Area 52D are shown in Figure 4.2-5a. TVOC concentrations above RISLs are also illustrated in Figure 4.2-5b. TCE, PCE, and vinyl chloride concentrations above their respective PGW SSLs are shown in Figure 4.2-6.

The TVOC concentrations illustrated in Figures 4.2-5a and 4.2-5b represent the sum of the ratio of the concentration for each detected VOC in the sample divided by its RISL. For example, if PCE at a concentration of 320 $\mu g/m^3$ and TCE at a concentration of 961 $\mu g/m^3$ were the only VOCs detected in the samples, then the sum of their respective concentrations divided by their respective RISLs of 320 and 961 $\mu g/m^3$ would be 2, or:

$$PCE = \frac{320\,\mu g/m^3}{320\,\mu g/m^3} = 1$$

$$TCE = \frac{961\,\mu g/m^3}{961\,\mu g/m^3} = 1$$

$$TVOC\ Ratio = 2$$

As agreed upon with the Agencies, soil vapor would be characterized during the BOU RI to the point where the TVOC concentration ratio was less than or equal to 10.

Cross sections presenting generalized vadose zone lithology and soil vapor sampling results for the Building 20009 Area are presented in Figures 4.3-5 and 4.3-6. Additional discussion of soil vapor investigation results is presented in Section 4.3.8.1.

Shallow Soil Vapor (0 to 10 feet bgs) – VOCs

- Eighteen primary soil vapor samples and one duplicate were collected from the shallow interval at 18 locations within the Building 20009 source areas and analyzed for VOCs, including TICs. Soil vapor sampling locations in Administration Area West are shown in Figure 4.3-2. Soil vapor sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2.
- TICs were not detected in the shallow soil vapor samples.
- TCE was the only VOC detected at concentrations above its RISL of 961 µg/m^3 in the shallow soil vapor samples collected from the source areas within the Building 20009 Area. Shallow soil vapor samples having concentrations of TCE and TVOCs above the RISL are listed on the table below and shown in Figure 4.2-5a. Additionally, TVOCs above the RISL are also shown in Figure 4.2-5b.
- Benzene, PCE, and TCE were detected at concentrations above their respective PGW SSLs in shallow soil vapor samples collected within Source Area 52D. Shallow soil vapor samples with concentrations of benzene, PCE, and TCE above their PGW SSLs are listed on the table below and shown in Figure 4.2-6.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
52D-SP29	10	Benzene	84	35	81	N	Y
52D-SP24	10	PCE	320	57	130	N	Y
52D-SP26	10				79	N	Y
52D-SP29	10				65	N	Y
52D-SP32	10				98	N	Y
52D-SP33	10				92	N	Y
52D-SP34	10				59	N	Y
52D-SP35	10				97	N	Y
52D-SP36	10				76	N	Y
52D-SP38	10				61	N	Y
52D-SP41	10				87	N	Y
52D-SP42	10				68	N	Y
52D-SP43	10				120	N	Y
52D-SP24	10	TCE	961	527	1,800	Y	Y
52D-SP25	10				1,200	Y	Y
52D-SP26	10				1,100	Y	Y
52D-SP29	10				2,600	Y	Y
52D-SP30	10				480	N	N
52D-SP32	10				780	N	Y

Intermediate Soil Vapor (11 to 20 feet bgs) – VOCs

- Sixteen primary soil vapor samples and one duplicate were collected from the intermediate interval at 16 locations within the Building 20009 source areas and analyzed for VOCs, including TICs. Intermediate soil vapor sampling locations are shown in Figure 4.3-2. Soil vapor sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2.
- Volatile organic TICs were not detected in the intermediate soil vapor samples.
- TCE was the only VOC detected at a concentration above its RISL of 961 µg/m³. TCE at 1,200 µg/m³ was detected in intermediate soil vapor sample 52D-SP30 (Figure 4.2-5a).
- PCE and TCE were detected in the shallow soil vapor samples above their respective PGW SSLs. Benzene at concentrations above its RISL or PGW SSL was not detected in the intermediate soil vapor samples. Intermediate soil vapor samples with concentrations of PCE and TCE above their PGW SSLs are listed on the table below and shown in Figure 4.2-6.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
52D-SP35	20	PCE	320	57	110	N	Y
52D-SP36	20				99	N	Y
52D-SP43	20				99	N	Y
52D-SP25	20	TCE	961	527	960	N	Y
52D-SP29	20				620	N	Y
52D-SP30	20				1,200	Y	Y

Deep Soil Vapor (21 to 30 feet bgs) – VOCs

Thirteen primary soil vapor samples and two duplicates were collected from the deep layer at 13 locations within the Building 20009 source areas and analyzed for VOCs, including TICs. Deep vapor sampling locations are shown in Figure 4.3-2. Soil vapor sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2.

- TICs were not detected in the deep soil vapor samples.
- Chloroform, PCE, and TCE were the only VOCs detected at concentrations above their respective RISLs in the deep soil vapor samples collected at the source areas within the Building 20009 Area. Deep soil vapor samples with concentrations of those VOCs and TVOCs above their RISLs are listed on the table below and shown in Figure 4.2-5a. TVOC concentrations above the RISLs are also shown in Figure 4.2-5b.
- Benzene, PCE, and TCE were detected at concentrations above their respective PGW SSLs in the deep soil vapor samples. Deep soil vapor samples with concentrations of those VOCs above their respective PGW SSLs are listed on the table below. PCE, TCE, and vinyl chloride concentrations above their respective PGW SSLs are shown in Figure 4.2-6.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
52D-SP44	30	Benzene	84	35	68	N	Y
52D-SP35	30	Chloroform	83	18,595	190	Y	N
52D-SP25	30	PCE	320	35	98	N	Y
52D-SP35	30				220	N	Y
52D-SP36	30				60	N	Y
52D-SP42	30				590	Y	Y
52D-SP25	30	TCE	961	527	1,800	Y	Y
52D-SP42	30				8,300	Y	Y

Very Deep Soil Vapor (greater than 31 feet bgs) – VOCs

One very deep soil vapor sample was collected at 40 feet bgs at one location (52D-SP44) within the Building 20009 source areas. The very deep soil vapor sampling location is shown in Figures 4.3-2 and 4.2-5a.

- VOCs at concentrations above their respective RISLs were not detected in the very deep soil vapor sample.
- Benzene at 62 µg/m^3, above the PGW SSL of 35 µg/m^3, was detected in the very deep soil vapor sample.

Summary of Investigation and Results – Metals

A total of 104 primary and 11 duplicate soil samples were collected at source areas within the Building 20009 Area and analyzed for metals and/or hexavalent chromium. The number of primary soil samples and sampling locations at Source Areas 6D and 52D in the Building 20009 Area are summarized on Table 4.3-8 and below. Summary statistics for the samples are also presented on Table 4.3-8.

		Surface/Near-Surface		Subsurface	
Source Area	**Compound**	**No. of Samples**	**No. of Locations**	**No. of Samples**	**No. of Locations**
6D	Metals	17	11	18	6
	Mercury	17	11	18	6
	Hex Chrome	11	8	16	5
52D	Metals	23	18	46	13
	Mercury	21	17	45	13
	Hex Chrome	19	15	32	10

The results of the metals analysis of surface/near-surface and subsurface soil samples collected at the source areas (6D and 52D) in the Building 20009 Area are presented in Appendix G and summarized below.

Metals detected in soil within Administration Area West at concentrations statistically different from background and subsequently compared to screening levels were antimony, cadmium, chromium, copper, lead, mercury, molybdenum, silver, and zinc (Section 3.1.3.1). Because boron, hexavalent chromium, lithium, strontium, and titanium were not included in the background evaluation, concentrations of these metals were also compared to screening levels.

Surface/near-surface and subsurface soil sampling locations are shown in Figures 4.3-3 and 4.3-4, respectively. Soil sampling locations and the

specific features they were sited to investigate are cross-referenced on Table 4.3-2. Cross sections showing the generalized lithology of the vadose zone within Administration Area West are provided in Figures 4.3-5 and 4.3-6.

Surface and Near-Surface Soil – Metals:

- Forty primary and 8 duplicate surface/near-surface soil samples were collected at 28 locations at source areas within the Building 20009 Area and analyzed for metals. Additionally, 38 of the 40 primary samples were analyzed for mercury and 30 of the samples were analyzed for hexavalent chromium.
- Thirteen surface and/or near-surface soil samples collected at eight locations contained cadmium, chromium, and/or lead at concentrations greater than background and their respective RISLs and/or PGW SSLs.
- Metals detected in surface/near-surface soil samples at concentrations above their screening levels, the location and depth of the sample, and the maximum detected concentration of those metals are listed on the table below. Metals detected at concentrations exceeding their respective RISL and/or PGW SSL in surface and near-surface soil samples at source areas within the Buildings 20009 Area are shown in Figures 4.3-7 and 4.3-8, respectively.

Sample Location	Depth (ft bgs)	Metal	RISL (mg/kg)	PGW SSL (mg/kg)	Conc. (mg/kg)	> RISL	> PGW SSL
6D-SNS06	0.5	Cadmium	1.7	1.2	12	Y	Y
		Chromium	211	500	19,000	Y	Y
		Lead	150	23	100	N	Y
	2.5	Cadmium	1.7	1.2	3	Y	Y
		Chromium	211	500	4,500	Y	Y
		Lead	150	23	32	N	Y
6D-SNS07	0.5	Cadmium	1.7	1.2	33	Y	Y
		Chromium	211	500	43,000	Y	Y
		Lead	150	23	640	Y	Y
	2.5	Cadmium	1.7	1.2	3.7	Y	Y
		Chromium	211	500	5,700	Y	Y
		Lead	150	23	57	N	Y
6D-SNS08	0.5	Cadmium	1.7	1.2	16	Y	Y
		Chromium	211	500	27,000	Y	Y
		Lead	150	23	300	Y	Y
	2.5	Cadmium	1.7	1.2	1.4	N	Y
		Chromium	211	500	1,000	Y	Y
		Lead	150	23	12	N	N

Sample Location	Depth (ft bgs)	Metal	RISL (mg/kg)	PGW SSL (mg/kg)	Conc. (mg/kg)	> RISL	> PGW SSL
6D-SB05	1.5	Cadmium	1.7	1.2	15	Y	Y
		Lead	150	23	80	N	Y
6D-SB06	1.0	Cadmium	1.7	1.2	3.3	Y	Y
		Chromium	211	500	290	Y	N
		Lead	150	23	26	N	Y
52D-SNS01	0.5	Cadmium	1.7	1.2	2.0	N	Y
		Chromium	211	500	280	Y	N
		Lead	150	23	130	N	Y
	2.5	Cadmium	1.7	1.2	0.72	N	N
		Chromium	211	500	47	N	N
		Lead	150	23	5.5	N	N
52D-SNS02	0.5	Cadmium	1.7	1.2	3.6	Y	Y
		Lead	150	23	36	N	Y
	2.5	Cadmium	1.7	1.2	0.84	N	N
		Lead	150	23	9.0	N	N
52D-SB11	1.0	Lead	150	23	37	N	Y

Subsurface Soil – Metals:

- Sixty-four primary and three duplicate subsurface soil samples were collected at 19 locations at source areas within the Building 20009 Area and analyzed for metals. Sixty-three of the primary samples at 19 locations were analyzed for mercury and 48 samples collected at 15 locations were also analyzed for hexavalent chromium. Subsurface sampling locations are shown in Figures 4.3-4, 4.3-7, and 4.3-8.
- Three subsurface soil samples collected at two locations contained concentrations of chromium and/or hexavalent chromium above their respective RISLs and PGW SSLs. Chromium and hexavalent chromium above their RISLs and PGW SSLs in subsurface soil samples in the Building 20009 Area are identified on the table below and shown in Figures 4.3-7 and 4.3-8, respectively.
- Metals were not detected at concentrations above their respective RISLs or PGW SSLs in subsurface soil samples collected from borings 6D-SB05 and 6D-SB06 where metals were detected in surface soil samples above their screening levels.

Sample Location	Depth (ft bgs)	Metal	RISL (mg/kg)	PGW SSL (mg/kg)	Conc. (mg/kg)	> RISL	> PGW SSL
6D-SB02	5.0	Chromium	211	500	820	Y	Y
		Hex Chromium	30	21	430	Y	Y
	11	Chromium	211	500	730	Y	Y
		Hex Chromium	30	21	630	Y	Y
	23	Chromium	211	500	95	N	N
		Hex Chromium	30	21	0.48	N	N
	35	Chromium	211	500	30	N	N
		Hex Chromium	30	21	0.32	N	N
	47	Chromium	211	500	25	N	N
		Hex Chromium	30	21	0.087	N	N
52D-SB10	5.0	Chromium	211	500	44	N	N
		Hex Chromium	30	21	0.31	N	N
	11	Chromium	211	500	550	Y	Y
		Hex Chromium	30	21	720	Y	Y
	23	Chromium	211	500	28	N	N
		Hex Chromium	30	21	0.53	N	N
	35	Chromium	211	500	32	N	N
		Hex Chromium	30	21	0.10	N	N
	39	Chromium	211	500	23	N	N
		Hex Chromium	30	21	0.37	N	N

Summary of Investigation and Results – Semivolatile Organic Compounds

A total of 80 primary and 6 duplicate soil samples were collected at Source Areas 6D and 52D and the Building 20009 Area during the BOU RI and analyzed for SVOCs, including TICs. The number of primary soil samples and sampling locations at Source Areas 6D and 52D for SVOCs are summarized on Table 4.3-8 and below. Summary statistics for the samples are also presented on Table 4.3-8.

		Surface/Near-Surface		Subsurface	
Source Area	Compound	No. of Samples	No. of Locations	No. of Samples	No. of Locations
6D	SVOCs	13	7	6	1
52D	SVOCs	21	17	40	10

The results of the SVOC analysis of surface and subsurface soil samples collected at Source Areas 6D and 52D and the Building 20009 Area are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations and SVOCs detected at concentrations above their RISLs and PGW SSLs are shown in Figures 4.3-9 and 4.3-10, respectively. Soil sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2.

Surface and Near-Surface Soil – SVOCs:

- Thirty-four primary and five duplicate surface and/or near-surface soil samples were collected at 24 locations within Source Areas 6D and 52D and the Building 20009 Area during the BOU RI and analyzed for SVOCs, including TICs.
- SVOCs at concentrations above their respective RISLs or PGW SSLs were not detected in any of the surface and/or near-surface soil samples.
- SVOC TICs detected in one surface soil sample collected at Source Area 52D are listed on the table below.

Sample Location	Depth (feet bgs)	SVOC TIC	Concentration (µg/kg)
52D-SB07	0.5	1,1′-Biphenyl, 2, 2′, 3, 3′, 6,6′-	610
		1,1′-Biphenyl, 2, 3, 3′, 4, 4′, 5-	320
		1,1′-Biphenyl, 2, 3, 3′, 4, 6- Pent	240
		1,1′-Biphenyl, 2, 3′, 4, 4′, 5, 5′-	470
		1,1′-Biphenyl, 2, 3′, 4, 4′, 6 – Pent	250
		1,1′-Biphenyl, 3, 3′, 4, 4′, 5, 5′-	360
		1,1′-Biphenyl, hexachloro-	460

Subsurface Soil – SVOCs:

- Forty-six primary and one duplicate subsurface soil samples were collected at 11 locations at Source Areas 6D and 52D and the Building 20009 Area during the BOU RI and analyzed for SVOCs, including TICs.
- TICs were not detected in the SVOC analysis of the subsurface soil samples.
- B(a)A, B(b&k)F, B(a)P, and indeno(1,2,3-cd)pyrene [I(1,2,3-cd)P] were detected in one subsurface soil sample collected at Source Area 52D at concentrations above their respective screening levels. SVOCs detected in subsurface soil at Source Area 52D above their RISL and PGW SSL, the depth at which the sample was collected, and the sampling location are identified on the table below. Concentrations of B(a)P detected in subsurface soil at Source Area 52D above its RISL are shown in Figure 4.3-9. SVOCs detected at concentrations above their respective PGW SSLs are shown in Figure 4.3-10.

Sample Location	Depth (ft bgs)	SVOC	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	> RISL	> PGW SSL
52D-SB07	5.0	Benzo(a)anthracene	620	29	330	N	Y
		Benzo(a)pyrene	38	2.9	340	Y	Y
		Benzo(b&k)fluoranthene	38	29	450	Y	Y
		Indeno(1,2,3-cd)pyrene	621	29	59	N	Y
	11	Benzo(a)anthracene	620	29	<9.5	N	N
		Benzo(a)pyrene	38	2.9	<9.5	N	?
		Benzo(b&k)fluoranthene	38	29	<19	N	N
		Indeno(1,2,3-cd)pyrene	621	29	<9.5	N	N

Summary of Investigation and Results – Polychlorinated Biphenyls

A total of five primary soil samples were collected at the PCB transformer oil release area at Source Area 52D during the BOU RI and analyzed for PCBs. PCBs were not identified as a COPC at Source Area 6D in the BOU FSP and therefore no samples collected within that Source Area were analyzed for PCBs.

The number of primary soil samples and sampling locations for PCBs at the PCB transformer oil release area at Source Area 52D are summarized on Table 4.3-8 and below. Summary statistics for the samples are also presented on Table 4.3-8.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
52D	PCBs	0	0	5	1

The results of the PCB analysis of surface/near-surface and subsurface soil samples collected at Source Area 52D and the Building 20009 Area are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations at Source Area 52D and the Building 20009 Area and PCBs 1254 and 1260 detected at concentrations above their respective RISLs and/or PGW SSLs are shown in Figures 4.3-11 and 4.3-12, respectively. Soil sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2.

Surface and Near-Surface Soil – PCBs:

Remedial action taken by the Air Force at the PCB transformer oil release area included the excavation of PCB-impacted soil to a depth of approximately 10 feet bgs and the placement of clean backfill material.

Surface and near-surface soil samples were therefore not collected within the backfill material.

Subsurface Soil – PCBs:

- Five primary subsurface soil samples were collected at one location at Source Area 52D and analyzed for PCBs. Subsurface soil sampling locations for PCBs are shown in Figures 4.3-11 and 4.3-12.
- Aroclor 1260 was the only PCB detected in the subsurface soil at concentrations above its respective RISL and/or PGW SSL. Aroclor 1260 concentrations above the RISL and PGW SSL, and the depths and location of the samples, are identified on the table below and shown in Figures 4.3-11 and 4.3-12.
- As shown in Figures 4.3-11 and 4.3-12, boring 52D-SB18 is located in an area affected by historical releases of transformer oil-containing PCBs. Soils with PCBs were excavated from this area to a depth of approximately 11 to 15 feet bgs under the direction of the USAF in 2004 and backfilled with clean material. Samples were not collected at depths shallower than 10 feet bgs at this location due to the presence of clean backfill.

Sample Location	Depth (ft bgs)	PCB	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	> RISL	> PGW SSL
052D-SB18	5	Aroclor 1260	220	34	---	---	
	10	Aroclor 1260	220	34	---	---	
	16	Aroclor 1260	220	34	120,000	Y	Y
	21	Aroclor 1260	220	34	800	Y	Y
	26	Aroclor 1260	220	34	180	N	Y
	31	Aroclor 1260	220	34	<23	N	N
	37	Aroclor 1260	220	34	<26	N	N

Summary of Investigation and Results – Perchlorate

A total of 79 primary and 6 duplicate soil samples were collected at Source Areas 6D and 52D and the Building 20009 Area during the BOU RI and analyzed for perchlorate. The number of primary soil samples and sampling locations at Source Areas 6D and 52D for perchlorate are summarized on Table 4.3-8 and below. Summary statistics for the samples are also presented on Table 4.3-8.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
6D	Perchlorate	13	7	6	1
52D	Perchlorate	20	16	40	9

The results of the perchlorate analysis of surface and subsurface soil samples collected at Source Areas 6D and 52D and the Building 20009 Area are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations and perchlorate detected at concentrations above its RISL and/or PGW SSL are shown in Figures 4.3-11 and 4.3-12, respectively. Soil sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2.

Surface and Near-Surface Soil – Perchlorate:

- Thirty-three primary and 6 duplicate surface and/or near-surface soil samples were collected at 23 locations within Source Areas 6D and 52D and the Building 20009 Area and analyzed for perchlorate. Surface and near-surface soil sampling locations are shown in Figures 4.3-3, 4.3-11, and 4.3-12.
- Perchlorate above its RISL was not detected in surface or near-surface soil samples collected at Source Area 6D (Figure 4.3-11).
- Three surface and/or near-surface soil samples collected at three locations at Source Area 6D contained perchlorate at concentrations above its PGW SSL of 60 µg/kg. The detected concentrations of perchlorate above its PGW SSL, the depths at which the samples were collected, and the sampling locations are identified on the table below and in Figure 4.3-12.

Sample Location	Depth (ft bgs)	Compound	RISL	PGW SSL	Conc. (µg/kg)	> RISL	> PGW SSL
6D-SNS09	0.5	Perchlorate	7,800	60	<5.1	N	N
	2.5	Perchlorate	7,800	60	1,300	N	Y
6D-SNS10	0.5	Perchlorate	7,800	60	<5.1	N	N
	2.5	Perchlorate	7,800	60	530	N	Y
6D-SNS11	0.5	Perchlorate	7,800	60	<5.2	N	N
	2.5	Perchlorate	7,800	60	1,900	N	Y

Subsurface Soil – Perchlorate:

- Forty-six primary subsurface soil samples were collected at 10 locations within Source Areas 6D and 52D and the Building 20009

Area and analyzed for perchlorate. Subsurface soil sampling locations are shown in Figures 4.3-4, 4.3-11, and 4.3-12.

- Perchlorate was not detected above its RISL or PGW SSL in the subsurface soil samples collected at Source Areas 6D and 52D and the Building 20009 Area.

Summary of Investigation and Results – Total Petroleum Hydrocarbons

A total of 82 primary and 6 duplicate soil samples were collected at Source Areas 6D, 52D, and the Building 20009 Area during the BOU RI and analyzed for TPH-D and TPH-Mo. The number of primary soil samples and sampling locations for TPH at the source areas in the Building 20009 Area are summarized on Table 4.3-8 and below. Summary statistics for the samples are also presented on Table 4.3-8.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
6D	TPH-D	13	7	6	1
	TPH-Mo	13	7	6	1
52D	TPH-D	20	16	43	9
	TPH-Mo	20	16	43	9

The results of TPH-D and TPH-Mo analyses of surface/near-surface and subsurface soil samples collected at Source Areas 6D, 52D, and the Building 20009 Area are presented in Appendix G and summarized below. Surface/near-surface and subsurface soil sampling locations at Source Areas 6D, 52D, and the Building 20009 Area and TPH-D and TPH-Mo concentrations above its PGW SSL are shown in Figures 4.3-3 and 4.3-12, respectively. Soil sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2.

Surface and Near-Surface Soil – TPH:

- Thirty-three primary and five duplicate surface/near-surface soil samples were collected at 23 locations at Source Areas 6D and 52D and the Building 20009 Area and analyzed for TPH-D and TPH-Mo. Surface and near-surface soil sampling locations for TPH at Source Areas 6D and 52D and in the Building 20009 Area are shown in Figure 4.3-3 and 4.3-12.
- TPH-D above its PGW SSL was detected in only one near-surface soil sample collected at one location at Source Area 52D. TPH-D detected in surface and/or near-surface soil at concentrations above its PGW

SSL and the location of the detection is identified on the table below and shown in Figure 4.3-12.

Sample Location	Depth (ft bgs)	Compound	PGW SSL (mg/kg)	Conc. (mg/kg)	> PGW SSL
52D-SNS03	0.5	TPH-D	100	130	Y
	2.5	TPH-D	100	5.3	N

Subsurface Soil – TPH:

- Forty-nine primary subsurface samples and one duplicate were collected at 10 locations within Source Areas 6D and 52D and the Building 20009 Area and analyzed for TPH-D and TPH-Mo. Subsurface soil sampling locations for TPH at Source Areas 6D and 52D and in the Building 20009 Area are shown in Figures 4.3-4 and 4.3-12.
- TPH-D and/or TPH-Mo at concentrations above their PGW SSLs were not detected in subsurface soil samples collected at Source Area 6D.
- Subsurface soil samples with TPH-D and/or TPH-Mo detected at Source Area 52D above their PGW SSLs are listed on the table below. TPH-D and TPH-Mo detected at concentrations above their PGW SSLs are shown in Figure 4.3-12. No samples were collected at location 52D-SNS03 at depths greater than 2.5 feet bgs.

Sample Location	Depth (ft bgs)	Compound	PGW SSL (mg/kg)	Conc. (mg/kg)	> PGW SSL
52D-SB07	5.0	TPH-D	100	220	Y
		TPH-Mo	500	530	Y
	11	TPH-D	100	3.4	N
		TPH-Mo	500	4.0	N
	23.5	TPH-D	100	2.8	N
		TPH-Mo	500	4.0	N
	35	TPH-D	100	1.7	N
		TPH-Mo	500	<5.1 J	N

Summary of Investigation and Results – Miscellaneous Compounds

Miscellaneous analyses performed on soil samples collected at Source Areas 6D and 52D and the Building 20009 Area were total cyanide, NDMA, pH, TOC, CEC, and/or DI-WET. The number of primary surface/near-surface and subsurface soil samples collected at each source area and the numbers of locations are summarized on the table below.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
6D	Total Cyanide	13	7	6	1
	NDMA	13	7	0	0
	pH	13	7	6	1
	TOC	1	1	6	1
	CEC	1	1	6	1
	DI-WET	0	0	0	0
52D	Total Cyanide	20	16	37	9
	NDMA	21	17	0	0
	pH	21	17	49	14
	TOC	5	5	32	8
	CEC	5	5	32	8
	DI-WET	0	0	4	3

The analytical results for the miscellaneous analyses of surface/near-surface and subsurface soil samples are presented in Appendix G and summarized below. The analytical data for pH, TOC, and CEC are used in the risk assessments to evaluate the bioavailability of some chemicals with respect to human and ecological receptors. The TOC, CEC, and DI-WET data are used in the FS to evaluate chemical and physical remedial actions, assess the potential for metals in soil to migrate into groundwater, and develop cleanup goals protective of groundwater.

Total Cyanide. Total cyanide was not detected in surface, near-surface, or subsurface soil samples collected at Source Areas 6D and 52D and the Building 20009 Area above its RISL or PGW SSL.

N-Nitrosodimethylamine. Surface/near-surface and subsurface soil sampling locations for NDMA at Source Areas 6D and 52D are shown in Figures 4.3-11 and 4.3-12. NDMA was not detected above the PQL using USEPA Method 8270C in the surface/near-surface and subsurface soil samples collected at Source Areas 6D and 52D and the Building 20009 Area.

pH. The results of the pH analysis of 39 surface/near-surface soil samples and 55 subsurface soil samples, including duplicates, collected at Source Areas 6D and 52D and the Building 20009 Area are summarized on the table below. The pH of the soil was within the normal range (5 to 9) expected for mineral soils (Brady, 1974).

Source Area	Surface/ Near-Surface Soil	Subsurface Soil
6D	6.83 – 8.47	7.09 – 8.13
52D	5.03 – 8.68	7.03 – 8.79

Total Organic Carbon. TOC above the PQL was not detected in the six surface/near-surface soil samples collected at Source Areas 6D and 52D. TOC above the PQL was detected in only 2 of the 38 subsurface soil samples collected at Source Areas 6D and 52D. TOC at 5,400 mg/kg was detected in soil sample 52D-SB17 collected at 11 feet bgs and at 3,700 mg/kg in soil sample 52D-SP18 collected at 26 feet bgs.

Cation Exchange Capacity. CEC in the surface/near-surface soil samples collected at Source Areas 6D and 52D ranged from 120 to 640 meq/K. CEC in the subsurface soil samples collected at Source Areas 6D and 52D ranged from 51 to 660 meq/K.

Deionized Water Waste Extraction Test. A DI-WET was performed on four soil samples collected at Source Area 52D and the extracts analyzed for various metals. The sample identifications, sample depths, and metal concentrations detected in the soil samples and sample extracts are presented on the table below.

Sample ID	Sample Depth (ft bgs)	Compound	Soil Conc. (mg/kg)	Extract Conc. (mg/L)
52D-SB08	11	Aluminum	14,000	0.52
		Antimony	0.12	0.0011
		Arsenic	4.4	0.0061
		Barium	85	0.039
		Beryllium	0.23	0.0002
		Boron	4.3	0.013
		Cadmium	0.35	0.0001
		Chromium	37	0.025
		Cobalt	8.2	0.0058
		Copper	42	0.025
		Lead	2.9	0.0034
		Lithium	9.5	0.0095
		Manganese	310	0.084
		Molybdenum	0.66	0.048
		Nickel	25	0.033
		Selenium	1.1	<0.002
		Silver	0.86	0.00009
		Strontium	45	0.018
		Thallium	3.0	<0.001
		Titanium	840	0.016
		Vanadium	62	0.034
		Zinc	36	0.041
52D-SB15	5.0	Thallium	1.0	<0.001
52D-SB15	39	Arsenic	6.3	<0.005
52D-SB17	5.0	Arsenic	12.0	<0.001
		Manganese	1,400	0.62
		Thallium	3.4	<0.001

No metals were detected in the samples at concentrations statistically above background (Section 3.1.3.1).

Summary of Investigation and Results – Geotechnical Parameters

A total of 58 soil samples were collected within Administration Area West, including the source areas in the Building 20009 Area, for geotechnical parameters during the BOU RI. Additionally, 17 soil samples for geotechnical parameters were collected from portions of Administration Area West between 2005 and 2007 as part of the J&E Model Calibration Study. The results of the geotechnical analyses of soil samples for moisture content, wet density, dry density, specific gravity, porosity, sieve analysis, and/or permeability are summarized on Table 4.3-7.

The geotechnical data will be used in the risk assessment to develop site-specific soil input parameters (moisture content, water-filled porosity, air-filled porosity, etc.) for fate and transport models and in the feasibility study to assess potential remedial actions such as vapor extraction. Fate and transport models are used in risk assessment to quantitatively evaluate the migration of volatile organics into outdoor and indoor air and the potential leaching of chemicals through soil and into groundwater.

4.3.8 *Discussion of Investigation Results with Respect to Data Quality Objectives – Building 20009 Area*

The analytical results presented in the previous sections identified the following chemical constituents in soil vapor and soil at the source areas in the Building 20009 Area at concentrations above their respective RISLs and/or PGW SSLs.

Soil vapor: Benzene, chloroform, PCE, and TCE.

Soil: Cadmium, chromium, hexavalent chromium, lead, B(a)A, B(b&k)F, B(a)P, I(1,2,3-cd)P, PCB Aroclor 1260, perchlorate, TPH-D, and TPH-Mo.

The presence of these COPCs in each source area is discussed below with respect to the data needs described in Section 4.3.6.3. Specifically,

- Has the investigation resulted in the sufficient characterization of the lateral and vertical distribution of each COPC in the vadose zone and identified a potential source for those COPCs?

- Has the investigation resulted in sufficient data to evaluate the potential for COPCs in soil to migrate into and degrade surface water and groundwater quality?
- Has the investigation resulted in data sufficient to support human health and ecological risk assessments and fate and transport modeling?
- Has the investigation resulted in sufficient data to evaluate the feasibility of remediating the identified compounds and concentrations to levels that do not pose a risk to human and ecological receptors or degrade surface water and groundwater quality?

For the purpose of this discussion, it is assumed that chemicals detected at concentrations above their RISL could potentially pose a risk to human health and chemicals detected above their PGW SSL could potentially migrate into groundwater or surface water. Sampling locations where VOCs, metals, and other non-VOCs (SVOCs, PCBs, perchlorate, NDMA, and TPH-D) were detected in surface and/or subsurface soil at concentrations above their respective PGW SSLs are shown in Figures 4.2-6, 4.3-8, 4.3-10, and 4.3-12.

The analytical results for surface water and groundwater within the Administration Area are discussed in Section 4.4 and 4.5 respectively and discussed with respect to potential soil and soil vapor sources in the Building 20009 Area. Additionally, the potential for chemicals in soil and soil vapor to migrate into surface water and groundwater is further evaluated in Section 8 of the HHERA (Volume II).

4.3.8.1 *Volatile Organic Compounds*

VOCs detected in soil vapor samples above their RISLs and/or PGW SSLs collected at the source areas in the Building 20009 Area are summarized in Section 4.3.7.4. PCE, TCE, vinyl chloride, and TVOC concentrations above their RISLs in the shallow, intermediate, and deep intervals are shown in Figure 4.2-5a. TVOC concentrations above their RISLs are also shown in Figure 4.2-5b. PCE, TCE, and vinyl chloride concentrations in the soil vapor intervals above their PGW SSLs are shown in Figure 4.2-6. Soil vapor sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2. Conclusions regarding the lateral and vertical characterization of VOCs and potential sources based on the data are summarized below:

- Chloroform, TCE, and PCE were the only VOCs detected at concentrations above their respective RISLs that could potentially pose a risk to human health.
- Benzene, TCE, and PCE were the only VOCs detected at concentrations above their PGW SSLs in soil vapor samples collected at source areas in the Building 20009 Area.
- As indicated on the table, concentrations of TCE and PCE at 52D-SP42 increase with depth. The increase in concentrations with depth coupled with the location not being in proximity to known sources indicate chloroform, TCE, and/or PCE at those locations could be due to migration from groundwater instead of a surface release.
- The table and figures also show that concentrations of TCE in soil vapor at four locations (52D-SP24, 52D-SP25, 52D-SP26, and 52D-SP29) are higher in the shallow layer and, with the exception of 52D-SP25, attenuate with depth. The data indicate that TCE at those locations is likely due to releases of that compound to surface or near-surface soils. The most likely source of TCE to soil in this area is the TCE degreaser in the inactive plating area.
- The concentrations of benzene, chloroform, TCE, and PCE detected in the soil vapor samples are less than 1 percent of their respective vapor saturation concentrations and therefore not indicative of the presence of NAPL.

As shown in Figures 4.2-5a, 4.2-5b, and 4.2-6, the lateral and vertical extent of benzene, chloroform, TCE, and PCE in the shallow, intermediate, and deep intervals in the Building 20009 Area has been characterized to concentrations below their RISL and PGW SSLs.

Based on the information presented above, the lateral and vertical extent of VOCs at source areas within the Building 20009 Area has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

4.3.8.2 Metals

Antimony, cadmium, chromium, hexavalent chromium, copper, lead, and mercury were detected in soil at Source Areas 6D and/or 52D at concentrations above background and their respective RISLs and/or PGW SSLs. The presence of those metals in soil with respect to the completeness of characterization, both laterally and vertically, and

potential sources are discussed below. Because the metals detected above their RISL and/or PGW SSL were identified primarily at Source Area 6D, the discussion below is segregated by source area instead of by individual metals as in previous sections.

Source Area 6D

Metals detected at concentrations above their RISLs and/or PGW SSLs in soil collected at Source Area 6D are summarized in Section 4.3.7.4 and shown in Figures 4.3-7 and 4.3-8, respectively. Soil sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2. Conclusions regarding the characterization of metals based on the data presented on the table and figures are presented below:

- Cadmium, chromium, hexavalent chromium, and/or lead were detected above their RISL and/or PGW SSL in surface and/or near-surface soil samples collected at five locations in the bermed area (Source Area 6D) west of Building 20009 (Figures 4.3-7 and 4.3-8). Because the bermed area was reportedly used on a single occasion to contain a process accident involving pickling, plating, or anodizing solutions containing metals, the presence of metals in this area is expected.
- As demonstrated by the samples collected from borings 6D-SNS07, 6D-SNS09 through 6D-SNS11, and 6D-SB03 through 6D-SB06, concentrations of cadmium and lead above their RISLs and/or PGW SSLs at Source Area 6D are apparently limited to depths less than 5 feet bgs.
- Only two metals (chromium and hexavalent chromium) were detected in soil samples collected at depths greater than 2.5 feet bgs at Source Area 6D. The vertical extent of these two metals in soil is defined by the absence of chromium and hexavalent chromium above their RISLs and PGW SSLs in soil samples collected at 23 feet bgs from boring 6D-SB02. The lateral extent of chromium and hexavalent chromium at depths greater than 2.5 feet bgs is defined by the absence of those metals at concentrations above their RISLs and PGW SSLs in subsurface soil samples collected from borings 6D-SNS07 and 6D-SB03 through 6D-SB06 (Figures 4.3-7 and 4.3-8).

Based on the information presented above, the lateral and vertical extent of metals above their RISLs and/or PGW SSLs at Source Area 6D has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial

alternatives. Additional evaluation of the potential risk to groundwater posed by the concentrations of antimony, cadmium, chromium, hexavalent chromium, copper, lead, and/or mercury in soil at Source Area 6D is presented in Section 8 of the HHERA (Volume II).

Source Area 52D

Cadmium, chromium, hexavalent chromium, and lead were detected at concentrations above their respective RISLs and/or PGW SSLs in near-surface soil samples collected at three (52D-SNS01, 52D-SNS02, and 52D-SB11) locations and in subsurface soil samples collected at only one (52D-SB10) location at Source Area 52D. Metals at concentrations above their respective RISLs and PGW SSLs are shown in Figures 4.3-7 and 4.3-8, respectively. Soil sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2. Conclusions regarding the characterization of metals based on the data presented on the table and figures are presented below:

52D-SNS01 and 52D-SNS02

- Cadmium, chromium, and lead were detected at concentrations above their respective RISLs and PGW SSLs in near-surface (0.5 foot bgs) soil samples collected at two locations 52D-SNS01 and 52D-SNS02. 52D-SNS01 and 52D-SNS02 are adjacent to the former waste treatment basins that received liquid wastes from Building 20009, particularly the former plating area (Figures 4.3-7 and 4.3-8).
- The vertical extent of these metals in soil at those locations is defined by the absence of those metals at concentrations above their RISLs and PGW SSLs in soil samples collected at 2.5 feet bgs at 52D-SNS01 and 52D-SNS02.
- The lateral extent in soil near locations 52D-SNS01 and 52D-SNS02 is defined by the absence of those metals at concentrations above their RISLs and PGW SSLs in soil samples collected at locations 52D-SNS03, 52D-SNS04, and 52D-SNS05.
- The presence of metals above their RISLs and PGW SSLs at locations 52D-SNS01 and 52D-SNS02 is attributed to overflows from the former waste treatment basins. The presence of metals in soil within the Source Area 5D ditch is also likely due to the discharge of fluids from the former waste treatment basins.

52D-SB10

- Chromium and hexavalent chromium were detected above their RISLs and PGW SSLs in a soil sample collected at 11 feet bgs from boring 52D-SB10, beneath the building foundation in the inactive plating area (Figures 4.3-7 and 4.3-8).
- The vertical extent of chromium and hexavalent chromium is defined by the absence of those metals at concentrations above their RISLs and PGW SSLs in soil samples collected at 23, 35, and 49 feet bgs in boring 52D-SB10.
- The absence of chromium and hexavalent chromium above their RISLs and PGW SSLs in the sample collected at 5 feet bgs from boring 52D-SB10 suggests that the boring may be close to, but not directly at, the source.
- The lateral extent of chromium and hexavalent chromium detected in subsurface soil from boring 52D-SB10 is defined by the absence of those metals at concentrations above their RISLs and PGW SSLs in subsurface soil samples collected from borings 52D-SB06, 52D-SB08, 52D-SB09, and 52D-SB13.

52D-SB11

- Lead above its PGW SSLs was detected in a soil sample collected at one foot bgs from boring 52D-SB11 (Figure 4.3-8). Boring 52D-SB11 is at the north end of the former waste treatment basins.
- The lateral extent of lead in soil near boring 52D-SB11 is defined by the absence of that metal above its PGW SSLs in soil samples collected from borings 52D-SB04, 52D-SB05, and 52D-SB09. As previously discussed, the presence of metals in soil within the Source Area 5D ditch may be due to the discharge of fluids from the former waste treatment basins.
- The vertical extent of lead is defined by the absence of that metal above its PGW SSL in the soil sample collected at 5 feet bgs from boring 52D-SB11.

Based on the information presented above, the lateral and vertical extent of metals above their RISLs and/or PGW SSLs at Source Area 52D has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives. Additional evaluation of the potential risk to groundwater posed by the concentrations of cadmium, chromium, hexavalent

chromium, lead, and mercury in soil at Source Area 52D is presented in Section 8 of the HHERA (Volume II).

4.3.8.3 *Semivolatile Organic Compounds*

B(a)A, B(b&k)F, B(a)P, and I(1,2,3-cd)P were the only SVOCs detected in soil at the source areas in the Building 20009 Area at concentrations above their respective RISLs and/or PGW SSLs (Section 4.3.7.4). Concentrations of B(a)P detected above its RISL in the source areas in the Building 20009 Area are shown in Figure 4.3-9. SVOCs detected above their PGW SSLs in the source areas in the Building 20009 Area are shown in Figure 4.3-10. Soil sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2. Conclusions regarding the lateral and vertical characterization of those compounds and potential sources are presented below:

- SVOCs at concentrations above their respective RISLs or PGW SSLs were not detected in surface and/or near-surface soil samples collected at source areas in the Building 20009 Area.
- B(a)A, B(b&k)F, B(a)P, and I(1,2,3-cd)P above their RISLs and/or PGW SSLs were detected in only one sample collected at 5 feet bgs at a single location (52D-SB07).
- As shown in Figures 4.3-9 and 4.3-10, 52D-SB07 is located near a former paint spray booth and former TCE degreaser inside Building 20009. The most likely source of SVOCs to soil in this area is one of those features or from other activities performed in the inactive plating area
- The vertical extent of B(a)A, B(b&k)F, B(a)P, and I(1,2,3-cd)P is defined by the absence of those compounds above their RISLs and/or PGW SSLs in the sample collected at 11 feet bgs from boring 52D-SB07.
- The lateral extent of B(a)A, B(b&k)F, B(a)P, and I(1,2,3-cd)P above their RISLs and/or PGW SSLs around boring 52D-SB07 is not well defined to the north and east. The extent of B(a)A, B(b&k)F, B(a)P, and I(1,2,3-cd)P to the west and south is defined by the absence of those compounds above their RISLs and PGW SSLs in soil samples collected from borings 52D-SB06 and 52D-SB08, respectively. Due to accessibility and space limitations inside Building 2009, the lateral extent has been defined to the extent possible.
- Seven SVOC TICs were detected in one surface soil sample collected from a single boring (52D-SB07) in the Building 20009 Area. Because of the uncertainty surrounding their identification and concentration, a

surrogate compound was not designated for the TICs and their concentrations were not compared to a RISL or PGW SSL.

Based on the information presented above, the lateral and vertical extent of SVOCs above their RISLs and/or PGW SSLs at Source Area 52D has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

4.3.8.4 *Polychlorinated Biphenyls*

PCBs were identified in the BOU FSP as COPCs only in the PCB transformer oil release area associated with the former AF Plant 70 (Building 20009) at Source Area 52D.

Aroclor 1260 was the only PCB detected in soil at concentrations above its RISL and/or PGW SSL in soil at the PCB transformer oil release area. Aroclor 1260 concentrations above its RISL and/or PGW SSL are summarized in Section 4.3.7.4 and shown in Figures 4.3-9 and 4.3-10, respectively. Soil sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2. Conclusions regarding the characterization of Aroclor 1260 based on the data presented on the table and figures are summarized below.

- As shown in Figures 4.3-4, 4.3-9, and 4.3-10, boring 52D-SB18 is located in an area affected by historical releases of transformer oil containing PCBs. Soils with PCBs were excavated from this area to a depth of approximately 11 to 15 feet bgs under the direction of the USAF in late 2004 and backfilled with clean material. Samples were not collected at depths shallower than 10 feet bgs at this location due to the presence of clean backfill.
- Aroclor 1260 was detected above its RISL in soil at location 52D-SB18 to a depth of 21 feet bgs and above its PGW SSL to a depth of 26 feet bgs. The presence of this PCB at a depth of up to 26 feet bgs suggests that it is the result of a substantial surface release or originated from a subgrade sump.
- The data indicate that PCBs above RISLs or PGW SSLs remain in soil below the former excavation.

Based on the information presented above, the lateral and vertical extent of Aroclor 1260 at source areas in the Building 20009 Area has been sufficiently characterized to evaluate potential risks to human health,

surface water, and groundwater and, if necessary, develop remedial alternatives.

4.3.8.5 *Perchlorate*

Perchlorate was not detected at concentrations above its RISL in soil samples collected at Source Areas 6D and 52D. Additionally, perchlorate above its PGW SSL was not detected in soil samples collected at Source Area 52D (Figure 4.3-11).

Perchlorate above its PGW SSL was detected in near-surface soil collected at three locations (6D-SNS09, 6D-SNS10, and 6D-SNS11) at Source Area 6D. Perchlorate concentrations above its PGW SSL are summarized in Section 4.3.7.4 and shown in Figure 4.3-12. Soil sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2. Conclusions regarding the characterization of perchlorate, both laterally and vertically, and potential sources of that compound to soil based on the data presented on the table and figures are summarized below:

- Perchlorate was detected above its PGW SSL in soil samples collected at 2.5 feet bgs at three (6D-SNS09, 6D-SNS10, and 6D-SNS11) locations at Source Area 6D (Figure 4.3-12).
- The absence of perchlorate in the surface (0.5 foot bgs) soil samples may be due to the historical placement of clean fill in the bermed area.
- The lateral extent of perchlorate in soil above its PGW SSL in the vicinity of locations 6D-SNS09, 6D-SNS10, and 6D-SNS11 is not well characterized. However, the absence of perchlorate above the PQL in surface and near-surface soil samples collected at locations 6D-SNS06, 6D-SNS07, and 6D-SNS08 indicate that the lateral extent is likely limited to within 50 feet.
- Although soil samples were not collected at depths greater than 2.5 feet bgs at the three locations, soil samples collected from boring 6D-SB02 at 1, 5, 11, 23, 35, 47, and 59 feet bgs were analyzed for perchlorate. As shown in Figure 4.3-12, boring 6D-SB02 is roughly 20 to 30 feet north of locations 6D-SNS09 and 6D-SNS11. Perchlorate was not detected above its PQL in the samples collected from 6D-SB02, indicating that if a release had occurred, it was relatively minor .
- The most likely origin of the perchlorate at Source Area 6D is plating solutions (perchloric acid) historically discharged to the bermed area.

Based on the information presented above, the lateral and vertical extent of perchlorate at Source Area 6D and other source areas in the Building 20009 Area has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

4.3.8.6 *Total Petroleum Hydrocarbons*

TPH-D and TPH-Mo were detected in soil at the source areas in the Building 20009 Area at concentrations above their PGW SSLs. TPH-D and TPH-Mo were not characterized laterally and vertically to their PGW SSLs during the BOU RI. Decisions regarding the need for additional characterizations during the field effort were based on the presence of SVOCs above their screening levels. The presence of those compounds in soil is discussed below.

TPH-D

TPH-D detected at concentrations above its PGW SSL are summarized in Section 4.3.7.4 and shown in Figure 4.3-12. Soil sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2. The presence of TPH-D in soil at Source Areas 6D and 52D based on the data presented on the table and figure are summarized below.

- TPH-D was not detected above its PGW SSL in soil samples collected at Source Area 6D.
- TPH-D was detected above its PGW SSL in one surface soil sample and one subsurface soil sample collected at Source Area 52D.
- TPH-D at concentrations above it PGW SSL was not detected in soil samples collected at depths greater than the sample having the exceedance.
- As shown in Figures 4.3-4 and 4.3-12, sample locations 52D-SNS03 and 52D-SB07 are located inside Building 20009 and the samples were collected beneath the building foundation.

Based on the information presented above, the lateral and vertical extent of TPH-D at source areas in the Building 20009 Area has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

TPH-Mo

TPH-Mo was not detected above its PGW SSL in the surface/near-surface soil samples collected at Source Areas 6D and 52D. TPH-Mo was detected above its PGW SSL in one subsurface soil sample collected at one (52D-SB07) location at Source Area 52D (Section 4.3.7.4; Figure 4.3-12). Boring 52D-SB07 is located near a former spray paint booth in the interior or Building 20009.

- The lateral extent of SVOCs and TPH-Mo to the west and south is defined by the absence of those compounds above their RISLs and PGW SSLs in soil samples collected from borings 52D-SB06 and 52D-SB08, respectively. The lateral extent of SVOCs, and subsequently TPH-Mo, is not well defined to the north and east. Due to accessibility and space limitations inside Building 2009, the lateral extent has been defined to the extent possible.
- The vertical extent of TPH-Mo is defined by the absence of that compound above its PGW SSL in soil samples collected at 11, 23.5, and 35 feet bgs from boring 52D-SB07.

Based on the information presented above, the lateral and vertical extent of TPH-Mo at source areas in the Building 20009 Area has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

4.3.9 *Former Sewage Treatment Plant Area – Administration Area West*

The FSTP Area includes Source Areas 8D and D(c) (Figures 4.1-1 and 4.3-1) and RCRA Units W and Y. The FSTP consisted of a number of buildings and several treatment tanks, including a 50,000-gallon capacity concrete holding tank, a concrete aerator, a settling pond, and drying beds. The FSTP provided secondary level treatment of domestic wastes from the Administration Area and for septic tank wastes transported to the plant from other remote Aerojet facilities. The treatment plant was operated in different modes over its period of use; at one time it was operated as a physical chemical plant with ferric chloride additions, and later as an activated sludge treatment plant. Specific dates for different modes of operation are not available. During the Stage 1 investigation, it was discovered that the sludge drying beds contained a 2- to 3-foot-thick bed of sand, which apparently facilitated the drainage and drying of sludge.

The sewage treatment plant was in use until 1972 and deactivated in 1972 or 1973. Between October 1979 and December 1983, the source area was potentially used for chemical waste collection and storage. The Source Area 8D settling pond was reportedly planned for deactivation in 1981. No additional information regarding Source Area D(c) historical activities was located during the record search. Figure 4.3-1 illustrates the basic site features. The investigation for these source areas also included sampling in the material staging area in the parking lot east of the wastewater treatment plant.

4.3.9.1 *Description of Source Areas – Former Sewage Treatment Plant Area*

The two source areas [8D and D(c)] and RCRA Units W and Y at the FSTP and site features associated with those source areas that may have contributed chemicals to soil in those source areas and Administration Area groundwater are described below. Site features were identified based on historical soil, soil vapor, and groundwater analytical data and/or visual inspection and limited data coverage. The source areas and associated features are shown in Figure 4.3-1.

<u>Source Area 8D</u>

Source Area 8D consists of a settling pond and a sludge drying bed located in the northeast corner of the former Aerojet sewage treatment plant. The settling pond has a capacity of 120,000 gallons and is located northeast of Building 20012 and northwest of Building 20018.

<u>Source Area D(c)</u>

Source Area D(c) is the sludge drying bed located in the northwest corner of the FSTP.

Other primary site features associated with Source Areas 8D and D(c) that may have contributed chemicals to source areas include the drainage ditch upgradient and to the southeast of the FSTP above 8D; including the area used for soil treatment operations; the west end of the secondary drainage ditch immediately north of the sewage treatment areas; and the treatment works at the FSTP including the holding tanks, settling basins, and digesters.

RCRA Unit W

RCRA Unit W formerly consisted of 10 tanks at Building 20018 used for the biological degradation of perchlorate (Figure 4.3-1). Eight of the 10 tanks were removed and disposed of as hazardous waste on 20 August 1990. The remaining two tanks were rinsed with pressurized water in June 1997 and all secondary containments and other features associated with the tanks were removed in August 1997. The DTSC indicated in a letter dated 16 June 1999 that RCRA Unit W had been clean closed above ground surface and that any residual soil contamination would be addressed under the partial consent decree.

RCRA Unit Y

RCRA Unit Y formerly consisted of several single- and double-walled polyethylene tanks and two Baker metal tanks enclosed within two secondary containment cells in a former parking lot immediately east of the FSTP. The tanks were used for the temporary storage of hazardous liquid wastes generated throughout the Aerojet facility. The tanks, secondary containments, and all associated features were decontaminated, removed, and disposed of and the unit was certified clean closed above ground surface by DTSC.

4.3.10 Summary and Results of Previous (Pre-2005) Vadose Zone Investigations – Former Sewage Treatment Plant Area

The following subsections summarize the scope and results of previous (prior to 2005) vadose zone investigations of the two source areas and various features at the FSTP Area, identify COPCs based on the previous investigations, and discuss the DQOs and sampling proposed in the BOU FSP.

4.3.10.1 Summary of Previous (Pre-2005) Vadose Zone Investigations – Former Sewage Treatment Plant Area

Soil samples were collected from 39 soil borings to depths up 10 feet bgs in the vicinity of Source Areas 8D and D(c) between 1986 and 1992 and analyzed for VOCs, SVOCs, TPH, PCBs, and/or metals. Additionally, six soil vapor samples were collected in the vicinity of those source areas between 1991 and 1992 and analyzed for VOCs. Previous investigations of those source areas are summarized below.

Source Area 8D

Two previous investigations were conducted at Source Area 8D in 1986 and 1992:

- 1986 Investigation – Thirty-two soil borings were advanced to depths of up to 9 feet bgs. The associated soil samples were analyzed for selected metals and VOCs.
- 1992 Investigation – Five soil borings were advanced to depths of up to 10 feet bgs, and samples were collected and analyzed for selected metals and SVOCs. Six soil vapor samples were collected to depths of up to 10 feet bgs and analyzed for selected VOCs.

Source Area D(c)

One previous investigation was conducted at Source Area D(c) in 1992:

- 1992 Investigation – Two soil borings were advanced in 1992. The associated soil samples were analyzed for SVOCs, TPH, PCBs, and metals.

RCRA Unit W

RCRA Unit W was certified clean closed above ground surface by DTSC in June 1999.

RCRA Unit Y

RCRA Unit Y was certified clean closed above ground surface by DTSC.

4.3.10.2 Results of Previous (Pre-2005) Vadose Zone Investigation Results – Former Sewage Treatment Plant Area

The results of the previous (prior to 2005) investigations of Source Areas 8D and D(c), as presented in the BOU FSP (Aerojet et al., 2006b), are summarized below.

Review of the previous data identified the following COPCs in soil and/or soil vapor at Source Areas 8D and D(c) and the FSTP Area:

- **Soil –** VOCs, SVOCs, metals (including hexavalent chromium), TPH, PCBs, and perchlorate.
- **Soil Vapor –** VOCs.

Figures showing previous sampling locations at the source areas within the FSTP Area and chemical groups detected in soil samples collected between 1991 and 2005 above human health and ecological screening levels were presented in the BOU FSP (Aerojet et al., 2006b) and are included in Appendix E. The BOU FSP also presented a summary of statistics and the sample results for chemicals detected in soil, soil vapor, and groundwater that exceed human health and ecological screening levels in the FSTP source areas.

4.3.10.3 Summary of Data Needs – Former Sewage Treatment Plant Area

Based on a review of the previous vadose zone investigation data, extensive aerial photograph research and review, and exhaustive research of historical documents, Aerojet determined that additional soil and soil vapor sampling was needed at the FSTP Area to:

- Confirm the presence of VOCs in source area soils;
- Characterize the present lateral and vertical extent of VOCs, SVOCs, PCBs, perchlorate, TPH, pH, and metals (including hexavalent chromium) in the vadose zone at concentrations that could potentially pose a risk to human and ecological receptors;
- Evaluate the potential for chemicals in soil to degrade surface or groundwater quality; and
- Obtain sufficient data to support fate and transport modeling, evaluate risk to human and ecological receptors, and evaluate potential remedial alternatives.

It should be noted that due to the time lapse (12 years) since the Stage 1 RI was performed and the elevated laboratory reporting limits for VOCs during that investigation, the investigation of VOCs performed during the BOU RI was designed to supersede all previous soil vapor and soil VOC investigation results.

4.3.11 Summary and Results of Boundary Operable Unit Vadose Zone Investigation – Former Sewage Treatment Plant Area

The following subsections summarize the recent (2005 to 2007) BOU investigation of the two source areas and associated features in the FSTP Area, describe deviations from sampling proposed in the approved BOU FSP, and summarize the results of the investigation. Conclusions as to the completeness of characterization and potential sources of constituents identified in the vadose zone are presented in Section 4.3.12.

4.3.11.1 *Summary of Boundary Operable Unit Vadose Zone Investigation – Former Sewage Treatment Plant Area*

The BOU RI of the vadose zone at Source Areas (8D and D(c) and associated features within the FSTP Area included the following activities:

Soil Vapor Investigation

- Twenty-three primary and two duplicate soil vapor samples were collected at 12 locations at Source Areas 8D and D(c) and associated features in the FSTP Area at depths ranging from 10 to 30 feet bgs. Soil vapor samples were analyzed for VOCs, including TICs. Soil vapor sampling locations are shown in Figure 4.3-2.
- The total number of soil vapor samples collected within each potential source site (including QA/QC samples) analyzed for VOCs are provided on Table 4.3-1.
- A cross-reference between soil vapor sampling locations at Source Areas 8D and D(c) and the specific features they were sited to investigate are provided on Table 4.3-2.

Surface and Subsurface Soil Investigation

- A total of 14 primary and one duplicate surface/near-surface (0 to 2.5 feet bgs) soil samples and 24 primary and one duplicate subsurface (2.6 to 35 feet bgs) soil samples were collected at Source Areas 8D and D(c) and associated features in the FSTP Area. Surface and subsurface soil sampling locations are shown in Figures 4.3-3 and 4.3-4, respectively.
- Surface and subsurface soil samples were analyzed for SVOCs, metals (including hexavalent chromium), perchlorate, TPH-D, TPH-Mo, pH, TOC, and/or CEC. The SVOC analysis of soil also included an evaluation of the presence of TICs. In accordance with the BOU FSP, sample analyses were based on the analytical results from previous investigations and therefore every sample was not analyzed for the full suite of constituents.
- The numbers of surface/near-surface and subsurface soil samples collected for each analysis (including QA/QC samples) at each of the source areas, along with the corresponding methods, are provided on Table 4.3-9.

- A cross-reference between soil sampling locations at Source Areas 8D and D(c) and the specific features they were sited to investigate are provided on Table 4.2-2.

4.3.11.2 Deviations from Boundary Operable Unit Data Quality Objectives and Sampling Design – Former Sewage Treatment Plant Area

Sampling activities at Source Areas 8D and D(c) and associated features in the FSTP Area during the BOU RI were generally consistent with those proposed by the BOU FSP, with the exceptions listed on Tables 4.3-5 and 4.3-6. Sampling was performed at locations proposed in the BOU FSP and step-out sampling was performed in accordance with the procedures agreed upon with the Agencies. A comparison of proposed and actual sampling activities, including sampling rationale, sample depth, and analyses, is provided on Tables 4.3-5 and 4.3-6. Soil and soil vapor sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2.

4.3.11.3 Site Specific Geology and Hydrogeology – Former Sewage Treatment Plant Area

The geology and hydrogeology of the FSTP Area are described below. The descriptions are based on information presented on field logs of borings drilled during the BOU RI.

<u>*Geology*</u>

The FSTP Area was not dredged for gold. Native material in the FSTP Area generally consists of hard, interbedded layers of gravel and sand grading to cobbles with depth. Near the sludge drying area and settling pond at Source Area 8D, native material consisted of a relatively thick (15 to 26 feet) layer of interbedded clay grading to cobbles. Near the sludge drying area at Source Area D(c), the subsurface lithology consisted primarily of silt mixed with sand and gravel to a depth of 20 feet bgs grading to sand and gravel with some silt below that depth.

<u>*Hydrogeology*</u>

Perched groundwater was encountered at a depth of 21 feet bgs in a layer of silty sand with gravel at one location [D(c)-SP07] in the FSTP Area.

Continuous groundwater was not encountered in any of the borings drilled in the FSTP Area. Based on the data presented in Section 4.5,

depth to continuous groundwater in the FSTP Area is approximately 35 feet bgs.

4.3.11.4 *Results of Boundary Operable Unit Vadose Zone Investigation – Former Sewage Treatment Plant Area*

The results of the VOC, metals, SVOC, PCB, perchlorate, TPH-D and TPH-Mo, pH, TOC, CEC, and geotechnical analyses of samples collected at source areas in the FSTP Area during the BOU RI are summarized below. The analytical data for soil vapor and soil samples are provided in Appendices F and G, respectively. A discussion of the results with respect to the completeness of the characterization of constituents identified above RISLs or PGW SSLs and potential sources is presented in Section 4.3.12.

Summary of Investigation and Results – Volatile Organic Compounds

Based on evaluation of the existing data for Source Areas 8D and D(c) and associated features in the FSTP Area, the BOU FSP concluded that additional soil vapor sampling was needed to sufficiently characterize the nature and extent of VOCs. The numbers of primary soil vapor samples collected at each source area in the FSTP Area are summarized on Table 4.3-1 and the table below. Summary statistics for the samples are also provided on Table 4.3-1.

Source Area	Interval Depth (feet bgs)	No. of Primary Samples	No. of Locations
8D	Shallow: 0-10	4	4
	Intermediate: 11-20	3	3
	Deep: 21-30	0	0
D(c)	Shallow: 0-10	7	7
	Intermediate: 11-20	8	8
	Deep: 21-30	1	1

The analytical results for the soil vapor samples collected from the shallow (0 to 10 feet bgs), intermediate (11 to 20 feet bgs), and deep (21 to 30 feet bgs) intervals at Source Areas 8D and D(c) and features in the FSTP Area are presented in Appendix F and summarized below. Soil vapor sampling locations in Administration Area West are shown in Figure 4.3-2. Soil vapor sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2.

TCE, PCE, vinyl chloride, and TVOC concentrations above their respective RISLs in the shallow, intermediate, and deep intervals within the FSTP Area are shown in Figure 4.2-5a. TVOC concentrations above the RISLs are also shown in Figure 4.2-5b. TCE, PCE, and vinyl chloride concentrations above their respective PGW SSLs are shown in Figure 4.2-6. The TVOC concentrations illustrated in Figures 4.2-5a and 4.2-5b represent the sum of the ratio of the concentration for each detected VOC in the sample divided by its RISL. For example, if PCE at a concentration of 320 μg/m^3 and TCE at a concentration of 961 μg/m^3 were the only VOCs detected in the samples, then the sum of their respective concentrations divided by their respective RISLs of 320 and 961 μg/m^3 would be 2, or:

$$PCE = \frac{320\,\mu g/m^3}{320\,\mu g/m^3} = 1$$

$$TCE = \frac{961\,\mu g/m^3}{961\,\mu g/m^3} = 1$$

$$TVOC\ Ratio = 2$$

As agreed upon with the Agencies, soil vapor would be characterized during the BOU RI to the point where the TVOC concentration ratio was less than or equal to 10.

Cross sections presenting generalized vadose zone lithology and soil vapor sampling results for the source areas and features in the FSTP Area are presented in Figure 4.3-6.

Shallow Soil Vapor (0 to 10 feet bgs) – VOCs:

- Eleven primary soil vapor samples and one duplicate were collected from the shallow interval at 11 locations at Source Areas 8D and D(c) and features in the FSTP Area and analyzed for VOCs, including TICs. Shallow soil vapor sampling locations and PCE, TCE, vinyl chloride, and TVOC concentrations above their respective RISLs are shown in Figures 4.3-2 and 4.2-5a, respectively. TVOC concentrations above the RISLs are also shown in Figure 4.2-5b. PCE, TCE, and vinyl chloride concentrations above their respective PGW SSLs are shown in Figure 4.2-6. Soil vapor sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2.
- Volatile organic TICs were not detected in the shallow soil vapor samples.

- Chloroform was the only VOC detected at a concentration above its RISL. The shallow soil vapor sample collected in the FSTP Area having a concentration of chloroform exceeding its RISL is listed on the table below.
- Benzene, TCE, and PCE were detected at concentrations above their respective PGW SSLs. Shallow soil vapor samples having concentrations of benzene, TCE, and PCE exceeding their PGW SSLs are listed on the table below.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
8D-SP08	10	Benzene	84	35	66	N	Y
AW-8D-SP10	10				57	N	Y
D(c)-SP05	10				49	N	Y
D(c)-SP11	10				35	N	Y
D(c)-SP06	10	Chloroform	83	18,595	560	Y	N
D(c)-SP06	10	TCE	961	527	690	N	Y
8D-SP08	10	PCE	320	57	71	N	Y
D(c)-SP12					69	N	Y

Intermediate Soil Vapor (11 to 20 feet bgs) – VOCs:

- Eleven primary intermediate soil vapor samples and one duplicate were collected from the intermediate layer at 11 locations at Source Areas 8D and D(c) and the FSTP Area and analyzed for VOCs, including TICs. Intermediate soil vapor sampling locations and PCE, TCE, vinyl chloride, and TVOC concentrations above their respective RISLs are shown in Figures 4.3-2 and 4.2-5a, respectively. TVOC concentrations above the RISLs are also shown in Figure 4.2-5b. PCE, TCE, and vinyl chloride concentrations above their respective PGW SSLs are shown in Figure 4.2-6. Soil vapor sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2.
- Volatile organic TICs were not detected in the intermediate soil vapor samples.
- Chloroform was the only VOC detected in the intermediate soil vapor samples collected at Source Area D(c) at concentrations above its RISL. Intermediate soil vapor samples having concentrations of chloroform exceeding its RISL or PGW SSL are listed on the table below.
- Benzene and PCE were detected in the intermediate soil vapor samples collected at Source Area D(c) at concentrations above their PGW SSLs.

The soil vapor samples having concentrations of those VOCs above their PGW SSLs are listed on the table below.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
8D-SP07	20	Benzene	84	35	39	N	Y
AW-8D-SP10					46	N	Y
D(c)-SP05	20	Chloroform	83	18,595	180	Y	N
D(c)-SP09					290	Y	N
D(c)-SP011					290	Y	N
D(c)-SP12	20	PCE	320	57	100	N	Y

Deep Soil Vapor (21 to 30 feet bgs) – VOCs:

- One deep primary soil vapor was collected at one location [D(c)-SP05] at Source Area D(c) and analyzed for VOCs, including TICs. The deep vapor sampling location is shown in Figures 4.3-2 and 4.2-5a. Soil vapor sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2.
- Volatile organic TICs were not detected in the deep soil vapor sample.
- Chloroform at 710 µg/m³ and TCE at 1,300 µg/m³, above their respective RISLs, were detected in the deep soil vapor sample. Additionally, the detected concentration of TCE is above its PGW SSL.

Summary of Investigation and Results – Metals

A total of 38 primary and 2 duplicate soil samples were collected at Source Areas 8D and D(c) and the FSTP Area during the BOU RI and analyzed for metals and/or hexavalent chromium. The number of primary soil samples and sampling locations at Source Areas 8D and D(c) are summarized on Table 4.3-9 and below. Summary statistics for the samples are also presented on Table 4.3-9.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
8D	Metals	8	7	13	6
	Mercury	8	7	13	6
	Hex Chrome	8	7	14	6
D(c)	Metals	6	5	9	4
	Mercury	6	5	9	4
	Hex Chrome	6	5	10	4

The results of the metals analysis of surface/near-surface and subsurface soil samples collected at Source Areas 8D and D(c) and the FSTP Area are presented in Appendix G and summarized below.

Metals detected in soil within Administration Area West at concentrations statistically different from background and subsequently compared to screening levels were antimony, cadmium, chromium, copper, lead, mercury, molybdenum, silver, and zinc (Section 3.1.3.1). Because boron, hexavalent chromium, lithium, strontium, and titanium were not included in the background evaluation, concentrations of these metals were also compared to screening levels.

Surface/near-surface and subsurface soil sampling locations in Administration Area West are shown in Figures 4.3-3 and 4.3-4, respectively. Soil sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2. A cross-section showing the generalized lithology of the vadose zone in the FSTP Area is presented in Figure 4.3-6.

Surface and Near-Surface Soil – Metals:

- Fourteen primary and one duplicate surface/near-surface soil samples were collected at 12 locations at Source Areas 8D and D(c) and the FSTP Area and analyzed for metals, including mercury and hexavalent chromium. Surface and near-surface soil sampling locations are shown in Figures 4.3-3, 4.3-7, and 4.3-8.
- Metals were not detected at concentrations statistically above background and their respective RISLs or PGW SSLs in any of the surface or near-surface soil samples collected at Source Areas 8D and D(c).

Subsurface Soil – Metals:

- Twenty-two primary samples and one duplicate subsurface soil samples were collected at 10 locations at Source Areas 8D and D(c) at depths ranging from 5 to 35 feet bgs and analyzed for metals, including mercury. Additionally, 24 primary samples and 1 duplicate sample were also analyzed for hexavalent chromium. Subsurface soil sampling locations are shown in Figures 4.3-4, 4.3-7, and 4.3-8.
- Metals were not detected at concentrations statistically above background and their respective RISLs or PGW SSLs in any of the subsurface soil samples collected at Source Areas 8D and D(c).

Summary of Investigation and Results – Semivolatile Organic Compounds

A total of 25 primary soil samples and 1 duplicate sample were collected at Source Areas 8D and D(c) and the FSTP Area during the BOU RI and analyzed for SVOCs, including TICs. The number of primary soil samples and sampling locations at Source Areas 8D and D(c) for SVOCs are summarized on Table 4.3-9 and below. Summary statistics for the samples are also presented on Table 4.3-9.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
8D	SVOCs	8	7	6	2
D(c)	SVOCs	6	5	5	2

The results of the SVOC analysis of surface/near-surface and subsurface soil samples collected at Source Areas 8D and D(c) and the FSTP Area are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations and SVOCs detected at concentrations above their respective RISLs are shown in Figure 4.3-9. Surface and subsurface soil sampling locations and SVOCs detected at concentrations above their respective PGW SSLs are shown in Figure 4.3-10. Soil sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2.

Surface and Near-Surface Soil – SVOCs:

- Fourteen primary surface and/or near-surface soil samples and one duplicate were collected at 12 locations within Source Areas 8D and D(c) during the BOU RI and analyzed for SVOCs, including TICs.
- TICs were not detected in the SVOC analysis of the surface and/or near-surface soil samples.
- SVOCs detected in surface and/or near-surface soil above their respective RISLs and/or PGW SSLs, the depth at which the sample was collected, and the sampling location are identified on the table below. B(a)P detected at concentrations above its RISL is shown in Figure 4.3-9. B(a)A, B(a)P, B(b&k)F, D(a,h)A, and I(1,23-cd)P detected at concentrations above their PGW SSLs are shown in Figure 4.3-10.

Sample Location	Depth (ft bgs)	SVOC	RISL	PGW SSL	Conc. (µg/kg)	> RISL	> PGW SSL
8D-SB02	0.5	Benzo(a)pyrene	38	2.9	20	N	Y
		Benzo(b&k)fluoranthene	38	29	31	N	Y
D(c)-SB05	1.0	Benzo(a)anthracene	620	29	77	N	Y
		Benzo(a)pyrene	38	2.9	100	Y	Y
		Benzo(b&k)fluoranthene	38	29	200	Y	Y
		Dibenz(a,h)anthracene	62	2.9	18	N	Y
		Indeno(1,2,3-cd)pyrene	621	29	59	N	Y

Subsurface Soil – SVOCs:

- Eleven primary samples were collected at four locations at Source Areas 8D and D(c) at depths ranging from 5 to 35 feet bgs during the BOU RI and analyzed for SVOCs, including TICs.
- TICs were not detected in the SVOC analysis of the subsurface soil samples.
- SVOCs were not detected at concentrations above their respective RISLs in the subsurface soil samples collected at Source Areas 8D and D(c).
- B(a)P at 8.5 µg/kg, above its PGW SSL of 2.9 µg/kg, was detected in a sample collected from boring 8D-SB02 at a depth of 5 feet bgs (Figure 4.3-10).

Summary of Investigation and Results – Polychlorinated Biphenyls

A total of 23 primary soil samples and 1 duplicate were collected at Source Areas 8D and D(c) and the FSTP Area during the BOU RI and analyzed for PCBs. The number of primary soil samples and sampling locations at Source Areas 8D and D(c) for PCBs are summarized on Table 4.3-9 and below. Summary statistics for the samples are also presented on Table 4.3-9.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
8D	PCBs	8	7	6	2
D(c)	PCBs	6	5	3	1

The results of the PCB analysis of surface/near-surface and subsurface soil samples collected at Source Areas 8D and D(c) and the FSTP Area are presented in Appendix G and summarized below. PCB Aroclor 1254 detected in surface and subsurface soil at concentrations above its RISL

and PGW SSL are shown in Figures 4.3-11 and 4.3-12, respectively. Soil sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2.

Surface and Near-Surface Soil – PCBs:

- Fourteen primary and one duplicate surface/near-surface soil samples were collected at 12 locations at Source Areas 8D and D(c) and analyzed for PCBs.
- PCB 1254 was detected above its RISL and PGW SSL in only one surface soil sample collected at Source Areas 8D and D(c). The detected concentration of PCB 1254 at Source Area 8D, and the depth and location of the sample, is listed below and shown in Figures 4.3-11 and 4.3-12.

Sample Location	Depth (ft bgs)	PCB	RISL	PGW SSL (µg/kg)	Conc. (µg/kg)	> RISL	> PGW SSL
8D-SB02	0.5	Aroclor 1254	220	34	270	Y	Y

Subsurface Soil – PCBs:

- Nine primary subsurface soil samples were collected at three locations at Source Areas 8D and D(c) at depths ranging from 5 to 35 feet bgs and analyzed for PCBs. Subsurface soil sampling locations for PCBs are shown in Figures 4.3-11 and 4.3-12.
- PCBs at concentrations above their respective RISLs and PGW SSLs were not detected in subsurface soils collected at Source Areas 8D and D(c). The results of the Aroclor 1254 analysis of subsurface soil samples collected from boring 8D-SB02 are listed in the table below.

Sample Location	Depth (ft bgs)	PCB	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	> RISL	> PGW SSL
8D-SB02	5	Aroclor 1254	220	34	34	N	N
	11				<22	N	N
	23				<24	N	N
	35				<24	N	N

Summary of Investigation and Results – Perchlorate

A total of 30 primary soil samples and two duplicates were collected at Source Areas 8D and D(c) and the FSTP Area during the BOU RI and analyzed for perchlorate. The number of primary soil samples and

sampling locations at Source Areas 8D and D(c) for perchlorate are summarized on Table 4.3-9 and below. Summary statistics for the samples are also presented on Table 4.3-9.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
8D	Perchlorate	8	7	12	5
D(c)	Perchlorate	6	5	4	1

The results of the perchlorate analysis of surface/near-surface and subsurface soil samples collected at Source Areas 8D and D(c) and the FSTP Area are presented in Appendix G and summarized below. Perchlorate detected at concentrations above its RISL and PGW SSL are shown in Figure 4.3-12. Soil sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2.

Surface and Near-Surface Soil – Perchlorate:

- Fourteen primary and one duplicate surface/near-surface soil samples were collected at 12 locations at Source Areas 8D and D(c) during the BOU RI and analyzed for perchlorate (Figures 4.3-11 and 4.3-12).
- Perchlorate was not detected at concentrations above its RISL in the surface soil samples collected at Source Areas 8D and D(c).
- Perchlorate at concentrations above its PGW SSL of 60 µg/kg was detected in two samples collected at Source Areas 8D and D(c). Perchlorate detected at concentrations above the PGW SSL, and the depths and locations of the samples, are listed on the table below and shown in Figure 4.3-12.

Sample Location	Depth (ft bgs)	Compound	RISL	PGW SSL	Conc. (µg/kg)	> RISL	> PGW SSL
8D-SB03	0.5	Perchlorate	7,800	60	99	N	Y
8D-SB06	1.0	Perchlorate	7,800	60	78	N	Y

Subsurface Soil – Perchlorate:

- Sixteen primary subsurface soil samples and one duplicate were collected at six locations at Source Areas 8D and D(c) at depths ranging from 5 to 35 feet bgs and analyzed for perchlorate (Figures 4.3-11 and 4.3-12).

- Perchlorate was not detected at concentrations above its RISL or PGW SSL in the subsurface soil samples collected at Source Areas 8D and D(c).

Summary of Investigation and Results – Total Petroleum Hydrocarbons

A total of 24 primary soil samples and 1 duplicate were collected at Source Areas 8D and D(c) and the FSTP Area during the BOU RI and analyzed for TPH-D and TPH-Mo. The number of primary soil samples and sampling locations for TPH at Source Areas 8D and D(c) are summarized on Table 4.3-9 and below. Summary statistics for the samples are also presented on Table 4.3-9.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
8D	TPH-D	8	7	6	2
	TPH-Mo	8	7	6	2
D(c)	TPH-D	6	5	4	1
	TPH-Mo	6	5	4	1

The results of the TPH-D and TPH-Mo analyses of surface/near-surface and subsurface soil samples collected at Source Areas 8D and D(c) and the FSTP Area are presented in Appendix G and summarized below. Surface and subsurface sampling locations for TPH are shown in Figures 4.3-3 and 4.3-4, respectively. TPH-D detected at concentrations above its PGW SSL is shown in Figure 4.3-12. Soil sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2.

Surface and Near-Surface Soil – TPH:

- Fourteen primary and one duplicate surface/near-surface soil samples were collected at 12 locations at Source Areas 8D and D(c) and analyzed for TPH-D and TPH-Mo. Surface and near-surface soil sampling locations for TPH at Source Areas 8D and D(c) and in the FSTP Area are shown in Figures 4.3-3 and 4.3-12.
- TPH-D and TPH-Mo were not detected at concentrations above their respective PGW SSLs in surface soil samples collected at Source Areas 8D and D(c).

Subsurface Soil – TPH:

- Ten primary subsurface soil samples were collected at three locations at Source Areas 8D and D(c) and analyzed for TPH-D and TPH-Mo.

Subsurface sampling locations for TPH at Source Areas 8D and D(c) and in the FSTP Area are shown in Figures 4.3-4 and 4.3-12.

- TPH-D and/or TPH-Mo were not detected at concentrations above their PGW SSLs in the subsurface soil samples collected at Source Areas 8D and D(c).

Summary of Investigation and Results – Miscellaneous Compounds

Miscellaneous analyses performed on soil samples collected at Source Areas 8D and D(c) and the FSTP Area were NDMA, pH, TOC, and/or CEC. The number of primary surface/near-surface and subsurface soil samples collected at each source area for each analyte and the numbers of locations are summarized on the table below.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
8D	NDMA	8	7	6	2
	pH	8	7	14	6
	TOC	2	2	6	2
	CEC	2	2	6	2
D(c)	NDMA	6	5	5	2
	pH	6	5	10	4
	TOC	1	1	4	1
	CEC	1	1	4	1

The analytical results for the miscellaneous analyses of surface/near-surface and subsurface soil samples are presented in Appendix G and summarized below. The analytical data for pH, TOC, and CEC are used in the risk assessments to evaluate the bioavailability of some chemicals with respect to human and ecological receptors. Additionally, the TOC and COC data are used in the FS to evaluate chemical and physical remedial actions, assess the potential for metals in soil to migrate into groundwater, and develop cleanup goals protective of groundwater.

N-Nitrosodimethylamine. NDMA was not detected above the PQL in the surface/near-surface and subsurface soil samples collected at Source Areas 8D and D(c) using USEPA Method 8270C.

pH. The results of pH analysis of 15 surface/near-surface and 25 subsurface soil samples, including duplicates, collected at Source Areas 8D and D(c) are summarized on the table below. The pH of the soil was within the normal range (5 to 9) expected for mineral soils (Brady, 1974).

Source Area	Surface/ Near-Surface Soil	Subsurface Soil
8D	6.17 – 7.21	6.32 – 7.75
D(c)	6.29 – 8.1	6.77 – 8.84

Total Organic Carbon. TOC was not detected above the PQL in the surface, near-surface, or subsurface soil samples collected at Source Areas 8D and D(c).

Cation Exchange Capacity. CEC in the surface/near-surface soil samples collected at Source Areas 8D and D(c) ranged from 31 to 220 meq/K. CEC in the subsurface soil samples ranged from 82 to 380 meq/K.

Summary of Investigation and Results – Geotechnical Parameters

A total of 58 soil samples were collected in Administration Area West, including the source areas in the FSTP Area, for geotechnical parameters during the BOU RI. Additionally, 17 soil samples for geotechnical parameters were collected from portions of Administration Area West between 2005 and 2007 as part of the J&E Model Calibration Study. The results of the geotechnical analyses of soil samples for moisture content, wet density, dry density, specific gravity, porosity, sieve analysis, and/or permeability are summarized on Table 4.3-7.

The geotechnical data will be used in the risk assessment to develop site-specific soil input parameters (moisture content, water-filled porosity, air-filled porosity, etc.) for fate and transport models and in the feasibility study to assess potential remedial actions such as vapor extraction. Fate and transport models are used in risk assessment to quantitatively evaluate the migration of volatile organics into outdoor and indoor air and the potential leaching of chemicals through soil and into groundwater.

4.3.12 *Discussion of Investigation Results with Respect to Data Quality Objectives – Former Sewage Treatment Plant Area*

The analytical results presented in the previous sections indicated that several chemical constituents were detected in soil and/or soil vapor at the source areas within the FSTP Area at concentrations above their respective RISLs and/or PGW SSLs.

Soil vapor: Benzene, chloroform, PCE and TCE.

Soil: PAHs [B(a)A, B(a)P, B(b&k)F, D(a,h)A, and/or I(1,2,3-cd)P], PCB Aroclor 1254, and perchlorate.

The presence of these COPCs in each source area is discussed below with respect to the data needs described in Section 4.3.10.3. Specifically,

- Has the investigation resulted in the sufficient characterization of the lateral and vertical distribution of each COPC in the vadose zone and identified a potential source for those COPCs?
- Has the investigation resulted in sufficient data to evaluate the potential for COPCs in soil to migrate into and degrade surface water and groundwater quality?
- Has the investigation resulted in data sufficient to support human health and ecological risk assessments and fate and transport modeling?
- Has the investigation resulted in sufficient data to evaluate the feasibility of remediating the identified compounds and concentrations to levels that do not pose a risk to human and ecological receptors or degrade surface water and groundwater quality?

For the purpose of this discussion, it is assumed that chemicals detected at concentrations above their RISLs could potentially pose a risk to human health and chemicals detected above their PGW SSL could potentially migrate into groundwater or surface water. Sampling locations where VOCs, metals, and other non-VOCs (SVOCs, PCBs, perchlorate, NDMA, and TPH-D) were detected in surface and/or subsurface soil at concentrations above their respective PGW SSLs are shown in Figures 4.2-6, 4.3-8, 4.3-10, and 4.3-12.

The analytical results for surface water and groundwater within the Administration Area are discussed in Sections 4.4 and 4.5, respectively, and discussed with respect to potential soil and soil vapor sources in the FSTP Area. Additionally, the potential for chemicals in soil and soil vapor to migrate into surface water and groundwater is further evaluated in Section 8 of the HHERA (Volume II).

4.3.12.1 *Volatile Organic Compounds*

VOCs detected in soil vapor samples collected at the source areas in the FSTP Area are summarized in Section 4.3.11.4. PCE, TCE, vinyl chloride, and TVOC concentrations above their RISLs in the shallow, intermediate, and deep intervals are shown in Figure 4.2-5a. TVOC concentrations

above the RISLs are also shown in Figure 4.2-5b. PCE, TCE, and vinyl chloride concentrations in the soil vapor intervals above their PGW SSLs are shown in Figure 4.2-6. Soil vapor sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2. Conclusions regarding the characterization of VOCs in the vadose zone and potential sources based on the data are summarized below:

- Chloroform was the only VOC detected at concentration above its RISL. Benzene, chloroform, PCE and TCE were detected at concentrations above their PGW SSLs.
- The data indicate that concentrations of chloroform in soil vapor samples collected at D(c)-SP05, D(c)-SP09, and D(c)-SP11 and TCE at D(c)-SP05 increase with depth. The increase in concentration with depth indicates chloroform and TCE detected at those locations are due to migration from groundwater instead of a surface release.
- The data also indicate that chloroform concentrations at one location D(c)-SP06 attenuate significantly with depth from 560 $\mu g/m^3$ to less than 6.0 $\mu g/m^3$ over 10 feet, suggesting that chloroform at this location is due to potential releases from the former treatment works.
- The concentrations of benzene, chloroform, PCE, and TCE detected in the soil vapor samples are less than 1 percent of their vapor saturation concentrations and therefore not indicative of the presence of NAPL.

Based on the information presented above, the lateral and vertical extent of VOCs at source areas in the FSTP Area has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

4.3.12.2 *Semivolatile Organic Compounds*

PAHs [B(a)A, B(a)P, B(b&k)F, D(a,h)A, and/or I(1,2,3-cd)P] were detected in soil at only two [8D-SB02 and D(c)-SB05 at the source areas in the FSTP Area at concentrations above their respective RISLs and/or PGW SSLs. PAHs at concentrations above their RISLs and PGW SSLs are shown in Figures 4.3-9 and 4.3-10, respectively. Soil sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2. The presence of those compounds in soil at each location with respect to the completeness of characterization, both laterally and vertically, and potential sources are discussed below.

8D-SB02 and D(c)-SB05

PAHs were detected at concentrations above their RISLs and/or PGW SSLs at locations 8D-SB02 and D(c)-SB05. The detections of PAHs at both locations appear to be isolated and unrelated.

The lateral extent of PAHs at 8D-SB02 is defined by the absence of PAHs in soil samples collected from borings 8D-SB01, 8D-SB03, and D(c)-SB04. The lateral extent of PAHs at D(c)-SB05 is defined by the extent of the low-lying area where the sample was collected. This is defined by the absence of PAHs above their RISL and/or PGW SSL in samples collected from borings 8D-SB05 and D(c)-SB02.

The vertical extent of PAHs at location 8D-SB02 is defined by the absence of those compounds above their RISLs and PGW SSLs in soil samples collected at a depth of 11 feet bgs at that location. The vertical extent of PAHs at location D(c)-SB05 is defined by the absence of PAHs in the sample collected at 5 feet bgs at that location.

Based on the information presented above, the lateral and vertical extent of SVOCs at Source Area D(c) has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

4.3.12.3 *Polychlorinated Biphenyls*

Aroclor 1254 was the only PCB detected in soil at the source areas in the FSTP Area at concentrations above its RISL and/or PGW SSL (Section 4.3.11.4). Conclusions regarding the characterization of Aroclor 1254 based on the data presented on the table and figures are summarized below.

Aroclor 1254 at concentrations above its RISL and PGW SSL was detected in only one surface soil sample collected at one location (8D-SB02) at the southwest corner of the sludge drying area (Figures 4.3-11 and 4.3-12). Soil sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2.

- The lateral extent of Aroclor 1254 at that location is defined by the absence of that compound in soil samples collected from Stage 1 RI boring 8D-AH01 and BOU RI borings 8D-SB01, 8D-SB03, and 8D-SB04.

- The vertical extent of Aroclor 1254 is defined by the absence of that compound above its RISL and PGW SSL in soil samples collected at 5, 11, 23, and 35 feet bgs from boring 8D-SB02.
- The most likely source of Aroclor 1254 in soil at location 8D-SB02 is from the sludge that was historically placed at that location for drying.

Based on the information presented above, the lateral and vertical extent of Aroclor 1254 at source areas in the FSTP Area has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

4.3.12.4 Perchlorate

Perchlorate was not detected above its RISL in surface, near-surface, or subsurface soil samples collected at the source areas in the FSTP Area (Section 4.3.11.4). Perchlorate was, however, detected at concentrations above its PGW SSL in surface/near-surface soil samples collected at two (8D-SB03 and 8D-SB06) locations at Source Area 8D (Figure 4.3-12). Soil sampling locations and the specific features they were sited to investigate are cross-referenced on Table 4.3-2. The lateral and vertical extent of perchlorate above its PGW SSL at those locations is discussed below.

<u>8D-SB03</u>

Perchlorate above its PGW SSL was detected in a soil sample collected at a depth of 0.5 foot bgs from boring 8D-SB03 near one of the former treatment works (Figure 4.3-12).

- The lateral extent of perchlorate is defined by the absence of that compound above its PGW SSL in soil samples collected from borings 8D-SB02 and 8D-SB04 (Figure 4.3-12). The absence of perchlorate above its PQL in the duplicate sample collected from boring 8D-SB03 indicates that the presence of perchlorate at Source Area 8D is inconsistent.
- The vertical extent of perchlorate is defined by the absence of that compound above the PQL in soil samples collected at 5 and 11.5 feet bgs from boring 8D-SB03.

8D-SB06

Perchlorate above its PGW SSL was detected in a soil sample collected at a depth of 1 foot bgs from boring 8D-SB06 near one of the former digester tanks (Figure 4.3-12).

- The lateral extent of perchlorate is defined by the absence of that compound above its PGW SSL in soil samples collected from borings 8D-SB04 and 8D-SB05 (Figure 4.3-12). As previously discussed, the absence of perchlorate above its PQL in the duplicate sample collected from boring 8D-SB03 indicates that the presence of perchlorate at Source Area 8D is inconsistent. Given that inconsistency and the absence of perchlorate above its PGW SSL in soil from borings SB04 and 8D-SB05, it appears unlikely that the perchlorate detected in borings 8D-SB03 and 8D-SB06 originated from a same source.
- The vertical extent of perchlorate is defined by the absence of that compound above its PGW SSL in soil samples collected at 5 and 11.5 feet bgs from boring 8D-SB06.

Based on the information presented above, the lateral and vertical extent of perchlorate at source areas in the FSTP Area has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

4.4 SUMMARY AND RESULTS OF SURFACE WATER REMEDIAL INVESTIGATION - ADMINISTRATION AREA DRAINAGE SYSTEM

The Administration Area Drainage System is an interconnected series of open ditches, underground culverts, and catch basins that direct surface water in the Administration Area into the main Administration Ditch and then the Westlakes Storm Water Retention Ponds west of the Administration Area.

As previously described, the ditches, culverts, and catch basins may have received discharges from various source areas and buildings in the Administration Area in addition to surface water runoff from parking areas and material handling areas. The ditches and associated drainage features such as catch basins have therefore been designated as source areas. The Administration Area Drainage System is comprised of Source Areas 4D, 10D, 11D in Administration Area East and Source Areas 5D, 7D, 9D, 12D, D(b), and D(d) in Administration Area West. Source Area ditches 7D and 10D and portions of Source Area 4D were previously

addressed as part of the PGOU RI. The source area ditches and drainages in the Administration Area and the direction of water flow through the ditches are shown in Figure 4.4-1.

This section describes surface water sampling of the Administration Area Drainage System conducted historically and during the BOU RI, presents the results of that sampling, and identifies COPCs in the surface water. A discussion regarding potential correlations between COPCs in surface water and those identified in surface soil at source areas in the Administration Area is presented in Section 4.4.4 of this report.

4.4.1 Summary and Results of Surface Water Remedial Investigations – Administration Area Drainage System

The following subsections briefly describe the source areas comprising the Administration Area Drainage System, summarize the scope and results of previous investigations conducted prior to 2005, present a preliminary identification of COPCs, and discuss DQOs and sampling proposed in the BOU FSP (Aerojet et al., 2006b).

The information presented below regarding the description of source areas and previous investigations was compiled from one or more of the following sources*: Stage 1 Sampling Plan-Zone 1* (Aerojet, 1993a); *Stage 1 Sampling Plan-Zones 3 and 4* (Aerojet, 1993b); *Stage 1 Sampling Plan-Zone 2* (Aerojet, 1993c); *Aerojet Superfund Site – Scoping Report, Volumes 1 through 6* (ICF Technology, Inc., 1989); *Aerojet Site Stage 1 Report - Zones 1 through 4* (ICF Kaiser Engineers, Inc., 1993); *Final Remedial Investigation/Feasibility Study Field Sampling Plan for Boundary Operable Unity* (FSP) (Aerojet et al., 2006b); and *Final Remedial Investigation Report for the Perimeter Groundwater Operable Unit (OU-5)* (Aerojet et. al., 2008).

4.4.1.1 Description of Source Areas - Administration Area Drainage System

A detailed description of each segment of the Administration Area drainage system was previously presented in Section 4.3.1.1 of this report. A brief description of the drainages, in the order in which water would flow (east to west), is provided below. Source area ditches are shown in Figures 4.1-1 and 4.4-1.

<u>Source Area 11D</u>

Source Area 11D is the drainage system associated with Building 20022 and the eastern portion of the Administration Area. The Source Area 11D

drainage system directs water into the underground drainage system between Buildings 20002 and 20004, Source Area 4D, and Source Area 10D ditch. The Source Area 10D ditch and the source area ditch (7D) immediately downstream of 10D were investigated as part of the PGOU. The underground drainage system between Buildings 20002 and 20004 discharges to Source Area ditches 4D and 5D.

Source Area 4D

Source Area 4D is a drainage system consisting of interconnected open ditches, underground culverts, and catch basins south of Buildings 20004, 20005, and 20019 (Figure 4.4-1). The Source Area 4D drainage system receives surface runoff from parking lots south of those building and possibly discharges from drains associated with buildings in Administration Area East. The Source Area 4D drainage system discharges to Source Areas 5D and 9D, which are part of the Administration Area West open ditch system (Section 4.3.1).

Source Area D(d)

Source Area D(d) is a drop inlet/catch basin 100 feet west of Building 20015/20025 and 100 feet south of the SMUD Substation fence line. The catch basin is part of the storm drain system used to control surface water runoff and water is directed into the Source Area 5D ditch. The catch basin was not part of any waste drainage system; only surface water flowed into the catch basin.

Source Area D(b)

Source Area D(b) consists of trenches that extend from the southwest corner of Building 20009. The trenches may have received drainage from a storage area on the south side of Building 20009. Source Area D(b) discharges to the Source Area 5D ditch.

Source Area 5D

Source Area 5D includes the north-south trending ditch west of Building 20009 and the east-west trending ditch south of Building 2009. The east-west trending section of the Source Area 5D ditch is downstream of Source Area Ditches 4D and 11D and drop inlet/catch basin [Source Area D(d)] and received drainage from those areas.

The north-south trending section of the Source Area 5D ditch is downstream of Source Area ditches 7D, 10D, 11D, and D(b) and received drainage from those source areas. This section of ditch also received drainage from the Building 20009, the west side of Building 20015, the SMUD Substation, and drop inlets or catch basins between these buildings and the open ditch.

Source Area 9D

Source Area 9D is the ditch along Alabama Avenue, approximately 300 feet north of the FSTP. The ditch is downstream of Source Areas 4D, 5D, 7D, 10D, 11D, D(b), and D(d) and may have received drainage from those source areas. Additionally, the ditch likely received surface runoff from Alabama Avenue, the parking lot south of Alabama Avenue, the areas around Buildings 20012 and 20018 (part of the FSTP), and Buildings 20019 and 20025 (former engineering buildings).

Source Area 12D

Source Area 12D is the ditch located southeast of the Nimbus-Alabama intersection. Source Area 12D is the upper portion of the main Administration Ditch and receives the combined discharge from all seven of the source area ditches and drop-inlet/catch basins in the Administration Area. Additionally, Source Area 12D potentially received discharge from the FSTP.

4.4.2 *Summary and Results of Previous (Pre-2005) Surface Water Investigations – Administration Area Drainage System*

Previous (prior to 2005) surface water investigation of the source areas that comprise the Administration Area Drainage System, the results of those investigations, and data needs identified in the BOU FSP (Aerojet et al., 2006b) are summarized below.

4.4.2.1 *Summary of Previous (Pre-2005) Surface Water Investigations – Administration Area Drainage System*

Surface water sampling of the Administration Area Drainage System was not conducted during previous remedial investigations. Surface water samples are, however, collected at one location (Station S-2) at Site 12D, the main Administration Area Ditch, directly below the confluence of Source Area ditches 5D and 9D (Figure 4.4-1). Surface water samples are regularly collected at Station S-2 when there is sufficient flow and

analyzed for selected constituents in accordance with the *Revised Waste Discharge Requirements for Aerojet-General Corporation and Aerojet Fine Chemicals* (NPDES Permit No. CA0004111) (RWQCB Order No. R5-1999-0016-R01, revised 2002). The schedule for various analyses of surface water samples collected at Station S-2 required under the NPDES permit is described below.

- **VOCs –** Minimum of one sample per week if sufficient water flow.
- **Metals –** Quarterly.
- **SVOCs and hydrazines –** Quarterly.
- **PCBs –** No analysis required under NPDES.
- **Miscellaneous –** Varying frequency in accordance with the NPDES permit when there is sufficient flow. Miscellaneous analyses include perchlorate, oil and grease, pH, temperature, turbidity, electrical conductivity, total dissolved hardness, dissolved oxygen, chemical oxygen demand, total organic halogen, total suspended solids, total dissolved solids, ammonia as nitrogen, chlorine, nitrate, nitrate as nitrogen, total Kjeldhal nitrogen, and organic Kjeldhal nitrogen.

4.4.2.2 *Results of Previous (Pre-2005) Surface Water Investigations – Administration Area Drainage System*

The results of the analysis of surface water samples collected at Station S-2 during the 4-year period between 1 January 2000 and 31 December 2004 analyzed for compounds (VOCs, SVOCs, and metals) identified as vadose zone COPCs at Administration Area source areas are summarized below. As previously indicated, surface water samples collected at Station S-2 are not analyzed for dissolved PCBs.

Volatile Organic Compounds

A total of 724 primary surface water samples were collected at Station S-2 during a 4-year period between 1 January 2000 and 31 December 2004 and analyzed for VOCs. The results of the sampling are summarized below:

- Acetone and chloroform were the only VOCs detected in surface water samples collected at Station S-2 during the 4-year period.
- Acetone at 20 and 100 µg/L was detected in surface water samples collected at Station S-2 on 5 and 21 March 2003, respectively.
- Chloroform was sporadically detected in two surface water samples collected in December 2001 and January 2002, and in six samples

collected between April and September 2004. Chloroform at 5.2 and 5.3 µg/L was detected in surface water samples collected on 17 December 2001 and 28 January 2002, respectively. Chloroform at concentrations ranging from 6.3 to 16 µg/L was detected in six surface water samples collected between April and September 2004. Chloroform at concentrations above the PQL of 5.0 µg/L was not detected in surface water samples collected at Station S-2 prior to December 2001 or after September 2004.

Semivolatile Organic Compounds

Nineteen primary surface water samples were collected at Station S-2 during the 4-year period and analyzed for SVOCs. SVOCs at concentrations above their respective PQL were not detected in the surface water samples.

Dissolved Metals

Nine primary surface water samples were collected at Station S-2 during the 4-year period and analyzed for dissolved metals. The results of the dissolved metals analysis of the samples are summarized below:

- Dissolved metals detected in at least one surface water sample collected at Station S-2 were aluminum ranging from less than 0.05 mg/L to just slightly above the PQL at 0.052 mg/L, barium ranging from 0.022 to 0.93 mg/L, boron ranging from 0.02 to 0.053 mg/L, calcium ranging from 1.2 to 13 mg/L, copper ranging from 0.006 to 0.04 mg/L, iron ranging from nondetect (less than 0.075 mg/L) to 0.64 mg/L, manganese ranging from 0.003 to 0.039 mg/L, magnesium ranging from 1.2 to 3.1 mg/L, molybdenum (one detect at 0.042 mg/L), potassium ranging from 1.1 to 45 mg/L, sodium ranging from 1.1 to 17 mg/L, vanadium ranging from 0.0017 to 0.005 mg/L, and zinc ranging from nondetect (less than 0.025 mg/L) to 0.14 mg/L.
- Dissolved concentrations of metals detected in the samples were below their respective surface water screening levels (SWSLs).

4.4.2.3 *Summary of Data Needs – Administration Area Drainage System*

Based on a review of the previous vadose zone investigation data, extensive aerial photograph research and review, and exhaustive research of historical documents, Aerojet determined that surface water sampling was needed to assess the potential presence of COPCs (VOCs, metals,

SVOCs, PCBs, TPH, and NDMA) identified at source areas within the Administration Area.

4.4.3 *Summary and Results of Boundary Operable Unit Surface Water Investigation – Administration Area Drainage System*

The following subsections summarize the recent (2005 to 2007) surface water investigation of the Administration Area Drainage System conducted as part of the BOU RI, describe deviations from sampling proposed in the BOU FSP (Aerojet et al., 2006b), and summarize the results of the investigation. The results of the investigation coupled with completeness of characterization and potential sources are discussed in Section 4.4.4.

4.4.3.1 *Summary of Boundary Operable Unit Surface Water Investigation – Administration Area Drainage System*

A total of 15 primary and two duplicate surface water samples were collected from the Administration Area Drainage System at 15 locations (Figure 4.4-1). The 15 primary and 2 duplicate samples were analyzed for VOCs, metals (total and dissolved), SVOCs, total extractable petroleum hydrocarbons, dissolved organic carbon, anions, and total alkalinity. Additionally, selected samples were also analyzed for cyanide, NDMA, nitrite, phosphate, and orthophosphate. As discussed in the BOU FSP, the analysis of surface water samples is based on COPCs identified in the vadose zone at source areas upstream and in proximity to the sampling location. Therefore, every surface water sample was not analyzed for the full suite of constituents.

Field measurements taken during collection of the surface water samples were conductivity, pH, redox potential, temperature, and turbidity.

The numbers of surface water samples collected for each analysis (including QA/QC samples) at each of the 15 sampling locations along the Administration Area Drainage System, along with the corresponding methods, are provided on Table 4.4-1.

4.4.3.2 *Deviations from Data Quality Objectives and Sampling Design – Administration Area Drainage System*

Surface water sampling at the source areas [4D, 5D, 9D, 12D, D(b), and D(d)] comprising the Administration Area Drainage System during the BOU RI was generally consistent with that proposed in the BOU FSP, with

the exceptions listed below. A comparison of proposed and actual sampling activities, including sampling rationale and analyses, is provided on Table 4.4-1.

- The sample collected at 9D-SW01 was not analyzed for nitrite.
- The samples collected at two locations (9D-SW01 and 9D-SW02) were not analyzed for phosphate.

4.4.3.3 *Results of Boundary Operable Unit Surface Water Investigation Results – Administration Area Drainage System*

The analytical results for the VOC, SVOC, total and dissolved metals, PCBs, perchlorate, TPH-D and TPH-Mo, cyanide, NDMA, pH, dissolved oxygen content, anions, total alkalinity, nitrate, nitrite, phosphate, and/or sulfate analyses of samples collected during the BOU RI are presented below.

Summary of Investigation and Results – Volatile Organic Compounds

A total of 15 primary surface water samples and 2 duplicate samples were collected from the Administration Area Drainage System at 15 locations during the BOU RI and analyzed for VOCs (Table 4.4-1). The results of the VOC analysis of surface water samples are presented in Appendix H and summarized below. Surface water sampling locations are shown in Figure 4.4-1.

- VOCs were detected in surface water samples at concentrations above the PQL at only two locations (3D-SW04 and 11D-SW01).
- VOCs detected in the surface water sample collected at 3D-SW04 were bromodichloromethane (BDCM) at 1.2 µg/L, bromoform at 0.92 µg/L, chloroform at 15 µg/L, and dibromochloromethane at 0.25 µg/L. The detected concentrations of BDCM and chloroform are above their respective SWSLs.
- PCE at 0.21 µg/L was the only VOC detected in the surface water sample collected at 11D-SW01. The detected concentration of PCE is above its SWSL.

Summary of Investigation and Results – Semivolatile Organic Compounds

A total of 15 primary surface water samples and two duplicates were collected from the Administration Area Drainage System at 15 locations during the BOU RI and analyzed for SVOCs (Table 4.4-1). The results of

the SVOC analysis of the surface water samples are presented in Appendix H.

SVOCs were not detected above their respective PQLs in the surface water samples collected from the Administration Area Drainage System.

Summary of Investigation and Results – Metals

A total of 15 primary surface water samples and 2 duplicate samples were collected from the Administration Area Drainage System at 15 locations during the BOU RI and analyzed for total and dissolved metals (Figure 4.4-1). The results of the total and dissolved metals analyses of surface water samples are presented in Appendix H and summarized below. Surface water sampling locations are shown in Figure 4.4-1.

Surface Water – Total Metals:

The range of total metal concentrations detected in surface water samples collected from the Administration Area Drainage System, the number of surface water samples with detected concentrations, and the sampling location having the maximum detected concentration are presented on the table below.

Metal	Range of Detected Concentrations (µg/L)	No. of Samples with Detections	Location of Maximum Concentration
Aluminum	63 – 11,000	13	9D-SW02
Antimony	0.29 – 3.2	3	11D-SW01
Arsenic	0.86 – 1.3	5	12D-SW01
Barium	8.2 – 90	14	9D-SW02
Beryllium	0.08 & 0.11	2	8D-SW01, 9D-SW03
Boron	20	1	9D-SW01
Cadmium	0.052 – 1.1	11	11D-SW01
Calcium	1,300 – 8,100	15	3D-SW02
Chromium	0.61 – 16	13	12D-SW01
Hex Chromium	5.6	1	3D-SW01
Cobalt	0.037 – 8.5	15	9D-SW02
Copper	3.9 – 140	15	3D-SW04
Iron	33 – 12,000	14	9D-SW02
Lead	0.2 – 14	15	9D-SW02
Lithium	9.9	1	3D-SW04
Magnesium	250 – 3,200	15	12D-SW01
Manganese	7.4 – 370	12	9D-SW02
Mercury	0.062 J	1	8D-SW01

Metal	Range of Detected Concentrations (µg/L)	No. of Samples with Detections	Location of Maximum Concentration
Molybdenum	0.3 – 1.5	4	5D-SW05
Nickel	0.49 – 11	15	9D-SW02 & 12D-SW01
Potassium	410 – 2,400	13	9D-SW02
Selenium	1.7 & 1.9	2	8D-SW01, 9D-SW03
Silver	0.037 – 2.4	5	5D-SW01
Sodium	520 – 7,800	14	9D-SW01
Strontium	7.5 – 53	15	12D-SW01
Thallium	0.18	1	5D-SW01
Titanium	3.3 – 410	12	12D-SW01
Vanadium	0.87 – 24	10	12D-SW01
Zinc	18 – 2,100	15	11D-SW01

Surface Water – Dissolved Metals:

The range of dissolved metal concentrations detected in surface water samples collected from the Administration Area Drainage System, the number of surface water samples with detected concentrations, and the sampling location having the maximum detected concentration are presented on the table below.

Metal	Range of Detected Concentrations (µg/L)	No. of Samples with Detections	Location of Maximum Concentration
Aluminum	40 – 720	9	9D-SW03
Antimony	0.068 – 3.0	6	11D-SW01
Arsenic	0.54 & 0.69	2	9D-SW03, 8D-SW01
Barium	7.3 – 63	12	9D-SW02
Beryllium	0.22	1	5D-SW01
Boron	ND	0	
Cadmium	0.03 – 1.1	11	11D-SW01
Calcium	930 – 7,600	15	3D-SW02
Chromium	0.62 – 14	7	12D-SW01
Hex Chromium	ND	0	
Cobalt	0.1 – 1.3	11	9D-SW03
Copper	2.0 – 130	15	3D-SW04
Iron	18 – 610	14	9D-SW03
Lead	0.14 – 9.7	14	5D-SW01
Lithium	ND	0	
Magnesium	220 – 2,400	15	9D-SW03
Manganese	9.6 – 31	6	9D-SW02
Mercury	ND	0	
Molybdenum	0.22 – 2.4	9	5D-SW05
Nickel	0.64 – 4.2	14	3D-SW01

Metal	Range of Detected Concentrations (µg/L)	No. of Samples with Detections	Location of Maximum Concentration
Potassium	380 – 1,700	13	9D-SW02
Selenium	ND	0	
Silver	ND	0	
Sodium	410 – 5,900	14	3D-SW02
Strontium	5.5 – 46	15	9D-SW03
Thallium	0.17 – 0.22	3	5D-SW02
Titanium	3.8 – 18	8	9D-SW03
Vanadium	1.1 – 5.1	5	9D-SW01
Zinc	19 – 2,200	13	11D-SW01

Arsenic, vanadium, and zinc were the only metals detected in surface water samples collected from the Administration Area Drainage System at dissolved concentrations above their respective SWSLs. Metals detected above their SWSLs and the sampling locations are listed on the table below.

Sample Location	Metal	Concentration (µg/L)
11D-SW01	Zinc	2,200
8D-SW01	Arsenic	0.69
9D-SW01	Vanadium	6.0
9D-SW03	Arsenic Vanadium	0.54 4.0

Summary of Investigation and Results – Polychlorinated Biphenyls

A total of 12 primary surface water samples and one duplicate were collected from the Administration Area Drainage System at 12 locations during the BOU RI and analyzed for PCBs (Table 4.4-1). The results of the PCB analysis of surface water samples are presented in Appendix H.

PCBs were not detected above their respective PQLs in the surface water samples collected from the Administration Area Drainage System.

Summary of Investigation and Results – Perchlorate

Three primary surface water samples and one duplicate were collected from the Administration Area Drainage System at three locations (5D-SW02, 9D-SW01, and 12D-SW01) during the BOU RI and analyzed for perchlorate (Table 4.4-1).

Perchlorate was not detected above the PQL of 1 µg/L in the three surface water samples collected from the Administration Area Drainage System.

Summary of Investigation and Results – Total Petroleum Hydrocarbons

A total of 15 primary surface water samples and 2 duplicates were collected from the Administration Area Drainage System at 15 locations during the BOU RI and analyzed for TPH (Table 4.4-1). The results of the TPH-D and TPH-Mo analyses of surface water samples are summarized below. Surface water sampling locations are shown in Figure 4.4-1.

- TPH-D was detected in surface water samples collected at only three locations from the Administration Area Drainage System. TPH-D at was detected in surface water samples collected at locations 5D-SW02 (52 µg/L), 9D-SW01 (55 µg/L), and 12D-SW01 (36 µg/L).
- TPH-Mo was detected in surface water samples collected from the Administration Area Drainage System at only five locations. TPH-Mo was detected in surface water samples collected at locations 3D-SW01 (180 µg/L), 3D-SW02 (140 µg/L), 11D-SW01 (250 µg/L), 9D-SW01 (100 µg/L), and 12D-SW01 (130 µg/L).

Summary of Investigation and Results – Miscellaneous Compounds

Miscellaneous analyses performed on surface water samples collected from the Administration Area Drainage System were cyanide, NDMA, dissolved oxygen content, anions, total alkalinity, nitrate as NO_3, Nitrite as NO_2, phosphate, orthophosphate, and/or sulfate. The number of primary surface water samples collected and identification of the sample locations are summarized on the table below.

Compound	No. of Samples	Sampling Locations
Cyanide	3	5D-SW02 9D-SW01 12D-SW01
NDMA	5	3D-SW01 3D-SW02 3D-SW03 3D-SW04 11D-SW01
Bicarbonate Alkalinity Carbonate Alkalinity Chloride Dissolved Organic Carbon Fluoride Hydroxide Alkalinity	15	3D-SW01 through 3D-SW04 11D-SW01 5D-SW01 through 5D-SW05 8D-SW01 9D-SW01 through 9D-SW03 12D-SW01

Compound	No. of Samples	Sampling Locations
Nitrate (as NO3) Sulfate Total Alkalinity		
Nitrite (as NO2)	14	All except 9D-SW01
Phosphate	12	All except 9D-SW01 and 9D-SW02
Orthophosphate	2	9D-SW02 and 12D-SW01

The analytical results for the miscellaneous analyses of surface water samples are presented in Appendix H and summarized below.

Total Cyanide. The results of the cyanide analysis on the three primary surface water samples collected from the Administration Area Drainage System are presented below:

- Total cyanide was detected in only one of the three surface water samples collected from the Administration Area Drainage System.
- Total cyanide, at an estimated concentration of 2.8 µg/L, was detected in surface water sample 9D-SW01. The detected concentration is below the SWSL.

N-Nitrosodimethylamine. NDMA was not detected above the PQL in the five surface water samples.

Anions. The results of anions analysis of 15 surface water samples, including duplicates, collected from the Administration Area West Open Ditch System are presented below.

Compound	Range of Detected Concentrations (µg/L)	Location of Maximum Concentration
Bicarbonate Alkalinity	5,200 – 34,000	3D-SW02 and 3D-SW03
Carbonate Alkalinity	Not Detected	
Chloride	260 – 10,000	9D-SW02
Dissolved Organic Carbon	1.4 – 6,200	12D-SW01
Fluoride	22 - 36	3D-SW01
Hydroxide Alkalinity	Not Detected	
Nitrate (as NO3)	390 – 5,700	12D-SW01
Nitrite (as NO2)	16 - 44	11D-SW01
Phosphate	Not Detected	
Orthophosphate	Not Detected	

Compound	Range of Detected Concentrations (µg/L)	Location of Maximum Concentration
Sulfate	640 – 6,800	12D-SW01
Total Alkalinity	5,200 – 34,000	3D-SW02 and 3D-SW03
pH		

Summary of Investigation and Results – Field Measurements

Parameters measured in the field during the collection of surface water samples from the Administration Area Drainage System were conductivity, pH, reduction/oxidation (redox) potential, temperature, and turbidity. Measurements for those parameters are summarized on the table below.

Sample Location	Conductivity (ms /cm)	pH	Redox Potential (mV)	Temperature (°C)	Turbidity (NTU)
3D-SW01	0.048	6.55	343.8	11.02	9.96
3D-SW02	0.101	7.53	522.6	12.42	3.56
3D-SW03	0.063	7.51	360.5	13.61	5.46
3D-SW04	-----	-----	-----	-----	-----
11D-SW01	-----	-----	-----	-----	-----
5D-SW01	0.031	7.54	331.6	11.50	41.6
5D-SW02	0.35	6.95	355.3	10.32	31.0
5D-SW03	0.20	6.5	388.6	10.88	36.2
5D-SW04	0.020	6.33	366.7	12.97	20.8
5D-SW05	0.024	6.57	361.9	12.79	6.73
8D-SW01	0.058	6.95	324.6	10.87	41.9
9D-SW01	0.08	7.07	312.3	10.15	45.4
9D-SW02	-----	6.81	55.0	16.8	350
9D-SW03	0.069	7.25	287.7	17.55	51.0
12D-SW01	-----	6.77	60	17.0	181

°C – Degrees Celsius
ms/cm – MilliSiemens per centimeter
mV - Millivolts
NTU – Nephelometric turbidity units

4.4.4 *Discussion of Surface Water Investigation Results with Respect to Data Quality Objectives – Administration Area Drainage System*

The analytical results presented in the previous sections indicated that some chemicals were detected in surface water samples collected from the Administration Area Drainage System at scattered locations. The presence of chemicals in surface water samples with respect to the degradation of surface water quality is discussed below.

4.4.4.1 *Volatile Organic Compounds*

- VOCs (BDCM, bromoform, chloroform, dibromochloromethane, and PCE) were detected in surface water sample collected at only two locations (3D-SW04 and 11D-SW01). As shown in Figure 4.4-1, these locations are essentially in the headwaters of the Administration Area Drainage System near areas where these chemicals may have been historically stored, handled, or used. However, as discussed in Sections 4.2.3.4 and 4.2.7.4, only chloroform and PCE were detected in soil vapor samples collected within Administration Area East.
- The absence of VOCs in BOU surface water samples collected at locations downstream of 3D-SW04 and 11-SW01, combined with only sporadic detections of acetone and chloroform at Station S-2 over a 4-year period, indicates that VOCs at the site are not degrading surface water quality.

4.4.4.2 *Semivolatile Organic Compounds*

The absence of SVOCs above the PQL in the BOU surface water samples and those collected over a 4-year period at Station S-2 demonstrates that SVOCs are not degrading surface water quality.

4.4.4.3 *Metals*

- Arsenic, vanadium, and zinc were the only metals detected in surface water samples collected from the Administration Area Drainage System above their respective SWSLs.
- As shown in Figure 4.4-1, arsenic and vanadium were only detected in surface water samples (8D-SW01, 9D-SW01, and 9D-SW03) collected at or near the confluence of the various ditches in the Administration Area and the Main Administration Area Ditch. Arsenic and vanadium were not detected in soil within the Administration Area at concentrations above background. Standing water has been observed at the locations where those metals were detected in surface water.

The presence of those metals may therefore be attributed to leaching as a result of the increased period of contact with the soil.

- The figure also shows that zinc was detected in only one surface water sample (11D-SW01) collected near the headwaters of the Administration Area Drainage System. Because structures in the Source Area 11D are constructed of walls and roofs made of sheet metals, it is not unexpected to find zinc in surface water runoff from those structures.
- Although zinc was detected in only one surface water sample, zinc has been detected in surface water samples collected over a 4-year period from Station S-2 at concentrations ranging from nondetect (less than 0.025 mg/L) to 140 mg/L. The data suggest that zinc in surface water may be related to the site; the concentrations at the most downstream locations are significantly less than the SWSL and are therefore not retained as a COPC.

4.4.4.4 *Polychlorinated Biphenyls*

- Although PCBs have been identified in soils in several of the drainages with the Administration Area, PCBs above their PQLs were not detected in the surface water samples collected from the Administration Area Drainage System.
- The data indicate that the presence of PCBs in soil in the ditches is not degrading surface water quality.

4.4.4.5 *Perchlorate*

Perchlorate was not detected above the PQL of 1 µg/L in the three surface water samples collected from the Administration Area Drainage System and no potential sources of perchlorate in soil were identified in the Administration Area.

4.4.4.6 *Total Petroleum Hydrocarbons*

- TPH-D and/or TPH-Mo were detected in surface water samples collected from the Administration Area Drainage System at five locations.
- Because the drainages receive surface water runoff from parking lots, roadways, and areas of the site where hydrocarbons are used for a variety of applications, the presence of hydrocarbons in surface water is expected.

- The detected concentrations of TPH-D (52, 55, and 36 µg/L) and TPH-Mo (180, 140, 250, 100, and 130 µg/L) are relatively low and a SWSL has not been established for those compounds.

4.4.4.7 *Cyanide and N-Nitrosodimethylamine:*

Cyanide and NDMA were not detected above their respective PQLs or SWSLs in surface water samples collected from the Administration Area Drainage System. These compounds do not pose a threat to surface water quality.

Based on the data presented above, COPCs identified in soil at source areas within the Administration Area do not appear to have, or will have, degraded surface water quality.

4.5 *GROUNDWATER REMEDIAL INVESTIGATION RESULTS — ADMINISTRATION AREA*

This section presents the groundwater data acquired during the RI field activities for the Administration Area portion of the BOU (Figure 4.1-1). Data were collected to satisfy the following DQOs as identified in the BOU FSP (Aerojet et al., 2006b):

- Do COPCs exist in groundwater at concentrations that could potentially pose a risk to human health?
- Do the groundwater data indicate a potential source for the COPCs in the vadose zone?
- Do COPCs exist in groundwater at concentrations indicative of the presence of residual product?
- Has the lateral and vertical distribution of COPCs in the groundwater been adequately characterized?
- Do COPCs in groundwater have the potential to migrate into and degrade surface water quality?
- Are the data sufficient to support human health and ecological risk assessments, support modeling to evaluate the migration of COPCs from groundwater into indoor air, and determine the feasibility of remediating the identified compounds and concentrations to levels that do not pose a risk to human and ecological receptors or degrade surface water and groundwater quality?

To meet these DQOs, the following tasks were completed:

- **Characterize groundwater flow —** Section 4.5.1 – *Groundwater Flow Characteristics* define the shallow groundwater as either Perched Groundwater or the FWBZ and presents interpretation of water level data, including hydraulic gradients and water level elevation trends. This section also presents the results of aquifer testing activities conducted to further characterize the hydraulic properties in a portion of the FWBZ. These data support analysis of the fate and transport of chemicals in groundwater and are used to develop and compare remedial alternatives in the Feasibility Study.
- **Determine the extent of groundwater containing COPCs —** Section 4.5.2 discusses the distribution of chemicals in groundwater and presents the results of groundwater sampling and analyses. These data are discussed relative to groundwater screening-level Applicable, Relevant and Appropriate Requirements (ARARs) (i.e., screening-level ARARs) that were selected to provide sufficient data for evaluating potential human health risks due to exposure to chemicals in groundwater.
- **Identify apparent COPC source areas and define the extent of potential residual sources in groundwater—** The potential correlation between chemicals reported in the vadose zone within source areas and chemicals reported in groundwater are discussed in Section 4.5.2 – *Distribution of Chemicals in Groundwater*.
- **Identify existing remedial actions —**Existing and planned remedial actions for groundwater within and downgradient of the BOU are discussed in Section 4.5.3.
- **Identify chemical migration pathways and attenuation processes —** Processes that influence the distribution and movement of chemicals in groundwater are discussed in Section 4.5.4**.**

4.5.1 Groundwater Flow Characteristics

The hydrostratigraphy of the Aerojet site, nature and occurrence of shallow groundwater, groundwater gradients, and the results of aquifer testing conducted during the BOU RI are described below.

4.5.1.1 Site Hydrostratigraphy

The regional aquifer beneath the Aerojet site has been divided into six hydrostratigraphic layers (Layers A through F) based on similar lithology,

relative depths and thicknesses, electrical conductivity, water levels, and aquifer testing. The hydrostratigraphic layers provide the framework for presenting the distribution of chemicals and groundwater characteristics.

The first groundwater encountered beneath a site occurs as either Perched Groundwater or the FWBZ. For the purposes of this Operable Unit, the FWBZ is defined as the upper 20 to 30 feet of saturated sediments that are laterally continuous. Perched Groundwater and the FWBZ were subdivided from the more regional hydrostratigraphic layer designations to allow for evaluation of potential risks associated with VOCs migrating upward as vapor through the soil into indoor air.

Hydrostratigraphic cross-sections were prepared to show the general lithologies and relative water levels for the hydrostratigraphic layers in the Administration Area. The following cross-section transects were prepared (cross-section locations are shown in each figure):

- Cross-section A-A′ trends approximately east to west through Site 03D in the eastern Administration Area and is aligned approximately along the direction of groundwater flow (Figure 4.5-1); and
- Cross-section B-B′ trends approximately southeast to northwest across the western Administration Area, approximately parallel to the groundwater flow direction (Figure 4.5-2).

Hydrostratigraphic Layer A is the shallowest layer and is composed of deposits from the ancestral American River. Within the Administration Area portion of the BOU, Layer A generally contains Perched Groundwater.

Layer B underlies Layer A and is generally not a significant water-bearing unit. South of the Administration Area, and in the westernmost portion of the Administration Area, there are monitoring wells completed in Layer B. As shown in Figure 4.5-2, the Layer B above the terrace is not hydraulically connected to the Layer B that separates Layer A from Layer C on the Lower Terrace.

Layer C is the upper portion of the Tertiary Mehrten Formation and is the first regionally extensive water-bearing unit. In the Administration Area, Layer C is generally 50- to 75-feet thick.

Layer D is generally the lower portion of the Mehrten Formation and overlies Layer E, which generally corresponds to the upper portion of the Tertiary Valley Springs Formation. Layer F refers to the water-bearing

sediments below Layer E and is generally below the depths of groundwater containing chemicals.

4.5.1.2 *Nature and Occurrence of Shallow Groundwater*

The first saturated sediments are either part of Perched Groundwater or within the FWBZ. Water level and water quality data collected from existing monitoring wells, monitoring wells constructed for this RI, and grab groundwater samples collected from soil borings (e.g., HydroPunch. samples), were classified as being representative of either Perched Groundwater or the FWBZ. Profiles showing the relative screened intervals for monitoring wells and grab groundwater sample collection depths at soil borings from the Perched Groundwater, FWBZ, and deeper intervals are provided in Appendix I.

The groundwater designation, survey data, and well construction information for the monitoring wells and grab groundwater samples collected from soil borings used for this RI are summarized on Tables 4.5-1 and 4.5-2, respectively. Boring logs for the monitoring wells installed for the BOU RI/FS are included as Appendix D.

There are no known locations in the Administration Area where groundwater discharges to surface water such as springs or seeps. The shallowest groundwater beneath the Administration Area was encountered at depths ranging from 7.2 to 25.1 feet bgs. Therefore, the DQO of determining whether chemicals in groundwater have the potential to degrade surface water quality has been achieved.

<u>Perched Groundwater</u>

Perched groundwater is the shallowest saturated unit and typically occurs in ancestral American River sediments that have been reworked by historical gold-dredging activities (Layer A). Dredging activities disturbed the natural stratigraphy and the resulting spoils were deposited as unconsolidated and somewhat stratified sediments. As a result, the dredged materials are very permeable and are underlain by sediments that are typically less permeable. The base of Perched Groundwater often coincides with the interface between dredged and undredged materials.

Thirteen monitoring wells are screened in Perched Groundwater in the Administration Area (Figures 4.5-3 and 4.5-4). In addition, Perched Groundwater was encountered at 23 soil boring locations, and was commonly encountered in the eastern portion of the Administration Area

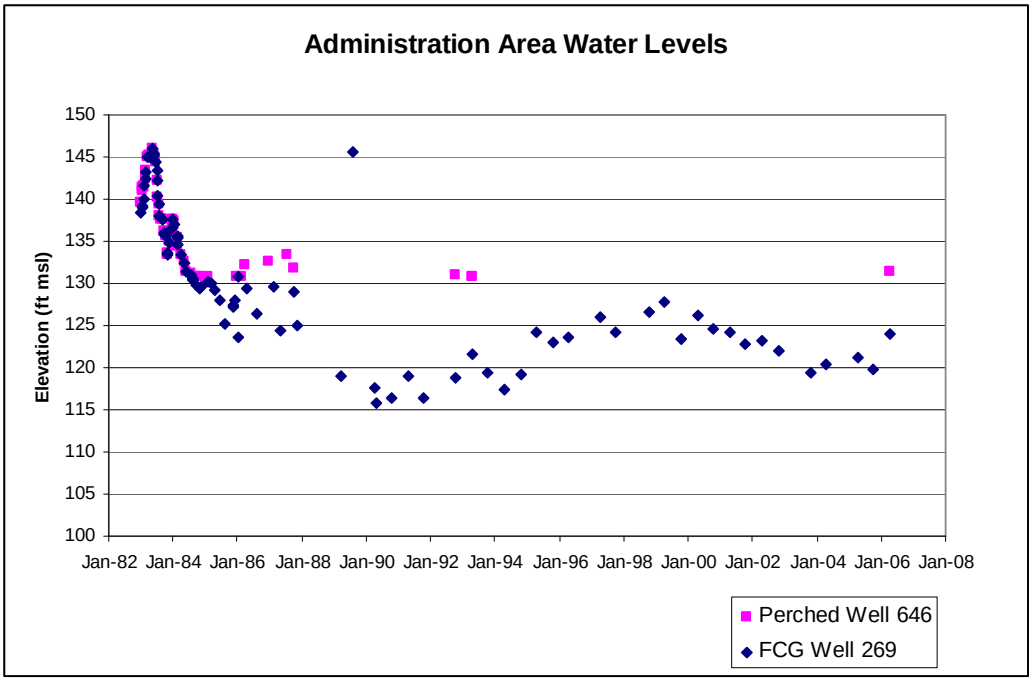
near Buildings 20002 and 20004 and in the western area near Building 20009. The Perched Groundwater in these two areas may be hydraulically connected, based on similar water level elevations and the relatively uniform hydraulic gradient between the two areas (Figure 4.5-4).

The lateral extent of Perched Groundwater, shown in Figure 4.5-3, was inferred from the absence of saturated sediments above the FWBZ in soil borings advanced during the BOU RI. There are sufficient data to identify the areas that are underlain by Perched Groundwater for the purposes of conducting the Baseline Risk Assessment.

In April 2006, the depth to Perched Groundwater ranged from 7.2 to 25.1 feet bgs and the median depth was 14 feet bgs. The depth to the top of Perched Groundwater was contoured to assist with the evaluation of potential risks associated with volatilized VOCs migrating upward as vapor through the soil to indoor air. The base of Perched Groundwater ranges from approximately 4 feet (Well 646) to 13 feet (Well 881) above the top of the FWBZ.

Water level hydrographs prepared for the Perched Groundwater monitoring well are presented in Appendix J. The highest Perched Groundwater elevations on record since the start of monitoring in 1982 were reported in 1983, following a year of above-average precipitation. The lowest Perched Groundwater levels generally occurred between 1988 and 1992 during a period of below-average precipitation. Approximately half of the monitoring wells screened in Perched Groundwater have been dry at least once since the start of monitoring activities in 1982.

In 1983 and 1984, the FWBZ was present at elevations nearly equal to the Perched Groundwater elevations. During this period, the Perched Groundwater was in hydraulic continuity with the FWBZ and technically did not exist. This is exemplified in the graph below, which compares the water levels in perched Well 646 with the water levels in the FWBZ at nearby Well 269.



In general, Perched Groundwater does not exhibit as much fluctuation as the FWBZ. The difference between the maximum and minimum recorded water levels averaged approximately 11 feet for the monitoring well screened in Perched Groundwater, in contrast with approximately 31 feet for the monitoring well screened in FWBZ. The greatest perched water level fluctuations were noted at Well 71 at the FSTP in Administration Area West.

First Water-Bearing Zone

For the purposes of this RI, the FWBZ was defined as the upper 20 to 30 feet of saturated sediments that are laterally continuous across the Administration Area. The FWBZ occurs in the upper portion of a sand and gravel unit containing variable amounts of silt ranging from approximately 50- to 75-feet thick, thinning to the east. This sand and gravel unit generally corresponds to Layer C of the *Western Groundwater Operable Unit Groundwater Flow Model* (Aerojet, 2004d).

There are some monitoring wells in the Administration Area assigned to the FWBZ that were constructed with screened intervals extending more than 30 feet into the FWBZ (e.g., Well 116 with 74 feet of screen). Water level and water quality data from these monitoring wells may not be comparable to data from other FWBZ monitor wells; when this is the case, the data are noted in the text and figures. Profiles showing the relative

screened intervals for monitoring wells in the Administration Area that are screened in perched, FWBZ, and deeper groundwater are provided in Appendix I.

The contoured depths to the FWBZ measured in April 2006 are presented in Figure 4.5-5. The depth to the top of the FWBZ ranges from 25 to 45 feet bgs, typically increasing in depth from east to west across the Administration Area. The FWBZ is deeper (50 to 75 feet bgs) south of the Administration Area due to the increased ground surface elevations associated with the ancestral American River terrace (described in Section 4.1.1).

Water level hydrographs for the FWBZ monitoring wells are presented in Appendix K. Since the start of monitoring in 1982, the highest water levels were recorded in 1983. The FWBZ water levels decreased an average of approximately 30 feet between 1983 and 1990, when the lowest water levels were recorded. Between October 2004 and April 2006, the water table elevation increased approximately 6 feet.

4.5.1.3 Groundwater Gradients

The potentiometric surfaces for the Perched Groundwater and FWBZ were contoured to evaluate hydraulic gradients. The most complete water level data set was collected in April 2006 and was used to contour the potentiometric surfaces. Previous water level data sets do not include the majority of FWBZ monitoring wells that were constructed in 2005 and 2006 for this RI. When more than one water level measurement was collected from a monitoring well in April 2006, the measurement corresponding to the April 2006 plant-wide groundwater measurement event was used on the contour maps. Water level data are summarized on Table 4.5-3. For reference, groundwater elevations noted during collection of grab groundwater samples are posted on the contour maps, but the data were not used to prepare the contours.

The potentiometric surface contours were generated using the linear kriging algorithm in Surfer® for Windows (Version 8) to create the initial contour lines. The contour lines were then reviewed and modified near some border areas where the data did not support the extension of the contour lines generated by Surfer®.

Perched Groundwater

The potentiometric surface for Perched Groundwater is more irregular in the eastern portion of the Administration Area than in the west (Figure 4.5-4). The irregular surface is primarily due to high points at Wells 645 and 879, and a low point at Well 646 between Building 20002 and 20004. The steepest hydraulic gradient of approximately 0.07 ft/ft was measured in the eastern area. The direction of flow in the eastern portion of the Administration Area is variable. Perched groundwater in the western portion of the Administration Area appears to flow west-northwest under a hydraulic gradient of approximately 0.01 ft/ft.

The elevation of the Perched Groundwater is higher than that of the underlying FWBZ. Head differences between the Perched Groundwater and FWBZ ranged from approximately 16 to 23 feet in April 2006. These relatively large differences suggest a potential for downward migration of Perched Groundwater into the FWBZ where lithologic conditions permit.

First Water-Bearing Zone

The contoured potentiometric surface of the FWBZ measured in April 2006 is presented in Figure 4.5-6. Water level data collected from monitoring wells outside the Administration Area were used to extend the contour lines. The FWBZ elevations ranged from 99.2 feet above mean sea level (msl) at Well 3255 to 173.02 feet msl at Well 3054.

The April 2006 potentiometric surface map for the FWBZ suggests a relatively uniform west-northwest flow direction across the Administration Area (Figure 4.5-6). This flow direction is consistent with the migration of groundwater from the eastern portions of the Administration Area towards groundwater extraction and treatment (GET) D Extraction Wells 4001 and 4035. An apparent deviation in the general flow field was noted at Well 3092, which is screened across both the Perched Groundwater and the FWBZ.

The average hydraulic gradient for the FWBZ across the Administration Area is approximately 0.01 ft/ft. The hydraulic gradient in the southeastern portion of the Administration Area is steeper and was estimated to be 0.03 ft/ft. Further to the northwest, the hydraulic gradient flattens to approximately 0.009 ft/ft.

Vertical gradients were evaluated where monitoring wells screened in the FWBZ are in close proximity to monitoring wells screened in the lower

portion of the same water-bearing unit. The April 2006 water level elevations were used for comparison. Vertical gradients were evaluated at well pairs 192–193, 202–203, 3096–3097, 3430-3400, and 3400–3401. An upwardly directed vertical gradient ranging from 0.012 to 0.19 ft/ft was observed in the monitoring wells located in the eastern portion of the Administration Area (i.e., Wells 192-3, and 202-3). The water level elevations in well pairs located in the western portions of the Administration Area suggested downwardly directed vertical gradients in the range of 0.016 (Wells 3096 and 3097) to 0.026 ft/ft (Wells 3430 and 3400). The easternmost well pairs had the highest upwardly directed vertical gradients and the westernmost well pairs had the highest downwardly directed vertical gradient. Downward gradients were also observed near the GET D Extraction Wells (4001 and 4035).

4.5.1.4 *Aquifer Testing*

Aquifer testing was performed at Site 52D in March and April 2006 to aid in characterizing the hydraulic parameters of a portion of the FWBZ in the western Administration Area. Aquifer testing activities included: (1) pre-test monitoring; (2) a stepped drawdown test (step test); and (3) constant rate pump testing with recovery monitoring. The details of the aquifer testing and data analysis are described in Appendix L.

In summary, the aquifer test was conducted during a period of heavy rains and significant barometric pressure fluctuations. Recharge was occurring during the test, which compromised the drawdown response data in the observation monitor wells. The early-time data from the pumping well were used to estimate a transmissivity of approximately 2,220 square feet per day. This corresponds to a hydraulic conductivity of approximately 120 feet per day.

4.5.2 *Distribution of Chemicals in Groundwater*

This section describes the nature and extent of chemicals detected in Perched Groundwater and the FWBZ beneath the Administration Area. The water quality data were collected between October 2005 and May 2007. This timeframe is referred to as the RI Sampling Period. The sampling locations and analytes were presented in the BOU FSP (Aerojet et al., 2006b). The analytes at each sampling location were selected based on historical chemical use at each potential source site. VOCs were the most frequently analyzed constituents in the Administration Area groundwater (analyzed using USEPA Method 8260). Other analyses selected based on historical operations included:

- SVOCs by USEPA Method 8270;
- Perchlorate by USEPA Method 314.1;
- Metals by USEPA Methods 6010, 6020, and 7000 Series;
- TPH by USEPA Method 8015 Modified;
- PCBs by USEPA Method 8082;
- NDMA by USEPA Method 1625C-Cl Modified; and
- Cyanide by USEPA Method 9014.

Additional analyses were performed to provide information for evaluating geochemical and biological processes that may affect possible remedial option selection. These analyses included:

- Alkalinity (total, bicarbonate, carbonate, and hydroxide) by USEPA Method 2320;
- Anions (chloride, fluoride, nitrate, nitrite, phosphate, and sulfate) by USEPA Method 300.0;
- Orthophosphate by USEPA Method 365.2; and
- Dissolved organic carbon by USEPA Method 415.1.

The extents of most chemicals in groundwater are discussed relative to their respective screening-level ARAR. In most cases, screening-level ARARs are Federal or State drinking water Primary Maximum Contaminant Levels (MCLs), following USEPA Region IX precedence, and other Water Quality Objectives as defined by the RWQCB.

RWQCB Water Quality Objectives may include Secondary MCLs, State of California Public Health Goals, State of California Department of Public Health (DPH) Action Levels, and USEPA Region 9 Preliminary Remediation Goals (PRGs). A summary of screening-level ARARs is included on Table 4.5-4.

Results of all analyses conducted during the RI Sampling Period, including results for compounds not detected in any samples, are included on a compact disc in Appendix M.

Data reported with laboratory qualifiers are included in this evaluation and are noted in the figures. Data reported between the Practical Quantitation Limit (PQL) and the Method Detection Limit are estimated concentrations and are flagged with a "J" qualifier. All data collected

during the RI Sampling Period were validated by a third party (Laboratory Data Consultants, Inc.).

Water quality data collected from soil borings as grab groundwater samples are included in this evaluation. These data are considered screening level data, and are not comparable to data collected from monitoring wells. In general, VOC concentrations were typically higher in grab groundwater samples than in samples collected from nearby monitoring wells. Therefore, some of the higher concentration VOC data from grab groundwater samples were not contoured in areas where there were no confirmatory data from monitor wells. The DQO of assessing the potential presence of residual product in groundwater was addressed by comparing VOC concentrations in groundwater samples with their respective solubility limits. As a conservative approach, it was assumed that residual product may be present when a VOC concentration exceeded 1 percent of its solubility limit. The solubility limits used were obtained from the USEPA, Region 9 website. The solubility limits for several of the most common VOCs are provided on the table below.

Compound	Solubility Limit (µg/L)	One Percent of Solubility Limit (µg/L)
PCE	200,000	2,000
TCE	1,100,000	11,000
cis-1,2-DCE	3,500,000	35,000
Vinyl chloride	2,800,000	28,000
1,1,1-Trichloroethane	1,300,000	13,000
Methylene chloride	13,000,000	130,000

4.5.2.1 *Perched Groundwater*

Perched Groundwater was investigated by sampling Wells 42, 71, 644, 645, 646, 879, 880, 881, 882, and 3676. Perched Wells 649, 654, and 3085 were not sampled. In addition, grab groundwater samples were collected from Perched Groundwater at 23 soil boring locations.

An isoconcentration contour map was prepared illustrating the distribution of the most common VOCs detected in Perched Groundwater (Figure 4.5-7). In addition, the distribution of SVOCs, PCBs, NDMA, and TPH-D is shown in Figure 4.5-8. The most recent analytical data are posted on the figures for monitoring wells sampled more than once during the RI Sampling Period. Grab groundwater data were used to

guide the placement of the contour lines, but were not used quantitatively in areas where they conflicted with data from nearby monitoring wells.

The lateral extents of chemicals in Perched Groundwater are physically limited by the lateral extent of the Perched Groundwater. The extents of several chemicals in Perched Groundwater are not delineated by "nondetects" or concentrations less than a screening level in areas where the Perched Groundwater was not encountered. Based on the information presented below, the lateral and vertical extents of chemicals in Perched Groundwater have been sufficiently characterized to identify potential sources, evaluate potential risks to human health, and if necessary, develop remedial alternatives.

Perched Groundwater – Volatile Organic Compounds

VOC analyses were performed on samples collected from 10 of the 13 Perched Groundwater monitoring wells, and on grab groundwater samples collected from 23 soil boring locations. VOCs present in Perched Groundwater are generally suggestive of a nearby source.

VOCs reported in at least one sample above screening levels include:

- PCE up to 9,400 µg/L;
- TCE up to 420 µg/L;
- cis-1,2-DCE up to 120 µg/L;
- Vinyl chloride up to 75 µg/L;
- Methylene chloride up to 22 µg/L;
- 1,1- DCA up to 16 µg/L;
- 1,1-DCE up to 14 µg/L; and
- 1,4-Dichlorobenzene up to 5.5 µg/L.

The presence of cis-1,2-DCE, vinyl chloride, and potentially 1,1-DCE are inferred as daughter products resulting from the intrinsic biodegradation of either PCE and/or TCE (Section 4.5.4).

Two grab groundwater samples collected beneath Building 20002 reported PCE at concentrations exceeding 2,000 µg/L, which is 1 percent of the solubility limit for PCE, suggesting the potential presence of residual PCE. The PCE concentrations in these two grab groundwater samples were similar to nearby Monitoring Well 646, which yielded

2,100 µg/L PCE. The potential presence and distribution of residual PCE is discussed in Section 4.5.2.3.

The VOCs in Perched Groundwater have similar distributions and are relatively limited in extent. The distributions of TCE, PCE, 1,2-DCE, and vinyl chloride are shown in Figure 4.5-7. The highest VOC concentrations are centered in the area beneath and between Buildings 20002 and 20004. Sources in these areas that appear to have contributed VOCs to Perched Groundwater are associated with Source Area 03D and include various sumps, degreasers, waste storage tanks, and utility corridors located within and between the buildings (Section 4.2.3). Potential sources of VOCs to perched groundwater within Administration Area East, including Source Area 03D, based on the soil vapor and groundwater data are shown in Figures 4.5-7 and 4.2-14.

Of the 41 VOC TICs reported, only two were reported in more than one sample. Most of the unknown peaks on the chromatographs were not identified and are reported as "Unknown Peaks" followed by a numeric identifier. The majority of the TICs were petroleum hydrocarbons consisting primarily of aromatics and cycloalkanes. Bicyclo(3,3,1)nonane was the TIC reported at the greatest concentration (89 µg/L in the grab groundwater sample from boring 03D-SP106).

Perched Groundwater – Semivolatile Organic Compounds

SVOC analyses, including an open-scan analysis for TICs, were performed on samples collected from eight monitoring wells and one grab groundwater sample. Bis(2-ethylhexyl)phthalate up to 5.5J µg/L (Well 881) (Figure 4.5-8) was the only SVOC reported at a concentration greater than screening levels, although the PQLs for several SVOCs slightly exceeded their respective screening levels.

Sixty-five TICs were reported in the samples collected from boring 03D-SB19 and Wells 644 and 881. All but nine of the TICs were reported as unknown compounds. None of the nine TICs were reported more than once. Seven of the TICs were branched alkanes. The TIC 7-methyl-tridecane was reported at the highest estimated concentration (69 µg/L).

Perched Groundwater – N-Nitrosodimethylamine

NDMA analyses were performed on samples collected from seven monitoring wells and one grab groundwater sample. The results of the NDMA analyses are posted in Figure 4.5-8. NDMA was detected in two

samples at estimated concentrations of 0.0015J µg/L (Well 882) and 0.0023J µg/L (Well 880). The detected NDMA concentrations are below the California DPH Action Level (0.01 µg/L), but above the USEPA Region 9 PRG of (0.0017 µg/L).

NDMA is not known to have been handled in the Administration Area and there are no liquid rocket testing facilities in the Administration Area. NDMA was not detected in soil samples collected from the Administration Area for this RI (Sections 4.2.4 and 4.2.8).

Perched Groundwater – Perchlorate

Perchlorate analyses were performed on Perched Groundwater samples collected from nine monitoring wells and one grab groundwater sample. Perchlorate exceeded the California MCL (6 µg/L) at one location. The sample collected from Monitoring Well 71 yielded perchlorate at 35 µg/L (Figure 4.5-8). Perchlorate was not reported above the PGW SSL in soil samples collected from the Administration Area, suggesting the perchlorate in Well 71 may have originated upgradient (i.e., Central Disposal Area).

Perched Groundwater – Metals

Metals analyses were performed on Perched Groundwater samples collected from eight monitor wells and one grab groundwater sample. Analyses were performed on both unfiltered and field-filtered samples to assess total and dissolved metals concentrations, respectively.

Several of the filtered metals samples collected from the western Site 03D area yielded iron (up to 5,600 µg/L) and manganese (up to 1,600 µg/L) above their respective Secondary MCLs. These metals were not reported above their respective PGW SSLs in soil samples collected from the Administration Area (Figure 4.2-10). The dissolved metals concentrations in the remaining samples were below their respective screening-level ARARs.

Perched Groundwater – Polychlorinated Biphenyls

Samples of Perched Groundwater were collected from seven monitoring wells and one grab groundwater sample (boring 03D-SB19) near the intersection of Baltimore Street and Boston Avenue (Figure 4.5-8). The PCB Aroclor 1254 was reported above the MCL (0.5 µg/L) at estimated concentrations of 16J and 1.3J µg/L in the samples collected from

Monitoring Wells 881 and 882, respectively. Aroclor 1254 was not reported (<1 µg/L) in a duplicate sample collected from Monitoring Well 882, nor in samples collected from the six nearby monitoring wells.

PCBs were reported above their PGW SSLs in soil samples collected from depths greater than 5 feet bgs at six locations near the intersection of Baltimore Street and Boston Avenue, and from four locations near the former oil tank at the northwest corner of Building 20004 (Section 4.2.4.3).

Perched Groundwater – Total Petroleum Hydrocarbons

Analyses for TPH-D and TPH-Mo were performed on groundwater samples collected from eight monitoring wells and the grab groundwater sample collected from boring 03D-SB19. The results of the TPH analyses are shown in Figure 4.5-8.

The TPH-D concentrations ranged from nondetect (< 50 µg/L) to an estimated 120,000 µg/L (Well 881). The taste and odor threshold for kerosene (100 µg/L), which was used as the screening-level ARAR for diesel, was exceeded in six of seven Perched Groundwater samples collected from the eastern Administration Area (Figure 4.5-8). Soil data indicate that several of the former USTs and ASTs located between Buildings 20001, 20002, 20004, and 20019 probably contributed to the TPH-D observed in this area (Sections 4.2.4.6 and 4.2.8.6).

The lateral extent of TPH-D in Perched Groundwater was not defined below 100 µg/L; however, the extent is limited by the relatively small areal extent of Perched Groundwater. The regulated components of diesel (e.g., benzene, toluene, ethylbenzene, xylenes, and polycyclic aromatic hydrocarbons) were not detected at concentrations greater than screening-level ARARs in VOC and SVOC analyses.

Perched Groundwater – Geochemical Parameters

Samples were collected for various geochemical parameters to provide data for assessing background water quality and chemical and biological oxidation/reduction processes in groundwater. Bicarbonate, carbonate, chloride, dissolved organic carbon, fluoride, hydroxide, nitrate (as NO_3), nitrite (as NO_2), phosphate, and sulfate analyses were performed on the groundwater samples collected from eight monitoring wells. The available MCLs for these anions were not exceeded in the samples collected. Reported alkalinity values ranged from 21 mg/L (Well 3676) to 360 mg/L (Well 881), and were due to bicarbonate. Dissolved organic

carbon content ranged from an estimated 590 µg/L at Well 71 to 5,800 µg/L at Well 881.

Perched Groundwater – Cyanide Analyses

Cyanide analyses were performed on samples collected from six monitoring wells at Site 03D and a grab groundwater sample from boring 03D-SB19. The purpose of the analyses was to assess potential presence of chemicals due to historical metals plating and etching operations. Cyanide was detected in the samples from Wells 645, 881, and 882 at concentrations ranging from an estimated 2.2J µg/L to an estimated 3.1J µg/L. The reported cyanide concentrations were less than the MCL of 150 µg/L. Cyanide was not detected above its PQL in surface and subsurface soil samples collected from the Administration Area (Sections 4.2.4.7 and 4.2.8.7).

4.5.2.2 *First Water-Bearing Zone*

The FWBZ was investigated through the collection of groundwater samples from 49 monitoring wells screened in the FWBZ, and grab groundwater samples collected from 55 soil boring locations. Chemical isoconcentration contour maps illustrating the distribution of the most frequently detected compounds (TCE, cis-1,2-DCE, and perchlorate) are provided as Figures 4.5-9 through 4.5-11, respectively. The most recent analytical data are posted on the figures for monitoring wells sampled more than once during the RI Sampling Period.

Based on the information presented below, the lateral and vertical extents of chemicals in the FWBZ within the Administration Area have been sufficiently characterized to identify potential sources, evaluate potential risks to human health, and if necessary, develop remedial alternatives.

FWBZ – Volatile Organic Compounds

VOC analyses were performed on samples collected from 49 monitoring wells with screened intervals constructed in the FWBZ, and on grab groundwater samples collected from 54 soil boring locations. TCE and cis-1,2-DCE were the most widely distributed VOCs in the FWBZ.

VOCs reported in at least one sample above their respective screening levels include:

- PCE up to 140,000 µg/L;

- TCE up to 12,000 µg/L;
- 1,1,1-TCA up to 9,500 µg/L;
- cis-1,2-DCE up to 1,600 µg/L;
- Methylene chloride up to 1,100 µg/L;
- 1,1-DCE up to 380 µg/L;
- Vinyl chloride up to 280 µg/L;
- 1,2-DCA up to 140 µg/L;
- 1,1-DCA up to 62 µg/L;
- 1,1,1,2-tetrachloroethane (PCA) up to 14 µg/L;
- Carbon tetrachloride up to 5.7 µg/L; and
- Benzene up to 2.2 µg/L.

The highest VOC concentrations in the FWBZ were detected in samples collected between Buildings 20001, 20002, 20004, and 20019 (Figures 4.5-9 to 4.5-11). Within this area, PCE was reported at 140,000 µg/L in a grab groundwater sample from boring 03D-SP102, located between Buildings 20002 and 20004. The same sample also had the highest reported concentrations of 1,1,1,2-PCA; 1,1,1-TCA; 1,2-DCA; and vinyl chloride.

VOC concentrations exceeding 1 percent of solubility limits, potentially suggesting the presence of residual product, were reported in grab groundwater samples collected from two locations. The potential presence and distribution of residual product is discussed in Section 4.5.2.3.

The distribution of TCE and cis-1,2-DCE, the most widely distributed VOCs in the FWBZ, are presented in Figures 4.5-9 and 4.5-10, respectively. These figures indicate that TCE and cis-1,2-DCE beneath the Administration Area are due to contributions from both local and upgradient sources. TCE and 1,2-DCE are migrating beneath the Administration Area from the western and eastern portions of the Central Disposal Area, respectively. As mentioned previously, cis-1,2-DCE is derived from the biodegradation of TCE and/or PCE.

In addition to the upgradient source(s), the current distribution of VOCs suggests that these compounds may have originated from multiple sources within the Administration Area including:

- Site 03D – Between Buildings 20002 and 20004 (decontamination area);
- Site 03D – Northwestern corner of Building 20004 (plastics lab sump and waste collection tank);
- Site 03D – Vicinity of former waste oil tank near soil vapor sampling location 3D-SP122;
- Site 03D – Near waste storage tank and degreaser in the interior of Building 20004 near soil vapor sampling location 03D-SP147; and
- Site 4D – Southern end of Building 20004 (septic tanks).

Sources of VOCs to groundwater within the Administration Area, based on the results of the BOU RI soil vapor and groundwater sampling, are shown in Figure 4.2-14.

VOC open-scan analyses for TICs were performed on the groundwater samples from 40 monitoring wells and 45 borings. The samples collected from 12 of the monitoring wells and 37 grab groundwater samples yielded TICs. Forty-three TICs were reported, although approximately 39 (91 percent) were reported only once. For samples that had duplicate analyses, the TICs reported in primary samples were generally not reported in the duplicate samples. Hexanol was detected at the highest concentration (140 µg/L) and was the most frequently reported TIC. Chlorotrifluoroethene was reported in three samples with a maximum estimated concentration of 9.1J µg/L.

<u>FWBZ – Semivolatile Organic Compounds</u>

SVOC analyses, including an open scan for TICs, were performed on samples collected from 43 monitoring wells and the grab groundwater samples collected from 16 soil borings. Two SVOCs were reported at two locations at concentrations slightly above their respective ARARs.

Probable fuel-related compounds such as benzo(a)anthracene (up to 0.63 µg/L) and benzo(a)pyrene (up to 0.31 µg/L) were reported at concentrations above their respective ARARs in the grab samples collected between Buildings 20002 and 20004 (borings 03D-SB30 and 03D-SB37) (Figure 4.5-12). SVOCs and TPH-D were reported in only one of the surface and near-surface soil samples collected from this area to assess the extent of diesel fuel associated with historical releases from several former USTs. SVOCs were not detected in deeper soil samples collected from the same location suggesting minimal, if any, continuing

source in the vadose zone. These compounds may be associated with historical releases of diesel fuel.

Several SVOCs with no screening-level ARARs were detected including:

- Acenaphthylene up to 0.48 µg/L (Well 3693);
- 2-Methylnaphthalene up to 28 µg/L (Well 3693);
- B(b&k)F up to 0.68J µg/L (boring 03D-SB30);
- n-Nitrosodiphenylamine up to 40J µg/L (Well 262); and
- Phenanthrene up to an estimated 3.8 µg/L (Well 3693).

Fifty-seven SVOC TICs were reported in the groundwater samples collected from 15 monitoring wells and 13 soil borings. Approximately 78 percent of the TICs were classified as unknown. The TICs with identifications (i.e., the non-unknown TICs), generally appear to be associated with petroleum hydrocarbons (primarily branched alkanes or aromatics). The TIC 2,6,10,15-tetramethylheptadecane was reported most frequently (four samples) and at the highest concentration (370 µg/L). The sample from Well 262, north of Building 20001 where the highest TPH concentrations were reported, had the highest number of TICs (30).

FWBZ – N-Nitrosodimethylamine

NDMA analyses were performed on groundwater samples collected from 33 monitoring wells and 12 grab groundwater samples. NDMA was reported in three of the samples above the California DPH Action Level of 0.01 µg/L and the USEPA Region 9 PRG of 0.0017 µg/L.

Estimated NDMA concentrations up to 0.057 µg/L were irregularly distributed in Administration Area East, and many samples collected from wells located between the isolated detections did not yield NDMA (Figure 4.5-13). There are no known sources of NDMA in the Administration Area, and NDMA was not detected in soil samples collected from various locations (Sections 4.2.4.8 and 4.2.8.8).

FWBZ – Perchlorate

Perchlorate analyses were performed on groundwater samples collected from 45 monitoring wells and on grab groundwater samples collected from 15 soil borings (Figure 4.5-11). The distribution of perchlorate in the FWBZ beneath the Administration Area suggests the majority of

perchlorate originated upgradient, in the Central Disposal Area (CDA). Relatively lower perchlorate concentrations detected in the northeastern portions of the Administration Area also appear to be due to an upgradient source.

The highest perchlorate concentrations (2,000 µg/L) were reported in Monitor Well 3015, upgradient of the BOU (Figure 4.5-11). Within the BOU, perchlorate was reported up to 840 µg/L in groundwater samples collected from Monitor Wells 3675 and 3684, located in the southwestern portion of the Administration Area.

There are no known operations involving perchlorate at Building 20009, although perchlorate was reported in surface soils collected just to the west of the building at Source Area 6D (Section 4.3.7.4). Perchlorate was not reported in deeper soils samples collected from the same location suggesting there is not a current source of perchlorate in the vadose zone.

FWBZ – Metals

Metals analyses were performed on groundwater samples collected from 42 monitoring wells and grab groundwater samples collected from 16 soil borings. Metals reported above their respective screening levels are posted in Figure 4.5-12. Iron and manganese, commonly reported above their respective Secondary MCLs, are not posted in Figure 4.5-12.

In the filtered samples, iron (up to 28,000 µg/L), manganese (up to 7,000 µg/L), and zinc (up to 13,000 µg/L) were the metals that exceeded their respective Secondary MCLs of 300, 50, and 5,000 µg/L, respectively. None of these compounds was reported above their respective PGW SSLs in soil samples collected from the Administration Area (Sections 4.2.4.2, 4.2.8.2, 4.3.4.2, 4.3.8.2, and 4.3.12.2).

Molybdenum (200 µg/L) and aluminum (1,900 µg/L) were each reported in a single grab groundwater sample above their respective screening levels. Hexavalent chromium was reported above the PGW SSL at depths up to 11 feet at Source Areas 5D and 6D; however, hexavalent chromium was not detected in groundwater samples collected beneath these areas (Section 4.3.8.2 and Figure 4.2-10).

FWBZ – Polychlorinated Biphenyls

PCB analyses were performed on the samples collected from 12 monitoring wells and 15 grab groundwater samples. PCBs

Aroclor 1254 (0.61J µg/L) and Aroclor 1260 (130 µg/L) each exceeded the MCL (0.5 µg/L) in different samples collected near the intersection of Baltimore Street and Boston Avenue (Figure 4.5-12). Both detections were in grab groundwater samples. PCBs were not reported in the remaining samples, although the laboratory PQLs (1 to 2 µg/L) slightly exceeded the MCL (0.5 µg/L). The PCBs in the FWBZ probably migrated downwards from the overlying Perched Groundwater where PCBs were also detected.

FWBZ – Total Petroleum Hydrocarbons

TPH-D and TPH-Mo analyses were performed on samples collected from 42 monitoring wells and grab groundwater samples from 22 borings. The monitoring wells and borings sampled and the analytical results are shown in Figure 4.5-14.

The soils and Perched Groundwater data indicate that several of the former USTs and ASTs located between Buildings 20001, 20002, 20004, and 20019 probably contributed to the TPH-D observed in this area (Section 4.2.4.6). TPH-D was detected extending from the eastern side of Building 20004, approximately 1,800 feet northwest towards GET D Extraction Well 4001 (Figure 4.5-14). The highest TPH-D concentration (29,000 µg/L) was observed at Well 262, located near the northwestern corner of Building 20002.

TPH-D (240 µg/L) was also identified in a grab sample collected near the southeast corner of Building 20004 (Figure 4.5-14). TPH-D was also identified up to 560 µg/L in groundwater near Site 11D. The extent of TPH-D greater than 100 µg/L is not well-defined, although the relatively low concentrations detected in this area would suggest the extent is relatively limited.

TPH-D was also reported in the area southwest of Building 20009. TPH-D was reported up to 1,400 µg/L and TPH-D concentrations greater than 100 µg/L extend approximately 1,500 feet downgradient (Figure 4.5-14). TPH above its PGW SSL was reported in soil samples collected near the former location of a transformer spill at the southwest corner of Building 20009 (Section 4.3.8.6 and Figure 4.3-11).

FWBZ – Geochemical Parameters

Bicarbonate, carbonate, chloride, dissolved organic carbon content, fluoride, hydroxide, nitrate as NO_3, nitrite as NO_2, phosphate, and sulfate analyses were performed on the groundwater samples collected from

43 monitoring wells and boring 08D-HP01. These data were collected to allow interpretation of geochemical processes that may affect possible remedial alternative selection.

Fluoride, nitrite, and sulfate were reported at concentrations below their respective MCLs. The grab groundwater sample collected from boring 08D-HP01 in the vicinity of the FSTP had nitrate reported at 48 mg/L, which exceeds the MCL of 45 mg/L. All alkalinity was due to bicarbonate with values ranging from 7.8 mg/L (Well 269) to 990 mg/L (Well 501).

The following are the median concentrations of the major ions:

- Bicarbonate (120 mg/L);
- Carbonate (less than 5 mg/L);
- Chloride (9.8 mg/L);
- Sulfate (12 mg/L); and
- Nitrate (5.8 mg/L).

Hydroxide and phosphate were not detected (less than 5 and 0.5 mg/L, respectively).

Analyses were conducted to assess the dissolved organic carbon content in samples collected from 43 monitoring wells to allow for evaluation of possible remedial options. The reported concentrations ranged from an estimated 0.54J mg/L at Well 274 to 48 mg/L at Well 3680. The median detected concentration was 1.0 mg/L.

Nitrate at concentrations of less than 1 mg/L, which suggests denitrifying conditions, was reported in the samples collected from the following areas:

- The central portion of Site 03D (Wells 269 and 3693);
- North of Building 20001 near Aerojet Road (Wells 3092 and 3096);
- Near the FSTP (Well 501); and
- Upgradient of the BOU (Wells 37 and 65).

Many of these areas also had sulfate concentrations less than 2 mg/L, suggesting sulfate-reducing conditions.

FWBZ – Cyanide Analyses

Cyanide analyses were performed on samples from 10 monitoring wells and from grab groundwater samples collected at soil borings to investigate former plating operations. Cyanide concentrations ranged from less than the PQL (5 µg/L) to 11 µg/L (Well 268). The MCL for cyanide is 150 µg/L. Cyanide was not detected above PQLs in surface and subsurface soil samples collected from the Administration Area (Sections 4.2.4.7, 4.2.8.7, 4.3.4.7, and 4.3.8.7).

4.5.2.3 *Residual Product*

The potential presence of residual product was investigated following the steps outlined in the *Source Area Investigation and Remedial Action Approach* (Aerojet, 2006c). In summary, step-out sampling was performed to delineate the lateral and vertical extent of suspected residual product in groundwater. The step-out sampling was initiated if groundwater concentrations exceeded 1 percent of the pure-phase solubility limit for a given compound.

In the Administration Area, PCE and TCE concentrations exceeded 1 percent of their respective solubility limits in two areas. Concentrations of PCE requiring further investigation for the presence of residual product were detected near former sumps and degreasers located between Buildings 20002 and 20004, and concentrations of PCE and TCE requiring further investigation for the presence of potential residual product were detected near the northwestern corner of Building 20004. The inferred extents of residual product in Perched Groundwater and the FWBZ are shown in Figures 4.5-15 and 4.5-16, respectively.

The following sections describe the findings of the confirmatory and step-out sampling for residual product.

Site 03D – Between Buildings 20002 and 20004

Two grab groundwater samples and one monitoring well yielded PCE concentrations in Perched Groundwater greater than 1 percent of the pure-phase solubility limit (2,000 µg/L) for PCE. PCE concentrations of 9,400 and 5,400 µg/L were reported in samples collected at depths of 20 feet bgs from borings 03D-SP105 and 03D-SP102 (Figure 4.5-15). Perched Monitoring Well 646 yielded 2,100 µg/L PCE from the same general area.

A deeper grab groundwater sample (03D-SP102) collected from the FWBZ in the same area yielded PCE at a concentration of 140,000 µg/L. To confirm the potential presence of residual product in the FWBZ, Monitoring Well 3729 was installed in the FWBZ approximately 10 feet from boring 03D-SP102.

PCE was detected at a concentration of 75 µg/L in the sample collected from Monitoring Well 3729, approximately four orders of magnitude lower than in the grab groundwater sample. The large difference in concentrations suggests that the grab groundwater sample is not representative of PCE concentrations in the FWBZ, and that the extent of residual product, if any, is limited to soil. Vertically, the deeper portion of the FWBZ does not appear to contain residual PCE as indicated by the relatively low PCE concentration (200 µg/L) in nearby Well 269 (Figure 4.5-16).

Site 03D – Northwestern Corner of Building 20004

To separate grab groundwater samples collected near the northwestern corner of Building 20004 yielded PCE and TCE concentrations in Perched Groundwater greater than 1 percent of the pure-phase solubility limits of 2,000 and 11,000 µg/L, respectively (Figure 4.5-15). A 40-feet bgs grab groundwater sample collected from boring 03D-SP107 yielded PCE at 5,800 and TCE at 12,000 µg/L. A 60-feet bgs grab groundwater sample from boring 03D-SB57 yielded PCE at 5,300 µg/L.

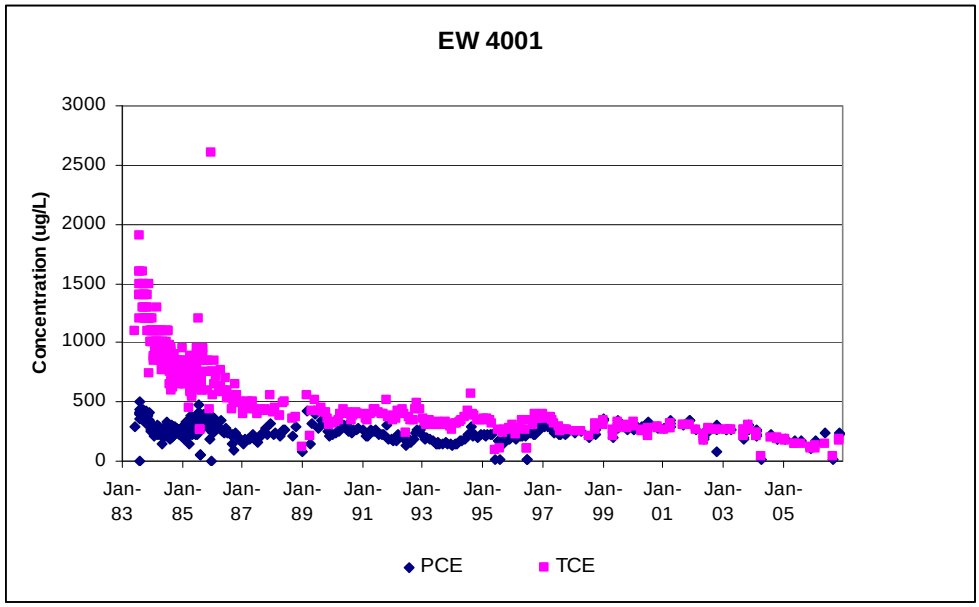
Monitoring Well 3730 was constructed in the FWBZ approximately 24 feet from these soil borings to assess the potential presence of residual PCE and TCE. Samples from the well yielded PCE at 17 µg/L and TCE at 190 µg/L. These results suggest that if residual product is present, the extent is likely limited.

Deeper Groundwater

The groundwater data from Monitor Well 3730 suggest that residual product PCE and TCE are unlikely in the FWBZ. There are no deeper monitoring wells at this location to assess whether there is residual product deeper in the aquifer. However, water quality data from downgradient monitoring and extraction wells were used to assess the potential presence of residual product in the deeper groundwater.

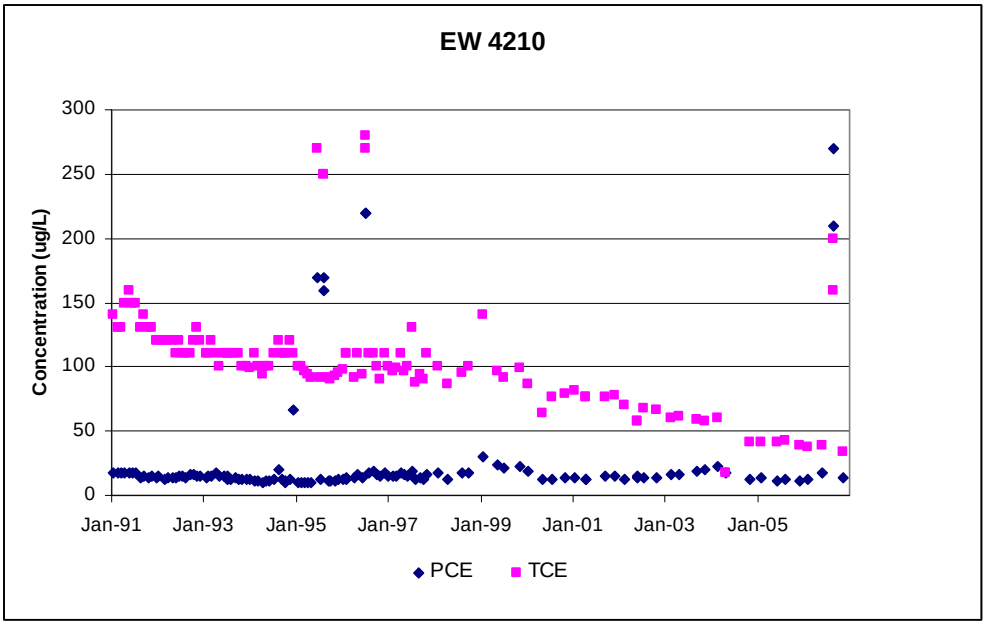
Extraction Well 4001 is screened across the lower portion of Layer C (Figure 4.5-1) and is approximately 1,000 feet downgradient of the two

areas at Site 03D, where residual product was suggested in the upper portion of the FWBZ (Figure 4.5-16). The influent PCE concentrations at Extraction Well 4001 have been relatively constant since 1983, while TCE concentrations have decreased during this same timeframe, as shown in the graph below.



Decreasing asymptotic concentrations are consistent with depletion of the source.

Extraction Well 4210, located downgradient of Building 20004 and 20019, is screened across Layer D and the upper portion of Layer E (Figure 4.5-1). The influent PCE and TCE concentrations at Extraction Well 4210 are approximately one order of magnitude less than at Extraction Well 4001 (see graph below), which suggests that residual product is not likely to be present in this deeper layer.



It does not appear that residual product is present in the perched, first water-wearing, or deeper layers beneath the Administration Area.

4.5.3 *Existing Remedial Actions*

There are two existing GET systems currently operating within and downgradient of the Administration Area. GET D is located on site, and some GET D extraction wells are located within or just downgradient of the BOU. The American River Groundwater Extraction and Treatment (ARGET) system is located off site, downgradient of GET D and the BOU. Both systems extract and treat chemicals in groundwater emanating from within or upgradient of the Administration Area.

GET D was constructed and operated in accordance with the Partial Consent Decree beginning in 1981. The ARGET system was constructed in compliance with a RWQCB Cleanup and Abatement Order (CAO 96-230) issued to address VOCs in groundwater on the northern and southern sides of the American River. Portions of both treatment systems are included as part of the remedy expected to be selected for the PGOU (OU-5).

When construction of the ARGET system is completed, it will provide hydraulic containment of the downgradient extent of chemicals emanating from the Administration Area. The GET D system will be used to reduce the remedy lifetime by extracting relatively higher VOC and perchlorate concentrations on site, closer to the source areas. Details

regarding the current and future hydraulic containment by GET D and ARGET are provided in the FS.

Prior to 2002, the GET D system comprised air-stripping towers for VOC removal and carbon-dioxide for pH adjustment. In August 2002, ion-exchange resins were added to the GET D system for perchlorate removal. The treated water from GET D is recharged back into the aquifer through a series of passive recharge wells located northwest of the Administration Area.

The ARGET system is designed to remove VOCs, primarily TCE and 1,4-dioxane, from the extracted groundwater using a combination of advanced oxidation (HiPOx) and an air-stripping treatment system. Treated groundwater from the ARGET system is discharged to Buffalo Creek and ultimately the American River under NPDES Permit CA008361.

4.5.4 Chemical Fate and Transport

Numerous processes governing chemical fate and transport have influenced the distribution of constituents currently observed in groundwater beneath the Administration Area. This section describes the various processes that may be occurring, and how they may influence potential remedy evaluation and selection.

The most significant observation regarding the fate and transport of chemicals in groundwater beneath the Administration Area is that chemical concentrations and distribution have decreased since the 1980s. Decreasing chemical concentrations coupled with plume contraction are consistent with source depletion. Mass removal from the existing GET D system and reductive dechlorination (RDC) from intrinsic biodegradation are the mechanisms promoting source depletion.

4.5.4.1 Perched Groundwater

Perched Groundwater is present beneath the eastern portion of the Administration Area near Buildings 20002 and 20004, and beneath the western portion of the Administration Area near Building 20009. The lateral extent of Perched Groundwater is relatively limited; therefore, the dominant transport mechanism for chemicals in Perched Groundwater is downward vertical migration into the FWBZ.

During the RI Sampling Period, hydraulic heads measured in Perched Groundwater ranged from 16 to 23 feet above the heads measured in the

FWBZ. This head difference provides the potential for downward vertical migration. Pathways for downward vertical migration may occur where there are discontinuities in the perching sediments.

VOCs and TPH, the most common constituents reported in the Perched Groundwater, appear to be attributable to local sources near Buildings 20002 and 20004. PCE was the only VOC in the Administration Area Perched Groundwater with concentrations exceeding 1 percent of its solubility limit (2,000 µg/L). However, further investigation to assess the presence of residual product indicates that if residual product is present, it is limited to the vadose zone.

Dissolved-phase VOCs present in Perched Groundwater are biodegrading via RDC. PCE and TCE degradation products cis-1,2-DCE and vinyl chloride are present in groundwater beneath the Administration Area. Petroleum hydrocarbons, which are commingled with VOCs in Perched Groundwater, serve as reductants (electron donors) that create the reduced conditions needed for RDC.

Comparison of water quality data collected during the Stage 1 RI (1991-1993) and during the current RI Sampling Period show that VOC concentrations have decreased over time in Perched Groundwater. Figure 4.5-17 illustrates the differences in PCE, TCE, 1,2-DCE, and vinyl chloride concentrations detected during Stage 1 and during the current RI Sampling Period. Only monitoring wells with data available during both RI periods are posted in the figures.

The relatively lower VOC concentrations reported in the current data indicate either (1) the flux of VOCs from the source area(s) is stable and biodegradation has increased since collection of 1993 data, or (2) the flux of VOCs from residual sources has diminished and biodegradation has remained at a comparable rate. Regardless of the process, it is apparent that the mass of VOCs within the Perched Groundwater has decreased.

The water quality and water level data collected beneath the Administration Area indicate minimal lateral migration of VOCs and TPH in Perched Groundwater as the plume (1) is over 20 years old and does not extend off site, and (2) appears to be contracting. Declining concentration trends for these constituents are attributable to minimal flux from vadose zone sources, mass removal from natural biodegradation, and vertical migration into the FWBZ. Vertical migration into the FWBZ does not appear to be substantial as concentrations in the FWBZ are also decreasing as discussed in the following subsections.

4.5.4.2 *First Water-Bearing Zone*

VOCs, perchlorate, and TPH-D were the most common constituents detected in FWBZ beneath the Administration Area. The distribution of these compounds indicates that they have migrated downgradient from various potential source areas by advective transport. Water quality trends show that concentrations and extents of chemicals in the FWBZ are decreasing due to biological degradation and mass removal by the GET D extraction system.

Hydraulic gradients in the FWBZ suggest a west-northwestern flow direction from the eastern Administration Area towards GET D Extraction Wells 4001 and 4035. Groundwater beneath the southwestern portions of the Administration Area flows northwest towards the cluster of GET D extraction wells in Aerojet Area 49 at the southwest corner of Folsom Boulevard and Hazel Avenue.

<u>Volatile Organic Compounds</u>

The highest VOC concentrations in FWBZ beneath the Administration Area were reported near Buildings 20002 and 20004, the same general area where the highest VOC concentrations were reported in Perched Groundwater.

As discussed in Section 4.5.2.3, PCE concentrations suggesting the potential presence of residual product were reported in two grab groundwater samples collected between Buildings 20002 and 20004. In addition, potential residual PCE and TCE were indicated in grab groundwater samples collected northwest of Building 20004. However, no monitoring wells screened in the FWBZ had PCE or TCE concentrations greater than 1 percent of their respective solubility limits during the RI Sampling Period, including monitoring wells installed in proximity of the borings that yielded residual-product-indicating concentrations.

Historical groundwater VOC data suggest that residual TCE and/or PCE may have been present in up to five Administration Area monitoring wells around Buildings 20002 and 20004. Not all monitoring wells with historical residual-product-indicating concentrations were sampled during the current RI Sampling Period; however, the wells sampled reported PCE and TCE concentrations below the 1 percent solubility limits. The following table summarizes the TCE and PCE data collected from monitoring wells where at least one sample historically yielded

potential residual-product-indicating concentrations.

Well No.	VOC	Pre-Stage 1 RI (1980 – 1991)	Stage 1 RI (1991 – 1993)	Post-Stage 1 RI (1993 to 2005)	Current RI (2005 – 2007)
106	PCE	16,000	13	NS	NS
	TCE	1,800	790	NS	NS
116	PCE	1,700	3	NS	1.9
	TCE	11,000	20	NS	3.3
263	PCE	30,000	NS	2,900	1.2
	TCE	37,000	NS	1,700	0.68
269	PCE	63,000	NS	3,800	320
	TCE	21,000	NS	100	200
279	PCE	2,500	8	NS	<0.5

Both PCE and TCE concentrations in the FWBZ appear to have decreased, and the extents of PCE and TCE above 5 µg/L are contracting. Figures 4.5-18 through 4.5-21 compare PCE, TCE, cis-1,2-DCE, and vinyl chloride concentrations reported during the Stage 1 RI (the maximum in 1992) to the concentrations reported during the current RI Sampling Period. Only monitoring wells with data available during both RI periods are posted in these figures. The areal extent of PCE has decreased by approximately 80 percent (Figure 4.5-18), and the extent of TCE has decreased by approximately 40 percent (Figure 4.5-19). The observed plume contraction is consistent with the apparent depletion of residual product in the source areas noted above.

Reductive dechlorination of chlorinated ethenes is occurring within eastern Administration Area groundwater. Groundwater between Buildings 20002 and 20004 appears to be strongly reduced (sulfate reducing or methanogenic) as indicated by the geochemistry reported for samples from Monitoring Wells 269 and 3693. The petroleum hydrocarbons present in this area appear to be the reductants. The presence of cis-1,2-DCE and vinyl chloride within this plume confirms RDC.

Geochemical conditions are generally not favorable for intrinsic RDC in other portions of Administration Area groundwater where TCE and, to a lesser extent, PCE were detected. The VOCs detected in the FWBZ east and west of the Buildings 20002 and 20004 area are present as relatively isolated pockets, and likely attenuate through advection and hydrodynamic dispersion.

In summary, geochemical conditions are favorable for RDC in the areas where the highest VOC and TPH concentrations were reported in the FWBZ around and between Buildings 20002 and 20004. Comparison of historical and current data confirms that VOC extent and concentrations have decreased. Available data suggest that several processes are governing these decreases, including RDC, residual source depletion, and mass removal via groundwater extraction. The VOCs emanating from the eastern Administration Area do not appear to extend downgradient beyond GET D Extraction Well 4001.

Perchlorate

Perchlorate detected in the FWBZ beneath the western portions of the Administration Area appears to be transported by advection from areas upgradient of the Administration Area. The current plume geometry does not indicate much, if any, contribution of perchlorate to groundwater from potential sources in the Administration Area. Hydraulic gradients in the FWBZ are consistent with a northwestern flow direction towards the GET D extraction systems. The perchlorate detected in the FWBZ is present within the upper portions of Layer C and will be contained by existing or proposed GET systems.

Within the portions of the Administration Area where perchlorate was detected, the denitrifying conditions needed for perchlorate degradation are not indicated by available geochemical data.

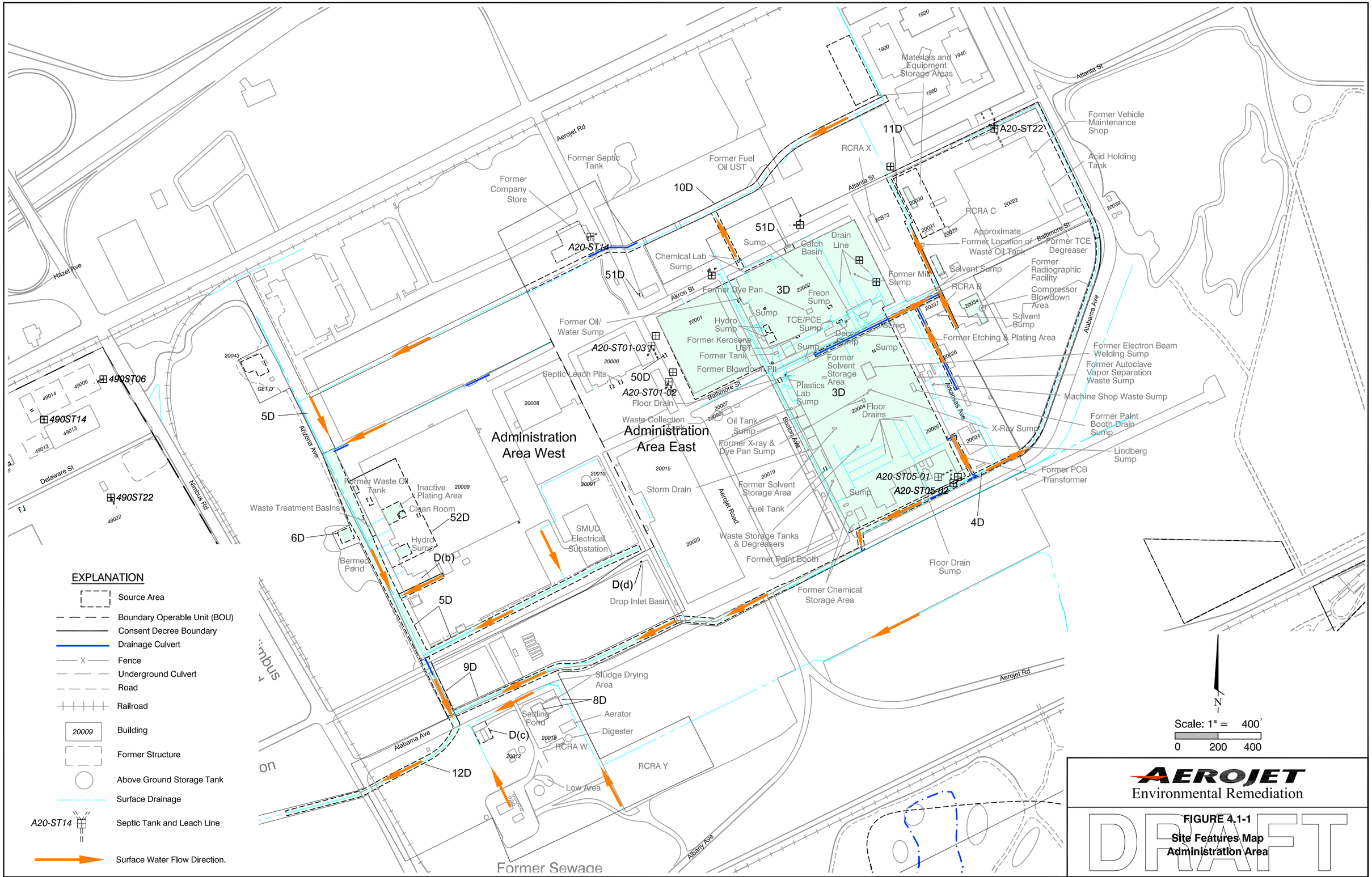


FIGURE 4.1-1
Site Features Map
Administration Area

7\16\08 PR SR10130969

LEGEND

Carveout Lands

Carveout Lands with Special Restrictions

Dredged Areas

N

Scale: 1" = 1000'

0 500 1000

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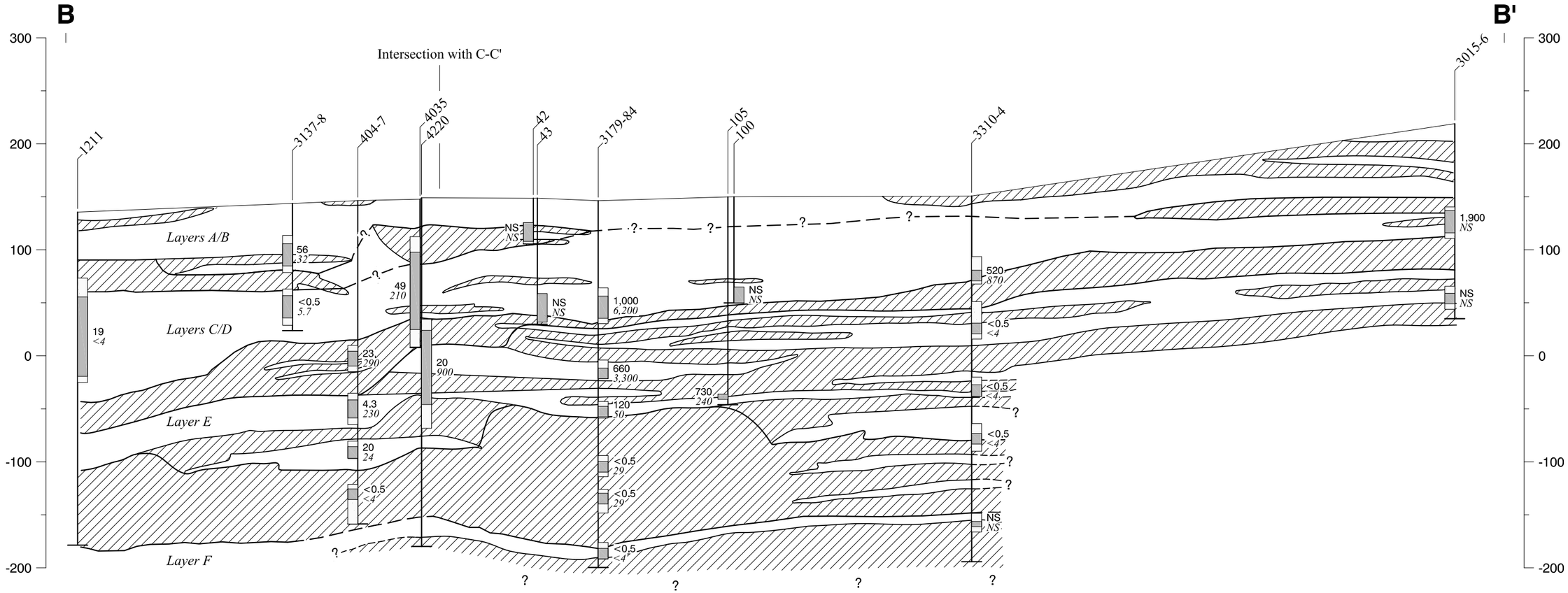
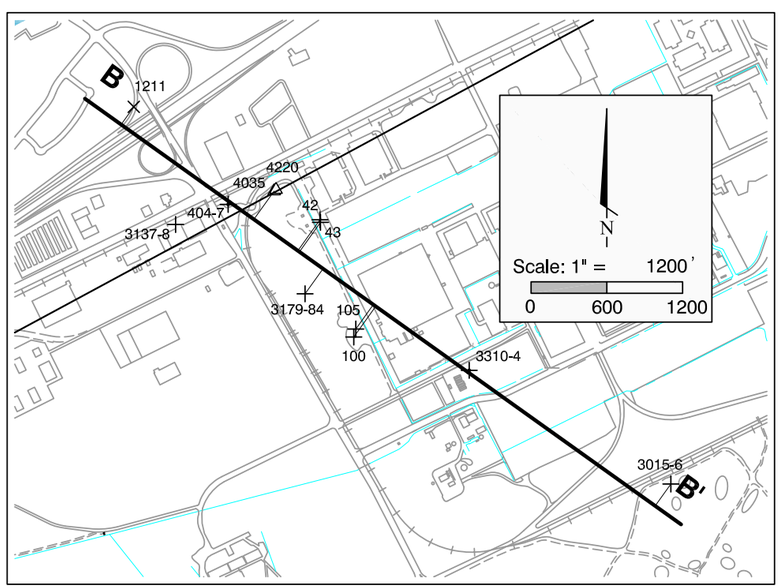
Environmental Remediation

FIGURE 4.1-2

Extent of Dredging in Study Area Administration Area

SR101123859 **FIGURE 4.1-4** 6/2/08 Herron, Al





EXPLANATION

1001 — Well Designation
Multiple Completions: Depth Increases by Ascending Well Number Order

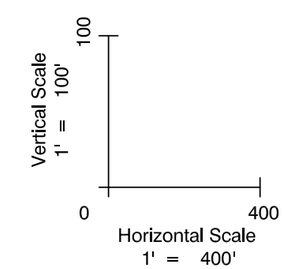
<0.5 — TCE Concentration in µg/L
<4 — Perchlorate Concentration in µg/L
(NS = Not Sampled)

Screened Interval
Filter Pack
Total Borehole Depth

TCE Trichloroethene
Layer Boundary
Geologic Contact

Relatively permeable sediments: Silty, poorly and well-graded sands and gravels (GP,GW,SP,SW); silty and clayey gravels (GM/GC) and silts.

Relatively lower permeability sediments: Low plasiticity clays and silts (CL,ML); silty and clayey sand (SM/SC).



Source: GET D Effectiveness Report (Aerojet, 1992)

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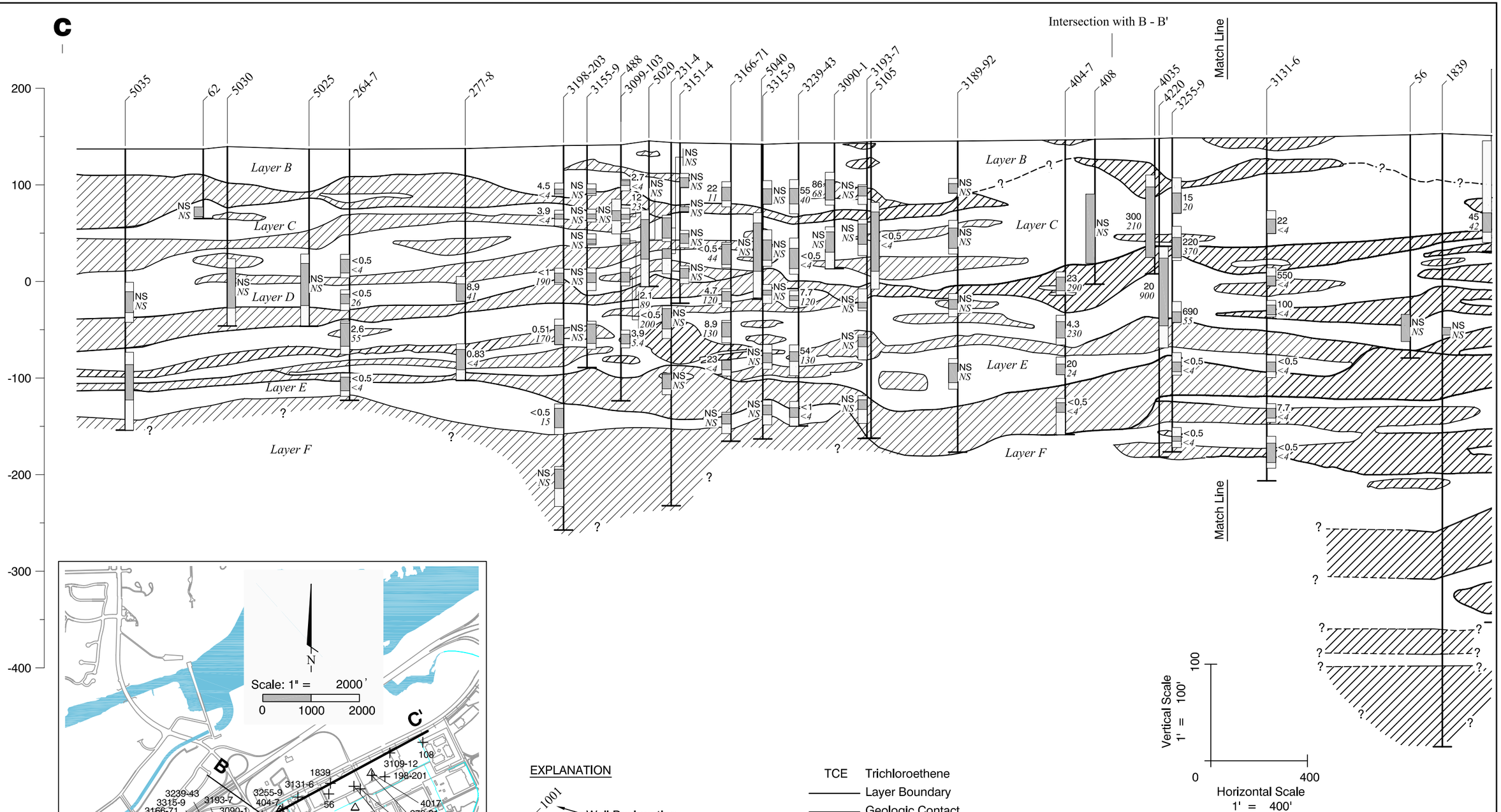
Environmental Remediation

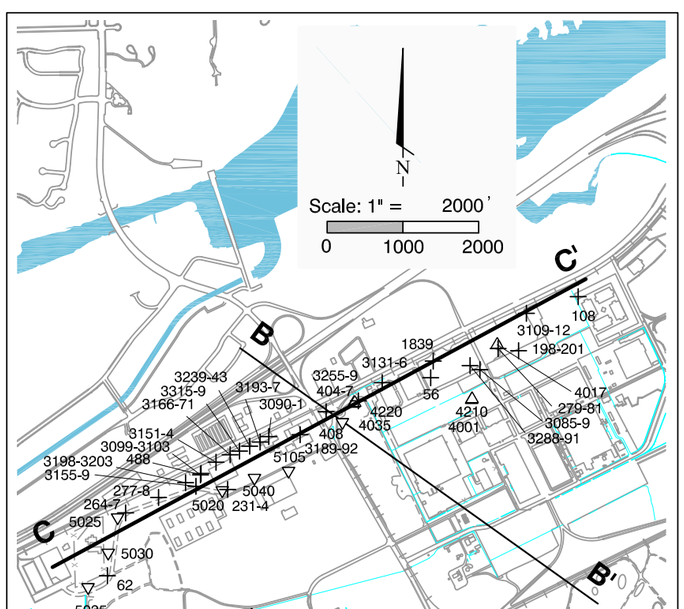
FIGURE 4.1-3

Hydrostratigraphic Cross Section B - B'
Administration Area

7\16\08 PR SR10130971



Source: GET D Effectiveness Report (Aerojet, 1992)



Cross Section Location Map

EXPLANATION

1001 — Well Designation
Multiple Completions: Depth Increases by Ascending Well Number Order

<0.5 — TCE Concentration in μg/L
<4 — Perchlorate Concentration in μg/L
(NS = Not Sampled)

Screened Interval
Filter Pack
Total Borehole Depth

TCE Trichloroethene
Layer Boundary
Geologic Contact
Relatively permeable sediments: Silty, poorly and well-graded sands and gravels (GP,GW,SP,SW); silty and clayey gravels (GM/GC) and silts.
Relatively lower permeability sediments: Low plasiticity clays and silts (CL,ML); silty and clayey sand (SM/SC).

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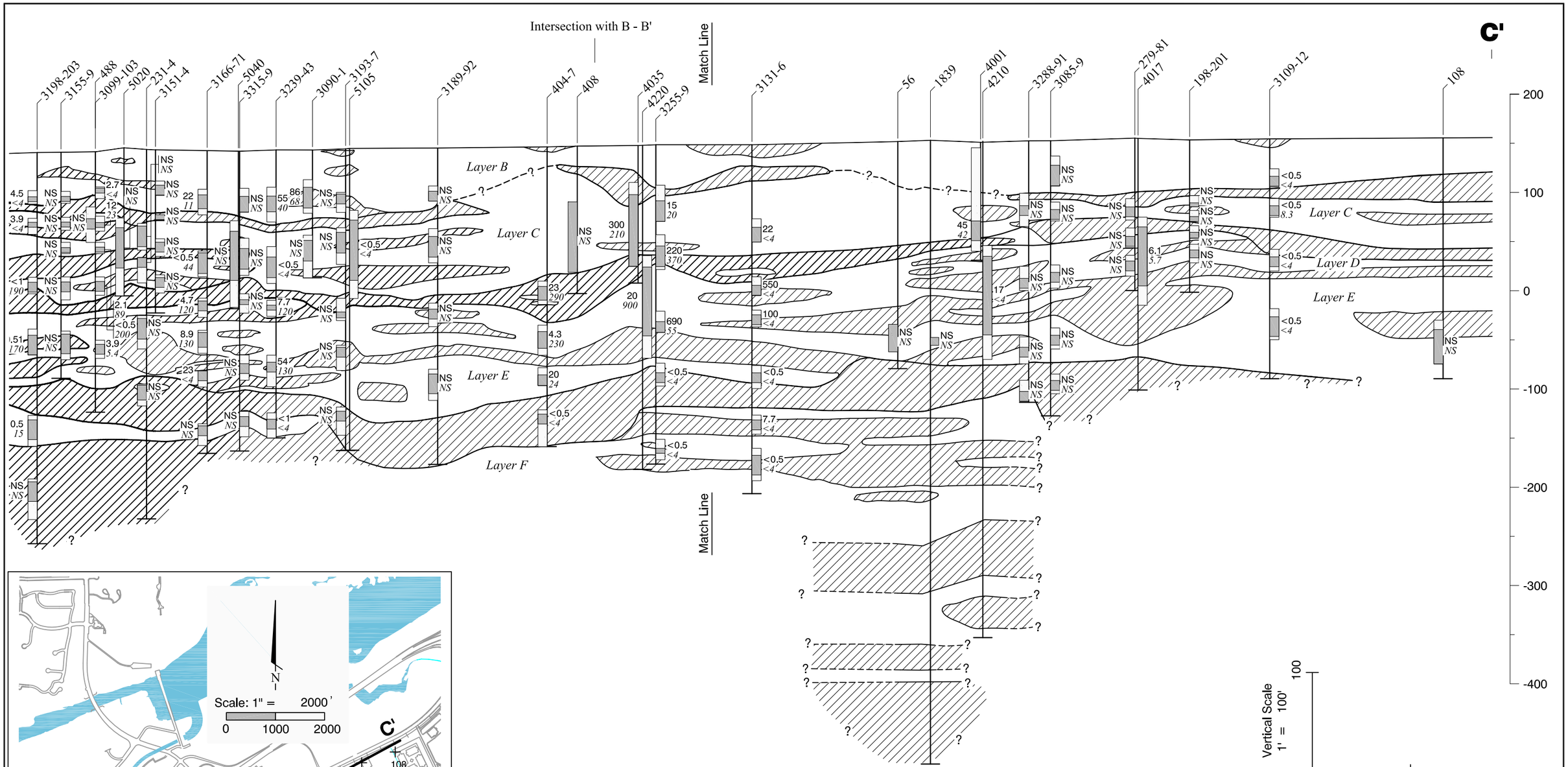
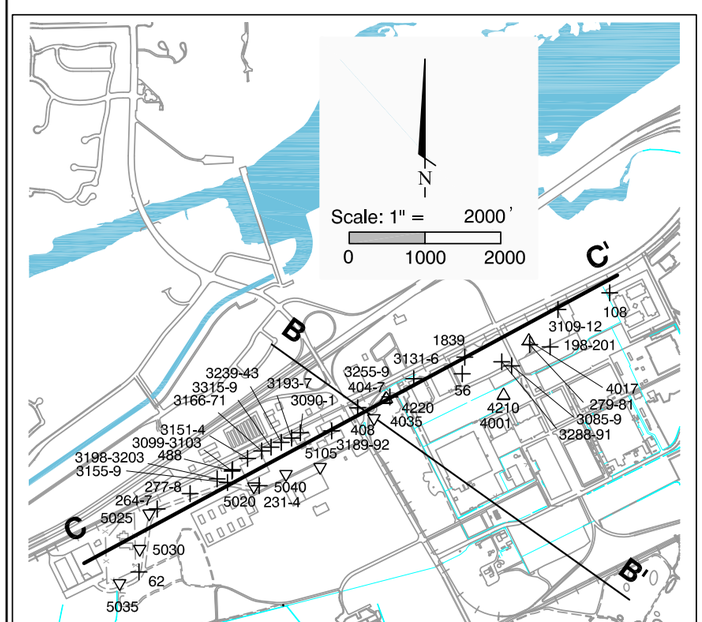
FIGURE 4.1-4a

Hydrostratigraphic Cross Section C-C'
Figure 1 of 2
Administration Area

7\16\08 PR SR10130972



Source: GET D Effectiveness Report (Aerojet, 1992)



Cross Section Location Map

EXPLANATION

1001 — Well Designation
Multiple Completions: Depth Increases by Ascending Well Number Order

<0.5 — TCE Concentration in µg/L
<4 — Perchlorate Concentration in µg/L
(NS = Not Sampled)

Screened Interval
Filter Pack
Total Borehole Depth

TCE Trichloroethene
Layer Boundary
Geologic Contact
Relatively permeable sediments: Silty, poorly and well-graded sands and gravels (GP,GW,SP,SW); silty and clayey gravels (GM/GC) and silts.
Relatively lower permeability sediments: Low plasiticity clays and silts (CL,ML); silty and clayey sand (SM/SC).

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Environmental Remediation

FIGURE 4.1-4b

Hydrostratigraphic Cross Section C-C'
Figure 2 of 2
Administration Area

7\16\08 PR SR10130973

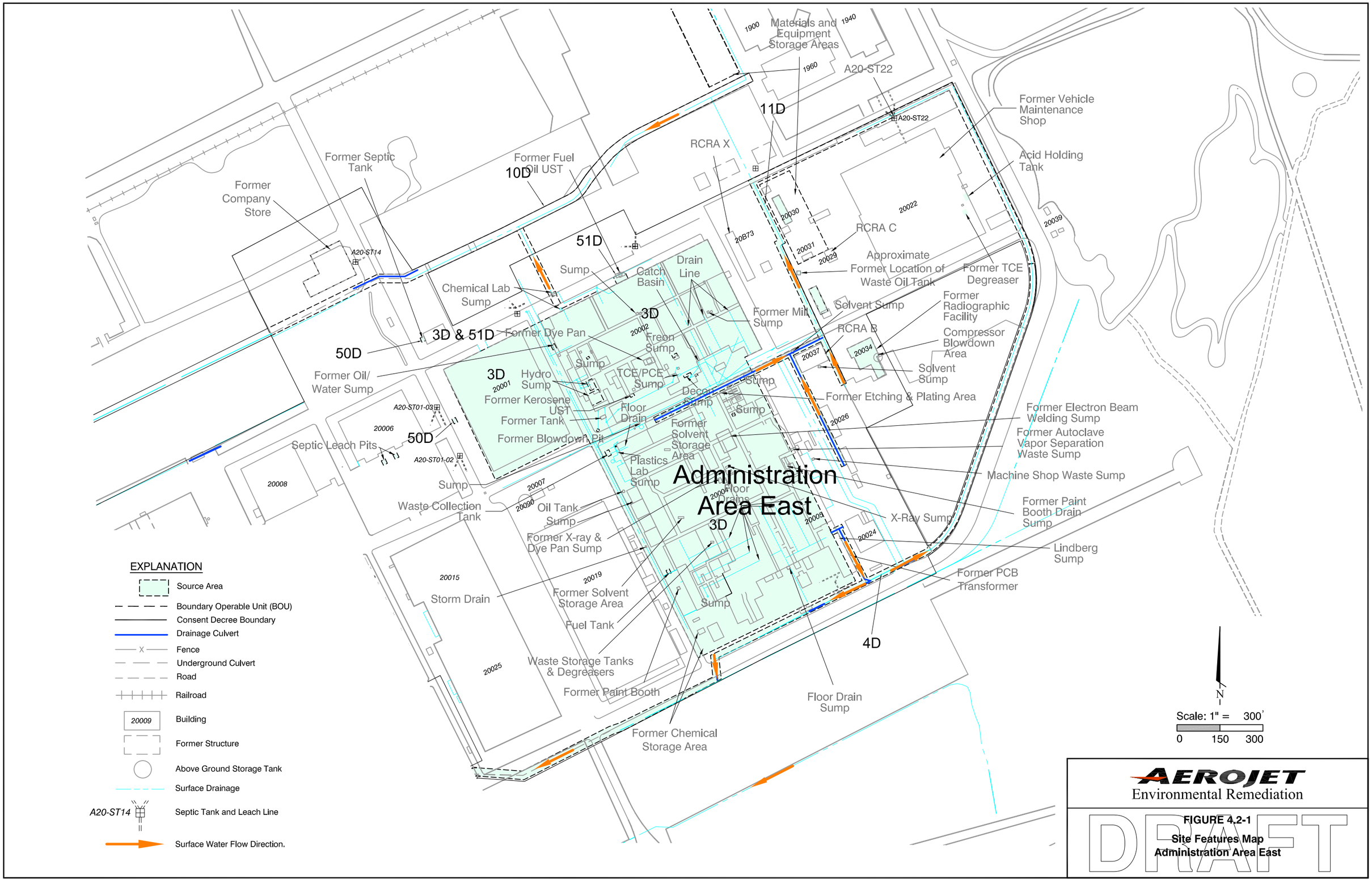
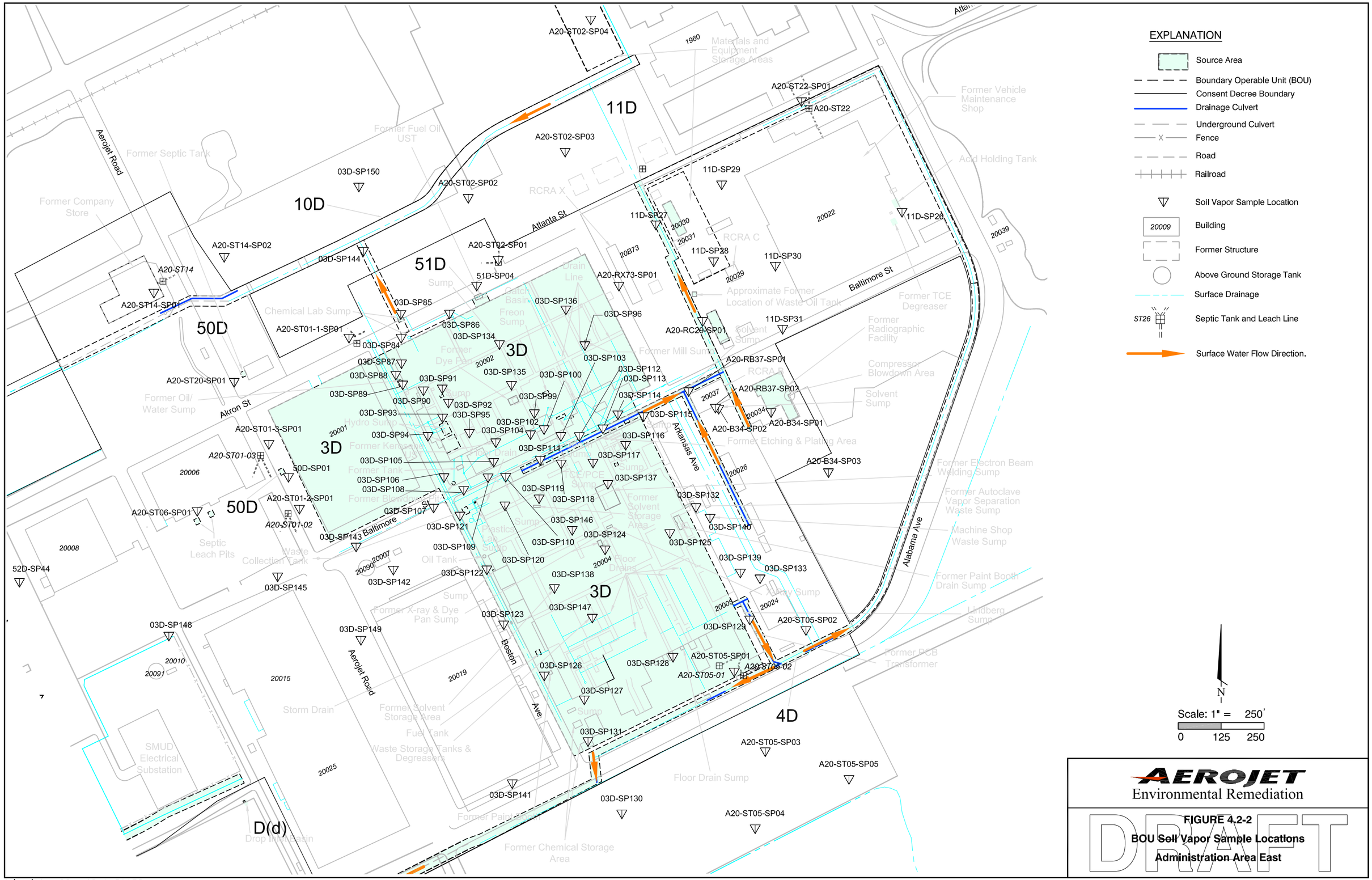


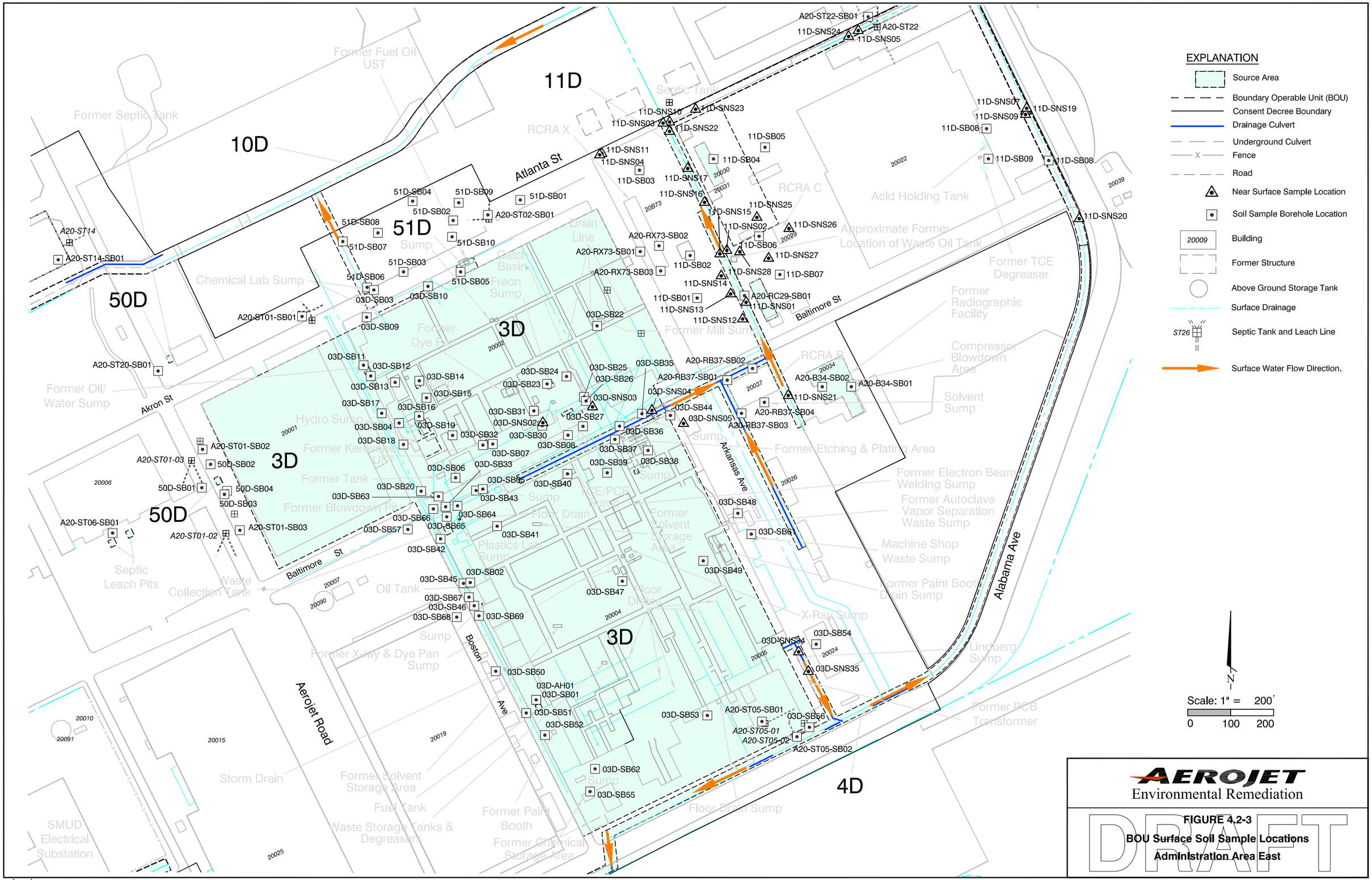
FIGURE 4.2-1

Site Features Map
Administration Area East

7\17\08 PR SR10130974



8/14/08 PR SR10130975

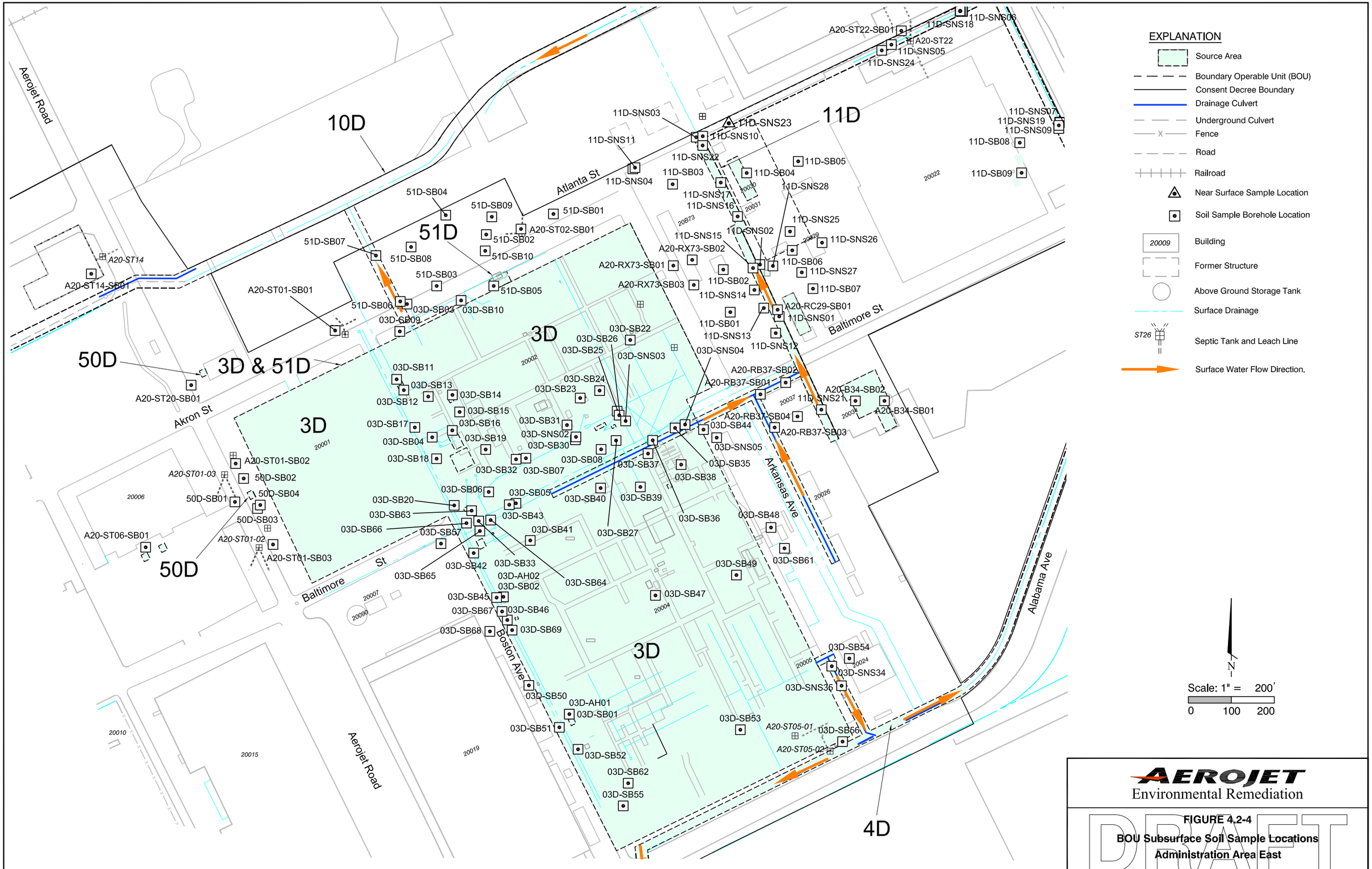


AEROJET
Environmental Remediation

DRAFT

FIGURE 4.2-3
BOU Surface Soil Sample Locations
Administration Area East

8/14/08 PR SR10130976

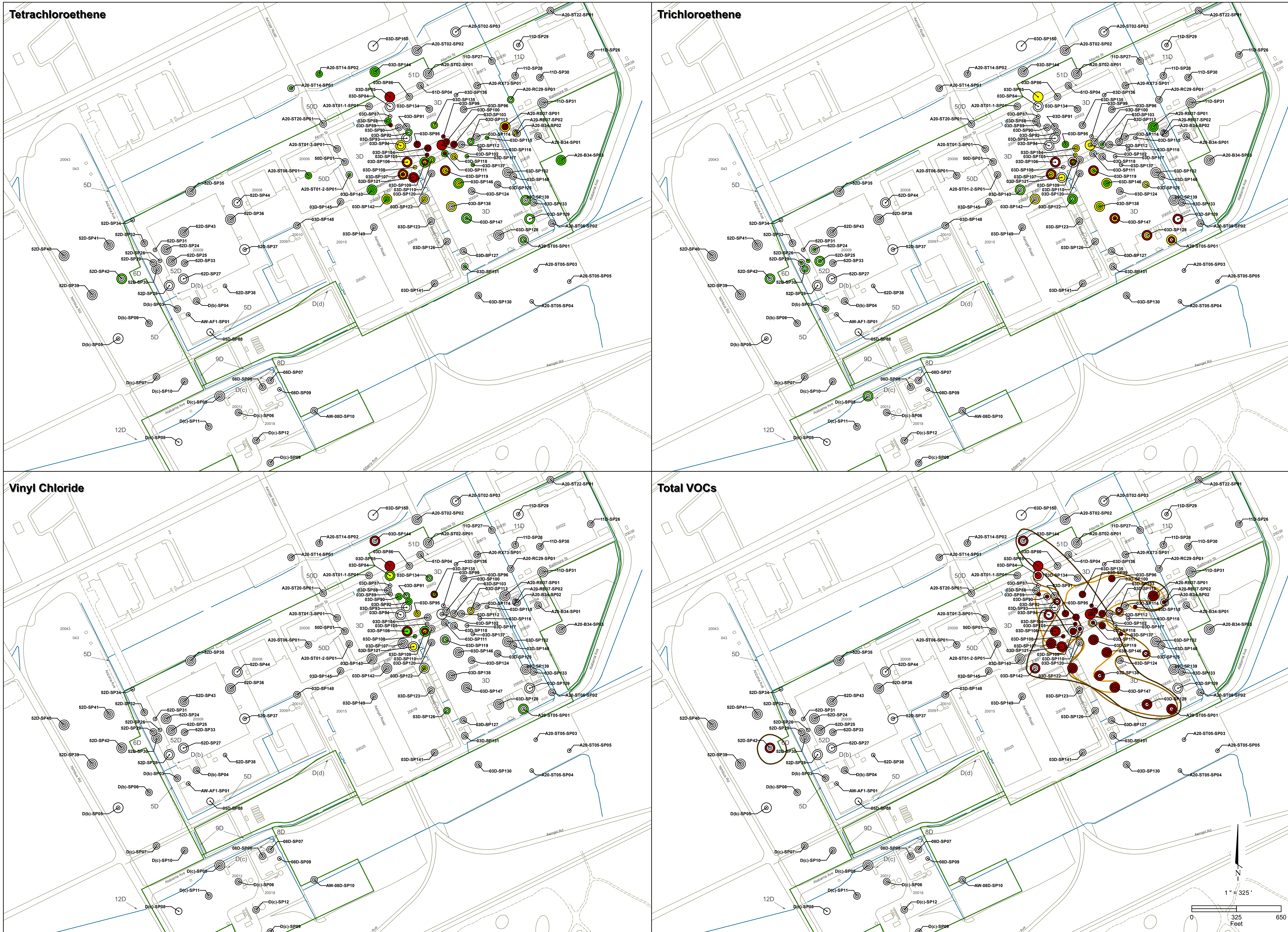


AEROJET
Environmental Remediation

DRAFT

FIGURE 4.2-4
BOU Subsurface Soil Sample Locations
Administration Area East

7/17/08 PR SR10130977



PCE, TCE, Vinyl Chloride Exceedances

- < Soil Vapor Screening Level (RISL)
- >= RISL and < 10x RISL
- >= 10x RISL and < 100x RISL
- >= 100x RISL

Total VOCs Exceedances

- Σ Detects to Screening Levels Ratios <= 10
- Σ Detects to Screening Levels Ratios > 10

<= 10 Feet bgs (Inner Circle)
11 to 20 Feet bgs (Middle Circle)
> 20 Feet bgs (Outer Circle)

Sample Location	<= 10 ft bgs			11-20 ft bgs			>20 ft bgs		
	Tetrachloroethene	Trichloroethene	Vinyl Chloride	Tetrachloroethene	Trichloroethene	Vinyl Chloride	Tetrachloroethene	Trichloroethene	Vinyl Chloride
Screening Level	320	961	31	320	961	31	320	961	31
Admin East									
03D-SP100	430,000	<SL	<SL	41,000	<SL	<SL	NC	NC	NC
03D-SP102	30,000,000	<SL	<SL	NC	NC	NC	5,900,000	12,000	<SL
03D-SP103	830,000	1,700	<SL	130,000	<SL	<SL	NC	NC	NC
03D-SP104	640,000	14,000	<SL	1,600,000	57,000	<SL	NC	NC	NC
03D-SP105	580,000	16,000	<SL	NC	NC	NC	NC	NC	NC
03D-SP106	NC	NC	NC	7,200	<SL	250	540,000	190,000	120,000
03D-SP107	98,000	86,000	<SL	13,000	12,000	<SL	340,000	260,000 J	<SL
03D-SP108	9,500	<SL	51	NC	NC	NC	NC	NC	NC
03D-SP109	18,000	2,300	550	530,000	110,000	26,000	2,400	NC	40
03D-SP110	11,000	<SL	<SL	2,900	<SL	<SL	NC	NC	NC
03D-SP111	56,000	<SL	<SL	1,300	<SL	<SL	NC	NC	NC
03D-SP112	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SP113	<SL	<SL	<SL	2,500	<SL	940	NC	NC	NC
03D-SP114	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SP115	660	<SL	<SL	NC	NC	NC	NC	NC	NC
03D-SP116	<SL	<SL	<SL	NC	NC	NC	NC	NC	NC
03D-SP117	1,000	<SL	<SL	NC	NC	NC	NC	NC	NC
03D-SP118	14,000	<SL	<SL	4,500	<SL	<SL	NC	NC	NC
03D-SP119	10,000	6,400	<SL	10,000	46,000	89	310,000	170,000	<SL
03D-SP120	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SP121	NC	NC	NC	320,000	10,000	2,500	89,000	<SL	<SL
03D-SP122	10,000 J	<SL	240	8,200	1,700	1,600	<SL	7,400	<SL
03D-SP123	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SP124	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SP125	<SL	<SL	<SL	<SL	15,000	<SL	NC	NC	NC
03D-SP126	<SL	<SL	<SL	<SL	<SL	60	NC	NC	NC
03D-SP127	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SP128	<SL	<SL	<SL	<SL	60,000	<SL	<SL	210,000	<SL
03D-SP129	NC	NC	NC	<SL	<SL	<SL	710	620,000	<SL
03D-SP130	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SP131	350	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SP132	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL
03D-SP133	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SP134	<SL	<SL	<SL	<SL	<SL	40 J	NC	NC	NC
03D-SP135	8,600	<SL	76	950	NC	22,000 J	NC	NC	NC
03D-SP136	<SL	<SL	<SL	NC	NC	NC	NC	NC	NC
03D-SP137	740	<SL	<SL	NC	NC	NC	NC	NC	NC
03D-SP138	<SL	3,400	<SL	<SL	16,000	<SL	15,000	9,700	<SL
03D-SP139	<SL	<SL	<SL	<SL	<SL	<SL	860	<SL	<SL
03D-SP140	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SP141	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SP142	790	<SL	<SL	510	<SL	<SL	4,100	37,000	<SL
03D-SP143	1,000	<SL	<SL	720	<SL	<SL	1,100	1,300	<SL
03D-SP144	1,100	<SL	<SL	1,600	<SL	<SL	1,500 J	<SL	14,000 J
03D-SP145	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SP146	6,400 J	4,100 J	<SL	4,800	5,800	<SL	2,300	18,000	<SL
03D-SP147	1,300	140,000	<SL	<SL	10,000	<SL	760	230,000	<SL
03D-SP148	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SP149	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SP150	NC	NC	NC	NC	NC	NC	<SL	<SL	<SL
03D-SP84	NC	NC	NC	<SL	<SL	420	<SL	<SL	48
03D-SP85	NC	NC	NC	NC	NC	NC	70,000	10,000	170,000
03D-SP86	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SP87	<SL	<SL	<SL	NC	NC	NC	NC	NC	NC
03D-SP88	580	<SL	<SL	590	<SL	<SL	NC	NC	NC
03D-SP89	33,000	<SL	<SL	NC	NC	NC	NC	NC	NC
03D-SP90	<SL	<SL	250	<SL	<SL	87	NC	NC	NC
03D-SP91	<SL	<SL	<SL	<SL	<SL	94	NC	NC	NC
03D-SP92	<SL	<SL	190	1,000	<SL	300	NC	NC	NC
03D-SP93	NC	NC	NC	<SL	<SL	<SL	<SL	<SL	<SL
03D-SP94	NC	NC	NC	7,100	<SL	<SL	3,300	<SL	<SL
03D-SP95	150,000	5,700	1,500	130,000	7,700	2,200	NC	NC	NC
03D-SP96	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SP99	280,000	<SL	<SL	NC	NC	NC	NC	NC	NC
11D-SP26	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
11D-SP27	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
11D-SP28	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
11D-SP29	<SL	<SL	<SL	NC	NC	NC	<SL	<SL	<SL
11D-SP30	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
11D-SP31	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL
50D-SP01	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
51D-SP04	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
A20-B34-SP01	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
A20-B34-SP02	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
A20-B34-SP03	870	<SL	<SL	860	<SL	<SL	1,000	<SL	<SL
A20-RB37-SP01	69,000	6,300	<SL	73,000	6,500	<SL	4,000	1,500	<SL
A20-RB37-SP02	7,100	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
A20-RC29-SP01	<SL	<SL	<SL	350	<SL	<SL	NC	NC	NC
A20-RX73-SP01	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
A20-ST01-1-SP01	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
A20-ST01-2-SP01	380	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
A20-ST01-3-SP01	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
A20-ST02-SP01	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL
A20-ST02-SP02	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL
A20-ST02-SP03	NC	NC	NC	<SL	<SL	<SL	<SL	<SL	<SL
A20-ST02-SP04	NC	NC	NC	NC	NC	NC	<SL	<SL	<SL
A20-ST05-SP01	<SL	<SL	<SL	470	700,000	<SL	<SL	34,000	160
A20-ST05-SP02	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
A20-ST05-SP03	<SL	<SL	<SL	NC	NC	NC	NC	NC	NC
A20-ST05-SP04	<SL	<SL	<SL	NC	NC	NC	NC	NC	NC
A20-ST05-SP05	<SL	<SL	<SL	NC	NC	NC	NC	NC	NC
A20-ST06-SP01	900	<SL	<SL	850	<SL	<SL	NC	NC	NC
A20-ST14-SP01	840	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
A20-ST14-SP02	760	<SL	<SL	1,100	<SL	<SL	NC	NC	NC
A20-ST20-SP01	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
A20-ST22-SP01	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
Admin West									
05D-SP08	NC	NC	NC	<SL	<SL	<SL	NC	NC	NC
08D-SP07	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
08D-SP08	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
08D-SP09	<SL	<SL	<SL	NC	NC	NC	NC	NC	NC
52D-SP24	<SL	1,800	<SL	<SL	<SL	<SL	<SL	<SL	<SL
52D-SP25	<SL	1,200	<SL	<SL	<SL	<SL	<SL	1,800	<SL
52D-SP26	<SL	1,100	<SL	NC	NC	NC	NC	NC	NC
52D-SP27	NC	NC	NC	<SL	<SL	<SL	<SL	<SL	<SL
52D-SP28	NC	NC	NC	<SL	<SL	<SL	<SL	<SL	<SL
52D-SP29	<SL	2,600	<SL	<SL	<SL	<SL	NC	NC	NC
52D-SP30	<SL	<SL	<SL	<SL	1,200	<SL	<SL	<SL	<SL
52D-SP31	<SL	<SL	<SL	NC	NC	NC	NC	NC	NC
52D-SP32	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
52D-SP33	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
52D-SP34	<SL	<SL	<SL	NC	NC	NC	NC	NC	NC
52D-SP35	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL
52D-SP36	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL
52D-SP37	<SL	<SL	<SL	NC	NC	NC	<SL	<SL	<SL
52D-SP38	<SL	<SL	<SL	NC	NC	NC	NC	NC	NC
52D-SP39	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL
52D-SP40	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL
52D-SP41	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL
52D-SP42	<SL	<SL	<SL	<SL	<SL	<SL	590	8,300	<SL
52D-SP43	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL
52D-SP44	NC	NC	NC	<SL	<SL	<SL	<SL	<SL	<SL
AW-08D-SP10	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
AW-AF1-SP01	<SL	<SL	<SL	NC	NC	NC	NC	NC	NC
D(b)-SP03	<SL	1,100	<SL	<SL	<SL	<SL	NC	NC	NC
D(b)-SP04	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
D(b)-SP05	<SL	<SL	<SL	NC	NC	NC	<SL	<SL	<SL
D(b)-SP06	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
D(c)-SP05	<SL	<SL	<SL	<SL	<SL	<SL	<SL	1,300	<SL
D(c)-SP06	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
D(c)-SP07	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
D(c)-SP08	NC	NC	NC	<SL	<SL	<SL	NC	NC	NC
D(c)-SP09	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
D(c)-SP10	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
D(c)-SP11	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
D(c)-SP12	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC

Units in $\mu g/m^3$.

<SL = either non-detect or detected concentration less than SL.

NC = Sample not collected.

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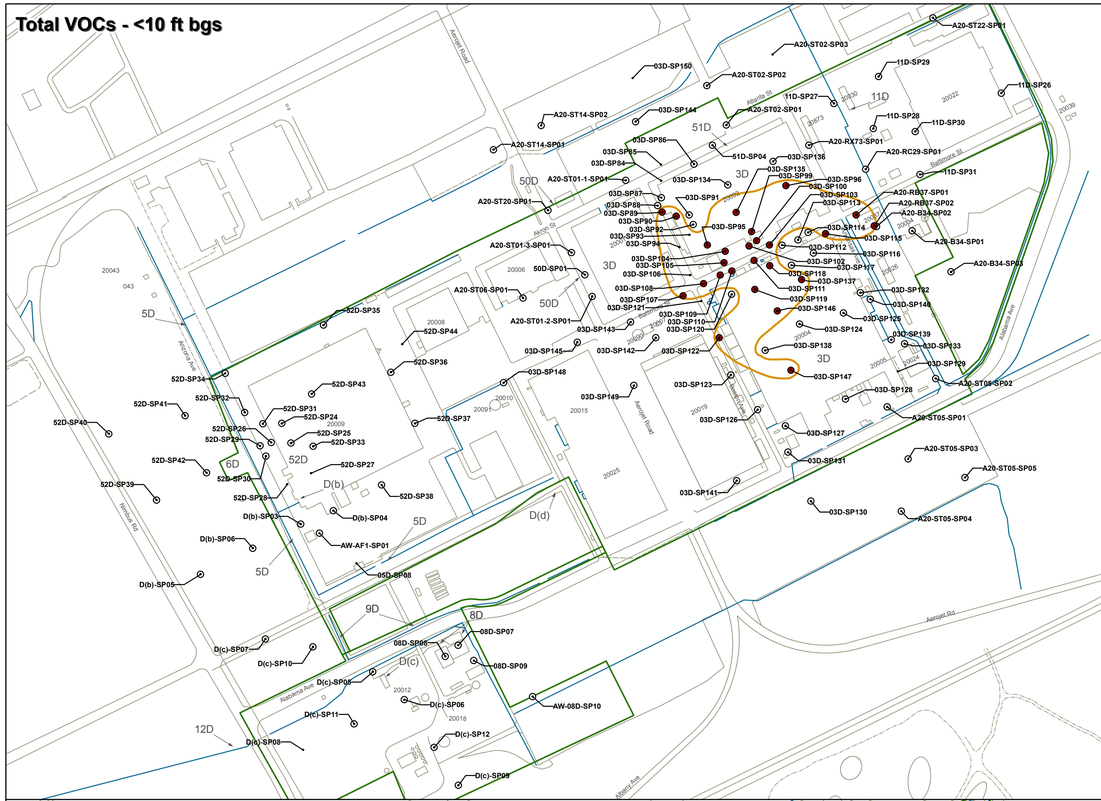
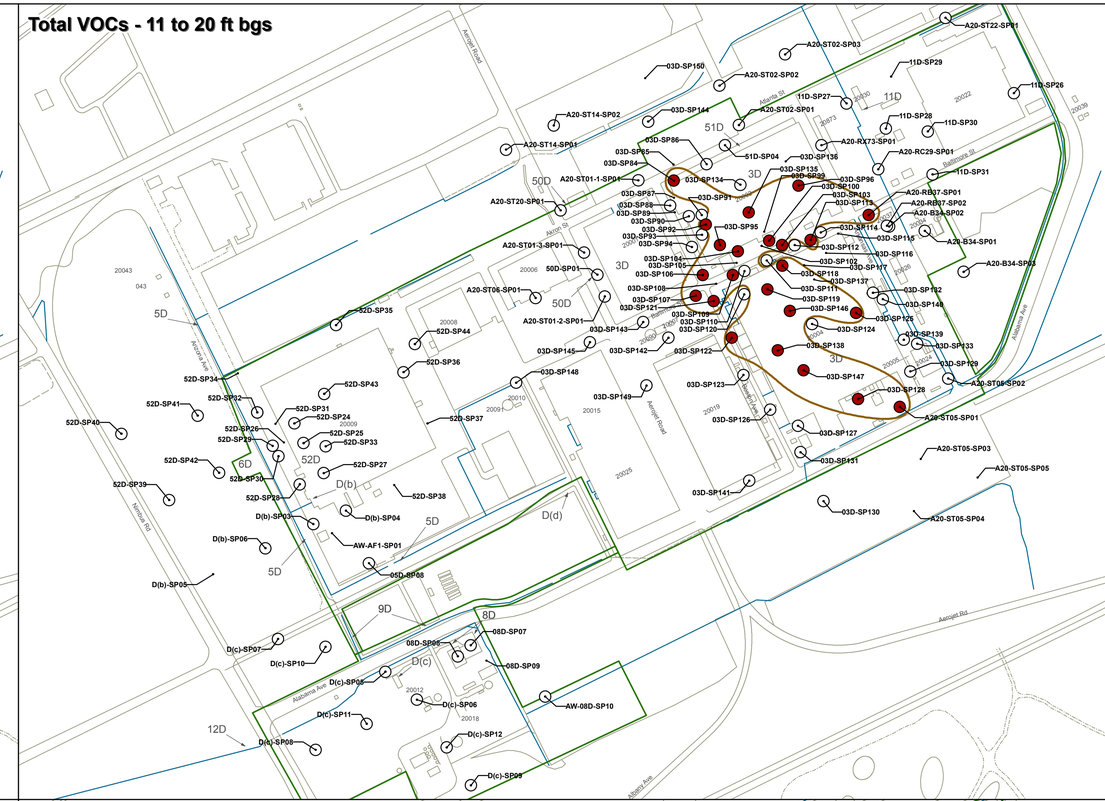
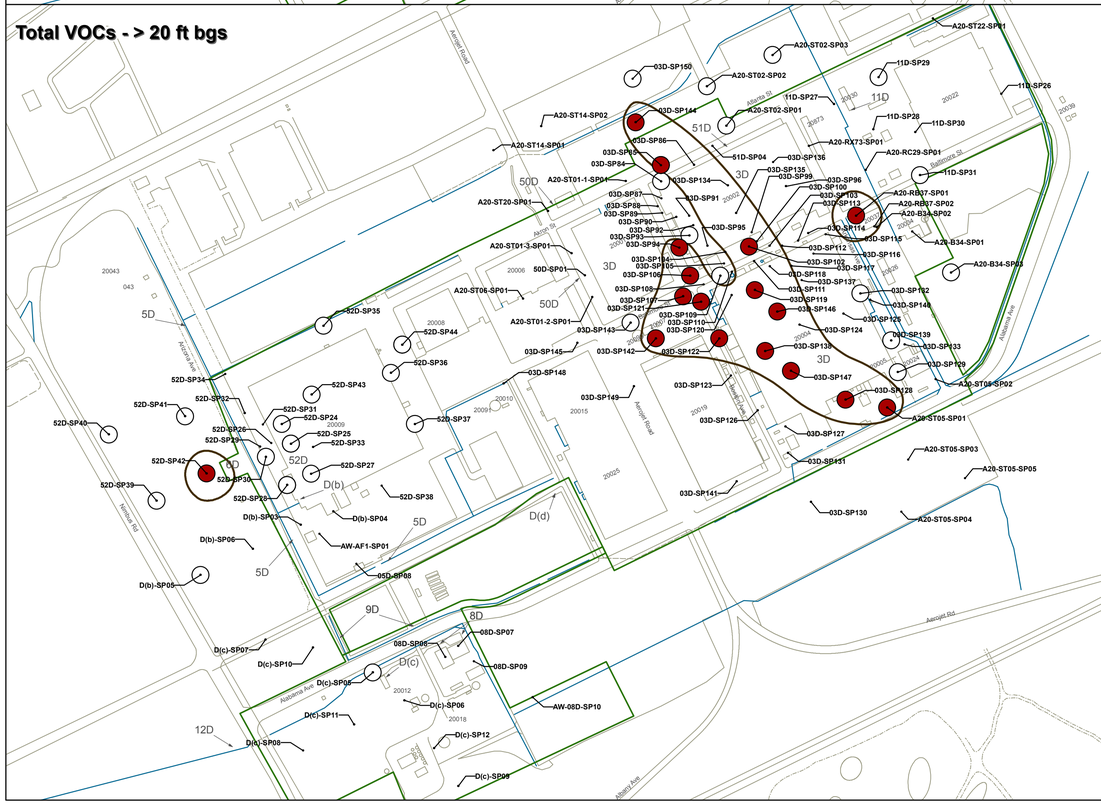
Environmental Remediation

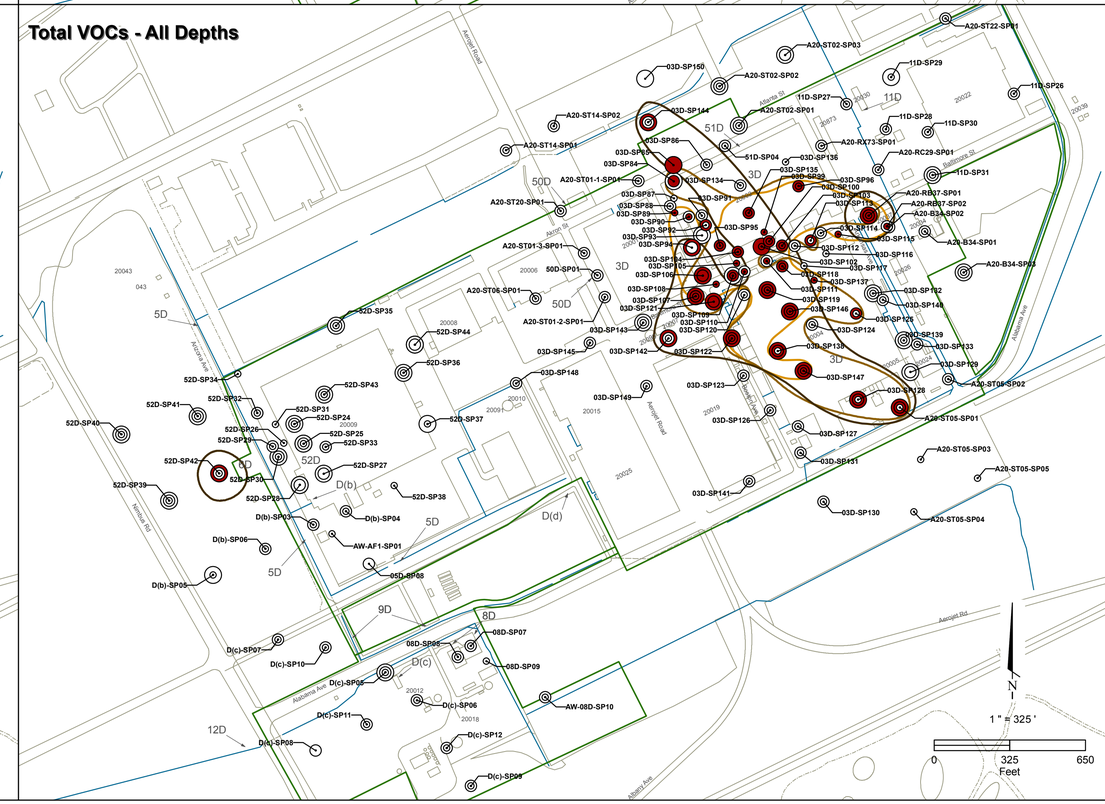
Figure 4.2-5a

PCE, TCE, Vinyl Chloride, and Total VOC Concentrations in Soil Vapor Above Remedial Investigation Screening Levels - Administration Area









Total VOCs Exceedances

- Σ Detects to Screening Levels Ratios <= 10
- Σ Detects to Screening Levels Ratios > 10

- <= 10 Feet bgs (Small Circle)
- 11 to 20 Feet bgs (Medium Circle)
- > 20 Feet bgs (Large Circle)

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Approximate Extent of Total Screening Level Ratio Exceeding 10 (< 10 ft bgs)
- Approximate Extent of Total Screening Level Ratio Exceeding 10 (11 to 20 ft bgs)
- Approximate Extent of Total Screening Level Ratio Exceeding 10 (> 20 ft bgs)

N

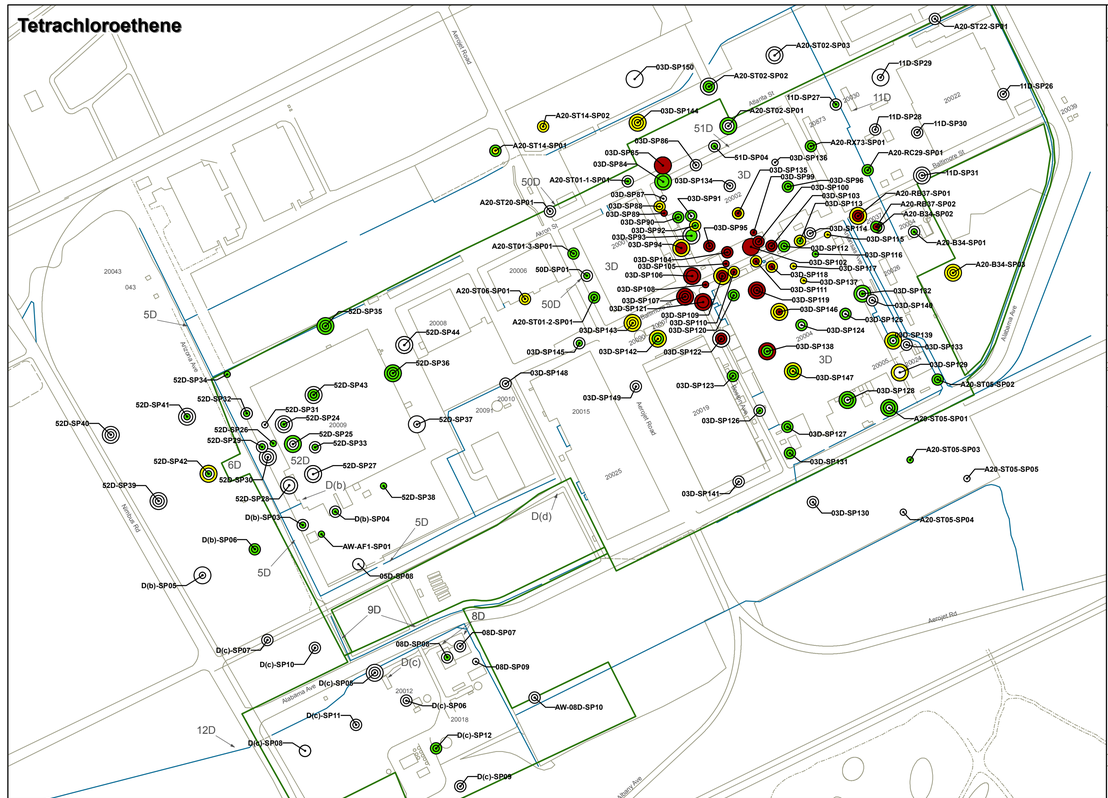
1 " = 325 '

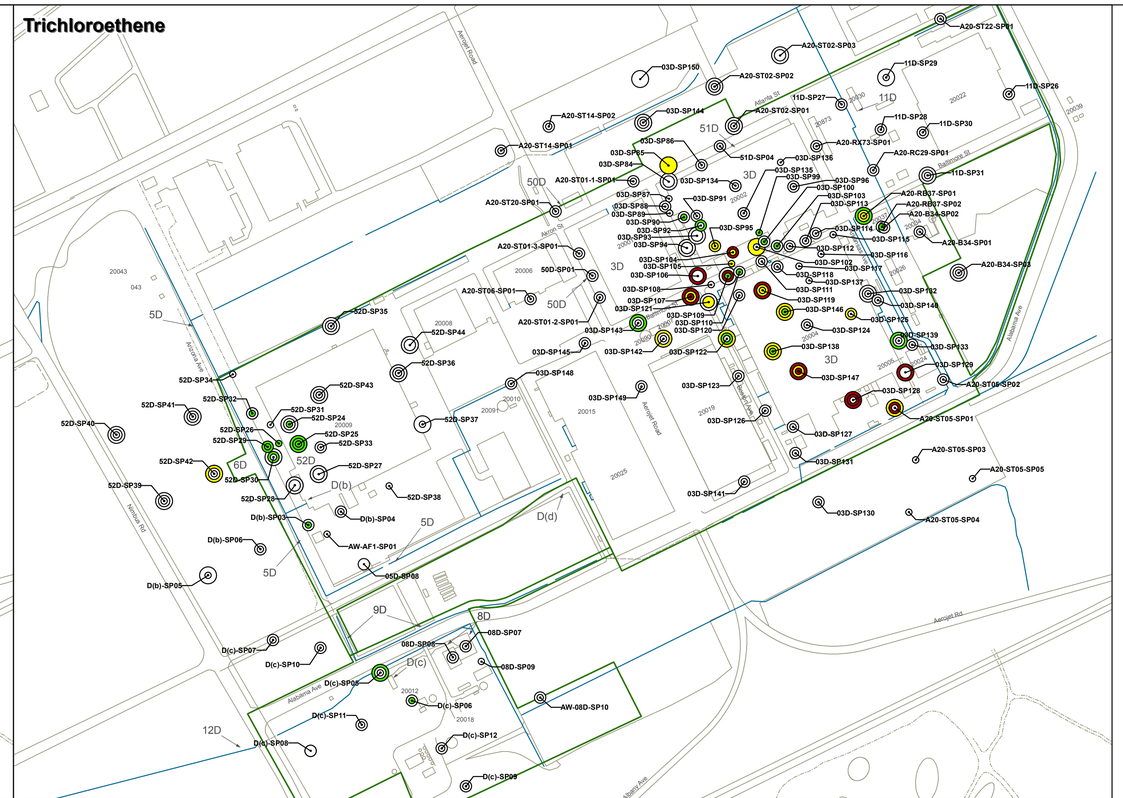
0 325 650
Feet

AEROJET
Environmental Remediation

Figure 4.2-5b

Total VOC Concentrations in Soil Vapor Above Remedial Investigation Screening Levels - Administration Area





PCE, TCE, Vinyl Chloride Exceedances

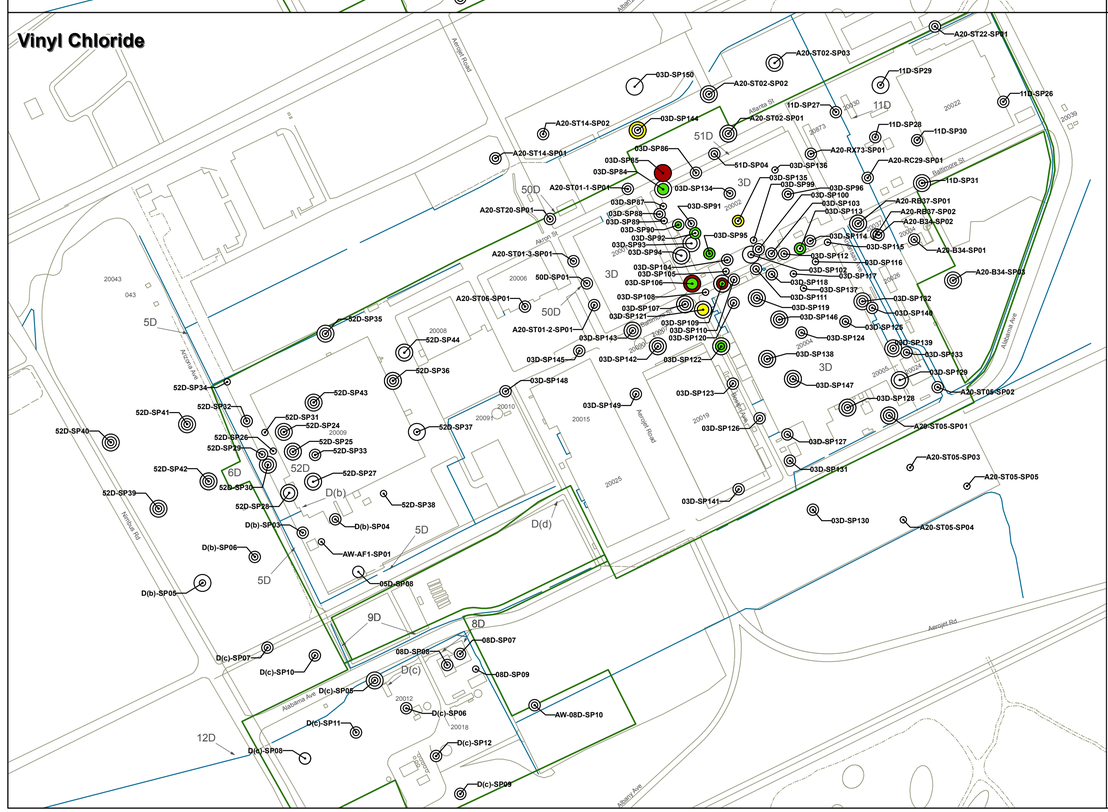
- < Soil Vapor Screening Level (PGW SVSL)
- >= PGW SVSL and < 10x PGW SVSL
- >= 10x PGW SVSL and < 100x PGW SVSL
- >= 100x PGW SVSL

Total VOCs Exceedances

- Σ Detects to Screening Levels Ratios <= 10
- Σ Detects to Screening Levels Ratios > 10

<= 10 Feet bgs (Inner Circle)
11 to 20 Feet bgs (Middle Circle)
> 20 Feet bgs (Outer Circle)

Source Area
Boundary Operable Unit (BOU)
Consent Decree Boundary



Sample Location	<= 10 ft bgs			11-20 ft bgs			>20 ft bgs		
	Tetrachloroethene	Trichloroethene	Vinyl Chloride	Tetrachloroethe	Trichloroethene	Vinyl Chloride	Tetrachloroethe	Trichloroethene	Vinyl Chloride
Screening Level	57	527	235	57	527	235	57	527	235
Admin East									
01D-SS784	NC	NC	NC	77	<SL	420	73	<SL	<SL
02D-SS785	NC	NC	NC	NC	NC	NC	70,000	10,000	170,000
03D-SS786	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SS787	<SL	<SL	<SL	NC	NC	NC	NC	NC	NC
03D-SS788	580	<SL	<SL	590	<SL	<SL	NC	NC	NC
03D-SS789	33,000	<SL	<SL	NC	NC	NC	NC	NC	NC
03D-SS90	270	560	250	270	<SL	<SL	NC	NC	NC
03D-SS91	<SL	<SL	<SL	190	<SL	<SL	NC	NC	NC
03D-SS92	140	<SL	<SL	1,000	660	300	NC	NC	NC
03D-SS93	NC	NC	NC	760	<SL	<SL	NC	NC	NC
03D-SS94	NC	NC	NC	7,100	<SL	<SL	3,300	<SL	<SL
03D-SS95	150,000	5,700	1,500	130,000	2,700	2,200	NC	NC	NC
03D-SS96	96	<SL	<SL	68	<SL	<SL	NC	NC	NC
03D-SS99	260,000	840	<SL	NC	NC	NC	NC	NC	NC
03D-SP100	430,000	580	<SL	41,000	<SL	<SL	NC	NC	NC
03D-SP102	30,000,000	<SL	<SL	NC	NC	NC	5,900,000	12,000	<SL
03D-SP103	830,000	1,700	<SL	130,000	<SL	<SL	NC	NC	NC
03D-SP104	640,000	14,000	<SL	1,600,000	57,000	<SL	NC	NC	NC
03D-SP105	580,000	16,000	<SL	NC	NC	NC	NC	NC	NC
03D-SP106	NC	NC	NC	7,200	<SL	250	540,000	190,000	120,000
03D-SP107	98,000	86,000	<SL	13,000	12,000	<SL	540,000	260,000	<SL
03D-SP108	9,500	<SL	<SL	NC	NC	NC	NC	NC	NC
03D-SP109	16,000	2,300	350	530,000	110,000	26,000	2,400	<SL	<SL
03D-SP110	11,000	950	<SL	2,900	<SL	<SL	NC	NC	NC
03D-SP111	56,000	<SL	<SL	1,300	<SL	<SL	NC	NC	NC
03D-SP113	240	<SL	<SL	190	<SL	<SL	NC	NC	NC
03D-SP114	270	<SL	<SL	2,500	<SL	940	NC	NC	NC
03D-SP115	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SP116	650	<SL	<SL	NC	NC	NC	NC	NC	NC
03D-SP117	150	<SL	<SL	NC	NC	NC	NC	NC	NC
03D-SP118	1,000	<SL	<SL	NC	NC	NC	NC	NC	NC
03D-SP119	14,000	<SL	<SL	8,500	<SL	<SL	NC	NC	NC
03D-SP120	10,000	6,400	<SL	10,000	86,000	<SL	310,000	170,000	<SL
03D-SP120	180	<SL	<SL	160	<SL	<SL	NC	NC	NC
03D-SP121	NC	NC	NC	320,000	10,000	2,500	89,000	<SL	<SL
03D-SP122	10,000	<SL	240	8,200	1,700	1,600	<SL	7,400	<SL
03D-SP123	180	<SL	<SL	190	<SL	<SL	NC	NC	NC
03D-SP124	<SL	<SL	<SL	58	<SL	<SL	NC	NC	NC
03D-SP125	<SL	<SL	<SL	150	15,000	<SL	NC	NC	NC
03D-SP126	59	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SP127	190	<SL	<SL	170	<SL	<SL	NC	NC	NC
03D-SP128	<SL	<SL	<SL	99	60,000	<SL	170	210,000	<SL
03D-SP129	NC	NC	NC	<SL	<SL	<SL	710	620,000	<SL
03D-SP130	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SP131	350	<SL	<SL	160	<SL	<SL	NC	NC	NC
03D-SP133	170	<SL	<SL	<SL	<SL	<SL	160	<SL	<SL
03D-SP133	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SP134	<SL	<SL	<SL	NC	NC	NC	NC	NC	NC
03D-SP135	8,600	<SL	<SL	950	<SL	22,000	NC	NC	NC
03D-SP136	<SL	<SL	<SL	NC	NC	NC	NC	NC	NC
03D-SP137	740	<SL	<SL	NC	NC	NC	NC	NC	NC
03D-SP138	60	3,400	<SL	140	16,000	<SL	15,000	9,700	<SL
03D-SP139	<SL	<SL	<SL	80	<SL	<SL	860	660	<SL
03D-SP140	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SP141	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SP142	790	<SL	<SL	510	<SL	<SL	4,100	37,000	<SL
03D-SP143	1,000	<SL	<SL	770	<SL	<SL	1,100	1,300	<SL
03D-SP144	1,000	<SL	<SL	1,600	<SL	<SL	1,300	<SL	14,000
03D-SP145	46	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SP146	6,400	4,100	<SL	4,800	5,800	<SL	2,300	18,000	<SL
03D-SP147	1,300	140,000	<SL	120	10,000	<SL	760	230,000	<SL
03D-SP148	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SP149	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SP150	NC	NC	NC	NC	NC	NC	<SL	<SL	<SL
11D-SP26	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
11D-SP27	130	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
11D-SP28	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
11D-SP29	<SL	<SL	<SL	NC	NC	NC	<SL	<SL	<SL
11D-SP30	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
11D-SP31	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
51D-SS01	140	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
51D-SS04	110	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
A20-B34-SP01	63	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
A20-B34-SP02	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
A20-B34-SP03	870	<SL	<SL	860	<SL	<SL	1,000	<SL	<SL
A20-R037-SP01	69,000	6,500	<SL	73,000	6,500	<SL	4,000	1,300	<SL
A20-R037-SP02	7,100	930	<SL	160	<SL	<SL	NC	NC	NC
A20-RC29-SP01	270	<SL	<SL	350	<SL	<SL	NC	NC	NC
A20-RX73-SP01	100	<SL	<SL	170	<SL	<SL	NC	NC	NC
A20-ST01-1-SP01	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
A20-ST01-2-SP01	380	<SL	<SL	95	<SL	<SL	NC	NC	NC
A20-ST01-3-SP01	64	<SL	<SL	71	<SL	<SL	NC	NC	NC
A20-ST02-SP01	200	<SL	<SL	<SL	<SL	<SL	62	<SL	<SL
A20-ST02-SP02	76	<SL	<SL	75	<SL	<SL	<SL	<SL	<SL
A20-ST02-SP03	NC	NC	NC	<SL	<SL	<SL	<SL	<SL	<SL
A20-ST02-SP04	NC	NC	NC	NC	NC	NC	<SL	<SL	<SL
A20-ST05-SP01	<SL	<SL	<SL	470	700,000	<SL	190	34,000	<SL
A20-ST05-SP02	<SL	<SL	<SL	170	<SL	<SL	NC	NC	NC
A20-ST05-SP03	320	<SL	<SL	NC	NC	NC	NC	NC	NC
A20-ST05-SP04	<SL	<SL	<SL	NC	NC	NC	NC	NC	NC
A20-ST05-SP05	95	<SL	<SL	NC	NC	NC	NC	NC	NC
A20-ST06-SP01	980	<SL	<SL	850	<SL	<SL	NC	NC	NC
A20-ST14-SP01	840	<SL	<SL	150	<SL	<SL	NC	NC	NC
A20-ST14-SP02	760	<SL	<SL	1,100	<SL	<SL	NC	NC	NC
A20-ST20-SP01	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
A20-ST22-SP01	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC

Sample Location	<= 10 ft bgs			11-20 ft bgs			>20 ft bgs		
	Tetrachloroethene	Trichloroethene	Vinyl Chloride	Tetrachloroethe	Trichloroethene	Vinyl Chloride	Tetrachloroethe	Trichloroethene	Vinyl Chloride
Screening Level	57	527	235	57	527	235	57	527	235
Admin West									
01D-SS198	NC	NC	NC	<SL	<SL	<SL	NC	NC	NC
01D-SS02	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
02D-SS199	71	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SS200	<SL	<SL	<SL	NC	NC	NC	NC	NC	NC
03D-SP24	130	1,800	<SL	<SL	<SL	<SL	<SL	<SL	<SL
03D-SP25	<SL	1,200	<SL	<SL	960	<SL	98	1,800	<SL
03D-SP26	79	1,100	<SL	NC	NC	NC	NC	NC	NC
03D-SP27	NC	NC	NC	<SL	<SL	<SL	<SL	<SL	<SL
03D-SP28	NC	NC	NC	<SL	<SL	<SL	<SL	<SL	<SL
03D-SP29	65	2,600	<SL	<SL	620	<SL	NC	NC	NC
03D-SP30	<SL	<SL	<SL	<SL	1,200	<SL	<SL	<SL	<SL
03D-SP31	<SL	<SL	<SL	NC	NC	NC	NC	NC	NC
03D-SP32	98	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SP33	62	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
03D-SP34	<SL	<SL	<SL	NC	NC	NC	NC	NC	NC
03D-SP35	97	<SL	<SL	110	<SL	<SL	220	<SL	<SL
03D-SP36	76	<SL	<SL	99	<SL	<SL	60	<SL	<SL
03D-SP37	<SL	<SL	<SL	NC	NC	NC	<SL	<SL	<SL
03D-SP38	61	<SL	<SL	NC	NC	NC	NC	NC	NC
03D-SP39	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL
03D-SP40	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL
03D-SP41	87	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL
03D-SP42	68	<SL	<SL	<SL	<SL	<SL	590	8,300	<SL
03D-SP43	120	<SL	<SL	99	<SL	<SL	<SL	<SL	<SL
03D-SP44	NC	NC	NC	<SL	<SL	<SL	NC	NC	NC
AW-08D-SP10	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
AW-AF1-SP01	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
D(b)-SP03	130	1,100	<SL	<SL	<SL	<SL	NC	NC	NC
D(b)-SP04	120	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
D(b)-SP05	<SL	<SL	<SL	NC	NC	NC	<SL	<SL	<SL
D(b)-SP06	68	<SL	<SL	200	<SL	<SL	NC	NC	NC
D(c)-SP05	<SL	<SL	<SL	<SL	<SL	<SL	<SL	1,300	<SL
D(c)-SP06	<SL	690	<SL	<SL	<SL	<SL	NC	NC	NC
D(c)-SP07	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
D(c)-SP08	NC	NC	NC	<SL	<SL	<SL	NC	NC	NC
D(c)-SP09	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
D(c)-SP10	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
D(c)-SP11	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
D(c)-SP12	69	<SL	<SL	100	<SL	<SL	NC	NC	NC

Units in ug/m³.
<SL = either non-detect or detected concentration less than SL.
NC = Sample not collected.

N

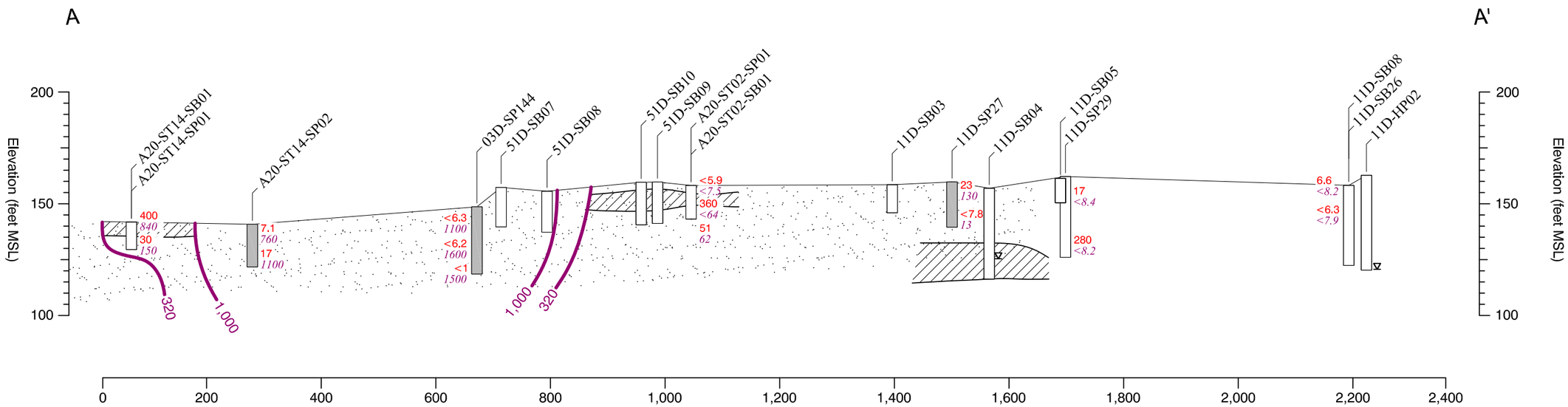
1 " = 325 '

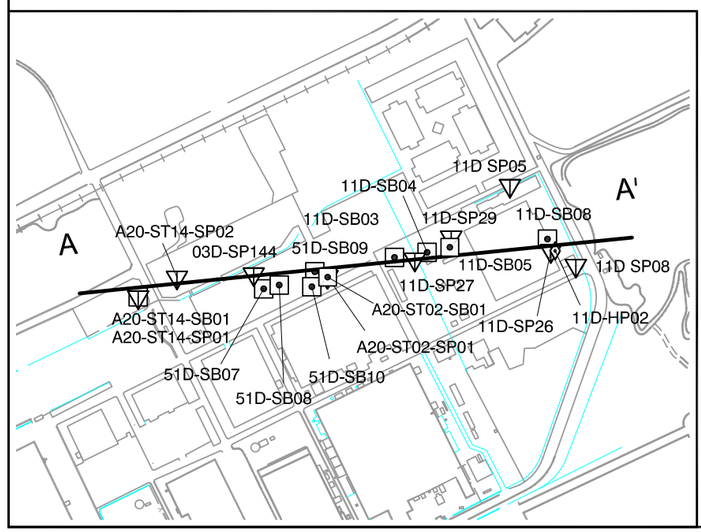
0 325 650
Feet

AEROJET
Environmental Remediation

Figure 4.2-6

PCE, TCE, and Vinyl Chloride Concentrations Above Protection of Groundwater Screening Levels for Soil Vapor - Administration Area





EXPLANATION

52D-SP39 — Boring Designation

Boring Location (Shaded Borings Lack Lithology)

23 — TCE Concentration ($\mu g/m^3$)

120 — PCE Concentration ($\mu g/m^3$)

(ND = Not Detected)

Total Borehole Depth

Initial Depth to Water

Final Depth to Water

320 — PCE Concentration in Micrograms per Cubic Meter ($\mu g/m^3$)

Note: TCE does not exceed screening levels at sample points in vicinity of transect.

PCE	Tetrachloroethene
TCE	Trichloroethene
MSL	Mean Sea Level

Geologic Contact

Relatively permeable sediments: Silty, poorly and well-graded sands and gravels (GP,GW,SP,SW); silty and clayey gravels (GM/GC) and silts.

Relatively lower permeability sediments: Low plasticity clays and silts (CL,ML); silty and clayey sand (SM/SC).

Dredge Tailings

Vertical Scale 1' = 50'

50

0

200

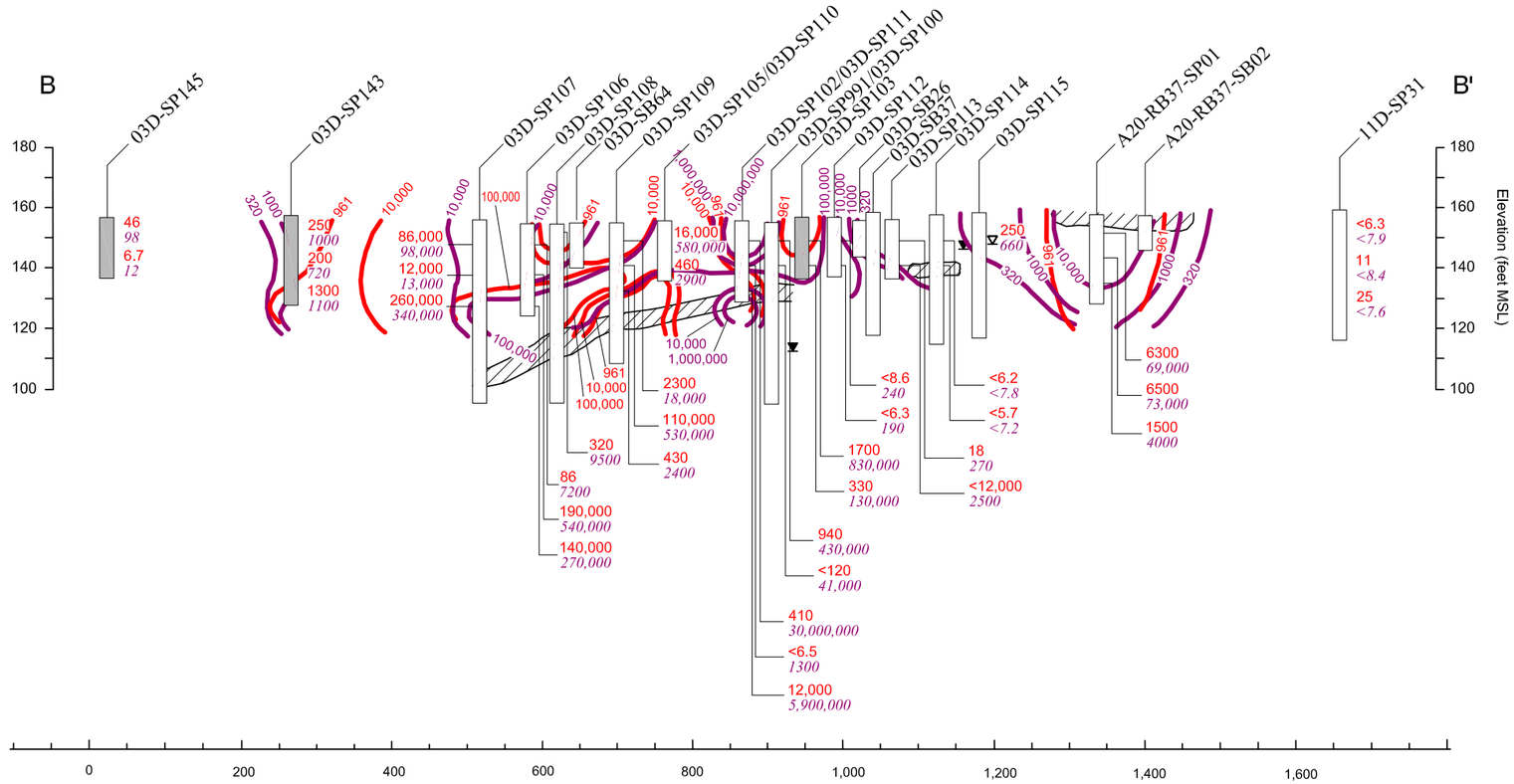
Horizontal Scale 1' = 200'

Vertical Exaggeration: 4X

AEROJET
Environmental Remediation

FIGURE 4.2-7
Vadose Zone Cross-Section A-A'
Administration Area East
Boundary Operable Unit

SR10130978 FIG 4.2-7 FIGURE 4.2-7 5/27/10 Carmelita Tallada



EXPLANATION

52D-SP39 — Boring Designation

Boring Location (Shaded Borings Lack Lithology)

23 — TCE Concentration (µg/m³)

120 — PCE Concentration (µg/m³)

(ND = Not Detected)

Total Borehole Depth

Initial Depth to Water

Final Depth to Water

961 — TCE Concentration in Micrograms per Cubic Meter (µg/m³)

320 — PCE Concentration in Micrograms per Cubic Meter (µg/m³)

PCE Tetrachloroethene

TCE Trichloroethene

MSL Mean Sea Level

Geologic Contact

Relatively permeable sediments: Silty, poorly and well-graded sands and gravels (GP,GW,SP,SW); silty and clayey gravels (GM/GC) and silts.

Relatively lower permeability sediments: Low plasticity clays and silts (CL,ML); silty and clayey sand (SM/SC).

Vertical Scale 1" = 50'

Horizontal Scale 1" = 200'

Vertical Exaggeration: 4X

AEROJET Environmental Remediation

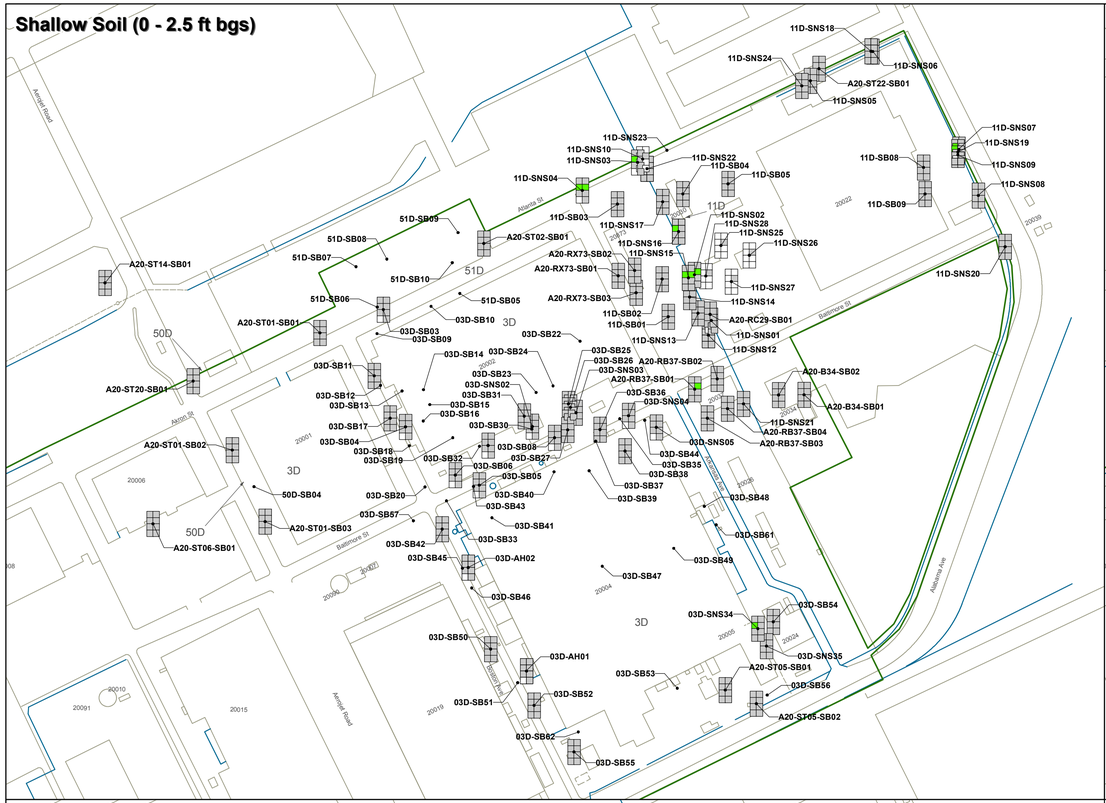
FIGURE 4.2-8

Vadose Zone Cross Section B - B"
Administration Area East

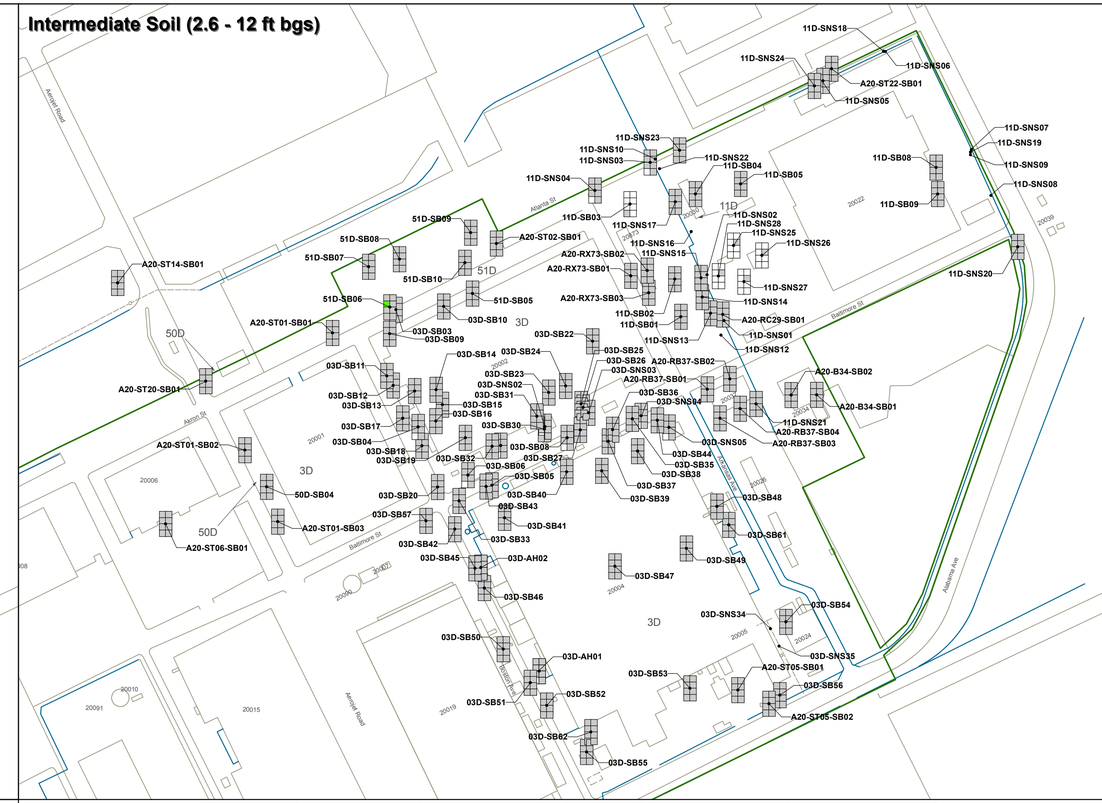
DRAFT

7/17/08 PR SR10130979

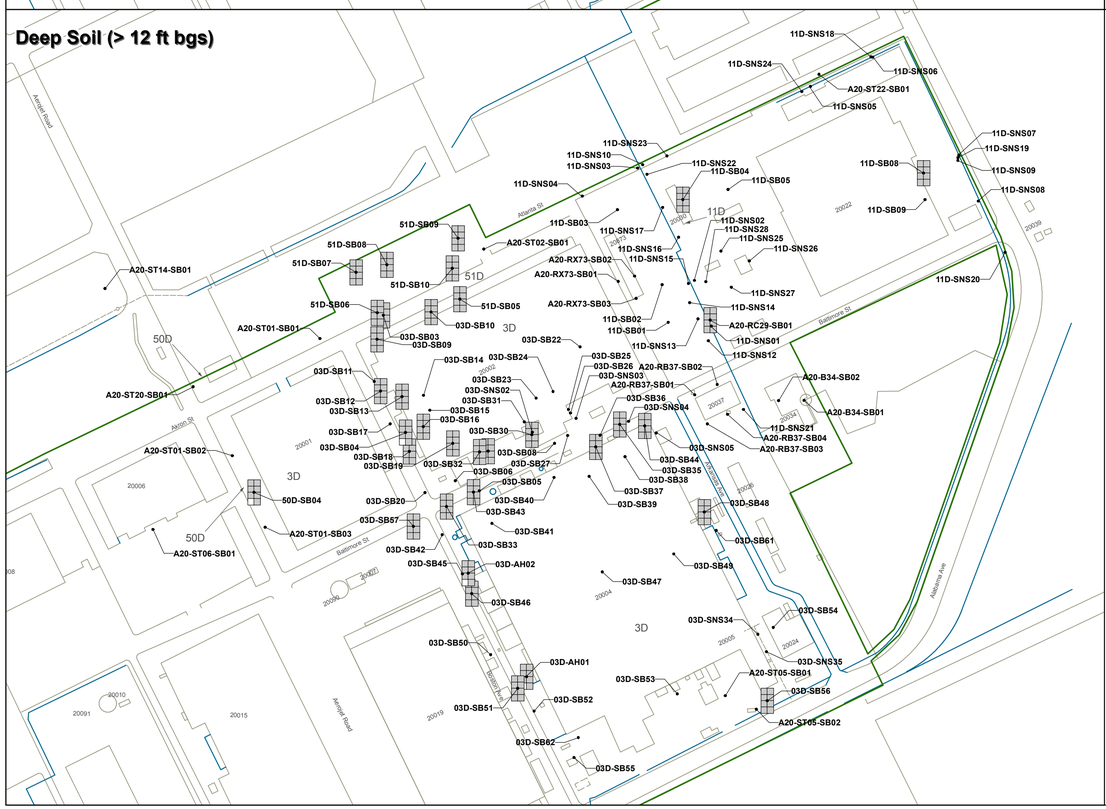
Shallow Soil (0 - 2.5 ft bgs)



Intermediate Soil (2.6 - 12 ft bgs)



Deep Soil (> 12 ft bgs)



Sample Location	Sample Depth	Antimony	Cadmium	Chromium	Chromium VI	Copper	Lead	Silver	Zinc
Screening Level		30	1.7	211	17	3000	150	380	23000
0 - 2.5 feet bgs									
03D-SNS34	0	<SL	**3.5**	<SL	<SL	<SL	<SL	<SL	<SL
11D-SNS02	0	<SL	**5.89**	<SL	NC	<SL	**379**	<SL	<SL
11D-SNS03	0	<SL	**2.47**	<SL	NC	<SL	<SL	<SL	<SL
11D-SNS04	0	<SL	**3.89**	<SL	NC	<SL	**288**	<SL	<SL
11D-SNS07	0	<SL	**3.39**	<SL	NC	<SL	<SL	<SL	<SL
11D-SNS09	2	<SL	**2**	<SL	<SL	<SL	<SL	<SL	<SL
11D-SNS15	1	<SL	**2.7**	<SL	<SL	<SL	**150**	<SL	<SL
11D-SNS16	1	<SL	**2**	<SL	<SL	<SL	<SL	<SL	<SL
11D-SNS16	2.5	<SL	**2.4**	<SL	<SL	<SL	<SL	<SL	<SL
11D-SNS19	1	<SL	**1.8**	<SL	<SL	<SL	<SL	<SL	<SL
11D-SNS22	1	<SL	**3.7**	<SL	<SL	<SL	<SL	<SL	<SL
A20-RB37-SB01	1	<SL	<SL	<SL	<SL	<SL	**210**	<SL	<SL
2.6 - 12 feet bgs									
03D-AH02	3	<SL	<SL	**268**	NC	<SL	<SL	<SL	<SL
03D-SB03	10	<SL	**3.12**	<SL	NC	<SL	<SL	<SL	<SL
51D-SB06	9	<SL	**2.2**	<SL	<SL	<SL	<SL	<SL	<SL
> 12 feet bgs									
03D-SB03	35	<SL	**30.4**	<SL	NC	<SL	<SL	<SL	<SL

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not analyzed for.
Units in mg/kg.

- Not Analyzed
- < Soil Screening Level (RISL)
- >= RISL and < 10x RISL
- >= 10x RISL and < 100x RISL
- >= 100x RISL

Antimony, Cadmium, Chromium, Chromium VI, Copper, Lead, Silver, Zinc

- Source Area
- Boundary Operable Unit (BOU)

N

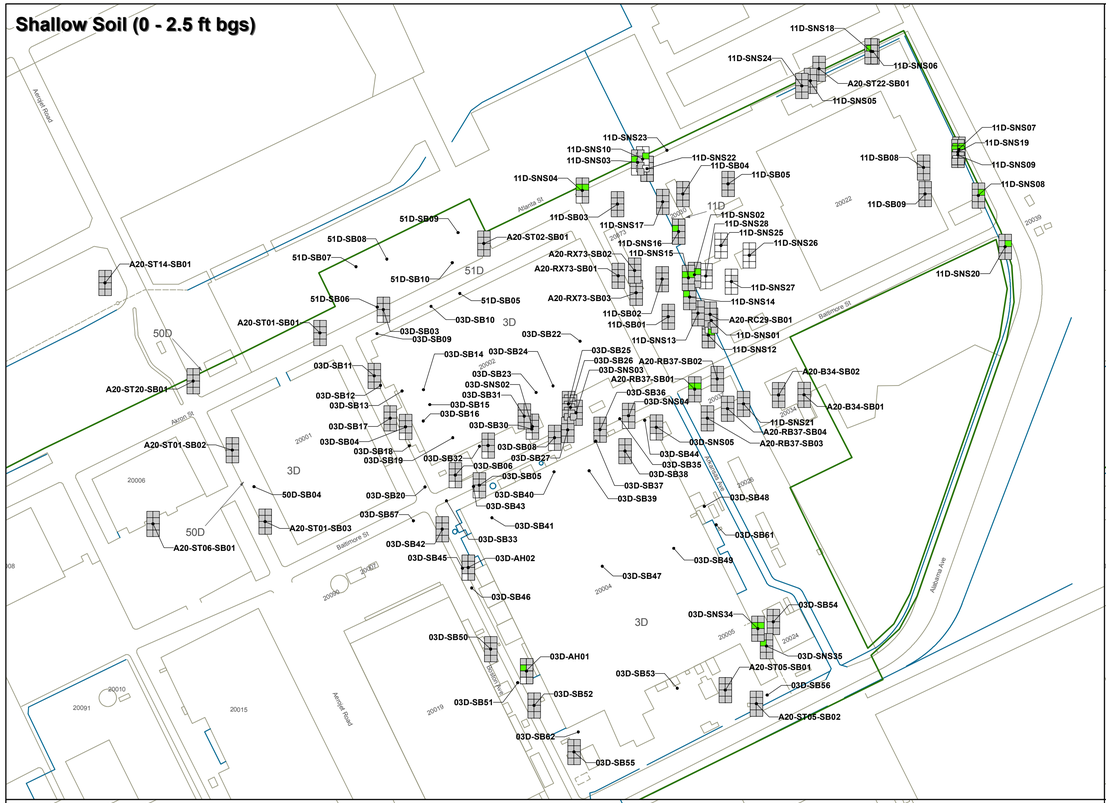
1 " = 200 '

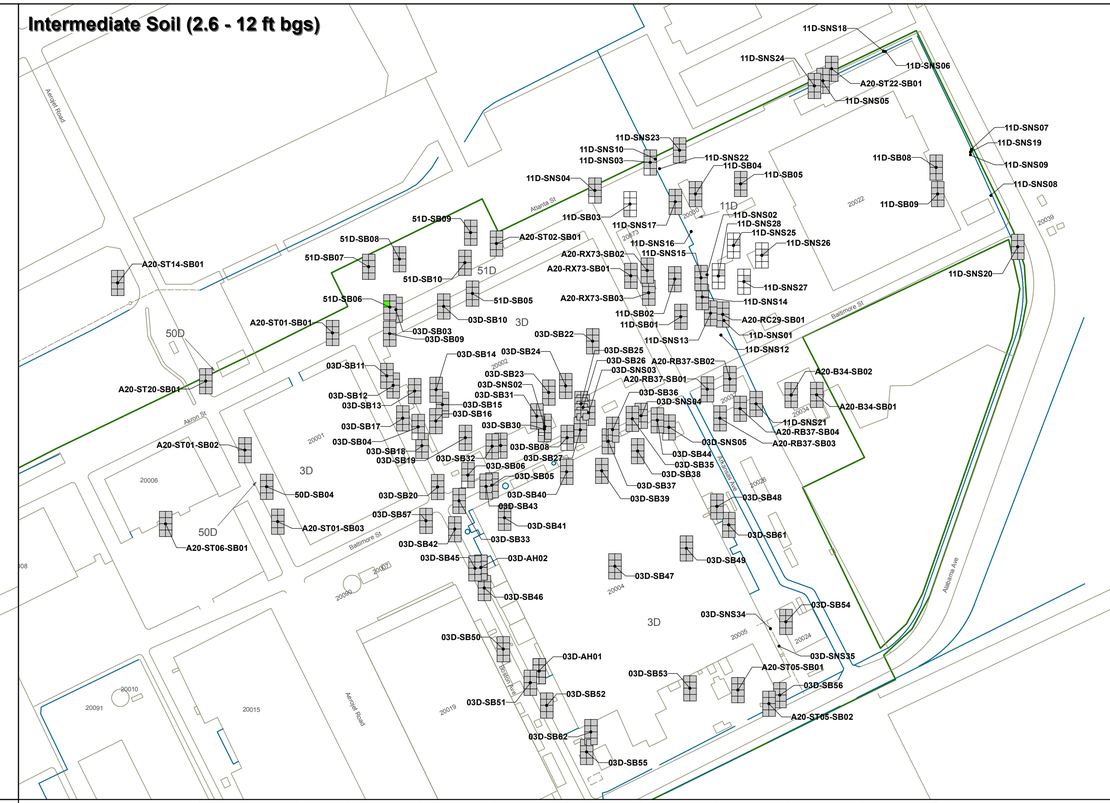
0 200 400
Feet

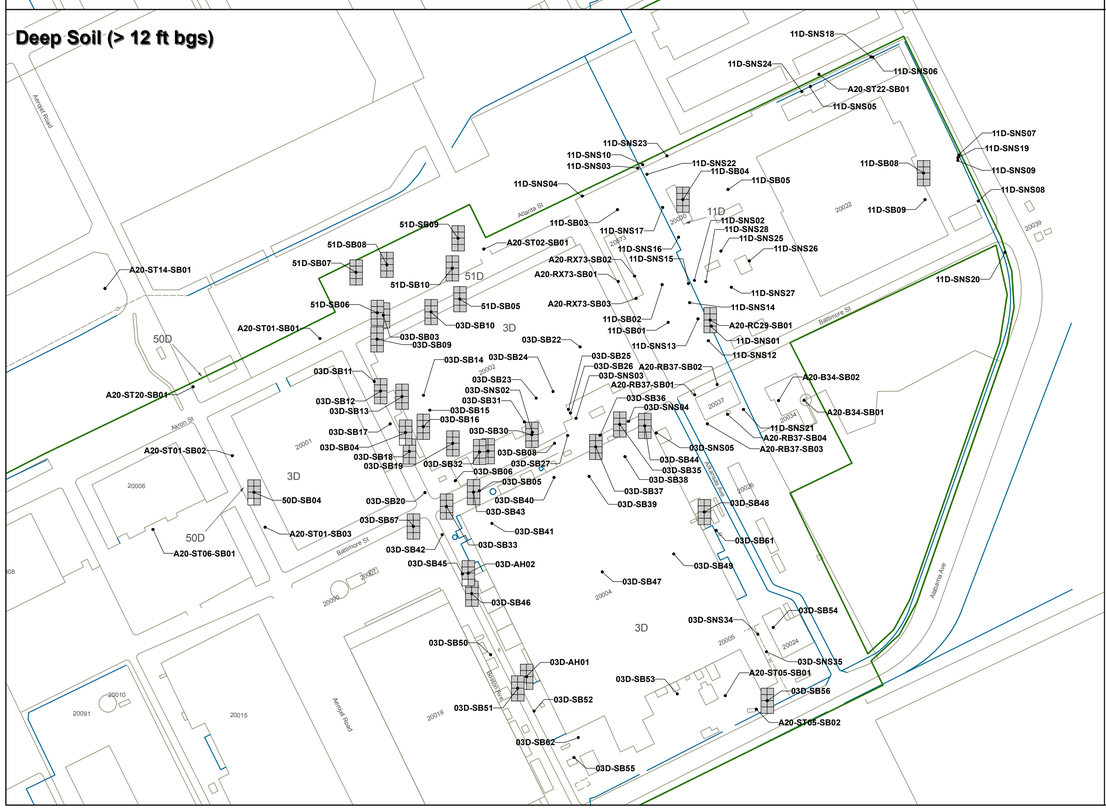
AEROJET
Environmental Remediation

Figure 4.2-9

Metals in Soil Above
Remedial Investigation Screening Levels
Administration Area East







Sample Location	Sample Depth	Antimony	Cadmium	Chromium	Chromium VI	Copper	Lead	Silver	Zinc
Screening Level		60	1.2	500	21	3000	42	1000	50000
0 - 2.5 feet bgs									
03D-SB01	1	<SL	**1.29**	<SL	NC	<SL	<SL	<SL	<SL
03D-SNS34	0	<SL	**3.5**	<SL	<SL	<SL	**110**	<SL	<SL
03D-SNS35	0	<SL	**1.4**	<SL	<SL	<SL	<SL	<SL	<SL
11D-SNS02	0	<SL	**5.89**	<SL	NC	<SL	**379**	<SL	<SL
11D-SNS03	0	<SL	**2.47**	<SL	NC	<SL	<SL	<SL	<SL
11D-SNS04	0	<SL	**3.89**	<SL	NC	<SL	**288**	<SL	<SL
11D-SNS06	0	<SL	**1.59**	<SL	<SL	<SL	<SL	<SL	<SL
11D-SNS07	0	<SL	**3.39**	<SL	NC	<SL	**67.2**	<SL	<SL
11D-SNS08	2	<SL	<SL	<SL	<SL	<SL	**79**	<SL	<SL
11D-SNS09	2	<SL	**2**	<SL	<SL	<SL	**110**	<SL	<SL
11D-SNS10	0	<SL	<SL	<SL	NC	<SL	**87**	<SL	<SL
11D-SNS12	2.5	<SL	<SL	<SL	<SL	<SL	**45**	<SL	<SL
11D-SNS14	1	<SL	**1.4**	<SL	<SL	<SL	<SL	<SL	<SL
11D-SNS15	1	<SL	**2.7**	<SL	<SL	<SL	**150**	<SL	<SL
11D-SNS16	1	<SL	**2**	<SL	<SL	<SL	<SL	<SL	<SL
11D-SNS16	2.5	<SL	**2.4**	<SL	<SL	<SL	<SL	<SL	<SL
11D-SNS19	1	<SL	**1.8**	<SL	<SL	<SL	**46**	<SL	<SL
11D-SNS20	1	<SL	<SL	<SL	<SL	<SL	**47**	<SL	<SL
11D-SNS22	1	<SL	**3.7**	<SL	<SL	<SL	<SL	<SL	<SL
A20-RB37-SB01	1	<SL	**1.6**	<SL	<SL	<SL	**210**	<SL	<SL
2.6 - 12 feet bgs									
03D-SB03	10	<SL	**3.12**	<SL	NC	<SL	<SL	<SL	<SL
51D-SB06	9	<SL	**2.2**	<SL	<SL	<SL	<SL	<SL	<SL
> 12 feet bgs									
03D-SB03	35	<SL	**30.4**	<SL	NC	<SL	<SL	<SL	<SL

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not analyzed for.
Units in milligrams per kilogram (mg/kg).

- Not Analyzed
- < Soil Screening Level (PGW SSL)
- >= PGW SSL and < 10x PGW SSL
- >= 10x PGW SSL and < 100x PGW SSL
- >= 100x PGW SSL

Antimony, Cadmium, Chromium, Chromium VI — Copper, Lead, Silver, Zinc

Source Area

Boundary Operable Unit (BOU)

N

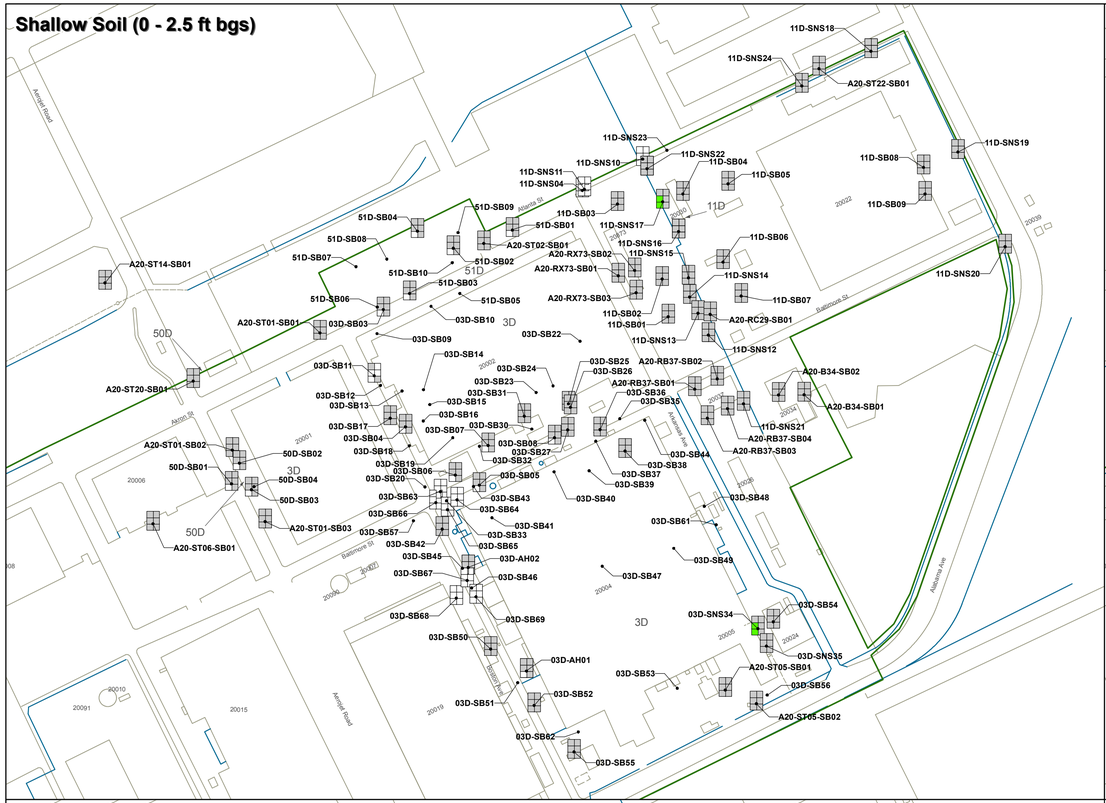
1 " = 200 '

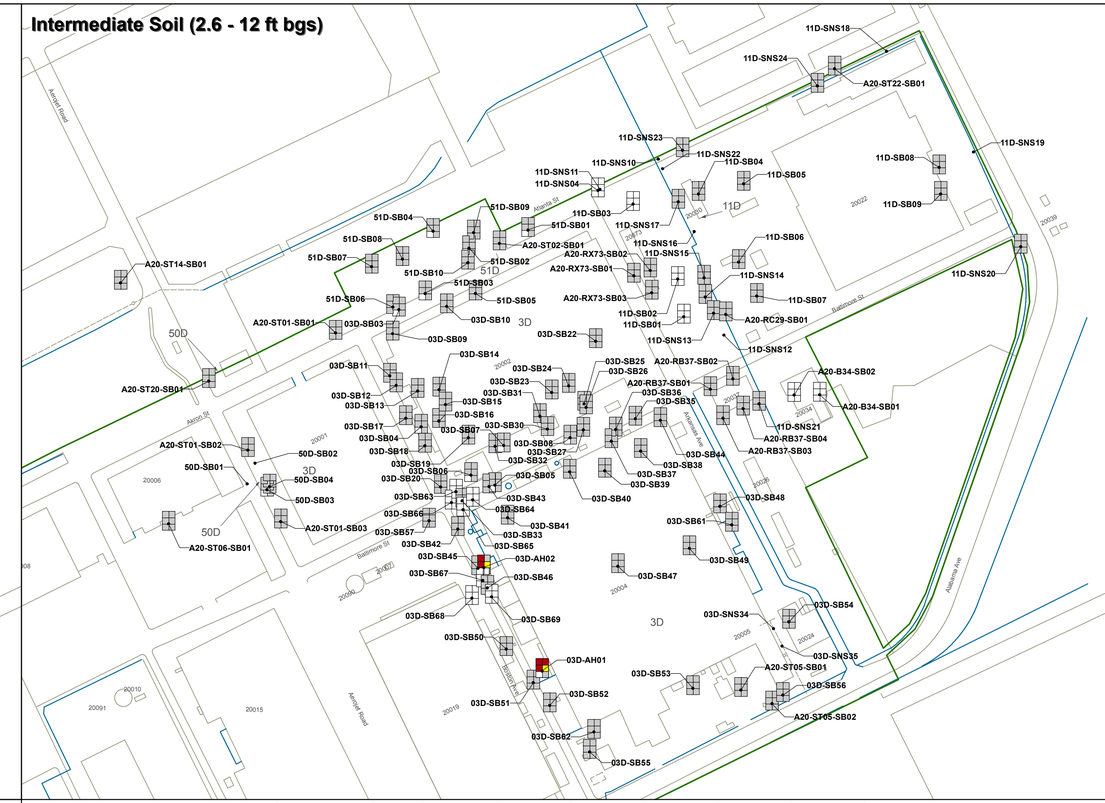
0 200 400
Feet

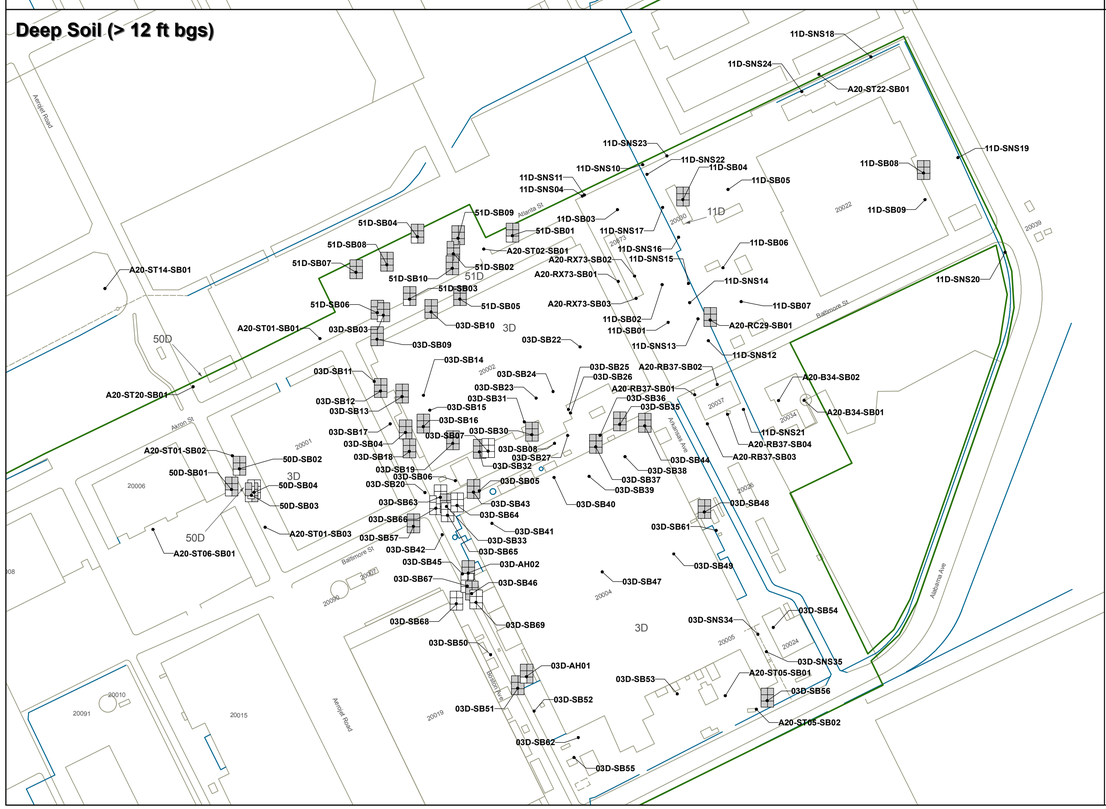
AEROJET
Environmental Remediation

Figure 4.2-10

Metals Above Protection of Groundwater Soil Screening Levels
Administration Area East







Sample Location	Sample Depth	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b&k) fluoranthene	Dibenz(a,h) anthracene	Indeno(1,2,3-cd)pyrene	Pentachloro-phenol
Screening Level		0.62	0.038	0.038	0.062	0.621	3000
0 - 2.5 feet bgs							
03D-SNS34	0	<SL	**0.038**	**0.088**	<SL	<SL	<SL
11D-SNS17	1	<SL	**0.041**	**0.064**	<SL	<SL	<SL
2.6 - 12 feet bgs							
03D-AH01	3	**88.4**	**62**	<SL	**6.44**	**21**	<SL
03D-AH02	3	**110**	**67**	<SL	<SL	**22**	<SL

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not analyzed for.
Units in mg/kg.

Not Analyzed
< Soil Screening Level (RISL)
>= RISL and < 10x RISL
>= 10x RISL and < 100x RISL
>= 100x RISL

Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b&k)fluoranthene
Dibenz(a,h)anthracene
Indeno(1,2,3-cd)pyrene
Pentachlorophenol

Source Area
Boundary Operable Unit (BOU)

N

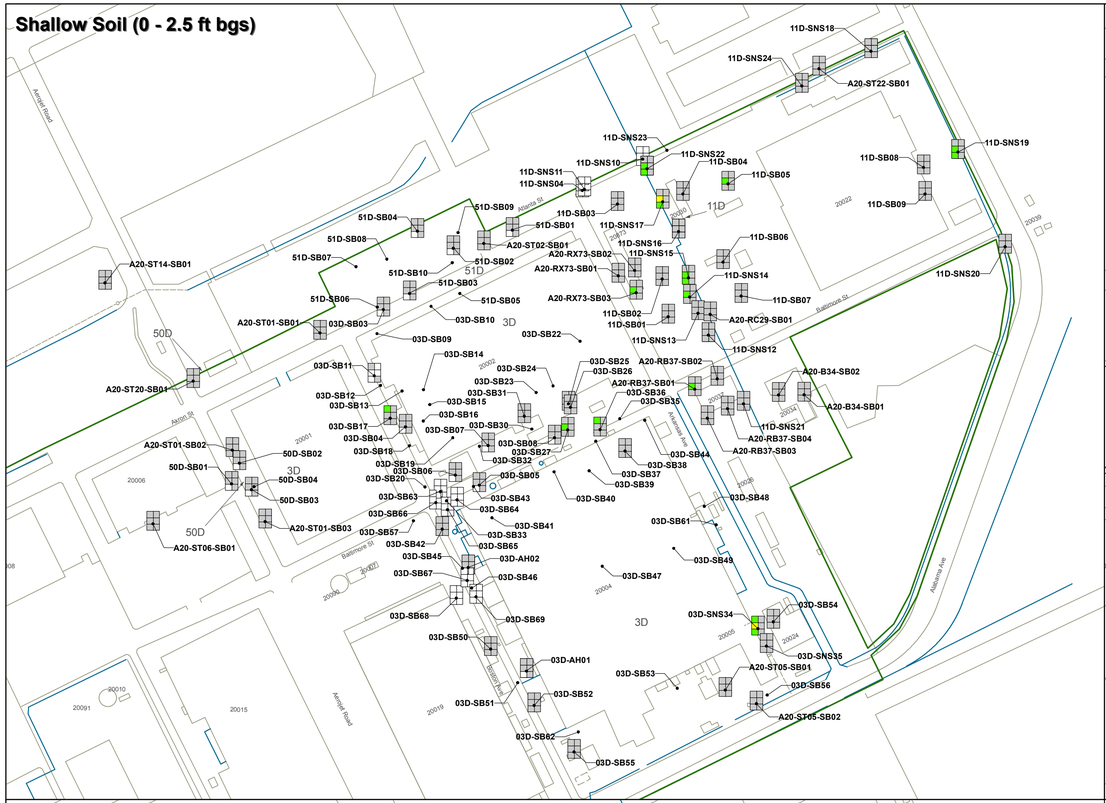
1 " = 200 '

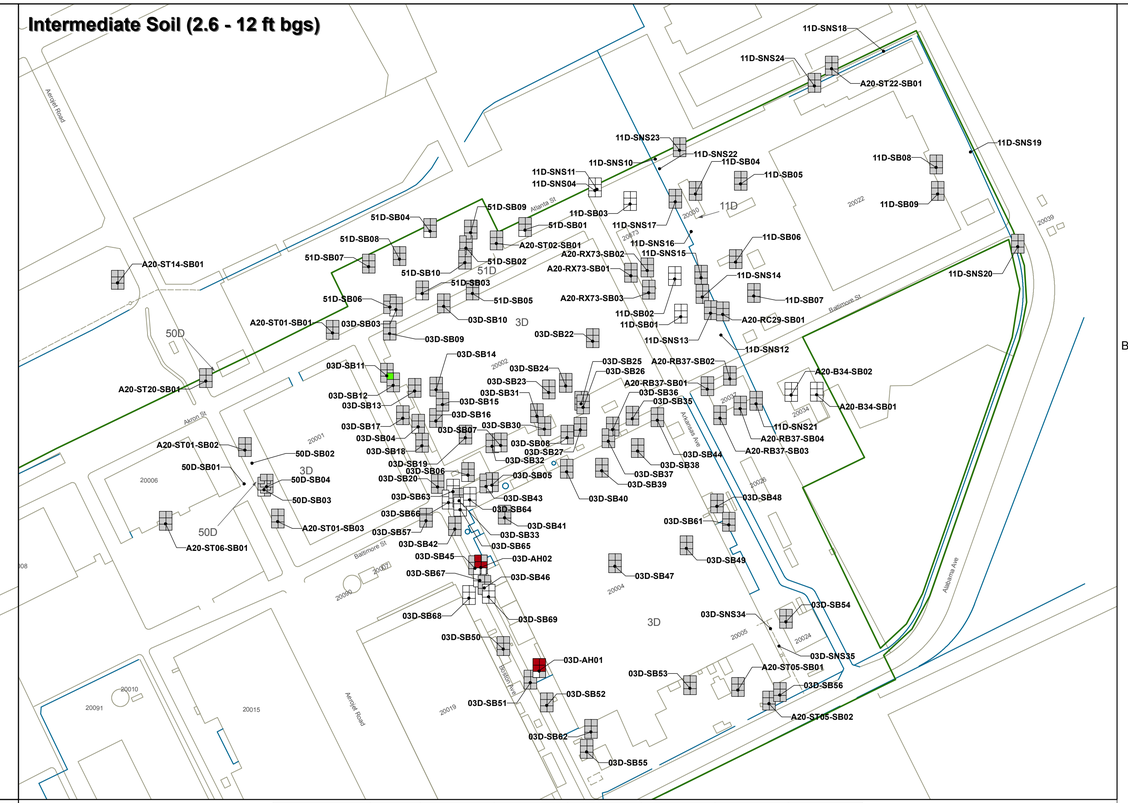
0 200 400
Feet

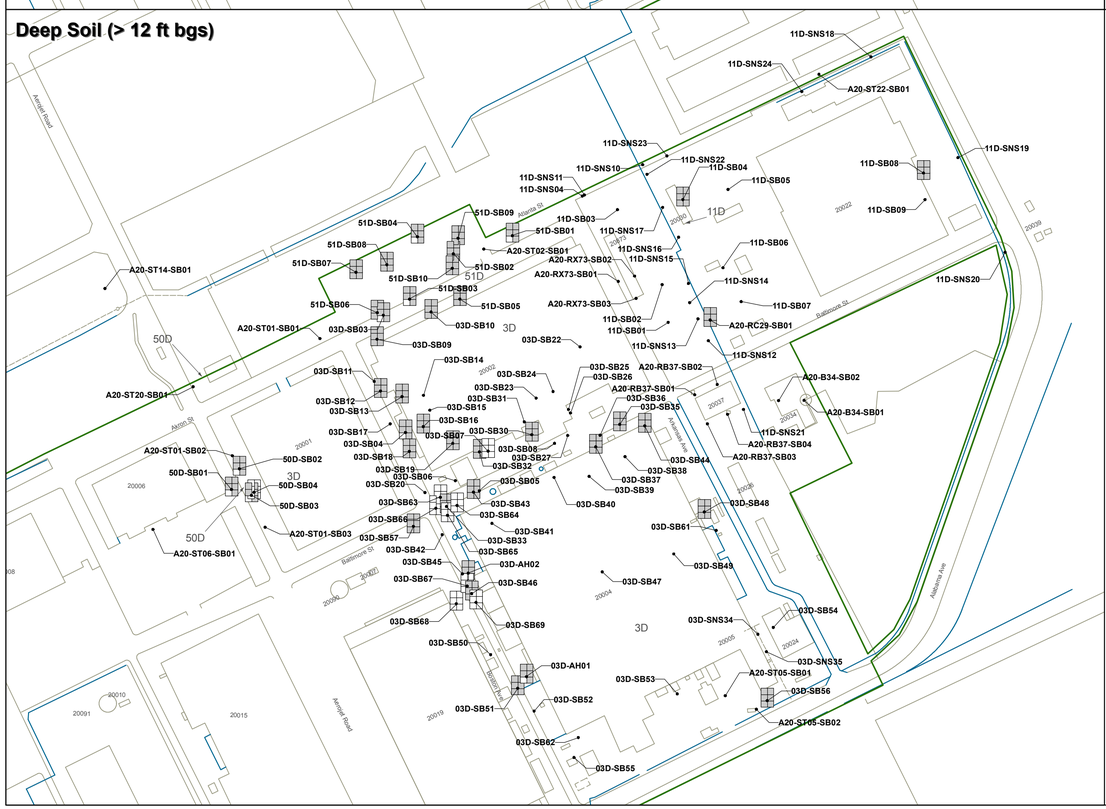
AEROJET
Environmental Remediation

Figure 4.2-11

SVOCs and Pentachlorophenol in Soil
Above Remedial Investigation Screening Levels
Administration Area East







Sample Location	Sample Depth	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b&k) fluoranthene	Dibenz(a,h) anthracene	Indeno(1,2,3-cd)pyrene	Pentachloro-phenol
Screening Level		0.029	0.0029	0.029	0.0029	0.029	0.40
0 - 2.5 feet bgs							
03D-SB17	1	**0.13**	<SL	<SL	<SL	<SL	<SL
03D-SB27	1	<SL	**0.0061**	<SL	<SL	<SL	<SL
03D-SB36	1	**0.042**	<SL	<SL	<SL	<SL	<SL
03D-SNS34	0	**0.042**	**0.038**	**0.088**	<SL	<SL	<SL
11D-SB05	1	<SL	**0.0062**	<SL	<SL	<SL	<SL
11D-SNS14	1	<SL	**0.007**	<SL	<SL	<SL	<SL
11D-SNS15	1	<SL	**0.01**	**0.03**	<SL	<SL	<SL
11D-SNS17	1	<SL	**0.041**	**0.064**	<SL	<SL	<SL
11D-SNS19	1	<SL	**0.0084**	**0.03**	<SL	<SL	<SL
11D-SNS22	1	<SL	**0.009**	<SL	<SL	<SL	<SL
11D-SNS22	2.5	<SL	**0.015**	**0.03**	<SL	<SL	<SL
A20-RB37-SB01	1	<SL	**0.016**	<SL	<SL	<SL	<SL
A20-RX73-SB03	1	<SL	**0.0074**	<SL	<SL	<SL	<SL
2.6 - 12 feet bgs							
03D-AH01	3	**88.4**	**62**	<SL	**6.44**	**21**	<SL
03D-AH02	3	**110**	**67**	<SL	<SL	**22**	<SL
03D-SB12	11	**0.045**	<SL	<SL	<SL	<SL	<SL

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not analyzed for.
Units in mg/kg.

- Not Analyzed
- < Soil Screening Level (PGW SSL)
- >= PGW SSL and < 10x PGW SSL
- >= 10x PGW SSL and < 100x PGW SSL
- >= 100x PGW SSL

Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b&k)fluoranthene
Dibenz(a,h)anthracene
Indeno(1,2,3-cd)pyrene
Pentachlorophenol

- Source Area
- Boundary Operable Unit (BOU)

N

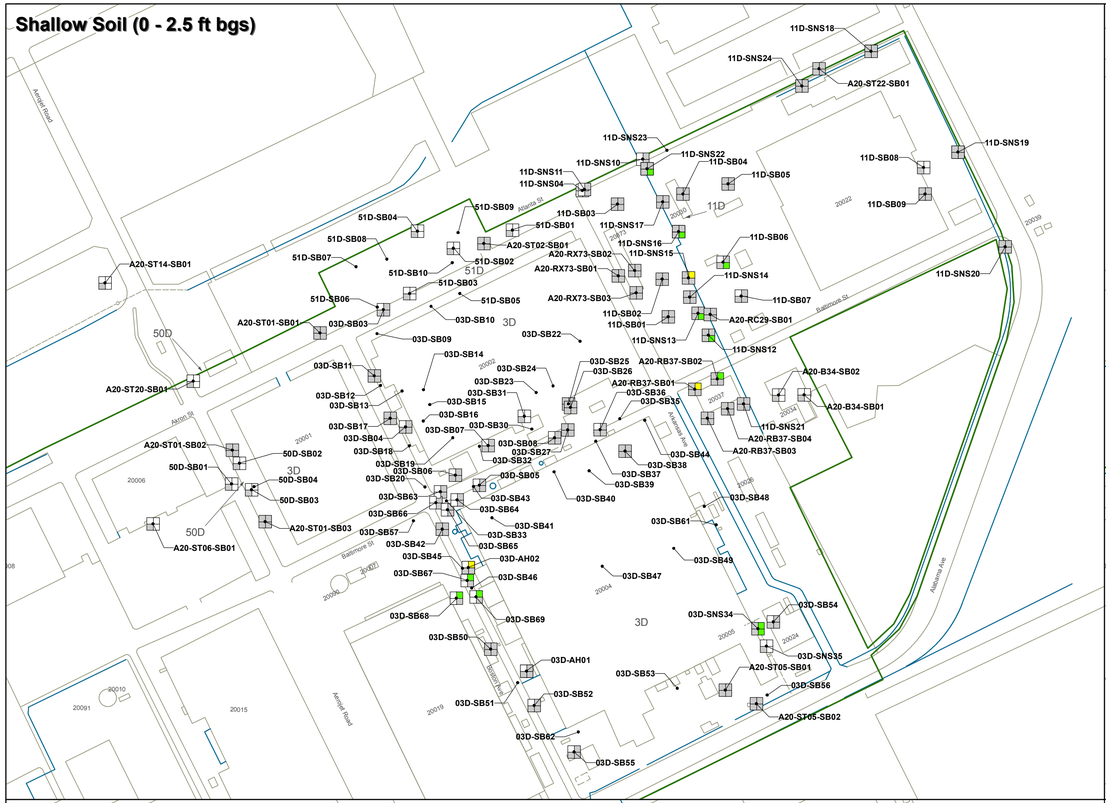
1 " = 200 '

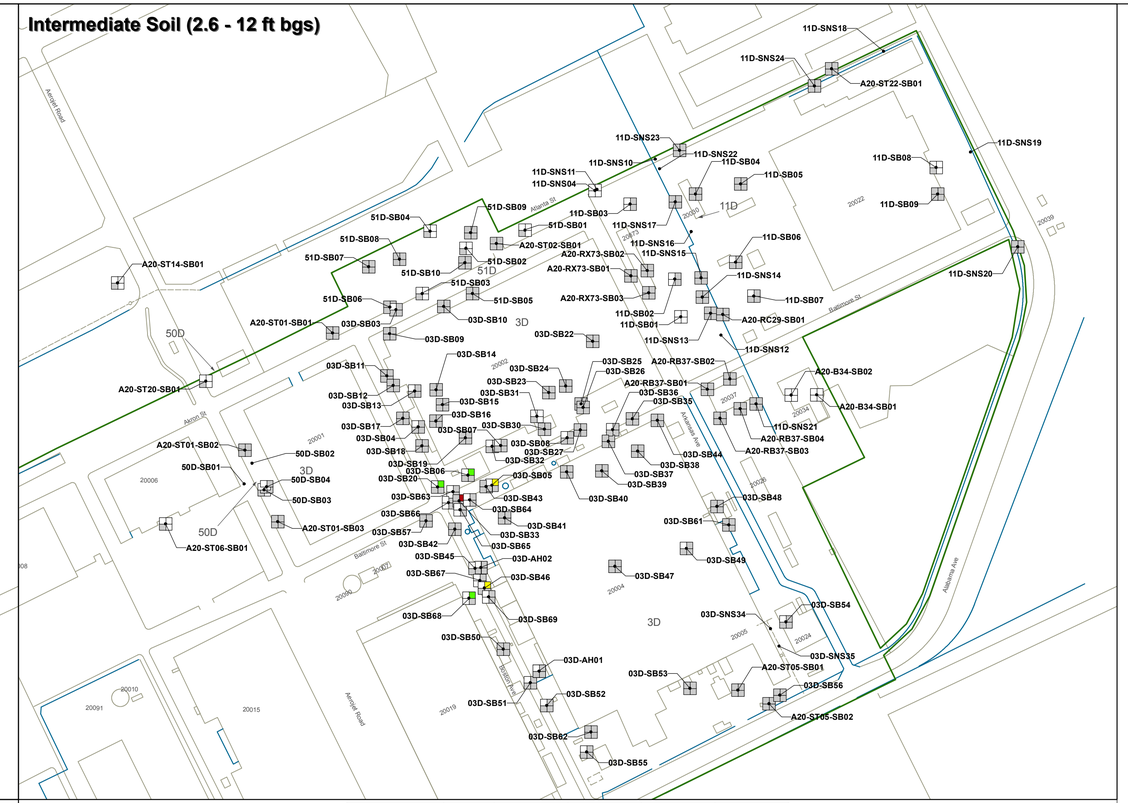
0 200 400
Feet

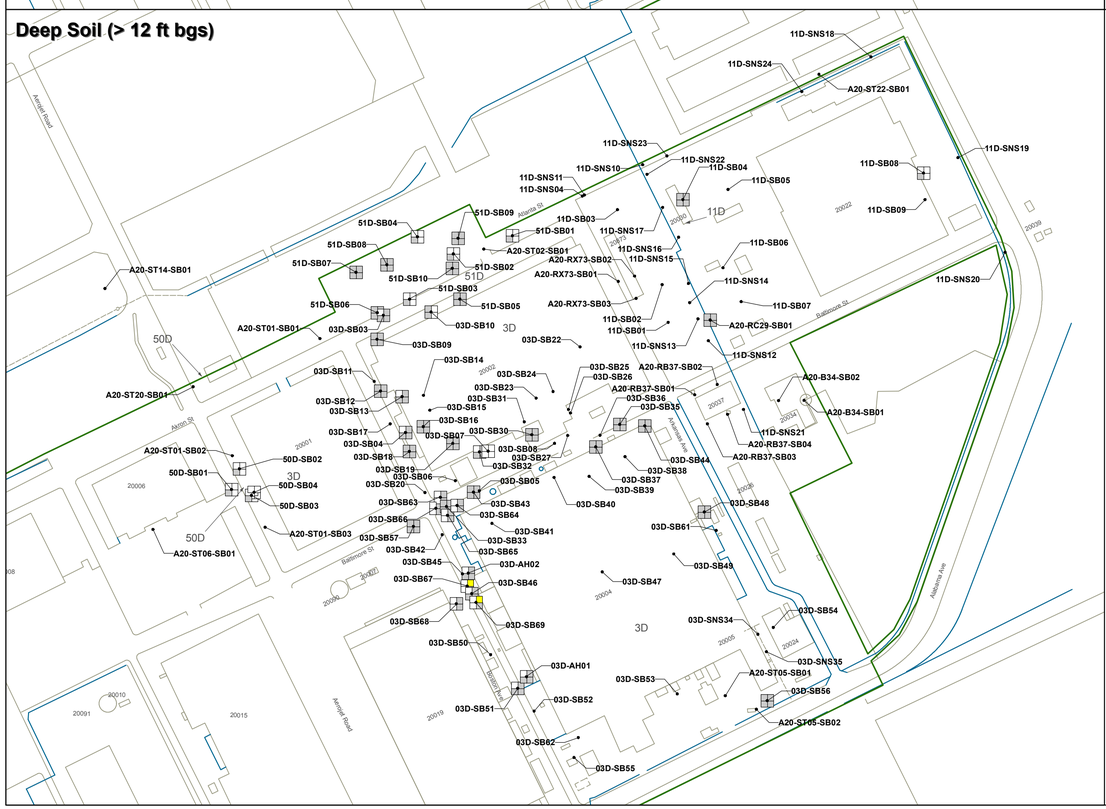
AEROJET
Environmental Remediation

Figure 4.2-12

SVOCs and Pentachlorophenol Above Protection of Groundwater Soil Screening Levels Administration Area East







Sample Location	Sample Depth	NDMA	PCB-1254	PCB-1260	Perchlorate
Screening Level		0.0095	0.22	0.22	7.8
0 - 2.5 feet bgs					
03D-SB02	1	<SL	**2.8**	<SL	NC
03D-SB67	1	NC	**0.51**	<SL	NC
03D-SB68	1	NC	**1.7**	<SL	NC
03D-SB69	1	NC	**0.37**	<SL	NC
03D-SNS34	0	<SL	**0.42**	**1.5**	<SL
11D-SB06	1	<SL	**<SL**	**1.6**	NC
11D-SNS12	1	<SL	**<SL**	**0.33**	<SL
11D-SNS12	2.5	<SL	<SL	**0.34**	<SL
11D-SNS13	1	<SL	**<SL**	**0.31**	<SL
11D-SNS15	1	<SL	**10**	<SL	<SL
11D-SNS16	1	<SL	**<SL**	**1.1**	<SL
11D-SNS22	1	<SL	**<SL**	**1.3**	<SL
A20-RB37-SB01	1	<SL	**3.1**	<SL	<SL
A20-RB37-SB02	1	<SL	**2**	<SL	<SL
2.6 - 12 feet bgs					
03D-SB05	5	<SL	**2.32**	<SL	NC
03D-SB06	10	<SL	**0.43**	<SL	NC
03D-SB20	11	<SL	**0.43**	<SL	NC
03D-SB33	5	<SL	**47**	<SL	<SL
03D-SB46	11	<SL	**11**	<SL	NC
03D-SB68	10	NC	**0.32**	<SL	NC
> 12 feet bgs					
03D-SB67	15	NC	**8.7**	<SL	NC
03D-SB69	15	NC	**16**	<SL	NC

Note: Symbols in figure represent maximum concentration within each depth interval.
PCB-1248 was detected at sample location 03D-SB22.
<SL = Result less than screening level or non-detect.
NC = Not analyzed for.
Units in mg/kg.

Not Analyzed
< Soil Screening Level (RISL)
>= RISL and < 10x RISL
>= 10x RISL and < 100x RISL
>= 100x RISL

Perchlorate
NDMA
Aroclor 1254
Aroclor 1260

Source Area
Boundary Operable Unit (BOU)

N

1 " = 200 '

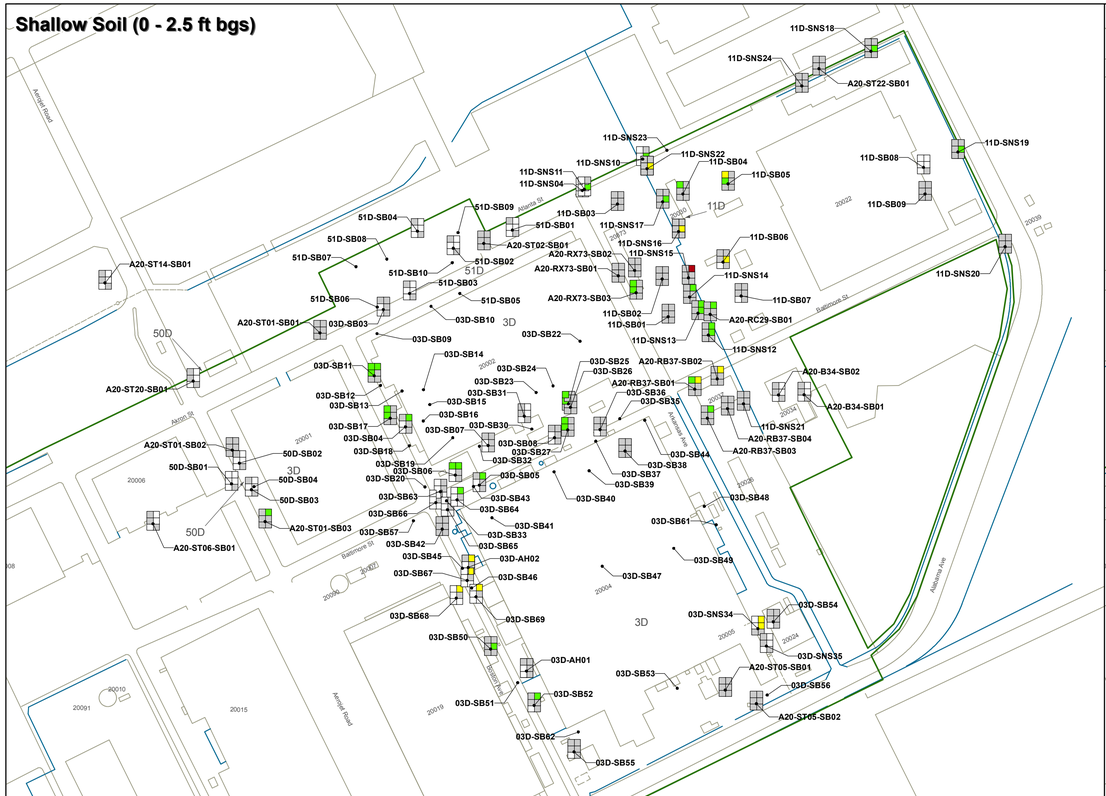
0 200 400
Feet

AEROJET
Environmental Remediation

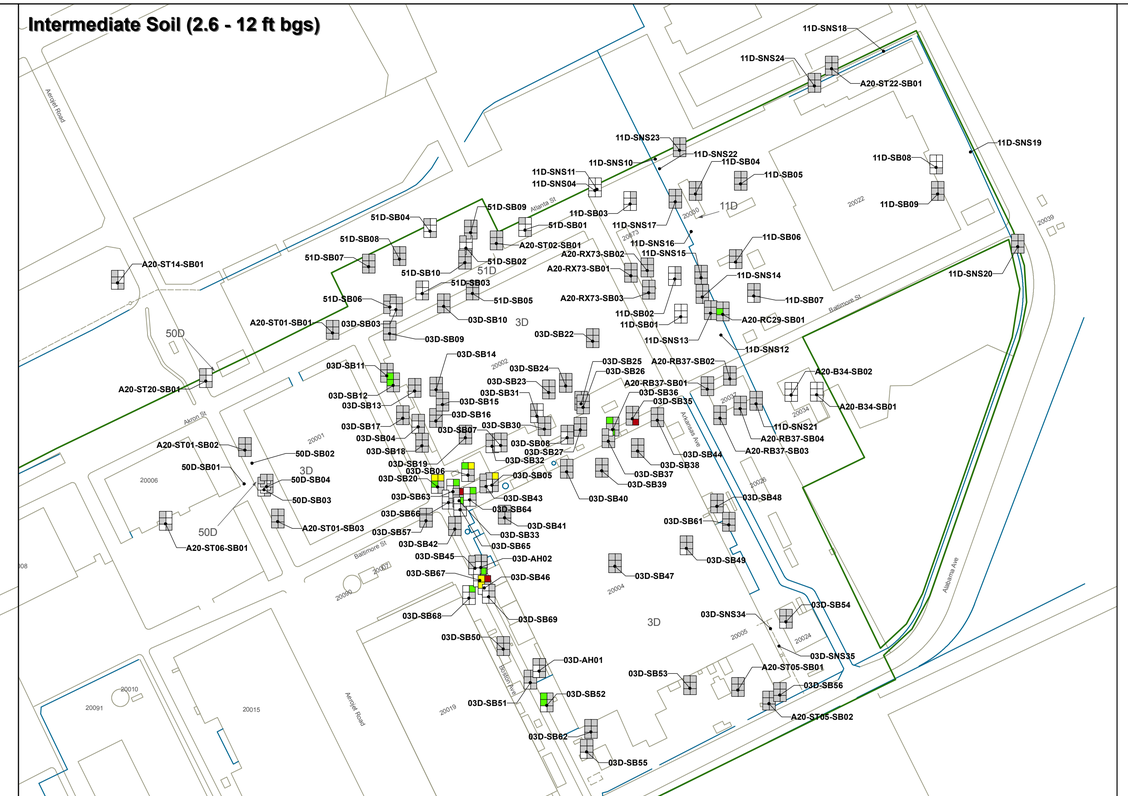
Figure 4.2-13

PCBs, NDMA and Perchlorate in Soil
Above Remedial Investigation Screening Levels
Administration Area East

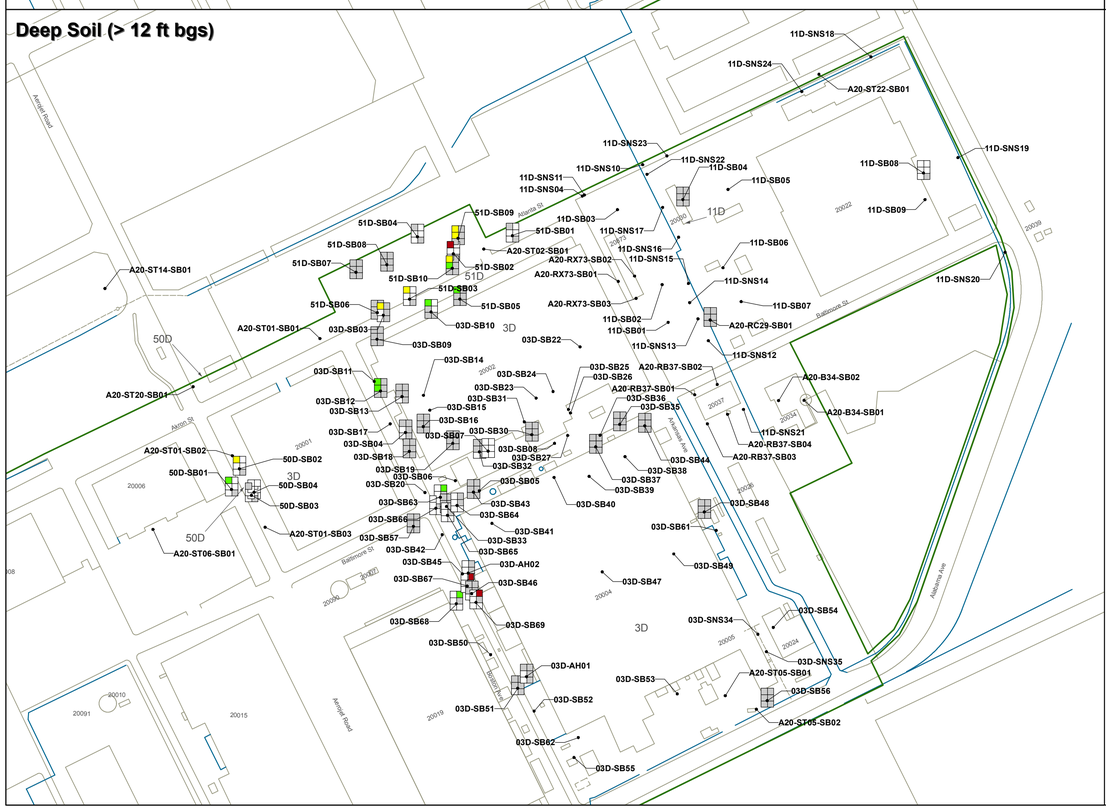
Shallow Soil (0 - 2.5 ft bgs)



Intermediate Soil (2.6 - 12 ft bgs)



Deep Soil (> 12 ft bgs)



Sample Location	Sample Depth	TPH as Diesel	TPH as Motor Oil	NDMA	PCB-1254	PCB-1260	Perchlorate
Screening Level		100	500	0.00003	0.034	0.034	0.06
0 - 2.5 feet bgs							
03D-SB02	1	<SL	NC	<SL	**2.8**	<SL	NC
03D-SB04	1	<SL	NC	<SL	**0.083**	<SL	NC
03D-SB05	1	<SL	NC	<SL	**0.122**	<SL	NC
03D-SB06	1	**140**	NC	<SL	**0.051**	<SL	NC
03D-SB11	1	**120**	**620**	<SL	**0.037**	<SL	<SL
03D-SB17	1	**850**	**4300**	<SL	<SL	<SL	<SL
03D-SB25	1	**120**	**520**	<SL	<SL	<SL	<SL
03D-SB27	1	**170**	**600**	<SL	<SL	<SL	<SL
03D-SB50	1	<SL	<SL	<SL	<SL	**0.065**	<SL
03D-SB52	1	<SL	<SL	<SL	**0.048**	<SL	NC
03D-SB64	1	NC	NC	NC	**0.05**	<SL	NC
03D-SB67	1	NC	NC	NC	**0.51**	<SL	NC
03D-SB68	1	NC	NC	NC	**1.7**	<SL	NC
03D-SB69	1	NC	NC	NC	**0.37**	<SL	NC
03D-SNS34	0	NC	NC	<SL	**0.42**	**1.5**	<SL
11D-SB04	1	**140**	<SL	<SL	<SL	<SL	<SL
11D-SB05	1	**1400**	**4200**	<SL	<SL	<SL	<SL
11D-SB06	1	<SL	<SL	<SL	<SL	**1.6**	NC
11D-SNS10	0	NC	NC	NC	<SL	**0.15**	NC
11D-SNS11	0	NC	NC	NC	<SL	**0.09**	NC
11D-SNS12	1	<SL	<SL	<SL	**0.16**	**0.33**	<SL
11D-SNS12	2.5	<SL	<SL	<SL	**0.16**	**0.34**	<SL
11D-SNS13	1	<SL	<SL	<SL	**0.12**	**0.31**	<SL
11D-SNS14	1	<SL	<SL	<SL	**0.15**	<SL	<SL
11D-SNS15	1	<SL	<SL	<SL	**10**	<SL	<SL
11D-SNS16	1	<SL	<SL	<SL	<SL	**1.1**	<SL
11D-SNS16	2.5	<SL	<SL	<SL	<SL	**0.041**	<SL
11D-SNS17	1	<SL	<SL	<SL	<SL	**0.15**	<SL
11D-SNS18	1	<SL	<SL	<SL	<SL	**0.042**	<SL
11D-SNS18	2.5	<SL	<SL	<SL	<SL	**0.045**	<SL
11D-SNS19	2.5	<SL	<SL	<SL	<SL	**0.12**	<SL
11D-SNS22	1	<SL	<SL	<SL	<SL	**1.3**	<SL
A20-RB37-SB01	1	**270**	<SL	<SL	**3.1**	<SL	<SL
A20-RB37-SB02	1	<SL	<SL	<SL	**2**	<SL	<SL
A20-RB37-SB03	1	<SL	<SL	<SL	**0.21**	<SL	<SL
A20-RC29-SB01	1	<SL	<SL	<SL	**0.059**	<SL	<SL
A20-RX73-SB03	1	**250**	**940**	<SL	<SL	<SL	<SL
A20-ST01-SB03	1	<SL	<SL	<SL	**0.13**	<SL	<SL
2.6 - 12 feet bgs							
03D-SB05	5	<SL	NC	<SL	**2.32**	<SL	NC
03D-SB05	10	<SL	NC	<SL	**0.0843**	<SL	NC
03D-SB06	10	**250**	NC	<SL	**0.43**	<SL	NC
03D-SB12	5	**180**	**1100**	<SL	<SL	<SL	<SL
03D-SB12	11	**350**	**2100**	<SL	<SL	<SL	<SL
03D-SB20	11	**6000**	**1000**	<SL	**0.43**	<SL	NC

Sample Location	Sample Depth	TPH as Diesel	TPH as Motor Oil	NDMA	PCB-1254	PCB-1260	Perchlorate
Screening Level		100	500	0.00003	0.034	0.034	0.06
2.6 - 12 feet bgs							
03D-SB33	5	<SL	<SL	<SL	**47**	<SL	<SL
03D-SB33	11	<SL	<SL	<SL	**0.098**	<SL	<SL
03D-SB35	5	<SL	<SL	**0.00032**	<SL	<SL	<SL
03D-SB36	11	**120**	<SL	<SL	<SL	<SL	NC
03D-SB37	5	<SL	<SL	<SL	**0.14**	<SL	<SL
03D-SB43	5	<SL	<SL	<SL	**0.11**	<SL	<SL
03D-SB43	11	<SL	<SL	<SL	**0.037**	<SL	<SL
03D-SB46	11	**9100**	**12000**	<SL	**11**	<SL	NC
03D-SB52	5	**110**	**660**	<SL	<SL	<SL	NC
03D-SB63	10	NC	NC	NC	**0.046**	<SL	NC
03D-SB64	5	NC	NC	NC	**0.047**	<SL	NC
03D-SB65	12	NC	NC	NC	**0.055**	<SL	NC
03D-SB66	10	NC	NC	NC	**0.051**	<SL	NC
03D-SB67	10	NC	NC	NC	**0.14**	<SL	NC
03D-SB68	5	NC	NC	NC	**0.086**	<SL	NC
03D-SB68	10	NC	NC	NC	**0.32**	<SL	NC
A20-RC29-SB01	5	<SL	**620**	<SL	<SL	<SL	<SL
> 12 feet bgs							
03D-SB03	20	**2050**	NC	<SL	<SL	<SL	NC
03D-SB03	35	**1900**	NC	<SL	<SL	<SL	NC
03D-SB03	40	**1910**	NC	<SL	<SL	<SL	NC
03D-SB10	15	**170**	<SL	<SL	NC	NC	<SL
03D-SB12	35	**970**	**750**	<SL	<SL	<SL	<SL
03D-SB63	15	NC	NC	NC	**0.063**	<SL	NC
03D-SB66	15	NC	NC	NC	**0.1**	<SL	NC
03D-SB67	15	NC	NC	NC	**8.7**	<SL	NC
03D-SB68	15	NC	NC	NC	**0.078**	<SL	NC
03D-SB69	15	NC	NC	NC	**16**	<SL	NC
50D-SB01	20	**260**	NC	<SL	NC	NC	NC
50D-SB02	15	**2540**	NC	<SL	NC	NC	NC
50D-SB02	20	**2900**	NC	<SL	NC	NC	NC
50D-SB02	30	**7220**	NC	<SL	NC	NC	NC
51D-SB02	15	**17300**	NC	<SL	NC	NC	NC
51D-SB02	20	**705**	NC	<SL	NC	NC	NC
51D-SB02	25	**192**	NC	<SL	NC	NC	NC
51D-SB03	15	**5400**	NC	<SL	NC	NC	NC
51D-SB03	20	**2120**	NC	<SL	NC	NC	NC
51D-SB03	25	**5520**	NC	<SL	NC	NC	NC
51D-SB03	30	**620**	NC	<SL	NC	NC	NC
51D-SB05	17	**440**	<SL	<SL	<SL	<SL	<SL
51D-SB09	13	**5300**	**3600**	<SL	<SL	<SL	<SL
51D-SB09	17	**8100**	**5500**	<SL	<SL	<SL	<SL
51D-SB10	13	**1200**	**790**	<SL	<SL	<SL	<SL
51D-SB10	17	**6500**	**3600**	<SL	<SL	<SL	<SL

Note: Symbols in figure represent maximum concentration within each depth interval.
PCB-1248 was detected at sample location 03D-SB22.
<SL = Result less than screening level or non-detect.
NC = Not analyzed for.
Units in mg/kg.

- Not Analyzed
- < Soil Screening Level (PGW SSL)
- >= PGW SSL and < 10x PGW SSL
- >= 10x PGW SSL and < 100x PGW SSL
- >= 100x PGW SSL

TPH-D, TPH-MO, Perchlorate — Arochlor 1254, Aroclor 1260, NDMA

- Source Area
- Boundary Operable Unit (BOU)

N

1 " = 200 '

0 200 400
Feet

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Figure 4.2-14

PCBs, NDMA, Perchlorate, TPH-D, and TPH-Mo Above Protection of Groundwater Soil Screening Levels - Administration Area East

Administration Area West

Akron St
Baltimore St
Arizona Ave
Alabama Ave

20001
20006
20008
20009
20010
20091
20015
20025
20018
20012

A20-ST01-03
A20-ST01-02
50D
Septic Leach Pits
Hazardous Materials Storage
Former Waste Oil Tank
Waste Treatment Basins
6D
Bermed Pond
Paint Spray Booth
Inactive Plating Area
Sump
TCE Degreaser
52D
Clean Room
Hydro Sump
D(b)
Hazardous Materials Storage
Concrete Pad
Dye Pen Sump
Deep Sump
SMUD Electrical Substation
Drop Inlet Basin
D(d)
5D
9D
8D
Sludge Drying Area
Settling Pond
Aerator
Digester
Sludge Drying Area
D(c)
RCRA W
Treatment Works
Digester
Treatment Works
Low Area
Holding Tank
RCRA Y
12D

EXPLANATION

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Drainage Culvert
- Fence
- Underground Culvert
- Road
- Railroad
- 20009 Building
- Former Structure
- Above Ground Storage Tank
- Surface Drainage
- ST26 Septic Tank and Leach Line
- Surface Water Flow Direction.

N

Scale: 1" = 200'

0 100 200

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FIGURE 4.3-1
Site Features Map
Administration Area West

7\17\08 PR SR10130982

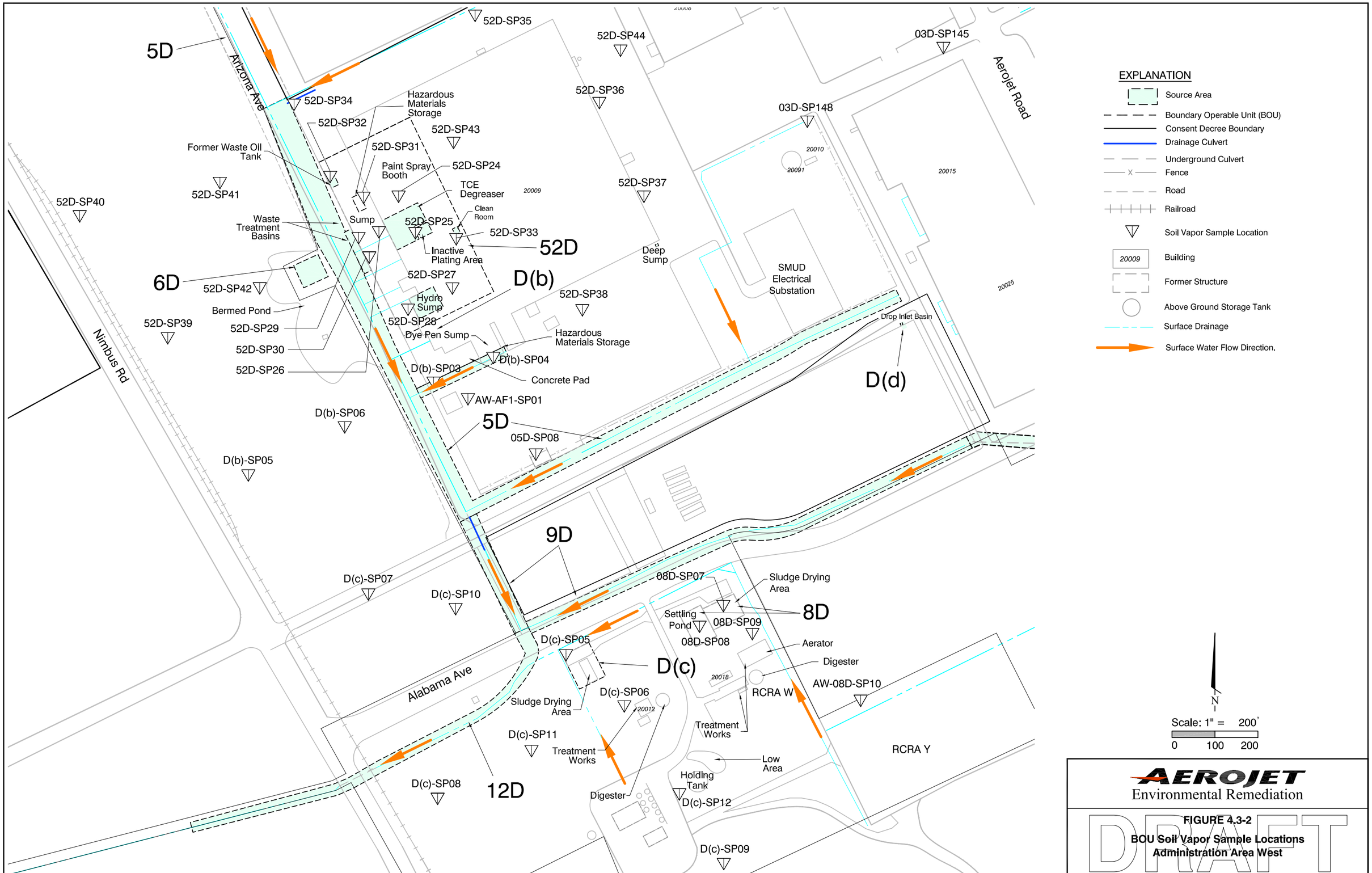


FIGURE 4.3-2
BOU Soil Vapor Sample Locations
Administration Area West

7\17\08 PR SR10130983

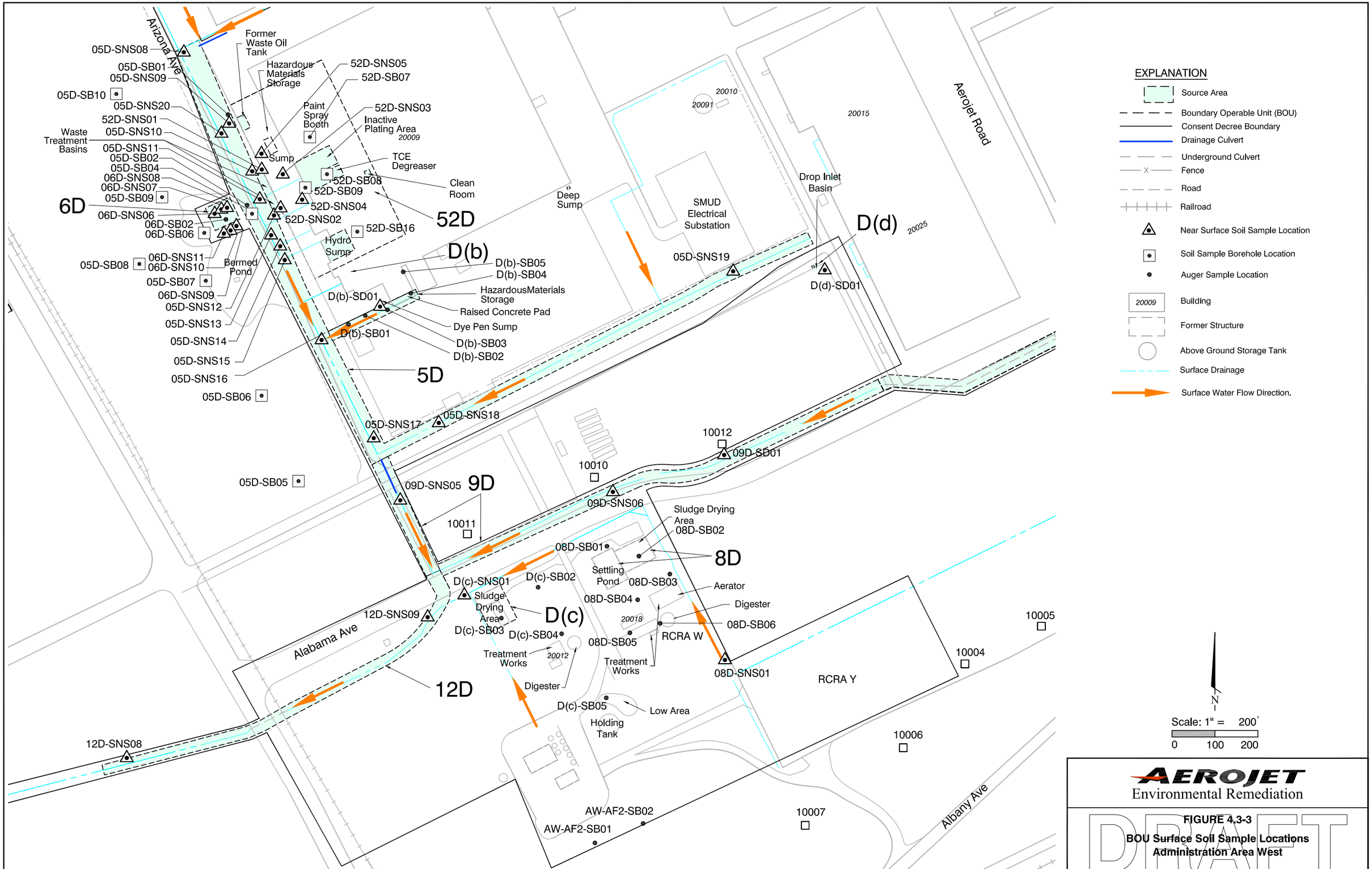
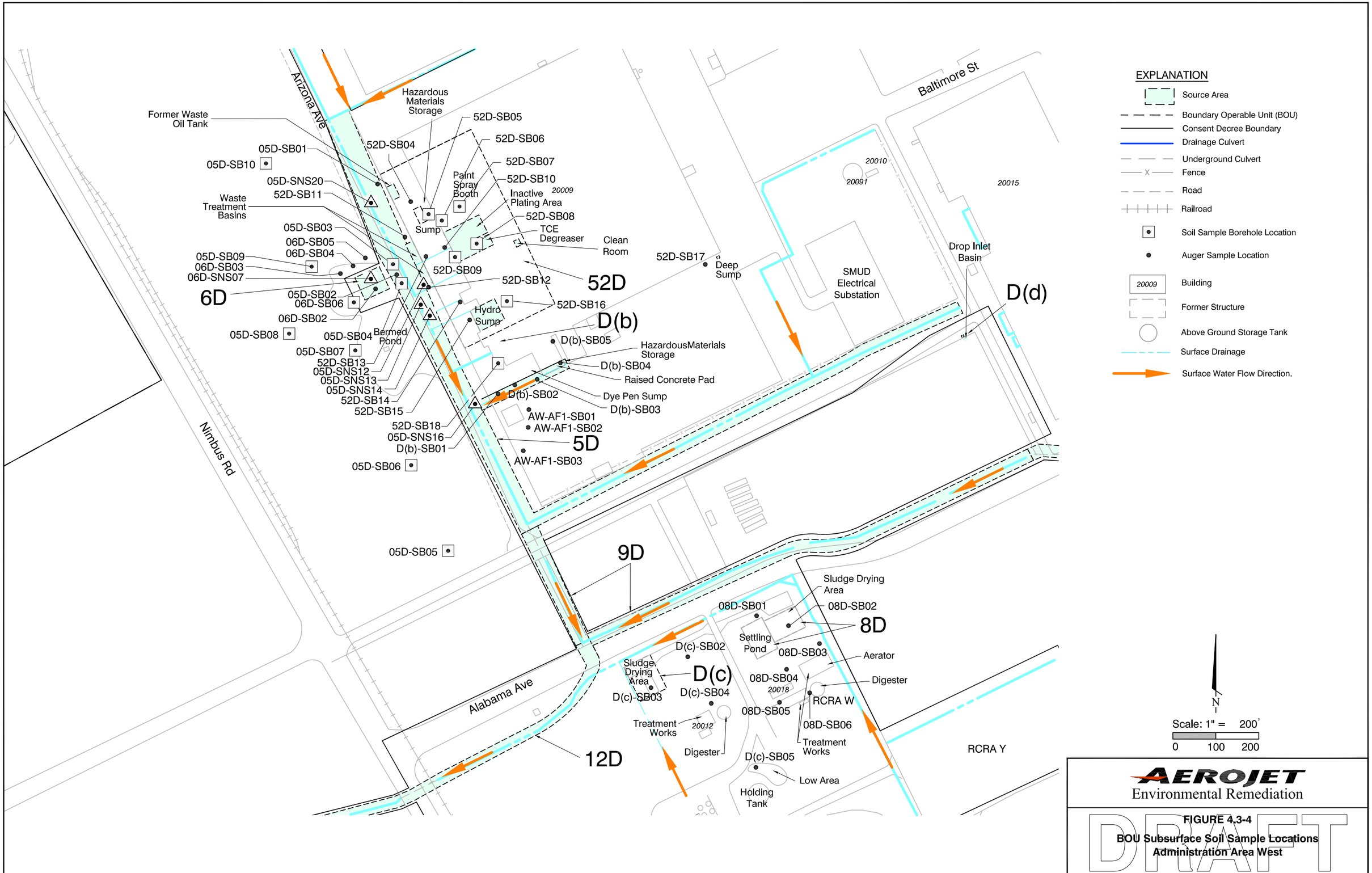
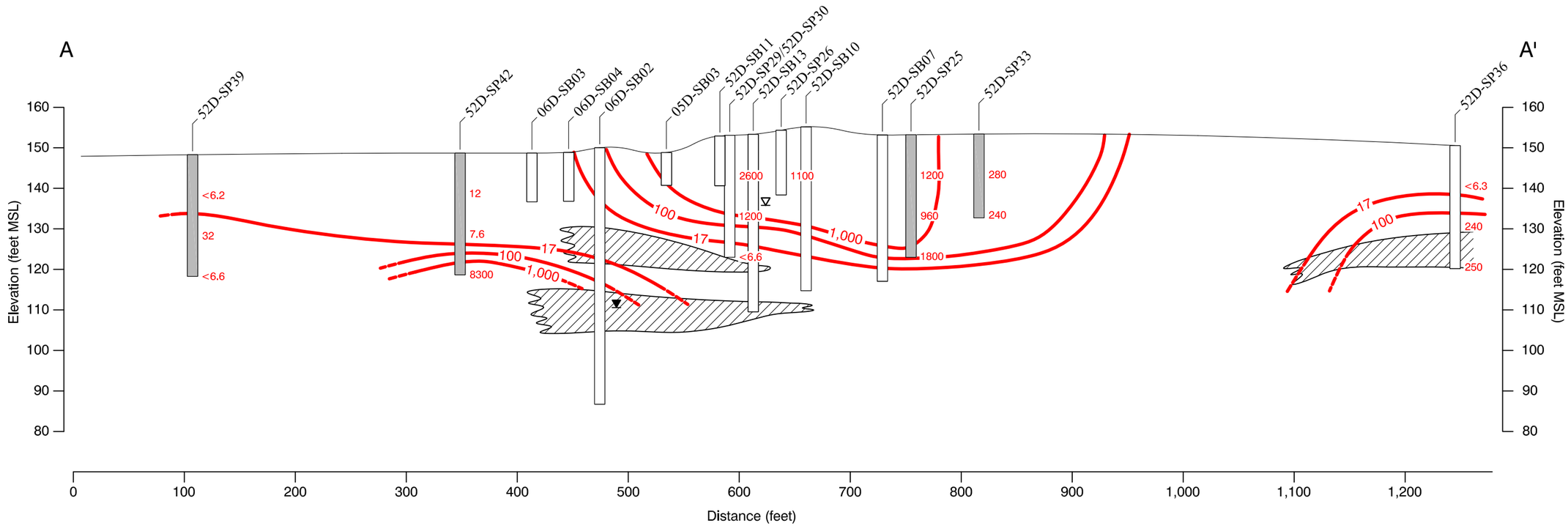


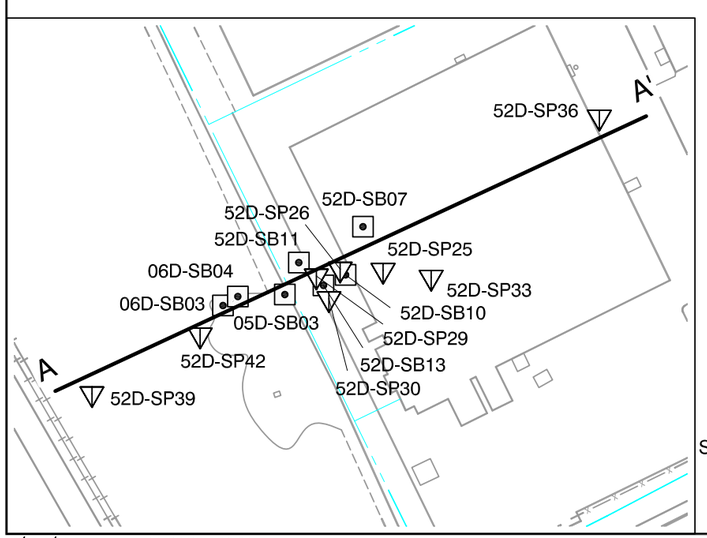
FIGURE 4.3-3
BOU Surface Soil Sample Locations
Administration Area West

7\17\08 PR SR10130984



7\17\08 PR SR10130985





N

Scale: 1" = 300'

0 150 300

Locator Scale

EXPLANATION

52D-SP39 — Well Designation

Well Location. Shaded Wells Lack Lithography.

32 — Concentration of Trichloroethene (TCE, $\mu g/m^3$) (ND = Not Detected)

Total Borehole Depth

Initial Depth to Water

Final Depth to Water

17 — TCE Concentration in Micrograms per Cubic Liter ($\mu g/m^3$)

Note: Chloroform does not exceed screening levels at sample points in the vicinity of transect.

MSL Mean Sea Level

Geologic Contact

Relatively permeable sediments: Silty, poorly and well-graded sands and gravels (GP,GW,SP,SW); silty and clayey gravels (GM/GC) and silts.

Relatively lower permeability sediments: Low plasticity clays and silts (CL,ML); silty and clayey sand (SM/SC).

Vertical Scale 1' = 25'

Horizontal Scale 1' = 100'

Vertical Exaggeration: 4X

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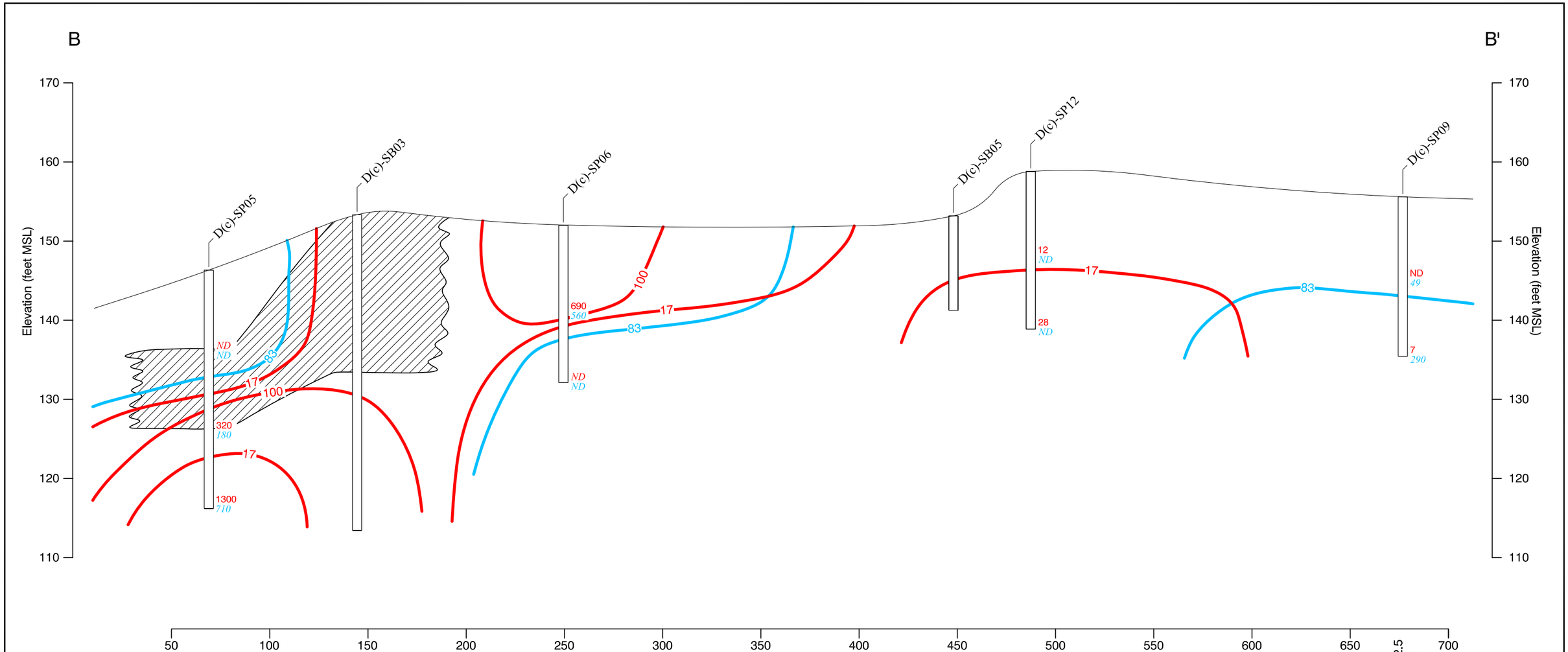
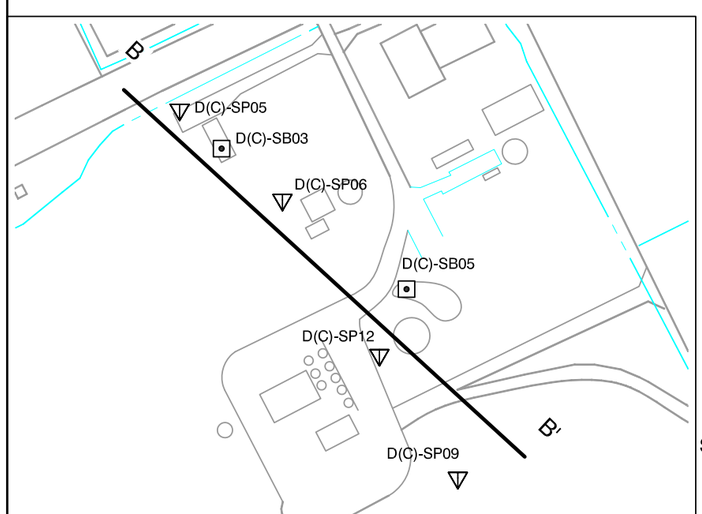
FIGURE 4.3-5
Vadose Zone Cross Section A - A'
Administration Area West
Boundary Operable Unit

7/17/08 pr SR10130986





Scale: 1" = 200'

0 100 200

Locator Scale

N

EXPLANATION

D(c)-SP05 — Well Designation

Well Location. Shaded Wells Lack Lithography.

32 — Concentration of Trichloroethene (µg/m³)

32 — Concentration of Chloroform (µg/m³)

(ND = Not Detected)

Total Borehole Depth

Initial Depth to Water

Final Depth to Water

17 — TCE Concentration in Micrograms per Cubic Liter (µg/m³)

83 — Chloroform Concentration in Micrograms per Cubic Liter (µg/m³)

MSL — Mean Sea Level

Geologic Contact

Relatively permeable sediments: Silty, poorly and well-graded sands and gravels (GP,GW,SP,SW); silty and clayey gravels (GM/GC) and silts.

Relatively lower permeability sediments: Low plasticity clays and silts (CL,ML); silty and clayey sand (SM/SC).

Vertical Scale 1' = 12.5'

0 12.5

Horizontal Scale 1' = 50'

0 50

Vertical Exaggeration: 4X

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Environmental Remediation

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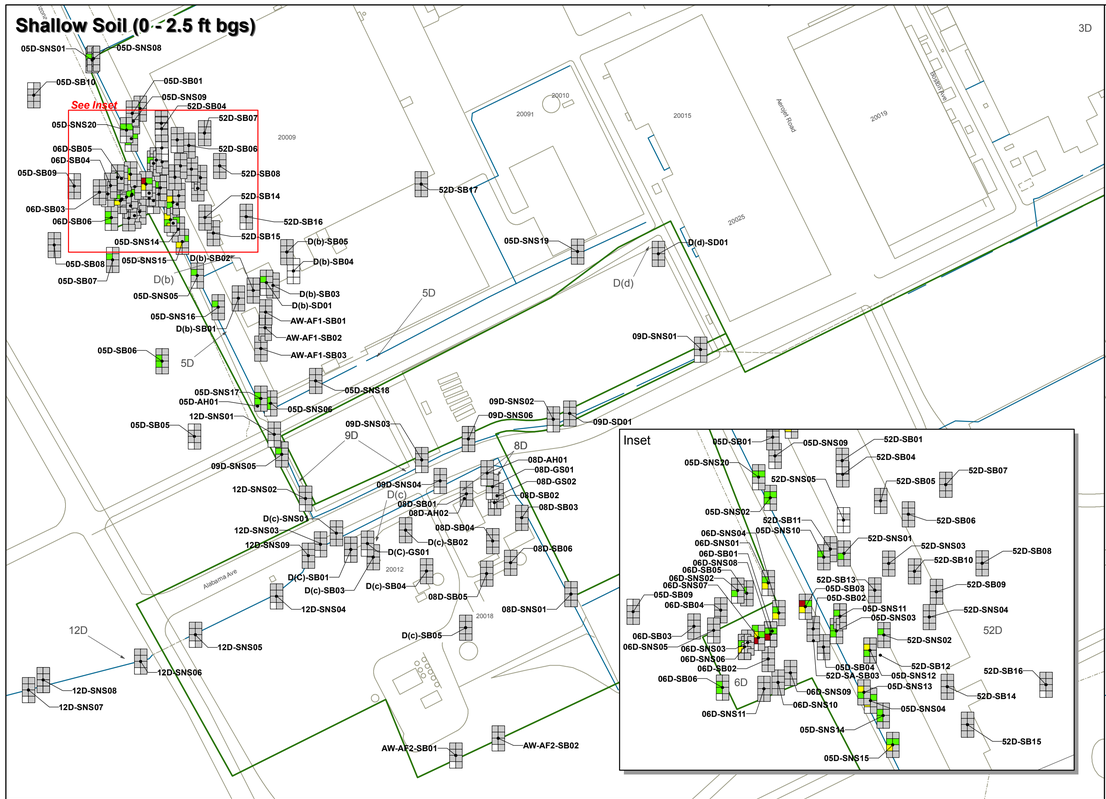
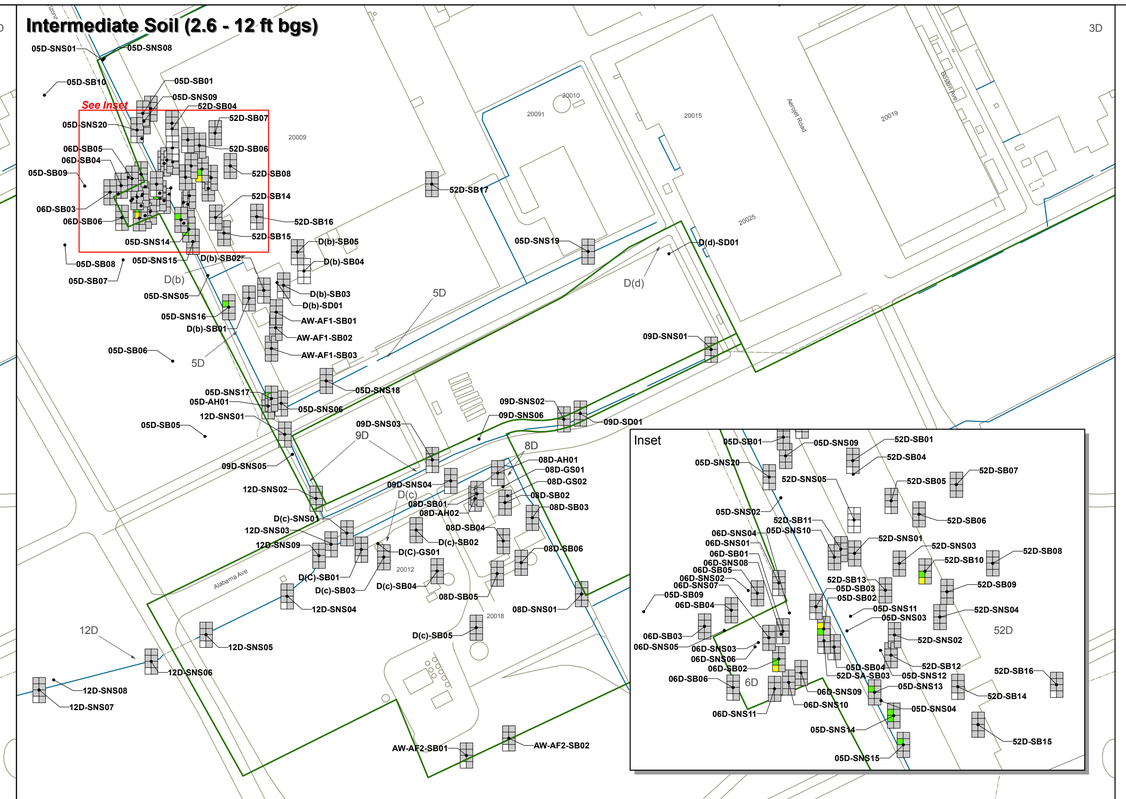
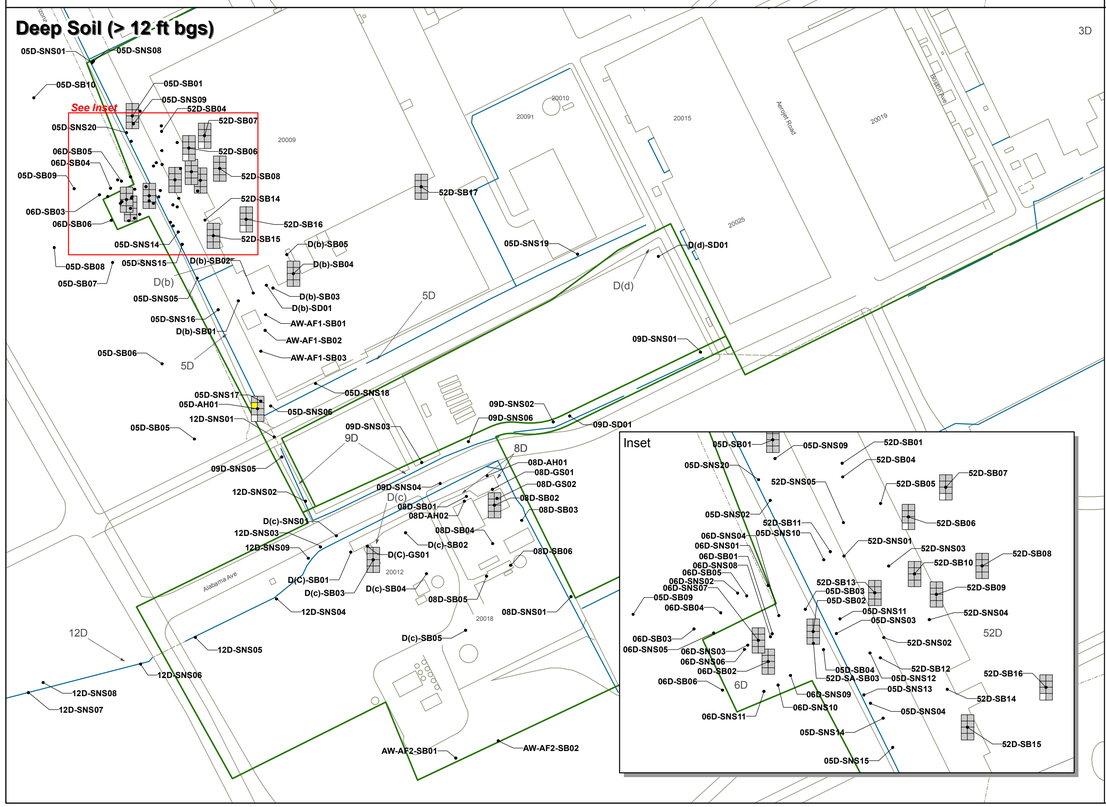
FIGURE 4.3-6
Vadose Zone Cross Section B - B'
Administration Area West
Boundary Operable Unit

7/17/08 PR SR10130987







- Not Analyzed
- < Soil Screening Level (RISL)
- >= RISL and < 10x RISL
- >= 10x RISL and < 100x RISL
- >= 100x RISL

Antimony, Cadmium, Chromium, Chromium VI, Copper, Lead, Silver, Zinc

- Source Area
- Boundary Operable Unit (BOU)

Sample Location	Sample Depth	Antimony	Cadmium	Chromium	Chromium VI	Copper	Lead	Silver	Zinc
Screening Level		30	1.7	211	17	3000	150	380	23000
0 - 2.5 feet bgs									
05D-SB03	1	<SL	**190**	**5300**	NC	<SL	**330**	<SL	<SL
05D-SB06	1	<SL	**9.6**	**670**	<SL	<SL	<SL	<SL	<SL
05D-SB07	1	<SL	**2.6**	<SL	<SL	<SL	<SL	<SL	<SL
05D-SNS01	2.5	<SL	**2.63**	<SL	NC	<SL	<SL	<SL	<SL
05D-SNS02	0	<SL	**9.55**	**2030**	NC	<SL	**210**	<SL	<SL
05D-SNS03	0	<SL	**6.44**	**437**	NC	<SL	<SL	<SL	<SL
05D-SNS04	0	<SL	**11.5**	**2140**	NC	<SL	**285**	<SL	<SL
05D-SNS05	0	<SL	**4.03**	<SL	NC	<SL	<SL	<SL	<SL
05D-SNS06	0	<SL	**7.39**	**408**	NC	<SL	<SL	<SL	<SL
05D-SNS10	1	<SL	**5.8**	<SL	<SL	<SL	<SL	<SL	<SL
05D-SNS11	1	<SL	**3.9**	<SL	<SL	<SL	<SL	<SL	<SL
05D-SNS11	2.5	<SL	**6.4**	<SL	<SL	<SL	<SL	<SL	<SL
05D-SNS12	1	<SL	**42**	<SL	<SL	<SL	<SL	<SL	<SL
05D-SNS12	2.5	<SL	**4.1**	**960**	<SL	<SL	<SL	<SL	<SL
05D-SNS13	1	<SL	**54**	**1800**	<SL	<SL	<SL	<SL	<SL
05D-SNS13	2.5	<SL	**15**	**380**	<SL	<SL	<SL	<SL	<SL
05D-SNS14	1	<SL	**2.5**	<SL	<SL	<SL	<SL	<SL	<SL
05D-SNS14	2.5	<SL	**9.4**	**1800**	<SL	<SL	<SL	<SL	<SL
05D-SNS15	1	<SL	**16**	**2300**	<SL	<SL	**260**	<SL	<SL
05D-SNS15	2.5	<SL	**6.3**	<SL	<SL	<SL	<SL	<SL	<SL
05D-SNS16	1	<SL	**4.6**	<SL	<SL	<SL	<SL	<SL	<SL
05D-SNS16	2.5	<SL	**3.9**	<SL	<SL	<SL	<SL	<SL	<SL
05D-SNS17	1	<SL	**5.6**	**460**	<SL	<SL	<SL	<SL	<SL
05D-SNS17	2.5	<SL	**2.3**	<SL	<SL	<SL	<SL	<SL	<SL
05D-SNS20	1	<SL	**1.8**	<SL	NC	<SL	**150**	<SL	<SL
06D-SB05	2	<SL	**15**	<SL	<SL	<SL	<SL	<SL	<SL
06D-SB06	1	<SL	**3.3**	**290**	NC	<SL	<SL	<SL	<SL
06D-SNS01	0	<SL	**10.8**	**10100**	NC	<SL	<SL	<SL	<SL
06D-SNS01	2.5	<SL	<SL	**480**	NC	<SL	<SL	<SL	<SL
06D-SNS02	0	<SL	<SL	**279**	NC	<SL	<SL	<SL	<SL
06D-SNS04	0	<SL	**4.8**	**3380**	NC	<SL	<SL	<SL	<SL
06D-SNS06	1	<SL	**12**	**19000**	<SL	<SL	<SL	<SL	<SL
06D-SNS06	2.5	<SL	**3**	**4500**	NC	<SL	<SL	<SL	<SL
06D-SNS07	1	**49**	**33**	**43000**	NC	<SL	**640**	<SL	<SL
06D-SNS07	2.5	<SL	**3.7**	**5700**	NC	<SL	<SL	<SL	<SL
06D-SNS08	1	<SL	**16**	**27000**	NC	<SL	**300**	<SL	<SL
06D-SNS08	2.5	<SL	<SL	**1000**	NC	<SL	<SL	<SL	<SL
08D-GS01	0	<SL	**5.06**	<SL	NC	<SL	<SL	<SL	<SL
09D-SNS05	1	<SL	**2.5**	<SL	<SL	<SL	<SL	<SL	<SL
52D-SB02	1	<SL	**14.3**	**3040**	NC	<SL	<SL	<SL	<SL
52D-SNS01	1	<SL	<SL	**280**	<SL	<SL	<SL	<SL	<SL
52D-SNS02	1	<SL	**3.6**	<SL	<SL	<SL	<SL	<SL	<SL
D(b)-SD01	0	<SL	**9.3**	<SL	NC	<SL	<SL	<SL	<SL
2.6 - 12 feet bgs									
05D-SB02	5	<SL	**25**	**1100**	<SL	<SL	<SL	<SL	<SL
05D-SNS15	5	<SL	**4**	<SL	<SL	<SL	<SL	<SL	<SL
05D-SNS15	10	<SL	**6.5**	<SL	<SL	<SL	<SL	<SL	<SL
05D-SNS16	5	<SL	**2**	<SL	<SL	<SL	<SL	<SL	<SL
06D-SB02	5	<SL	<SL	**820**	**430**	<SL	<SL	<SL	<SL
06D-SB02	11	<SL	<SL	**730**	**630**	<SL	<SL	<SL	<SL
52D-SB10	11	<SL	<SL	**550**	**720**	<SL	<SL	<SL	<SL
> 12 feet bgs									
05D-AH01	15	<SL	**22.4**	<SL	NC	<SL	<SL	<SL	<SL

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not analyzed for.
Units in mg/kg.

N

1 " = 200 '

0 200 400
Feet

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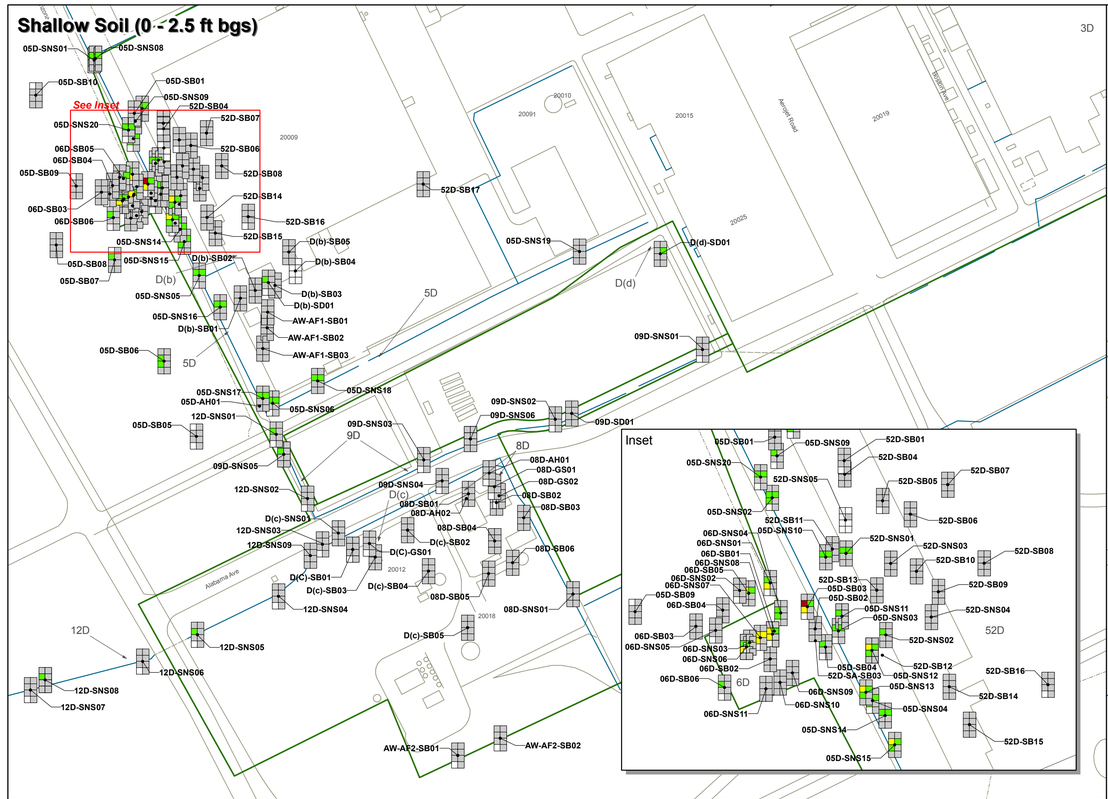
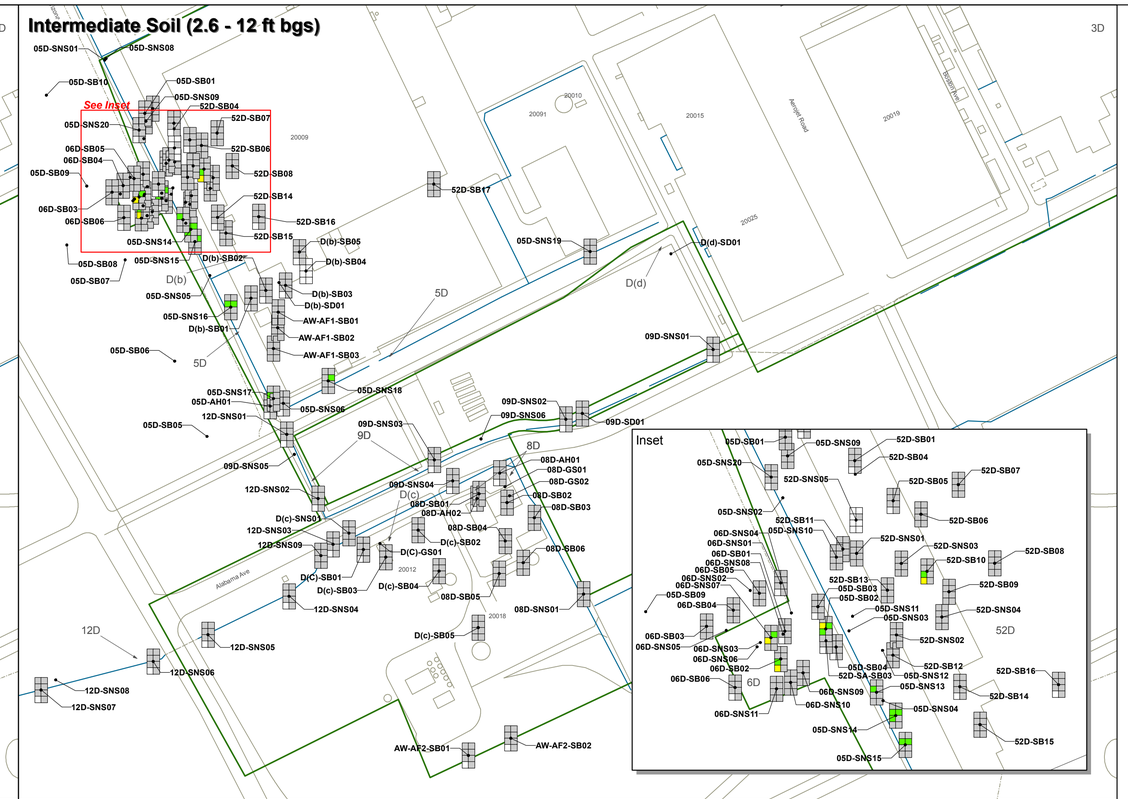
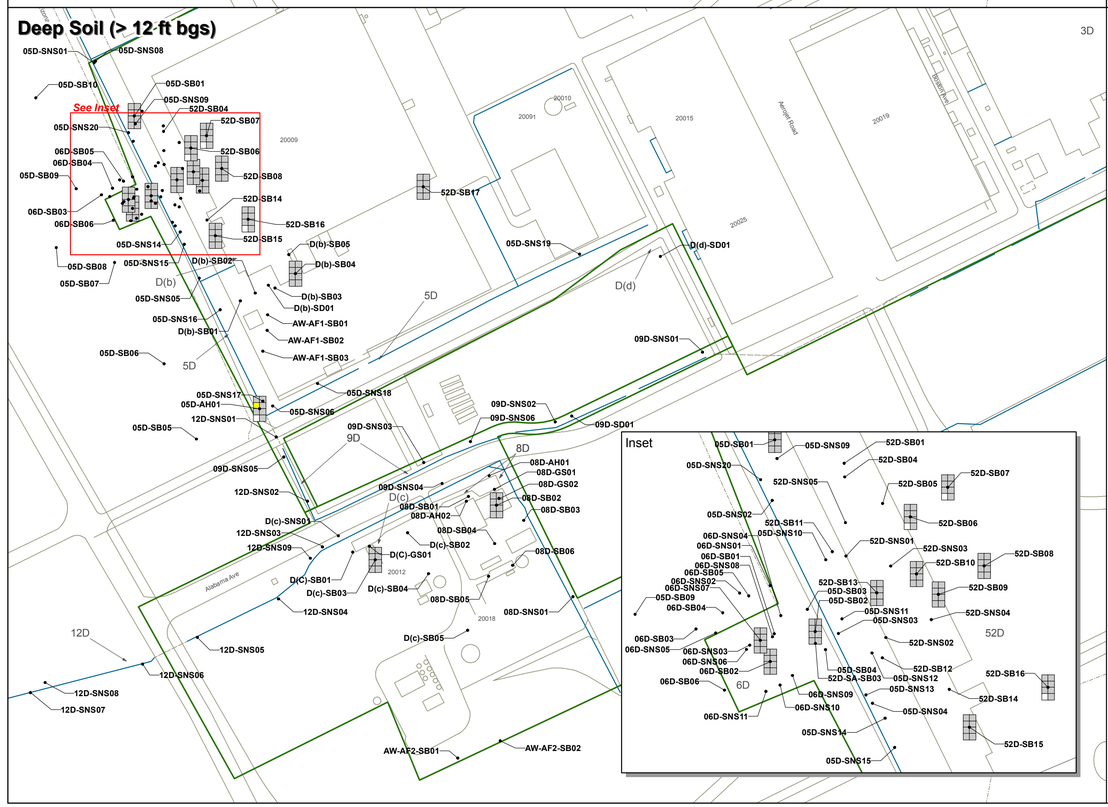
Figure 4.3-7

Metals in Soil Above
Remedial Investigation Screening Levels
Administration Area West







- Not Analyzed
- < Soil Screening Level (PGW SSL)
- >= PGW SSL and < 10x PGW SSL
- >= 10x PGW SSL and < 100x PGW SSL
- >= 100x PGW SSL

Antimony, Cadmium, Chromium, Chromium VI, Copper, Lead, Silver, Zinc

- Source Area
- Boundary Operable Unit (BOU)

Sample Location	Sample Depth	Antimony	Cadmium	Chromium	Chromium VI	Copper	Lead	Silver	Zinc
Screening Level		60	1.2	500	21	3000	42	1000	50000
0 - 2.5 feet bgs									
05D-SB03	1	<SL	**190**	**5300**	NC	<SL	**330**	<SL	<SL
05D-SB04	1	<SL	**1.7**	<SL	NC	<SL	<SL	<SL	<SL
05D-SB06	1	<SL	**9.6**	**670**	<SL	<SL	<SL	<SL	<SL
05D-SB07	1	<SL	**2.6**	<SL	<SL	<SL	<SL	<SL	<SL
05D-SNS01	0	<SL	**1.39**	<SL	NC	<SL	**106**	<SL	<SL
05D-SNS01	2.5	<SL	**2.63**	<SL	NC	<SL	<SL	<SL	<SL
05D-SNS02	0	<SL	**9.55**	**2030**	NC	<SL	**210**	<SL	<SL
05D-SNS03	0	<SL	**6.44**	<SL	NC	<SL	**134**	<SL	<SL
05D-SNS04	0	<SL	**11.5**	**2140**	NC	<SL	**285**	<SL	<SL
05D-SNS05	0	<SL	**4.03**	<SL	NC	<SL	**60.2**	<SL	<SL
05D-SNS06	0	<SL	**7.39**	<SL	NC	<SL	**126**	<SL	<SL
05D-SNS07	0	<SL	**1.44**	<SL	NC	<SL	**101**	<SL	<SL
05D-SNS08	1	<SL	**1.5**	<SL	<SL	<SL	**70**	<SL	<SL
05D-SNS08	2.5	<SL	**1.5**	<SL	<SL	<SL	**67**	<SL	<SL
05D-SNS09	1	<SL	**1.6**	<SL	NC	<SL	<SL	<SL	<SL
05D-SNS10	1	<SL	**5.8**	<SL	<SL	<SL	**100**	<SL	<SL
05D-SNS11	1	<SL	**3.9**	<SL	<SL	<SL	<SL	<SL	<SL
05D-SNS11	2.5	<SL	**6.4**	<SL	<SL	<SL	<SL	<SL	<SL
05D-SNS12	1	<SL	**42**	<SL	<SL	<SL	<SL	<SL	<SL
05D-SNS12	2.5	<SL	**4.1**	**960**	<SL	<SL	**76**	<SL	<SL
05D-SNS13	1	<SL	**54**	**1800**	<SL	<SL	**140**	<SL	<SL
05D-SNS13	2.5	<SL	**15**	<SL	<SL	<SL	<SL	<SL	<SL
05D-SNS14	1	<SL	**2.5**	<SL	<SL	<SL	**50**	<SL	<SL
05D-SNS14	2.5	<SL	**9.4**	**1800**	<SL	<SL	**120**	<SL	<SL
05D-SNS15	1	<SL	**16**	**2300**	<SL	<SL	**260**	<SL	<SL
05D-SNS15	2.5	<SL	**6.3**	<SL	<SL	<SL	**110**	<SL	<SL
05D-SNS16	1	<SL	**4.6**	<SL	<SL	<SL	**65**	<SL	<SL
05D-SNS16	2.5	<SL	**3.9**	<SL	<SL	<SL	**76**	<SL	<SL
05D-SNS17	1	<SL	**5.6**	<SL	<SL	<SL	**130**	<SL	<SL
05D-SNS17	2.5	<SL	**2.3**	<SL	<SL	<SL	<SL	<SL	<SL
05D-SNS18	1	<SL	**1.7**	<SL	<SL	<SL	**48**	<SL	<SL
05D-SNS18	2.5	<SL	<SL	<SL	<SL	<SL	**62**	<SL	<SL
05D-SNS19	1	<SL	**1.2**	<SL	<SL	<SL	<SL	<SL	<SL
05D-SNS20	1	<SL	**1.8**	<SL	NC	<SL	**150**	<SL	<SL
06D-SB05	2	<SL	**15**	<SL	<SL	<SL	**80**	<SL	<SL
06D-SB06	1	<SL	**3.3**	<SL	NC	<SL	<SL	<SL	<SL
06D-SNS01	0	<SL	**10.8**	**10100**	NC	<SL	<SL	<SL	<SL
06D-SNS04	0	<SL	**4.8**	**3380**	NC	<SL	<SL	<SL	<SL
06D-SNS06	1	<SL	**12**	**19000**	<SL	<SL	**100**	<SL	<SL
06D-SNS06	2.5	<SL	**3**	**4500**	NC	<SL	<SL	<SL	<SL
06D-SNS07	1	<SL	**33**	**43000**	NC	<SL	**640**	<SL	<SL
06D-SNS07	2.5	<SL	**3.7**	**5700**	<SL	<SL	**57**	<SL	<SL
06D-SNS08	1	<SL	**16**	**27000**	NC	<SL	**300**	<SL	<SL
06D-SNS08	2.5	<SL	**1.4**	**1000**	NC	<SL	<SL	<SL	<SL
08D-GS01	0	<SL	**5.06**	<SL	NC	<SL	<SL	<SL	<SL
09D-SNS05	1	<SL	**2.5**	<SL	<SL	<SL	<SL	<SL	<SL
09D-SNS05	2.5	<SL	**1.7**	<SL	<SL	<SL	<SL	<SL	<SL
12D-SNS01	0	<SL	**1.58**	<SL	NC	<SL	<SL	<SL	<SL
12D-SNS05	0	<SL	**1.24**	<SL	NC	<SL	<SL	<SL	<SL
12D-SNS08	2.5	<SL	**1.7**	<SL	<SL	<SL	<SL	<SL	<SL

Sample Location	Sample Depth	Antimony	Cadmium	Chromium	Chromium VI	Copper	Lead	Silver	Zinc
Screening Level		60	1.2	500	21	3000	42	1000	50000
0 - 2.5 feet bgs									
52D-SB02	1	<SL	**14.3**	**3040**	NC	<SL	**45.4**	<SL	<SL
52D-SB11	1	<SL	**1.2**	<SL	<SL	<SL	<SL	<SL	<SL
52D-SNS01	1	<SL	**1.4**	<SL	<SL	<SL	**130**	<SL	<SL
52D-SNS02	1	<SL	**3.6**	<SL	<SL	<SL	<SL	<SL	<SL
D(b)-SD01	0	<SL	**9.3**	<SL	NC	<SL	<SL	<SL	<SL
D(d)-SD01	0	<SL	<SL	<SL	<SL	<SL	**120**	<SL	<SL
2.6 - 12 feet bgs									
05D-SB02	5	<SL	**25**	**1100**	<SL	<SL	**74**	<SL	<SL
05D-SNS13	10	<SL	**4.7**	<SL	<SL	<SL	<SL	<SL	<SL
05D-SNS14	5	<SL	**1.4**	<SL	<SL	<SL	<SL	<SL	<SL
05D-SNS14	10	<SL	**4.7**	<SL	<SL	<SL	<SL	<SL	<SL
05D-SNS15	5	<SL	**4**	<SL	<SL	<SL	<SL	<SL	<SL
05D-SNS15	10	<SL	**6.5**	<SL	<SL	<SL	<SL	<SL	<SL
05D-SNS16	5	<SL	**2**	<SL	<SL	<SL	<SL	<SL	<SL
06D-SB02	5	<SL	<SL	**820**	**430**	<SL	<SL	<SL	<SL
06D-SB02	11	<SL	<SL	**730**	**630**	<SL	<SL	<SL	<SL
52D-SA-SB03	5	<SL	**1.36**	<SL	NC	<SL	<SL	<SL	<SL
52D-SB10	11	<SL	<SL	**550**	**720**	<SL	<SL	<SL	<SL
> 12 feet bgs									
05D-AH01	15	<SL	**22.4**	<SL	NC	<SL	<SL	<SL	<SL

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not analyzed for.
Units in mg/kg.

N

1 " = 200 '

0 200 400
Feet

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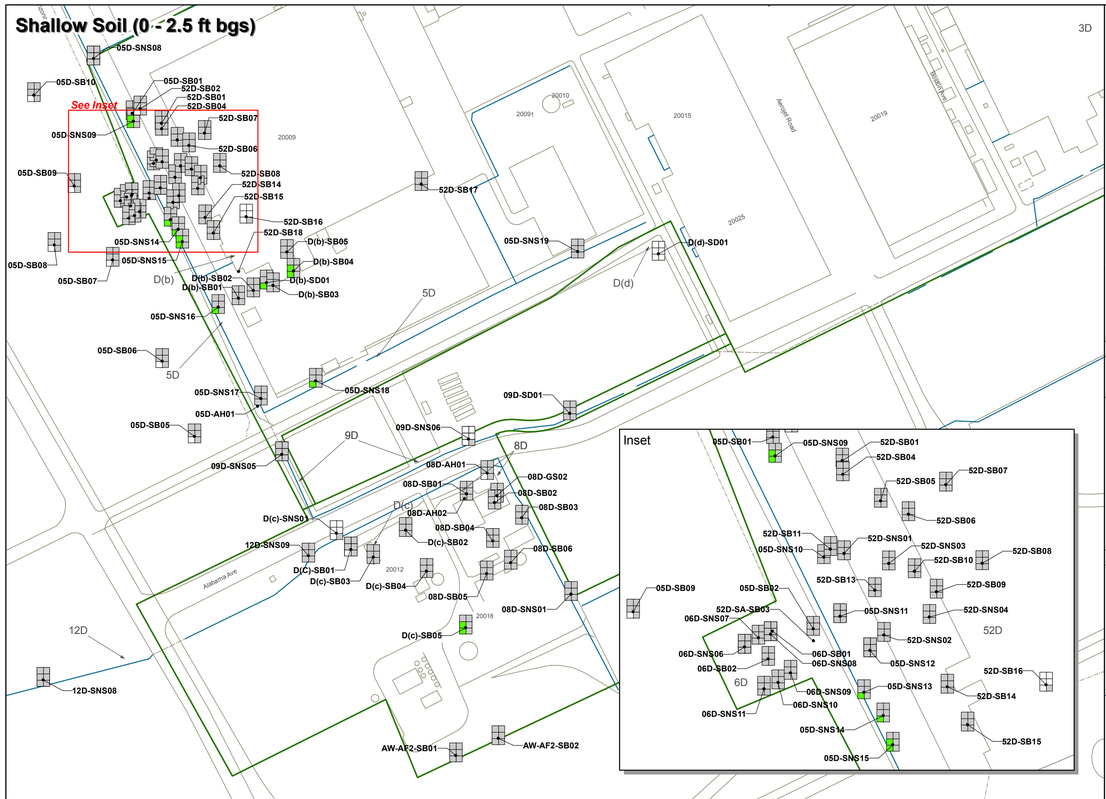
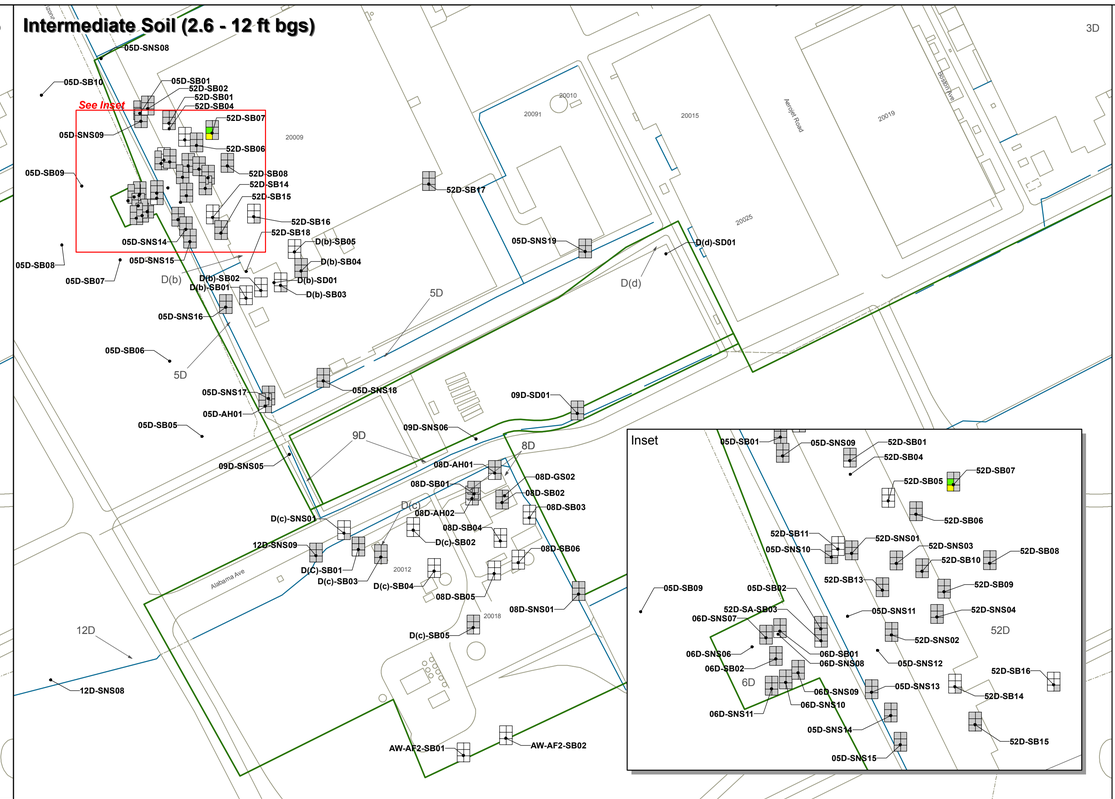
Figure 4.3-8

Metals Above Protection of Groundwater Soil Screening Levels
Administration Area West

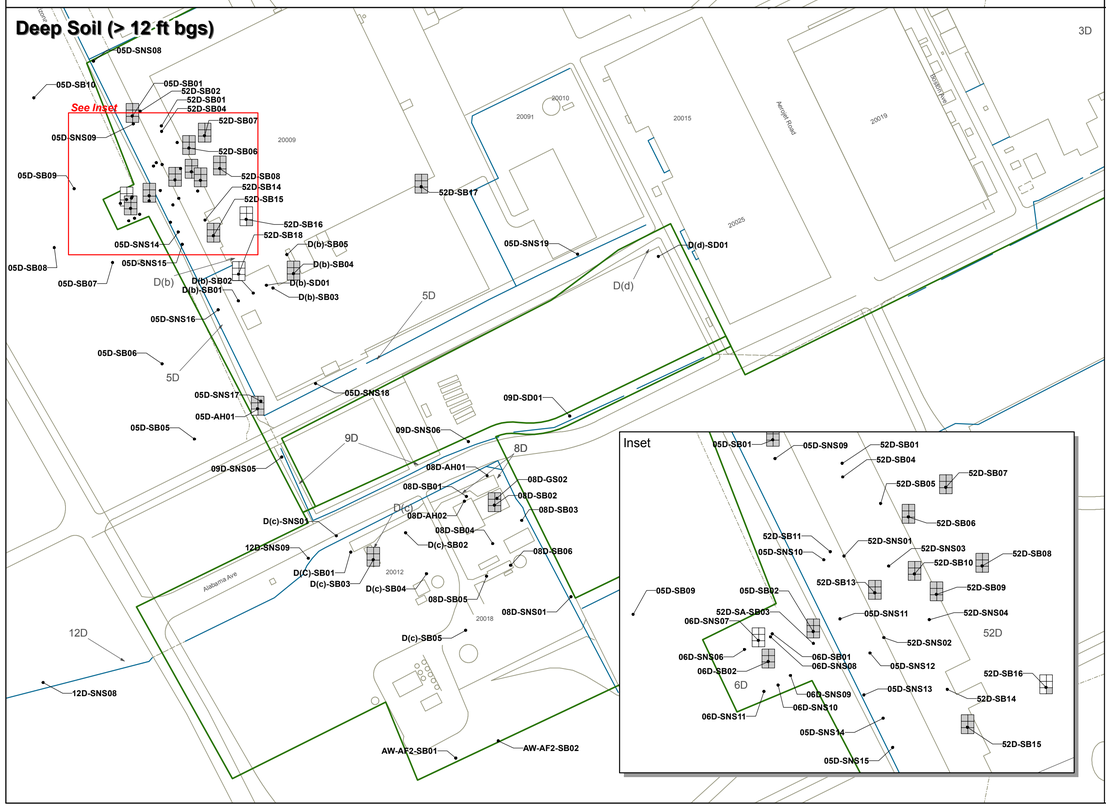




- Not Analyzed
- < Soil Screening Level (RISL)
- >= RISL and < 10x RISL
- >= 10x RISL and < 100x RISL
- >= 100x RISL

Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b&k)fluoranthene
Dibenz(a,h)anthracene
Indeno(1,2,3-cd)pyrene
Pentachlorophenol

- Source Area
- Boundary Operable Unit (BOU)



Sample Location	Sample Depth	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b&k) fluoranthene	Dibenz(a,h) anthracene	Indeno(1,2,3-cd)pyrene	Pentachloro-phenol
Screening Level		0.62	0.038	0.038	0.062	0.621	3000
0 - 2.5 feet bgs							
05D-SNS09	1	<SL	**0.089**	**0.23**	<SL	<SL	<SL
05D-SNS13	1	<SL	<SL	**0.097**	<SL	<SL	<SL
05D-SNS14	1	<SL	<SL	**0.096**	<SL	<SL	<SL
05D-SNS15	1	<SL	**0.041**	**0.16**	<SL	<SL	<SL
05D-SNS16	1	<SL	<SL	**0.26**	<SL	<SL	<SL
D(b)-SB04	1	<SL	**0.059**	**0.12**	<SL	<SL	<SL
D(b)-SD01	0	<SL	<SL	**0.075**	<SL	<SL	<SL
D(c)-SB05	1	<SL	**0.1**	**0.2**	<SL	<SL	<SL
2.6 - 12 feet bgs							
52D-SB07	5	<SL	**0.34**	**0.45**	<SL	<SL	<SL

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not analyzed for.
Units in mg/kg.

N

1 " = 200 '

0 200 400
Feet

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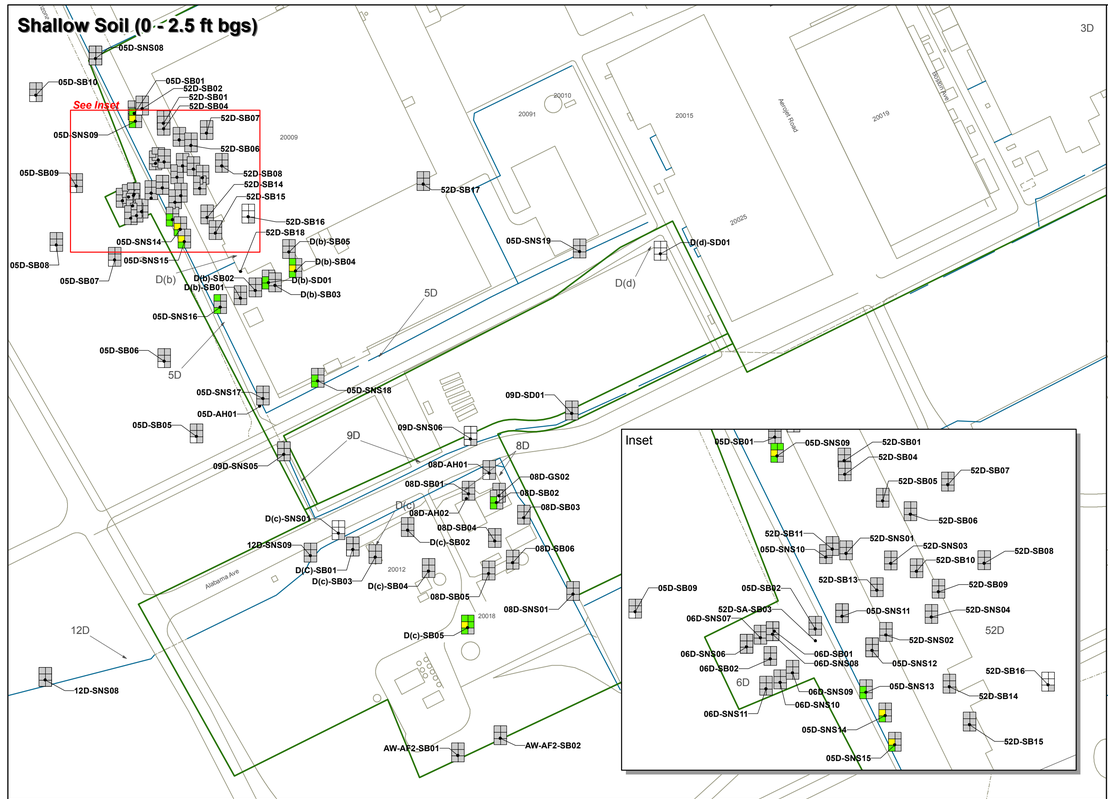
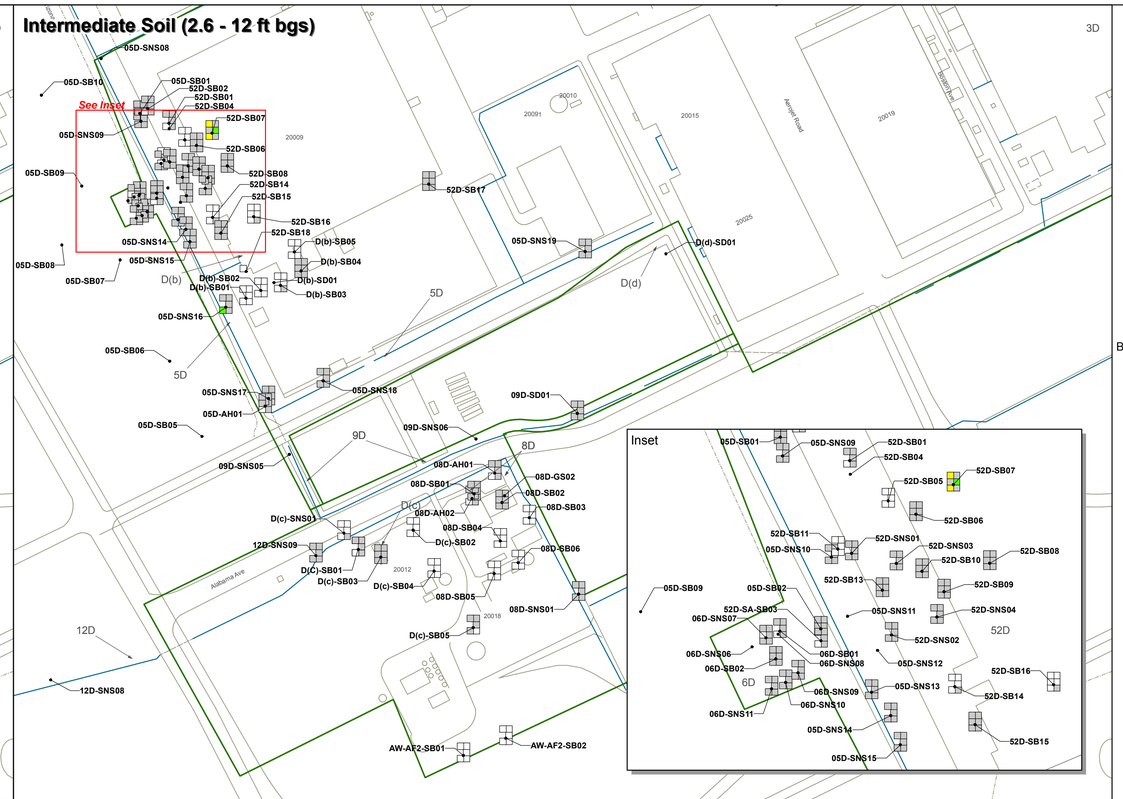
Figure 4.3-9

SVOCs and Pentachlorophenol in Soil
Above Remedial Investigation Screening Levels
Administration Area West

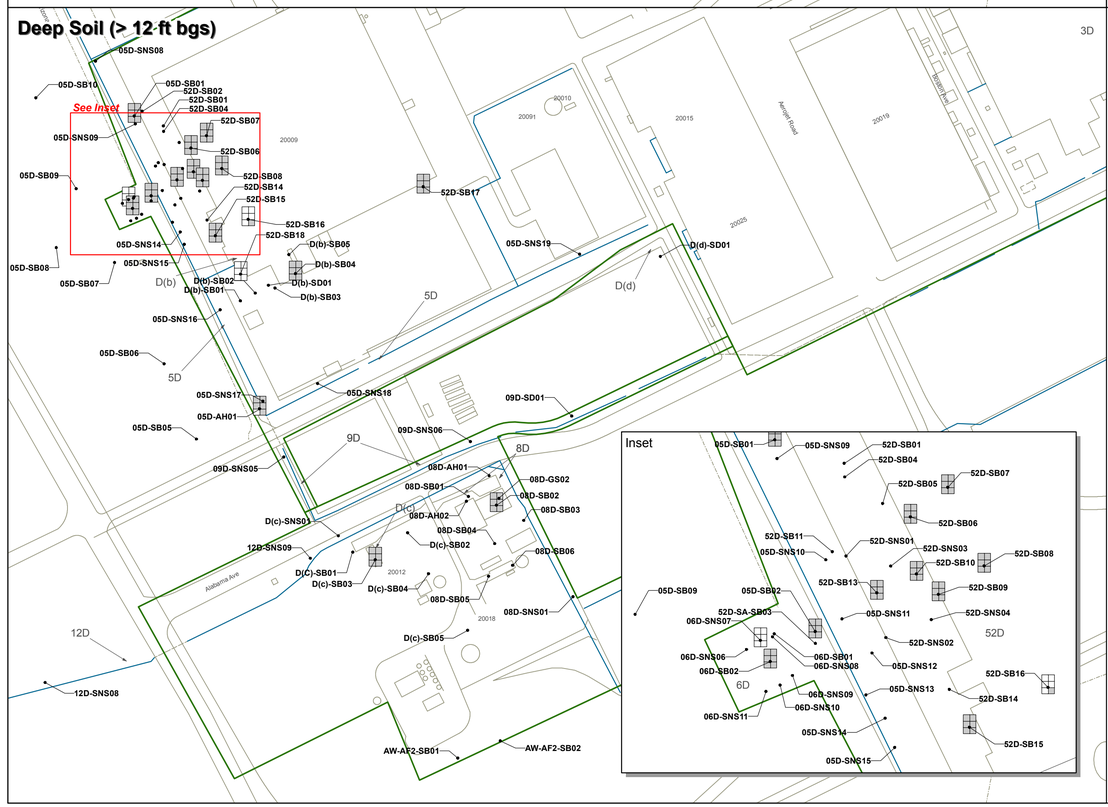




- Not Analyzed
- < Soil Screening Level (PGW SSL)
- >= PGW SSL and < 10x PGW SSL
- >= 10x PGW SSL and < 100x PGW SSL
- >= 100x PGW SSL

Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b&k)fluoranthene
Dibenz(a,h)anthracene
Indeno(1,2,3-cd)pyrene
Pentachlorophenol

- Source Area
- Boundary Operable Unit (BOU)



Sample Location	Sample Depth	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b&k) fluoranthene	Dibenz(a,h) anthracene	Indeno(1,2,3-cd)pyrene	Pentachloro-phenol
Screening Level		0.029	0.0029	0.029	0.0029	0.029	0.4
0 - 2.5 feet bgs							
05D-SNS09	1	**0.068**	**0.089**	**0.23**	**0.0068**	<SL	<SL
05D-SNS13	1	<SL	**0.026**	**0.097**	<SL	<SL	<SL
05D-SNS14	1	<SL	**0.032**	**0.096**	<SL	<SL	<SL
05D-SNS15	1	<SL	**0.041**	**0.16**	<SL	<SL	<SL
05D-SNS16	1	**0.047**	<SL	**0.26**	<SL	<SL	<SL
05D-SNS16	2.5	<SL	**0.007**	**0.03**	<SL	<SL	<SL
05D-SNS18	1	<SL	**0.014**	**0.038**	<SL	<SL	<SL
08D-SB02	1	<SL	**0.02**	**0.031**	<SL	<SL	<SL
D(b)-SB04	1	**0.049**	**0.059**	**0.12**	<SL	<SL	<SL
D(b)-SD01	0	<SL	**0.021**	**0.075**	<SL	<SL	<SL
D(c)-SB05	1	**0.077**	**0.1**	**0.2**	**0.018**	**0.059**	<SL
2.6 - 12 feet bgs							
08D-SB02	5	<SL	**0.0084**	<SL	<SL	<SL	<SL
52D-SB07	5	**0.33**	**0.34**	**0.45**	<SL	**0.059**	<SL
D(b)-SB04	5	<SL	**0.0072**	<SL	<SL	<SL	<SL

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not analyzed for.
Units in mg/kg.

N

1 " = 200 '

0 200 400
Feet

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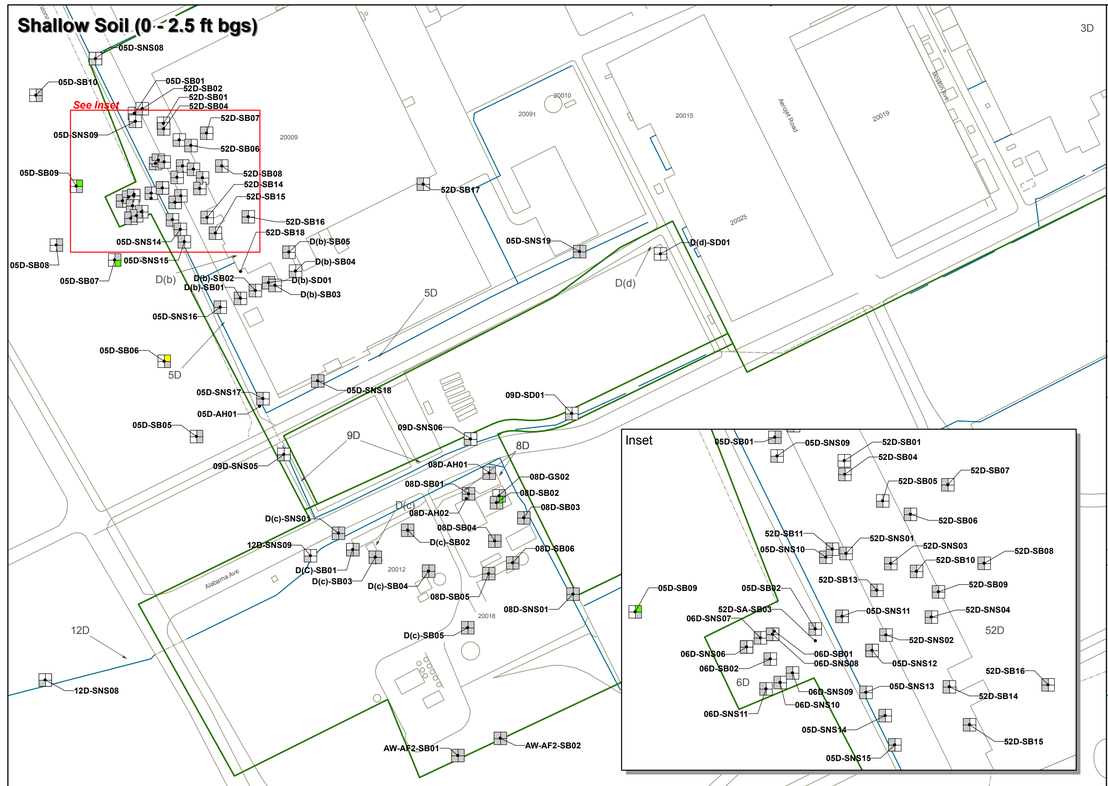
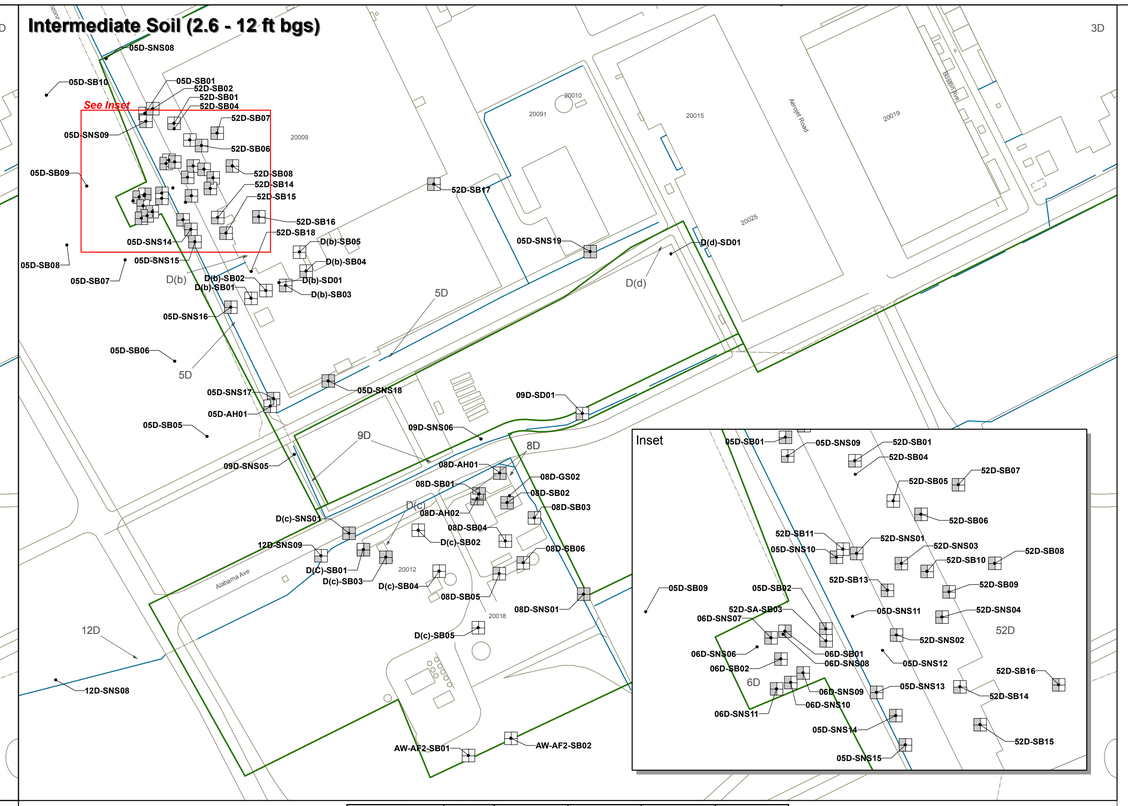
Environmental Remediation

Figure 4.3-10

SVOCs and Pentachlorophenol Above Protection of Groundwater Soil Screening Levels Administration Area West





Not Analyzed

< Soil Screening Level (RISL)

>= RISL and < 10x RISL

>= 10x RISL and < 100x RISL

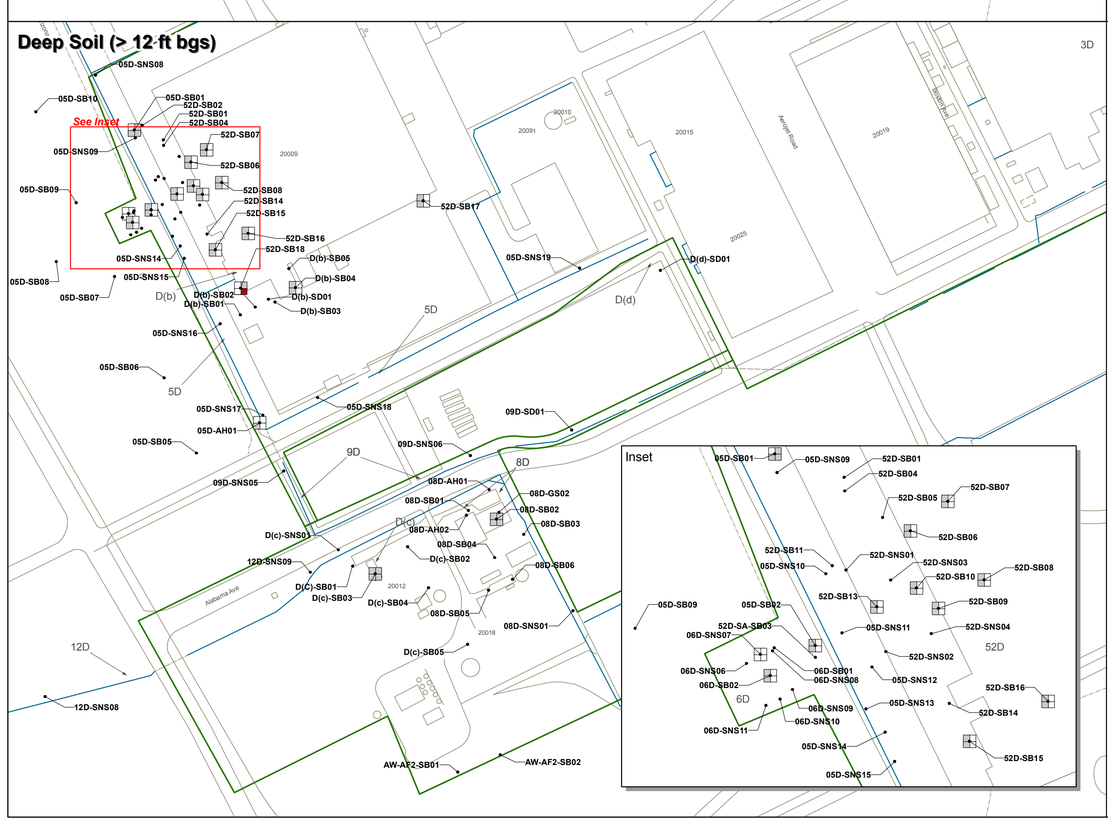
>= 100x RISL

Perchlorate
NDMA

Aroclor 1254
Aroclor 1260

Source Area

Boundary Operable Unit (BOU)



Sample Location	Sample Depth	NDMA	PCB-1254	PCB-1260	Perchlorate
Screening Level		0.0095	0.22	0.22	7.8
0 - 2.5 feet bgs					
05D-SB06	1	NC	**2.5**	<SL	NC
05D-SB07	1	NC	<SL	**0.8**	NC
05D-SB09	1	NC	**0.61**	<SL	NC
08D-SB02	1	<SL	**0.27**	<SL	<SL
> 12 feet bgs					
52D-SB18	16	NC	<SL	**120**	NC
52D-SB18	21	NC	<SL	**0.8**	NC

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not analyzed for.
Units in mg/kg.

N

1 " = 200 '

0 200 400
Feet

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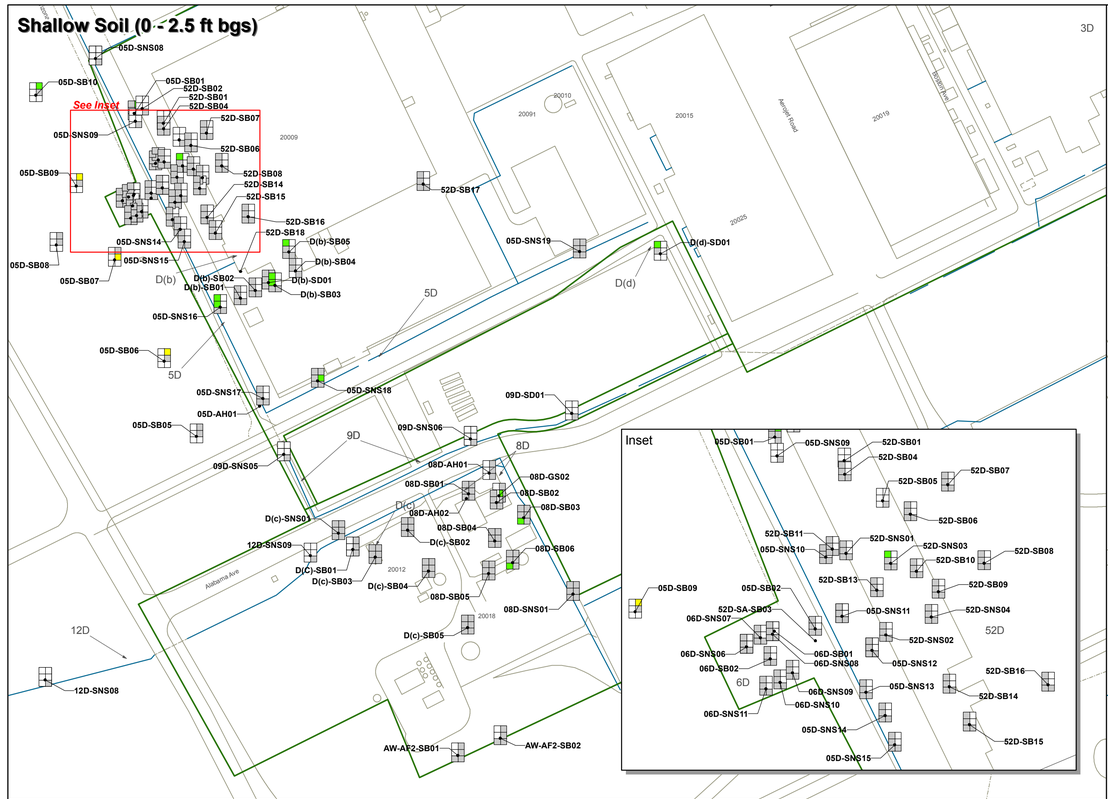
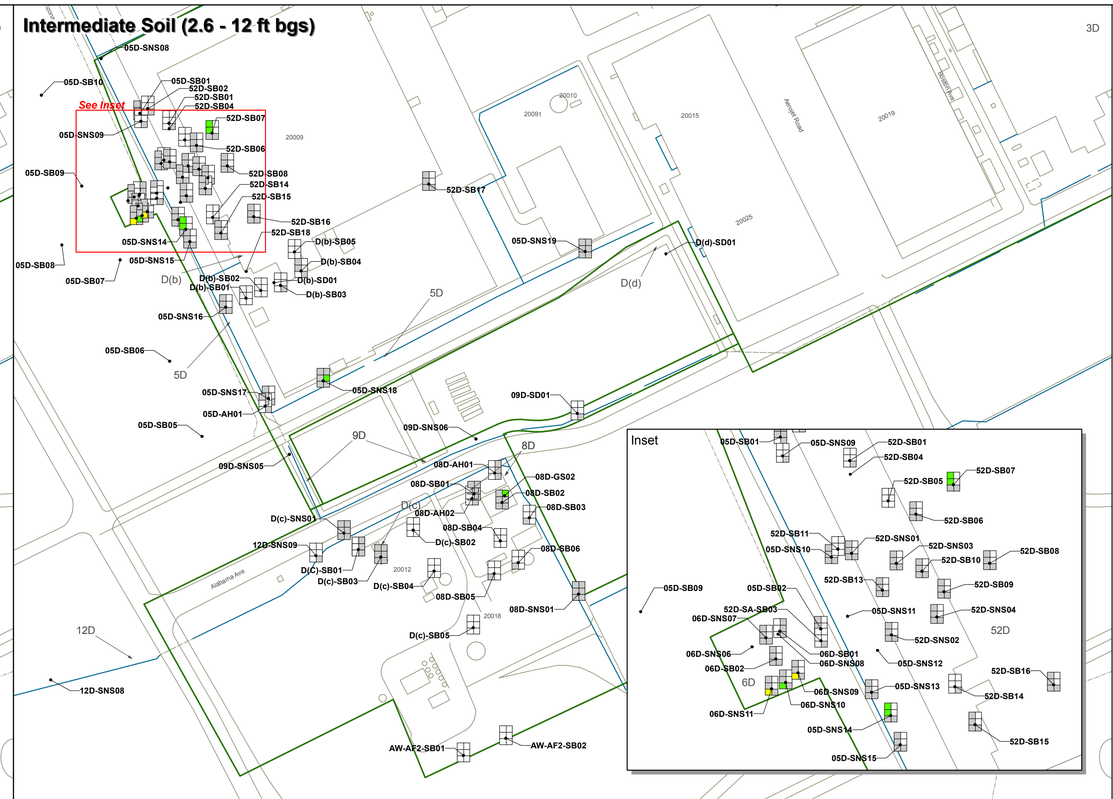
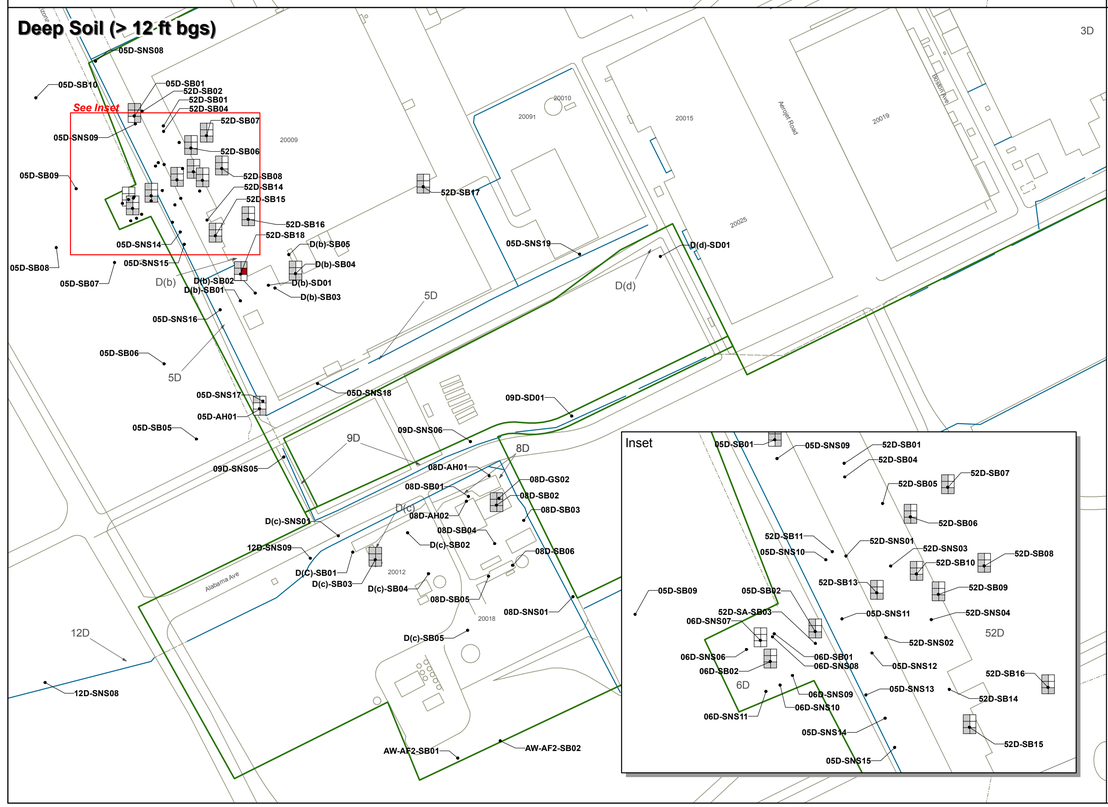
Environmental Remediation

Figure 4.3-11

PCBs, NDMA and Perchlorate in Soil
Above Remedial Investigation Screening Levels
Administration Area West







- Not Analyzed
- < Soil Screening Level (PGW SSL)
- >= PGW SSL and < 10x PGW SSL
- >= 10x PGW SSL and < 100x PGW SSL
- >= 100x PGW SSL

TPH-D, TPH-MO, Perchlorate — Arochlor 1254, Aroclor 1260, NDMA

- Source Area
- Boundary Operable Unit (BOU)

Sample Location	Sample Depth	TPH as Diesel	TPH as Motor Oil	NDMA	PCB-1254	PCB-1260	Perchlorate
Screening Level		100	500	0.00003	0.034	0.034	0.06
0 - 2.5 feet bgs							
05D-SB01	1	<SL	<SL	<SL	**0.076**	<SL	NC
05D-SB06	1	NC	NC	NC	**2.5**	<SL	NC
05D-SB07	1	NC	NC	NC	<SL	**0.8**	NC
05D-SB09	1	NC	NC	NC	**0.61**	<SL	NC
05D-SB10	1	NC	NC	NC	**0.046**	<SL	NC
05D-SNS13	1	<SL	<SL	<SL	NC	NC	<SL
05D-SNS13	2.5	<SL	<SL	<SL	NC	NC	<SL
05D-SNS14	1	<SL	<SL	<SL	NC	NC	<SL
05D-SNS14	2.5	**230**	**640**	<SL	NC	NC	<SL
05D-SNS15	1	<SL	<SL	<SL	NC	NC	<SL
05D-SNS16	1	**250**	**850**	<SL	NC	NC	<SL
05D-SNS18	1	<SL	<SL	<SL	<SL	**0.1**	<SL
05D-SNS18	2.5	<SL	<SL	<SL	<SL	**0.065**	<SL
06D-SNS09	2.5	<SL	<SL	<SL	NC	NC	**1.3**
06D-SNS10	2.5	<SL	<SL	<SL	NC	NC	**0.53**
06D-SNS11	2.5	<SL	<SL	<SL	NC	NC	**1.9**
08D-SB02	1	<SL	<SL	<SL	**0.27**	<SL	<SL
08D-SB03	1	<SL	<SL	<SL	<SL	<SL	**0.099**
08D-SB06	1	<SL	<SL	<SL	<SL	<SL	**0.078**
52D-SN503	1	**130**	<SL	<SL	NC	NC	<SL
D(b)-SB03	1	**240**	**730**	<SL	NC	NC	<SL
D(b)-SB05	1	**100**	<SL	<SL	NC	NC	<SL
D(b)-SD01	0	<SL	<SL	<SL	<SL	**0.17**	<SL
D(d)-SD01	0	**130**	<SL	NC	NC	NC	NC
2.6 - 12 feet bgs							
52D-SB07	5	**220**	**530**	<SL	NC	NC	<SL
> 12 feet bgs							
52D-SB18	16	<SL	<SL	NC	<SL	**120**	NC
52D-SB18	21	<SL	<SL	NC	<SL	**0.8**	NC
52D-SB18	26	<SL	<SL	NC	<SL	**0.18**	NC

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not analyzed for.
Units in mg/kg.

N

1 " = 200 '

0 200 400
Feet

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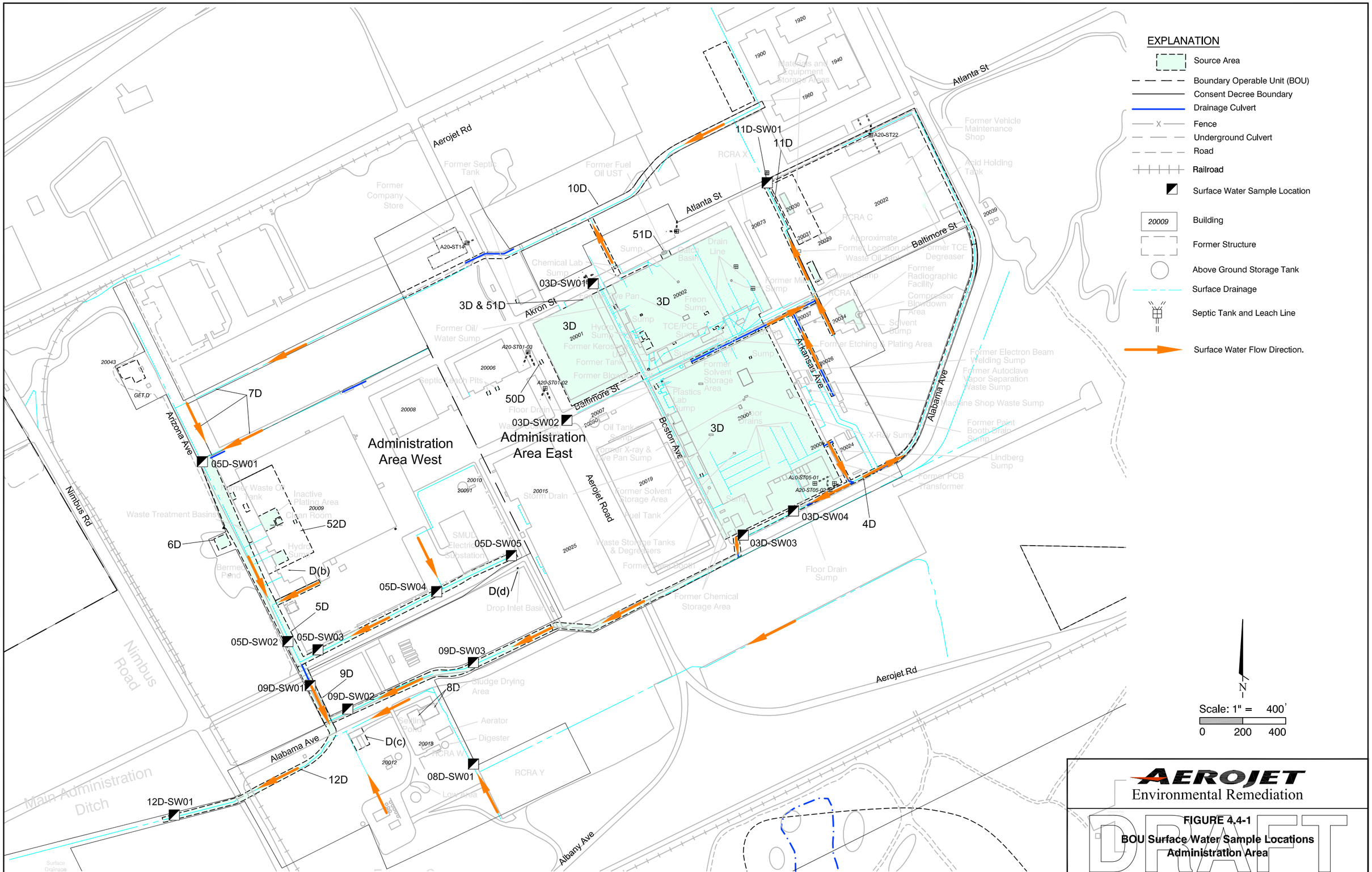
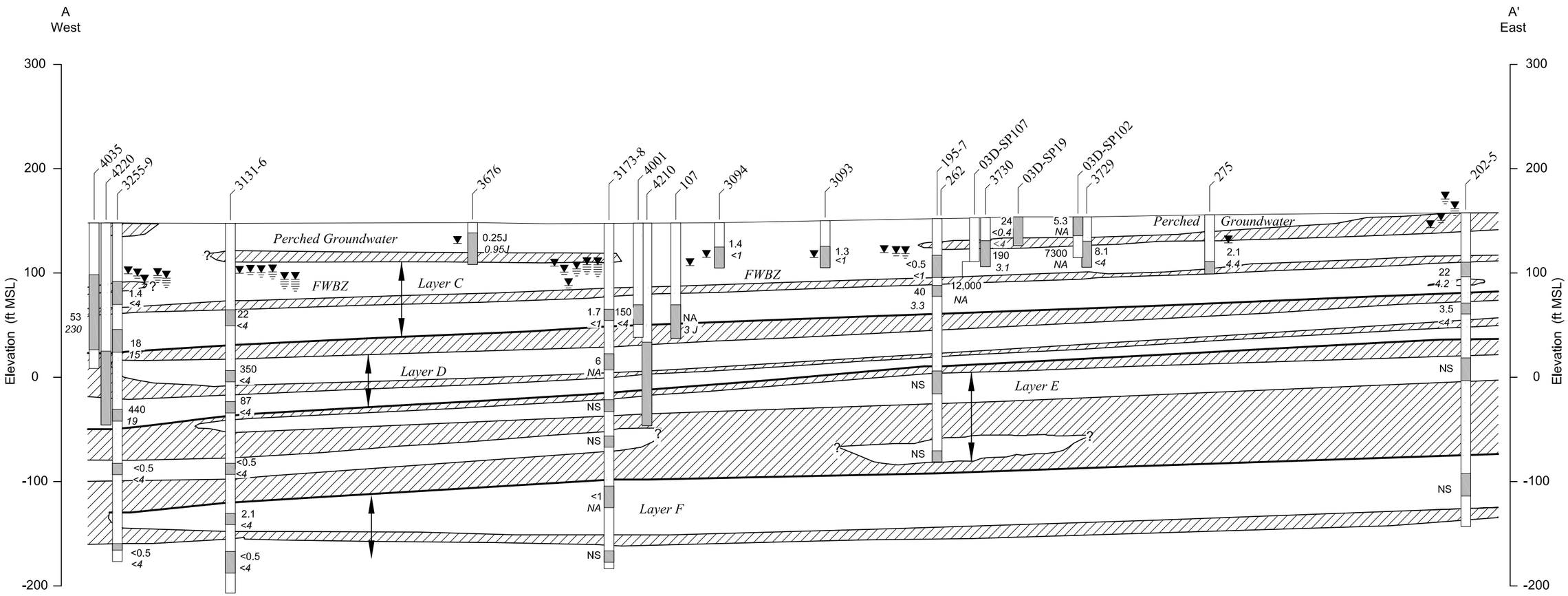
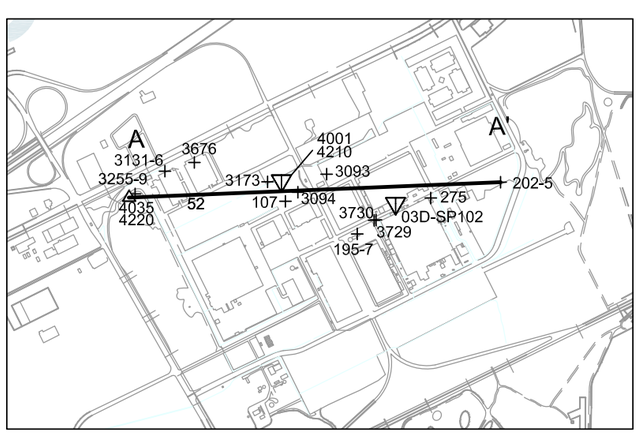
Figure 4.3-12

PCBs, NDMA, Perchlorate, TPH-D, and TPH-Mo Above Protection of Groundwater Soil Screening Levels - Administration Area West



9\11\08 PR SR10130989





Scale: 1" = 1,600'

0 800 1,600

Locator Scale

N

EXPLANATION

1001 — Well Designation
Multiple Completions: Depth Increases by Ascending Well Number Order

<0.5 — TCE Concentration in µg/L (Most Recent 2005-2006)

<4 — Perchlorate Concentration in µg/L (Most Recent 2005-2006)
(NS = Not Sampled)
(NA = Not Analyzed)

Screened Interval

Total Borehole Depth

▼ Water Level: Number of Ticks Indicates Screen Level

FWBZ First Water-Bearing Zone

Layer Boundary

Geologic Contact

Relatively permeable sediments: Silty, poorly and well-graded sands and gravels (GP,GW,SP,SW); silty and clayey gravels (GM/GC) and silts.

Relatively lower permeability sediments: Low plasticity clays and silts (CL,ML).

Vertical Scale 1' = 100'

100

0 300

Horizontal Scale 1' = 300'

Vertical Exaggeration: 3X

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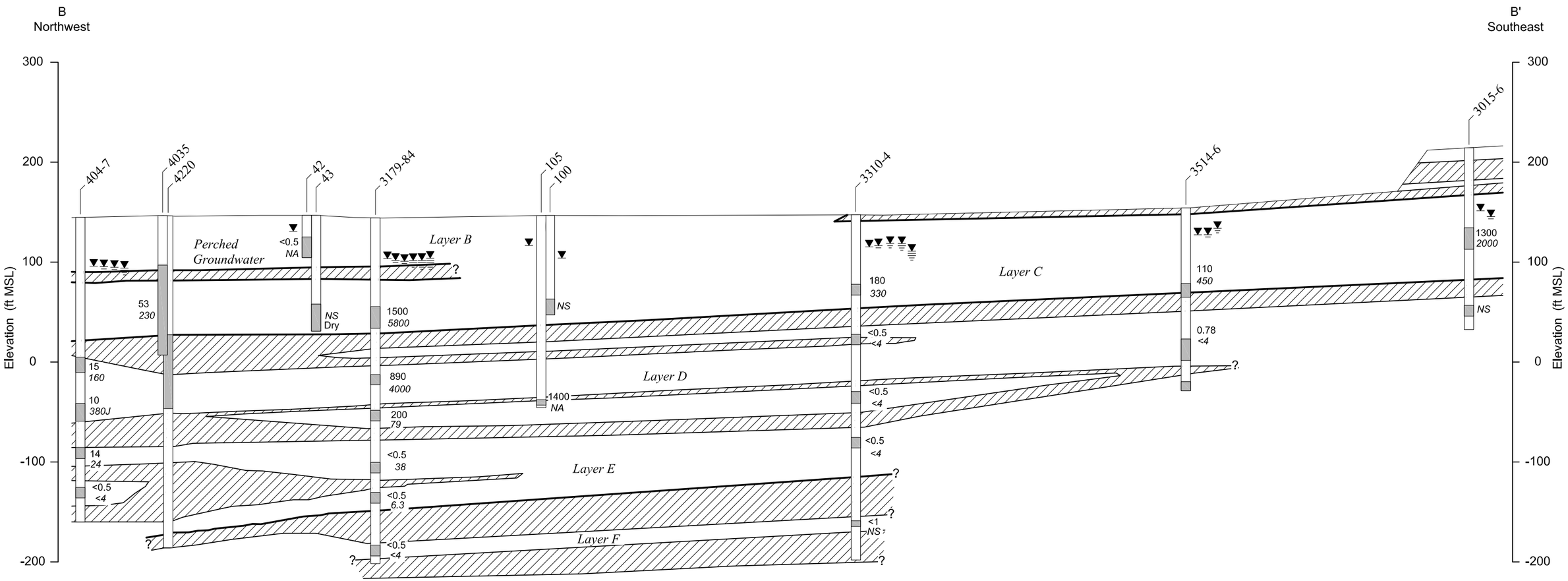
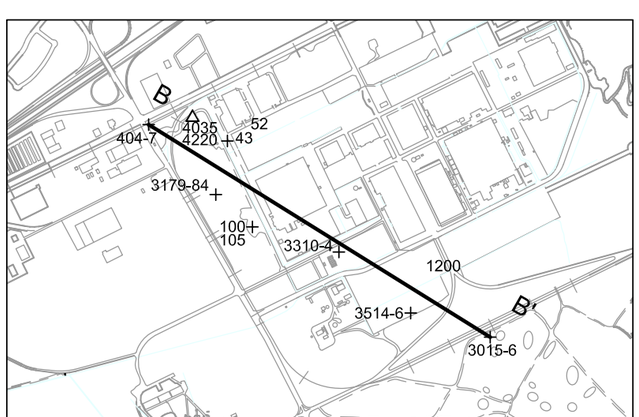
FIGURE 4.5-1
Hydrostratigraphic Cross-Section A-A'
Administration Area
Boundary Operable Unit (OU-6)

DRAFT

SR10130990 FIG 4.5-1 FIGURE 4.5-1 6/22/10 Carmelita Tallada 10:48:37 AM AEROJET SUPERFUND SITE, SACRAMENTO COUNTY, CA





Scale: 1" = 1,600'

0 800 1,600

Locator Scale

N

EXPLANATION

1001 — Well Designation
Multiple Completions: Depth Increases by Ascending Well Number Order

<0.5 — TCE Concentration in µg/L (Most Recent 2005-2006)

<4 — Perchlorate Concentration in µg/L (Most Recent 2005-2006)

(NS = Not Sampled)
(NA = Not Analyzed)

Screened Interval

Total Borehole Depth

Water Level: Number of Ticks Indicates Screen Level

FWBZ First Water-Bearing Zone

Layer Boundary

Geologic Contact

Relatively permeable sediments: Silty, poorly and well-graded sands and gravels (GP,GW,SP,SW); silty and clayey gravels (GM/GC) and silts.

Relatively lower permeability sediments: Low plasticity clays and silts (CL,ML).

Vertical Scale 1' = 100'

100

0 300

Horizontal Scale 1' = 300'

Vertical Exaggeration: 3X

AEROJET
Environmental Remediation

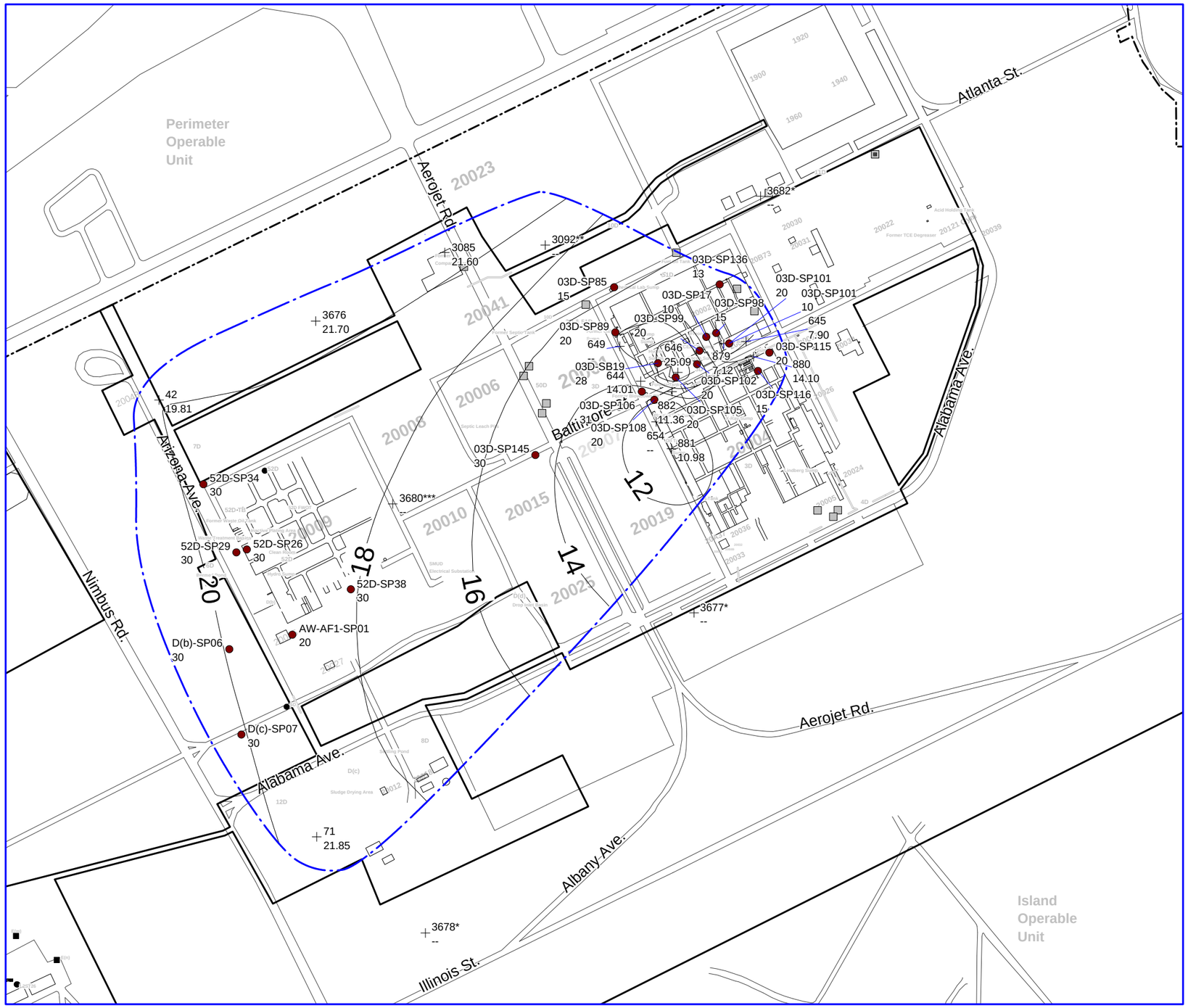
FIGURE 4.5-2
Hydrostratigraphic Cross-Section B-B'
Administration Area
Boundary Operable Unit (OU-6)

DRAFT

AEROJET SUPERFUND SITE, SACRAMENTO COUNTY, CA

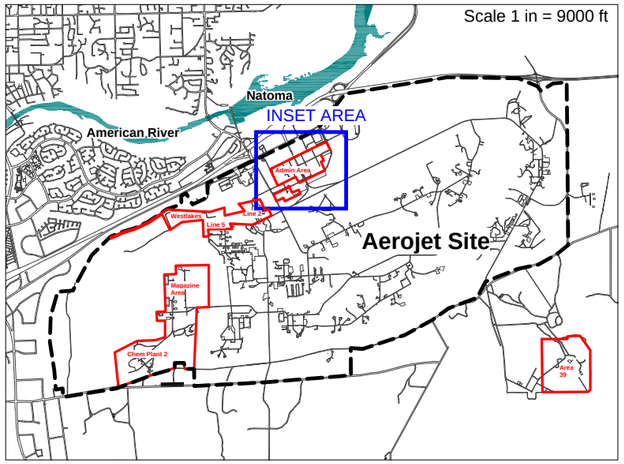
Carmelita Tallada 6/22/10 FIGURE 4.5-2

SR10130991 FIG 4.5-2



Explanation

- 03D-SP29 61.3 — Grab Groundwater Sample Location and Depth to Groundwater (ft, bgs) - Data not used for contouring
- 645 61.3 — Monitoring Well, ID and Depth to Groundwater (ft, bgs)
- 4035 -- — Extraction Well, ID and Depth to Groundwater (ft, bgs)
- * - Denotes first water-bearing zone well for which log indicates perched groundwater was not present
- ** - Denotes well screened in both perched and first water-bearing zone
- *** - Denotes first water-bearing zone well for which log indicates perched groundwater was present
- -- = not measured
- Area of Perched Groundwater
- Depth to Groundwater Contour (ft, bgs)
- Aerojet Property Boundary
- Consent Decree Boundary
- 20026 — Building
- Septic Tank
- 5(d) — Source Area ID
- Drainage Culvert



N

0 500 1,000

feet

AEROJET

Environmental Remediation

Figure 4.5-3
Perched Groundwater
Depth to Groundwater, April 2006
Administration Area - Boundary Operable Unit (OU-6)

Figure created on behalf of Aerojet by: CVEI CENTRAL VALLEY ENVIRONMENTAL, INC.

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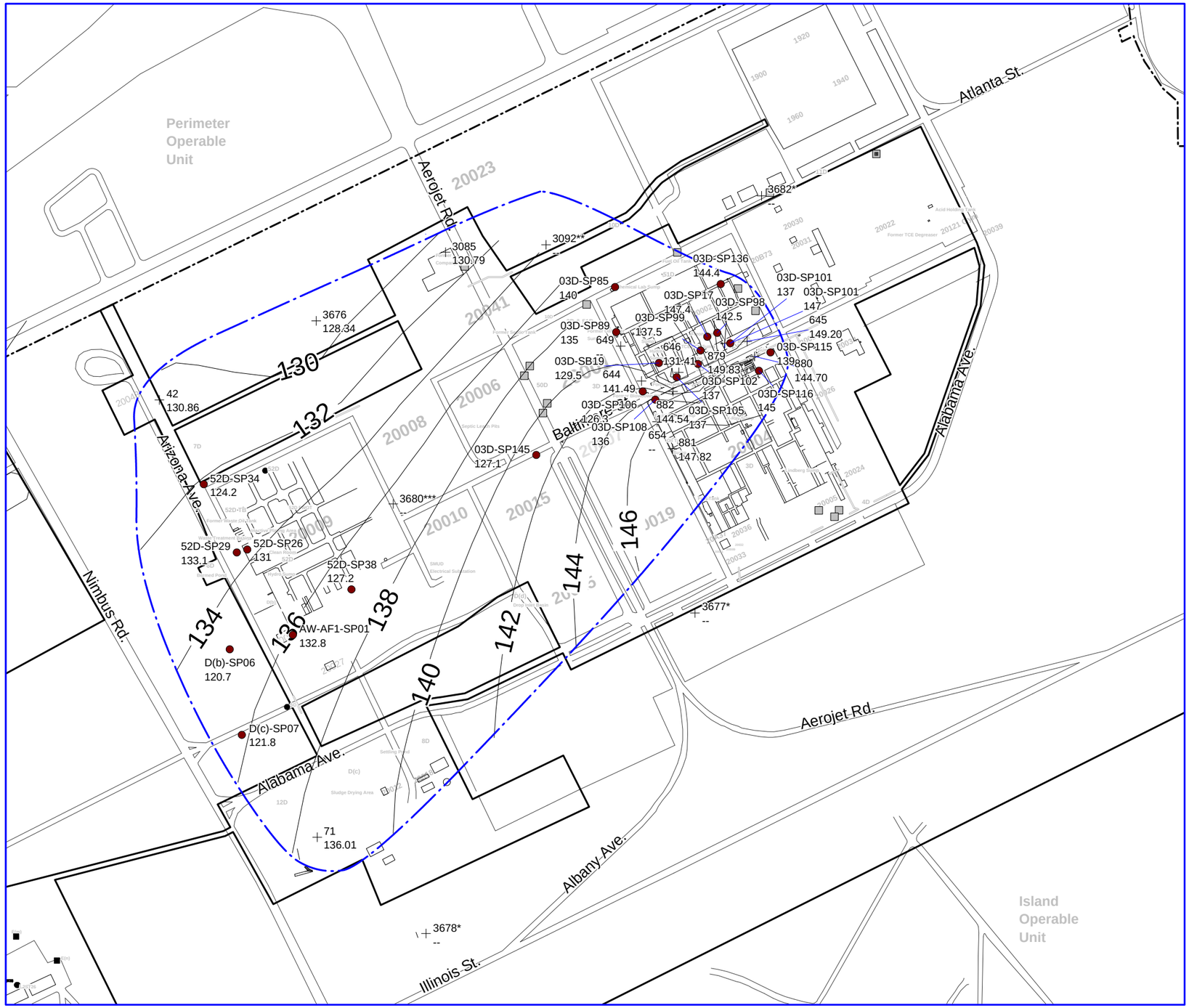
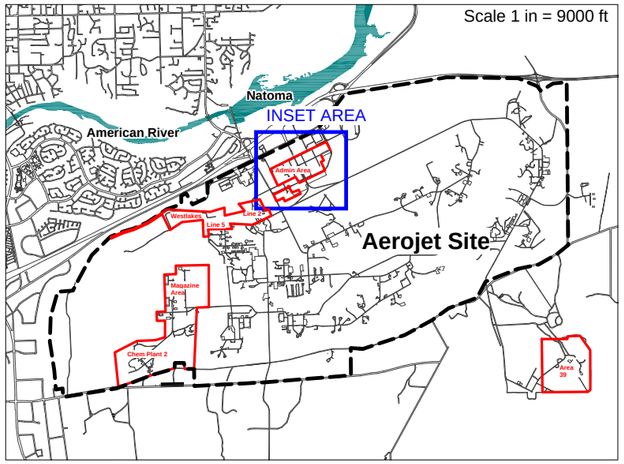


Explanation

- 03D-SP29 61.3 — Grab Groundwater Sample Location and Water Level Elevation (ft, msl) - Data not used for contouring
- 645 61.3 — Monitoring Well, ID and Water Level Elevation (ft, msl)
- 4035 -- — Extraction Well, ID and Water Level Elevation (ft, msl)
- * - Denotes first water-bearing zone well for which log indicates perched groundwater was not present
- ** - Denotes well screened in both perched and first water-bearing zone
- *** - Denotes first water-bearing zone well for which log indicates perched groundwater was present
- -- = not measured
- Area of Perched Groundwater
- Water Level Elevation Contour (ft, msl)
- Aerojet Property Boundary
- Consent Decree Boundary
- 20026 — Building
- Septic Tank
- 5(d) — Source Area ID
- Drainage Culvert



AEROJET
Environmental Remediation

Figure 4.5-4
Perched Groundwater
Potentiometric Surface Map, April 2006
Administration Area - Boundary Operable Unit (OU-6)

Figure created on behalf of Aerojet by: CVEI CENTRAL VALLEY ENVIRONMENTAL, INC.

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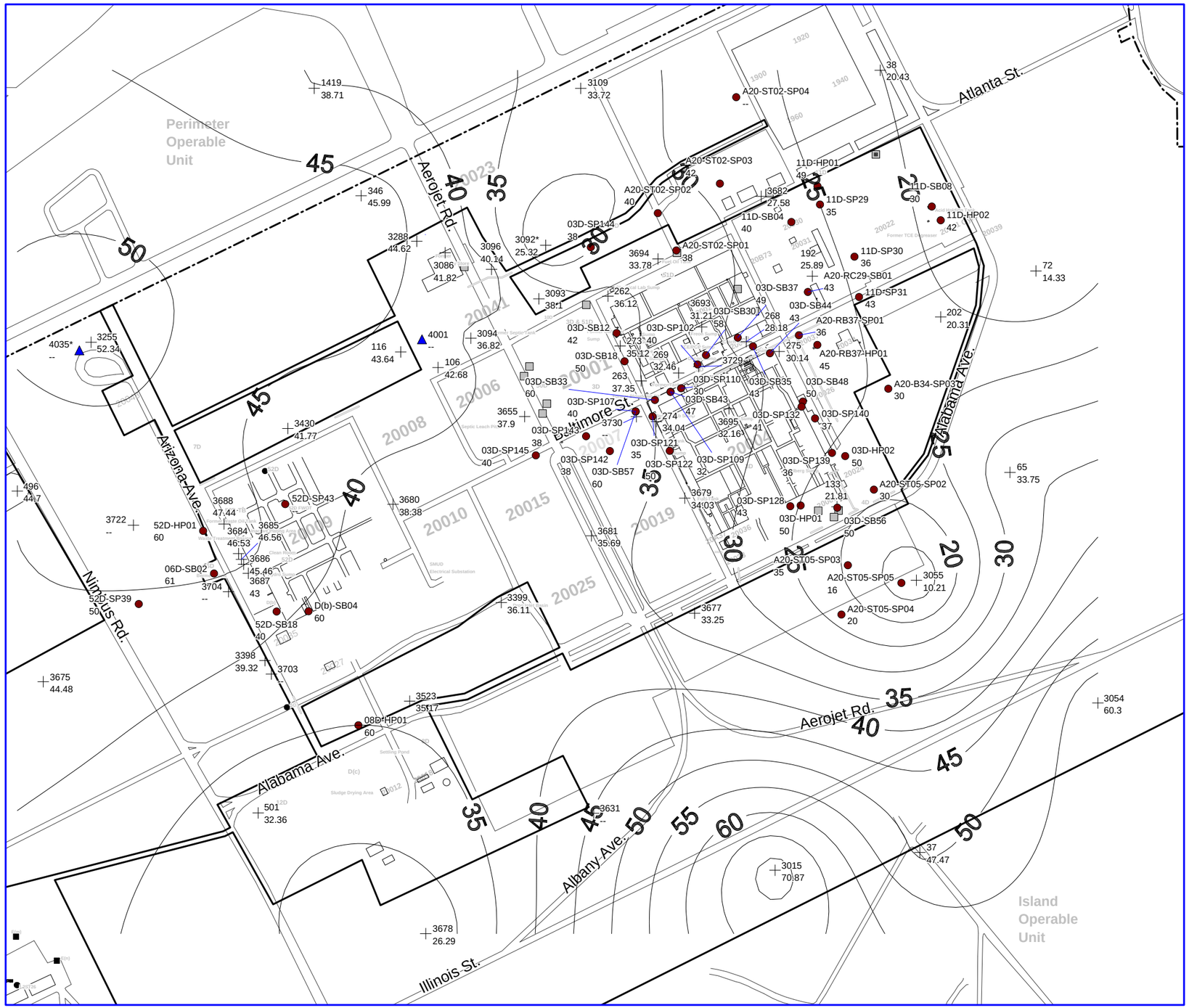


Explanation

03D-SP29 61.3 — Grab Groundwater Sample Location and Depth to Groundwater (ft, bgs) - Data not used for contouring

645 61.3 — Monitoring Well, ID and Depth to Groundwater (ft, bgs)

4001 -- — Extraction Well, ID and Depth to Groundwater (ft, bgs)

Note: -- = not measured
* - denotes well screened in both perched and first water-bearing zone

Depth to Groundwater Contour (ft, bgs)

Aerojet Property Boundary

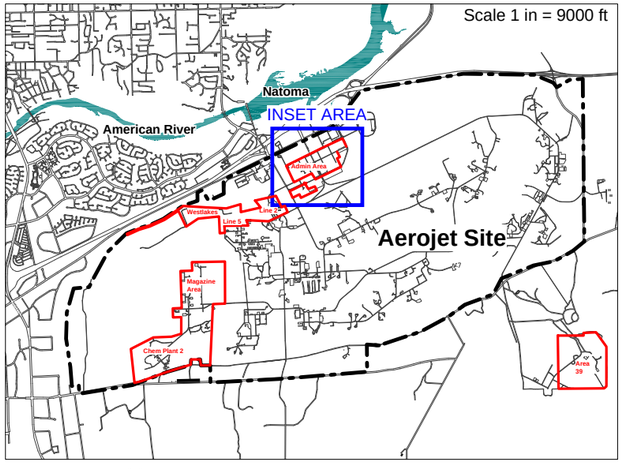
Consent Decree Boundary

20026 — Building

Septic Tank

5(d) — Source Area ID

Drainage Culvert



N

0 500 1,000
feet

AEROJET
Environmental Remediation

Figure 4.5-5
First Water-Bearing Zone
Depth to Groundwater, April 2006
Administration Area - Boundary Operable Unit (OU-6)

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

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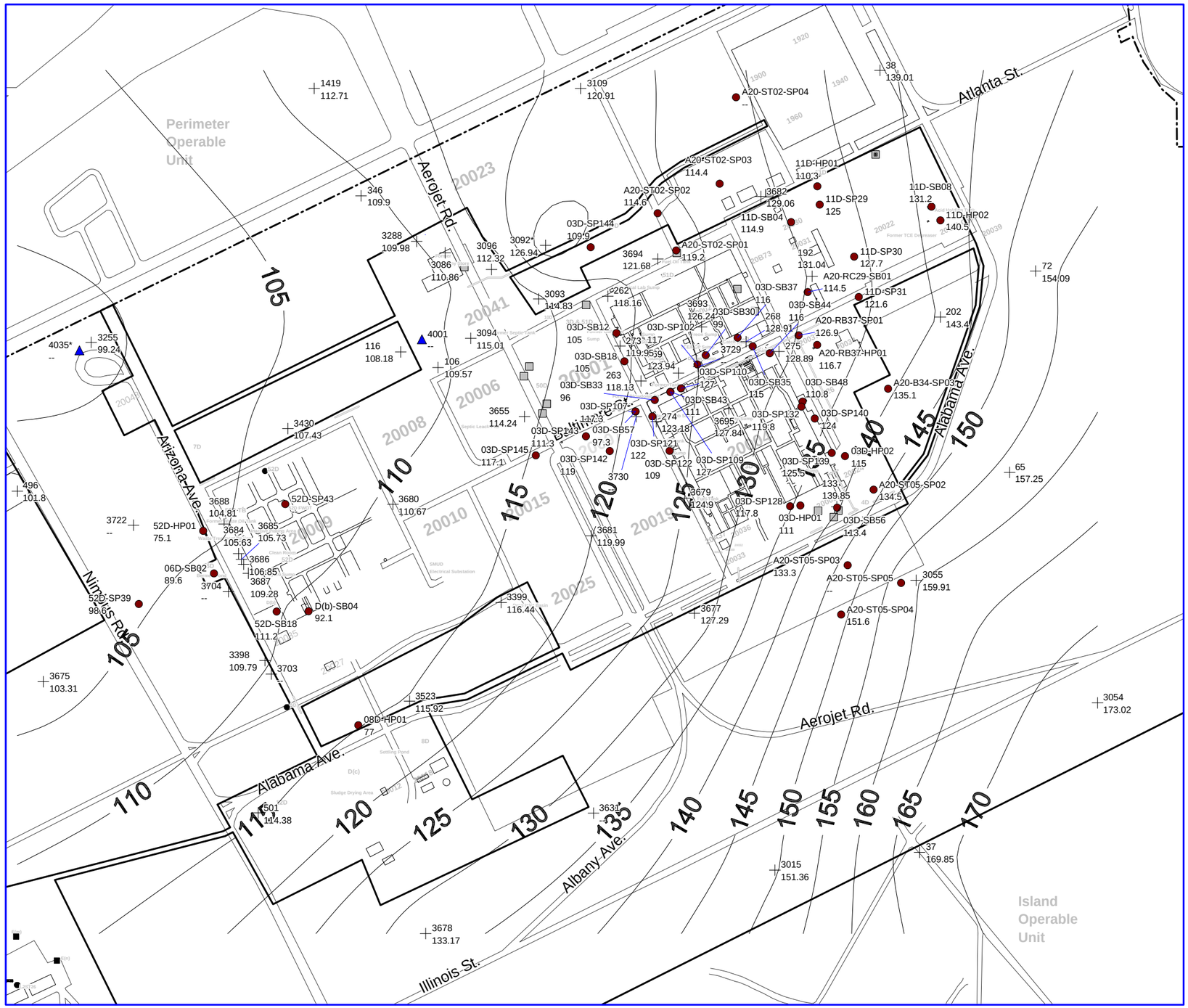


Explanation

03D-SP29 61.3 — Grab Groundwater Sample Location and Water Level Elevation (ft, msl) - Data not used for contouring

645 61.3 — Monitoring Well, ID and Water Level Elevation (ft, msl)

4001 -- — Extraction Well, ID and Water Level Elevation (ft, msl)

Note: -- = not measured
* - denotes well screened in both perched and first water-bearing zone

Water Level Elevation Contour (ft, msl)

Aerojet Property Boundary

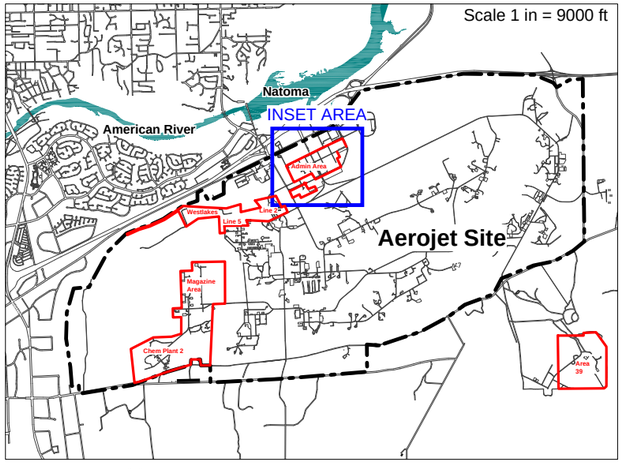
Consent Decree Boundary

20026 — Building

Septic Tank

5(d) — Source Area ID

Drainage Culvert



N

0 500 1,000
feet

AEROJET
Environmental Remediation

Figure 4.5-6
First Water-Bearing Zone
Potentiometric Surface Map, April 2006
Administration Area - Boundary Operable Unit (OU-6)

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

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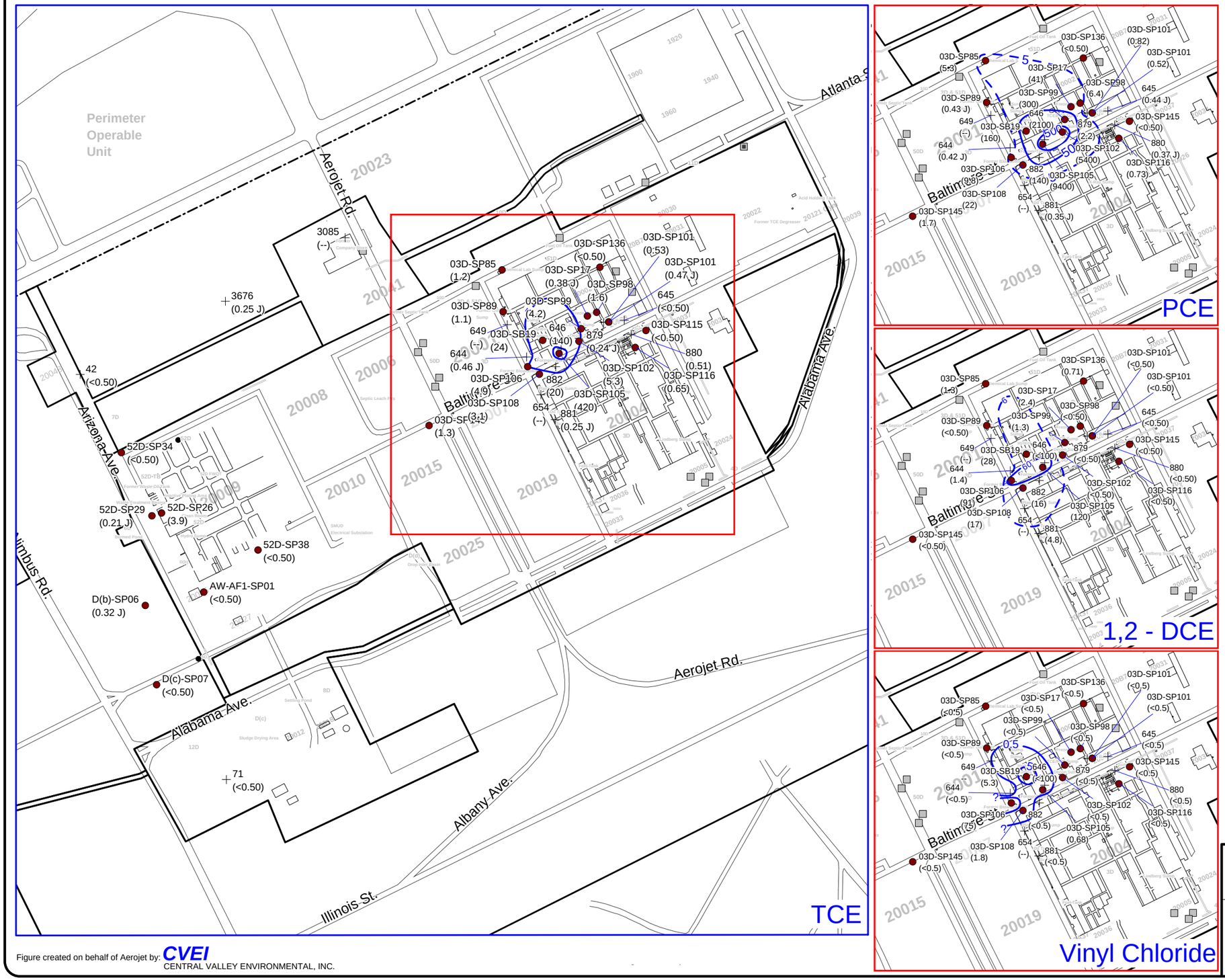
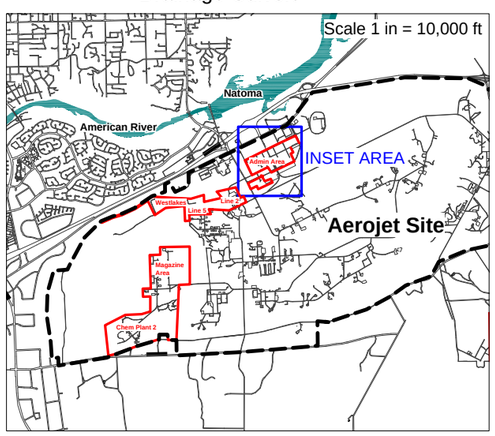


Explanation

- 03D-SP29 (61.3) — Grab Groundwater Sample Location and Concentration (ug/L) - Data not used for contouring
- 645 (61.3) — Monitoring Well, ID and Concentration (ug/L)

Note: -- = not sampled.
"J" = Estimated Concentration
Sample Period - October 2005 to October 2006

- Iso-Concentration Contour (ug/L) - lines dashed where inferred
- Aerojet Property Boundary
- Consent Decree Boundary
- 20026 — Building
- Septic Tank
- 5(d) — Source Area ID
- Drainage Culvert



N

0 500 1,000
feet

AEROJET
Environmental Remediation

Figure 4.5-7
Perched Groundwater
VOC Iso-concentration Contours
Administration Area - Boundary Operable Unit (OU-6)

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

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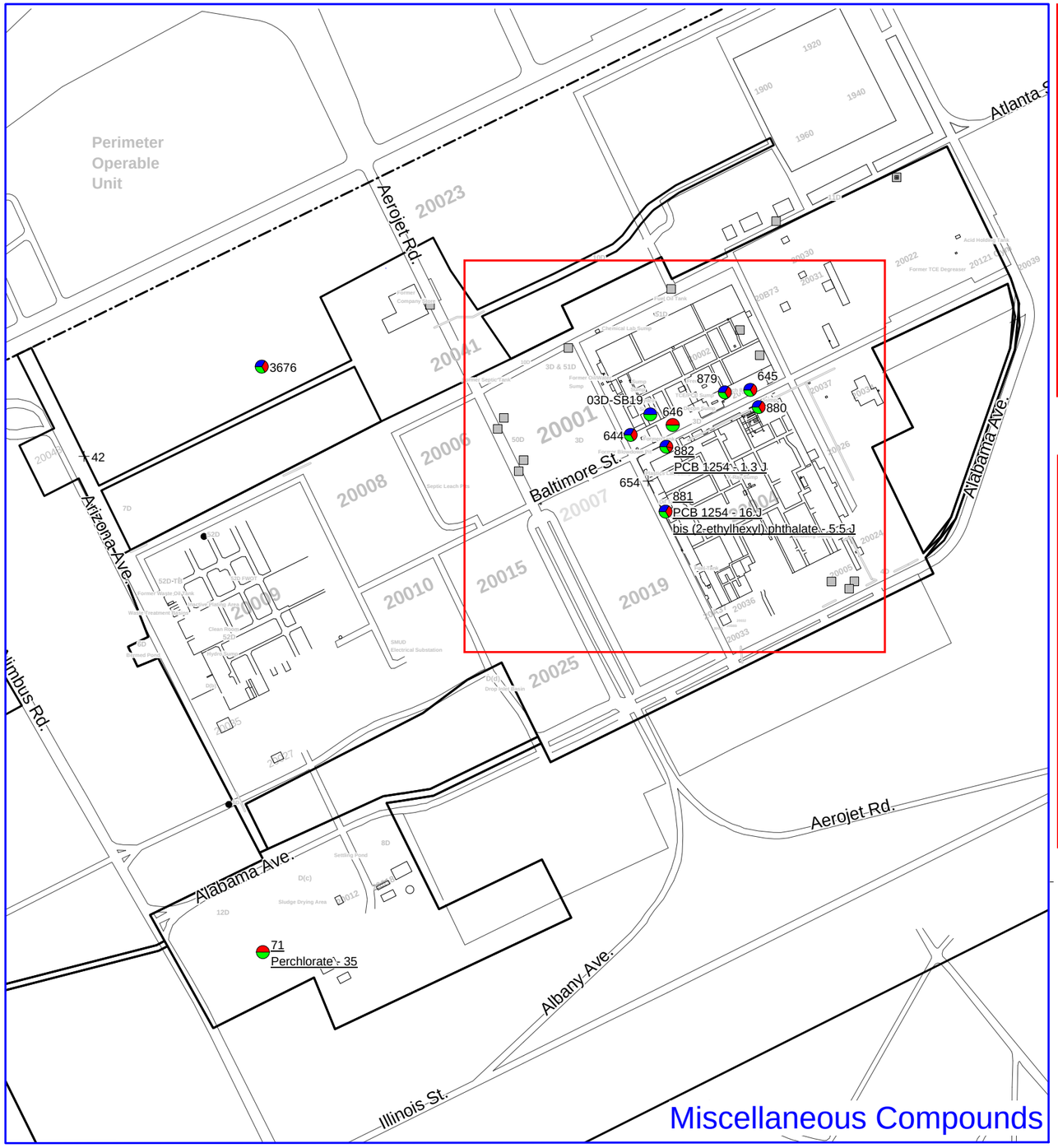
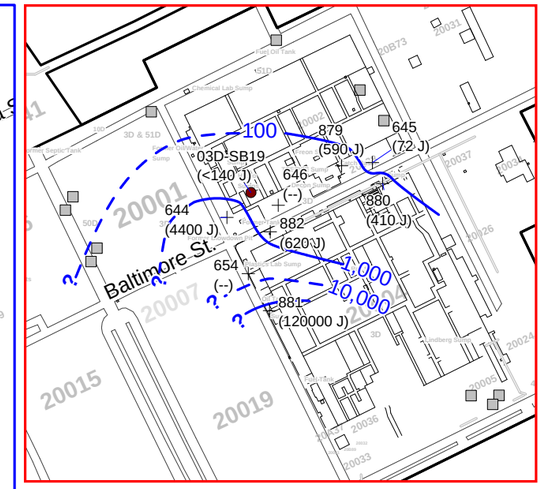




TPH-diesel

NDMA

Explanation

645 (61.3) — Monitoring Well, ID and Concentration (ug/L)

03D-SB19 (61.3) — Grab Groundwater Sample Location and Concentration (ug/L) - Data not used for contouring

- Analyzed for Perchlorate
- Analyzed for SVOCs
- Analyzed for PCBs

Note: -- = not sampled.
"J" = Estimated Concentration
Only compounds reported at concentrations greater than screening level ARARs are posted.

03D-SB19 is a grab groundwater sample

Sample Period - October 2005 to October 2006

Iso-Concentration Contour (ug/L) - lines dashed where inferred

Aerojet Property Boundary

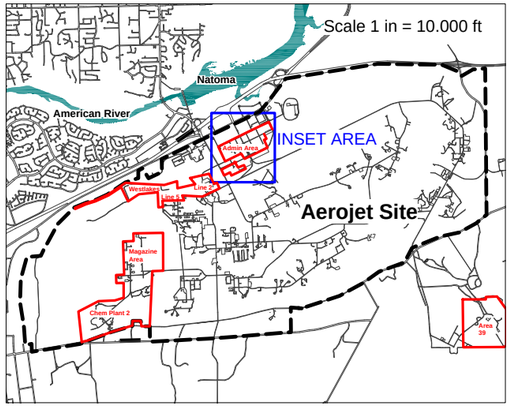
Consent Decree Boundary

20026 — Building

5(d) — Source Area ID

Septic Tank

Drainage Culvert



N

0 500 1,000
feet

AEROJET
Environmental Remediation

Figure 4.5-8
Perched Groundwater
TPH-diesel, NDMA, and Miscellaneous Compounds
Administration Area - Boundary Operable Unit (OU-6)

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

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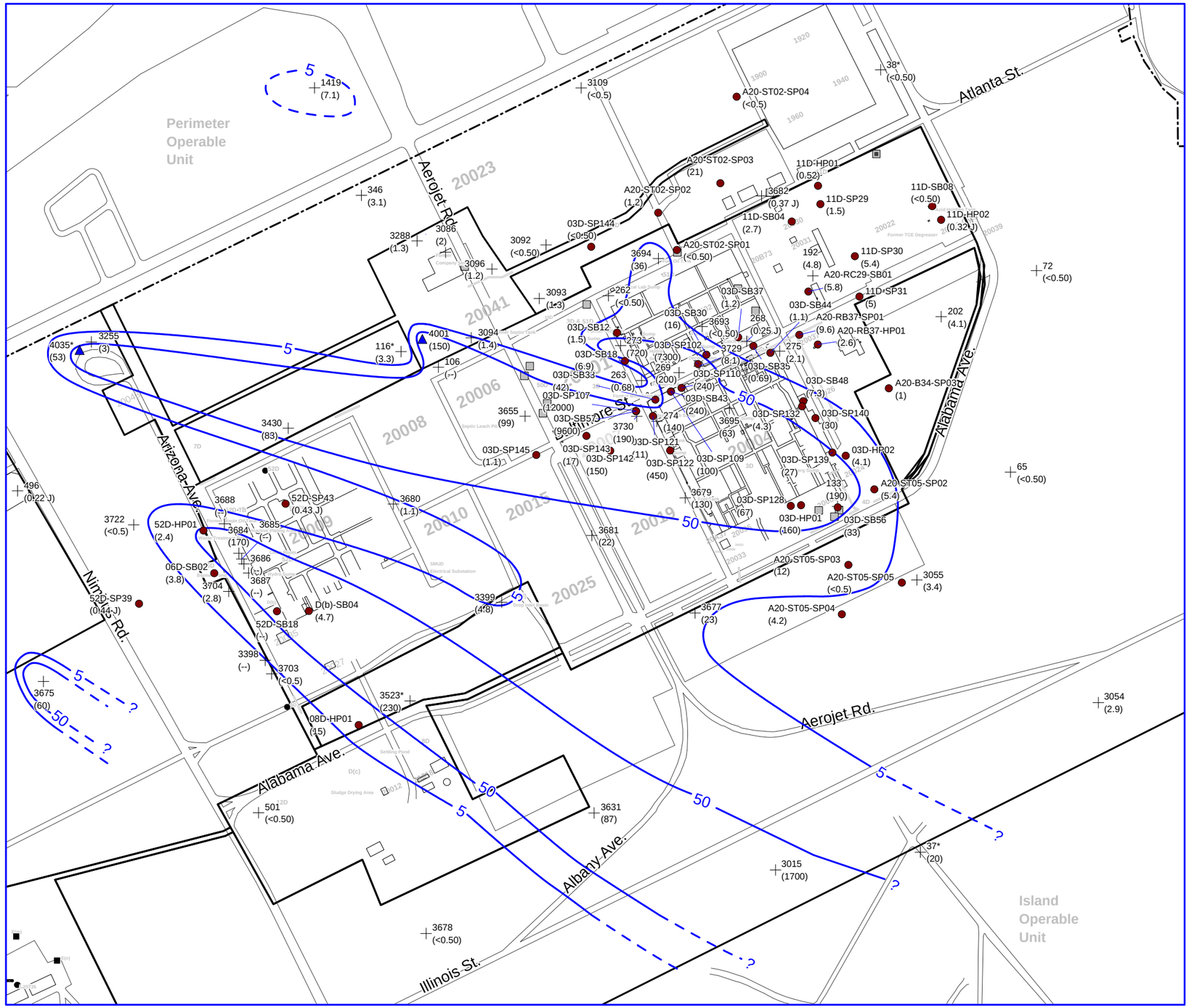


Explanation

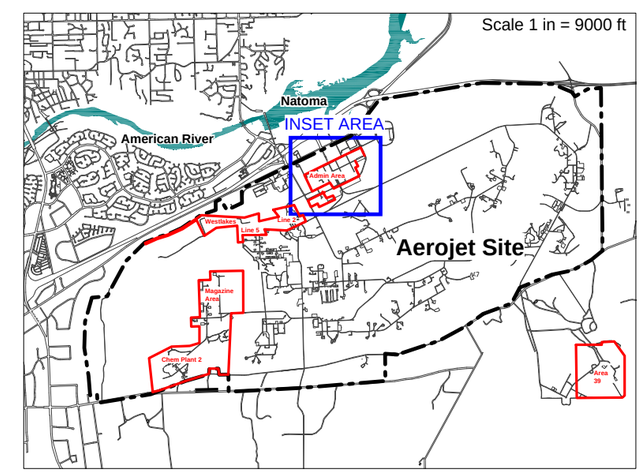
- 03D-SP29 (61.3) — Grab Groundwater Sample Location and Concentration (ug/L) - Data not used for contouring
- 645 (61.3) — Monitoring Well, ID and Concentration (ug/L)
- 4001 -- — Extraction Well, ID and Concentration (ug/L)

* = Well screen extends below the first water-bearing zone (FWBZ) Concentrations may not be representative of the FWBZ

-- = not sampled. "J" = estimated concentration

Sample Period - October 2005 to October 2006

- Iso-Concentration Contour (ug/L) - lines dashed where inferred
- Aerojet Property Boundary
- Consent Decree Boundary
- 20026 — Building
- Septic Tank
- 5(d) — Source Area ID
- Drainage Culvert



N

0 500 1,000 feet

AEROJET
Environmental Remediation

Figure 4.5-9
First Water-Bearing Zone
TCE Iso-concentration Contours
Administration Area - Boundary Operable Unit (OU-6)

Figure created on behalf of Aerojet by: CVEI CENTRAL VALLEY ENVIRONMENTAL, INC.

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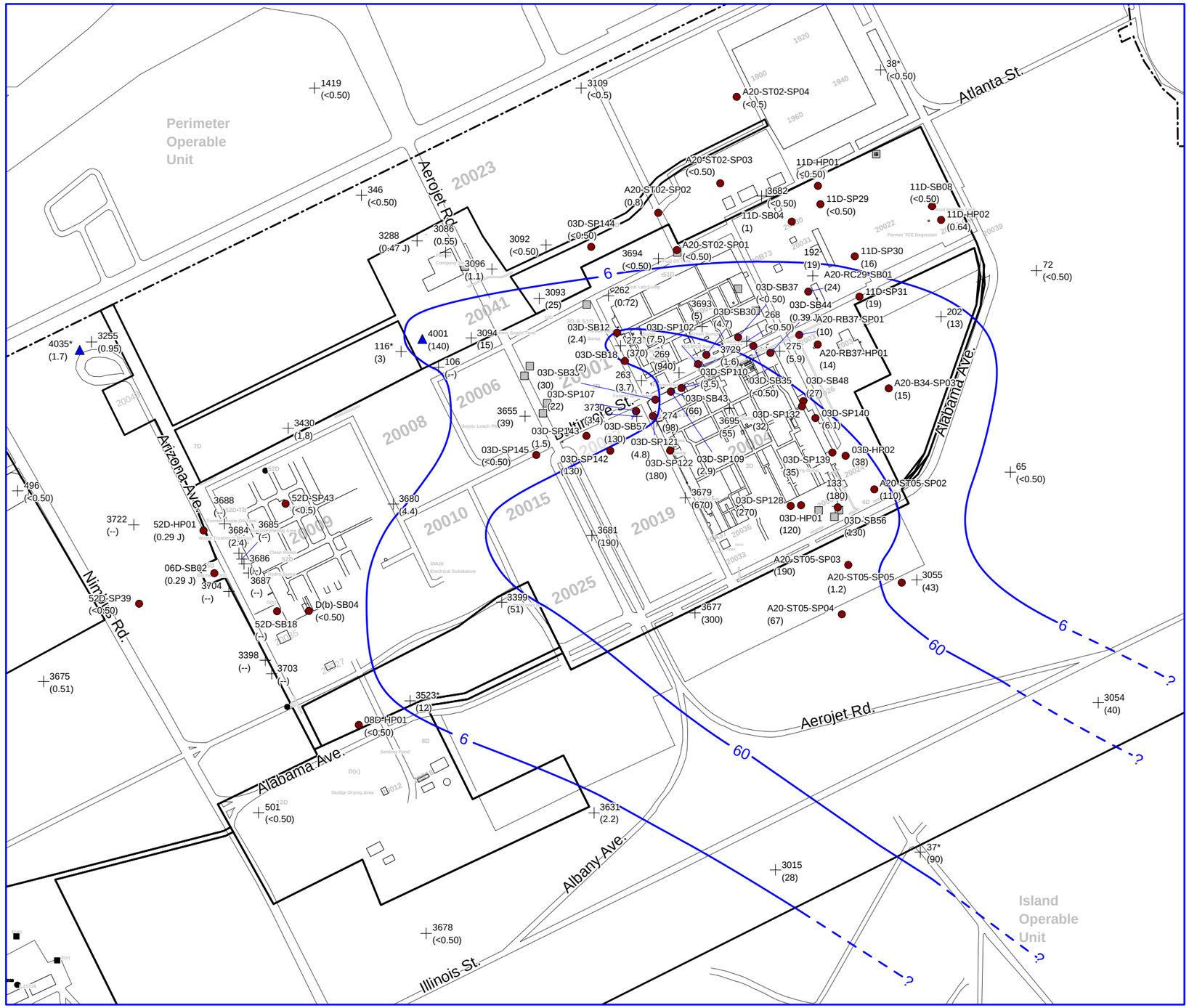


Explanation

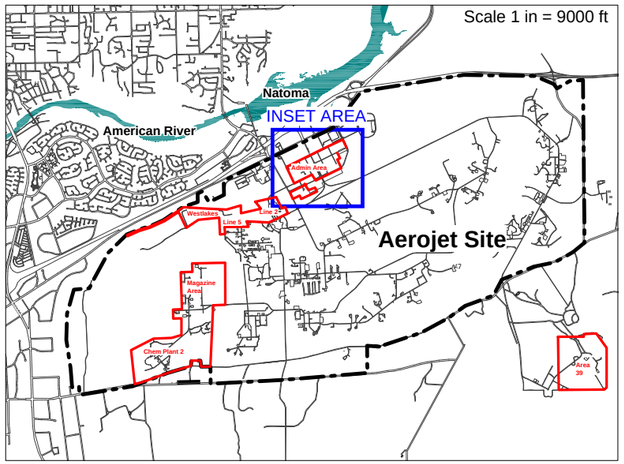
03D-SP29 (61.3)	Grab Groundwater Sample Location and Concentration (ug/L) - Data not used for contouring
645 (61.3)	Monitoring Well, ID and Concentration (ug/L)
4001 --	Extraction Well, ID and Concentration (ug/L)

* = Well screen extends below the first water-bearing zone (FWBZ) Concentrations may not be representative of the FWBZ

-- = not sampled. "J" = estimated concentration

Sample Period - October 2005 to October 2006

	Iso-Concentration Contour (ug/L) - lines dashed where inferred
	Aerojet Property Boundary
	Consent Decree Boundary
20026	Building
	Septic Tank
5(d)	Source Area ID
	Drainage Culvert



N

0 500 1,000

feet

AEROJET

Environmental Remediation

Figure 4.5-10
First Water-Bearing Zone
cis-1,2-DCE Iso-concentration Contours
Administration Area - Boundary Operable Unit (OU-6)

Figure created on behalf of Aerojet by: CVEI CENTRAL VALLEY ENVIRONMENTAL, INC.

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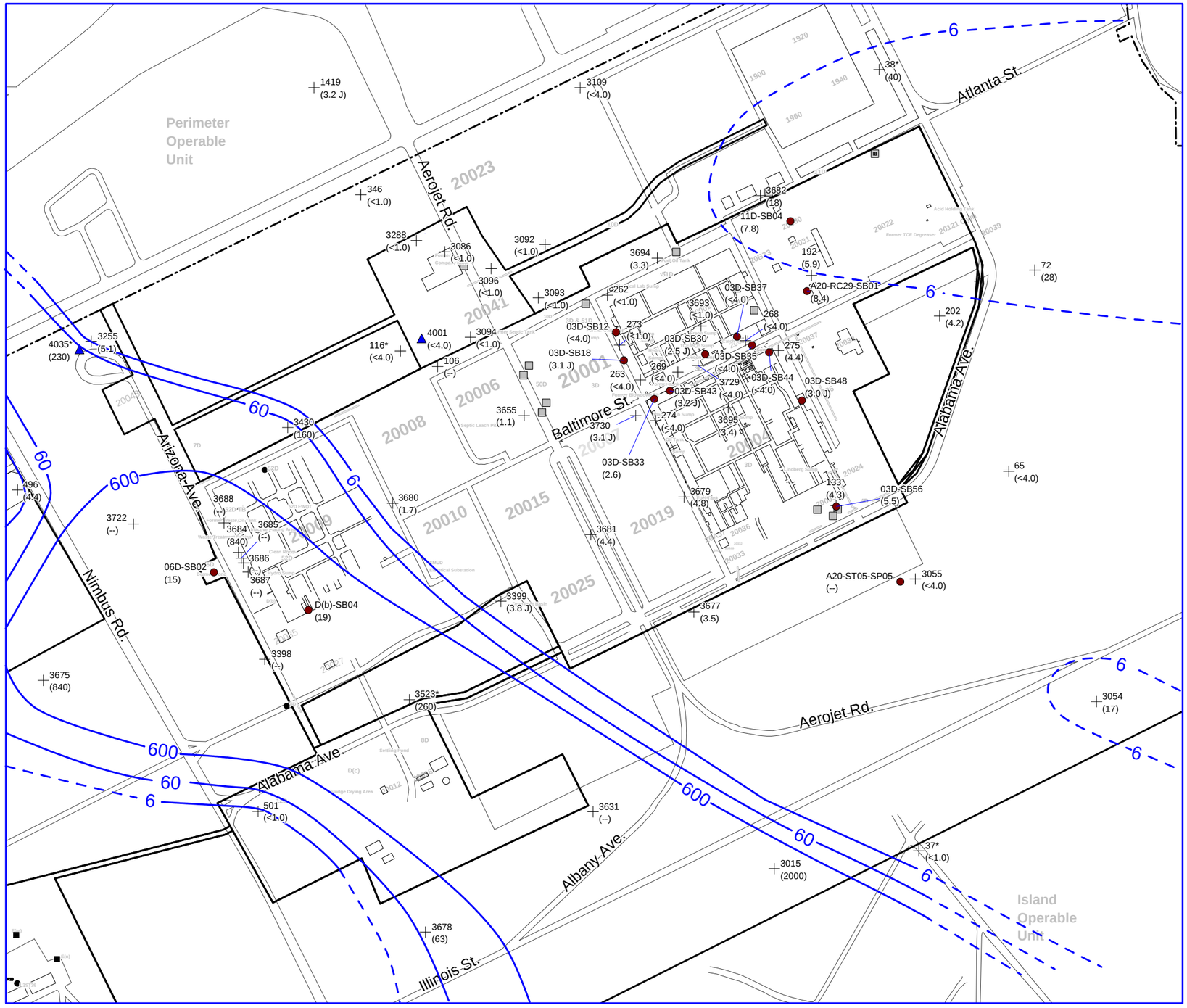


Explanation

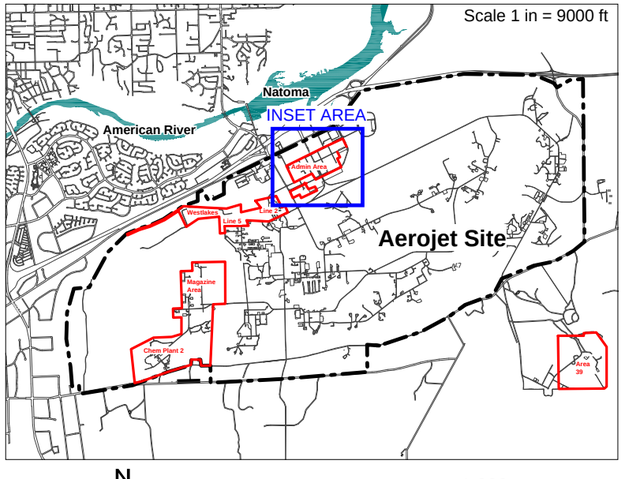
- 03D-SP29 (61.3) — Grab Groundwater Sample Location and Concentration (ug/L) - Data not used for contouring
- 645 (61.3) — Monitoring Well, ID and Concentration (ug/L)
- 4001 -- — Extraction Well, ID and Concentration (ug/L)

* = Well screen extends below the first water-bearing zone (FWBZ) Concentrations may not be representative of the FWBZ

-- = not sampled. "J" = estimated concentration

Sample Period - October 2005 to October 2006

- Iso-Concentration Contour (ug/L) - lines dashed where inferred
- Aerojet Property Boundary
- Consent Decree Boundary
- 20026 — Building
- Septic Tank
- 5(d) — Source Area ID
- Drainage Culvert



N

0 500 1,000 feet

AEROJET
Environmental Remediation

Figure 4.5-11
First Water-Bearing Zone
Perchlorate Iso-concentration Contours
Administration Area - Boundary Operable Unit (OU-6)

Figure created on behalf of Aerojet by: CVEI CENTRAL VALLEY ENVIRONMENTAL, INC.

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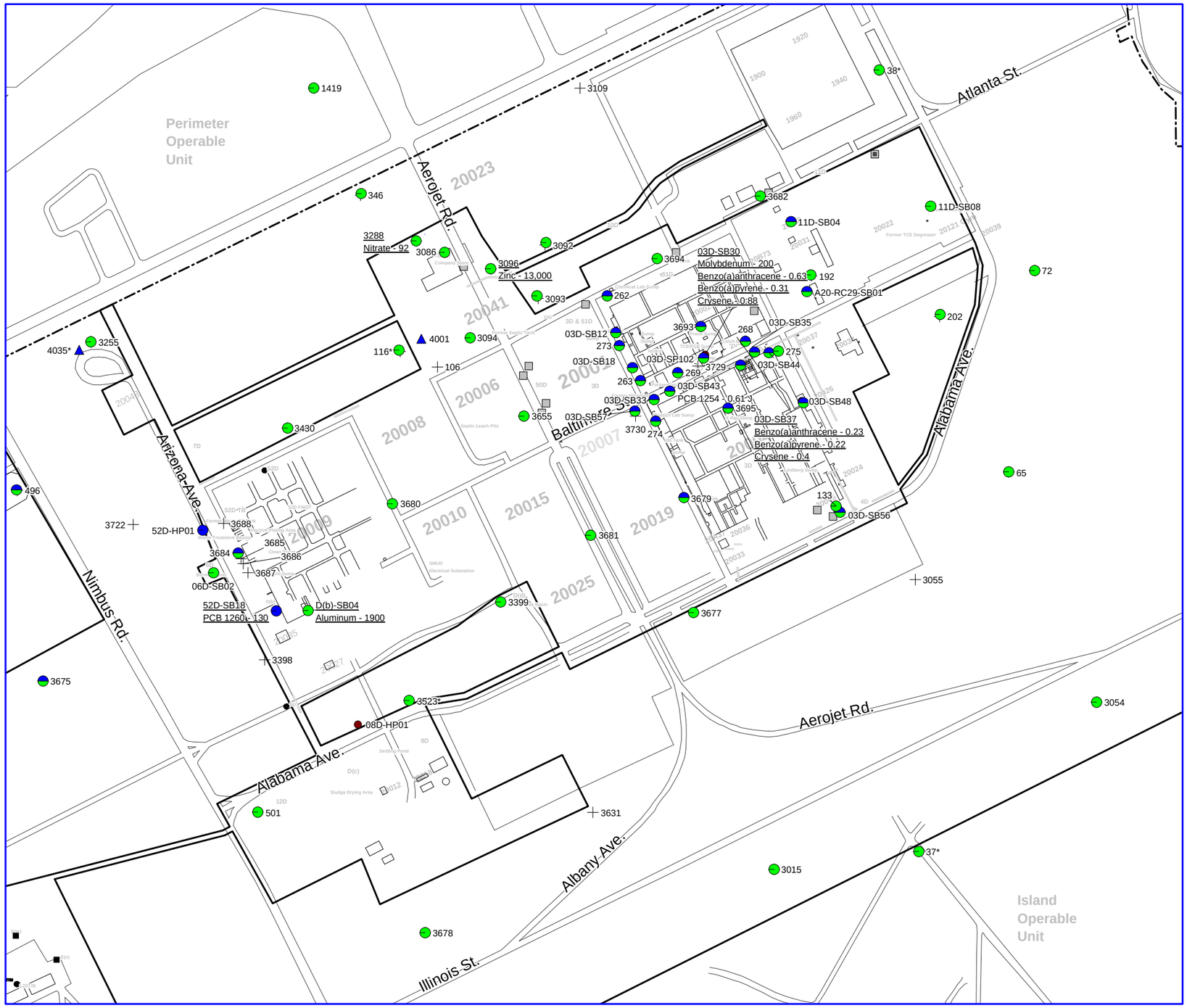
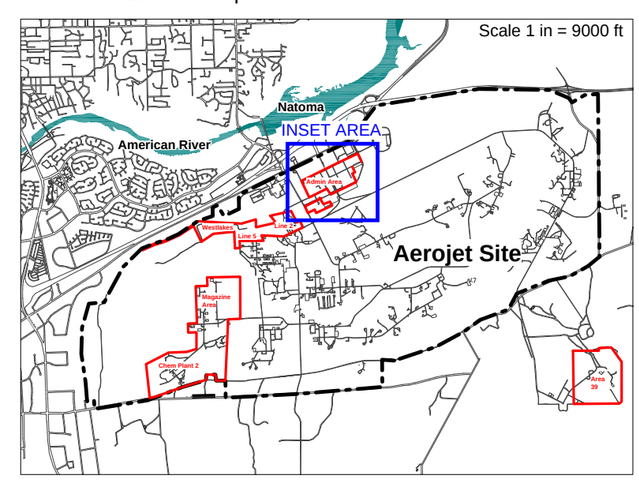


Explanation

03D-SP29 61.3	Grab Groundwater Sample Location and Concentration (ug/L) - Data not used for contouring
645 61.3	Monitoring Well, ID and Concentration (ug/L)
4001	Extraction Well, ID and Concentration (ug/L)
	Analyzed for SVOCs
	Analyzed for PCBs

* = Well screen extends below the first water-bearing zone (FWBZ)
Concentrations may not be representative of the FWBZ
"J" = estimated concentration
Only compounds reported at concentrations greater than screening level ARARs are posted.
Sample Period - October 2005 to October 2006

	Aerojet Property Boundary
	Consent Decree Boundary
20026	Building
5(d)	Source Area ID
	Drainage Culvert
	Septic Tank



N

0 500 1,000
feet

AEROJET
Environmental Remediation

Figure 4.5-12
First Water-Bearing Zone
Miscellaneous Compounds Detected
Administration Area - Boundary Operable Unit (OU-6)

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

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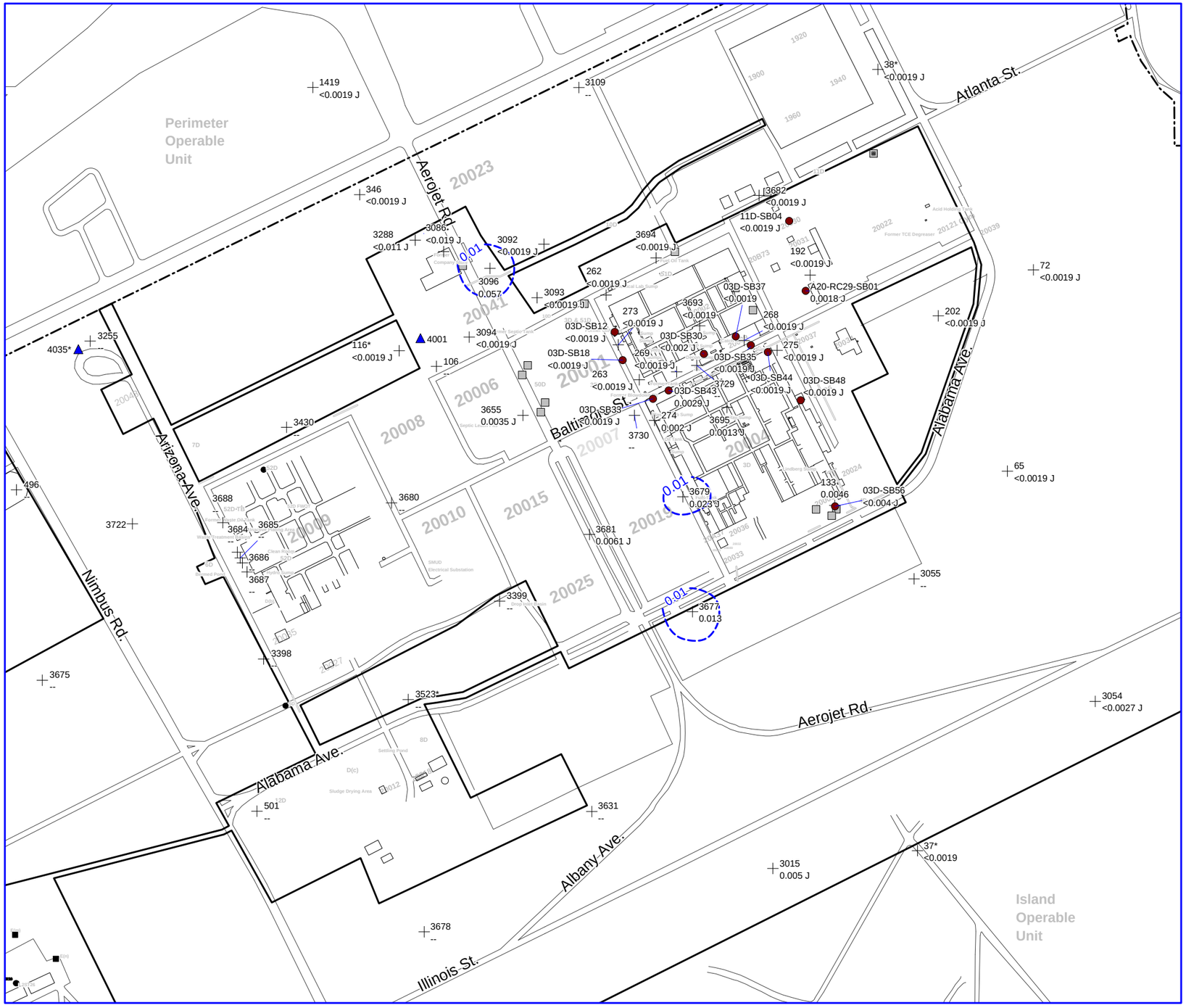
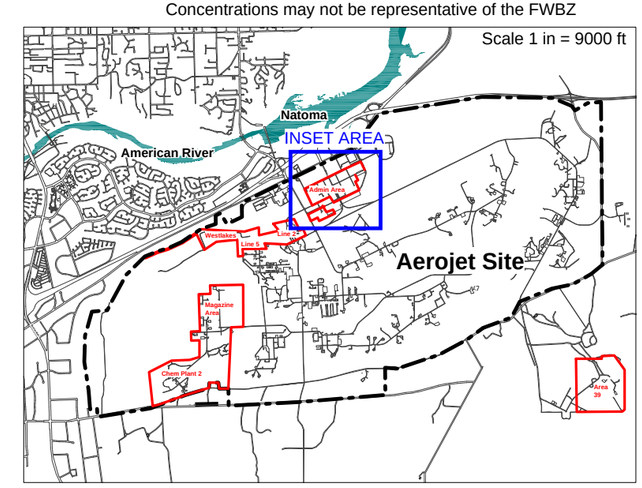


Explanation

03D-SP29 (61.3)	Grab Groundwater Sample Location and Concentration (ug/L) - Data not used for contouring
645 (61.3)	Monitoring Well, ID and Concentration (ug/L)
4001	Extraction Well, ID
	Iso-Concentration Contour (ug/L) - lines dashed where inferred
	Aerojet Property Boundary
	Consent Decree Boundary
20026	Building
5(d)	Source Area ID
	Drainage Culvert
	Septic Tank

-- = not sampled. "J" = estimated concentration
Sample Period - October 2005 to October 2006

* = Well screen extends below the first water-bearing zone (FWBZ)
Concentrations may not be representative of the FWBZ



N

0 500 1,000
feet

AEROJET
Environmental Remediation

Figure 4.5-13
First Water-Bearing Zone
NDMA Iso-concentration Contours
Administration Area - Boundary Operable Unit (OU-6)

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

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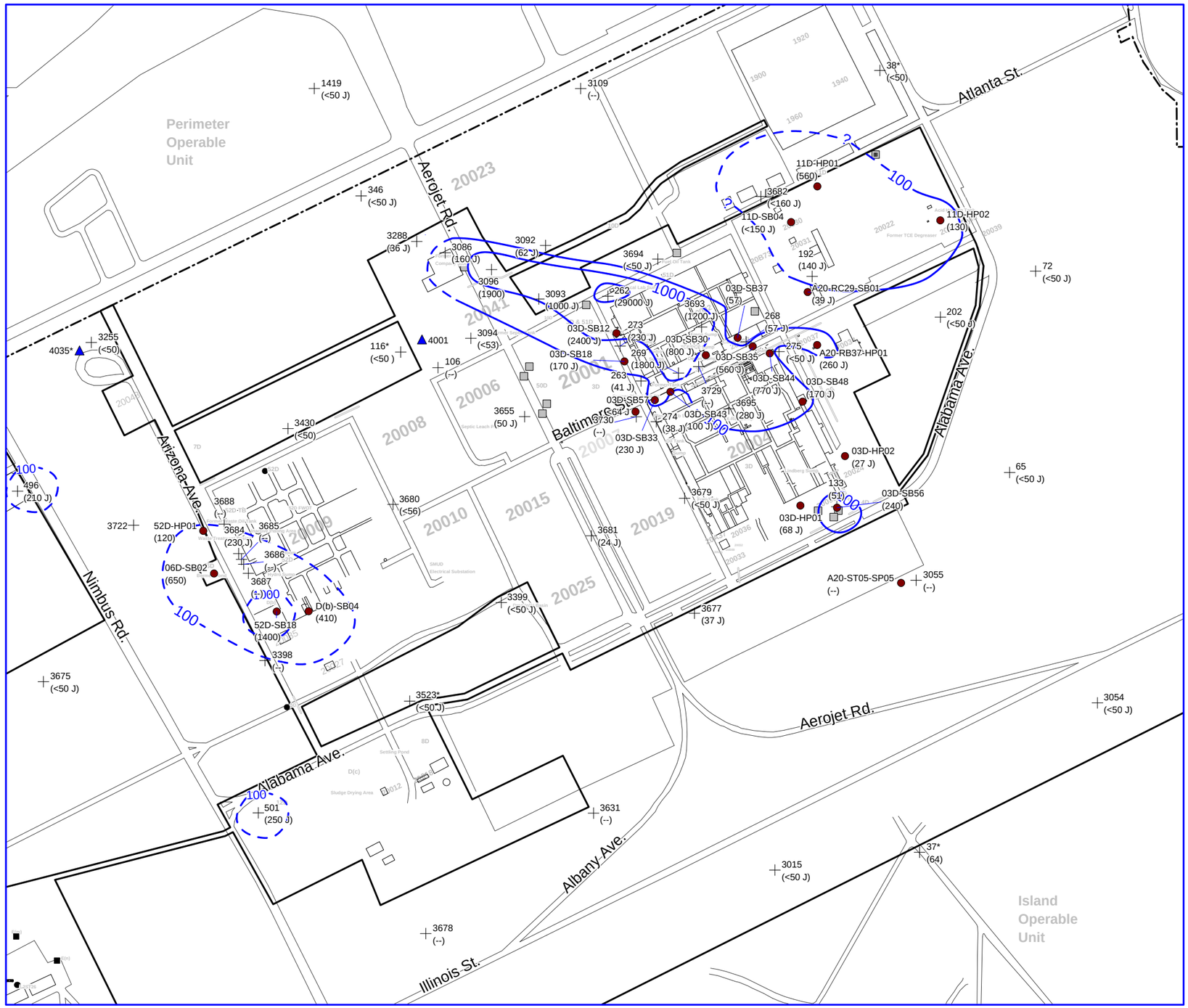
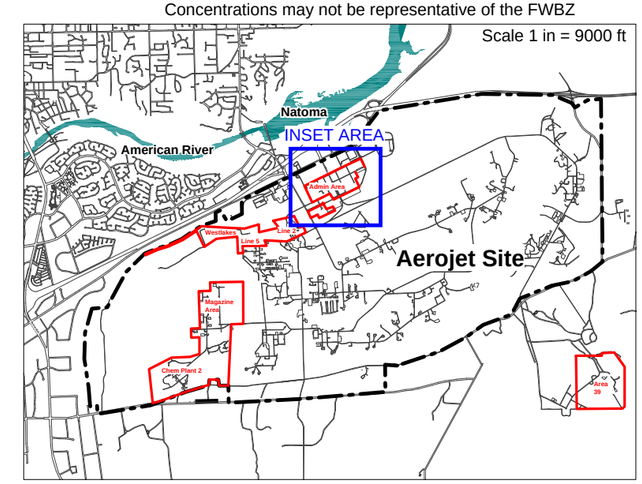


Explanation

- 03D-SP29 (61.3) — Grab Groundwater Sample Location and Concentration (ug/L) - Data not used for contouring
- 645 (61.3) — Monitoring Well, ID and Concentration (ug/L)
- 4001 — Extraction Well, ID
- Iso-Concentration Contour (ug/L) - lines dashed where inferred
- Aerojet Property Boundary
- Consent Decree Boundary
- 20026 — Building
- 5(d) — Source Area ID
- Drainage Culvert
- Septic Tank

-- = not sampled. "J" = estimated concentration
Sample Period - October 2005 to October 2006

* = Well screen extends below the first water-bearing zone (FWBZ)
Concentrations may not be representative of the FWBZ



N

0 500 1,000
feet

AEROJET
Environmental Remediation

Figure 4.5-14
First Water-Bearing Zone
TPH-diesel Iso-concentration Contours
Administration Area - Boundary Operable Unit (OU-6)

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

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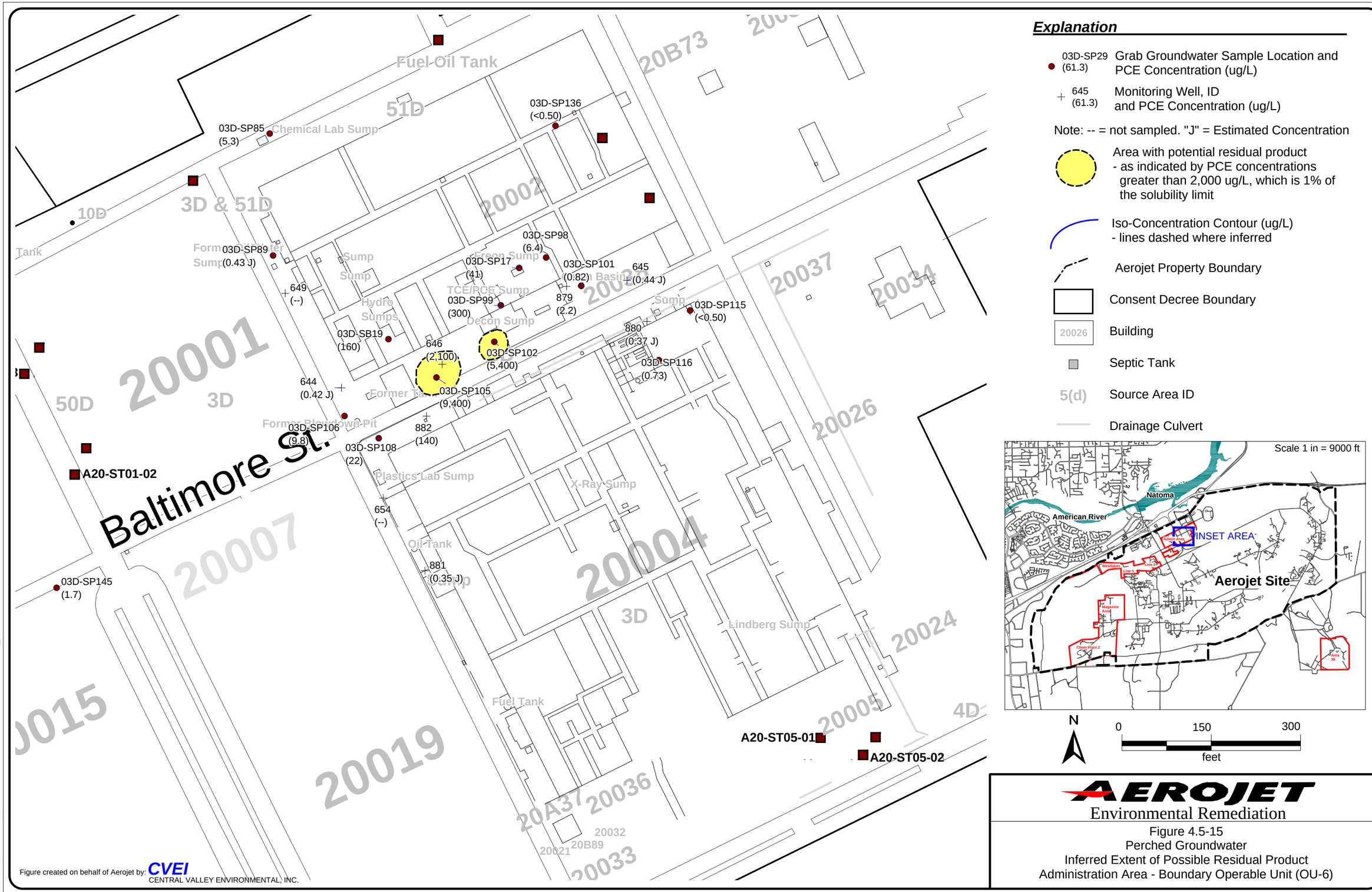
SR10131063


Explanation
03D-SP29 (61.3) Grab Groundwater Sample Location and PCE Concentration (ug/L)
645 (61.3) Monitoring Well, ID and PCE Concentration (ug/L)
Note: -- = not sampled. "J" = Estimated Concentration
Area with potential residual product - as indicated by PCE concentrations greater than 2,000 ug/L, which is 1% of the solubility limit
Iso-Concentration Contour (ug/L) - lines dashed where inferred
Aerojet Property Boundary
Consent Decree Boundary
20026 Building
Septic Tank
5(d) Source Area ID
Drainage Culvert
Baltimore St.
Fuel Oil Tank
51D
20B73
03D-SP136 (<0.50)
03D-SP85 (5.3)
Chemical Lab Sump
3D & 51D
10D
20002
03D-SP98 (6.4)
03D-SP89 (0.43 J)
Sump
Sump
Decon Sump
03D-SP17 (41)
03D-SP101 (0.82)
645 (0.44 J)
649 (--)
TCE/PCE Sump
03D-SP99 (300)
879 (2.2)
20037
20034
Hydro Sumps
Decon Sump
03D-SP115 (<0.50)
03D-SB19 (160)
646 (2,100)
03D-SP102 (5,400)
880 (0.37 J)
03D-SP116 (0.73)
20001
50D
3D
644 (0.42 J)
03D-SP105 (9,400)
20026
03D-SP106 (9.8)
882 (140)
03D-SP108 (22)
A20-ST01-02
Plastics Lab Sump
X-Ray Sump
654 (--)
20007
Oil Tank
881 (0.35 J)
20004
03D-SP145 (1.7)
3D
Lindberg Sump
20024
Fuel Tank
4D
20005
A20-ST05-01
A20-ST05-02
20019
20A37
20036
20032
20B89
20021
20033
Figure created on behalf of Aerojet by: CVEI CENTRAL VALLEY ENVIRONMENTAL, INC.
Scale 1 in = 9000 ft
Natoma
American River
INSET AREA
Aerojet Site
N
0 150 300
feet
AEROJET
Environmental Remediation
Figure 4.5-15
Perched Groundwater
Inferred Extent of Possible Residual Product
Administration Area - Boundary Operable Unit (OU-6)
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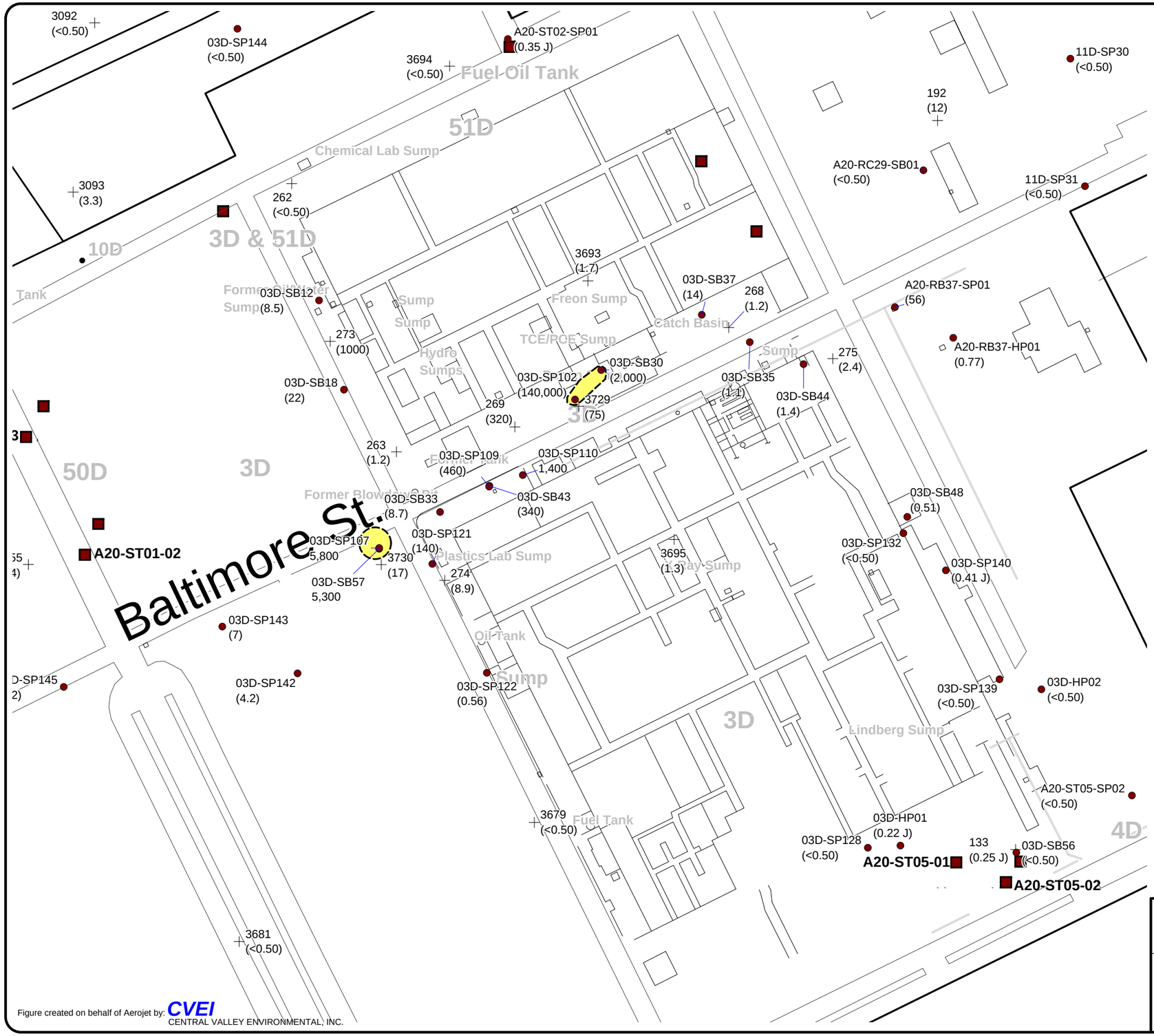


Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

Explanation

03D-SP29 (61.3) — Grab Groundwater Sample Location and PCE Concentration (ug/L)

645 (61.3) — Monitoring Well, ID and PCE Concentration (ug/L)

Note: -- = not sampled. "J" = Estimated Concentration

Area with potential residual product - as indicated by PCE concentrations greater than 2,000 ug/L, which is 1% of the solubility limit

Iso-Concentration Contour (ug/L) - lines dashed where inferred

Aerojet Property Boundary

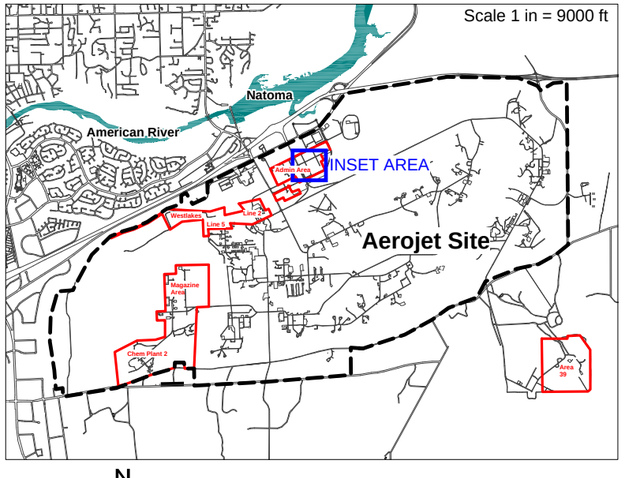
Consent Decree Boundary

20026 — Building

Septic Tank

5(d) — Source Area ID

Drainage Culvert



N

0 150 300
feet

AEROJET
Environmental Remediation

Figure 4.5-16
First Water-Bearing Zone
Inferred Extent of Possible Residual Product
Administration Area - Boundary Operable Unit (OU-6)

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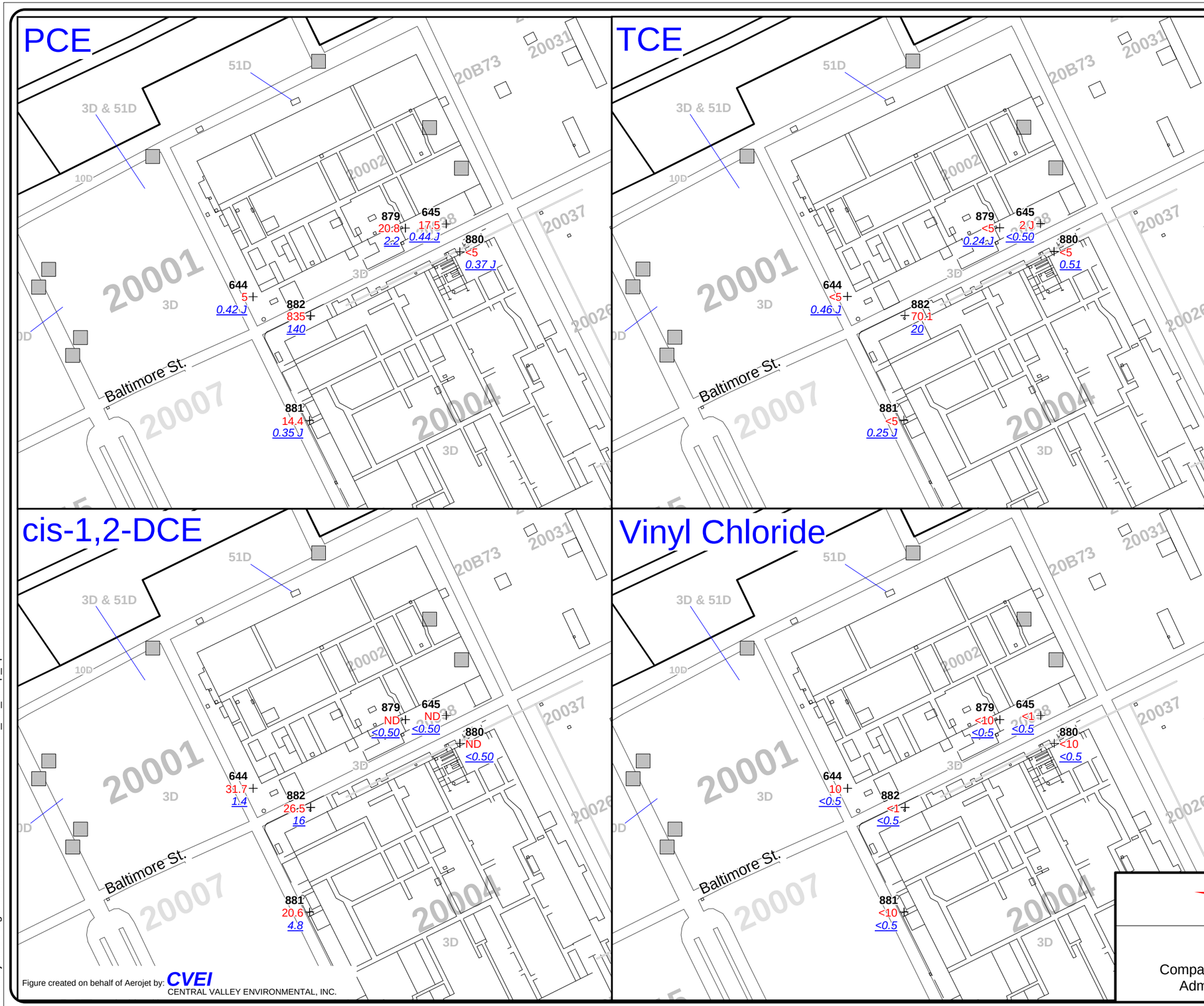


Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

Explanation

645 + Monitoring Well Location and ID

< 5 Stage 1 RI VOC Concentration (ug/l)
- maximum in 1993

< 5 Most Recent VOC Concentration (ug/l)
- collected between October 2005 and October 2006

PCE: Tetrachloroethene

TCE: Trichloroethene

cis-1,2-DCE: cis-1,2-Dichloroethene

VOC: Volatile Organic Compound

Aerojet Property Boundary

Consent Decree Boundary

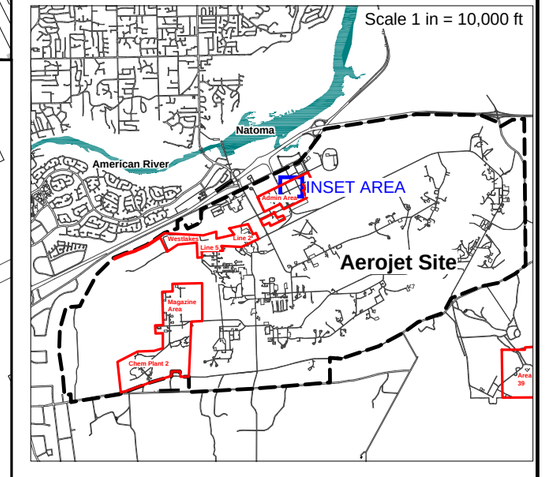
Septic Tank

20026 Building

5(d) Source Area ID

Drainage Culvert

Notes:
J = estimated value.
ND = non-detect (reporting limit not available)
Only locations with both sets of data are posted



0 250 500
feet

N

AEROJET
Environmental Remediation

Figure 4.5-17
Perched Groundwater
Comparison of Current and Stage 1 RI VOC Concentrations
Administration Area - Boundary Operable Unit (OU-6)

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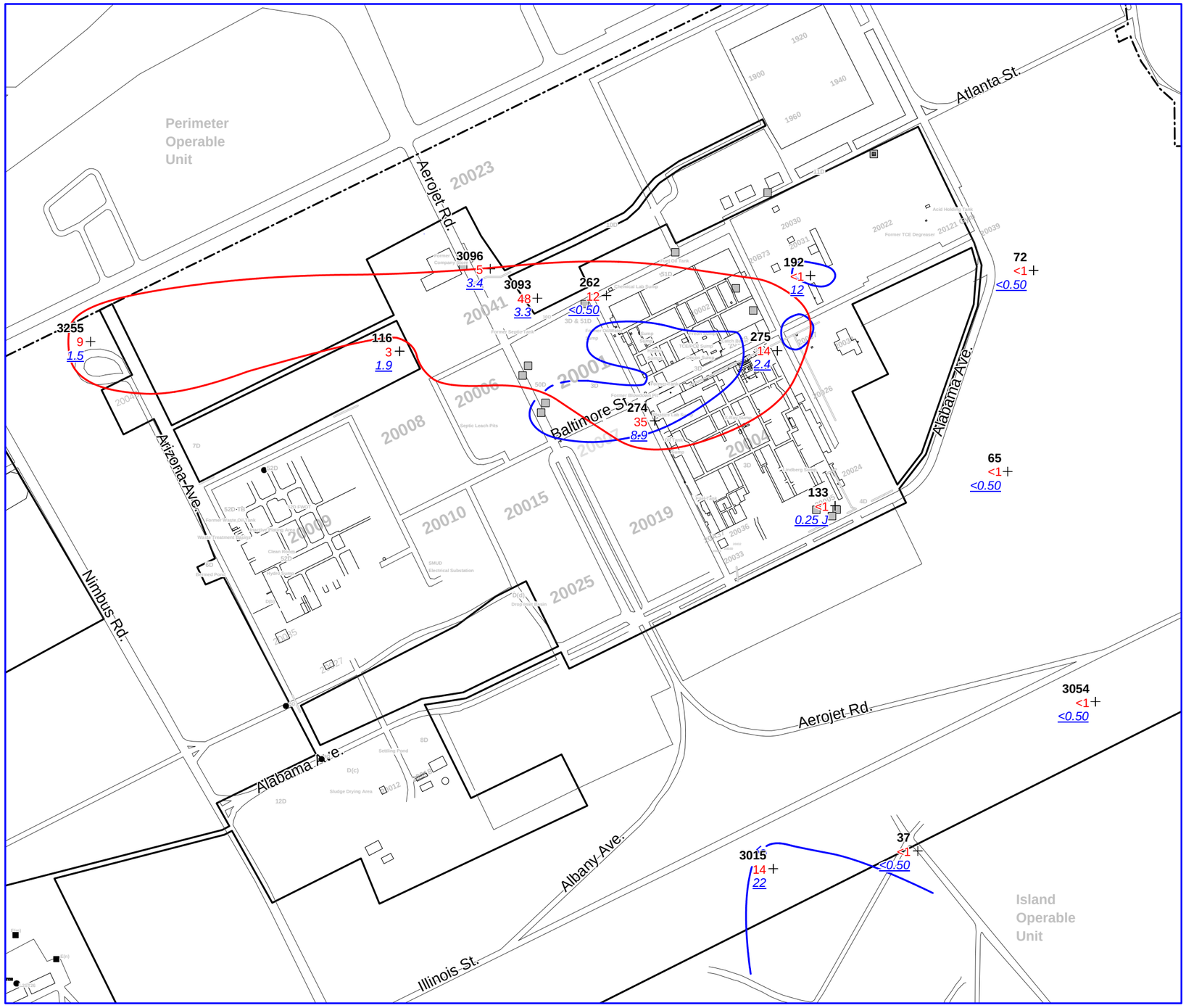


Explanation

645 — Monitoring Well Location and ID

< 5 — Stage 1 RI PCE concentration (ug/l) (maximum in 1992)

< 5 — Most recent PCE concentration (ug/l) collected between October 2005 and October 2006

PCE: Tetrachloroethene

Stage 1 - Iso-concentration Contour (5 ug/l)

Most Recent - Iso-concentration Contour (5 ug/l)

Aerojet Property Boundary

Note: J = estimated value.
Only locations with both sets of data are posted

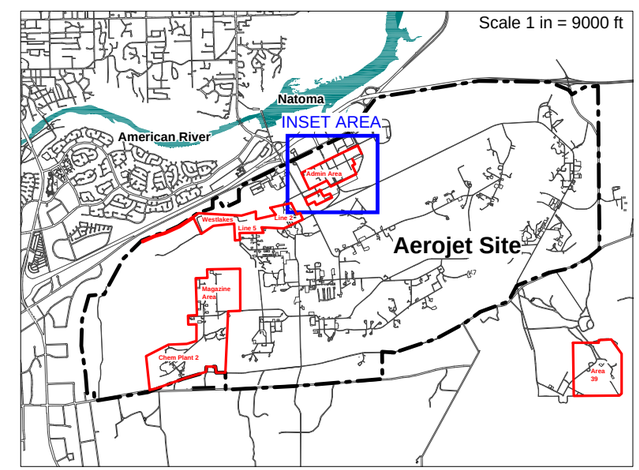
Consent Decree Boundary

20026 — Building

Septic Tank

5(d) — Source Area ID

Drainage Culvert



N

0 500 1,000
feet

AEROJET
Environmental Remediation

Figure 4.5-18
First Water-Bearing Zone
Comparison of Current and Stage 1 RI PCE Extents
Administration Area - Boundary Operable Unit (OU-6)

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

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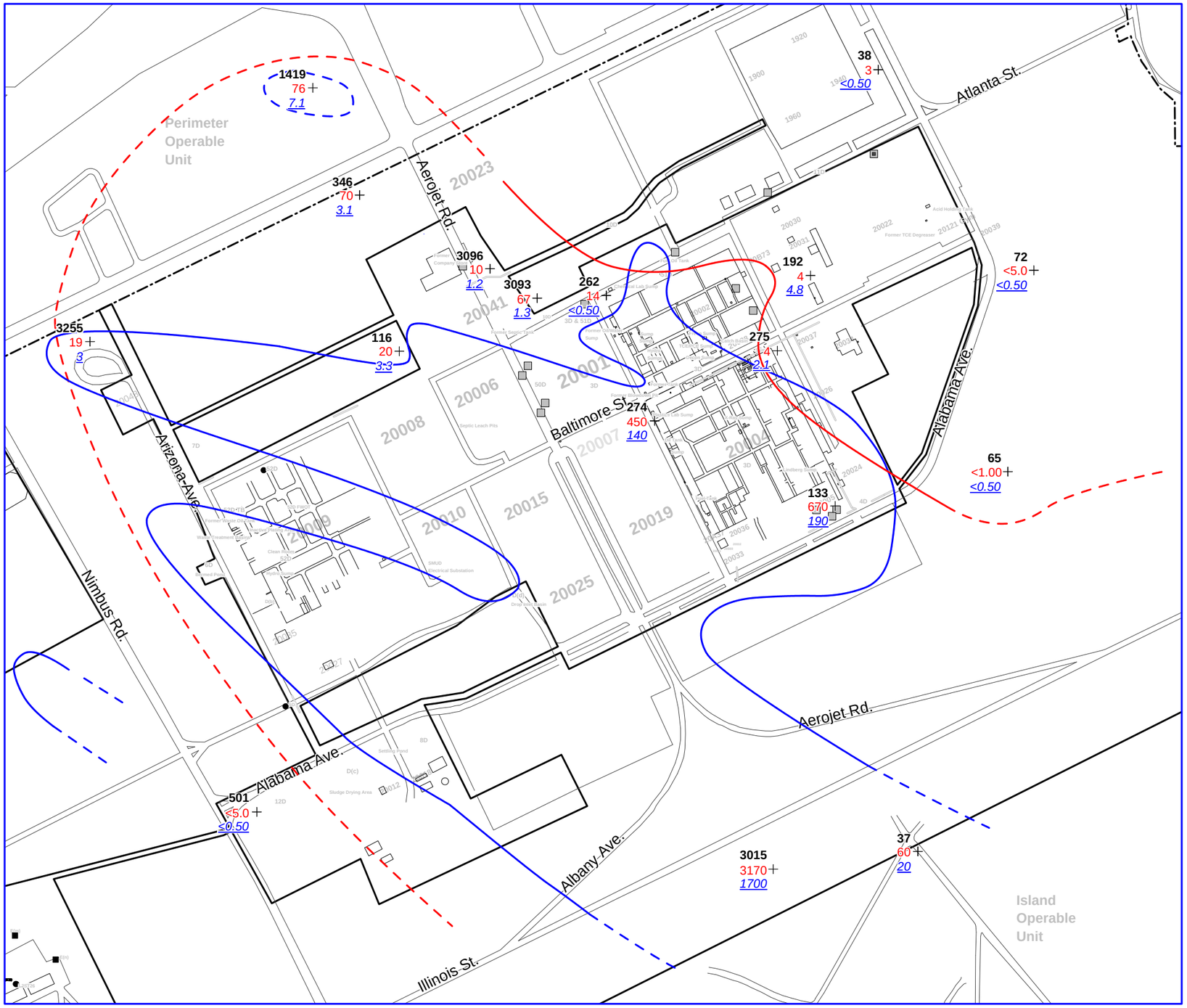


Explanation

645 + Monitoring Well Location and ID

< 5 - Stage 1 RI TCE concentration (ug/l) (maximum in 1992)

≤ 5 - Most recent TCE concentration (ug/l) collected between October 2005 and October 2006

TCE: Trichloroethene

Stage 1 - Iso-concentration Contour (5 ug/l)

Most Recent - Iso-concentration Contour (5 ug/l)

Aerojet Property Boundary

Note: J = estimated value.
Only locations with both sets of data are posted

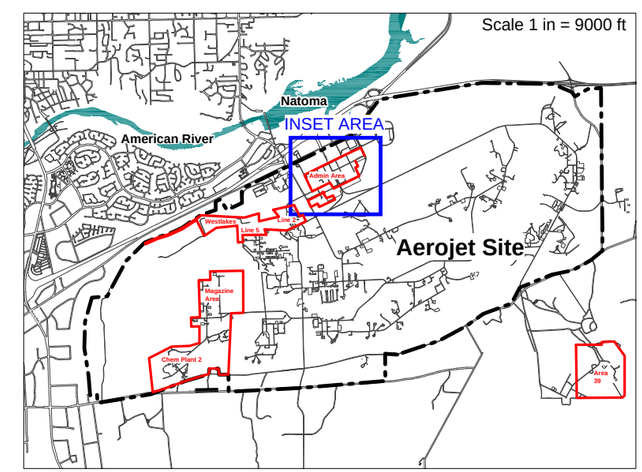
Consent Decree Boundary

20026 Building

Septic Tank

5(d) Source Area ID

Drainage Culvert



N

0 500 1,000
feet

AEROJET
Environmental Remediation

Figure 4.5-19
First Water-Bearing Zone
Comparison of Current and Stage 1 RI TCE Extents
Administration Area - Boundary Operable Unit (OU-6)

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

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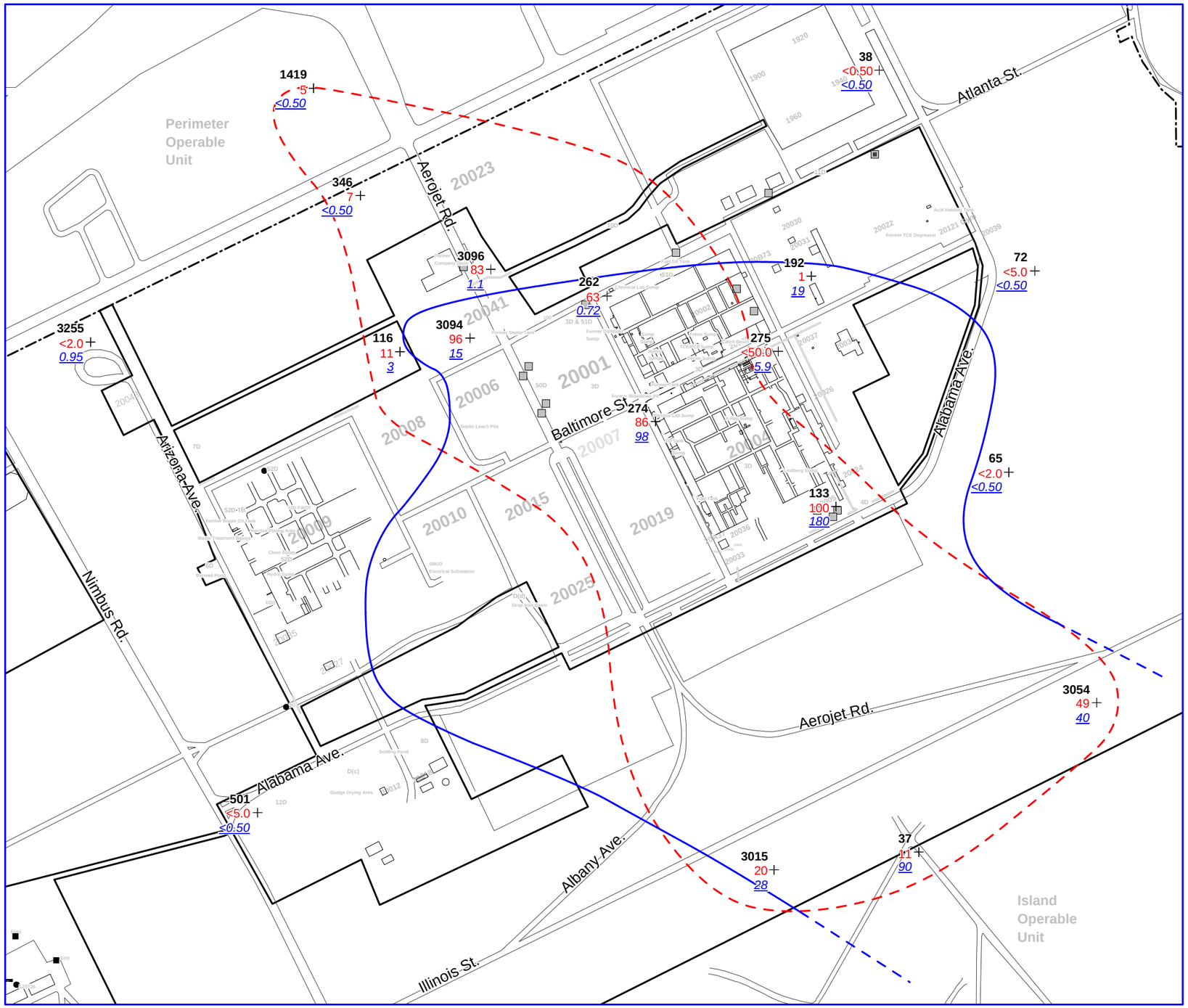


Explanation

645 + Monitoring Well Location and ID

< 5 - Stage 1 RI cis-1,2-DCE concentration (ug/l) (maximum in 1992)

< 5 - Most recent cis-1,2-DCE concentration (ug/l) collected between October 2005 and October 2006

cis-1,2-DCE: cis-1,2-Dichloroethene

Stage 1 - Iso-concentration Contour (6 ug/l)

Most Recent - Iso-concentration Contour (6 ug/l)

Aerojet Property Boundary

Note: J = estimated value.
Only locations with both sets of data are posted

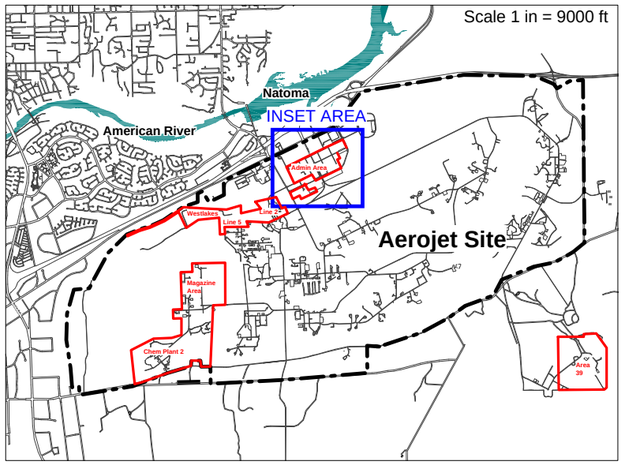
Consent Decree Boundary

20026 Building

Septic Tank

5(d) Source Area ID

Drainage Culvert



N

0 500 1,000

AEROJET
Environmental Remediation

Figure 4.5-20
First Water-Bearing Zone
Comparison of Current and Stage 1 RI cis-1,2-DCE Extents
Administration Area - Boundary Operable Unit (OU-6)

Figure created on behalf of Aerojet by: CVEI
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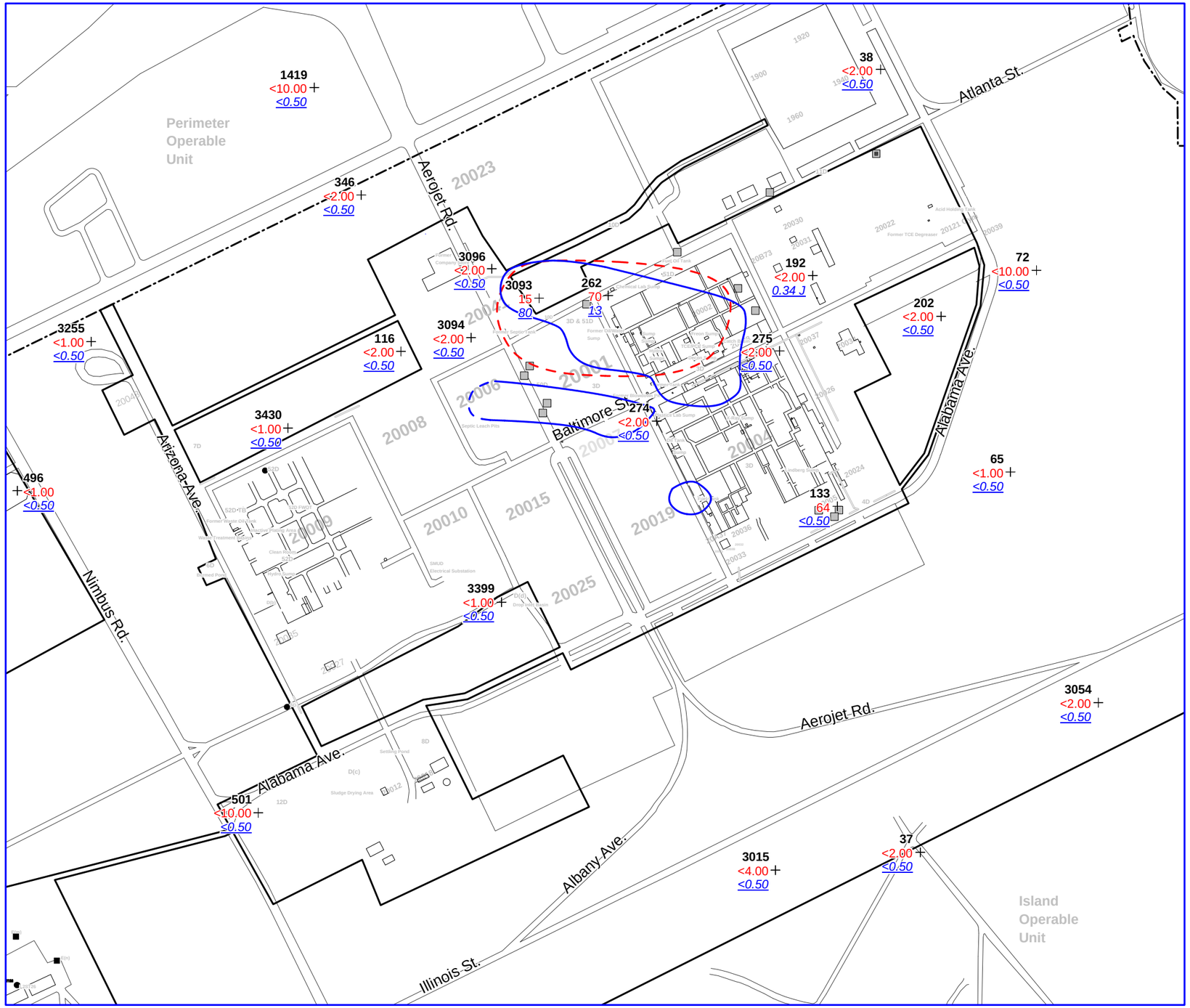


Explanation

645 + Monitoring Well Location and ID

< 5 - Stage 1 RI VC concentration (ug/l) (maximum in 1992)

≤ 5 - Most recent VC concentration (ug/l) collected between October 2005 and October 2006

VC: Vinyl Chloride

Stage 1 - Iso-concentration Contour (5 ug/l)

Most Recent - Iso-concentration Contour (5 ug/l)

Aerojet Property Boundary

Note: J = estimated value.
Only locations with both sets of data are posted

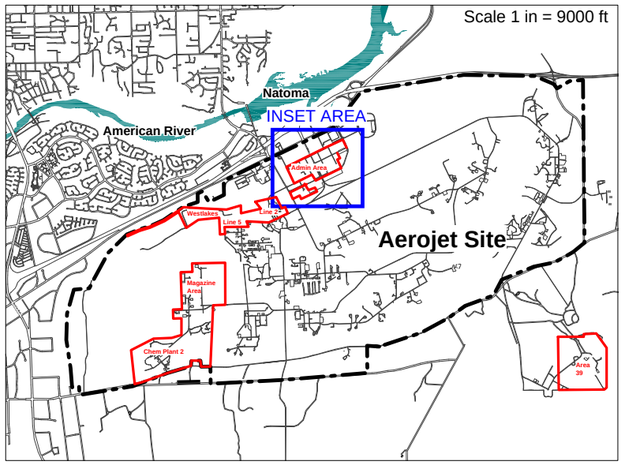
Consent Decree Boundary

20026 Building

Septic Tank

5(d) Source Area ID

Drainage Culvert



N

0 500 1,000
feet

AEROJET
Environmental Remediation

Figure 4.5-21
First Water-Bearing Zone
Comparison of Current and Stage 1 RI Vinyl Chloride Extents
Administration Area - Boundary Operable Unit (OU-6)

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

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Table 4.0-1 *Source Area/Area of Interest*
Administration Area
Boundary Operable Unit RI/FS
Aerojet Superfund Site
Sacramento County, California

Source Area/ Area of Interest	Description
3D and 51D	Liquid Rocket Engine Manufacturing - Sumps in Building 20002 and 20004, Former 3,000-gallon waste tank north of Building 20002, Former 5,000-gallon fuel oil tank southwest of Building 20002
5D	Area 20 Surface Water Drainage system - Ditch system & waste treatment ponds near Building 20009
9D	Area 20 Surface Water Drainage system - Ditch system south of Building 20009
11D	Area 20 Surface Water Drainage system - Ditch system and former 5,000-gallon acid holding tank associated with Building 20022
12D	Area 20 Surface Water Drainage system - Ditch system west of Sites 8D & D(c)
D(b)	Building 20009 Surface Water Drainage System - Ditch System west of Building 20009
D(d)	Storm Drain Sump - Sump west of Building 20025
6D	Building 20009 Drainage - Abandoned pond
52D	Waste Oil storage - Former underground waste oil tank west of Building 20009
52D FWOT & 52D TB	Waste Oil storage - Former waste oil tank near Building 20009
8D	Sewage Treatment - Sewage treatment ponds
D(c)	Sewage Treatment Plant - Treatment plant sludge drying area
50D	Boiler Fuel Oil Storage - Former 4,000-gallon underground fuel oil tank west of Building
Building 20034	X-Ray Facility
A20-ST01-1	Septic Tank - northeast corner of Building 20001, 10,000-gallon capacity, abandoned
A20-ST01-2	Septic Tank - at the south west side of Building 20001, 10,000-gallon capacity, abandoned
A20-ST01-3	Septic Tank - at the north west side of Building 20001, 10,000-gallon capacity, abandoned
A20-ST05-1	Septic Tank - serviced a restroom inside Building 20005, abandoned
A20-ST05-2	Septic Tank - 1,000 gallon capacity, replaced A20-ST05-1
A20-ST14	Septic Tank - east of Building 20014, 1,000-gallon capacity
A20-ST22	Septic Tank - serviced a restroom in the northeast corner of the Building 20022
RCRA-B	RCRA Unit - consists of Building 20037, a chemical storage building located northwest of Building 20034, a former X-ray facility; closed
RCRA-C	RCRA Unit - consists of Building 20029, a former decontamination area located northwest of Building 20002; closed
RCRA-W	RCRA Unit – consists of Building 20018, Storage and Treatment Tank, closed
RCRA-X	RCRA Unit - consists of Building 20B73, a former oil shed located west of Building 20022;
RCRA-Y	RCRA Unit - consists of 20025 Storage, closure pending

Notes and Key:
FWOT = Former waste oil tank
RCRA = Resource, Conservation, and Recovery Act
ST = Septic tank
TB = Treatment basin

Table 4.2-1 Summary of Soil Vapor Sampling and Sampling Statistics for Administration Area East Boundary Operable Unit Remedial Investigation Aerojet Superfund Site Sacramento County, California

Source Area	Interval	Depth (feet bgs)	Locations	Primary Samples	Duplicates	Detects	Frequency of Duplicates	Frequency of Primary Detects
Area 03D	Shallow	0-10	71	71	7	70	10%	99%
	Intermediate	11-20	64	64	4	63	6%	98%
	Deep	>20	28	30	1	30	3%	100%
Site 50D	Shallow	0-10	4	4	0	4	0%	100%
	Intermediate	11-20	4	4	0	4	0%	100%
	Deep	>20	0	0	0	0	0%	0%
Site 51D	Shallow	0-10	1	1	1	1	100%	100%
	Intermediate	11-20	1	1	0	1	0%	100%
	Deep	>20	0	0	0	0	0%	0%
Area 11D	Shallow	0-10	7	7	1	7	14%	100%
	Intermediate	11-20	6	6	0	6	0%	100%
	Deep	>20	2	2	0	2	0%	100%
Building 20034	Shallow	0-10	3	3	1	3	33%	100%
	Intermediate	11-20	3	3	0	3	0%	100%
	Deep	>20	1	1	0	1	0%	100%
		Totals	**195**	**197**	**15**	**195**	8%	99%

Notes and Key:

All samples analyzed for volatile organic compounds (VOCs) by USEPA Method TO-15

% = Percent

bgs = Below ground surface

Table 4.2-2 *Cross-Reference Between Soil and Soil Vapor Sampling Locations and Investigated Features*
Administration Area East
Buildings 20002/20004 Area and Building 20022 Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Site Feature	Source Area	Soil Sampling Location(s)	Soil Vapor Sampling Location(s)
BUILDING 20002/20004 AREA			
CHEMICAL DELIVERY & STORAGE AREA Former chemical delivery and storage area north of plating shop in the northwest corner of Building 20002.	3D		03D-SP87
CHEMICAL LAB SUMPS Sumps outside north side of Building 20002 receiving discharge from former film processing area, test benches, laboratory.	3D	03D-SB09 03D-SB10	03D-SP84 03D-SP85 03D-SP86 03D-SP144 03D-SP150
DECON SUMPS & UTILITY CORRIDOR Includes sumps serving the eastern half of Building 20002, the southern portion of building 20002, and plating shop and decontamination area in Buildings 20002. Also includes a former acid holding tank.	3D	03D-SB26 03D-SB27 03D-SB30 03D-SB57	03D-SP99 03D-SP100 03D-SP102 03D-SP103 03D-SP104 03D-SP105 03D-SP107 03D-SP108 03D-SP109 03D-SP110 03D-SP111 03D-SP112 03D-SP142 03D-SP143 03D-SP145 03D-SP148 03D-SP149
DIESEL UST Underground diesel tank on west side of Building 20001.	50D	50D-SB04	50D-SP01
FLOOR DRAIN SUMP Sump associated with floor drains in southern portion of Building 20004.	3D	03D-SB53 03D-SB62	03D-SP127 03D-SP128
FORMER ALUMINUM FOUNDRY West-central side of Building 20024 (former aluminum foundry).	3D	03D-SB54	03D-SP133 03D-SP139
FORMER AUTOCLAVE VAPOR SEPARATION WASTE SUMP Autoclave vapor separation waste sump on east	3D	03D-SB48	03D-SP132

Table 4.2-2 Cross-Reference Between Soil and Soil Vapor Sampling Locations and Investigated Features
Administration Area East
Buildings 20002/20004 Area and Building 20022 Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Site Feature	Source Area	Soil Sampling Location(s)	Soil Vapor Sampling Location(s)
side of Building 20004.			
FORMER 5-AXIS MILL SUMP Former 5-axis mill sump in the east central portion of Building 20002.	3D	03D-SB22	03D-SP96 03D-SP136
FORMER BLOWDOWN PIT Former boiler blow-down pit and underground diesel tank near southwest corner of Building 20002.	3D	03D-SB20 03D-SB63	03D-SP106
FORMER CHEMICAL STORAGE AREA Former chemical storage area and aero-physics laboratory near southwest corner of Building 20004.	3D	03D-SB55 03D-SB62	03D-SP130 03D-SP131 03D-SP141
FORMER DYE PEN Machine shop and former dye pen in central portion of Building 20002	3D		03D-SP135
FORMER FUEL OIL UST/CHEMICAL LAB SUMP Former underground fuel oil tank on north side of Building 20002. Large sump northwest of Building 20002 receiving discharge from former chemical laboratory.	51D	51D-SB05 51D-SB06 51D-SB07 51D-SB08 51D-SB09 51D-SB10	51D-SP04
FORMER KEROSENE UST Former underground kerosene tank on south side of Building 20002.	3D	03D-SB32	03D-SP104
FORMER OIL/WATER SUMP Plating shop sump inside bump out in the northwest portion of Building 20002.	3D	03D-SB11 03D-SB12 03D-SB13	03D-SP88 03D-SP89
FORMER ELECTRON BEAM WELDING SUMP North of electron beam welder sump in north east portion of Building 20004.	3D		03D-SP137
FORMER PAINT BOOTH Former paint booth northwest of plating shop in Building 20002.	3D	03D-SB31	03D-SP99
FORMER PAINT BOOTH Former paint booth in the northeast corner of Building 20004.	3D	03D-SB44	03D-SP115
FORMER PAINT BOOTH Former paint booth in southwest portion of Building 20004.	3D	03D-SB52	0D-SP126

Table 4.2-2 *Cross-Reference Between Soil and Soil Vapor Sampling Locations and Investigated Features*
Administration Area East
Buildings 20002/20004 Area and Building 20022 Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Site Feature	Source Area	Soil Sampling Location(s)	Soil Vapor Sampling Location(s)
FORMER PAINT BOOTH DRAIN SUMP Paint booth drain sump in east-central portion of Building 20004.	3D	03D-SB49	03D-SP125
FORMER SOLVENT STORAGE AREA Former solvent storage and dispensing areas in Building 20004.	3D		03D-SP119 03D-SP138
FORMER SUMP Former sump inside of machine shop in north central portion of Building 20002	3D		03D-SP134
FORMER WASTE OIL UST Former waste-oil UST west of Building 20004.	3D	03D-SB46 03D-SB67 03D-SB68 03D-SB69	03D-SP122
FORMER X-RAY AND DYE PEN SUMP X-Ray and dye pen sump in Building 20004.	3D	03D-SB47	03D-SP124 03D-SP146
FREON SUMP Large degreaser sump underlying decontamination area clean room in Building 20002.	3D	03D-SB23 03D-SB24	03D-SP97
FUEL TANK Former underground fuel oil tank on southwest side of Building 20004.	3D	03D-SB51	
HYDROSUMP Hydro sump in southwest portion of Building 20002 receiving drainage from test benches, test cells, and floor drains in western half of building. Manhole on west side of Building 20002, collection point of piping from hydro sump area. Hydro sump area within western portion of Building 20002 receiving drainage from test benches, test cells, and floor drains in western half of Building 20002.	3D	03D-SB16 03D-SB17 03D-SB18 03D-SB19	03D-SP92 03D-SP93 03D-SP94 03D-SP95
LINDBERG SUMP Within south end of Building 20005, south of Lindberg Sump that was used for hydrostatic testing of rocket and missile casings. Lindberg sump pump point of discharge to storm drain system	3D	03D-SB56	03D-SP129
LINDBERG SUMP SURFACE WATER DISCHARGE	3D	03D-SNS34	

Table 4.2-2 Cross-Reference Between Soil and Soil Vapor Sampling Locations and Investigated Features
Administration Area East
Buildings 20002/20004 Area and Building 20022 Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Site Feature	Source Area	Soil Sampling Location(s)	Soil Vapor Sampling Location(s)
Lindberg sump pump point of discharge to storm drain system			
MACHINE SHOP WASTE SUMP Waste sump on east side of Building 20004	3D	03D-SB61	03D-SP140
OIL TANK Former underground fuel oil tank on northwest side of Building 20004.	3D	03D-SB45	
PARTS CLEANING AND ETCHING AREA Parts cleaning and etching area along the north portion of Building 20004.	3D	03D-SB40	03D-SP118
PHOTO-ETCH SUMP Former photo-etch sump north of Building 20004.	3D	03D-SB35 03D-SB36	03D-SP113 03D-SP114
PHOTO ETCHING AND PLATING AREA Photo etching and plating area within northeast portion of Building 20004.	3D	03D-SB37 03D-SB38 03D-SB39	03D-SP116 03D-SP117
PLASTICS LAB SUMP & FLOOR DRAINS Northwest of plastics lab in and utility corridor north of Building 20004.	3D	03D-SB33 03D-SB41 03D-SB42 03D-SB43 03D-SB41 03D-SB64 03D-SB65 03D-SB66	03D-SP120 03D-SP121
SEPTIC LEACH PITS South of Building 20006.	Area 20	A20-ST06-SB01	A20-ST06-SP01
SEPTIC TANK A20-ST01-01 Northeast of Building 20001.	Area 20	A20-ST01-SB01	A20-ST01-1-SP01
SEPTIC TANK A20-ST01-02 West of Building 20001.	Area 20	A20-ST01-SB03	A20-ST01-2-SP01
SEPTIC TANK A20-ST01-03 West of Building 20001.	Area 20	A20-ST01-SB02	A20-ST01-3-SP01
SEPTIC TANK A20-ST02 North of Building 20002.	Area 20	A20-ST02-SB01	A20-ST02-SP01 A20-ST02-SP02 A20-ST02-SP03 A20-ST02-SP04

Table 4.2-2 Cross-Reference Between Soil and Soil Vapor Sampling Locations and Investigated Features
Administration Area East
Buildings 20002/20004 Area and Building 20022 Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Site Feature	Source Area	Soil Sampling Location(s)	Soil Vapor Sampling Location(s)
SEPTIC TANKS A20-ST05-01 & A20-ST05-02 Southwest of Building 20005.	Area 20	A20-ST05-SB01 A20-ST05-SB02	A20-ST05-SP01 A20-ST05-SP02 A20-ST05-SP03 A20-ST05-SP04 A20-ST05-SP05
SEPTIC TANK A20-ST14 Near southwest corner of former Company Store.	Area 20	A20-ST14-SB01	A20-ST14-SP01 A20-ST14-SP02
SEPTIC TANK A20-ST20 Northwest of Building 20001.	Area 20	A20-ST20-SB01	A20-ST20-SP01
STORM WATER DRAIN Drain serving west side of Building 20004.	3D	03D-SB50	03D-SP123
SUMP Former plating shop degreaser and test cells in western portion of Building 20002.	3D	03D-SB14 03D-SB15	03D-SP90 03D-SP91
SUMP Small degreasing sump adjacent to the plating shop wall.	3D	03D-SB25	03D-SP98
TRANSFORMER Existing transformer (formerly contained PCBs) on southeast side of Building 20005.	3D	03D-SNS35	
UTILITY CORRIDOR Northwest of Building 20004 along utility corridor	3D	03D-SB57	
WASTE STORAGE TANKS & DEGREASERS South-central portion of Building 20004.	3D		03D-SP147
BUILDING 20022 AREA			
ACID HOLDING TANK Former underground acid holding tank on east side of Building 20022.	11D	11D-SB08	
DRAINAGE DITCH Drainage ditch receiving runoff from equipment and materials storage yards near Building 20022.	11D	11D-SNS12 11D-SNS13 11D-SNS14 11D-SNS15 11D-SNS16 11D-SNS17 11D-SNS21 11D-SNS22	
DRUM STORAGE AREA East side of Building 20030 (drum storage), in	11D	11D-SB04	11D-SP27 11D-SP29

Table 4.2-2 *Cross-Reference Between Soil and Soil Vapor Sampling Locations and Investigated Features*
Administration Area East
Buildings 20002/20004 Area and Building 20022 Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Site Feature	Source Area	Soil Sampling Location(s)	Soil Vapor Sampling Location(s)
materials and equipment storage yard west of Building 20022.			
FORMER TCE DEGREASER Former TCE degreaser at east side of Building 20022.	11D	11D-SB09	11D-SP26
FORMER X-RAY FACILITY (BUILDING 20034) Exterior compressor blow down area.	A20	A20-B34-SB01	
FORMER X-RAY FACILITY (BUILDING 20034) Former location of above-ground storage tank and magnaflux/dye pen.	A20	A20-B34-SB02	A20-B34-SP01 A20-B34-SP02 A20-B34-SP03
MATERIALS AND EQUIPMENT STORAGE YARDS Materials and equipment storage yards and associated former structures east and west of Building 20002.	11D	11D-SB01 11D-SB02 11D-SB03 11D-SB05 11D-SB06 11D-SB07	11D-SP28 11D-SP30
RCRA-B Exterior sumps on north and south sides of RCRA-B Unit, Building 20037 (chemical storage), southwest of Building 20022.	A20	A20-RB37-SB01 A20-RB37-SB02 A20-RB37-SB03 A20-RB37-SB04	A20-RB37-SP01 A20-RB37-SP02
RCRA-C RCRA-C Unit, Building 20029 (decontamination area), southwest of Building 20022.	Area 20	A20-RC29-SB01	A20-RC29-SP01 11D-SP31
RCRA-X RCRA-X Unit, Building 20B73 (former oil shed), west of Building 20022.	Area 20	A20-RX73-SB01 A20-RX73-SB02 A20-RX73-SB03	A20-RX73-SP01
SEPTIC TANK A20-ST22 North of Building 20022.	Area 20	A20-ST22-SB01	A20-ST22-SP01
VEHICLE MAINTANANCE AT BUILDING 20022	Area 20	Not identified as potential source area. Managed under contemporary programs.	

Table 4.2-3
Summary of Soil Sampling and Sampling Statistics for Source Areas 3D, 50D, and 51D
Administration Area East
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

				Area 03D						Area 50D						Area 51D					
Compound(s)	**Analyte**	**Method**	**Depth (feet bgs)**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**
Metals and Cyanide	Metals	6010B	0-2.5	30	35	9	30	26%	100%	2	2	0	2	0%	100%	0	0	0	0	0%	0%
		6020	0-2.5	30	35	9	30	26%	100%	2	2	0	2	0%	100%	0	0	0	0	0%	0%
		6010B	>2.5	62	158	16	158	10%	100%	3	7	0	7	0%	100%	6	25	1	24	4%	100%
		6020	>2.5	62	156	16	142	10%	91%	3	7	0	7	0%	100%	6	22	1	21	5%	95%
	Chromium VI	7199	0-2.5	30	35	9	26	26%	87%	2	2	0	2	0%	100%	0	0	0	0	0%	0%
		7199	>2.5	62	136	16	141	12%	95%	3	7	0	4	0%	67%	6	24	1	21	4%	88%
	Mercury	7471A	0-2.5	30	35	9	29	26%	97%	2	2	0	2	0%	100%	0	0	0	0	0%	0%
		7471A	>2.5	61	147	16	135	11%	85%	3	6	0	7	0%	100%	6	24	1	24	4%	100%
SVOCs		8270C	0-2.5	24	24	9	22	38%	73%	2	2	0	1	0%	50%	0	0	0	0	0%	0%
		8270C	>2.5	62	130	15	50	12%	38%	3	4	0	1	0%	25%	6	24	1	16	4%	67%
PCBs		8082	0-2.5	26	26	9	15	35%	44%	0	0	0	0	0%	0%	0	0	0	0	0%	0%
		8082	>2.5	67	152	16	30	11%	20%	1	2	0	0	0%	0%	6	23	1	0	4%	0%
Perchlorate		314.0, 314.0M	0-2.5	15	15	7	0	47%	0%	0	0	0	0	0%	0%	0	0	0	0	0%	0%
		314.0, 314.0M	>2.5	49	103	12	1	12%	1%	0	0	0	0	0%	0%	6	24	1	0	4%	0%
TPH	Diesel	8015B-SVOA - Diesel	0-2.5	21	21	9	29	43%	100%	2	2	0	2	0%	100%	0	0	0	0	0%	0%
		8015B-SVOA - Diesel	>2.5	63	135	15	131	11%	97%	3	4	0	4	0%	100%	6	24	1	22	4%	96%
	Motor Oil	8015B-SVOA - Oil	0-2.5	21	21	9	28	43%	97%	2	2	0	2	0%	100%	0	0	0	0	0%	0%
		8015B-SVOA - Oil	>2.5	63	135	15	118	11%	87%	3	4	0	3	0%	75%	6	24	1	22	4%	96%
Misc.	Total Cyanide	9014	0-2.5	16	16	8	0	50%	0%	0	0	0	0	0%	0%	0	0	0	0	0%	0%
		9014	>2.5	46	96	11	0	11%	0%	0	0	0	0	0%	0%	0	0	0	0	0%	0%
	NDMA	1625C-CI M	0-2.5	14	14	6	0	43%	0%	0	0	0	0	0%	0%	0	0	0	0	0%	0%
		1625C-CI M	>2.5	45	92	12	1	13%	1%	0	0	0	0	0%	0%	6	24	1	0	4%	0%
	Total Solids	160.3, 160.3M, 2540G	0-2.5	37	37	10	37	27%	100%	2	2	0	2	0%	100%	0	0	0	0	0%	0%
		160.3, 160.3M, 2540G	>2.5	69	182	17	182	9%	100%	3	7	0	7	0%	100%	6	24	1	24	4%	100%
	pH	9045C	0-2.5	20	20	9	28	45%	100%	2	2	0	2	0%	100%	0	0	0	0	0%	0%
		9045C	>2.5	56	145	13	145	9%	100%	2	4	0	4	0%	100%	6	24	1	24	4%	100%
	TOC	9060A MOD	0-2.5	0	0	0	0	0%	0%	0	0	0	0	0%	0%	0	0	0	0	0%	0%
		9060A MOD	>2.5	9	36	5	0	14%	0%	0	0	0	0	0%	0%	0	0	0	0	0%	0%
	CEC	9081	0-2.5	0	0	0	1	0%	100%	0	0	0	0	0%	0%	0	0	0	0	0%	0%
		9081	>2.5	9	36	5	42	14%	100%	0	0	0	0	0%	0%	0	0	0	0	0%	0%

Notes and Key:

> = Greater than
bgs = Below ground surface
CEC = Cation exchange capacity
Chromium VI = Hexavalent chromium
NDMA = N-Nitrosodimethylamine
% = Percent
PCBs = Polychlorinated biphenyls
SVOCs = Semivolatile organic compounds
TOC = Total organic content
TPH = Total petroleum hydrocarbons

Table 4.2-4
Summary of Soil Sampling Activities and Deviations from Field Sampling Plan
Administration Area East
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Proposed Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
3D	Sumps outside north side of Building 20002 receiving discharge from former film processing area, test benches, laboratory.	Subsurface Soil	2	4, 10, 14	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, NDMA, pH	Assess whether releases from the sumps occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment. Assess a possible release from the base of the sump.	6	03D-SB09	5, 11, 15	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, pH	
								03D-SB10	5, 11, 15	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, pH	Not analyzed for PCB at 15 ft bgs.
3D	Plating shop sump inside bump out in the northwest portion of Building 20002.	Subsurface Soil	1	0, 4, 10	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, cyanide, pH	Assess contamination that may have migrated from the sump. Evaluate the vertical extent of potential chemicals in soil, potential for water quality impacts, and support risk assessment.	3	03D-SB11	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, ClO4, cyanide, pH	Not analyzed for PCB, ClO4 and cyanide at 11 ft bgs.
3D	Waste-oil sump outside and floor sump inside "bump out" in the northwest portion of Building 20002.	Subsurface Soil	1	4, 10, 22, 34, ***36***	SVOCs, TPH, PCBs, ClO4, metals (including CrVI), NDMA, pH, ***physical properties***, ***DI-WET***	Assess whether releases to the East-West span of the 5D drainage ditch have occurred and to evaluate possible release points, evaluate potential for water quality impacts, and support risk assessment.	4	03D-SB12	5, 11, 23, 35	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, pH, MC, GS	Sample not collected at 36 ft bgs. Not analyzed for BD, PD, perm, TOC and CEC. Not analyzed for DI-WET.
		Grab Groundwater	1	First water	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, NDMA, ClO4		1	03D-SB12	42	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, NDMA, ClO4	
3D	Former plating shop sump in western portion of Building 20002.	Subsurface Soil	1	4, 10, 22, ***34***, ***36***	SVOCs, TPH, PCBs, metals (including CrVI), cyanide, pH, ***physical properties***, DI-WET	Assess whether a release from the sump in the former (1955) plating shop has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	3	03D-SB13	6, 11.5, 22.5	SVOCs, metals (including CrVI), TPH, PCBs, cyanide, pH, DI-WET, MC, BD, PD, GS, perm	PD only analyzed at 10.5 ft bgs. All other physical parameters only analyzed at 10.5 and 23.5 ft bgs. Refusal at 28 ft bgs. Not analyzed for TOC and CEC.
		Grab Groundwater	***1***	First water	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, NDMA, ClO4		0	03D-SB13			Sample not collected due to refusal at 28 ft bgs before first water.
3D	Former plating shop degreaser and test cells in western portion of Building 20002.	Subsurface Soil	2	***0***, 4, 10	SVOCs, TPH, PCBs, metals ***(including CrVI)***, ClO4, NDMA, pH	Assess whether releases from the degreaser at the former plating area and the test cells have occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	6	03D-SB14	3.5, 7.5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, pH	Only analyzed for metals (including CrVI) at 11 ft bgs. Proposed surface sample taken at 3.5 ft bgs.
								03D-SB15	3, 6, 11.5	SVOCs, metals, TPH, PCBs, NDMA, ClO4, pH	Proposed surface sample taken at 3.5 ft bgs. No CrVI analysis.
3D	Hydro sump in southwest portion of Building 20002 receiving drainage from test benches, test cells, and floor drains in western half of building.	Subsurface Soil	1	4, 10, 22, ***34***	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, cyanide, NDMA, pH	Assess whether a release from the hydro sump has occurred, evaluate vertical extent of chemicals in soil and potential for water quality impacts, and support risk assessment.	3	03D-SB16	5, 11.5, 23	SVOCs, metals (including CrVI), TPH, PCBs, ClO4, cyanide, pH	Sample not collected at 34 ft bgs due to refusal at 25 ft bgs.
		Grab Groundwater	***1***	First water	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, cyanide, NDMA, ClO4		0	03D-SB16			Sample not collected due to refusal at 25 ft bgs before first water.
3D	Manhole on west side of Building 20002, collection point of piping from hydro sump area.	Subsurface Soil	1	0, 4, 10	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, cyanide, pH	Assess whether a release from the manhole and/or piping from hydro sump area has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	3	03D-SB17	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, ClO4, cyanide, pH	Only analyzed for metals (including CrVI), TPH, and pH at 11 ft bgs.
3D	Hydro sump area within western portion of Building 20002 receiving drainage from test benches, test cells, and floor drains in western half of Building 20002.	Subsurface Soil	2	***4***, 10, 22, ***34***	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, cyanide, NDMA, pH	Assess whether a release has occurred from the hydro sump, evaluate vertical extent of chemicals in soil and potential for water quality impacts, and support risk assessment.	6	03D-SB18	11, 23, 35	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	No soil recovery from 4-6 ft bgs.
								03D-SB19	7.5, 11.5, 23.5	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	No soil recovery from 4-6 ft bgs, proposed surface sample collected at 7.5 ft bgs. Water at 28 ft bgs.
		Grab Groundwater	2	First water	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, cyanide, NDMA, ClO4		1	03D-SB18	50	VOC, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide	
								03D-SB19	28	VOC, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide	

Source Area	Associated Site Feature	Proposed Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
3D	Former boiler blow-down pit and underground diesel tank near southwest corner of Building 20002.	Subsurface Soil	1	4, 10	SVOCs, TPH, metals (including CrVI), PCBs	Assess whether releases from the former boiler blow-down pit and/or diesel UST have occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	2	03D-SB20	5, 11	SVOCs, metals (including CrVI), TPH, PCBs	
3D	Former 5-axis mill sump in the east central portion of Building 20002.	Subsurface Soil	1	4, 10	SVOCs, TPH, PCBs, metals (including CrVI), cyanide, ClO4, NDMA, pH	Assess whether a release from the mill sump has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	2	03D-SB22	7.75, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	No analysis for TPH at 7.75 ft bgs.
3D	Large degreaser sump underlying decontamination area clean room in Building 20002.	Subsurface Soil	1	4, 14, ***18***	SVOCs, TPH, PCBs, metals (including CrVI), cyanide, ClO4, NDMA, pH	Assess whether a release from the decontamination area sump has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	2	03D-SB23	6, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Sample not collected at 18 ft bgs due to no soil recovery from 18-20 ft bgs.
3D	Large degreaser sump underlying decontamination area clean room in Building 20002.	Subsurface Soil	1	4, 10	SVOCs, TPH, PCBs, metals (including CrVI), cyanide, ClO4, NDMA, pH	Address the lateral extent of contamination from the large degreasing sump adjacent to 03D-SB23, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	2	03D-SB24	7.5, 11.5	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Only metals and pH analyzed at 11.5 ft bgs.
3D	Small degreasing sump adjacent to the plating shop wall.	Subsurface Soil	1	0, 4, 10	SVOCs, TPH, PCBs, metals (including CrVI), cyanide, ClO4, NDMA, pH	Address the small degreasing sump adjacent to the plating shop wall, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	3	03D-SB25	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Only metals (including CrVI), TPH, and pH analyzed at 11 ft bgs.
3D	Decontamination area exterior sump serving the eastern half of Building 20002.	Subsurface Soil	1	0, 4, 10	SVOCs, TPH, PCBs, metals (including CrVI), cyanide, ClO4, NDMA, pH	Assess whether a release from the exterior decontamination area sump has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	3	03D-SB26	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Only metals (including CrVI) and pH analyzed at 11 ft bgs.
3D	Exterior deactivated sump formerly serving decon. area in southern portion of Building 20002.	Subsurface Soil	1	0, 4, 10	SVOCs, TPH, PCBs, metals (including CrVI), cyanide, ClO4, NDMA, pH	Assess whether a release from the deactivated sump has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	3	03D-SB27	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Only metals (including CrVI), TPH, and pH analyzed at 11 ft bgs.
3D	Sump serving plating shop and decon. area in Buildings 20002 and 20038 as well as former acid holding tank.	Subsurface Soil	1	4, 10, 22, 34	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, cyanide, NDMA, pH, ***physical properties***, DI-WET	Assess whether a release has occurred from the sump and/or the former acid holding tank and migrated into the utility corridor between Buildings 20002 and 20004, evaluate vertical extent of chemicals in soil and potential for water quality impacts, and support risk assessment.	4	03D-SB30	5, 11, 23, 35	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH, DI-WET, MC, GS, TOC, CEC	Not analyzed for BD, PD, perm.
		Grab Groundwater	1	First water	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, cyanide, NDMA, ClO4		1	03D-SB30	58	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide	
3D	Former paint booth northwest of plating shop in Building 20002.	Subsurface Soil	1	0, 4, 10	SVOCs, TPH, metals (including CrVI)	Assess whether a release from the former paint booth has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	3	03D-SB31	1.5, 5.5, 11.5	SVOCs, metals (including CrVI), TPH	
3D	Former underground kerosene tank on south side of Building 20002.	Subsurface Soil	1	4, 10, 14	SVOCs, TPH, PCBs, metals (including CrVI)	Assess whether a release from the former kerosene UST has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	3	03D-SB32	5, 11, 15	SVOCs, metals (including CrVI), TPH, PCBs	
3D	Northwest of plastics lab in and utility corridor north of Building 20004.	Subsurface Soil	1	4, 10, 22, 34	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, cyanide, NDMA, pH, ***physical properties***, DI-WET	Assess whether a release has occurred from the plastics lab and/or migrated into the utility corridor between Buildings 20002 and 20004, evaluate vertical extent of chemicals in soil and potential for water quality impacts, and support risk assessment.	4	03D-SB33	5, 11, 23, 35	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH, MC, PD, GS, perm, TOC, CEC	No physical properties analyzed at 5 ft bgs. Not analyzed for BD. MC and GS only analyzed at 11, 23, and 35 ft bgs. PD and perm only analyzed at 23 ft bgs.
		Grab Groundwater	1	First water	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, cyanide, NDMA, ClO4		1	03D-SB33	60	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide	

Table 4.2-4
Summary of Soil Sampling Activities and Deviations from Field Sampling Plan
Administration Area East
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Proposed Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
3D	Former photo-etch sump north of Building 20004.	Subsurface Soil	1	4, 10, 22, 34	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, cyanide, pH, ***physical properties***, ***DI-WET***	Assess whether a release has occurred from the former photo-etch sump and/or migrated into the utility corridor north of Building 20004, evaluate vertical extent of chemicals in soil and potential for water quality impacts, and support risk assessment.	4	03D-SB35	5, 11, 23, 35	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH, MC, GS, perm, TOC, CEC	Not analyzed for DI-WET. Not analyzed for BD and PD. Perm only analyzed at 11 ft bgs.
		Grab Groundwater	1	First water	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, cyanide, NDMA, ClO4		1	03D-SB35	43	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide	
3D	Plating and photo-etch sump north of Building 20004.	Subsurface Soil	1	2, 4, 10	SVOCs, TPH, PCBs, metals (including CrVI), cyanide, pH	Assess whether a release has occurred from the plating and photo-etch sump on the north side of Building 20004, evaluate vertical extent of chemicals in soil and potential for water quality impacts, and support risk assessment.	3	03D-SB36	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, cyanide, pH	
3D	Photo etching and plating area within northeast portion of Building 20004.	Subsurface Soil	1	4, 10, 22, 34	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, cyanide, ***NDMA***, pH, ***physical properties***, ***DI-WET***	Assess whether a release has occurred from the photo-etch and plating area in the northeast portion of Building 20004 and/or migrated into the utility corridor north of the building, evaluate vertical extent of chemicals in soil and potential for water quality impacts.	4	03D-SB37	5, 11, 23, 32	SVOCs, metals (including CrVI), TPH, PCBs, ClO4, cyanide, pH, TOC, CEC	Not analyzed for NDMA, DI-WET. Not analyzed for BD, GS, MC, PD, and perm.
		Grab Groundwater	1	First water	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, cyanide, NDMA, ClO4		1	03D-SB37	41	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, MC, BD, PD, GS, perm	PD and perm only analyzed at 11 and 23 ft bgs.
3D	Photo etching and plating area within northeast portion of Building 20004.	Subsurface Soil	2	***0***, 4, 10	SVOCs, TPH, PCBs, metals (including CrVI), cyanide, ClO4, NDMA, pH	Determine if a release from the former sewage treatment plant above D(c) has occurred, evaluate vertical extent of chemicals in soil and potential for water quality impacts, and support risk assessment.	6	03D-SB38	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Only analyzed for metals, PCBs, and pH at 11 ft bgs.
								03D-SB39	3.5, 5, 11.5	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Proposed surface sample taken at 3.5 ft bgs. Only analyzed for metals, TPH, and pH at 11 ft bgs.
3D	Parts cleaning and etching area along the north portion of Building 20004.	Subsurface Soil	1	***0***, 4, 10	SVOCs, TPH, PCBs, metals (including CrVI), cyanide, ClO4, NDMA, pH	Assess whether a release from the parts cleaning and etching area in the north-central portion of Building 20004 has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	3	03D-SB40	3.75, 7.5, 11.75	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Proposed surface sample taken at 3.75 ft bgs. Only analyzed for TPH, and PCBs at 11.75 ft bgs.
3D	Upgradient of plastics laboratory in Building 20004.	Subsurface Soil	1	***0***, 4, 10	SVOCs, TPH, PCBs, metals (including CrVI), cyanide, ClO4, NDMA, pH	Assess whether a release from the plastics lab in the northwest portion of Building 20004 has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	3	03D-SB41	3, 6, 11.75	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Proposed surface sample taken at 3 ft bgs. Only analyzed for metals at 11.75 ft bgs.
3D	Plastics laboratory sump west of Building 20004.	Subsurface Soil	1	0, 4, 10	SVOCs, TPH, PCBs, metals (including CrVI), cyanide, ClO4, NDMA, pH	Assess whether a release from the plastics lab sump has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	3	03D-SB42	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Only analyzed for metals (including CrVI), SVOCs, and pH at 11 ft bgs.
3D	Sump north of plastics laboratory in Building 20004.	Subsurface Soil	1	4, 10, 22, 34	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, cyanide, NDMA, pH, ***physical properties***, ***DI-WET***	Assess whether a release has occurred from the sump northwest of Building 20004 and/or migrated into the utility corridor north of the building, evaluate vertical extent of chemicals in soil and potential for water quality impacts, and support risk assessment.	4	03D-SB43	5, 11, 23, 35	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH, MC, GS, TOC, CEC	Not analyzed for DI-WET. Not analyzed for BD, PD, and Perm.
		Grab Groundwater	1	First water	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, cyanide, NDMA, ClO4		1	03D-SB43	47	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide	
3D	Step-out samples taken northwest of Building 20004.	Subsurface Soil	***0***	None	None	If soil chemical concentrations at the proposed location and depths exceed screening criteria, then additional samples will be collected in accordance with step-out and step-down procedures.	16	03D-SB63	1, 5, 10, 15	PCBs	
								03D-SB64	1, 5, 10, 15	PCBs	
								03D-SB65	1, 5, 12, 17	PCBs	
								03D-SB66	1, 5, 10, 15	PCBs	

Source Area	Associated Site Feature	Proposed Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
3D	Former paint booth in the northeast corner of Building 20004.	Subsurface Soil	1	4, 10, 22, 34	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, cyanide, NDMA, pH, physical properties, ***DI-WET***	Assess whether a release from the former paint booth in the northeast corner of Building 20004 has occurred. Evaluate results for vertical extent of chemicals in soil, potential for water quality impacts, and support risk assessment.	4	03D-SB44	5, 11, 23, 33	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH, physical properties	Not analyzed for DI-WET. BD, PD and perm only analyzed at 11 ft bgs.
		Grab Groundwater	1	First water	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, cyanide, NDMA, ClO4		1	03D-SB44	43	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide	
3D	Former underground fuel oil tank on northwest side of Building 20004.	Subsurface Soil	1	4, ***10***, ***14***	SVOCs, TPH, PCBs, metals (including CrVI)	Assess whether a release from the former fuel oil UST has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	1	03D-SB45	5	SVOCs, metals (including CrVI), TPH, PCBs	Sample not collected at 10 and 14 ft bgs due to perched water zone.
3D	Former waste-oil UST west of Building 20004.	Subsurface Soil	1	4, 10, 14	SVOCs, TPH, PCBs, metals (including CrVI)	Assess whether a release from the former waste-oil UST has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	3	03D-SB46	5, 11, 15	SVOCs, metals (including CrVI), TPH, PCBs	
3D	Step-out samples taken west of Building 20004.	Subsurface Soil	***0***	None	None	If soil chemical concentrations at the proposed location and depths exceed screening criteria, then additional samples will be collected in accordance with step-out and step-down procedures.	12	03D-SB67	1, 5, 10, 15	PCBs	
								03D-SB68	1, 5, 10, 15	PCBs	
								03D-SB68	1, 5, 10, 15	PCBs	
3D	X-Ray and dye pen sump in Building 20004.	Subsurface Soil	1	4, 10	SVOCs, TPH, PCBs, metals (including CrVI), cyanide, ClO4, NDMA, pH	Assess whether a release from the X-ray and dye pen sump has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	2	03D-SB47	7.5, 11.5	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	
3D	Autoclave vapor separation waste sump on east side of Building 20004.	Subsurface Soil	1	4, 10, 22, 34	SVOCs, TPH, PCBs, metals (including CrVI), cyanide, ClO4, NDMA, pH, physical properties, ***DI-WET***	Assess whether a release from the plastics lab sump has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	4	03D-SB48	5, 11, 23, 35	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH, physical properties	Not analyzed for DI-WET. MC, BD, PD, and perm only analyzed at 5, 11, and 23 ft bgs.
		Grab Groundwater	1	First water	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, cyanide, NDMA, ClO4		1	03D-SB48	50	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide	
3D	Paint booth drain sump in east-central portion of Building 20004.	Subsurface Soil	1	4, 10	SVOCs, TPH, PCBs, metals (including CrVI), pH	Assess whether a release from the paint booth drain sump in the east-central portion of Building 20004 has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	2	03D-SB49	5, 11.5	SVOCs, metals (including CrVI), TPH, PCBs, pH	
3D	Drain sump serving west side of Building 20004.	Subsurface Soil	1	0, 4, 10	SVOCs, TPH, PCBs, metals (including CrVI), cyanide, ClO4, NDMA, pH	Assess whether a release from the drain sump west of Building 20004 has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	3	03D-SB50	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Only analyzed for metals (including CrVI), PCBs, and pH at 11 ft bgs.
3D	Former underground fuel oil tank on southwest side of Building 20004.	Subsurface Soil	1	4, 10, 14	SVOCs, TPH, PCBs, metals (including CrVI)	Assess whether a release from the former fuel oil UST has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	3	03D-SB51	5, 11, 15	SVOCs, metals (including CrVI), TPH, PCBs	
3D	Former paint booth in southwest portion of Building 20004.	Subsurface Soil	1	0, 4, 10	SVOCs, TPH, PCBs, metals (including CrVI), pH	Assess whether a release from the paint booth has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	3	03D-SB52	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, pH	Only analyzed for metals and pH at 11 ft bgs.

Source Area	Associated Site Feature	Proposed Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
3D	Sump associated with floor drains in southern portion of Building 20004.	Subsurface Soil	1	4, 10	SVOCs, TPH, PCBs, metals (including CrVI), cyanide, ClO4, NDMA, pH	Assess whether a release from the floor drain sump has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	2	03D-SB53	5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Only analyzed for metals (including CrVI), PCBs, and pH at 11 ft bgs.
3D	West-central side of Building 20024 (former aluminum foundry).	Subsurface Soil	1	0, 4, 10	SVOCs, TPH, PCBs, metals (including CrVI), pH	Assess whether a release from the former aluminum foundry building has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	3	03D-SB54	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, pH	Only analyzed for metals (including CrVI), and pH at 11 ft bgs.
3D	Former chemical storage area and aero-physics laboratory near southwest corner of Building 20004.	Subsurface Soil	1	0, 4, 10	SVOCs, TPH, PCBs, metals (including CrVI), pH	Assess whether a release from the former structures has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	3	03D-SB55	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, pH	SVOC and TPH only analyzed at 1 and 5 ft bgs.
3D	Within south end of Building 20005, south of Lindberg Sump that was used for hydrostatic testing of rocket and missile casings.	Subsurface Soil	1	4, 10, 22, 34	SVOCs, TPH, PCBs, metals (including CrVI), cyanide, ClO4, NDMA, pH, ***physical properties*** , ***DI-WET***	Assess whether a release from the Lindberg Sump has occurred, evaluate vertical extent of chemicals in soil and potential for water quality impacts, and support risk assessment. Asses a possible release from the base of the sump.	4	03D-SB56	5, 11, 23, 35	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH, MC, GS, TOC, CEC	Not analyzed for DI-WET. Not analyzed for BD, PD, and Perm.
		Grab Groundwater	1	First water	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, cyanide, NDMA, ClO4		1	03D-SB56	50	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide	
3D	Drain sump serving west side of Building 20004.	Subsurface Soil	1	4, 10, 22, 34	SVOCs, TPH, PCBs, metals (including CrVI), cyanide, ClO4, NDMA, pH, physical properties, ***DI-WET***	Assess whether chemicals have migrated along the utility corridor between Buildings 20002 and 20004 (downgradient from the plastics lab in Building 20004), evaluate vertical extent of chemicals in soil and potential for water quality impacts, and support risk assessment.	4	03D-SB57	5, 11, 23, 35	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH, physical properties	Not analyzed for DI-WET. BD, PD, and perm only analyzed at 5 and 23 ft bgs.
		Grab Groundwater	1	First water	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, cyanide, NDMA, ClO4		1	03D-SB57	60	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide	
3D	Waste sump on east side of Building 20004	Subsurface Soil	1	4, 10	SVOCs, TPH, PCBs, metals (including CrVI), cyanide, ClO4, NDMA, pH	Assess whether a release from the waste sump has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	2	03D-SB61	5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Only analyzed for metals (including CrVI) and pH at 11 ft bgs.
3D	Sump associated with floor drains in southern portion of Building 20004.	Subsurface Soil	1	4, 10	SVOCs, TPH, PCBs, metals (including CrVI), cyanide, ClO4, NDMA, pH	Assess whether a release from the floor drain sump has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	2	03D-SB62	5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Only analyzed for metals and pH at 11 ft bgs.
3D	Lindberg sump pump point of discharge to storm drain system.	Surface and Near-Surface Soil	1	0, 2	SVOCs, TPH, PCBs, metals (including CrVI), cyanide, ClO4, NDMA, pH	Assess whether a release has occurred from the Lindberg sump pump at the point of discharge to the storm drain system, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	1	03D-SNS34	0.25	SVOCs, metals (including CrVI), PCBs, NDMA, ClO4, cyanide, pH	Sample not collected at 2 ft bgs due to concrete casing in the storm drain.
3D	Existing transformer (formerly contained PCBs) on southeast side of Building 20005.	Surface and Near-Surface Soil	1	0, 2	SVOCs, TPH, PCBs, metals (including CrVI)	Assess whether a release from the now-retrofitted transformer has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	1	03D-SNS35	0.25	SVOCs, metals (including CrVI), TPH, NDMA	Sample not collected at 2 ft bgs due to concrete casing in the storm drain.
3D	Septic tank A20-ST01-1, northeast of Building 20001.	Subsurface Soil	1	0, 4, 10	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, cyanide, NDMA, pH	Assess whether a release from the septic tank has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	3	A20-ST01-SB01	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Only analyzed for metals (including CrVI), PCBs, and pH at 11 ft bgs.

Table 4.2-4
Summary of Soil Sampling Activities and Deviations from Field Sampling Plan
Administration Area East
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Proposed Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
3D	Septic tank A20-ST01-03, west of Building 20001.	Subsurface Soil	1	0, 4, 10	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, cyanide, NDMA, pH	Assess whether a release from the septic tank has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	3	A20-ST01-SB02	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Only analyzed for metals and pH at 11 ft bgs.
3D	Septic tank A20-ST01-02, west of Building 20001.	Subsurface Soil	1	0, 4, 10	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, cyanide, NDMA, pH	Assess whether a release from the septic tank has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	3	A20-ST01-SB03	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Only analyzed for metals and pH at 11 ft bgs.
3D	Septic tank A20-ST02, north of Building 20002.	Subsurface Soil	1	0, 4, 10	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, cyanide, NDMA, pH	Assess whether a release from the septic tank has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	3	A20-ST02-SB01	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Only analyzed for metals (including CrVI) and pH at 11 ft bgs.
3D	Septic tanks A20-ST05-01 and A20-ST05-02, southwest of Building 20005.	Subsurface Soil	2	0, 4, 10	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, cyanide, NDMA, pH	Assess whether a release from the septic tanks has occurred, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	6	A20-ST05-SB01	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Only analyzed for metals (including CrVI) and pH at 11 ft bgs.
								A20-ST05-SB02	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Only analyzed for metals (including CrVI) and pH at 11 ft bgs.
3D	Septic leach pits A20-ST06, south of Building 20006.	Subsurface Soil	1	0, 4, 10	SVOCs, TPH, metals (including CrVI), pH	Assess whether a release has occurred at the septic leach pits, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	3	A20-ST06-SB01	1, 5, 11	SVOCs, metals (including CrVI), TPH, pH	Only analyzed for metals (including CrVI) and pH at 11 ft bgs.
3D	Exterior sumps on north and south sides of RCRA-B Unit, Building 20037 (chemical storage), southwest of Building 20022.	Subsurface Soil	4	0, 4, 10	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, cyanide, NDMA, pH	Assess contamination that may have migrated from the sumps. Evaluate the vertical extent of potential chemicals in soil, potential for water quality impacts, and support risk assessment.	12	A20-RB37-SB01	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Only analyzed for metals (including CrVI), PCBs, and pH at 11 ft bgs.
								A20-RB37-SB02	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Only analyzed for metals (including CrVI) and pH at 11 ft bgs.
								A20-RB37-SB03	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Only analyzed for metals and pH at 11 ft bgs.
								A20-RB37-SB04	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Only analyzed for metals (including CrVI) and pH at 11 ft bgs.
3D	RCRA-C Unit, Building 20029 (decontamination area), southwest of Building 20022.	Subsurface Soil	1	0, 4, 10, 17, 22, 27, 32	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, cyanide, NDMA, pH, ***physical properties*** , ***DI-WET***	Assess whether a release has occurred at the decontamination area (wash rack) that contained an aboveground holding tank. Evaluate vertical extent of potential chemicals in soil, potential for water quality impacts, and support risk assessment.	7	A20-RC29-SB01	1, 5, 11, 18, 23, 28, 33	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH, MC, GS, TOC, CEC	Not analyzed for DI-WET. Not analyzed for BD, PD, and Perm.
		Grab Groundwater	1	First water	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, cyanide, NDMA, ClO4		1	A20-RC29-SB01	43	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide	
3D	RCRA-X Unit, Building 20B73 (former oil shed), west of Building 20022.	Subsurface Soil	3	0, 4, 10	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, cyanide, NDMA, pH	Assess whether a release has occurred at the former structure that included holding tanks and associated piping and drum storage areas. Evaluate vertical extent of potential chemicals in soil, potential for water quality impacts, and support risk assessment.	9	A20-RX73-SB01	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Only analyzed for metals (including CrVI) and pH at 11 ft bgs.
								A20-RX73-SB02	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Only analyzed for metals (including CrVI) and pH at 11 ft bgs.
								A20-RX73-SB03	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Only analyzed for metals (including CrVI), TPH, and pH at 11 ft bgs.
11D	Materials and equipment storage yards and associated former structures east of Building 20002.	Subsurface Soil	3	0, 4, 10	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, cyanide, NDMA, pH	Assess contamination that may have been released into soils underlying the storage areas west of 11D drainage ditch, evaluating vertical extent of potential chemicals in soil and potential for water quality impacts, and supporting risk assessment.	9	11D-SB01	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Only analyzed for metals (including CrVI) and pH at 5 and 11 ft bgs.
								11D-SB02	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Only analyzed for metals (including CrVI) and pH at 5 and 11 ft bgs, PCBs only analyzed at 1 and 5 ft bgs.
								11D-SB03	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Only analyzed for metals (including CrVI), PCBs, and pH at 5 and 11 ft bgs.

Source Area	Associated Site Feature	Proposed Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
11D	East side of Building 20030 (drum storage), in materials and equipment storage yard west of Building 20022.	Subsurface Soil	1	0, 4, 10, 17, 22, 27, 32	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, cyanide, NDMA, pH, physical properties, ***DI-WET***	Assess contamination that may have been released into soil near Building 20030, evaluating vertical extent of potential chemicals in soil and potential for water quality impacts, and supporting risk assessment.	7	11D-SB04	1, 5, 11, 18, 23, 28, 33	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH, physical properties	Not analyzed for DI-WET. BD, PD, and perm only analyzed at 11, 18, 28, and 35 ft bgs.
		Grab Groundwater	1	First water	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, cyanide, NDMA, ClO4		1	11D-SB04	40	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide	
11D	Materials and equipment storage yards and associated former structures west of Building 20022.	Subsurface Soil	***3***	0, 4, 10	SVOCs, TPH, PCBs, ***metals (including CrVI)***, ***ClO4***, ***cyanide***, NDMA, pH	Assess contamination that may have been released into soils underlying the storage areas west of Building 20022, evaluating vertical extent of potential chemicals in soil and potential for water quality impacts, and supporting risk assessment.	9	11D-SB05	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Only analyzed for metals (including CrVI), TPH, cyanide, and pH at 11 ft bgs.
								11D-SB06	1, 5, 11	SVOCs, TPH, PCBs, NDMA, pH	Not analyzed for metals (including CrVI), ClO4 and cyanide. Only analyzed for PCBs and pH at 11 ft bgs.
								11D-SB07	1, 5, 11	SVOCs, TPH, PCBs, NDMA, pH	Not analyzed for metals (including CrVI), ClO4 and cyanide. SVOC and NDMA not analyzed at 11 ft bgs.
							8	11D-SNS25	0.5, 2.5	Metals (including CrVI), TPH, pH	
								11D-SNS26	0.5, 2.5	Metals (including CrVI), TPH, pH	
								11D-SNS27	0.5, 2.5	Metals (including CrVI), TPH, pH	
								11D-SNS28	0.5, 2.5	Metals (including CrVI), TPH, pH	
11D	Former underground acid holding tank on east side of Building 20022.	Subsurface Soil	1	0, 4, 14, 17, 22, 27, 32	SVOCs, metals (including CrVI), pH, physical properties, DI-WET	Assess whether a release may have occurred from the former acid holding tank, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	7	11D-SB08	1, 5, 15, 18, 23, 28, 33	SVOCs, metals (including CrVI), pH, DI-WET, physical properties	BD, PD, and perm only analyzed at 23, 28, and 33 ft bgs.
		Grab Groundwater	1	First water	VOCs, SVOCs, total and filtered metals (including CrVI)		1	11D-SB08	30	VOCs, SVOCs, total and filtered metals (including CrVI), ***NDMA***	NDMA included as additional analyses.
11D	Former TCE degreaser at east side of Building 20022.	Subsurface Soil	1	0, 4, 10	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, NDMA	Assess whether chemicals were released from the former TCE degreaser, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	3	11D-SB09	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4	Only analyzed for metals (including CrVI) at 11 ft bgs.
11D	Western, N-S reach of 11D drainage ditch receiving runoff from equipment and materials storage yards west of Building 20022.	Surface and Near-Surface Soil	7	0, 2	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, cyanide, NDMA, pH	Evaluate whether chemicals have migrated into the drainage ditch from the storage areas west of Building 20022, the potential for water quality impacts, and support risk assessment.	14	11D-SNS12	0.5, 2.5	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	
								11D-SNS13	0.5, 2.5	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	
								11D-SNS14	0.5, 2.5	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	
								11D-SNS15	0.5, 2.5	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	
								11D-SNS16	0.5, 2.5	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	
								11D-SNS17	0.5, 2.5	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	
								11D-SNS22	0.5, 2.5	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	

Source Area	Associated Site Feature	Proposed Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
11D	E-W reach of 11D drainage ditch receiving runoff from areas northwest, north, and northeast of Building 20022.	Surface and Near-Surface Soil	3	0, 2	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, cyanide, NDMA, pH	Assess contamination that may migrate into 11D from areas north of Building 20022, evaluating potential for water quality impacts, and supporting risk assessment.	6	11D-SNS18	0.5, 2.5	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	
								11D-SNS23	3.5, 4.5	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	Proposed surface and subsurface samples were taken at 3.5 and 4.5 ft bgs.
								11D-SNS24	0.5, 2.5	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	
11D	Eastern, N-S reach of 11D drainage ditch receiving runoff from areas southeast and east of Building 20022.	Surface and Near-Surface Soil	2	0, 2	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, cyanide, NDMA, pH	Assess contamination that may migrate into 11D from areas east and southeast of Building 20022, evaluating potential for water quality impacts, and supporting risk assessment.	4	11D-SNS19	0.5, 2.5	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	
								11D-SNS20	0.5, 2.5	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	
11D	Southern end of western, N-S reach of 11D drainage ditch receiving runoff from areas near Building 20034 (former X-ray facility).	Surface and Near-Surface Soil	1	0, 2	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, cyanide, NDMA, pH	Assessing contamination that may have migrated into 11D from adjacent areas, a basis for comparing results from samples collected downstream within 11D, evaluating potential for water quality impacts, and supporting risk assessment.	2	11D-SNS21	0.5, 2.5	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, cyanide, pH	
50D	Underground diesel tank on west side of Building 20001.	Subsurface Soil	1	4, 10, 14	SVOCs, TPH, PCBs, metals (including CrVI)	Assess whether a release from the former diesel UST has occurred (the tank may have been abandoned in place), evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	3	50D-SB04	5, 11, 15	SVOCs, metals (including CrVI), TPH, PCBs	Only analyzed for metals at 15 ft bgs.
51D	Former underground diesel tank on north side of Building 20002. Large sump northwest of Building 20002 receiving discharge from former chemical laboratory.	Subsurface Soil	6	4, 8, 12, 16	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, NDMA, pH	Assess possible contamination near the former tank.	24	51D-SB05	5, 9, 13, 17	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, pH	
								51D-SB06	5, 9, 13, 17	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, pH	PCBs not analyzed at 5 ft bgs.
								51D-SB07	5, 9, 13, 17	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, pH	
								51D-SB08	5, 9, 13, 17	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, pH	TPH not analyzed at 13 ft bgs.
								51D-SB09	5, 9, 13, 17	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, pH	
								51D-SB10	5, 9, 13, 17	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, pH	
A20	Septic tank A20-ST22, north of Building 20022.	Subsurface Soil	1	0, 4, 10	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, NDMA, pH	Assess whether a release has occurred at the septic tank on the northeast side of Building 20022, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	3	A20-ST22-SB01	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, NDMA, ClO4, pH	Only analyzed for metals, TPH, PCBs, and pH at 11 ft bgs.
A20	Septic tank A20-ST14, near southwest corner of former Company Store.	Subsurface Soil	1	0, 4, 10	SVOCs, TPH, metals (including CrVI), pH	Assess whether a release has occurred at the septic tank, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	3	A20-ST14-SB01	1, 5, 11	SVOCs, metals (including CrVI), TPH, pH	Only analyzed for metals (including CrVI) and pH at 11 ft bgs.
A20	Septic tank A20-ST20, northwest of Building 20001.	Subsurface Soil	1	0, 4, 10	SVOCs, TPH, metals (including CrVI), pH	Assess whether a release has occurred at the septic tank, evaluate vertical extent of potential chemicals in soil and potential for water quality impacts, and support risk assessment.	3	A20-ST20-SB01	1, 5, 11	SVOCs, metals (including CrVI), TPH, pH	Only analyzed for metals (including CrVI) and pH at 11 ft bgs.

Table 4.2-4
Summary of Soil Sampling Activities and Deviations from Field Sampling Plan
Administration Area East
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Proposed Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
Building 20034	Former X-ray facility (Building 20034), including former film processing area and unnamed, above-ground storage tank; exterior compressor blow down area.	Subsurface Soil	2	0, 4, 10	SVOCs, TPH, metals (including CrVI), pH	Evaluate vertical extent of potential chemicals in soil, potential for water quality impacts, and supporting risk assessment.	6	A20-B34-SB01	1, 5, 11	SVOCs, metals (including CrVI), TPH, pH	SVOCs, TPH, and NDMA only analyzed at 1 ft bgs.
								A20-B34-SB02	1, 5, 11	SVOCs, metals (including CrVI), TPH, pH	SVOCs, TPH, and NDMA only analyzed at 1 ft bgs.

Notes and Key:
Bulk density includes dry density, wet density and specific gravity.
Physical properties include bulk density, permeability, porosity, moisture content, total organic carbon, grain size, and CEC.
Bold, italicized and underlined data does not agree with the analytical results. See "Deviations from Field Sampling Plan" column for more information on discrepancies.

Admin. = Administration
ft bgs = Feet Below ground surface
ID = Identification
BD = Bulk Density
GS = Grain Size
CEC = Cation exchange capacity
DI-WET = Deionized waste extract test
ClO4 = Perchlorate
CrVI = Hexavalent chromium
MC = Moisture Content
NDMA = N-Nitrosodimethylamine
PD = Porosity
pH = Paste pH
Perm = Permeability
PCBs = Poly-chlorinated biphenyls
RCRA = Resource Conservation and Recovery Act
SVOCs = Semivolatile organic compounds
TPH = Total petroleum hydrocarbons
TCE = Trichloroethene
UST = Underground storage tank
VOCs = Volatile organic compounds

Table 4.2-5
Summary of Soil Vapor Sampling Activities and Deviations from Field Sampling Plan, Administration Area East
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Rationale and Comments	Number of Samples Collected	Sampling Activity	Sample ID	Sample Depths (ft bgs)	Deviations from Field Sampling Plan
3D	Sump outside northwest corner of Building 20002 receiving discharge from former film processing area, test benches, laboratory.	1	15, 25	Determine if a release to soil has occurred from the sump.	2	Soil Vapor	03D-SP84	15, 25	
3D	Large sump northwest of Building 20002 receiving discharge from the former chemical laboratory.	1	15, 25	Determine if a source is present within the vadose zone. Collect additional step out and step down samples where soil vapor concentrations at the proposed location and depths exceed soil vapor screening levels.	2	Soil Vapor	03D-SP85	25, 30	
					1	Grab Groundwater	03D-SP85	15	
3D	Former chemical laboratory in the north central portion of Building 20002.	1	10, 20	Determine if a release to soil has occurred from the chemical laboratory.	2	Soil Vapor	03D-SP86	10, 20	
3D	Former chemical delivery and storage area north of plating shop in the northwest corner of Building 20002.	1	10, ***20***	Determine if a release to soil has occurred from the former chemical delivery and storage area.	1	Soil Vapor	03D-SP87	10	No sample collected at 20 ft bgs, no flow.
3D	Plating shop sump inside bump out in the northwest portion of Building 20002.	1	10, 20	Determine if a release to soil has occurred from the plating shop sump.	2	Soil Vapor	03D-SP88	10, 20	
3D	Waste oil sump outside and floor sump inside bump out in the northwest portion of Building 20002.	1	10, 20	Determine if a release to soil has occurred from the waste oil and floor sumps.	1	Soil Vapor	03D-SP89	10	
					1	Grab Groundwater	03D-SP89	20	
3D	Former plating shop sump in western portion of Building 20002.	1	10, 20	Determine if a release to soil has occurred from the former plating shop sump.	2	Soil Vapor	03D-SP90	10, 20	
3D	Former plating shop degreaser in western portion of Building 20002.	1	10, 20	Determine if a release to soil has occurred from the former plating shop degreaser.	2	Soil Vapor	03D-SP91	10, 20	
3D	Test cells and flow benches in western portion of Building 20002.	1	10, 20	Determine if a release to soil has occurred from the test cells and flow benches.	2	Soil Vapor	03D-SP92	10, 20	
3D	Hydro sump receiving drainage from test benches, test cells, and floor drains in western half of Building 20002.	1	15, 25	Determine if a release to soil has occurred from the hydro sump.	2	Soil Vapor	03D-SP93	15, 25	
3D	Piping from hydro sump receiving drainage from test benches, test cells, and floor drains in western half of Building 20002.	1	15, 25	Determine if a release to soil has occurred from the piping associated with the hydro sump.	2	Soil Vapor	03D-SP94	15, 25	
3D	Hydro sump receiving drainage from test benches, test cells, and floor drains in western half of Building 20002.	1	15, 25	Determine if a release to soil has occurred from the hydro sump.	2	Soil Vapor	03D-SP95	10, 18	
3D	Former 5-axis mill oil sump in the east central portion of Building 20002.	1	10, 20	Determine if a release to soil has occurred from the former 5-axis mill oil sump.	2	Soil Vapor	03D-SP96	10, 17	
3D	Large degreasing sump underlying decontamination area clean room in Building 20002.	1	***15, 25***	Prior Soil Vapor results suggest the presence of NAPL. Determine the outer extent of the potential NAPL source area within the vadose zone.	1	Grab Groundwater	03D-SP97		Groundwater at 9.8 ft bgs, sample not collected.
3D	Small degreasing sump serving decontamination conveyor line in Building 20002.	1	10, ***20***	Prior Soil Vapor results suggest the presence of NAPL. Determine the outer extent of the potential NAPL source area within the vadose zone.	1	Grab Groundwater	03D-SP98	15	No sample collected, water at 10 ft bgs.
3D	Former paint booth northwest of plating shop in Building 20002.	1	10, 20	Determine if a release to soil has occurred from the former paint booth.	1	Soil Vapor	03D-SP99	10	
					1	Grab Groundwater	03D-SP99	20	
3D	Sump serving plating shop and decontamination area in Buildings 20002 and 20038.	1	10, 20	Prior Soil Vapor results suggest the presence of NAPL. Determine the outer extent of the potential NAPL source area within the vadose zone.	2	Soil Vapor	03D-SP100	10, 20	
3D	Decontamination area sump and floor drain sump serving the eastern half of Building 20002.	1	10, 20	Prior Soil Vapor results are above screening levels. Determine if a source is present within the vadose zone.	2	Grab Groundwater	03D-SP101	10, 20	
3D	Potential NAPL soil source area south of Building 20002 and west of Building 20038 along storm drain corridor.	1	10, 20	Prior Soil Vapor results suggest the presence of NAPL. Determine the outer extent of the potential NAPL source area within the vadose zone.	2	Soil Vapor	03D-SP102	10, 28	
					2	Grab Groundwater	03D-SP102	20, 40	

Table 4.2-5
Summary of Soil Vapor Sampling Activities and Deviations from Field Sampling Plan, Administration Area East
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Rationale and Comments	Number of Samples Collected	Sampling Activity	Sample ID	Sample Depths (ft bgs)	Deviations from Field Sampling Plan
3D	Potential NAPL soil source area south of Buildings 20002 and 20038.	1	10, 20	Prior Soil Vapor results suggest the presence of NAPL. Determine the outer extent of the potential NAPL source area within the vadose zone.	2	Soil Vapor	03D-SP103	10, 20	
3D	Potential NAPL soil source area south of Building 20002 and adjacent to abandoned kerosene UST.	1	10, 20	Prior Soil Vapor results suggest the presence of NAPL. Determine the outer extent of the potential NAPL source area within the vadose zone.	2	Soil Vapor	03D-SP104	10, 20	
3D	Potential NAPL soil source area south of Building 20002 along storm drain corridor.	1	10, 20	Prior Soil Vapor results suggest the presence of NAPL. Determine the outer extent of the potential NAPL source area within the vadose zone.	1	Soil Vapor	03D-SP105	10	
					1	Grab Groundwater	03D-SP105	20	
3D	Former leaching pit and diesel UST southwest of Building 20002.	1	15, 25	Determine if a release to soil has occurred from the leaching pit or UST. Collect to 25 feet bgs because the pit extends to approximately 10 feet below grade.	3	Soil Vapor	03D-SP106	15, 25, 30	
					1	Grab Groundwater	03D-SP106	31	
3D	Northwest of Building 20004 along utility corridor.	***1***	10, 20	Determine if a release to soil has occurred from the storm drain or sanitary sewer corridor releases associated with Buildings 20002 and 20004 as suggested by prior results exceeding screening levels.	3	Soil Vapor	03D-SP107	10, 20, 29	
							03D-SP142	10, 20, 30	
							03D-SP143	10, 20, 30	
							03D-SP145	10, 20	
							03D-SP149	10, 20	
					1	Grab Groundwater	03D-SP107	40	
							03D-SP142	38	
							03D-SP143	38, 47	
							03D-SP145	30, 40	
3D	North of Building 2004 along utility corridor.	1	10, 20	Determine if a release to soil has occurred from the storm drain or sanitary sewer corridor releases associated with Buildings 20002 and 20004.	1	Soil Vapor	03D-SP108	10	
					1	Grab Groundwater	03D-SP108	20	
3D	Sump north of plastics laboratory in Building 20004.	1	10, 20	Determine if source is present within the vadose zone adjacent to the sump.	3	Soil Vapor	03D-SP109	10, 20, 30	
					1	Grab Groundwater	03D-SP109	32	
3D	Potential NAPL soil source area north of Building 20004 along utility corridor.	1	10, 20	Determine the outer extent of the potential NAPL source area within the vadose zone.	2	Soil Vapor	03D-SP110	10, 20	
					1	Grab Groundwater	03D-SP110	30	
3D	Potential NAPL soil source area north of Building 20004 along utility corridor.	1	10, 20	Determine the outer extent of the potential NAPL source area within the vadose zone.	2	Soil Vapor	03D-SP111	10, 20	
3D	Potential NAPL soil source area north of Building 20004 plating shop degreaser.	1	10, 20	Determine the outer extent of the potential NAPL source area within the vadose zone.	2	Soil Vapor	03D-SP112	10, 20	
3D	Plating and photo etch sump north of Building 20004.	1	10, 20	Determine if a release to soil has occurred from the former plating and photo etch shop sump.	2	Soil Vapor	03D-SP113	10, 20	
3D	Former photo etch sump north of Building 20004.	1	10, 20	Determine if a source is present within the vadose zone adjacent to sump at the point of highest VOC concentration during the previous investigation.	2	Soil Vapor	03D-SP114	10, 20	
3D	Former paint booth in the northeast corner of Building 20004.	1	10, 20	Determine if a release to soil has occurred from the former paint booth.	1	Soil Vapor	03D-SP115	10	
					1	Grab Groundwater	03D-SP115	20	
3D	East of photo etch shop in Building 20004.	1	10, 20	Determine if a release to soil has occurred from the former photo etch shop.	1	Soil Vapor	03D-SP116	10	
					1	Grab Groundwater	03D-SP116	15	
3D	West of photo etch shop in Building 20004.	1	10, ***20***	Determine if a release to soil has occurred from the former photo etch shop.	1	Soil Vapor	03D-SP117	10	No sample collected at 20 ft bgs due to no flow.
3D	Parts cleaning and etching area along the north portion of Building 20004.	1	10, 20	Determine if a release to soil has occurred from the parts cleaning and etching area.	2	Soil Vapor	03D-SP118	10, 20	
3D	Former solvent storage and dispensing area in Building 20004.	1	10, 20	Determine if a source is present within the vadose zone adjacent to the former solvent storage and dispensing area.	3	Soil Vapor	03D-SP119	10, 20, 29	

Table 4.2-5
Summary of Soil Vapor Sampling Activities and Deviations from Field Sampling Plan, Administration Area East
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Rationale and Comments	Number of Samples Collected	Sampling Activity	Sample ID	Sample Depths (ft bgs)	Deviations from Field Sampling Plan
3D	Up gradient of plastics laboratory in Building 20004.	1	10, 20	Determine if a release to soil has occurred from the plastics laboratory.	2	Soil Vapor	03D-SP120	10, 20	
3D	Potential NAPL source area adjacent to the plastics laboratory sump west of Building 20004.	1	15, 25	Assess whether a release to soils has occurred from the plastics lab sump and determine the outer extent of the potential NAPL source area within the vadose zone.	2	Soil Vapor	03D-SP121	15, 25	
					1	Grab Groundwater	03D-SP121	35	
3D	Former waste oil UST west of Building 20004.	1	10, 20	Determine if a source is present within the vadose zone adjacent to the former waste oil UST at the point of highest VOC concentration during the previous investigation.	3	Soil Vapor	03D-SP122	10, 20, 30	
					1	Grab Groundwater	03D-SP122	50	
3D	Storm drain sump serving west side of Building 20004.	1	10, 20	Determine if a release to soil has occurred from the storm drain sump receiving discharge from boilers and compressors along the west side of Building 20004.	2	Soil Vapor	03D-SP123	10, 20	
3D	X-Ray and dye pen sump in Building 20004.	***1***	10, 20	Determine if a source is present within the vadose zone adjacent to the sump serving the X-ray and former dye pen areas.	8	Soil Vapor	03D-SP124	10, 20	
							03D-SP146	10, 20, 27	
							03D-SP147	10, 20, 27	
3D	Paint booth drain sump in east central portion of Building 20004.	1	10, 20	Determine if a release to soil has occurred from the paint booth sump.	2	Soil Vapor	03D-SP125	10, 20	
3D	Former paint booth in south west portion of Building 20004.	1	10, 20	Determine if a release to soil has occurred from the former paint booth.	2	Soil Vapor	03D-SP126	10, 20	
3D	Sumps associated with floor drains in southern portion of Building 20004.	2	10, 20	Determine if a release to soil has occurred from the Building 20004 floor drain sumps.	2	Soil Vapor	03D-SP127	10, 20	
					3	Soil Vapor	03D-SP128	10, 20, 30	
					1	Grab Groundwater	03D-SP128	43	
3D	Lindberg sump pump point of discharge to storm drain system.	1	15, 25	Assess if a source is present within the vadose zone.	2	Soil Vapor	03D-SP129	15, 25	
3D	Former chemical storage area and aero physics laboratory south of Building 20004.	***1***	10, 20	Determine if a release to soil has occurred from the chemical storage area or laboratory.	6	Soil Vapor	03D-SP131	10, 20	
							03D-SP130	10, 20	
							03D-SP141	10, 20	
3D	Autoclave vapor separation waste sump on east side of Building 20004.	1	10, 20	Determine if a release to soil has occurred from the vapor separation waste sump.	3	Soil Vapor	03D-SP132	10, 20, 30	
					1	Grab Groundwater	03D-SP132	41	
3D	North side of Building 20024, former aluminum foundry.	***1***	10, 20	Determine if a source is present within the vadose zone.	2	Soil Vapor	03D-SP133	10, 20	
						Soil Vapor	03D-SP139	10, 20, 28	
					1	Grab Groundwater	03D-SP139	36	
3D	Former sump inside of machine shop in north central portion of Building 20002.	1	10, 20	Determine if a release to soil has occurred from the machine shop sump.	2	Soil Vapor	03D-SP134	10, 20	
3D	Machine shop and former dye pen in central portion of Building 20002.	1	10, 20	Determine if a release to soil has occurred from the machine shop and former dye pen area.	2	Soil Vapor	03D-SP135	10, 20	
3D	Former 5-axis mill oil sump in northeast portion of Building 20002.	1	10, ***20***	Determine if a release to soil has occurred from the mill oil sump.	1	Soil Vapor	03D-SP136	10	
					1	Grab Groundwater	03D-SP136	13	
3D	North of electron beam welder sump in north east portion of Building 20004.	1	10, ***20***	Determine if a release to soil has occurred from the welder sump and floor drains in the north east portion of Building 20004.	1	Soil Vapor	03D-SP137	10	No sample collected at 20 ft bgs, no flow.
3D	Former solvent storage area in central portion of Building 20004.	1	10, 20	Determine if a release to soil has occurred from the former solvent storage area.	3	Soil Vapor	03D-SP138	10, 19, 30	
3D	Machine shop waste sump on east side of Building 20004.	1	10, 20	Determine if a release to soil has occurred from the machine shop sump.	2	Soil Vapor	03D-SP140	10, 20	
					1	Grab Groundwater	03D-SP140	37	

Table 4.2-5
Summary of Soil Vapor Sampling Activities and Deviations from Field Sampling Plan, Administration Area East
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Rationale and Comments	Number of Samples Collected	Sampling Activity	Sample ID	Sample Depths (ft bgs)	Deviations from Field Sampling Plan
3D	Step-out samples taken north of Building 20002.	***0***	None	Soil vapor concentrations at the proposed location and depths exceed soil vapor screening levels; additional samples define the extent of the vadose zone source.	4	Soil Vapor	03D-SP150	30	
							03D-SP144	10, 20, 30	
					1	Grab Groundwater	03D-SP144	38	
3D	Step-out samples taken north of Building 20010.	***0***		Soil vapor concentrations at the proposed location and depths exceed soil vapor screening levels; additional samples define the extent of the vadose zone source.	1	Soil Vapor	03D-SP148	10, 20	
3D	Septic tank A20-ST01-1.	1	10, 20	Determine if a source is present within the vadose zone at the point of highest VOC concentration at the septic tank northeast of Building 20001 during previous investigation.	2	Soil Vapor	A20-ST01-1-SP01	10, 20	
3D	Septic tank A20-ST01-2.	1	10, 20	Determine if a source is present within the vadose zone at the point of highest VOC concentration at the septic tank northeast of Building 20001 during previous investigation.	2	Soil Vapor	A20-ST01-2-SP01	10, 20	
3D	Septic tank A20-ST01-3.	1	10, 20	Determine if a release to soil has occurred from the septic tank west of Building 20001.	2	Soil Vapor	A20-ST01-3-SP01	10, 20	
3D	Septic tank A20-ST02.	***1***	10, 20, 30	Determine if a release to soil has occurred from the septic tank and leach lines north of Building 20002. Collect additional step out and step down samples where soil vapor concentrations at the proposed location and depths exceed soil vapor screening levels.	9	Soil Vapor	A20-ST02-SP01	10, 20, 30	
							A20-ST02-SP02	10, 20, 30	
							A20-ST02-SP03	20, 30	
							A20-ST02-SP04	30	
					4	Grab Groundwater	A20-ST02-SP01	38	
							A20-ST02-SP02	40	
							A20-ST02-SP03	42	
							A20-ST02-SP04	30	
3D	Septic tanks A20-ST05-1 and A20-ST05-2.	***1***	10, 20	Determine if a release to soil has occurred from the two septic tanks and leach lines southwest of Building 20005. Collect additional step out and step down samples where soil vapor concentrations at the proposed location and depths exceed soil vapor screening levels.	8	Soil Vapor	A20-ST05-SP01	10, 20, 30	
							A20-ST05-SP02	10, 20	
							A20-ST05-SP03	10	
							A20-ST05-SP04	10	
							A20-ST05-SP05	10	
					4	Grab Groundwater	A20-ST05-SP02	30	
							A20-ST05-SP03	35	
							A20-ST05-SP04	20	
							A20-ST05-SP05	16	
3D	Septic tank A20-ST06.	1	10, 20	Determine if a source is present within the vadose zone.	2	Soil Vapor	A20-ST06-SP01	10, 20	
3D	Solvent sumps on the north and south sides of Building 20037, hazardous waste storage area.	2	10, 20	Determine if a release to soil has occurred from the two solvent sumps.	3	Soil Vapor	A20-RB37-SP01	10, 20, 30	
					2	Soil Vapor	A20-RB37-SP02	10, 20	
					1	Grab Groundwater	A20-RB37-SP01	36	
3D	Decontamination area sump and storage tank inside of former Building 20029.	1	10, 20	Determine if a release to soil has occurred from the sump and waste storage tank.	2	Soil Vapor	A20-RC29-SP01	10, 20	
3D	Former hazardous waste storage and transfer area.	1	10, 20	Determine if a release to soil has occurred from the hazardous material storage area, holding tanks, or waste transfer area.	2	Soil Vapor	A20-RX73-SP01	10, 20	
3D	Septic tank A20-ST20-1.	1	10, 20	Determine if a release to soil has occurred from the former septic tank southwest of Building 20020.	3	Soil Vapor	A20-ST20-SP01	10, 20	
11D	Former TCE degreaser sump on east side of Building 20022.	1	10, 20	Determine if a source is present within the vadose zone adjacent to the TCE degreaser.	2	Soil Vapor	11D-SP26	10, 20	
11D	West side of drum storage area at Building 20030.	1	10, 20	Determine if a source is present within the vadose zone at the point of highest VOC concentration at the former drum storage area during the previous investigation.	2	Soil Vapor	11D-SP27	10, 20	
11D	Material and drum storage area associated with former structure east of former Building 20031.	1	10, 20	Determine if a release to soil has occurred from the material and drum storage area.	2	Soil Vapor	11D-SP28	10, 20	

Table 4.2-5
Summary of Soil Vapor Sampling Activities and Deviations from Field Sampling Plan, Administration Area East
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Rationale and Comments	Number of Samples Collected	Sampling Activity	Sample ID	Sample Depths (ft bgs)	Deviations from Field Sampling Plan
11D	Step-out sample taken west of Building 20022.	***0***	None	Collect additional step out and step down samples where soil vapor concentrations at the proposed location and depths exceed soil vapor screening levels.	7	Soil Vapor	11D-SP29	10, 30	
							11D-SP30	10, 20	
							11D-SP31	10, 20, 30	
					3	Grab Groundwater	11D-SP29	35	
							11D-SP30	36	
							11D-SP31	31	
11D	Septic tank A20-ST22-1.	1	10, 20	Determine if a source is present within the vadose zone at the point of highest VOC concentration around the septic tank north of Building 20022.	2	Soil Vapor	A20-ST22-SP01	10, 20	
50D	Adjacent to diesel UST west of Building 20001.	1	10, 20	Determine if a VOC release to soil has occurred from the UST.	2	Soil Vapor	50D-SP01	10, 20	
50D	Septic tank A20-ST14.	***1***	10, 20	Determine if a source is present within the vadose zone at the point of highest VOC concentration near the septic tank east of Building 20014. Collect additional step out and step down samples where soil vapor concentrations at the proposed location and depths exceed soil vapor screening levels.	4	Soil Vapor	A20-ST14-SP01	10, 20	
							A20-ST14-SP02	10, 21	
51D	Adjacent to diesel UST north of Building 20002.	1	10, 20	Assess potential extent of VOC release to soil from the UST.	2	Soil Vapor	51D-SP04	10, 20	
Building 20034	Magnaflux and dye pen in southern portion of Building 20034.	1	10, 20	Determine if a release to soil has occurred from the Magnaflux and dye pen area.	2	Soil Vapor	A20-B34-SP01	10, 20	
Building 20034	Compressor blow down area and storage tank on the east side of Building 20034.	1	10, 20	Determine if a release to soil has occurred from the blowdown area or storage tank.	2	Soil Vapor	A20-B34-SP02	10, 20	
Building 20034	Step-out sample taken southeast of Building 20034.	***0***	None	Collect additional step out and step down samples where soil vapor concentrations at the proposed location and depths exceed soil vapor screening levels.	3	Soil Vapor	A20-B34-SP03	10, 20, 29	
					1	Grab Groundwater	A20-B34-SP03	30	

Notes and Key:

Grab groundwater collected when soil vapor point was below the groundwater table.
Bold, italicized and underlined data does not agree with the analytical results. See "Deviations from Field Sampling Plan" column for more information on discrepancies.

Admin. = Administration
ft bgs = Feet below ground surface
ID = Identification
NAPL = Non-aqueous phase liquids
UST = Underground storage tank
TCE = Trichloroethene
VOC = Volatile Organic Compound
Proposed analyses = VOC analysis
Performed analyses = VOC analysis
RCRA = Resource Conservation and Recovery Act

Table 4.2-6 Summary of Geotechnical Soil Parameters
Administration Area East
Aerojet Boundary Operable Unit
Aerojet Corporation
Sacramento County, California

			Geo Physical Parameters (ASTM D2937, D854)					Sieve Analysis (ASTM D422)				Permeability (ASTM D5084)	
Test No.	Date	Description of Test Location	Moisture Content (%)	Wet Density (pcf)	Dry Density (pcf)	Specific Gravity	Porosity	Cobbles (%)	Gravel (%)	Sand (%)	Silt / Clay (%)	Average Hydraulic Gradient	Perm (cm/sec)
19	12/16/05	03D-SB35-5	13.3					0.0	67.8	18.4	13.8		
20	12/16/05	03D-SB35-11	22.4					0.0	0.2	40.8	59.0	10.5	1.50E-07
21	12/16/05	03D-SB35-23	12.8					0.0	33.2	31.3	35.5		
22	12/16/05	03D-SB35-35	3.3					0.0	34.4	27.3	38.3		
23	12/16/05	03D-SB43-5	5.4					0.0	73.6	12.4	14.0		
24	12/16/05	03D-SB43-11	5.2					0.0	52.9	33.3	13.8		
25	12/16/05	03D-SB43-35	8.2					0.8	19.3	34.4	45.5		
26	12/16/05	03D-SB30-5	13.3					0.0	50.3	35.6	14.1		
27	12/16/05	03D-SB30-11	25.0					0.0	16.3	50.7	33.0		
28	12/16/05	03D-SB30-23	6.8					0.0	44.4	24.0	31.6		
29	12/16/05	03D-SB30-35	5.7					2.8	10.6	31.4	55.2		
64	12/16/05	03D-SB57-5	17.5	118.6	100.9	2.750	0.4120	0.0	0.3	92.5	7.2	10.7	1.87E-04
65	12/16/05	03D-SB57-11	4.9					0.0	45.5	38.5	16.0		
66	12/16/05	03D-SB57-23	17.7	137.7	117.0	2.690	0.3030	0.0	10.3	45.4	44.3	10.5	1.46E-08
67	12/16/05	03D-SB57-35	17.5					0.0	0.4	58.2	41.4		
68	12/16/05	03D-SB56-5	8.0					0.0	59.3	26.3	14.4		
69	12/16/05	03D-SB56-11	8.7					0.0	47.8	32.4	19.8		
70	12/16/05	03D-SB56-23	14.2					0.0	60.8	25.0	14.2		
71	12/16/05	03D-SB56-35	9.6					0.0	49.8	34.8	15.4		
104	11/23/05	03D-SB13-23.5	18.4	142.4	120.2	2.700	0.2860	0.0	0.2	60.6	39.2	7.7	1.50E-07
105	11/23/05	03D-SB13-10.5	4.3	132.1	126.6	Not Enough Sample		0.0	36.1	45.5	18.4	8.5	1.15E-05
108	1/17/06	03D-SB48-5	18.8	138.3	116.4	2.760	0.3240	0.0	1.9	10.2	87.9	6.7	8.08E-09
109	1/17/06	03D-SB48-11	7.2	143.7	134.0	2.710	0.2080	0.0	39.1	41.1	19.8	8.1	2.32E-07
110	1/17/06	03D-SB48-23	14.6	136.3	118.9	2.850	0.3310	0.0	24.6	39.3	36.1	10.3	6.91E-09
111	1/17/06	03D-SB48-35	10.9					0.0	38.1	38.8	23.1		
140	1/17/06	03D-SB12-5	2.0					0.0	77.3	17.6	5.1		
141	1/17/06	03D-SB12-11	4.3					0.0	48.5	34.9	16.6		
142	1/17/06	03D-SB12-23	8.2					0.0	65.1	22.2	12.7		
143	1/17/06	03D-SB12-35	6.7					0.0	21.0	39.3	39.7		
144	1/17/06	11D-SB04-1	2.7										
145	1/17/06	11D-SB04-5	10.0					0.0	56.2	19.2	24.3		
146	1/17/06	11D-SB04-11	25.3	117.6	93.9	2.650	0.4320	0.0	43.7	12.3	44.0	8.6	2.03E-08
147	1/17/06	11D-SB04-18	7.5	149.4	139.0	2.650	0.1600	37.0	36.4	17.8	8.8	5.9	5.58E-08
148	1/17/06	11D-SB04-23	7.9					0.0	42.8	27.3	29.9		
149	1/17/06	11D-SB04-28	19.8	130.2	108.7	2.730	0.3620	0.0	24.9	29.5	45.6	4.4	1.76E-07
150	1/17/06	11D-SB04-33						0.0	28.0	51.6	20.4		
161	1/17/06	11D-SB04-33	10.8	141.5	127.7	2.700	0.2420	0.0	28.0	51.6	20.4	9.3	4.90E-08

Table 4.2-6 Summary of Geotechnical Soil Parameters
Administration Area East
Aerojet Boundary Operable Unit
Aerojet Corporation
Sacramento County, California

			Geo Physical Parameters (ASTM D2937, D854)					Sieve Analysis (ASTM D422)				Permeability (ASTM D5084)	
Test No.	Date	Description of Test Location	Moisture Content (%)	Wet Density (pcf)	Dry Density (pcf)	Specific Gravity	Porosity	Cobbles (%)	Gravel (%)	Sand (%)	Silt / Clay (%)	Average Hydraulic Gradient	Perm (cm/sec)
178	11/18/05	11D-SB08-1.0	18.9					0.0	0.8	27.8	71.4		
179	11/18/05	11D-SB08-5.0	11.4					0.0	7.1	66.4	26.5		
180	11/18/05	11D-SB08-15	3.8					0.0	42.0	34.4	23.6		
181	11/18/05	11D-SB08-18	6.4					0.0	61.1	27.1	11.8		
182	11/18/05	11D-SB08-23	7.7	152.0	141.2	2.740	0.1740	0.0	37.9	35.7	26.4	5.0	3.30E-08
183	11/18/05	11D-SB08-28	29.3	119.0	92.1	2.550	0.4220	0.0	20.3	54.5	25.2	8.2	3.80E-08
184	11/18/05	11D-SB08-33	7.5	135.6	126.2	2.660	0.2400	14.4	51.6	22.5	11.5	3.0	3.78E-04
195	1/17/06	03D-SB37-5	8.2			2.540		0.0	55.8	27.1	17.1		
196	1/17/06	03D-SB37-11	16.8	142.3	121.8	2.660	0.2800	0.0	16.1	18.1	65.8	11.7	4.32E-08
197	1/17/06	03D-SB37-23	25.9	126.2	100.2	2.630	0.3820	0.0	2.7	65.0	32.3	11.0	5.18E-05
198	1/17/06	03D-SB37-32	100.2			2.660		0.0	29.7	33.9	36.4		
199	12/16/05	03D-SB33-5	No Sample										
200	12/16/05	03D-SB33-11	12.1					0.0	62.9	23.6	13.5		
201	12/16/05	03D-SB33-23	35.1	118.1	87.4		0.4810	0.0	1.4	54.6	44.0	4.4	5.15E-07
202	12/16/05	03D-SB33-35	1.3					0.0	37.7	28.7	33.6		
247	12/16/05	A20-RC29-SB01-1	3.6					0.0	56.4	34.3	9.3		
248	12/16/05	A20-RC29-SB01-5	15.2					0.0	0.9	40.3	58.8		
249	12/16/05	A20-RC29-SB01-11	5.8					0.0	24.2	40.4	35.4		
250	12/16/05	A20-RC29-SB01-18	5.2					0.0	21.4	43.1	35.5		
251	12/16/05	A20-RC29-SB01-23	5.8					0.0	46.8	24.2	29.0		
252	12/16/05	A20-RC29-SB01-28	7.9					0.0	33.1	31.3	35.6		
253	12/16/05	A20-RC29-SB01-33	6.8					0.0	48.2	26.7	25.1		
254	12/16/05	03D-SB44-5	7.9					0.0	62.2	24.3	13.5		
255	12/16/05	03D-SB44-11	12.6	133.7	118.7	2.727	0.3020	0.0	30.6	57.2	12.2	10.0	1.40E-07
256	12/16/05	03D-SB44-23	12.7					0.0	75.2	24.6	0.2		
257	12/16/05	03D-SB44-33	6.2					0.0	22.3	28.9	48.8		
		Mean	**12.7**	**134.2**	**116.2**	**2.7**	**0.3**	**0.9**	**35.0**	**35.2**	**28.9**	**8.1**	**3.3E-05**
		Median	**8.2**	**136.0**	**118.8**	**2.7**	**0.3**	**0.0**	**36.4**	**33.3**	**25.2**	**8.5**	**1.4E-07**
		Geomean	**9.5**	**133.7**	**115.1**	**2.7**	**0.3**		**20.1**	**32.3**	**22.8**	**7.7**	**2.6E-07**

Notes and Key:
% = Percent
cm/sec = Centimeters per second
No. = Number
pcf = Pounds per cubic foot

Table 4.2-7 Summary of Soil Sampling and Sampling Statistics for Source Areas 11D and Building 20034
Administration Area East
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

				Source Area 11D						Source Area Building 20034					
Compound(s)	**Analyte**	**Method**	**Depth (feet bgs)**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**
Metals	Metals	6010B	0-2.5	20	32	15	32	46.9%	100.0%	2	2	0	2	0.0%	100.0%
		6010B	>2.5	8	24	1	24	4.2%	100.0%	2	4	0	4	0.0%	100.0%
		6020	0-2.5	24	40	15	40	37.5%	100.0%	2	2	0	2	0.0%	100.0%
		6020	>2.5	8	23	1	21	4.3%	91.3%	2	3	0	3	0.0%	100.0%
	Chromium VI	7199	0-2.5	20	32	15	32	46.9%	100.0%	2	2	0	2	0.0%	100.0%
		7199	>2.5	9	25	1	24	4.0%	96.0%	2	4	0	4	0.0%	100.0%
	Mercury	7471A	0-2.5	20	32	15	30	46.9%	93.8%	2	2	0	2	0.0%	100.0%
		7471A	>2.5	8	24	1	16	4.2%	66.7%	2	4	0	4	0.0%	100.0%
SVOCs	SVOCs	8270C	0-2.5	31	43	15	20	34.9%	46.5%	2	2	0	1	0.0%	50.0%
		8270C	>2.5	8	19	1	6	5.3%	31.6%	0	0	0	0	0.0%	0.0%
PCBs	PCBs	8082	0-2.5	29	41	15	15	36.6%	36.6%	0	0	0	0	0.0%	0.0%
		8082	>2.5	9	18	1	1	5.6%	5.6%	0	0	0	0	0.0%	0.0%
Perchlorate	Perchlorate	314.0, 314.0M	0-2.5	27	39	15	1	38.5%	2.6%	0	0	0	0	0.0%	0.0%
		314.0, 314.0M	>2.5	5	11	1	0	9.1%	0.0%	0	0	0	0	0.0%	0.0%
TPH	TPH	8015B-SVOA - Diesel	0-2.5	29	36	15	31	41.7%	86.1%	2	2	0	2	0.0%	100.0%
		8015B-SVOA - Diesel	>2.5	7	15	1	15	6.7%	100.0%	0	0	0	0	0.0%	0.0%
		8015B-SVOA - Oil	0-2.5	29	36	15	30	41.7%	83.3%	2	2	0	1	0.0%	50.0%
		8015B-SVOA - Oil	>2.5	7	15	1	14	6.7%	93.3%	0	0	0	0	0.0%	0.0%
Misc.	Total Cyanide	9014	0-2.5	25	32	15	0	46.9%	0.0%	0	0	0	0	0.0%	0.0%
		9014	>2.5	3	10	1	0	10.0%	0.0%	0	0	0	0	0.0%	0.0%
	NDMA	1625C-CI M	0-2.5	27	39	15	0	38.5%	0.0%	0	0	0	0	0.0%	0.0%
		1625C-CI M	>2.5	5	11	1	0	9.1%	0.0%	0	0	0	0	0.0%	0.0%
	Total Solids	160.3, 160.3M, 2540G	0-2.5	26	42	15	42	35.7%	100.0%	2	2	0	2	0.0%	100.0%
		160.3, 160.3M, 2540G	>2.5	11	30	1	30	3.3%	100.0%	2	4	0	4	0.0%	100.0%
	pH	9045C	0-2.5	29	29	15	33	51.7%	113.8%	2	2	0	2	0.0%	100.0%
		9045C	>2.5	10	28	1	28	3.6%	100.0%	2	4	0	4	0.0%	100.0%
	TOC	9060A MOD	0-2.5	3	3	0	1	0.0%	33.3%	0	0	0	0	0.0%	0.0%
		9060A MOD	>2.5	3	18	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	CEC	9081	0-2.5	3	3	0	2	0.0%	66.7%	0	0	0	0	0.0%	0.0%
		9081	>2.5	3	18	0	12	0.0%	66.7%	0	0	0	0	0.0%	0.0%

Notes and Key:

> = Greater than
% = Percent
bgs = Below ground surface
CEC = Cation exchange capacity
Chromium VI = Hexavalent chromium
NDMA = N-Nitrosodimethylamine
PCBs = Polychlorinated biphenyls
SVOCs = Semivolatile organic compounds
TOC = Total organic content
TPH = Total petroleum hydrocarbons

Table 4.3-1 Summary of Soil Vapor Sampling and Sampling Statistics for Administration Area West Boundary Operable Unit Remedial Investigation Aerojet Superfund Site Sacramento County, California

Source Area	Interval	Depth (feet bgs)	Locations	Primary Samples	Duplicate Samples	Detects	Frequency of Duplicates	Frequency of Primary Detects
5D	Shallow	0-10	0	0	0	0	0.0%	0.0%
	Intermediate	11-20	1	1	0	1	0.0%	100.0%
	Deep	20	0	0	0	0	0.0%	0.0%
8D	Shallow	0-10	4	4	0	4	0.0%	100.0%
	Intermediate	11-20	3	3	0	3	0.0%	100.0%
	Deep	20	0	0	0	0	0.0%	0.0%
52D	Shallow	0-10	18	18	1	18	5.6%	100.0%
	Intermediate	11-20	16	16	1	16	6.3%	100.0%
	Deep	21-30	13	13	2	13	15.4%	100.0%
	Very Deep	40	1	1	0	1	0.0%	100.0%
D(b)	Shallow	0-10	5	5	0	5	0.0%	100.0%
	Intermediate	11-20	3	3	0	3	0.0%	100.0%
	Deep	30	1	1	0	1	0.0%	100.0%
D(c)	Shallow	0-10	7	7	1	7	14.3%	100.0%
	Intermediate	11-20	8	8	1	8	12.5%	100.0%
	Deep	30	1	1	0	1	0.0%	100.0%
		Totals:	**81**	**81**	**6**	**81**	**7.4%**	**100.0%**

Notes and Key:

All samples analyzed for volatile organic compounds (VOCs) by USEPA Method TO-15.

% = Percent

bgs = Below ground surface

Table 4.3-2 *Cross-Reference Between Soil and Soil Vapor Sampling Locations and Investigated Features*
Administration Area West
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Site Feature	Source Area	Soil Sampling Location(s)	Soil Vapor Sampling Location(s)
ADMINISTRATION AREA WEST OPEN DITCH SYSTEM			
DRAINAGE DITCH (5D) Northern end of 5D drainage ditch receiving runoff from PGOU Source Areas 10D and 7D.	5D	05D-SNS08	
DRAINAGE DITCH (5D) Section of 5D drainage ditch receiving runoff from PGOU Source Areas 10D and 7D and discharges from drain lines at or near Building 20009.	5D	05D-SNS10 05D-SNS11 05D-SNS12 05D-SNS13 05D-SNS14 05D-SNS15 05D-SNS16 05D-SNS17	
DRAINAGE DITCH (5D) East-West section of 5D drainage ditch receiving runoff from within western Administration Area, including SMUD substation and Source Area D(d).	5D	05D-SNS18 05D-SNS19	05D-SP08
5D DRAINAGE DITCH (5D) West bank of 5D N-S drainage ditch (adjacent to road) and directly west of drain line from Building 20009 to former waste treatment basins.	5D	05D-SB02	
9D DRAINAGE DITCH (9D) Sections of 9D drainage ditch receiving runoff from Source Area 5D ditches and former sewage treatment plant (FSTP).	9D	9D-SD01 9D-SNS05 9D-SNS06	
12D DRAINAGE DITCH (12D) 12D drainage ditch receiving runoff from within Administration Area, including 5D and 9D ditches.	12D	12D-SNS08	
12D DRAINAGE DITCH (12D) 12D drainage ditch receiving runoff from within Administration Area, including 5D and 9D ditches.	12D	12D-SNS08	
DROP INLET BASIN Grated drop inlet receiving stormwater runoff from Bridgeport Ave., and adjacent parking lot. DI also receives runoff via piping from east (under Buildings 20015/2025) and discharges at east end of 5D ditch.	D(d)	D(d)-SD01	

Table 4.3-2 *Cross-Reference Between Soil and Soil Vapor Sampling Locations and Investigated Features*
Administration Area West
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Site Feature	Source Area	Soil Sampling Location(s)	Soil Vapor Sampling Location(s)
BUILDING 20009 AREA			
ACID STORAGE SPILL AREA Spill from acid storage area south of Building 20035	AW	AW-AF1-SB01 AW-AF1-SB02 AW-AF1-SB03	AW-AF1-SP01
BERMED POND Former bermed pond west of Building 20009 that received liquid wastes, particularly from the former metal plating area in Building 20009.	6D	06D-SNS06 06D-SNS07 06D-SNS08 06D-SNS09 06D-SNS10 06D-SNS11 06D-SB02	
CLEAN ROOM Clean room in west-central portion of Building 20009.	52D		52D-SP33 52D-SP34 52D-SP35
DEEP SUMP Deep sump near southeast corner of Building 20009.	52D	52D-SB17	
FORMER PCB SPILL AREA Former excavation to remove soils impacted by PCBs, outside, near southwest corner of Building 20009.	52D	52D-SB18	
FORMER WASTE OIL TANK West of Building 20009.	5D	05D-SB01 05D-SNS09	52D-SP32
HAZARDOUS MATERIALS STORAGE Hazardous materials storage areas on exterior west side of Building 20009.	52D	52D-SB04 52D-SB05	52D-SP31
HYDROSUMP Hydro Sump on west side and adjacent metal plate-covered pit area inside Building 20009. Buried, near-surface drain line north of Hydro Sump.	52D	52D-SB14 52D-SB15 52D-SB16	52D-SP27 52D-SP28

Table 4.3-2 Cross-Reference Between Soil and Soil Vapor Sampling Locations and Investigated Features Administration Area West Boundary Operable Unit Remedial Investigation Aerojet Superfund Site Sacramento County, California

Site Feature	Source Area	Soil Sampling Location(s)	Soil Vapor Sampling Location(s)
INACTIVE PLATING AREA & TCE DEGREASER Former plating area and TCE degreaser inside Building 20009 and adjacent, exterior concrete pad (see feature associated with 52D-SNS03).	52D	52D-SB06 52D-SB08 52D-SB09 52D-SB10	52D-SP24 52D-SP25 52D-SP26 52D-SP36 52D-SP37 52D-SP38 52D-SP39 52D-SP40 52D-SP41 52D-SP42 52D-SP44
PAINT SPRAY BOOTH Paint spray booth on interior west side of Building 20009.	52D	52D-SB07	52D-SP24 52D-SP43
TRENCH DRAINS Grated trenches in concrete pads along exterior west side of Building 20009.	52D	52D-SNS03 52D-SNS04	
WASTE TREATMENT BASINS Former waste treatment basins that received waste liquids from Building 20009, particularly the former plating area.	52D	52D-SNS01 52D-SNS02 52D-SB11 52D-SB12 52D-SB13	52D-SP29 52D-SP30
FORMER SEWAGE TREATMENT PLANT (FSTP)			
FORMER SETTLING POND Northwest of former sewage treatment plant above 8D.	8D	8D-SB01	8D-SP08
HOLDING TANK Holding tank in southern portion of former sewage treatment area.	8D/D(c)		D(c)-SP12
SLUDGE DRYING AREA (EASTERN) Concrete-walled and -lined, former sludge drying pits northeast of former sewage treatment plant above 8D.	8D	8D-SB02	8D-SP07
SLUDGE DRYING PIT (WESTERN) Concrete-walled and -lined, former sludge drying pits northwest of former sewage treatment plant above D(c).	D(c)	D(c)-SNS01 D(c)-SB02 D(c)-SB03	D(c)-SP05
SURFACE DEBRIS Surface debris area south of former RCRA facility	AW	AW-AF2-SB01 AW-AF2-SB02	D(c)-SP09

Table 4.3-2 Cross-Reference Between Soil and Soil Vapor Sampling Locations and Investigated Features Administration Area West Boundary Operable Unit Remedial Investigation Aerojet Superfund Site Sacramento County, California

Site Feature	Source Area	Soil Sampling Location(s)	Soil Vapor Sampling Location(s)
TREATMENT WORKS (EASTERN) Treatment works at former sewage treatment plant, including holding tanks, settling basins, digesters.	8D	8D-SNS01 8D-SB03 8D-SB04 8D-SB05 8D-SB06	8D-SP09 AW-8D-SP10
TREATMENT WORKS (WESTERN) Treatment works at former sewage treatment plant, including holding tanks, settling basins, digesters.	D(c)	D(c)-SB04 D(c)-SB05	D(c)-SP06 D(c)-SP07 D(c)-SP08 D(c)-SP10 D(c)-SP11

Notes and Key:

AW = Administration Area West

Table 4.3-3
Summary of Soil Sampling and Sampling Statistics for Source Areas 5D, 9D, and 12D
Administration Area West
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

				Source Area 5D						Source Area 9D						Source Area 12D					
Compound(s)	**Analyte**	**Method**	**Depth (feet bgs)**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**
Metals	Metals	6010B	0-2.5	17	30	4	30	13.3%	100.0%	3	6	0	6	0%	100%	2	4	0	4	0.0%	100.0%
		6020	0-2.5	17	30	4	29	13.3%	96.7%	3	6	0	6	0.0%	100.0%	2	4	0	4	0.0%	100.0%
		6010B	>2.5	10	24	3	24	12.5%	100.0%	1	1	0	1	0.0%	100.0%	0	0	0	0	0.0%	0.0%
		6020	>2.5	10	24	3	21	12.5%	87.5%	1	1	0	1	0.0%	100.0%	0	0	0	0	0.0%	0.0%
	Chromium VI	7199	0-2.5	14	25	3	25	12.0%	100.0%	3	6	1	6	16.7%	100.0%	2	4	0	4	0.0%	100.0%
		7199	>2.5	6	18	2	17	11.1%	94.4%	1	1	0	1	0.0%	100.0%	0	0	0	0	0.0%	0.0%
	Mercury	7471A	0-2.5	17	30	4	30	13.3%	100.0%	3	6	0	4	0.0%	66.7%	2	4	0	3	0.0%	75.0%
		7471A	>2.5	10	24	3	22	12.5%	91.7%	1	1	0	1	0.0%	100.0%	0	0	0	0	0.0%	0.0%
SVOCs	SVOCs	8270C	0-2.5	14	26	2	14	7.7%	53.8%	3	6	0	2	0.0%	33.3%	2	4	0	1	0.0%	25.0%
		8270C	>2.5	2	9	0	2	0.0%	22.2%	1	1	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
PCBs	PCBs	8082	0-2.5	3	5	2	3	40.0%	60.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		8082	>2.5	1	5	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
Perchlorate	Perchlorate	314.0, 314.0M	0-2.5	11	21	1	0	4.8%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		314.0, 314.0M	>2.5	1	4	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
TPH	Diesel	8015B-SVOA - Diesel	0-2.5	12	22	2	22	9.1%	100.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		8015B-SVOA - Diesel	>2.5	2	9	0	7	0.0%	77.8%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	Motor Oil	8015B-SVOA - Oil	0-2.5	12	22	2	22	9.1%	100.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		8015B-SVOA - Oil	>2.5	2	9	0	7	0.0%	77.8%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
Misc.	Total Cyanide	9014	0-2.5	11	21	1	4	4.8%	19.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		9014	>2.5	1	1	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	NDMA	1625C-CI M	0-2.5	1	1	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		1625C-CI M	>2.5	1	1	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	Total Solids	160.3, 160.3M, 2540G	0-2.5	17	38	5	38	13.2%	100.0%	3	9	1	9	11.1%	100.0%	2	6	0	6	0.0%	100.0%
		160.3, 160.3M, 2540G	>2.5	10	24	3	24	12.5%	100.0%	1	1	0	1	0.0%	100.0%	0	0	0	0	0.0%	0.0%
	pH	9045C	0-2.5	13	25	1	25	4.0%	100.0%	3	6	0	6	0.0%	100.0%	2	4	0	4	0.0%	100.0%
		9045C	>2.5	1	5	0	5	0.0%	100.0%	1	1	0	1	0.0%	100.0%	0	0	0	0	0.0%	0.0%
	TOC	9060A MOD	0-2.5	1	1	0	0	0.0%	0.0%	1	2	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		9060A MOD	>2.5	0	0	0	0	0.0%	0.0%	1	1	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	CEC	9081	0-2.5	0	0	0	0	0.0%	0.0%	1	2	0	2	0.0%	100.0%	0	0	0	0	0.0%	0.0%
		9081	>2.5	0	0	0	0	0.0%	0.0%	1	1	0	1	0.0%	100.0%	0	0	0	0	0.0%	0.0%

Notes and Key:

> = Greater than
% = Percent
bgs = Below ground surface
CEC = Cation exchange capacity
Chromium VI = Hexavalent chromium
NDMA = N-Nitrosodimethylamine
PCBs = Polychlorinated biphenyls
SVOCs = Semivolatile organic compounds
TOC = Total organic content
TPH = Total petroleum hydrocarbons

Table 4.3-4
Summary of Soil Sampling and Sampling Statistics for Source Areas D(b) and D(d)
Administration Area West
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

				Source Area D(b)						Source Area D(d)					
Compound(s)	**Analyte**	**Method**	**Depth (feet bgs)**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**
Metals	Metals	6010B	0-2.5	8	8	6	8	75.0%	100.0%	3	3	0	3	0%	100.00%
		6020	0-2.5	8	8	6	8	75.0%	100.0%	3	3	0	3	0.0%	100.0%
		6010B	>2.5	7	15	1	15	6.7%	100.0%	2	4	0	4	0.0%	100.0%
		6020	>2.5	7	14	1	14	7.1%	100.0%	2	2	0	2	0.0%	100.0%
	Chromium VI	7199	0-2.5	7	7	6	7	85.7%	100.0%	1	1	0	0	0.0%	0.0%
		7199	>2.5	3	8	1	8	12.5%	100.0%	0	0	0	0	0.0%	0.0%
	Mercury	7471A	0-2.5	8	8	6	7	75.0%	87.5%	3	3	0	3	0.0%	100.0%
		7471A	>2.5	7	14	1	12	7.1%	85.7%	2	4	0	2	0.0%	50.0%
SVOCs	SVOCs	8270C	0-2.5	6	6	5	5	83.3%	83.3%	2	2	0	1	0.0%	50.0%
		8270C	>2.5	2	5	0	3	0.0%	60.0%	0	0	0	0	0.0%	0.0%
PCBs	PCBs	8082	0-2.5	1	1	2	1	200.0%	100.0%	2	2	0	0	0.0%	0.0%
		8082	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
Perchlorate	Perchlorate	314.0, 314.0M	0-2.5	5	5	5	0	100.0%	0.0%	2	2	0	0	0.0%	0.0%
		314.0, 314.0M	>2.5	1	2	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
TPH	Diesel	8015B-SVOA - Diesel	0-2.5	6	6	5	6	83.3%	100.0%	1	1	0	1	0.0%	100.0%
		8015B-SVOA - Diesel	>2.5	1	4	0	4	0.0%	100.0%	0	0	0	0	0.0%	0.0%
	Motor Oil	8015B-SVOA - Oil	0-2.5	6	6	5	6	83.3%	100.0%	1	1	0	1	0.0%	100.0%
		8015B-SVOA - Oil	>2.5	1	4	0	0.75	0.0%	0.0%	0	0	0	0	0.0%	0.0%
Misc.	Total Cyanide	9014	0-2.5	4	4	3	0	75.0%	0.0%	0	0	0	0	0.0%	0.0%
		9014	>2.5	1	2	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	NDMA	1625C-CI M	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		1625C-CI M	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	Total Solids	160.3, 160.3M, 2540G	0-2.5	9	9	6	9	66.7%	100.0%	3	3	0	3	0.0%	100.0%
		160.3, 160.3M, 2540G	>2.5	8	17	1	17	5.9%	100.0%	2	4	0	4	0.0%	100.0%
	pH	9045C	0-2.5	9	9	6	9	66.7%	100.0%	0	0	0	0	0.0%	0.0%
		9045C	>2.5	8	17	1	17	5.9%	100.0%	0	0	0	0	0.0%	0.0%
	TOC	9060A MOD	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		9060A MOD	>2.5	1	2	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	CEC	9081	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		9081	>2.5	1	2	0	2	0.0%	100.0%	0	0	0	0	0.0%	0.0%

Notes and Key:

> = Greater than
% = Percent
bgs = Below ground surface
CEC = Cation exchange capacity
Chromium VI = Hexavalent chromium
NDMA = N-Nitrosodimethylamine
PCBs = Polychlorinated biphenyls
SVOCs = Semivolatile organic compounds
TOC = Total organic content
TPH = Total petroleum hydrocarbons

Table 4.3-5
Summary of Soil Sampling Activities and Deviations from Field Sampling Plan
Administration Area West
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Proposed Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
5D	Northern end of 5D N-S drainage ditch receiving runoff from within western Admin. Area.	Surface and Near-Surface Soil	1	0, 2	SVOCs, metals (including CrVI), pH	Assess contamination that may migrate into 5D from upstream, compare results from samples collected downstream within 5D, evaluate potential for water quality impacts, and support risk assessment.	2	05D-SNS08	0.5, 2.5	SVOCs, metals (including CrVI), pH	
5D	N-S reach of 5D drainage ditch receiving runoff from within western Admin. Area and discharges from drain lines at or near Building 20009.	Surface and Near-Surface Soil	8	0, 2	SVOCs, TPH, ClO4, metals (including CrVI), cyanide, pH	Assess whether releases to the North-South span of the 5D drainage ditch have occurred, evaluate possible release points and potential for water quality impacts, support risk assessment.	26	05D-SNS10	0.5, 2.5	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH	
								05D-SNS11	0.5, 2.5	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH	
								05D-SNS12	0.5, 2.5, 5, 10	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH	
								05D-SNS13	0.5, 2.5, ***5***, 10	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH	
								05D-SNS14	0.5, 2.5, 5, 10	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH	
								05D-SNS15	0.5, 2.5, 5, 10	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH	
								05D-SNS16	0.5, 2.5, 5, 10	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH	
								05D-SNS17	0.5, 2.5	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH	
		Subsurface Soil	***1***	0, 4, 10, 22, 34, 38	SVOCs, TPH, ClO4, metals (including CrVI), cyanide, pH	Evaluate vertical extent of chemicals in soil.	10	05D-SB02	1, 5, 11, 23, 35, 39	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH	At 11 ft bgs, only analyzed for metals (including CrVI) and pH.
								05D-SB03	1, 5	Metals	
								05D-SB04	1, 5	Metals	
5D	South-western side of the N-S drainage ditch.	None	***0***	None	None	Additional step-out soil samples collected due to exceedances of screening criteria in nearby proposed soil sampling location 05D-SNS16.	2	05D-SB05	1	SVOCs, PCB, cyanide, metals, TOC	
								05D-SB06	1	SVOCs, PCB, cyanide, metals (including CrVI), TOC	
5D	Western side of the N-S drainage ditch surrounding the bermed pond.	None	***0***	None	None	Additional step-out soil samples collected due to exceedances of screening criteria in nearby proposed soil sampling locations 05D-SB01, 05D-SNS09, 05D-SNS14, 05D-SNS15, and 05D-SNS16.	3	05D-SB07	1	SVOCs, PCB, cyanide, metals (including CrVI), TOC	
								05D-SB08	1	SVOCs, PCB, cyanide, metals (including CrVI), TOC	
								05D-SB09	1	SVOCs, PCB, cyanide, metals (including CrVI), TOC	
5D	North-Western side of the N-S drainage ditch.	None	0	None	None	Additional step-out soil samples collected due to exceedances of screening criteria in nearby proposed soil sampling location 05D-SB01 and 05D-SNS09.	1	05D-SB10	1	SVOCs, PCB, cyanide, metals (including CrVI), TOC	
5D	E-W reach of 5D drainage ditch receiving runoff from within western Admin. Area, including SMUD substation and source area D(d).	Surface and Near-Surface Soil	2	0, 2	SVOCs, TPH, PCBs, ClO4, metals (including CrVI), cyanide, pH	Assess whether releases to the East-West span of the 5D drainage ditch have occurred, evaluate possible release points and potential for water quality impacts, support risk assessment.	4	05D-SNS18	0.5, 2.5	SVOCs, metals (including CrVI), TPH, PCBs, ClO4, cyanide, pH	
								05D-SNS19	0.5, 2.5	SVOCs, metals (including CrVI), TPH, PCBs, ClO4, cyanide, pH	
5D	Former waste-oil underground storage tank west of Building 20009.	Surface and Near-Surface Soil	***1***	0, 2	SVOCs, metals, pH	Evaluate vertical extent of chemicals in soil and potential for water quality impacts, support risk assessment. Prior soil results for TPH and/or PCBs exceed screening levels, with TPH below 10 ft bgs and PCBs below 26.5 ft bgs.	6	05D-SNS09	0.5, 2.5	SVOCs, metals (including CrVI), pH	
								05D-SNS20	0.5, 2.5, 5, 10	Metals	
		Subsurface Soil	1	0, 4, 10, 22, 34, 38	SVOCs, TPH, metals (including CrVI), PCBs		6	05D-SB01	1, 5, 11, 23, 35, 39	SVOCs, metals (including CrVI), TPH, PCBs	

Table 4.3-5
Summary of Soil Sampling Activities and Deviations from Field Sampling Plan
Administration Area West
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Proposed Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
6D	Former bermed pond west of Building 20009 that received liquid wastes, particularly from the former metal plating area in Building 20009.	Surface and Near-Surface Soil	6	0, 2	SVOCs, TPH, metals (including CrVI), ClO4, cyanide, pH	Requested by the regulatory agencies, used to confirm results of previous investigations, evaluate potential for water quality impacts, and support risk assessment.	16	06D-SNS06	0.5, 2.5	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH	No CrVI analysis at 2.5 ft bgs.
								06D-SNS07	0.5, 2.5, 10, 14, 16, 19	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH	
								06D-SNS08	0.5, 2.5	SVOCs, metals, TPH, ClO4, cyanide, pH	
								06D-SNS09	0.5, 2.5	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH	
								06D-SNS10	0.5, 2.5	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH	
								06D-SNS11	0.5, 2.5	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH	
		Subsurface Soil	***1***	0, 4, 10, 22, 34, 46, 58	SVOCs, TPH, metals (including CrVI), ClO4, cyanide, pH, DI-WET physical properties	Confirm results of previous investigations, evaluate vertical extent of chemicals in soil and potential for water quality impacts, and support risk assessment.	19	06D-SB02	1, 5, 11, 23, 35, 47, 59	SVOCs, metals (including CrVI), TPH ClO4, cyanide, pH, DI-WET, physical properties	BD, PD and perm were analyzed at only 23, 35 and 59 ft bgs.
								06D-SB03	1.5, 5, 11	Metals (including CrVI)	
								06D-SB04	1.5, 5, 11	Metals (including CrVI)	
								06D-SB05	1.5, 5, 11	Metals (including CrVI)	
								06D-SB06	1, 5, 11	Metals	
		Grab Groundwater	1	First water	VOCs, SVOCs, TPH, total and filtered metals (including CrVI), ClO4, cyanide		1	06D-SB02	61	VOCs, SVOCs, metals, TPH, cyanide	
8D	Drainage ditch upstream and to southeast of former treatment plant.	Surface and Near-Surface Soil	1	0, 2	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, pH	Assess contamination that may migrate into ditches north and west of 8D (including 9D and 12D) from upstream areas, compare results from samples collected within 9D and 12D.	2	8D-SNS01	0.5, 2.5	SVOCs, metals (including CrVI), TPH, PCBs, ClO4, pH	
8D	Former settling pond and sludge drying pits near the former sewage treatment plant.	Subsurface Soil	1	0, 4, 10, 22, 34, ***38***	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, pH, DI-WET, physical properties	Determine if a release into underlying soils from the former settling pond and sludge drying pits has occurred, evaluate vertical extent of chemicals in soil and potential for water quality impacts, and support risk assessment.	3	8D-SB01	1, 5, 11, 23, 35	SVOCs, metals (including CrVI), TPH, PCBs, ClO4, pH, DI-WET, physical properties	Not sampled at 38 ft bgs. BD, PD and perm were analyzed at only 5 and 11 ft bgs. TOC and CEC analyzed at only 1, 5, and 11 ft bgs.
							5	8D-SB02	0.5, 5, 11, 23, 35	SVOCs, metals (including CrVI), TPH, PCBs, ClO4, pH, DI-WET, MC, GS	Not sampled at 38 ft bgs. Not analyzed for BD, PD and perm.
8D	Treatment works at former sewage treatment plant, including holding tanks, settling basins, digesters.	Subsurface Soil	1	0, 4, 10	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, pH	Determine if a release from the treatment works at the former sewage treatment plant has occurred, evaluate vertical extent of chemicals in soil and potential for water quality impacts, and support risk assessment.	12	8D-SB03	0.5, 5, 11.5	SVOCs, metals (including CrVI), TPH, PCBs, ClO4, pH	SVOCs, TPH, and PCBs only analyzed at 0.5 ft bgs.
								8D-SB04	1, 5, 11.5	SVOCs, metals (including CrVI), TPH, PCBs, ClO4, pH	At 5 and 11.5 ft bgs, only analyzed for metals (including CrVI) and pH.
								8D-SB05	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, ClO4, pH	SVOCs, TPH, and PCBs only analyzed at 1 ft bgs. Resampled for ClO4 at 11.5 ft bgs.
								8D-SB06	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, ClO4, pH	SVOCs, TPH, and PCBs only analyzed at 1 ft bgs. metals analyzed at 1 and 5 ft bgs. Resampled for ClO4 at 11.5 ft bgs.
9D	Northern end of 9D N-S drainage ditch receiving runoff from within western Admin. Area via 5D drainage ditches.	Surface and Near-Surface Soil	1	0, 2	SVOCs, metals (including CrVI), pH	Requested by the regulatory agencies, assess contamination that may migrate into 9D from upstream, compare results from samples collected downstream within 9D and 12D, evaluate potential for water quality impacts, and support risk assessment.	2	9D-SNS05	0.5, 2.5	SVOCs, metals (including CrVI), pH	
9D	Western portion of 9D E-W drainage ditch receiving runoff from within western Admin. Area, including former sewage treatment plant.	Surface and Near-Surface Soil	1	0, 2	SVOCs, metals (including CrVI), pH	Assess contamination that may have migrated into 9D from south (8D) and east (eastern Admin Area), compare results from samples collected downstream within 9D and 12D ditches, evaluate potential for water quality impacts, and support risk assessment.	5	9D-SNS06	0.5, 2.5	SVOCs, metals (including CrVI), pH	
		Sediment	1	0, 1, 4	***VOCs***, SVOCs, metals (including CrVI), pH, ***physical properties***			9D-SD01	0.25, 1.5, 5	SVOCs, metals (including CrVI), pH, DI-WET, TOC, CEC	Not analyzed for VOCs, BD, MC, PD, perm,

Table 4.3-5
Summary of Soil Sampling Activities and Deviations from Field Sampling Plan
Administration Area West
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Proposed Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
12D	Western portion of 12D E-W drainage ditch receiving runoff from within Admin. Area, including 5D and 9D ditches.	Surface and Near-Surface Soil	1	0, 2	SVOCs, metals (including CrVI), pH	Assess contamination that may have migrated into 12D, compare results from samples collected upstream within 5D and 9D drainage ditches, evaluate potential for water quality impacts, and support risk assessment.	4	12D-SNS08	0.5, 2.5	SVOCs, metals (including CrVI), pH	
								12D-SNS09	0.5, 2.5	SVOCs, metals (including CrVI), pH	
52D	Former waste treatment basins that received waste liquids from Building 20009, particularly the former plating area.	Surface and Near-Surface Soil	2	0, 2	SVOCs, TPH, metals (including CrVI), ClO4, cyanide, pH	Confirm results of previous investigations, evaluate vertical extent of chemicals in soil and potential for water quality impacts, and support risk assessment.	4	52D-SNS01	0.5, 2.5	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH	
								52D-SNS02	0.5, 2.5	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH	
		Subsurface Soil	2	0, 4, 10			4	52D-SB11	1, 5, 11	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH	At 5 and 11 ft bgs, only analyzed for metals (including CrVI) and pH.
								52D-SB12	11	Metals (including CrVI), pH	
			1	0, 4, 10, 22, 34, 38	SVOCs, TPH, metals (including CrVI), ClO4, cyanide, pH, DI-WET, physical properties		6	52D-SB13	1, 5, 11, 22, 35, 39	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH, physical properties	DI-WET was not analyzed. BD, MC, PD, perm, GS were not analyzed 1 and 5 ft bgs.
52D	Former plating area and TCE degreaser inside Building 20009, grated trenches, adjacent exterior concrete pads.	Surface and Near-Surface Soil	2	0, 2	SVOCs, TPH, metals (including CrVI), ClO4, cyanide, pH	Assess whether chemicals were released into the underlying soils from the adjacent inactive plating area or from the shallow trenches in the concrete pads, evaluate vertical extent of chemicals in soil and potential for water quality impacts, and support risk assessment.	6	52D-SNS03	0.5, 2.5	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH	
								52D-SNS04	0.5, 2.5	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH	
								52D-SNS05	0.5, 2.5	Lead	
		Subsurface Soil	5	0, 4, 10, 22, 34, 38	SVOCs, TPH, metals (including CrVI), ClO4, cyanide, pH, DI-WET, physical properties		25	52D-SB06	1, 5, 11, 27, 34.5	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH	CrVI only analyzed at 1, 5, and 11 ft bgs.
								52D-SB07	1.5, 5, 11, 23.5, 35	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH, TOC, CEC	CrVI only analyzed at 1.5, 5, and 11.
								52D-SB08	1, 5, 11, 22.5	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH	No TPH analysis at 5 ft bgs.
								52D-SB09	0.5, 4.5, 10.5, 22.5, 34.5	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH, TOC, CEC	No CrVI analysis at 34.5 ft bgs. physical properties analyzed only at 34.5 ft bgs.
								52D-SB10	1, 5, 11, 23, 35, 39	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH, physical properties	BD, PD and perm were not analyzed at 11 ft bgs.
52D	Hazardous materials storage areas on exterior west side of Building 20009.	Subsurface Soil	1	0, 4, 10	SVOCs, TPH, metals (including CrVI), ClO4, cyanide, pH	Assess whether chemicals were released into the underlying soil from the adjacent hazardous materials storage area, evaluate vertical extent of chemicals in soil and potential for water quality impacts, and support risk assessment.	1	52D-SB04	1, 5, 11	SVOCs, metals (including CrVI), ClO4, cyanide, pH	At 5 and 11 ft bgs, only analyzed for pH.
52D	Paint spray booth on interior west side of Building 20009.	Subsurface Soil	1	0, 4, 10	SVOCs, metals, pH	Assess whether chemicals were released into the underlying soil from the adjacent paint spray booth, evaluate vertical extent of chemicals in soil and potential for water quality impacts, and support risk assessment.	3	52D-SB05	1, 5, 11	SVOCs, metals, pH	SVOCs only analyzed at 1 ft bgs.
52D	Buried, near-surface drain line north of Hydro Sump.	Subsurface Soil	1	0, 4, 10	SVOCs, TPH, metals (including CrVI), ClO4, cyanide, pH	Determine if a release from the drain line emanating from the concrete pad immediately north of the Hydro Sump has occurred, evaluate vertical extent of chemicals in soil and potential for water quality impacts, and support risk assessment.	3	52D-SB14	1, 5, 11	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH	At 11 ft bgs, only analyzed for metals and pH. at 5 ft bgs, only analyzed for SVOCs, metals, and pH.

Table 4.3-5
Summary of Soil Sampling Activities and Deviations from Field Sampling Plan
Administration Area West
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Proposed Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
52D	Hydro Sump on west side and adjacent metal plate-covered pit area inside Building 20009.	Subsurface Soil	2	0, 4, 10, 22, 34, 38	SVOCs, TPH, metals (including CrVI), ClO4, cyanide, pH, DI-WET, physical properties	Determine if a release has occurred from the Hydro Sump and the adjacent covered pit, evaluate vertical extent of chemicals in soil and potential for water quality impacts, and support risk assessment.	12	52D-SB15	1, 5, 11, 21, 34, 39	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH, physical properties	DI-WET analyzed at 5 and 39 ft bgs. Cyanide not analyzed at 34 and 39 ft bgs. BD, PD and perm were not analyzed at 21 ft bgs. physical properties not analyzed at 1 and 5 ft bgs.
								52D-SB16	0.5, 5.5, 11.5, 22.5, 35.5, 39.5	SVOCs, metals, TPH, ClO4, cyanide, pH, TOC, CEC	Not analyzed for DI-WET. Not analyzed for BD, MC, PD, perm, GS.
52D	Deep sump near southeast corner of Building 20009.	Subsurface Soil	1	0, 4, 10, 22, 34, 38	SVOCs, TPH, metals (including CrVI), ClO4, cyanide, pH, DI-WET, physical properties	Determine if a release has occurred from the deep sump, evaluate vertical extent of chemicals in soil and potential for water quality impacts, and support risk assessment. It is not known if the sump discharges to either the storm water or sewer system.	5	52D-SB17	1, 5, 11, 23, 35	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH, MC, GS	DI-WET analyzed only at 5 ft bgs.
52D	Former excavation to remove soils impacted by PCBs, outside, near southwest corner of Building 20009.	Subsurface Soil	1	15, 20, 25, 30, 38	PCBs, TPH, DI-WET, physical properties	Assess possible levels of PCBs residing in soil at the base of transformer-related excavation, evaluate vertical extent of chemicals in soil and potential for water quality impacts.	5	52D-SB18	16, 21, 26, 31, 37	TPH, PCBs, MC, GS	
		Grab Groundwater	1	First water	PCBs, TPH		1	52D-SB18	40	TPH, PCBs	
D(b)	Grated, concrete-lined, shallow drainage trench receiving discharge from hazardous waste storage area, dye pen sump, film developing lab, sandblast area, and floor drains in the southwest corner of Building 20009.	Sediment	1	0	***VOCs***, SVOCs, TPH, PCBs, metals (including CrVI), ClO4, cyanide, pH	Assess whether the soils beneath the shallow drainage trench were impacted by chemicals from Building 20009, evaluate vertical extent of chemicals in soil and potential for water quality impacts, and support risk assessment.	1	D(b)-SD01	0	SVOCs, metals (including CrVI), TPH, PCBs, ClO4, cyanide, pH	Not analyzed for VOCs.
		Subsurface Soil	5	0, 4, ***10***	SVOCs, TPH, metals (including CrVI), ClO4, cyanide, pH, physical properties		16	D(b)-SB01	1, 5	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH	At 5 ft bgs, only analyzed for metals and pH. No recovery at 10 ft bgs.
								D(b)-SB02	1, 5, 11	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH	At 5 and 11 ft bgs, only analyzed for metals and pH.
								D(b)-SB03	1, 5, 11	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH	At 5 ft bgs, only analyzed for metals and pH. at 11 ft bgs only analyzed for SVOCs, metals, and pH.
								D(b)-SB05	1, 5, 11	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH	At 5 and 11 ft bgs, only analyzed for metals and pH.
				0, 4, 10, 32, 54				D(b)-SB04	1, 5, 11, 33, 55	SVOCs, metals (including CrVI), TPH, ClO4, cyanide, pH, physical properties	At 1, 5, and 11 ft bgs, only analyzed for SVOCs, TPH, and pH. BD, PD, perm were not analyzed at 55 ft bgs.
		Grab Groundwater	1	First water	VOCs, SVOCs, TPH, total and filtered metals (included CrVI), ClO4, cyanide		1	D(b)-SB04	60	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, cyanide	Not analyzed for ClO4.
D(c)	West end of secondary drainage ditch immediately north of sewage treatment areas above D(c) and 8D. near junction with 12D ditch.	Surface and Near-Surface Soil	1	0, 2	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, pH	Determine if a release from the former sewage treatment plants above D(c) and 8D has migrated downstream in the main and secondary drainage ditches, compare results from sampling downstream in 12D, evaluate potential for water quality impacts, and support risk assessment.	2	D(c)-SNS01	0.5, 2.5	SVOCs, metals (including CrVI), TPH, PCBs, ClO4, pH	
D(c)	Low area in northeast portion of former sewage treatment plant. route of facility's runoff to secondary ditch to north.	Subsurface Soil	1	0, 4, 10	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, pH	Determine if a release from the former sewage treatment plant above D(c) has occurred, evaluate vertical extent of chemicals in soil and potential for water quality impacts, and support risk assessment.	3	D(c)-SB02	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, ClO4, pH	At 11 ft bgs, only analyzed for CrVI and pH. At 5 ft bgs, only analyzed for metals (including CrVI) and pH.
D(c)	Concrete-walled and -lined, former sludge drying pits northwest of former sewage treatment plant above D(c).	Subsurface Soil	1	0, 4, 10, 22, 34, 38	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, pH, physical properties	Determine if a release from the former sludge drying beds has occurred, evaluate vertical extent of chemicals in soil vertical extent of chemicals in soil and potential for water quality impacts, and support risk assessment.	5	D(c)-SB03	1, 5, 11, 23, 35	SVOCs, metals (including CrVI), TPH, PCBs, ClO4, pH, MC, GS	Not analyzed for BD, PD, TOC, CEC, perm.

Table 4.3-5
Summary of Soil Sampling Activities and Deviations from Field Sampling Plan
Administration Area West
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Proposed Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
D(c)	Treatment works at former sewage treatment plant, including holding tanks, settling basins, digesters.	Subsurface Soil	2	0, 4, 10	SVOCs, TPH, PCBs, metals (including CrVI), ClO4, pH	Determine if a release from the treatment works at the former sewage treatment plant above D(c) has occurred, evaluate vertical extent of chemicals in soil and potential for water quality impacts, and support risk assessment.	6	D(c)-SB04	1, 5, 11	SVOCs, metals (including CrVI), TPH, PCBs, ClO4, pH	At 5 and 11 ft bgs, only analyzed for metals (including CrVI) and pH.
								D(c)-SB05	1, 5, 10.5	SVOCs, metals (including CrVI), TPH, PCBs, ClO4, pH	ClO4, TPH, and PCBs only analyzed at 1 ft bgs. SVOCs analyzed at 1 and 5 ft bgs.
D(d)	Grated drop inlet (DI) receiving storm water runoff from Bridgeport Ave., adjacent parking lot, and piping from east (under Buildings 20015/2025).	Sediment	1	0	TPH, metals (including CrVI)	Assess contamination that may be discharged into E-W reach of source area 5D, compare results from samples collected downstream within 5D. Collect sample inside of a concrete basin rather than soil underlying the basin.	1	D(d)-SD01	0.25	TPH, metals (including CrVI)	
Admin Area West	Spill from acid storage area south of Building 20035.	Subsurface Soil	3	0, 4, 10	Metals (including CrVI), pH, ***DI-WET***, ***PD***	Determine if a release from the acid storage area to soil has occurred, evaluate vertical extent of chemicals in soil and potential for water quality impacts, and support risk assessment.	9	AW-AF1-SB01	1, 5, 11	Metals (including CrVI), pH	Not analyzed for DI-WET, PD.
								AW-AF1-SB02	1, 5, 11	Metals (including CrVI), pH	Not analyzed for DI-WET, PD.
								AW-AF1-SB03	1, 5, 11	Metals (including CrVI), pH	Not analyzed for DI-WET, PD.
Admin Area West	Surface debris area south of former RCRA facility.	Subsurface Soil	2	0, 4, 10	SVOCs, PCBs, metals (including CrVI), ClO4, TOC, CEC, PD, perm	Determine if chemicals are present in the debris area that have been released to soil, evaluate vertical extent of chemicals in soil and potential for water quality impacts, and support risk assessment.	6	AW-AF2-SB01	1, 5, 11	SVOCs, metals, PCBs, ClO4	SVOCs, PCBs, and ClO4 only analyzed at 1 ft bgs. not analyzed for TOC, CEC, PD, perm.
								AW-AF2-SB02	1, 5, 11	SVOCs, metals, PCBs, ClO4	SVOCs, PCBs, and ClO4 only analyzed at 1 ft bgs. not analyzed for TOC, CEC, PD, perm.

Notes and Key:
Bulk density includes dry density, wet density and specific gravity.
Physical properties include bulk density, permeability, porosity, moisture, organic carbon, grain size, and CEC.
Bold, italicized and underlined data does not agree with the analytical results. See "Deviations from Field Sampling Plan" column for more information on discrepancies.

Admin. = Administration
ft bgs = Feet Below ground surface
ID = Identification
BD = Bulk Density
GS = Grain Size
CEC = Cation exchange capacity
DI-WET = Deionized waste extract test
ClO4 = Perchlorate
CrVI = Hexavalent chromium
MC = Moisture Content
PD = Porosity
Perm = Permeability
PCBs = Polychlorinated biphenyls
RCRA = Resource Conservation and Recovery Act
SMUD = Sacramento Municipal Utility District
SVOCs = Semivolatile organic compounds
TPH = Total petroleum hydrocarbons
VOCs = Volatile organic compounds
WWTP = Wastewater treatment plant

Table 4.3-6
Summary of Soil Vapor Sampling Activities and Deviations from Field Sampling Plan
Administration Area West
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Rationale and Comments	Number of Samples Collected	Sampling Activity	Sample ID	Sample Depths (ft bgs)	Deviations from Field Sampling Plan
05D	Drainage ditch downstream of Building 20027.	1	***10***, 20	Location is at the point of highest VOC concentration during previous investigation, used to determine if a source is present within the vadose zone.	1	Soil Vapor	05D-SP08	20	Not sampled at 10 ft bgs due to no flow.
08D	Former waste water treatment facility, sludge drying beds.	1	10, 20	Location is at the point of highest VOC concentration during previous investigation, used to determine if a source is present within the vadose zone.	2	Soil Vapor	08D-SP07	10, 20	
08D	Former waste water treatment facility, final settling pond.	1	10, 20	Location is at the point of highest VOC concentration during previous investigation, used to determine if a source is present within the vadose zone.	2	Soil Vapor	08D-SP08	10, 20	
08D	Former waste water treatment facility, primary and secondary settling ponds.	1	10, ***20***	Determine if a release to soil has occurred from the secondary treatment vault at the WWTP.	1	Soil Vapor	08D-SP09	10	Not sampled at 20 ft bgs, no reason given.
08D	Material stage area for former RCRA facility and soil stockpile area.	1	10, 20	Location used to differentiate a potential release at Source Area 08D from up gradient source areas.	2	Soil Vapor	AW-08D-SP10	10, 20	
52D	Former plating shop located inside Building 2009.	2	10, 20, 30	Determine if a source is present within the vadose zone; collected to 30 ft bgs because the plating shop floor is approximately 10 ft below grade.	6	Soil Vapor	52D-SP24	10, 20, 30	
							52D-SP25	10, 20, 30	
52D	Sump receiving waste from former plating shop.	1	10, 20, 30	Determine if a release to soil has occurred from the plating shop drainage sump, collected to 30 ft bgs because the sump extends to approximately 10 ft below grade.	1	Soil Vapor	52D-SP26	10	Not sampled at 20 ft bgs due to the presence of water.
					1	Grab Groundwater	52D-SP26	30	
52D	Hydrosump located inside Building 2009.	2	20, 30	Determine if a source is present within the vadose zone. Samples will be collected to 30 ft bgs because the sump extends to approximately 15 ft below grade.	4	Soil Vapor	52D-SP27	20, 30	
							52D-SP28	20, 30	
52D	Former treatment basins receiving waste from the plating shop.	2	10, 20, 30	Determine if a release to soil has occurred from the plating shop treatment basins located west of Building 20009, collected to 30 feet bgs because the basins extend to approximately 10 feet below grade.	5	Soil Vapor	52D-SP30	10, 20, 30	
							52D-SP29	10, 20	
					1	Grab Groundwater	52D-SP29	30	
52D	Former paint spray booth and hazardous materials storage area.	1	10, ***20***	Determine if a release to soil has occurred from the paint spray booth and hazardous material storage area located in the northwest corner of Building 20009.	1	Soil Vapor	52D-SP31	10	Sample not collected due to no flow at 20 ft bgs.
52D	Former waste oil tank.	1	10, 20	Determine if a source is present within the vadose zone.	2	Soil Vapor	52D-SP32	10, 20	
52D	Clean room.	1	10, 20	Determine if a source is present within the vadose zone.	2	Soil Vapor	52D-SP33	10, 20	
52D	Step-out samples taken north and east of Area 52D.	***0***	None	Soil vapor concentrations at the proposed location and depths exceed soil vapor screening levels; additional samples define the extent of the vadose zone source.	16	Soil Vapor	52D-SP35	10, 20, 30	
							52D-SP36	10, 20, 30	
							52D-SP37	10, 30	
							52D-SP44	20, 30, 40	
							52D-SP34	10	
							52D-SP38	10	
							52D-SP43	10, 20, 30	
					3	Grab Groundwater	52D-SP34	30	
							52D-SP38	30	
							52D-SP43	54	
52D	Step-out samples taken west of Area 52D.	***0***	None	Soil vapor concentrations at the proposed location and depths exceed soil vapor screening levels; additional samples define the extent of the vadose zone source.	12	Soil Vapor	52D-SP40	10, 20, 28	
							52D-SP41	10, 20, 30	
							52D-SP42	10, 20, 30	
							52D-SP39	10, 20, 30	
					1	Grab Groundwater	52D-SP39	50	

Table 4.3-6
Summary of Soil Vapor Sampling Activities and Deviations from Field Sampling Plan
Administration Area West
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Rationale and Comments	Number of Samples Collected	Sampling Activity	Sample ID	Sample Depths (ft bgs)	Deviations from Field Sampling Plan
D(b)	Concrete culvert draining southwest corner of Building 20009.	1	10, 20	Location is at the point of highest VOC concentration during previous investigation, used to determine if a source is present within the vadose zone.	2	Soil Vapor	D(b)-SP03	10, 20	
D(b)	Dye pen sump located in southwest corner of Building 20009.	1	10, 20, ***30***	Determine if a release to soil has occurred from the dye pen sump; collected to 30 ft bgs because the sump extends to approximately 10 ft below grade.	2	Soil Vapor	D(b)-SP04	10, 20	Sample not collected due to moisture at 30 ft bgs.
D(c)	Former waste water treatment facility, sludge drying beds.	1	10, 20	Location is at the point of highest VOC concentration during previous investigation, used to determine if a source is present within the vadose zone.	3	Soil Vapor	D(c)-SP05	10, 20, ***30***	
D(c)	Former waste water treatment facility, primary and secondary settling ponds.	1	10, 20	Determine if a release to soil has occurred from the secondary treatment vault at the WWTP.	2	Soil Vapor	D(c)-SP06	10, 20	
D(c)	Step-out samples taken west of Area D(c).	***0***	None	Soil vapor concentrations at the proposed location and depths exceed soil vapor screening levels; additional samples define the extent of the vadose zone source.	7	Soil Vapor	D(c)-SP08	20	Not sampled at 10 ft bgs due to no flow.
							D(c)-SP10	10, 20	
							D(c)-SP11	10, 20	
							D(c)-SP07	10, 20	
					1	Grab Groundwater	D(c)-SP07	30	
D(c)	Step-out samples taken west of Area D(c).	***0***	None	Soil vapor concentrations at the proposed location and depths exceed soil vapor screening levels; additional samples define the extent of the vadose zone source.	4	Soil Vapor	D(c)-SP09	10, 20	
							D(c)-SP12	10, 20	
Admin Area West	Spill from acid storage area south of Building 20035.	1	10, 20	Determine if a release to soil has occurred from chemical spill in the acid storage area.	1	Soil Vapor	AW-AF1-SP01	10	
					1	Grab Groundwater	AW-AF1-SP01	20	

Notes and Key:
Grab groundwater collected when soil vapor point was below the groundwater table.
Bold, italicized and underlined data does not agree with the analytical results. See "Deviations from Field Sampling Plan" column for more information on discrepancies.

Admin. = Administration
ft bgs = Feet below ground surface
ID = Identification
VOC = Volatile Organic Compound
Proposed analyses = VOC analysis
Performed analyses = VOC analysis
RCRA = Resource Conservation and Recovery Act

Table 4.3-7 Summary of Geotechnical Soil Parameters
Administration Area West
Aerojet Boundary Operable Unit
Aerojet Corporation
Sacramento County, California

			Geo Physical Parameters (ASTM D2937, D854)					Sieve Analysis (ASTM D422)				Permeability (ASTM D5084)	
Test No.	Date	Description of Test Location	Moisture Content (%)	Wet Density (pcf)	Dry Density (pcf)	Specific Gravity	Porosity	Cobbles (%)	Gravel (%)	Sand (%)	Silt / Clay (%)	Average Hydraulic Gradient	Perm (cm/sec)
1	11/30/2005	08b-SB01-39	18.5					0.0	0.0	56.0	44.0		
2	11/30/2005	D(b)-SB04-1	15.6	133.2	115.2	2.600	0.2900	0.0	39.4	23.4	37.2	9.7	3.76E-08
3	11/30/2005	D(b)-SB04-5	18.9	138.0	116.1	2.610	0.2870	3.4	28.3	37.9	30.4	11.8	5.94E-09
4	11/30/2005	D(b)-SB04-11	1.6	142.4	140.2	2.690	0.1650	0.0	66.9	21.6	11.5	8.8	3.70E-08
5	11/30/2005	D(b)-SB04-33	15.8	142.9	123.4	2.670	0.2590	0.0	13.1	50.1	36.8	8.2	1.50E-08
6	11/30/2005	D(b)-SB04-55	10.7					0.0	76.1	21.4	2.5		
7	11/30/2005	MW-8043-51	29.3	118.0	91.2	2.720	0.4620	0.0	0.0	51.3	48.7	12.1	3.11E-04
8	11/30/2005	MW-8043-55	26.7	117.6	92.8	2.750	0.4590	0.0	17.6	49.1	33.3	10.0	1.71E-04
9	11/30/2005	MW-8043-60	10.0	120.6	109.6	2.650	0.3370	0.0	83.6	16.3	0.1	11.6	3.79E-05
10	11/30/2005	MW-8043-65	7.3	125.7	117.2	2.720	0.3100	0.0	60.8	34.7	4.5	11.2	1.44E-03
49	11/23/05	09D-SD01-0.25	23.7					0.0	2.0	40.6	57.4		
50	11/23/05	09D-SD01-1.5	18.5					0.0	1.7	44.2	54.1		
51	11/23/05	09D-SD01-5	22.1					0.0	0.9	40.4	58.7		
57	11/23/05	52D-SB13-11	4.8	149.5	142.6	2.680	0.1470	0.0	77.7	13.2	9.1	9.3	1..45E-06
58	11/23/05	52D-SB13-22	16.0	134.2	115.7	2.670	0.3050	0.0	4.3	71.1	24.6	5.4	5.27E-06
59	11/23/05	52D-SB13-35	24.5	110.2	88.5	2.480	0.4280	0.0	14.4	62.1	23.5	5.3	1.12E-06
60	11/23/05	52D-SB13-39	33.2	117.1	87.9	2.570	0.4520	0.0	0.3	55.9	43.8	9.1	3.97E-05
61	11/23/05	52D-SB10-1	5.1	128.5	122.3	2.600	0.2460	0.0	12.4	70.5	17.1	7.8	5.92E-04
62	11/23/05	52D-SB10-11	3.7					0.0	85.6	9.5	4.9		
63	11/23/05	52D-SB10-23	10.9	144.4	130.2	2.750	0.2410	0.0	67.5	22.0	10.5	8.9	2.87E-04
72	11/30/05	08D-SB02-0.5	1.2					0.0	19.5	52.7	27.8		
73	11/30/05	08D-SB02-5	14.0					0.0	0.6	31.5	67.9		
74	11/30/05	08D-SB02-11	6.7					0.0	44.6	38.1	17.3		
75	11/30/05	08D-SB02-23	22.0					0.0	3.3	61.6	35.1		
76	11/30/05	08D-SB02-35	18.6					0.0	0.0	60.8	39.2		
77	11/30/05	08D-SB01-1	13.5					0.0	0.0	40.8	59.2		
78	11/30/05	08D-SB01-5	16.6	121.8	104.4	2.700	0.3800	0.0	0.0	47.3	52.7	7.0	2.27E-07
79	11/30/05	08D-SB01-11	15.6	135.7	117.4	2.480	0.2420	0.0	31.8	34.6	33.6	10.8	3.37E-09
80	11/30/05	08D-SB01-23	20.9					0.0	0.4	65.9	33.7		
81	11/30/05	08D-SB01-35	17.7					0.0	0.0	69.5	30.5		
167	11/30/05	52D-SB15-34	36.3	116.7	85.6	2.520	0.4560	0.0	0.1	48.9	51.0	8.9	8.40E-08
168	11/30/05	52D-SB15-39	25.0	130.1	104.1	2.539	0.3430	0.0	13.1	54.6	32.3	9.3	2.60E-08
176	11/23/05	52D-SB10-35	13.1	118.5	104.8	2.549	0.3410	0.0	6.8	5.8	35.3	4.1	1.15E-06
177	11/23/05	52D-SB10-39	19.7					0.0	0.1	43.0	56.9		
185	11/23/05	D(c)-SB03-1	3.5										

Table 4.3-7 Summary of Geotechnical Soil Parameters
Administration Area West
Aerojet Boundary Operable Unit
Aerojet Corporation
Sacramento County, California

			Geo Physical Parameters (ASTM D2937, D854)					Sieve Analysis (ASTM D422)				Permeability (ASTM D5084)	
Test No.	Date	Description of Test Location	Moisture Content (%)	Wet Density (pcf)	Dry Density (pcf)	Specific Gravity	Porosity	Cobbles (%)	Gravel (%)	Sand (%)	Silt / Clay (%)	Average Hydraulic Gradient	Perm (cm/sec)
186	11/23/05	D(c)-SB03-5	1.7					4.1	15.4	37.5	43.0		
187	11/23/05	D(c)-SB03-11	4.3					3.2	38.9	36.9	21.0		
188	11/23/05	06D-SB02-1	3.3					0.0	50.4	28.6	21.0		
189	11/23/05	06D-SB02-5	5.6					6.9	43.9	30.8	18.4		
190	11/23/05	06D-SB02-11	4.1					9.6	5.6	25.1	9.2		
191	11/23/05	06D-SB02-23	20.1	133.2	110.9	2.730	0.3490	0.0	10.8	48.8	40.4	6.6	7.86E-08
192	11/23/05	06D-SB02-35	33.7	109.2	81.7	2.670	0.5100	0.0	0.4	51.2	48.4	4.1	3.57E-05
193	11/23/05	06D-SB02-47	23.9					0.0	1.3	62.1	36.6		
194	11/23/05	06D-SB02-59	24.3	113.2	91.1	2.700	4.5900	0.0	0.5	77.4	22.1	8.8	2.69E-04
207	11/23/05	52D-SB15-21	14.5					0.0	25.3	46.8	27.9		
228	11/23/05	52D-SB10-11	12.7	171.6	152.3	2.647	0.0780	0.0	82.5	12.6	4.9	8.0	1.58E-04
229	11/23/05	52D-SB10-1	14.6	126.8	110.6	2.627	0.3250	0.0	48.7	40.9	10.4	8.1	3.00E-08
230	11/23/05	52D-SB10-5	3.9	143.1	137.7	2.839	0.2220	0.0	93.8	5.9	0.3	6.7	4.43E-04
231	12/16/06	D(c)-SB03- 23	5.9					0.0	54.2	32.1	13.7		
232	12/16/06	D(c)-SB03- 35	4.7					0.0	57.7	26.8	15.5		
233	12/16/06	52D-SB17-11	8.1					0.0	15.8	44.2	40.0		
234	12/16/06	52D-SB17-23	8.7					0.0	36.3	37.8	25.9		
235	12/16/06	52D-SB17-35	25.6					0.0	16.7	46.6	36.7		
242	1/17/06	52D-SB18-16	6.6					0.0	53.3	37.0	9.7		
243	1/17/06	52D-SB18-21	11.7					0.0	85.1	5.6	9.3		
244	1/17/06	52D-SB18-26	20.4					0.0	0.7	50.8	48.5		
245	1/17/06	52D-SB18-31	6.9					13.1	35.1	25.5	26.3		
246	1/17/06	52D-SB18-37	31.4					0.0	0.3	61.8	37.9		
	9/14/05	D7-SS01-05M	9.8			2.73			27.3	67.5	5.3		
	9/14/05	D7-SS02-10M	11.4			2.73			63.4	32.1	4.5		
	9/14/05	D7-SS03-29	16.6			2.67			23.6	65.2	11.3		
	9/15/05	D7-SS04-41.5M	24.6			2.61			0.0	63.9	36.1		
	9/9/05	U6-SS01-23	23.8			2.52			8.2	70.8	21.0		
	9/13/05	U7-SS01-05	8.2			2.75			23.6	63.0	13.4		
	9/13/05	U7-SS02-10	7.1			2.73			30.8	61.2	8.0		
	9/13/05	U7-SS03-15	8.4			2.74			18.4	71.2	10.4		
	9/13/05	U7-SS04-20	9.2			2.81			18.5	72.1	9.4		
	9/13/05	U7-SS05-25	26.1			2.56			0.0	56.6	43.5		
	9/13/05	U7-SS06-33	17.8			2.61			0.0	82.2	17.8		
	10/11/05	UA1-SS01-05M	14.1			2.72			24.5	62.8	12.7		

Table 4.3-7 Summary of Geotechnical Soil Parameters
Administration Area West
Aerojet Boundary Operable Unit
Aerojet Corporation
Sacramento County, California

			Geo Physical Parameters (ASTM D2937, D854)					Sieve Analysis (ASTM D422)				Permeability (ASTM D5084)	
Test No.	Date	Description of Test Location	Moisture Content (%)	Wet Density (pcf)	Dry Density (pcf)	Specific Gravity	Porosity	Cobbles (%)	Gravel (%)	Sand (%)	Silt / Clay (%)	Average Hydraulic Gradient	Perm (cm/sec)
	10/11/05	UA1-SS02-10M	17.1			2.72			0.0	56.0	44.0		
	10/11/05	UA1-SS03-15B	9.5			2.77			35.5	54.2	10.3		
	7/14/06	VMP-1-2-15B							0.0	12.9	87.1		
	7/21/06	VMP-1-4-15B							0.0	35.9	64.1		
	7/24/06	VMP-1-4-35A							0.0	68.5	31.5		
		Mean	**14.8**	**129.7**	**111.7**	**2.6**	**0.5**	**0.7**	**27.1**	**40.7**	**29.7**	**8.5**	**1.6E-04**
		Median	**14.6**	**128.5**	**110.9**	**2.7**	**0.3**	**0.0**	**15.4**	**40.8**	**30.5**	**8.8**	**3.2E-06**
		Geomean	**11.4**	**129.0**	**110.2**	**2.6**	**0.3**			**35.3**	**20.9**	**8.1**	**2.8E-06**

Notes and Key:

% = Percent
cm/sec = Centimeters per second
No. = Number
pcf = Pounds per cubic foot

Table 4.3-8
Summary of Soil Sampling and Sampling Statistics for Source Areas 6D and 52D
Administration Area West
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Compound	Analyte	Method	Depth (feet bgs)	Source Area 6D						Source Area 52D					
				Locations	Primary Samples	Duplicate Samples	Detects	Frequency of Duplicates	Frequency of Primary Detects	Locations	Primary Samples	Duplicate Samples	Detects	Frequency of Duplicates	Frequency of Primary Detects
Metals	Metals	6010B	0-2.5	11	17	4	17	23.5%	100.0%	17	21	4	21	19.0%	100.0%
		6020	0-2.5	11	17	4	16	23.5%	94.1%	18	23	4	22	17.4%	95.7%
		6010B	>2.5	6	18	3	18	16.7%	100.0%	13	46	0	46	0.0%	100.0%
		6020	>2.5	6	18	3	15	16.7%	83.3%	13	46	0	39	0.0%	84.8%
	Chromium VI	7199	0-2.5	8	11	2	11	18.2%	100.0%	15	19	4	17	21.1%	89.5%
		7199	>2.5	5	16	3	16	18.8%	100.0%	10	32	0	30	0.0%	93.8%
	Mercury	7471A	0-2.5	11	17	4	17	23.5%	100.0%	17	21	4	17	19.0%	81.0%
		7471A	>2.5	6	18	3	15	16.7%	83.3%	13	45	0	30	0.0%	66.7%
SVOCs	SVOCs	8270C	0-2.5	7	13	1	4	7.7%	30.8%	17	21	4	12	19.0%	57.1%
		8270C	>2.5	1	6	0	0	0.0%	0.0%	10	40	1	23	2.5%	57.5%
PCBs	PCBs	8082	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		8082	>2.5	0	0	0	0	0.0%	0.0%	1	5	0	3	0.0%	60.0%
Perchlorate	Perchlorate	314.0, 314.0M	0-2.5	7	13	1	3	7.7%	23.1%	16	20	4	0	20.0%	0.0%
		314.0, 314.0M	>2.5	1	6	0	0	0.0%	0.0%	9	39	0	0	0.0%	0.0%
TPH	Diesel	8015B-SVOA - Diesel	0-2.5	7	13	1	13	7.7%	100.0%	16	20	4	20	20.0%	100.0%
		8015B-SVOA - Diesel	>2.5	1	6	0	6	0.0%	100.0%	10	43	1	39	2.3%	90.7%
	Motor Oil	8015B-SVOA - Oil	0-2.5	7	13	1	13	7.7%	100.0%	16	20	4	20	20.0%	100.0%
		8015B-SVOA - Oil	>2.5	1	6	0	6	0.0%	100.0%	10	43	1	33	2.3%	76.7%
Misc.	Total Cyanide	9014	0-2.5	7	13	1	5	7.7%	38.5%	16	20	4	2	20.0%	10.0%
		9014	>2.5	1	6	0	1	0.0%	16.7%	9	37	0	0	0.0%	0.0%
	NDMA	1625C-CI M	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		1625C-CI M	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	Total Solids	160.3, 160.3M, 2540G	0-2.5	11	18	4	18	22.2%	100.0%	18	27	4	27	14.8%	100.0%
		160.3, 160.3M, 2540G	>2.5	6	18	3	18	16.7%	100.0%	15	57	1	57	1.8%	100.0%
	pH	9045C	0-2.5	7	13	1	13	7.7%	100.0%	17	21	4	21	19.0%	100.0%
		9045C	>2.5	1	6	0	6	0.0%	100.0%	14	48	1	48	2.1%	100.0%
	TOC	9060A MOD	0-2.5	1	1	0	0	0.0%	0.0%	5	5	1	0	20.0%	0.0%
		9060A MOD	>2.5	1	6	0	0	0.0%	0.0%	8	32	0	2	0.0%	6.3%
	CEC	9081	0-2.5	1	1	0	1	0.0%	100.0%	5	5	1	5	20.0%	100.0%
		9081	>2.5	1	6	0	6	0.0%	100.0%	8	32	0	32	0.0%	100.0%

Notes and Key:

> = Greater than
% = Percent
bgs = Below ground surface
CEC = Cation exchange capacity
Chromium VI = Hexavalent chromium
NDMA = N-Nitrosodimethylamine
PCBs = Polychlorinated biphenyls
SVOCs = Semivolatile organic compounds
TOC = Total organic content
TPH = Total petroleum hydrocarbons

Table 4.3-9
Summary of Soil Sampling and Sampling Statistics for Source Areas 08D and D(c)
Administration Area West
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

				Source Area 8D						Source Area D(c)					
Compound	**Analyte**	**Method**	**Depth (feet bgs)**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**
Metals	Metals	6010B	0-2.5	7	8	1	8	12.5%	100.0%	5	6	0	6	0.0%	100.0%
		6010B	>2.5	6	13	1	13	7.7%	100.0%	4	9	0	9	0.0%	100.0%
		6020	0-2.5	7	8	1	7	12.5%	87.5%	5	6	0	6	0.0%	100.0%
		6020	>2.5	6	13	1	11	7.7%	84.6%	4	9	0	7	0.0%	77.8%
	Chromium VI	7199	0-2.5	7	8	1	8	12.5%	100.0%	5	6	0	6	0.0%	100.0%
		7199	>2.5	6	14	1	14	7.1%	100.0%	4	10	0	10	0.0%	100.0%
	Mercury	7471A	0-2.5	7	8	1	7	12.5%	87.5%	5	6	0	3	0.0%	50.0%
		7471A	>2.5	6	13	1	8	7.7%	61.5%	4	9	0	4	0.0%	44.4%
SVOCs	SVOCs	8270C	0-2.5	7	8	1	2	12.5%	25.0%	5	6	0	2	0.0%	33.3%
		8270C	>2.5	2	6	0	1	0.0%	16.7%	2	5	0	0	0.0%	0.0%
PCBs	PCBs	8082	0-2.5	7	8	1	1	12.5%	12.5%	5	6	0	0	0.0%	0.0%
		8082	>2.5	2	6	0	1	0.0%	16.7%	1	3	0	0	0.0%	0.0%
Perchlorate	Perchlorate	314.0, 314.0M	0-2.5	7	8	1	3	12.5%	37.5%	5	6	0	1	0.0%	16.7%
		314.0, 314.0M	>2.5	5	12	1	3	8.3%	25.0%	1	4	0	0	0.0%	0.0%
TPH	Diesel Range	8015B-SVOA - Diesel	0-2.5	7	8	1	7	12.5%	87.5%	5	6	0	6	0.0%	100.0%
		8015B-SVOA - Diesel	>2.5	2	6	0	3	0.0%	50.0%	1	4	0	2	0.0%	50.0%
	Motor Oil Range	8015B-SVOA - Oil	0-2.5	7	8	1	7	12.5%	87.5%	5	6	0	6	0.0%	100.0%
		8015B-SVOA - Oil	>2.5	2	6	0	4	0.0%	66.7%	1	4	0	3	0.0%	75.0%
Misc.	Total Cyanide	9014	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		9014	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	NDMA	1625C-CI M	0-2.5	7	8	0	0	0.0%	0.0%	5	6	0	0	0.0%	0.0%
		1625C-CI M	>2.5	2	6	0	0	0.0%	0.0%	2	5	0	0	0.0%	0.0%
	Total Solids	160.3, 160.3M, 2540G	0-2.5	7	8	1	8	12.5%	100.0%	5	8	0	8	0.0%	100.0%
		160.3, 160.3M, 2540G	>2.5	6	20	2	20	10.0%	100.0%	4	10	0	10	0.0%	100.0%
	pH	9045C	0-2.5	7	8	1	8	12.5%	100.0%	5	6	0	6	0.0%	100.0%
		9045C	>2.5	6	14	1	14	7.1%	100.0%	4	10	0	10	0.0%	100.0%
	TOC	9060A MOD	0-2.5	2	2	0	0	0.0%	0.0%	1	1	0	0	0.0%	0.0%
		9060A MOD	>2.5	2	6	0	0	0.0%	0.0%	1	4	0	0	0.0%	0.0%
	CEC	9081	0-2.5	2	2	0	2	0.0%	100.0%	1	1	0	1	0.0%	100.0%
		9081	>2.5	2	6	0	6	0.0%	100.0%	1	4	0	4	0.0%	100.0%

Notes and Key:

> = Greater than
% = Percent
bgs = Below ground surface
CEC = Cation exchange capacity
Chromium VI = Hexavalent chromium
NDMA = N-Nitrosodimethylamine
PCBs = Polychlorinated biphenyls
SVOCs = Semivolatile organic compounds
TOC = Total organic content
TPH = Total petroleum hydrocarbons

Table 4.4-1
Summary of Surface Water Sampling Activities and Deviations from Field Sampling Plan
Administration Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Number of Proposed Sampling Locations	Proposed Sampling Depths	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
3D	Eastern Admin. Area storm drain system drop inlets (DIs) - access to water routed away from eastern Admin. Area into Admin. Ditch system.	2	Middle to bottom of water column	VOCs, SVOCs, TPH, PCBs, total and filtered metals (including CrVI), NDMA, chemical properties	Assess contamination that may migrate through eastern Admin Area storm drain system and into the Admin. Area ditches that route water downstream, ultimately to the West Lakes ponds. Determine whether to pursue additional surface water sampling in upstream sections of the storm drain system to help identify possible release points.	2	03D-SW01	1.5	VOCs, SVOCs, TPH, PCBs, total and filtered metals (including CrVI), NDMA, chemical properties	
							03D-SW02	4.5	VOCs, SVOCs, TPH, PCBs, total and filtered metals (including CrVI), NDMA, chemical properties	
3D	Runoff from within northeast portion of eastern Admin. Area; into ditch near northwest corner of 11D (north side of Atlanta).	2	Collect water discharged only from end of pipe	VOCs, SVOCs, TPH, PCBs, total and filtered metals (including CrVI), NDMA, chemical properties	Assess contamination that may emanate from Building 20004 into the 4D ditch (north of Alabama) that routes water through the eastern Admin Area, ultimately to the West Lakes ponds. Decide whether to pursue additional sampling within the building to help identify possible release points.	2	03D-SW03	1	VOCs, SVOCs, TPH, PCBs, total and filtered metals (including CrVI), NDMA, chemical properties	
							03D-SW04	1	VOCs, SVOCs, TPH, PCBs, total and filtered metals (including CrVI), NDMA, chemical properties	
5D	Runoff from within western Admin. Area into north end of 5D, near intersection with 7D.	1	Middle to bottom of water column	VOCs, SVOCs, total and filtered metals (including CrVI), ***chemical properties***	Assess contamination that may migrate into 5D from upstream and compare results from samples collected downstream within 5D and 9D.	1	5D-SW01	4	VOCs, SVOCs, total and filtered metals (including CrVI), DOC, ALK	Not analyzed for anions.
5D	Runoff from areas upstream and adjacent to N-S reach of 5D (including Building 20009). near south end of 5D's N-S reach and intersection with 5D's E-W reach.	1	Middle to bottom of water column	VOCs, SVOCs, TPH, PCBs, perchlorate, total and filtered metals (including CrVI), cyanide, ***chemical properties***	Assess contamination that may migrate through N-S reach of 5D from upstream and adjacent areas and compare results from samples collected within E-W reach of 5D and downstream within 9D.	1	5D-SW02	6	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, perchlorate, cyanide, DOC, ALK	Not analyzed for anions.
5D	Runoff from areas upstream and adjacent to E-W reach of 5D (including SMUD substation). at west end of 5D's E-W reach near intersection with 5D's N-S reach.	1	Middle to bottom of water column	VOCs, SVOCs, PCBs, total and filtered metals (including CrVI), ***chemical properties***	Assess contamination that may migrate through E-W reach of 5D from upstream and adjacent areas and compare results from samples collected within N-S reach of 5D and downstream within 9D.	1	5D-SW03	4	VOCs, SVOCs, total and filtered metals (including CrVI), PCBs, DOC, ALK	Not analyzed for anions.
5D	Runoff from within western Admin. Area into eastern half of 5D's E-W reach, including SMUD substation.	1	Middle to bottom of water column	VOCs, SVOCs, PCBs, and total and filtered metals (including CrVI), ***chemical properties***	Assess contamination that may migrate into E-W reach of 5D from upstream and adjacent areas and compare results from samples collected downstream within 5D and 9D.	1	5D-SW04	2	VOCs, SVOCs, total and filtered metals (including CrVI), PCBs, DOC, ALK	Not analyzed for anions.
5D	Runoff from within western Admin. Area into eastern end of 5D's E-W reach, including from source area D(d) (drop inlet).	1	Middle to bottom of water column	VOCs, SVOCs, and total and filtered metals (including CrVI), ***chemical properties***	Assess contamination that may enter E-W reach of 5D from upstream and adjacent areas and compare results from samples collected downstream within 5D and 9D.	1	5D-SW05	1	VOCs, SVOCs, total and filtered metals (including CrVI), DOC, ALK	Not analyzed for anions.
8D	Runoff from areas upstream and southeast of 8D, including area used for soil-treatment operations.	1	Middle to bottom of water column	VOCs, SVOCs, PCBs, and total and filtered metals (including CrVI), chemical properties	Assess contamination that may migrate into ditches north and west of 8D (including 9D and 12D) from upstream areas and compare results from samples collected within 9D and 12D.	1	8D-SW01	1.5	VOCs, SVOCs, total and filtered metals (including CrVI), PCBs, DOC, ALK	Not analyzed for anions.
9D	Runoff from within western Admin. Area through N-S reach of 9D, near intersection with E-W reach of 9D.	1	Middle to bottom of water column	VOCs, SVOCs, TPH, PCBs, perchlorate, total and filtered metals (including CrVI), cyanide, ***chemical properties***	Assess contamination that may migrate through N-S reach of 9D from upstream and adjacent areas and compare results from samples collected within E-W reach of 9D.	1	9D-SW01	3	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, perchlorate, cyanide, DOC, ALK	Not analyzed for anions.
9D	Runoff from areas upstream and adjacent to E-W reach of 9D. at west end of 9D's E-W reach, near intersection with 9D's N-S reach.	1	Middle to bottom of water column	VOCs, SVOCs, PCBs, total and filtered metals (including CrVI), ***chemical properties***	Assess contamination that may migrate through E-W reach of 9D from upstream and adjacent areas and compare results from samples collected within N-S reach of 9D.	1	9D-SW02	1	VOCs, SVOCs, total and filtered metals (including CrVI), PCBs, DOC, ALK	Not analyzed for anions.
9D	Runoff from areas upstream and adjacent to E-W reach of 9D.	1	Middle to bottom of water column	VOCs, SVOCs, total and filtered metals (including CrVI), ***chemical properties***	Assess contamination that may migrate through E-W reach of 9D from upstream and adjacent areas and compare results from samples collected downstream within 9D.	1	9D-SW03	3	VOCs, SVOCs, total and filtered metals (including CrVI), DOC, ALK	Not analyzed for anions.

Table 4.4-1
Summary of Surface Water Sampling Activities and Deviations from Field Sampling Plan
Administration Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Number of Proposed Sampling Locations	Proposed Sampling Depths	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
11D	Runoff from within northeast portion of eastern Admin. Area; into ditch near northwest corner of 11D (north side of Atlanta).	1	Middle to bottom of water column	VOCs, SVOCs, TPH, PCBs, total and filtered metals (including CrVI), NDMA, chemical properties	Assess contamination that may exit 11D to the north, from areas upstream and surrounding Building 20022 (warehouse) and its associated storage yards west of the building. Decide whether to pursue additional surface water and/or sediment sampling in the upstream reaches of 11D.	1	11D-SW01	1	VOCs, SVOCs, TPH, PCBs, total and filtered metals (including CrVI), NDMA, chemical properties	
12D	Runoff from areas upstream within western Admin Area, including 5D and 9D ditches and ditch north of D(c) and 8D.	1	Middle to bottom of water column	VOCs, SVOCs, TPH, PCBs, total and filtered metals (including CrVI), perchlorate, cyanide, ***chemical properties***	Assess contamination that may migrate into main ditch that conveys collected runoff to the west away from Admin. Area into the West Lakes ponds and compare results from samples collected within upstream ditches 5D, 9D, and north of sewage treatment plants D(c) and 8D.	1	12D-SW01	2	VOCs, SVOCs, total and filtered metals (including CrVI), TPH, PCBs, perchlorate, cyanide, DOC, ALK	Not analyzed for anions.

Notes and Key:
Proposed chemical properties include dissolved organic carbon, anions, and total alkalinity.
Bold, italicized and underlined data does not agree with the analytical results. See "Deviations from Field Sampling Plan" column for more information on discrepancies.

Admin. = Administration
ft bgs = Feet Below ground surface
ID = Identification
ALK = Total Alkalinity
CrVI = Hexavalent Chromium
SMUD = Sacramento Municipal Utility District
DOC = Dissolved Organic Carbon
SVOC = Semivolatile Organic Compound
TPH = Total Petroleum Hydrocarbons
VOC = Volatile Organic Compound
PCBs = Polychlorinated Biphenyl

Table 4.5-1 Well Construction Details
Perched and First-Water-Bearing Zone
Administration Area, Boundary Operable Unit (OU-6)
Aerojet Superfund Site
Sacramento County, California

Groundwater Unit	Sample Name	X Coordinate	Y Coordinate	GSE (ft msl)	TOC (ft msl)	TOS (ft bgs)	BOS (ft bgs)	Well TD
Perched	42	2225238	351336	148.7	150.7	23	43	43
Perched	71	2225955	349348	157.4	157.9	28	33	33
Perched	644	2227430	351421	155.5	155.5	16	26	26
Perched	645	2227910	351602	157.1	157.1	10	20	20
Perched	646	2227599	351461	156.5	156.5	18	29	29
Perched	654	2227500	351236	157.3	157.3	15	25	25
Perched	879	2227808	351592	157.0	157.0	10	25	30
Perched	880	2227944	351533	158.8	158.8	15	25	29
Perched	881	2227570	351114	158.8	158.8	12	21.5	21.5
Perched	882	2227573	351374	155.9	155.9	17	27	27
Perched	3676	2225951	351695	150.0	150.0	10	40	50
Perched	3708	2228481	349090	216.2	219.1	36	39.5	39.5
FWBZ	37	2228697	349279	215.0	217.3	40	94	94
FWBZ	38	2228517	352837	157.4	159.4	17	70	70
FWBZ	65	2229107	351008	190.2	191.0	52	80	80
FWBZ	72	2229225	351924	165.5	168.4	25	50	66
FWBZ	106	2226501	351493	151.2	152.3	34	41	41
FWBZ	116	2226331	351562	150.9	151.8	30	104	104
FWBZ	133	2228320	350851	161.4	161.7	27	37	27
FWBZ	192	2228206	351904	156.9	156.9	40	50	50
FWBZ	202	2228795	351724	161.1	163.7	46	60	60
FWBZ	262	2227279	351809	154.3	154.3	35	57	57
FWBZ	263	2227430	351423	155.5	155.5	35	52	57
FWBZ	268	2227908	351602	157.1	157.1	36	56	57
FWBZ	269	2227600	351459	156.4	156.4	35	55	57
FWBZ	273	2227334	351582	155.1	155.1	43	53	57
FWBZ	274	2227499	351238	157.2	157.2	45	55	57
FWBZ	275	2228058	351557	159.0	159.0	45	55	57
FWBZ	346	2226159	352274	153.5	155.9	64	85	85
FWBZ	496	2224590	350926	146.4	146.5	50	65	70
FWBZ	501	2225688	349459	145.5	146.7	42	43	53
FWBZ	1419	2225943	352755	151.4	151.4	54	75	75
FWBZ	3015	2228039	349199	219.0	222.2	82	103	103
FWBZ	3054	2229507	349959	231.3	233.3	76	91	91
FWBZ	3092	2227000	352051	152.2	152.3	25	55	55
FWBZ	3093	2226959	351809	152.8	152.9	25	45	65
FWBZ	3094	2226655	351618	25.0	151.8	25	45	46
FWBZ	3096	2226748	351932	152.4	152.5	42	52	52
FWBZ	3255	2224928	351599	147.3	151.6	57	78	78
FWBZ	3399	2226794	350415	152.6	152.6	30	51	51
FWBZ	3430	2225824	351207	149.0	149.2	53	75	75
FWBZ	3523	2226377	349967	151.0	151.1	56	94	94
FWBZ	3655	2226900	351262	152.1	152.1	45	65	68
FWBZ	3675	2224711	350056	144.3	147.8	47	77	77
FWBZ	3677	2227672	350367	160.5	160.5	35	55	60
FWBZ	3678	2226450	348910	156.0	159.5	45	75	80
FWBZ	3679	2227628	350891	158.9	158.9	39	59	60
FWBZ	3680	2226301	350863	149.0	149.1	45	65	68

Table 4.5-1 Well Construction Details
Perched and First-Water-Bearing Zone
Administration Area, Boundary Operable Unit (OU-6)
Aerojet Superfund Site
Sacramento County, California

Groundwater Unit	Sample Name	X Coordinate	Y Coordinate	GSE (ft msl)	TOC (ft msl)	TOS (ft bgs)	BOS (ft bgs)	Well TD
FWBZ	3681	2227204	350719	155.6	155.7	50	70	71
FWBZ	3682	2227976	352263	156.6	156.6	39	59	60
FWBZ	3684	2225599	350638	152.1	152.2	45	65	70
FWBZ	3685	2225612	350612	152.3	152.3	35	65	66
FWBZ	3686	2225622	350590	152.3	152.3	35	65	68
FWBZ	3687	2225643	350549	152.3	152.3	45	65	66
FWBZ	3688	2225533	350773	152.2	152.3	45	65	66
FWBZ	3693	2227705	351669	157.5	157.5	25	45	45
FWBZ	3694	2227506	351978	155.4	155.5	47	67	67
FWBZ	3695	2227829	351298	160.0	160.0	36	56	60
FWBZ	3702	2227271	349350	164.9	167.8	28.5	32	32
FWBZ	3703	2225748	350091	145.8	148.7	36	39.5	39.5
FWBZ	3704	2225553	350465	149.0	151.0	43.5	46.5	46.5
FWBZ	3705	2228036	349189	218.3	221.3	75.5	79	79
FWBZ	3706	2228127	349338	220.8	223.7	75	78.5	78.5
FWBZ	3707	2228489	349489	216.9	219.8	62.5	67	67
FWBZ	3711	2228123	348648	212.1	215.0	62	65.5	65.5
FWBZ	3713	2227664	348741	206.7	209.6	70.5	74	74
FWBZ	3714	2227750	349058	207.2	210.1	65	68.5	68.5
FWBZ	3715	2227581	349176	190.5	193.4	56	59.5	59.5
FWBZ	3718	2227205	348990	178.1	177.8	37	41	41
FWBZ	3719	2226856	348793	172.0	175.2	31	35	35
FWBZ	3720	2226838	349237	157.0	159.6	16.5	21	21
FWBZ	3722	2225121	350768	145.4	148.4	40	44	44
FWBZ	4001	2226433	351613	151.0	152.2	80	100	111
FWBZ	4035	2224875	351563	147.8	149.4	50	123	133

Key:
FWBZ - First Water-Bearing Zone
GSE - Ground Surface Elevation
TOC - Top of Casing
TOS - Top of screened interval of well
BOS - Bottom of screened interval of well
TD - Total Depth
ft msl - feet mean sea level
ft bgs - feet below ground surface

Table 4.5-2 Soil Boring Details
Perched and First Water-Bearing Zone
Administration Area, Boundary Operable Unit (OU-6)
Aerojet Superfund Site
Sacramento County, California

Groundwater Unit	Sample Name	X Coordinate	Y Coordinate	GSE (ft msl)	Sample Depth (ft bgs)	Sample Elevation (ft msl)
Perched	03D-SB19-GW01-28	2227509	351503	157.5	28	129.5
Perched	03D-SP101-GW01-10	2227833	351593	157.0	10	253.2
Perched	03D-SP101-GW01-20	2227833	351593	157.0	20	243.2
Perched	03D-SP102-GW01-20	2227687	351499	156.4	20	159.6
Perched	03D-SP105-GW01-20	2227589	351439	155.9	20	184.8
Perched	03D-SP106-GW01-31	2227435	351374	155.3	31	126.3
Perched	03D-SP108-GW01-20	2227492	351337	155.9	20	140.8
Perched	03D-SP115-GW01-20	2228016	351551	159.5	20	148.9
Perched	03D-SP116-GW01-15	2227963	351468	160.0	15	145.0
Perched	03D-SP136-GW01-13	2227790	351862	157.4	13	144.4
Perched	03D-SP145-GW01-30	2226951	351085	157.1	30	127.1
Perched	03D-SP17-GW01-10	2227728	351623	157.4	10	147.4
Perched	03D-SP85-GW01-15	2227309	351849	159.0	15	144.0
Perched	03D-SP89-GW01-20	2227315	351644	155.2	20	150.2
Perched	03D-SP98-GW01-15	2227774	351640	157.5	15	142.5
Perched	03D-SP99-GW01-20	2227698	351560	157.5	20	137.5
Perched	52D-SP26-GW01-30	2225637	350656	161.0	30	131.0
Perched	52D-SP29-GW01-30	2225590	350642	163.1	30	133.1
Perched	52D-SP34-GW01-30	2225440	350952	154.2	30	124.2
Perched	52D-SP34-GW01-30-T	2225440	350952	154.2	30	124.2
Perched	52D-SP38-GW01-30	2226111	350474	157.2	30	127.2
Perched	52D-SP38-GW01-30-T	2226111	350474	157.2	30	127.2
Perched	A20-ST05-SP05-GW01-16	2228613	350505	172.4	16	156.4
Perched	AW-AF1-SP01-GW01-20	2225844	350267	152.8	20	132.8
Perched	D(b)-SP06-GW01-30	2225558	350202	150.7	30	120.7
Perched	D(c)-SP07-GW01-30	2225613	349813	151.8	30	121.8
FWBZ	03D-HP01-50	2228155	350857	161.7	50	282.4
FWBZ	03D-HP02-50	2228358	351082	159.5	50	115.0
FWBZ	03D-SB12-GW01-42	2227318	351641	159.7	42	117.7
FWBZ	03D-SB18-GW01-50	2227354	351513	154.6	50	206.5
FWBZ	03D-SB30-GW01-58	2227724	351541	156.4	58	113.7
FWBZ	03D-SB33-GW01-60	2227492	351337	155.9	60	99.9
FWBZ	03D-SB35-GW01-43	2227938	351582	158.8	43	194.8
FWBZ	03D-SB37-GW01-49	2227886	351494	159.8	49	110.8
FWBZ	03D-SB43-GW01-47	2227563	351375	156.0	47	111.3
FWBZ	03D-SB44-GW01-43	2228015	351550	159.5	43	123.8
FWBZ	03D-SB48-GW01-50	2228165	351330	158.5	50	122.9
FWBZ	03D-SB56-GW01-50	2228322	350847	161.4	50	113.4
FWBZ	03D-SB57-GW01-60	2227405	351284	157.3	60	97.3
FWBZ	03D-SP102-GW01-40	2227687	351499	156.4	40	139.6
FWBZ	03D-SP107-GW01-40	2227405	351285	157.3	40	117.3
FWBZ	03D-SP109-GW01-32	2227563	351374	156.0	32	127.0
FWBZ	03D-SP110-GW01-30	2227611	351390	155.9	30	131.0
FWBZ	03D-SP110-GW01-30-T	2227611	351390	155.9	30	131.0
FWBZ	03D-SP121-GW01-35	2227481	351262	157.6	35	124.6
FWBZ	03D-SP122-GW01-50	2227559	351106	157.4	50	113.4
FWBZ	03D-SP122-GW01-50-T	2227559	351106	157.4	50	113.4
FWBZ	03D-SP128-GW01-43	2228108	350854	156.7	43	154.7
FWBZ	03D-SP132-GW01-41	2228159	351306	158.5	41	142.3
FWBZ	03D-SP139-GW01-36	2228297	351096	159.4	36	137.4

Table 4.5-2 Soil Boring Details
Perched and First Water-Bearing Zone
Administration Area, Boundary Operable Unit (OU-6)
Aerojet Superfund Site
Sacramento County, California

Groundwater Unit	Sample Name	X Coordinate	Y Coordinate	GSE (ft msl)	Sample Depth (ft bgs)	Sample Elevation (ft msl)
FWBZ	03D-SP140-GW01-37	2228220	351253	159.2	37	144.2
FWBZ	03D-SP142-GW01-38	2227287	351105	157.1	38	121.1
FWBZ	03D-SP143-GW01-47	2227179	351172	158.3	47	111.3
FWBZ	03D-SP144-GW01-38	2227201	352032	147.9	38	109.9
FWBZ	03D-SP145-GW01-40	2226951	351085	157.1	40	117.1
FWBZ	06D-SB02-GW01-61	2225487	350548	150.6	61	89.6
FWBZ	08D-HP01-60	2226144	349858	137.0	60	77.0
FWBZ	11D-HP01-49	2228232	352310	159.3	49	110.3
FWBZ	11D-HP02-42	2228792	352155	159.2	42	122.5
FWBZ	11D-SB04-GW01-40	2228113	352147	154.9	40	114.9
FWBZ	11D-SB08-GW01-30	2228751	352217	159.2	30	131.2
FWBZ	11D-SP29-GW01-35	2228243	352226	160.0	35	125.0
FWBZ	11D-SP29-GW01-35-T	2228243	352226	160.0	35	125.0
FWBZ	11D-SP30-GW01-36	2228399	351989	156.7	36	127.7
FWBZ	11D-SP30-GW01-36-T	2228399	351989	156.7	36	127.7
FWBZ	11D-SP31-GW01-43	2228420	351806	160.6	43	121.6
FWBZ	11D-SP31-GW01-43-T	2228420	351806	160.6	43	121.6
FWBZ	52D-HP01-60	2225438	350742	135.1	60	75.1
FWBZ	52D-SB18-GW01-40	2225772	350375	151.2	40	111.2
FWBZ	52D-SP39-GW01-50	2225146	350409	148.6	50	98.6
FWBZ	A20-B34-SP03-GW01-30	2228554	351388	165.1	30	135.1
FWBZ	A20-RB37-HP01-45	2228231	351588	159.0	45	116.7
FWBZ	A20-RB37-SP01-GW01-36	2228147	351632	159.0	36	126.9
FWBZ	A20-RB37-SP01-GW01-36-T	2228147	351632	159.0	36	126.9
FWBZ	A20-RC29-SB01-GW01-43	2228188	351829	157.2	43	139.0
FWBZ	A20-ST02-SP01-GW01-38	2227590	352017	157.2	38	119.2
FWBZ	A20-ST02-SP02-GW01-40	2227506	352187	154.6	40	114.6
FWBZ	A20-ST02-SP03-GW01-42	2227788	352321	156.4	42	114.4
FWBZ	A20-ST05-SP02-GW01-30	2228488	350929	164.5	30	134.5
FWBZ	A20-ST05-SP03-GW01-35	2228370	350586	168.3	35	133.3
FWBZ	A20-ST05-SP03-GW01-35-T	2228370	350586	168.3	35	133.3
FWBZ	A20-ST05-SP04-GW01-20	2228340	350361	171.6	20	151.6
FWBZ	D(b)-SB04-GW01-60	2225917	350376	152.1	60	92.1

Key:
FWBZ - First Water-Bearing Zone
GSE - Ground Surface Elevation
ft msl - feet mean sea level
ft bgs - feet below ground surface
Samples names that end with a "T" are duplicate samples

Table 4.5-3 April 2006 Plant-wide Groundwater Data
Administration Area
Boundary Operable Unit (OU-6)
Aerojet Superfund Site
Sacramento County, California

Groundwater Unit	Well ID	Date	Water Level (ft msl)	Depth to Water (ft bgs)
perched	42	04/17/06	130.86	19.81
perched	71	04/17/06	136.01	21.85
perched	644	04/06/06	141.49	14.01
perched	645	04/07/06	149.20	7.90
perched	646	04/06/06	131.41	25.09
perched	879	04/06/06	149.83	7.12
perched	880	04/06/06	144.70	14.10
perched	881	04/06/06	147.82	10.98
perched	882	04/06/06	144.54	11.36
perched	3085	04/17/06	130.79	21.60
perched	3676	04/06/06	128.34	21.70
FWBZ	37	04/20/06	169.85	47.47
FWBZ	38	04/17/06	139.01	20.43
FWBZ	65	04/17/06	157.25	33.75
FWBZ	72	04/17/06	154.09	14.33
FWBZ	106	04/17/06	109.57	42.68
FWBZ	116	04/17/06	108.18	43.64
FWBZ	133	04/17/06	139.85	21.81
FWBZ	192	04/17/06	131.04	25.89
FWBZ	202	04/17/06	143.40	20.31
FWBZ	262	04/06/06	118.16	36.12
FWBZ	263	04/17/06	118.13	37.35
FWBZ	268	04/17/06	128.91	28.18
FWBZ	269	04/17/06	123.94	32.46
FWBZ	273	04/17/06	119.95	35.12
FWBZ	274	04/17/06	123.18	34.04
FWBZ	275	04/06/06	128.89	30.14
FWBZ	346	04/17/06	109.90	45.99
FWBZ	496	04/17/06	101.80	44.70
FWBZ	501	04/06/06	114.38	32.36
FWBZ	1419	04/18/06	112.71	38.71
FWBZ	3015	04/20/06	151.36	70.87
FWBZ	3054	04/20/06	173.02	60.30
FWBZ	3055	04/17/06	159.90	10.21
FWBZ	3086	04/17/06	110.86	41.81
FWBZ	3092	04/17/06	126.94	25.32
FWBZ	3093	04/17/06	114.83	38.10
FWBZ	3094	04/17/06	115.01	36.82
FWBZ	3096	04/17/06	112.32	40.14
FWBZ	3109	04/17/06	120.90	33.72
FWBZ	3255	04/17/06	99.24	52.34
FWBZ	3288	04/17/06	109.98	44.62
FWBZ	3398	04/17/06	109.79	39.32
FWBZ	3399	04/17/06	116.44	36.11
FWBZ	3430	04/17/06	107.43	41.77
FWBZ	3523	04/17/06	115.92	35.17
FWBZ	3655	04/06/06	114.24	37.90
FWBZ	3675	04/05/06	103.31	44.48
FWBZ	3677	04/06/06	127.29	33.25
FWBZ	3678	04/07/06	133.17	26.29
FWBZ	3679	04/06/06	124.90	34.03

Table 4.5-3 April 2006 Plant-wide Groundwater Data
Administration Area
Boundary Operable Unit (OU-6)
Aerojet Superfund Site
Sacramento County, California

Groundwater Unit	Well ID	Date	Water Level (ft msl)	Depth to Water (ft bgs)
FWBZ	3680	04/06/06	110.67	38.38
FWBZ	3681	04/06/06	119.99	35.69
FWBZ	3682	04/06/06	129.06	27.58
FWBZ	3684	04/10/06	105.63	46.53
FWBZ	3685	04/10/06	105.73	46.56
FWBZ	3686	04/10/06	106.85	45.46
FWBZ	3687	04/10/06	109.28	43.00
FWBZ	3688	04/10/06	104.81	47.44
FWBZ	3693	04/06/06	126.24	31.21
FWBZ	3694	04/06/06	121.68	33.78
FWBZ	3695	04/10/06	127.84	32.16

Key:
FWBZ - First Water-Bearing Zone
ft msl - Feet above mean sea level
ft bgs - Feet below ground surface

Table 4.5-4 Screening-Level Applicable, Relevant and Appropriate Requirements (ARARs)
Administration Area
Boundary Operable Unit (OU-6)
Aerojet Superfund Site
Sacramento County, California

Type	Analyte	Screening Level (µg/L)	Potential ARAR
Metal	Aluminum	1,000	CA MCL
Metal	Antimony	6	Fed MCL
Metal	Arsenic	10	Fed MCL
Metal	Barium	1,000	CA MCL
Metal	Beryllium	4	Fed MCL
Metal	Boron	1,000	DHS Action Level
Metal	Cadmium	5	CA MCL
Metal	Calcium		
Metal	Chromium	50	CA MCL
Metal	Cobalt	50	secondary MCL
Metal	Copper	1,300	CA MCL
Metal	Hexavalent chromium	110	PRG for tap water
Metal	Iron	300	secondary MCL
Metal	Lead	15	Fed MCL
Metal	Lithium	730	PRG for tap water
Metal	Magnesium		
Metal	Manganese	50	secondary MCL
Metal	Mercury (inorganic)	2	Fed MCL
Metal	Molybdenum	180	PRG for tap water
Metal	Nickel	100	CA MCL
Metal	Potassium		
Metal	Selenium	50	Fed MCL
Metal	Silver	100	secondary MCL
Metal	Sodium		
Metal	Strontium	4,000	SNARL -noncarcinogenic
Metal	Thallium	2	Fed MCL
Metal	Titanuim		
Metal	Vanadium	50	DHS Action Level
Metal	Zinc	5,000	secondary MCL
Misc.	10-10'-Oxybis-10H-Phenoxarsine (OBPA)		
Misc.	Bicarbonate Alkalinity		
Misc.	Carbonate Alkalinity		
Misc.	Hydroxide Alkalinity		
Misc.	Total Alkalinity		
Misc.	Chloride	250,000	CA secondary MCL
Misc.	delta-BHC	500	SNARL -noncarcinogenic
Misc.	Diesel	100	Taste and Odor Threshold
Misc.	Dissolved Organic Carbon		
Misc.	Fluoride	2,000	CA MCL
Misc.	Kerosene	100	Taste and Odor Threshold
Misc.	Motor Oil		
Misc.	NDMA	0.01	DHS Action Level
Misc.	Nitrate [d]	45,000	Fed MCL
Misc.	Nitrite [d]	1,000	Fed MCL
Misc.	Nitroguanidine	700	IRIS-RfD as drinking water
Misc.	Pendimethalin (PROWL)	1,500	PRG for tap water
Misc.	Phosphate		
Misc.	Phosphate (Ortho) as P		
Misc.	Perchlorate	6	CA MCL
Misc.	Sulfate	500,000	Fed MCL
Misc.	Total Cyanide	150	CA MCL
Misc.	Total Nitrate and Nitrite [d]	10,000	Fed MCL

Table 4.5-4 Screening-Level Applicable, Relevant and Appropriate Requirements (ARARs)
Administration Area
Boundary Operable Unit (OU-6)
Aerojet Superfund Site
Sacramento County, California

Type	Analyte	Screening Level (µg/L)	Potential ARAR
Misc.	PCBs	0.5	Fed MCL
SVOC	1,4-Dioxane	3	DHS Action Level
SVOC	2-methylnaphthalene		
SVOC	Acenaphthene	420	IRIS-RfD as drinking water
SVOC	Acenaphthylene		
SVOC	Anthracene	2,100	IRIS-RfD as drinking water
SVOC	Benzo (a) anthracene	0.1	Fed MCL
SVOC	Benzo (a) pyrene	0.2	Fed MCL
SVOC	Benzo (b & k) fluoranthene (total)		
SVOC	Benzoic acid	150,000	PRG for tap water
SVOC	Bis(2-ethylhexyl)phthalate	5	PRG for tap water
SVOC	Chrysene	0.175	Prop 65
SVOC	diethylphthalate		
SVOC	Fluoranthene	280	IRIS-RfD as drinking water
SVOC	Fluorene	280	IRIS-RfD as drinking water
SVOC	N-Nitrosodiphenylamine (as Diphenylamine		
SVOC	Phenanthrene		
SVOC	Phenol	4,200	DHS Action Level
SVOC	Pyrene	180	PRG for tap water
VOC	1,1,1,2-Tetrachloroethane	0.43	PRG for tap water
VOC	1,1,1-Trichloroethane	200	Fed MCL
VOC	1,1,2-Trichloroethane	5	Fed MCL
VOC	1,1-Dichloroethane	5	CA MCL
VOC	1,1-Dichloroethene	6	CA MCL
VOC	1,2,4-Trimethylbenzene	330	DHS Action Level
VOC/SVOC	1,2-Dichlorobenzene	600	Fed MCL
VOC	1,2-Dichloroethane	0.5	CA MCL
VOC	1,2-Dichloroethene (cis)	6	CA MCL
VOC	1,2-Dichloroethene (trans)	10	CA MCL
VOC	1,2-Dichloropropane	5	Fed MCL
VOC	1,3,5-Trimethylbenzene	330	DHS Action Level
VOC	1,3-Dichlorobenzene	600	DHS Action Level
VOC	1,4-Dichlorobenzene	5	CA MCL
VOC	Benzene	1	CA MCL
VOC	Bromodichloromethane [c]	80	Fed MCL (for total THMs)
VOC	Bromoform	80	Fed MCL
VOC	Bromomethane	8.7	PRG for tap water
VOC	Carbon tetrachloride	0.5	CA MCL
VOC	Chlorobenzene	70	CA MCL
VOC	Chloroethane	4.6	PRG for tap water
VOC	Chloroform	80	Fed MCL
VOC	Chloromethane	1.5	PRG for tap water
VOC	Cyclohexane	35,000	PRG for tap water
VOC	Dibromochloromethane	80	Fed MCL
VOC	Dichlorodifluoromethane	1,000	DHS Action Level
VOC	Dichloromethane (MeCl)	5	Fed MCL
VOC	Ethylbenzene	300	CA MCL
VOC	Freon-113	1,200	CA MCL
VOC	Isopropylbenzene		
VOC	p-Isopropyltoluene		
VOC	Methyl tert-butyl ether (MTBE)	13	CA MCL
VOC	Methylene chloride	5	Fed MCL

Table 4.5-4 Screening-Level Applicable, Relevant and Appropriate Requirements (ARARs)
Administration Area
Boundary Operable Unit (OU-6)
Aerojet Superfund Site
Sacramento County, California

Type	Analyte	Screening Level (µg/L)	Potential ARAR
VOC/SVOC	Naphthalene	170	DHS Action Level
VOC	n-Butylbenzene	260	DHS Action Level
VOC	tert-Butylbenzene	260	DHS Action Level
VOC	sec-Butylbenzene	240	PRG for tap water
VOC	n-propylbenzene	240	PRG for tap water
VOC	propene		
VOC	Styrene	100	Fed MCL
VOC	Tetrachloroethene	5	Fed MCL
VOC	Toluene	150	CA MCL
VOC	Trichloroethene	5	Fed MCL
VOC	Trichlorofluoromethane	150	CA MCL
VOC	Vinyl chloride	0.5	CA MCL
VOC	Xylenes (total)	1,750	CA MCL
Pesticide	4,4'-DDD	0.28	PRG for tap water
Pesticide	4,4'-DDE	0.2	PRG for tap water
Pesticide	4,4'-DDT	0.2	PRG for tap water
Pesticide	Aldrin	0.004	PRG for tap water
Pesticide	alpha-BHC	0.015	DHS Action Level
Pesticide	beta-BHC	0.025	DHS Action Level
Pesticide	Chlordane (tech)	0.1	CA MCL
Pesticide	delta-BHC		
Pesticide	Dieldrin	0.0042	PRG for tap water
Pesticide	Endosulfan I	220	PRG for tap water
Pesticide	Endosulfan II	220	PRG for tap water
Pesticide	Endosulfan sulfate		
Pesticide	Endrin	2	CA MCL
Pesticide	Endrin aldehyde		
Pesticide	Endrin ketone		
Pesticide	gamma-BHC (Lindane)	0.2	CA MCL
Pesticide	Heptachlor	0.01	CA MCL
Pesticide	Heptachlor epoxide	0.01	CA MCL
Pesticide	Methoxychlor	30	CA MCL
Pesticide	Toxaphene	3	CA MCL

Key:
µg/L = Micrograms per liter
DHS = Department of Health Services
IRIS-rfd = USEPA Integrated Risk Information System - reference dose as a drinking water level
MCL = Maximum Contaminant Level
PHG = Public Health Goal
PRG = Preliminary Remediation Goal (for tap water)
SNARL = Suggested No-Adverse-Response Levels
SVOC = Semivolatile organic compound
VOC = Volatile organic Compounds

5.0 *SUMMARY AND RESULTS OF REMEDIAL INVESTIGATION – WESTLAKES, LINE 02, LINE 05 NORTH, AND OPEN SPACE AREAS 5, 6, AND 7*

The Westlakes; Line 02; Line 05 North; and Open Space Areas 5, 6, and 7 (referred to hereafter as the WLLO Area) of the Boundary Operable Unit (BOU) encompass the six management areas listed below and shown in Figure 5.0-1:

- **Line 02 Region:** Includes all of Source Areas 28E, 29E, 59E, E(d), E(e), E(m), E(n), and the Former Drum Storage Area (DSA); Resource Conservation and Recovery Act (RCRA) Units T and Z; and various features such as collection systems, floor drains, sumps, storage areas, septic tanks and leach fields, and a cleaning slab.
- **Line 05 North (previously referred to as Line 02 West in the *Final Remedial Investigation/Feasibility Study Field Sampling Plan for Boundary Operable Unit* (BOU FSP) (Aerojet et al., 2006b):** Includes all of Source Areas 51E, 52E, and E[l] in proximity to the northernmost building (05085) in Line 05 and various site features that may have contributed chemicals to soil and/or groundwater.
- **Westlakes Storm Water Retention Basins/Open Space 6.**
- **Western Main Administration Area Ditch and Buffalo Creek.**
- **Open Spaces 5 and 7.**

Septic tank and leach lines and RCRA units within the management areas not identified as separate source areas are discussed within the source areas in which they are associated. This section provides a description of each of the six management areas, including the environmental setting, and a discussion regarding the presence and distribution of chemicals in both the vadose zone and groundwater. Additionally, the following information is presented for each of the areas:

- A summary of background information, including historical operations and activities;
- A summary of the scope and results of previous (prior to 2005) investigations;
- A summary of the scope and results of recent (2005 through 2007) investigations for volatile organic compounds (VOCs), metals, and other non-VOCs in soil, soil vapor, and groundwater; and

- A discussion of the investigation results.

5.1 *SUMMARY AND RESULTS OF VADOSE ZONE REMEDIAL INVESTIGATION – LINE 02 REGION*

The Line 02 Region encompasses eight source sites and various other features investigated during the BOU Remedial Investigation (RI) (Figure 5.0-1). Additionally, step-out sampling conducted to characterize the extent of VOCs detected in the vadose zone within the Line 02 Region extended toward the south into Area 00. However, Area 00 is not within the boundaries of the BOU RI and therefore data quality objectives (DQOs) and a sampling design for the investigation of source areas within Area 00 were not included in the BOU FSP. Consequently, soil sampling that may be required to complete the RI of Area 00 was not performed as part of the BOU RI.

To simplify the discussions and presentation of data, the Line 02 Region has been divided into two areas, DSA and Main Line 02 Area, which encompass source sites and other investigated features that are related, are in proximity to one another, or appear to be linked based on the presence of similar chemicals in soil and/or groundwater. The two investigation areas in the Line 02 Region are described below and shown in Figure 5.1-1:

- **Drum Storage Area –** Includes all of Source Areas 28E, 59E, and DSA; RCRA Unit Z; and various features such as collection systems, floor drains, sumps, storage areas, and a cleaning slab associated with the drum cleaning activities in the DSA and a septic tank and leach field.
- **Main Line 02 Area –** Includes all of Source Areas 29E, E(d), E(e), E(m), and E(n); RCRA Unit T; and various features such as collection systems, drainage ditches, sumps, storage areas, tanks, and septic tanks and leach fields.

This section presents the environmental setting for the Line 02 Region and provides the following information for each of the two areas of investigation in the Line 02 Area:

- Describes the area of investigation;
- Describes each of the source areas and other features, including septic tanks, investigated during the previous investigations and the BOU RI;

- Summarizes previous vadose zone investigations and the results of those investigations;
- Identifies chemicals of potential concern (COPCs) identified during the previous investigations;
- Presents the data needs identified in the BOU FSP;
- Summarizes the sampling activities performed during the BOU RI and deviations from the sampling proposed in the BOU FSP;
- Presents the analytical results for samples collected during the BOU RI and historical data, where appropriate; and
- Provides a discussion of the investigation results, which includes the identification of COPCs; lateral and vertical characterization of COPCs; fate and transport of the COPCs; and the potential for those COPCs to impact human health, surface water, and groundwater.

The information presented was compiled from one or more of the following sources*: Stage 1 Sampling Plan-Zone 1* (Aerojet, 1993a); *Stage 1 Sampling Plan-Zones 3 and 4* (Aerojet, 1993b); *Stage 1 Sampling Plan-Zone 2* (Aerojet, 1993c); *Aerojet Superfund Site – Scoping Report, Volumes 1 through 6* (ICF Technology, Inc., 1989); *Aerojet Site; Stage 1 Report - Zones 1 through 4* (ICF Kaiser Engineers, Inc., 1993); or BOU FSP (Aerojet et al., 2006b).

5.1.1 Environmental Setting – Line 02 Region

The topography, geology, soils, surface water hydrology, general hydrogeology, and ecological habitat of the Line 02 Region are described in the following subsections.

5.1.1.1 Topography

The topography of the Line 02 Area consists of a relatively flat top with a gentle to relatively moderate slope towards the north and northwest. Elevations in the Line 02 Area range from approximately 175 to 150 feet above mean sea level (amsl).

5.1.1.2 Geology

Based on the descriptions from borehole logs for perched and unconfined groundwater wells and borings, the lithologies underlying the Line 02 Area are comprised of native, undisturbed (undredged) interbedded layers of relatively permeable and relatively lower permeability

sediments. Relatively permeable layers are made up of silty, poorly and well-graded sands and gravels; and silty and clayey gravels and silts. Relatively lower permeability sediment layers consist of low plasticity clays and silts, and silty and clayey sands. The interbedded sediments of the terrace beneath Line 02 is flanked on the south by an area of dredge tailings that indicates a fairly abrupt change in the geology from finer-grained materials to interbedded gravels, sand, silt, and clays. Reviews of aerial photographs indicate that an east-west trending slickens area at or near the contact between the dredged and undredged areas may have been used in construction of the Main Administration Ditch.

5.1.1.3 *Soils*

Large areas of the Line 02 Area have been graded and covered by impervious surfaces or structures, such as roads, driveways, sidewalks, buildings, and parking lots. The Line 02 Area is situated along an ancestral American River terrace and soils consist primarily of the Redding-Corning-Red Bluff complex. As described in the 1993 United State Department of Agriculture (USDA - Natural Resources Conservation Service [USDA – NRCS], 1993) Soil Conservation Service, Soil Survey of Sacramento County, the Redding-Corning-Red Bluff complex consists of moderately well-drained soils that are moderately deep over a cemented hard pan. This soil unit is found on intermediate and high terraces, terrace remnants, and the side slopes of terraces in the eastern part of Sacramento County. The soils form in alluvium that is derived from mixed rock sources. The Redding soils are typically a surface layer of gravelly loam with subsoil comprised of a gravelly claypan, which is in turn underlain by a hardpan at a depth of 20 to 40 inches. The Corning-Red Bluff soils are typically a loam with a subsoil of clay loam, gravelly loam, and gravelly clay loam.

5.1.1.4 *Surface Water Hydrology*

Local surface water features within or adjacent to the Line 02 Area are the Main Administration Area Ditch and Upper Buffalo Creek. Storm water runoff originating in the DSA flows west into Buffalo Creek or accumulates in a low-lying area to the south within the Buffalo Creek drainage area. Storm water runoff originating in the Main Line 02 Area either flows towards the north where it accumulates in a low area immediately south of the Main Administration Area Ditch or into a man-made ditch that discharges into the Main Administration Area Ditch. Water in Buffalo Creek and the Main Administration Area Ditch are directed into the Westlakes where it is allowed to infiltrate or, when the

Westlakes become full, is discharged to Lower Buffalo Creek and ultimately discharged to the American River. Storm water discharges to Buffalo Creek/American River are regulated through the National Pollutant Discharge Elimination System (NPDES) (California Regional Water Quality Control Board [RWQCB], 2002).

5.1.1.5 *Local Hydrogeology*

The first saturated sediments encountered beneath the Administration Area are either part of Perched Groundwater or within the first water-bearing zone (FWBZ). For the purposes of this RI, FWBZ is defined as the upper 20 to 30 feet of saturated sediments that are laterally continuous across the Westlakes/Line 02 Region.

The general hydrogeology of the Perched Groundwater and FWBZ beneath the Line 02 Area is discussed below. Details regarding the occurrence of groundwater within the Line 02 Area and distribution of chemicals in the groundwater are presented in Section 5.7.

<u>Perched Groundwater</u>

Perched Groundwater is the shallowest saturated unit and was encountered in the Line 02 Area during the BOU RI at depths of 43 to 45 feet below ground surface (bgs) (123 to 129 feet amsl) in the undredged sediments beneath the western portion of Line 02. Perched Groundwater beneath the Line 02 Area and throughout the Westlakes/Line 02 Area is discontinuous and lateral hydraulic gradients were not evaluated.

<u>First Water-Bearing Zone</u>

The FWBZ is defined as the first saturated sediments that are laterally continuous across the Westlakes/Line 02 Area. The FWBZ occurs within sands and gravels (with variable amounts of silt) ranging from approximately 20- to 60-feet thick. These sands and gravels comprise the upper portion of Layer C of the Sitewide Hydrostratigraphic Model.

The depth to the top of the FWBZ increases from east to west across the Westlakes/Line 02 Area. The FWBZ is shallowest (34 feet bgs) to the east of Line 02, increasing to approximately 76 feet bgs in the Line 05 North Area.

The highest water levels in the FWBZ were recorded when measurements began in 1983. Since that time, the water level elevations in most FWBZ

wells have declined by up to approximately 30 feet. The highest rates of decline (approximately 5 feet per year) were observed from 1983 through 1989. Water level elevations were relatively stable in most wells from 1991 through 2006, with typical water level elevation increases and decreases of approximately 5 feet. Seasonal water level elevation fluctuations of up to 42 feet were observed, although seasonal fluctuations of 5 to 10 feet were more common. Wells located near the Westlakes storm water retention cells exhibited the highest seasonal fluctuations.

The hydraulic gradient for the FWBZ was evaluated based on a single water level data set collected in April 2006. This data set available was selected because it included water level measurements from the new monitor wells installed during the BOU RI, as well as from existing monitoring wells.

The overall direction of the hydraulic gradient for the FWBZ is from east to west. The gradient deviates beneath Line 02 where the hydraulic gradient trends more to the northwest. This apparent deviation is nearly coincident with the contact between the dredged and non-dredged areas. Downgradient of Line 02 and throughout the Line 05 and Westlakes areas, the direction of the hydraulic gradient is west. The magnitude of the hydraulic gradient across the Line 02/Westlakes Area averages approximately 0.01 feet per foot (ft/ft).

Potential vertical hydraulic gradients between Perched Groundwater and the FWBZ have not been calculated, but Perched Groundwater ranges from approximately 20 to 50 feet higher in elevation than the FWBZ, suggesting a strong potential for downward vertical migration of Perched Groundwater to the FWBZ.

5.1.1.6 *Ecological Habitat*

The Line 02 Area is primarily comprised of paved and ruderal/disturbed habitats with buildings. Vegetation communities west of the disturbed area of Line 02 consist mainly of annual grassland with areas of oak woodland, Fremont cottonwood-oak woodland along the current and former Buffalo Creek drainage area, and some patches of coyote brush scrub and willow scrub. Vegetation communities north of Line 02/ Area 00 consist of annual grassland changing to oak woodland and valley foothill riparian along Buffalo Creek.

Typical flora in the Main Line 02 Region includes herbaceous weeds, non-native naturalized Mediterranean grasses, trees including oaks and

cottonwood, woody shrubs, and various riparian plants. Typical fauna in the vegetation communities includes various raptors, wild turkey, northern flicker, yellow-rumped warbler, Bullock's oriole, savannah sparrow, western meadowlark, song sparrow, black-headed grosbeak, Acorn woodpecker, Nuttal's woodpecker, western scrub jay, yellow-billed magpie, oak titmouse, white-breasted nuthatch, western bluebird, American robin, Phainopepla, lark sparrow, western fence lizard, southern alligator lizard, Gilbert's skink, slender salamander, Pacific gopher snake, racer, sharp-tailed snake, common kingsnake, Pacific treefrog, black-tailed deer, coyote, deer mouse, California vole, and California ground squirrel. Blue elderberry shrubs, potential habitat for the Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), were observed primarily in the southern portion of Line 02 near the Main Administration Ditch and along Buffalo Creek. A *Biological Assessment Report* (ECORP Consulting, Inc., 2005) for the BOU was presented as Appendix B in the BOU FSP (Aerojet et al., 2006b).

5.1.2 *Drum Storage Area – Line 02 Region*

The DSA consists of Source Areas 28E, 59E, and DSA located in and around the former location of a drum storage and cleaning facility (Figure 5.1-1). The DSA also includes various features such as sumps, drains, ponds, concrete slabs, and septic tanks associated with the source areas and/or historical drum cleaning process.

5.1.2.1 *Description of Source Areas – Drum Storage Area*

The source areas in the DSA and various site features that may have contributed chemicals to soil and/or groundwater are described below and shown in Figure 5.1-1. Site features were identified based on historical soil, soil vapor, and groundwater analytical data and/or visual inspection and limited data coverage.

<u>Source Area 28E</u>

Source Area 28E is a former drum and equipment cleaning area that includes a concrete cleaning slab, a concrete-lined sump, and two ponds. The ponds consist of one 100-square foot, concrete-lined pond; and one 225-square foot unlined pond. The concrete cleaning slab is located 40 feet southeast of the two ponds. Historically, a concrete-lined trough directed wash water runoff from the concrete cleaning slab to the concrete-lined sump. Overflow from the concrete-lined sump was discharged to the two ponds via aboveground pipes. A drain at the bottom of the sump also

may have been used to discharge wash water to the ground. Surface runoff from the area of the drain may have been directed toward the lined pond.

VOCs, perchlorate, and metals were likely associated with the drum cleaning activities at Source Area 28E.

Source Area 59E

Source Area 59E is a low-lying area encompassing approximately 5,400-square feet adjacent to and southwest of Source Area 28E. The low-lying area is approximately 40 feet west-southwest of the concrete wash slab at Source Area 28E. Source Area 59E may have received runoff from the drum cleaning activities conducted at the wash slab.

Features associated with Source Area 59E that could have contributed to chemicals in soil include surface runoff generated from drum cleaning activities associated with Source Area 28E and various surface water runoff collection areas at the source area.

Source Area Drum Storage Area

The DSA is located east of 59E and southeast of 28E and is historically associated with activities conducted at Source Area 28E. In addition, septic tank L2-ST28 is located on the west side of Building 02028, adjacent to the DSA. L2-ST28 is a 2,000-gallon septic tank with associated leach lines that serviced a restroom in Building 02028. Building 02028 was the Solid Rocket Plant Safety and Facilities Control Building.

As discussed in the BOU FSP, references in the Demonstration Project Record Search to a separate septic tank (L2-ST90) associated with Building 02090 appear to be inaccurate. No documentation has been found to support the existence of this septic tank and field reconnaissance of the area indicated no features that would indicate the presence of a septic tank. The nearby septic tank and leach lines running beneath Building 02090 are associated with L2-ST28 and Building 02028.

RCRA Units

RCRA Z formerly consisted of two 25,000-gallons treatment and storage tanks, a Dilute Wastewater Treatment Plant, and a Nitroplasticizer Treatment System. The two 25,000-gallons treatment and storage tanks were constructed from fiberglass reinforced plastic filament within an

impervious coated concrete containment. The Dilute Wastewater Treatment Plant had two separate containment systems consisting of a concrete wall and pad reinforced with rebar. The Nitroplasticizer Treatment System had a perimeter L shaped outside curb containment wall with all wetted-internal areas reinforced with an epoxy coating.

RCRA Z was certified as closed by the Department of Toxic Substances Control (DTSC) in November 2006 following the removal and management of all hazardous waste and wastewater from the unit, decontamination of the tanks and secondary containment features, and the sampling and analysis of soil beneath the tanks (DTSC, November 2006b).

5.1.3 Summary and Results of Previous (Prior to 2005) Vadose Zone Investigations – Drum Storage Area

The following subsections summarize the scope and results of previous (prior to 2005) vadose zone investigations of the three source areas, septic tanks, and various features within the DSA; identifies COPCs based on the previous investigations; and discusses the DQOs and sampling proposed in the BOU FSP.

5.1.3.1 Summary of Previous (Pre-2005) Vadose Zone Investigations – Drum Storage Area

Soil samples from 10 soil borings and 20 soil vapor samples were collected in the vicinity of Source Areas 28E, 59E, and DSA within the DSA between 1984 and 1993. Soil vapor samples were analyzed for VOCs. Soil samples were analyzed for VOCs, semivolatile organic compounds (SVOCs), perchlorate, and/or metals. Previous investigations of those source areas conducted between 1984 and 1993 are summarized below. The purposes of the previous investigations are discussed in Section 2.7.

<u>Source Area 28E</u>

Previous vadose zone investigations were conducted at Source Area 28E in March and April 1984, April 1992, and August 1993. The scope of those investigations is outlined below.

- March and April 1984 – Soil samples were collected from four soil borings advanced to depths ranging from 0 to 50 feet bgs and analyzed for select VOCs and perchlorate.

- April 1992 – Soil vapor samples were collected at 19 locations from depths ranging from 5 to 40 feet bgs and analyzed for select VOCs.
- August 1993 – Soil samples were collected from three soil borings advanced to depths ranging from 0 to 20 feet bgs and analyzed for select metals.

Source Area 59E

Previous vadose zone investigations were conducted at Source Area 59E in March and April 1984, April 1992, and August 1993. The scope of those investigations is outlined below.

- March and April 1984 – Soil samples were collected from four soil borings advanced to depths ranging from 0 to 50 feet bgs and analyzed for select VOCs and perchlorate.
- April 1992 – Soil vapor samples were collected at 19 locations from depths ranging from 5 to 40 feet bgs and analyzed for select VOCs.
- August 1993 – Soil samples were collected from three soil borings advanced to depths ranging from 0 to 20 feet bgs for analysis of select metals.

Source Area DSA

A previous vadose zone investigation of the DSA was conducted in April 1992. Soil vapor samples were collected at six locations from a depth of 10 feet bgs and analyzed for VOCs.

5.1.3.2 *Results of Previous (Pre-2005) Vadose Zone Investigation – Drum Storage Area*

The results of the previous (prior to 2005) investigations of Source Areas 28E, 59E, and DSA, as presented in the BOU FSP (Aerojet et al., 2006b), are summarized below.

Review of the previous data identified the following COPCs in soil and/or soil vapor within the source areas that comprise the DSA:

- **Soil –** SVOCs, metals, and perchlorate.
- **Soil Vapor –**VOCs.

Polychlorinated biphenyls (PCBs) and pesticides were not identified as COPCs in soil within the source areas that comprise the DSA. Therefore,

sampling for these constituents during the BOU was not proposed in the BOU FSP.

Figures showing previous sampling locations in the source areas within the Line 02 Area and chemical groups detected in soil samples collected between 1991 and 2005 above human health and ecological screening levels were presented in the BOU FSP (Aerojet et al., 2006b) and are included in Appendix E. The FSP also presented a summary of statistics and the sample results for chemicals detected in soil, soil vapor, and groundwater that exceed human health and ecological screening levels in the Line 02 Area.

5.1.3.3 *Summary of Data Needs – Drum Storage Area*

Based on a review of the previous vadose zone investigation data, extensive aerial photograph research and review, and exhaustive research of historical documents, Aerojet determined that additional soil and soil vapor sampling was needed to:

- Characterize the present lateral and vertical extent of VOCs, SVOCs, metals, perchlorate, total petroleum hydrocarbons (TPH), and pH in soil in the vadose zone at the source areas and site features that may have contributed chemicals in soil at concentrations that could potentially impact human and ecological receptors;
- Evaluate the potential for chemicals in soil to degrade surface or groundwater quality; and
- Obtain sufficient data to support fate and transport modeling, evaluation of risk to human and ecological receptors, and evaluation of potential remedial alternatives.

It should be noted that due to the time lapse (12 years) since the Stage 1 RI was performed and the elevated laboratory reporting limits for VOCs during that investigation, the investigation of VOCs performed during the BOU was designed to supersede all previous soil vapor and soil VOC investigation results.

5.1.4 *Summary and Results of Boundary Operable Unit Vadose Zone Investigation – Drum Storage Area*

The following subsections summarize the BOU investigation (2005 to 2007) of the three source areas and various features within the DSA, describe deviations from sampling proposed in the BOU FSP, describe the

site-specific geology and hydrogeology, and present the results of the BOU RI. The results of the sampling with respect to the completeness of the characterization and identification of potential sources are discussed in Section 5.1.5.

5.1.4.1 *Summary of Boundary Operable Unit Vadose Zone Investigation – Drum Storage Area*

The BOU RI of the vadose zone at the source areas (28E, 59E, and DSA) that comprise the DSA included the following activities:

Surface and Subsurface Soil Investigation

- A total of 16 primary and two duplicate surface and/or near-surface (0 to 2.5 feet bgs) soil samples and 61 primary and three duplicate subsurface (2.6 to 63 feet bgs) soil samples were collected at the three source areas, various features, and septic tanks in the DSA. Surface and subsurface soil sampling locations are shown in Figures 5.1-2 and 5.1-3, respectively.
- Surface and/or near-surface soil samples were analyzed for SVOCs, metals (including hexavalent chromium), TPH as diesel (TPH-D), TPH as motor oil (TPH-Mo), perchlorate, N-nitrosodimethylamine (NDMA), total organic carbon (TOC), cation exchange capacity (CEC), and/or geotechnical parameters. The SVOC analysis of soil samples also included an evaluation of the presence of tentatively identified compounds (TICs). In accordance with the BOU FSP, sample analysis was based on the analytical results from previous investigations and, therefore, every sample was not analyzed for the full suite of constituents.
- Subsurface soil samples were analyzed for SVOCs, metals (including hexavalent chromium), TPH-D, TPH-Mo, perchlorate, NDMA, TOC, CEC, and/or geotechnical parameters. The SVOC analysis of soil samples also included an evaluation of the presence of TICs. In accordance with the BOU FSP, sample analysis was based on the analytical results from previous investigations and, therefore, every sample was not analyzed for the full suite of constituents.
- The numbers of surface/near-surface and subsurface soil samples collected for each analysis (including quality assurance/quality control [QA/QC] samples) at each of the three source areas, along with the corresponding methods, are provided on Table 5.1-1.

- A cross-reference between soil sampling locations within the DSA and the specific features they were sited to investigate are provided on Table 5.1-2.

Soil Vapor Investigation

- A total of 75 primary and 10 duplicate soil vapor samples were collected from the three source areas within the DSA and analyzed for VOCs. The VOC analysis included an evaluation of the presence of TICs. Soil vapor sampling locations are shown in Figure 5.1-4.
- The number of soil vapor samples (including QA/QC samples) collected at each of the three source areas, along with the analytical method, are provided on Table 5.1-3.
- A cross-reference between soil vapor sampling locations within the DSA and the specific features they were sited to investigate is provided on Table 5.1-2.

5.1.4.2 *Deviations from Boundary Operable Unit Data Quality Objectives and Sampling Design – Drum Storage Area*

Sampling activities at the source areas (28E, 59E, and DSA) within the DSA during the BOU RI were generally consistent with those proposed by the BOU FSP, with the exceptions listed on Tables 5.1-4 and 5.1-5. Sampling was performed at locations proposed in the BOU FSP and step-out sampling was performed in accordance with the procedures agreed upon with the agencies. A comparison of proposed and actual sampling activities, including sampling rationale, sample depth, and analyses, is provided on Tables 5.1-4 and 5.1-5. Soil and soil vapor sampling locations and the specific features they were sited to investigate are cross-referenced on Table 5.1-2.

5.1.4.3 *Results of Boundary Operable Unit Vadose Zone Investigation Results – Drum Storage Area*

The results of the VOC, metals, SVOC, perchlorate, TPH-D and TPH-Mo, NDMA, TOC, CEC, Waste Extraction Test using deionized water (DI-WET), and geotechnical analysis of the samples collected during the BOU RI are summarized below. The analytical results for all soil vapor and soil samples are provided in Appendices F and G, respectively.

Summary of Investigation and Results – Volatile Organic Compounds

Based on evaluation of the existing data for the source areas comprising the DSA, the BOU FSP concluded that additional soil vapor sampling was needed to sufficiently characterize the nature and extent of VOCs. As indicated on Table 5.1-3 and below, 75 primary soil vapor samples were collected at Source Areas 28E, 59E, and DSA within the DSA and analyzed for VOCs. Additionally, the presence of TICs was evaluated as part of the VOC analysis.

Source Area	Depth (ft bgs)	No. of Primary Samples	No. of Locations
28E	0-10	1	1
	11-20	1	1
	21-30	1	1
	>30	1	1
59E	0-10	2	2
	11-20	2	2
	21-30	0	0
	>30	0	0
DSA	0-10	29	29
	11-20	28	28
	21-30	7	7
	>30	3	3

The analytical results for the soil vapor samples collected from the shallow (0 to 10 feet bgs), intermediate (11 to 20 feet bgs), and deep (21 to 30 feet bgs) intervals at Source Areas 28E, 59E, and DSA are presented in Appendix F and summarized below. Soil vapor sampling locations in the DSA are shown in Figure 5.1-4. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 5.1-2.

Soil vapor sampling locations and tetrachloroethene (PCE), trichloroethene (TCE), chloroform, and total VOC (TVOC) concentrations above their respective Remedial Investigation Screening Levels (RISLs) and Protection of Groundwater (PGW) Soil Screening Levels (SSLs) in the shallow, intermediate, and deep intervals in the DSA are shown in Figures 5.1-5a and 5.1-6. Additionally, TVOC concentrations above the RISLs are also shown in Figure 5.1-5b. Figure 5.1-5b shows the extent of VOCs detected in soil vapor above 10x the RISL. The investigation was considered complete if the total VOC concentration was less than 10x the RISL. The analytical results and concentrations are presented for PCE, TCE, and chloroform because they were the VOCs most frequently detected above their screening levels in soil vapor in the Line 02 Area.

The TVOC concentrations illustrated in Figures 5.1-5a and 5.1-5b represent the sum of the ratio of the concentration for each detected VOC in the sample divided by its RISL. For example, if PCE at a concentration of 320 micrograms per cubic meter (µg/m^3) and TCE at a concentration of 961 µg/m^3 were the only VOCs detected in the samples, then the sum of their respective concentrations divided by their respective RISLs of 320 and 961 µg/m^3 would be 2, or:

$$PCE = \frac{320\,\mu g/m^3}{320\,\mu g/m^3} = 1$$

$$TCE = \frac{961\,\mu g/m^3}{961\,\mu g/m^3} = 1$$

$$TVOC\ Ratio = 2$$

As agreed upon with the agencies, this line represents the extent to which soil vapor characterization would be performed during the BOU RI.

Cross sections presenting generalized vadose zone lithology and soil vapor sampling results in Line 02 Area are presented in Figures 5.1-7 and 5.1-8. Additional discussion of soil vapor investigation results for the source areas within the DSA is presented in Section 5.1.5.1.

Shallow Soil Vapor (0 to 10 feet bgs) – Volatile Organic Compounds:

- Thirty-two primary soil vapor samples were collected from the shallow interval at 32 locations in the source areas (28E, 59E, and DSA) within the DSA and analyzed for VOCs, including TICs. Soil vapor sampling locations are shown in Figure 5.1-4. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 5.1-2.
- Benzene, chloroform, cis-1,2-dichloroethene (cis-1,2-DCE), PCE, and TCE were the only VOCs detected in the shallow soil vapor at concentrations above their respective RISLs. Concentrations of those VOCs detected above their RISLs are provided on the table below. Shallow soil vapor sampling locations and PCE, TCE, chloroform, and TVOC concentrations above their RISLs are shown in Figure 5.1-5a. TVOC concentrations above RISLs are also shown in Figure 5.1-5b.
- Benzene, cis-1,2-DCE, PCE, and TCE were the only VOCs detected in shallow soil vapor samples at concentrations above their respective

PGW SSLs. Shallow soil samples having concentrations of those VOCs above their PGW SSLs are listed on the table below. Concentrations of PCE and TCE above their PGW SSLs are shown in Figure 5.1-6.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
28E-SP17	10	Benzene	84	35	40	N	Y
DSA-SP10	10				77	N	Y
DSA-SP13	10				130	Y	Y
DSA-SP18	10				56	N	Y
DSA-SP19	10				81	N	Y
DSA-SP22	10				59	N	Y
DSA-SP24	10				48	N	Y
DSA-SP26	10				58	N	Y
DSA-SP31	10				62	N	Y
DSA-SP08	10	Chloroform	83	18,595	210	Y	N
DSA-SP09	10				990	Y	N
DSA-SP16	10				270	Y	N
28E-SP16	10	cis-1,2-DCE	3,650	1,641	55,000	Y	Y
28E-SP16	10	PCE	320	57	800,000	Y	Y
59E-SP09	10				950	Y	Y
DSA-SP15	10				68	N	Y
28E-SP16	10	TCE	961	527	10,000,000	Y	Y
59E-SP09	10				5,900	Y	Y
DSA-SP04	10				2,700	Y	Y
DSA-SP05	10				6,700	Y	Y
DSA-SP06	10				780	N	Y
DSA-SP07	10				2,200	Y	Y
DSA-SP16	10				840	N	Y
DSA-SP17	10				2,400	Y	Y
DSA-SP20	10				3,000	Y	Y
DSA-SP27	10				540	N	Y

Intermediate Soil Vapor (11 to 20 feet bgs) – Volatile Organic Compounds:

- Thirty-one primary soil vapor samples were collected from the intermediate interval at 31 locations in the source areas (28E and DSA) within the DSA and analyzed for VOCs, including TICs. Soil vapor sampling locations are shown in Figure 5.1-4. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 5.1-2.
- Benzene, carbon tetrachloride (Carbon Tet), chloroform, PCE, and TCE were the only VOCs detected in the intermediate soil vapor at concentrations above their respective RISLs. Intermediate soil vapor samples having concentrations of those VOCs above their respective RISLs are listed on the table below. Concentrations of TCE, PCE,

chloroform, and TVOCs above their RISLs are shown in Figure 5.1-5a. TVOC concentrations above RISLs are also illustrated in Figure 5.1-5b.

- Benzene, PCE, and TCE were the only VOCs detected in intermediate soil vapor samples at concentrations above their respective PGW SSLs. Intermediate soil vapor samples having concentrations of those VOCs above their PGW SSLs, are listed on the table below. Concentrations of TCE and PCE above their PGW SSLs are shown in Figure 5.1-6.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
28E-SP19	20	Benzene	84	35	37	N	Y
DSA-SP08	20				45	N	Y
DSA-SP10	20				110	Y	Y
DSA-SP13	20				40	N	Y
DSA-SP18	20				170	Y	Y
DSA-SP20	20				190	Y	Y
DSA-SP24	20				78	N	Y
DSA-SP26	20				280	Y	Y
DSA-SP30	20				66	N	Y
DSA-SP31	20				40	N	Y
DSA-SP32	20				290	Y	Y
DSA-SP04	20	Carbon Tet	58	195	180	Y	N
DSA-SP04	20	Chloroform	83	18,595	470	Y	N
DSA-SP08	20				530	Y	N
DSA-SP10	20				96	Y	N
DSA-SP12	20				180	Y	N
DSA-SP16	20				1,200	Y	N
DSA-SP20	20				99	Y	N
28E-SP16	20	PCE	320	57	97,000	Y	Y
DSA-SP04	20				280	N	Y
DSA-SP12	20				200	N	Y
DSA-SP25	20				70	N	Y
DSA-SP26	20				310	N	Y
28E-SP16	20	TCE	961	527	3,200,000	Y	Y
DSA-SP04	20				98,000	Y	Y
DSA-SP05	20				4,700	Y	Y
DSA-SP08	20				820	N	Y
DSA-SP09	20				2,100	Y	Y
DSA-SP10	20				2,000	Y	Y
DSA-SP12	20				540	N	Y
DSA-SP16	20				2,300	Y	Y
DSA-SP17	20				1,300	Y	Y
DSA-SP20	20				24,000	Y	Y
DSA-SP27	20				2,300	Y	Y

Deep Soil Vapor (21 to 30 feet bgs) – Volatile Organic Compounds:

- Eight primary soil vapor samples were collected from the deep interval at 8 locations in the source areas (28E and DSA) within the DSA and analyzed for VOCs, including TICs. Soil vapor sampling locations are

shown in Figure 5.1-4. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 5.1-2.

- Benzene, Carbon Tet, chloroform, 1,2-dichloroethane (1,2-DCA), PCE, and TCE were the only VOCs detected in the deep soil vapor at concentrations above their respective RISLs. Deep soil vapor samples having concentrations of those VOCs above their respective RISLs are listed on the table below. Concentrations of PCE, TCE, chloroform, and TVOCs above their RISLs are shown in Figure 5.1-5a. TVOC concentrations above the RISL are also shown in Figure 5.1-5b.
- Benzene, Carbon Tet, 1,2-DCA, PCE, and TCE were the only VOCs detected in deep soil vapor samples at concentrations above their respective PGW SSLs. Deep soil vapor samples having concentrations of those VOCs above their respective PGW SSLs are listed on the table below. Concentrations of PCE and TCE above their PGW SSLs are shown in Figure 5.1-6.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
DSA-SP24	30	Benzene	84	35	140	Y	Y
DSA-SP04	30	Carbon Tet	58	195	320	Y	Y
DSA-SP10	30				78	Y	N
28E-SP16	30	Chloroform	83	18,595	310	Y	N
DSA-SP04	30				770	Y	N
DSA-SP10	30				160	Y	N
DSA-SP16	30				1,400	Y	N
DSA-SP17	30				150	Y	N
DSA-SP24	30				110	Y	N
28E-SP16	30	1,2-DCA	73.9	21	190	Y	Y
28E-SP16	30	PCE	320	57	2,200	Y	Y
DSA-SP04	30				1,400	Y	Y
28E-SP16	30	TCE	961	527	430,000	Y	Y
DSA-SP04	30				160,000	Y	Y
DSA-SP10	30				7,700	Y	Y
DSA-SP16	30				1,900	Y	Y
DSA-SP17	30				910	N	Y
DSA-SP23	30				1,200	Y	Y
DSA-SP24	30				1,700	Y	Y

Very Deep Soil Vapor (greater than 31 feet bgs) – Volatile Organic Compounds:

- Four primary soil vapor samples were collected from the very deep interval at four locations in the source areas (28E and DSA) within the DSA and analyzed for VOCs, including TICs.

- Carbon Tet, chloroform, PCE, and TCE were detected in the very deep soil vapor at concentrations above their respective RISLs. Very deep soil vapor samples having concentrations of those VOCs above their respective RISLs are listed on the table below. Concentrations for PCE, TCE, chloroform, and TVOCs above their RISLs are shown in Figure 5.1-5a. TVOC concentrations above the RISL are also illustrated in Figure 5.1-5b.
- Carbon Tet, cis-1,2-DCE, PCE, and TCE were detected in the very deep soil vapor samples at concentrations above their respective PGW SSLs. Deep soil vapor samples having concentrations of those VOCs above their respective PGW SSLs are listed on the table below. Concentrations of PCE and TCE above their PGW SSLs are shown in Figure 5.1-6.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
DSA-SP04	40	Carbon Tet	58	195	250	Y	Y
28E-SP16	40	Chloroform	83	18,595	510	Y	N
DSA-SP04	40				580	Y	N
DSA-SP10	40				85	Y	N
DSA-SP16	40				1,600	Y	N
28E-SP16	40	cis-1,2-DCE	3,650	1,641	2,200	N	Y
28E-SP16	40	PCE	320	57	13,000	Y	Y
DSA-SP04	40				1,200	Y	Y
28E-SP16	40	TCE	961	527	430,000	Y	Y
DSA-SP04	40				130,000	Y	Y
DSA-SP10	40				2,900	Y	Y
DSA-SP16	40				3,500	Y	Y

Summary of Investigation and Results – Metals

A total of 48 primary and four duplicate soil samples were collected at Source Areas 28E, 59E, and DSA in the DSA during the BOU RI and analyzed for metals, including mercury. Additionally, three samples were also analyzed for hexavalent chromium. The number of primary soil samples and sampling locations at Source Areas 28E, 59E, and DSA are summarized on Table 5.1-1, and below. Summary statistics for the samples are also presented on Table 5.1-1.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
28E	Metals	3	3	14	3
	Mercury	3	3	14	3
	Hex Chrome	0	0	0	0
59E	Metals	3	3	8	3
	Mercury	3	3	8	3
	Hex Chrome	3	3	0	0
DSA	Metals	5	5	15	5
	Mercury	5	5	15	5
	Hex Chrome	0	0	0	0

The results of the metals analysis of surface/near-surface and subsurface soil samples collected from the source areas (28E, 59E, and DSA) within the DSA are presented in Appendix G and summarized below.

Metals detected in soil within the Line 02 Area at concentrations statistically different from background and subsequently compared to screening levels were aluminum, antimony, arsenic, beryllium, cadmium, chromium, copper, manganese, molybdenum, nickel, selenium, silver, thallium, and zinc. Because boron, hexavalent chromium, lithium, strontium, and titanium were not included in the background evaluation, concentrations of these metals were also compared to screening levels.

Surface and subsurface soil sampling locations and metals detected at concentrations above their RISLs and PGW SSLs at Source Areas 28E, 59E, and DSA area shown in Figures 5.1-9 and 5.1-10, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 5.1-2. Cross sections showing the generalized lithology of the vadose zone within Line 02 Area are provided in Figures 5.1-7 and 5.1-8.

Surface and Near-Surface Soil – Metals:

- Eleven primary and one duplicate surface/near-surface soil samples were collected at 11 locations in the source areas (28E, 59E, and DSA) within the DSA and analyzed for metals, including mercury. Three samples collected at three locations in Source Area 59E were also analyzed for hexavalent chromium. Surface/near-surface sampling locations are shown in Figures 5.1-2, 5.1-9, and 5.1-10.
- Metals were not detected at concentrations above background and their respective RISLs in surface/near-surface soil samples collected in the source areas within the DSA.

- Aluminum, manganese, and thallium at concentrations above background and their respective PGW SSLs were detected in surface/near-surface soil samples. The detected concentrations, and location and depth of the samples, are identified on the table below and shown in Figure 5.1-10.

Sample Location	Depth (ft bgs)	Metal	RISL (mg/kg)	PGW SSL (mg/kg)	Conc. (mg/kg)	> RISL	> PGW SSL
59E-SB03	2.0	Thallium	5.0	2.5	3.4	N	Y
59E-SB04	2.5	Aluminum	76,140	43,000	48,000	N	Y
		Manganese	1,762	1,100	1,500	N	Y

mg/kg = Milligrams per kilogram

Subsurface Soil – Metals:

- Thirty-seven primary and three duplicate subsurface soil samples were collected at 11 locations at Source Areas 28E, 59E, and DSA within the DSA and analyzed for all metals, including mercury. Subsurface soil samples were not analyzed for hexavalent chromium. Subsurface sampling locations are shown in Figures 5.1-3, 5.1-9, and 5.1-10.
- Aluminum, manganese, and thallium were the only metals detected at concentrations statistically above background and their respective RISLs in subsurface soil samples collected within the DSA. The detected concentrations of those metals, and location and depth of the samples, are identified on the table below and shown in Figure 5.1-9.
- Aluminum, manganese, nickel, and thallium at concentrations statistically above background and their respective PGW SSLs were detected in subsurface soil samples. The detected concentrations, and location and depth of the samples, are identified on the table below and shown in Figure 5.1-10.

Sample Location	Depth (ft bgs)	Metal	RISL (mg/kg)	PGW SSL (mg/kg)	Conc. (mg/kg)	> RISL	> PGW SSL
28E-SB01	11.5	Nickel	1,564	120	130	N	Y
	23	Thallium	5.0	2.5	3.2	N	Y
	35	Manganese	1,762	1,100	1,300	N	Y
	47	Manganese	1,762	1,100	1,500	N	Y
		Thallium	5.0	2.5	2.8	N	Y
28E-SB02	35	Aluminum	76,140	43,000	53,000	N	Y
		Thallium	5.0	2.5	5.1	Y	Y
		Manganese	1,762	1,100	1,800	Y	Y
	47	Manganese	1,762	1,100	590	N	N
	59	Manganese	1,762	1,100	1,500	N	Y
59E-SB02	10.5	Aluminum	76,140	43,000	48,000	N	Y
	35	Manganese	1,762	1,100	1,400	N	Y
59E-SB03	11	Aluminum	76,140	43,000	79,000	Y	Y
		Nickel	1,564	120	130	N	Y
		Thallium	5.0	2.5	3.4	N	Y
59E-SB04	11	Nickel	1,564	120	210	N	Y
		Thallium	5.0	2.5	2.8	N	Y
DSA-SB01	20	Aluminum	76,140	43,000	65,000	N	Y
		Manganese	1,762	1,100	1,300	N	Y
	33	Aluminum	76,140	43,000	51,000	N	Y
		Manganese	1,762	1,100	2,100	Y	Y
	43	Manganese	1,762	1,100	5,000	Y	Y
DSA-SB04	5	Thallium	5.0	2.5	3.0	N	Y

Summary of Investigation and Results – Semivolatile Organic Compounds

A total of 46 primary and 5 duplicate soil samples were collected at Source Areas 28E, 59E, and DSA in the DSA during the BOU RI and analyzed for SVOCs, including TICs. The number of primary soil samples and sampling locations at Source Areas 28E, 59E, and DSA for SVOCs are summarized on Table 5.1-1, and below. Summary statistics for the samples are also presented on Table 5.1-1.

		Surface/Near-Surface		Subsurface	
Source Area	Compound	No. of Samples	No. of Locations	No. of Samples	No. of Locations
28E	SVOCs	4	4	12	2
59E	SVOCs	3	3	8	3
DSA	SVOCs	5	5	14	5

The results of the SVOC and SVOC TIC analysis of surface/near-surface and subsurface soil samples collected from the source areas (28E, 59E, and DSA) in the DSA are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations for SVOCs at Source Areas 28E, 59E, and DSA are shown in Figures 5.1-11 and 5.1-12. Soil sampling locations and the features being investigated are cross-referenced on Table 5.1-2. SVOC TICs were not identified in the surface and subsurface soil samples collected in the DSA.

Surface and Near-Surface Soil – Semivolatile Organic Compounds:

- Twelve primary and one duplicate surface and/or near-surface soil samples were collected at 12 locations in the source areas (28E, 59E, and DSA) within the DSA and analyzed for SVOCs, including TICs.
- SVOCs were not detected in the surface and near-surface soil samples in the DSA at concentrations above their respective RISL or PGW SSLs.

Subsurface Soil – Semivolatile Organic Compounds:

- Thirty-seven primary and three duplicate subsurface soil samples were collected at 11 locations in the source areas (28E, 59E, and DSA) within the DSA and analyzed for SVOCs, including TICs.
- SVOCs were not detected in the subsurface soil samples in the DSA at concentrations above their respective RISL or PGW SSLs.

Summary of Investigation and Results – Perchlorate

A total of 72 primary and five duplicate soil samples were collected in Source Areas 28E, 59E, and DSA within the DSA during the BOU RI and analyzed for perchlorate. The number of primary soil samples and sampling locations at Source Areas 28E, 59E, and DSA for perchlorate are summarized on Table 5.1-1, and below. Summary statistics for the samples are also presented on Table 5.1-1.

		Surface/Near-Surface		Subsurface	
Source Area	**Compound**	**No. of Samples**	**No. of Locations**	**No. of Samples**	**No. of Locations**
28E	Perchlorate	7	7	38	7
59E	Perchlorate	3	3	8	3
DSA	Perchlorate	4	4	12	4

The results of the perchlorate analysis of surface/near-surface and subsurface soil samples collected from Source Areas 28E, 59E, and DSA within the DSA are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations and perchlorate detected at concentrations above its RISL or PGW SSLs are shown in Figures 5.1-13 and 5.1-14, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 5.1-2.

Surface and Near-Surface Soil – Perchlorate:

- Fourteen primary and one duplicate surface/near-surface soil samples were collected at 14 locations in the source areas (28E, 59E, and DSA) within the DSA and analyzed for perchlorate (Figures 5.1-13 and 5.1-14 and Table 5.1-1).
- Perchlorate was not detected above its RISL in any of the surface or near-surface soil samples collected from Source Areas 28E, 59E, and DSA within the DSA.
- Perchlorate was detected above its PGW SSL in two surface/near-surface soil samples collected in Source Area 28E and one near-surface soil sample collected at Source Area DSA. The location and depth of the samples and the concentration of perchlorate detected in the samples are listed on the table below. Perchlorate concentrations above the PGW SSL are shown in Figure 5.1-14.

Sample Location	Depth (ft bgs)	Compound	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	< RISL	< PGW SSL
28E-SB05	1.0	Perchlorate	7,800	60	670	N	Y
28E-SB06	1.0	Perchlorate	7,800	60	110	N	Y
L2-ST28-SB01	2.5	Perchlorate	7,800	60	75	N	Y

µg/kg = Micrograms per kilogram

Subsurface Soil – Perchlorate:

- Fifty-eight primary and four duplicate subsurface soil samples were collected at 14 locations in the source areas (28E, 59E, and DSA) within the DSA and analyzed for perchlorate.
- Perchlorate was detected at a concentration above the RISL in only one soil sample collected at one location in Source Area 28E. The location and depth of the sample and the detected concentration of perchlorate is listed on the table below. Perchlorate concentrations above the RISL are shown in Figure 5.1-13.

- Perchlorate at concentrations above its PGW SSL was detected in 32 subsurface soil samples at 10 locations at Source Areas 28E, 59E, and DSA. Perchlorate detected at concentrations above its PGW SSL, and the location and depth of the sample having the detected concentration, are summarized on the table below. Perchlorate concentrations above its PGW SSL area shown in Figure 5.1-14.

Sample Location	Depth (ft bgs)	Compound	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	< RISL	< PGW SSL
28E-SB01	23	Perchlorate	7,800	60	510	N	Y
	35				1,700	N	Y
	47				610	N	Y
28E-SB02	11	Perchlorate	7,800	60	1,400	N	Y
	23				3,700	N	Y
	35				2,100	N	Y
	47				170	N	Y
28E-SB03	11	Perchlorate	7,800	60	69	N	Y
28E-SB04	20	Perchlorate	7,800	60	83	N	Y
	30				81	N	Y
	40				94	N	Y
	46				340	N	Y
28E-SB05	5	Perchlorate	7,800	60	26	N	N
	10				69	N	Y
	20				500	N	Y
	30				220	N	Y
	40				480	N	Y
	50				1,100	N	Y
28E-SB06	5	Perchlorate	7,800	60	5,100	N	Y
	10				4,300	N	Y
	20				480	N	Y
	30				270	N	Y
	40				630	N	Y
	50				1,600	N	Y
28E-SB07	5	Perchlorate	7,800	60	<47	N	N
	10				<48	N	N
	20				380	N	Y
	30				3,400	N	Y
	40				10,000	Y	Y
	50				140	N	Y
59E-SB02	35	Perchlorate	7,800	60	85	N	Y
DSA-SB01	5	Perchlorate	7,800	60	13	N	N
	11				<41	N	N
	20				800	N	Y
	33				620	N	Y
	43				650	N	Y
L2-ST28-90-SB01	4.5	Perchlorate	7,800	60	140	N	Y

Summary of Investigation and Results – Total Petroleum Hydrocarbons

A total of 44 primary and four duplicate soil samples were collected at Source Areas 28E, 59E, and DSA within the DSA during the BOU RI and analyzed for TPH-D and TPH-Mo. The number of primary soil samples and sampling locations at Source Areas 28E, 59E, and DSA are summarized on Table 5.1-1, and below. Summary statistics for the samples are also presented on Table 5.1-1.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
28E	TPH-D	3	3	12	2
	TPH-Mo	3	3	12	2
59E	TPH-D	3	3	8	3
	TPH-Mo	3	3	8	3
DSA	TPH-D	5	5	13	4
	TPH-Mo	5	5	13	4

The results of TPH analyses (TPH-D and TPH-Mo) of surface/near-surface and subsurface soil samples collected at Source Areas 28E, 59E, and DSA within the DSA re presented in Appendix G and summarized below. Surface and subsurface sampling locations and TPH-D detected at concentrations above its PGW SSL are shown in Figure 5.1-14. Soil sampling locations and the features being investigated are cross-referenced on Table 5.1-2.

Surface/Near-Surface Soil – Total Petroleum Hydrocarbons:

- Eleven primary and one duplicate surface/near-surface soil samples were collected at 11 locations in the source areas (28E, 59E, and DSA) within the DSA and analyzed for TPH-D and TPH-Mo. Surface soil sampling locations for TPH at Source Areas 28E, 59E, and DSA are shown in Figure 5.1-14.
- TPH-D and/or TPH-Mo were not detected above their PGW SSL in any of the surface or near-surface soil samples collected from Source Areas 28E, 59E, and DSA within the DSA.

Subsurface Soil – Total Petroleum Hydrocarbons:

- Thirty-three primary and three duplicate subsurface soil samples were collected at nine locations in the source areas (28E, 59E, and DSA) within the DSA and analyzed for TPH-D and TPH-Mo. Subsurface soil

sampling locations for TPH at Source Areas 28E, 59E, and DSA are shown in Figure 5.1-14.

- TPH-D and/or TPH-Mo were not detected above their PGW SSL in any of the subsurface soil samples collected from Source Areas 28E, 59E, and DSA within the DSA.

Summary of Investigation and Results – Miscellaneous Compounds

Miscellaneous analyses performed on soil samples collected from the source areas (28E, 59E, and DSA) within the DSA during the BOU RI were NDMA, TOC, CEC, and/or DI-WET. The number of primary surface/near-surface and subsurface soil samples collected at each source area and the numbers of locations are summarized on the table below.

		Surface/Near-Surface		Subsurface	
Source Area	**Compound**	**No. of Samples**	**No. of Locations**	**No. of Samples**	**No. of Locations**
28E	NDMA	3	3	12	2
	TOC	0	0	0	0
	CEC	0	0	0	0
	DI-WET	1	1	1	1
59E	NDMA	3	3	8	3
	TOC	4	2	1	1
	CEC	4	2	1	1
	DI-WET	0	0	2	1
DSA	NDMA	4	4	12	4
	TOC	1	1	7	1
	CEC	1	1	7	1
	DI-WET	0	0	2	1

The analytical results for the miscellaneous analyses of surface/near-surface and subsurface soil samples are presented in Appendix G and summarized below. The analytical data for pH, TOC, and CEC are used in the risk assessments to evaluate the bioavailability of some chemicals with respect to human and ecological receptors. The TOC, CEC, and DI-WET data are used in the FS to evaluate chemical and physical remedial actions, assess the potential for metals in soil to migrate into groundwater, and develop cleanup goals protective of groundwater.

N-Nitrosodimethylamine: Surface and subsurface soil sampling locations for NDMA in the source areas (28E, 59E, and DSA) within the DSA are shown in Figures 5.1-13 and 5.1-14. Soil sampling locations and the features being investigated are cross-referenced on Table 5.1-2.

- NDMA was not detected at concentrations above its RISL in any soil samples collected in Source Areas 28E, 59E, and DSA.
- NDMA at concentrations above its PGW SSL of 0.03 µg/kg was detected in one subsurface soil sample collected in Source Area 28E and one subsurface soil sample collected in Source Area 59E. NDMA at an estimated concentration of 1.3 µg/kg was detected in a sample collected at 35 feet bgs from boring 28E-SB02. NDMA at an estimated concentration of 0.21 µg/kg was detected in a soil sample collected at 23 feet bgs from boring 59E-SB02. However, NDMA was not detected at concentrations above the practical quantitation limit (PQL) in samples collected at 1, 5, 11, 23, 47, and 59 feet bgs from boring 28E-SB02 or in samples collected at 2, 5, 10.5, and 35 feet bgs from boring 59E-SB02.

Total Organic Carbon: TOC was not detected in the one surface and eight subsurface soil samples, including duplicates, collected from the source areas (28E, 59E, and DSA) within the DSA.

Cation Exchange Capacity: CEC was detected in the one surface/near-surface soil samples collected from Source Area DSA at 220 milliequivalents per kilogram (meq/K). CEC in the eight subsurface soil samples, including duplicates, collected from Source Area DSA ranged from 100 to 880 meq/K.

Waste Extraction Test using Deionized Water: A DI-WET preparation was performed on six soil samples collected at Source Areas 28E, 59E, and DSA and the extract was analyzed for metals. The sample identification, sample depth, and metal concentrations detected in the soil samples and sample extracts are presented on the table below.

Sample ID	Sample Depth (ft bgs)	Compound	Soil Concentration (mg/kg)	Extract Concentration (mg/L)
28E-SB01	1.5	Aluminum	27,000	6.4
		Antimony	1.9	<0.010
		Arsenic	2.8	<0.005
		Barium	130	0.24
		Beryllium	0.64	<0.004
		Boron	<6.2	<0.05
		Cadmium	<0.62	<0.005
		Chromium	58	0.0074
		Cobalt	15	0.0077
		Copper	33	0.015
		Lead	8.7	0.0087
		Lithium	7.7	<0.05
		Manganese	650	0.54

Sample ID	Sample Depth (ft bgs)	Compound	Soil Concentration (mg/kg)	Extract Concentration (mg/L)
		Molybdenum	1.6	0.0023
		Nickel	33	0.007
		Selenium	<2.5	<0.01
		Silver	<1.2	<0.01
		Strontium	23	0.039
		Thallium	<6.2	<0.01
		Titanium	820	0.11
		Vanadium	83	0.032
		Zinc	43	0.046
28E-SB01	47	Manganese	1,500	0.94
		Thallium	2.8	<0.001
		Titanium	1,200	0.33
59E-SB02	10.5	Aluminum	48,000	2.9
		Antimony	1.9	<0.010
		Arsenic	<2.8	<0.005
		Barium	160	0.17
		Beryllium	1.1	<0.004
		Boron	<6.9	<0.05
		Cadmium	<0.69	<0.005
		Chromium	30	0.003
		Cobalt	15	0.0041
		Copper	32	0.015
		Lead	6.8	0.0062
		Lithium	3.8	<0.05
		Manganese	380	0.24
		Molybdenum	<2.8	0.0022
		Nickel	53	0.004
		Selenium	<2.8	<0.01
		Silver	<1.4	<0.01
		Strontium	44	0.044
		Thallium	1.2	<0.01
		Titanium	1,500	0.024
		Vanadium	94	0.034
		Zinc	66	0.05
59E-SB02	35	Manganese	1,400	0.25
		Titanium	2,400	0.24
DSA-SB01	5	Arsenic	6.6	<0.001
DSA-SB01	43	Manganese	5,000	5.0
		Titanium	1,900	0.73

mg/L = Milligrams per liter

Summary of Investigation and Results – Geotechnical Parameters

A total of 37 soil samples were collected from within the Line 02 Area, including the source areas in the DSA, for geotechnical analyses. The results of the geotechnical analyses for moisture content, wet density, dry density, specific gravity, porosity, sieve analysis, and/or permeability are summarized on Table 5.1-6.

The geotechnical data will be used in the risk assessment to develop site-specific soil input parameters (moisture content, water-filled porosity, air-filled porosity, etc.) for fate and transport models and in the Feasibility Study (FS) to assess potential remedial actions such as vapor extraction. Fate and transport models are used in risk assessment to quantitatively evaluate the migration of volatile organics into outdoor and indoor air and the potential leaching of chemicals through soil and into groundwater.

5.1.5 Discussion of Investigation Results with Respect to Data Quality Objectives – Drum Storage Area

The analytical results presented in the previous sections identified the following chemical constituents in soil vapor and soil at the source areas within the DSA Area at concentrations above their respective RISLs and/or PGW SSLs:

Soil vapor: Benzene, carbon tetrachloride, chloroform, 1,2-DCA, cis-1,2-DCE, PCE, and TCE.

Soil: Aluminum, beryllium, manganese, nickel, thallium, perchlorate, and NDMA.

The presence of these COPCs in each source area is discussed below with respect to the data needs described in Section 5.1.3.3. Specifically,

- Has the investigation resulted in sufficient characterization of the lateral and vertical distribution of each COPC in the vadose zone and identified a potential source for those COPCs?
- Has the investigation resulted in sufficient data to evaluate the potential for COPCs in soil to migrate into and degrade surface water and groundwater quality?
- Has the investigation resulted in data sufficient to support human health and ecological risk assessments and fate and transport modeling?
- Has the investigation resulted in sufficient data to evaluate the feasibility of remediating the identified compounds and concentrations to levels that do not pose a risk to human and ecological receptors or degrade surface water and groundwater quality?

For the purpose of this discussion, it is assumed that chemicals detected at concentrations above their RISL could potentially pose a risk to human

health and chemicals detected above their PGW SSL could potentially migrate into groundwater or surface water. Sampling locations where VOCs, metals, and other non-VOCs (SVOCs, PCBs, perchlorate, NDMA, TPH-D, and TPH-Mo) were detected in surface and/or subsurface soil at concentrations above their respective PGW SSLs are shown in Figures 5.1-6, 5.1-10, 5.1-12, and 5.1-14.

The analytical results for surface water and groundwater within the WLLO Area are discussed in Sections 5.6 and 5.7, respectively and discussed with respect to potential soil and soil vapor sources in the DSA. Additionally, the potential for chemicals in soil and soil vapor to migrate into surface water and groundwater is further evaluated in Section 8 of the *Human Health Ecological Risk Assessment* (HHERA) (Volume II).

5.1.5.1 *Volatile Organic Compounds*

VOCs detected in soil vapor samples collected from the source areas comprising the DSA are summarized in Section 5.1.4.3. PCE, TCE, chloroform, and TVOC concentrations in the shallow, intermediate, and deep intervals above their RISLs are shown in Figure 5.1-5a. TVOC concentrations greater than the RISLs are also shown in Figure 5.1-5b. PCE, TCE, chloroform, and TVOC concentrations in the shallow, intermediate, and deep intervals above their PGW SSLs are shown in Figure 5.1-6.

Benzene, Carbon Tet, chloroform, 1,2-DCA, cis-1,2-DCE, PCE, and TCE were detected in at least one soil vapor sample collected in the DSA at concentrations above their RISLs or PGW SSLs. TCE and chloroform were the VOCs most commonly detected at concentrations above their RISLs. Benzene and TCE were the VOCs most commonly detected at concentrations above their PGW SSLs. The presence of benzene, chloroform, TCE, and PCE in soil vapor in the DSA with respect to potential sources and completeness of characterization are discussed below. VOCs are discussed in the order of their prevalence and concentrations in soil vapor. VOCs associated with the degradation of PCE and TCE (1,1-dichloroethene [1,1-DCE], cis-1,2-DCE, and trans-1,2-dichloroethene [trans-1,2-DCE]) and compounds detected at only one or two locations (Carbon Tet and 1,2-DCA) are not included in this discussion.

Benzene

Although benzene at concentrations above its RISL and/or PGW SSL was detected in the shallow, intermediate, deep, and/or or very deep intervals at 14 locations designated with the prefix DSA, only one (DSA-SP08) sample was specifically collected from within the DSA. The other 12 locations (see table below) where benzene at concentrations above its RISL and/or PGW SSL was detected are located in Area 00, in an open field west of the DSA, or in an open field east of the Main Line 02 Area, outside the boundary of the BOU.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
28E-SP17	10	Benzene	84	35	40	N	Y
28E-SP19	20	Benzene	84	35	37	N	Y
DSA-SP08	20	Benzene	84	35	45	N	Y
DSA-SP10	10	Benzene	84	35	77	N	Y
	20				110	Y	Y
DSA-SP13	10	Benzene	84	35	130	Y	Y
	20				40	N	Y
DSA-SP18	10	Benzene	84	35	56	N	Y
	20				170	Y	Y
DSA-SP19	10	Benzene			81	N	Y
DSA-SP20	20	Benzene	84	35	190	Y	Y
DSA-SP22	10	Benzene	84	35	59	N	Y
DSA-SP24	10	Benzene	84	35	48	N	Y
	20				78	N	Y
	30				140	Y	Y
DSA-SP26	10	Benzene	84	35	58	N	Y
	20				280	Y	Y
DSA-SP30	20	Benzene	84	35	66	N	Y
DSA-SP31	10	Benzene	84	35	62	N	Y
	20				40	N	Y
DSA-SP32	20	Benzene	84	35	290	Y	Y

Detections of benzene at concentrations above its RISL and/or PGW SSL in the Line 02 Area appear to be isolated and sporadic, with locations having benzene above its RISL and/or PGW SSL surrounded by locations containing benzene at concentrations less than its RISL and/or PGW SSL. As previously noted, the majority of the locations where benzene was detected above its RISL and/or PGW SSL were in Area 00 and outside the boundary of the BOU. The configuration of the benzene detections suggest that the presence of that compound in soil vapor is due to migration from groundwater.

Trichloroethene and Tetrachloroethene

- TCE was the predominant VOC detected in the vadose zone within the DSA. The highest TCE concentrations (up to 10,000,000 µg/m^3) in shallow, intermediate, and deep soil vapor were detected at location 28E-SP16 (Figure 5.1-5a), which is immediately adjacent to the former location of the concrete-lined and unlined sump and ponds comprising Source Area 28E.
- As indicated in Figure 5.1-5a, TCE concentrations in soil vapor in the shallow, intermediate, and deep layers radiate laterally outward from the former location of the sump and ponds at Source Area 28E. The figure also shows that concentrations of TCE in soil vapor above its RISL originating from Source Area 28E has migrated towards the east and commingled with TCE and other VOCs originating from source areas within the Main Line 02 Area (Sections 5.2.4.3 and 5.2.5.1). The presence of thick brush and trees prohibited completion of the lateral extent of TCE in soil vapor north of the ponds at Source Area 28E. In general, the lateral extent of TCE concentrations in soil vapor above its RISL appears to increase with depth, with increased commingling and expansion in the intermediate and deep intervals (Figure 5.1-5a) encompassing an area of roughly 40 acres within the Line 02 Region.
- TCE at concentrations above its PGW SSL in the shallow, intermediate, and deep intervals generally correspond to those locations having TCE above its RISL. TCE above its PGW SSL, but below its RISL, was detected in the shallow interval at location DSA-SP06 and the intermediate layer at location DSA-SP08.
- TCE was detected at concentrations above its 1 percent vapor saturation concentration (4,877,690 µg/m^3) and potentially indicative of the presence of residual product in the shallow interval at only one location (28E-SP16) at Source Area 28E. As discussed in Section 5.7.2, TCE was not detected in groundwater in the Line 02 Area at concentrations indicative of the presence of residual product. However, the data suggest that TCE in the vadose zone at Source Area 28E may have contributed to the concentrations of TCE in groundwater in that area.
- PCE was detected at concentrations above its RISL and PGW SSL in the shallow, intermediate, and/or deep soil vapor intervals at only three locations (28E-SP16, 59E-SP09, and DSA-SP04). The maximum concentration of PCE at 800,000 µg/m^3 was detected in the shallow soil vapor at location 28E-SP16. The maximum concentration of PCE is less

than 1 percent of its vapor saturation concentration and therefore not indicative of the presence of nonaqueous-phase liquids (NAPL).

- PCE at concentrations above its PGW SSL in the shallow, intermediate, and deep intervals correspond to those locations having PCE or other VOCs at concentrations above their RISL.
- The data show that PCE is also present at the same locations as TCE, but at significantly less concentrations, which indicate that these two VOCs likely originated from the same source (Source Area 28E).
- As shown in Figure 5.1-5a and 5.1-5b, the presence of VOCs in soil vapor within the DSA are most attributed to releases associated with the various features. However, as will be discussed in Section 5.7.2, VOCs present in the FWBZ could also be contributing VOCs to the soil vapor.

As indicated by the TVOC concentrations illustrated in Figures 5.1-5a and 5.1-5b, the lateral extent of TCE and PCE in the vadose zone beneath the DSA has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

<u>Chloroform</u>

- Chloroform was the second most predominant and widely distributed VOC in soil vapor within the DSA at concentrations above its RISL. The concentration plots shown in Figure 5.1-5a, the highest chloroform concentrations (up to 1,600 $\mu g/m^3$) were detected in the deep soil vapor interval at location 28E-SP16 immediately adjacent to the former location of the concrete-lined and unlined sump and ponds (Source Area 28E). The maximum concentration of chloroform is less than 1 percent of its vapor saturation concentrations and, therefore, not indicative of the presence of NAPL.
- Soil vapor samples collected from the shallow, intermediate, and deep intervals at location 28E-SP16 also contained the highest concentrations of TCE and PCE. The presence of TCE, PCE, and chloroform at their maximum detected concentrations at that location indicates that these VOCs originated from the same source (Source Area 28E).
- As illustrated by the concentration plots shown in Figure 5.1-5a, the lateral extent of chloroform at concentrations above its RISL in soil vapor in the shallow, intermediate, and deep layers generally coincide with the lateral extent of TCE. As previously discussed, the lateral extent of VOCs, including chloroform, north of the ponds at Source

Area 28E could not be completely characterized due to the presence of thick brush and trees. As with TCE, the lateral extent of chloroform in soil vapor above its RISL increases with depth becoming commingled with VOC soil vapor plumes potentially originating in the Main Line 02 Area.

The vertical extent of chloroform has been characterized to first groundwater at multiple locations in the DSA. As indicated by the TVOC concentrations illustrated in Figures 5.1-5a and 5.1-5b, the lateral extent of chloroform in the vadose zone beneath the DSA has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

5.1.5.2 Metals

Aluminum, beryllium, manganese, nickel, and thallium were detected at concentrations above background and their respective RISLs and/or PGW SSLs in soil samples collected at seven (28E-SB01, 28E-SB02, 59E-SB02, 59E-SB03, 59E-SB04, DSA-SB01, and DSA-SB04) locations within the DSA (Section 5.1.4.3 and Figures 5.1-9 and 5.1-10). The presence of those metals at each of the seven locations with respect to the completeness of characterization, both laterally and vertically, and potential sources are discussed below.

<u>28E-SB01 and 28E-SB02</u>

Aluminum, nickel, manganese, and/or thallium at concentrations above their RISLs and/or revised PGW SSLs were detected only in soil samples collected at depths greater than 11 feet bgs from borings 28E-SB01 and 28E-SB02. These borings are adjacent to the unlined pond at Source Area 28E (Figures 5.1-9 and 5.1-10).

- Aluminum at 53,000 mg/kg was detected in a soil sample collected at 35 feet bgs from boring 28E-SB02. The detected concentration is below its RISL, but above its revised PGW SSL of 43,000 mg/kg. The absence of that metal above its PGW SSL in soil samples collected from borings 28E-SB01 and 28E-SB03 indicate that the lateral extent is limited to the area near the unlined pond. The vertical extent of aluminum at that location is defined by the absence of that metal above its PGW SSL in subsurface soil samples collected at 1, 5, 11, 23, 47, and 59 feet bgs in boring 28E-SB02 and in subsurface soil samples collected from borings 28E-SB01 and 28E-SB03. Based on the absence of aluminum at concentrations above its PGW SSL in soil samples collected from

surrounding borings and in samples collected at depths below 35 feet bgs in boring 28E-SB02, the detected concentration of aluminum is likely to be naturally occurring.

- Nickel at 130 mg/kg, below its RISL but above its revised PGW SSL, was detected in a sample collected at 11.5 feet bgs from boring 28E-SB01. The lateral extent of nickel was defined to its PGW SSL of 730 mg/kg established in the BOU FSP. However, the lateral extent is also defined to its revised PGW SSL of 120 mg/kg by the absence of nickel above its revised PGW SSL in soil samples collected from borings 28E-SB02 and 28E-SB03. The vertical extent of nickel is defined by the absence of that metal above its revised PGW SSL in soil samples collected at 35 and 47 feet bgs from boring 28E-SB01 and in samples collected at 11, 23, 35, 47 feet bgs from boring 28E-SB02. Based on the absence of nickel at concentrations above its PGW SSL in soil samples collected from surrounding borings and in samples collected at depths below 35 feet bgs in boring 28E-SB02, the detected concentration of nickel appears to be naturally occurring.
- Manganese at concentrations below its RISL, but above its revised PGW SSL, was detected in soil samples collected at 35 and 47 feet bgs in boring 28E-SB01 and at 35 and 59 feet bgs in boring 28E-SB02. Additionally, the detected concentration of manganese detected in the sample collected at 35 feet bgs from boring 28E-SB02 was above its RISL. The presence of manganese at concentrations greater than its revised PGW SSL of 1,100 mg/kg only in soil samples collected from borings 28E-SB01 and 28E-SB02 at depths below 30 feet bgs and the absence of manganese at concentrations greater than 740 mg/kg in samples collected from boring 28E-SB03 indicates that the detected concentrations are naturally occurring.
- Thallium at a concentration above its RISL and PGW SSL was detected in a soil sample collected at 35 feet bgs from boring 28E-SB02 and at concentrations below its RISL, but above its PGW SSL in soil samples collected at 11.5 and 47 feet bgs from boring 28E-SB01. The vertical extent of thallium in boring 28E-SB01 is defined by the absence of that metal above its PGW SSL in a soil sample collected at 59 feet bgs. The vertical extent of thallium in boring 28E-SB02 is defined by the absence of that metal above its PGW SSL in soil samples collected at 47 and 59 feet bgs. The detections of thallium above its RISL and/or PGW SSL in soil samples collected at varying depths from borings within 15 feet of the other suggests that the detections of thallium are random and likely to be naturally occurring and not due to historical activities.

59E-SB02

Metals at concentrations above their RISLs were not detected in the soil samples collected from boring 59E-SB02. Boring 59E-SB02 is in a low-lying area adjacent to Buffalo Creek in the southern portion of Source Area 59E (Figure 5.1-10).

Aluminum above its PGW SSL was detected in a soil sample collected at 10.5 feet bgs and manganese above its PGW SSL was detected in a soil sample collected at 35 feet bgs from boring 59E-SB02. It should be noted that while the detected concentrations of aluminum and manganese in the samples exceed their PGW SSLs for Redding Corning-Red Bluff soil of 43,000 and 1,400 mg/kg, respectively, the concentrations are below their PGW SSLs for Xerorthent soil of 54,000 and 1,500 mg/kg, respectively. Boring 59E-SB02 is located along the boundary between Redding Corning-Red Bluff and Xerorthents and, therefore, the detected concentrations of aluminum and manganese may be indicative of Xerorthents.

59E-SB03

Thallium below its RISL, but above its PGW SSL, was detected in soil samples collected at 2 and 11 feet bgs from boring 59E-SB03. Aluminum above its RISL and PGW SSL and nickel above its PGW SSL were also detected in the soil sample collected at 11 feet bgs from boring 59E-SB03. Boring 59E-SB03 is in a low-lying area adjacent to Buffalo Creek in the central portion of Source Area 59E (Figures 5.1-9 and 5.1-10).

- The lateral extent of aluminum above its RISL is defined by the absence of that metal above its RISL in soil samples collected from borings 59E-SB02 and 59E-SB04. The lateral extent aluminum, nickel, and thallium above their PGW SSLs is defined by the absence of those metals above their PGW SSLs in soil samples collected from Stage 1 RI boring 59E-SB01 and BOU RI boring 59E-SB02.
- The vertical extent of aluminum above its RISL and PGW SSL and nickel and thallium above their PGW SSLs was not defined below a depth of 11 feet bgs. The potential threat to groundwater posed by the detected concentrations of aluminum, nickel, and thallium are further evaluated in Section 8 of the HHERA (Volume II).

59E-SB04

Metals at concentrations above their respective RISLs were not detected in the soil samples collected from boring 59E-SB04. Aluminum and

manganese above their PGW SSLs were detected in a soil sample collected at 2.5 feet bgs and nickel and thallium were detected in a soil sample collected at 11 feet bgs from boring 59E-SB04 (Figure 5.1-10).

- The lateral extent of aluminum and manganese is defined by the absence of those metals above their PGW SSLs in soil samples collected at depths less than 5 feet bgs from borings 59E-SB02 and 59E-SB03. The lateral extent of nickel and thallium is defined by the absence of those metals above their PGW SSLs in soil samples collected from boring 59E-SB02.
- The vertical extent of aluminum and manganese is defined by the absence of those metals above their PGW SSLs in soil samples collected at 6 and 11 feet bgs from boring 59E-SB04.
- The vertical extent of nickel and thallium above their revised PGW SSLs was not defined below a depth of 11 feet bgs. The potential threat to groundwater posed by the detected concentrations of nickel and thallium are further evaluated in Section 8 of the HHERA (Volume II).

DSA-SB01

Aluminum above its PGW SSL and manganese above its RISL and/or PGW SSL were detected in soil samples collected at 20, 33, and 43 feet bgs from boring DSA-SB01. Boring DSA-SB01 is in the central portion of the former DSA (Figures 5.1-9 and 5.1-10).

- The lateral extent of these metals is defined by the absence of those metals above their respective RISLs and PGW SSLs in soil samples collected from borings DSA-SB02, DSA-SB03, and DSA-SB04.
- The vertical extent of aluminum is defined by the absence of that metal above its PGW SSL in soil samples collected at 43, 53, and 63 feet bgs from boring DSA-SB01. The vertical extent of manganese is defined by the absence of that metal above its RISL and PGW SSL in soil samples collected at 53 and 63 feet bgs from boring DSA-SB01.

DSA-SB04

Metals at concentrations above their respective RISLs were not detected in soil samples collected from boring DSA-SB04. Boring DSA-SB04 is near the septic tank (L2-ST28) associated with Building 02028 (Figure 5.1-9).

Thallium above its PGW SSL was detected in a soil sample collected at 5 feet bgs from boring DSA-SB04. The lateral extent of thallium is defined

by the absence of that metal above its PGW SSL in soil samples collected from borings DSA-SB01, DSA-SB02, and L2-ST28-90-SB01 (Figure 5.1-10). The vertical extent of thallium is defined by the absence of that metal above its PGW SSL in soil samples collected at 11 feet bgs from boring DSA-SB04.

Based on the information presented above, the lateral and vertical extent of aluminum, beryllium, manganese, nickel, and thallium at source areas within the DSA has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives. Additional evaluation of the potential risk to groundwater posed by those metals in soil is presented in Section 8 of the HHERA (Volume II).

5.1.5.3 *Perchlorate*

Perchlorate detected at concentrations above its RISL and/or PGW SSL in soil at Source Areas 28E, 59E, and DSA within the DSA are summarized in Section 5.1.4.3 and shown in Figures 5.1-13 and 5.1-14.

Perchlorate above its RISL was detected in only one soil sample collected at one location at Source Area 28E. Perchlorate above its PGW SSL, however, was detected in 3 surface/near-surface soil samples and 32 subsurface soil samples collected at 10 locations at Source Areas 28E and DSA. The presence of perchlorate at the 10 locations and conclusions regarding the characterization of perchlorate based on the data presented on the table and figures are summarized below.

<u>28E-SB01, 28E-SB02, 28E-SB03, 28E-SB04, 28E-SB05, 28E-SB06, and 28E-SB07</u>

As shown in Figures 5.1-13 and 5.1-14, perchlorate concentrations above its RISL and/or PGW SSL was detected in surface and/or subsurface soil samples collected from seven borings (28E-SB01, 28E-SB02, 28E-SB03, 28E-SB04, 28E-SB05, 28E-SB06, and 28E-SB07) within and adjacent to the former location of the lined and unlined ponds at Source Area 28E.

- The most likely source of perchlorate is the discharge of wash water from historical cleaning of drums at Source Area 38E containing minor quantities of ammonium perchlorate.
- Perchlorate above its RISL of 7,800 µg/kg was detected in only one subsurface soil sample collected at a depth of 40 feet bgs from boring 28E-SB07. The lateral extent of perchlorate above its RISL to the north,

east, and south is defined by the absence of that compound above its RISL in subsurface soil samples collected from borings 28E-SB04, 28E-SB05, and 28E-SB06. Characterization of perchlorate to the west of boring 28E-SB07 was precluded by the presence of a steep slope along the edge of the Buffalo Creek Cutoff channel.

- Perchlorate above its revised PGW SSL of 60 µg/kg was detected in near-surface (1 foot bgs) samples collected from two (28E-SB05 and 28E-SB06) borings and in 27 subsurface soil samples collected from 7 (28E-SB01, 28E-SB02, 28E-SB03, 28E-SB04, 28E-SB05, 28E-SB06, and 28E-SB07) borings. As shown in Figure 5.1-14, the lateral extent of perchlorate in the area of the lined and unlined pond could not be completely characterized due to the presence of a steep slope to the west and thick brush and vegetation to the north. However, perchlorate concentrations were characterized to the PGW SSL of 3,650 µg/kg proposed in the BOU FSP. The results of the groundwater RI (Section 5.7.2) indicate that the ponds are a source of perchlorate to the perched and unconfined groundwater in the Line 02 Area. The potential threat to groundwater posed by perchlorate in soil within and adjacent to the former locations of the lined and unlined ponds at Source Area 28E is further evaluated in Section 8 of the HHERA (Volume II).

<u>59E-SB02</u>

Perchlorate at 85 µg/kg, above its revised PGW SSL of 60 µg/kg, was detected in a soil sample collected at 35 feet bgs from boring 59E-SB02, in a low-lying area adjacent to Buffalo Creek in the southern portion of Source Area 59E (Figure 5.1-14). Perchlorate was also detected in soil samples collected at 10.5 and 23 feet bgs from boring 59E-SB02, but at concentrations (7.9 and 10 µg/kg) significantly less than its PGW SSL. The lateral extent of perchlorate at this location is defined by the absence of that compound above its RISL and the PGW SSL proposed in the BOU FSP in soil samples collected from Stage 1 RI boring 59E-SB01 and BOU RI borings 59E-SB03 and 59E-SB04.

The presence of perchlorate in the soil sample collected at 35 feet bgs could potentially be attributed to the presence of perchlorate in the perched groundwater in the Line 02 Area (Section 5.7.2). However, the presence of low concentrations of perchlorate in soil samples collected at 10.5 and 23 feet bgs suggests that perchlorate has migrated into the soil from the surface at this location. The potential threat to groundwater

posed by perchlorate detected in soil from boring 59E-SB02 is further evaluated in Section 8 of the HHERA (Volume II).

DSA-SB01

Perchlorate at concentrations above its PGW SSL of 60 µg/kg was detected in subsurface soil samples collected at 20, 33, and 43 feet bgs from boring DSA-SB01 in the central portion of the former DSA (Figure 5.1-14). The lateral extent of perchlorate was characterized to the PGW SSL of 3,650 µg/kg proposed in the BOU FSP, but not to the revised PGW SSL of 60 µg/kg. The vertical extent of perchlorate is defined by the absence of perchlorate above the PGW SSL of 60 µg/kg in soil samples collected at 53 and 63 feet bgs from boring DSA-SB01.

Although perchlorate ranging from 10 to 59 µg/kg was detected in soil samples collected between 1 and 12 feet bgs from borings DSA-SB01, DSA-SB02, and DSA-SB03, the detected concentrations appear too low to be indicative of the movement of perchlorate through the soil column that would result in the presence of perchlorate up to 800 µg/kg at 20 feet bgs.

L2-ST28-90-SB01

Perchlorate at concentrations above its PGW SSL of 60 µg/kg was detected in soil samples collected at 2.5 and 4.5 feet bgs from boring L2-ST28-90-SB01 near the septic tank associated with Building 02028 (Figure 5.1-14). The lateral and vertical extent of perchlorate was defined to its PGW SSL presented in the agency approved FSP. The potential threat to groundwater posed by perchlorate detected in soil from boring L2-ST28-90-SB01 is further evaluated in Section 8 of the HHERA (Volume II).

Based on the information presented above, the lateral and vertical extent of perchlorate at source areas in the DSA has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

5.1.5.4 *N-Nitrosodimethylamine*

NDMA was not detected at concentrations above its RISL in any soil samples collected in Source Areas 28E, 59E, and DSA.

NDMA at concentrations above its revised PGW SSL of 0.03 µg/kg was detected in a subsurface soil sample collected at one location (28E-SB02) in

Source Area 28E and one subsurface soil sample collected at one location (59E-SB02) in Source Area 59E. The presence of NDMA at the two locations and conclusions regarding the characterization of perchlorate based on the data presented on the table and figures are summarized below.

28E-SB02

NDMA at an estimated concentration of 1.3 µg/kg was detected in a sample collected at 35 feet bgs from boring 28E-SB02 adjacent to the unlined pond at Source Area 28E (Figure 5.1-14). The lateral extent of NDMA at that location was defined to the PGW SSL of 1.3 µg/kg proposed in the BOU FSP. NDMA was not detected at concentrations above the PQL in samples collected at 1, 5, 11, 23, 47, and 59 feet bgs from boring 28E-SB02.

59E-SB02

NDMA at an estimated concentration of 0.21 µg/kg was detected in a soil sample collected at 23 feet bgs from boring 59E-SB02 (Figure 5.1-14). The lateral extent of NDMA at that location was defined to the PGW SSL of 1.3 µg/kg proposed in the BOU FSP. NDMA was not detected at concentrations above the PQL in samples collected at 2, 5, 10.5, and 35 feet bgs from boring 59E-SB02.

5.1.6 Main Line 02 Area – Line 02 Region

The Main Line 02 Area consists of Source Areas 29E, E(d), E(e), E(m), and E(n). Additionally, the Main Line 02 Area also includes various features such as sumps, drainage ditches, tanks, and septic tanks associated with the source areas. As previously discussed, step-out sampling conducted to characterize the extent of VOCs detected in the vadose zone within the Line 02 Region also encompassed source areas in Area 00. Area 00 is not, however, within the boundaries of the BOU RI and, therefore, DQOs and a sampling design for the investigation of source areas within Area 00 were not included in the BOU FSP. Therefore, source areas within Area 00 are not identified or described in this report except where data indicate the presence of a source of VOCs unrelated to source areas within the Main Line 02 Area.

5.1.6.1 *Description of Source Areas – Main Line 02 Area*

The source areas in the Main Line 02 Area and various site features that may have contributed chemicals to soil and/or groundwater are described below and shown in Figure 5.1-1. Site features were identified based on historic soil, soil vapor, and groundwater analytical data; and/or visual inspection and limited data coverage.

Source Area 29E

Source Area 29E consists of a former pond located approximately 40 feet north of Building 02024 (Crawford Bomb Station). The pond was filled in, and a covered storage structure exists at the site. The surface area of the pond was approximately 1,600 square feet. Propellants were handled at Building 02024, and wastewater potentially containing solvents, perchlorate, and beryllium was directed to the pond through a concrete-lined trough. The *Industrial and Domestic Waste Control Report No. LRP 216* identified approximately 200 gallons per day of neutral industrial wastewater was sent to the pond (Aerojet, 1961). Beryllium waste was deposited in a 4- by 4- by 4-foot concrete sump located behind Building 02024. The sump was backfilled in 1979 or 1980.

Additionally, a 1,000-gallon septic tank, L2-ST24 and associated leach line, a drainage ditch west of E(m) receiving runoff from Source Area 29E, and three potholes that are located south of former Building 02026 are included with the investigation in this source area. L2-ST24 was connected to both Buildings 02026 and 02024. At some point, according to Aerojet's internal Septic Tank Inventory 6104-04, L2-ST24 was disconnected from former Building 02026.

Features associated with Source Area 29E that could have contributed to chemicals in soil include the former concrete sump at Building 02024 including a concrete lined trough, low-lying area beneath the concrete lined trough, former unlined pond, discharge end along with corrugated pipe near the former unlined pond, and areas receiving runoff from Buildings 02021, 02022, and 02023 (Figure 5.1-1).

Source Areas E(d) and E(e)

Source Areas E(d) and E(e) are next to Building 02020, identified as an oxidizer grind station. Source Area E(d) was identified as the drainage area from Building 02020. Source Area E(e) was identified as a pit inside Building 02020; however, no pit was identified during site visits.

Historical facility drawings from 1952 indicate that a dry well was located within the building. According to the facility drawings, Building 02020 was constructed with multiple levels and drainage from all levels was directed to the area of the dry well. Wastewater from Building 02020 may have reached the soils at Source Areas E(d) and E(e).

RCRA Unit T, a 10,500-gallon, hazardous waste tank with concrete secondary containment was formerly located north of Building 02030. RCRA T was certified as closed by DTSC in April 2006 following the removal and management of all hazardous waste and hazardous waste residue within the unit, cutting up and removal of the waste tank and associated piping, and decontamination of the sump and secondary containment features (DTSC, April 2006a).

Source Areas E(m) and E(n)

Source Area E(m) is identified as the 1,100-gallon septic tank L2-ST26 and associated leach line, located north of former Building 02026, and the 1,000-gallon septic tank L2-ST24 and associated leach lines. Although septic tank L2-ST24 and associated leach lines are identified as part of Source Area E(m), due to proximity, it is discussed with potential Source Area 29E. Building 02026 is identified as a solid rocket plant/industrial relation's office building. No known chemical or production processes occurred within Building 02026.

Source Area E(n) is identified as a 3-inch industrial waste line from former Building 02025 that discharged to a low-lying area east of the former building. Former Building 02025 is identified as a solid rocket plant office building. No known chemical or production processes occurred within Building 02025. In addition, it was noted during site walks in 2003 that drainage swales originating at Buildings 02021, 02022, and 02023 were directed to the low-lying area, Source Area E(n). Buildings 02021, 020222, and 02023 were identified as a process engineering laboratory and two mechanical property laboratories, respectively. Small quantities of miscellaneous chemicals were handled and were typically collected for disposal.

5.1.7 Summary and Results of Previous (Pre-2005) Vadose Zone Investigations – Main Line 02 Area

The following subsections summarize the scope and results of previous (prior to 2005) vadose zone investigations of the five source areas and septic systems that comprise the Main Line 02 Area, identify COPCs based

on the previous investigations, and discuss the DQOs and sampling proposed in the BOU FSP (Aerojet et al., 2006b).

5.1.7.1 *Summary of Previous (Pre-2005) Vadose Zone Investigations – Main Line 02 Area*

Soil samples from five soil borings and 12 soil vapor samples were collected in the vicinity of Source Areas 29E, E(d), E(e), E(m), and E(n) between 1984 and 2002. Soil vapor samples were analyzed for VOCs. Soil samples were analyzed for VOCs, SVOCs, perchlorate, PCBs, TPH, pesticides, and/or metals. Previous investigations of those source areas are summarized below. The purpose of the previous investigations is discussed in Section 2.7.

Source Area 29E

Previous vadose zone investigations were conducted at Source Area 29E in 1984, April 1992, and August 1993. The scope of those investigations is summarized below:

- 1984 – A soil sample was collected at 6 feet bgs from one boring and analyzed for VOCs.
- April 1992 – Soil vapor samples were collected at a depth of 10 feet bgs at three locations in Line 02 during the Stage 1 RI and analyzed for select VOCs.
- August 1993 – Soil samples were collected from two borings at depths ranging from 1 to 40 feet bgs and analyzed for SVOCs. Soil samples were also collected at 1 and 3 feet bgs from a boring (29E-SB01) adjacent to the beryllium sump during the Stage 1 RI and analyzed for beryllium. Beryllium was not detected (less than 0.5 mg/kg) in either sample. These data were not discussed in the FSP. Soil vapor samples were collected at 30 and 39 feet bgs at one location and analyzed for VOCs.

Source Areas E(d) and E(e)

- Soil samples were collected at depths between 1 and 40 feet bgs from three soil borings at Source Areas E(d) and E(e) in August 1993. The samples were analyzed for VOCs, perchlorate, pesticides, and PCBs.

Source Area E(m) and E(n)

Previous vadose zone investigations were conducted at Source Areas E(m) and E(n) in April 1992 and 2002. The scope of those investigations is outlined below:

- April 1992 – Soil vapor samples were collected at a depth of 10 feet bgs at four locations and analyzed for VOCs.
- 2002 – Soil vapor samples were collected at three locations from a depth of 10 feet bgs and analyzed for VOCs.

5.1.7.2 *Results of Previous (Pre-2005) Vadose Zone Investigation Results – Main Line 02 Area*

The results of the previous (prior to 2005) investigations of Source Areas 29E, E(d), E(e), E(m), and E(n), as presented in the BOU FSP (Aerojet et al., 2006b), are summarized below.

Review of the previous data identified the following COPCs in soil and/or soil vapor within one of the source areas in the Main Line 02 Area:

- **Soil –** VOCs, SVOCs, NDMA, metals (including hexavalent chromium), PCBs, pesticides, perchlorate, and TPH.
- **Soil Vapor –** VOCs.

Figures showing previous sampling locations in the source areas within the Main Line 02 Area and chemical groups detected in soil samples collected between 1991 and 2005 above human health and ecological screening levels were presented in the BOU FSP (Aerojet et al., 2006b). The FSP also presented a summary of statistics and the sample results for chemicals detected in soil, soil vapor, and groundwater that exceed human health and ecological screening levels in the Main Line 02 source areas.

Pre-2000 (1991 to 1999) soil vapor sampling locations and associated TVOC plumes are shown in Appendix E. PCE, TCE, DCE, and Freon 113 plumes based on the pre-2000 soil vapor sampling data are shown in Appendix E. Pre-2005 soil sampling locations within Line 02 Area are shown in Appendix E. Metals, SVOCs, PCBs, perchlorate, and TPH above their RISLs or PGW SSLs in pre-2005 soil samples are shown in Appendix E.

5.1.7.3 *Summary of Data Needs – Main Line 02 Area*

Based on a review of the previous vadose zone investigation data, extensive aerial photograph research and review, and exhaustive research of historical documents, Aerojet determined that additional soil and soil vapor sampling was needed to:

- Confirm the presence of VOCs in the vadose zone within the source areas and, if present, characterize the lateral and vertical extent of VOCs in the vadose zone;
- Characterize the present lateral and vertical extent of SVOCs, metals (including hexavalent chromium), PCBs, perchlorate, TPH, NDMA, pesticides, and pH and in soil in the vadose zone at concentrations that could potentially impact human and ecological receptors;
- Evaluate the potential for chemicals in soil to migrate into and degrade surface or groundwater quality; and
- Obtain sufficient data to support fate and transport modeling, evaluate risk to human and ecological receptors, and identify and evaluate potential remedial alternatives.

It should be noted that due to the time lapse (12 years) since the Stage 1 RI was performed and the elevated laboratory reporting limits for VOCs during that investigation, the investigation of VOCs performed during the BOU RI was designed to supersede all previous soil vapor and soil VOC investigation results.

5.1.8 *Summary and Results of Boundary Operable Unit Vadose Zone Investigation – Main Line 02 Area*

The following subsections summarize the BOU investigation (2005 to 2007) of the five source areas and associated features within the Main Line 02 Area, describe deviations from the sampling proposed in the BOU FSP, describe the site-specific geology and hydrogeology, and present the results of the BOU RI. The results of the sampling with respect to the completeness of the characterization and identification of potential sources are discussed in Section 5.1.9.

5.1.8.1 *Summary of Boundary Operable Unit Vadose Zone Investigation – Main Line 02 Area*

The BOU RI of the vadose zone at Source Areas 29E, E(d), E(e), E(m), and E(n) within the Main Line 02 Area included the following activities.

Surface and Subsurface Soil Investigation

- A total of 54 primary and eight duplicate surface and/or near-surface (0 to 2.5 feet bgs) soil samples and 51 primary subsurface (2.6 to 50 feet bgs) soil samples were collected at the five source areas, various features, and septic tanks in the Main Line 02 Area. Surface and subsurface soil sampling locations are shown in Figures 5.1-2 and 5.1-3, respectively.
- Surface and/or near-surface soil samples were analyzed for SVOCs, metals (including hexavalent chromium), PCBs, perchlorate, TPH-D, TPH-Mo, NDMA, pesticides, pH, TOC, CEC, and/or geotechnical parameters. The SVOC analysis of soil samples also included an evaluation of the presence of TICs. In accordance with the BOU FSP (Aerojet et al., 2006b), sample analysis was based on the analytical results from previous investigations and, therefore, every sample was not analyzed for the full suite of constituents.
- Subsurface soil samples were analyzed for SVOCs, metals (including hexavalent chromium), PCBs, perchlorate, TPH-D, TPH-Mo, NDMA, pesticides, pH, TOC, CEC, and/or geotechnical parameters. The SVOC analysis of soil samples also included an evaluation of the presence of TICs. In accordance with the BOU FSP, sample analysis was based on the analytical results from previous investigations and, therefore, every sample was not analyzed for the full suite of constituents.
- The numbers of surface/near-surface and subsurface soil samples collected for each analysis (including QA/QC samples) at each of the five source areas, along with the corresponding methods, are provided on Tables 5.1-7 and 5.1-8.
- A cross-reference between soil sampling locations within the Main Line 02 Area and the specific features they were sited to investigate is provided on Table 5.1-9.

Soil Vapor Investigation

- A total of 53 primary and 6 duplicate soil vapor samples were collected at 22 locations in the Main Line 02 Area at depths ranging from 10 to 40 feet bgs. Soil vapor sampling locations are shown in Figure 5.1-4.
- The number of soil vapor samples (including QA/QC samples) collected at each of the five source areas, along with the analytical method, are provided on Table 5.1-3.

- A cross-reference between soil vapor sampling locations within the Main Line 02 Area and the specific features they were sited to investigate is provided on Table 5.1-9.

5.1.8.2 Deviations from Boundary Operable Unit Data Quality Objectives and Sampling Design – Main Line 02 Area

Sampling activities conducted at Source Areas 29E, E(d), E(e), E(m), and E(n) during the BOU RI were generally consistent with those proposed in the BOU FSP, with the exceptions listed on Tables 5.1-4 and 5.1-5. Sampling was performed at locations proposed in the BOU FSP and step-out sampling was performed in accordance with the procedures agreed upon with the agencies. A comparison of proposed and actual sampling activities, including sampling rationale, sample depth, and analyses, is provided on Tables 5.1-4 and 5.1-5. Soil and soil vapor sampling locations and the specific features they were sited to investigate are cross-referenced on Table 5.1-9.

5.1.8.3 Results of Boundary Operable Unit Vadose Zone Investigation – Main Line 02 Area

The results of the VOC, SVOC, metals, PCB, perchlorate, TPH-D and TPH-Mo, NDMA, pesticides, pH, TOC, CEC, DI-WET, and geotechnical analyses of samples collected during the BOU RI are summarized below. The analytical results for all soil vapor and soil samples are provided in Appendices F and G, respectively.

Summary of Investigation and Results – Volatile Organic Compounds

Based on evaluation of the existing data for the source areas comprising the Main Line 02 Area, the BOU FSP concluded that additional soil vapor sampling was needed to sufficiently characterize the nature and extent of VOCs. As indicated on Table 5.1-3 and below, 51 primary soil vapor samples were collected at Source Area 29E, E(d), E(e), E(m), and E(n) in the Main Line 02 Area and analyzed for VOCs, including TICs.

Source Area	Depth (ft bgs)	No. of Primary Samples	No. of Locations
29E	0-10	6	6
	11-20	6	6
	21-30	2	2
	>30	2	2

Source Area	Depth (ft bgs)	No. of Primary Samples	No. of Locations
E(d)	0-10	2	2
	11-20	1	1
	21-30	0	0
	>30	0	0
E(m)	0-10	6	6
	11-20	8	8
	21-30	0	0
	>30	0	0
E(n)	0-10	8	8
	11-20	8	8
	21-30	1	1
	>30	1	1

The analytical results for the soil vapor samples collected from the shallow (0 to 10 feet bgs), intermediate (11 to 20 feet bgs), deep (21 to 30 feet bgs), and very deep (greater than 30 feet bgs) intervals at Source Areas 29E, E(d), E(e), E(m), and E(n) are presented in Appendix F and summarized below. Soil vapor sampling locations in the Main Line 02 Area are shown in Figure 5.1-4. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 5.1-9.

Soil vapor sampling locations and PCE, TCE, chloroform, and TVOC concentrations above their respective RISLs or PGW SSLs in the shallow, intermediate, and deep soil vapor intervals in the Main Line 02 Area are shown in Figures 5.1-5a and 5.1-6, respectively. TVOC concentrations above the RISLs are also shown in Figure 5.1-5b. The analytical results and concentrations are presented for PCE, TCE, and chloroform because they were the VOCs most frequently detected above their screening levels in soil vapor in Line 02 Area.

The TVOC concentrations illustrated in Figures 5.1-5a and 5.1-5b represent the sum of the ratio of the concentration for each detected VOC in the sample divided by its RISL that is greater than or equal to 10. For example, if PCE at a concentration of 320 $\mu g/m^3$ and TCE at a concentration of 961 $\mu g/m^3$ were the only VOCs detected in the samples, then the sum of their respective concentrations divided by their respective RISLs of 320 and 961 $\mu g/m^3$ would be 2, or:

$$PCE = \frac{320\,\mu g/m^3}{320\,\mu g/m^3} = 1$$

$$TCE = \frac{961\,\mu g/m^3}{961\,\mu g/m^3} = 1$$

$$TVOC\ Ratio = 2$$

As agreed upon with the agencies, this line represents the extent to which soil vapor characterization would be performed during the BOU RI.

Cross-sections presenting generalized vadose zone lithology and soil vapor sampling results in the Line 02 Area are presented in Figures 5.1-7 and 5.1-8. Additional discussion of soil vapor investigation results for the Main Line 02 Area is presented in Section 5.1.9.1.

Shallow Soil Vapor (0 to 10 feet bgs) – Volatile Organic Compounds:

- Twenty-two primary and one duplicate soil vapor samples were collected from the shallow interval at 22 locations at Source Areas 29E, E(d), E(e), E(m), and E(n) within the Main Line 02 Area and analyzed for VOCs, including TICs. Soil vapor sampling locations in the Main Line 02 Area are shown in Figure 5.1-4. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 5.1-9.
- Carbon Tet, chloroform, PCE, and TCE were the only VOCs detected in the shallow soil vapor at concentrations above their respective RISLs. Shallow soil vapor samples having concentrations of those VOCs above their respective RISLs are listed on the table below. Concentrations of PCE, TCE, chloroform, and TVOCs above their RISLs are shown in Figure 5.1-5a. TVOC concentrations above the RISL are also illustrated in Figure 5.1-5b.
- Benzene, Carbon Tet, PCE, and TCE were detected in the shallow soil vapor at concentrations above their respective PGW SSLs. Shallow soil vapor samples having concentrations of those VOCs above their PGW SSLs are listed on the table below. Concentrations of PCE and TCE above their PGW SSLs are shown in Figure 5.1-6.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
29E-SP08	10	Benzene	84	35	51	N	Y
E(n)-SP04	10				76	N	Y
L2-ST26-SP05	10				83	N	Y

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
29E-SP09	10	Carbon Tet	58	195	2,200	Y	Y
29E-SP09	10	Chloroform	83	18,595	990	Y	N
29E-SP07	10	PCE	320	57	60	N	Y
E(m)-SP10	10				560	Y	Y
E(n)-SP04	10				530	Y	Y
E(n)-SP05	10				850	Y	Y
L2-ST26-SP05	10				140	N	Y
29E-SP09	10	TCE	961	527	18,000	Y	Y

Intermediate Soil Vapor (11 to 20 feet bgs) – Volatile Organic Compounds:

- Twenty-three primary and four duplicate soil vapor samples were collected from the intermediate interval at 23 locations at Source Areas 29E, E(d), E(e), E(m), and E(n) within the Main Line 02 Area and analyzed for VOCs, including TICs. Soil vapor sampling locations in the Main Line 02 Area are shown in Figure 5.1-4. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 5.1-9.
- Benzene, Carbon Tet, chloroform, PCE, and TCE were detected in the intermediate soil vapor at concentrations above their respective RISLs. Intermediate soil vapor samples having concentrations of those VOCs above their respective RISLs are listed on the table below. Concentrations of PCE, TCE, chloroform, and TVOCs above their RISLs are shown in Figure 5.1-5a. TVOC concentrations above their RISLs are also illustrated in Figure 5.1-5b.
- Benzene, Carbon Tet, PCE, and TCE were detected in the intermediate soil vapor at concentrations above their respective PGW SSLs. Intermediate soil vapor samples having concentrations of those VOCs above their PGW SSLs are listed on the table below. Concentrations of PCE and TCE above their PGW SSLs are shown in Figure 5.1-6.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
29E-SP10	20	Benzene	84	35	36	N	Y
DSA-SP08	20				45	N	Y
DSA-SP10	20				110	Y	Y
DSA-SP13	20				40	N	Y
E(d)-SP02	20				39	N	Y
E(m)-SP09	20				77	N	Y
E(n)-SP05	20				37	N	Y
L2-ST26-SP05	20				120	Y	Y

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
29E-SP09	20	Carbon Tet	58	195	7,000	Y	Y
29E-SP10	20				100	Y	N
E(m)-SP10	20				62	Y	N
29E-SP09	20	Chloroform	83	18,595	2,400	Y	N
29E-SP11	20				120	Y	N
E(n)-SP08	20				210	Y	N
E(n)-SP09	20				540	Y	N
29E-SP07	20	PCE	320	57	770	Y	Y
29E-SP08	20				1,600	Y	Y
29E-SP11	20				240	N	Y
L2-ST24-SP03	20				190	N	Y
E(m)-SP09	20				83	N	Y
E(m)-SP10	20				7,100	Y	Y
E(n)-SP05	20				2,200	Y	Y
L2-ST26-SP04	20				150	N	Y
L2-ST26-SP05	20				360	Y	Y
L2-ST26-SP06	20				330	Y	Y
29E-SP07	20	TCE	961	527	8,900	Y	Y
29E-SP08	20				62,000	Y	Y
29E-SP09	20				64,000	Y	Y
29E-SP10	20				780	N	Y
29E-SP11	20				15,000	Y	Y
E(m)-SP10	20				1,100	Y	Y
E(n)-SP05	20				1,700	Y	Y
L2-ST26-SP04	20				690	N	Y

Deep Soil Vapor (21 to 30 feet bgs) – Volatile Organic Compounds:

- Three primary and two duplicate soil vapor samples were collected from the deep interval at three locations within the Main Line 02 source areas. Soil vapor sampling locations in the Main Line 02 Area are shown in Figure 5.1-4. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 5.1-9.
- Carbon Tet, chloroform, PCE, and TCE were detected in the deep soil vapor at concentrations above their respective RISLs. Deep soil vapor samples having concentrations of those VOCs above their respective RISLs are listed on the table below. Concentrations of PCE, TCE, chloroform, and TVOCs above their RISLs are shown in Figure 5.1-5a. TVOC concentrations above the RISL are also illustrated in Figure 5.1-5b.
- Carbon Tet, PCE, and TCE were detected at concentrations above their respective PGW SSLs, as indicated on the table below. Concentrations of PCE and TCE above their PGW SSLs are shown in Figure 5.1-6.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
29E-SP09	30	Carbon Tet	58	195	280	Y	Y
29E-SP09	30	Chloroform	83	18,595	210	Y	N
E(n)-SP11	25				190	Y	N
29E-SP08	30	PCE	320	57	2,500	Y	Y
29E-SP09	30				1,400	Y	Y
29E-SP08	30	TCE	961	527	44,000	Y	Y
29E-SP09	30				23,000	Y	Y

Very Deep Soil Vapor (greater than 31 feet bgs) – Volatile Organic Compounds:

- Three very deep soil vapor samples were collected at 40 feet bgs at three locations [29E-SP08, 29E-SP09, and E(n)-SP05] within Source Area 29E. Soil vapor sampling locations are shown in Figure 5.1-4. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 5.1-9.
- Carbon Tet, chloroform, PCE, and TCE were the only VOCs detected in the very deep soil vapor at concentrations above their respective RISLs. VOC concentrations detected in the very deep soil vapor samples were included in the concentrations for the deep soil vapor (Figures 5.1-5a and 5.1-5b).
- Carbon Tet, PCE, and TCE were also detected in the very deep soil vapor samples at concentrations above their respective PGW SSLs, as indicated on the table below. VOC concentrations detected in the very deep soil vapor samples were included in the concentrations for the deep soil vapor (Figures 5.1-6).

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
29E-SP09	40	Carbon Tet	58	195	410	Y	Y
E(n)-SP05	40				77	Y	N
29E-SP09	40	Chloroform	83	18,595	260	Y	N
29E-SP08	40	PCE	320	57	3,300	Y	Y
29E-SP09	40				840	Y	Y
E(n)-SP05	40				21,000	Y	Y
29E-SP08	40	TCE	961	527	46,000	Y	Y
29E-SP09	40				18,000	Y	Y
E(n)-SP05	40				2,600	Y	Y

Summary of Investigation and Results - Metals

A total of 88 primary and 7 duplicate soil samples were collected at Source Areas 29E, E(d), E(e), E(m), and E(n) in the Main Line 02 Area during the BOU RI and analyzed for metals. Eighty-one of the 88 primary samples and two of the seven duplicate soil samples were also analyzed for mercury and three of the 88 primary samples were analyzed for hexavalent chromium. The number of primary soil samples and sampling locations at Source Areas 29E, E(d), E(e), E(m), and E(n) are summarized on Tables 5.1-7 and 5.1-8, and below. Summary statistics for the samples are also presented on Tables 5.1-7 and 5.1-8.

		Surface/Near-Surface		Subsurface	
Source Area	**Compound**	**No. of Samples**	**No. of Locations**	**No. of Samples**	**No. of Locations**
29E	Metals	17	15	16	7
	Mercury	14	12	12	7
	Hex Chrome	2	2	0	0
E(d)	Metals	6	3	0	0
	Mercury	6	3	0	0
	Hex Chrome	0	0	0	0
E(e)	Metals	5	3	4	1
	Mercury	5	3	4	1
	Hex Chrome	0	0	0	0
E(m)	Metals	8	6	12	6
	Mercury	8	6	12	6
	Hex Chrome	0	0	0	0
E(n)	Metals	11	7	9	4
	Mercury	11	7	9	4
	Hex Chrome	0	0	0	0

The results of the metals analysis of surface/near-surface and subsurface soil samples collected from the source areas [29E, E(d), E(e), E(m), and E(n)] within the Main Line 02 Area are presented in Appendix G and summarized below.

Metals detected in soil within the Line 02 Area at concentrations statistically different from background and subsequently compared to screening levels were aluminum, antimony, arsenic, beryllium, cadmium, chromium, copper, manganese, molybdenum, nickel, selenium, silver, thallium, and zinc. Because boron, hexavalent chromium, lithium, strontium, and titanium were not included in the background evaluation, concentrations of these metals were also compared to screening levels.

Surface and subsurface soil sampling locations and metals detected in soil within Source Areas 29E, E(d), E(e), E(m), and E(n) at concentrations above their respective RISLs and PGW SSLs are shown in Figures 5.1-9 and 5.1-10, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 5.1-9. Cross sections showing the generalized lithology of the vadose zone within the Main Line 02 Area are provided in Figures 5.1-7 and 5.1-8.

Surface and Near-Surface Soil – Metals:

- Forty-seven primary and six duplicate surface/near-surface soil samples were collected at 35 locations in the source areas within the Main Line 02 Area and analyzed for metals. Forty-four of the 48 primary samples and all six duplicate surface/near-surface soil samples were also analyzed for mercury and two of the 47 primary soil samples were analyzed for hexavalent chromium.
- Cadmium was the only metals detected at a concentration statistically above background and its RISLs in surface and/or near-surface soil collected within the Main Line 02 Area. The detected concentration of cadmium and the location and depth of the sample is provided on the table below and shown in Figure 5.1-9.
- Aluminum, cadmium, manganese, and thallium were detected in at least one surface and/or near-surface soil sample within the Main Line 02 Area at concentrations exceeding their respective PGW SSLs. The detected concentrations of those metals above their PGW SSLs, and the locations and depths of the samples, are listed on the table below and are shown in Figure 5.1-10.

Sample Location	Depth (ft bgs)	Metal	RISL (mg/kg)	PGW SSL (mg/kg)	Conc. (mg/kg)	> RISL	> PGW SSL
29E-SB05	2.0	Cadmium	1.7	0.72	1.2	N	Y
29E-SB09	1.0	Aluminum	76,140	43,000	47,000	N	Y
29E-SB10	1.0	Cadmium	1.7	0.72	1.2	N	Y
L2-ST24-SB01	2.0	Manganese	1,762	1,100	1,200	N	Y
L2-ST26-SB04	1.0	Thallium	5.0	2.5	2.8	N	Y
E(n)-SD01	0.25	Cadmium	1.7	0.72	0.74	N	Y
	1.5	Cadmium	1.7	0.72	0.79	N	Y
		Manganese	1,762	1,100	1,700	N	Y
E(n)-SNS01	0.5	Cadmium	1.7	0.72	3.3	Y	Y
	2.5	Cadmium	1.7	0.72	0.4	N	N
E(n)-SB01	1.0	Cadmium	1.7	0.72	0.85	N	Y
		Thallium	5.0	2.5	2.9	N	Y

Subsurface Soil – Metals:

- Forty-one primary and three duplicate subsurface soil samples were collected at 18 locations in the source areas within the Main Line 02 Area and analyzed for metals. Thirty-seven of the 41 primary samples and all three duplicate samples were also analyzed for mercury. Subsurface soil samples collected at the source areas within the Main Line 02 Area were not analyzed for hexavalent chromium. Subsurface sampling locations are shown in Figures 5.1-9 and 5.1-10.
- Manganese and thallium were the only metals detected in subsurface soil samples collected at the source areas within the Main Line 02 Area above background and their respective RISLs. Detected concentrations for those two metals and the depth and location of the samples are provided on the table below and shown in Figure 5.1-9.
- Aluminum, cadmium, manganese, and thallium were detected in subsurface soil samples at concentrations above their respective PGW SSLs. The location and depth of the subsurface samples having concentrations of those metals above PGW SSLs, and the detected concentration of those metals, are listed on the table below and shown in Figure 5.1-10.
- Metals were not detected above their respective RISLs and/or PGW SSLs in subsurface soil samples collected from borings 29E-SB10, L2-ST26-SB04, and E(n)-SB01 where metals were detected in surface/near-surface soil.

Sample Location	Depth (ft bgs)	Metal	RISL (mg/kg)	PGW SSL (mg/kg)	Conc. (mg/kg)	> RISL	> PGW SSL
29E-SB03	23	Aluminum	76,140	43,000	50,000	N	Y
	45	Thallium	5.0	2.5	2.7	N	Y
29E-SB05	6.0	Cadmium	1.7	0.72	1.2	N	Y
	11.5	Cadmium	1.7	0.72	<0.43	N	N
29E-SB09	5.0	Aluminum	76,140	43,000	45,000	N	Y
	11	Aluminum	76,140	43,000	20,000	N	N
L2-ST24-SB01	6.0	Aluminum	76,140	43,000	4,800	N	N
		Manganese	1,762	1,100	130	N	N
	11.5	Aluminum	76,140	43,000	45,000	N	Y
E(e)-SB02	11	Thallium	5.0	2.5	4.6	N	Y
	22	Aluminum	76,140	43,000	51,000	N	Y
		Manganese	1,762	1,100	4,900	Y	Y
		Thallium	5.0	2.5	5.1	Y	Y
	42	Manganese	1,762	1,100	1,300	N	Y
		Thallium	5.0	2.5	4.2	N	Y

Sample Location	Depth (ft bgs)	Metal	RISL (mg/kg)	PGW SSL (mg/kg)	Conc. (mg/kg)	> RISL	> PGW SSL
E(n)-SB03	43	Thallium	5.0	2.5	3.1	N	Y

Summary of Investigation and Results – Semivolatile Organic Compounds

A total of 84 primary and 7 duplicate soil samples were collected in Source Areas 29E, E(d), E(e), E(m), and E(n) in the Main Line 02 Area during the BOU RI and analyzed for SVOCs, including TICs. The number of primary soil samples and sampling locations at Source Areas 29E, E(d), E(e), E(m), and E(n) for SVOCs are summarized on Tables 5.1-7 and 5.1-8, and below. Summary statistics for the samples are also presented on Tables 5.1-7 and 5.1-8.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
29E	SVOCs	13	11	14	6
E(d)	SVOCs	6	3	0	0
E(e)	SVOCs	5	3	4	1
E(m)	SVOCs	14	9	12	6
E(n)	SVOCs	11	7	5	2

The results of the SVOC and SVOC TIC analyses of surface/near-surface and subsurface soil samples collected from Source Areas 29E, E(d), E(e), E(m), and E(n) within the Main Line 02 Area are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations at Source Areas 29E, E(d), E(e), E(m), and E(n) are shown in Figures 5.1-11 and 5.1-12. Soil sampling locations and the features being investigated are cross-referenced on Table 5.1-9. TICs were not identified in the SVOC analysis of surface/near-surface and subsurface soil samples collected at the source areas in the Main Line 02 Area.

Surface and Near-Surface Soil – Semivolatile Organic Compounds:

- A total of 49 primary and seven duplicate surface and/or near-surface soil samples were collected at 33 locations at Source Areas 29E, E(d), E(e), E(m), and E(n) and analyzed for SVOCs, including TICs (Figures 5.1-11 and 5.1-12 and Tables 5.1-7 and 5.1-8).
- SVOCs detected in surface and/or near-surface soil above their respective RISLs or PGW SSLs are listed on the table below. Benzo(b&k)fluoranthene [B(b&k)F] and benzo(a)pyrene [B(a)P] detected in soil at concentrations above their RISLs are shown in

Figure 5.1-11. Benzo(a)anthracene [B(a)A], B(a)P, B(b&k)F, dibenz(a,h)anthracene [D(a,h)A] and indeno(1,2,3-cd)pyrene [I(1,2,3-cd)P] detected in soil at concentrations above their PGW SSLs are shown in Figure 5.1-12.

Sample Location	Depth (ft bgs)	SVOC	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	> RISL	> PGW SSL
29E-SNS03	0.5	Benzo(a)pyrene	38	2.9	6.9	N	Y
29E-SNS06	0.5	Benzo(a)pyrene	38	2.9	8.7	N	Y
29E-SB05	2.0	Benzo(b&k)fluoranthene	38	29	31	N	Y
		Indeno(1,2,3-cd)pyrene	621	29	33	N	Y
E(d)-SNS01	0.5	Benzo(a)pyrene	38	2.9	36	N	Y
		Benzo(b&k)fluoranthene	38	29	88	Y	Y
		Indeno(1,2,3-cd)pyrene	621	29	31	N	Y
L2-ST26-SB01	2.0	Benzo(a)anthracene	620	29	410	N	Y
		Benzo(a)pyrene	38	2.9	320	Y	Y
		Benzo(b&k)fluoranthene	38	29	740	Y	Y
		Dibenz(a,h)anthracene	62	2.9	31	N	Y
		Indeno(1,2,3-cd)pyrene	621	29	85	N	Y
L2-ST26-SNS02	0.5	Benzo(a)pyrene	38	2.9	55	Y	Y
L2-ST26-SNS03	0.5	Benzo(a)pyrene	38	2.9	6.2	N	Y

Subsurface Soil – Semivolatile Organic Compounds:

- A total of 35 primary subsurface soil samples were collected at 15 locations at Source Areas 29E, E(d), E(e), E(m), and E(n) and analyzed for SVOCs (Figures 5.1-11 and 5.1-12 and Tables 5.1-7 and 5.1-8).
- SVOCs were not detected above their respective RISLs or PGW SSLs in subsurface soil collected in the source areas [29E, E(d), E(e), E(m), and E(n)] within the Main Line 02 Area.

Summary of Investigation and Results - Polychlorinated Biphenyls

Three primary soil samples were collected at Source Area E(m) during the BOU RI and analyzed for PCBs. The number of sampling locations and primary soil samples analyzed for PCBs at Source Areas 29E, E(d), E(e), E(m), and E(n) are summarized on Tables 5.1-7 and 5.1-8, and below. Summary statistics for the samples are also presented on Tables 5.1-7 and 5.1-8.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
29E	PCBs	0	0	0	0
E(d)	PCBs	0	0	0	0

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
E(e)	PCBs	0	0	0	0
E(m)	PCBs	2	1	1	1
E(n)	PCBs	0	0	0	0

The results of the PCB analysis of surface/near-surface and subsurface soil samples collected at Source Area E(m) are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations for PCBs are shown in Figures 5.1-13 and 5.1-14. Soil sampling locations and the features being investigated are cross-referenced on Table 5.1-9.

Surface and Near-Surface Soil – Polychlorinated Biphenyls:

- Two primary surface and/or near-surface soil samples were collected from a low area [E(m)-SD01] south of the former location of Buildings 02025, 02026, and 02027 and analyzed for PCBs. Sample E(m)-SD01 is in a low-lying area that receives surface water runoff from a large portion of the Main Line 02 Area (Figures 5.1-13 and 5.1-14). Contaminants that may have been transported by surface water could have potentially been deposited in this area and that is the reason sampling was performed.
- PCBs were not detected in the two surface and/or near-surface soil samples collected at E(m)-SD01 above their respective RISLs or PGW SSLs.

Subsurface Soil – Polychlorinated Biphenyls:

- One primary subsurface soil sample was collected at the same location E(m)-SD01 as the surface/near-surface samples and analyzed for PCBs (Figures 5.1-13 and 5.1-14).
- PCBs were not detected in the subsurface soil sample collected at E(m)-SD01 above their respective RISLs or PGW SSLs.

<u>Summary of Investigation and Results – Perchlorate</u>

A total of 80 primary and 6 duplicate soil samples were collected at Source Areas 29E, E(d), E(e), E(m), and E(n) in the Main Line 02 Area during the BOU RI and analyzed for perchlorate. The number of sampling locations and primary soil samples analyzed for perchlorate at Source Areas 29E, E(d), E(e), E(m), and E(n) are summarized on Tables 5.1-7 and 5.1-8, and

below. Summary statistics for the samples are also presented on Tables 5.1-7 and 5.1-8.

Source Area	Compound	Surface/Near-Surface No. of Samples	Surface/Near-Surface No. of Locations	Subsurface No. of Samples	Subsurface No. of Locations
29E	Perchlorate	12	10	7	3
E(d)	Perchlorate	6	3	4	1
E(e)	Perchlorate	6	4	10	2
E(m)	Perchlorate	8	6	11	6
E(n)	Perchlorate	11	7	5	2

The results of the perchlorate analysis of surface/near-surface and subsurface soil samples collected at Source Areas 29E, E(d), E(e), E(m), and E(n) within the Main Line 02 Area are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations and perchlorate detected at concentrations above its RISL or PGW SSL are shown in Figures 5.1-13 and 5.1-14, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 5.1-9.

Surface and Near-Surface Soil – Perchlorate:

- Forty-three primary and six duplicate surface and/or near-surface soil samples were collected at 30 locations at Source Areas 29E, E(d), E(e), E(m), and E(n) and analyzed for perchlorate (Figures 5.1-13 and 5.1-14).
- Perchlorate was not detected at concentrations above its RISL in any of the surface/near-surface soil samples collected in the Main Line 02 Area.
- Perchlorate was detected at concentrations above its PGW SSL in seven surface/near-surface soil samples collected at four locations in the Main Line 02 Area. Perchlorate concentrations above the PGW SSL, and the depths and locations of the samples, are provided in the table below and shown in Figure 5.1-14.

Sample Location	Depth (ft bgs)	Compound	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	< RISL	< PGW SSL
E(d)-SNS03	0.5	Perchlorate	7,800	60	210	N	Y
	2.5				160	N	Y
E(e)-SNS01	0.5	Perchlorate	7,800	60	140	N	Y
	2.5				74	N	Y
E(e)-SB03	1	Perchlorate	7,800	60	140	N	Y

Sample Location	Depth (ft bgs)	Compound	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	< RISL	< PGW SSL
E(n)-SNS03	0.5	Perchlorate	7,800	60	550	N	Y
	2.5				250	N	Y

Subsurface Soil – Perchlorate:

- Thirty-seven primary subsurface soil samples were collected at 14 locations at Source Areas 29E, E(d), E(e), E(m), and E(n) and analyzed for perchlorate (Figures 5.1-13 and 5.1-14).
- Perchlorate was not detected at concentrations above its RISL in subsurface soil samples collected at Source Areas within the Main Line 02 Area.
- Four subsurface soil samples collected at one location at Source Area E(d) and eight subsurface soil samples collected at two locations at Source Area E(e) contained perchlorate at concentrations above its PGW SSL. The concentration of perchlorate detected above its PGW SSL, the depth at which the sample was collected, and the sampling location are identified on the table below. Perchlorate concentrations above the PGW SSL are shown in Figure 5.1-14.

Sample Location	Depth (ft bgs)	Compound	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	< RISL	< PGW SSL
E(d)-SNS03	10	Perchlorate	7,800	60	68	N	Y
	20				500	N	Y
	30				1,000	N	Y
	40				330	N	Y
E(e)-SB02	11	Perchlorate	7,800	60	290	N	Y
	22				420	N	Y
	42				170	N	Y
E(e)-SB03	5	Perchlorate	7,800	60	140	N	Y
	20				1,700	N	Y
	30				770	N	Y
	40				870	N	Y
	50				120	N	Y

<u>Summary of Investigation and Results – Total Petroleum Hydrocarbons</u>

A total of 54 primary and 5 duplicate soil samples were collected at Source Areas 29E, E(d), E(e), E(m), and E(n) in the Main Line 02 Area during the BOU RI and analyzed for TPH-D and TPH-Mo. The number of sampling locations and primary soil samples analyzed for TPH at Source Areas 29E, E(d), E(e), E(m), and E(n) in the Main Line 02 Area are summarized on

Tables 5.1-7 and 5.1-8, and below. Summary statistics for the samples are also presented on Tables 5.1-7 and 5.1-8.

		Surface/Near-Surface		Subsurface	
Source Area	**Compound**	**No. of Samples**	**No. of Locations**	**No. of Samples**	**No. of Locations**
29E	TPH-D	13	11	14	6
	TPH-Mo	13	11	14	6
E(d)	TPH-D	6	3	0	0
	TPH-Mo	6	3	0	0
E(e)	TPH-D	5	3	4	1
	TPH-Mo	5	3	4	1
E(m)	TPH-D	2	1	1	1
	TPH-Mo	2	1	1	1
E(n)	TPH-D	8	4	1	1
	TPH-Mo	8	4	1	1

The results of TPH analysis (TPH-D and TPH-Mo) of surface/near-surface and subsurface soil samples collected at Source Areas 29E, E(d), E(e), E(m), and E(n) within the Main Line 02 Area are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations and TPH-D and TPH-Mo concentrations above their PGW SSLs are shown in Figure 5.1-14. Soil sampling locations and the features being investigated are cross-referenced on Table 5.1-9.

Surface and Near-Surface Soil – Total Petroleum Hydrocarbons:

- Thirty-four primary and five duplicate surface/near-surface soil samples were collected at 22 locations at Source Areas 29E, E(d), E(e), E(m), and E(n) within the Main Line 02 Area and analyzed for TPH-D and TPH-Mo.
- TPH-D and/or TPH-Mo was detected above its PGW SSL in five surface and/or near-surface soil samples collected at four locations at Source Areas E(d) and E(e) and the septic tank for Building 02024. Hydrocarbons detected at concentrations above their PGW SSL and the location and depth of the samples having the detected concentrations are summarized on the table below. TPH-D and TPH-Mo concentrations above their PGW SSLs are shown in Figure 5.1-14.

Sample Location	Depth (ft bgs)	Compound	PGW SSL (mg/kg)	Conc. (mg/kg)	< PGW SSL
E(d)-SNS03	0.5	TPH-D	100	250	Y
		TPH-Mo	500	760	Y
	2.5	TPH-D	100	280	Y
		TPH-Mo	500	710	Y
E(e)-SNS01	0.5	TPH-D	100	110	Y
	2.5	TPH-D	100	9.1	N
L2-ST24-SB01	2.0	TPH-D	100	370	Y
		TPH-Mo	500	1,200	Y

Subsurface Soil – Total Petroleum Hydrocarbons:

- Twenty primary subsurface samples were collected at nine locations at Source Areas 29E, E(d), E(e), E(m), and E(n) within the Main Line 02 Area and analyzed for TPH-D and TPH-Mo.
- TPH-D and TPH-Mo were not detected above the PGW SSL in subsurface soil samples collected at the source areas within the Main Line 02 Area, including those collected at 6 and 11.5 feet bgs from boring L2-ST24-SB01.

Summary of Investigation and Results – Miscellaneous Compounds

Miscellaneous analyses performed on soil samples collected from Source Areas 29E, E(d), E(e), E(m), and E(n) within the Main Line 02 Area were NDMA, pesticides, pH, TOC, CEC, and/or DI-WET. The number of primary surface/near-surface and subsurface soil samples collected at each source area and the numbers of locations are summarized on the table below:

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
29E	NDMA	13	11	7	3
	Pesticides	0	0	0	0
	pH	0	0	0	0
	TOC	1	1	4	1
	CEC	1	1	4	1
	DI-WET	0	0	0	0
E(d)	NDMA	0	0	0	0
	Pesticides	0	0	0	0
	pH	0	0	0	0
	TOC	0	0	0	0
	CEC	0	0	0	0
	DI-WET	0	0	0	0

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
E(e)	NDMA	0	0	0	0
	Pesticides	0	0	0	0
	pH	0	0	0	0
	TOC	1	1	4	1
	CEC	1	1	4	1
	DI-WET	0	0	1	1
E(m)	NDMA	0	0	0	0
	Pesticides	2	1	1	1
	pH	4	2	2	2
	TOC	4	2	2	2
	CEC	4	2	2	2
	DI-WET	2	2	0	0
E(n)	NDMA	6	3	0	0
	Pesticides	0	0	0	0
	pH	2	1	1	1
	TOC	3	2	5	2
	CEC	3	2	5	2
	DI-WET	1	1	1	1

The analytical results for the miscellaneous analyses of surface/near-surface and subsurface soil samples are presented in Appendix G and summarized below. The analytical data for pH, TOC, and CEC are used in the risk assessments to evaluate the bioavailability of some chemicals with respect to human and ecological receptors. The TOC, CEC, and DI-WET data are used in the FS to evaluate chemical and physical remedial actions, assess the potential for metals in soil to migrate into groundwater, and develop cleanup goals protective of groundwater.

N-Nitrosodimethylamine: Surface and subsurface soil sampling locations for NDMA at Source Areas 29E, E(d), E(e), E(m), and E(n) are shown in Figures 5.1-13 and 5.1-14. Soil sampling locations and the features being investigated are cross-referenced on Table 5.1-9.

NDMA was not detected above its PQL in surface, near-surface, or subsurface soil samples collected from the source areas within the Main Line 02 Area.

Pesticides: Surface and subsurface soil sampling locations at Source Areas 29E, E(d), E(e), E(m), and E(n) are shown in Figures 5.1-2 and 5.1-3. Soil sampling locations and the features being investigated are cross-referenced on Table 5.1-9.

Pesticides were not detected above their RISLs or PGW SSLs in the surface or near-surface soil samples collected from the low-lying area north of Source Area E(m).

pH: The results of the pH analysis of six surface/near-surface soil samples and three subsurface soil samples collected at Source Areas 29E, E(d), E(e), E(m), and E(n) in the Main Line 02 Area are summarized on the table below. The pH of the soil is within the normal range (5 to 9) for mineral soils (Brady, 1974).

Source Area	Surface/ Near-Surface Soil	Subsurface Soil
29E	NA	NA
E(d)	NA	NA
E(e)	NA	NA
E(m)	5.97 – 7.13	6.44 – 6.89
E(n)	5.27 – 6.22	6.91

Total Organic Carbon: TOC was not detected in the 9 primary surface/near-surface and 15 primary subsurface soil samples collected at Source Areas 29E, E(d), E(e), E(m), and E(n).

Cation Exchange Capacity: CEC in the surface/near-surface and subsurface soil samples collected at Source Areas 29E, E(d), E(e), E(m), and E(n) in the Main Line 02 Area ranged from 73 to 600 meq/K.

Deionized Water - Waste Extraction Test: A DI-WET was performed on five soil samples collected at Source Areas E(e), E(m), and E(n) and the extracts analyzed for various metals. The sample identification, sample depth, and metal concentrations detected in the soil samples and sample extracts are presented on the table below.

Sample ID	Sample Depth (ft bgs)	Compound	Soil Conc. (mg/kg)	Extract Conc. (mg/L)
E(e)-SB02	22	Manganese	4,900	2.8
		Thallium	5.1	0.65
		Titanium	2,100	<0.001
E(m)-SD01	1.5	Arsenic	8.1	<0.001
		Manganese	1,100	0.092
E(n)-SB03	43	Thallium	3.1	0.00019 J
		Titanium	1,900	1.0
E(n)-SD01	1.5	Manganese	1,700	0.19

Sample ID	Sample Depth (ft bgs)	Compound	Soil Conc. (mg/kg)	Extract Conc. (mg/L)
L2-ST26-SB01	2	Aluminum	14,000	9.1 J
		Antimony	1.1	<0.01
		Arsenic	<2.1	<0.005
		Barium	93	0.19
		Beryllium	0.37	0.0011 J
		Boron	<4.2	<0.05
		Cadmium	<0.42	<0.005
		Chromium	35	0.012
		Cobalt	8.6	0.012
		Copper	18	0.039
		Lead	4.4	0.018
		Lithium	4.7	<0.05
		Manganese	340	0.71
		Molybdenum	0.42	<0.02
		Nickel	24	0.0095 J
		Selenium	<1.7	<0.01
		Silver	<0.84	<0.01
		Strontium	12	0.062
		Thallium	<4.2	<0.01
		Titanium	480	0.15
		Vanadium	47	0.083
		Zinc	27	0.048

Summary of Investigation and Results – Geotechnical Parameters

A total of 42 soil samples were collected from the source areas within the Line 02 Region during the BOU RI for geotechnical parameters. The results of the geotechnical analyses of soil samples for moisture content, wet density, dry density, specific gravity, porosity, sieve analysis, and/or permeability are summarized on Table 5.1-6.

The geotechnical data will be used in the risk assessment to develop site-specific soil input parameters (moisture content, water-filled porosity, air-filled porosity, etc.) for fate and transport models and in the FS to assess potential remedial actions such as vapor extraction. Fate and transport models are used in risk assessment to quantitatively evaluate the migration of volatile organics into outdoor and indoor air and the potential leaching of chemicals through soil and into groundwater.

5.1.9 *Discussion of Investigation Results with Respect to Data Quality Objectives – Main Line 02 Area*

The analytical results presented in the previous sections identified the following chemical constituents in soil vapor and soil at the source areas within the Main Line 02 Area at concentrations above their respective RISLs and/or PGW SSLs:

Soil vapor: Benzene, Carbon Tet, chloroform, PCE, and TCE.

Soil: Aluminum, cadmium, manganese, thallium, B(a)P, B(a)A], B(b&k)F], D(a,h)A, I(1,2,3-cd)P, perchlorate, TPH-D, and TPH-Mo.

The presence of these COPCs in each source area is discussed below with respect to the data needs described in Section 5.1.7.3. Specifically,

- Has the investigation resulted in sufficient characterization of the lateral and vertical distribution of each COPC in the vadose zone and identified a potential source for those COPCs?
- Has the investigation resulted in sufficient data to evaluate the potential for COPCs in soil to migrate into and degrade surface water and groundwater quality?
- Has the investigation resulted in data sufficient to support human health and ecological risk assessments and fate and transport modeling?
- Has the investigation resulted in sufficient data to evaluate the feasibility of remediating the identified compounds and concentrations to levels that do not pose a risk to human and ecological receptors or degrade surface water and groundwater quality?

For the purpose of this discussion, it is assumed that chemicals detected at concentrations above their RISL could potentially pose a risk to human health and chemicals detected above their PGW SSL could potentially migrate into groundwater or surface water. Sampling locations where VOCs, metals, and other non-VOCs (SVOCs, PCBs, perchlorate, NDMA, TPH-D, and TPH-Mo) were detected in surface and/or subsurface soil at concentrations above their respective PGW SSLs are shown in Figures 5.1-6, 5.1-10, 5.1-12, and 5.1-14.

The analytical results for surface water and groundwater within the Administration Area are discussed in Sections 5.6 and 5.7, respectively, and discussed with respect to potential soil and soil vapor sources in the Main Line 02 Area. Additionally, the potential for chemicals in soil and soil vapor to migrate into surface water and groundwater is further evaluated in Section 8 of the HHERA (Volume II).

5.1.9.1 *Volatile Organic Compounds*

VOCs detected in soil vapor samples collected from the source areas comprising the Main Line 02 Area are summarized in Section 5.1.8.3.

PCE, TCE, chloroform, and TVOC concentrations in the shallow, intermediate, and deep intervals above their RISLs or PGW SSLs are shown in Figures 5.1-5a and 5.1-6, respectively. TVOC concentrations above the RISL are also shown in Figure 5.1-5b.

Benzene, Carbon Tet, chloroform, PCE, and TCE were detected in at least one soil vapor sample collected in the Main Line 02 Area at concentrations above their RISLs or PGW SSLs. The presence of benzene, chloroform, PCE, and TCE in soil vapor within the Main Line 02 Area with respect to potential sources and completeness of the characterization are discussed below. VOCs are discussed in the order of their prevalence and magnitude of concentrations in soil vapor. VOCs associated with the degradation of PCE and TCE (1,1-DCE, cis-1,2-DCE, and trans-1,2-DCE) and compounds detected at only one or two locations (Carbon Tet) are not included in this discussion.

Trichloroethene and Tetrachloroethene

- TCE was the predominant VOC detected in the vadose zone within the Main Line 02 Area. The highest concentrations of TCE (up to 64,000 $\mu g/m^3$) in the shallow, intermediate, and deep soil vapor intervals were detected adjacent to a former concrete sump at the northeast corner of Building 02024. TCE concentrations detected in soil vapor within this area were less than 1 percent of its vapor saturation concentration (4,877,690 $\mu g/m^3$) and therefore not indicative of the potential presence of residual product. The data indicate that the presence of TCE in soil vapor within the Main Line 02 Area is likely attributed to discharges of diluted concentrations of VOCs to the former concrete sump at Building 02024.
- The step-out sampling conducted as part of the BOU RI to characterize the extent of VOCs originating from source areas within the DSA and the Main Line 02 Area also identified elevated TCE concentrations at one location (DSA-SP20) in Area 00. TCE was detected above its RISL or PGW SSL in the shallow (3,000 $\mu g/m^3$) and intermediate (24,000 $\mu g/m^3$) soil vapor intervals at DSA-SP20, along the ditch north of Building 00022. The TCE concentrations detected in soil vapor at location DSA-SP20 are less than 1 percent of its vapor saturation concentration and, therefore, not indicative of the presence of residual product.
- The concentration plots shown in Figures 5.1-5a and 5.1-5b show that TCE concentrations originating from the former concrete sump at Building 02024, Source Area 28E in the DSA, and the likely source

within Area 00 have commingled and expanded to encompass an area of roughly 40 acres within the Line 02 Region. The commingling and expansion of the TCE soil vapor plumes in all three intervals (shallow, intermediate, and deep) suggest that it may be attributed to a combination of the presence of native, undredged material and the presence of VOCs in groundwater. Better lateral conductivity of the lithologic material comprising the native, undredged material combined with the absence of barriers to lateral migration produced by dredging may have influenced the migration of VOCs in soil vapor.

- PCE was the second most common VOC detected at concentrations above its RISL and PGW SSL in shallow, intermediate, and/or deep soil vapor intervals within the Main Line 02 Area. PCE above its RISL and PGW SSL was detected in soil vapor at eight (29E-SP07, 29E-SP08, 29E-SP09, E(m)-SP10, E(n)-SP04, E(n)-SP05, L2-ST26-SP05, and L2-ST26-SP06) locations. The eight locations are located near the former unlined pond and concrete-lined trough at Source Area 29E and the area of former Buildings 02025 and 02027. The presence of PCE in the vadose zone in the area of Buildings 02025 and 02027 appears to be associated with the former septic systems [Source Areas E(m) and E(n)] for those buildings.
- PCE at concentrations greater than its PGW SSL, but less than its RISL, were generally detected in soil vapor samples collected at the same location as those having PCE above its RISL. However, PCE above its PGW SSL, but less than its RISL, was detected in soil vapor at four (29E-SP11, L2-ST24-SP03, E(m)-SP09, and L2-ST26-SP04) locations. As shown by the concentration plots in Figure 5.1-5b, these locations are typically close to locations where PCE was detected at concentrations above its RISL.

As indicated by the TVOC concentrations illustrated in Figures 5.1-5a and 5.1-5b and the extent of TCE in shallow groundwater, the extent of TCE and other VOCs in the vadose zone beneath the Main Line 02 Area has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

<u>Chloroform</u>

- As with the DSA, chloroform was the third most commonly detected VOC in soil vapor within the Main Line 02 Area at concentrations above its RISL. The concentration plots in Figure 5.1-5a show that the highest chloroform concentrations in the shallow, intermediate, and

deep soil vapor intervals were detected adjacent to a former concrete sump at the northeast corner of Building 02024. Soil vapor samples at this location also exhibited the highest concentrations of TCE and is, therefore, most likely attributed to the same source (discharges of wastewater to the former concrete sump at Building 02024).

- Step-out sampling conducted during the BOU also identified chloroform concentrations above its RISL at one location (DSA-SP16) within Area 00. Chloroform was detected in the shallow (270 µg/m^3), intermediate (1,000 µg/m^3), and deep (1,600 µg/m^3) intervals at location DSA-SP16 immediately adjacent to the drainage ditch north of Building 00004. The detected concentrations of chloroform are less than 1 percent of its vapor saturation concentrations and, therefore, not indicative of the presence of NAPL.
- As illustrated in Figure 5.1-5a, the lateral extent of chloroform at concentrations above its RISL in soil vapor in the shallow, intermediate, and deep layers generally coincide with lateral extent of TCE. As with TCE, the lateral extent of chloroform in soil vapor above its RISL increases with depth and commingles with VOC soil vapor plumes originating within the DSA, the Main Line 02 Area, and Area 00.

The vertical extent of chloroform has been characterized to first groundwater at multiple locations in the Main Line 02 Area. As indicated by the TVOC concentrations shown in Figures 5.1-5a and 5.1-5b, the lateral extent of chloroform in the vadose zone beneath the Main Line 02 Area, and the Line 02 Region as a whole, has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

5.1.9.2 Metals

Aluminum, cadmium, manganese, and thallium were detected at concentrations above background and their respective RISLs and/or PGW SSLs in soil samples collected at 11 [29E-SB03, 29E-SB05, 29E-SB09, 29E-SB10, L2-ST24-SB01, L2-ST26-SB04, E(e)-SB02, E(n)-SD01, E(n)-SNS01, E(n)-SB01, and E(n)-SB03] locations within the DSA (Section 5.1.4.3 and Figures 5.1-9 and 5.1-10). The presence of those metals at each of the 11 locations with respect to the completeness of characterization, both laterally and vertically, and potential sources are discussed below.

29E-SB05 and 29E-SB09

Metals at concentrations above their respective RISLs were not detected in the soil samples collected from borings 29E-SB05 and 29E-SB09.

Cadmium at a concentration above its PGW SSL was detected in soil samples collected at 2 and 6 feet bgs from boring 29E-SB05 (Figure 5.1-10).

- The absence of that metal above its PGW SSL in soil samples collected from boring 29E-SB09 suggests that the lateral extent of cadmium is likely limited to the soil immediately adjacent to the trough.
- The vertical extent of cadmium at that location is defined by the absence of that metal above its PGW SSL in soil collected at 11.5 feet bgs from boring 29E-SB05.

Aluminum at concentrations above its PGW SSL was detected in soil samples collected at 1 and 5 feet bgs from boring 29E-SB09 adjacent to a concrete-lined trough from Building 02024 (Figure 5.1-10).

- The absence of that metal above its PGW SSL in soil collected from borings 29E-SB05 and 29E-SB06 indicates that the lateral extent of aluminum is likely limited to the soil immediately adjacent to the trough.
- The vertical extent of aluminum at that location is defined by the absence of that metal above its PGW SSL in the soil sample collected at 11 feet bgs from boring 29E-SB09.

29E-SB03

Metals at concentrations above their respective RISLs were not detected in the soil samples collected from boring 29E-SB03.

Aluminum at a concentration of 50,000 mg/kg, above its PGW SSL, was detected in a soil sample collected at 23 feet bgs from boring 29E-SB03 (Figure 5.1-10). The absence of that metal above its PGW SSL of 43,000 mg/kg in soil samples collected at 1, 5, 11, and 45 feet bgs from that boring and in samples collected from borings 29E-SB05 through 29E-SB08 indicates that the detected concentration of aluminum may be naturally occurring.

Thallium at a concentration of 2.7 mg/kg, above its PGW SSL, was detected in a soil sample collected at 45 feet bgs from boring 29E-SB03. The absence of that metal above its PGW SSL of 2.5 mg/kg in soil samples

collected at 1, 5, 11, and 23 feet bgs from that boring and in soil samples collected from borings 29E-SB05 through 29E-SB09 indicates that the detected concentration of thallium may be naturally occurring.

29E-SB10

Metals at concentrations above their respective RISLs were not detected in the soil samples collected from boring 29E-SB10.

Cadmium at a concentration above its revised PGW SSL was detected in a soil sample collected at 1 foot bgs from boring 29E-SB10 (Figure 5.1-10).

- The lateral extent of cadmium above its PGW SSL is defined by the absence of that metal above its PGW SSL in soil samples collected from borings 29E-SNS07, 29E-SB11, 29E-SB12, and L2-ST26-SB02.
- The vertical extent of cadmium at that location was characterized to the PGW SSL of 18 mg/kg proposed in the BOU FSP, but not to the revised PGW SSL of 0.72 mg/kg.

L2-ST24-SB01

Metals at concentrations above their respective RISLs were not detected in the soil samples collected from boring L2-ST24-SB01.

Manganese at a concentration of 1,200 mg/kg, above its PGW SSL of 1,100 mg/kg, was detected in a soil sample collected at 2 feet bgs and aluminum at 45,000 mg/kg, above its PGW SSL of 43,000 mg/kg, was detected in a soil sample collected at 11.5 feet bgs from boring L2-ST24-SB01 (Figure 5.1-10).

- The lateral extent of aluminum and manganese in the vicinity of boring L2-ST24-SB01 is defined by the absence of those metals above their PGW SSLs in the soil samples collected from co-located boring L2-ST26-SB01.
- The vertical extent of manganese at that location is defined by the absence of that metal above its revised PGW SSL in soil samples collected at 6 and 11.5 feet bgs from boring L2-ST24-SB01 and in soil samples collected at 2, 5, and 11.5 feet bgs from co-located boring L2-ST26-SB01. The vertical extent of aluminum above its revised PGW SSL is defined by the absence of that metal above its PGW SSL in soil samples collected at 2, 5, 11.5, 23, and 45 feet bgs from co-located boring L2-ST26-SB01.

L2-ST26-SB04

Metals at concentrations above their respective RISLs were not detected in the soil samples collected from boring L2-ST26-SB04.

Thallium at a concentration slightly above its revised PGW SSL of 2.5 mg/kg was detected in a soil sample collected at 1 foot bgs from boring L2-ST26-SB04 (Figure 5.1-10).

- Based on the detected concentration (2.8 mg/kg), the lateral extent of thallium is likely limited to the immediate area of the boring.
- The vertical extent of thallium is defined by the absence of that metal above its PGW SSL in soil samples collected at 5 and 11 feet bgs from boring L2-ST26-SB04.

E(n)-SD01 and E(n)-SB01

Cadmium, manganese, and thallium above their PGW SSLs were detected in surface/near-surface (0 to 2.5 feet bgs) soil samples collected at two [E(n)-SD01 and E(n)-SB01] locations in the drainage in the southern portion of the Main Line 02 Area (Figure 5.1-10). The absence of those metals in surface/near-surface soil samples collected at upstream location E(n)-SB02 and downstream location E(m)-SD02 indicates that the extent of those metals is likely limited to a 100-foot section of that ditch. The vertical extent of cadmium, manganese, and thallium is defined by the absence of those metals above their PGW SSLs in soil samples collected at 5 feet bgs at location E(n)-SD01 and at 5 and 9.5 feet bgs in boring E(n)-SB01.

E(n)-SNS01

Cadmium above its RISL and PGW SSL was detected in a near-surface (0.5 foot bgs) soil sample collected at location E(n)-SNS01 along the drainage north of Building 02021.

- The lateral extent of cadmium is defined by the area in which water accumulates at that location.
- The vertical extent of cadmium is defined by the absence of that metal in soil samples collected at 2.5 feet bgs at location E(n)-SNS01.

E(n)-SB03

Thallium at a concentration above its revised PGW SSL of 2.5 mg/kg was detected in a soil sample collected at 43 feet bgs from boring E(n)-SB03 (Figure 5.1-10). The absence of cadmium above its PGW SSL in soil samples collected at 1, 5, 11, and 21 feet bgs from boring E(n)-SB03 and in subsurface soil samples collected from other borings (L2-ST26-SB03, E(n)-SB01, and E(n)-SB02) in that area indicates that the detected concentration of cadmium may be a statistical outlier.

E(e)-SB02

Manganese and thallium at concentrations above their RISLs and PGW SSLs and aluminum above its PGW SSL were detected in soil samples collected from boring E(e)-SB02. Boring E(e)-SB02 is along the east side of the paved driveway north of Building 02020 (Figures 5.1-9 and 5.1-10).

Thallium was detected at a concentration slightly above its RISL in the soil sample collected at 22 feet bgs and at concentrations above its PGW SSL in soil samples collected at 11, 22, and 42 feet bgs from boring E(e)-SB02. Aluminum above its PGW SSL was detected in the soil sample collected at 22 feet bgs and manganese above its PGW SSL was detected in soil samples collected at 22 and 42 feet bgs from boring E(e)-SB02.

- The lateral extent of these metals in soil is not well defined at a depth below 11 feet bgs. However, thallium was not detected above its RISL or PGW SSL in soil samples collected at depths less than 11 feet bgs from boring E(e)-SB02 and aluminum and manganese were not detected above their RISLs or PGW SSLs in soil samples collected at depths less than 22 feet bgs from boring E(e)-SB02. Additionally, aluminum, manganese, and thallium were not detected at concentrations above their RISL or PGW SSLs in surface and near-surface (0.5 and 2.5 feet bgs) soil samples collected at locations E(d)-SNS01, E(d)-SNS02, E(d)-SNS03, E(e)-SNS01, or E(e)-SNS02.
- The presence of aluminum, manganese, and thallium above their respective RISLs and/or PGW SSLs in soil in the vicinity of boring E(e)-SNS02 between 11 and 42 feet bgs and the absence of those metals in surface soil suggests a source other than a surface release.

Based on the information presented above, Aerojet believes that the lateral and vertical extent of aluminum, cadmium, manganese, and thallium above their RISLs or PGW SSLs at the source areas within the Main Line 02 Area has been sufficiently characterized to evaluate potential risks

to human health, surface water, and groundwater and, if necessary, develop remedial alternatives. Additional evaluation of the potential risk to groundwater posed by those metals in soil is presented in Section 8 of the HHERA (Volume II).

5.1.9.3 *Semivolatile Organic Compounds*

B(a)A, B(a)P, B(b&k)F, D(a,h)A, and/or I(1,2,3-cd)P at concentrations above their respective RISLs and/or PGW SSL were detected in seven surface/near-surface (0 to 2.5 feet bgs) soil samples collected at seven locations at the source areas within the Main Line 02 Area (Section 5.1.8.3). B(b&k)F and B(a)P detected in soil at concentrations above their RISLs are shown in Figure 5.1-11. B(a)A, B(a)P, B(b&k)F, D(a,h)A and I(1,2,3-cd)P detected in soil at concentrations above their PGW SSLs are shown in Figure 5.1-12. The presence of each of those compounds in soil at each of the seven locations with respect to the completeness of characterization, both laterally and vertically, are discussed below.

<u>29E-SNS03</u>

SVOCs at concentrations above their respective RISLs were not detected in the soil sample collected at location 29E-SNS03.

B(a)P at a concentration above its revised PGW SSL was detected in a near-surface (0.5 foot bgs) soil sample collected at location 29E-SNS03 within the former unlined pond at Source Area 29E (Figure 5.1-12).

- The absence of that compound at concentrations above the PQL in surface and near-surface soil samples collected at locations 29E-SNS04, 29E-SNS05, 29E-SB03, 29E-SB06, 29E-SB07, and 29E-SB08 indicates that the lateral extent of B(a)P is likely limited to within 10 feet of location 29E-SNS03.
- The vertical extent of B(a)P was defined to the PGW SSL of 9.2 µg/kg presented in the agency approved BOU FSP. Based on the detected concentration of 6.9 µg/kg, B(a)P is likely limited to the upper 1 to 3 feet of soil.

<u>29E-SNS06</u>

SVOCs at concentrations above their respective RISLs were not detected in the soil sample collected at location 29E-SNS06.

B(a)P at a concentration above its revised PGW SSL was detected in a near-surface (0.5 foot bgs) soil sample collected at location 29E-SNS06 along a drainage west of the former location of Building 02027 (Figure 5.1-12).

- The absence of that compound at concentrations above the PQL in surface and near-surface soil samples collected at locations 29E-SNS07 and L2-ST26-SB02 indicates that the lateral extent of B(a)P is likely limited to the ditch and within 10 feet of location 29E-SNS06.
- The vertical extent is defined by the absence of B(a)P at a concentration above its PQL in the soil sample collected at 2.5 feet bgs at location 29E-SNS06.

<u>29E-SB05</u>

SVOCs at concentrations above their respective RISLs were not detected in the soil samples collected from boring 29E-SB05.

B(b&k)F and I(1,2,3-cd)P at concentrations above their PGW SSLs were detected in a near-surface (2 feet bgs) soil sample collected from boring 29E-SB05 near the concrete-lined trough north of Building 02024 (Figure 5.1-12).

- The absence of those compounds at concentrations above their PGW SSLs in surface and near-surface soil samples collected at locations 29E-SNS03, 29E-SNS05, 29E-SB03, 29E-SB06, and 29E-SB07 indicates that the lateral extent of B(b&k)F and I(1,2,3-cd)P is likely limited to within 10 feet of location 29E-SB05.
- The vertical extent of B(b&k)F and I(1,2,3-cd)P at concentrations above their PGW SSLs is defined by the absence of those compounds at concentrations above their PQLs in the sample collected at 6 feet bgs from boring 29E-SB05.

<u>E(d)-SNS01</u>

SVOCs at concentrations above their respective RISLs were not detected in the soil samples collected from boring E(d)-SNS01.

B(a)P and B(b&k)F were detected at concentrations above their PGW SSLs in a surface (0.5 foot bgs) soil sample collected from boring E(d)-SNS01, south of Building 02020 (Figure 5.1-12).

- The absence of those compounds in soil samples collected at locations E(d)-SNS02, E(d)-SNS03, and E(d)-SB02 indicates that the lateral extent is likely limited to within 5 feet of location E(d)-SNS01.
- The vertical extent of B(a)P and B(b&k)F in soil at location E(d)-SN01 is defined by the absence of those compounds above their PGW SSLs in the soil sample collected at 2.5 feet bgs.

L2-ST26-SB01

SVOCs at concentrations above their respective RISLs were not detected in the soil samples collected from boring L2-ST26-SB01.

B(a)P, B(a)A, B(b&k)F, and D(a,h)A were detected at concentrations above their respective RISLs or PGW SSLs in a near-surface (2 feet bgs) soil sample collected from boring L2-ST26-SB01, situated at the southeast corner of Building 02024 (Figures 5.1-11 and 5.1-12).

- The presence of these SVOCs in surface soil at the edge of the pavement suggests that they are associated with surface spills of hydrocarbons at that building.
- The absence of those SVOCs above their PGW SSLs in the soil sample collected from boring L2-ST24-SB01 indicates that the lateral extent of those compounds is likely limited to within a few feet of L2-ST26-SB01.
- The vertical extent of B(a)P, B(a)A, B(b&k)F, and D(a,h)A is defined by the absence of those compounds above their PGW SSLs in subsurface soil samples collected at 5, 11.5, 23, and 45 feet bgs from boring L2-ST26-SB01 and at 2, 6, and 11.5 feet from boring L2-ST24-SB01.

L2-ST26-SNS02 and L2-ST26-SNS03

B(a)P was detected at a concentration above its RISL and PGW SSL in a surface (0.5 foot bgs) soil sample collected at location (L2-ST26-SNS02) and above its PGW SSL in a surface (0.5 foot bgs) soil sample collected at location L2-ST26-SNS03. Both locations are in a paved parking area north of Building 02026 in the vicinity of Source Area E(m).

The absence of B(a)P in the near-surface (2.5 feet bgs) soil samples collected at both locations and in surface and/or near-surface soil samples collected from borings L2-ST26-SNS01 and L2-ST26-SB03 indicates that B(a)P is limited to surface soil in the proximity of those two sampling locations.

Based on the information presented above, the lateral and vertical extent of B(a)P, B(a)A, B(b&k)F, and D(a,h)A at the source areas within the Main Line 02 Area has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives. Additional evaluation of the potential risk to groundwater posed by those metals in soil is presented in Section 8 of the HHERA (Volume II).

5.1.9.4 *Perchlorate*

Perchlorate at concentrations above its RISL of 7,800 µg/kg was not detected in soil samples collected at the source areas within the Main Line 02 Area (Section 5.1.8.3 and Figure 5.1-13).

Perchlorate at concentrations above its revised PGW SSL of 60 µg/kg was detected in 17 soil samples collected at four locations in Source Areas E(d) and E(e) and one location in Source Area E(n) (Section 5.1.8.3). Concentrations of perchlorate above its PGW SSL are shown in Figure 5.1-14. Conclusions regarding the characterization and potential sources of perchlorate at each of the five locations based on the data and figures are summarized below.

<u>E(d)-SNS03, E(e)-SNS01, E(e)-SB02, and E(e)-SB03</u>

Perchlorate at concentrations above its PGW SSL was detected in soil samples collected at four [E(d)-SNS03, E(e)-SNS01, E(e)-SB02, and E(e)-SB03] locations near Building 02020, a former oxidizer grind station (Figure 5.1-14).

- The lateral extent of perchlorate in soil near Building 02020 was characterized to the PGW SSL of 3,650 µg/kg proposed in the BOU FSP. The detections of perchlorate at the four locations suggest that the lateral extent of perchlorate in soil could potentially encompass an area roughly 200 feet by 50 feet.
- The presence of perchlorate above its PGW SSL in soil samples collected at depths between 10 and 50 feet in borings E(d)-SNS03, E(e)-SB02, and E(e)-SB03 and the results of the groundwater RI (Section 5.7.2) indicate that the Building 02020 area is a potential source of perchlorate to groundwater. The potential threat to groundwater posed by the detected concentrations of perchlorate in the soil in the vicinity of the former oxidizer grind station is further evaluated in Section 8 of the HHERA (Volume II).

E(n)-SNS03

Perchlorate at concentrations above its revised PGW SSL of 60 µg/kg was detected in surface (0.5 foot bgs) and near-surface (2.5 feet bgs) soil samples collected at location E(n)-SNS03. Location E(n)-SNS03 is along a surface drainage north of Building 02023 (Figure 5.1-14).

- The absence of perchlorate in surface and/or near-surface soil samples collected at locations E(n)-SNS01 and E(n)-SNS02 indicates that the perchlorate detected at E(n)-SNS03 is not directly related to the perchlorate detected in the vicinity of the former oxidizer grind station (Building 02020).
- The lateral and vertical extent of perchlorate at location E(n)-SNS03 was characterized to the PGW SSL of 3,650 µg/kg proposed in the BOU FSP.

Based on the information presented above, the lateral and vertical extent of perchlorate at Source Areas E(d) and E(e) and other source areas in the Main Line 02 Area has not been characterized to the revised PGW SSL of 60 µg/kg. Although the current data is sufficient to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives, additional sampling will likely be required prior to implementing any proposed remedial action.

5.1.9.5 *Total Petroleum Hydrocarbons*

TPH-D and TPH-Mo were detected in soil at concentrations above their PGW SSLs at four locations [E(d)-SNS01, E(d)-SNS03, E(e)-SNS01, and L2-ST24-SB01] within the Main Line 02 Area (Section 5.1.8.3; Figures 5.1-14). TPH-D and TPH-Mo were not characterized laterally and vertically to their PGW SSLs during the BOU RI. Decisions regarding the need for additional characterizations during the field effort were based on the presence of SVOCs above their screening levels. The presence of TPH-D and TPH-Mo in soil within the Main Line 02 Area at each of the five locations is discussed below.

E(d)-SNS01, E(d)-SNS03, and E(e)-SNS01

TPH-D and/or TPH-Mo were detected above their PGW SSLs in four surface and/or near-surface (0 to 2.5 feet bgs) soil samples collected at three [E(d)-SNS01, E(d)-SNS03, and E(e)-SNS01) locations adjacent to and north of the former oxidizer grind station (Building 02020) (Figure 5.1-14). The presence of those compounds in soil is likely due to surface releases

and limited in extent, both laterally and vertically. SVOCs detected in surface soil in this area are likely associated with the hydrocarbons.

L2-ST24-SB01

TPH-D and TPH-Mo were detected above their PGW SSLs in a near-surface (2 feet bgs) soil sample collected from boring L2-ST24-SB01, at the southeast corner of Building 02024. SVOCs were also detected in near-surface soil at this location and their presence is likely associated with the hydrocarbons. TPH-D and TPH-Mo were not detected above their PGW SSLs in subsurface soil samples collected at 6 and 11.5 feet bgs from boring L2-ST24-SB01. The data indicate that the presence of TPH is likely due to a surface release and that the extent is likely limited to an area of less than 10 feet and a depth of 3 feet.

5.2 SUMMARY AND RESULTS OF VADOSE ZONE REMEDIAL INVESTIGATIONS – LINE 05 NORTH AREA

The Line 05 North Area encompasses three source areas [Source Areas 51E, 52E, and E(l)] and various other features including sumps, a possible missile test stand, test cells and associated blast areas, a material storage area, and drains associated with former activities conducted at Building 05087 (Figure 5.2-1). Building 05087 is identified as a former engineering test laboratory where solid propellants, liner materials, trichloroethane (TCA), and TCE were handled.

Source areas identified within the Line 05 North Area, as presented in the BOU FSP (Aerojet et al., 2006b), are listed on Table 5.2-1. Classes of chemicals identified in soil, soil vapor, and groundwater within the Line 05 North Area during previous investigations include the following:

- **Soil –** SVOCs, metals, and perchlorate.
- **Soil Vapor –** VOCs.
- **Groundwater –** VOCs, SVOCs, pesticides/PCBs, perchlorate, NDMA, and metals.

This section provides the following information for the Line 05 North Area:

- Describes the environmental setting for the Line 05 North Area;

- Describes each source area and other features investigated during the previous investigations and the BOU RI;
- Summarizes previous vadose zone investigations and the results of those investigations;
- Identifies COPCs identified during the previous investigations;
- Presents the data needs identified in the BOU FSP;
- Summarizes the sampling activities performed during the BOU RI and deviations from the sampling proposed in the BOU FSP; and
- Presents the analytical results for samples collected during the BOU RI and historical data, where appropriate.

The results of the BOU RI with respect to the identification of COPCs; lateral and vertical characterization of COPCs; completeness of the characterization; potential sources; fate and transport of COPCs; and the potential for those COPCs to affect human health, surface water, and groundwater are discussed in Section 5.2.5.

The information presented below regarding the description of source areas and previous investigations was compiled from one or more of the following sources: *Stage 1 Sampling Plan-Zone 1* (Aerojet, 1993a); *Stage 1 Sampling Plan-Zones 3 and 4* (Aerojet 1993b); *Stage 1 Sampling Plan-Zone 2* (Aerojet, 1993c); *Aerojet Superfund Site – Scoping Report, Volumes 1 through 6* (ICF Technology, Inc., 1989); *Aerojet Site; Stage 1 Report - Zones 1 through 4* (ICF Kaiser Engineers, Inc., 1993); or BOU FSP (Aerojet et al., 2006b).

5.2.1 Environmental Setting – Line 05 North Area

The topography, geology, soils, surface water hydrology, general hydrogeology, and ecological habitat of the Line 05 North Area are described in the following subsections.

5.2.1.1 Topography

With the exception of approximately 20-feet-high earth revetments around Building 05087, the Line 05 North Area is relatively flat with a gentle, one degree dip that directs surface runoff to the northwest. A low-lying area identified as Source Area E(l) is located west of Building 05087 and a drainage ditch is located in the northeast portion of the Line 05 North Area. Surface elevations in the Line 05 North Area range from 167 feet amsl in the east to 151 feet amsl in the west.

5.2.1.2 *Geology*

The site-specific geology of the Line 05 North Area, based on information presented on field logs of borings drilled during previous investigations and the BOU RI, is described below.

The surface and near-surface lithologies in the Line 05 North Area are comprised of reworked Quaternary-aged fluvial deposits of cobbles, sand, silt, and clay to a depth of approximately 20 feet. Historical information indicates that a smaller dredger performed the dredging in the vicinity of the Line 05 North Area, which accounts for the dredging depth of approximately 20 feet compared to up to 90 feet elsewhere on the site. The Line 05 North Area has been graded and paved, but a review of historical photographs show that the area is surrounded by dredge tailings. The photographs also show that the dredge furrows are truncated by the grading in the Line 05 North Area, indicating the high likelihood that Line 05 North is in a dredged area. Additionally, subsurface lithologies described in well logs and most of the borehole logs are consistent with those observed in dredged areas. Native soils below the dredge tailings generally consist of fluvial deposits of sand and silt.

5.2.1.3 *Soils*

Soils in the Line 05 North Area consist primarily of Xerorthents that were graded for construction of Building 05087 and associated features. Xerorthents are very deep, somewhat excessively drained and excessively drained soils associated with dredge tailings. They are formed in material that has a high content of gravel and cobbles derived from mixed sources. The material was deposited as tailings after most of the fine-earth material was washed from it and removed during gold dredging activities. Slopes are short, complex, and disturbed (USDA – NRCS, 1993).

5.2.1.4 *Surface Water Hydrology*

Local surface water features within the Line 05 North Area consist of a drainage ditch and low-lying areas (Figure 5.2-1). The low-lying area west of Building 05087 is identified as Source Area E(l) and collects storm water runoff from the western portion of the Line 05 North Area. A ditch in the northeast portion of the Line 05 North Area conveys seasonal storm water runoff from the area surrounding Building 05087 to Buffalo Creek to the north. Buffalo Creek discharges to the West Lakes Storm Water Retention Ponds.

5.2.1.5 *Local Hydrogeology*

The first saturated sediments encountered beneath the Line 05 North Area are either part of Perched Groundwater or within the FWBZ. The general hydrogeology of the Perched Groundwater and FWBZ beneath the Line 05 North Area is discussed below. Details regarding the occurrence of groundwater within the Line 05 North Area and distribution of chemicals in the groundwater are presented in Section 5.7.

Perched Groundwater

Perched Groundwater is the shallowest saturated unit and typically occurs in ancestral American River sediments that have been reworked by historical gold-dredging activities. Dredging activities disturbed the natural stratigraphy and the resulting spoils were deposited as unconsolidated and somewhat stratified sediments. As a result, the dredged materials are very permeable and are underlain by sediments that are typically less permeable. The base of Perched Groundwater often coincides with the interface between dredged and undredged materials.

Perched Groundwater was frequently encountered throughout the Line 05 North Area during the BOU RI at depths ranging from 9 to 20 feet bgs, with a median depth of 15.5 feet bgs. Based on similar water level elevations and the relatively uniform hydraulic gradient within Line 05 North, Perched Groundwater in the Line 05 North Area appears to be hydraulically connected. The direction of flow in the Perched Groundwater beneath the Line 05 North Area is variable and the hydraulic gradient ranges from approximately 0.0057 to 0.0278 ft/ft. The base of Perched Groundwater ranges from approximately 22 to 41 feet above the top of the FWBZ.

First Water-Bearing Zone

The FWBZ was encountered in three of four boreholes drilled in the Line 05 North Area during the BOU RI at depths ranging from 42 to 50 feet bgs. Depth to the FWBZ typically increased from east to west across the Line 05 North Area and flow direction in the FWBZ is primarily towards the west with an average gradient of approximately 0.01 ft/ft.

5.2.1.6 *Ecological Habitat*

The Line 05 North Area is comprised of paved and ruderal/disturbed habitat surrounded primarily by dredger tailings with some patches of oak woodland, Fremont cottonwood-oak woodland, and willow scrub.

Typical flora within the dredger tailings consists primarily of non-native grasses and other weedy species, such as Italian thistle and yellow star-thistle. Typical flora within the other vegetative communities include blue oak, valley oak, interior live oak, Fremont cottonwood, poison oak, hoary coffeeberry, California buckeye, wild oak, ripgut brome, hedgehog dog-tail grass, bedstraw, soap plant, and lupine. Fauna commonly encountered within the communities include various raptors, songbirds, Pacific treefrog, southern alligator lizard, mountain garter snake, western rattlesnake, wild turkey, Northern Flicker, Nuttall's woodpecker, California vole, deer mouse, western gray squirrel, raccoon, dusky-footed woodrat, desert cottontail, Botta pocket gopher, coyote, and black-tailed deer. Fauna are not common in the dredger tailings due in part to the cobble-boulder substrate and sparse vegetation cover. Blue elderberry shrubs, potential habitat for the valley elderberry longhorn beetle (*desmocerus californicus dimorphus*) are also scattered throughout the area surrounding Line 05 North.

A *Biological Assessment Report* (ECORP Consulting, Inc., 2005), including a habitat and vegetation map for the Line 05 North Area, was presented in Appendix B of the BOU FSP.

5.2.2 ***Description of Source Areas – Line 05 North Area***

The three source areas (51E, 52E, and E[l]) within the Line 05 North Area and various site features that may have contributed chemicals to soil and/or groundwater are described below and shown in Figure 5.2-1. Site features were identified based on historical soil, soil vapor, and groundwater analytical data, and/or visual inspection and limited data coverage.

5.2.2.1 *Source Area 51E Area*

Source Area 51E is an inactive concrete wash sump approximately 50 feet west of Building 05087. Other features in the Line 05 North Area in proximity to Source Area 51E include a drainage pipe that extended from the wash sump to the low-lying area (Source Area E[l]) immediately west

of the sump. Chemicals that may have been used or handled at Building 05087 include solid propellant, liner materials, and solvents.

5.2.2.2 *Source Area 52E Area*

Source Area 52E is identified as septic tank L5-ST87, an inactive 375-gallon septic tank with associated leach lines directly north of Building 05087. Building 05087 is identified as an engineering test laboratory where solid propellants, liner materials, 1,1,1-trichloroethane, and TCE were handled. Inactive features in the Line 05 North Area that are in proximity to Source Area 52E include:

- Building 05087, including trenches and floor drains;
- A sump south of Building 05087;
- An engine test cell and drainage area west of Building 05087;
- A test cell and blast area at Building 05112;
- A tower pad identified as a potential vertical rocket test stand;
- A material storage area in the southeast portion of the site; and
- A drainage swale in the northeast corner of the Line 05 North Area that potentially received surface water runoff from the area surrounding Building 05087.

5.2.2.3 *Source Area E(l) Area*

Source Area E(l) encompasses two low-lying areas west and northeast of Building 05087. The low-lying area 100 feet west of Building 05087 received overflow from the inactive concrete wash sump (Source Area 51E). Chemicals handled at Building 05087 that could have potentially been discharged to the wash sump include solid propellant, line material, and solvents. The low-lying area approximately 50 feet northeast of Building 05087 potentially received surface water runoff from the inactive storage tank area west of Building 05087.

5.2.3 *Summary and Results of Previous (Pre-2005) Vadose Zone Remedial Investigation – Line 05 North Area*

The following subsections summarize the scope and results of previous (prior to 2005) vadose zone investigations of the source areas and features in the Line 05 North Area, identifies COPCs based on the previous

investigations, and discusses the DQOs and sampling proposed in the BOU FSP.

5.2.3.1 *Summary of Previous (Pre-2005) Vadose Zone Investigations – Line 05 North Area*

Soil samples were collected from four soil borings and seven soil vapor samples were collected at seven locations in the vicinity of Source Areas 51E and 52E between 1984 and 1993. No soil or soil vapor samples were collected in the vicinity of Source Area E(l). Previous investigation areas are described below:

- 1984 – One soil sample was collected from a boring at a depth of 15 feet bgs and analyzed for perchlorate and VOCs.
- 1992 – Seven soil vapor samples were collected at five locations from depths between 4.5 and 18 feet bgs and analyzed for select VOCs.
- 1993 – Soil samples were collected from three soil borings at depths between 1 and 10 feet bgs and analyzed for perchlorate, SVOCs, and selected metals.

5.2.3.2 *Results of Previous (Pre-2005) Vadose Zone Investigations – Line 05 North Area*

The results of the previous investigations of Source Areas 51E and 52E, as presented in the BOU FSP (Aerojet et al., 2006b), are summarized below. Review of the previous data identified the following COPCs in soil and/or soil vapor within the Line 05 North Area:

- **Soil –** SVOCs, perchlorate, and metals; and
- **Soil Vapor –** VOCs, including light hydrocarbons.

Figures showing previous sampling locations in the source areas within the Line 05 North Area and chemical groups detected in soil vapor and soil samples collected between 1991 and 2005 above human health and ecological screening levels were presented in the BOU FSP (Aerojet et al., 2006b) and are included in Appendix E. The BOU FSP also presented a summary of statistics and the sample results for chemicals detected in soil, soil vapor, and groundwater that exceed human health and ecological screening levels in the Line 05 North Area.

5.2.3.3 *Summary of Data Needs – Line 05 North Area*

Based on a review of the previous vadose zone investigation data, extensive aerial photograph research and review, and exhaustive research of historical documents, Aerojet determined that additional soil and soil vapor sampling was needed in the Line 05 North Area to:

- Characterize the present lateral and vertical extent of VOCs, SVOCs, metals (not including hexavalent chromium), perchlorate, TPH, NDMA, and nitroguanidine in the vadose zone at the source areas and surrounding site features that could potentially pose a risk to human and ecological receptors;
- Evaluate the potential for chemicals in soil to degrade surface or groundwater quality; and
- Obtain sufficient data to support fate and transport modeling, evaluation of risk to human and ecological receptors, and evaluation of potential remedial alternatives.

It should be noted that due to the time lapse (12 years) since the Stage 1 RI was performed and the elevated laboratory reporting limits for VOCs during that investigation, the investigation of VOCs performed during the BOU was designed to supersede all previous soil vapor and soil VOC investigation results.

5.2.4 *Summary and Results of Boundary Operable Unit Vadose Zone Investigation – Line 05 North Area*

The following subsections summarize the BOU investigation (2005 to 2007) of the three source areas and various features within the Line 05 North Area, describe deviations from the sampling proposed in the BOU FSP, describe the site-specific geology and hydrogeology, and present the results of the BOU RI. The results of the sampling with respect to the completeness of the characterization and identification of potential sources are discussed in Section 5.2.5.

5.2.4.1 *Summary of Boundary Operable Unit Vadose Zone Investigation – Line 05 North Area*

The BOU RI of the vadose zone at the source areas [51E, 52E, and E(l)] and other features in the Line 05 North Area included the following activities.

Soil Vapor Investigation

- A total of 29 primary and 7 duplicate soil vapor samples were collected within the Line 05 North Area and analyzed for VOCs, including TICs. Soil vapor sampling locations are shown in Figure 5.2-2.
- The number of soil vapor samples (including QA/QC samples) collected at each of the three source areas, along with the analytical methods, are provided on Table 5.2-2.
- A cross-reference between soil vapor sampling locations within the Line 05 North Area and the specific features they were sited to investigate is provided on Table 5.2-3.

Surface and Subsurface Soil Investigation

- A total of 24 primary and 5 duplicate surface and/or near-surface (0 to 2.5 feet bgs) soil samples and 50 primary and 8 duplicate subsurface (3.75 to 62 feet bgs) soil samples were collected at the three source areas and various features in the Line 05 North Area. Surface/near-surface and subsurface soil sampling locations are shown in Figures 5.2-3 and 5.2-4, respectively.
- Surface and/or near-surface soil samples were analyzed for SVOCs, metals (including hexavalent chromium), perchlorate, TPH-D, TPH-Mo, total cyanide, NDMA, nitroguanidine, CEC, pH and/or geotechnical parameters. The SVOC analysis of soil samples also included an evaluation of the presence of TICs. In accordance with the BOU FSP, sample analysis was based on the analytical results from previous investigations and, therefore, every sample was not analyzed for the full suite of constituents.
- Subsurface soil samples were analyzed for SVOCs, metals (including hexavalent chromium), perchlorate, TPH-D, TPH-Mo, NDMA, nitroguanidine, TOC, CEC, pH, DI-WET, and/or geotechnical parameters. The SVOC analysis included an evaluation of TICs. In accordance with the BOU FSP, sample analysis was based on the analytical results from previous investigations and, therefore, every sample was not analyzed for the full suite of constituents.
- The numbers of surface/near-surface and subsurface soil samples collected for each analysis (including QA/QC samples) at each of the five source areas, along with the corresponding methods, are provided on Table 5.2-1.

- A cross-reference between soil sampling locations within the Line 05 North Area and the specific features they were sited to investigate is provided on Table 5.2-3.

5.2.4.2 *Deviations from Boundary Operable Unit Data Quality Objectives and Sampling Design – Line 05 North Area*

Soil and soil vapor sampling activities at Source Areas 51E, 52E, and E(l) and other site features in the Line 05 North Area during the RI were generally consistent with those proposed by the BOU FSP, with the exceptions listed on Tables 5.2-4 and 5.2-5. Sampling was performed at locations proposed in the BOU FSP and step-out sampling was performed in accordance with the procedures agreed upon with the agencies. A comparison of proposed and actual sampling activities, including sampling rationale, sample depth, and analyses, is provided on Tables 5.2-4 and 5.2-5. Soil and soil vapor sampling locations and the specific features they were sited to investigate are cross-referenced on Table 5.2-3.

5.2.4.3 *Results of Boundary Operable Unit Vadose Zone Investigation – Line 05 North Area*

The results of the VOC, SVOC, metals, perchlorate, TPH-D and TPH-Mo, total cyanide, nitroguanidine, NDMA, pH, TOC, CEC, DI-WET, and geotechnical analyses of samples collected in the Line 05 North Area during the BOU RI are summarized below. The analytical results for all soil vapor and soil samples are provided in Appendices F and G, respectively.

<u>Summary of Investigation and Results – Volatile Organic Compounds</u>

Based on evaluation of the existing data for the Line 05 North Area, the BOU FSP concluded that additional soil vapor sampling was needed to sufficiently characterize the nature and extent of VOCs. As indicated on Table 5.2-2 and below, 29 primary soil vapor samples were collected at Source Areas 51E and 52E and other site features in the Line 05 North Area during the BOU RI and analyzed for VOCs. The number of primary soil vapor samples analyzed for VOCs and sampling locations at Source Areas 51E and 52E are summarized on Table 5.2-2 and below. Summary statistics for the samples are also presented on Table 5.2-2.

Source Area	Depth (ft bgs)	No. of Primary Samples	No. of Locations
51E	0-10	1	1
	11-20	1	1
	21-30	0	0
	>30	0	0
52E	0-10	21	21
	11-20	5	5
	21-30	2	2
	>30	0	0

The analytical results for the soil vapor samples collected from the shallow (0 to 10 feet bgs), intermediate (11 to 20 feet bgs), and deep (21 to 30 feet bgs) intervals at Source Areas 51E, 52E, and other site features in the Line 05 North Area, are presented in Appendix F and summarized below. Soil vapor sampling locations in the Line 05 North Area are shown in Figure 5.2-2. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 5.2-3. TICs were not detected in the soil vapor samples collected from the shallow, intermediate, and deep intervals.

Soil vapor sampling locations and PCE, TCE, chloroform, and TVOC concentrations in the shallow, intermediate, and deep intervals in the Line 05 North Area above their RISLs are shown in Figure 5.2-5a. Additionally, TVOC concentrations above the RISL are shown in Figure 5.2-5b. PCE, TCE, and chloroform concentrations in the shallow, intermediate, and deep intervals in the Line 05 North Area above their PGW SSLs are shown in Figure 5.2-6. The analytical results and concentrations are presented for PCE, TCE, and chloroform because they were the VOCs most frequently detected above their screening levels in the Line 05 North Area.

The TVOC concentrations illustrated in Figures 5.2-5a and 5.2-5b represent the sum of the ratio of the concentration for each detected VOC in the sample divided by its RISL. For example, if PCE at a concentration of 320 $\mu g/m^3$ and TCE at a concentration of 961 $\mu g/m^3$ were the only VOCs detected in the samples, then the sum of their respective concentrations divided by their respective RISLs of 320 and 961 $\mu g/m^3$ would be 2, or:

$$PCE = \frac{320\,\mu g/m^3}{320\,\mu g/m^3} = 1$$

$$TCE = \frac{961\,\mu g/m^3}{961\,\mu g/m^3} = 1$$

$$TVOC\ Ratio = 2$$

As agreed upon with the agencies, this line represents the extent to which soil vapor characterization would be performed during the BOU RI.

Cross sections presenting generalized vadose zone lithology and soil vapor sampling results in the Line 05 North Area are presented in Figures 5.2-7 and 5.2-8.

Shallow Soil Vapor (0 to 10 feet bgs) – Volatile Organic Compounds:

- A total of 22 primary and 5 duplicate soil vapor samples were collected from the shallow layer at 22 locations associated with Source Areas 51E, 52E, and other site features in the Line 05 North Area. Soil vapor sampling locations are shown in Figure 5.2-2. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 5.2-3.
- TCE was the only VOC detected in the shallow soil vapor at concentrations above its RISL and PGW SSL. TCE was detected at a concentration of 1,600 µg/m^3, above its RISL of 320 µg/m^3, and PGW SSL of 527 µg/m^3 in the shallow soil vapor sample collected at location 52E-SP22 (Figure 5.2-5a).

Intermediate Soil Vapor (11 to 20 feet bgs) – Volatile Organic Compounds:

- Six primary and one duplicate soil vapor samples were collected from the intermediate layer at six locations associated with Source Areas 51E, 52E, and other site features in the Line 05 North Area. Soil vapor sampling locations in the Line 05 North Area are shown in Figure 5.2-2. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 5.2-3.
- PCE and TCE were the only VOCs detected in intermediate soil vapor samples at concentrations above their respective RISLs. Intermediate soil vapor samples having concentrations of PCE and TCE exceeding their RISLs are listed on the table below. An intermediate soil vapor sample was not collected at location 52E-SP22 due to the presence of

Perched Groundwater. Concentrations of PCE, TCE, and TVOCs above their RISLs are shown in Figure 5.2-5a. TVOC concentrations above the RISLs are also shown on Figure 5.2-5b.

- PCE and TCE were also the only VOCs detected in intermediate soil vapor samples at concentrations above their respective PGW SSLs, as indicated on the table below. Concentrations of PCE and TCE above PGW SSLs are shown in Figure 5.2-6.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
51E-SP11	20	TCE	961	527	7,800	Y	Y
		PCE	320	57	600	Y	Y
52E-SP07	20	TCE	961	527	27,000	Y	Y
		PCE	320	57	2,300	Y	Y

Deep Soil Vapor (21 to 30 feet bgs) – Volatile Organic Compounds:

- Two primary and one duplicate soil vapor samples were collected from the deep interval at two locations (52E-SP17 and 52E-SP19) in the Line 05 North Area. Deep soil vapor sampling locations in the Line 05 North Area and PCE, TCE, and chloroform concentrations are depicted in Figures 5.2-5a and 5.2-6. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 5.2-3.
- VOCs were not detected above their respective RISLs or PGW SSLs in the deep soil vapor samples. Deep soil vapor samples were not collected at locations 51E-SP11 and 52E-SP07 due to the presence of groundwater.

<u>Summary of Investigation and Results – Metals</u>

A total of 73 primary and 13 duplicate soil samples were collected at Source Areas 51E, 52E, E(l), and other site features in the Line 05 North Area during the BOU RI and analyzed for metals, including hexavalent chromium and/or mercury. The number of primary soil samples and sampling locations in the Line 05 North Area are summarized on Table 5.2-1 and below. Summary statistics for the samples are also presented on Table 5.2-1.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
51E	Metals	2	2	6	2
	Mercury	2	2	5	2
	Hex Chrome	0	0	0	0
52E	Metals	20	20	39	20
	Mercury	19	19	38	19
	Hex Chrome	2	2	0	0
E(l)	Metals	1	1	5	1
	Mercury	1	1	5	1
	Hex Chrome	0	0	0	0

The results of the metals analysis of surface/near-surface and subsurface soil samples collected at Source Areas 51E, 52E, E(l), and other site features in the Line 05 North Area are presented in Appendix G and summarized below.

Metals detected in soil within the Line 05 North Area at concentrations statistically different than background and subsequently compared to screening levels were antimony, cadmium, lead, molybdenum, and zinc. Because boron, hexavalent chromium, lithium, strontium, and titanium were not included in the background evaluation, concentrations of these metals were also compared to screening levels.

Surface and subsurface soil sampling locations and metals detected at concentrations above their respective RISLs and PGW SSLs are shown in Figures 5.2-9 and 5.2-10, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 5.2-3.

Surface and Near-Surface Soil – Metals:

- A total of 23 primary and 5 duplicate surface/near-surface soil samples were collected at 23 locations at Source Areas 51E, 52E, E(l), and other site features in the Line 05 North Area and analyzed for metals. Twenty-two of the 23 surface/near-surface soil samples were analyzed for mercury and two samples were also analyzed for hexavalent chromium.
- Cadmium and lead were the only metals detected in surface/near-surface soils collected within the Line 05 North Area above background and above its RISL or PGW SSL. The detected concentrations of those metals above their respective RISLs and PGW SSLs, along with the depth and location of the samples are provided on the table below. The location of surface/near-surface samples with

concentrations of cadmium and lead above their RISLs and PGW SSLs are shown in Figure 5.2-9 and 5.2-10, respectively.

Sample Location	Depth (ft bgs)	Metal	RISL (mg/kg)	PGW SSL (mg/kg)	Conc. (mg/kg)	> RISL	> PGW SSL
52E-SNS01	0.5	Cadmium	1.7	1.2	4.8	Y	Y
		Lead	150	23	170	Y	Y
52E-SB05	1.5	Cadmium	1.7	1.2	1.8	Y	Y
		Lead	150	23	52	N	Y
52E- SB12	1.0	Cadmium	1.7	1.2	4.0	Y	Y
		Lead	150	23	39	N	Y

Subsurface Soil – Metals:

- A total of 50 primary and 7 duplicate subsurface soil samples were collected at 23 locations at Source Areas 51E, 52E, E(l), and other site features in the Line 05 North Area and analyzed for metals. Forty-eight of the 50 primary soil samples were also analyzed for mercury and one of the primary samples was analyzed for hexavalent chromium. Subsurface soil sampling locations for metals are shown in Figures 5.2-9 and 5.2-10.
- Metals were not detected above their respective RISLs or PGW SSLs in the subsurface soil samples collected in the Line 05 North Area, including those collected from borings 52E-SNS01, 52E-SB05, and 52E-SB12.

Summary of Investigation and Results – Semivolatile Organic Compounds

A total of 46 primary and 7 duplicate soil samples were collected at Source Areas 51E, 52E, E(l), and other site features in the Line 05 North Area, during the BOU RI and analyzed for SVOCs, including TICs. The number of primary soil samples and sampling locations in the Line 05 North Area for SVOCs are summarized on Table 5.2-1 and below. Summary statistics for the samples are also presented on Table 5.2-1.

		Surface/Near-Surface		Subsurface	
Source Area	Compound	No. of Samples	No. of Locations	No. of Samples	No. of Locations
51E	SVOCs	2	2	4	1
52E	SVOCs	18	18	16	9
E(l)	SVOCs	1	1	5	1

The results of the SVOC analysis of surface/near-surface and subsurface soil samples collected from the Line 05 North Area are presented in Appendix G and below. Surface/near-surface and subsurface soil sampling locations and SVOCs detected at concentrations above their RISLs and PGW SSLs are shown in Figures 5.2-11 and 5.2-12, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 5.2-3.

Surface and Near-Surface Soil – Semivolatile Organic Compounds:

- A total of 21 primary and 5 duplicate surface and/or near-surface soil samples were collected at 21 locations within the Line 05 North Area and analyzed for SVOCs, including TICs (Figures 5.2-11 and 5.2-12).
- The TIC heptadecane was detected in a near surface soil sample (51E-SB04 at 1 foot bgs) at a concentration of 300 µg/kg.
- SVOCs detected in surface and/or near-surface soil above their respective RISLs or PGW SSLs are listed on the table below. B(a)P and B(b&k)F concentrations above their RISLs are shown in Figure 5.2-11. B(a)A, B(a)P, B(b&k)F, D(a,h)A, and I(1,2,3-cd)P concentrations above their respective PGW SSLs are shown in Figure 5.2-12.

Sample Location	Depth (ft bgs)	SVOC	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	> RISL	> PGW SSL
52E-SNS01	0.5	Benzo(a)anthracene	620	29	88	N	Y
		Benzo(b&k)fluoranthene	38	29	350	Y	Y
		Benzo(a)pyrene	38	2.9	130	Y	Y
		Dibenz(a,h)anthracene	62	2.9	14	N	Y
		Indeno(1,2,3-cd)pyrene	621	29	57	N	Y
52E-SB04	1.0	Benzo(b&k)fluoranthene	38	29	180	Y	Y

Subsurface Soil – Semivolatile Organic Compounds:

- A total of 25 primary and 2 duplicate subsurface soil samples were collected at 11 locations within the Line 05 North Area and analyzed for SVOCs, including TICs (Figures 5.2-11 and 5.2-12).
- Two TICs were detected in subsurface soil samples collected in the Line 05 North Area. (Z)-9-Octadecenamide was detected at 160 µg/kg in a sample collected at 5 feet bgs at location 51E-SB04. 1,1,2-Trichloroethane was detected at 240 and 220 µg/kg in samples collected from boring E(l)-SB01 at 22 and 62 feet bgs, respectively.
- SVOCs were not detected above their respective RISLs or PGW SSLs in subsurface soil within the Line 05 North Area. Subsurface soil samples

were not collected at locations 52E-SNS01 and 52E-SB04 where SVOCs were detected above their screening levels in surface/near-surface soil.

Summary of Investigation and Results – Perchlorate

A total of 72 primary and 6 duplicate soil samples were collected at Source Areas 51E, 52E, and E(l) and other site features in the Line 05 North Area during the BOU RI and analyzed for perchlorate. The number of primary soil samples and sampling locations in the Line 05 North Area for perchlorate are summarized on Table 5.2-1 and below. Summary statistics for the samples are also presented on Table 5.2-1.

		Surface/Near-Surface		Subsurface	
Source Area	**Compound**	**No. of Samples**	**No. of Locations**	**No. of Samples**	**No. of Locations**
51E	Perchlorate	2	2	6	2
52E	Perchlorate	21	21	37	17
E(l)	Perchlorate	1	1	5	1

The results of the perchlorate analysis of surface/near-surface and subsurface soil samples collected within the Line 05 North Area are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations for perchlorate are shown in Figure 5.2-13. Soil sampling locations and the features being investigated are cross-referenced on Table 5.2-3.

Surface and Near-Surface Soil – Perchlorate:

- A total of 24 primary and 4 duplicate surface and/or near-surface soil samples were collected at 24 locations at Source Areas 51E, 52E, and E(l) and other site features in the Line 05 North Area and analyzed for perchlorate (Figure 5.2-13).
- Perchlorate was not detected above its RISL in any of the surface/near-surface soil samples collected within the Line 05 North Area.
- Perchlorate was detected at concentrations above its PGW SSL in five surface/near-surface soil samples collected at five locations within the Line 05 North Area. Detected concentrations of perchlorate above its PGW SSL and the sample location and depth are provided in the table below. Perchlorate concentrations above the PGW SSL are shown in Figure 5.2-13.

Sample Location	Depth (ft bgs)	Compound	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	< RISL	< PGW SSL
52E-SB05	1.5	Perchlorate	7,800	60	260	N	Y
52E-SB07	1.0	Perchlorate	7,800	60	77	N	Y
52E-SB12	1.0	Perchlorate	7,800	60	65	N	Y
52E-SB14	1.5	Perchlorate	7,800	60	86	N	Y
E(l)-SB01	0.25	Perchlorate	7,800	60	86	N	Y

Subsurface Soil – Perchlorate:

- A total of 48 primary and 2 duplicate subsurface soil samples were collected at 20 locations at Source Areas 51E, 52E, and E(l) and other site features in the Line 05 North Area and analyzed for perchlorate (Figure 5.2-13).
- Perchlorate was not detected at concentrations above its RISL in subsurface soil samples collected within the Line 05 North Area.
- Perchlorate at concentrations above its PGW SSL was detected in only two subsurface soil samples collected at one location within the Line 05 North Area. The detected concentrations of perchlorate and the locations and depths of the samples are provided on the table below. Perchlorate concentrations above its PGW SSL are shown in Figure 5.2-13.
- As indicated on the table below, perchlorate was not detected at concentrations above its PGW SSL in subsurface soil samples collected at locations 52E-SB05, 52E-SB07, 52E-SB12, and E(l)-SB01.

Sample Location	Depth (ft bgs)	Compound	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	< RISL	< PGW SSL
52E-SB05	5.0	Perchlorate	7,800	60	54	N	N
	11.5				<5.3	N	N
52E-SB07	5.0	Perchlorate	7,800	60	<20	N	N
	11				<20	N	N
52E-SB12	5.0	Perchlorate	7,800	60	<58	N	N
	11				<57	N	N
	22				<52	N	N
	42				<55	N	N
	62				<59	N	N
52E-SB14	5.0	Perchlorate	7,800	60	520	N	Y
	11.5				240	N	Y

Sample Location	Depth (ft bgs)	Compound	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	< RISL	< PGW SSL
E(l)-SB01	5	Perchlorate	7,800	60	<58	N	N
	11				<57	N	N
	22				<52	N	N
	42				<55	N	N
	62				<59	N	N

Summary of Investigation and Results – Total Petroleum Hydrocarbons

A total of 57 primary and 7 duplicate soil samples were collected at Source Areas 51E, 52E and E(l) and other site features in the Line 05 North Area during the BOU RI and analyzed for TPH-D and TPH-Mo. The number of primary soil samples and sampling locations for TPH in the Line 05 North Area are summarized on Table 5.2-1 and below. Summary statistics for the samples are also presented on Table 5.2-1.

		Surface/Near-Surface		Subsurface	
Source Area	Compound	No. of Samples	No. of Locations	No. of Samples	No. of Locations
51E	TPH-D & Mo	0	0	6	2
52E	TPH-D & Mo	19	19	26	14
E(l)	TPH-D & Mo	1	1	5	1

The results of TPH-D and TPH-Mo analysis of surface/near-surface and subsurface soil samples collected within the Line 05 North Area are presented in Appendix G and below. Surface and subsurface soil sampling locations and TPH-D detected at concentrations above its PGW SSL are shown in Figure 5.2-13. Soil sampling locations and the features being investigated are cross-referenced on Table 5.2-3.

Surface/Near-Surface Soil – Total Petroleum Hydrocarbons:

- A total of 20 primary and 5 duplicate surface/near-surface soil samples were collected at 20 locations at Source Areas 51E, 52E, and E(l) and other site features in the Line 05 North Area and analyzed for TPH-D and TPH-Mo.
- TPH-D and/or TPH-Mo above their PGW SSLs were detected in only four surface/near-surface soil samples collected at four locations (Figure 5.2-13). These samples were located at Source Area E(l), the test cell at the west end of Building 05087, adjacent to the sump on the

south side of Building 05087, and at the inlet to the drainage ditch in the northeast corner of the Line 05 North Area.

- Hydrocarbons detected at concentrations above their PGW SSLs, the location and the depth of the sample with the detected concentration, are summarized on the table below. TPH-D and TPH-Mo concentrations above their PGW SSLs are shown in Figure 5.2-13.

Sample Location	Depth (ft bgs)	Compound	PGW SSL (mg/kg)	Conc. (mg/kg)	< PGW SSL
51E-SB04	1.0	TPH-D	100	29	N
		TPH-Mo	500	89	N
52E-SNS01	0.5	TPH-D	100	180	Y
		TPH-Mo	500	550	Y
52E-SB04	1.0	TPH-D	100	33	N
		TPH-Mo	500	81	N
52E-SB05	1.5	TPH-D	100	2,200	Y
		TPH-Mo	500	5,700	Y
52E-SB06	1.5	TPH-D	100	230	Y
		TPH-Mo	500	580	Y
52E-SB19	1	TPH-D	100	89	N
		TPH-Mo	500	340	N
L5-ST87-SB01	1	TPH-D	100	100	N
		TPH-Mo	500	330	N
E(l)-SB01	0.25	TPH-D	100	150	Y
		TPH-Mo	500	220 J	N

Subsurface Soil – Total Petroleum Hydrocarbons:

- A total of 37 primary and 2 duplicate subsurface soil samples were collected at 17 locations at Source Areas 51E, 52E, and E(l) and other site features in the Line 05 North Area and analyzed for TPH-D and TPH-Mo.

- TPH-D and TPH-Mo were not detected above their respective PGW SSLs in subsurface soil samples collected within the Line 05 North Area, including those collected from borings 52E-SB05, 52E-SB06, and E(l)-SB01.

Sample Location	Depth (ft bgs)	Compound	PGW SSL (mg/kg)	Conc. (mg/kg)	< PGW SSL
51E-SB04	5.0	TPH-D	100	<2.1	N
		TPH-Mo	500	5.0	N
	11	TPH-D	100	54	N
		TPH-Mo	500	170	N

Sample Location	Depth (ft bgs)	Compound	PGW SSL (mg/kg)	Conc. (mg/kg)	< PGW SSL
	23	TPH-D	100	<2.7	N
		TPH-Mo	500	4.6	N
	45	TPH-D	100	<2.6	N
		TPH-Mo	500	3.5	N
52E-SNS01	5.0	TPH-D	100	1.5	N
		TPH-Mo	500	2.7	N
	11	TPH-D	100	<2.5	N
		TPH-Mo	500	2.6	N
52E-SB04	5.5	TPH-D	100	14	N
		TPH-Mo	500	24	N
52E-SB05	5.0	TPH-D	100	17	N
		TPH-Mo	500	14	N
	11.5	TPH-D	100	<3.9	N
		TPH-Mo	500	<6.1	N
52E-SB06	5.0	TPH-D	100	10	N
		TPH-Mo	500	<15	N
52E-SB19	5.0	TPH-D	100	9.2	N
		TPH-Mo	500	26	N
	11	TPH-D	100	<2.9	N
		TPH-Mo	500	3.0	N
L5-ST87-SB01	4.0	TPH-D	100	<22	N
		TPH-Mo	500	74	Y
	11	TPH-D	100	<2.3	N
		TPH-Mo	500	4.9	N
	23	TPH-D	100	<3.0	N
		TPH-Mo	500	3.8	N
	43	TPH-D	100	<2.5	N
		TPH-Mo	500	<5.1	N
E(l)-SB01	5.0	TPH-D	100	1.7	N
		TPH-Mo	500	4.4	N
	11	TPH-D	100	23	N
		TPH-Mo	500	35	N
	22	TPH-D	100	2.7	N
		TPH-Mo	500	5.7	N
	42	TPH-D	100	2.2	N
		TPH-Mo	500	3.9	N
	62	TPH-D	100	2.2	N
		TPH-Mo	500	4.9	N

Summary of Investigation and Results – Miscellaneous Compounds

Miscellaneous analyses performed on soil samples collected from Source Areas 51E, 52E, and E(l) and other site features in the Line 05 North Area

were total cyanide, NDMA, nitroguanidine, pH, TOC, CEC, and/or DI-WET. The number of primary surface/near-surface and subsurface soil samples collected and the numbers of locations associated with each source area are summarized on the table below.

		Surface/Near-Surface		Subsurface	
Source Area	**Compound**	**No. of Samples**	**No. of Locations**	**No. of Samples**	**No. of Locations**
51E	NDMA	2	2	4	1
	Nitroguanidine	2	2	4	1
	TOC	1	1	4	1
	CEC	1	1	4	1
52E	Total Cyanide	1	1	0	0
	NDMA	17	17	9	5
	Nitroguanidine	16	16	31	15
	pH	1	1	1	1
	TOC	1	1	0	0
	DI-WET	0	0	1	1
E(l)	Nitroguanidine	1	1	5	1
	DI-WET	0	0	1	1

The analytical results for the miscellaneous analyses of surface/near-surface and subsurface soil samples are presented in Appendix G and summarized below. The analytical data for pH, TOC, and CEC are used in the risk assessments to evaluate the bioavailability of some chemicals with respect to human and ecological receptors. The TOC, CEC, and DI-WET data are used in the FS to evaluate chemical and physical remedial actions, assess the potential for metals in soil to migrate into groundwater, and develop cleanup goals protective of groundwater.

Total Cyanide: The soil sampling location (52E-SB12) for total cyanide in the Line 05 North Area is shown in Figure 5.2-3. Soil sampling locations and the features being investigated are cross-referenced on Table 5.2-3.

Total cyanide was not detected above its PQL of 540 µg/kg in the near-surface soil sample collected at 52E-SB12. The PQL is well below the RISL and PGW SSL for cyanide.

N-Nitrosodimethylamine: Surface and subsurface soil sampling locations for NDMA within the Line 05 North Area are shown in Figures 5.2-13. Soil sampling locations and the features being investigated are cross-referenced on Table 5.2-3.

NDMA was not detected at concentrations above the PQL in surface/near-surface or subsurface soil samples collected within the Line 05 North Area.

Nitroguanidine: Surface and subsurface soil sampling locations for in the Line 05 North Area are shown in Figures 5.2-3 and 5.2-4. Soil sampling locations and the features being investigated are cross-referenced on Table 5.2-3.

Nitroguanidine was not detected at concentrations above the PQL, RISL, or PGW SSL in surface/near-surface or subsurface soil samples collected within the Line 05 North Area.

pH: The results of pH analysis of two surface/near-surface and one subsurface soil samples, including duplicates, collected from sample location 52E-SB12, within Building 05087 ranged from 8.01 to 8.67. The pH of the soil is within the normal range (5 to 9) for mineral soils (Brady, 1974).

Total Organic Carbon: TOC was detected at a concentration of 5,600 mg/kg in one near-surface soil sample collected at 1 foot bgs at location 52E-SB23. TOC was not detected in the surface/near surface and subsurface soil samples collected at location 51E-SB04.

Cation Exchange Capacity: CEC in the five surface/near surface and subsurface soil samples collected from boring 51E-SB04 ranged from 100 to 720 meq/K.

Waste Extraction Test using Deionized Water: A DI-WET was performed on two samples collected within the Line 05 North Area (Figure 5.2-4). The sample extracts were analyzed for arsenic, manganese, thallium, and/or titanium. The concentrations of those metals detected in the soil sample and the sample extract are presented on the table below.

Sample ID	Sample Depth (ft bgs)	Compound	Soil Conc. (mg/kg)	Extract Conc. (µg/L)
L5-ST87-SB01	23	Titanium	1,500	380
E(l)-SB01	5	Titanium	1,600	130
		Manganese	1,300	380
		Arsenic	7.4	<1.0 U
		Thallium	3.1	<1.0 U

µg/L = Micrograms per liter

Summary of Investigation and Results – Geotechnical Parameters

A total of five soil samples were collected from boring 51E-SB04 directly north of Source Area 51E and analyzed for geotechnical parameters, including moisture content, wet density, dry density, specific gravity, porosity, sieve analysis, and/or permeability. The results of the geotechnical analyses are summarized on Table 5.2-6.

The geotechnical data will be used in the risk assessment to develop site-specific soil input parameters (moisture content, water-filled porosity, air-filled porosity, etc.) for fate and transport models and in the FS to assess potential remedial actions such as vapor extraction. Fate and transport models are used in risk assessment to quantitatively evaluate the migration of volatile organics into outdoor and indoor air and the potential leaching of chemicals through soil and into groundwater.

5.2.5 Discussion of Investigation Results with Respect to Data Quality Objectives – Line 05 North Area

The analytical results presented in the previous sections identified the following chemical constituents in soil vapor and soil at the source areas within the Line 05 North Area at concentrations above their respective RISLs and/or PGW SSLs:

Soil vapor: TCE and PCE.

Soil: Cadmium, lead, B(a)A, B(b&k)F, B(a)P, D(a,h)A, I(1,2,3-cd)P, perchlorate, TPH-D, and TPH-Mo.

The presence of these COPCs in each source area is discussed below with respect to the data needs described in Section 5.2.3.3. Specifically,

- Has the investigation resulted in sufficient characterization of the lateral and vertical distribution of each COPC in the vadose zone and identified a potential source for those COPCs?
- Has the investigation resulted in sufficient data to evaluate the potential for COPCs in soil to migrate into and degrade surface water and groundwater quality?
- Has the investigation resulted in data sufficient to support human health and ecological risk assessments and fate and transport modeling?

- Has the investigation resulted in sufficient data to evaluate the feasibility of remediating the identified compounds and concentrations to levels that do not pose a risk to human and ecological receptors or degrade surface water and groundwater quality?

For the purpose of this discussion, it is assumed that chemicals detected at concentrations above their RISL could potentially pose a risk to human health and chemicals detected above their PGW SSL could potentially migrate into groundwater or surface water. Sampling locations where VOCs, metals, and other non-VOCs (SVOCs, PCBs, perchlorate, NDMA, TPH-D, and TPH-Mo) were detected in surface and/or subsurface soil at concentrations above their respective PGW SSLs are shown in Figures 5.2-6, 5.2-10, 5.2-12, and 5.2-13.

The analytical results for surface water and groundwater within the WLLO Area are discussed in Sections 5.6 and 5.7, respectively, and discussed with respect to potential soil and soil vapor sources in the Line 05 North Area. Additionally, the potential for chemicals in soil and soil vapor to migrate into surface water and groundwater is further evaluated in Section 8 of the HHERA (Volume II).

5.2.5.1 *Volatile Organic Compounds*

VOCs detected in soil vapor samples collected from the Line 05 North Area are summarized in Section 5.2.4.3. TCE, PCE, chloroform, and TVOC concentrations in the shallow, intermediate, and deep intervals above their RISLs and PGW SSLs are shown in Figures 5.2-5a and 5.2-6, respectively. TVOC concentrations above the RISL are also shown in Figure 5.2-5b. Conclusions regarding the characterization of VOCs based on the data presented in Section 5.2.4.3 and the figures are summarized below.

- TCE and PCE were the only VOCs detected in at least one soil vapor sample collected within the Line 05 North Area above their respective RISLs or PGW SSLs.
- TCE was detected above its RISL in only one shallow soil vapor sample (52E-SP22) collected near a former storage area in the southeast portion of the Line 05 North Area (Figure 5.2-5a). The presence of Perched Groundwater at approximately 16 feet bgs precluded the collection of soil vapor samples from the intermediate and deep intervals at that location.

- As indicated by the concentration plots in Figures 5.2-5a and 5.2-6, Perched Groundwater was commonly encountered at depths greater than 10 feet bgs in the Line 05 North Area, which precluded the collection of soil vapor samples from the intermediate and deep intervals at numerous locations.
- As shown in Figures 5.2-5a and 5.2-6, PCE and TCE were detected above their RISLs and PGW SSLs in the intermediate layer at two locations (51E-SP11 and 52E-SP07) in the Line 05 North Area. The presence of only TCE in the shallow layer at those locations at significantly lower concentrations (16 and 130 $\mu g/m^3$), suggests that the detection of TCE and PCE in the intermediate interval at 51E-SP11 and 52E-SP07 is due to the migration of those VOCs from the Perched Groundwater. Potential sources of VOCs to the Perched Groundwater beneath the Line 05 North Area include the septic system or releases to ground associated with the former test stand area or storage area.

Based on the information presented above and in Figures 5.2-5a and 5.2-6, the lateral and vertical extent of TCE and PCE in the vadose zone in the Line 05 North Area has been characterized to the extent possible given the presence of Perched Groundwater in the area. The VOC data is considered sufficient to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

5.2.5.2 *Metals*

Cadmium and lead were the only metals detected above background and their respective RISLs or PGW SSLs in three soil samples collected at three (52E-SNS01, 52E-SB05, and 52E-SB12) locations at Source Area 52E within the Line 05 North Area (Section 5.2.4.3 and Figures 5.2-9 and 5.2-10). Conclusions regarding the characterization of cadmium and lead at each of the three locations based on the data presented in the text and figures are summarized below.

<u>52E-SNS01 and 52E-SB12</u>

Cadmium was detected above its RISL in a near-surface soil sample (52E-SB12) collected near the northeast corner of Building 05087 and a surface soil sample (52E-SNS01) collected from the west end of the drainage swale (Figure 5.2-9). Additionally, lead was detected above its PGW SSL in the near-surface soil sample collected from boring 52E-SB12 and above its RISL and PGW SSL in the surface soil sample collected at location 52E-SNS01. The data suggest that cadmium and lead released to

soil near the building may have potentially washed into the adjacent drainage swale.

- The lateral extent of cadmium and lead at those locations is characterized by the absence of those metals above their RISLs and PGW SSLs in soil samples collected at surrounding locations (52E-SB10, 52E-SB11, and 52E-SB17).
- The vertical extent is characterized by the absence of cadmium and lead in the samples collected at 5 feet bgs at locations 52E-SNS01 and 52E-SB12.

52E-SB05

Cadmium at a concentration slightly above its RISL and lead above its PGW SSL was detected in a near-surface (1.5 feet bgs) soil sample collected from boring 52E-SB05 at the west edge of Building 05087 (Figures 5.2-9 and 5.2-10). The absence of cadmium and lead in subsurface soil samples collected from boring 52E-SB05 and in surface soil samples from adjacent borings (52E-SB04, 52E-SB19, and 51E-SB04) indicates that the detected concentrations may be naturally occurring and not indicative of a release.

Based on the information presented above, the lateral and vertical extent of cadmium and lead at Source Area 52E has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives. Additional evaluation of the potential risk to groundwater posed by those metals in soil is presented in Section 8 of the HHERA (Volume II).

5.2.5.3 *Semivolatile Organic Compounds*

B(a)A, B(b&k)F, B(a)P, D(a,h)A, and/or I(1,2,3-cd)P were detected above their respective RISLs or PGW SSLs in two surface/near-surface (0 to 2.5 feet bgs) samples collected at two (52E-SNS01 and 52E-SB04) locations within the Line 05 North Area (Section 5.2.4.3.). B(a)P and B(b&k)F concentrations above their RISLs are shown in Figure 5.2-11. B(a)A, B(a)P, B(b&k)F, D(a,h)A, and I(1,2,3-cd)P concentrations above their respective PGW SSLs are shown in Figure 5.2-12. Conclusions regarding the characterization of SVOCs at both locations based on the data are summarized below.

Three SVOC TICs [(Z)-9-Octadecenamide; 1,1,2-trichloroethane; and heptadecane) were detected in soil samples collected within the Line 05

North Area. Because of the uncertainty surrounding their identification and concentration, a surrogate compound was not identified for the TICs and their concentrations were not compared to RISLs or PGW SSLs.

52E-SNS01

B(b&k)F and B(a)P above their RISLs and PGW SSLs and B(a)A, D(ah)A, and I(1,2,3-cd)P above the PGW SSLs were detected in a surface (0.5 foot bgs) soil sample collected at location 52E-SNS01 (Figures 5.2-11 and 5.2-12). Location 52E-SNS01 is at the outfall of a drain line into the drainage swale in the northeast portion of Line 05 North.

The absence of SVOCs in surface/near-surface soil samples 52E-SB17 and 52E-SNS02, downstream of 52E-SNS01, indicates that SVOCs are likely limited to surface/near-surface soil in a short section of the drainage.

52E-SB04

B(a)P was detected above its RISL and PGW SSL in a near-surface (1 foot bgs) soil sample collected from boring 51E-SB04 at the north end of the concrete wash sump (Figures 5.2-11 and 5.2-12). The presence of B(a)P in soil at this location may be related to historical activities related to the former concrete wash sump or test areas at the west end of Building 05087.

Due to elevated PQLs, the potential presence of B(a)P above its RISL or PGW SSL in three samples collected at two locations (52E-SB04 and 52E-SB05) could not be dismissed. However, the absence of B(a)P in soil at other locations [51E-SB03, E(l)-SB01, and L5-ST87-SB02] indicate that B(a)P is not widespread and that the lateral extent of that compound is likely limited to surface soil in the vicinity of the former concrete wash sump.

Based on the information presented above, the lateral and vertical extent of B(a)A, B(b&k)F, B(a)P, D(a,h)A, and I(1,2,3-cd)P within the Line 05 North Area has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives. Additional evaluation of the potential risk to groundwater posed by those SVOCs in soil is presented in Section 8 of the HHERA (Volume II).

5.2.5.4 *Perchlorate*

Perchlorate at concentrations above its RISL of 7,800 µg/kg was not detected in surface, near-surface, or subsurface soil samples collected from the source areas within the Line 05 North Area (Section 5.2.4.3).

Perchlorate at concentrations above its revised PGW SSL of 60 µg/kg was detected in soil samples collected at five locations in Source Area 52E and one location in Source Area E(l) (Section 5.2.4.3 and Figure 5.2-13). Conclusions regarding the characterization and potential sources of perchlorate at each of the five locations based on the data and figures are summarized below.

<u>52E-SB05</u>

Perchlorate at concentrations above its revised PGW SSL was detected in soil samples collected at 1.5 and 5 feet bgs from boring 52E-SB05 in a drainage area below an engine test cell at Building 05087 (Figure 5.2-13).

- The lateral extent of perchlorate at that location is defined by the absence of that compound above its PGW SSL in soil samples collected from borings 51E-SB03, 51E-SB04, 52E-SB04, and 52E-SB19.
- The vertical extent of perchlorate is defined by the absence of that compound above its PQL and PGW SSL in the soil sample collected at 11.5 feet bgs from boring 52E-SB05.

<u>52E-SB07 and 52E-SB12</u>

Perchlorate at concentrations above its revised PGW SSL was detected in a soil sample collected at 1 foot bgs from borings 52E-SB07 and 52E-SB12, adjacent to the trenches and floor drains inside Building 05087 (Figure 5.2-13).

- The lateral extent of perchlorate at those locations is defined by the absence of that compound above its PGW SSL in soil samples collected from borings 52E-SB06, 52E-SB08, 52E-SB10, 52E-SB11, and 52E-SB13.
- The vertical extent of perchlorate is defined by the absence of that compound above its PQL and PGW SSL in the soil samples collected at depths greater than 1 foot bgs in borings 52E-SB07 and 52E-SB12.

52E-SB14

Perchlorate at concentrations above its revised PGW SSL was detected in soil samples collected at 1.5, 5, and 11.5 feet bgs from boring 52E-SB14, adjacent to the test cell at Building 10112 (Figure 5.2-13).

- The lateral extent of perchlorate at that location is defined by the absence of that compound above its PGW SSL in soil samples collected from borings 52E-SB16, 52E-SB20, 52E-SB21, and 52E-SB22.
- The vertical extent of perchlorate in boring 52E-SB14 was characterized to the PGW SSL of 3,650 µg/kg proposed in the BOU FSP. Concentrations of perchlorate detected in soil from boring 52E-SB14 attenuate with depth

E(l)-SB01

Perchlorate at a concentration above its revised PGW SSL was detected in a soil sample collected at 0.25 foot bgs from boring E(l)-SB01 in a low-lying area west of the engine test cells and former concrete wash sump at Building 05087 (Figure 5.2-13).

- The lateral extent of perchlorate at that location is defined by the absence of that compound above its PGW SSL in soil samples collected from borings 51E-SB03, 51E-SB04, and L5-ST87-SB02.
- The vertical extent of perchlorate is defined by the absence of that compound above its PQL and PGW SSL in the soil samples collected at 5, 11, 22, 42, and 62 feet bgs from boring E(l)-SB01.

Based on the information presented above, the lateral and vertical extent of perchlorate in the Line 05 North Area has not been characterized to the revised PGW SSL of 60 µg/kg. Although the current data is sufficient to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives, additional sampling will likely be required prior to implementing any proposed remedial action.

5.2.5.5 *Total Petroleum Hydrocarbons*

TPH-D and/or TPH-MO were detected in soil at concentrations above their PGW SSLs at four locations [52E-SNS01, 52E-SB05, 52E-SB06, and E(l)-SB01] within the Line 05 North Area (Section 5.1.8.3; Figure 5.2-13). TPH-D and TPH-Mo were not characterized laterally and vertically to their PGW SSLs during the BOU RI. Decisions regarding the need for additional characterizations during the field effort were based on the

presence of SVOCs above their screening levels. Based on the TPH and SVOC results, there is no clear correlation between the occurrences of those compounds in soil in the Line 05 North Area. The presence of TPH-D and TPH-Mo in soil at the four locations within the Line 05 North Area is discussed below.

52E-SNS01

TPH-D and TPH-Mo at concentrations above their PGW SSLs were detected in a near-surface (0.5 foot bgs) soil sample collected at location 52E-SNS01 (Figure 5.2-13). Location 52E-SNS01 is at the outfall of a drain line into the drainage swale in the northeast portion of Line 05 North. The absence of TPH-D and TPH-Mo above their PGW SSLs in soil samples collected from borings 52E-SB17 and 52E-SB18 and in soil samples collected at 5 and 11 feet bgs at location 52E-SNS01 indicates that those compounds are limited to the southern end of the drainage near the outfall.

52E-SB05

TPH-D and TPH-Mo were detected at concentrations above their PGW SSLs in a soil sample collected from boring 52E-SB05 adjacent to the test cells at the west end of Building 05087 (Figure 5.2-13). The presence of TPH-D and TPH-Mo in soil at that location is likely due to surface releases of those compounds during activities associated with the test cells.

- The lateral extent of TPH-D and TPH-Mo in that area is defined by the absence of those compounds above their PGW SSLs in soil samples collected from borings 51E-SB03, 51E-SB04, 52E-SB04, and 52E-SB19.
- The vertical extent of TPH-D and TPH-Mo is defined by the absence of those compounds above their PGW SSLs in soil samples collected at 5 and 11.5 feet bgs from boring 52E-SB05.

52E-SB06

TPH-D and TPH-Mo were detected at concentrations above their PGW SSLs in a near-surface (1.5 feet bgs) soil sample collected from boring 52E-SB06, near the sump along the south side of Building 05087 (Figure 5.2-13). The absence of TPH-D and TPH-Mo in soil samples collected from borings 52E-SB08 and 52E-SB13 and in subsurface soil collected at 5 feet bgs from boring 52E-SB06 indicates that those compounds are limited to soil adjacent to the sump.

E(l)-SB01

TPH-D and TPH-Mo at concentrations above their PGW SSLs were detected in a surface (0.25 foot bgs) soil sample collected at location E(l)-SB01 in the low-lying area [Source Area E(l)] west of Building 05087 (Figure 5.2-13). The low-lying area receives surface water runoff from the west end of Building 05087.

- Although not above their PGW SSLs, the presence of TPH-D and TPH-Mo in the near-surface soil sample collected from boring 51E-SB03 indicates that the detections of those compounds at E(l)-SB01 are probably related to the hydrocarbons identified in boring, 2E-SB05.
- The vertical extent of TPH-D and TPH-Mo at that location is defined by the absence of those compounds above their PGW SSLs in soil samples collected at 5, 11, 22, 42, and 62 feet bgs from boring E(l)-SB01.

Based on the information presented above, the lateral and vertical extent of TPH-D and TPH-Mo in the Line 05 North Area has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives. Additional evaluation of the potential risk to groundwater posed by TPH in soil is presented in Section 8 of the HHERA (Volume II).

5.3 WESTLAKES STORM WATER DETENTION BASINS/OPEN SPACE 6

The Westlakes storm water detention system and Open Space Area 6 (OS6) are synonymous and investigation associated with both areas is discussed in this section. The Westlakes storm water detention system/OS6 (referred to hereafter as the Westlakes) consists of two detention ponds (East and West Pond) and three associated overflow cells (Cells 1 through 3) surrounded by earthen embankments (Figure 5.3-1). Roads atop most of the embankments provided year-round access to the various surface water control features within the Westlakes. The Westlakes was constructed during the 1980s for the purpose of detaining surface water runoff from the Aerojet facility to allow settling of solids prior to discharge from the facility and to provide a mechanism for capture of potentially degraded water before it can migrate off site.

The Westlakes receives storm water runoff from various areas of the Aerojet facility via the Main Administration Area Ditch and Buffalo Creek. The Administration Ditch receives storm water from the following BOU Source Areas: 3D, 4D, 5D, 6D, 8D, 9D, 11D, 12D, 50D, 51D, 52D,

D(b), D(c), D(d), and 52D. In addition, storm water flow is captured from selected Perimeter Groundwater Operable Unit (PGOU) Source Areas including 7D, 10D, and the Former Company Store. Buffalo Creek transects the Aerojet site and receives storm water from many source areas in Area 00, Line 01, Line 02, Line 06, and Zone 3.

Storm water runoff is staged in the Westlakes where it is generally allowed to infiltrate. On the rare occasion when the Westlakes become full, water is discharged from the Westlakes into Lower Buffalo Creek, which empties into the American River. Storm water discharges from the Westlakes to lower Buffalo Creek and the American River are regulated through the NPDES process (RWQCB, 2002).

The movement of water into and between the two ponds and three cells of the Westlakes is controlled through a series of culverts, flow gates, weirs, and pumping stations (Figure 5.3-1). A weir gate controls storm water flows in the Main Administration Ditch. A pump station near the northwest corner of the East Pond lifts storm water from the ditch into the East Pond. Natural flow in Buffalo Creek is towards the west and the Westlakes. Buffalo Creek runs along the south side of the Westlakes and usually discharges directly to Cell 1. If required, a bypass gate in the creek at the midpoint between the East and West Ponds can direct water from Buffalo Creek into one or both ponds. Water that is in the East and/or West Ponds is discharged, as necessary, to the three cells via the pathway described below.

If the East Pond becomes full, a flow gate structure allows water to be directed into the West Pond. When both the East and West Ponds become full, another flow gate structure allows water from both ponds to be discharged into Cell 1. Flow gate structures between the three cells allow for the movement of water from Cell 1 into Cell 2 and from Cell 2 into Cell 3. In addition to being transferred to the adjacent cell, storm water held in Cells 1, 2, and 3 can also be discharged via outlet structures to Lower Buffalo Creek.

No source areas have been identified within the Westlakes and, therefore, the Westlakes were not subject to any previous investigations. Because the potential exists for chemicals from various parts of the Aerojet site to have been carried into and deposited within the Westlakes via surface water and sediment transport through the Main Administration Area Ditch and Buffalo Creek, the Westlakes was included in the BOU RI. Chemicals that could have potentially been present in surface water and

sediment include heavy metals, chlorinated solvents, and rocket fuel components.

This section provides the following information for the Westlakes:

- Describes the environmental setting for the Westlakes;
- Identifies COPCs identified during the previous investigations;
- Presents the data needs identified in the BOU FSP (Aerojet et al., 2006b);
- Summarizes the sampling activities performed during the BOU RI and deviations from the sampling proposed in the BOU FSP; and
- Presents the analytical results for samples collected during the BOU RI and historical data, where appropriate.

The results of the BOU RI with respect to the identification of COPCs; lateral and vertical characterization of COPCs; completeness of the characterization; potential sources; fate and transport of COPCs; and the potential for those COPCs to affect human health, surface water, and groundwater are discussed in Section 5.3.4.

The information presented below regarding the description of source areas and previous investigations was compiled from one or more of the following sources*: Stage 1 Sampling Plan-Zone 1* (Aerojet, 1993a); *Stage 1 Sampling Plan-Zones 3 and 4* (Aerojet 1993b); *Stage 1 Sampling Plan-Zone 2* (Aerojet, 1993c); *Aerojet Superfund Site – Scoping Report, Volumes 1 through 6* (ICF Technology, Inc., 1989); *Aerojet Site; Stage 1 Report - Zones 1 through 4* (ICF Kaiser Engineers, Inc., 1993); or BOU FSP (Aerojet et al., 2006b).

5.3.1 Environmental Setting – Westlakes

The topography, geology, soils, surface water hydrology, general hydrogeology, and ecological habitat of the Westlakes Area are described in the following subsections.

5.3.1.1 Topography

With the exception of the earthen embankments surrounding the Westlakes, the topography is generally flat with a gradual grade that directs surface water from east to west. Surface elevations in the Westlakes range from 125 amsl in the west to 149 amsl in the east.

5.3.1.2 *Geology*

Based on the descriptions from borehole logs for perched and unconfined groundwater wells and borings, the lithologies underlying the Westlakes are comprised of interbedded gravel, sand, silt, and clays overlain by a thin surface layer of silt originating from the retention of surface water in the ponds and cells. Indurated silt (siltstone), clay (claystone), and sand (sandstone) were encountered in several wells at varying depths.

The surface and near surface lithologies in the Westlakes Area are comprised of reworked Quaternary-aged fluvial deposits of cobbles, sand, silt, and clay. Historical information indicates that a smaller dredger performed the dredging in the Westlakes. In the vicinity of the Westlakes Area, the soils were dredged to depths ranging from 20 to 30 feet bgs. Grading activities during construction of the Westlakes makes it difficult to ascertain the actual extent of dredging; the presence of dredge tailings along the south and west boundaries of the Westlakes Area indicate that the entire area was most likely dredged.

The shallow subsurface lithologies described in the well logs and most of the borehole logs are generally consistent with those observed in dredged areas elsewhere on site. However, borelogs from within the detention ponds generally include a surface layer of silt, likely deposited from recent alluvial activity.

5.3.1.3 *Soils*

Soils in the vicinity of the Westlakes consist primarily of Xerorthents, dredge tailings-urban land complex with 0 to 2 percent slopes. The area is made up of leveled dredge tailings. The slopes have been shaped for urban uses. The region is about 45 percent Xerorthents and 40 percent urban land. Included in this region are small areas of Americanos and Natomas soils and Slickens. Americanos soils are on low stream channels and Natomas soils are on low terraces. Xerorthents are small, very deep, and are somewhat excessively drained to excessively drained soils found in areas of dredge tailings. They are formed in material that has a high content of gravel and cobbles derived from mixed sources. The material was deposited as tailings after most of the fine-earth material was washed from it and removed during gold dredging activities. Slopes are generally short, complex, and disturbed (USDA – NRCS 1993).

5.3.1.4 *Surface Water Hydrology*

In addition to the Westlakes, local surface water features include Upper and Lower Buffalo Creek, the Main Administration Ditch, and the Folsom South Canal. With the exception of the Folsom South Canal, surface water features in the Westlakes Area are used to divert and control seasonal storm water runoff from the Aerojet site. The Folsom South Canal, which parallels the Aerojet property line to the south and west, was constructed to provide cooling water to the now inactive Rancho Seco Nuclear facility. Water from the canal is currently used for irrigation.

As described earlier, storm water from various areas of the Aerojet site flows into upper Buffalo Creek or the Administration Ditch and then into the Westlakes. Storm water runoff is staged in the Westlakes where it either infiltrates or is discharged to Lower Buffalo Creek and ultimately to the American River.

5.3.1.5 *Local Hydrogeology*

The first saturated sediments encountered beneath the Westlakes are either part of Perched Groundwater or within the FWBZ. The general hydrogeology beneath the Westlakes is discussed below. Details regarding the occurrence of groundwater within the Westlakes Area and distribution of chemicals in the groundwater are presented in Section 5.7.

<u>Perched Groundwater</u>

Perched Groundwater was not encountered in the boreholes drilled within the Westlakes during the BOU RI. However, because the boreholes were only drilled to a total depth of 6 or 12 feet bgs, it is possible that Perched Groundwater may be present in the Westlakes at depths greater than 12 feet bgs. As discussed in Section 5.7.1.2, isolated Perched Groundwater was encountered at various depths at several locations in the Westlakes Area. The thickness of the perched unit generally ranges from 10- to 60-feet thick and appears to be greatest west of the Westlakes cells.

<u>First Continuous Groundwater</u>

The FWBZ is defined as the first saturated sediments that are laterally continuous across the Westlakes Area. The FWBZ occurs within sands and gravels (with variable amounts of silt) that range from approximately

20- to 60-feet thick. These sands and gravels comprise the upper portion of Layer C of the Sitewide Hydrostratigraphic Model.

The depth to the top of the FWBZ increases from east to west from Line 02 to the Westlakes Area. The top of the FWBZ was encountered at depths of approximately 80 feet bgs near the west side of the Westlakes storm water retention cells. Water level elevations in most FWBZ wells have declined by up to approximately 30 feet. The highest rates of decline (approximately 5 feet per year) were observed from 1983 through 1989. Water level elevations were relatively stable in most wells from 1991 through 2006, with typical water level elevation increases and decreases of approximately 5 feet. Seasonal water level elevation fluctuations of up to 42 feet have been observed, although seasonal fluctuations of 5 to 10 feet were more common. Wells located near the Westlakes Storm Water Retention Cells exhibited the highest seasonal fluctuations.

5.3.1.6 *Hydraulic Gradients*

The hydraulic gradient for the FWBZ was evaluated based on a single water level data set collected in April 2006. This data set was selected because it included water level measurements from the new monitor wells installed during the BOU RI, as well as from existing monitoring wells.

The overall direction of the hydraulic gradient for the FWBZ is from east to west. The gradient deviates beneath Line 02 where the hydraulic gradient trends more to the northwest. This apparent deviation is nearly coincident with the contact between the dredged and non-dredged areas. Downgradient of Line 02 and throughout the Line 05 and Westlakes areas, the direction of the hydraulic gradient is west. The magnitude of the hydraulic gradient across the Line 02/Westlakes Area averages approximately 0.01 ft/ft.

Potential vertical hydraulic gradients between Perched Groundwater and the FWBZ have not been calculated, but Perched Groundwater ranges from approximately 20 to 50 feet higher in elevation than the FWBZ, suggesting a strong potential for downward vertical migration of Perched Groundwater to the FWBZ.

5.3.1.7 *Ecological Habitat*

The storm water detention ponds (Westlakes) are surrounded to the north by annual grassland and to the south by dredger tailings. The detention ponds consist of riparian flora interspersed with ruderal/disturbed

habitat; a highly disturbed vegetation community. Typical flora in the detention ponds consist of cottonwood and willow trees, herbaceous weeds, curly dock, and hard-stem bullrush. Non-native, naturalized Mediterranean grasses represent the predominant flora species within annual grassland habitat and the dredger tailings. Typical fauna in this area includes wild turkey, great blue heron, various raptors and song birds, rock wren, deer mouse, western harvest mouse, common king snake, western rattlesnake, and coyote.

A seasonal wet area was observed along the west boundary of the Westlakes. In addition, Buffalo Creek traverses through the area and riparian flora such as cottonwood and willow trees, blackberry bushes, elderberry shrubs, and various herbaceous species were observed along the edges of the creek. Typical fauna in these areas includes red-wing black bird, marsh wren, and great blue heron.

Blue elderberry shrubs, potential habitat for the valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), were observed scattered throughout the entire Westlakes Area.

5.3.2 *Summary and Results of Previous (Pre-2005) Vadose Zone Remedial Investigation – Westlakes*

As discussed earlier, no source areas have been identified within the Westlakes and, therefore, no previous investigations have been conducted. Due to the potential for chemicals from various parts of the Aerojet site to have been transported into and deposited within the Westlakes via surface water and sediment transport through Buffalo Creek and the Main Administration Area Ditch, Aerojet determined that soil sampling was needed to:

- Assess the potential presence of chemicals in soil within the Westlakes that may have originated from upstream source areas. Chemicals included SVOCs, pesticides (including Prowl), 10,10′-oxybis-10H-phenoxarsine (OBPA), PCBs, perchlorate, nitroguanidine, and metals (including hexavalent chromium);
- Evaluate the potential for chemicals in soil to affect surface or groundwater quality; and
- Obtain sufficient data to support fate and transport modeling, evaluation of risk to human and ecological receptors, and evaluation of potential remedial alternatives.

5.3.3 *Summary and Results of Boundary Operable Unit Vadose Zone Investigation – Westlakes*

The following subsections summarize the BOU investigation (2005 to 2007) of the detention ponds comprising the Westlakes, describe deviations from the sampling proposed in the BOU FSP, and present the results of the BOU RI. The results of the sampling with respect to the completeness of the characterization and identification of potential sources are discussed in Section 5.3.4.

5.3.3.1 *Summary of Boundary Operable Unit Vadose Zone Investigation – Westlakes*

The BOU RI of the vadose zone in the Westlakes included the following activities.

Surface and Subsurface Soil Investigation

- A total of 37 primary surface and/or near-surface (0 to 2.5 feet bgs) soil samples and 19 primary subsurface (4 to 11.5 feet bgs) soil samples were collected at 20 locations within the various ponds and cells comprising the Westlakes. Surface/near-surface and subsurface soil sampling locations are shown in Figures 5.3-2 and 5.3-3, respectively.
- Surface/near-surface and subsurface soil samples were analyzed for SVOCs, metals (including hexavalent chromium), perchlorate, PCBs, TPH-D, TPH-Mo, pesticides, NDMA, nitroguanidine, CEC, TOC, pH, DI-WET, and/or geotechnical parameters. Analysis of soil samples for SVOCs also included an evaluation of the presence of TICs. In accordance with the BOU FSP, sample analysis was based on the analytical results from previous investigations and, therefore, every sample was not analyzed for the full suite of constituents.
- The numbers of surface/near-surface and subsurface soil samples collected within the Westlakes for each analysis (including QA/QC samples), along with the corresponding methods, are provided on Table 5.3-1.
- Soil sampling locations and the specific features they were sited to investigate are cross-referenced on Table 5.3-2.

Soil Vapor Investigation

Soil vapor sampling for VOCs was not proposed in the BOU FSP (Aerojet et al., 2006b) due to the likelihood of encountering wet soil. However, four soil samples collected at two locations were analyzed for VOCs.

5.3.3.2 *Deviations from Boundary Operable Unit Data Quality Objectives and Sampling Design - Westlakes*

Sampling activities in the Westlakes performed during the RI were generally consistent with those proposed in the BOU FSP, with the exceptions listed on Table 5.3-3. Sampling was performed at locations proposed in the BOU FSP and step-out sampling was performed in accordance with the procedures agreed upon with the agencies. A comparison of proposed and actual sampling activities, including sampling rationale, sample depth, and analyses, is provided on Table 5.3-3. Soil sampling locations and the specific features they were sited to investigate are cross-referenced on Table 5.3-2.

5.3.3.3 *Results of Boundary Operable Unit Vadose Zone Investigation - Westlakes*

The results of the metals (including hexavalent chromium), SVOC, PCBs, perchlorate, TPH-D and TPH-Mo, NDMA, pesticides, nitroguanidine, pH, TOC, CEC, DI-WET, and geotechnical analyses of samples collected during the BOU RI from the ponds and cells comprising the Westlakes are summarized below. The analytical results for all soil vapor and soil samples are provided in Appendices F and G, respectively.

Summary of Investigation and Results – Metals

A total of 52 primary soil samples were collected within the Westlakes during the BOU RI and analyzed for metals. Two additional samples were analyzed only for mercury and/or hexavalent chromium. The number of primary soil samples and sampling locations within the Westlakes are summarized on Table 5.3-1 and below. Summary statistics for the samples are also presented on Table 5.3-1.

	Surface/Near-Surface		Subsurface	
Compound	**No. of Samples**	**No. of Locations**	**No. of Samples**	**No. of Locations**
Metals	37	20	15	9
Mercury	34	17	14	9
Hex Chrome	34	17	13	8

The results of the metals analysis of surface/near-surface and subsurface soil samples collected within the Westlakes are presented in Appendix G and summarized below.

Metals detected in soil within the Westlakes at concentrations statistically different than background and subsequently compared to screening levels were antimony and molybdenum. Because boron, hexavalent chromium, lithium, strontium, and titanium were not included in the background evaluation, concentrations of these metals were also compared to screening levels.

Surface and subsurface soil sampling locations within the Westlakes are shown in Figures 5.3-2 and 5.3-3. Soil sampling locations and the features being investigated are cross-referenced on Table 5.3-2.

Surface and Near-Surface Soil – Metals:

- Thirty-seven primary surface/near-surface soil samples were collected at 20 locations within the Westlakes and analyzed for metals, including mercury and hexavalent chromium. Additionally, two primary surface/near-surface soil samples collected at one location were also analyzed only for mercury and hexavalent chromium.
- Antimony and molybdenum were not detected at concentrations above their respective RISLs and PGW SSLs in the surface/near-surface soil samples collected within the Westlakes.

Subsurface Soil – Metals:

- Fifteen primary subsurface soil samples were collected at nine locations within the Westlakes and analyzed for metals, including mercury. Subsurface samples collected at all but one location were also analyzed for hexavalent chromium.
- Antimony and molybdenum were not detected at concentrations above their RISLs or PGW SSLs in the subsurface soil samples collected within the Westlakes.

<u>Summary of Investigation and Results – Semivolatile Organic Compounds</u>

A total of 47 primary soil samples were collected within the Westlakes during the BOU RI and analyzed for SVOCs, including TICs. The number of primary soil samples and sampling locations within the Westlakes for SVOCs are summarized on Table 5.3-1 and below. Summary statistics for the samples are also presented on Table 5.3-1.

Compound	Surface/Near-Surface		Subsurface	
	No. of Samples	No. of Locations	No. of Samples	No. of Locations
SVOCs	34	17	13	9

The results of the SVOC analysis of surface/near-surface and subsurface soil samples collected within the Westlakes are presented in Appendix G and summarized below. Surface/near-surface and subsurface soil sampling locations and B(a)P and B(b&k)F detected at concentrations above their PGW SSLs are shown in Figure 5.3-5. Soil sampling locations and the features being investigated are cross-referenced on Table 5.3-2.

Surface and Near-Surface Soil – Semivolatile Organic Compounds:

- Thirty-four primary surface and/or near-surface soil samples were collected at 17 locations within the Westlakes for SVOCs (Figures 5.3-4 and 5.3-5).
- TICs were not detected during the SVOC analysis of the surface and/or near-surface soil samples.
- SVOCs were not detected above their respective RISLs in surface and/or near-surface soil collected within the Westlakes (Figure 5.3-4).
- B(a)P and B(b&k)F were detected above their PGW SSLs of 2.9 and 29 µg/kg, respectively, in one surface and/or near-surface soil sample collected within the Westlakes. B(a)P at 9.2 µg/kg and B(b&k)F at 29 µg/kg were detected in a soil sample collected at 0.5 foot bgs at location WL-SD08 (Figure 5.3-5). B(a)P and B(b&k)F were not, however, detected at concentrations above their PQL in the soil sample collected at 1.5 feet bgs at that location.

Subsurface Soil – Semivolatile Organic Compounds:

- Thirteen primary subsurface soil samples were collected at nine locations within the Westlakes and analyzed for SVOCs (Figures 5.3-4 and 5.3-5).
- SVOCs were not detected above their respective PQLs and RISLs or PGW SSLs in subsurface soil samples collected within the Westlakes. Additionally, TICs were not detected during the SVOC analysis of the subsurface soil samples.

Summary of Investigation and Results – Polychlorinated Biphenyls

A total of 41 primary soil samples were collected within Westlakes during the BOU RI and analyzed for PCBs. The number of primary soil samples and sampling locations within the Westlakes are summarized on Table 5.3-1 and below. Summary statistics for the samples are also presented on Table 5.3-1.

	Surface/Near-Surface		Subsurface	
Compound	**No. of Samples**	**No. of Locations**	**No. of Samples**	**No. of Locations**
PCBs	34	17	7	5

The results of the PCBs analysis of surface/near-surface and subsurface soil samples collected within the Westlakes are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations and PCBs 1254 and 1260 detected at concentrations above their respective RISLs and PGW SSLs are shown in Figures 5.3-6 and 5.3-7, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 5.3-2.

Surface and Near-Surface Soil – Polychlorinated Biphenyls:

- Thirty-four primary surface/near-surface soil samples were collected at 17 locations within the Westlakes and analyzed for PCBs (Figures 5.3-6 and 5.3-7).
- PCBs were not detected above their respective RISLs in the surface/near-surface soil samples collected within the Westlakes.
- Aroclor 1260 was detected above its PGW SSL in three surface/near-surface soil samples collected from the East and West Ponds within the Westlakes. The location, depth, and associated Aroclor 1260 concentration detected above its PGW SSL in surface and/or near-surface soil are listed on the table below and shown in Figure 5.3-7.

Sample Location	Depth (ft bgs)	PCB	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	> RISL	> PGW SSL
WL-SD04	0.5	Aroclor 1260	220	34	37 J	N	Y
	1.5				<21 UJ	N	N
WL-SD06	0.5	Aroclor 1260	220	34	32 J	N	N
	1.5				38 J	N	Y
WL-SD07	0.5	Aroclor 1260	220	34	35 J	N	Y
	1.5				<20 UJ	N	N

Subsurface Soil – Polychlorinated Biphenyls:

- Seven primary subsurface soil samples were collected at five locations within the Westlakes and analyzed for PCBs (Figures 5.3-6 and 5.3-7).
- PCBs were not detected above their respective RISLs or PGW SSLs in subsurface soil samples collected within the Westlakes.

Summary of Investigation and Results – Perchlorate

A total of 50 primary soil samples were collected within the Westlakes during the BOU RI and analyzed for perchlorate. The number of primary soil samples and sampling locations for perchlorate within the Westlakes are summarized on Table 5.3-1 and below. Summary statistics for the samples are also presented on Table 5.3-1.

	Surface/Near-Surface		Subsurface	
Compound	No. of Samples	No. of Locations	No. of Samples	No. of Locations
Perchlorate	31	17	19	11

The results of the perchlorate analysis of surface/near-surface and subsurface soil samples collected within the Westlakes are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations and perchlorate concentrations above its RISL and PGW SSL are shown in Figures 5.3-6 and 5.3-7. Soil sampling locations and the features being investigated are cross-referenced on Table 5.3-2.

Surface and Near-Surface Soil – Perchlorate:

- Thirty-one primary surface and/or near-surface soil samples were collected at 17 locations within the Westlakes and analyzed for perchlorate (Figures 5.3-6 and 5.3-7).
- Perchlorate was not detected above its RISL or PGW SSL in surface/near-surface soil samples collected within Westlakes.

Subsurface Soil – Perchlorate:

- Nineteen subsurface soil samples were collected at 11 locations within the Westlakes and analyzed for perchlorate (Figures 5.3-6 and 5.3-7).
- Perchlorate was detected at a concentration of 9,000 µg/kg, above the RISL and PGW SSL, in a sample collected at 5 feet bgs from boring

WL-SB01 in Cell 1. Perchlorate was not detected in the soil samples collected at 0.5 and 11 feet bgs from that same boring.

Summary of Investigation and Results – Total Petroleum Hydrocarbons

A total of 14 primary soil samples were collected within the Westlakes during the BOU RI and analyzed for TPH-D and TPH-Mo. The number of primary soil samples and sampling locations for TPH in the Westlakes are summarized on Table 5.3-1 and below. Summary statistics for the samples are also presented on Table 5.3-1.

	Surface/Near-Surface		Subsurface	
Compound	No. of Samples	No. of Locations	No. of Samples	No. of Locations
TPH-D & Mo	14	7	0	0

The results of the TPH-D and TPH-Mo analysis of surface/near-surface soil samples collected within the Westlakes are presented in Appendix G and summarized below. Surface/near-surface soil sampling locations and TPH-D concentrations above the PGW SSL are shown in Figure 5.3-7. Soil sampling locations and the features being investigated are cross-referenced on Table 5.3-2.

- TPH-D and TPH-Mo were not detected above their PGW SSLs in surface/near-surface soil samples collected within the Westlakes.

Summary of Investigation and Results – Miscellaneous Compounds

Miscellaneous analyses performed on soil samples collected within the Westlakes were NDMA, pesticides, OBPA, nitroguanidine, pH, TOC, CEC, and/or DI-WET. The number of primary surface/near-surface and subsurface soil samples collected within the Westlakes for each analysis, and the numbers of locations are summarized on Table 5.3-1 and below. Summary statistics for the samples are presented on Table 5.3-1.

	Surface/Near-Surface		Subsurface	
Compound	No. of Samples	No. of Locations	No. of Samples	No. of Locations
NDMA	8	4	5	4
Pesticides	34	17	7	5
OBPA	42	21	12	8
Nitroguanidine	34	17	7	5
pH	34	17	17	10
TOC	13	10	1	1

Compound	Surface/Near-Surface		Subsurface	
	No. of Samples	No. of Locations	No. of Samples	No. of Locations
CEC	6	5	1	1
DI-WET	10	10	4	4

The analytical results for the miscellaneous analyses of surface/near-surface and subsurface soil samples are presented in Appendix G and summarized below. The analytical data for pH, TOC, and CEC are used in the risk assessments to evaluate the bioavailability of some chemicals with respect to human and ecological receptors. The TOC, CEC, and DI-WET data are used in the FS to evaluate chemical and physical remedial actions, assess the potential for metals in soil to migrate into groundwater, and develop cleanup goals protective of groundwater.

N-Nitrosodimethylamine: Surface and subsurface soil sampling locations for NDMA within the Westlakes are shown in Figures 5.3-6 and 5.3-7. Soil sampling locations and the features being investigated are cross-referenced on Table 5.3-2.

NDMA was not detected above its PQL in the surface/near-surface or subsurface soil samples collected within the Westlakes.

Pesticides: Surface and subsurface soil sampling locations ~~for pesticides~~ within the Westlakes are shown in Figures 5.3-2 and 5.3-3. Soil sampling locations and the features being investigated are cross-referenced on Table 5.3-2.

Pesticides, including pendimethalin (prowl), were not detected above their respective PQL, RISLs, or PGW SSLs in surface/near-surface or subsurface soil collected within the Westlakes.

10,10'-Oxybis-10H-Phenoxarsine: Surface and subsurface soil sampling locations within the Westlakes are shown in Figures 5.3-2 and 5.3-3. Soil sampling locations and the features being investigated are cross-referenced on Table 5.3-2.

OBPA was not detected above its PQL, RISL, or PGW SSL in surface/near-surface or subsurface soil samples collected within the Westlakes.

Nitroguanidine: Surface and subsurface soil sampling locations within the Westlakes are shown in Figures 5.3-2 and 5.3-3. Soil sampling locations and the features being investigated are cross-referenced on Table 5.3-2.

Nitroguanidine was not detected above the PQL, RISL, or PGW SSL in surface/near-surface or subsurface soil samples collected within the Westlakes.

pH: The results of pH analysis of 42 surface/near-surface and 17 subsurface soil samples collected within the Westlakes are presented below. The pH of the soils is within the normal range (5 to 9) for mineral soils in humid/semi-arid regions (Brady, 1974).

Surface/ Near-Surface Soil	Subsurface Soil
5.43 - 9.53	5.77 – 8.15

Total Organic Carbon: TOC was not detected in surface/near-surface or subsurface soil samples collected within Westlakes.

Cation Exchange Capacity: CEC in the surface/near-surface soil samples collected within the Westlakes ranged from 170 to 390 meq/K. CEC in the subsurface soil sample collected from boring WL-SB07 in Cell 3 was 180 meq/K.

Waste Extraction Test using Deionized Water: The results of DI-WET analysis of 10 surface/near surface and 4 subsurface soil samples collected within the Westlakes are presented on Table 5.3-4.

Summary of Investigation and Results – Geotechnical Parameters

A total of 18 surface and/or near-surface soil samples and 2 subsurface soil samples were collected from 12 sample locations within the Westlakes for geotechnical analyses. The results of the geotechnical analyses for moisture content, wet density, dry density, specific gravity, porosity, sieve analysis, and/or permeability are summarized on Table 5.3-5.

The geotechnical data will be used in the risk assessment to develop site-specific soil input parameters (moisture content, water-filled porosity, air-filled porosity, etc.) for fate and transport models and in the FS to assess potential remedial actions such as vapor extraction. Fate and transport models are used in risk assessment to quantitatively evaluate the migration of volatile organics into outdoor and indoor air and the potential leaching of chemicals through soil and into groundwater.

5.3.4 *Discussion of Investigation Results with Respect to Data Quality Objectives – Westlakes*

The analytical results presented in the previous sections identified B(a)P, B(b&k)F, PCB Aroclor 1260, and perchlorate in soil and/or sediment above their respective RISLs or PGW SSLs within the Westlakes. As previously discussed, soil vapor samples were not collected from the Westlakes due to the likelihood of encountering saturated soils. However, VOCs were not detected above their PQLs in soil samples collected from the Westlakes. The presence of the COPCs listed above in soil and/or sediment within the Westlakes is discussed below with respect to the data needs described in Section 5.3.2. Specifically,

- Has the investigation resulted in the sufficient characterization of the lateral and vertical distribution of each COPC in the vadose zone and identify a potential source for those COPCs?
- Has the investigation resulted in sufficient data to evaluate the potential for COPCs in soil to migrate into and degrade surface water and groundwater quality?
- Has the investigation resulted in data sufficient to support human health and ecological risk assessments and fate and transport modeling?
- Has the investigation resulted in sufficient data to evaluate the feasibility of remediating the identified compounds and concentrations to levels that do not pose a risk to human and ecological receptors or degrade surface water and groundwater quality?

For the purpose of this discussion, it is assumed that chemicals detected at concentrations above their RISL could potentially pose a risk to human health and chemicals detected above their PGW SSL could potentially migrate into groundwater or surface water. Sampling locations where VOCs, metals, and other non-VOCs (SVOCs, PCBs, perchlorate, NDMA, TPH-D, and TPH-Mo) were detected in surface and/or subsurface soil at concentrations above their respective PGW SSLs are shown in Figures 5.3-5 and 5.3-7.

The analytical results for surface water and groundwater within the WLLO Area are discussed in Sections 5.6 and 5.7, respectively, and discussed with respect to potential soil sources within the Westlakes. Additionally, the potential for chemicals in soil to migrate into surface water and groundwater is further evaluated in Section 8 of the HHERA (Volume II).

5.3.4.1 *Semivolatile Organic Compounds*

SVOCs were not detected above their respective RISLs in surface and/or near-surface soil collected within the Westlakes. Additionally, TICs were not detected during the SVOC analysis of the samples.

B(a)P and B(b&k)F were detected above their PGW SSLs of 2.9 µg/kg and 29 µg/kg, respectively, in one surface and/or near-surface (0.5 foot bgs) soil sample collected at one (WL-SD08) location in the West Pond (Figure 5.3-7).

- The lateral extent of B(a)P and B(b&k)F is defined by the absence of those compounds above their PGW SSLs in soil samples collected at locations WL-SD06, WL-SD07, and WL-SB09.
- The vertical extent of B(a)P and B(b&k)F is defined by the absence of those compounds at concentrations above their PGW SSLs in the soil sample collected at 1.5 feet bgs at location WL-SD08.

Based on the information presented above, the lateral and vertical extent of B(a)P and B(b&k)F within the Westlakes has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives. Additional evaluation of the potential risk to groundwater posed by those SVOCs in soil is presented in Section 8 of the HHERA (Volume II).

5.3.4.2 *Polychlorinated Biphenyls*

PCBs were not detected above their respective RISLs in the surface/near-surface soil samples or above their respective RISLs and PGW SSLs in subsurface soil samples collected within the Westlakes.

Aroclor 1260 was detected above its PGW SSL in surface/near-surface (0 to 1.5 feet bgs) at two (WL-SD04 and WL-SD06) locations within the East Pond and one (WL-SD07) location in the West Pond. Conclusions regarding the characterization of Aroclor 1260 at those three locations, based on the data presented in Section 5.3.3.3 and Figure 5.3-7, are summarized below.

<u>WL-SD04 and WL-SD06</u>

Aroclor 1260 at concentrations above its PGW SSL was detected in near-surface soil samples collected at locations WL-SD04 and WL-SD06 in the East Pond (Section 5.3.3.3 and Figure 5.3-7). Because the East and West

Ponds receive surface water runoff from Buffalo Creek and the Administration Area ditch, which carry runoff from the majority of the Aerojet site, the origin of the PCBs can not be determined with any certainty.

The lateral extent of Aroclor 1260 above its PGW SSL in the East Pond is limited by the berm that encompasses the pond. The absence of Aroclor 1260 in the soil samples collected at locations WL-SD05 and WL-SB10 indicates that that compound is not homogeneously distributed in surface soil in the bottom of the pond. The vertical extent of Aroclor 1260 is defined by the absence of that compound above its PGW SSL in soil samples collected at depths greater than 1.5 feet bgs at locations WL-SD04, WL-SD05, WL-SD06, and WL-SB10.

WL-SD07

Aroclor 1260 was detected at an estimated concentration of 35 µg/kg, slightly above its PGW SSL of 34 µg/kg, in a sample collected at 0.5 foot bgs at location WL-SD07 in the West Pond (Section 5.3.3.3 and Figure 5.3-7). The lateral extent of Aroclor 1260 detected at that location is defined by the absence of that compound above its PGW SSL in soil samples collected at locations WL-SD08, WL-SD10, and WL-SB09. The vertical extent is defined by the absence of Aroclor 1260 above its PGW SSL in the soil samples collected at 1.5 feet bgs at location WL-SD07.

The data indicate that Aroclor 1260 above its PGW SSL in the East and West Ponds is limited to surface/near-surface soils in the immediate vicinity of the sampling locations.

Based on the information presented above, the lateral and vertical extent of Aroclor 1260 within the Westlakes has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives. Additional evaluation of the potential risk to groundwater posed by Aroclor 1260 in soil within the Westlakes is presented in Section 8 of the HHERA (Volume II).

5.3.4.3 Perchlorate

Perchlorate was detected at a concentration above its RISL and PGW SSL in only one soil sample collected at one location (WL-SB01) within the Westlakes (Section 5.3.3.3; Figures 5.3-6 and 5.3-7). Conclusions regarding the characterization of perchlorate in soil within the Westlakes are summarized below.

- The absence of perchlorate above its RISL or PGW SSL in two borings (WL-SB11 or WL-SB12) in proximity to boring WL-SB01, indicates that the lateral extent of perchlorate is limited to the immediate area of boring WL-SB01.
- Perchlorate at 9,000 µg/kg was detected in a sample collected at 5 feet bgs at location WL-SB01 in Cell 1. Perchlorate was not, however, detected in samples collected at 0.5 and 11 feet bgs from that boring (WL-SB01). The data indicate that the vertical extent of perchlorate is limited to soil at the depth the sample was collected.

Based on the information presented above, the lateral and vertical extent of perchlorate within the Westlakes has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives. Additional evaluation of the potential risk to groundwater posed by the detected concentration of perchlorate in soil within the Westlakes is presented in Section 8 of the HHERA (Volume II).

Based on the information presented above, the lateral and vertical extent of TPH-Mo within the Westlakes has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

5.4 WESTERN ADMINISTRATION DITCH AND BUFFALO CREEK

The western portion of the Main Administration Area Ditch and Buffalo Creek comprise the two drainages that historically and currently discharge directly into the Westlakes (Figure 5.4-1).

Between 1951 and 1980, the lower section of Buffalo Creek in the southern portion of the Aerojet property has been realigned numerous times to accommodate construction at Aerojet and construction of the Folsom South Canal and Westlakes (Aerojet, 2002b). Prior to 1951, Buffalo Creek flowed south towards the general area of Line 02 where it turned back towards the west and emptied into an area of dredge tailings. Sometime between 1951 and 1961, the Administration Area Ditch was extended westward to Buffalo Creek and Buffalo Creek west of Line 02 was excavated and realigned for use as a drainage ditch. During construction of the Folsom South Canal in the early 1970s, Buffalo Creek was again realigned and its course diverted towards the south and over the Folsom South Canal via an overpass. Review of aerial photographs show that the

East and West Ponds and Cells 1 and 2 of the Westlakes were present in the early 1970s at the start of construction of the Folsom South Canal, with final construction completed in the late 1970s. Buffalo Creek underwent a final realignment during construction of the Westlakes and redirected towards the west in the area of Line 02 to allow discharge into the Westlakes. An approximate 800-feet section of Buffalo Creek abandoned as a result of the realignment is present immediately west of Line 02.

The western portion of the Main Administration Area Ditch and Buffalo Creek in the area of the Westlakes and within the BOU are described below and shown in Figure 5.4-1.

Western Main Administration Area Ditch – The Main Administration Area Ditch receives storm water from BOU Source Areas 3D, 4D, 5D, 6D, 8D, 9D, 11D, 12D, 50D, 51D, 52D, D(b), D(c), D(d), and 52D and PGOU Source Areas 7D and 10D. The BOU RI of the upper portion of the Main Administration Area Ditch was presented in Section 4.3 of this report.

Buffalo Creek – Buffalo Creek transects the Aerojet site and receives storm water from many source areas in Area 00, Line 01, Line 02, Line 06, and Zone 3. Within the BOU, Buffalo Creek is comprised of three principal drainages referred to in this report as Upper, Lower, and Cutoff (Figure 5.4-1). Upper Buffalo Creek includes its current channel beginning just east of the BOU to the point of discharge to Westlakes. Lower Buffalo Creek includes the current channel that receives surface water discharges from the Westlakes and from the American River Groundwater Extraction and Treatment facility. Abandoned Buffalo Creek refers to a section of drainage adjacent to Line 02 that formerly connected Buffalo Creek and the Main Administration Area Ditch. This section of the channel was abandoned following construction of the Westlakes that runs adjacent to Line 02 and formerly discharged to the Main Administration Area Ditch southwest of Line 02.

This section provides the following information for the western portion of the Administration Area Ditch and Buffalo Creek:

- Describes the environmental setting;
- Identifies COPCs identified during the previous investigations;
- Presents the data needs identified in the BOU FSP;
- Summarizes the sampling activities performed during the BOU RI and deviations from the sampling proposed in the BOU FSP; and

- Presents the analytical results for samples collected during the BOU RI and historical data, where appropriate.

The results of the BOU RI with respect to the identification of COPCs, lateral and vertical characterization of COPCs, completeness of the characterization, potential sources, fate and transport of COPCs, and the potential for those COPCs to affect human health, surface water, and groundwater are discussed in Section 5.4.4.

The information presented below regarding the description of source areas and previous investigations was compiled from one or more of the following sources*: Stage 1 Sampling Plan-Zone 1* (Aerojet, 1993a); *Stage 1 Sampling Plan-Zones 3 and 4* (Aerojet 1993b); *Stage 1 Sampling Plan-Zone 2* (Aerojet, 1993c); *Aerojet Superfund Site – Scoping Report, Volumes 1 through 6* (ICF Technology, Inc., 1989); *Aerojet Site, Stage 1 Report - Zones 1 through 4* (ICF Kaiser Engineers, Inc., 1993); or BOU FSP (Aerojet et al., 2006b).

5.4.1 Environmental Setting – Western Administration Area Ditch and Buffalo Creek

The topography, geology, soils, surface water hydrology, general hydrogeology, and ecological habitat of the Westlakes Area are described in the following subsections.

5.4.1.1 Topography

An elevated access road runs parallel to the north side of the Main Administration Area Ditch from Hazel Boulevard to the Westlakes. Between the Administration Area and Westlakes, the ditch is approximately 10-feet deep and roughly 10- to 20-feet wide. A gentle east-west slope provides enough elevation change to allow water to flow towards the Westlakes. East of Line 02, the Main Administration Ditch is bordered on the north by dredge tailings and on the south by native, undredged material of an ancestral American River terrace. West of Line 02, the Main Administration Area Ditch/Buffalo Creek is bordered on the south and north by dredge tailings.

As previously discussed, Buffalo Creek transects the entire Aerojet site from east to west. Within the BOU, Buffalo Creek has a fairly uniform slope that provides drainage towards the west and Westlakes. Buffalo Creek is bordered in some areas of the BOU by facility areas (paved, disturbed areas). Between Line 02 and Westlakes, Buffalo Creek is bordered to the north and south by dredge tailings.

5.4.1.2 *Geology*

The Main Administration Area Ditch and Buffalo Creek transect both dredged and undredged portions of the Aerojet site. Surface geology of the dredged areas consists of cobbles mixed with silts and clays and the undredged areas consist of indurated, dense layers of silts and clays interbedded with sands and cobbles with clays and silts.

5.4.1.3 *Soils*

The Main Administration Area Ditch and Buffalo Creek transect Xerorthents and the Redding-Corning-Red Bluff complex. Xerorthents are a dredge tailings-urban land complex with 0 to 2 percent slopes. Xerorthents along the drainages have been graded and reshaped during construction of the drainages. The Xerorthents are divided by elongated areas of Americanos and Natomas soils and Slickens. These soils are very deep and are somewhat excessively drained to excessively drained soils.

The Redding-Corning-Red Bluff complex consists of moderately well-drained soils that are moderately deep over a cemented hard pan. This soil unit is found on intermediate and high terraces, terrace remnants, and the side slopes of terraces in the eastern part of Sacramento County. The soils form in alluvium that is derived from mixed rock sources. The Redding soils are typically a surface layer of gravelly loam with subsoil comprised of a gravelly claypan, which is in turn underlain by a hardpan at a depth of 20 to 40 inches. The Corning-Red Bluff soils are typically a loam with a subsoil of clay loam, gravelly loam, and gravelly clay loam.

5.4.1.4 *Surface Water Hydrology*

In addition to Buffalo Creek and the Main Administration Ditch, local surface water features include the Westlakes, the Folsom South Canal, and remnants of the former Valley Ditch. Buffalo Creek and the Main Administration Area Ditch are used to control seasonal storm water runoff from the Aerojet site and discharge into the Westlakes. Storm water runoff is staged in the Westlakes where it either infiltrates or is discharged to Lower Buffalo Creek and ultimately to the American River under the NPDES.

5.4.1.5 *Local Hydrogeology*

The first saturated sediments encountered beneath the Westlakes Area transected by the Main Administration Area Ditch and Buffalo Creek are

either part of Perched Groundwater or within the FWBZ. The general hydrogeology beneath the Westlakes Area is summarized in Section 5.3.1. Details regarding the occurrence of groundwater within the Westlakes Area and distribution of chemicals in the groundwater are presented in Section 5.7.

5.4.1.6 *Ecological Habitat*

Within the BOU, the Main Administration Area Ditch and Buffalo Creek flow through a variety of vegetative communities populated by a fairly wide range of flora and fauna. Vegetative communities commonly found adjacent to the Main Administration Area Ditch and Buffalo Creek include annual grassland, oak woodland, Fremont cottonwood-oak woodland, and patches of coyote brush scrub and willow scrub. Additionally, valley foothill riparian is found along much of Buffalo Creek within the BOU.

Typical flora encountered in those vegetative communities include herbaceous weeds, non-native naturalized Mediterranean grasses, trees including oaks and cottonwood, woody shrubs, and various riparian plants. Typical fauna include various raptors, wild turkey, northern flicker, yellow-rumped warbler, Bullock's oriole, savannah sparrow, western meadowlark, song sparrow, black-headed grosbeak, Acorn woodpecker, Nuttal's woodpecker, western scrub jay, yellow-billed magpie, oak titmouse, white-breasted nuthatch, western bluebird, American robin, Phainopepla, lark sparrow, western fence lizard, southern alligator lizard, Gilbert's skink, slender salamander, Pacific gopher snake, racer, sharp-tailed snake, common kingsnake, Pacific treefrog, bullfrog, black-tailed deer, coyote, brush rabbit, Virginia opossum, deer mouse, California vole, and California ground squirrel. Blue elderberry shrubs, potential habitat for the Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), were also observed along the banks and adjacent to the Main Administration Area Ditch and Buffalo Creek. A *Biological Assessment Report* (ECORP Consulting, Inc., 2005) for the BOU was presented as Appendix B in the BOU FSP (Aerojet et al., 2006b).

5.4.2 *Summary and Results of Previous (Pre-2005) Remedial Investigations – Western Administration Area Ditch and Buffalo Creek*

The following subsections summarize the scope and results of previous (prior to 2005) vadose zone investigations of the western portion of the Administration Area Ditch and Buffalo Creek, identify COPCs based on

the previous investigations, and discuss the DQOs and sampling proposed in the BOU FSP.

5.4.2.1 *Summary of Previous (Pre-2005) Vadose Zone Investigations – Western Administration Area Ditch and Buffalo Creek*

Sediment/soil samples were collected at 1,000-foot intervals along Buffalo Creek during the Stage 1 RI in 1993. Sampling locations along Buffalo Creek near Line 01 and Area 00 were biased toward locations where drainages from source areas entered Buffalo Creek. Sediment/soil samples were analyzed for metals (silver, lead, mercury, and selenium); SVOCs; NDMA; and/or perchlorate.

One sediment/soil sample was collected from the Main Administration Area Ditch west of the Administration Area in 1993 and analyzed for metals.

5.4.2.2 *Results of Previous (Pre-2005) Vadose Zone Investigations – Western Administration Area Ditch and Buffalo Creek*

The results of the previous investigations of the western portion of the Administration Area Ditch and Buffalo Creek are summarized below. Review of the previous data identified metals (cadmium, copper, lead, and mercury) in sediment/soil in the Main Administration Area Ditch west of the Administration Area and Buffalo Creek.

Figures showing previous sampling locations in the source areas along the western portion of the Administration Area Ditch and chemical groups detected in soil vapor and soil samples collected between 1991 and 2005 above human health and ecological screening levels were presented in the BOU FSP (Aerojet et al., 2006b) and are included in Appendix E. The results of the sediment/soil sampling along Buffalo Creek are presented in Section 11 of the *Aerojet Site; Stage 1 Report – Zone 2* (ICF Kaiser Engineers, Inc., 1993).

5.4.2.3 *Summary of Data Needs – Western Administration Area Ditch and Buffalo Creek*

Based on a review of the previous vadose zone investigation data, extensive aerial photograph research and review, and exhaustive research of historical documents, Aerojet determined that additional sampling was needed within and adjacent to the Administration Area Ditch and Buffalo Creek to:

- Characterize the present lateral and vertical extent of VOCs, SVOCs, metals, perchlorate, TPH, NDMA, and nitroguanidine in sediment/soil within the ditch at concentrations that could potentially pose a risk to human and ecological receptors;
- Evaluate the presence and extent of potential COPCs in soil historically removed from the ditch and creek and placed on the banks as part of drainage maintenance;
- Evaluate the potential for chemicals in sediment/soil to degrade surface or groundwater quality; and
- Obtain sufficient data to support fate and transport modeling, evaluation of risk to human and ecological receptors, and evaluation of potential remedial alternatives.

It should be noted that due to the time lapse (12 years) since the Stage 1 RI was performed and the elevated laboratory reporting limits for VOCs during that investigation, the investigation of VOCs performed during the BOU was designed to supersede all previous soil vapor and soil VOC investigation results.

5.4.3 Summary and Results of Boundary Operable Unit Vadose Zone Investigation – Western Administration Area Ditch and Buffalo Creek

The following subsections summarize the BOU investigation (2005 to 2007) of the western portion of the Main Administration Area Ditch and Buffalo Creek, describe deviations from the sampling proposed in the BOU FSP, and present the results of the BOU RI. The results of the sampling with respect to the completeness of the characterization and identification of potential sources are discussed in Section 5.4.4.

5.4.3.1 Summary of Boundary Operable Unit Vadose Zone Investigation – Western Administration Area Ditch and Buffalo Creek

The BOU RI of the western portion of the Main Administration Area Ditch and Buffalo Creek included the following:

<u>Surface and Subsurface Soil Investigation</u>

- A total of 31 primary and two duplicate surface and/or near-surface (0 to 2.5 feet bgs) sediment/soil samples and one primary subsurface (2.6 to 5 feet bgs) soil sample were collected at 23 locations within and adjacent to the western portion of the Main Administration Area Ditch

and Buffalo Creek. Surface/near-surface and subsurface soil sampling locations are shown in Figure 5.4-2.

- Surface/near-surface sediment/soil samples and the subsurface soil sample were analyzed for VOCs, SVOCs, metals (including hexavalent chromium), perchlorate, PCBs, TPH-D, TPH-Mo, pesticides, NDMA, nitroguanidine, CEC, TOC, and/or pH. Analysis of soil samples for SVOCs also included an evaluation of the presence of TICs. In accordance with the BOU FSP, sample analysis was based on the analytical results from previous investigations and, therefore, every sample was not analyzed for the full suite of constituents.
- The numbers of surface/near-surface sediment/soil samples and subsurface soil samples collected within and adjacent to the western portion of the Main Administration Area Ditch and Buffalo Creek for each analysis (including QA/QC samples), along with the corresponding methods, are provided on Table 5.4-1. Summary statistics for the samples are also presented on Table 5.4-1.
- A cross-reference between surface/near-surface and subsurface soil sampling locations within the western portion of the Main Administration Area Ditch and Buffalo Creek and the specific features they were sited to investigate is provided on Table 5.4-2.

Soil Vapor Investigation

Soil vapor sampling for VOCs within the Main Administration Ditch and Buffalo Creek was not proposed in the BOU FSP (Aerojet et al., 2006b) due to the likelihood of encountering wet soil. However, as previously indicated, selected soil samples were analyzed for VOCs.

5.4.3.2 *Deviations from Boundary Operable Unit Data Quality Objectives and Sampling Design - Western Administration Area Ditch and Buffalo Creek*

Sampling activities associated with the western portion of the Main Administration Area Ditch and Buffalo Creek performed during the RI were generally consistent with those proposed in the BOU FSP, with the exceptions listed on Table 5.4-3. Sampling was performed at locations proposed in the BOU FSP and step-out sampling was performed in accordance with the procedures agreed upon with the agencies. A comparison of proposed and actual sampling activities, including sampling rationale, sample depth, and analyses, is provided on Table 5.4-3. Soil sampling locations and the specific features they were sited to investigate are cross-referenced on Table 5.4-2.

5.4.3.3 *Results of Boundary Operable Unit Vadose Zone Investigation - Western Administration Area Ditch and Buffalo Creek*

The numbers of primary sediment/soil samples collected from the western portion of the Administration Area Ditch and Buffalo Creek and analyzed for VOCs, metals, PCBs, perchlorate, and TPH-D and TPH-Mo are summarized on the table below.

	Surface/Near-Surface		Subsurface or Bank	
Compound	**No. of Samples**	**No. of Locations**	**No. of Samples**	**No. of Locations**
VOCs	4	2	0	0
Metals	31	23	1	1
Mercury	17	9	1	1
Hexavalent Chromium	18	13	0	0
Select Metals	13	12	3	3
SVOCs	18	9	1	1
PCBs	22	14	1	1
Perchlorate	13	7	1	1
TPH-D & TPH-Mo	13	7	1	1

The results of the VOCs, metals, SVOCs, PCBs, perchlorate, TPH-D, and TPH-Mo analyses of the surface/near-surface sediment/soil and subsurface soil samples are presented in Appendix G and summarized below. Sampling locations along the Administration Area Ditch and Buffalo Creek are shown in Figures 5.4-2 and 5.4-3. Soil sampling locations and the features being investigated are cross-referenced on Table 5.4-2.

<u>Summary of Investigation and Results – Volatile Organic Compounds</u>

Four primary sediment/near-surface sediment samples were collected at 0.25 and 1 foot bgs at two locations (WL-SD01 and WL-SD02) in Lower Buffalo Creek during the BOU RI and analyzed for VOCs (Figure 5.4-3).

VOCs were not detected in the sediment samples at concentrations above their RISLs or PGW SSLs.

<u>Summary of Investigation and Results – Metals</u>

A total of 32 primary samples were collected at 23 locations within and adjacent to the western portion of the Administration Area Ditch and Buffalo Creek. The sampling included the following:

- A total of 26 primary surface soil/sediment samples were collected at 23 locations within the western portion of the Administration Area Ditch and Buffalo Creek (Table 5.4-1). Seventeen samples were analyzed for all metals, including mercury and hexavalent chromium. Nine step-out soil/sediment samples were analyzed for selected metals including aluminum, cadmium, chromium, hexavalent chromium, copper, lead, nickel, silver, and zinc.
- One sample (WL-SD15) was collected from a drainage between Schnitzer Steel and Buffalo Creek and analyzed for select metals.
- One subsurface soil sample was collected at 5 feet bgs at one location (59E-SD01) and analyzed for all metals, including mercury and hexavalent chromium (Table 5.4-3).
- Four surface/near-surface soil samples were collected from the banks of Buffalo Creek at three locations and analyzed for select metals. The samples were collected to evaluate the presence of metals in soil removed from the ditch as part of previous maintenance activities. Bank sampling locations and corresponding surface sediment/soil sampling locations are identified on the table below.

Bank Sample Location	Drainage Sample Location
59E-SB07	59E-SD01
59E-SB06/28E-SNS01	59E-SD04
59E-SB08	59E-SD02

- Metals detected in surface sediment/soil, subsurface soil, or bank soil samples along the Administration Area Ditch and Buffalo Creek at concentrations statistically different than background and subsequently compared to screening levels were antimony, cadmium, lead, mercury, molybdenum, silver, and zinc. Because boron, hexavalent chromium, lithium, strontium, and titanium were not included in the background evaluation, concentrations of these metals were also compared to screening levels.
- Cadmium and lead were the only metals detected at concentrations statistically above background and their respective RISLs and/or PGW SSLs. Concentrations of those two metals above their RISL and/or PGW SSLs and the location and sample depth are listed on the table below and shown in Figure 5.4-3.

Sample Location	Depth (ft bgs)	Metal	RISL (mg/kg)	PGW SSL (mg/kg)	Conc. (mg/kg)	> RISL	> PGW SSL
29E-SD01	0.25	Cadmium	1.7	1.2	1.6	N	Y
	0.25	Lead	150	23	37.9	N	Y
59E-SB05	1	Lead	150	23	57	N	Y
59E-SD02	0.25	Lead	150	23	25	N	Y
59E-SD03	0.25	Lead	150	23	45.5	N	Y
BC-SD01	0.25	Cadmium	1.7	1.2	27.9	Y	Y
	0.25	Lead	150	23	72.1	N	Y
BC-SD02	0.25	Lead	150	23	29.9	N	Y
WL-SD02	0.25	Lead	150	23	38	N	Y
WL-SD13	0.25	Lead	150	23	33	N	Y
WL-SD16	0.25	Lead	150	23	25.7	N	Y

Summary of Investigation and Results – Semivolatile Organic Compounds

A total of 18 primary and 1 duplicate sediment/surface soil samples were collected at 9 locations within the western portion of the Main Administration Area Ditch and Buffalo Creek and analyzed for SVOCs, including TICs. Additionally, one subsurface soil sample was collected at 5 feet bgs at one location (59E-SD01) and analyzed for SVOCs. Sampling locations are shown in Figures 5.4-2 and 5.4-3. Soil sampling locations and the features being investigated are cross-referenced on Table 5.4-2.

B(a)P, B(b&k)F, and D(a,h)A were the only SVOCs detected above their respective RISLs or PGW SSLs in the sediment/soil samples collected from the Westlake Drainages. The location and sample depth at which those compounds were detected are listed on the table below. B(a)P and B(b&k)F above their RISLs and B(A)p, B(b&k)F, and D(a,h)A at concentrations above their PGW SSLs are shown in Figures 5.4-2 and 5.4-3, respectively.

Sample Location	Depth (ft bgs)	SVOC	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	> RISL	> PGW SSL
WL-SD09	0.5	Benzo(a)pyrene	38	2.9	6.9	N	Y
WL-SD11	0.5	Benzo(a)pyrene	38	2.9	45	Y	Y
		Benzo (b&k)fluoranthene	38	29	110	Y	Y
		Dibenz(a,h)anthracene	62	2.9	8.2	N	Y
	1.5	Benzo(a)pyrene	38	2.9	21	N	Y
		Benzo (b&k)fluoranthene	38	29	46	Y	Y

Summary of Investigation and Results – Polychlorinated Biphenyls

A total of 23 primary and 1 duplicate sediment/soil samples were collected at 15 locations along the western portion of the Main Administration Area Ditch and Buffalo Creek during the BOU RI and analyzed for PCBs. Sampling locations are shown in Figures 5.4-2 and 5.4-3. Soil sampling locations and the features being investigated are cross-referenced on Table 5.4-2.

Aroclor 1254 was detected above its RISL or PGW SSL in surface sediment soil samples collected from Buffalo Creek at 10 locations. Aroclor 1254 detected in the surface sediment/soil above its screening levels is listed on the table below and shown in Figure 5.4-3.

Sample Location	Depth (ft bgs)	PCB	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	> RISL	> PGW SSL
BC-SD01	0.25	Aroclor 1254	220	34	740	Y	Y
BC-SD02	0.25	Aroclor 1254	220	34	1,100	Y	Y
59E-SD01	0.25	Aroclor 1254	220	34	73	N	Y
59E-SD02	1.5	Aroclor 1254	220	34	91	N	Y
59E-SD03	0.25	Aroclor 1254	220	34	210	N	Y
59E-SD04	0.25	Aroclor 1254	220	34	200	N	Y
WL-SD02	0.25	Aroclor 1254	220	34	240	Y	Y
	1.5	Aroclor 1254	220	34	250	Y	Y
WL-SD09	0.5	Aroclor 1254	220	34	79	N	Y
	1.5	Aroclor 1254	220	34	360	Y	Y
WL-SD11	0.5	Aroclor 1254	220	34	430	Y	Y
	1.5	Aroclor 1254	220	34	160	N	Y
WL-SD12	0.5	Aroclor 1254	220	34	98	N	Y
	1.5	Aroclor 1254	220	34	110	N	Y

Summary of Investigation and Results – Perchlorate

A total of 12 primary surface sediment/soil samples were collected at 6 locations (59E-SD01, 59E-SD02, WL-SD01, WL-SD02, WL-SD11, and WL-SD12) along Buffalo Creek during the BOU RI and analyzed for perchlorate. Additionally, one subsurface soil sample collected at 5 feet bgs at one location (59E-SD01) and one bank sample collected at one location (28E-SNS01) were also analyzed for perchlorate. Sampling locations are shown in Figures 5.4-2 and 5.4-3. Soil sampling locations and the features being investigated are cross-referenced on Table 5.4-2.

Perchlorate was not detected above its PQL in the surface sediment/soil, subsurface soil, and bank soil samples collected within and adjacent to Buffalo Creek.

Summary of Investigation and Results – Total Petroleum Hydrocarbons

A total of 12 primary surface sediment/soil samples were collected at 6 locations (59E-SD01, 59E-SD02, WL-SD09, WL-SD11, WL-SD12, and WL-SD13) along Buffalo Creek during the BOU RI and analyzed for TPH-D and TPH-Mo. Additionally, one subsurface soil sample collected at 5 feet bgs (59E-SD01) and one bank sample collected at (28E-SNS01) were also analyzed for TPH-D and TPH-Mo. Sampling locations are shown in Figures 5.4-2 and 5.4-3. Soil sampling locations and the features being investigated are cross-referenced on Table 5.4-2.

- TPH-D and TPH-Mo were not detected above their PGW SSLs in the surface sediment/soil, subsurface soil, and bank soil samples collected within and adjacent to Buffalo Creek.

Summary of Investigation and Results – Miscellaneous Compounds

Miscellaneous analyses performed on soil samples collected within and adjacent to the western portion of the Administration Area Ditch and Buffalo Creek were NDMA, pesticides, OBPA, nitroguanidine, pH, TOC, and CEC. The number of primary surface/near-surface and subsurface soil samples collected within the Westlakes for each analysis, and the numbers of locations are summarized on Table 5.4-1 and below. Summary statistics for the samples are also presented on Table 5.4-1.

	Surface/Near-Surface		Subsurface or Bank	
Compound	No. of Samples	No. of Locations	No. of Samples	No. of Locations
NDMA	5	3	0	0
Pesticides	20	13	1	1
OBPA	10	5	0	0
Nitroguanidine	10	5	0	0
pH	8	4	0	0
TOC	9	6	0	0
CEC	2	1	0	0

The analytical results for the miscellaneous analyses of surface/near-surface sediment/soil samples are presented in Appendix G and

summarized below. The analytical data for pH, TOC, and CEC are used in the risk assessments to evaluate the bioavailability of some chemicals with respect to human and ecological receptors. Additionally, the TOC and CEC data are used in the FS to evaluate chemical and physical remedial actions.

N-Nitrosodimethylamine: Four surface/near-surface sediment/soil samples were collected at two locations (WL-SD01 and WL-SD02) along Lower Buffalo Creek during the BOU RI and analyzed for NDMA. Additionally, one near-surface soil sample was collected from the bank at one location (28E-SNS01) and analyzed for NDMA. Sampling locations are shown in Figures 5.4-2 and 5.4-3. Soil sampling locations and the features being investigated are cross-referenced on Table 5.4-2.

NDMA was not detected above its PQL in the sediment samples or bank sample collected from Lower Buffalo Creek.

Pesticides: Twenty surface/near-surface sediment/soil samples and one subsurface soil sample were collected at 13 locations (BC-SD01, BC-SD02, BC-SD03, BC-SD04, 59E-SD01, 59E-SD02, 59E-SD03, 59E-SD04, WL-SD01, WL-SD02, WL-SD09, WL-SD11, and WL-SD12) along the western portion of the Main Administration Area Ditch and Buffalo Creek and analyzed for pesticides. Sampling locations are shown in Figure 5.4-2. Soil sampling locations and the features being investigated are cross-referenced on Table 5.4-2.

Pesticides, including prowl, were not detected above their respective RISLs or PGW SSLs in the surface/sediment samples collected along the western portion of the Main Administration Area Ditch and Buffalo Creek.

10,10'-Oxybis-10H-Phenoxarsine: Ten surface/near-surface sediment/soil samples were collected at five locations (WL-SD01, WL-SD02, WL-SD09, WL-SD11, and WL-SD12) along the western portion of the Main Administration Area Ditch and Buffalo Creek and analyzed for OBPA. Sampling locations are shown in Figure 5.4-2. Soil sampling locations and the features being investigated are cross-referenced on Table 5.4-2.

OBPA was not detected above its PQL in the surface or near-surface sediment/soil samples collected from the western portion of the Administration Area Ditch or Buffalo Creek.

Nitroguanidine: Ten surface and near-surface sediment/soil samples were collected at six (WL-SD01, WL-SD02, WL-SD09, WL-SD11, WL-SD12, and WL-SD13) locations along Buffalo Creek during the BOU RI and analyzed for nitroguanidine. Soil sampling locations are shown in Figure 5.4-2. Soil sampling locations and the features being investigated are cross-referenced on Table 5.4-2.

Nitroguanidine was not detected above the PQL, RISL, or PGW SSL in the surface or near-surface sediment samples collected from Buffalo Creek.

pH: Eight surface/near-surface sediment/soil samples were collected at four locations (WL-SD02, WL-SD09, WL-SD11, and WL-SD12) along Buffalo Creek for pH. pH of the samples ranged from 5.68 to 8.77, within the normal range (5 to 9) for mineral soils (Brady, 1974).

Total Organic Carbon: Nine surface/near-surface sediment/soil samples were collected at six locations (WL-SD01, WL-SD02, WL-SD09, WL-SD11, WL-SD12, and WL-SD13) along Buffalo Creek and analyzed for TOC. TOC in the samples ranged from 2,400,000 to 54,000,000 µg/kg.

Cation Exchange Capacity: Two surface/near-surface sediment/soil samples were collected at one location (WL-SD01 along Buffalo Creek and analyzed for CEC. CEC in the samples ranged from 68 to 550 meq/K.

5.4.4 *Discussion of Investigation Results with Respect to Data Quality Objectives – Western Administration Area Ditch and Buffalo Creek*

The analytical results presented in the previous sections identified the following chemical constituents were present in sediment/soil within the western portion of the Administration Area Ditch and/or Buffalo Creek above their respective RISLs or PGW SSLs:

Soil: Cadmium, lead, mercury, B(a)A, B(a)P, B(b&k)F, NAP, PCB Aroclor 1248, PCB Aroclor 1254, and PCB Aroclor 1260.

The presence of these COPCs in sediment/soil within the western portion of the Administration Area Ditch and Buffalo Creek is discussed below with respect to the data needs described in Section 5.4.2.3. Specifically,

- Has the investigation resulted in sufficient characterization of the lateral and vertical distribution of each COPC in the vadose zone and identified a potential source for those COPCs?

- Has the investigation resulted in sufficient data to evaluate the potential for COPCs in soil to migrate into and degrade surface water and groundwater quality?
- Has the investigation resulted in data sufficient to support human health and ecological risk assessments and fate and transport modeling?
- Has the investigation resulted in sufficient data to evaluate the feasibility of remediating the identified compounds and concentrations to levels that do not pose a risk to human and ecological receptors or degrade surface water and groundwater quality?

For the purpose of this discussion, it is assumed that chemicals detected at concentrations above their RISL could potentially pose a risk to human health and chemicals detected above their PGW SSL could potentially migrate into groundwater or surface water. Sampling locations where VOCs, metals, and other non-VOCs (SVOCs, PCBs, perchlorate, NDMA, TPH-D, and TPH-Mo) were detected in sediment, surface, and/or subsurface soil at concentrations above their respective PGW SSLs are shown in Figure 5.4-3.

The analytical results for surface water and groundwater within the WLLO Area are discussed in Sections 5.6 and 5.7, respectively, and discussed with respect to soil sources within the western portion of the Administration Area Ditch and Buffalo Creek. Additionally, the potential for chemicals in soil to migrate into surface water and groundwater is further evaluated in Section 8 of the HHERA (Volume II).

5.4.4.1 *Metals*

Cadmium and lead were detected at concentrations above their respective RISLs and/or PGW SSLs in surface sediment/soil, subsurface soil, or bank soil samples collected at nine locations along the western portion of the Administration Area Ditch and 6 locations along Buffalo Creek (Section 5.4.3.3 and Figure 5.4-3). Conclusions regarding the characterization of cadmium and lead at each of the nine locations, based on the data presented in the text and figure, are summarized below.

<u>29E-SD01</u>

Cadmium and lead below their RISLs, but above their PGW SSLs, were detected in a surface (0.25 foot bgs) soil sample collected at location 29E-SD01. Locations 29E-SD01 is roughly 50 feet upstream of the

confluence of the Administration Area Ditch and the Buffalo Creek Cutoff (Figure 5.4-3).

The lateral extent of cadmium at that location in the Administration Area ditch is defined by the absence of that metal above its PGW SSL in surface and near-surface soil samples collected at downstream location WL-SD09 and upstream location 12D-SNS09. The lateral extent of lead is defined by the absence of that metal above its PGW SSL in the surface and near-surface soil samples collected at downstream location WL-SD09 and upstream location 12D-SNS08 (Figures 5.4-3 and 4.2-10). Soil samples were not collected at depths below 0.25 foot bgs at location 29E-SD01. However, the absence of cadmium and lead above their PGW SSL in surface and near-surface soils collected upstream and downstream of that location indicates that those metals are likely limited to the surface soils.

59E-SD03 and 59E-SB05

Lead at concentrations below its RISL, but above its PGW SSL, was detected in a surface soil sample collected at location 59E-SD03 and in a near-surface soil sample collected from boring 59E-SB05. Location 59E-SD03 is in the bottom of the Buffalo Creek Cutoff west of Line 02 and boring 59E-SB05 is along the bank directly across from 59E-SD03. The lateral extent of lead is defined by the absence of that metal above its PGW SSL in surface and near-surface soil samples collected at downstream location WL-SD09 and in surface soil samples collected at upstream locations 28E-SNS01, 59E-SD04, and 59E-SB06. Samples were not collected below a depth of 1 foot bgs from locations 59E-SD03 and 59E-SB05. However, the absence of lead above its PGW in upstream and downstream soil samples indicates that the vertical extent of lead is likely limited to the upper 1 to 2 feet of soil.

BC-SD01, BC-SD02, 59E-SD02

Cadmium and/or lead above its RISL and/or PGW SSL was detected in three soil samples collected at locations BC-SD01, BC-SD02, and 59E-SD02 along the upper portion of Buffalo Creek between Aerojet Road and the point of discharge into the Westlakes (Figures 5.4-2 and 5.4-3).

Cadmium above its RISL and PGW SSL was detected in only one (BC-SD01) of the three surface soil samples collected along the upper portion of Buffalo Creek (Figures 5.4-2 and 5.4-3). The extent of cadmium in the upper portion of Buffalo Creek is defined by the absence of that metal above its RISL and PGW SSL in soil samples collected at upstream

location BC-SD02 and downstream locations WL-SD11 and WL-SD14. The vertical extent of cadmium at location BC-SD01 was not defined, but is likely limited to accumulated sediments within the drainage.

Lead above its PGW SSL was detected in surface soil at three locations (BC-SD01, BC-SD02, and 59E-SD02) in the upper portion of Buffalo Creek. The extent of lead is defined by the absence of that metal above its PGW SSL in soil samples collected at upstream location BC-SD03 and downstream locations WL-SD14 and WL-SD11. The vertical extent of lead above its PGW SSL is not defined at locations BC-SD01 and BC-SD02, but lead was not detected above its PGW SSL in the soil sample collected at 1.5 feet bgs at location 59E-SB02. The data suggest that the vertical extent of lead is likely limited to accumulated sediments within the drainage.

<u>WL-SD02, WL-SD13, and WL-SD16</u>

Lead below its RISL, but above its PGW SSL, was detected in three soil samples collected at locations WL-SD02, WL-SD13, and WL-SD16, along the lower portion of Buffalo Creek between the Westlakes and the Folsom South Canal overpass (Figures 5.4-2 and 5.4-3).

The lateral extent of lead in the lower portion of Buffalo Creek is defined by the absence of that metal above its PGW SSL in surface soil samples collected at upstream location WL-SD12 and downstream location WL-SD01. The vertical extent of lead in that portion of Buffalo Creek is defined by the absence of lead above its PGW SSL in soil samples collected at 1.5 feet bgs at locations WL-SD02 and WL-SD13. Concentrations of lead in surface soil along Buffalo Creek may be attributed to the presence of that metal in surface water runoff from vehicle parking areas.

Based on the information presented above, the lateral and vertical extent of cadmium and lead in sediment/soil within the lower portion of the Administration Area Ditch and Buffalo Creek has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives. Additional evaluation of the potential risk to groundwater posed by those metals in soil is presented in Section 8 of the HHERA (Volume II).

5.4.4.2 *Semivolatile Organic Compounds*

B(a)P, B(b&k)F, and D(a,h)A were detected above their respective RISLs or PGW SSLs in surface/near-surface/sediment soil samples collected at

only two locations (WL-SD09 and WL-SD11) within Buffalo Creek (Section 5.4.3.3). B(a)P and B(b&k)F above their RISL and B(a)P, B(b&k)F, and D(a,h)A above their respective PGW SSLs are shown in Figure 5.4-3. The presence of SVOCs in the soil samples collected at both locations with respect to the completeness of characterization is discussed below.

WL-SD09

B(a)P above its PGW SSL was detected in the near-surface (0.5 foot bgs) soil sample collected at location WL-SD09 at the confluence between the Administration Area Ditch and the Buffalo Creek Cutoff (Figure 5.4-3).

- The lateral extent of B(a)P is defined by the absence of that compound above its PGW SSL in soil samples collected at upstream locations 28E-SNS01, 29E-SD01, 59E-SD03, and 59E-SD04; and downstream location WL-SD12.
- The vertical extent of B(a)P is defined by the absence of that compound above its PGW SSL in the soil sample collected at 1.5 feet bgs at location WL-SD09.

WL-SD11

B(a)P and B(b&k)F above their respective RISLs and PGW SSLs and D(a,h)A above its PGW SSL were detected in the surface (0.5 foot bgs) soil sample collected at location WL-SD11. Additionally, B(b&k)F above its RISL and PGW SSL and B(a)P above its PGW SSL were detected in the near-surface (1.5 feet bgs) soil sample collected at location WL-SD11. Location WL-SD11 is immediately upstream of the flow control gate used to divert water from Buffalo Creek into the East and West Ponds (Figures 5.4-2 and 5.4-3).

- The upstream extent of B(a)P, B(b&k)F, and D(a,h)A is defined by the absence of those compounds above their RISLs and PGW SSLs in soil samples collected at upstream locations WL-SD14, 59E-SD02, and 59E-SD01. B(a)P and B(b&k)F above their PGW SSLs were detected in a surface (0.5 foot bgs) soil sample collected at one (WL-SD08) of four locations in the West Pond that received surface water via the flow control gate (Figure 5.3-6). B(a)P, B(b&k)F, and D(a,h)A above their RISLs and PGW SSLs were not detected in soil samples collected from the East Pond or the lower portion of Buffalo Creek.
- The vertical extent of D(a,h)A, however, is defined by the absence of that compound above its PGW SSL in the soil samples collected at 1.5 feet bgs at location WL-SD11. The vertical extent of B(a)P and

B(b&k)F above their RISLs and/or PGW SSLs was not defined at depths greater than 1.5 feet, but is likely limited to the upper 3 feet of sediment accumulated upstream of the flow control gate.

Based on the information presented above, the lateral and vertical extent of B(a)P, B(b&k)F, and D(a,h)A in the lower portion of the Administration Area Ditch and Buffalo Creek has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives. Additional evaluation of the potential risk to groundwater posed by those compounds in soil is presented in Section 8 of the HHERA (Volume II).

5.4.4.3 *Polychlorinated Biphenyls*

Aroclor 1254 was detected in 14 surface/sediment and/or near-surface soil samples collected at 10 locations in the western portion of the Administration Area Ditch, Buffalo Creek, or the Buffalo Creek Cutoff at concentrations above its RISL or PGW SSL (Section 5.4.3.3). The presence of Aroclor 1254 at the 10 locations with respect to potential sources and characterization is discussed below.

<u>BC-SD01, BC-SD02, 59E-SD01, 59E-SD02, and WL-SD11</u>

Aroclor 1254 at concentrations above its RISL and PGW SSL was detected in surface (0.25 foot bgs) soil samples collected at two locations (BC-SD01 and BC-SD02) in the upper portion of Buffalo Creek (Figure 5.4-3). Additionally, Aroclor 1254 at concentrations below its RISL, but above its PGW SSL, was detected in surface and/or near-surface soil samples collected at three (59E-SD01, 59E-SD02, and WL-SD11) other locations in the upper portion of Buffalo Creek (Figure 5.4-3).

- Based on PCB data collected during the BOU RI and the Stage 2 RI, concentrations of Aroclor 1254 in the upper portion of Buffalo Creek may have originated from source areas in Area 00.
- The data indicate that concentrations of Aroclor 1254 at concentrations above its RISL and/or PGW SSL are present in sediment/soil along the entire 2,700-foot upper portion of Buffalo Creek from just south of Area 00 (BC-SD02) to the flow control gate (WL-SD11) for the East and West Ponds. The vertical extent of Aroclor 1254 above its RISL and PGW SSL at the 10 locations was not defined at depths greater than 1.5 feet bgs.

- Although Aroclor 1254 above its RISL and PGW SSL was detected in soil samples collected at location WL-SD11, immediately upstream of the flow control gate (WL-SD11) for the East and West Ponds, Aroclor 1254 was not detected above its RISL and/or PGW SSL in the soil samples collected from either pond.

59E-SD03, 59E-SD04, WL-SD09, and WL-SD12

Aroclor 1254 at concentrations above its RISL and PGW SSL was detected in a near-surface (1.5 feet bgs) soil sample collected at one (WL-SD09) location along the Buffalo Creek Cutoff west of Line 02 (Figure 5.4-3). Additionally, Aroclor 1254 at concentrations below its RISL, but above its PGW SSL, was detected in surface and/or near-surface soil samples collected at three (59E-SD03, 59E-SD04, and WL-SD12) other locations along the Buffalo Creek Cutoff and the western portion of the Administration Area Ditch (Figure 5.4-3).

- The data indicate that concentrations of Aroclor 1254 above its RISL are present in soil at the confluence of the Buffalo Creek Cutoff and the western portion of the Administration Area Ditch (Figure 5.4-3). The data also indicate that concentrations of Aroclor 1254 above its PGW SSL are likely present in sediment/soil along the entire 1,300-foot length of the Buffalo Creek Cutoff and the 1,400-foot section of the western portion of the Administration Area Ditch below the confluence of the Buffalo Creek Cutoff. The vertical extent of Aroclor 1254 above its RISL and/or PGW SSL at the four locations was not defined at depths greater than 1.5 feet bgs.
- Based on PCB data collected during the BOU RI and the Stage 2 RI, concentrations of Aroclor 1254 in the Buffalo Creek Cutoff and the western portion of the Administration Area Ditch likely originated from the same source areas in Area 00 that contributed that PCB to the upper portion of Buffalo Creek. The data suggest that releases of Aroclor 1254 from the source areas in Area 00 potentially occurred prior to the realignment of Buffalo Creek to allow discharge into the Westlakes.
- Although Aroclor 1254 above its PGW SSL was detected in soil samples collected at location WL-SD12, immediately upstream of the pumping station that transfers water from the Administration Area Ditch to the East and West Ponds, Aroclor 1254 was not detected above its RISL and/or PGW SSL in the soil samples collected from either pond.

WL-SD02

Aroclor 1254 at concentrations above its RISL and PGW SSL was detected in surface and near-surface (0.25 and 1.5 feet bgs) soil samples collected at one (WL-SD02) location along the lower portion of Buffalo Creek downstream of the Westlakes (Figure 5.4-3).

- The lateral extent of Aroclor 1254 at that location is defined by the absence of that PCB above its RISL and PGW SSL in soil samples collected at upstream location WL-SD13 and downstream location WL-SD01.
- The vertical extent of Aroclor 1254 above its RISL and/or PGW SSL at location WL-SD02 was not defined at depths greater than 1.5 feet bgs.

Based on the information presented above, the extent of Aroclor 1254 in the upper and lower portions of Buffalo Creek, the Buffalo Creek Cutoff, and the western portion of the Administration Area Ditch has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives. Additional evaluation of the potential risk to groundwater posed by the presence of Aroclor 1254 in soil along the drainages in the WLLO Area is presented in Section 8 of the HHERA (Volume II).

5.5 *SUMMARY AND RESULTS OF VADOSE ZONE REMEDIAL INVESTIGATIONS – OPEN SPACE AREAS 5, 6, AND 7*

Since 1961, the Aerojet facility has primarily been used for the design, development, and testing of solid and liquid fuel rocket propulsion systems. In accordance with United States Department of Defense and National Aeronautics and Space Administration regulations regarding operations involving energetic materials, these operations were separated from one another and neighboring properties by large tracts of open land (buffer zones). No testing was conducted within these buffer zones.

Open Space Areas 5, 6, and 7 (OS5, OS6, and OS7) consist of buffer zones located between operational areas (Line 02 and Line 05 North) on the site and neighboring properties to the north (Figure 5.5-1). OS6 is incorporated into and synonymous with the Westlakes Area, as described and discussed in Section 5.3.

This section describes the environmental setting of OS5 and OS7, summarizes the scope and results of historical and recent investigations,

and discusses the results of the investigation with respect to potential source and completeness of characterization.

The information presented was compiled from one or more of the following sources: *Stage 1 Sampling Plan-Zone 1* (Aerojet, 1993a); *Stage 1 Sampling Plan-Zones 3 and 4* (Aerojet, 1993b); *Stage 1 Sampling Plan-Zone 2* (Aerojet, 1993c); *Aerojet Superfund Site – Scoping Report, Volumes 1 through 6* (ICF Technology, Inc., 1989); *Aerojet Site, Stage 1 Report - Zones 1 through 4* (ICF Kaiser Engineers, Inc., 1993); or BOU FSP (Aerojet et al., 2006b).

5.5.1 Environmental Setting – Open Space Areas 5 and 7

The topography, geology, soils, surface water hydrology, general hydrogeology, and ecological habitat of OS5 and OS7 are described in the following subsections. As previously discussed, OS6 is synonymous with the Westlakes Area and is discussed in Section 5.3.

5.5.1.1 Topography

OS5 is relatively flat with a shallow low-lying area adjacent to Buffalo Creek. OS5 was not dredged, but the eastern portion of the area was graded during the realignment of Buffalo Creek as part of the construction of the Westlakes. Buffalo Creek runs along the eastern and northern border of OS5. A dirt road traverses OS5 from east to west.

OS7 consists of an area of east-west aligned dredge tailings divided by slickens and the topography is undulating and irregular. A dirt road transects the area from east to west.

5.5.1.2 Geology

No borings are within OS5 and, therefore, no site-specific geological information is available. However, as with Line 02, OS5 is located along an ancestral American River terrace and the geology is expected to be similar to that of Line 02. The geology of the terrace areas consists of interbedded layers of relatively permeable and relatively lower permeability sediments. Relatively permeable layers are made up of silty, poorly and well-graded sands and gravels; and silty and clayey gravels and silts. Relatively lower permeability sediment layers consist of low plasticity clays and silts, and silty and clayey sands.

Borings were not drilled within OS7, but the review of aerial photographs show that OS7 and Line 05 North are both included in the same dredge

field. Therefore, the geology of OS7 is likely the same as for Line 05 North, which consists of reworked Quaternary-aged fluvial deposits of cobbles, sand, silt, and clay to a depth of approximately 20 feet. Native soils below the dredge tailings generally consist of fluvial deposits of sand and silt.

5.5.1.3 *Soils*

OS5 was not dredged and soils are classified as Redding-Corning-Red Bluff consisting of moderately well-drained soils that are moderately deep over a cemented hard pan. This soil unit is found on intermediate and high terraces, terrace remnants, and the side slopes of terraces in the eastern part of Sacramento County. The soils form in alluvium that is derived from mixed rock sources. The Redding soils are typically a surface layer of gravelly loam with subsoil comprised of a gravelly claypan, which is in turn underlain by a hardpan at a depth of 20 to 40 inches. The Corning-Red Bluff soils are typically a loam with a subsoil of clay loam, gravelly loam, and gravelly clay loam.

OS7 was dredged and the soils are classified as Xerorthents. Xerorthents are very deep, somewhat excessively drained, and excessively drained soils associated with dredge tailings. They are formed in material that has a high content of gravel and cobbles derived from mixed sources. The material was deposited as tailings after most of the fine-earth material was washed from it and removed during gold dredging activities. Slopes are short, complex, and disturbed (USDA – NRCS 1993).

5.5.1.4 *Surface Water Hydrology*

Buffalo Creek is the only surface water feature within OS5 and OS7 (Figure 5.5-1). Surface water runoff in OS5 is generally towards Buffalo Creek to the east and north. Surface water runoff in OS7 is limited by the presence of the dredge tailings and generally infiltrates into the subsurface.

5.5.1.5 *Local Hydrogeology*

The first saturated sediments encountered beneath OS5 and OS7 are either part of Perched Groundwater or within the FWBZ. The general hydrogeology of the Perched Groundwater and FWBZ beneath those areas is discussed below. Details regarding the occurrence of groundwater within the Westlakes Area and distribution of chemicals in the groundwater are presented in Section 5.7.

Perched Groundwater

Borings were not drilled in OS5 and OS7 and, therefore, site-specific information regarding the presence of Perched Groundwater can not be ascertained. However, the geology of OS5 and OS7 are similar to that observed in Line 02 and Line 05 North and, therefore, their hydrogeology is likely similar.

Perched Groundwater was encountered in the Line 02 Area during the BOU RI at depths of 43 to 45 feet bgs (123 to 129 feet amsl) in the undredged sediments beneath the western portion of Line 02. Perched Groundwater beneath the Line 02 Area and throughout the Westlakes/Line 02 Area is discontinuous and lateral hydraulic gradients were not evaluated.

Perched Groundwater typically occurs in ancestral American River sediments that have been reworked by historical gold-dredging activities as in OS7. Within Line 05 North, located immediately east of OS7, Perched Groundwater was frequently encountered at depths ranging from 9 to 20 feet bgs, with a median depth of 15.5 feet bgs. The direction of flow in the Perched Groundwater beneath the Line 05 North Area was variable with hydraulic gradients ranging from approximately 0.0057 to 0.0278 ft/ft.

First Water-Bearing Zone

The depth to the top of the FWBZ increases from east to west across the Westlakes/Line 02 Area. The FWBZ is shallowest (34 feet bgs) to the east of Line 02, increasing to approximately 76 feet bgs in the Line 05 North/OS7 Area.

5.5.1.6 *Ecological Habitat*

A *Biological Assessment Report* (ECORP Consulting, Inc., 2005) for the BOU was presented as Appendix B in the BOU FSP (Aerojet et al., 2006b). A brief description of the ecological habitats within OS5 and OS7, based on the data presented in that report, are provided below.

OS5 includes lands that were not dredged and annual grassland constitutes the principal vegetative community with valley foothill riparian occurring along Buffalo Creek. Non-native, naturalized Mediterranean grasses are the dominant species within the annual grassland. Typical fauna within these communities include various

raptors, western fence lizard, Gilbert's skink, Pacific gopher snake, racer, common kingsnake, bullfrog, wild turkey, savannah sparrow, western meadowlark, bushtit, Hutton's vireo, hermit thrush, Wilson's warbler, black-headed grosbeak, brush mouse, deer mouse, western harvest mouse, brush rabbit, Virginia opossum, California vole, California ground squirrel, and coyote.

OS7 consists of dredge tailings. Vegetative communities within that area include Fremont cottonwood-oak woodland and willow scrub. Valley foothill riparian is associated with Buffalo Creek. Typical flora in these areas include Fremont cottonwood and oaks with an understory of annual grasses, coyote brush, Himalayan blackberry, poison oak, pennyroyal, sedge, bulrush, vervain, and cattail. Examples of wildlife species encountered in these communities include various raptors, California slender salamander, Gilbert's skink, southern alligator lizard, northern flicker, Acorn woodpecker, Nuttal's woodpecker, oak titmouse, white-breasted nuthatch, deer mouse, California vole, western gray squirrel, and Botta pocket gopher.

Blue elderberry shrubs, potential habitat for the Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), have been observed scattered through OS5 and OS7.

5.5.2 *Description of Areas – Open Space Areas 5 and 7*

OS5 and OS7, and associated site features, are described below and shown in Figure 5.5-1.

5.5.2.1 *Open Space Area 5*

OS5 consists of buffer lands between Line 02 and Line 05 North. No source areas have been identified within OS5, but a storage yard and two former tanks are present in the southeast corner of the site near the dirt road west of Buffalo Creek. Historical use of the storage yard and tanks is unknown, but may have potentially been associated with activities in Line 02.

5.5.2.2 *Open Space Area 7*

OS7 consists of buffer lands west of Line 05 North. No source areas have been identified within OS7 and no indications of historical industrial activities were observed during site reconnaissance performed as part of the BOU RI.

5.5.3 *Summary and Results of Previous (Pre-2005) Vadose Zone Remedial Investigation – Open Space Areas 5 and 7*

OS5 and OS7 were not included in previous investigations conducted at the Aerojet site. Based on an evaluation of the open spaces, the BOU FSP determined that soil and soil vapor sampling were needed in OS5 to determine if COPCs were present as a result of the historical use of the storage yard and tanks.

5.5.4 *Summary and Results of Boundary Operable Unit Vadose Zone Investigation – Open Space Areas 5 and 7*

The following subsections summarize the recent BOU investigation of the site features within OS5, describe deviations from the sampling proposed in the BOU FSP, present the results of the BOU RI, and discuss the results of the sampling with respect to the completeness of the characterization and identification of potential sources.

5.5.4.1 *Summary of Boundary Operable Unit Vadose Zone Investigation – Open Space Areas 5 and 7*

The BOU RI of the vadose zone in OS5 included the following activities:

<u>Soil Vapor Investigation</u>

- A total of three primary soil vapor samples were collected within OS5 and analyzed for VOCs, including TICs. Soil vapor sampling locations are shown in Figure 5.5-2.
- The number of soil vapor samples (including QA/QC samples) collected in OS5, along with the analytical method, is provided on Table 5.5-1.
- A cross-reference between soil vapor sampling locations within OS5 and the specific features they were sited to investigate is provided on Table 5.5-2.

<u>Surface and Subsurface Soil Investigation</u>

- Two primary and two duplicate surface and/or near-surface (0 to 2.5 feet bgs) soil samples and two primary and one duplicate subsurface (5 to 11 feet bgs) soil samples were collected at OS5. Surface and subsurface soil sampling locations are shown in Figure 5.5-3.

- Surface and/or near-surface soil samples were analyzed for metals SVOCs, perchlorate, and TPH. Subsurface soil samples were analyzed for SVOCs. The SVOC analysis of soil samples also included an evaluation of the presence of TICs. In accordance with the FSP, sample analysis was based on the analytical results from previous investigations and, therefore, every sample was not analyzed for the full suite of constituents.
- The number of surface/near-surface and subsurface soil samples collected for each analysis (including QA/QC samples) at OS5, along with the corresponding methods, is provided on Table 5.5-3.
- A cross-reference between surface/near-surface and subsurface soil sampling locations within OS5 and the specific features they were sited to investigate is provided on Table 5.5-2.

5.5.4.2 *Deviations from Boundary Operable Unit Data Quality Objectives and Sampling Design – Open Space Areas 5 and 7*

Soil and soil vapor sampling performed in OS5 during the BOU RI were generally consistent with those proposed by the BOU FSP, with the exceptions listed on Tables 5.5-4 and 5.5-5. A comparison of proposed and actual sampling activities, including sampling rationale, sample depth, and analyses, is provided on Tables 5.5-4 and 5.5-5.

5.5.4.3 *Results of Boundary Operable Unit Vadose Zone Investigation – Open Space Areas 5 and 7*

The results of the VOC, SVOC, metals, perchlorate, and TPH-D and TPH-Mo analyses of samples collected during the BOU RI at OS5 are summarized below. The result of the BOU RI for OS6/Westlakes is presented in Section 5.3. No soil or soil vapor sampling was conducted within OS7 during the BOU RI.

The analytical results for all soil vapor and soil samples are provided in Appendices F and G, respectively.

<u>Summary of Investigation and Results – Volatile Organic Compounds</u>

Based on evaluation of the existing data for OS5, the BOU FSP concluded that soil vapor sampling was needed to determine if VOCs were present in the vadose zone within the storage yard and near the tanks at OS5.

As indicated on Table 5.5-1 and below, six primary samples were collected at four locations within OS5 during the BOU RI and analyzed for VOCs. Soil vapor samples were collected at two locations (OS5-F1-SP01 and OS5-F2-SP01) to evaluate the presence of VOCs at the storage yard and near the former tanks. Soil vapor samples were collected at two other locations (28E-SP17 and 28E-SP19) as part of step-out sampling to evaluate the extent of VOCs originating from Source Area 28E in Line 02.

Area	Depth (ft bgs)	No. of Primary Samples	No. of Locations
OS5	0-10	2	2
	11-20	1	1
28E	0-10	2	2
	11-20	1	1

The analytical results for the soil vapor samples collected from the shallow (0 to 10 feet bgs) and intermediate (11 to 20 feet bgs) intervals at OS5 are presented in Appendix F and summarized below. Soil vapor sampling locations in the shallow and intermediate intervals in OS5 are shown in Figure 5.5-2. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 5.5-2.

VOCs were not detected above their respective RISLs or PGW SSLs in the shallow and intermediate soil vapor samples collected in OS5. Additionally, TICs were not identified in the samples.

Summary of Investigation and Results – Metals

Two primary and two duplicate soil samples were collected at two locations (OS5-F1-SB01 and OS5-F2-SB01) within the storage yard and near the former tanks during the BOU RI and analyzed for metals, including mercury. The number of primary soil samples and sampling locations in OS5, along with summary statistics for the samples, are summarized on Table 5.5-3. The analytical results are presented in Appendix G and summarized below. Sampling locations are shown in Figures 5.5-3 and 5.5-4. Soil sampling locations and the features being investigated are cross-referenced on Table 5.5-2.

Because the number of samples collected in OS5 was insufficient to perform a statistical comparison to background, those metals (antimony, cadmium, lead, molybdenum, and zinc) detected at concentrations statistically different from background in the adjacent management area (Line 05 North) were also screened for OS5. Additionally, because boron,

hexavalent chromium, lithium, strontium, and titanium were not included in the background evaluation, concentrations of these metals were also compared to screening levels.

Metals were not detected at concentrations above their respective RISLs or PGW SSLs in the surface/near-surface soil samples collected in OS5.

Summary of Investigation and Results – Semivolatile Organic Compounds

Four primary and three duplicate soil samples were collected at two locations (OS5-F1-SB01 and OS5-F2-SB01) within the storage yard and near the former tanks during the BOU RI and analyzed for SVOCs. The number of primary soil samples and sampling locations in OS5 for SVOCs are summarized on Table 5.5-3 and below. Summary statistics for the samples are also presented on Table 5.5-3.

		Surface/Near-Surface		Subsurface	
Source Area	**Compound**	**No. of Samples**	**No. of Locations**	**No. of Samples**	**No. of Locations**
OS5	SVOCs	2	2	2	1

The results of the SVOC analysis of surface/near-surface and subsurface soil samples collected from OS5 are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations and SVOCs are shown in Figures 5.5-3 and 5.5-4. Soil sampling locations and the features being investigated are cross-referenced on Table 5.5-2.

SVOCs were not detected at concentrations above their respective RISLs or PGW SSLs in surface, near-surface, or subsurface soil collected within OS5.

Summary of Investigation and Results – Perchlorate

Two primary and two duplicate surface/near-surface soil samples were collected at two locations (OS5-F1-SB01 and OS5-F2-SB01) within the storage yard and near the former tanks during the BOU RI and analyzed for perchlorate during the BOU RI. The number of primary soil samples and sampling locations in OS5 for perchlorate and summary statistics are presented on Table 5.5-3. Sampling locations are shown in Figures 5.5-3 and 5.5-4. Soil sampling locations and the features being investigated are cross-referenced on Table 5.5-2.

Perchlorate was not detected above its PQL, RISL, or PGW SSL in the surface/near-surface soil samples collected within OS5.

Summary of Investigation and Results – Total Petroleum Hydrocarbons

Two primary and two duplicate surface/near-surface soil samples were collected at two locations (OS5-F1-SB01 and OS5-F2-SB01) within the storage yard and near the former tanks during the BOU RI and analyzed for TPH-D and TPH-Mo. The number of primary soil samples and sampling locations in OS5 for TPH and summary statistics are presented on Table 5.5-3. Sampling locations are shown in Figures 5.5-3 and 5.5-4. Soil sampling locations and the features being investigated are cross-referenced on Table 5.5-2.

TPH-D and TPH-Mo were not detected above their PGW SSLs in the surface/near-surface soil samples collected within OS5.

5.5.5 Discussion of Investigation Results with Respect to Data Quality Objectives – Open Space Areas 5 and 7

The analytical results presented in the previous section indicated that no chemicals are present in soil or soil vapor within OS5 at concentrations above their respective RISLs or PGW SSLs.

5.6 SUMMARY AND RESULTS OF SURFACE WATER REMEDIAL INVESTIGATION – CENTRAL PORTION OF THE BOUNDARY OPERABLE UNIT

The central portion of the BOU, also referred to as the WLLO Area, includes Buffalo Creek and the western portion of the Main Administration Area Ditch, both of which discharge into the Westlakes (Figures 1.1-2, 5.6-1 and 5.6-2). As discussed in Section 5.4, Buffalo Creek transects the Aerojet site and receives storm water from many source areas in Area 00, Line 01, Line 02, Line 06, and Zone 3. The Main Administration Area Ditch receives storm water from approximately 18 source areas and parking/storage lots, including BOU Source Areas 3D, 4D, 5D, 6D, 8D, 9D, 11D, 12D, 50D, 51D, 52D, D(b), D(c), D(d), and 52D and PGOU Source Areas 7D and 10D. The results of the surface water RI for the ditches within the Administration Area was presented and discussed in Section 4.3.4 of this report.

This section describes surface water sampling of the western portion of the Administration Area Ditch, Buffalo Creek below Area 00, and the Westlakes conducted during the BOU RI, presents the results of that sampling, and identifies COPCs in the surface water. Additionally, the results of sampling of storm water that ponds in low-lying areas within and adjacent to source areas within the WLLO are presented and discussed in the section. A discussion regarding potential correlations between COPCs in surface water and those identified in surface soil at source areas is presented in Section 5.6.4 of this report.

5.6.1 Summary and Results of Surface Water Remedial Investigations – WLLO Area

The following subsections briefly describe the surface water drainages within the WLLO Area, summarize the scope and results of previous investigations conducted prior to 2005, present a preliminary identification of COPCs, and discuss DQOs and sampling proposed in the BOU FSP (Aerojet et al., 2006b).

The information presented was compiled from one or more of the following sources*: Stage 1 Sampling Plan-Zone 1* (Aerojet, 1993a); *Stage 1 Sampling Plan-Zones 3 and 4* (Aerojet, 1993b); *Stage 1 Sampling Plan-Zone 2* (Aerojet, 1993c); *Aerojet Superfund Site – Scoping Report, Volumes 1 through 6* (ICF Technology, Inc., 1989); *Aerojet Site; Stage 1 Report - Zones 1 through 4* (ICF Kaiser Engineers, Inc., 1993); BOU FSP (Aerojet et al., 2006b); and *Final Remedial Investigation Report for the Perimeter Groundwater Operable Unit (OU-5)* (Aerojet et. al., 2008).

5.6.1.1 Description of Drainages - WLLO Area

Drainages and low-lying areas that accumulate storm water during periods of precipitation and the Westlakes are shown in Figures 5.6-1 and 5.6-2. Detailed descriptions of the drainages, source areas, and site features in the vicinity of the surface water sampling locations are provided in Sections 5.3 and 5.4 and are described briefly below.

<u>Buffalo Creek</u>

Buffalo Creek transects the Aerojet site and receives storm water from source areas in Zone 3, Line 01, Area 00, Line 06, and Line 02. Sediment/soil sampling conducted along Buffalo Creek during the BOU RI and the analytical results for those samples are presented and described in Section 5.4.

Administration Ditch

The western portion of the Administration Ditch receives storm water from the Administration Area Drainage system that potentially originates from the following source areas within the BOU and the PGOU: 3D, 4D, 5D, 6D, 7D, 8D, 9D, 10d, 11D, 12D, 50D, 51D, 52D, D(b), D(c), D(d), and 52D. The results of the surface water RI for the ditches within the Administration Area were presented and discussed in Section 4.3.4 of this report.

Westlakes

The Westlakes consist of two detention ponds (East and West Ponds) and three associated overflow cells (Cells 1 through 3) surrounded by earthen embankments (Figure 5.6-2). The Westlakes receive storm water runoff from various areas of the Aerojet facility via the Administration Area Ditch and Buffalo Creek. Surface water in the Westlakes is allowed to infiltrate or, in the rare case when the Westlakes become full, is discharged to the section of Buffalo Creek south of the lakes.

Source Area E(l)

Source Area E(l) is a low-lying area located approximately 100 feet west of Building 05087 (Figure 5.6-1). Source Area E(l) received surface runoff from the inactive concrete wash sump (Source Area 51E) and the inactive storage tank area west of Building 05087.

Source Areas E(m) and E(n)

Surface water drainages in the vicinity of Source Areas E(m) and E(n) include a drainage swale east of the former location of Buildings 02025, 02026, and 02027, and a low-lying area between those buildings and the Administration Area Ditch. The drainage swale discharges to the low-lying area where the accumulated water evaporates or infiltrates into the soil. The drainage swale and low-lying area receives surface water runoff from the areas surrounding Buildings 02021, 02022, 02023, 02025, 02026, and 02027; and possibly 02020, a former oxidizer grind station. Additionally, the swale received discharges from Building 02025 via a 3-inch industrial waste line [Source Area E(n)].

5.6.2 *Summary and Results of Previous Surface Water Investigations – WLLO Area*

Surface water sampling of the western portion of the Administration Area Ditch and Buffalo Creek was not conducted during previous investigations. Sampling and analysis of surface water in the Westlakes is performed prior to release to Buffalo Creek in accordance with the requirements of an NPDES permit (RWQCB, 2002).

The BOU FSP determined that surface water sampling was needed in the Westlakes, Line 02, and Line 05 North areas to assess the potential presence of COPCs (VOCs, SVOCs, TPH, total and dissolved metals, NDMA, perchlorate, pesticides, OBPA, and nitroguanidine) that may have been identified at source areas.

5.6.3 *Summary and Results of Boundary Operable Unit Surface Water Investigation – WLLO Area*

The following subsections summarize the recent surface water investigation conducted as part of the BOU RI, describe deviations from sampling proposed in the BOU FSP, present the results of the investigation, and discuss the results with respect to characterization and potential sources.

5.6.3.1 *Summary of Boundary Operable Unit Surface Water Investigation – WLLO Area*

A total of 13 primary and 8 duplicate surface water samples were collected from the WLLO Area at 13 locations (Figures 5.6-1 and 5.6-2). The 13 primary and 8 duplicate samples were analyzed for VOCs; total and dissolved metals; SVOCs; OBPA; total extractable petroleum hydrocarbons; dissolved organic carbon (DOC); anions (including nitrate, nitrite, phosphate, sulfate, chloride, and fluoride); and alkalinity. Additionally, selected samples were also analyzed for NDMA, perchlorate pesticides, nitroguanidine, hexavalent chromium (total and dissolved), and TPH. As discussed in the BOU FSP, the analysis of surface water samples is based on COPCs identified in the vadose zone at source areas upstream and in proximity to the sampling location. Therefore, every surface water sample was not analyzed for the full suite of constituents.

Field measurements taken during collection of the surface water samples were conductivity, pH, redox potential, and temperature. Each sample was also measured for dissolved oxygen, total dissolved solids, or turbidity.

The numbers of surface water samples collected for each analysis (including QA/QC samples) at each of the 13 sampling locations along the WLLO Area, along with the corresponding methods, are provided on Table 5.6-1.

5.6.3.2 *Deviations from Data Quality Objectives and Sampling Design – WLLO Area*

Surface water sampling performed in the Line 02, Line 05 North and Westlakes Areas during the BOU RI was generally consistent with that proposed in the BOU FSP, except that four samples were not analyzed for OPBA. A comparison of proposed and actual sampling activities, including sampling rationale and analyses, is provided on Table 5.6-1.

5.6.3.3 *Results of Boundary Operable Unit Surface Water Investigation Results – WLLO Area*

The analytical results for the VOC, SVOC, total and dissolved metals (including hexavalent chromium), perchlorate, TPH-D and TPH-Mo, NDMA, nitroguanidine, pesticides, OBPA, DOC, anions, and/or alkalinity analyses of surface water samples collected during the BOU RI are presented below.

<u>Summary of Investigation and Results – Volatile Organic Compounds</u>

A total of 13 primary surface water samples and 8 duplicate samples were collected at 13 locations within the WLLO Area during the BOU RI and analyzed for VOCs (Table 5.6-1). Surface water sampling locations are shown in Figures 5.6-1 and 5.6-2.

VOCs were not detected above their respective RISL surface water screening levels (SWSLs) in the surface water samples collected within the WLLO Area.

<u>Summary of Investigation and Results – Semivolatile Organic Compounds</u>

A total of 13 primary surface water samples and 8 duplicates were collected at 13 locations within the WLLO Area during the BOU RI and analyzed for SVOCs. Surface water sampling activities are summarized on Table 5.6-1 and surface water sampling locations are shown in Figure 5.6-2.

Bis(2-ethylhexyl)phthalate [B(2-EH)P], a common laboratory contaminant, at an estimated concentration of 110 µg/L, was detected in only one

surface water sample (WL-SW04). B(2-EH)P at concentrations greater than the PQL of 50 µg/L was not detected in surface water samples collected at Station S-2 between January 2000 and December 2004.

Summary of Investigation and Results – Total and Dissolved Metals

A total of 13 primary surface water samples and 8 duplicate samples were collected at 13 locations within the WLLO during the BOU RI and analyzed for total and dissolved metals (Table 5.6-1). The results of the total and dissolved metals analyses of surface water samples are summarized below. Surface water sampling locations are show in Figures 5.6-1 and 5.6-2.

Surface Water – Total Metals:

The range of total metal concentrations detected in surface water samples collected from the WLLO Area, the number of surface water samples with detected concentrations, and the sampling location having the maximum detected concentration are presented on the table below.

Metal	Range of Detected Conc. (µg/L)	No. of Samples with Detections	Location of Maximum Conc.	Drainage or Source Area
Aluminum	300 J – 23,000	13	E(l)-SW01	Line 05 North - Source Area E(l)
Antimony	0.071 J - 1.8 J	10	WL-SW08	
Arsenic	0.55 J – 4.0	7	E(l)-SW01	Line 05 North - Source Area E(l)
Barium	16 – 150	13	E(l)-SW01	Line 05 North - Source Area E(l)
Beryllium	0.2 J – 0.42 J	4	E(l)-SW01	Line 05 North - Source Area E(l)
Boron	8.6 J – 28 J	6	E(l)-SW01	Line 05 North - Source Area E(l)
Cadmium	0.027 J - 0.46 J	11	E(l)-SW01	Line 05 North - Source Area E(l)
Calcium	1700 – 22,000	13	WL-SW01	West end of Buffalo Creek
Chromium	1.8 J – 30	12	E(l)-SW01	Line 05 North - Source Area E(l)
Hex Chromium	3.4 J – 4.5 J	2	WL-SW02	Buffalo Creek South of Westlake
Cobalt	0.23 J - 6.2	13	E(l)-SW01	Line 05 North - Source Area E(l)
Copper	2.8 – 4,100	10	WL-SW04	Westlakes – West Pond
Iron	270 – 21,000	13	E(l)-SW01	Line 05 North - Source Area E(l)
Lead	0.48 J – 140	13	WL-SW04	Westlakes – West Pond
Magnesium	740 – 8,300	13	WL-SW01	West end of Buffalo Creek
Manganese	12 J – 240	12	E(l)-SW01	Line 05 North - Source Area E(l)
Mercury	0.05 J - 0.17 J	2	E(l)-SW01	Line 05 North - Source Area E(l)
Molybdenum	0.21 J – 82	10	WL-SW04	Westlakes – West Pond
Nickel	1.4 J – 30	10	E(l)-SW01	Line 05 North - Source Area E(l)
Potassium	380 J – 12,000	13	E(l)-SW01	Line 05 North - Source Area E(l)
Silver	0.04 J – 1.3	10	59E-SW02	Buffalo Creek South of Westlake
Sodium	780 – 9,300	13	WL-SW01	West end of Buffalo Creek
Strontium	14 J – 230	13	WL-SW01	West end of Buffalo Creek
Thallium	0.2 J – 0.26 J	4	E(n)-SW01	Line 02 - Source Area E(n)

Metal	Range of Detected Conc. (µg/L)	No. of Samples with Detections	Location of Maximum Conc.	Drainage or Source Area
Titanium	12 – 610	13	E(l)-SW01	Line 05 North - Source Area E(l)
Vanadium	3.5 J – 45	13	E(l)-SW01	Line 05 North - Source Area E(l)
Zinc	16 J – 480	9	WL-SW04	Westlakes – West Pond

J – Estimated concentration

Antimony, arsenic, copper, iron, lead, manganese, molybdenum, thallium, and vanadium were the only metals detected in surface water samples collected from the WLLO Area at total concentrations above their respective SWSLs. Metals detected above their SWSLs and the sampling locations at which those metals were detected are listed on the table below and shown in Figure 5.6-3.

Sample Location	Drainage or Source Area	Metal	SWSL (µg/L)	Conc. (µg/L)
59E-SW01	Buffalo Creek south of Line 02 at Illinois Street Bridge	Iron	1,095	1,500
		Vanadium	3.6	7.1
59E-SW02	Buffalo Creek downstream of Line 02	Iron	1,095	2,500
		Vanadium	3.6	9.2
WL-SW01	West End of Buffalo Creek near discharge from GET E/F	Vanadium	3.6	4.6
WL-SW03	Eastern Pond	Iron	1,095	1,300
		Vanadium	3.6	4.0
WL-SW04	Western Pond	Arsenic	0.0071	0.55
		Copper	146	4,100
		Iron	1,095	4,200
		Lead	15	140
		Molybdenum	18.2	82
		Vanadium	3.6	8.2
WL-SW05	Buffalo Creek near diversion gate into Eastern and Western Ponds	Arsenic	0.0071	0.75
		Iron	1,095	1,600
		Vanadium	3.6	6.0
WL-SW06	Administration Area Ditch upstream of Pump Station	Iron	1,095	1,800
		Vanadium	3.6	4.6
WL-SW07	Confluence of Buffalo Creek Cutoff and Administration Area Ditch	Arsenic	0.0071	0.56
		Iron	1,095	2,800
		Vanadium	3.6	7.2
WL-SW08	Drainage Ditch between Beck's Furniture to Buffalo Creek	Antimony	1.5	1.8
		Arsenic	0.0071	0.82
		Iron	1,095	1500
		Lead	15	26
		Vanadium	3.6	3.9`
E(m)-SW01	Line 02 – Source Area E(m) Low-lying area in northern portion of Line 02	Arsenic	0.0071	1.4
		Iron	1,095	10,000
		Manganese	87.6	110
		Vanadium	3.6	22

Sample Location	Drainage or Source Area	Metal	SWSL (µg/L)	Conc. (µg/L)
E(n)-SW01	Line 02 - Source Area E(n) Drainage ditch west of former location of Building 02025	Arsenic	0.0071	1.7
		Iron	1,095	13,000
		Manganese	87.6	220
		Thallium	0.2	0.26
		Vanadium	3.6	27
E(l)-SW01	Line 05 North - Source Area E(l) Low-lying area west of Building 05087	Arsenic	0.0071	4.0
		Iron	1,095	21,000
		Lead	15	16
		Manganese	87.6	240
		Thallium	0.2	0.24
		Vanadium	3.6	45

J – Estimated concentration

Surface Water – Dissolved Metals:

The range of dissolved metal concentrations detected in surface water samples collected from the WLLO Area, the number of surface water samples with detected concentrations, and the sampling location having the maximum detected concentration are presented on the table below.

Metal	Range of Detected Conc.. (µg/L)	No. of Samples with Detections	Location of Maximum Conc.	Drainage or Source Area
Aluminum	48 J – 1,200 J	13	E(l)-SW01	Line 05 North - Source Area E(l)
Antimony	0.13 J – 1.3 J	7	WL-SW08	Drainage from Beck's Furniture
Arsenic	0.52 J – 1.7	2	E(l)-SW01	Line 05 North - Source Area E(l)
Barium	11 – 62	13	E(l)-SW01	Line 05 North - Source Area E(l)
Beryllium	0.087 J	1	WL-SW04	Westlakes - West Pond
Boron	8 J – 21 J	3	E(l)-SW01	Line 05 North - Source Area E(l)
Cadmium	0.026 J – 0.13 J	7	E(l)-SW01	Line 05 North - Source Area E(l)
Calcium	1,400 – 22,000	13	WL-SW01	West end of Buffalo Creek
Chromium	1.1 J – 2.9	8	WL-SW08	Drainage from Beck's Furniture
Hex Chromium	2.3 J	1	WL-SW01	West end of Buffalo Creek
Cobalt	0.035 J – 2.2	12	E(l)-SW01	Line 05 North - Source Area E(l)
Copper	0.25 J – 24	11	WL-SW04	Westlakes - West Pond
Iron	54 – 700	11	E(l)-SW01	Line 05 North - Source Area E(l)
Lead	0.059 J – 3.3	13	WL-SW08	Drainage from Beck's Furniture
Lithium	ND	0	---	
Magnesium	610 – 8,300	13	WL-SW01	West end of Buffalo Creek
Manganese	7.2 J – 83	7	E(n)-SW01	Line 02 - Source Area E(n)
Mercury	ND	0	---	
Molybdenum	0.15 J – 2.5	10	WL-SW04	Westlakes - West Pond
Nickel	0.94 J – 7.1	10	E(l)-SW01	Line 05 North - Source Area E(l)
Potassium	410 J – 10,000	13	E(l)-SW01	Line 05 North - Source Area E(l)
Selenium	ND	0	---	
Silver	0.031 J – 0.13 J	8	WL-SW05	Buffalo Creek
Sodium	520 – 11,000	12	WL-SW01	West end of Buffalo Creek
Strontium	13 J – 240	13	WL-SW01	West end of Buffalo Creek

Metal	Range of Detected Conc.. (µg/L)	No. of Samples with Detections	Location of Maximum Conc.	Drainage or Source Area
Thallium	0.15 J – 0.24 J	3	WL-SW05	Buffalo Creek
Titanium	2.8 J – 37	11	E(n)-SW01	Line 02 - Source Area E(n)
Vanadium	0.81 J – 6.6	12	E(l)-SW01	Line 05 North - Source Area E(l)
Zinc	16 J – 100	8	WL-SW07	Confluence of Admin Ditch/Buffalo Creek

J – Estimated concentration

Arsenic and vanadium were the only metals detected in surface water samples collected from the WLLO Area at dissolved concentrations above their respective SWSLs. Metals detected above their SWSL and the sampling locations are listed on the table below.

Drainage or Source Area	Sample Location	Metal	Conc. (µg/L)
Buffalo Creek	59E-SW01	Vanadium	4.6
Buffalo Creek	59E-SW02	Vanadium	4.6
Buffalo Creek	WL-SW05	Vanadium	4.1
Buffalo Creek	WL-SW06	Arsenic	0.52 J
Line 02 - Source Area E(n)	E(n)-SW01	Vanadium	4.1
Line 05 North - Source Area E(l)	E(l)-SW01	Arsenic Vanadium	1.7 4.1

J – Estimated concentration

Summary of Investigation and Results – Perchlorate

A total of 12 primary and 7 duplicate surface water samples were collected at 12 locations within the WLLO Area during the BOU RI and analyzed for perchlorate (Table 5.6-1). Perchlorate was detected in 10 of the surface water samples collected from the WLLO Area at concentrations ranging from 1.6 to 130 µg/L. Sampling locations where perchlorate was detected at concentrations above the SWSL are listed on the table below and shown in Figure 5.6-3.

Drainage or Management Area	Sample Location	Compound	Conc. (µg/L)
Line 2 – Low Area	E(m)-SW01	Perchlorate	4.4
Line 2 – Drainage Swale	E(n)-SW01	Perchlorate	9.8
Line 05 North - Source Area E(l)	E(l)-SW01	Perchlorate	130
Buffalo Creek	59E-SW01	Perchlorate	2.1
Buffalo Creek	59E-SW02	Perchlorate	1.8
Confluence of Admin Ditch & Buffalo Creek	WL-SW07	Perchlorate	3.2
Buffalo Creek – South side of Westlakes	WL-SW06	Perchlorate	3

Drainage or Management Area	Sample Location	Compound	Conc. (µg/L)
Buffalo Creek – North side of Westlakes	WL-SW05	Perchlorate	1.7
West End of Buffalo Creek	WL-SW01	Perchlorate	2.5 J

J – Estimated concentration

Summary of Investigation and Results – Total Petroleum Hydrocarbons

One primary surface water sample and one duplicate were collected from the drainage originating from the area of Beck's Furniture (WL-SW08) during the BOU and analyzed for TPH-D and TPH-Mo (Table 5.6-1). Surface water sampling locations are shown in Figures 5.6-1 and 5.6-2.

TPH-D and TPH-Mo were detected at 300 and 560 µg/L, respectively, in the surface water sample collected at WL-SW08. A SWSL has not been established for TPH-D and TPH-Mo.

Summary of Investigation and Results – Pesticides

A total of nine primary surface water samples and five duplicates were collected at nine locations within the WLLO Area during the BOU RI and analyzed for pesticides (Table 5.6-1).

Aldrin, alpha-BHC, heptachlor epoxide, and heptachlor were the only pesticides detected in surface water samples collected from the WLLO Area at dissolved concentrations above their respective SWSLs. Pesticides detected above their SWSLs and the sampling locations are listed on the table below.

Drainage or Source Area	Sample Location	Pesticide	Conc. (µg/L)
Low-Lying Area	E(m)-SW01	Aldrin	0.013 J
		alpha-BHC	0.012 J
		Heptachlor	0.1 J
		Heptachlor epoxide	0.018 J
Buffalo Creek	59E-SW02	Aldrin	0.01 J
		alpha-BHC	0.013 J
		Heptachlor	0.013 J
		Heptachlor epoxide	0.11 J

J – Estimated concentration

Summary of Investigation and Results – Miscellaneous Compounds

Miscellaneous analyses performed on surface water samples collected from the WLLO Area were NDMA; nitroguanidine; DOC; anions (including chloride, fluoride, nitrate as NO_3, nitrite as NO_2, phosphate, and sulfate); alkalinity (bicarbonate alkalinity, carbonate alkalinity, hydroxide alkalinity, and total alkalinity); and/or field parameters (conductivity, pH, redox potential, temperature, dissolved oxygen, total dissolved solids, and/or turbidity). The number of primary surface water samples collected and the number and identification of the sample locations are summarized on the table below.

Compound	No. of Samples	Sampling Locations
NDMA	9	E(l)-SW01 E(n)-SW01 WL-SW01 through WL-SW07
Nitroguanidine	8	E(l)-SW01 WL-SW01 through WL-SW07
OBPA	13	59E-SW01 59E-SW02 E(l)-SW01 E(m)-SW01 E(n)-SW01 WL-SW01 through WL-SW08
Alkalinity Anions DOC	13	59E-SW01 59E-SW02 E(l)-SW01 E(m)-SW01 E(n)-SW01 WL-SW01 through WL-SW08

The analytical results for the miscellaneous analysis of surface water samples are presented below.

N-Nitrosodimethylamine. Four [E(l)-SW01, E(n)-SW01, WL-SW03, and WL-SW04] surface water samples contained NDMA at detectable concentrations. Duplicate samples were collected at each of these locations and analyzed for NDMA. Three of these locations [E(n)-SW01, E(l)-SW01 and WL-SW04] contained estimated concentrations of NDMA in either the primary or duplicate sample; however, the other sample at each location did not contain detectable concentrations of NDMA (max PQL for these locations was <0.0033 µg/L). Since both the primary and duplicate samples from these two locations contain NDMA at concentrations that are either below detection limits or estimated, these results are not considered positive detections. Additional sampling at

these locations is not warranted. NDMA was positively identified in the primary sample for WL-SW03 at a concentration of 0.11 µg/L. Although the duplicate sample did not contain NDMA above the PQL (<0.0019 µg/L), Aerojet decided to collect a confirmatory sample (WL-SW09) from this location.

On 21 January 2010, a surface water sample (WL-SW09) was collected at the same location as WL-SW03 in the East Pond to confirm the detection of NDMA at 0.11 µg/L in January 2006. NDMA was not detected above its PQL of 0.005 µg/L or method detection limit of 0.001 µg/L in the surface water sample.

Drainage or Management Area	Sample Location	Compound	Conc. (µg/L)
Line 05 North - Source Area E(l)	E(l)-SW01	NDMA	0.04 J D - 0.13 J
Line 2 – Drainage Swale	E(n)-SW01	NDMA	0.066 J D - <0.002
Westlakes – East Pond	WL-SW03 (2006)	NDMA	<0.0019 J D - 0.11
	WL-SW09 (2010)	NDMA	<0.005
Westlakes - West Pond	WL-SW04	NDMA	<0.0033 J D - 0.0046 J

D = Duplicate sample
J – Estimated concentration

Nitroguanidine. Nitroguanidine was not detected above its PQL or RISL SWSL in the eight primary and six duplicate surface water samples collected from the drainages and low-lying areas within the WLLO Area.

10,10'-Oxybis-10H-Phenoxarsine. OBPA was not detected above its PQL or RISL SWSL in the eight primary and six duplicate surface water samples collected from the drainages and low-lying areas within the WLLO Area.

Anions and Alkalinity. The results of anions analysis of 13 primary and 8 duplicate surface water samples collected from the WLLO Area are presented below.

Compound	No. of Samples with Detections	Range of Detected Conc. (µg/L)	Location of Maximum Conc.	Drainage or Source Area
Bicarbonate Alkalinity	13	8,000 – 110,000 J	WL-SW01	West end of Buffalo Creek
Carbonate Alkalinity	0	Not Detected		

Compound	No. of Samples with Detections	Range of Detected Conc. (µg/L)	Location of Maximum Conc.	Drainage or Source Area
Chloride	13	510 – 9,000 J	WL-SW01	West end of Buffalo Creek
DOC	13	460 J – 15,000	E(l)-SW01	Line 05 North - Source Area E(l)
Fluoride	7	22 J – 97 J	WL-SW01	West end of Buffalo Creek
Hydroxide Alkalinity	0	Not Detected		
Nitrate (as NO3)	11	420 – 8,000	E(l)-SW01	Line 05 North - Source Area E(l)
Nitrite (as NO2)	3	17 J – 58 J	E(l)-SW01	Line 05 North - Source Area E(l)
Phosphate	1	1,500 J	E(l)-SW01	Line 05 North - Source Area E(l)
Sulfate	12	500 – 7,200	WL-SW01	West end of Buffalo Creek
Total Alkalinity	13	8,000 – 110000 J	WL-SW01	West end of Buffalo Creek

J – Estimated concentration

Summary of Investigation and Results – Field Measurements

Parameters measured in the field during the collection of surface water samples from the WLLO Area were conductivity, pH, reduction/ oxidation (redox) potential, temperature, and turbidity. Measurements for those parameters are summarized on the table below.

Sample Location	pH	Temp (°C)	Conductivity (mS /cm)	Redox Potential (mV)	Dissolved Oxygen (mg/L)	Total Dissolved Solids (g/L)	Turbidity (NTU)
E(l)-SW01	7.44	13.55	0.138	266.1	---	---	330
E(m)-SW01	8.37	10.27	0.024	236.6	---	---	198
E(n)-SW01	7.54	11.65	0.035	305.4	---	---	354
59E-SW01	7.16	13.59	0.113	324.6	---	---	19.6
59E-SW02	7.64	13.10	0.112	282.6	---	---	30.9
WL-SW01	7.44	13.40	0.244	300.9	8.00	0.159	---
WL-SW02	8.46	15.10	0.206	276.1	7.71	0.135	---
WL-SW03	8.58	11.46	0.034	240.8	7.87	0.018	---
WL-SW04	8.56	11.80	0.044	174.0	---	---	45
WL-SW05	8.21	11.21	0.107	237.9	---	---	25
WL-SW06	8.55	10.32	0.046	245.9	---	---	33
WL-SW07	8.43	8.30	0.033	273.6	---	---	50
WL-SW08	9.46	20.56	0.069	159.0	---	---	28.6

°C – Degrees Celsius
g/L – Gram per liter

ms/cm – MilliSiemens per centimeter
mV - Millivolts
NTU – Nephelometric turbidity units

5.6.4 *Discussion of Surface Water Investigation Results with Respect to Data Quality Objectives – WLLO Area*

The analytical results presented in the previous section indicated that some chemicals were detected in surface water samples collected from drainages and low-lying areas within the WLLO Area. The presence of chemicals in surface water samples with respect to potential sources and adverse impact to surface water quality is discussed below.

5.6.4.1 *Volatile Organic Compounds*

VOCs were not detected above their SWSLs in surface water samples collected from the WLLO Area (Section 5.6.3.3). Therefore, VOCs are not adversely degrading surface water quality.

5.6.4.2 *Semivolatile Organic Compounds*

The SVOC bis(2-ethylhexyl)phthalate was detected above the RISL SWSL in one surface water sample (WL-SW04) collected from within the West Pond in the Westlakes Area (Section 5.6.3.3). The location of WL-SW04 is shown in Figures 5.6-1 and 5.6-2. SVOCs were not detected in any other surface water sample collected in the WLLO Area.

The absence of SVOCs in surface water samples collected at locations downstream of the detention ponds indicates that SVOCs at the site are not adversely impacting surface water quality.

5.6.4.3 *Metals*

Antimony, arsenic, copper, iron, lead, manganese, molybdenum, thallium, and vanadium were detected in at least one surface water sample collected from the WLLO Area at total concentrations above their respective SWSLs. Arsenic, iron, and vanadium were the metals detected most frequently at concentrations above their respective SWSLs.

It should be noted that arsenic was not detected above its HH SSL or PGW SSL in surface/near-surface sediment/soil at any other source areas within the WLLO or upstream source areas within the WLLO. Naturally occurring concentrations of arsenic at the Aerojet site are above PRGs and

the presence of arsenic in surface water is therefore assumed to be naturally occurring.

As shown in Figure 5.6-3, surface water samples [E(m)-SW01, E(n)-SW01, E(l)-SW01, and WL-SW04] collected from areas where surface water accumulates and then percolates into the soil typically contained more metals at concentrations above their SWSLs than those collected from drainages such as the Administration Area Ditch and Buffalo Creek that have intermittent flow. Because surface water at locations E(m)-SW01, E(n)-SW01, and E(l)-SW01 do not discharge directly into the Administration Area Ditch or Buffalo Creek, total metal concentrations in surface water at those locations will not result in impacts to surface water in the Westlakes.

Total concentrations of antimony, arsenic, iron, lead, and vanadium above their respective SWSLs were detected in the surface water sample collected at location WL-SW08, along the drainage between Beck's Furniture and Buffalo Creek. Although water in this drainage flows into Buffalo Creek, vanadium above its SWSL was detected in only one (WL-SW01) downstream location. Vanadium above its SWSL was also detected in surface water samples WL-SW03, WL-SW04, and WL-SW07 collected upstream of the point of discharge of that drainage into Buffalo Creek. The origin of vanadium above its SWSL in the downstream surface water sample at location WL-SW01 can not be ascertained with any certainty.

Although several metals were detected in surface water samples at total concentrations above their respective SWSLs, the majority of those metals were not detected at total concentrations above their SWSLs in surface water samples WL-SW01 and WL-SW02. The data suggest that the detention of surface water in the Westlakes allows those metals to precipitate out of the surface water.

5.6.4.4 *Perchlorate*

As presented in Section 5.6.3.3 and shown in Figures 5.6-3, perchlorate was detected above its SWSL in surface water samples collected from drainages and low-lying areas at the following locations within the WLLO Area:

- E(l)-SW01, a low-lying area west of Building 05087 in Line 05 North;

- E(m)-SW01 and E(n)-SW01, a drainage swale and low-lying area north of the former location of Buildings 02025, 02026, and 02027 in the northeast portion of Line 02;
- WL-SW06 and WL-SW07 in the section of Administration Ditch/Buffalo Creek;
- 59E-SW01, 59E-SW02, and WL-SW05 within Buffalo Creek upstream of Westlakes; and
- WL-SW01 at the southern portion of Buffalo Creek, downstream of Westlakes.

The highest concentrations of perchlorate were detected in the surface water sample collected from the low-lying area west of Building 05087 [Source Area E(l)]. The presence of perchlorate in the surface water at this location is attributed to historical testing activities conducted at this facility. Surface water at Source E(l) accumulates in the low-lying area and does not discharge to the Administration Area Ditch or Buffalo Creek. The presence of perchlorate in surface water at Source Area E(l) is therefore unlikely to degrade surface water quality in the Aerojet drainages.

As previously discussed, Buffalo Creek transects the Aerojet site and receives surface water runoff from multiple source areas in Zone 3, Area 46, Line 01, Line 02, and Area 00. The detections of perchlorate in surface water collected from Buffalo Creek may not be attributable to a single source. However, the presence of perchlorate in Buffalo Creek at locations 59E-SW01 suggests that perchlorate may originate from source areas upstream of the BOU.

The presence of perchlorate in surface water collected from the surface drainage [E(n)-SW01] east of the former location of Buildings 02025, 02026, and 02027 and the low-lying area [E(m)-SW01] in the northern portion of Line 02 is attributed to surface water runoff from the areas surrounding Buildings 02020 (an oxidizer grind station), 02021, 02022, 02023, and 02025. Surface water in the area of E(n)-SW01 and E(m)-SW01 either evaporates or infiltrates into the soil and does not discharge into the Administration Area Ditch or Buffalo Creek. The presence of perchlorate in surface water at these locations is, therefore, unlikely to degrade surface water quality downstream of the Aerojet site.

Based on the data and conclusions presented above, perchlorate in surface water within the WLLO appears to be associated with multiple sources.

Perchlorate is present in surface water that accumulates in low-lying areas west of Building 05087 in Line 05 North and in the northern portion of Line 02. Surface water at these locations does not discharge to the Administration Area Ditch or Buffalo Creek and appear to be associated with localized conditions. Perchlorate in surface water collected from Buffalo Creek and the Administration Area Ditch downstream of the confluence with Buffalo Creek may be due to surface water discharges originating upstream of the WLLO Area and the BOU. The occurrence of perchlorate in surface water has been adequately characterized to evaluate potential remedial options.

5.6.4.5 *Total Petroleum Hydrocarbons*

TPH-D and TPH-Mo were detected in a surface water sample (WL-SW08) collected within the drainage originating from the area of Beck's Furniture (Section 5.6.3.3). A SWSL has not been established for TPH-D and TPH-Mo. The presence of these hydrocarbons in surface water at this location is likely related to surface water runoff from parking lots outside the Aerojet site.

5.6.4.6 *Pesticides*

The pesticides aldrin, alpha-BHC, heptachlor, and heptachlor epoxide were detected at concentrations greater than their SWSLs in surface water samples collected from E(m)-SW01 and 59E-SW02 (Section 5.6.3.3 and Figure 5.6-3).

E(m)-SW01 is located within a low-lying area in the northeastern portion of Line 02. As previously discussed, surface water that accumulates in this area does not discharge to Buffalo Creek or the Administration Ditch and is therefore unlikely to degrade surface water quality downstream of the Aerojet site. The presence of pesticides in surface water is attributed to the historical use of these compounds for the control of weeds and rodents.

Pesticides were detected above their SWSLs in only one surface water sample (59E-SW02) collected from Buffalo Creek. Pesticides were not detected above their SWSLs in surface water samples collected upstream (59E-SW01) or downstream (WL-SW05) of that location.

The data indicate that the presence of pesticides in surface water within the drainages is inconsistent. The absence of pesticides above their SWSL in surface water collected from the Westlakes indicates that pesticides do

not pose a significant threat to surface water quality downstream of the Aerojet site.

5.6.4.7 *N-Nitrosodimethylamine*

NDMA was detected above its SWSL in four primary or duplicate surface water samples collected at the four locations listed below within the WLLO (Section 5.6.3.3 and Figure 5.6-3). Conclusions regarding the presence and potential source of NDMA in surface water based on the data are summarized below.

- E(l)-SW01 – A low-lying area west of Building 05087 [Source Area E(l)];
- E(n)-SW01 – A drainage swale east of the former location of Buildings 02025, 02026, and 02027 in the northeast portion of Line 02; and
- WL-SW03 and WL-SW04 located within the Westlakes.

Although NDMA was detected at estimated concentrations above its SWSL at three [E(l)-SW01, E(n)-SW01, and WL-SW04] of the four locations, the duplicate analysis did not detect NDMA above the PQL; therefore, these results are not considered positive detections of NDMA.

The remaining sample (WL-SW03) did contain a positive detection of NDMA (0.11 µg/L). Since the duplicate sample for this location indicated NDMA was below detection limits (<0.0019 µg/L), Aerojet collected a confirmatory sample. The results of this sample indicated that NDMA was not detected (<0.0019 µ/L). Since the positive detection of NDMA at location WL-SW03 could not be verified in two samples from the same location, NDMA is not considered a chemical of concern at this location.

As discussed in Section 5.7, the presence of NDMA in groundwater within the WLLO Area is attributed to the presence of that chemical in surface water in Buffalo Creek originating from the liquid rocket test areas in Zone 3 at the east end of the Aerojet site.

Based on the data and conclusions presented above, NDMA is not adversely impacting surface water quality.

5.6.4.8 *Nitroguanidine*

Nitroguanidine was not detected in surface water samples collected from the WLLO Area. Therefore, nitroguanidine is not adversely impacting surface water quality.

5.6.4.9 *10,10'-Oxybis-10H-Phenoxarsine*

OBPA was not detected in surface water samples collected from the WLLO Area. Therefore, OBPA is not adversely impacting surface water quality.

5.7 *SUMMARY AND RESULTS OF GROUNDWATER REMEDIAL INVESTIGATION – WLLO AREA OF THE BOUNDARY OPERABLE UNIT*

This section presents the groundwater data acquired for the RI for the six management areas (Line 02, Line 05 North, Westlakes, Western Administration Area Ditch and Buffalo Creek, and Open Space Areas 5 and 7) collectively referred to as the Westlakes, Line 02, Line 05, Open Space (WLLO) Area in this section of the report. Data were collected to satisfy the following DQOs as identified in the BOU FSP (Aerojet and others, 2006):

- Do COPCs exist in groundwater at concentrations that could potentially pose a risk to human health?
- Do the vadose zone data indicate a potential source for the COPCs in groundwater?
- Do COPCs exist in groundwater at concentrations indicative of the presence of residual product?
- Has the lateral and vertical distribution of COPCs in the groundwater been adequately characterized?
- Do COPCs in groundwater have the potential to migrate into and degrade surface water quality?
- Are the data sufficient to support human health and ecological risk assessments, support modeling to evaluate the migration of COPCs from groundwater into indoor air, and determine the feasibility of remediating the identified compounds and concentrations to levels that do not pose a risk to human and ecological receptors or degrade surface water and groundwater quality?

To meet these DQO's, the following tasks were completed:

- **Characterize groundwater flow —** Section 5.7.1 – Groundwater Flow Characteristics defines the shallow groundwater as either Perched Groundwater or the FWBZ and presents interpretation of water level data, including hydraulic gradients and water level elevation trends. This section also presents the results of aquifer testing activities conducted to further characterize the hydraulic properties in a portion of the FWBZ. These data support analysis of the fate and transport of chemicals in groundwater, and they are used to develop and compare remedial alternatives in the FS.
- **Determine the extent of groundwater impacted by COPCs —** Section 5.7.2 discusses the distribution of chemicals in groundwater and presents the results of groundwater sampling and analysis. These data are discussed relative to groundwater screening-level Applicable, Relevant and Appropriate Requirements (ARARs) (i.e., screening-level ARARs) that were selected to provide sufficient data for evaluating potential human health risks due to exposure to chemicals in groundwater.
- **Identify apparent COPC source areas and define the extent of potential residual sources in groundwater —** Discussion regarding potential correlation between chemicals reported in the vadose zone beneath source areas and chemicals reported in groundwater are included in Section 5.7.2 – Distribution of Chemicals in Groundwater.
- **Identify existing remedial actions —** Existing and planned remedial actions for groundwater within and downgradient of the BOU are discussed in Section 5.7.3.
- **Identify chemical migration pathways and attenuation processes —** Processes that influence the distribution and movement of chemicals in groundwater are discussed in Section 5.7.4**.**

5.7.1 Groundwater Flow Characteristics

The hydrostratigraphy for the WLLO Area, nature and occurrence of shallow groundwater, and groundwater gradients are discussed below.

5.7.1.1 Site Hydrostratigraphy

The first groundwater encountered beneath the site occurs as either Perched Groundwater or the FWBZ. For the purposes of this Operable Unit, the FWBZ is defined as the upper 20 to 30 feet of saturated

sediments that are laterally continuous. Perched groundwater and the FWBZ were subdivided from the more regional hydrostratigraphic layer designations to allow for evaluation of potential risks associated with VOCs migrating upward as vapor through the soil into indoor air.

Hydrostratigraphic cross-section A-A' was prepared to show the general lithology and relative water levels for the water-bearing units defined beneath the WLLO Area (Figure 5.7-1). This transect is aligned approximately parallel to the general direction of groundwater flow, and trends through potential source areas in Line 02 and northern Line 05.

The regional aquifer beneath the Aerojet site has been divided into six hydrostratigraphic layers (Layers A through F) based on similar lithology, relative depths and thicknesses, electrical conductivity, water levels, and aquifer testing.

Perched groundwater beneath the WLLO generally occurs within regional Hydrostratigraphic Layers (Layers) A and B. The eastern portion of the WLLO Area is undredged, and Perched Groundwater occurs within the Tertiary Laguna Formation or Layer B (Figure 5.7-2). The western portions of the WLLO are dredged, and Perched Groundwater is present within Layer A.

The FWBZ beneath the WLLO occurs within the upper portion of Layer C. Layer C is within the upper portion of the Tertiary Mehrten Formation. In the WLLO Area, Layer C is typically encountered at depths ranging from 50 to 80 feet bgs. Layer C increases from approximately 30 to 90 feet in thickness from east to west across the WLLO Area.

Layer D is generally the lower portion of the Mehrten Formation and overlies Layer E, which generally corresponds to the upper portion of the Tertiary Valley Springs Formation. Layer F refers to the water-bearing sediments below Layer E and is generally below the depths of contamination.

5.7.1.2 *Nature and Occurrence of Shallow Groundwater*

The first saturated sediments encountered beneath the WLLO Area include Perched Groundwater and the FWBZ. Perched groundwater and the FWBZ were evaluated using groundwater samples collected from existing monitoring wells, monitoring wells constructed for this RI, and grab groundwater samples collected from soil borings (Tables 5.7-1 and

5.7-2). Boring logs for the monitoring wells installed during the RI are included as Appendix D.

The depths and elevations of Perched Groundwater and the FWBZ are presented in the following sections. Information on the depth to shallow groundwater is primarily presented for use in the Baseline Risk Assessment.

Perched Groundwater

There are no monitor wells screened in Perched Groundwater in the WLLO Area, although, Perched Groundwater was encountered in many soil borings advanced in Line 02, Area 00, and northern Line 05. The Perched Groundwater in Line 02 and Area 00 appears to be hydraulically connected. The Perched Groundwater in these areas does not appear to be hydraulically connected to the Perched Groundwater beneath northern Line 05.

In Line 02 and Area 00, Perched Groundwater was typically encountered at depths of 43 to 45 feet bgs (123 to 129 feet amsl) in the undredged sediments beneath the eastern portion of Line 02 (Figure 5.7-3). Further west beneath Line 05, Perched Groundwater was shallower at 15 to 20 feet bgs (approximately 127 to 150 feet amsl) (Figure 5.7-3). The Perched Groundwater encountered beneath Line 05 appears to be related to areas that were dredged.

Historical water level data from eight monitor wells screened in Perched Groundwater and located adjacent to the WLLO Area were reviewed to evaluate Perched Groundwater temporal trends and seasonal fluctuations (Appendix J). The eight monitor wells are shown in Figure 5.7-3 and the hydrographs are presented in Appendix J.

The water level trends observed in Perched Groundwater were similar to those observed elsewhere and in the FWBZ. Generally, the highest water levels were recorded in the early 1980s, and the lowest measurements were recorded in approximately 1993. During this period, water levels in most Perched Groundwater wells declined approximately 15 to 20 feet. Perched Groundwater levels remained constant or increased slightly (~5 feet) between 1993 through 2008.

At the wells with sufficient data, seasonal water level fluctuations of 5 to 8 feet were typical. Well 63, located near one of the Westlakes storm water retention cells, exhibited seasonal fluctuations of up to 25 feet, which may

reflect seasonal filling and draining of the cells. Monitor well 3472, located south of the WLLO in Line 05, did not exhibit seasonal water level changes.

Several monitor wells screened in Perched Groundwater are currently dry or have been dry in the past (Figure 5.7-3). Monitor Well 448 has been dry since 2001. Monitor Wells 63 and 71 were dry at some point between 2003 and 2005, but contained water in April 2006.

First Water-Bearing Zone

For the purposes of this RI, the FWBZ is defined as the first saturated sediments that are laterally continuous beneath Lines 02 and 05, and the Westlakes Area. For reference, most monitor wells screened in the FWBZ are designated as Layer C wells in the site-wide hydrostratigraphic layering system. However, a few of the wells may be designated as Layer B.

The top of the FWBZ typically occurs at depths ranging from approximately 44 to 71 feet bgs beneath Line 02 (Figure 5.7-4). The depth to the FWBZ was shallowest (34 feet bgs) east of Line 02, and deepest (approximately 76 feet bgs) in western Line 05. The depth to the top of the FWBZ was contoured for evaluation of the potential migration of VOCs from first water into indoor air as part of the Baseline Risk Assessment and should not be used to infer hydraulic gradients (Figure 5.7-4).

Water level hydrographs for the FWBZ wells are presented in Appendix K. The highest water levels were recorded when measurements began in 1983. Between 1983 and 1993, water levels in many FWBZ monitor wells declined by as much as 30 feet. Water level elevations were relatively stable in most wells from 1991 through 2006, with typical water level fluctuations of approximately 5 feet.

Most FWBZ monitor wells displayed seasonal water level fluctuations of 5 to 10 feet. However, very little or no seasonal variation was noted in several wells. Since mid-1985, monitor well 53, located in the furthest west storm water retention cell, exhibited seasonal water level variations of up to 50 feet. These anomalously high fluctuations are suspect and may be attributable to a bad well seal and flooding from storm-water accumulation.

5.7.1.3 *Hydraulic Gradients*

There were insufficient data to determine the lateral hydraulic gradient for Perched Groundwater. However, the elevations of Perched Groundwater measured in monitor wells and encountered in soil borings are posted on Figure 5.7-5. Monitor well water levels were measured in April 2006, and the grab groundwater elevations were measured during RI field activities, generally between January and April 2006. These data were not contoured because most of the data are from grab groundwater samples that do not represent static water levels. In addition, the various Perched Groundwater bodies do not appear to be hydraulically connected.

The water level elevations from monitor wells screened in the FWBZ were contoured to create a potentiometric surface using the linear kriging algorithm in Surfer® for Windows (Version 8) (Figure 5.7-6). A single data set collected in April 2006 was the only data set available with water level measurements from new monitoring wells installed for this RI and from existing monitoring wells. Water level elevations from FWBZ grab groundwater samples are posted in Figure 5.7-6 for reference, but were not contoured.

The general direction of the hydraulic gradient for the FWBZ is from east to west across the WLLO Area (Figure 5.7-6), although the hydraulic gradient is slightly northwest in the eastern portion of Line 02. Downgradient of Line 02 and throughout the Line 05 and Westlakes areas, the direction of the hydraulic gradient is to the west. The magnitude of the hydraulic gradient across the WLLO Area averages approximately 0.01 ft/ft.

Vertical head differences between Perched Groundwater and the FWBZ suggest a strong potential for downward vertical migration from Perched Groundwater to the FWBZ. Vertical head differences ranged from approximately 20 to 50 feet.

5.7.2 *Distribution of Chemicals in Groundwater*

This section describes the nature and extent of chemicals detected in Perched Groundwater and the FWBZ beneath the WLLO Area. The majority of water quality data were collected between October 2005 and October 2006, referred to as the RI Sampling Period. The sampling locations and analytes were presented in the BOU FSP (Aerojet et al.,

2006b). The analytes at each sample location were selected based on historical chemical use at the potential source sites.

VOCs (United States Environmental Protection Agency [USEPA] Methods 8260 and 601) and perchlorate (USEPA Method 314 Series) were the most frequently analyzed constituents in groundwater. Other analytes selected based on historical operations or to evaluate geochemical conditions included:

- SVOCs (USEPA Method 8270);
- NDMA (USEPA Method 1625C-Cl Modified and EA0042);
- Metals (USEPA Methods 6010B, 6020, and 7470A);
- Pendimethalin (PROWL) (USEPA Method 8081A);
- Nitroguanadine (USEPA Method 8330M);
- Anions (USEPA Method 300 Series); and
- Cations (USEPA Method 6010B/6020).

The extents of most chemicals in groundwater are discussed relative to their respective screening-level ARAR. In most cases, screening-level ARARs are Federal or State Drinking Water Primary Maximum Contaminant Levels (MCLs), following USEPA Region IX precedence, and other Water Quality Objectives, as defined by the RWQCB. Other drinking water standards such as Secondary MCLs, State of California Public Health Goals (PHGs), State of California Department of Public Health Action Levels, and USEPA Region 9 Preliminary Remediation Goals (PRGs) were used for those chemicals with no MCLs. A summary of screening-level ARARs is included on Table 4.5-4.

Results of all analyses conducted during the RI sampling period, including results for compounds not detected in any samples, are included on a compact disc provided in Appendix M.

Data reported with laboratory qualifiers are included in this evaluation and are noted in the text and figures. Data reported between the PQL and the method detection limit are estimated concentrations and are flagged with a "J" qualifier. All data were validated by a third party (Laboratory Data Consultants, Inc.). Data that were considered estimated during the data validation process were also given a "J" flag.

Water quality data from grab groundwater samples collected at soil boring locations are included in this evaluation. However, the water quality data collected as grab groundwater samples are not considered comparable to data collected from monitoring wells.

The DQO of assessing the potential presence of residual product in groundwater was addressed by comparing VOC concentrations in groundwater samples with their respective solubility limits. There were no compounds in the WLLO Area that exceeded one percent of their solubility limit, and residual product is not suspected in groundwater.

The chemical distribution maps include vadose zone locations where soil vapor or soil chemical concentrations exceeded their respective Protection of Groundwater Screening Levels as defined in Sections 5.1 through 5.5. This information is presented to assist with evaluation of whether individual source areas are ongoing sources of chemicals to groundwater.

5.7.2.1 *Perched Groundwater*

The assessment of chemicals in Perched Groundwater is based solely on the results from grab groundwater samples collected from beneath Line 02, Line 05 North, and Area 00. Water quality data from several Perched Groundwater wells located along the peripheries of these areas are posted in the figures, where available.

Most Perched Groundwater grab samples were analyzed for VOCs and several were analyzed for perchlorate. One grab groundwater sample was analyzed for SVOCs, metals, and NDMA. In addition, water quality samples collected from two Perched Groundwater wells located outside the perimeter of the BOU (monitoring wells 48 and 3472) were analyzed for VOCs, SVOCs, perchlorate, NDMA, metals, anions, and cations.

TCE and perchlorate were the most frequently detected compounds in Perched Groundwater, although the highest concentrations were relatively low and their distribution in Perched Groundwater appears limited. Isoconcentration contours illustrating the distribution of TCE and perchlorate in Perched Groundwater are shown in Figures 5.7-7 and 5.7-8, respectively.

<u>Perched Groundwater – Volatile Organic Compounds</u>

TCE was the only VOC reported in Perched Groundwater at more than one location above screening levels, and the extent of TCE is relatively

limited. TCE was detected up to 5.1 µg/L beneath Area 00, and up to 1.9 J µg/L beneath northern Line 02 (Figure 5.7-7). TCE concentrations above its PGW SSL in Line 02 are shown on Figure 5.1-6. Note Perched Groundwater was not encountered at most soil boring locations.

TCE was detected up to 42 J µg/L, above the PHG (0.8 µg/L) and the MCL (5 µg/L) in Perched Groundwater grab samples collected from soil borings advanced at Source Areas 51E and 52E in Line 05 North. TCE was detected in soil vapor samples above its PGW SSL at two locations in this area (Section 5.2.4.3 and Figure 5.2-6). Potential sources of TCE in the vadose zone and groundwater at Source Areas 51E and 52E include a concrete wash sump, a septic tank and associated leach lines, and a test cell and blast area.

Note higher TCE concentrations (up to 3,200 µg/L) were reported south of the BOU in northern Line 05. Groundwater in this area will be addressed under the Island Operable Unit (OU-7).

Benzene (1.1 µg/L), the only other VOC detected above a screening level (MCL of 1.0 µg/L), was detected in a grab groundwater sample collected from boring DSA-SP15 in Line 02.

TICs were reported in the VOC open-scan analyses on the samples collected from several Perched Groundwater grab samples including 1-butene (4.0J µg/L); 1-pentene (up to 3.2J µg/L); heptanol (4.9J µg/L); hexanol (up to 3.5J µg/L); propene (up to 27J µg/L); nonanal (up to 8.0J µg/L); tetradecane (5.6J µg/L), and "unknown Peaks" (up to 51 µg/L).

<u>Perched Groundwater – Perchlorate</u>

Four grab samples collected from Perched Groundwater were analyzed for perchlorate (Figure 5.7-8). Perchlorate was detected in each of the samples at concentrations ranging from 4.5 to 78 µg/L. The highest perchlorate concentration (78 µg/L) was detected in a sample collected beneath the former DSA in Line 02. The lateral extent of perchlorate in Perched Groundwater beneath Line 02 is limited by the extent of where Perched Groundwater is present.

Perchlorate was detected above its PGW SSL in subsurface soil samples collected from Source Areas 28E, the DSA, and in surface soil near Building 02020, a former oxidizer grind station located in Line 02 (Sections 5.1.5.4 and 5.1.9.5) (Figure 5.7-8). The presence of perchlorate in

Perched Groundwater beneath Line 02 indicates that it originated from those source areas.

Perchlorate was also reported in Perched Groundwater above the screening level of 6 µg/L at two locations in Line 05 North, and south of the BOU in monitor well 3472. Perchlorate was not reported above the PGW SSL in soil samples collected from northern Line 05.

Perched Groundwater – Miscellaneous Analyses

Grab groundwater samples collected from boring 59E-SB02, located at the former DSA in Line 02, were analyzed for SVOCs, NDMA, and metals. Bis(2-ethylhexyl)phthalate, a common laboratory artifact, was detected at 6 µg/L and was the only SVOC reported at a concentration above a screening level. NDMA was detected at an estimated concentration of 0.098J µg/L, above the action level of 0.01 µg/L. In the metals analysis, the field-filtered sample yielded metals exceeding Secondary MCLs including: aluminum (9,700 µg/L), barium (3,600 µg/L), beryllium (4.7 µg/L), cobalt (64 µg/L), iron (4,700 µg/L), and manganese (5,300 µg/L).

NDMA and metals (including aluminum, barium, beryllium, cobalt, iron, and manganese) were not detected at concentrations above their respective PGW SSLs in surface/near-surface sediment/soil or subsurface soil collected within the six management areas (Line 02, Line 05 North, Westlakes, Buffalo Creek and the Administration Area Ditch, and Open Spaces 5 and 7) within the central portion of the BOU.

Perched Groundwater – Geochemical Parameters

Samples were collected from monitoring well 48 and analyzed for bicarbonate, carbonate, chloride, fluoride, hydroxide, nitrate (as NO_3), nitrite (as NO_2), phosphate, and sulfate. None of these compounds were reported above their respective MCLs or other Water Quality Objectives.

5.7.2.2 *First Water-Bearing Zone*

Water quality of the FWBZ was investigated through the collection of groundwater samples from 22 new or existing monitoring wells and collecting grab groundwater samples from 10 soil boring locations. TCE and perchlorate were the most frequently and widely distributed chemicals in the FWBZ. The highest concentrations of TCE and perchlorate appear to be associated with a former cleaning slab (Source

Area 28E) and former DSA (Source Area DSA) in Line 02. The upgradient extents of these compounds are undefined as there appear to be sources of both compounds upgradient of the BOU.

First Water-Bearing Zone – Volatile Organic Compounds

The majority of groundwater samples collected from the FWBZ were analyzed for VOCs. TCE was the most common and widely distributed VOC. The highest TCE concentrations were detected beneath potential Source Sites 28E and 29E in Line 02 (Figure 5.7-9). TCE concentrations exceeded the PGW SSL at 19 soil vapor sampling locations in Line 02 and Area 00, and one soil vapor sample collected adjacent to the former sump and associated ponds at Site 28E in Line 02 suggested the potential presence of residual TCE in the vadose zone (Section 5.1.5.1).

TCE concentrations greater than 500 µg/L were reported in two grab groundwater samples collected beneath the former DSA and Site 28E in Line 02 (Figure 5.7-9). The highest TCE concentration in a monitor well located in Line 02 and Area 00 was 120J µg/L. The downgradient extent of TCE above the MCL (5 µg/L) in Area 00 and Line 02 is reasonably well-defined. However, TCE concentrations exceeding the PHG (0.8 µg/L) were detected throughout the WLLO Area and extend off site to the west.

Higher TCE concentrations (1,000 µg/L) were reported south of Line 02 at monitor well 28. This well is south of the BOU and the source of TCE in this area is probably located in Line 01. TCE was reported up to 49 J µg/L in monitor well 3668, located just south of Source Sites 51E and 52E in northern Line 05.

PCE was reported above the MCL (5 µg/L) in one monitor well (well 3668) and three grab groundwater samples. The extent of PCE above the MCL was within the extent of TCE above the MCL. PCE was not reported above the PGW SSL in the WLLO Area soil vapor samples, although PCE was detected in soil vapor samples.

VOCs were not detected above MCLs in the FWBZ wells located near the Westlakes storm water retention cells. This area is located generally downgradient of VOC sources located outside of the BOU in Line 05 and Chemical Plant 1. Most VOC-impacted groundwater from these areas is deeper than the FWBZ, although TCE was reported in several monitoring wells screened in the deeper portions of the FWBZ.

Based on the results of the BOU RI, the presence of TCE and PCE in the vadose zone and groundwater in the WLLO are likely due to historical discharges associated with the sump and ponds at Source Area 28E and the former sump at Building 02024. Additionally, although detected in only one grab groundwater sample, Carbon Tet was detected in soil vapor in the DSA.

First Water-Bearing Zone – Semivolatile Organic Compounds

SVOC analysis, including an open scan for TICs, was performed on samples collected from monitor wells and soil borings located throughout the WLLO Area. Bis(2-ethylhexyl)phthalate, a common laboratory contaminant, was the only SVOC reported above potential ARARs in the FWBZ. Bis(2-ethylhexyl)phthalate was reported at concentrations ranging from 5.1 to 72 µg/L, above the PRG of 5 µg/L, in one monitoring well and three grab groundwater samples. SVOCs detected in the FWBZ, but at concentrations below potential ARARs, included benzoic acid, naphthalene, and 2-methylnaphthalene.

Four SVOC TICs and several unknown peaks were reported in the samples collected from six wells and three borings located within and around the WLLO Area. The sample collected from boring DSA-SB01, located within Source Area DSA in Line 02, reported 26 unknown peaks with estimated concentrations ranging 4.2 to 130 µg/L.

First Water-Bearing Zone – Perchlorate

Perchlorate was detected in approximately the same areas where TCE was also detected (Figure 5.7-10). The highest perchlorate concentrations (up to 1,400 µg/L) were reported in grab groundwater samples collected from the Line 02 area. The majority of monitoring wells were installed in this area for this RI, therefore, a sufficient number of temporal sampling events have not been performed in order to evaluate trends in concentration.

The eastern and southern extents of perchlorate extend beyond the boundaries of the BOU, and will be further characterized in the pending Island Operable Unit (IOU) RI.

The presence of perchlorate in the FWBZ within the WLLO corresponds with the presence of that chemical in the vadose zone and Perched Groundwater beneath Line 02 (Figure 5.7-10). As discussed in Sections 5.1.5.4 and 5.1.9.5, perchlorate was detected above its PGW SSL in

subsurface soil at Source Areas 28E and DSA and in surface soil near Building 02020, a former oxidizer grind station, in Line 02. Based on the results of the BOU RI, those two source areas are the most likely source of perchlorate to the vadose zone, Perched Groundwater, and FWBZ within the WLLO.

First Water-Bearing Zone – N-Nitrosodimethylamine

NDMA analysis was conducted on grab groundwater samples collected beneath potential source areas in Line 02 and northern Line 05, and samples collected from new and existing monitoring wells installed on the peripheries of Lines 02 and 05, and the Westlakes Area. NDMA is typically associated with liquid rocket testing activities, none of which are known to have occurred within the WLLO Area. However, deluge water that could have potentially contained NDMA from liquid rocket test stands located in Zone 3 was discharged to Buffalo Creek, which flows between Lines 02 and 05, and the northern portion of the Westlakes Area.

The distribution of NDMA in the FWBZ is presented in Figure 5.7-11. NDMA was detected above the screening level (0.010 µg/L) in monitoring wells 3663, 3664, and 3668 at estimated concentrations ranging from 0.018 to 0.03 µg/L. NDMA was not detected (<0.00038J to < 0.0096J µg/L) in samples collected directly beneath potential sources areas located in Lines 02 and 05.

NDMA was not detected at concentrations above its PQL, RISL, or PGW SSL in surface/near-surface sediment/soil or subsurface soil collected within the six management areas (Line 02, Line 05 North, Westlakes, Buffalo Creek and the Administration Area Ditch, and Open Spaces 5 and 7) within the central portion of the BOU.

First Water-Bearing Zone – Metals

Metal analyses were performed on groundwater samples collected from monitoring wells and soil borings within and around the WLLO Area. Analyses were performed on both unfiltered and field-filtered samples to measure total and dissolved metal concentrations, respectively. Iron (up to 23,000 µg/L) and manganese (up to 670 µg/L) were the dissolved metals that most commonly exceeded their potential ARARs (secondary MCLs). Aluminum was reported above the MCL of 1,000 µg/L at a concentration of 1,700 µg/L in the sample from boring E(e)-SB02. The remaining dissolved metal concentrations reported were all below their respective potential ARARs.

Metals (including aluminum, iron, and manganese) were not detected at concentrations above their respective RISLs or PGW SSLs in surface or near-surface sediment/soil and subsurface soil collected from the six management areas within the WLLO.

First Water-Bearing Zone – Geochemical Parameters

Bicarbonate, carbonate, chloride, fluoride, hydroxide, nitrate (as NO_3), nitrite (as NO_2), phosphate, and sulfate analyses were performed on the groundwater samples collected from multiple monitoring wells within and around the WLLO Area. Fluoride, nitrite, and sulfate were reported at concentrations below MCLs. Reported alkalinity values ranged from 76 mg/L (wells 3250 and 3652) to 230 mg/L (wells 3665 and 3666) and all alkalinity was due to bicarbonate.

First Water-Bearing Zone – Miscellaneous Analyses

Analyses were conducted to assess the DOC content in samples collected from monitoring wells within and around the WLLO Area. The reported concentrations ranged from an estimated 0.5J mg/L at well 3653 to 16 mg/L at well 3666. Nitroguanidine was not detected (less than 20 µg/L) in samples collected from 15 FWBZ monitoring wells.

5.7.3 Existing Remedial Actions

There are two existing groundwater extraction and treatment (GET) facilities located downgradient of the WLLO Area. The GET D extraction system is located downgradient of the eastern portion of Line 02, and the GET E/F extraction system is located downgradient of western Line 02, Line 05, and the Westlakes Area.

The Record of Decision for the Western Groundwater Operable Unit requires hydraulic containment of all site-related chemicals in groundwater along the northern Aerojet property boundary in all hydrostratigraphic layers (USEPA, 2001). This requirement applies to the northern Aerojet property boundary downgradient of the WLLO Areas, and is addressed by the GET E/F extraction system.

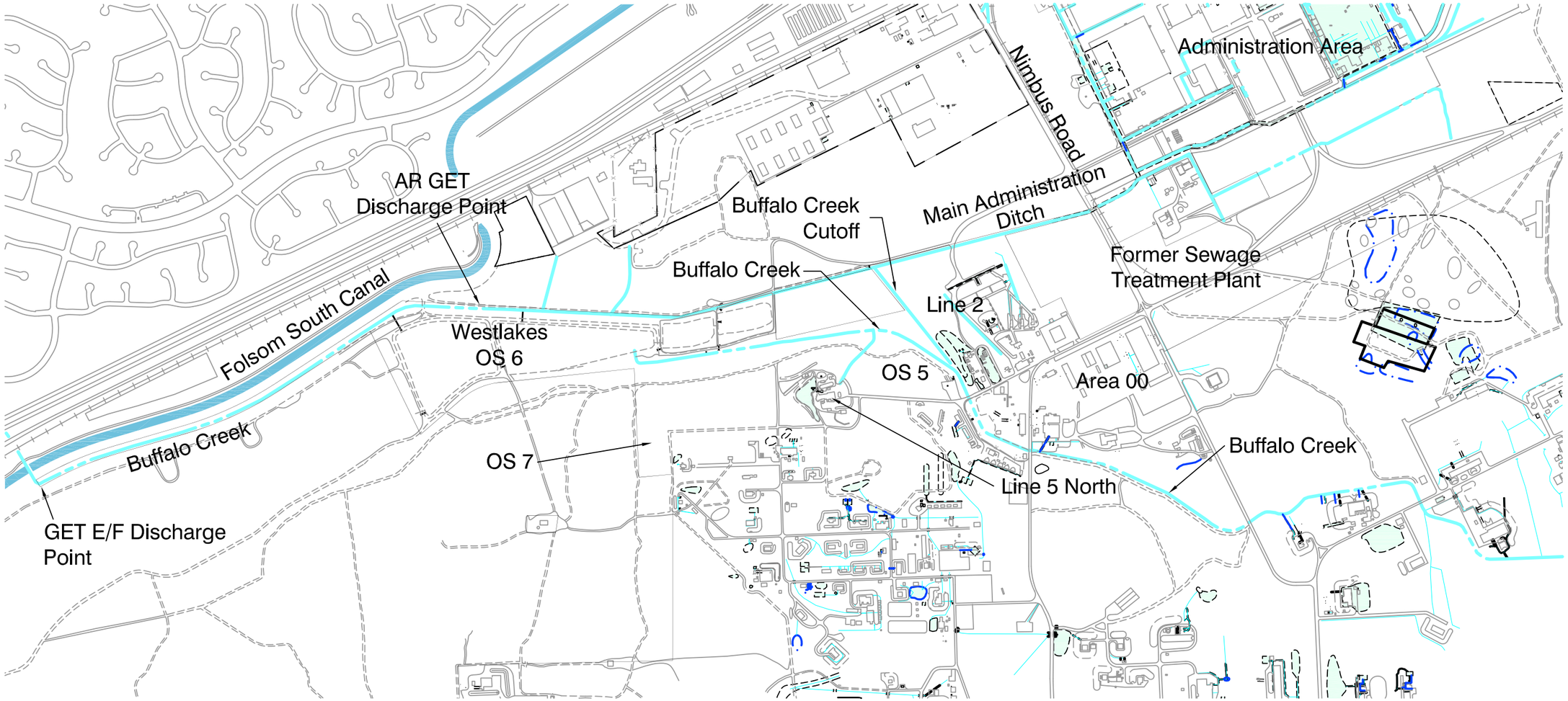
The GET E/F extraction wells are not shown on the FWBZ figures prepared for the BOU because the tops of the screens are generally below the depths defined as the FWBZ for the BOU. However, the FWBZ within the WLLO corresponds to the upper portion of hydrostratigraphic Layer C, where the majority of GET E/F extraction wells are screened.

Evaluation of the effectiveness of GET E/F is on-going, but the agencies and Aerojet are in agreement that the GET E/F Layer C extraction wells are providing effective hydraulic containment along the northern Aerojet property boundary (USEPA, 2006).

5.7.4 *Chemical Fate and Transport*

There are very few monitoring wells located in the Line 02 and 05 source areas with historic data available for evaluating the processes governing fate and transport of chemicals observed in groundwater beneath the WLLO Area. However, as exhibited elsewhere on the Aerojet site, the bulk of groundwater impacts due to releases from these areas have probably already occurred, and chemical concentration trends can generally be inferred to be decreasing.

The relatively higher concentrations of TCE and perchlorate reported in groundwater beneath Line 02 and northern Line 05 appear to be migrating west due to advective flow. Relatively lower concentrations observed downgradient of the source areas are probably a result of hydrodynamic dispersion. Reductive dechlorination does not appear to play a significant role in reducing TCE concentrations as little or no potential degradation daughter products were observed (e.g., 1,2-DCE and vinyl chloride), and the groundwater is generally aerobic.



EXPLANATION

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Drainage Culvert
- Underground Culvert
- Fence
- Road
- Railroad
- AR — American River
- GET — Groundwater Extraction and Treatment
- 20009 — Building
- Former Structure
- Above Ground Storage Tank
- Surface Drainage
- L2-ST24 — Septic Tank and Leach Line

N

Scale: 1" = 1000'

0 500 1000

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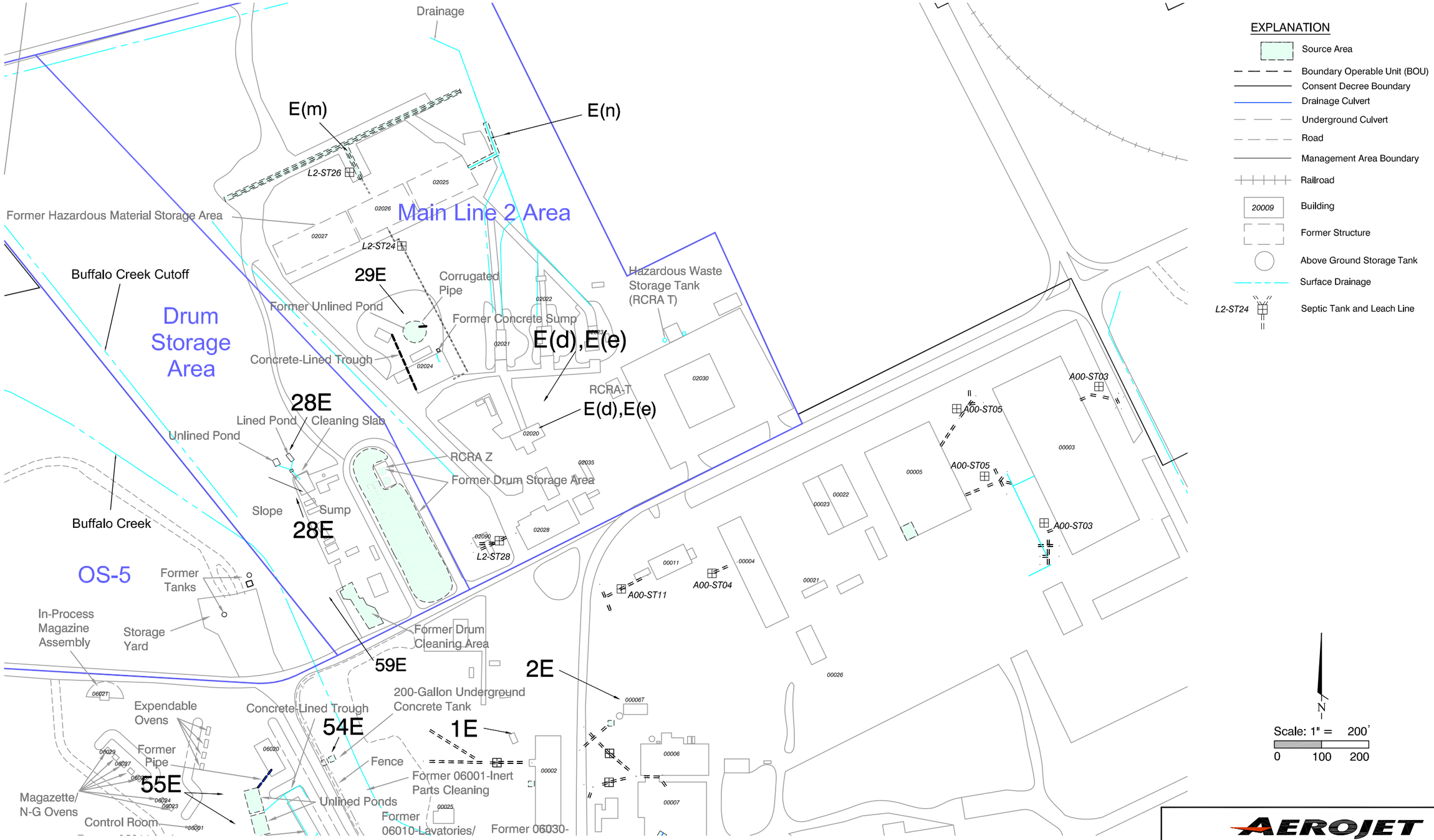
FIGURE 5.0-1
Site Location Map
Line 02, Line 5 North, Westlakes, Buffalo Creek, and Open Space Areas 5, 6 and 7

9\11\08 PR SR10130992



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DRAFT

FIGURE 5.1-1
Site Features Map
Line 02

09/15/10 PER SR10130994

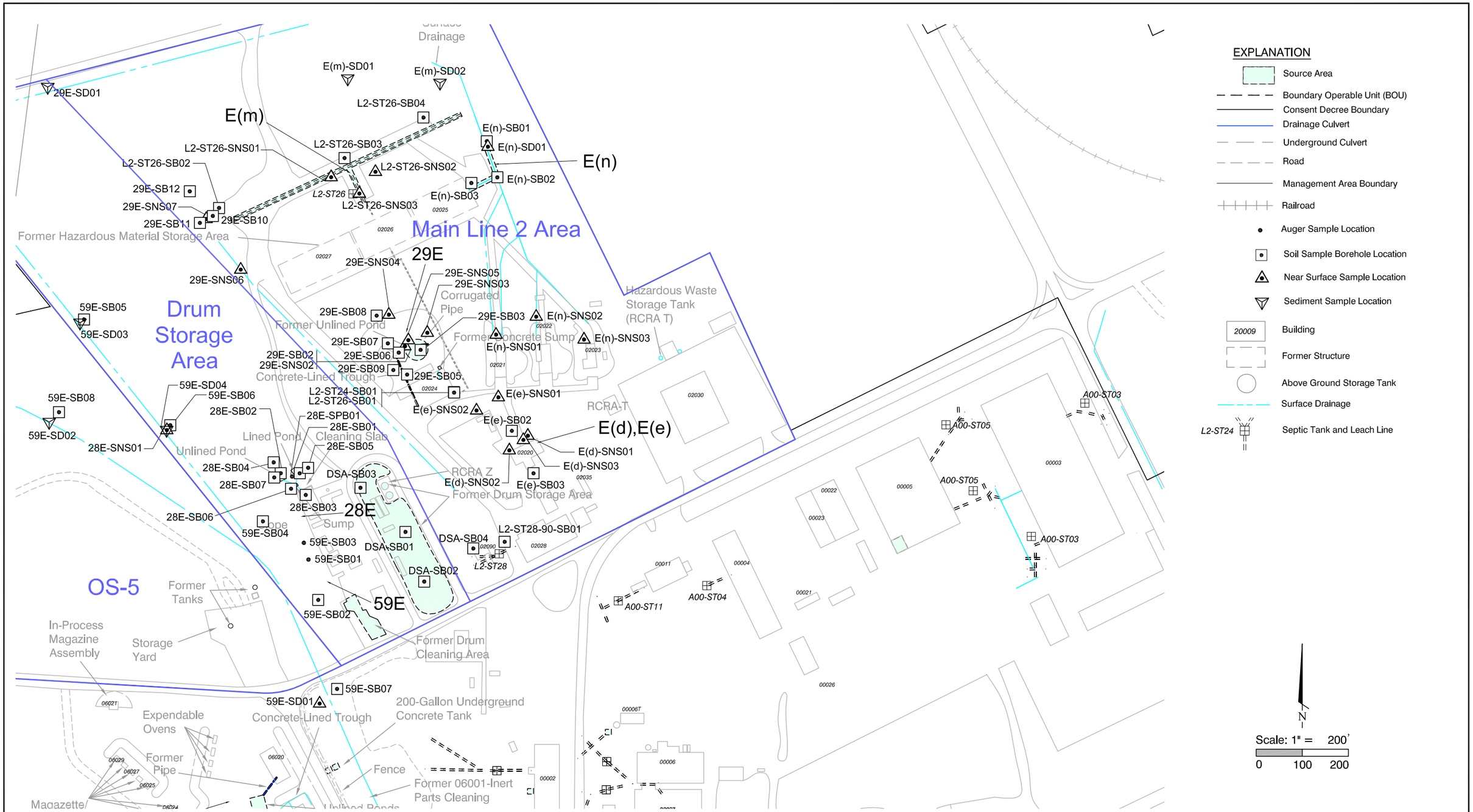

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FIGURE 5.1-2
BOU Surface Soil Sample Locations
Line 02

09/15/10 PER SR10130995

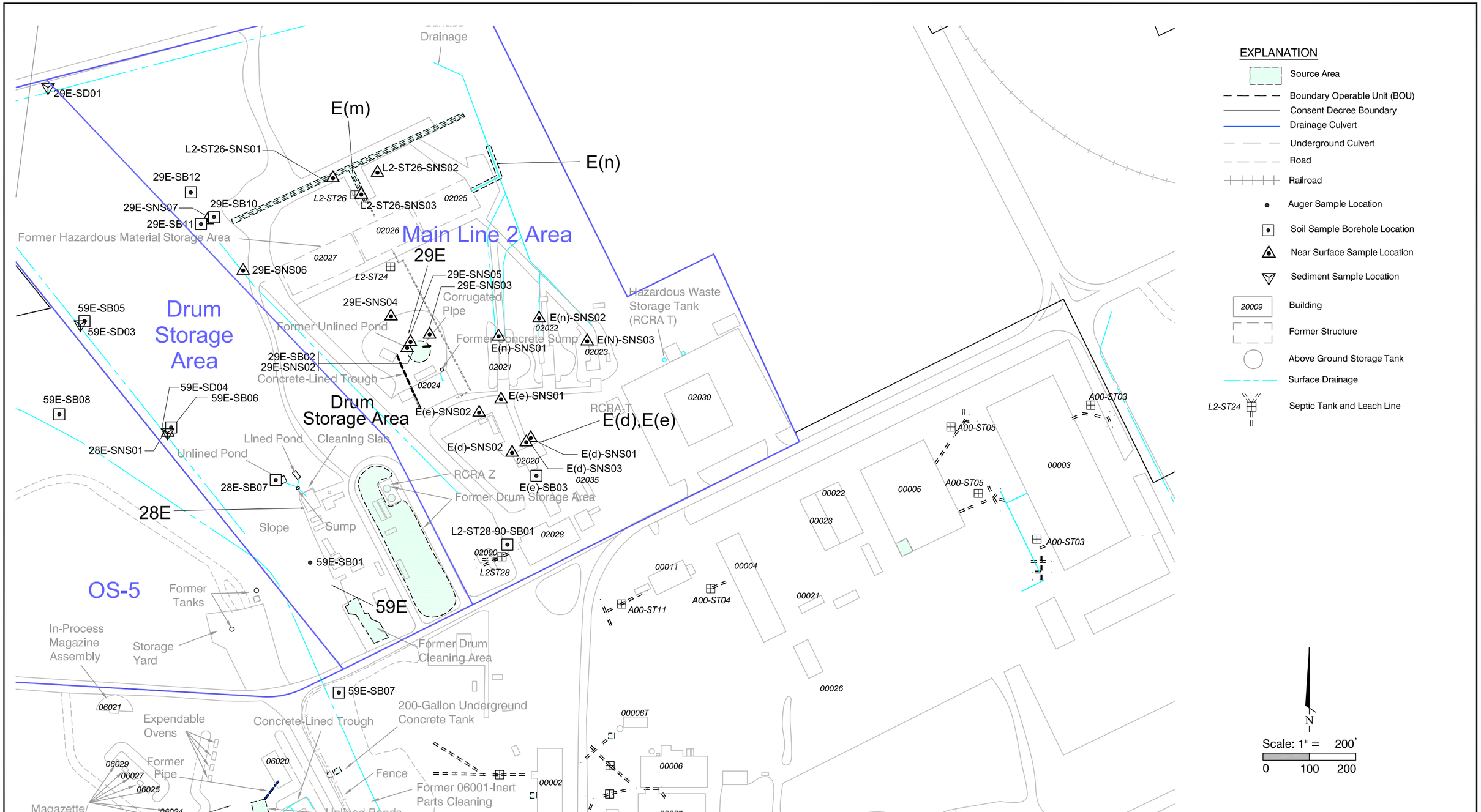

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FIGURE 5.1-3
BOU Subsurface Soil Sample Locations
Line 02

09/15/10 PER SR10130996

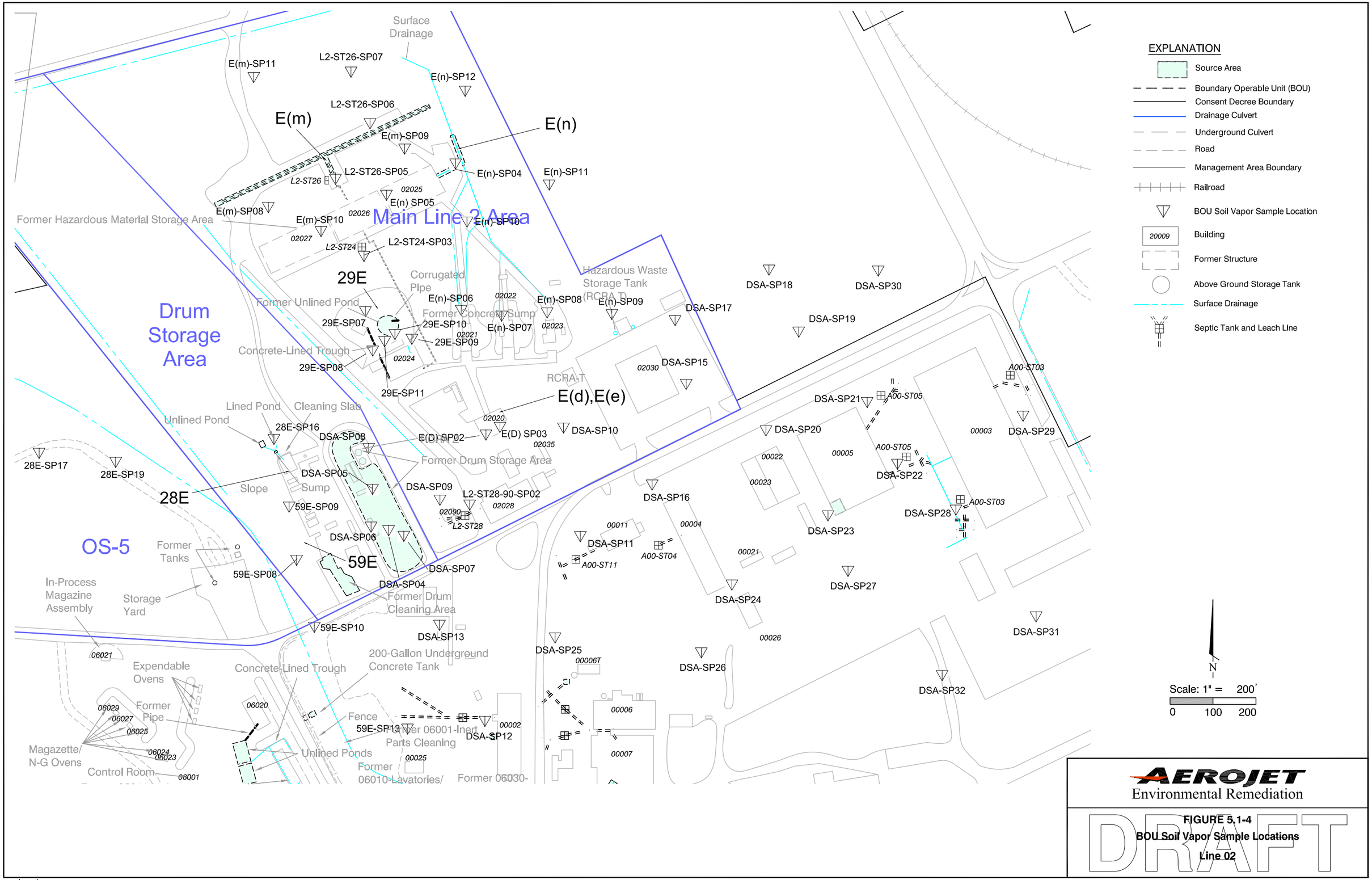

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FIGURE 5.1-4
BOU Soil Vapor Sample Locations
Line 02

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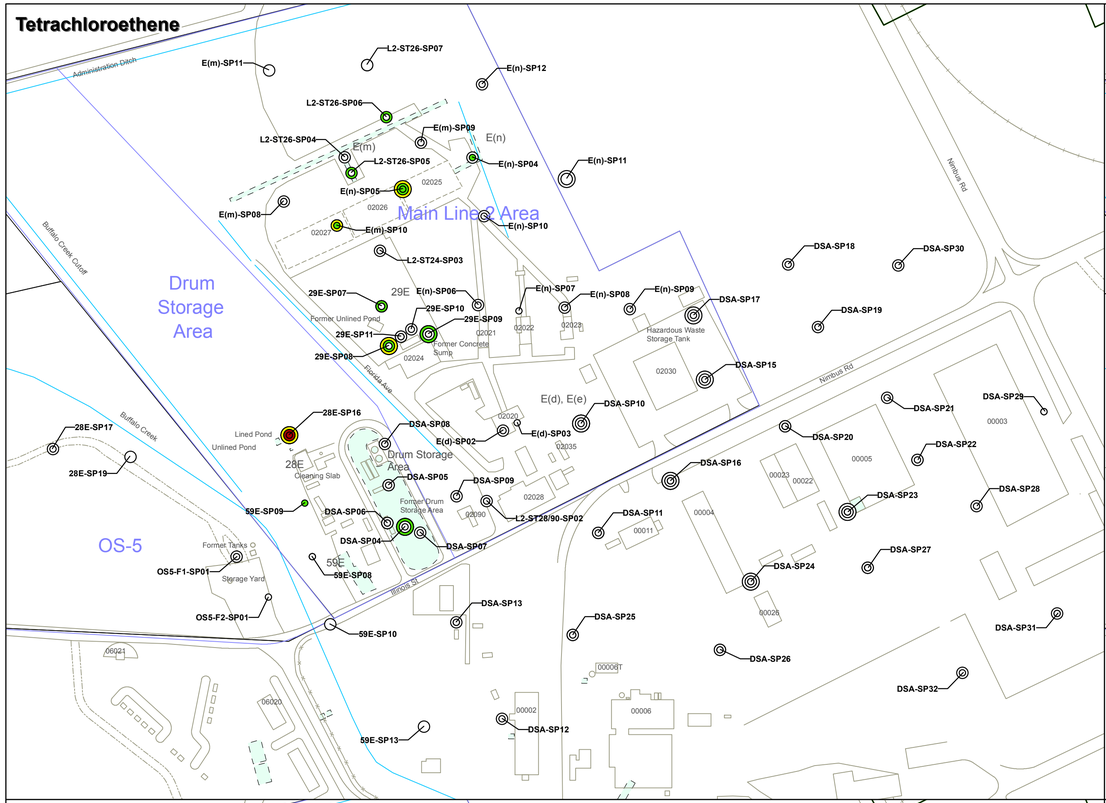
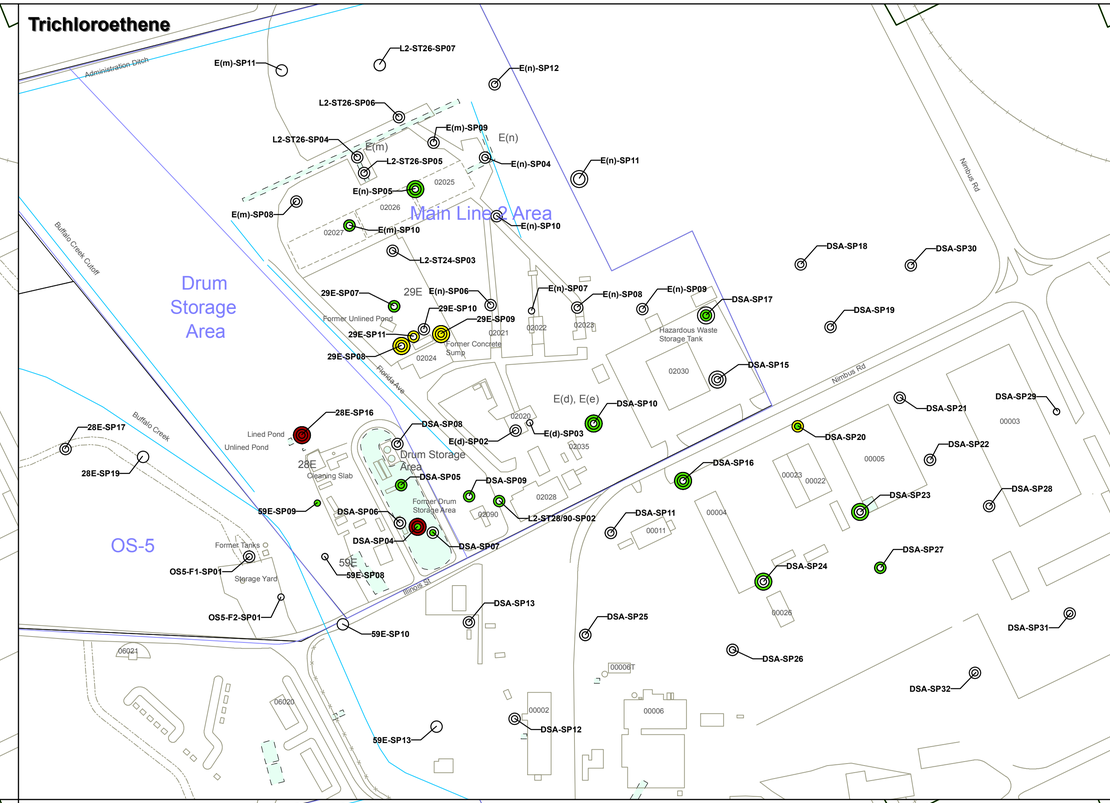
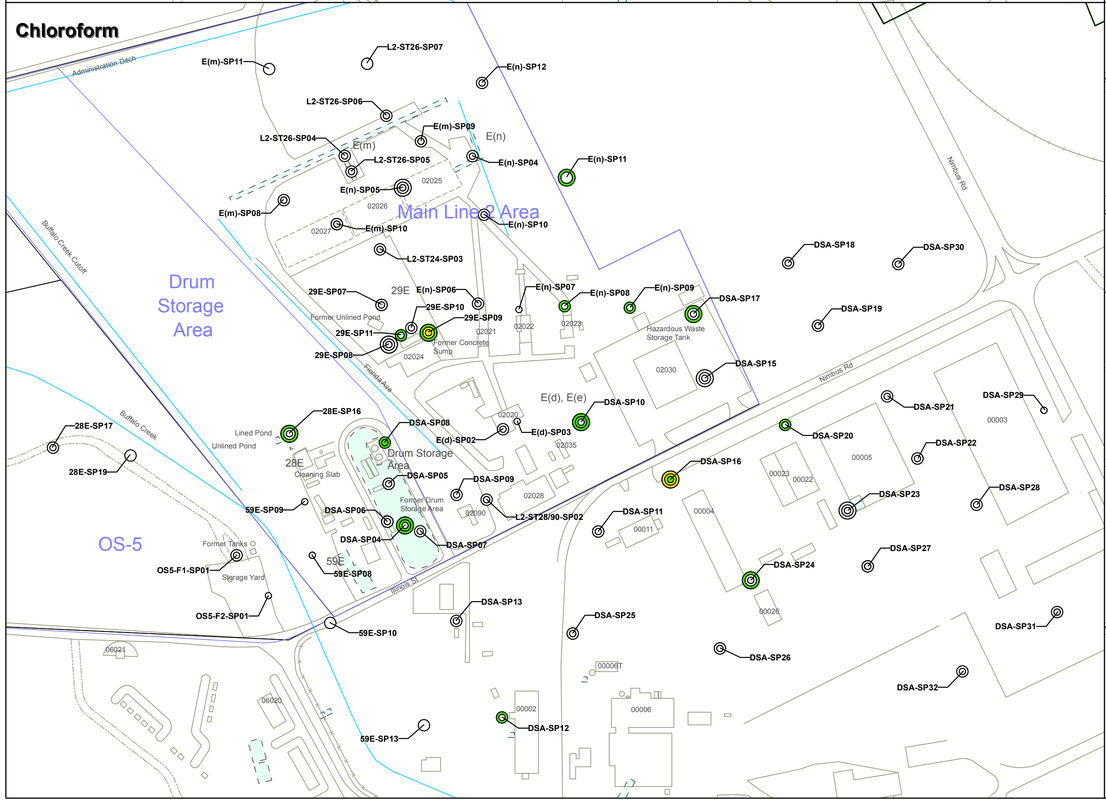
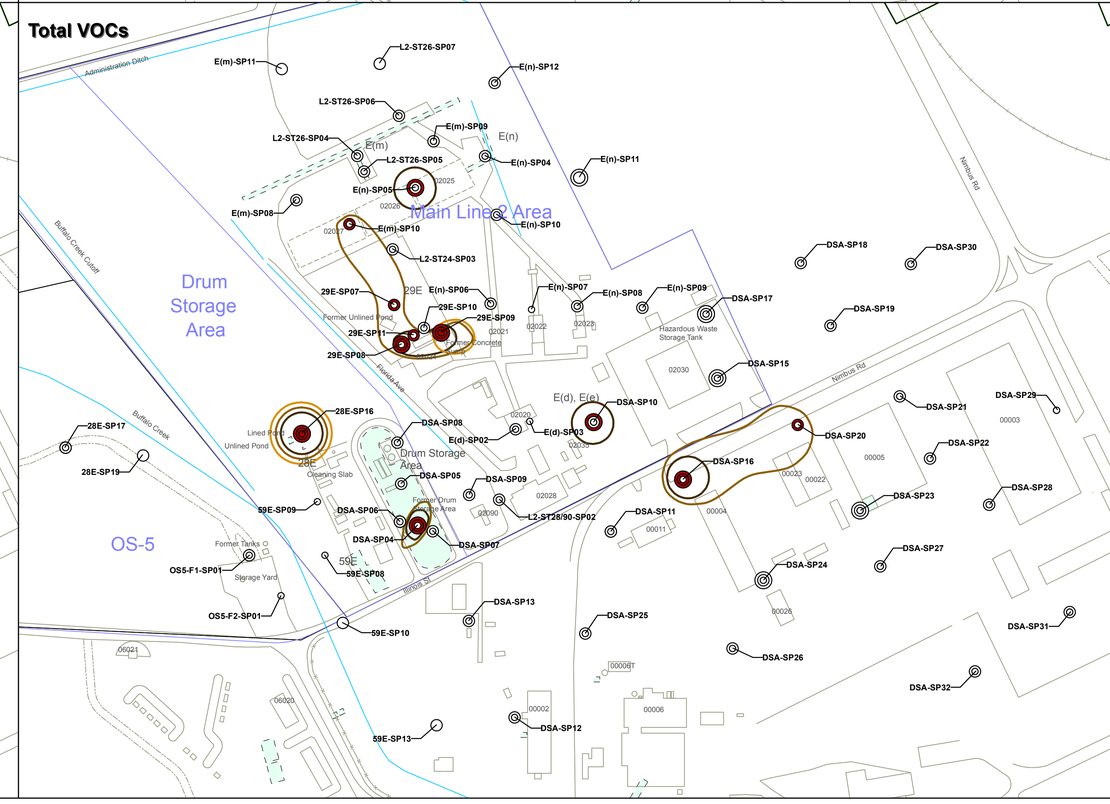
09/14/10 PER SR10130997







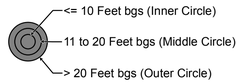


PCE, TCE, Chloroform Exceedances

- < Soil Vapor Screening Level (RISL)
- >= RISL and < 10x RISL
- >= 10x RISL and < 100x RISL
- >= 100x RISL

Total VOCs Exceedances

- Σ Detects to Screening Levels Ratios <= 10
- Σ Detects to Screening Levels Ratios > 10



- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary

Sample Location	<= 10 ft bgs			11-20 ft bgs			21-30 ft bgs		
	Trichloroethene	Tetrachloroethene	Chloroform	Trichloroethene	Tetrachloroethene	Chloroform	Trichloroethene	Tetrachloroethene	Chloroform
Screening Level	320	962	43	320	962	43	320	962	43
DSA									
DSA-SP16	**800,000**	**10,000,000**	<SL	**97,000**	**3,500,000**	<SL	**15,000**	**470,000**	**910**
DSA-SP09	**950**	**3,900**	<SL	NC	NC	NC	NC	NC	NC
DSA-SP04	<SL	**2,700**	<SL	<SL	**90,000**	**475**	**1,400**	**160,000**	**770**
DSA-SP05	<SL	**6,700**	<SL	<SL	**4,700**	<SL	NC	NC	NC
DSA-SP07	<SL	**1,200**	<SL	<SL	<SL	<SL	NC	NC	NC
DSA-SP08	<SL	<SL	<SL	<SL	**550**	<SL	NC	NC	NC
DSA-SP06	<SL	<SL	<SL	<SL	**2,100**	<SL	NC	NC	NC
DSA-SP10	<SL	<SL	<SL	<SL	**2,000**	<SL	**1,700**	**300**	NC
DSA-SP22	<SL	<SL	<SL	<SL	**890**	NC	NC	NC	NC
DSA-SP24	<SL	<SL	**270**	<SL	**3,700**	**1,200**	<SL	**3,500**	**1,400**
DSA-SP27	**1,400**	<SL	<SL	<SL	**3,700**	<SL	<SL	<SL	**550**
DSA-SP20	<SL	**5,000**	<SL	<SL	**24,000**	**99**	NC	NC	NC
DSA-SP21	<SL	<SL	<SL	<SL	<SL	<SL	<SL	**1,200**	<SL
DSA-SP26	<SL	<SL	<SL	<SL	<SL	<SL	<SL	**1,750**	**510**
DSA-SP32	<SL	<SL	<SL	<SL	**2,700**	<SL	NC	NC	NC
MAIN LINE 2E									
29E-SP07	<SL	<SL	<SL	**770**	**5,900**	<SL	NC	NC	NC
29E-SP09	<SL	<SL	<SL	**1,400**	**62,000**	<SL	**3,300**	**46,000**	<SL
29E-SP10	<SL	**15,300**	**990**	<SL	**84,000**	**2,400**	**1,400**	**25,000**	**260**
29E-SP11	<SL	<SL	<SL	<SL	**15,000**	**420**	NC	NC	NC
Elev-SP10	**360**	<SL	<SL	**7,100**	**3,100**	<SL	NC	NC	NC
29E-SP16	**550**	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
Elev-SP10	**850**	<SL	<SL	**2,200**	**1,700**	<SL	**21,000**	**2,600**	NC
Elev-SP09	<SL	<SL	<SL	<SL	<SL	**212**	NC	NC	NC
Elev-SP09	<SL	<SL	<SL	<SL	<SL	**542**	NC	NC	NC
Elev-SP11	NC	NC	NC	<SL	<SL	<SL	<SL	<SL	**190**
L-ST26-SP05	<SL	<SL	<SL	**960**	<SL	<SL	NC	NC	NC
L-ST26-SP06	<SL	<SL	<SL	**250**	<SL	<SL	NC	NC	NC

Units in $\mu g/m^3$.

<SL = either non-detect or detected concentration less than SL.

N

1 " = 175 '

0 175 350
Feet

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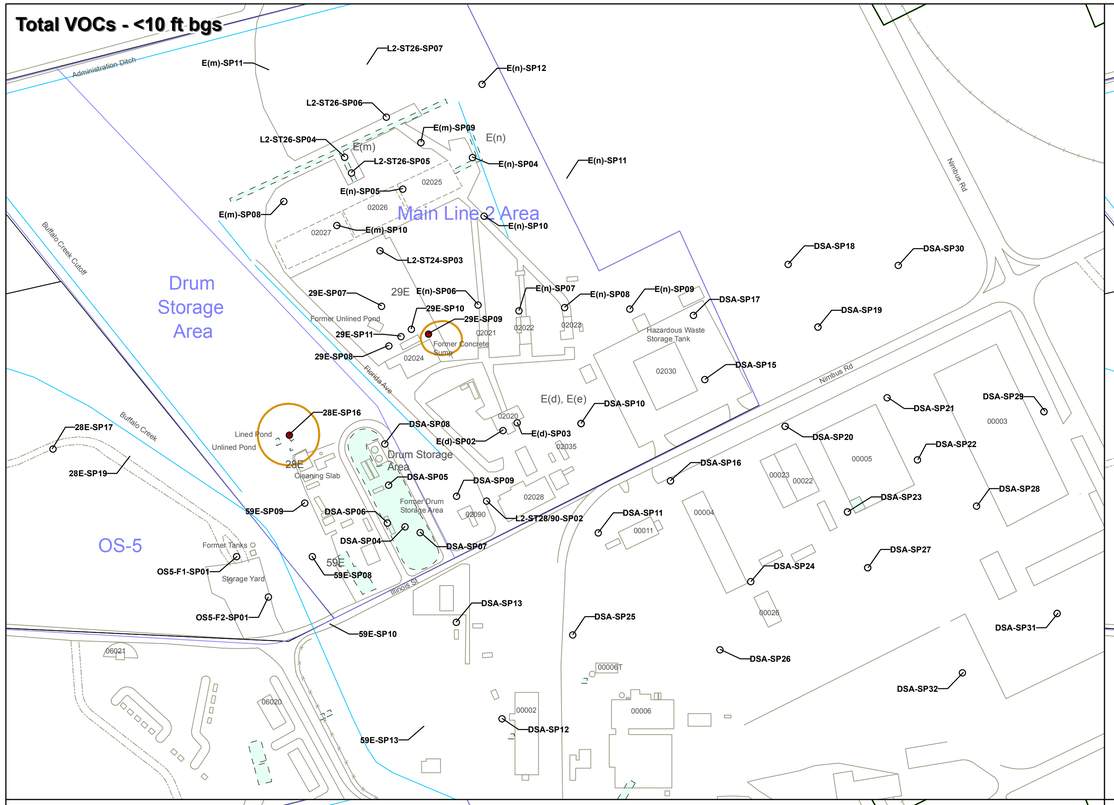
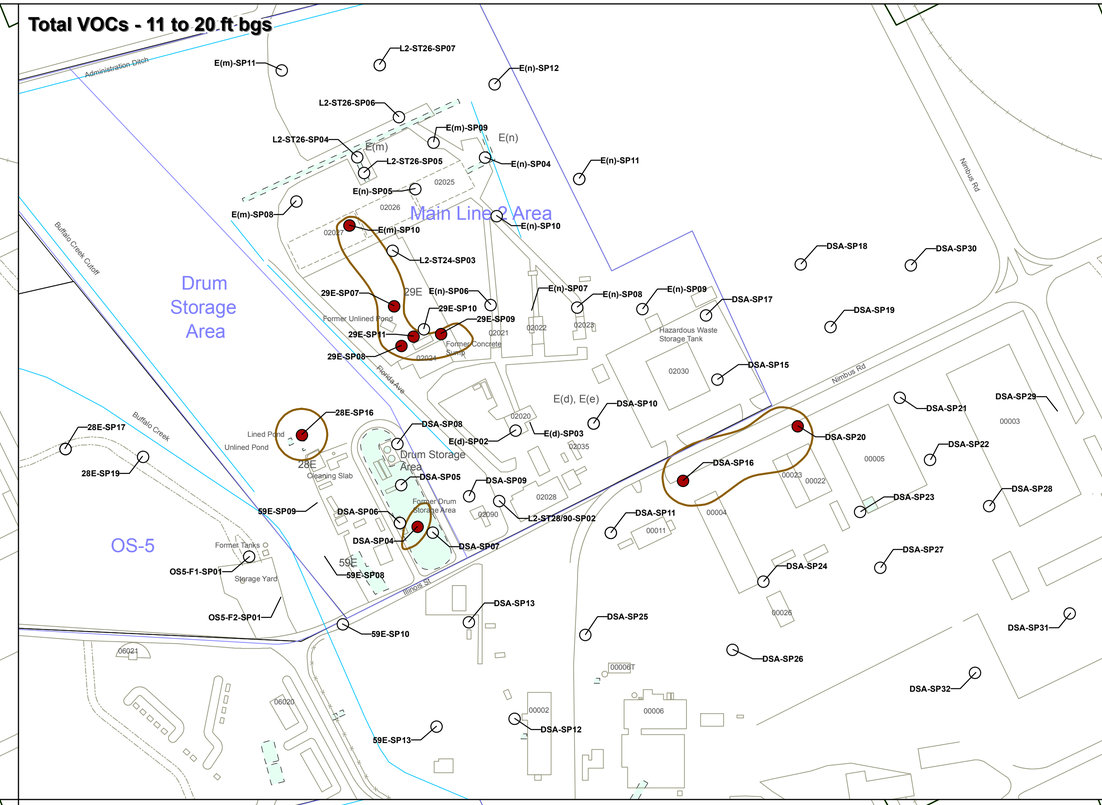
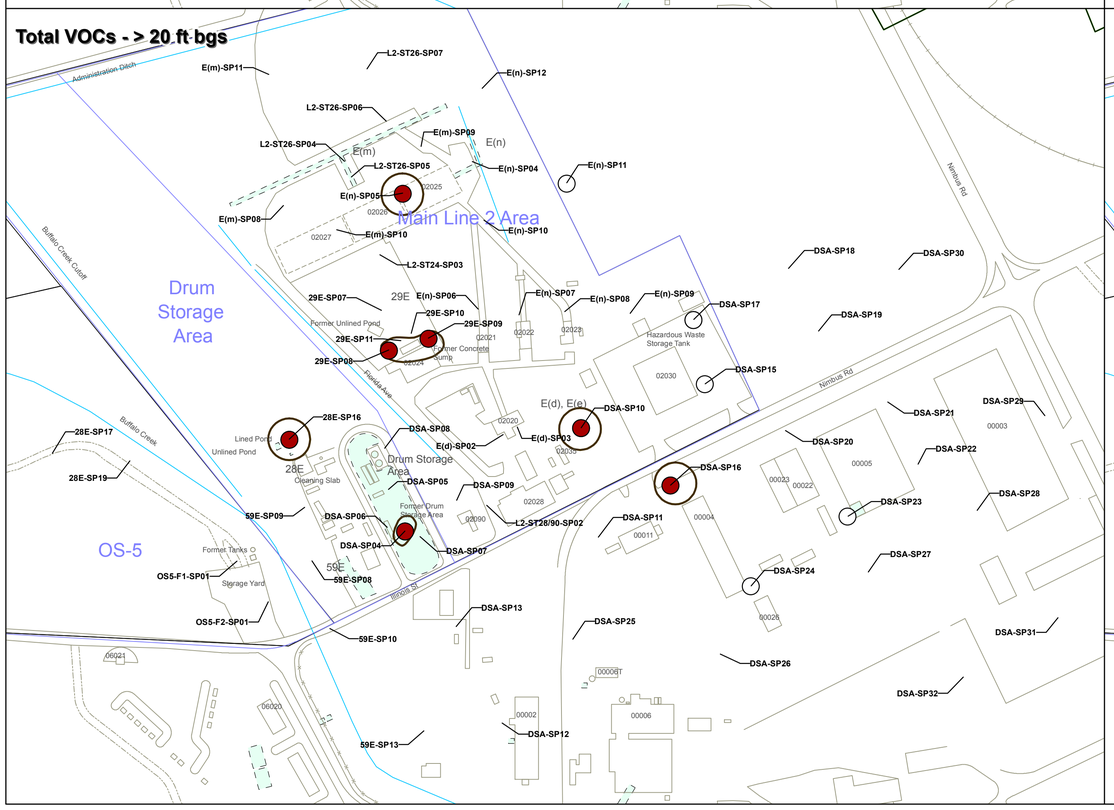
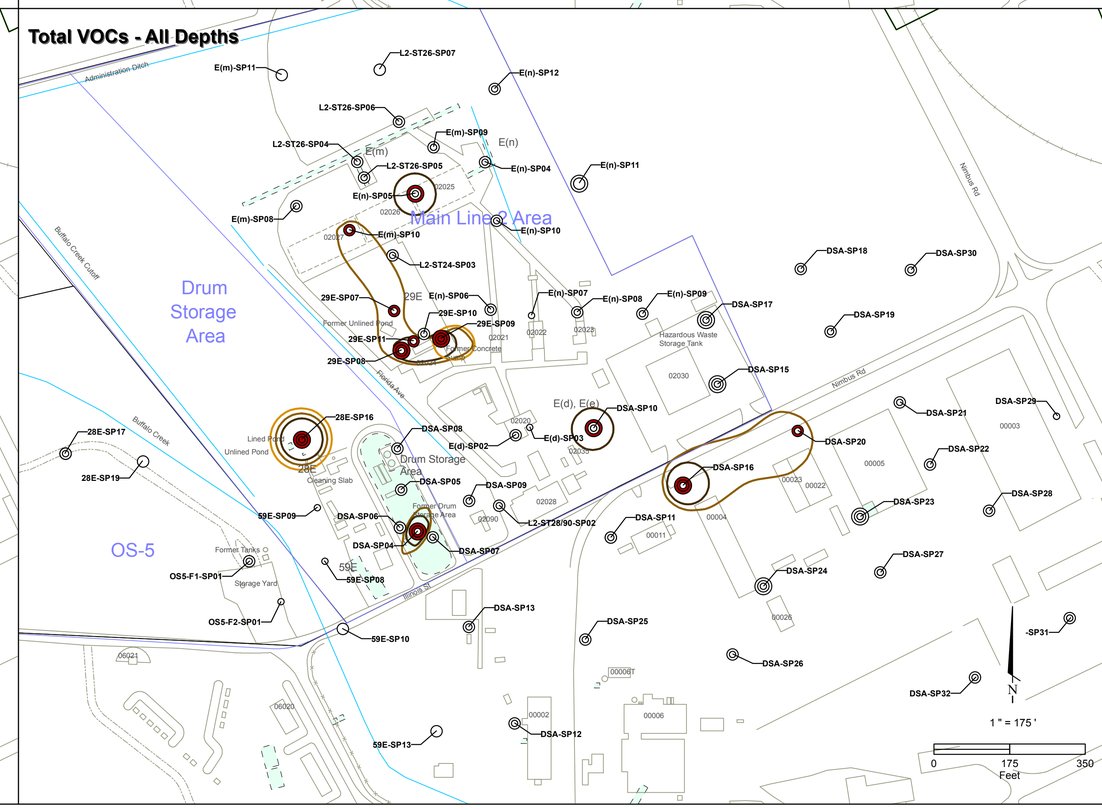
Figure 5.1-5a

PCE, TCE, Chloroform, and Total VOC Concentrations in Soil Vapor Above Remedial Investigation Screening Levels - Line 02









Total VOCs Exceedances

- Σ Detects to Screening Levels Ratios <= 10
- Σ Detects to Screening Levels Ratios > 10

- <= 10 Feet bgs (Small Circle)
- 11 to 20 Feet bgs (Medium Circle)
- > 20 Feet bgs (Large Circle)

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Approximate Extent of Total Screening Level Ratio Exceeding 10 (< 10 ft bgs)
- Approximate Extent of Total Screening Level Ratio Exceeding 10 (11 to 20 ft bgs)
- Approximate Extent of Total Screening Level Ratio Exceeding 10 (> 20 ft bgs)

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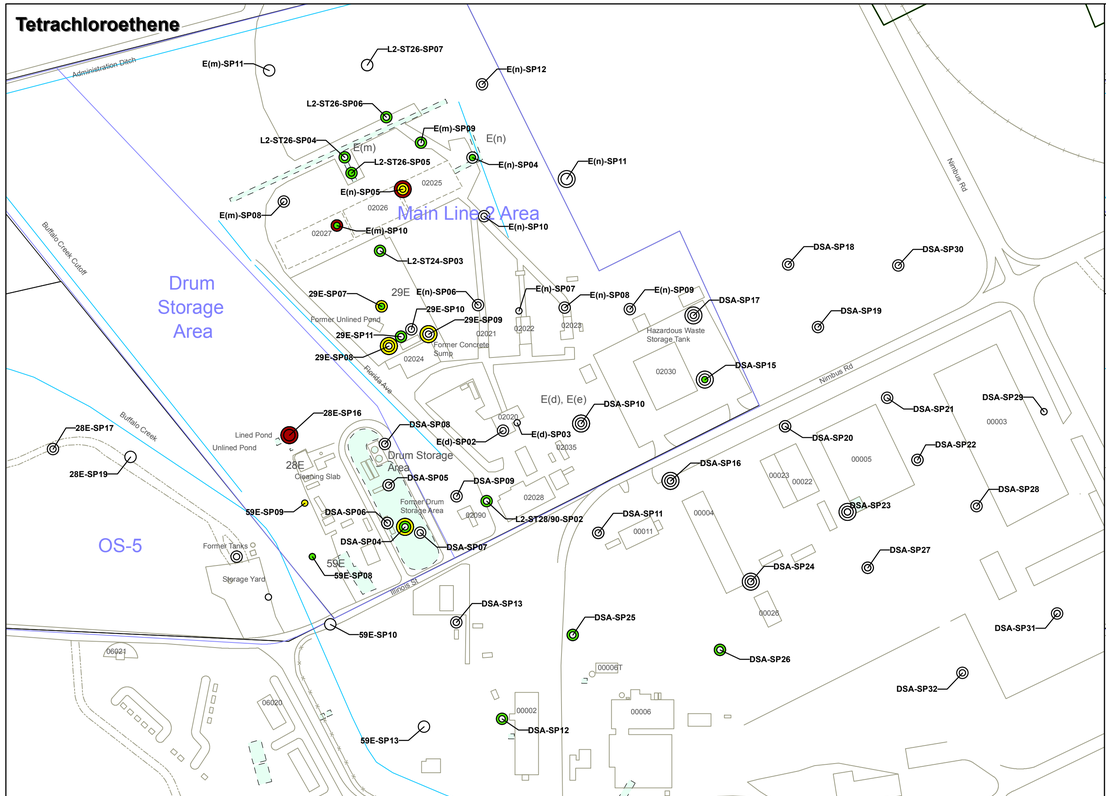
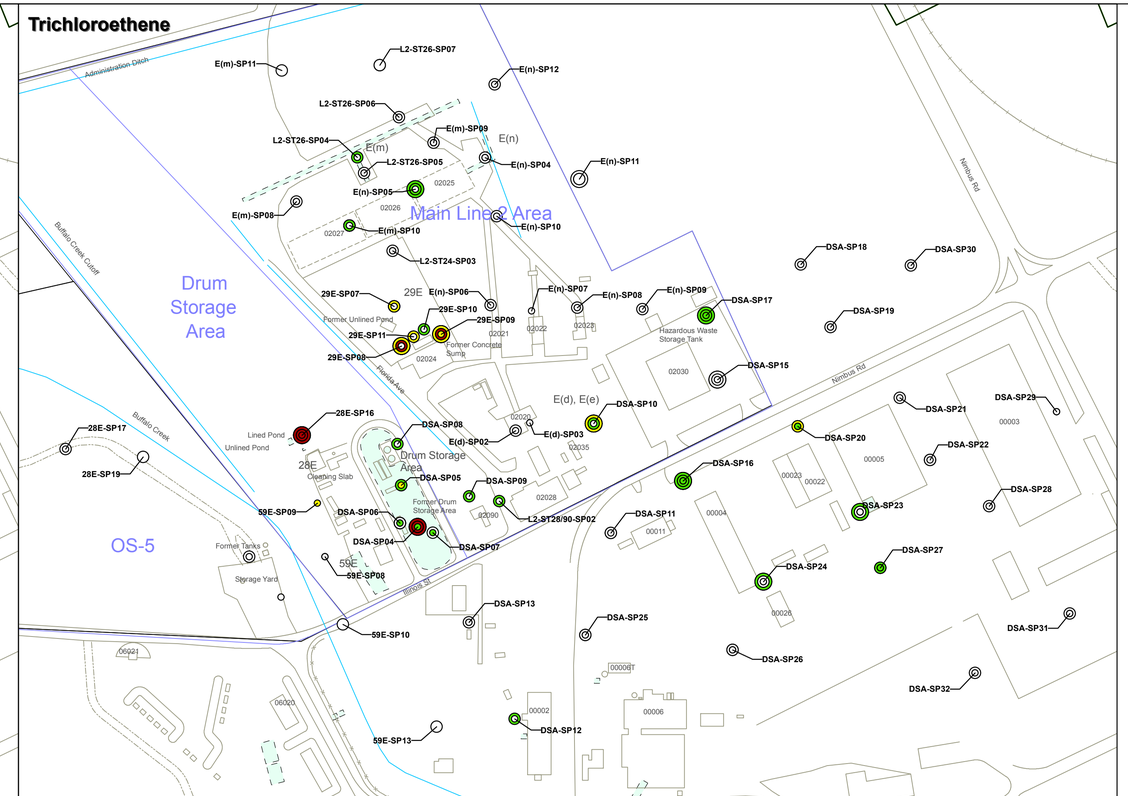
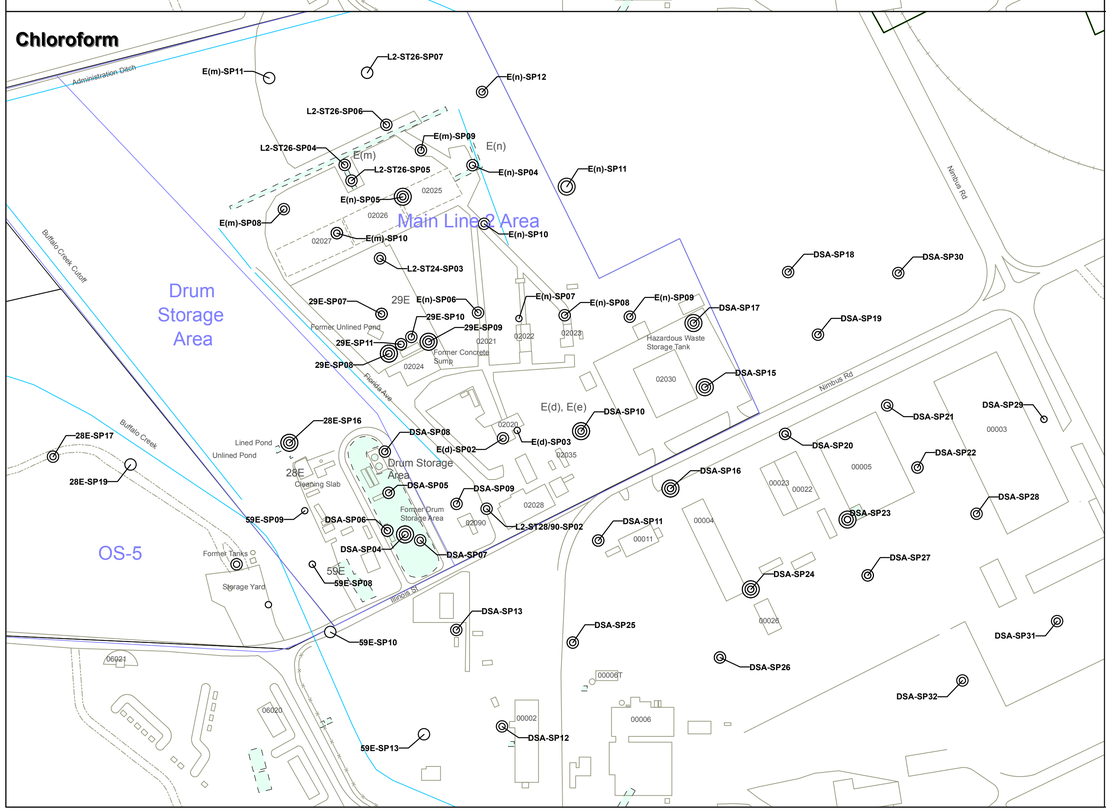
Environmental Remediation

Figure 5.1-5b

Total VOC Concentrations in Soil Vapor Above Remedial Investigation Screening Levels - Line 02







Sample Location	<= 10 ft bgs			11-20 ft bgs			21-30 ft bgs			>31 ft bgs		
	Tetrachloroethene	Trichloroethene	Chloroform	Tetrachloroethe	Trichloroethene	Chloroform	Tetrachloroethe	Trichloroethene	Chloroform	Tetrachloroethe	Trichloroethene	Chloroform
Screening Level	57	527	18,595	57	527	18,595	57	527	18,595	57	527	18,595
DSA												
28E-SP16	800,000	10,000,000	<SL	97,000	3,200,000	<SL	2,200	430,000	<SL	13,000	430,000	<SL
59E-SP09	950	5,900	<SL	NC	NC	NC	NC	NC	NC	NC	NC	NC
DSA-SP04	<SL	2,700	<SL	280	98,000	<SL	1,400	160,000	<SL	1,200	130,000	<SL
DSA-SP05	<SL	6,700	<SL	<SL	4,700	<SL	NC	NC	NC	NC	NC	NC
DSA-SP06	<SL	780	<SL	<SL	<SL	<SL	NC	NC	NC	NC	NC	NC
DSA-SP07	<SL	2,200	<SL	<SL	<SL	<SL	NC	NC	NC	NC	NC	NC
DSA-SP08	<SL	<SL	<SL	<SL	820	<SL	NC	NC	NC	NC	NC	NC
DSA-SP09	<SL	<SL	<SL	<SL	2,100	<SL	NC	NC	NC	NC	NC	NC
DSA-SP10	<SL	<SL	<SL	<SL	2,000	<SL	<SL	7,700	<SL	<SL	2,900	<SL
DSA-SP12	<SL	<SL	<SL	200	540	<SL	NC	NC	NC	NC	NC	NC
DSA-SP15	68	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
DSA-SP16	<SL	840	<SL	<SL	2,300	<SL	<SL	1,900	<SL	<SL	3,500	<SL
DSA-SP17	<SL	2,400	<SL	<SL	1,300	<SL	<SL	910	<SL	NC	NC	NC
DSA-SP20	<SL	3,000	<SL	<SL	24,000	<SL	NC	NC	NC	NC	NC	NC
DSA-SP23	<SL	<SL	<SL	<SL	<SL	<SL	<SL	1,200	<SL	NC	NC	NC
DSA-SP24	<SL	<SL	<SL	<SL	<SL	<SL	<SL	1,700	<SL	NC	NC	NC
DSA-SP25	<SL	<SL	<SL	70	<SL	<SL	NC	NC	NC	NC	NC	NC
DSA-SP26	<SL	<SL	<SL	310	<SL	<SL	NC	NC	NC	NC	NC	NC
DSA-SP27	<SL	540	<SL	<SL	2,300	<SL	NC	NC	NC	NC	NC	NC
MAIN LINE 02												
29E-SP07	60	<SL	<SL	770	8,900	<SL	NC	NC	NC	NC	NC	NC
29E-SP08	<SL	<SL	<SL	1,600	62,000	<SL	2,500	44,000	<SL	3,300	46,000	<SL
29E-SP09	<SL	18,000	<SL	<SL	64,000	<SL	1,400	23,000	<SL	840	18,000	<SL
29E-SP10	<SL	<SL	<SL	<SL	780	<SL	NC	NC	NC	NC	NC	NC
29E-SP11	<SL	<SL	<SL	240	15,000	<SL	NC	NC	NC	NC	NC	NC
E(m)-SP09	<SL	<SL	<SL	83	<SL	<SL	NC	NC	NC	NC	NC	NC
E(m)-SP10	560	<SL	<SL	7,100	1,100	<SL	NC	NC	NC	NC	NC	NC
E(n)-SP04	530	<SL	<SL	<SL	<SL	<SL	NC	NC	NC	NC	NC	NC
E(n)-SP05	850	<SL	<SL	2,200	1,700	<SL	NC	NC	NC	21,000	2,600	<SL
E(n)-SP08	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC	NC	NC	NC
E(n)-SP09	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC	NC	NC	NC
E(n)-SP11	NC	NC	NC	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
L2-ST24-SP03	<SL	<SL	<SL	190	<SL	<SL	NC	NC	NC	NC	NC	NC
L2-ST26-SP04	<SL	<SL	<SL	150	690	<SL	NC	NC	NC	NC	NC	NC
L2-ST26-SP05	140	<SL	<SL	360	<SL	<SL	NC	NC	NC	NC	NC	NC
L2-ST26-SP06	<SL	<SL	<SL	330	<SL	<SL	NC	NC	NC	NC	NC	NC

Units in $\mu g/m^3$.
<SL = either non-detect or detected concentration less than SL.

PCE, TCE, Chloroform Exceedances

- < Soil Vapor Screening Level (PGW SVSL)
- >= PGW SVSL and < 10x PGW SVSL
- >= 10x PGW SVSL and < 100x PGW SVSL
- >= 100x PGW SVSL

- <= 10 Feet bgs (Inner Circle)
- 11 to 20 Feet bgs (Middle Circle)
- > 20 Feet bgs (Outer Circle)

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary

N

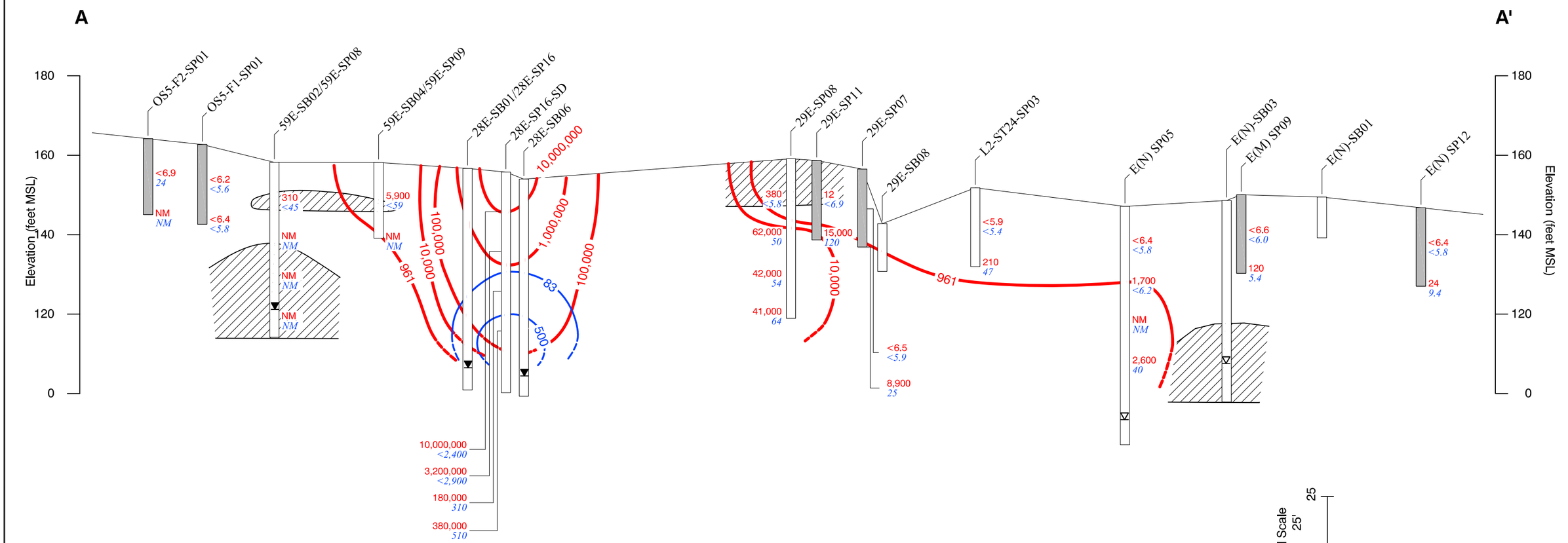
1 " = 175 '

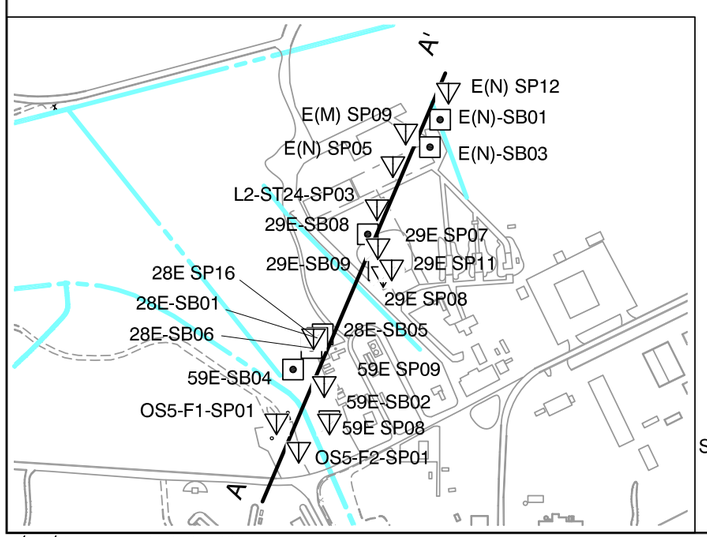
0 175 350
Feet

AEROJET
Environmental Remediation

Figure 5.1-6

PCE, TCE, and Chloroform Concentrations in Above Protection of Groundwater Screening Levels for Soil Vapor - Line 02





Scale: 1" = 500'

0 25 500

Locator Scale

N

EXPLANATION

29E-SP08 — Boring Designation

<0.5 — TCE Concentration in $\mu g/m^3$

<4 — Chloroform Concentration in $\mu g/m^3$ (NS-W = not sampled due to presence of groundwater)

Total Borehole Depth

Initial Depth to Groundwater

Final Depth to Groundwater

961 — TCE Concentration in Micrograms per Cubic Meter ($\mu g/m^3$)

83 — Chloroform Concentration in Micrograms per Cubic Meter ($\mu g/m^3$)

Note: Contour Lines Dashed Where Inferred

TCE Trichloroethene

MSL Mean Sea Level

Geologic Contact

Relatively permeable sediments: Silty, poorly and well-graded sands and gravels (GP,GW,SP,SW); silty and clayey gravels (GM/GC) and silts.

Relatively lower permeability sediments: Low plasticity clays and silts (CL,ML); silty and clayey sand (SM/SC).

Vertical Scale 1' = 25'

25

0

100

Horizontal Scale 1' = 100'

Vertical Exaggeration: 4X

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Environmental Remediation

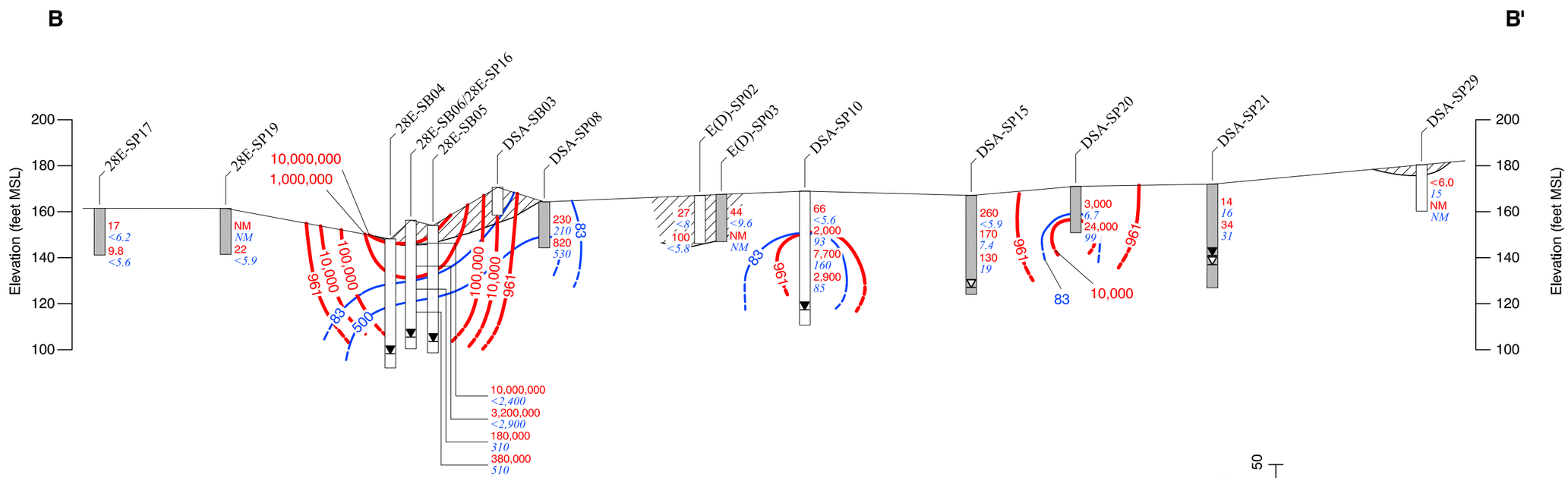
DRAFT

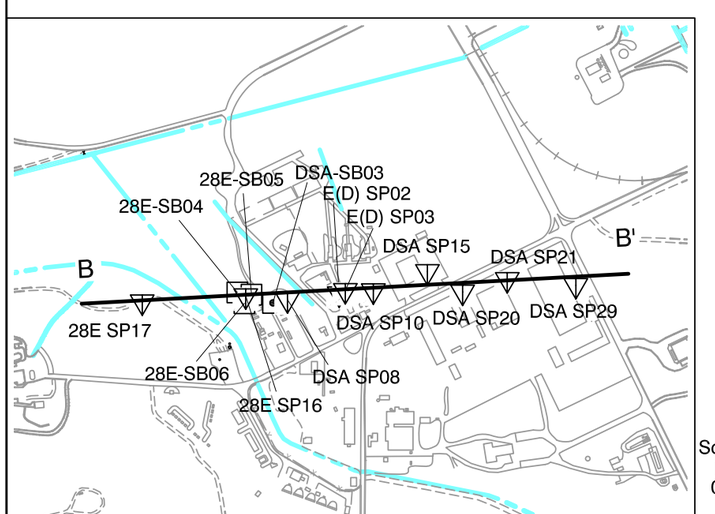
FIGURE 5.1-7

Vadose Zone Cross Section A - A'

Line 02

7/18/08 pr SR10130998





Scale: 1" = 800'

0 400 800

Locator Scale

N

EXPLANATION

28E-SP17 — Boring Designation

<0.5 — TCE Concentration in $\mu g/m^3$

<4 — Chloroform Concentration in $\mu g/m^3$ (NS-W = not sampled due to presence of groundwater)

Total Borehole Depth

Initial Depth to Groundwater

Final Depth to Groundwater

961 — TCE Concentration in Micrograms per Cubic Meter ($\mu g/m^3$)

83 — Chloroform Concentration in Micrograms per Cubic Meter ($\mu g/m^3$)

Note: Contour Lines Dashed Where Inferred

TCE Trichloroethene

MSL Mean Sea Level

Geologic Contact

Relatively permeable sediments: Silty, poorly and well-graded sands and gravels (GP,GW,SP,SW); silty and clayey gravels (GM/GC) and silts.

Relatively lower permeability sediments: Low plasticity clays and silts (CL,ML); silty and clayey sand (SM/SC).

Vertical Scale 1' = 50'

50

0 200

Horizontal Scale 1' = 200'

Vertical Exaggeration: 4X

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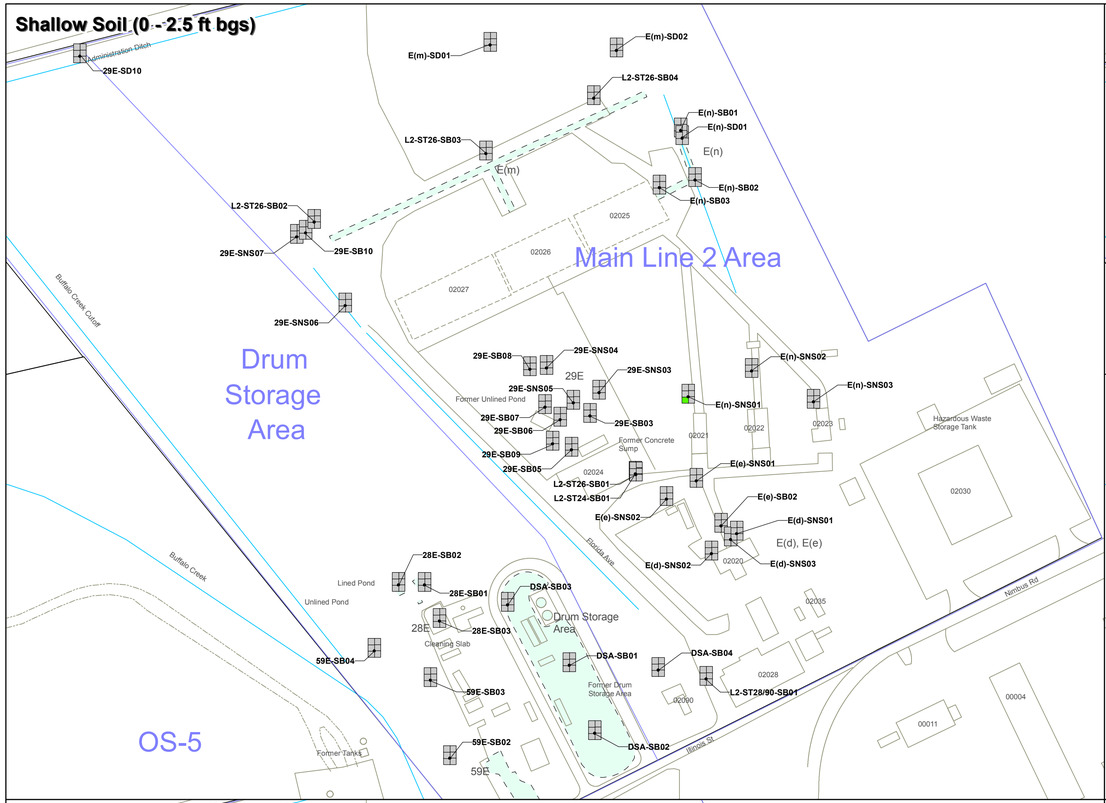
Environmental Remediation

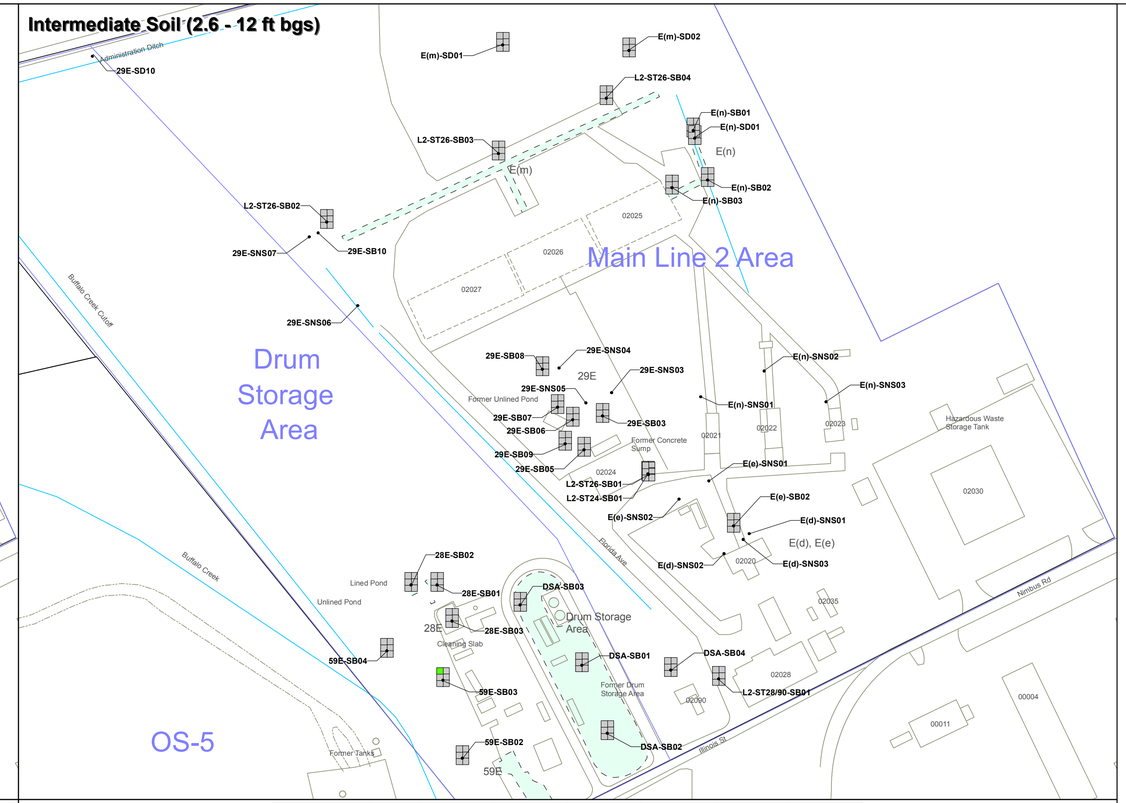
DRAFT

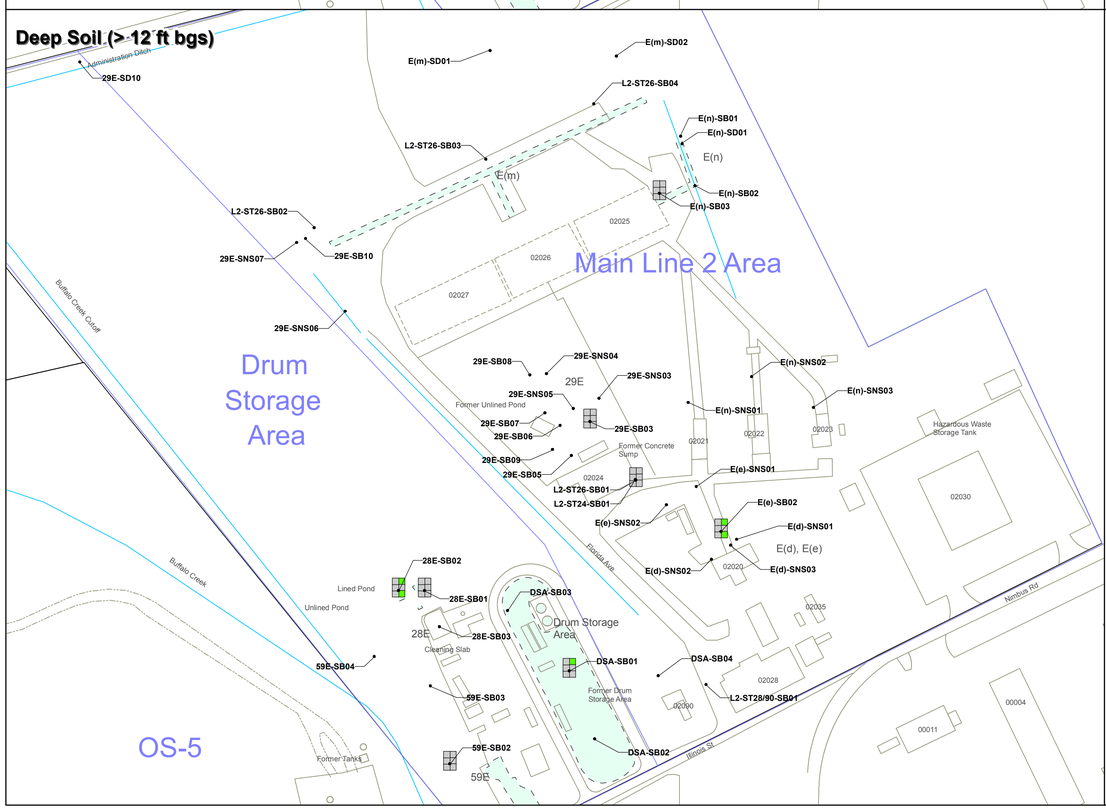
FIGURE 5.1-8

Vadose Zone Cross Section B - B'
Line 02

7/18/08 pr SR10130999







Sample Location	Sample Depth	Aluminum	Beryllium	Cadmium	Manganese	Nickel	Thallium
Screening Level		76,140	150	1.7	1,762	1,564	5
0 - 2.5 feet bgs							
E(n)-SNS01	0.5	<SL	<SL	**3.3**	<SL	<SL	<SL
2.6 - 12 feet bgs							
59E-SB03	11	**79,000**	<SL	<SL	<SL	<SL	<SL
> 12 feet bgs							
28E-SB02	35	<SL	<SL	<SL	**1,800**	<SL	**5.1**
DSA-SB01	33	<SL	<SL	<SL	**2,100**	<SL	<SL
DSA-SB01	43	<SL	<SL	<SL	**5,000**	<SL	<SL
E(e)-SB02	22	<SL	<SL	<SL	**4,900**	<SL	**5.1**

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not analyzed for.
Units in milligrams per kilogram (mg/kg).

- Not Analyzed
- < Soil Screening Level (RISL)
- >= RISL and < 10x RISL
- >= 10x RISL and < 100x RISL
- >= 100x RISL

Aluminum, Beryllium, Cadmium
Manganese, Nickel, Thallium

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary

N

1 " = 120 '

0 120 240
Feet

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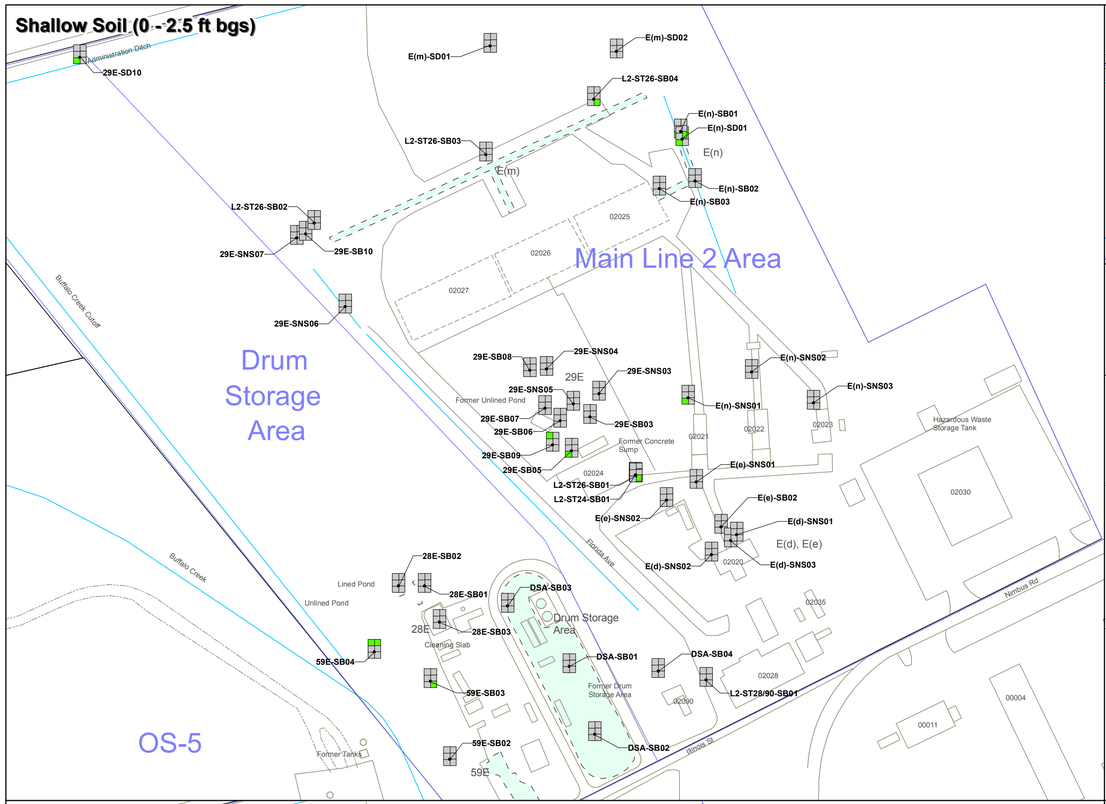
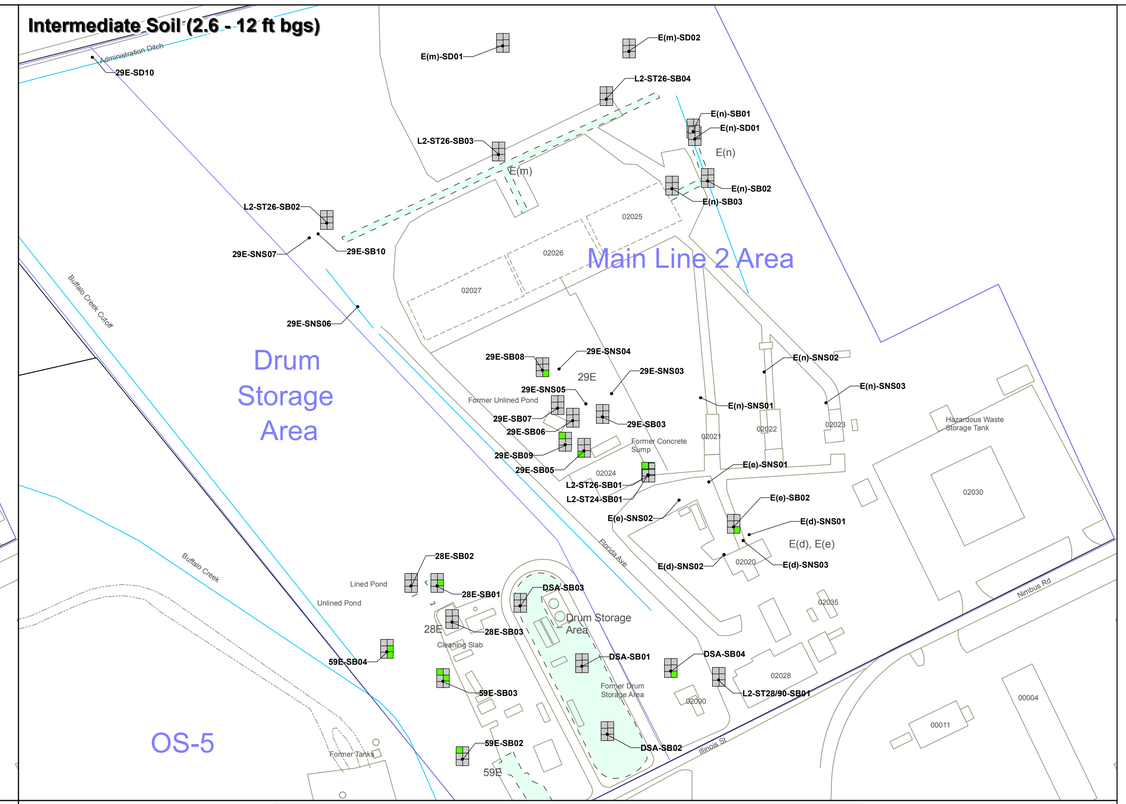
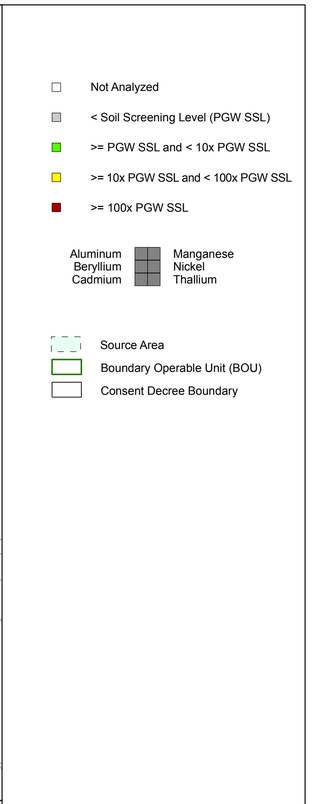
Environmental Remediation

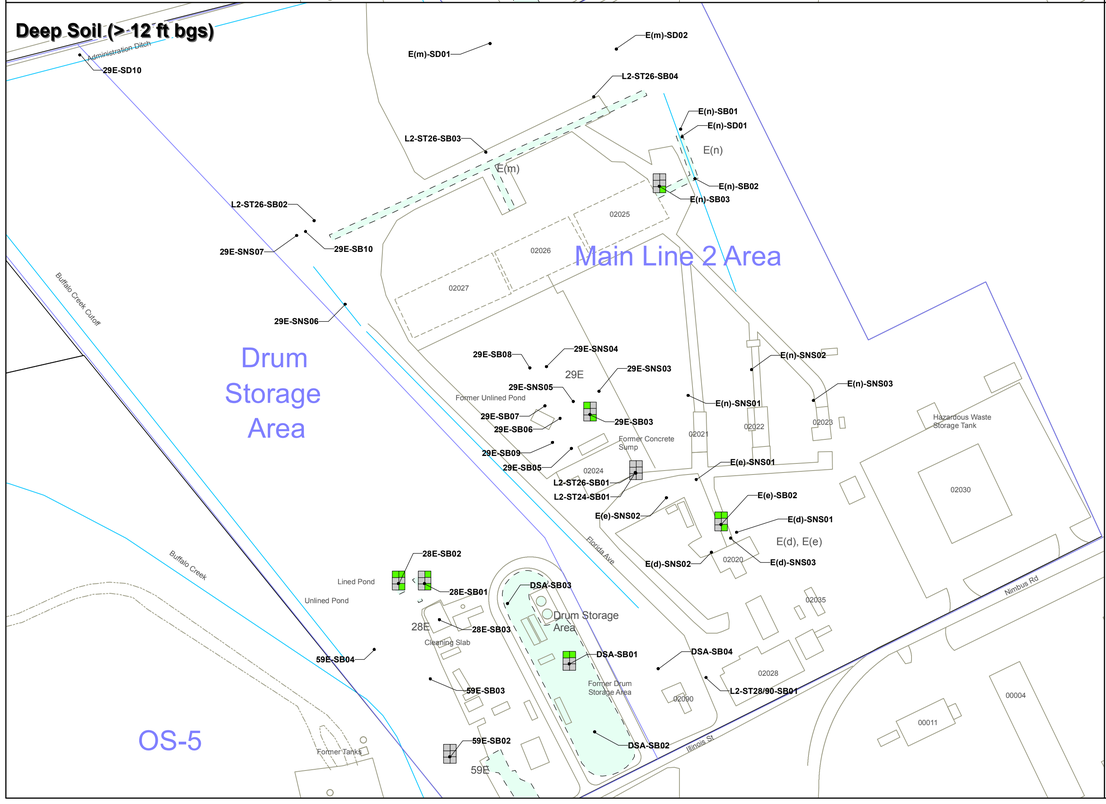
Figure 5.1-9

Metals in Soil Above
Remedial Investigation Screening Levels
Line 02









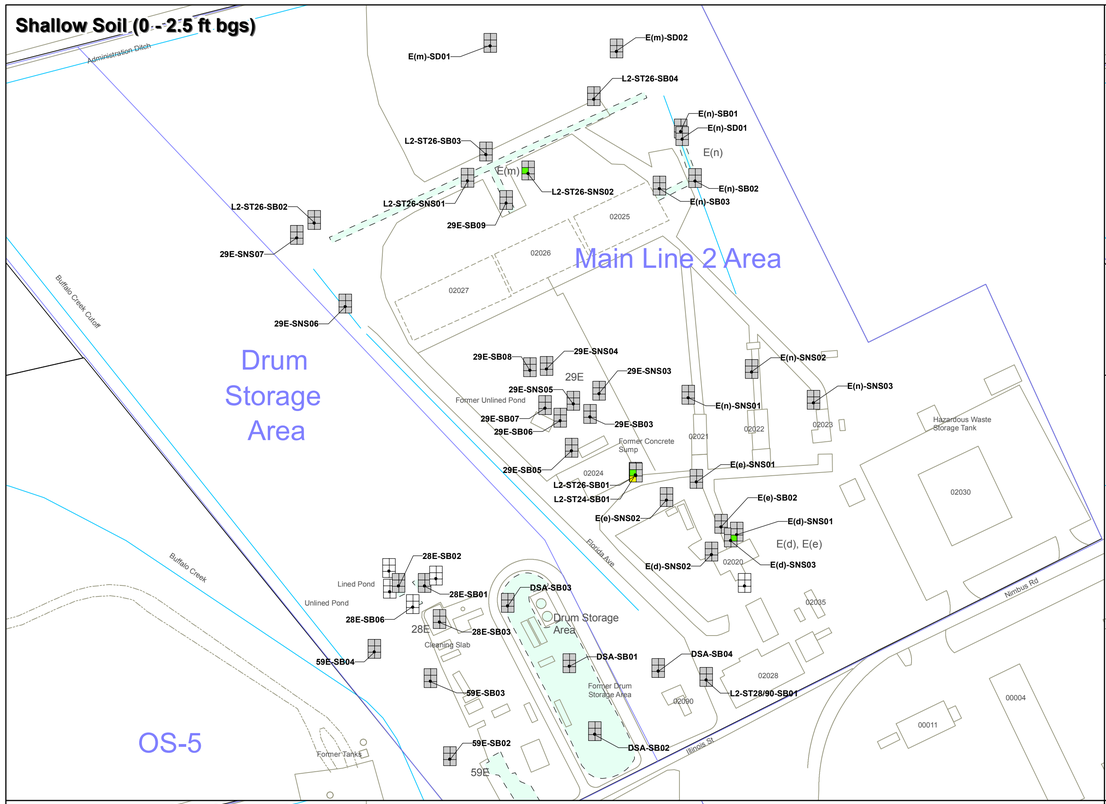
Sample Location	Sample Depth	Aluminum	Beryllium	Cadmium	Manganese	Nickel	Thallium
Screening Level		43,000	10	0.72	1,100	120	2.5
0 - 2.5 feet bgs							
29E-SB05	2.0	<SL	<SL	**1.2**	<SL	<SL	<SL
29E-SB09	1.0	**47,000**	<SL	<SL	<SL	<SL	<SL
29E-SB10	1.0	<SL	<SL	**1.2**	<SL	<SL	<SL
59E-SB03	2.0	<SL	<SL	<SL	<SL	<SL	**3.4**
59E-SB04	2.5	**48,000**	<SL	<SL	<SL	<SL	<SL
E(n)-SB01	1.0	<SL	<SL	**0.85**	<SL	<SL	**2.9**
E(n)-SD01	0.25	<SL	<SL	**0.74**	<SL	<SL	<SL
E(n)-SD01	1.5	<SL	<SL	**0.79**	**1,700**	<SL	<SL
E(n)-SNS01	0.5	<SL	<SL	**3.3**	<SL	<SL	<SL
L2-ST24-SB01	2.0	<SL	<SL	<SL	**1,200**	<SL	**4.6**
L2-ST24-SB04	1.0	<SL	<SL	<SL	<SL	<SL	**2.8**
2.6 - 12 feet bgs							
28E-SB01	11.5	<SL	<SL	<SL	<SL	**130**	<SL
29E-SB05	6.0	<SL	<SL	**1.2**	<SL	<SL	<SL
29E-SB09	5.0	**45,000**	<SL	<SL	<SL	<SL	<SL
DSA-SB04	5.0	<SL	<SL	<SL	<SL	<SL	**3.0**
59E-SB02	10.5	**48,000**	<SL	<SL	<SL	<SL	<SL
59E-SB03	11	**79,000**	<SL	<SL	<SL	**130**	<SL
59E-SB04	11	<SL	<SL	<SL	<SL	**210**	**2.8**
E(e)-SB02	11	<SL	<SL	<SL	<SL	<SL	**4.6**
L2-ST24-SB01	11.5	**45,000**	<SL	<SL	<SL	<SL	<SL
> 12 feet bgs							
28E-SB01	23	<SL	<SL	<SL	<SL	<SL	**3.2**
28E-SB01	35	<SL	<SL	<SL	**1,300**	<SL	<SL
28E-SB01	47	<SL	<SL	<SL	<SL	<SL	**2.8**
29E-SB03	23	**50,000**	<SL	<SL	<SL	<SL	<SL
29E-SB03	45	<SL	<SL	<SL	<SL	<SL	**2.7**
28E-SB02	35	**53,000**	<SL	<SL	**1,800**	<SL	**5.1**
28E-SB02	59	<SL	<SL	<SL	**1,500**	<SL	<SL
DSA-SB01	20	**65,000**	<SL	<SL	**1,300**	<SL	<SL
DSA-SB01	33	**51,000**	<SL	<SL	**2,100**	<SL	<SL
DSA-SB01	43	<SL	<SL	<SL	**5,000**	<SL	<SL
E(e)-SB02	22	**51,000**	<SL	<SL	**4,900**	<SL	**5.1**
E(e)-SB02	42	<SL	<SL	<SL	1,300	<SL	**4.2**
E(n)-SB03	43	<SL	<SL	<SL	<SL	<SL	**3.1**

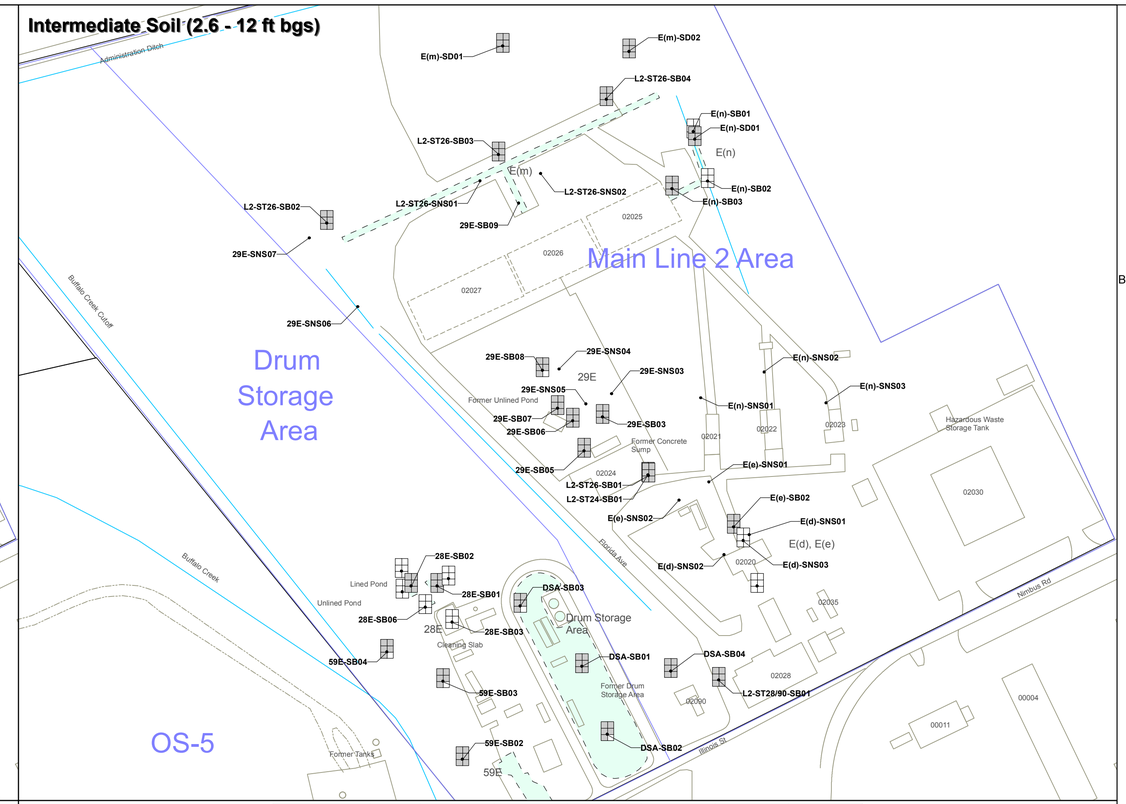
Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Less than screening level or non-detect.
NC = Not analyzed for.
Units in milligrams per kilogram (mg/kg).

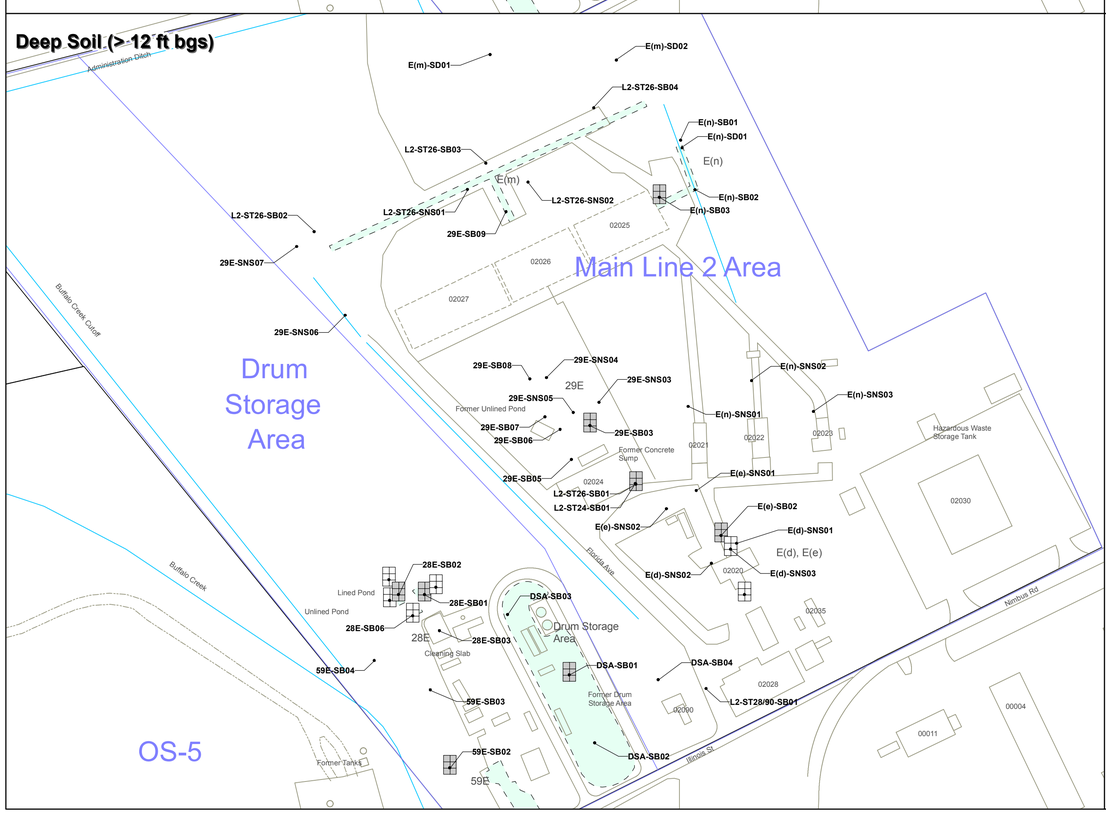
AEROJET
Environmental Remediation

Figure 5.1-10

Metals Above Protection of Groundwater Soil Screening Levels
Line 02







Sample Location	Sample Depth	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b&k) fluoranthene	Dibenz(a,h) anthracene	Indeno(1,2,3-cd)pyrene	Pentachloro-phenol
Screening Level		0.62	0.038	0.038	0.062	0.621	3000
0 - 2.5 feet bgs							
E(d)-SNS01	0.5	<SL	<SL	**0.088**	<SL	<SL	<SL
L2-ST26-SB01	2.0	<SL	**0.32**	**0.74**	<SL	<SL	<SL
L2-ST26-SNS02	0.5	<SL	**0.055**	<SL	<SL	<SL	<SL

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not collected.
Units in milligrams per kilogram (mg/kg).

Not Analyzed
< Soil Screening Level (RISL)
>= RISL and < 10x RISL
>= 10x RISL and < 100x RISL
>= 100x RISL

Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b&k)fluoranthene
Dibenz(a,h)anthracene
Indeno(1,2,3-cd)pyrene
Pentachlorophenol

Source Area
Boundary Operable Unit (BOU)
Consent Decree Boundary

N

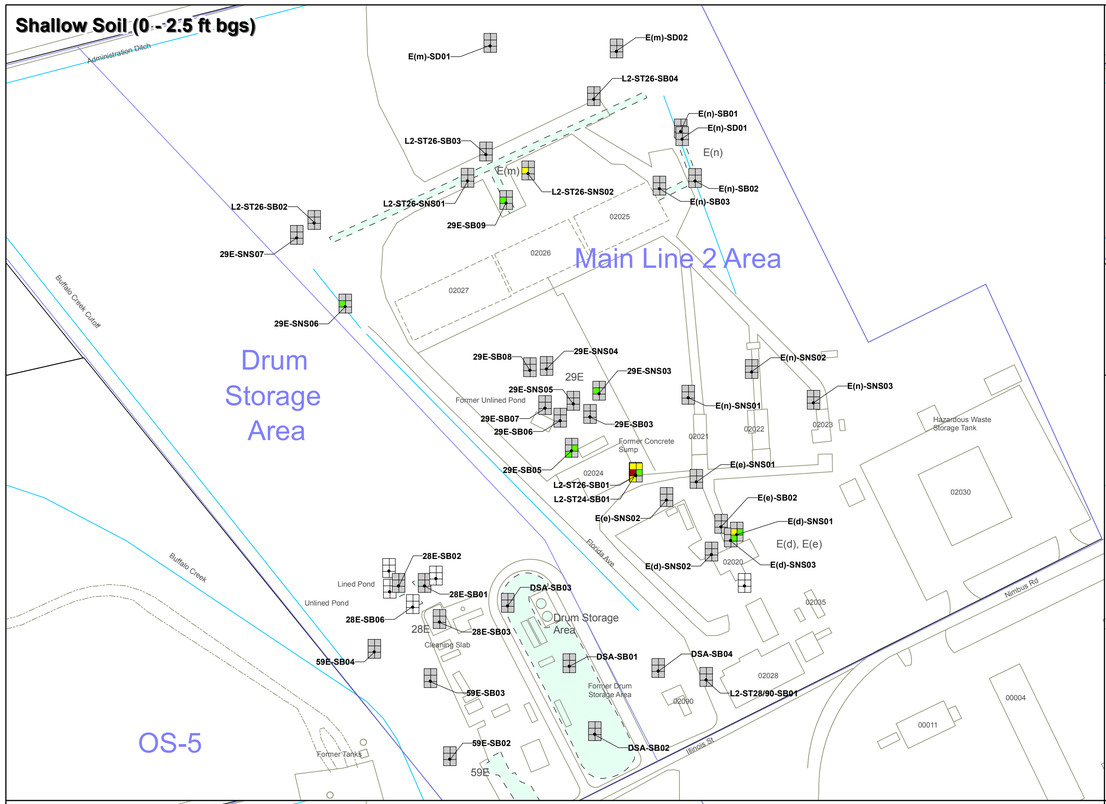
1 " = 120 '

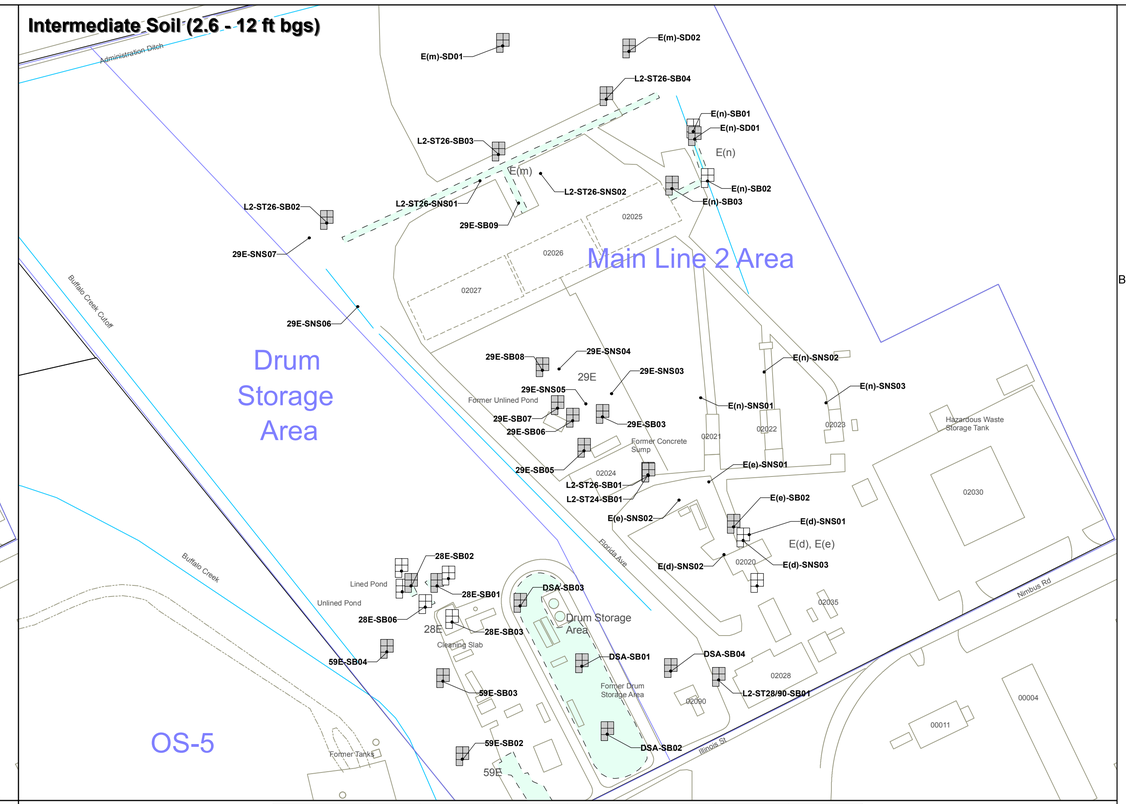
0 120 240
Feet

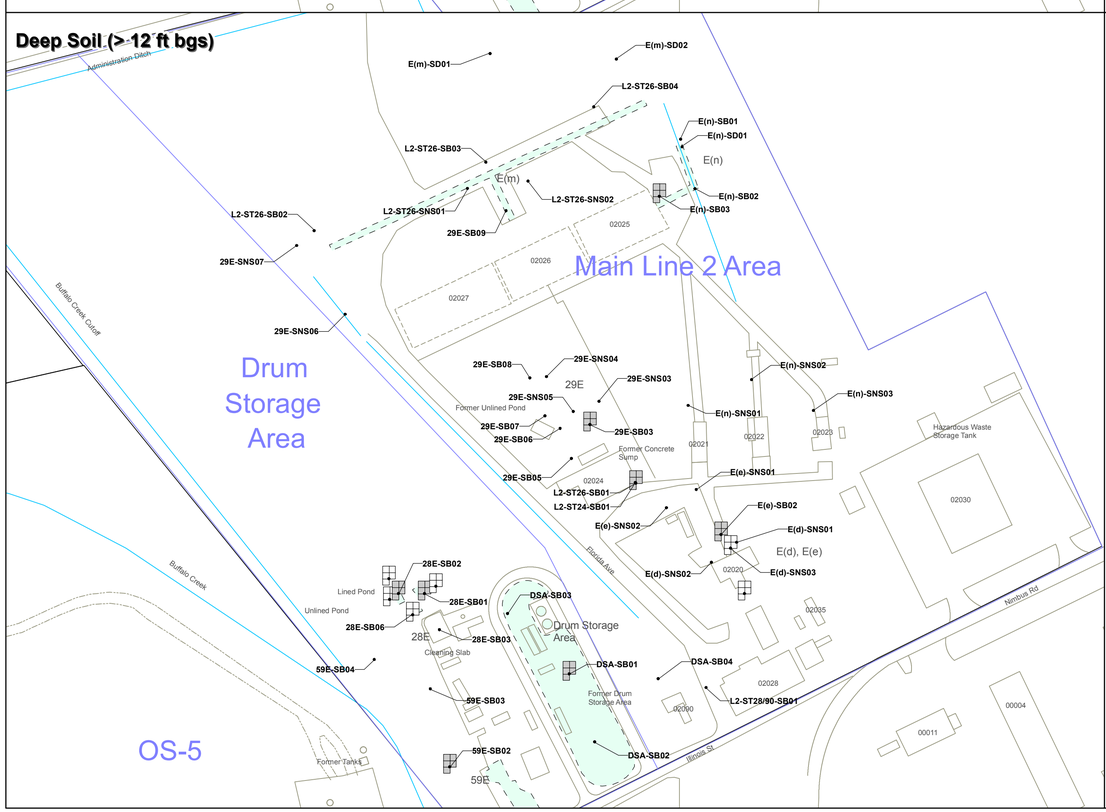
AEROJET
Environmental Remediation

Figure 5.1-11

SVOCs and Pentachlorophenol in Soil Above Remedial Investigation Screening Levels - Line 02







Sample Location	Sample Depth	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b&k) fluoranthene	Dibenz(a,h) anthracene	Indeno(1,2,3-cd)pyrene	Pentachloro-phenol
Screening Level		0.029	0.0029	0.029	0.0029	0.029	0.4
0 - 2.5 feet bgs							
29E-SB05	2.0	<SL	<SL	**0.031**	<SL	**0.033**	<SL
29E-SNS03	0.5	<SL	**0.0069**	<SL	<SL	<SL	<SL
29E-SNS06	0.5	<SL	**0.0087**	<SL	<SL	<SL	<SL
E(d)-SNS01	0.5	<SL	**0.036**	**0.088**	<SL	**0.031**	<SL
L2-ST26-SB01	2.0	**0.41**	**0.32**	**0.74**	**0.031**	**0.085**	<SL
L2-ST26-SNS02	0.5	<SL	**0.055**	<SL	<SL	<SL	<SL
L2-ST26-SNS03	0.5	<SL	**0.0062**	<SL	<SL	<SL	<SL

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not collected.
Units in milligrams per kilogram (mg/kg).

Not Analyzed
< Soil Screening Level (PGW SSL)
>= PGW SSL and < 10x PGW SSL
>= 10x PGW SSL and < 100x PGW SSL
>= 100x PGW SSL

Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b&k)fluoranthene
Dibenz(a,h)anthracene
Indeno(1,2,3-cd)pyrene
Pentachlorophenol

Source Area
Boundary Operable Unit (BOU)
Consent Decree Boundary

N

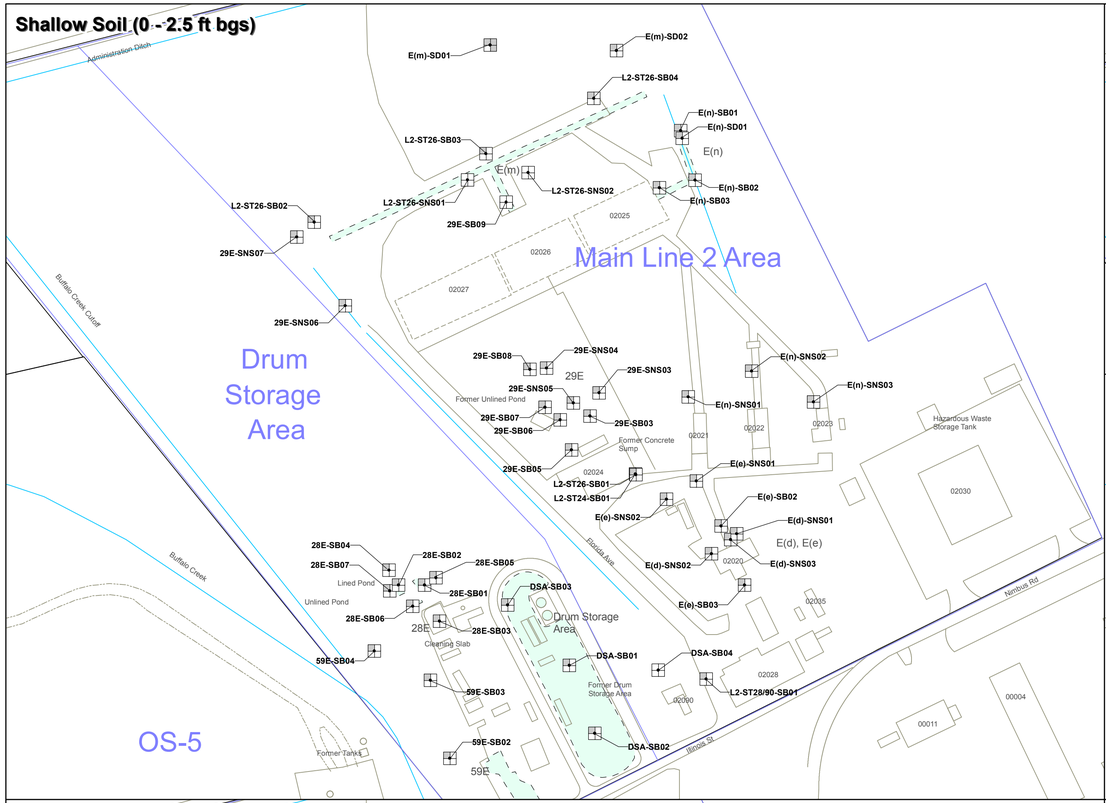
1 " = 120 '

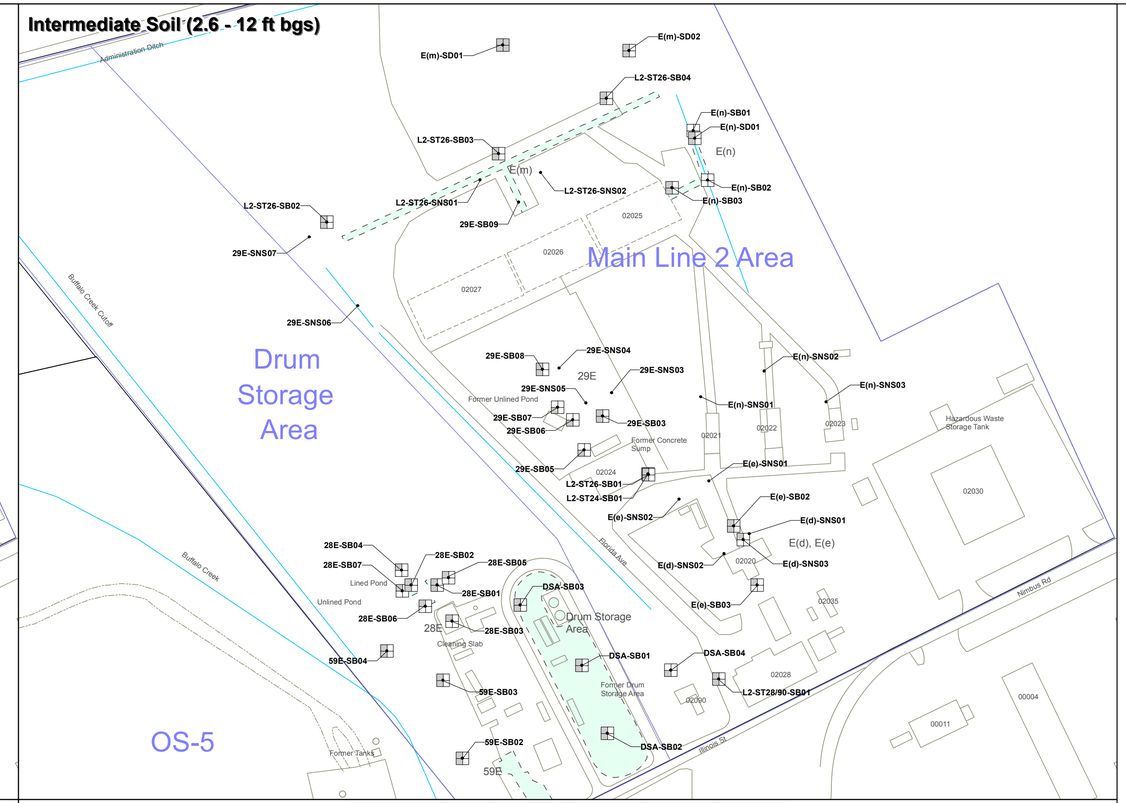
0 120 240
Feet

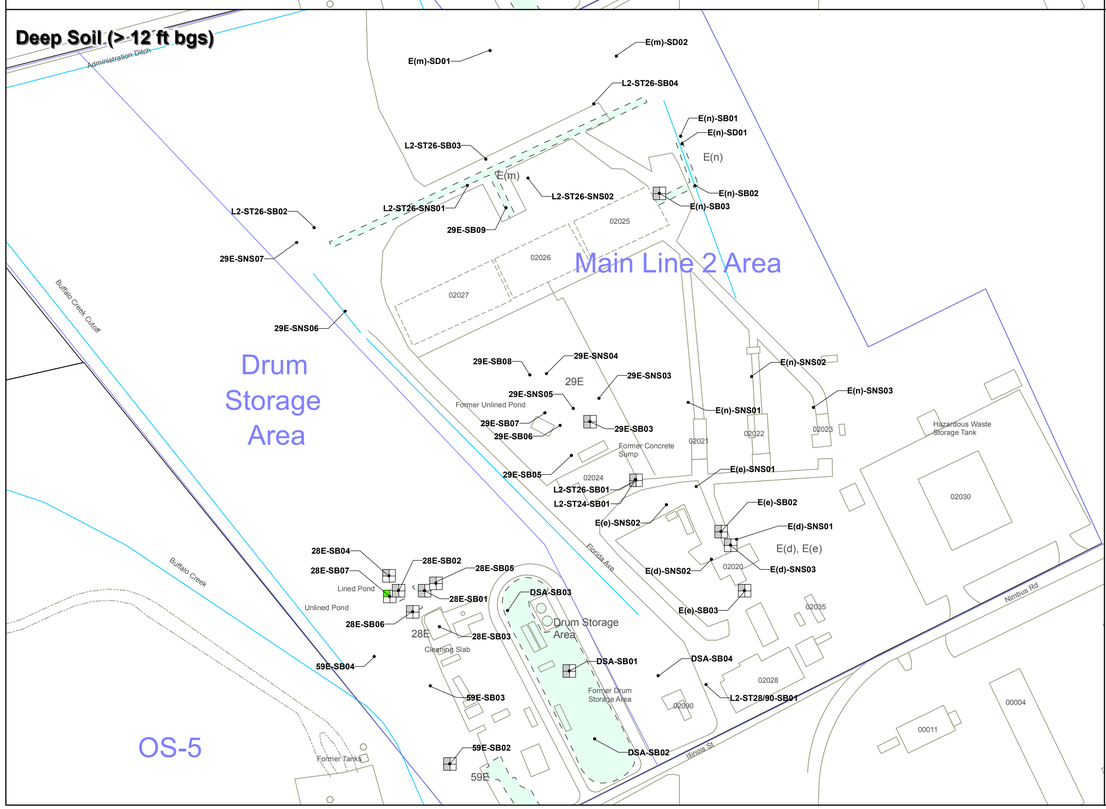
AEROJET
Environmental Remediation

Figure 5.1-12

SVOCs and Pentachlorophenol Above Protection of Groundwater Soil Screening Levels - Line 02







Sample Location	Sample Depth	NDMA	PCB-1254	PCB-1260	Perchlorate
Screening Level		0.0095	0.22	0.22	7.8
> 12 feet bgs					
28E-SB07	40	NC	NC	NC	**10**

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not analyzed for.
Units in milligrams per kilogram (mg/kg).

Not Analyzed
< Soil Screening Level (RISL)
>= RISL and < 10x RISL
>= 10x RISL and < 100x RISL
>= 100x RISL

Perchlorate
NDMA
Aroclor 1254
Aroclor 1260

Source Area
Boundary Operable Unit (BOU)
Consent Decree Boundary

N

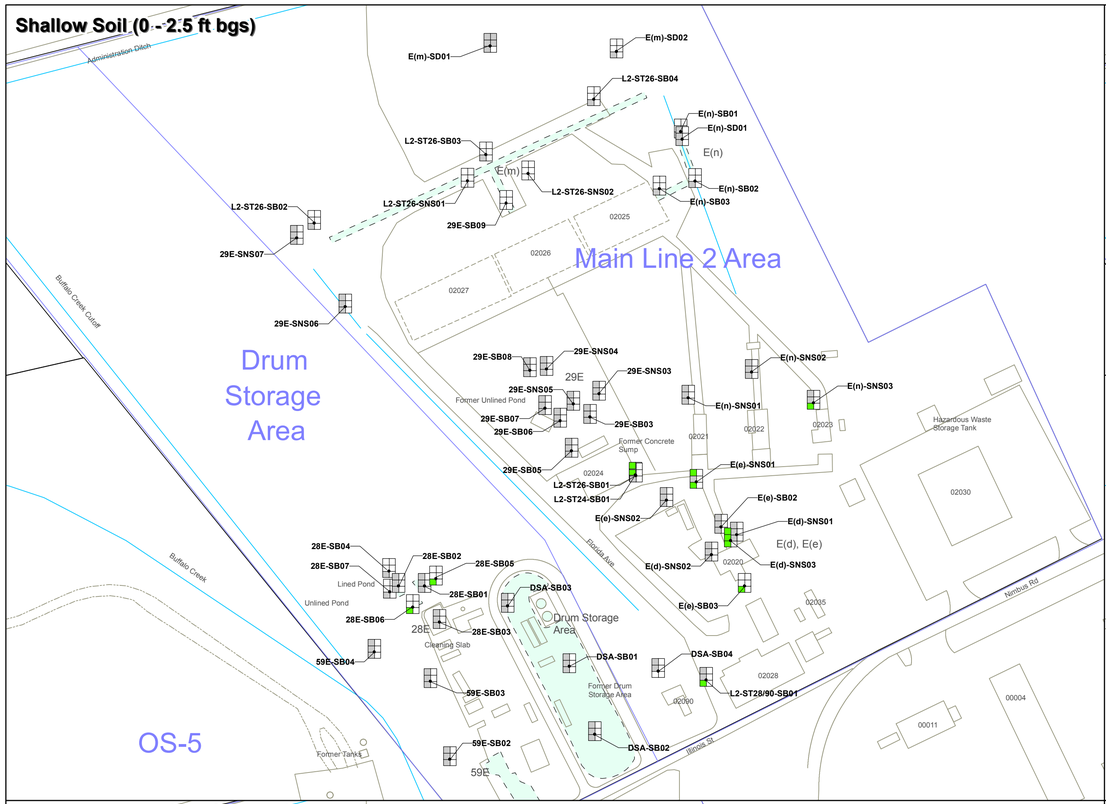
1 " = 120 '

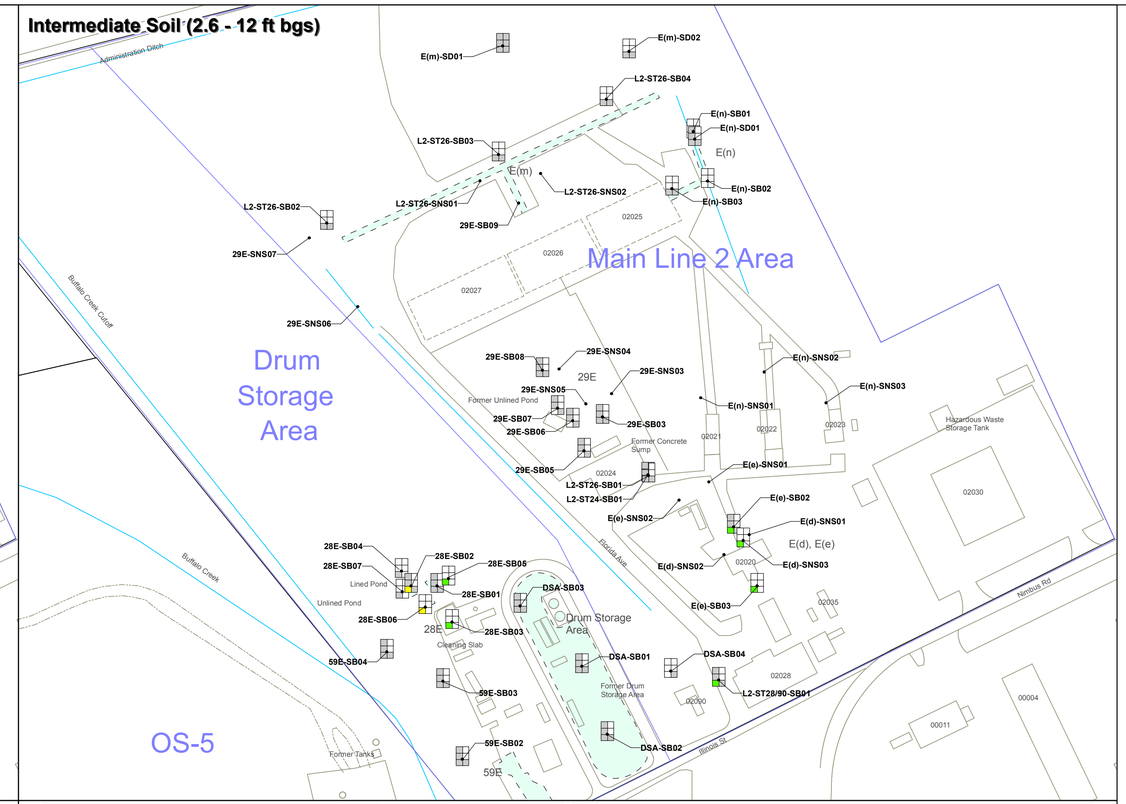
0 120 240
Feet

AEROJET
Environmental Remediation

Figure 5.1-13

PCBs, NDMA and Perchlorate in Soil Above Remedial Investigation Screening Levels - Line 02





Not Analyzed

< Soil Screening Level (PGW SSL)

>= PGW SSL and < 10x PGW SSL

>= 10x PGW SSL and < 100x PGW SSL

>= 100x PGW SSL

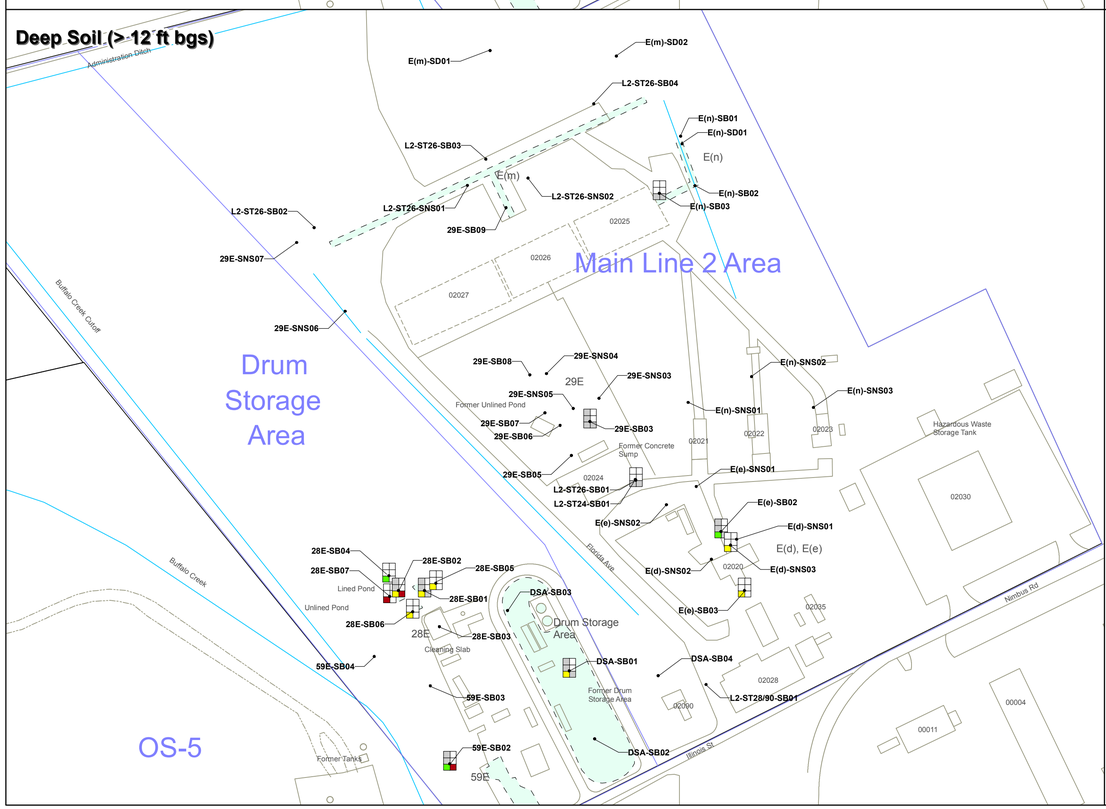
TPH-D
TPH-MO
Perchlorate

Arochlor 1254
Aroclor 1260
NDMA

Source Area

Boundary Operable Unit (BOU)

Consent Decree Boundary



Sample Location	Sample Depth	TPH as Diesel	TPH as Motor Oil	NDMA	PCB-1254	PCB-1260	Perchlorate
Screening Level		100	500	0.00003	0.034	0.034	0.06
0 - 2.5 feet bgs							
28E-SB05	1.0	NC	NC	NC	NC	NC	**0.67**
28E-SB06	1.0	NC	NC	NC	NC	NC	**0.11**
E(d)-SNS03	0.5	**250**	**760**	<SL	NC	NC	**0.21**
E(d)-SNS03	2.5	**280**	**710**	<SL	NC	NC	**0.16**
E(e)-SB03	1.0	NC	NC	NC	NC	NC	**0.14**
E(e)-SNS01	0.5	**110**	<SL	<SL	NC	NC	**0.14**
E(e)-SNS01	2.5	<SL	<SL	<SL	NC	NC	**0.074**
E(n)-SNS03	0.5	<SL	<SL	<SL	NC	NC	**0.55**
E(n)-SNS03	2.5	<SL	<SL	<SL	NC	NC	**0.25**
L2-ST24-SB01	2.0	**370**	**1,200**	<SL	NC	NC	<SL
L2-ST28/90-SB01	2.5	<SL	<SL	<SL	NC	NC	**0.075**
2.6 - 12 feet bgs							
28E-SB02	11	<SL	<SL	<SL	NC	NC	**1.4**
28E-SB03	11	NC	NC	NC	NC	NC	**0.069**
28E-SB05	10	NC	NC	NC	NC	NC	**0.069**
28E-SB06	5.0	NC	NC	NC	NC	NC	**5.1**
28E-SB06	10	NC	NC	NC	NC	NC	**4.3**
E(d)-SNS03	10	NC	NC	NC	NC	NC	**0.068**
E(e)-SB02	11	<SL	<SL	<SL	NC	NC	**0.29**
E(e)-SB03	5.0	NC	NC	NC	NC	NC	**0.14**
L2-ST28/90-SB01	4.5	<SL	<SL	<SL	NC	NC	**0.14**
> 12 feet bgs							
28E-SB01	23	<SL	<SL	<SL	NC	NC	**0.51**
28E-SB01	35	<SL	<SL	<SL	NC	NC	**1.7**
28E-SB01	47	<SL	<SL	<SL	NC	NC	**0.61**
28E-SB02	23	<SL	<SL	<SL	NC	NC	**3.7**
28E-SB02	35	<SL	<SL	**0.0013**	NC	NC	**2.1**
28E-SB02	47	<SL	<SL	<SL	NC	NC	**0.17**
28E-SB04	20	NC	NC	NC	NC	NC	**0.083**

Sample Location	Sample Depth	TPH as Diesel	TPH as Motor Oil	NDMA	PCB-1254	PCB-1260	Perchlorate
Screening Level		100	500	0.00003	0.034	0.034	0.06
> 12 feet bgs							
28E-SB04	30	NC	NC	NC	NC	NC	**0.081**
28E-SB04	40	NC	NC	NC	NC	NC	**0.094**
28E-SB04	46	NC	NC	NC	NC	NC	**0.34**
28E-SB05	20	NC	NC	NC	NC	NC	**0.5**
28E-SB05	30	NC	NC	NC	NC	NC	**0.22**
28E-SB05	40	NC	NC	NC	NC	NC	**0.48**
28E-SB05	50	NC	NC	NC	NC	NC	**1.1**
28E-SB06	20	NC	NC	NC	NC	NC	**0.48**
28E-SB06	30	NC	NC	NC	NC	NC	**0.27**
28E-SB06	40	NC	NC	NC	NC	NC	**0.63**
28E-SB06	50	NC	NC	NC	NC	NC	**1.6**
28E-SB07	20	NC	NC	NC	NC	NC	**0.38**
28E-SB07	30	NC	NC	NC	NC	NC	**3.4**
28E-SB07	40	NC	NC	NC	NC	NC	**10**
28E-SB07	50	NC	NC	NC	NC	NC	**0.14**
59E-SB02	35	<SL	<SL	**0.00021**	NC	NC	**0.085**
DSA-SB01	20	<SL	<SL	<SL	NC	NC	**0.8**
DSA-SB01	33	<SL	<SL	<SL	NC	NC	**0.62**
DSA-SB01	43	<SL	<SL	<SL	NC	NC	**0.65**
E(d)-SNS03	20	NC	NC	NC	NC	NC	**0.5**
E(d)-SNS03	30	NC	NC	NC	NC	NC	**1**
E(d)-SNS03	40	NC	NC	NC	NC	NC	**0.33**
E(e)-SB02	22	<SL	<SL	<SL	NC	NC	**0.42**
E(e)-SB02	42	<SL	<SL	<SL	NC	NC	**0.17**
E(e)-SB03	20	<SL	<SL	<SL	NC	NC	**1.7**
E(e)-SB03	30	NC	NC	NC	NC	NC	**0.77**
E(e)-SB03	40	NC	NC	NC	NC	NC	**0.87**
E(e)-SB03	50	NC	NC	NC	NC	NC	**0.12**

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not analyzed for.
Units in milligrams per kilogram (mg/kg).

N

1 " = 120 '

0 120 240
Feet

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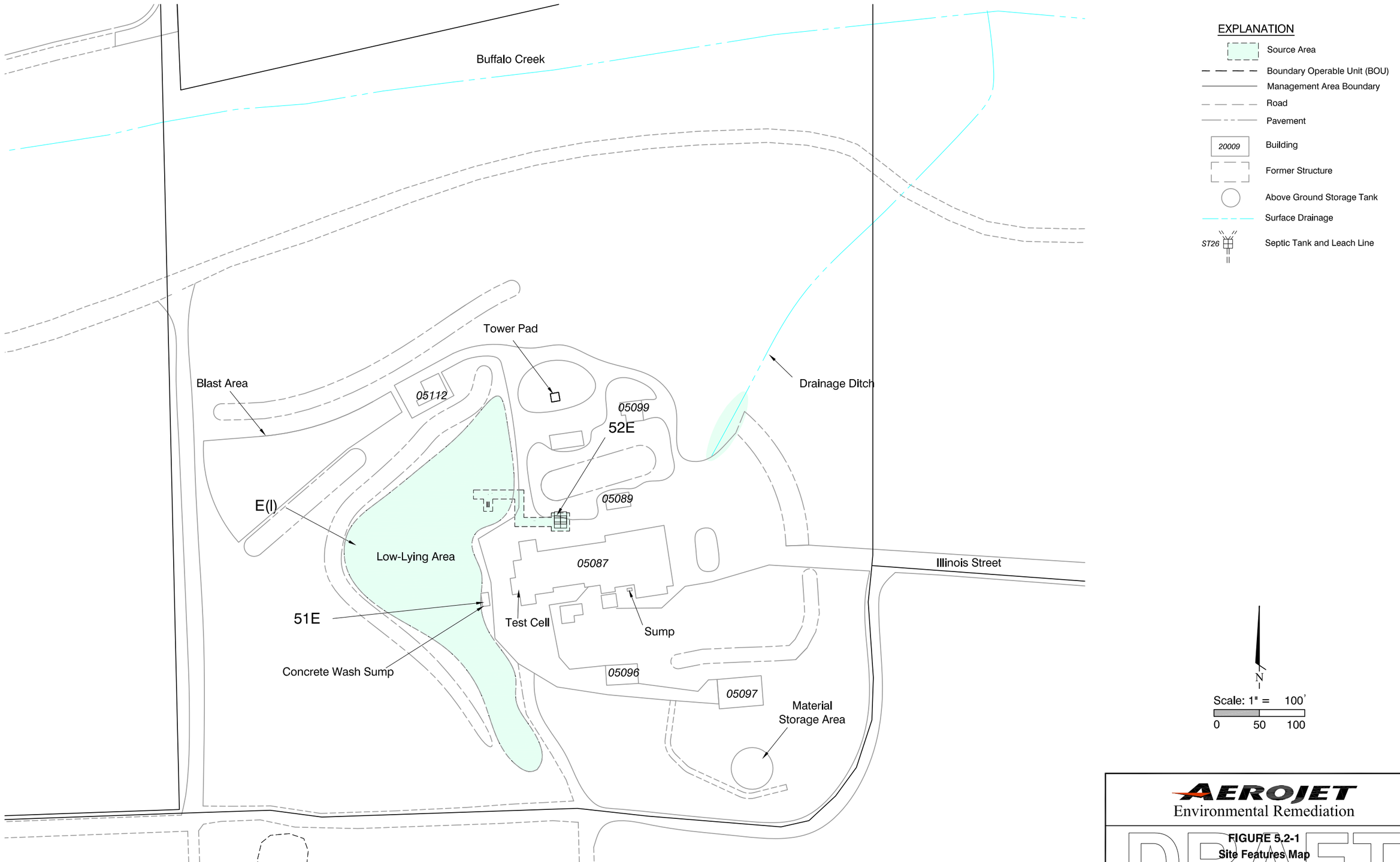
Figure 5.1-14

PCBs, NDMA, Perchlorate, TPH-D, and TPH-Mo Above Protection of Groundwater Soil Screening Levels - Line 02



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Environmental Remediation

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FIGURE 5.2-1
Site Features Map
Line 5 North

7/22/08 PER SR10131000

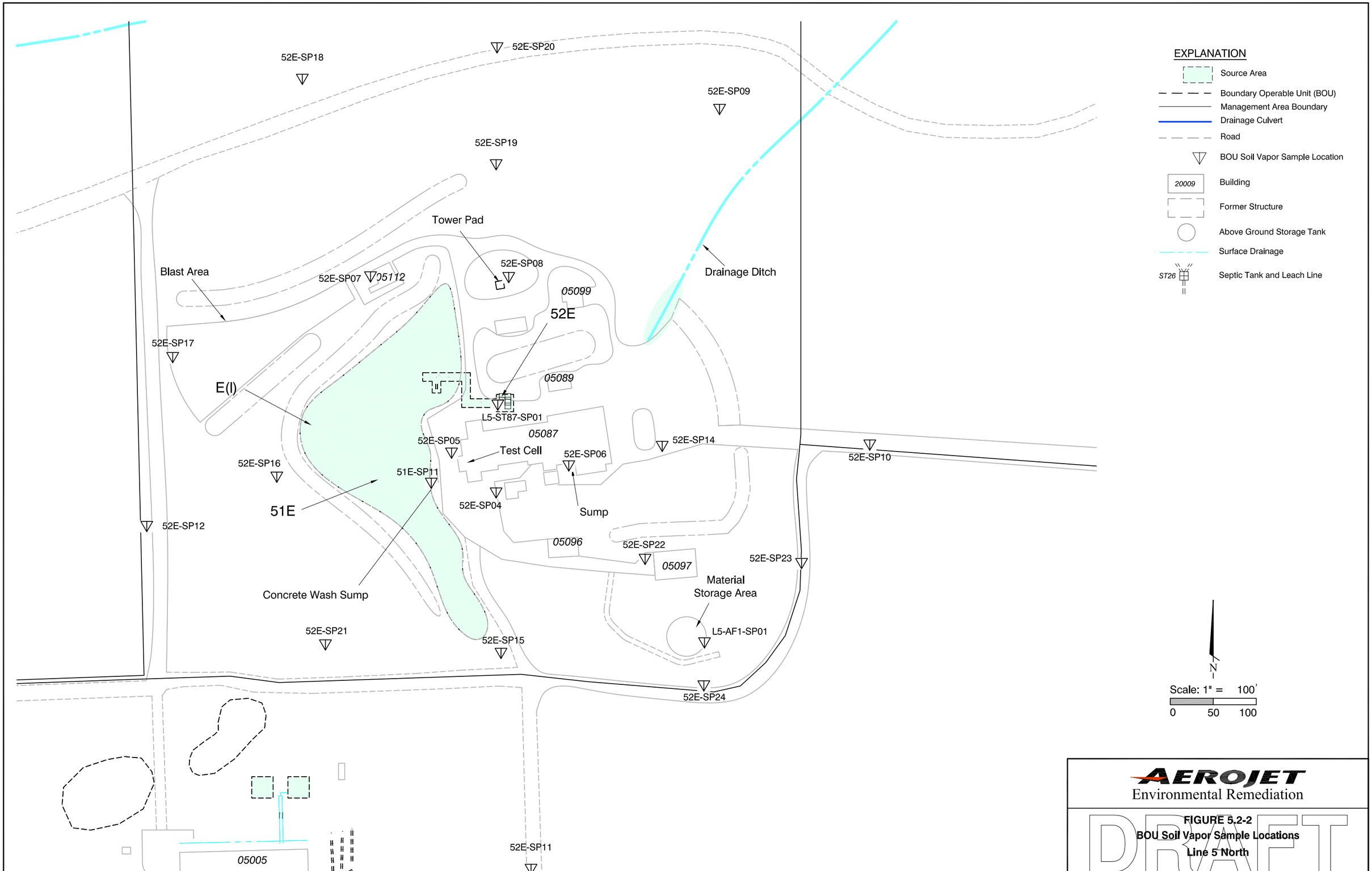

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FIGURE 5.2-2
BOU Soil Vapor Sample Locations
Line 5 North

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7/22/08 PER SR10131001

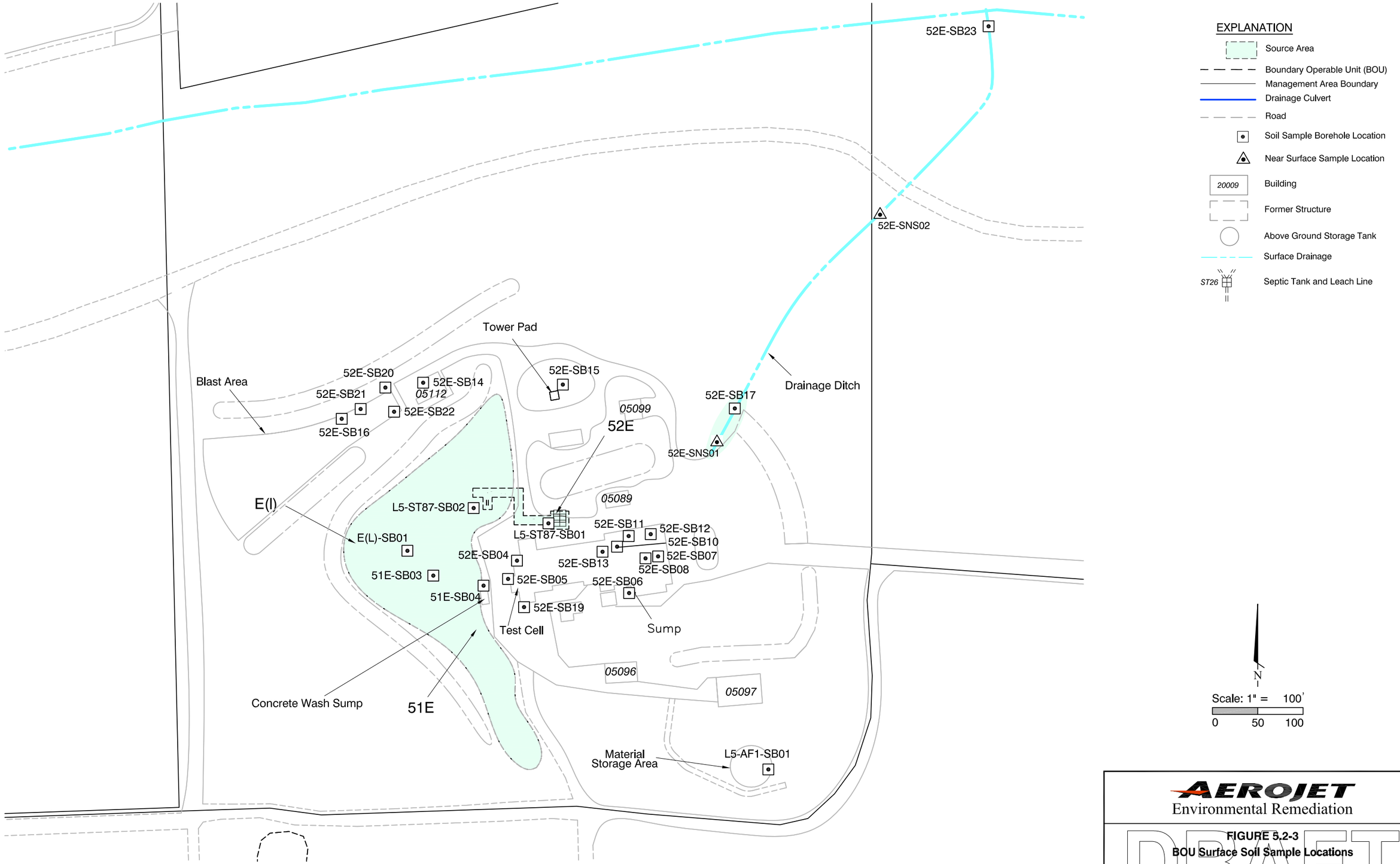

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FIGURE 5.2-3
BOU Surface Soil Sample Locations
Line 5 North

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7/22/08 PER SR10131002

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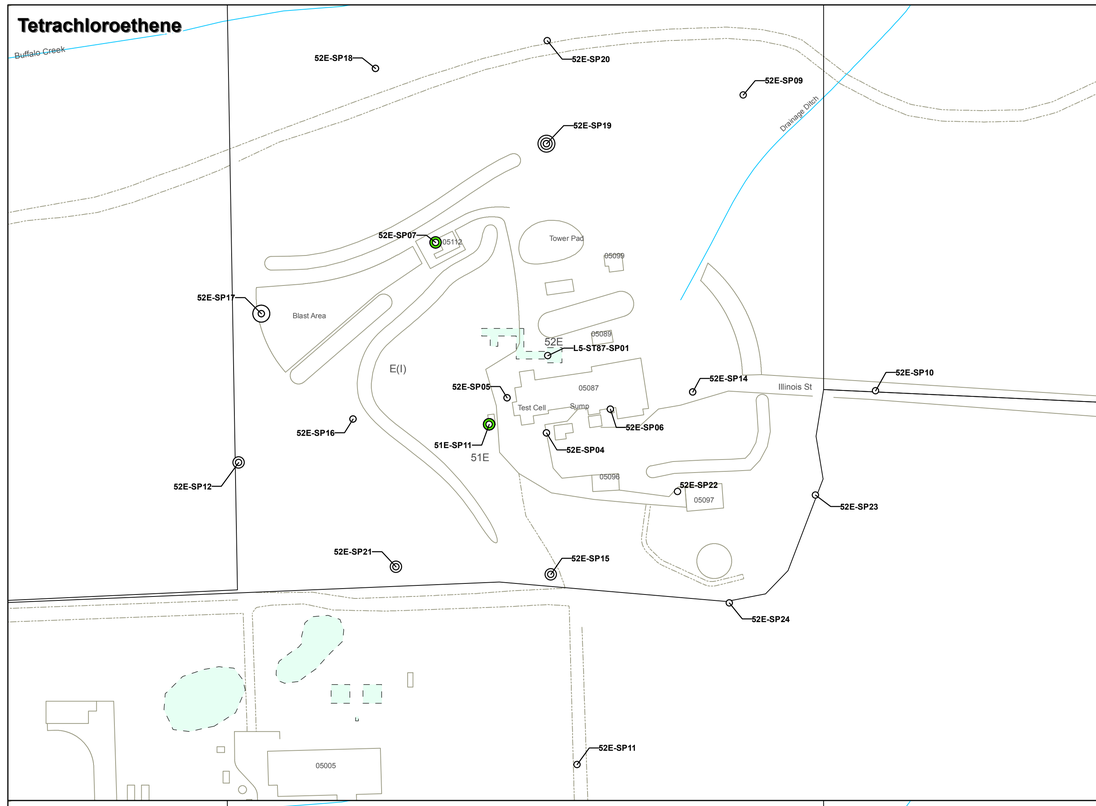
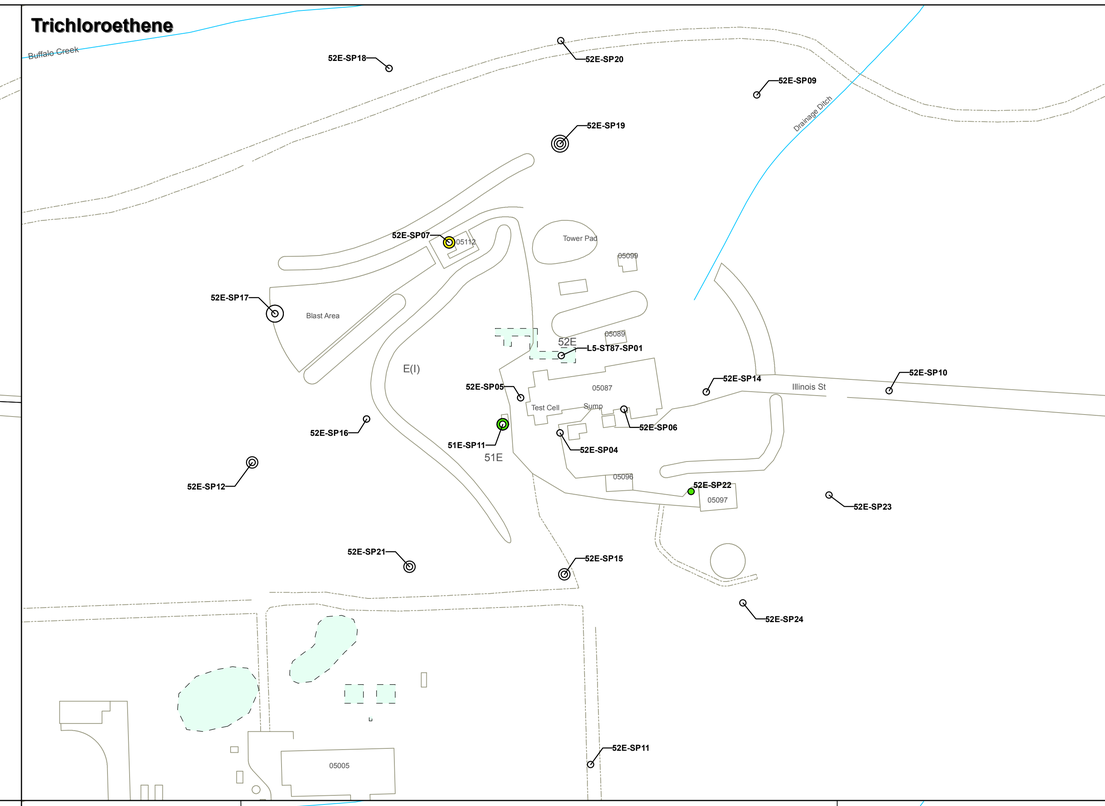
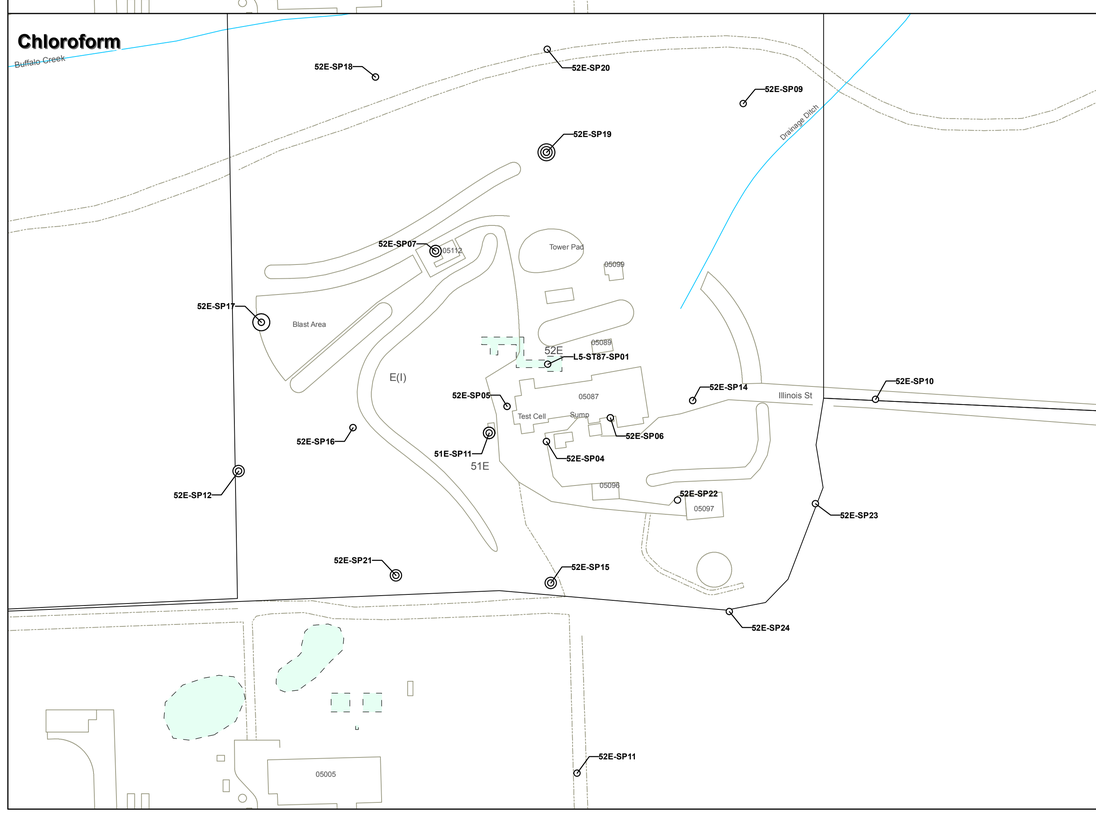
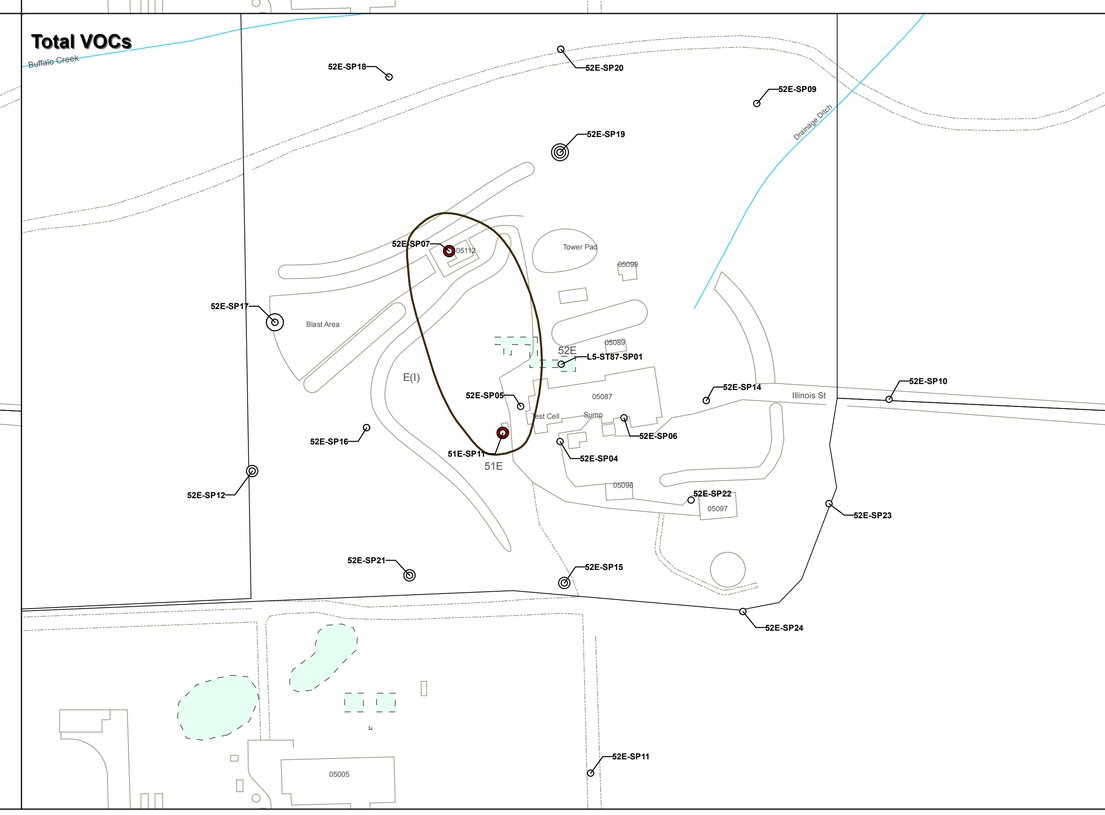
FIGURE 5.2-4
BOU Subsurface Soil Sample Locations
Line 5 North

7/22/08 PER SR10131003









PCE, TCE, Chloroform Exceedances

- < Soil Vapor Screening Level (RISL)
- >= RISL and < 10x RISL
- >= 10x RISL and < 100x RISL
- >= 100x RISL

Total VOCs Exceedances

- Σ Detects to Screening Levels Ratios <= 10
- Σ Detects to Screening Levels Ratios > 10

<= 10 Feet bgs (Inner Circle)
11 to 20 Feet bgs (Middle Circle)
> 20 Feet bgs (Outer Circle)

Source Area
Boundary Operable Unit (BOU)
Consent Decree Boundary

Sample Location	<= 10 ft bgs			11-20 ft bgs			21-30 ft bgs		
	Tetrachloroethene	Trichloroethene	Chloroform	Tetrachloroethene	Trichloroethene	Chloroform	Tetrachloroethene	Trichloroethene	Chloroform
Screening Level	320	963	83	320	963	83	320	963	83
Line 5 North									
52E-SP11	<SL	<SL	<SL	**600**	**7,800**	<SL	NC	NC	NC
52E-SP07	<SL	<SL	<SL	**2,300**	**27,000**	<SL	NC	NC	NC
52E-SP22	<SL	**1,600**	<SL	NC	NC	NC	NC	NC	NC

Units in $\mu g/m^3$.

<SL = either non-detect or detected concentration less than SL.

N

1 " = 100 '

0 100 200
Feet

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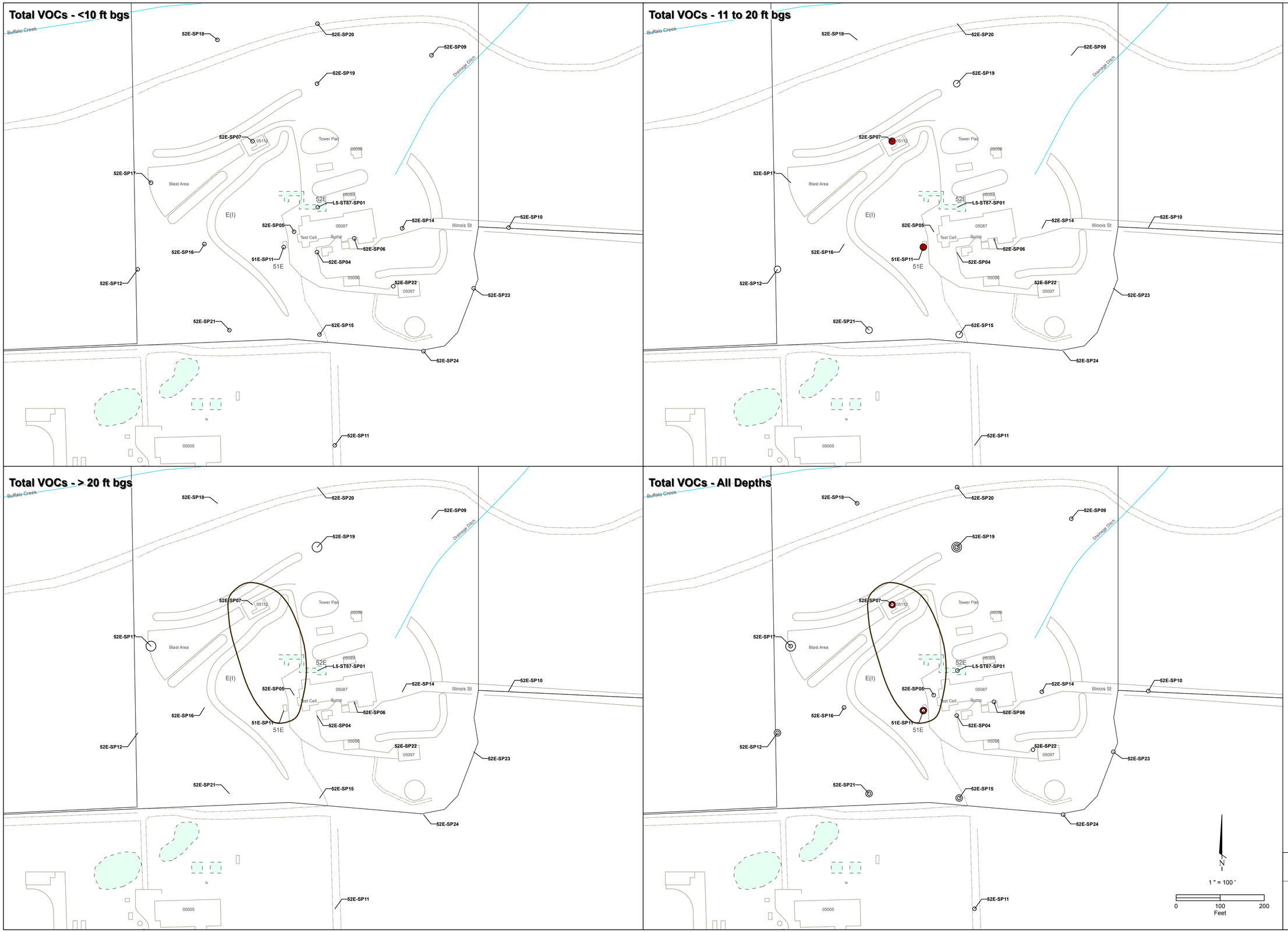
Environmental Remediation

Figure 5.2-5a

PCE, TCE, Chloroform, and Total VOC Concentrations in Soil Vapor Above Remedial Investigation Screening Levels - Line 5 North



Total VOCs Exceedances

- Σ Detects to Screening Levels Ratios <= 10
- Σ Detects to Screening Levels Ratios > 10

- <= 10 Feet bgs (Small Circle)
- 11 to 20 Feet bgs (Medium Circle)
- > 20 Feet bgs (Large Circle)

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Approximate Extent of Total Screening Level Ratio Exceeding 10 (< 10 ft bgs)
- Approximate Extent of Total Screening Level Ratio Exceeding 10 (11 to 20 ft bgs)
- Approximate Extent of Total Screening Level Ratio Exceeding 10 (> 20 ft bgs)

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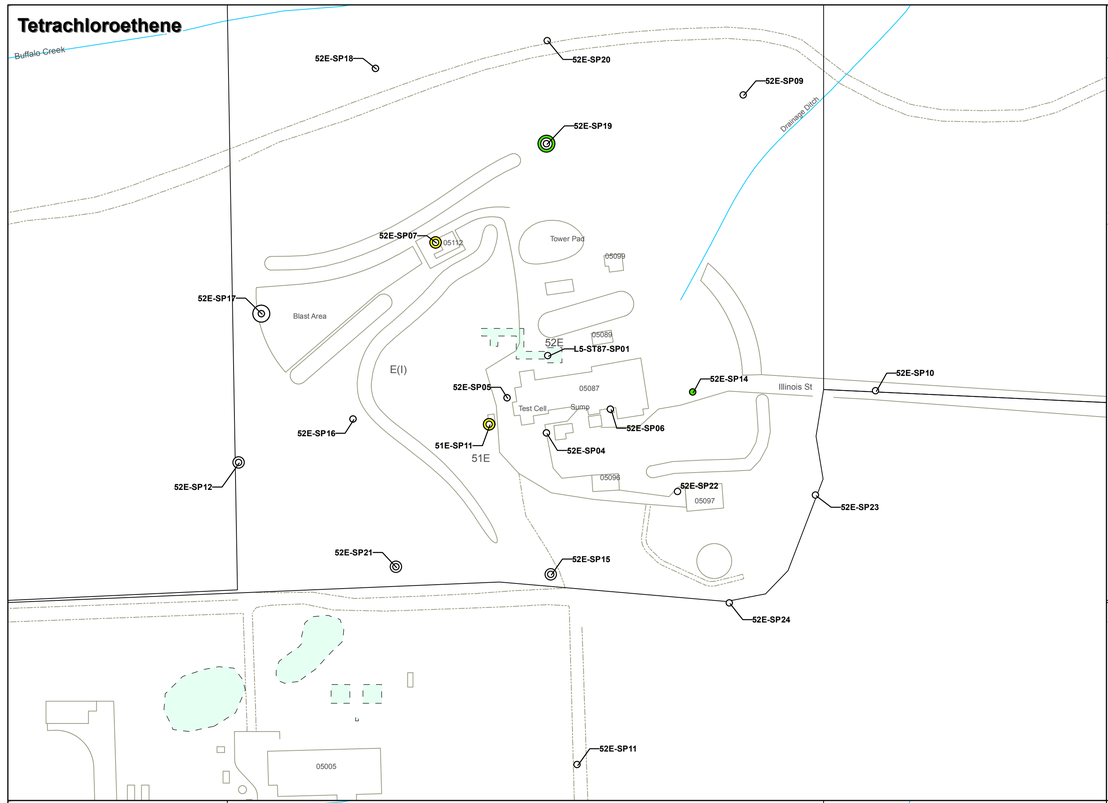
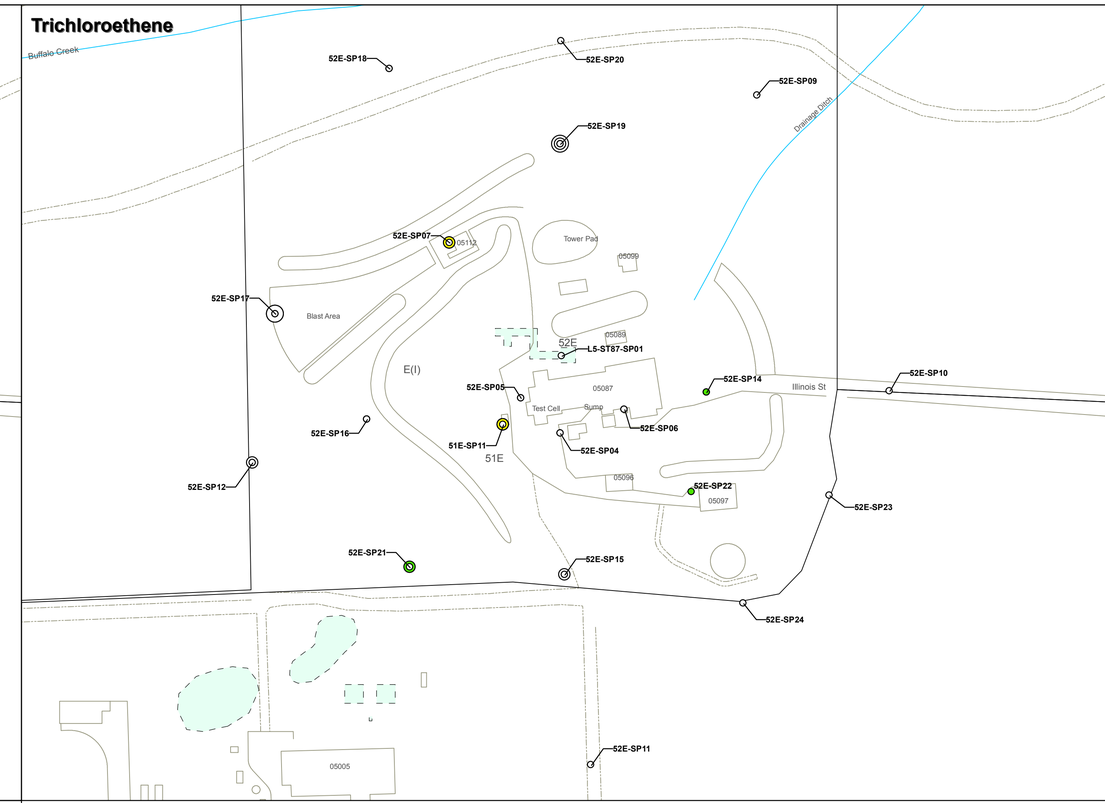
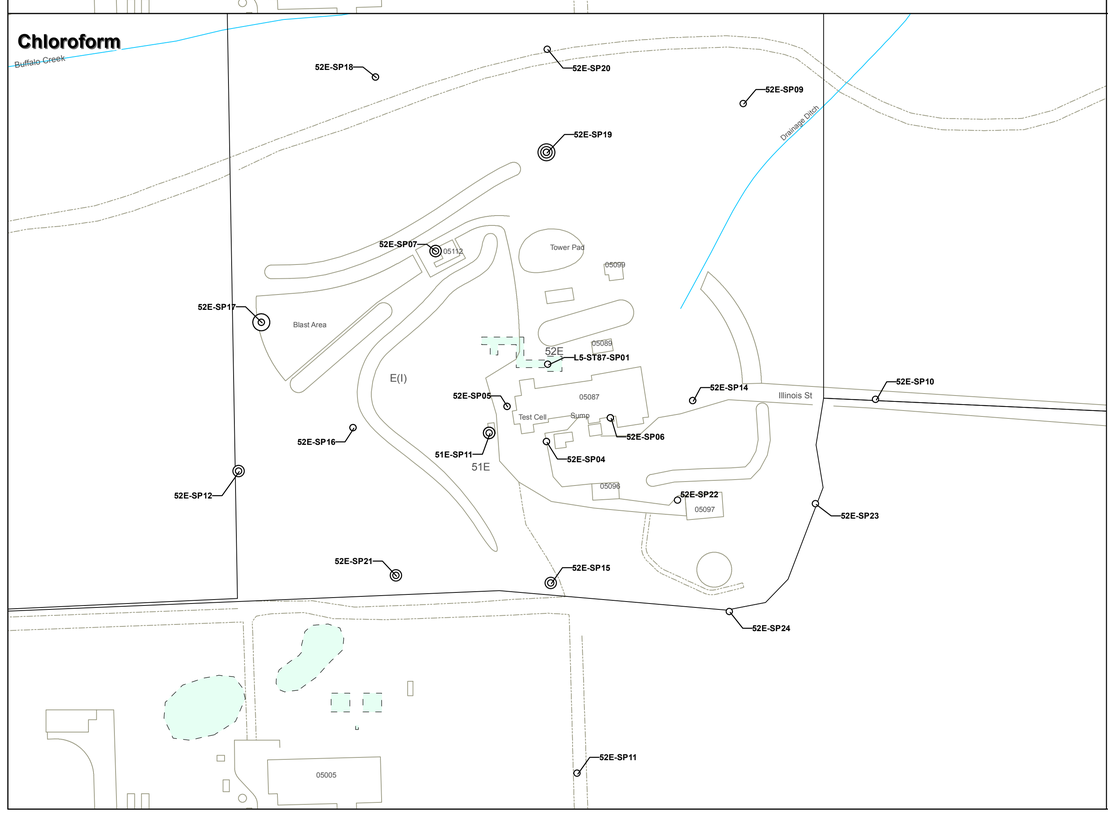
Figure 5.2-5b

Total VOC Concentrations in Soil Vapor Above Remedial Investigation Screening Levels - Line 5 North





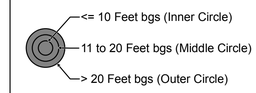


Sample Location	<= 10 ft bgs			11-20 ft bgs			21-30 ft bgs			>31 ft bgs		
	Tetrachloroethene	Trichloroethene	Chloroform	Tetrachloroethe	Trichloroethene	Chloroform	Tetrachloroethe	Trichloroethene	Chloroform	Tetrachloroethe	Trichloroethene	Chloroform
Screening Level	57	527	18,595	57	527	18,595	57	527	18,595	57	527	18,595
Line 5 North												
51E-SP11	<SL	<SL	<SL	**600**	**7,800**	<SL	NC	NC	NC	NC	NC	NC
52E-SP07	<SL	<SL	<SL	**2,300**	**27,000**	<SL	NC	NC	NC	NC	NC	NC
52E-SP22	<SL	**1,600**	<SL	NC	NC	NC	NC	NC	NC	NC	NC	NC

Units in $\mu g/m^3$.
<SL = either non-detect or detected concentration less than SL.

PCE, TCE, Chloroform Exceedances

- < Soil Vapor Screening Level (PGW SVSL)
- >= PGW SVSL and < 10x PGW SVSL
- >= 10x PGW SVSL and < 100x PGW SVSL
- >= 100x PGW SVSL



- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary

1 " = 100 '

0 100 200
Feet

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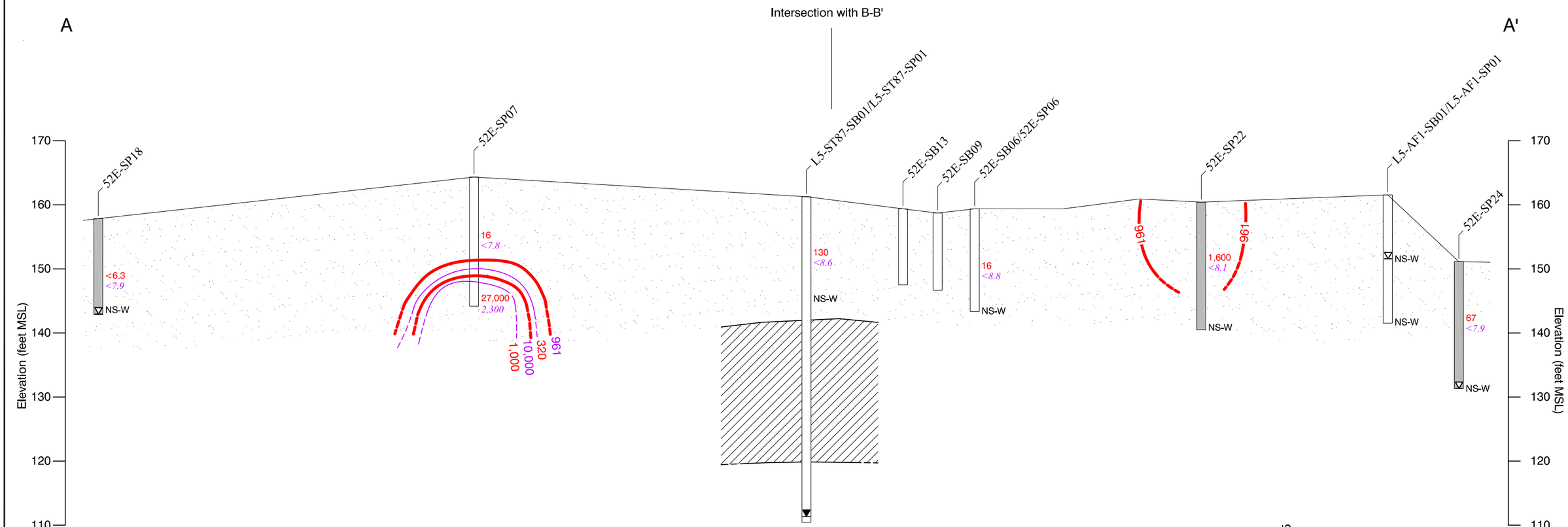
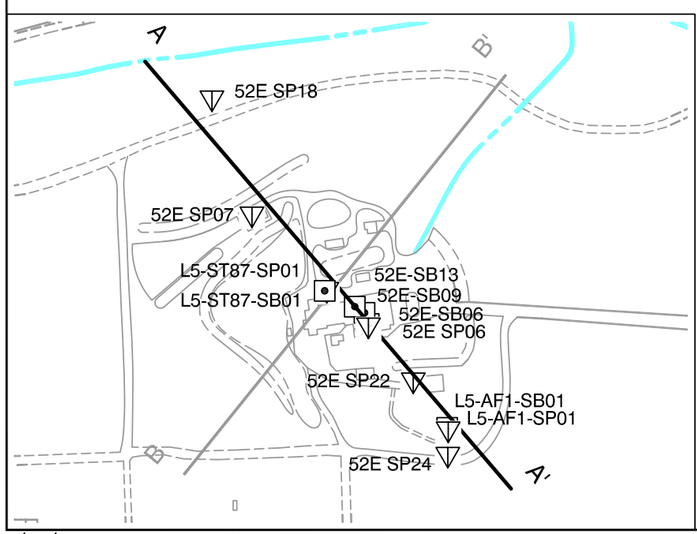
Figure 5.2-6

PCE, TCE, and Chloroform Concentrations in Above Protection of Groundwater Screening Levels for Soil Vapor - Line 5 North





N

Scale: 1" = 300'

0 150 300

Locator Scale

EXPLANATION

52E-SP07 — Boring Designation

Boring Location (Shaded Borings Lack Lithology)

<0.5 — TCE Concentration in $\mu g/m^3$

<4 — PCE Concentration in $\mu g/m^3$

(NS-W = not sampled due to presence of groundwater)

Total Borehole Depth

Initial Depth to Groundwater

Final Depth to Groundwater

961 — TCE Concentration in Micrograms per Cubic Meter ($\mu g/m^3$)

320 — PCE Concentration in Micrograms per Cubic Meter ($\mu g/m^3$)

Note: Contour Lines Dashed Where Inferred

TCE Trichloroethene

PCE Tetrachloroethene

MSL Mean Sea Level

Geologic Contact

Relatively permeable sediments: Silty, poorly and well-graded sands and gravels (GP,GW,SP,SW); silty and clayey gravels (GM/GC) and silts.

Relatively lower permeability sediments: Low plasticity clays and silts (CL,ML); silty and clayey sand (SM/SC).

Dredge Tailings

Vertical Scale 1' = 15'

15

0 60

Horizontal Scale 1' = 60'

Vertical Exaggeration: 4X

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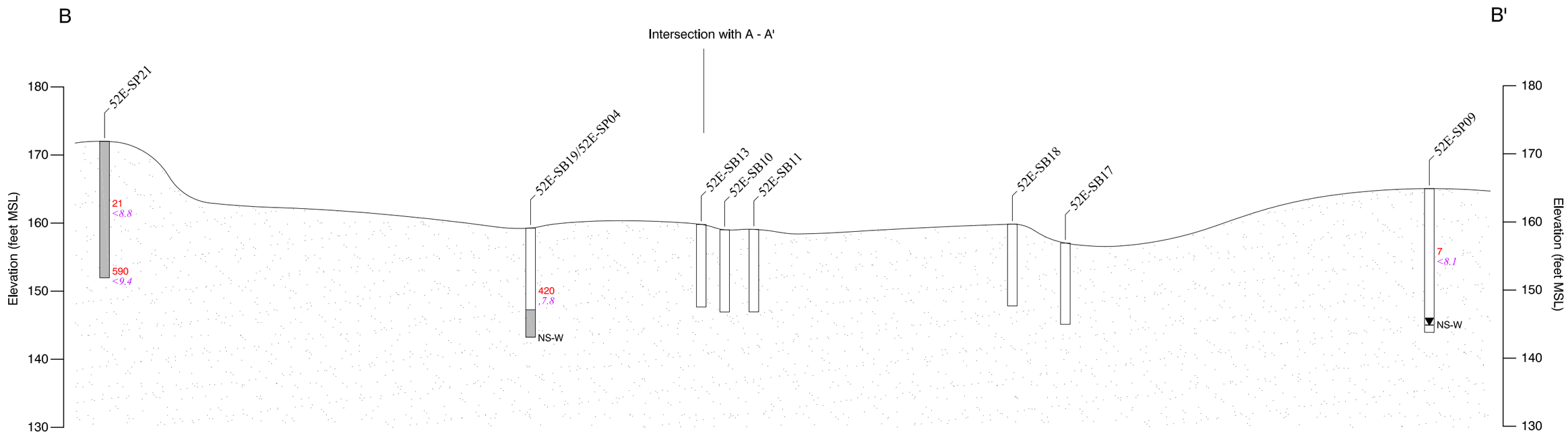
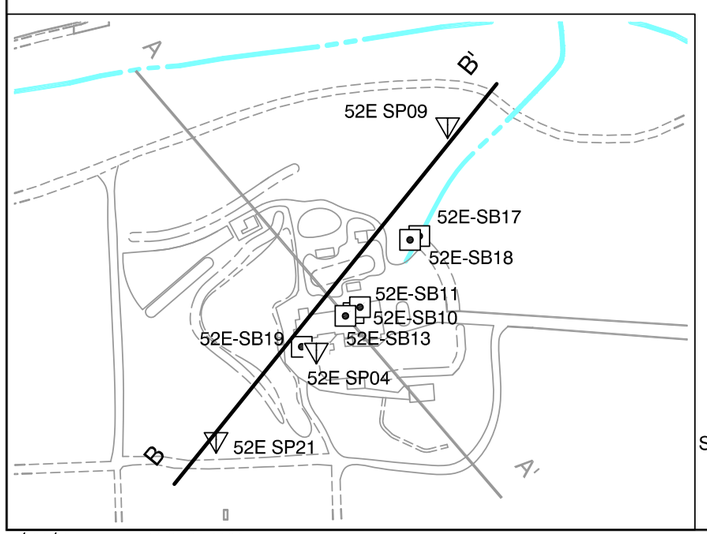
FIGURE 5.2-7

Vadose Zone Cross Section A - A'

Line 5 North

7/22/08 pr SR10131004





Scale: 1" = 300'

0 150 300

Locator Scale

EXPLANATION

52E-SB11 — Boring Designation

Boring Location (Shaded Borings Lack Lithology)

<0.5 — Trichloroethene Concentration in $\mu g/m^3$

<4 — Tetrachloroethene Concentration in $\mu g/m^3$

(NS-W = not sampled due to presence of groundwater)

Screened Interval

Total Borehole Depth

Final Depth to Groundwater

MSL Mean Sea Level

Dredge Tailings

Vertical Scale 1' = 15'

15

0 60

Horizontal Scale 1' = 60'

Vertical Exaggeration: 4X

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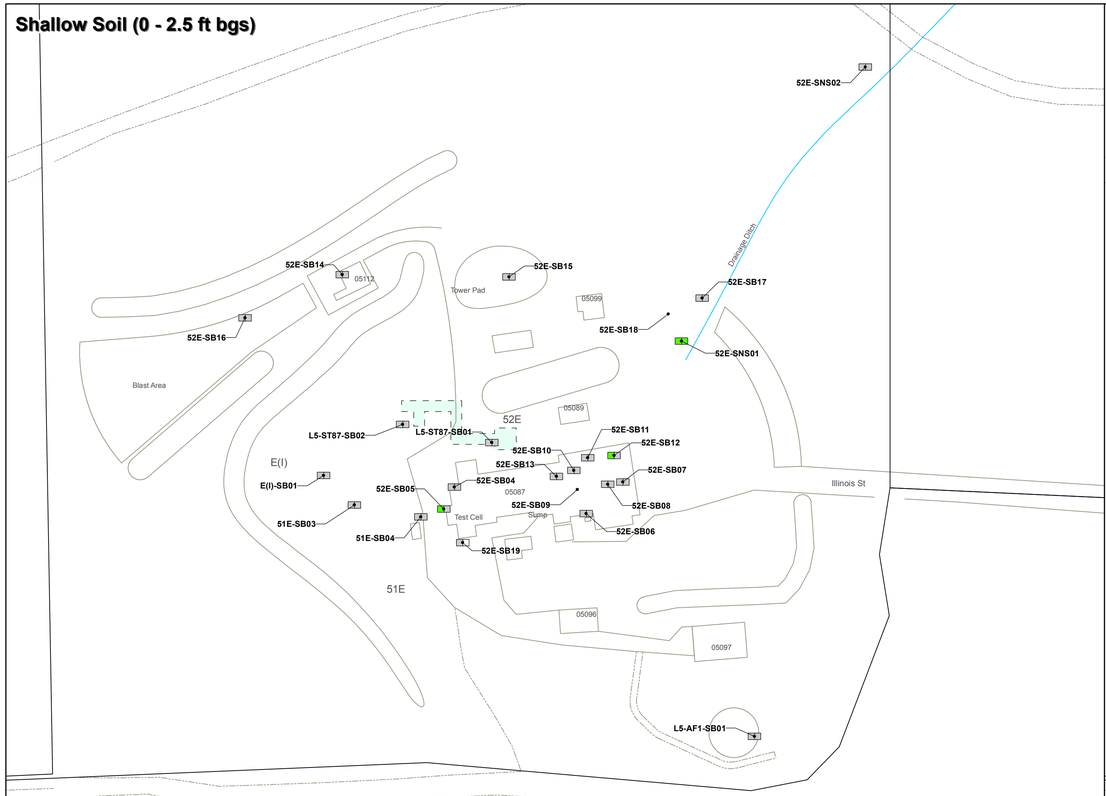
FIGURE 5.2-8

Vadose Zone Cross Section B - B'

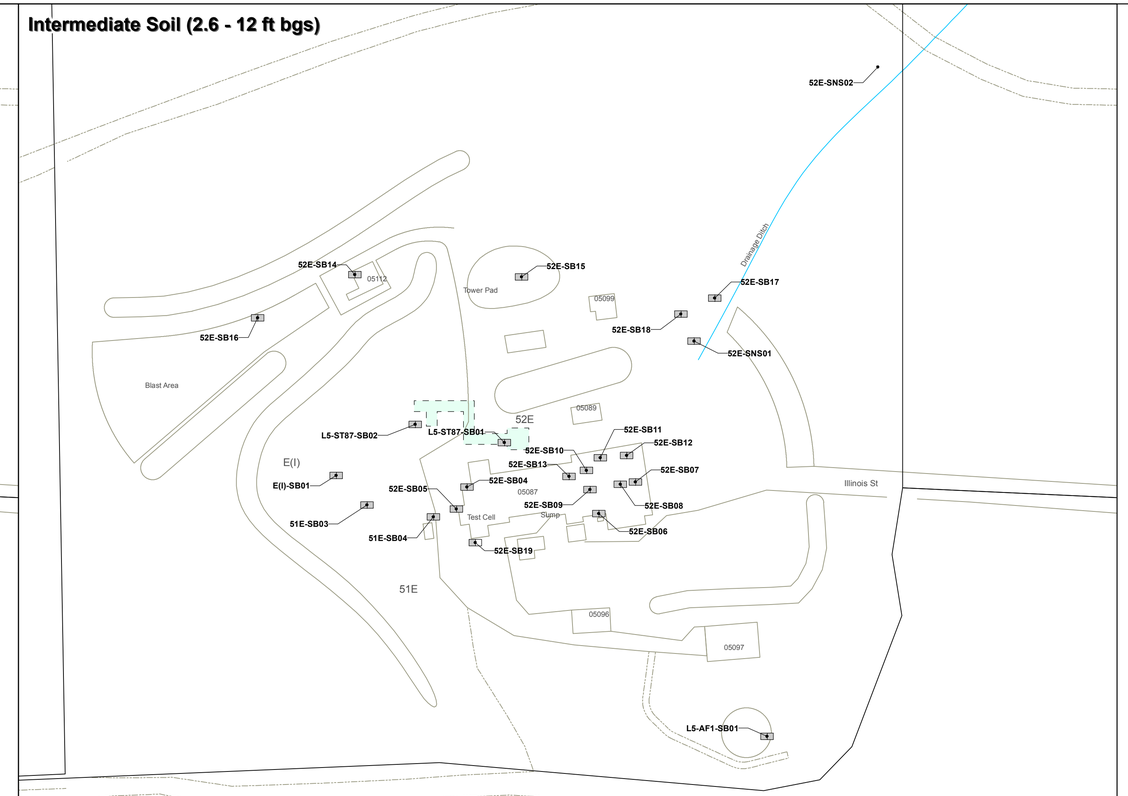
Line 5 North

7/22/08 pr SR10131005

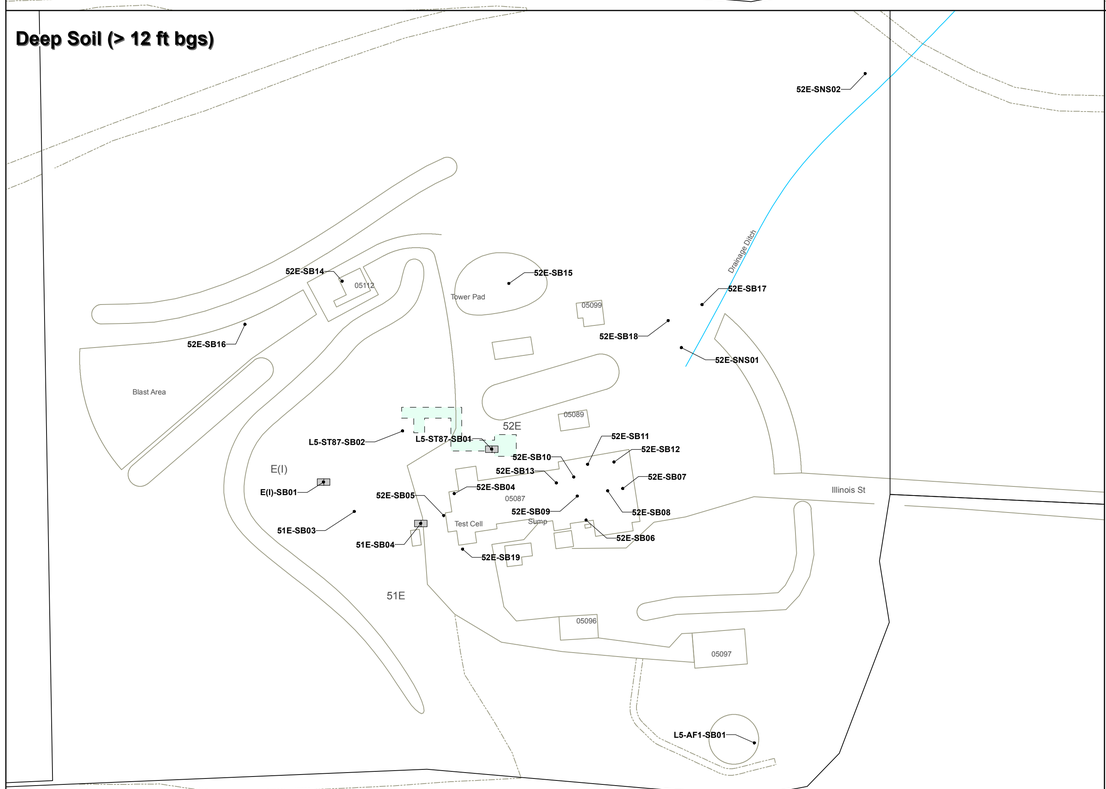
Shallow Soil (0 - 2.5 ft bgs)



Intermediate Soil (2.6 - 12 ft bgs)



Deep Soil (> 12 ft bgs)



Sample Location	Sample Depth	Cadmium	Lead
Screening Level		1.7	150
0 - 2.5 feet bgs			
52E-SB05	1.0	**1.8**	<SL
52E-SB12	0.5	**4**	<SL
52E-SNS01	0.5	**4.8**	**170**

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not collected.
Units in milligrams per kilogram (mg/kg).

- Not Analyzed
- < Soil Screening Level (RISL)
- >= RISL and < 10x RISL
- >= 10x RISL and < 100x RISL
- >= 100x RISL

Cadmium Lead

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary

N

1 " = 70 '

0 70 140
Feet

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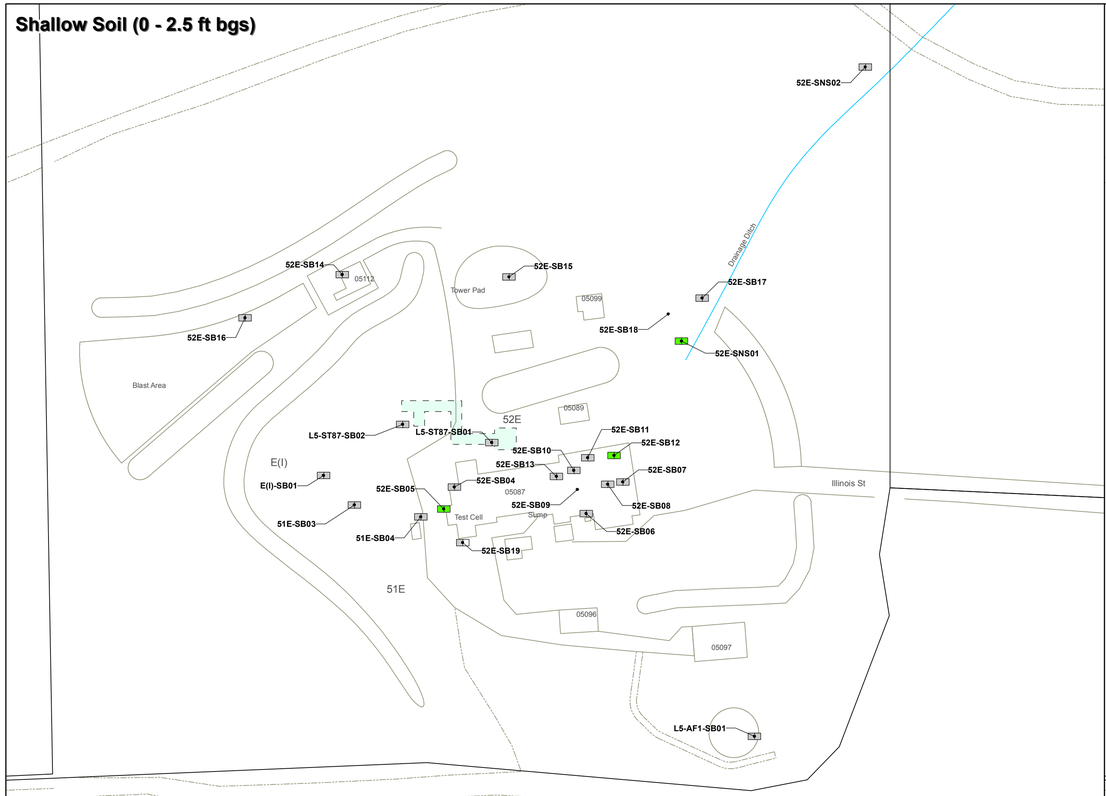
Environmental Remediation

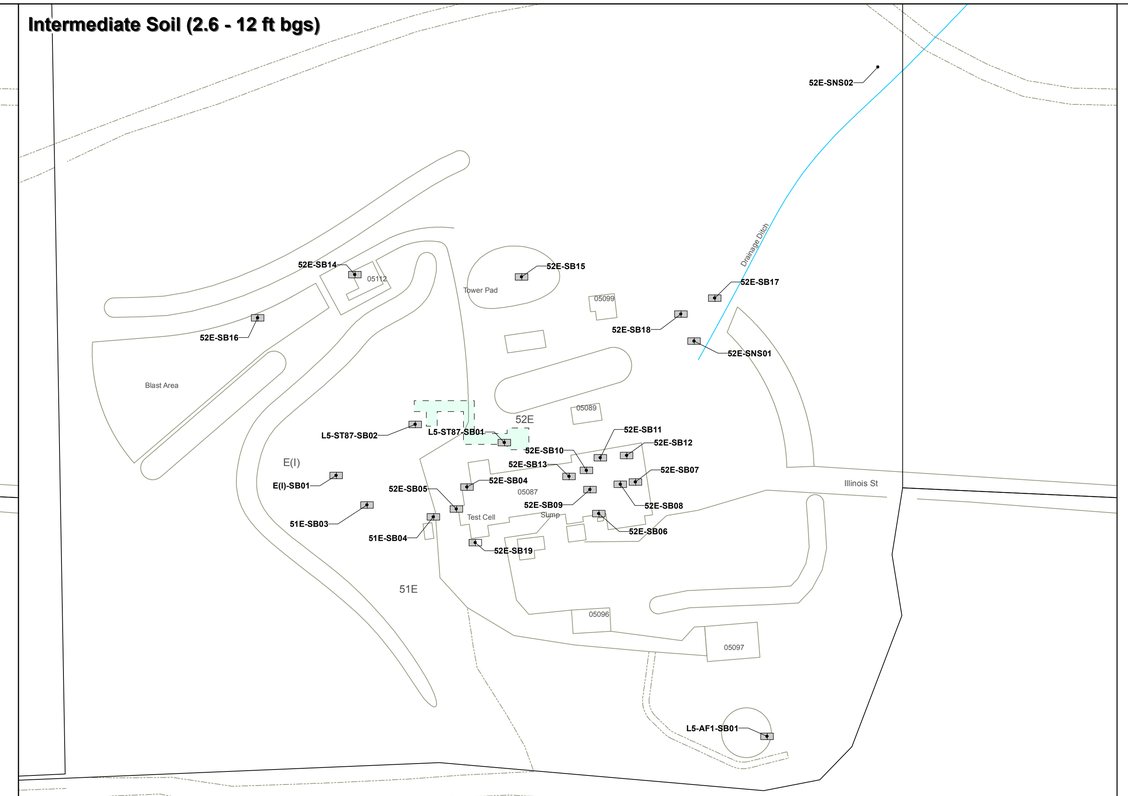
Figure 5.2-9

Metals in Soil Above
Remedial Investigation Screening Levels
Line 5 North

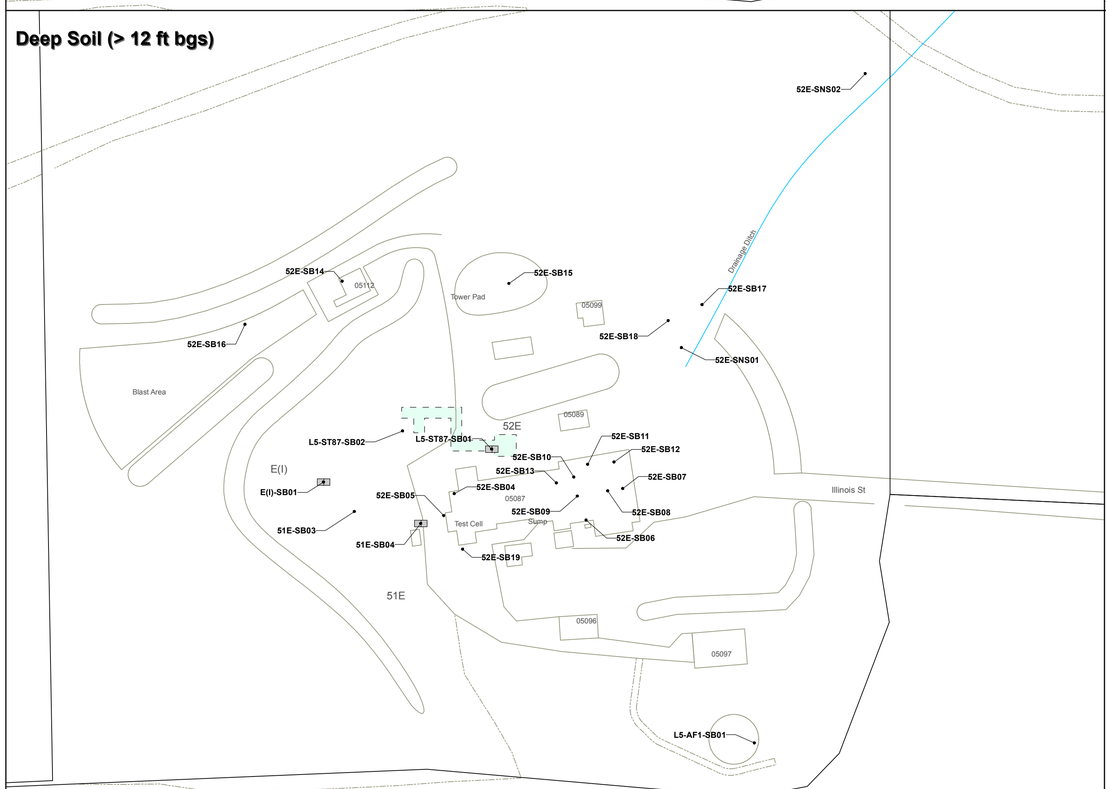
Shallow Soil (0 - 2.5 ft bgs)



Intermediate Soil (2.6 - 12 ft bgs)



Deep Soil (> 12 ft bgs)



Sample Location	Sample Depth	Cadmium	Lead
Screening Level		1.2	23
0 - 2.5 feet bgs			
52E-SB05	1.5	**1.8**	**52**
52E-SB12	1.0	**4**	**39**
52E-SNS01	0.5	**4.8**	**170**

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not collected.
Units in milligrams per kilogram (mg/kg).

- Not Analyzed
- < Soil Screening Level (PGW SSL)
- >= PGW SSL and < 10x PGW SSL
- >= 10x PGW SSL and < 100x PGW SSL
- >= 100x PGW SSL

Cadmium Lead

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary

N

1 " = 70 '

0 70 140
Feet

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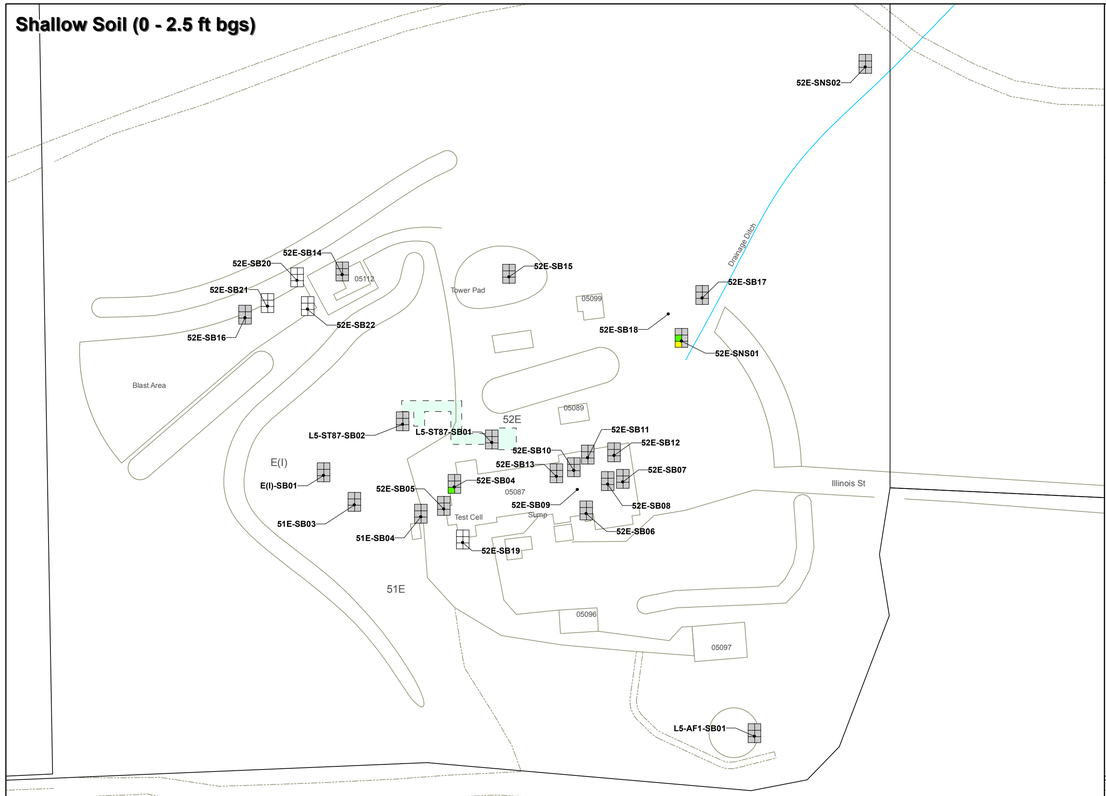
Environmental Remediation

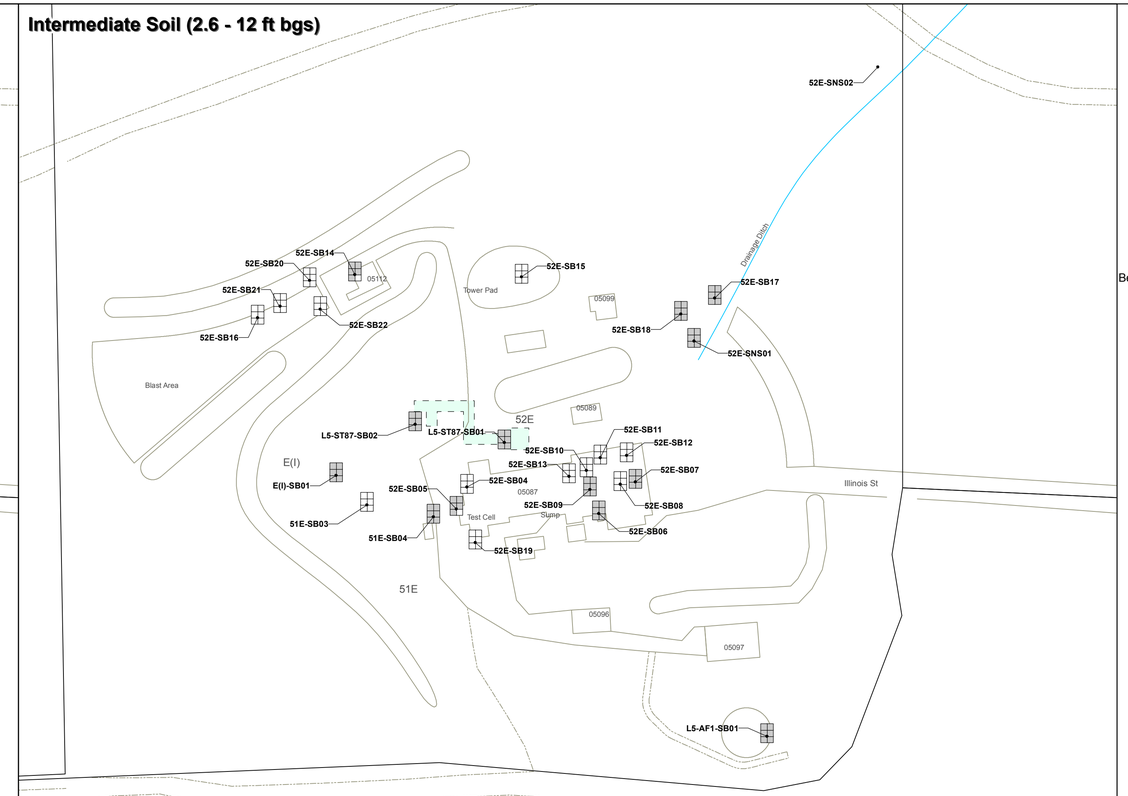
Figure 5.2-10

Metals Above Protection of Groundwater Soil Screening Levels
Line 5 North

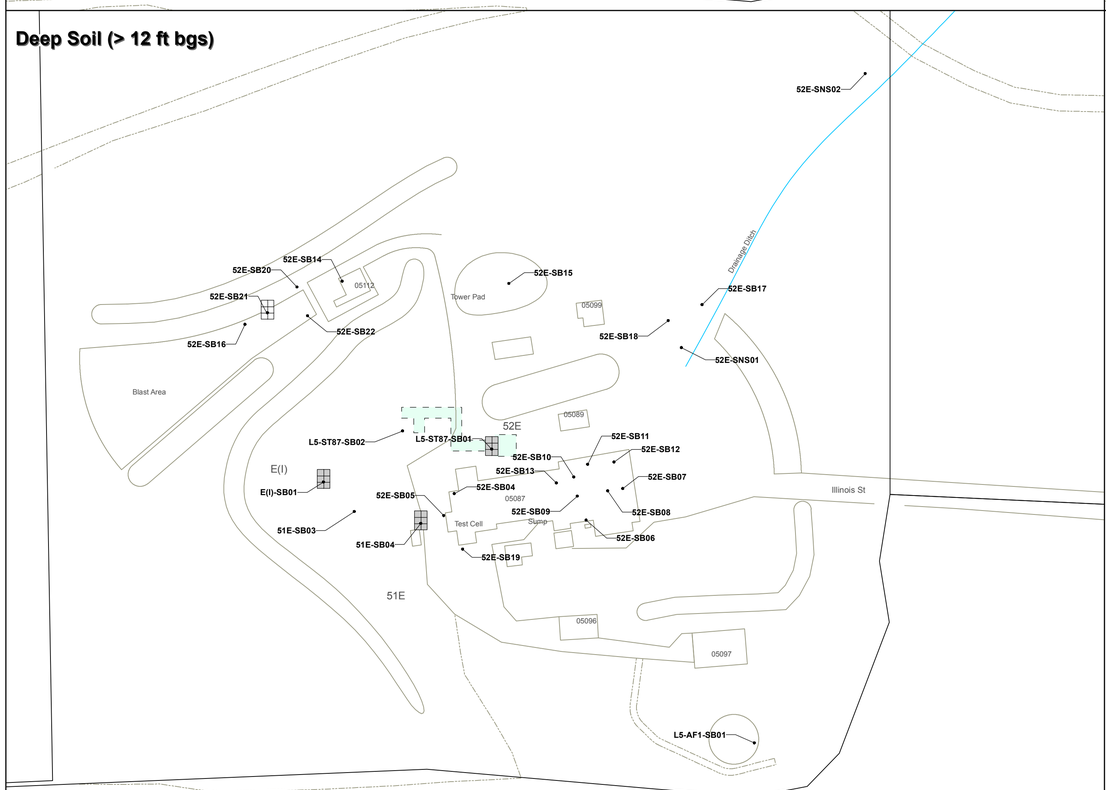
Shallow Soil (0 - 2.5 ft bgs)



Intermediate Soil (2.6 - 12 ft bgs)



Deep Soil (> 12 ft bgs)



Sample Location	Sample Depth	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b&k) fluoranthene	Dibenz(a,h) anthracene	Indeno(1,2,3-cd)pyrene	Pentachloro-phenol
Screening Level		0.62	0.038	0.038	0.062	0.621	3000
0 - 2.5 feet bgs							
52E-SB04	1.0	<SL	<SL	**0.18**	<SL	<SL	<SL
52E-SNS01	0.5	<SL	<SL	**0.13**	**0.35**	<SL	<SL

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not collected.
Units in milligrams per kilogram (mg/kg).

- Not Analyzed
- < Soil Screening Level (RISL)
- >= RISL and < 10x RISL
- >= 10x RISL and < 100x RISL
- >= 100x RISL

Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b&k)fluoranthene
Dibenz(a,h)anthracene
Indeno(1,2,3-cd)pyrene
Pentachlorophenol

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary

N

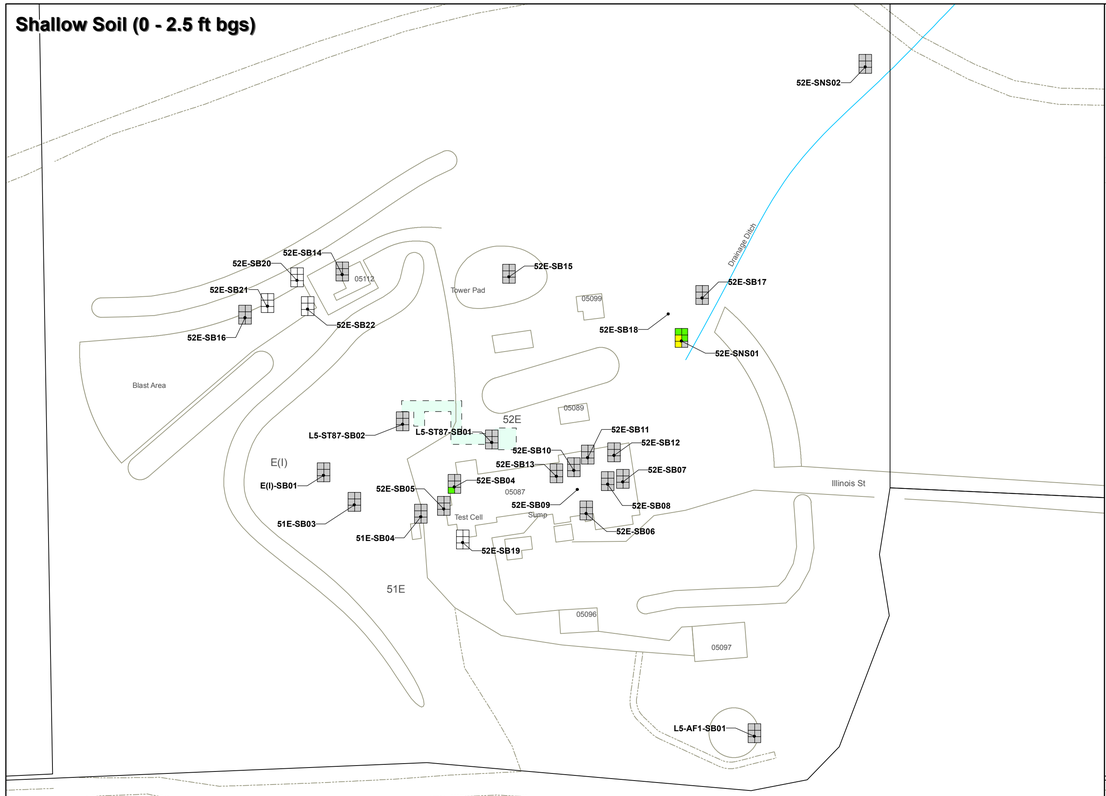
1 " = 70 '

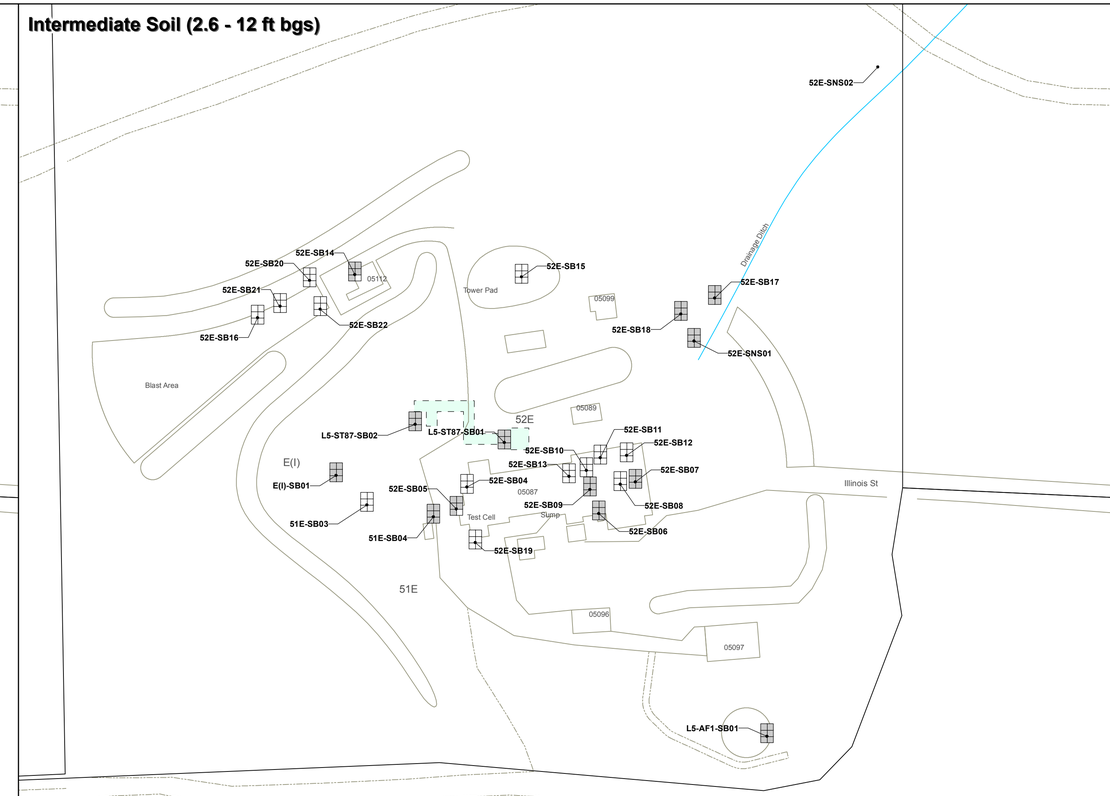
0 70 140
Feet

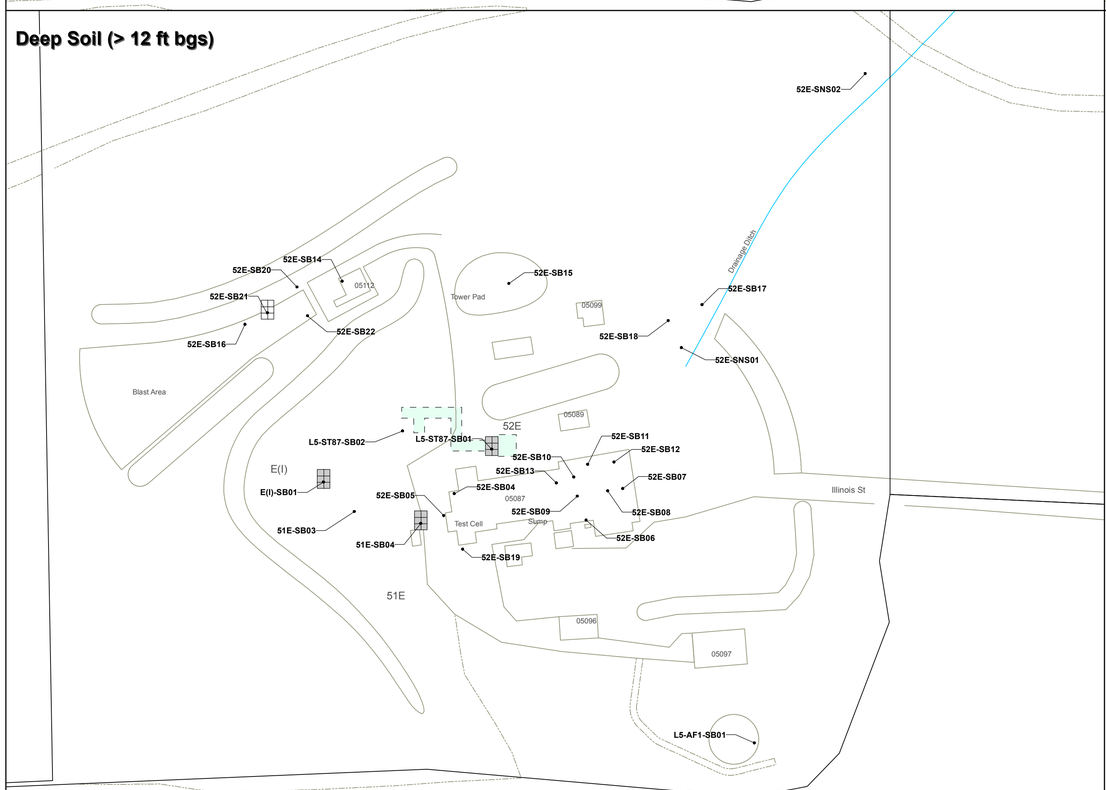
AEROJET
Environmental Remediation

Figure 5.2-11

SVOCs and Pentachlorophenol in Soil Above Remedial Investigation Screening Levels - Line 5 North







Sample Location	Sample Depth	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b&k) fluoranthene	Dibenz(a,h) anthracene	Indeno(1,2,3-cd)pyrene	Pentachloro-phenol
Screening Level		0.029	0.0029	0.029	0.0029	0.029	0.4
0 - 2.5 feet bgs							
52E-SB04	1.0	<SL	<SL	**0.18**	<SL	<SL	<SL
52E-SNS01	0.5	**0.088**	**0.13**	**0.35**	**0.014**	**0.057**	<SL

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not collected.
Units in milligrams per kilogram (mg/kg).

Not Analyzed
< Soil Screening Level (PGW SSL)
>= PGW SSL and < 10x PGW SSL
>= 10x PGW SSL and < 100x PGW SSL
>= 100x PGW SSL

Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b&k)fluoranthene
Dibenz(a,h)anthracene
Indeno(1,2,3-cd)pyrene
Pentachlorophenol

Source Area
Boundary Operable Unit (BOU)
Consent Decree Boundary

N

1 " = 70 '

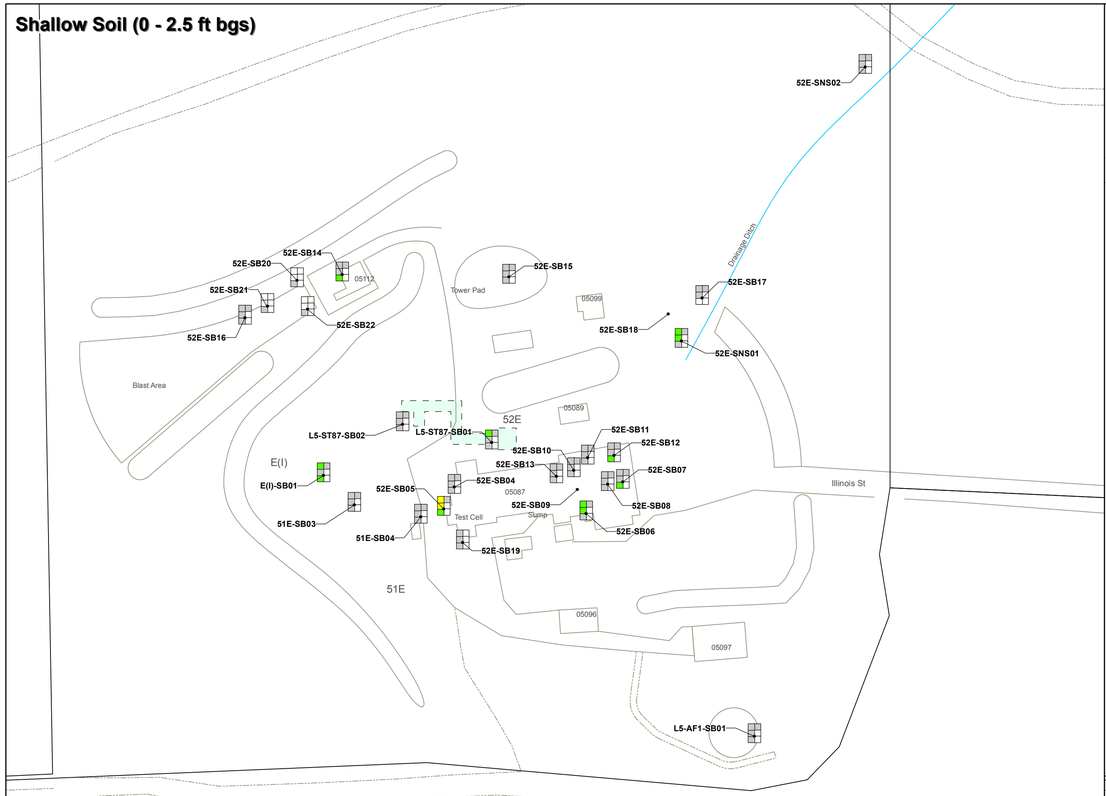
0 70 140
Feet

AEROJET
Environmental Remediation

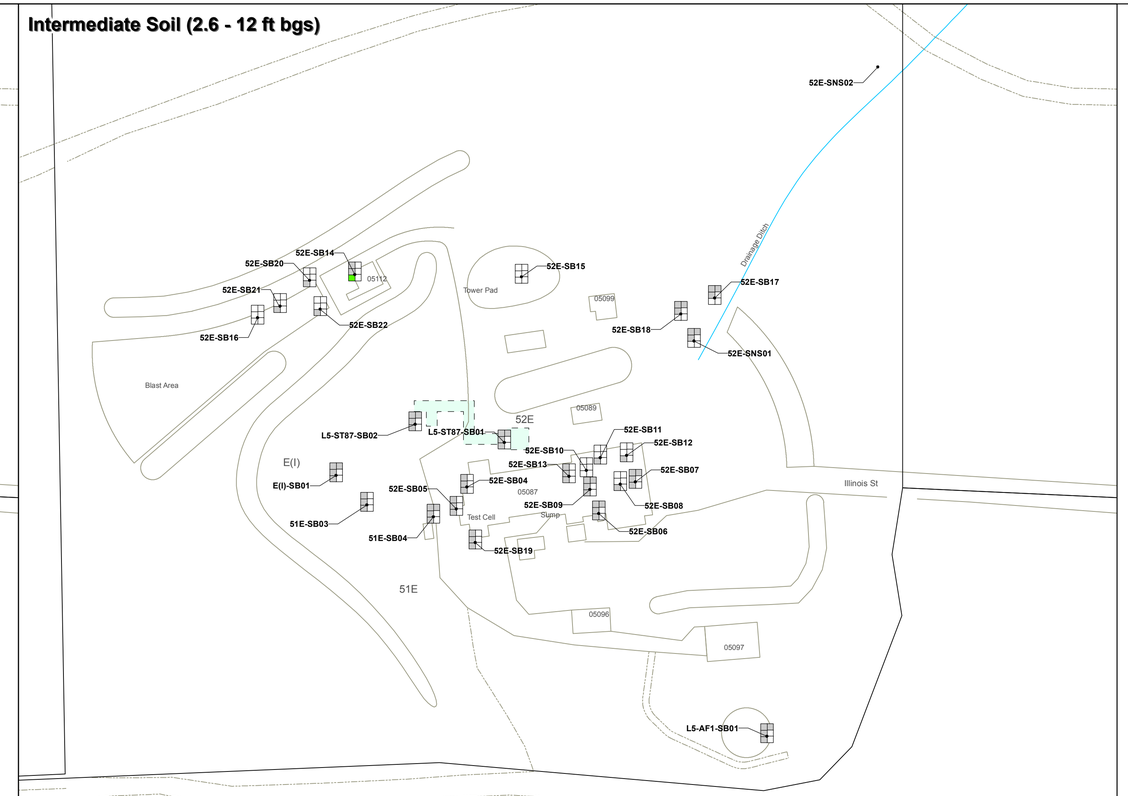
Figure 5.2-12

SVOCs and Pentachlorophenol Above Protection of Groundwater Soil Screening Levels - Line 5 North

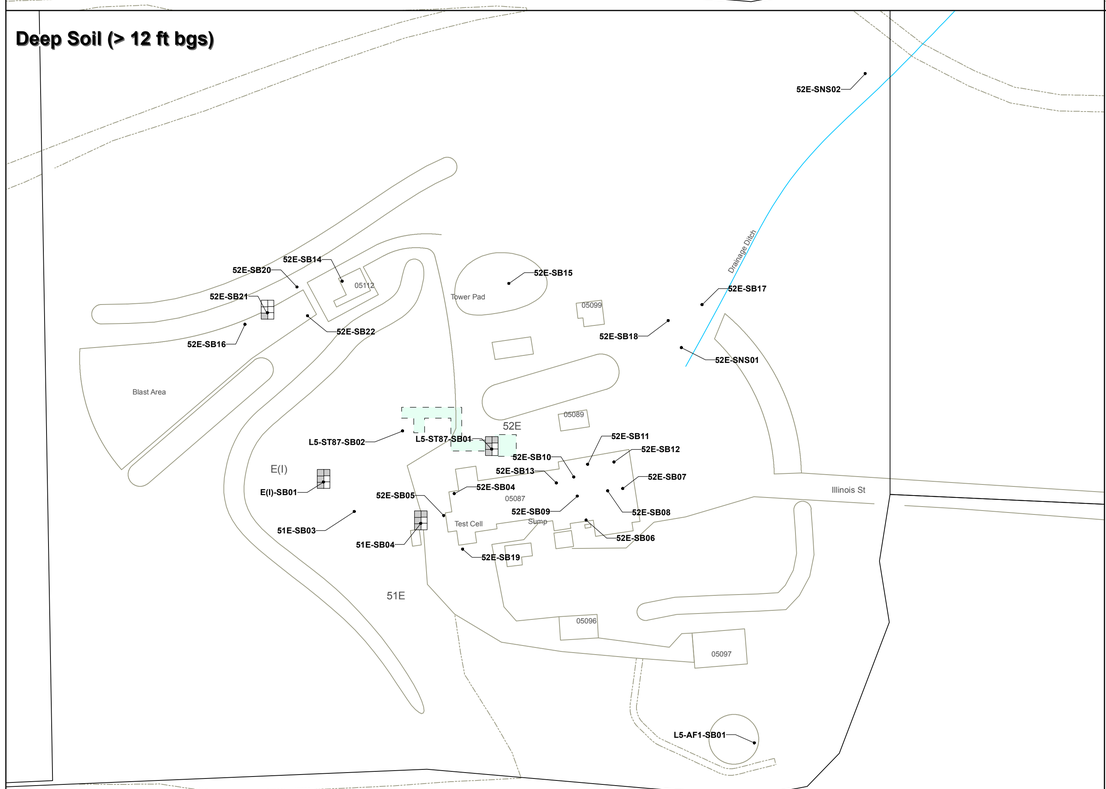
Shallow Soil (0 - 2.5 ft bgs)



Intermediate Soil (2.6 - 12 ft bgs)



Deep Soil (> 12 ft bgs)



Sample Location	Sample Depth	TPH as Diesel	TPH as Motor Oil	NDMA	PCB-1254	PCB-1260	Perchlorate
Screening Level		100	500	0.00003	0.034	0.034	0.06
0 - 2.5 feet bgs							
52E-SB05	1.5	**2,200**	**5,700**	<SL	NC	NC	**0.26**
52E-SB06	1.5	**230**	**580**	<SL	NC	NC	<SL
52E-SB07	1.0	<SL	<SL	<SL	NC	NC	**0.077**
52E-SB12	1.0	<SL	<SL	<SL	NC	NC	**0.065**
52E-SB14	1.5	<SL	<SL	<SL	NC	NC	**0.086**
52E-SNS01	0.5	**180**	**550**	<SL	NC	NC	<SL
E(I)-SB01	0.25	**150**	<SL	<SL	NC	NC	**0.086**
2.6 - 12 feet bgs							
52E-SB14	5.0	<SL	<SL	NC	NC	NC	**0.52**
52E-SB14	11.5	<SL	<SL	NC	NC	NC	**0.24**

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not collected.
Units in milligrams per kilogram (mg/kg).

- Not Analyzed
- < Soil Screening Level (PGW SSL)
- >= PGW SSL and < 10x PGW SSL
- >= 10x PGW SSL and < 100x PGW SSL
- >= 100x PGW SSL

TPH-D, TPH-MO, Perchlorate — Arochlor 1254, Aroclor 1260, NDMA

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary

N

1 " = 70 '

0 70 140
Feet

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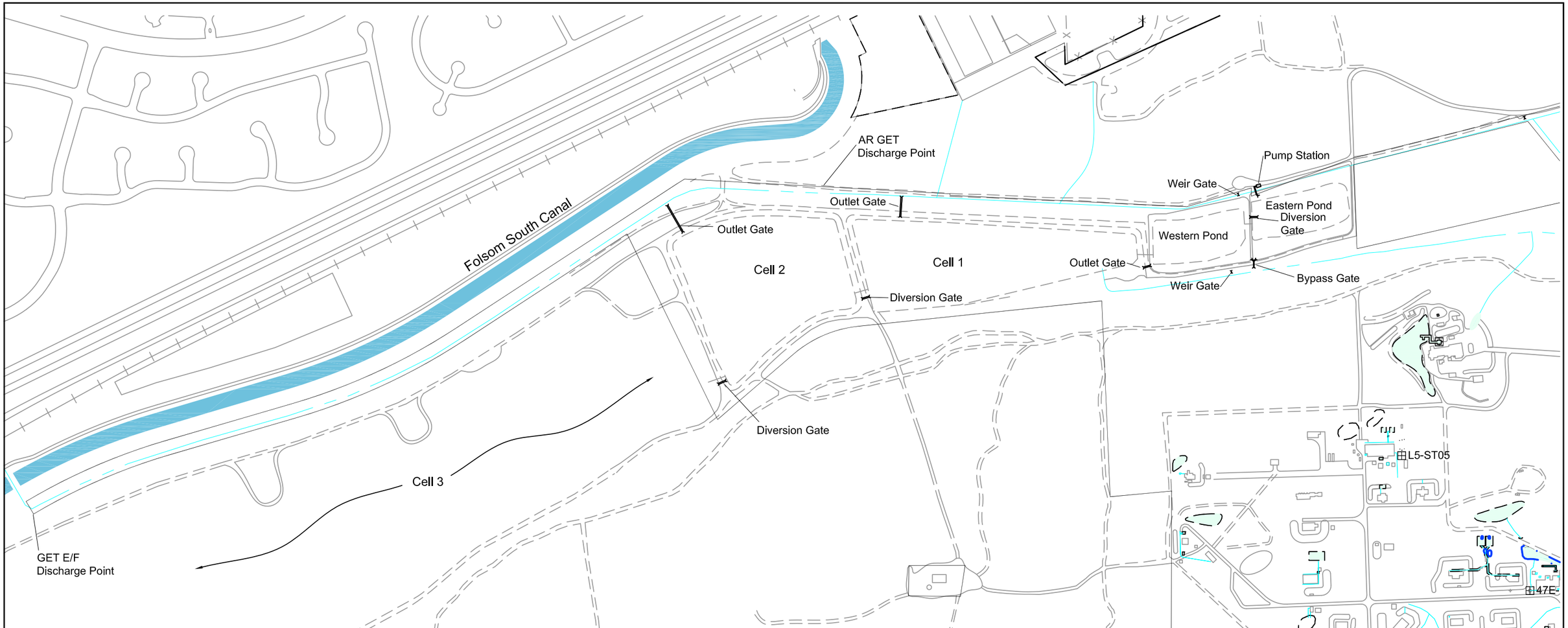
Environmental Remediation

Figure 5.2-13

PCBs, NDMA, Perchlorate, TPH-D, and TPH-Mo Above Protection of Groundwater Soil Screening Levels - Line 5 North



EXPLANATION

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Drainage Culvert
- Road
- Railroad
- 20009 Building
- Above Ground Storage Tank
- Surface Drainage
- Septic Tank and Leach Line
- AR American River
- GET Groundwater Extraction and Treatment

N

Scale: 1" = 500'

0 250 500

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Environmental Remediation

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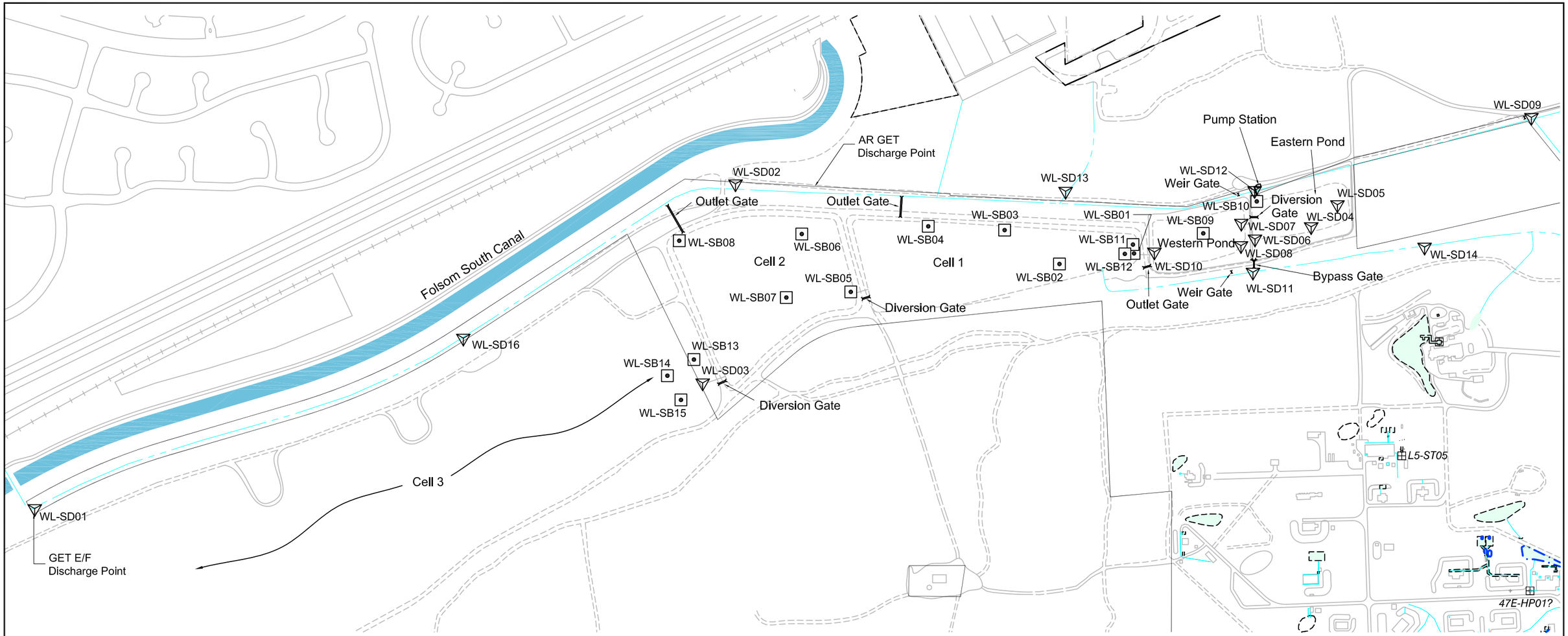
FIGURE 5.3-1
Site Features Map
Westlakes and Open Space Area 6

9/8/08 PER SR10131006



EXPLANATION

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Drainage Culvert
- Road
- Sediment Sample Location
- Soil Sample Borehole Location
- 20009 Building
- Former Structure
- Above Ground Storage Tank
- Surface Drainage
- ST26 Septic Tank and Leach Line
- AR American River
- GET Groundwater Extraction and Treatment

N

Scale: 1" = 500'

0 250 500

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Environmental Remediation

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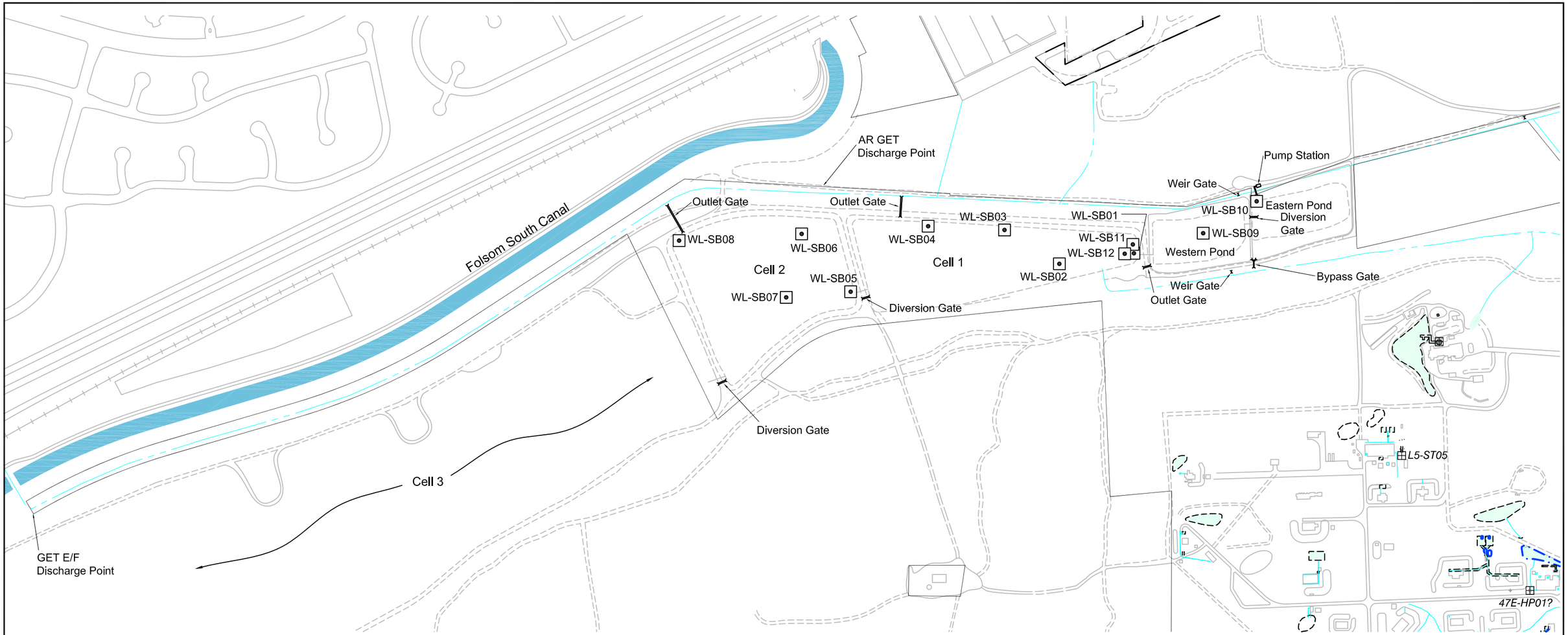
FIGURE 5.3-2
BOU Surface Soil Sample Locations
Westlakes

7/22/08 PER SR10131007



EXPLANATION

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Drainage Culvert
- Road
- Sediment Sample Location
- Soil Sample Borehole Location
- 20009 — Building
- Former Structure
- Above Ground Storage Tank
- Surface Drainage
- ST26 — Septic Tank and Leach Line
- AR — American River
- GET — Groundwater Extraction and Treatment

N

Scale: 1" = 500'

0 250 500

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Environmental Remediation

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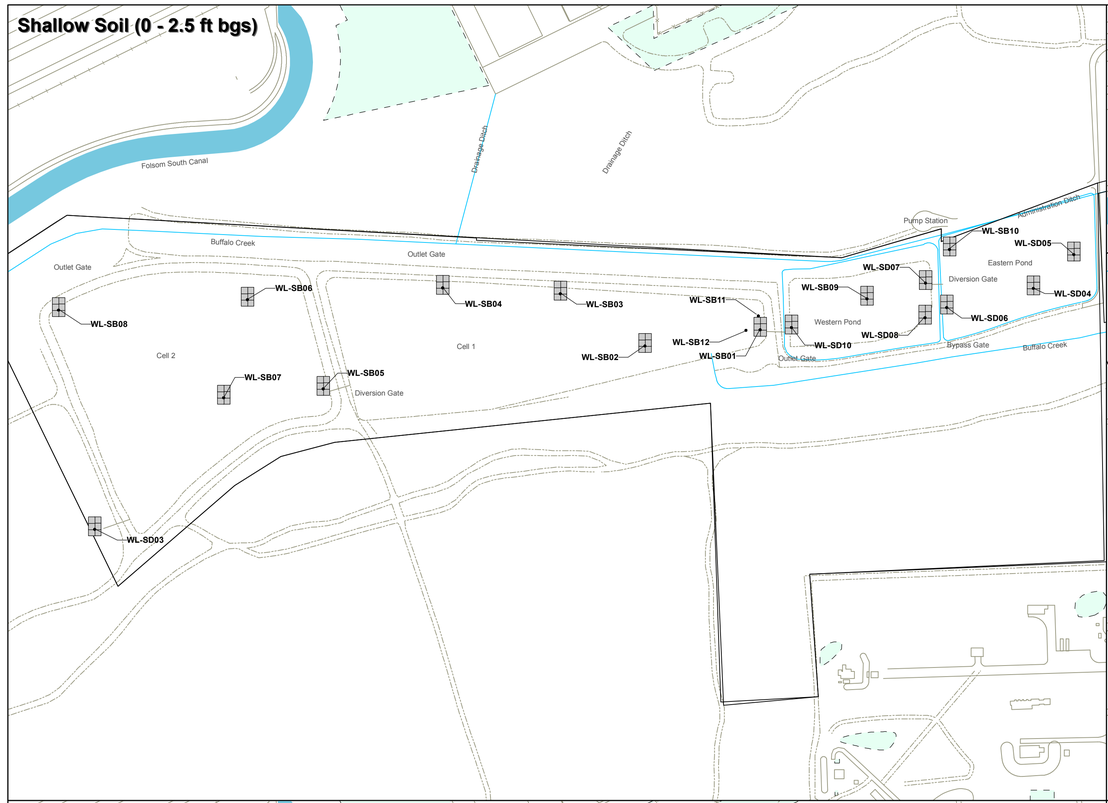
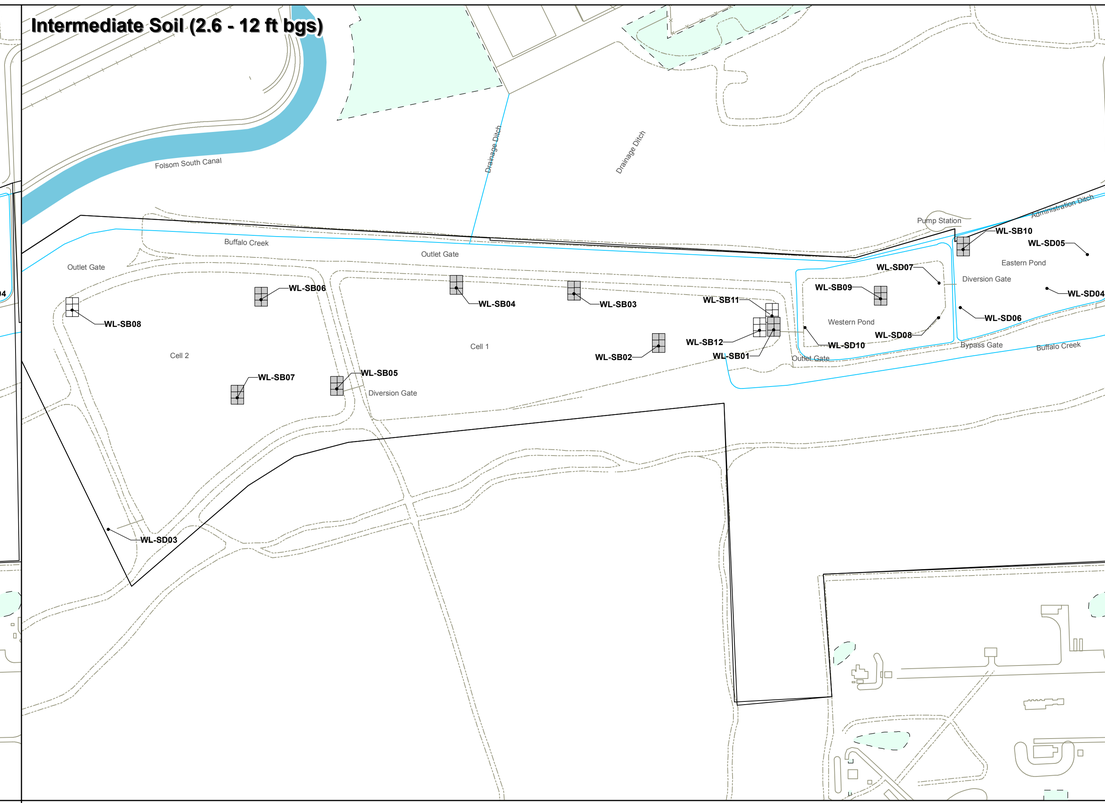
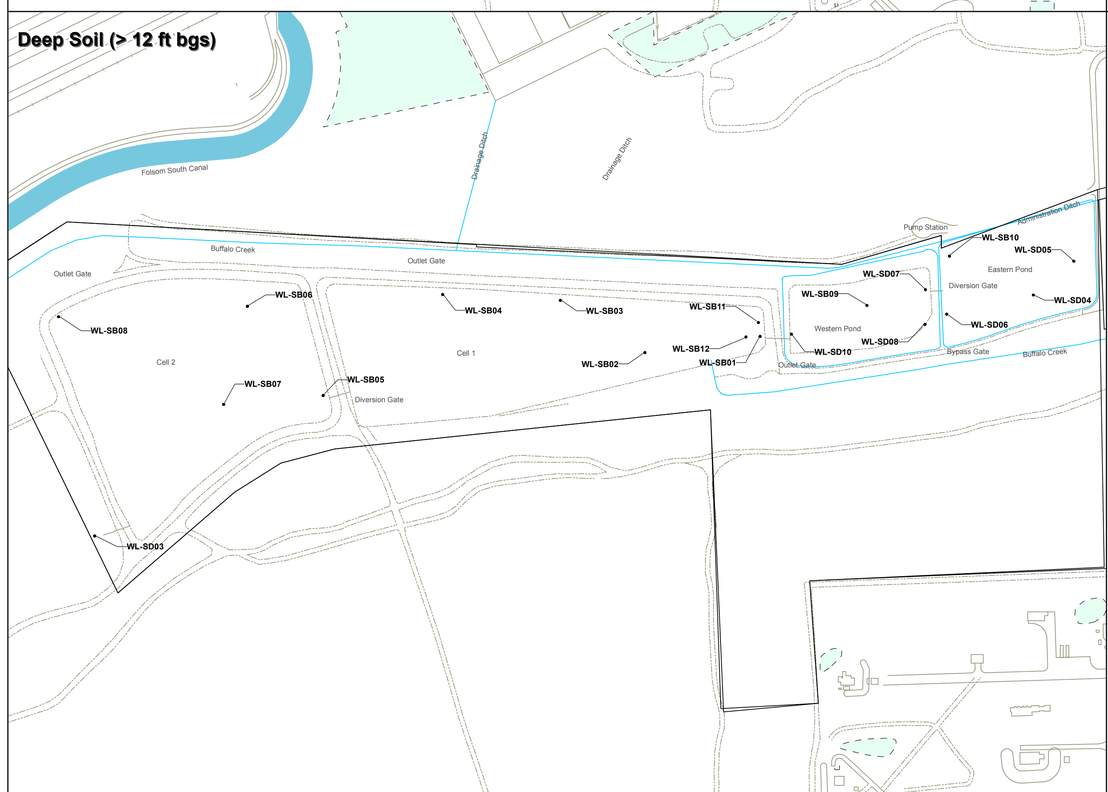
FIGURE 5.3-3
BOU Subsurface Soil Sample Locations
Westlakes

7/22/08 PER SR10131008







- Not Analyzed
- < Soil Screening Level (RISL)
- >= RISL and < 10x RISL
- >= 10x RISL and < 100x RISL
- >= 100x RISL

Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b&k)fluoranthene
Dibenz(a,h)anthracene
Indeno(1,2,3-cd)pyrene
Pentachlorophenol

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary

Sample Location	Sample Depth	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b&k) fluoranthene	Dibenz(a,h) anthracene	Indeno(1,2,3-cd)pyrene	Pentachloro-phenol
Screening Level		0.62	0.038	0.038	0.062	0.621	3000
0 - 2.5 feet bgs							
NO PAHs above RISL in WL							

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not collected.
Units in milligrams per kilogram (mg/kg).

N

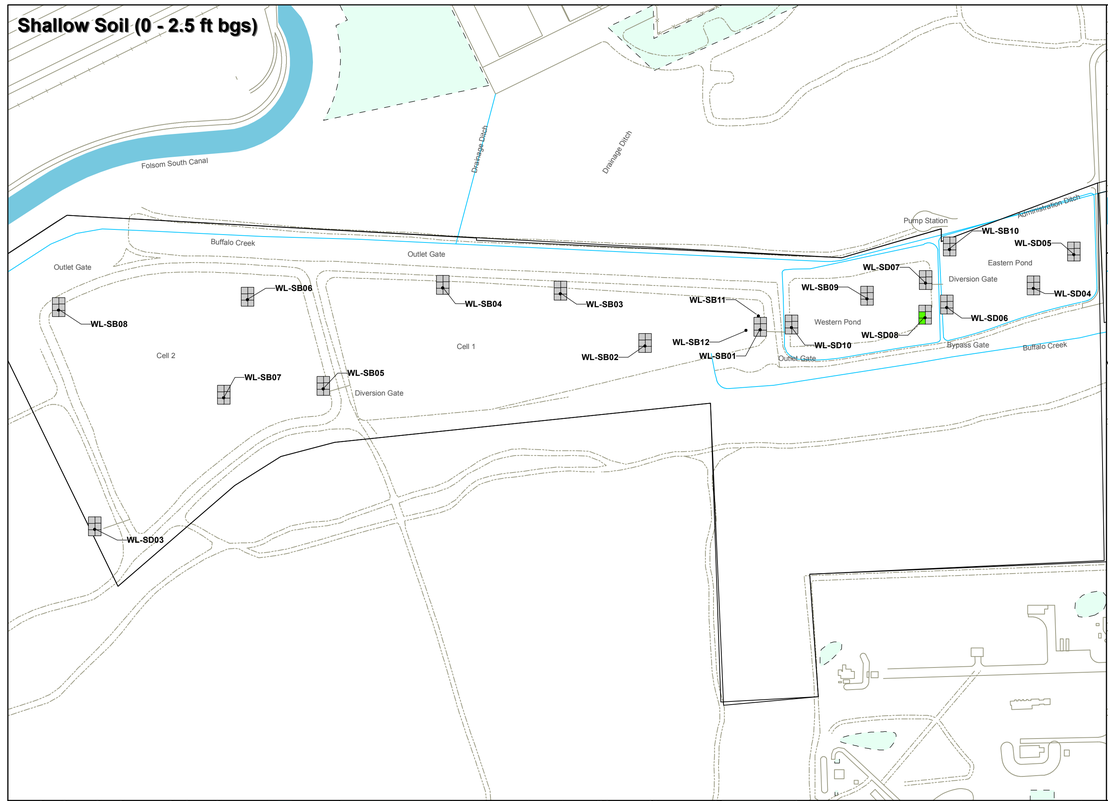
1 " = 250 '

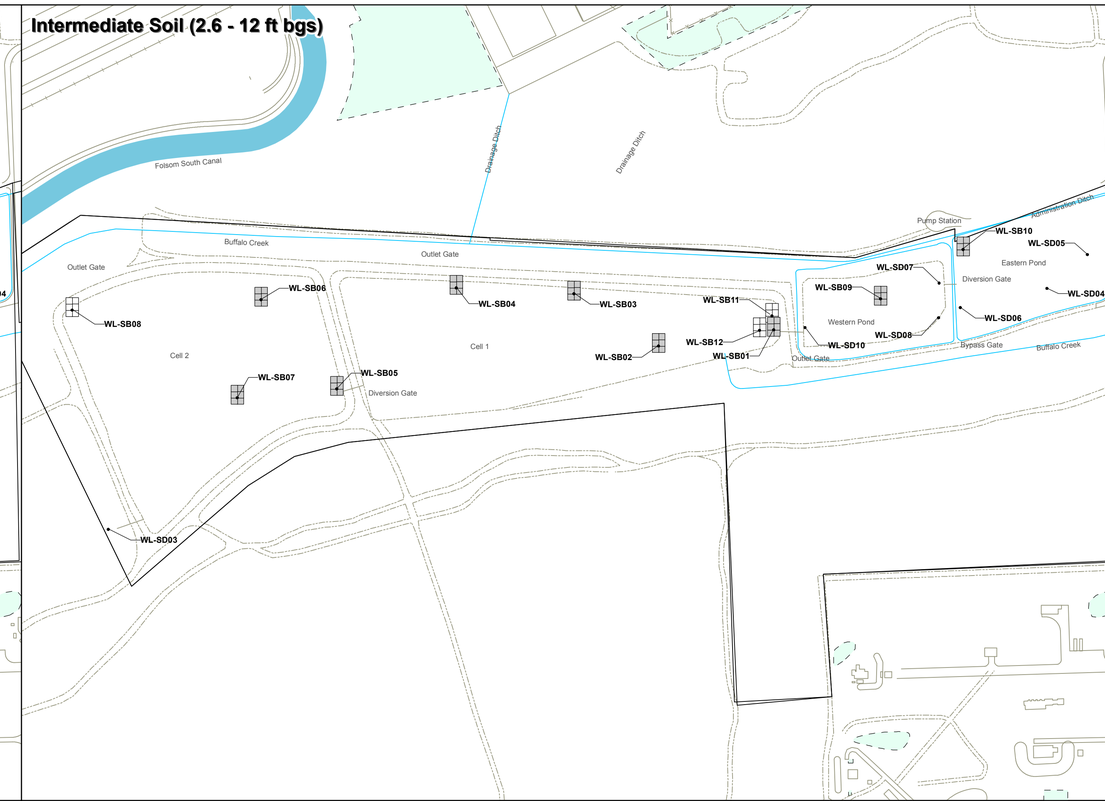
0 250 500
Feet

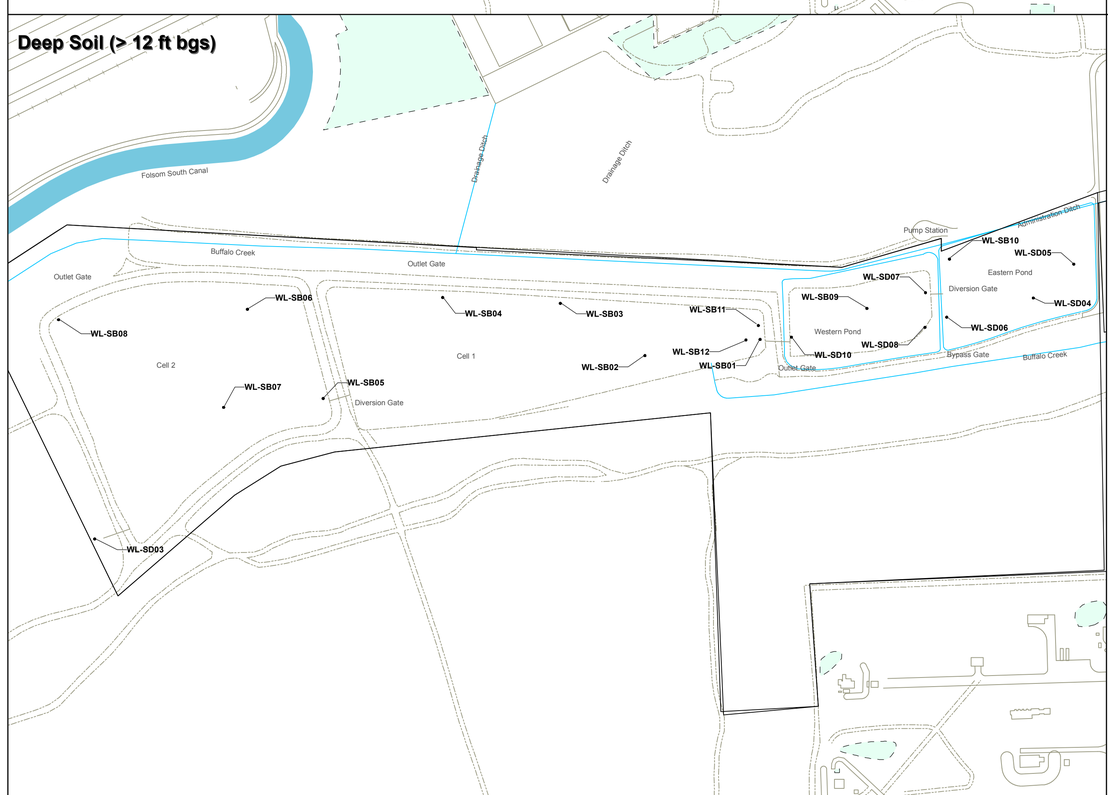
AEROJET
Environmental Remediation

Figure 5.3-4

SVOCs and Pentachlorophenol in Soil Above Remedial Investigation Screening Levels - Westlakes







Sample Location	Sample Depth	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b&k) fluoranthene	Dibenz(a,h) anthracene	Indeno(1,2,3-cd)pyrene	Pentachloro-phenol
Screening Level		0.029	0.0029	0.029	0.0029	0.029	0.4
0 - 2.5 feet bgs							
WL-SD08	0.5	<SL	**0.0092**	**0.029**	<SL	<SL	<SL

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not collected.
Units in milligrams per kilogram (mg/kg).

- Not Analyzed
- < Soil Screening Level (PGW SSL)
- >= PGW SSL and < 10x PGW SSL
- >= 10x PGW SSL and < 100x PGW SSL
- >= 100x PGW SSL

Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b&k)fluoranthene
Dibenz(a,h)anthracene
Indeno(1,2,3-cd)pyrene
Pentachlorophenol

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary

N

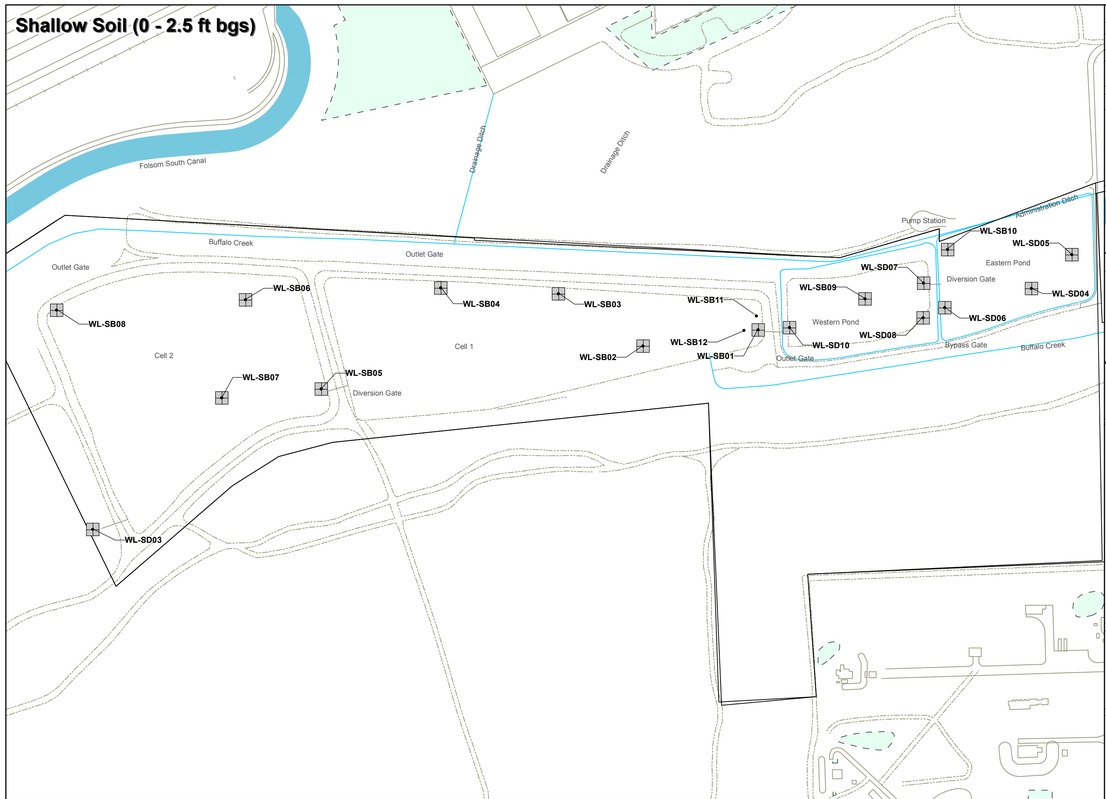
1 " = 250 '

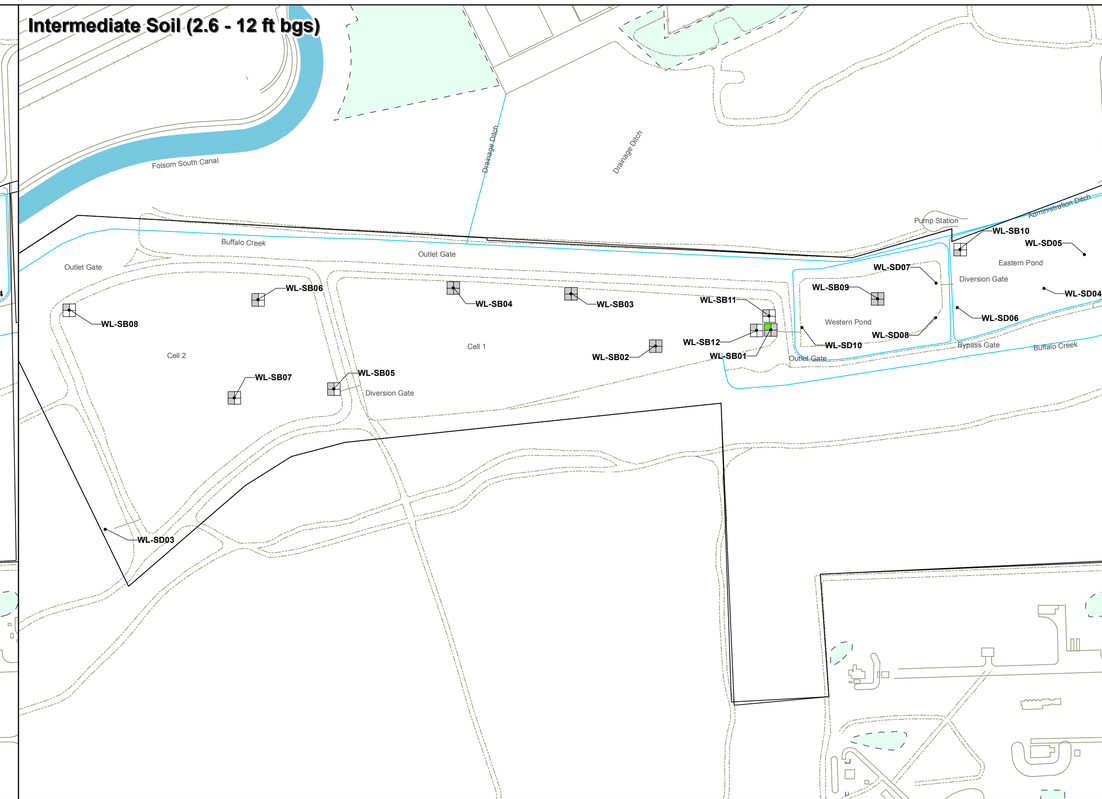
0 250 500
Feet

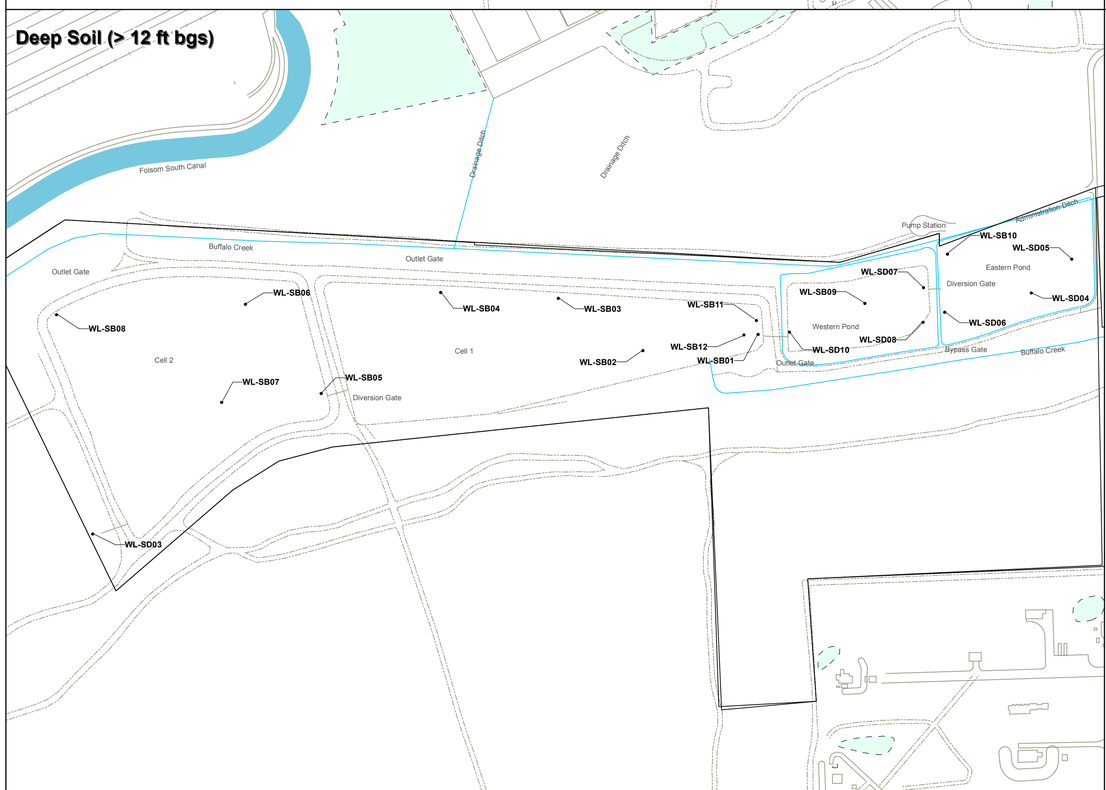
AEROJET
Environmental Remediation

Figure 5.3-5

SVOCs and Pentachlorophenol Above Protection of Groundwater Soil Screening Levels - Westlakes







Sample Location	Sample Depth	NDMA	PCB-1254	PCB-1260	Perchlorate
Screening Level		0.0095	0.22	0.22	7.8
2.6 - 12 feet bgs					
WL-SB01	5.0	<SL	<SL	<SL	**9**

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not collected.
Units in milligrams per kilogram (mg/kg).

Not Analyzed
< Soil Screening Level (RISL)
>= RISL and < 10x RISL
>= 10x RISL and < 100x RISL
>= 100x RISL

Perchlorate
NDMA
Aroclor 1254
Aroclor 1260

Source Area
Boundary Operable Unit (BOU)
Consent Decree Boundary

N

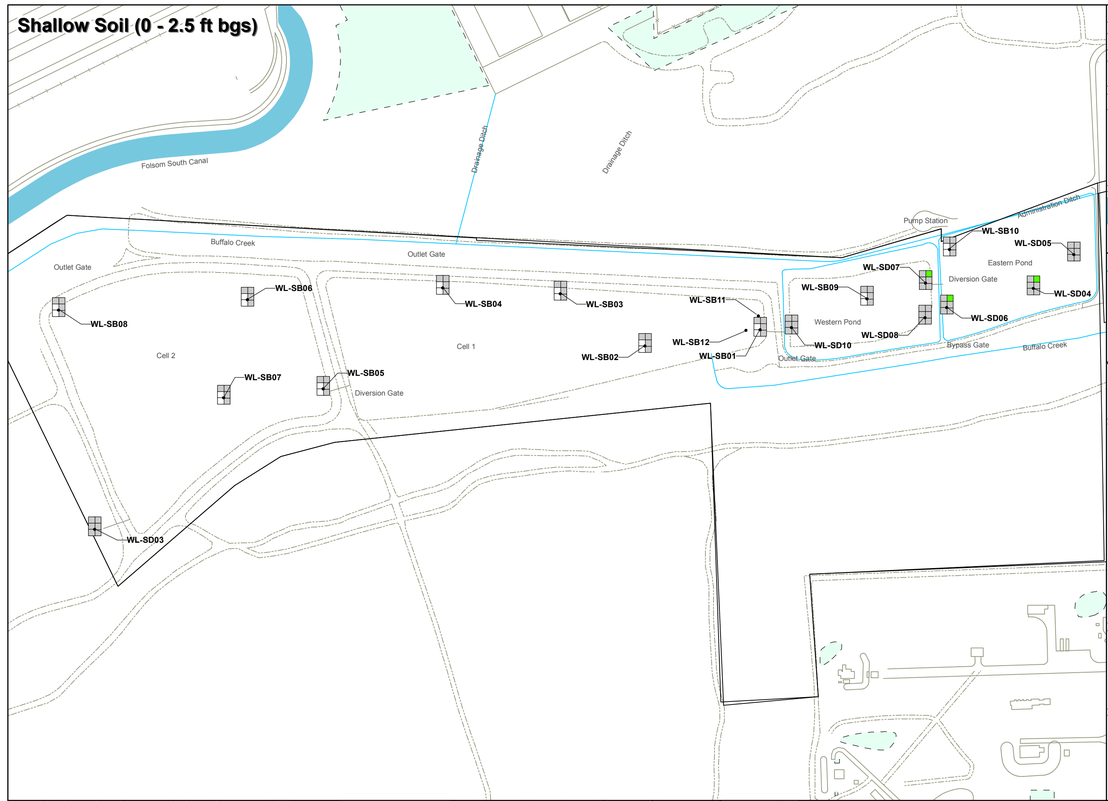
1 " = 250 '

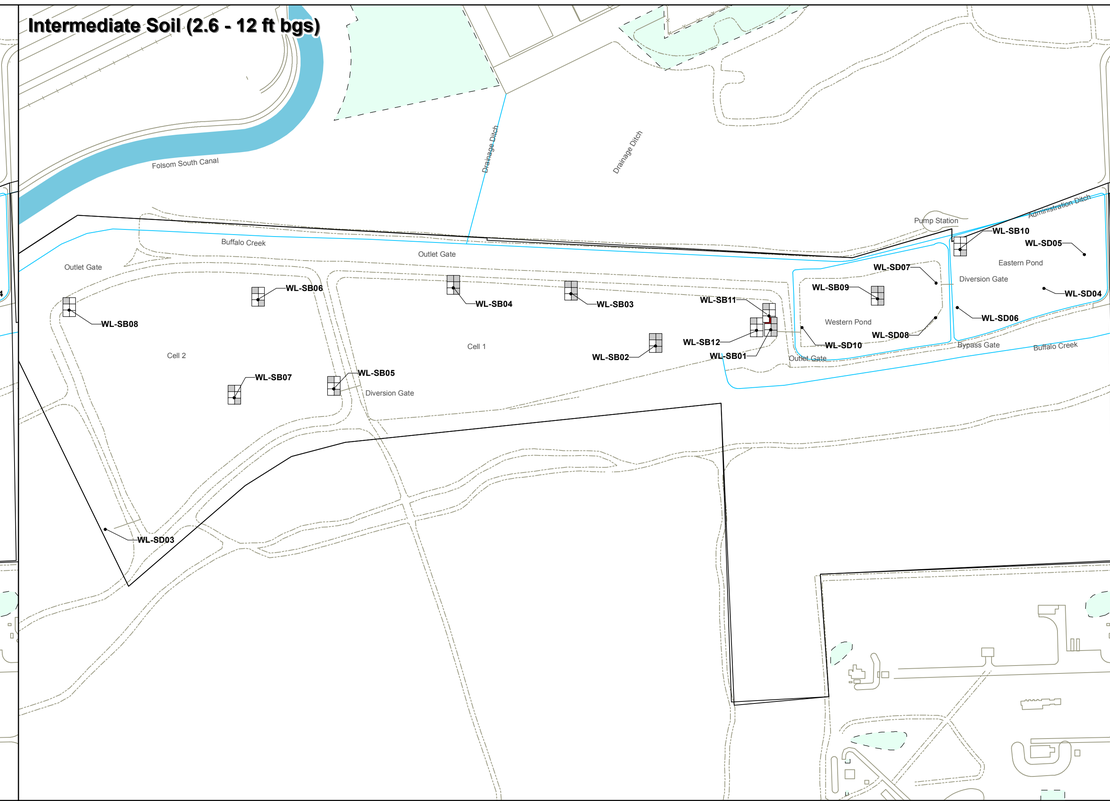
0 250 500
Feet

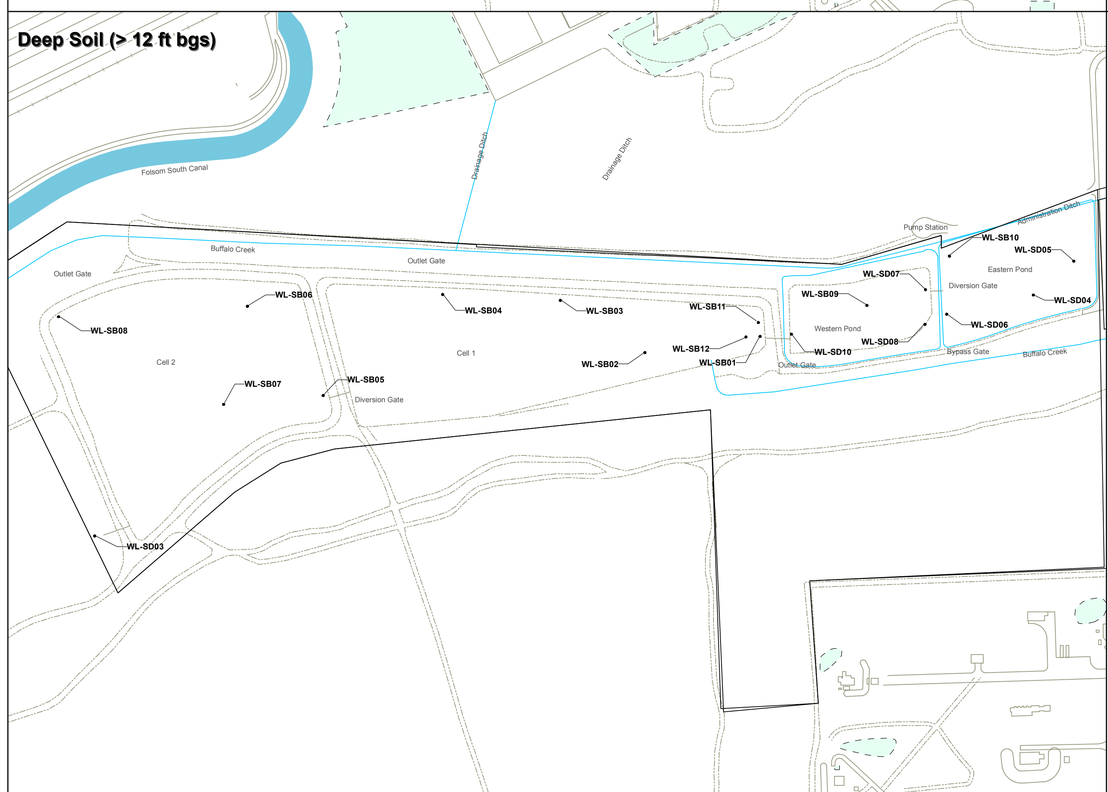
AEROJET
Environmental Remediation

Figure 5.3-6

PCBs, NDMA and Perchlorate in Soil Above Remedial Investigation Screening Levels - Westlakes







Sample Location	Sample Depth	TPH as Diesel	TPH as Motor Oil	NDMA	PCB-1254	PCB-1260	Perchlorate
Screening Level		100	500	0.00003	0.034	0.034	0.06
0 - 2.5 feet bgs							
WL-SD04	0.5	<SL	<SL	<SL	<SL	**0.037**	<SL
WL-SD06	1.5	<SL	<SL	<SL	<SL	**0.038**	<SL
WL-SD07	0.5	<SL	<SL	<SL	<SL	**0.035**	<SL
2.6 - 12 feet bgs							
WL-SB01	5.0	NC	NC	<SL	<SL	<SL	**9**

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not collected.
Units in milligrams per kilogram (mg/kg).

Not Analyzed
< Soil Screening Level (PGW SSL)
>= PGW SSL and < 10x PGW SSL
>= 10x PGW SSL and < 100x PGW SSL
>= 100x PGW SSL

TPH-D
TPH-MO
Perchlorate

Arochlor 1254
Aroclor 1260
NDMA

Source Area
Boundary Operable Unit (BOU)
Consent Decree Boundary

N

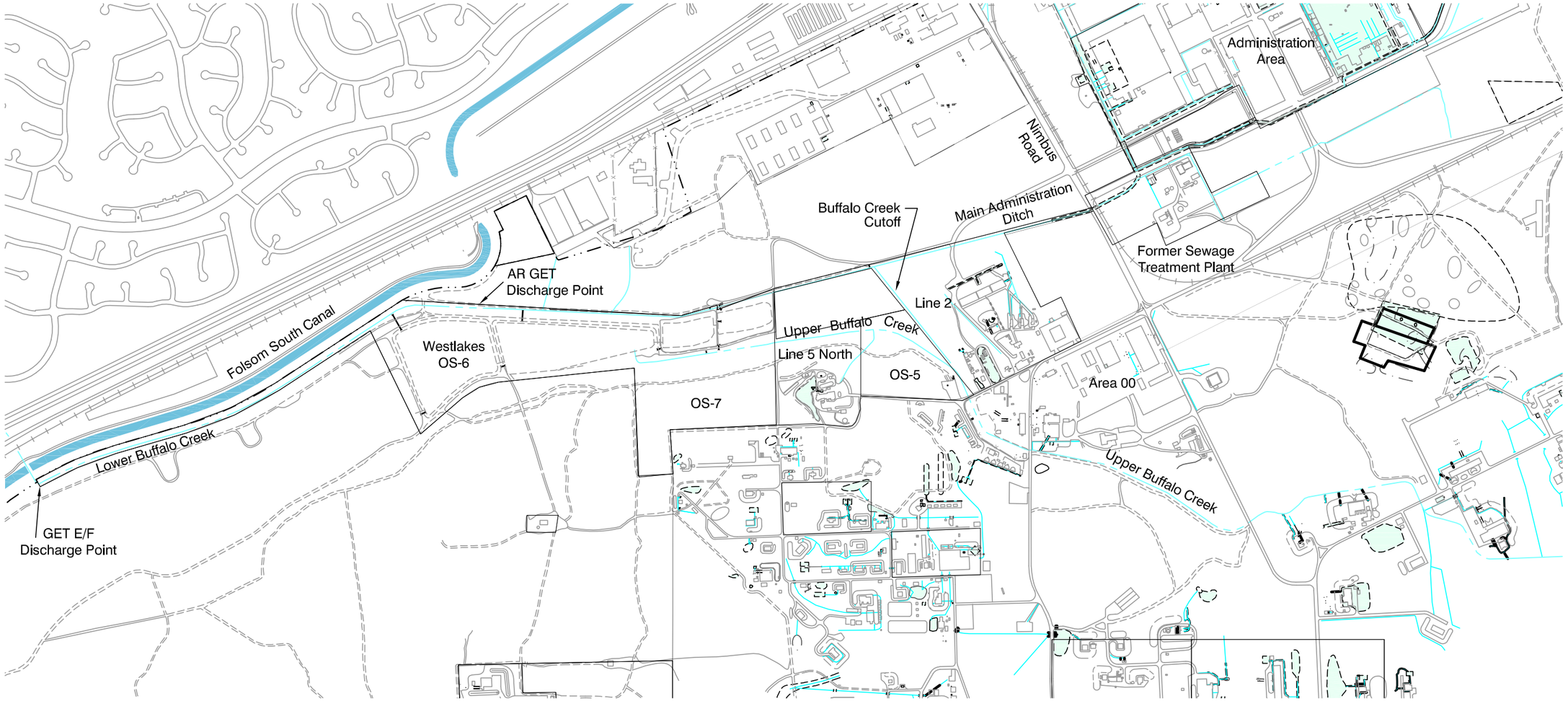
1 " = 250 '

0 250 500
Feet

AEROJET
Environmental Remediation

Figure 5.3-7

PCBs, NDMA, Perchlorate, TPH-D, and TPH-Mo Above Protection of Groundwater Soil Screening Levels - Westlakes



EXPLANATION

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Drainage Culvert
- Underground Culvert
- Fence
- Road
- Railroad
- AR — American River
- GET — Groundwater Extraction and Treatment
- 20009 — Building
- Former Structure
- Above Ground Storage Tank
- Surface Drainage
- L2-ST24 — Septic Tank and Leach Line

N

Scale: 1" = 1000'

0 500 1000

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Environmental Remediation

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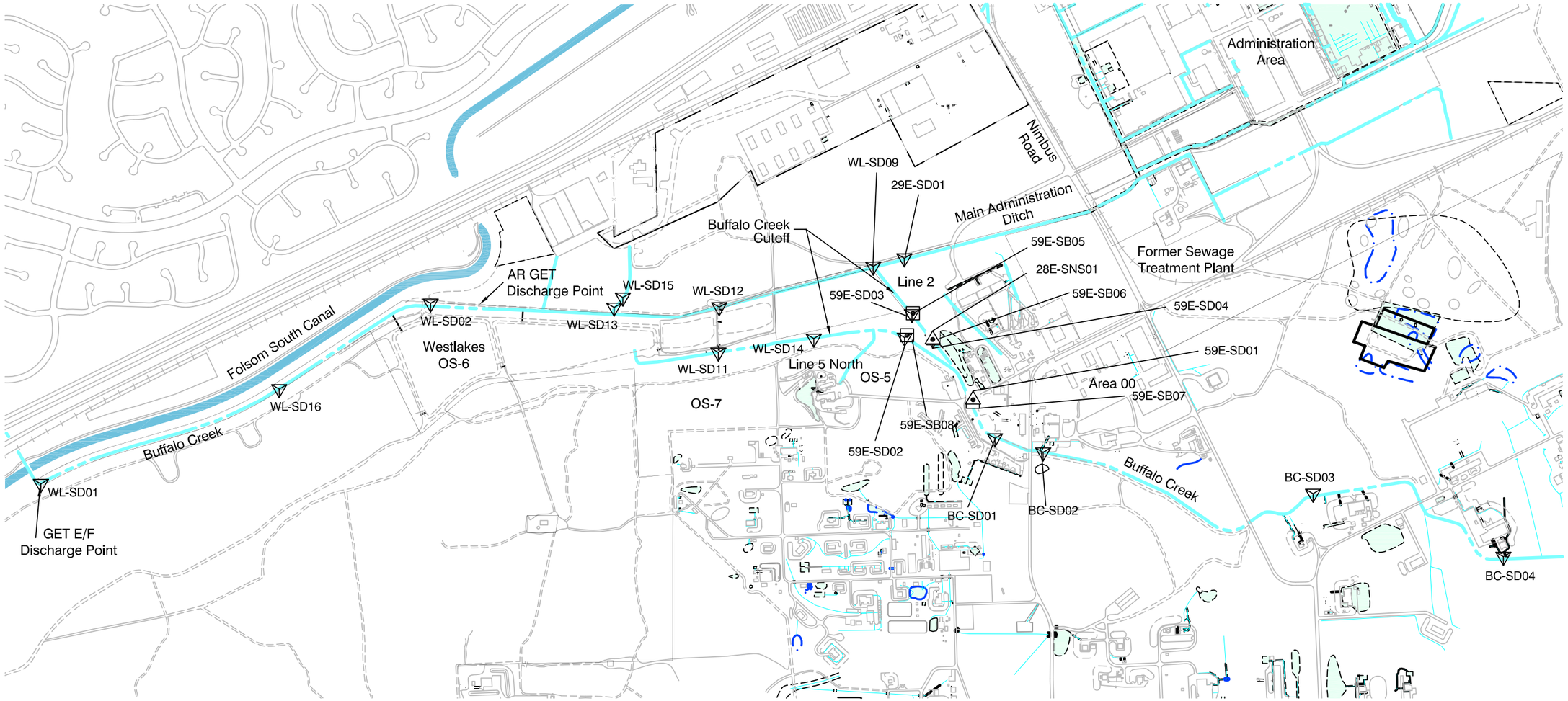
FIGURE 5.4-1
Site Features Map
Buffalo Creek

09/10/10 PR SR10131009



EXPLANATION

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Drainage Culvert
- Underground Culvert
- Fence
- Road
- Railroad
- Soil Sample Borehole Location
- Near Surface Sample Location
- Sediment Sample
- 20009 — Building
- Former Structure
- Above Ground Storage Tank
- Surface Drainage
- L2-ST24 — Septic Tank and Leach Line
- AR — American River
- GET — Groundwater Extraction and Treatment

N

Scale: 1" = 1000'

0 500 1000

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Environmental Remediation

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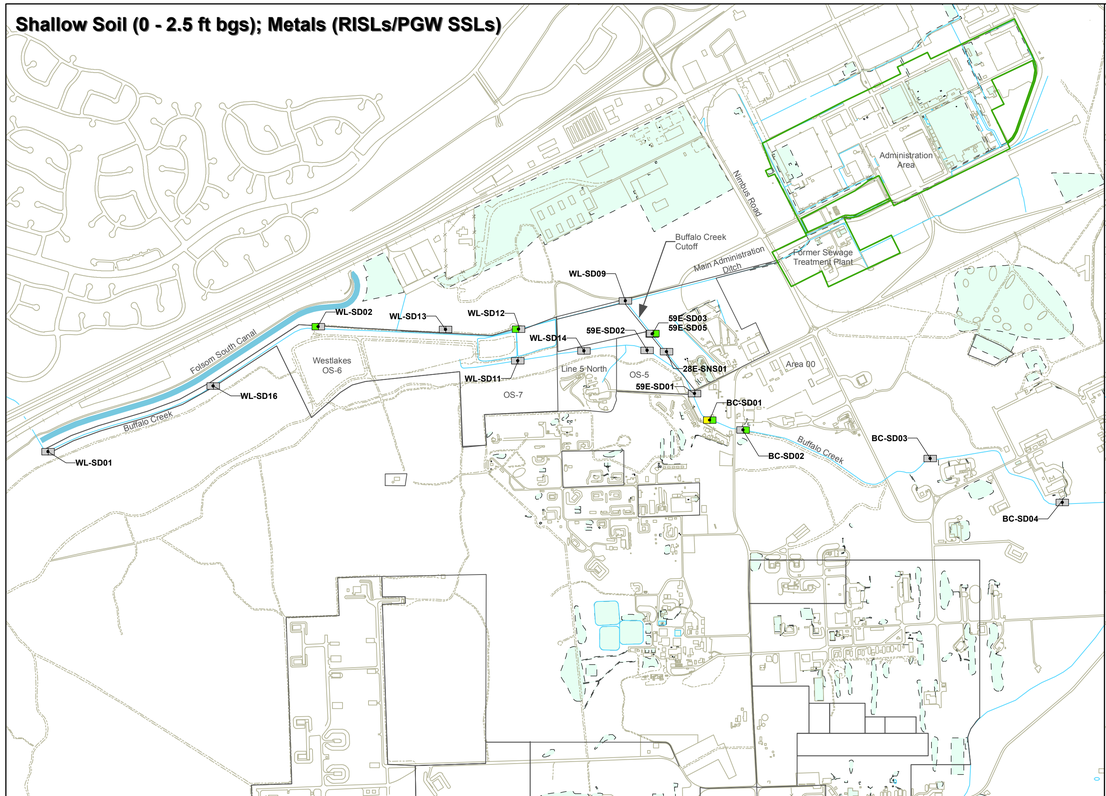
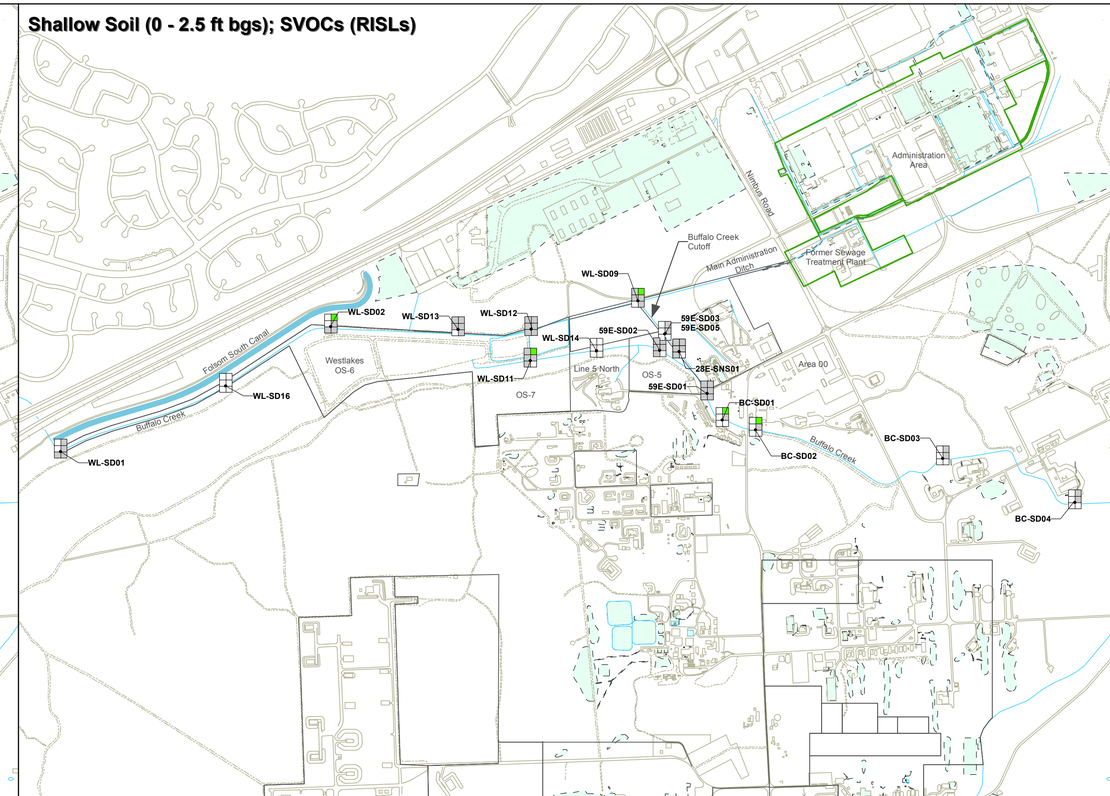
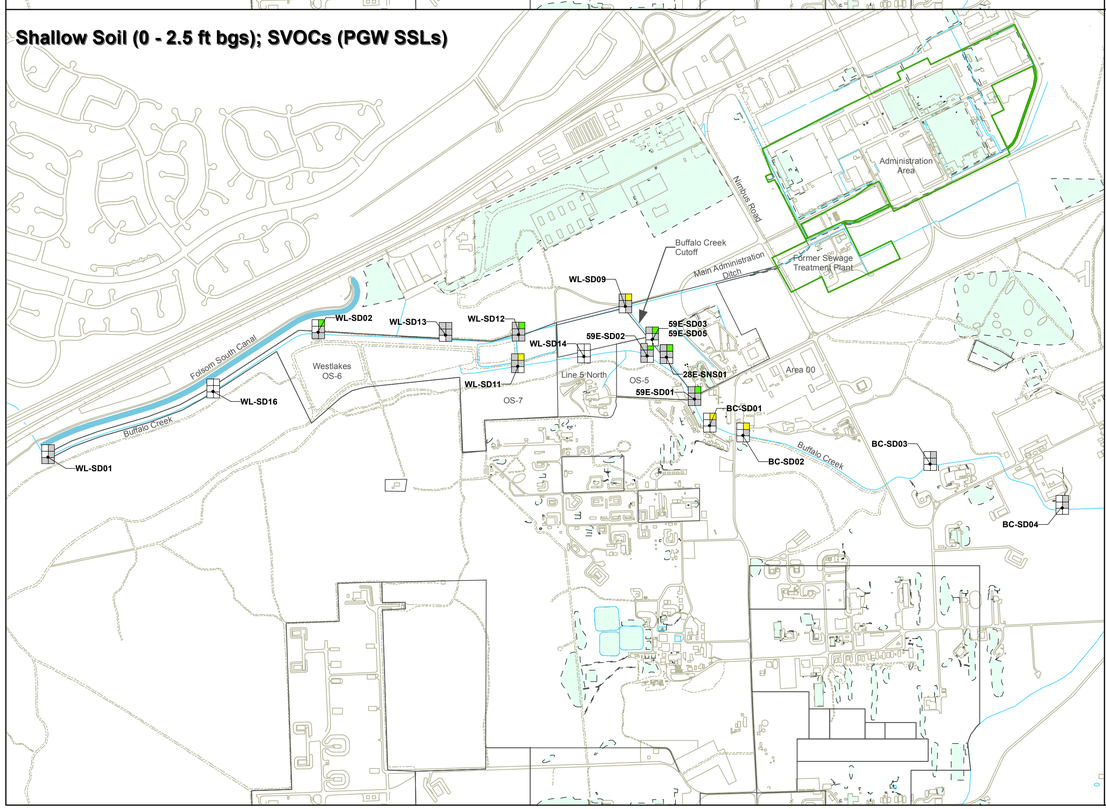
FIGURE 5.4-2
BOU Soil Sample Locations
Buffalo Creek

7\22\08 PR SR10131010







Not Analyzed

< Soil Screening Level (RISL/PGW SSL)

>= RISL/PGW SSL and < 10x RISL/PGW SSL

>= 10x RISL/PGW SSL and < 100x RISL/PGW SSL

>= 100x RISL/PGW SSL

Metals:

Cadmium, Lead

SVOCs:

TPH-D, TPH-MO, Perchlorate, Arochlor 1254, Aroclor 1260, NDMA

Source Area

Boundary Operable Unit (BOU)

Consent Decree Boundary

PGW SSLs			
Sample Location	Sample Depth	Cadmium	Lead
Screening Level		1.2	23
0 - 2.5 feet bgs			
29E-SD01	0.25	**1.6**	**37.9**
59E-SB05	1.0	<SL	**57**
59E-SD02	0.25	<SL	**25**
59E-SD03	0.25	<SL	**45.5**
BC-SD01	0.25	**27.9**	**72.1**
BC-SD02	0.25	<SL	**29.9**
WL-SDO2	0.25	<SL	**38**
WL-SD13	0.25	<SL	**33**
WL-SD16		<SL	**25.7**

RISLs			
Sample Location	Sample Depth	Cadmium	Lead
Screening Level		1.7	150
0 - 2.5 feet bgs			
BC-SD01	0.25	**27.9**	<SL

PGW SSLs							
Sample Location	Sample Depth	TPH as Diesel	TPH as Motor Oil	NDMA	PCB-1254	PCB-1260	Perchlorate
Screening Level		100	500	0.00003	0.034	0.034	0.06
0 - 2.5 feet bgs							
BC-SD01	0.25	NC	NC	NC	**0.74**	<SL	NC
BC-SD02	0.25	NC	NC	NC	**1.1**	<SL	NC
59E-SD01	0.25	<SL	<SL	<SL	**0.073**	<SL	<SL
59E-SD02	1.5	<SL	<SL	NC	**0.091**	<SL	<SL
59E-SD03	0.25	NC	NC	NC	**0.21**	<SL	NC
59E-SD04	0.25	NC	NC	NC	**0.2**	<SL	NC
WL-SD02	0.25	NC	NC	<SL	**0.24**	<SL	<SL
WL-SD02	1.5	NC	NC	<SL	**0.25**	<SL	<SL
WL-SD09	0.5	<SL	<SL	<SL	**0.079**	<SL	NC
WL-SD09	1.5	<SL	<SL	<SL	**0.36**	<SL	NC
WL-SD11	0.5	<SL	<SL	NC	**0.43**	<SL	<SL
WL-SD11	1.5	<SL	<SL	NC	**0.16**	<SL	<SL
WL-SD12	0.5	<SL	<SL	NC	**0.098**	<SL	<SL
WL-SD12	1.5	<SL	<SL	NC	**0.11**	<SL	<SL

RISLs					
Sample Location	Sample Depth	NDMA	PCB-1254	PCB-1260	Perchlorate
Screening Level		0.0095	0.22	0.22	7.8
0 - 2.5 feet bgs					
BC-SD01	0.25	NC	**0.74**	<SL	NC
BC-SD02	0.25	NC	**1.1**	<SL	NC
WL-SD02	0.25	<SL	**0.24**	<SL	<SL
WL-SD02	1.5	<SL	**0.25**	<SL	<SL
WL-SD09	1.5	<SL	**0.36**	<SL	NC
WL-SD11	0.5	NC	**0.43**	<SL	<SL

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not collected.
Units in milligrams per kilogram (mg/kg).

N

1 " = 1,000 '

0 1,000 2,000
Feet

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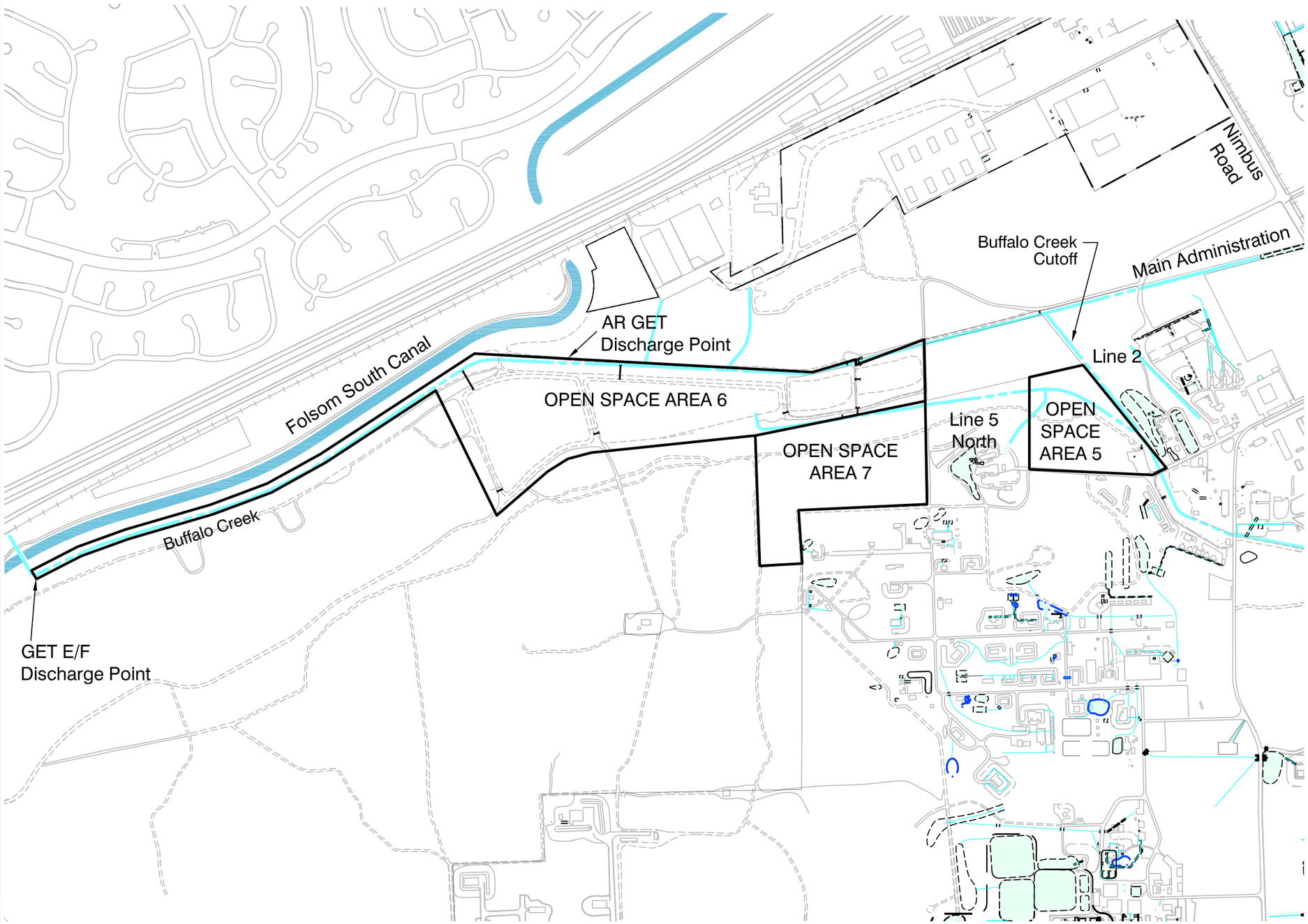
Environmental Remediation

Figure 5.4-3

All Compounds in Soil
Above Screening Levels
Buffalo Creek



EXPLANATION

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Drainage Culvert
- Road
- Management Area Boundary
- 20009 Building
- Former Structure
- Above Ground Storage Tank
- Surface Drainage
- AR American River
- GET Groundwater Extraction and Treatment

N

Scale: 1" = 800'

0 400 800

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Environmental Remediation

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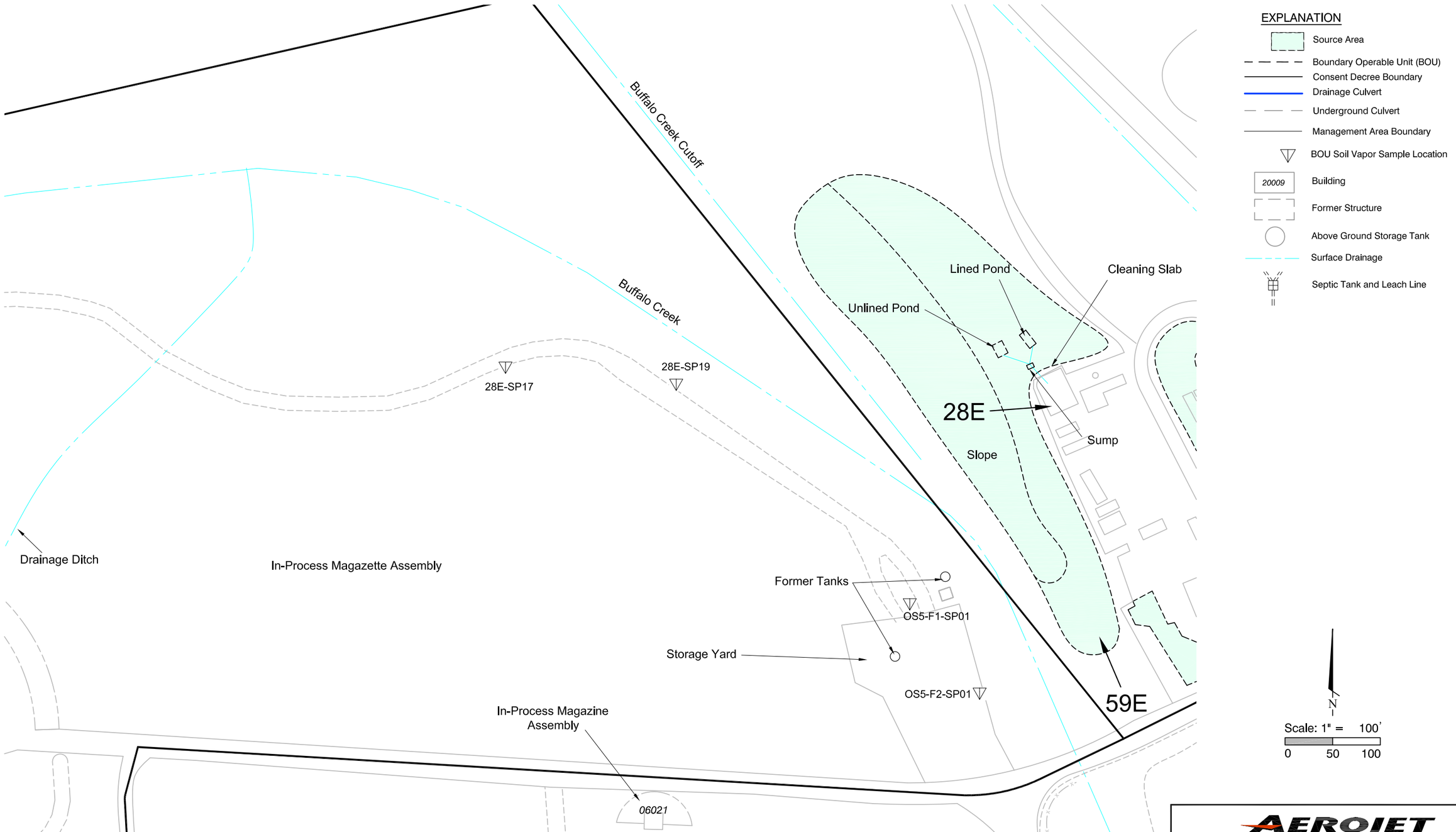
FIGURE 5.5-1
Site Features
Open Space Areas 5, 6, and 7

8/14/08 pr SR10131011



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Environmental Remediation

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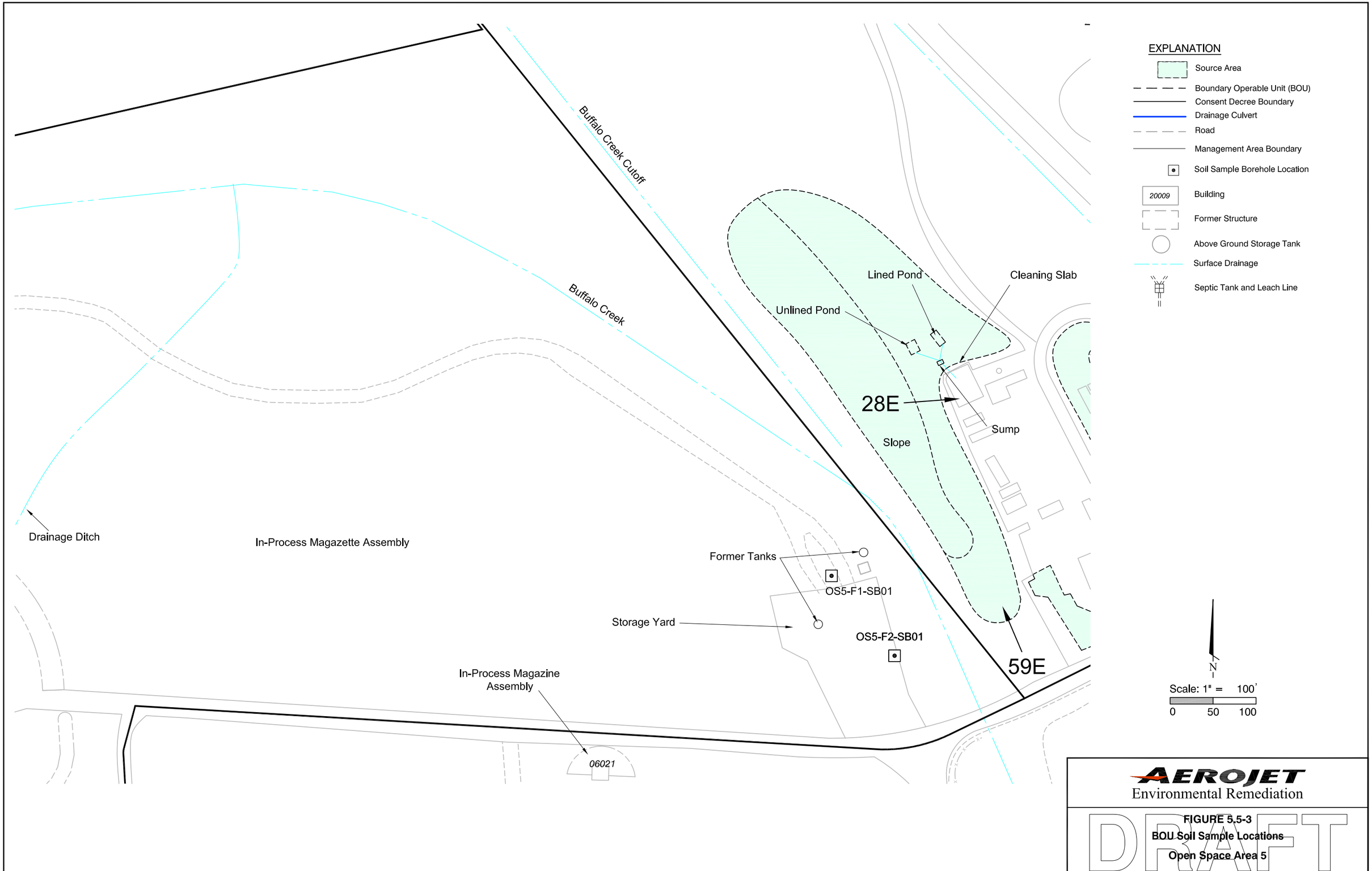
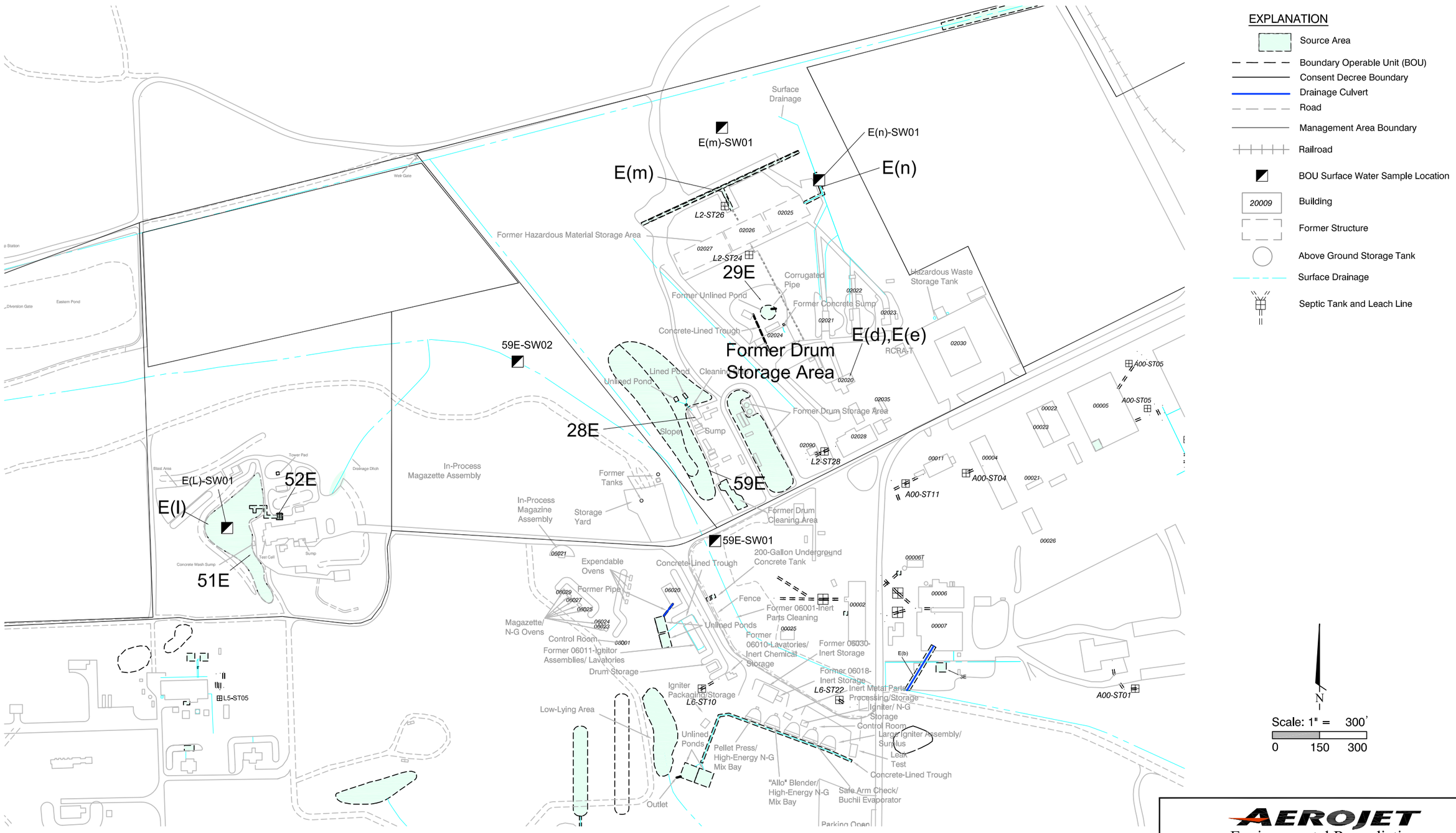
FIGURE 5.5-2
BOU Soil Vapor Sample Locations
Open Space Area 5

3/12/08 PER SR10131012



9/11/08 PER SR10131013

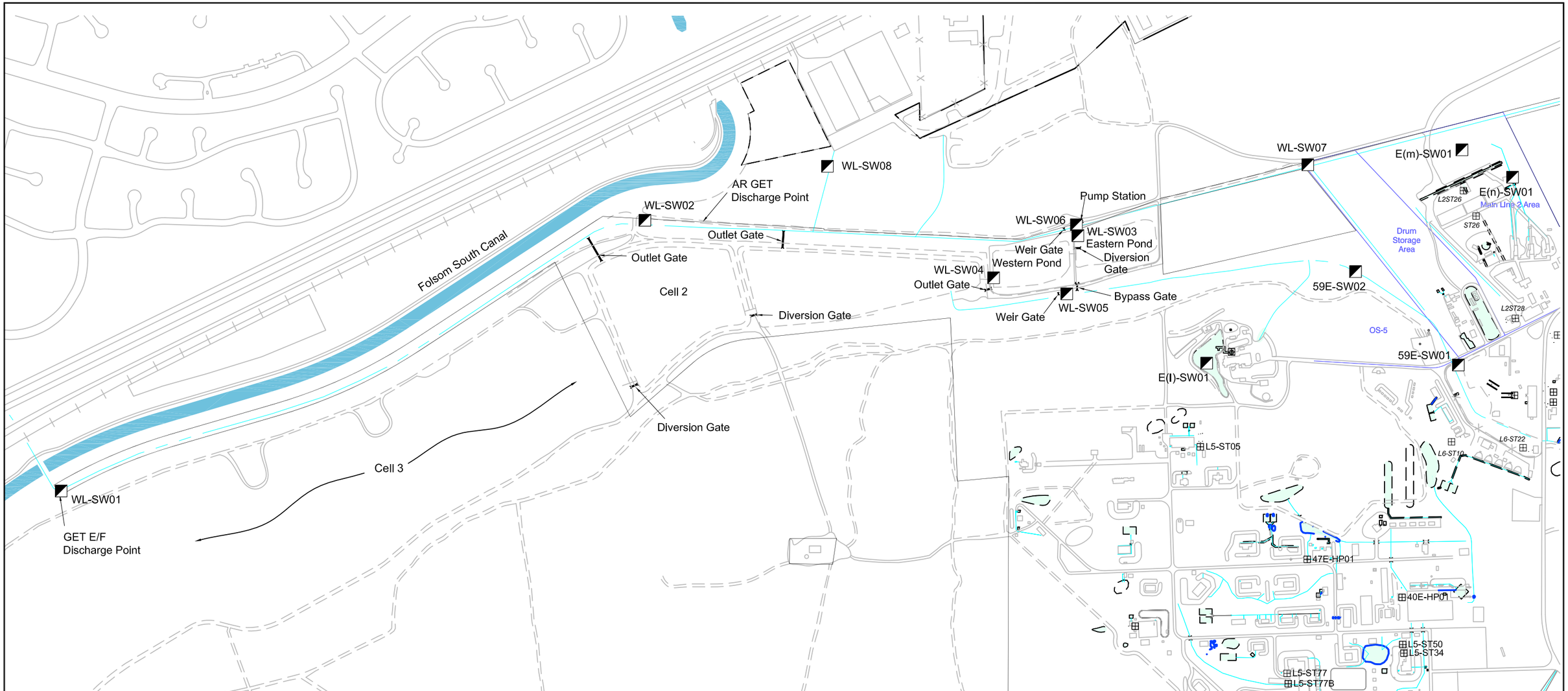


AEROJET
Environmental Remediation

FIGURE 5.6-1
BOU Surface Water Sample Locations
Line 02 and Line 5 North, and Buffalo Creek Areas

DRAFT

9/8/08 PER SR10131014



EXPLANATION

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Drainage Culvert
- Road
- BOU Surface Water Sample Location
- Railroad
- 20009 Building
- Above Ground Storage Tank
- Surface Drainage
- Septic Tank and Leach Line
- AR American River
- GET Groundwater Extraction and Treatment

N

Scale: 1" = 600'

0 300 600

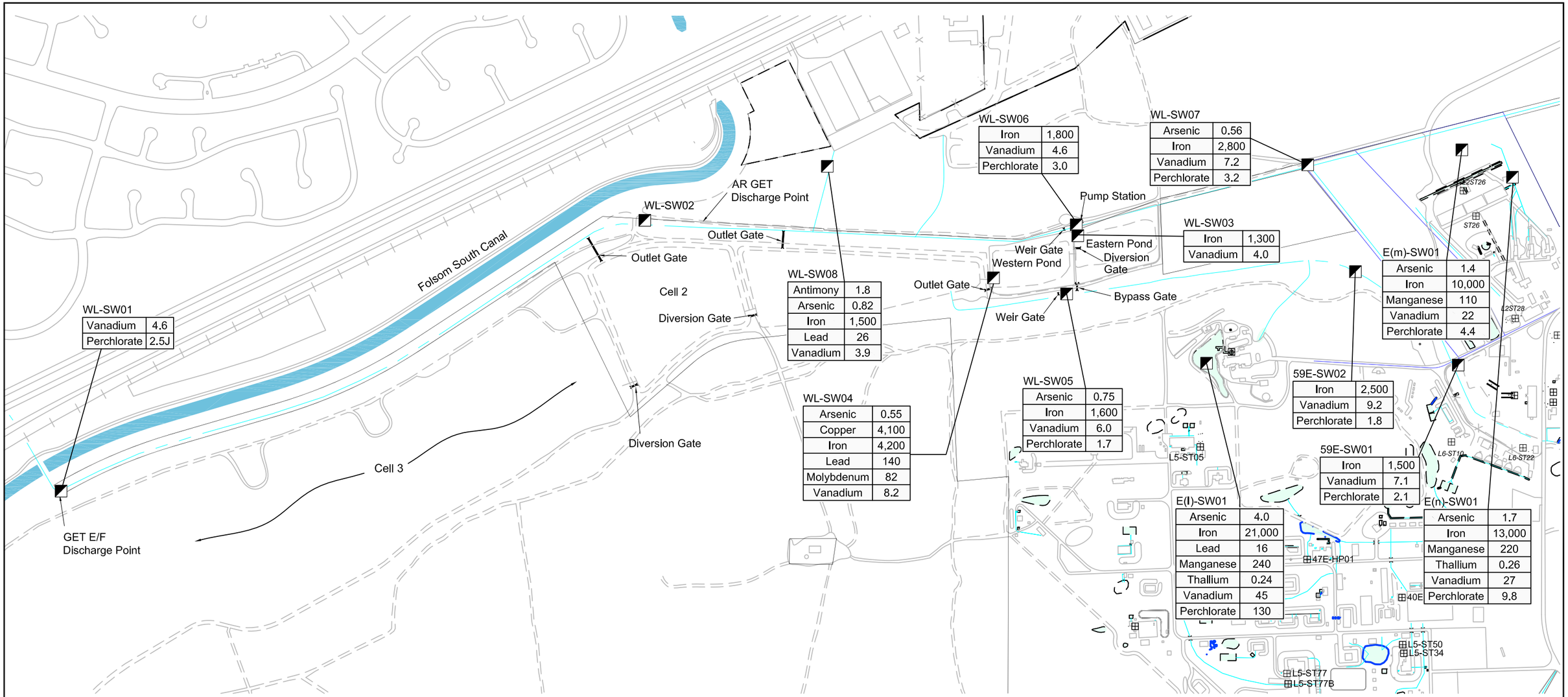
AEROJET
Environmental Remediation

FIGURE 5.6-2

BOU Surface Water Sample Locations

Westlakes Area

7/22/08 PER SR10131015



EXPLANATION

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Drainage Culvert
- Road
- BOU Surface Water Sample Location
- Railroad
- 20009 Building
- Above Ground Storage Tank
- Surface Drainage
- Septic Tank and Leach Line
- AR American River
- GET Groundwater Extraction and Treatment
- J Estimated Concentration

NOTE

Concentrations in micrograms per liter (µg/L).

N

Scale: 1" = 600'

0 300 600

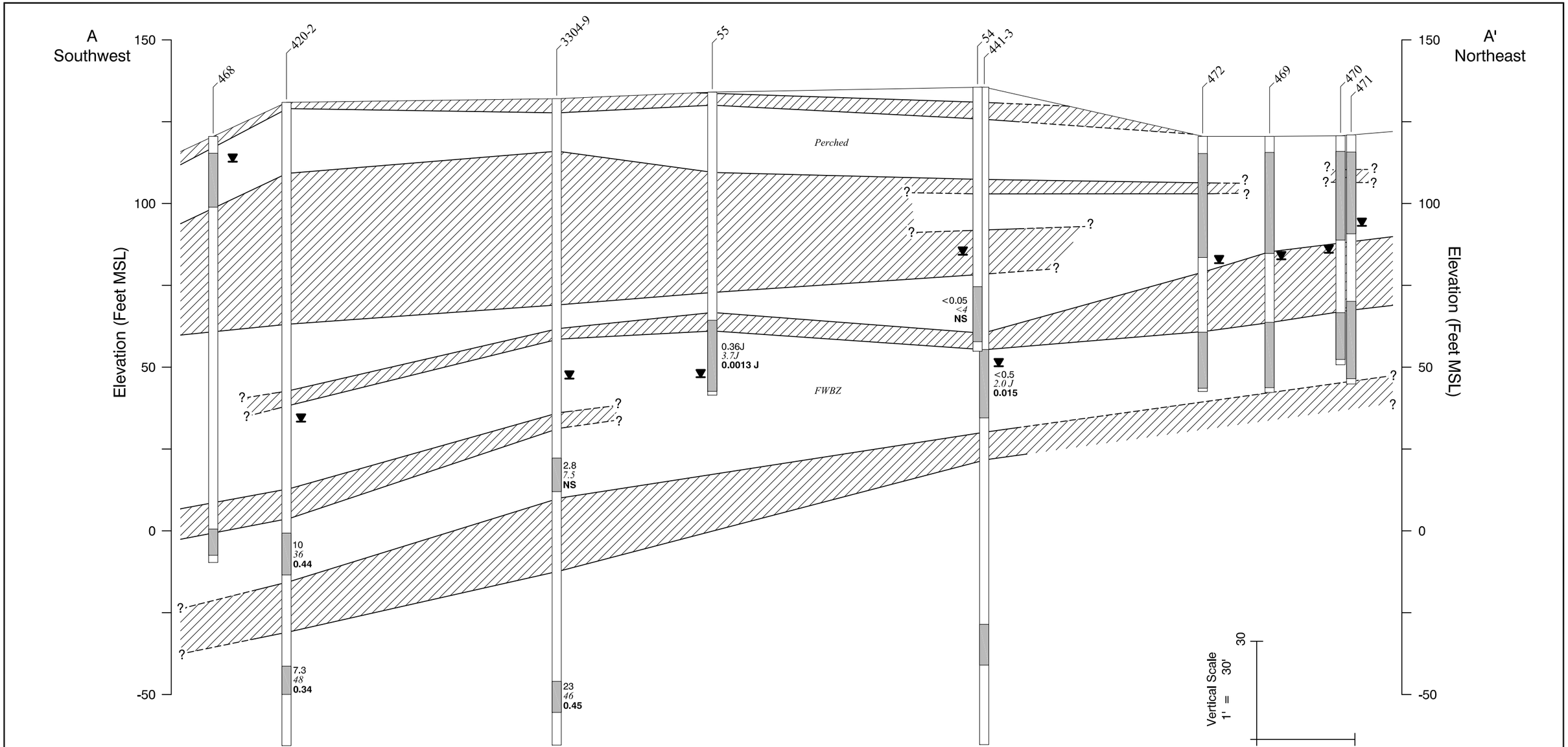
AEROJET
Environmental Remediation

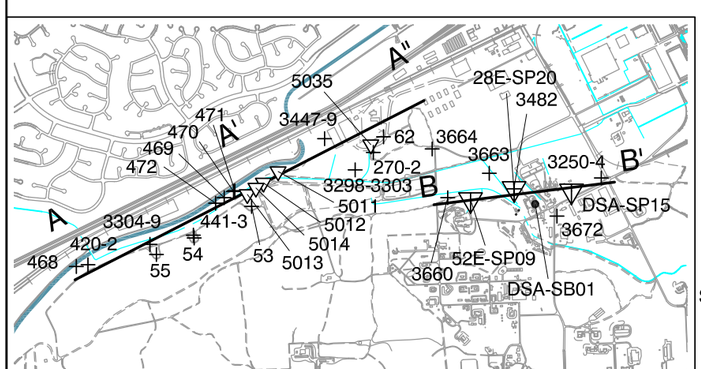
FIGURE 5.6-3

Total Metals and Perchlorate Above Surface Water Screening Levels

Westlakes Area

7/22/08 PER SR10130189





Scale: 1" = 3000'

0 1500 3000

Locator Scale

N

EXPLANATION

1001 — Well Designation
Multiple Completions: Depth Increases by Ascending Well Number Order

<0.5 — TCE Concentration in µg/L
<4 — Perchlorate Concentration in µg/L
<0.0075 — NDMA Concentration in µg/L
(NS = Not Sampled)

Screened Interval

Total Borehole Depth

Water Level

Layer Boundary

Geologic Contact

Relatively permeable sediments: Silty, poorly and well-graded sands and gravels (GP,GW,SP,SW); silty and clayey gravels (GM/GC) and silts.

Relatively lower permeability sediments: Low plasticity clays and silts (CL,ML); silty and clayey sand (SM/SC).

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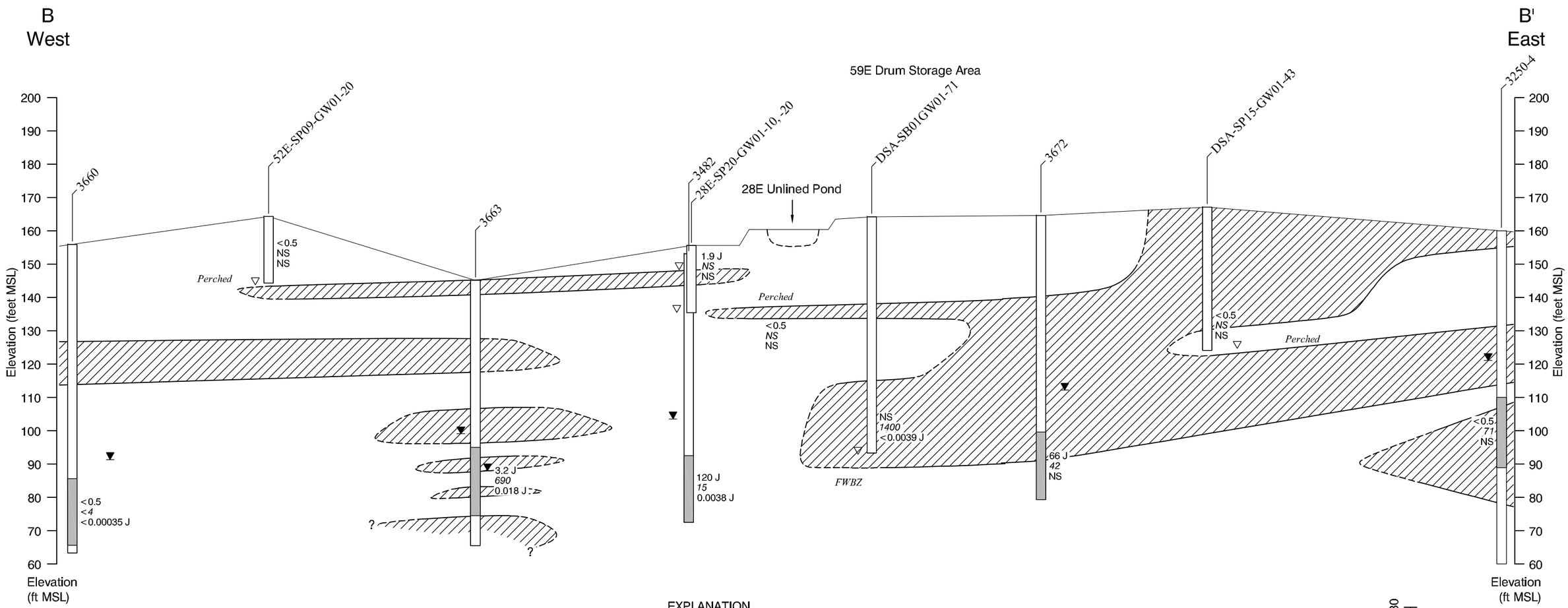
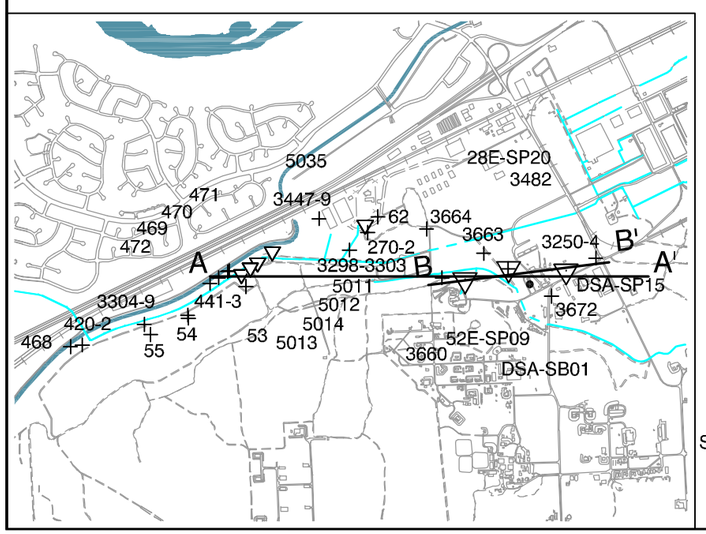
Environmental Remediation

DRAFT

FIGURE 5.7-1
Hydrostratigraphic Cross Section A - A'
Westlakes Area
Boundary Operable Unit (OU-6)

6/21/07 ah SR10131016





Scale: 1" = 3,000'

0 1,500 3,000

Locator Scale

N

EXPLANATION

1001 — Well Designation
Multiple Completions: Depth Increases by Ascending Well Number Order

<0.5 — TCE Concentration in µg/L
<4 — Perchlorate Concentration in µg/L
<0.00035 J — NDMA Concentration in Mg/L
(NS = Not Sampled)

Screened Interval
Total Borehole Depth

▽ Grab Groundwater Sample Collection Depth

▼ Water Level

Layer Boundary

Geologic Contact

Relatively permeable sediments: Silty, poorly and well-graded sands and gravels (GP,GW,SP,SW); silty and clayey gravels (GM/GC) and silts.

Relatively lower permeability sediments: Low plasticity clays and silts (CL,ML); silty and clayey sand (SM/SC).

Vertical Scale 1' = 30'

0 30

0 210

Horizontal Scale 1' = 210'

Vertical Exaggeration: 7X

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Environmental Remediation

FIGURE 5.7-2

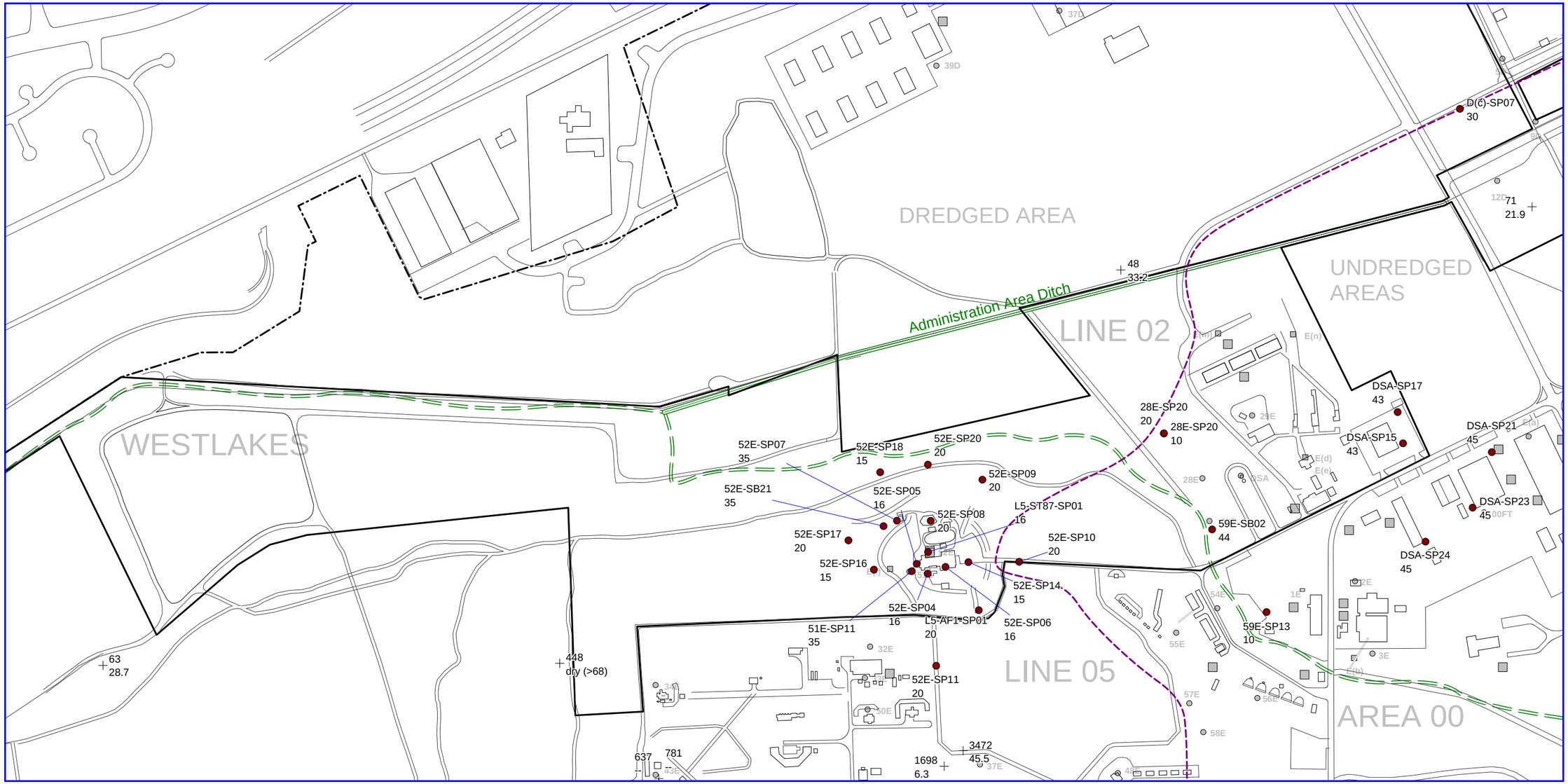
Hydrostratigraphic Cross-Section B-B'
Westlakes Area
Boundary Operable Unit (OU-5)

AEROJET SUPERFUND SITE, SACRAMENTO COUNTY, CA

Gram, Bob 2:10:15 PM 10/9/08

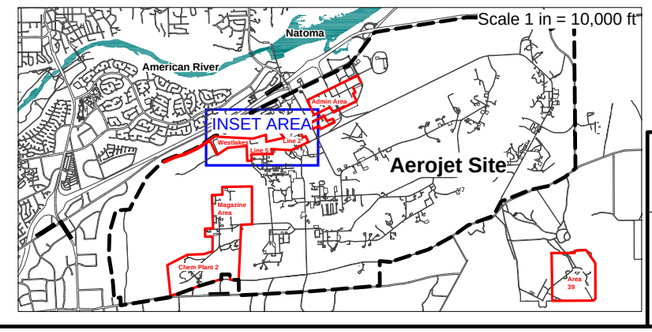
FIGURE 5.7-2

SR10121810



Explanation

- 03D-SP01 61.3 — Grab Groundwater Sample Location and Depth to Groundwater (ft, bgs) -- = Not Measured
- 645 61.3 — Monitoring Well, ID and Depth to Groundwater (ft, bgs)
- Buffalo Creek
- Dredged/Undredged Contact (from ICF, 1991)
- Aerojet Property Boundary
- Building
- Consent Decree Boundary
- Septic Tank
- Drainage Culvert
- 39D — Source Site ID



N

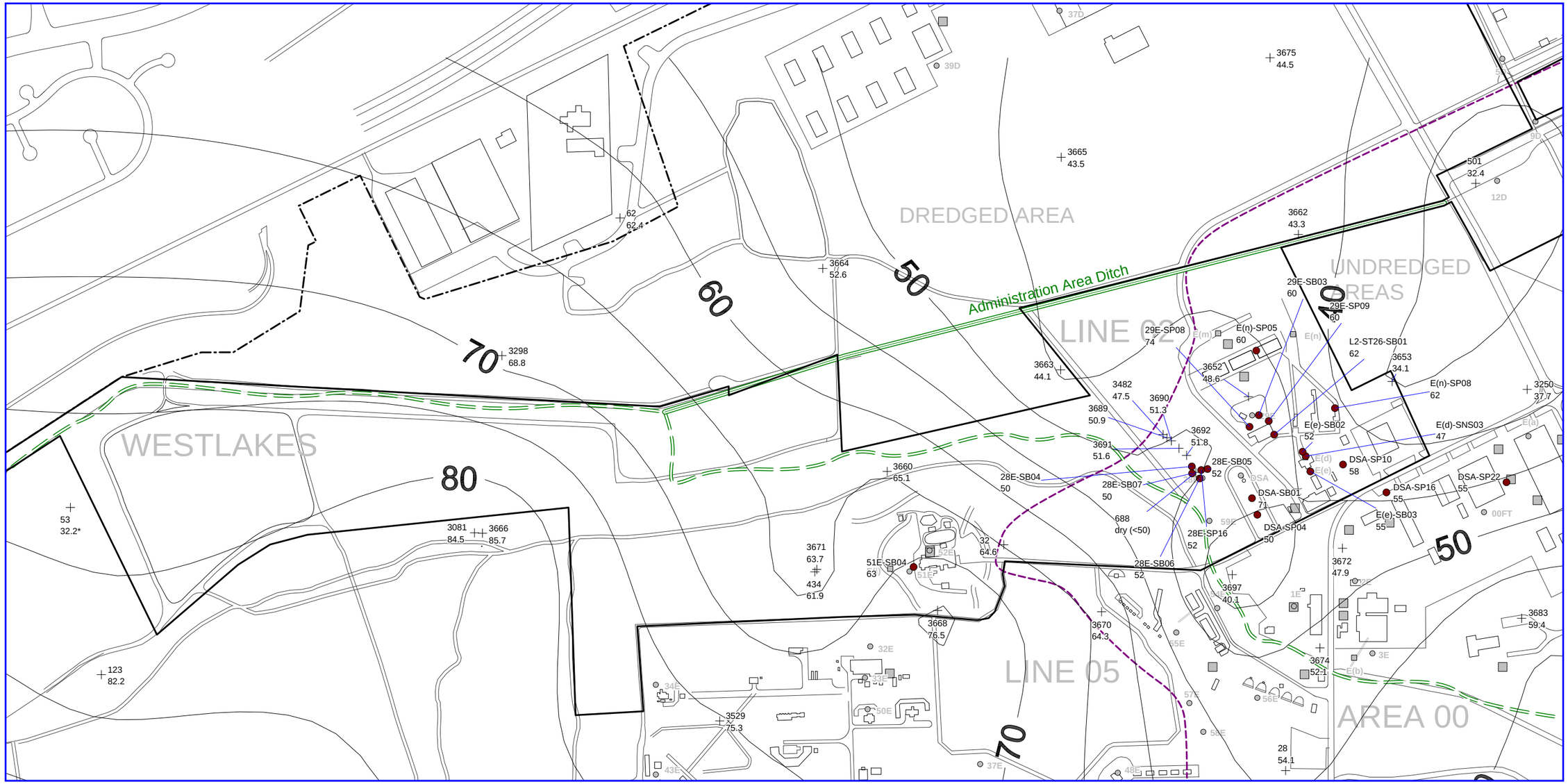
0 500 1,000
feet

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

AEROJET
Environmental Remediation

Figure 5.7-3
Perched Groundwater
Depth to Groundwater, January - April 2006
Westlakes Area, Boundary Operable Unit (OU-6)

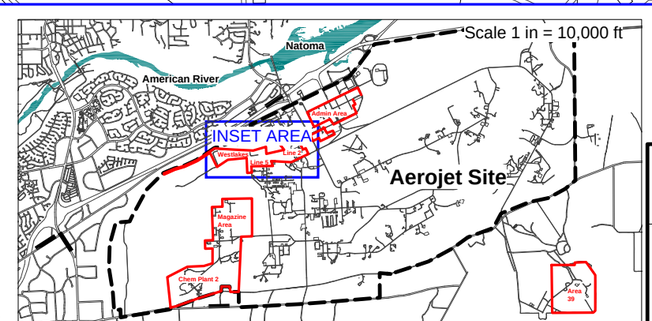
SR10131064



Explanation

- 03D-SP01 61.3 — Grab Groundwater Sample Location and Depth to Groundwater Elevation (ft, bgs) - data not used in contouring
- 645 61.3 — Monitoring Well, ID and Depth to Groundwater (ft, bgs)
- Depth to Groundwater Contour (ft, bgs)
- Buffalo Creek
- Dredged/Undredged Contact (from ICF 1991)
- Aerojet Property Boundary
- Building
- Consent Decree Boundary
- Septic Tank
- 39D — Source Site ID
- Drainage Culvert

Note: -- = Not Measured * = data not used in contouring



N

0 500 1,000
feet

Figure created on behalf of Aerojet by: CVEI
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AEROJET
Environmental Remediation

Figure 5.7-4
First Water-Bearing Zone
Depth to Groundwater, April 2006
Westlakes Area, Boundary Operable Unit (OU-6)

SR10131064

DREDGED AREA

UNDREDGED AREAS

WESTLAKES

LINE 02

LINE 05

AREA 00

Administration Area Ditch

D(c)-SP07
121.8

71
136

48
116

DSA-SP17
124.9

28E-SP20
135.4

28E-SP20
145.4

DSA-SP15
123.8

DSA-SP21
126.8

DSA-SP23
129.3

DSA-SP24
127.6

59E-SB02
114.1

59E-SP13
155.3

52E-SP07
129.7

52E-SP18
143.7

52E-SP20
136.7

52E-SP09
144.1

52E-SB21
127.6

52E-SP05
142.5

52E-SP08
140.5

L5-ST87-SP01
143.9

52E-SP17
138.7

52E-SP10
143.4

52E-SP16
145.2

52E-SP14
150.2

51E-SP11
117.2

52E-SP06
143.3

52E-SP04
142.9

52E-SP11
143.1

L5-AF1-SP01
141

63
106.5

448
dry (<85.1)

3472
120.3

1698
156.3

637

781

Explanation

03D-SP01 61.3 — Grab Groundwater Sample Location and Groundwater Elevation (ft, msl)

645 61.3 — Monitoring Well, ID and Groundwater Elevation (ft, msl)

Buffalo Creek

Dredged/Undredged Contact (from ICF, 1991)

Aerojet Property Boundary

Note: -- = Not Measured

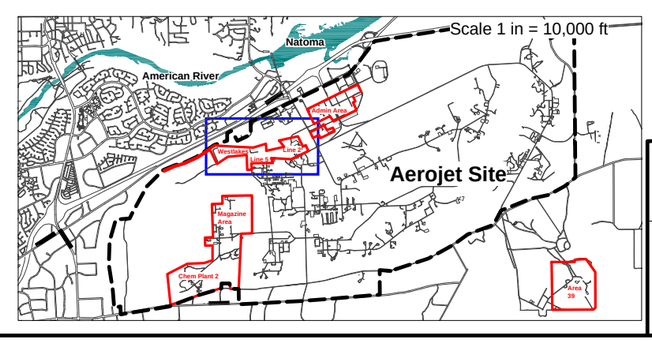
Building

Consent Decree Boundary

Septic Tank

Drainage Culvert

39D — Source Site ID



N

0 500 1,000
feet

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

AEROJET
Environmental Remediation

Figure 5.7-5
Perched Groundwater
Groundwater Elevations, January - April 2006
Westlakes Area, Boundary Operable Unit (OU-6)

SR10131064

DREDGED AREA

UNDREDGED AREAS

LINE 02

LINE 05

WESTLAKES

AREA 00

Administration Area Ditch

60 70 80 90 100 110 120

3675 103.3
3665 104.2
3662 104.4
501 114.4
62 77.5
3664 91.1
3298 70.7
3663 103.8
3652 104.6
3653 118.4
3250 124.5
3482 106.3
3690 103.1
3689 103.1
3692 103.1
3691 103.1
3660 93.9
28E-SB04 98.7
28E-SB07 106.2
28E-SB05 102.2
28E-SB06 104.9
28E-SP16 104
688 dry (<101.7)
32 101.1
51E-SB04 95.5
3671 89.1
434 90.7
3668 87.7
3670 101.5
3697 121.5
3672 116.5
3674 110.9
3683 121.8
28 116.2
3529 80.4
53 105*
123 54.8
3081 69
3666 67.3

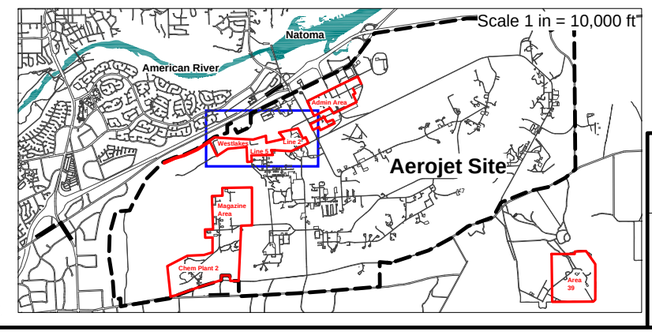
29E-SB03 98.4
29E-SP09 98.8
29E-SP08 84.6
E(m)-SP05 86.9
L2-ST26-SB01 95
E(n)-SP08 87.9
E(e)-SB02 108.3
E(d)-SNS03 114.1
DSA-SP10 110.3
DSA-SP22 118
DSA-SP16 115.7
E(e)-SB03 112.2
DSA-SB01 93
DSA-SP04 113.7

39D 37D 12D 9D 5D 59E 52E 51E 32E 34E 43E 50E 57E 55E 54E 1E 32E 5E 56E 58E 48E 00FT E(m) E(n) E(d) E(e) E(a) E(b)

Explanation

- 03D-SP01 61.3 — Grab Groundwater Sample Location and Groundwater Elevation (ft, msl) - data not used in contouring
- 645 61.3 — Monitoring Well, ID and Groundwater Elevation (ft, msl)
- Groundwater Elevation Contour (ft, msl)
- Buffalo Creek
- Dredged/Undredged Contact (from ICF 1991)
- Aerojet Property Boundary
- Building
- Consent Decree Boundary
- Septic Tank
- Drainage Culvert
- 39D — Source Site ID

Note: -- = Not Measured * = data not used in contouring



N

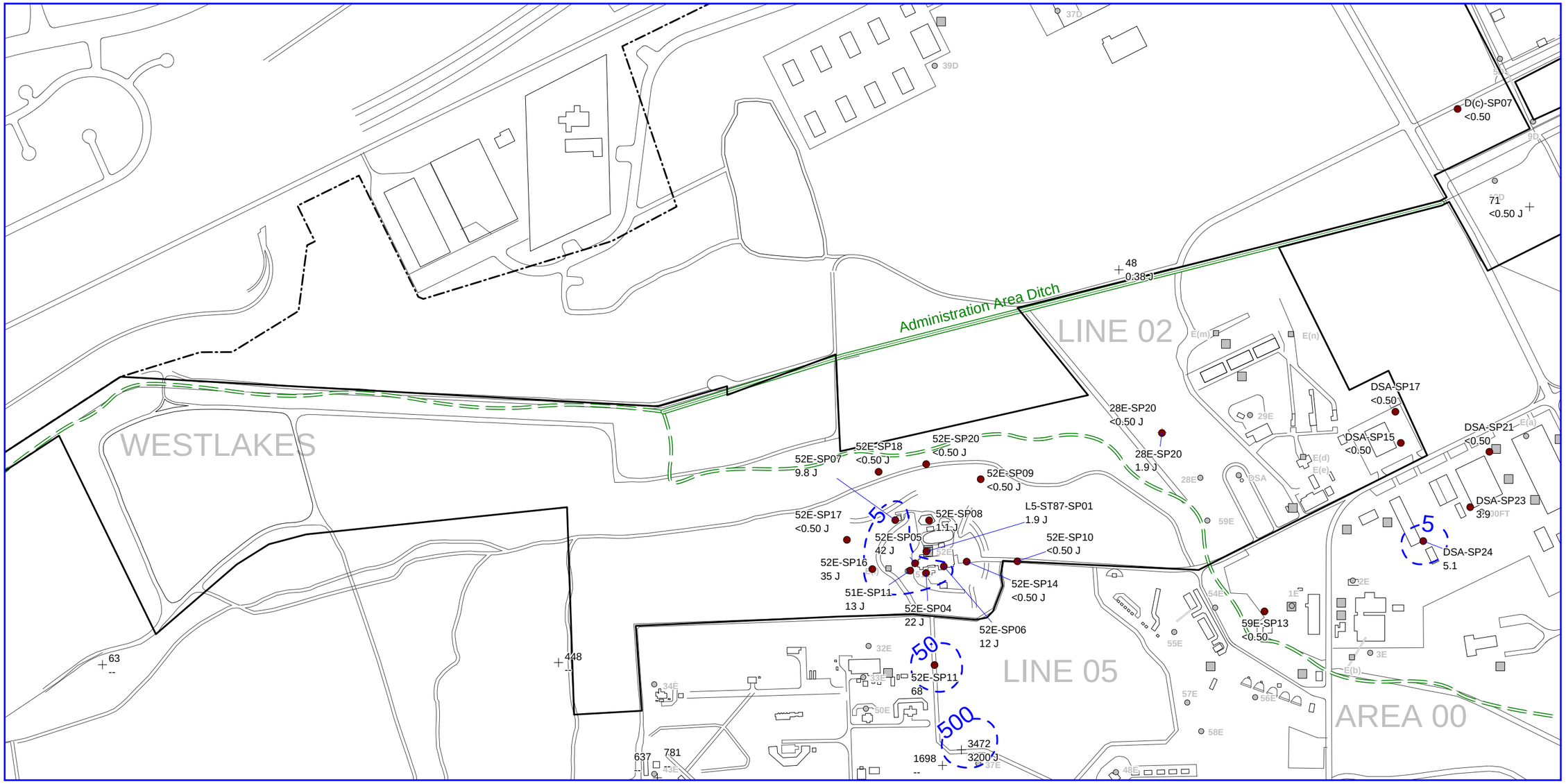
0 500 1,000
feet

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

AEROJET
Environmental Remediation

Figure 5.7-6
First Water-Bearing Zone
Potentiometric Surface Map, April 2006
Westlakes Area, Boundary Operable Unit (OU-6)

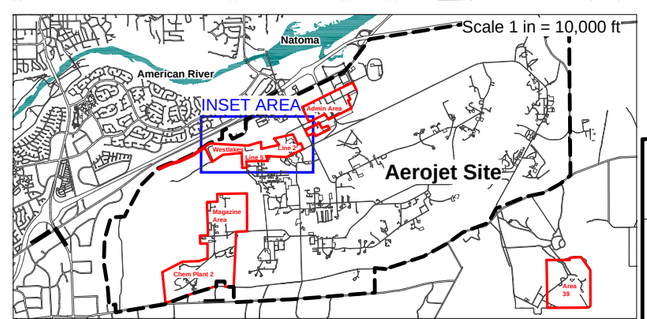
SR10131064



Explanation

- 03D-SP01 61.3 — Grab Groundwater Sample Location and Concentration (ug/L)
- 645 61.3 — Monitoring Well, ID and Concentration (ug/L)
- Iso-Concentration Contour (ug/L) - lines dashed where inferred
- Aerojet Property Boundary
- Buffalo Creek
- Building
- Consent Decree Boundary
- Drainage Culvert
- Septic Tank
- 39D — Source Site ID

Note: -- = Not Sampled Sample Period - October 2005 to October 2006
* = Asterisk Indicates Data Collected Outside RI Sampling Period. J = Estimated Value PGW SVSL = Protection to Groundwater Soil Vapor Screening Level



N

0 500 1,000
feet

Figure created on behalf of Aerojet by: CVEI
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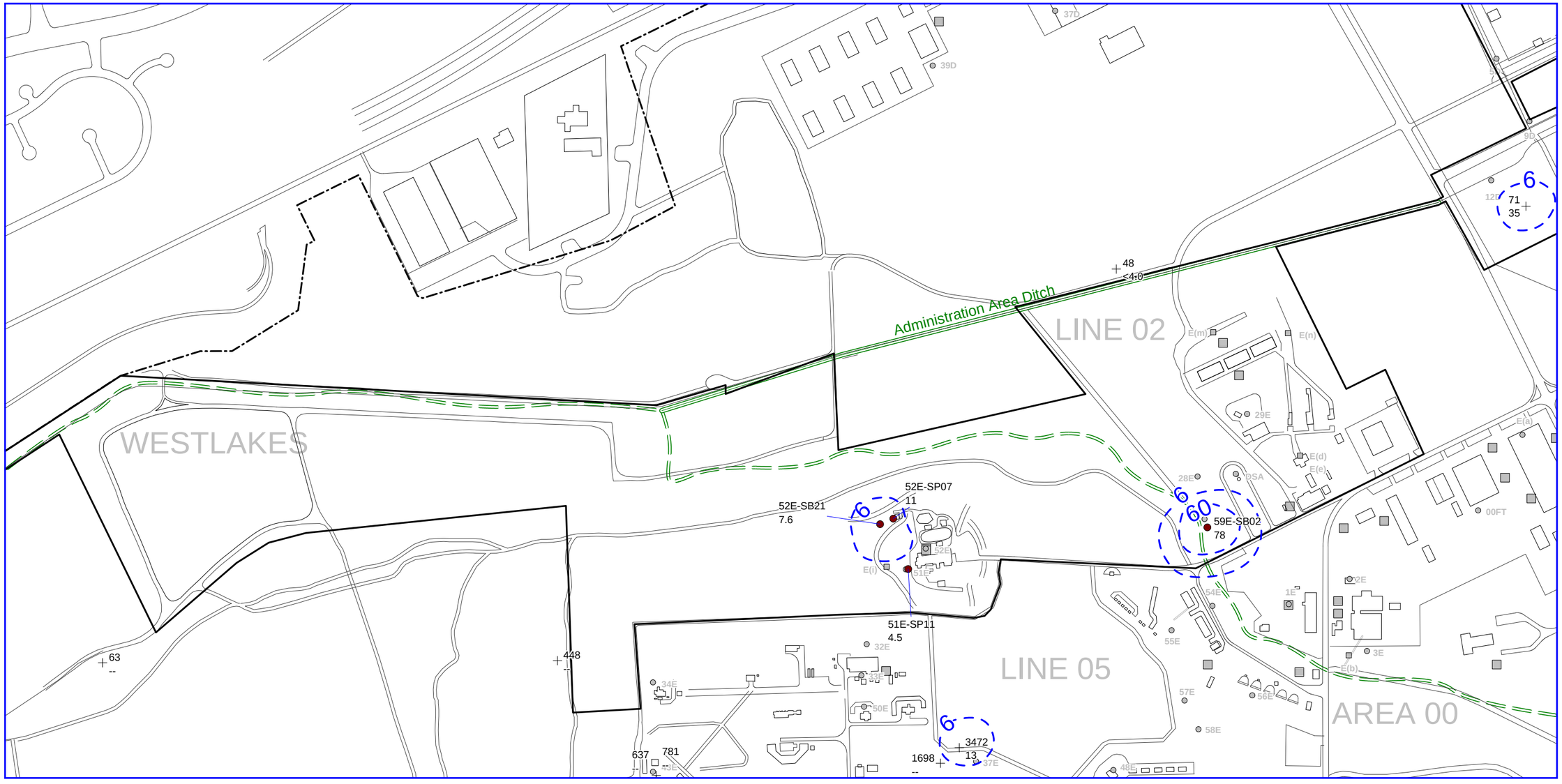
AEROJET
Environmental Remediation

Figure 5.7-7
Perched Groundwater
TCE Iso-concentration Contours
Westlakes Area, Boundary Operable Unit (OU-6)

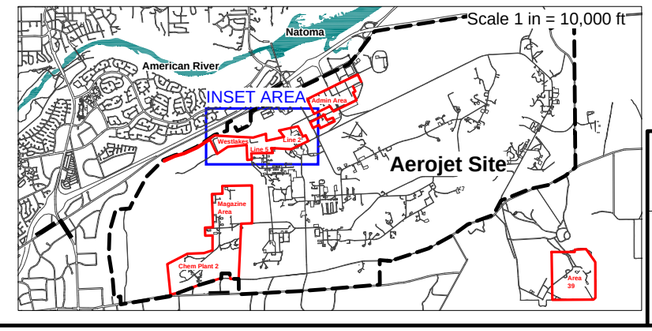
SR10131064



Explanation

- 03D-SP01 61.3 — Grab Groundwater Sample Location and Concentration (ug/L)
- 645 61.3 — Monitoring Well, ID and Concentration (ug/L)
- Iso-Concentration Contour (ug/L) - lines dashed where inferred
- Aerojet Property Boundary
- Buffalo Creek
- Building
- Consent Decree Boundary
- Septic Tank
- Drainage Culvert
- 39D — Source Site ID

Note: -- = Not Sampled Sample Period - October 2005 to October 2006
* = Asterisk Indicates Data Collected Outside RI Sampling Period. J = Estimated Value PGW SSL = Protection to groundwater soil screening level



N

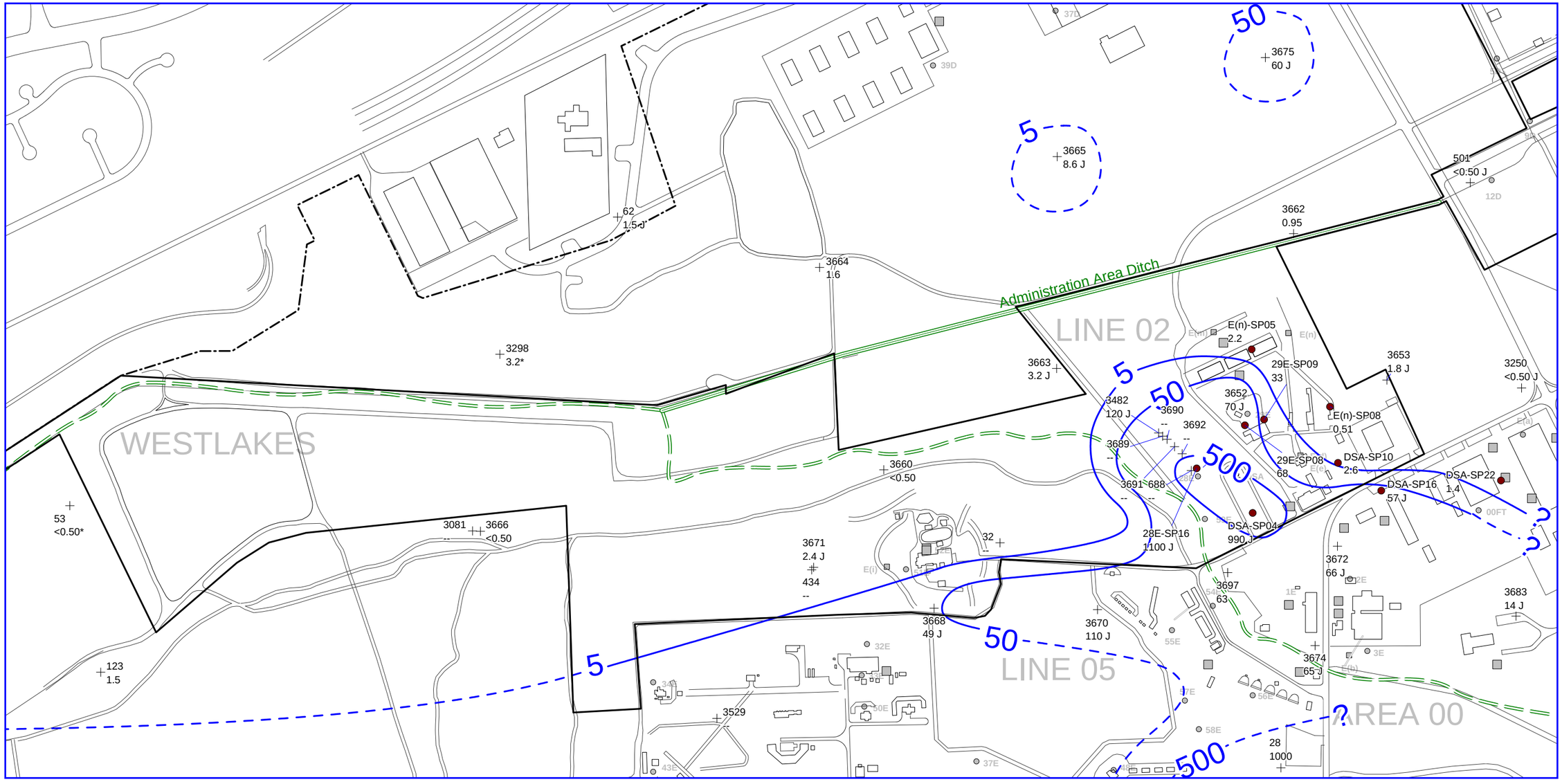
0 500 1,000
feet

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

AEROJET
Environmental Remediation

Figure 5.7-8
Perched Groundwater
Perchlorate Iso-concentration Contours
Westlakes Area, Boundary Operable Unit (OU-6)

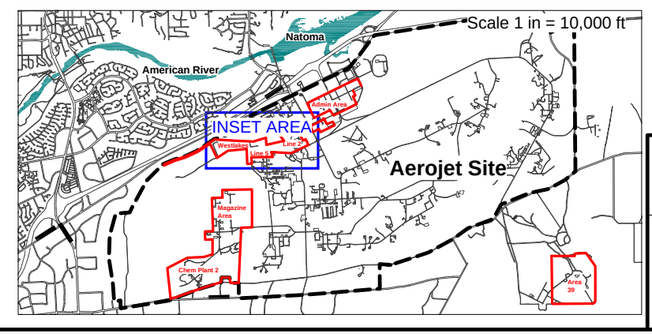
SR10131064



Explanation

- 03D-SP01 61.3 — Grab Groundwater Sample Location and Concentration (ug/L)
- 645 61.3 — Monitoring Well, ID and Concentration (ug/L)
- Iso-Concentration Contour (ug/L) - lines dashed where inferred
- Aerojet Property Boundary
- Buffalo Creek
- Building
- Consent Decree Boundary
- Septic Tank
- Drainage Culvert
- 39D — Source Site ID

Note: -- = Not Sampled Sample Period - October 2005 to October 2006
* = Asterisk Indicates Data Collected Outside RI Sampling Period. J = Estimated Value PGW SVSL = Protection to Groundwater Soil Vapor Screening Level



N

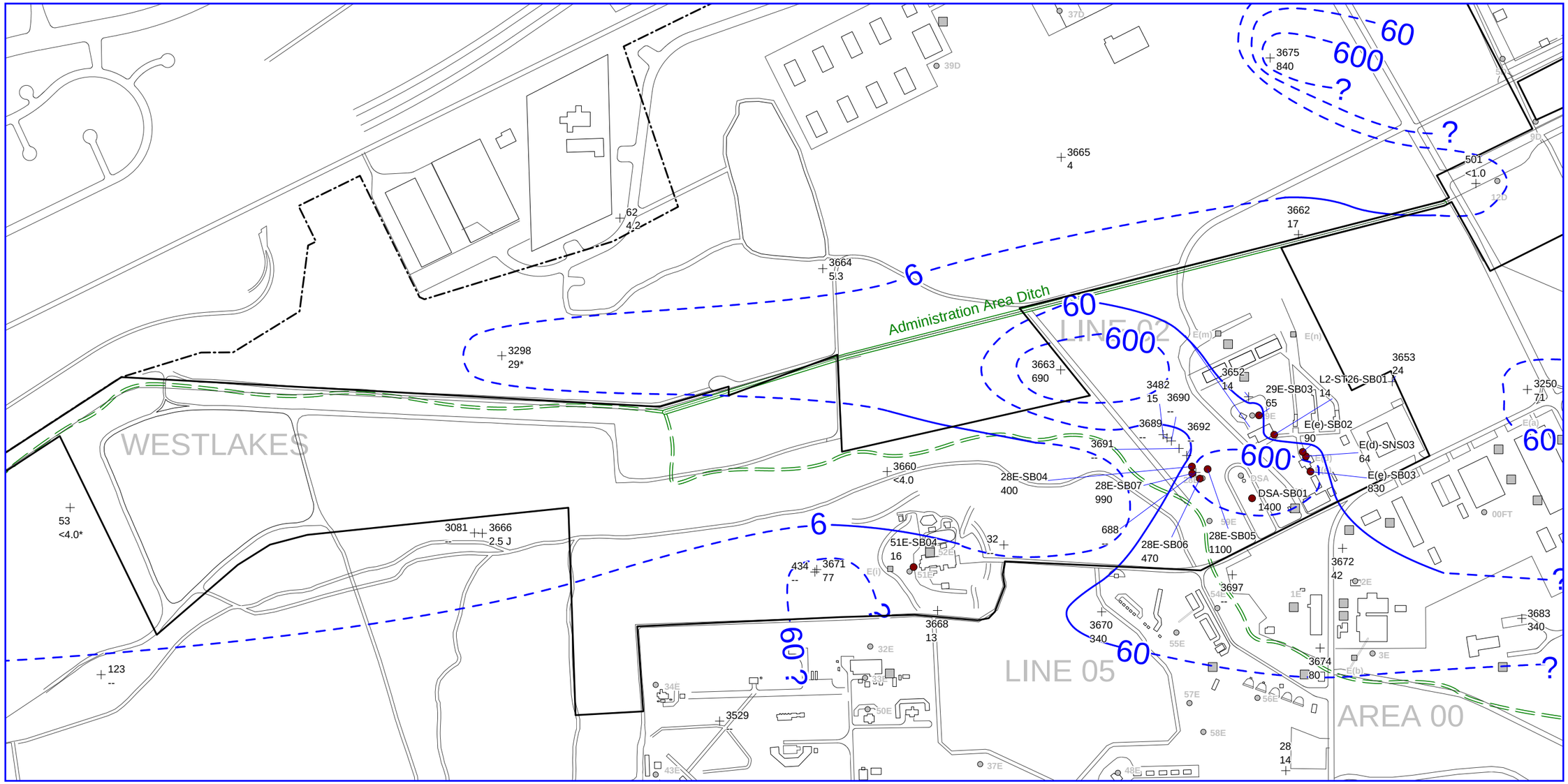
0 500 1,000
feet

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

AEROJET
Environmental Remediation

Figure 5.7-9
First Water-Bearing Zone
TCE Iso-Concentration Contours
Westlakes Area, Boundary Operable Unit (OU-6)

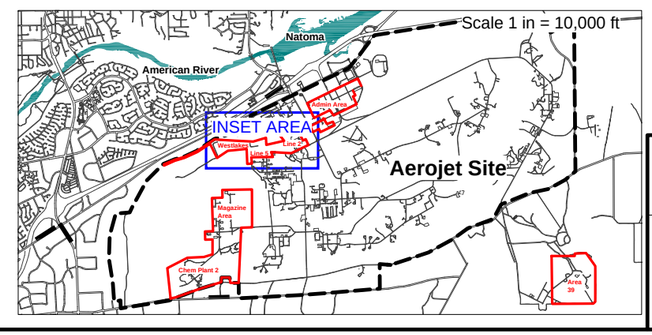
SR10131064



Explanation

03D-SP01 61.3	Grab Groundwater Sample Location and Concentration (ug/L)
645 61.3	Monitoring Well, ID and Concentration (ug/L)
	Iso-Concentration Contour (ug/L) - lines dashed where inferred
	Aerojet Property Boundary
	Buffalo Creek
	Building
	Consent Decree Boundary
	Septic Tank
	Drainage Culvert
39D	Source Site ID

Note: -- = Not Sampled J = Estimated Value PGW SSL = Protection to Groundwater Soil Screening Level
* = Asterisk Indicates Data Collected Outside RI Sampling Period Sample Period = October 2005 to October 2006



N

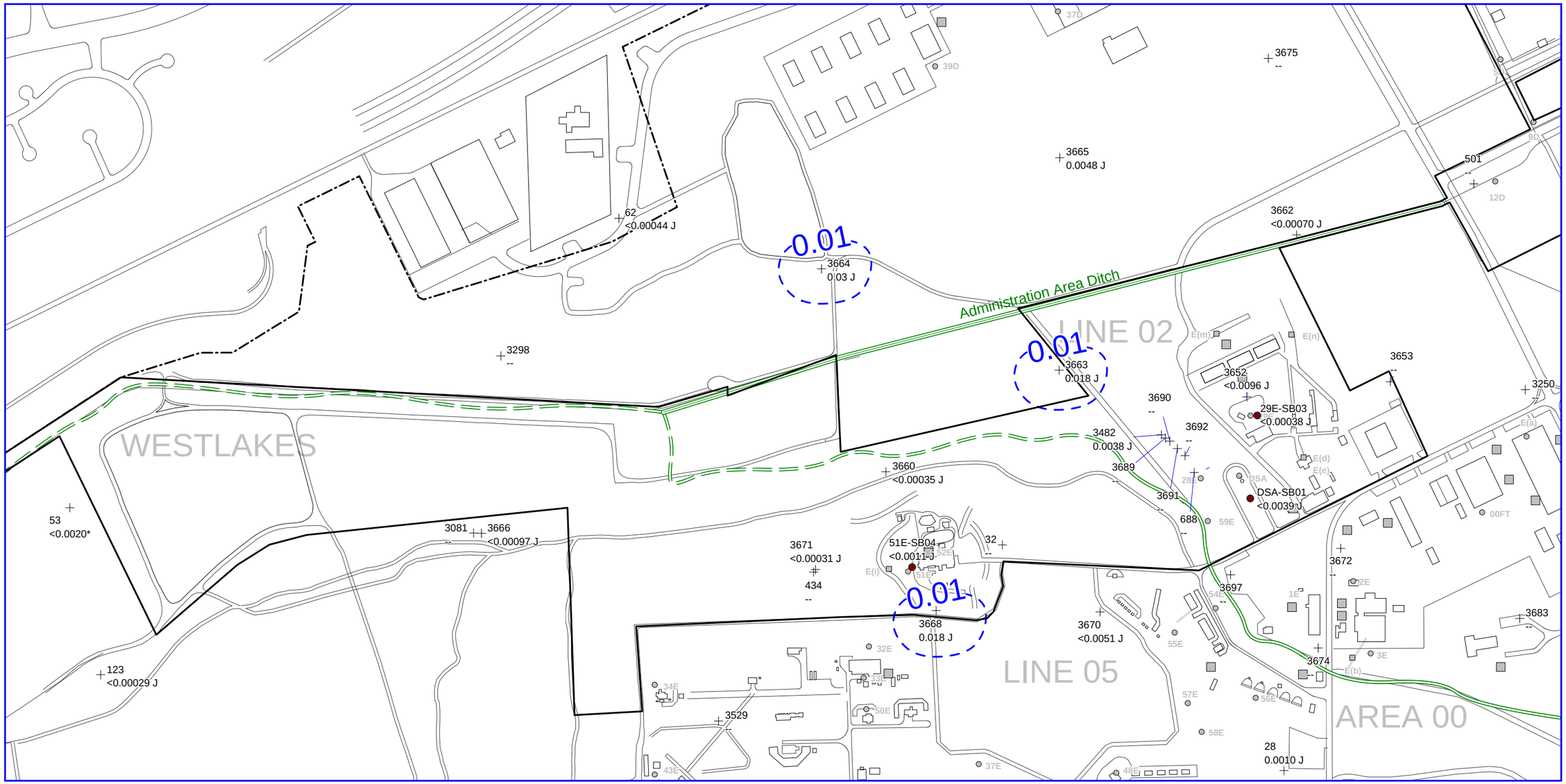
0 500 1,000
feet

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

AEROJET
Environmental Remediation

Figure 5.7-10
First Water-Bearing Zone
Perchlorate Iso-Concentration Contours
Westlakes Area, Boundary Operable Unit (OU-6)

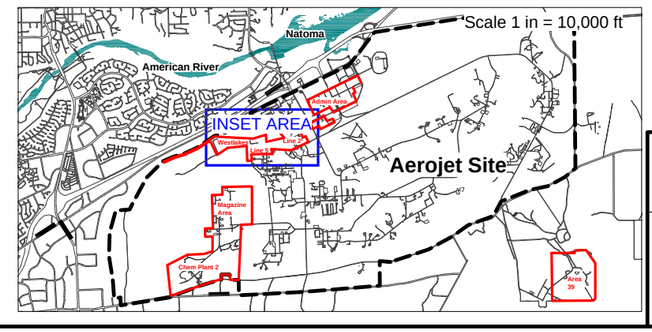
SR10131064



Explanation

- 03D-SP01 61.3 — Grab Groundwater Sample Location and Concentration (ug/L)
- 645 61.3 — Monitoring Well, ID and Concentration (ug/L)
- Iso-Concentration Contour (ug/L) - lines dashed where inferred
- Aerojet Property Boundary
- Buffalo Creek
- Building
- Consent Decree Boundary
- Septic Tank
- Drainage Culvert
- 39D — Source Site ID

Note: -- = Not Sampled Sample Period - October 2005 to October 2006
* = Asterisk Indicates Data Collected Outside RI Sampling Period. J = Estimated Value



N

0 500 1,000
feet

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

AEROJET
Environmental Remediation

Figure 5.7-11
First Water-Bearing Zone
NDMA Iso-Concentration Contours
Westlakes Area, Boundary Operable Unit (OU-6)

SR10131064

Table 5.1-1
Summary of Soil Sampling and Sampling Statistics for Source Areas 28E, 59E and DSA
Line 02 Region
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

				Source Area 28E						Source Area 59E						Source Area DSA					
Compound(s)	**Analyte**	**Method**	**Depth (feet bgs)**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**
Metals	Metals	6010B	0-2.5	3	3	1	3	33.3%	100.0%	3	3	0	3	0.0%	100.0%	5	5	0	5	0.0%	100.0%
		6020	0-2.5	3	3	1	3	33.3%	100.0%	2	4	0	4	0.0%	100.0%	3	3	0	3	0.0%	100.0%
		6010B	>2.5	3	14	1	14	7.1%	100.0%	3	8	1	8	12.5%	100.0%	5	15	1	15	6.7%	100.0%
		6020	>2.5	3	12	1	12	8.3%	100.0%	2	3	1	3	33.3%	100.0%	3	11	1	10	9.1%	90.9%
	Chromium VI	7199	0-2.5	0	0	0	0	0.0%	0.0%	3	3	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		7199	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	Mercury	7471A	0-2.5	3	3	1	3	33.3%	100.0%	3	3	0	3	0.0%	100.0%	5	5	0	5	0.0%	100.0%
		7471A	>2.5	3	14	1	12	7.1%	85.7%	3	8	1	5	12.5%	62.5%	5	15	1	13	6.7%	86.7%
SVOCs	SVOCs	8270C	0-2.5	4	4	2	2	50.0%	50.0%	3	3	0	3	0.0%	100.0%	5	5	0	2	0.0%	40.0%
		8270C	>2.5	2	12	1	2	8.3%	16.7%	3	8	1	1	12.5%	12.5%	5	14	1	2	7.1%	14.3%
PCBs	PCBs	8082	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		8082	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
Perchlorate	Perchlorate	314.0, 314.0M	0-2.5	7	7	1	4	14.3%	57.1%	3	3	0	0	0.0%	0.0%	4	4	0	4	0.0%	100.0%
		314.0, 314.0M	>2.5	7	38	2	34	5.3%	89.5%	3	8	1	4	12.5%	50.0%	4	12	1	10	8.3%	83.3%
TPH	Diesel	8015B-SVOA - Diesel	0-2.5	3	3	1	3	33.3%	100.0%	3	3	0	3	0.0%	100.0%	5	5	0	5	0.0%	100.0%
		8015B-SVOA - Diesel	>2.5	2	12	1	12	8.3%	100.0%	3	8	1	8	12.5%	100.0%	4	13	1	12	7.7%	92.3%
	Motor Oil	8015B-SVOA - Oil	0-2.5	3	3	1	3	33.3%	100.0%	3	3	0	6	0.0%	200.0%	5	5	0	5	0.0%	100.0%
		8015B-SVOA - Oil	>2.5	2	12	1	10	8.3%	83.3%	3	8	1	7	12.5%	87.5%	4	13	1	12	7.7%	92.3%
Misc.	Total Cyanide	9014	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		9014	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	NDMA	1625C-CI M	0-2.5	3	3	1	0	33.3%	0.0%	3	3	0	0	0.0%	0.0%	4	4	0	0	0.0%	0.0%
		1625C-CI M	>2.5	2	12	1	0	8.3%	0.0%	3	8	1	1	12.5%	12.5%	4	12	1	0	8.3%	0.0%
	pH	9045C	0-2.5	0	0	0	0	0.0%	0.0%	2	4	0	4	0.0%	100.0%	0	0	0	0	0.0%	0.0%
		9045C	>2.5	0	0	0	0	0.0%	0.0%	1	1	0	1	0.0%	100.0%	0	0	0	0	0.0%	0.0%
	TOC	9060A MOD	0-2.5	0	0	0	0	0.0%	0.0%	2	4	0	2	0.0%	50.0%	1	1	0	0	0.0%	0.0%
		9060A MOD	>2.5	0	0	0	0	0.0%	0.0%	1	1	0	0	0.0%	0.0%	1	7	1	0	14.3%	0.0%
	CEC	9081	0-2.5	0	0	0	0	0.0%	0.0%	2	4	0	4	0.0%	100.0%	1	1	0	1	0.0%	100.0%
		9081	>2.5	0	0	0	0	0.0%	0.0%	1	1	0	1	0.0%	100.0%	1	7	1	7	14.3%	100.0%

Notes and Key:

> = Greater than
% = Percent
bgs = Below ground surface
CEC = Cation Exchange Capacity
Chromium VI = Hexavalent chromium
NDMA = N-Nitrosodimethylamine
PCBs = Polychlorinated biphenyls
SVOCs = Semivolatile organic compounds
TOC = Total Organic Content
TPH = Total petroleum hydrocarbons

Table 5.1-2 Cross-Reference Between Soil and Soil Vapor Sampling Locations and Investigated Features
Line 02 - Drum Storage Area (DSA)
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Associated Site Feature	Source Area	Soil Sampling Location(s)	Soil Vapor Sampling Location(s)
CLEANING SLAB & SUMP Cleaning slab (concrete slab) and concrete-lined sump on slope above lined and unlined ponds	28E	28E-SB03 28E-SB06	
FORMER DRUM STORAGE AREA / RCRA-Z Former unlined drum storage area and former RCRA-Z.	DSA	DSA-SB01 DSA-SB02 DSA-SB03	DSA-SP04 DSA-SP05 DSA-SP06 DSA-SP07 DSA-SP08 DSA-SP12 DSA-SP13 59E-SP10 59E-SP13
FORMER MATERIAL STORAGE AREA Former material storage area north of Building 02090	DSA	DSA-SB04	
LINED POND Lined pond receiving runoff from the cleaning slab	28E	28E-SB01 28E-SB05	28E-SP16
LOW-LYING AREA BETWEEN CLEANING SLAB AND BUFFALO CREEK CUTOFF Buffalo Creek up and down stream of Source Area 59E	59E	59E-SB01 59E-SB02 59E-SB03 59E-SB04	59E-SP08 59E-SP09
UNLINED POND Unlined pond receiving runoff from the cleaning slab	28E	28E-SB02 28E-SB04	

Table 5.1-2 *Cross-Reference Between Soil and Soil Vapor Sampling Locations and Investigated Features*
Line 02 - Drum Storage Area (DSA)
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Associated Site Feature	Source Area	Soil Sampling Location(s)	Soil Vapor Sampling Location(s)
VAPOR PLUME STEP-OUT SAMPLES	DSA		28E-SP17
Soil vapor samples collected to characterize vapor plume in Line 02/Area 00	and		DSA-SP16
	Main		DSA-SP11
	Line 02		DSA-SP18
	Area		DSA-SP19
			DSA-SP20
			DSA-SP21
			DSA-SP22
			DSA-SP23
			DSA-SP24
			DSA-SP25
			DSA-SP26
			DSA-SP27
			DSA-SP28
			DSA-SP29
			DSA-SP30
			DSA-SP31
			DSA-SP32

Notes and Key:
DSA = Drum storage area
RCRA = Resource conservation and recovery act

Table 5.1-3 Summary of Soil Vapor Sampling and Sampling Statistics
Line 02 Region
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Interval	Depth (feet bgs)	Locations	Primary Samples	Duplicate Samples	Detects	Frequency of Duplicates	Frequency of Primary Detects
28E	Shallow	0-10	1	1	0	1	0.0%	100.0%
	Intermediate	11-20	1	1	0	1	0.0%	100.0%
	Deep	21-30	2	2	0	2	0.0%	100.0%
29E	Shallow	0-10	6	6	0	6	0.0%	100.0%
	Intermediate	11-20	6	6	1	6	16.7%	100.0%
	Deep	21-30	2	4	1	4	25.0%	100.0%
59E	Shallow	0-10	2	2	0	2	0.0%	100.0%
	Intermediate	11-20	2	2	0	2	0.0%	100.0%
	Deep	21-30	0	0	0	0	0.0%	0.0%
DSA	Shallow	0-10	29	29	7	29	24.1%	100.0%
	Intermediate	11-20	28	28	2	28	7.1%	100.0%
	Deep	21-30	7	10	1	10	10.0%	100.0%
E(d)	Shallow	0-10	2	2	0	2	0.0%	100.0%
	Intermediate	11-20	1	1	0	1	0.0%	100.0%
	Deep	21-30	0	0	0	0	0.0%	0.0%
E(e)	Shallow	0-10	0	0	0	0	0.0%	0.0%
	Intermediate	11-20	0	0	0	0	0.0%	0.0%
	Deep	21-30	0	0	0	0	0.0%	0.0%
E(m)	Shallow	0-10	6	6	1	6	16.7%	100.0%
	Intermediate	11-20	8	8	2	8	25.0%	100.0%
	Deep	21-30	0	0	0	0	0.0%	0.0%
E(n)	Shallow	0-10	8	8	0	8	0.0%	100.0%
	Intermediate	11-20	8	8	1	8	12.5%	100.0%
	Deep	21-30	2	2	0	2	0.0%	100.0%
		Totals:	**121**	**126**	**16**	**126**	**12.7%**	**100.0%**

Notes and Key:
All samples analyzed for volatile organic compounds (VOCs) by USEPA Method TO-15.
% = Percent
bgs = Below ground surface

Table 5.1-4
Summary of Soil Vapor Sampling Activities and Deviations from Field Sampling Plan
Line 02 Region
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Rationale and Comments	Number of Samples Collected	Sampling Activity	Sample ID	Sample Depths (ft bgs)	Deviations from Field Sampling Plan
28E	Drum cleaning area ponds.	1	10, 20	Sampling location is at the point of highest VOC concentration during previous investigation, used to determine if a source is present within the vadose zone.	4	Soil Vapor	28E-SP16	10, 20, ***30, 40***	
					1	Grab Groundwater	28E-SP16	***52***	
28E	West of concrete-lined trough.	***0***	None	Additional samples collected because chemical concentrations exceeded screening criteria.	2	Grab Groundwater	28E-SP20	10, 20	
29E	Concrete lined channel and former pond inlet.	2	10, 20	Sampling location is at the point of highest VOC concentration during previous investigation and used to determine if a source is present within the vadose zone.	6	Soil Vapor	29E-SP07	10, 20	
							29E-SP08	10, 20, ***30, 40***	
					1	Grab Groundwater	29E-SP08	***74***	
29E	Reaction bomb areas and exterior sumps.	3	10, 20	Determine if a release to soil has occurred in the bomb areas (29E-SP09 and 29E-SP11) and at a sump (29E-SP10).	8	Soil Vapor	29E-SP10	10, 20	
							29E-SP11		
							29E-SP09	10, 20, ***30, 40***	
					1	Grab Groundwater	29E-SP09	***60***	
59E	Low-lying area adjacent to drum storage and cleaning area.	2	10, ***20, 30, 40***	Determine if a source present within the vadose zone.	2	Soil Vapor	59E-SP08	10	Samples not collected at 20 and 30 ft bgs due to no flow. Not sampled at 40 ft bgs due to wet soil.
			10, 20				59E-SP09	10	
59E	South of former drum storage and cleaning area.	***0***	None	Additional samples collected because chemical concentrations exceeded screening criteria.	1	Soil Vapor	59E-SP10	20	
59E	North of Building 00025 and close to leach lines of septic tank serving Building 00002.	***0***	None	Additional samples collected because chemical concentrations exceeded screening criteria.	1	Soil Vapor	59E-SP13	20	
					1	Grab Groundwater	59E-SP13	10	
DSA	Northeast of Building 02035.	***0***	None	Additional samples collected because chemical concentrations exceeded screening criteria.	4	Soil Vapor	DSA-SP10	10, 20, 30, 40	
					1	Grab Groundwater	DSA-SP10	58	
DSA	Septic tank A00-ST11 and associated leach lines serving Building 00011.	***0***	None	Additional samples collected because chemical concentrations exceeded screening criteria.	2	Soil Vapor	DSA-SP11	10, 20	
DSA	Septic tank and leach lines serving Building 00002.	***0***	None	Additional samples collected because chemical concentrations exceeded screening criteria.	2	Soil Vapor	DSA-SP12	10, 20	
DSA	Approximately 150 ft north of Building 00002.	***0***	None	Additional samples collected because chemical concentrations exceeded screening criteria.	2	Soil Vapor	DSA-SP13	10, 20	

Table 5.1-4
Summary of Soil Vapor Sampling Activities and Deviations from Field Sampling Plan
Line 02 Region
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Rationale and Comments	Number of Samples Collected	Sampling Activity	Sample ID	Sample Depths (ft bgs)	Deviations from Field Sampling Plan
DSA	East of Building 02030.	***0***	None	Additional samples collected because chemical concentrations exceeded screening criteria.	3	Soil Vapor	DSA-SP15	10, 20, 30	
					1	Grab Groundwater	DSA-SP15	43	
DSA	North of septic tank A00-ST04 and associated leach lines serving Building 00004.	***0***	None	Additional samples collected because chemical concentrations exceeded screening criteria.	4	Vapor	DSA-SP16	10, 20, 30, 40	
					1	Grab Groundwater	DSA-SP16	55	
DSA	East of Hazardous waste storage tank.	***0***	None	Additional samples collected because chemical concentrations exceeded screening criteria.	5	Soil Vapor	DSA-SP17	10, 20, 30	
							DSA-SP19	10, 20	
					1	Grab Groundwater	DSA-SP17	43	
DSA	Approximately 180 ft northeast of Hazardous waste storage tank.	***0***	None	Additional samples collected because chemical concentrations exceeded screening criteria.	2	Soil Vapor	DSA-SP18	10, 20	
DSA	North of Building 00022.	***0***	None	Additional samples collected because chemical concentrations exceeded screening criteria.	2	Soil Vapor	DSA-SP20	10, 20	
DSA	Septic tank A00-ST05 and associated leach lines serving Building 00005.	***0***	None	Additional samples collected because chemical concentrations exceeded screening criteria.	2	Soil Vapor	DSA-SP21	10, 20	
					1	Grab Groundwater	DSA-SP21	45	
DSA	Septic tank A00-ST05 and associated leach lines serving Building 00005.	***0***	None	Additional samples collected because chemical concentrations exceeded screening criteria.	2	Soil Vapor	DSA-SP22	10, 20	
					1	Grab Groundwater	DSA-SP22	55	
DSA	South of Building 00005.	***0***	None	Additional samples collected because chemical concentrations exceeded screening criteria.	3	Soil Vapor	DSA-SP23	10, 20, 30	
					1	Grab Groundwater	DSA-SP23	45	
DSA	North of Building 00026.	***0***	None	Additional samples collected because chemical concentrations exceeded screening criteria.	3	Soil Vapor	DSA-SP24	10, 20, 30	
					1	Grab Groundwater	DSA-SP24	45	
DSA	Northwest of Building 000067.	***0***	None	Additional samples collected because chemical concentrations exceeded screening criteria.	2	Soil Vapor	DSA-SP25	10, 20	
DSA	Southwest of Building 00026.	***0***	None	Additional samples collected because chemical concentrations exceeded screening criteria.	2	Soil Vapor	DSA-SP26	10, 20	
DSA	Northeast of Building 00026.	***0***	None	Additional samples collected because chemical concentrations exceeded screening criteria.	2	Soil Vapor	DSA-SP27	10, 20	
DSA	Septic tank A00-ST03 serving Building 00003.	***0***	None	Additional samples collected because chemical concentrations exceeded screening criteria.	2	Soil Vapor	DSA-SP28	10, 20	
DSA	East of Building 00003.	***0***	None	Additional samples collected because chemical concentrations exceeded screening criteria.	1	Soil Vapor	DSA-SP29	10	
					1	Grab Groundwater	DSA-SP29	20	

Table 5.1-4
Summary of Soil Vapor Sampling Activities and Deviations from Field Sampling Plan
Line 02 Region
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Rationale and Comments	Number of Samples Collected	Sampling Activity	Sample ID	Sample Depths (ft bgs)	Deviations from Field Sampling Plan
DSA	Approximately 130 ft north of Septic tank A00-ST05 serving Building 00005.	***0***	None	Additional samples collected because chemical concentrations exceeded screening criteria.	2	Soil Vapor	DSA-SP30	10, 20	
DSA	Approximately 300 ft east of Building 00026.	***0***	None	Additional samples collected because chemical concentrations exceeded screening criteria.	2	Soil Vapor	DSA-SP31	10, 20	
DSA	Approximately 200 ft southeast of Building 00026.	***0***	None	Additional samples collected because chemical concentrations exceeded screening criteria.	2	Soil Vapor	DSA-SP32	10, 20	
DSA	Line 2 Drum storage area.	3	10, 20	Determine if a source is present within the vadose zone.	6	Soil Vapor	DSA-SP05	10, 20	
							DSA-SP06	10, 20	
							DSA-SP07	10, 20	
		1	10, 20, 30, 40		4	Soil Vapor	DSA-SP04	10, 20, 30, 40	
					1	Grab Groundwater	DSA-SP04	***50***	
DSA	Aboveground storage tanks and containment basin.	1	10, 20	Determine if a release to soil has occurred as a result of tank leakage or material spillage during transfer to the tanks.	2	Soil Vapor	DSA-SP08	10, 20	
DSA	Former material storage area north of Building 02090.	1	10, 20	Determine if a release to soil has occurred as a result of spills within the former material storage area.	2	Soil Vapor	DSA-SP09	10, 20	
E(d)	Potential fire training areas on southeast and southwest corners of Building 02020.	2	10, ***20***	Determine if a release to soil has occurred as a result of potential fire training activities.	3	Soil Vapor	E(d)-SP02	10, 20	
						Soil Vapor	E(d)-SP03	10	Sample not collected at 20 ft bgs due to no flow.
E(m)	Former hazardous materials staging area north of former Buildings 02025, 02026, and 02027.	2	10, 20	Determine if a release to soil has occurred as a result of spills within the former hazardous material storage area.	4	Soil Vapor	E(m)-SP08	10, 20	
						Soil Vapor	E(m)-SP09	10, 20	
E(m)	Former hazardous materials storage area on foundation of former Building 02027.	1	10, 20	Determine if a release to soil has occurred as a result of spills within the former hazardous material storage area.	2	Soil Vapor	E(m)-SP10	10, 20	
E(m)	Approximately 100 ft northwest of Septic tank L2-ST26.	***0***	None	Additional samples collected because chemical concentrations exceeded screening criteria.	1	Soil Vapor	E(m)-SP11	20	
E(n)	Industrial waste line from Building 02025 and point of discharge to surface drainage.	2	10, 20	Determine if a source is present within the vadose zone.	6	Soil Vapor	E(n)-SP04	10, 20	
							E(n)-SP05	10, 20, ***40***	
					1	Grab Groundwater	E(n)-SP05	***60***	

Table 5.1-4
Summary of Soil Vapor Sampling Activities and Deviations from Field Sampling Plan
Line 02 Region
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Rationale and Comments	Number of Samples Collected	Sampling Activity	Sample ID	Sample Depths (ft bgs)	Deviations from Field Sampling Plan
E(n)	Engineering and mechanical property laboratories; Buildings 02021, 02022, 02023.	3	10, ***20***	Determine if a release to soil has occurred as a result of operations at the engineering laboratories.	5	Soil Vapor	E(n)-SP06	10, 20	
							E(n)-SP07	10	Sample not collected at 20 ft bgs due to refusal.
							E(n)-SP08	10, 20	
					1	Grab Groundwater	E(n)-SP08	***43***	
E(n)	Hazardous waste storage tank north of Building 02030.	1	10, 20	Determine if a release to soil has occurred as a result of spills at the hazardous waste storage tank.	2	Soil Vapor	E(n)-SP09	10, 20	
E(n)	Surrounding the industrial waste lines serving Building 02025.	***0***	None	Additional samples collected because chemical concentrations exceeded screening criteria.	6	Soil Vapor	E(n)-SP10	10, 20	
							E(n)-SP11	15, 25	
							E(n)-SP12	10, 20	
Line 2	Septic tank L2-ST28/90 serving Buildings 02028 and 02090.	1	10, 20	Determine if a source is present within the vadose zone.	2	Soil Vapor	L2-ST28/90-SP02	10, 20	
Line 2	Septic tank L2-ST26 and associated leach lines.	3	10, 20	Determine if a source is present within the vadose zone.	6	Soil Vapor	L2-ST26-SP04	10, 20	
							L2-ST26-SP05	10, 20	
							L2-ST26-SP06	10, 20	
Line 2	Septic tank L2-ST24 and associated leach lines serving Buildings 02024 and 02026.	1	10, 20	Determine if a source is present within the vadose zone.	2	Soil Vapor	L2-ST24-SP03	10, 20	
Line 2	Approximately 50 ft north of leach lines of Septic tank L2-ST26.	***0***	None	Additional samples collected because chemical concentrations exceeded screening criteria.	1	Soil Vapor	L2-ST26-SP07	18	

Notes and Key:
Grab groundwater collected when soil vapor point was below the groundwater table.
Bold, italicized and underlined data does not agree with the analytical results. See "Deviations from Field Sampling Plan" column for more information on discrepancies.

ft bgs = Feet below ground surface
ID = Identification
Proposed analyses = VOC analysis
Performed analyses = VOC analysis
VOC = Volatile organic compound

Table 5.1-5
Summary of Soil Sampling Activities and Deviations from Field Sampling Plan
Line 02 Region
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
28E	Lined pond receiving runoff from the cleaning slab.	Subsurface Soil	***1***	0, 4, 10, 22, 30, 40, 50, 60	SVOCs, metals, TPH, NDMA, ClO4, DI-WET	Requested by the regulatory agencies to confirm results of previous investigations, evaluate vertical extent of chemicals in soil, support risk assessment, and evaluate potential for water quality impacts.	7	28E-SB01	1.5, 5.5, 11.5, 23, 35, 47, 59	SVOCs, metal, TPH, NDMA, ClO4, DI-WET	DI-WET only analyzed at 1.5 and 47 ft bgs. Samples spaced at intervals greater than 10 ft.
							12	28E-SB05	1, 5, 10, 20, 30, 40, 50	ClO4	
								28E-SB06	1, 5, 10, 20, 30, 40, 50	ClO4	
		Grab Groundwater	***0***	None	None		2	28E-SB05	52	ClO4	
								28E-SB06	52	ClO4	
28E	Unlined pond receiving runoff from the cleaning slab.	Subsurface Soil	***1***	0, 4, 10, 22, 30, 40, 50, 60	SVOCs, metals, TPH, NDMA, ClO4	Requested by the regulatory agencies to confirm results of previous investigations, evaluate vertical extent of chemicals in soil, and support risk assessment	7	28E-SB02	1, 5, 11, 23, 35, 47, 59	SVOCs, metal, TPH, NDMA, ClO4	Samples spaced at intervals greater than 10 ft.
							14	28E-SB04	1, 5, 10, 20, 30, 40, 46	ClO4	
								28E-SB07	1, 5, 10, 20, 30, 40, 50	ClO4	
		Grab Groundwater	***0***	None	None		2	28E-SB04	50	ClO4	
								28E-SB07	50	ClO4	
28E	Cleaning slab.	Subsurface Soil	1	0, 4, 10	SVOCs, metals, TPH, NDMA, ClO4	Confirm results of previous investigations, evaluate vertical extent of chemicals in soil, and support risk assessment. The sample will be collected along a major crack in the slab surface.	3	28E-SB03	1, 5, 11	SVOCs, metal, TPH, NDMA, ClO4	SVOCs, NDMA, and TPH only analyzed at 1 ft bgs.
28E	Concrete lined trough from Building 02024 to former unlined pond.	Subsurface Soil	***0***	None	None	Additional samples collected because chemical concentrations exceeded screening criteria.	3	29E-SB09	1, 5, 11	Metals	
29E	Crawford bomb station former concrete sump.	Subsurface Soil	1	0, 4, 10, 22, 40, ***60***	SVOCs, metals, TPH, NDMA, ClO4, DI-WET, physical properties	Confirm results of previous investigations, evaluate vertical extent of chemicals in soil, support risk assessment, and evaluate potential for water quality impacts. Location selected based on proximity to source area.	5	29E-SB03	1, 5, 11, 23, 45	SVOCs, metals, TPH, NDMA, ClO4, physical properties	BD, PD, and perm not analyzed at 1, 5, and 11 ft bgs. Not sampled at 60 ft bgs due to groundwater.
		Grab Groundwater	1	First water			1	29E-SB03	60	SVOCs, total and dissolved metals, NDMA, ClO4	
29E	Concrete lined trough from Building 02024 to former unlined pond.	Subsurface Soil	3	0, 4, 10	SVOCs, metals, TPH, NDMA, ClO4	Confirm results of previous investigations, evaluate vertical extent of chemicals in soil, and support risk assessment.	9	29E-SB05	2, 6, 11.5	SVOCs, metals, TPH, NDMA, ClO4	NDMA and ClO4 only analyzed at 2 ft bgs.
								29E-SB06	2, 5.5, 11.5	SVOCs, metals, TPH, NDMA, ClO4	NDMA and ClO4 only analyzed at 2 ft bgs.
								29E-SB07	1.5, 5.5, 11.5	SVOCs, metals, TPH, NDMA, ClO4	NDMA and ClO4 only analyzed at 1.5 ft bgs.
29E	Low-lying area below concrete lined trough from Building 02024 and former unlined pond.	Subsurface Soil	1	0, 4, 10	SVOCs, metals, TPH, NDMA, ClO4	Determine if a release from the concrete lined trough and former unlined pond has occurred, evaluate vertical extent of chemicals in soil, and support risk assessment.	3	29E-SB08	1.5, 5.5, 11.5	SVOCs, metals, TPH, NDMA, ClO4	
29E	Discharge end of corrugated pipe serving former unlined pond.	Surface and Near-Surface Soil	1	0	SVOCs, metals, TPH, NDMA, ClO4	Determine if a release from the discharge end of a corrugated pipe draining the former unlined pond has occurred, evaluate vertical extent of chemicals in soil, and support risk assessment.	1	29E-SNS03	0.5	SVOCs, metals, TPH, NDMA, ClO4	

Table 5.1-5
Summary of Soil Sampling Activities and Deviations from Field Sampling Plan
Line 02 Region
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
29E	Low-lying area down gradient of concrete lined trough from Building 02024 and former unlined pond.	Surface and Near-Surface Soil	1	0	SVOCs, metals, TPH, NDMA, ClO4	Determine if a release from the concrete lined trough and former unlined pond via surface runoff to the low-lying area has occurred, evaluate vertical extent of chemicals in soil, and support risk assessment.	1	29E-SNS04	0.5	SVOCs, metals, TPH, NDMA, ClO4	
29E	Former unlined pond receiving runoff from Building 02024.	Surface and Near-Surface Soil	1	3	SVOCs, metals, TPH, NDMA, ClO4	Requested by the regulatory agencies to confirm results of previous investigations and to support risk assessment.	1	29E-SNS05	0.5	SVOCs, metals, TPH, NDMA, ClO4	Surface and Near-Surface sample collected at a shallower depth than proposed.
29E	Drainage channel serving Source Area 29E.	Surface and Near-Surface Soil	2	0, 2	SVOCs, metals, TPH, NDMA, ClO4	Determine if chemicals discharge from Source Area 29E has impacted soil in the drainage channel, and support risk assessment.	4	29E-SNS06	0.5, 2.5	SVOCs, metals, TPH, NDMA, ClO4	
								29E-SNS07	0.5, 2.5	SVOCs, metals, TPH, NDMA, ClO4	
							3	29E-SB10	1	Metals	
								29E-SB11	1	Metals	
								29E-SB12	1	Metals	
29E	Septic tank L2-ST24 serving Buildings 02024 and 02026.	Subsurface Soil	1	0, 4, 10	SVOCs, metals, TPH, NDMA, ClO4	Proposed sampling location and analyses will determine if a release from the septic tank has occurred, to evaluate vertical extent of chemicals in soil, and to support risk assessment.	3	L2-ST24-SB01	2, 6, 11.5	SVOCs, metals, TPH, NDMA, ClO4	NDMA analyzed at 2 and 6 ft bgs. ClO4 analyzed at 6 ft bgs only.
59E	Low-lying area in central portion of drum cleaning facility area.	Subsurface Soil	1	0, 4, 10, 22, 30, 40, ***50***, ***60***	SVOCs, metals, TPH, NDMA, ClO4, DI-WET	Requested by the regulatory agencies to confirm results of previous investigations, evaluate vertical extent of chemicals in soil, to support risk assessment, and evaluate potential for water quality impacts.	5	59E-SB02	2, 5, 10.5, 23, 35	SVOCs, metals, TPH, NDMA, ClO4, DI-WET	DI-WET only analyzed at 10.5 and 35 ft bgs. Not sampled at 50 and 60 ft bgs due to groundwater at 44 ft bgs.
		Grab Groundwater	1	First water	SVOCs, total and dissolved metals, ClO4, NDMA		1	59E-SB02	44	SVOCs, total and dissolved metals, NDMA, ClO4	
59E	Low-lying area in northern portion of drum cleaning facility area.	Subsurface Soil	2	0, 4, 10	SVOCs, metals, TPH, NDMA, ClO4	Determine if a release from northern portion of the drum cleaning facility has occurred, evaluate vertical extent of chemicals in soil, and support risk assessment.	6	59E-SB03	2, 6, 11	SVOCs, metals, TPH, NDMA, ClO4	
								59E-SB04	2.5, 6, 11	SVOCs, metals, TPH, NDMA, ClO4	
DSA	Former drum storage area.	Subsurface Soil	2	0, 4, 10	SVOCs, metals, TPH, NDMA, ClO4	Determine if a release from the former drum storage area has occurred, evaluate vertical extent of chemicals in soil, and support risk assessment.	14	DSA-SB02	1.5, 4.5, 10.5	SVOCs, metals, TPH, NDMA, ClO4	SVOCs were not analyzed at 10.5 ft bgs.
								DSA-SB03	2, 4.5, 12	SVOCs, metals, TPH, NDMA, ClO4	
			1	0, 4, 10, 22, 30, 40, 50, 60	SVOCs, metals, TPH, NDMA, ClO4, DI-WET, physical properties	Requested by the regulatory agencies to evaluate vertical extent of chemicals in soil, support risk assessment, and evaluate potential for water quality impacts.		DSA-SB01	1, 5, 11, 20, 33, 43, 53, 63	SVOCs, metals, TPH, NDMA, ClO4, DI-WET, physical properties	BD, PD, and perm not analyzed at 11 ft bgs. DI-WET only analyzed at 5 and 43 ft bgs.
		Grab Groundwater	1	First water	SVOCs, total and dissolved metals, ClO4, NDMA		1	DSA-SB01	71	SVOCs, total and dissolved metals, NDMA, ClO4	
DSA	Former material storage area north of Building 02090.	Subsurface Soil	1	0, 4, 10	SVOCs, metals, TPH	Determine if a release from the former material storage area north of Building 02090 has occurred, evaluate vertical extent of chemicals in soil, and support risk assessment.	3	DSA-SB04	1, 5, 11	SVOCs, metals, TPH	TPH only analyzed at 1 ft bgs.

Table 5.1-5
Summary of Soil Sampling Activities and Deviations from Field Sampling Plan
Line 02 Region
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
DSA	Septic tank L2-ST28/90 for Building 02028 and 02090.	Subsurface Soil	1	0, 4, 10	SVOCs, metals, TPH, NDMA, ClO4	Confirm results of previous investigations, evaluate vertical extent of chemicals in soil, and support risk assessment.	3	L2-ST28/90-SB01	2.5, 4.5, 10.5	SVOCs, metals, TPH, NDMA, ClO4	NDMA and ClO4 not analyzed at 10.5 ft bgs
E(d)	Drainage area from Building 02020.	Surface and Near-Surface Soil	3	0, 2	SVOCs, NDMA, metals, TPH, ClO4	Requested by the regulatory agencies to confirm results of previous investigations, evaluate lateral extent of chemicals in soil, and support risk assessment.	10	E(d)-SNS01	0.5, 2.5	SVOCs, metals, TPH, ClO4	
								E(d)-SNS02	0.5, 2.5	SVOCs, metals, TPH, ClO4	
								E(d)-SNS03	0.5, 2.5, ***10, 20, 30, 40***	SVOCs, metals, TPH, ClO4	At 10, 20, 30, and 40 ft bgs, only analyzed for ClO4. Step-out samples were taken at 10, 20, 30, and 40 ft bgs.
		Grab Groundwater	***0***	None	None		1	E(d)-SNS03	47	ClO4	
E(e)	Drainage area from Building 02020.	Surface and Near-Surface Soil	2	0, 2	SVOCs, metals, TPH, ClO4	Requested by the regulatory agencies to confirm results of previous investigations, evaluate lateral extent of chemicals in soil, and support risk assessment.	4	E(e)-SNS01	0.5, 2.5	SVOCs, ***NDMA***, metals, TPH, ClO4	NDMA was included as additional analysis.
								E(e)-SNS02	0.5, 2.5	SVOCs, ***NDMA***, metals, TPH, ClO4	NDMA was included as additional analysis.
		Subsurface Soil	***1***	0, 4, 10, 22, 40, ***60***	SVOCs, NDMA, TPH, ClO4, metals, DI-WET, physical properties	Confirm results of previous investigations, evaluate vertical extent of chemicals in soil, support risk assessment, and evaluate potential for water quality impacts. Location selected based on proximity to the source area.	12	E(e)-SB02	1, 5, 11, 22, 42	SVOCs, NDMA, metals, TPH, ClO4, DI-WET, physical properties	MC, BD, PD, and perm not analyzed at 1, 5, and 11 ft bgs. DI-WET only analyzed at 22 ft bgs. Not sampled at 60 ft bgs due to groundwater.
								E(e)-SB03	1, 5, 10, 20, 30, 40, 50	ClO4	
		Grab Groundwater	***1***	First water	SVOCs, total and dissolved metals, ClO4	Confirm results of previous investigations, evaluate vertical extent of chemicals in soil, support risk assessment, and evaluate potential for water quality impacts. Location selected based on proximity to the source area.	2	E(e)-SB02	52	SVOCs, total and dissolved metals, ClO4	
								E(e)-SB03	55	ClO4	
E(m)	Ephemeral creek draining Line 2 source area, including 29E, E(d), E(e), E(m), and E(n).	Surface and Near-Surface Soil	2	0, 1, 4	***VOCs***, SVOCs, pesticides, PCBs, TPH, ClO4, metals, ***CEC***, ***TOC***, MC, BD, GS, pH, DI-WET	Up gradient soil results are above screening levels. Sampling locations used to determine if chemicals are present in the creek draining the Line 2 area north of the E(m) Source Area. The creek is ephemeral and discharges to the Administration Ditch to	6	E(m)-SD01	0.25, 1.5, 5	SVOCs, PAHs, ***NDMA***, metals, pesticides, TPH, PCBs, ClO4, pH, DI-WET, MC, BD, GS, ***PD, perm***	NDMA, PD, and perm were included as additional analyses. DI-WET only analyzed at 1.5 ft bgs. Not analyzed for VOCs.
				0, 1, 4	***VOCs,*** SVOCs, metals, ClO4, ***CEC, TOC, MC, BD, GS***, pH, DI-WET			E(m)-SD02	0.25, 1.5, 5	SVOCs, PAHs, ***NDMA***, metals, ClO4, pH	NDMA was included as additional analysis. VOCs, CEC, TOC, MC, BD, and GS were not analyzed.
E(m)	Septic tank L2-ST26 line from Building 02024.	Subsurface Soil	1	0, 4, 10, 22, 40, 60	SVOCs, metals, ClO4, DI-WET	Confirm results of previous investigations, evaluate vertical extent of chemicals in soil, support risk assessment, and evaluate potential for water quality impacts. Location selected based on proximity to the source area.	5	L2-ST26-SB01	2, 5, 11.5, 23, 45	SVOCs, ***NDMA***, metals, ClO4, DI-WET	NDMA was included as additional analysis. DI-WET only analyzed at 2 ft bgs.
		Grab Groundwater	1	First water	SVOCs, total and dissolved metals, ClO4		1	L2-ST26-SB01	62	SVOCs, total and dissolved metals, ClO4	

Table 5.1-5
Summary of Soil Sampling Activities and Deviations from Field Sampling Plan
Line 02 Region
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
E(m)	Leach lines from septic tank L2-ST26.	Subsurface Soil	3	0, 4, 10	SVOCs, metals, ClO4	Determine if a release from the septic tank and leach lines has occurred, evaluate vertical extent of chemicals in soil, and support risk assessment.	9	L2-ST26-SB02	2, 4.5, 10	SVOCs, metals, ClO4, ***NDMA***	NDMA was included as additional analysis.
								L2-ST26-SB03	2, 5, 11.5	SVOCs, metals, ClO4, ***NDMA***	NDMA was included as additional analysis.
								L2-ST26-SB04	1, 5, 11	SVOCs, metals, ClO4, ***NDMA***	NDMA was included as additional analysis. ClO4 and NDMA not analyzed at 11 ft bgs.
E(m)	Leach lines from septic tank L2-ST26.	Surface and Near-Surface Soil	***0***	None	None	Additional samples collected because chemical concentrations exceeded screening criteria.	6	L2-ST26-SNS01	0.5, 2.5	SVOCs, NDMA	
								L2-ST26-SNS02	0.5, 2.5	SVOCs, PAHs, NDMA	
								L2-ST26-SNS03	0.5, 2.5	SVOCs, NDMA	
E(n)	Drain line from Building 02025.	Subsurface Soil	2	0, 4, 10	SVOCs, NDMA, metals, ClO4	Determine if a release from the drain line serving Building 02025 has occurred, evaluate vertical extent of chemicals in soil, and support risk assessment.	11	E(n)-SB01	1, 5, 9.5	SVOCs, NDMA, metals, ClO4	SVOCs, NDMA, and ClO4 only analyzed at 1 ft bgs.
								E(n)-SB02	1, 5, 11	SVOCs, NDMA, metals, ClO4	SVOCs, NDMA, and ClO4 only analyzed at 1 ft bgs.
			1	0, 4, 10, 22, 40, ***60***	SVOCs, NDMA, metals, ClO4, DI-WET, physical properties	Confirm results of previous investigations, evaluate vertical extent of chemicals in soil, support risk assessment, and evaluate potential for water quality impacts. Location selected based on proximity to the source area.		E(n)-SB03	1, 5, 11, 21, 43	SVOCs, NDMA, metals, ClO4, DI-WET, physical properties	BD, PD, and perm not analyzed at 5 and 11 ft bgs. DI-WET only analyzed at 43 ft bgs. Not sampled at 60 ft bgs due to groundwater.
E(n)	Areas receiving runoff from Buildings 02021, 02022, and 02023.	Surface and Near-Surface Soil	3	0, 2	SVOCs, metals, TPH, NDMA, ClO4	Requested by the regulatory agencies to evaluate potential releases from the three engineering laboratories and support risk assessment.	6	E(n)-SNS01	0.5, 2.5	SVOCs, metals, TPH, NDMA, ClO4	
								E(n)-SNS02	0.5, 2.5	SVOCs, metals, TPH, NDMA, ClO4	
								E(n)-SNS03	0.5, 2.5	SVOCs, metals, TPH, NDMA, ClO4	
E(n)	Ephemeral creek draining Line 2 source area, Including 29E, E(d), and E(e).	Surface and Near-Surface Soil	1	0, 1, 4	***VOCs***, SVOCs, NDMA, metals, TPH, ClO4, DI-WET, ***CEC***, ***TOC***, MC, ***BD***, GS, pH	Up gradient soil results are above screening levels. Sampling locations used to determine if chemicals are present in the creek draining 29E, E(d), and E(e). The creek is ephemeral and discharges to the low-lying area north of E(m) .	3	E(n)-SD01	0.25, 1.5, 5	SVOCs, PAHs, NDMA, metals, TPH, ClO4, pH, DI-WET, MC, BD, GS, ***PD***, ***perm***	PD and perm were included as additional analyses. DI-WET only analyzed at 1.5 ft bgs. VOCs and SG was not analyzed.

Notes and Key:
PAH was analyzed by USEPA 8270 SIM method.
Bulk density includes dry density, wet density, and specific gravity.
Physical properties include bulk density, permeability, porosity, moisture, organic carbon, grain size, and CEC.
Bold, italicized and underlined data does not agree with the analytical results. See "Deviations from Field Sampling Plan" column for more information on discrepancies.

BD = Bulk density
CEC = Cation Exchange Capacity
ClO4 = Perchlorate
CrVI = Hexavalent chromium
DI-WET = Deionized waste extract test
ft = Feet
ft bgs = Feet below ground surface
GS = Grain size
ID = Identification
MC = Moisture content
NDMA = N-Nitrosodimethylamine
Nitro = Nitroguanidine
PAH = Polyaromatic hydrocarbon
PCB = Polychlorinated biphenyl
pH = Paste pH
SG = Specific gravity
SVOC = Semivolatile organic compound
TOC = Total organic carbon
TPH = Total petroleum hydrocarbons

Table 5.1-6 Summary of Geotechnical Soil Parameters
Line 02 Region
Aerojet Boundary Operable Unit
Aerojet Superfund Site
Sacramento County, California

			Geo Physical Parameters (ASTM D2937, D854)					Sieve Analysis (ASTM D422)				Permeability (ASTM D5084)	
Test No.	Date	Description of Test Location	Moisture Content (%)	Wet Density (pcf)	Dry Density (pcf)	Specific Gravity	Porosity	Cobbles (%)	Gravel (%)	Sand (%)	Silt / Clay (%)	Average Hydraulic Gradient	Perm (cm/sec)
11	11/23/05	DSA-SB01-1	9.7	112.2	111.4	2.630	0.3210	0.0	37.0	23.8	39.2	5.8	1.45E-05
12	11/23/05	DSA-SB01-5	9.3	133.1	121.7	2.650	0.2640	0.0	40.3	35.6	24.1	8.1	1.09E-05
13	11/23/05	DSA-SB01-11	5.1					0.0	33.3	36.9	30.4		
14	11/23/05	DSA-SB01-20	47.8	105.3	71.3	2.510	0.5450	0.0	0.3	68.6	31.1	5.6	8.96E-05
15	11/23/05	DSA-SB01-33	33.7	116.1	86.8	2.680	0.4810	0.0	0.2	59.2	40.6	9.3	1.12E-06
16	11/23/05	DSA-SB01-43	33.8	116.1	86.8	2.680	0.4810	0.0	0.9	57.2	41.9	4.8	5.26E-07
17	11/23/05	DSA-SB01-53	42.1	105.2	74.1	2.630	0.5490	0.0	7.6	28.6	63.8	9.2	4.86E-05
18	11/23/05	DSA-SB01-63	38.7	116.5	84.0	2.700	0.5010	0.0	40.0	33.9	26.1	9.1	1.82E-08
52	11/23/05	P3482A-61	28.1	119.5	93.2	2.670	0.4400	0.0	22.2	75.2	2.6	4.6	4.57E-04
53	11/23/05	P3482A-66	25.5	115.3	91.8	2.640	0.4430	0.0	38.8	56.3	4.9	9.3	4.07E-04
54	11/23/05	P3482A-75.5	16.4	102.2	87.8	2.670	0.4730	0.0	55.4	40.7	3.9	2.4	9.13E-04
55	11/23/05	P3482A-76	37.0	114.2	83.3	2.670	0.5000	0.0	65.2	33.7	1.1	10.4	3.80E-04
56	11/23/05	P3482A-80	7.4	135.6	126.2	2.630	0.2310	0.0	84.0	15.9	0.1		
82	11/23/05	E(m)-SD01-5	10.6	135.7	122.7	2.640	0.2550	0.0	3.6	26.3	70.1	8.2	2.49E-07
83	11/23/05	E(m)-SD01-0.25	6.9	113.7	106.3	2.710	0.3710	0.0	0.2	35.8	64.0	6.9	3.65E-06
84	11/23/05	E(m)-SD01-1.5	10.1	113.7	103.3	2.670	0.3800	0.0	0.0	26.6	72.4	10.2	4.54E-07
85	11/23/05	E(m)-SD01-5	14.1	137.6	120.6	2.650	0.2710	0.0	0.0	38.4	61.6	3.5	3.91E-06
86	11/23/05	29E-SB03-1	4.2					0.0	20.8	32.3	46.9		
87	11/23/05	29E-SB03-5	12.0					0.0	2.4	29.2	68.4		
88	11/23/05	29E-SB03-11	14.2					0.0	0.0	39.7	60.3		
89	11/23/05	29E-SB03-23	43.8	112.1	77.9	2.600	0.5200	0.0	3.1	56.1	40.8	11.3	5.56E-06
90	11/23/05	29E-SB03-45	46.7	115.5	78.7	2.620	0.5190	0.0	11.6	35.2	53.2	9.8	4.48E-05
106	11/23/05	E(m)-SD01-0.25	6.9	113.7	106.3	2.710	0.3710	0.0	0.2	35.8	64.0	11.8	2.38E-07
107	11/23/05	E(m)-SD01-1.5	11.1	119.6	107.7	2.700	0.3610	0.0	0.2	37.5	62.3	5.0	5.76E-07
124	6/2/06	59E-SD01-0.25	34.1	145.0	108.1			0.0	74.1	35.3	0.6		
125	6/2/06	59E-SD01-1.5	27.8	50.2	39.3			0.0	63.6	20.3	16.1		
126	6/2/06	59E-SD01-5	69.4	120.0	70.8			0.0	24.2	43.8	32.0		
128	6/2/06	59E-SD02-0.25	80.6	161.5	89.5			0.0	4.7	35.2	60.1		
129	6/2/06	59E-SD02-1.5	92.6	158.2	82.1			0.0	7.8	26.9	65.3		
130	11/18/05	E(n)-SB03-1	14.6	142.1	124.1	2.730	0.2720	0.0	45.3	22.9	31.8	7.8	2.42E-08
131	11/18/05	E(n)-SB03-5	2.4					0.0	55.4	25.4	19.2		
132	11/18/05	E(n)-SB03-11	4.9					0.0	64.0	22.0	14.0		

Table 5.1-6 Summary of Geotechnical Soil Parameters
Line 02 Region
Aerojet Boundary Operable Unit
Aerojet Superfund Site
Sacramento County, California

			Geo Physical Parameters (ASTM D2937, D854)					Sieve Analysis (ASTM D422)				Permeability (ASTM D5084)	
Test No.	Date	Description of Test Location	Moisture Content (%)	Wet Density (pcf)	Dry Density (pcf)	Specific Gravity	Porosity	Cobbles (%)	Gravel (%)	Sand (%)	Silt / Clay (%)	Average Hydraulic Gradient	Perm (cm/sec)
133	11/18/05	E(n)-SB03-21	9.2	122.7	112.3	2.700	0.3330	0.0	1.0	71.6	27.4	5.8	2.47E-04
134	11/18/05	E(n)-SB03-43	27.1	124.4	97.9	2.660	0.4100	0.0	9.7	57.6	32.7	6.9	2.01E-07
135	11/18/05	E(e)-SB02-1						0.0	40.2	30.4	29.4		
136	11/18/05	E(e)-SB02-5						0.0	13.2	52.7	34.1		
137	11/18/05	E(e)-SB02-11						0.0	8.5	53.1	38.4		
138	11/18/05	E(e)-SB02-22	32.5	109.9	83.0	2.240	0.4060	0.0	13.2	51.0	35.8	8.7	6.13E-05
139	11/18/05	E(e)-SB02-42	21.0	121.3	100.2	2.690	0.4030	0.0	14.5	38.7	46.8	4.0	2.86E-06
173	11/23/05	E(n)-SD01-0.25	11.7	125.1	111.9		0.3260	0.0	3.4	30.7	65.9	6.9	3.65E-06
174	11/23/05	E(n)-SD01-1.5	11.5	141.7	127.0		0.2460	0.0	1.8	61.4	36.8	5.1	2.92E-06
175	11/23/05	E(n)-SD01-5	24.5	115.7	92.9		0.4420	0.0	38.3	60.9	0.8	9.2	1.18E-05
		Mean	**25.1**	**120.9**	**96.4**	**2.6**	**0.4**	**0.0**	**22.6**	**40.4**	**37.2**	**7.4**	**1.0E-04**
		Median	**16.4**	**116.5**	**93.2**	**2.7**	**0.4**	**0.0**	**12.4**	**35.8**	**36.3**	**7.8**	**3.9E-06**
		Geomean	**17.9**	**119.1**	**94.12**	**2.6**	**0.38**			**37.8**	**22.4**	**6.9**	**5.9E-06**

Key:
% = Percent
cm/sec = Centimeters per second
pcf = Pounds per cubic foot

Table 5.1-7
Summary of Soil Sampling and Sampling Statistics for Source Areas 29E, E(d), and E(e)
Line 02 Region
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

				Source Area 29E						Source Area E(d)						Source Area E(e)					
Compound(s)	**Analyte**	**Method**	**Depth (feet bgs)**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**
Metals	Metals	6010B	0-2.5	15	17	4	17	23.5%	100.0%	3	6	0	6	100.0%	100.0%	3	5	1	5	20.0%	100.0%
		6020	0-2.5	15	17	4	17	23.5%	100.0%	3	6	0	6	100.0%	100.0%	3	5	1	5	20.0%	100.0%
		6010B	>2.5	7	16	0	16	0.0%	100.0%	0	0	0	0	0.0%	0.0%	1	4	0	4	0.0%	100.0%
		6020	>2.5	7	16	0	15	0.0%	93.8%	0	0	0	0	0.0%	0.0%	1	4	0	4	0.0%	100.0%
	Chromium VI	7199	0-2.5	2	2	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		7199	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	Mercury	7471A	0-2.5	12	14	4	14	28.6%	100.0%	3	6	0	6	100.0%	100.0%	3	5	1	5	20.0%	100.0%
		7471A	>2.5	7	12	0	11	0.0%	91.7%	0	0	0	0	0.0%	0.0%	1	4	0	4	0.0%	100.0%
SVOCs	SVOCs	8270C	0-2.5	11	13	3	9	23.1%	69.2%	3	6	0	4	100.0%	100.0%	3	5	1	1	20.0%	20.0%
		8270C	>2.5	6	14	0	5	0.0%	35.7%	0	0	0	0	0.0%	0.0%	1	4	0	2	0.0%	50.0%
PCBs	PCBs	8082	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		8082	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
Perchlorate	Perchlorate	314.0, 314.0M	0-2.5	10	12	3	3	25.0%	25.0%	3	6	0	3	100.0%	100.0%	4	6	1	3	16.7%	50.0%
		314.0, 314.0M	>2.5	3	7	0	4	0.0%	57.1%	1	4	0	4	100.0%	100.0%	2	10	0	10	0.0%	100.0%
TPH	Diesel	8015B-SVOA - Diesel	0-2.5	11	13	3	13	23.1%	100.0%	3	6	0	6	100.0%	100.0%	3	5	1	5	20.0%	100.0%
		8015B-SVOA - Diesel	>2.5	6	14	0	14	0.0%	100.0%	0	0	0	0	0.0%	0.0%	1	4	0	4	0.0%	100.0%
	Motor Oil	8015B-SVOA - Oil	0-2.5	11	13	3	13	23.1%	100.0%	3	6	0	6	100.0%	100.0%	3	5	1	5	20.0%	100.0%
		8015B-SVOA - Oil	>2.5	6	14	0	12	0.0%	85.7%	0	0	0	0	0.0%	0.0%	1	4	0	4	0.0%	100.0%
Misc.	Total Cyanide	9014	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		9014	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	NDMA	1625C-CI M	0-2.5	11	13	3	0	23.1%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		1625C-CI M	>2.5	3	7	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	Pesticides	8270C	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		8270C	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	pH	9045C	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		9045C	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	TOC	9060A MOD	0-2.5	1	1	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	1	1	0	0	0.0%	0.0%
		9060A MOD	>2.5	1	4	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	1	4	0	0	0.0%	0.0%
	CEC	9081	0-2.5	1	1	0	1	0.0%	100.0%	0	0	0	0	0.0%	0.0%	1	1	0	1	0.0%	100.0%
		9081	>2.5	1	4	0	4	0.0%	100.0%	0	0	0	0	0.0%	0.0%	1	4	0	4	0.0%	100.0%

Notes and Key:

> = Greater than
% = Percent
bgs = Below ground surface
CEC = Cation Exchange Capacity
Chromium VI = Hexavalent chromium
NDMA = N-Nitrosodimethylamine
PCBs = Polychlorinated biphenyls
SVOCs = Semivolatile organic compounds
TOC = Total Organic Content
TPH = Total petroleum hydrocarbons

Table 5.1-8
Summary of Soil Sampling and Sampling Statistics for Source Areas E(m) and E(n)
Line 02 Region
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

				Source Area E(m)						Source Area E(n)					
Compound(s)	**Analyte**	**Method**	**Depth (feet bgs)**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**
Metals	Metals	6010B	0-2.5	6	8	0	8	0.0%	100.0%	7	11	2	11	18.2%	100.0%
		6020	0-2.5	3	5	0	5	0.0%	100.0%	7	11	2	11	18.2%	100.0%
		6010B	>2.5	6	12	0	12	0.0%	100.0%	4	9	0	9	0.0%	100.0%
		6020	>2.5	4	6	0	5	0.0%	83.3%	4	9	0	9	0.0%	100.0%
	Chromium VI	7199	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		7199	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	Mercury	7471A	0-2.5	6	8	0	6	0.0%	75.0%	7	11	2	10	18.2%	90.9%
		7471A	>2.5	6	12	0	7	0.0%	58.3%	4	9	0	6	0.0%	66.7%
SVOCs	SVOCs	8270C	0-2.5	9	14	1	8	7.1%	57.1%	7	11	2	4	18.2%	36.4%
		8270C	>2.5	6	12	0	0	0.0%	0.0%	2	5	0	2	0.0%	40.0%
PCBs	PCBs	8082	0-2.5	1	2	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		8082	>2.5	1	1	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
Perchlorate	Perchlorate	314.0, 314.0M	0-2.5	6	8	0	0	0.0%	0.0%	7	11	2	3	18.2%	27.3%
		314.0, 314.0M	>2.5	6	11	0	0	0.0%	0.0%	2	5	0	0	0.0%	0.0%
TPH	Diesel	8015B-SVOA - Diesel	0-2.5	1	2	0	2	0.0%	100.0%	4	8	1	8	12.5%	100.0%
		8015B-SVOA - Diesel	>2.5	1	1	0	1	0.0%	100.0%	1	1	0	1	0.0%	100.0%
	Motor Oil	8015B-SVOA - Oil	0-2.5	1	2	0	2	0.0%	100.0%	4	8	1	8	12.5%	100.0%
		8015B-SVOA - Oil	>2.5	1	1	0	1	0.0%	100.0%	1	1	0	1	0.0%	100.0%
Misc.	Total Cyanide	9014	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		9014	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	NDMA	1625C-CI M	0-2.5	0	0	0	0	0.0%	0.0%	3	6	2	0	33.3%	0.0%
		1625C-CI M	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	Pesticides	8270C	0-2.5	2	1	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		8270C	>2.5	1	1	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	pH	9045C	0-2.5	2	4	0	4	0.0%	100.0%	1	2	0	2	0.0%	100.0%
		9045C	>2.5	2	2	0	2	0.0%	100.0%	1	1	0	1	0.0%	100.0%
	TOC	9060A MOD	0-2.5	2	4	0	0	0.0%	0.0%	2	3	0	0	0.0%	0.0%
		9060A MOD	>2.5	2	2	0	0	0.0%	0.0%	2	5	0	0	0.0%	0.0%
	CEC	9081	0-2.5	2	4	0	4	0.0%	100.0%	2	3	0	3	0.0%	100.0%
		9081	>2.5	2	2	0	2	0.0%	100.0%	2	5	0	5	0.0%	100.0%

Notes and Key:

> = Greater than
% = Percent
bgs = Below ground surface
CEC = Cation Exchange Capacity
Chromium VI = Hexavalent chromium
NDMA = N-Nitrosodimethylamine
PCBs = Polychlorinated biphenyls
SVOCs = Semivolatile organic compounds
TOC = Total Organic Content
TPH = Total petroleum hydrocarbons

Table 5.1-9 Cross-Reference Between Soil and Soil Vapor Sampling Locations and Investigated Features
Line 02 – Main Line 02 Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Associated Site Feature	Source Area	Soil Sampling Location(s)	Soil Vapor Sampling Location(s)
CONRETE LINED TROUGH Concrete lined trough from Building 02024 to former unlined pond	29E	29E-SNS02 29E-SB02 29E-SB05 29E-SB09	29E-SP07 29E-SP08
CORRUGATED PIPE Discharge end of corrugated pipe serving former unlined pond	29E	29E-SNS03	
FORMER CONCRETE SUMP AT BUILDING 02024 Crawford bomb station former concrete sump	29E	29E-SB03 29E-SB06 29E-SB07	
FORMER HAZARDOUS WASTE STORAGE AREA Former Building 02027			E(m)-SP10
FORMER OXIDIZER GRIND STATION - BUILDING 02020 Drainage areas from Building 02020, former oxidizer grind station.	E(d)	E(d)-SNS01 E(d)-SNS02 E(d)-SNS03 E(e)-SNS01 E(e)-SNS02 E(e)-SB02 E(e)-SB03	E(d)-SP02 E(d)-SP03 DSA-SP10
FORMER UNLINED POND Low-lying area below concrete lined trough from Building 02024 and former unlined pond	29E	29E-SB08 29E-SNS04 29E-SNS05	29E-SP09 29E-SP10 29E-SP11
HAZARDOUS WASTE STORAGE TANK North of Building 02030			E(n)-SP09 DSA-SP15 DSA-SP17
SEPTIC TANK L2-ST24 Septic tank L2-ST24 serving Buildings 02024 and 02026	Line 2	L2-ST24-SB01 L2-ST26-SB01	L2-ST24-SP03
SEPTIC TANK AND LEACH LINES: L2-ST26 Septic tank L2-ST26 line from Building 02024	Line 2	L2-ST26-SNS01 L2-ST26-SNS02 L2-ST26-SNS03 L2-ST26-SB02 L2-ST26-SB03 L2-ST26-SB04 29E-SB10 29E-SB11 29E-SB12	L2-ST26-SP05 L2-ST26-SP06 E(m)-SP08 E(m)-SP09

Table 5.1-9 Cross-Reference Between Soil and Soil Vapor Sampling Locations and Investigated Features
Line 02 – Main Line 02 Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Associated Site Feature	Source Area	Soil Sampling Location(s)	Soil Vapor Sampling Location(s)
SEPTIC TANK L2-ST28 Septic tank L2-ST28/90 for Building 02028 and 02090	Line 2	L2-ST28-90-SB01 DSA-SB04	L2-ST28-90-SP01 DSA-SP09
SOURCE AREA E(n) **DRAIN LINE FROM BUILDING 02025** Drain line from Building 02025	E(n)	E(n)-SB01 E(n)-SB02 E(n)-SB03	E(n)-SP04 E(n)-SP05 E(n)-SP10 E(n)-SP11 E(n)-SP12
SURFACE DRAINAGE Surface drainage from Line 02 source areas, including 29E, E(d), E(e), E(m), and E(n)	E(m)	E(m)-SD01 E(m)-SD02	L2-ST26-SP07 E(m)-SP11
SURFACE DRAINAGE Ephemeral creek draining Line 2 source area. Including 29E, E(d), and E(e).	E(n)	E(n)-SD01	E(n)-SP04 E(n)-SP10 E(n)-SP11 E(n)-SP12
SURFACE DRAINAGES Surface drainages receiving runoff from Buildings 02021, 02022, and 02023	E(n)	E(n)-SNS01 E(n)-SNS02 E(n)-SNS03	E(n)-SP06 E(n)-SP07 E(n)-SP08
SURFACE WATER DRAINAGE Drainage channel serving Source Area 29E	29E	29E-SNS06 29E-SNS07	
VAPOR PLUME STEP-OUT SAMPLES Soil vapor samples collected to characterize vapor plume in Line 02/Area 00			28E-SP17 DSA-SP16 DSA-SP11 DSA-SP18 DSA-SP19 DSA-SP20 DSA-SP21 DSA-SP22 DSA-SP23 DSA-SP24 DSA-SP25 DSA-SP26 DSA-SP27 DSA-SP28 DSA-SP29 DSA-SP30 DSA-SP31 DSA-SP32

Table 5.2-1
Summary of Soil Sampling and Sampling Statistics for Source Areas 51E, 52E and E(l)
Line 05 North
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

				Source Area 51E						Source Area 52E						Source Area E(l)					
Compound(s)	**Analyte**	**Method**	**Depth (feet bgs)**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**
Metals	Metals	6010B	0-2.5	2	2	0	2	0.0%	100.0%	20	20	5	20	25.0%	100.0%	1	1	0	1	0.0%	100.0%
		6020	0-2.5	2	2	0	2	0.0%	100.0%	20	20	5	17	25.0%	85.0%	1	1	0	1	0.0%	100.0%
		6010B	>2.5	2	6	0	6	0.0%	100.0%	20	39	7	39	17.9%	100.0%	1	5	0	5	0.0%	100.0%
		6020	>2.5	2	6	0	6	0.0%	100.0%	20	39	7	39	17.9%	100.0%	1	5	0	5	0.0%	100.0%
	Chromium VI	7199	0-2.5	0	0	0	0	0.0%	0.0%	2	2	1	1	50.0%	50.0%	0	0	0	0	0.0%	0.0%
		7199	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	Mercury	7471A	0-2.5	2	2	0	2	0.0%	100.0%	19	19	5	17	26.3%	89.5%	1	1	0	1	0.0%	100.0%
		7471A	>2.5	2	5	0	5	0.0%	100.0%	19	38	8	38	21.1%	100.0%	1	5	0	5	0.0%	100.0%
SVOCs	SVOCs	8270C	0-2.5	2	2	0	2	0.0%	100.0%	18	18	5	11	27.8%	61.1%	1	1	0	1	0.0%	100.0%
		8270C	>2.5	1	4	0	2	0.0%	50.0%	9	16	2	5	12.5%	31.3%	1	5	0	2	0.0%	40.0%
PCBs	PCBs	8082	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		8082	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
Perchlorate	Perchlorate	314.0, 314.0M	0-2.5	2	2	0	0	0.0%	0.0%	21	21	4	6	19.0%	28.6%	1	1	0	1	0.0%	100.0%
		314.0, 314.0M	>2.5	2	6	0	3	0.0%	50.0%	17	37	2	8	5.4%	21.6%	1	5	0	0	0.0%	0.0%
TPH	Diesel	8015B-SVOA - Diesel	0-2.5	0	0	0	2	0.0%	0.0%	19	19	5	20	26.3%	105.3%	1	1	0	1	0.0%	100.0%
		8015B-SVOA - Diesel	>2.5	2	6	0	6	0.0%	100.0%	14	26	2	26	7.7%	100.0%	1	5	0	5	0.0%	100.0%
	Motor Oil	8015B-SVOA - Oil	0-2.5	0	0	0	2	0.0%	0.0%	19	19	5	20	26.3%	105.3%	1	1	0	1	0.0%	100.0%
		8015B-SVOA - Oil	>2.5	2	6	0	6	0.0%	100.0%	14	26	2	23	7.7%	88.5%	1	5	0	5	0.0%	100.0%
Misc.	Total Cyanide	9014	0-2.5	0	0	0	0	0.0%	0.0%	1	1	1	0	100.0%	0.0%	0	0	0	0	0.0%	0.0%
		9014	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	NDMA	1625C-CI M	0-2.5	2	2	0	0	0.0%	0.0%	17	17	3	0	17.6%	0.0%	0	0	0	0	0.0%	0.0%
		1625C-CI M	>2.5	1	4	0	0	0.0%	0.0%	5	9	2	0	22.2%	0.0%	0	0	0	0	0.0%	0.0%
	Nitroguanadine	Nitroguanadine-DISS	0-2.5	2	2	0	0	0.0%	0.0%	16	16	3	0	18.8%	0.0%	1	1	0	0	0.0%	0.0%
			>2.5	1	4	0	0	0.0%	0.0%	15	31	5	0	16.1%	0.0%	1	5	0	0	0.0%	0.0%
	pH	9045C	0-2.5	0	0	0	0	0.0%	0.0%	1	1	1	1	100.0%	100.0%	0	0	0	0	0.0%	0.0%
		9045C	>2.5	0	0	0	0	0.0%	0.0%	1	1	0	1	0.0%	100.0%	0	0	0	0	0.0%	0.0%
	TOC	9060A MOD	0-2.5	1	1	0	0	0.0%	0.0%	1	1	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		9060A MOD	>2.5	1	4	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	CEC	9081	0-2.5	1	1	0	1	0.0%	100.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		9081	>2.5	1	4	0	4	0.0%	100.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%

Notes and Key:

> = Greater than
% = Percent
bgs = Below ground surface
CEC = Cation Exchange Capacity
Chromium VI = Hexavalent chromium
NDMA = N-Nitrosodimethylamine
PCBs = Polychlorinated biphenyls
SVOCs = Semivolatile organic compounds
TOC = Total Organic Content
TPH = Total petroleum hydrocarbons

Table 5.2-2 Summary of Soil Vapor Sampling and Sampling Statistics
Line 05 North
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Interval	Depth (feet bgs)	Locations	Primary Samples	Duplicate Samples	Detects	Frequency of Duplicates	Frequency of Primary Detects
51E	Shallow	0-10	1	1	0	1	0.0%	100.0%
	Intermediate	11-20	1	1	1	1	100.0%	100.0%
	Deep	20	0	0	0	0	0.0%	0.0%
52E	Shallow	0-10	20	21	5	20	23.8%	95.2%
	Intermediate	11-20	5	5	0	5	0.0%	100.0%
	Deep	30	2	2	1	2	50.0%	100.0%
E(l)	Shallow	0-10	0	0	0	0	0.0%	0.0%
	Intermediate	11-20	0	0	0	0	0.0%	0.0%
	Deep	20	0	0	0	0	0.0%	0.0%
		Totals:	**29**	**30**	**7**	**29**	**23.3%**	**96.7%**

Notes and Key:
All samples analyzed for volatile organic compounds (VOCs) by USEPA Method TO-15.
% = Percent
bgs = Below ground surface

Table 5.2-3 Cross-Reference Between Soil and Soil Vapor Sampling Locations and Investigated Features
Line 05 North
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Associated Site Feature	Source Area	Soil Sampling Location(s)	Soil Vapor Sampling Location(s)
BLAST AREA – BUILDING 05112 Test cell blast area associated with Building 05112	52E	52E-SB16 52E-SB20 52E-SB21 52E-SB22	52E-SP17
DRAINAGE DITCH Drainage ditch serving outlying buildings and potentially floor drains within Building 05087	52E	52E-SNS01 52E-SNS02 52E-SB17 52E-SB18 52E-SB23	
FORMER CONRETE WASH SUMP Former concrete wash sump	51E	51E-SB04	51E-SP11 52E-SP11
MATERIAL STORAGE AREA Material storage area south of Building 05097	Line 5	L5-AF1-SB01	L5-AF1-SP01 52E-SP22 52E-SP23 52E-SP24
SEPTIC TANK AND LEACH LINE: 05-ST87 Septic tank from Building 05087	Line 5	L5-ST87-SB01 L5-ST87-SB02 52E-SB01	L5-ST87-SP01
SOURCE AREA E(l)- **LOW-LYING AREA WEST OF BUILDING 05087** Low-lying area west of the engine test cell and the former concrete wash sump and drainage from former sump to low-lying area.	E(l)	E(l)-SB01 51E-SB03	52E-SP11 52E-SP12 52E-SP15 52E-SP16 52E-SP21
SUMP AT BUILDING 05087 Sump south of Building 05087	52E	52E-SB06	52E-SP06 52E-SP10 52E-SP14
TEST CELL – BUILDING 05087 Former test cell and drainage area at west end of Building 05087.	52E	52E-SB04 52E-SB05 52E-SB19	52E-SP04 52E-SP05
TEST CELL - BUILDING 05112 Motor test cell		52E-SB14	52E-SP07
TOWER PAD Potential vertical missile test stand	52E	52E-SB15	52E-SP08 52E-SP09 52E-SP18 52E-SP19 52E-SP20

Table 5.2-3 Cross-Reference Between Soil and Soil Vapor Sampling Locations and Investigated Features
Line 05 North
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Associated Site Feature	Source Area	Soil Sampling Location(s)	Soil Vapor Sampling Location(s)
TRENCHES & FLOOR DRAINS – BUILDING 05087 Trenches and floor drains in concrete floor within Building 05087	52E	52E-SB07 52E-SB08 52E-SB09 52E-SB10 52E-SB11 52E-SB12 52E-SB13	

Table 5.2-4
Summary of Soil Vapor Sampling Activities and Deviations from Field Sampling Plan
Line 05 North
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Rationale and Comments	Number of Samples Collected	Sampling Activity	Sample ID	Sample Depths (feet bgs)	Analyses Performed	Deviations from Field Sampling Plan
51E	Concrete wash sump.	1	10, 20	Determine if a source is present within the vadose zone.	2	Soil Vapor	51E-SP11	10, 20	VOCs	
					1	Grab Groundwater	51E-SP11	***35***	VOCs, ClO4	
52E	Testing laboratory.	1	10, 20	Determine if a release to soil has occurred as a result of activities in the testing laboratory.	1	Soil Vapor	52E-SP04	10	VOCs	Not sampled at 20 ft bgs due to groundwater.
					1	Grab Groundwater	52E-SP04	16	VOCs	
52E	Engine test cell.	2	10, 20	Determine if a release to soil has occurred as a result of engine testing at each test cell.	3	Soil Vapor	52E-SP05	10	VOCs	
							52E-SP07	10, 20	VOCs	
					2	Grab Groundwater	52E-SP05	16	VOCs	
							52E-SP07	***35***	VOCs, ClO4	
52E	Sump along southeast side of Building 05087.	1	10, 20	Determine if a release to soil has occurred as a result of a release from the sump serving Building 05087.	1	Soil Vapor	52E-SP06	10	VOCs	
					1	Grab Groundwater	52E-SP06	16	VOCs	
52E	East of tower pad.	1	***10***, 20	Determine if a release to soil has occurred as a result of engine testing at Building 05112.	1	Grab Groundwater	52E-SP08	20	VOCs	Not sampled at 10 ft bgs due to groundwater.
52E	Step-out samples taken approximately 170 ft north of tower pad.	***0***	None	Additional samples collected in accordance with step-out and step-down procedures.	3	Soil Vapor	52E-SP09	10	VOCs	
							52E-SP18	10	VOCs	
							52E-SP20	10	VOCs	
					3	Grab Groundwater	52E-SP09	20	VOCs	
							52E-SP18	15	VOCs	
							52E-SP20	20	VOCs	
52E	Step-out sample taken approximately 80 ft north of tower pad.	***0***	None	Additional samples collected in accordance with step-out and step-down procedures.	1	Soil Vapor	52E-SP19	10, 20, 30	VOCs	
52E	Step-out samples taken east of Building 05087.	***0***	None	Additional samples collected in accordance with step-out and step-down procedures.	2	Soil Vapor	52E-SP10	10	VOCs	
							52E-SP14	10	VOCs	
					2	Grab Groundwater	52E-SP10	20	VOCs	
							52E-SP14	15	VOCs	
52E	Step-out samples taken approximately 220 ft south of Building 05096.	***0***	None	Additional samples collected in accordance with step-out and step-down procedures.	1	Soil Vapor	52E-SP11	10	VOCs	
					1	Grab Groundwater	52E-SP11	20	VOCs	

Table 5.2-4
Summary of Soil Vapor Sampling Activities and Deviations from Field Sampling Plan
Line 05 North
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Rationale and Comments	Number of Samples Collected	Sampling Activity	Sample ID	Sample Depths (feet bgs)	Analyses Performed	Deviations from Field Sampling Plan
52E	Step-out samples taken east of Building 05096.	***0***	None	Additional samples collected in accordance with step-out and step-down procedures.	2	Soil Vapor	52E-SP22	10	VOCs	
							52E-SP23	10	VOCs	
					1	Grab Groundwater	52E-SP22	20	VOCs	
							52E-SP23	20	VOCs	
52E	Step-out samples taken west of test cell.	***0***	None	Additional samples collected in accordance with step-out and step-down procedures.	1	Soil Vapor	52E-SP16	10	VOCs	
					1	Grab Groundwater	52E-SP16	15	VOCs	
52E	Step-out sample taken southwest of test cell.	***0***	None	Additional samples collected in accordance with step-out and step-down procedures.	1	Soil Vapor	52E-SP12	10	VOCs	
52E	Step-out samples taken approximately 80 ft north Building 05096.	***0***	None	Additional samples collected in accordance with step-out and step-down procedures.	5	Soil Vapor	52E-SP24	10	VOCs	
							52E-SP15	10, 20	VOCs	
							52E-SP21	10, 20	VOCs	
					1	Grab Groundwater	52E-SP24	20	VOCs	
52E	Step-out samples taken west of Building 05089.	***0***	None	Additional samples collected in accordance with step-out and step-down procedures.	1	Soil Vapor	52E-SP17	10, 30	VOCs	
					1	Grab Groundwater	52E-SP17	20	VOCs	
52E	Material storage south of Building 05097.	1	***10***, 20	Determine if a release to soil has occurred from stored material.	0	Soil Vapor	L5-AF1-SP01	None	None	Not sampled due to groundwater.
					1	Grab Groundwater	L5-AF1-SP01	20	VOCs	
52E	Septic tank and leach lines associated with Building 05087.	1	10, 20	Determine if a source is present within the vadose zone.	1	Soil Vapor	L5-ST87-SP01	10	VOCs	
					2	Grab Groundwater	L5-ST87-SP01	16, 20	VOCs	

Notes and Key:
Grab groundwater collected when soil vapor point was below the groundwater table.
Bold, italicized and underlined data does not agree with the analytical results. See "Deviations from Field Sampling Plan" column for more information on discrepancies.

ft bgs = Feet below ground surface
ID = Identification
Proposed analyses = VOC analysis
VOC = Volatile organic compound

Table 5.2-5
Summary of Soil Sampling Activities and Deviations from Field Sampling Plan
Line 05 North
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
51E	Drainage ditch transmitting discharge from the former concrete wash sump to a low-lying area to the northwest of the sump.	Subsurface Soil	1	0, 4, 10	SVOCs, ClO4, nitro, NDMA, TPH, metals	Confirm results of previous investigations, evaluate vertical extent of chemicals in soil, and support risk assessment.	3	51E-SB03	1.5, 5, 11.5	SVOCs, metals, TPH, ClO4, NDMA, nitro	SVOCs, NDMA, and nitro only analyzed at 1.5 ft bgs.
51E	Former concrete wash sump.	Subsurface Soil	1	0, 4, 10, 22, 40, ***60***	SVOCs, ClO4, nitro, NDMA, TPH, metals, physical properties, DI-WET	Confirm results of previous investigations, evaluate vertical extent of chemicals in soil, support risk assessment, and evaluate potential for water quality impacts.	5	51E-SB04	1, 5, 11, 23, 45	SVOCs, metals, TPH, ClO4, NDMA, nitro, physical properties, DI-WET	BD, PD, and perm were not analyzed at 1, 5, 11, and 45 ft bgs. Not sampled at 60 ft bgs due to groundwater.
		Grab Groundwater	1	First water	SVOCs, ClO4, ***nitro***, NDMA, total and dissolved metals		1	51E-SB04	63	SVOCs, total and dissolved metals, ClO4, NDMA	Analytical result for nitro is not available .
52E	Drainage area below engine test cell.	Subsurface Soil	2	0, 4, 10	SVOCs, ClO4, nitro, NDMA, TPH, metals	Determine if a release from the engine test cells has occurred, evaluate vertical extent of chemicals in soil, and support risk assessment.	6	52E-SB04	1, 5.5, 11	SVOCs, metals, TPH, ClO4, NDMA, nitro	SVOCs and NDMA analyzed only at 1 ft bgs. At 5.5 ft bgs, only analyzed for TPH and ClO4. At 11 ft bgs, only analyzed for metals, ClO4, nitro.
								52E-SB05	1.5, 5, 11.5	SVOCs, metals, TPH, ClO4, NDMA, nitro	Metals only analyzed at 1.5 and 11.5 ft bgs. SVOCs, NDMA, and nitro only analyzed at 1.5 ft bgs.
52E	Sump south of Building 05087.	Subsurface Soil	1	0, 4, 10	SVOCs, ClO4, nitro, NDMA, TPH, metals	Determine if a release from the sump has occurred, evaluate vertical extent of chemicals in soil, and support risk assessment.	3	52E-SB06	1.5, 5, 11.5	SVOCs, metals, TPH, ClO4, NDMA, nitro	TPH and nitro not analyzed at 11.5 ft bgs. At 5 ft bgs, only Hg was analyzed.
52E	Drainage area below engine test cell.	Subsurface Soil	3	0, 4, 10	SVOCs, ClO4, nitro, NDMA, TPH, metals	Determine if a release from the floor drains and trenches has occurred, evaluate vertical extent of chemicals in soil, and support risk assessment.	9	52E-SB07	1, 5, 11	SVOCs, metals, TPH, ClO4, NDMA, nitro	
								52E-SB08	1, 5, 11	SVOCs, metals, TPH, ClO4, NDMA, nitro	SVOCs, NDMA, and TPH only analyzed at 1 ft bgs.
								52E-SB11	1, 5, 11	SVOCs, metals, TPH, ClO4, NDMA, nitro	SVOCs, TPH, and NDMA only analyzed at 1 ft bgs.
52E	Drainage area below engine test cell.	Subsurface Soil	3	0, 4, ***10***	SVOCs, ClO4, nitro, NDMA, TPH, metals	Determine if a release from the floor drains and trenches has occurred, evaluate vertical extent of chemicals in soil, and support risk assessment.	8	52E-SB09	3.75, 5.5, 11.5	SVOCs, metals, TPH, ClO4, NDMA, nitro	Proposed surface sample taken at 3.75 ft bgs. SVOCs, NDMA, and TPH only analyzed at 3.75 ft bgs.
								52E-SB10	1.5, 5.5, 11.5	SVOCs, metals, TPH, ClO4, NDMA, nitro	SVOCs, NDMA, TPH, and ClO4 only analyzed at 1.5 ft bgs.
								52E-SB12	1, 5	SVOCs, metals ***(including CrVI)***, TPH, ClO4, NDMA, nitro, ***cyanide***, pH	No soil recovery at 10 ft bgs. Cyanide and CrVI were included as additional analyses. SVOCs, TPH, NDMA, and cyanide only analyzed at 1 ft bgs.
52E	Floor drain in middle portion of Building 05087.	Subsurface Soil	1	0, 4, 10	SVOCs, ClO4, nitro, NDMA, TPH, metals	Determine if a release from the floor drain has occurred, evaluate vertical extent of chemicals in soil, and support risk assessment.	3	52E-SB13	1, 5, 11	SVOCs, metals, TPH, ClO4, NDMA, nitro	SVOCs and NDMA only analyzed at 1 ft bgs.

Table 5.2-5
Summary of Soil Sampling Activities and Deviations from Field Sampling Plan
Line 05 North
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
52E	Test cell.	Subsurface Soil	1	0, 4, 10	SVOCs, ClO4, nitro, NDMA, TPH, metals	Determine if a release from the test cell has occurred, evaluate vertical extent of chemicals in soil, and support risk assessment.	3	52E-SB14	1.5, 5, 11.5	SVOCs, metals, TPH, ClO4, NDMA, nitro	SVOCs and NDMA analyzed at 1.5 ft bgs only.
52E	Potential vertical missile test stand.	Subsurface Soil	1	0, 4, 10	SVOCs, ClO4, nitro, NDMA, TPH, metals	Determine if a release from the potential test stand has occurred, evaluate vertical extent of chemicals in soil, and support risk assessment.	3	52E-SB15	1, 5, 11	SVOCs, metals, TPH, ClO4, NDMA, nitro	SVOCs, NDMA, TPH, and ClO4 only analyzed at 1 ft bgs.
52E	Test cell blast area.	Subsurface Soil	1	0, 4, 10	SVOCs, ClO4, nitro, NDMA, TPH, metals	Determine if a release within the test cell blast area has occurred, evaluate vertical extent of chemicals in soil, and support risk assessment.	3	52E-SB16	1, 5, 11	SVOCs, metals, TPH, ClO4, NDMA, nitro	SVOCs, NDMA, TPH, and ClO4 only analyzed at 1 ft bgs.
52E	Drainage ditch serving outlying buildings and potentially floor drains within Building 05087.	Surface and Near-Surface Soil	2	0	SVOCs, ClO4, ***nitro***, NDMA, TPH, metals	Determine if a release from the Building 05087 area has occurred, evaluate vertical extent of chemicals in soil, and support risk assessment.	4	52E-SNS01	0.5, ***5***, ***11***	SVOCs, metals, TPH, ClO4, NDMA	Not analyzed for nitro. Step-out sample locations at 5 and 11 ft bgs. SVOCs, NDMA, and ClO4 only analyzed at 0.5 ft bgs.
								52E-SNS02	0.5	SVOCs, metals, TPH, ClO4, NDMA, nitro	
52E	Material storage south of Building 50097.	Subsurface Soil	1	0, 4, 10	SVOCs, ClO4, nitro, NDMA, TPH, metals	Determine if a release to soil from stored material has occurred, evaluate vertical extent of chemicals in soil, and support risk assessment.	3	L5-AF1-SB01	1, 5, 11	SVOCs, metals, TPH, ClO4, NDMA, nitro	
52E	Septic tank from Building 05087.	Subsurface Soil	1	0, 4, 10, 22, 40, ***60***	SVOCs, ClO4, nitro, NDMA, TPH, metals, DI-WET	Confirm results of previous investigations, evaluate vertical extent of chemicals in soil, support risk assessment, and evaluate potential for water quality impacts.	5	L5-ST87-SB01	1, 4, 11, 23, 43	SVOCs, metals, TPH, ClO4, NDMA, nitro, DI-WET	DI-WET only analyzed at 23 ft bgs. Not sampled at 60 ft bgs due to water at 49 ft bgs.
52E	Septic tank leach line from Building 05087.	Subsurface Soil	1	0, 4, 10	SVOCs, ClO4, nitro, NDMA, TPH, metals	Confirm results of previous investigations, evaluate vertical extent of chemicals in soil, and support risk assessment.	3	L5-ST87-SB02	1, 5, 11	SVOCs, metals, TPH, ClO4, NDMA, nitro	At 11 ft bgs, only metals and nitro analyzed.
52E	East of Building 05099.	Subsurface Soil	***0***	None	None	Additional samples collected because chemical concentrations exceeded screening criteria.	5	52E-SB17	1, 5, 11	SVOCs, TPH, metals, NDMA	
								52E-SB18	5, 11	SVOCs, TPH, metals, NDMA	
52E	East of former concrete wash sump.	Subsurface Soil	***0***	None	None	Additional samples collected because chemical concentrations exceeded screening criteria.	3	52E-SB19	1, 5, 11	TPH, ClO4, Cd	
52E	West of tower pad.	Subsurface Soil	***0***	None	None	Additional samples collected because chemical concentrations exceeded screening criteria.	11	52E-SB20	1, 5, 11	ClO4	
								52E-SB22	1, 5, 11	ClO4	
								52E-SB21	1, 5, 11, 20, 40	ClO4	
		Grab Groundwater	***0***	None	None	Additional samples collected because chemical concentrations exceeded screening criteria.	1	52E-SB21	35	ClO4	

Table 5.2-5
Summary of Soil Sampling Activities and Deviations from Field Sampling Plan
Line 05 North
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
52E	Near the dirt road, 250 ft north of Building 05099.	Surface and Near-Surface Soil	***0***	None	None	Additional samples collected because chemical concentrations exceeded screening criteria.	1	52E-SB23	1	SVOCs, TOC, metals (including CrVI)	
E(l)	Low-lying area west of the engine test cells and the former concrete wash sump.	Subsurface Soil	1	0, 4, 10, 22, 40, 60	SVOCs, nitro, DI-WET, ClO4, TPH, metals	Determine if a release from the engine test cells (52E) or concrete wash sump (51E) has occurred via discharge or storm water runoff. Evaluate vertical extent of chemicals in soil, support risk assessment, and evaluate potential for water quality impacts.	6	E(l)-SB01	0.25, 5, 11, 22, 42, 62	SVOCs, metals, TPH, ClO4, nitro, DI-WET	DI-WET only analyzed at 5 ft bgs.

Notes and Key:
Bulk density includes dry density, wet density, and specific gravity.
Physical properties include bulk density, permeability, porosity, moisture, organic carbon, grain size, and CEC.
Bold, italicized and underlined data does not agree with the analytical results. See "Deviations from Field Sampling Plan" column for more information on discrepancies.

BD = Bulk density
Cd = Cadmium
CEC = Cation Exchange Capacity
ClO4 = Perchlorate
CrVI = Hexavalent chromium
DI-WET = Deionized waste extract test
ft bgs = Feet below ground surface
Hg = Mercury
ID = Identification
NDMA = N-Nitrosodimethylamine
nitro = Nitroguanidine
PCBs = Polychlorinated biphenyls
PD = Porosity
Perm = Permeability
pH = Paste pH
SVOC = Semivolatile organic compound
TOC = Total organic carbon
TPH = Total petroleum hydrocarbons

Table 5.2-6 *Summary of Geotechnical Soil Parameters*
Line 05 North
Aerojet Boundary Operable Unit
Aerojet Superfund Site
Sacramento County, California

			Geophysical Parameters (ASTM D2937, D854)						Sieve Analysis (ASTM D422)				Permeability (ASTM D5084)	
Test No.	Date	Description of Test Location	Moisture Content (%)	Wet Density (pcf)	Dry Density (pcf)	Wet Density	Specific Gravity	Porosity	Cobbles (%)	Gravel (%)	Sand (%)	Silt / Clay (%)	Average Hydraulic Gradient	Permeability (cm/sec)
99	11/23/05	51E-SB04-1	7.3						0.0	66.4	23.1	10.5		
100	11/23/05	51E-SB04-5	3.8						0.0	80.2	12.8	7.0		
101	11/23/05	51E-SB04-11	10.4						0.0	66.7	21.3	12.0		
102	11/23/05	51E-SB04-23	46.0	183.9	125.9		2.418	0.1650	0.0	15.2	41.1	43.7	12.4	1.39E-08
103	11/23/05	51E-SB04-45	24.1						0.0	0.1	44.7	55.2		
		Mean	**18.3**	**183.9**	**125.9**	**0.0**	**2.4**	**0.2**	**0.0**	**45.7**	**28.6**	**25.7**	**12.4**	**1.4E-08**
		Median	**10.4**	**183.9**	**125.9**	**0.0**	**2.4**	**0.2**	**0.0**	**41.6**	**29.7**	**28.7**	**12.4**	**1.4E-08**
		Geomean	**18.6**	**183.9**	**125.9**	**0.0**	**2.4**	**0.2**	**0.0**	**33.9**	**33.1**	**33.1**	**12.4**	**1.4E-08**

Notes and Key:
% = Percent
No. = Number
cm/sec = Centimeters per second
pcf = Pounds per cubic foot

Table 5.3-1 *Summary of Soil Sampling and Sampling Statistics*
Westlakes/Open Space Area 6
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Compound(s)	Analyte	Method	Depth (feet bgs)	Westlakes/OS6					
				Locations	Primary Samples	Duplicates	Detects	Frequency of Duplicates	Frequency of Primary Detects
VOCs	VOCs	8260B	0-2.5	2	4	0	2	0.0%	50.0%
		8260B	>2.5	0	0	0	0	0.0%	0.0%
Metals	Metals	6010B	0-2.5	20	37	0	37	0.0%	100.0%
		6020	0-2.5	18	36	0	36	0.0%	100.0%
		6010B	>2.5	9	15	0	15	0.0%	100.0%
		6020	>2.5	5	10	0	10	0.0%	100.0%
	Chromium VI	7199	0-2.5	17	34	0	32	0.0%	94.1%
		7199	>2.5	8	13	0	13	0.0%	100.0%
	Mercury	7471A	0-2.5	17	34	0	33	0.0%	97.1%
		7471A	>2.5	9	14	0	14	0.0%	100.0%
SVOCs	SVOCs	8270C	0-2.5	17	34	0	12	0.0%	35.3%
		8270C	>2.5	9	13	0	0	0.0%	0.0%
PCBs	PCBs	8082	0-2.5	17	34	0	6	0.0%	17.6%
		8082	>2.5	5	7	0	0	0.0%	0.0%
Perchlorate	Perchlorate	314.0, 314.0M	0-2.5	17	31	0	0	0.0%	0.0%
		314.0, 314.0M	>2.5	11	19	0	2	0.0%	10.5%
TPH	Diesel	8015B-SVOA - Diesel	0-2.5	7	14	0	14	0.0%	100.0%
		8015B-SVOA - Diesel	>2.5	0	0	0	0	0.0%	0.0%
	Motor Oil	8015B-SVOA - Oil	0-2.5	7	14	0	14	0.0%	100.0%
		8015B-SVOA - Oil	>2.5	0	0	0	0	0.0%	0.0%
Misc.	Total Cyanide	9014	0-2.5	0	0	0	0	0.0%	0.0%
		9014	>2.5	0	0	0	0	0.0%	0.0%
	NDMA	1625C-CI M	0-2.5	4	8	0	0	0.0%	0.0%
		1625C-CI M	>2.5	4	5	0	0	0.0%	0.0%
	Pesticides	8081A/8141A	0-2.5	17	34	0	9	0.0%	26.5%
		8081A/8141A	>2.5	5	7	0	0	0.0%	0.0%
	OBPA	8270C	0-2.5	21	42	0	0	0.0%	0.0%
		8270C	>2.5	8	12	0	0	0.0%	0.0%
	Nitroguanadine	Nitroguandine-DISS	0-2.5	17	34	0	0	0.0%	0.0%
		Nitroguandine-DISS	>2.5	5	7	0	0	0.0%	0.0%
	pH	9045C	0-2.5	17	34	0	34	0.0%	100.0%
		9045C	>2.5	10	17	0	17	0.0%	100.0%
	TOC	9060A MOD	0-2.5	10	13	0	7	0.0%	53.8%
		9060A MOD	>2.5	1	1	0	0	0.0%	0.0%
	CEC	9081	0-2.5	5	6	0	6	0.0%	100.0%
		9081	>2.5	1	1	0	1	0.0%	100.0%

Notes and Key:

> = Greater than
% = Percent
bgs = Below ground surface
CEC = Cation Exchange Capacity
Chromium VI = Hexavalent chromium
NDMA = N-Nitrosodimethylamine
OBPA = 10,10'-Oxybis-10H-Phenoxarsine
PCBs = Polychlorinated biphenyls
SVOCs = Semivolatile organic compounds
TPH = Total petroleum hydrocarbons
TOC = Total Organic Content
VOCs = Volatile Organic Compounds

Table 5.3-2 *Cross-Reference Between Soil and Soil Vapor Sampling Locations and Investigated Features*
Westlakes
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Associated Site Feature	Soil Sampling Location(s)
WESTLAKES - EASTERN POND Receives surface water discharges from Western Administration Area Ditch and Buffalo Creek Cutoff. May also receive surface water discharge from Buffalo Creek in case of spill.	WL-SD04 WL-SD05 WL-SD06 WL-SB10
WESTLAKES - WESTERN POND Receives surface water discharges from Western Administration Area Ditch, Buffalo Creek Cutoff, and Eastern Pond. May also receive surface water discharge from Buffalo Creek in case of spill.	WL-SD07 WL-SD08 WL-SD10 WL-SB09
WESTLAKES - CELL 1 Cell 1 receives discharge from the western detention pond and Buffalo Creek.	WL-SB01 WL-SB02 WL-SB03 WL-SB04 WL-SB11 WL-SB12
WESTLAKES – CELL 2 Cell 2 receives overflow from Cell 1 when storm flows are extremely high.	WL-SB05 WL-SB06 WL-SB07 WL-SB08
WESTLAKES – CELL 3 Cell 3 receives overflow from Cell 2 when storm flows are extremely high.	WL-SD03 WL-SB13 WL-SB14 WL-SB15

Table 5.3-3
Summary of Soil Sampling Activities and Deviations from Field Sampling Plan
Westlakes Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
Eastern side of Cell 1 receiving discharge from east and west ponds and Buffalo Creek	Cell 1	Subsurface Soil	***1***	0, 1, 4, ***10***	SVOCs, PAHs, pesticides, Prowl, OBPA, PCBs, metals (including CrVI), ClO4, nitro, pH, DI-WET	Assess contamination in the detention basins that could have resulted by release from upstream detention ponds serving Administration Ditch and Buffalo Creek, support risk assessment, and evaluate the potential for water quality impacts.	4	WL-SB01	0.5, 1.5, 5, 11	SVOCs, PAHs, pesticides, ***NDMA***, pH, Prowl, OBPA, PCBs, metals (including CrVI), ClO4, nitro, DI-WET	Refusal at 6 ft bgs. OBPA not analyzed at 5 ft bgs. DI-WET not analyzed at 0.5 and 1.5 ft bgs. ClO4 not analyzed at 1.5 ft bgs. Redrilled to 11 ft bgs and analyzed only for ClO4. NDMA was included as additional analysis.
							2	WL-SB11	5, 11	ClO4	
							2	WL-SB12	5, 11	ClO4	
Discharge from east and west ponds and Buffalo Creek	Cell 1	Subsurface Soil	2	0, 1, 4, ***10***	SVOCs, PAHs, pesticides, Prowl, OBPA, PCBs, metals (including CrVI), ClO4, nitro, pH, ***DI-WET***	Assess contamination in the detention basins that could have resulted by release from upstream detention ponds serving Administration Ditch and Buffalo Creek, support risk assessment, and evaluate the potential for water quality impacts.	3	WL-SB03	0.5, 1.5, 4	SVOCs, PAHs, pesticides, ***NDMA***, pH, Prowl, OBPA, PCBs, metals (including CrVI), ClO4, nitro, DI-WET	Refusal at 4.5 ft bgs. DI-WET analyzed only at 4 ft bgs. NDMA was included as additional analysis.
							5	WL-SB04	0.5, 1.5, 5.5, 10.5, ***11***	SVOCs, PAHs, pesticides, ***NDMA***, pH, Prowl, OBPA, PCBs, nitro, metals (including CrVI), ClO4, ***BD, GS, MC, PD, perm, SG*** .	NDMA, BD, GS MC, SG, PD, and perm were included as additional analyses. Redrilled to 11 ft bgs and analyzed only for BD, GS, MC, PD, perm, and SG. Not analyzed for DI-WET.
Discharge from east and west ponds and Buffalo Creek	Cell 1	Subsurface Soil	1	0, 1, 4, ***10***	SVOCs, PAHs, pesticides, Prowl, OBPA, PCBs, metals (including CrVI), ClO4, nitro, pH, DI-WET, physical properties	Assess contamination in the detention basins that could have resulted by release from upstream detention ponds serving Administration Ditch and Buffalo Creek, support risk assessment, and evaluate the potential for water quality impacts.	4	WL-SB02	0.5, ***1***, 1.5, 4	SVOCs, PAHs, pesticides, Prowl, OBPA, PCBs, metals (including CrVI), ClO4, nitro, ***NDMA***, pH, DI-WET, physical properties	Refusal at 6 ft bgs. ClO4 not analyzed at 0.5 ft bgs. DI-WET not analyzed at 0.5 and 1.5 ft bgs. Additional sample at 1 ft bgs analyzed only for BD, GS, and MC. CEC and TOC not analyzed at 0.5 and 4 ft bgs. NDMA was included as additional analysis.
Discharge from east and west ponds and Buffalo Creek	Cell 2	Subsurface Soil	3	0, 1, 4, 10	SVOCs, PAHs, pesticides, Prowl, OBPA, PCBs, nitro, metals (including CrVI), ClO4, pH, DI-WET	Assess contamination in the detention basins that could have resulted by release from upstream detention ponds serving Administration Ditch and Buffalo Creek, support risk assessment, and evaluate the potential for water quality impacts.	4	WL-SB05	0.5, 1.5, 5, 11	SVOCs, PAHs, pesticides, Prowl, OBPA, PCBs, metals (including CrVI), ClO4, nitro, ***NDMA***, pH, DI-WET	PAHs, PCBs, nitro not analyzed at 5 and 11 ft bgs. DI-WET analyzed only at 0.5 ft bgs. NDMA was included as additional analysis.
							4	WL-SB06	0.5, 1.5, 5, 11	SVOCs, PAHs, pesticides, Prowl, OBPA, PCBs, metals (including CrVI), ClO4, nitro, ***NDMA***, pH, DI-WET	NDMA was included as additional analysis. PAHs not analyzed at 5 ft bgs. SVOC, PAHs, OBPA, and NDMA not analyzed at 11 ft bgs. PCBs and metals (including CrVI) not analyzed at 5 and 11 ft bgs.
							4	WL-SB08	0.5, 1.5, 5, 11.5	SVOCs, PAHs, pesticides, Prowl, OBPA, PCBs, metals (including CrVI), ClO4, nitro, ***NDMA***, pH, DI-WET	DI-WET analyzed only at 5 ft bgs. NDMA was included as additional analysis. SVOCs, PAHs, OBPA, PCBs, nitro, and NDMA not analyzed at 5 and 11.5 ft bgs.
Discharge from east and west ponds and Buffalo Creek	Cell 2	Subsurface Soil	1	0, 1, 4, 10	SVOCs, PAHs, pesticides, Prowl, OBPA, PCBs, metals (including CrVI), ClO4, nitro, pH, DI-WET, physical properties	Assess contamination in the detention basins that could have resulted by release from upstream detention ponds serving Administration Ditch and Buffalo Creek, support risk assessment, and evaluate the potential for water quality impacts.	5	WL-SB07	0.5, ***1***, 1.5, 5, 11	SVOCs, PAHs, pesticides, Prowl, OBPA, PCBs, metals (including CrVI), DI-WET, ClO4, nitro, pH, ***NDMA, SG, PD, perm***, physical properties	Additional sample at 1 ft bgs. BD, GS and MC analyzed only at 1 and 11 ft bgs. DI-WET analyzed only at 5 ft bgs. SVOCs, PAHs, and PCBs not analyzed at 5 and 11 ft bgs. CEC and TOC not analyzed at 0.5 and 5 ft bgs. NDMA, SG, PD, and perm were included as additional analyses.
Discharge from east pond	West Pond	Subsurface Soil	1	0, 1, 4, 10	SVOCs, PAHs, pesticides, Prowl, OBPA, PCBs, metals (including CrVI), ClO4, nitro, pH, DI-WET, physical properties	Assess contamination in the detention basins that could have resulted by release from upstream detention ponds serving Administration Ditch and Buffalo Creek, support risk assessment, and evaluate the potential for water quality impacts.	4	WL-SB09	0.5, 1.5, 5, 11	SVOCs, PAHs, pesticides, Prowl, OBPA, PCBs, metals (including CrVI), ClO4, nitro, ***NDMA***, pH, DI-WET, physical properties	ClO4 not analyzed at 1.5 and 5 ft bgs. CEC, TOC, and DI-WET analyzed only at 1.5 ft bgs. NDMA was included as additional analysis.
Discharge from Admin Ditch	East Pond	Subsurface Soil	1	0, 1, 4, 10	SVOCs, PAHs, pesticides, Prowl, OBPA, PCBs, metals (including CrVI), ClO4, nitro, pH, DI-WET, ***physical properties***	Assess contamination in the detention basins that could have resulted by release from upstream detention ponds serving Administration Ditch and Buffalo Creek, support risk assessment, and evaluate the potential for water quality impacts.	4	WL-SB10	0.5, 1.5, 5, 11	SVOCs, PAHs, pesticides, Prowl, OBPA, PCBs, metals (including CrVI), ClO4, nitro, ***NDMA***, pH, DI-WET	DI-WET not analyzed at 1.5, 5, 11 ft bgs. SVOCs, NDMA, and OBPA not analyzed at 5 ft bgs. PAHs, PCBs, ClO4, and nitro not analyzed at 5, 11 ft bgs. Physical properties not analyzed. NDMA was included as additional analysis.

Source Area	Associated Site Feature	Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
Eastern corner of Cell 3	Cell 3	Surface and Near-Surface Soil	***1***	0, 1	***VOCs***, SVOCs, PAHs, pesticides, Prowl, OBPA, PCBs, metals (including CrVI), ClO4, nitro, pH, DI-WET	Assess contamination that could be present within the active storm water detention ponds, support risk assessment, and evaluate the potential for water quality impacts.	1	WL-SB13	1	Metals	
							1	WL-SB14	1	Metals	
							1	WL-SB15	1	Metals	
							2	WL-SD03	0.5, 1.5	SVOCs, PAHs, ***TPH***, pesticides, Prowl, OBPA, PCBs, metals (including CrVI), ClO4, nitro, pH, ***NDMA***, DI-WET	Not analyzed for VOCs. TPH and NDMA were included as additional analyses. DI-WET not analyzed at 0.5 ft bgs.
Discharge from Administration Ditch and Buffalo Creek	East Pond	Surface and Near-Surface Soil	1	0, 1, 4, ***10***	***VOCs***, SVOCs, PAHs, pesticides, Prowl, OBPA, PCBs, metals (including CrVI), ClO4, nitro, pH, DI-WET, ***physical properties***	Assess contamination that could be present within the active storm water detention ponds, support risk assessment, and evaluate the potential for water quality impacts.	4	WL-SD04	0.25, 0.5, 1.5, 4	SVOCs, PAHs, ***TPH***, pesticides, Prowl, OBPA, PCBs, metals (including CrVI), ClO4, nitro, pH, ***NDMA***, ***TPH***, DI-WET, ***SG***, ***PD***, ***perm***, BD, MC, GS	No sample collected at 10 ft bgs. NDMA, TPH, SG, PD, and perm were included as additional analyses. VOCs, CEC, and TOC not analyzed. DI-WET not analyzed at 1.5 ft bgs. Samples collected at 0.25 and 4 ft bgs analyzed only for BD, GS, MC, PD, SG, and perm.
Discharge from Administration Ditch and Buffalo Creek	East Pond	Surface and Near-Surface Soil	2	0, 1	***VOCs***, SVOCs, PAHs, pesticides, Prowl, OBPA, PCBs, metals (including CrVI), pH, ClO4, nitro, DI-WET	Assess contamination that could be present within the active storm water detention ponds, support risk assessment, and evaluate the potential for water quality impacts.	4	WL-SD05	0.5, 1.5	SVOCs, PAHs, ***TPH***, pesticides, Prowl, OBPA, PCBs, metals (including CrVI), ClO4, nitro, pH, ***NDMA***, DI-WET, ***CEC***, ***TOC***	TPH and NDMA were included as additional analyses. VOCs not analyzed. DI-WET not analyzed at 1.5 ft bgs. CEC and TOC were an additional analysis at 1.5 ft bgs.
								WL-SD06	0.5, 1.5	SVOCs, PAHs, ***TPH***, pesticides, Prowl, OBPA, PCBs, metals (including CrVI), ClO4, nitro, pH, ***NDMA***, DI-WET	TPH and NDMA were included as additional analyses. VOCs not analyzed. DI-WET not analyzed at 0.5 ft bgs.
Discharge from Administration Ditch and Buffalo Creek	West Pond	Surface and Near-Surface Soil	2	0, 1	***VOCs***, SVOCs, PAHs, pesticides, Prowl, ***OBPA***, PCBs, metals (including CrVI), ClO4, nitro, pH, DI-WET	Assess contamination that could be present within the active storm water detention ponds, support risk assessment, and evaluate the potential for water quality impacts.	4	WL-SD07	0.5, 1.5	SVOCs, PAHs, pesticides, Prowl, OBPA, ***TPH***, PCBs, metals (including CrVI), ClO4, nitro, ***NDMA***, pH, DI-WET	TPH and NDMA were included as additional analyses. VOCs not analyzed. DI-WET not analyzed at 1.5 ft bgs.
								WL-SD08	0.5, 1.5	SVOCs, PAHs, pesticides, Prowl, ***TPH***, PCBs, metals (including CrVI), ClO4, nitro, ***NDMA***, pH, DI-WET	TPH and NDMA were included as additional analyses. VOCs and OBPA not analyzed. DI-WET not analyzed at 1.5 ft bgs.
Discharge from Administration Ditch and Buffalo Creek	West Pond	Surface and Near-Surface Soil	1	0, 1	***VOCs***, SVOCs, PAHs, pesticides, Prowl, OBPA, PCBs, metals (including CrVI), ClO4, nitro, pH, DI-WET	Assess contamination that could be present within the active storm water detention ponds, support risk assessment, and evaluate the potential for water quality impacts.	2	WL-SD10	0.5, 1.5	SVOCs, PAHs, pesticides, Prowl, OBPA, CEC, TOC, ***TPH***, PCBs, nitro, pH, ClO4, ***NDMA***, metals (including CrVI), DI-WET	TPH and NDMA were included as additional analyses. VOCs not analyzed. DI-WET not analyzed at 1.5 ft bgs.

Notes and Key:
PAHs analyzed by USEPA 8270 SIM method.
Bulk density includes dry density and wet density.
Physical properties include bulk density, moisture, grain size, total organic carbon, and CEC.
Bold, italicized and underlined data does not agree with the analytical results. See "Deviations from Field Sampling Plan" column for more information on discrepancies.

BD = Bulk density
CEC = Cation exchange capacity
ClO4 = Perchlorate
CrVI = Hexavalent chromium
DI-WET = Deionized waste extract test
ft bgs = Feet below ground surface
GS = Grain size
ID = Identification
MC = Moisture content
NDMA = N-Nitrosodimethylamine
nitro = Nitroguanidine
OBPA = 10,10'-oxybis-10H-Phenoxarsine
PAH = Polyaromatic hydrocarbon
PCB = Polychlorinated biphenyl
PD = Porosity
Perm = Permeability
pH = Paste pH
SG = Specific gravity
SVOCs = Semivolatile organic compounds
TCE = Trichloroethene
TOC = Total organic carbon
TPH = Total petroleum hydrocarbons

Table 5.3-4 *Results of Waste Extraction Test Using Deionized Water*
Westlakes Area
Aerojet Boundary Operable Unit
Aerojet Superfund Site
Sacramento County, California

Sample ID	Sample Depth (feet bgs)	Metal	Soil Concentration (mg/kg)	Extract Concentration (µg/L)
WL-SB01	5	Aluminum	16,000	12,000
		Antimony	----	<10
		Arsenic	5.40	<5.0
		Barium	100	1,100
		Beryllium	0.29	2.2 J
		Boron	----	<50
		Cadmium	<0.43	<5.0
		Chromium	34.0	15.0
		Hex Chromium	0.12	----
		Cobalt	9.3	40.0
		Copper	37.0	61.0
		Lead	3.4	12.0
		Lithium	8.1	<50
		Manganese	300	1,200
		Mercury	0.0067	----
		Molybdenum	0.67	<20
		Nickel	20.0	15.0
		Selenium	<1.7	<10
		Silver	<0.85	<10
		Strontium	23.0	190
		Thallium	0.96	<10
		Titanium	800	35.0
		Vanadium	70.0	45.0
		Zinc	30.0	58.0
WL-SB02	4	Aluminum	13,000	640
		Antimony	----	<10
		Arsenic	2.40	<5.0
		Barium	73.0	24.0
		Beryllium	0.23	<4.0
		Boron	----	<50
		Cadmium	<0.41	<5.0
		Chromium	17.0	<5.0
		Hex Chromium	0.22	----
		Cobalt	6.30	<10
		Copper	18.0	4.0 J
		Lead	4.80	<5.0
		Lithium	10.0	<50
		Manganese	320	65.0
		Mercury	0.0065	----
		Molybdenum	0.34	2.4 J
		Nickel	15.0	<10
		Selenium	<1.6	<10
		Silver	<0.82	<10
		Strontium	16.0	46.0
		Thallium	0.94	<10
		Titanium	860	14.0
		Vanadium	37.0	6.3 J
		Zinc	32.0	<20

Table 5.3-4 *Results of Waste Extraction Test Using Deionized Water*
Westlakes Area
Aerojet Boundary Operable Unit
Aerojet Superfund Site
Sacramento County, California

Sample ID	Sample Depth (feet bgs)	Metal	Soil Concentration (mg/kg)	Extract Concentration (µg/L)
WL-SB03	4	Aluminum	14,000	12,000
		Antimony	----	<10
		Arsenic	4.8	<5.0
		Barium	100	810
		Beryllium	0.31	1.5 J
		Boron	----	<50
		Cadmium	<0.41	<5
		Chromium	31.0	16.0
		Hex Chromium	0.24	----
		Cobalt	8.2	25.0
		Copper	27.0	58.0
		Lead	4.50	3.8 J
		Lithium	8.30	<50
		Manganese	430	2,700
		Mercury	0.0092	----
		Molybdenum	0.62	2.1 J
		Nickel	23.0	18.0
		Selenium	<1.6	<10
		Silver	<0.82	<10
		Strontium	25.0	150
		Thallium	<4.1	<10
		Titanium	560	36.0
		Vanadium	46.0	33.0
		Zinc	31.0	62.0
WL-SD05	0.5	Aluminum	26,000	18,000
		Antimony	0.34	<10
		Arsenic	4.70	6.3 J
		Barium	150	630 J
		Beryllium	0.65	<4.0
		Boron	<8.2	<50
		Cadmium	0.86	8.40
		Chromium	77.0	70.0
		Hex Chromium	0.10	----
		Cobalt	18.0	3.3 J
		Copper	46.0	1200 J
		Lead	13.0	35.0 J
		Lithium	12.0	<50
		Manganese	560	260
		Mercury	0.072	----
		Molybdenum	0.54	18.0 J
		Nickel	47.0	79.0
		Selenium	<1.0	<10
		Silver	3.4	61.0
		Strontium	26.0	1,100
		Thallium	0.23	<10
		Titanium	770	66 J
		Vanadium	90.0	180
		Zinc	89.0	1000 J

Table 5.3-4 *Results of Waste Extraction Test Using Deionized Water*
Westlakes Area
Aerojet Boundary Operable Unit
Aerojet Superfund Site
Sacramento County, California

Sample ID	Sample Depth (feet bgs)	Metal	Soil Concentration (mg/kg)	Extract Concentration (µg/L)
WL-SD06	1.5	Aluminum	17,000	1,100
		Antimony	0.018	<10
		Arsenic	4.5	26.0
		Barium	110	130
		Beryllium	0.47	<4.0
		Boron	7.0	10.0 J
		Cadmium	0.63	<5.0
		Chromium	59.0	2.1 J
		Hex Chromium	0.19	----
		Cobalt	12.0	13.0
		Copper	48.0	2.5 J
		Lead	23.0	<5.0
		Lithium	9.80	<50
		Manganese	520	5,700
		Mercury	0.05	----
		Molybdenum	0.41	5.4 J
		Nickel	34.0	9.5 J
		Selenium	<1.0	<10
		Silver	6.40	<10
		Strontium	19.0	230
		Thallium	0.14	<10
		Titanium	530	30.0
		Vanadium	52.0	4.4 J
		Zinc	120	<20
WL-SD07	0.5	Aluminum	16,000	300
		Antimony	0.22	<10
		Arsenic	4.40	8.60
		Barium	120	130
		Beryllium	0.49	<4.0
		Boron	12.0	<50
		Cadmium	0.31	<5.0
		Chromium	46.0	<5.0
		Hex Chromium	0.43	----
		Cobalt	12.0	18.0
		Copper	31.0	<10
		Lead	24.0	<5.0
		Lithium	8.6	<50
		Manganese	510	3,600
		Mercury	0.03	----
		Molybdenum	0.54	<20
		Nickel	28.0	5.7 J
		Selenium	<1.0	<10
		Silver	1.20	<10
		Strontium	15.0	140
		Thallium	0.15	<10
		Titanium	500	8.80
		Vanadium	53.0	<10
		Zinc	180	43.0

Table 5.3-4 *Results of Waste Extraction Test Using Deionized Water*
Westlakes Area
Aerojet Boundary Operable Unit
Aerojet Superfund Site
Sacramento County, California

Sample ID	Sample Depth (feet bgs)	Metal	Soil Concentration (mg/kg)	Extract Concentration (µg/L)
WL-SD08	0.5	Aluminum	14,000	370
		Antimony	0.46	<10
		Arsenic	4.40	8.60
		Barium	110	140
		Beryllium	0.41	<4.0
		Boron	29.0	17 J
		Cadmium	0.71	<5.0
		Chromium	52.0	<5.0
		Hex Chromium	0.13	----
		Cobalt	10.0	6.6 J
		Copper	42.0	<10
		Lead	60.0	<5.0
		Lithium	8.90	<50
		Manganese	300	3,200
		Mercury	0.06	----
		Molybdenum	0.49	5.2 J
		Nickel	37.0	5.6 J
		Selenium	0.22	<10
		Silver	1.70	<10
		Strontium	23.0	210
		Thallium	1.10	<10
		Titanium	520	12.0
		Vanadium	52.0	<10
		Zinc	440	<10
WL-SD10	0.5	Aluminum	20,000	11,000
		Antimony	0.23	<10
		Arsenic	5.10	6.40
		Barium	150	640
		Beryllium	0.60	1.8 J
		Boron	8.90	<50
		Cadmium	<0.43	<5.0
		Chromium	46.0	13.0
		Hex Chromium	0.58	----
		Cobalt	14.0	4.7 J
		Copper	34.0	33.0
		Lead	16.0	24.0
		Lithium	11.0	<50
		Manganese	630	350
		Mercury	0.02	----
		Molybdenum	0.57	<20
		Nickel	35.0	6.5 J
		Selenium	<1.1	<10
		Silver	<0.86	<10
		Strontium	21.0	120
		Thallium	0.16	<10
		Titanium	600	160
		Vanadium	62.0	100
		Zinc	63.0	30.0

Table 5.3-4 *Results of Waste Extraction Test Using Deionized Water*
Westlakes Area
Aerojet Boundary Operable Unit
Aerojet Superfund Site
Sacramento County, California

Sample ID	Sample Depth (feet bgs)	Metal	Soil Concentration (mg/kg)	Extract Concentration (µg/L)
WL-SB05	0.5	Arsenic	8.40	5.8 J
WL-SB07	5	Arsenic	8.00	<3.2 J
WL-SB09	1.5	Arsenic	6.40	<3.1
WL-SB10	1.5	Arsenic	6.70	3.4 J
WL-SD03	1.5	Arsenic	7.40	3.70
WL-SB10	1.5	Thallium	3.10	0.16 J

Notes and Key:

< = Less than the noted practical quantitation limit (PQL)
---- = Not analyzed
bgs = Below ground surface
Hex Chromium = Hexavalent chromium
J = Estimated concentration
mg/kg = Milligrams per kilogram
µg/L = Micrograms per liter

Table 5.3-5 Summary of Geotechnical Soil Parameters
Westlakes Area
Aerojet Boundary Operable Unit
Aerojet Superfund Site
Sacramento County, California

			Geo Physical Parameters (ASTM D2937, D854)						Sieve Analysis (ASTM D422)				Permeability (ASTM D5084)	
Test No.	Date	Description of Test Location	Moisture Content (%)	Wet Density (pcf)	Dry Density (pcf)	Wet Density	Specific Gravity	Porosity	Cobbles (%)	Gravel (%)	Sand (%)	Silt / Clay (%)	Average Hydraulic Gradient	Perm (cm/sec)
91	1123/05	WL-SD04-0.25	10.1	111.9	101.7		2.660	0.3880	0.0	5.2	19.9	74.9	6.8	5.41E-06
92	1123/05	WL-204-1.5	9.9	144.2	131.2		2.690	0.2180	0.0	1.0	20.8	78.2	5.9	8.36E-08
93	1123/05	WL-SD04-5.0	24.0	131.8	106.3		2.680	0.3640	0.0	2.0	11.5	86.5	8.9	3.81E-08
94	1123/05	WL-SB09-0.25	10.3	111.8	101.3		2.660	0.3900	0.0	0.0	34.8	65.2	9.4	1.75E-05
95	1123/05	WL-SB09-1.5	14.9	127.6	111.1		2.690	0.3380	0.0	0.0	37.9	62.1	5.9	8.49E-06
96	1123/05	WL-SB04-11	5.0	135.8	128.4		2.730	0.2460	0.0	31.6	40.3	28.1	8.6	8.40E-06
97	1123/05	WL-SB09-5.0	21.9	125.8	103.2		2.650	0.3760	0.0	0.0	43.7	56.3	4.6	7.97E-08
98	1123/05	WL-SB09-11	8.1	152.3	141.0		2.690	0.1600	0.0	64.1	28.0	7.9	10.7	4.61E-08
123	11/18/06	WL-SD01-1.5	15.4	134.9	117.0				0.0	77.3	22.7	0.0		
158	4/12/06	WL-SD13-1.5	20.0	122.2	101.8				0.0	2.8	36.1	61.1		
220	10/4/05	WL-SD04-1.5	10.3	111.8	101.3				8.7	18.7	27.2	45.4		
221	10/4/05	WL-SB09-1.5	13.1	144.3	127.6				0.0	41.1	34.6	24.3		
222	10/4/05	WL-SD11-1.5	22.7	113.0	92.1				0.0	1.8	41.5	56.7		
223	10/4/05	WL-SD12-1.5	13.3	91.2	80.6				0.0	1.6	36.0	62.4		
224	10/4/05	WL-SD09-1.5	10.9	105.9	95.5				0.0	2.0	22.7	75.3		
225	10/4/05	WL-SB02-1.0	4.9	120.7	115.1				0.0	19.8	30.0	50.2		
226	10/4/05	WL-SB07-1.0	4.2	119.8	115.0				0.0	0.5	59.2	40.3		
227	10/4/05	WL-SB07-11.0	14.7	145.3	126.6				0.0	30.5	33.5	36.0		
240	2/3/06	WL-SD02-0.25	87.7	91.1	48.5				0.0	0.0	36.0	64.0		

Table 5.3-5 Summary of Geotechnical Soil Parameters
Westlakes Area
Aerojet Boundary Operable Unit
Aerojet Superfund Site
Sacramento County, California

			Geo Physical Parameters (ASTM D2937, D854)						Sieve Analysis (ASTM D422)				Permeability (ASTM D5084)	
Test No.	**Date**	**Description of Test Location**	**Moisture Content (%)**	**Wet Density (pcf)**	**Dry Density (pcf)**	**Wet Density**	**Specific Gravity**	**Porosity**	**Cobbles (%)**	**Gravel (%)**	**Sand (%)**	**Silt / Clay (%)**	**Average Hydraulic Gradient**	**Perm (cm/sec)**
241	2/3/06	WL-SD02-1.5	47.0	106.1	72.1				0.0	29.3	39.2	31.5		
		Mean	**18.4**	**122.4**	**105.9**	**0.0**	**2.7**	**0.3**	**0.4**	**16.5**	**32.8**	**50.3**	**7.6**	**5.0E-06**
		Median	**13.2**	**121.5**	**104.8**	**0.0**	**2.7**	**0.4**	**0.0**	**2.4**	**34.7**	**56.5**	**7.7**	**2.7E-06**
		Geomean	**13.7**	**121.2**	**103.3**	**0.0**	**2.7**	**0.3**	**0.0**	**0.0**	**31.0**	**0.0**	**7.3**	**7.3E-07**

Notes and Key:

% = Percent
No. = Number
cm/sec = Centimeters per second
pcf = Pounds per cubic foot

Table 5.4-1 Summary of Soil Sampling and Sampling Statistics
Western Administration Ditch and Buffalo Creek
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Compound(s)	Analyte	Method	Depth (feet bgs)	Buffalo Creek					
				Locations	Primary Samples	Duplicates	Detects	Frequency of Duplicates	Frequency of Primary Detects
VOCs	VOCs	8260B	0-2.5	2	4	0	3	0.0%	75.0%
		8260B	>2.5	0	0	0	0	0.0%	0.0%
Metals	Metals	6010B	0-2.5	23	31	2	31	6.5%	100.0%
		6020	0-2.5	22	30	2	29	6.7%	96.7%
		6010B	>2.5	1	1	0	1	0.0%	100.0%
		6020	>2.5	1	1	0	1	0.0%	100.0%
	Chromium VI	7199	0-2.5	13	18	1	13	5.6%	72.2%
		7199	>2.5	0	0	0	0	0.0%	0.0%
	Mercury	7471A	0-2.5	9	17	1	17	5.9%	100.0%
		7471A	>2.5	1	1	0	1	0.0%	100.0%
SVOCs	SVOCs	8270C	0-2.5	9	18	1	9	5.6%	50.0%
		8270C	>2.5	1	1	0	0	0.0%	0.0%
PCBs	PCBs	8082	0-2.5	14	22	1	17	4.5%	77.3%
		8082	>2.5	1	1	0	0	0.0%	0.0%
Perchlorate	Perchlorate	314.0, 314.0M	0-2.5	7	13	1	0	7.7%	0.0%
		314.0, 314.0M	>2.5	1	1	0	0	0.0%	0.0%
TPH	Diesel	8015B-SVOA - Diesel	0-2.5	7	13	1	12	7.7%	92.3%
		8015B-SVOA - Diesel	>2.5	1	1	0	1	0.0%	100.0%
	Motor Oil	8015B-SVOA - Oil	0-2.5	7	13	1	11	7.7%	84.6%
		8015B-SVOA - Oil	>2.5	1	1	0	0	0.0%	0.0%
Misc.	Total Cyanide	9014	0-2.5	0	0	0	0	0.0%	0.0%
		9014	>2.5	0	0	0	0	0.0%	0.0%
	NDMA	1625C-CI M	0-2.5	3	5	1	0	20.0%	0.0%
		1625C-CI M	>2.5	0	0	0	0	0.0%	0.0%
	Pesticides	8081A	0-2.5	13	20	1	15	0.0%	0.0%
		8081A	>2.5	1	1	0	0	0.0%	0.0%
	OBPA	8270C	0-2.5	5	10	0	0	0.0%	0.0%
		8270C	>2.5	0	0	0	0	0.0%	0.0%
	Nitroguanadine	Nitroguanadine-DISS	0-2.5	5	10	0	0	0.0%	0.0%
		Nitroguanadine-DISS	>2.5	0	0	0	0	0.0%	0.0%
	pH	9045C	0-2.5	4	8	0	8	0.0%	100.0%
		9045C	>2.5	0	0	0	0	0.0%	0.0%
	TOC	9060A MOD	0-2.5	6	9	0	7	0.0%	77.8%
		9060A MOD	>2.5	0	0	0	0	0.0%	0.0%
	CEC	9081	0-2.5	1	2	0	2	0.0%	100.0%
		9081	>2.5	0	0	0	0	0.0%	0.0%

Notes and Key:

> = Greater than
% = Percent
bgs = Below ground surface
CEC = Cation Exchange Capacity
Chromium VI = Hexavalent chromium
NDMA = N-Nitrosodimethylamine
OBPA = 10,10'-Oxybis-10H-Phenoxarsine
PCBs = Polychlorinated biphenyls
SVOCs = Semivolatile organic compounds
TOC = Total Organic Content
VOCs = Volatile organic compounds

Table 5.4-2 ***Cross-Reference Between Soil and Soil Vapor Sampling Locations and Investigated Features Western Administration Area Ditch and Buffalo Creek Boundary Operable Unit Remedial Investigation Aerojet Superfund Site Sacramento County, California***

Associated Site Feature	Soil Sampling Location(s)
UPPER BUFFALO CREEK Upstream of Westlakes. Upstream portion of Buffalo Creek that receives drainage from Area 00 and potential upstream source areas.	BC-SD01 BC-SD02 BC-SD03 BC-SD04 59E-SD01 59E-SB07
UPPER BUFFALO CREEK Section of Buffalo Creek from directly upstream of Line 2 to point of discharge to Westlakes.	59E-SD02 WL-SD14 59E-SB08
UPPER BUFFALO CREEK Buffalo Creek adjacent to detention ponds at flow control weir.	WL-SD11
WESTERN ADMINISTRATION AREA DITCH Directly upstream of Buffalo Creek Cutoff and at confluence with Buffalo Creek Cutoff. Receives discharges from source areas in Administration Area and Line 02.	29E-SD01 WL-SD09
BUFFALO CREEK CUTOFF Former section of Buffalo Creek directly East of Line 02 (Drum Storage Area).	28E-SNS01 59E-SD03 59E-SD04 59E-SB05 59E-SB06
WESTERN ADMINISTRATION AREA DITCH/BUFFALO CREEK Pump station that discharges water to East and West Ponds.	WL-SD12
LOWER BUFFALO CREEK Drainage ditch from commercial area along Folsom Boulevard.	WL-SD15
LOWER BUFFALO CREEK Buffalo Creek at discharge of drainage ditch from commercial area along Folsom Boulevard.	WL-SD13
LOWER BUFFALO CREEK Buffalo Creek downstream of Cell 2 point of discharge.	WL-SD02
LOWER BUFFALO CREEK Buffalo Creek between Cell 2 point of discharge and facility point of discharge.	WL-SD16
LOWER BUFFALO CREEK Downstream of Westlakes. Buffalo Creek at facility point of discharge. Discharge from ponds, cells, and Buffalo Creek.	WL-SD01

Table 5.4-3
Summary of Soil Sampling Activities and Deviations from Field Sampling Plan
Western Administration Area Ditch and Buffalo Creek
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
Discharge from ponds, cells, and Buffalo Creek	Buffalo Creek at facility point of discharge.	Surface and Near-Surface Soil	1	0, 1	VOCs, SVOCs, PAHs, pesticides, Prowl, OBPA, PCBs, metals (including CrVI), ClO4, nitro, ***pH***, ***DI-WET***, physical properties	Assess contamination that could be present at the facility point of discharge, support risk assessment, and evaluate the potential for water quality impacts.	2	WL-SD01	0.5, 1.5	VOCs, SVOCs, PAHs, pesticides, Prowl, OBPA, PCBs, metals (including CrVI), ClO4, nitro, ***NDMA***, physical properties	NDMA was included as additional analysis. DI-WET and pH not analyzed. MC, BD, and GS not analyzed at 0.5 ft bgs.
Discharge from ponds, cells, and Buffalo Creek	Buffalo Creek downstream of Cell 2 point of discharge.	Surface and Near-Surface Soil	1	0, 1	VOCs, SVOCs, PAHs, pesticides, Prowl, OBPA, PCBs, metals (including CrVI), ClO4, nitro, pH, ***DI-WET***, physical properties	Assess contamination that could be present in Buffalo Creek downstream of the detention basins, support risk assessment, and evaluate the potential for water quality impacts.	2	WL-SD02	0.25, 1.5	VOCs, SVOCs, PAHs, pesticides, Prowl, OBPA, PCBs, metals (including CrVI), ClO4, nitro, pH, ***NDMA***, physical properties	DI-WET not analyzed. NDMA was included as additional analysis.
		Grab Groundwater	***0***	None	None	Additional samples collected because chemical concentrations exceeded screening criteria.	1	WL-SD02	0.25	VOCs	
Discharge from Administration Ditch and Buffalo Creek	Administration Ditch at Buffalo Creek Bypass.	Surface and Near-Surface Soil	1	0, 1, ***4***, ***10***	***VOCs***, SVOCs, PAHs, pesticides, Prowl, OBPA, PCBs, metals (including CrVI), ***ClO4***, nitro, pH, ***DI-WET***, physical properties	Assess contamination that could be present in the Administration Ditch at the Buffalo Creek Bypass, support risk assessment, and evaluate the potential for water quality impacts.	2	WL-SD09	0.5, 1.5	SVOCs, PAHs, pesticides, Prowl, OBPA, ***TPH***, PCBs, metals (including CrVI), nitro, ***NDMA***, pH, physical properties	No sample collected at 4 and 10 ft bgs. TPH and NDMA were included as additional analyses. VOCs, ClO4, and DI-WET not analyzed. Physical properties not analyzed at 0.5 ft bgs.
Discharge from Buffalo Creek	Buffalo Creek adjacent to detention ponds at flow control weir.	Surface and Near-Surface Soil	1	0, 1	***VOCs***, SVOCs, PAHs, pesticides, Prowl, OBPA, PCBs, metals (including CrVI), ClO4, nitro, pH, ***DI-WET***, physical properties	Assess contamination that could be present in Buffalo Creek upstream of the detention basins, support risk assessment, and evaluate the potential for water quality impacts.	2	WL-SD11	0.5, 1.5	SVOCs, PAHs, pesticides, Prowl, OBPA, ***TPH***, PCBs, metals (including CrVI), ClO4, nitro, ***NDMA***, pH, physical properties	TPH and NDMA were included as additional analyses. VOCs and DI-WET not analyzed. Physical properties not analyzed at 0.5 ft bgs.
Discharge from Administration Ditch and Buffalo Creek	Administration Ditch upstream of detention ponds at pump station.	Surface and Near-Surface Soil	1	0, 1	***VOCs***, SVOCs, PAHs, pesticides, Prowl, OBPA, PCBs, metals (including CrVI), ClO4, nitro, pH, ***DI-WET***, physical properties	Assess contamination that could be present in the Administration Ditch upstream of the detention basins, support risk assessment, and evaluate the potential for water quality impacts.	2	WL-SD12	0.5, 1.5	SVOCs, PAHs, pesticides, Prowl, OBPA, ***TPH***, PCBs, metals (including CrVI), ClO4, nitro, ***NDMA***, pH, physical properties	TPH and NDMA were included as additional analyses. VOCs and DI-WET not analyzed. Physical properties not analyzed at 0.5 ft bgs.
Discharge from Schnitzer Steel Property	Ditch draining Schnitzer Steel Property.	Surface and Near-Surface Soil	***1***	0, 1	***VOCs***, SVOCs, PCBs, PAHs, nitro, metals (including CrVI), TPH, ***DI-WET***, TOC, MC, BD, GS	Assess contamination that could be present in the ditch draining the Schnitzer Steel property and evaluate the potential for water quality impacts.	2	WL-SD13	0.25, 1.5	SVOCs, PAHs, TPH, PCBs, ***NDMA***, metals (including CrVI), TOC, BD, GS, MC	NDMA was included as additional analysis. VOCs and DI-WET not analyzed.
							1	WL-SD15	0.25	Metals	
South-eastern side of eastern pond receiving discharge from ponds, cells, and Buffalo Creek	Eastern pond.	Surface and Near-Surface Soil	***0***	None	None	Additional samples collected because chemical concentrations exceeded screening criteria.	1	WL-SD14	0.25	Metals	
Western side of Cell 2 receiving discharge from ponds, cells, and Buffalo Creek	Cell 2.	Surface and Near-Surface Soil	***0***	None	None	Additional samples collected because chemical concentrations exceeded screening criteria.	1	WL-SD16	0.25	Metals	

Table 5.4-3
Summary of Soil Sampling Activities and Deviations from Field Sampling Plan
Western Administration Area Ditch and Buffalo Creek
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
28E	Drainage ditch receiving runoff from the cleaning slab and ponds.	Surface and Near-Surface Soil	1	0	SVOCs, metals, TPH, NDMA, ClO4	Determine if the drainage ditch was impacted by drum cleaning operations, evaluate vertical extent of chemicals in soil, and support risk assessment.	1	28E-SNS01	0.5	SVOCs, metals, TPH, NDMA, ClO4	
29E	Approximately 230 ft northwest of leach lines of septic tank L2-ST26.	Surface and Near-Surface Soil	***0***	None	None	Additional samples collected because chemical concentrations exceeded screening criteria.	1	29E-SD01	0.25	Metals	
59E	Buffalo Creek up and down stream of Source Area 59E.	Surface and Near-Surface Soil	1	0, 1, 4	VOCs, SVOCs, PAHs, metals, ClO4, pH, physical properties	Upstream soil results and results from 59E are above screening levels. Locations used to determine if chemicals present in the drainage channel west of Source Area 59E.	3	59E-SD01	0.25, 1.5, 5	SVOCs, PAHs, ***NDMA***, metals, TPH, ClO4, PCBs, pesticides, pH, physical properties	NDMA was included as additional analysis.
				None	None	Additional samples collected because chemical concentrations exceeded screening criteria.	1	59E-SB07	1	Metals	
59E	Buffalo Creek up and down stream of Source Area 59E.	Surface and Near-Surface Soil	1	0, 1, 4	VOCs, SVOCs, PAHs, metals, TPH, pesticides, PCBs, ClO4, pH, physical properties	Upstream soil results and results from 59E are above screening levels. Locations used to determine if chemicals present in the drainage channel west of Source Area 59E.	2	59E-SD02	0.25, 1.5	SVOCs, PAHs, ***NDMA***, metals, TPH, pesticides, PCBs, ClO4, pH, physical properties	NDMA was included as additional analysis.
				None	None	Additional samples collected because chemical concentrations exceeded screening criteria.	1	59E-SB08	1	Metals	
59E	Drainage ditch receiving runoff from the cleaning slab and ponds.	Surface and Near-Surface Soil	***0***	None	None	Additional samples collected because chemical concentrations exceeded screening criteria.	2	59E-SB06	1	Metals	
								59E-SD04	0.25	Metals, pesticides, PCBs	
59E	Drainage ditch receiving runoff from the cleaning slab and ponds.	Surface and Near-Surface Soil	***0***	None	None	Additional samples collected because chemical concentrations exceeded screening criteria.	2	59E-SB05	1	Metals	
								59E-SD03	0.25	Metals, pesticides, PCBs	
Upstream Source Area	Buffalo Creek.	Surface and Near-Surface Soil	***0***	None	None	Additional samples collected because chemical concentrations exceeded screening criteria.	4	BC-SD01	0.25	PCBs, pesticides, metals, AVS/SEM	
								BC-SD02	0.25	PCBs, pesticides, metals (including CrVI), AVS/SEM	
								BC-SD03	0.25	PCBs, pesticides, metals, AVS/SEM	
								BC-SD04	0.25	PCBs, pesticides, metals (including CrVI), AVS/SEM	

Notes and Key:
PAHs analyzed by USEPA 8270 SIM method.
Bulk density includes dry density and wet density.
Physical properties include bulk density, moisture, grain size, total organic carbon, and CEC.
Bold, italicized and underlined data does not agree with the analytical results. See "Deviations from Field Sampling Plan" column for more information on discrepancies.

AVS/SEM = Acid volatile sulfide/Simultaneously extracted metals
BD = Bulk density
CEC = Cation exchange capacity
ClO4 = Perchlorate
CrVI = Hexavalent chromium
DI-WET = Deionized waste extract test
ft = Feet
ft bgs = Feet below ground surface
GS = Grain size
ID = Identification
MC = Moisture content
NDMA = N-Nitrosodimethylamine
nitro = Nitroguanidine
OBPA = 10,10'-oxybis-10H-Phenoxarsine
PAH = Polyaromatic hydrocarbon
PCB = Polychlorinated biphenyl
SVOC = Semivolatile organic compound
TOC = Total organic carbon
VOC = Volatile organic compound
TPH = Total petroleum hydrocarbons

Table 5.5-1 Summary of Soil Vapor Sampling and Sampling Statistics
Open Space Areas 5 and 7
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Interval	Depth (feet bgs)	Locations	Primary Samples	Duplicate Samples	Detects	Frequency of Duplicates	Frequency of Primary Detects
Open Space Area 5	Shallow	0-10	2	2	0	2	0.0%	100.0%
	Intermediate	11-20	1	1	0	1	0.0%	100.0%
	Deep	20	0	0	0	0	0.0%	0.0%
Open Space Area 7	Shallow	0-10	0	0	0	0	0.0%	0.0%
	Intermediate	11-20	0	0	0	0	0.0%	0.0%
	Deep	30	0	0	0	0	0.0%	0.0%
		Totals:	**3**	**3**	**0**	**3**	**0.0%**	**100.0%**

Notes and Key:
All samples analyzed for volatile organic compounds (VOCs) by USEPA Method TO-15.
% = Percent
bgs = Below ground surface

Table 5.5-2 *Cross-Reference Between Soil and Soil Vapor Sampling Locations and Investigated Features*
Open Space Area 5
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Associated Site Feature	Source Area	Soil Sampling Location(s)	Soil Vapor Sampling Location(s)
FORMER TANKS Former tanks on northern edge of storage yard.	OS5	OS5-F1-SB01	OS5-F1-SP01
MATERIAL STORAGE AREA Material stored on eastern edge of storage yard.	OS5	OS5-F2-SB01	OS5-F2-SP01

Notes and Key:
OS5 = Open space area 5

Table 5.5-3 Summary of Soil Sampling and Sampling Statistics
Open Space Areas 5 and 7
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Compound(s)	Analyte	Method	Depth (feet bgs)	Open Space Area 5					
				Locations	Primary Samples	Duplicates	Detects	Frequency of Duplicates	Frequency of Primary Detects
Metals	Metals	6010B	0-2.5	2	2	2	2	100.0%	100.0%
		6020	0-2.5	2	2	2	2	100.0%	100.0%
		6010B	>2.5	0	0	0	0	0.0%	0.0%
		6020	>2.5	0	0	0	0	0.0%	0.0%
	Chromium VI	7199	0-2.5	0	0	0	0	0.0%	0.0%
		7199	>2.5	0	0	0	0	0.0%	0.0%
	Mercury	7471A	0-2.5	2	2	2	2	100.0%	100.0%
		7471A	>2.5	0	0	0	0	0.0%	0.0%
SVOCs	SVOCs	8270C	0-2.5	2	2	2	1	100.0%	50.0%
		8270C	>2.5	1	2	1	1	50.0%	50.0%
PCBs	PCBs	8082	0-2.5	0	0	0	0	0.0%	0.0%
		8082	>2.5	0	0	0	0	0.0%	0.0%
Perchlorate	Perchlorate	314.0, 314.0M	0-2.5	2	2	2	0	100.0%	0.0%
		314.0, 314.0M	>2.5	0	0	0	0	0.0%	0.0%
TPH	Diesel	8015B-SVOA - Diesel	0-2.5	2	2	2	2	100.0%	100.0%
		8015B-SVOA - Diesel	>2.5	0	0	0	0	0.0%	0.0%
	Motor Oil	8015B-SVOA - Oil	0-2.5	2	2	2	2	100.0%	100.0%
		8015B-SVOA - Oil	>2.5	0	0	0	0	0.0%	0.0%
Misc.	Total Cyanide	9014	0-2.5	0	0	0	0	0.0%	0.0%
		9014	>2.5	0	0	0	0	0.0%	0.0%
	NDMA	1625C-CI M	0-2.5	0	0	0	0	0.0%	0.0%
		1625C-CI M	>2.5	0	0	0	0	0.0%	0.0%
	pH	9045C	0-2.5	0	0	0	0	0.0%	0.0%
		9045C	>2.5	0	0	0	0	0.0%	0.0%
	TOC	9060A MOD	0-2.5	0	0	0	0	0.0%	0.0%
		9060A MOD	>2.5	0	0	0	0	0.0%	0.0%
	CEC	9081	0-2.5	0	0	0	0	0.0%	0.0%
		9081	>2.5	0	0	0	0	0.0%	0.0%

Notes and Key:

> = Greater than
% = Percent
bgs = Below ground surface
CEC = Cation Exchange Capacity
Chromium VI = Hexavalent chromium
NDMA = N-Nitrosodimethylamine
PCBs = Polychlorinated biphenyls
SVOCs = Semivolatile organic compounds
TOC = Total organic content
TPH = Total petroleum hydrocarbons

Table 5.5-4 Summary of Soil Vapor Sampling Activities and Deviations from Field Sampling Plan
Open Space Area 5
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Rationale and Comments	Number of Samples Collected	Sampling Activity	Sample ID	Sample Depths (ft bgs)	Details of Analyses Performed
Open Space Area 5	Former tanks on northern edge of storage yard.	1	10, 20	Determine if a release has occurred due to former above ground tanks, evaluate vertical extent of chemicals in soil, support risk assessment.	2	Soil Vapor	OS5-F1-SB01	10, 20	
Open Space Area 5	Material stored on eastern edge of storage yard.	1	10, ***20***	Determine if a release to soil has occurred from stored material, evaluate vertical extent of chemicals in soil, support risk assessment.	1	Soil Vapor	OS5-F2-SB01	10	Not sampled due to no flow.
28E	West of unlined pond.	***0***	None	Additional samples collected because chemical concentrations exceeded screening criteria.	3	Soil Vapor	28E-SP17	10, 20	
							28E-SP19	20	

Notes and Key:
Bold, italicized and underlined data does not agree with the analytical results. See "Deviations from Field Sampling Plan" column for more information on discrepancies.

ft = Feet
bgs = Below ground surface
ID = Identification

Proposed analyses = VOC analysis
Performed analyses = VOC analysis
VOC = Volatile organic compound

Table 5.5-5 Summary of Soil Sampling Activities and Deviations from Field Sampling Plan
Open Space Area 5
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
Open Space Area 5	Former tanks on northern edge of storage yard.	Subsurface Soil	1	0, ***4***, ***10***	***VOCs***, SVOCs, ClO4, metals, TPH, ***DI-WET***	Determine if a release has occurred due to former above ground tanks, evaluate vertical extent of chemicals in soil, support risk assessment.	1	OS5-F1-SB01	1	SVOCs, ClO4, metals, TPH	VOCs and DI-WET not analyzed. No analyses were carried out at 4 and 10 ft bgs.
Open Space Area 5	Material stored on eastern edge of storage yard.	Subsurface Soil	1	0, 4, 10	***VOCs***, SVOCs, ClO4, metals, TPH, ***DI-WET***	Determine if a release to soil has occurred from stored material, evaluate vertical extent of chemicals in soil, support risk assessment.	3	OS5-F2-SB01	1, 5, 11	SVOCs, ClO4, metals, TPH	VOCs and DI-WET not analyzed. ClO4, metals, and TPH not analyzed at 5 and 11 ft bgs.

Notes and Key:
Bold, italicized, and underlined data does not agree with the analytical results. See "Deviations from Field Sampling Plan" column for more information on discrepancies.

ClO4 = Perchlorate
DI-WET = Deionized waste extract test
ft bgs = Feet below ground surface
ID = Identification
SVOC = Semivolatile organic compound
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound

Table 5.6-1
Summary of Surface Water Sampling Activities and Deviations from Field Sampling Plan
Line 02, Line 5 North and Westlakes Areas
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Number of Proposed Sampling Locations	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
Discharge from ponds, cells, and Buffalo Creek	Buffalo Creek at facility point of discharge.	1	VOCs, SVOCs, PAHs, pesticides, Prowl, OBPA, total and filtered metals (including CrVI), ClO4, nitro, NDMA, chemical properties	Assess contamination that could be present at the facility point of discharge, support risk assessment, and evaluate the potential for water quality impacts.	1	WL-SW01	1	VOCs, SVOCs, PAHs, pesticides, OBPA, Prowl, total and filtered metals (including CrVI), ClO4, NDMA, nitro, chemical properties	
Discharge from ponds, cells, and Buffalo Creek	Buffalo Creek downstream of Cell 2 point of discharge.	1	VOCs, SVOCs, PAHs, pesticides, Prowl, OBPA, total and filtered metals (including CrVI), ClO4, nitro, NDMA, chemical properties	Assess contamination that could be present in Buffalo Creek downstream of the detention basins, support risk assessment, and evaluate the potential for water quality impacts.	1	WL-SW02	1	VOCs, SVOCs, PAHs, pesticides, OBPA, Prowl, total and filtered metals (including CrVI), ClO4, NDMA, nitro, chemical properties	
Discharge from Administration Ditch and Buffalo Creek	Eastern pond.	1	VOCs, SVOCs, PAHs, pesticides, Prowl, OBPA, total and filtered metals ***(including CrVI)*** , ClO4, nitro, NDMA, chemical properties	Assess contamination that could be present within the active storm water detention ponds, support risk assessment, and evaluate the potential for water quality impacts.	1	WL-SW03	0.5	VOCs, SVOCs, PAHs, pesticides, OBPA, Prowl, total (including CrVI) and filtered metals, ClO4, NDMA, nitro, chemical properties	Not analyzed for filtered CrVI.
Discharge from Administration Ditch and Buffalo Creek	Western pond.	1	VOCs, SVOCs, PAHs, pesticides, Prowl, OBPA, total and filtered metals (including CrVI), ClO4, nitro, NDMA, chemical properties	Assess contamination that could be present within the active storm water detention ponds, support risk assessment, and evaluate the potential for water quality impacts.	1	WL-SW04	1	VOCs, SVOCs, PAHs, pesticides, Prowl, total and filtered metals (including CrVI), ClO4, nitro, NDMA, chemical properties	Not analyzed for OBPA.
Discharge from Buffalo Creek	Buffalo Creek adjacent to detention ponds at flow control weir.	1	VOCs, SVOCs, PAHs, pesticides, Prowl, ***OBPA*** , total and filtered metals (including CrVI), ClO4, nitro, NDMA, chemical properties	Assess contamination that could be present in Buffalo Creek downstream of the detention basins, support risk assessment, and evaluate the potential for water quality impacts.	1	WL-SW05	9	VOCs, SVOCs, PAHs, pesticides, Prowl, total and filtered metals (including CrVI), ClO4, nitro, NDMA, chemical properties	Not analyzed for OBPA.
Discharge from Administration Ditch and Buffalo Creek	Administration Ditch at pump station.	1	VOCs, SVOCs, PAHs, pesticides, Prowl, ***OBPA*** , total and filtered metals (including CrVI), ClO4, nitro, NDMA, chemical properties	Assess contamination that could be present in the Administration Ditch upstream of the detention basins, support risk assessment, and evaluate the potential for water quality impacts.	1	WL-SW06	9	VOCs, SVOCs, PAHs, pesticides, Prowl, total and filtered metals (including CrVI), ClO4, nitro, NDMA, chemical properties	Not analyzed for OBPA.
Discharge from Administration Ditch and Buffalo Creek	Discharge from Administration Ditch at Buffalo Creek Bypass.	1	VOCs, SVOCs, PAHs, pesticides, Prowl, ***OBPA*** , total and filtered metals ***(including CrVI)*** , ClO4, nitro, NDMA, chemical properties	Assess contamination that could be present in the Administration Ditch at the Buffalo Creek Bypass, support risk assessment, and evaluate the potential for water quality impacts.	1	WL-SW07	1.5	VOCs, SVOCs, PAHs, pesticides, Prowl, total and filtered metals (including CrVI), ClO4, nitro, NDMA, chemical properties	Not analyzed for OBPA and total CrVI.
Discharge from Schnitzer Steel Property	Ditch draining Schnitzer Steel property.	1	VOCs, SVOCs, PAHs, TPH, total and filtered metals (including CrVI), chemical properties	Assess contamination that could be present in the ditch draining the Schnitzer Steel property and evaluate the potential for water quality impacts.	1	WL-SW08	1	VOCs, SVOCs, PAHs, TPH, total and filtered metals (including CrVI), ***NDMA*** , chemical properties	NDMA was an additional analysis.
59E	Buffalo Creek up and down stream of Source Area 59E.	2	VOCs, SVOCs, total and filtered metals, ClO4, chemical properties	Upstream soil results and results from 59E are above screening levels. Determine if chemicals are present in the drainage channel west of Source Area 59E.	1	59E-SW01	4.5	VOCs, SVOCs, total and filtered metals, ClO4, chemical properties	
			VOCs, SVOCs, total and filtered metals, pesticides, ClO4, chemical properties		1	59E-SW02	2	VOCs, SVOCs, total and filtered metals, pesticides, ClO4, chemical properties	

Table 5.6-1
Summary of Surface Water Sampling Activities and Deviations from Field Sampling Plan
Line 02, Line 5 North and Westlakes Areas
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Number of Proposed Sampling Locations	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
E(m)	Ephemeral creek draining Line 2 source area. Including 29E, E(d), E(e), E(m), and E(n).	1	VOCs, SVOCs, total and filtered metals, pesticides, ClO4, chemical properties	Up gradient soil results are above screening levels. Determine if chemicals are present in the creek draining the Line 2 area north of the E(m) Source Area. The creek is ephemeral and discharges to the Administration Ditch to the north.	1	E(m)-SW01	1	VOCs, SVOCs, total and filtered metals, pesticides, ClO4, chemical properties	
E(n)	Ephemeral creek draining Line 2 source area. Including 29E, E(d), and E(e).	1	VOCs, SVOCs, total and filtered metals, NDMA, ClO4, chemical properties	Up gradient soil results are above screening levels. Determine if chemicals are present in the creek draining 29E, E(d), and E(e). The creek is ephemeral and discharges to the low-lying area north of E(m).	1	E(n)-SW01	2	VOCs, SVOCs, total and filtered metals, NDMA, ClO4, chemical properties	
E(l)	Low-lying area west of the engine test cell and the former concrete wash sump.	1	VOCs, SVOCs, PAHs, ClO4, nitro, NDMA, total and filtered metals, chemical properties	Prior soil results within the low lying area are above screening levels. Evaluate runoff from the engine test cell and the former concrete wash sump.	1	E(l)-SW01	1	VOCs, PAHs, SVOCs, ClO4, NDMA, nitro, total and filtered metals, chemical properties	

Notes and Key:
Proposed depth is middle to bottom of water column.
Chemical properties include dissolved organic carbon, anions, and total alkalinity.
Bold, italicized and underlined data does not agree with the analytical results. See "Deviations from Field Sampling Plan" column for more information on discrepancies.

ClO4 = Perchlorate
CrVI = Hexavalent Chromium
ft bgs = Feet below ground surface
ID = Identification
nitro = Nitroguanidine
NDMA = N-Nitrosodimethylamine
OBPA = 10,10'-oxybis-10H-Phenoxarsine
PAHs = Polyaromatic hydrocarbons
SVOCs = Semivolatile organic compounds
TPH = Total petroleum hydrocarbons
VOCs = Volatile Organic Compounds

Table 5.7-1 Well Construction Details for Monitoring Wells
Line 02 Region
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Well ID	Groundwater Unit	Well Type	Easting	Northing	GSE (ft msl)	TOC (ft msl)	TOS (ft bgs)	BOS (ft bgs)	Well TD
48	Perched	Monitor	2224002	349048	146.48	149.24	32	42	43
54	Perched	Monitor	2217874	347293	134.4	137.69	60	77	80
63	Perched	Monitor	2219168	347170	132.7	135.15	37	42	47
286	Perched	Monitor	2221311	345253	163.82	166.85	55	65	65
424	Perched	Monitor	2216857	345950	140.79	143.95	60	70	70
448	Perched	Monitor	2221337	347180	150.36	153.11	35	68	70
468	Perched	Abandoned	2215542	346729	120.74	120.74	5	22	141
		Recharge					120	128	
637	Perched	Monitor	2221807	346613	152	152.85	24	25	30
689	Perched	Monitor	2223093	345829	161.14	164.14	20	30	30
781	Perched	Monitor	2221808	346632	152.12	152.96	21	26	26
902	Perched	Monitor	2217882	345494	141.32	142.51	48	78	78
1698	Perched	Monitor	2223163	346691	160.31	162.59	5.3	35.3	35.3
3409	Perched	Monitor	2216093	345500	139.64	142.14	76	97	97
3472	Perched	Monitor	2223252	346764	163	165.86	40	55	55
28	FWBZ	Monitor	2224785	346669	168.1	170.35	38	83	83
31	FWBZ	Monitor	2220705	346484	146.15	149.29	58	83	83
32	FWBZ	Monitor	2223446	347742	163	165.67	45	65	65
44	FWBZ	Monitor	2224188	350637	144.22	145.46	40	76	76
53	FWBZ	Monitor	2219011	347919	136.8	137.19	70	94	94
55	FWBZ	Monitor	2217128	346967	132	134.24	70	92	92
62	FWBZ	Monitor	2221622	349295	137.4	139.94	60	70	72
121	FWBZ	Monitor	2222301	345981	158.8	162.3	80	100	100
123	FWBZ	Monitor	2219158	347125	133.5	136.98	73	93	93
291	FWBZ	Monitor	2220729	346488	146.39	149.13	96	112	112
420	FWBZ	Monitor	2215773	346763	131.25	133.69	132	145	225
425	FWBZ	Monitor	2216857	345950	140.79	143.95	105	115	115
434	FWBZ	Monitor	2222548	347613	149.53	152.61	56	66	68
441	FWBZ	Monitor	2217858	347350	134.98	137.71	80	101	264
469	FWBZ	Abandoned	2218468	348090	119.85	119.85	5	35	77
		Recharge					57	77	
470	FWBZ	Abandoned	2218653	348214	120.11	120.11	5	32	70
		Recharge					54	69	
471	FWBZ	Abandoned	2218679	348229	119.96	119.85	5	30	0
		Recharge					50	74	
472	FWBZ	Abandoned	2218298	347980	119.89	119.89	5	38	78
		Recharge					60	77	
688	FWBZ	Monitor	2224358	348086	151.7	153.73	40	50	50
3081	FWBZ	Monitor	2220931	347799	150.42	153.5	70	91	91
3189	FWBZ	Monitor	2224169	351153	144.94	145.29	44	54	54
3250	FWBZ	Monitor	2225933	348480	162.32	162.17	50	71	356
3298	FWBZ	Monitor	2221061	348641	136.68	139.56	57	78	400
3304	FWBZ	Monitor	2216999	347166	132.02	135.33	110	120	426
3482	FWBZ	Monitor	2224202	348266	153	153.8	60.5	80.5	80.5
3484	FWBZ	Monitor	2223055	345908	164	165.92	60	80	80
3485	FWBZ	Monitor	2224481	346271	170	169.62	60	80	80
3529	FWBZ	Monitor	2222095	346905	152.9	155.7	55	75	75
3639	FWBZ	Monitor	2220353	345414	159.1	163.12	100	120	121.5
3652	FWBZ	Monitor	2224608	348446	150.3	153.14	55	75	76
3653	FWBZ	Monitor	2225291	348518	149.3	152.53	55	80	81
3660	FWBZ	Monitor	2222892	348090	155.7	159.03	70	90	92
3662	FWBZ	Monitor	2224845	349216	144.2	147.72	50	80	80
3663	FWBZ	Monitor	2223716	348573	145.1	147.9	50	70	80
3664	FWBZ	Monitor	2222585	349055	140.8	143.66	45	75	80
3665	FWBZ	Monitor	2223719	349583	144.3	147.61	50	80	80
3666	FWBZ	Monitor	2220969	347797	150.1	152.96	95	125	130
3668	FWBZ	Monitor	2223131	347430	160.8	164.13	80	110	115
3669	FWBZ	Monitor	2221812	346606	151.7	154.53	67	107	110

Table 5.7-1 Well Construction Details for Monitoring Wells
Line 02 Region
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Well ID	Groundwater Unit	Well Type	Easting	Northing	GSE (ft msl)	TOC (ft msl)	TOS (ft bgs)	BOS (ft bgs)	Well TD
3670	FWBZ	Monitor	2223910	347424	165.8	165.87	59	109	110
3671	FWBZ	Monitor	2222557	347625	149.4	152.76	68	98	101
3672	FWBZ	Monitor	2225055	347726	164.4	164.43	65	85	87
3674	FWBZ	Monitor	2224948	347252	162.9	162.95	70	100	111
3683	FWBZ	Monitor	2225906	347392	178	181.23	61	91	100
3689	FWBZ	Monitor	2224221	348250	151	153.93	60.5	80.5	81.5
3690	FWBZ	Monitor	2224242	348236	151.5	154.37	60	80	80.5
3691	FWBZ	Monitor	2224278	348200	151.6	154.67	60	80	80.5
3692	FWBZ	Monitor	2224314	348167	151.9	154.9	60	80	80.5
3697	FWBZ	Monitor	2224531	347600	158.6	161.57	65	95	100
4020	FWBZ	Extraction	2220630	346476	145.91	147.08	108	148	158
5010	FWBZ	Abandoned	2219941	348576	134.05	136.72	20	90	160
		Recharge					110	147	
5011	FWBZ	Abandoned	2219535	348609	137.52	140.86	20	90	160
		Recharge					110	147	
5012	FWBZ	Abandoned	2219244	348383	135.83	138.79	20	90	160
		Recharge					110	145	
5013	FWBZ	Abandoned Recharge	2218926	348156	135.58	138.49	20	85	160
5014	FWBZ	Abandoned	2219097	348283	135.25	138.09	20	90	160
		Recharge					110	147	
30192	FWBZ	Monitor	2216163	349056	112.79	112.79	94	104	104

Key:
BOS = Bottom of screen
ft bgs = Feet below ground surface
ft msl = Feet above mean sea level
FWBZ = First water-bearing zone
GSE = Ground surface elevation
TD = Total depth
TOC = Top of casing
TOS = Top of screen

Table 5.7-2 *Boring Details for Screening-Level Groundwater Samples*
Line 02 Region
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Sample ID	Boring Location	Groundwater Unit	Easting	Northing	GSE (ft msl)	Sample Depth (ft bgs)	Date Collected
28E-SP20-GW01-10	28E-SP20	Perched	2224207	348272	155.41	20	01/25/06
28E-SP20-GW02-20	28E-SP20	Perched	2224207	348272	155.41	20	01/25/06
51E-SP11-GW01-35	51E-SP11	Perched	2223009	347617	152.15	35	08/24/06
52E-SB21-GW-35	52E-SB21	Perched	2222875	347831	162.62	35	08/25/06
52E-SP04-GW01-16	52E-SP04	Perched	2223085	347606	158.90	16	03/07/06
52E-SP05-GW01-16	52E-SP05	Perched	2223033	347652	158.51	16	03/07/06
52E-SP06-GW01-16	52E-SP06	Perched	2223169	347638	159.31	16	03/07/06
52E-SP07-GW01-35	52E-SP07	Perched	2222939	347857	164.69	35	08/25/06
52E-SP08-GW01-20	52E-SP08	Perched	2223099	347857	160.51	20	01/11/06
52E-SP09-GW01-20	52E-SP09	Perched	2223345	348052	164.15	20	01/19/06
52E-SP10-GW01-20	52E-SP10	Perched	2223519	347662	163.38	20	01/19/06
52E-SP11-GW01-20	52E-SP11	Perched	2223125	347168	163.05	20	01/16/06
52E-SP14-GW01-15	52E-SP14	Perched	2223278	347660	165.18	15	02/14/06
52E-SP16-GW01-15	52E-SP16	Perched	2222830	347624	160.23	15	02/13/06
52E-SP17-GW01-20	52E-SP17	Perched	2222708	347764	158.71	20	03/01/06
52E-SP18-GW01-15	52E-SP18	Perched	2222859	348087	158.70	15	02/13/06
52E-SP20-GW01-20	52E-SP20	Perched	2223086	348124	156.67	20	03/08/06
59E-SB02-GW01-44	59E-SB02	Perched	2224436	347816	158.13	44	11/18/05
59E-SP13-GW01-10	59E-SP13	Perched	2224694	347423	165.32	10	01/20/06
DSA-SP15-GW01-43	DSA-SP15	Perched	2225343	348225	166.84	43	02/09/06
DSA-SP17-GW01-43	DSA-SP17	Perched	2225317	348373	167.87	43	02/09/06
DSA-SP21-GW01-45	DSA-SP21	Perched	2225764	348183	171.76	45	04/25/06
DSA-SP23-GW01-45	DSA-SP23	Perched	2225673	347919	174.32	45	04/25/06
DSA-SP24-GW01-45	DSA-SP24	Perched	2225449	347758	172.59	45	04/26/06
DSA-SP29-GW01-20	DSA-SP29	Perched	2226126	348151	180.44	20	09/15/06
L5-AF1-SP01-GW01-20	L5-AF1-SP01	Perched	2223327	347432	160.96	20	01/11/06
L5-ST87-SP01-GW01-16	L5-ST87-SP01	Perched	2223087	347708	159.90	16	03/07/06
28E-SB04-50	28E-SB04	FWBZ	2224339	348114	148.66	50	09/06/06
28E-SB05-GW01-52	28E-SB05	FWBZ	2224414	348102	154.19	52	09/07/06
28E-SB06-GW01-52	28E-SB06	FWBZ	2224377	348057	156.89	52	09/06/06
28E-SB07-GW01-50	28E-SB07	FWBZ	2224340	348081	156.18	50	09/07/06
28E-SP16-GW01-52	28E-SP16	FWBZ	2224383	348097	155.98	52	02/07/06
29E-SB03-GW01-60	29E-SB03	FWBZ	2224658	348358	158.37	60	11/18/05
29E-SP08-GW01-74	29E-SP08	FWBZ	2224613	348302	158.62	74	02/08/06
29E-SP09-GW01-60	29E-SP09	FWBZ	2224704	348330	158.77	60	02/08/06
51E-SB04-GW01-63	51E-SB04	FWBZ	2223017	347637	158.54	63	11/21/05
DSA-SB01-GW01-71	DSA-SB01	FWBZ	2224625	347963	164.01	71	11/15/05
DSA-SP10-GW01-58	DSA-SP10	FWBZ	2225057	348123	168.31	58	02/10/06
DSA-SP16-GW01-55	DSA-SP16	FWBZ	2225263	347991	170.70	55	02/06/06
DSA-SP22-GW01-55	DSA-SP22	FWBZ	2225834	348039	173.05	55	04/24/06
E(d)-SNS03-GW01-47	E(d)-SNS03	FWBZ	2224880	348163	161.11	47	09/08/06
E(e)-SB02-GW01-52	E(e)-SB02	FWBZ	2224865	348184	160.34	52	11/17/05
E(e)-SB03-GW01-55	E(e)-SB03	FWBZ	2224902	348090	167.23	55	09/08/06
E(n)-SP05-GW01-60	E(n)-SP05	FWBZ	2224645	348665	146.89	60	02/09/06
E(n)-SP08-GW01-43	E(n)-SP08	FWBZ	2225019	348391	149.95	43	02/09/06
L2-ST26-SB01-GW01-62	L2-ST26-SB01	FWBZ	2224730	348265	156.95	62	11/17/05

Key:
ft bgs = feet below ground surface
ft msl = feet above mean sea level
FWBZ = First water-bearing zone
GSE = Ground surface elevation

6.0 *SUMMARY AND RESULTS OF REMEDIAL INVESTIGATION – CHEMICAL PLANT 2 REGION*

The Chemical Plant 2 Region of the Boundary Operable Unit (BOU) encompasses the five seven management areas listed below.

- **Chemical Plant 2 North:**
  - Source Areas 59F, 62F, CP2-07, CP2-08, and F(c) and various features and structures associated with the former nitroplasticizer and chemical manufacturing facilities (Buildings 15002, 15007, 15008, 15009, 15010, 15014, 15015, 15016, and 15020);
  - Former Resource Conservation and Recovery Act (RCRA) Unit I; and
  - Septic tank at Building 15007 (CP2-ST07).
- **Chemical Plant 2 South:**
  - Source Areas 60F and 61F and various features and structures associated with the former nitroplasticizer and chemical manufacturing facilities (Buildings 15001, 15003, 15004, 15005, 15011, 15017, and 15094);
  - RCRA Unit E; and
  - Septic tanks at Building 15001 (CP2-ST01/03).
- **Magazine Area (Includes Open Space Area 3):**
  - Septic Tanks at Buildings 48013 (A48-ST13) and 48019 (A48-ST19);
  - Former RCRA Unit C; and
  - Magazine Buildings 48004, 48010, and Building 48014.
- **Dredge Pit and Eastern Basin:** Source Area 25F.
- **Open Spaces 1, 2, and 4.**

Septic tank and leach lines within the management units not identified as separate source areas are discussed within the source areas they are associated. This section provides a description of the each of the five management areas, including the environmental setting, and a discussion regarding the presence and distribution of chemicals in both the vadose zone and groundwater. Additionally, the following information is presented for each of the areas:

- A summary of background information, including historical operations and activities;
- A summary of the scope and results of previous (prior to 2005) investigations;
- A summary of the scope and results of recent (2005 through 2007) investigations for volatile organic compounds (VOCs), metals, and other non-VOCs in soil, soil vapor, and groundwater; and a discussion of the investigation results.

6.1 SUMMARY AND RESULTS OF VADOSE ZONE REMEDIAL INVESTIGATION – CHEMICAL PLANT 2

Chemical Plant 2 was originally operated as a nitroplasticizer manufacturing facility by Aerojet. The plant was shut down in 1968 and later reactivated in 1975 by Cordova Chemical Company for other chemical manufacturing activities. Reported chemical usage at Chemical Plant 2 included potassium carbonate, methyl-2-bromobutyrate, ethylenimine, toluene, acetone, ATS, styrene oxide, t-BuOH, methanol, methylene chloride, sodium carbonate, acetic anhydride, sulfuric acid, caustic soda, hydrogen chloride, hydrogen sulfide, epichlorohydrin, crotononitirle, ethylene oxide, isopropanol alcohol, pluracol, N-tetramethylethylene diamine, pentaerythryitol triacrylate, and trimethylol propane triacrylate.

Chemical Plant 2 encompasses seven source areas [59F, 60F, 61F, 62F, F(c), CP2-07, and CP2-08 (also referred to as F(c)N in the BOU FSP (Aerojet et al., 2006b)] and various other features including sumps, drains, septic systems, storage and manufacturing facilities, and the former locations of two injection wells (Figure 6.1-1). The injection wells were used to inject wastewater from Chemical Plant 2 into deep groundwater zones below a depth of approximately 1,000 feet below ground surface (bgs). Injection Well 1 was constructed in 1962 and received nitroplasticizer manufacturing process wastewater and chemical manufacturing wastewater from 1963 to 1985. Injection Well 2 was constructed in 1976 to provide standby waste disposal capacity for the waste stream from Chemical Plant 2 operations. Both injection wells were closed pursuant to separate state and federal orders.

To simplify the discussions and presentation of data, Chemical Plant 2 has been divided into two investigation areas that encompass source sites and other investigated features that are related, are in proximity to one

another, or appear to be linked based on the presence of similar chemicals in soil and/or groundwater. The division of Chemical Plant 2 into two areas is also based on the direction of surface water flow and areas of surface water accumulation. The two investigation areas at Chemical Plant 2 are described below and shown in Figure 6.1-1:

- **Chemical Plant 2 Area North –** Includes Source Areas 59F, 62F, CP2-07, CP2-08, and F(c); RCRA Unit I; and various features north of the railroad tracks that transect the area. Various features in Chemical Plant 2 Area North include chemical manufacturing facilities, collection systems, waste lines, floor drains, sumps, storage areas, holding basins, aboveground storage tanks, underground storage tanks, septic tanks and leachfields, drainage ditches, and low-lying areas.
- **Chemical Plant 2 Area South –** Includes Source Areas 60F and 61F, former RCRA Unit E, the former location of the Stouffer Chemical Plant, and various features south of the railroad tracks that transect the area. Various features in Chemical Plant 2 Area South include the former offices, control rooms, and laboratories (Building 15001) associated with the chemical plants; drainages; sumps; former hazardous waste and material storage areas; and septic tanks and leach fields.

This section presents the environmental setting for the Chemical Plant 2 Area and provides the following information for each of the two areas of investigation:

- Describes the area of investigation;
- Describes each of the source areas and other features, including septic tanks, investigated during the previous investigations and the BOU Remedial Investigation (RI);
- Summarizes previous vadose zone investigations and the results of those investigations;
- Identifies chemicals of potential concern (COPCs) identified during the previous investigations;
- Presents the data needs identified in the BOU FSP;
- Summarizes the sampling activities performed during the BOU RI and deviations from the sampling proposed in the BOU FSP;
- Presents the analytical results for samples collected during the BOU RI and historical data, where appropriate; and

- Provides a discussion of the investigation results that includes the identification of COPCs; lateral and vertical characterization of COPCs; fate and transport of the COPCs; and the potential for those COPCs to impact human health, surface water, and groundwater.

The information presented was compiled from one or more of the following sources*: Stage 1 Sampling Plan-Zone 1* (Aerojet, 1993a); *Stage 1 Sampling Plan-Zones 3 and 4* (Aerojet, 1993b); *Stage 1 Sampling Plan-Zone 2* (Aerojet, 1993c); *Aerojet Superfund Site – Scoping Report, Volumes 1 through 6* (ICF Technology, Inc., 1989); *Aerojet Site; Stage 1 Report - Zones 1 through 4* (ICF Kaiser Engineers, Inc., 1993); or the BOU FSP (Aerojet et al., 2006b).

6.1.1 Environmental Setting – Chemical Plant 2 Area

The topography, geology, soils, surface water hydrology, general hydrogeology, and ecological habitat of the Chemical Plant 2 Area are described in the following subsections.

6.1.1.1 Topography

Chemical Plant 2 is situated on a relatively flat area due to the extensive grading during construction of the facility. The relative flatness of the facility is broken by the presence of large earthen revetments around several of the buildings and storage tanks. The facility area is sited in an area that was historically dredged and is surrounded by areas of dredging. Although grading makes it difficult to ascertain, the presence of dense, indurated material during drilling suggests that undredged areas may have been present at the facility site. During construction, the elevation of the facility area was raised and its elevation is approximately 5 to 10 feet higher than the surrounding area. North of the railroad tracks), the ground surface slopes towards the north-northwest and surface water drainage in the northern portion of the Chemical Plant 2 Area is in that direction. In the southern portion of Chemical Plant 2, the ground slopes towards the south-southeast and surface water drainage in that area is primarily in that direction. The southern boundary of Chemical Plant 2 consists of slickens areas that are roughly 10 feet lower than the facility.

A rail line enters the site from the west and splits into four separate lines within the facility. The rail line transects the facility from east to west and as a result, surface water drainage north of the tracks is generally towards the north and surface water drainage south of the rail line is towards the south.

6.1.1.2 *Geology*

Available historical aerial photographs indicate that the native landscape in the vicinity of Chemical Plant 2 has been extensively altered by historical dredging and grading and that much of the facility was likely constructed on dredge tailings. However, as will be discussed below, an undredged ancestral American River terrace is also present within the Chemical Plant 2 Area. Review of the aerial photographs indicates that the area surrounding Chemical Plant 2 may have been dredged more than once. Dredge tailings are present around the southern and southeastern boundaries of the site, and the northernmost potions of the site (including the low area north of Site 59F). Dredge tailings in the Chemical Plant 2 Area extend to depths between 70 and 90 feet bgs.

A northeast-southwest trending ancestral American River terrace forms a strip of undredged material that extends across the northern portion of Chemical Plant 2 (Source Area 59F), and to undredged material exposed in the Dredge Pit and Eastern Basin. This terrace is evidenced by the presence of hard, indurated material encountered during drilling in the northwest half of the site in the area of Source Areas 59F and CP2-08. Historically, auger rigs encountered refusal in these areas at an average depth of approximately 25 feet. The geologic material of the terrace consists of moderate to well indurated siltstones with thin layers of gravels, gravels with sand, clayey sands, clayey gravels with sand, and gravels with clay and sand.

6.1.1.3 *Soils*

Dredge tailings are classified as Xerorthents. Xerorthents are very deep, somewhat excessively drained and excessively drained soils associated with dredge tailings. They are formed in material that has a high content of gravel and cobbles derived from mixed sources. The material was deposited as tailings after most of the fine-earth material was washed from it and removed during gold dredging activities. Slopes are short, complex, and disturbed (United State Department of Agriculture [USDA] – Natural Resources Conservation Service [NRCS], 1993).

Soils in the undredged areas are classified as Redding-Corning-Red Bluff, which are moderately well-drained soils that are moderately deep over a cemented hard pan. This soil unit is found on intermediate and high terraces, terrace remnants, and the side slopes of terraces in the eastern part of Sacramento County. The soils form in alluvium that is derived from mixed rock sources. The Redding soils are typically a surface layer

of gravelly loam with subsoil comprised of a gravelly claypan, which is in turn underlain by a hardpan at a depth of 20 to 40 inches. The Corning-Red Bluff soils are typically a loam with a subsoil of clay loam, gravelly loam, and gravelly clay loam.

6.1.1.4 *Surface Water Hydrology*

The nearest bodies of water are Rebel Hill Ditch approximately one-half mile to the south, Folsom South Canal approximately one mile to the west, and Buffalo Creek approximately one and one-half miles to the north.

As discussed in Section 6.1.1.1, the rail line that transects the site from east to west provides a man-made diversion for surface water flow at the facility. North of the rail line, surface water flow is primarily towards the north-northwest with the majority of surface water flow into the low-lying areas north of the facility. In the southern portion of the facility, south of the rail line, surface water flow is primarily towards the south-southwest and into the slicken areas along the southern boundary of the facility.

6.1.1.5 *Local Hydrogeology*

The first saturated sediments encountered beneath Chemical Plant 2 are either part of Perched Groundwater or within the first water-bearing zone (FWBZ). The general hydrogeology of the Perched Groundwater and FWBZ beneath Chemical Plant 2 is discussed below. Details regarding the occurrence of groundwater within the Chemical Plant 2 Region and distribution of chemicals in the groundwater are presented in Section 6.6.

<u>Perched Groundwater</u>

There are several Perched Groundwater zones in the Chemical Plant 2 Region, which have been generally grouped into an Upper Perched Zone and a Lower Perched Zone. The definitions refer to an assemblage of several perched groundwater zones, and not one specific unit.

The Upper Perched Zone typically occurs in ancestral American River sediments that have been reworked by historical gold-dredging activities. The base of the Upper Perched Zone generally coincides with the interface between the permeable dredged material and the relatively impermeable, undredged material. In the Chemical Plant 2 Area, the Upper Perched Zone typically occurs within the upper 40 feet of the ground surface, but was noted as shallow as 10 feet bgs along the western boundary (boring 59F-SP39) of Chemical Plant 2 Area North and as deep as 75 feet

bgs in Chemical Plant 2 Area South (Well 129). Upper Perched Groundwater elevations have stayed relatively stable since approximately 1988 and generally demonstrate 10 feet or less of seasonal fluctuation.

Lower Perched Groundwater within Chemical Plant 2 occurs in discontinuous sand lenses in a generally fine-grained lithologic unit. Due to its presence in the sand lenses, the Lower Perched Groundwater is also discontinuous and is encountered at depths between 74 and 93 feet bgs. Historical groundwater data indicates that prior to 1998, the FWBZ was present at elevations nearly equal to the Lower Perched Groundwater and the Lower Perched Groundwater technically did not exist. The Lower Perched Groundwater represents water left perched as a result of the decrease in water levels in the FWBZ.

Due to the limited number of monitoring wells, groundwater flow direction and gradient within the Upper and Lower Perched Groundwater could not be ascertained with any certainty.

First Water-Bearing Zone

The FWBZ in the Chemical Plant 2 Region occurs within Layer A. Depth to the top of FWBZ in the Chemical Plant 2 Area ranges from 80 to 110 feet bgs and generally increases southeast of Chemical Plant 2, mostly due to increased elevations associated with the ancestral American River terrace. Groundwater elevations in the FWBZ have decreased an average of 39 feet between 1983/1984 and April 2006, with lowest levels generally occurring between 1994 and 1996. Data indicate that groundwater elevations in the FWBZ are continuing to drop.

Flow direction in the FWBZ is generally towards the west, consistent with the migration of groundwater from the Line 03 Area east of Chemical Plant 2 towards Aerojet Groundwater and Extraction System E/F (GET E/F) Extraction Wells 4007 and 4310. The average hydraulic gradient across the Chemical Plant 2 Area is approximately 0.0064 feet per foot (ft/ft), but flattens to approximately 0.0004 ft/ft in the area immediately upgradient (east) of Chemical Plant 2.

6.1.1.6 *Ecological Habitat*

Chemical Plant 2 is surrounded by a variety of habitats including buildings, ruderal/disturbed habitat, paved surfaces, dredger tailings with annual grassland, Fremont cottonwood woodland, Fremont cottonwood-oak woodland, and coyote brush-willow scrub.

Flora near the buildings, ruderal/disturbed habitat, and paved surfaces typically include herbaceous weeds, non-native invasive species, and ornamental landscape species. Fauna species common to this area are habitat generalists such as the rock pigeon, mourning dove, western fence lizard, European starling, house mouse, and deer mouse, or species that may venture in from adjacent vegetation communities.

Non-native, naturalized Mediterranean grasses represent the predominant flora species within the annual grassland habitat interspersed with the dredger tailings. Fauna species are not common in the dredger tailings due in part to the cobble-boulder substrate and sparse vegetation cover. However, the annual grassland mixed in with the dredger tailings allows for foraging ground for some species, including the western fence lizard, common king snake, white-tailed kite, red-tailed hawk, and coyote.

Fremont cottonwood woodland and Fremont cottonwood-oak woodland support similar flora and fauna. Fremont cottonwood is the dominant tree species, with oak and willow species as sub-dominant members of the canopy. The understory ranges from open areas dominated by annual grasses to dense, developed shrub layers. Flora species typically observed in the understory include coyote brush, poison oak, willow, and various annual grasses. Common fauna species include Pacific treefrog, western rattlesnake, Cooper's hawk, red-tailed hawk, American kestrel, wild turkey, great horned owl, various songbirds, California vole, deer mouse, coyote, and black-tailed deer. In addition, an emergent marsh area and a few seasonal wet areas are located within this habitat type.

The coyote brush-willow scrub community is dominated by coyote brush and shrub-type willows. Other common flora includes blue elderberry, poison oak, hoary coffeeberry, a variety of thistles, and annual grasses. This community is typically found in low-lying areas between the dredge tailing piles. Fauna species typically include a variety of snakes, California quail, towhee, mourning dove, California vole, black-tailed jackrabbit, desert cottontail, raccoon, gray fox, coyote, and black-tailed deer.

A large, low-lying area is located north of the Chemical Plant 2 Area that retains rain water and remains indurated throughout the wet season and dries up in the dry season. A variety of waterfowl utilize the seasonal ponds during the wet season.

Blue elderberry shrubs, potential habitat for the Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), were observed

scattered throughout the entire Chemical Plant 2 Area. A *Biological Assessment Report* (ECORP Consulting, Inc., 2005) for the BOU was presented in Appendix B of the BOU FSP.

6.1.2 *Chemical Plant 2 – Chemical Plant 2 Area North*

Chemical Plant 2 Area North consists of Source Areas 59F, 62F, CP2-07, CP2-08, and F(c) located near the former nitroplasticizer manufacturing facility (Building 15007), north of the railroad tracks that transect the area (Figure 6.1-1). Chemical Plant 2 Area North also includes various features such as sumps, holding basins, storage tanks, waste lines, and septic tanks associated with the source areas and/or historical chemical manufacturing processes.

6.1.2.1 *Description of Source Areas – Chemical Plant 2 Area North*

The source areas in Chemical Plant 2 Area North and various site features that may have contributed chemicals to soil and/or groundwater are described below and shown in Figure 6.1-1. Site features were identified based on historical soil, soil vapor, and groundwater analytical data and/or visual inspection and limited data coverage.

<u>Source Area 59F</u>

Source Area 59F is the Chemical Plant 2 deep well injection headworks and associated area (Figure 6.1-1). Injection Well 1 was constructed in 1962 and beginning in 1963, nitroplasticizer manufacturing process wastewater was injected into deep groundwater zones, below a depth of approximately 1,000 feet bgs. Chemical Plant 2 was shut down in 1968 and later reactivated in 1975 by Cordova Chemical Company for other chemical manufacturing activities. Injection Well 2 was constructed in 1976 to provide standby waste disposal capacity for the waste stream from Chemical Plant 2 operations. Both injection wells operated until 1985. Closure of the injection wells was conducted pursuant to separate state and federal orders.

Features within Source Area 59F that may have contributed or received chemicals include the following:

- A former 245,000 gallon, concrete-lined, holding basin constructed in 1978 to replace an existing hypalon-membrane-lined gunite holding basin;

- Three concrete lined sumps (with capacities of 7,000, 1,300, and 4,500 gallons) formerly located west of the holding basin;
- A 1,000-gallon, asphalt-coated, steel tank previously located north and west of the sumps;
- Industrial waste lines that formerly connected the holding basins, sumps, and tank; and
- A 25- to 30-acre low-lying area located north of the injection wells;

The holding basin, sumps, and steel tank potentially received aqueous wastes from the nitroplasticizer manufacturing process building (Building 15007) and backwash from the injection well filtration system. The wastes either flowed directly to the injection well via an industrial waste line or were temporarily held in the holding basin, sumps, and tanks before they were disposed of by deep-well injection. The low-lying area potentially received surface water runoff from the area of Chemical Plant 2 until late 1979, when an unlined ditch was constructed north of the holding basin and injection well pad to intercept surface water runoff before it could reach the low-lying area. The unlined ditch directed surface runoff southwesterly.

The source area investigation for 59F also includes the investigation for a RCRA-I facility (700 Area Storage and Treatment Tanks Area), a RCRA incinerator area (Incinerator Area 16), and a RCRA injection well area. According to the *RCRA-I Facility Closure Report* (Aerojet, 2004b), many of the site features were removed in 2004 and Source Area 59F is now a predominantly open area. The 700 Area Storage and Treatment Tanks Area is now closed under RCRA. Incinerator Area 16, is a test incinerator area, and Underground Injection Wells IW-1 and IW-2 are deep well injection headworks that are included in the investigation areas.

<u>Source Area 62F</u>

Source Area 62F is the former location of a stainless steel storage tank approximately 320 feet southwest of Building 15010 (Figure 6.1-1). The tank was placed in service in 1962 and was used until 1982 to store paraldehyde. The tank was hydrostatically leak tested and visually inspected in 1982 and 1990. No detectable leaks were reported. During the 1990s, the tank was permitted by Sacramento County for storage of acetaldehyde. There are no records of discharge from the tank after being permitted for storage of acetaldehyde. The tank was removed in 1998. A nitroethane tank and a railcar transfer station are also in the vicinity of

Source Area 62F. However, no historical information is available for these site features. Other features in proximity to Source Area 62F that may have contributed chemicals to the vadose zone include several possible areas of Prowl spills in the rail line, a former railcar transfer station, a former chemical storage area, and a low-lying area along the western fence line that may have received drainage from the area of the paraldehyde and nitroethane tanks.

Source Area CP2-07

CP2-07 encompasses the main Chemical Plant 2 Manufacturing facility (Building 15007) and various associated features (Figure 6.1-1). During the Stage 1 investigation, an area of yellow discoloration was identified beneath piping that connected to Building 15007. The discolored surface soil, potentially the result of a release of Prowl, was removed from the site. Features associated with Building 15007 that may have also contributed chemicals to the vadose zone and investigated during the BOU RI include the following:

- Trench floor drains within Building 15007 and a sump that received discharges from the floor drains;
- The waste line originating from Building 15007 that formerly connected to the holding basins, sumps, and tanks associated with Source Area 59F;
- A sump that received surface water runoff from equipment areas (pumps, boilers, condensation tanks, boiler blowdown) within the berm surrounding Building 15007;
- Several potential areas of Prowl spills along the rail lines south of Building 15007;
- A former hazardous and explosive materials storage area (Building 15016); and
- A 2,000-gallon septic tank with three potholes north of Building 15007 identified during the Demonstration Project Record Search. The septic tank received wastewater from Building 15007 restrooms.

Six chemical aboveground storage tanks with concrete secondary containment units were formerly located between the railroad tracks and the revetment south of Building 15007. Because these tanks had secondary containment and no visible indications of spills or releases were observed, these tanks were not identified for investigation and not included in the BOU FSP (Aerojet et al., 2006b).

Source Area CP2-08

Source Area CP2-08, referred to as F(c)N in the BOU FSP, consists of Building 15008, a Chemical Plant 2 storage facility north of Building 15010, and encompasses various facilities in proximity to Building 15008 (Figure 6.1-1). Historical plot plans of the area indicate that drums were stored adjacent to Building 15008 and drums containing solvent still bottoms were stored in the facility. No documentation is available on other materials potentially stored in Building 15008; however, site personnel have indicated that vacuum-pump and booster-pump oil-containing polychlorinated biphenyls (PCBs) may have been stored in the facility during the 1960s. Other features encompassed by Source Area CP2-08 include the following:

- A boiler and compressor blow-down sump from Buildings 15014 and 15015;
- A dry well that received waste water from Building 15010;
- Area of former test incinerator and Injection Well 2 headworks;
- An aboveground diesel storage tank; and
- A ditch that received surface water runoff from the hazardous waste storage areas and directs surface water toward the north.

Source Area F(c)

Source Area F(c) is a 500-gallon capacity concrete sump near the east side of Building 15010 (Figure 6.1-1). Building 15010 has been identified as the former Brine Chiller Facility. The sump received boiler blowdown water, refrigeration compressor seal water, and maintenance shop wash water, which may have contained solvents used in the facility. Wastes from Building 15010 were discharged to the sump from 1975 to 1985. Sump contents were possibly transferred to the 7,000-gallon sump located west of Injection Well 1 at Source Area 59F for disposal. A concrete pad and electrical substation with a former PCB transformer were also located near the sump. An unrelated sump located 50 feet north of Building 15010 may have also received boiler blowdown from the building. The sump functioned as a drain; there was no means (i.e., sump pump) to remove fluids collected.

The effluent generated from within Building 15010 potentially contained methanol, ammonium thiosulfate, ammonia, sodium bicarbonate, sodium acetate, methylene chloride, ethyleneimine, mercaptoethylamine,

isopropanol, sodium hydroxide, sodium chloride, sodium sulfide, chloroform, sodium nitrite, sodium nitrate, pyridine, potassium carbonate, potassium bicarbonate, toluene, phosphoric acid, formaldehyde, paraldehyde, potassium chloride, potassium sulfate, sodium dinitroethane, sodium fluorborate, sodium nitroethane, sodium nitropropane, ethylene oxide, and 1,2-dichloroethane (1,2-DCA).

6.1.3 Summary and Results of Previous (Prior to 2005) Vadose Zone Investigations – Chemical Plant 2 Area North

The following subsections summarize the scope and results of previous (prior to 2005) vadose zone investigations of the five source areas, septic tanks, and various features within the Chemical Plant 2 Area North; identify COPCs based on the previous investigations; and discuss the data quality objectives (DQOs) and sampling proposed in the BOU FSP.

6.1.3.1 Summary of Previous (Pre-2005) Vadose Zone Investigations – Chemical Plant 2 Area North

Soil samples from approximately 30 soil borings and over 40 soil vapor samples were collected in the vicinity of Source Areas 59F, 62F, F(c), CP2-07, and CP2-08 between 1979 and 2004. Soil vapor samples were analyzed for VOCs. Soil samples were analyzed for VOCs, semivolatile organic compounds (SVOCs), perchlorate, paraldehyde, Prowl, and/or metals. Previous investigations of those source areas are summarized below. The purpose of the previous investigations is discussed in Section 2.7.

<u>Source Area 59F</u>

Previous vadose zone investigations were conducted at Source Area 59F between 1979 and 2004. The scope of those investigations is outlined below:

- 1979 – Twenty-one shallow trenches (1 through 21) were excavated in the vicinity of the holding basin and the low-lying area to depths between 11 and 14 feet bgs, where hard pan was encountered. Soil samples were collected for chemical analysis from three trenches in the low-lying area at depths of 18, 20, and 21 feet bgs. In April 1979, water samples were collected from the French drain sump adjacent to the holding basin and the low-lying area. In April and May 1979, three water samples were collected from the low-lying area for chemical analysis. In May 1979, five groundwater monitoring wells were

completed in the vicinity of the low-lying area to depths ranging from 33 to 110 feet bgs. Water samples were collected from each of these monitoring wells.

- January 1984 – Soil samples were collected from three borings at Site 59F and analyzed for VOCs, metals, perchlorate, and Prowl.
- 1992 – Thirty-three soil vapor samples were collected at depths ranging from 10 to 15 feet bgs and analyzed for selected VOCs.
- August 1993 – Eleven soil samples were collected from borings and analyzed for selected VOCs, SVOCs, and metals. Additionally, five soil vapor samples were collected and analyzed for selected VOCs.
- June 2004 – Soil samples were collected at depths between 0 and 1 foot bgs from 13 soil borings and analyzed for selected metals.

Source Area 62F

Previous vadose zone investigations were conducted at Source Area 62F between 1990 and 1993. The scope of those investigations is outlined below:

- 1990 – Soil samples were collected during the installation of two vadose zone vapor monitoring wells next to the storage tank. No information regarding analysis of the samples has been identified.
- 1992/1993 – Four soil samples were collected at depths ranging from 1 to 20 feet bgs during the Stage 1 RI and analyzed for paraldehyde. Additionally, one soil vapor sample was collected at 19.5 feet bgs and analyzed for selected VOCs.

Source Area F(c)

Previous vadose zone investigations were conducted at Source Area F(c) in 1992 and 1993. The scope of those investigations is outlined below:

- October 1992 – Four soil vapor samples were collected at a depth of 10 feet bgs and analyzed for VOCs.
- September 1993 – Soil samples were collected from one boring at depths ranging from 1 to 20 feet bgs and analyzed for metals.

Source Area CP2-07

Soil samples were collected at 1, 5, and 10 feet bgs from one boring in the area of yellow discoloration in 1992 and analyzed for Prowl.

Source Area CP2-08

Soil samples were collected in 1992 from six borings advanced to depths of up to 10 feet bgs and analyzed for SVOCs, metals, and PCBs. Additionally, soil vapor samples were collected at depths ranging from 4.5 to 20 feet bgs and analyzed for selected VOCs.

6.1.3.2 *Results of Previous (Pre-2005) Vadose Zone Investigation – Chemical Plant 2 Area North*

The results of the previous (prior to 2005) investigations of Source Areas 59F, 62F, F(c), CP2-07, and CP2-08 in Chemical Plant 2 Area North, as presented in the BOU FSP (Aerojet et al., 2006b), are summarized below.

Review of the previous data identified the following COPCs in soil and/or soil vapor within the source areas that comprise the Chemical Plant 2 Area North:

- **Soil –** VOCs, SVOCs, perchlorate, pesticides (including Prowl), PCBs, and metals.
- **Soil Vapor –** VOCs.

Figures showing previous sampling locations at the source areas within Chemical Plant 2 Area North and chemical groups detected in soil samples collected between 1991 and 2005 above human health and ecological screening levels were presented in the BOU FSP (Aerojet et al., 2006b) and are included in Appendix E. The BOU FSP also presented a summary of statistics and the sample results for chemicals detected in soil, soil vapor, and groundwater that exceed human health and ecological screening levels in the Chemical Plant 2 Area.

6.1.3.3 *Summary of Data Needs – Chemical Plant 2 Area North*

Based on a review of the previous vadose zone investigation data, extensive aerial photograph research and review, and exhaustive research of historical documents, Aerojet determined that additional soil and soil vapor sampling was needed in the Chemical Plant 2 Area North to:

- Characterize the present lateral and vertical extent of VOCs, SVOCs, PCBs, perchlorate, pesticides, and metals in soil in the vadose zone at the majority of the source areas and site features that may have

contributed chemicals in soil at concentrations that could potentially impact human and ecological receptors;

- Evaluate the potential for chemicals in soil to degrade surface or groundwater quality; and
- Obtain sufficient data to support fate and transport modeling, evaluate risk to human and ecological receptors, and evaluate potential remedial alternatives.

It should be noted that due to the time lapse (12 years) since the Stage 1 RI was performed and the elevated laboratory reporting limits for VOCs during that investigation, the investigation of VOCs performed during the BOU RI was designed to supersede all previous soil vapor and soil VOC investigation results.

6.1.4 *Summary and Results of Boundary Operable Unit Vadose Zone Investigation – Chemical Plant 2 Area North*

The following subsections summarize the BOU investigation (2005 to 2007) of the four source areas and various features within Chemical Plant 2 Area North, describe deviations from sampling proposed in the BOU FSP, and present the results of the BOU RI. The results of the sampling with respect to the completeness of the characterization and identification of potential sources are discussed in Section 6.1.5.

6.1.4.1 *Summary of Boundary Operable Unit Vadose Zone Investigation – Chemical Plant 2 Area North*

The BOU RI of the vadose zone at the source areas [59F, 62F, F(c), CP2-07, and CP2-08] within Chemical Plant 2 Area North included the following activities.

<u>Soil Vapor Investigation</u>

- A total of 73 primary and 8 duplicate soil vapor samples were collected at the five source areas within Chemical Plant 2 Area North and analyzed for VOCs. The VOC analysis included an evaluation of the presence of tentatively identified compounds (TICs). Soil vapor sampling locations are shown in Figure 6.1-2.
- The number of soil vapor samples (including quality assurance/quality control [QA/QC] samples) collected at each of the five source areas, along with the analytical method, are provided on Table 6.1-1.

- A cross-reference between soil vapor sampling locations within Chemical Plant 2 Area North and the specific features they were sited to investigate are provided on Table 6.1-2.

Surface and Subsurface Soil Investigation

- A total of 103 primary and 10 duplicate surface and/or near-surface (0 to 2.5 feet bgs) soil samples and 155 primary and 12 duplicate subsurface (2.6 to 120 feet bgs) soil samples were collected at the five source areas, various features, and septic tanks within the Chemical Plant 2 Area North. Surface and subsurface soil sampling locations are shown in Figures 6.1-3 and 6.1-4, respectively.
- Surface and/or near-surface soil samples were analyzed for SVOCs, metals, perchlorate, total petroleum hydrocarbons (TPH) as diesel (TPH-D), TPH as motor oil (TPH-Mo), pesticides, pH, total organic carbon (TOC), cation exchange capacity (CEC), Waste Extraction Test using deionized water (DI-WET), and/or geotechnical parameters. The SVOC analysis of soil samples also included an evaluation of the presence of TICs, including 10,10'-oxybis-10H-phenoxarsine (OBPA). In accordance with the BOU FSP, sample analysis was based on the analytical results from previous investigations and therefore not every sample was analyzed for the full suite of constituents.
- Subsurface soil samples were analyzed for SVOCs, metals, perchlorate, TPH-D, TPH-Mo, pesticides, pH, TOC, CEC, DI-WET, and/or geotechnical parameters. The SVOC analysis of soil samples also included an evaluation of the presence of TICs, including OBPA. In accordance with the BOU FSP, sample analysis was based on the analytical results from previous investigations and therefore not every sample was analyzed for the full suite of constituents.
- The numbers of surface/near-surface and subsurface soil samples collected for each analysis (including QA/QC samples) at each of the five source areas, along with the corresponding methods, are provided on Tables 6.1-3, 6.1-4, and 6.1-5.
- A cross-reference between surface/near-surface and subsurface soil sampling locations within the Chemical Plant 2 Area North and the specific features they were sited to investigate are provided on Table 6.1-2.

6.1.4.2 *Deviations from Boundary Operable Unit Data Quality Objectives and Sampling Design –Chemical Plant 2 Area North*

Sampling activities conducted at the source areas [59F, 62F, F(c), CP2-07, and CP2-08] within Chemical Plant 2 Area North Area during the BOU RI were generally consistent with those proposed by the BOU FSP, with the exceptions listed on Tables 6.1-6 and 6.1-7. Sampling was performed at locations proposed in the BOU FSP and step-out sampling was performed in accordance with the procedures agreed upon with the agencies. A comparison of proposed and actual sampling activities, including sampling rationale, sample depth, and analyses, is provided on Tables 6.1-6 and 6.1-7. Soil and soil vapor sampling locations and the specific features they were sited to investigate are cross-referenced on Table 6.1-2.

6.1.4.3 *Results of Boundary Operable Unit Vadose Zone Investigation Results – Chemical Plant 2 Area North*

The results of the VOC, metals, SVOC, PCB, perchlorate, TPH-D and TPH-Mo, pesticide, pH, TOC, CEC, DI-WET, and geotechnical analysis of the samples collected at the source areas within Chemical Plant 2 Area North during the BOU RI are summarized below. The analytical results for all soil vapor and soil samples are provided in Appendices F and G, respectively. A discussion of the results with respect to the completeness of the characterization of constituents identified above RISLs or protection of groundwater (PGW) soil screening levels (SSLs) and potential sources are presented in Section 6.1.5.

<u>Summary of Investigation and Results – Volatile Organic Compounds</u>

Based on evaluation of the existing data for the source areas within Chemical Plant 2 Area North, the BOU FSP concluded that additional soil vapor sampling was needed to sufficiently characterize the nature and extent of VOCs. As indicated on Table 6.1-1 and below, 73 primary soil vapor samples were collected at Source Areas 59F, 62F, F(c), CP2-07, and CP2-08 within Chemical Plant 2 Area North and analyzed for VOCs. Additionally, the presence of TICs was evaluated as part of the VOC analysis.

Source Area	Depth (ft bgs)	No. of Primary Samples	No. of Locations
59F	0-10	8	8
	11-20	8	8
	21-30	1	1

Source Area	Depth (ft bgs)	No. of Primary Samples	No. of Locations
	>30	0	0
62F	0-10	5	4
	11-20	7	6
	21-30	0	0
	>30	0	0
F(c)	0-10	1	1
	11-20	2	2
	21-30	0	0
	>30	0	0
CP2-07	0-10	15	15
	11-20	15	15
	21-30	5	5
	>30	0	0
CP2-08	0-10	4	4
	11-20	2	2
	21-30	0	0
	>30	0	0

The analytical results for the soil vapor samples collected from the shallow (0 to 10 feet bgs), intermediate (11 to 20 feet bgs), and very deep (greater than 30 feet bgs) intervals at Source Areas 59F, 62F, F(c), CP2-07, and CP2-08 within Chemical Plant 2 Area North are presented in Appendix F and summarized below. Soil vapor samples were not collected from the deep (21 to 30 feet bgs) interval within the Chemical Plant 2 Area North. Soil vapor sampling locations in the Chemical Plant 2 Area are shown in Figure 6.1-2. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 6.1-2.

1,2-DCA, chloroform, vinyl chloride, and total volatile organic compound (TVOC) concentrations above their respective Human Health Remedial Investigation Screening levels (RISLs) in the shallow, intermediate, deep, and very deep intervals within the Chemical Plant 2 Area are shown in Figure 6.1-5a. Additionally, TVOC concentrations above the RISLs are also illustrated in Figure 6.1-5b. 1,2-DCA, chloroform, and vinyl chloride concentrations above their respective PGW SSLs are shown in Figure 6.1-6.

The TVOC concentrations illustrated in Figures 6.1-5a and 6.1-5b represent the sum of the ratio of the concentration for each detected VOC in the sample divided by its RISL. For example, if tetrachloroethene (PCE) at a concentration of 320 micrograms per cubic meter ($\mu g/m^3$) and trichloroethene (TCE) at a concentration of 961 $\mu g/m^3$ were the only VOCs detected in the samples, then the sum of their respective concentrations divided by their respective SSLs of 320 and 961 $\mu g/m^3$ would be 2, or:

$$PCE = \frac{320\,\mu g/m^3}{320\,\mu g/m^3} = 1$$

$$TCE = \frac{961\,\mu g/m^3}{961\,\mu g/m^3} = 1$$

$$TVOC\ Ratio = 2$$

As agreed upon with the agencies, soil vapor would be characterized during the BOU RI to the point where the TVOC concentration ratio was less than or equal to 10.

Cross sections presenting generalized vadose zone lithology and soil vapor sampling results in the Chemical Plant 2 Area are presented in Figures 6.1-7 and 6.1-8. Additional discussion of soil vapor investigation results for the source areas within Chemical Plant 2 Area North is presented in Section 6.1.5.1.

Shallow Soil Vapor (0 to 10 feet bgs) – Volatile Organic Compounds:

- Thirty-three primary soil vapor samples were collected from the shallow interval at 32 locations in the source areas [59F, 62F, F(c), CP2-07, and CP2-08] within the Chemical Plant 2 Area North and analyzed for VOCs, including TICs. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 6.1-2.
- 1,2-DCA, benzene, carbon tetrachloride (Carbon Tet), chloroform, PCE, tetrahydrofuran (THF), and vinyl chloride were the only VOCs detected in the shallow soil vapor at concentrations above their respective RISLs. Shallow soil samples having concentrations of those VOCs above their RISLs are listed on the table below. Concentrations of 1,2-DCA, chloroform, vinyl chloride, and TVOC above their RISLs are shown in Figure 6.1-5a. TVOC concentrations above the RISL are also shown in Figure 6.1-5b.
- 1,2-DCA, benzene, Carbon Tet, PCE, and vinyl chloride were the only VOCs detected in shallow soil vapor samples at concentrations above their respective PGW SSLs. Shallow soil samples having concentrations of those VOCs above their PGW SSLs are listed on the table below. 1,2-DCA and vinyl chloride concentrations above their PGW SSLs are shown in Figure 6.1-6.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL SSL	> PGW SSL
59F-SP33	10	1,2-DCA	73.9	21	4,300	Y	Y
59F-SP34	10				41,000	Y	Y
59F-SP35	10				88,000	Y	Y
62F-SP04	10				57	N	Y
62F-SP06	10				78	Y	Y
CP2-07-SP01	10				230,000	Y	Y
CP2-07-SP04	10				180	Y	Y
CP2-07-SP06	10				480	Y	Y
CP2-08-SP11	10				170	Y	Y
CP2-07-SP01	10	Benzene	84	35	100	Y	Y
CP2-07-SP02	10	Carbon Tet	58	195	1,500	Y	Y
CP2-07-SP03	10				610	Y	Y
CP2-07-SP06	10				96	Y	N
CP2-07-SP07	10				140	Y	N
59F-SP36	10	Chloroform	83	18,595	120	Y	N
CP2-07-SP01	10				3,700	Y	N
CP2-07-SP04	10				210	Y	N
CP2-07-SP05	10				190	Y	N
CP2-07-SP06	10				1,400	Y	N
59F-SP38	10	PCE	320	57	510	Y	Y
CP2-07-SP05	10				88	N	Y
CP2-07-SP06	10				220	N	Y
CP2-07-SP07	10				140	N	Y
CP2-07-SP13	10				62	N	Y
CP2-07-SP01	10	Tetra-hydrofuran	989	NE	2,800	Y	–
59F-SP34	10	Vinyl Chloride	31	235	51	Y	N
59F-SP35	10				540	Y	Y
CP2-07-SP01	10				64,000	Y	Y

NE = Not established

Intermediate Soil Vapor (11 to 20 feet bgs) – Volatile Organic Compounds:

- Thirty-four primary soil vapor samples were collected from the intermediate interval at 33 locations in the source areas [59F, 62F, F(c), CP2-07, and CP2-08] within the Chemical Plant 2 Area North and analyzed for VOCs, including TICs. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 6.1-2.
- 1,2-DCA, benzene, Carbon Tet, chloroform, PCE, and vinyl chloride were detected in the intermediate soil vapor at concentrations above their respective RISLs. Intermediate soil vapor samples having concentrations of those VOCs above their RISLs are listed on the table below. Concentrations of 1,2-DCA, chloroform, vinyl chloride, and TVOC above their RISLs are shown in Figure 6.1-5a. TVOC concentrations above the RISL are also shown in Figure 6.1-5b.

- 1,2-DCA, benzene, PCE, and vinyl chloride were the only VOCs detected in intermediate soil vapor samples at concentrations above their respective PGW SSLs. Intermediate soil vapor samples having concentrations of those VOCs above their PGW SSLs are listed on the table below. Concentrations of 1,2-DCA and vinyl chloride above their PGW SSLs are shown in Figure 6.1-6.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL SSL	> PGW SSL
59F-SP33	20	1,2-DCA	73.9	21	33,000	Y	Y
59F-SP34	15				30,000	Y	Y
59F-SP35	20				310,000	Y	Y
59F-SP36	20				120	Y	Y
62F-SP06	20				79	Y	Y
CP2-07-SP01	20				8,600,000	Y	Y
CP2-07-SP04	20				210	Y	Y
CP2-07-SP06	20				160	Y	Y
CP2-08-SP11	20				52	N	Y
CP2-08-SP12	20				2,600 J	Y	Y
CP2-07-SP04	20	Benzene	84	35	50	N	Y
CP2-07-SP10	20				89	Y	Y
CP2-07-SP06	20	Carbon Tet	58	195	100	Y	N
59F-SP35	20	Chloroform	83	18,595	160	Y	N
CP2-07-SP01	20				120,000	Y	Y
CP2-07-SP04	20				740	Y	N
CP2-07-SP05	20				360	Y	N
CP2-07-SP06	20				530	Y	N
CP2-RE05-SP01	20				1,200	Y	N
CP2-RE05-SP02	20				120	Y	N
59F-SP38	20	PCE	320	57	380	Y	Y
59F-SP33	15	Vinyl	31	235	71	Y	N
59F-SP34	20	Chloride			55	Y	N
59F-SP35	20				830	Y	Y
CP2-07-SP01	20				120,000	Y	Y

Deep Soil Vapor (21 to 30 feet bgs) – Volatile Organic Compounds:

Soil vapor samples were not collected from the deep interval at the Source Areas [59F, 62F, F(c), CP2-07, and CP2-08] within Chemical Plant 2 Area North.

Very Deep Soil Vapor (greater than 31 feet bgs) – Volatile Organic Compounds:

- Eleven primary soil vapor samples were collected from the very deep interval at 11 locations at Source Areas 59F, 62F, and CP2-07 within the Chemical Plant 2 Area North and analyzed for VOCs, including TICs.

Very deep soil vapor sampling locations and 1,2-DCA, chloroform, vinyl chloride, and TVOC concentrations above their respective RISLs are shown in Figure 6.1-5. 1,2-DCA, chloroform, and vinyl chloride concentrations above their respective PGW SSLs are shown in Figure 6.1-6. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 6.1-2.

- 1,2-DCA and chloroform were the only VOCs detected in the very deep soil vapor at concentrations above their RISLs and 1,2-DCA and benzene were the only VOCs detected at concentrations above their PGW SSL. Very deep soil vapor samples having concentrations of those VOCs above their respective RISL and/or PGW SSLs are listed on the table below.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL SSL	> PGW SSL
CP2-07-SP01	40	1,2-DCA	73.9	21	2,200,000	Y	Y
CP2-07-SP12	40	Benzene	84	35	64	N	Y
CP2-07-SP01	40	Chloroform	83	18,595	12,000	Y	N

Summary of Investigation and Results – Metals

A total of 217 primary and 17 duplicate soil samples were collected at Source Areas 59F, 62F, F(c), CP2-07, and CP2-08 within Chemical Plant 2 Area North during the BOU RI and analyzed for metals. Additionally, 212 samples were also analyzed for mercury and three were analyzed for hexavalent chromium. The number of primary soil samples and sampling locations at Source Areas 59F, 62F, F(c), CP2-07, and CP2-08 are summarized on Tables 6.1-3 and 6.1-4, and below. Summary statistics for the samples are also presented on Tables 6.1-3 and 6.1-4.

		Surface/Near-Surface		Subsurface	
Source Area	Compound	No. of Samples	No. of Locations	No. of Samples	No. of Locations
59F	Metals	37	28	39	15
	Mercury	29	24	39	15
	Hex Chrome	1	1	0	0
62F	Metals	9	8	21	7
	Mercury	9	8	21	7
F(c)	Metals	6	6	10	4
	Mercury	6	6	10	4
CP2-07	Metals	17	17	43	16
	Mercury	17	17	40	14
	Hex Chrome	1	1	1	1

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
CP2-08	Metals	15	11	20	7
	Mercury	15	11	17	6

The results of the metals analysis of surface/near-surface and subsurface soil samples collected at the source areas [59F, 62F, F(c), CP2-07, and CP2-08] within Chemical Plant 2 Area North are presented in Appendix G and summarized below.

Metals detected in soil samples collected within the Chemical Plant 2 Area at concentrations statistically different from background and subsequently compared to screening levels were aluminum, antimony, arsenic, barium, cadmium, chromium, copper, mercury, molybdenum, nickel, selenium, silver, thallium, and zinc. Because boron, lithium, strontium, and titanium were not included in the background evaluation, concentrations of these metals were also compared to screening levels. Because soils within the Chemical Plant 2 Area may include both soil types (Xerorthents and Redding-Corning-Red Bluff), concentrations for metals were compared to the lowest PGW SSL for those soil types.

Surface/near-surface and subsurface soil sampling locations in Chemical Plant 2 Area North are shown in Figures 6.1-3 and 6.1-4, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 6.1-2. Cross sections showing the generalized lithology of the vadose zone in the Chemical Plant 2 Area are provided in Figures 6.1-7 and 6.1-8.

Surface and Near-Surface Soil – Metals:

- Eighty-four primary and seven duplicate surface/near-surface soil samples were collected at 70 locations in the source areas [59F, 62F, F(c), CP2-07, and CP2-08] within Chemical Plant 2 Area North and analyzed for metals. Seventy-six samples collected at 66 locations were analyzed for mercury and two samples collected at two locations were analyzed for hexavalent chromium. Surface/near-surface sampling locations for metals are shown in Figures 6.1-3, 6.1-9, and 6.1-10.
- Arsenic was the only metal detected at a concentration statistically above background and its RISL in surface/near-surface soil samples collected in the source areas within Chemical Plant 2 Area North (Figure 6.1-9). However, it should be noted that while the concentrations are above the background level of 11 milligrams per

kilogram (mg/kg) for RCRB soil, they are generally below the background level of 17 mg/kg for Xerorthents soil.

- Aluminum, arsenic, cadmium, lead, and thallium were detected at concentrations above their respective PGW SSLs. Detected concentrations of those metals above their PGW SSLs, along with the location and depth of the sample containing the detected concentration, is listed on the table below. With the exception of thallium, metals detected at concentrations above the PGW SSLs are shown in Figure 6.1-10.

Sample Location	Depth (ft bgs)	Metal	RISL (mg/kg)	PGW SSL (mg/kg)	Conc. (mg/kg)	> RISL	> PGW SSL
59F-SNS01	0.5	Cadmium	1.7	0.72	0.82	N	Y
	2.5	Arsenic	0.07	11	17	Y	Y
59F-SNS02	0.5	Cadmium	1.7	0.72	0.96	N	Y
	2.5	Cadmium	1.7	0.72	0.8	N	Y
		Thallium	5.0	2.5	2.8	N	Y
59F-SNS03	2.5	Cadmium	1.7	0.72	0.83	N	Y
		Thallium	5.0	2.5	3.2	N	Y
59F-SNS04	0.5	Thallium	5.0	2.5	3.2	N	Y
59F-SD01	0.25	Lead	150	23	140	N	Y
	1.5	Aluminum	76,140	43,000	52,000	N	Y
59F-SD02	0.25	Aluminum	76,140	43,000	51,000	N	Y
	1.5	Aluminum	76,140	43,000	64,000	N	Y
		Arsenic	0.07	11	15	Y	Y
59F-SB12	1.0	Thallium	5.0	2.5	3.2	N	Y
59F-SB22	1.0	Aluminum	76,140	43,000	44,000	N	Y
62F-SB10	1	Arsenic	0.07	11	35	Y	Y
F(c)-SNS01	0.5	Cadmium	1.7	0.72	0.75	N	Y
CP2-08-SNS04	0.5	Cadmium	1.7	0.72	1.0	N	Y
CP2-07-SB11	1	Thallium	5.0	2.5	2.8	N	Y
CP2-08-SB12	1	Thallium	5.0	2.5	2.8	N	Y
CP2-08-SB14	1	Chromium	211	500	240	Y	N

Subsurface Soil – Metals:

- A total of 133 primary and 10 duplicate subsurface soil samples were collected at 48 locations at Source Areas 59F, 62F, F(c), CP2-07, and CP2-08 within Chemical Plant 2 Area North and analyzed for metals. Additionally, 127 samples collected at 61 locations were analyzed for mercury and 1 sample was analyzed for hexavalent chromium.

Subsurface sampling locations are shown in Figures 6.1-4, 6.1-9, and 6.1-10.

- Metals were not detected above their respective RISLs in the subsurface soil samples collected within Chemical Plant 2 Area North Figure 6.1-9).
- Cadmium and thallium were the only metals detected at concentrations above their respective PGW SSLs in the subsurface soil samples collected within Chemical Plant 2 Area North. Detected concentrations of those metals above their PGW SSLs, along with the location and depth of the sample containing the detected concentration, is listed on the table below. Cadmium detected at concentrations above the PGW SSLs are shown in Figure 6.1-10.

Sample Location	Depth (ft bgs)	Metal	RISL (mg/kg)	PGW SSL (mg/kg)	Conc. (mg/kg)	> RISL	> PGW SSL
59F-SB11	5.0	Thallium	5.0	2.5	3.6	N	Y
59F-SB12	5.0	Thallium	5.0	2.5	2.9	N	Y
59F-SB13	5.0	Cadmium	1.7	0.72	0.84	N	Y
CP2-07-SB02	55	Thallium	5.0	2.5	2.6	N	Y
CP2-07-SB03	11	Thallium	5.0	2.5	2.8	N	Y
CP2-07-SB05	71	Thallium	5.0	2.5	2.9	N	Y
CP2-07-SB11	5.0	Thallium	5.0	2.5	3.1	N	Y
CP2-08-SB11	80	Cadmium	1.7	0.72	0.79	N	Y
CP2-08-SB15	11	Thallium	5.0	2.5	2.8	N	Y

Summary of Investigation and Results – Semivolatile Organic Compounds

A total of 167 primary and 15 duplicate soil samples were collected at Source Areas 59F, 62F, F(c), CP2-07, and CP2-08 within Chemical Plant 2 Area North during the BOU RI and analyzed for SVOCs, including TICs. The number of primary soil samples and sampling locations at Source Areas 59F, 62F, F(c), CP2-07, and CP2-08 for SVOCs are summarized on Tables 6.1-3 and 6.1-4, and below. Summary statistics for the samples are also presented on Tables 6.1-3 and 6.1-4.

		Surface/Near-Surface		Subsurface	
Source Area	Compound	No. of Samples	No. of Locations	No. of Samples	No. of Locations
59F	SVOCs	29	24	34	14
62F	SVOCs	8	6	16	5
F(c)	SVOCs	6	6	8	2

Source Area	Compound	Surface/Near-Surface No. of Samples	Surface/Near-Surface No. of Locations	Subsurface No. of Samples	Subsurface No. of Locations
CP2-07	SVOCs	12	12	25	8
CP2-08	SVOCs	15	11	14	4

The results of the SVOC and SVOC TIC analyses of surface/near-surface and subsurface soil samples collected at the source areas [59F, 62F, F(c), CP2-07, and CP2-08] within Chemical Plant 2 Area North are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations and PAHs detected at concentrations above their RISLs and PGW SSLs are shown in Figures 6.1-11 and 6.1-12, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 6.1-2. SVOC TICs were not identified in the surface and subsurface soil samples collected in Chemical Plant 2 Area North.

Surface and Near-Surface Soil – Semivolatile Organic Compounds:

- Seventy primary and six duplicate surface and/or near-surface soil samples were collected at 59 locations in the source areas [59F, 62F, F(c), CP2-07, and CP2-08] within Chemical Plant 2 Area North and analyzed for SVOCs, including TICs (Figures 6.1-11 and 6.1-12).
- SVOCs detected in surface/near-surface soil above their respective RISLs and/or PGW SSLs in the source areas [59F, 62F, F(c), CP2-07, and CP2-08] within Chemical Plant 2 Area North are listed on the table below. SVOCs detected at concentrations above their RISLs and PGW SSLs are shown in Figures 6.1-11 and 6.1-12, respectively.

Sample Location	Depth (ft bgs)	SVOC	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	> RISL	> PGW SSL
59F-SNS01	0.5	Benzo(a)pyrene	38	2.9	19	N	Y
		Benzo(b&k)fluoranthene	38	29	48	Y	Y
59F-SNS03	0.5	Benzo(a)pyrene	38	2.9	6.8	N	Y
		Benzo(b&k)fluoranthene	38	29	13	N	N
59F-SB12	1.0	Benzo(a)pyrene	38	2.9	14	N	Y
		Benzo(b&k)fluoranthene	38	29	38	N	Y
59F-SB22	1.0	Benzo(a)anthracene	620	29	51	N	Y
		Benzo(a)pyrene	38	2.9	39	Y	Y
		Benzo(b&k)fluoranthene	38	29	84	Y	Y

Sample Location	Depth (ft bgs)	SVOC	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	> RISL	> PGW SSL
59F-SB26	1.0	Benzo(a)anthracene	620	29	170	N	Y
		Benzo(a)pyrene	38	38	150 J	Y	Y
		Benzo(b)fluoranthene	620	29	230 J	N	Y
		Benzo(k)fluoranthene	38	290	110 J	Y	N
		Indeno(1,2,3-cd)pyrene	621	29	100 J	N	Y
62F-SNS01	0.5	Benzo(a)pyrene	38	2.9	7.0	N	Y
		Benzo(b&k)fluoranthene	38	29	29	N	N
62F-SNS02	0.5	Benzo(b&k)fluoranthene	38	29	39	Y	Y
62F-SB06	2.0	Benzo(a)pyrene	38	2.9	7.5	N	Y
F(c)-SNS01	0.5	Benzo(a)pyrene	38	2.9	8.0	N	Y
F(c)-SNS02	0.5	Benzo(a)pyrene	38	2.9	14	N	Y
		Benzo(b&k)fluoranthene	38	29	33	N	Y
F(c)-SNS03	0.5	Benzo(a)pyrene	38	2.9	12	N	Y
		Benzo(b&k)fluoranthene	38	29	30	N	Y
CP2-08-SNS02	0.5	Benzo(a)pyrene	38	2.9	7.2	N	Y
CP2-08-SNS04	0. 5	Benzo(a)anthracene	620	29	120 J	N	Y
		Benzo(a)pyrene	38	2.9	94 J	Y	Y
		Benzo(b&k)fluoranthene	38	29	220 J	Y	Y
		Dibenz(a,h)anthracene	62.1	2.9	8.4	N	Y
CP2-08-SB12	1.0	Benzo(a)pyrene	38	2.9	11	N	Y
OS1-F2-SNS03	0.5	Benzo(a)pyrene	38	2.9	12	N	Y

µg/kg = Micrograms per kilogram

Subsurface Soil – Semivolatile Organic Compounds:

- A total of 97 primary and 9 duplicate subsurface soil samples were collected at 33 locations in the source areas [59F, 62F, F(c), CP2-07, and CP2-08] within Chemical Plant 2 Area North and analyzed for SVOCs, including TICs (Figures 6.1-11 and 6.1-12).
- Benzo(b&k)fluoranthene [B(b&k)F] was detected in only one subsurface soil sample collected within the Chemical Plant 2 Area North at a concentration above its RISL. As indicated in the table below, B(b&k)F at 41 µg/kg was detected in a soil sample collected at five feet bgs from boring 59F-SB15.
- Benzo(a)pyrene [B(a)P] and B(b&k)F were detected in two subsurface soil samples collected within the Chemical Plant 2 Area North at concentrations above their respective PGW SSLs. Concentrations of those two compounds above their PGW SSLs along with the depth and location of the samples are provided in the table below. SVOCs detected at concentrations above their PGW SSLs are shown in Figure 6.1-12. B(a)P and B(b&k)F were not detected above their respective practical quantitation limits (PQLs) in soil samples collected

from boring 59F-SB15 at 1, 17, 31, 55, and 77 feet bgs. Additionally, B(a)P was not detected above the PQL in soil samples collected from boring 62F-SB07 at 10, 20, 30, and 40 feet bgs.

Sample Location	Depth (ft bgs)	SVOC	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	> RISL	> PGW SSL
59F-SB15	5.0	Benzo(a)pyrene	38	2.9	13	N	Y
		Benzo(b&k)fluoranthene	38	29	41	Y	Y
62F-SB07	5.0	Benzo(a)pyrene	38	2.9	8.1	N	Y

Summary of Investigation and Results – Polychlorinated Biphenyls

A total of 52 primary and 3 duplicate soil samples were collected at Source Areas 59F, F(c), and CP2-08 within Chemical Plant 2 Area North during the BOU RI and analyzed for PCBs. The number of primary soil samples and sampling locations at Source Areas 59F, F(c), and CP2-08 for PCBs are summarized on Tables 6.1-3 and 6.1-4 and below. Summary statistics for the samples are also presented on Tables 6.1-3 and 6.1-4.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
59F	PCBs	9	7	2	2
62F	PCBs	0	0	0	0
F(c)	PCBs	6	6	8	2
CP2-07	PCBs	0	0	0	0
CP2-08	PCBs	13	9	14	5

The results of the PCB analysis of surface/near-surface and subsurface soil samples collected at Source Areas 59F, F(c), and CP2-08 within Chemical Plant 2 Area North are presented in Appendix G and summarized below. PCB Aroclors 1254 and 1260 detected in surface and subsurface soil at concentrations above their RISLs and PGW SSLs are shown in Figures 6.1-13 and 6.1-14, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 6.1-2.

Surface and Near-Surface Soil – Polychlorinated Biphenyls:

- Twenty-eight primary and 2 duplicate surface/near-surface soil samples were collected at 22 locations at Source Areas 59F, F(c), and CP2-08 and analyzed for PCBs.

- Only two PCBs (Aroclors 1248 and 1254) were detected at concentrations exceeding their respective RISLs and/or PGW SSLs in surface and/or near-surface soil samples within Chemical Plant 2 Area North. The PCB Aroclor detected above its screening level, the detected concentration, and the depth and location of the sample are identified below and shown in Figures 6.1-13 and 6.1-14.

Sample Location	Depth (ft bgs)	PCB	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	> RISL	> PGW SSL
59F-SD01	0.25	Aroclor 1248	220	34	16,000 J	Y	Y
	1.5				<26 J	N	N
59F-SD02	0.25	Aroclor 1248	220	34	540 J	Y	Y
	1.5	Aroclor 1254	220	34	320 J	Y	Y
59F-SB26	1.0	Aroclor 1254	220	34	1,100	Y	Y
59F-SB27	1.0	Aroclor 1254	220	34	350	Y	Y
59F-SB28	1.0	Aroclor 1254	220	34	2,800	Y	Y
F(c)-SNS02	0.5	Aroclor 1254	220	34	200 J	N	Y
F(c)-SNS03	0.5	Aroclor 1254	220	34	230	Y	Y
F(c)-SB02	1.0	Aroclor 1254	220	34	77	N	Y
F(c)-SB04	1.0	Aroclor 1248	220	34	120,000	Y	Y
CP2-08-SNS01	0.5	Aroclor 1254	220	34	68	N	Y
CP2-08-SNS02	0.5	Aroclor 1254	220	34	120	N	Y
CP2-08-SNS03	0.5	Aroclor 1254	220	34	75	N	Y
	2.5				45	N	Y
CP2-08-SNS04	0.5	Aroclor 1254	220	34	480	Y	Y
	2.5				<24	N	N
CP2-08-SB10	2.0	Aroclor 1248	220	34	230 J	Y	Y
CP2-08-SB12	1.0	Aroclor 1254	220	34	1,900	Y	Y
CP2-08-SB13	1.0	Aroclor 1254	220	34	68	N	Y
OS1-F2-SB03	1.0	Aroclor 1254	220	34	61	N	Y
OS1-F2-SB04	1.0	Aroclor 1254	220	34	93	N	Y
OS1-F3-SD01	0.25	Aroclor 1254	220	34	160	N	Y

Subsurface Soil – Polychlorinated Biphenyls:

- Twenty-four primary and one duplicate subsurface soil samples were collected at 9 locations at Source Areas 59F, F(c), and CP2-08 at depths ranging from 5 to 99 feet bgs and analyzed for PCBs. Subsurface soil sampling locations for PCBs are shown in Figures 6.1-13 and 6.1-14.
- Aroclor 1254 was the only PCB detected in the subsurface soil at a concentration above its RISL and PGW SSL.

- Aroclor 1254 was detected at an estimated concentration of 440 µg/kg, above its RISL and PGW SSL, in a sample collected at 5 feet bgs at location 59F-SD02 (Figures 6.1-13 and 6.1-14). PCBs were not detected above their respective RISLs and PGW SSLs in subsurface soil samples collected at locations 59F-SD01, CP2-08-SB04, CP2-08-SB10, CP2-08-SB12, and CP2-08-SB13.

Summary of Investigation and Results – Perchlorate

A total of 56 primary and 7 duplicate soil samples were collected 19 locations at Source Area 59F during the BOU RI and analyzed for perchlorate. The number of primary soil samples and sampling locations at Source Area 59F are summarized on Table 6.1-3. Summary statistics for the samples are also presented on Table 6.1-3.

The results of the perchlorate analysis of surface/near-surface and subsurface soil samples collected at Source Area 59F within Chemical Plant 2 Area North are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations for perchlorate and detected concentrations above its RISL and PGW SSL are shown in Figures 6.1-13 and 6.1-14, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 6.1-2.

Surface and Near-Surface Soil – Perchlorate:

- Twenty-four primary and 3 duplicate surface/near-surface soil samples were collected at 19 locations at Source Area 59F and analyzed for perchlorate (Figures 6.1-13 and 6.1-14).
- Perchlorate was not detected above its RISL or PGW SSL in any of the surface or near-surface soil samples collected at Source Area 59F.

Subsurface Soil – Perchlorate:

- Thirty-two primary and 4 duplicate subsurface soil samples were collected at 13 locations at Source Area 59F within Chemical Plant 2 Area North and analyzed for perchlorate.
- Perchlorate was detected at a concentration above its PGW SSL, but below its RISL in only one subsurface soil sample collected at Source Area 59F. Perchlorate at 95 µg/kg was detected in a soil sample collected at 5 feet bgs from boring 59F-SB11 (Figure 6.1-14). Perchlorate was not detected at concentrations above the PQL in soil samples collected at 11 and 15 feet bgs from that same boring.

Summary of Investigation and Results – Total Petroleum Hydrocarbons

A total of 26 primary and 2 duplicate soil samples were collected at Source Areas F(c), CP2-07, and CP2-08 within Chemical Plant 2 Area North during the BOU RI and analyzed for TPH-D and TPH-Mo. The number of primary soil samples and sampling locations at Source Areas F(c), CP2-07, and CP2-08 are summarized on Tables 6.1-3 and 6.1-4, and below. Summary statistics for the samples are also presented on Tables 6.1-3 and 6.1-4.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
F(c)	TPH-D & TPH-Mo	6	6	7	2
CP2-07	TPH-D & TPH-Mo	1	1	7	1
CP2-08	TPH-D & TPH-Mo	2	2	3	2

The results of the TPH analysis (TPH-D and TPH-Mo) of surface/near-surface and subsurface soil samples collected at Source Areas F(c), CP2-07, and CP2-08 within Chemical Plant 2 Area North are presented in Appendix G and summarized below. Surface and subsurface sampling locations for TPH and concentrations of TPH-Mo above its PGW SSL are shown in Figure 6.1-14. Soil sampling locations and the features being investigated are cross-referenced on Table 6.1-2.

Surface/Near-Surface Soil – Total Petroleum Hydrocarbons:

- Nine primary surface/near-surface soil samples were collected at nine locations at Source Areas F(c), CP2-07, and CP2-08 within Chemical Plant 2 Area North and analyzed for TPH-D and TPH-Mo. Surface soil sampling locations for TPH in Chemical Plant 2 Area North are shown in Figure 6.1-14.
- TPH-D and TPH-Mo were not detected above their respective PGW SSLs in any of the surface or near-surface soil samples collected at Source Areas F(c), CP2-07, and CP2-08.

Subsurface Soil – Total Petroleum Hydrocarbons:

- Seventeen primary and two duplicate subsurface soil samples were collected at five locations at Source Areas F(c), CP2-07, and CP2-08 within Chemical Plant 2 Area North and analyzed for TPH-D and TPH-Mo. Subsurface soil sampling locations for TPH in Chemical Plant 2 Area North are shown in Figure 6.1-14.

- TPH-D and/or TPH-Mo were not detected above their PGW SSLs in any of the subsurface soil samples collected at Source Areas F(c), CP2-07, and CP2-08.

Summary of Investigation and Results – Miscellaneous Compounds

Miscellaneous analyses performed on soil samples collected at the source areas [59F, 62F, F(c), CP2-07, and CP2-08] within Chemical Plant 2 Area North during the BOU RI were pesticides (including Prowl), OBPA, pH, TOC, CEC, and/or DI-WET. The number of primary surface/near-surface and subsurface soil samples collected at each source area and the numbers of locations are summarized on the table below.

		Surface/Near-Surface		Subsurface	
Source Area	**Compound**	**No. of Samples**	**No. of Locations**	**No. of Samples**	**No. of Locations**
59F	Pesticides	29	24	35	22
	OBPA	24	19	33	22
	pH	24	19	39	23
	TOC	10	8	7	4
	CEC	5	3	7	4
	DI-WET	1	1	0	0
62F	Pesticides	9	8	9	4
	OBPA	7	6	3	2
	pH	2	1	1	1
	TOC	3	2	4	3
	CEC	3	2	4	3
F (c)	Pesticides	0	0	0	0
	OBPA	1	1	4	2
	pH	0	0	0	0
	TOC	0	0	0	0
	CEC	0	0	0	0
	DI-WET	0	0	0	0
CP2-07	Pesticides	22	22	37	17
	OBPA	17	17	25	11
	pH	11	11	35	14
	TOC	1	1	5	2
	CEC	1	1	5	2
	DI-WET	0	0	1	1
CP2-08	Pesticides	12	8	8	3
	OBPA	12	8	6	2
	pH	2	2	4	2
	TOC	1	1	6	2
	CEC	1	1	6	2

The analytical results for the miscellaneous analyses of surface/near-surface and subsurface soil samples are presented in Appendix G and summarized below. The analytical data for pH, TOC, and CEC are used in the risk assessments to evaluate the bioavailability of some chemicals

with respect to human and ecological receptors. The TOC, CEC, and DI-WET data are used in the Feasibility Study (FS) to evaluate chemical and physical remedial actions, assess the potential for metals in soil to migrate into groundwater, and develop cleanup goals protective of groundwater.

Pesticides: Surface and subsurface soil sampling locations at Source Areas 59F, 62F, F(c), CP2-07, and CP2-08 within Chemical Plant 2 Area North are shown in Figures 6.1-3 and 6.1-4. Soil sampling locations and the features being investigated are cross-referenced on Table 6.1-2.

Pesticides, including pendimethalin (Prowl), were not detected above their RISLs in any of the surface/near-surface or subsurface soil samples collected at the source areas within Chemical Plant 2 Area North. Pesticides detected at concentrations above their respective PGW SSLs are listed in the table below. Sampling locations are shown in Figures 6.1-3 and 6.1-4. Concentrations of pesticides above their PGW SSLs are not shown in a figure.

Sample Location	Depth (ft bgs)	Pesticide	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	> RISL	> PGW SSL
59F-SB22	1.0	4,4′-DDD	2,300	280	2,300 J	N	Y
		4,4′-DDT	1,600	200	1,200 J	N	Y
59F-SB28	1.0	Dieldrin	30.4	4.2	5.4	N	Y
62F-SB06	2.0	Heptachlor epoxide	53.4	6.0	33	N	Y
CP2-08-SNS04	0.5	Aldrin	30	4.0	7.4	N	Y
OS1-F2-SNS02	0.5	Heptachlor epoxide	53	6.0	28	N	Y
		Dieldrin	30	4.2	8.3	N	Y
OS1-F2-SNS03	0.5	Dieldrin	30.4	4.2	5.1	N	Y

OBPA: OBPA was not detected above its PQL, RISL, or PGW SSL in surface/near-surface or subsurface soil samples collected within Chemical Plant 2 Area North.

pH. The results of pH analysis of 39 surface/near-surface and 79 subsurface soil samples, including duplicates, collected at Source Areas 59F, 62F, F(c), CP2-07, and CP2-08 within Chemical Plant 2 Area North are summarized on the table below.

Source Area	Surface/ Near-Surface Soil	Subsurface Soil
59F	5.41 – 9.17	5.03 – 9.85
62F	7.45 – 7.69	7.61

Source Area	Surface/ Near-Surface Soil	Subsurface Soil
CP2-07	6.64 – 11.7	6.26 – 8.64
CP2-08	5.15 – 8.05	6.96 – 8.23

With the exception of two samples, the pH of the surface and subsurface soil samples was within the normal range (5 to 9) for mineral soil (Brady, 1974). A pH of 11.7 was measured in a soil sample collected at 1 foot bgs from boring CP2-07-SB12 and a pH of 9.85 was measured in a soil sample collected at 5 feet bgs from boring 59F-SB16.

Total Organic Carbon: TOC in the 15 surface/near-surface soil samples collected at source areas 59F, 62F, CP2-07, and CP2-08 ranged from 6,500 to 22,100 mg/kg. TOC at 3,200 mg/kg was detected in only one (62F-SB04 at 11 feet bgs) of the 22 subsurface soil samples collected at the source areas [59F, 62F, F(c), CP2-07, and CP2-08] within Chemical Plant 2 Area North.

Cation Exchange Capacity: CEC in the 10 surface/near-surface soil samples collected at Source Areas 59F, 62F, CP2-07, and CP2-08 ranged from 110 to 140 milliequivalents per kilogram (meq/K). CEC in the 22 subsurface soil samples, including duplicates, collected at Source Areas 59F, 62F, CP2-07, and CP2-08 ranged from 81 to 370 meq/K.

Waste Extraction Test using Deionized Water: A DI-WET was performed on one soil sample collected at Source Area 59F and one sample collected at CP2-07. The sample identification, sample depth, and metal concentrations detected in the soil samples and sample extracts are presented on the table below.

Sample ID	Sample Depth (ft bgs)	Compound	Soil Conc. (mg/kg)	Extract Conc. (mg/L)
59F-SD02	1.5	Arsenic	15	<0.001
		Manganese	1,000	1.2
		Thallium	0.17	<0.001
		Vanadium	170	1.2
CP207-SB02	55	Thallium	2.6	0.00015

mg/L = Milligrams per liter

Summary of Investigation and Results – Geotechnical Parameters

A total of 27 soil samples were collected within Chemical Plant 2 Area North for geotechnical analyses. The results of the geotechnical analyses

for moisture content, wet density, dry density, specific gravity, porosity, sieve analysis, and/or permeability are summarized on Table 6.1-5.

The geotechnical data will be used in the risk assessment to develop site-specific soil input parameters (moisture content, water-filled porosity, air-filled porosity, etc.) for fate and transport models and in the FS to assess potential remedial actions such as vapor extraction. Fate and transport models are used in risk assessment to quantitatively evaluate the migration of volatile organics into outdoor and indoor air and the potential leaching of chemicals through soil and into groundwater.

6.1.5 Discussion of Investigation Results with Respect to Data Quality Objectives – Chemical Plant 2 Area North

The analytical results presented in the previous sections identified the following chemical constituents in soil vapor and soil at Source Areas 59F, 62F, F(c), CP2-07, and CP2-08 within Chemical Plant 2 Area North at concentrations above their respective RISLs and/or PGW SSLs:

Soil vapor: 1,2-DCA, benzene, Carbon Tet, chloroform, PCE, tetrahydrofuran, and vinyl chloride.

Soil: Metals (aluminum, arsenic, cadmium, chromium, lead, and thallium); PAHs [benzo(a)anthracene [B(a)A], benzo(b)fluoranthene [B(b)F], benzo(k)fluoranthene [B(k)F], B(b&k)F, B(a)P, dibenz(a,h)anthracene [D(a,h)A], and indeno(1,2,3-cd)pyrene [I(1,2,3-cd)P]; PCBs (Aroclors 1248 and 1254); perchlorate; and pesticides (heptachlor epoxide, dieldrin, aldrin, 4,4'-DDD, and 4,4'-DDT).

The presence of these COPCs in each source area is discussed below with respect to the data needs described in Section 6.1.3.3. Specifically,

- Has the investigation resulted in sufficient characterization of the lateral and vertical distribution of each COPC in the vadose zone and identified a potential source for those COPCs?
- Has the investigation resulted in sufficient data to evaluate the potential for COPCs in soil to migrate into and degrade surface water and groundwater quality?
- Has the investigation resulted in data sufficient to support human health and ecological risk assessments and fate and transport modeling?

- Has the investigation resulted in sufficient data to evaluate the feasibility of remediating the identified compounds and concentrations to levels that do not pose a risk to human and ecological receptors or degrade surface water and groundwater quality?

For the purpose of this discussion, it is assumed that chemicals detected at concentrations above their RISL could potentially pose a risk to human health and chemicals detected above their PGW SSL could potentially migrate into groundwater or surface water. Sampling locations where VOCs, metals, and other non-VOCs (SVOCs, PCBs, perchlorate, pesticides, and TPH-Mo) were detected in surface and/or subsurface soil at concentrations above their respective RISLs are shown in Figures 6.1-5a, 6.1-5b, 6.1-9, 6.1-11, and 6.1-13. Sampling locations where VOCs, metals, and other non-VOCs were detected in surface and/or subsurface soil at concentrations above their respective PGW SSLs are shown in Figures 6.1-6, 6.1-10, 6.1-12, and 6.1-14.

The analytical results for surface water and groundwater in the southwestern portion of the BOU, including Chemical Plant 2, are discussed in Sections 6.5 and 6.6, respectively, and discussed with respect to potential soil and soil vapor sources within the Chemical Plant 2 Area North. Additionally, the potential for chemicals in soil and soil vapor to migrate into surface water and groundwater is further evaluated in Section 8 of the *Human Health Ecological Risk Assessment* (HHERA) (Volume II).

6.1.5.1 *Volatile Organic Compounds*

VOCs detected in soil vapor samples collected at the source areas within Chemical Plant 2 Area North are summarized in Section 6.1.4.3. 1,2-DCA, chloroform, vinyl chloride, and TVOC concentrations above their RISLs in the shallow, intermediate, and very deep intervals are shown in Figure 6.1-5a. Additionally, TVOC concentrations above the RISL are also shown in Figure 6.1-5b. 1,2-DCA, chloroform, and vinyl chloride concentrations above their PGW SSLs in the shallow, intermediate, and very deep intervals are shown in Figure 6.1-6. Soil vapor samples were not collected from the deep soil vapor interval within Chemical Plant 2 Area North.

1,2-DCA was the predominant VOC detected in soil vapor within Chemical Plant 2 Area North at concentrations above its RISL and/or PGW SSL. Other VOCs detected in soil vapor at concentrations above their respective RISL and/or PGW SSLs include benzene, chloroform,

Carbon Tet, PCE, THF, and vinyl chloride. The presence of 1,2-DCA, chloroform, and vinyl chloride in soil vapor in the Chemical Plant 2 Area North with respect to potential sources and completeness of characterization are discussed below. Compounds detected at only a few locations (benzene, Carbon Tet, PCE, and THF) are not included in this discussion.

1,2-Dichloroethane

- 1,2-DCA was the predominant VOC detected in the vadose zone within the Chemical Plant 2 Area North. As shown in Figures 6.1-5a and 6.1-6, the highest 1,2-DCA concentrations (up to 8,600,000 $\mu g/m^3$) were detected in the shallow, intermediate, and deep soil vapor intervals adjacent to a sump north of Building 15007. The sump received discharges from trench drains within Chemical Plant 2. The figures also show that concentrations of 1,2-DCA above its RISL and/or PGW SSL were detected within and north of the former location of the holding basins and tanks (Source Area 59F and at locations between the sump and the holding basin and tanks). As noted in Section 6.1.2.1, the former holding basins and tanks received discharge from the sump north of Building 15007 via pipes and drain lines. Concentrations of 1,2-DCA detected in the vadose zone adjacent to Building 15007, the former holding basins and sumps (Source Area 59F), and between the two areas are attributed to releases from the sump, holding basins and tanks, and the former waste lines connecting the two features.
- Figures 6.1-5a and 6.1-6 also show that the lateral extent of 1,2-DCA above its RISL and/or PGW SSL in the shallow and intermediate soil vapor intervals appears to be relatively unchanged and encompasses an area roughly 160-feet wide by 480-feet long. As will be discussed in Section 6.6, historical groundwater data indicated that 1,2-DCA likely originating from Chemical Plant 2 had migrated into groundwater.
- 1,2-DCA was detected at concentrations above its 1 percent vapor saturation concentration (4,186,000 $\mu g/m^3$) and potentially indicative of the presence of residual product in the intermediate (20 feet bgs) interval at only one location (CP2-07-SP01), adjacent to the sump north of Building 15007. As discussed in Section 6.6, VOCs were not detected in groundwater within the Chemical Plant 2 Region at concentrations potentially indicative of residual product.
- In addition to the sump, holding basins, and waste lines, 1,2-DCA was detected at concentrations above its RISL, but below its PGW SSL, at three other locations (CP2-07-SP04, CP2-08-SP11, and CP2-RE05-SP05)

within Chemical Plant 2 Area North. The presence of 1,2-DCA at those locations is discussed below.

- ***Former Drum/Chemical Storage Area (Building 15008):*** As shown in Figures 6.1-5a and 6.1-6, the extent of 1,2-DCA in soil vapor at location CP2-07-SP04 appears to be limited to the vicinity of the sampling location adjacent to Building 15008, a former drum/chemical storage area. The presence of 1,2-DCA in the vadose zone at this location is attributed to historical surface spills during activities at Building 15008.
- ***Former Hazardous and Explosive Materials Storage Area (Building 15016):*** The extent of 1,2-DCA in soil vapor at location CP2-08-SP11 appears to be limited to the immediate vicinity of the sampling location. The presence of 1,2-DCA in the vadose zone at this location is likely due to historical surface spills during activities conducted at Building 15016. However, the data also suggests that the 1,2-DCA detected at this location may also represent the most northern extent of 1,2-DCA originating from the area of the former Stouffer Chemical Plant within Chemical Plant 2 Area South. The presence of 1,2-DCA in the vadose zone within Chemical Plant 2 Area South is discussed in Section 6.1.9.1.
- ***Structure at East End of Railroad Tracks:*** The presence of 1,2-DCA in soil vapor samples collected at location CP2-RE05-SP05 could potentially represent the northern extent of the plume originating from the former Stouffer Chemical. However, the absence of chloroform in soil vapor suggests that the VOCs in the vadose zone at that location may potentially be due to surface releases associated with historical activities at a structure at the east end of the railroad tracks near Building 15007 instead of migration from the former Stouffer Chemical Plant.

As indicated by the TVOC contours shown in Figures 6.1-5a and 6.1-5b, the lateral extent of 1,2-DCA in the vadose zone beneath the Chemical Plant 2 Area North has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

<u>Chloroform</u>

- Chloroform was the second most predominant VOC detected in soil vapor within Chemical Plant 2 Area North at concentrations above its RISL, but below its PGW SSL. As indicated in Figures 6.1-5a and 6.1-6, chloroform was detected above its RISL at the same locations where

1,2-DCA was detected above its RISL and/or PGW SSL and the extent of chloroform generally corresponds to the extent of 1,2-DCA. The maximum concentrations of chloroform (up to 12,000 $\mu g/m^3$) were detected in the intermediate and very deep soil vapor intervals at location CP2-07-SP01, adjacent to the sump that received discharges from the trench drains within Building 15007. The maximum concentration of chloroform is less than 1 percent of its vapor saturation concentrations and therefore not indicative of the presence of nonaqueous-phase liquid (NAPL). The presence of chloroform in the vadose zone is attributed to releases from the sump north of Building 15007, the waste basins and sumps at Source Area 59F, and the waste lines connecting the two features.

- Chloroform was also detected above its RISL in the shallow and intermediate soil vapor intervals at location CP2-07-SP04, adjacent to the former hazardous and explosives material storage area (Building 15016). The presence of chloroform in the vadose zone at this location is likely due to historical surface spills during activities conducted at Building 15016.

Based on the data presented above, and as indicated by the TVOC symbols shown in Figures 6.1-5a and 6.1-5b, the lateral and vertical extent of VOCs, including chloroform within the vadose zone, within Chemical Plant 2 Area North has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

Vinyl Chloride

As indicated in Figures 6.1-5a and 6.1-6, vinyl chloride was detected above its RISL and/or PGW SSL at those locations (59F-SP34, 59F-SP35, and CP2-07-SP01) having the highest concentrations of 1,2-DCA. The extent of vinyl chloride in soil vapor above its RISL and/or PGW SSL is encompassed within the footprint of the 1,2-DCA plume. The maximum concentration of vinyl chloride at 120,000 $\mu g/m^3$ is less than 1 percent of its vapor saturation concentration and therefore not indicative of the presence of NAPL.

Based on the data presented above, and as indicated by the TVOC symbols shown in Figures 6.1-5a and 6.1-5b, the lateral and vertical extent of vinyl chloride in the vadose zone within Chemical Plant 2 Area North has been sufficiently characterized to evaluate potential risks to human

health, surface water, and groundwater and, if necessary, develop remedial alternatives.

6.1.5.2 *Metals*

Arsenic and chromium were the only metals detected at concentrations different than background and above their respective RISLs in soil samples collected in the source areas within Chemical Plant 2 Area North. Aluminum, arsenic, cadmium, chromium, lead, and thallium were detected in soil samples collected in the source areas within Chemical Plant 2 Area North at concentrations different than background and above their PGW SSLs, but below their RISLs. Concentrations of those metals above their RISLs and/or PGW SSLs are summarized in Section 6.1.4.3 and shown in Figures 6.1-9 and 6.1-10, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 6.1-2. Conclusions regarding the characterization of aluminum, arsenic, cadmium, chromium, lead, and thallium based on the data presented on the table and figures are summarized below.

Aluminum

Aluminum above its PGW SSL was detected in soil samples collected at three (59F-SD01, 59F-SD02, and 59F-SB22) separate locations within Chemical Plant 2 Area North. The characterization of aluminum at each of those locations is discussed below. Based on the distance between locations 59F-SD02 and 59F-SB22, the detections of aluminum are not related. The characterization of aluminum at both locations is discussed below.

59F-SD01

Aluminum above its PGW SSL was detected in a near-surface (1.5 feet bgs) soil sample collected at location 59F-SD01. Location 59F-SD01 is in the low-lying area north of the former Spill Prevention, Control, and Countermeasures (SPCC) sump (Figure 6.1-10). As will be discussed later, lead above its PGW SSL was also detected in the surface soil sample collected at this location. Surface and near-surface soil samples were collected for lead at four locations (59F-SD03, 59F-SD04, 59F-SD05, and 59F-SD06) surrounding 59F-SD01. Lead concentrations in those samples were significantly less than the sample from 59F-SD01. It is therefore likely that aluminum concentrations mimic those of lead and likely less than its PGW SSL in the soil at those four surrounding locations. The lateral extent of aluminum is also characterized by the absence of that

metal above its PGW SSL in soil samples collected at locations 59F-SD07, 59F-SB26, and 59F-SB27. The vertical extent of aluminum was not defined below a depth of 1.5 feet bgs, but based on the lateral extent, the vertical extent is likely limited to the upper 5 feet of soil.

59F-SD02

Aluminum above its PGW SSL was detected in a surface (0.25 foot bgs) and near-surface (1.5 feet bgs) soil samples collected at location 59F-SD02. Location 59F-SD02 is in the east-central portion of the low-lying area north of Building 15007 (Figure 6.1-10). The lateral extent of aluminum is characterized by the absence of that metal above its PGW SSL in soil samples collected at locations 59F-SD07, 59F-SB26, and 59F-SB27. The vertical extent of aluminum was not defined below a depth of 1.5 feet bgs, but based on the lateral extent, the vertical extent is likely limited to the upper 5 feet of soil.

59F-SB22

Aluminum above its PGW SSL was detected in a near-surface (1.0 foot bgs) soil sample collected from boring 59F-SB22. Boring 59F-SB22 is along a surface water drainage between the former SPCC sump and the low-lying area north of Building 15007 (Figure 6.1-10). The lateral extent of aluminum is characterized by the absence of that metal above its PGW SSL in soil samples collected at locations 59F-SD01, 59F-SD05, 59F-SD06, 59F-SB19, and 59F-SB21. The vertical extent of aluminum is defined by the absence of that metal above its PGW SSL in soil samples collected from boring 59F-SB22 at 5.5 feet bgs.

<u>Arsenic</u>

Arsenic at concentrations above its background level of 11 mg/kg for RCRB soils and its RISL and PGW SSL was detected in soil samples collected at three (59F-SD02, 59F-SNS01, and 62F-SB10) locations within Chemical Plant 2 Area North (Figures 6.1-9 and 6.1-10). The characterization of arsenic at each of those locations is discussed below.

59F-SD02

Arsenic above its background level of 11 mg/kg and RISL and PGW SSL was detected in a near-surface (1.5 feet bgs) soil sample collected at location 59F-SD02. Location 59F-SD02 is in the east-central portion of the low-lying area north of Building 15007 (Figures 6.1-9 and 6.1-10). The

lateral extent of arsenic is characterized by the absence of that metal above its background level of 11 mg/kg in soil samples collected at locations 59F-SD07, 59F-SB26, and 59F-SB27. The vertical extent of arsenic is defined by the absence of that metal above the background level of 11 mg/kg in the sample collected at 5 feet bgs.

59F-SNS01

Arsenic above its background level of 11 mg/kg and RISL and PGW SSL was detected in a near-surface (2.5 feet bgs) soil sample collected at location 59F-SNS01. Location 59F-SNS01 is along a surface water drainage channel west of the former SPCC sump (Figures 6.1-9 and 6.1-10). The lateral extent of arsenic is characterized by the absence of that metal above its background level of 11 mg/kg in soil samples collected within the surface water drainage at locations OS1-F2-SNS01 through OS1-F2-SNS04 and 59F-SB20. The vertical extent of arsenic was not defined below a depth of 2.5 feet bgs, but based on the lateral extent and the absence of arsenic above 11 mg/kg in the sample collected at 0.5 foot bgs, the vertical extent is likely limited to the upper 5 feet of soil.

62F-SB10

Arsenic above its background level of 11 mg/kg and RISL and PGW SSL was detected in a near-surface (1 foot bgs) soil sample collected from boring 62F-SB10. Boring 62F-SB10 is in a potential spill area between the railroad tracks south of the former location of the nitroethane tank (Figures 6.1-9 and 6.1-10). The lateral extent of arsenic is characterized by the absence of that metal above its background level of 11 mg/kg in soil samples collected at 62F-SB04, 62F-SB05, 62F-SB06, 62F-SB08, and 62F-SB09. The vertical extent of arsenic is defined by the absence of that metal above its background level of 11 mg/kg in soil samples collected at 5 and 11 feet bgs from boring 62F-SB10.

<u>Cadmium</u>

Cadmium at concentrations above its PGW SSL, but below its RISL, was detected in eight soil samples collected at seven [59F-SNS01, 59F-SNS02, 59F-SNS03, 59F-SB13, F(c)-SNS01, CP2-08-SNS04, and CP2-08-SB11] locations within Chemical Plant 2 Area North (Figure 6.1-10). The characterization of cadmium at each of those locations is discussed below.

59F-SNS01

Cadmium above its PGW SSL was detected in a near-surface (2.5 feet bgs) soil sample collected at location 59F-SNS01. Location 59F-SNS01 is along a surface water drainage channel west of the former SPCC sump (Figure 6.1-10). The lateral extent of cadmium is characterized by the absence of that metal above its PGW SSL in soil samples collected from within the surface water drainage channel at locations OS1-F2-SNS01 through OS1-F2-SNS04 and 59F-SB20. The vertical extent of cadmium is defined by the absence of that metal above its PGW SSL in the soil sample collected at 2.5 feet bgs at location 59F-SNS01.

59F-SNS02, 59F-SNS03, and 59F-SB13

Cadmium above its PGW SSL was detected in near-surface (0.5 and 2.5 feet bgs) soil samples collected at location 59F-SNS02, in a near-surface (2.5 feet bgs) soil sample collected at location 59F-SNS03, and in a subsurface (5 feet bgs) soil sample collected from boring 59F-SB12. Sampling locations 59F-SNS02 and 59F-SNS03 are within the low-lying area north of Building 15007. Boring 59F-SB13 is along a drainage into the low-lying area and upstream of locations 59F-SNS02 and 59F-SNS03 (Figure 6.1-10).

The presence of cadmium at concentrations above its PGW SSL, in surface and/or near-surface soils at locations 59F-SNS02 and 59F-SNS03, appear to be isolated occurrences, as both locations are surrounded by locations (59F-SB10, 59F-SB28, 59F-SNS04, 59F-SB14, 59F-SB26, 59F-SB13, and 59F-SD04) with cadmium concentrations in surface and near-surface soil below its PGW SSL. The absence of cadmium above its PGW SSL in the soil sample collected at 1 foot bgs from boring 59F-SB13 and in subsurface soil samples collected from other nearby borings (59F-SB10, 59F-SB14, 59F-SB15, 59F-SB11) indicates that the presence of cadmium above its PGW SSL in the sample collected at 5 feet bgs from boring 59F-SB13 is also an isolated occurrence.

The vertical extent of cadmium at locations 59F-SNS02 and 59F-SNS03 is not defined below a depth of 2.5 feet bgs. However, based on the lateral extent and the absence of cadmium above its PGW SSL in the surface soil at location 59F-SNS03, the vertical extent of cadmium at both locations is likely limited to the upper 5 feet of soil.

F(c)-SNS01 and CP2-08-SNS04

Cadmium above its PGW SSL was detected in near-surface (0.5 foot bgs) soil samples collected at locations F(c)-SNS01 and CP2-08-SNS04. Both locations are along a surface water drainage on the west side of Chemical Plant 2 North (Figure 6.1-10). The absence of cadmium above its PGW SSL in samples at other locations [F(c)-SNS02, F(c)-SNS03, CP2-08-SNS01, CP2-08-SNS02, and CP2-08-SNS03] along the drainage indicates that the presence of cadmium above its PGW SSL at locations F(c)-SNS01 and CP2-08-SNS04 are isolated occurrences and not the result of downstream migration. The vertical extent of cadmium at location CP2-08-SNS04 is defined by the absence of that metal above its PGW SSL in the sample collected at 2.5 feet bgs. The vertical extent of cadmium above its PGW SSL at location F(c)-SNS01 was not defined below a depth of 0.5 foot bgs. However, based on the sampling results for CP2-08-SNS04, the vertical extent of cadmium at F(c)-SNS01 is likely limited to the upper 5 feet of soil.

CP2-08-SB11

Cadmium above its PGW SSL was detected in soil sample collected at 80 feet bgs from boring CP2-08-SB11 near the former hazardous waste storage area (Building 15008) (Figure 6.1-10). The presence of cadmium above its PGW SSL in the soil sample appears to be an isolated occurrence and likely naturally occurring. Cadmium above its PGW SSL was not detected in shallower samples collected at 1, 5, 11, 33, 55, or a deeper sample collected at 99 feet bgs from boring CP2-08-SB11.

<u>Chromium</u>

Chromium at a concentration above its RISL, but below its PGW SSL, was detected in one soil samples collected at one (CP2-08-SB14) location within Chemical Plant 2 Area North (Figure 6.1-9). The characterization of chromium at that location is discussed below.

CP2-08-SB14

Chromium above its RISL was detected in a near-surface (1 foot bgs) soil sample collected at location CP2-08-SB14 near the former location of Injection Well #2 (Figure 6.1-9). The lateral extent of chromium is generally defined by the absence of that metal above its PGW SSL in samples collected at locations 62F-SD01, F(c)-SNS02, and CP2-08-SB15. The vertical extent of chromium in boring CP2-08-SB14 is defined by the

absence of that metal above its PGW SSL in the soil sample collected at 5 feet bgs.

Lead

Lead above its PGW SSL, but below its RISL, was detected in a surface (0.25 foot bgs) soil sample collected at location 59F-SD01 in the low-lying area north of Building 15007 (Figure 6.1-10). The lateral extent of lead is defined by the absence of that metal above its PGW SSL in surface and near-surface soil samples collected at locations 59F-SD03, 59F-SD04, 59F-SD05, and 59F-SD06. The vertical extent of lead at location 59F-SD01 is defined by the absence of that metal above its PGW SSL in the soil sample collected at 1.5 feet bgs at that location.

Thallium

Thallium at concentrations above its PGW SSL, but below its RISL, was detected in 13 soil samples collected at 11 (59F-SNS02, 59F-SNS03, 59F-SNS04, 59F-SB11, 59F-SB12, CP2-07-SB02, CP2-07-SB03, CP2-07-SB05, CP2-07-SB11, CP2-08-SB12 and CP2-08-SB15) locations within Chemical Plant 2 Area North (Figure 6.1-10). The characterization of thallium at each of those locations is discussed below.

The presence of thallium above its PGW SSL, but below its RISL, in surface and/or near-surface soil samples collected at scattered locations within the Chemical Plant 2 North area, combined with the presence of thallium above its PGW SSL in soil samples collected at depths up to 80 feet from borings where that metal was not detected in shallower soil samples, suggests that the detected concentrations are naturally occurring. As will be discussed in Section 7, concentrations of thallium consistent with those detected in soil at Chemical Plant 2 were also detected in soil samples collected within Area 39. During the background metals evaluation performed in 2007 (Aerojet et al., 2007), relatively few background samples were collected from undredged material within the Chemical Plant 2 Area and no samples were collected from Area 39. The data suggest that background concentrations of thallium in the undredged material within the Chemical Plant 2 Area and Area 39 may be higher than is reflected in the site-wide background dataset.

Based on the information presented above, the lateral and vertical extent of aluminum, arsenic, cadmium, chromium, lead, and thallium in soil at source areas within the Chemical Plant 2 Area North have been sufficiently characterized to evaluate potential risks to human health,

surface water, and groundwater and, if necessary, develop remedial alternatives.

6.1.5.3 Semivolatile Organic Compounds

B(a)A, B(b)F, B(k)F, B(b&k)F, B(a)P, D(a,h)A, and/or I(1,2,3-cd)P were the detected in soil at 17 locations within Chemical Plant 2 Area North at concentrations above their respective RISLs and/or PGW SSLs (Section 6.1.4.3; Figures 6.1-11 and 6.1-12). Conclusions regarding the characterization and presence of those compounds in soil, based on the data presented on the table and figures, are summarized below.

F(c)-SNS01, F(c)-SNS02, F(c)-SNS03, CP2-08-SNS02, CP2-08-SNS04, 59F-SB22, 59F-SNS01, OS1-F2-SNS02

B(a)A, B(a)P, B(b&k)F, and D(a,h)A were detected in near-surface (0.5 to 1 foot bgs) soil samples collected at eight [F(c)-SNS01, F(c)-SNS02, F(c)-SNS03, CP2-08-SNS02, CP2-08-SNS04, 59F-SB22, 59F-SNS01, and OS1-F2-SNS02] locations along the shallow unlined surface water drainage swale on the western side of the Chemical Plant 2 North area and secondary drainages to the low-lying areas to the north and west (Figures 6.1-11 and 6.1-12). The primary north-south drainage swale received surface water runoff from the features identified in Source Areas CP2-08 and F(c) and discharged to the low-lying areas to the north and west.

B(a)P and B(b&k)F were detected at concentrations above their respective RISLs and PGW SSLs in samples collected at two (59F-SB22 and CP2-08-SNS04) of the eight locations (Figures 6.1-11 and 6.1-12). B(a)A, B(a)P, B(b&k)F and/or D(a,h)A were detected above their respective PGW SSLs, but below their RISLs in the remaining six [F(c)-SNS01, F(c)-SNS02, F(c)-SNS03, CP2-08-SNS02, 59F-SNS01, and OS1-F2-SNS02] locations.

The lateral extent of B(a)P and B(b&k)F above their RISLs in soil at boring 59F-SB22 is defined by the absence of those compounds above their RISLs in soil samples collected at locations 59F-SB21, 59F-SB19, and 59F-SD01. The vertical extent of B(a)P and B(b&k)F above their RISLs at 59F-SB22 is defined by the absence of those compounds above their RISLs in the soil samples collected at 5.5 feet bgs from that boring.

The lateral extent of B(a)P and B(b&k)F above their RISLs in soil at location CP2-08-SNS04 is defined by the absence of those compounds above their RISLs in soil samples collected at locations 59F-SB18,

59F-SB19, 59F-SB20, and 59F-SB21. The vertical extent of B(a)P and B(b&k)F above their RISLs at CP2-08-SNS04 is defined by the absence of those compounds above their RISLs in the soil samples collected at 2.5 feet bgs at that location.

As indicated in Figure 6.1-12, B(a)A, B(a)P, B(b&k)F and/or D(a,h)A above their respective PGW SSLs were detected in surface/near-surface soil samples collected along the unlined surface water drainage ditch. The upstream extent of B(a)A, B(a)P, B(b&k)F and/or D(a,h)A above their PGW SSLs is defined by the southern end of the surface drainage. The downstream extent of those compounds towards the low-lying area to the north is defined by the absence of those compounds above their PGW SSLs in soil samples collected at 59F-SD01, 59F-SNS02, and 59F-SB21. The downstream extent of those compounds towards the low-lying area to the west is defined by the absence of those compounds above their PGW SSLs in soil samples collected at OS1-F2-SNS03, OS1-F2-SNS04, OS1-F2-SB02, OS1-F2-SB03, and OS1-F2-SB04. The lateral extent of B(a)A, B(a)P, B(b&k)F and/or D(a,h)A above their PGW SSLs on each side of the drainage ditch is not well characterized, but it is likely that those compounds were concentrated in the bottom of the ditch.

CP2-08-SB12

B(a)P above its PGW SSL was detected in a near-surface (1 foot bgs) soil sample collected from boring CP2-08-SB12 adjacent to a former chemical storage area at Building 15008 (Figure 6.1-12). The lateral extent of B(a)P at that location is defined by the absence of that compound above its PGW SSL in soil samples collected from borings CP2-08-SB09, CP2-08-SB11, and CP2-08-SB13. The vertical extent of B(a)P above its PGW SSL in boring CP2-08-SB12 was not defined below a depth of 1 foot bgs. However, the absence of that compound above its PGW SSL in soil samples collected between 5 and 99 feet bgs from surrounding borings CP2-08-SB09, CP2-08-SB11, and CP2-08-SB13 indicate that the vertical extent of B(a)P is likely limited to the upper 5 feet of soil.

59F-SB12 and 59F-SB13

B(b&k)F above its RISL and PGW SSL and B(a)P above its PGW SSL were detected in a soil sample collected at 5 feet bgs from boring 59F-SB13. B(a)P and B(b&k)F above their PGW SSLs were detected in a near-surface (1 foot bgs) soil sample collected from boring 59F-SB12. Borings 59F-SB12 and 59F-SB15 are within the footprint of the former waste holding basins at Source Area 59F (Figures 6.1-11 and 6.1-12). The presence of B(a)P and

B(b&k)F in soil at those locations is attributed to releases to ground surface during use of the former waste holding basins.

The lateral extent of B(a)P and B(b&k)F is defined by the absence of those compounds above their PGW SSLs in surface, near-surface, and subsurface soil samples collected from borings 59F-SB11, 59F-SB13, 59F-SB16, and 59F-SB23. The vertical extent of B(a)P and B(b&k)F in boring 59F-SB12 is defined by the absence of those compounds above their PGW SSLs in soil samples collected at 5, 11, and 15 feet bgs from that boring. The vertical extent of B(a)P and B(b&k)F in boring 59F-SB15 is defined by the absence of those compounds above their RISLs and PGW SSLs in soil samples collected at 11 and 31 feet bgs from that boring.

59F-SNS03

B(a)P and B(b&k)F above their PGW SSLs were detected in a near-surface (0.5 foot bgs) soil sample collected at location 59F-SNS03 in the low-lying area north of the former holding basins and Building 15007 (Figure 6.1-12). Although these compounds were also detected in soil at the former waste holding basins, releases of SVOCs from the holding basins would have entered a drainage ditch upslope of 59F-SNS03.

The lateral extent of B(a)P and B(b&k)F is defined by the absence of those compounds above their PGW SSLs in soil samples collected at locations 59F-SNS02, 59F-SNS04, 59F-SB13, and 59F-SB14. The vertical extent of B(a)P and B(b&k)F at location 59F-SNS03 is defined by the absence of those compounds above their PGW SSLs in the soil sample collected at 2.5 feet bgs at that location.

59F-SB26

B(k)F above its RISL; B(a)P above its RISL and PGW SSL; and B(a)A, B(b)F, and I(1,2,3-cd)P above their PGW SSLs were detected in a near-surface (1 foot bgs) soil sample collected from boring 59F-SB26. Boring 59F-SB26 is in the low-lying area north of the holding basins and Building 15007 (Figures 6.1-11 and 6.1-12).

The lateral extent of B(a)A, B(a)P, B(b)F, B(k)F, and I(1,2,3-cd)P is defined by the absence of those compounds above their RISLs and PGW SSLs in soil samples collected at locations 59F-SD02, 59F-SNS04, 59F-SB14, 59F-SB25, 59F-SB27, and CP2-07-SB08. The vertical extent of those compounds above their screening levels in boring 59F-SB26 is not defined at depths below 1 foot bgs. However, based on the absence of those

compounds above their screening levels in surface, near-surface, and subsurface soil samples collected at surrounding locations, the vertical extent is likely limited to the upper 5 feet of soil.

62F-SNS01 and 62F-SB07

B(a)P and B(b&k)F above their PGW SSLs were detected in a near-surface (0.5 foot bgs) soil sample collected at 62F-SNS01 and B(a)P above its PGW SSL was detected in a subsurface soil sample collected from boring 62F-SB07. Boring 62F-SB07 is located in the former location of the paraldehyde tank and location 62F-SNS01 is located in a low-lying area that may have received surface water runoff from the area around the former paraldehyde tank (Figure 6.1-12).

The lateral extent of B(a)P and B(b&k)F above their PGW SSLs in the vicinity of 62F-SNS01 and 62F-SB07 is not well defined, but as indicated on Figure 6.1-12, the presence of PAHs in the area appears to be relatively random. The vertical extent of B(a)P and B(b&k)F at 62F-SNS01 is defined by the absence of those compounds above their PGW SSLs in the soil sample collected at 2.5 feet bgs at that location. The vertical extent of B(a)P in boring 62F-SB07 is defined by the absence of those compounds above their PGW SSLs in the soil samples collected at 10 and 20 feet bgs from that boring.

62F-SB06

B(a)P above its PGW SSL was detected in a near-surface (2 feet bgs) soil sample collected from boring 62F-SB06 adjacent to the former chemical storage and railcar transfer station (Figure 6.1-12). The presence of that compound is attributed to former activities associated with the storage area and transfer station.

The lateral extent of B(a)P is defined to the south, east, and west by the absence of that compound above its PGW SSL in soil samples collected from borings 62F-SB04, 62F-SB05, 62F-SB09, and 62F-SB10. The presence of the berm surrounding the nitroethane tank precluded the collection of soil samples to the north.

The vertical extent of B(a)P is defined by the absence of that compound above its PGW SSL in soil at 5.5 and 11 feet bgs from boring 62F-SB06.

62F-SNS02

B(b&k)F above its PGW SSL was detected in a near-surface (0.5 foot bgs) soil sample collected at location 62F-SNS02 at the west end of a drainage area originating near Building 15004 (Figure 6.1-12). The presence of that compound is attributed to former activities associated with Building 15004.

The lateral extent of B(b&k)F above its PGW SSL upstream (east) and downstream (west) of location 62F-SNS02 is not well defined. The lateral extent of B(b&k)F to the north is defined by the absence of that compound above its PGW SSL in soil samples collected from borings 62F-SB08 and 62F-SB09. The lateral extent of B(b&k)F to the south is defined by the absence of that compound above its PGW SSL in soil samples collected at location 61F-SNS02.

The vertical extent of B(b&k)F was not defined below a depth of 0.5 foot. However, based on the detections of PAHs at other locations in the area, the vertical extent is likely limited to the upper 5 feet or less of soil.

Based on the information presented above, Aerojet believes that the lateral and vertical extent of B(a)A, B(b)F, B(k)F, B(b&k)F, B(a)P, D(a,h)A, and I(1,2,3-cd)P in soil at source areas within Chemical Plant 2 Area North has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

6.1.5.4 *Polychlorinated Biphenyls*

Only two PCBs (Aroclors 1248 and 1254) were detected at concentrations exceeding their respective RISLs and/or PGW SSLs in soil samples collected within Chemical Plant 2 Area North (Section 6.1.4.3; Figures 6.1-13 and 6.1-14). Conclusions regarding the characterization and presence of those compounds in soil, based on the data presented on the table and figures, are summarized below.

The PCB Aroclors 1248 or 1254 were detected above their RISLs and/or PGW SSLs in 22 surface/near-surface soil samples collected at 19 locations in the Chemical Plant 2 Area North. Although PCB Aroclor 1254 was detected above its RISL and PGW SSL in a sample collected at 5 feet bgs at one location (59F-SD02), PCBs were primarily detected in surface/near-surface (0 to 2.5 feet bgs) soil samples. As indicated in Figures 6.1-13 and 6.1-14, PCBs above their RISLs and PGW SSLs were detected in soil

around the former hazardous waste and chemical storage area (Building 15008-Source Area CP2-08); the former location of a PCB transformer [Source Area F(c)]; in numerous soil samples along the drainages; and within the low-lying areas downstream of those areas. The data indicate that releases of oils containing PCBs associated with activities at the former hazardous waste and chemical storage area and PCB transformer entered the surface water system and were transported and deposited in soil along the drainages.

The lateral extent of PCB Aroclors 1248 and 1254 is fairly well defined in that they are present primarily along the drainages and within the low areas. As previously indicated, PCB Aroclor 1254 was detected in only one subsurface soil sample and the vertical extent of PCBs in Chemical Plant 2 Area North is generally confined to the upper 2 to 3 feet of soil.

Based on the information presented above, the lateral and vertical extent of Aroclors 1248 and 1254 within Chemical Plant 2 Area North has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

6.1.5.5 *Perchlorate*

Perchlorate at a concentration above its PGW SSL, but below its RISL, was detected in only one sample collected within Chemical Plant 2 North. Perchlorate at a concentration of 95 µg/kg was detected in a soil sample collected at 5 feet bgs from boring 59F-SB11 (Figure 6.1-14). The lateral extent of perchlorate is defined by the absence of that compound above its PGW SSL in soil samples collected from borings 59F-SB14, 59F-SB15, 59F-SB16, 59F-SB23, and CP2-07-SB08. The vertical extent of perchlorate in boring 59F-SB11 is defined by the absence of that compound above its PQL in soil samples collected at 11 and 15 feet bgs from that same boring.

6.1.5.6 *Pesticides*

Pesticides, including pendimethalin (Prowl), were not detected above their RISLs in any of the surface/near-surface or subsurface soil samples collected at the source areas within Chemical Plant 2 Area North (Section 6.1.4.3).

Heptachlor epoxide, dieldrin, 4,4′-DDD, and/or 4,4′-DDT were detected at concentrations above their respective PGW SSLs in six soil samples collected at six (59F-SB22, 59F-SB28, 62F-SB06, CP2-08-SNS04, OS1-F2-

SNS02, and OS1-F2-SNS03) locations at the source areas within Chemical Plant 2 Area. Sampling locations are shown in Figure 6.1-3.

Pesticides were detected in soil in four areas within Chemical Plant 2: the northern portion of the unlined drainage swale that discharges to the low-lying areas to the north and west of Source Area 59F, the low-lying area north of Source Area 59F, the low-lying area west of Source Area 59F, and near the former chemical storage shed south of the nitroethane tank (Figure 6.1-3).

Although the detections of pesticides above their PGW SSLs are generally random, the pesticides identified in soil at all but one location (former chemical shed south of the nitroethane tank) may potentially be attributed to surface releases associated with the former holding tanks. Surface releases in the area of the former holding tank may have entered the surface water drainage ditch system on the northern end of the Chemical Plant 2 area and subsequently discharged to the low-lying areas to the north and south. The presence of heptachlor epoxide in near-surface (2 feet bgs) soil near the former chemical storage shed is attributed to surface releases associated with activities at that location.

As indicated above, the detections of pesticides above their PGW SSLs is generally random, with locations having pesticides above their PGW SSLs surrounded by locations with no pesticides above their PGW SSLs. The table below provides a list of sampling locations that define the lateral and vertical extent of pesticides at each location where those compounds were detected above their PGW SSLs.

Sample Location	Depth (ft bgs)	Pesticide Above PGW SSL	Lateral Extent Definition	Vertical Extent Definition
59F-SB22	1.0	4,4′-DDD 4,4′-DDT	59F-SB21, 59F-SD01, 59F-SB19, 59F-SB13,	<PGW SSL at 5.5 and 10.5 feet bgs
59F-SB28	1.0	Dieldrin	59F-SNS02, 59F-SNS03, 59F-SNS04, 59F-SB14, 59F-SB26, OS1-F3-SD01	<PGW SSL at 0.5 and 2.5 feet bgs at 59F-SNS02, 59F-SNS04, and 59F-SB25.
62F-SB06	2.0	Heptachlor epoxide	62f-SB04, 62F-SB05, 62F-SB09, 62F-SB10	<PGW SSL at 5.5 feet bgs
CP2-08-SNS04	0.5	Aldrin	59F-SB21, 59F-SB20, 59F-SB19, CP2-08-SNS03	<PGW SSL at 2.5 feet bgs

Sample Location	Depth (ft bgs)	Pesticide Above PGW SSL	Lateral Extent Definition	Vertical Extent Definition
OS1-F2-SNS02	0.5	Heptachlor epoxide Dieldrin	59F-SNS01, 59F-SB20, OS1-F2-SNS04, OS1-F2-SB02, OS1-F2-SB03, OS1-F2-SB04	<PGW SSL at 0.5 and 2.5 feet bgs in OS1-F2-SNS04.
OS1-F2-SNS03	0.5	Dieldrin	59F-SNS01, 59F-SB20, OS1-F2-SNS04, OS1-F2-SB02, OS1-F2-SB03, OS1-F2-SB04	<PGW SSL at 2.5 feet bgs.

Based on the information presented above, the lateral and vertical extent of pesticides above their PGW SSLs at the source areas within Chemical Plant 2 Area North have been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

6.1.6 Chemical Plant 2 – Chemical Plant 2 Area South

Chemical Plant 2 Area South encompasses Source Areas 60F and 61F, two former storage areas that were part of RCRA E, the former location of the Stouffer Chemical Plant, and various features south of the railroad tracks that transect the area (Figure 6.1-1). Various features include sumps, hazardous material storage areas, a chemical disposal dry well, drainage areas, and the previous location of storage tanks associated with the former Stouffer chemical plant.

6.1.6.1 Description of Source Areas – Chemical Plant 2 Area South

The source areas in Chemical Plant 2 Area South and various site features that may have contributed chemicals to soil and/or groundwater are described below and shown in Figure 6.1-1. Site features were identified based on historic soil, soil vapor, and groundwater analytical data, and/or visual inspection.

Source Area 60F

Source Area 60F consists of a single 3,500-gallon septic tank (CP2-ST01/03), and four potholes located east-northeast of Building 15001, and the septic tank and leach lines associated with restrooms in Buildings 15001 and 15003. The only reported inflow to this septic tank was from the restrooms at Buildings 15001 and 15003. Building 15001 is identified as a laboratory and Building 15003 is identified as a control room (Figure 6.1-1).

Source Area 60F also encompasses former hazardous waste container storage areas, a chemical disposal dry well associated with Building 15001, and areas that may have received surface water runoff from Source Area 60F and associated features.

Source Area 61F and RCRA Unit E

Source Area 61F is a concrete sump located at the 15001N drum storage area (Figure 6.1-1). The 15001N storage area (RCRA E) was designated for storage of OBPA wastes and other solid wastes. No documentation is available on materials discharged to the sump.

RCRA Unit E included two former hazardous material storage areas (Buildings 15001N and 15005) within Chemical Plant 2 Area South (Figure 6.1-1). Building 15001N was a 30-foot by 80-foot concrete pad surrounded by an asphalt berm north of Building 15001. Drainage from the concrete pad was directed to a concrete sump (Source Area 61F) at the northwest corner of the pad. Building 15005 was a 30-foot by 60-foot concrete pad with a corrugated metal A-frame roof formerly used as a drum storage area (Figure 6.1-1). Drainage from the concrete pad was directed to a 200-gallon sump with a pump at the southeast corner of the pad. A 1,500-gallon tank within a secondary containment area provided emergency containment of fluids if the sump became full. Both storage areas were certified by the California Department of Toxic Substances Control (DTSC) as clean-closed under RCRA in December 2004.

The RCRA Unit E Area (CP2-RE) also encompasses the former location of the Stouffer Chemical Plant (Figure 6.1-1).

6.1.7 Summary and Results of Previous (Pre-2005) Vadose Zone Investigations – Chemical Plant 2 Area South

The following subsections summarize the scope and results of previous (prior to 2005) vadose zone investigations of the two source areas and septic systems within Chemical Plant 2 Area South, identify COPCs based on the previous investigations, and discuss the DQOs and sampling proposed in the BOU FSP.

6.1.7.1 Summary of Previous (Pre-2005) Vadose Zone Investigations – Chemical Plant 2 Area South

Soil samples from 5 soil borings and 10 soil vapor samples were collected in the vicinity of Source Areas 60F and 61F, the former Stouffer Chemical

Plant, and associated features between 1984 and 2002. Soil vapor samples were analyzed for VOCs. Soil samples were analyzed for SVOCs, perchlorate, PCBs, TPH, pesticides, and/or metals. Previous investigations of those source areas are summarized below. The purpose of the previous investigations is discussed in Section 2.7.

Source Area 60F

Previous vadose zone investigations were conducted at Source Area 60F in 1992, 1993, and 2004. The scope of those investigations is summarized below:

- October 1992 – Seven soil vapor samples were collected at depths up to 20 feet bgs and analyzed for selected VOCs.
- August 1993 – Soil samples were collected at depths ranging from 1 to 10 feet bgs from one soil boring and analyzed for selected metals.
- July 2004 – Surface and near-surface soil samples were collected at two locations and analyzed for metals.

Source Areas 61F

Source Area 61F was previously investigated in 1993. Soil samples were collected at depths between 1 and 50 feet bgs from two borings and analyzed for metals and SVOCs. Additionally, three soil vapor samples were collected to a maximum depth of 19.5 feet bgs and analyzed for VOCs.

6.1.7.2 *Results of Previous (Pre-2005) Vadose Zone Investigation Results – Chemical Plant 2 Area South*

The results of the previous (prior to 2005) investigations of Source Areas 60F and 61F, as presented in the BOU FSP (Aerojet et al., 2006b), are summarized below.

Review of the previous data identified the following COPCs in soil and/or soil vapor within the source areas in Chemical Plant 2 Area South:

- **Soil –** VOCs, SVOCs, metals (including hexavalent chromium), pesticides (including Prowl), perchlorate, and TPH.
- **Soil Vapor –** VOCs.

Figures showing previous sampling locations at the source areas within Chemical Plant 2 Area South and chemical groups detected in soil samples collected between 1991 and 2005 above human health and ecological screening levels were presented in the BOU FSP (Aerojet et al., 2006b). The BOU FSP also presented a summary of statistics and the sample results for chemicals detected in soil, soil vapor, and groundwater that exceed human health and ecological screening levels in the Chemical Plant 2 South source areas.

Pre-2000 (1991 to 1999) soil vapor sampling locations and associated TVOC plumes are shown in Appendix E. PCE, TCE, dichloroethene (DCE), and Freon 113 plumes based on the pre-2000 soil vapor sampling data are shown in Appendix E. Pre-2005 soil sampling locations within Chemical Plant 2 Area are shown in Appendix E. Metals, SVOCs, PCBs, perchlorate, and TPH above their RISLs and/or PGW SSLs in pre-2005 soil samples are shown in Appendix E.

6.1.7.3 *Summary of Data Needs – Chemical Plant 2 Area South*

Based on a review of the previous vadose zone investigation data, extensive aerial photograph research and review, and exhaustive research of historical documents, Aerojet determined that additional soil and soil vapor sampling was needed at the Source Areas within Chemical Plant 2 Area South to:

- Confirm the presence of VOCs in the vadose zone within the source areas;
- Characterize the present lateral and vertical extent of SVOCs, metals, PCBs, TPH, and pesticides in soil in the vadose zone at concentrations that could potentially impact human and ecological receptors;
- Evaluate the potential for chemicals in soil to migrate into and degrade surface or groundwater quality; and
- Obtain sufficient data to support fate and transport modeling, evaluate risk to human and ecological receptors, and identify and evaluate potential remedial alternatives.

It should be noted that due to the time lapse (12 years) since the Stage 1 RI was performed and the elevated laboratory reporting limits for VOCs during that investigation, the investigation of VOCs performed during the BOU RI was designed to supersede all previous soil vapor and soil VOC investigation results.

6.1.8 *Summary and Results of Boundary Operable Unit Vadose Zone Investigation – Chemical Plant 2 Area South*

The following subsections summarize the BOU investigation (2005 to 2007) of the two source areas and associated features within Chemical Plant 2 Area South, describe deviations from the sampling proposed in the BOU FSP, and present the results of the BOU RI. The results of the sampling with respect to the completeness of the characterization and identification of potential sources are discussed in Section 6.1.9.

6.1.8.1 *Summary of Boundary Operable Unit Vadose Zone Investigation – Chemical Plant 2 Area South*

The BOU RI of the vadose zone at Source Areas 60F and 61F and the various features within Chemical Plant 2 Area South included the following activities.

Soil Vapor Investigation

- A total of 35 primary and 7 duplicate soil vapor samples were collected at 35 locations within Chemical Plant 2 Area South at depths ranging from 10 to 30 feet bgs. Soil vapor sampling locations are shown in Figure 6.1-2.
- The number of soil vapor samples (including QA/QC samples) collected at the two source areas and associated features, along with the analytical method, are provided on Table 6.1-1.
- A cross-reference between soil vapor sampling locations within Chemical Plant 2 Area South and the specific features they were sited to investigate are provided on Table 6.1-2.

Surface and Subsurface Soil Investigation

- A total of 17 primary and 5 duplicate surface and/or near-surface (0 to 2.5 feet bgs) soil samples and 35 primary and 2 duplicate subsurface (2.6 to 99 feet bgs) soil samples were collected at Source Areas 60F and 61F and associated features in Chemical Plant 2 Area South. Surface and subsurface soil sampling locations are shown in Figures 6.1-3 and 6.1-4, respectively.
- Surface and/or near-surface soil samples were analyzed for SVOCs, metals, PCBs, TPH-D, TPH-Mo, pesticides, pH, TOC, CEC, and/or geotechnical parameters. The SVOC analysis of soil samples also included an evaluation of the presence of TICs, including OBPA. In

accordance with the BOU FSP, sample analysis was based on the analytical results from previous investigations and therefore not every sample was analyzed for the full suite of constituents.

- Subsurface soil samples were analyzed for SVOCs, metals, PCBs, TPH-D, TPH-Mo, pesticides, pH, TOC, CEC, and/or geotechnical parameters. The SVOC analysis of soil samples also included an evaluation of the presence of TICs, including OBPA. In accordance with the BOU FSP, sample analysis was based on the analytical results from previous investigations and therefore not every sample was analyzed for the full suite of constituents.
- The numbers of surface/near-surface and subsurface soil samples collected for each analysis (including QA/QC samples) at Source Areas 60F and 61F and associated features, along with the corresponding methods, are provided on Table 6.1-8.
- A cross-reference between surface/near-surface and subsurface soil sampling locations within the Chemical Plant 2 Area South and the specific features they were sited to investigate are provided on Table 6.1-2.

6.1.8.2 *Deviations from Boundary Operable Unit Data Quality Objectives and Sampling Design – Chemical Plant 2 Area South*

Sampling activities conducted at Source Areas 60F and 61F and other features within Chemical Plant Area South during the BOU RI were generally consistent with those proposed in the BOU FSP, with the exceptions listed on Tables 6.1-6 and 6.1-7. Sampling was performed at locations proposed in the BOU FSP and step-out sampling was performed in accordance with the procedures agreed upon with the agencies. A comparison of proposed and actual sampling activities, including sampling rationale, sample depth, and analyses, is provided on Tables 6.1-6 and 6.1-7. Soil and soil vapor sampling locations and the specific features they were sited to investigate are cross-referenced on Table 6.1-2.

6.1.8.3 *Results of Boundary Operable Unit Vadose Zone Investigation – Chemical Plant 2 Area South*

The results of the VOC, metals, SVOC, PCB, TPH-D and TPH-Mo, pesticides, pH, TOC, CEC, and geotechnical analyses of samples collected in the source areas within Chemical Plant 2 Area South during the BOU RI are summarized below. The analytical results for all soil vapor and soil

samples are provided in Appendices F and G, respectively. A discussion of the results with respect to the completeness of the characterization of constituents identified above RISLs or PGW SSLs and potential sources are presented in Section 6.1.9.

Summary of Investigation and Results – Volatile Organic Compounds

Based on evaluation of the existing data for Source Areas 60F and 61F and other features within Chemical Plant 2 Area South, the BOU FSP concluded that additional soil vapor sampling was needed to sufficiently characterize the nature and extent of VOCs. As indicated on Table 6.1-1 and below, 35 primary soil vapor samples were collected at Source Areas 60F and 61F and other areas within Chemical Plant 2 Area South and analyzed for VOCs, including TICs.

Source Area	Depth (ft bgs)	No. of Primary Samples	No. of Locations
60F	0-10	11	11
	11-20	11	11
	21-30	0	0
	>30	5	5
61F	0-10	4	4
	11-20	4	4
	21-30	0	0
	>30	0	0

The analytical results for the soil vapor samples collected from the shallow (0 to 10 feet bgs), intermediate (11 to 20 feet bgs), and very deep (greater than 30 feet bgs) intervals at Source Areas 60F and 61F are presented in Appendix F and summarized below. Soil vapor samples were not collected from the deep (21 to 30 feet bgs) interval within Chemical Plant 2 Area South. Soil vapor sampling locations in the Chemical Plant 2 Area are shown in Figure 6.1-2. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 6.1-2.

1,2-DCA, chloroform, vinyl chloride, and TVOC concentrations above their respective RISLs in the shallow, intermediate, deep, and very deep intervals within the Chemical Plant 2 Area are shown in Figure 6.1-5a. Additionally, TVOC concentrations above RISLs are also illustrated in Figure 6.1-5b. 1,2-DCA, chloroform, and vinyl chloride concentrations above their respective PGW SSLs are shown in Figure 6.1-6.

The TVOC concentrations illustrated in Figures 6.1-5a and 6.1-5b represent the sum of the ratio of the concentration for each detected VOC

in the sample divided by its RISL. For example, if PCE at a concentration of 320 µg/m^3 and TCE at a concentration of 961 µg/m^3 were the only VOCs detected in the samples, then the sum of their respective concentrations divided by their respective SSLs of 320 and 961 µg/m^3 would be 2, or:

$$PCE = \frac{320\,\mu g/m^3}{320\,\mu g/m^3} = 1$$

$$TCE = \frac{961\,\mu g/m^3}{961\,\mu g/m^3} = 1$$

$$TVOC\ Ratio = 2$$

As agreed upon with the agencies, soil vapor would be characterized during the BOU RI to the point where the TVOC concentration ratio was less than or equal to 10.

Cross-sections presenting generalized vadose zone lithology and soil vapor sampling results in the Chemical Plant 2 Area are presented in Figures 6.1-7 and 6.1-8. Additional discussion of soil vapor investigation results for the source areas within Chemical Plant 2 Area South is presented in Section 6.1.9.1.

Shallow Soil Vapor (0 to 10 feet bgs) – Volatile Organic Compounds:

- Fifteen primary and five duplicate soil vapor samples were collected from the shallow interval at 15 locations at Source Areas 60F and 61F within Chemical Plant 2 Area South and analyzed for VOCs, including TICs. Shallow soil vapor sampling locations are shown in Figure 6.1-2. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 6.1-2.
- 1,2-DCA, chloroform, and vinyl chloride were the only VOCs detected in the shallow soil vapor at concentrations above their respective RISLs. Shallow soil vapor samples having concentrations of those VOCs above their RISLs are listed on the table below. Concentrations of 1,2-DCA, chloroform, vinyl chloride, and TVOCs above their RISLs are illustrated in Figure 6.1-5a. TVOC concentrations above the RISLs are also shown in Figure 6.1-5b.
- 1,2-DCA and vinyl chloride were the only VOCs detected above their respective PGW SSLs, as indicated on the table below. Concentrations

of 1,2-DCA and vinyl chloride above their PGW SSLs are shown in Figure 6.1-6.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL SSL	> PGW SSL
61F-SP03	10	1,2-DCA	73.9	21	760	Y	Y
CP2-RE05-SP01	10				300,000	Y	Y
CP2-RE05-SP02	10				38,000	Y	Y
CP2-RE05-SP05	10				340	Y	Y
CP2-RE05-SP06	10				12,000	Y	Y
CP2-RE05-SP01	10	Chloroform	83	18,595	3,000	Y	N
CP2-RE05-SP02	10				400	Y	N
CP2-RE05-SP01	10	Vinyl Chloride	31	235	240	Y	Y

Intermediate Soil Vapor (11 to 20 feet bgs) – Volatile Organic Compounds:

- Fifteen primary and one duplicate soil vapor samples were collected from the intermediate interval at 15 locations at Source Areas 60F and 61F within Chemical Plant 2 Area South and analyzed for VOCs, including TICs. Soil vapor sampling locations are shown in Figure 6.1-2. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 6.1-2.
- 1,2-DCA, chloroform, and vinyl chloride were the only VOCs detected in the intermediate soil vapor at concentrations above their respective RISLs. Intermediate soil vapor samples having concentrations of those VOCs above their RISLs are listed on the table below. Concentrations of 1,2-DCA, chloroform, vinyl chloride, and TVOCs above their RISLs are illustrated in Figure 6.1-5a. TVOC concentrations above the RISL are also shown in Figure 6.1-5b.
- 1,2-DCA was the only VOC detected in the intermediate soil vapor at concentrations above its PGW SSL, as indicated in the table below. Concentrations of 1,2-DCA above its PGW SSL are shown in Figure 6.1-6.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL SSL	> PGW SSL
61F-SP03	20	1,2-DCA	73.9	21	330	Y	Y
CP2-RE05-SP01	20				110,000	Y	Y
CP2-RE05-SP02	20				9,900	Y	Y
CP2-RE05-SP06	20				4,300	Y	Y
CP2-RE05-SP01	20	Chloroform	83	18,595	1,200	Y	N
CP2-RE05-SP02	20				120	Y	N

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL SSL	> PGW SSL
CP2-RE05-SP01	20	Vinyl Chloride	31	235	58	Y	N

Deep Soil Vapor (21 to 30 feet bgs) – Volatile Organic Compounds:

Soil vapor samples were not collected from the deep interval at Source Areas 60F and 61F and other features within Chemical Plant 2 Area South.

Very Deep Soil Vapor (greater than 31 feet bgs) – Volatile Organic Compounds:

- Five primary and one duplicate soil vapor samples were collected from the very deep (40 feet bgs) soil vapor intervals at five locations within Source Area 60F. Soil vapor sampling locations in Chemical Plant 2 Area South are shown in Figure 6.1-2. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 6.1-2.
- 1,2-DCA was detected at 910 µg/m^3, above its RISL, in only one (CP2-RE05-SP06) of the five very deep soil vapor samples collected at Source Area 60F. Concentrations of 1,2-DCA and TVOCs above their RISLs are illustrated in Figure 6.1-5a. TVOC concentrations above the RISL are also shown in Figure 6.1-5b.
- VOCs were not detected above their PGW SSL in the five very deep soil vapor samples.

<u>Summary of Investigation and Results – Metals</u>

A total of 52 primary and 7 duplicate soil samples were collected at Source Areas 60F and 61F in Chemical Plant 2 Area South during the BOU RI and analyzed for metals, including mercury. The number of primary soil samples and sampling locations at Source Areas 60F and 61F are summarized on Table 6.1-8, and below. Summary statistics for the samples are also presented on Table 6.1-8.

		Surface/Near-Surface		Subsurface	
Source Area	Compound	No. of Samples	No. of Locations	No. of Samples	No. of Locations
60F	Metals	12	12	29	11
	Mercury	12	12	29	11
61F	Metals	3	3	6	1
	Mercury	5	5	6	1

The results of the metals analysis of surface/near-surface and subsurface soil samples collected at Source Areas 60F and 61F and other features within Chemical Plant 2 Area South are presented in Appendix G and summarized below.

Metals detected in soil samples collected within the Chemical Plant 2 Area at concentrations statistically different than background and subsequently compared to screening levels were aluminum, antimony, arsenic, barium, cadmium, chromium, copper, mercury, molybdenum, nickel, selenium, silver, thallium, and zinc. Because boron, lithium, strontium, and titanium were not included in the background evaluation, concentrations of these metals were also compared to screening levels. Because soils within the Chemical Plant 2 Area may include both soil types (Xerortnents and Redding-Corning-Redbluff), concentrations for metals were compared to the lowest PGW SSL for those soil types.

Surface and subsurface soil sampling locations at Source Areas 60F and 61F and other features within Chemical Plant 2 Area South are shown in Figures 6.1-3 and 6.1-4, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 6.1-2. Cross-sections showing the generalized lithology of the vadose zone within Chemical Plant 2 Area South are provided in Figures 6.1-7 and 6.1-8.

Surface and Near-Surface Soil – Metals:

- Fifteen primary and five duplicate surface/near-surface soil samples were collected at 15 locations at Source Areas 60F and 61F within Chemical Plant 2 Area South and analyzed for metals, including mercury.
- Metals were not detected at concentrations above their respective RISLs in the surface/near-surface soil samples collected within Chemical Plant 2 Area South (Figure 6.1-9).
- As indicated on the table below, cadmium was detected at concentrations above its PGW SSLs in only two surface/near-surface soil samples collected at two locations within Chemical Plant 2 Area South (Figure 6.1-10).

Sample Location	Depth (ft bgs)	Metal	RISL (mg/kg)	PGW SSL (mg/kg)	Conc. (mg/kg)	> RISL	> PGW SSL
61F-SNS01	0.5	Cadmium	1.7	0.72	1.6	N	Y
		Lead	150	23	50	N	Y
61F-SNS02	0.5	Cadmium	1.7	0.72	1.0	N	Y

Subsurface Soil – Metals:

- Thirty-five primary and two duplicate subsurface soil samples were collected at 12 locations at Source Areas 60F and 61F within Chemical Plant 2 Area South and analyzed for metals, including mercury. Subsurface soil sampling locations in Chemical Plant 2 Area South for metals are shown in Figures 6.1-9 and 6.1-10.
- Metals were not detected above their respective RISLs in the subsurface soil samples collected within Chemical Plant 2 Area South (Figure 6.1-9).
- Cadmium at a concentration above its PGW SSL was detected in only one subsurface soil sample. Cadmium at 1.0 mg/kg was detected in a sample collected at 11 feet bgs from boring CP2-RE05-SB04 (Figure 6.1-10).

Summary of Investigation and Results – Semivolatile Organic Compounds

A total of 48 primary and 7 duplicate soil samples were collected at Source Areas 60F and 61F within Chemical Plant 2 Area South during the BOU RI and analyzed for SVOCs, including TICs. The number of primary soil samples and sampling locations at Source Areas 60F and 61F for SVOCs are summarized on Table 6.1-8, and below. Summary statistics for the samples are also presented on Table 6.1-8.

		Surface/Near-Surface		Subsurface	
Source Area	Compound	No. of Samples	No. of Locations	No. of Samples	No. of Locations
60F	SVOCs	12	12	25	9
61F	SVOCs	5	5	6	1

The results of the SVOC and SVOC TIC analyses of surface/near-surface and subsurface soil samples collected at Source Areas 60F and 61F within Chemical Plant 2 Area South are presented in Appendix G and summarized below. TICs were not identified in the SVOC analysis of surface/near-surface and subsurface soil samples collected at the source areas in Chemical Plant 2 Area South.

Surface and subsurface soil sampling locations within Chemical Plant 2 Area South are shown in Figures 6.1-3 and 6.1-4, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 6.1-2. SVOCs detected at concentrations above their

RISLs and/or PGW SSLs in soil at Source Areas 60F and 61F are shown in Figures 6.1-11 and 6.1-12, respectively.

Surface and Near-Surface Soil – Semivolatile Organic Compounds:

- Seventeen primary and five duplicate surface and/or near-surface soil samples were collected at 17 locations at Source Areas 60F and 61F and analyzed for SVOCs, including TICs (Figures 6.1-11 and 6.1-12).
- SVOCs detected in surface and/or near-surface soil above their respective RISLs and/or PGW SSLs are listed on the table below. SVOCs detected at concentrations above their RISLs and PGW SSLs are shown in Figures 6.1-11 and 6.1-12.

Sample Location	Depth (ft bgs)	SVOC	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	> RISL	> PGW SSL
60F-SNS01	0.5	Benzo(a)pyrene	38	2.9	14	N	Y
		Benzo(b&k)fluoranthene	38	29	58	Y	Y
61F-SNS01	0.5	Benzo(a)pyrene	38	2.9	33 J	N	Y
		Benzo(b&k)fluoranthene	38	29	130 J	Y	Y
		Pentachlorophenol	56	400	2,800	Y	Y

Subsurface Soil – Semivolatile Organic Compounds:

- A total of 31 primary and 2 duplicate subsurface soil samples were collected at 10 locations at Source Areas 60F and 61F and analyzed for SVOCs (Figures 6.1-11 and 6.1-12).
- SVOCs were not detected above their respective RISLs and/or PGW SSLs in subsurface soil collected at Source Areas 60F and 61F within Chemical Plant 2 Area South.

<u>Summary of Investigation and Results – Polychlorinated Biphenyls</u>

Three primary soil samples were collected at Source Area 60F within Chemical Plant 2 Area South during the BOU RI and analyzed for PCBs. The number of primary soil samples and sampling locations at Source Area 60F for PCBs are summarized on Table 6.1-8, and below. Summary statistics for the samples are also presented on Table 6.1-8.

		Surface/Near-Surface		Subsurface	
Source Area	Compound	No. of Samples	No. of Locations	No. of Samples	No. of Locations
60F	PCBs	1	1	2	1

The results of the PCB analysis of surface/near-surface and subsurface soil samples collected at Source Area 60F are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations are shown in Figures 6.1-13 and 6.1-14. Soil sampling locations and the features being investigated are cross-referenced on Table 6.1-2.

Surface and Near-Surface Soil – Polychlorinated Biphenyls:

- One primary near-surface soil sample was collected at a depth of 1 foot bgs from boring CP2-RE01-SB01, adjacent to the former hazardous material storage pad storm water drawdown valve, and analyzed for PCBs (Figures 6.1-13 and 6.1-14).
- PCBs were not detected in the near-surface soil sample at concentrations above their respective PQLs or RISLs and PGW SSLs.

Subsurface Soil – Polychlorinated Biphenyls:

- Two primary subsurface soil samples were collected at 5 and 11 feet bgs from boring CP2-RE01-SB01, adjacent to the former hazardous material storage pad storm water drawdown valve, and analyzed for PCBs (Figures 6.1-13 and 6.1-14).
- PCBs were not detected in the subsurface soil samples at concentrations above their respective PQLs or RISLs and PGW SSLs.

Summary of Investigation and Results – Total Petroleum Hydrocarbons

Two primary and two duplicate soil samples were collected at Source Area 60F within Chemical Plant 2 Area South during the BOU RI and analyzed for TPH-D and TPH-Mo. The number of primary soil samples and sampling locations for TPH at Source Areas 60F are summarized on Table 6.1-8, and below. Summary statistics for the samples are also presented on Table 6.1-8.

		Surface/Near-Surface		Subsurface	
Source Area	**Compound**	**No. of Samples**	**No. of Locations**	**No. of Samples**	**No. of Locations**
60F	TPH-D & TPH-Mo	2	2	0	0

The results of TPH analysis (TPH-D and TPH-Mo) of the two near-surface soil samples collected at Source Area 60F within Chemical Plant 2 Area South are presented in Appendix G and summarized below. Surface soil sampling locations are shown in Figures 6.1-3 and 6.1-14. Soil sampling

locations and the features being investigated are cross-referenced on Table 6.1-2.

Surface and Near-Surface Soil – Total Petroleum Hydrocarbons:

- Two primary and two duplicate near-surface soil samples were collected at two locations (CP2-RE05-SB04 and CP2-RE05-SB05) at the former location of the Stouffer Chemical Plant and associated storage tanks at Source Area 60F and analyzed for TPH-D and TPH-Mo.
- TPH-D and/or TPH-Mo were not detected above their PGW SSLs in the near-surface soil samples collected at Source Areas 60F.

Subsurface Soil – Total Petroleum Hydrocarbons:

Subsurface soil samples were not collected at the source areas within Chemical Plant 2 Area South for TPH-D or TPH-Mo.

Summary of Investigation and Results – Miscellaneous Compounds

Miscellaneous analyses performed on soil samples collected at Source Areas 60F and 61F and other features within Chemical Plant 2 Area South were pesticides, OBPA, pH, TOC, and CEC. The number of primary surface/near-surface and subsurface soil samples collected at each source area and the number of locations are summarized on the table below.

		Surface/Near-Surface		Subsurface	
Source Area	**Compound**	**No. of Samples**	**No. of Locations**	**No. of Samples**	**No. of Locations**
60F	Pesticides	12	12	21	9
	OBPA	13	12	19	8
	pH	11	11	27	12
61F	Pesticides	5	5	6	2
	OBPA	3	3	6	2
	pH	2	2	0	0
	TOC	3	3	6	2
	CEC	1	1	6	2

The analytical results for the miscellaneous analysis of surface/near-surface and subsurface soil samples are presented in Appendix G and summarized below. Surface/near-surface and subsurface soil sampling locations within Chemical Plant 2 Area South are shown in Figures 6.1-3 and 6.1-4, respectively.

Pesticides: Surface and subsurface soil sampling locations at Source Areas 60F and 61F are shown in Figures 6.1-3 and 6.1-4. Soil sampling locations and the features being investigated are cross-referenced on Table 6.1-2.

- Pesticides, including pendimethalin (Prowl), were not detected in the surface/near-surface and subsurface soil samples collected at Source Areas 60F and 61F at concentrations above their respective RISLs.
- Heptachlor epoxide was detected above its PGW SSL in near-surface soil samples collected at two locations in Chemical Plant 2 Area South. Heptachlor epoxide was detected at 8.2 µg/kg in a sample collected at 1 foot bgs from boring CP2-RE05-SB03 and at 41 µg/kg in a sample collected at 1 foot bgs from boring 61F-SB04.

OBPA: Surface and subsurface soil sampling locations within Chemical Plant 2 Area South are shown in Figures 6.1-3 and 6.1-4. Soil sampling locations and the features being investigated are cross-referenced on Table 6.1-2.

OBPA was not detected above its PQL in surface/near-surface or subsurface soil samples collected at Source Areas 60F and 61F within Chemical Plant 2 Area South.

pH: The results of the pH analysis of 13 surface/near-surface soil samples and 27 subsurface soil samples collected at Source Areas 60F and 61F within Chemical Plant 2 Area South are summarized on the table below. The pH of the soil is within the normal range (5 to 9) for mineral soils (Brady, 1974).

Source Area	Surface/ Near-Surface Soil	Subsurface Soil
60F	6.68 - 8.69	6.24 – 8.23
61F	5.81 – 7.44	-----

Total Organic Carbon: TOC at 14,600 and 25,100 mg/kg was detected in near-surface soil samples collected from borings 61F-SB04 and 61F-SB05, respectively. TOC at 11,000 mg/kg was detected in the subsurface soil sample collected at 5 feet bgs from boring 61F-SB03.

Cation Exchange Capacity: CEC in the one near-surface and six subsurface soil samples collected from boring 61F-SB03 ranged from 130 to 270 meq/K.

Summary of Investigation and Results – Geotechnical Parameters

Seven soil samples were collected from the source areas within the Chemical Plant 2 Area South during the BOU RI for geotechnical parameters. The results of the geotechnical analyses of soil samples for moisture content, wet density, dry density, specific gravity, porosity, sieve analysis, and/or permeability are summarized on Table 6.1-5.

The geotechnical data will be used in the risk assessment to develop site-specific soil input parameters (moisture content, water-filled porosity, air-filled porosity, etc.) for fate and transport models and in the FS to assess potential remedial actions such as vapor extraction. Fate and transport models are used in risk assessment to quantitatively evaluate the migration of volatile organics into outdoor and indoor air and the potential leaching of chemicals through soil and into groundwater.

6.1.9 Discussion of Investigation Results with Respect to Data Quality Objectives – Chemical Plant 2 Area South

The analytical results presented in the previous sections identified the following chemical constituents in soil vapor and soil at Source Areas 60F and 61F and other features within Chemical Plant 2 Area South at concentrations above their respective RISLs and/or PGW SSLs:

Soil vapor: 1,2-DCA, chloroform, and vinyl chloride.

Soil: Metals (cadmium); PAHs [B(a)P, B(b&k)F, and pentachlorophenol]; and the pesticide heptachlor epoxide.

The presence of these COPCs in each source area is discussed below with respect to the data needs described in Section 4.2.2.3. Specifically,

- Has the investigation resulted in sufficient characterization of the lateral and vertical distribution of each COPC in the vadose zone and identified a potential source for those COPCs?
- Has the investigation resulted in sufficient data to evaluate the potential for COPCs in soil to migrate into and degrade surface water and groundwater quality?
- Has the investigation resulted in data sufficient to support human health and ecological risk assessments and fate and transport modeling?

- Has the investigation resulted in sufficient data to evaluate the feasibility of remediating the identified compounds and concentrations to levels that do not pose a risk to human and ecological receptors or degrade surface water and groundwater quality?

For the purpose of this discussion, it is assumed that chemicals detected at concentrations above their RISL could potentially pose a risk to human health and chemicals detected above their PGW SSL could potentially migrate into groundwater or surface water. Sampling locations where VOCs, metals, and other non-VOCs (SVOCs, PCBs, perchlorate, pesticides, and TPH-Mo) were detected in surface and/or subsurface soil at concentrations above their respective RISLs are shown in Figures 6.1-5a, 6.1-5b, 6.1-9, 6.1-11, and 6.1-13. Sampling locations where VOCs, metals, and other non-VOCs were detected in surface and/or subsurface soil at concentrations above their respective PGW SSLs are shown in Figures 6.1-6, 6.1-10, 6.1-12, and 6.1-14.

The analytical results for surface water and groundwater in the southwestern portion of the BOU, including Chemical Plant 2, are discussed in Sections 6.5 and 6.6, respectively, and discussed with respect to potential soil and soil vapor sources within Chemical Plant 2 Area South. Additionally, the potential for chemicals in soil and soil vapor to migrate into surface water and groundwater is further evaluated in Section 8 of the HHERA (Volume II).

6.1.9.1 *Volatile Organic Compounds*

VOCs detected in soil vapor samples collected at the source areas within Chemical Plant 2 Area South are summarized in Section 6.1.8.3. 1,2-DCA, chloroform, vinyl chloride, and TVOC concentrations above their RISLs in the shallow, intermediate, and very deep intervals are shown in Figure 6.1-5. Additionally, TVOC concentrations above the RISL are also shown in Figure 6.1-5b. 1,2-DCA, chloroform, and vinyl chloride concentrations above their PGW SSLs in the shallow, intermediate, and very deep intervals are shown in Figure 6.1-6. Soil vapor samples were not collected from the deep soil vapor interval within Chemical Plant 2 Area South.

1,2-DCA was the predominant VOC detected in soil vapor within Chemical Plant 2 Area South at concentrations above its RISL and/or PGW SSL. Chloroform and vinyl chloride were the only other VOCs detected in soil vapor at concentrations above their respective RISL and/or PGW SSLs. The presence of 1,2-DCA, chloroform, and vinyl

chloride in soil vapor in the Chemical Plant 2 Area South with respect to potential sources and completeness of characterization are discussed below.

1,2-Dichloroethane

- 1,2-DCA was the predominant VOC detected in the vadose zone within the Chemical Plant 2 Area South. As shown in Figures 6.1-5a and 6.1-6, the highest 1,2-DCA concentrations (up to 300,000 $\mu g/m^3$) were detected in the shallow and intermediate soil vapor intervals at locations CP2-RE05-SP01 and CP2-RE05-SP02 in the area of the former Stouffer Chemical Plant and associated storage tanks. The figures also show that concentrations of 1,2-DCA above its RISL and/or PGW SSLs were detected in soil vapor at locations north (CP2-RE05-SP05) and northeast (CP2-RE05-SP06) of that location.
- The data indicate that while concentrations of 1,2-DCA in the area of CP2-RE05-SP01 and CP2-RE05-SP02 attenuate rapidly to the west, south, and east, 1,2-DCA was detected in soil vapor over 600 feet towards the north and northeast, as defined by the presence of that compound in soil vapor at locations CP2-RE05-SP05 and CP2-RE05-SP06. However, the absence of chloroform in the shallow and intermediate soil vapor samples collected at CP2-RE05-SP05 suggests that the VOCs, including 1,2-DCA, at that location may not be related to the VOCs detected at CP2-RE05-SP06. Based on the similarity of VOCs in the soil vapor, the VOCs detected at CP2-RE05-SP06 may have originated from the area of the former Stouffer Chemical Plant (CP2-RE05-SP01 and CP2-RE05-SP02). A review of historical aerial photographs indicates that the migration of soil vapor in the vadose zone in this area may be influenced by the alignment of former dredge tailings. As discussed in Section 6.1.5.1, VOCs detected in soil vapor at location CP2-RE05-SP05 may potentially be due to surface releases associated with historical activities at a structure near the east end of the railroad tracks instead of migration from the former Stouffer Chemical Plant.
- 1,2-DCA was also detected at concentrations above its RISL, but below its PGW SSL, in the shallow and intermediate soil vapor intervals at location 61F-SP03, near the former concrete sump (Source Area 61F) at the 15001 N drum storage area (Figures 6.1-5a and 6.1-6). The presence of 1,2-DCA at this location is attributed to releases from the sump. The absence of 1,2-DCA in other soil vapor samples (61F-SP04, 61F-SP04, and 61F-SP04) indicates that the extent of 1,2-DCA appears to be limited to the immediate area of the sump.

As indicated by the TVOC concentrations illustrated in Figures 6.1-5a and 6.1-5b, the lateral extent of 1,2-DCA in the vadose zone beneath Chemical Plant 2 Area South has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

Chloroform

Chloroform was the second most predominant VOC detected in soil vapor within Chemical Plant 2 Area South at concentrations above its RISL, but below its PGW SSL. As indicated in Figures 6.1-5a and 6.1-6, chloroform was detected above its RISL in the shallow and intermediate soil vapor intervals at two locations (CP2-RE05-SP01 and CP2-RE05-SP02) within Chemical Plant 2 Area South. As previously discussed, chloroform was also detected in the shallow and intermediate soil vapor intervals at location CP2-RE05-SP06, but at concentrations below its RISL and PGW SSLs. The soil vapor data indicate that chloroform in soil vapor within Chemical Plant 2 Area South is likely associated with the former Stouffer Chemical Plant (Figures 6.1-5a and 6.1-6). The data also indicate that the extent of chloroform in soil vapor is encompassed within the plume of 1,2-DCA originating from the area of the former Stouffer Chemical Plant.

Based on the data presented above and in Section 6.1.8.3, the extent of chloroform in the vadose zone within Chemical Plant 2 Area South has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

Vinyl Chloride

Vinyl chloride was detected above its RISL, but below its PGW SSL, in the shallow and intermediate soil vapor intervals at only one location (CP2-RE05-SP01) within Chemical Plant 2 Area South (Figures 6.1-5a and 6.1-6). The detection of vinyl chloride in soil vapor at this location is attributed to releases associated with the former Stouffer Chemical Plant. The lateral and vertical extent of vinyl chloride in the vadose zone is evidenced by the absence of that compound in shallow and intermediate soil vapor intervals at locations CP2-RE05-SP02, CP2-RE05-SP03, and CP2-RE05-SP04 and at 40 feet bgs at CP2-RE05-SP01. The maximum concentration of vinyl chloride is less than 1 percent of its vapor saturation concentration and therefore not indicative of the presence of NAPL.

Based on the data presented above and in Section 6.1.8.3, the extent of vinyl chloride in the vadose zone within Chemical Plant 2 Area South has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

6.1.9.2 *Metals*

Metals were not detected at concentrations above their respective RISLs in the surface/near-surface soil samples collected within Chemical Plant 2 Area South (Section 6.1.8.3; Figure 6.1-9). Cadmium at concentrations above it PGW SSL was detected in soil samples collected at three (61F-SNS01, 61F-SNS02, and CP2-RE05-SB04) locations within Chemical Plant 2 Area South. Concentrations of those metals above their PGW SSLs are summarized in Section 6.1.8.3 and shown in Figure 6.1-10. Soil sampling locations and the features being investigated are cross-referenced on Table 6.1-2. Conclusions regarding the characterization of metals at the three locations within Chemical Plant 2 Area South based on the data presented on the table and figures are summarized below.

<u>61F-SNS01</u>

Cadmium above its PGW SSL was detected in a surface (0.5 foot bgs) soil sample collected at location 61F-SNS01. Location 61F-SNS01 is in an area that received surface water runoff from the former laboratory (Building 15001) and hazardous material storage pad area (Figure 6.1-10).

The lateral extent of cadmium is defined by the absence of that metal above its PGW SSL in soil samples collected at locations 60F-SB03, 61F-SB04, and 61F-SB05. The vertical extent of cadmium was defined to the PGW SSL proposed in the BOU FSP, but not to the revised PGW SSL.

<u>61F-SNS02</u>

Cadmium above its PGW SSLs was detected in a surface (0.5 foot bgs) soil sample collected at location 61F-SNS02. Location 61F-SNS02 is in an area that received surface water runoff from the pump house area and water storage tank flushing (Figure 6.1-10).

The lateral extent of cadmium is defined by the absence of that metal above its PGW SSL in soil samples collected at locations 61F-SB05 and 62F-SNS02. The vertical extent of cadmium was defined to the PGW SSL

of 18.25 mg/kg proposed in the BOU FSP, but not to the revised PGW SSL of 0.72 mg/kg.

CP2-RE05-SB04

Cadmium at a concentration above its PGW SSL was detected in a subsurface soil sample collected at 11 feet bgs from boring CP2-RE05-SB04, near the hazardous waste storage pad and former aboveground tanks (Figure 6.1-10). The lateral extent of cadmium is defined by the absence of that metal above its PGW SSL in soil samples collected from borings CP2-RE05-SB02 and CP2-RE05-SB03. The vertical extent of cadmium is defined by the absence of that metal above its PGW SSL in soil samples collected at 1, 5, and 11 feet bgs from borings CP2-RE05-SB02 and CP2-RE05-SB03.

Based on the data presented above and in Section 6.1.8.3, the lateral and vertical extent of cadmium, mercury, and nickel in the vadose zone within Chemical Plant 2 Area South has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

6.1.9.3 *Semivolatile Organic Compounds*

SVOCs were not detected in soil at the source areas within Chemical Plant 2 Area South at concentrations above their respective RISLs (Figure 6.1-11). B(a)P, B(b&k)F, and pentachlorophenol were, however, detected in soil at two locations (60F-SNS01 and 61F-SNS01) within Chemical Plant 2 Area South above their respective PGW SSLs (Section 6.1.8.3; Figure 6.1-12). The presence of each of those compounds in soil at both locations with respect to the completeness of characterization, both laterally and vertically, are discussed below.

60F-SNS01

B(a)P and B(b&k)F above their PGW SSLs were detected in a near-surface (0.5 foot bgs) soil sample collected at location 60F-SNS01, situated in an area that received surface water runoff from the former laboratory (Building 15001) (Figure 6.1-12).

The lateral extent of B(a)P and B(b&k)F is defined by the absence of those compounds above their PGW SSLs in soil samples collected from borings 60F-SB01, 60F-SB02, 60F-SB04, 60F-SB05, and CP2-RE01-SB01. The vertical extent of those PAHs is defined by the absence of those compounds above

their PGW SSLs in the subsurface soil samples collected from borings 60F--SB01, 60F-SB02, 60F-SB04, 60F-SB05, and CP2-RE01-SB01.

61F-SNS01

B(a)P, B(b&k)F, and pentachlorophenol above their PGW SSLs were detected in a near-surface (0.5 foot bgs) soil sample collected at location 61F-SNS01. Location 61F-SNS01 is in an area that received surface water runoff from the former laboratory and hazardous material storage pad area (Figure 6.1-12).

The lateral extent of B(a)P, B(b&k)F, and pentachlorophenol is defined by the absence of those compounds above their PGW SSLs in soil samples collected at locations 60F-SB03, 61F-SB04, and 61F-SB05. The vertical extent of those PAHs was defined to the PGW SSLs proposed in the BOU FSP, but not to their revised PGW SSLs.

Based on the information presented above, the lateral and vertical extent of B(a)P, B(b&k)F, and pentachlorophenol at the source areas within Chemical Plant 2 Area South have been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

6.1.9.4 *Pesticides*

Pesticides, including pendimethalin (Prowl), were not detected at concentrations above their RISLs in surface or near-surface soil samples collected at the source areas within Chemical Plant 2 Area South (Section 6.1.8.3).

The pesticide heptachlor epoxide was detected above its PGW SSL in near-surface soil samples collected at two locations (61F-SB04 and CP2-RE05-SB03) (Figure 6.1-3). The presence of that compound in soil at both locations with respect to the completeness of characterization, both laterally and vertically, is discussed below.

61F-SB04

Heptachlor epoxide was detected above its PGW SSL in a near-surface (1 foot bgs) soil sample collected from boring 61F-SB04 in Chemical Plant 2 Area South. Boring 61F-SB04 is in an area that received surface water runoff from the former laboratory and hazardous material storage pad area (Figure 6.1-3).

The lateral and vertical extent of heptachlor epoxide at that location is not well defined. However, the absence of that compound in soil samples collected at locations 60F-SB02, 60F-SB03, 61F-SNS01, 61F-SB05 indicate that this compound is not prevalent in the area and therefore the lateral and vertical extent is likely limited to a small area near 61F-SB04.

CP2-RE05-SB03

Heptachlor epoxide was detected above its PGW SSL in a near-surface (1 foot bgs) soil sample collected from boring CP2-RE05-SB03, near the hazardous waste storage pad and former aboveground tanks (Figure 6.1-3).

The lateral extent of heptachlor epoxide at that location is defined by the absence of that compound above its PGW SSL in soil samples collected at locations CP2-RE05-SB02 and CP2-RE05-SB04. The vertical extent of heptachlor epoxide is defined by the absence of that compound in soil samples collected from co-located boring CP2-RE05-SB04.

Based on the results of the BOU RI, the lateral and vertical extent of heptachlor epoxide in the source areas within Chemical Plant 2 Area South have been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

6.2 *SUMMARY AND RESULTS OF VADOSE ZONE REMEDIAL INVESTIGATION – MAGAZINE AREA*

The Magazine Area (Aerojet Area 48) consists of storage bunkers, shipping and transfer facilities, and safety shelters (Figures 6.0-1 and 6.2-1). The Magazine Area and Open Space 3 (OS3), as identified in the BOU FSP (Aerojet et al., 2006b), essentially encompass the same lands and therefore are discussed in this section as the Magazine Area. A brief description of the use of each structure is provided below:

- Buildings 48001 through 48008 – High explosive magazines;
- Building 48009 – Used to store finished rockets, and is a high-explosive hardware storage area;
- Building 48010 – An aging facility currently used to store explosive hardware and pyrotechnics;
- Buildings 48013 and 48019 – Shipping buildings;

- Buildings 48017 and 48018 – Magazettes;
- Buildings 48014, 48015, 48020, and 48022 – In-process or motor storage buildings;
- Building 48021 – Boiler house;
- Buildings 48016 – Nitroplasticizer warehouse;
- Buildings 48024 through 48027 – Oxidizer storage; and
- Building 48028 – Safety shelter for Building 48013.

Source areas within the Magazine Area are limited to septic systems associated with two buildings (Buildings 48013 and 48019) and a former RCRA Unit (RCRA-C) that was certified clean closed by DTSC in 2005. The septic systems primarily received sewage waste from restrooms, but may have also received rinse water containing VOCs or propellants, and therefore may have the potential to result in a release of contaminants to the subsurface.

This section provides the following information for the Magazine Area:

- Describes the environmental setting for the Magazine Area;
- Describes all features in the Magazine Area investigated during the previous investigations and the BOU RI;
- Summarizes previous vadose zone investigations and the results of those investigations;
- Identifies COPCs identified during the previous investigations;
- Presents the data needs identified in the BOU FSP;
- Summarizes the sampling activities performed during the BOU RI and deviations from the sampling proposed in the BOU FSP; and
- Presents the analytical results for samples collected during the BOU RI and historical data, where appropriate.

The results of the BOU RI with respect to the identification of COPCs, lateral and vertical characterization of COPCs, completeness of the characterization, and potential sources are discussed in Section 6.2.5.

The information presented below regarding descriptions of features and previous investigations was compiled from one or more of the following sources: *Stage 1 Sampling Plan-Zone 1* (Aerojet, 1993a); *Stage 1 Sampling Plan-Zones 3 and 4* (Aerojet 1993b); *Stage 1 Sampling Plan-Zone 2* (Aerojet,

1993c); *Aerojet Superfund Site – Scoping Report, Volumes 1 through 6* (ICF Technology, Inc., 1989); *Aerojet Site Stage 1 Report - Zones 1 through 4* (ICF Kaiser Engineers, Inc., 1993); or BOU FSP (Aerojet et al., 2006b).

6.2.1 *Environmental Setting – Magazine Area*

The topography, geology, soils, surface water hydrology, general hydrogeology, and ecological habitat of the Magazine Area are described in the following subsections.

6.2.1.1 *Topography*

The topography of the Magazine Area is relatively flat as result of grading during construction of the bunkers. The relatively flat topography is broken up by the presence of large revetments around each of the bunkers and by some remnant dredging features such as slicken valleys and some cobble piles.

6.2.1.2 *Geology*

The site-specific geology of the Magazine Area, based on information presented on field logs of borings drilled during previous investigations and the BOU RI, is described below.

The surface and near-surface lithologies in the Magazine Area are comprised of reworked Quaternary-aged fluvial deposits of cobbles, sand, silt, and clay to a depth between 45 and 55 feet. The Magazine Area has been heavily graded and paved, but a review of historical photographs shows that the area is surrounded by dredge tailings. Native soils below the dredge tailings generally consist of fluvial deposits of sand and silt and are likely similar to those encountered during drilling in the dredge pit and Eastern Basin (Section 6.3.1).

6.2.1.3 *Soils*

Soils in the vicinity of the Magazine Area consist primarily of Xerorthents; dredge tailings with 2 to 50 percent slopes. These are very deep, somewhat excessively drained to excessively drained soils found in areas of dredge tailings. They are formed in material that has a high content of gravel and cobbles derived from mixed sources. The material was deposited as tailings after most of the fine-earth material was washed from it and removed during gold dredging activities. Slopes are short, complex, and disturbed (USDA – NRCS, 1993).

6.2.1.4 *Surface Water Hydrology*

There are no prominent surface water features such as creeks, ponds, or ditches within the Magazine Area. Surface water runoff from the area surrounding the bunkers generally percolates into the ground or flows into nearby low-lying areas, primarily remnant slickens valleys.

6.2.1.5 *Local Hydrogeology*

The first saturated sediments encountered beneath the Magazine Area are either part of Perched Groundwater or within the FWBZ. The general hydrogeology of the Perched Groundwater and FWBZ beneath the Magazine Area is discussed below. Details regarding the occurrence of groundwater within the Chemical Plant 2 Region and distribution of chemicals in the groundwater are presented in Section 6.6.

Perched Groundwater

There are several Perched Groundwater zones in the Chemical Plant 2 Region, which have been generally grouped into an Upper Perched Zone and a Lower Perched Zone. The definitions refer to an assemblage of several perched groundwater zones, and not one specific unit.

The Upper Perched Zone typically occurs in ancestral American River sediments that have been reworked by historical gold-dredging activities. The base of the Upper Perched Zone generally coincides with the interface between the permeable dredged material and the relatively impermeable, undredged material. The Upper Perched Zone was identified at two locations in the northern portion of the Magazine Area near Buildings 48013 and 48019 at depths of 30 and 46 feet bgs.

Lower Perched Groundwater occurs in discontinuous sand lenses in a generally fine-grained lithologic unit that have not been dredged. Lower Perched Groundwater was not encountered in the Magazine Area.

First Water-Bearing Zone

The FWBZ in the Magazine Area occurs within Layer A, but the saturated thickness of that layer in the Magazine Area during the BOU RI sampling period was only about two feet during the RI sampling period.

Depth to the top of FWBZ in the Magazine Area ranges from approximately 65 to 80 feet bgs and decreases towards the south-southeast

in the direction of the Dredge Pit and Eastern Basin. Groundwater elevations in the FWBZ have decreased an average of 39 feet between 1983/1984 and April 2006, with lowest levels generally occurring between 1994 and 1996. Data indicates that groundwater elevations in the FWBZ are continuing to drop.

Flow direction in the FWBZ is general towards the west, consistent with the migration of groundwater from the Line 03 Area east of Chemical Plant 2 towards GET E/F Extraction Wells 4007 and 4310. The average hydraulic gradient across Chemical Plant 2 Area is approximately 0.0064 ft/ft, but flattens to approximately 0.0004 in the area immediately upgradient (east) of Chemical Plant 2.

6.2.1.6 *Ecological Habitat*

The Magazine Area contains a wide variety of habitats including buildings, ruderal/disturbed habitat, paved surfaces, dredger tailings, annual grassland, Fremont cottonwood woodland, Fremont cottonwood-oak woodland, and coyote brush-willow scrub.

Flora near the buildings, ruderal/disturbed habitat, and paved surfaces typically includes herbaceous weeds, non-native invasive species, and ornamental landscape species. Fauna species common to this area are habitat generalists such as the rock pigeon, mourning dove, western fence lizard, European starling, house mouse, and deer mouse; or species that may venture in from adjacent vegetation communities.

Non-native, naturalized Mediterranean grasses represent the predominant flora species within the annual grassland habitat interspersed with the dredger tailings. Fauna species are not common in the dredger tailings due in part to the cobble-boulder substrate and sparse vegetation cover. However, the annual grassland mixed in with the dredger tailings allows for foraging ground for some species, including the western fence lizard, common king snake, white-tailed kite, red-tailed hawk, and coyote.

Fremont cottonwood woodland and Fremont cottonwood-oak woodland support similar flora and fauna. Fremont cottonwood is the dominant tree species, with oak and willow species as sub-dominant members of the canopy. The understory ranges from open areas dominated by annual grasses to dense, developed shrub layers. Flora species typically observed in the understory include coyote brush, poison oak, willow, and various annual grasses. Common fauna species include the Pacific tree frog, western rattlesnake, Cooper's hawk, red-tailed hawk, American kestrel,

wild turkey, great horned owl, various songbirds, California vole, deer mouse, coyote, and black-tailed deer.

The coyote brush-willow scrub community is dominated by coyote brush and shrub type willows. Other common flora includes blue elderberry, poison oak, hoary coffeeberry, a variety of thistles, and annual grasses. This community is typically found in low-lying areas between the dredge tailing piles. Fauna species typically include a variety of snakes, California quail, towhee, mourning dove, California vole, black-tailed jackrabbit, desert cottontail, raccoon, gray fox, coyote, and black-tailed deer.

Blue elderberry shrubs, potential habitat for the Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), were observed scattered throughout the entire Magazine Area. A *Biological Assessment Report* (ECORP Consulting, Inc. 2005) for the Boundary OU was presented as Appendix B in the BOU FSP (Aerojet et al., 2006b).

6.2.2 *Magazine Area*

The Magazine Area consists of storage bunkers and shipping facilities. Source areas within the Magazine Area are limited to two septic tank systems and a RCRA Unit (RCRA-C). In response to concerns expressed by the United States Environmental Protection Agency (USEPA), Aerojet and USEPA conducted a review of the materials historically stored and handled at each of the bunkers within the Magazine Area. Based on that review, it was agreed that soil sampling would be conducted near the loading/unloading areas at several bunkers. The septic systems, RCRA-C, and the bunkers where samples were collected are described below.

6.2.2.1 *Source Area Description – Magazine Area*

The two septic systems identified during the Demonstration Project Record Search, RCRA-C, and the bunkers/magazines identified by Aerojet and USEPA for sampling are described below.

<u>Septic Tank A48-ST13</u>

Septic tank A48-ST13 consists of a 1,000-gallon tank and associated passive infiltration wells (two potholes) located southwest of Building 48013 (Figure 6.2-1). Building 48013 is identified as a loading and shipping facility in the Magazine Area.

Septic Tank A48-ST19

Septic tank A48-ST19 is a 1,000-gallon tank located north of Building 48019 (Figure 6.2-1). The method of liquid drainage (leach line or passive infiltration well [pothole]) from the septic tank is unknown. Building 48019 is identified as an on-site shipping operations office located in the Magazine Area. No known chemicals were handled at Building 48019.

RCRA-C

Building 48008 (RCRA-C) was formerly used for the storage of liquid and solid rocket propellants. Aerojet submitted the *RCRA-C, Building 28008 Facility Closure Report* to DTSC in July 2005 hat included closure procedures, closure activities, analytical results for samples, and third-party certification that closure was performed in accordance with DTSC approved closure plans. The DTSC provided their concurrence that Aerojet had performed all closure activities in accordance with approved closure plans and that the first foot of soil beneath the building had been clean closed in a letter dated 27 December 2005.

Magazines

As previously discussed, based on a review of material storage history of the bunkers and magazines in the Magazine Area, the following three bunkers were selected for sampling:

- Building 48004 – High explosive magazine;
- Building 48010 – An aging facility currently used to store explosive hardware and pyrotechnics; and
- Building 48014 – In-process or motor storage.

6.2.3 *Summary and Results of Previous (Pre-2005) Vadose Zone Remedial Investigation – Magazine Area*

The following subsections summarize the scope and results of a previous (prior to 2005) vadose zone investigation of the Magazine Area, identify COPCs based on the previous investigations, and discuss the DQOs and sampling proposed in the BOU FSP.

6.2.3.1 *Summary of Previous (Pre-2005) Vadose Zone Investigations – Magazine Area*

Previous investigation activities in the Magazine Area were limited to soil vapor. Soil vapor samples were collected at a depth of 10 feet bgs at four locations in the vicinity of the septic systems at Buildings 48013 and 48019 in 1993 and analyzed for select VOCs.

6.2.3.2 *Results of Previous (Pre-2005) Vadose Zone Investigations – Magazine Area*

The results of the previous investigation indicated the presence of VOCs in the vadose zone adjacent to the two septic systems in the Magazine Area.

Figures showing previous sampling locations within the Magazine Area and chemical groups detected in soil vapor samples collected in 1993 above human health and ecological screening levels were presented in the BOU FSP (Aerojet et al., 2006b) and are included in Appendix E. The BOU FSP also presented a summary of statistics and the sample results for chemicals detected in soil vapor and groundwater that exceed human health and ecological screening levels in the Magazine Area.

6.2.3.3 *Summary of Data Needs – Magazine Area*

Based on a review of the previous vadose zone investigation data, extensive aerial photograph research and review, and exhaustive research of historical documents, Aerojet determined that additional soil and soil vapor sampling was needed in the Magazine Area to:

- Characterize the present lateral and vertical extent of VOCs, SVOCs, perchlorate, nitroguanidine, and metals in the vadose zone at the source areas and site features that may be related to chemical concentrations that could potentially pose a risk to human and ecological receptors;
- Evaluate the potential for chemicals in soil to degrade surface or groundwater quality; and
- Obtain sufficient data to support fate and transport modeling, evaluate risk to human and ecological receptors, and evaluate potential remedial alternatives.

It should be noted that due to the time lapse (12 years) since the Stage 1 RI was performed and the elevated laboratory reporting limits for VOCs during that investigation, the investigation of VOCs performed during the

BOU RI was designed to supersede all previous soil vapor and soil VOC investigation results.

6.2.4 *Summary and Results of Boundary Operable Unit Vadose Zone Investigation – Magazine Area*

The following subsections summarize the BOU investigation (2005 to 2006) of the septic tanks, RCRA-C, and bunkers in the Magazine Area; describe deviations from the sampling proposed in the BOU FSP; and present the results of the BOU RI. The results of the sampling with respect to the completeness of the characterization and identification of potential sources are discussed in Section 6.2.5.

6.2.4.1 *Summary of Boundary Operable Unit Vadose Zone Investigation – Magazine Area*

The BOU RI of the vadose zone in proximity to the septic tanks, RCRA-C, and bunkers identified by Aerojet and USEPA included the following activities.

<u>Soil Vapor Investigation</u>

- A total of 27 primary and 1 duplicate soil vapor samples were collected within the Magazine Area and analyzed for VOCs, including TICs. Soil vapor sampling locations are shown in Figure 6.2-2.
- The number of soil vapor samples (including QA/QC samples) collected at the Magazine Area, along with the analytical methods, is provided on Table 6.2-1.
- A cross-reference between soil vapor sampling locations within the Magazine Area and the specific features they were sited to investigate are provided on Table 6.2-2.

<u>Surface and Subsurface Soil Investigation</u>

- A total of eight primary and one duplicate surface and/or near-surface (0 to 2.5 feet bgs) soil samples and seven primary subsurface (2.6 to 11.5 feet bgs) soil samples were collected within the Magazine Area. Surface/near-surface and subsurface soil sampling locations are shown in Figures 6.2-3 and 6.2-4, respectively.
- Surface and/or near-surface soil samples were analyzed for SVOCs, metals, perchlorate, nitroguanidine, DI-WET, and/or geotechnical parameters. The SVOC analysis of soil samples also included an

evaluation of the presence of TICs. In accordance with the BOU FSP, sample analysis was based on the analytical results from previous investigations and therefore every sample was not analyzed for the full suite of constituents.

- Subsurface soil samples were analyzed for SVOCs, metals, perchlorate, nitroguanidine, DI-WET, and/or geotechnical parameters. The SVOC analysis included an evaluation of TICs. In accordance with the BOU FSP, sample analysis was based on the analytical results from previous investigations and therefore every sample was not analyzed for the full suite of constituents.
- The numbers of surface/near-surface and subsurface soil samples collected for each analysis (including QA/QC samples) within the Magazine Area, along with the corresponding methods, are provided on Table 6.2-3.
- A cross-reference between surface/near-surface and subsurface soil sampling locations within the Magazine Area and the specific features they were sited to investigate are provided on Table 6.2-2.

6.2.4.2 *Deviations from Boundary Operable Unit Data Quality Objectives and Sampling Design – Magazine Area*

Sampling activities conducted at Magazine Area and other features within Magazine Area during the BOU RI were generally consistent with those proposed in the BOU FSP, with the exceptions listed on Tables 6.2-4 and 6.2-5. Sampling was performed at locations proposed in the BOU FSP and step-out sampling was performed in accordance with the procedures agreed upon with the agencies. A comparison of proposed and actual sampling activities, including sampling rationale, sample depth, and analyses, is provided on Tables 6.2-4 and 6.2-5. Soil and soil vapor sampling locations and the specific features they were sited to investigate are cross-referenced on Table 6.2-2.

6.2.4.3 *Results of Boundary Operable Unit Vadose Zone Investigation – Chemical Plant 2 Area South*

The results of the SVOC, metals, perchlorate, nitroguanidine, DI-WET, and geotechnical analyses of samples collected in the Magazine Area during the BOU RI are summarized below. A discussion of the results with respect to the completeness of the characterization of constituents identified above RISLs or PGW SSLs and potential sources are presented

in Section 6.2.5. The analytical results for all soil vapor and soil samples are provided in Appendices F and G, respectively.

Summary of Investigation and Results – Volatile Organic Compounds

Based on evaluation of the existing data for the Magazine Area, the BOU FSP concluded that additional soil vapor sampling was needed to sufficiently characterize the nature and extent of VOCs. As indicated on Table 6.2-1 and below, 27 primary soil vapor samples were collected within the Magazine Area during the BOU RI and analyzed for VOCs, including TICs. The number of primary soil vapor samples analyzed for VOCs and sampling locations and depth are summarized on Table 6.2-1 and below. Summary statistics for the samples are also presented on Table 6.2-1.

Area	Depth (ft bgs)	No. of Primary Samples	No. of Locations
Magazine Area	0-10	11	11
	11-20	11	11
	21-30	5	5
	>30	0	0

The analytical results for the soil vapor samples collected from the shallow (0 to 10 feet bgs), intermediate (11 to 20 feet bgs), and deep (21 to 30 feet bgs) intervals within the Magazine Area are presented in Appendix F and summarized below. Soil vapor sampling locations in the Magazine Area are shown in Figure 6.2-2.

PCE, TCE, vinyl chloride, and TVOC concentrations above their respective RISLs in the shallow, intermediate, deep, and deep intervals within the Magazine Area are shown in Figure 6.2-5a. Additionally, TVOC concentrations above the RISL are also shown in Figure 6.2-5b. PCE, TCE, and vinyl chloride concentrations above their respective PGW SSLs are shown in Figure 6.2-6. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 6.2-2.

The TVOC concentrations illustrated in Figures 6.2-5a and 6.2-5b represent the sum of the ratio of the concentration for each detected VOC in the sample divided by its RISL. For example, if PCE at a concentration of 320 $\mu g/m^3$ and TCE at a concentration of 961 $\mu g/m^3$ were the only VOCs detected in the samples, then the sum of their respective

concentrations divided by their respective SSLs of 320 and 961 µg/m³ would be 2, or:

$$PCE = \frac{320\,\mu g/m^3}{320\,\mu g/m^3} = 1$$

$$TCE = \frac{961\,\mu g/m^3}{961\,\mu g/m^3} = 1$$

$$TVOC\ Ratio = 2$$

As agreed upon with the agencies, soil vapor would be characterized during the BOU RI to the point where the TVOC concentration ratio was less than or equal to 10.

Shallow Soil Vapor (0 to 10 feet bgs) – Volatile Organic Compounds:

- A total of 11 primary soil vapor samples were collected from the shallow layer at 11 locations in the Magazine Area. Soil vapor sampling locations are shown in Figure 6.2-2. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 6.2-2.
- PCE was the only VOC detected in the shallow soil vapor at concentrations above its RISL SSL. As indicated on the table below, PCE was detected at a concentration of 1,800 µg/m³ at location A48-ST13-SP06, adjacent to the septic tank and leach system associated with Building 48013 (Figures 6.2-5a and 6.2-5b).
- PCE was the only VOC detected in the shallow soil vapor interval above its PGW SSL. Shallow soil vapor samples having concentrations of PCE above its PGW SSL are listed on the table below and shown in Figure 6.2-6.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
A48-ST13-SP04	10	PCE	320	57	140	N	Y
A48-ST13-SP06	10				1,800	Y	Y
A48-ST13-SP07	10				110	N	Y

Intermediate Soil Vapor (11 to 20 feet bgs) – Volatile Organic Compounds:

- Eleven primary and one duplicate soil vapor samples were collected from the intermediate layer at 11 locations within the Magazine Area.

Soil vapor sampling locations are shown in Figure 6.2-2, 6.2-5a, 6.2-5b, and 6.2-6. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 6.2-2.

- VOCs were not detected above their respective RISLs in the intermediate soil vapor samples.
- PCE was the only VOC detected in the intermediate soil vapor interval above its PGW SSL. Intermediate soil vapor samples having concentrations of PCE above its PGW SSL are listed on the table below and shown in Figure 6.2-6.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
A48-ST13-SP04	10	PCE	320	57	160	N	Y
A48-ST13-SP06	10				210	N	Y

Deep Soil Vapor (21 to 30 feet bgs) – Volatile Organic Compounds:

- Five primary soil vapor samples were collected from the deep interval at five locations within the Magazine Area. Soil vapor sampling locations and the features being investigated are cross-referenced on Table 6.2-2.
- PCE was the only VOC detected in the deep soil vapor at concentrations above its RISL. PCE was detected at a concentration of 400 µg/m^3 at location A48-ST13-SP06, adjacent to the septic tank and leach system associated with Building 48013. Concentrations of PCE and TVOCs above their RISLs are shown in Figure 6.2-5a. TVOC concentrations above the RISL are also shown in Figure 6.2-5b.
- PCE was also the only VOC detected in the deep soil vapor at concentrations above its PGW SSL. Deep soil vapor samples having concentrations of PCE above its PGW SSL are listed on the table below and shown in Figure 6.2-6.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
A48-ST13-SP04	10	PCE	320	57	180	N	Y
A48-ST13-SP06	10				400	Y	Y
A48-ST13-SP07	10				140	N	Y

Summary of Investigation and Results – Metals

A total of 9 primary soil samples were collected within the Magazine Area during the BOU RI and analyzed for metals, including mercury. The number of primary soil samples and sampling locations in the Magazine Area are summarized on Table 6.2-3 and below. Summary statistics for the samples are also presented on Table 6.2-3.

		Surface/Near-Surface		Subsurface	
Area	**Compound**	**No. of Samples**	**No. of Locations**	**No. of Samples**	**No. of Locations**
Magazine Area	Metals	8	5	7	3
	Mercury	8	5	7	3

The results of the metals analysis of surface/near-surface and subsurface soil samples collected within the Magazine Area are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations are shown in Figures 6.2-3 and 6.2-4, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 6.2-2.

Metals detected in soil samples collected within the Magazine Area at concentrations statistically different than background and subsequently compared to screening levels were antimony, beryllium, molybdenum, thallium, and vanadium. Because boron, lithium, strontium, and titanium were not included in the background evaluation, concentrations of these metals were also compared to screening levels. Because soils within the Magazine Area consist only of Xerortnents, the concentrations for metals were compared to the PGW SSL for that soil type.

Surface and Near-Surface Soil – Metals:

- A total of eight primary and surface/near-surface soil samples were collected at five (A48-RC08-SB01, A48-ST13-SB01, OS3-F1-SB01, OS3-F1-SB02, and OS3-F1-SB03) locations within the Magazine Area and analyzed for metals, including mercury.
- Metals were not detected at concentrations above their respective RISLs or PGW SSLs in surface/near-surface soil samples collected within the Magazine Area.

Subsurface Soil – Metals:

- A total of seven primary subsurface soil samples were collected at three (A48-RC08-SB01, A48-ST13-SB01, A48-ST19-SB01) locations within the Magazine Area and analyzed for metals, including mercury.
- Metals were not detected at concentrations above their respective RISLs in subsurface soil samples collected within the Magazine Area.
- Thallium was detected at a concentration above its PGW SSL of 2.5 mg/kg in one subsurface soil sample collected within the Magazine Area. Thallium at 4.5 mg/kg was detected in a sample collected at a depth of 11.5 feet bgs in boring A48-RC08-SB01. The location of boring A48-RC08-SB01 is shown in Figure 6.2-4.

Summary of Investigation and Results – Semivolatile Organic Compounds

A total of 15 primary and 1 duplicate soil samples were collected within the Magazine Area during the BOU RI and analyzed for SVOCs, including TICs. The number of primary soil samples and sampling locations for SVOCs are summarized on Table 6.2-3 and below. Summary statistics for the samples are also presented on Table 6.2-3.

		Surface/Near-Surface		Subsurface	
Area	**Compound**	**No. of Samples**	**No. of Locations**	**No. of Samples**	**No. of Locations**
Magazine Area	SVOCs	8	5	7	3

The results of the SVOC and SVOC TIC analyses of surface/near-surface and subsurface soil samples collected within the Magazine Area are presented in Appendix G and summarized below. SVOC TICs were not identified in the surface or subsurface soil samples collected within the Magazine Area. Surface and subsurface soil sampling locations in the Magazine Area are shown in Figures 6.2-3 and 6.2-4, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 6.2-2.

Surface and Near-Surface Soil – Semivolatile Organic Compounds:

- A total of eight primary and one duplicate surface and/or near-surface soil samples were collected at five (A48-RC08-SB01, A48-ST13-SB01, OS3-F1-SB01, OS3-F1-SB02, and OS3-F1-SB03) locations within the Magazine Area and analyzed for SVOCs, including TICs.
- SVOCs were not detected above their RISLs or PGW SSLs in surface and/or near-surface soil in the Magazine Area.

Subsurface Soil – Semivolatile Organic Compounds:

- A total of seven primary subsurface soil samples were collected at three (A48-RC08-SB01, A48-ST13-SB01, and A48-ST19-SB01) locations within the Magazine Area and analyzed for SVOCs.
- SVOCs were not detected above their RISLs or PGW SSLs in subsurface soil in the Magazine Area.

Summary of Investigation and Results – Perchlorate

A total of nine primary and one duplicate soil samples were collected within the Magazine Area during the BOU RI and analyzed for perchlorate. The number of primary soil samples and sampling locations at the Magazine Area for perchlorate are summarized on Table 6.2-3 and below. Summary statistics for the samples are also presented on Table 6.2-3.

		Surface/Near-Surface		Subsurface	
Area	**Compound**	**No. of Samples**	**No. of Locations**	**No. of Samples**	**No. of Locations**
Magazine Area	Perchlorate	8	4	2	1

The results of the perchlorate analysis of surface/near-surface and subsurface soil samples collected within the Magazine Area are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations in the Magazine Area are shown in Figures 6.2-3 and 6.2-4, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 6.2-2.

Surface and Near-Surface Soil – Perchlorate:

- A total of eight primary and one duplicate surface and/or near-surface soil sample was collected at four (A48-RC08-SB01, OS3-F1-SB01, OS3-F1-SB02, and OS3-F1-SB03) locations within the Magazine Area and analyzed for perchlorate.
- Perchlorate was not detected above its RISL or PGW SSL in the surface/near-surface soil samples collected within the Magazine Area.

Subsurface Soil – Perchlorate:

- Two primary subsurface soil samples were collected at one (A48-ST13-SB01) location within the Magazine Area and analyzed for perchlorate.

- Perchlorate was detected above its PGW SSL, but below its RISL, in two subsurface soil samples collected within the Magazine Area. Perchlorate at 330 µg/kg and 64 µg/kg was detected in soil samples collected from boring A48-ST13-SB01 at 6 and 11.5 feet bgs, respectively. Subsurface soil sampling locations are shown in Figure 6.2-4.

Summary of Investigation and Results – Miscellaneous Compounds

Miscellaneous analyses performed on soil samples within the Magazine Area were nitroguanidine and DI-WET. The number of primary surface/near-surface and subsurface soil samples collected at each source area for each analysis, and the numbers of locations are summarized on the table below.

		Surface/Near-Surface		Subsurface	
Area	**Compound**	**No. of Samples**	**No. of Locations**	**No. of Samples**	**No. of Locations**
Magazine Area	Nitroguanidine	8	5	7	3
	DI-WET	1	1	0	0

The analytical results for the nitroguanidine and DI-WET analyses of surface/near-surface and subsurface soil samples are presented in Appendix G and summarized below.

Nitroguanidine: Eight primary and one duplicate surface/near-surface soil samples were collected at five (A48-RC08-SB01, A48-ST13-SB01, OS3-F1-SB01, OS3-F1-SB02, and OS3-F1-SB03) locations and seven subsurface soil samples were collected at three (A48-RC08-SB01, A48-ST13-SB01, and A48-ST19-SB01) locations within the Magazine Area and analyzed for nitroguanadine. Surface and subsurface soil sampling locations in the Magazine Area are shown in Figures 6.2-3 and 6.2-4, respectively. Soil sampling locations and the features being investigated are cross-referenced on Table 6.2-2.

Nitroguanidine was not detected above its PQL, RISL, or PGW SSL in any of the surface/near-surface and subsurface soil samples collected within the Magazine Area.

Deionized Water - Waste Extraction Test: A DI-WET was performed on one sample (A48-RC08-SB01) collected within the Magazine Area at a depth of 2 feet bgs. The concentrations detected in the soil sample and the sample extract are presented on the table below.

Sample ID	Sample Depth (ft bgs)	Compound	Soil Conc. (mg/kg)	Extract Conc. (mg/L)
A48-RC08-SB01	2.0	Aluminum	8,100	10
		Antimony	---	<0.01
		Arsenic	1.8	0.0099
		Barium	59	1.1 J
		Beryllium	0.16	0.001 J
		Boron	<4.2	<0.05 U
		Cadmium	<0.42	0.0064
		Chromium	26	0.06
		Cobalt	3.5	0.0025 J
		Copper	19	0.84 J
		Lead	2.4	0.027 J
		Lithium	4.5	0.0079 J
		Manganese	130	0.3
		Molybdenum	1.6	0.015 J
		Nickel	24	0.04
		Selenium	<1.7	<0.01
		Silver	<0.83	0.028
		Strontium	32	0.1
		Thallium	<4.2	<0.01
		Titanium	420	0.052 J
		Vanadium	26	0.17
		Zinc	35	0.95 J

Summary of Investigation and Results – Geotechnical Parameters

A total of four soil samples were collected within the Magazine Area for geotechnical analyses. The results of the geotechnical analyses for moisture content, wet density, dry density, specific gravity, porosity, sieve analysis, and/or permeability are summarized on Table 6.2-6.

The geotechnical data will be used in the risk assessment to develop site-specific soil input parameters (moisture content, water-filled porosity, air-filled porosity, etc.) for fate and transport models and in the FS to assess potential remedial actions such as vapor extraction. Fate and transport models are used in risk assessment to quantitatively evaluate the migration of volatile organics into outdoor and indoor air and the potential leaching of chemicals through soil and into groundwater.

6.2.5 *Discussion of Investigation Results with Respect to Data Quality Objectives – Magazine Area*

The analytical results presented in the previous sections identified the following chemical constituents in soil vapor and soil within the Magazine Area at concentrations above their respective RISLs and/or PGW SSLs:

Soil vapor: PCE.

Soil: Thallium and perchlorate.

The presence of these COPCs in each source area is discussed below with respect to the data needs described in Section 4.2.2.3. Specifically,

- Has the investigation resulted in sufficient characterization of the lateral and vertical distribution of each COPC in the vadose zone and identified a potential source for those COPCs?
- Has the investigation resulted in sufficient data to evaluate the potential for COPCs in soil to migrate into and degrade surface water and groundwater quality?
- Has the investigation resulted in data sufficient to support human health and ecological risk assessments and fate and transport modeling?
- Has the investigation resulted in sufficient data to evaluate the feasibility of remediating the identified compounds and concentrations to levels that do not pose a risk to human and ecological receptors or degrade surface water and groundwater quality?

For the purpose of this discussion, it is assumed that chemicals detected at concentrations above their RISL could potentially pose a risk to human health and chemicals detected above their PGW SSL could potentially migrate into groundwater or surface water. Sampling locations where VOCs were detected in soil vapor at concentrations above their respective RISLs and PGW SSLs are shown in Figures 6.2-5a, 6.2-5b, and 6.2-6.

The analytical results for surface water and groundwater in the southwestern portion of the BOU, including the Magazine Area, are discussed in Sections 6.5 and 6.6, respectively, and discussed with respect to potential soil and soil vapor sources within the Magazine Area. Additionally, the potential for chemicals in soil and soil vapor to migrate into surface water and groundwater is further evaluated in Section 8 of the HHERA (Volume II).

6.2.5.1 *Volatile Organic Compounds*

VOCs detected in soil vapor samples collected at the Magazine Area are summarized in Section 6.2.4.3. Concentrations of PCE and TVOC detected in soil vapor above their RISL and PGW SSL in the shallow, intermediate, and deep intervals are shown in Figures 6.2-5a and 6.2-6, respectively. TVOC concentrations above their RISLs are shown in Figures 6.2-5a and

6.2-5b. Conclusions regarding the characterization of VOCs based on the data presented in Section 6.2.4.3 and the figures are summarized below:

- PCE was detected above its RISL in the shallow and deep interval at only one location (A48-ST13-SP06), adjacent to the septic tank and infiltration wells west of Building 48013 (Figure 6.2-5a). Building 48013 is identified as a loading and shipping facility. The presence of PCE in the vadose zone at this location is attributed to the historical discharge of this chemical to the septic system.
- PCE was detected above its PGW SSL in shallow, intermediate, and/ deep soil vapor samples collected at three (A48-ST13-SP04, A48-ST13-SP06, and A48-ST13-SP07) locations within the Magazine Area (Figure 6.2-6).
- The presence of PCE at 1,800 $\mu g/m^3$ in the shallow soil vapor collected at location A48-ST13-SP06 suggests that PCE in the soil vapor may be due to a historical surface releases of that compound and are not attributed to the septic tank.

Based on the information presented above and in Figures 6.2-5a, 6.2-5b, and 6.2-6, the lateral and vertical extent of PCE in the vadose zone within the Magazine Area has been characterized to the extent possible given the presence of perched groundwater in the area. The VOC data is considered sufficient to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

6.2.5.2 *Metals*

Thallium was detected at a concentration above its PGW SSL in a soil sample collected at 11.5 feet bgs from boring A48-RC08-SB01. Boring A48-RC08-SB01 is immediately in front of RCRA C (Building 48008) within the Magazine Area (Figure 6.2-4). The absence of thallium above its PGW SSL in soil samples collected at 2, 4, 5.5, and 6 feet bgs from boring A48-RC08-SB01 suggests that the detected concentration is naturally occurring.

Based on the information presented above, the lateral and vertical extent of thallium in the vadose zone within the Magazine Area is considered sufficient to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

6.2.5.3 *Perchlorate*

Perchlorate was not detected above its RISL in surface, near-surface, or subsurface soil samples collected within the Magazine Area (Section 6.2.4.3). Perchlorate above its PGW SSL was detected in soil samples collected at 6 and 11.5 feet bgs from one boring (A48-ST13-SB01) within the Magazine Area. Boring A48-ST13-SB01 is adjacent to the septic tank and leach system associated with Building 48013. The lateral and vertical extent of perchlorate was defined to the PGW SSL of 3,650 µg/kg proposed in the BOU FSP, but not to the revised PGW SSL of 60 µg/kg. However, it should be noted that perchlorate concentrations in soil from boring A48-ST13-SB01 attenuate with depth to a concentration only slightly above the revised PGW SSL of 60 µg/kg.

Based on the information presented above, the extent of perchlorate in the vadose zone within the Magazine Area is considered sufficient to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

6.3 *SUMMARY AND RESULTS OF VADOSE ZONE REMEDIAL INVESTIGATION – DREDGE PIT AND EASTERN BASIN*

Gold dredging in the area of Aerojet was historically performed by dredges of varying sizes, but primarily by huge, floating dredges. These dredges floated on a large man-made pond and water levels in the pond could be increased or decreased by adding or pumping out water as needed to vary the depth to which dredging was accomplished. The man-made pond essentially moved with the dredger and was backfilled with cobbles, sand, silt, and clay reworked by the dredger to extract the gold. Following the completion of dredging activities, the floating dredgers were dismantled and moved to a different location. The pond in which the dredger was floating at the time that it was dismantled was not backfilled and remained as large, open pits referred to as dredge pits. Depending on depth to groundwater, the dredged pits either remained flooded, resulting in a man-made pond, or the pond became dry resulting in a deep pit. Dredge pits that were not deep enough to encounter the groundwater table may accumulate water during the raining season and dry out during the summer.

Two historical dredge pits are located approximately 2,400 feet (one-half mile) east, northeast of Chemical Plant 2 (Figure 6.3-1). The western-most dredge pit (Source Area 25F) is referred to as the Dredge Pit and the

eastern-most pit is referred to as the Eastern Basin. The edges of the Dredge Pit and Eastern Basin are roughly 180 feet apart and may have historically been connected by a small draw. The Eastern Basin is not identified as a source area but was included in the BOU RI to assess the potential presence of chemicals.

This section provides the following information for the Dredge Pit (Source Area 25F) and Eastern Basin:

- Describes the environmental setting for the Dredge Pit and Eastern Basin;
- Describes each source area investigated during the previous investigations and the BOU RI;
- Summarizes previous vadose zone investigations and the results of those investigations;
- Identifies COPCs identified during the previous investigations;
- Presents the data needs identified in the BOU FSP;
- Summarizes the sampling activities performed during the BOU RI and deviations from the sampling proposed in the BOU FSP; and
- Presents the analytical results for samples collected during the BOU RI and historical data, where appropriate.

The results of the BOU RI with respect to the identification of COPCs; lateral and vertical characterization of COPCs; completeness of the characterization; potential sources; fate and transport of COPCs; and the potential for those COPCs to affect human health, surface water, and groundwater are discussed in Section 6.3.5.

The information presented below regarding the description of source areas and previous investigations was compiled from one or more of the following sources: *Stage 1 Sampling Plan-Zone 1* (Aerojet, 1993a); *Stage 1 Sampling Plan-Zones 3 and 4* (Aerojet 1993b); *Stage 1 Sampling Plan-Zone 2* (Aerojet, 1993c); *Aerojet Superfund Site – Scoping Report, Volumes 1 through 6* (ICF Technology, Inc., 1989); *Aerojet Site; Stage 1 Report - Zones 1 through 4* (ICF Kaiser Engineers, Inc., 1993); or BOU FSP (Aerojet et al., 2006b).

6.3.1 *Environmental Setting – Dredge Pit and Eastern Basin*

The topography, geology, soils, surface water hydrology, general hydrogeology, and ecological habitat of the Dredge Pit and Eastern Basin are described in the following subsections.

6.3.1.1 *Topography*

The topography of the area north, south, and east of the Dredge Pit and Eastern Basin is dominated by dredge tailings consisting of furrows of cobbles divided by slicken valleys. West of the Dredge Pit and Eastern Basin, the terrain is relatively flat with a slight upward slope towards the west. The review of aerial photographs indicate that hard, indurated material (possibly an ancestral American River terrace) that likely did not contain significant amount of gold was encountered by the dredgers as they moved towards the west and therefore dredging operations were halted.

The Dredge Pit and Eastern Basin are connected to each other and the main paved roads (Burma Road and Oklahoma Road) by dirt roads.

6.3.1.2 *Geology*

The site-specific geology of the Dredge Pit and Eastern Basin, based on information presented on field logs of borings drilled during previous investigations and the BOU RI, is described below.

As previously discussed, the Dredge Pit and Eastern Basin are on the contact between dredged and undredged material, which reflects a change in the lithologic material. The dredged areas surrounding the pits are comprised of approximately 70 to 90 feet of reworked Quaternary-aged fluvial deposits of cobbles, sand, silt, and clay underlain by undisturbed layers of weak to well indurated poorly graded gravels with sand, clayey sands, clayey gravels with sand, and gravels with clay and sand to depth of 70 feet below the bottom of the Dredge Pit.

In the undredged areas west of the dredge pits, and on the north, south, and west sidewalls of the Dredge Pit, the lithology consists of interbeds of moderate to well indurated siltstones with thin layers of gravels, gravels with sand, clayey sands, clayey gravels with sand, and gravels with clay and sand; similar to the lithologies encountered below the dredge pits.

6.3.1.3 *Soils*

The Dredge Pit and Eastern Basin are located at the contact between dredged and undredged material and therefore the soils consist of both Xerorthents and Redding-Corning-Red Bluff. Xerorthents are very deep, somewhat excessively drained and excessively drained soils associated with dredge tailings. They are formed in material that has a high content of gravel and cobbles derived from mixed sources. The material was deposited as tailings after most of the fine-earth material was washed from it and removed during gold dredging activities. Slopes are short, complex, and disturbed (USDA – NRCS, 1993).

The Redding-Corning-Red Bluff complex consists of moderately well-drained soils that are moderately deep over a cemented hard pan. The soils form in alluvium that is derived from mixed rock sources. The Redding soils are typically a surface layer of gravelly loam with subsoil comprised of a gravelly claypan, which is in turn underlain by a hardpan at a depth of 20 to 40 inches. The Corning-Red Bluff soils are typically a loam with a subsoil of clay loam, gravelly loam, and gravelly clay loam (USDA – NRCS, 1993).

6.3.1.4 *Surface Water Hydrology*

Rain water accumulation in the Dredge Pit and Eastern Basin during the wet season account for the only local surface water features. Surface water runoff in the area of the dredge tailings is minimal and most of the precipitation infiltrates into the soil. The Dredge Pit and Eastern Basin generally contain water during the wet season and dry out during the summer and fall. The duration in which water may be present in the pits varies depending on the amount of precipitation received during the winter months.

6.3.1.5 *Local Hydrogeology*

The first saturated sediments encountered in the area of the Dredge Pit and Eastern Basin is either part of Perched Groundwater or within the FWBZ. The general hydrogeology of the Perched Groundwater and FWBZ beneath the Dredge Pit and Eastern Basin is discussed below. Details regarding the occurrence of groundwater within the Chemical Plant 2 Region and distribution of chemicals in the groundwater are presented in Section 6.6.

Perched Groundwater

There are several Perched Groundwater zones in the Chemical Plant 2 Region, which have been generally grouped into an Upper Perched Zone and a Lower Perched Zone. The definitions refer to an assemblage of several perched groundwater zones, and not one specific unit.

The Upper Perched Zone typically occurs in ancestral American River sediments that have been reworked by historical gold-dredging activities and the base generally coincides with the interface between the permeable dredged material and the relatively impermeable, undredged material. In the Dredge Pit Area, the Upper Perched Zone was encountered at a depth of roughly 10 feet bgs.

Lower Perched Groundwater occurs in discontinuous sand lenses in a generally fine-grained lithologic unit and is water that was left perched as a result of the decrease in water levels in the FWBZ. Lower Perched Groundwater was not encountered beneath the Dredge Pit and Eastern Basin.

First Water-Bearing Zone

The FWBZ in the area of the Dredge Pit and Eastern Basin occurs within Layer A. Depth to the top of FWBZ in the area ranges from 54 feet bgs in the Dredge Pit to 115 feet bgs in the dredged areas south of the pits. The increase in depth to groundwater is generally due to increased elevations beyond the interior of the pits and an ancestral American River terrace. Groundwater elevations in the FWBZ have decreased an average of 39 feet between 1983/1984 and April 2006, with lowest levels generally occurring between 1994 and 1996. Data indicates that groundwater elevations in the FWBZ are continuing to drop.

Flow direction in the FWBZ is general towards the west, consistent with the migration of groundwater from the Line 03 Area east of Chemical Plant 2 towards GET E/F Extraction Wells 4007 and 4310. The average hydraulic gradient across Chemical Plant 2 Area is approximately 0.0064 ft/ft, but flattens to approximately 0.0004 in the area immediately upgradient (east) of Chemical Plant 2.

6.3.1.6 *Ecological Habitat*

The area surrounding the Dredge Pit and Eastern Basin consists primarily of dredger tailings and patches of coyote scrub brush.

Typical flora within the dredger tailings consists primarily of non-native grasses and other weedy species, such as Italian thistle and yellow star-thistle. The coyote scrub brush community is most commonly encountered in the slickens area between the dredge piles and is dominated by coyote brush and other shrubs such as blue elderberry, poison oak, willow, and hoary coffeeberry. Fauna commonly encountered within the coyote scrub brush include various raptors, western fence lizard, mountain garter snake, western rattlesnake, ringneck snake, Pacific gopher snake, California quail, Bewick's wren, wrentit, California thrasher, spotted towhee, California towhee, deer mouse, California vole, black-tailed jackrabbit, desert cottontail, raccoon, gray fox, coyote, and black-tailed deer. Fauna are not common in the dredger tailings due in part to the cobble-boulder substrate and sparse vegetation cover.

Blue elderberry shrubs, potential habitat for the valley elderberry longhorn beetle (*desmocerus californicus dimorphus*) are also scattered throughout the area surrounding the Dredge Pit and Eastern Basin.

A *Biological Assessment Report* (ECORP Consulting, Inc. 2005), including a habitat and vegetation map for the dredge pit area, was presented in Appendix B of the BOU FSP.

6.3.2 *Description of Source Areas – Dredge Pit and Eastern Basin*

The Dredge Pit (Source Area 25F) and the Eastern Basin are described below and shown in Figure 6.3-1.

6.3.2.1 *Source Area 25F (Dredge Pit)*

Source Area 25F, referred to as the Dredge Pit, is roughly 1 acre in size, approximately 40 feet bgs at its deepest point, and has an estimated capacity of roughly 6,000,000 gallons. From June 1976 to June 1978, the Dredge Pit intermittently received waste from the manufacturing processes associated with the organic herbicide Prowl and OBPA, and other manufacturing facility wastes from Chemical Plant 2. Wastes were discharged to the Dredge Pit when the deep injection well at Chemical Plant 2 became fouled. From July to October 1978, waste material contained in the Dredge Pit was pumped back to Cordova Chemical Company Plant 2 and injected into deep injection wells.

6.3.2.2 *Eastern Basin*

The Eastern Basin dredge pit encompasses roughly 1 acre and is approximately 40 feet bgs at its deepest point. An apparent man-made cut apparently connected the Dredge Pit (Source Area 25F) and the Eastern Basin at some time in the past, but this route was blocked during construction of the dirt road between the two pits. The man-made cut may have been constructed when the dredgers were being dismantled.

6.3.3 *Summary and Results of Previous (Pre-2005) Vadose Zone Investigations – Dredge Pit and Eastern Basin*

The following subsections summarize the scope and results of previous (prior to 2005) vadose zone investigations of the Dredge Pit and Eastern Basin, identify COPCs based on the previous investigations, and discuss the DQOs and sampling proposed in the BOU FSP.

6.3.3.1 *Summary of Previous (Pre-2005) Vadose Zone Investigations – Dredge Pit and Eastern Basin*

Soil samples from soil borings and trenches and 11 soil vapor samples were collected in the bottom of the Dredge Pit (Source Area 25F) between 1978 and 1993. Soil vapor samples were analyzed for VOCs. Soil samples were analyzed for VOCs, SVOCs, metals, and/or pesticides (including Prowl). Previous investigations of those source areas are summarized below. The purpose of the previous investigations is discussed in Section 2.7.

<u>Source Area 25F</u>

Previous vadose zone investigations were conducted at Source Area 25F (Dredge Pit) between 1978 and August 1993. The scope of those investigations is outlined below:

- March 1978 – Two surface water samples were collected from the Dredge Pit and analyzed for metals and other compounds.
- April 1979 – Four surface soil samples were collected from the north and west banks and bottom of the Dredge Pit and analyzed for metals and other compounds. Additionally, three surface water samples were collected and analyzed for metals, Prowl, and related organics.
- May 1979 – Continuous core samples were collected from the bottom of the Dredge Pit to a depth of 24 inches bgs at three locations. The

cores (A, B, and C) were segmented into twelve 2-inch samples and analyzed for Prowl and related organics.

- 1979 – Four 12-feet-deep exploration trenches (DP-1 through DP-4) were dug in the bottom of the Dredge Pit. Three samples were collected from each trench except DP-2, where trench wall instability was encountered. Samples were analyzed for metals and other compounds.
- September 1983 – Soil samples were collected at depths between 1 and 62.5 feet from four soil borings and analyzed for selected VOCs.
- August 1992 – Ten soil vapor samples were collected between 5 and 20 feet bgs and analyzed for VOCs.
- September 1993 – Soil samples were collected between 1 and 10 feet bgs from three borings and analyzed for selected SVOCs and metals. Additionally, one soil vapor sample was collected at 39.5 feet bgs and analyzed for selected VOCs.

<u>Eastern Basin</u>

Previous vadose zone investigations were not conducted in the Eastern Basin.

6.3.3.2 *Results of Previous (Pre-2005) Vadose Zone Investigation Results – Dredge Pit and Eastern Basin*

The results of the previous (prior to 2005) investigations of Source Area 25F, as presented in the BOU FSP (Aerojet et al., 2006b), are summarized below.

Review of the previous data identified the following COPCs in soil and/or soil vapor at Source Area 25F:

- **Soil –** VOCs, SVOCs, metals, and pesticides (including Prowl).
- **Soil Vapor –** VOCs.

Figures showing previous sampling locations at Source Area 25F and chemical groups detected in soil samples collected between 1991 and 2005 above human health and ecological screening levels were presented in the BOU FSP (Aerojet et al., 2006b). The BOU FSP also presented a summary of statistics and the sample results for chemicals detected in soil, soil vapor, and groundwater that exceed human health and ecological screening levels at Source Area 25F.

Pre-2000 (1991 to 1999) soil vapor sampling locations and associated TVOC plumes are shown in Appendix E. PCE, TCE, DCE, and Freon 113 plumes, based on the pre-2000 soil vapor sampling data, are shown in Appendix E. Pre-2005 soil sampling locations within Source Area 25F are shown in the figures in Appendix E. Chemicals detected above their RISL and/or PGW SSL in pre-2005 soil samples are also shown in the figures in Appendix E.

6.3.3.3 *Summary of Data Needs – Dredge Pit and Eastern Basin*

Based on a review of the previous vadose zone investigation data, extensive aerial photograph research and review, and exhaustive research of historical documents, Aerojet determined that additional soil and soil vapor sampling was needed at Source Area 25F and the Eastern Basin to:

- Confirm the presence of VOCs in the vadose zone;
- Characterize the present lateral and vertical extent of VOCs, metals, SVOC, and pesticides in soil in the vadose zone at concentrations that could potentially impact human and ecological receptors;
- Evaluate the potential for chemicals in soil to migrate into and degrade surface or groundwater quality; and
- Obtain sufficient data to support fate and transport modeling, evaluate risk to human and ecological receptors, and identify and evaluate potential remedial alternatives.

6.3.4 *Summary and Results of Boundary Operable Unit Vadose Zone Investigation – Dredge Pit and Eastern Basin*

The following subsections summarize the BOU investigation (2005 to 2007) of the Dredge Pit (Source Area 25F) and the Eastern Basin, describe deviations from the sampling proposed in the BOU FSP, and present the results of the BOU RI. The results of the sampling with respect to the completeness of the characterization and identification of potential sources are discussed in Section 6.3.5.

6.3.4.1 *Summary of Boundary Operable Unit Vadose Zone Investigation – Dredge Pit and Eastern Basin*

The BOU RI of the vadose zone at Source Area 25F (Dredge Pit) and Eastern Basin included the following activities.

Soil Vapor Investigation

Soil vapor samples were not collected at the bottom of the Dredge Pit (Source Area 25F) or the Eastern Basin due to the presence of ponded water. Soil samples were collected at one location in the Dredge Pit and analyzed for VOCs.

Surface and Subsurface Soil Investigation

- A total of 19 primary and two duplicate surface and/or near-surface (0 to 2.5 feet bgs) soil samples and 48 primary and four duplicate subsurface (2.6 to 61 feet bgs) soil samples were collected at Source Area 25F and the Eastern Basin. Surface and subsurface soil sampling locations are shown in Figures 6.3-2 and 6.3-3, respectively.
- Surface and/or near-surface soil samples were analyzed for VOCs, SVOCs, metals, N-nitrosodimethylamine (NDMA), pesticides (including Prowl), pH, TOC, CEC, and/or geotechnical parameters. The SVOC analysis of soil samples also included an evaluation of the presence of TICs, including OBPA. In accordance with the BOU FSP, sample analyses were based on the analytical results from previous investigations and therefore every sample was not analyzed for the full suite of constituents.
- Subsurface soil samples were analyzed for VOCs, SVOCs, metals, pesticides (including Prowl), pH, TOC, CEC, DI-WET, and/or geotechnical parameters. The SVOC analysis of soil samples also included an evaluation of the presence of TICs, including OBPA. In accordance with the BOU FSP, sample analysis was based on the analytical results from previous investigations and therefore every sample was not analyzed for the full suite of constituents.
- The numbers of surface/near-surface and subsurface soil samples collected for each analysis (including QA/QC samples) at Source Area 25F and the Eastern Basin, along with the corresponding methods, are provided on Table 6.3-1.
- A cross-reference between surface/near-surface and subsurface soil sampling locations within the Dredge Pit and Eastern Basin are provided on Table 6.3-2.

6.3.4.2 *Deviations from Boundary Operable Unit Data Quality Objectives and Sampling Design – Dredge Pit and Eastern Basin*

Sampling activities conducted at Source Area 25F and the Eastern Basin during the BOU RI were generally consistent with those proposed in the BOU FSP, with the exceptions listed on Table 6.3-3. Sampling was performed at locations proposed in the BOU FSP and step-out sampling was performed in accordance with the procedures agreed upon with the agencies. A comparison of proposed and actual sampling activities, including sampling rationale, sample depth, and analyses, is provided on Table 6.3-3. Soil sampling locations associated with the Dredge Pit and Eastern Basin are listed on Table 6.3-2.

6.3.4.3 *Results of Boundary Operable Unit Vadose Zone Investigation – Dredge Pit and Eastern Basin*

The results of the VOC, metals, SVOC, pesticides, pH, TOC, CEC, DI-WET, and geotechnical analyses of samples collected at Source Area 25F and the Eastern Basin during the BOU RI are summarized below. The analytical results for all soil samples are provided in Appendix G. A discussion of the results with respect to the completeness of the characterization of constituents identified above RISLs or PGW SSLs and potential sources are presented in Section 6.3.5.

<u>Summary of Investigation and Results – Volatile Organic Compounds</u>

Based on evaluation of the existing data for the Dredge Pit (Source Area 25F) and Eastern Basin, the BOU FSP concluded that additional sampling was needed to characterize the nature and extent of VOCs.

Soil samples were collected at 0.25, 1.5, and 5 feet bgs from one boring (25F-SD01) drilled at the lowest point in the Dredge Pit (Source Area 25F) and analyzed for VOCs, including TICs. The analytical results for the soil samples are presented in Appendix G and summarized below. The soil sampling locations are shown in Figures 6.3-2 and 6.3-3.

VOCs were not detected at concentrations above their respective RISLs or PGW SSLs in the soil samples collected from boring 25F-SD01.

<u>Summary of Investigation and Results – Metals</u>

A total of 53 primary and 6 duplicate soil samples were collected 27 locations at Source Area 25F and the Eastern Basin during the BOU RI and

analyzed for metals, including mercury. The number of primary soil samples and sampling locations at Source Areas 25F and the Eastern Basin are summarized on Table 6.3-1, and below. Summary statistics for the samples are also presented on Table 6.3-1.

		Surface/Near-Surface		Subsurface	
Source Area	**Compound**	**No. of Samples**	**No. of Locations**	**No. of Samples**	**No. of Locations**
25F	Metals	15	13	38	14
	Mercury	15	13	38	14
Eastern Basin	Metals	5	4	10	4
	Mercury	5	4	10	4

The results of the metals analysis of surface/near-surface and subsurface soil samples collected at Source Area 25F (Dredge Pit) and the Eastern Basin are presented in Appendix G and summarized below.

Because the Dredge Pit and Eastern Basin could have potentially received discharges originating from Chemical Plant 2, the same list of metals detected in soil samples collected within the Chemical Plant 2 Area at concentrations statistically different than background was also utilized for these features. Metals compared to screening levels for the Dredge Pit and Eastern Basin were aluminum, antimony, arsenic, barium, cadmium, chromium, copper, mercury, molybdenum, nickel, selenium, silver, thallium, and zinc. Because boron, lithium, strontium, and titanium were not included in the background evaluation, concentrations of these metals were also compared to screening levels. Because soils within the Dredge Pit and Eastern Basin were derived from both soil types (Xerorthents and Redding-Corning-Red Bluff), concentrations for metals were compared to the lowest PGW SSL for those soil types.

Surface and subsurface soil sampling locations at Source Area 25F and the Eastern Basin are shown in Figures 6.3-2 and 6.3-3. Soil sampling locations associated with the Dredge Pit and Eastern Basin are listed on Table 6.3-2. Metals detected in the Dredge Pit and Eastern Basin at concentrations above their RISLs and PGW SSLs are shown in Figure 6.3-4.

Surface and Near-Surface Soil – Metals:

- Fifteen primary and two duplicate surface/near-surface soil samples were collected at 13 locations at Source Area 25F and the Eastern Basin and analyzed for metals, including mercury.

- Mercury was the only metal detected at a concentration statistically above background and its RISL of 18 mg/kg and PGW SSL of 5.7 mg/kg in surface and/or near-surface soil collected within the Dredge Pit. Mercury at 34 mg/kg was detected in a near-surface (1 foot bgs) soil sample collected from boring 25F-SB07 (Figure 6.3-4).
- Metals were not detected above their respective RISLs and/or PGW SSLs in surface and/or near-surface soil collected within the Eastern Basin.

Subsurface Soil – Metals:

- Thirty-eight primary and four duplicate subsurface soil samples were collected at 14 locations at Source Area 25F and the Eastern Basin and analyzed for metals, including mercury. Subsurface soil sampling locations in the Dredge Pit and Eastern Basin are shown in Figures 6.3-3 and 6.3-4.
- Metals were not detected above their respective RISLs in the subsurface soil samples collected from the Dredge Pit (Source Area 25F). Additionally, metals were not detected above their respective RISLs or PGW SSLs in the subsurface soil samples collected within the Eastern Basin.
- Mercury and thallium were the only metals detected in subsurface soil samples collected within the Dredge Pit above their respective PGW SSLs. The location and depth of the subsurface samples having mercury and/or thallium above their PGW SSL and the detected concentrations are listed on the table below. Mercury and thallium concentrations above their PGW SSLs are shown in Figure 6.3-4.

Sample Location	Depth (ft bgs)	Metal	RISL (mg/kg)	PGW SSL (mg/kg)	Conc. (mg/kg)	> RISL	> PGW SSL
25F-SB07	5	Thallium	5.0	3.3	4.0	N	Y
	11	Mercury	18	5.7	14	N	Y
	41	Thallium	5.0	3.3	3.6	N	Y

Summary of Investigation and Results – Semivolatile Organic Compounds

A total of 54 primary and 5 duplicate soil samples were collected at Source Area 25F and the Eastern Basin and analyzed for SVOCs, including TICs. The number of primary soil samples and sampling locations at Source Area 25F and the Eastern Basin for SVOCs are summarized on Table 6.3-1,

and below. Summary statistics for the samples are also presented on Table 6.3-1.

		Surface/Near-Surface		Subsurface	
Source Area	**Compound**	**No. of Samples**	**No. of Locations**	**No. of Samples**	**No. of Locations**
25F (Dredge Pit)	SVOCs	7	6	28	10
Eastern Basin	SVOCs	9	8	10	4

The results of the SVOC and SVOC TIC analyses of surface/near-surface and subsurface soil samples collected at Source Area 25F and the Eastern Basin are presented in Appendix G and summarized below. TICs were not identified in the SVOC analyses of surface/near-surface and subsurface soil samples collected at Source Area 25F and the Eastern Basin.

Surface and subsurface soil sampling locations within Source Area 25F and the Eastern Basin are shown in Figures 6.3-2 and 6.3-3, respectively. Soil sampling locations associated with the Dredge Pit and Eastern Basin are listed on Table 6.3-2. SVOCs detected at concentrations above their RISLs and PGW SSLs in soil at Source Area 25F and the Eastern Basin are shown in Figure 6.3-5.

Surface and Near-Surface Soil – Semivolatile Organic Compounds:

- Sixteen primary and one duplicate surface and/or near-surface soil samples were collected at 14 locations at Source Area 25F and the Eastern Basin and analyzed for SVOCs, including TICs (Figure 6.3-5).
- SVOCs were not detected above their respective RISLs in the surface/near-surface soil samples collected within the Dredge Pit and Eastern Basin.
- B(a)P and/or B(b&k)F were detected in only two of the 19 near-surface soil samples collected from within the Dredge Pit (Source Area 25F) at concentrations above their respective PGW SSLs. The detected concentrations of B(a)P and B(b&k)F, and the location and depth of the samples, are provided in the table below. Concentrations of B(a)P and B(b&k)F are shown in Figure 6.3-5.
- SVOCs above their respective PGW SSLs were not detected in surface/near-surface soil within the Eastern Basin.

Sample Location	Depth (ft bgs)	SVOC	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	> RISL	> PGW SSL
25F-HA01	1.0	Benzo(a)pyrene	38	2.9	10 J	N	Y
25F-SB06	0.5	Benzo(a)pyrene	38	2.9	14 J	N	Y
		Benzo(b&k)fluoranthene	38	29	36	N	Y

Subsurface Soil – Semivolatile Organic Compounds:

- A total of 38 primary and 4 duplicate subsurface soil samples were collected at 14 locations at Source Area 25F and the Eastern Basin and analyzed for SVOCs (Figure 6.3-5).
- SVOCs were not detected above their respective RISLs in subsurface soil collected at Source Area 25F and the Eastern Basin.
- B(a)P and B(b&k)F were detected at concentrations above their respective PGW SSLs in only one subsurface soil sample collected within the Dredge Pit. B(a)P at 20 µg/kg and B(b&k)F at 40 µg/kg were detected in a sample collected at a depth of 5 feet bgs from boring 25F-SB06. SVOCs were not detected above their respective PGW SSLs in subsurface soil samples collected from boring 25F-HA01.
- SVOCs above their respective PGW SSLs were not detected in surface/near-surface soil within the Eastern Basin.

Summary of Investigation and Results – Miscellaneous Compounds

Miscellaneous analyses performed on soil samples collected at Source Area 25F and the Eastern Basin were pesticides, OBPA, pH, TOC, CEC, and DI-WET. The number of primary surface/near-surface and subsurface soil samples collected at each source area and the number of locations are summarized on the table below.

		Surface/Near-Surface		Subsurface	
Source Area	Compound	No. of Samples	No. of Locations	No. of Samples	No. of Locations
25F (Dredge Pit)	Pesticides	10	9	28	6
	OBPA	7	6	28	10
	pH	7	6	28	6
	TOC	6	5	8	3
	CEC	3	2	8	3
	DI-WET	0	0	1	1

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
Eastern Basin	Pesticides	5	4	10	4
	OBPA	5	4	10	4
	pH	5	4	10	4
	TOC	6	5	1	1
	CEC	2	1	1	1
	DI-WET	0	0	1	1

The analytical results for the miscellaneous analyses of surface/near-surface and subsurface soil samples collected at Source Area 25F and the Eastern Basin are presented in Appendix G and summarized below. Surface/near-surface and subsurface soil sampling locations at Source Area 25F and the Eastern Basin are shown in Figures 6.3-2 and 6.3-3, respectively.

The analytical data for pH, TOC, and CEC are used in the risk assessments to evaluate the bioavailability of some chemicals with respect to human and ecological receptors. Additionally, the TOC and CEC data are used in the FS to evaluate chemical and physical remedial actions.

Pesticides: Surface and subsurface soil sampling locations at Source Area 25F and the Eastern Basin are shown in Figures 6.3-2 and 6.3-3, respectively. Soil sampling locations associated with the Dredge Pit and Eastern Basin are listed on Table 6.3-2.

Pesticides, including Prowl, were not detected above their respective RISLs and PGW SSLs in the soil samples collected from the Dredge Pit (Source Area 25F) or Eastern Basin.

OBPA: OBPA was not detected above its PQL in surface/near-surface or subsurface soil samples collected at Source Area 25F and the Eastern Basin.

pH: The results of the pH analysis of 12 surface/near-surface soil samples and 38 subsurface soil samples collected at Source Area 25F and the Eastern Basin are summarized on the table below.

Source Area	Surface/ Near-Surface Soil	Subsurface Soil
25F	7.05 – 9.76	8.01 – 10.2
Eastern Basin	7.21 – 8.83	6.36 – 8.11

Total Organic Carbon: TOC at 2,900; 3,500; and 11,700 mg/kg was detected in near-surface soil samples collected from borings 25F-SB12, 25F-SB13, and 25F-SB14, respectively, at Source Area 25F. TOC was not detected in the subsurface soil samples collected within Source Area 25F.

TOC at 7,600; 17,000; 2,000; and 5,800 mg/kg was detected in near-surface soil samples collected from borings 25F-SB08, 25F-SB09, 25F-SB10, and 25F-SB11, respectively, in the Eastern Basin. TOC was not detected in any of the subsurface soil samples collected within the Eastern Basin.

Cation Exchange Capacity: CEC in the surface/near-surface and subsurface soil samples collected at Source Area 25F ranged from 200 to 410 meq/K. CEC in the two surface/near-surface and one subsurface soil samples collected from boring 25F-SD02 in the Eastern Basin ranged from 190 to 220 meq/K.

Summary of Investigation and Results – Geotechnical Parameters

Twenty soil samples were collected at Source Area 25F and the Eastern Basin during the BOU RI for geotechnical parameters. The results of the geotechnical analyses of soil samples for moisture content, wet density, dry density, specific gravity, porosity, sieve analysis, and/or permeability are summarized on Table 6.3-4.

The geotechnical data will be used in the risk assessment to develop site-specific soil input parameters (moisture content, water-filled porosity, air-filled porosity, etc.) for fate and transport models and in the FS to assess potential remedial actions such as vapor extraction. Fate and transport models are used in risk assessment to quantitatively evaluate the migration of volatile organics into outdoor and indoor air and the potential leaching of chemicals through soil and into groundwater.

6.3.5 Discussion of Investigation Results with Respect to Data Quality Objectives – Dredge Pit and Eastern Basin

The analytical results presented in the previous sections identified the chemical constituents listed below in soil within the Dredge Pit (Source Area 25F) at concentrations above their respective RISLs and/or PGW SSLs. No chemicals were detected above their RISLs or PGW SSLs in soil within the Eastern Basin.

Soil: Metals (mercury and thallium) and PAHs [B(a)P and B(b&k)F].

The presence of these COPCs in each source area is discussed below with respect to the data needs described in Section 4.2.2.3. Specifically,

- Has the investigation resulted in sufficient characterization of the lateral and vertical distribution of each COPC in the vadose zone and identified a potential source for those COPCs?
- Has the investigation resulted in sufficient data to evaluate the potential for COPCs in soil to migrate into and degrade surface water and groundwater quality?
- Has the investigation resulted in data sufficient to support human health and ecological risk assessments and fate and transport modeling?
- Has the investigation resulted in sufficient data to evaluate the feasibility of remediating the identified compounds and concentrations to levels that do not pose a risk to human and ecological receptors or degrade surface water and groundwater quality?

For the purpose of this discussion, it is assumed that chemicals detected at concentrations above their RISL could potentially pose a risk to human health and chemicals detected above their PGW SSL could potentially migrate into groundwater or surface water. Sampling locations where metals and SVOCs were detected in surface and/or subsurface soil at concentrations above their respective RISLs and PGW SSLs are shown in Figures 6.3-4 and 6.3-5.

The analytical results for surface water and groundwater in the southwestern portion of the BOU, including the Dredge Pit and Eastern Basin, are discussed in Sections 6.5 and 6.6, respectively, and discussed with respect to potential soil sources within the Dredge Pit. Additionally, the potential for chemicals in soil to migrate into surface water and groundwater is further evaluated in Section 8 of the HHERA (Volume II).

6.3.5.1 *Metals*

Metals were not detected at concentrations above their respective RISLs and PGW SSLs in soil samples collected from the Eastern Basin (Section 6.3.4.3; Figure 6.3-4). Mercury above its RISL and PGW SSL and thallium above its PGW SSL was detected in soil samples collected from one boring (25F-SB07) within the Dredge Pit (Source Area 25F) (Figure 6.3-4).

The lateral extent of mercury and thallium is defined by the absence of those metals above their respective PGW SSLs in soil samples collected from borings 25F-SB04, 25F-SB05, 25F-SB06, and 25F-SB12.

The vertical extent of mercury is defined by the absence of that metal in soil samples collected at 21, 31, 41, and 49 feet bgs from boring 25F-SB07.

Thallium was detected above its PGW SSL in only two of seven soil samples from boring 25F-SB07 at 5 and 41 feet bgs. The absence of thallium in soil samples collected at 1, 11, 21, 31, and 49 feet bgs from boring 25F-SB07 and in soil samples collected from surrounding borings indicates that the detected concentrations of 4.0 and 3.6 mg/kg may be naturally occurring.

Based on the information presented above, the lateral and vertical extent of mercury and thallium above their PGW SSLs within the Dredge Pit have been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

6.3.5.2 *Semivolatile Organic Compounds*

SVOCs were not detected above their respective RISLs in the soil samples collected within the Dredge Pit and Eastern Basin. Additionally, SVOCs were not detected above their respective PGW SSLs in the soil samples collected within the Eastern Basin.

B(a)P and/or B(b&k)F were detected above their PGW SSLs in soil samples collected at only two locations (25F-HA01 and 25F-SB06) within the Dredge Pit (Source Area 25F) (Figure 6.3-5). The characterization of those compounds at both locations is discussed below.

<u>25F-HA01</u>

B(a)P above its PGW SSL was detected in a near-surface (1 foot bgs) soil sample collected at one location (25F-HA01) within the Dredge Pit (Figure 6.3-5). The lateral extent of B(a)P is defined by the absence of that compound above its PGW SSL in soil samples collected at locations 25F-SD01, 25F-SB07, and 25F-SB12. The vertical extent of B(a)P is defined by the absence of that compound above its PGW SSL in soil samples collected at 5 feet bgs at location 25F-HA01.

25F-SB06

B(a)P and B(b&k)F were detected at concentrations above their respective PGW SSLs in soil samples collected at 0.5 and 5 feet bgs at one location (25F-SB06) within the Dredge Pit.

The lateral extent of B(a)P and B(b&k)F is defined by the absence of those compounds above their PGW SSLs in soil samples collected from borings 25F-SD01, 25F-SB05, 25F-SB07, and 25F-SB13. The vertical extent of B(a)P and B(b&k)F is defined by the absence of those compounds above their PGW SSLs in soil samples collected at 11 and 21 feet bgs from boring 25F-SB06.

Based on the information presented above, the lateral and vertical extent of B(a)P and B(b&k)F within the Dredge Pit (Source Area 25F) has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

6.3.5.3 pH

The results of the pH analysis of 12 surface/near-surface soil samples and 38 subsurface soil samples collected at Source Area 25F and the Eastern Basin are summarized on the table below.

Source Area	Surface/ Near-Surface Soil	Subsurface Soil
25F	7.05 – 9.76	8.01 – 10.2
Eastern Basin	7.21 – 8.83	6.36 – 8.11

Four surface soil samples and 22 subsurface soil samples collected within the Dredge Pit (Source Area 25F) had a pH above the normal high level of 9 for mineral soils (Brady, 1974). The high pH observed in the soils could potentially be related to discharges of wastes from Chemical Plant 2.

The pHs for soil within the Eastern Basin were within the normal range (5 to 9) for mineral soils.

6.4 *SUMMARY AND RESULTS OF VADOSE ZONE REMEDIAL INVESTIGATION – OPEN SPACE AREAS 1, 2, 3, AND 4*

As discussed in Section 2.4, the Aerojet facility has primarily been used for the design, development, and testing of solid and liquid fuel rocket propulsion systems. In accordance with United States Department of Defense and National Aeronautics and Space Administration regulations regarding operations involving energetic materials, these operations were separated from one another and neighboring properties by large tracts of open land (buffer zones). No testing was conducted within these buffer zones.

Open Space Areas 1, 2, and 4 (OS1, OS2, and OS4) consist of buffer zones located between operational areas (Chemical Plant 2 and Line 03) on the site and neighboring properties to the west and south (Figure 6.0-1). OS3 is incorporated into and synonymous with the Magazine Area, as described and discussed in Section 6.2.

This section describes the environmental setting of OS1, OS2, and OS4, summarizes the scope and results of historical and recent investigations, and discusses the results of the investigation with respect to potential source and completeness of characterization.

The information presented was compiled from one or more of the following sources: *Stage 1 Sampling Plan - Zone 1* (Aerojet, 1993a); *Stage 1 Sampling Plan - Zones 3 and 4* (Aerojet, 1993b); *Stage 1 Sampling Plan – Zone 2* (Aerojet, 1993c); *Aerojet Superfund Site – Scoping Report, Volumes 1 through 6* (ICF Technology, Inc., 1989); *Aerojet Site, Stage 1 Report - Zones 1 through 4* (ICF Kaiser Engineers, Inc., 1993); or BOU FSP (Aerojet et al., 2006b).

6.4.1 *Environmental Setting – Open Space Areas 1, 2, and 4*

The topography, geology, soils, surface water hydrology, general hydrogeology, and ecological habitat of OS1, OS2, and OS4 are described below. As previously discussed, OS3 is synonymous with the Magazine Area and is discussed in Section 6.2.

6.4.1.1 *Topography*

With the exception of graded areas around a few buildings such as Aerojet GET E/F, OS1 consists primarily of dredge tailings comprised of relatively low mounds of cobbles separated by low-lying slicken valleys.

Topographic relief in the area is provided by a strip of undredged material representing an ancestral American River terrace transects OS1 diagonally from the southwest to the northeast. This thin section of elevated land may have potentially been used as an access road during dredging and possibly may have included a branch line/ditch extending from Rebel Hill Ditch near Old White Rock Road.

OS2 is buffer land between Chemical Plant 2/Magazine Area and Line 03. OS2 consists of land that has been deeply and extensively dredged and consists of high, wide cobble piles separated by deep slicken valleys that support vegetation. A few graded dirt roads along the top of the cobble piles cross the area.

OS4 is buffer land between the Magazine Area and Chemical Plant 1/ Line 05. OS4 consists of dredge tailings with both north-south and east-west trending cobble piles separated by slickens valleys that support vegetation. A dirt road is present along the eastern boundary of OS4.

6.4.1.2 *Geology*

The geology of Open Space Areas 1, 2, and 4, based on borings and wells located within or adjacent to those areas, is described below.

<u>Open Space Areas 1 and 2</u>

The majority of the land within OS1 and OS2 has been extensively dredged for gold and data indicate that dredging in these areas was accomplished to depths ranging from 70 to 90 feet bgs. The geology in OS1 and OS2 is similar to that observed in the area of the Dredge Pit and Eastern Basin consisting of reworked Quaternary-aged fluvial deposits of cobbles, sand, silt, and clay to depths of 70 to 90 feet, underlain by undisturbed layers of weak to well-indurated poorly graded gravels with sand, clayey sands, clayey gravels with sand, and gravels with clay and sand.

Although the majority of the land encompassed by OS1 and OS2 has been dredged, a northeast-southwest trending ancestral American River terrace forms a strip of undredged material that divides the dredging areas in OS1 and OS2 from those in the Magazine Area and OS4. This strip of undredged American River terrace extends from near the intersection of Old White Rock Road and New White Rock Road to across the northern portion of Chemical Plant 2 (Source Area 59F) to the undredged material exposed in the Dredge Pit and Eastern Basin. The geologic material of the

terrace consists of moderate to well-indurated siltstones with thin layers of gravels, gravels with sand, clayey sands, clayey gravels with sand, and gravels with clay and sand.

Open Space Area 4

The lands encompassed by OS4 have been entirely dredged and the lithologic material consists of reworked Quaternary-aged fluvial deposits of cobbles, sand, silt, and clay to depths between 45 and 55 feet bgs, underlain by undisturbed layers of weak to well-indurated poorly graded gravels with sand, clayey sands, clayey gravels with sand, and gravels with clay and sand.

6.4.1.3 *Soils*

Dredge tailings are classified as Xerorthents. Xerorthents are very deep, somewhat excessively drained, and excessively drained soils associated with dredge tailings. They are formed in material that has a high content of gravel and cobbles derived from mixed sources. The material was deposited as tailings after most of the fine-earth material was washed from it and removed during gold dredging activities. Slopes are short, complex, and disturbed (USDA – NRCS, 1993).

Undredged portions of OS1, OS2, and OS4 are classified as Redding-Corning-Red Bluff consisting of moderately well-drained soils that are moderately deep over a cemented hard pan. This soil unit is found on intermediate and high terraces, terrace remnants, and the side slopes of terraces in the eastern part of Sacramento County. The soils form in alluvium that is derived from mixed rock sources. The Redding soils are typically a surface layer of gravelly loam with subsoil comprised of a gravelly claypan, which is in turn underlain by a hardpan at a depth of 20 to 40 inches. The Corning-Red Bluff soils are typically a loam with a subsoil of clay loam, gravelly loam, and gravelly clay loam.

6.4.1.4 *Surface Water Hydrology*

Surface water within the dredge tailings typically infiltrates quickly into the underlying soils or temporarily ponds in the slickens valleys. No predominant surface water features are present within OS1, OS2, and OS4, but historical remnants of Rebel Hill Ditch may be found along the southern boundary of OS1 and OS2.

6.4.1.5 *Local Hydrogeology*

The first saturated sediments encountered beneath Open Space Areas 1, 2, and 4 are either part of Perched Groundwater or within the FWBZ. The general hydrogeology of the Open Space Areas is discussed below. Details regarding the occurrence of groundwater within the Chemical Plant 2 Region and distribution of chemicals in the groundwater are presented in Section 6.6.

Perched Groundwater

There are several Perched Groundwater zones in the Chemical Plant 2 Region, which have been generally grouped into an Upper Perched Zone and a Lower Perched Zone. The definitions refer to an assemblage of several perched groundwater zones, and not one specific unit.

The Upper Perched Zone typically occurs in ancestral American River sediments that have been reworked by historical gold-dredging activities. The base of the Upper Perched Zone generally coincides with the interface between the permeable dredged material and the relatively impermeable, undredged material. The Upper Perched Groundwater typically occurs within the upper 40 feet of the ground surface, but was noted as shallow as 10 feet bgs along the western boundary of Chemical Plant 2 and as deep as 75 feet bgs in the southern portion of Chemical Plant 2. Since the geology of OS1 and OS2 are similar to that encountered at Chemical Plant 2, it is likely that Upper Perched Groundwater exists within the dredged portions of OS1 and OS2. Additionally, Upper Perched Groundwater was identified at the northern boundary of OS4 at a depth of 46 feet bgs and is likely present within much of the dredged areas encompassed by OS4.

Lower Perched Groundwater was found to occur in discontinuous sand lenses in a generally fine-grained lithologic unit primarily within the Chemical Plant 2 area. Insufficient data exists to determine the presence of Lower Perched Groundwater beneath OS1, OS2, and OS4, but several wells within OS2 that historically monitored the FWBZ were dry during the BOU RI sampling period.

First Water-Bearing Zone

The FWBZ in the southwestern portion of the Aerojet site and beneath OS1, OS2, and OS4 generally occurs within Layer A. However, the thickness of Layer A varies and the saturated thickness of Layer A in the

Magazine Area (OS3 and OS4) was only 2 feet. Depth to the top of FWBZ beneath Open Space Areas 1, 2, and 4 ranges from approximately 75 to 110 feet bgs and generally increases southeast of Chemical Plant 2, mostly due to increased elevations associated with the ancestral American River terrace. Groundwater elevations in the FWBZ have decreased an average of 39 feet between 1983/1984 and April 2006, with lowest levels generally occurring between 1994 and 1996. Data indicates that groundwater elevations in the FWBZ are continuing to drop.

Flow direction in the FWBZ is general towards the west, consistent with the migration of groundwater from the Line 03 Area east of Chemical Plant 2 towards GET E/F Extraction Wells 4007 and 4310. The average hydraulic gradient across Chemical Plant 2 Area is approximately 0.0064 ft/ft, but flattens to approximately 0.0004 in the area immediately upgradient (east) of Chemical Plant 2.

6.4.1.6 *Ecological Habitat*

A *Biological Assessment Report* (ECORP Consulting, Inc., 2005) for the BOU was presented as Appendix B in the BOU FSP (Aerojet et al., 2006b). A brief description of the ecological habitats within OS1, OS2, and OS4, based on the data presented in that report, are provided below.

<u>Open Space 1</u>

OS1 includes both dredged and undredged lands. With the exception of those areas that have been graded (ruderal/disturbed), the predominant vegetative communities consist of annual grassland and coyote brush scrub. Large areas of Fremont-cottonwood woodland are present in the central portion of OS1 and coyote brush-willow scrub is present primarily along historical slicken valleys. Non-native, naturalized Mediterranean grasses are the dominant species within the annual grassland and coyote brush and other shrubs such as blue elderberry, poison oak, willow, and hoary coffeeberry dominate the coyote brush-willow scrub community. Fremont cottonwood is the principal tree species within the Fremont-cottonwood woodland with willow and/or oak occurring as subdominant members.

Typical fauna within these communities include various raptors, Pacific treefrog, southern alligator lizard, western fence lizard, Gilbert's skink, Pacific gopher snake, racer, common kingsnake, western rattlesnake, northern harrier, wild turkey, savannah sparrow, western meadowlark, Northern flicker, Nutall's woodpecker, western scrub-jay, oak titmouse,

American robin, yellow-rumped warbler, Bullock's oriole, deer mouse, western harvest mouse, California vole, California ground squirrel, coyote, and black-tailed deer.

Blue elderberry shrubs, potential habitat for the Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), have been observed scattered throughout OS1.

Open Space 2

OS2 consists primarily of dredge tailings with small portions of undredged areas present in the northern portion of the area. Vegetative communities within OS2 consist of Fremont cottonwood-oak woodland surrounded by annual grassland and occasional patches of willow scrub. Non-native, naturalized Mediterranean grasses are the dominant species within the annual grassland and Fremont cottonwood is the principal tree species within the Fremont-cottonwood woodland with willow and/or oak occurring as subdominant members. The willow scrub community occurs primarily within the slicken valleys between the cobble furrows and consists of densely-spaced shrub willow.

Wildlife species encountered in these communities include various raptors, Pacific treefrog, California slender salamander, Gilbert's skink, southern alligator lizard, western fence lizard, mountain garter snake, Pacific gopher snake, racer, common kingsnake, western rattlesnake, northern flicker, Acorn woodpecker, Nuttal's woodpecker, oak titmouse, white-breasted nuthatch, mourning dove, black phoebe, Bewick's wren, bushtit, spotted towhee, California towhee, deer mouse, California vole, dusky-footed woodrat, desert cottontail, raccoon, western gray squirrel, Botta pocket gopher, and black-tailed deer.

Blue elderberry shrubs, potential habitat for the Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), have been observed scattered through OS2.

Open Space 4

OS4 consists entirely of dredge tailings with linear mounds of cobbles separated by slicken valleys. Vegetation in OS4 is found almost exclusively within the slicken valleys and consists of Fremont cottonwood woodland or coyote brush-willow scrub.

Typical fauna within these communities include various raptors, Pacific treefrog, southern alligator lizard, western fence lizard, mountain garter snake, ringneck snake, Pacific gopher snake, western rattlesnake, wild turkey, Northern flicker, California quail, Nuttal's woodpecker, western scrub-jay, oak titmouse, California thrasher, American robin, yellow-rumped warbler, Bullock's oriole, Bewick's wren, spotted towhee, California towhee, deer mouse, California vole, black-tailed jackrabbit, desert cottontail, gray fox, coyote, and black-tailed deer.

Blue elderberry shrubs, potential habitat for the Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), have also been observed scattered through OS4.

6.4.2 *Description of Areas – Open Space Areas 1, 2, and 4*

OS1, OS2, and OS4 are described below and shown in Figure 6.0-1.

6.4.2.1 *Open Space Area 1*

OS1 consists of buffer lands between Chemical Plant 2 and areas west of the Aerojet site. No source areas have been identified within OS1, but a railroad line transects the southern portion of OS1 from east to west. Reconnaissance of this section of rail line as part of the carve-out work performed in 1999 and 2000 identified no potential areas of environmental concern (ERM, 2000 and 2001).

6.4.2.2 *Open Space Area 2*

OS2 consists of buffer lands between Chemical Plant 2, the Magazine Area, and Line 03. No source areas have been identified within OS2.

6.4.2.3 *Open Space Area 4*

OS4 consists of buffer lands between the Magazine Area and Chemical Plant 1. No source areas have been identified within OS4 and no indications of historical industrial activities were observed during site reconnaissance performed as part of the BOU RI.

6.4.3 *Summary and Results of Previous (Pre-2005) Vadose Zone Remedial Investigation – Open Space Areas 1, 2, and 4*

OS1, OS2, and OS4 were not included in previous investigations conducted at the Aerojet site. To evaluate the potential migration of VOCs

into the vadose zone off groundwater originating from the Line 1 area to the east, the BOU FSP determined that soil vapor sampling was needed along the eastern boundary of OS4. The BOU FSP also determined that soil sampling was needed in OS1 and OS2 adjacent to Chemical Plant 2 to evaluate the potential presence of chemicals that may have originated from that area.

6.4.4 *Summary and Results of Boundary Operable Unit Vadose Zone Investigation – Open Space Areas 1, 2, and 4*

The following subsections summarize the recent BOU investigation of OS1, OS2, and OS4; describe deviations from the sampling proposed in the BOU FSP; present the results of the BOU RI; and discuss the results of the sampling with respect to the completeness of the characterization and identification of potential sources.

6.4.4.1 *Summary of Boundary Operable Unit Vadose Zone Investigation – Open Space Areas 1, 2, and 4*

The BOU RI of OS1, OS2, and OS4 included the following investigations.

Soil Vapor Investigation

- A total of 10 primary soil vapor samples were collected within OS1, OS2, and OS4 and analyzed for VOCs, including TICs. Soil vapor sampling locations are shown in Figure 6.4-1.
- The number of soil vapor samples (including QA/QC samples) collected in OS1, OS2, and OS4, along with the analytical method, is provided on Table 6.4-1.
- A cross-reference between soil vapor sampling locations within OS1, OS2, and OS4 and the specific features they were sited to investigate are provided on Table 6.4-2.

Surface and Subsurface Soil Investigation

- Three primary and two duplicate surface and/or near-surface (0 to 2.5 feet bgs) soil samples and 11 primary and 3 duplicate subsurface (5 to 121 feet bgs) were collected at OS1 and OS2. Surface and subsurface soil sampling locations are shown in Figure 6.4-1.
- Surface/near-surface and subsurface soil samples were analyzed for metals SVOCs, and/or pesticides. The SVOC analyses of soil samples also included an evaluation of the presence of TICs. In accordance

with the BOU FSP, sample analyses were based on the analytical results from previous investigations and therefore every sample was not analyzed for the full suite of constituents.

- The number of surface/near-surface and subsurface soil samples collected for each analysis (including QA/QC samples) at OS1 and OS2, along with the corresponding methods, is provided on Table 6.4-3.
- A cross-reference between surface/near-surface and subsurface soil sampling locations within OS1, OS2, and OS4 and the specific features they were sited to investigate are provided on Table 6.4-2.

6.4.4.2 *Deviations from Boundary Operable Unit Data Quality Objectives and Sampling Design – Open Space Areas 1, 2, and 4*

Soil and soil vapor sampling performed in OS1, OS2, and OS4 during the BOU RI were generally consistent with those proposed by the BOU FSP, with the exceptions listed on Tables 6.4-4 and 6.4-5. A comparison of proposed and actual sampling activities, including sampling rationale, sample depth, and analyses, is provided on Tables 6.4-4 and 6.4-5. Soil and soil vapor sampling locations and the specific features they were sited to investigate are cross-referenced on Table 6.4-2.

6.4.4.3 *Results of Boundary Operable Unit Vadose Zone Investigation – Open Space Areas 1, 2, and 4*

The results of the VOC, SVOC, metals, and pesticides analyses of samples collected within OS1, OS2, and OS4 during the BOU RI are summarized below. The results of the BOU RI for OS3/Magazine Area are summarized in Section 6.2. A discussion of the results with respect to the completeness of the characterization of constituents identified above RISLs or PGW SSLs and potential sources are presented in Section 6.4.5. The analytical results for all soil vapor and soil samples are provided in Appendices F and G, respectively.

<u>Summary of Investigation and Results – Volatile Organic Compounds</u>

Based on evaluation of the existing data, the BOU FSP concluded that soil vapor sampling was needed to evaluate the potential migration of VOCs from groundwater beneath OS1, OS2, and OS4.

As indicated on Table 6.4-1 and below, 10 primary samples were collected at 5 locations within OS1, OS2, and OS4 during the BOU RI and analyzed

for VOCs. Soil vapor samples were collected at single locations (OS1-F2-SP02 and OS2-F1-SP01) in both OS1 and OS2 and at three locations (OS4-F1-SP01, OS4-F1-SP02, and OS4-F1-SP03) in OS4.

Soil vapor samples designated with an open space prefix (OS) that contained VOCs above their RISL and/or PGW SSLs originating from adjacent source areas were incorporated into the discussion under those sections. For example, if VOCs were detected in an open space soil vapor sample (OS1-F1-SP01) and detections appeared to be associated with an adjacent source area (Source Area 59F at Chemical Plant 2), that sample was included in the discussion under Source Area 59F. Additionally, the open space boundaries were revised to exclude those sampling locations where VOCs were detected.

Area	Depth (ft bgs)	No. of Primary Samples	No. of Locations
OS1	0-10	1	1
	11-20	1	1
OS2	0-10	1	1
	11-20	1	1
OS4	0-10	3	3
	11-20	3	3

The analytical results for the soil vapor samples collected from the shallow (0 to 10 feet bgs) and intermediate (11 to 20 feet bgs) intervals at OS1, OS2, and OS4 are presented in Appendix F and summarized below. Soil vapor sampling locations in the shallow and intermediate intervals in OS1, OS2, and OS4 are shown in Figure 6.4-1. Soil vapor sampling locations in OS1, OS2, and OS4 are listed on Table 6.4-2.

- VOCs were not detected above their respective RISL and/or PGW SSLs in the shallow and intermediate soil vapor samples collected in OS1 and OS2. Additionally, TICs were not identified in the samples.
- Benzene was detected above its RISL, but below its PGW SSL, in intermediate soil vapor samples collected at two locations in OS4. Benzene at 88 and 98 $\mu g/m^3$ were detected in soil vapor samples collected at a depth of 20 feet bgs at OS4-F1-SP02 and OS4-F1-SP03, respectively. Benzene was not detected above its RISL in the shallow (10 feet bgs) soil vapor samples collected at those locations. Additionally, benzene was not detected above its RISL in the shallow and intermediate soil vapor samples collected at OS4-F1-SP01.

Summary of Investigation and Results – Metals

Fourteen primary and five duplicate soil samples were collected at one location (OS1-F1-SB01) in OS1 and two locations (OS2-F1-SB01 and OS2-F1-SB02) in OS2 during the BOU RI and analyzed for metals, including mercury. The number of primary soil samples and sampling locations in OS1 and OS2 along with summary statistics for the samples are summarized on the table below and Table 6.4-3. Soil samples were not collected in OS4. The analytical results are presented in Appendix G and summarized below. Sampling locations are shown in Figure 6.4-1. Soil sampling locations in OS1 and OS2 are listed on Table 6.4-2.

		Surface/Near-Surface		Subsurface	
Source Area	**Compound**	**No. of Samples**	**No. of Locations**	**No. of Samples**	**No. of Locations**
OS1	Metals	1	1	2	1
	Hex Chrom	0	0	0	0
	Mercury	1	1	2	1
OS2	Metals	2	2	9	2
	Mercury	2	1	9	2

Metals detected in soil samples collected within OS1, OS2, and OS4 at concentrations statistically different than background and subsequently compared to screening levels were antimony, mercury, and molybdenum. Because boron, lithium, strontium, and titanium were not included in the background evaluation, concentrations of these metals were also compared to screening levels.

Metals were not detected above their respective RISLs or PGW SSLs in the surface/near-surface and subsurface soil samples collected in OS1 and OS2.

Summary of Investigation and Results – Semivolatile Organic Compounds

Eleven primary and five duplicate soil samples were collected at one location (OS1-F1-SB01) in OS1 and at two locations (OS2-F1-SB01 and OS2-F1-SB02) in OS2 during the BOU RI and analyzed for SVOCs. The number of primary soil samples and sampling locations at OS1 and OS2 for SVOCs are summarized on Table 6.4-3 and below. Summary statistics for the samples are also presented on Table 6.4-3.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
OS1	SVOCs	1	1	0	0
OS2	SVOCs	2	2	9	2

The results of the SVOC analysis of surface/near-surface and subsurface soil samples collected within OS1 and OS2 are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations are shown in Figure 6.4-1. Soil sampling locations in OS1 and OS2 are listed on Table 6.4-2.

SVOCs were not detected above their respective RISLs or PGW SSLs in surface, near-surface, or subsurface soil collected within OS1 and OS2.

Summary of Investigation and Results – pH

pH of the one near-surface soil sample collected from boring OS2-F1-SB02 was 7.57. pH of the seven subsurface soil samples collected that boring ranged from 7.18 to 8.19.

6.4.5 *Discussion of Investigation Results with Respect to Data Quality Objectives – Open Space Areas 1, 2, and 4*

Conclusions based on the analytical results presented in the previous sections are presented below and discussed with respect to DQOs.

- Metals, SVOCs, and pesticides were not detected in soil within OS1 and OS2 at concentrations above their respective RISLs and PGW SSLs.
- VOCs were not detected above their respective RISL and/or PGW SSLs in the shallow and intermediate soil vapor samples collected in OS1 and OS2.
- Benzene was detected above its RISL, but below its PGW SSL, in intermediate soil vapor samples collected at two locations in OS4. However, benzene was not detected above its RISL in the shallow (10 feet bgs) soil vapor samples collected at those locations or in shallow and intermediate soil vapor samples collected at OS4-F1-SP01.
- pHs of the soil samples were within the normal range (5 to 9) expected for mineral soils (Brady, 1974).

Based on the conclusions presented above, the lateral and vertical extent of chemicals in the vadose zone within Open Space Areas 1, 2, and 4 has

been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater and, if necessary, develop remedial alternatives.

6.5 *SUMMARY AND RESULTS OF SURFACE WATER REMEDIAL INVESTIGATION – CHEMICAL PLANT 2 REGION*

The majority of the lands encompassed within the Chemical Plant 2 Region consist of ancestral American River sediments that have been reworked by historical gold-dredging activities. Dredging activities disturbed the natural stratigraphy and the resulting spoils were deposited as unconsolidated and somewhat stratified sediments. As a result, the dredged materials are very permeable, and precipitation and storm water generally infiltrate into the soil quickly and there is very little surface water runoff. Consequently, there are few areas within the Chemical Plant 2 Region where water ponds for longer than a couple of months after the rainy season. Two areas where surface water accumulates for any period of time and potentially received discharges from source areas are the low-lying area immediately north of Source Area 59F at Chemical Plant 2 and the Dredge Pit (Source Area 25F).

This section describes surface water sampling of the low-lying area north of Source Area 59F at Chemical Plant 2 and the Dredge Pit (Source Area 25F) conducted during the BOU RI, presents the results of that sampling, and identifies COPCs in the surface water. A discussion regarding potential correlations between COPCs in surface water and those identified in surface soil at source areas is presented in Section 6.5.4 of this report.

6.5.1 *Summary and Results of Surface Water Remedial Investigations – Chemical Plant 2 Region*

The following subsections briefly describe the surface water features within the Chemical Plant 2 Region, summarize the scope and results of previous investigations conducted prior to 2005, present a preliminary identification of COPCs, and discuss DQOs and sampling proposed in the BOU FSP (Aerojet et al., 2006b).

The information presented was compiled from one or more of the following sources*: Stage 1 Sampling Plan-Zone 1* (Aerojet, 1993a); *Stage 1 Sampling Plan-Zones 3 and 4* (Aerojet, 1993b); *Stage 1 Sampling Plan-Zone 2* (Aerojet, 1993c); *Aerojet Superfund Site – Scoping Report, Volumes 1 through*

6 (ICF Technology, Inc., 1989); *Aerojet Site, Stage 1 Report - Zones 1 through 4* (ICF Kaiser Engineers, Inc., 1993); BOU FSP (Aerojet et al., 2006b); and *Final Remedial Investigation Report for the Perimeter Groundwater Operable Unit (OU-5)* (Aerojet, 2008).

6.5.1.1 *Description of Surface Water Features – Chemical Plant 2 Region*

The low-lying area north of Source Area 59F at Chemical Plant 2 and the Dredge Pit are shown in Figures 6.1-3 and 6.3-2, respectively. A brief description of the two features is provided below. Detailed descriptions of the low-lying area and Dredge Pit are provided in Sections 6.1.2.1 and 6.3.2.

Low-Lying Area North of Source Area 59F

The low-lying area north of Source Area 59F encompasses roughly 20 to 30 acres of a former slickens valley that was altered during construction of Chemical Plant 2 to serve as an informal surface water collection basin. The low-lying area received discharges of surface water from source areas within Chemical Plant 2 North via shallow drainage ditches and swales (Section 6.1.2.1).

Dredge Pit (Source Area 25F)

The Dredge Pit is roughly 1 acre in size, approximately 40 feet bgs at its deepest point, and has an estimated capacity of roughly 6,000,000 gallons (Section 6.3.2.1). From June 1976 to June 1978, the Dredge Pit intermittently received waste from the manufacturing processes associated with the organic herbicide Prowl and OBPA, and other manufacturing facility wastes from Chemical Plant 2. Wastes were discharged to the Dredge Pit when the deep injection well at Chemical Plant 2 became fouled. From July to October 1978, waste material contained in the Dredge Pit was pumped back to Cordova Chemical Company Plant 2 and injected into deep injection wells.

6.5.2 *Summary and Results of Previous Surface Water Investigations – Chemical Plant 2 Region*

Surface water sampling of the low-lying area north of Source Area 59F and the Dredge Pit was not conducted during previous investigations. It should be noted that these areas only contain water after periods of heavy rainfall and are dry most of the year.

The BOU FSP determined that surface water sampling was needed in the low-lying area and the Dredge Pit to assess the potential presence of COPCs that may have been identified in soil at source areas.

6.5.3 *Summary and Results of Boundary Operable Unit Surface Water Investigation – Chemical Plant 2 Region*

The following subsections summarize the recent surface water investigation conducted as part of the BOU RI, describe deviations from sampling proposed in the BOU FSP, present the results of the investigation, and discuss the results with respect to characterization and potential sources.

6.5.3.1 *Summary of Boundary Operable Unit Surface Water Investigation – Chemical Plant 2 Region*

Two primary and one duplicate surface water samples were collected from both the low-lying area and the Dredge Pit (Figures 6.1-3 and 6.3-2). The samples were analyzed for VOCs; total and dissolved metals; SVOCs; OBPA; pesticides (including Prowl); dissolved organic carbon (DOC); nitrate; nitrite; anions (including phosphate, sulfate, chloride, and fluoride); and alkalinity. As discussed in the BOU FSP, the analysis of surface water samples is based on COPCs identified in the vadose zone at source areas upstream and in proximity to the sampling location. Therefore, every surface water sample was not analyzed for the full suite of constituents.

Field measurements taken during collection of the surface water samples were pH, temperature, conductivity, reduction/oxidation (redox) potential, and turbidity.

The numbers of surface water samples collected for each analysis (including QA/QC samples) from the low-lying area north of Source Area 59F and the Dredge Pit (Source Area 25F), along with the corresponding methods, are provided on Table 6.5-1.

6.5.3.2 *Deviations from Surface Water Data Quality Objectives and Sampling Design – Chemical Plant 2 Region*

Surface water sampling performed in the low-lying area and the Dredge Pit during the BOU RI was generally consistent with that proposed in the BOU FSP, with the exceptions listed on Table 6.5-1. A comparison of

proposed and actual sampling activities, including sampling rationale and analyses, is provided on Table 6.5-1.

6.5.3.3 Results of Boundary Operable Unit Surface Water Investigation Results – Chemical Plant 2 Region

The analytical results for the VOC, SVOC, total and dissolved metals, pesticides, OBPA, DOC, anions, and/or alkalinity analyses of samples collected during the BOU RI, along with field measurements, are presented below. The analytical results for all surface water samples are presented in Appendix H.

Summary of Investigation and Results – Volatile Organic Compounds

Two primary and one duplicate surface water samples were collected at two locations within both the low-lying area and the Dredge Pit during the BOU RI and analyzed for VOCs (Table 6.5-1; Figure 6.1-3 and 6.3-2).

VOCs were not detected at concentrations above their respective RISL surface water screening levels (SWSLs) in the surface water samples collected within the low-lying area north of Source Area 59F or the Dredge Pit (Source Area 25F).

Summary of Investigation and Results – Semivolatile Organic Compounds

Two primary and one duplicate surface water samples were collected at two locations within both the low-lying area and the Dredge Pit during the BOU RI and analyzed for SVOCs (Table 6.5-1; Figures 6.1-3 and 6.3-2).

SVOCs were not detected at concentrations above their respective RISL SWSLs in the surface water samples collected within the low-lying area north of Source Area 59F or the Dredge Pit (Source Area 25F).

Summary of Investigation and Results – Total and Dissolved Metals

Two primary and one duplicate surface water samples were collected from the low-lying area north of Source Area 59F and one primary and one duplicate surface water samples were collected from the Dredge Pit during the BOU RI and analyzed for total and dissolved metals. The results of the total and dissolved metals analyses of those samples are summarized below. Surface water sampling locations in the low-lying area north of Source Area 59F and the Dredge Pit are shown in Figures 6.1-3 and 6.3-2, respectively.

Surface Water – Total Metals

Total metal concentrations detected in surface water samples collected from the low-lying area north of Source Area 59F and the Dredge Pit (Source Area 25F) are presented on the table below. For comparative purposes, the RISL SWLS for dissolved concentrations are also provided on the table below.

Metal	SWSL	59F-SW01	59F-SW02	25F-SW01	25F-SW02
Aluminum	3,650	**3,900**	**12,000**	**18,000**	**110,000**
Antimony	1.46	0.34 J	0.28 J	<2.0	0.13 J
Arsenic	10	4.2	2.3	3.1	7.2 J
Barium	100	**160**	82	75	**420**
Beryllium	4.0	0.10 J	0.19 J	0.42 J	1.7
Boron	730	110	47 J	<50	23 J
Cadmium	1.82	0.35 J	0.095 J	0.18 J	0.26 J
Calcium	NA	19,000	2,700	2,200	5,800
Chromium	50	8.8	13	35	**100 J**
Cobalt	73	1.4	1.9	5.4	19 J
Copper	146	7.8	13	27	71
Iron	1,095	**2,900 J**	**8,800**	**19,000**	**110,000 J**
Lead	15	2.1	3.1	7.7	**28**
Magnesium	NA	2,600	1,400	2,900	8,500
Manganese	50	39	**60**	**210**	**1,100**
Mercury	1.09	<0.2	<0.2	**2.8**	0.08 J
Molybdenum	18.2	0.46 J	<2.0	3.8	0.15 J
Nickel	73	13	9.0	28	61 J
Potassium	NA	6,500	2,800	1,300	5,600
Selenium	18.2	<2.0	<2.0	<2.0	<2.0
Silver	10	0.032 J	0.037 J	0.093 J	0.18 J
Sodium	NA	12,000	11,000	20,000	58,000
Strontium	2,190	96	26	26	85
Thallium	0.24	<1.0	<1.0	<1.0	0.22 J
Titanium	14,598	92	260	470	2,800
Vanadium	3.65	**12**	**21**	**38**	**160**
Zinc	100	20	35	45	**150**

Concentrations in micrograms per liter (µg/L)
J – Estimated concentration
NA – Not applicable

As indicated in the table, total concentrations of aluminum, barium, chromium, iron, manganese, mercury, vanadium, and zinc exceeded their respective SWSLs in at least one of the surface water samples collected at Source Areas 25F and 59F. However, it should be noted that the SWSLs were developed for comparison to dissolved concentrations. Total concentrations for metals in samples are higher than dissolved due to the presence of suspended solids.

Surface Water – Dissolved Metals:

Dissolved concentrations of metals detected in surface water samples collected from the low-lying area north of Source Area 59F and the Dredge Pit (Source Area 25F) are presented on the table below.

Metal	SWSL	59F-SW01	59F-SW02	25F-SW01
Aluminum	3,650	500	510	300
Antimony	1.46	<2.0	0.28 J	0.11 J
Arsenic	10	4.1	1.4	1.6
Barium	100	100	37	19
Beryllium	4.0	<0.5	<0.5	<0.5
Boron	730	89	40 J	<50
Cadmium	1.82	0.028 J	<1.0	0.057 J
Calcium	NA	18,000	2,100	1,100
Chromium	50	3.0	3.0	3.4
Cobalt	73	1.0	1.4	2.9
Copper	146	4.8	5.9	7.8
Iron	1,095	300	350	420
Lead	15	0.18 J	0.58 J	1.1
Magnesium	NA	2,300	800	910
Manganese	50	7.6 J	10 J	40
Mercury	1.09	<0.2	<0.2	0.86
Molybdenum	18.2	0.81 J	<2.0	4.2
Nickel	73	2.2	3.2	10
Potassium	NA	6,000	2,200	500
Selenium	18.2	<2.0	<2.0	<2.0
Silver	10	0.059 J	<1.0	<1.0
Sodium	NA	11,000	11,000	21,000
Strontium	2,190	84	17	12
Thallium	0.24	<1.0	<1.0	<1.0
Titanium	14,598	16	11	4.9
Vanadium	**3.65**	**4.6**	**4.9**	**8.3**
Zinc	100	<20	<20	<20

Concentrations in micrograms per liter (µg/L)
J – Estimated concentration
NA – Not applicable

Vanadium was the only metal detected in surface water samples collected from the low-lying area north of Source Area 59F and the Dredge Pit (Source Area 25F) at dissolved concentrations above its respective RISL SWSLs. It should be noted that the PQL for thallium is above the RISL SWSL.

Summary of Investigation and Results – Pesticides

One primary and duplicate surface water samples were collected at one location (25F-SW01) in the low-lying area and two primary and one

duplicate surface water samples were collected at two locations (25F-SW01 and 25F-SW02) in the Dredge Pit during the BOU RI and analyzed for pesticides (Table 6.5-1).

Heptachlor epoxide was the only pesticide detected in surface water samples collected from the low-lying area and the Dredge Pit at dissolved concentrations above its RISL SWSLs. Pesticides detected in the surface water samples are presented on the table below.

Pesticide	SWSL	59F-SW01	59F-SW02	25F-SW01	25F-SW02
Heptachlor	0.01	<0.24	<0.024	0.0084 J	<0.024 J
Heptachlor Epoxide	.007	0.11 J	<0.024	**0.012 J**	<0.024 J
Pendimethalin (Prowl)	146	16	0.37 J	7.3	<0.12 J
Alpha-BHC	NA	0.12 J	<0.024	<0.024	<0.024
Delta-BHC	NA	0.6 J	0.019 J	0.0077 J	<0.024

Concentrations in micrograms per liter (µg/L)
BHC – Benzene hexachloride
J – Estimated concentration
NA – Not applicable

Summary of Investigation and Results – Miscellaneous Compounds

Miscellaneous analyses performed on surface water samples collected from the low-lying area north of Source Area 59F and the Dredge Pit (Source Area 25F) were nitrate as NO_3; nitrite as NO_2; DOC; anions (including chloride, fluoride, phosphate, and sulfate); and alkalinity (bicarbonate alkalinity, carbonate alkalinity, hydroxide alkalinity, and total alkalinity). The analytical results for the miscellaneous analyses of surface water samples are presented below.

Nitrate and Nitrite. The results of nitrate and nitrite analyses of the primary and duplicate surface water samples collected from the low-lying area north of Source Area 59F and the Dredge Pit (Source Area 25F) are presented below.

Compound	RISL SWSL	59F-SW01	59F-SW02	25F-SW01	25F-SW02
Nitrate (as NO_3)	**1,000**	**3,600**	**1,300**	69 J	480
Nitrite (as NO_2)	**100**	**170**	21 J	<100	25 J

Concentrations in micrograms per liter (µg/L)
J – Estimated concentration

Nitrate and nitrite were detected at concentrations above their respective RISL SWSLs in the surface water samples collected from the low-lying area north of Source Area 59F.

Anions and Alkalinity. The results of anions analysis of the surface water samples collected from the low-lying area north of Source Area 59F and the Dredge Pit (Source Area 25F) are presented below.

Compound	59F-SW01	59F-SW02	25F-SW01	25F-SW02
Bicarbonate Alkalinity	68,000	27,000	47,000	77,000
Carbonate Alkalinity	<5,000	<5,000	<5,000	<5,000
Chloride	1,900	1,300	1,100	3,500
DOC	5,700	5,000	18,000	15,000
Fluoride	1,200	560	93	86
Hydroxide Alkalinity	<5,000	<5,000	<5,000	<5,000
Phosphate	<500	<500	<500	<500
Sulfate	14,000	4,600	4,400	31,000
Total Alkalinity	68,000	27,000	47,000	77,000

Concentrations in micrograms per liter (µg/L)
J – Estimated concentration

Summary of Investigation and Results – Field Measurements

Parameters measured in the field during the collection of surface water samples from the low-lying area north of Source Area 59F and the Dredge Pit were pH, temperature, conductivity, redox potential, and turbidity. Measurements for those parameters are summarized on the table below.

Sample Location	pH	Temp (°C)	Conductivity (mS /cm)	Redox Potential (mV)	Turbidity (NTU)
25F-SW01	9.28	12.51	0.107	191.5	200
25F-SW02	7.87	14.60	0.256	244.4	600
59F-SW01	9.10	23.07	0.156	175.6	70
59F-SW02	9.16	16.07	0.162	196.7	726

°C – Degrees Celsius
ms/cm – MilliSiemens per centimeter
mV - Millivolts
NTU – Nephelometric turbidity units

6.5.4 *Discussion of Surface Water Investigation Results with Respect to Data Quality Objectives – Chemical Plant 2 Region*

The analytical results presented in Section 6.5.3.3 indicated that metals (arsenic and vanadium), a pesticide (heptachlor epoxide), nitrate, and nitrite were present in surface water samples collected from either the low-lying area north of Source Area 59F or the Dredge Pit. The presence of chemicals in surface water samples with respect to potential sources and adverse impact to surface water quality is discussed below.

6.5.4.1 *Metals*

Arsenic and vanadium were the only metals detected in surface water samples collected from the low-lying area north of Source Area 59F and the Dredge Pit (Source Area 25F) at dissolved concentrations above their respective RISL SWSLs (Section 6.5.3.3).

With the exception of zinc in one surface water sample collected from within the Administration Area, arsenic and vanadium were the only metals detected above their RISL SWSLs in surface water samples collected within the management areas of the BOU (Sections 4.4.3.3, 5.6.3.3, and 6.5.3.3).

Arsenic and vanadium were not detected above background in any of the surface/near-surface soil or sediment collected within the source areas within the BOU or in areas that discharged surface water to the low-lying area and Dredge Pit. Naturally occurring concentrations of arsenic and vanadium at the Aerojet site are above Preliminary Remediation Goals (PRGs) and the presence of those metals in surface water is therefore assumed to be naturally occurring.

Based on the data and conclusions presented above, dissolved metals in surface water appear to be naturally occurring. While their presence in surface water may pose a potential risk, the data indicate that it is not due to historical industrial activities conducted by Aerojet.

6.5.4.2 *Pesticides*

The pesticide heptachlor epoxide was detected at concentrations above its SWSL in surface water samples collected at one location (59F-SW01) in the low-lying area north of Source Area 59F and at one location (25F-SW01) in the Dredge Pit (Source Area 25F). The presence of that pesticide in the surface water is likely the result of historical discharges from Chemical Plant 2 (Building 15007).

The data indicate that the presence of pesticides in surface water within the drainages is inconsistent. The presence of heptachlor epoxide above its RISL SWSL in surface water within the low-lying area and Dredge Pit may pose a concern to ecological receptors and groundwater. However, because water that accumulates in those areas does not discharge to other surface water features, it is unlikely that heptachlor epoxide poses a substantial risk to human health.

Based on the data presented above, the presence of pesticides in surface water within the Chemical Plant 2 Region has been sufficiently characterized to evaluate potential risk and remedial alternatives.

6.5.4.3 *Nitrate and Nitrite*

Nitrate and nitrite was detected above their respective RISL SWSLs in surface water samples collected from the low-lying area north of Source Area 59F. As with heptachlor epoxide, the presence of nitrate and nitrite in the surface water could pose a concern to ecological receptors and groundwater. However, because water that accumulates in the low-lying area infiltrates and does not discharge to other surface water features, it is unlikely that nitrate and nitrite poses a substantial risk to human health.

Based on the data presented above, the presence of nitrate and nitrite in surface water within the Chemical Plant 2 Region has been sufficiently characterized to evaluate potential risk and remedial alternatives.

6.6 *SUMMARY AND RESULTS OF GROUNDWATER REMEDIAL INVESTIGATION – CHEMICAL PLANT 2 REGION*

This section presents the groundwater data acquired during the RI for the seven management areas (Chemical Plant 2, Magazine Area/Open Space Area 3, Dredge Pit and Eastern Basin, and Open Space Areas 1, 2, and 4) in the Chemical Plant 2 Region of the BOU (Figure 6.0-1). Because groundwater beneath these management areas was evaluated as a whole, this section of the report collectively refers to the seven management areas as being within the Chemical Plant 2 Region. Data were collected to satisfy the following DQOs as identified in the BOU FSP (Aerojet et al., 2006b):

- Do COPCs exist in groundwater at concentrations that could potentially pose a risk to human health?
- Do the groundwater data indicate a potential source for the COPCs in the vadose zone?
- Do COPCs exist in groundwater at concentrations indicative of the presence of residual product?
- Has the lateral and vertical distribution of COPCs in the groundwater been adequately characterized?

- Do COPCs in groundwater have the potential to migrate into and degrade surface water quality?
- Are the data sufficient to support human health and ecological risk assessments, support modeling to evaluate the migration of COPCs from groundwater into indoor air, and determine the feasibility of remediating the identified compounds and concentrations to levels that do not pose a risk to human and ecological receptors or degrade surface water and groundwater quality?

To meet these DQOs, the following tasks were completed as part of the BOU RI:

- **Characterize groundwater flow —** Section 6.6.1 – Groundwater Flow Characteristics define the shallow groundwater as either Perched Groundwater or the FWBZ and present interpretation of water level data, including hydraulic gradients and water level elevation trends. This section also presents the results of aquifer testing activities conducted to further characterize the hydraulic properties in a portion of the FWBZ. These data support analysis of the fate and transport of chemicals in groundwater and are used to develop and compare remedial alternatives in the FS.
- **Determine the extent of groundwater impacted by COPCs —** Section 6.6.2 discusses the distribution of chemicals in groundwater and presents the results of groundwater sampling and analyses. These data are discussed relative to groundwater screening-level Applicable, Relevant, and Appropriate Requirements (ARARs) (i.e., screening-level ARARs) that were selected to provide sufficient data for evaluating potential human health risks due to exposure to chemicals in groundwater.
- **Identify apparent COPC source areas and define the extent of potential residual sources in groundwater —** Discussion regarding potential correlation between chemicals reported in the vadose zone within source areas and chemicals reported in groundwater are included in Section 6.6.2 – Distribution of Chemicals in Groundwater.
- **Identify existing remedial actions —**Existing and planned remedial actions for groundwater within and downgradient of the BOU are discussed in Section 6.6.3.
- **Identify chemical migration pathways and attenuation processes —** Processes that influence the distribution and movement of chemicals in groundwater are discussed in Section 6.6.4**.**

6.6.1 *Groundwater Flow Characteristics*

The hydrostratigraphy for the Chemical Plant 2 Region, nature and occurrence of shallow groundwater, and groundwater gradients are discussed below.

6.6.1.1 *Site Hydrostratigraphy*

The regional aquifer beneath the Aerojet site has been divided into six hydrostratigraphic layers (Layers A through F) based on similar lithology, relative depths and thicknesses, electrical conductivity, water levels, and aquifer testing. The hydrostratigraphic layers provide the framework for presenting the distribution of chemicals and groundwater characteristics.

Perched Groundwater and the FWBZ were subdivided from the more regional hydrostratigraphic layer designations to allow for evaluation of potential risks associated with VOCs migrating upward as vapor through the soil into indoor air.

Hydrostratigraphic cross-sections were prepared to show the general lithologies and relative water levels for the hydrostratigraphic layers in the Chemical Plant 2 Region. The cross-section transects for the Chemical Plant 2 Region are described below:

- Cross-section A-A′ trends approximately southwest to northeast across Chemical Plant 2 and Open Space Areas 1 and 2, and is aligned approximately along the direction of groundwater flow (Figure 6.6-1); and
- Cross-section B-B′ trends approximately northwest to southeast across the Chemical Plant 2 Region, approximately perpendicular to the groundwater flow direction (Figure 6.6-2).

Hydrostratigraphic Layer A is the shallowest layer and is composed of deposits from the ancestral American River. Within the Chemical Plant 2 Region, Layer A contains both Perched Groundwater and the FWBZ.

The FWBZ (Layer A) appears to be perched in portions of the Chemical Plant 2 Region. Layer A is underlain by unconfined groundwater in Layer C in the vicinity of the Dredge Pit (Site 25F) and Chemical Plant 2 (e.g., Monitoring Well 3221-6). This indicates that Layer A is perched in these areas.

Layer B underlies Layer A and refers to the sand lenses within generally fine-grained sediments and are consistent with the Laguna Formation. These sand lenses appear to be laterally discontinuous. Layer B is not continuously saturated across the study area, and is generally not a significant water-bearing unit.

Layer C is the upper portion of the Tertiary Mehrten Formation and is the first regionally extensive water-bearing unit. Within the Chemical Plant 2 Region, Layer C groundwater occurs under both unconfined and semi-confined conditions.

Layer D is generally the lower portion of the Mehrten Formation and overlies Layer E, which generally corresponds to the upper portion of the Tertiary Valley Springs Formation. Layer F refers to the water-bearing sediments below Layer E and is generally below the depths of contamination.

6.6.1.2 *Nature and Occurrence of Shallow Groundwater*

The first saturated sediments are either part of Perched Groundwater or within the FWBZ. Water level and water quality data collected from existing monitoring wells, monitoring wells constructed for this RI, and grab groundwater samples collected from soil borings (e.g., HydroPunch samples), were classified as being from either Perched Groundwater, the FWBZ, or a deeper hydrostratigraphic layer. The hydrostratigraphic layer designation, survey data, and well construction information for the monitoring wells and grab groundwater samples collected from soil borings used for this RI are summarized on Tables 6.6-1 and 6.6-2, respectively. Boring logs for the monitoring wells installed for the BOU RI are included as Appendix D.

<u>Perched Groundwater</u>

Perched Groundwater is the shallowest saturated unit. There are several Perched Groundwater zones in the Chemical Plant 2 Region that have been generally grouped into an Upper Perched Groundwater zone and a Lower Perched Groundwater zone.

Eighteen monitoring wells are screened in Perched Groundwater in the Chemical Plant 2 Region, eight in the Upper Perched Groundwater and 10 in the Lower Perched Groundwater (Figures 6.6-3 through 6.6-6). In addition, Perched Groundwater was encountered at 17 soil boring

locations. The lateral extent of the Perched Groundwater zones, shown in Figures 6.6-3 through 6.6-6, was inferred based on the following evidence:

- The presence of unsaturated sediments in the same elevation intervals as Perched Groundwater in soil borings advanced during the BOU RI; and
- The presence of dry wells screened in the same elevation intervals as Perched Groundwater.

Water level hydrographs prepared for the Perched Groundwater wells are presented in Appendix J.

Upper Perched Groundwater

The Upper Perched Groundwater typically occurs in ancestral American River sediments, some of which have been reworked by historical gold-dredging activities. Dredging activities disturbed the natural stratigraphy and the resulting spoils were deposited as unconsolidated and somewhat stratified sediments. As a result, the dredged materials are very permeable and are underlain by sediments that are typically less permeable. The base of the Upper Perched Groundwater often coincides with the interface between dredged and undredged materials.

Upper Perched Groundwater was identified in the Chemical Plant 2 area, the Dredge Pit (Site 25F), and the northern Magazine Area (Figure 6.6-3). The Upper Perched Groundwater typically occurs within 40 feet of the ground surface, but was noted as shallow as 10 feet bgs at boring 59F-SP39 and as deep as 75 feet bgs at Well 129, both within the Chemical Plant 2 Area.

The available data suggest the undredged terrace slope north of Chemical Plant 2 has a lower permeability than the dredged materials located on either side of the terrace slope, and that these undredged sediments act as a lateral divide between the Upper Perched Groundwater zones.

Since the start of monitoring in 1982, most Upper Perched Groundwater wells exhibited maximum groundwater elevations between 1982 and 1984, following a period of above-average precipitation. Upper Perched Groundwater elevations have been relatively stable since approximately 1988 and typically demonstrate 10 feet or less of seasonal fluctuation (see hydrographs in Appendix J).

The greatest change (decline) in the Upper Perched Groundwater elevation was observed in Monitoring Well 129 south of Chemical Plant 2. Groundwater elevations decreased from approximately 163 feet above mean sea level (amsl) in 1982 to approximately 100 feet amsl between 1988 and 2006. The remaining Upper Perched Groundwater wells in the Chemical Plant 2 Region have demonstrated approximately 20 feet or less of fluctuation during similar time periods.

The data indicate that there is possibly a hydraulic connection between Well 10 (completed in the FWBZ) and the Upper Perched Groundwater. The screened interval elevation for Well 10 is similar to the screened intervals of other FWBZ wells in the area; however, the water level elevations at Well 10 fluctuate between being consistent with FWBZ water levels and Upper Perched Groundwater water levels. Due to this uncertainty, groundwater depth and elevation data from Well 10 were not used in the preparation of contour maps.

Lower Perched Groundwater

A zone of perched groundwater was encountered beneath the Upper Perched Groundwater zone and above the FWBZ. This Lower Perched Groundwater zone was identified within laterally discontinuous sand lenses present in a generally fine-grained lithologic unit beneath Chemical Plant 2 (Figure 6.6-5).

Only three of nine Lower Perched Groundwater wells that existed in April 2006 contained water. In the three wells, groundwater was encountered between 52 and 81 feet bgs, and elevations of approximately 77 to 91 feet amsl (Figures 6.6-5 and 6.6-6, respectively). Historically, between 1983 and 1998, the Lower Perched Groundwater was present at elevations nearly equal to the FWBZ. During this period, the Lower Perched Groundwater was in hydraulic continuity with FWBZ and was not perched.

At Chemical Plant 2, most of the wells designated as being screened in the Lower Perched Groundwater, and which were dry in April 2006, appear to monitor the FWBZ (Layer A) when they do contain water (e.g., Wells 376, 3221, and 3363). These wells were grouped with Lower Perched Groundwater because they are screened in a comparable interval, and because they are dry, they are useful for evaluating the lateral extent of Lower Perched Groundwater.

First Water-Bearing Zone

The FWBZ occurs within Layer A in the Chemical Plant 2 Region. The depths and elevations of groundwater in the FWBZ are shown in Figures 6.6-7 and 6.6-8, respectively.

The depth to the top of FWBZ ranges from 54 feet bgs in the Dredge Pit (Site 25F) to 121 feet bgs at Well 3645, south of the Dredge Pit. Depths to FWBZ generally increase southeast of Chemical Plant 2 due to the increasing ground surface elevation associated with the ancestral American River terrace (Section 6.1.1).

Water level hydrographs prepared for FWBZ wells are presented in Appendix K. The highest groundwater elevations on record since the start of monitoring in 1982 were reported in 1983 and 1984, following a period of above-average precipitation. Groundwater elevations in the FWBZ have decreased an average of approximately 39 feet between 1983/1984 and April 2006. The lowest groundwater levels generally occurred between 1994 and 1996. Groundwater elevations increased slightly between 1996 and 2004, but have since been decreasing. Many of the groundwater levels in the FWBZ wells recorded in 2006 are approaching their lowest levels on record (see for example the hydrograph for Well 215 in Appendix K). As a result of the decreasing water levels, many of the Layer A wells have gone dry (e.g., Monitoring Wells 7, 355, 1244, and 3244 in southwestern Chemical Plant 2 area).

6.6.1.3 *Groundwater Gradients*

The potentiometric surface for the FWBZ was contoured to evaluate hydraulic gradients. Water level data from wells located outside the Chemical Plant 2 Region were used to extend the contour lines. The most complete water level data set was collected in April 2006 and was used to contour the potentiometric surfaces. Previous water level data sets do not include the majority of wells constructed in 2005 and 2006 specifically for the BOU RI. If more than one water level measurement was collected from a monitoring well in April 2006, the measurement taken during the April 2006 plant-wide groundwater measurement event was used on the contour maps. Water level data are summarized on Table 6.6-3.

The initial potentiometric surface contours were generated using the linear kriging algorithm in Surfer® for Windows (Version 8). For reference, groundwater elevations noted during collection of grab

groundwater samples are posted on the contour maps, but the depth and sample elevation data were not used in kriging.

Perched Groundwater

An insufficient number of monitoring wells in the Upper and Lower Perched Groundwater contained water to allow assessment of groundwater flow direction and gradient.

First Water-Bearing Zone

The contoured potentiometric surface of the FWBZ measured in April 2006 is presented in Figure 6.6-8. FWBZ groundwater elevations ranged from 57.43 feet amsl at Well 3431 to 92.44 feet amsl at Well 181.

The April 2006 potentiometric surface map for the FWBZ suggests a general westerly flow direction across Chemical Plant 2 Area (Figure 6.6-8). This flow direction is consistent with the migration of groundwater from the Line 03 Area east of Chemical Plant 2 towards Groundwater Extraction and Treatment system E/F (GET E/F) Extraction Wells 4007 and 4310.

An apparent "ridge" of groundwater is noted in the southern portion of the Magazine Area, which may be the result of increased recharge occurring at the Dredge Pit (Source Area 25F).

The average hydraulic gradient across Chemical Plant 2 Area is approximately 0.0064 ft/ft. The hydraulic gradient flattens to approximately 0.0004 in the area immediately upgradient (east) of Chemical Plant 2.

The potentiometric surface elevations in the FWBZ (i.e., Layer A) are higher than in the underlying Layers B or C, indicating vertical gradients are directed downwards.

6.6.1.4 *Aquifer Testing*

Aquifer testing was performed at Source Area 59F at Chemical Plant 2 and in the Magazine Area to characterize the hydraulic parameters of a portion of the FWBZ. The results of those tests are summarized below.

Chemical Plant 2 Slug Tests

Slug tests were performed on Monitoring Well 3654, at Site 59F in February 2006. Monitoring Well 3654 was completed in Layer B and is not technically a part of the FWBZ. Three separate slug–in and slug-out tests were performed. The details of the slug tests and data analysis are described in Appendix L. The results indicate an average horizontal hydraulic conductivity of approximately 2.1 feet per day (ft/day), or 7.3 x 10^{-4} centimeters per second (cm/sec).

Magazine Area Pump Test

A constant rate pump test was performed on Monitoring Well 3641 in the Magazine Area in April 2006. Monitoring Well 3641 is completed in Layer C and is not technically a FWBZ well. Aquifer testing activities included: (1) pre-test monitoring, (2) a stepped drawdown test (step test), and (3) constant rate pump testing with recovery monitoring. The details of the aquifer testing and data analysis are described in Appendix L.

In summary, the aquifer test was conducted during a period of heavy rains and significant barometric pressure fluctuations. Recharge was occurring during the test, which compromised the drawdown response data in the observation wells. The early-time data from the pumping well were used to estimate a transmissivity of 1,300 square feet per day. This corresponds to a hydraulic conductivity of approximately 65 feet per day, or 2.3 x 10^{-2} cm/sec.

6.6.2 *Distribution of Chemicals in Groundwater*

This section describes the nature and extent of chemicals detected in Perched Groundwater and the FWBZ beneath the southwestern portion of the BOU, including the Chemical Plant 2 Region. The majority of the water quality data were collected between October 2005 and October 2006, referred to as the RI Sampling Period. Additional sampling was conducted after the RI Sampling Period to address data gaps identified after preliminary analysis of the data. Data collected after the RI Sampling Period are noted in the figures and the text.

The sampling locations and analytes were presented in the BOU FSP (Aerojet et al., 2006b). The analytes at each sample location were selected based on historical chemical use at each potential source area. VOCs were the most frequently analyzed constituents in the Chemical Plant 2 Region groundwater and were analyzed using USEPA Method 8260. Other

analytes selected based on historical operations or to evaluate geochemical and biological processes that may affect possible remedial option selection are listed below.

- SVOCs by USEPA Method 8270;
- Perchlorate by USEPA Method 314.1;
- Metals by USEPA Methods 6010, 6020, and 7000 Series;
- TPH by USEPA Method 8015 Modified;
- PCBs by USEPA Method 8082;
- Organochlorine pesticides by USEPA Method 8081A;
- Pendimethalin (Prowl) by USEPA Method 8081A;
- OBPA by USEPA Method 8270C;
- Alkalinity (total, bicarbonate, carbonate, and hydroxide) by USEPA Method 2320;
- Anions (chloride, fluoride, nitrate, nitrite, phosphate, and sulfate) by USEPA Method 300.0; and
- DOC by USEPA Method 415.1.

The extents of most chemicals in groundwater are discussed relative to their respective screening-level ARAR. In most cases, screening-level ARARs are federal or state drinking water primary maximum contaminant levels (MCLs), following USEPA Region IX precedence, and other Water Quality Objectives, as defined by the RWQCB. RWQCB Water Quality Objectives may include Secondary MCLs, State of California Public Health Goals, State of California Department of Public Health (Action Levels, and USEPA Region 9 PRGs. A summary of screening-level ARARs is included on Table 4.5-4.

Results of all analyses conducted during the RI Sampling Period, and the results of applicable analyses conducted after the RI Sampling Period are included on a compact disc in Appendix M. The data includes the complete results, even for compounds not detected in any samples.

Data reported with laboratory qualifiers are included in this evaluation and are noted in the text and figures. Data reported between the PQL and the Method Detection Limit are estimated concentrations and are flagged with a "J" qualifier. All data were validated by a third party (Laboratory

Data Consultants, Inc.), and all data that were considered estimates by the data validators were also given a "J" flag.

Water quality data for grab groundwater samples collected from soil borings are also included in this evaluation. However, the water quality data for grab groundwater samples are not considered comparable to data collected from monitoring wells.

Perched Groundwater Wells 6, 9, 30, 57, 110, 180, 302, 330, 376, 516, 3057, 3221, and 3363 were either dry or did not have enough water to sample in November 2005, during the RI Sampling Period. Monitoring Well 9 contained water in May 2007 and was sampled.

Isoconcentration contour maps were prepared illustrating the distribution of 1,2-DCA in Upper and Lower Perched Groundwater (Figures 6.6-9 and 6.6-10, respectively). In the FWBZ, the distribution of TCE (Figure 6.6-11); 1,2-DCA (Figure 6.6-12); and perchlorate (Figure 6.6-13) were contoured. The most recent analytical data are posted in the figures for wells sampled more than once during the RI Sampling Period.

6.6.2.1 *Volatile Organic Compounds*

VOC concentrations were compared to their respective compound solubility limits as a means of assessing the potential presence of residual product (i.e., NAPL). The solubility limits used were obtained from the USEPA, Region 9 website. The solubility limits for several of the most common VOCs are provided on the table below.

Compound	*Solubility Limit (µg/L)*	*1 Percent of Solubility Limit (µg/L)*	*Maximum detected in SW BOU Areas (µg/L)*
PCE	*200,000*	*2,000*	*7.8*
TCE	*1,100,000*	*11,000*	*1,800*
cis-1,2-DCE	*3,500,000*	*35,000*	*43*
Vinyl chloride	*2,800,000*	*28,000*	*2.4*
1,2-DCA	*8,500,000*	*85,000*	*24,000*
Chloroform	*7,900,000*	*79,000*	*110*

DCE = Dichloroethene
PCE = Tetrachloroethene

As indicated on the table, reported VOC concentrations in groundwater samples collected in the Chemical Plant 2 Region did not exceed 1 percent of their solubility limit and therefore not indicative of the presence of residual product.

The results of the VOC analysis of groundwater samples collected from the Perched Groundwater and FWBZ are summarized below.

Perched Groundwater – Volatile Organic Compounds

VOC analysis was performed on groundwater samples collected from the following:

- Upper Perched Groundwater Wells 9, 286, and 3696, and 15 Upper Perched Groundwater soil borings; and
- Lower Perched Groundwater Wells 902 and 3728 and three Lower Perched Groundwater soil borings.

VOCs present in Perched Groundwater are considered indicative of a nearby source, except in some areas where historically the Lower Perched Groundwater was in hydraulic continuity with the FWBZ.

The only VOCs reported at concentrations above MCLs in either the Upper or Lower Perched Groundwater were 1,2-DCA (up to 24,000 µg/L in one grab groundwater sample and 2.5 µg/L in one monitoring well) and vinyl chloride (up to 2.4 µg/L in one grab groundwater sample).

The extents of these VOCs in Upper Perched Groundwater appear relatively limited and are primarily defined by screening-level grab groundwater samples. In Upper Perched Groundwater, 1,2-DCA (up to 7,500 µg/L) is present at concentrations greater than the MCL of 0.5 µg/L in an area extending from Building 15007 (Source Area CP2-07) approximately 350 feet to Source Area 59F (Figure 6.6-9). Upper Perched Groundwater in the vicinity of Source Area 59F also contains vinyl chloride (up to 1.9 µg/L), above the MCL of 0.5 µg/L. As indicated by the soil vapor data presented in Section 6.1.4.3, a sump associated with Building 15007 and a holding basin associated with the deep injection well headworks are potential VOC sources in these areas.

At the Dredge Pit (Source Area 25F), one grab groundwater sample collected from the Upper Perched Groundwater at boring 25F-SP11 yielded 1,2-DCA at 6.1 µg/L. The former Dredge Pit is a potential source of VOCs in this area.

The extents of VOCs in Lower Perched Groundwater also appear relatively limited. At Building 15007 (Source Area CP2-07), 1,2-DCA at 24,000 µg/L and vinyl chloride at 2.4 µg/L were reported in the grab groundwater sample from boring CP2-07-SB05. Based on the screening-

level sample result, Monitoring Well 3728 was installed approximately 10 feet southwest of boring CP2-07-SB05. The sample collected from the monitoring well yielded 1,2-DCA at an estimated concentration of 2.5J µg/L (Figure 6.6-10).

TICs were reported in the VOC open-scan analyses on grab samples collected from five Perched Groundwater borings. The majority of the TICs were C_5 to C_9 aldehydes, the remainder were unknown peaks on the chromatographs that were not identified and are reported as "Unknown Peaks" followed by a numeric identifier. Hexanal was the TIC reported at the greatest estimated concentration (110 µg/L in the grab groundwater sample from Upper Perched boring 62F-SP04).

First Water-Bearing Zone – Volatile Organic Compounds

VOC analyses were performed on samples collected from 20 monitoring wells completed in the FWBZ and three grab groundwater samples collected from the FWBZ (Figures 6.6-11 and 6.6-12).

VOCs reported in the FWBZ groundwater samples above their respective screening-level ARARs included TCE (up to 1,800 µg/L); chloroform (up to 110 µg/L); cis-1,2-DCE (up to 43 µg/L); 1,1-DCE (up to 33 µg/L); benzene (up to 10J µg/L); PCE (up to 7.8 µg/L); and 1,2-DCA (up to 4.7J µg/L).

TCE is the most widely distributed VOC in the FWBZ, and its extent encompasses the distribution of the other VOCs reported above screening-level ARARs.

Groundwater beneath the eastern portion of Chemical Plant 2; the Magazine Area, and Open Space Areas 2, 3, and 4 contains VOCs originating from sources upgradient of the BOU. VOCs present in groundwater beneath the Magazine Area and Open Space Areas 3 and 4 appear to have originated from upgradient sources near Chemical Plant 1, where the same compounds are present at relatively higher concentrations.

TCE in groundwater east of Chemical Plant 2 and OS2 appears to originate from upgradient sources in Line 03. TCE in groundwater in this area extends approximately 3,500 feet from Line 03 to GET E/F Extraction Wells 4007 and 4310 (Figure 6.6-11).

Vinyl chloride was detected above screening-levels in soil vapor and in Perched Groundwater, but was not detected in groundwater samples collected from the FWBZ.

1,2-DCA was the primary VOC reported in soil vapor and Perched Groundwater beneath the Chemical Plant 2 area. However, 1,2-DCA was detected in only three monitoring wells screened in the FWBZ, and the maximum detected concentration was 4.7 J µg/L (Figure 6.6-12).

The only VOC TIC reported was propene, a C_3 olefin. The estimated concentration was 3 µg/L in a grab sample collected from boring OS2-F1-SB02, east of the Chemical Plant 2 area.

6.6.2.2 *Semivolatile Organic Compounds*

SVOC analysis, including the open-scan analysis for TICs, was performed on groundwater samples from the following:

- Upper Perched Groundwater Well 286;
- Lower Perched Groundwater Well 902 and two Lower Perched Groundwater borings; and
- Nineteen FWBZ monitoring wells and seven FWBZ borings.

The results of the SVOC analysis of groundwater samples collected from the Perched Groundwater and FWBZ are summarized below:

- SVOCs were not detected above their respective PQLs in the Perched Groundwater samples.
- Bis(2-ethylhexyl)phthalate was the only SVOC in FWBZ reported above a screening-level ARAR (up to 42 µg/L in a grab sample from boring CP2-07-SB14).
- Reported TICs and their estimated concentrations are provided in Appendix M. The majority of the detections were unknown. Of the compounds that were tentatively identified, none were reported in more than one sample. Octanoic acid at 92J µg/L was the TIC reported at the highest estimated concentration.

6.6.2.3 *Perchlorate*

Perchlorate analysis was performed on the samples collected from the following:

- Upper Perched Groundwater Wells 9 and 286;
- Lower Perched Groundwater Wells 902 and 3728; and
- Twenty FWBZ monitoring wells.

The results of the perchlorate analysis of groundwater samples collected from the Perched Groundwater and FWBZ are summarized below.

Perched Groundwater – Perchlorate

Perchlorate was not detected (less than 4 µg/L) in the two Upper Perched Groundwater wells sampled. Perchlorate was detected at a concentration of 216 µg/L in Monitoring Well 3728, the only well screened in the Lower Perched Groundwater having a detection of perchlorate.

Monitoring Well 3728 is located near a sump at Building 15007 (Source Area CP2-07) and is approximately 150 feet east of Source Area 59F, where perchlorate was detected in soil. Soil sampling for perchlorate was not conducted near Building 15007. These data are consistent with Source Area 59F and/or Source Area CP2-07 having contributed perchlorate to Lower Perched Groundwater.

First Water-Bearing Zone – Perchlorate

In the FWBZ, perchlorate analysis was performed on groundwater samples collected from 20 monitoring wells (Figure 6.6-13). The detected perchlorate concentrations ranged from 1.8 µg/L in Well 3659 to 6,100 µg/L in Well 3645. Perchlorate is primarily distributed in groundwater east of Chemical Plant 2 (OS2) and the eastern portion of the Magazine Area (OS4). The presence of perchlorate in the FWBZ appears to be associated with sources upgradient (east) of the BOU. The highest perchlorate concentration was reported in a sample from Well 3645, located at the most upgradient portion of OS2 and downgradient of potential sources within Line 03 (Figure 6.6-13). Perchlorate in groundwater in the eastern portion of the BOU extends west to GET E/F Extraction Wells 4007 and 4310.

Contributions of perchlorate, if any, to the FWBZ from the Lower Perched groundwater beneath Chemical Plant 2 are masked by the perchlorate in the FWBZ from upgradient sources.

6.6.2.4 *Metals*

Metal analyses were performed on groundwater samples collected from the following:

- Upper Perched Groundwater Well 286;
- Lower Perched Groundwater Well 902 and Lower Perched boring CP2-07-SB02; and
- Seventeen FWBZ monitoring wells and six FWBZ borings.

Analyses were performed on both unfiltered and field-filtered samples to measure total and dissolved metals concentrations, respectively. The results of the metals analysis of filtered groundwater samples are summarized below:

- Iron up to 11,000 µg/L and manganese up to 1,600 µg/L were the dissolved metals that most commonly exceeded their screening-level ARARs (secondary MCLs of 300 and 50 µg/L, respectively).
- Other dissolved metals sporadically reported at concentrations greater than their MCLs in monitoring well or grab groundwater samples included:
  - Aluminum up to 1,400 µg/L and mercury up to 4.6 µg/L in one sample (Lower Perched boring CP2-07-SB02);
  - Thallium up to 9.7 µg/L in a Lower Perched Groundwater sample from Well 902, west-northwest of the Magazine Area; and
  - Thallium up to 9.7 µg/L in FWBZ Well 3645, located in eastern OS2 and downgradient of potential sources in Line 03 outside the BOU.

As discussed in Sections 6.1.5.2, 6.1.9.2, and 6.2.5.2, none of these metals were reported above their respective screening-levels in soil samples collected from the source areas within the Chemical Plant 2 Region.

6.6.2.5 *Polychlorinated Biphenyls*

PCB analysis was performed on groundwater samples collected from the following:

- A grab sample from the Lower Perched Groundwater at Source Area CP2-0-7;
- FWBZ Monitoring Well 3642 at Source Area CP2-RE05; and

- Grab groundwater samples from the FWBZ at two locations in Chemical Plant 2 area at Source Areas 61F and CP2-ST07.

PCBs were not detected above their PQLs, which varied from 1 to 2 µg/L. The MCL for PCBs is 0.5 µg/L.

6.6.2.6 *Total Petroleum Hydrocarbons*

TPH-D and TPH-Mo analyses were performed on a grab FWBZ groundwater sample from boring CP2-07-SB14. TPH-D was reported at a concentration of 260 µg/L and TPH-Mo was reported at 340 µg/L.

6.6.2.7 *Organochlorine Pesticides*

Organochlorine pesticide analysis was performed on groundwater samples collected from the following:

- A grab sample from Lower Perched Groundwater soil boring CP2-07-SB02;
- FWBZ Monitoring Wells 3642, 3645, and 3651; and
- Grab groundwater samples collected from six FWBZ soil borings.

Monitoring well and/or grab groundwater samples analyzed for organochlorine pesticides were collected at Sites 25F, 60F, 61F, CP2-07, CP2-RE05, CP2-ST07, and OS2-F1 within the BOU. Additionally groundwater samples were also collected from two FWBZ monitoring wells (Wells 3645 and 3651) upgradient of the BOU and analyzed for organochlorine pesticides.

The results of the organochlorine pesticide analysis of groundwater samples collected from the Perched Groundwater and FWBZ are summarized below:

- Organochlorine pesticides were not detected at concentrations greater than their respective PQL. It is noted, however, that the PQL for aldrin, alpha-BHC, chlordane, dieldrin, heptachlor, and heptachlor epoxide exceeded their respective screening-level ARARs.
- Heptachlor was tentatively identified in the FWBZ grab groundwater sample collected from a boring (25F-SB06) in the Dredge Pit (Source Area 25F) at an estimated concentration of 0.013J µg/L, which exceeds the State MCL of 0.01 µg/L.

6.6.2.8 *Pendimethalin (Prowl) and 10-10′ Oxybis-10H-Phenoxarsine*

Analysis for the herbicide Prowl and the fungicide OBPA was performed on groundwater samples from the following:

- Lower Perched Groundwater from Well 902 (Prowl only) and a grab groundwater sample from the Lower Perched Groundwater (boring CP2-07-SB02); and
- FWBZ Monitoring Wells 3642, 3645, and 3651, and grab groundwater samples collected from the FWBZ at six locations.

Monitoring well and/or grab groundwater samples analyzed for Prowl and OBPA were collected at Source Areas 25F, 60F, 61F, CP2-07, CP2-ST07, CP2-RE05, and OS2. Additionally, groundwater samples collected from Monitoring Wells 3645 and 3651 in the most upgradient portion of the BOU area were also analyzed for Prowl and OBPA.

The results of the Prowl and OBPA analysis of groundwater samples collected from the Perched Groundwater and FWBZ are summarized below.

- Prowl was detected at a maximum estimated concentration of 16J µg/L in a grab groundwater sample collected from the FWBZ at boring 25F-SB06. The reported concentration of Prowl is significantly lower than the tap water PRG of 1,500 µg/L.
- OBPA was not detected above the PQL of 5 µg/L in the samples analyzed.

6.6.2.9 *Geochemical Parameters*

Samples were analyzed for various geochemical parameters to provide data for assessing background water quality and chemical and biological reduction processes in groundwater. Bicarbonate, carbonate, chloride, fluoride, hydroxide, nitrate (as NO_3), nitrite (as NO_2), phosphate, and sulfate analyses were performed on the groundwater samples collected from the following:

- Upper Perched Groundwater Well 286;
- Lower Perched Groundwater Well 902; and
- Nineteen FWBZ monitoring wells.

The results of the geochemical analysis of the groundwater samples are summarized below:

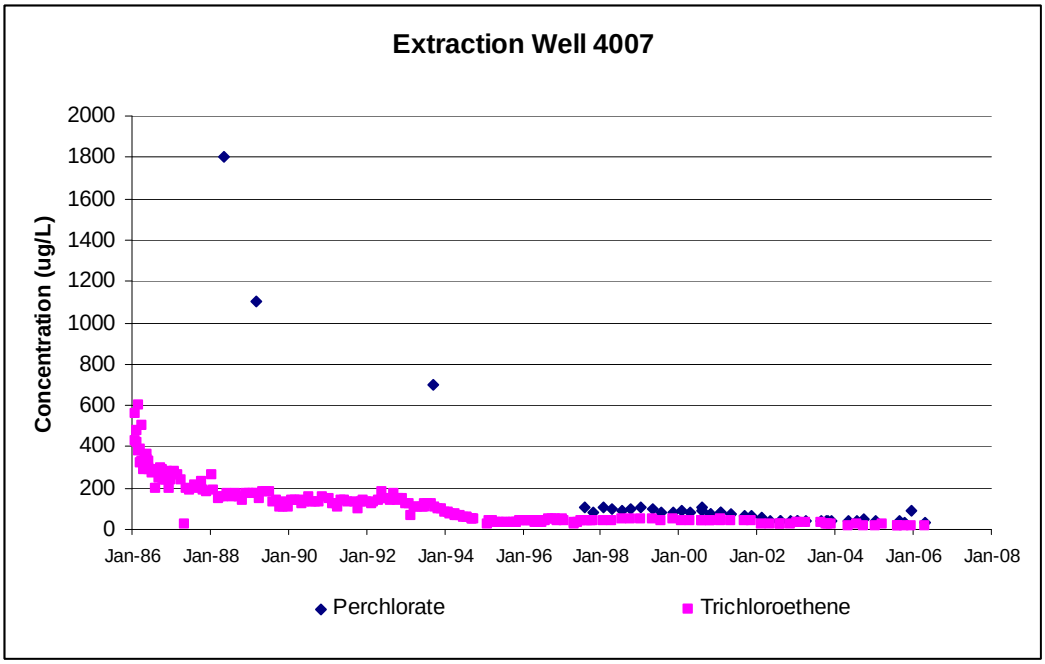
- Sulfate was reported at 520 mg/L in a groundwater sample collected from FWBZ Monitoring Well 3348, near a septic tank at Source Area 60F in the southern portion of Chemical Plant 2. The reported concentration of sulfate is above the MCL of 500 mg/L.
- Nitrate was reported at 140 mg/L in a groundwater sample collected from FWBZ Monitoring Well 3642 at Site CP2-RE05 in the southern portion of Chemical Plant 2. The reported concentration of nitrate exceeds the MCL of 45 mg/L.
- The median concentrations of the major ions were bicarbonate (170 mg/L), carbonate (less than 5 mg/L), chloride (5.9 mg/L), sulfate (13 mg/L), and nitrate (4.2 mg/L).
- Hydroxide and phosphate were not detected (less than 5 and 0.5 mg/L, respectively).
- All alkalinity was due to bicarbonate with values ranging from 74 mg/L (FWBZ Well 3651) to 340 mg/L (Upper Perched Well 286).
- DOC concentrations ranged from 0.69J to 0.82J mg/L in Perched Groundwater and from less than 1.0 to 5.4 mg/L in FWBZ.

6.6.3 Existing Remedial Actions

The GET E/F system is located within and downgradient of the Chemical Plant 2 Region. GET E/F is operated to minimize or prevent the off-site migration of chemicals in groundwater, including those that may have originated at source areas within the Chemical Plant 2 Region.

GET E/F includes shallow extraction wells that are screened in Layer A and deeper extraction wells screened in Layers C, D, and E. Extraction Wells 4007 and 4310 are screened in Layer A (i.e., the FWBZ), and are located near suspected source areas in Chemical Plant 2. Extraction Well 4007 currently operates at a flow rate of approximately 2 gallons per minute. Well 4310 has not operated since 1997, as it is unable to maintain flow due the dewatering of Layer A in this area.

As shown on the graph below, TCE and perchlorate concentrations in groundwater from Extraction Well 4007 have decreased over the past 21 years.



The effectiveness of the GET E/F system was recently evaluated in the *Draft Interim Inner-Barrier Effectiveness Evaluation, Western Groundwater Operable Unit, Aerojet-General Superfund Site* (CVEI and Aerojet, 2007).

6.6.4 *Chemical Fate and Transport* `

Numerous processes governing contaminant fate and transport have influenced the distribution of chemicals currently observed in groundwater beneath the southwestern portion of the Aerojet site, including the Chemical Plant 2 Region. This section describes the various processes, and how they may influence potential remedy evaluation and selection.

Chemical Fate and Transport is only relevant to areas where COPCs were identified at concentrations greater than their screening-level ARARs. Therefore, the Upper Perched Groundwater in the northern portion of the Magazine Area and the Lower Perched Groundwater west-northwest of the Magazine Area were not evaluated.

6.6.4.1 *Upper Perched Groundwater*

Upper Perched Groundwater at Sites 59F and CP2-07 at Chemical Plant 2 contains 1,2-DCA (up to 7,500 µg/L in grab samples and 2.5J µg/L in monitoring well samples) and vinyl chloride (up to 1.9 µg/L in grab samples, but not detected in monitoring well samples). As discussed in

Section 6.6.1.2, the Upper Perched Groundwater in the Chemical Plant 2 Area is an assemblage of several laterally discontinuous perched zones. That is, no one single perched groundwater layer appears to be laterally continuous throughout the Chemical Plant 2 Area. Because each individual perched groundwater layer within the Upper Perched Groundwater Zone appears discontinuous, based on relative depths and elevations, minimal lateral transport of perched groundwater containing COPCs is anticipated.

The dominant transport mechanism for the Upper Perched Groundwater is likely downward vertical migration to either the Lower Perched Groundwater or the FWBZ. Hydraulic heads measured in the Upper Perched Groundwater ranged from approximately 51 to 62 feet above heads measured in the FWBZ, providing the potential for downward vertical migration. Pathways for downward vertical migration may occur where there are discontinuities in the perching sediments.

6.6.4.2 *Lower Perched Groundwater*

Lower Perched Groundwater beneath Chemical Plant 2 contained VOCs and perchlorate at reported concentrations greater than their respective screening-level ARARs. The lateral extents of these chemicals were limited to a limited area defined by one soil boring (CP2-07-SB05) and one monitoring well (3728) approximately 10 feet from boring CP2-07-05. The data suggest that lateral groundwater flow in the Lower Perched Groundwater zone is negligible.

Hydraulic heads measured in the Lower Perched Groundwater ranged from approximately 5 to 27 feet above those measured in the FWBZ, providing the potential for downward vertical migration.

The data indicate that VOCs (1,2-DCA and vinyl chloride) present in the Lower Perched Groundwater are either not detected or present at relatively minor concentrations in the FWBZ, which suggests that vertical migration of groundwater from the Lower Perched Groundwater into the FWBZ is not significant.

6.6.4.3 *First Water-Bearing Zone*

VOCs and perchlorate were the constituents most commonly detected in FWBZ beneath the southwestern portion of the Aerojet site, including the Chemical Plant 2 Region. The distribution of these compounds indicates that they migrated from various upgradient potential source areas by

advective flow. Water quality trends show that the concentrations and extents of chemicals in the FWBZ are decreasing as a result of mass removal by the GET F system, source depletion, and possibly biodegradation.

There is an area of FWBZ groundwater in the southern portion of Chemical Plant 2 (Monitoring Wells 131 and 3348) that contains 1,2-DCA at concentrations greater than the MCL. The presence of 1,2-DCA in the FWBZ at that location appears to be a small remnant of a larger 1,2-DCA plume that existed in the area historically. In the Stage 1 RI Report (ICF Kaiser, 1993), the Chemical Plant 2 area was depicted as being enveloped by the 5 µg/L isoconcentration contour for 1,2-DCA, with concentrations greater than 1,000 µg/L reported in several Chemical Plant 2 FWBZ wells (see table below). During the BOU RI Sampling Period, the highest concentration of 1,2-DCA in the FWBZ was an estimated 4.7J µg/L.

1,2-DCA Concentrations in FWBZ in 1993 and 2006

Monitoring Well	Stage 1 RI (1992-93)	BOU RI (2005-06)
22	520	0.34J
24	820	<0.5
25	130	<0.5
131	7,900	0.61
215	6,300	0.45J
3222	2,200	<0.5
3292	110	<0.5
3348	43	1.7

Concentrations reported in µg/L.
Only FWBZ wells with data available during both periods are included in the above table.

The decrease in 1,2-DCA concentrations in the FWBZ beneath the Chemical Plant 2 Region, and the southwestern portion of the Aerojet site, is an indication that 1,2-DCA mass contributions from Perched Groundwater and/or soil vapor, if any, are not significant. Factors that could have contributed to the attenuation of 1,2-DCA in the FWBZ in the Chemical Plant 2 Region include:

- *GET E/F Operation* – Two of the three wells with 1,2-DCA detections greater than the PQL are located near operating GET E/F Extraction Well 4007;
- *Biodegradation* – Available data indicate the groundwater is aerobic and 1,2-DCA can biodegrade aerobically; and

- *Source Area Depletion* – Plume contraction is generally an indication that the mass at the source, and hence the mass flux out of the source, is decreasing.

Groundwater containing VOCs, primarily TCE, is migrating from source areas in Line 3 downgradient towards the west beneath OS2 and eastern Chemical Plant 2 (Figure 6.6-11). Hydraulic gradients in the FWBZ indicate a westerly flow direction from the Line 03 area towards GET E/F Extraction Well 4007.

As with 1,2-DCA, TCE concentrations in the FWBZ beneath the Chemical Plant 2 Region, and the southwestern portion of the Aerojet site, are also decreasing. TCE concentrations reported in monitoring wells during the Stage 1 RI (ICF Kaiser, 1993) and the BOU RI are summarized on the table below.

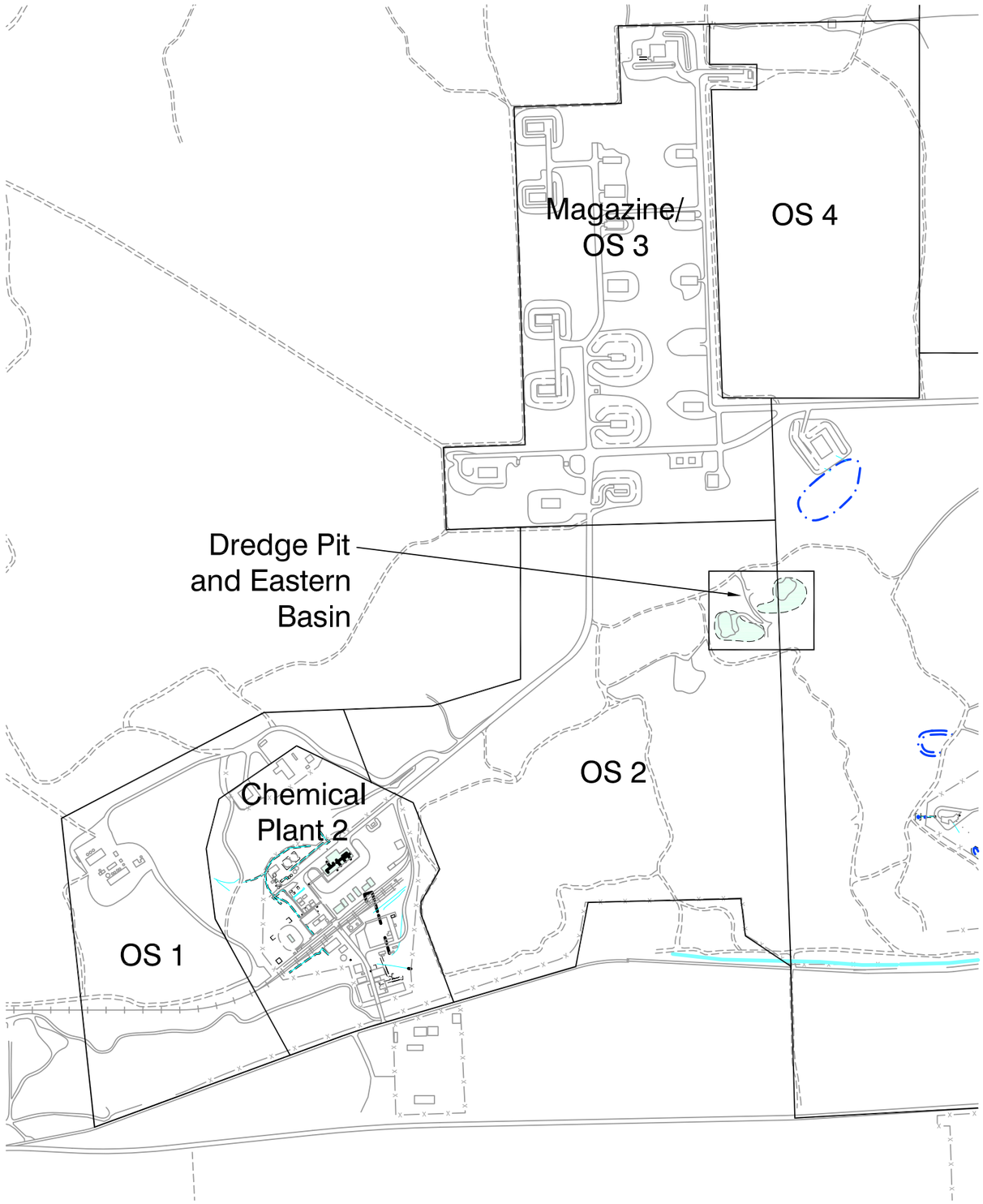
TCE Concentrations in FWBZ in 1993 and 2006

Monitoring Well	Stage 1 RI (1992-93)	BOU RI (2005-06)
22	1,100	110
24	320	6
25	92	9
131	55	11
181	21,000	1,100
215	150	5
3048	32	2
3222	150	4
3233	120	2
3292	69	1
3348	1,300	30

Concentrations reported in µg/L.
Only FWBZ wells with data available during both periods are included in the above table.

The attenuation of TCE concentrations in the FWBZ beneath the southern portion of the Aerojet site and the Chemical Plant 2 Region is suspected to be due to source depletion and mass removal by GET E/F. Geochemical conditions are generally not favorable for intrinsic reductive chlorination in the area upgradient of Chemical Plant 2, as available data are consistent with the groundwater generally being aerobic.

Perchlorate detected in the FWBZ beneath the western portions of the Chemical Plant 2 Region appears to be transported by advection to the GET E/F system. The denitrifying conditions needed for perchlorate degradation are not indicated by available geochemical data.



EXPLANATION

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Drainage Culvert
- Underground Culvert
- Fence
- Road
- Railroad
- 20009 Building
- Former Structure
- Above Ground Storage Tank
- Surface Drainage
- L2-ST24 Septic Tank and Leach Line

N

Scale: 1" = 1000'

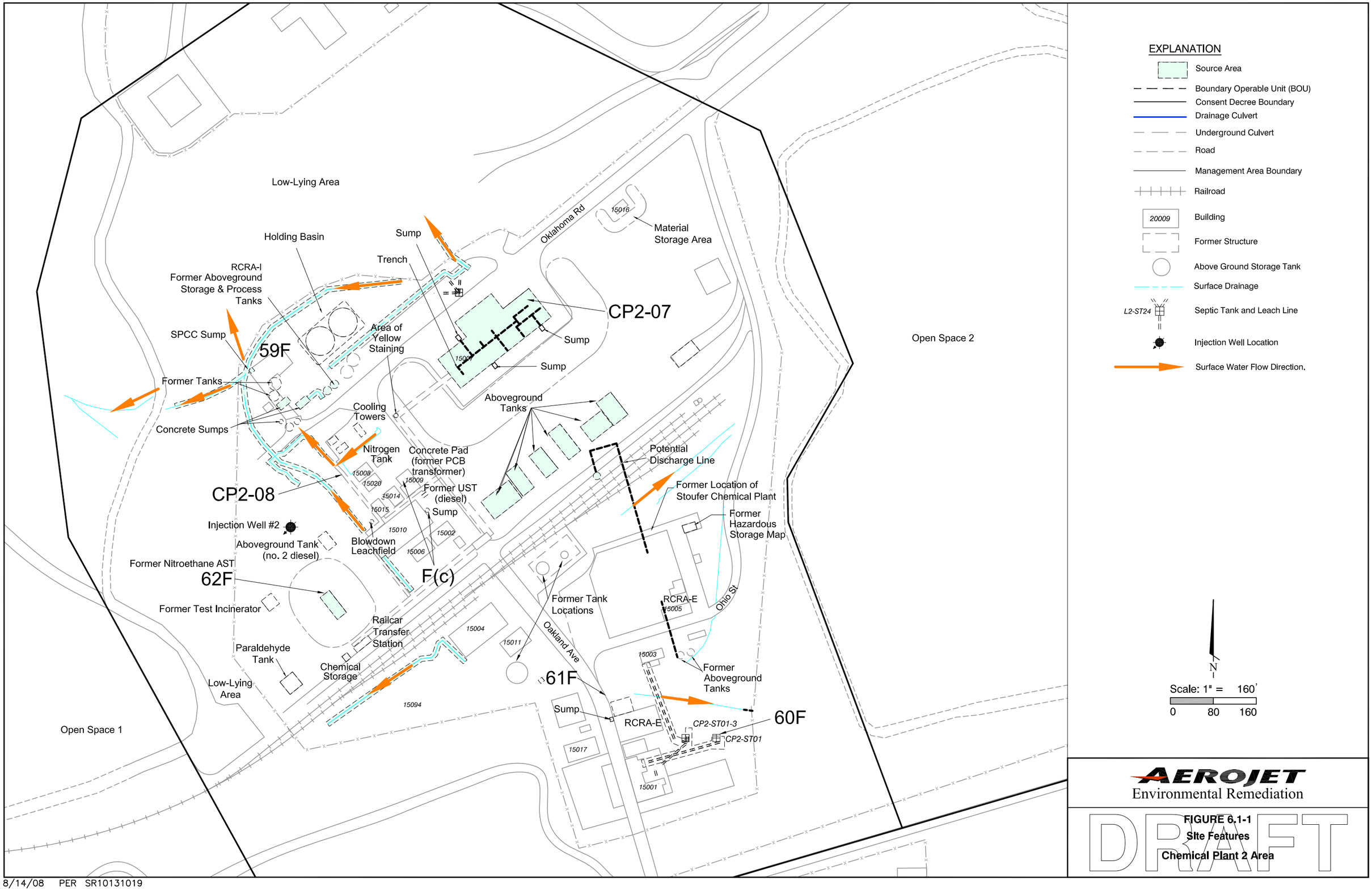
0 500 1000

AEROJET
Environmental Remediation

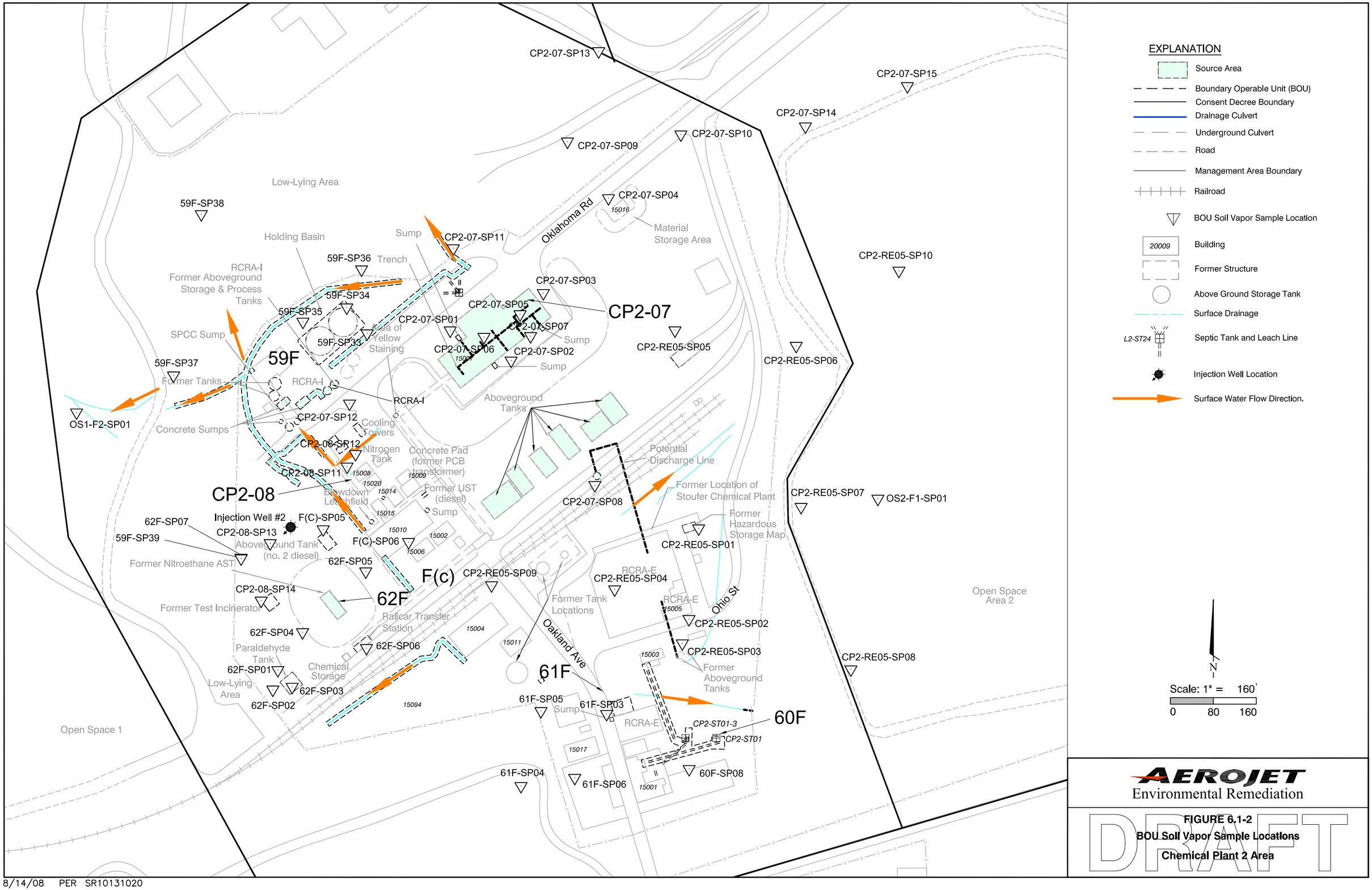
DRAFT

FIGURE 6.0-1
Site Location Map
Chemical Plant 2, Magazine, Dredge Pit and Eastern Basin, and Open Space Areas 1,2,3 and 4

9\11\08 PR SR10131018



8/14/08 PER SR10131019



8/14/08 PER SR10131020

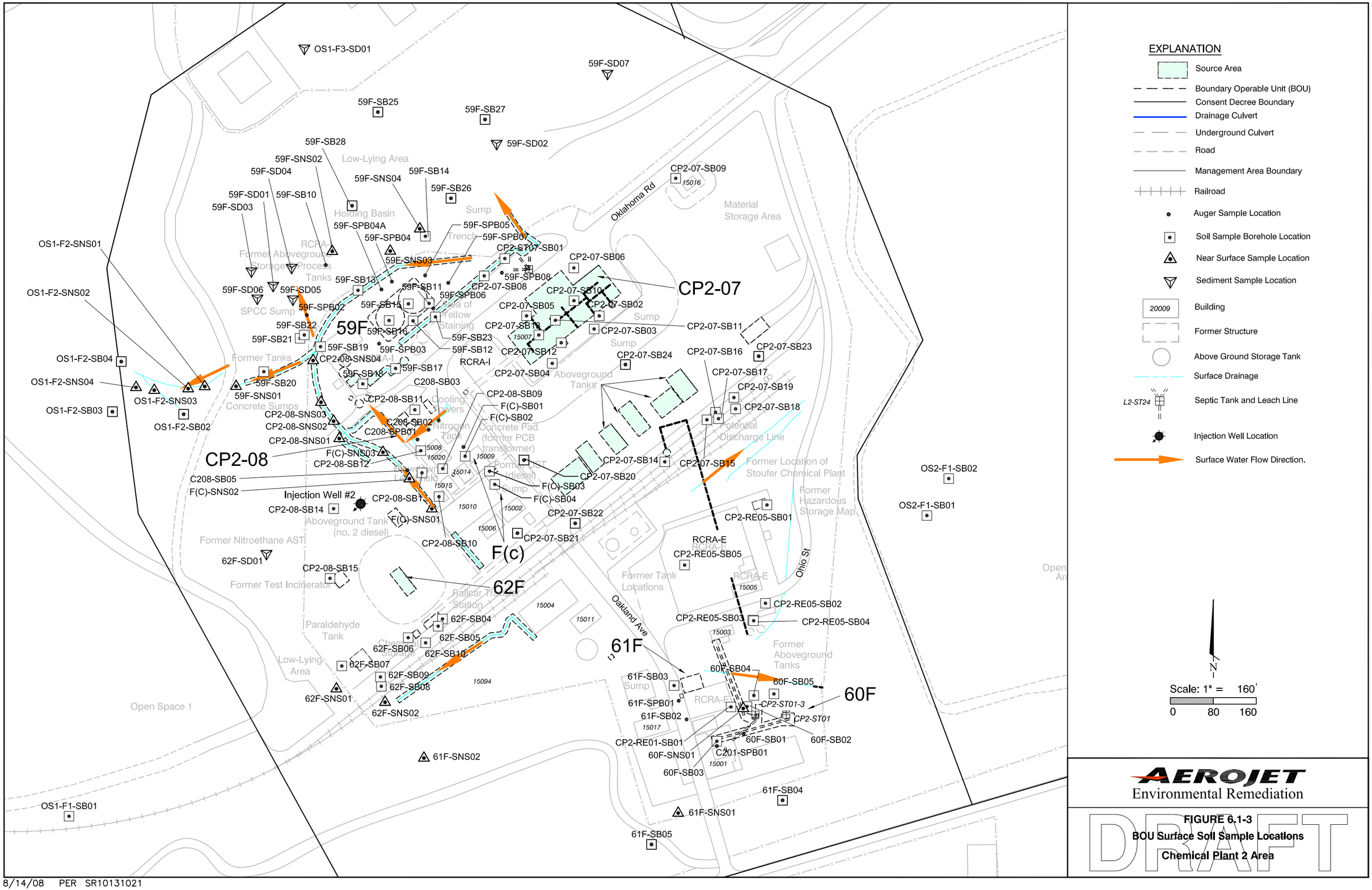


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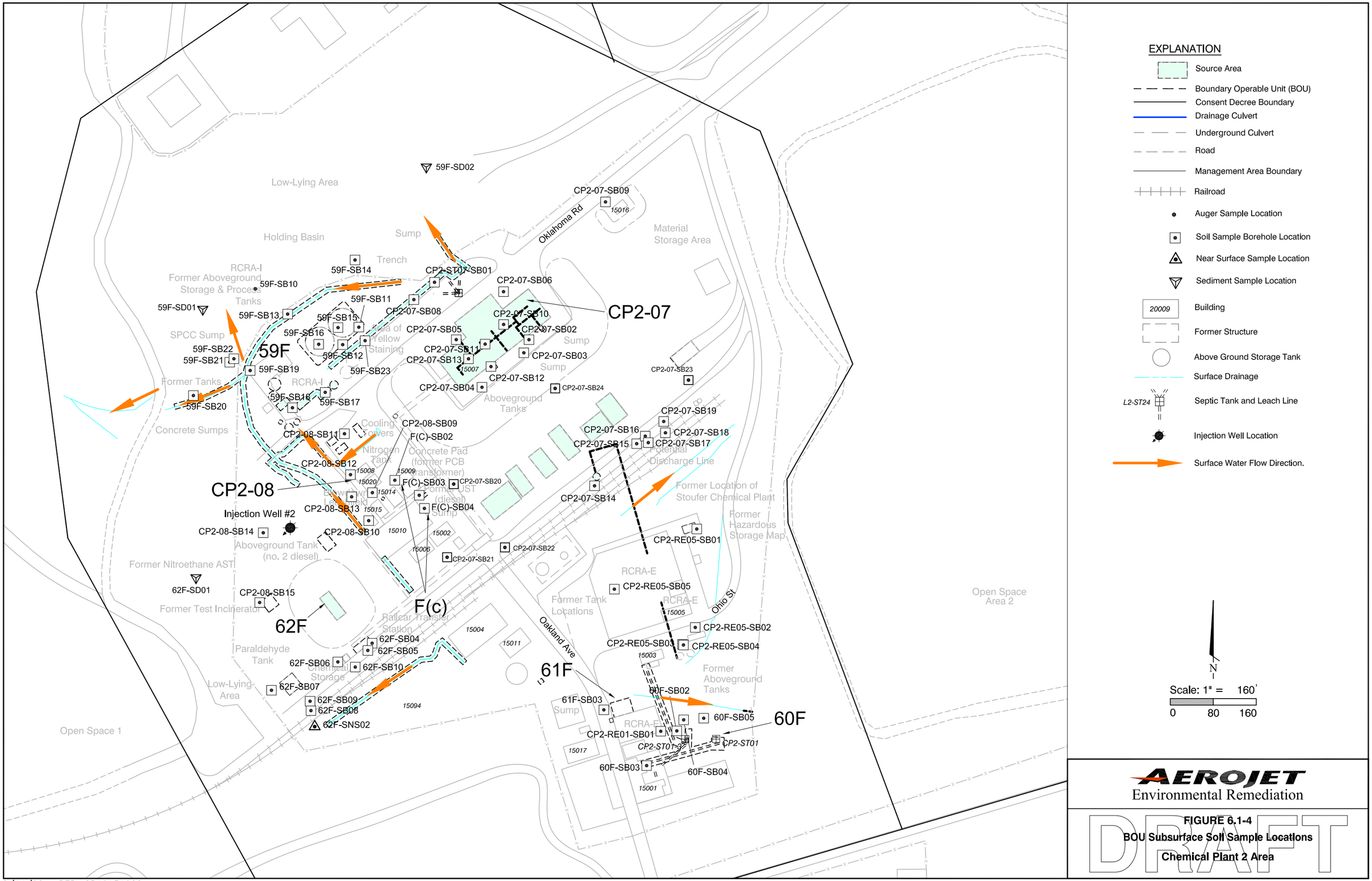
FIGURE 6.1-3
BOU Surface Soil Sample Locations
Chemical Plant 2 Area

8/14/08 PER SR10131021



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Environmental Remediation

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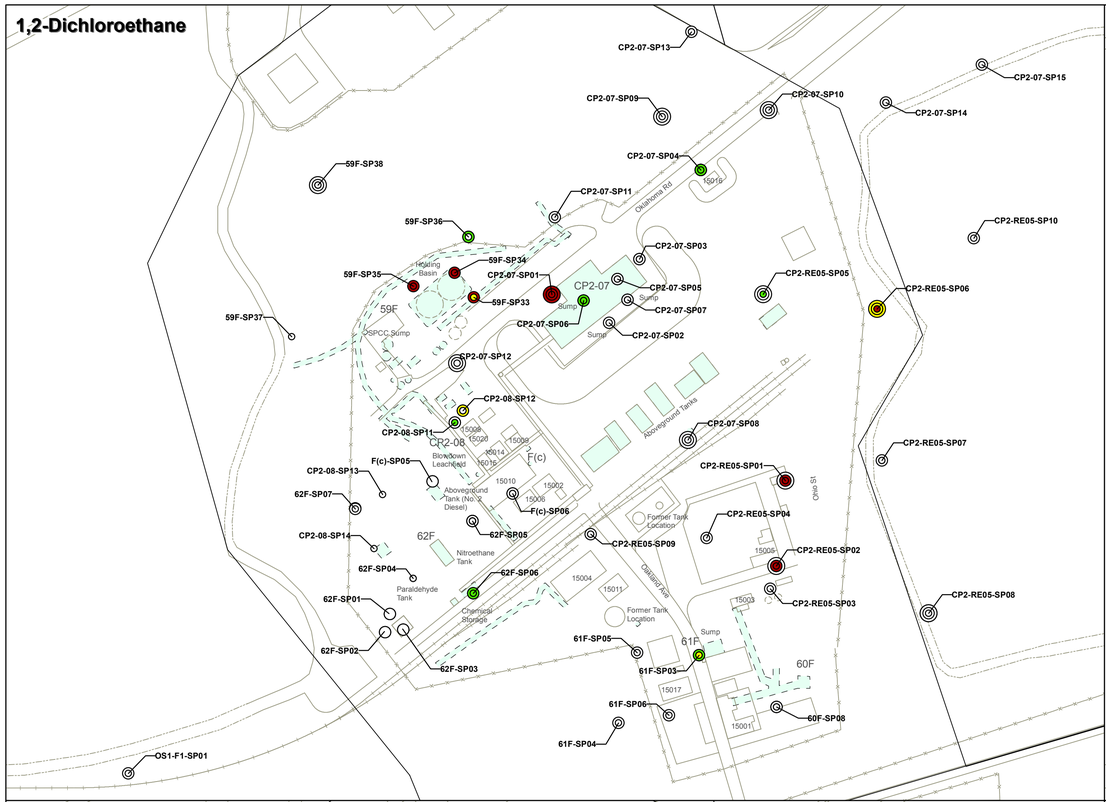
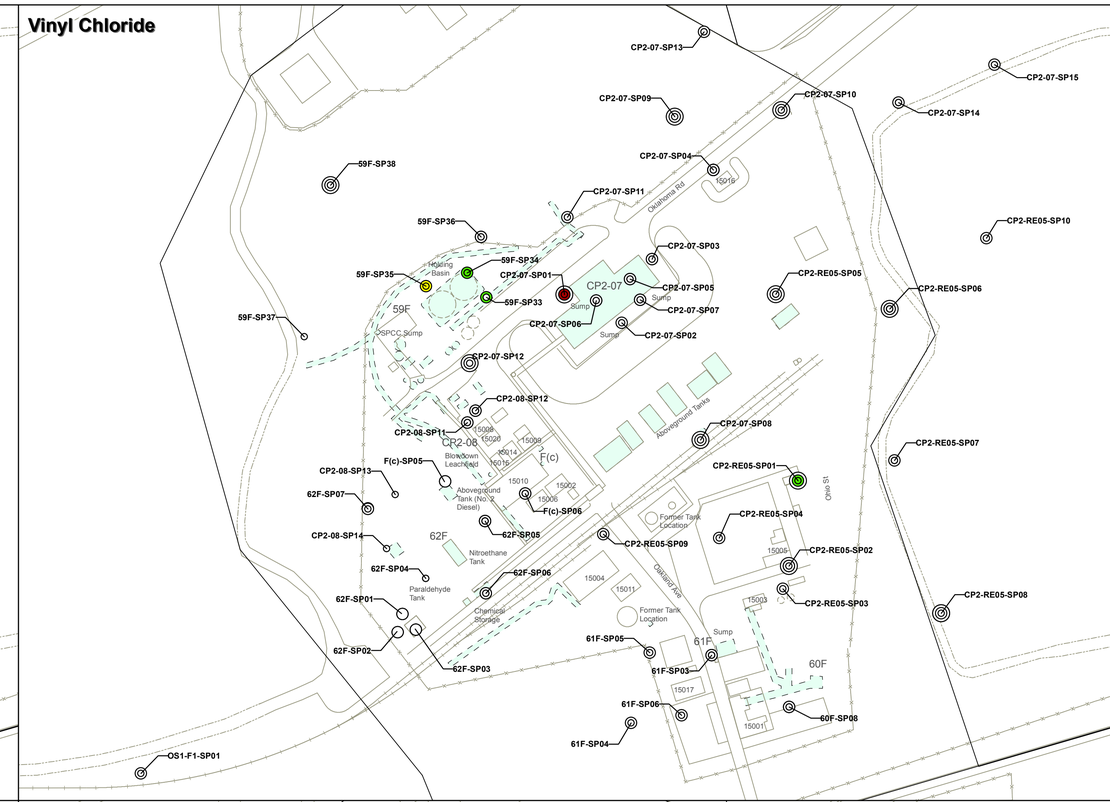
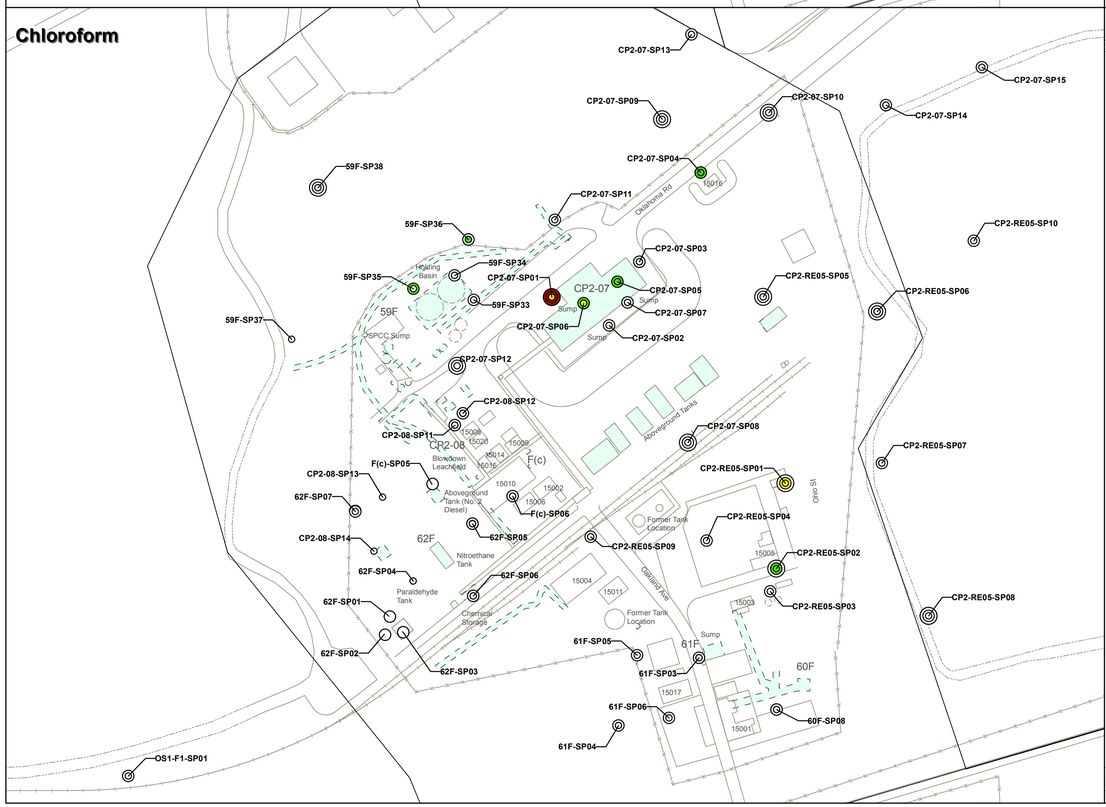
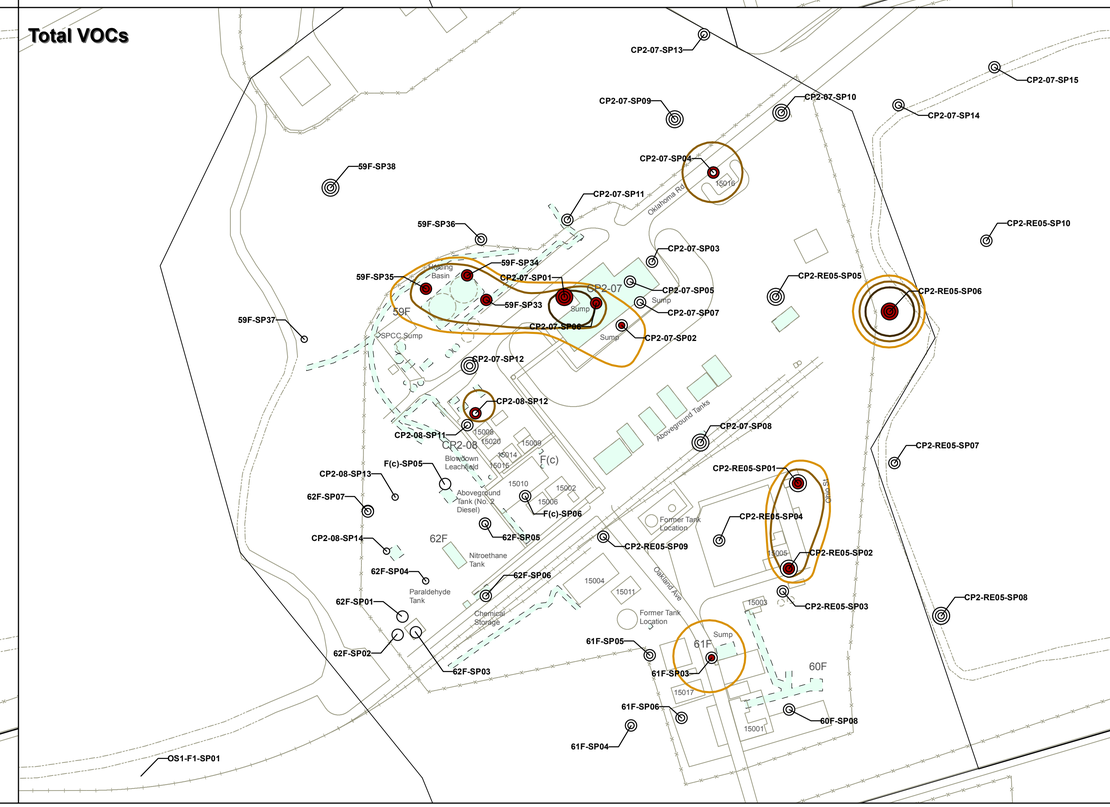
FIGURE 6.1-4
BOU Subsurface Soil Sample Locations
Chemical Plant 2 Area

8/14/08 PER SR10131022









1,2-DCA, Vinyl Chloride, Chloroform Exceedances

- < Soil Vapor Screening Level (RISL)
- >= RISL and < 10x RISL
- >= 10x RISL and < 100x RISL
- >= 100x RISL

Total VOCs Exceedances

- Σ Detects to Screening Levels Ratios <= 10
- Σ Detects to Screening Levels Ratios > 10

- <= 10 Feet bgs (Inner Circle)
- 11 to 20 Feet bgs (Middle Circle)
- > 20 Feet bgs (Outer Circle)

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary

Sample Location	<= 10 ft bgs			11-20 ft bgs			>20 ft bgs		
	1,2-Dichloroethane	Benzene	Vinyl Chloride	1,2-Dichloroethane	Benzene	Vinyl Chloride	1,2-Dichloroethane	Benzene	Vinyl Chloride
Screening Level	21.6	4.5	11	21.6	4.5	11	21.6	4.5	11
Chemical Plant 2									
59F-SP33	**6,540**	<SL	<SL	**10,000**	<SL	71	NC	NC	NC
59F-SP34	**41,000**	<SL	51	**36,000**	<SL	53	NC	NC	NC
59F-SP35	**40,000**	<SL	**540**	**102,000**	**360**	**410**	NC	NC	NC
59F-SP36	<SL	**120**	<SL	**120**	<SL	<SL	NC	NC	NC
CP2-07-SP01	**250,000**	**1,700**	**66,500**	**8,600,000**	**110,000**	**120,000**	**2,200,000**	**12,000**	<SL
CP2-07-SP04	**180**	**210**	<SL	**210**	**560**	<SL	NC	NC	NC
CP2-07-SP05	<SL	**190**	<SL	<SL	**360**	<SL	NC	NC	NC
CP2-07-SP06	**400**	**1,400**	<SL	**340**	**550**	<SL	NC	NC	NC
CP2-08-SP12	**170**	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
CP2-08-SP12	<SL	<SL	<SL	**1,600**	<SL	<SL	NC	NC	NC
Chemical Plant 2 Area South									
61F-SP03	**760**	<SL	<SL	**310**	<SL	<SL	NC	NC	NC
60F-SP06	**76**	<SL	<SL	**79**	<SL	<SL	NC	NC	NC
CP2-RE05-SP01	**935,000**	**1,800**	**240**	**110,000**	**1,200**	**50**	<SL	<SL	<SL
CP2-RE05-SP02	**56,000**	**410**	<SL	**9,900**	**120**	<SL	<SL	<SL	<SL
CP2-RE05-SP03	**360**	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL
CP2-RE05-SP06	**12,000**	<SL	<SL	**4,900**	<SL	<SL	**932**	<SL	<SL

Units in ug/m³.

<SL = either non-detect or detected concentration less than SL.

NC = Sample not collected.

N

1 " = 150 '

0 150 300
Feet

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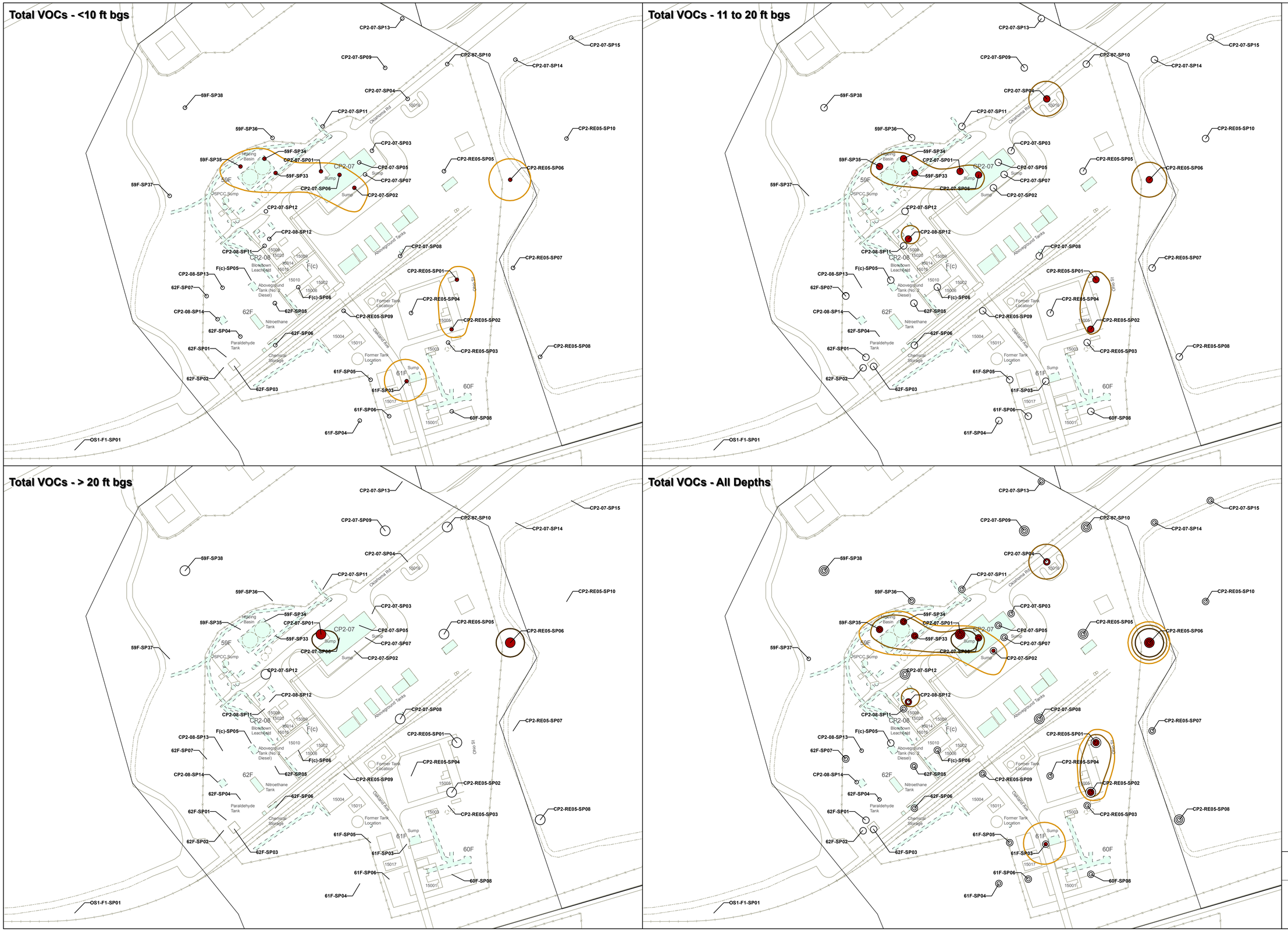
Environmental Remediation

Figure 6.1-5a

1,2-DCA, Vinyl Chloride, Chloroform, and Total VOC Concentrations in Soil Vapor Above Remedial Investigation Screening Levels - Chemical Plant 2 Area



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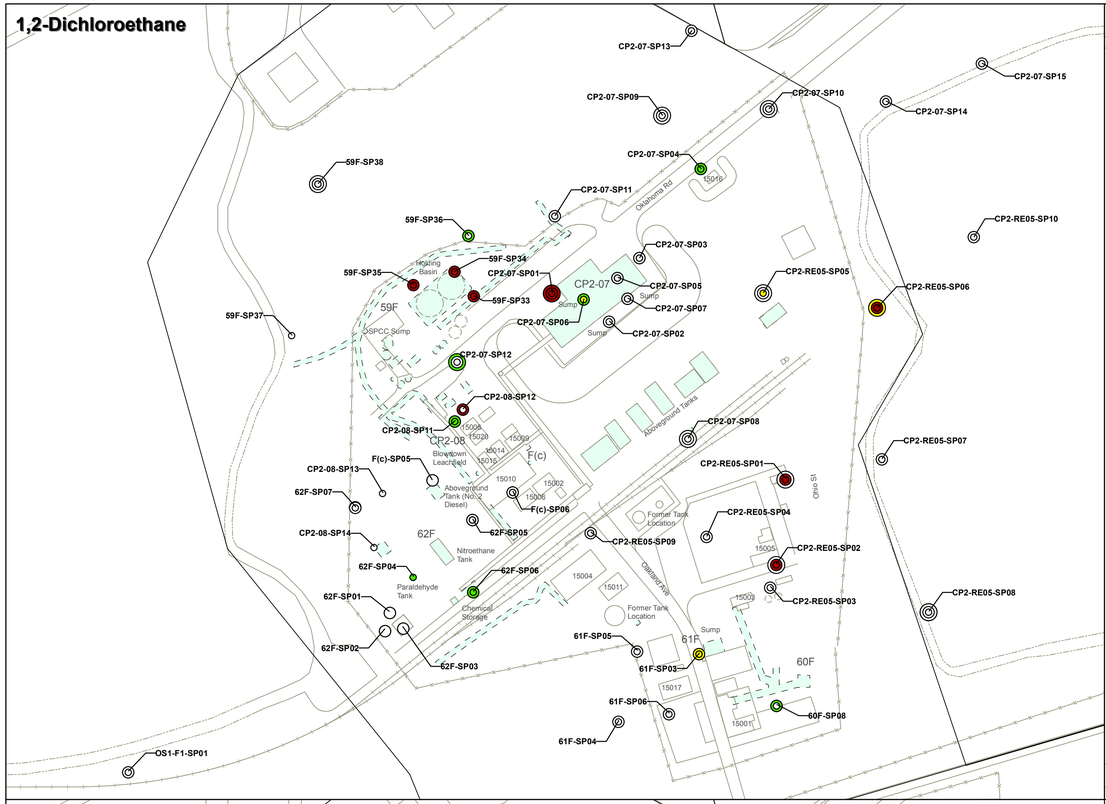
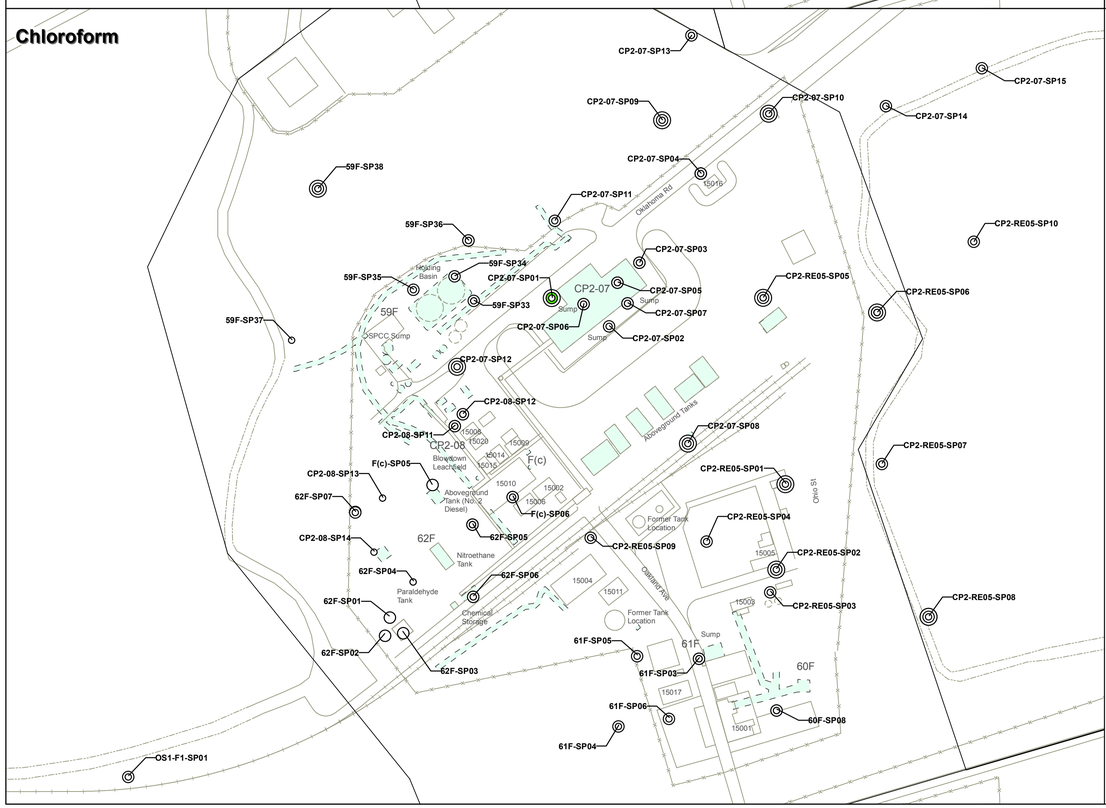
Environmental Remediation

Figure 6.1-5b

Total VOC Concentrations in Soil Vapor Above Remedial Investigation Screening Levels
Chemical Plant 2 Area





Sample Location	<= 10 ft bgs			11-20 ft bgs			>20 ft bgs		
	1,2-Dichloroethane	Chloroform	Vinyl Chloride	1,2-Dichloroethane	Chloroform	Vinyl Chloride	1,2-Dichloroethane	Chloroform	Vinyl Chloride
Screening Level	21	18,595	235	21	18,595	235	21	18,595	235
Chemical Plant 2									
59F-SP33	**4,300**	<SL	<SL	**33,000**	<SL	<SL	NC	NC	NC
59F-SP34	**41,000**	<SL	<SL	**30,000**	<SL	<SL	NC	NC	NC
59F-SP35	**88,000**	<SL	**540**	**310,000**	<SL	**830**	NC	NC	NC
59F-SP36	<SL	<SL	<SL	**120**	<SL	<SL	NC	NC	NC
59F-SP38	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL
62F-SP04	**57**	<SL	<SL	NC	NC	NC	NC	NC	NC
CP2-07-SP01	**230,000**	<SL	**64,000**	**8,600,000**	**120,000**	**120,000**	**2,200,000**	<SL	<SL
CP2-07-SP04	**180**	<SL	<SL	**210**	<SL	<SL	NC	NC	NC
CP2-07-SP05	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
CP2-07-SP06	**480**	<SL	<SL	**160**	<SL	<SL	NC	NC	NC
CP2-07-SP07	<SL	<SL	<SL	<SL	<SL	<SL	NC	NC	NC
CP2-08-SP11	**170**	<SL	<SL	**52**	<SL	<SL	NC	NC	NC
CP2-08-SP12	<SL	<SL	<SL	**2,600**	<SL	<SL	NC	NC	NC
CP2-08-SP13	<SL	<SL	<SL	NC	NC	NC	NC	NC	NC
Chemical Plant 2 Area South									
61F-SP03	**760**	<SL	<SL	**330**	<SL	<SL	NC	NC	NC
62F-SP06	**78**	<SL	<SL	**79**	<SL	<SL	NC	NC	NC
CP2-RE05-SP01	**300,000**	<SL	**240**	**110,000**	<SL	<SL	<SL	<SL	<SL
CP2-RE05-SP02	**38,000**	<SL	<SL	**9,900**	<SL	<SL	<SL	<SL	<SL
CP2-RE05-SP05	**340**	<SL	<SL	<SL	<SL	<SL	<SL	<SL	<SL
CP2-RE05-SP06	**12,000**	<SL	<SL	**4,300**	<SL	<SL	**910**	<SL	<SL

Units in $\mu g/m^3$.

<SL = either non-detect or detected concentration less than SL.

NC = Sample not collected.

1,2-DCA, Vinyl Chloride, Chloroform Exceedances

- < Soil Vapor Screening Level (PGW SVSL)
- >= PGW SVSL and < 10x PGW SVSL
- >= 10x PGW SVSL and < 100x PGW SVSL
- >= 100x PGW SVSL

- <= 10 Feet bgs (Inner Circle)
- 11 to 20 Feet bgs (Middle Circle)
- > 20 Feet bgs (Outer Circle)

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary

N

1 " = 150 '

0 150 300
Feet

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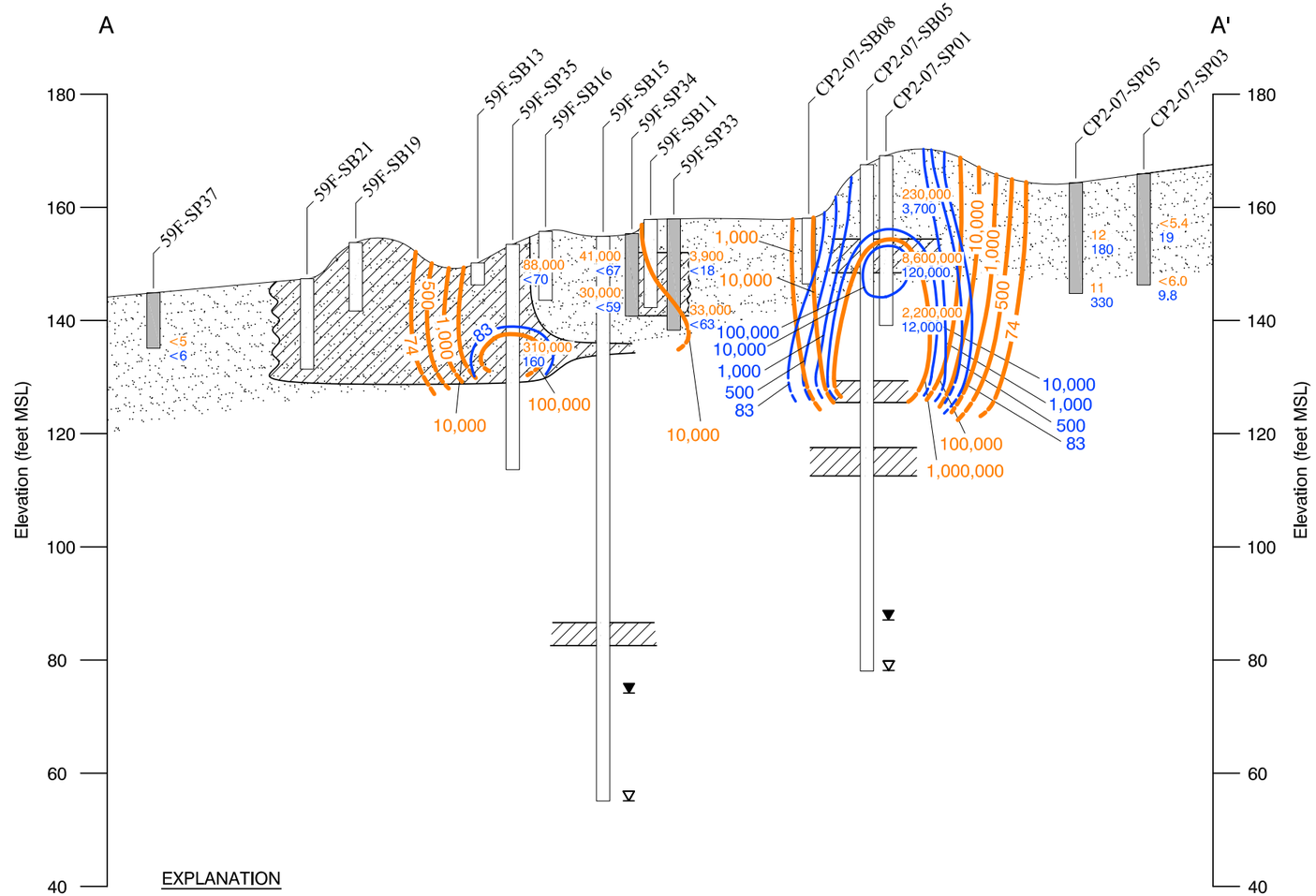
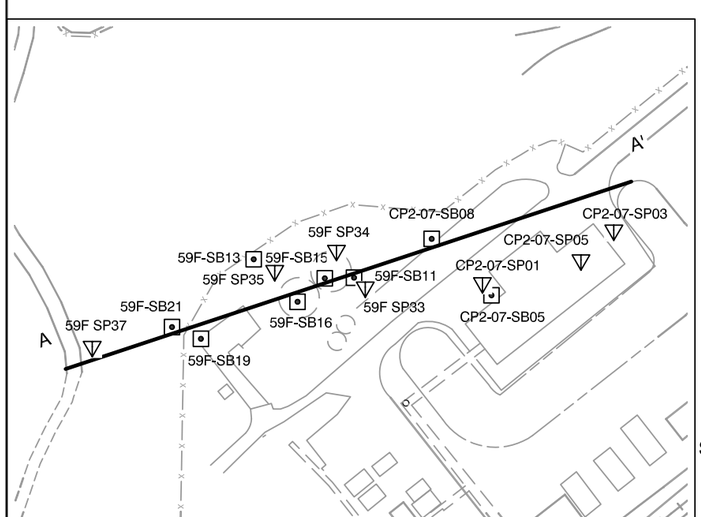
Environmental Remediation

Figure 6.1-6

1,2-DCA, Vinyl Chloride, and Chloroform Concentrations in Soil Vapor Above Protection of Groundwater Screening Levels - Chemical Plant 2 Area





N

Scale: 1" = 200'

0 100 200

Locator Scale

EXPLANATION

1001 — Boring Designation

<0.5 / <4 — 1,2-DCA Concentration in $\mu g/m^3$ / Chloroform Concentration in $\mu g/m^3$ (NS-W = not sampled due to presence of groundwater)

Total Borehole Depth

Initial Depth to Groundwater

Final Depth to Groundwater

74 — 1,2-DCA Concentration in Micrograms per Cubic Meter ($\mu g/m^3$)

83 — Chloroform Concentration in Micrograms per Cubic Meter ($\mu g/m^3$)

Note: Contour Lines Dashed Where Inferred

1,2-DCA 1,2-Dichloroethane

MSL Mean Sea Level

Geologic Contact

Relatively permeable sediments: Silty, poorly and well-graded sands and gravels (GP,GW,SP,SW); silty and clayey gravels (GM/GC) and silts.

Relatively lower permeability sediments: Low plasticity clays and silts (CL,ML); silty and clayey sand (SM/SC).

Dredge Tailings

Vertical Scale 1' = 400'

0 400

Horizontal Scale 1' = 100'

0 100

Vertical Exaggeration: 4X

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Environmental Remediation

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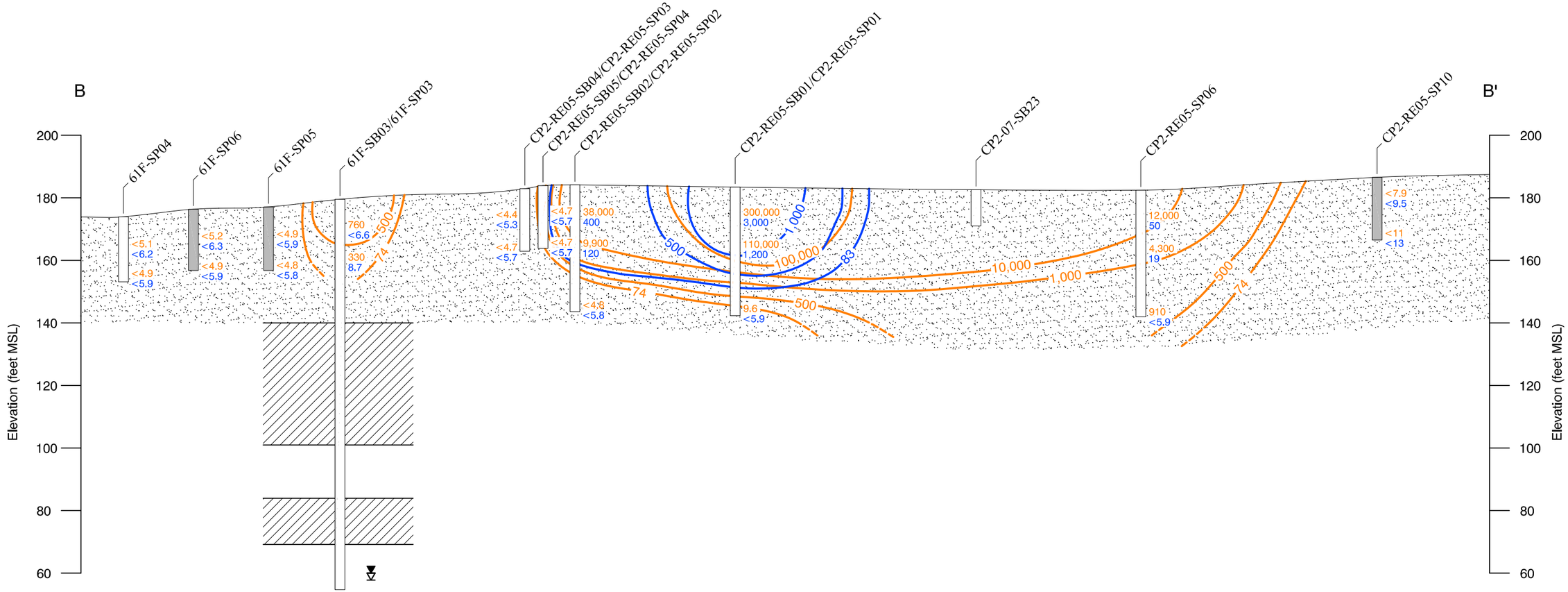
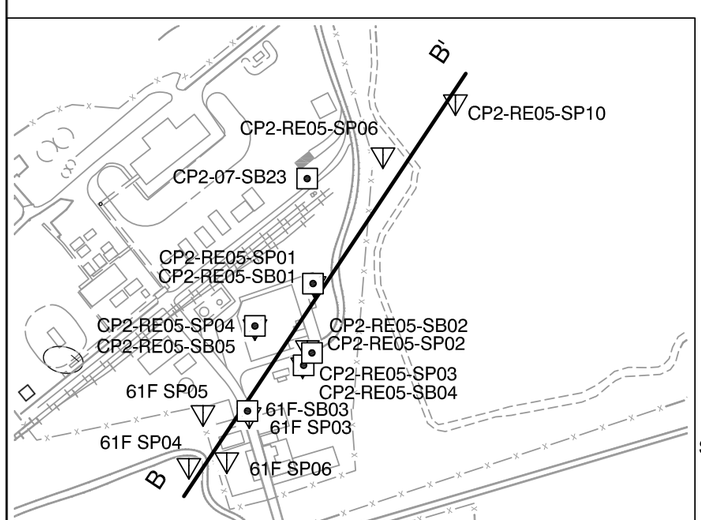
FIGURE 6.1-7

Vadose Zone Cross Section A-A'

Chemical Plant 2 Area

2/14/08 ah SR10131023





EXPLANATION

61F-SP04 — Boring Designation

Boring Location (Shaded Borings Lack Lithology)

<0.5 — 1,2-DCA Concentration in $\mu g/m^3$

<4 — Chloroform Concentration in $\mu g/m^3$ (NS-W = not sampled due to presence of groundwater)

Total Borehole Depth

Initial Depth to Groundwater

Final Depth to Groundwater

74 — 1,2-DCA Concentration in Micrograms per Cubic Meter ($\mu g/m^3$)

83 — Chloroform Concentration in Micrograms per Cubic Meter ($\mu g/m^3$)

Note: Contour Lines Dashed Where Inferred

1,2-DCA 1,2-Dichloroethane

MSL Mean Sea Level

Geologic Contact

Relatively permeable sediments: Silty, poorly and well-graded sands and gravels (GP,GW,SP,SW); silty and clayey gravels (GM/GC) and silts.

Relatively lower permeability sediments: Low plasticity clays and silts (CL,ML); silty and clayey sand (SM/SC).

Dredge Tailings

Vertical Scale 1' = 400'

400

0

100

Horizontal Scale 1' = 100'

Vertical Exaggeration: 4X

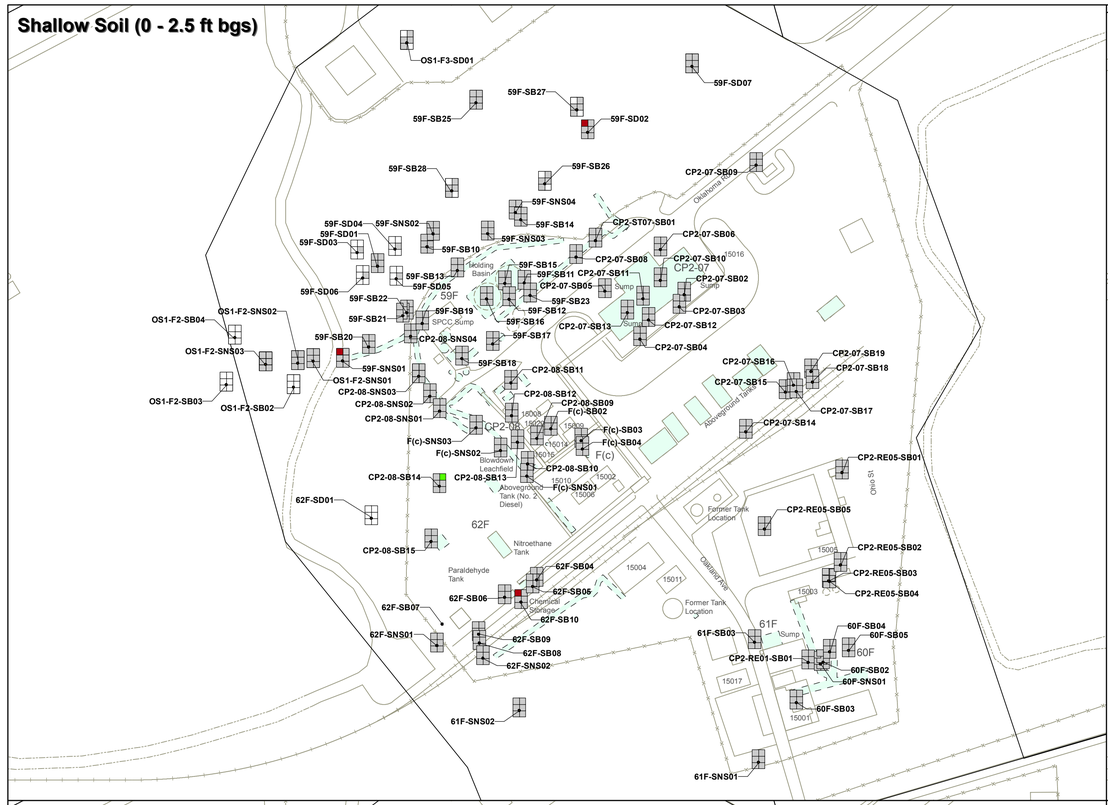
AEROJET
Environmental Remediation

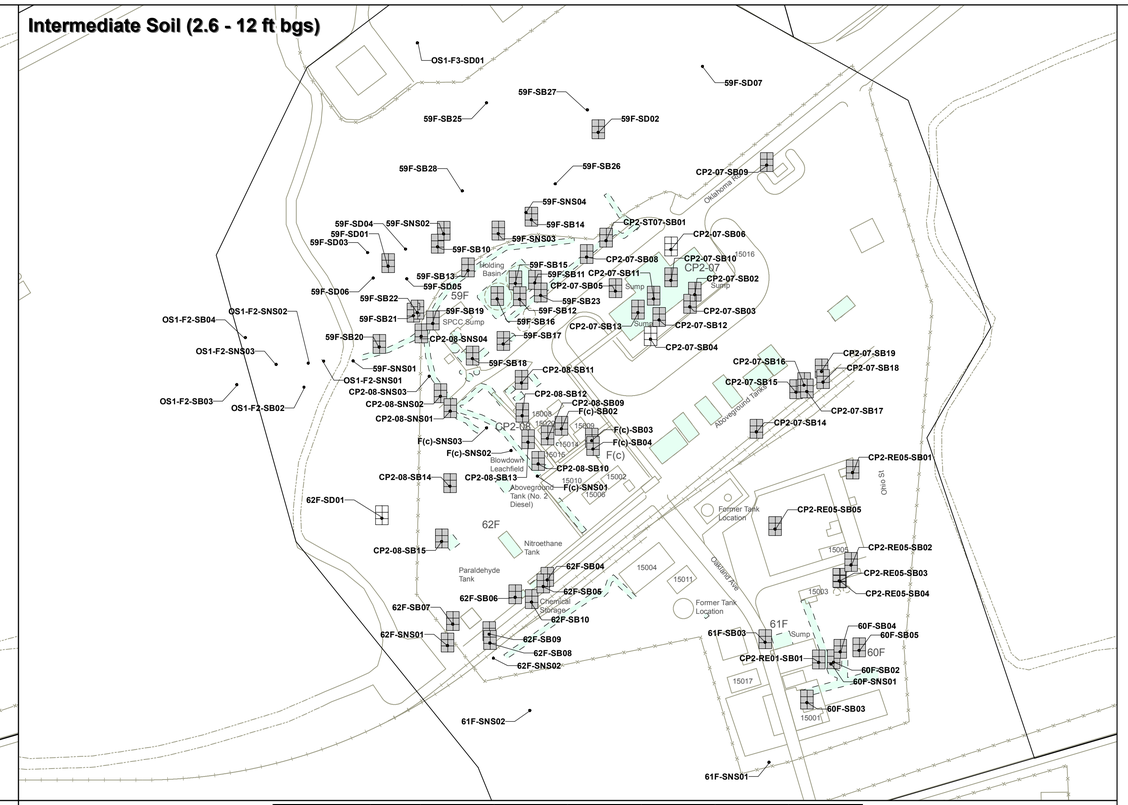
DRAFT

FIGURE 6.1-8

Vadose Zone Cross Section B - B'
Chemical Plant 2 Area

2/14/08 ah SR10131024





Not Analyzed

< Soil Screening Level (RISL)

>= RISL and < 10x RISL

>= 10x RISL and < 100x RISL

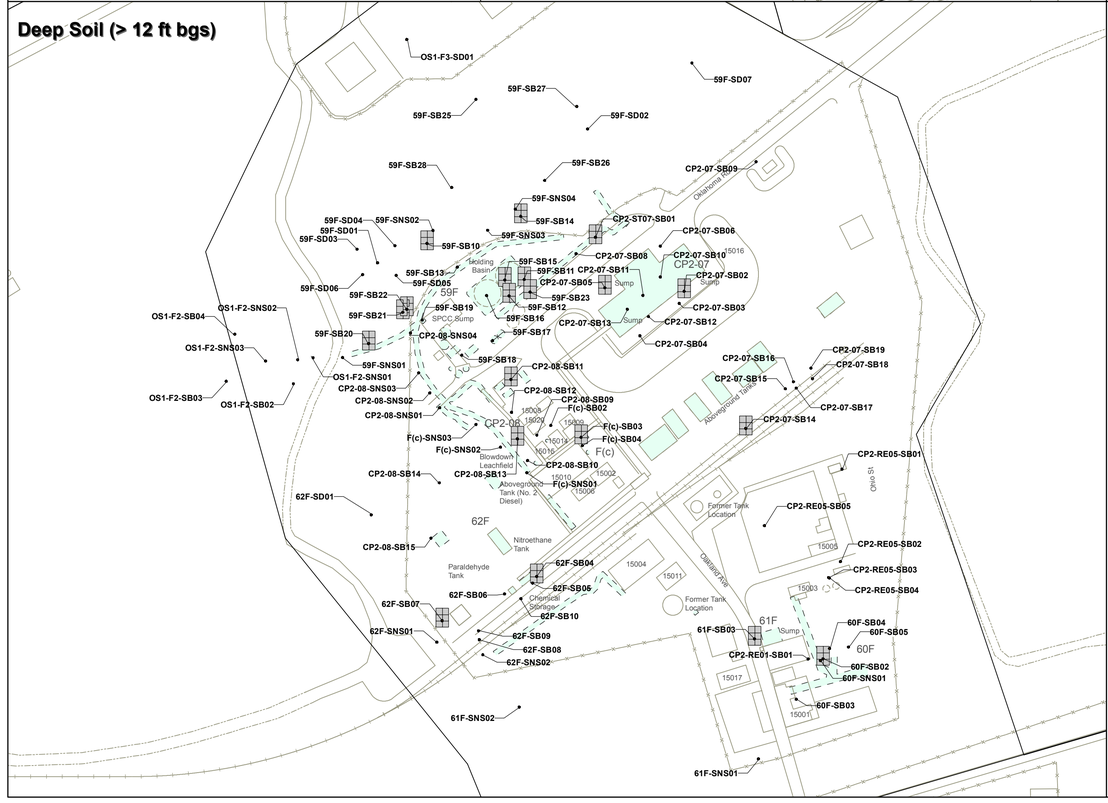
>= 100x RISL

Arsenic
Aluminum
Cadmium
Chromium
Lead
Thallium

Source Area

Boundary Operable Unit (BOU)

Consent Decree Boundary



Sample Location	Sample Depth	Arsenic	Aluminum	Cadmium	Chromium	Lead	Thallium
Screening Level		0.07	76,140	1.7	211	150	5.0
0 - 2.5 feet bgs							
59F-SNS01	2.5	**17**	<SL	<SL	<SL	<SL	<SL
59F-SD02	1.5	**15**	<SL	<SL	<SL	<SL	<SL
62F-SB10	1.0	**35**	<SL	<SL	<SL	<SL	<SL
CP2-08-SB14	1.0	<SL	<SL	<SL	**240**	<SL	<SL

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not analyzed for.
Units in mg/kg.

N

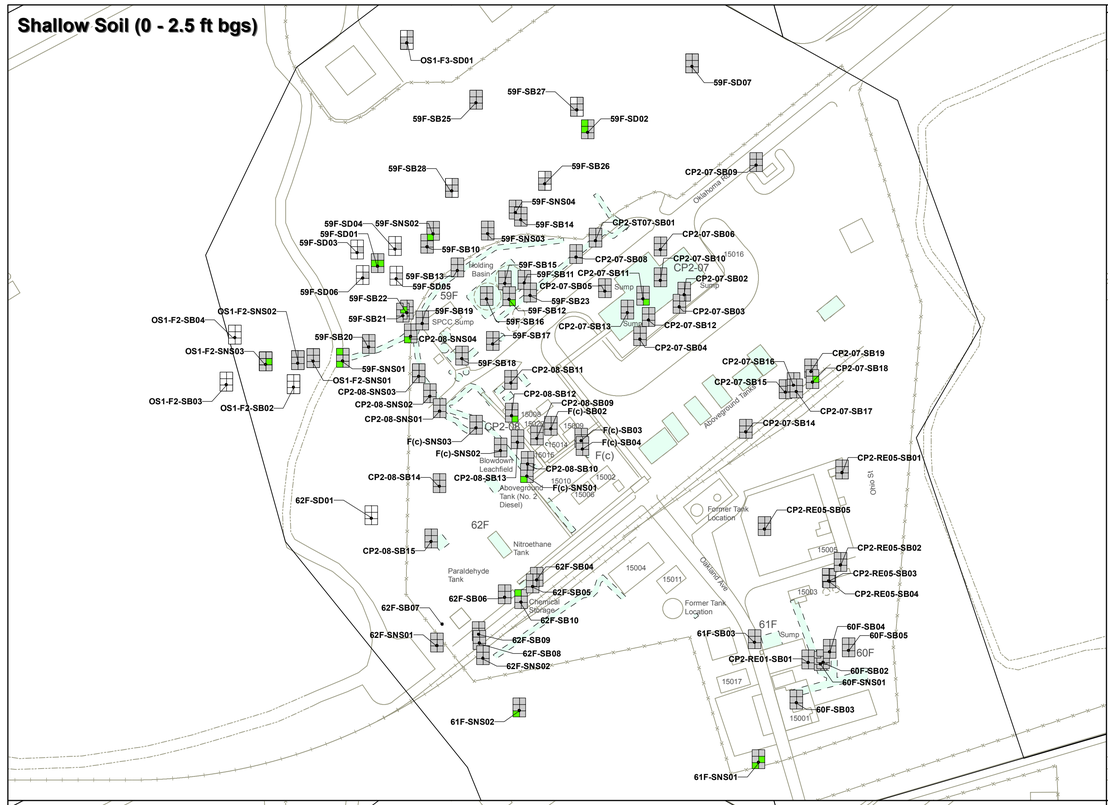
1 " = 150 '

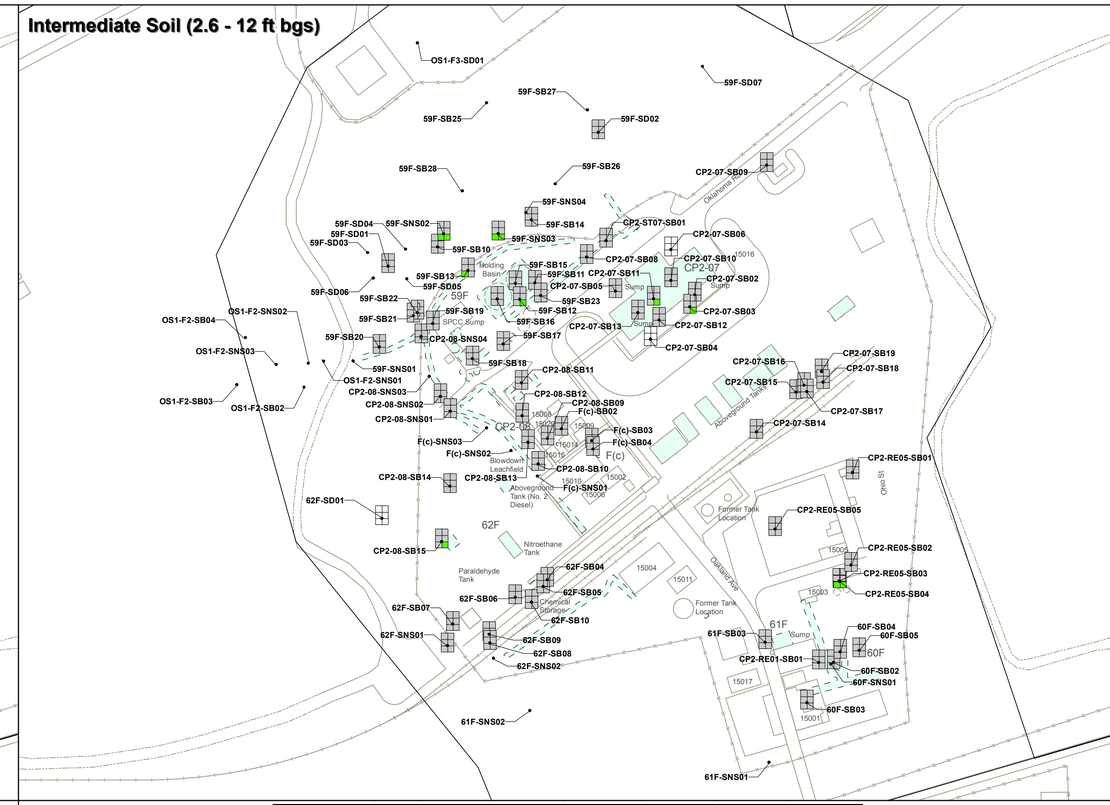
0 150 300
Feet

AEROJET
Environmental Remediation

Figure 6.1-9

Metals in Soil Above Remedial Investigation Screening Levels Chemical Plant 2 Area





Not Analyzed

< Soil Screening Level (PGW SSL)

>= PGW SSL and < 10x PGW SSL

>= 10x PGW SSL and < 100x PGW SSL

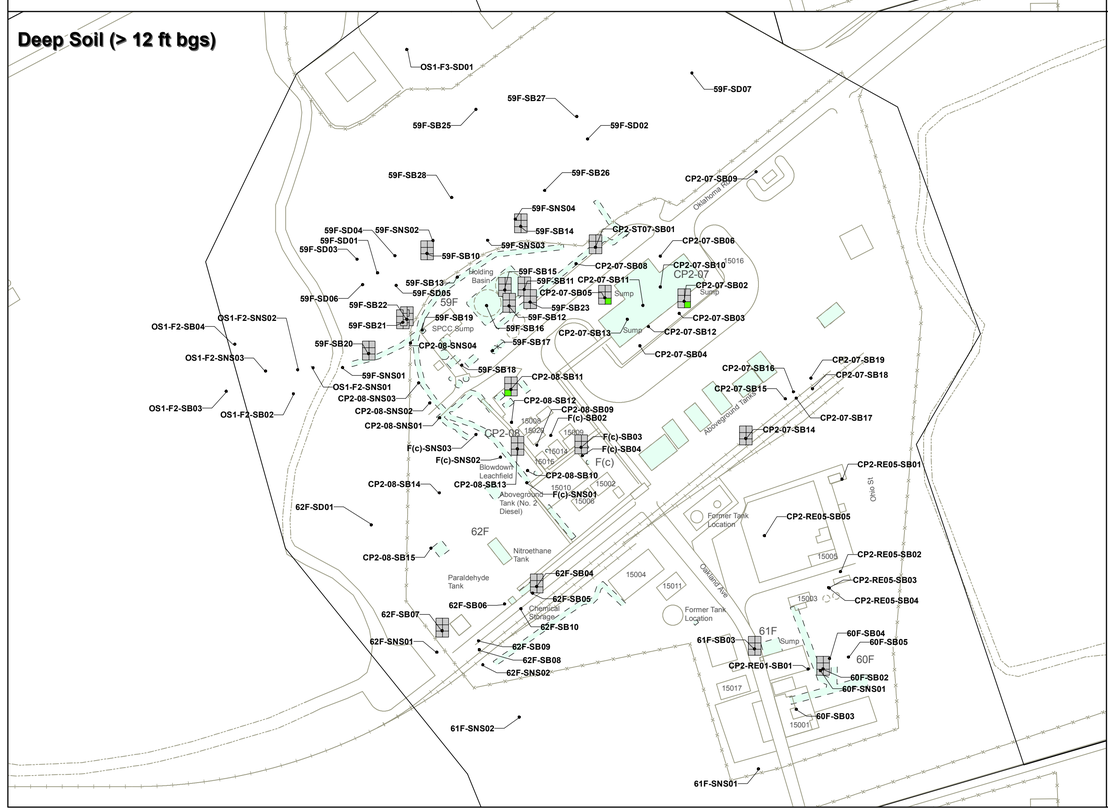
>= 100x PGW SSL

Arsenic
Aluminum
Cadmium
Chromium
Lead
Thallium

Source Area

Boundary Operable Unit (BOU)

Consent Decree Boundary



Sample Location	Sample Depth	Arsenic	Aluminum	Cadmium	Chromium	Lead	Thallium
Screening Level		11	43,000	0.72	500	23	2.5
0 - 2.5 feet bgs							
59F-SNS01	0.5	<SL	<SL	**0.82**	<SL	<SL	<SL
59F-SNS01	2.5	**17**	<SL	<SL	<SL	<SL	<SL
59F-SNS02	0.5	<SL	<SL	**0.96**	<SL	<SL	<SL
59F-SNS02	2.5	<SL	<SL	**0.80**	<SL	<SL	**2.8**
59F-SNS03	2.5	<SL	<SL	**0.83**	<SL	<SL	**3.2**
59F-SNS04	0.5	<SL	<SL	<SL	<SL	<SL	**3.2**
59F-SD01	0.25	<SL	<SL	<SL	<SL	**140**	<SL
59F-SD01	1.5	<SL	**52,000**	<SL	<SL	<SL	<SL
59F-SD02	0.25	<SL	**51,000**	<SL	<SL	<SL	<SL
59F-SD02	1.5	**15**	**64,000**	<SL	<SL	<SL	<SL
59F-SB12	1.0	<SL	<SL	<SL	<SL	<SL	**3.2**
59F-SB22	1.0	<SL	**44,000**	<SL	<SL	<SL	<SL
62F-SB10	1.0	**35**	<SL	<SL	<SL	<SL	<SL
F(c)-SN501	0.5	<SL	<SL	**0.75**	<SL	<SL	<SL
CP2-08-SN504	0.5	<SL	<SL	**1.0**	<SL	<SL	<SL
CP2-07-SB11	1.0	<SL	<SL	<SL	<SL	<SL	**2.8**
CP2-08-SB12	1.0	<SL	<SL	<SL	<SL	<SL	**2.8**
CP2-08-SB14	1.0	<SL	<SL	<SL	<SL	<SL	<SL
61F-SN501	0.5	<SL	<SL	**1.6**	<SL	**50**	<SL
61F-SN502	0.5	<SL	<SL	**1.0**	<SL	<SL	<SL
2.6 - 12 feet bgs							
59F-SB11	5.0	<SL	<SL	<SL	<SL	<SL	**3.6**
59F-SB12	5.0	<SL	<SL	<SL	<SL	<SL	**2.9**
59F-SB13	5.0	<SL	<SL	**0.84**	<SL	<SL	<SL
CP2-07-SB03	11	<SL	<SL	<SL	<SL	<SL	**2.8**
CP2-07-SB11	5.0	<SL	<SL	<SL	<SL	<SL	**3.1**
CP2-08-SB15	11	<SL	<SL	<SL	<SL	<SL	**2.8**
CP2-RE05-SB04	11	<SL	<SL	**1.0**	<SL	<SL	<SL
A48-RC08-SB01	11.5	<SL	<SL	<SL	<SL	<SL	**4.5**
> 12 feet bgs							
CP2-07-SB02	55	<SL	<SL	<SL	<SL	<SL	**2.6**
CP2-07-SB05	71	<SL	<SL	<SL	<SL	<SL	**2.9**
CP2-08-SB11	80	<SL	<SL	**0.79**	<SL	<SL	<SL

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not analyzed for.
Units in mg/kg.

N

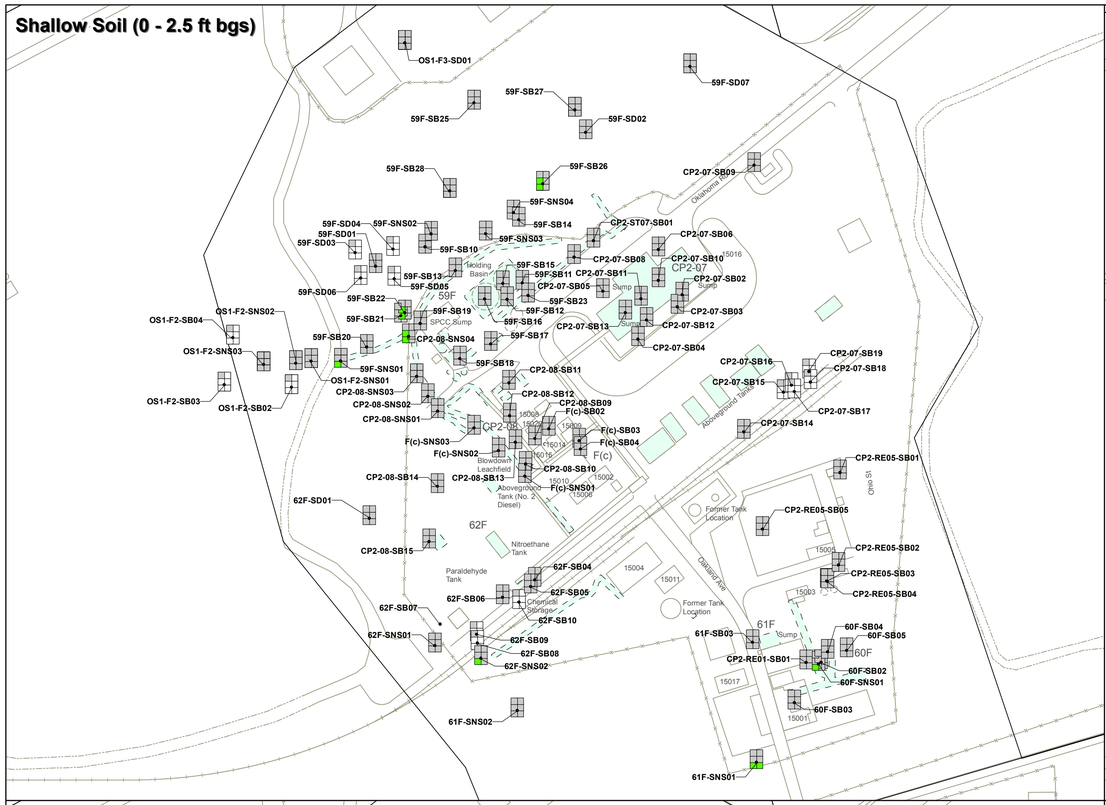
1 " = 150 '

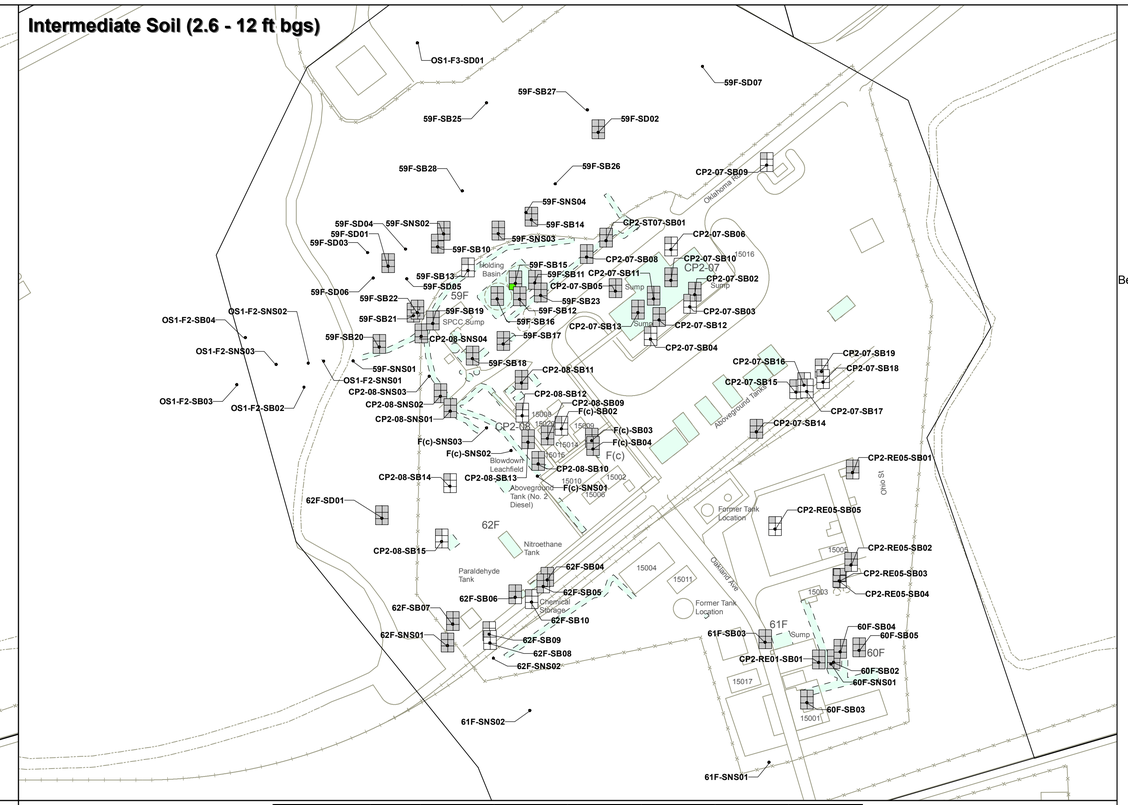
0 150 300
Feet

AEROJET
Environmental Remediation

Figure 6.1-10

Metals Above Protection of Groundwater Soil Screening Levels
Chemical Plant 2 Area





Not Analyzed

< Soil Screening Level (RISL)

>= RISL and < 10x RISL

>= 10x RISL and < 100x RISL

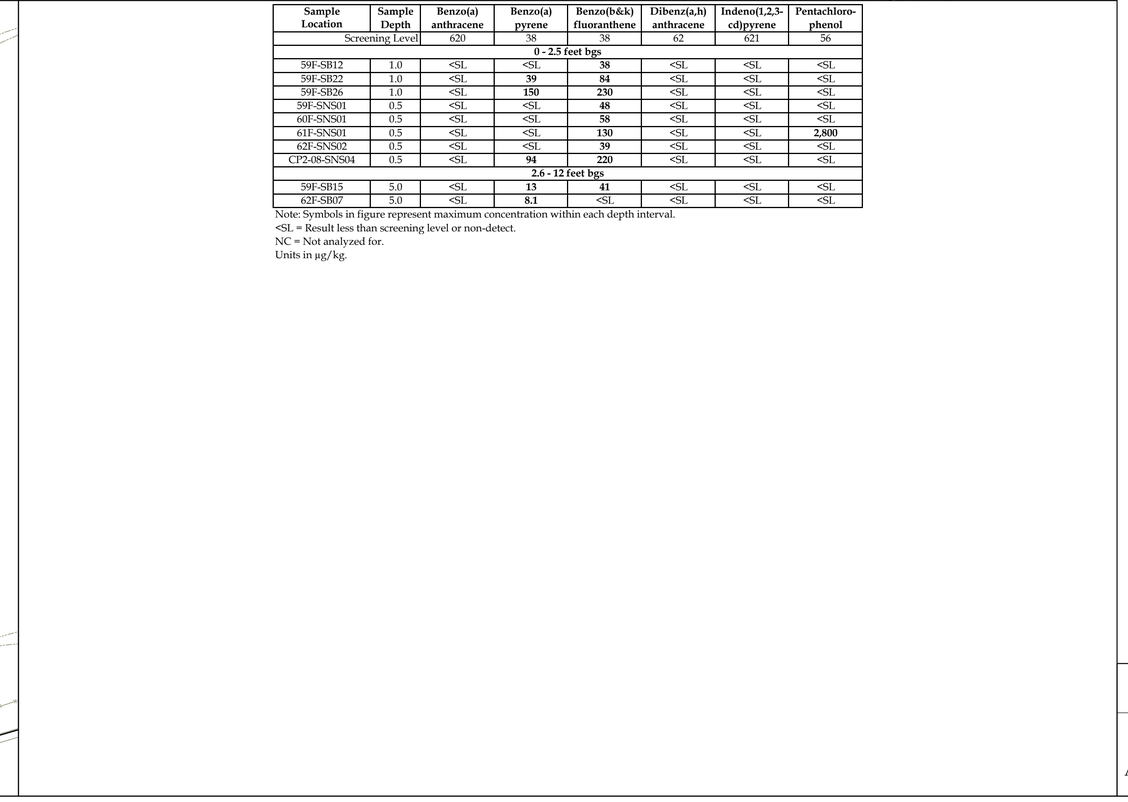
>= 100x RISL

Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b&k)fluoranthene
Dibenz(a,h)anthracene
Indeno(1,2,3-cd)pyrene
Pentachlorophenol

Source Area

Boundary Operable Unit (BOU)

Consent Decree Boundary



Sample Location	Sample Depth	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b&k) fluoranthene	Dibenz(a,h) anthracene	Indeno(1,2,3-cd)pyrene	Pentachloro-phenol
Screening Level		620	38	38	62	621	56
0 - 2.5 feet bgs							
59F-SB12	1.0	<SL	<SL	**38**	<SL	<SL	<SL
59F-SB22	1.0	<SL	**39**	**84**	<SL	<SL	<SL
59F-SB26	1.0	<SL	**150**	**230**	<SL	<SL	<SL
59F-SNS01	0.5	<SL	<SL	**48**	<SL	<SL	<SL
60F-SNS01	0.5	<SL	<SL	**58**	<SL	<SL	<SL
61F-SNS01	0.5	<SL	<SL	**130**	<SL	<SL	**2,800**
62F-SNS02	0.5	<SL	<SL	**39**	<SL	<SL	<SL
CP2-08-SNS04	0.5	<SL	**94**	**220**	<SL	<SL	<SL
2.6 - 12 feet bgs							
59F-SB15	5.0	<SL	**13**	**41**	<SL	<SL	<SL
62F-SB07	5.0	<SL	**8.1**	<SL	<SL	<SL	<SL

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not analyzed for.
Units in µg/kg.

N

1 " = 150 '

0 150 300
Feet

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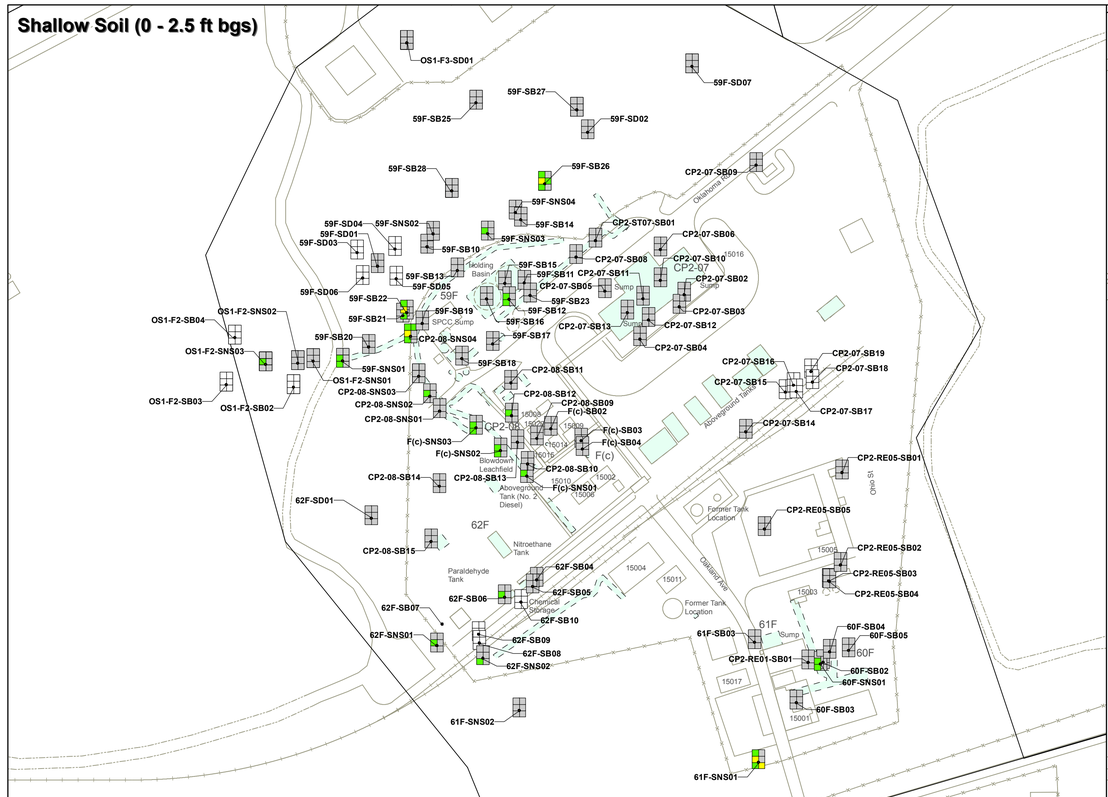
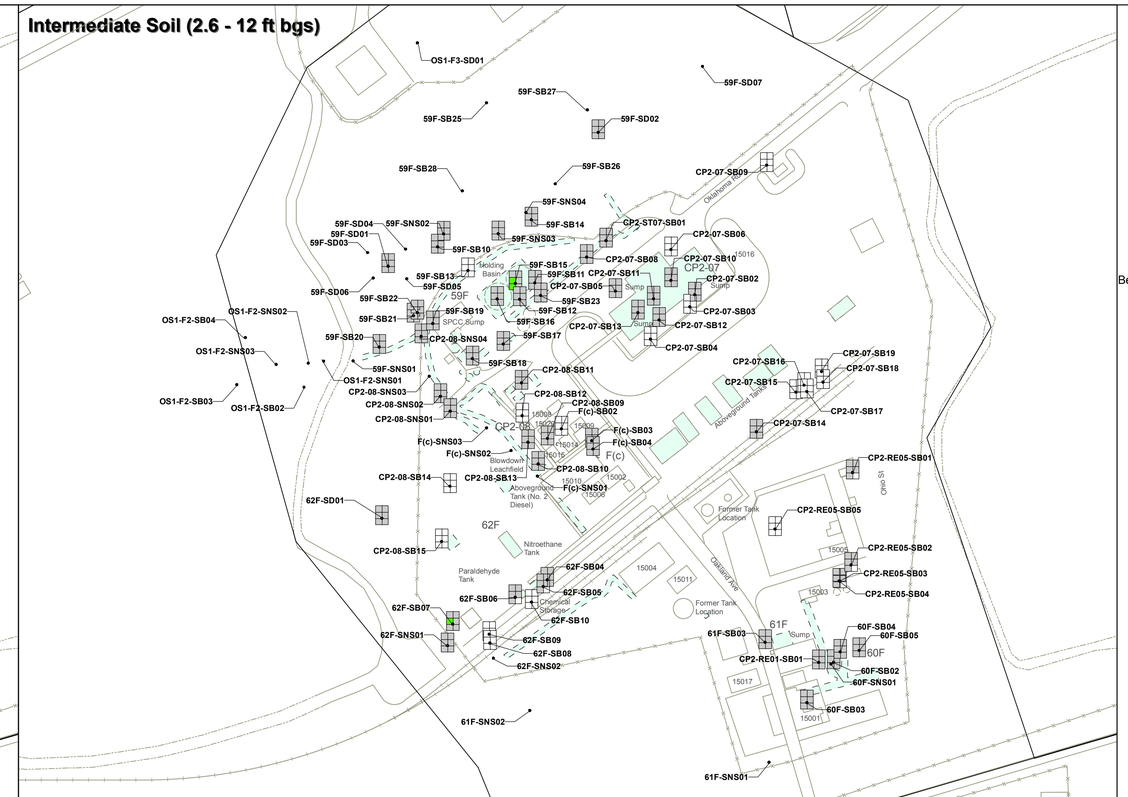
Environmental Remediation

Figure 6.1-11

SVOCs and Pentachlorophenol in Soil
Above Remedial Investigation Screening Levels
Chemical Plant 2 Area





Not Analyzed

< Soil Screening Level (PGW SSL)

>= PGW SSL and < 10x PGW SSL

>= 10x PGW SSL and < 100x PGW SSL

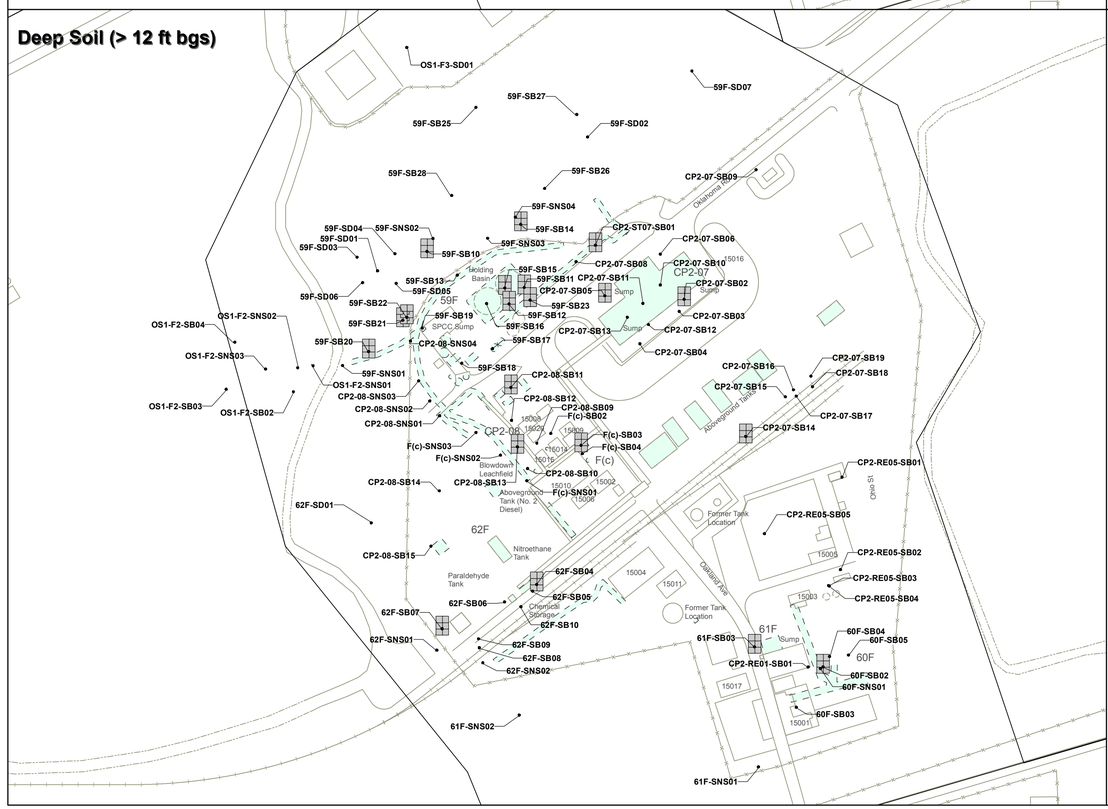
>= 100x PGW SSL

Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b&k)fluoranthene
Dibenz(a,h)anthracene
Indeno(1,2,3-cd)pyrene
Pentachlorophenol

Source Area

Boundary Operable Unit (BOU)

Consent Decree Boundary



Sample Location	Sample Depth	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b&k) fluoranthene	Dibenz(a,h) anthracene	Indeno(1,2,3-cd)pyrene	Pentachloro-phenol
Screening Level		29	2.9	29	2.9	29	400
0 - 2.5 feet bgs							
59F-SB12	1.0	<SL	**14**	**38**	<SL	<SL	<SL
59F-SB22	1.0	**51**	**39**	**84**	<SL	<SL	<SL
59F-SB26	1.0	**170**	**150**	**230**	<SL	**100**	<SL
59F-SNS01	0.5	<SL	**19**	**48**	<SL	<SL	<SL
59F-SNS03	0.5	<SL	**6.8**	<SL	<SL	<SL	<SL
60F-SNS01	0.5	<SL	**14**	**58**	<SL	<SL	<SL
61F-SNS01	0.5	<SL	**33**	**130**	<SL	<SL	**2,800**
62F-SB06	2.0	<SL	**7.5**	<SL	<SL	<SL	<SL
62F-SNS01	0.5	<SL	**7**	<SL	<SL	<SL	<SL
62F-SNS02	0.5	<SL	<SL	**39**	<SL	<SL	<SL
62F-SB06	2.0	<SL	**7.5**	<SL	<SL	<SL	<SL
CP2-08-SB12	1.0	<SL	**11**	<SL	<SL	<SL	<SL
CP2-08-SNS02	0.5	<SL	**7.2**	<SL	<SL	<SL	<SL
CP2-08-SNS04	0.5	**120**	**94**	**220**	**8.4**	<SL	<SL
F(c)-SNS01	0.5	<SL	**8**	<SL	<SL	<SL	<SL
F(c)-SNS02	0.5	<SL	**14**	**33**	<SL	<SL	<SL
F(c)-SNS03	0.5	<SL	**12**	**30**	<SL	<SL	<SL
OS1-F2-SNS03	0.5	<SL	**12**	<SL	<SL	<SL	<SL
2.6 - 12 feet bgs							
59F-SB15	5.0	<SL	**13**	**41**	<SL	<SL	<SL
62F-SB07	5.0	<SL	**8.1**	<SL	<SL	<SL	<SL

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not analyzed for.
Units in µg/kg.

N

1 " = 150 '

0 150 300
Feet

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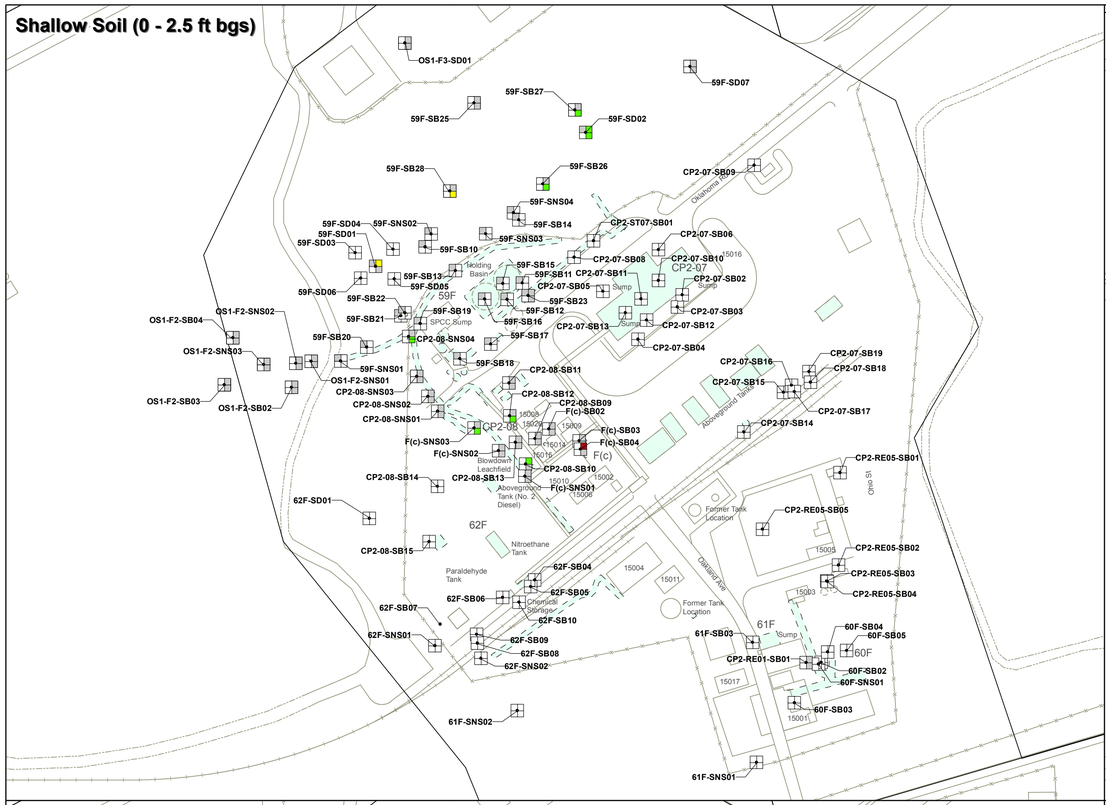
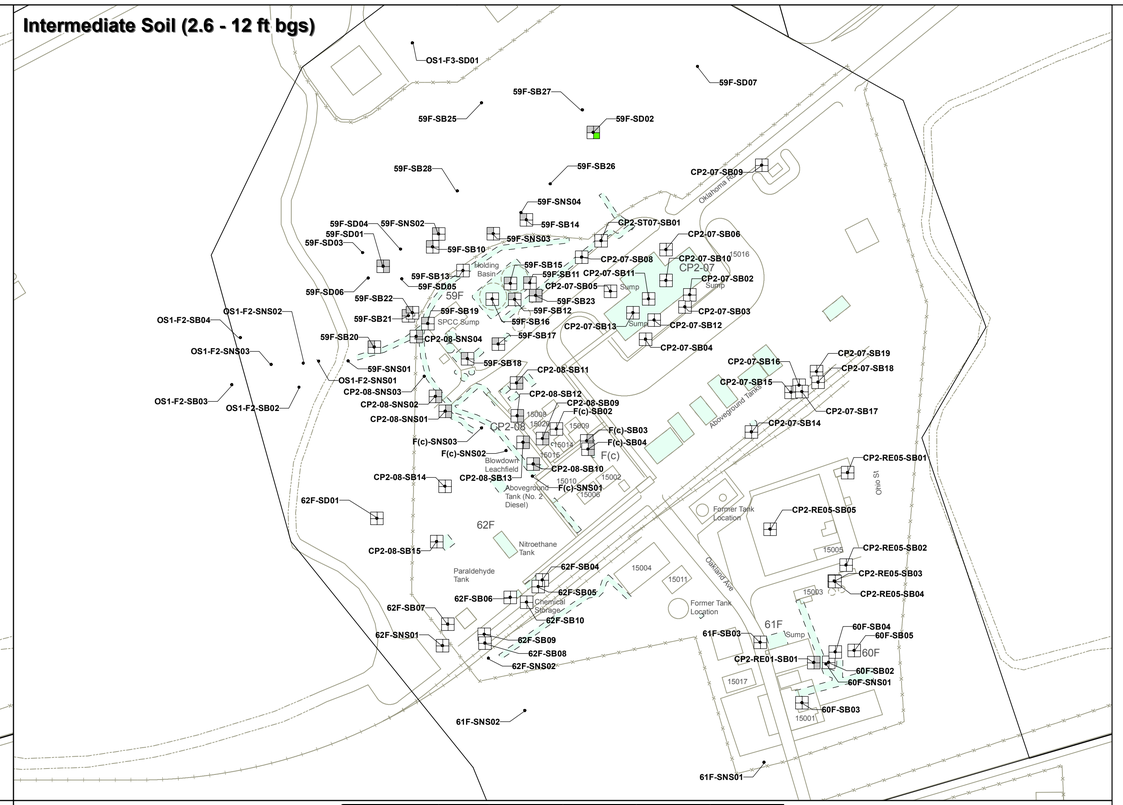
Environmental Remediation

Figure 6.1-12

SVOCs and Pentachlorophenol Above Protection of Groundwater Soil Screening Levels
Chemical Plant 2 Area





Not Analyzed

< Soil Screening Level (RISL)

>= RISL and < 10x RISL

>= 10x RISL and < 100x RISL

>= 100x RISL

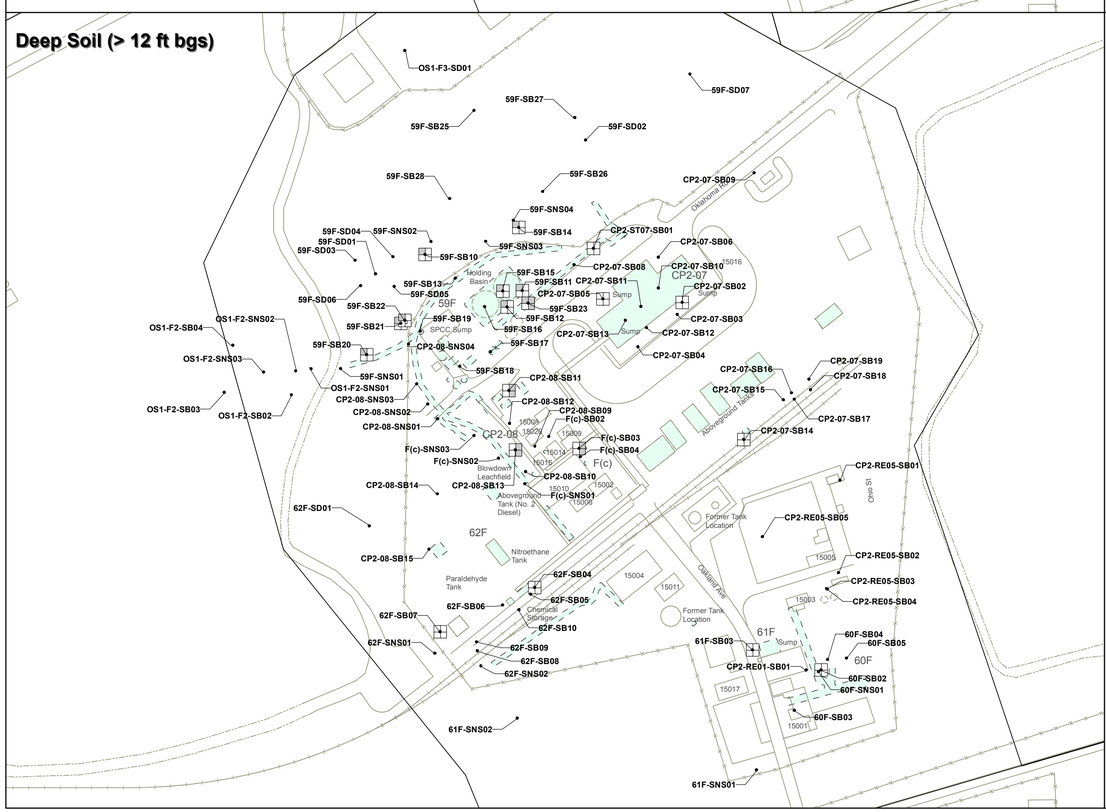
Perchlorate
NDMA

Aroclor 1248
Aroclor 1254

Source Area

Boundary Operable Unit (BOU)

Consent Decree Boundary



Sample Location	Sample Depth	NDMA	PCB-1248	PCB-1254	Perchlorate
Screening Level		9.5	220	220	7,800
0 - 2.5 feet bgs					
59F-SD01	0.25	NC	**16,000**	<SL	<SL
59F-SD02	0.25	NC	**540**	<SL	<SL
59F-SD02	1.5	NC	<SL	**320**	<SL
59F-SB26	1.0	NC	<SL	**1,100**	NC
59F-SB27	1.0	NC	<SL	**350**	NC
59F-SB28	1.0	NC	<SL	**2,800**	NC
F(c)-SNS02	0.5	NC	<SL	**200**	NC
F(c)-SNS03	0.5	NC	<SL	**230**	NC
F(c)-SB04	1.0	NC	**120,000**	<SL	NC
CP2-08-SNS04	0.5	NC	<SL	**480**	NC
CP2-08-SB10	2.0	NC	**230**	<SL	NC
CP2-08-SB12	1.0	NC	<SL	**1,900**	NC
2.6 - 12 feet bgs					
59F-SD02	5.0	NC	<SL	**440**	<SL

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not analyzed for.
Units in µg/kg.

N

1 " = 150 '

0 150 300
Feet

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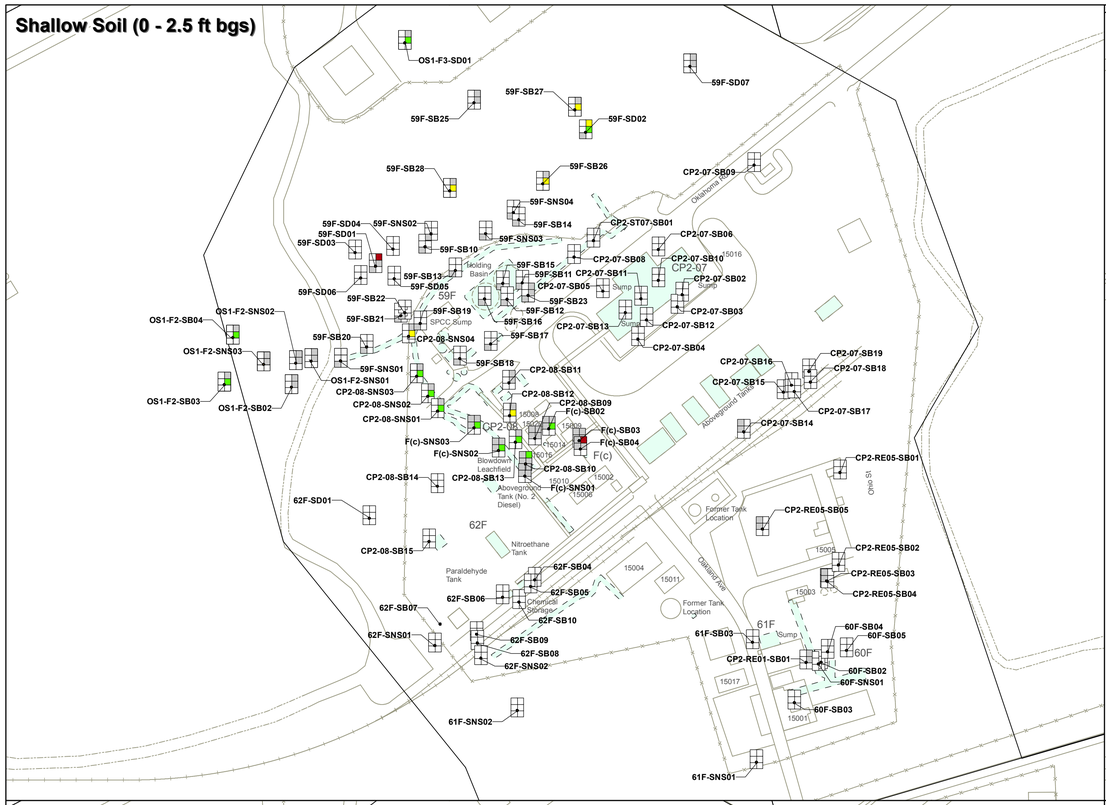
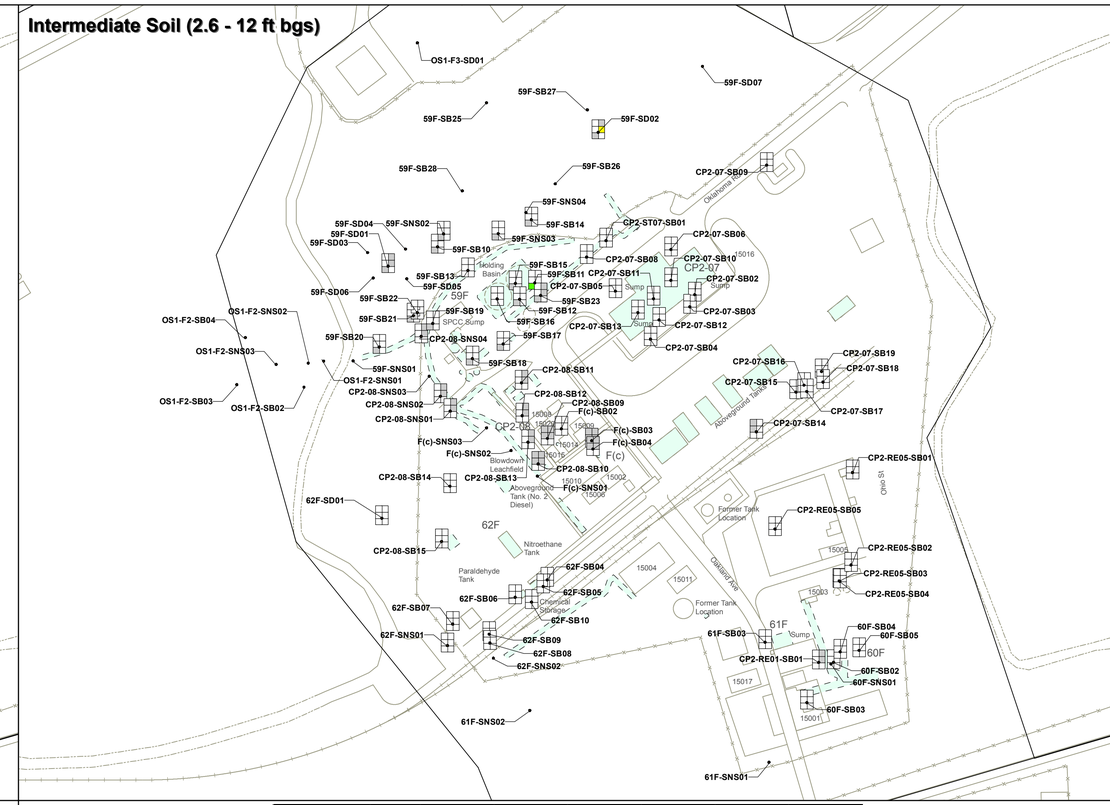
Environmental Remediation

Figure 6.1-13

PCBs, NDMA and Perchlorate in Soil
Above Remedial Investigation Screening Levels
Chemical Plant 2 Area





Not Analyzed

< Soil Screening Level (PGW SSL)

>= PGW SSL and < 10x PGW SSL

>= 10x PGW SSL and < 100x PGW SSL

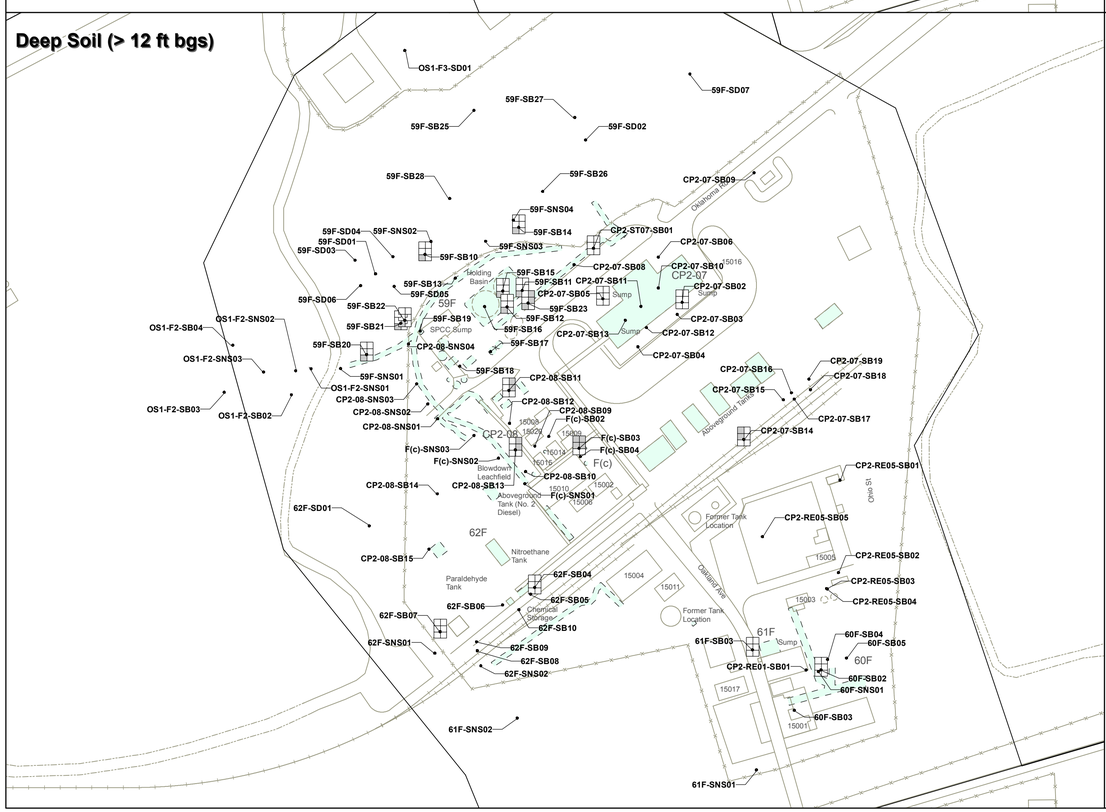
>= 100x PGW SSL

TPH-D — Arochlor 1248
TPH-MO — Aroclor 1254
Perchlorate — NDMA

Source Area

Boundary Operable Unit (BOU)

Consent Decree Boundary



Sample Location	Sample Depth	TPH as Diesel	TPH as Motor Oil	NDMA	PCB-1248	PCB-1254	Perchlorate
Screening Level		100	500	0.03	34	34	60
0 - 2.5 feet bgs							
59F-SD01	0.25	NC	NC	NC	**16,000**	<SL	<SL
59F-SD01	1.5	NC	NC	NC	<SL	<SL	<SL
59F-SD02	0.25	NC	NC	NC	**540**	<SL	<SL
59F-SD02	1.5	NC	NC	NC	<SL	**320**	<SL
59F-SB26	1.0	NC	NC	NC	<SL	**1,100**	NC
59F-SB27	1.0	NC	NC	NC	<SL	**350**	NC
59F-SB28	1.0	NC	NC	NC	<SL	**2,800**	NC
F(c)-SNS02	0.5	NC	NC	NC	<SL	**200**	NC
F(c)-SNS03	0.5	NC	NC	NC	<SL	**230**	NC
F(c)-SB02	1.0	NC	NC	NC	<SL	**77**	NC
F(c)-SB04	1.0	NC	NC	NC	**120,000**	<SL	NC
CP2-08-SNS01	0.5	NC	NC	NC	<SL	**68**	NC
CP2-08-SNS02	0.5	NC	NC	NC	<SL	**120**	NC
CP2-08-SNS03	0.5	NC	NC	NC	<SL	**75**	NC
CP2-08-SNS03	2.5	NC	NC	NC	<SL	**45**	NC
CP2-08-SNS04	0.5	NC	NC	NC	<SL	**480**	NC
CP2-08-SB10	2.0	NC	NC	NC	**230**	<SL	NC
CP2-08-SB12	1.0	NC	NC	NC	<SL	**1,900**	NC
CP2-08-SB13	1.0	NC	NC	NC	<SL	**68**	NC
0S1-F2-SB03	1.0	NC	NC	NC	<SL	**61**	NC
0S1-F2-SB04	1.0	NC	NC	NC	<SL	**93**	NC
0S1-F3-SB01	0.25	NC	NC	NC	<SL	**160**	NC
59F-SB11	1.0	NC	NC	NC	NC	NC	NC
2.6 - 12 feet bgs							
59F-SB11	5.0	NC	NC	NC	NC	NC	**95**
59F-SB15	5.0	NC	NC	NC	NC	NC	<SL
59F-SD02	5.0	NC	NC	NC	<SL	**440**	<SL
A48-ST13-SB01	6.0	NC	NC	NC	NC	NC	**330**
A48-ST13-SB01	11.5	NC	NC	NC	NC	NC	**64**
> 12 feet bgs							
59F-SB15	77	NC	NC	NC	NC	NC	<SL

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not analyzed for.
Units for NDMA, PCBs, and perchlorate in µg/kg.
Units for TPH-Diesel and TPH-Motor Oil in mg/kg

N

1 " = 150 '

0 150 300
Feet

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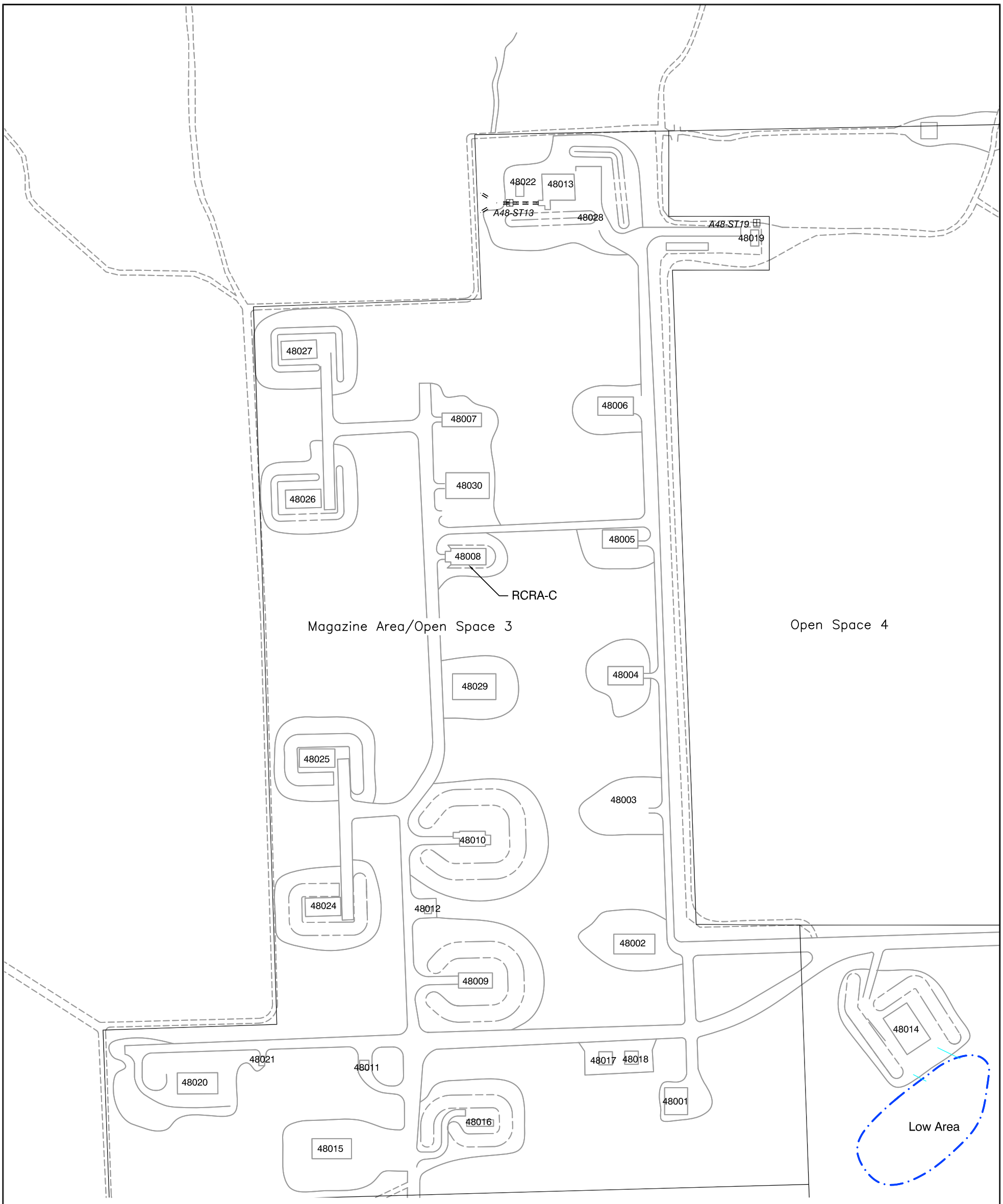
Environmental Remediation

Figure 6.1-14

PCBs, NDMA, Perchlorate, TPH-D, and TPH-Mo Above Protection of Groundwater Soil Screening Levels - Chemical Plant 2 Area



EXPLANATION

- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Management Area Boundary
- Road
- Berm
- 40815 Building
- Surface Drainage
- ST26 Septic Tank and Leach Line

N

Scale: 1" = 300'

0 150 300

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Environmental Remediation

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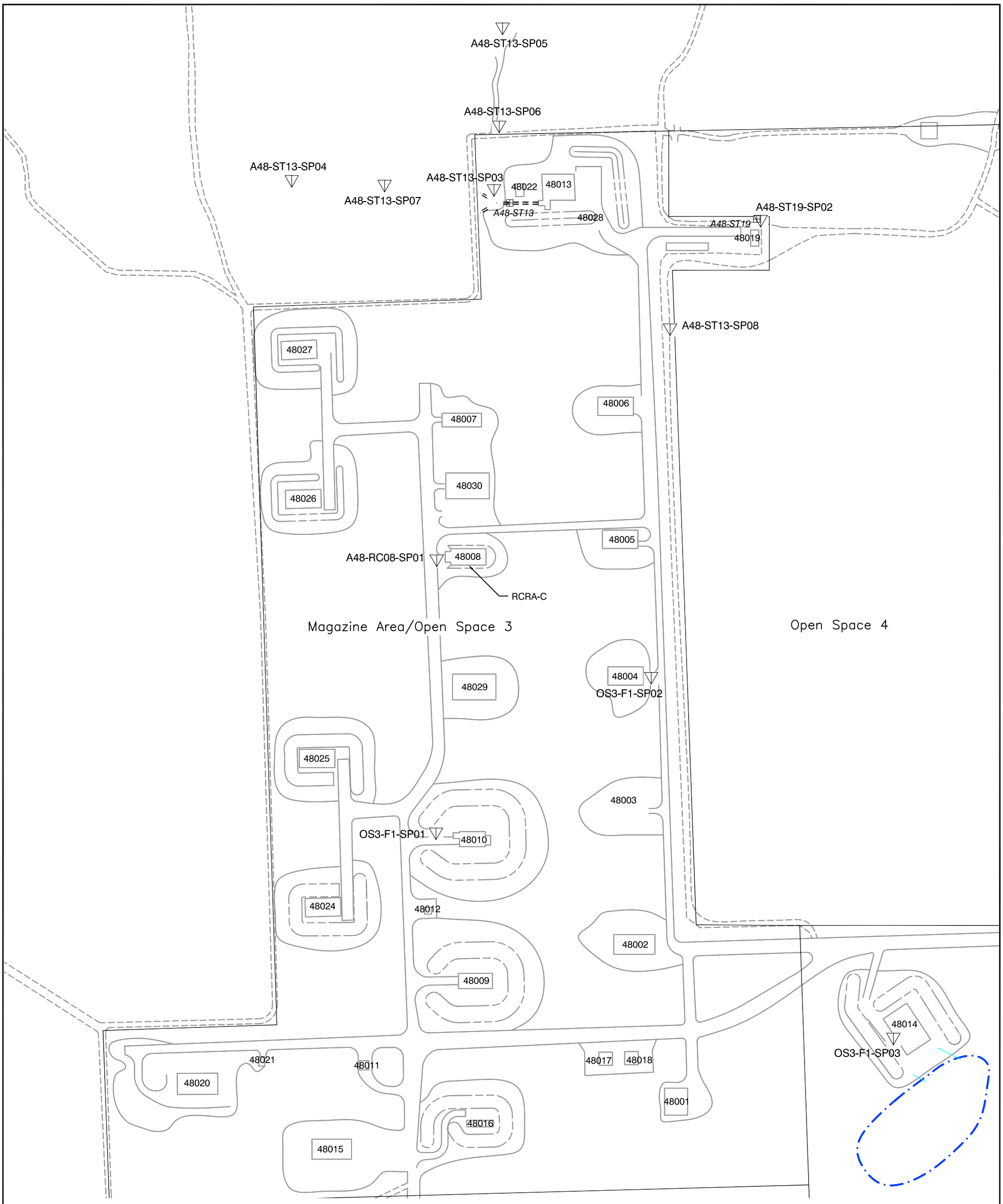
FIGURE 6.2-1
Site Features
Magazine Area and Open Space 3

8/14/08 pr SR10131025



EXPLANATION

- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Management Area Boundary
- Road
- Berm
- BOU Soil Vapor Sample Location
- 40815 Building
- Surface Drainage
- ST26 Septic Tank and Leach Line

N

Scale: 1" = 300'

0 150 300

AEROJET
Environmental Remediation

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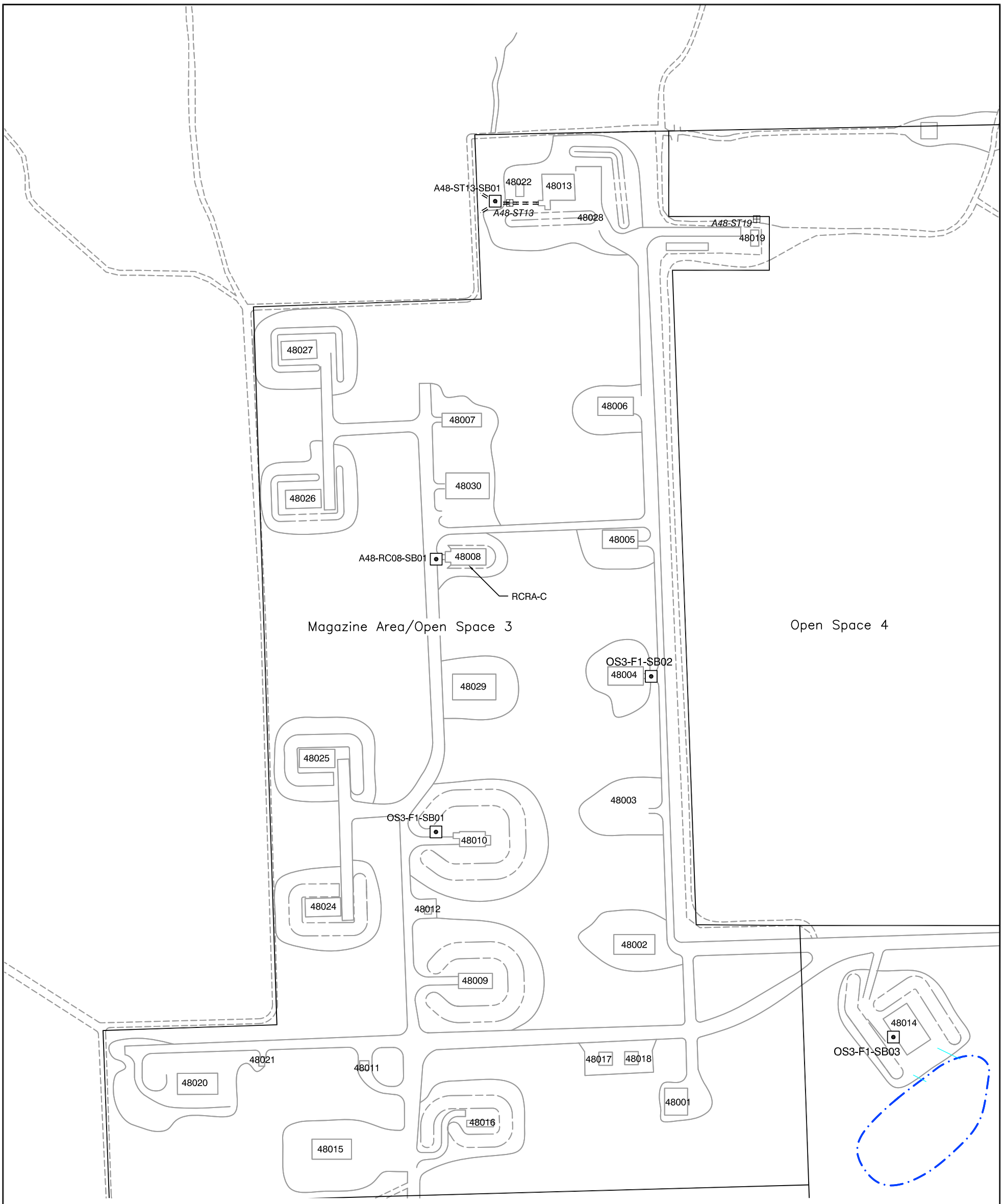
FIGURE 6.2-2
BOU Soil Vapor Sample Locations
Magazine Area and Open Space 3

5/22/08 pr SR10122424



EXPLANATION

- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Management Area Boundary
- Road
- Berm
- Soil Sample Borehole Location
- 40815 Building
- Surface Drainage
- ST26 Septic Tank and Leach Line

N

Scale: 1" = 300'

0 150 300

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Environmental Remediation

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FIGURE 6.2-3
BOU Surface Soil Sample Locations
Magazine Area and Open Space 3

5/22/08 pr SR10131027

EXPLANATION

- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Management Area Boundary
- Road
- Berm
- Soil Sample Borehole Location
- 40815 Building
- Surface Drainage
- ST26 Septic Tank and Leach Line

N

Scale: 1" = 300'

0 150 300

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Environmental Remediation

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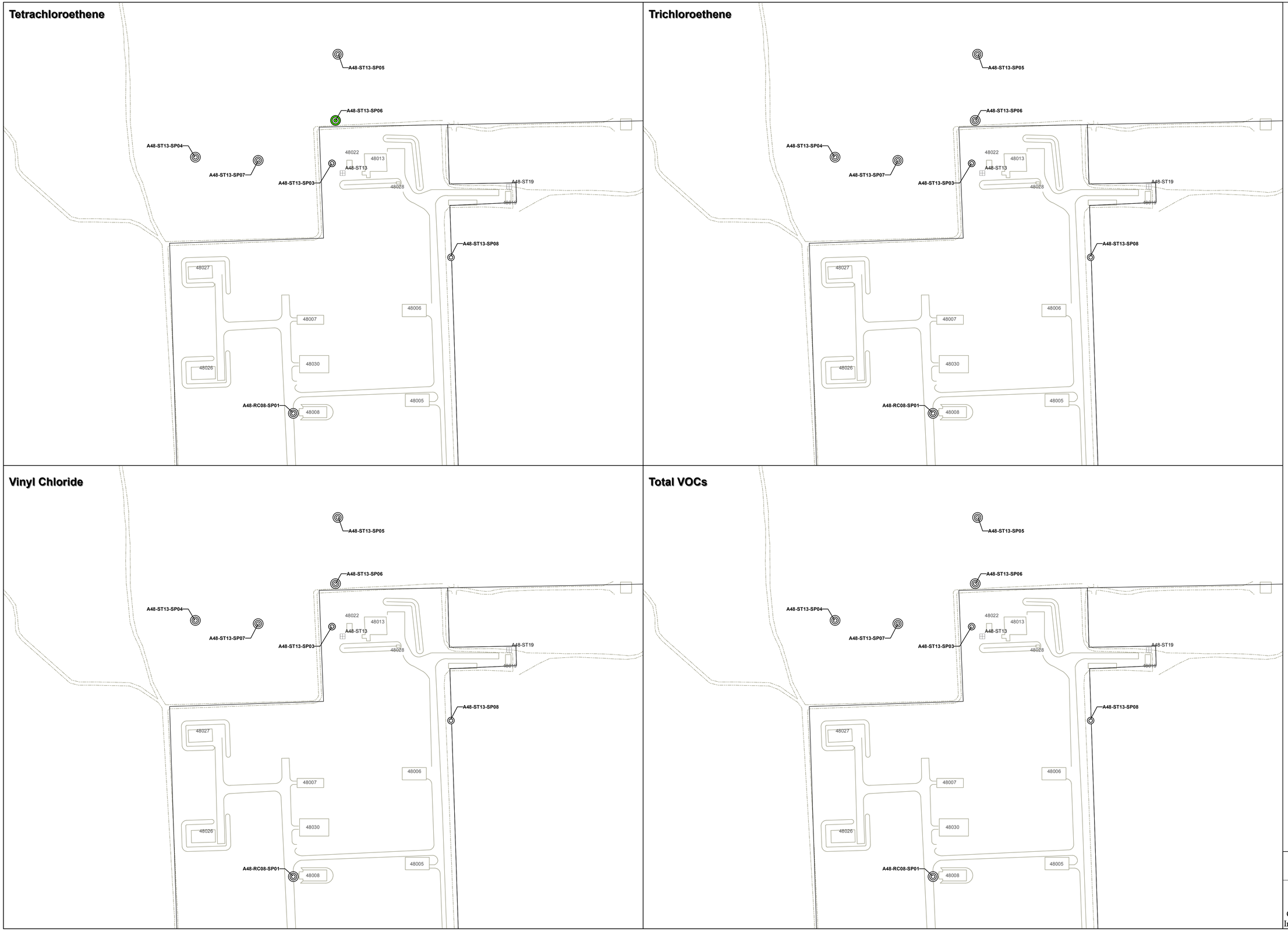
FIGURE 6.2-4
BOU Subsurface Soil Sample Locations
Magazine Area and Open Space 3

5/22/08 pr SR10131028



PCE, TCE, Vinyl Chloride Exceedances

- < Soil Vapor Screening Level (RISL)
- >= RISL and < 10x RISL
- >= 10x RISL and < 100x RISL
- >= 100x RISL

Total VOCs Exceedances

- Σ Detects to Screening Levels Ratios <= 10
- Σ Detects to Screening Levels Ratios > 10

<= 10 Feet bgs (Inner Circle)
11 to 20 Feet bgs (Middle Circle)
> 20 Feet bgs (Outer Circle)

Source Area
Boundary Operable Unit (BOU)
Consent Decree Boundary
Septic Tank

N

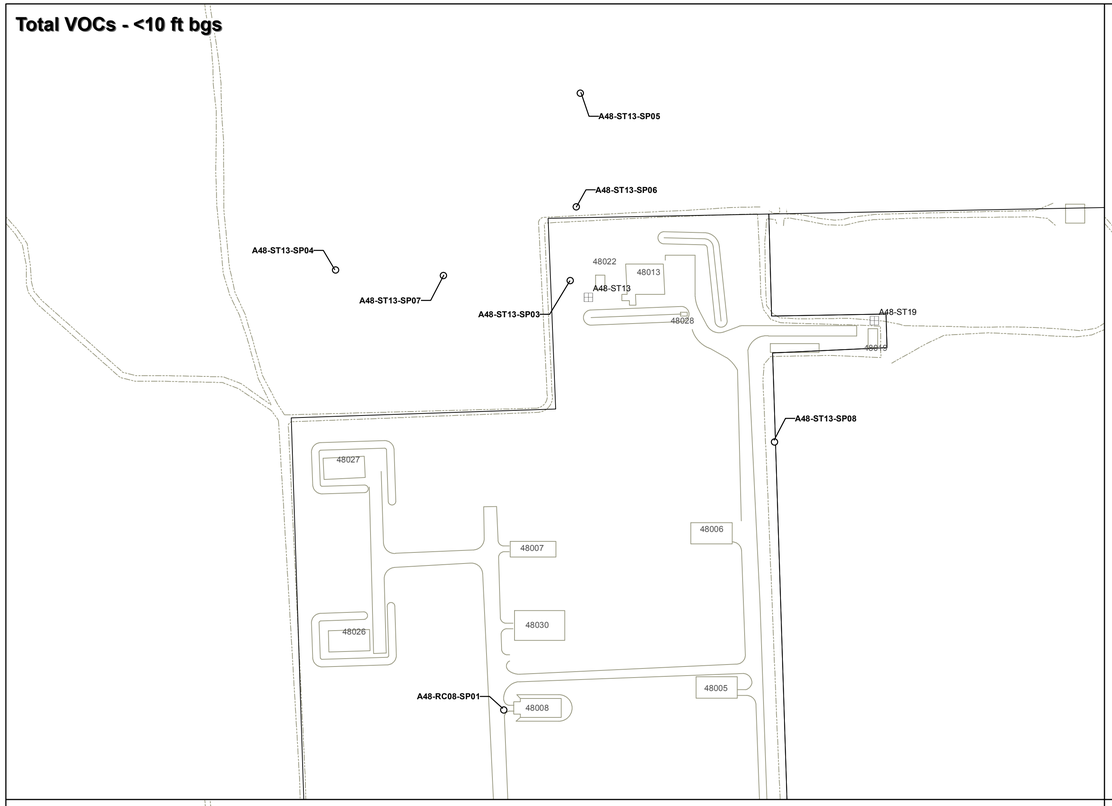
1 " = 200 '

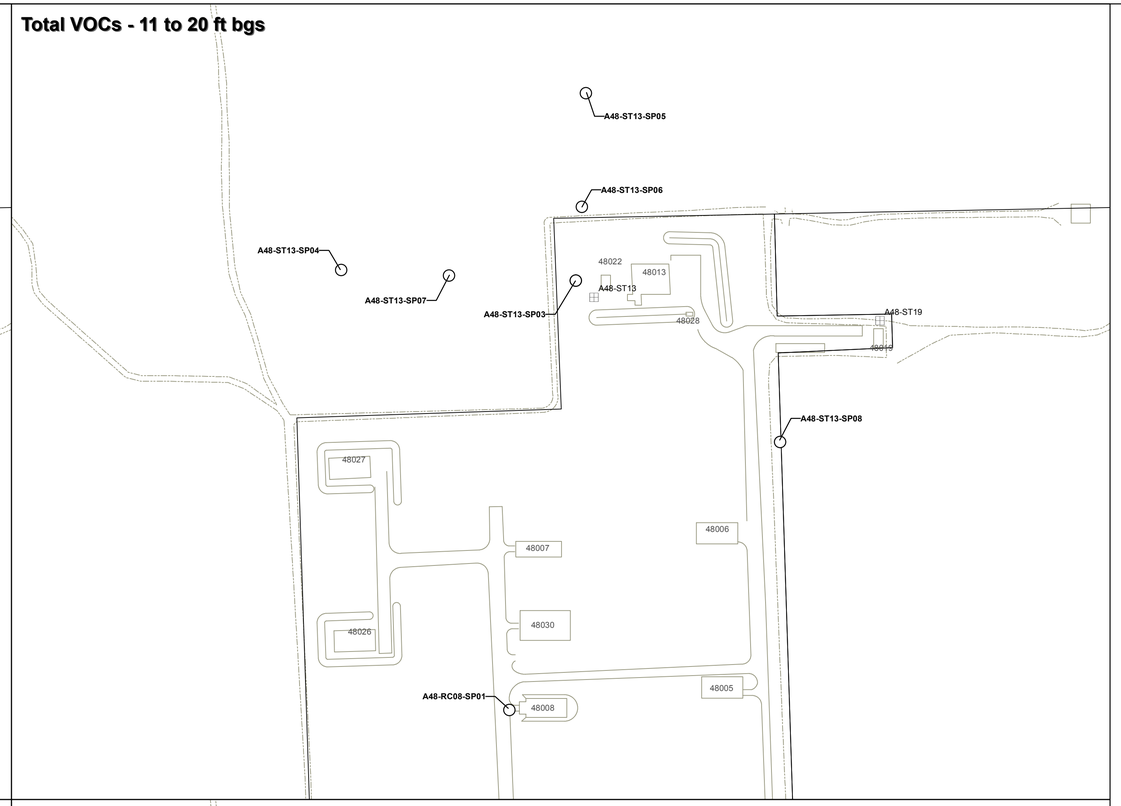
0 200 400
Feet

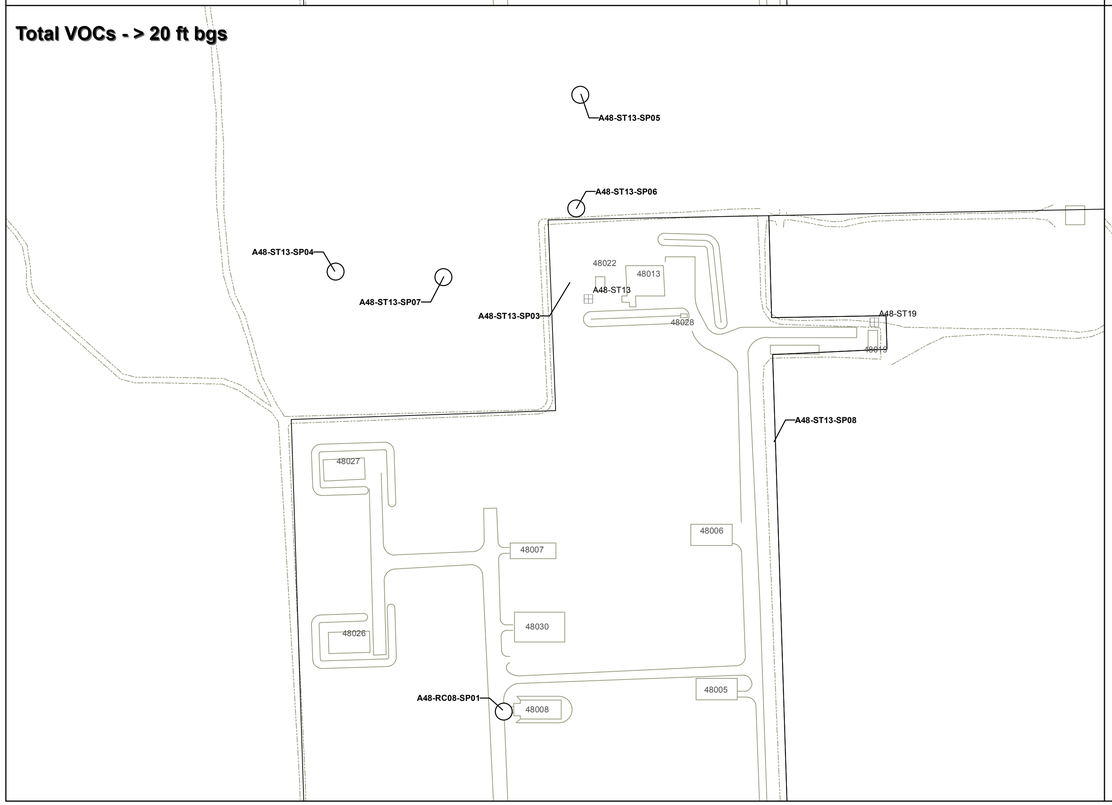
AEROJET
Environmental Remediation

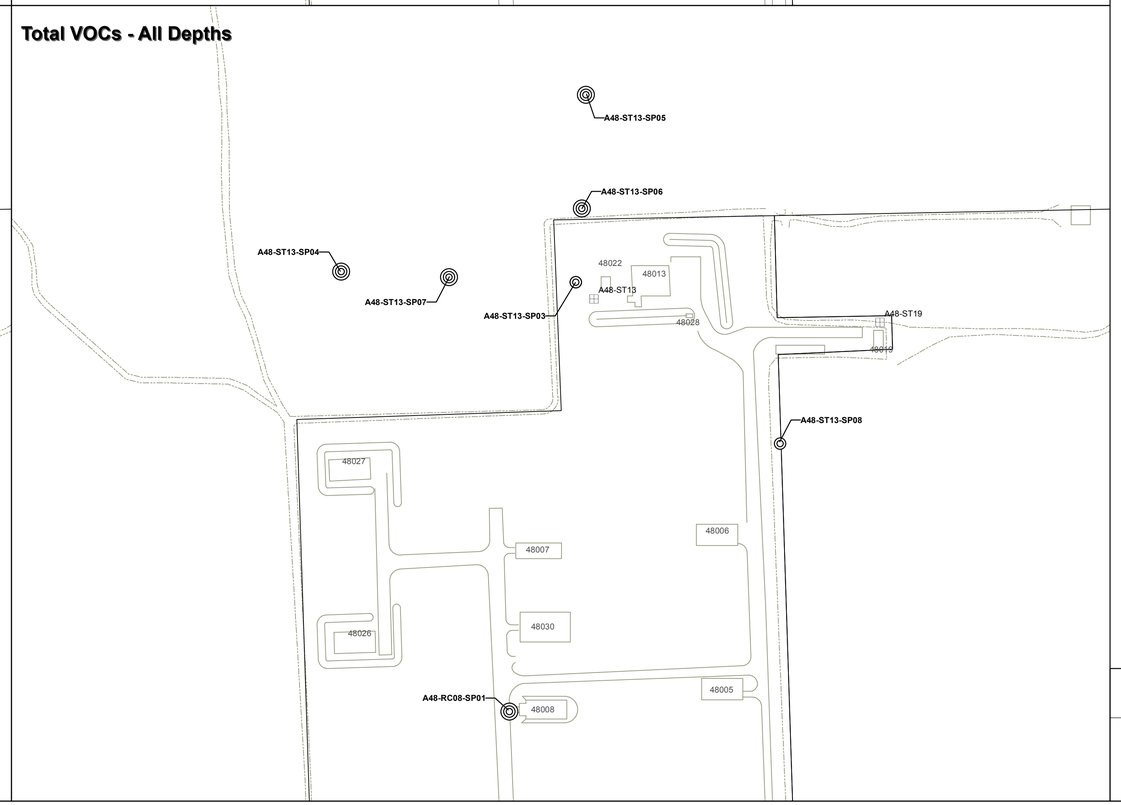
Figure 6.2-5a

PCE, TCE, Vinyl Chloride, and Total VOC Concentrations in Soil Vapor Above Remedial Investigation Screening Levels - Magazine Area









Total VOCs Exceedances

- Σ Detects to Screening Levels Ratios <= 10
- Σ Detects to Screening Levels Ratios > 10

- <= 10 Feet bgs (Small Circle)
- 11 to 20 Feet bgs (Medium Circle)
- > 20 Feet bgs (Large Circle)

- Septic Tank
- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Approximate Extent of Total Screening Level Ratio Exceeding 10 (< 10 ft bgs)
- Approximate Extent of Total Screening Level Ratio Exceeding 10 (11 to 20 ft bgs)
- Approximate Extent of Total Screening Level Ratio Exceeding 10 (> 20 ft bgs)

N

1 " = 200 '

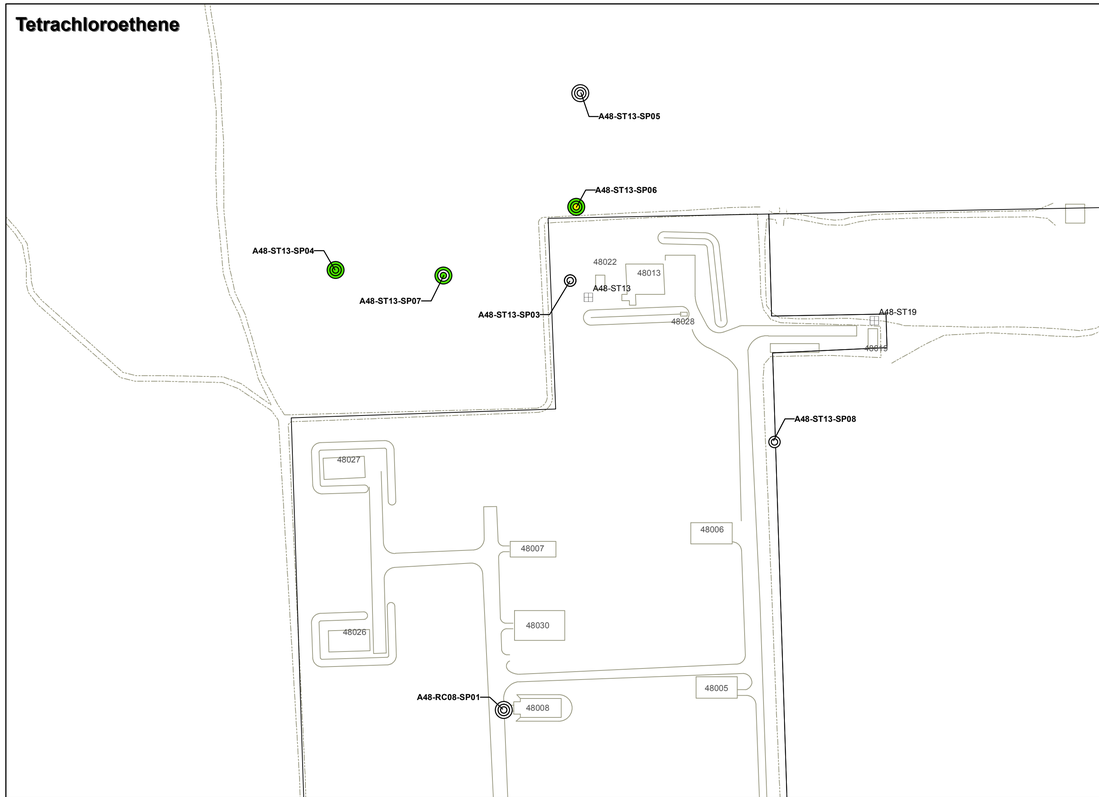
0 200 400
Feet

AEROJET
Environmental Remediation

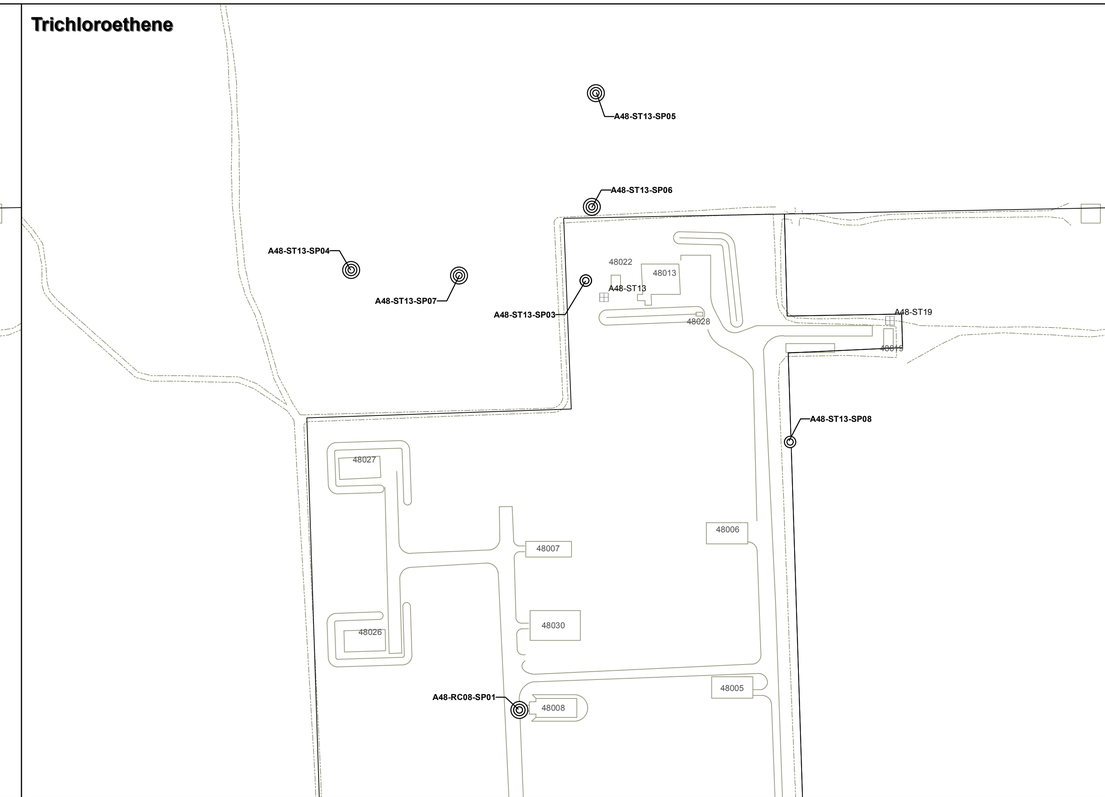
Figure 6.2-5b

Total VOC Concentrations in Soil Vapor Above Remedial Investigation Screening Levels - Magazine Area

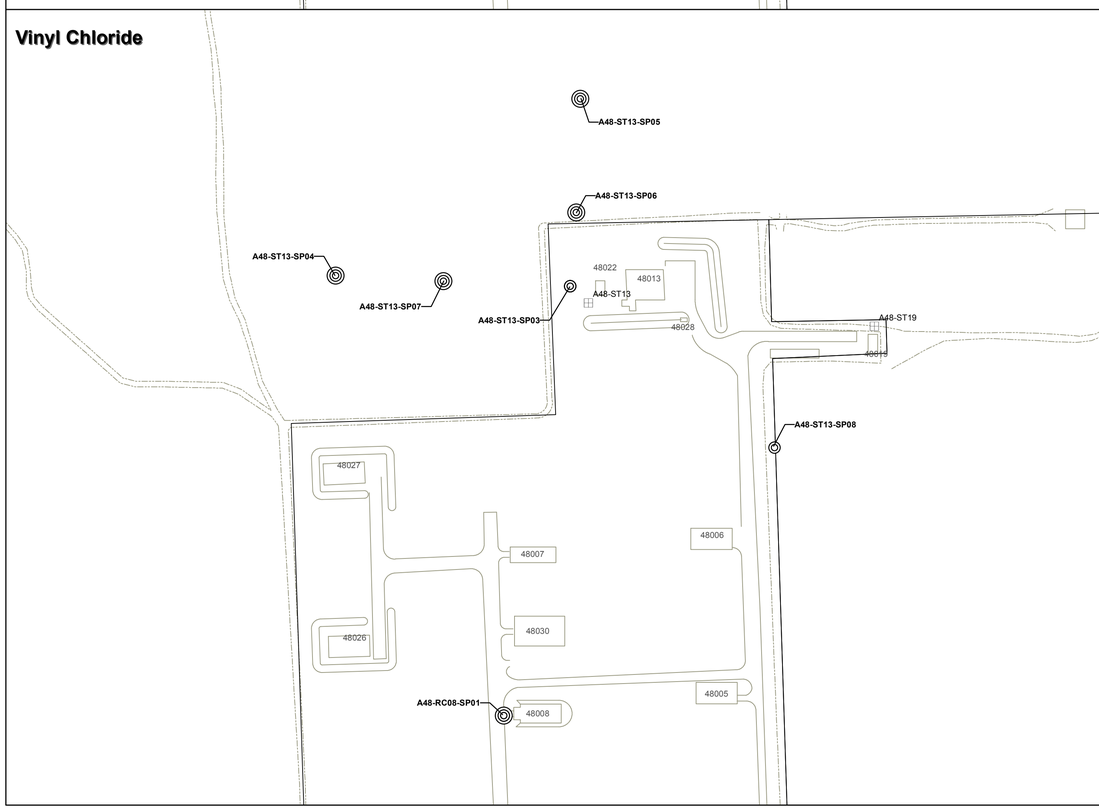
Tetrachloroethene



Trichloroethene



Vinyl Chloride



PCE, TCE, Vinyl Chloride Exceedances

- < Soil Vapor Screening Level (PGW SVSL)
- >= PGW SVSL and < 10x PGW SVSL
- >= 10x PGW SVSL and < 100x PGW SVSL
- >= 100x PGW SVSL

<= 10 Feet bgs (Inner Circle)
11 to 20 Feet bgs (Middle Circle)
> 20 Feet bgs (Outer Circle)

Source Area
Boundary Operable Unit (BOU)
Consent Decree Boundary
Septic Tank

N

1 " = 200 '

0 200 400
Feet

AEROJET
Environmental Remediation

Figure 6.2-6

PCE, TCE, and Vinyl Chloride Concentrations in Soil Vapor Above Protection of Groundwater Screening Levels - Magazine Area

EXPLANATION

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Road
- Management Area Boundary

N

Scale: 1" = 100'

0 50 100

AEROJET
Environmental Remediation

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FIGURE 6.3-1
Site Features
Dredge Pit and Eastern Basin

8/14/08 PER SR10131029

EXPLANATION

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Road
- Management Area Boundary
- Soil Sample Borehole Location
- Sediment Sample Location

N

Scale: 1" = 100'

0 50 100

AEROJET
Environmental Remediation

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FIGURE 6.3-2
BOU Surface Soil Sample Locations
Dredge Pit and Eastern Basin

8/14/08 PER SR10131030

EXPLANATION

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Road
- Management Area Boundary
- Soil Sample Borehole Location
- Sediment Sample Location

N

Scale: 1" = 100'

0 50 100

AEROJET
Environmental Remediation

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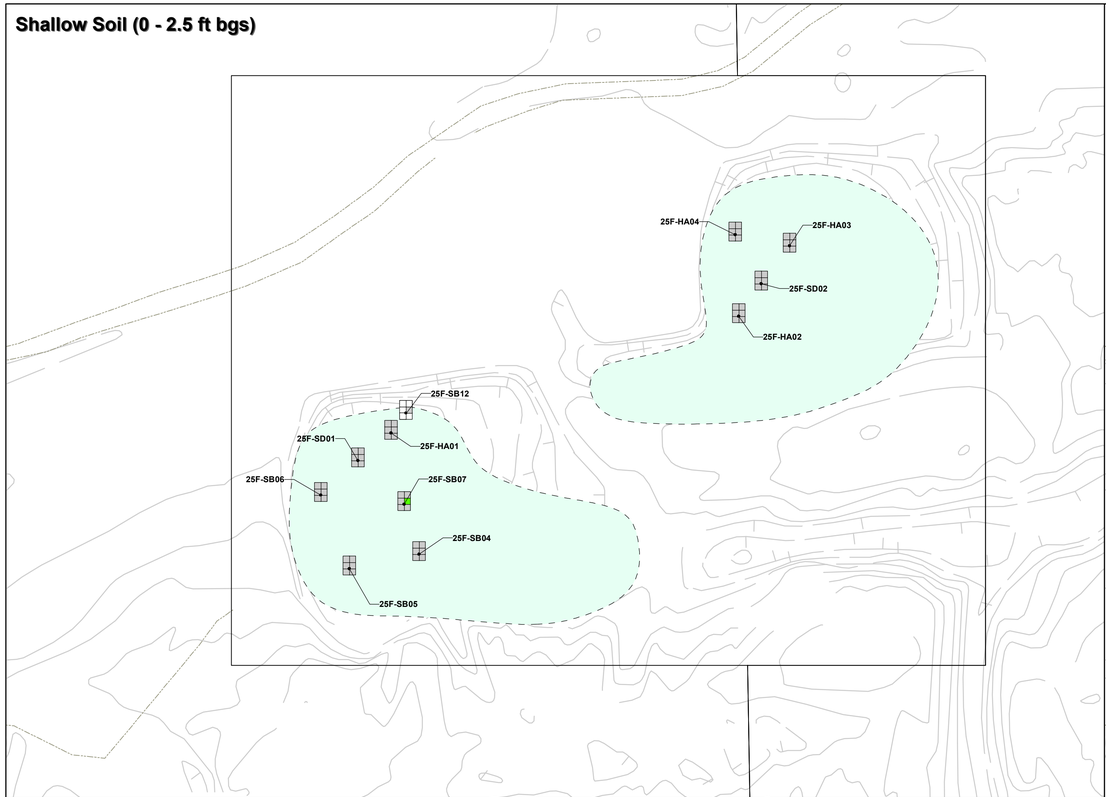
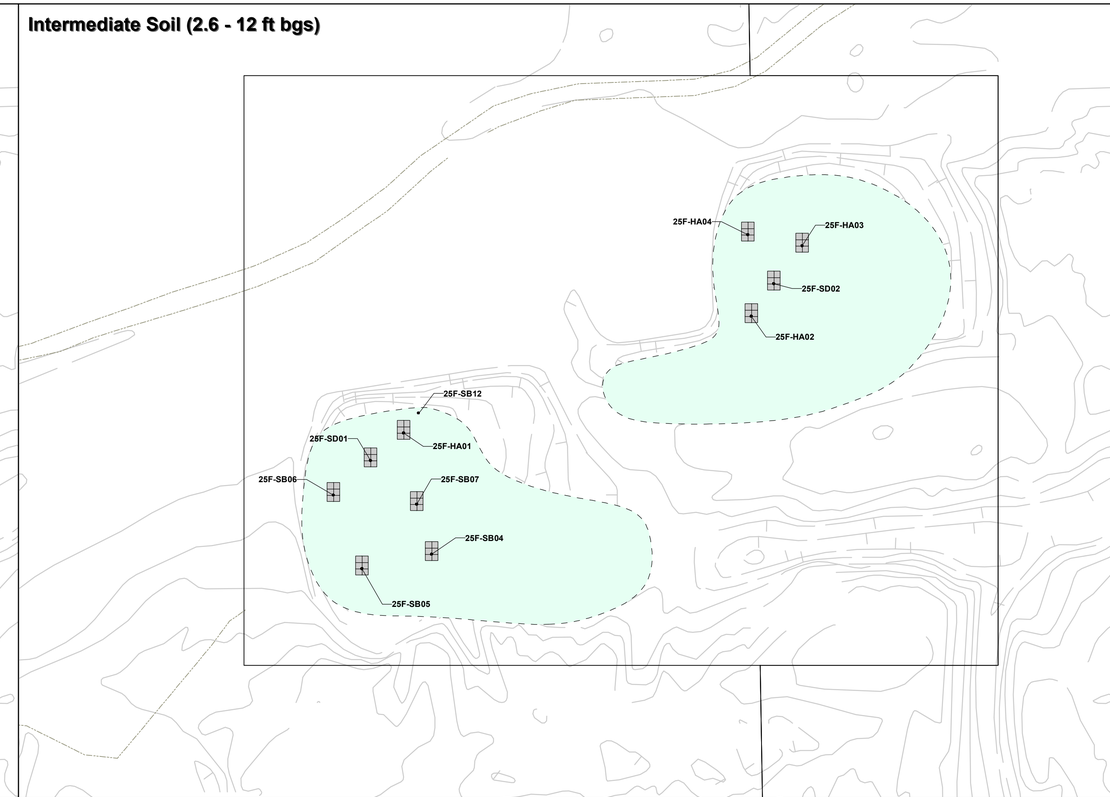
FIGURE 6.3-3
BOU Subsurface Soil Sample Locations
Dredge Pit and Eastern Basin

8/14/08 PER SR10131031

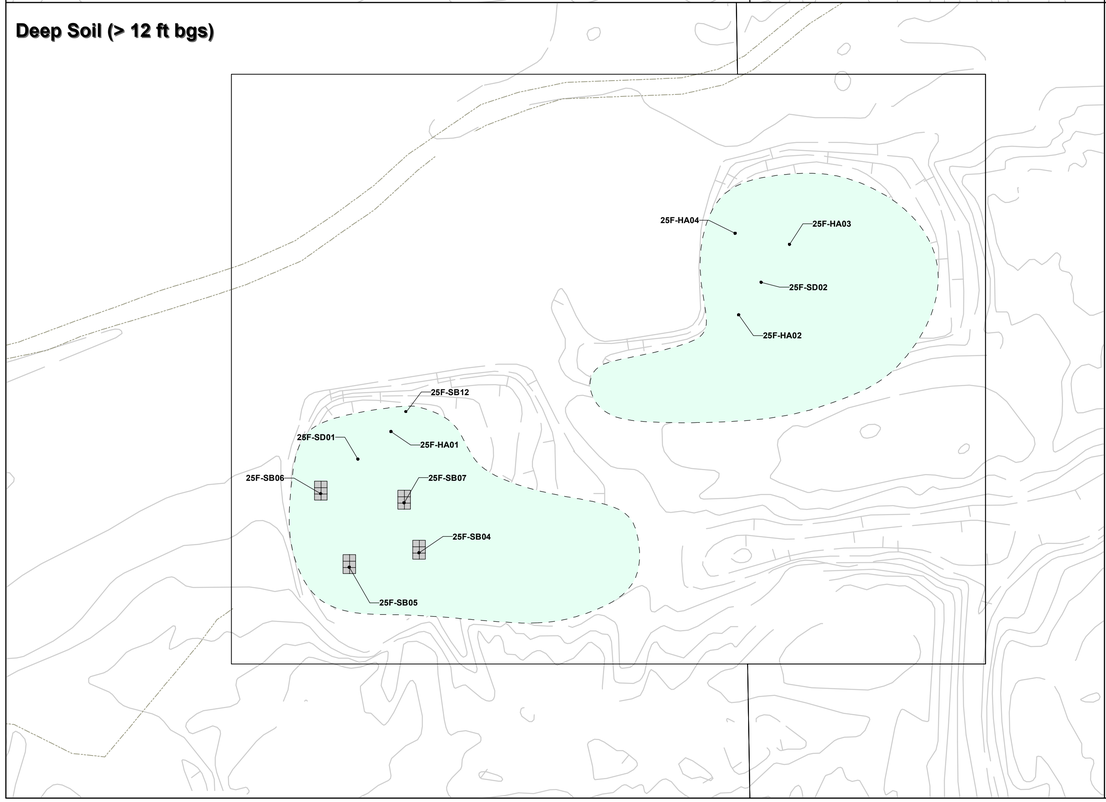
Shallow Soil (0 - 2.5 ft bgs)



Intermediate Soil (2.6 - 12 ft bgs)



Deep Soil (> 12 ft bgs)



RISLs							
Sample Location	Sample Depth	Aluminum	Beryllium	Cadmium	Lead	Mercury	Nickel
Screening Level		76,140	150	1.7	150	18	1564
0 - 2.5 feet bgs							
25F-SB07	1.0	<SL	<SL	<SL	<SL	**34**	<SL

PGW SSLs							
Sample Location	Sample Depth	Aluminum	Beryllium	Cadmium	Lead	Mercury	Nickel
Screening Level		54000	10	0.72	23	5.7	120
0 - 2.5 feet bgs							
25F-SB07	1.0	<SL	<SL	<SL	<SL	**34**	<SL
2.6 - 12 feet bgs							
25F-SB07	11	<SL	<SL	<SL	<SL	**14**	<SL

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not analyzed for.
Units in mg/kg.

- Not Analyzed
- < Soil Screening Level (RISL/PGW SSL)
- >= SSL and < 10x SSL
- >= 10x SSL and < 100x SSL
- >= 100x SSL

Aluminum, Beryllium, Cadmium, Lead, Mercury, Nickel

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary

N

1 " = 70 '

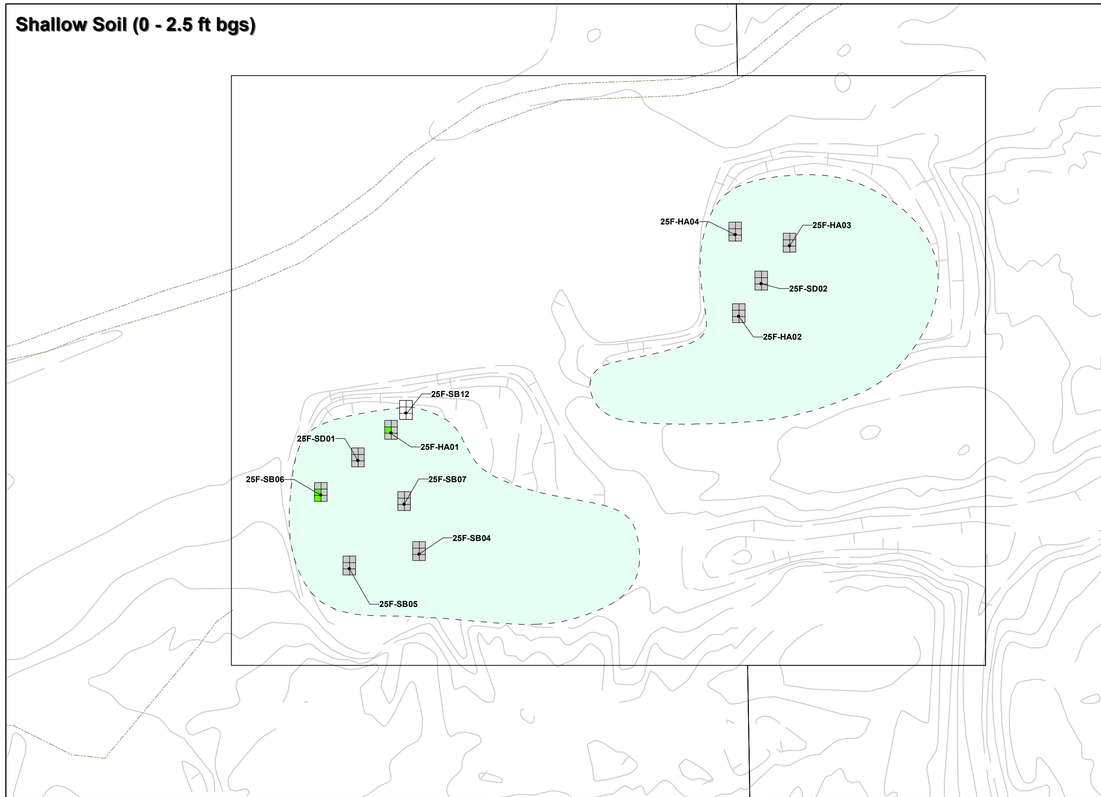
0 35 70
Feet

AEROJET
Environmental Remediation

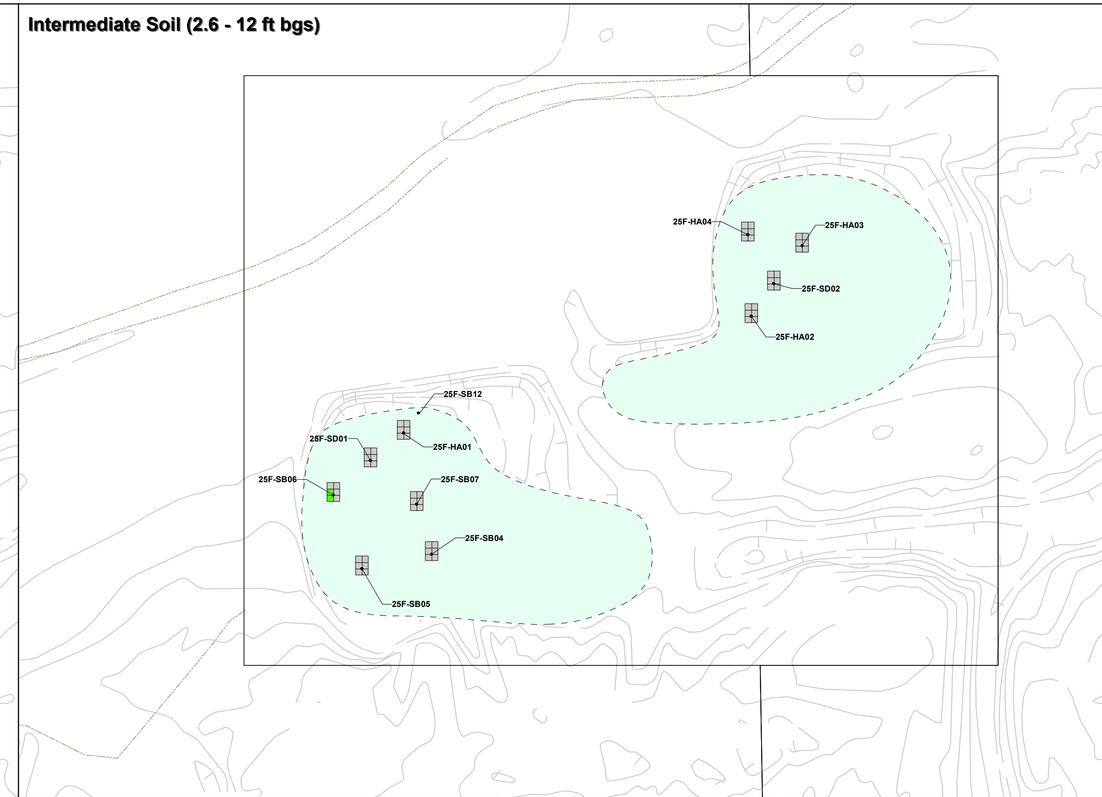
Figure 6.3-4

Metals in Soil Above Remedial Investigation and Protection of Groundwater Screening Levels Dredge Pit and Eastern Basin

Shallow Soil (0 - 2.5 ft bgs)



Intermediate Soil (2.6 - 12 ft bgs)



Deep Soil (> 12 ft bgs)

Sample Location	Sample Depth	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b&k) fluoranthene	Dibenz(a,h) anthracene	Indeno(1,2,3-cd)pyrene	Pentachloro-phenol
Screening Level (RISL)		620	38	38	62.1	621	56
Screening Level (PGW SSL)		29	2.9	29	2.9	29	400
0 - 2.5 feet bgs							
25F-HA01	1.0	<SL	**10**	**22**	<SL	<SL	<SL
25F-SB06	0.5	<SL	**14**	**36**	<SL	<SL	<SL
2.6 - 12 feet bgs							
25F-SB06	5.0	<SL	**20**	**40**	<SL	<SL	<SL

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not analyzed for.
Units in µg/kg

Not Analyzed
< Soil Screening Level (RISL/PGW SSL)
>= SSL and < 10x SSL
>= 10x SSL and < 100x SSL
>= 100x SSL

Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b&k)fluoranthene
Dibenz(a,h)anthracene
Indeno(1,2,3-cd)pyrene
Pentachlorophenol

Source Area
Boundary Operable Unit (BOU)
Consent Decree Boundary

N

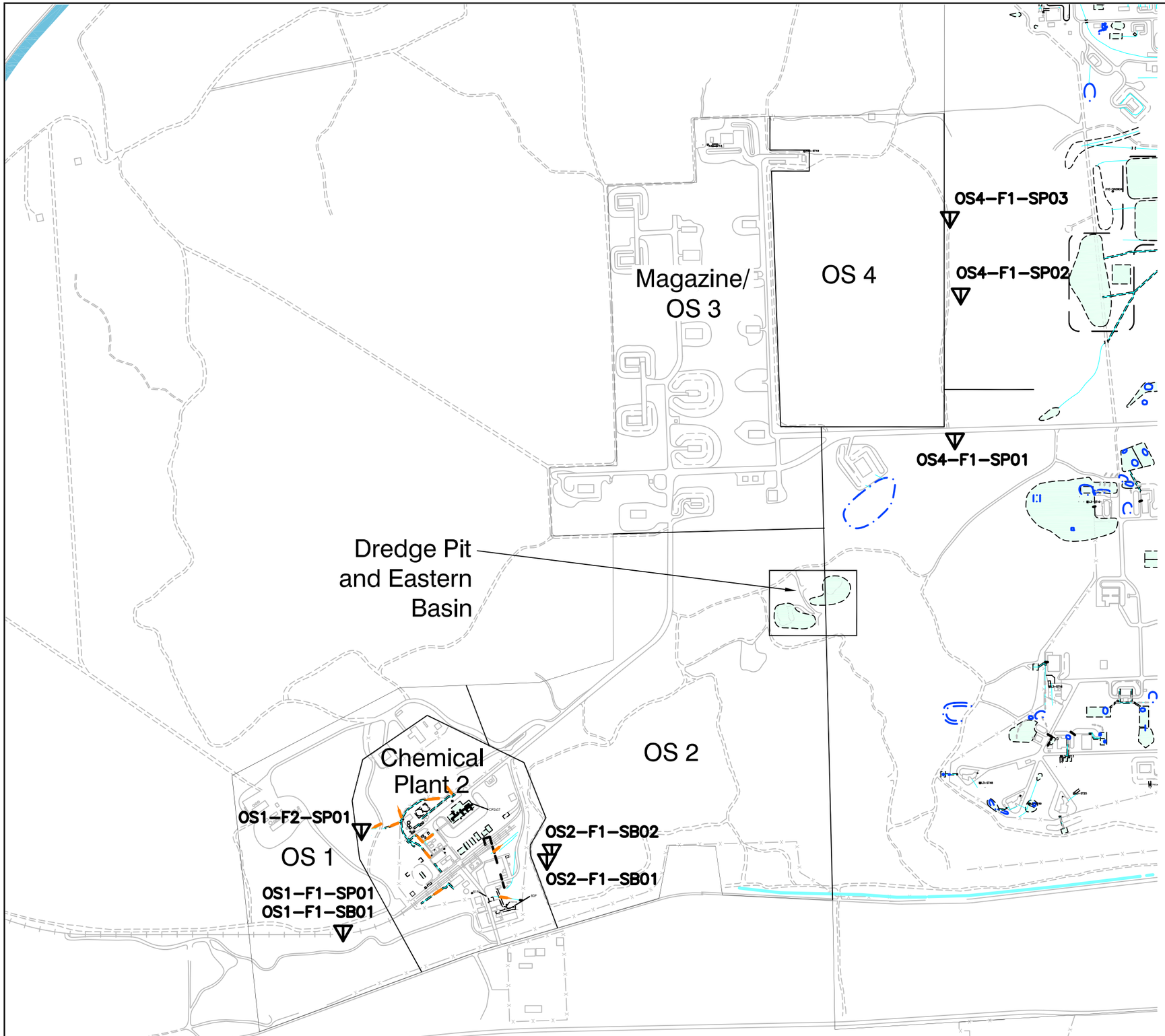
1 " = 70 '

0 35 70
Feet

AEROJET
Environmental Remediation

Figure 6.3-5

SVOCs and Pentachlorophenol Above Remedial Investigation and Protection of Groundwater Screening Levels - Dredge Pit and Eastern Basin



EXPLANATION

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Drainage Culvert
- Underground Culvert
- Fence
- Road
- Railroad
- BOU Soil Vapor Sample Location
- 20009 Building
- Former Structure
- Above Ground Storage Tank
- Surface Drainage

N

Scale: 1" = 100'

0 50 100

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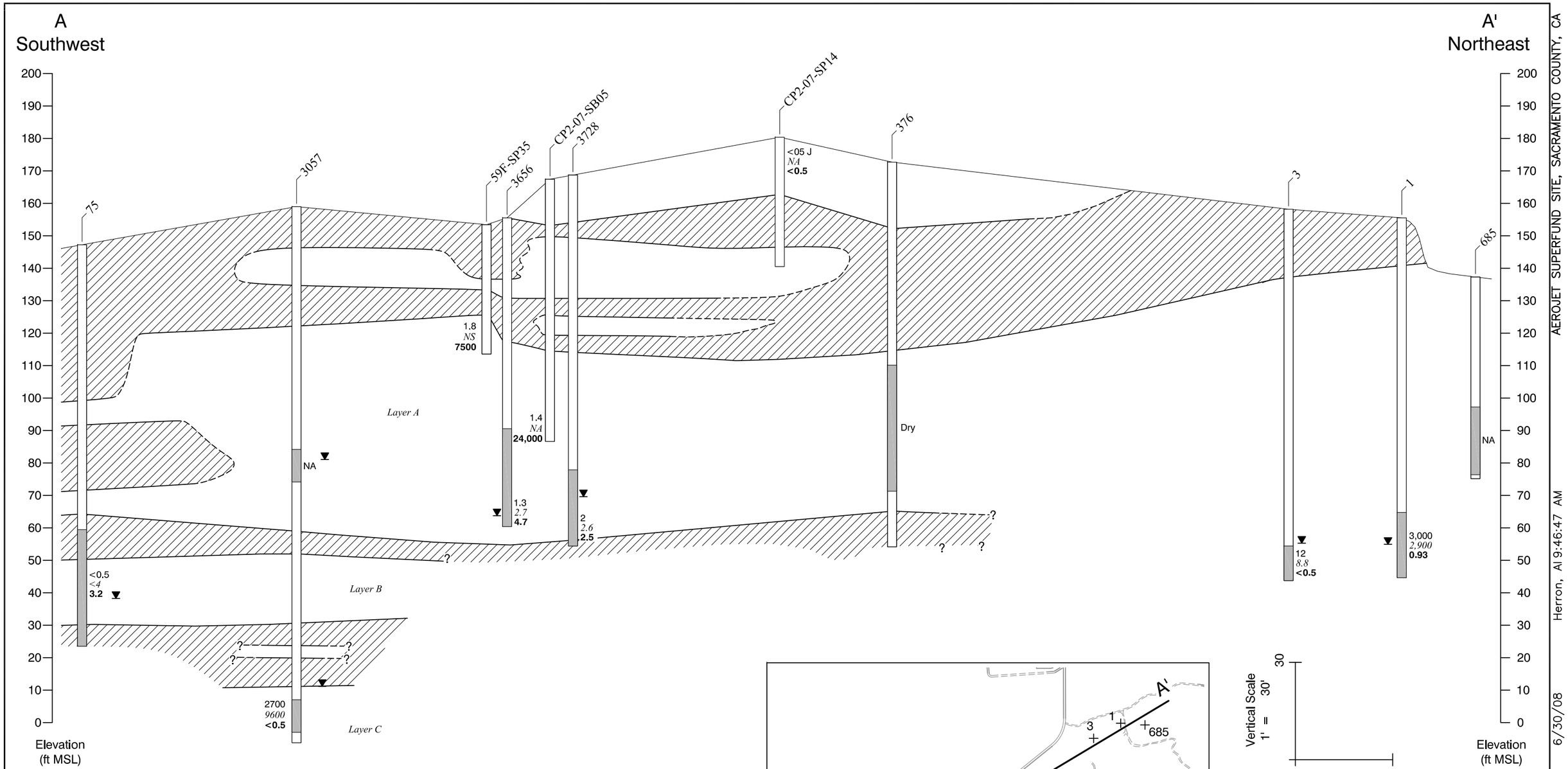
Environmental Remediation

DRAFT

FIGURE 6.4-1
BOU Soil Vapor Sample Locations
Open Space Area 2

5\22\08 PR SR10131032



EXPLANATION

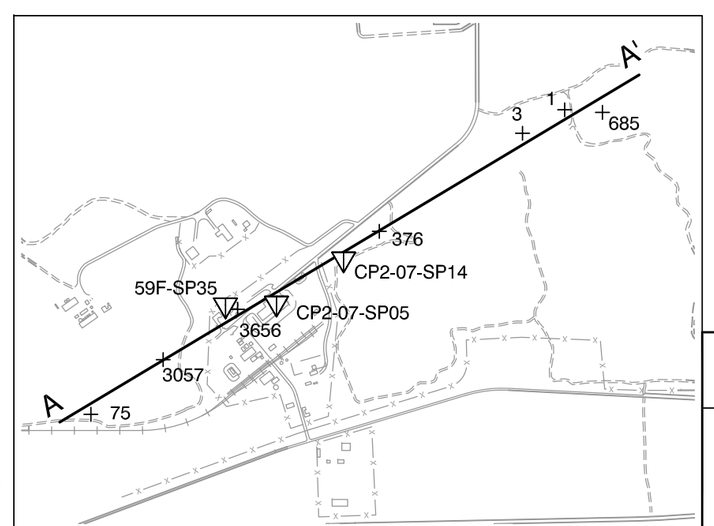
1001 — Well Designation
Multiple Completions: Depth Increases by Ascending Well Number Order

<0.5 — TCE Concentration in µg/L
<4 — Perchlorate Concentration in µg/L
<0.5 — 1,2-DCA Concentration in µg/L
(NS = Not Sampled)
(NM = Not Measured)
(NA = Not Analyzed)

Screened Interval
Total Borehole Depth

Layer Boundary
Geologic Contact
Relatively permeable sediments: Silty, poorly and well-graded sands and gravels (GP,GW,SP,SW); silty and clayey gravels (GM/GC) and silts.
Relatively lower permeability sediments: Low plasticity clays and silts (CL,ML); silty and clayey sand (SM/SC).
Water Level (April 2006)

N
Scale: 1" = 1,200'
0 600 1,200
Locator Scale

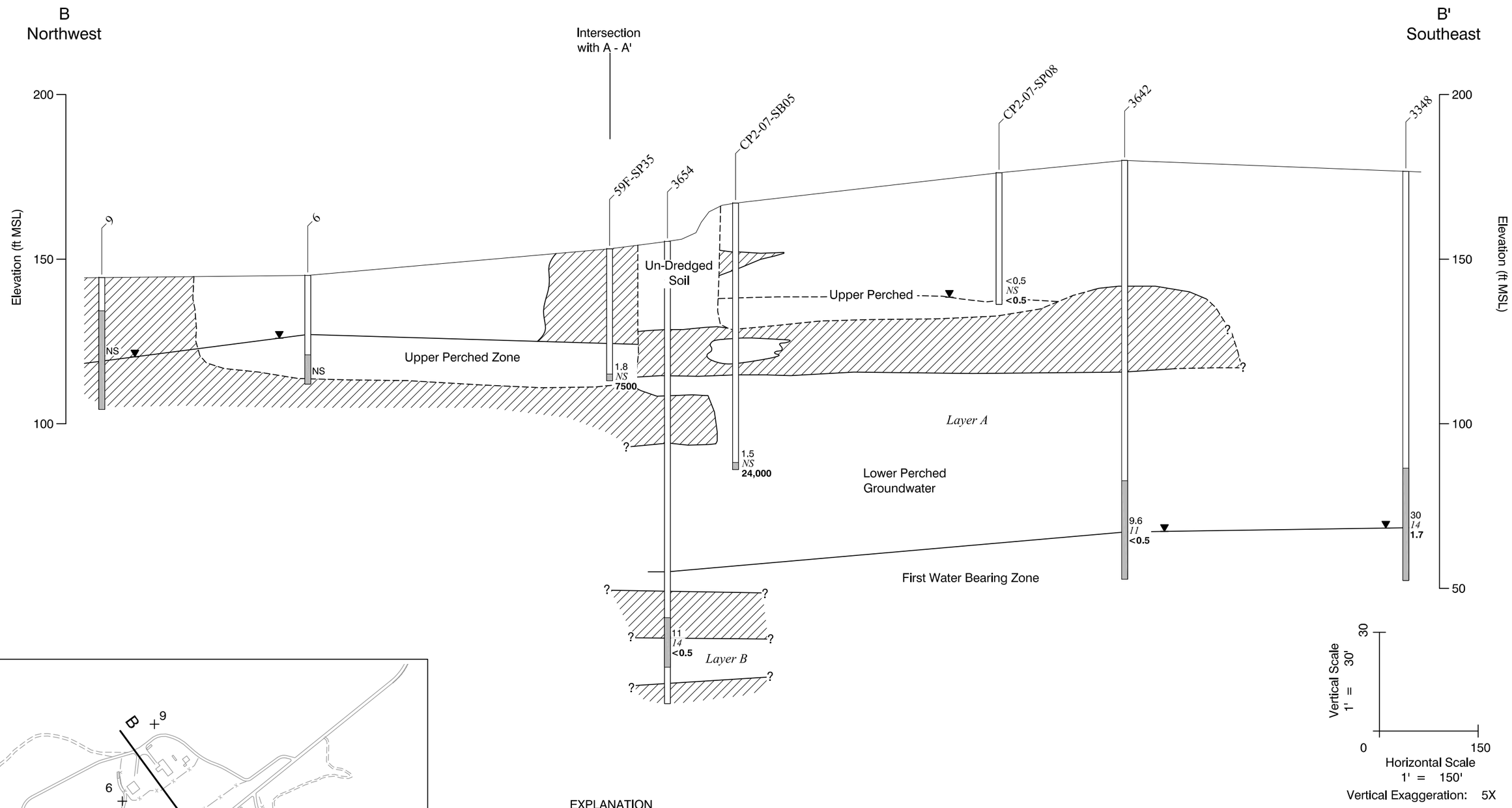


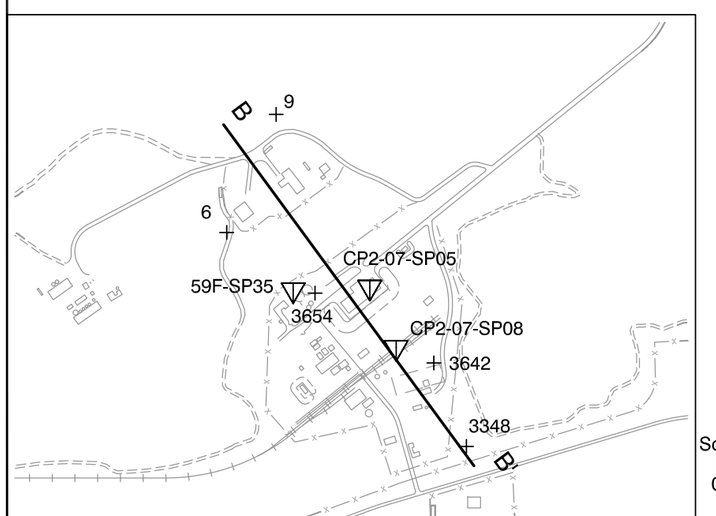
AEROJET
Environmental Remediation

FIGURE 6.6-1
Hydrostratigraphic Cross Section A - A'
Chemical Plant 2 Region
Boundary Operable Unit (OU-6)

DRAFT

AEROJET SUPERFUND SITE, SACRAMENTO COUNTY, CA
Herron, Al 9:46:47 AM
6/30/08
FIGURE 6.6-1
SR10121813





Scale: 1" = 800'
0 400 800
Locator Scale

EXPLANATION

1001 — Well Designation
Multiple Completions: Depth Increases by Ascending Well Number Order

<0.5 — TCE Concentration in µg/L
<4 — Perchlorate Concentration in µg/L
<0.5 — 1,2-DCA in µg/L
(NS = Not Sampled)

Screened Interval
Total Borehole Depth

Water Level
Layer Boundary
Geologic Contact

Relatively permeable sediments: Silty, poorly and well-graded sands and gravels (GP,GW,SP,SW); silty and clayey gravels (GM/GC) and silts.

Relatively lower permeability sediments: Low plasticity clays and silts (CL,ML); silty and clayey sand (SM/SC).

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Environmental Remediation

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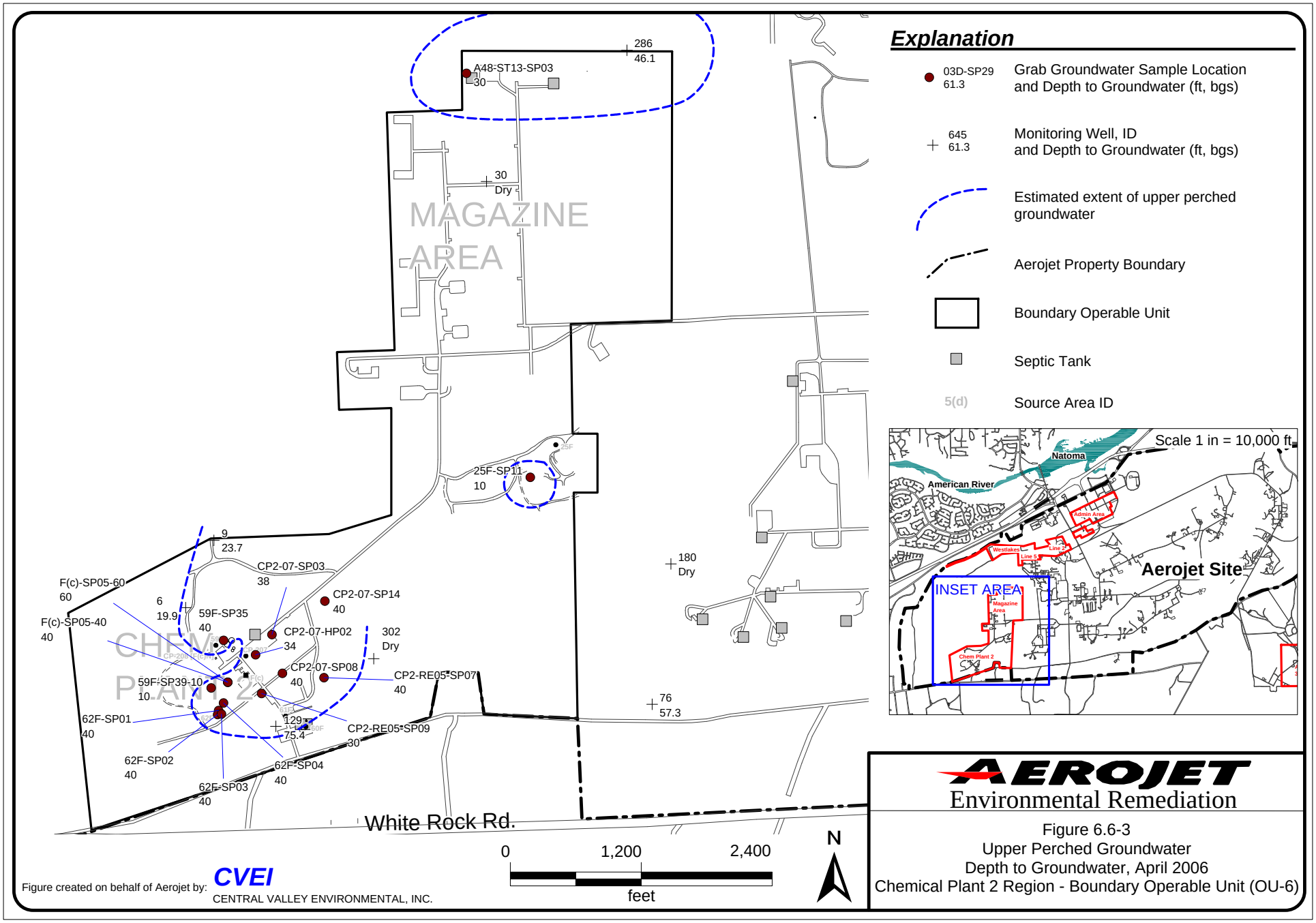
FIGURE 6.6-2
North-South Hydrostratigraphic Cross Section B - B'
Chemical Plant 2 Region
Boundary Operable Unit (OU-6)

SR10121814 FIGURE 6.6-2 6/30/08 Herron, Al


Explanation
03D-SP29
61.3
Grab Groundwater Sample Location and Depth to Groundwater (ft, bgs)
645
61.3
Monitoring Well, ID and Depth to Groundwater (ft, bgs)
Estimated extent of upper perched groundwater
Aerojet Property Boundary
Boundary Operable Unit
Septic Tank
5(d)
Source Area ID
Scale 1 in = 10,000 ft
Natoma
American River
Aerojet Site
INSET AREA
Admin Area
Westlakes
Line 5
Line 2
Magazine Area
Chem Plant 2
286
46.1
A48-ST13-SP03
30
30
Dry
MAGAZINE AREA
25F-SP11
10
9
23.7
CP2-07-SP03
38
F(c)-SP05-60
60
6
19.9
CP2-07-SP14
40
F(c)-SP05-40
40
59F-SP35
40
CP2-07-HP02
34
302
Dry
CHEM PLANT 2
CP2-07-SP08
40
CP2-RE05-SP07
40
59F-SP39-10
10
62F-SP01
40
129
75.4
CP2-RE05-SP09
30
62F-SP02
40
62F-SP04
40
62F-SP03
40
180
Dry
76
57.3
White Rock Rd.
0
1,200
2,400
feet
N
Figure created on behalf of Aerojet by:
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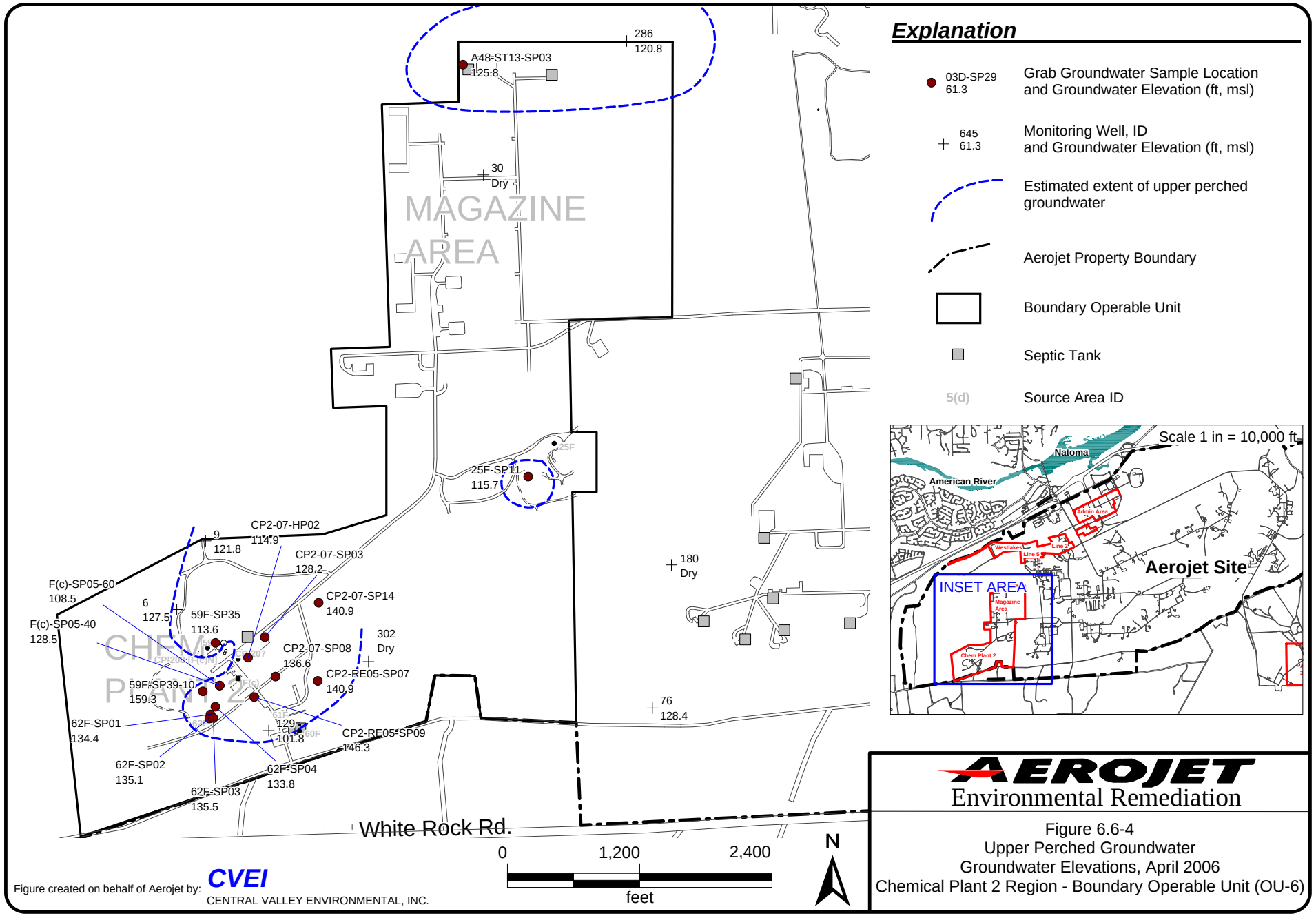
AEROJET
Environmental Remediation
Figure 6.6-3
Upper Perched Groundwater
Depth to Groundwater, April 2006
Chemical Plant 2 Region - Boundary Operable Unit (OU-6)

SR10131065


Explanation
03D-SP29
61.3
Grab Groundwater Sample Location and Groundwater Elevation (ft, msl)
645
61.3
Monitoring Well, ID and Groundwater Elevation (ft, msl)
Estimated extent of upper perched groundwater
Aerojet Property Boundary
Boundary Operable Unit
Septic Tank
5(d)
Source Area ID
Scale 1 in = 10,000 ft
Natoma
American River
Aerojet Site
INSET AREA
Admin Area
Westlakes
Line 5
Line 2
Magazine Area
Chem Plant 2
MAGAZINE AREA
CHEM PLANT 2
White Rock Rd.
286
120.8
A48-ST13-SP03
125.8
30
Dry
25F-SP11
115.7
180
Dry
76
128.4
9
121.8
CP2-07-HP02
114.9
CP2-07-SP03
128.2
CP2-07-SP14
140.9
F(c)-SP05-60
108.5
6
127.5
59F-SP35
113.6
F(c)-SP05-40
128.5
CP2-07-SP08
136.6
302
Dry
CP2-RE05-SP07
140.9
59F-SP39-10
159.3
62F-SP01
134.4
129
101.8
CP2-RE05-SP09
146.3
62F-SP02
135.1
62F-SP04
133.8
62F-SP03
135.5
0
1,200
2,400
feet
N
Figure created on behalf of Aerojet by:
CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.
AEROJET
Environmental Remediation
Figure 6.6-4
Upper Perched Groundwater
Groundwater Elevations, April 2006
Chemical Plant 2 Region - Boundary Operable Unit (OU-6)

SR10131065

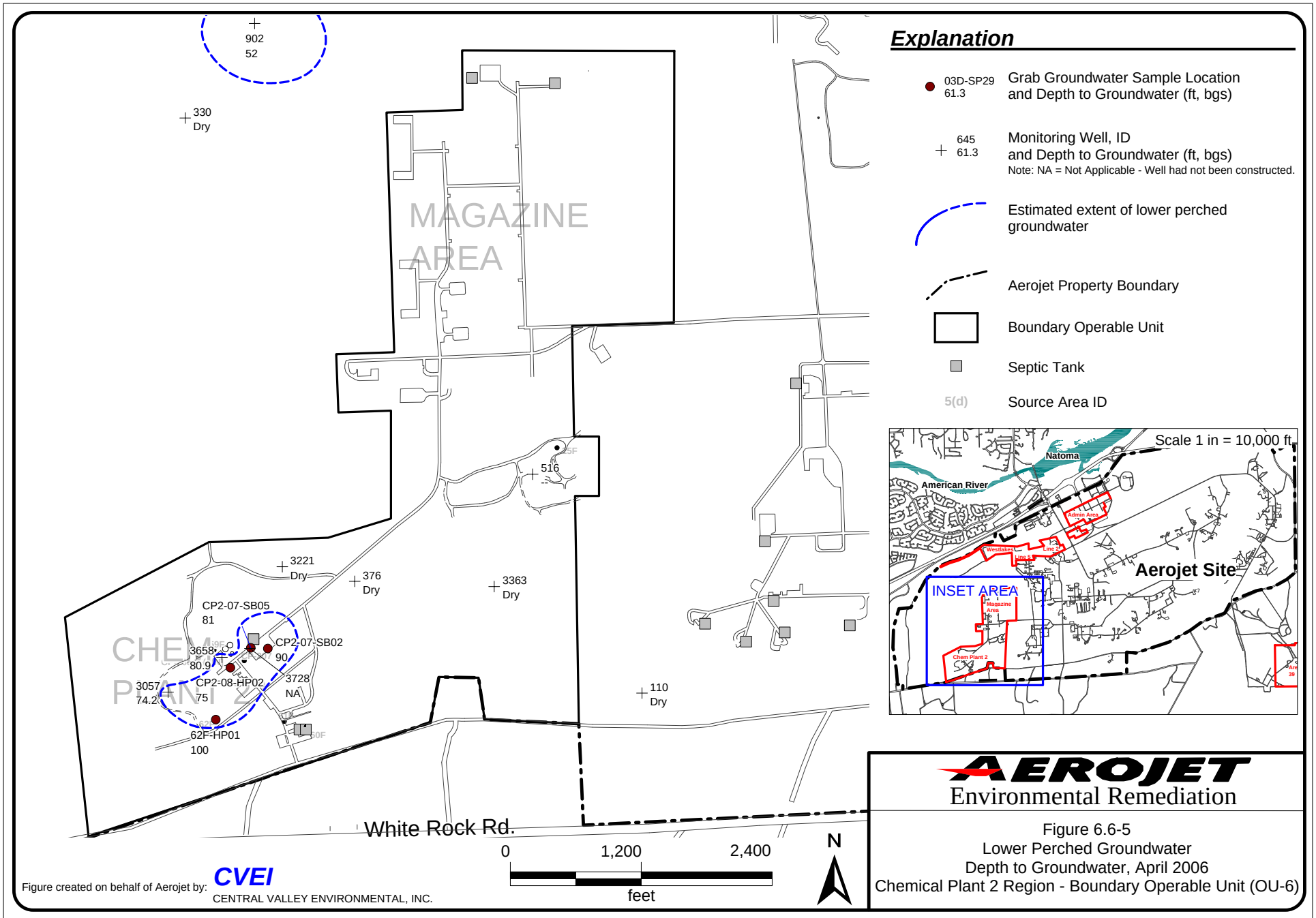
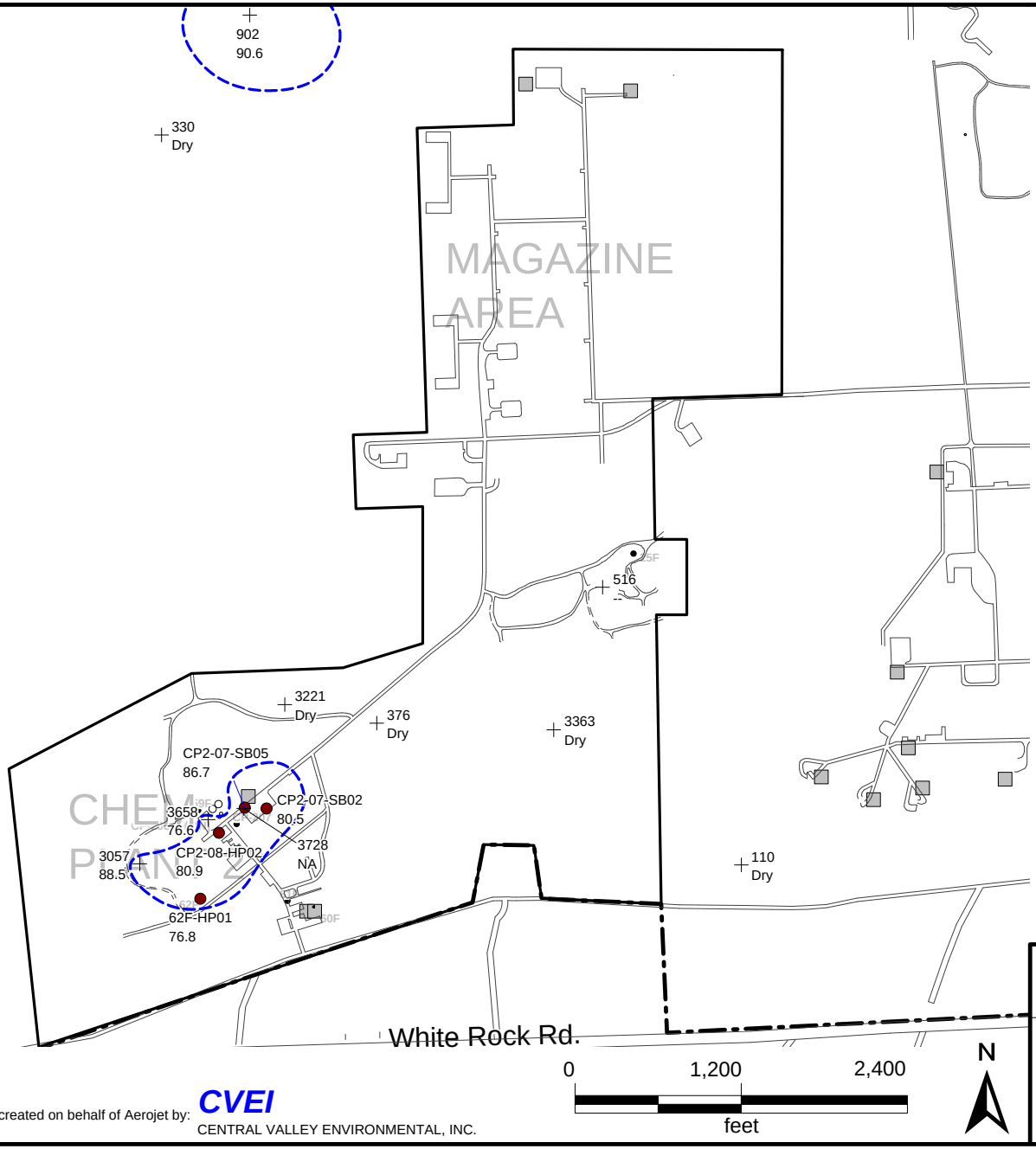


Figure 6.6-5
Lower Perched Groundwater
Depth to Groundwater, April 2006
Chemical Plant 2 Region - Boundary Operable Unit (OU-6)

SR10131065



Explanation

03D-SP29 61.3	Grab Groundwater Sample Location and Groundwater Elevation (ft, msl)
645 61.3	Monitoring Well, ID and Groundwater Elevation (ft, msl) Note: NA = Not Applicable - Well had not been constructed.
	Estimated extent of lower perched groundwater
	Aerojet Property Boundary
	Boundary Operable Unit
	Septic Tank
5(d)	Source Area ID

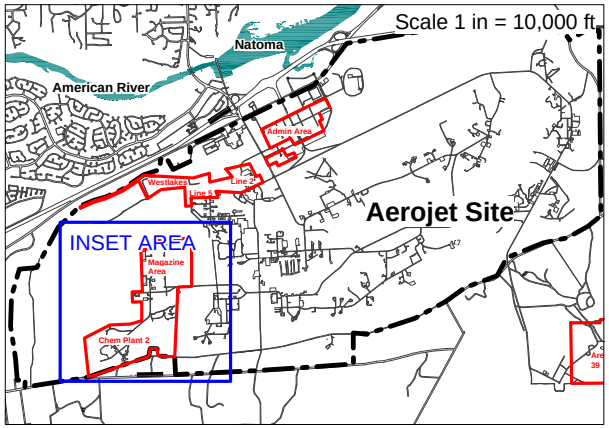


Figure created on behalf of Aerojet by: **CVEI** CENTRAL VALLEY ENVIRONMENTAL, INC.

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Figure 6.6-6
Lower Perched Groundwater
Groundwater Elevations, April 2006
Chemical Plant 2 Region - Boundary Operable Unit (OU-6)

SR10131065

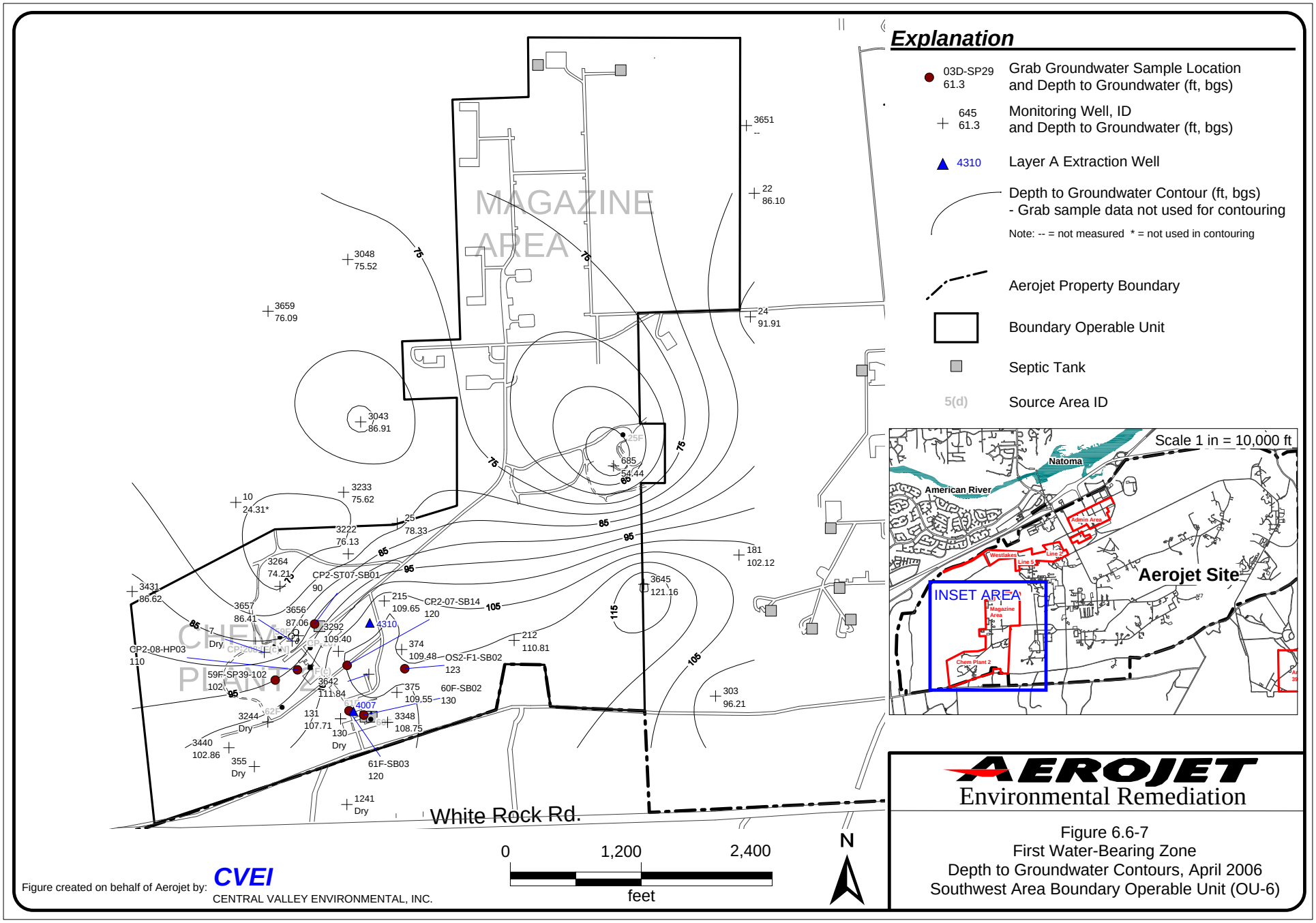

Figure created on behalf of Aerojet by: **CVEI**
CENTRAL VALLEY ENVIRONMENTAL, INC.

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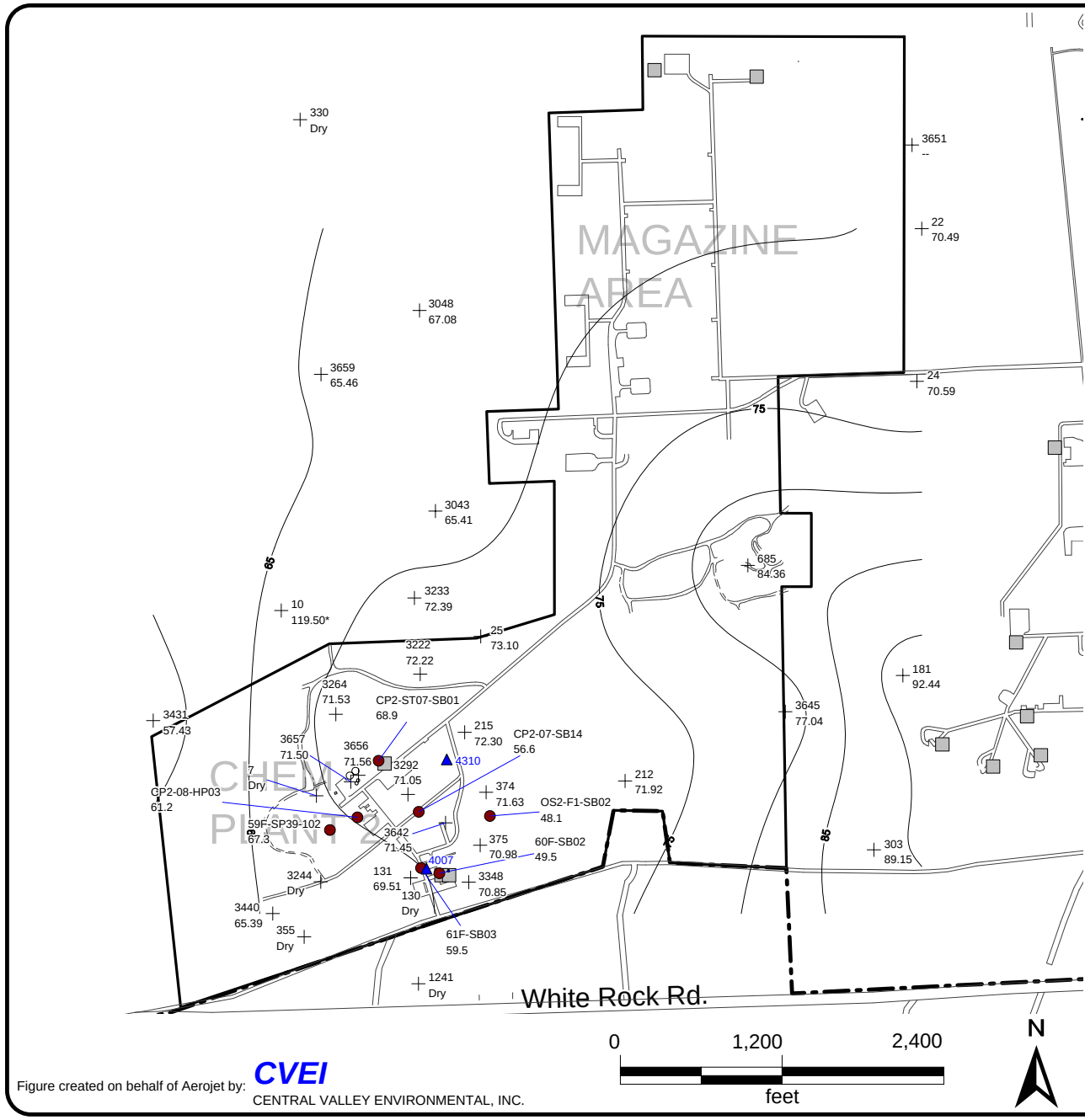
Environmental Remediation

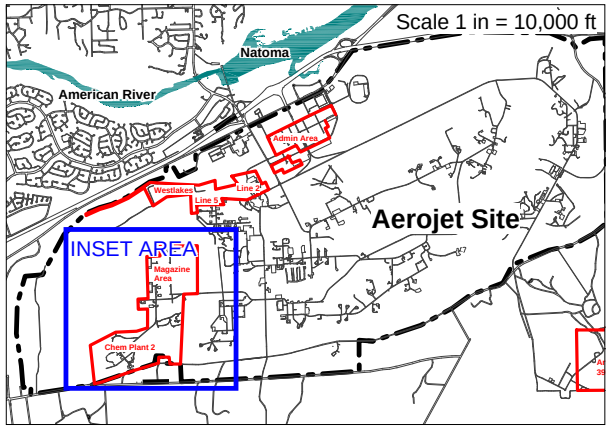
Figure 6.6-7
First Water-Bearing Zone
Depth to Groundwater Contours, April 2006
Southwest Area Boundary Operable Unit (OU-6)

SR10131065



Explanation

- 03D-SP29 61.3 — Grab Groundwater Sample Location and Groundwater Elevation (ft, msl)
- 645 61.3 — Monitoring Well, ID and Groundwater Elevation (ft, msl)
- 4310 — Extraction Well
- Groundwater Elevation Contour (ft, msl) - Grab sample data not used for contouring
- Note: -- = not measured * = not used in contouring
- Aerojet Property Boundary
- Boundary Operable Unit
- Septic Tank
- 5(d) — Source Area ID



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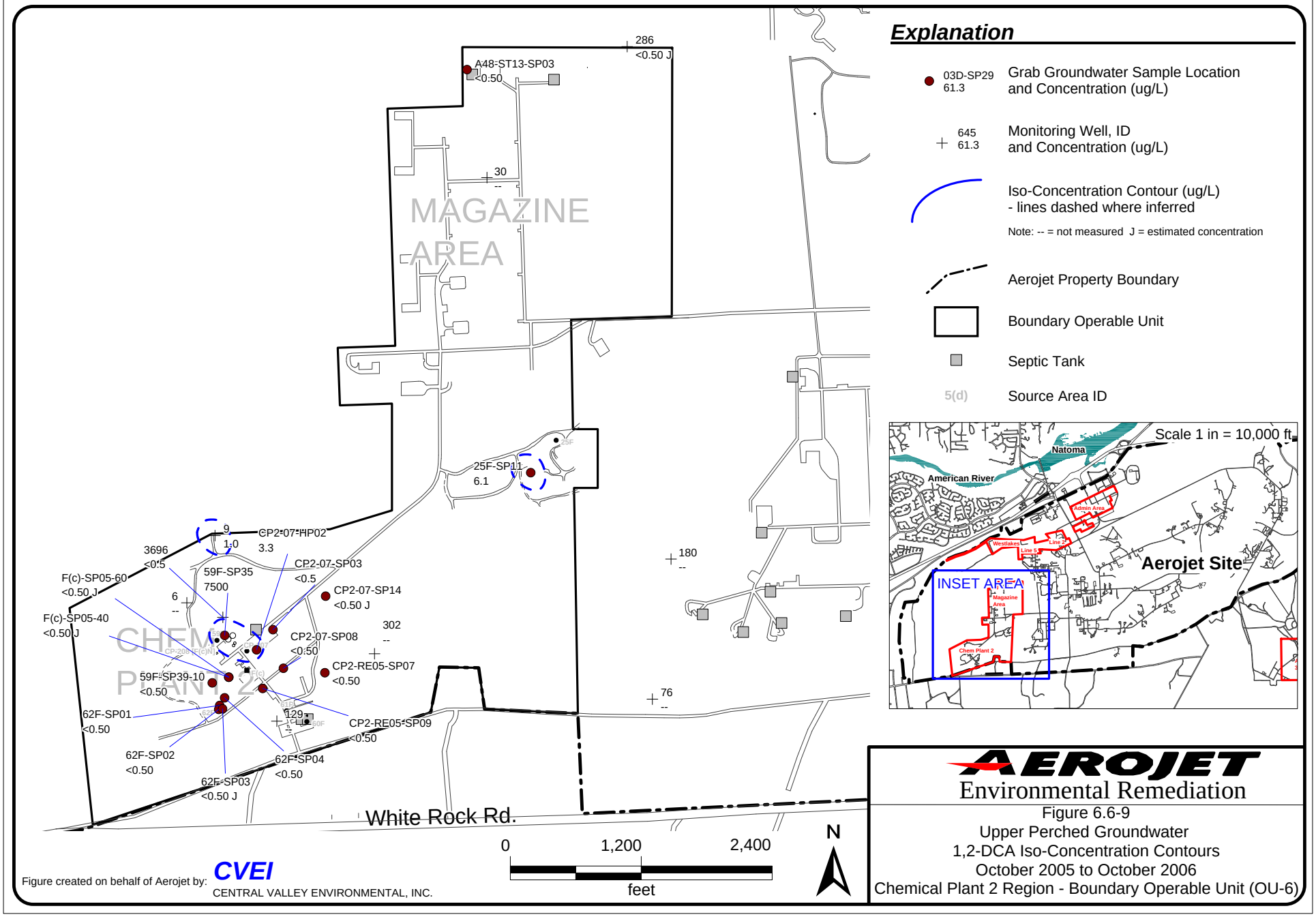
Environmental Remediation

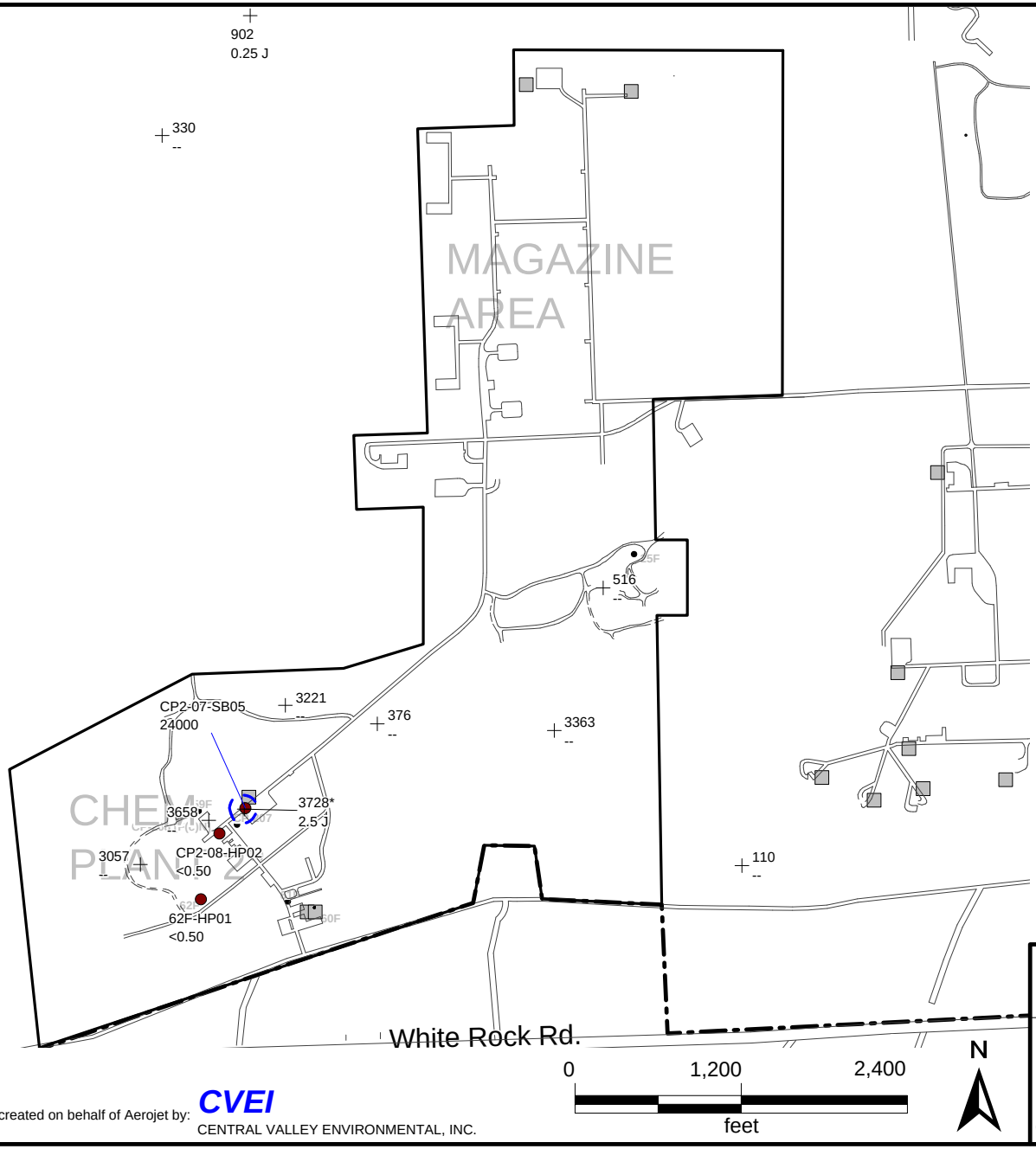
Figure 6.6-8
First Water-Bearing Zone
Potentiometric Surface Map, April 2006
Southwest Area Boundary Operable Unit (OU-6)

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

SR10131065


Explanation
03D-SP29
61.3
Grab Groundwater Sample Location and Concentration (ug/L)
645
61.3
Monitoring Well, ID and Concentration (ug/L)
Iso-Concentration Contour (ug/L) - lines dashed where inferred
Note: -- = not measured J = estimated concentration
Aerojet Property Boundary
Boundary Operable Unit
Septic Tank
5(d)
Source Area ID
Scale 1 in = 10,000 ft
Natoma
American River
Aerojet Site
INSET AREA
Admin Area
Westlakes
Line 5
Line 2
Magazine Area
Chem Plant 2
MAGAZINE AREA
CHEM PLANT 2
White Rock Rd.
286
<0.50 J
A48-ST13-SP03
<0.50
30
--
25F-SP11
6.1
180
--
76
--
9
1.0
CP2-07-HP02
3.3
3696
<0.5
CP2-07-SP03
<0.5
59F-SP35
7500
F(c)-SP05-60
<0.50 J
CP2-07-SP14
<0.50 J
6
--
F(c)-SP05-40
<0.50 J
302
--
CP2-07-SP08
<0.50
CP2-RE05-SP07
<0.50
59F-SP39-10
<0.50
62F-SP01
<0.50
129
--
CP2-RE05-SP09
<0.50
62F-SP02
<0.50
62F-SP04
<0.50
62F-SP03
<0.50 J
0
1,200
2,400
feet
N
Figure created on behalf of Aerojet by:
CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.
AEROJET
Environmental Remediation
Figure 6.6-9
Upper Perched Groundwater
1,2-DCA Iso-Concentration Contours
October 2005 to October 2006
Chemical Plant 2 Region - Boundary Operable Unit (OU-6)

SR10131065



Explanation

03D-SP29 61.3 — Grab Groundwater Sample Location and Concentration (ug/L)

645 61.3 — Monitoring Well, ID and Concentration (ug/L)

Note: -- = not measured J = estimated concentration
* = sampled in May 2007

Iso-Concentration Contour (ug/L) - lines dashed where inferred

Aerojet Property Boundary

Boundary Operable Unit

Septic Tank

5(d) — Source Area ID

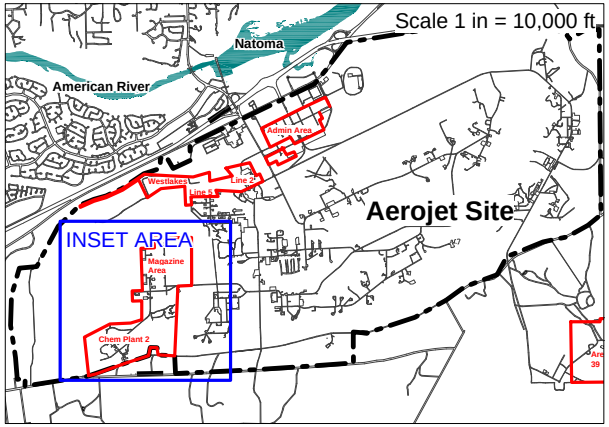
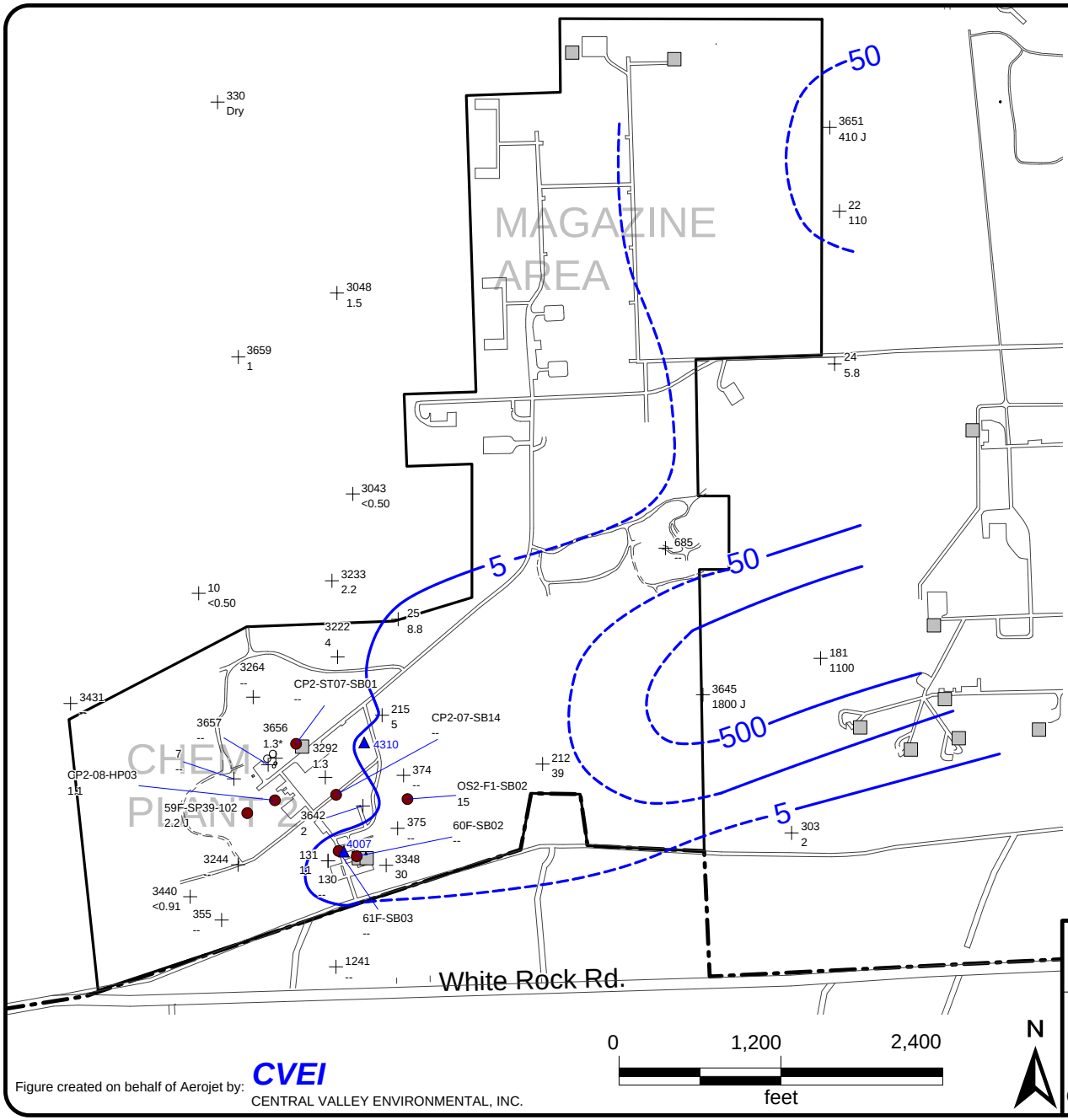


Figure created on behalf of Aerojet by: **CVEI** CENTRAL VALLEY ENVIRONMENTAL, INC.

AEROJET
Environmental Remediation

Figure 6.6-10
Lower Perched Groundwater
1,2-DCA Iso-Concentration Contours
October 2005 to October 2006
Chemical Plant 2 Region - Boundary Operable Unit (OU-6)

SR10131065



Explanation

03D-SP29 50	Grab Groundwater Sample Location and Concentration (ug/L)
645 50	Monitoring Well, ID and Concentration (ug/L)
4310	Extraction Well
	Iso-Concentration Contour (ug/L) - line dashed where inferred
	Aerojet Property Boundary
	Boundary Operable Unit
	Septic Tank
5(d)	Source Area ID

Note: -- = not analyzed * = analyzed in May 2007
J = estimated value

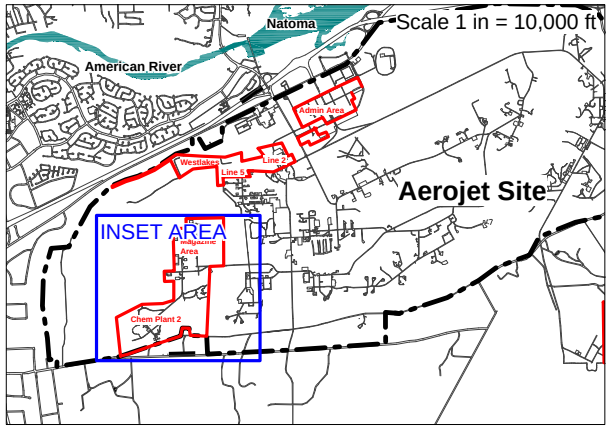
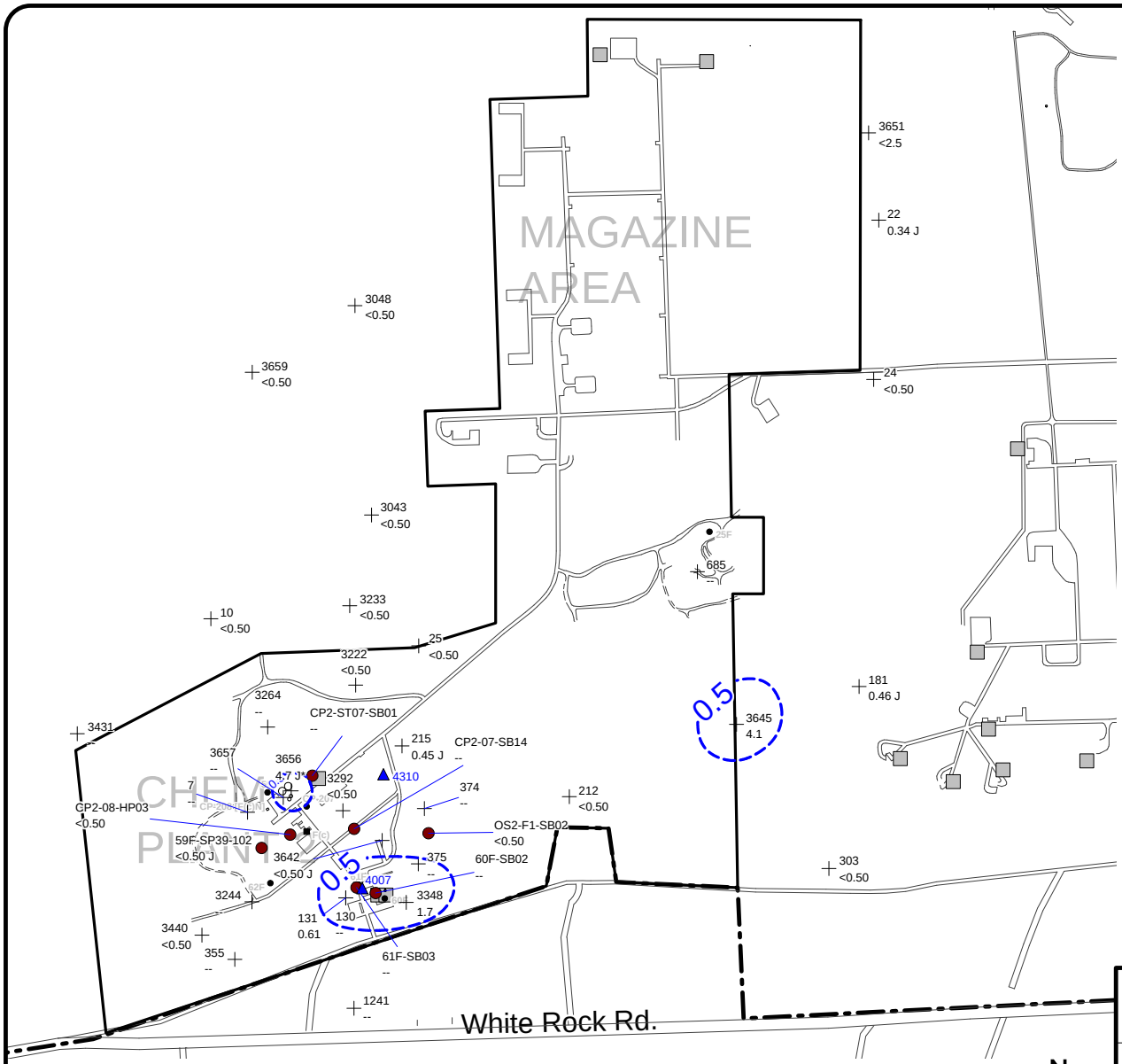


Figure created on behalf of Aerojet by: **CVEI** CENTRAL VALLEY ENVIRONMENTAL, INC.

AEROJET
Environmental Remediation

Figure 6.6-11
First Water-Bearing Zone
TCE Iso-Concentration Contours
October 2005 - October 2006
Chemical Plant 2 Region - Boundary Operable Unit (OU-6)

SR10131065



Explanation

03D-SP29 50	Grab Groundwater Sample Location and Concentration (ug/L)
645 50	Monitoring Well, ID and Concentration (ug/L)
4310	Extraction Well
	Iso-Concentration Contour (ug/L) - line dashed where inferred
	Aerojet Property Boundary
	Boundary Operable Unit
	Septic Tank
5(d)	Source Area ID

Note: -- = not analyzed * = analyzed in May 2007
J = estimated value

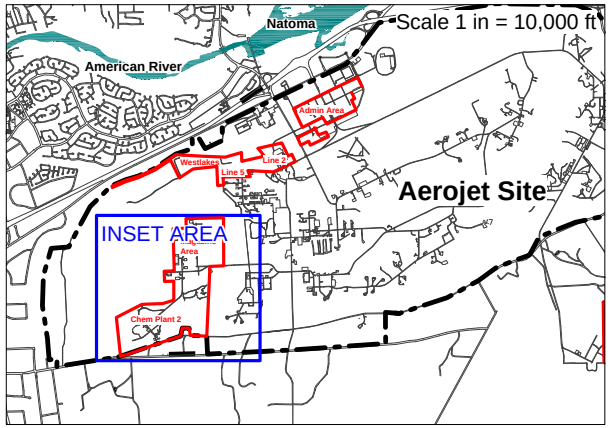
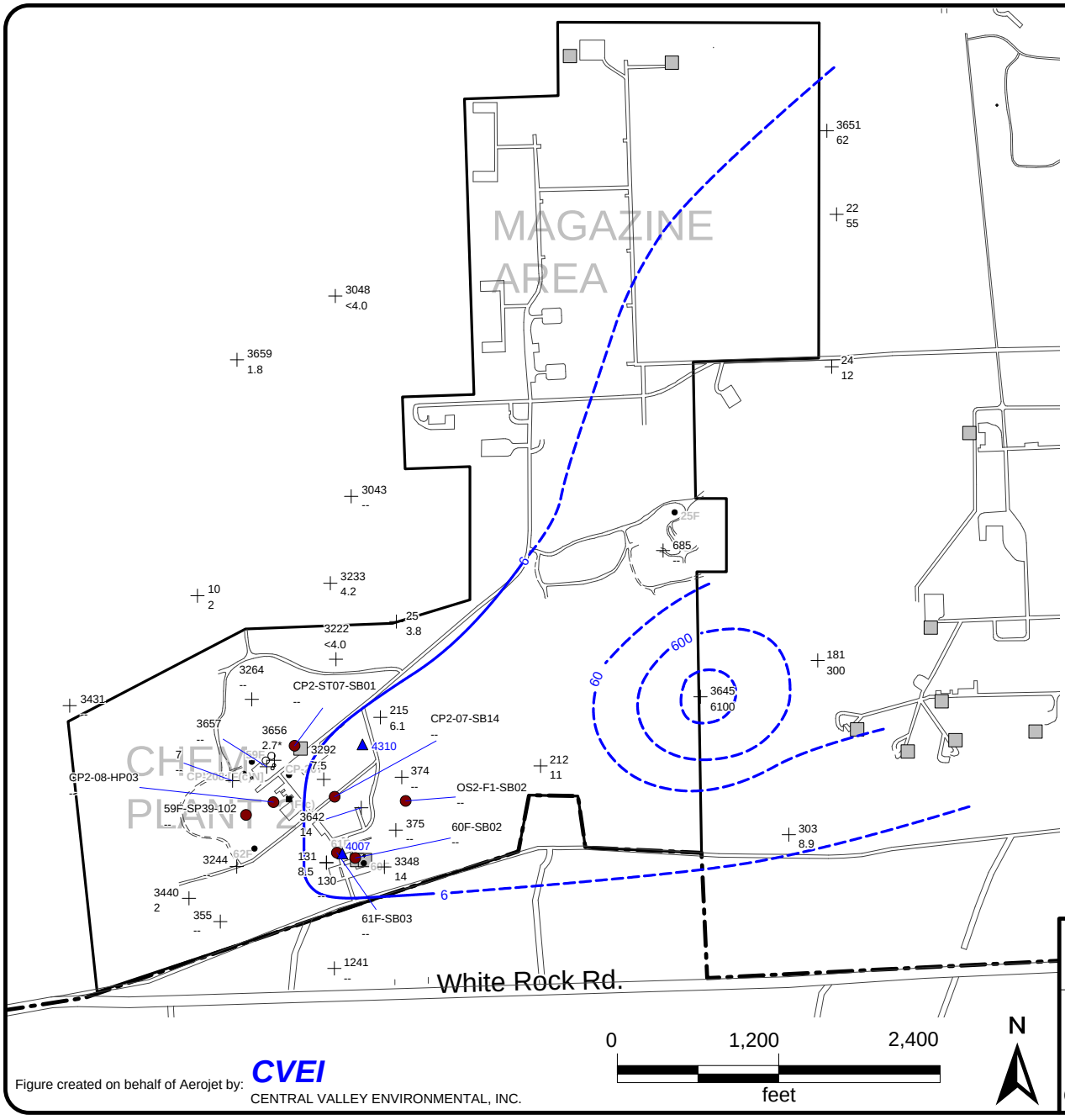


Figure created on behalf of Aerojet by: **CVEI**
CENTRAL VALLEY ENVIRONMENTAL, INC.

AEROJET
Environmental Remediation

Figure 6.6-12
First Water-Bearing Zone
1,2 - DCA Iso-Concentration Contours
October 2005 - October 2006
Chemical Plant 2 Region - Boundary Operable Unit (OU-6)

SR10131065



Explanation

03D-SP29 50	Grab Groundwater Sample Location and Concentration (ug/L)
645 50	Monitoring Well, ID and Concentration (ug/L)
4310	Extraction Well
	Iso-Concentration Contour (ug/L) - line dashed where inferred
	Aerojet Property Boundary
	Boundary Operable Unit
	Septic Tank
5(d)	Source Area ID

Note: -- = not analyzed * = analyzed in May 2007
J = estimated value

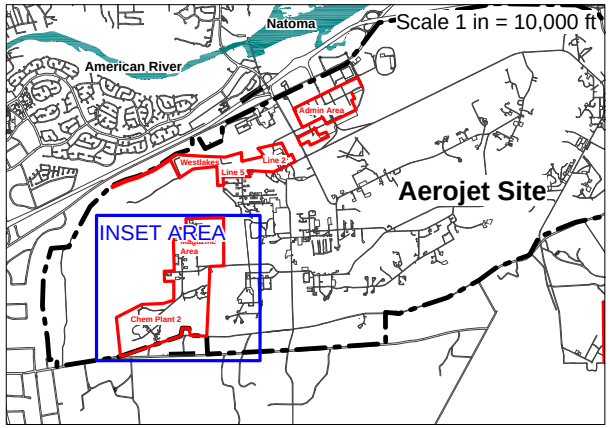


Figure created on behalf of Aerojet by: **CVEI** CENTRAL VALLEY ENVIRONMENTAL, INC.

AEROJET
Environmental Remediation

Figure 6.6-13
First Water-Bearing Zone
Perchlorate Iso-Concentration Contours
October 2005 - October 2006
Chemical Plant 2 Region - Boundary Operable Unit (OU-6)

SR10131065

Table 6.1-1 Summary of Soil Vapor Sampling and Sampling Statistics
Chemical Plant 2 Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Interval	Depth (feet bgs)	Locations	Primary Samples	Duplicate Samples	Detects	Frequency of Duplicates	Frequency of Primary Detects
59F	Shallow	0-10	8	8	2	8	25.0%	100.0%
	Intermediate	11-20	8	8	1	8	12.5%	100.0%
	Deep	21-30	1	1	0	1	0.0%	100.0%
60F	Shallow	0-10	11	11	4	11	36.4%	100.0%
	Intermediate	11-20	11	11	1	11	9.1%	100.0%
	Deep	21-30	5	5	1	5	20.0%	100.0%
61F	Shallow	0-10	4	4	1	4	25.0%	100.0%
	Intermediate	11-20	4	4	0	4	0.0%	100.0%
	Deep	21-30	0	0	0	0	0.0%	0.0%
62F	Shallow	0-10	4	5	1	5	20.0%	100.0%
	Intermediate	11-20	6	7	0	7	0.0%	100.0%
	Deep	21-30	0	0	0	0	0.0%	0.0%
F(c)	Shallow	0-10	1	1	0	1	0.0%	100.0%
	Intermediate	11-20	2	2	0	2	0.0%	100.0%
	Deep	21-30	0	0	0	0	0.0%	0.0%
CP2-07	Shallow	0-10	15	15	2	15	13.3%	100.0%
	Intermediate	11-20	15	15	1	14	6.7%	93.3%
	Deep	21-30	5	5	0	5	0.0%	100.0%
CP2-08	Shallow	0-10	4	4	1	4	25.0%	100.0%
	Intermediate	11-20	2	2	0	2	0.0%	100.0%
	Deep	21-30	0	0	0	0	0.0%	0.0%
		Totals:	**106**	**108**	**15**	**107**	**14%**	**99%**

Notes and Key:

All samples analyzed for volatile organic compounds (VOCs) by USEPA Method TO-15.

bgs = Below ground surface

% = Percent

Table 6.1-2 *Cross-Reference Between Soil and Soil Vapor Sampling Locations and Investigated Features*
Chemical Plant 2 Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Associated Site Feature	Source Area	Soil Sampling Location(s)	Soil Vapor Sampling Location(s)
CHEMICAL PLANT 2 NORTH			
AREA OF YELLOW STAINING	CP2-07	STAGE 1 RI	STAGE 1 RI
DRAINAGE DOWNSLOPE OF FORMER HOLDING BASINS East-west drainage swale downslope of former holding basins and French drains.	59F	59F-SB13	59F-SP36
DRY WELL – BUILDING 15010 Dry well that received waste from Building 15010.	CP2-08	CP2-08-SB10	
FORMER WASTE TANK LOCATIONS	59F	59F-SB17 59F-SB18	CP2-07-SP12
FORMER SPCC SUMP Sump located near holding basin	59F	59F-SB19	
FORMER CHEMICAL STORAGE BUILDING NEAR NITROETHANE TANK Former chemical storage also associated with railcar transfer and pumping station.	62F	62F-SB06	
FORMER PCB TRANSFORMER Concrete pad for former PCB transformer.	F(c)	F(c)-SB02	
FORMER LOCATION OF DIESEL UST Former location of UST containing diesel.	F(c)	F(c)-SB03	
FORMER PARALDEHYDE TANK Former location of UST for paraldehyde.	62F	62F-SB07	62F-SP01 62F-SP02 62F-SP03
FORMER HOLDING BASINS Former holding basin and French drain	59F	59F-SB11 59F-SB12 59F-SB15 59F-SB16	59F-SP33 59F-SP34 59F-SP35
FORMER HAZARDOUS MATERIALS STORAGE AREA Former hazardous material storage area	CP2-07	CP2-07-SB09	
FORMER HAZARDOUS WASTE STORAGE AREA – BUILDING 15008 Former hazardous waste storage area for Building 15008.	CP2-08	CP2-08-SB11	CP2-08-SP11 CP2-08-SP12
FORMER CHEMICAL STORAGE AREA – BUILDING 15008 Former chemical storage area for Building 15008.	CP2-08	CP2-08-SB12	CP2-08-SP11 CP2-08-SP12

Table 6.1-2 *Cross-Reference Between Soil and Soil Vapor Sampling Locations and Investigated Features*
Chemical Plant 2 Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Associated Site Feature	Source Area	Soil Sampling Location(s)	Soil Vapor Sampling Location(s)
FORMER ABOVE-GROUND PIPING Former above ground piping associated with Buildings 15008, 15015, and 15020.	CP2-08	CP2-08-SB13	
FORMER TEST INCINERATOR Former test incinerator near nitroethane tank.	CP2-08	CP2-08-SB15	CP2-08-SP14
FORMER DIESEL UST Former location of diesel UST west of Building 15015	F(c)		F(c)-SP05
INJECTION WELL 2 HEADWORKS Former location of headworks for injection well No. 2.	CP2-08	CP2-08-SB14	CP2-08-SP13 62F-SP07 59F-SP39
LOW-LYING AREA NORTH OF FORMER HOLDING BASIN AND BUILDING 15007 Low-lying area that received surface water runoff from former French drain around the former holding basin, the former holding basin area, source areas in Chem Plant 2 Area North, the chemical plant (Building 15007), the hazardous material storage area (CP-208), and blow-down sump [F(c)].	59F	59F-SD01 59F-SD02 59F-SD03 59F-SD04 59F-SD05 59F-SD06 59F-SD07 59F-SNS02 59F-SNS03 59F-SNS04 59F-SB14 59F-SB23 59F-SB25 59F-SB26 59F-SB27 59F-SB28	59F-SP38 CP2-07-SP09 CP2-07-SP13
MATERIALS STORAGE AREA Former materials storage area near entrance to Chemical Plant 2.	CP2-07	CP2-07-SB09	CP2-07-SP04 CP2-07-SP10 CP2-07-SP14 CP2-07-SP15
NITROETHANE TANK Former location of above-ground nitroethane tank	62F		62F-SP04 62F-SP05
POTENTIAL SPILL AREA IN RAILROAD BALLAST Potential spill area in railroad ballast across from paraldehyde and nitroethane tanks.	62F	62F-SB08 62F-SB09 62F-SB10	

Table 6.1-2 *Cross-Reference Between Soil and Soil Vapor Sampling Locations and Investigated Features Chemical Plant 2 Area Boundary Operable Unit Remedial Investigation Aerojet Superfund Site Sacramento County, California*

POTENTIAL SPILL AREAS ALONG RAIL LINES Potential spill areas in rail road ballast across from former product storage ASTs.	CP2-07	CP2-07-SB15 CP2-07-SB16 CP2-07-SB17 CP2-07-SB18 CP2-07-SB19 CP2-07-SB22	
PUMPS, BOILERS, AND TANKS – BUILDING 15007 Pumps, boilers and condensation tanks and waste line originating from Building 15007.	CP2-07	CP2-07-SB03 CP2-07-SB04 CP2-07-SB06 CP2-07-SB24	
RAILCAR TRANSFER AND PUMPING STATION Transfer and product pumping station from rail line to former nitroethane tank.	62F	62F-SB04 62F-SB05	62F-SP06
SEPTIC TANK – BUILDING 15007 Septic tank from Building 15007.	CP2	CP2-ST07-SB01	CP2-07-SP11
SURFACE WATER DRAINAGE DITCH Ditch receiving surface water runoff from Buildings 15008 and other buildings on west side of Oakland Avenue.	F(c)	F(c)-SNS01 F(c)-SNS02 F(c)-SNS03	
SURFACE WATER DRAINAGE Drainage ditch from Building 15004.	62F	62F-SNS02	
SURFACE WATER DRAINAGE DITCH Lower section of ditch receiving surface water runoff from former hazardous waste storage area and from 15008 and other buildings on west side of Oakland Avenue.	CP2-08	CP2-08-SNS01 CP2-08-SNS02 CP2-08-SNS03 CP2-08-SNS04	
SURFACE WATER RUNOFF AREA Surface water runoff area from around the former paraldehyde tank, former nitroethane tank, and railcar transfer station	62F	62F-SD01	
SURFACE WATER RUNOFF AREA Low-lying area that receives storm water runoff from former nitroethane tank and railcar transfer station.	62F	62F-SNS01	
SURFACE WATER RUNOFF AREA – BUILDINGS 15002 AND 15006 Area of surface water accumulation from Building 15002 and 15006	CP2-07	CP2-07-SB21	
SURFACE WATER RUNOFF FROM SPCC SUMP AND CHEM PLANT 2 AREA TO THE NORTH Runoff from former SPCC sump and Chem Plant 2 North Area to low-lying area to the north.	59F	59F-SB21 59F-SB22	

Table 6.1-2 *Cross-Reference Between Soil and Soil Vapor Sampling Locations and Investigated Features Chemical Plant 2 Area Boundary Operable Unit Remedial Investigation Aerojet Superfund Site Sacramento County, California*

SURFACE WATER RUNOFF FROM SPCC SUMP AND CHEM PLANT 2 AREA TO THE WEST Runoff from former SPCC sump and Chem Plant 2 North Area to low-lying area to the west.	59F	59F-SNS01 59F-SB20 OS1-F2-SNS01 OS1-F2-SNS02 OS1-F2-SNS03 OS1-F2-SNS04 OS1-F2-SB02 OS1-F2-SB03 OS1-F2-SB04	59F-SP37 OS1-FS-SP01
SUMP Sump receiving boiler blowdown, refrigeration compressor seal water, and wash water	F(c)	F(c)-SB04	
SUMP – NORTH SIDE OF BUILDING 15007 Sump receiving discharge from trench system in the interior of Building 15007.	CP2-07 Bldg 15007	CP2-07-SB05	CP2-07-SP01 CP2-07-SP11
SUMP – END OF WASTE LINE ORGINATING FROM BUILDING 15007 Sump at end of waste line at Building 15007.	CP2-07 Bldg 15007	CP2-07-SB08	
SUMP – SOUTH SIDE OF BUILDING 15007 Sump serving bermed area containing pumps, boilers, and tanks on the south side of Building 15007.	CP2-07 Bldg 15007	CP2-07-SB12	CP2-07-SP02
SUMP – SOUTH SIDE OF BUILDING 15007 Sump serving bermed area containing pumps, boilers, and tanks on the south side of Building 15007.	CP2-07 Bldg 15007	CP2-07-SB02	
SUMP - BUILDINGS 15014 AND 15015 Boiler and compressor blow-down sump from Buildings 15014 and 15015.	CP2-08	CP2-08-SB09	F(c)-SP06
TRENCH DRAIN SYSTEM – BUILDING 15007 Trench system draining interior of Building 15007.	CP2-07 Bldg 15007	CP2-07-SB10 CP2-07-SB11 CP2-07-SB13	CP2-07-SP03 CP2-07-SP05 CP2-07-SP06 CP2-07-SP07
WASTE LINES FROM BUILDING 15007 TO FORMER HOLDING BASIN Industrial waste line from Building 15007 to former holding basin.	59F	59F-SB11 59F-SB12 59F-SB23	

Table 6.1-2 *Cross-Reference Between Soil and Soil Vapor Sampling Locations and Investigated Features*
Chemical Plant 2 Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

CHEMICAL PLANT 2 SOUTH			
DRAINAGE AREA AT EAST END OF RAIL LINES	CP2-07	CP2-07-SB23	CP2-RE05-SP05
DRY WELL AND SEPTIC TANKS – BUILDING 15001 Chemical disposal dry well and former laboratory septic tanks.	60F	60F-SB03 60F-SB04 60F-SB05	
FORMER HAZARDOUS WASTE STORAGE PAD Includes stained areas on storage pad and former hazardous waste storage pad	CP2	CP2-RE05-SB01 CP2-RE05-SB02 CP2-RE05-SB03	CP2-RE05-SP01 CP2-RE05-SP02 CP2-RE05-SP03 CP2-RE05-SP05 CP2-RE05-SP06 CP2-RE05-SP07 CP2-RE05-SP08 CP2-RE05-SP09 CP2-RE05-SP10 OS2-F1-SP01
FORMER STOUFFER CHEMICAL PLANT STORAGE TANKS Former location of storage tanks associated with former Stouffer Chemical Plant.	CP2	CP2-RE05-SB04	CP2-RE05-SP04
FORMER STOUFFER CHEMICAL PLANT Former location of Stouffer Chemical Plant	CP2	CP2-RE05-SB05	
HAZARDOUS WASTE STORAGE PAD STORMWATER DRAWDOWN VALVE Former hazardous material storage pad storm water drawdown valve.	CP2	CP2-RE01-SB01	
LOW-LYING AREA Low-lying area receiving storm water runoff from pump house area and water storage tank flushing	61F	61F-SNS02	
POTENTIAL DISCHARGE LINE Potential area of discharge from Former Stouffer Chemical Plant.	CP2-07	CP2-07-SB14	CP2-07-SP08
SEPTIC TANK CP2-ST01 AND CP2-ST01-3 – BUILDING 15001 Former laboratory septic tanks and leach lines.	60F	60F-SB02	60F-SP08
SURFACE WATER RUNOFF AREA Surface water runoff area from former laboratory and hazardous material storage pad area.	61F	61F-SNS01 61F-SB04 61F-SB05	61F-SP04

Table 6.1-2 ***Cross-Reference Between Soil and Soil Vapor Sampling Locations and Investigated Features Chemical Plant 2 Area Boundary Operable Unit Remedial Investigation Aerojet Superfund Site Sacramento County, California***

SURFACE WATER RUNOFF AREA Surface water runoff area from laboratory – Building 15001.	60F	60F-SNS01	
SUMP (SOURCE AREA 61F) Hazardous material storage pad sump.	61F	61F-SB03	61F-SP03 61F-SP05 61F-SP06

Table 6.1-3
Summary of Soil Sampling and Sampling Statistics for Source Areas 59F, 62F and F(c)
Chemical Plant 2 Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

				Source Area 59F						Source Area 62F						Source Area F(c)					
Compound(s)	**Analyte**	**Method**	**Depth (feet bgs)**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**
Metals	Metals	6010B	0-2.5	28	37	3	37	8.1%	100.0%	8	9	1	9	11.1%	100.0%	6	6	0	6	0.0%	100.0%
		6020	0-2.5	23	32	3	32	9.4%	100.0%	8	9	1	9	11.1%	100.0%	6	6	0	5	0.0%	0.0%
		6010B	>2.5	15	39	4	39	10.3%	100.0%	7	21	1	21	4.8%	100.0%	3	10	1	10	10.0%	100.0%
		6020	>2.5	15	39	4	38	10.3%	97.4%	6	19	1	19	5.3%	100.0%	3	10	1	8	0.0%	0.0%
	Chromium VI	7199	0-2.5	1	1	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		7199	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	Mercury	7471A	0-2.5	24	29	3	31	10.3%	106.9%	8	9	1	9	11.1%	100.0%	6	6	0	5	0.0%	83.3%
		7471A	>2.5	15	39	4	31	10.3%	79.5%	7	21	1	20	4.8%	95.2%	3	10	1	9	0.0%	0.0%
SVOCs	SVOCs	8270C	0-2.5	24	29	3	25	10.3%	86.2%	6	8	0	6	0.0%	75.0%	6	6	0	5	0.0%	83.3%
		8270C	>2.5	14	34	4	26	11.8%	76.5%	5	16	1	3	6.3%	18.8%	2	8	1	1	0.0%	0.0%
PCBs	PCBs	8082	0-2.5	7	9	0	7	0.0%	77.8%	0	0	0	0	0.0%	0.0%	6	6	0	4	0.0%	66.7%
		8082	>2.5	2	2	0	1	0.0%	50.0%	0	0	0	0	0.0%	0.0%	2	8	1	1	0.0%	0.0%
Perchlorate	Perchlorate	314.0, 314.0M	0-2.5	19	24	3	1	12.5%	4.2%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		314.0, 314.0M	>2.5	13	32	4	3	12.5%	9.4%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
TPH	Diesel	8015B-SVOA - Diesel	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	6	6	0	6	0.0%	0.0%
		8015B-SVOA - Diesel	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	2	7	1	7	0.0%	0.0%
	Motor Oil	8015B-SVOA - Oil	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	6	6	0	6	0.0%	0.0%
		8015B-SVOA - Oil	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	2	7	1	6	0.0%	0.0%
Misc.	Total Cyanide	9014	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		9014	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	Pesticides	8081A/8141A	0-2.5	24	29	3	32	10.3%	110.3%	8	9	1	6	11.1%	66.7%	0	0	0	0	0.0%	0.0%
		8081A/8141A	>2.5	14	35	4	12	11.4%	34.3%	3	9	1	2	11.1%	22.2%	0	0	0	0	0.0%	0.0%
	NDMA	1625C-CI M	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		1625C-CI M	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	pH	9045C	0-2.5	19	24	3	24	12.5%	100.0%	1	2	0	2	0.0%	100.0%	0	0	0	0	0.0%	0.0%
		9045C	>2.5	15	39	4	39	10.3%	100.0%	1	1	0	1	0.0%	100.0%	0	0	0	0	0.0%	0.0%
	TOC	9060A MOD	0-2.5	8	10	0	4	0.0%	40.0%	2	3	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		9060A MOD	>2.5	3	7	1	0	14.3%	0.0%	2	4	1	1	25.0%	25.0%	0	0	0	0	0.0%	0.0%
	CEC	9081	0-2.5	3	5	0	5	0.0%	100.0%	2	3	0	3	0.0%	100.0%	0	0	0	0	0.0%	0.0%
		9081	>2.5	3	7	1	7	14.3%	100.0%	2	4	1	4	25.0%	100.0%	0	0	0	0	0.0%	0.0%

Notes and Key:

> = Greater than
% = Percent
bgs = Below ground surface
CEC = Cation Exchange Capacity
Chromium VI = Hexavalent Chromium
NDMA = N-Nitrosodimethylamine
PCBs = Polychlorinated biphenyls
SVOCs = Semivolatile organic compounds
TOC = Total organic content
TPH = Total petroleum hydrocarbons

Table 6.1-4
Summary of Soil Sampling and Sampling Statistics for Source Areas CP2-07 and CP2-08
Chemical Plant 2 Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

				Source Area CP2-07						Source Area CP2-08					
Compound(s)	**Analyte**	**Method**	**Depth (feet bgs)**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**
Metals	Metals	6010B	0-2.5	17	17	0	17	0.0%	100.0%	11	15	3	15	20.0%	100.0%
		6020	0-2.5	17	17	0	15	0.0%	88.2%	11	15	3	14	20.0%	93.3%
		6010B	>2.5	16	43	4	43	9.3%	100.0%	7	20	0	20	0.0%	100.0%
		6020	>2.5	16	43	4	36	9.3%	83.7%	7	18	0	14	0.0%	77.8%
	Chromium VI	7199	0-2.5	1	1	0	1	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		7199	>2.5	1	1	0	1	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	Mercury	7471A	0-2.5	17	17	0	13	0.0%	76.5%	11	15	3	14	20.0%	93.3%
		7471A	>2.5	14	40	4	27	10.0%	67.5%	6	17	0	13	0.0%	76.5%
SVOCs	SVOCs	8270C	0-2.5	12	12	0	9	0.0%	75.0%	11	15	3	7	20.0%	46.7%
		8270C	>2.5	8	25	3	7	12.0%	28.0%	4	14	0	4	0.0%	28.6%
PCBs	PCBs	8082	0-2.5	0	0	0	0	0.0%	0.0%	9	13	2	8	15.4%	61.5%
		8082	>2.5	0	0	0	0	0.0%	0.0%	5	14	0	1	0.0%	7.1%
Perchlorate	Perchlorate	314.0, 314.0M	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		314.0, 314.0M	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
TPH	Diesel	8015B-SVOA - Diesel	0-2.5	1	1	0	1	0.0%	100.0%	2	2	0	2	0.0%	100.0%
		8015B-SVOA - Diesel	>2.5	1	7	1	4	14.3%	57.1%	2	3	0	3	0.0%	100.0%
	Motor Oil	8015B-SVOA - Oil	0-2.5	1	1	0	0	0.0%	0.0%	2	2	0	2	0.0%	100.0%
		8015B-SVOA - Oil	>2.5	1	7	1	4	14.3%	57.1%	2	3	0	2	0.0%	66.7%
Misc.	Total Cyanide	9014	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		9014	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	Pesticides	8081A/8141A	0-2.5	22	22	0	7	0.0%	31.8%	8	12	2	8	16.7%	66.7%
		8081A/8141A	>2.5	14	37	5	5	13.5%	13.5%	2	8	0	2	0.0%	25.0%
	NDMA	1625C-CI M	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		1625C-CI M	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	pH	9045C	0-2.5	11	11	0	11	0.0%	100.0%	2	2	1	2	50.0%	100.0%
		9045C	>2.5	11	35	3	35	8.6%	100.0%	2	4	0	4	0.0%	100.0%
	TOC	9060A MOD	0-2.5	1	1	0	0	0.0%	0.0%	1	1	0	0	0.0%	0.0%
		9060A MOD	>2.5	1	5	1	0	20.0%	0.0%	1	6	0	0	0.0%	0.0%
	CEC	9081	0-2.5	1	1	0	1	0.0%	100.0%	1	1	0	1	0.0%	100.0%
		9081	>2.5	1	5	1	5	20.0%	100.0%	1	6	0	6	0.0%	100.0%

Notes and Key:

> = Greater than
% = Percent
bgs = Below ground surface
CEC = Cation Exchange Capacity
Chromium VI = Hexavalent chromium
NDMA = N-Nitrosodimethylamine
PCBs = Polychlorinated biphenyls
SVOCs = Semivolatile organic compounds
TOC = Total organic content
TPH = Total petroleum hydrocarbons

Table 6.1-5 Summary of Geotechnical Soil Parameters
Chemical Plant 2 Area
Aerojet Boundary Operable Unit
Aerojet Corporation
Sacramento County, California

			Geo Physical Parameters (ASTM D2937, D854)					Sieve Analysis (ASTM D422)				Permeability (ASTM D5084)	
Test No.	Date	Description of Test Location	Moisture Content (%)	Wet Density (pcf)	Dry Density (pcf)	Specific Gravity	Porosity	Cobbles (%)	Gravel (%)	Sand (%)	Silt / Clay (%)	Average Hydraulic Gradient	Perm (cm/sec)
39	11/23/2005	61F-SB03-1.0	11.1	146.6	132.0	2.720	0.2220		49.2	35.4	15.4	8.3	1.99E-07
40	11/23/05	61F-SB03-5	2.8						53.3	30.4	16.3		
41	11/23/05	61F-SB03-11	6.7						46.8	34.8	18.4		
42	11/23/05	61F-SB03-33	5.8						77.8	12.1	10.1		
43	11/23/05	61F-SB03-55	23.8	128.3	103.7	2.860	0.4190		3.3	47.5	49.2	8.0	2.18E-05
44	11/23/05	61F-SB03-77	9.7						39.2	40.7	20.1		
45	11/23/05	61F-SB03-99	8.8						17.4	49.7	32.9		
46	11/23/05	59F-SB15-1	3.9						39.4	42.8	17.8		
47	11/23/05	59F-SB15-5	9.5						18.3	54.9	26.8		
48	11/23/05	59F-SB15-11	12.3	138.6	123.5	2.580	0.2		2.0	43.4	54.6	6.3	7.70E-08
120	11/18/06	8001-SB-121	23.0	129.6	105.4	2.575	0.3440		2.5	86.8	10.7	3.2	1.65E-04
121	11/18/06	8001-SB-123	24.5	123.1	98.9	2.552	0.4		6.2	78.7	15.1	7.0	1.55E-07
122	11/18/06	8001-SB-128	35.4	96.9	71.6	2.459	0.5		22.4	22.5	55.1	4.0	1.08E-05
127	6/2/06	MW-3651-100	40.5	109.5	77.9	2.567	0.5		46.0	40.9	13.1	6.1	4.80E-04
151	11/18/05	62F-SB04-1							44.0	37.8	18.2		
152	11/18/05	62F-SB04-5							46.9	39.3	13.8		
153	11/18/05	62F-SB04-11							55.7	32.9	11.4		
154	11/18/05	62F-SB04-33	55.5	109.0	70.1	2.680	0.5802		6.4	58.1	35.5	6.1	2.54E-08
155	11/18/05	62F-SB04-55							26.1	36.8	37.1		
156	11/18/05	62F-SB04-77	5.4	133.9	127.0		0.2		3.9	45.7	50.4	3.3	1.70E-06
157	11/18/05	62F-SB04-99							7.0	78.3	14.7		
162	12/16/05	CP2-08-SB11-1	13.2	142.8	126.1	2.710	0.2540		6.8	35.2	58.0	8.0	1.87E-08
163	12/16/05	CP2-08-SB11-5	8.9	129.9	119.3	2.730	0.3000		27.2	31.5	41.3	5.7	1.28E-07
164	12/16/05	CP2-08-SB11-11	11.3	140.8	126.5	2.720	0.2550	2.4	49.0	31.1	17.5	8.3	1.64E-08
165	12/16/06	CP2-08-SB11-80	11.3	134.0	120.4	2.650	0.2720		2.0	71.0	27.0	4.2	5.04E-06
166	12/16/06	CP2-08-SB11-99	15.2	131.7	114.3	2.710	0.3240		20.2	57.9	21.9	10.1	2.35E-08
208	11/18/06	59F-SD01-0.25	28.7	104.9	81.5					1.0	99.0		
209	11/18/06	59F-SD01-1.5	33.8	115.7	86.5					0.1	99.9		
210	11/18/06	59F-SD01-5	39.7	111.6	79.9					0.2	99.8		
211	11/18/06	59F-SD02-0.25	27.1	122.9	96.7					0.5	99.5		
212	11/18/06	59F-SD02-1.5	27.4	127.2	99.8					1.0	99.0		
213	11/18/06	59F-SD02-5	31.7	127.7	96.9					0.5	99.5		
214	11/18/06	62F-SD01-0.25	4.1	161.2	154.8			3.8	46.7	25.0	24.5		
215	11/18/06	62F-SD01-1.5	6.1	144.9	136.6			5.3	50.9	27.5	16.3		
216	11/18/06	62F-SD01-5	5.7	142.1	134.4				50.6	25.7	23.7		

Table 6.1-5 Summary of Geotechnical Soil Parameters
Chemical Plant 2 Area
Aerojet Boundary Operable Unit
Aerojet Corporation
Sacramento County, California

			Geo Physical Parameters (ASTM D2937, D854)					Sieve Analysis (ASTM D422)				Permeability (ASTM D5084)	
Test No.	Date	Description of Test Location	Moisture Content (%)	Wet Density (pcf)	Dry Density (pcf)	Specific Gravity	Porosity	Cobbles (%)	Gravel (%)	Sand (%)	Silt / Clay (%)	Average Hydraulic Gradient	Perm (cm/sec)
217	11/18/06	25F-SD02-0.25	19.4	81.2	68.0						100.0		
218	11/18/06	25F-SD02-1.5	19.1	112.0	94.0					0.1	99.9		
219	11/18/06	25F-SD02-5	28.5	112.1	87.2					1.1	98.9		
258	11/23/05	25F-SB06-1	14.6						55.7	10.9	33.4		
259	11/23/05	25F-SB06-5	3.4						72.6	17.2	10.2		
260	11/23/05	25F-SB06-11	6.7						19.4	53.1	27.5		
261	11/23/05	25F-SB06-21	21.9	127.3	104.4	2.628	0.3630		37.8	29.6	32.6	2.3	7.29E-08
262	11/23/05	25F-SB06-31	9.7						24.8	37.0	38.2		
263	11/23/05	25F-SB06-41	14.2						12.2	39.5	48.3		
264	11/23/05	25F-SB06-51	18.9	138.0	116.0	2.508	0.2590		16.6	45.3	38.1	7.5	1.28E-08
265	11/23/05	25F-SB06-61	25.8						37.7	32.6	29.7		
Mean			**17.7**	**125.8**	**105.5**	**2.6**	**0.3**	**3.8**	**30.9**	**33.9**	**41.7**	**6.2**	**4.3E-05**
Median			**14.2**	**128.0**	**104.1**	**2.7**	**0.3**	**3.8**	**27.2**	**35.2**	**31.2**	**6.2**	**1.4E-07**
Geomean			**13.7**	**124.6**	**103.0**	**2.6**	**0.3**	**3.6**	**20.9**	**16.6**	**32.0**	**5.7**	**4.8E-07**

Key:
% = Percent
cm/sec = Centimeters per second
pcf = Pounds per cubic foot

Table 6.1-6
Summary of Soil Vapor Sampling Activities and Deviations from Field Sampling Plan
Chemical Plant 2 Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Rationale and Comments	Number of Samples Collected	Sampling Activity	Sample ID	Sample Depths (ft bgs)	Deviations from Field Sampling Plan
59F	Former holding basin industrial waste transfer lines.	3	10, 20	Sampling locations are within the area of highest VOC concentration detected during previous investigation and were used to determine vertical extent of release.	6	Soil Vapor	59F-SP33	10, 20	
							59F-SP34	10, 15	
							59F-SP36	10, 20	
59F	Former French drain northwest of holding basin.	1	10, 20	Sampling location is within the area of highest VOC concentration detected during previous investigation and was used to determine vertical and lateral extent of release.	2	Soil Vapor	59F-SP35	10, 20	
					1	Grab Groundwater	59F-SP35-GW	***40***	
59F	West branch of drainage ditch receiving discharge from SPCC Sump.	1	10, ***20***	Determine vertical and lateral extent of release from the SPCC Sump.	1	Soil Vapor	59F-SP37	10	Not sampled at 20 ft bgs due to no sonic access.
59F	Approximately 240 ft northwest of Holding Basin.	***0***	None	Additional samples collected because chemical concentrations exceeded screening-level criteria.	3	Soil Vapor	59F-SP38	10, 20, 40	
59F	Former test incinerator and injection well No.2 head works.	***0***	None	Additional samples collected because chemical concentrations exceeded screening-level criteria.	1	Soil Vapor	59F-SP39	20	
					1	Grab Groundwater	59F-SP39-GW	10	
59F	Plasticizer spill in rail road ballast west of Chemical Plant fence line.	1	10, 20	Determine if spill in rail road ballast impacted the vadose zone.	2	Soil Vapor	OS1-F1-SP01	10, 20	
60F	Laboratory septic tanks and leach lines.	1	10, 20	Determine if the source is still present within the vadose zone.	2	Soil Vapor	60F-SP08	10, 20	
60F	Hazardous material storage area and staining around nearby drum storage area, Building 15005.	2	10, 20	Determine if source is present within the vadose zone.	6	Soil Vapor	CP2-RE05-SP01	10, 20, ***40***	
							CP2-RE05-SP02	10, 20, ***40***	
60F	Former Stouffer Chemical Plant storage tanks.	1	10, 20	Determine if release from the former storage tanks to the vadose zone occurred.	2	Soil Vapor	CP2-RE05-SP03	10, 20	
60F	Former Stouffer Chemical Plant.	1	10, 20	Determine if release from the former Stouffer Chemical Plant to the vadose zone occurred.	2	Soil Vapor	CP2-RE05-SP04	10, 20	

Table 6.1-6
Summary of Soil Vapor Sampling Activities and Deviations from Field Sampling Plan
Chemical Plant 2 Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Rationale and Comments	Number of Samples Collected	Sampling Activity	Sample ID	Sample Depths (ft bgs)	Deviations from Field Sampling Plan
60F	Northeast of aboveground tanks.	***0***	None	Additional samples collected because chemical concentrations exceeded screening-level criteria.	6	Soil Vapor	CP2-RE05-SP05	10, 20, 40	
							CP2-RE05-SP06	10, 20, 40	
60F	Southeast of aboveground tanks.	***0***	None	Additional samples collected because chemical concentrations exceeded screening-level criteria.	5	Soil Vapor	CP2-RE05-SP07	10, 20	
							CP2-RE05-SP08	10, 20, 40	
					1	Grab Groundwater	CP2-RE05-SP07-GW	40	
60F	North of Building 15004.	***0***	None	Additional samples collected because chemical concentrations exceeded screening-level criteria.	2	Soil Vapor	CP2-RE05-SP09	10, 20	
					1	Grab Groundwater	CP2-RE05-SP09-GW	31	
60F	Approximately 500 ft southeast of Building 15016.	***0***	None	Additional samples collected because chemical concentrations exceeded screening-level criteria.	2	Soil Vapor	CP2-RE05-SP10	10, 20	
61F	Sump receiving runoff from generation and accumulation point, north of Building 15001.	1	10, 20	Determine if the source is still present within the vadose zone as prior results indicated high chloroform concentration in shallow soil.	2	Soil Vapor	61F-SP03	10, 20	
61F	South of Building 15017.	***0***	None	Additional samples collected because chemical concentrations exceeded screening-level criteria.	4	Soil Vapor	61F-SP04	10, 20	
							61F-SP06	10, 20	
61F	Approximately 100 ft south of Building 15011.	***0***	None	Additional samples collected because chemical concentrations exceeded screening-level criteria.	2	Soil Vapor	61F-SP05	10, 20	
62F	Former paraldehyde tank.	3	20, 40	Location requested by regulatory agencies to determine if source is present within the vadose zone.	3	Soil Vapor	62F-SP01	20	
							62F-SP02	20	
							62F-SP03	20	
					3	Grab Groundwater	62F-SP01-GW	40	
							62F-SP02-GW	40	
							62F-SP03-GW	40	

Table 6.1-6
Summary of Soil Vapor Sampling Activities and Deviations from Field Sampling Plan
Chemical Plant 2 Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Rationale and Comments	Number of Samples Collected	Sampling Activity	Sample ID	Sample Depths (ft bgs)	Deviations from Field Sampling Plan
62F	Former nitroethane tank and railcar transfer station.	3	10, 20	Determine if a source associated with the former tank and rail transfer station is present within the vadose zone.	4	Soil Vapor	62F-SP05	10, 20	
							62F-SP06	10, 20	
			20, 40	Determine if a source associated with the former tank and rail transfer station is present within the vadose zone.	1	Soil Vapor	62F-SP04	10	Shallow sample taken instead of intermediate.
					1	Grab Groundwater	62F-SP04-GW	40	
62F	Former test incinerator and injection well No.2 head works.	***0***	None	Additional samples collected because chemical concentrations exceeded screening-level criteria.	2	Soil Vapor	62F-SP07	10, 20	
F(c)	Former aboveground storage tank.	1	20, ***40, 60***	Location requested by regulatory agencies to determine if source is present within the vadose zone.	1	Soil Vapor	F(c)-SP05	20	Not sampled at 40 and 60 ft bgs due to groundwater.
					2	Grab Groundwater	F(c)-SP05-GW	40, 60	
F(c)	Former boiler blow-down sump.	1	10, 20	Determine if a source is present within vadose zone.	2	Soil Vapor	F(c)-SP06	10, 20	
CP2-07	Chemical Plant Building 15007.	3	10, 20	Determine if source is present within the vadose zone.	7	Soil Vapor	CP2-07-SP01	10, 20, ***40***	
							CP2-07-SP02	10, 20	
							CP2-07-SP03	10, 20	
					1	Grab Groundwater	CP2-07-SP03-GW	38	
CP2-07	Hazardous and explosive materials storage, Building 15016.	1	10, 20	Determine if source is present within the vadose zone.	2	Soil Vapor	CP2-07-SP04	10, 20	
CP2-07	Trench system draining interior of Building 15007.	2	10, 20	Determine if release from the trench system in the interior of Building 15007 occurred.	4	Soil Vapor	CP2-07-SP05	10, 20	
							CP2-07-SP06	10, 20	
CP2-07	Reaction area in the southeast corner of Building 15007.	1	10, 20	Determine if spills to the floor of the chemical reaction area has impacted the vadose zone.	2	Soil Vapor	CP2-07-SP07	10, 20	
CP2-07	Southeast of aboveground tanks.	***0***	None	Additional samples collected because chemical concentrations exceeded screening-level criteria.	3	Soil Vapor	CP2-07-SP08	10, 20, 30	
					1	Grab Groundwater	CP2-07-SP08-GW	40	

Table 6.1-6
Summary of Soil Vapor Sampling Activities and Deviations from Field Sampling Plan
Chemical Plant 2 Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Rationale and Comments	Number of Samples Collected	Sampling Activity	Sample ID	Sample Depths (ft bgs)	Deviations from Field Sampling Plan
CP2-07	Close to cooling towers.	***0***	None	Additional samples collected because chemical concentrations exceeded screening-level criteria.	3	Soil Vapor	CP2-07-SP12	10, 20, 40	
CP2-07	In the vicinity of hazardous and explosive materials, Building 15016.	***0***	None	Additional samples collected because chemical concentrations exceeded screening-level criteria.	12	Soil Vapor	CP2-07-SP09	10, 20, 34	
							CP2-07-SP10	10, 20, 40	
							CP2-07-SP11	10, 20	
							CP2-07-SP13	10, 20	
							CP2-07-SP14	10, 18.5	
					1	Grab Groundwater	CP2-07-SP14-GW	40	
					2	Soil Vapor	CP2-07-SP15	10, 20	
CP2-07	Former Stouffer Chemical Plant potential discharge area.	1	10, 20	Determine if release from the former Stouffer Chemical Plant has impacted the vadose zone.	3	Soil Vapor	CP2-07-SP08	10, 20, 30	
CP2-08	Hazardous material storage area.	2	10, 20	Sampling locations are within the area of highest VOC concentration detected during previous investigation and were used to determine vertical and lateral extent of release.	4	Soil Vapor	CP2-08-SP11	10, 20	
							CP2-08-SP12	10, 20	
CP2-08	Former test incinerator and injection well No.2 head works.	2	10, 20	Determine if release from test incinerator and injection well No.2 head works impacted vadose zone.	4	Soil Vapor	CP2-08-SP13	10, 20	
							CP2-08-SP14	10, 20	

Notes and Key:
Bold, italicized and underlined data does not agree with the analytical results. See "Deviations from Field Sampling Plan" column for more information on discrepancies.

CP2 = Chemical Plant 2
ft = Feet
bgs = Below ground surface
ID = Identification

Proposed analyses = VOC analysis
Performed analyses = VOC analysis
SPCC = Spill prevention control and countermeasures
VOC = Volatile organic compound

Table 6.1-7
Summary of Soil Sampling Activities and Deviations from Field Sampling Plan
Chemical Plant 2 Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Proposed Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
59F	Industrial waste line from Building 15007 to former holding basin.	Subsurface Soil	3	0, 5, 10, 15	SVOCs, ClO4, pesticides, Prowl, OBPA, metals, pH	Location requested by regulatory agencies.	12	59F-SB23*	1, 5, 11, 15	SVOCs, ClO4, pesticides, Prowl, OBPA, metals, pH	
								59F-SB11	1, 5, 11, 15	SVOCs, ClO4, pesticides, Prowl, OBPA, metals, pH	
								59F-SB12	1, 5, 11, 15	SVOCs, ClO4, pesticides, Prowl, OBPA, metals, pH	
59F	Former holding basin and French drain.	Subsurface Soil	1	0, 4, 10	SVOCs, ClO4, pesticides, Prowl, OBPA, metals, pH	Determine whether releases from the holding basin and French drain occurred.	3	59F-SB13	1, 5, 11	SVOCs, ClO4, pesticides, Prowl, OBPA, metals, pH	
59F	Low-lying area below holding basin	Subsurface Soil	1	0, 5, 10, 15, 20	SVOCs, ClO4, pesticides, Prowl, OBPA, metals, pH	Location requested by regulatory agencies.	5	59F-SB14	1, 5.5, 10.5, 15.5, 20.5	SVOCs, ClO4, pesticides, Prowl, OBPA, metals, pH	
59F	Former holding basin.	Subsurface Soil	1	0, 4, 10, 32, 50, 70, ***90***	SVOCs, ClO4, pesticides, Prowl, OBPA, metals, pH, ***DI-WET***, physical properties	Determine if release from the holding basin occurred.	6	59F-SB15	1, 5, 11, 31, 55, 77	SVOCs, pesticides, Prowl, OBPA, ClO4, metals, pH, physical properties	Not analyzed for DI-WET. Not sampled at 90 ft bgs due to groundwater at 98 ft bgs.
				0, 4, 10	SVOCs, pesticides, Prowl, OBPA, ClO4, metals, pH		3	59F-SB16	1, 5, 11	SVOCs, pesticides, Prowl, OBPA, ClO4, metals, pH	
59F	Former waste tank location and former waste sump location.	Subsurface Soil	2	0, 4, 10	SVOCs, pesticides, Prowl, OBPA, ClO4, metals, pH	Determine if releases from the former waste tank and former waste sump locations occurred.	6	59F-SB17	1, 5, 11	SVOCs, pesticides, Prowl, OBPA, ClO4, metals, pH	
								59F-SB18	1, 5, 11	SVOCs, pesticides, Prowl, OBPA, ClO4, metals, pH	
59F	Former SPCC sump.	Subsurface Soil	1	0, 4, 10	SVOCs, pesticides, Prowl, OBPA, ClO4, metals, pH	Determine if release from the SPCC sump occurred.	3	59F-SB19	1, 5, 11	SVOCs, pesticides, Prowl, OBPA, ClO4, metals, pH	
59F	Runoff from former SPCC sump to low-lying area.	Subsurface Soil	3	0, 5, 10, 15	SVOCs, pesticides, Prowl, OBPA, ClO4, metals, pH	Location requested by regulatory agencies.	12	59F-SB20	1, 5.5, 10.5, 15.5	SVOCs, pesticides, Prowl, OBPA, ClO4, metals, pH	
								59F-SB21	1, 5.5, 10.5, 15.5	SVOCs, pesticides, Prowl, OBPA, ClO4, metals, pH	
								59F-SB22	1, 5.5, 10.5, 15.5	SVOCs, pesticides, Prowl, OBPA, ClO4, metals, pH	
59F	In the vicinity of the former holding basin.	Surface/Near Surface Soil	***0***	None	None	Additional samples collected because chemical concentrations exceeded screening-level criteria.	4	59F-SB25	1	SVOCs, TOC, pesticides, Prowl, PCBs, metals	
								59F-SB26	1	SVOCs, TOC, pesticides, Prowl, PCBs, metals	
								59F-SB27	1	SVOCs, TOC, pesticides, Prowl, PCBs, metals	
								59F-SB28	1	SVOCs, TOC, pesticides, Prowl, PCBs, metals (including CrVI)	

Source Area	Associated Site Feature	Proposed Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
59F	Western branch of drainage ditch receiving storm water runoff from lower portion of CP2 area.	Surface/Near Surface Soil	1	0, 2	SVOCs, pesticides, Prowl, OBPA, ClO4, metals, pH	Location requested by regulatory agencies.	2	59F-SNS01	0.5, 2.5	SVOCs, pesticides, Prowl, OBPA, ClO4, metals, pH	
59F	Low-lying area below former holding basin area and sediment delta receiving storm water runoff from holding basin area.	Subsurface Soil	3	0, 2	SVOCs, pesticides, Prowl, OBPA, ClO4, metals, pH	Location requested by regulatory agencies.	5	59F-SNS02	0.5, 2.5	SVOCs, pesticides, Prowl, OBPA, ClO4, metals, pH	
								59F-SNS03	0.5, 2.5	SVOCs, pesticides, Prowl, OBPA, ClO4, metals, pH	
								59F-SNS04	0.5	SVOCs, pesticides, Prowl, OBPA, ClO4, metals, pH	
59F	Drainage area below former holding basin area.	Surface/Near Surface Soil	***1***	0	SVOCs, pesticides, Prowl, OBPA, ClO4, metals, pH	Location requested by regulatory agencies.	0	59F-SNS05	None	None	Not sampled.
59F	Runoff from former French drain around the former holding basin, the existing chemical plant (Building 15007), the existing hazardous material storage area (CP2-08), and blowdown sump (F(c)).	Sediment	2	0	SVOCs, pesticides, Prowl, OBPA, PCBs, metals, ClO4, CEC, TOC, GS, MC, BD, pH, DI-WET	Determine if chemicals are present in the low lying area north of Source Area 59F where sediment and water accumulate.	15	59F-SD01	0.25, 1.5, 5	SVOCs, pesticides, Prowl, OBPA, PCBs, ClO4, metals, pH, CEC, TOC, MC, GS, WD, DD, DI-WET	Not analyzed for GS. DI-WET analyzed only at 1.5 ft bgs.
								59F-SD02	0.25, 1.5, 5	SVOCs, pesticides, Prowl, OBPA, PCBs, ClO4, metals, pH, CEC, TOC, MC, GS, WD, DD, DI-WET	Not analyzed for GS. DI-WET analyzed only at 1.5 ft bgs.
			0	None	None	Additional samples collected because chemical concentrations exceeded screening-level criteria.		59F-SD03	0.25, 1.5	Metals	
								59F-SD04	0.25, 1.5	Metals	
								59F-SD05	0.25, 1.5	Metals	
								59F-SD07	0.25	SVOCs, PCBs, pesticides, TOC, metals	
								59F-SD06	0.25, 1.5	Metals	
59F	Ditch and pond receiving discharge from SPCC sump and Source Area 59F.	Surface/Near Surface Soil	***0***	None	None	Additional samples collected because chemical concentrations exceeded screening-level criteria.	3	OS1-F2-SB02	1	Prowl, PCBs, pesticides, TOC	
								OS1-F2-SB03	1	Prowl, PCBs, pesticides, TOC	
								OS1-F2-SB04	1	Prowl, PCBs, pesticides, TOC	
59F	Ditch and pond receiving discharge from SPCC sump and Source Area 59F.	Surface/Near Surface Soil	4	0, 2	SVOCs, pesticides, Prowl, OBPA, metals	Determine if release from the pond to soil occurred.	8	OS1-F2-SNS01	0.25, 2.5	SVOCs, pesticides, Prowl, OBPA, metals	
								OS1-F2-SNS02	0.25, 2.5	SVOCs, pesticides, Prowl, OBPA, metals	
								OS1-F2-SNS03	0.25, 2.5	SVOCs, pesticides, Prowl, OBPA, metals	
								OS1-F2-SNS04	0.25, 2.5	SVOCs, pesticides, Prowl, OBPA, metals	

Source Area	Associated Site Feature	Proposed Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
59F	Approximately 450 ft north of holding basin.	Surface/Near Surface Soil	***0***	None	None	Additional samples collected because chemical concentrations exceeded screening-level criteria.	1	OS1-F3-SD01	0.25	SVOCs, pesticides, Prowl, TOC, PCBs, metals (including CrVI)	
60F	Former laboratory septic tanks and leach lines.	Subsurface Soil	1	0, 4, 10, 32, 50, 70, 90, ***110***	SVOCs, pesticides, Prowl, OBPA, metals, pH, DI-WET	Determine if releases from the laboratory septic tank and leach lines occurred.	7	60F-SB02	1, 5, 11, 33, 55, 77, 99	SVOCs, pesticides, Prowl, OBPA, metals, pH	Not analyzed for DI-WET.
		Grab Groundwater	1	First water	SVOCs, pesticides, Prowl, OBPA, total and dissolved metals		1	60F-SB02-GW	130	SVOCs, pesticides, Prowl, total and dissolved metals	
60F	Chemical disposal dry well and former laboratory septic tanks.	Subsurface Soil	3	0, 4, 10	SVOCs, pesticides, Prowl, OBPA, metals, pH	Determine if releases from the chemical disposal dry well and laboratory septic tanks occurred.	9	60F-SB03	1, 5, 11	SVOCs, pesticides, Prowl, OBPA, metals, pH	
								60F-SB04	1, 5, 11	SVOCs, pesticides, Prowl, OBPA, metals, pH	
								60F-SB05	1, 5, 11	SVOCs, pesticides, Prowl, OBPA, metals, pH	
60F	Storm water runoff from laboratory.	Surface/Near Surface Soil	1	0	SVOCs, pesticides, Prowl, OBPA, metals, pH	Location requested by regulatory agencies.	1	60F-SNS01	0.5	SVOCs, pesticides, Prowl, OBPA, metals, pH	
60F	Storage pad stained area and former hazardous waste storage pad.	Subsurface Soil	3	0, 4, 10	SVOCs, pesticides, Prowl, OBPA, metals, pH	Determine if releases from the storage pad stained area and hazardous waste storage pad occurred.	9	CP2-RE05-SB01	1, 5, 11	SVOCs, pesticides, Prowl, OBPA, metals, pH	
								CP2-RE05-SB02	1, 5, 11	SVOCs, pesticides, Prowl, OBPA, metals, pH	
								CP2-RE05-SB03	1, 5, 11	SVOCs, pesticides, Prowl, OBPA, metals, pH	
60F	Former Stouffer Chemical Plant storage tanks.	Subsurface Soil	1	0, 4, 10	SVOCs, pesticides, Prowl, OBPA, metals, pH, TPH	Determine if release from the former storage tanks south of the former Stouffer Chemical Plant occurred.	3	CP2-RE05-SB04	1, 5, 11	SVOCs, pesticides, Prowl, OBPA, TPH, metals, pH	
60F	Former Stouffer Chemical Plant.	Subsurface Soil	1	0, 4, 10	SVOCs, TPH, pesticides, Prowl, OBPA, metals, pH	Determine if release from the former west end of the former Stouffer Chemical Plant occurred.	3	CP2-RE05-SB05	1, 5, 11	SVOCs, pesticides, Prowl, OBPA, TPH, metals, pH	
60F	Former hazardous material storage pad storm water drawdown valve.	Subsurface Soil	1	0, 4, 10	SVOCs, pesticides, Prowl, OBPA, PCBs, metals	Determine if release from the hazardous material storage pad storm water drawdown valve occurred.	3	CP2-RE01-SB01	1, 5, 11	SVOCs, pesticides, Prowl, OBPA, PCBs, metals	
61F	Hazardous material storage pad sump.	Subsurface Soil	1	0, 4, 10, 32, 50, 70, 90, ***110***	SVOCs, pesticides, Prowl, OBPA, metals, DI-WET, physical properties	Determine if release from the hazardous material storage pad sump had occurred.	7	61F-SB03	1, 5, 11, 31, 55, 77, 99	SVOCs, pesticides, Prowl, OBPA, metals, pH, physical properties	Not analyzed for DI-WET.
		Grab Groundwater	1	First water	SVOCs, total and dissolved metals, pesticides, Prowl, OBPA, PCBs		1	61F-SB03-GW	120	SVOCs, pesticides, Prowl, PCBs, total and dissolved metals	Not analyzed for OBPA.
61F	South of Building 15001.	Surface/Near Surface Soil	***0***	None	None	Additional samples collected because chemical concentrations exceeded screening-level criteria.	2	61F-SB04	1	SVOCs, TOC, pesticides, metals	
								61F-SB05	1	SVOCs, TOC, pesticides, metals	

Source Area	Associated Site Feature	Proposed Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
61F	Storm water runoff from former laboratory and hazardous material, storage pad area.	Surface/Near Surface Soil	1	0	SVOCs, pesticides, Prowl, OBPA, metals, pH	Determine if release from the hazardous material storage pad areas occurred.	1	61F-SNS01	0.5	SVOCs, pesticides, Prowl, OBPA, metals, pH	
61F	Low-lying area receiving storm water runoff from pump house area and water storage tank flushing.	Surface/Near Surface Soil	1	0	SVOCs, pesticides, Prowl, OBPA, metals, pH	Determine if release to the low-lying area receiving storm water runoff from the pump house area and water storage tank flushing occurred.	1	61F-SNS02	0.5	SVOCs, pesticides, Prowl, OBPA, metals, pH	
62F	Product pumping station to former nitroethane tank area.	Subsurface Soil	1	0, 4, 10, 32, 50, 70, 90, ***110***	SVOCs, pesticides, Prowl, OBPA, DI-WET, physical properties	Determine if release from the product pumping station to the former nitroethane tank area occurred.	7	62F-SB04	1, 5, 11, 33, 55, 77, 99	SVOCs, pesticides, Prowl, OBPA, metals, physical properties	Not analyzed for DI-WET. MC, SG, PD, and perm analyzed only at 33 and 77 ft bgs.
62F	Transfer station from rail line to former nitroethane tank.	Subsurface Soil	1	0, 4, 10	SVOCs, pesticides, Prowl, OBPA, metals	Determine if release from the transfer station from the rail line to the former nitroethane tank occurred.	3	62F-SB05	1, 5, 11	SVOCs, pesticides, Prowl, OBPA, metals	
62F	Former chemical storage building.	Subsurface Soil	1	0, 4, 10	SVOCs, metals	Determine if release from the chemical storage building has occurred.	3	62F-SB06	2, 6, 11.5	SVOCs, pesticides, metals	
62F	Former paraldehyde tank.	Subsurface Soil	1	***0***, 5, 10, 20, 30, 40	***VOCs***, SVOCs, metals	Location requested by regulatory agencies.	5	62F-SB07	5, 10, 20, 30, 40	SVOCs, metals	Surface sample not collected due to no recovery.
62F	Spills in rail road ballast across from paraldehyde and nitroethane tanks.	Subsurface Soil	3	0, 4, 10	Prowl, OBPA, pesticides, metals	Determine if spills in the rail road ballast has impacted shallow soil.	9	62F-SB08	1, 5, 11	Prowl, OBPA, pesticides, metals	
								62F-SB09	1, 5, 11	Prowl, OBPA, pesticides, metals	
								62F-SB10	1, 5, 11	Prowl, OBPA, pesticides, metals	
62F	Low-lying area receiving storm water runoff from former nitroethane tank and railcar transfer station.	Surface/Near Surface Soil	1	0, 2	SVOCs, pesticides, Prowl, OBPA, metals	Determine if release to the low-lying area receiving storm water runoff from the former nitroethane tank and railcar transfer station occurred.	2	62F-SNS01	0.5, 2.5	SVOCs, pesticides, Prowl, OBPA, metals	
62F	Drainage ditch from Building 15004	Surface/Near Surface Soil	1	0	SVOCs, metals, ***pH***	Determine if release to the drainage ditch from Building 15004 occurred.	1	62F-SNS02	0.5	SVOCs, ***pesticides, Prowl***, metals	Not analyzed for pH. Pesticides and Prowl were additional analyses.
62F	Runoff from the area around the former paraldehyde tank, former nitroethane tank, and railcar transfer station.	Sediment	1	0	SVOCs, pH, CEC, TOC, GS, MC, BD	Determine if chemicals were released to the low lying area west of Source Area 62F where sediment and water accumulate.	3	62F-SD01	0.25, 1.5, 5	SVOCs, pH, CEC, TOC, MC, GS, DD, WD	
F(c)	Former PCB transformer.	Subsurface Soil	1	0, 4, 10	SVOCs, TPH, PCBs, metals	Determine if release from the former PCB transformer occurred.	3	F(c)-SB02	1, 5, 11	SVOCs, PCBs, TPH, metals	
F(c)	Former UST.	Subsurface Soil	1	0, 4, 10, 32, 50, 70, 90, ***110***	SVOCs, TPH, PCBs, metals, ***DI-WET***	Location requested by regulatory agencies due to its proximity to area of highest chemical concentration.	7	F(c)-SB03	1, 5, 11, 33, 55, 77, 99	SVOCs, OBPA, PCBs, TPH, metals	Not analyzed for VOCs and DI-WET. Not sampled at 110 ft bgs. OBPA not analyzed at 99 ft bgs.

Source Area	Associated Site Feature	Proposed Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
F(c)	Sump receiving boiler blow-down, refrigeration compressor seal water, and wash water.	Subsurface Soil	1	0, 4, 10	SVOCs, TPH, PCBs, metals	Determine if releases from the sump receiving boiler blow-down water, refrigeration compressor seal water, and maintenance shop wash water occurred.	3	F(c)-SB04	1, 5, 11	SVOCs, PCBs, TPH, metals	
F(c)	Ditch receiving runoff from Building 15008.	Surface/Near Surface Soil	3	0	SVOCs, TPH, PCBs, metals	Location requested by regulatory agencies.	3	F(c)-SNS01	0.5	SVOCs, PCBs, TPH, metals	
								F(c)-SNS02	0.5	SVOCs, PCBs, TPH, metals	
								F(c)-SNS03	0.5	SVOCs, PCBs, TPH, metals	
CP2-07	Pumps, boilers, condensation tanks, and waste line originating from Building 15007.	Subsurface Soil	3	0, 4, 10	SVOCs, pesticides, Prowl, OBPA, metals, pH	Determine if releases from the chemical transfer pumps, boilers, condensation tanks, and waste line originating from Building 15007 occurred.	9	CP2-07-SB03	1, 5, 11	SVOCs, pesticides, Prowl, OBPA, metals, pH	
								CP2-07-SB04	1, 5, 11	SVOCs, pesticides, Prowl, OBPA, metals, pH	
								CP2-07-SB06	1, 5, 11	SVOCs, pesticides, Prowl, OBPA, metals (including CrVI), pH	CrVI was additional analysis.
CP2-07	Sump receiving discharge from trench system in the interior of Building 15007.	Subsurface Soil	1	0, 4, 10, 22, 30, ***40***, 50, 60, 70	SVOCs, pesticides, Prowl, OBPA, metals, pH, DI-WET	Determine if release from the sump on the northwest side of Building 15007 occurred.	8	CP2-07-SB05	1, 5, 11, 23, 35, 47, 59, 71	SVOCs, pesticides, Prowl, OBPA, metals, pH	Not analyzed for DI-WET.
		Grab Groundwater	1	First water	VOCs, SVOCs, pesticides, Prowl, OBPA, total and dissolved metals		1	CP2-07-SB05-GW	81	VOCs	Not analyzed for SVOCs, pesticides, Prowl, OBPA, total and dissolved metals
CP2-07	Sump at end of waste line at Building 15007.	Subsurface Soil	1	0, 4, 10	SVOCs, pesticides, Prowl, OBPA, metals, pH	Determine if release from the sump at the end of the waste line at Building 15007 occurred.	3	CP2-07-SB08	1, 5, 11	SVOCs, pesticides, Prowl, OBPA, metals, pH	
CP2-07	Former hazardous material storage area.	Subsurface Soil	1	0, 4, 10	SVOCs, pesticides, Prowl, OBPA, metals	Determine if release from the hazardous material storage area occurred.	3	CP2-07-SB09	1, 5, 11	SVOCs, Prowl, OBPA, metals	

Source Area	Associated Site Feature	Proposed Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
CP2-07	Trench system draining interior of Building 15007.	Subsurface Soil	3	0, 4, 10	SVOCs, pesticides, Prowl, OBPA, metals, pH	Determine if release from the trench system in the interior of Building 15007 occurred.	9	CP2-07-SB10	1, 5, 11	SVOCs, pesticides, Prowl, OBPA, metals, pH	
								CP2-07-SB11	1, 5, 11	SVOCs, pesticides, Prowl, OBPA, metals, pH	
								CP2-07-SB13	1, 5, 11	SVOCs, pesticides, Prowl, OBPA, metals, pH	
CP2-07	Sump serving bermed area containing pumps, boilers, and tanks on the south side of Building 15007.	Subsurface Soil	2	0, 4, 10	SVOCs, pesticides, Prowl, OBPA, metals, pH	Determine if releases from the sumps serving the chemical transfer pumps, boilers, and condensation tanks on the southeast side of Building 15007 occurred.	3	CP2-07-SB12	1, 5, 11	SVOCs, pesticides, Prowl, OBPA, metals, pH	
				0, 4, 10, 32, 50, 70, 90, 110	SVOCs, pesticides, Prowl, OBPA, metals, pH, Di-WET, physical properties	Determine if releases from the sumps serving the chemical transfer pumps, boilers, and condensation tanks on the northeast side of Building 15007 occurred, evaluate potential water quality impacts, support risk assessment.	6	CP2-07-SB02	1, 5, 11, 33, 55, 77	SVOCs, pesticides, Prowl, OBPA, metals, pH, CEC, TOC, DI-WET	Not analyzed for MC, GS, BD, PD, and perm. DI-WET analyzed only at 55 ft bgs.
		Grab Groundwater	1	First water	SVOCs, pesticides, Prowl, OBPA, PCBs, total and dissolved metals		1	CP2-07-SB02-GW	90	SVOCs, pesticides, Prowl, PCBs, total and dissolved metals	Not analyzed for OBPA.
CP2-07	Former Stouffer Chemical Plant potential discharge area.	Subsurface Soil	1	0, 4, 10, 32, 50, 70, 90, 110	SVOCs, pesticides, Prowl, OBPA, TPH, metals, pH, ***DI-WET***	Determine if release from the former Stouffer Chemical Plant potential discharge line occurred, evaluate potential water quality impacts, support risk assessment.	8	CP2-07-SB14	1, 5, 11, 33, 55, 77, 99, 120	SVOCs, TPH, pesticides, Prowl, OBPA, metals, pH	Not analyzed for DI-WET.
		Grab Groundwater	1	First water	SVOCs, pesticides, Prowl, ***OBPA***, TPH, total and dissolved metals		1	CP2-07-SB14-GW	120	SVOCs, pesticides, Prowl, PCBs, TPH, total and dissolved metals	Not analyzed for OBPA.
CP2-07	Spills in rail road ballast across from product storage tanks.	Subsurface Soil	5	0, 4, 10	Prowl, OBPA, pesticides, metals	Determine if spills in the rail road ballast has impacted shallow soil.	15	CP2-07-SB15	1, 5, 11	Prowl, OBPA, pesticides, metals	
								CP2-07-SB16	1, 5, 11	Prowl, OBPA, pesticides, metals	
								CP2-07-SB17	1, 5, 11	Prowl, OBPA, pesticides, metals	
								CP2-07-SB18	1, 5, 11	Prowl, OBPA, pesticides, metals	
								CP2-07-SB19	1, 5, 11	Prowl, OBPA, pesticides, metals	
CP2-07	Septic tank from Building 15007.	Subsurface Soil	1	0, 4, 10, 32, 50, 70, ***90***	SVOCs, pesticides, Prowl, OBPA, metals, pH, ***PCBs, DI-WET***	Determine if release from the septic tank from Building 15007 occurred.	6	CP2-ST07-SB01	1, 5, 11, 31, 55, 77	SVOCs, pesticides, Prowl, OBPA, metals, pH	Not analyzed for PCBs, and DI-WET.Not sampled at 90 ft bgs due to groundwater.
		Grab Groundwater	1	First water	SVOCs, pesticides, Prowl, OBPA, PCBs, total and dissolved metals		1	CP2-ST07-SB01-GW	90	SVOCs, pesticides, Prowl, PCBs, total and dissolved metals	Not analyzed for OBPA.

Source Area	Associated Site Feature	Proposed Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
CP2-08	Boiler and compressor blow-down sump from Buildings 15014 and 15015; dry well receiving waste from Building 15010.	Subsurface Soil	2	0, 4, 10	SVOCs, TPH, PCBs, metals	Determine if releases from the boiler blow-down and compressor blow-down sump from Building 15014 and 15015, and dry well receiving waste from Building 15010 occurred.	6	CP2-08-SB09	1, 5, 12	SVOCs, PCBs, TPH, metals	
								CP2-08-SB10	2, 6, 11.5	SVOCs, PCBs, TPH, metals	
CP2-08	Former hazardous waste storage area for Building 15008.	Subsurface Soil	1	0, 4, 10, 32, 50, 70, 90, ***110***	SVOCs, pesticides, Prowl, OBPA, PCBs, metals, ***DI-WET***, physical properties	Location requested by regulatory agencies due to its proximity to area of highest chemical concentration.	7	CP2-08-SB11	1, 5, 11, 33, 55, 80, 99	SVOCs, PCBs, pesticides, Prowl, OBPA, metals, pH, physical properties	
CP2-08	Former chemical storage, Building 15008.	Subsurface Soil	1	0, 4, 10	SVOCs, pesticides, Prowl, OBPA, PCBs, metals	Determine if release from the chemical storage area Building 15008 occurred.	3	CP2-08-SB12	1, 5, 11	SVOCs, pesticides, Prowl, OBPA, PCBs, metals	
CP2-08	Building 15008.	Subsurface Soil	1	0, 4, 10, 15, 20	SVOCs, PCBs, metals	Location requested by regulatory agencies.	5	CP2-08-SB13	1, 5, 11, 16, 21	SVOCs, PCBs, metals	
CP2-08	Former test incinerator and injection well No.2 head works.	Subsurface Soil	2	0, 4, 10	SVOCs, pesticides, Prowl, OBPA, metals, pH	Determine if releases from the incinerator and injection well No. 2 head works occurred.	6	CP2-08-SB14	1, 5, 11	SVOCs, pesticides, Prowl, OBPA, metals, pH	
								CP2-08-SB15	1, 5, 11	SVOCs, pesticides, Prowl, OBPA, metals, pH	
CP2-08	Ditch receiving runoff from former hazardous waste storage area.	Surface/Near Surface Soil	4	0, 2	SVOCs, pesticides, Prowl, OBPA, PCBs, metals	Location requested by regulatory agencies.	8	CP2-08-SNS01	0.5, 2.5	SVOCs, PCBs, pesticides, Prowl, OBPA, metals	
								CP2-08-SNS02	0.5, 2.5	SVOCs, PCBs, pesticides, Prowl, OBPA, metals	
								CP2-08-SNS03	0.5, 2.5	SVOCs, PCBs, pesticides, Prowl, OBPA, metals	
								CP2-08-SNS04	0.5, 2.5	SVOCs, PCBs, pesticides, Prowl, OBPA, metals	

Notes and Key:
* Sample ID 59F-SB10 was changed to 59F-SB23.
PAHs analyzed by USEPA 8270 SIM method.
TPH includes both diesel range organics and motor oil range organics
Bulk density includes dry density, wet density and specific gravity.
Physical properties include bulk density, permeability, porosity, moisture, organic carbon, grain size, and CEC.
Bold, italicized and underlined data does not agree with the analytical results. See "Deviations from Field Sampling Plan" column for more information on discrepancies.

ft bgs = Feet below ground surface
ID = Identification
BD = Bulk density
CEC = Cation exchange capacity
ClO4 = Perchlorate
CrVI = Hexavalent chromium
CP2 = Chemical Plant 2
DD = Dry density
DI-WET = Deionized waste extract test
GS = Grain size
Hg = Mercury
MC = Moisture content
Mo = Molybdenum
OBPA = 10,10'-oxybis-10H-Phenoxarsine
PAH = Polyaromatic hydrocarbon
Pb = Lead
PD = Porosity
Perm = Permeability
PCB = Polychlorinated biphenyl
pH = Paste pH
Se = Selenium
SG = Specific gravity
SPCC = Spill prevention control and countermeasures
SVOC = Semivolatile organic compound
TPH = Total petroleum hydrocarbons
UST = Underground storage tank
VOC = Volatile organic compound
WD = Wet density

Table 6.1-8
Summary of Soil Sampling and Sampling Statistics for Source Areas 60F and 61F
Chemical Plant 2 Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

				Source Area 60F						Source Area 61F					
Compound(s)	**Analyte**	**Method**	**Depth (feet bgs)**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**
Metals	Metals	6010B	0-2.5	12	12	5	12	41.7%	100.0%	3	3	0	3	0.0%	100.0%
		6020	0-2.5	12	12	5	12	41.7%	100.0%	3	3	0	3	0.0%	100.0%
		6010B	>2.5	11	29	2	29	6.9%	100.0%	1	6	0	6	0.0%	100.0%
		6020	>2.5	11	29	2	26	6.9%	89.7%	1	6	0	5	0.0%	83.3%
	Chromium VI	7199	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		7199	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	Mercury	7471A	0-2.5	12	12	5	11	41.7%	91.7%	5	5	0	2	0.0%	40.0%
		7471A	>2.5	11	29	2	25	6.9%	86.2%	1	6	0	4	0.0%	66.7%
SVOCs	SVOCs	8270C	0-2.5	12	12	5	8	41.7%	66.7%	5	5	0	2	0.0%	40.0%
		8270C	>2.5	9	25	2	8	8.0%	32.0%	1	6	0	1	0.0%	16.7%
PCBs	PCBs	8082	0-2.5	1	1	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		8082	>2.5	1	2	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
Perchlorate	Perchlorate	314.0, 314.0M	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		314.0, 314.0M	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
TPH	Diesel	8015B-SVOA - Diesel	0-2.5	2	2	2	2	100.0%	100.0%	0	0	0	0	0.0%	0.0%
		8015B-SVOA - Diesel	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	Motor Oil	8015B-SVOA - Oil	0-2.5	2	2	2	2	100.0%	100.0%	0	0	0	0	0.0%	0.0%
		8015B-SVOA - Oil	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
Misc.	OBPA	8270C	0-2.5	0	0	0	0	0.0%	0.0%	4	4	0	0	0.0%	0.0%
		8270C	>2.5	1	2	0	0	0.0%	0.0%	1	5	0	0	0.0%	0.0%
	Pesticides	8081A/8141A	0-2.5	12	12	5	9	0.0%	0.0%	5	5	0	3	0.0%	0.0%
		8081A/8141A	>2.5	7	21	2	4	0.0%	0.0%	1	6	0	1	0.0%	0.0%
	NDMA	1625C-CI M	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		1625C-CI M	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	pH	9045C	0-2.5	11	11	5	11	45.5%	100.0%	2	2	0	2	0.0%	100.0%
		9045C	>2.5	10	27	2	27	7.4%	100.0%	0	0	0	0	0.0%	0.0%
	TOC	9060A MOD	0-2.5	0	0	0	0	0.0%	0.0%	3	3	0	0	0.0%	0.0%
		9060A MOD	>2.5	0	0	0	0	0.0%	0.0%	1	6	0	1	0.0%	16.7%
	CEC	9081	0-2.5	0	0	0	0	0.0%	0.0%	1	1	0	1	0.0%	100.0%
		9081	>2.5	0	0	0	0	0.0%	0.0%	1	6	0	6	0.0%	100.0%

Notes and Key:

> = Greater than
% = Percent
bgs = Below ground surface
CEC = Cation Exchange Capacity
Chromium VI = Hexavalent chromium
NDMA = N-Nitrosodimethylamine
PCBs = Polychlorinated biphenyls
SVOCs = Semivolatile organic compounds
TOC = Total organic content
TPH = Total petroleum hydrocarbons

Table 6.2-1 Summary of Soil Vapor Sampling and Sampling Statistics
Magazine Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Area	Interval	Depth (feet bgs)	Locations	Primary Samples	Duplicate Samples	Detects	Frequency of Duplicates	Frequency of Primary Detects
Magazine Area	Shallow	0-10	11	11	0	11	0.0%	100.0%
	Intermediate	11-20	11	11	1	11	9.1%	100.0%
	Deep	21-30	5	5	0	5	0.0%	100.0%
		Totals:	**27**	**27**	**1**	**27**	**4%**	**100%**

Notes and Abbreviations:
All samples analyzed for volatile organic compounds (VOCs) by USEPA Method TO-15.
% = Percent
bgs = Below ground surface

Table 6.2-2 Cross-Reference Between Soil and Soil Vapor Sampling Locations and Investigated Features
Magazine Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Associated Site Feature	Soil Sampling Location(s)	Soil Vapor Sampling Location(s)
BUILDING 48004 High explosives storage magazine	OS3-F1-SB02	OS3-F1-SP02
BUILDING 48010 Aging building used for storage of explosives hardware and pyrotechnics	OS3-F1-SB01	OS3-F1-SP01
BUILDING 48014 Bunker used for storage of in-process or completed motors	OS3-F1-SB03	OS3-F1-SP03
RCRA C Hazardous waste/material storage area (Building 48008)	A48-RC08-SB01	A48-RC08-SP01
SEPTIC TANK & POTHOLE – BUILDING 48013	A48-ST13-SB01	A48-ST13-SP03 A48-ST13-SP04 A48-ST13-SP05 A48-ST13-SP06 A48-ST13-SP07 A48-ST13-SP08
SEPTIC TANK & LEACH LINES – BUILDING 48019	A48-ST19-SB01	A48-ST19-SP02 A48-ST13-SP08

Table 6.2-3 Summary of Soil Sampling and Sampling Statistics
Magazine Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Compound(s)	Analyte	Method	Depth (feet bgs)	Magazine Area					
				Locations	Primary Samples	Duplicates	Detects	Frequency of Duplicates	Frequency of Primary Detects
Metals	Metals	6010B	0-2.5	5	8	1	8	12.5%	100.0%
		6020	0-2.5	4	7	1	7	14.3%	100.0%
		6010B	>2.5	3	7	0	7	0.0%	100.0%
		6020	>2.5	1	2	0	2	0.0%	100.0%
	Chromium VI	7199	0-2.5	0	0	0	0	0.0%	0.0%
		7199	>2.5	0	0	0	0	0.0%	0.0%
	Mercury	7471A	0-2.5	5	8	1	8	12.5%	100.0%
		7471A	>2.5	3	7	0	7	0.0%	100.0%
SVOCs	SVOCs	8270C	0-2.5	8	14	2	6	14.3%	42.9%
		8270C	>2.5	3	7	0	1	0.0%	14.3%
PCBs	PCBs	8082	0-2.5	0	0	0	0	0.0%	0.0%
		8082	>2.5	0	0	0	0	0.0%	0.0%
Perchlorate	Perchlorate	314.0, 314.0M	0-2.5	7	13	2	1	15.4%	7.7%
		314.0, 314.0M	>2.5	1	2	0	2	0.0%	100.0%
TPH	Diesel	8015B-SVOA - Diesel	0-2.5	0	0	0	0	0.0%	0.0%
		8015B-SVOA - Diesel	>2.5	0	0	0	0	0.0%	0.0%
	Motor Oil	8015B-SVOA - Oil	0-2.5	0	0	0	0	0.0%	0.0%
		8015B-SVOA - Oil	>2.5	0	0	0	0	0.0%	0.0%
Misc.	Total Cyanide	9014	0-2.5	0	0	0	0	0.0%	0.0%
		9014	>2.5	0	0	0	0	0.0%	0.0%
	NDMA	1625C-CI M	0-2.5	0	0	0	0	0.0%	0.0%
		1625C-CI M	>2.5	0	0	0	0	0.0%	0.0%
	Nitroguanadine	Nitroguanadine-DSS	0-2.5	5	8	1	0	12.5%	0.0%
		Nitroguanadine-DSS	>2.5	3	7	0	0	0.0%	0.0%
	pH	9045C	0-2.5	0	0	0	0	0.0%	0.0%
		9045C	>2.5	0	0	0	0	0.0%	0.0%
	TOC	9060A MOD	0-2.5	0	0	0	0	0.0%	0.0%
		9060A MOD	>2.5	0	0	0	0	0.0%	0.0%
	CEC	9081	0-2.5	0	0	0	0	0.0%	0.0%
		9081	>2.5	0	0	0	0	0.0%	0.0%

Notes and Abbreviations:

> = Greater than
% = Percent
bgs = Below ground surface
CEC = Cation Exchange Capacity
Chromium VI = Hexavalent chromium
NDMA = N-Nitrosodimethylamine
PCBs = Polychlorinated biphenyls
SVOCs = Semivolatile organic compounds
TOC = Total organic content
TPH = Total petroleum hydrocarbons

Table 6.2-4 Summary of Soil Vapor Sampling Activities and Deviations from Field Sampling Plan
Magazine Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Proposed Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Rationale and Comments	Number of Samples Collected	Sampling Activity	Sample ID	Sample Depths (ft bgs)	Deviations from Field Sampling Plan
A48	Hazardous waste/ material container storage; Building 48008.	Soil Vapor	1	10, 20	Determine if a source is present within the vadose zone.	3	Soil Vapor	A48-RC08-SP01	10, 20, ***30***	
A48	Septic tank and pot holes; Building 48013.	Soil Vapor	***1***	10, 20	Determine if a release to soil has occurred at this location.	16	Soil Vapor	A48-ST13-SP03	10, 20	
								A48-ST13-SP04	10, 20, 30	
								A48-ST13-SP05	10, 20, 30	
								A48-ST13-SP06	10, 20, 30	
								A48-ST13-SP07	10, 20, 30	
								A48-ST13-SP08	10, 20	
						1	Grab Groundwater	A48-ST13-SP03	30	
A48	Septic tank and leach lines; Building 48019.	Soil Vapor	1	10, 20	Determine if a release to soil has occurred at this location.	2	Soil Vapor	A48-ST19-SP03	10, 20	
OS3	West of Building 48010.	None	***0***	None	Additional samples collected because chemical concentrations exceeded screening-level criteria.	6	Soil Vapor	OS3-F1-SP01	10, 20	
	East of Building 48004.							OS3-F1-SP02	10, 20	
	West of Building 48014.							OS3-F1-SP03	10, 20	

Notes and Key:
Grab groundwater collected when soil vapor point was below the groundwater table.
Bold, italicized and underlined data does not agree with the analytical results. See "Deviations from Field Sampling Plan" column for more information on discrepancies.

ft bgs = Feet below ground surface
ID = Identification
Proposed analyses = VOC analysis
Performed analyses = VOC analysis
VOC = Volatile organic compound

Table 6.2-5
Summary of Soil Sampling Activities and Deviations from Field Sampling Plan
Magazine Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Proposed Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
A48	Hazardous waste/ material container storage; Building 48008.	Subsurface Soil	1	0, 4, 10	SVOCs, metals, nitro, ClO4, DI-WET	Support risk assessment and evaluate the potential for water quality impacts. No prior soil investigation has been conducted.	3	A48-RC08-SB01	2, 5.5, 11.5	SVOCs, metals, nitro, ClO4, DI-WET.	ClO4 and DI-WET analyzed only at 2 ft bgs.
A48	Septic tank and pot holes; Building 48013.	Subsurface Soil	1	0, 4, 10	SVOCs, metals, nitro, ClO4, ***DI-WET***	Determine if a release from the septic tank and pot holes has occurred, support risk assessment and evaluate the potential for water quality impacts. No prior soil investigation has been conducted.	3	A48-ST13-SB01	2, 6, 11.5	SVOCs, metals, nitro, ClO4	ClO4 analyzed only at 6 and 11.5 ft bgs.
A48	Septic tank and leach lines; Building 48019.	Subsurface Soil	1	0, 4, 10	SVOCs, metals, nitro, ***ClO4***, ***DI-WET***	Determine if a release from the septic tank and pot holes has occurred, support risk assessment and evaluate the potential for water quality impacts. No prior soil investigation has been conducted.	3	A48-ST19-SB01	4, 6, 11.5	SVOCs, metals, nitro	Not analyzed for ClO4 and DI-WET.
OS3	West of Building 48010.	None	***0***	None	None	Additional samples collected because chemical concentrations exceeded screening-level criteria.	6	OS3-F1-SB01	0.5, 2	SVOCs, metals, nitro, ClO4	
	East of Building 48004.							OS3-F1-SB02	0.5, 2	SVOCs, metals, nitro, ClO5	
	West of Building 48014.							OS3-F1-SB03	0.5, 2	SVOCs, metals, nitro, ClO4	

Notes and Key:
PAHs analyzed by USEPA Method 8270-SIM
Bold, italicized, and underlined data does not agree with the analytical results. See "Deviations from Field Sampling Plan" column for more information on discrepancies.

ClO4 = Perchlorate
DI-WET = Deionized Waste Extraction Test
ft bgs = Feet below ground surface
ID = Identification
Nitro = Nitroguanidine
SVOC = Semivolatile organic compound
PAH = Polyaromatic hydrocarbon

Table 6.2-6 Summary of Geotechnical Parameters
Magazine Area
Aerojet Boundary Operable Unit
Aerojet Corporation
Sacramento County, California

Test No.	Date	Description of Test Location	Geo Physical Parameters (ASTM D2937, D854)					Sieve Analysis (ASTM D422)				Permeability (ASTM D5084)	
			Moisture Content (%)	Wet Density (pcf)	Dry Density (pcf)	Specific Gravity	Porosity	Cobbles (%)	Gravel (%)	Sand (%)	Silt / Clay (%)	Average Hydraulic Gradient	Perm (cm/sec)
116	11/18/06	8007-SB-90.5	50.9	103.8	68.8	2.385	0.5380	0.0	22.1	50.5	24.7	3.8	6.21E-06
117	11/18/06	8007-SB-98.5	56.7	104.6	66.7	2.498	0.5720	0.0	0.2	16.2	83.6	6.5	8.96E-08
118	11/18/06	8007-SB-100.5	42.8	122.9	86.0	2.561	0.4620	0.0	19.3	73.4	7.3	4.4	1.74E-03
119	11/18/06	8007-SB-118.5	41.6	107.5	76.0	2.473	0.5080	0.0	44.2	46.8	9.0	3.2	3.36E-04
		Mean	**48.0**	**109.7**	**74.4**	**2.5**	**0.5**	**0.0**	**21.5**	**46.7**	**31.2**	**4.5**	**5.2E-04**
		Median	**46.9**	**106.1**	**72.4**	**2.5**	**0.5**	**0.0**	**20.7**	**48.7**	**16.9**	**4.1**	**1.7E-04**
		Geomean	**47.6**	**109.4**	**74.0**	**2.5**	**0.5**	**0.0**	**7.8**	**40.9**	**19.2**	**4.3**	**2.4E-05**

Key:
% = Percent
cm/sec = Centimeters per second
pcf = Pounds per cubic foot

Table 6.3-1 Summary of Soil Sampling and Sampling Statistics for Source Area 25F
Dredge Pit and Eastern Basin Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Compound(s)	Analyte	Method	Depth (feet bgs)	Source Area 25F					
				Locations	Primary Samples	Duplicates	Detects	Frequency of Duplicates	Frequency of Primary Detects
Metals	Metals	6010B	0-2.5	13	15	2	15	13.3%	100.0%
		6020	0-2.5	10	12	1	12	8.3%	100.0%
		6010B	>2.5	14	38	4	38	10.5%	100.0%
		6020	>2.5	10	38	4	37	10.5%	97.4%
	Chromium VI	7199	0-2.5	0	0	0	0	0.0%	0.0%
		7199	>2.5	0	0	0	0	0.0%	0.0%
	Mercury	7471A	0-2.5	13	15	2	12	13.3%	80.0%
		7471A	>2.5	14	38	4	35	10.5%	92.1%
SVOCs	SVOCs	8270C	0-2.5	14	16	1	9	6.3%	56.3%
		8270C	>2.5	14	38	4	15	10.5%	39.5%
PCBs	PCBs	8082	0-2.5	0	0	0	0	0.0%	0.0%
		8082	>2.5	0	0	0	0	0.0%	0.0%
Perchlorate	Perchlorate	314.0, 314.0M	0-2.5	0	0	0	0	0.0%	0.0%
		314.0, 314.0M	>2.5	0	0	0	0	0.0%	0.0%
TPH	Diesel	8015B-SVOA - Diesel	0-2.5	0	0	0	0	0.0%	0.0%
		8015B-SVOA - Diesel	>2.5	0	0	0	0	0.0%	0.0%
	Motor Oil	8015B-SVOA - Oil	0-2.5	0	0	0	0	0.0%	0.0%
		8015B-SVOA - Oil	>2.5	0	0	0	0	0.0%	0.0%
Misc.	OBPA	9014	0-2.5	10	12	1	0	0.0%	0.0%
		9014	>2.5	14	38	4	0	0.0%	0.0%
	Pesticides	8081A/8141A	0-2.5	13	15	2	12	13.3%	80.0%
		8081A/8141A	>2.5	18	48	6	30	12.5%	62.5%
	NDMA	1625C-CI M	0-2.5	0	0	0	0	0.0%	0.0%
		1625C-CI M	>2.5	0	0	0	0	0.0%	0.0%
	pH	9045C	0-2.5	10	12	1	12	8.3%	100.0%
		9045C	>2.5	14	38	4	38	10.5%	100.0%
	TOC	9060A MOD	0-2.5	10	12	1	0	8.3%	0.0%
		9060A MOD	>2.5	4	9	0	0	0.0%	0.0%
	CEC	9081	0-2.5	3	5	0	5	0.0%	100.0%
		9081	>2.5	4	9	0	9	0.0%	100.0%

Notes and Key:

> = Greater than
% = Percent
bgs = Below ground surface
CEC = Cation Exchange Capacity
Chromium VI = Hexavalent chromium
NDMA = N-Nitrosodimethylamine
OBPA = 10,10'-Oxybis-10H-Phenoxarsine
PCBs = Polychlorinated biphenyls
SVOCs = Semivolatile organic compounds
TOC = Total organic content
TPH = Total petroleum hydrocarbons

Table 6.3-2 ***List of Soil Sampling Locations in the Dredge Pit and Eastern Basin Boundary Operable Unit Remedial Investigation Aerojet Superfund Site Sacramento County, California***

Site Feature	Source Area	Soil Sampling Location(s)
DREDGE PIT Former chemical waste discharge to westernmost dredge pit	25F	25F-SD01 25F-HA01 25F-SB04 25F-SB05 25F-SB06 25F-SB07 25F-SB12 25F-SB13 25F-SB14
EASTERN BASIN Eastern most dredge pit. East of Source Area 25F (dredge pit)	25F	25F-SD02 25F-HA02 25F-HA03 25F-HA04 25F-SB08 25F-SB09 25F-SB10 25F-SB11

Table 6.3-3
Summary of Soil Sampling Activities and Deviations from Field Sampling Plan
Dredge Pit and Eastern Basin Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Proposed Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
25F	Dredge Pit Used for infiltration of chemical waste from Chemical Plant 2	Subsurface Soil	4	0, 4, 10, 22, 30, 40, 50	***VOCs***, SVOCs, pesticides, Prowl, OBPA, metals, pH	Location requested by regulatory agencies.	21	25F-SB04	1, 5, 11, 21, 31, 41, 49	SVOCs, pesticides, Prowl, OBPA, metals, pH	Not analyzed for VOCs.
								25F-SB05	1, 5, 11, 21, 31, 41, 49	SVOCs, pesticides, Prowl, OBPA, metals, pH	Not analyzed for VOCs.
								25F-SB07	1, 5, 11, 21, 31, 41, 49	SVOCs, pesticides, Prowl, OBPA, metals, pH	Not analyzed for VOCs.
				0, 4, 10, 32, 50	***VOCs***, SVOCs, pesticides, Prowl, OBPA, ***DI-WET***, metals, pH, physical properties	Location requested by regulatory agencies due to its proximity to area of highest chemical concentration.	8	25F-SB06	1, 5, 11, ***21***, 31, ***41***, 51, ***61***	SVOCs, pesticides, Prowl, OBPA, metals, pH, physical properties	After 10 ft bgs, samples were taken at 10 ft interval instead of 20. Not analyzed for VOCs and DI-WET. PAHs was an additional analysis.
		Grab Groundwater	1	First water	SVOCs, pesticides, Prowl, ***OBPA***, total and dissolved metals		1	25F-SB06-GW	65	SVOCs, pesticides, Prowl, total and dissolved metals	Not analyzed for OBPA.
		Subsurface Soil	1	***0***, 2, 4, 8	***VOCs***, SVOCs, pesticides, Prowl, OBPA, metals, pH	Location requested by regulatory agencies and changed to hand auger due to access problems.	3	25F-HA01	1, 5, 9	SVOCs, pesticides, Prowl, OBPA, metals, pH	No surface sample collected at 0 ft bgs. Not analyzed for VOCs.
		Surface/Near Surface Soil	***0***	None	None	Additional samples collected because chemical concentrations exceeded screening level criteria.	3	25F-SB12	1	Metals	
								25F-SB13	1	Metals	
								25F-SB14	1	Metals	
25F	Eastern Basin Dredge Pit East of Source Area 25F	Subsurface Soil	3	0, 2, 4, 8	***VOCs***, SVOCs, pesticides, Prowl, OBPA, metals, pH	Location requested by regulatory agencies and changed to hand auger due to access problems.	12	25F-HA02	1, 3, 5, 9	SVOCs, pesticides, Prowl, OBPA, metals, pH	Not analyzed for VOCs.
								25F-HA03	1, 3, 5, 9	SVOCs, pesticides, Prowl, OBPA, metals, pH	Not analyzed for VOCs.
								25F-HA04	1, 3, 5, 9	SVOCs, pesticides, Prowl, OBPA, metals, pH	Not analyzed for VOCs.
		Surface/Near Surface Soil	***0***	None	None	Additional samples collected because chemical concentrations exceeded screening level criteria.	4	25F-SB08	1	SVOCs, TOC	
								25F-SB09	1	SVOCs, TOC	
								25F-SB10	1	SVOCs, TOC	
								25F-SB11	1	SVOCs, TOC	

Table 6.3-3
Summary of Soil Sampling Activities and Deviations from Field Sampling Plan
Dredge Pit and Eastern Basin Area
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Proposed Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
25F	Dredge Pit and Eastern Basin	Sediment	2	0	***VOCs***, SVOCs, pesticides, Prowl, OBPA, metals, pH, CEC, TOC, BD, MC, GS, DI-WET	Determine if chemicals are still present in the pits.	6	25F-SD01	0.25, 1.5, 5	VOCs, SVOCs, pesticides, Prowl, OBPA, metals, pH, CEC, TOC, MC, WD, DD, GS, DI-WET	DI-WET analyzed only at 5 ft bgs for. Not analyzed for GS.
								25F-SD02	0.25, 1.5, 5	SVOCs, pesticides, Prowl, OBPA, metals, pH, MC, WD, DD, GS, CEC, TOC, DI-WET	Not analyzed for VOCs and GS. DI-WET analyzed only at 5 ft bgs.

Notes and Key:
* Sample ID 59F-SB10 was changed to 59F-SB23.
PAHs analyzed by USEPA 8270 SIM Method.
TPH includes both diesel range organics and motor oil range organics
Bulk density includes dry density, wet density and specific gravity.
Physical properties include bulk density, permeability, porosity, moisture, organic carbon, grain size, and CEC.
Bold, italicized and underlined data does not agree with the analytical results. See "Deviations from Field Sampling Plan" column for more information on discrepancies.

ft bgs = Feet Below ground surface
BD = Bulk Density
CEC = Cation exchange capacity
ClO4 = Perchlorate
CrVI = Hexavalent chromium
CP2 = Chemical Plant 2
DD = Dry density
DI-WET = Deionized waste extract test
GS = Grain Size
Hg = Mercury
ID = Identification
MC = Moisture Content
Mo = Molybdenum
OBPA = 10,10'-oxybis-10H-Phenoxarsine
PAHs = Polyaromatic hydrocarbons
Pb = Lead
PD = Porosity
Perm = Permeability
PCBs = Polychlorinated biphenyls
pH = Paste pH
Se = Selenium
SG = Specific gravity
SPCC = Spill prevention control and countermeasures
SVOCs = Semivolatile organic compounds
TPH = Total petroleum hydrocarbons
UST = Underground storage tank
VOCs = Volatile organic compounds
WD = Wet density

Table 6.3-4 Summary of Geotechnical Soil Parameters
Dredge Pit and Eastern Basin Area
Aerojet Boundary Operable Unit
Aerojet Corporation
Sacramento County, California

			Geo Physical Parameters (ASTM D2937, D854)					Sieve Analysis (ASTM D422)				Permeability (ASTM D5084)	
Test No.	Date	Description of Test Location	Moisture Content (%)	Wet Density (pcf)	Dry Density (pcf)	Specific Gravity	Porosity	Cobbles (%)	Gravel (%)	Sand (%)	Silt / Clay (%)	Average Hydraulic Gradient	Perm (cm/sec)
30	11/18/2005	25F-SD01-0.25	17.9	109.9	93.2			0.0	1.0	12.9	86.1		
31	11/18/2005	25F-SD01-1.5	43.4	125.8	87.8			0.0	1.5	13.5	85.0		
32	11/18/2005	25F-SD01-5	48.0	106.1	71.7			0.0	1.2	11.9	86.9		
33	11/18/2005	25F-SD015-1	7.3	127.9	119.2	2.720	0.2980	0.0	56.9	31.0	12.1	7.6	8.83E-05
34	11/18/2005	25F-SD015-5	4.5	143.3	137.0	2.610	0.1590	0.0	66.5	24.9	8.6	6.7	9.32E-05
35	11/18/2005	25F-SD015-11	3.9	156.7	150.9	2.670	0.1	0.0	61.3	28.1	10.6	5.7	4.23E-04
36	11/18/2005	25F-SD017-1	13.5	133.3	117.4	2.650	0.2900	0.0	23.7	46.2	30.1	10.3	1.80E-05
37	11/18/2005	25F-SD017-5	45.1	116.6	80.4	2.600	0.5050	0.0	24.4	35.2	40.4	8.4	5.82E-08
38	11/18/2005	25F-SD017-11	5.1	138.3	131.6	2.760	0.2360	0.0	15.8	44.2	40.0	3.2	3.85E-04
Mean			**21.0**	**128.7**	**109.9**	**2.7**	**0.3**	**0.0**	**28.0**	**27.5**	**44.4**	**7.0**	**1.7E-04**
Median			**13.5**	**127.9**	**117.4**	**2.7**	**0.3**	**0.0**	**23.7**	**28.1**	**40.0**	**7.2**	**9.1E-05**
Geomean			**13.5**	**127.7**	**106.7**	**2.7**	**0.2**	**0.0**	**11.6**	**24.5**	**31.9**	**6.6**	**3.3E-05**

Key:
% = Percent
cm/sec = Centimeters per second
pcf = Pounds per cubic foot

Table 6.4-1 Summary of Soil Vapor Sampling and Sampling Statistics
Open Space Areas 1, 2, and 4
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Area	Interval	Depth (feet bgs)	Locations	Primary Samples	Duplicate Samples	Detects	Frequency of Duplicates	Frequency of Primary Detects
Open Space Area 1	Shallow	0-10	1	1	0	1	0.0%	100.0%
	Intermediate	11-20	1	1	0	1	0.0%	100.0%
	Deep	21-30	0	0	0	0	0.0%	0.0%
Open Space Area 2	Shallow	0-10	1	1	0	1	0.0%	100.0%
	Intermediate	11-20	1	1	0	1	0.0%	100.0%
	Deep	21-30	0	0	0	0	0.0%	0.0%
Open Space Area 4	Shallow	0-10	3	3	0	3	0.0%	100.0%
	Intermediate	11-20	3	3	0	3	0.0%	100.0%
	Deep	21-30	0	0	0	0	0.0%	0.0%
		Totals:	**10**	**10**	**0**	**10**	**0%**	**100%**

Notes and Key:

All samples analyzed for volatile organic compounds (VOCs) by USEPA Method TO-15.

% = Percent

bgs = Below ground surface

Table 6.4-2 *List of Soil and Soil Vapor Sampling Locations in Open Space Areas 1, 2, and 4 Boundary Operable Unit Remedial Investigation Aerojet Superfund Site Sacramento County, California*

Site Feature	Source Area	Soil Sampling Location(s)	Soil Vapor Sampling Location(s)
OPEN SPACE AREA 1 Buffer zone west of Chemical Plant 2	OS1	OS1-F1-SB01	OS1-F1-SP01
OPEN SPACE AREA 2 Buffer zone east of Chemical Plant 2. Between Chemical Plant 2 and Line 03.	OS2	OS2-F1-SB01 OS2-F1-SB02	OS2-F1-SP01
OPEN SPACE AREA 4 Buffer zone east of Magazine Area.	OS4		OS4-F1-SP01 OS4-F1-SP02 OS4-F1-SP03

Table 6.4-3
Summary of Soil Sampling and Sampling Statistics
Open Space Areas 1, 2, and 4
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

				Open Space Area 1						Open Space Area 2						Open Space Area 4					
Compound(s)	**Analyte**	**Method**	**Depth (feet bgs)**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**
Metals	Metals	6010B	0-2.5	1	1	1	1	100.0%	100.0%	2	2	1	2	50.0%	100.0%	0	0	0	0	0.0%	0.0%
		6020	0-2.5	1	1	1	1	100.0%	100.0%	2	2	1	2	50.0%	100.0%	0	0	0	0	0.0%	0.0%
		6010B	>2.5	1	2	1	2	50.0%	100.0%	2	9	2	9	22.2%	100.0%	0	0	0	0	0.0%	0.0%
		6020	>2.5	1	2	1	2	50.0%	100.0%	2	9	2	9	22.2%	100.0%	0	0	0	0	0.0%	0.0%
	Chromium VI	7199	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		7199	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	Mercury	7471A	0-2.5	1	1	1	1	100.0%	100.0%	2	4	0	2	0.0%	50.0%	0	0	0	0	0.0%	0.0%
		7471A	>2.5	1	2	1	1	50.0%	50.0%	3	9	2	9	22.2%	100.0%	0	0	0	0	0.0%	0.0%
SVOCs	SVOCs	8270C	0-2.5	1	1	1	1	100.0%	100.0%	2	4	0	1	0.0%	25.0%	0	0	0	0	0.0%	0.0%
		8270C	>2.5	0	0	0	0	0.0%	0.0%	3	13	2	1	15.4%	7.7%	0	0	0	0	0.0%	0.0%
PCBs	PCBs	8082	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		8082	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
Perchlorate	Perchlorate	314.0, 314.0M	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		314.0, 314.0M	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
TPH	Diesel	8015B-SVOA - Diesel	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		8015B-SVOA - Diesel	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	Motor Oil	8015B-SVOA - Oil	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		8015B-SVOA - Oil	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
Misc.	Total Cyanide	9014	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		9014	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	NDMA	1625C-CI M	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		1625C-CI M	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	pH	9045C	0-2.5	0	0	0	0	0.0%	0.0%	1	1	0	1	0.0%	100.0%	0	0	0	0	0.0%	0.0%
		9045C	>2.5	0	0	0	0	0.0%	0.0%	2	9	2	7	22.2%	77.8%	0	0	0	0	0.0%	0.0%
	TOC	9060A MOD	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		9060A MOD	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	CEC	9081	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		9081	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%

Notes and Key:

> = Greater than
% = Percent
bgs = Below ground surface
CEC = Cation Exchange Capacity
Chromium VI = Hexavalent chromium
NDMA = N-Nitrosodimethylamine
PCBs = Polychlorinated biphenyls
SVOCs = Semivolatile organic compounds
TOC = Total organic content
TPH = Total petroleum hydrocarbons

Table 6.4-4 Summary of Soil Vapor Sampling Activities and Deviations from Field Sampling Plan
Open Space Areas 1, 2, and 4
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Rationale and Comments	Number of Samples Collected	Sampling Activity	Sample ID	Sample Depths (ft bgs)	Deviations from Field Sampling Plan
Open Space Area 1	Pond receiving discharge from SPCC sump and Source Area 59F.	1	10, 20	Determine if release to pond impacted the vadose zone.	2	Soil Vapor	OS1-F2-SP01	10, 20	
Open Space Area 2	Debris, drums, and pond east of the Chemical Plant fence line.	1	10, 20	Determine if release from debris, drums, or pond to the vadose zone occurred.	2	Soil Vapor	OS2-F1-SP01	10, 20	
Open Space Area 4	East of Magazine Area.	0	None	Additional samples collected because chemical concentrations exceeded screening-level criteria.	6	Soil Vapor	OS4-F1-SP01	10, 20	
							OS4-F1-SP02	10, 20	
							OS4-F1-SP03	10, 20	

Notes and Key:

Bold, italicized and underlined data does not agree with the analytical results. See "Deviations from Field Sampling Plan" column for more information on discrepancies.

ft bgs = Feet below ground surface
ID = Identification
Proposed analyses = VOC analysis
Performed analyses = VOC analysis
VOC = Volatile organic compound

Table 6.4-5
Summary of Soil Sampling Activities and Deviations from Field Sampling Plan
Open Space Areas 1 and 2
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
Open Space Area 1	Plasticizer spill in rail west of Chemical Plant fence line.	Subsurface Soil	1	0, 4, 10	SVOCs, metals	Determine if the spill in the rail road ballast has impacted shallow soils.	3	OS1-F1-SB01	1, 5, 11	SVOCs, metals	
Open Space Area 2	Debris and drums east of the Chemical Plant fence line.	Subsurface Soil	1	0, 4, 10	SVOCs, pesticides, prowl, OBPA, metals	Determine if a release from the debris or drums to soil has occurred.	3	OS2-F1-SB01	1, 5, 11	SVOCs, pesticides, prowl, OBPA, metals	
Open Space Area 2	Pond east of the Chemical Plant fence line.	Subsurface Soil	1	0, 4, 10, 32, 50, 70, 90, 110	SVOCs, pesticides, prowl, OBPA, pH, metals, ***DI-WET***	Determine if a release from the pond to soil has occurred.	8	OS2-F1-SB02	1, 5, 11, 33, 55, 77, 99, 121	SVOCs, pesticides, prowl, OBPA, pH, metals	Not analyzed for DI-WET.
		Grab Groundwater	1	First water	SVOCs, pesticides, prowl, OBPA, total and dissolved metals		1	OS2-F1-SB02-GW	123	VOCs, SVOCs, pesticides, prowl, total and filtered metals	Not analyzed for OBPA.

Notes and Key:
Bold, italicized and underlined data does not agree with the analytical results. See "Deviations from Field Sampling Plan" column for more information on discrepancies.

ClO4 = Perchlorate
DI-WET = Deionized Waste Extraction Test
ft bgs = Feet below ground surface
ID = Identification
OBPA = 10,10'-oxybis-10H-Phenoxarsine
PAH = Polyaromatic hydrocarbon
pH = Paste pH
SVOC = Semivolatile organic compound
VOC = Volatile organic compound

Table 6.5-1 Summary of Surface Water Sampling Activities and Deviations from Field Sampling Plan
Chemical Plant 2, Dredge Pit, and Eastern Basin
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Number of Proposed Sampling Locations	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
25F	Dredge Pit	2	VOCs, SVOCs, PAHs, pesticides, Prowl, ***OBPA***, total and dissolved metals, chemical properties	Determine if chemicals are still present in the pits.	2	25F-SW01	2	VOCs, SVOCs, PAHs, pesticides, Prowl, total and dissolved metals, chemical properties	Not analyzed for OBPA.
						25F-SW02	2	VOCs, SVOCs, PAHs, pesticides, Prowl, total and dissolved metals, chemical properties	Not analyzed for OBPA.
59F	Drainage from Holding Basin and Chemical Plant 2 Area	2	VOCs, SVOCs, PAHs, pesticides, Prowl, ***OBPA***, total and dissolved metals, chemical properties	Determine if chemicals are present in the low lying area north of Source Area 59F where sediment and water accumulate.	2	59F-SW01	6	VOCs, SVOCs, PAHs, pesticides, Prowl, total and dissolved metals, chemical properties	Not analyzed for OBPA.
						59F-SW02	6	VOCs, SVOCs, PAHs, pesticides, Prowl, total and dissolved metals, chemical properties	Not analyzed for OBPA.
62F	Runoff from the area around the former paraldehyde tank and railcar transfer station	1	VOCs, SVOCs, PAHs, pesticides, Prowl, ***OBPA***, total and dissolved metals, chemical properties	Determine if chemicals were released to the low lying area west of Source Area 62F where sediment and water accumulate.	***0***	62F-SW01	None	None	Not sampled due to heavy rain.

Notes and Key:
PAHs analyzed by USEPA Method 8270-SIM.
Proposed sampling depth is middle to bottom of water column.
Chemical properties include dissolved organic carbon, anions, and total alkalinity.
Bold, italicized and underlined data does not agree with the analytical results. See "Deviations from Field Sampling Plan" column for more information on discrepancies.

ft bgs = Feet Below ground surface
ID = Identification
OBPA = 10,10'-oxybis-10H-Phenoxarsine
PAHs = Polyaromatic hydrocarbons
SVOCs = Semivolatile organic compounds
VOCs = Volatile organic compounds

Table 6.6-1 Well Construction Details, Perched and First Water-Bearing Zone
Chemical Plant 2 Region
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Well ID	Groundwater Unit	Well Type	Easting	Northing	GSE (ft msl)	TOC (ft msl)	TOS (ft bgs)	BOS (ft bgs)	Well TD (ft)
6	Upper Perched	Monitor	2217231	340098	145.4	147.4	0	24	24
9	Upper Perched	Monitor	2217492	340721	144.6	145.5	10	40	40
30	Upper Perched	Monitor	2220012	344039	150.3	151.8	40	63.7	63.7
76	Upper Perched	Monitor	2221544	339205	181.6	185.6	32	67	69
129	Upper Perched	Monitor	2218065	339001	174.7	177.2	55	75	75
180	Upper Perched	Monitor	2221717	340503	192.0	194.6	60	75	75
286	Upper Perched	Monitor	2221311	345253	163.8	166.9	55	65	65
302	Upper Perched	Monitor	2218970	339626	181.6	183.5	65	93	93
3696	Upper Perched	Monitor	2217564	339964	145.0	148.1	15	35	35
57	Lower Perched	Monitor	2215073	345401	129.9	132.4	46	62	62
110	Lower Perched	Monitor	2221432	339355	180.2	182.5	67	86	92
330	Lower Perched	Monitor	2217246	344628	137.0	139.2	44	58	58
376	Lower Perched	Monitor	2218800	340379	172.7	176.0	60	98	98
516	Lower Perched	Monitor	2220430	341361	125.3	132.8	25	26	31
902	Lower Perched	Monitor	2217882	345494	141.3	142.5	48	78	78
3057	Lower Perched	Monitor	2217089	339363	159.1	162.8	75	85	85
3221	Lower Perched	Monitor	2218136	340513	145.3	148.4	53	74	74
3363	Lower Perched	Monitor	2220077	340331	179.1	181.7	89	99	99
3658	Lower Perched	Monitor	2217583	339682	154.5	157.5	68	78	78
3728	Lower Perched	Monitor	2217839	339763	164.4	164.1	86	106	106
7	FWBZ	Monitor	2217367	339610	146.8	147.9	55	83	83
10	FWBZ	Monitor	2217106	340985	142.5	143.8	60	100	100
22	FWBZ	Monitor	2221857	343819	157.4	156.6	49	89	101
24	FWBZ	Monitor	2221821	342686	161.3	162.5	60	100	100
25	FWBZ	Monitor	2218585	340793	150.3	151.4	80	95	95
130	FWBZ	Monitor	2218065	339001	174.7	177.2	95	105	105
131	FWBZ	Monitor	2218065	339001	174.7	177.2	124	130	130
181	FWBZ	Monitor	2221717	340503	192.0	194.6	95	112	112
212	FWBZ	Monitor	2219656	339720	179.9	182.7	90	120	120
215	FWBZ	Monitor	2218466	340081	179.1	182.0	114	126	126
303	FWBZ	Monitor	2221502	339209	181.9	185.4	90	100	100
355	FWBZ	Monitor	2217276	338563	170.4	173.3	82	103	103
374	FWBZ	Monitor	2218625	339636	178.4	181.1	78	120	120
375	FWBZ	Monitor	2218581	339243	178.5	180.5	73	115	118
685	FWBZ	Monitor	2220567	341320	137.6	138.8	40	61	62.2
1241	FWBZ	Monitor	2218124	338215	173.3	173.3	84	94	94
3043	FWBZ	Monitor	2218249	341723	149.0	152.3	76	86	86
3048	FWBZ	Monitor	2218131	343212	139.8	142.5	75	85	85
3222	FWBZ	Monitor	2218136	340513	145.3	148.4	94	104	104
3233	FWBZ	Monitor	2218094	341078	144.7	148.0	71	86	86
3244	FWBZ	Monitor	2217398	338972	172.0	174.9	81	102	102
3264	FWBZ	Monitor	2217510	340215	143.0	145.7	75	96	96
3292	FWBZ	Monitor	2218045	339620	177.6	180.5	98	119	119
3348	FWBZ	Monitor	2218496	338969	176.4	179.6	90	124	124
3431	FWBZ	Monitor	2216156	340168	141.0	144.1	78	88	88
3440	FWBZ	Monitor	2217043	338736	166.0	168.3	106	111	111

Table 6.6-1 Well Construction Details, Perched and First Water-Bearing Zone
Chemical Plant 2 Region
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Well ID	Groundwater Unit	Well Type	Easting	Northing	GSE (ft msl)	TOC (ft msl)	TOS (ft bgs)	BOS (ft bgs)	Well TD (ft)
3642	FWBZ	Monitor	2218324	339409	180.1	183.3	97	127	127
3645	FWBZ	Monitor	2220845	340234	195.2	198.2	119	139	140
3651	FWBZ	Monitor	2221785	344440	164.3	166.3	82	112	112
3656	FWBZ	Monitor	2217678	339762	155.6	158.6	65	95	95
3657	FWBZ	Monitor	2217621	339714	154.9	157.9	68	98	98
3659	FWBZ	Monitor	2217400	342738	138.6	141.6	65	95	95

Key:
BOS = Bottom of screen
ft bgs = feet below ground surface
ft msl = feet above mean sea level
FWBZ = First water-bearing zone
GSE = Ground surface elevation
TD = total depth
TOC = Top of casing
TOS = Top of screen

Table 6.6-2 *Soil Boring Details, Perched and First Water-Bearing Zone*
Chemical Plant 2 Region
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Sample Name	Boring Location	Groundwater Unit	Easting	Northing	GSE (ft msl)	Sample Depth (ft bgs)	Date Collected
62F-HP01-100	62F-HP01	Lower Perched	2217526	339111	176.78	100	17-Nov-05
CP2-07-SB02-GW01-90	CP2-07-SB02	Lower Perched	2218003	339763	170.49	90	09-Nov-05
CP2-07-SB05-GW01-81	CP2-07-SB05	Lower Perched	2217846	339769	167.72	81	08-Nov-05
CP2-08-HP02-75	CP2-08-HP02	Lower Perched	2217660	339587	155.93	75	05-Dec-05
25F-SP11-GW01-10	25F-SP11	Upper Perched	2220417	341304	125.65	10	28-Aug-06
59F-SP35-GW01-40	59F-SP35	Upper Perched	2217582	339795	153.55	40	06-Jan-06
59F-SP39-GW01-10	59F-SP39	Upper Perched	2217467	339356	169.27	10	24-Apr-06
59F-SP39-GW01-102	59F-SP39	Upper Perched	2217467	339356	169.27	102	09-Feb-06
62F-SP01-GW01-40	62F-SP01	Upper Perched	2217535	339147	174.40	40	16-Jan-06
62F-SP02-GW01-40	62F-SP02	Upper Perched	2217526	339110	175.06	40	16-Jan-06
62F-SP03-GW01-40	62F-SP03	Upper Perched	2217562	339116	175.52	40	17-Jan-06
62F-SP04-GW01-40	62F-SP04	Upper Perched	2217581	339217	173.80	40	16-Jan-06
A48-ST13-SP03-GW01-30	A48-ST13-SP03	Upper Perched	2219827	345040	155.82	30	01-Feb-06
CP2-07-HP02-GW01-34	CP2-07-HP02	Upper Perched	2217877	339662	148.95	34	17-Oct-06
CP2-07-SP03-GW01-38	CP2-07-SP03	Upper Perched	2218029	339849	166.19	38	16-Oct-06
CP2-07-SP08-GW01-40	CP2-07-SP08	Upper Perched	2218125	339491	176.57	40	03-Feb-06
CP2-07-SP14-GW01-40	CP2-07-SP14	Upper Perched	2218517	340159	180.91	40	03-Feb-06
CP2-RE05-SP07-GW01-40	CP2-RE05-SP07	Upper Perched	2218509	339451	180.89	40	20-Jan-06
CP2-RE05-SP09-GW01-31	CP2-RE05-SP09	Upper Perched	2217933	339305	176.30	31	13-Jan-06
F(c)-SP05-GW01-40	F(C)-SP05	Upper Perched	2217620	339409	168.52	40	23-Jan-06
F(c)-SP05-GW01-60	F(C)-SP05	Upper Perched	2217620	339409	168.52	60	23-Jan-06
25F-SB06-GW01-65	25F-SB06	FWBZ	2220424	341319	128.54	65	04-Nov-05
59F-SP39-GW01-10	59F-SP39	FWBZ	2217467	339356	169.27	10	24-Apr-06
59F-SP39-GW01-102	59F-SP39	FWBZ	2217467	339356	169.27	102	09-Feb-06
60F-SB02-GW01-130	60F-SB02	FWBZ	2218278	339035	179.47	130	14-Nov-05
61F-SB03-GW01-120	61F-SB03	FWBZ	2218143	339074	179.51	120	11-Nov-05
CP2-07-SB14-GW01-120	CP2-07-SB14	FWBZ	2218125	339491	176.57	120	04-Jan-06
CP2-08-HP03-110	CP2-08-HP03	FWBZ	2217671	339450	171.20	110	15-Nov-05
CP2-ST07-SB01-GW01-90	CP2-ST07-SB01	FWBZ	2217827	339870	158.87	90	09-Nov-05
OS2-F1-SB02-GW01-123	OS2-F1-SB02	FWBZ	2218654	339460	171.09	123	17-Feb-06

Key:
GSE = ground surface elevation
ft msl = feet above mean sea level
ft bgs = feet below ground surface
FWBZ = First water-bearing zone

Table 6.6-3 April 2006 Plantwide Groundwater Data
Chemical Plant 2 Region
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Well ID	Groundwater Unit	Date	DTW (ft bgs)	Monitor Point Elev. (ft msl)	GWE (ft msl)
330	Lower Perched	02-Dec-05	Dry	139.15	Dry
330	Lower Perched	25-Jan-06	Dry	139.15	Dry
330	Lower Perched	10-Feb-06	Dry	139.15	Dry
330	Lower Perched	07-Mar-06	Dry	139.15	Dry
330	Lower Perched	05-Apr-06	Dry	139.15	Dry
330	Lower Perched	04-May-06	Dry	139.15	Dry
376	Lower Perched	10-Nov-05	Dry	176.01	Dry
376	Lower Perched	03-Jan-06	Dry	176.01	Dry
376	Lower Perched	13-Feb-06	Dry	176.01	Dry
376	Lower Perched	07-Mar-06	Dry	176.01	Dry
376	Lower Perched	04-Apr-06	Dry	176.01	Dry
376	Lower Perched	04-May-06	Dry	176.01	Dry
516	Lower Perched	10-Nov-05	32.11	132.81	100.7
516	Lower Perched	04-Jan-06	Obst	132.81	Obst
516	Lower Perched	10-Feb-06	Obst	132.81	Obst
516	Lower Perched	07-Mar-06	Obst	132.81	Obst
516	Lower Perched	04-Apr-06	Obst	132.81	Obst
516	Lower Perched	12-May-06	31.6	132.81	101.21
902	Lower Perched	10-Jan-06	68.56	142.51	73.95
902	Lower Perched	09-Feb-06	67.91	142.51	74.6
902	Lower Perched	07-Mar-06	68.03	142.51	74.48
902	Lower Perched	05-Apr-06	58.1	142.51	84.41
902	Lower Perched	08-May-06	55.42	142.51	87.09
3057	Lower Perched	10-Nov-05	Dry	162.759	Dry
3057	Lower Perched	03-Jan-06	Dry	162.759	Dry
3057	Lower Perched	10-Feb-06	Dry	162.759	Dry
3057	Lower Perched	08-Mar-06	Dry	162.759	Dry
3057	Lower Perched	04-Apr-06	77.95	162.759	84.809
3057	Lower Perched	04-May-06	71.66	162.759	91.099
3658	Lower Perched	01-Dec-05	80.8	157.49	76.69
3658	Lower Perched	04-Jan-06	81.16	157.49	76.33
3658	Lower Perched	10-Feb-06	80.85	157.49	76.64
3658	Lower Perched	05-Apr-06	80.86	157.49	76.63
3658	Lower Perched	04-May-06	80.89	157.49	76.6
6	Upper Perched	10-Nov-05	Dry	147.4	Dry
6	Upper Perched	03-Jan-06	20.46	147.4	126.94
6	Upper Perched	10-Feb-06	Dry	147.4	Dry
6	Upper Perched	07-Mar-06	19.98	147.4	127.42
6	Upper Perched	05-Apr-06	17.45	147.4	129.95
6	Upper Perched	04-May-06	21.9	147.4	125.5
9	Upper Perched	10-Nov-05	Dry	145.5	Dry
9	Upper Perched	03-Jan-06	29.75	145.5	115.75
9	Upper Perched	10-Feb-06	26.95	145.5	118.55
9	Upper Perched	07-Mar-06	26.84	145.5	118.66
9	Upper Perched	04-Apr-06	25.28	145.5	120.22
9	Upper Perched	04-May-06	23.52	145.5	121.98
180	Upper Perched	10-Nov-05	Dry	194.56	Dry
180	Upper Perched	03-Jan-06	76.81	194.56	117.75
180	Upper Perched	10-Feb-06	Dry	194.56	Dry
180	Upper Perched	08-Mar-06	Dry	194.56	Dry
180	Upper Perched	04-Apr-06	Dry	194.56	Dry
180	Upper Perched	03-May-06	Dry	194.56	Dry
286	Upper Perched	04-Jan-06	53.12	166.85	113.73
286	Upper Perched	13-Feb-06	50.62	166.85	116.23
286	Upper Perched	08-Mar-06	49.06	166.85	117.79
286	Upper Perched	04-Apr-06	46.37	166.85	120.48
286	Upper Perched	05-May-06	45.99	166.85	120.86
302	Upper Perched	10-Nov-05	Dry	183.51	Dry
302	Upper Perched	03-Jan-06	Dry	183.51	Dry

Table 6.6-3 April 2006 Plantwide Groundwater Data
Chemical Plant 2 Region
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Well ID	Groundwater Unit	Date	DTW (ft bgs)	Monitor Point Elev. (ft msl)	GWE (ft msl)
302	Upper Perched	13-Feb-06	Dry	183.51	Dry
302	Upper Perched	08-Mar-06	Dry	183.51	Dry
302	Upper Perched	04-Apr-06	Dry	183.51	Dry
302	Upper Perched	04-May-06	Dry	183.51	Dry
10	FWBZ	10-Nov-05	76.96	143.805	66.845
10	FWBZ	03-Jan-06	75.82	143.805	67.985
10	FWBZ	10-Feb-06	65	143.805	78.805
10	FWBZ	07-Mar-06	69.77	143.805	74.035
10	FWBZ	05-Apr-06	27.06	143.805	116.745
10	FWBZ	04-May-06	24.24	143.805	119.565
22	FWBZ	10-Nov-05	86.94	156.59	69.65
22	FWBZ	04-Jan-06	87.22	156.59	69.37
22	FWBZ	13-Feb-06	86.65	156.59	69.94
22	FWBZ	09-Mar-06	86.51	156.59	70.08
22	FWBZ	10-Apr-06	86.12	156.59	70.47
22	FWBZ	04-May-06	85.68	156.59	70.91
24	FWBZ	10-Nov-05	92.19	162.5	70.31
24	FWBZ	04-Jan-06	Dry	162.5	Dry
24	FWBZ	13-Feb-06	92.36	162.5	70.14
24	FWBZ	03-Mar-06	92.23	162.5	70.27
24	FWBZ	04-Apr-06	91.71	162.5	70.79
24	FWBZ	03-May-06	91.59	162.5	70.91
25	FWBZ	10-Nov-05	76.69	151.43	74.74
25	FWBZ	03-Jan-06	77.73	151.43	73.7
25	FWBZ	13-Feb-06	77.5	151.43	73.93
25	FWBZ	07-Mar-06	77.79	151.43	73.64
25	FWBZ	04-Apr-06	77.79	151.43	73.64
25	FWBZ	04-May-06	78.28	151.43	73.15
130	FWBZ	10-Nov-05	Dry	177.22	Dry
130	FWBZ	03-Jan-06	Dry	177.22	Dry
130	FWBZ	10-Feb-06	Dry	177.22	Dry
130	FWBZ	08-Mar-06	Dry	177.22	Dry
130	FWBZ	05-Apr-06	104.74	177.22	72.48
130	FWBZ	04-May-06	Dry	177.22	Dry
131	FWBZ	10-Nov-05	105.58	177.22	71.64
131	FWBZ	03-Jan-06	106.36	177.22	70.86
131	FWBZ	10-Feb-06	106.24	177.22	70.98
131	FWBZ	08-Mar-06	106.52	177.22	70.7
131	FWBZ	05-Apr-06	106.48	177.22	70.74
131	FWBZ	04-May-06	106.7	177.22	70.52
181	FWBZ	10-Nov-05	102.13	194.56	92.43
181	FWBZ	03-Jan-06	102.68	194.56	91.88
181	FWBZ	10-Feb-06	102.34	194.56	92.22
181	FWBZ	08-Mar-06	102.3	194.56	92.26
181	FWBZ	04-Apr-06	102.04	194.56	92.52
181	FWBZ	03-May-06	101.93	194.56	92.63
212	FWBZ	10-Nov-05	109.53	182.728	73.198
212	FWBZ	04-Jan-06	110.41	182.728	72.318
212	FWBZ	13-Feb-06	110.13	182.728	72.598
212	FWBZ	08-Mar-06	110.49	182.728	72.238
212	FWBZ	04-Apr-06	110.34	182.728	72.388
212	FWBZ	04-May-06	110.87	182.728	71.858
215	FWBZ	10-Nov-05	107.95	181.95	74
215	FWBZ	03-Jan-06	109.28	181.95	72.67
215	FWBZ	13-Feb-06	108.99	181.95	72.96
215	FWBZ	08-Mar-06	109.38	181.95	72.57
215	FWBZ	04-Apr-06	109.21	181.95	72.74
215	FWBZ	04-May-06	109.76	181.95	72.19
303	FWBZ	10-Nov-05	95.03	185.36	90.33

Table 6.6-3 April 2006 Plantwide Groundwater Data
Chemical Plant 2 Region
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Well ID	Groundwater Unit	Date	DTW (ft bgs)	Monitor Point Elev. (ft msl)	GWE (ft msl)
303	FWBZ	03-Jan-06	95.76	185.36	89.6
303	FWBZ	10-Feb-06	95.61	185.36	89.75
303	FWBZ	07-Mar-06	95.49	185.36	89.87
303	FWBZ	04-Apr-06	95.17	185.36	90.19
303	FWBZ	03-May-06	94.62	185.36	90.74
355	FWBZ	10-Nov-05	Dry	173.34	Dry
355	FWBZ	04-Jan-06	102.05	173.34	71.29
355	FWBZ	10-Feb-06	Dry	173.34	Dry
355	FWBZ	08-Mar-06	101.85	173.34	71.49
355	FWBZ	04-Apr-06	101.88	173.34	71.46
355	FWBZ	03-May-06	101.81	173.34	71.53
685	FWBZ	10-Nov-05	53.08	138.8	85.72
685	FWBZ	04-Jan-06	Obst	138.8	Obst
685	FWBZ	25-Jan-06	54.16	138.8	84.64
685	FWBZ	10-Feb-06	54.27	138.8	84.53
685	FWBZ	07-Mar-06	54.39	138.8	84.41
685	FWBZ	04-Apr-06	54.44	138.8	84.36
685	FWBZ	04-May-06	52.43	138.8	86.37
3043	FWBZ	10-Nov-05	87.55	152.324	64.774
3043	FWBZ	04-Jan-06	87.55	152.324	64.774
3043	FWBZ	10-Feb-06	87.2	152.324	65.124
3043	FWBZ	08-Mar-06	87.2	152.324	65.124
3043	FWBZ	05-Apr-06	87.2	152.324	65.124
3043	FWBZ	04-May-06	87.19	152.324	65.134
3048	FWBZ	10-Nov-05	73.36	142.53	69.17
3048	FWBZ	04-Jan-06	74.43	142.53	68.1
3048	FWBZ	10-Feb-06	74.7	142.53	67.83
3048	FWBZ	09-Mar-06	75.03	142.53	67.5
3048	FWBZ	05-Apr-06	75.5	142.53	67.03
3048	FWBZ	04-May-06	75.75	142.53	66.78
3222	FWBZ	10-Nov-05	74.61	148.35	73.74
3222	FWBZ	03-Jan-06	75.59	148.35	72.76
3222	FWBZ	13-Feb-06	75.31	148.35	73.04
3222	FWBZ	07-Mar-06	75.6	148.35	72.75
3222	FWBZ	04-Apr-06	75.56	148.35	72.79
3222	FWBZ	04-May-06	76.09	148.35	72.26
3233	FWBZ	10-Nov-05	74.02	148.014	73.994
3233	FWBZ	03-Jan-06	75.01	148.014	73.004
3233	FWBZ	10-Feb-06	74.79	148.014	73.224
3233	FWBZ	07-Mar-06	75.11	148.014	72.904
3233	FWBZ	04-Apr-06	75.16	148.014	72.854
3233	FWBZ	04-May-06	75.68	148.014	72.334
3244	FWBZ	10-Nov-05	Dry	174.9	Dry
3244	FWBZ	03-Jan-06	Dry	174.9	Dry
3244	FWBZ	10-Feb-06	Dry	174.9	Dry
3244	FWBZ	04-Apr-06	104.58	174.9	70.32
3244	FWBZ	04-May-06	Dry	174.9	Dry
3292	FWBZ	10-Nov-05	107.25	180.45	73.2
3292	FWBZ	03-Jan-06	108.65	180.45	71.8
3292	FWBZ	13-Feb-06	108.42	180.45	72.03
3292	FWBZ	08-Mar-06	108.78	180.45	71.67
3292	FWBZ	05-Apr-06	108.75	180.45	71.7
3292	FWBZ	04-May-06	109.09	180.45	71.36
3348	FWBZ	10-Nov-05	107.53	179.6	72.07
3348	FWBZ	03-Jan-06	108.51	179.6	71.09
3348	FWBZ	13-Feb-06	108.24	179.6	71.36
3348	FWBZ	08-Mar-06	108.6	179.6	71
3348	FWBZ	04-Apr-06	108.48	179.6	71.12
3348	FWBZ	04-May-06	108.79	179.6	70.81

Table 6.6-3 April 2006 Plantwide Groundwater Data
Chemical Plant 2 Region
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Well ID	Groundwater Unit	Date	DTW (ft bgs)	Monitor Point Elev. (ft msl)	GWE (ft msl)
3440	FWBZ	10-Nov-05	103.15	168.25	65.1
3440	FWBZ	04-Jan-06	Dry	168.25	Dry
3440	FWBZ	10-Feb-06	102.84	168.25	65.41
3440	FWBZ	08-Mar-06	102.93	168.25	65.32
3440	FWBZ	04-Apr-06	102.4	168.25	65.85
3440	FWBZ	03-May-06	102.48	168.25	65.77
3642	FWBZ	30-Nov-05	110.57	183.29	72.72
3642	FWBZ	04-Jan-06	111.7	183.29	71.59
3642	FWBZ	13-Feb-06	111.54	183.29	71.75
3642	FWBZ	08-Mar-06	111.87	183.29	71.42
3642	FWBZ	05-Apr-06	111.84	183.29	71.45
3642	FWBZ	04-May-06	112.1	183.29	71.19
3645	FWBZ	30-Nov-05	121.13	198.2	77.07
3645	FWBZ	04-Jan-06	121.7	198.2	76.5
3645	FWBZ	10-Feb-06	121.42	198.2	76.78
3645	FWBZ	07-Mar-06	121.33	198.2	76.87
3645	FWBZ	04-Apr-06	121.16	198.2	77.04
3645	FWBZ	04-May-06	121.49	198.2	76.71
3656	FWBZ	01-Dec-05	85.55	158.62	73.07
3656	FWBZ	04-Jan-06	86.91	158.62	71.71
3656	FWBZ	10-Feb-06	86.77	158.62	71.85
3656	FWBZ	08-Mar-06	87.1	158.62	71.52
3656	FWBZ	05-Apr-06	87.06	158.62	71.56
3656	FWBZ	04-May-06	87.4	158.62	71.22
3657	FWBZ	01-Dec-05	84.94	157.91	72.97
3657	FWBZ	04-Jan-06	86.25	157.91	71.66
3657	FWBZ	10-Feb-06	86.1	157.91	71.81
3657	FWBZ	08-Mar-06	86.44	157.91	71.47
3657	FWBZ	05-Apr-06	86.41	157.91	71.5
3657	FWBZ	04-May-06	86.74	157.91	71.17
3659	FWBZ	30-Nov-05	73.27	141.55	68.28
3659	FWBZ	04-Jan-06	74.61	141.55	66.94
3659	FWBZ	10-Feb-06	75.07	141.55	66.48
3659	FWBZ	09-Mar-06	75.41	141.55	66.14
3659	FWBZ	10-Apr-06	76.09	141.55	65.46
3659	FWBZ	04-May-06	76.67	141.55	64.88

Key:
DTW = Depth to water
ft bgs = feet below ground surface
ft msl = Feet above mean sea level
GWE = Groundwater potentiometric surface elevation
FWBZ = First water-bearing zone
Obst = Obstructed

7.0 *SUMMARY AND RESULTS OF REMEDIAL INVESTIGATION – AREA 39*

Aerojet Area 39 encompasses approximately 90 acres within the 835-acre Prairie City State Vehicular Recreation Area (SVRA) that is owned and operated by the State of California (County of Sacramento Department of Parks and Recreation). Rocket test facilities were constructed within Area 39 by Aerojet in the 1960s, but the programs were halted and the facilities were never used. Area 39 was used between 1970 and 1972 for burning chemical wastes generated by Aerojet.

Numerous off-road vehicle roads and trails traverse Area 39 and as a result, many of the surface features associated with former operations conducted by Aerojet have been altered or completely eliminated.

This section provides a description of Area 39, including the environmental setting, and a discussion regarding the presence and distribution of chemicals in both the vadose zone and groundwater. Additionally, the following information is presented for each of the sites:

- A summary of background information, including historical operations and activities;
- A summary of the scope and results of previous (prior to 2005) investigations;
- Chemicals of potential concern (COPCs) identified during the previous investigations;
- Presents the data needs identified in the *Remedial Investigation/Feasibility Study Field Sampling Plan for Boundary Operable Unit* (BOU FSP) (Aerojet et al., 2006b);
- A summary of the sampling activities performed during the Boundary Operable Unit (BOU) Remedial Investigation (RI) and deviations from the sampling proposed in the BOU FSP;
- Presents the analytical results for samples collected during the BOU RI and historical data, where appropriate; and
- Provides a discussion of the investigation results, which includes the identification of COPCs; lateral and vertical characterization of COPCs; fate and transport of the COPCs; and the potential for those COPCs to impact human health, surface water, and groundwater.

The information presented was compiled from one or more of the following sources: *Stage 1 Sampling Plan-Zone 1* (Aerojet, 1993a); *Stage 1 Sampling Plan-Zones 3 and 4* (Aerojet, 1993b); *Stage 1 Sampling Plan-Zone 2* (Aerojet, 1993c); *Aerojet Superfund Site – Scoping Report, Volumes 1 through 6* (ICF Technology, Inc., 1989); *Aerojet Site Stage 1 Report - Zones 1 through 4* (ICF Kaiser Engineers, Inc., 1993); or the BOU FSP (Aerojet et al., 2006).

7.1 ENVIRONMENTAL SETTING – AREA 39

The topography, geology, soils, surface water hydrology, general hydrogeology, and ecological habitat of Area 39 are described in the following subsections.

7.1.1 Topography

The topography of Area 39 consists of rolling hills and ravines with elevations ranging from approximately 220 to 330 feet above mean sea level (msl). The man-made ravine/blast apron constructed as part of the former K-1 Test Stand for the control of deluge water during testing is approximately 25 to 30 feet below grade at its deepest point and is a predominant topographic feature in the area. The ravine/blast apron also serves as the headwaters for the main surface water drainage feature within Area 39.

7.1.2 Geology

Area 39 is located in the southeastern portion of the Prairie City SVRA. The western areas of the SVRA were dredged for gold; however, the potential source areas are located on undredged sediments. Drill logs and exposed outcrops indicate that the majority of sediment comprising the vadose zone is fine-grained, generally consisting of interbedded layers of dense, indurated, sandstone, sandy and gravelly siltstone, and claystone. Exceptions occur in some areas where coarse sand channels of the Mehrten Formation are incised into the finer-grained materials. The vadose zone ranges in thickness from 20 to 70 feet. The general subsurface lithologies for Area 39 are shown on figures presented in Section 7.2.3.3.

7.1.3 Soils

Area 39 soils are made up of four distinct map units: Hadselville-Pentz complex, 2 to 30 percent slopes; Pentz-Lithic Xerorthents complex, 30 to

40 percent slopes; Red Bluff-Xerarents dredge tailings complex, 2 to 50 percent slopes; and Redding gravelly loam, 0 to 8 percent slopes. The following text provides a brief description of each soil unit from the soil survey of Sacramento County, California (United States Department of Agriculture – Natural Resources Conservation Service, 1993).

The Hadselville-Pentz complex, 2 to 30 percent slopes unit, is found on hills. Slopes are complex and are characterized by mound-intermound microrelief. This unit is about 45 percent Hadselville soil and 45 percent Pentz soil. The Hadselville soil is in the intermound areas. The Pentz soil is on the mounds. Included in this unit are small areas of Hicksville, Keyes, Ranchoseco, Pardee, Peters, and Redding soils and Lithic Xerorthents. Also included are areas that have slopes of 30 to 50 percent and soils that have a subsoil of sandy clay loam and are underlain by weakly consolidated sediments at a depth of 20 to 40 inches. Included areas make up about 10 percent of the total acreage.

The Pentz-Lithic Xerorthents complex, 30 to 40 percent slopes map unit, is on the side slopes of hills. Slopes are convex or plane. This unit is about 80 percent Pentz soil and 15 percent Lithic Xerorthents. Lithic Xerorthents are in scattered areas where the underlying sediments are strongly consolidated and hard. Included in this unit are small areas of Keyes and Redding soils and Rock outcrop. Keyes soils are in concave areas at the base of the slopes. Redding soils are on high terrace remnants. The Rock outcrop occurs as horizontal bands and ledges. Also included are soils that have slopes of less than 30 percent or more than 50 percent and soils that have a subsoil of sandy clay loam and are underlain by consolidated sediment at a depth of about 20 to 30 inches. Included areas make up about 5 percent of the total acreage.

The Red Bluff-Xerorthents dredge tailings complex, 2 to 50 percent slopes map unit, is on high terraces that have been disturbed during mining activities. Slopes are complex. This unit is about 45 percent Red Bluff soil and 40 percent Xerorthents. The Red Bluff soil is in the relatively undisturbed areas on terraces where slopes are 2 to 5 percent and are convex. The Xerorthents are in dredge tailings where slopes are 2 to 50 percent and are short, complex, and disturbed. Included in this unit are small areas of Corning, Hicksville, and Redding soils and Slickens. Hicksville soils are on low-stream terraces. Slickens are at the base of the slopes in the areas of tailings. Also included are soils that have a hardpan layer at a depth of 40 to 60 inches and soils that have slopes of 5 to 30 percent. Included areas make up about 15 percent of the total acreage.

The Redding gravelly loam, 0 to 8 percent slopes map unit, is a moderately deep, moderately well-drained soil on high terraces and terrace remnants. It formed in gravelly and cobbly alluvium derived from mixed rock sources. Slopes are dominantly convex, but are incised by many shallow intermittent drainage ways and depressions. Typically, the surface layer is strong brown gravelly loam about 7 inches thick. The upper 13 inches of the subsoil is yellowish red loam and gravelly loam. The lower 8 inches is a claypan of reddish brown and yellowish red gravelly clay. A very gravelly clay hardpan that is strongly cemented with silica is at a depth of about 28 inches. In some areas, the surface layer is gravelly sandy loam. In other areas, the subsoil has a very gravelly strata. Included in this unit are small areas of Corning, Hicksville, Keyes, and Pardee soils and Xerorthents. Hicksville soils are on low-stream terraces. Keyes and Pardee soils are on hills. Red Bluff soils are on the slightly higher, convex slopes north of the Consumnes River. Also included are Durixeralfs and Xerarents in areas that have been cut and filled during land leveling or grading activities, soils that have a hardpan at a depth of 40 to 60 inches, and soils on the side slopes of terraces that have slopes of 8 to 15 percent. Included areas make up about 25 percent of the total acreage.

7.1.4 *Surface Water Hydrology*

There are no naturally occurring lakes, rivers, or streams within Area 39 that contain water on a year-round basis. However, there are several drainages that may support ephemeral streams or storm water runoff during the rainy season. Surface water runoff at Area 39 is towards the south-southeast and into Coyote Creek, beyond the boundary presented in Figure 7.1-1.

There are two local drainages within Area 39. One drainage originates near the east end of the former K-1 Rocket Test Stand (Site 29B) blast apron and trends southeast to the southern perimeter of Area 39. Two ponds are located along the course of the drainage. The ponds were not present during the Stage 1 RI, and were apparently created by the construction of two small earthen dams across the drainage channel. For reference, the northern pond has been designated as A39-Pond 1 and the southern pond was designated A39-Pond 2 (Figure 7.1-1).

The second drainage originates near the top of the hill in the central portion of Source Area 30B, the former Production Waste Burn Area. The drainage is joined by other smaller drainages and trends towards the

south-southwest and the southern perimeter of Area 39 and eventually into Coyote Creek.

All these drainages are crisscrossed by tracks left by off-road vehicles operating within the SVRA.

7.1.5 Local Hydrogeology

The first saturated sediments encountered beneath Area 39 are either part of perched groundwater or within the first water-bearing zone (FWBZ). The general hydrogeology of the perched groundwater and FWBZ beneath Area 39 is discussed below. Details regarding the occurrence of groundwater within Area 39 and the distribution of chemicals in the groundwater are presented in Section 7.4.

7.1.5.1 Perched Groundwater

Perched groundwater is the shallowest saturated unit and generally occurs in 5- to 25-feet-thick sand lenses throughout Area 39. As discussed in Section 7.1.2, the lithologic material within Area 39 consists of indurated sedimentary units, which were not dredged for gold. Because the area was not dredged, perched groundwater is present within the permeable sand lenses as opposed to the contact between dredged and undredged materials as observed in most other areas within the BOU. Due to the variable topography and the existence of water in the sand lenses, perched groundwater is encountered within Area 39 at depths ranging from 9 to 75 feet below ground surface (bgs). Depth to perched groundwater is greater along the hills and ridges and shallower closer to the drainages.

Due to the relatively impermeable lithologic material within Area 39, most precipitation flows off the site instead of infiltrating into the soil. As a result, perched groundwater in Area 39 does not demonstrate significant seasonal variations.

7.1.5.2 First Water-Bearing Zone

The FWBZ within Area 39 occurs in 5- to 10-feet-thick sand lenses that generally correspond to the upper portion of Layer C of the *Western Groundwater Operable Unit Groundwater Flow Model* (Aerojet, 2004d). In May 2007, the depth to the top of the FWBZ ranged from approximately 38 to 109 feet bgs. Depth to the FWBZ is generally greater near ridges, and shallower near drainages.

As with the perched groundwater, the FWBZ at Area 39 demonstrates a relatively small degree of seasonal fluctuation relative to the other sites investigated within the BOU. Groundwater flow in the FWBZ across Area 39 is generally to the southwest with a gradient of approximately 0.02 feet per foot (ft/ft).

7.1.6 Ecological Habitat

Area 39 is located on a State of California-operated off-highway vehicle (OHV) park. The park is called the Prairie City SVRA. The entire park is scattered with OHV trails, most are unpaved; however, there are some paved main roads. Area 39 is mainly ruderal/disturbed annual grassland habitat, intermixed with some paved areas, and a few seasonal ponds.

The ruderal/disturbed annual grassland community is dominated by herbaceous weeds, and non-native, naturalized Mediterranean grasses. Fauna species common to this area are habitat generalists such as the rock pigeon, mourning dove, western fence lizard, European starling, house mouse, and deer mouse, or species that may venture in from adjacent vegetation communities. Because Area 39 is located on land owned by the State of California, the *Biological Assessment Report* (ECORP Consulting, Inc., 2005) for the BOU did not include a survey of Area 39.

7.2 SUMMARY AND RESULTS OF VADOSE ZONE REMEDIAL INVESTIGATION – AREA 39

Area 39 encompasses seven source areas (29B, 30B, 31B, 32B, 33B, 34B, and 35B) that include former test stands and areas used for the burning of laboratory wastes and propellants (Figure 7.1-1).

7.2.1 Description of Source Areas – Area 39

Area 39 includes Source Areas 29B through 35B encompassed within an approximate 90-acre parcel within the Prairie City SVRA, owned by the State of California (Figure 7.1-1). The source areas and historical activities conducted in each area are described below.

<u>Source Area 29B</u>

Source Area 29B is the Test Stand Burn Area. The Test Stand Burn Area is within a 50-feet-deep ravine/blast apron that extends approximately 100 feet southeast of Building 39007 (former K-1 Test Stand) (Figure 7.1-1).

The ravine/blast apron was cut into the underlying bedrock during construction of the former K-1 Test Stand (Building 39007).

A concrete pad extends from the base of the former test stand approximately 300 feet to the southeast into the ravine/blast apron. Oxidizers were reportedly burned on the pad from 1970 to 1972. The K-1 Test Stand was destroyed with explosives by the U.S. Army in 1975 under direction from Sacramento County (ICF Kaiser Engineers, Inc., 1993). The first 300 feet of the ravine/blast apron was partially filled using debris generated during the demolition and borrowed material from a gravel hill. Portions of the concrete pad that were partially buried during demolition of the K-1 Test Stand were subsequently excavated by the Department of Parks and Recreation. A representative of the County in charge of development of the OHV Park indicated that law enforcement officials had used the concrete pad at the southeast end of the canyon site to detonate confiscated explosives. The area is fenced and public access is limited to the pistol shooting range in the northwest end of the ravine/blast apron.

Source Area 30B

Source Area 30B is the former Production Waste Burn Area located approximately 1,200 feet southeast of former K-1 Test Stand (Building 39007) (Figure 7.1-1).

The former burn area is a nearly level plateau surrounded by slopes dipping or rising from approximately 5 to 15 degrees. Materials were burned in trenches dug southwest of Source Area 34B (Chemical Storage Pad). Most of Source Area 30B is covered by seasonal vegetation. Visual evidence of Aerojet's activity at the site is limited to the remains of trenches left by earth-moving equipment and occasional scraps of metal (ICF Kaiser Engineers, Inc., 1993). The area is currently fenced from the public and is not presently used for off-road vehicle activities.

Source Area 31B

Source Area 31B is the former Igniter/Small Rocket Motor Burn Area (formerly 39-K-3) approximately 1,300 feet southeast of the former K-1 Test Stand (Building 39007), and adjacent to the Chemical Storage Pad (Source Area 34B) (Figure 7.1-1).

Igniters and small rocket motors were reportedly burned at this site. Burns were reported to be infrequent, and no chemical wastes other than

oxidizers were handled. There are no physical indications of historic Aerojet activities at the site. A natural surface drainage is present on the northern perimeter of the site (ICF Kaiser Engineers, Inc., 1993). Numerous off-road trails are now present at the site and it appears heavily impacted by off-road vehicle use.

Source Area 32B

Source Area 32B is the former Oxidizer Burn Area (formerly 39-K-4), located approximately 300 feet northeast of the former K-1 Test Stand (Figure 7.1-1). Source Area 32B and adjacent Source Area 33B (former Lab Supply Burn Area) together comprise the northeast portion of Area 39.

The perimeter of the burn area is poorly defined, but is estimated to cover approximately 50,000 square feet. Several small scraps of metallic debris, along with historic aerial photographs, suggest that the Oxidizer Burn Area was located just north of the main road. The area has been heavily impacted by OHV use, along with a motor-cross racetrack, which has been constructed in the western portion of the site. The racetrack and related off-road activities have obscured any obvious signs of Aerojet's previous activities at the site.

Source Area 33B

Source Area 33B is the former Lab Supply Burn Area, located approximately 800 feet east of former K-1 Test Stand (Figure 7.1-1). Source Area 33B and adjacent Source Area 32B (a former Oxidizer Burn Area) together comprise the northeast portion of Area 39. The perimeter of this burn area is poorly defined, but is believed to be marked or covered by a partial asphalt pad. The area has been heavily impacted by OHV use and related off-road activities have obscured any obvious signs of Aerojet's previous activities at the site.

Source Area 34B

Source Area 34B is the former Chemical Storage Pad, located approximately 200 feet southeast of K-1 Test Stand (Figure 7.1-1). The Chemical Storage Pad is an asphalt pad located at the terminus of a partially visible roadway leading to the former K-1 Test Stand located in the eastern portion of Area 39 between Source Areas 30B and 31B. Burns were reportedly conducted on the pad and chemical waste drums were stored at the site prior to disposal. Numerous off-road vehicle trails are located within Source Area 34B and the site has been heavily impacted by

off-road vehicle use, which has obscured any obvious signs of Aerojet's previous activities at the site.

Source Area 35B

Source Area 35B is an area of dredge tailing located approximately 1,400 feet northwest of former K-1 Test Stand (Figure 7.1-1). Source Area 35B reportedly was not used for any Aerojet activities, but was investigated previously because of proposed developments on the site and to establish background levels for metals and perchlorate.

7.2.2 *Summary and Results of Previous (Prior to 2005) Vadose Zone Investigations – Area 39*

The following subsections summarize the scope and results of previous (prior to 2005) vadose zone investigations of the seven source areas within Area 39; identify COPCs based on the previous investigations; and discuss the data quality objectives (DQOs) and sampling proposed in the BOU FSP.

7.2.2.1 *Summary of Previous (Pre-2005) Vadose Zone Investigations – Area 39*

Over 250 soil samples and roughly 35 soil vapor samples were collected at Source Areas 29B through 35B between 1985 and 1993. Soil vapor samples were analyzed for volatile organic compounds (VOCs). Soil samples were analyzed for VOCs, semivolatile organic compounds (SVOCs), metals, perchlorate, N-nitrosodimethylamine (NDMA), and/or dioxins and furans. Previous investigations of those source areas are summarized below. The purposes of the previous investigations are discussed in Section 2.7.

Source Area 29B

Previous vadose zone investigations were conducted at Source Area 29B between 1984 and 2002. The scope of those investigations is outlined below:

- 1985 – Fifty-six soil samples were collected around the Test Stand Burn Area (Source Area 29B) at depths ranging from surface to 4.4 feet bgs. Soil samples were also collected at depths ranging from surface to 21 feet bgs at one location. Selected soil samples were analyzed for various constituents including VOCs, metals, perchlorate, and NDMA.

- 1993 – Six soil vapor samples were collected to depths up to 10 feet bgs and analyzed for VOCs. Soil vapor samples were not collected at depths greater than 10 feet due to the presence of hard, indurated, and/or low permeability material.

Source Area 30B

Previous vadose zone investigations were conducted at Source Area 30B between 1985 and 1993. The scope of those investigations is outlined below:

- 1985 – Seventy-two soil samples were collected at 27 locations at depths ranging from surface to 2.4 feet bgs. Additionally, 36 soil samples were collected from two soil borings (AH 796 and AH 797) at depths ranging between surface and 31 feet bgs. Selected samples were analyzed for various constituents including VOCs, perchlorate, metals, dioxins and furans, and NDMA.
- 1993 – Five soil vapor samples were collected at a depth of 10 feet bgs and analyzed for VOCs. Additionally, a grab groundwater sample was collected at a depth of 45 feet bgs at one location and analyzed for VOCs.

Source Area 31B

Previous vadose zone investigations were conducted at Source Area 31B in 1995 and 1993. The scope of those investigations is outlined below:

- 1985 – Thirty-five surface and/or near-surface soil samples were collected at 10 locations to define the lateral extent of potential chemical wastes burned at Source Area 31B. Additionally, seven subsurface soil samples were collected at one location. Selected samples were analyzed for VOCs, perchlorate, and metals.
- 1993 – Near-surface soil samples and samples from one boring were collected at Source Area 31B and analyzed for perchlorate and dioxins and furans. Soil vapor samples were collected at a depth of 10 feet bgs and analyzed for VOCs. In addition, a grab groundwater sample was collected from the boring at a depth of 19 feet bgs and analyzed for VOCs.

Source Area 32B

Previous vadose zone investigations were conducted at Source Area 32B in 1995 and 1993. The scope of those investigations is outlined below:

- 1985 – Soil samples were collected from eight borings at depths between surface and 25.5 feet bgs and analyzed for VOCs, metals, and perchlorate.
- 1993 – Soil vapor samples were collected at a depth of 10 feet bgs at six locations and analyzed for VOCs.

Source Area 33B

Previous vadose zone investigations were conducted at Source Area 33B in 1985, 1992, and 1993. The scope of those investigations is outlined below:

- 1985 – Soil samples were collected from seven borings at depths between 0.25 and 17.25 feet bgs and analyzed for metals and perchlorate.
- 1992 – Soil vapor samples were collected at depths ranging from 3.5 to 10 feet bgs at seven locations and analyzed for VOCs.
- 1993 – A soil vapor sample was collected at a depth of 8 feet bgs at one location and analyzed for VOCs. In addition, soil samples were collected at depths ranging from 1 to 20 feet bgs from two borings and analyzed for SVOCs.

Source Area 34B

Previous vadose zone investigations were conducted at Source Area 34B in 1985, 1992, and 1993. The scope of those investigations is outlined below:

- 1985 – Soil samples were collected from seven borings at depths up to 20 feet bgs and analyzed for VOCs, metals, and perchlorate.
- 1992 – Soil vapor samples were collected at a depth of 10 feet bgs at two locations and analyzed for VOCs. In addition, soil samples were collected from one boring and analyzed for dioxins and furans.
- 1993 – Soil samples were collected from one soil boring advanced to a depth of 20 feet bgs and analyzed for SVOCs.

Source Area 35B

Previous vadose zone investigations were conducted at Source Area 35B in 1985 and 1993. The scope of those investigations is outlined below:

- 1985 – Soil samples were collected between surface and 1.75 feet bgs at 12 locations and analyzed for VOCs, metals, and perchlorate.
- 1993 – Soil vapor samples were collected at a depth of 10 feet bgs at three locations and analyzed for VOCs.

7.2.2.2 *Results of Previous (Pre-2005) Vadose Zone Investigation – Area 39*

The results of the previous (prior to 2005) investigations of Source Areas 29B through 35B in Area 39, as presented in the BOU FSP (Aerojet et al., 2006), are summarized below.

Review of the previous data identified the following COPCs in soil and/or soil vapor within the source areas within Area 39:

- **Soil –** VOCs, SVOCs, metals, perchlorate, dioxins and furans, and metals.
- **Soil Vapor –** VOCs.

Figures showing previous sampling locations at the source areas within Area 39 and chemical groups detected in soil samples collected between 1991 and 2005 above human health and ecological screening levels were presented in the BOU FSP (Aerojet et al., 2006) and are included in Appendix E. The BOU FSP also presented a summary of statistics and the sample results for chemicals detected in soil, soil vapor, and groundwater that exceed human health and ecological screening levels in Area 39.

7.2.2.3 *Summary of Data Needs – Area 39*

Based on a review of the previous vadose zone investigation data, extensive aerial photograph research and review, and exhaustive research of historical documents, Aerojet determined that additional soil and soil vapor sampling was needed in Area 39 to:

- Characterize the present lateral and vertical extent of VOCs, SVOCs, metals, perchlorate, and/or dioxins and furans in the vadose zone at the source areas at concentrations that could potentially impact human and ecological receptors;
- Evaluate the potential for chemicals in soil to degrade surface or groundwater quality; and
- Obtain sufficient data to support fate and transport modeling, evaluate risk to human and ecological receptors, and evaluate potential remedial alternatives.

It should be noted that due to the time lapse (12 years) since the Stage 1 RI was performed and the elevated laboratory reporting limits for VOCs during that investigation, the investigation of VOCs performed during the BOU RI was designed to supersede all previous soil vapor and soil VOC investigation results.

7.2.3 *Summary and Results of Boundary Operable Unit Vadose Zone Investigation – Area 39*

The following subsections summarize the BOU investigation (2005 to 2007) of the seven source areas in Area 39, describe deviations from sampling proposed in the BOU FSP, and present the results of the BOU RI. The results of the sampling with respect to the completeness of the characterization and identification of potential sources are discussed in Section 7.2.4.

7.2.3.1 *Summary of Boundary Operable Unit Vadose Zone Investigation – Area 39*

The BOU RI of the vadose zone at the source areas (29B, 30B, 31B, 32B, 33B, 34B, and 35B) within Area 39 included the following activities.

Soil Vapor Investigation

- A total of 63 primary and 5 duplicate soil vapor samples were collected at 32 locations at the seven source areas within Area 39 and analyzed for VOCs. The VOC analysis included an evaluation of the presence of tentatively identified compounds (TICs). Soil vapor sampling locations are shown in Figure 7.2-1.
- The number of soil vapor samples (including quality assurance/ quality control [QA/QC] samples) collected at each of the seven source areas, along with the analytical methods, are provided on Table 7.2-1.
- Soil vapor sampling locations associated with each of the seven source areas within Area 39 are listed on Table 7.2-2.

Surface and Subsurface Soil Investigation

- A total of 36 primary and one duplicate surface and/or near-surface (0 to 2.5 feet bgs) soil samples and 36 primary and one duplicate subsurface (2.6 to 32 feet bgs) soil samples were collected at the seven source areas within Area 39. Surface and subsurface soil sampling locations are shown in Figures 7.2-2 and 7.2-3, respectively.

- Surface and/or near-surface soil samples were analyzed for SVOCs, metals, perchlorate, dioxins and furans, total organic carbon (TOC), cation exchange capacity (CEC), Waste Extraction Test using deionized water (DI-WET), and/or geotechnical parameters. The SVOC analysis of soil samples also included an evaluation of the presence of TICs. In accordance with the BOU FSP, sample analysis was based on the analytical results from previous investigations and, therefore, every sample was not analyzed for the full suite of constituents.
- Subsurface soil samples were analyzed for metals, perchlorate, TOC, CEC, DI-WET, and/or geotechnical parameters. The SVOC analysis of soil samples also included an evaluation of the presence of TICs. In accordance with the BOU FSP, sample analysis was based on the analytical results from previous investigations and, therefore, every sample was not analyzed for the full suite of constituents.
- The number of surface/near-surface and subsurface soil samples collected for each analysis (including QA/QC samples) at each of the seven source areas, along with the corresponding methods, are provided on Tables 7.2-3, 7.2-4, and 7.2-5.
- Soil sampling locations associated with each of the seven source areas within Area 39 are listed on Table 7.2-2.

7.2.3.2 *Deviations from Boundary Operable Unit Data Quality Objectives and Sampling Design – Area 39*

Sampling activities conducted at the source areas (29B through 35B) within Area 39 during the BOU RI were generally consistent with those proposed by the BOU FSP, with the exceptions listed on Tables 7.2-6 and 7.2-7. Sampling was performed at locations proposed in the BOU FSP and step-out sampling was performed in accordance with the procedures agreed upon with the agencies. A comparison of proposed and actual sampling activities, including sampling rationale, sample depth, and analyses, is provided on Tables 7.2-6 and 7.2-7. Soil and soil vapor sampling locations associated with each of the seven source areas within Area 39 are listed on Table 7.2-2.

7.2.3.3 *Results of Boundary Operable Unit Vadose Zone Investigation Results – Area 39*

The results of the VOC, metals, SVOC, perchlorate, dioxin and furan, TOC, CEC, DI-WET, and geotechnical analyses of the samples collected at the source areas within Area 39 during the BOU RI are summarized

below. The analytical results for all soil vapor and soil samples are provided in Appendices F and G, respectively.

The analytical data are compared to screening levels to assist the reader in the identification of those constituents that may potentially be of concern. Because potential risks to human and ecological receptors are cumulative rather than dependent on a single constituent, no constituents were eliminated from further evaluation of potential migration or risk based on the comparison. The potential risk posed by chemicals detected in soil, soil vapor, surface water, and groundwater to human and ecological receptors is addressed in *Volume II – Human Health and Ecological Risk Assessment*.

Summary of Investigation and Results – Volatile Organic Compounds

Based on evaluation of the existing data for the source areas within Area 39, the BOU FSP concluded that additional soil vapor sampling was needed to sufficiently characterize the nature and extent of VOCs. As indicated on Table 7.2-1 and below, 63 primary soil vapor samples were collected at 32 locations at Source Areas 29B through 35B within Area 39 and analyzed for VOCs. Additionally, the presence of TICs was evaluated as part of the VOC analysis.

Source Area	Depth (ft bgs)	No. of Primary Samples	No. of Locations
30B	0-10	13	13
	11-20	10	10
32B	0-10	5	5
	11-20	6	5
	21-30	0	0
	>30	1	1
33B	0-10	13	13
	11-20	12	12
	21-30	0	0
	>30	1	1
35B	0-10	1	1
	11-20	1	1

The analytical results for the soil vapor samples collected from the shallow (0 to 10 feet bgs), intermediate (11 to 20 feet bgs), and very deep (greater than 30 feet bgs) intervals at Source Areas 29B through 35B within Area 39 are presented in Appendix F and summarized below. Soil vapor samples were not collected from the deep (21 to 30 feet bgs) interval within Area 39. Soil vapor sampling locations at Source Areas 29B through 35B

are shown in Figure 7.2-1. Soil vapor sampling locations associated with each of the seven source areas within Area 39 are listed on Table 7.2-2.

Trichloroethene (TCE), carbon tetrachloride (Carbon Tet), chloroform, and total volatile organic compound (TVOC) concentrations above their respective Remedial Investigation Screening Levels (RISLs) in the shallow, intermediate, deep, and very deep intervals within Area 39 are shown in Figure 7.2-4a. Additionally, TVOC concentrations above the RISL are also shown in Figure 7.2-4b. TCE, Carbon Tet, and chloroform concentrations above their respective protection of groundwater (PGW) soil screening levels (SSLs) are shown in Figure 7.2-5.

The TVOC concentrations illustrated in Figures 7.2-4a and 7.2-4b represents the sum of the ratio of the concentration for each detected VOC in the sample divided by its RISL. For example, if PCE at a concentration of 320 micrograms per cubic meter ($\mu g/m^3$) and TCE at a concentration of 961 $\mu g/m^3$ were the only VOCs detected in the samples, then the sum of their respective concentrations divided by their respective RISLs of 320 and 961 $\mu g/m^3$ would be 2, or:

$$PCE = \frac{320\,\mu g/m^3}{320\,\mu g/m^3} = 1$$

$$TCE = \frac{961\,\mu g/m^3}{961\,\mu g/m^3} = 1$$

$$TVOC\ Ratio = 2$$

As agreed upon with the agencies, soil vapor would be characterized during the BOU RI to the point where the TVOC concentration ratio was less than or equal to 10.

Cross sections presenting generalized vadose zone lithology and soil vapor sampling results in Area 39 are presented in Figures 7.2-6 and 7.2-7. Additional discussion of soil vapor investigation results for the seven source areas within Area 39 is presented in Section 7.2.4.1.

Shallow Soil Vapor (0 to 10 feet bgs) – Volatile Organic Compounds:

- Thirty-two primary and four duplicate soil vapor samples were collected from the shallow interval at 32 locations at Source Areas 30B, 32B, 33B, and 35B within Area 39 and analyzed for VOCs, including TICs. Soil vapor sampling locations are shown in Figure 7.2-1. Soil

vapor sampling locations associated with each of the seven source areas within Area 39 are listed on Table 7.2-2.

- Benzene, Carbon Tet, chloroform, 1,1-dichloroethene (1,1-DCE), PCE, and TCE were the only VOCs detected in the shallow soil vapor at concentrations above their respective RISLs. Shallow soil samples having concentrations of those VOCs above their RISLs are listed on the table below. Concentrations of TCE, Carbon Tet, chloroform, and TVOC concentrations above their respective RISLs are shown in Figure 7.2-4a. Concentrations of TVOCs above the RISL are also shown in Figure 7.2-4b.
- Benzene; Carbon Tet; 1,1-DCE; PCE; and TCE were also detected in the shallow soil vapor at concentrations above their respective PGW SSLs. Shallow soil vapor samples having concentrations of those VOCs above their PGW SSLs are listed on the table below. TCE was the most predominant VOC detected and at the highest concentrations. Concentrations of TCE and Carbon Tet above their respective PGW SSLs are shown in Figure 7.2-5.
- TICs identified in the VOC analysis of the shallow soil vapor sample collected at location 33B-SP16 were acetaldehyde at 6.7 parts per billion volume (ppbv); 2-methyl-1-propene at 14 ppbv; 2,4-dimethyl-hexane at 8 ppbv; and unknown at 17 ppbv. The units are reported in ppbv because the molecular weight for the TICs is uncertain and, therefore, not used to convert the units to $\mu g/m^3$.

Sample Location	Depth (ft bgs)	VOC	RISL ($\mu g/m^3$)	PGW SSL ($\mu g/m^3$)	Conc. ($\mu g/m^3$)	> RISL	> PGW SSL
32B-SP07	10	Benzene	84	35	100	Y	Y
33B-SP20	10				48	N	Y
30B-SP15	10	Carbon Tet	58	195	4,700	Y	Y
30B-SP22	10				190	Y	N
30B-SP23	10				59	Y	N
32B-SP11	10	Chloroform	83	18,595	94	Y	N
33B-SP11	10				100	Y	N
33B-SP14	10				1,600	Y	N
33B-SP21	10				2,100	Y	N
33B-SP14	10	1,1-DCE	20,805	18,180	27,000	Y	Y
33B-SP21	10				43,000	Y	Y
32B-SP11	10	PCE	320	57	77	N	Y
33B-SP14	10				24,000	Y	Y
30B-SP13	10	TCE	961	527	830	N	Y
30B-SP15	10				920	N	Y
32B-SP11	10	TCE		527	95,000	Y	Y
33B-SP11	10				1,200	Y	Y
33B-SP14	10				1,200,000	Y	Y
33B-SP15	10				920	N	Y
33B-SP20	10				16,000	Y	Y

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
33B-SP21	10				1,700,000	Y	Y

Intermediate Soil Vapor (11 to 20 feet bgs) – Volatile Organic Compounds:

- Twenty-nine primary and one duplicate soil vapor samples were collected from the intermediate interval at 28 locations at Source Areas 30B, 32B, 33B, and 35B within Area 39 and analyzed for VOCs, including TICs. Soil vapor sampling locations are shown in Figures 7.2-1, 7.2-4a, 7.2-4b, and 7.2-5. Soil vapor sampling locations associated with each of the seven source areas within Area 39 are listed on Table 7.2-2.
- Benzene, Carbon Tet, chloroform, 1,1-DCE, PCE, and TCE were detected in the intermediate soil vapor at concentrations above their respective RISLs. Intermediate soil vapor samples having concentrations of those VOCs above their RISLs are listed on the table below. Concentrations of TCE, Carbon Tet, chloroform, and TVOCs above their RISLs are shown in Figure 7.2-4a. TVOC concentrations above the RISL are also shown in Figure 7.2-4b.
- Benzene, Carbon Tet, 1,1-DCE, PCE, and TCE were also detected in the intermediate soil vapor at concentrations above their respective PGW SSLs. Intermediate soil vapor samples having concentrations of those VOCs above their PGW SSLs are listed on the table below. Concentrations of TCE and Carbon Tet above their PGW SSLs are shown in Figure 7.2-5.
- TICs identified in the VOC analysis of the intermediate soil vapor sample collected at location 33B-SP16 were acetaldehyde at 58 ppbv; 1-propene at 69 ppbv; 2-methyl-1-propene at 55 ppbv; 2,2,9-trimethyl-decane at 63 ppbv; 4-methyl-heptane at 46 ppbv; hexanal at 75 ppbv; hexane at 8 ppbv; 1,1,1,2,2,3,3,4,4,5,5,6,6-hexane at 58 ppbv; 3,6-dimethyl-octane at 51 ppbv; unknown #1 at 71 ppbv; unknown #2 at 50 ppbv; and unknown #3 at 57 ppbv. The units are reported in ppbv because the molecular weight for the TICs is uncertain and, therefore, not used to convert the units to µg/m³.

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
30B-SP13	20	Benzene	84	35	52	N	Y
30B-SP15	16				320	Y	Y
30B-SP17	20				48	N	Y
32B-SP08	20				90	Y	Y

Sample Location	Depth (ft bgs)	VOC	RISL (µg/m³)	PGW SSL (µg/m³)	Conc. (µg/m³)	> RISL	> PGW SSL
33B-SP13	20				57	N	Y
33B-SP20	20				62	N	Y
30B-SP13	20	Carbon Tet	58	195	66	Y	N
30B-SP14	20				1,700	Y	Y
30B-SP15	16				280	Y	Y
30B-SP22	20				160	Y	N
30B-SP23	20				360	Y	Y
30B-SP14	20	Chloroform	83	18,595	800	Y	N
30B-SP15	16				110	Y	N
32B-SP11	20				100	Y	N
33B-SP09	20				130	Y	N
33B-SP11	20				640	Y	N
33B-SP14	20				1,700	Y	N
33B-SP21	20				2,300	Y	N
33B-SP14	20	1,1-DCE	20,805	18,180	28,000	Y	Y
33B-SP21	20				60,000	Y	Y
30B-SP14	20	PCE	320	57	530	Y	Y
30B-SP13	20	TCE	961	527	2,500	Y	Y
30B-SP14	20				24,000	Y	Y
32B-SP11	20				130,000	Y	Y
33B-SP09	20				1,300	Y	Y
33B-SP11	20				15,000	Y	Y
33B-SP14	20				1,200,000	Y	Y
33B-SP15	20				4,300	Y	Y
33B-SP20	20				3,700	Y	Y
33B-SP21	20				1,700,000	Y	Y

Deep Soil Vapor (21 to 30 feet bgs) – Volatile Organic Compounds:

Soil vapor samples were not collected from the deep interval at Source Areas 30B, 32B, 33B, and 35B within Area 39.

Very Deep Soil Vapor (greater than 30 feet bgs) – Volatile Organic Compounds:

- Two primary soil vapor samples were collected from the very deep interval at one location (32B-SP08 at 40 feet bgs) at Source Area 32B and one location (33B-SP16 at 32 feet bgs) at Source Area 33B and analyzed for VOCs, including TICs. Very deep soil vapor sampling locations are shown in Figure 7.2-1. Soil vapor sampling locations associated with each of the seven source areas within Area 39 are listed on Table 7.2-2.
- VOCs were not detected above their respective RISLs or PGW SSLs in the very deep soil vapor collected at Source Areas 32B and 33B.

- TICs identified in the VOC analysis of the very deep (32 feet bgs) soil vapor sample collected at location 33B-SP16 were acetaldehyde at 82 ppbv; 2-methyl-1-propene at 130 ppbv; 3-methyl-heptane at 57 ppbv; 3-methylene-heptane at 55 ppbv; 1,1,1,2,2,3,3,4,4,5,5,6,6-hexane at 84 ppbv; octane at 160 ppbv; pentane at 69 ppbv; unknown #1 at 110 ppbv; unknown #2 at 160 ppbv; unknown #3 at 200 ppbv; and unknown #4 at 210 ppbv. The units are reported in ppbv because the molecular weight for the TICs is uncertain and, therefore, not used to convert the units to $\mu g/m^3$.

Summary of Investigation and Results – Metals

A total of 64 primary and two duplicate soil samples were collected at Source Areas 29B through 34B within Area 39 during the BOU RI and analyzed for metals, including mercury. The number of primary soil samples and sampling locations at Source Areas 29B, 30B, 31B, 32B, 33B, and 34B are summarized on Tables 7.2-3, 7.2-4, and 7.2-5, and below. Summary statistics for the samples are also presented on Tables 7.2-3, 7.2-4, and 7.2-5.

		Surface/Near-Surface		Subsurface	
Source Area	**Compound**	**No. of Samples**	**No. of Locations**	**No. of Samples**	**No. of Locations**
29B	Metals	9	8	15	8
	Mercury	9	8	13	8
30B	Metals	5	5	10	5
	Mercury	5	5	10	5
31B	Metals	5	3	2	1
	Mercury	5	3	2	1
32B	Metals	4	4	8	4
	Mercury	4	4	8	4
33B	Metals	2	2	2	1
	Mercury	2	2	2	1
34B	Metals	1	1	1	1
	Mercury	1	1	1	1

The results of the metals analysis of surface/near-surface and subsurface soil samples collected at the six source areas within Area 39 are presented in Appendix G and summarized below.

Metals detected in Area 39 at concentrations statistically different than background and subsequently compared to RISLs and PGW SSLs were aluminum, barium, beryllium, cadmium, silver, thallium, vanadium, and zinc. Because boron, hexavalent chromium, lithium, strontium, and

titanium were not included in the background evaluation, concentrations of these metals were also compared to screening levels.

Surface/near-surface and subsurface soil sampling locations in Area 39 are shown in Figures 7.2-2 and 7.2-3, respectively. Soil sampling locations associated with each of the seven source areas within Area 39 are listed on Table 7.2-2. Cross-sections showing the generalized lithology of the vadose zone in Area 39 are provided in Figures 7.2-6 and 7.2-7.

Surface and Near-Surface Soil – Metals:

- Twenty-six primary and one duplicate surface/near-surface soil samples were collected at 23 locations at Source Areas 29B through 34B and analyzed for metals, including mercury. Surface/near-surface sampling locations are shown in Figure 7.2-2.
- Cadmium was detected in one near-surface (1.5 feet bgs) soil sample at a concentration above their respective RISLs. The location and depth of the samples and the detected concentration of cadmium is provided in the table below and shown in Figure 7.2-8.
- Cadmium and/or thallium were detected above their respective PGW SSLs in three surface/near-surface soil samples collected at three locations in the source areas within Area 39. The location and depth of the samples and the detected concentrations of cadmium and thallium are provided in the table below. Metals detected at concentrations above their PGW SSLs are shown in Figure 7.2-8.

Sample Location	Depth (ft bgs)	Metal	RISL (mg/kg)	PGW SSL (mg/kg)	Conc. (mg/kg)	> RISL	> PGW SSL
30B-SB04	1.0	Thallium	5.0	2.5	4.6	N	Y
31B-SB02	1.5	Thallium	5.0	2.5	3.1	N	Y
33B-SB03	1.5	Cadmium	1.7	0.72	3.9	Y	Y

Subsurface Soil – Metals:

- Thirty-eight primary and one duplicate subsurface soil samples were collected at 20 locations at Source Areas 29B through 34B and analyzed for metals, including mercury. Subsurface sampling locations are shown in Figure 7.2-3.
- Thallium was detected in three subsurface soil samples collected at only two locations within Area 39 at concentrations above its RISL.

The location and depth of the samples and the detected concentrations of those metals is provided in the table below. Metals detected in subsurface soil samples above their RISLs are shown in Figure 7.2-8.

- Aluminum, cadmium, and/or thallium were detected in 20 subsurface soil samples collected at 14 locations within Area 39 at concentrations above their respective PGW SSLs. The location and depth of the samples and the detected concentrations of those metals is provided in the table below. Metals detected in subsurface soil samples above their PGW SSLs are shown in Figure 7.2-8.

Sample Location	Depth (ft bgs)	Metal	RISL (mg/kg)	PGW SSL (mg/kg)	Conc. (mg/kg)	> RISL	> PGW SSL
29B-SB06	5.0	Cadmium	1.7	0.72	0.74	N	Y
		Thallium	5.0	2.5	4.6	N	Y
29B-SB08	5.0	Thallium	5.0	2.5	3.5	N	Y
29B-SB09	5.0	Cadmium	1.7	0.72	1.5	N	Y
		Thallium	5.0	2.5	6.3	Y	Y
29B-SB10	5.0	Thallium	5.0	2.5	4.1	N	Y
29B-SB11	5.0	Thallium	5.0	2.5	3.1	N	Y
30B-SB04	5	Thallium	5.0	2.5	4.5	N	Y
	11	Thallium	5.0	2.5	2.9	N	Y
30B-SB05	5.0	Cadmium	1.7	0.72	0.75	N	Y
		Thallium	5.0	2.5	3.3	N	Y
30B-SB06	5.0	Cadmium	1.7	0.72	0.84	N	Y
		Thallium	5.0	2.5	2.9	N	Y
	11	Thallium	5.0	2.5	4.4	N	Y
30B-SB07	5.0	Thallium	5.0	2.5	3.8	N	Y
	11	Thallium	5.0	2.5	3.0	N	Y
31B-SB02	5.0	Thallium	5.0	2.5	2.6	N	Y
	11	Cadmium	1.7	0.72	0.76	N	Y
		Thallium	5.0	2.5	3.2	N	Y
	21	Cadmium	1.7	0.72	0.73	N	Y
32B-SB03	5.0	Thallium	5.0	2.5	4.5	N	Y
32B-SB04	5.0	Aluminum	76,140	43,000	69,000	N	Y
		Cadmium	1.7	0.72	0.81	N	Y
		Thallium	5.0	2.5	6.6	Y	Y
	11.5	Cadmium	1.7	0.72	0.77	N	Y
		Thallium	5.0	2.5	6.0	Y	Y
33B-SB03	5.0	Thallium	5.0	2.5	3.4	N	Y
34B-SB02	11	Thallium	5.0	2.5	3.8	N	Y

Summary of Investigation and Results – Semivolatile Organic Compounds

Four primary surface and near-surface soil samples were collected at two locations (31B-SD01 and 31B-SD02) at Source Area 31B during the BOU RI and analyzed for SVOCs, including TICs. Soil sampling locations associated with each of the seven source areas within Area 39 are listed on Table 7.2-2.

SVOCs were not detected in the surface and near-surface soil samples collected at Source Area 31B at concentrations above their respective practical quantitation limits (PQLs).

Summary of Investigation and Results – Perchlorate

A total of 63 primary and 2 duplicate soil samples were collected at Source Areas 29B through 35B within Area 39 during the BOU RI and analyzed for perchlorate. The number of primary soil samples and sampling locations at Source Areas 29B, 30B, 31B, 32B, 33B, and 34B are summarized on Tables 7.2-3, 7.2-4, and 7.2-5, and below. Summary statistics for the samples are also presented on Tables 7.2-3, 7.2-4, and 7.2-5.

		Surface/Near-Surface		Subsurface	
Source Area	**Compound**	**No. of Samples**	**No. of Locations**	**No. of Samples**	**No. of Locations**
29B	Perchlorate	9	8	14	8
30B	Perchlorate	5	5	9	5
31B	Perchlorate	5	3	2	1
32B	Perchlorate	4	4	8	4
33B	Perchlorate	2	2	2	1
34B	Perchlorate	1	1	2	1

The results of the perchlorate analysis of surface/near-surface and subsurface soil samples collected at Source Areas 29B through 34B are presented in Appendix G and summarized below. Surface and subsurface soil sampling locations are shown in Figures 7.2-2 and 7.2-3. Soil sampling locations associated with each of the seven source areas within Area 39 are listed on Table 7.2-2.

Surface and Near-Surface Soil – Perchlorate:

- Twenty-six primary and one duplicate surface/near-surface soil samples were collected at 23 locations at Source Areas 29B, 30B, 31B, 32B, 33B, 34B, and 35B and analyzed for perchlorate (Figure 7.2-2).
- Perchlorate was not detected above its RISL in any of the surface or near-surface soil samples collected at Source Areas 29B through 34B.
- Perchlorate above its PGW SSL was detected in only one surface/near-surface soil sample collected in Area 39. Perchlorate at 490 micrograms per kilogram (µg/kg) was detected in a soil sample collected at 1 foot bgs from boring 30B-SB04 (Figure 7.2-8).

Subsurface Soil – Perchlorate:

- Thirty-seven and one duplicate subsurface soil samples were collected at 22 locations at Source Areas 29B, 30B, 31B, 32B, 33B, 34B, and 35B within Area 39 and analyzed for perchlorate.
- Perchlorate was not detected at concentrations above its RISL in any of the subsurface soil samples collected at Source Areas 29B through 34B.
- Perchlorate was detected at concentrations above its PGW SSL in five subsurface soil samples collected at three locations. Concentrations of perchlorate detected above its PGW SSL along with the sample depth and location are provided in the table below. Sampling locations with perchlorate above its PGW SSL are shown in Figure 7.2-8.

Sample Location	Depth (ft bgs)	Compound	RISL (µg/kg)	PGW SSL (µg/kg)	Conc. (µg/kg)	< RISL	< PGW SSL
29B-SB07	4.5	Perchlorate	7,800	60	77	N	Y
						N	Y
30B-SB04	5.0	Perchlorate	7,800	60	230	N	Y
	11				110	N	Y
33B-SB03	5.0	Perchlorate	7,800	60	750	N	Y
	11				1,600	N	Y

Summary of Investigation and Results – Dioxins and Furans

A total of 16 primary soil samples were collected at eight locations at Source Areas 30B and 34B within Area 39 during the BOU RI and analyzed for dioxins and furans (Figure 7.2-8). The number of primary soil samples and sampling locations at Source Areas 30B and 34B for dioxins and furans are summarized on Tables 7.2-3 and 7.2-5, respectively,

and below. Summary statistics for the samples are also presented on Tables 7.2-3 and 7.2-5.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
30B	Dioxins & Furans	10	5	0	0
34B	Dioxins & Furans	6	3	0	0

The results of the dioxin and furan analysis of the surface/near-surface samples collected at Source Areas 30B and 34B are presented in Appendix G and summarized below. Calculation of the Toxic Equivalency Quotients (TEQs) for dioxins and furans are presented in Appendix B of the Human Health and Ecological Risk Assessment (HHERA) (Volume II of the BOU RI/FS). Surface and subsurface sampling locations are shown in Figures 7.2-2 and 7.2-3. Soil sampling locations associated with each of the seven source areas within Area 39 are listed on Table 7.2-2.

The TEQ for dioxins and furans in all surface/near-surface soil samples collected at Source Areas 30B and 34B was below its RISL and PGW SSL.

During review of the Draft BOU RI, it was noted that the BOU FSP did not propose the collection of soil samples for dioxins and furans at Source Areas 32B and 33B, both burn areas. During the Stage 1 RI, two samples were collected at one location within Source Area 32B and two samples were collected at one location within Source Area 33B and analyzed for dioxins and furans. The TEQ for dioxins and furans in the four soil samples were below its RISL and PGW SSLs.

Summary of Investigation and Results – Miscellaneous Compounds

Miscellaneous analyses performed on soil samples collected at Source Areas 29B, 30B, 31B, and 32B within Area 39 during the BOU RI were TOC, CEC, and/or DI-WET. The number of primary surface/near-surface and subsurface soil samples collected at each of the source areas for each analysis and the numbers of locations are summarized on the table below.

Source Area	Compound	Surface/Near-Surface		Subsurface	
		No. of Samples	No. of Locations	No. of Samples	No. of Locations
29B	DI-WET	1	1	0	0
30B	TOC	1	1	3	1
	CEC	1	1	3	1
	DI-WET	0	0	1	1
31B	TOC	4	2	0	0
	CEC	4	2	0	0
	DI-WET	0	0	1	1
32B	TOC	1	1	3	1
	CEC	1	1	3	1

The analytical results for the miscellaneous analyses of surface/near-surface and subsurface soil samples are presented in Appendix G and summarized below. The analytical data for pH, TOC, and CEC are used in the risk assessments to evaluate the bioavailability of some chemicals with respect to human and ecological receptors. The TOC, CEC, and DI-WET data are used in the FS to evaluate chemical and physical remedial actions, assess the potential for metals in soil to migrate into groundwater, and develop cleanup goals protective of groundwater.

Total Organic Carbon: TOC was not detected above its PQL in any of the surface/near-surface and subsurface soil samples collected at Source Areas 29B, 30B, 31B, and 32B within Area 39.

Cation Exchange Capacity: CEC was detected in the samples collected from boring 30B-SB08 at 1 foot (450 milliequivalents per kilogram [meq/K]), 5 feet (680 meq/K), 11 feet (430 meq/K), and 32 feet bgs (340 meq/K). CEC was detected at 34 and 320 meq/K in the samples collected at 0.25 and 1.5 feet bgs, respectively, at location 31B-SD01. CEC was detected at 280 and 270 meq/K in the samples collected at 0.25 and 1.5 feet bgs, respectively, at location 31B-SD02.

Waste Extraction Test using Deionized Water: A DI-WET was performed on one soil sample collected from each of the following source areas: 29B, 30B, and 31B. The sample identification, sample depth, and metal concentrations detected in the soil samples and sample extracts are presented on the table below.

Sample ID	Sample Depth (ft bgs)	Compound	Soil Conc. (mg/kg)	Extract Conc. (mg/L)
29B-SB04	1.5	Manganese	960	0.091
30B-SB08	5.0	Vanadium	250	0.019
31B-SB02	5.0	Aluminum	27,000	0.00015
		Antimony	<1.5	<0.01
		Arsenic	1.60	<0.005
		Barium	260	0.410
		Beryllium	1.0	0.0011
		Boron	2.3	<0.05
		Cadmium	0.67	<0.005
		Chromium	16	<0.005
		Cobalt	14	0.0036
		Copper	34	0.0083
		Lead	6.8	<0.005
		Lithium	9.9	<0.05
		Manganese	390	0.12
		Molybdenum	<1.5	0.003
		Nickel	8.9	0.0038
		Selenium	0.44	<0.01
		Silver	<1.2	<0.01
		Strontium	200	0.17
		Thallium	2.6	<0.01
		Titanium	710	0.049
		Vanadium	190	0.050
		Zinc	49	0.044

mg/L = Milligrams per liter

Summary of Investigation and Results – Geotechnical Parameters

A total of 18 soil samples were collected at the 7 source areas within Area 39 for geotechnical analyses. The results of the geotechnical analyses for moisture content, wet density, dry density, specific gravity, porosity, sieve analysis, and/or permeability are summarized on Table 7.2-8.

The geotechnical data will be used in the risk assessment to develop site-specific soil input parameters (moisture content, water-filled porosity, air-filled porosity, etc.) for fate and transport models and in the Feasibility Study (FS) to assess potential remedial actions such as vapor extraction. Fate and transport models are used in risk assessment to quantitatively evaluate the migration of volatile organics into outdoor and indoor air and the potential leaching of chemicals through soil and into groundwater.

7.2.4 *Discussion of Investigation Results with Respect to Data Quality Objectives – Area 39*

The analytical results presented in the previous sections identified the following chemical constituents in soil vapor and soil at the source areas within Area 39 at concentrations above their respective RISLs and/or PGW SSLs:

Soil vapor: Benzene; Carbon Tet; chloroform; 1,1-DCE; PCE; and TCE.

Soil: Metals (aluminum, cadmium, and thallium); perchlorate; and dioxins and furans.

The presence of these COPCs in each source area is discussed below with respect to the data needs described in Section 7.2.2.3. Specifically,

- Has the investigation resulted in sufficient characterization of the lateral and vertical distribution of each COPC in the vadose zone and identified a potential source for those COPCs?
- Has the investigation resulted in sufficient data to evaluate the potential for COPCs in soil to migrate into and degrade surface water and groundwater quality?
- Has the investigation resulted in data sufficient to support human health and ecological risk assessments and fate and transport modeling?
- Has the investigation resulted in sufficient data to evaluate the feasibility of remediating the identified compounds and concentrations to levels that do not pose a risk to human and ecological receptors or degrade surface water and groundwater quality?

For the purpose of this discussion, it is assumed that chemicals detected at concentrations above their RISL could potentially pose a risk to human health and chemicals detected above their PGW SSL could potentially migrate into groundwater or surface water. Sampling locations where VOCs, metals, and perchlorate were detected in surface and/or subsurface soil at concentrations above their respective PGW SSLs are shown in Figures 7.2-5 and 7.2-8. The analytical results for surface water and groundwater within Area 39 are presented in Sections 7.3 and 7.4, respectively, and discussed with respect to potential soil and soil vapor sources in Area 39. Additionally, the potential for chemicals in soil and soil vapor to migrate into surface water and groundwater is further evaluated in Section 8 of the HHERA (Volume II).

7.2.4.1 *Volatile Organic Compounds*

VOCs detected in soil vapor samples collected at the source areas within Area 39 are summarized in Section 7.2.3.3. TCE, Carbon Tet, chloroform, and TVOC concentrations above their RISLs in the shallow, intermediate, and very deep intervals are shown in Figure 7.2-4a. TVOC concentrations above their RISLs are also shown in Figure 7.2-4b. TCE, Carbon Tet, and chloroform concentrations above their PGW SSLs in the shallow and intermediate intervals are shown in Figure 7.2-5. Soil vapor samples were not collected from the deep soil vapor interval within Area 39. Soil vapor sampling locations associated with each of the seven source areas within Area 39 are listed on Table 7.2-2.

TCE was the predominant VOC detected in soil vapor within Area 39 at concentrations above its RISL and/or PGW SSL. Other VOCs detected in soil vapor at concentrations above their respective RISLs and/or PGW SSLs include benzene; Carbon Tet; chloroform; 1,1-DCE; and PCE. The presence of TCE, Carbon Tet, chloroform, and benzene in soil vapor within Area 39 with respect to potential sources and completeness of characterization are discussed below. Compounds detected at only one or two locations (benzene and PCE) and compounds associated with the reductive chlorination of TCE (1,1-DCE) are not included in this discussion.

<u>Trichloroethene</u>

TCE was detected at concentrations above its RISL and/or PGW SSL in soil vapor in three source areas (30B, 32B, and 33B). The presence of TCE in those source areas is discussed below.

Source Area 30B – Former Production Waste Burn Area:

- TCE was not detected above its RISL or PGW SSL in shallow soil vapor samples collected at Source Area 30B. TCE was, however, detected at concentrations above its RISL and/or PGW SSL in intermediate soil vapor samples collected at two locations (30B-SP13 and 30B-SP14) in the northeastern portion of Source Area 30B (Figures 7.2-4a and 7.2-5). The presence of TCE in the vadose zone at Source Area 30B is attributed to releases associated with historical burning activities.
- As shown in Figures 7.2-4a and 7.2-5, the two locations (30B-SP13 and 30B-SB14) are separated by approximately 200 feet and may either represent separate releases or one vapor plume that encompasses an area roughly 150-feet wide by 300-feet long along the top of the hill.

- The detected concentrations of TCE are less than 1 percent of its vapor saturation concentration and, therefore, not indicative of the potential presence of residual product.
- The lateral extent of TCE detected at locations 30B-SP13 and 30B-SP14 is defined by the absence of that VOC above its RISL and PGW SSL in soil vapor samples collected at locations 30B-SP10, 30B-SP15, 30B-SP17, 30B-SP18, 30B-SP19, 30B-SP20, and 30B-SP21. The vertical extent of TCE above its RISL and PGW SSL was defined to a depth of 20 feet bgs. As will be discussed in Section 7.4.2, TCE was not detected in the FWBZ beneath Source Area 30B.

Source Area 32B - Former Oxidizer Burn Area:

- TCE was detected at concentrations above its RISL and PGW SSL in the shallow and intermediate soil vapor intervals at only one location (32B-SP11) at Source Area 32B. This location is topographically higher than Source Area 33B and, therefore, the TCE detected at location 32B-SP11 does not appear to be associated with the TCE concentrations observed at Source Area 33B. The presence of TCE in soil vapor at 32B-SP11 is attributed to surface releases during historical burning activities conducted in this area.
- The maximum detected concentrations of TCE in the shallow and intermediate layers at 32B-SP11 are less than 1 percent of its vapor saturation concentration and, therefore, not indicative of the potential presence of residual product.
- The lateral extent of TCE detected at location 32B-SP11 is defined by the absence of that VOC above its RISL and PGW SSL in soil vapor samples collected at locations 30B-SP18, 32B-SP07, 32B-SP10, and 33B-SP12. The vertical extent was defined to the FWBZ at a depth of approximately 25 feet bgs (Section 7.4.1).

Source Area 33B – Former Lab Supply Burn Area:

- As shown in Figures 7.2-4a and 7.2-5, concentrations of TCE up to 1,700,000 $\mu g/m^3$ were detected in the shallow and intermediate soil vapor intervals northwest of the former asphalt pad at Source Area 33B. The figures also show that TCE concentrations above its RISL and/or PGW SSL are present in shallow and intermediate soil vapor that encompasses an area 200-feet wide by 450-feet long, extending to the northwest from the former burn pad. The presence of TCE in soil vapor at Source Area 33B is attributed to surface releases during historical burning activities. The high concentrations of TCE in

soil vapor northwest of the concrete pad may be due to the accumulation of liquids originating from the burn pad in a topographic low area.

- The maximum TCE concentrations detected in the shallow and intermediate layers at Source Area 33B are less than 1 percent of its vapor saturation concentration (4,877,690 $\mu g/m^3$) and, therefore, not indicative of the potential presence of residual product. As discussed in Section 7.4.2, TCE concentrations detected in groundwater appear to have originated at Source Area 33B.
- The lateral extent of TCE in soil vapor at Source Area 33B is defined by the absence of that VOC above its RISL and PGW SSL in soil vapor samples collected at locations 33B-SP10, 33B-SP12, 33B-SP13, 33B-SP16, 33B-SP17, 33B-SP18, and 33B-SP19. The vertical extent was defined to the top of Perched Groundwater at approximately 25 feet bgs (Section 7.4.1).

As indicated by the TVOC contours shown in Figures 7.2-4a and 7.2-4b, the lateral extent of TCE in the vadose zone at Source Areas 30B, 32B, and 33B in Area 39 has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater; and, if necessary, develop remedial alternatives. Additionally, soil vapor sampling in Area 39 was performed to the degree possible given the accessibility of some areas due to topographic relief.

<u>Chloroform</u>

- Chloroform was the second most predominant VOC detected in soil vapor within Area 39 at concentrations above its RISL, but below its PGW SSL. As indicated in Figure 7.2-4a, chloroform was detected above its RISL in soil vapor samples collected within those areas where TCE was also detected. The presence of chloroform in the soil vapor samples where TCE was also detected indicates they likely originated from the same source, presumably surface releases during historical burning activities.
- The maximum concentration of chloroform at 2,300 $\mu g/m^3$ is less than 1 percent of its vapor saturation concentrations and, therefore, not indicative of the presence of residual product.

As indicated by the TVOC contours shown in Figures 7.2-4a and 7.2-4b, the lateral extent of chloroform in the vadose zone at Source Areas 30B, 32B, and 33B in Area 39 has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater; and, if

necessary, develop remedial alternatives. Additionally, soil vapor sampling in Area 39 was performed to the degree possible given the accessibility of some areas due to topographic relief.

Carbon Tetrachloride

- As indicated in Figures 7.2-4a and 7.2-5b, Carbon Tet was detected above its RISL, but below its PGW SSL, in the shallow and/or intermediate soil vapor intervals at five locations (30B-SP13, 30B-SP14, 30B-SP15, 30B-SP22, and 30B-SP23) in only one (Source Area 30B) of the seven source areas within Area 39.
- Figure 7.2-4a also shows that Carbon Tet was detected in soil vapor at concentrations above its RISL in two separate places within Source Area 30B. Carbon Tet was detected above its RISL in the shallow and intermediate soil vapor intervals in the southwest corner of Source Area 30B and in the intermediate interval in the northeast corner of Source Area 30B (Figure 7.2-4a). In both areas, TCE and chloroform were also detected along with Carbon Tet, but generally at concentrations less than their RISLs. The presence of TCE and Carbon Tet in soil vapor in both areas suggests they likely originated from the same source, which are presumably surface releases during historical burning activities.
- The maximum detected concentration of Carbon Tet of 4,700 $\mu g/m^3$ is well below 1 percent of its vapor saturation concentration and, therefore, not indicative of the potential presence of residual product.

As indicated by the TVOC contours shown in Figures 7.2-4a and 7.2-4b, the lateral extent of Carbon Tet in the vadose zone at Source Areas 30B, 32B, and 33B in Area 39 has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater; and, if necessary, develop remedial alternatives. Additionally, soil vapor sampling in Area 39 was performed to the degree possible given the accessibility of some areas due to topographic relief.

7.2.4.2 *Metals*

Aluminum, cadmium, and/or thallium were detected in surface, near-surface, and subsurface soil samples collected at six of the seven source areas within Area 39 at concentrations above their respective RISLs and/or PGW SSLs (Section 5.1.4.3 and Figure 7.2-8). Soil sampling locations associated with each of the seven source areas within Area 39 are listed on Table 7.2-2.

The presence of aluminum, cadmium, and/or thallium in subsurface soil samples at locations where those metals were not detected in surface/near-surface soil samples seems unusual. In the case of aluminum, the detection of that metal at 69,000 mg/kg (above its PGW SSL) in a sample collected at 5 feet bgs from one boring (32B-SB04), but not in samples collected at 1.5 and 11.5 feet bgs, suggests that the detected concentration is a naturally occurring anomaly.

With respect to cadmium and thallium, the detection of those metals at concentrations above their PGW SSLs in 20 subsurface soil samples at 14 locations, but in only three near-surface soil samples at three locations, does not seem logical and suggests that naturally occurring background concentrations for those metals may be higher than is reflected in the site-wide background dataset. During the background metals evaluation performed in 2007 (Aerojet et. al., 2007), background samples were only collected from the main Aerojet site; no samples were specifically collected within Area 39. In light of this uncertainty, the lateral and vertical extent of only cadmium, detected above its RISL in soil samples collected at depths less than 5 feet bgs, is discussed below.

Cadmium above its RISL and PGW SSL was detected in a near-surface (1.5 feet bgs) soil sample collected from one boring (33B-SB03) within Area 39. Based on the absence of cadmium at concentrations above its RISL and PGW SSL in soil samples collected from nearby Source Area 32B, the lateral extent of cadmium above its RISL is likely limited to within 10 feet of boring 33B-SB03. The vertical extent of cadmium is defined by the absence of that compound above its RISL and PGW SSL in soil samples collected at 5 and 11 feet bgs from boring 33B-SB03.

Based on the information presented above, Aerojet believes that the lateral and vertical extent of aluminum, cadmium, and thallium in soil at source areas within Area 39 has been sufficiently characterized to evaluate potential risks to human health, surface water, and groundwater; and, if necessary, develop remedial alternatives.

7.2.4.3 *Perchlorate*

Perchlorate was not detected at concentrations above its RISL in the soil samples collected at the source areas within Area 39 (Section 7.2.3.3). Perchlorate at concentrations above its PGW SSL was detected in six soil samples collected at three locations within Area 39. The presence of perchlorate at the four locations and conclusions regarding the characterization of perchlorate based on the data presented in Section

7.2.3.3 are summarized below. Soil sampling locations associated with each of the seven source areas within Area 39 are listed on Table 7.2-2.

29B-SB07

Perchlorate above its PGW SSL was detected in a subsurface (4.5 feet bgs) soil sample collected from boring 29B-SB07, at the southeast end of the ravine/blast apron at Source Area 29B (Figure 7.2-8). The presence of perchlorate in the vadose zone at that location is attributed to historical burning of igniters and small rocket motors.

The lateral extent of perchlorate is defined by the absence of that compound above its PGW SSL in soil samples collected from borings 29B-SB04 and 29B-SB06 (both located in the bottom of the ravine/blast area) and in soil samples collected at location 31B-SD01, downstream of 29B-SB07. The vertical extent of perchlorate was defined to the PGW SSL presented in the agency-approved BOU FSP to a depth of 4.5 feet bgs. The potential threat to groundwater posed by perchlorate in soil within Source Area 29B is further evaluated in Section 8 of the HHERA (Volume II).

30B-SB04

Perchlorate above its PGW SSL was detected in soil samples collected at 1, 5, and 11 feet bgs from boring 30B-SB04 located adjacent to the former asphalt pad at Source Area 30B. The presence of perchlorate at that location is attributed to historical burning of production wastes.

The lateral extent of perchlorate is defined to the revised PGW SSL of 60 µg/kg by the absence of that compound above its revised PGW SSL in soil samples collected from borings 30B-SB06, 30B-SB07, and 30B-SB08.

The vertical extent of perchlorate was defined to the PGW SSL presented in the agency-approved BOU FSP to a depth of 11 feet bgs. However, as will be discussed in Section 7.4.2, the presence of perchlorate in perched groundwater in the vicinity of boring 30B-SB04 indicates that perchlorate is present within the vadose zone within Source Area 30B. The potential threat to groundwater posed by perchlorate in soil within Source Area 30B is further evaluated in Section 8 of the HHERA (Volume II).

33B-SB03

Perchlorate at 1,600 µg/kg, above its PGW SSL, was detected in a soil sample collected at 11 feet bgs from boring 33B-SB03. The presence of

perchlorate in the vadose zone at that location is attributed to historical burning, possibly of oxidizers.

The lateral and vertical extent of perchlorate at Source Area 33B was characterized to the PGW SSL presented in the agency-approved BOU FSP to a depth of 11 feet bgs. However, as will be discussed in Section 7.4.1.2, the presence of perchlorate in perched groundwater in the vicinity of boring 33B-SB03 indicates that perchlorate is present within the vadose zone within Source Area 30B. The potential threat to groundwater posed by perchlorate in soil within Source Area 30B is further evaluated in Section 8 of the HHERA (Volume II).

7.2.4.4 *Dioxins and Furans*

Dioxins and furans were identified in the FSP as COPCs only at Source Areas 30B and 34B. The TEQ for dioxins and furans in all surface/near-surface soil samples collected at Source Areas 30B and 34B was below the RISL and PGW SSL. The lateral and vertical extent of dioxins and furans at those source areas has, therefore, been sufficiently characterized.

As previously discussed in Section 7.2.3.3, it was noted during review of the Draft BOU RI that the BOU FSP did not propose the collection of soil samples for dioxins and furans at Source Areas 32B and 33B, both burn areas. During the Stage 1 RI, two samples were collected at one location within Source Area 32B and two samples were collected at one location within Source Area 33B and analyzed for dioxins and furans. The TEQ for dioxins and furans in the four soil samples were below its RISL and PGW SSLs.

7.3 *SUMMARY AND RESULTS OF SURFACE WATER REMEDIAL INVESTIGATION – AREA 39*

As discussed in Section 7.1.4, there are no naturally occurring lakes, rivers, or streams within Area 39 that contain water on a year-round basis. Several local drainages, however, provide storm water runoff during the rainy season.

This section describes surface water sampling along the drainage originating near the east end of the former K-1 Rocket Test Stand conducted during the BOU RI, presents the results of that sampling, and identifies COPCs in the surface water. A discussion regarding potential

correlations between COPCs in surface water and those identified in surface soil at source areas is presented in Section 7.3.4 of this report.

7.3.1 *Summary and Results of Surface Water Remedial Investigations – Area 39*

The following subsections briefly describe the surface water features within Area 39, summarize the scope and results of previous investigations conducted prior to 2005, present a preliminary identification of COPCs, and discuss DQOs and sampling proposed in the BOU FSP (Aerojet et al., 2006).

The information presented was compiled from one or more of the following sources*: Stage 1 Sampling Plan-Zone 1* (Aerojet, 1993a); *Stage 1 Sampling Plan-Zones 3 and 4* (Aerojet, 1993b); *Stage 1 Sampling Plan-Zone 2* (Aerojet, 1993c); *Aerojet Superfund Site – Scoping Report, Volumes 1 through 6* (ICF Technology, Inc., 1989); *Aerojet Site Stage 1 Report - Zones 1 through 4* (ICF Kaiser Engineers, Inc., 1993); BOU FSP (Aerojet et al., 2006); and *Final Remedial Investigation Report for the Perimeter Operable Unit (OU-5)* (Aerojet, 2008).

7.3.1.1 *Description of Surface Water Features – Area 39*

There are two local drainages within Area 39 that have been observed to contain surface water runoff during the rainy season. The main drainage within Area 39 originates near the east end of the former K-1 Rocket Test Stand (Site 29B) and trends southeast to the southern perimeter of Area 39. Two ponds are located along the course of the drainage downstream of the former Test Stand. The ponds were not present during the Stage 1 RI, and were apparently created by the construction of two small earthen dams across the drainage channel. The northern pond has been designated as A39-Pond 1 and the southern pond was designated A39-Pond 2 (Figure 7.3-1).

A second, smaller drainage originates near the top of the hill in the central portion of Source Area 30B, the former Production Waste Burn Area. The drainage is joined by other smaller drainages and trends towards the south-southwest and the southern perimeter of Area 39.

7.3.2 *Summary and Results of Previous Surface Water Investigations – Area 39*

Surface water sampling was not conducted at Area 39 during previous investigations.

The BOU FSP determined that surface water sampling was needed to evaluate the potential presence of COPCs that may have been identified in soil at source areas.

7.3.3 *Summary and Results of Boundary Operable Unit Surface Water Investigation – Area 39*

The following subsections summarize the recent surface water investigation conducted as part of the BOU RI, describe deviations from sampling proposed in the BOU FSP, present the results of the investigation, and discuss the results with respect to characterization and potential sources.

7.3.3.1 *Summary of Boundary Operable Unit Surface Water Investigation – Area 39*

Four primary surface water samples were collected at four locations along the main drainage originating from near the east end of the former K-1 Rocket Test Stand (Site 29B) (Figure 7.3-1). The samples were analyzed for VOCs; total and dissolved metals; SVOCs; perchlorate; dissolved organic carbon (DOC); nitrate; nitrite; anions (including phosphate, sulfate, chloride, and fluoride); and alkalinity. As discussed in the BOU FSP, the analysis of surface water samples is based on COPCs identified in the vadose zone at source areas upstream and in proximity to the sampling location. Therefore, every surface water sample was not analyzed for the full suite of constituents.

Field measurements taken during collection of the surface water samples were pH, temperature, conductivity, oxygen reduction potential, dissolved oxygen, and total dissolved solids.

The number of surface water samples collected for each analysis (including QA/QC samples) from the drainage within Area 39, along with the corresponding methods, are provided on Table 7.3-1.

7.3.3.2 *Deviations from Surface Water Data Quality Objectives and Sampling Design – Area 39*

Surface water sampling performed at Area 39 was generally consistent with that proposed in the BOU FSP, with the exceptions listed on Table 7.3-1. A comparison of proposed and actual sampling activities, including sampling rationale and analyses, is provided on Table 7.3-1.

7.3.3.3 *Results of Boundary Operable Unit Surface Water Investigation Results – Area 39*

The analytical results for the VOC, SVOC, total and dissolved metals, perchlorate, nitrate and nitrite, and/or alkalinity analyses of samples collected during the BOU RI, along with field measurements, are presented below.

<u>Summary of Investigation and Results – Volatile Organic Compounds</u>

Four primary surface water samples were collected at four locations along the main drainage originating from the ravine/blast apron associated with the former K-1 Test Stand during the BOU RI and analyzed for VOCs (Table 7.3-1 and Figure 7.3-1).

VOCs were not detected at concentrations above their respective RISL surface water screening levels (SWSLs) in the surface water samples collected within the drainage.

<u>Summary of Investigation and Results – Semivolatile Organic Compounds</u>

Two primary surface water samples were collected at two locations within the main drainage originating from the ravine/blast apron associated with the former K-1 Test Stand during the BOU RI and analyzed for SVOCs (Table 7.3-1 and Figure 7.3-1).

SVOCs were not detected at concentrations above their PQLs or respective RISL SWSLs in the surface water samples collected from the main drainage within Area 39.

<u>Summary of Investigation and Results – Total and Dissolved Metals</u>

Two primary surface water samples were collected at two locations within the main drainage originating from the ravine/blast apron associated with the former K-1 Test Stand within Area 39 during the BOU RI and analyzed

for total and dissolved metals. The results of the total and dissolved metals analyses of those samples are summarized below. Surface water sampling locations and dissolved metals detected above their SWSLs, if any, are shown in Figure 7.3-1.

Surface Water – Total Metals:

Total metal concentrations detected in the surface water samples collected from the main drainage within Area 39 are presented on the table below.

Metal	31B-SW01	31B-SW02
Aluminum	18,000	<50
Antimony	0.16 J	0.14 J
Arsenic	1.5	1.6
Barium	230	92
Beryllium	0.49 J	0.83
Boron	18 J	12 J
Cadmium	0.049 J	0.06 J
Calcium	8,100	7,000
Chromium	12	<5.0
Cobalt	4.9 J	8.1
Copper	14	2.0 J
Iron	17,000	<62
Lead	7.8	9.2
Magnesium	5,300	3,100
Manganese	300	52
Mercury	<0.2	<0.2
Molybdenum	<2.0	<2.0
Nickel	12	<10
Potassium	2,700	2,000
Selenium	<10	<10
Silver	<10	<10
Sodium	2,000	3,400
Strontium	130	110
Thallium	<1.0	<1.0
Titanium	700	2.8 J
Vanadium	30	39
Zinc	40	<20

Concentrations in micrograms per liter (µg/L)
J – Estimated concentration

Surface Water – Dissolved Metals:

Dissolved concentrations of metals detected in the surface water samples collected from the main drainage at Area 39 are presented on the table below.

Metal	31B-SW01	31B-SW02
Aluminum	<50	<50
Antimony	0.24 J	0.18 J
Arsenic	<1.0	<1.0
Barium	92	92
Beryllium	<0.50	<0.5
Boron	<50	<50
Cadmium	0.042 J	<1.0
Calcium	5,700	7,000
Chromium	<5.0	<5.0
Cobalt	0.31 J	0.2 J
Copper	<10	<10
Iron	<59	<52
Lead	0.27 J	0.25 J
Magnesium	3,100	3,200
Manganese	52	37
Mercury	<0.20	<0.20
Molybdenum	0.20 J	0.19 J
Nickel	<10	<10
Potassium	1,700	1,800
Selenium	<10	<10
Silver	<10	<10
Sodium	1,700	3,300
Strontium	92	110
Thallium	<1.0	<1.0
Titanium	4.0 J	3.5 J
Vanadium	2.50	2.10
Zinc	<20	<10

Concentrations in micrograms per liter (µg/L)
J – Estimated concentration

Metals were not detected in surface water samples collected from the main drainage within Area 39 at dissolved concentrations above their respective RISL SWSLs.

Summary of Investigation and Results – Perchlorate

Two primary surface water samples were collected at two locations within the main drainage within Area 39 during the BOU RI and analyzed for perchlorate.

Perchlorate was not detected in the surface water samples above the PQL or its RISL SWSL.

Summary of Investigation and Results – Miscellaneous Compounds

Miscellaneous analyses performed on surface water samples collected at two locations (31B-SW01 and 31B-SW02) along the main drainage at Area 39 were nitrate as NO_3; nitrite as NO_2; DOC; anions (including chloride, fluoride, phosphate, and sulfate); and alkalinity (bicarbonate alkalinity, carbonate alkalinity, hydroxide alkalinity, and total alkalinity). The analytical results for the miscellaneous analyses of surface water samples are presented below.

Nitrate and Nitrite. Nitrate was detected at a concentration of 2,700 µg/L in the surface water sample collected at location 31B-SW02. Nitrate was not detected above the PQL of 100 µg/L in the surface water sample collected at location 31B-SW01.

Nitrite was not detected in the two surface water samples collected from the main drainage within Area 39 at concentrations above the PQL of 100 µg/L.

Anions and Alkalinity. The results of anions analysis of the two surface water samples collected along the main drainage at Area 39 are presented below.

Compound	31B-SW01	31B-SW02
Bicarbonate Alkalinity	38,000	25,000
Carbonate Alkalinity	<5,000	16,000
Chloride	810	1,500
DOC	4,300	5,400
Fluoride	61	57
Hydroxide Alkalinity	<5,000	<5,000
Phosphate	<500	<500
Sulfate	370	1,100
Total Alkalinity	41,000	38,000

Concentrations in micrograms per liter (µg/L)
J – Estimated concentration

Summary of Investigation and Results – Field Measurements

Parameters measured in the field during the collection of the two surface water samples from the main drainage within Area 39 were pH, temperature, conductivity, oxygen reduction potential, dissolved oxygen,

and total dissolved solids. Measurements for those parameters are summarized on the table below.

Sample Location	pH	Temp (°C)	Conductivity (mS /cm)	Oxygen Reduction Potential (mV)	Dissolved Oxygen (mg/L)	Total Dissolved Solids (g/L)
31B-SW01	7.84	8.60	0.185	308.1	8.50	0.119
31B-SW02	6.90	8.05	0.157	326.3	4.52	0.103

°C – Degrees Celsius
g/L – Grams per liter
ms/cm – MilliSiemens per centimeter
mV - Millivolts

7.3.4 *Discussion of Surface Water Investigation Results with Respect to Data Quality Objectives – Area 39*

The analytical results presented in Section 7.3.3.3 indicated that nitrate above its RISL SWSL was present in a surface water sample collected from the main drainage within Area 39. The presence of chemicals in surface water samples with respect to potential sources and adverse impact to surface water quality is discussed below.

7.3.4.1 *Volatile Organic Compounds*

VOCs were not detected at concentrations above their respective RISL SWSLs in the four surface water samples collected along the main drainage within Area 39.

7.3.4.2 *Semivolatile Organic Compounds*

SVOCs were not detected at concentrations above their PQLs or respective RISL SWSLs in the surface water samples collected from the main drainage within Area 39.

7.3.4.3 *Metals*

Metals were not detected in the surface water samples collected from the main drainage within Area 39 at dissolved concentrations above their respective RISL SWSLs (Section 7.3.3.3 and Figure 7.3-1).

7.3.4.4 *Perchlorate*

Perchlorate was not detected in the surface water samples above the PQL or its RISL SWSL. The presence of perchlorate in surface water within Area 39 has therefore been sufficiently characterized.

7.3.4.5 *Nitrate and Nitrite*

Nitrate was detected at a concentration of 2,700 µg/L in the surface water sample collected at location 31B-SW02. Nitrate was not detected above the PQL of 100 µg/L in the surface water sample collected at location 31B-SW01.

Nitrite was not detected in the two surface water samples collected from the main drainage within Area 39 at concentrations above the PQL of 100 µg/L or its RISL SWSL.

Based on the data presented above, the presence of nitrate and nitrite in surface water within Area 39 has been sufficiently characterized to evaluate potential risk and remedial alternatives.

7.4 *GROUNDWATER REMEDIAL INVESTIGATION RESULTS — AREA 39*

This section presents the groundwater data acquired during the RI field activities for the Area 39 portion of the BOU. Data were collected to satisfy the following DQOs, as identified in the BOU FSP (Aerojet et al., 2006):

- Do COPCs exist in groundwater at concentrations that could potentially pose a risk to human health?
- Do the groundwater data indicate a potential source for the COPCs in the vadose zone?
- Do COPCs exist in groundwater at concentrations indicative of the presence of residual product?
- Has the lateral and vertical distribution of COPCs in the groundwater been adequately characterized?
- Do COPCs in groundwater have the potential to migrate into and degrade surface water quality?
- Are the data sufficient to support human health and ecological risk assessments, support modeling to evaluate the migration of COPCs

from groundwater into indoor air, and determine the feasibility of remediating the identified compounds and concentrations to levels that do not pose a risk to human and ecological receptors or degrade surface water and groundwater quality?

To meet these DQOs, the following tasks were completed:

- **Characterize groundwater flow —** Section 7.4.1– *Groundwater Flow Characteristics* define the shallow groundwater as either Perched Groundwater or the FWBZ and presents interpretation of water level data, including hydraulic gradients and water level elevation trends. These data support analysis of the fate and transport of chemicals in groundwater and are used to develop and compare remedial alternatives in the FS.
- **Determine the extent of groundwater impacted by COPCs —** Section 7.4.2 discusses the distribution of chemicals in groundwater and presents the results of groundwater sampling and analyses. These data are discussed relative to groundwater screening-level Applicable, Relevant and Appropriate Requirements (ARARs) (i.e., screening-level ARARs) that were selected to provide sufficient data for evaluating potential human health risks due to exposure to chemicals in groundwater.
- **Identify apparent COPC source areas and define the extent of potential residual sources in groundwater —** The potential correlation between chemicals reported in the vadose zone within source areas and chemicals reported in groundwater are discussed in Section 7.4.2 – *Distribution of Chemicals in Groundwater.*
- **Identify existing remedial actions —** Existing and planned remedial actions for groundwater within and downgradient of the BOU are discussed in Section 7.4.3.
- **Identify chemical migration pathways and attenuation processes —** Processes that influence the distribution and movement of chemicals in groundwater are discussed in Section 7.4.4.

7.4.1 Groundwater Flow Characteristics

The hydrostratigraphy of the Aerojet site, nature and occurrence of shallow groundwater, and groundwater gradients are described below.

7.4.1.1 *Site Hydrostratigraphy*

The regional aquifer beneath the Aerojet site has been divided into six hydrostratigraphic layers (Layers A through F) based on similar lithology, relative depths and thicknesses, electrical conductivity, water levels, and aquifer testing. The hydrostratigraphic layers provide the framework for presenting the distribution of chemicals and groundwater characteristics.

Perched Groundwater and the FWBZ were subdivided from the more regional hydrostratigraphic layer designations to allow for evaluation of potential risks associated with VOCs migrating upward as vapor through the soil into indoor air. The FWBZ is defined as the first water-bearing sediments that are continuously saturated across Area 39. The FWBZ is correlative with the upper portion of the site-wide hydrostratigraphic Layer C.

Hydrostratigraphic cross-sections were prepared to show the general lithologies and relative water levels for the hydrostratigraphic layers in the Administration Area. The following cross-section transects were prepared (cross-section locations are shown in each figure):

- Cross-section A-A′ trends approximately northwest to southeast through Sites 32B and 33B in the northern Area 39 (Figure 7.4-1);
- Cross-section B-B′ trends approximately north to south across Area 39 through Sites 33B and 30B and is generally aligned parallel to the direction of groundwater flow (Figure 7.4-2); and
- Cross-section C-C′ trends approximately west to east across the southern portion of Area 39 across Site 30B (Figure 7.4-3).

Cross-sections B-B′ and C-C′ tie into the regional hydrostratigraphic layers that have been designated at Zone 3/Off-site GET B.

Hydrostratigraphic Layer A is the shallowest layer and is composed of deposits from the ancestral American River. Layer B underlies Layer A and generally corresponds with the Tertiary Laguna Formation. At Area 39, Layers A and B are not distinguished, and contain Perched Groundwater (Figure 7.4-3).

Layer C is the upper portion of the Tertiary Mehrten Formation. Within Area 39, Layer C contains the FWBZ. Layer D is generally the lower portion of the Mehrten Formation and overlies Layer E, which generally corresponds to the upper portion of the Tertiary Valley Springs

Formation. Layer F refers to the water-bearing sediments below Layer E. Layers D, E, and F were not investigated at Area 39 as they appear to be below the depths of contamination.

7.4.1.2 *Nature and Occurrence of Shallow Groundwater*

The first saturated sediments are either part of Perched Groundwater or within the FWBZ. Water level and water quality data collected from existing monitoring wells, monitoring wells constructed for this RI, and grab groundwater samples collected from soil borings (e.g., HydroPunch samples) were classified as being representative of either Perched Groundwater or the FWBZ.

The groundwater designation, survey data, and well construction information for the monitoring wells and grab groundwater samples collected from soil borings used for this RI are summarized on Tables 7.4-1 and 7.4-2, respectively. Boring logs for the monitoring wells installed for the BOU RI/FS are included as Appendix D.

The depths to Perched Groundwater and FWBZ were contoured to assist with the evaluation of potential risks associated with volatilized VOCs migrating upward as vapor through the soil into indoor air. The contours were prepared by kriging depths to water between wells.

<u>Perched Groundwater</u>

Perched groundwater is the shallowest saturated unit. Twenty-two monitoring wells are screened in Perched Groundwater at Area 39 (Figures 7.4-4 and 7.4-5). In addition, Perched Groundwater was encountered at 13 soil boring locations (Figure 7.4-4). Perched Groundwater typically occurs in 5- to 25-feet-thick sand lenses within Layer B.

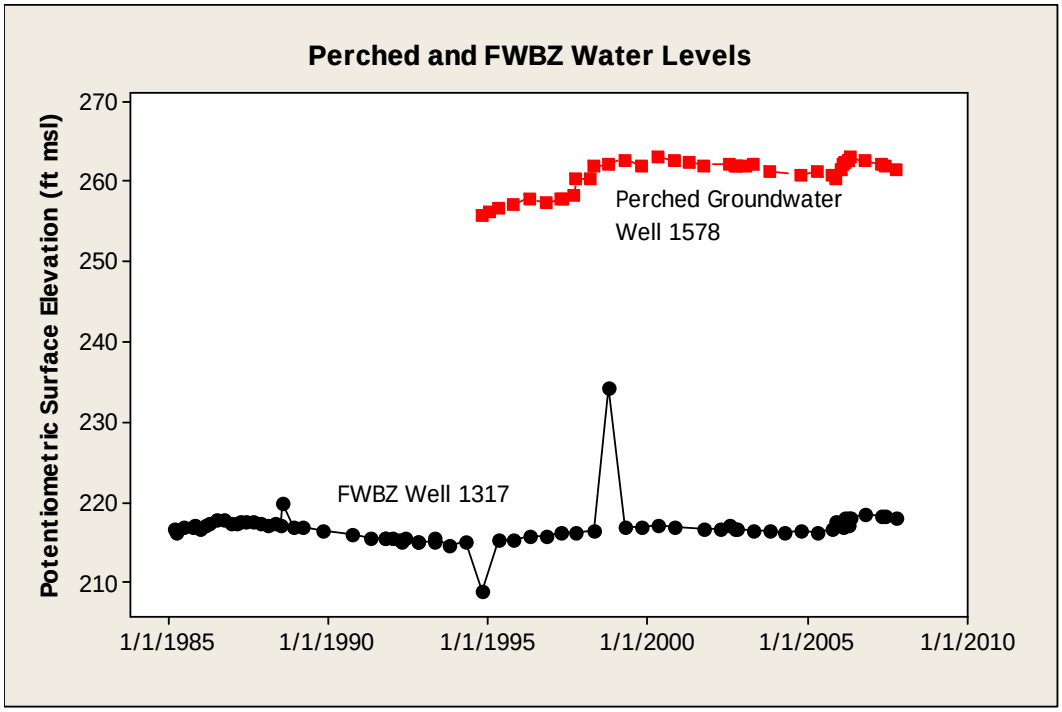
Monitor Wells 31022 and 31023 appear to be screened across both Perched Groundwater and the FWBZ (Figure 7.4-2). Water level and water quality data from these monitoring wells are not comparable to data from other Perched Groundwater monitor wells.

Perched Groundwater was encountered throughout most of the investigated portion of Area 39, as shown in Figure 7.4-4. The lateral extent of perched groundwater was identified north of Area 39. There are sufficient data to identify the areas that are underlain by Perched

Groundwater for the purposes of conducting the Baseline Risk Assessment.

In May 2007, the depth to Perched Groundwater ranged from approximately 9 to 75 feet bgs (Figure 7.4-4) and the median depth was 35 feet bgs. The variable topography affects the depths to Perched Groundwater. Generally, the depths to Perched Groundwater are greatest along the hills and ridges, and shallower closer to the drainages.

Water level hydrographs prepared for the Perched Groundwater monitoring wells are presented in Appendix J. The graph below depicts the water levels in Perched Groundwater Monitor Well 1578 and FWBZ Monitor Well 1317. These two wells were selected to typify their respective water-bearing units because they had among the longest monitoring history and were proximally located. As shown on the graph below, Perched Groundwater does not demonstrate significant seasonal variations.



Water levels were measured monthly between December 2005 and May 2006. During this period, the median change in Perched Groundwater water surface elevations was approximately 1.5 feet. The greatest change in Perched Groundwater water levels (3.8 feet) was measured at Monitor Well 1577, which is located near an ephemeral drainage.

First Water-Bearing Zone

The FWBZ occurs in 5- to 10-feet-thick sand lenses that generally correspond to Layer C of the *Western Groundwater Operable Unit Groundwater Flow Model* (Aerojet, 2004d).

The contoured depths to the FWBZ measured in May 2007 are presented in Figure 7.4-6. In May 2007, the depth to the top of the FWBZ ranged from approximately 38 to 109 feet bgs. Generally, the depths to groundwater are greatest near ridges, and shallower closer to the drainages.

The FWBZ at Area 39 demonstrates a smaller degree of seasonal fluctuation relative to the other sites investigated within this BOU. The graph embedded in the text above shows how little seasonal water level fluctuation is observed in the FWBZ at Area 39. In addition, water levels were measured monthly within the Area 39 monitor wells between December 2005 and May 2006. During this period, the median change in FWBZ water levels was approximately 0.8 foot. The greatest change in water levels (1.37 feet) was measured at Monitor Well 31012. Water level hydrographs for the FWBZ monitoring wells are presented in Appendix K.

7.4.1.3 *Groundwater Gradients*

The potentiometric surfaces for the Perched Groundwater and FWBZ were contoured to evaluate hydraulic gradients. The most complete water level dataset was collected in May 2007 and was used to contour the potentiometric surfaces. Previous water level datasets did not include the monitoring wells that were constructed for this RI. Water level data are summarized on Table 7.4-3.

The potentiometric surface contours were generated using the linear kriging algorithm in Surfer® for Windows (Version 8) to create the initial contour lines. The contour lines were then reviewed and modified near some border areas where the data did not support the extension of the contour lines generated by Surfer®.

Perched Groundwater

Perched Groundwater appears mounded beneath Area 39 (Figure 7.4-5). North of Site 33B, the Perched Groundwater potentiometric surface contours indicate a northerly to northwesterly flow direction with a

hydraulic gradient of approximately 0.010 ft/ft. South of Site 33B, the Perched Groundwater potentiometric surface contours indicate a southeasterly flow direction under a hydraulic gradient of approximately 0.008 ft/ft. The steepest hydraulic gradient of approximately 0.05 ft/ft was measured in the western area and was influenced by Monitor Well 795. The Perched Groundwater at Monitor Well 795 occurs within a sand unit that does not appear to be correlative to the other sand layers that contain Perched Groundwater. The hydraulic connection between the Perched Groundwater at Monitor Well 795 and the other Perched Groundwater units is uncertain.

The elevation of Perched Groundwater is higher than that of the underlying FWBZ. Head differences between the Perched Groundwater and FWBZ ranged from approximately 35 to 48 feet in May 2007. These relatively large differences suggest a potential for downward migration of Perched Groundwater into the FWBZ, where lithologic conditions permit.

Monitor Wells 31022 and 31023 are screened in both Perched Groundwater and the FWBZ (Figure 7.4-2), and may be acting as a conduit for Perched Groundwater to flow into the FWBZ. The potentiometric surface elevations in these wells are lower than the other nearby Perched Groundwater monitor wells and greater than the FWBZ wells that are screened in Layer C only.

Perched Groundwater has the potential to discharge to surface water. There are two surface water impoundments located in an ephemeral drainage that trends southeast out of Site 29B and across Site 31B (Figure 7.4-4). As shown on Cross Section C-C′ (Figure 7.4-3), the Perched Groundwater at Monitor Well 31019 occurs at a higher elevation than the lower impoundment, which is near Monitor Well 1317, indicating the potential for discharge to the impoundment.

<u>First Water-Bearing Zone</u>

The contoured potentiometric surface of the FWBZ measured in May 2007 is presented in Figure 7.4-7. The FWBZ elevations ranged from 218.21 feet above msl at Monitor Well 1317 to 231.21 feet msl at Well 31024.

The May 2007 potentiometric surface map for the FWBZ suggests a general south-southeast flow direction across Area 39 (Figure 7.4-7). The average hydraulic gradient for the FWBZ across Area 39 is approximately 0.007 ft/ft. The hydraulic gradient is steepest in the northeastern portion of the site (0.015 ft/ft) and shallowest in the central portion (0.002 ft/ft).

An apparent deviation in the general flow field was noted around the upper impoundment; the apparent mounding in this vicinity may be consistent with increased localized recharge.

Vertical gradients could not be evaluated as there are no monitor wells screened below the FWBZ.

7.4.2 *Distribution of Chemicals in Groundwater*

This section describes the nature and extent of chemicals detected in Perched Groundwater and the FWBZ beneath Area 39. The water quality data were collected between October 2005 and June 2007. This timeframe is referred to as the RI Sampling Period. The sampling locations and analytes were presented in the BOU FSP (Aerojet et al., 2006). The analytes at each sampling location were selected based on historical chemical use at each potential source site. VOCs were the most frequently analyzed constituents at Area 39 groundwater (analyzed using USEPA Method 8260). Other analyses selected based on historical operations included:

- SVOCs by USEPA Method 8270;
- Perchlorate by USEPA Method 314.0;
- Metals by USEPA Methods 6010, 6020, and 7000 Series; and
- Dioxins/Furans by USEPA Method 8290 D/F.

Additional analyses were performed to provide information for evaluating geochemical and biological processes that may affect possible remedial option selection. These analyses included:

- Alkalinity (total, bicarbonate, carbonate, and hydroxide) by USEPA Method 2320;
- Anions (chloride, fluoride, nitrate, nitrite, phosphate, and sulfate) by USEPA Method 300.0; and
- Dissolved organic carbon by USEPA Method 415.1.

The extents of most chemicals in groundwater are discussed relative to their respective screening-level ARARs. In most cases, screening-level ARARs are Federal or State drinking water Primary Maximum Contaminant Levels (MCLs), following USEPA Region IX precedence, and other Water Quality Objectives, as defined by the RWQCB.

RWQCB Water Quality Objectives may include Secondary MCLs, State of California Public Health Goals, State of California Department of Public Health Action Levels, and USEPA Region 9 Preliminary Remediation Goals. A summary of screening-level ARARs is included on Table 4.5-4.

Results of all analyses conducted during the RI Sampling Period, including results for compounds not detected in any samples, are included on a compact disc in Appendix M.

Data reported with laboratory qualifiers are included in this evaluation and are noted in the figures. Data reported between the PQL and the Method Detection Limit are estimated concentrations and are flagged with a "J" qualifier. All data collected during the RI Sampling Period were validated by a third party (Laboratory Data Consultants, Inc.).

Water quality data collected from soil borings as grab groundwater samples are included in this evaluation. These data are considered screening level data, and are generally not comparable to data collected from monitoring wells, but were contoured in areas where there were no confirmatory data from monitor wells.

The DQO of assessing the potential presence of residual product in groundwater was addressed by comparing VOC concentrations in groundwater samples with their respective solubility limits. As a conservative approach, it was assumed that residual product may be present when a VOC concentration exceeded 1 percent of its solubility limit. The solubility limits used were obtained from the USEPA, Region IX website. The solubility limits for several of the most commonly detected VOCs are provided on the table below.

Compound	Solubility Limit (µg/L)	One Percent of Solubility Limit (µg/L)	Max. Concentration at Area 39 (µg/L)
TCE	1,100,000	11,000	4,600
cis-1,2-DCE	3,500,000	35,000	30
1,1-DCE	2,300,000	23,000	31
1,1,2-Trichloroethane	4,400,000	44,000	7.9
1,2-DCA	8,500,000	85,000	1.1

The available VOC data from Area 39 do not indicate the presence of residual product.

7.4.2.1 *Perched Groundwater*

Perched Groundwater was investigated by sampling Wells 796, 1318, 1575 through 1578, 31006, 31008, 31009, 31017, 31019, 31026, 31028, 31029, and 31046 through 31048. Perched Well 792 appears to have been destroyed when the area was converted to a shooting range. Monitor Well 795 did not contain sufficient water to sample in December 2005. Well 31049 was dry shortly after its installation in July 2008. Grab Perched Groundwater samples were collected from 11 soil boring locations.

Isoconcentration contour maps were prepared illustrating the distribution of TCE, the most common VOC detected in Perched Groundwater (Figure 7.4-8), and perchlorate (Figure 7.4 9). The most recent analytical data are posted on the figures for monitoring wells sampled more than once during the RI Sampling Period. The data presented in this section indicate that the lateral extents of TCE and perchlorate in Perched Groundwater have been adequately delineated.

<u>Perched Groundwater – Volatile Organic Compounds</u>

VOC analyses were performed on samples collected from 17 monitoring wells screened in Perched Groundwater, and on grab groundwater samples collected from 11 soil boring locations. VOCs present in Perched Groundwater are generally suggestive of a nearby source.

VOCs reported in at least one sample above screening levels include:

- TCE up to 4,600 µg/L;
- 1,1-DCE up to 31 µg/L;
- cis-1,2-DCE up to 30 µg/L;
- 1,1,2-TCA up to 7.9 µg/L; and
- 1,2-DCA up to 1.1 µg/L.

The presence of residual product is not indicated by the available data. The presence of cis-1,2-DCE, and potentially 1,1-DCE, are inferred as degradation products resulting from biological reductive dechlorination of TCE (Section 7.4.4).

The VOC impacts to Perched Groundwater appear to be limited to the Site 33B vicinity, the Laboratory Supply Burn Area (Figure 7.4-8). TCE was the VOC most often detected and reported at the highest

concentrations. The distribution of TCE envelops the other detected VOCs. The discussion on VOCs, therefore, is focused on TCE.

The highest TCE concentration (4,600 µg/L) was reported in a grab groundwater sample collected from boring 33B-SP14. The extent of TCE greater than 0.8 µg/L has been adequately delineated (Figure 7.4-8). The highest VOC concentrations reported in the Perched Groundwater monitor wells located at Site 33B are one to two orders of magnitude lower than the grab groundwater samples collected from soil borings.

Most of the unknown peaks on the chromatograms were not identified and were reported as "Unknown Peaks" followed by a numeric identifier. Nonanal was the TIC reported at the greatest concentration (17 µg/L in the grab groundwater sample from boring 32B-SP08). Hexanal was the only TIC reported in more than one sample (grab samples from borings 32B-SP08, 33B-SP10, and 33B-SP11 at estimated concentrations of 4.5J to 5.8J µg/L).

Perched Groundwater – Semivolatile Organic Compounds

SVOC analysis, including an open-scan analysis for TICs, was performed on samples collected from eight Perched Groundwater monitor wells located throughout Area 39. SVOCs were not reported at concentrations greater than the laboratory PQL, although the PQLs for several SVOCs slightly exceeded their respective screening levels.

Perched Groundwater – Perchlorate

The distribution of perchlorate in Perched Groundwater is shown in Figure 7.4-9. Perchlorate analysis was performed on Perched Groundwater samples collected from 17 monitoring wells and two grab groundwater samples. The reported perchlorate concentrations exceeded the California MCL (6 µg/L) in all but seven of the samples.

Perchlorate in Perched Groundwater occurs in two general areas: one located in the northern portions of Area 39 that appears to be associated with Sites 32B and 33B; and the second located in the southern portion of Area 39 that appears to be associated with Sites 30B and 31B.

The highest detected perchlorate concentration (2,500 µg/L) was reported in the sample from Monitor Well 1576 located at Site 33B, the Laboratory Supply Burn Area. The region of Perched Groundwater containing perchlorate extends approximately 1,800 feet north of Site 33B

(Figure 7.4-9). The northern extent of perchlorate in Perched Groundwater appears to be limited by physical presence of Perched Groundwater. That is, the lateral extent of Perched Groundwater does not appear to extend to Monitor Well 31049 (Figure 7.4-2).

In the southern portion of Area 39, perchlorate appears to extend (south-southeast) approximately 1,000 feet downgradient from Sites 30B and 31B (Figure 7.4-9). The lateral extent appears to be adequately delineated to the southeast.

Perched Groundwater – Metals

Metals analyses were performed on Perched Groundwater samples collected from nine monitor wells and one grab groundwater sample. The samples were collected from throughout Area 39, including Sites 30B, 31B, 32B, 33B, and 35B. Analyses were performed on both unfiltered and field-filtered samples to assess total and dissolved metals concentrations, respectively.

The filtered metals sample collected from Monitor Well 1575, located at the Background Area (Site 35B), yielded cadmium up to 8.7 µg/L and thallium up to 8.3J, which exceeds their respective MCLs. Neither cadmium nor thallium were detected above PQLs in the remaining Perched Groundwater samples analyzed. The dissolved metals concentrations in the remaining Perched Groundwater samples were below their respective screening-level ARARs. (Note: the PQL for the grab sample from boring 30B-SB08 was above the screening-level ARAR for antimony and thallium.)

Perched Groundwater – Dioxins/Furans

Samples of Perched Groundwater were collected from Monitor Wells 796, 1578, and 31019, located at Sites 30B and 31B, and analyzed for dioxins/furans.

The dioxin/furan isomers were converted to equivalent toxicities of 2,3,7,8-TCDD (TEQ) by Frontier Laboratory using the World Health Organization (2005) method. The TEQs for Wells 796, 1578, and 31019 were 0.0664 and 0.00582, and zero (0), picograms per liter (pg/L), respectively. The Federal MCL is 30 pg/L.

Perched Groundwater – Geochemical Parameters

Samples were collected for various geochemical parameters to provide data for assessing background water quality and chemical and biological oxidation/reduction processes in groundwater. Bicarbonate, carbonate, chloride, dissolved organic carbon, fluoride, hydroxide, nitrate (as NO_3), nitrite (as NO_2), phosphate, and sulfate analyses were performed on the groundwater samples collected from 12 monitoring wells. The available MCLs for these anions were not exceeded in the samples collected and analyzed.

The following are the median concentrations of the major ions:

- Bicarbonate (103 mg/L);
- Chloride (7.5 mg/L);
- Fluoride (0.32 mg/L);
- Nitrate (9.6 mg/L);
- Nitrite (0.13 mg/L);
- Phosphate (0.66 mg/L); and
- Sulfate (8.0 mg/L).

Hydroxide and carbonate were not detected (less than 5 mg/L). Dissolved organic carbon content ranged from an estimated 1.6 mg/L at Well 31019 to 7.4 mg/L at Well 1575 and the median concentration was 4.5 mg/L.

7.4.2.2 *First Water-Bearing Zone*

The FWBZ was investigated through the collection of groundwater samples from 10 monitoring wells screened in the FWBZ. Chemical isoconcentration contour maps illustrating the distribution of TCE and perchlorate are provided as Figures 7.4-10 and 7.4-11, respectively. The most recent analytical data are posted on the figures for monitor wells sampled more than once during the RI Sampling Period.

Based on the information presented below, the lateral and vertical extents of chemicals in the FWBZ within Area 39 have been sufficiently characterized to identify potential sources, evaluate potential risks to human health, and if necessary, develop remedial alternatives.

First Water-Bearing Zone – Volatile Organic Compounds

VOC analyses were performed on samples collected from 10 monitoring wells with screened intervals constructed in the FWBZ. VOCs were not detected at concentrations greater than screening-level ARARs in the FWBZ. Available data indicate that the TCE detected in Perched Groundwater has not significantly migrated downwards into the FWBZ.

First Water-Bearing Zone – Semivolatile Organic Compounds

SVOC analyses, including an open scan for TICs, were performed on samples collected from Monitor Wells 1317, 1318, 31011, 31012, and 31024 (Sites 31B, 32B, and 33B). SVOCs were not detected at concentrations greater than the laboratory PQL; although, PQLs were slightly greater than their respective screening-level ARAR for several compounds [i.e., benzo(a)anthracene, bis(2-ethylhexyl)phthalate, and chrysene].

First Water-Bearing Zone – Perchlorate

Perchlorate analyses were performed on groundwater samples collected from 10 monitor wells (Figure 7.4-11). Monitor Well 31011, located near Site 31B (the Igniter/Small Rocket Motor Burn Area) most recently contained 31 µg/L perchlorate and was the only well that yielded a sample containing perchlorate concentrations greater than 6 µg/L at Area 39. Available data indicate that the perchlorate detected in Perched Groundwater has only a limited impact on the FWBZ.

First Water-Bearing Zone – Metals

Metals analyses were performed on groundwater samples collected from Monitoring Wells 1317, 1318, 31011, 31012, and 31024. Analyses were performed on both unfiltered and field-filtered samples to assess total and dissolved metals concentrations, respectively.

In the filtered samples, manganese (up to 210 µg/L) was the only metal that exceeded its screening-level ARAR (the Secondary MCL of 50 µg/L). Manganese was not reported above background concentrations in soil samples collected from Area 39.

First Water-Bearing Zone – Dioxins/Furans

A groundwater sample was collected from Monitor Well 31011 located at Site 31B (the Igniter/Small Rocket Motor Burn Area) and analyzed for

dioxins/furans, which were not detected at concentrations greater than the laboratory PQL.

First Water-Bearing Zone – Geochemical Parameters

Bicarbonate, carbonate, chloride, dissolved organic carbon content, fluoride, hydroxide, nitrate as NO_3, nitrite as NO_2, phosphate, and sulfate analyses were performed on the groundwater samples collected from seven monitoring wells located throughout Area 39. In addition, ortho-phosphate analysis was performed on the groundwater sample from Monitor Well 31012. These data were collected to allow interpretation of geochemical processes that may affect possible remedial alternative selection. Fluoride, nitrite, and sulfate were reported at concentrations below their respective MCLs.

The following are the median concentrations of the major ions:

- Bicarbonate (109 mg/L);
- Carbonate (78 mg/L);
- Chloride (13 mg/L);
- Fluoride (0.25 mg/L);
- Hydroxide (190 mg/L);
- Nitrate (3.25 mg/L);
- Nitrite (0.12 mg/L);
- Phosphate (less than 0.5 mg/L); and
- Sulfate (24 mg/L).

The above statistics for hydroxide and carbonate may be skewed by suspect data reported for the samples from Monitor Wells 31012 and 31024 collected in December 2005. The reported concentrations of hydroxide and carbonate for the samples from these two wells require a pH value greater than approximately 10, which is incongruent with the pH measured during sampling (6.7 to 7.0). That the December 2005 carbonate and hydroxide data from Monitor Well 31012 may be suspect is supported by a subsequent sample from Monitor Well 31012 collected in May 2006 that had carbonate and hydroxide reported at less than the PQL, which is more typical of the other Area 39 wells.

Dissolved organic carbon concentrations ranged from 2.3 to 8.8 mg/L and the median was 3.8 mg/L.

Nitrate concentrations less than 1 mg/L may indicate denitrifying conditions, and were reported in the samples collected from Site 31B (Monitor Wells 1317 and 31011).

Sulfate-reducing conditions were not indicated by the available data.

7.4.3 *Existing Remedial Actions*

The GET B system, located west of Area 39, is currently extracting and treating groundwater emanating from the Aerojet Site. Figure 7.4-12 shows the location of GET B extraction wells that have screen in Layer C and the Layer C potentiometric surface elevations for Layer C monitoring wells at Area 39 and in the GET B vicinity. The potentiometric surface elevation contours shown in Figure 7.4-12 are consistent with GET B capturing Layer C groundwater (i.e., the FWBZ) beneath Area 39.

7.4.4 *Chemical Fate and Transport*

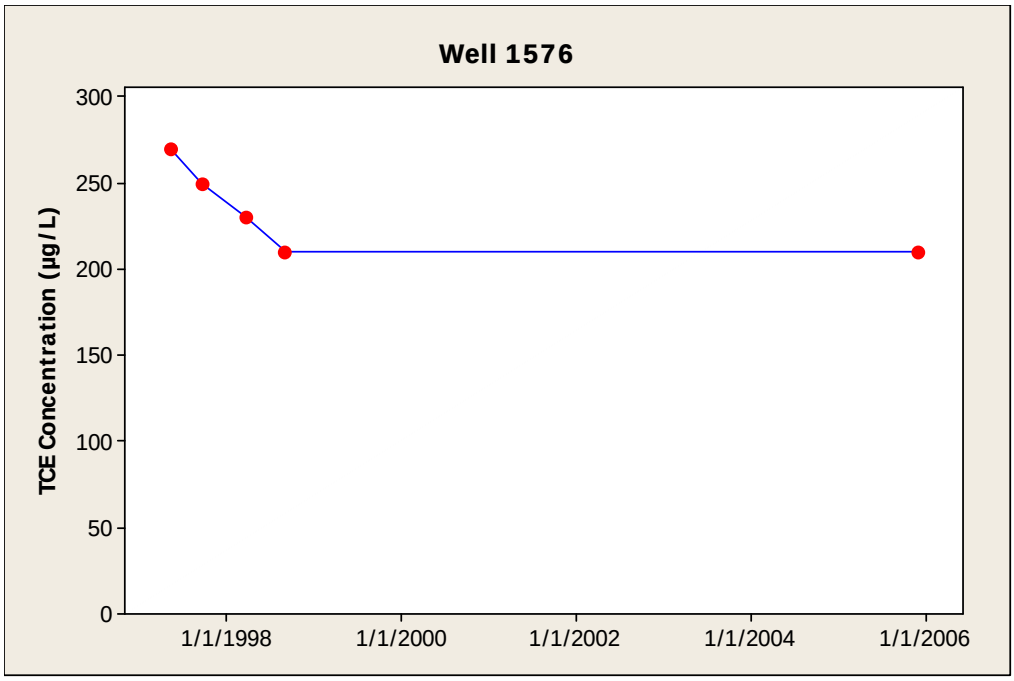
Numerous processes governing chemical fate and transport have influenced the distribution of constituents currently observed in groundwater beneath Area 39. This section describes the various processes that may be occurring, and how they may influence potential remedy evaluation and selection.

The evaluation of chemical concentration trends, from which degradation processes may be identified, was limited by infrequent historic data. The majority of the monitor wells at Area 39 were installed during the RI Sampling Period. The monitor wells that were installed historically were sampled infrequently.

The extent of chemicals, particularly perchlorate and TCE, in Perched Groundwater appear to be migrating primarily laterally. This is indicated by low to nondetect chemical concentrations reported in the FWBZ underlying or downgradient of the areas in Perched Groundwater where COPCs were identified.

Degradation does not appear to be a significant attenuation mechanism. There are indications that TCE in Perched Groundwater at Site 33B may be degrading as indicated by the presence of the degradation product cis-1,2-DCE. TCE concentrations at Monitor Well 1576 are shown in the

graph below. Well 1576 has the longest monitoring history with VOC detections at Area 39. The graph below indicates concentrations are either stabilized or decreasing slowly.

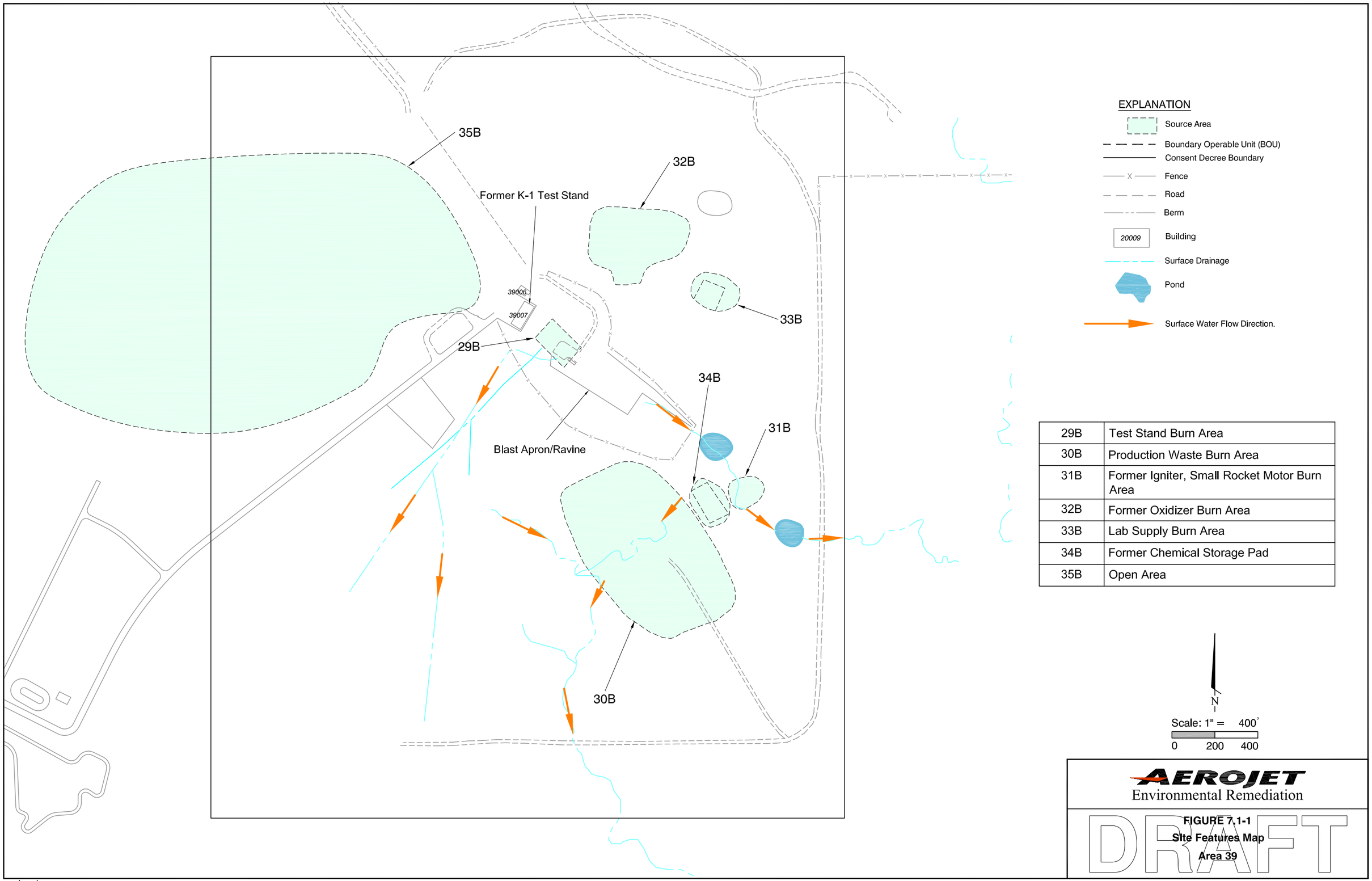


The Chemical Waste Burn Areas at Area 39 were last used in 1972 (i.e., approximately 34 years prior to the RI Sampling Period). In the southern half of Area 39, the most widespread compound in Perched Groundwater, perchlorate, appears to may have been transported laterally approximately 1,000 feet downgradient (Figure 7.4-9).

Water level and chemical concentration data indicate that a portion of Perched Groundwater is providing recharge to the FWBZ at Site 31B. It is suspected that the ephemeral drainage that flows past Site 31B locally increases the downwardly directed hydraulic gradient. As an apparent consequence, perchlorate was detected (31 µg/L) in the FWBZ beneath Site 31B (Figure 7.4-11).

The perchlorate in the FWBZ attenuates before leaving the BOU (Figure 7.4-11). The denitrifying conditions that are needed for perchlorate degradation are indicated by the nitrate concentrations less than 1 mg/L at the FWBZ wells in the Site 31B vicinity (Wells 31011 and 1317).

As was discussed in Section 7.4.3, the available data are consistent with GET B capturing the FWBZ at Area 39.



29B	Test Stand Burn Area
30B	Production Waste Burn Area
31B	Former Igniter, Small Rocket Motor Burn Area
32B	Former Oxidizer Burn Area
33B	Lab Supply Burn Area
34B	Former Chemical Storage Pad
35B	Open Area

FIGURE 7.1-1
Site Features Map
Area 39

09/14/10 PR SR10131035

35B
32B
33B
29B
34B
31B
30B

35B-SP04
32B-SP08
32B-SP09
32B-SP10
32B-SP11
32B-SP07
39006
39007
33B-SP13
33B-SP10
33B-SP09
33B-SP11
33B-SP12
33B-SP16
33B-SP14
33B-SP15
33B-SP20
33B-SP21
33B-SP19
33B-SP17
33B-SP18
30B-SP18
30B-SP17
30B-SP13
30B-SP14
30B-SP21
30B-SP19
30B-SP20
30B-SP10
30B-SP11
30B-SP15
30B-SP22
30B-SP12
30B-SP23

EXPLANATION

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Fence
- Road
- Berm
- BOU Soil Vapor Sample Location
- 20009 Building
- Surface Drainage
- Pond
- Surface Water Flow Direction.

N

Scale: 1" = 300'

0 150 300

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Environmental Remediation

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FIGURE 7.2-1
BOU Soil Vapor Sample Locations
Area 39

09/14/10 PR SR10131036

35B
32B
32B-SB04
32B-SB02
32B-SB05
32B-SB03
33B-SB03
33B
39006
39007
29B
29B-SB05
29B-SB04
29B-SB06
34B
29B-SB08
29B-SB09
29B-SB07
31B-SD01
31B
29B-SB10
34B-SB02
34B-SNS02
34B-SNS03
30B-SB07
30B-SNS02
29B-SB11
31B-SB02
30B-SB04
30B-SNS04
30B-SNS03
34B-SNS01
31B-SD02
30B-SB08
30B-SNS05
30B-SNS01
30B-SB05
30B-SB06
30B

EXPLANATION

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Fence
- Road
- Berm
- Soil Sample Borehole Location
- Near Surface Sample Location
- Sediment Sample Location
- 20009 Building
- Surface Drainage
- Pond
- Surface Water Flow Direction.

N

Scale: 1" = 300'

0 150 300

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Environmental Remediation

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FIGURE 7.2-2
BOU Surface Soil Sample Locations
Area 39

09/14/10 PR SR10131037

35B
32B
32B-SB04
32B-SB02
32B-SB05
32B-SB03
33B-SB03
33B
39006
39007
29B
29B-SB05
29B-SB04
29B-SB06
34B
29B-SB08
29B-SB09
29B-SB07
34B-SB02
31B
29B-SB10
30B-SB07
31B-SB02
29B-SB11
30B-SB04
30B-SB08
30B-SB05
30B-SB06
30B

EXPLANATION

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Fence
- Road
- Berm
- Soil Sample Borehole Location
- 20009 Building
- Surface Drainage
- Pond
- Surface Water Flow Direction.

N

Scale: 1" = 300'

0 150 300

AEROJET
Environmental Remediation

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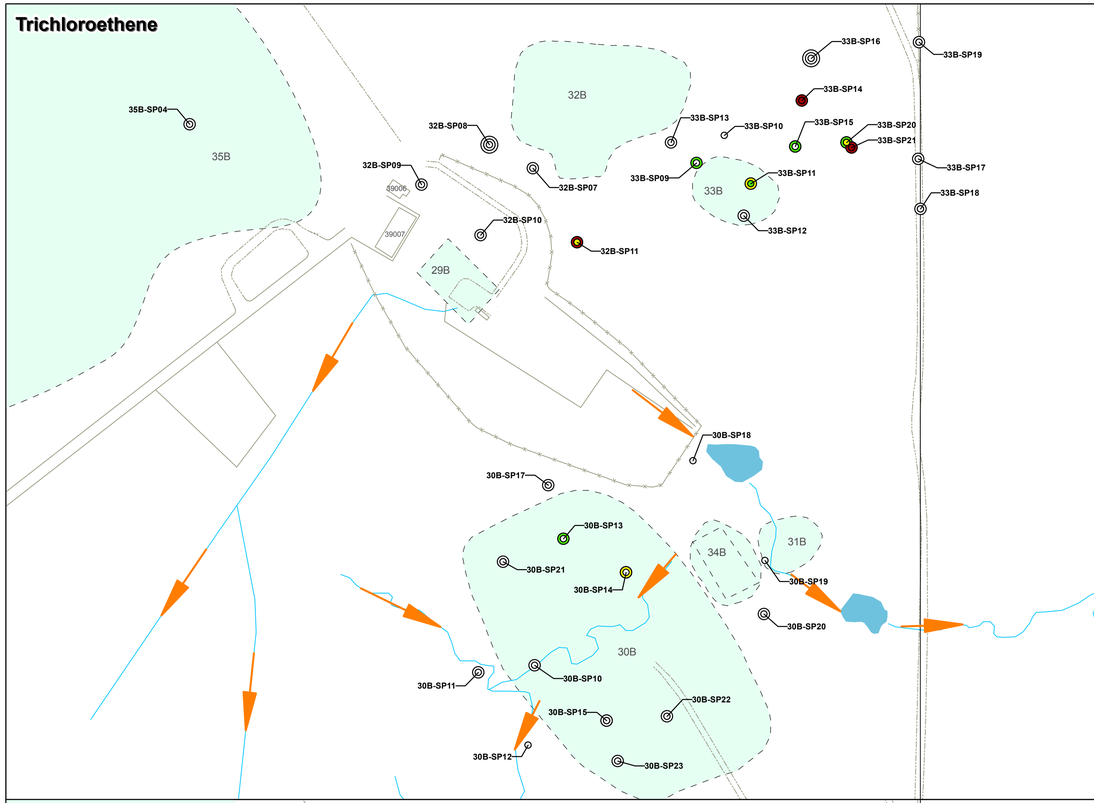
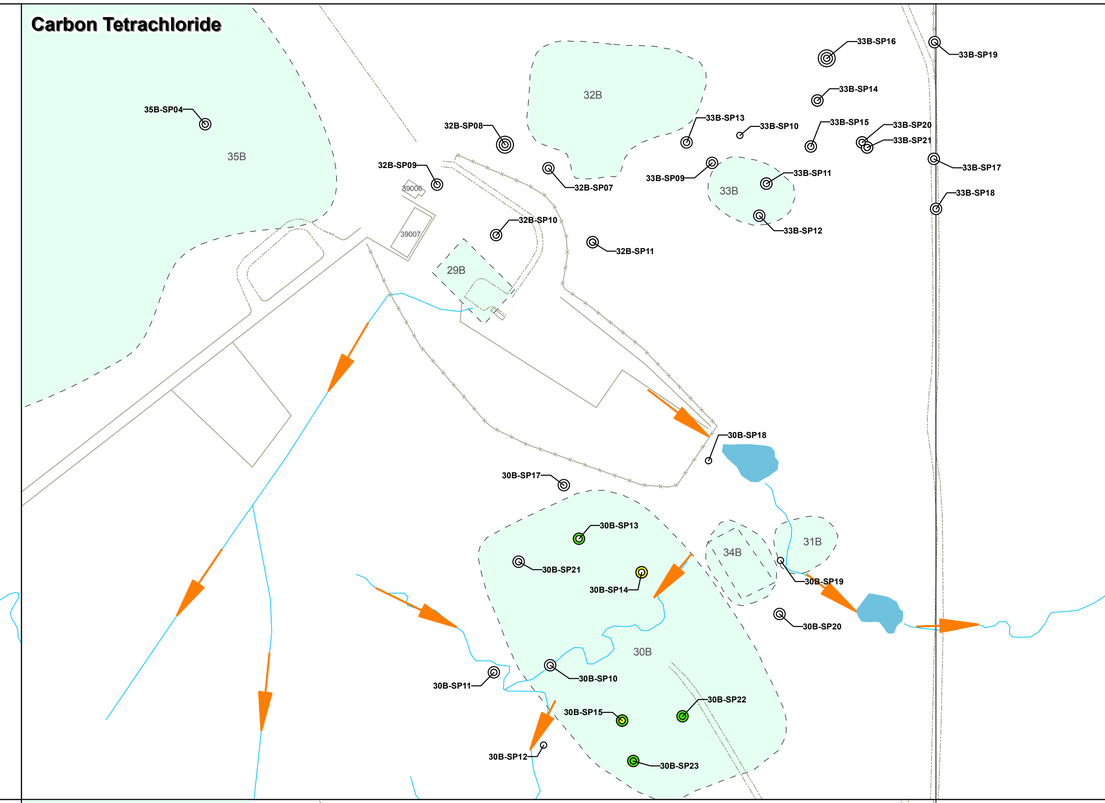
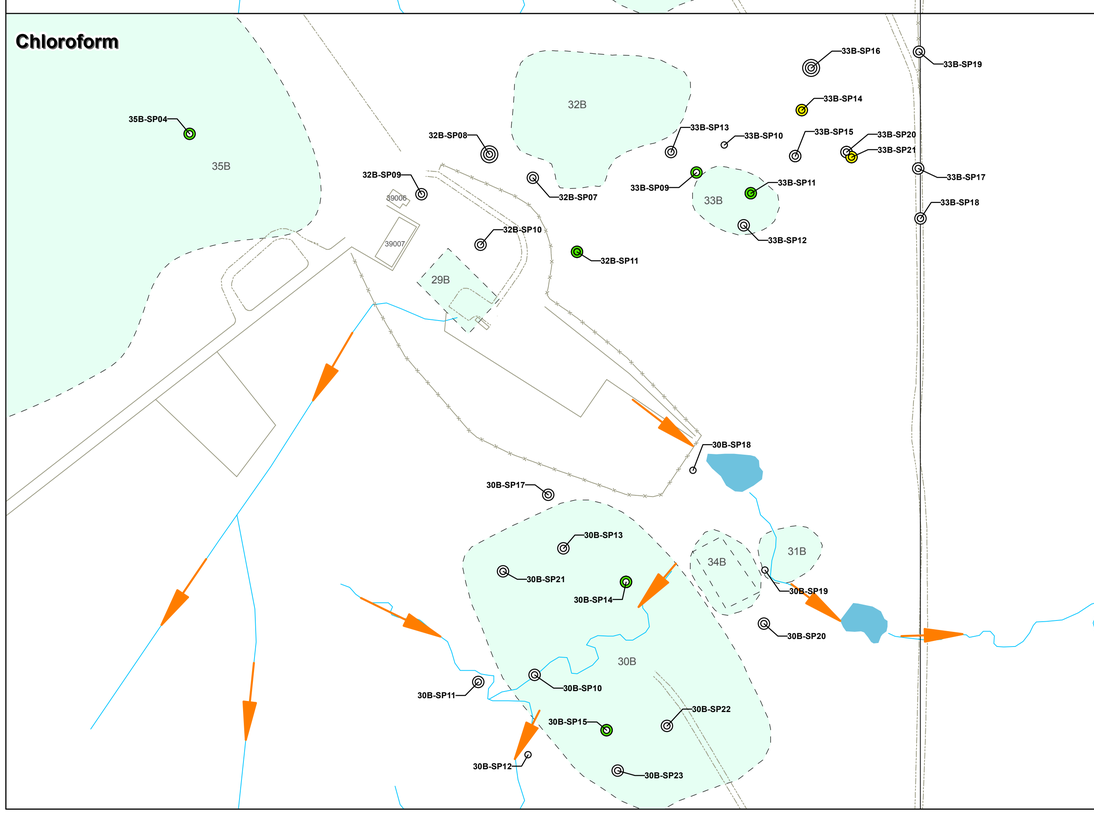
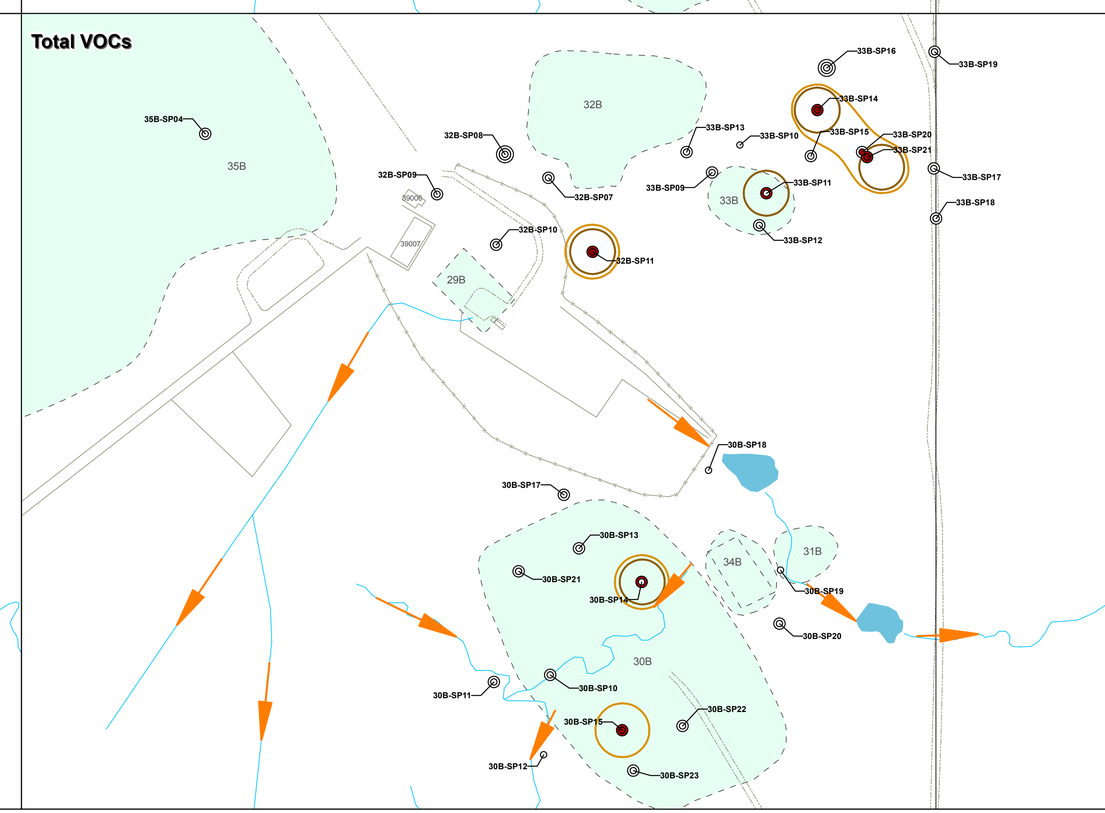
FIGURE 7.2-3
BOU Subsurface Soil Sample Locations
Area 39

09/14/10 PR SR10131038









TCE, Carbon Tetrachloride, Chloroform Exceedances

- < Soil Vapor Screening Level (RISL)
- >= RISL and < 10x RISL
- >= 10x RISL and < 100x RISL
- >= 100x RISL

Total VOCs Exceedances

- Σ Detects to Screening Levels Ratios <= 10
- Σ Detects to Screening Levels Ratios > 10

- <= 10 Feet bgs (Inner Circle)
- 11 to 20 Feet bgs (Middle Circle)
- > 20 Feet bgs (Outer Circle)

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Surface Water Flow Direction

Sample Location	<= 10 ft bgs			11-20 ft bgs			>20 ft bgs		
	Trichloroethene	Carbon Tetrachloride	Chloroform	Trichloroethene	Carbon Tetrachloride	Chloroform	Trichloroethene	Carbon Tetrachloride	Chloroform
Screening Level	463	58	83	463	58	83	463	58	83
Area 39									
30B-SP11	<1L	<1L	<1L	**3,500**	**66**	<1L	NC	NC	NC
30B-SP14	<1L	<1L	<1L	**20,000**	**1,700**	**800**	NC	NC	NC
30B-SP21	<1L	**6,700**	<1L	<1L	**200**	**110**	NC	NC	NC
30B-SP22	<1L	**190**	<1L	<1L	**160**	<1L	NC	NC	NC
30B-SP23	<1L	**26**	<1L	<1L	**360**	<1L	NC	NC	NC
32B-SP11	**95,000**	<1L	**96**	**150,000**	<1L	**100**	NC	NC	NC
33B-SP09	<1L	<1L	<1L	**1,300**	<1L	**110**	NC	NC	NC
33B-SP11	**1,200**	<1L	**100**	**15,000**	<1L	**440**	NC	NC	NC
33B-SP14	**1,500,000**	<1L	**3,600**	**1,300,000**	<1L	**1,700**	NC	NC	NC
33B-SP21	<1L	<1L	<1L	**4,500**	<1L	<1L	NC	NC	NC
33B-SP30	**16,000**	<1L	<1L	**1,700**	<1L	<1L	NC	NC	NC
35B-SP11	**1,700,000**	<1L	**2,100**	**1,700,000**	<1L	**1,500**	NC	NC	NC

Units in µg/m³.

<1L = either non-detect or detected concentration less than SL.

NC = Sample not collected.

N

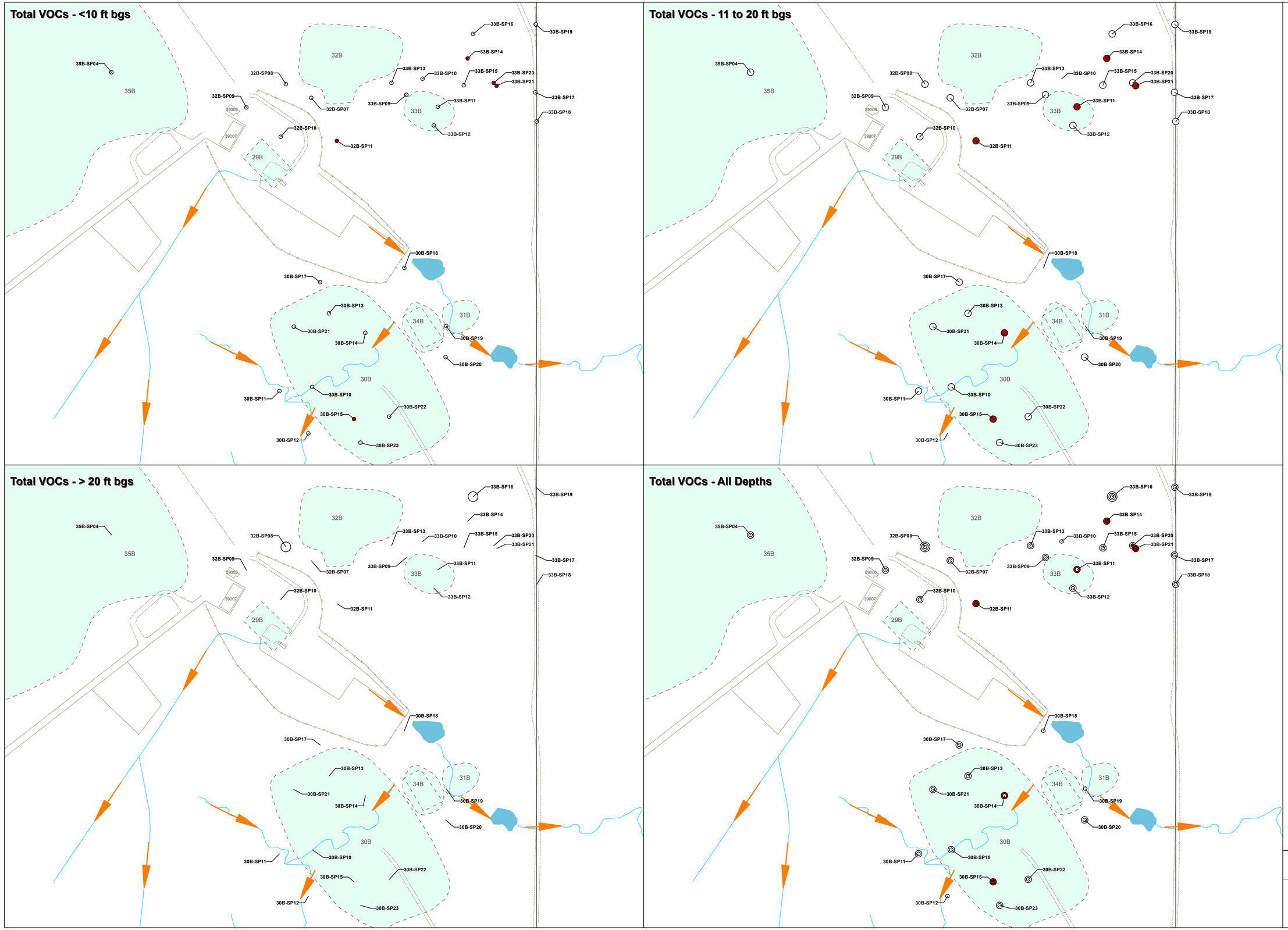
1 " = 200 '

0 200 400
Feet

AEROJET
Environmental Remediation

Figure 7.2-4a

TCE, Carbon Tetrachloride, Chloroform, and Total VOC Concentrations in Soil Vapor Above Remedial Investigation Screening Levels - Area 39



Total VOCs Exceedances

- Σ Detects to Screening Levels Ratios <= 10
- Σ Detects to Screening Levels Ratios > 10

- <= 10 Feet bgs (Small Circle)
- 11 to 20 Feet bgs (Medium Circle)
- > 20 Feet bgs (Large Circle)

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Approximate Extent of Total Screening Level Ratio Exceeding 10 (< 10 ft bgs)
- Approximate Extent of Total Screening Level Ratio Exceeding 10 (11 to 20 ft bgs)
- Approximate Extent of Total Screening Level Ratio Exceeding 10 (> 20 ft bgs)
- Surface Water Flow Direction

N

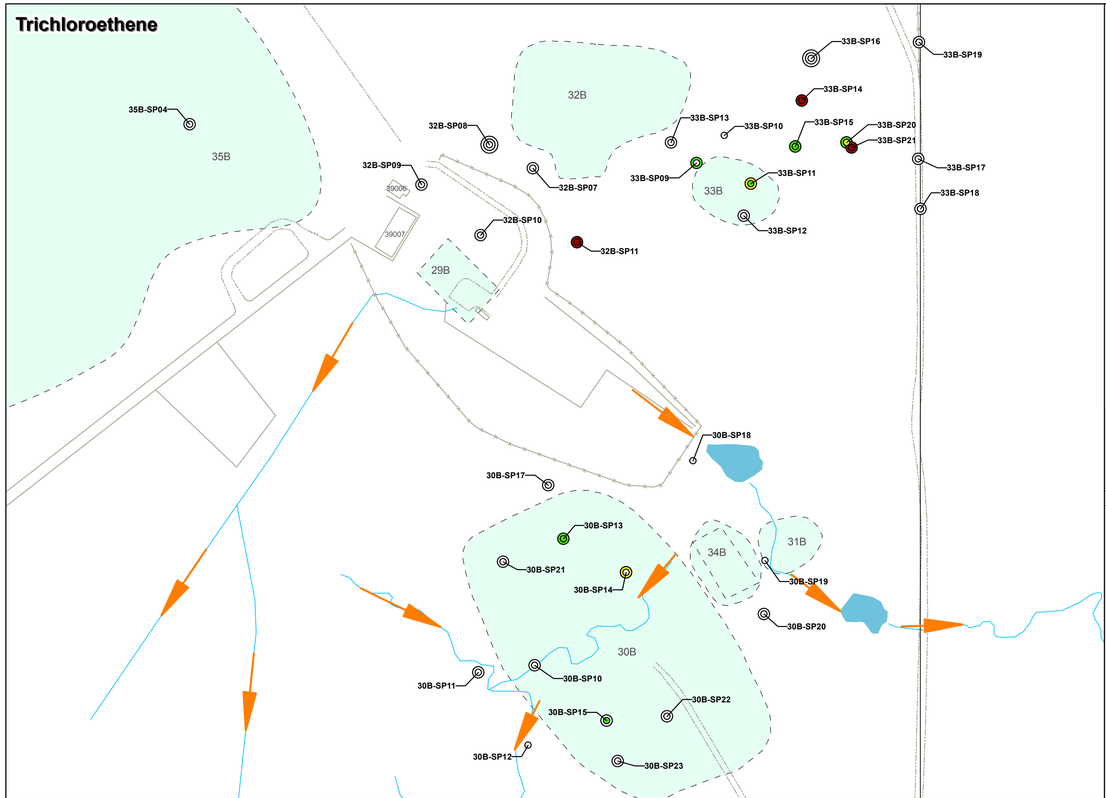
1 " = 200 '

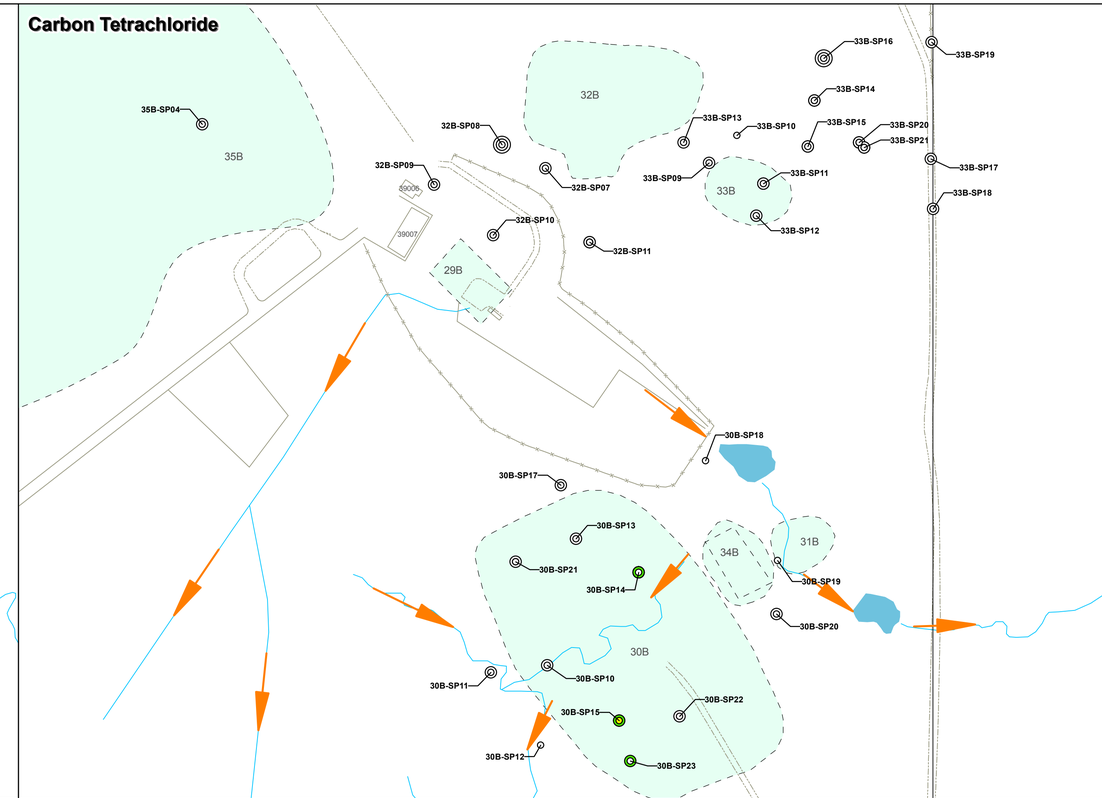
0 200 400
Feet

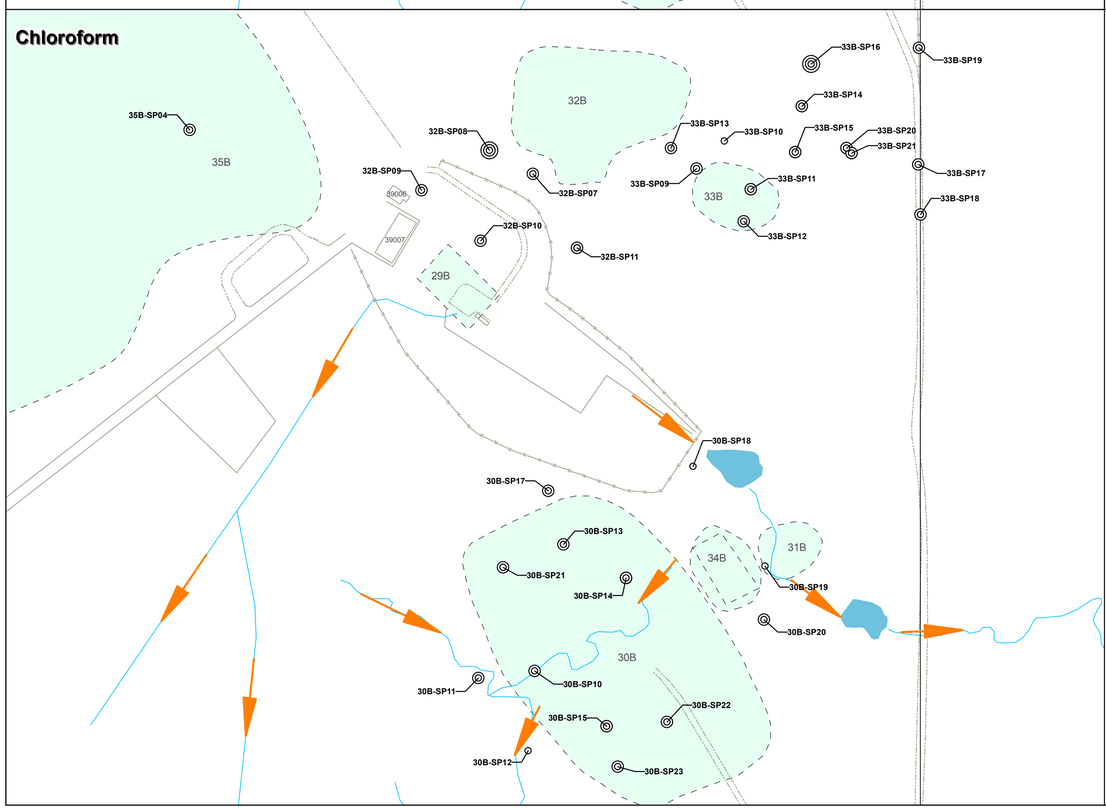
AEROJET
Environmental Remediation

Figure 7.2-4b

Total VOC Concentrations in Soil Vapor Above Remedial Investigation Screening Levels - Area 39







Sample Location	<= 10 ft bgs			11-20 ft bgs			>20 ft bgs		
	Trichloroethene	Carbon Tetrachloride	Chloroform	Trichloroethene	Carbon Tetrachloride	Chloroform	Trichloroethene	Carbon Tetrachloride	Chloroform
Screening Level	527	195	18,595	527	195	18,595	527	195	18,595
Area 39									
30B-SP13	**830**	<SL	<SL	**2,500**	<SL	<SL	NC	NC	NC
30B-SP14	<SL	<SL	<SL	**24,000**	**1,700**	<SL	NC	NC	NC
30B-SP15	**920**	**4,700**	<SL	<SL	**280**	<SL	NC	NC	NC
30B-SP23	<SL	<SL	<SL	<SL	**360**	<SL	NC	NC	NC
32B-SP11	**95,000**	<SL	<SL	**130,000**	<SL	<SL	NC	NC	NC
33B-SP09	<SL	<SL	<SL	**1,300**	<SL	<SL	NC	NC	NC
33B-SP11	**1,200**	<SL	<SL	**15,000**	<SL	<SL	NC	NC	NC
33B-SP14	**1,200,000**	<SL	<SL	**1,200,000**	<SL	<SL	NC	NC	NC
33B-SP15	**920**	<SL	<SL	**4,300**	<SL	<SL	NC	NC	NC
33B-SP20	**16,000**	<SL	<SL	**3,700**	<SL	<SL	NC	NC	NC
33B-SP21	**1,700,000**	<SL	<SL	**1,700,000**	<SL	<SL	NC	NC	NC

Units in $\mu g/m^3$.
<SL = either non-detect or detected concentration less than SL.
NC = Sample not collected.

TCE, Carbon Tetrachloride, Chloroform Exceedances

- < Soil Vapor Screening Level (PGW SVSL)
- >= PGW SVSL and < 10x PGW SVSL
- >= 10x PGW SVSL and < 100x PGW SVSL
- >= 100x PGW SVSL

- <= 10 Feet bgs (Inner Circle)
- 11 to 20 Feet bgs (Middle Circle)
- > 20 Feet bgs (Outer Circle)

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Surface Water Flow Direction

N

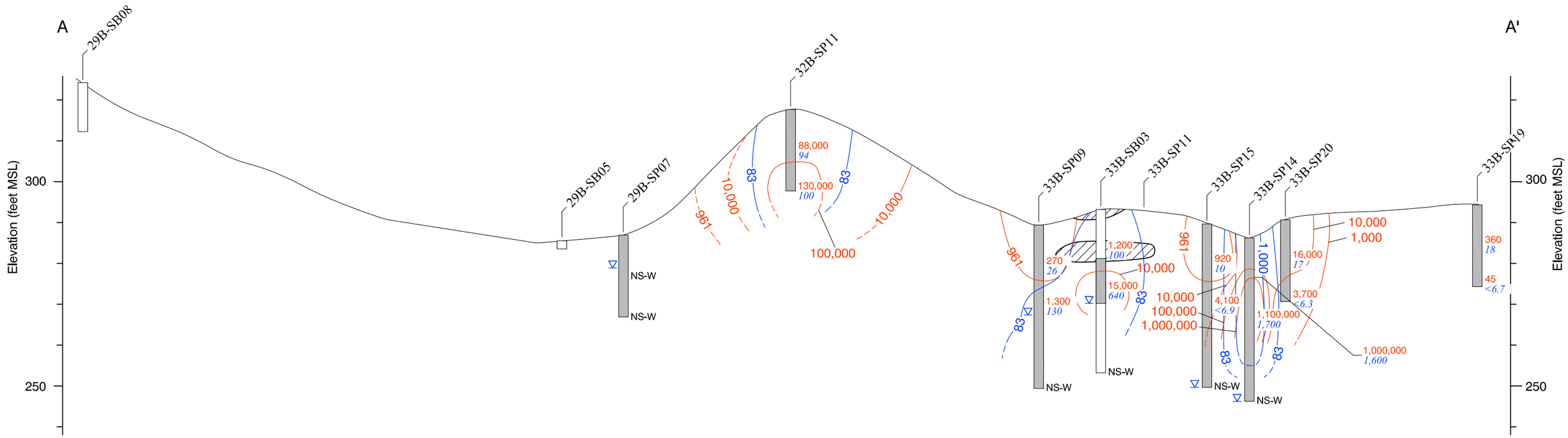
1 " = 200 '

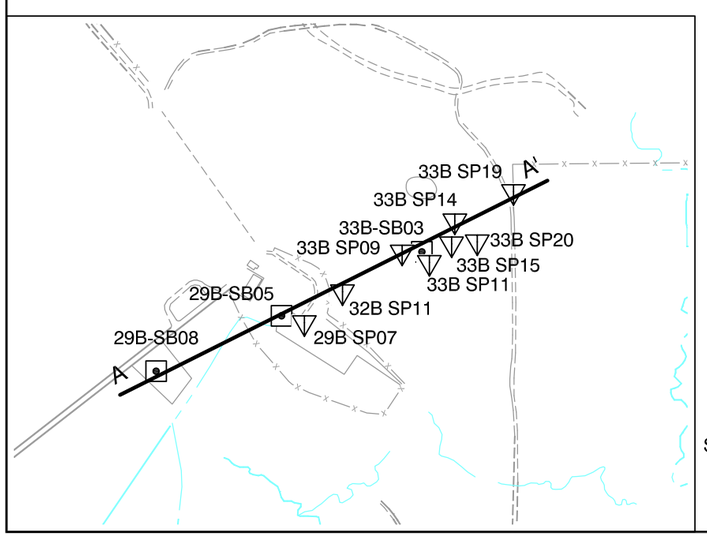
0 200 400
Feet

AEROJET
Environmental Remediation

Figure 7.2-5

TCE, Carbon Tetrachloride, and Chloroform Concentrations in Soil Vapor Above Protection of Groundwater Screening Levels - Area 39





Scale: 1" = 800'

0 400 800

Locator Scale

N

EXPLANATION

32B-SP11 — Boring Designation

<0.5 / <4 — Trichloroethene (TCE) in $\mu g/m^3$; Chloroform in $\mu g/m^3$ (NS-W = not sampled due to presence of groundwater)

Shaded Borings Lack Lithology

Total Borehole Depth

Initial Depth to Groundwater

961 — Trichloroethene (TCE) Concentration in Micrograms per Cubic Meter ($\mu g/m^3$)

83 — Chloroform Concentration in Micrograms per Cubic Meter ($\mu g/m^3$)

Note: Contour Lines Dashed Where Inferred

MSL — Mean Sea Level

Ground Surface

Geologic Contact

Relatively permeable sediments: Silty, poorly and well-graded sands and gravels (GP,GW,SP,SW); silty and clayey gravels (GM/GC) and silts.

Relatively lower permeability sediments: Low plasticity clays and silts (CL,ML); silty and clayey sand (SM/SC).

Vertical Scale 1' = 25'

25

0 100

Horizontal Scale 1' = 100'

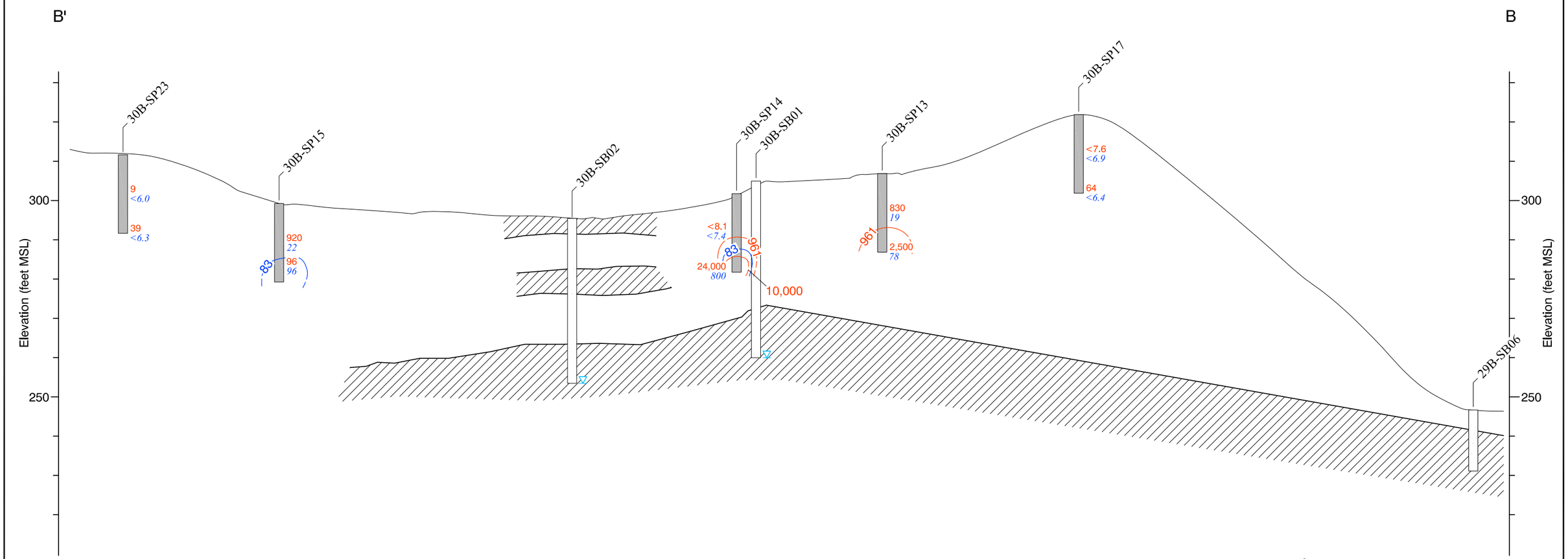
Vertical Exaggeration: 4X

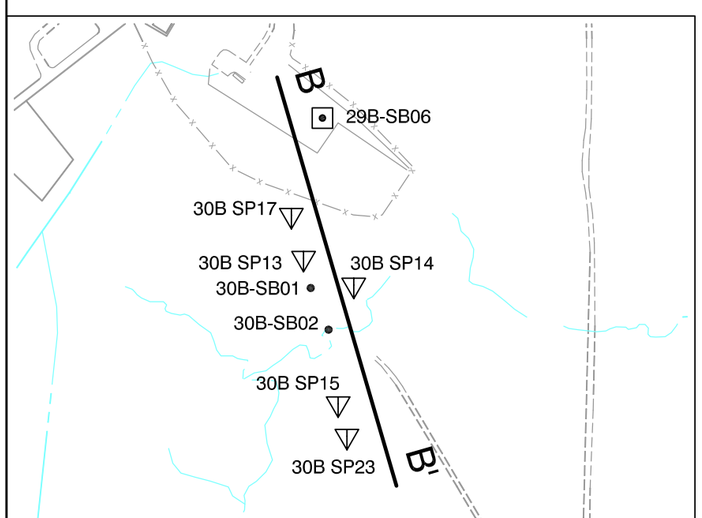
AEROJET Environmental Remediation

DRAFT

FIGURE 7.2-6
Vadose Zone Cross Section A - A'
Area 39

SR10131039 FIG 7.2-6 6/1/10 Carmelita Tallada





N

Scale: 1" = 800'

0 400 800

Locator Scale

EXPLANATION

32B-SP11 — Boring Designation

<0.5 — Trichloroethene (TCE) in $\mu g/m^3$

<4 — Chloroform in $\mu g/m^3$

(NS-W = not sampled due to presence of groundwater)

Shaded Borings Lack Lithology

Total Borehole Depth

Initial Depth to Groundwater

961 — Trichloroethene (TCE) Concentration in Micrograms per Cubic Meter ($\mu g/m^3$)

83 — Chloroform Concentration in Micrograms per Cubic Meter ($\mu g/m^3$)

Note: Contour Lines Dashed Where Inferred

MSL — Mean Sea Level

Ground Surface

Geologic Contact

Relatively permeable sediments: Silty, poorly and well-graded sands and gravels (GP,GW,SP,SW); silty and clayey gravels (GM/GC) and silts.

Relatively lower permeability sediments: Low plasticity clays and silts (CL,ML); silty and clayey sand (SM/SC).

Vertical Scale 1' = 25'

25

0

Horizontal Scale 1' = 100'

100

Vertical Exaggeration: 4X

AEROJET

Environmental Remediation

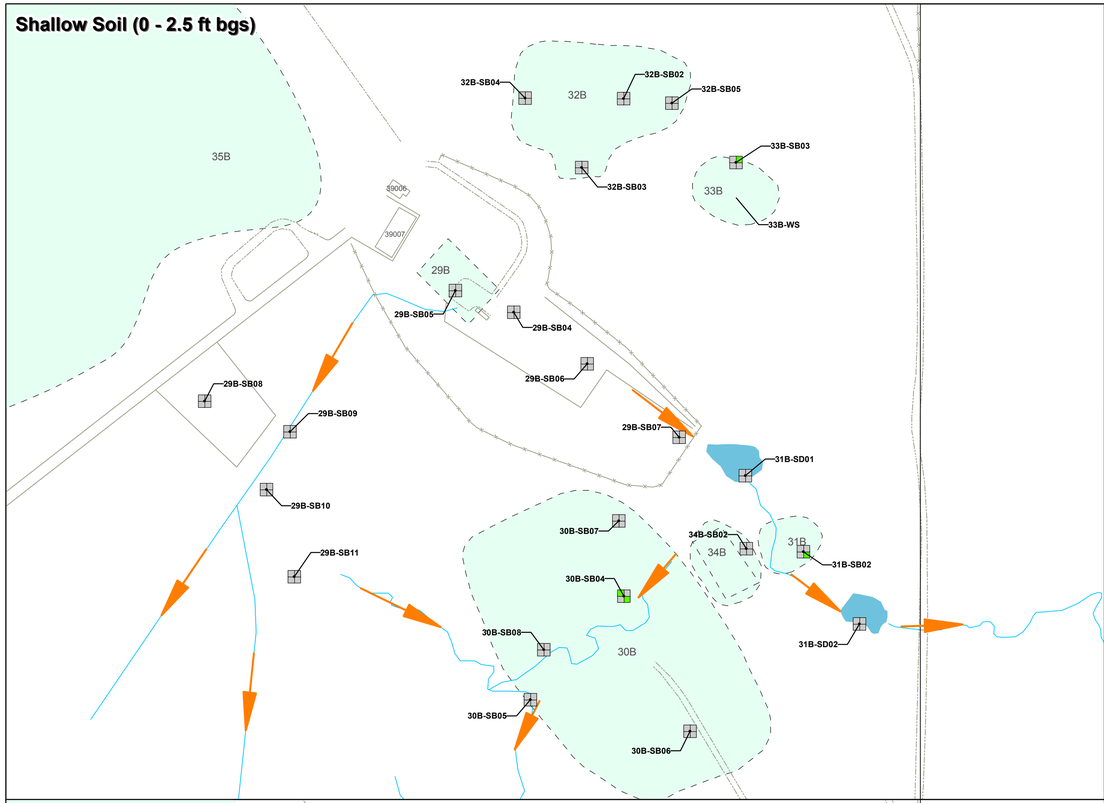
DRAFT

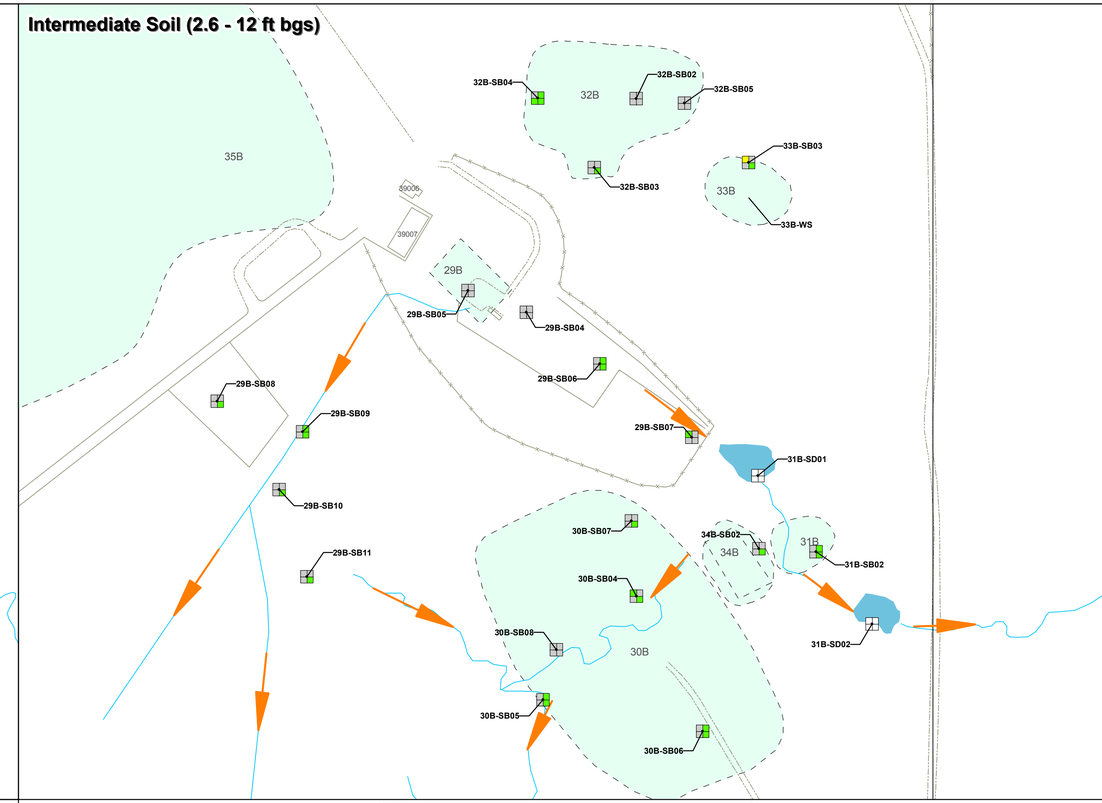
FIGURE 7.2-7

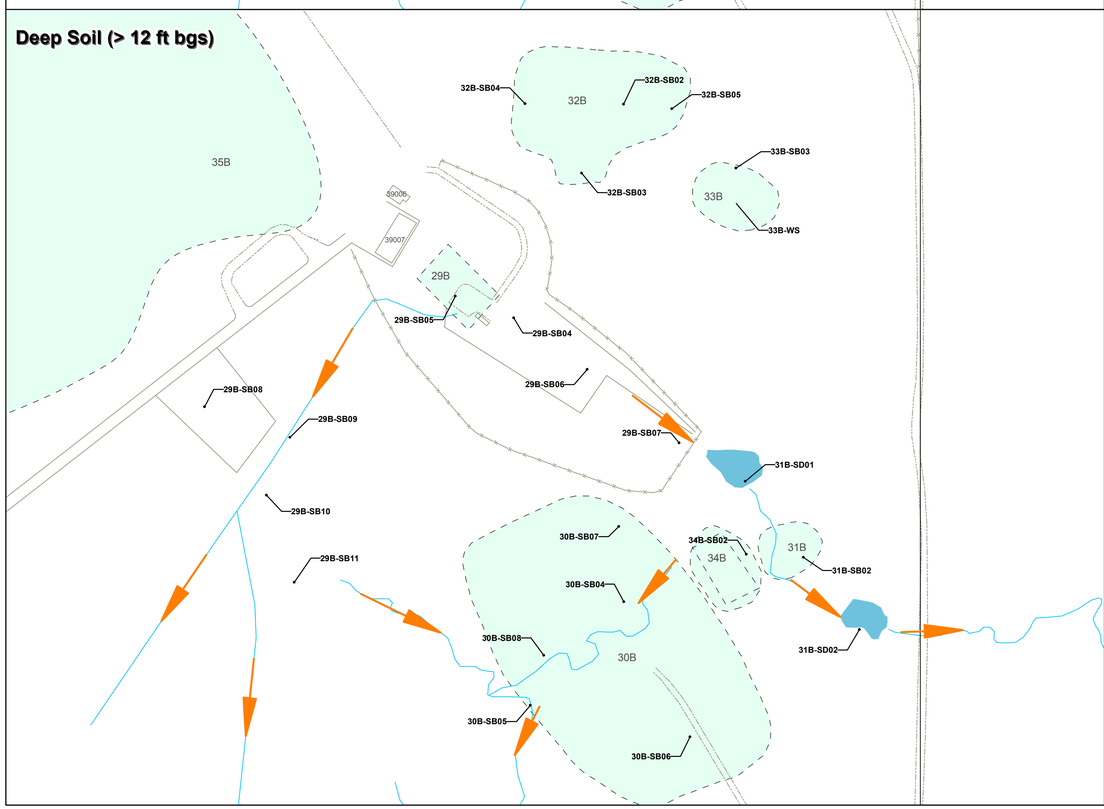
Vadose Zone Cross Section B- B'

Area 39

SR10131040 FIG 7.2-7 6/1/10 Carmelita Tallada







- Not Analyzed
- < Soil Screening Level (RISL/PGW SSL)
- >= SSL and < 10x SSL
- >= 10x SSL and < 100x SSL
- >= 100x SSL

Perchlorate, Aluminum, Cadmium, Thallium

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Surface Water Flow Direction

PGW SSLs				
Sample Location	Sample Depth	Aluminum	Cadmium	Thallium
Screening Level		43,000	0.72	2.5
0 - 2.5 feet bgs				
30B-SB04	1.0	<SL	<SL	**4.6**
31B-SB02	1.5	<SL	<SL	**3.1**
33B-SB03	1.5	<SL	**3.9**	<SL
2.6 - 12 feet bgs				
29B-SB06	5.0	<SL	**0.74**	**4.6**
29B-SB08	5.0	<SL	<SL	**3.5**
29B-SB09	5.0	<SL	**1.5**	**6.3**
29B-SB10	5.0	<SL	<SL	**4.1**
29B-SB11	5.0	<SL	<SL	**3.1**
30B-SB04	5.0	<SL	<SL	**4.5**
30B-SB04	11	<SL	<SL	**2.9**
30B-SB05	5.0	<SL	**0.75**	**3.3**
30B-SB06	5.0	<SL	**0.84**	**2.9**
30B-SB06	11	<SL	<SL	**4.4**
30B-SB07	5.0	<SL	<SL	**3.8**
30B-SB07	11	<SL	<SL	**3.0**
31B-SB02	5.0	<SL	<SL	**2.6**
31B-SB02	11	<SL	**0.76**	**3.2**
32B-SB03	5.0	<SL	<SL	**4.5**
32B-SB04	5.0	**69,000**	**0.81**	**6.6**
32B-SB04	11.5	<SL	**0.77**	**6.0**
33B-SB03	5.0	<SL	<SL	**3.4**
34B-SB02	11	<SL	<SL	**3.8**
2.6 - 12 feet bgs				
31B-SB02	21	<SL	**0.73**	<SL

RISLs				
Sample Location	Sample Depth	Aluminum	Cadmium	Thallium
Screening Level		76,140	1.7	5.0
0 - 2.5 feet bgs				
33B-SB03	1.5	<SL	**3.9**	<SL
2.6 - 12 feet bgs				
29B-SB09	5.0	<SL	<SL	**6.3**
32B-SB04	5.0	<SL	<SL	**6.6**
32B-SB04	11.5	<SL	<SL	**6.0**

PGW SSLs		
Sample Location	Sample Depth	Perchlorate
Screening Level		0.06
0 - 2.5 feet bgs		
30B-SB04	1	**0.49**
2.6 - 12 feet bgs		
29B-SB07	4.5	**0.077**
30B-SB04	5.0	**0.23**
30B-SB04	11	**0.11**
33B-SB03	5.0	**0.75**
33B-SB03	11	**1.6**

Note: Symbols in figure represent maximum concentration within each depth interval.
<SL = Result less than screening level or non-detect.
NC = Not analyzed for.
Units in mg/kg.

N

1 " = 200 '

0 200 400
Feet

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Environmental Remediation

Figure 7.2-8

All Compounds in Soil Above Screening Levels - Area 39

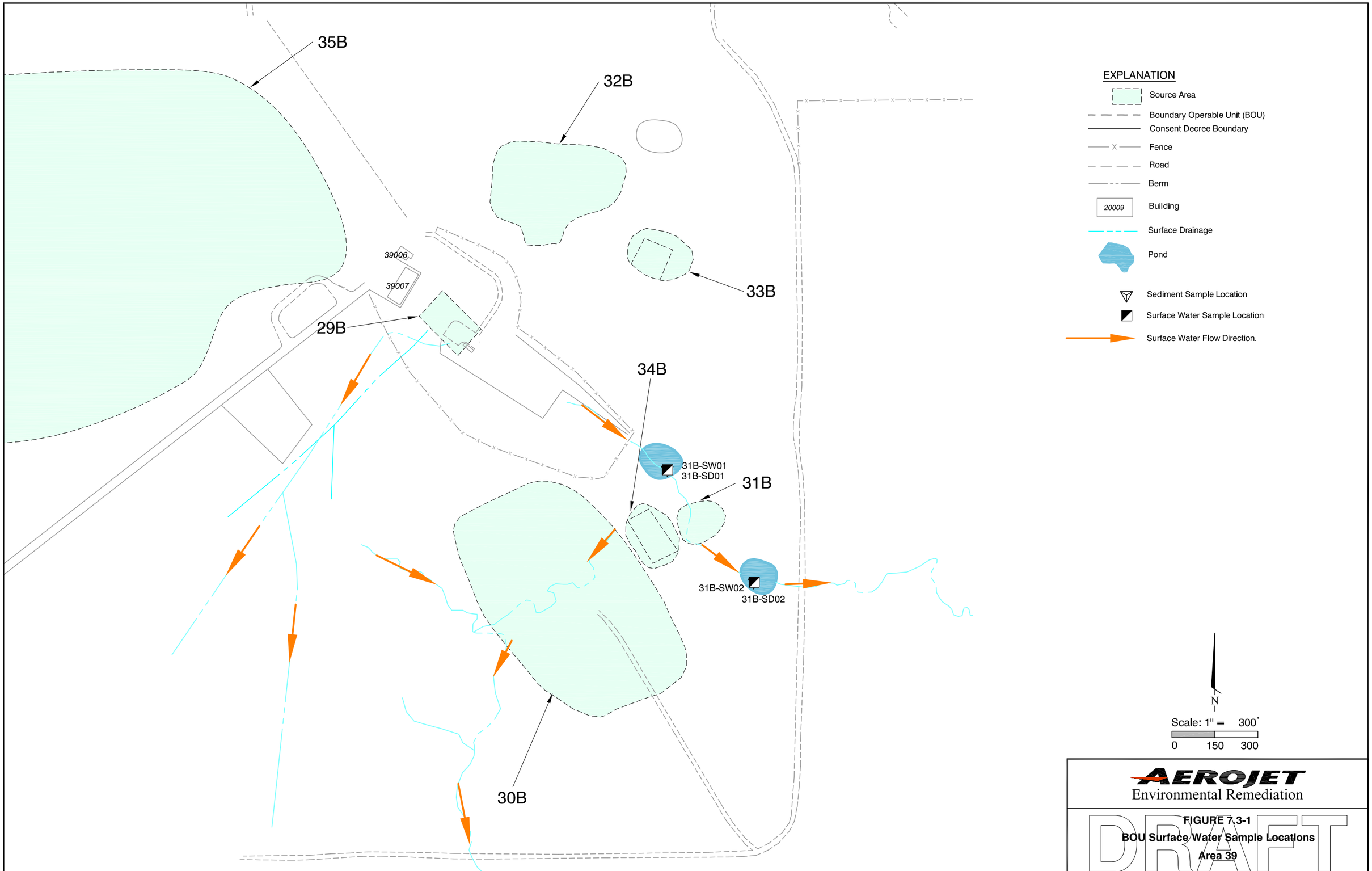
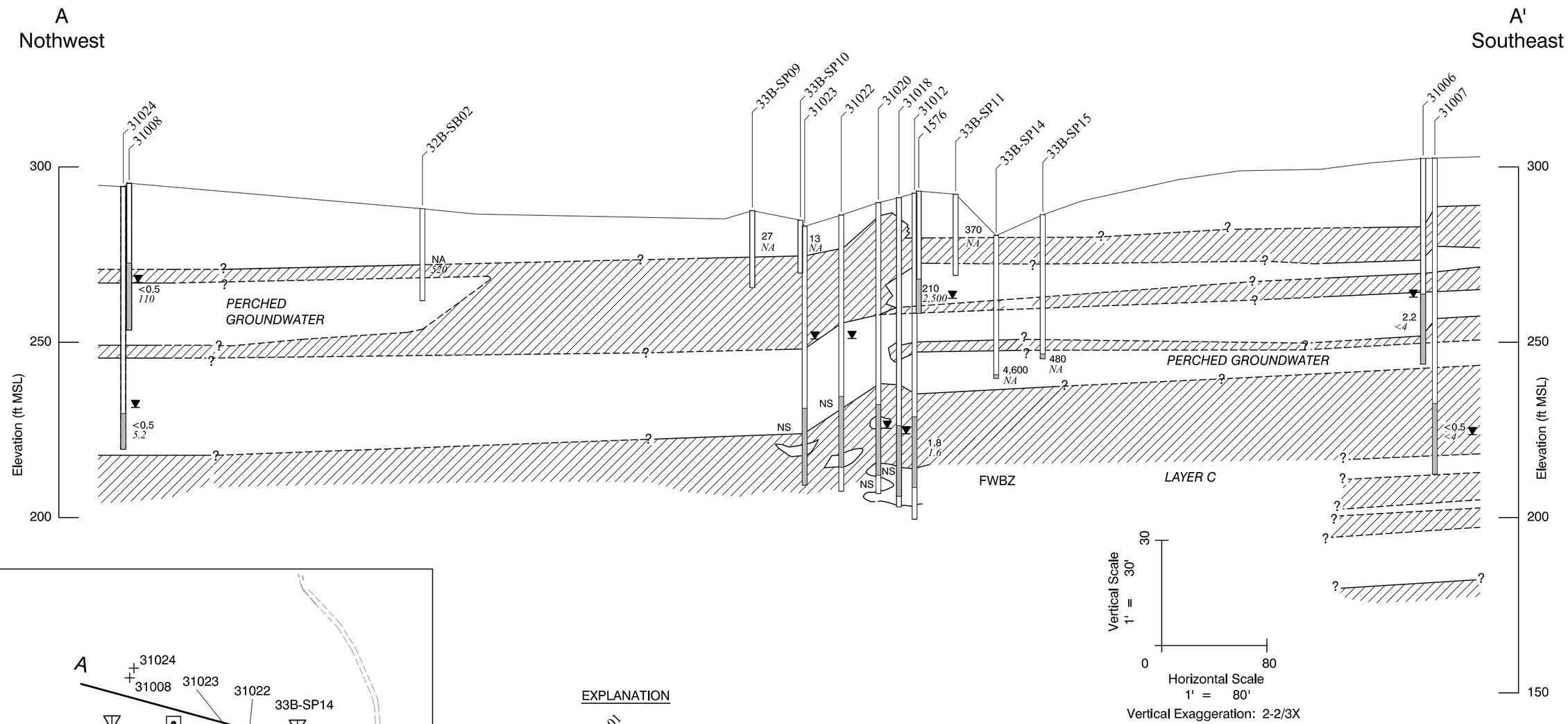
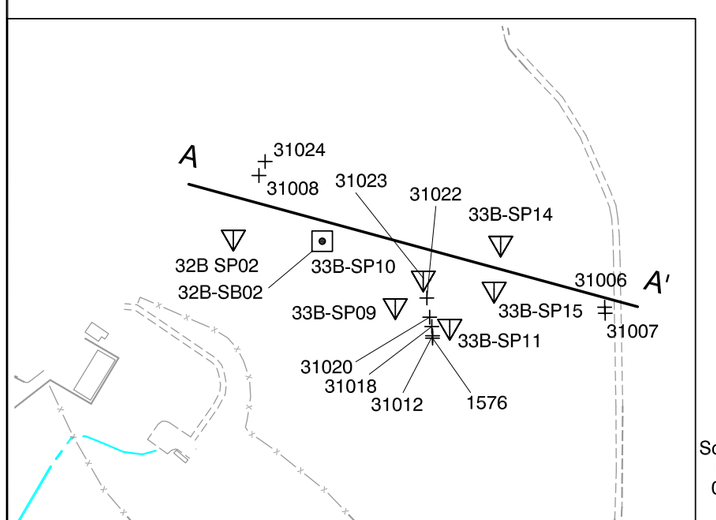


FIGURE 7.3-1
BOU Surface Water Sample Locations
Area 39

9\11\08 PR SR10131042





EXPLANATION

1001 — Well Designation
Multiple Completions: Depth Increases by Ascending Well Number Order

<0.5 — TCE Concentration in µg/L
<4 — Perchlorate Concentration in µg/L
(NA = Not Analyzed)
(NS = Not Sampled)

Screened Interval

Total Borehole Depth

FWBZ — First Water-Bearing Zone

Water Level (May 2007)

Layer Boundary

Geologic Contact

Relatively permeable sediments: Silty, poorly and well-graded sands and gravels (GP,GW,SP,SW); silty and clayey gravels (GM/GC) and silts.

Relatively lower permeability sediments: Low plasticity clays and silts (CL, ML).

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Environmental Remediation

FIGURE 7.4-1
Hydrostratigraphic Cross Section A - A'
Area 39
Boundary Operable Unit

DRAFT

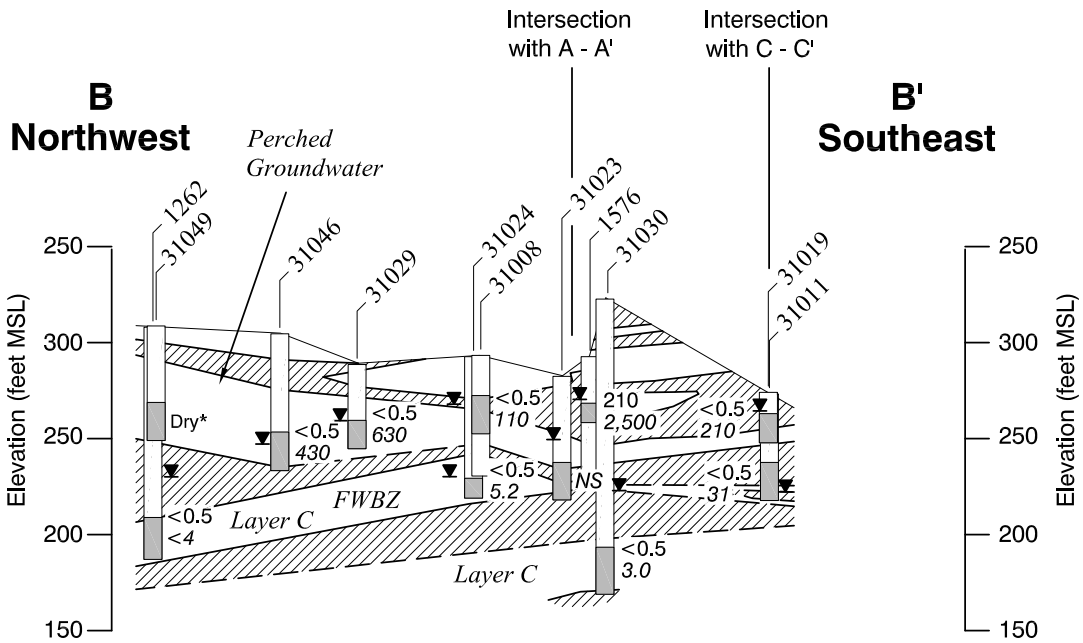
AEROJET SUPERFUND SITE, SACRAMENTO COUNTY, CA

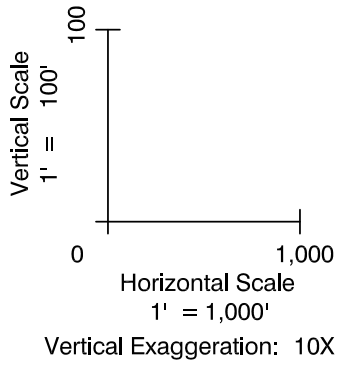
Herron, Al 12:42:24 PM

6/16/08

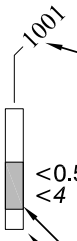
FIGURE 4.7-1

SR10121809





EXPLANATION



Well Designation
Multiple Completions: Depth Increases by Ascending Well Number Order

TCE Concentration (µg/L) (October 2005 to June 2008)

Perchlorate Concentration (µg/L) (NS = Not Sampled)

Screened Interval

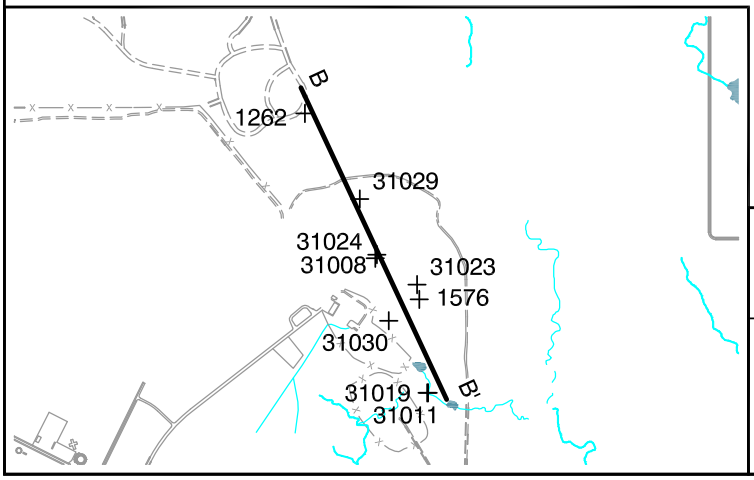
Total Borehole Depth

▼ 231 Water Level (May 2007)

Geologic Contact

Relatively permeable sediments: Silty, poorly and well-graded sands and gravels (GP,GW,SP,SW); silty and clayey gravels (GM/GC) and silts.

Relatively lower permeability sediments: Low plasticity clays and silts (CL,ML); silty and clayey sand (SM/SC).



N

Scale: 1" = 2,000'

0 1,000 2,000

Locator Scale

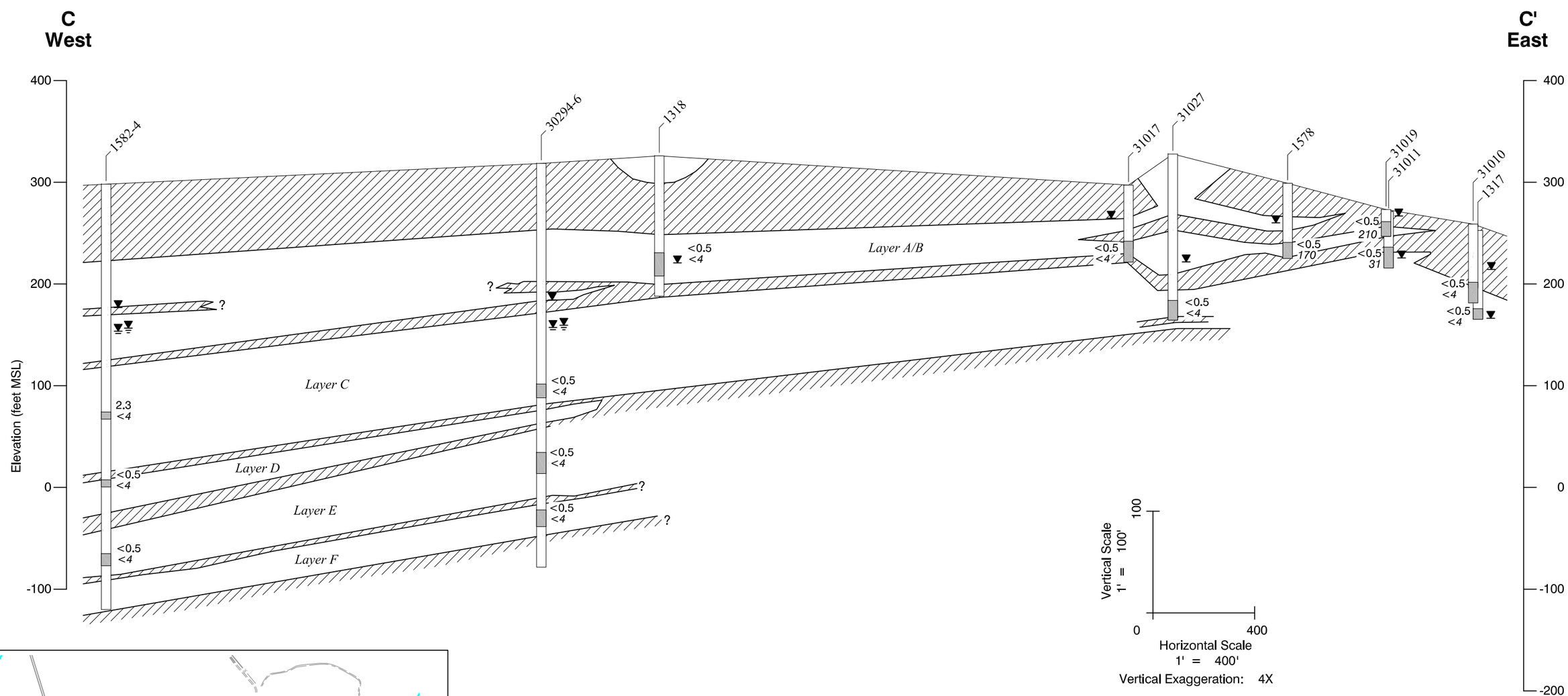
AEROJET
Environmental Remediation

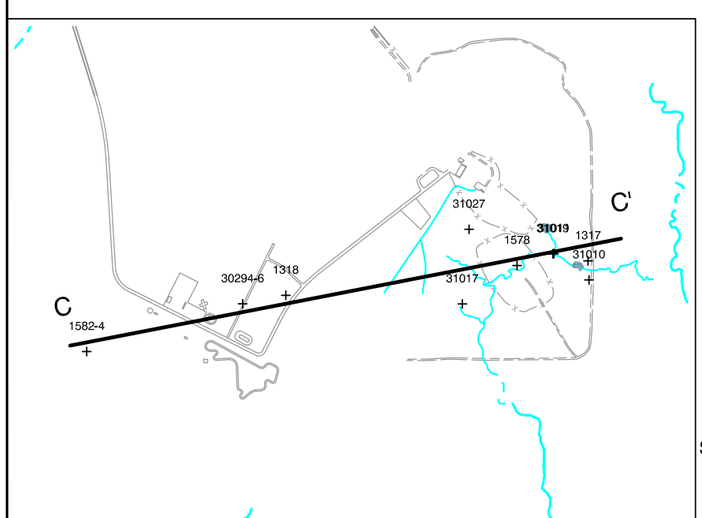
DRAFT

FIGURE 7.4-2
Hydrostratigraphic Cross Section B - B'
Area 39
Boundary Operable Unit

FIGURE 7.4-2 10/10/08 Herron, Al

SR10124598





Scale: 1" = 1600'
0 800 1600
Locator Scale

EXPLANATION

1001 — Well Designation
Multiple Completions: Depth Increases by Ascending Well Number Order

<0.5 — TCE Concentration (µg/L) (October 2005 to June 2008)

<4 — Perchlorate Concentration (µg/L) (NS = Not Sampled)

Screened Interval

Total Borehole Depth

▼ 231 — Water Level (April/May 2007) Number of Ticks Indicates Screen Level

Geologic Contact

Relatively permeable sediments: Silty, poorly and well-graded sands and gravels (GP,GW,SP,SW); silty and clayey gravels (GM/GC) and silts.

Relatively lower permeability sediments: Low plasticity clays and silts (CL,ML); silty and clayey sand (SM/SC).

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Environmental Remediation

FIGURE 7.4-3
Hydrostratigraphic Cross-Section C-C'
Area 39
Boundary Operable Unit

DRAFT

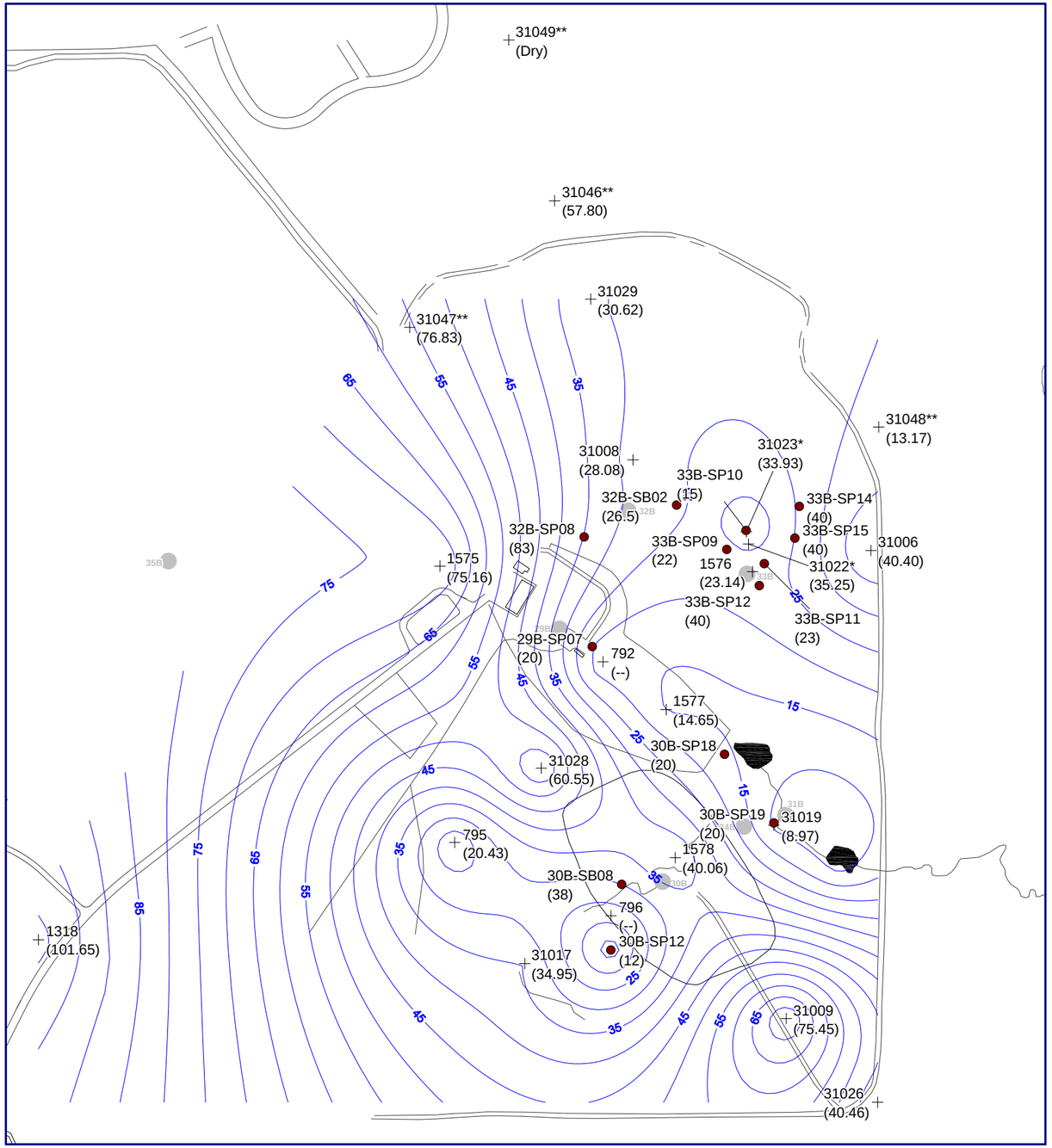
AEROJET SUPERFUND SITE, SACRAMENTO COUNTY, CA

Herron, Al 11:23:42 AM

10/10/08

FIGURE 7.4–3

SR10124599



Explanation

30B-SP08 (61.3) — Grab Groundwater Sample Location, ID and Depth to Groundwater (ft, bgs)
- data only used to lessen the depths to water as samples can be collected below water table

645 (61.3) — Monitoring Well, ID and Depth to Groundwater (ft, bgs)

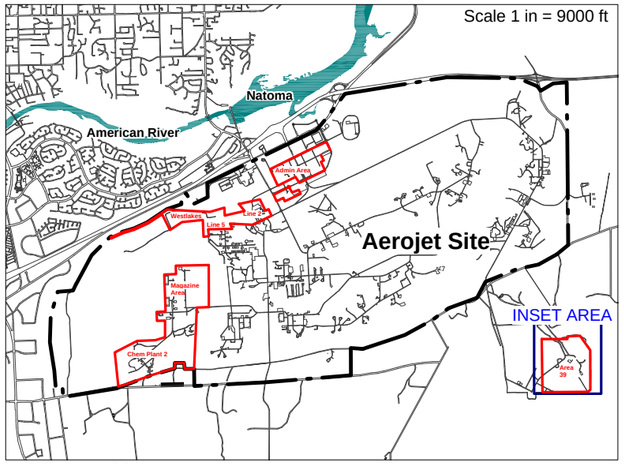
* - well partially screened in the FWBZ

** - data collected in June/July 2008, not used for contouring

-- = not measured

Depth to Groundwater Contour (ft, bgs)

29B — Source Area IDs



N

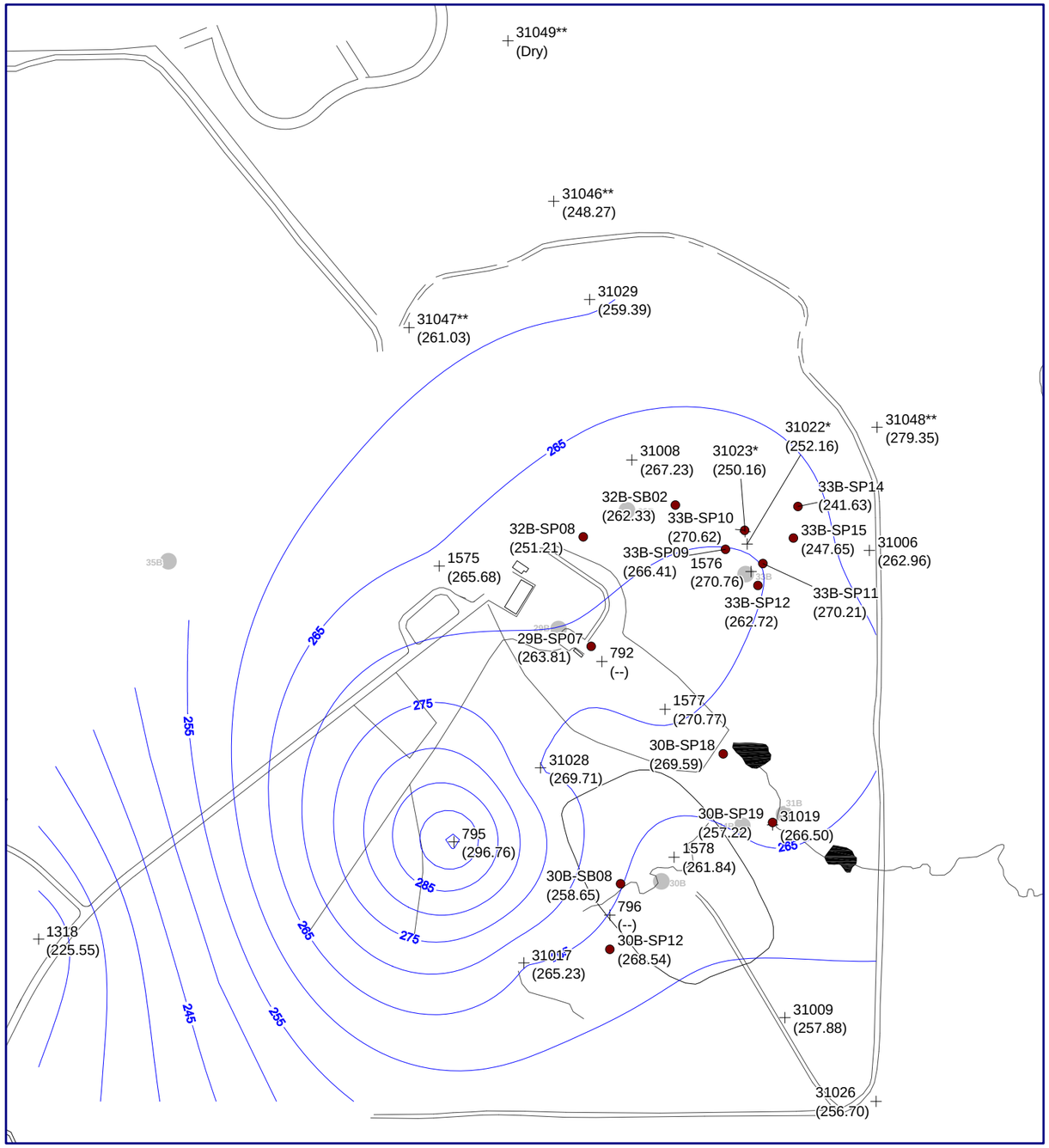
0 500 1,000
feet

AEROJET
Environmental Remediation

Figure 7.4-4
Perched Groundwater
Depth to Groundwater Map, May 2007
Area 39 - Boundary Operable Unit (OU-6)

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

SR10130166



Explanation

30B-SP08 (61.3) — Grab Groundwater Sample Location, ID and Groundwater Elevation (ft, msl)
- data only used to raise contours as sample can be collected below water table

645 (61.3) — Monitoring Well, ID and Groundwater Elevation (ft, msl)

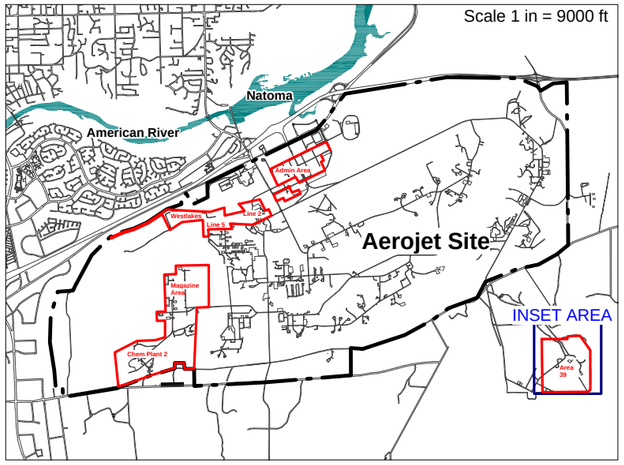
* - well partially screened in the FWBZ

** - data collected in June/July 2008, not used for contouring

-- = not measured

Groundwater Elevation Contour (ft, msl)

29B — Source Area IDs



N

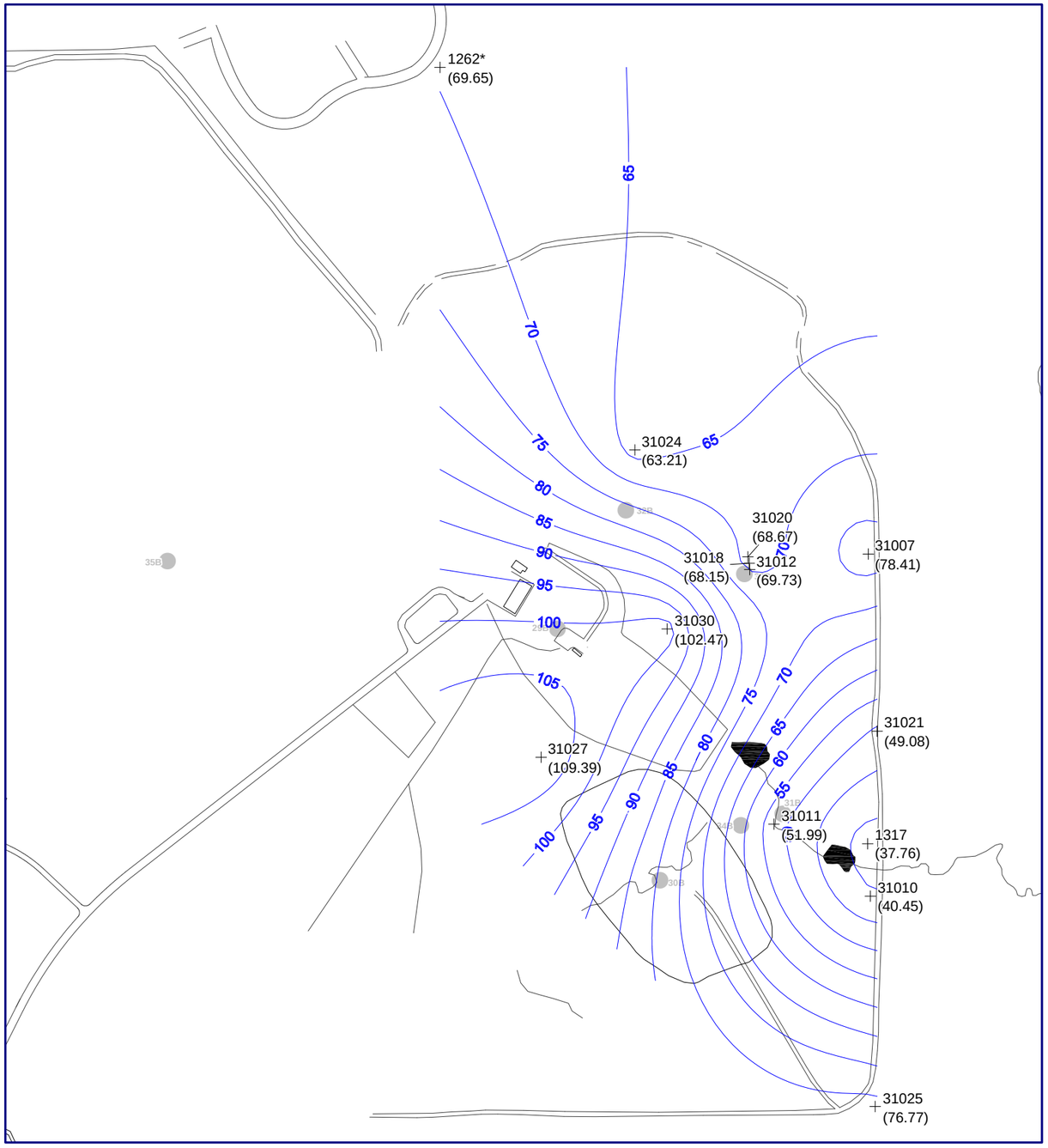
0 500 1,000
feet

AEROJET
Environmental Remediation

Figure 7.4-5
Perched Groundwater
Groundwater Elevation Map, May 2007
Area 39 - Boundary Operable Unit (OU-6)

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

SR10130166



Explanation

+ 645 (61.3)	Monitoring Well, ID and Depth to Groundwater (ft, bgs) * = Collected April 2007 -- = not measured
	Depth to Groundwater Contour (ft, bgs)
29B	Source Area IDs

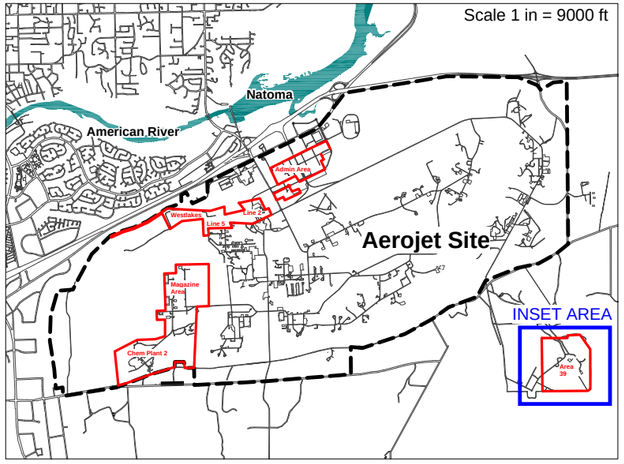


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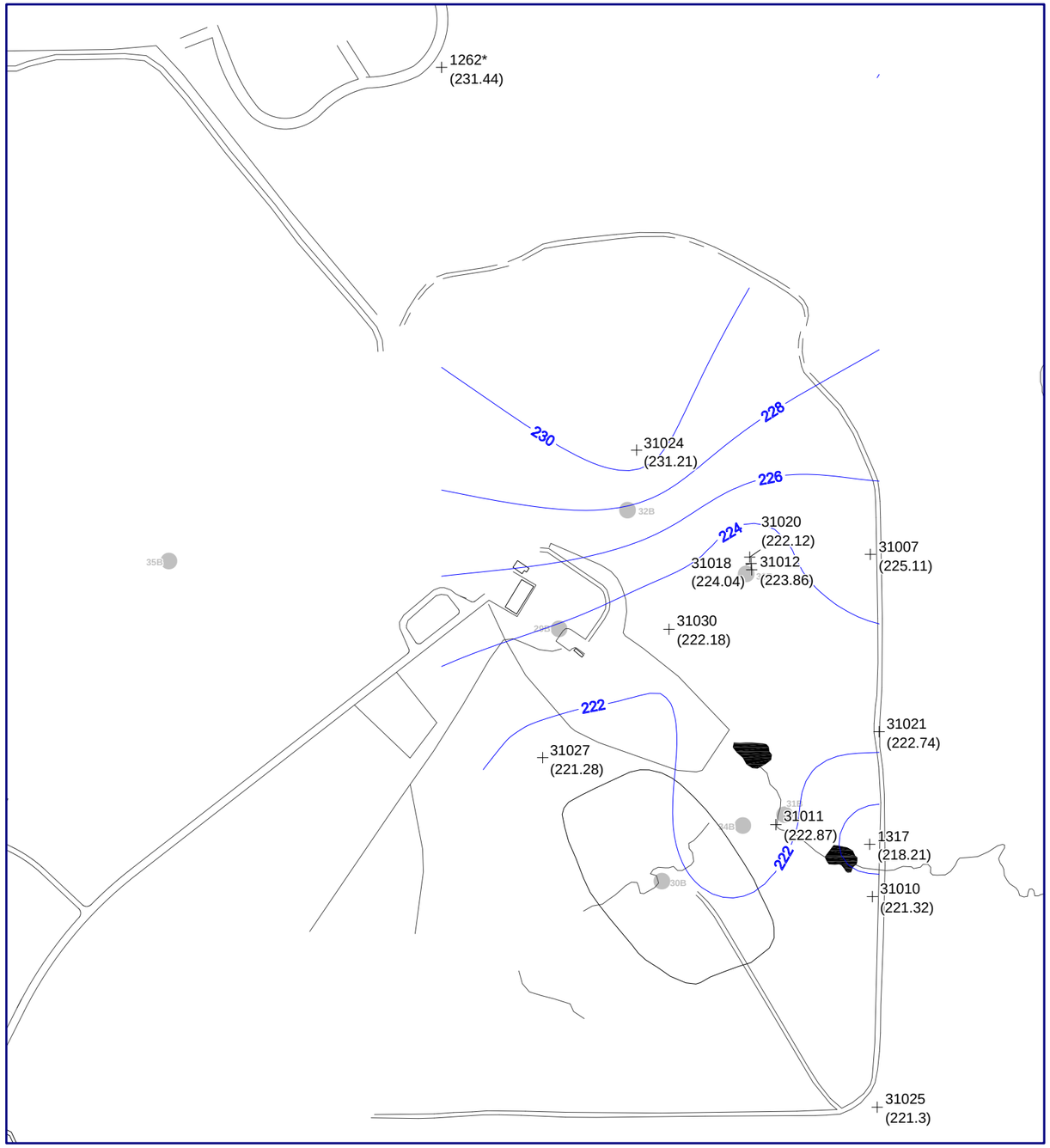
Figure 7.4-6
First Water-Bearing Zone
Depth to Groundwater, May 2007
Area 39 - Boundary Operable Unit (OU-6)

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

SR10130166



Explanation

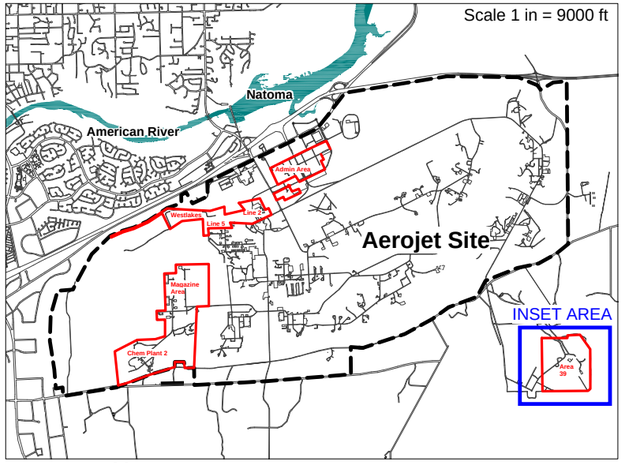
645 (61.3) — Monitoring Well, ID and Groundwater Elevation (ft, msl)

* = Collected April 2007

-- = not measured

Groundwater Elevation Contour (ft, msl)

29B — Source Area IDs

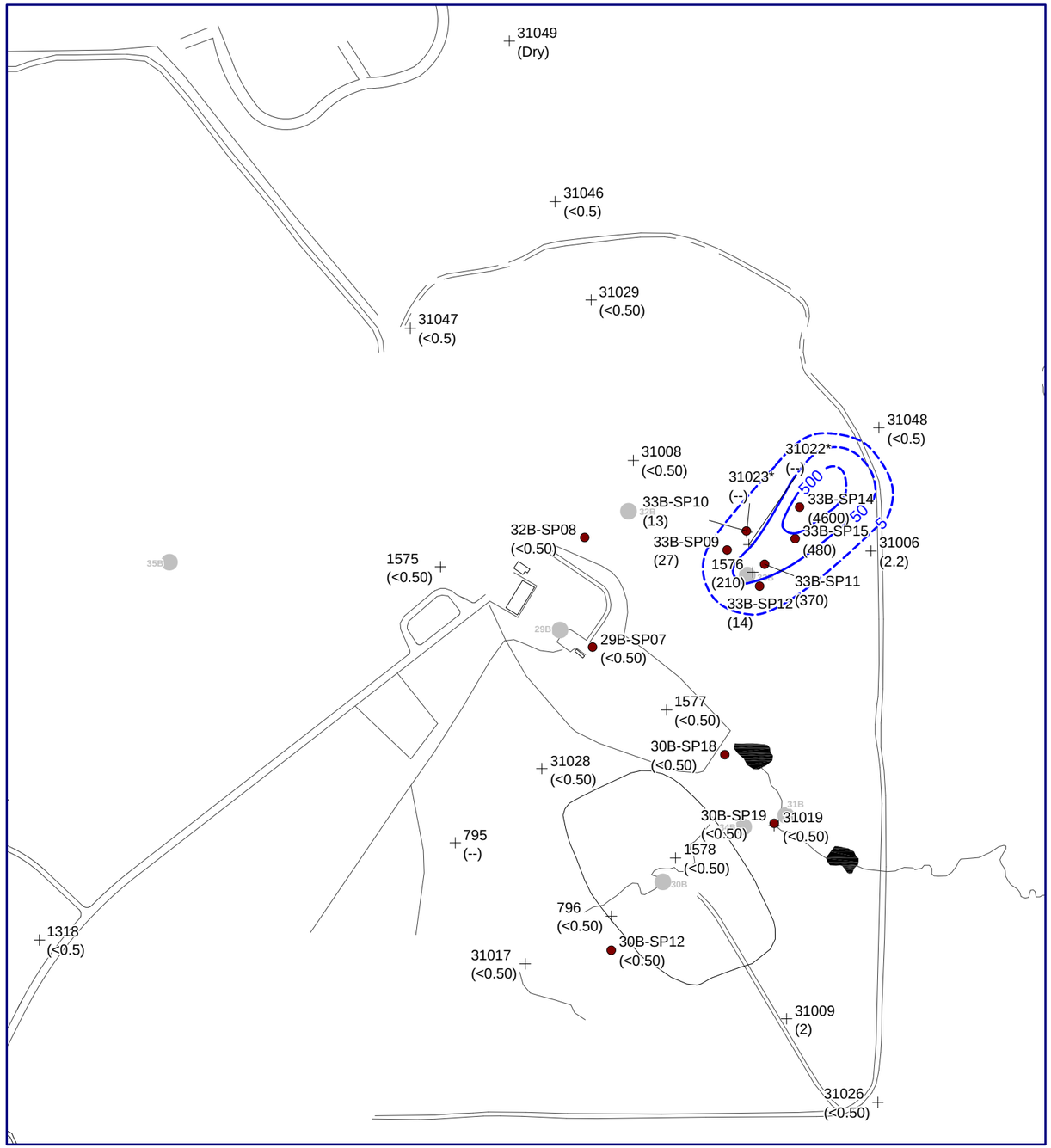


AEROJET
Environmental Remediation

Figure 7.4-7
First Water-Bearing Zone
Potentiometric Surface Map, May 2007
Area 39 - Boundary Operable Unit (OU-6)

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

SR10130166



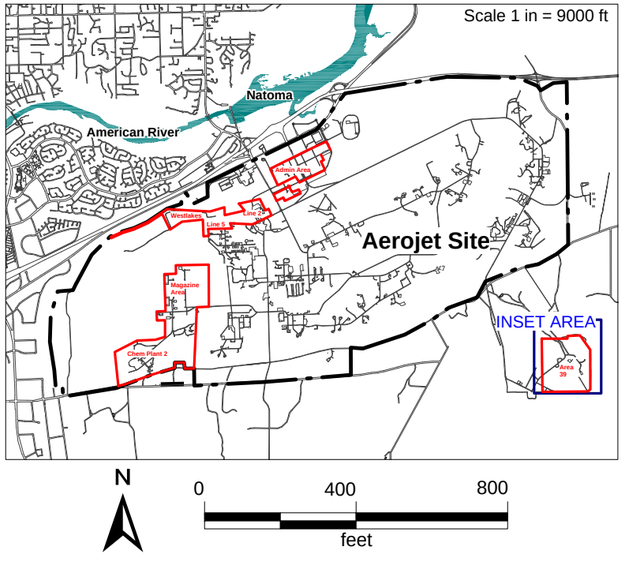
Explanation

03D-SP29 (61.3)	Grab Groundwater Sample Location and Concentration (ug/L)
645 (61.3)	Monitoring Well, ID and Concentration (ug/L)
	* - well partially screened in the FWBZ

Note: -- = not sampled. "J" = Estimated Concentration

Iso-Concentration Contour (ug/L)
- lines dashed where inferred

29B Source Area IDs

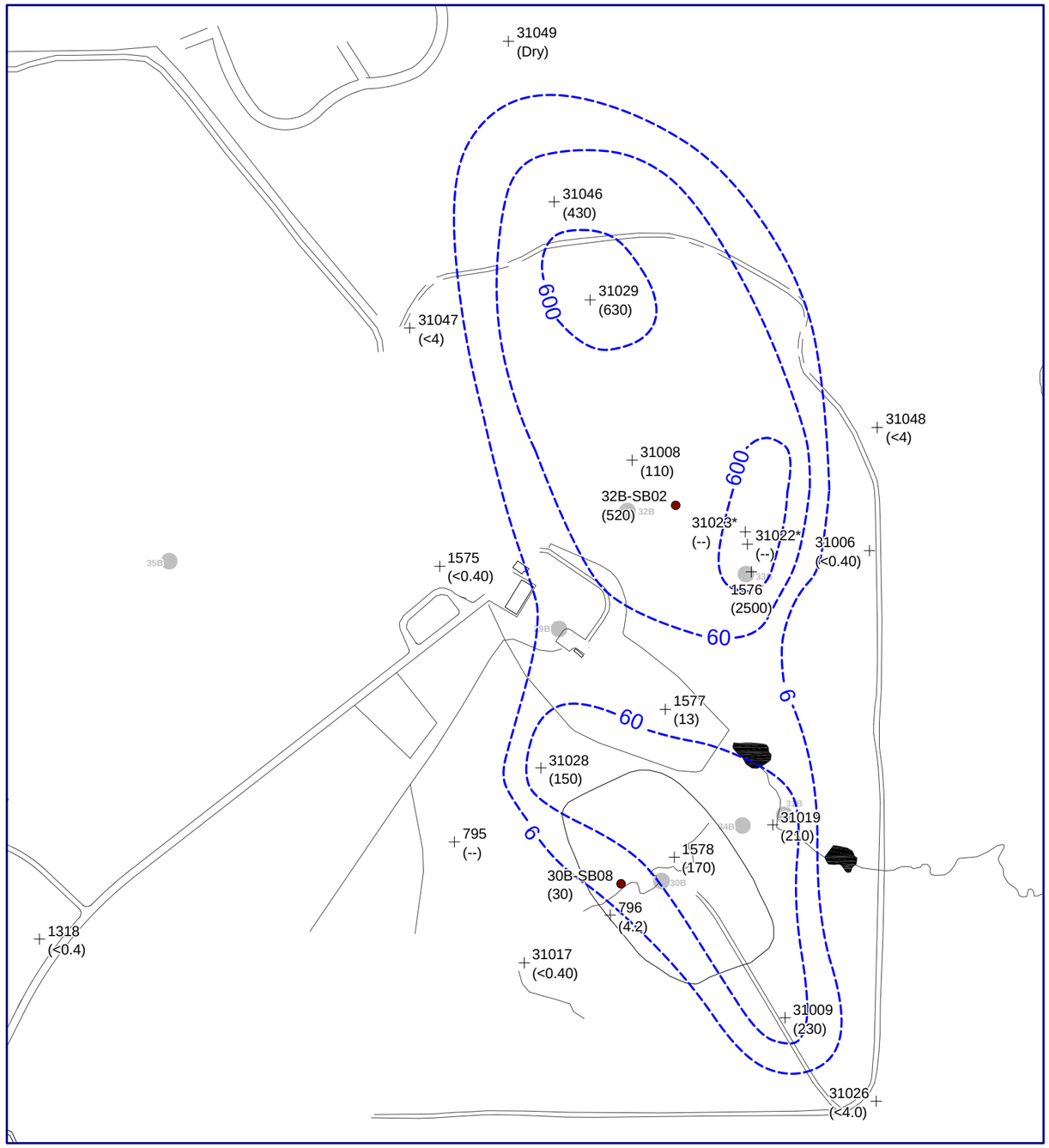


AEROJET
Environmental Remediation

Figure 7.4-8
Perched Groundwater
TCE Iso-Concentration Contours October 2005 to June 2008
Area 39 - Boundary Operable Unit (OU-6)

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

SR10130166



Explanation

03D-SP29 (61.3) — Grab Groundwater Sample Location and Concentration (ug/L)

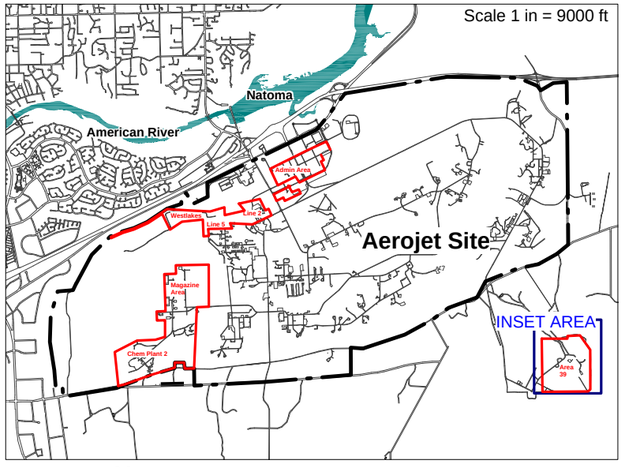
645 (61.3) — Monitoring Well, ID and Concentration (ug/L)

* - well partially screened in the FWBZ

Note: -- = not sampled. "J" = Estimated Concentration

Iso-Concentration Contour (ug/L) - lines dashed where inferred

29B — Source Area IDs



N

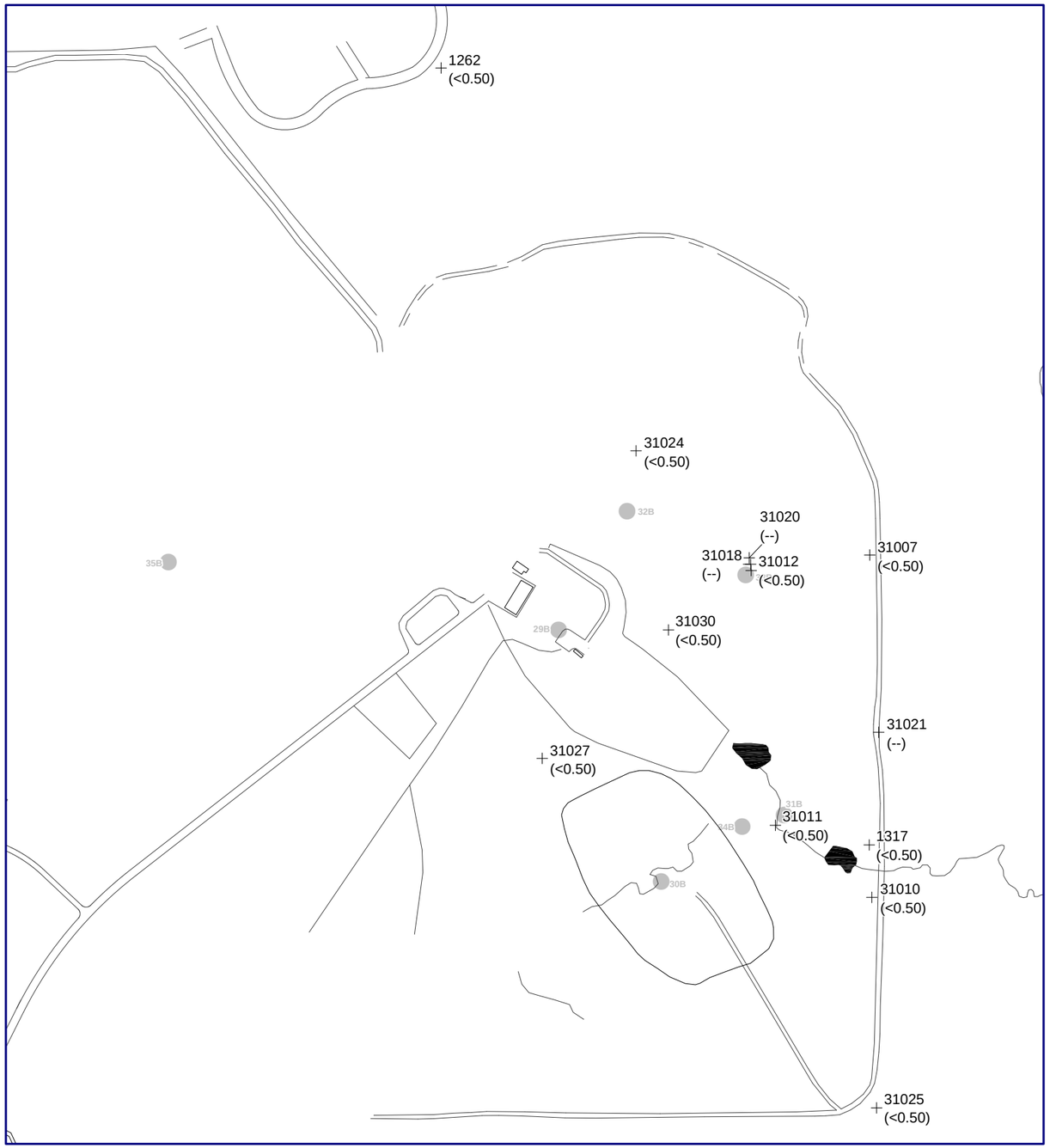
0 500 1,000
feet

AEROJET
Environmental Remediation

Figure 7.4-9
Perched Groundwater
Perchlorate Iso-Concentration Contours October 2005 to June 2008
Area 39 - Boundary Operable Unit (OU-6)

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

SR10130166

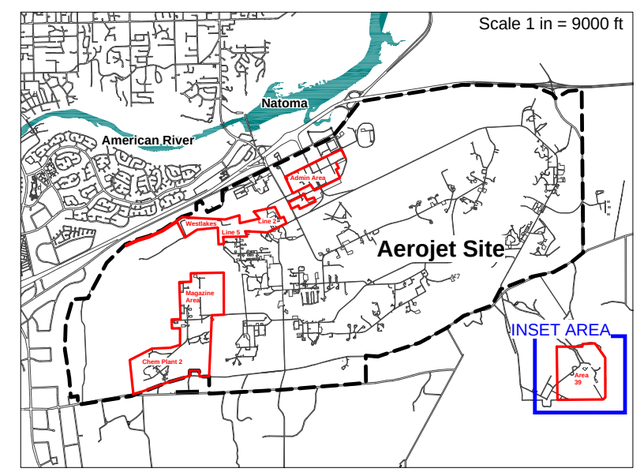


Explanation

+ 645 (61.3) Monitoring Well, ID and Concentration (ug/L)

Note: -- = not sampled. "J" = Estimated Concentration

29B Source Area IDs



N

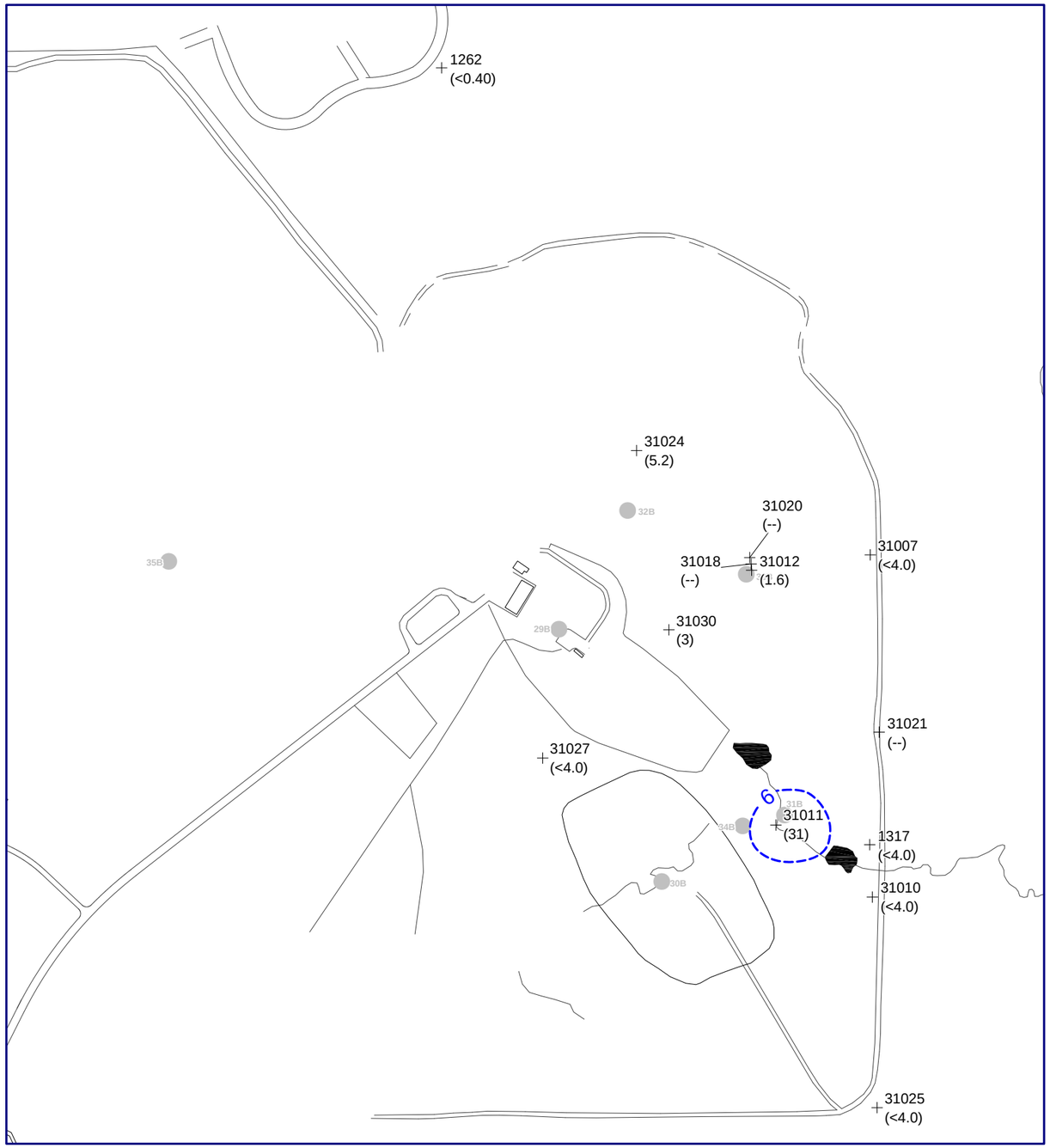
0 500 1,000
feet

AEROJET
Environmental Remediation

Figure 7.4-10
First Water-Bearing Zone
TCE Iso-Concentration Contours October 2005 to June 2008
Area 39 - Boundary Operable Unit (OU-6)

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

SR10130166



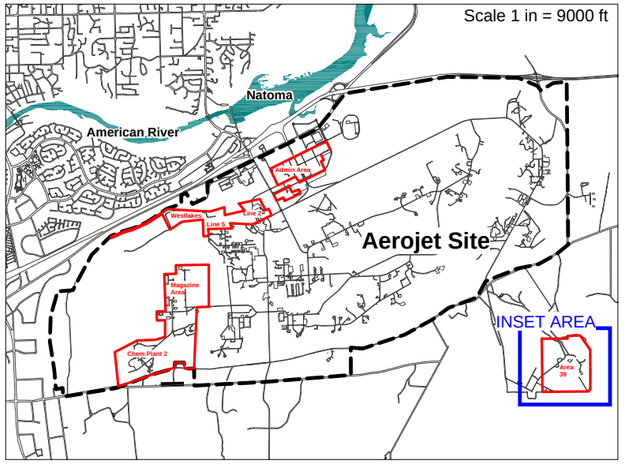
Explanation

645 (61.3) — Monitoring Well, ID and Concentration (ug/L)

Note: -- = not sampled. "J" = Estimated Concentration

Iso-Concentration Contour (ug/L) - lines dashed where inferred

29B — Source Area IDs



N

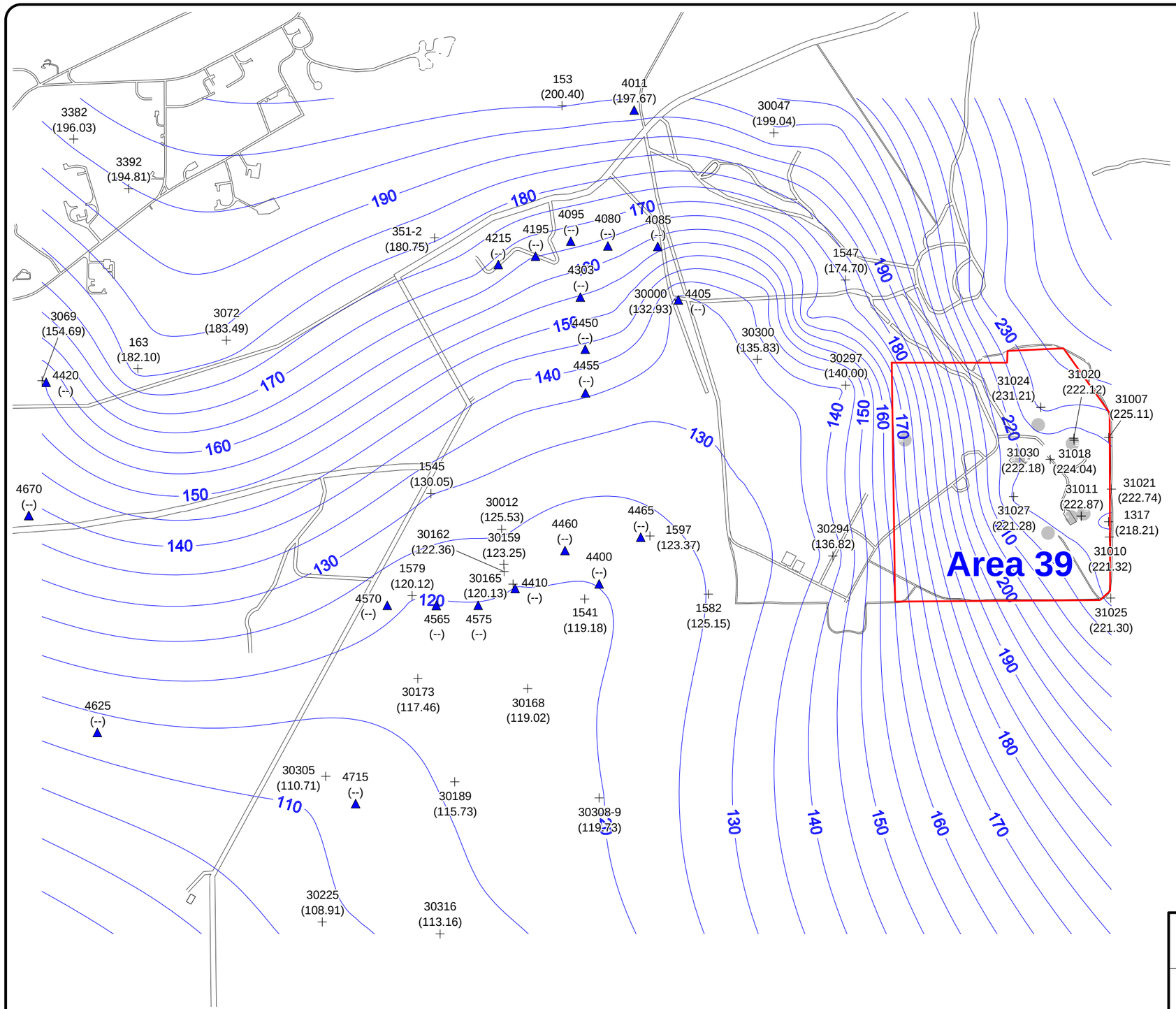
0 500 1,000
feet

AEROJET
Environmental Remediation

Figure 7.4-11
First Water-Bearing Zone
Perchlorate Iso-Concentration Contours October 2005 to October 2007
Area 39 - Boundary Operable Unit (OU-6)

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

SR10130166

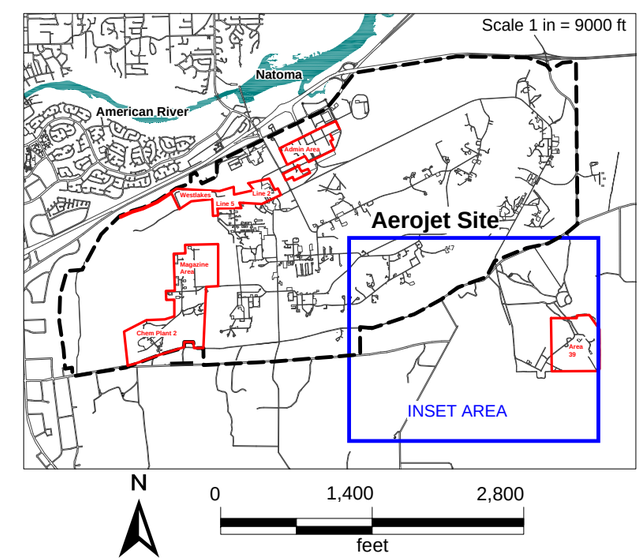


Explanation

645 (111.00) Monitoring Well, ID, Water Level (ft, msl)

4011 (--) Extraction Well, ID, Water Level (ft, msl)
-- = not measured

Groundwater Elevation Contour (ft, msl)



AEROJET
Environmental Remediation

Figure 7.4-12
Layer C
Potentiometric Surface Map, April and May 2007
Area 39 - Boundary Operable Unit (OU-6)

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

SR10130166

Table 7.2-1 Summary of Soil Vapor Sampling and Sampling Statistics
Area 39
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Interval	Depth (feet bgs)	Locations	Primary Samples	Duplicate Samples	Detects	Frequency of Duplicates	Frequency of Primary Detects
29B	Shallow	0-10	0	0	0	0	0.0%	0.0%
	Intermediate	11-20	0	0	0	0	0.0%	0.0%
	Deep	21-30	0	0	0	0	0.0%	0.0%
30B	Shallow	0-10	13	13	1	13	7.7%	100.0%
	Intermediate	11-20	10	10	1	10	10.0%	100.0%
	Deep	21-30	0	0	0	0	0.0%	0.0%
31B	Shallow	0-10	0	0	0	0	0.0%	0.0%
	Intermediate	11-20	0	0	0	0	0.0%	0.0%
	Deep	21-30	0	0	0	0	0.0%	0.0%
32B	Shallow	0-10	5	5	1	5	20.0%	100.0%
	Intermediate	11-20	5	6	0	6	0.0%	100.0%
	Deep	21-30	0	0	0	0	0.0%	0.0%
	Very Deep	>30	1	1	0	1	0.0%	100.0%
33B	Shallow	0-10	13	13	2	13	15.4%	100.0%
	Intermediate	11-20	12	12	0	12	0.0%	100.0%
	Deep	21-30	0	0	0	0	0.0%	0.0%
	Very Deep	>30	1	1	0	1	0.0%	100.0%
34B	Shallow	0-10	0	0	0	0	0.0%	0.0%
	Intermediate	11-20	0	0	0	0	0.0%	0.0%
	Deep	21-30	0	0	0	0	0.0%	0.0%
35B	Shallow	0-10	1	1	0	1	0.0%	100.0%
	Intermediate	11-20	1	1	0	1	0.0%	100.0%
	Deep	21-30	0	0	0	0	0.0%	0.0%
		Totals:	**32**	**63**	**5**	**63**	**8%**	**100%**

Notes and Key:

All samples analyzed for volatile organic compounds (VOCs) by USEPA Method TO-15.

bgs = Below ground surface

% = Percent

Table 7.2-2 Cross-Reference Between Soil and Soil Vapor Sampling Locations and Source Areas
Area 39
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Soil Sampling Location(s)	Soil Vapor Sampling Location(s)
29B	**TEST STAND BURN AREA** 50-foot deep ravine southwest of former K-1 test stand (Building 39007)	29B-SB04 29B-SB05 29B-SB06 29B-SB07	
29B	**TEST STAND BURN AREA** Drainages on surface above the ravine	29B-SB08 29B-SB09 29B-SB10 29B-SB11	
30B	**FORMER PRODUCTION WASTE BURN AREA** Level plateau surrounded by slopes.	30B-SNS01 30B-SNS02 30B-SNS03 30B-SNS04 30B-SNS05 30B-SB04 30B-SB05 30B-SB06 30B-SB07 30B-SB08	30B-SP10 30B-SP11 30B-SP12 30B-SP13 30B-SP14 30B-SP15 30B-SP17 30B-SP18 30B-SP19 30B-SP20 30B-SP21 30B-SP22 30B-SP23
31B	**FORMER IGNITOR/SMALL ROCKET MOTOR BURN AREA** Infrequent burning of igniters and small rocket motors.	31B-SB02	30B-SP19
31B	**FORMER IGNITOR/SMALL ROCKET MOTOR BURN AREA** Small ponds upstream and downstream of Source Area 31B.	31B-SD01 31B-SD02	
32B	**FORMER OXIDIZER BURN AREA**	32B-SB02 32B-SB03 32B-SB04 32B-SB05	32B-SP07 32B-SP08 32B-SP09 32B-SP10 32B-SP11

Table 7.2-2 Cross-Reference Between Soil and Soil Vapor Sampling Locations and Source Areas
Area 39
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Soil Sampling Location(s)	Soil Vapor Sampling Location(s)
33B	**FORMER LABORATORY SUPPLY BURN AREA** Asphalt pad	33B-SB03	33B-SP09 33B-SP10 33B-SP11 33B-SP12 33B-SP13 33B-SP14 33B-SP15 33B-SP16 33B-SP17 33B-SP18 33B-SP19 33B-SP20 33B-SP21
34B	**FORMER CHEMICAL STORAGE PAD** Asphalt pad	34B-SNS01 34B-SNS02 34B-SNS03 34B-SB02	30B-SP18 30B-SP19 30B-SP20
35B	**AREA OF DREDGE TAILINGS** No documented features or industrial activities		35B-SP04

Table 7.2-3
Summary of Soil Sampling and Sampling Statistics for Source Areas 29B, 30B, and 31B
Area 39
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

				Source Area 29B						Source Area 30B						Source Area 31B					
Compound(s)	**Analyte**	**Method**	**Depth (feet bgs)**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**
Metals	Metals	6010B	0-2.5	8	9	1	9	11.1%	100.0%	5	5	0	5	0.0%	100.0%	3	5	0	5	0.0%	100.0%
		6020	0-2.5	8	9	1	9	11.1%	100.0%	5	5	0	5	0.0%	100.0%	3	5	0	5	0.0%	100.0%
		6010B	>2.5	8	15	0	15	0.0%	100.0%	5	9	0	9	0.0%	100.0%	1	2	0	2	0.0%	100.0%
		6020	>2.5	7	13	0	12	0.0%	92.3%	5	9	0	9	0.0%	100.0%	1	2	0	2	0.0%	100.0%
	Chromium VI	7199	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		7199	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	Mercury	7471A	0-2.5	8	9	1	7	11.1%	77.8%	5	5	0	5	0.0%	100.0%	3	5	0	4	0.0%	80.0%
		7471A	>2.5	8	13	0	12	0.0%	92.3%	5	9	0	7	0.0%	77.8%	1	2	0	2	0.0%	100.0%
SVOCs	SVOCs	8270C	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	2	4	0	0	0.0%	0.0%
		8270C	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
PCBs	PCBs	8082	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		8082	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
Perchlorate	Perchlorate	314.0, 314.0M	0-2.5	8	9	1	0	11.1%	0.0%	5	5	0	1	0.0%	20.0%	3	5	0	0	0.0%	0.0%
		314.0, 314.0M	>2.5	8	14	0	1	0.0%	7.1%	5	9	0	2	0.0%	22.2%	1	2	0	1	0.0%	50.0%
Dioxins/Furans	Dioxins/Furans	8290 D/F	0-2.5	0	0	0	0	0.0%	0.0%	5	10	0	4	0.0%	40.0%	0	0	0	0	0.0%	0.0%
		8290 D/F	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
TPH	Diesel	8015B-SVOA - Diesel	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		8015B-SVOA - Diesel	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	Motor Oil	8015B-SVOA - Oil	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		8015B-SVOA - Oil	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
Misc.	Total Cyanide	9014	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		9014	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	NDMA	1625C-CI M	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		1625C-CI M	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	pH	9045C	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		9045C	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	TOC	9060A MOD	0-2.5	0	0	0	0	0.0%	0.0%	1	1	0	0	0.0%	0.0%	2	4	0	0	0.0%	0.0%
		9060A MOD	>2.5	0	0	0	0	0.0%	0.0%	1	3	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	CEC	9081	0-2.5	0	0	0	0	0.0%	0.0%	1	1	0	1	0.0%	100.0%	2	4	0	4	0.0%	100.0%
		9081	>2.5	0	0	0	0	0.0%	0.0%	1	3	0	3	0.0%	100.0%	0	0	0	0	0.0%	0.0%

Notes and Key:

> = Greater than
% = Percent
bgs = Below ground surface
CEC = Cation exchange capacity
Chromium VI = Hexavalent chromium
NDMA = N-Nitrosodimethylamine
PCB = Polychlorinated biphenyl
SVOC = Semivolatile organic compound
TOC = Total organic content
TPH = Total petroleum hydrocarbons

Table 7.2-4
Summary of Soil Sampling and Sampling Statistics for Source Areas 32B and 33B
Area 39
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

				Source Area 32B						Source Area 33B					
Compound(s)	**Analyte**	**Method**	**Depth (feet bgs)**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**
Metals	Metals	6010B	0-2.5	4	4	0	4	0.0%	100.0%	2	2	0	2	0.0%	100.0%
		6020	0-2.5	4	4	0	4	0.0%	100.0%	1	1	0	1	0.0%	100.0%
		6010B	>2.5	4	7	1	7	14.3%	100.0%	1	2	0	2	0.0%	100.0%
		6020	>2.5	4	7	1	7	14.3%	100.0%	1	2	0	2	0.0%	100.0%
	Chromium VI	7199	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		7199	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	Mercury	7471A	0-2.5	4	4	0	4	0.0%	100.0%	2	2	0	2	0.0%	100.0%
		7471A	>2.5	4	7	1	5	14.3%	71.4%	1	2	0	2	0.0%	100.0%
SVOCs	SVOCs	8270C	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		8270C	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
PCBs	PCBs	8082	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		8082	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
Perchlorate	Perchlorate	314.0, 314.0M	0-2.5	4	4	0	0	0.0%	0.0%	2	2	0	1	0.0%	50.0%
		314.0, 314.0M	>2.5	4	7	1	1	14.3%	14.3%	1	2	0	2	0.0%	100.0%
Dioxins/Furans	Dioxins/Furans	8290 D/F	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		8290 D/F	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
TPH	Diesel	8015B-SVOA - Diesel	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		8015B-SVOA - Diesel	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	Motor Oil	8015B-SVOA - Oil	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		8015B-SVOA - Oil	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
Misc.	Total Cyanide	9014	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		9014	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	NDMA	1625C-CI M	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		1625C-CI M	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	pH	9045C	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		9045C	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	TOC	9060A MOD	0-2.5	1	1	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		9060A MOD	>2.5	1	3	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	CEC	9081	0-2.5	1	1	0	1	0.0%	100.0%	0	0	0	0	0.0%	0.0%
		9081	>2.5	1	3	0	3	0.0%	100.0%	0	0	0	0	0.0%	0.0%

Notes and Key:

> = Greater than
% = Percent
bgs = Below ground surface
CEC = Cation exchange capacity
Chromium VI = Hexavalent chromium
NDMA = N-Nitrosodimethylamine
PCB = Polychlorinated biphenyls
SVOC = Semivolatile organic compounds
TOC = Total organic content
TPH = Total petroleum hydrocarbons

Table 7.2-5
Summary of Soil Sampling and Sampling Statistics for Source Areas 34B and 35B
Area 39
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

				Source Area 34B						Source Area 35B					
Compound(s)	**Analyte**	**Method**	**Depth (feet bgs)**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**	**Locations**	**Primary Samples**	**Duplicates**	**Detects**	**Frequency of Duplicates**	**Frequency of Primary Detects**
Metals	Metals	6010B	0-2.5	1	1	0	1	0.0%	100.0%	0	0	0	0	0.0%	0.0%
		6020	0-2.5	1	1	0	1	0.0%	100.0%	0	0	0	0	0.0%	0.0%
		6010B	>2.5	1	1	0	1	0.0%	100.0%	0	0	0	0	0.0%	0.0%
		6020	>2.5	1	1	0	1	0.0%	100.0%	0	0	0	0	0.0%	0.0%
	Chromium VI	7199	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		7199	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	Mercury	7471A	0-2.5	1	1	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		7471A	>2.5	1	1	0	1	0.0%	100.0%	0	0	0	0	0.0%	0.0%
SVOCs	SVOCs	8270C	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		8270C	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
PCBs	PCBs	8082	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		8082	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
Perchlorate	Perchlorate	314.0, 314.0M	0-2.5	1	1	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		314.0, 314.0M	>2.5	1	1	0	1	0.0%	100.0%	0	0	0	0	0.0%	0.0%
Dioxins/Furans	Dioxins/Furans	8290 D/F	0-2.5	3	6	0	4	0.0%	66.7%	0	0	0	0	0.0%	0.0%
		8290 D/F	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
TPH	Diesel	8015B-SVOA - Diesel	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		8015B-SVOA - Diesel	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	Motor Oil	8015B-SVOA - Oil	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		8015B-SVOA - Oil	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
Misc.	Total Cyanide	9014	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		9014	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	NDMA	1625C-CI M	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		1625C-CI M	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	Total Solids	160.3, 160.3M, 2540G	0-2.5	1	1	0	1	0.0%	100.0%	0	0	0	0	0.0%	0.0%
		160.3, 160.3M, 2540G	>2.5	1	2	0	2	0.0%	100.0%	0	0	0	0	0.0%	0.0%
	pH	9045C	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		9045C	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	TOC	9060A MOD	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		9060A MOD	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
	CEC	9081	0-2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%
		9081	>2.5	0	0	0	0	0.0%	0.0%	0	0	0	0	0.0%	0.0%

Notes and Key:

> = Greater than
% = Percent
bgs = Below ground surface
CEC = Cation exchange capacity
Chromium VI = Hexavalent chromium
NDMA = N-Nitrosodimethylamine
PCB = Polychlorinated biphenyl
SVOC = Semivolatile organic compound
TOC = Total organic content
TPH = Total petroleum hydrocarbons

Table 7.2-6 Summary of Soil Vapor Sampling Activities and Deviations from Field Sampling Plan
Area 39
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Rationale and Comments	Number of Samples Collected	Sampling Activity	Sample ID	Sample Depths (ft bgs)	Details of Analyses Performed
29B	Test Stand Burn Area	1	***10***, 20	Proposed location was at the point of highest VOC concentration and used to determine if a source was present in the vadose zone.	0	Soil Vapor	29B-SP07	None	Not sampled as water rose to 9 ft bgs.
					1	Grab Groundwater	29B-SP07-GW	20	
30B	Former Production Waste Burn Area	3	10, 20	Proposed location 30B-SP10 was at the point of highest VOC concentration and used to determine if a source was present in the vadose zone.	5	Soil Vapor	30B-SP10	10, 20	
							30B-SP11	10, 20	
							30B-SP12	10	
					1	Grab Groundwater	30B-SP12-GW	12	
30B	Former Production Waste Burn Area	***0***	None	Additional samples collected because chemical concentrations exceeded screening level criteria.	2	Soil Vapor	30B-SP13	10, 20	
					2	Soil Vapor	30B-SP14	10, 20	
					2	Soil Vapor	30B-SP15	10, 16	
					2	Soil Vapor	30B-SP17	10, 20	
					1	Soil Vapor	30B-SP18	10	
					1	Grab Groundwater	30B-SP18-GW	20	
					1	Soil Vapor	30B-SP19	10	
					1	Grab Groundwater	30B-SP19-GW	20	
					2	Soil Vapor	30B-SP20	10, 20	
					2	Soil Vapor	30B-SP21	10, 20	
					2	Soil Vapor	30B-SP22	10, 20	
					2	Soil Vapor	30B-SP23	10, 20	
32B	Former Oxidizer Burn Area.	2	10, 20	Proposed location was at the point of highest VOC concentration and used to determine if a source was present in the vadose zone.	6	Soil Vapor	32B-SP07	10, 20	
							32B-SP08	10, 17, ***20***, ***40***	
					1	Grab Groundwater	32B-SP08-GW	83	

Table 7.2-6 Summary of Soil Vapor Sampling Activities and Deviations from Field Sampling Plan
Area 39
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Rationale and Comments	Number of Samples Collected	Sampling Activity	Sample ID	Sample Depths (ft bgs)	Details of Analyses Performed
32B	Former Oxidizer Burn Area.	***0***	None	Additional samples collected because chemical concentrations exceeded screening level criteria.	6	Soil Vapor	32B-SP09	10, 20	
							32B-SP10	10, 20	
							32B-SP11	10, 20	
33B	Former Lab Supply Burn Area.	1	10, 20	Proposed location was at the point of highest VOC concentration and used to determine if a source was present in the vadose zone.	2	Soil Vapor	33B-SP09	10, 20	
					1	Grab Groundwater	33B-SP09-GW	22	
33B	Former Lab Supply Burn Area.	***0***	None	Additional samples collected because chemical concentrations exceeded screening level criteria.	1	Soil Vapor	33B-SP10	10	
					1	Grab Groundwater	33B-SP10-GW	15	
					2	Soil Vapor	33B-SP11	10, 20	
					1	Grab Groundwater	33B-SP11-GW	23	
					2	Soil Vapor	33B-SP12	10, 20	
					1	Grab Groundwater	33B-SP12-GW	40	
					2	Soil Vapor	33B-SP13	7.5, 20	
					2	Soil Vapor	33B-SP14	10, 20	
					1	Grab Groundwater	33B-SP14-GW	40	
					2	Soil Vapor	33B-SP15	10, 20	
					1	Grab Groundwater	33B-SP15-GW	40	
					3	Soil Vapor	33B-SP16	10, 20, 32	
33B	Former Lab Supply Burn Area.	***0***	None	Additional samples collected because chemical concentrations exceeded screening level criteria.	2	Soil Vapor	33B-SP17	6, 20	
					2	Soil Vapor	33B-SP18	7, 20	
					2	Soil Vapor	33B-SP19	10, 20	
					2	Soil Vapor	33B-SP20	10, 20	
					2	Soil Vapor	33B-SP21	10, 20	

Table 7.2-6 Summary of Soil Vapor Sampling Activities and Deviations from Field Sampling Plan
Area 39
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Rationale and Comments	Number of Samples Collected	Sampling Activity	Sample ID	Sample Depths (ft bgs)	Details of Analyses Performed
35B	Dredge Tailings	1	10, 20	Proposed location was at the point of highest VOC concentration and used to determine if a source was present in the vadose zone.	2	Soil Vapor	35B-SP04	10, 20	

Notes and Key:
Bold, italicized and underlined data does not agree with the analytical results. See "Deviations from Field Sampling Plan" column for more information on discrepancies.

ft bgs = Feet below ground surface
ID = Identification
Proposed analyses = VOCs analysis
Performed analyses = VOC analysis
VOC = Volatile organic compound

Table 7.2-7
Summary of Soil Sampling Activities and Deviations from Field Sampling Plan
Area 39
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
29B	Test Stand Burn Area	Subsurface Soil	1	0, 4, 10	VOCs*, ClO4, DI-WET, metals	Evaluate vertical extent of chemicals in soil risk assessment and potential for water quality impacts.	3	29B-SB04	1.5, 5, 11	ClO4, DI-WET, metals	DI-WET analyzed only at 1.5 ft bgs.
29B	Test Stand Burn Area	Subsurface Soil	3	0, 4, ***10***	VOCs*, ClO4, metals	Evaluate vertical extent of chemicals in soil risk assessment.	9	29B-SB05	0.5, ***1***, 5, 11	ClO4, metals	Resampled due to refusal at 1.5 ft bgs.
								29B-SB06	1.5, 5, 11	ClO4, metals	Only metals analyzed at 11 ft bgs.
								29B-SB07	1, 4.5	ClO4, metals	Not sampled at 10 ft bgs due to refusal at 5 ft bgs.
29B	Drainage above Test Stand Burn Area	Subsurface Soil	4	0, 4, 10	VOCs*, ClO4, metals	Determine if the area west of 29B contributed contamination to the source area, evaluate vertical extent of chemicals in soil to support risk assessment.	12	29B-SB08	1.5, 5, 11.5	ClO4, metals	
								29B-SB09	1.5, 5, 11.5	ClO4, metals	
								29B-SB10	1.5, 5, 11.5	ClO4, metals	
								29B-SB11	1.5, 5, 11.5	ClO4, metals	
30B	Former Production Waste Burn Area	Subsurface Soil	4	0, 4, ***10***	VOCs*, ClO4, metals	Evaluate lateral and vertical extent of chemicals in soil to support risk assessment.	11	30B-SB04	1, 5, 11	ClO4, metals	
								30B-SB05	1, 5	ClO4, metals	Not sampled at 10 ft bgs due to refusal at 7 ft bgs.
								30B-SB06	1, 5, 11	ClO4, metals	
								30B-SB07	1, 5, 11	ClO4, metals	
30B	Former Production Waste Burn Area	Subsurface Soil	1	0, 4, 10, 32, ***54, 76, 98***	VOCs*, ClO4, DI-WET, metals, physical properties	Location requested by regulatory agencies. Determine if VOCs at a hotspot identified in previous investigation migrated to groundwater. Evaluate potential water quality impact due to its proximity to the area of highest chemical concentration.	4	30B-SB08	1, 5, 11, 32	ClO4, DI-WET, metals, physical properties	DI-WET analyzed only at 5 ft bgs. Not sampled at 54, 76, and 98 ft bgs due to groundwater.
		Grab Groundwater	1	First water	ClO4, total and dissolved metals		1	30B-SB08-GW	38	ClO4, total and dissolved metals	
30B	Former Production Waste Burn Area	Surface/Near Surface Soil	5	0, 2	DF	Define the lateral extent of dioxins and furans and support risk assessment.	10	30B-SNS01	0.25, 2.5	DF	
								30B-SNS02	0.25, 2.5	DF	
								30B-SNS03	0.25, 2.5	DF	
								30B-SNS04	0.25, 2.5	DF	
								30B-SNS05	0.25, 2.5	DF	
31B	Former Igniter/Small Rocket Burn Area	Subsurface Soil	1	0, 4, 10	ClO4, DI-WET, metals	Location selected due to its proximity to the area of highest chemical concentration.	3	31B-SB02	1.5, 5, 11	ClO4, metals, DI-WET	DI-WET analyzed only at 5 ft bgs.
		Sediment	2	0, 1	VOCs*, SVOCs, CLO4, metals, CEC, TOC, BD, GS, MC, DI-WET	Determine if chemicals are present in the ponds northwest and southeast of source area 31B.	2	31B-SD01	0.25, 1.5	VOCs, SVOCs, ***PAHs,*** ClO4, metals, CEC, TOC, MC, GS, DD, WD	PAHs included as an additional analysis. DD and WD not analyzed at 1.5 ft bgs.
								31B-SD02	0.25, 1.5	SVOCs, ***PAHs,*** ClO4, metals, CEC, TOC, MC, GS, DD, WD	PAHs included as an additional analysis. DD and WD not analyzed at 1.5 ft bgs.
32B	Former Oxidizer Burn Area	Subsurface Soil	1	0, 4, 10, 32, ***54, 76, 98***	VOCs*, ClO4, DI-WET, metals, physical properties	Evaluate potential water quality impact due to its proximity to the area of highest chemical concentration.	4	32B-SB02	2, 5, 11, 21	ClO4, metals, physical properties	Not analyzed for DI-WET. Not sampled at 54, 76, and 98 ft bgs due to groundwater.
		Grab Groundwater	1	First water	ClO4, total and dissolved metals		1	32B-SB02-GW	26.5	ClO4, total metals	Not analyzed for dissolved metals.

Table 7.2-7
Summary of Soil Sampling Activities and Deviations from Field Sampling Plan
Area 39
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Sampling Activity	Number of Proposed Sampling Locations	Proposed Sampling Depths (ft bgs)	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
32B	Former Oxidizer Burn Area	Subsurface Soil	3	0, 4, ***10***	VOCs*, ClO4, metals	Evaluate lateral and vertical extent of chemicals in soil to support risk assessment.	8	32B-SB03	1.5, 5, 11.5	ClO4, metals	
								32B-SB04	1.5, 5, 11.5	ClO4, metals	
								32B-SB05	1.5, 5	ClO4, metals	Not sampled at 10 ft bgs due to refusal at 5.5 ft bgs.
33B	Former Laboratory Supply Burn Area	Subsurface Soil	1	0, 4, 10	VOCs*, ClO4, metals	Location was selected due to its proximity to the area of highest chemical concentration. Evaluate vertical extent of chemicals in soil to support risk assessment.	3	33B-SB03	1.5, 5, 11	ClO4, metals	
34B	Former Chemical Storage Pad	Subsurface Soil	1	0, ***4,*** 10	ClO4, DI-WET, metals	Evaluate vertical extent of chemicals in soil to support risk assessment and potential for water quality impacts.	2	34B-SB02	1.5, 11	ClO4, metals	Not sampled at 4 ft bgs. Not analyzed for DI-WET.
34B	Former Chemical Storage Pad	Surface/Near Surface Soil	3	0, 2	DF	Evaluate lateral extent of chemicals in soil to support risk assessment.	6	34B-SNS01	0.5, 2.5	DF	
								34B-SNS02	0.5, 2.5	DF	
								34B-SNS03	0.5, 2.5	DF	

Notes and Key:

* Soil samples to be analyzed for VOCs only if soil vapor data indicates presence of dense non-aqueous phase liquid (DNAPL)
PAHs analyzed by USEPA Method 8270-SIM.
Bulk density includes dry density, wet density, and specific gravity.
Physical properties include bulk density, moisture, grain size, porosity, permeability, total organic carbon, and CEC.
Bold, italicized and underlined data does not agree with the analytical results. See "Deviations from Field Sampling Plan" column for more information on discrepancies.

BD = Bulk density
CEC = Cation exchange capacity
ClO4 = Perchlorate
DD = Dry density
DF = Dioxins and Furans
DI-WET = Deionized waste extract test
ft bgs = Feet below ground surface
GS = Grain size
ID = Identification
MC = Moisture content
PAH = Polynuclear aromatic hydrocarbon
PD = Porosity
perm = Permeability
SVOC = Semivolatile organic compound
TOC = Total organic carbon
VOC = Volatile organic compound
WD = Wet density

Table 7.2-8 Summary of Geotechnical Soil Parameters
Area 39
Aerojet Boundary Operable Unit
Aerojet Corporation
Sacramento County, California

			Geo Physical Parameters (ASTM D2937, D854)					Sieve Analysis (ASTM D422)				Permeability (ASTM D5084)	
Test No.	Date	Description of Test Location	Moisture Content (%)	Wet Density (pcf)	Dry Density (pcf)	Specific Gravity	Porosity	Cobbles (%)	Gravel (%)	Sand (%)	Silt / Clay (%)	Average Hydraulic Gradient	Perm (cm/sec)
112	11/18/05	03D-SB35-5	49.6	104.1	69.6	2.540	0.6	0.0	30.9	51.1	18.0	6.8	2.41E-04
113	11/18/05	03D-SB35-11	15.9	136.4	117.8	2.660	0.3	0.0		53.0	47.0	4.8	2.03E-07
114	11/18/05	03D-SB35-23	15.4	115.8	100.4	2.630	0.4	0.0	1.5	74.6	23.9	6.7	3.59E-07
115	11/18/05	03D-SB35-35	12.7	137.8	122.3	2.660	0.3	0.0		63.8	36.2	9.2	3.02E-08
159	2/9/06	03D-SB43-5	30.9					0.0	3.3	40.1	56.6		
160	2/9/06	03D-SB43-11	31.8					0.0	1.2	46.5	52.3		
169	11/18/05	03D-SB43-35	19.6	96.2	80.4	2.450	0.5	0.0	2.9	41.1	56.0	7.4	1.86E-06
170	11/18/05	03D-SB30-5	47.3	104.2	70.8	2.430	0.5	0.0		45.2	54.8	10.1	7.08E-06
171	11/18/05	03D-SB30-11	39.0	111.2	80.0	2.580	0.5	0.0	4.8	20.7	74.5	9.4	6.82E-07
172	11/18/05	03D-SB30-23	44.3	112.0	77.6	2.580	0.5	0.0	12.8	54.5	32.7	8.1	4.08E-05
203	10/10/05	03D-SB30-35	22.9	96.6	78.6	2.564	0.5	0.0	42.2	36.1	21.7	3.7	1.40E-03
204	10/10/05	03D-SB57-5	31.9	112.4	85.2	2.612	0.4770	0.0	12.5	44.0	43.5	6.8	1.09E-04
205	10/10/05	03D-SB57-11	39.5	108.4	77.7	2.622	0.5	0.0	30.5	40.4	29.1	3.0	6.08E-04
206	10/10/05	03D-SB57-23	47.2	101.6	69.0	2.571	0.5700	0.0	19.2	5.9	22.1	3.6	6.92E-04
236	2/3/06	03D-SB57-35	26.7	119.7	94.5			0.0	0.1	91.6	8.3		
237	2/3/06	03D-SB56-5	34.2					0.0	6.3	39.3	57.4		
238	2/3/06	03D-SB56-11	24.2	127.1	102.0			0.0	3.3	39.3	57.4		
239	2/3/06	03D-SB56-23	20.0					0.0	6.6	43.6	49.8		
		Mean	**30.7**	**113.1**	**87.6**	**2.6**	**0.5**	**0.0**	**11.9**	**46.2**	**41.2**	**6.6**	**2.6E-04**
		Median	**31.4**	**111.6**	**80.2**	**2.6**	**0.5**	**0.0**	**6.3**	**43.8**	**45.3**	**6.8**	**2.4E-05**
		Geomean	**28.4**	**112.4**	**86.1**	**2.6**	**0.5**	**0.0**	**5.5**	**41.2**	**36.5**	**6.2**	**1.2E-05**

Notes and Key:

% = Percent
No. = Number
cm/sec = Centimeters per second
pcf = Pounds per cubic foot

Table 7.3-1 Summary of Surface Water Sampling Activities and Deviations from Field Sampling Plan
Area 39
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Source Area	Associated Site Feature	Number of Proposed Sampling Locations	Proposed Sampling Depths	Proposed Analyses	Rationale and Comments	Number of Samples Collected	Sample ID	Sample Depths (ft bgs)	Analyses Performed	Deviations from Field Sampling Plan
31B	Former Igniter/ Small Rocket Burn Area	2	Middle to bottom of water column	VOCs, SVOCs, ClO4, total and dissolved metals, chemical properties	Determine if chemicals are present in the ponds northwest and southeast of source area 31B.	2	31B-SW01	1	VOC, SVOCs, ***PAHs,*** ClO4, total and dissolved metals, chemical properties	PAHs included as additional analysis.
							31B-SW02	1	VOC, SVOCs, ***PAHs,*** ClO4, total and dissolved metals, chemical properties	PAHs included as additional analysis.
		0	None	None	Additional samples collected because chemical concentrations exceeded screening criteria.	2	31B-SD01	1.5	VOCs	
							31B-SD02	1.5	VOCs	

Notes and Key:
PAHs was analyzed by USEPA Method 8270-SIM.
Chemical properties include dissolved organic carbon, anions, and total alkalinity.
Bold, italicized and underlined data does not agree with the analytical results. See "Deviations from Field Sampling Plan" column for more information on discrepancies.

ft bgs = Feet below ground surface
CLO4 = Perchlorate
ID = Identification
PAH = Polynuclear aromatic hydrocarbon
SVOC = Semivolatile organic compound
VOC = Volatile organic compound

Table 7.4-1 Well Construction Details
Perched and First Water-Bearing Zone
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Well ID	Groundwater Unit	Well Type	Easting	Northing	GSE (ft msl)	TOC (ft msl)	TOS (ft bgs)	BOS (ft bgs)	Well TD (ft)
792	Perched	Monitor	2243343	339448	287.7	287.7	17	22.5	22.5
795	Perched	Monitor	2242775	338755	316.9	317.2	16.0	21.5	27
796	Perched	Monitor	2243373	338474	290.1	289.9	13.5	19.0	22
1318	Perched	Monitor	2241179	338382	327.3	327.2	97.0	118.0	118
1575	Perched	Monitor	2242718	339815	341.0	340.8	85.0	95.0	95
1576	Perched	Monitor	2243916	339793	294.0	293.9	25.0	35.0	35
1577	Perched	Monitor	2243585	339265	285.5	285.4	15.0	30.0	30
1578	Perched	Monitor	2243620	338697	302.0	301.9	59.5	74.5	74.5
31006	Perched	Monitor	2244370	339875	303.3	303.4	38.5	58.5	75
31008	Perched	Monitor	2243458	340222	294.8	295.3	21.7	41.7	58
31009	Perched	Monitor	2244046	338080	333.1	333.3	72.5	87.5	89.5
31017	Perched	Monitor	2243043	338291	300.0	300.2	56.5	76.5	78
31019	Perched	Monitor	2243998	338821	275.4	275.5	11.5	26.5	28
31022	Perched	Monitor	2243901	339899	287.3	287.4	52.1	72.1	79
31023	Perched	Monitor	2243893	339947	284.1	284.1	45.7	65.7	74
31026	Perched	Monitor	2244396	337759	296.7	297.2	40.0	50.0	51.5
31028	Perched	Monitor	2243107	339040	330.0	330.3	65.0	85.0	86
31029	Perched	Monitor	2243296	340839	289.9	290.0	30.0	45.0	46.5
31046	Perched	Monitor	2243158	341216	305.7	305.6	52.0	72.0	72
31047	Perched	Monitor	2242602	340730	337.4	337.5	75.0	95.0	95
31048	Perched	Monitor	2244400	340348	292.5	292.2	10.0	20.0	20
31049	Perched	Monitor	2242982	341832	309.0	309.0	40.0	60.0	60
1262	FWBZ	Monitor	2242725	341730	298.1	301.1	90.0	111.0	111
1317	FWBZ	Monitor	2244370	338746	255.8	256.0	78.0	88.0	88
31007	FWBZ	Monitor	2244372	339859	303.5	303.5	80.0	90.0	120
31010	FWBZ	Monitor	2244380	338544	261.7	261.8	57.6	77.6	94.5
31011	FWBZ	Monitor	2244009	338821	274.8	274.9	36.0	56.0	82
31012	FWBZ	Monitor	2243916	339800	293.4	293.6	64.0	84.0	93
31018	FWBZ	Monitor	2243914	339824	292.1	292.2	64.9	84.9	88
31020	FWBZ	Monitor	2243909	339849	290.6	290.8	57.7	77.7	83
31021	FWBZ	Monitor	2244406	339178	271.8	271.8	40.0	50.0	55
31024	FWBZ	Monitor	2243474	340259	294.2	294.4	64.7	74.7	78
31025	FWBZ	Monitor	2244398	337736	297.7	298.1	102.0	112.0	120
31027	FWBZ	Monitor	2243114	339078	330.5	330.7	145.0	165.0	182
31030	FWBZ	Monitor	2243599	339571	324.4	324.6	130.0	155.0	157

Notes and Key:
ft bgs = Feet below ground surface
ft msl = Feet above mean sea level
BOS = Bottom of screen
FWBZ = First water-bearing zone
GSE = Ground surface elevation
ID = Inside diameter
TD = Total depth
TOC = Top of casing
TOS = Top of screen

Table 7.4-2 Soil Boring Details
Perched and First Water-Bearing Zone
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Sample Name	Boring Location	Groundwater Unit	Easting	Northing	GSE (ft msl)	Sample Depth (ft bgs)	Date Collected
29B-SP07-GW01-20	29B-SP07	perched	2243302	339507	283.81	20	01/23/06
30B-SB08-GW01-38	30B-SB08	perched	2243415	338594	296.65	38	10/26/05
30B-SP12-GW01-12	30B-SP12	perched	2243373	338343	280.54	12	10/27/05
30B-SP18-GW01-20	30B-SP18	perched	2243809	339093	289.59	20	04/18/06
30B-SP19-GW01-20	30B-SP19	perched	2243998	338830	277.22	20	04/19/06
32B-SB02-GW01-26.5	32B-SB02	perched	2243625	340049	288.83	26.5	10/05/05
32B-SP08-GW01-83	32B-SP08	perched	2243271	339927	334.21	83	02/16/06
33B-SP09-GW01-22	33B-SP09	perched	2243818	339879	288.41	22	02/15/06
33B-SP10-GW01-15	33B-SP10	perched	2243892	339952	285.62	15	02/15/06
33B-SP11-GW01-23	33B-SP11	perched	2243961	339824	293.21	23	02/15/06
33B-SP12-GW01-40	33B-SP12	perched	2243942	339740	302.72	40	02/15/06
33B-SP14-GW01-40	33B-SP14	perched	2244096	340044	281.63	40	02/23/06
33B-SP15-GW01-40	33B-SP15	perched	2244079	339922	287.65	40	02/23/06

Notes and Key:
ft bgs = Feet below ground surface
ft msl = Feet above mean sea level
GSE = Ground surface elevation

Table 7.4-3 Groundwater Elevation Data
Perched and First Water-Bearing Zone
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Area	Well ID	Groundwater Unit	Date	DTW (ft bgs)	Monitor Point Elev. (ft msl)	GWE (ft msl)
Area 39	1317	FWBZ	11/23/05	38.45	255.97	217.52
Area 39	1317	FWBZ	01/11/06	38.75	255.97	217.22
Area 39	1317	FWBZ	02/15/06	39.04	255.97	216.93
Area 39	1317	FWBZ	03/10/06	37.84	255.97	218.13
Area 39	1317	FWBZ	04/11/06	37.91	255.97	218.06
Area 39	1317	FWBZ	05/11/06	37.92	255.97	218.05
Area 39	31007	FWBZ	11/23/05	80.35	303.52	223.17
Area 39	31007	FWBZ	01/11/06	80.49	303.52	223.03
Area 39	31007	FWBZ	02/09/06	80.12	303.52	223.40
Area 39	31007	FWBZ	03/09/06	59.77	303.52	223.75
Area 39	31007	FWBZ	04/11/06	79.83	303.52	223.69
Area 39	31007	FWBZ	05/11/06	79.68	303.52	223.84
Area 39	31010	FWBZ	11/23/05	41.39	261.77	220.38
Area 39	31010	FWBZ	01/11/06	41.4	261.77	220.37
Area 39	31010	FWBZ	02/09/06	40.99	261.77	220.78
Area 39	31010	FWBZ	03/10/06	40.38	261.77	221.39
Area 39	31010	FWBZ	04/11/06	40.34	261.77	221.43
Area 39	31010	FWBZ	05/11/06	40.22	261.77	221.55
Area 39	31011	FWBZ	11/23/05	51.38	274.86	223.48
Area 39	31011	FWBZ	01/11/06	51.89	274.86	222.97
Area 39	31011	FWBZ	02/09/06	51.68	274.86	223.18
Area 39	31011	FWBZ	03/10/06	51.69	274.86	223.17
Area 39	31011	FWBZ	04/11/06	51.7	274.86	223.16
Area 39	31011	FWBZ	05/11/06	51.72	274.86	223.14
Area 39	31012	FWBZ	11/23/05	70.55	293.59	223.04
Area 39	31012	FWBZ	01/11/06	70.97	293.59	222.62
Area 39	31012	FWBZ	02/09/06	70.71	293.59	222.88
Area 39	31012	FWBZ	03/09/06	69.84	293.59	223.75
Area 39	31012	FWBZ	04/11/06	69.6	293.59	223.99
Area 39	31012	FWBZ	05/11/06	70.11	293.59	223.48
Area 39	31018	FWBZ	12/12/05	68.79	292.19	223.40
Area 39	31018	FWBZ	01/11/06	69.01	292.19	223.18
Area 39	31018	FWBZ	02/09/06	68.68	292.19	223.51
Area 39	31018	FWBZ	03/09/06	68.18	292.19	224.01
Area 39	31018	FWBZ	04/11/06	68.28	292.19	223.91
Area 39	31018	FWBZ	05/11/06	68.17	292.19	224.02
Area 39	31020	FWBZ	12/12/05	66.53	290.79	224.26
Area 39	31020	FWBZ	01/11/06	66.6	290.79	224.19
Area 39	31020	FWBZ	02/09/06	66.19	290.79	224.60
Area 39	31020	FWBZ	03/09/06	65.63	290.79	225.16
Area 39	31020	FWBZ	04/11/06	65.3	290.79	225.49
Area 39	31020	FWBZ	05/11/06	65.71	290.79	225.08
Area 39	31021	FWBZ	11/23/05	49.34	271.82	222.48
Area 39	31021	FWBZ	01/11/06	49.6	271.82	222.22

Table 7.4-3 Groundwater Elevation Data
Perched and First Water-Bearing Zone
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Area	Well ID	Groundwater Unit	Date	DTW (ft bgs)	Monitor Point Elev. (ft msl)	GWE (ft msl)
Area 39	31021	FWBZ	02/09/06	49.3	271.82	222.52
Area 39	31021	FWBZ	03/10/06	49.25	271.82	222.57
Area 39	31021	FWBZ	04/11/06	49.21	271.82	222.61
Area 39	31021	FWBZ	05/11/06	49.24	271.82	222.58
Area 39	31024	FWBZ	11/23/05	63.4	294.42	231.02
Area 39	31024	FWBZ	01/11/06	63.73	294.42	230.69
Area 39	31024	FWBZ	02/09/06	63.36	294.42	231.06
Area 39	31024	FWBZ	03/09/06	62.91	294.42	231.51
Area 39	31024	FWBZ	04/11/06	63.02	294.42	231.40
Area 39	31024	FWBZ	05/11/06	63.16	294.42	231.26
Area 39	795	Perched	11/23/05	21.19	317.19	296.00
Area 39	795	Perched	01/11/06	21	317.19	296.19
Area 39	795	Perched	02/09/06	20.34	317.19	296.85
Area 39	795	Perched	03/10/06	19.87	317.19	297.32
Area 39	795	Perched	04/11/06	19.4	317.19	297.79
Area 39	795	Perched	05/11/06	19.02	317.19	298.17
Area 39	796	Perched	11/23/05	16.94	289.89	272.95
Area 39	796	Perched	01/11/06	17.57	289.89	272.32
Area 39	796	Perched	02/09/06	17.2	289.89	272.69
Area 39	796	Perched	03/10/06	16.88	289.89	273.01
Area 39	796	Perched	04/11/06	16.36	289.89	273.53
Area 39	796	Perched	05/11/06	15.75	289.89	274.14
Area 39	1318	Perched	11/23/05	104.35	327.2	222.85
Area 39	1318	Perched	01/11/06	104.7	327.2	222.50
Area 39	1318	Perched	02/09/06	104.39	327.2	222.81
Area 39	1318	Perched	03/09/06	104.15	327.2	223.05
Area 39	1318	Perched	04/11/06	104.23	327.2	222.97
Area 39	1318	Perched	05/11/06	104.32	327.2	222.88
Area 39	1575	Perched	11/23/05	76.11	340.84	264.73
Area 39	1575	Perched	01/25/06	75.05	340.84	265.79
Area 39	1575	Perched	02/09/06	76.12	340.84	264.72
Area 39	1575	Perched	03/09/06	75.85	340.84	264.99
Area 39	1575	Perched	04/11/06	76.05	340.84	264.79
Area 39	1575	Perched	05/11/06	75.88	340.84	264.96
Area 39	1576	Perched	11/23/05	23.68	293.9	270.22
Area 39	1576	Perched	01/11/06	23.93	293.9	269.97
Area 39	1576	Perched	02/09/06	23.34	293.9	270.56
Area 39	1576	Perched	03/09/06	22.94	293.9	270.96
Area 39	1576	Perched	04/11/06	22.88	293.9	271.02
Area 39	1576	Perched	05/11/06	22.43	293.9	271.47
Area 39	1577	Perched	11/23/05	14.94	285.421	270.48
Area 39	1577	Perched	01/11/06	13.26	285.421	272.16
Area 39	1577	Perched	02/09/06	12.92	285.421	272.50
Area 39	1577	Perched	03/10/06	12.19	285.421	273.23

Table 7.4-3 Groundwater Elevation Data
Perched and First Water-Bearing Zone
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Area	Well ID	Groundwater Unit	Date	DTW (ft bgs)	Monitor Point Elev. (ft msl)	GWE (ft msl)
Area 39	1577	Perched	05/11/06	11.11	285.421	274.31
Area 39	1578	Perched	11/23/05	41.47	301.9	260.43
Area 39	1578	Perched	01/11/06	40.33	301.9	261.57
Area 39	1578	Perched	02/09/06	39.76	301.9	262.14
Area 39	1578	Perched	03/10/06	39.41	301.9	262.49
Area 39	1578	Perched	04/11/06	39.2	301.9	262.70
Area 39	1578	Perched	05/11/06	38.92	301.9	262.98
Area 39	31006	Perched	11/23/05	40.66	303.36	262.70
Area 39	31006	Perched	01/11/06	41.13	303.36	262.23
Area 39	31006	Perched	02/09/06	40.79	303.36	262.57
Area 39	31006	Perched	03/09/06	40.44	303.36	262.92
Area 39	31006	Perched	04/11/06	40.49	303.36	262.87
Area 39	31006	Perched	05/11/06	40.52	303.36	262.84
Area 39	31008	Perched	11/23/05	28.6	295.31	266.71
Area 39	31008	Perched	01/11/06	28.9	295.31	266.41
Area 39	31008	Perched	02/09/06	28.55	295.31	266.76
Area 39	31008	Perched	03/09/06	28.34	295.31	266.97
Area 39	31008	Perched	04/11/06	28.26	295.31	267.05
Area 39	31008	Perched	05/11/06	28.12	295.31	267.19
Area 39	31009	Perched	11/23/05	75.5	333.33	257.83
Area 39	31009	Perched	01/11/06	75.79	333.33	257.54
Area 39	31009	Perched	02/09/06	75.54	333.33	257.79
Area 39	31009	Perched	03/10/06	75.31	333.33	258.02
Area 39	31009	Perched	04/11/06	75.41	333.33	257.92
Area 39	31009	Perched	05/11/06	75.35	333.33	257.98
Area 39	31017	Perched	11/23/05	36.03	300.18	264.15
Area 39	31017	Perched	01/25/06	35.78	300.18	264.40
Area 39	31017	Perched	02/09/06	35.81	300.18	264.37
Area 39	31017	Perched	03/10/06	35.36	300.18	264.82
Area 39	31017	Perched	04/11/06	35.45	300.18	264.73
Area 39	31017	Perched	05/11/06	35.35	300.18	264.83
Area 39	31019	Perched	11/23/05	9.46	275.47	266.01
Area 39	31019	Perched	01/11/06	8.31	275.47	267.16
Area 39	31019	Perched	02/09/06	7.87	275.47	267.60
Area 39	31019	Perched	03/10/06	7.37	275.47	268.10
Area 39	31019	Perched	04/11/06	6.66	275.47	268.81
Area 39	31019	Perched	05/11/06	7.09	275.47	268.38
Area 39	31022	Perched	12/12/05	37.92	287.41	249.49
Area 39	31022	Perched	01/11/06	37.75	287.41	249.66
Area 39	31022	Perched	02/09/06	37.08	287.41	250.33
Area 39	31022	Perched	03/09/06	36.71	287.41	250.70
Area 39	31022	Perched	04/11/06	36.36	287.41	251.05
Area 39	31022	Perched	05/11/06	36.17	287.41	251.24
Area 39	31023	Perched	12/12/05	32.2	284.09	251.89

Table 7.4-3 Groundwater Elevation Data
Perched and First Water-Bearing Zone
Boundary Operable Unit Remedial Investigation
Aerojet Superfund Site
Sacramento County, California

Area	Well ID	Groundwater Unit	Date	DTW (ft bgs)	Monitor Point Elev. (ft msl)	GWE (ft msl)
Area 39	31023	Perched	01/11/06	33.71	284.09	250.38
Area 39	31023	Perched	02/09/06	33.42	284.09	250.67
Area 39	31023	Perched	03/09/06	33.28	284.09	250.81
Area 39	31023	Perched	04/11/06	33.18	284.09	250.91
Area 39	31023	Perched	05/11/06	33.33	284.09	250.76

Notes and Key:
ft bgs = Feet below ground surface
ft msl = Feet above mean sea level
GWE = Groundwater potentiometric surface elevation
FWBZ = First water-bearing zone

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