Final

Phase I
Technical Memorandum
EAST GATE DISPOSAL YARD
EXPANDED SITE INVESTIGATION

Logistics Center
Fort Lewis, Washington

Prepared for

U.S. Army Corps of Engineers
Seattle District
4735 East Marginal Way South
Seattle, Washington 98134

October 1999

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Project No. 53F0E9518Q00

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EXECUTIVE SUMMARY

The East Gate Disposal Yard (EGDY) is adjacent to the Logistics Center at Fort Lewis, Washington, and has been identified as the primary source of trichloroethene (TCE) contamination in groundwater beneath the Logistics Center. This Expanded Site Investigation was conducted to evaluate the presence of TCE source material in the EGDY. The investigation was designed to be conducted in phases. The main components of Phase I are described in this report: a geophysical survey, a soil-gas survey, exploratory trenching, and groundwater sampling from drivepoints. Phase II, which will be conducted at a later date, is designed to better characterize the nature and extent of contamination in the aquifer with soil borings and monitoring wells.

Except for two large disposal pits that are partially filled, there is no surface expression of the disposal areas at the EGDY. Geophysical surveys using an electromagnetic conductivity instrument (EM-61) were conducted in October 1998 and in February and March 1999 over a total area of 35 acres. The surveys were effective in identifying the locations of former trenches and other disposal areas that contained metallic debris. The identification of these areas was used in planning the additional Phase I investigations.

Soil-gas was sampled at a depth of 5 feet from drivepoints installed at 45 locations near the disposal areas during October 1998. The vapor was analyzed on site for chlorinated solvents and benzene, toluene, ethylbenzene, and xylenes (BTEX). TCE was detected in 33 samples at concentrations ranging from 0.29 ppmV to 150 ppmV. Cis-1,2-dichloroethylene (cis-1,2-DCE) was detected in 24 samples at concentrations ranging from 0.34 to 81.7 ppmV and trans-1,2-dichloroethylene (trans-1,2-DCE) was detected in 6 samples in concentrations from 0.34 ppmV to 1.77 ppmV. Vinyl chloride was detected only twice, at 5.81 and 490 ppmV. Of the BTEX compounds, only total xylenes were detected, and only once, at 0.37 ppmV. The 45 soil-gas measurements were used as a guide to select some of the exploratory trench locations.

The original field plan called for excavating 15 trenches in former disposal areas to better characterize the debris, measure soil and water contamination, and identify light nonaqueous-phase liquid (LNAPL) on the water table, if present. Only 8 of the 15 trenches were completed because two mortar rounds were uncovered in the eighth trench and the investigation was not designed to include clearance of unexploded ordnance. The eight exploratory trenches were excavated in October 1998.

From a contamination standpoint, the most significant information obtained from excavation of the exploratory trenches was the number of drums encountered and the presence of LNAPL on the water table. Five of the eight trenches contained one or more drums and many of the drums were intact. A drum in trench T-1 was punctured by the backhoe. It was removed by Fort Lewis

personnel and the contents were found to be primarily TCE (832,000 mg/kg). A variety of petroleum products were found in other drums with exposed contents and in the soil. LNAPL was found floating on the water table in five of the exploratory trenches. LNAPL in trenches T-1 and T-3 contained TCE in addition to total petroleum hydrocarbons (TPH). The LNAPL in trenches T-6, T-7, and T-8 consisted predominantly of TPH with little or no TCE, based on soil and LNAPL analytical results.

Groundwater samples were collected from 4 depths in the shallow aquifer at 50 locations throughout the study area. The water was collected from temporary sampling points installed by a drivepoint push rig. The sampling was conducted over two periods, October and November 1998 and March and April 1999. Water quality parameters (pH, Eh, temperature, dissolved oxygen, conductivity, and turbidity) were measured in a flow-through cell and chlorinated solvents and BTEX were analyzed by a field laboratory. Dissolved iron and manganese were measured using field test kits and by a fixed laboratory.

The primary purpose of the groundwater sampling was to identify major sources of TCE and other chlorinated compounds that might indicate the presence of dense nonaqueous-phase liquid (DNAPL). TCE and cis-1,2-DCE were detected in groundwater at every drivepoint location at a minimum of one depth per location. A TCE concentration of 10,000 µg/L or greater was considered indicative of the presence of DNAPL. This concentration was exceeded at 9 of the 50 drivepoint locations. Elevated TCE concentrations (greater than 1,000 µg/L) were encountered at eight additional drivepoints. The highest concentrations (500,000 to 1,000,000 µg/L) were found at the lower sampling points in the upper aquifer, which suggests the presence of DNAPL accumulated on the aquitard surface or a zone of lower permeability within the aquifer. The drivepoint locations with probable DNAPL can be grouped into four distinct areas: northwest of the treatment system, near the southern fence corner (DP-9), near the infiltration galleries (DP-5 and DP-6), and at DP-14 in the west-central portion of the EGDY.

The relative rate of penetration of the drivepoint, and the color and relative infiltration rate of groundwater were used to estimate the locations of low- permeability units that might impede the vertical flow of DNAPL. DNAPL might accumulate both on localized low-permeability units in the upper aquifer and in depressions on the surface of the aquitard at the base of the upper aquifer. In 5 of the 17 drivepoint locations where DNAPL is likely present or where TCE concentrations exceeded 1,000 µg/L, a correlation was made between the presence of DNAPL/elevated concentrations and localized zones of low permeability. In seven of the drivepoint locations, a correlation was made between DNAPL/elevated concentrations and the aquitard.

The accumulations of DNAPL and the product in the drums represent the major sources of current and future TCE contamination to groundwater. The locations of DNAPL and depressions in the aquitard surface are areas for additional investigation and possible remediation activities. It is also recommended that the drums containing NAPL be addressed in future site activities.

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ABBREVIATIONS AND ACRONYMS

bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CBD	citrate-bicarbonate-dithionite
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DCE	dichloroethylene
DCQCR	daily chemical quality control report
DNAPL	dense nonaqueous-phase liquid
EGDY	East Gate Disposal Yard
EPA	U.S. Environmental Protection Agency
IDW	investigation-derived waste
LCS	laboratory control sample
LNAPL	light nonaqueous-phase liquid
LOGRAM	Logistics Center remedial action monitoring
MS/MSD	matrix spike/matrix spike duplicate
NAPL	nonaqueous-phase liquid
PCB	polychlorinated biphenyl
PE	performance evaluation
PID	photoionization detector
POL	petroleum, oil, and lubricants
PPE	personal protective equipment
QA/QC	quality assurance/quality control
RPD	relative percent difference
SVOC	semivolatile organic compound
TCE	trichloroethene
TEG	Transglobal Environmental Geosciences Northwest, Inc.
TIC	total inorganic carbon
TOC	total organic carbon
TPH-D	total petroleum hydrocarbons–diesel
TPH-G	total petroleum hydrocarbons–gasoline
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound

UNITS OF MEASURE

dynes/cm	dynes per centimeter
gm/cc	grams per cubic centimeter
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
ppm	part per million
ppmV	parts per million volume

1.0 INTRODUCTION

1.1 PURPOSE AND OBJECTIVES

The East Gate Disposal Yard (EGDY) at Fort Lewis, Washington (Figure 1-1) was used from approximately 1946 through at least 1971 as a disposal site for liquid and solid wastes. Trenches and pits were used for the disposal of trichloroethene (TCE) and petroleum, oil, and lubricants (POL) from equipment cleaning and degreasing activities conducted at the Fort Lewis Mount Rainier Ordnance Depot (now included in the Logistics Center). Past disposal practices at the EGDY have been identified as a likely source of present-day TCE groundwater contamination (Shannon & Wilson 1986).

The purpose of this expanded site investigation was to evaluate the presence of sources of TCE to groundwater in and near the former disposal area. Specific objectives of the field activities were the following:

To evaluate whether a significant amount of nonaqueous-phase liquid (NAPL) remains beneath the EGDY area (unsaturated and shallow saturated zones) that might provide a continuing source of TCE and cis-1,2-dichloroethylene (DCE) to groundwater (DCE may have been co-disposed with TCE or may be a degradation product of TCE)

To estimate the occurrence and extent of light and dense NAPL, if present

To collect hydrogeologic data to refine the assessment of NAPL fate and transport presented in the conceptual site model (USACE 1998).

Data collected during this investigation may be used in a separate project to evaluate remedial alternatives and develop appropriate solutions for treatment/containment. In particular, data were collected that can aid in the characterization of geochemical and natural attenuation properties of the system, and that can be used to evaluate the applicability of a redox manipulation approach to groundwater remediation.

1.2 LOCATION AND SCOPE

The original study area, as described in the management plan (USACE 1998), included the area within the former EGDY fenceline, property immediately adjacent to the fenceline where disposal may have also occurred in the past, and the area hydrologically immediately downgradient from the EGDY where high levels of dissolved TCE have been measured (Figure 1-2). Phase I of the field work was originally scheduled to be conducted in fall 1998. It

was designed to locate potential NAPL sources in the unsaturated zone and provide initial data on groundwater contamination. Phase II field work, originally scheduled for summer 1999, was designed to more completely characterize contamination in the aquifer. Because of the discovery of a number of drums containing NAPL during the early portion of Phase I, it was decided to divide the first phase into Phase IA and IB. This was done so that additional fieldwork could be conducted to better define the extent of former trenches and to locate likely disposal areas that might contain drums. The results of additional geophysics were used to minimize the likelihood of puncturing drums and to aid in the placement of additional drivepoints for groundwater sampling. The boundaries of the study area were also adjusted (Figure 1-2) to be more likely to encompass all former disposal locations in the vicinity of the EGDY. The commencement of Phase II work has been delayed because of the extension of Phase I work. The scope and schedule for the Phase II work are contingent on conclusions reached during the Phase I study. Recommendations for Phase II work are provided in Section 5 of this report.

Field work conducted during Phase IA (September through November 1998) consisted of the following activities:

Brush removal and establishment of a survey grid over a 9-acre area where historical air photos showed likely disposal of liquids in former trenches

EM-61 geophysical survey over the 9-acre area to locate buried metallic debris such as drums and to identify boundaries of former disposal trenches and pits

Soil-gas screening to aid in locating potential sources of shallow groundwater contamination

Excavation of exploratory trenches at the locations of the former disposal areas to evaluate the potential presence of buried drums and other sources of TCE contamination as well as shallow soil and groundwater contamination

Groundwater screening at 20 temporary drivepoints (4 depths at each location) to identify the potential presence of NAPL, to assess the vertical variation in contaminated groundwater, and to locate the top of the aquitard surface depicted in the investigation conceptual site model (USACE 1998).

Field work conducted during Phase IB (January through April 1999) consisted of the following activities:

Brush removal and establishment of a survey grid over a 26-acre area surrounding the initial 9 debrushed acres

EM-61 survey over the 26 acres to locate buried metallic debris that might indicate disposal areas

Groundwater screening at 30 temporary drivepoints (4 depths at each location) to identify the potential presence of NAPL, to assess the vertical variation in contaminated groundwater, and to locate the top of the aquitard surface

This technical memorandum describes the field work conducted during Phase I activities, summarizes the results of the physical and chemical analyses, and provides an interpretation of the results in terms of the presence of NAPL in the subsurface that could provide a continuing source of groundwater contamination.

1.3 DEVIATIONS FROM THE MANAGEMENT PLAN

This investigation was conducted in accordance with the *Management Plan for East Gate Disposal Yard Expanded Site Investigation* (USACE 1998) except as described in the following sections.

1.3.1 Sampling and Analysis Plan

Field activities were conducted in accordance with the sampling and analysis plan (USACE 1998) with the following deviations:

As described above, Phase I field activities were conducted in two phases. Based on the results obtained during Phase IA, additional debrushing, surveying, and geophysical survey activities were conducted during Phase IB.

Prior to the beginning of field activities, the Phase IA investigation area was estimated to be 7 acres. After completion of Phase IA field activities, including surveying, the actual acreage was determined to be 9 acres. The addition of the Phase IB area increased the investigation area to 35 acres.

During soil-gas sampling, the push-probe rods were not decontaminated prior to use at each location, per the approval of the U.S. Army Corp of Engineers (USACE), unless visible contamination was present on the rods. It was decided that such decontamination was not necessary and that the quality of the soil-gas samples would not be compromised.

Only 8 of the intended 15 trenches were excavated. The trenching task was terminated due to the unexpected uncovering of unexploded ordnance.

Only three of the eight trenches excavated were fully completed. The remaining five trenches were partially completed because of the presence of NAPL in other parts of the trench, or conditions (i.e., the presence of drums or mortar shells) that resulted in premature abandonment of the trench.

The telescoping sampling device intended to be used to sample groundwater and NAPL from the trenches was not used due to the difficulty in properly decontaminating it. Disposable sampling containers were substituted.

The management plan stated that 2 soil samples would be collected from trench segment for a total of 10 per trench, and of these, 3 soil samples per trench would be submitted for chemical analysis. One of these three was to be collected from below the water table. Per USACE approval, only one soil sample per segment was collected from a depth that represented evidence of or the potential for contamination. As possible, three soil samples per trench were submitted for chemical analysis. Evidence of contamination included field screening results and visual or olfactory observations. Also, no samples were collected from below the water table because the samples were not considered representative. The actual number and location of samples collected varied among trenches and is discussed in Section 2.5.

The management plan stated that approximately 12 soil samples would be collected from the trenches for physical analysis: 3 contaminated and 3 non-contaminated samples from 2 distinct stratigraphic layers. Only six samples were collected for physical analysis from four trenches because fewer trenches were completed than expected.

Selected trench soil and NAPL samples were analyzed for the presence of SVOCs and PCBs.

For ease of measurement, water quality parameter measurements were collected using a YSI 6820 instrument instead of the combination of YSI 3560, YSI dissolved oxygen, and the Hach turbidity meters described in the management plan. This had no impact on data quality. During Phase IB, neither the organic vapor monitoring nor the dye test field screening was performed on the groundwater. Based on Phase IA results, vapor monitoring was determined to be unnecessary and the dye test was not effective.

The trench sample locations and drums encountered in the trenches were not surveyed in accordance with the management plan. The exact locations could not be marked properly after backfilling each trench. The ends of each trench were

surveyed and the locations of sampling points and drums were estimated from these known points.

1.3.2 Quality Assurance Project Plan

The field and laboratory activities were conducted in accordance with the quality assurance project plan (USACE 1998) with the following deviations:

The required frequency of field duplicate collection and analysis (10 percent) was not met for soil-gas samples (8.9 percent).

The required frequency of field blank collection and analysis (5 percent) was not met for drivepoint groundwater samples collected during March and April 1999 (4.5 percent).

Trip blanks were not included with NAPL samples submitted to MultiChem Analytical Services, Inc. (MultiChem) for VOC analyses.

Rinse blanks were not included with NAPL samples submitted to MultiChem for VOC and total petroleum hydrocarbon (TPH) analysis because disposable sampling equipment was used during sample collection.

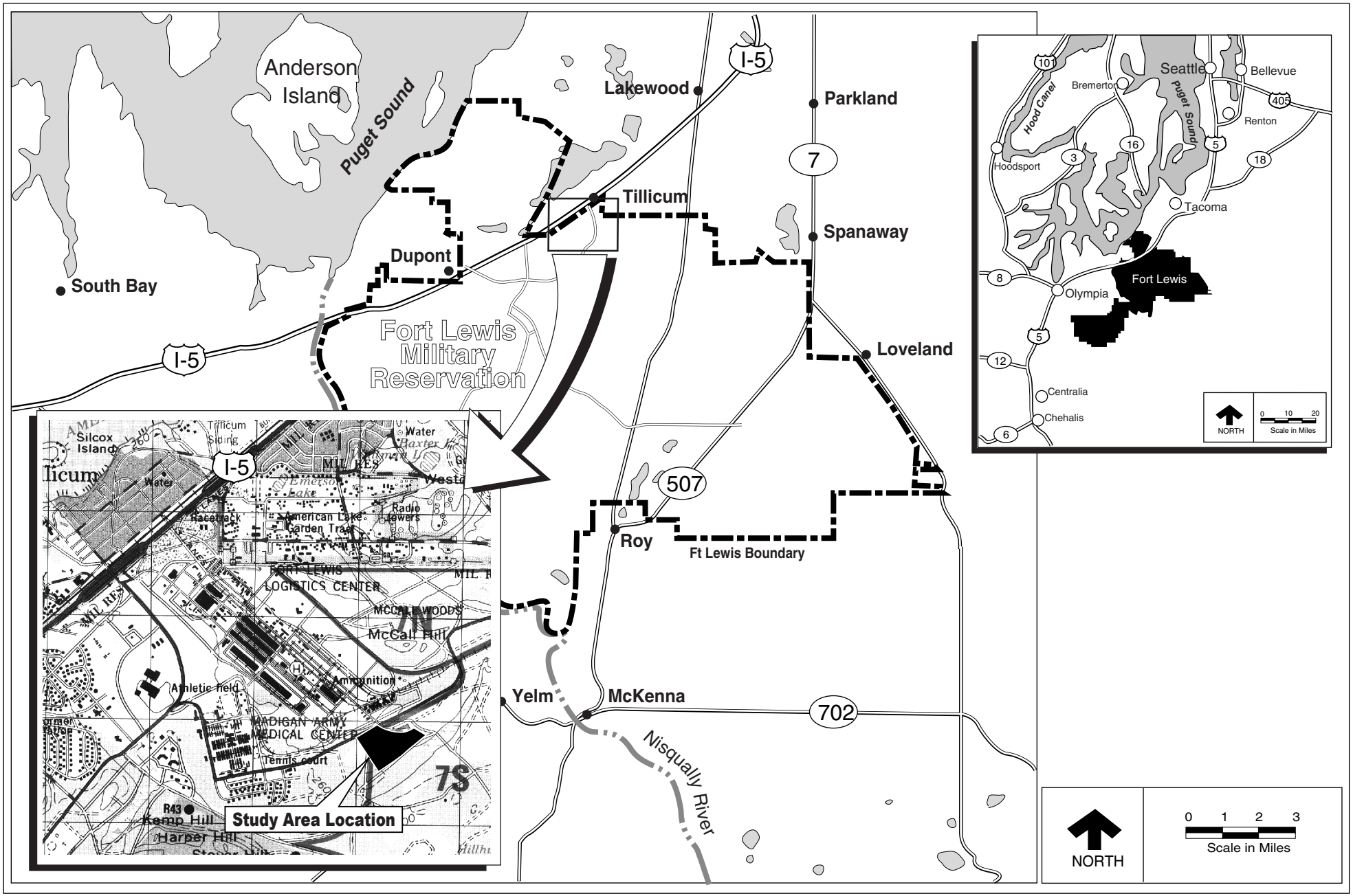
Field duplicate NAPL samples were not submitted for chemical or physical testing due to limited sample volume.

Three NAPL samples (DT005B03, NT007B13, and DT005C03) were collected in the field and submitted to MultiChem without being included on a chain of custody form.

Only one performance evaluation (PE) sample (soil matrix) was submitted for analysis with soil-gas samples for VOC analysis by Transglobal Environmental Geosciences Northwest, Inc. (TEG), instead of the two water matrix PE samples indicated in the management plan. The management plan incorrectly indicated that water matrix PE samples could be analyzed with the soil-gas samples. As a result of the delay in obtaining the correct (i.e., soil matrix) PE sample, time allowed for only one sample to be analyzed.

Because the exploratory trenching was truncated after eight trenches, only one PE sample (soil matrix) was submitted for analysis with trench soil samples for VOC analysis by TEG, instead of the five indicated in the management plan. Only 20 primary soil samples were submitted to TEG for analysis instead of the 45 indicated in the management plan.

Five water matrix PE samples were submitted for analysis with trench and drivepoint groundwater samples for VOC analysis by TEG instead of the three indicated in the management plan.



URS Greiner Woodward Clyde	Figure 1-1 East Gate Disposal Yard Site Location	Project No. E9518Q East Gate Disposal Yard Fort Lewis, Washington

53F00E95182-1-070999

EAST LINCOLN DRIVE

RAINIER DRIVE

EAST LINCOLN DRIVE

Treatment System

EGDY Fenceline

Injection Gallery

Original Study Area

Phase IA 9–Acre Geophysics Study Area (October 1998)

Phase IB Additional 26–Acre Geophysics Study Area (February–March 1999)

N

0 75 150

SCALE IN FEET

East Gate Disposal Yard Fort Lewis, Washington	Project No. E9518Q	Expanded Site Investigation Study Areas	1–2
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2.0 FIELD ACTIVITIES

This section describes the field activities conducted during the site investigation. Figure 2-1 shows the locations of all field activities. A copy of the field logbooks is provided in Appendix A.

2.1 SITE RECONNAISSANCE

For the purpose of determining proper health and safety procedures, a surficial soil sample was collected from an area devoid of vegetation (the "barren area") near former disposal trench 6 (Figure 2-1). Primary and duplicate samples (RS001 and RS501, respectively) were collected following procedures outlined in the management plan (USACE 1998). The samples were analyzed for volatile organic compounds (VOCs) by Method 8260B/5035, semivolatile organic compounds (SVOCs) by Method 8270C, pesticides/polychlorinated biphenyls (PCBs) by Method 8081/8082, and chlorinated herbicides by Method 8151A. The results are presented in Section 3.

2.2 DEBRUSHING

The study area was overgrown with Scotch-broom, grass, small and large trees, and other vegetation. Most of the vegetation was removed prior to the start of field activities using the procedures described below. The original 9 acres and the additional 26 acres were debrushed September 29 through October 2, 1998, and January 11 through February 5, 1999, respectively. Debrushing was conducted to provide access to the proposed locations of the geophysical grid and other field activity locations. All debrushing was conducted by Pacific Northern Environmental of Longview, Washington.

Scotch-broom and low-lying vegetation was removed using a small tractor with a brush-cutting attachment or portable gasoline-powered blade trimmers. Trees greater than 8 inches in diameter were delimbed to a height of 10 feet using a trackhoe bucket or chainsaws. Trees less than 8 inches in diameter were downed using chainsaws. All cut brush, limbs, and trees were moved to a central location using a trackhoe or frontloader with a clamshell attachment, and occasionally a dumptruck. This cut vegetation was chipped using a shredder or a tub grinder. The chips were spread on site using a frontloader.

2.3 GEOPHYSICAL SURVEY

An electromagnetic conductivity survey was conducted during Phase I using EM-61 instruments at the site. The Phase IA survey was conducted over the initial 9-acre area from October 6 through 8, 1998, and the Phase IB survey was conducted over an additional 26-acre area from February 22 through March 2, 1999. The objective of these surveys was to locate former disposal trenches and other disposal areas containing buried metallic debris. The electromagnetic conductivity technique and instrumentation are described in the management plan (USACE 1998).

Prior to beginning each geophysical survey, a grid of 50-foot spacing was established by contracted surveyors (Section 2.7). The Phase IB grid was extended from the existing Phase IA grid. Within this base grid, lines were established at 10-foot intervals for reference, but readings were collected on lines 5 feet apart in an east-west grid direction. On each of these lines, readings were collected on a paced, 2.5-foot interval, which was corrected when reaching the 50 feet mark, if necessary.

The 9-acre Phase IA geophysical survey area was located in the western portion of the fenced area (Figure 2-1) and extended approximately from 0N to 800N and from 0E to 650E. The disposal yard fence marked the north and west grid boundaries. Roads marked the south and northeast boundaries. The northeast boundary tapered from approximately 800N, 300E to 450N, 650E. The Phase IB geophysical survey was an extension of the Phase IA survey and surrounded the original 9-acre area (Figure 2-1). This survey extended from approximately –200N to 1200N and –700E to 1000E.

After completion of the field portion of each survey, the data were plotted and the anomalies were contoured using SURFER, a computer software contouring program. After the Phase IB survey was completed, the Phase IA survey data were incorporated and the two were contoured as one area. The results and interpretation of the geophysical surveys are presented in Section 3.0.

2.4 SOIL-GAS SCREENING

Soil-gas screening was conducted to aid in locating potential sources of contamination. The 45 sampling locations (SG-1 through SG-45) and rationale for choosing each location are presented in Table 2-1. Transglobal Environmental Geosciences Northwest (TEG) of Lacey, Washington, conducted soil-gas probe installation, sampling, and analysis.

Each soil-gas sample was collected from a depth of 5 feet below ground surface using the push-probe technique described in the management plan (USACE 1998). Prior to collecting each sample, organic vapor monitoring was performed in both the drill rod and sample tubing using a photoionization detector (PID). Soil-gas samples were collected through new, unused

polyethylene tubing at each location. The soil-gas was sampled using a low-suction technique with a syringe. Samples were transferred from the syringe to a 22-ml glass vial with a crimp lid.

The soil-gas samples were analyzed by TEG's on-site laboratory for halogenated, aromatic hydrocarbons and benzene, toluene, ethylbenzene, and xylenes (BTEX) by modified U.S. Environmental Protection Agency (EPA) Methods 8021 and 8015. After completion of the soil-gas survey, the locations were surveyed as described in Section 2.7.

2.5 TRENCHING

Exploratory trenches were excavated from October 15 through 21, 1998, to evaluate the potential presence of buried drums and other sources of TCE. Eight trenches (T-1 through T-8) were completed at various lengths and depths. The trench locations and rationale for choosing each location are presented in Table 2-2.

A trackhoe was used to excavate each trench. The width of each trench was the width of the trackhoe bucket and the nominal length was 50 feet, divided into five 10-foot segments. As described below, not all segments in each trench were excavated because of the occurrence of drums and NAPL, which limited digging. Soil samples were collected from the center of the trackhoe bucket using a decontaminated stainless steel spoon. The trackhoe bucket was decontaminated using a hot-water pressure washer after backfilling the trench. The decontamination wash water was allowed to infiltrate into the ground surface at the trench. Groundwater and NAPL samples were collected using a clean, disposable cup taped to a polypropylene rod. Soil rinsate blank samples were collected by pouring distilled water over the decontaminated stainless steel spoon and allowing the water to flow into the sample container. Groundwater rinsate blank samples were not collected.

One soil sample per segment, up to five per trench, was collected for field screening and/or analysis. The sample was collected from a depth that represented evidence of or the potential for contamination. Based on field screening results, three soil samples per trench were selected for chemical analysis from zones of apparent contamination, where present. Soil samples collected for physical analysis were selected from layers or zones representing different physical properties. These characteristics included reddish iron oxide staining, change of grain size, and presence of organic material.

One groundwater sample was collected per segment for field screening. After completion of the trench, one groundwater sample was collected from the trench for measurement of groundwater parameters and analysis. If NAPL was present, a sample of NAPL was collected, but a separate groundwater sample was not collected and groundwater parameters were not measured.

At trenches where NAPL was encountered in a segment, the further excavation of subsequent segments commonly was eliminated. At a few trenches, a segment or remainder of the trench

was abandoned prematurely due to the presence of crushed or broken drums or mortar shells. Also, in various trenches, drums were uncovered but the trench was not abandoned prematurely. A summary of the activities follows:

> In trench T-1, segments B, C, and D were not excavated due to the presence of NAPL in segment A. Segment E was prematurely abandoned after the trackhoe bucket punctured a drum.
>
> In trench T-2, an intact drum was present on the west wall of segment A.
>
> In trench T-3, four drums were visible on the south wall.
>
> In trench T-5, multiple drums and smaller containers were uncovered in segments B and C. The trench was prematurely abandoned after two of the drums were broken and leaking dark, viscous product.
>
> In trench T-6, three drums were visible on the south wall.
>
> In trench T-7, segment D was eliminated due to the presence of NAPL.
>
> Trench T-8 was prematurely abandoned after two mortar shells were uncovered in segment A.

A summary of samples collected and analyses performed is presented in Table 2-3.

2.5.1 Trench T-1

The two segments (A and E) of trench T-1 were excavated from west to east. Soil sample ST001A08 and duplicate sample ST501A08 were collected from a depth of 8 feet bgs on the northwest wall of segment A. NAPL sample NT001A09 was collected from approximately the center of segment A from a depth of 9 feet below ground surface (bgs).

Due to the presence of NAPL in segment A of trench T-1, segments B, C, and D were eliminated. At 3 feet bgs in segment E, an intact, 55-gallon metal drum was encountered and punctured by the trackhoe bucket. The contents of the drum had a strong solvent odor, similar to that of TCE. The trench was abandoned and no samples were collected. Groundwater was not encountered. The Fort Lewis Public Works Department Hazardous Waste Office was summoned to properly dispose of the drum and its contents. Fort Lewis personnel sampled the contents of the drum for disposal characterization. The contents of the drum were solidified and removed with the drum and approximately 3 cubic feet of affected soil.

2.5.2 Trench T-2

All five segments of trench T-2 were excavated from north to south. Soil sample ST002A02 was collected from a depth of 2 feet bgs at the southern end and soil sample ST002A10 was collected from a depth of 10 feet bgs from near the center of segment A. Groundwater sample GT002A10 was collected from approximately the center of segment A for screening purposes only. Soil samples ST002B02 and ST002B07 were collected from 2 and 7 feet bgs, respectively, from the south end of segment B. Sample ST002B07 was collected for screening purposes only. Groundwater sample GT002B10 was collected from approximately the center of the segment for screening purposes only. Soil samples ST002C04 and ST002C08 were collected from the south end of segment C from 4 and 8 feet bgs, respectively. Soil sample ST002C08 was collected for screening purposes only. Groundwater sample GT002C10 was collected from approximately the center of the segment for screening purposes only. Soil sample ST002D06 was collected from the south end of the segment C from a depth of 6 feet bgs. Soil sample ST002D11 was collected from the base of the segment at 11 feet bgs for screening purposes only. Groundwater sample GT002D10 and duplicate sample GT502D10 were collected from 10 feet bgs from approximately the center of segment D. Groundwater parameters of this sample were measured. Soil sample ST002E05 was collected from the south end of segment E from a depth of 5 feet bgs. Groundwater sample GT002E10 was collected from approximately the center of the segment from a depth of 10 feet bgs for screening purposes only.

2.5.3 Trench T-3

All five segments (A through E) of trench T-3 were excavated from east to west. Soil sample ST003A06 was collected from the western end of segment A from a depth of 6 feet bgs for screening purposes only. Groundwater sample GT003A06 was collected from the eastern portion of the segment from a depth of 6 feet bgs for screening purposes only. Soil sample ST003B06 was collected from a depth of 6 feet bgs from the western edge of segment B for screening purposes only. Groundwater sample GT003B6.5 was collected from a depth of 6.5 feet bgs from the eastern portion of the segment for screening purposes only. Soil sample ST003C06 was collected from a depth of 6 feet bgs from the western edge of segment C. Groundwater sample GT003C6.5 was collected from a depth of 6.5 feet bgs from the eastern portion of the segment for screening purposes only. Soil sample ST003D07 was collected from a depth of 7 feet bgs from the western edge of segment D, below the water table. Groundwater sample GT003D6.5 was collected from a depth of 6.5 feet bgs from the eastern portion of the segment. Groundwater quality parameters were measured on this sample. Soil sample ST003E07 was collected from a depth of 7 feet bgs from the western edge of segment E, below the water table. Groundwater sample GT003E6.5 was collected from a depth of 6.5 feet bgs from the western portion of the segment for screening purposes only.

2.5.4 Trench T-4

All five segments (A through E) of trench T-4 were excavated from south to north. Soil samples ST004A02 and ST004A14 were collected from the northern end of segment A from 2 and 14 feet bgs, respectively. Soil samples ST004B09 (and duplicate ST504B09) and ST004B15 (and duplicate ST504B15) were collected from the northern end of segment B from depths of 9 and 15 feet bgs, respectively. Soil samples ST004C14, ST004D14, and ST004E14 were collected from segments C, D, and E, respectively, from a depth of 14 feet bgs. Samples ST004C14 and ST004E14 were collected for screening purposes only. Groundwater was not encountered down to the maximum reach of the trackhoe.

2.5.5 Trench T-5

A total of three segments (A, B, and C) of trench T-5 were excavated from west to east. Soil sample ST005A07 was collected from the eastern end of segment A from a depth of 7 feet bgs for screening purposes only. Groundwater samples GT005A12 and GT005A14 were collected from the western portion of the segment from depths of 12 and 14 feet bgs, respectively. Groundwater parameters of the shallower sample were measured. The deeper sample was collected for screening purposes only.

Trench T-5 was abandoned after multiple drums were uncovered in segments B and C. A sample was collected from one drum at segment B (DT005B03) and one drum at segment C (DT005C03). No soil samples were collected from these segments, and groundwater was not encountered.

2.5.6 Trench T-6

All of segments A, B, D, and E and half of segment C were excavated in a southeast to northwest direction. Soil sample ST006A05 was collected from the northwest end of segment A from a depth of 5 feet bgs. Soil samples ST006B06 and ST006B14 were collected from the northwest end of segment B from 6 feet bgs, and from the center of segment B from 14 feet bgs, respectively. Soil sample ST006B06 was collected for screening purposes only. NAPL sample NT006B12 was collected from the center of the segment from a depth of 15 feet bgs. Soil sample ST006E14 was collected from the northwest end of segment E from a depth of 14 feet bgs.

2.5.7 Trench T-7

Four segments (A, B, C, and E) of trench T-7 were excavated from south to north. Segment D was not excavated due to the presence of NAPL in segments B and C. No soil samples were collected from segment A because the walls of the segment were sloughing and the trackhoe had limited maneuverability due to the presence of trees. Any samples collected would have been slough and not representative of a discrete sidewall sample. Groundwater sample GT007A13

was collected from a depth of 13 feet bgs from the center of the segment for screening purposes only. Soil sample ST007B12 and NAPL sample NT007B13 were collected from the center of segment B from depths of 12 and 13 feet bgs, respectively.

Soil samples ST007C06 and ST007C12 were collected from the north end of segment C from depths of 6 and 12 feet bgs, respectively. The shallow sample was collected from directly beneath a solidified tar-like material. Soil sample ST007E12 was collected from the north end of segment E at 12 feet bgs. NAPL sample NT007C13 was collected from the northern portion of segment C from 13 feet bgs.

2.5.8 Trench T-8

One segment of trench T-8 was excavated from east to west. Soil sample ST008A09 was collected from the center of segment A from a depth of 9 feet bgs. Groundwater and NAPL samples were not collected. The trench was abandoned due to the presence of two mortar shells. Each 4.2-inch-diameter by 12-inch long shell was removed and disposed of by detonation by the 707th Ordnance Company, Fort Lewis.

2.6 DRIVEPOINT SAMPLING

Groundwater screening was conducted at a total of 50 locations (DP-1 through DP-50) in two phases. During Phase IA, screening locations DP-1 through D-20 were sampled from October 29 through November 20, 1998. The remaining locations (DP-21 through DP-50) were sampled from March 15 through April 14, 1999. (TEG conducted the drivepoint probe installation and on-site groundwater chemical analysis.) The sampling locations and rationale for choosing each location are presented in Table 2-4.

In order to assess the presence of NAPL and the vertical variation in contaminated groundwater, groundwater samples were collected from four discrete depths at each location. A shallow sample was collected near the top of the water table at each location in order to assess potential light NAPL (LNAPL) presence. During Phase IA, this depth typically was 8 to 13 feet bgs. During Phase IB, when the water table was shallower, this depth typically was 6 to 10 feet bgs. The second and third mid-depth samples were collected at approximately 20 and 25 feet bgs during Phase IA, and 19 and 24 feet bgs during Phase IB. The deepest sampling depth from each location was collected at the aquitard interface when it was located, or at an arbitrary depth at approximately 35 to 38 feet bgs.

Groundwater samples were collected using the same push-probe technique that was used during soil-gas screening. Samples were collected through polyethylene tubing using a peristaltic pump. The bottom of the tubing was placed within the discrete sample depth where the drill rods were extracted to expose the borehole to groundwater. Details of the installation and sampling methods are described in the management plan (USACE 1998). Water quality parameter

measurements were collected using a YSI 6820 water quality meter. Organic vapor monitoring using a PID and a NAPL dye test were conducted on an aliquot of purge water for each sample collected during Phase IA.

The water quality meter was calibrated and used according to the manufacturer's recommended procedures. Standard calibration procedures were followed for calibration of pH, conductivity, and turbidity. The dissolved oxygen calibration was conducted by allowing a few drops of water in the calibration cup to equilibrate, then inputting a barometric pressure of 760mm Hg. The oxidation reduction potential calibration was performed by completely immersing the probe in Zobell solution, reading the temperature of the solution, and inputting the respective mV reading for that temperature as printed on the calibration solution bottle. The oxidation reduction potential reading was converted to Eh by adding 200 mV, per the instrument manufacturer's recommendations.

All of the samples collected were analyzed by TEG in its mobile laboratory and by MultiChem Analytical Services. The samples were analyzed by TEG for VOCs by Method 8021B and by MultiChem for dissolved iron and manganese by Method 6010A.

To aid in locating zones of decreased permeability and estimating the top of the aquitard surface, changes in the drilling penetration and groundwater purge rates were assessed and recorded during advancement of the probes from one sample depth to the next. Typically, a low-permeability zone was characterized by a faster drilling penetration rate; little or no infiltration of groundwater into the drivepoint borehole; turbid, gray sample purge water; and occasional dense NAPL (DNAPL) presence. The drilling rate would increase when lower permeability fine-grained material such as fine sand, silt, and clay was encountered. In order to advance past a cobble, the rods must first push it aside, which decreased the drilling penetration rate.

2.7 LOCATION SURVEYING

Prior to commencement of field activities, a baseline grid was established by INCA Engineers of Bellevue, Washington to use during the subsequent geophysical survey and sampling. This grid was established over the initial 9-acre and additional 26-acre areas presented on Figure 2-1. Semi-permanent survey monuments made predominantly of rebar and caps were established at 12 new control points. These semi-permanent monuments were surveyed to existing control points at monitoring wells LC-135, LC-145, LC-148, and LC-155. Baselines marked by lath and tape were established at a 50-foot grid spacing and tied in to the control points.

The surveying contractor surveyed the coordinates and ground surface elevation of Phase I sampling locations. The surveyed locations included soil-gas and drivepoint sampling points and the ends of the exploratory trenches (Table 2-5). The horizontal coordinates were surveyed to the closest 1.0 foot and referenced to the State Plane Coordinate System, Washington

Coordinates, South Zone (NAD 27). The ground surface vertical elevations were surveyed to the closest 0.1 foot and referenced to the National Geodetic Vertical Datum of 1929.

2.8 DISPOSITION OF INVESTIGATION-DERIVED WASTE

Investigation-derived waste (IDW) generated during Phase I field activities was stored, handled, and disposed of according to the project IDW plan (USACE 1998). The site investigation was conducted as a Defense Environmental Restoration Program project under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) by the USACE. As a CERCLA response action, no federal, state, or local permits were required for actions pursuant to CERCLA Section 104 [40 CFR 300.400(e)]. In accordance with EPA guidelines, the IDW was managed as described below.

Soil generated from excavation of the exploratory trenches was backfilled into each trench as sampling was completed. Waste soil was not generated using this technique.

The approximately 150 gallons of purge water and 250 gallons of decontamination washwater generated during Phase IA drivepoint groundwater sampling was stored onsite in a Baker tank. The Fort Lewis Public Works Department Hazardous Waste Office sampled, transferred, and disposed of the contents of the Baker tank in March 1999 under supervision of the USACE. The approximately 200 gallons of purge water and 250 gallons of decontamination washwater generated during Phase IB drivepoint groundwater sampling was stored onsite in 55-gallon drums. The disposal of the contents of these drums is pending.

Personal protective equipment (PPE) and disposable sampling equipment was decontaminated, if necessary, then bagged and disposed of in designated containers located at the Fort Lewis Public Works Department building. Field laboratory waste, including used sample jars and spent solvent, was properly disposed of by TEG.

RAINIER DRIVE

EAST LINCOLN DRIVE

LEGEND

- DP-39 △ — Drivepoint Groundwater Sampling Location
- SG-19 ⊕ — Soil-Gas Sample Location
- E T-7 A — Exploratory Trench Location
- RS-1 □ — Reconnaissance Soil Sampling Location

N

0 65 130

SCALE IN FEET

Original Study Area

Phase IA 9-Acre Geophysics Study Area (October 1998)

Phase IB Additional 26-Acre Geophysics Study Area (February-March 1999)

East Gate Disposal Yard Fort Lewis, Washington	Project No. E9518Q	Expanded Site Investigation Sampling Locations	2-1
URS Greiner Woodward Clyde			

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Table 2-1
Soil-Gas Sampling Locations and Rationale

Sampling Location Number	Grid Location	Date Completed	Reasons for Selecting Location
SG-1	N 120, E 325	10/12/98	USGS wells; geophysical anomaly
SG-2	N 155, E 425	10/12/98	Geophysical anomaly
SG-3	N 190, E 400	10/12/98	Geophysical anomaly
SG-4	N 175, E 325	10/12/98	Geophysical anomaly; USGS well B, where metal was encountered during drilling
SG-5	N 220, E 300	10/12/98	Geophysical anomaly
SG-6	N 230, E 370	10/12/98	Geophysical anomaly
SG-7	13 SE of LC-136A and 17 SE of LC-136B	10/12/98	LC-136A and LC-136B, where TCE in groundwater highest during LOGRAM
SG-8	8 E of LC-150 and 17 E of SW corner of LX-18 pumphouse	10/12/98	Downgradient of LX-18, which has high TCE in gw during LOGRAM
SG-9	Former TP-10, near treatment plant	10/12/98	Former TP-10[a] and former location of LX-17
SG-10	8 W of LC-134 and 37 NE of treatment plant fence corner	10/12/98	LC-134, where high TCE encountered during LOGRAM
SG-11	N 650, E 250	10/12/98	Former TP-1[a]
SG-12	N 545, E 495	10/12/98	NE area of western disposal pit; geophysical anomaly
SG-13	N 615, E 390	10/12/98	Western disposal pit; geophysical anomaly
SG-14	N 690, E 290	10/12/98	Western disposal pit; geophysical anomaly
SG-15	N 130, E 410	10/13/98	Near SG-1; geophysical anomaly
SG-16	N 200, E 250	10/13/98	Geophysical anomaly
SG-17	N 080, E 330	10/13/98	USGS wells; geophysical anomaly
SG-18	N 085, E 380	10/13/98	USGS wells; geophysical anomaly
SG-19	N 400, E 620	10/13/98	Geophysical anomaly; former disposal trench 2 identified on aerial photos
SG-20	N 435, E 590	10/13/98	Geophysical anomaly; former disposal trench 2 identified on aerial photos
SG-21	46 NE of SG-21 and 64 E of LC-135	10/13/98	Former soil and soil-gas location F-1[b]
SG-22	25 SE of LC-135 and 135 W-SW of LC-154	10/13/98	Former soil and soil-gas location F-1[b]
SG-23	59 NE of LC-158 and 130 E-NE of LC-153	10/13/98	Bare area identified near LX-18
SG-24	N 405, E 400	10/13/98	Geophysical anomaly
SG-25	N 480, E 330	10/13/98	Geophysical anomaly
SG-26	N 545, E 265	10/13/98	Geophysical anomaly; on former disposal trench 3 identified on aerial photos
SG-27	N 300, E 080	10/13/98	Near “barren area” and former disposal trench 6 identified on aerial photos
SG-28	N 235, E 160	10/13/98	Geophysical anomaly; on former disposal trench 4 identified on aerial photos

Table 2-1 (Continued)
Soil-Gas Sampling Locations and Rationale

Sampling Location Number	Grid Location	Date Completed	Reasons for Selecting Location
SG-29	N 380, E 110	10/13/98	Geophysical anomaly; on former disposal trench 4 identified on aerial photos
SG-30	N 500, E 075	10/13/98	On former disposal trench 4 identified on aerial photos
SG-31	N 320, E 225	10/13/98	Geophysical anomaly; on former disposal trench 5 identified on aerial photos
SG-32	N 470, E 160	10/13/98	Geophysical anomaly; on former disposal trench 5 identified on aerial photos
SG-33	N 610, E 110	10/13/98	Geophysical anomaly; on former disposal trench 5 identified on aerial photos
SG-34	N 680, 075	10/13/98	Geophysical anomaly; on former disposal trench 1 identified on aerial photos
SG-35	N 725, E 175	10/13/98	Geophysical anomaly; on former disposal trench 1 identified on aerial photos
SG-36	N 106, E 306	10/14/98	USGS wells; geophysical anomaly; near SG-1 and SG-17
SG-37	N 013, E 300	10/14/98	Across road from USGS well cluster; upgradient of infiltration system
SG-38	14 SW of LC-136A and 23 SW of LC-136B	10/14/98	LC-136A and LC-136B, where TCE in groundwater highest during LOGRAM
SG-39	26 NW of LC-136B and 21 NW of LC-136A	10/14/98	LC-136A and LC-136B, where TCE in groundwater highest during LOGRAM
SG-40	N 550, E 165	10/14/98	Geophysical anomaly; on former disposal trench 7 identified on aerial photos
SG-41	N 505, E 150	10/14/98	Geophysical anomaly; on former disposal trench 5 identified on aerial photos; near SG-32 where vinyl chloride detected
SG-42	N 465, E 235	10/14/98	Geophysical anomaly; near SG-32 where vinyl chloride detected
SG-43	N 430, E 300	10/14/98	Geophysical anomaly; on former disposal trench 3 identified on aerial photos
SG-44	N 340, E 295	10/14/98	Geophysical anomaly
SG-45	N 540, E 385	10/14/98	Western disposal pit; geophysical anomaly; on former disposal trench 8 identified on aerial photos

[a]Test pit sampling locations from 1993 soil investigation (USACE 1993)
[b]Soil-gas sampling location from 1987 remedial investigation (Envirosphere 1988)

Notes:
cis-DCE - cis-1,2-dichloroethene
LOGRAM - Logistics Center remedial action monitoring
ppmV - parts per million volume
TCE - trichloroethene
USGS - United States Geological Survey

Table 2-2
Exploratory Trench Locations and Rationale

Trench Number	Grid Location	Date Completed	Reasons for Selecting Location	Segments Completed
T-1	N 120, E 300 to N 120, E 350	10/15/98	Near SG-1 where highest level of TCE was found in soil-gas (150 ppmV)	A, E
T-2	N 470, E 160 to N 495, E 196	10/16/98	Vinyl chloride at 490 ppmV in SG-32	A through E
T-3	N 80, E 335 to N 85, E 380	10/19/98	Geophysical anomalies; TCE (ppmV) at 32.9 (SG-17), 23.8 (SG-18), and 50.4 (SG-36)	A through E
T-4	Adjacent to LC-136A and LC-136B	10/19/98	LC-136A highest TCE in groundwater from LOGRAM; SG-7: TCE = 51.9 ppmV, cis-DCE = 10.4 ppmV	A through E
T-5	Adjacent to LC-134	10/20/98	LC-134 LOGRAM groundwater TCE at about 2 mg/L; near SG-10 (TCE = 2.93 ppmV)	A, B, C
T-6	N 545, E 495 to N 570, E 450	10/20/98	SG-12: TCE = 16.1 ppmV, cis-DCE = 14.8 ppmV; first gas probe penetrated moist soil at 4 feet bgs	A through E
T-7	N 625, E 245 to N 675, E245	10/21/98	SG-11: TCE = 2.75 ppmV, cis-DCE = 12.8 ppmV; near former TP-1	A through E
T-8	N 665, E 100 to N 685, E 150	10/21/98	Geophysical anomalies; active former trenching; location of former disposal trench identified on aerial photos	A

Notes:
cis-DCE - cis-1,2-dichloroethene
LOGRAM - Logistics Center remedial action monitoring
ppmV - parts per million volume
TCE - trichloroethene

Table 2-3
Exploratory Trench Sample Summary

Trench Number	Date	Segment	Depth (feet)	Sample Number	Matrix	Field Screen	Analyses and (Labs)
T-1	10/15/98	A	8	ST001A08	Soil	PID	VOC/TPH (TEG)
			8	ST501A08*	Soil	PID	VOC/TPH (TEG)
			9	NT001A09	NAPL		VOC/TPH (TEG); VOC/TPH, SVOCs, PCBs (MultiChem); physical (PTS)
		E	NA	DT001E	NAPL (drum)	None	VOCs/SVOCs/PCBs/Pesticides (Anatek Labs, Inc., for Fort Lewis)
T-2	10/16/98	A	2	ST002A02	Soil	Dye test; PID	VOC/TPH (TEG)
			10	ST002A10	Soil	Dye test; PID	TOC/TIC (ARI); Fe/Mn, SVOCs, PCBs (MultiChem); CBD (Core); grain size (Soil Tech)
			10	GT002A10	Water	Dye test	None
		B	2	ST002B02	Soil	Dye test; PID	VOC/TPH (TEG)
			7	ST002B07	Soil	Dye test; PID	None
			10	GT002B10	Water	Dye test	None
		C	4	ST002C04	Soil	Dye test; PID	VOC/TPH (TEG)
			8	ST002C08	Soil	Dye test; PID	None
			10	GT002C10	Water	Dye test	None
		D	6	ST002D06	Soil	Dye test; PID	VOC/TPH (TEG)
			11	ST002D11	Soil	Dye test; PID	None
			10	GT002D10	Water	Dye test; PID; water quality parameters	VOC/TPH (TEG); dissolved Fe/Mn (MultiChem)
			10	GT502D10*	Water	Dye test; PID; water quality parameters	VOC/TPH (TEG); dissolved Fe/Mn (MultiChem)
		E	5	ST002E05	Soil	Dye test; PID	VOC/TPH (TEG)
			10	GT002E10		Dye test	None
T-3	10/19/98	A	6	ST003A06	Soil	Dye test; PID	None
			6	GT003A06	Water	Dye test; PID	None
		B	6	ST003B06	Soil	Dye test; PID	None
			6.5	GT003B6.5	Water	Dye test; PID	None
		C	6	ST003C06	Soil	Dye test; PID	VOC/TPH (TEG)
			6.5	GT003C6.5	Water	Dye test; PID	None
		D	7	ST003D07	Soil	Dye test; PID	VOC/TPH (TEG)
			6.5	GT003D6.5	Water	Dye test; PID; water quality parameters	VOC/TPH (TEG); dissolved Fe/Mn (MultiChem)
		E	7	ST003E07	Soil	Dye test; PID	VOC/TPH (TEG)
			6.5	GT003E6.5	Water	Dye test; PID	None

Table 2-3 (Continued)
Exploratory Trench Sample Summary

Trench Number	Date	Segment	Depth (feet)	Sample Number	Matrix	Field Screen	Analyses and (Labs)
T-4	10/19/98	A	2	ST004A02	Soil	Dye test	TOC/TIC (ARI); Fe/Mn (MultiChem); CBD (Core); grain size (Soil Tech)
			14	ST004A14	Soil	Dye test; PID	VOC/TPH (TEG); TOC/TIC (ARI); Fe/Mn, SVOCs, PCBs (MultiChem); CBD (Core); grain size (Soil Tech)
		B	9	ST004B09	Soil		TOC/TIC (ARI); Fe/Mn, SVOCs, PCBs (MultiChem); CBD (Core); grain size (Soil Tech)
			9	ST504B09*	Soil		TOC/TIC (ARI); Fe/Mn, SVOCs, PCBs (MultiChem); CBD (Core); grain size (Soil Tech)
			15	ST004B15	Soil	Dye test; PID	VOC/TPH (TEG)
			15	ST504B15*	Soil	Dye test	VOC/TPH (TEG)
		C	14	ST004C14	Soil	Dye test; PID	None
		D	14	ST004D14	Soil	Dye test; PID	VOC/TPH (TEG)
		E	14	ST004E14	Soil	Dye test; PID	None
T-5	10/20/98	A	7	ST005A07	Soil	Dye test; PID	VOC/TPH (TEG)
			12	GT005A12	Water	Dye test; PID; water quality parameters	VOC/TPH (TEG); dissolved Fe/Mn (MultiChem)
			14	GT005A14	Water	Dye test; PID	None
			3	DT005B03	NAPL (drum)		SVOCs, PCBs (MultiChem)
			3	DT005C03	NAPL (drum)		SVOCs, PCBs (MultiChem)
T-6	10/20/98	A	5	ST006A05	Soil	Dye test; PID	VOC/TPH (TEG)
		B	6	ST006B06	Soil	Dye test; PID	None
			14	ST006B14	Soil	Dye test; PID	VOC/TPH (TEG)
			15	NT006B15	NAPL	Dye test; PID	VOC/TPH (TEG); VOC/TPH, SVOCs, PCBs (MultiChem)
		E	14	ST006E14	Soil	Dye test	VOC/TPH (TEG); TOC/TIC (ARI); Fe/Mn (MultiChem); CBD (Core); Grain Size (Soil Tech)
T-7	10/21/98	A	13	GT007A13	Water	Dye test; PID	None
		B	12	ST007B12	Soil	Dye test; PID	VOC/TPH (TEG)
			13	NT007B13	NAPL	Dye test; PID	SVOCs, PCBs (MultiChem)
		C	6	ST007C06	Soil		TOC/TIC (ARI); Fe/Mn (MultiChem); CBD (Core); grain size (Soil Tech)

Table 2-3 (Continued)
Exploratory Trench Sample Summary

Trench Number	Date	Segment	Depth (feet)	Sample Number	Matrix	Field Screen	Analyses and (Labs)
			12	ST007C12	Soil	Dye test; PID	VOC/TPH (TEG)
			13	NT007C13	NAPL	Dye test; PID	VOC/TPH (TEG); VOC/TPH (MultiChem); physical (PTS)
		E	12	ST007E12	Soil	Dye test; PID	VOC/TPH (TEG)
T-8	10/21/98	A	9	ST008A09	Soil	Dye test; PID	VOC/TPH (TEG)

*Duplicate of preceding sample

Notes:
ARI - Analytical Resources, Inc.
CBD - citrate-bicarbonate-dithionite
Core - Core Laboratories, Inc.
Fe/Mn - iron/manganese
MultiChem - MultiChem Analytical Services, Inc.
PCB - polychlorinated biphenyl
PID - photoionization detector
PTS - PTS Laboratories, Inc.
Soil Tech - Soil Technology, Inc.
SVOC - semivolatile organic compound
TEG - Transglobal Environmental Geosciences Northwest, Inc.
TOC/TIC - total organic carbon/total inorganic carbon
TPH - total petroleum hydrocarbons
VOC - volatile organic compounds

Table 2-4
Drivepoint Sampling Locations and Rationale

Drivepoint Number	Grid Location	Date Completed	Reasons for Selecting Location	Sample Depths (feet bgs)
DP-1	N 700, E 080	10/29/98	Former disposal trench 1; exploratory trench T-8; SG-34	11, 20, 25, 30
DP-2	N 685, E 230	10/30/98	Downgradient of exploratory trench T-7 and SG-11; Near LC-162	13, 20, 23, 36
DP-3	N 480, E 175	11/3/98	SG-32 and exploratory trench T-2	12, 20, 25, 33
DP-4	N 575, E 420	11/3/98	Downgradient of exploratory trench T-6, at western disposal pit; downgradient of SG-12	16, 20, 25, 35
DP-5	N 130, E 420	11/4/98	Downgradient of SG-1 and exploratory trench T-1A	10, 20, 24, 33
DP-6	N 095, E 350	11/5/98	Downgradient of exploratory trench T-3 and geophysical anomaly; near USGS well cluster and DP-5	10, 20, 24
DP-7	N 590, E 240	11/5/98	Downgradient of SG-26 and geophysical anomalies; on former disposal trench 3; near LC-161	13, 20, 25, 35
DP-8	N 280, E 320	11/9/98	Downgradient of SG-5 and SG-6; spatial variability	13, 20, 25, 36
DP-9	N 305, E 080	11/10/98	Near SG-27; at former disposal trench 6 (“barren area”)	11, 20, 25, 36
DP-10	N 200, E 500	11/11/98	Spatial variability	13, 20, 25, 37
DP-11	N 125, E 175	11/11/98	Spatial variability	15, 20, 25, 36
DP-12	N 455, E 090	11/12/98	At former disposal trench 4; between SG-29 and SG-30	12, 20, 25, 36
DP-13	N 441, E 575	11/13/98	Near former disposal trench 2 and large geophysical anomaly at end of trench near road	14, 20, 25,39
DP-14	N 500, E 250	11/16/98	In central part of geophysical grid, amid anomalies; near former disposal trench 3	11, 20, 25, 32
DP-15	N 575, E 015	11/16/98	Near end of former disposal trench 4, along fence line	15, 20, 25, 30
DP-16	N 355, E 225	11/17/98	Near center of grid, between former disposal trench 5 and geophysical anomalies.	11, 20, 25, 35
DP-17	N 215, E 010	11/18/98	Near corner of fence in SW part of grid; elevation about 5 feet higher	17, 22, 31, 38
DP-18	N 225, E 230	11/18/98	Near USGS well cluster C and SG-16; downgradient of DP-5, DP-6, SG-1, SG-36, and T-1	11, 20, 25, 37
DP-19	N 130, E 000	11/19/98	Upgradient of DP-17 and crossgradient to DP-11, DP-5, DP-6, SG-1, SG-17, SG-36, SG-37, and T-1	16, 22, 27, 37
DP-20	N 380, E 450	11/20/98	Near former disposal trench 2; crossgradient of T-6	13, 20, 26, 36
DP-21	N 900, E -150	3/15/99	Next to treatment plant; downgradient of LC-138 and exploratory trench T-5	10, 12, 23, 27
DP-22	N 935, E 120	3/16/99	Near geophysical anomaly	8, 16, 24, 32

Table 2-4 (Continued)
Drivepoint Sampling Locations and Rationale

Drivepoint Number	Grid Location	Date Completed	Reasons for Selecting Location	Sample Depths (feet bgs)
DP-23	N 1065, E -205	3/17/99	Near exploratory trench T-4, SG-7, LC-136A/B; near large geophysical anomaly	8, 16, 24, 39
DP-24	N 735, E -235	3/17/99	Downgradient of large geophysical anomalies	9, 19, 24, 35
DP-25	N 510, E -125	3/18/99	Near geophysical anomaly; spatial variability	7, 19, 24, 30
DP-26	N 430, E 800	3/19/99	Located on rim of eastern disposal pit; downgradient of large, strong geophysical anomalies	9, 19, 25, 38.5
DP-27	N 240, E 800	3/19/99	Near former disposal trench 9 and geophysical anomalies	9, 19, 23, 38
DP-28	N 20, E 385	3/22/99	Upgradient of exploratory trench T-3, DP-5, DP-6, and infiltration gallery; background data	10, 19, 24, 31
DP-29	N 200, E 300	3/23/99	Downgradient of geophysical anomaly, exploratory trench T-3, DP-5, and DP-6; spatial variability	8.5, 10, 24, 28
DP-30	N 50, E 100	3/23/99	Spatial variability; background data	13, 19, 24, 35
DP-31	N 1150, E -200	3/24/99	Crossgradient of exploratory trench T-4; downgradient of geophysical anomaly	9, 12, 27, 35
DP-32	N 875, E -25	3/25/99	Near exploratory trench T-5, LC-134, and geophysical anomalies	9, 19, 24, 28
DP-33	N 1040, E -275	3/26/99	Crossgradient of exploratory trench T-4 and LC-136A/B; amid strong geophysical anomalies	9, 24, 29, 35
DP-34	N 1140, E 310	3/29/99	Spatial variability	9, 19, 24, 37
DP-35	N 645, E -305	3/29/99	Downgradient of large geophysical anomaly	9, 19, 24, 34
DP-36	N 380, E -300	3/30/99	Spatial variability	12, 19, 24, 36
DP-37	N 675, E 340	3/31/99	Crossgradient of western disposal pit and exploratory trench T-6	13, 19, 22, 34
DP-38	N 590, E -60	3/31/99	Downgradient of geophysical anomaly	7.5, 19, 24, 31
DP-39	N 600, E 775	4/1/99	Downgradient of eastern disposal pit	13, 19, 24, 35
DP-40	N 835, E 350	4/2/99	Downgradient of small geophysical anomalies; spatial variability	15, 19, 23, 37
DP-41	N 1050, E -400	4/5/99	Down- to crossgradient of geophysical anomalies, LC-136A/B, DP-21, and DP-33	8, 19, 30, 33
DP-42	N 1065, E -125	4/6/99	Cross- to upgradient of exploratory trench T-4, LC-136A/B, and SG-7; spatial variability	8, 16, 23, 39
DP-43	N 870, E -205	4/6/99	Downgradient of treatment plant; crossgradient of DP-21	7, 19, 24, 30
DP-44	N -25, E 135	4/7/99	Background data; spatial variability	12, 19, 24, 33
DP-45	N 580, E 140	4/8/99	Near former disposal trench 7; amid geophysical anomalies; downgradient of DP-14	6, 17, 22, 28
DP-46	N 940, E -300	4/8/99	Downgradient of treatment plant and DP-21; crossgradient of geophysical anomalies, DP-33, and LC-136A/B	7, 18, 24, 32

Table 2-4 (Continued)
Drivepoint Sampling Locations and Rationale

Drivepoint Number	Grid Location	Date Completed	Reasons for Selecting Location	Sample Depths (feet bgs)
DP-47	N 1110, E -300	4/9/99	Downgradient of LC-136A/B, DP-23, DP-33, and exploratory trench T-4; near geophysical anomaly	9, 17, 21, 32
DP-48	N 370, E70	4/9/99	Downgradient of former disposal trenches 4 and 6 (“barren area”) and DP-9	6, 19, 24, 33
DP-49	N 190, E 175	4/12/99	Upgradient of former disposal trench 4 and large geophysical anomaly; downgradient of exploratory trench T-3, DP-5, and DP-6	7, 19, 22, 32
DP-50	N 30, E 270	4/13/99	Upgradient of infiltration gallery; background data; spatial variability	9, 19, 24, 31

Notes:
bgs - below ground surface
USGS - United States Geological Survey

Table 2-5
Survey Coordinates of Sampling Locations

Sampling Location	Northing	Easting	Elevation (feet msl)
Soil-Gas Sampling Locations			
SG-1	651926.56	1497329.75	277.45
SG-2	652004.83	1497400.32	278.77
SG-3	652023.31	1497361.60	278.93
SG-4	652042.53	1497314.95	278.71
SG-5	652000.54	1497259.21	277.94
SG-6	651973.11	1497303.70	278.35
SG-7	652475.36	1496361.96	276.72
SG-8	652550.65	1496627.22	279.51
SG-9	652379.38	1496588.21	277.11
SG-10	652380.58	1496663.56	275.32
SG-11	652350.27	1497004.42	281.16
SG-12	652381.80	1497269.50	282.64
SG-13	652387.83	1497143.08	284.21
SG-14	652405.64	1497020.31	286.06
SG-15	651973.78	1497398.83	277.95
SG-16	651959.81	1497224.24	277.71
SG-17	651883.31	1497364.33	277.04
SG-18	651918.27	1497395.03	277.16
SG-19	652314.03	1497448.77	282.98
SG-20	652334.08	1497408.02	281.88
SG-21	652607.26	1496747.14	280.33
SG-22	652628.06	1496791.58	281.45
SG-23	652533.72	1496519.29	275.68
SG-24	652208.89	1497256.56	278.67
SG-25	652243.98	1497161.50	278.77
SG-26	652274.61	1497083.83	279.49
SG-27	651963.72	1497030.16	277.53
SG-28	651946.63	1497129.61	277.14
SG-29	652045.03	1497018.54	277.13
SG-30	652133.63	1496930.71	277.63
SG-31	652049.94	1497145.01	277.95
SG-32	652150.42	1497016.87	278.40
SG-33	652245.85	1496902.74	275.84
SG-34	652290.61	1496838.68	277.02
SG-35	652379.54	1496900.10	278.30
SG-36	651903.79	1497319.58	277.05
SG-37	651819.55	1497361.04	279.76
SG-38	652468.59	1496339.95	277.10
SG-39	652499.28	1496339.40	276.94
SG-40	652221.97	1496980.89	277.9
SG-41	652175.81	1496989.78	278.10
SG-42	652182.76	1497082.93	278.58

Table 2-5 (Continued)
Survey Coordinates of Sampling Locations

Sampling Location	Northing	Easting	Elevation (feet msl)
Soil-Gas Sampling Locations (Continued)			
SG-43	652181.38	1497157.02	278.86
SG-44	652100.78	1497197.19	278.32
SG-45	652320.83	1497176.82	279.18
Exploratory Trench Locations			
T-1A Beginning	651928.95	1497346.57	276.88
T-1A End	651935.05	1497355.90	277.25
T-1E Beginning	651916.01	1497322.65	277.35
T-1E End	651909.37	1497311.88	277.84
T-2A Beginning	652171.30	1496995.23	278.06
T-2E End	652146.89	1497027.53	277.86
T-3A Beginning	651925.02	1497403.80	277.77
T-3E End	651892.74	1497359.00	276.77
T-4A Beginning	652456.16	1496351.35	276.64
T-4E End	652494.58	1496390.95	276.28
T-5A Beginning	652390.23	1496631.03	275.75
T-5C End	652390.17	1496667.52	275.37
T-6A Beginning	652380.59	1497268.83	282.52
T-6E End	652377.91	1497208.29	282.58
T-7A Beginning	652322.99	1497015.04	280.46
T-7E End	652370.06	1496988.36	282.05
T-8A Beginning	652293.58	1496864.03	277.20
T-8A End	652301.08	1496875.00	277.70
Drivepoint Sampling Locations			
DP-1	652310.90	1496833.14	276.77
DP-2	652373.75	1496965.45	279.39
DP-3	652159.47	1497028.01	278.23
DP-4	652372.35	1497191.81	281.73
DP-5	651933.40	1497316.70	277.83
DP-6	651914.84	1497366.10	276.86
DP-7	652294.24	1497024.40	279.47
DP-8	652061.97	1497249.52	278.78
DP-9	651971.50	1497022.42	277.61
DP-10	652079.44	1497444.67	280.09
DP-11	651858.27	1497191.00	281.51
DP-12	652103.23	1496962.41	278.01
DP-13	652325.20	1497390.99	280.71
DP-14	652219.91	1497078.09	279.24
DP-15	652170.63	1496837.76	277.14
DP-16	652078.51	1497127.25	278.12
DP-17	651858.88	1497009.45	282.75
DP-18	651971.30	1497197.50	277.67
DP-19	651770.97	1497040.23	283.36
DP-20	652212.96	1497310.82	279.77

Table 2-5 (Continued)
Survey Coordinates of Sampling Locations

Sampling Location	Northing	Easting	Elevation (feet msl)
Drivepoint Sampling Locations (Continued)			
DP-21	652373.70	1496533.72	276.86
DP-22	652532.24	1496747.72	280.39
DP-23	652486.78	1496401.78	276.75
DP-24	652184.35	1496547.09	279.83
DP-25	652047.58	1496748.39	278.20
DP-26	652425.90	1497595.51	281.83
DP-27	652261.27	1497684.80	282.00
DP-28	651868.19	1497431.88	278.07
DP-29	651982.47	1497269.19	277.78
DP-30	651753.13	1497168.66	284.46
DP-31	652565.42	1496366.35	277.10
DP-32	652412.77	1496658.31	275.67
DP-33	652432.11	1496357.16	277.48
DP-34	652807.63	1496819.99	278.92
DP-35	652073.39	1496525.32	280.07
DP-36	651848.78	1496658.21	282.51
DP-37	652402.13	1497063.51	285.94
DP-38	652143.56	1496761.42	278.47
DP-39	652565.76	1497487.29	286.04
DP-40	652561.84	1497002.56	288.00
DP-41	652380.42	1496241.44	276.72
DP-42	652526.28	1496477.46	276.68
DP-43	652327.42	1496495.55	277.27
DP-44	651704.34	1497229.50	282.85
DP-45	652234.86	1496943.32	277.39
DP-46	652334.14	1496382.50	276.64
DP-47	652480.35	1496302.89	278.24
DP-48	652015.50	1496983.01	277.33
DP-49	651916.08	1497164.95	277.68
DP-50	651820.53	1497330.27	280.44

Horizontal coordinates referenced to the State Plane Coordinate System, Washington Coordinates, South Zone, NAD 27
Vertical elevations referenced to the National Geodetic Vertical Datum of 1929

Note:
msl - mean sea level

3.0 FIELD MEASUREMENTS AND ANALYTICAL RESULTS

This section provides the results of all investigation activities conducted during Phase I. It includes the initial site reconnaissance soil sampling, the geophysical surveys, and sampling and analysis of soil-gas, soil, water, and NAPL from drivepoints and trenches.

3.1 SITE RECONNAISSANCE

The results of the analysis of soil collected at the barren area are shown in Tables 3-1, 3-2, and 3-3. TCE was detected in sample RS001 at a concentration of 0.079 mg/kg. No other VOCs were detected above the analytical detection limit. Ten SVOCs were detected in this sample at estimated concentrations up to 0.028 mg/kg. No pesticides, PCBs, or chlorinated herbicides were detected above the analytical detection limit. These analytical results did not warrant amending the health and safety plan (USACE 1998).

3.2 GEOPHYSICAL SURVEY

An EM-61 instrument was used to conduct the geophysical surveys at the study area. This instrument has an upper coil and a lower coil that respond to metallic materials. Output from the upper coil is recorded on Channel 1 of the data recorder and output from the lower coil is recorded on Channel 2. Output from the coil nearest the ground surface (Channel 2) reflects the greatest amount of metallic objects. The Channel 2 results of the combined Phase IA and IB EM-61 geophysical surveys are shown on Figure 3-1. The application of Channel 1 data is discussed below. (Channel 1 data are not shown on a figure.)

The EM-61 is designed so that a metal object at the ground surface produces the same response for the upper coil (Channel 1) and lower coil (Channel 2), assuming an average operating height above the ground. In this case, the differential of the Channel 1 and 2 responses would be relatively small. As the depth to the target increases, the response difference between the two coils also increases. That is, a deeper target shows a greater response in the lower coil than in the upper coil and consequently the difference in channel response increases.

The differential of the outputs between the upper and lower coils is measured on Channel 4 and presented on Figure 3-2. On Channel 4, near surface metallic objects are subdued relative to the Channel 2 response and deeper objects are enhanced. Many of the anomalies shown on Figure 3-1 (Channel 2 response) do not appear on Figure 3-2 suggesting that much of the metal debris is relatively shallow, within a few feet of the surface. The anomalies that are shown on Figure 3-2 likely represent objects at depths between a few feet to 10 feet below ground surface.

Distinct disposal areas and random debris are identifiable on Figure 3-1. Narrow linear features that represent buried metallic debris in disposal trenches are located within the entire geophysical study area. Some of these features align with former disposal trenches identified within the EGDY fenced area on aerial photographs. These features generally are 200 to 500 feet long, but vary in orientation and size.

Linear features that represent former disposal trenches are also located near the treatment system. These features are broader, approximately 100 feet long, and oriented in an east-west direction surrounding the treatment system. The former disposal trenches appear to extend beneath the treatment system fenced area.

The western disposal pit is clearly outlined and filled with geophysical anomalies. The geophysical anomalies associated with the eastern disposal pit are located on the southern side of the pit. Few anomalies were identified at the base or on the remaining walls of this pit.

A disposal area approximately 200 feet in diameter was identified south of the fenced area near the infiltration galleries of the treatment system. Other disposal areas identified by geophysical anomalies are located near the treatment system. These areas are spread north and south of the system and vary in shape and size. Linear features, which likely are disposal trenches, are less than 100 feet long in this area. Other features appear to be random metallic debris or surface interferences such as monitoring and extraction wells.

No geophysical anomalies were found south of the road across from the recharge trenches, north of the eastern disposal pit, or in the southwest portion of the Phase IB geophysics area.

3.3 SOIL-GAS SCREENING

Soil-gas results are presented in Table 3-4 and Figure 3-3. TCE was detected in 33 of the 45 soil-gas samples at concentrations ranging from 0.29 ppmV to 150 ppmV. The highest TCE concentration was detected at soil-gas sampling location SG-1 (150 ppmV). The next highest concentrations were 51.0 ppmV (SG-7) and 50.4 ppmV (SG-36). The remaining detected concentrations of TCE averaged approximately 4 ppmV.

Cis-1,2-DCE was detected in 24 soil-gas samples at concentrations ranging from 0.34 ppmV to 81.7 ppmV. This compound was detected only in samples in which TCE also was detected. The highest DCE concentration was detected at soil-gas sampling location SG-32 (81.7 ppmV), and the next highest concentrations were 29.9 ppmV (SG-36) and 21.5 ppmV (SG-17). The remaining detected concentrations of DCE averaged approximately 4.5 ppmV.

Trans-1,2-DCE was detected in six soil-gas samples at concentrations ranging from 0.34 ppmV to1.77 ppmV. Concentrations of 1,1,1-TCA and total xylenes were detected in separate samples

at 0.46 ppmV and 0.37 ppmV, respectively. Vinyl chloride was detected in two samples at concentrations of 5.81 ppmV (SG-11) and 490 ppmV (SG-32).

3.4 TRENCHING

A summary of field observations, stratigraphy, and analytical results for each trench follows. Field observations and field screening results, including locations of drums encountered, are presented in Table 3-5. Groundwater quality parameters and test kit results and groundwater analytical results are presented in Table 3-6. Exploratory trench soil results are presented in Tables 3-7, 3-8, and 3-9, and NAPL analytical results are presented in Tables 3-10 through 3-15. Analytical results of soil, groundwater, and NAPL samples collected from the exploratory trenches are presented on Figure 3-4. Exploratory trench soil and NAPL physical test results are presented in Tables 3-16 and 3-17, respectively.

3.4.1 Trench T-1

The uppermost 3 feet of segment A consisted of dark brown to black, organic, silty sandy gravel with cobbles to 6 inches in diameter. Buried debris was encountered from approximately 3.5 feet bgs to the base of the trench at 9 feet bgs. This debris consisted of deteriorated metal strapping and plates, and metal pieces possibly from an automobile. Other debris encountered included a pipe at 6 feet bgs, and an automobile windshield and various metal and glass debris at 9 feet bgs. Iron oxide staining and an increase in sand content were observed at 5 feet bgs. At 7 feet bgs, the metallic debris was conglomerated with a hardened matrix. At 8 feet bgs, the color of the sandy gravel changed to gray and the diameter of the cobbles increased to 12 inches (Steilacoom Gravel). A strong hydrocarbon-like odor and sheen were observed at this depth. Groundwater with NAPL was encountered at 9 feet bgs. The dye test result indicated that LNAPL was present in segment A.

Due to the presence of NAPL in segment A of trench T-1, segments B, C, and D were not excavated. The surface soil at segment E was dark brown organic silt and sand grading to brown gravelly sand. At 3 feet bgs in segment E, an intact, 55-gallon metal drum was encountered and punctured by the trackhoe bucket. The contents of the drum had a strong solvent odor like TCE. Based on analytical results from the sample for disposal characterization of the drum and its contents (DT001E), TCE and tetrachlorethene were detected at concentrations of 832,000 mg/kg and 648 mg/kg, respectively. No other VOCs, SVOCs, PCBs, or pesticides were detected in this sample above the analytical detection limits.

Mineral spirits and oil were detected at estimated concentrations of 8,240 and 37,000 mg/kg, respectively, in soil sample ST001A08. Gasoline and diesel were not detected in this soil sample above the analytical detection limit.

Detected concentrations of TCE, cis-1,2-DCE, and trans-1,2-DCE were estimated at 3,400 mg/kg, 370 mg/kg, and 5.8 mg/kg, respectively, in soil sample ST001A08. Toluene, ethylbenzene, and total xylenes were detected at concentrations of 4.0 mg/kg, 3.6 mg/kg, and 27 mg/kg, respectively. TCA, vinyl chloride, and benzene were not detected above the respective detection limits.

According to analytical results from TEG, oil and mineral spirits were detected in NAPL sample NT001A09 at concentrations of 190,000 mg/kg and 150,000 mg/kg; diesel and gasoline were not detected above the respective analytical detection limits (9,000 mg/kg and 4,200 mg/kg). According to analytical results from MultiChem, diesel, oil, and gasoline were detected in this sample at concentrations of 160,000 mg/kg, 400,000 mg/kg, and 43,000 mg/kg. The concentration of TPH in the mineral spirits range was not provided by MultiChem.

According to analytical results of VOC analysis performed by TEG, TCE, cis-1,2-DCE, total xylenes, and ethylbenzene were detected in NAPL sample NT001A09 at concentrations of 180 mg/kg, 44 mg/kg, 78 mg/kg, and 344 mg/kg, respectively. According to analytical results from MultiChem, five VOCs were detected in this NAPL sample at a range of estimated concentrations from 38 mg/kg for 1,3,5-trimethylbenzene to 440 mg/kg for cis-DCE. Nine SVOCs were detected in this sample at a maximum estimated concentration of 47 mg/kg for bis(2-ethylhexyl)phthalate, which is likely to be a laboratory contaminant. The PCBs Aroclor 1254 and Aroclor 1260 were detected in this sample at concentrations of 1,800 µg/kg and 1,600 µg/kg, respectively. No other analytes were detected above the analytical detection limits.

Physical parameters of NAPL sample NT001A09 were measured. The density of this sample ranged from 0.882 grams per cubic centimeter (gm/cc) at 100ºF to 0.8959 gm/cc at 60ºF. The interfacial tension at 74ºF was 8.96 dynes per centimeter. Specific gravity ranged from 0.8758 at 100ºF to 0.8967 at 60ºF. Finally, the viscosity in centistokes ranged from 61.3 at 100ºF to 184.2 at 60ºF.

3.4.2 Trench T-2

All five segments (A through E) of trench T-2 were excavated from north to south. The upper 2 feet of soil encountered in this segment consisted of dark brown organic sand and gravel with cobbles to a diameter of 6 inches. Buried debris was encountered from 2 to 8 feet bgs and was visible mostly on the west wall. This debris consisted of miscellaneous waste such as small metal cans and glass; an odor was noted. An intact, 55-gallon metal drum was visible on the west wall at approximately 3 feet bgs. Native soil and less debris were present at 4 feet bgs, and no odor was noted. The soil consisted of light reddish brown (iron oxide staining), silty, cobbly gravel with natural organic material such as rootlets. From 6 feet bgs to the base of the trench (11 feet bgs), the soil (Steilacoom Gravel) consisted of light brown sand and cobbles up to 12 inches in diameter with few fine grains. Based on grain size test results of soil sample ST002A10, the soil at 10 feet bgs is a poorly graded gravel with sand.

Groundwater was encountered in trench T-2 at 10 feet bgs. The dye test results and visual observation indicated that NAPL was not present in any of the segments of trench T-2. Groundwater quality parameters for sample GT002D10 are presented in Table 3-7.

The stratigraphy in segment B was similar to that encountered in segment A, but much less debris was encountered. The stratigraphy in segment C was similar to that encountered in segments A and B, but no debris was encountered. The upper 2 feet of soil in segment D consisted of dark brown to black, silty, fine to medium sand with some gravel. Debris was encountered from 4 to 9 feet bgs and consisted predominantly of glass and paper. Evidence of burning, including soot, ash, and charred paper, was observed in the upper 2 feet of the debris. Native soil (Steilacoom Gravel) with iron oxide staining was encountered at 9 feet bgs, which is deeper than in previous segments in trench T-2.

The stratigraphy observed in segment E was similar to that encountered in segment D. Debris consisting of metal, glass, and brick was encountered from 5 to 8 feet bgs. Native soil (Steilacoom Gravel) with iron oxide staining was encountered at 8 feet bgs. Black staining was observed on the gravel at the groundwater level at 10 feet bgs.

Oil was detected in soil samples collected from every segment of trench T-2 at concentrations ranging from 160 mg/kg (ST002E05) to 890 mg/kg (ST002D06). Gasoline, diesel, and mineral spirits were not detected above the analytical detection limit in these soil samples. TCE and DCE were detected in every soil sample collected from trench T-2; concentrations of TCE ranged from 0.52 mg/kg to 26.3 mg/kg and concentrations of DCE ranged from 0.55 mg/kg to 16.1 mg/kg. The highest concentrations of TCE, DCE, and oil, and the only detection of benzene (0.84 mg/kg) were detected in sample ST002D06. Trans-1,2-DCE also was detected in samples ST002D06 (0.99 mg/kg) and ST002E05 (4.1 mg/kg).

In soil sample ST002A10, eight SVOCs were detected at a maximum estimated concentration of 0.13 mg/kg (di-n-octyl-phthalate). The PCB Aroclor 1254 was detected in this sample at a concentration of 58 µg/kg.

In soil sample ST002A10, iron and manganese were detected at concentrations of 12,000 and 200 mg/kg, respectively. Extractable iron and manganese were detected at concentrations of 13,000 and 490 mg/kg, respectively, and total inorganic and organic carbon were detected at concentrations of 3,302 and 12,000 mg/kg, respectively.

TCE, cis-1,2-DCE, and trans-1,2-DCE were detected at concentrations of 38.5 µg/L, 69.0 µg/L, and 2.6 µg/L, respectively, in groundwater sample GT002D10. The analytes 1,1,1-TCA, vinyl chloride, BTEX, and dissolved iron and manganese were not detected above the respective analytical detection limits.

3.4.3 Trench T-3

The upper 2 feet of soil encountered in segment A consisted of dark brown sand and gravel with cobbles to a diameter of 6 inches, and natural organic material. Buried debris was encountered beginning at a depth of 2 feet bgs. This debris consisted of miscellaneous waste such as wire and other metallic debris, wood, brick, and glass. A concrete slab was encountered at approximately 5 feet bgs. It sloped slightly towards the west and appeared to be buried waste material and not part of a structure. To gain access to the slab in segment A, the trackhoe began excavation of segment B (on the far side of the slab). The trackhoe was then able to reach over and lift up the slab. Segment A was then excavated to a total depth of 6 feet bgs, where groundwater was encountered. The soil beneath the concrete slab consisted of silty, sandy, fine to medium gravel. The soil exhibited evidence of burning such as soot. Dye test results and visual observation indicated that NAPL was not present in segment A. Groundwater quality parameters for sample GT003D6.5 are provided in Table 3-7.

At segment B, a large amount of debris was encountered from the ground surface to the total depth of 6.5 feet bgs. This debris consisted mostly of fireproof bricks, deteriorated metal, and glass. The concrete slab observed in segment A was not encountered in this segment. A crushed 55-gallon metal drum was visible on the south wall near the center of the segment at approximately 5 feet bgs. A solvent odor similar to that of TCE was noted. Groundwater and possibly NAPL were encountered at a depth of 6.5 feet bgs. The groundwater exhibited a sheen; however, the dye test and visual observation indicated that NAPL was not present in segment B.

The stratigraphy and debris encountered in segment C were similar to that encountered in segment B. A crushed 55-gallon metal drum was visible on the south wall near the center of the segment at approximately 5 feet bgs. Groundwater and NAPL that appeared to consist of grease were encountered at a depth of 6.5 feet bgs. The dye test and visual observation indicated the presence of LNAPL associated with the groundwater in segment C.

The stratigraphy and debris encountered in segment D were similar to that encountered in segments A through C. A possibly intact, 55-gallon metal drum was visible on the south wall near the center of the segment at approximately 3 feet bgs. Groundwater and NAPL were encountered at a depth of 6.5 feet bgs, and infiltrated slowly into the trench. The dye test and visual observation indicated that LNAPL may be present in the soil and groundwater samples from segment D.

The stratigraphy and debris encountered in segment E were similar to that of segments A through D. A possibly intact, 55-gallon metal drum was visible on the south wall near the center of the segment at approximately 2 feet bgs. Groundwater was encountered at a depth of 6.5 feet bgs. The groundwater exhibited a sheen. The dye test and visual observation indicated that NAPL was not present in the soil or groundwater in segment E.

Oil was detected in soil samples from trench T-3 at concentrations of 3,800 mg/kg (ST003C06), 7,200 mg/kg (ST003D07), and 18,000 mg/kg (ST003E07). Mineral spirits were detected at concentrations of 55 mg/kg (ST003C06), 860 mg/kg (ST003D07), and 1,920 mg/kg (ST003E07). Gasoline and diesel were not detected above the analytical detection limit in these soil samples.

TCE was detected in all three soil samples collected from trench T-3 at estimated concentrations of 590 mg/kg (ST003C06), 2,400 mg/kg (ST003D07), and 2,000 mg/kg (ST003E07). DCE was detected in samples ST003C06 (20.5 mg/kg, estimated) and ST003D07 (40.8 mg/kg, estimated). Due to an elevated detection limit (180 mg/kg), the presence of DCE at sample ST003E07 could not be verified. No other analytes were detected above the respective detection limits.

TCE and cis-1,2-DCE were detected in the groundwater sample GT003D6.5 at concentrations of 180,000 µg/L and 5,700 µg/L, respectively. Trans-DCE and vinyl chloride were detected in this sample at 36.4 µg/L and 17.4 µg/L, respectively. Ethylbenzene, toluene, and total xylenes were detected at concentrations of 5.7 µg/L, 9.4 µg/L, and 47.9 µg/L, respectively, but benzene was not detected in this sample above the analytical detection limit. Dissolved iron and manganese were detected at concentrations of 3.2 mg/L and 0.7 mg/L, respectively.

3.4.4 Trench T-4

The upper 1 foot of soil encountered in segment A consisted of dark brown silt and sand with natural organic material such as grass, plants, and roots. Beneath the topsoil, the stratigraphy encountered was a reddish brown (iron oxide staining) to light brown gravel with cobbles of varied lithology up to a diameter of 6 inches. Based on grain size analytical results for soil sample ST004A02, the soil at 2 feet bgs is a poorly graded gravel with sand. From 2.5 feet bgs to the total depth of the segment (16 feet bgs), the soil consisted of dark brown medium coarse sandy gravel with cobbles to 24 inches in diameter (Steilacoom Gravel). Based on grain size analytical results for soil sample ST004A14, the soil at 14 feet bgs is a poorly graded gravel with sand. At 8.5 feet bgs, black staining was observed on some cobbles. At 12 feet bgs, evidence of contamination such as a solvent-like odor, gray staining, and an increase in moisture were observed. No buried debris was encountered in this segment, and the stratigraphy consisted of native material. Groundwater was not encountered in trench T-4, and dye test results and visual observation indicated that NAPL was not present in trench T-4.

The stratigraphy in segments B through E was similar to that encountered in segment A, except the Steilacoom Gravel was encountered at 4 feet bgs, and the diameter of the cobbles reached 12 inches in diameter. Based on grain size analytical results for soil sample ST004B09, the soil at 9 feet bgs in segment B is a poorly graded gravel. The evidence of contamination observed in segment A was observed in segment B beginning at a depth of 7 feet bgs. At 14 feet bgs, the intensity of the odor increased and a small amount of NAPL was observed on a cobble excavated from the trench.

Gasoline was detected at concentrations of 1,050 mg/kg (ST004A14), 380 mg/kg estimated (ST004B15), and 1,120 mg/kg (ST004D14) in the three soil samples collected from trench T-4. Oil was detected at a concentration of 570 mg/kg in one sample collected from this trench (ST004A14). Diesel and mineral spirits were not detected above the analytical detection limit in these soil samples.

TCE was detected at concentrations of 672 mg/kg estimated (ST004A14), 122 mg/kg estimated (ST004B15), and 0.42 mg/kg (ST004D14). In soil sample ST004D14, ethylbenzene (1.9 mg/kg) and total xylenes (3.2 mg/kg) were detected. Fourteen SVOCs were detected in sample ST004A14 at a maximum estimated concentration of 0.3 mg/kg (naphthalene). None of the remaining VOC or SVOC analytes or PCBs were detected above the analytical detection limits.

In the shallow soil sample from segment A of trench T-4 (ST004A02), iron and manganese were detected at concentrations of 14,000 and 210 mg/kg, respectively. Extractable iron and manganese were detected in this sample at concentrations of 36,500 and 800 mg/kg, respectively, and total inorganic and organic carbon were detected at concentrations of 6,378 and 39,000 mg/kg, respectively. In the deeper soil sample from segment A of trench T-4 (ST004A14), iron and manganese were detected at concentrations of 12,000 and 340 mg/kg, respectively. Extractable iron and manganese were detected in this sample at concentrations of 10,900 and 700 mg/kg, respectively, and total inorganic and organic carbon were detected at concentrations of 9,977 and 22,000 mg/kg, respectively.

Iron and manganese were detected in the soil sample from segment B (ST004B09) at concentrations of 16,000 and 300 mg/kg, respectively. Extractable iron and manganese were detected in this sample at concentrations of 26,300 and 1,500 mg/kg, respectively, and total inorganic and organic carbon were detected at concentrations of 494 and 3,700 mg/kg, respectively.

3.4.5 Trench T-5

The upper 6 feet of soil encountered in segment A consisted of dark brown sand and gravel with cobbles up to a diameter of 6 inches. The surface soil contained natural organic material. A crushed 55-gallon metal drum and various crushed 5-gallon metal containers were encountered in segment B at a depth of 2 to 3 feet bgs. A crushed 55-gallon metal drum containing a dark, viscous, odorous product was encountered at the eastern end of the segment. A sample (DT005B03) of the contents of this drum was collected. Another 55-gallon metal drum was visible behind this drum. This drum also contained a similar type of product that was leaking slowly from the container. In segment C, a broken 55-gallon metal drum leaking a similar type of product was uncovered at the eastern end of the segment at a depth of 2 feet bgs. The contents of this drum also were sampled (DT005C03).

The products collected from the two drums were analyzed for SVOCs and PCBs. Eight SVOCs were detected in sample DT005B03 and five SVOCs were detected in sample DT005C03 at concentrations ranging from 12 mg/kg estimated to 230 mg/kg. The PCB Aroclor 1254 was detected in both samples at concentrations of 720 µg/kg (DT005B03) and 1,200 µg/kg (DT005C03).

In addition to the multiple drums encountered in segments B and C, buried debris was encountered in this trench beginning at a depth of 2 feet bgs. This debris consisted of miscellaneous waste such as cable, strapping, and other metallic debris, as well as wood, brick, and glass. Native soil was encountered at a depth of 6 feet bgs, and consisted of brown to reddish brown (iron oxide staining) silty, sandy gravel with cobbles up to a diameter of 12 inches (Steilacoom Gravel). At 12 feet bgs, the sand content and cobble diameter of the soil decreased and groundwater infiltrated. The groundwater table was encountered at the base of segment A at 14 feet bgs. Dye test results and visual observation of the soil and groundwater indicated that NAPL was not present. Groundwater quality parameters for sample GT005A12 are presented in Table 3-7.

Petroleum hydrocarbons were not detected above the analytical detection limits in the soil sample collected from trench T-5 (ST005A07). TCE was detected in this sample at a concentration of 1.1 mg/kg. No other analytes were detected above the analytical detection limits in this sample.

TCE, cis-1,2-DCE, and vinyl chloride were detected in groundwater at concentrations of 109 µg/L, 18.2 µg/L, and 19.1 µg/L, respectively. Dissolved manganese was detected in the groundwater at a concentration of 0.3 mg/L, but dissolved iron was not detected above the analytical detection limit. Trans-DCE, 1,1,1-TCA, and BTEX also were not detected above the respective analytical detection limits.

3.4.6 Trench T-6

The soil encountered in segment A consisted of dark brown to black, silty, sandy gravel with some buried debris. Rusted metal debris such as pipe, cable, springs, and crushed drums, and other debris such as new wire and newspaper (dated 1967) were encountered to the total depth of the trench. This segment was abandoned at a depth of 4 feet bgs due to the presence of several drums. A crushed 55-gallon metal drum containing rainwater infiltrated from the surface was encountered at approximately 2 feet bgs on the south wall at the southeast end of the segment. A second partially intact 55-gallon metal drum was encountered on the south wall of the segment at a depth of approximately 3 feet bgs, beneath the first drum. This drum contained a liquid that had an odor of mineral spirits. A third intact 55-gallon metal drum was encountered next to the second drum. It was not determined if this drum contained liquids or any other materials.

The surface soil and buried debris encountered at segments B through E were similar to those encountered in segment A. A crushed 55-gallon metal drum was found at the surface of segment B at the northwestern end. At 3 feet bgs, the soil exhibited iron oxide staining and the buried debris was rusted. At this depth in segment D, a very hard, solid material similar to solidified tar was encountered, and the shallow buried debris included glass and various metals such as nails. At 4 feet bgs in segments B through E, the soil appeared black, as if it may have been burned. The soil at 6 feet bgs consisted of brown medium to coarse sand with some black staining. At 7 feet bgs (to the total depth of the trench at 15 feet bgs), the soil graded to gravel with a diameter up to 6 inches. Based on grain size analytical results for soil sample ST006E14 from segment E, the soil at 14 feet bgs was a well graded gravel with sand. Evidence of contamination such as gray staining and a strong diesel odor was noted at 14 feet bgs.

Groundwater was encountered at 15 feet bgs, and NAPL was visible on the water table. Dye test results and visual observation indicated that NAPL was not present in the shallow soil, and LNAPL was suspected to be present in the deeper soil.

Oil was detected at concentrations of 490 mg/kg (ST006A05), 1,300 mg/kg (ST006B14), and 2,000 mg/kg (ST006E14) in the three soil samples collected from trench T-6. Mineral spirits were detected at concentrations of 900 mg/kg (ST006B14) and 2,300 mg/kg (ST006E14) in two of the samples. Gasoline and diesel were not detected in these soil samples at concentrations above the analytical detection limits.

TCE was detected in soil sample ST006A05 at a concentration of 0.75 mg/kg. Toluene and ethylbenzene were detected in soil samples ST006B14 (1.0 mg/kg estimated), and ST006E14 (3.4 mg/kg estimated). Total xylenes were detected in soil samples ST006B14 (9.1 mg/kg) and ST006E14 (13.7 mg/kg estimated).

Iron and manganese were detected at concentrations of 12,000 and 130 mg/kg, respectively, in soil sample ST006E14. In this sample, extractable iron and manganese were detected at concentrations of 5,500 and 100 mg/kg, respectively, and total organic carbon was detected at a concentration of 16,000 mg/kg. Total inorganic carbon was not detected above the analytical detection limit.

According to analytical results from TEG, oil and mineral spirits were detected in NAPL sample NT006B15 at concentrations of 150,000 mg/kg, estimated, and 450,000 mg/kg; diesel and gasoline were not detected above the respective analytical detection limits (7,000 mg/kg and 10,000 mg/kg). According to analytical results from MultiChem, diesel, oil, and gasoline were detected in this sample at concentrations of 150,000 mg/kg, 450,000 mg/kg, and 410,000 mg/kg. The concentration of TPH in the mineral spirits range was not provided by MultiChem.

According to analytical results from TEG for NAPL sample NT006B15, ethylbenzene and total xylenes were detected at concentrations of 520 mg/kg and 3,600 mg/kg, respectively. According

to analytical results from MultiChem, one VOC was detected in this NAPL sample at an estimated concentration of 320 mg/kg (n-butylbenzene). Five SVOCs were detected in this sample; the maximum estimated concentration was 31 mg/kg for bis(2-ethylhexyl)phthalate. No other analytes were detected above the analytical detection limits.

3.4.7 Trench T-7

The upper 4 feet of soil encountered in segments A, B, C, and E consisted of dark brown, silty, sandy gravel with natural organic material and well sorted cobbles up to a diameter of 3 inches. The gravel at 2 feet bgs in segments C and E was poorly sorted and mixed with minimal debris. Additional debris was observed in segments C and E on the west wall at 6 feet bgs. Minimal pieces of buried debris were present on the west wall in segment B. A very hard, black, solid material with the appearance of solidified tar was encountered at a depth of 2 feet bgs in segment A and 4 feet bgs in segment E. Fill material consisting of dark brown silt and sand was present from 4 to 6 feet bgs. At 6 feet bgs, native soil consisting of silty, sandy gravel with cobbles up to 6 inches in diameter and iron oxide staining was encountered. Based on grain size analytical results of soil sample ST007C06, the soil at 6 feet bgs is a poorly graded gravel with silt. The iron oxide staining was no longer present at 9 feet bgs, and the cobble size increased to 10 inches in diameter. At 12 feet bgs in segments A and C, evidence of contamination such as gray staining and diesel or kerosene odor was noted.

Groundwater was encountered at the base of trench T-7 at 13 feet bgs. LNAPL was visible on the water table in segments B and C. A sheen was observed on the water table in segments A and E, but NAPL was not present in segment A and was only suspected to be present in segment E. Dye test results and visual observation indicated that NAPL was present in soil in segment B and was suspected to be present in the deeper soil samples from segments C and E. It was not present in soil in segment A or in the shallow soil sample from segment C.

Oil was detected at concentrations of 1,200 mg/kg (ST007B12), 1,900 mg/kg (ST007C12), and 1,000 mg/kg (ST007E12) in the three soil samples collected from trench T-7. Mineral spirits were detected at estimated concentrations 4,800 mg/kg (ST007B12), 8,400 mg/kg (ST007C12), and 4,500 mg/kg (ST007E12) in these soil samples. Gasoline and diesel were not detected above the analytical detection limits in these soil samples.

Ethylbenzene and total xylenes were detected at estimated concentrations in soil samples ST007B12 (2.8 mg/kg and 12.8 mg/kg), ST007C12 (10 mg/kg and 30.6 mg/kg) and ST007E12 (3.7 mg/kg and 16.2 mg/kg). No other analytes were detected above the analytical detection limits.

Iron and manganese were detected at concentrations of 16,000 and 160 mg/kg, respectively, in soil sample ST007C06. In this sample, extractable iron and total organic carbon were detected at

concentrations of 39,500 mg/kg and 6,700 mg/kg, respectively. Extractable manganese and total inorganic carbon were not detected above the respective analytical detection limits.

According to analytical results from TEG, oil and mineral spirits were detected in NAPL sample NT007C13 at concentrations of 240,000 mg/kg and 640,000 mg/kg, estimated; diesel and gasoline were not detected above the analytical detection limit (10,000 mg/kg). According to analytical results from MultiChem, diesel, oil, and gasoline were detected in this sample at concentrations of 140,000 mg/kg, 400,000 mg/kg, and 423,000 mg/kg. The concentration of TPH in the mineral spirits range was not provided by MultiChem.

According to analytical results from TEG, toluene, ethylbenzene, and total xylenes were detected in NAPL sample NT007B13 at concentrations of 266 mg/kg, 1,030 mg/kg, and 2,400 mg/kg, respectively. According to analytical results from MultiChem, three VOCs were detected in this NAPL sample, with a maximum estimated concentration of 350 mg/kg for n-butylbenzene. One SVOC was detected in NAPL sample NT007B13 at an estimated concentration of 23 mg/kg, bis(2-ethylhexyl)phthalate. No other analytes were detected above the analytical detection limits.

Physical parameters of NAPL sample NT007C13 were measured. The density of this sample ranged from 0.8464 gm/cc at 100ºF to 0.8579 gm/cc at 60ºF. Interfacial tension at 74ºF in this sample was 11.21 dynes/cm. Specific gravity ranged from 0.8405 at 100ºF to 0.8586 at 60ºF. Finally, viscosity of this sample in centistokes ranged from 8.82 at 100ºF to 19.6 at 60ºF.

3.4.8 Trench T-8

The surface soil consisted of brown, silty, sandy gravel. Buried debris such as concrete, metal (pipes, crushed drums, wire, strapping), glass, and fireproof bricks were present. At 3 feet bgs, the metal was rusted and deteriorated, and material that appeared to be ash was present. The soil graded to black, silty, sandy gravel at 4 feet bgs. A strong unidentified odor and groundwater with NAPL were encountered at 10 feet bgs. The trench was abandoned due to the presence of mortar shells. The dye test result and visual observation indicated that the presence of LNAPL was suspected in the soil and apparent in the groundwater.

Diesel, oil, and mineral spirits were detected at concentrations of 2,200 mg/kg estimated, 13,000 mg/kg estimated, and 7,700 mg/kg, respectively, in soil sample ST008A09. Gasoline was not detected above the analytical detection limit in this soil sample.

TCE and cis-1,2-DCE were both detected in this soil sample at the same estimated concentrations of 5.4 mg/kg. Toluene, ethylbenzene, and total xylenes were detected in this sample at estimated concentrations of 10.8 mg/kg, 19.6 mg/kg, and 98.8 mg/kg, respectively. None of the remaining analytes were detected above the analytical detection limits.

3.5 DRIVEPOINT SAMPLING

Drivepoint field screen results, groundwater quality parameter measurements, and test kit results are presented in Table 3-18. Drivepoint groundwater results are presented in Table 3-19 and Figures 3-5 and 3-6.

The drivepoint drilling and sampling technique was a successful guide in locating the potentially continuous aquitard and other zones of decreased permeability. Good evidence for the presence of the aquitard was discovered in 34, of the drivepoint locations (Tables 3-20 and 3-21). At the remaining drivepoint locations, the aquitard may have been present below the total depth of the drivepoint borehole, may not have been apparent during field activities, or may have been absent. For the purpose of contouring the surface topography of the aquitard, it was assumed that the layer is laterally extensive. The elevation of this aquitard layer encountered at drivepoint locations and existing monitoring wells is presented in Table 3-20 and discussed in Section 4. Shallower zones of decreased permeability were observed in 17 of the drivepoint locations (Table 3-21). The other zones of decreased permeability are discussed in Section 4.

Every analyte was detected at a minimum of three drivepoint locations. TCE and cis-DCE were detected at every drivepoint sampling location at a minimum of one depth per location. Very high concentrations (exceeding 10,000 µg/L) of TCE were detected in samples collected from the following nine drivepoint locations:

DP-5 at 24 and 33 feet bgs
DP-6 at 10 feet bgs
DP-9 at 11, 20, 25, and 36 feet bgs
DP-14 at 32 feet bgs
DP-18 at 20 feet bgs
DP-23 at 16, 24, and 39 feet bgs
DP-33 at 24 feet bgs
DP-47 at 32 feet bgs
DP-49 at 32 feet bgs

Additional elevated concentrations (exceeding 1,000 µg/L) of TCE were detected in samples collected from the following locations:

DP-1 at 25 and 30 feet bgs
DP-3 at 33 feet bgs
DP-6 at 20 and 24 feet bgs
DP-18 at 11 and 25 feet bgs
DP-21 at 10 and 12 feet bgs
DP-22 at 24 feet bgs

DP-29 at 24 feet bgs
DP-32 at 24 feet bgs
DP-33 at 29 and 35 feet bgs
DP-41 at 19, 30, and 33 feet bgs
DP-46 at 7, 18, and 24 feet bgs

Some of these elevated concentrations are located immediately above the aquitard or a zone of decreased permeability (Table 3-21). The 12 drivepoint locations and depths that correlate are the following:

DP-1 at 30 feet bgs
DP-3 at 33 feet bgs
DP-5 at 24 feet bgs
DP-6 at 24 feet bgs
DP-14 at 32 feet bgs
DP-18 at 20 feet bgs
DP-21 at 10 and 12 feet bgs
DP-23 at 39 feet bgs
DP-33 at 35 feet bgs
DP-41 at 19 and 30 feet bgs
DP-47 at 32 feet bgs
DP-49 at 32 feet bgs

Vinyl chloride was detected at concentrations ranging from 7.6µg/L to 1,000 µg/L at various depths at 29 drivepoint locations. 1,1,1-TCA was detected at four drivepoint locations at various depths at concentrations ranging from 4µg/L to 1,800 µg/L. Trans-1,2-DCE was detected at concentrations from 2.6µg/L to 270 µg/L at 11 drivepoint locations at various depths. Benzene was detected at three drivepoint locations at concentrations ranging from 4.9 µg/L to 2,200 µg/L. Toluene was detected at five drivepoint locations at various depths at concentrations ranging from 7.2 µg/L to 4,200 µg/L. Ethylbenzene was detected at five drivepoint locations at various depths at concentrations ranging from 2.2 µg/L to 1,100 µg/L. Total xylenes were detected at concentrations ranging from 7.7 µg/L to 4,700 µg/L at various depths at six drivepoint locations. Dissolved manganese was detected at every drivepoint location, and dissolved iron was detected at 42 of the locations. The maximum concentrations of dissolved iron and manganese were 2.4 mg/L and 1.2 mg/L, respectively.

3.6 QUALITY ASSURANCE SUMMARY

After review of information contained in the field notes, laboratory deliverables, and the daily chemical quality control report (DCQCR), an evaluation of how well the analytical portion of the

project was executed and to what extent the chemical data achieved the project-specific data quality objectives was performed. Overall project precision, accuracy, representativeness, comparability, and completeness were evaluated and are summarized in this section.

3.6.1 Data Quality Review Methods

Data were reviewed using criteria established in the quality assurance project plan (QAPP) (USACE 1998) for precision, accuracy, representativeness, comparability, and completeness. Results for the following field and laboratory control samples were reviewed:

Rinsate, field, and laboratory blanks
Field and laboratory duplicates
Laboratory control samples (LCS)
PE samples
Matrix spike/matrix spike duplicate (MS/MSD) samples
Surrogates
Initial and continuing calibration standards

Additionally, chain of custody forms and cooler receipt forms were reviewed for evaluation of sample handling methods and holding times. Laboratory reporting limits were reviewed to determine if project sensitivity requirements were met. Frequency of collection and analysis of field QC samples was reviewed to evaluate completeness and adherence to the management plan (USACE 1998).

Table 3-22 summarizes analytical data sets that were reviewed. Data quality summary reports for each of these data sets are included in Appendix B.

The NAPL sample (DT001E) collected by Ft. Lewis personnel from a drum uncovered in trench T-1, segment E, was analyzed for waste characterization purposes for VOCs, SVOCs, and PCBs by Anatek Labs, Inc. of Moscow, Idaho. Quality assurance/quality control (QA/QC) data were not available for review; therefore, data quality could not be evaluated. Results for this sample are included in this report for additional information on NAPL characteristics but are considered estimated with limited use.

3.6.2 Summary of Precision, Accuracy, Representativeness, Comparability, and Completeness Review Results for Chemical Analyses

Data quality summary reports for each of the above data sets are included in Appendix B. These summary reports were reviewed to identify trends in quality control parameters that may impact overall data usability. Infrequent and random exceedances of control limits are expected and do not necessarily limit data usability. These exceedances and resulting data qualification are

discussed in this section. Overall data quality was high and data are acceptable for all project uses.

Precision

Precision is evaluated by comparison of results for primary and sample duplicate analyses. Field and laboratory duplicate results were reviewed. The required frequencies of laboratory (5 percent) and field duplicate (10 percent) collection and analysis were met with the exception of soil-gas field duplicate samples (8.9 percent).

Relative percent differences (RPDs) were generally within control limits. Exceptions were due to high levels of target analytes in samples, which required several dilutions to bring concentrations within the calibration range of the instrument (e.g., high VOC concentrations in drivepoint groundwater analyzed by TEG); exceptions were also random and may have been caused by sample heterogeneity. Additionally, RPDs for duplicate sample results near the limit of detection tended to have higher RPDs. For example, all citrate-bicarbonate-dithionite (CBD)-extractable iron and manganese results were qualified as estimated due to poor field duplicate precision. The RPDs for CBD-extractable iron and manganese were 83 and 98 percent, respectively.

Accuracy

Accuracy is evaluated using the analytical results for blanks, surrogates, matrix spikes, blank spikes, performance evaluation samples, and initial and continuing calibration standards. The required frequency of these quality control samples for collection and analysis were met with exception of field blanks collected during the March and April 1999 drivepoint groundwater sampling.

Method, rinsate, and field blanks were generally free of target analytes. Only di-n-butylphthalate and bis(2-ethylhexyl)phthalate were detected in the method blank associated with the barren area soil samples. These are common laboratory contaminants and are not considered representative of site conditions. Barren area soil results for these compounds were qualified as not detected.

Surrogates were diluted out or showed poor recovery due to high VOC target analyte concentrations in numerous drivepoint groundwater and trench soil samples analyzed by TEG, and in NAPL and soil samples submitted to MultiChem for SVOC analyses. Results were qualified as estimated when both surrogates were affected. Barren area soil chlorinated herbicide results were qualified as estimated due to poor surrogate recovery.

All total organic carbon (TOC) and total inorganic carbon (TIC) results were qualified as estimated because the matrix spike percent recovery (131 percent) was outside the control limits (75 to 125 percent). All other quality control results for these analytes were acceptable.

Barren area soil chlorinated herbicide results were qualified as estimated due to poor LCS spike recovery.

Performance evaluation samples were submitted to TEG for VOC analysis with samples of soil-gas (SG90105), soil (ST901A05), and groundwater (GD90100, GD90301, GD90713, GT901A, GT904A). Results were acceptable with two exceptions (1,1,1-TCA in GD90100 and ethylbenzene and total xylenes in GT901A). Results for all other compounds in all other PE samples were acceptable. PE sample results are presented in Tables 3-23, 3-24, and 3-25.

Recoveries of continuing calibration standards for chlorinated herbicide analyses of barren area soil samples were greater than control limits. Chlorinated herbicide results were considered estimated.

Representativeness

Representativeness is evaluated by examining chain of custody paperwork, field notes, and sample labels to verify that analysis was performed within allowable holding times and that proper documentation was maintained to allow traceability of analytical results to specific field sampling locations.

Samples were generally handled according to the management plan with a few exceptions. Laboratory results for the sample identified as field blank sample GD72224 had detections of iron and manganese. Review of the metals data package showed that this sample also contained concentrations of major ions (calcium, magnesium, and sodium) that are indicators of a natural water and not of the distilled water used for the field blanks. Additionally, the sample identified as GD02224 did not contain these major ions. The data reviewer concluded that these two samples were mislabeled in the field and results for both samples were rejected and qualified with “R”.

Three NAPL samples (DT005B03, NT007B13 and DT005C03) were collected in the field and submitted to MultiChem without being included on a chain of custody form. Analytical results from these samples were considered estimated with limited use due to lack of documentation and proper labeling. Lack of documentation limits use for legally defensible purposes only and does not impact the reported analytical results.

Several NAPL samples submitted for VOC, SVOC, PCB, and fuels analyses, and soils samples submitted for SVOC and PCB analyses were analyzed past the recommended holding times by MultiChem. Results for these samples were considered estimated.

Barren area soil samples submitted to MultiChem for chlorinated herbicides were analyzed past the recommended holding time.

Comparability

Comparability is evaluated by examining laboratory reporting limits and analysis methods. Actual reporting limits were compared with required reporting limits and were determined to be acceptable for this project. The laboratories performed all analyses according to standard operating procedures approved for this project.

Field notes and laboratory results for all three NAPL samples (NT001A09, NT006B15, and NT007C13) were reviewed to evaluate precision and comparability of results. The three samples were analyzed for VOCs and TPH by TEG and MultiChem. A comparison of results is presented in Table 3-26. The following issues were identified:

Issue	Laboratory		Interpretation
	TEG	**MultiChem**	
Sample Collection	1. 40-ml VOA vial with thin layer of product on water	1. 40-ml VOA vial with thin layer of product on water	1. Samples were not homogenized so are likely to be inherently different
	2. Samples analyzed within 24 hrs of collection	2. Samples analyzed up to 32 days after sample collection (results qualified as J)	2. Volatiles may have been released during MultiChem's long holding time
Analysis Method	Gas chromatograph-flame ionization detector-electron capture detector in series	Gas chromatograph/mass spectrometer	Methods are inherently different and can have high RPDs under the best circumstances
Quality Assurance	1. VOC PE samples (soil matrix) acceptable	1. No PE samples analyzed	Accuracy of TEG results appears to be more reliable than accuracy of MultiChem results
	2. Surrogate results acceptable	2. Surrogate recoveries outside acceptance criteria (results qualified as J)	
Results	1. Positive low-level VOC results	1. Low-level VOC results inconsistent with TEG results	Data sets are inconsistent; however, PE samples and surrogate results suggest a higher confidence in TEG results
	2. TPH results lower than MultiChem results	2. TPH results higher than TEG results	

Based on the above observations, it is most likely that the difference in results reported by the two laboratories is attributable to (1) the difference in the length of time between sample analyses by the two laboratories, (2) differences in analysis methods, and (3) sample collection methods.

TEG analyzed samples within 24 hours of collection while MultiChem analyzed the samples approximately 30 days after sample collection. This may have resulted in low concentrations of highly volatile compounds being lost from samples. Additionally, inherent differences in laboratory and analysis methods (VOCs and TPH) will result in different results being reported

for identical samples. Product samples are also a difficult matrix to analyze. MultiChem's report narratives pointed out that matrix interference was causing poor VOC surrogate recovery. Because matrix spikes were not analyzed for these samples due to the complex matrix, surrogate recoveries are the only measure of potential matrix interferences affecting the analysis. TEG's VOC surrogate recoveries were acceptable. There is also inherent uncertainty associated with identifying and quantifying low levels of VOCs near the reporting limit in a petroleum hydrocarbon matrix. We are having MultiChem review these results and provide additional information on handling and analysis of these samples.

Additionally, these NAPL samples were collected from open trenches, allowing for aeration and volatilization before samples were even collected. This may also have strongly impacted the accuracy of VOC results and the ability to conclude that TCE and other volatiles are present in the LNAPL. Based on the above, it is suggested that the VOC data sets be used together to qualitatively evaluate the presence of VOCs in LNAPL. Due to the uncertainty associated with this data set, during Phase II of this investigation it may be necessary to collect NAPL samples from monitoring wells under controlled circumstances.

TPH results reported by TEG were generally lower than TPH results reported by MultiChem. For product samples, it is expected that results will be around 100 percent (1,000,000 mg/kg or a million parts per million). MultiChem's results ranged from 600,000 to 1,010,000 mg/kg while TEG results ranged from 340,000 to 880,000 mg/kg. This may indicate that MultiChem's extraction was more efficient and/or reflect the inherent difficulties with accurately quantifying results from highly diluted samples. TPH results from both laboratories should be used only qualitatively to identify product types based on chromatogram profiles.

Completeness

Completeness is evaluated by calculating the amount of data acceptable for project uses. It is the ratio of the number of acceptable results divided by the planned number of samples. Results for two groundwater samples analyzed for dissolved iron and manganese were rejected because samples appeared to have been mislabeled in the field. Additionally, chlorinated herbicide results for barren area soil samples were qualified due to numerous out of control quality control parameters. These data should be used with caution. Overall completeness for this project is above 99 percent.

Field analysis data quality was evaluated for accuracy and precision. Accuracy was evaluated by reviewing field notes for instrument calibration records. Field test kit precision was evaluated by calculating the RPD between the dissolved oxygen results from the field test kit and the YSI meter, and from field duplicate results for dissolved oxygen, alkalinity, and ferrous iron test kits. Control limits were not established for field measurement data; however, an RPD limit of 50 was used in this evaluation.

Dissolved oxygen results measured using the YSI between October 29, 1998, and the first measurement collected on November 9, 1998, are inaccurate due to incorrect barometric pressure settings on the YSI. These data should not be used. On November 9, 1998, the correct settings were used and continued to be used for the rest of the drivepoint groundwater sampling effort. The calibration of the YSI and the PID were checked on a daily basis against commercially supplied calibration standards. The instruments were recalibrated if initial readings were unacceptable.

RPDs for dissolved oxygen measurements from the YSI and the field test kit collected after 10 a.m. on November 9, 1998, were acceptable; few RPD values were greater than 50, indicating good precision between results.

Field duplicates were analyzed after every 10 samples tested for dissolved oxygen, alkalinity, and ferrous iron. RPDs were all less than 50, indicating good precision between results.

Turbidity interfered with the dissolved oxygen, ferrous iron, and alkalinity test kit readings in some of the samples, as recorded in the field notes. However, the high turbidity was not known to not have interfered with dissolved metals or other analytical results. Samples of inadequate volume were not submitted to the laboratories. LNAPL in one of the trenches and LNAPL/DNAPL observed in the drivepoints were not able to be sampled due to limited volume.

Results from field instruments and test kits are acceptable for project uses with the exception of the dissolved oxygen measurements collected from the YSI between October 29, 1998, and 10 a.m., November 9, 1998.

3.7 OVERALL DATA USABILITY

After review of information contained in the field notes, laboratory deliverables, and the DCQCRs, an evaluation of how well the analytical portion of the project was executed and to what extent the chemical data achieved the project specific data quality objectives was performed.

The overall data quality objective for this project was to generate data to support the following uses:

Identifying TCE/DCE-containing LNAPL or DNAPL present in the unsaturated zone

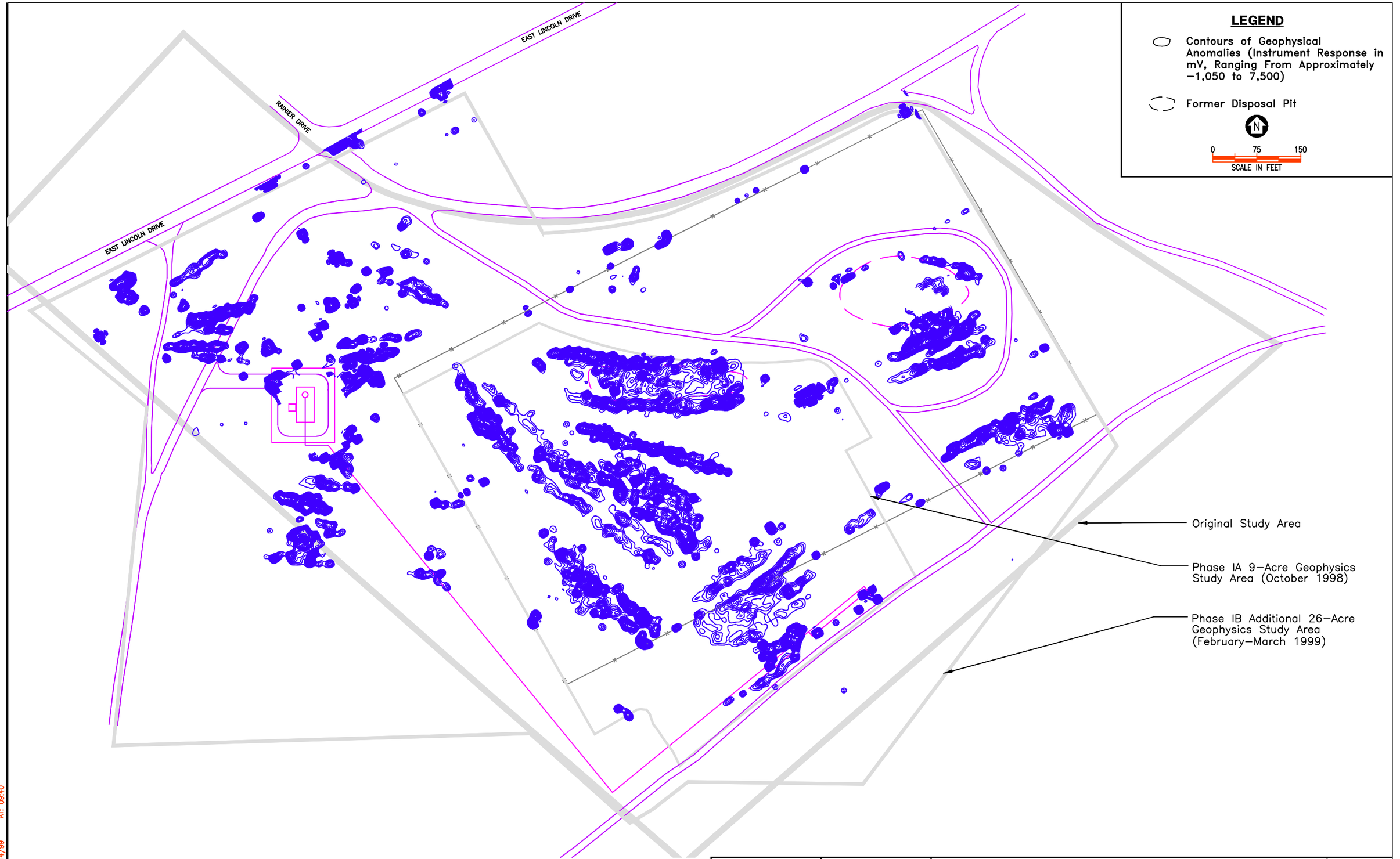
Identifying TCE/DCE-containing DNAPL present in the saturated zone

Identifying physical characteristics of the NAPL and the site

Identifying geochemical/biochemical site characteristics

Data are not intended to be legally defensible, used to prepare a risk assessment, or for evaluating compliance with regulatory screening levels; therefore, less rigorous documentation and a higher level of uncertainty in quantitation is acceptable. The data quality issues identified above primarily impact the documentation of sample handling during transport to the project laboratory and the quantitation of analytes in highly contaminated samples; therefore, overall data usability is not seriously affected. However, the achievement of the first data use—identifying the presence of TCE and DCE in LNAPL (no DNAPL samples were collected)—is still uncertain due to sample collection methods (samples collected from open trenches) and a complex sample matrix, which resulted in poor duplicate precision of NAPL sample results. Additionally, only three NAPL samples were analyzed for VOCs, which may not be an adequate data set from which to draw conclusions.

The data are acceptable for use on this project with the exceptions discussed above. NAPL samples were analyzed by MultiChem for VOCs after the 14-day holding time established in the QAPP. No explanation was given in the case narrative. NAPL and trench soil samples were also analyzed several months past the holding time for SVOCs and PCBs because archived samples were reaccessioned for analysis based on review by the project team of VOC and TPH results. Uncertainty in data quality was primarily the result of high concentrations of target analytes in project samples, which resulted in poor quality control sample results, sample heterogeneity, and limited errors in field documentation.



East Gate Disposal Yard Fort Lewis, Washington	Project No. E9518Q	Expanded Site Investigation Geophysics Results (EM−61, Channel 2)	3−1
URS Greiner Woodward Clyde			

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EAST LINCOLN DRIVE

RAINIER DRIVE

EAST LINCOLN DRIVE

LEGEND

Contours of Geophysical Anomalies (Instrument Response in mV, Ranging From Approximately −1,050 to 10,000)

Former Disposal Pit

N

0 75 150

SCALE IN FEET

Original Study Area

Phase IA 9−Acre Geophysics Study Area (October 1998)

Phase IB Additional 26−Acre Geophysics Study Area (February−March 1999)

East Gate Disposal Yard Fort Lewis, Washington	Project No. E9518Q	Expanded Site Investigation Geophysics Results (EM−61, Channel 4)	3−2
URS Greiner Woodward Clyde			

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LEGEND

SG-18⊕ Soil-Gas Sampling Location Results in ppmV; Bold Indicates Analyte Detected

U Not Detected Above Analytical Detection Limit

J Estimated

TCE Trichloroethene

C-DCE Cis-1,2-Dichloroethene

VC Vinyl Chloride

Note: All soil-gas samples collected from depth of 5 feet below ground surface and analyzed by Transglobal Environmental Geosciences.

N

0 75 150

SCALE IN FEET

EAST LINCOLN DRIVE

RAINIER DRIVE

EAST LINCOLN DRIVE

SG-39	TCE	C-DCE	VC
	2.57	1.66	0.86 U

SG-7	TCE	C-DCE	VC
	8.83	1.95	0.86 U

SG-38	TCE	C-DCE	VC
	51.9	10.4 J	0.86 U

SG-9	TCE	C-DCE	VC
	1.46	0.81	0.86 U

SG-10	TCE	C-DCE	VC
	2.93	0.33 U	0.86 U

SG-23	TCE	C-DCE	VC
	0.5	0.33 U	0.86 U

SG-8	TCE	C-DCE	VC
	0.28	0.33 U	0.86 U

SG-21	TCE	C-DCE	VC
	0.56	0.33 U	0.86 U

SG-22	TCE	C-DCE	VC
	0.25 U	0.33 U	0.86 U

SG-35	TCE	C-DCE	VC
	0.25 U	0.33 U	0.86 U

SG-14	TCE	C-DCE	VC
	0.25 U	0.33 U	0.86 U

SG-13	TCE	C-DCE	VC
	0.37	0.33 U	0.86 U

SG-12	TCE	C-DCE	VC
	0.36	0.33 U	0.86 U

SG-20	TCE	C-DCE	VC
	0.29	0.33 U	0.86 U

SG-19	TCE	C-DCE	VC
	150	19 J	0.86 U

SG-11	TCE	C-DCE	VC
	2.75	12.8	5.81

SG-34	TCE	C-DCE	VC
	0.75	0.34	0.86 U

SG-33	TCE	C-DCE	VC
	3.15 J	1.9	0.86 U

SG-41	TCE	C-DCE	VC
	1.16	1.63	0.86 U

SG-30	TCE	C-DCE	VC
	0.25 U	0.33 U	0.86 U

SG-29	TCE	C-DCE	VC
	2.12	1.16	0.86 U

SG-27	TCE	C-DCE	VC
	2.16	9.47	0.86 U

SG-28	TCE	C-DCE	VC
	0.42	0.91	0.86 U

SG-40	TCE	C-DCE	VC
	1.91	0.64	0.86 U

SG-26	TCE	C-DCE	VC
	0.25 U	0.33 U	0.86 U

SG-42	TCE	C-DCE	VC
	5.8	1.85	0.86 U

SG-43	TCE	C-DCE	VC
	2.77	3.41	0.86 U

SG-32	TCE	C-DCE	VC
	1.66	81.7	490 J

SG-31	TCE	C-DCE	VC
	0.25 U	0.33 U	0.86 U

SG-45	TCE	C-DCE	VC
	16.1	14.8	0.86 U

SG-25	TCE	C-DCE	VC
	0.25 U	0.33 U	0.86 U

SG-24	TCE	C-DCE	VC
	0.25 U	0.33 U	0.86 U

SG-44	TCE	C-DCE	VC
	1.98	0.64	0.86 U

SG-4	TCE	C-DCE	VC
	0.25 U	0.33 U	0.86 U

SG-5	TCE	C-DCE	VC
	0.98	1.59	0.86 U

SG-3	TCE	C-DCE	VC
	0.59	0.33 U	0.86 U

SG-2	TCE	C-DCE	VC
	0.79	0.33 U	0.86 U

SG-6	TCE	C-DCE	VC
	2.15	0.72	0.86 U

SG-15	TCE	C-DCE	VC
	0.25 U	0.33 U	0.86 U

SG-16	TCE	C-DCE	VC
	1	1.66	0.86 U

SG-1	TCE	C-DCE	VC
	50.4	29.9	0.86 U

SG-18	TCE	C-DCE	VC
	23.8	7.1	17.2 U

SG-36	TCE	C-DCE	VC
	32.9	21.5	0.86 U

SG-17	TCE	C-DCE	VC
	0.25 U	0.33 U	0.86 U

SG-37	TCE	C-DCE	VC
	0.25 U	0.33 U	0.86 U

Original Study Area

Phase IA 9-Acre Geophysics Study Area (October 1998)

Phase IB Additional 26-Acre Geophysics Study Area (February-March 1999)

East Gate Disposal Yard Fort Lewis, Washington	Project No. E9518Q	Expanded Site Investigation Soil-Gas Analytical Results	3-3
URS Greiner Woodward Clyde			

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EAST LINCOLN DRIVE

RAINIER DRIVE

EAST LINCOLN DRIVE

SAMPLE ID	DEPTH	TOTAL TPH	TCE	C–DCE	VC
ST004A14	14	1,620	672 J	60 UJ	300 UJ
ST004B15	15	380	122 J	6 UJ	30 UJ
ST00AD14	14	1,120	0.42	0.3 U	1.5 U
Groundwater not encountered; Small amount of NAPL visible on cobble.					

SAMPLE ID	DEPTH	TOTAL TPH	TCE	C–DCE	VC
ST007B12	12	6,000	1.5 UJ	1.5 UJ	7.5 UJ
ST007C12	12	10,300	3 UJ	3 UJ	15 UJ
ST007E12	12	5,500	1.5 UJ	1.5 UJ	7.5 UJ

NT006B15							
TOTAL TPH		TCE		C–DCE		VC	
TEG	MC	TEG	MC	TEG	MC	TEG	MC
600,000	1,010,000	100 U	12 UJ	100 U	12 UJ	500 U	12 UJ

SAMPLE ID	DEPTH	TOTAL TPH	TCE	C–DCE	VC
ST005A07	07	100 U	1.1	0.3 U	1.5 U
GT005A12	12	NA	109	18.2	19.1
Multiple drums containing NAPL uncovered.					

SAMPLE ID	DEPTH	TOTAL TPH	TCE	C–DCE	VC
ST006A05	05	490	0.75	0.15 U	0.75 U
ST006B14	14	2,200	1.5 U	1.5 U	7.5 U
ST006E14	14	4,300	1.2 UJ	1.2 UJ	6 UJ

NT007C13							
TOTAL TPH		TCE		C–DCE		VC	
TEG	MC	TEG	MC	TEG	MC	TEG	MC
880,000	963,000	30U	50 J	30U	36 J	150 U	12 UJ

SAMPLE ID	DEPTH	TOTAL TPH	TCE	C–DCE	VC
ST008A09	09	22,900	5.4 J	5.4 J	15 UJ
LNAPL encountered, not sampled.					

SAMPLE ID	DEPTH	TOTAL TPH	TCE	C–DCE	VC
ST002A02	02	600	0.52	0.55	0.75 U
ST002B02	02	320	0.78	0.77	0.75 U
ST002C04	04	550	0.56	0.6	0.75 U
ST002D06	06	890	26.3 J	16.1 J	0.75 U
ST002E05	05	160	11.4	6.8	0.75 U
GT002D10	10	NA	38.5	80	7.5 U
LNAPL not encountered.					

SAMPLE ID	DEPTH	TOTAL TPH	TCE	C–DCE	VC
ST001A08	08	42,240	3,400 J	370 J	15 UJ

SAMPLE ID	TOTAL TPH	TCE	C–DCE	VC
DT001E	NA	832,000	250 U	NA

NT001A09							
TOTAL TPH		TCE		C–DCE		VC	
TEG	MC	TEG	MC	TEG	MC	TEG	MC
340,000	603,000	180	12 UJ	44	440 J	150 U	12 UJ

SAMPLE ID	DEPTH	TOTAL TPH	TCE	C–DCE	VC
ST003C06	06	3,855	590	20.5 J	7.5 UJ
ST003D07	07	8,060	2,400 J	40.8 J	45 UJ
ST003E07	07	19,920	2,000 J	180 UJ	900 UJ
GT003D6.5	6.5	NA	180,000 J	5,700 J	17.4
LNAPL encountered, not sampled.					

LEGEND

A●——●E	Exploratory Trench Location
ST005A07	Soil Sample (mg/kg)
GT005A12	Groundwater Sample (ug/L)
NT006B15	NAPL Sample (mg/kg)
DT001E	NAPL Sample from Drum (mg/kg)
NA	Not Analyzed
U	Not Detected Above Analytical Detection Limit
J	Estimated
TPH	Total Petroleum Hydrocarbons
TCE	Trichloroethene
C–DCE	Cis–1,2–Dichloroethene
VC	Vinyl Chloride
TEG	Sample Analyzed by Transglobal Environmental Geosciences (TEG)
MC	Sample Analyzed by Multichem Analytical Services (MC)

Note: Bold indicates analyte detected. Depth in feet.

N

0 75 150

SCALE IN FEET

Original Study Area

Phase IA 9–Acre Geophysics Study Area (October 1998)

Phase IB Additional 26–Acre Geophysics Study Area (February–March 1999)

East Gate Disposal Yard Fort Lewis, Washington	Project No. E9518Q	Expanded Site Investigation–Exploratory Trench Selected Soil, Groundwater, and NAPL Analytical Results	3–4
URS Greiner Woodward Clyde			

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LEGEND

- DP-26 Drivepoint Sampling Location Results in ug/L; Bold Indicates Analyte Detected; Depth in feet
- U Not Detected Above Analytical Detection Limit
- J Estimated
- TCE Trichloroethene
- C-DCE Cis-1,2-Dichloroethene
- VC Vinyl Chloride
- Note: Analyzed by Transglobal Environmental Geosciences

0 65 130
SCALE IN FEET

RAINIER DRIVE

EAST LINCOLN

DP-34

Depth	C-DCE	TCE	VC
9	2.5 U	4.2	12
19	2.5 U	41	7.5 U
24	2.5 U	6	13
37	2.5 U	23	7.7

DP-31

Depth	C-DCE	TCE	VC
9	5	50	18
12	4.3	32	17
27	22	440	22
35	200	930	12

DP-42

Depth	C-DCE	TCE	VC
8	7.7	63	7.5 U
16	96	390	15 U
23	50 U	270	150 U
39	12.5 U	96	37.5 U

DP-22

Depth	C-DCE	TCE	VC
8	2.5 U	42	11
16	3.6	51	27
24	57	1,800	15
32	5.3	61	22

DP-40

Depth	C-DCE	TCE	VC
15	2.5 U	19	8
19	2.5 U	16	7.5 U
23	2.5 U	16	7.5 U
37	8.8	88	7.5 U

DP-39

Depth	C-DCE	TCE	VC
13	2.5 U	7.1	7.5 U
19	2.5 U	2.5 U	7.5 U
24	2.5 U	2.5 U	7.5 U
35	2.5 U	4.7	7.5 U

DP-47

Depth	C-DCE	TCE	VC
8	180	740	300 U
16	6,000	500,000	3,000 U
24	2,300	970,000	3,000 U
39	1,000 U	48,000	3,000 U

DP-23

Depth	C-DCE	TCE	VC
9	260	770	7.5 U
17	170	550	150 U
21	77	610	150 U
32	330	21,000	170

DP-33

Depth	C-DCE	TCE	VC
9	37	900	13
24	1,300	75,000	187.5 U
29	125 U	7,100	375 U
35	500 U	9,900	1,500 U

DP-41

Depth	C-DCE	TCE	VC
8	230	610	7.5 U
19	120	1,000	150 U
30	140	1,100	300 U
33	120	1,200	300 U

DP-46

Depth	C-DCE	TCE	VC
7	150	2,000	16
18	150	1,700	300 U
24	76 J	1,100	300 U
32	100 U	360	300 U

Depth	C-DCE	TCE	VC
7	37	310	7.5 U
19	54	120	75 U
24	39	120	30 U
30	110	530	30 U

DP-43

DP-21

Depth	C-DCE	TCE	VC
10	140	1,500	23
12	150	1,300	7.5 U
23	150	470	7.5 U
27	58	400	110

DP-32

Depth	C-DCE	TCE	VC
9	5.3	220	7.6
19	50 U	960	150 U
24	86	2,200	150 U
28	125 U	840	375 U

DP-37

Depth	C-DCE	TCE	VC
13	18	48	9.8
19	17	12	15 U
22	7.3	19	15 U
34	4.5	17	7.5 U

DP-4

Depth	C-DCE	TCE	VC
16	5 U	5 U	15 U
20	2.5 U	2.5 U	7.5 U
25	8.4	47.6	7.5 U
35	5 U	5 U	15 U

DP-26

Depth	C-DCE	TCE	VC
9	35	310	8.2
19	2.5 U	14	13
23	2.5 U	18	13
38	2.7	28	17

DP-2

Depth	C-DCE	TCE	VC
31.8	12.7	30 U	
20	73.2	34.7	21.6 J
23	197	269	20.8 J
36	10 U	18.6	30 U

DP-1

Depth	C-DCE	TCE	VC
11	53	10 U	46.1
20	63.9	112	38.8
25	2,100 J	3,400 J	291 J
30	2,600 J	5,600 J	33.6 J

DP-7

Depth	C-DCE	TCE	VC
13	2.5 U	8.4	7.5 U
20	11.8	59	15 U
25	19	109	15 U
35	5 U	21.3	15 U

DP-13

Depth	C-DCE	TCE	VC
14	2.5 U	6.2	7.5 U
20	2.5 U	3.3	7.5 U
25	2.5 U	2.5 U	7.5 U
39	2.5 U	30.7	7.5 U

DP-27

Depth	C-DCE	TCE	VC
9	2.5	37	18
19	2.5 U	2.5	7.5 U
23	2.7	4.8	7.5 U
38	2.5 U	2.5 U	13

DP-45

Depth	C-DCE	TCE	VC
6	4.9	11	7.5 U
17	110	260	19
22	210	490	75 U
28	180	440	75 U

DP-14

Depth	C-DCE	TCE	VC
11	2.5 U	3.5	7.5 U
20	2.5 U	17.5	7.5 U
25	2.8	26.6	7.5 U
32	58.5	39,000	7.5 U

DP-20

Depth	C-DCE	TCE	VC
13	5 U	5 U	15 U
20	2.5 U	2.5 U	7.5 U
24	2.5 U	2.5 U	7.5 U
36	2.5 U	2.5 U	7.5 U

DP-24

Depth	C-DCE	TCE	VC
9	200	89	12
19	150	68	12
24	200	78	14
35	33	29	7.5 U

DP-15

Depth	C-DCE	TCE	VC
11	5 U	119	15 U
20	5 U	71.6	15 U
25	27	426	15 U
30	25 U	398	75 U

DP-3

Depth	C-DCE	TCE	VC
12	5 U	4.3 J	15 U
20	2.8	13.3	7.5 U
25	5 U	18	15 U
33	12.3 J	2,500	37.5 U

DP-38

Depth	C-DCE	TCE	VC
7	2.5 U	4.8	7.5 U
19	4.3	6.9	7.5 U
24	2.5 U	4.5	7.5 U
31	29	450	7.5 U

DP-12

Depth	C-DCE	TCE	VC
12	2.5 U	10.4	7.5 U
20	4.8	7.9	7.5 U
25	3.4	43.6	7.5 U
36	12	800	7.5 U

DP-16

Depth	C-DCE	TCE	VC
13	15	36.6	7.5 U
20	6.4	70.1	15 U
25	17.8	132	15 U
35	5.4	115	15 U

DP-10

Depth	C-DCE	TCE	VC
13	3.9	40.1	7.5 U
20	3	32.6	7.5 U
25	2.5 U	16.3	7.5 U
37	2.5 U	2.5	7.5 U

DP-35

Depth	C-DCE	TCE	VC
9	2.9	9.2	9.2
19	13	13	14
24	20	21	15
34	5.5	19	7.5 U

DP-25

Depth	C-DCE	TCE	VC
7	2.6	13	21
19	3.6	18	24
24	3.7	23	10
30	10	83	18

DP-48

Depth	C-DCE	TCE	VC
6	120	35	8.4
19	10 U	46	30 U
24	31	350	30 U
33	41	870	75 U

DP-8

Depth	C-DCE	TCE	VC
13	8.1	13.1	15 U
20	2.5 U	4.6	7.5 U
25	2.5 U	21.6	7.5 U
36	2.5 U	2.7	7.5 U

DP-9

Depth	C-DCE	TCE	VC
11	72,000	120,000	390
20	6,600	35,000	300 U
25	3,100 J	700,000	600 U
36	4,400	55,000	600 U

DP-18

Depth	C-DCE	TCE	VC
11	2,670	9,020	7.5 U
20	5,890	12,000	60 U
25	3,650	8,770	150 U
37	98.2	233	150 U

DP-29

Depth	C-DCE	TCE	VC
8	2,400	48	700
19	99	180	75 U
24	150	1,200	7.5 U
28	100	520	187.5 U

DP-17

Depth	C-DCE	TCE	VC
7	41	43	7.5 U
19	17	91	18
22	10 U	27	30 U
32	59	11,000 J	7.5 U

DP-49

DP-5

DP-6

Depth	C-DCE	TCE	VC
10	12,000 J	77,000 J	300 U
20	240	2,700	300 U
24	200	3,500	150 U

DP-28

Depth	C-DCE	TCE	VC
10	19,000	87 J	1,000
20	630	156	5 U
24	3,400	1,000,000 J	600 U
33	200 U	52,000	600 U

DP-36

Depth	C-DCE	TCE	VC
12	8.7	14	7.5 U
19	14	21	7.5 U
24	27	350	12
36	75	460	140

DP-11

Depth	C-DCE	TCE	VC
15	3.1	17.4	7.5 U
20	23.8	400	7.5 U
25	25 U	89.5	75 U
36	6.9	93.7	15 U

DP-50

Depth	C-DCE	TCE	VC
9	12	23	7.5 U
19	7.1	7.6	7.5 U
24	2.5 U	8.6	7.5 U
31	2.5 U	6.3	7.5 U

DP-19

Depth	C-DCE	TCE	VC
16	7.6	91.6	7.5 U
22	15.4	218	15 U
27	27.9	363	30 U
37	38.2	595	60 U

DP-30

Depth	C-DCE	TCE	VC
13	170	400	26
19	42	87	14
24	380	780	21
35	110	990	21

DP-44

Depth	C-DCE	TCE	VC
12	7.5	8.3	7.5 U
19	79	200	8.1
24	50	160	37.5 U
33	12.5 U	130	37.5 U

Original Study Area

Phase IA 9-Acre Geophysics Study Area (October 1998)

Phase IB Additional 26-Acre Geophysics Study Area (February-March 1999)

East Gate Disposal Yard Fort Lewis, Washington	Project No. E9518Q	Expanded Site Investigation-Drivepoint Groundwater Analytical Results
URS Greiner Woodward Clyde		3-5

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RAINIER DRIVE

EAST LINCOLN DRIVE

DP-34

Depth	FE	MN
9	0.05 U	0.034
19	0.084	0.099
24	0.05 U	0.069
37	0.46	0.4

DP-31

Depth	FE	MN
9	0.05 U	0.01 U
12	0.15	0.024
27	0.05 U	0.098
35	1.8	0.8

DP-22

Depth	FE	MN
8	0.18	0.045
16	0.13	0.024
24	R	R
32	0.068	0.039

DP-47

Depth	FE	MN
9	0.05 U	0.01 U
17	0.061	0.01 U
21	0.33	0.17
32	0.05 U	0.12

DP-23

Depth	FE	MN
8	0.067	0.36
16	0.093	0.4
24	0.13	0.23
39	0.38	0.11

DP-42

Depth	FE	MN
8	0.05 U	0.012
16	0.12	0.25
23	0.068	0.1
39	0.19	0.39

DP-40

Depth	FE	MN
15	0.11	0.01 U
19	0.12	0.018
23	0.13	0.062
37	0.3	0.16

DP-39

Depth	FE	MN
13	0.05 U	0.039
19	0.17	0.036
24	0.15	0.064
35	0.05 U	0.45

DP-33

Depth	FE	MN
9	0.083	0.028
24	0.14	0.24
29	0.13	0.085
35	0.16	0.083

DP-32

Depth	FE	MN
9	0.05 U	0.087
19	0.14	0.12
24	0.66	0.49
28	0.31	0.56

DP-21

Depth	FE	MN
10	0.05 U	0.06
12	0.26	0.11
23	0.95	0.18
27	2.2	0.84

DP-37

Depth	FE	MN
13	0.1	0.01 U
19	0.11	0.018
22	0.42	0.52
34	0.05 U	0.26

DP-26

Depth	FE	MN
9	0.093	0.39
19	0.05 U	1.2
25	0.05 U	0.3
38	0.05 U	0.27

DP-41

Depth	FE	MN
8	0.05 U	0.12
19	0.17	0.4
30	1.2	0.56
33	0.66	0.21

DP-2

Depth	FE	MN
13	1.7	0.15
20	1.1	0.64
23	0.05 U	0.14
36	0.05 U	0.074

DP-4

Depth	FE	MN
16	0.074	0.02
20	0.05 U	0.12
25	0.05 U	0.056
35	0.05 U	0.12

DP-13

Depth	FE	MN
14	0.05 U	0.01 U
20	0.05 U	0.05
25	0.065	0.079
39	0.093	0.4

DP-46

Depth	FE	MN
7	0.05 U	0.011
18	0.24	0.36
24	0.28	0.066
32	0.91	0.7

DP-43

Depth	FE	MN
7	0.05 U	0.01 U
19	0.63	0.56
24	0.65	0.4
30	0.83	0.2

DP-1

Depth	FE	MN
11	1.8	0.45
20	0.05 U	0.96
25	0.27	0.82
30	0.05 U	0.42

DP-45

Depth	FE	MN
6	0.073	0.028
17	0.05 U	0.5
22	0.05 U	0.24
28	0.074	0.23

DP-7

Depth	FE	MN
13	0.05 U	0.01 U
20	0.05 U	0.093
25	0.43	0.33
35	0.05 U	0.3

DP-27

Depth	FE	MN
9	0.05 U	0.016
19	0.05 U	0.24
23	0.083	0.19
38	0.061	0.37

DP-14

Depth	FE	MN
11	0.05 U	0.01 U
20	0.05 U	0.054
25	0.11	0.13
32	0.05 U	0.098

DP-20

Depth	FE	MN
13	0.05 U	0.01 U
20	0.05 U	0.037
24	0.05 U	0.092
36	0.11	0.38

DP-24

Depth	FE	MN
9	0.057	0.017
19	0.77	0.57
24	0.4	0.21
35	0.13	0.023

DP-38

Depth	FE	MN
7	0.05 U	0.036
19	0.32	0.23
24	0.41	0.22
31	0.067	0.37

DP-15

Depth	FE	MN
11	0.15	0.12
20	0.12	0.18
25	0.05 U	0.46
30	0.05 U	0.48

DP-3

Depth	FE	MN
12	0.05 U	0.01 U
20	0.05 U	0.16
25	0.16	0.57
33	0.22	0.087

DP-35

Depth	FE	MN
9	0.06	0.01 U
19	0.07	0.019
24	0.28	0.097
34	0.76	0.51

DP-12

Depth	FE	MN
12	0.05	0.011
20	0.05 U	0.022
25	0.08	0.058
36	0.053	0.12

DP-16

Depth	FE	MN
13	0.05 U	0.025
20	0.05 U	0.039
25	0.05 U	0.47
35	0.05 U	0.66

DP-8

Depth	FE	MN
13	0.05 U	0.013
20	0.05 U	0.024
25	0.05 U	0.13
36	0.05 U	0.1

DP-10

Depth	FE	MN
13	0.05 U	0.01 U
20	0.05 U	0.01 U
25	0.69	0.051
37	0.077	0.23

DP-25

Depth	FE	MN
7	0.05 U	0.014
19	0.19	0.39
24	0.27	0.45
30	0.072	0.35

DP-48

Depth	FE	MN
6	0.05 U	0.12
19	0.13	0.038
24	0.05 U	0.022
33	0.05 U	0.12

DP-29

Depth	FE	MN
8	0.05 U	0.095
19	0.05 U	0.51
24	0.05 U	0.26
28	0.05 U	0.48

DP-9

Depth	FE	MN
11	0.05 U	0.17
20	1.3	0.16
25	0.05 U	0.27
36	2.4	0.052

DP-18

Depth	FE	MN
11	0.43	0.096
20	0.2	0.031
25	0.21	0.2
37	0.05 U	0.31

DP-49

Depth	FE	MN
7	0.05 U	0.01 U
19	0.05 U	0.18
22	0.05 U	0.16
32	0.05 U	0.26

DP-5

Depth	FE	MN
10	0.051	0.11
20	0.47	0.2
24	0.05 U	0.29 J
33	0.062	0.065

DP-6

Depth	FE	MN
10	0.05 U	0.069
20	0.05 U	0.31
24	0.05 U	0.055

DP-36

Depth	FE	MN
12	0.096	0.01 U
19	0.086	0.012
24	0.11	0.23
36	0.17	0.46

DP-17

Depth	FE	MN
17	0.68 J	0.052
22	0.05 U	0.17
31	0.05 U	0.25
38	0.05 U	0.12

DP-11

Depth	FE	MN
15	0.062	0.017
20	0.05 U	0.031
25	0.05 U	0.095
36	0.05 U	0.22

DP-28

Depth	FE	MN
10	0.05 U	0.037
19	0.058	0.33
24	0.05 U	0.26
31	0.05 U	0.23

DP-19

Depth	FE	MN
16	0.05 U	0.041
22	0.05 U	0.044
27	0.05 U	0.25
37	0.05 U	0.46

DP-50

Depth	FE	MN
9	0.051	0.024
19	0.05 U	0.039
24	0.05 U	0.15
31	0.05 U	0.14

DP-30

Depth	FE	MN
13	0.05 U	0.036
19	0.05 U	0.038
24	0.05 U	0.13
35	0.05 U	0.38

DP-44

Depth	FE	MN
12	0.05 U	0.01 U
19	0.05 U	0.087
24	0.05 U	0.089
33	0.05 U	0.22

LEGEND

DP-26 Drivepoint Groundwater Sampling Location Results in mg/L; Bold Indicates Analyte Detected; Depth in feet.

U Not Detected Above Analytical Detection Limit

J Estimated

FE Iron

MN Manganese

R Result Rejected

Note: Samples analyzed by Multichem Analytical Services.

N

0 65 130

SCALE IN FEET

Original Study Area

Phase IA 9-Acre Geophysics Study Area (October 1998)

Phase IB Additional 26-Acre Geophysics Study Area (February-March 1999)

FILENAME: T:\COE\egate\PHASE1-TECH-MEMO\Final_10-99\CAD\Fig3-6.dwg
EDIT DATE: 10/14/99 AT: 10:57

East Gate Disposal Yard
Fort Lewis, Washington

Project No. E9518Q

URS Greiner Woodward Clyde

Expanded Site Investigation- Drivepoint Dissolved Iron and Manganese in Groundwater Analytical Results

3-6

Table 3-1
Analytical Results for VOCs in Surface Soil Samples

Location	RS-1	RS-1
Sample	RS001	RS501*
Date	9/28/98	9/28/98
Depth (ft bgs)	0	0
Analyte (mg/kg)		
1,1-Dichloroethane	0.05 U	0.056 U
1,1-Dichloroethene	0.05 U	0.056 U
1,1-Dichloropropene	0.05 U	0.056 U
1,1,1-Trichloroethane	0.05 U	0.056 U
1,1,1,2-Tetrachloroethane	0.05 U	0.056 U
1,1,2-Trichloroethane	0.05 U	0.056 U
1,1,2,2-Tetrachloroethane	0.05 U	0.056 U
1,2-Dibromo-3-chloropropane	0.16 U	0.17 U
1,2-Dibromoethane	0.05 U	0.056 U
1,2-Dichlorobenzene	0.11 U	0.11 U
1,2-Dichloroethane	0.05 U	0.056 U
1,2-Dichloropropane	0.05 U	0.056 U
1,2,3-Trichlorobenzene	0.27 U	0.28 U
1,2,3-Trichloropropane	0.05 U	0.056 U
1,2,4-Trichlorobenzene	0.27 U	0.28 U
1,2,4-Trimethylbenzene	0.11 U	0.11 U
1,3-Dichlorobenzene	0.11 U	0.11 U
1,3-Dichloropropane	0.05 U	0.056 U
1,3,5-Trimethylbenzene	0.05 U	0.056 U
1,4-Dichlorobenzene	0.11 U	0.11 U
2-Chlorotoluene	0.05 U	0.056 U
2,2-Dichloropropane	0.05 U	0.056 U
4-Chlorotoluene	0.05 U	0.056 U
Benzene	0.11 U	0.11 U
Bromobenzene	0.05 U	0.056 U
Bromochloromethane	0.05 U	0.056 U
Bromodichloromethane	0.16 U	0.17 U
Bromoform	0.16 U	0.17 U
Bromomethane	0.53 U	0.56 U
Carbon tetrachloride	0.05 U	0.056 U
Chlorobenzene	0.05 U	0.056 U
Chlorodibromomethane	0.11 U	0.11 U
Chloroethane	0.05 U	0.056 U
Chloroform	0.05 U	0.056 U
Chloromethane	0.27 U	0.28 U
cis-1,2-Dichloroethene	0.05 U	0.056 U
cis-1,3-Dichloropropene	0.16 U	0.17 U
Dibromomethane	0.05 U	0.056 U
Dichlorodifluoromethane	0.05 U	0.056 U

Table 3-1 (Continued)
Analytical Results for VOCs in Surface Soil Samples

Location	RS-1	RS-1
Sample	RS001	RS501*
Date	9/28/98	9/28/98
Depth (ft bgs)	0	0
Analyte (mg/kg)		
Ethylbenzene	0.05 U	0.056 U
Hexachlorobutadiene	0.16 U	0.17 U
Isopropylbenzene	0.05 U	0.056 U
m- and *p*-Xylenes	0.05 U	0.056 U
Methylene chloride	0.27 U	0.28 U
N-Butylbenzene	0.05 U	0.056 U
N-Propylbenzene	0.05 U	0.056 U
Naphthalene	0.27 U	0.28 U
o-Xylene	0.05 U	0.056 U
P-Isopropyltoluene	0.11 U	0.11 U
sec-Butylbenzene	0.05 U	0.056 U
Styrene	0.05 U	0.056 U
tert-Butylbenzene	0.05 U	0.056 U
Tetrachloroethene	0.05 U	0.056 U
Toluene	0.05 U	0.056 U
trans-1,2-Dichloroethene	0.05 U	0.056 U
trans-1,3-Dichloropropene	0.16 U	0.17 U
Trichloroethene	**0.079**	**0.067**
Trichlorofluoromethane	0.05 U	0.056 U
Vinyl chloride	0.05 U	0.056 U

*field duplicate

Notes:
Boldface indicates analyte detected
U - not detected at the associated value

Analysis by MultiChem Analytical Services

Table 3-2
Analytical Results for SVOCs in Surface Soil Samples

Location	RS-1		RS-1	
Sample	RS001		RS501*	
Date	9/28/98		9/28/98	
Analyte (mg/kg)				
1,2-Dichlorobenzene	0.18	U	0.18	U
1,2,4-Trichlorobenzene	0.18	U	0.18	U
1,3-Dichlorobenzene	0.18	U	0.18	U
1,4-Dichlorobenzene	0.18	U	0.18	U
2-Chloronaphthalene	0.18	U	0.18	U
2-Chlorophenol	0.18	U	0.18	U
2-Methylnaphthalene	0.18	U	0.18	U
2-Methylphenol	0.18	U	0.18	U
2-Nitroaniline	0.9	U	0.9	U
2-Nitrophenol	0.18	U	0.18	U
2,4-Dichlorophenol	0.18	U	0.18	U
2,4-Dimethylphenol	0.18	U	0.18	U
2,4-Dinitrophenol	0.9	U	0.9	U
2,4-Dinitrotoluene	0.18	U	0.18	U
2,4,5-Trichlorophenol	0.9	U	0.9	U
2,4,6-Trichlorophenol	0.18	U	0.18	U
2,6-Dinitrotoluene	0.18	U	0.18	U
3-Nitroaniline	0.9	U	0.9	U
3,3-Dichlorobenzidine	0.36	U	0.36	U
4-Bromophenyl-phenylether	0.18	U	0.18	U
4-Chloro-3-methylphenol	0.18	U	0.18	U
4-Chloroaniline	0.18	U	0.18	U
4-Chlorophenyl-phenylether	0.18	U	0.18	U
4-Methylphenol	0.18	U	0.18	U
4-Nitroaniline	0.9	U	0.9	U
4-Nitrophenol	0.9	U	0.9	U
4,6-Dinitro-2-methylphenol	0.9	U	0.9	U
Acenaphthene	0.18	U	0.18	U
Acenaphthylene	0.18	U	0.18	U
Aniline	0.18	U	0.18	U
Anthracene	0.18	U	0.18	U
Benzidine	1.8	U	1.8	U
Benzo(a)anthracene	**0.013**	J	**0.011**	J
Benzo(a)pyrene	**0.013**	J	**0.014**	J
Benzo(b)fluoranthene	**0.017**	J	**0.019**	J
Benzo(ghi)perylene	**0.019**	J	**0.018**	J
Benzo(k)fluoranthene	**0.014**	J	**0.013**	J
Benzoic acid	0.9	U	0.9	U
Benzyl alcohol	0.18	U	0.18	U
bis(2-Chloroethoxy)methane	0.18	U	0.18	U
bis(2-Chloroethyl)ether	0.18	U	0.18	U

Table 3-2 (Continued)
Analytical Results for SVOCs in Surface Soil Samples

Location	RS-1		RS-1	
Sample	RS001		RS501*	
Date	9/28/98		9/28/98	
Analyte (mg/kg)				
bis(2-Chloroisopropyl)ether	0.18	U	0.18	U
bis(2-Ethylhexyl)phthalate	0.18	U	0.18	U
Butylbenzylphthalate	0.18	U	0.18	U
Carbazole	0.18	U	0.18	U
Chrysene	**0.027**	J	**0.022**	J
Di-n-octyl-phthalate	0.18	U	0.18	U
Di-n-butyl-phthalate	0.18	U	0.18	U
Dibenzo(a,h)anthracene	0.18	U	0.18	U
Dibenzofuran	0.18	U	0.18	U
Diethylphthalate	0.18	U	0.18	U
Dimethylphthalate	0.18	U	0.18	U
Fluoranthene	**0.028**	J	**0.024**	J
Fluorene	0.18	U	0.18	U
Hexachlorobenzene	0.18	U	0.18	U
Hexachlorobutadiene	0.18	U	0.18	U
Hexachlorocyclopentadiene	0.18	U	0.18	U
Hexachloroethane	0.18	U	0.18	U
Indeno(1,2,3-c,d)pyrene	**0.014**	J	**0.014**	J
Isophorone	0.18	U	0.18	U
N-Nitroso-di-n-propylamine	0.18	U	0.18	U
N-Nitrosodimethylamine	0.18	U	0.18	U
N-Nitrosodiphenylamine	0.18	U	0.18	U
Naphthalene	0.18	U	0.18	U
Nitrobenzene	0.18	U	0.18	U
Pentachlorophenol	0.9	U	0.9	U
Phenanthrene	**0.019**	J	**0.015**	J
Phenol	0.18	U	0.18	U
Pyrene	**0.023**	J	**0.019**	J

*field duplicate

Notes:
Boldface indicates analyte detected
J - value is an estimated amount
U - not detected at the associated value

Analysis by MultiChem Analytical Services

Table 3-3
Analytical Results for PCBs, Pesticides, and Herbicides in Surface Soil Samples

Location	RS-1		RS-1	
Sample	RS001		RS501*	
Date	9/28/98		9/28/98	
PCBs (µg/kg)				
Aroclor 1016	36	UJ	36	UJ
Aroclor 1221	36	UJ	36	UJ
Aroclor 1232	36	UJ	36	UJ
Aroclor 1242	36	UJ	36	UJ
Aroclor 1248	36	UJ	36	UJ
Aroclor 1254	36	UJ	36	UJ
Aroclor 1260	36	UJ	36	UJ
Pesticides (µg/kg)				
4,4-DDD	3.6	UJ	3.6	UJ
4,4-DDE	3.6	UJ	3.6	UJ
4,4-DDT	3.6	UJ	3.6	UJ
Aldrin	1.8	UJ	1.8	UJ
Alpha BHC	1.8	UJ	1.8	UJ
Alpha chlordane	1.8	UJ	1.8	UJ
Beta BHC	1.8	UJ	1.8	UJ
Delta BHC	1.8	UJ	1.8	UJ
Dieldrin	3.6	UJ	3.6	UJ
Endosulfan I	1.8	UJ	1.8	UJ
Endosulfan II	3.6	UJ	3.6	UJ
Endosulfan sulfate	3.6	UJ	3.6	UJ
Endrin	3.6	UJ	3.6	UJ
Endrin aldehyde	3.6	UJ	3.6	UJ
Endrin ketone	3.6	UJ	3.6	UJ
Gamma BHC	1.8	UJ	1.8	UJ
Gamma chlordane	1.8	UJ	1.8	UJ
Heptachlor	1.8	UJ	1.8	UJ
Heptachlor epoxide	1.8	UJ	1.8	UJ
Methoxychlor	18	UJ	18	UJ
Toxaphene	36	UJ	36	UJ
Herbicides (µg/kg)				
2,4-D	22	UJ	22	UJ
2,4-DB	22	UJ	22	UJ
2,4,5-T	3.2	UJ	3.2	UJ
Dalapon	43	UJ	43	UJ
Dicamba	2.2	UJ	2.2	UJ
Dichloroprop	22	UJ	22	UJ
Dinoseb	11	UJ	11	UJ
MCPA	1100	UJ	1100	UJ
MCPP	1100	UJ	1100	UJ
Silvex	4.4	UJ	2.2	UJ

Table 3-3 (Continued)
Analytical Results for PCBs, Pesticides, and Herbicides in Surface Soil Samples

*field duplicate

Notes:
Boldface indicates analyte detected
J - value is an estimated amount
U - not detected at the associated value

Analysis by MultiChem Analytical Services

Table 3-4
Analytical Results for VOCs in Soil-Gas

Location Number	Sample	Date	1,1,1-TCA (ppmV)	Benzene (ppmV)	cis-DCE (ppmV)	Ethylbenzene (ppmV)	Toluene (ppmV)	trans-DCE (ppmV)	TCE (ppmV)	Vinyl Chloride (ppmV)	Xylenes (Total) (ppmV)
SG-01	SG00105	10/12/98	0.24 U	0.41 U	**19 J**	0.31 U	0.35 U	**1.54**	**150**	0.86 U	0.31 U
SG-02	SG00205	10/12/98	0.24 U	0.41 U	0.33 U	0.31 U	0.35 U	0.33 U	**0.79**	0.86 U	0.31 U
SG-03	SG00305	10/12/98	0.24 U	0.41 U	0.33 U	0.31 U	0.35 U	0.33 U	**0.59**	0.86 U	0.31 U
SG-04	SG00405	10/12/98	0.24 U	0.41 U	0.33 U	0.31 U	0.35 U	0.33 U	0.25 U	0.86 U	0.31 U
SG-05	SG00505	10/12/98	0.24 U	0.41 U	**1.59**	0.31 U	0.35 U	0.33 U	**0.98**	0.86 U	0.31 U
SG-06	SG00605	10/12/98	0.24 U	0.41 U	0.33 U	0.31 U	0.35 U	0.33 U	0.25 U	0.86 U	0.31 U
SG-07	SG00705	10/12/98	0.24 U	0.41 U	**10.4 J**	0.31 U	0.35 U	0.33 U	**51.9**	0.86 U	0.31 U
SG-07	SG50705*	10/12/98	9.6 U	16.4 U	**9.47 J**	12.4 U	14 U	13.4 U	**44.4**	34.4 U	12.4 U
SG-08	SG00805	10/12/98	0.24 U	0.41 U	0.33 U	0.31 U	0.35 U	0.33 U	**0.28**	0.86 U	0.31 U
SG-09	SG00905	10/12/98	0.24 U	0.41 U	**0.81**	0.31 U	0.35 U	0.33 U	**1.46**	0.86 U	0.31 U
SG-10	SG01005	10/12/98	0.24 U	0.41 U	0.33 U	0.31 U	0.35 U	0.33 U	**2.93**	0.86 U	0.31 U
SG-11	SG01105	10/12/98	1.2 U	2.05 U	**12.8**	1.55 U	1.75 U	1.65 U	**2.75**	**5.81**	1.55 U
SG-12	SG01205	10/12/98	0.24 U	0.41 U	**14.8**	0.31 U	0.35 U	**0.34**	**16.1**	0.86 U	0.31 U
SG-13	SG01305	10/12/98	0.24 U	0.41 U	0.33 U	0.31 U	0.35 U	0.33 U	**0.37**	0.86 U	0.31 U
SG-14	SG01405	10/12/98	0.24 U	0.41 U	0.33 U	0.31 U	0.35 U	0.33 U	0.25 U	0.86 U	0.31 U
SG-15	SG01505	10/13/98	0.24 U	0.41 U	**0.72**	0.31 U	0.35 U	0.33 U	**2.15**	0.86 U	0.31 U
SG-16	SG01605	10/13/98	0.24 U	0.41 U	**1.66**	0.31 U	0.35 U	**0.53**	**1**	0.86 U	0.31 U
SG-17	SG01705	10/13/98	0.24 U	0.41 U	**21.5**	0.31 U	0.35 U	**1.06**	**32.9**	0.86 U	0.31 U
SG-18	SG01805	10/13/98	4.8 U	8.2 U	**7.1**	6.2 U	7 U	6.6 U	**23.8**	17.2 U	6.2 U
SG-19	SG01905	10/13/98	0.24 U	0.41 U	0.33 U	0.31 U	0.35 U	0.33 U	**0.29**	0.86 U	0.31 U
SG-20	SG02005	10/13/98	0.24 U	0.41 U	0.33 U	0.31 U	0.35 U	0.33 U	**0.36**	0.86 U	0.31 U
SG-21	SG02105	10/13/98	0.24 U	0.41 U	0.33 U	0.31 U	0.35 U	0.33 U	**0.56**	0.86 U	0.31 U
SG-21	SG52105*	10/13/98	0.24 U	0.41 U	0.33 U	0.31 U	0.35 U	0.33 U	**0.4**	0.86 U	0.31 U
SG-22	SG02205	10/13/98	0.24 U	0.41 U	0.33 U	0.31 U	0.35 U	0.33 U	0.25 U	0.86 U	0.31 U
SG-23	SG02305	10/13/98	0.24 U	0.41 U	0.33 U	0.31 U	0.35 U	0.33 U	**0.5**	0.86 U	0.31 U
SG-24	SG02405	10/13/98	0.24 U	0.41 U	0.33 U	0.31 U	0.35 U	0.33 U	0.25 U	0.86 U	0.31 U
SG-25	SG02505	10/13/98	0.24 U	0.41 U	0.33 U	0.31 U	0.35 U	0.33 U	0.25 U	0.86 U	0.31 U

Table 3-4 (Continued)
Analytical Results for VOCs in Soil-Gas

Location Number	Sample	Date	1,1,1-TCA (ppmV)	Benzene (ppmV)	cis-DCE (ppmV)	Ethylbenzene (ppmV)	Toluene (ppmV)	trans-DCE (ppmV)	TCE (ppmV)	Vinyl Chloride (ppmV)	Xylenes (Total) (ppmV)
SG-26	SG02605	10/13/98	0.24 U	0.41 U	0.33 U	0.31 U	0.35 U	0.33 U	0.25 U	0.86 U	0.31 U
SG-27	SG02705	10/13/98	0.24 U	0.41 U	**9.47**	0.31 U	0.35 U	0.33 U	**2.16**	0.86 U	0.31 U
SG-28	SG02805	10/13/98	0.24 U	0.41 U	**0.91**	0.31 U	0.35 U	0.33 U	**0.42**	0.86 U	0.31 U
SG-29	SG02905	10/13/98	0.24 U	0.41 U	**1.16**	0.31 U	0.35 U	0.33 U	**2.12**	0.86 U	0.31 U
SG-30	SG03005	10/13/98	0.24 U	0.41 U	0.33 U	0.31 U	0.35 U	0.33 U	0.25 U	0.86 U	0.31 U
SG-30	SG53005*	10/13/98	0.24 U	0.41 U	0.33 U	0.31 U	0.35 U	0.33 U	0.25 U	0.86 U	0.31 U
SG-31	SG03105	10/13/98	0.24 U	0.41 U	0.33 U	0.31 U	0.35 U	0.33 U	0.25 U	0.86 U	0.31 U
SG-32	SG03205	10/13/98	0.24 U	0.56 U	**81.7**	0.31 U	0.35 U	**1.77**	**1.66**	**490 J**	**0.37**
SG-33	SG03305	10/13/98	0.24 U	0.41 U	**1.9**	0.31 U	0.35 U	0.33 U	**3.15 J**	0.86 U	0.31 U
SG-34	SG03405	10/13/98	**0.46**	0.41 U	**0.34**	0.31 U	0.35 U	0.33 U	**0.75**	0.86 U	0.31 U
SG-35	SG03505	10/13/98	0.24 U	0.41 U	0.33 U	0.31 U	0.35 U	0.33 U	0.25 U	0.86 U	0.31 U
SG-36	SG03605	10/14/98	0.24 U	0.41 U	**29.9**	0.31 U	0.35 U	**1.54**	**50.4**	0.86 U	0.31 U
SG-37	SG03705	10/14/98	0.24 U	0.41 U	0.33 U	0.31 U	0.35 U	0.33 U	0.25 U	0.86 U	0.31 U
SG-38	SG03805	10/14/98	0.24 U	0.41 U	**1.95**	0.31 U	0.35 U	0.33 U	**8.83**	0.86 U	0.31 U
SG-39	SG03905	10/14/98	0.24 U	0.41 U	**1.66**	0.31 U	0.35 U	0.33 U	**2.57**	0.86 U	0.31 U
SG-40	SG04005	10/14/98	0.24 U	0.41 U	**0.64**	0.31 U	0.35 U	0.33 U	**1.91**	0.86 U	0.31 U
SG-41	SG04105	10/14/98	0.24 U	0.41 U	**1.48**	0.31 U	0.35 U	0.33 U	**0.92**	0.86 U	0.31 U
SG-41	SG54105*	10/14/98	0.24 U	0.41 U	**1.63**	0.31 U	0.35 U	0.33 U	**1.16**	0.86 U	0.31 U
SG-42	SG04205	10/14/98	0.24 U	0.41 U	**1.85**	0.31 U	0.35 U	0.33 U	**5.8**	0.86 U	0.31 U
SG-43	SG04305	10/14/98	0.24 U	0.41 U	**3.41**	0.31 U	0.35 U	0.33 U	**2.77**	0.86 U	0.31 U
SG-44	SG04405	10/14/98	0.24 U	0.41 U	**0.64**	0.31 U	0.35 U	0.33 U	**1.98**	0.86 U	0.31 U
SG-45	SG04505	10/14/98	0.24 U	0.41 U	0.33 U	0.31 U	0.35 U	0.33 U	0.25 U	0.86 U	0.31 U

*field duplicate

Notes:
Boldface indicates analyte detected

Table 3-4 (Continued)
Analytical Results for VOCs in Soil-Gas

1,1,1-TCA - 1,1,1-trichloroethane
cis-DCE - cis-1,2-dichloroethene
J - value is an estimated amount
ppmV - parts per million volume
TCE - trichloroethene
trans-DCE - trans-1,2-dichloroethene
U - substance not detected at the associated value

Analysis by Transglobal Environmental Geosciences Northwest

Table 3-5
Exploratory Trench Observations and Field Screen Results

Trench Number	Date	Depth (ft bgs)	Summary of Stratigraphy and Key Observations	Segment	Sample	Matrix	Depth (ft bgs)	NAPL Dye Test Result[a]	PID (ppm)
T-1	10/15/98	0-3	Organic, silty, sandy gravel	A	ST001A08	Soil	8	A	1,100
		3-9	Buried debris, with iron oxide staining at 5 ft; conglomerated at 8 ft		ST501A08*	Soil	8		
		8	Native soil (Steilacoom Gravel); strong hydrocarbon odor and sheen		NT001A09	NAPL	9	A	
		9	Groundwater with NAPL; total depth of segment; segments B,C,and D skipped						
		0-3	Organic silt grading to gravelly sand	E	None				
		3	Broken drum, strong TCE odor; sampled and removed by Ft. Lewis; segment abandoned at 3 ft						
T-2	10/16/98	0-4	Organic sand and gravel grading to silty, sandy gravel	A	ST002A02	Soil	2	C	6
		2-8	Buried debris on west wall; odor; intact drum at 3 ft on west wall		ST002A10	Soil	10	C	0.8
		4	Native soil and less debris; no odor; iron oxide staining		GT002A10	GW	10	C	
		6-11	Steilacoom Gravel						
		10	Groundwater (in all segments)						
			Stratigraphy similar to segment A, except much less debris	B	ST002B02	Soil	2	C	4.8
					ST002B07	Soil	7	C	0
					GT002B10	GW	10	C	
			Stratigraphy similar to segments B and C, except debris not encountered	C	ST002C04	Soil	4	C	1.9
					ST002C08	Soil	8	C	0.5
					GT002C10	GW	10	C	
		0-9	Silty, fine to medium sand with some gravel	D	ST002D06	Soil	6	C	13.2
		4-9	Debris; evidence of burning in upper 2 ft		ST002D11	Soil	11	C	0.5
		9	Steilacoom Gravel with iron oxide staining		GT002D10	GW	10	C	
					GT502D10*	GW	10		
			Stratigraphy similar to segment D, except:	E	ST002E05	Soil	5	C	1.4
		5-8	Debris						
		8	Steilacoom Gravel with iron oxide staining		GT002E10	GW	10	C	
		10	Black oxidation visible on gravel at water table						

Table 3-5 (Continued)
Exploratory Trench Observations and Field Screen Results

Trench Number	Date	Depth (ft bgs)	Summary of Stratigraphy and Key Observations	Segment	Sample	Matrix	Depth (ft bgs)	NAPL Dye Test Result[a]	PID (ppm)
T-3	10/19/98	0-6	Organic sand and gravel (all segments)	A	ST003A06	Soil	6	C	33
		2-8	Debris; concrete slab at 5 ft in segment A		GT003A06	GW	6	C	3.4
		6	Groundwater						
		0-6.5	Debris; crushed drum on south wall; solvent odor	B	ST003B06	Soil	6	C	425
		6.5	Groundwater with sheen and possibly NAPL		GT003B6.5	GW	6.5	C	116
		5	Crushed drum on south wall	C	ST003C06	Soil	6	C	899
		6.5	Groundwater with NAPL similar to grease		GT003C6.5	GW	6.5	B	1,077
		3	Possibly intact drum on south wall	D	ST003D07	Soil	7	B	1,080
		6.5	Groundwater with NAPL		GT003D6.5	GW	6.5	B	1,036
		2	Possibly intact drum on south wall	E	ST003E07	Soil	7		1,080
		6.5	Groundwater with sheen; total depth of trench		GT003E6.5	GW	6.5	C	92
T-4	10/19/98	0-1	Organic silt and sand	A	ST004A02	Soil	2	C	
		1-2.5	Gravel with iron oxide staining		ST004A14	Soil	14	C	1,080
		2.5-16	Medium to coarse sandy gravel (Steilacoom Gravel)						
		8.5	Black oxidation on gravel						
		12	Evidence of contamination (solvent odor)						
			Debris and fill material not encountered; groundwater not encountered to 15 ft (total depth of trench)						
		4-15	Steilacoom Gravel (segments B-E)	B	ST004B09	Soil	9		
		7	Evidence of contamination		ST504B09*	Soil	9		
		14	Intensity of odor increased; small amount of NAPL on cobble		ST004B15	Soil	15	C	1,077
					ST504B15*	Soil	15	C	
				C	ST004C14	Soil	14	C	11.4
				D	ST004D14	Soil	14	C	335
				E	ST004E14	Soil	14	C	3.3

Table 3-5 (Continued)
Exploratory Trench Observations and Field Screen Results

Trench Number	Date	Depth (ft bgs)	Summary of Stratigraphy and Key Observations	Segment	Sample	Matrix	Depth (ft bgs)	NAPL Dye Test Result[a]	PID (ppm)
T-5	10/20/98	0-6	Sand and gravel; organic at surface	A	ST005A07	Soil	7	C	9.7
		2-14	Debris		GT005A12	GW	12		
		6	Silty, sandy gravel (Steilacoom Gravel) (native soil)		GT005A14	GW	14	C	0
		12	Sand content and cobble size decreased; groundwater infiltrating						
		14	Groundwater						
		2-3	3 crushed drums and other containers encountered, including one drum with dark, viscous, odorous product that was sampled; segment abandoned at 3 ft	B	DT005B03	NAPL	3		
		3	Broken drum with similar type of product; contents sampled; segment abandoned at 3 ft; trench abandoned	C	DT005C03	NAPL	3		
T-6	10/20/98	0-4	Silty, sandy gravel with rusted debris (segment abandoned at 4 ft)	A	ST006A05	Soil	5	C	3.6
		2-3	3 crushed or intact drums on south wall; one with rainwater, one with mineral spirits odor						
		0-6	Silty, sandy gravel (segments B-E); crushed drum at surface (segment B)	B	ST006B06	Soil	6	C	1.8
		3	Iron oxide staining on soil (segments B-E)		ST006B14	Soil	14	B	347
		4	Evidence of burning (segments B-E)		NT006B15	NAPL	15	A	568
		6-14	Medium to coarse sand with some black oxidation, grading to gravel (segments B-E)						
		14	Evidence of contamination (gray staining and strong diesel odor) (segments B-E)						
		15	Groundwater with NAPL (segments B-E); total depth of trench						
			Segment C partially eliminated	C	None				
		3	Very hard solid material similar to solidified tar encountered	D	None				
				E	ST006E14	Soil	14	B	

Table 3-5 (Continued)
Exploratory Trench Observations and Field Screen Results

Trench Number	Date	Depth (ft bgs)	Summary of Stratigraphy and Key Observations	Segment	Sample	Matrix	Depth (ft bgs)	NAPL Dye Test Result[a]	PID (ppm)
T-7	10/21/98	0-4 2 4-7 7-13 12 13	Organic, silty, sandy gravel Very hard solid material similar to solidified tar encountered Silt and sand (fill material) Silty, sandy gravel (native soil); iron oxide staining 7 to 9 ft Evidence of contamination (gray staining and strong diesel or kerosene odor) (all segments) Groundwater with a sheen; no debris in segment A	A	GT007A13	GW	13	C	105
		 13	Stratigraphy similar to segment A, except minimal debris on west wall Groundwater with NAPL	B	ST007B12 NT007B13	Soil NAPL	12 13	A A	419 185
		 2-6 13	Stratigraphy similar to segments A and B, except: Debris Groundwater with NAPL; segment D skipped	C	ST007C06 ST007C12 NT007C13	Soil Soil NAPL	6 12 13	C B A	3.2 301 514
		 2-6 4 13	Stratigraphy similar to preceding segments, except: Debris Very hard solid material similar to solidified tar encountered Groundwater with a sheen; total depth of trench	E	ST007E12	Soil	12	B	620
T-8	10/21/98	0-10 10	Silty, sandy gravel with debris; rust and ash at 3 ft Groundwater with NAPL and odor Trench abandoned after segment A due to presence of two mortar shells	A	ST008A09	Soil	9	B	353

*field duplicate
[a]A = NAPL apparent; B = NAPL suspected; C = NAPL not present

Notes:
ft bgs - below ground surface
GW - groundwater
NAPL - nonaqueous-phase liquid
PID - photoionization detector

Table 3-6
Exploratory Trench Groundwater Quality Parameter Measurements, Test Kit Results, and Analytical Results

Trench Number	Segment	Depth (ft bgs)	Date	Sample	Temperature (°C)	pH	Specific Conductivity (µS/cm)	Eh (mV)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Dissolved Oxygen (Test Kit) (mg/L)	Alkalinity (Test Kit) (mg/L)	Ferrous Iron (Test Kit) (mg/L)
T-2	D	10	10/16/98	GT002D10	11.68	7.99	160	414	11.22	764.6	9	<50	>10
T-3	D	6.5	10/19/98	GT003D6.5	11.03	6.71	336		3.1	343	4	78	2.6
T-5	A	12	10/20/98	GT005A12	11.05	6.9	96		5.88	1229	4.5	54	7.7

Trench Number	Segment	Depth (ft bgs)	Date	Sample	Iron (mg/L)	Mn (mg/L)	1,1,1-TCA (µg/L)	Benzene (µg/L)	cis-DCE (µg/L)	Ethylbenzene (µg/L)	Toluene (µg/L)	TCE (µg/L)	VC (µg/L)	Xylene (Total) (µg/L)
T-2	D	10	10/16/98	GT002D10	0.05 U	0.01 U	2.5 U	2.5 U	**69**	2.5 U	2.5 U	**38.5**	7.5 U	2.5 U
T-2	D	10	10/16/98	GT502D10*	**0.11**	0.01 U	2.5 U	2.5 U	**80**	2.5 U	2.5 U	**36.4**	7.5 U	2.5 U
T-3	D	6	10/19/98	GT003D65	**3.2**	**0.7**	2.5 U	2.5 U	**5.700 J**	**5.7 J**	**9.4**	**180,000**	**17.4**	**47.9 J**
T-5	A	12	10/20/98	GT005A12	0.05 U	**0.3**	2.5 U	2.5 U	**18.2**	2.5 U	2.5 U	**109**	**19.1**	2.5 U

Notes:
Boldface indicates analyte detected
cis-DCE - cis-1,2-dichloroethene
°C - degrees Celsius
Eh - oxidation reduction potential
ft bgs - feet below ground surface
µS/cm - microsiemens per centimeter
mg/L - milligrams per liter
mV - millivolt
NTU - nephelometric turbidity unit
pH - hydrogen ion concentration
1,1,1-TCA - 1,1,1-trichloroethane
TCE - trichloroethene
VC - vinyl chloride

Table 3-7
Analytical Results for TPH and VOCs in Trench Soil Samples

Location	T-1A	T-1A	T-2A	T-2B	T-2C	T-2D	T-2E	T-3C
Sample	ST001A08	ST501A08*	ST002A02	ST002B02	ST002C04	ST002D06	ST002E05	ST003C06
Date	10/15/98	10/15/98	10/16/98	10/16/98	10/16/98	10/16/98	10/16/98	10/19/98
Depth (ft bgs)	8	8	2	2	4	6	5	6
Analyte (mg/kg)								
VOCs								
1,1,1-Trichloroethane	3 UJ	60 UJ	0.15 U	0.15 U	0.15 U	0.15 U	1.5 U	1.5 UJ
Benzene	3 UJ	60 UJ	0.15 U	0.15 U	0.15 U	**0.84**	1.5 U	1.5 UJ
cis-1,2-Dichloroethene	**370** J	**210** J	**0.55**	**0.77**	**0.6**	**16.1** J	**6.8**	**20.5** J
Ethylbenzene	**3.6** J	60 UJ	0.15 U	0.15 U	0.15 U	0.15 U	1.5 U	1.5 UJ
Toluene	**4** J	60 UJ	0.15 U	0.15 U	0.15 U	0.15 U	1.5 U	1.5 UJ
trans-1,2-Dichloroethene	**5.8** J	60 UJ	0.15 U	0.15 U	0.15 U	**0.99**	**4.1**	1.5 UJ
Trichloroethene	**3,400** J	**2,000** J	**0.52**	**0.78**	**0.56**	**26.3** J	**11.4**	**590** J
Vinyl chloride	15 UJ	300 UJ	0.75 U	0.75 U	0.75 U	0.75 U	7.5 U	7.5 UJ
Xylenes (total)	**27** J	60 UJ	0.15 U	0.15 U	0.15 U	0.15 U	1.5 U	1.5 UJ
TPH-D								
Diesel-range	2,000 UJ	1,000 UJ	50 U	50 U	50 U	50 U	50 U	50 U
Oil-range	**37,000** J	**31,000** J	**600**	**320**	**550**	**890**	**160**	**3,800**
TPH-G								
Gasoline-range	30 UJ	300 UJ	30 U	30 U	30 U	30 U	30 U	30 U
Mineral-spirits-range	**8,240** J	**2,650** J	30 U	30 U	30 U	30 U	30 U	**55**
TPH								
Total TPH	**45,240**	**33,650**	**600**	**320**	**550**	**890**	**160**	**3,855**

Table 3-7 (Continued)
Analytical Results for TPH and VOCs in Trench Soil Samples

Location	T-3D	T-3E	T-4A	T-4B	T-4B	T-4D	T-5A	T-6A
Sample	ST003D07	ST003E07	ST004A14	ST004B15	ST504B15*	ST004D14	ST005A07	ST006A05
Date	10/19/98	10/19/98	10/19/98	10/19/98	10/19/98	10/19/98	10/19/98	10/20/98
Depth (ft bgs)	7	7	14	15	15	14	7	5
Analyte (mg/kg)								
VOCs								
1,1,1-Trichloroethane	9 UJ	180 UJ	60 UJ	6 UJ	18 UJ	0.3 U	0.3 U	0.15 U
Benzene	9 UJ	180 UJ	60 UJ	6 UJ	18 UJ	0.3 U	0.3 U	0.15 U
cis-1,2-Dichloroethene	**40.8** J	180 UJ	60 UJ	6 UJ	18 UJ	0.3 U	0.3 U	0.15 U
Ethylbenzene	9 UJ	180 UJ	60 UJ	6 UJ	18 UJ	**1.9**	0.3 U	0.15 U
Toluene	9 UJ	180 UJ	60 UJ	6 UJ	18 UJ	0.3 U	0.3 U	0.15 U
trans-1,2-Dichloroethene	9 UJ	180 UJ	60 UJ	6 UJ	18 UJ	0.3 U	0.3 U	0.15 U
Trichloroethene	**2,400** J	**2,000** J	**672** J	**109** J	**122** J	**0.42**	**1.1**	**0.75**
Vinyl chloride	45 UJ	900 UJ	300 UJ	30 UJ	90 UJ	1.5 U	1.5 U	0.75 U
Xylenes (total)	9 UJ	180 UJ	60 UJ	6 UJ	18 UJ	**3.2**	0.3 U	0.15 U
TPH-D								
Diesel-range	250 U	250 UJ	200 U	200 U	200 U	200 U	50 U	50 U
Oil-range	**7,200**	**18,000** J	**570**	400 U	400 U	400 U	100 U	**490**
TPH-G								
Gasoline-range	30 UJ	30 UJ	**1,050**	**330** J	**380** J	**1,120**	30 U	30 U
Mineral-spirits-range	**860** J	**1,920** J	120 U	120 UJ	120 UJ	120 U	30 U	30 U
TPH								
Total TPH	**8,060**	**19,920**	**1,620**	**330**	**380**	**1,120**	100 U	**490**

Table 3-7 (Continued)
Analytical Results for TPH and VOCs in Trench Soil Samples

Location	T-6B	T-6E	T-7B	T-7C	T-7E	T-8A
Sample	ST006B14	ST006E14	ST007B12	ST007C12	ST007E12	ST008A09
Date	10/20/98	10/20/98	10/21/98	10/21/98	10/21/98	10/21/98
Depth (ft bgs)	14	14	12	12	12	9
Analyte (mg/kg)						
VOCs						
1,1,1-Trichloroethane	1.5 U	1.2 UJ	1.5 UJ	3 UJ	1.5 UJ	3 UJ
Benzene	1.5 U	1.2 UJ	1.5 UJ	3 UJ	1.5 UJ	3 UJ
cis-1,2-Dichloroethene	1.5 U	1.2 UJ	1.5 UJ	3 UJ	1.5 UJ	**5.4** J
Ethylbenzene	1.5 U	**3.4** J	**2.8** J	**10** J	**3.7** J	**19.6** J
Toluene	**1** J	1.2 UJ	1.5 UJ	3 UJ	1.5 UJ	**10.8** J
trans-1,2-Dichloroethene	1.5 U	1.2 UJ	1.5 UJ	3 UJ	1.5 UJ	3 UJ
Trichloroethene	1.5 U	1.2 UJ	1.5 UJ	3 UJ	1.5 UJ	**5.4** J
Vinyl chloride	7.5 U	6 UJ	7.5 UJ	15 UJ	7.5 UJ	15 UJ
Xylenes (total)	**9.1**	**13.7** J	**12.8** J	**30.6** J	**16.2** J	**98.8** J
TPH-D						
Diesel-range	50 U	200 U	50 U	50 U	50 U	**2,200** J
Oil-range	**1,300**	**2,000**	**1,200**	**1,900**	**1,000**	**13,000** J
TPH-G						
Gasoline-range	30 U	30 U	30 U	30 U	30 U	120 U
Mineral-spirits-range	**900**	**2,300**	**4,800** J	**8,400** J	**4,500** J	**7,700**
TPH						
Total TPH	**2,200**	**4,300**	**6,000**	**10,300**	**5,500**	**22,900**

*field duplicate

Notes:
Boldface indicates analyte detected
ft bgs - feet below ground surface
J - value is an estimated amount
U - not detected at the associated value

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Table 3-8
Analytical Results for SVOCs in Trench Soil Samples

Location	T-2A		T-4A		T-4B		T-4B	
Sample	ST002A10		ST004A14		ST004B09		ST504B09*	
Date	10/16/98		10/19/98		10/19/98		10/19/98	
Depth (ft bgs)	10		14		9		9	
Analyte (mg/kg)								
1,2-Dichlorobenzene	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
1,2,4-Trichlorobenzene	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
1,3-Dichlorobenzene	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
1,4-Dichlorobenzene	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
2-Chloronaphthalene	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
2-Chlorophenol	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
2-Methylnaphthalene	**0.032**	J	**0.12**	J	0.2	UJ	0.2	UJ
2-Methylphenol	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
2-Nitroaniline	1	UJ	1	UJ	1	UJ	1	UJ
2-Nitrophenol	1	UJ	0.21	UJ	1	UJ	1	UJ
2,4-Dichlorophenol	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
2,4-Dimethylphenol	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
2,4-Dinitrophenol	1	UJ	1	UJ	1	UJ	1	UJ
2,4-Dinitrotoluene	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
2,4,5-Trichlorophenol	1	UJ	1	UJ	1	UJ	1	UJ
2,4,6-Trichlorophenol	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
2,6-Dinitrotoluene	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
3-Nitroaniline	1	UJ	1	UJ	1	UJ	1	UJ
3,3-Dichlorobenzidine	0.41	UJ	0.42	UJ	0.41	UJ	0.4	UJ
4-Bromophenyl-phenylether	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
4-Chloro-3-methylphenol	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
4-Chloroaniline	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
4-Chlorophenyl-phenylether	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
4-Methylphenol	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
4-Nitroaniline	1	UJ	1	UJ	1	UJ	1	UJ
4-Nitrophenol	1	UJ	1	UJ	1	UJ	1	UJ
4,6-Dinitro-2-methylphenol	1	UJ	1	UJ	1	UJ	1	UJ
Acenaphthene	**0.038**	J	**0.043**	J	0.2	UJ	0.2	UJ
Acenaphthylene	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
Aniline	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
Anthracene	0.21	UJ	**0.066**	J	0.2	UJ	0.2	UJ
Benzidine	2	UJ	2.1	UJ	2	UJ	2	UJ
Benzo(a)anthracene	0.21	UJ	**0.056**	J	0.2	UJ	0.2	UJ
Benzo(a)pyrene	0.21	UJ	**0.042**	J	0.2	UJ	0.2	UJ
Benzo(b)fluoranthene	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
Benzo(ghi)perylene	0.21	UJ	**0.027**	J	0.2	UJ	0.2	UJ
Benzo(k)fluoranthene	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
Benzoic acid	1	UJ	1	UJ	1	UJ	1	UJ
Benzyl alcohol	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
bis(2-Chloroethoxy)methane	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ

Table 3-8 (Continued)
Analytical Results for SVOCs in Trench Soil Samples

Location	T-2A		T-4A		T-4B		T-4B	
Sample	ST002A10		ST004A14		ST004B09		ST504B09*	
Date	10/16/98		10/19/98		10/19/98		10/19/98	
Depth (ft bgs)	10		14		9		9	
Analyte (mg/kg)								
bis(2-Chloroethyl)ether	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
bis(2-Chloroisopropyl)ether	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
bis(2-Ethylhexyl)phthalate	1.4	UJ	0.27	UJ	0.2	UJ	0.2	UJ
Butylbenzylphthalate	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
Carbazole	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
Chrysene	**0.018**	J	**0.093**	J	0.2	UJ	0.2	UJ
Di-n-octyl-phthalate	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
Di-n-butyl-phthalate	**0.13**	J	**0.17**	J	0.2	UJ	0.2	UJ
Dibenzo(a,h)anthracene	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
Dibenzofuran	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
Diethylphthalate	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
Dimethylphthalate	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
Fluoranthene	0.21	UJ	**0.051**	J	0.2	UJ	0.2	UJ
Fluorene	**0.017**	J	**0.037**	J	0.2	UJ	0.2	UJ
Hexachlorobenzene	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
Hexachlorobutadiene	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
Hexachlorocyclopentadiene	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
Hexachloroethane	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
Indeno(1,2,3-c,d)pyrene	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
Isophorone	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
N-Nitroso-di-n-propylamine	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
N-Nitrosodimethylamine	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
N-Nitrosodiphenylamine	**0.016**	J	**0.03**	J	0.2	UJ	0.2	UJ
Naphthalene	0.21	UJ	**0.3**	J	0.2	UJ	0.2	UJ
Nitrobenzene	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
Pentachlorophenol	1	UJ	1	UJ	1	UJ	1	UJ
Phenanthrene	**0.067**	J	**0.56**	J	0.2	UJ	0.2	UJ
Phenol	0.21	UJ	0.21	UJ	0.2	UJ	0.2	UJ
Pyrene	**0.026**	J	**0.41**	J	0.2	UJ	0.2	UJ

*field duplicate

Notes:
Boldface indicates analyte detected
J - value is an estimated amount
U - not detected at the associated value

Analysis by MultiChem Analytical Services

Table 3-9
Analytical Results for PCBs in Trench Soil Samples

Location	T-2A		T-4A		T-4B		T-4B	
Sample	ST002A10		ST004A14		ST004B09		ST504B09*	
Date	10/16/98		10/19/98		10/19/98		10/19/98	
Depth	10		14		9		9	
PCBs (µg/kg)								
Aroclor 1016	41	UJ	42	UJ	41	UJ	40	UJ
Aroclor 1221	41	UJ	42	UJ	41	UJ	40	UJ
Aroclor 1232	41	UJ	42	UJ	41	UJ	40	UJ
Aroclor 1242	41	UJ	42	UJ	41	UJ	40	UJ
Aroclor 1248	41	UJ	42	UJ	41	UJ	40	UJ
Aroclor 1254	**58**	J	42	UJ	41	UJ	40	UJ
Aroclor 1260	41	UJ	42	UJ	41	UJ	40	UJ
Total Aroclors	**58**	J	42	UJ	41	UJ	40	UJ

*field duplicate

Notes:
Boldface indicates analyte detected
J - value is an estimated amount
U - not detected at the associated value

Analysis by MultiChem Analytical Services

Table 3-10
Analytical Results for VOCs in NAPL in Drum From Trench T-1E

Location	T-1E	
Sample	DT001E[a]	
Date	10/16/98	
Analyte (mg/kg)		
1,1-Dichloroethane	250	U
1,1-Dichloroethene	250	U
1,1-Dichloropropene	250	U
1,1,1-Trichloroethane	250	U
1,1,1,2-Tetrachloroethane	250	U
1,1,2-Trichloroethane	250	U
1,1,2,2-Tetrachloroethane	250	U
1,2-Dibromo-3-chloropropane	250	U
1,2-Dibromoethane	250	U
1,2-Dichlorobenzene	250	U
1,2-Dichloroethane	250	U
1,2-Dichloropropane	250	U
1,2,3-Trichlorobenzene	250	U
1,2,3-Trichloropropane	250	U
1,2,4-Trichlorobenzene	250	U
1,2,4-Trichloropropane	250	U
1,3-Dichlorobenzene	250	U
1,3-Dichloropropane	250	U
1,3,5-Trimethylbenzene	250	U
1,4-Dichlorobenzene	250	U
2-Chlorotoluene	250	U
2,2-Dichloropropane	250	U
4-Chlorotoluene	250	U
Benzene	250	U
Bromobenzene	250	U
Bromochloromethane	250	U
Bromodichloromethane	250	U
Bromoform	250	U
Bromomethane	250	U
Carbon Tetrachloride	250	U
Chlorobenzene	250	U
Chlorodibromomethane	250	U
Chloroethane	250	U
Chloroform	250	U
Chloromethane	250	U
cis-1,2-Dichloroethene	250	U
Dibromomethane	250	U
Dichlorodifluoromethane	250	U
Ethylbenzene	250	U
Hexachlorobutadiene	250	U

Table 3-10 (Continued)
Analytical Results for VOCs in NAPL in Drum from Trench T-1E

Location	T-1E	
Sample	DT001E[a]	
Date	10/16/98	
Analyte (mg/kg)		
Isopropylbenzene	250	U
Methylene chloride	250	U
N-Butylbenzene	250	U
N-Propylbenzene	250	U
Naphthalene	250	U
P-Isopropyltoluene	250	U
sec-Butylbenzene	250	U
Styrene	250	U
tert-Butylbenzene	250	U
Tetrachloroethene	**648**	
Toluene	250	U
trans-1,2-Dichloroethene	250	U
Trichloroethene	**832,000**	
Trichlorofluoromethane	250	U

[a]The sample was collected from an overpacked drum by Fort Lewis personnel.

Notes:
Boldface indicates analyte detected
U - not detected at the associated value

Analysis by Anatek Labs, Inc.

Table 3-11
Analytical Results for SVOCs in NAPL in Drum From Trench T-1E

Location	T-1E	
Sample	DT001E[a]	
Date	10/16/98	
Analyte (mg/kg)		
1-Naphthylamine	50	U
1,2-Dichlorobenzene	50	U
1,2-Diphenylhydrazine	50	U
1,2,4-Trichlorobenzene	50	U
1,2,4,5-Tetrachlorobenzene	50	U
1,3-Dichlorobenzene	50	U
1,4-Dichlorobenzene	50	U
2-Chloronaphthalene	50	U
2-Chlorophenol	50	U
2-Fluorobiphenyl	50	U
2-Methylnaphthalene	50	U
2-Methylphenol	50	U
2-Naphthylamine	50	U
2-Nitroaniline	50	U
2-Nitrophenol	50	U
2-Picoline	50	U
2,3,4,5-Tetrachlorophenol	50	U
2,4-Dichlorophenol	50	U
2,4-Dimethylphenol	50	U
2,4-Dinitrophenol	50	U
2,4-Dinitrotoluene	50	U
2,4,5-Trichlorophenol	50	U
2,4,6-Trichlorophenol	50	U
2,6-Dinitrotoluene	50	U
3-Methylchloroanthrene	50	U
3-Nitroaniline	50	U
4-Chloro-3-methylphenol	50	U
4-Chloroaniline	50	U
4-Chlorophenylphenylether	50	U
4-Methylphenol	50	U
4-Nitroaniline	50	U
4-Nitrophenol	50	U
4,6-Dinitro-2-methylphenol	50	U
7,12-Dimethylbenz(a)anthracene	50	U
A,A-dimethylphenylamine	50	U
Acenaphthene	50	U
Acenaphthylene	50	U
Aniline	50	U
Anthracene	50	U
Benzidine	50	U

Table 3-11 (Continued)
Analytical Results for SVOCs in NAPL in Drum From Trench T-1E

Location	T-1E	
Sample	DT001E[a]	
Date	10/16/98	
Analyte (mg/kg)		
Benzo(a)anthracene	50	U
Benzo(a)pyrene	50	U
Benzo(b)fluoranthene	50	U
Benzo(g,h,i)perylene	50	U
Benzo(k)fluoranthene	50	U
Benzoic acid	50	U
Benzyl alcohol	50	U
bis(2-Chloroethoxy)methane	50	U
bis(2-Chloroethyl)ether	50	U
bis(2-Chloroisopropyl)ether	50	U
bis(2-Ethylhexyl)phthalate	50	U
Chrysene	50	U
Di-n-octylphthalate	50	U
Di-n-butylphthalate	50	U
Dibenzo(a,h)anthracene	50	U
Dibenzofuran	50	U
Diethylphthalate	50	U
Dimethylphthalate	50	U
Diphenylamine	50	U
Ethyl methanesulfonate	50	U
Fluoranthene	50	U
Fluorene	50	U
Hexachlorobenzene	50	U
Hexachlorobutadiene	50	U
Hexachlorocyclopentadiene	50	U
Hexachloroethane	50	U
Indeno(1,2,3-cd)pyrene	50	U
Isophorone	50	U
N-Nitroso-di-n-propylamine	50	U
N-Nitrosodibutylamine	50	U
N-Nitrosodiphenylamine	50	U
Naphthalene	50	U
Nitrobenzene	50	U
P-Dimethylaminoazobenzene	50	U
Pentachlorbenzene	50	U
Pentachloronitrobenzene	50	U
Pentachlorophenol	50	U
Phenacetin	50	U
Phenanthrene	50	U

Table 3-11 (Continued)
Analytical Results for SVOCs in NAPL in Drum From Trench T-1E

Location	T-1E	
Sample	DT001E[a]	
Date	10/16/98	
Analyte (mg/kg)		
Phenol	50	U
Pyrene	50	U

[a]The sample was collected from an overpacked drum by Fort Lewis personnel.

Notes:
U - not detected at the associated value

Analysis by Anatek Labs, Inc.

Table 3-12
Analytical Results for PCBs and Pesticides in Drum From Trench T-1E

Location	T-1E	
Sample	DT001E[a]	
Date	10/16/98	
PCBs (mg/kg)		
Aroclor 1016	1	U
Aroclor 1221	1	U
Aroclor 1232	1	U
Aroclor 1242	1	U
Aroclor 1248	1	U
Aroclor 1254	1	U
Aroclor 1260	1	U
Total Aroclors	1	U
Pesticides (mg/kg)		
4,4'-DDD	5	U
4,4'-DDE	5	U
4,4'-DDT	5	U
Aldrin	5	U
Alpha BHC	5	U
Beta BHC	5	U
Chlordane	10	U
Delta BHC	5	U
Dieldrin	5	U
Endosulfan I	5	U
Endosulfan II	5	U
Endosulfan sulfate	5	U
Endrin	5	U
Endrin aldehyde	5	U
Endrin ketone	5	U
Gamma BHC	5	U
Heptachlor	5	U
Heptachlor epoxide	5	U
Methoxychlor	10	U
Toxaphene	10	U

[a]The sample was collected from an overpacked drum by Fort Lewis personnel.

Notes:
U - not detected at the associated value

Analysis by Anatek Labs, Inc.

Table 3-13
Analytical Results for VOCs in NAPL

Location	T-1A		T-6B		T-7C	
Sample	NT001A09		NT006B15		NT007C13	
Date	10/15/98		10/20/98		10/21/98	
Depth (ft bgs)	9		15		13	
Analyte (mg/kg)						
1,1-Dichloroethane	12	UJ	12	UJ	12	UJ
1,1-Dichloroethene	12	UJ	12	UJ	12	UJ
1,1-Dichloropropene	12	UJ	12	UJ	12	UJ
1,1,1-Trichloroethane	12	UJ	12	UJ	12	UJ
1,1,1-Trichloroethane[a]	30	U	100	U	30	U
1,1,1,2-Tetrachloroethane	12	UJ	12	UJ	12	UJ
1,1,2-Trichloroethane	12	UJ	12	UJ	12	UJ
1,1,2,2-Tetrachloroethane	12	UJ	12	UJ	12	UJ
1,2-Dibromo-3-chloropropane	38	UJ	38	UJ	38	UJ
1,2-Dibromoethane	12	UJ	12	UJ	12	UJ
1,2-Dichlorobenzene	25	UJ	25	UJ	25	UJ
1,2-Dichloroethane	12	UJ	12	UJ	12	UJ
1,2-Dichloropropane	12	UJ	12	UJ	12	UJ
1,2,3-Trichlorobenzene	62	UJ	62	UJ	62	UJ
1,2,3-Trichloropropane	12	UJ	12	UJ	12	UJ
1,2,4-Trichlorobenzene	62	UJ	62	UJ	62	UJ
1,2,4-Trimethylbenzene	**220**	J	25	UJ	25	UJ
1,3-Dichlorobenzene	25	UJ	25	UJ	25	UJ
1,3-Dichloropropane	12	UJ	12	UJ	12	UJ
1,3,5-Trimethylbenzene	**38**	J	12	UJ	12	UJ
1,4-Dichlorobenzene	25	UJ	25	UJ	25	UJ
2-Chlorotoluene	12	UJ	12	UJ	12	UJ
2,2-Dichloropropane	12	UJ	12	UJ	12	UJ
4-Chlorotoluene	12	UJ	12	UJ	12	UJ
Benzene	25	UJ	25	UJ	25	UJ
Benzene[a]	30	U	100	U	30	U
Bromobenzene	12	UJ	12	UJ	12	UJ
Bromochloromethane	12	UJ	12	UJ	12	UJ
Bromodichloromethane	38	UJ	38	UJ	38	UJ
Bromoform	38	UJ	38	UJ	38	UJ
Bromomethane	120	UJ	120	UJ	120	UJ
Carbon Tetrachloride	12	UJ	12	UJ	12	UJ
Chlorobenzene	12	UJ	12	UJ	12	UJ
Chlorodibromomethane	25	UJ	25	UJ	25	UJ
Chloroethane	12	UJ	12	UJ	12	UJ
Chloroform	12	UJ	12	UJ	12	UJ
Chloromethane	62	UJ	62	UJ	62	UJ
cis-1,2-Dichloroethene	**440**	J	12	UJ	**36**	J
cis-1,2-Dichloroethene[a]	**44**		100	U	30	U

Table 3-13 (Continued)
Analytical Results for VOCs in NAPL

Location	T-1A		T-6B		T-7C	
Sample	NT001A09		NT006B15		NT007C13	
Date	10/15/98		10/20/98		10/21/98	
Depth (ft bgs)	9		15		13	
Analyte (mg/kg)						
cis-1,3-Dichloropropene	38	UJ	38	UJ	38	UJ
Dibromomethane	12	UJ	12	UJ	12	UJ
Dichlorodifluoromethane	12	UJ	12	UJ	12	UJ
Ethylbenzene	12	UJ	12	UJ	12	UJ
Ethylbenzene[a]	**78**		**520**		**1,030**	
Hexachlorobutadiene	38	UJ	38	UJ	38	UJ
Isopropylbenzene	12	UJ	12	UJ	12	UJ
m- and p-Xylenes	12	UJ	12	UJ	12	UJ
Methylene Chloride	62	UJ	62	UJ	62	UJ
N-Butylbenzene	**210**	J	**320**	J	**350**	J
N-Propylbenzene	12	UJ	12	UJ	12	UJ
Naphthalene	**93**	J	62	UJ	62	UJ
o-Xylene	12	UJ	12	UJ	12	UJ
P-Isopropyltoluene	25	UJ	25	UJ	25	UJ
sec-Butylbenzene	12	UJ	12	UJ	12	UJ
Styrene	12	UJ	12	UJ	12	UJ
tert-Butylbenzene	12	UJ	12	UJ	12	UJ
Tetrachloroethene	12	UJ	12	UJ	12	UJ
Toluene	12	UJ	12	UJ	12	UJ
Toluene[a]	30	U	100	U	**266**	
trans-1,2-Dichloroethene	12	UJ	12	UJ	12	UJ
trans-1,2-Dichloroethene[a]	30	U	100	U	30	U
trans-1,3-Dichloropropene	38	UJ	38	UJ	38	UJ
Trichloroethene	12	UJ	12	UJ	**50**	J
Trichloroethene[a]	**180**		100	U	30	U
Trichlorofluoromethane	12	UJ	12	UJ	12	UJ
Vinyl Chloride	12	UJ	12	UJ	12	UJ
Vinyl Chloride[a]	150	U	500	U	150	U
Xylenes (Total)[a]	**344**		**3,600**		**2,400**	

[a]Analysis by Transglobal Environmental Geosciences Northwest

Notes:
Boldface indicates analyte detected
J - value is an estimated amount
U - not detected at the associated value

Analysis by MultiChem Analytical Services except where indicated

Table 3-14
Analytical Results for SVOCs in NAPL

Location	T-1A		T-5B		T-5C		T-6B		T-7B	
Sample	NT001A09		DT005B03		DT005C03		NT006B15		NT007B13	
Date	10/15/98		10/20/98		10/20/98		10/20/98		10/21/98	
Depth (ft bgs)	9		3		3		15		13	
Analyte (mg/kg)										
1,2-Dichlorobenzene	50	UJ	**230**	J	200	UJ	100	UJ	180	UJ
1,2,4-Trichlorobenzene	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
1,3-Dichlorobenzene	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
1,4-Dichlorobenzene	50	UJ	**42**	J	200	UJ	100	UJ	180	UJ
2-Chloronaphthalene	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
2-Chlorophenol	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
2-Methylnaphthalene	**9.2**	J	**27**	J	**44**	J	**7.6**	J	180	UJ
2-Methylphenol	50	UJ	**24**	J	200	UJ	100	UJ	180	UJ
2-Nitroaniline	250	UJ	1,000	UJ	1,000	UJ	500	UJ	910	UJ
2-Nitrophenol	250	UJ	200	UJ	200	UJ	100	UJ	180	UJ
2,4-Dichlorophenol	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
2,4-Dimethylphenol	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
2,4-Dinitrophenol	250	UJ	1,000	UJ	1,000	UJ	500	UJ	910	UJ
2,4-Dinitrotoluene	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
2,4,5-Trichlorophenol	250	UJ	1,000	UJ	1,000	UJ	500	UJ	910	UJ
2,4,6-Trichlorophenol	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
2,6-Dinitrotoluene	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
3-Nitroaniline	250	UJ	1,000	UJ	1,000	UJ	500	UJ	910	UJ
3,3-Dichlorobenzidine	100	UJ	400	UJ	400	UJ	200	UJ	360	UJ
4-Bromophenyl-phenylether	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
4-Chloro-3-methylphenol	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
4-Chloroaniline	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
4-Chlorophenyl-phenylether	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
4-Methylphenol	50	UJ	**49**	J	200	UJ	100	UJ	180	UJ
4-Nitroaniline	250	UJ	1,000	UJ	1,000	UJ	500	UJ	910	UJ
4-Nitrophenol	250	UJ	1,000	UJ	1,000	UJ	500	UJ	910	UJ
4,6-Dinitro-2-methylphenol	250	UJ	1,000	UJ	1,000	UJ	500	UJ	910	UJ
Acenaphthene	**11**	J	200	UJ	200	UJ	100	UJ	180	UJ
Acenaphthylene	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
Aniline	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
Anthracene	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
Benzidine	500	UJ	2,000	UJ	2,000	UJ	1,000	UJ	1,800	UJ
Benzo(a)anthracene	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
Benzo(a)pyrene	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
Benzo(b)fluoranthene	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
Benzo(g,h,i)perylene	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
Benzo(k)fluoranthene	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
Benzoic Acid	250	UJ	1,000	UJ	1,000	UJ	500	UJ	910	UJ
Benzyl Alcohol	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ

Table 3-14 (Continued)
Analytical Results for SVOCs in NAPL

Location	T-1A		T-5B		T-5C		T-6B		T-7B	
Sample	NT001A09		DT005B03		DT005C03		NT006B15		NT007B13	
Date	10/15/98		10/20/98		10/20/98		10/20/98		10/21/98	
Depth (ft bgs)	9		3		3		15		13	
Analyte (mg/kg)										
bis(2-Chloroethoxy)methane	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
bis(2-Chloroethyl)ether	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
bis(2-Chloroisopropyl)ether	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
bis(2-Ethylhexyl)phthalate	**47**	J	200	UJ	**36**	J	**31**	J	**23**	J
Butylbenzylphthalate	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
Carbazole	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
Chrysene	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
Di-n-octyl-phthalate	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
Di-n-butyl-phthalate	**9.4**	J	**90**	J	**81**	J	100	UJ	180	UJ
Dibenzo(a,h)anthracene	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
Dibenzofuran	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
Diethylphthalate	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
Dimethylphthalate	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
Fluoranthene	**6.6**	J	200	UJ	200	UJ	100	UJ	180	UJ
Fluorene	**12**	J	200	UJ	200	UJ	**7.6**	J	180	UJ
Hexachlorobenzene	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
Hexachlorobutadiene	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
Hexachlorocyclopentadiene	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
Hexachloroethane	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
Indeno(1,2,3-cd)pyrene	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
Isophorone	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
N-Nitroso-di-n-propylamine	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
N-Nitrosodimethylamine	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
N-Nitrosodiphenylamine	**9.5**	J	200	UJ	200	UJ	100	UJ	180	UJ
Naphthalene	50	UJ	**12**	J	**190**	J	100	UJ	180	UJ
Nitrobenzene	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
Pentachlorophenol	250	UJ	1,000	UJ	1,000	UJ	500	UJ	910	UJ
Phenanthrene	**26**	J	**16**	J	**12**	J	**10**	J	180	UJ
Phenol	50	UJ	200	UJ	200	UJ	100	UJ	180	UJ
Pyrene	**23**	J	200	UJ	200	UJ	**7.5**	J	180	UJ

Notes:
Boldface indicates analyte detected
J - value is an estimated amount
U - not detected at the associated value

Analysis by MultiChem Analytical Services

Table 3-15
Analytical Results for PCBs and TPH in NAPL

Location	T-1A	T-5B	T-5C	T-6B	T-7B	T-7C
Sample	NT001A09	DT005B03	DT005C03	NT006B15	NT007B13	NT007C13
Date	10/15/98	10/20/98	10/20/98	10/20/98	10/21/98	10/21/98
Depth (ft bgs)	9	3	3	15	13	13
PCBs (µg/kg)						
Aroclor 1016	500 U	500 U	500 U	500 U	1,200 U	--
Aroclor 1221	500 U	500 U	500 U	500 U	1,200 U	--
Aroclor 1232	500 U	500 U	500 U	500 U	1,200 U	--
Aroclor 1242	500 U	500 U	500 U	500 U	1,200 U	--
Aroclor 1248	500 U	500 U	500 U	500 U	1,200 U	--
Aroclor 1254	**1,800**	**720** J	**1,200** J	500 U	1,200 U	--
Aroclor 1260	**1,600**	500 U	500 U	500 U	1,200 U	--
Total Aroclors	**3,400**	**720** J	**1,200** J	500 U	1,200 U	--
TPH-D (mg/kg)						
Diesel-range	**160,000** J	--	--	**150,000** J	--	**140,000** J
Motor-oil-range	**400,000** J	--	--	**450,000** J	--	**400,000** J
Diesel-range[a]	9,000 U	--	--	7,000 UJ	--	10,000 U
Oil-range[a]	**190,000**	--	--	**150,000** J	--	**240,000**
TPH-G (mg/kg)						
Gasoline-range	**43,000** J	--	--	**410,000** J	--	**423,000** J
Gasoline-range[a]	4,200 U	--	--	10,000 U	--	10,000 UJ
Mineral-spirits-range[a]	**150,000**	--	--	**450,000**	--	**640,000** J
Total TPH (mg/kg)						
Total TPH	**603,000**	--	--	**1,010,000**	--	**963,000**
Total TPH[a]	**340,000**	--	--	**600,000**	--	**880,000**

[a]Analysis by Transglobal Environmental Geosciences Northwest

Notes:
Boldface indicates analyte detected
J - value is an estimated amount
U - not detected at the associated value

Analysis by MultiChem Analytical Services except where noted

Table 3-16
Chemical and Physical Test Results for Trench Soil Samples

Location	T-2A	T-4A	T-4A	T-4B	T-4B	T-6E	T-7C
Sample	ST002A10	ST004A02	ST004A14	ST004B09	ST504B09*	ST006E14	ST007C06
Date	10/16/98	10/19/98	10/19/98	10/19/98	10/19/98	10/20/98	10/21/98
Depth (ft bgs)	10	2	14	9	9	14	6
Conventionals (mg/kg)							
Total Inorganic Carbon[a]	**3,302**	**6,378**	**9,977**	50 U	**494**	50 U	50 U
Total Organic Carbon[a]	**12,000**	**39,000**	**22,000**	**3,700**	**3,300**	**16,000**	**6,700**
Metals (mg/kg)							
Iron	**12,000**	**14,000**	**12,000**	**13,000**	**16,000**	**12,000**	**16,000**
Manganese	**200**	**210**	**340**	**270**	**300**	**130**	**160**
Extractable Iron[b]	**13,000**	**36,500**	**10,900**	**10,900**	**26,300**	**5,500**	**39,500**
Extractable Manganese[b]	**490**	**800**	**700**	**510**	**1,500**	**100**	100 U
Particle Size[c]							
USCS Group Symbol	GP	GP	GP	GP	GP	GW	GP-GM
Soil Description for Group Symbol	Poorly graded gravel with sand.	Poorly graded gravel with sand.	Poorly graded gravel with sand.	Poorly graded gravel.	Poorly graded gravel.	Well graded gravel with sand.	Poorly graded gravel with silt and sand.
Percent Cobbles							
Percent Gravel	81.6	81.6	75.9	82.9	83.3	80.2	65.8
Percent Sand	16.3	17.5	21.5	13.9	13.9	17.4	27.5
Percent Silt	1.5	0.7	1.5	1.4	1.4	1.6	5.7
Percent Clay	0.6	0.2	1.1	1.8	1.4	0.8	1.0
Percent Finer of Sieve Size 3 in	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Percent Finer of Sieve Size 2.5 in		95.2	91.8	92.9		87.3	91.9
Percent Finer of Sieve Size 2 in	75.1	88.3		86.7	93.7	77.6	
Percent Finer of Sieve Size 1.5 in	49.8	82.9	76.3	74.0	83.9	66.6	87.3
Percent Finer of Sieve Size 1 in	38.1	62.3	62.8	56.9	61.0	55.9	69.9
Percent Finer of Sieve Size 0.75 in	34.9	50.3	53.0	47.8	49.8	49.3	61.6
Percent Finer of Sieve Size 0.5 in	28.8	36.8	42.6	34.2	35.5	38.3	50.1
Percent Finer of Sieve Size 0.375 in	25.1	28.9	35.4	27.2	27.3	31.5	42.9
Percent Finer of Sieve #4	18.4	18.4	24.1	17.1	16.7	19.8	34.2
Percent Finer of Sieve #10	13.9	13.4	16.6	11.8	12.0	12.2	30.4

Table 3-16 (Continued)
Chemical and Physical Tests Results for Trench Soil Samples

Location	T-2A	T-4A	T-4A	T-4B	T-4B	T-6E	T-7C
Sample	ST002A10	ST004A02	ST004A14	ST004B09	ST504B09*	ST006E14	ST007C06
Date	10/16/98	10/19/98	10/19/98	10/19/98	10/19/98	10/20/98	10/21/98
Depth (ft bgs)	10	2	14	9	9	14	6
Particle Size[c]							
Percent Finer of Sieve #20	10.2	10.3	11.1	8.4	9.0	8.8	28.4
Percent Finer of Sieve #40	6.3	6.1	7.7	6.2	6.7	5.4	21.7
Percent Finer of Sieve #60	3.9	2.1	5.4	4.6	4.7	3.8	13.1
Percent Finer of Sieve #140	2.5	1.1	3.1	3.4	3.2	2.7	7.9
Percent Finer of Sieve #200	2.1	0.9	2.6	3.2	2.8	2.4	6.7

[a]Total organic carbon and total inorganic carbon analyzed by Analytical Resources, Inc.
[b]Extractable iron and extractable manganese analyzed by Core Lab using extractable method citrate-bicarbonate-dithionite
[c]Particle size analyzed by Soil Technologies

*field duplicate

Notes:
Boldface indicates analyte detected
U - not detected at the associated value

Table 3-17
Physical Parameters Results for NAPL

Location	T-1A	T-7C
Sample	NT001A09	NT007C13
Date	10/15/98	10/21/98
Depth (ft bgs)	9	13
Parameter (units)		
Density at 100 degrees (gm/cc)	0.882	0.8464
Density at 60 degrees (gm/cc)	0.8959	0.8579
Density at 80 degrees (gm/cc)	0.8894	0.8515
Interfacial tension at 74 degrees (dynes/centimeter)	8.96	11.21
Specific gravity at 100 degrees	0.8758	--
Specific gravity at 100 degrees (degrees API)	--	0.8405
Specific gravity at 60 degrees	0.8967	0.8586
Specific gravity at 80 degrees	0.8864	0.8486
Viscosity at 100 degrees (centistokes)	61.3	8.82
Viscosity at 100 degrees (centipoise)	54.1	7.47
Viscosity at 60 degrees (centistokes)	184.2	19.6
Viscosity at 60 degrees (centipoise)	165.2	16.8
Viscosity at 80 degrees (centistokes)	101.9	12.3
Viscosity at 80 degrees (centipoise)	90.7	10.5

Analysis by PTS Laboratories

Table 3-18
Water Quality Parameter Measurements and Field Screen Results in Drivepoint Groundwater

Drivepoint Number	Depth (ft bgs)	Sample ID	Sample Date	Temperature (°C)	pH	Specific Conductivity (µS/cm)	Eh (mV)[a]	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Flow Rate (mL/min)	Dissolved Oxygen (Test Kit) (mg/L)	Alkalinity (Test Kit) (mg/L)	Ferrous Iron (Test Kit) (mg/L)	PID (ppm)[b]	NAPL Dye Test Result[b,c]	Depth to NAPL (ft bgs)
DP-1	11	GD00111	10/29/98	—	—	—	—	—	—	—	—	—	—	—	A	9.5
	20	GD00120	10/29/98	12.79	6.8	276.7	-203.9	0.03	245.7	200	1	200	1.1	138	A	—
	25	GD00125	10/29/98	13.27	7.2	565	-418.4	0	24.9	140	1	70	0.4	198	B	—
	30	GD00130	10/29/98	12.64	7.5	292.5	-319.3	0	245.4	150	0.8	100	5.6	138	B	—
DP-2	13	GD00213	10/30/98	11.17	6.3	195.3	-91	0	61.3	225	0.3	64	2.6	276	A	13
	20	GD00220	10/30/98	11.34	6.6	198.2	-150.8	0.01	244.3	250	0.5	72	10	29.5	C	—
	23	GD00223	10/30/98	11.69	6.9	346.4	-138.2	0	42.5	250	0.3	102	0.6	14.8	C	—
	36	GD00236	10/30/98	11.59	6.8	223.4	136.4	0	178.5	200	0.8	75	5.2	28	C	—
DP-3	12	GD00312	11/02/98	11.36	6.7	102	-30.4	0.4	124.2	200	1	50	0.4	0.1	C	—
	20	GD00320	11/02/98	11.68	6.9	132	172.7	0.44	—	200	4.0	50	10	11.0	C	—
	25	GD00325	11/02/98	11.57	6.7	141	110.8	0.22	—	250	4.25	62	3.6	17.2	C	—
	33	GD00333	11/03/98	10.73	6.6	115	140.1	0.35	41	250	3.5	50	1.9	47.2	C	—
DP-4	16	GD00416	11/03/98	11.93	6.5	94	290.9	0.39	19.1	250	5.25	50	0.8	140	C	—
	20	GD00420	11/03/98	11.81	6.5	94	314.2	0.42	238.2	250	9	50	10	14.3	C	—
	25	GD00425	11/03/98	11.54	6.7	131	171.5	0.21	49.6	250	3.5	65	1.0	68.1	C	—
	35	GD00435	11/03/98	11.61	6.9	132	103.7	0.23	200	240	5.5	62	10	32	C	—
DP-5	10	GD00510	11/04/98	—	—	—	—	—	—	—	—	—	—	—	A	10
	20	GD00520	11/04/98	11.49	6.7	106	98.8	0.03	11.4	250	0.3	50	1.4	138	C	—
	24	GD00524	11/04/98	—	—	—	—	—	—	—	—	—	—	—	A	24
	33	GD00533	11/04/98	12.15	7.2	155	-154.3	0.01	141.6	250	0.5	70	10	572	C	—
DP-6	10	GD00610	11/04/98	11.44	6.8	164	261.9	0.39	-2.2	250	2.5	65	0.6	816	A	8
	20	GD00620	11/04/98	11.49	7.3	114	180.6	0.33	403.1	250	5.0	68	10	140	C	—
	24	GD00624	11/05/98	10.92	7	107	181.2	0.33	165.5	250	5	66	5	493	C	—
DP-7	13	GD00713	11/05/98	11.15	6.5	89	334.8	0.18	-9.1	250	5	50	0.6	11	C	—
	20	GD00720	11/05/98	11.39	6.6	113	256.8	0.21	107.1	200	4.5	59	10	7	C	—
	25	GD00725	11/05/98	10.96	6.7	128	98.3	0.13	285.6	200	2.5	63	4.0	6	C	—
	35	GD00735	11/05/98	11.57	7.8	147	-391.7	0.24	402.9	200	2	NA	1.4	3.5	C	—
DP-8	13	GD00813	11/09/98	11.25	6.7	113	308.3	0.31	16.2	240	4.5	53	1.6	0.2	C	—
	20	GD00820	11/09/98	10.99	7.1	113	264.5	8.1	75.5	150	7	50	1.0	5.7	C	—
	25	GD00825	11/09/98	11.5	6.9	108	219.1	6.6	435.2	155	7.0	50	1.4	4.7	C	—
	36	GD00836	11/09/98	11.87	7.1	114	165.9	7.13	458.4	160	7	60	10	1.1	C	—

Table 3-18 (Continued)
Water Quality Parameter Measurements and Field Screen Results in Drivepoint Groundwater

Drivepoint Number	Depth (ft bgs)	Sample ID	Sample Date	Temperature (°C)	pH	Specific Conductivity (µS/cm)	Eh (mV)[a]	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Flow Rate (mL/min)	Dissolved Oxygen (Test Kit) (mg/L)	Alkalinity (Test Kit) (mg/L)	Ferrous Iron (Test Kit) (mg/L)	PID (ppm)[b]	NAPL Dye Test Result[b,c]	Depth to NAPL (ft bgs)
DP-9	11	GD00911	11/10/98	—	—	—	—	—	—	—	—	—	—	—	A	10
	20	GD00920	11/10/98	—	—	—	—	—	—	—	—	—	—	—	A	—
	25	GD00925	11/10/98	—	—	—	—	—	—	—	—	—	—	—	A	—
	36	GD00936	11/10/98	12.8	7.6	149	69	5.78	1508.6	250	3.5	67	0.8	1.194	C	—
DP-10	13	GD01013	11/10/98	10.75	7.5	116	321.5	8.15	125.1	265	7	50	2.1	11.8	C	—
	20	GD01020	11/10/98	10.81	7.6	116	279.4	5.95	222.2	250	7	51	0.8	3.0	C	—
	25	GD01025	11/10/98	11.18	7.3	110	158.1	5.25	1500.3	210	3.5	50	10	4.5	C	—
	37	GD01037	11/11/98	11.52	7.5	127	29.9	4.83	1502.0	225	5	57	1	2.8	C	—
DP-11	15	GD01115	11/11/98	10.78	7.3	113	308.4	7.4	403.6	250	7	50	10	4.1	C	—
	20	GD01120	11/11/98	10.9	6.7	97	250.8	6.03	37.8	250	7	50	0.8	16.5	C	—
	25	GD01125	11/11/98	11.62	7	108	186.6	4.51	619.5	250	8	57	3.0	10.7	C	—
	36	GD01136	11/11/98	12.3	7.2	119	117.9	3.85	1506.3	250	6	100	1	7.0	C	—
DP-12	12	GD01212	11/11/98	10.99	6.7	108	304	5.36	14.2	260	10	50	0.4	0	C	—
	20	GD01220	11/12/98	10.97	6.9	108	219.8	4.7	209.5	175	6	50	1.0	2.5	C	—
	25	GD01225	11/12/98	11.4	6.6	101	222.3	9.39	93.4	275	7	50	3.6	1.0	C	—
	37	GD01237	11/12/98	12.1	6.9	122	301.8	5.32	1307.7	225	5.5	50	10	5.9	C	—
DP-13	14	GD01314	11/12/98	11.22	6.6	106	320	4.66	117.6	260	5.0	50	0.9	9.0	C	—
	20	GD01320	11/12/98	11	6.8	107	268	4.66	378.6	280	7	50	4	7	C	—
	25	GD01325	11/13/98	10.71	6.9	125	218.7	7.65	136.5	200	5	55	1.1	0.6	C	—
	39	GD01339	11/13/98	11.88	7.1	145	28.3	3.07	1306	225	4	125	4.5	6.4	C	—
DP-14	11	GD01411	11/13/98	11.04	6.7	105	312.7	7.54	21.8	340	7	50	0.2	3.6	C	—
	20	GD01420	11/13/98	11.01	6.6	108	267.1	9.28	57.3	230	4.5	50	1.5	4.8	C	—
	25	GD01425	11/13/98	10.97	6.6	118	185	6.38	566	320	6	65	10.2	7.6	C	—
	32	GD01432	11/16/98	10.95	9.1	139	-119.1	0.73	696	210	1	95	10	39.2	C	—
DP-15	11	GD01511	11/16/98	11.66	7.7	99	94.4	1.87	443	210	2	40	1.8	14.5	C	—
	20	GD01520	11/16/98	11.77	7.8	109	106.4	1.12	368	200	1.5	58	7.5	0.9	C	—
	25	GD01525	11/16/98	11.29	8.3	144	56	1.15	1313	210	1.5	80	6.8	3.9	C	—
	30	GD01530	11/16/98	11.01	8.3	132	132.6	1.98	1311	150	1.5	64	8.6	8.5	C	—
DP-16	11	GD01611	11/17/98	11.02	8.3	116	315.8	7.46	171	300	6	56	1.9	1.3	C	—
	20	GD01620	11/17/98	10.72	8.2	105	264.3	8.83	301	240	7	45	1.3	9.6	C	—
	25	GD01625	11/17/98	11.13	8.4	112	144.8	7.54	1201	275	7	70	2.2	0.2	C	—
	36	GD01635	11/17/98	12.37	8.5	131	29	5.54	1206	260	5	100	1	3.9	C	—

Table 3-18 (Continued)
Water Quality Parameter Measurements and Field Screen Results in Drivepoint Groundwater

Drivepoint Number	Depth (ft bgs)	Sample ID	Sample Date	Temperature (°C)	pH	Specific Conductivity (µS/cm)	Eh (mV) [a]	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Flow Rate (mL/min)	Dissolved Oxygen (Test Kit) (mg/L)	Alkalinity (Test Kit) (mg/L)	Ferrous Iron (Test Kit) (mg/L)	PID (ppm) [b]	NAPL Dye Test Result [b,c]	Depth to NAPL (ft bgs)
DP-17	17	GD01717	11/17/98	11.72	8	112	111.4	1	264	240	0.35	60	3.1	398	A	17
	22	GD01722	11/17/98	11.4	7.9	92	107.6	0.91	872	200	0.9	50	9.8	4.8	C	—
	31	GD01731	11/18/98	11.46	7.5	107	71.4	5.95	790	240	5	54	10	41.7	C	—
	38	GD01738	11/18/98	12.24	7	125	103.1	5.52	439	200	5.5	54	10.2	95	C	—
DP-18	11	GD01811	11/18/98	10.86	8.1	148	153.5	0.54	0	300	0.4	50	0.9	81.9	C	—
	20	GD01820	11/18/98	10.97	7.6	148	150.7	1.43	21.2	290	1.5	52	1.1	468	C	—
	25	GD01825	11/18/98	11.21	7.5	151	-55.8	0.77	442	250	0.8	64	10	205	C	—
	37	GD01837	11/18/98	11.55	6.1	131	84.2	5.87	790	260	6	80	5.8	10.6	C	—
DP-19	16	GD01916	11/19/98	11.14	6.9	104	273.8	6.99	319	180	6	50	5.8	3.1	C	—
	22	GD01922	11/19/98	11.26	7.3	99	278	5.24	114	250	5.5	50	2.1	4.4	C	—
	27	GD01927	11/19/98	11.85	7.3	99	201.7	5.54	791	240	5.5	60	9.6	11.7	C	—
	37	GD01937	11/19/98	11.73	6.8	116	106.7	5	790	240	7	85	1.0	6.7	C	—
DP-20	13	GD02013	11/19/98	10.93	7.1	98	377.3	8.74	205	300	8	50	1.5	4.9	C	—
	20	GD02020	11/20/98	10.84	6.9	99	256	4.6	137	250	6	50	3.1	3.6	C	—
	26	GD02026	11/20/98	11.04	6.8	104	110.9	7.5	789	240	8	53	6.5	3.3	C	—
	36	GD02036	11/20/98	12.95	7	119	8	7.33	794	280	7	90	0.4	2.5	C	—
DP-21	10	GD02110	03/15/99	8.38	5.9	91	260.3	6.83	330	275	3.5	50	1.4	—	—	—
	12	GD02112	03/15/99	9.25	6	92	153.5	3.61	244	350	3.5	50	1.6	—	—	—
	23	GD02123	03/15/99	10.05	6.3	140	57.4	2.1	351.8	250	1	70	4.7	—	—	—
	27	GD02127	03/15/99	10.13	6.5	136	-57	1.02	1262.1	300	1.5	60	—	—	—	—
DP-22	8	GD02208	03/16/99	8.55	6.1	82	361.2	8.58	95.1	250	4.5	50	0.4	—	—	—
	16	GD02216	03/16/99	10.01	6.3	95	272.5	7.65	30.8	300	7	50	0.5	—	—	—
	24	GD02224	03/16/99	10.36	7.5	164	140.8	3.2	1264.9	280	3.5	81	5.8	—	—	—
	32	GD02232	03/16/99	11.79	7.2	137	51.3	3.63	1271.4	300	2.5	88	4.4	—	—	—
DP-23	8	GD02308	03/16/99	8.22	6.3	154	307.7	5.86	53.8	310	3.5	50	0.4	—	—	—
	16	GD02316	03/16/99	9.08	7.2	220	-192.8	1	1258.5	200	1.5	94	1.6	—	—	—
	24	GD02324	03/17/99	9.68	7.3	229	-226	0.33	420.0	250	0.4	110	2.5	—	—	—
	39	GD02339	03/17/99	10.27	6.6	151	77.7	1.74	849.0	300	1.5	64	9.6	—	—	—
DP-24	9	GD02409	03/17/99	8.12	6.2	172	180.7	0.69	66.3	350	0.8	55	0.4	—	—	—
	19	GD02419	03/17/99	8.96	6.2	164	-197	0.42	550.0	300	0.6	65	6.8	—	—	—
	24	GD02424	03/17/99	9.58	6.3	176	-278.8	0.6	1230.0	350	0.5	69	6	—	—	—
	35	GD02435	03/17/99	10.47	6.6	163	-351.9	0.12	1263.9	250	—	—	—	—	—	—

Table 3-18 (Continued)
Water Quality Parameter Measurements and Field Screen Results in Drivepoint Groundwater

Drivepoint Number	Depth (ft bgs)	Sample ID	Sample Date	Temperature (°C)	pH	Specific Conductivity (µS/cm)	Eh (mV)[a]	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Flow Rate (mL/min)	Dissolved Oxygen (Test Kit) (mg/L)	Alkalinity (Test Kit) (mg/L)	Ferrous Iron (Test Kit) (mg/L)	PID (ppm)[b]	NAPL Dye Test Result[b,c]	Depth to NAPL (ft bgs)
DP-25	7	GD02507	03/18/99	8.79	6.2	95	337.8	2.15	108.0	350	1.5	50	0.7	—	—	—
	19	GD02519	03/18/99	9.52	6.5	112	111.6	4	1260.0	200	3	50	7.4	—	—	—
	24	GD02524	03/18/99	10.12	6.6	115	127.8	4.1	1262.8	300	3	50	5.4	—	—	—
	30	GD02530	03/18/99	10.53	6.9	125	43.4	4.07	1264.8	325	4	75	3.5	—	—	—
DP-26	9	GD02609	03/18/99	9.24	6.9	678	130	0.91	29.4	300	0.5	175	0.8	—	—	—
	19	GD02619	03/18/99	9.67	6.5	85	240.3	6	125.0	250	4.5	50	4.0	—	—	—
	25	GD02625	03/19/99	8.99	6.5	88	345.5	5.39	791.1	320	4	50	6.4	—	—	—
	38.5	GD02638.5	03/19/99	11.01	6.9	123	185.6	4.65	506.5	250	5.5	50	8.2	—	—	—
DP-27	9	GD02709	03/19/99	7.41	6.7	126	293.1	5.04	96.0	350	4	50	0.8	—	—	—
	19	GD02719	03/19/99	8.01	6.4	79	202.7	4.91	537.7	300	4	50	5.8	—	—	—
	23	GD02723	03/19/99	9.66	7	136	60.3	3.63	1261.2	200	4	65	4.5	—	—	—
	38	GD02738	03/19/99	10.52	6.9	121	111.1	6.22	1264.8	420	5	90	—	—	—	—
DP-28	10	GD02810	03/22/99	10.19	7.2	110	327.3	10.14	647.6	380	9	50	1.2	—	—	—
	19	GD02819	03/22/99	10.81	7.1	110	95.1	9.16	1144.4	200	5.5	57	9.0	—	—	—
	24	GD02824	03/22/99	11.12	7.1	117	79.5	7.85	1146.3	320	5	50	—	—	—	—
	31	GD02831	03/22/99	11.94	7.1	119	13.8	6.26	1149.3	300	5.5	70	—	—	—	—
DP-29	8.5	GD0298.5	03/22/99	7.71	6.8	246	193.8	0.2	66.7	350	0.25	90	0.2	—	—	—
	19	GD02919	03/22/99	8.66	6.9	113	-64	2.48	1137.5	200	—	—	—	—	—	—
	24	GD02924	03/23/99	9.1	7.1	133	115.2	5.5	1137.8	300	4	60	10	—	—	—
	28	GD02928	03/23/99	10.23	7	127	-8.3	5.17	1142.2	250	—	—	—	—	—	—
DP-30	13	GD03013	03/23/99	9.98	6.9	135	314.8	4.28	51.6	210	3.5	51	0.4	—	—	—
	19	GD03019	03/23/99	9.65	6.9	127	230.9	6	52.9	300	5.5	50	0.7	—	—	—
	24	GD03024	03/23/99	10.27	6.8	121	235.9	8.31	284.6	300	4.5	50	1.4	—	—	—
	35	GD03035	03/23/99	11.51	7	118	96.8	4.94	1147.1	300	3.5	64	—	—	—	—
DP-31	9	GD03109	03/24/99	9.1	6.1	79	448.5	9.16	24.3	350	7	50	0.2	—	—	—
	12	GD03112	03/24/99	9.41	6	73	223.1	9.11	43.6	310	7	50	0.6	—	—	—
	27	GD03127	03/24/99	11.31	7.8	168	-338.1	0.59	1178.6	200	0.8	90	10	—	—	—
	35	GD03135	03/24/99	11.1	6.8	135	-5.8	1.45	1177.2	300	—	—	—	—	—	—
DP-32	9	GD03209	03/25/99	8.93	6.3	94	264.5	7.4	143.2	320	6	50	0.8	—	—	—
	19	GD03219	03/25/99	9.38	6.5	112	182	6.44	1147.5	300	5.5	50	10	—	—	—
	24	GD03224	03/25/99	10.11	6.7	143	103.7	3.97	1173.4	300	3.5	80	—	—	—	—
	28	GD03228	03/25/99	10.83	7.2	176	-312.7	0.4	1176.3	280	0.6	100	1.8	—	—	—

Table 3-18 (Continued)
Water Quality Parameter Measurements and Field Screen Results in Drivepoint Groundwater

Drivepoint Number	Depth (ft bgs)	Sample ID	Sample Date	Temperature (°C)	pH	Specific Conductivity (µS/cm)	Eh (mV) [a]	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Flow Rate (mL/min)	Dissolved Oxygen (Test Kit) (mg/L)	Alkalinity (Test Kit) (mg/L)	Ferrous Iron (Test Kit) (mg/L)	PID (ppm) [b]	NAPL Dye Test Result [b,c]	Depth to NAPL (ft bgs)
DP-33	9	GD03309	03/25/99	8.27	6.1	102	270.1	4.97	50.7	300	4	50	0.6	—	—	—
	24	GD03324	03/25/99	10.04	7.3	199	-154.2	0.7	1173.2	250	0.70	94	10	—	—	—
	29	GD03329	03/26/99	10.01	7.2	189	139	2.36	560.0	275	2	73	9.0	—	—	—
	35	GD03335	03/26/99	9.49	7.3	192	-116	1.04	353.5	300	1.0	105	2.8	—	—	—
DP-34	9	GD03409	03/26/99	8.15	6.4	76	389	10.4	72.2	250	10	50	0.4	—	—	—
	19	GD03419	03/26/99	9.26	6.8	122	180.5	6.72	1145.0	275	6	56	9.5	—	—	—
	24	GD03424	03/26/99	9.51	7.4	150	167.9	4.99	1160.0	250	4.5	72	1.6	—	—	—
	37	GD03437	03/29/99	10.28	6.8	122	48.8	5.5	1174.3	250	5	—	—	—	—	—
DP-35	9	GD03509	03/29/99	8.47	6.3	98	300.6	1.34	clear	240	1.0	50	0.4	—	—	—
	19	GD03519	03/29/99	8.74	6.3	107	-165.3	0.6	136.5	280	0.7	50	0.5	—	—	—
	24	GD03524	03/29/99	8.85	6.4	124	-260.2	0.26	515.2	280	0.35	50	1.8	—	—	—
	34	GD03534	03/29/99	9.43	6.8	138	-122.6	1.65	1170.2	220	1.5	50	—	—	—	—
DP-36	12	GD03612	03/30/99	7.51	6.4	90	409.7	8.01	45.1	280	6	50	0.4	—	—	—
	19	GD03619	03/30/99	7.23	6.5	90	358.1	7.71	47.5	320	6	50	0.5	—	—	—
	24	GD03624	03/30/99	8.5	6.5	110	183.6	6.98	518.7	275	5.5	50	2.4	—	—	—
	36	GD03636	03/30/99	9.89	7	133	21.5	3.37	1173.0	250	3	68	—	—	—	—
DP-37	13	GD03713	03/30/99	9.18	6.6	191	338.4	3.48	17.0	300	3	75	0.3	—	—	—
	19	GD03719	03/30/99	9.61	6.4	105	244	3.18	88.2	300	2.5	50	0.4	—	—	—
	22	GD03722	03/31/99	9.26	6.3	116	-228.2	0.68	549.3	220	0.7	50	1.2	—	—	—
	34	GD03734	03/31/99	10.57	7.3	157	-25	1.83	1174.0	250	2	70	4.2	—	—	—
DP-38	7.5	GD0387.5	03/31/99	8.98	6.2	96	274.5	2.25	16.2	240	1.5	50	0.4	—	—	—
	19	GD03819	03/31/99	9.42	6.5	100	194	3.63	1170.8	240	2.5	50	10	—	—	—
	24	GD03824	03/31/99	9.86	6.5	109	20.1	2.27	1173.2	220	2.5	53	10	—	—	—
	31	GD03831	03/31/99	10	7.3	159	-182.1	0.72	1173.1	270	0.9	75	—	—	—	—
DP-39	13	GD03913	04/01/99	9.83	6.1	78	360.1	10.25	31.1	270	9	50	0.5	—	—	—
	19	GD03919	04/01/99	10.67	6.3	84	269.2	8.1	81.0	200	6.5	50	1.2	—	—	—
	24	GD03924	04/01/99	11.49	6.5	89	250	7.08	1177.6	220	6	50	5.8	—	—	—
	35	GD03935	04/01/99	11.58	7.1	135	79.8	4.59	1180.7	250	4	73	10	—	—	—
DP-40	15	GD04015	04/01/99	1081	6.2	96	412	10.37	clear	200	8.5	50	0.3	—	—	—
	19	GD04019	04/01/99	10.01	6.3	95	384.7	10.21	20.9	250	9.5	50	0.2	—	—	—
	23	GD04023	04/02/99	9.5	6.4	99	260.2	8.81	49.8	200	6.5	50	0.4	—	—	—
	37	GD04037	04/02/99	11.38	6.8	136	141.8	4.2	1179.5	250	3.5	70	10	—	—	—

Table 3-18 (Continued)
Water Quality Parameter Measurements and Field Screen Results in Drivepoint Groundwater

Drivepoint Number	Depth (ft bgs)	Sample ID	Sample Date	Temperature (°C)	pH	Specific Conductivity (µS/cm)	Eh (mV)[a]	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Flow Rate (mL/min)	Dissolved Oxygen (Test Kit) (mg/L)	Alkalinity (Test Kit) (mg/L)	Ferrous Iron (Test Kit) (mg/L)	PID (ppm)[b]	NAPL Dye Test Result[b,c]	Depth to NAPL (ft bgs)
DP-41	8	GD04108	04/02/99	9.16	5.7	87	248.2	4.94	30.1	250	3.5	50	0.4	—	—	—
	19	GD04119	04/02/99	9.63	6.3	143	168	3.31	1172.3	200	3.5	62	10	—	—	—
	30	GD04130	04/02/99	9.79	6.8	184	-189.4	0.72	1171.1	300	—	—	—	—	—	—
	33	GD04133	04/05/99	10.11	6.5	157	-26.9	2.9	1172.8	350	2.5	68	3.2	—	—	—
DP-42	8	GD04208	04/05/99	9.46	6.1	89	368.1	10.09	375.1	250	8.5	50	0.2	—	—	—
	16	GD04216	04/05/99	9.84	6.2	106	162.8	8.86	204.2	250	8	50	7	—	—	—
	23	GD04223	04/05/99	10.91	6.9	155	181.7	5.56	750.2	225	5.5	65	3.2	—	—	—
	39	GD04239	04/06/99	10.16	6.9	139	65.4	4.2	1177.5	200	—	—	—	—	—	—
DP-43	7	GD04307	04/06/99	9.05	6.1	96	405.1	5.36	146.7	275	4.5	50	0.2	—	—	—
	19	GD04319	04/06/99	9.87	6.3	123	49.3	2.38	1170.0	270	2.5	68	9.4	—	—	—
	24	GD04324	04/06/99	10.04	6.2	130	59.6	1.06	1171.6	350	1.0	60	10	—	—	—
	30	GD04330	04/06/99	10.68	6.4	136	-239.9	0.1	1098.2	300	0.3	55	2.2	—	—	—
DP-44	12	GD04412	04/06/99	10.09	7	111	416.2	13.75	52.7	350	12	50	0	—	—	—
	19	GD04419	04/07/99	9.5	7	110	195.8	13.4	1158.8	200	11	50	1.8	—	—	—
	24	GD04424	04/07/99	10.07	7	109	272	12.12	1168.8	200	11	50	6.2	—	—	—
	33	GD04433	04/07/99	10.77	7.6	121	-15.7	2.6	1179.5	200	3	75	10	—	—	—
DP-45	6	GD04506	04/07/99	9.05	6.2	97	289.9	4	109.6	200	2.5	50	0.4	—	—	—
	17	GD04517	04/07/99	9.41	7	173	-315.2	0.28	903.6	250	0.7	77	10	—	—	—
	22	GD04522	04/07/99	9.73	7.1	195	-310.1	0.3	1114.1	250	0.5	88	10	—	—	—
	28	GD04528	04/08/99	9.96	7.3	168	-270.1	0.6	173.1	250	0.6	84	—	—	—	—
DP-46	7	GD04607	04/08/99	8.38	6.2	115	345.2	5.22	88.1	250	3	50	0.2	—	—	—
	18	GD04618	04/08/99	9.85	6.4	155	114.5	5.6	1169.3	200	5	75	10	—	—	—
	24	GD04624	04/08/99	9.65	6.2	115	241.7	4.5	1171.8	260	4	50	10	—	—	—
	32	GD04632	04/08/99	10.38	6.6	167	-212.1	0.66	1168.3	200	0.8	88	—	—	—	—
DP-47	9	GD04709	04/08/99	8.44	6	89	427.3	8.46	25.0	300	7	50	0	—	—	—
	17	GD04717	04/08/99	9.14	6	90	390.3	8	4.3	240	6	50	0.4	—	—	—
	21	GD04721	04/09/99	8.56	6.3	103	244.5	8	1170.2	200	7	50	3.4	—	—	—
	32	GD04732	04/09/99	9.79	7.9	201	-362.4	0.09	1177.3	150	—	—	—	—	—	—
DP-48	6	GD04806	04/09/99	7.2	6.6	163	-18.9	0.86	59.2	280	0.7	60	0.5	—	—	—
	19	GD04819	04/09/99	7.9	6.5	87	310.2	9.68	24.3	240	8	50	0.5	—	—	—
	24	GD04824	04/09/99	8.77	6.6	98	303.2	7.74	78.1	280	6	50	0.4	—	—	—
	33	GD04833	04/09/99	9.56	6.5	96	235.4	7.82	123.4	300	6	50	0.6	—	—	—

Table 3-18 (Continued)
Water Quality Parameter Measurements and Field Screen Results in Drivepoint Groundwater

Drivepoint Number	Depth (ft bgs)	Sample ID	Sample Date	Temperature (°C)	pH	Specific Conductivity (µS/cm)	Eh (mV)[a]	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Flow Rate (mL/min)	Dissolved Oxygen (Test Kit) (mg/L)	Alkalinity (Test Kit) (mg/L)	Ferrous Iron (Test Kit) (mg/L)	PID (ppm)[b]	NAPL Dye Test Result[b,c]	Depth to NAPL (ft bgs)
DP-49	7	GD04907	04/12/99	7.28	6.5	112	339.2	3.69	10.8	250	2.5	50	0	—	—	—
	19	GD04919	04/12/99	7.55	6.5	103	236.9	7.79	614.1	250	7	50	10	—	—	—
	22	GD04922	04/12/99	8.07	6.5	101	301.4	8.1	1177.3	300	7	50	10	—	—	—
	32	GD04932	04/12/99	9.5	7.5	147	59.2	3.54	1167.9	225	3	72	10	—	—	—
DP-50	9	GD05009	04/12/99	10.22	7.2	113	365	13.52	100.4	300	11	50	0.4	—	—	—
	19	GD05019	04/13/99	9.56	7.2	111	250.9	13.14	794.3	250	11	50	1.8	—	—	—
	24	GD05024	04/13/99	10.15	7.5	115	194.9	11.1	1159.4	200	11	58	10	—	—	—
	31	GD05031	04/13/99	10.87	7.5	114	210.2	11.48	1163.2	220	10	52	10	—	—	—

[a]Eh calculated by adding 200 mv to oxidation reduction potential measurement collected in field
[b]PID screening and NAPL dye test were discontinued after completion of first 20 drivepoint locations because neither test proved useful for the investigation
[c]A = NAPL apparent, B = NAPL suspected, C = NAPL not present

Notes:
— - Groundwater sample not collected or test not conducted
Eh - oxidation reduction potential
ft bgs - feet below ground surface
µS/cm - microsiemens per centimeter
mL/min - milliliters per minute
mV - millivolt
NAPL - nonaqueous-phase liquid
NTU - nephelometric turbidity unit
PID - photoionization detector
ppm - parts per million

Table 3-19
Analytical Results for Metals and VOCs in Drivepoint Groundwater

Location	Sample	Date	Depth (ft bgs)	Metals		VOCs									
				Iron (mg/L)	Manganese (mg/L)	1,1,1-TCA (µg/L)	Benzene (µg/L)	cis-DCE (µg/L)	Ethyl-benzene (µg/L)	Toluene (µg/L)	Trans-DCE	TCE (µg/L)	Vinyl Chloride (µg/L)	Xylenes (Total) (µg/L)
DP-1	GD00111	10/29/98	11	**1.8**	**0.45**	10 U	10 U	**53**	**25.1**	10 U	10 U	10 U	**46.1**	**112**
DP-1	GD00120	10/29/98	20	0.05 U	**0.96**	10 U	10 U	**63.9**	**10.4**	10 U	10 U	**112**	**38.8**	**47.9**
DP-1	GD00125	10/29/98	25	**0.27**	**0.82**	**140** J	**4.9** J	**2,100** J	**7.6** J	**7.2** J	**18.8** J	**3,400** J	**291** J	**32.4** J
DP-1	GD00130	10/29/98	30	0.05 U	**0.42**	**49.2** J	20 UJ	**2,600** J	20 UJ	20 UJ	**73.5** J	**5,600** J	**33.6** J	**27.7** J
DP-2	GD00213	10/29/98	13	**1.7**	**0.15**	10 U	10 U	**31.8**	**19.6**	10 U	10 U	**12.7**	30 U	**83.6**
DP-2	GD00220	10/30/98	20	**1.1**	**0.64**	**10**	10 U	**73.2**	10 U	10 U	10 U	**34.7**	**21.6** J	**27.1**
DP-2	GD00223	10/30/98	23	0.05 U	**0.14**	10 U	10 U	**197**	10 U	10 U	10 U	**269**	**20.8** J	10 U
DP-2	GD00236	10/30/98	36	0.05 U	**0.074**	10 U	10 U	10 U	10 U	10 U	10 U	**18.6**	30 U	10 U
DP-3	GD00312	11/2/98	12	0.05 U	0.01 U	5 U	5 U	5 U	5 U	5 U	5 U	**4.3** J	15 U	5 U
DP-3	GD00320	11/2/98	20	0.05 U	**0.15**	2.5 U	2.5 U	**2.8**	2.5 U	2.5 U	2.5 U	**13.3**	7.5 U	2.5 U
DP-3	GD50320*	11/2/98	20	0.05 U	**0.16**	2.5 U	2.5 U	**1.8** J	2.5 U	2.5 U	2.5 U	**11.5**	7.5 U	2.5 U
DP-3	GD00325	11/2/98	25	**0.16**	**0.57**	5 U	5 U	5 U	5 U	5 U	5 U	**18**	15 U	5 U
DP-3	GD00333	11/3/98	33	**0.22**	**0.087**	12.5 U	12.5 U	**12.3** J	12.5 U	12.5 U	12.5 U	**2,500**	37.5 U	12.5 U
DP-4	GD00416	11/3/98	16	**0.074**	**0.02**	5 U	5 U	5 U	5 U	5 U	5 U	5 U	15 U	5 U
DP-4	GD00420	11/3/98	20	0.05 U	**0.12**	2.5 U	2.5 U	2.5 U	**2.2** J	2.5 U	2.5 U	2.5 U	7.5 U	**11**
DP-4	GD00425	11/3/98	25	0.05 U	**0.056**	2.5 U	2.5 U	**8.4**	2.5 U	2.5 U	2.5 U	**47.6**	7.5 U	2.5 U
DP-4	GD00435	11/3/98	35	0.05 U	**0.12**	5 U	5 U	5 U	**3** J	5 U	5 U	5 U	15 U	**9.7**
DP-5	GD00510	11/3/98	10	**0.051**	**0.11**	200 U	200 U	**19,000**	**740**	200 U	**270**	**87** J	**1,000**	**3,000**
DP-5	GD00520	11/4/98	20	**0.47**	**0.2**	5 U	50 U	**630**	5 U	5 U	**15.3**	**156**	5 U	**12.4**
DP-5	GD00524	11/4/98	24	0.05 U	**0.29** J	200 U	200 U	**1,410**	**1,110**	**290**	200 U	**470,000**	600 U	**460**
DP-5	GD50524*	11/4/98	24	0.05 U	**0.1** J	2,000 U	2,000 U	**3,400**	2,000 U	2,000 U	2,000 U	**1,000,000** J	6,000 U	2,000 U
DP-5	GD00533	11/4/98	33	**0.062**	**0.065**	200 U	200 U	200 U	200 U	200 U	200 U	**52,000**	600 U	200 U
DP-6	GD00610	11/4/98	10	0.05 U	**0.069**	100 U	100 U	**12,000** J	100 U	100 U	100 U	**77,000** J	300 U	100 U
DP-6	GD00620	11/4/98	20	0.05 U	**0.31**	100 U	100 U	**240**	100 U	100 U	100 U	**2,700**	300 U	100 U
DP-6	GD00624	11/4/98	24	0.05 U	**0.055**	50 U	50 U	**200**	50 U	50 U	50 U	**3,500**	150 U	50 U
DP-7	GD00713	11/5/98	13	0.05 U	0.01 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**8.4**	7.5 U	2.5 U
DP-7	GD00720	11/5/98	20	0.05 U	**0.093**	5 U	5 U	**11.8**	5 U	5 U	5 U	**59**	15 U	5 U
DP-7	GD00725	11/5/98	25	**0.43**	**0.33**	5 U	5 U	**19**	5 U	5 U	5 U	**109**	15 U	5 U
DP-7	GD00735	11/5/98	35	0.05 U	**0.3**	5 U	5 U	5 U	5 U	5 U	5 U	**21.3**	15 U	5 U
DP-8	GD00813	11/9/98	13	0.05 U	**0.013**	5 U	5 U	**8.1**	5 U	5 U	5 U	**13.1**	15 U	5 U
DP-8	GD00820	11/9/98	20	0.05 U	**0.024**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**4.6**	7.5 U	2.5 U
DP-8	GD00825	11/9/98	25	0.05 U	**0.13**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**21.6**	7.5 U	2.5 U
DP-8	GD50825*	11/9/98	25	0.05 U	**0.11**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**21.6**	7.5 U	2.5 U
DP-8	GD00836	11/9/98	36	0.05 U	**0.1**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**2.7**	7.5 U	2.5 U

Table 3-19 (Continued)
Analytical Results for Metals and VOCs in Drivepoint Groundwater

Location	Sample	Date	Depth (ft bgs)	Metals		VOCs									
				Iron (mg/L)	Manganese (mg/L)	1,1,1-TCA (µg/L)	Benzene (µg/L)	cis-DCE (µg/L)	Ethyl-benzene (µg/L)	Toluene (µg/L)	Trans-DCE	TCE (µg/L)	Vinyl Chloride (µg/L)	Xylenes (Total) (µg/L)
DP-9	GD00911	11/9/98	11	0.05 U	**0.17**	**960**	**290**	**72,000**	**270**	**1,500**	100 U	**120,000**	**390**	**1,500**
DP-9	GD00920	11/10/98	20	**1.3**	**0.16**	**140**	**62** J	**6,600**	**110**	**640**	100 U	**35,000**	300 U	**640**
DP-9	GD00925	11/10/98	25	0.05 U	**0.27**	**1,800** J	**98** J	**3,100** J	**790** J	**1,100** J	200 UJ	**700,000**	600 UJ	**4,700** J
DP-9	GD00936	11/10/98	36	**2.4**	**0.052**	**310**	200 U	**4,400**	**240**	**1,000**	200 U	**55,000**	600 U	**1,300**
DP-10	GD01013	11/10/98	13	0.05 U	0.01 U	2.5 U	2.5 U	**3.9**	2.5 U	2.5 U	2.5 U	**40.1**	7.5 U	2.5 U
DP-10	GD01020	11/10/98	20	0.05 U	0.01 U	2.5 U	2.5 U	**3**	2.5 U	2.5 U	2.5 U	**32.6**	7.5 U	2.5 U
DP-10	GD01025	11/10/98	25	**0.69**	**0.051**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**16.3**	7.5 U	2.5 U
DP-10	GD01037	11/11/98	37	**0.077**	**0.23**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**2.5**	7.5 U	2.5 U
DP-11	GD01115	11/11/98	15	**0.05**	**0.01**	2.5 U	2.5 U	**2.6**	2.5 U	2.5 U	2.5 U	**17.4**	7.5 U	2.5 U
DP-11	GD51115*	11/11/98	15	**0.062**	**0.017**	2.5 U	2.5 U	**3.1**	2.5 U	2.5 U	2.5 U	**16.7**	7.5 U	2.5 U
DP-11	GD01120	11/11/98	20	0.05 U	**0.031**	2.5 U	2.5 U	**23.8**	2.5 U	2.5 U	2.5 U	**400**	7.5 U	2.5 U
DP-11	GD01125	11/11/98	25	0.05 U	**0.095**	25 U	25 U	25 U	25 U	25 U	25 U	**89.5**	75 U	25 U
DP-11	GD01136	11/11/98	36	0.05 U	**0.22**	5 U	5 U	**6.9**	5 U	5 U	5 U	**93.7**	15 U	5 U
DP-12	GD01212	11/11/98	12	**0.05**	**0.011**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**10.4**	7.5 U	2.5 U
DP-12	GD01220	11/11/98	20	0.05 U	**0.022**	2.5 U	2.5 U	**4.8**	2.5 U	2.5 U	2.5 U	**7.9**	7.5 U	2.5 U
DP-12	GD01225	11/11/98	25	**0.08**	**0.058**	2.5 U	2.5 U	**3.4**	2.5 U	2.5 U	2.5 U	**43.6**	7.5 U	2.5 U
DP-12	GD01236	11/11/98	36	**0.053**	**0.12**	2.5 U	2.5 U	**12**	2.5 U	2.5 U	2.5 U	**800**	7.5 U	2.5 U
DP-13	GD01314	11/11/98	14	0.05 U	0.01 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**6.2**	7.5 U	2.5 U
DP-13	GD01320	11/11/98	20	0.05 U	**0.05**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**3.3**	7.5 U	2.5 U
DP-13	GD01325	11/13/98	25	**0.065**	**0.079**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	7.5 U	2.5 U
DP-13	GD01339	11/13/98	39	**0.065**	**0.4**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**27**	7.5 U	2.5 U
DP-13	GD51339*	11/13/98	39	**0.093**	**0.36**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**30.7**	7.5 U	2.5 U
DP-14	GD01411	11/13/98	11	0.05 U	0.01 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**3.5**	7.5 U	2.5 U
DP-14	GD01420	11/13/98	20	0.05 U	**0.054**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**17.5**	7.5 U	2.5 U
DP-14	GD01425	11/13/98	25	**0.11**	**0.13**	2.5 U	2.5 U	**2.8**	2.5 U	2.5 U	2.5 U	**26.6**	7.5 U	2.5 U
DP-14	GD01432	11/16/98	32	0.05 U	**0.098**	2.5 U	2.5 U	**58.5**	2.5 U	2.5 U	**13.6**	**39,000**	7.5 U	2.5 U
DP-15	GD01511	11/16/98	11	**0.12**	**0.11**	5 U	5 U	5 U	5 U	5 U	5 U	**119**	15 U	5 U
DP-15	GD51511*	11/16/98	11	**0.15**	**0.12**	5 U	5 U	5 U	5 U	5 U	5 U	**109**	15 U	5 U
DP-15	GD01520	11/16/98	20	**0.12**	**0.18**	5 U	5 U	5 U	5 U	5 U	5 U	**71.6**	15 U	5 U
DP-15	GD01525	11/16/98	25	0.05 U	**0.46**	5 U	5 U	**27**	5 U	5 U	5 U	**426**	15 U	5 U
DP-15	GD01530	11/16/98	30	0.05 U	**0.48**	25 U	25 U	25 U	25 U	25 U	25 U	**398**	75 U	25 U
DP-16	GD01613	11/17/98	13	0.05 U	**0.025**	2.5 U	2.5 U	**15**	2.5 U	2.5 U	2.5 U	**36.6**	7.5 U	2.5 U
DP-16	GD01620	11/17/98	20	0.05 U	**0.039**	5 U	5 U	**6.4**	5 U	5 U	5 U	**70.1**	15 U	5 U
DP-16	GD01625	11/17/98	25	0.05 U	**0.47**	5 U	5 U	**17.8**	5 U	5 U	5 U	**132**	15 U	5 U

Table 3-19 (Continued)
Analytical Results for Metals and VOCs in Drivepoint Groundwater

				Metals		VOCs								
Location	Sample	Date	Depth (ft bgs)	Iron (mg/L)	Manganese (mg/L)	1,1,1-TCA (µg/L)	Benzene (µg/L)	cis-DCE (µg/L)	Ethyl-benzene (µg/L)	Toluene (µg/L)	Trans-DCE	TCE (µg/L)	Vinyl Chloride (µg/L)	Xylenes (Total) (µg/L)
DP-16	GD01635	11/17/98	35	0.05 U	**0.66**	5 U	5 U	**5.4**	5 U	5 U	5 U	**115**	15 U	5 U
DP-17	GD01717	11/17/98	17	**0.45** J	**0.052**	5 U	5 U	**354**	5 U	5 U	**4.4** J	**128**	**64.7**	**7.7**
DP-17	GD51717*	11/17/98	17	**0.68** J	**0.052**	20 U	20 U	**469**	20 U	20 U	20 U	**168**	**85.4**	20 U
DP-17	GD01722	11/17/98	22	0.05 U	**0.17**	10 U	10 U	**62.2**	10 U	10 U	10 U	**255**	30 U	10 U
DP-17	GD01731	11/18/98	31	0.05 U	**0.25**	15 U	15 U	**50.5**	15 U	15 U	15 U	**385**	45 U	15 U
DP-17	GD01738	11/18/98	38	0.05 U	**0.12**	10 U	10 U	**94.3**	10 U	10 U	10 U	**369**	10 U	10 U
DP-18	GD01811	11/18/98	11	**0.43**	**0.096**	2.5 U	2.5 U	**2,670**	2.5 U	2.5 U	**24.4**	**9,020**	7.5 U	2.5 U
DP-18	GD01820	11/18/98	20	**0.2**	**0.031**	20 U	20 U	**5,890**	20 U	20 U	**73.8**	**12,000**	60 U	20 U
DP-18	GD01825	11/18/98	25	**0.21**	**0.2**	50 U	50 U	**3,650**	50 U	50 U	**57**	**8,770**	150 U	50 U
DP-18	GD01837	11/18/98	37	0.05 U	**0.31**	50 U	50 U	**98.2**	50 U	50 U	50 U	**233**	150 U	50 U
DP-19	GD01916	11/19/98	16	0.05 U	**0.041**	2.5 U	2.5 U	**7.6**	2.5 U	2.5 U	2.5 U	**91.6**	7.5 U	2.5 U
DP-19	GD01922	11/19/98	22	0.05 U	**0.044**	5 U	5 U	**15.4**	5 U	5 U	5 U	**218**	15 U	5 U
DP-19	GD01927	11/19/98	27	0.05 U	**0.25**	10 U	10 U	**27.9**	10 U	10 U	10 U	**363**	30 U	10 U
DP-19	GD01937	11/19/98	37	0.05 U	**0.46**	20 U	20 U	**38.2**	20 U	20 U	20 U	**595**	60 U	20 U
DP-20	GD02013	11/19/98	13	0.05 U	0.01 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	15 U	5 U
DP-20	GD02020	11/20/98	20	0.05 U	**0.037**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	7.5 U	2.5 U
DP-20	GD02024	11/20/98	24	0.05 U	**0.092**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	7.5 U	2.5 U
DP-20	GD52024*	11/20/98	24	0.05 U	**0.085**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	7.5 U	2.5 U
DP-20	GD02036	11/20/98	36	**0.11**	**0.38**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	7.5 U	2.5 U
DP-21	GD02110	3/15/99	10	0.05 U	**0.06**	2.5 U	2.5 U	**140**	2.5 U	2.5 U	2.5 U	**1,500**	**23**	2.5 U
DP-21	GD02112	3/15/99	12	**0.26**	**0.11**	2.5 U	2.5 U	**150**	2.5 U	2.5 U	2.5 U	**1,300**	7.5 U	2.5 U
DP-21	GD02123	3/15/99	23	**0.95**	**0.18**	2.5 U	2.5 U	**150**	2.5 U	2.5 U	2.5 U	**470**	7.5 U	2.5 U
DP-21	GD02127	3/15/99	27	**2.2**	**0.84**	10 U	10 U	**58**	10 U	10 U	10 U	**400**	**110**	10 U
DP-22	GD02208	3/16/99	8	**0.18**	**0.045**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**42**	**11**	2.5 U
DP-22	GD02216	3/16/99	16	**0.13**	**0.024**	2.5 U	2.5 U	**3.6**	2.5 U	2.5 U	2.5 U	**51**	**27**	2.5 U
DP-22	GD02224	3/16/99	24	R	R	2.5 U	2.5 U	**57**	2.5 U	2.5 U	2.5 U	**1,800**	**15**	2.5 U
DP-22	GD02232	3/16/99	32	**0.068**	**0.039**	5 U	5 U	**5.3**	5 U	5 U	5 U	**61**	**22**	5 U
DP-23	GD02308	3/16/99	8	**0.067**	**0.36**	100 U	100 U	**180**	100 U	100 U	100 U	**740**	300 U	100 U
DP-23	GD02316	3/16/99	16	**0.093**	**0.4**	1,000 U	1,000 U	**5,100**	1,000 U	1,000 U	1,000 U	**470,000**	3,000 U	1,000 U
DP-23	GD52316*	3/16/99	16	0.05 U	**0.075**	1,000 U	1,000 U	**6,000**	1,000 U	1,000 U	1,000 U	**500,000**	3,000 U	1,000 U
DP-23	GD02324	3/17/99	24	**0.13**	**0.23**	1,000 U	**2,200**	**2,300**	1,000 U	**4,200**	1,000 U	**970,000**	3,000 U	1,000 U
DP-23	GD02339	3/17/99	39	**0.38**	**0.11**	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	**48,000**	3,000 U	1,000 U
DP-24	GD02409	3/17/99	9	**0.057**	**0.017**	**4**	2.5 U	**200**	2.5 U	2.5 U	**2.6**	**89**	**12**	2.5 U
DP-24	GD02419	3/17/99	19	**0.77**	**0.57**	**5.4**	2.5 U	**150**	2.5 U	2.5 U	**2.6**	**68**	**12**	2.5 U

Table 3-19 (Continued)
Analytical Results for Metals and VOCs in Drivepoint Groundwater

				Metals		VOCs								
Location	Sample	Date	Depth (ft bgs)	Iron (mg/L)	Manganese (mg/L)	1,1,1-TCA (µg/L)	Benzene (µg/L)	cis-DCE (µg/L)	Ethyl-benzene (µg/L)	Toluene (µg/L)	Trans-DCE	TCE (µg/L)	Vinyl Chloride (µg/L)	Xylenes (Total) (µg/L)
DP-24	GD02424	3/17/99	24	**0.4**	**0.21**	**8.4**	2.5 U	**200**	2.5 U	2.5 U	2.5 U	**78**	**14**	2.5 U
DP-24	GD02435	3/17/99	35	**0.13**	**0.023**	2.5 U	2.5 U	**33**	2.5 U	2.5 U	2.5 U	**29**	7.5 U	2.5 U
DP-25	GD02507	3/18/99	7	0.05 U	**0.014**	2.5 U	2.5 U	**2.6**	2.5 U	2.5 U	2.5 U	**13**	**21**	2.5 U
DP-25	GD02519	3/18/99	19	**0.19**	**0.39**	2.5 U	2.5 U	**3.6**	2.5 U	2.5 U	2.5 U	**18**	**24**	2.5 U
DP-25	GD02524	3/18/99	24	**0.27**	**0.45**	2.5 U	2.5 U	**3.7**	2.5 U	2.5 U	2.5 U	**23**	**10**	2.5 U
DP-25	GD02530	3/18/99	30	**0.072**	**0.35**	2.5 U	2.5 U	**10**	2.5 U	2.5 U	2.5 U	**83**	**18**	2.5 U
DP-26	GD02609	3/18/99	9	**0.093**	**0.39**	2.5 U	2.5 U	**35**	2.5 U	2.5 U	2.5 U	**310**	**8.2**	2.5 U
DP-26	GD02619	3/18/99	19	0.05 U	**1.2**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**14**	**13**	2.5 U
DP-26	GD02625	3/19/99	25	0.05 U	**0.3**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**18**	**13**	2.5 U
DP-26	GD02638.5	3/19/99	38	0.05 U	**0.27**	2.5 U	2.5 U	**2.7**	2.5 U	2.5 U	2.5 U	**28**	**17**	2.5 U
DP-27	GD02709	3/19/99	9	0.05 U	**0.016**	2.5 U	2.5 U	**2.5**	2.5 U	2.5 U	2.5 U	**37**	**18**	2.5 U
DP-27	GD02719	3/19/99	19	0.05 U	**0.24**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**2.5**	7.5 U	2.5 U
DP-27	GD02723	3/19/99	23	**0.083**	**0.19**	2.5 U	2.5 U	**2.7**	2.5 U	2.5 U	2.5 U	**4.8**	7.5 U	2.5 U
DP-27	GD02738	3/19/99	38	**0.061**	**0.37**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**11**	2.5 U
DP-27	GD52738*	3/19/99	38	0.05 U	**0.35**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**13**	2.5 U
DP-28	GD02810	3/22/99	10	0.05 U	**0.037**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**11**	2.5 U
DP-28	GD02819	3/22/99	19	**0.058**	**0.33**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**11**	2.5 U
DP-28	GD02824	3/22/99	24	0.05 U	**0.26**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**2.8**	**18**	2.5 U
DP-28	GD02831	3/22/99	31	0.05 U	**0.23**	2.5 U	2.5 U	**2.8**	2.5 U	2.5 U	2.5 U	**2.6**	**13**	2.5 U
DP-29	GD02908.5	3/22/99	8	0.05 U	**0.095**	2.5 U	2.5 U	**2,400**	2.5 U	2.5 U	**20**	**48**	**700**	2.5 U
DP-29	GD02919	3/22/99	19	0.05 U	**0.51**	25 U	25 U	**99**	25 U	25 U	25 U	**180**	75 U	25 U
DP-29	GD02924	3/23/99	24	0.05 U	**0.26**	2.5 U	2.5 U	**150**	2.5 U	2.5 U	2.5 U	**930**	7.5 U	**7.3**
DP-29	GD52924*	3/23/99	24	0.05 U	**0.24**	2.5 U	2.5 U	**130**	2.5 U	2.5 U	2.5 U	**1,200**	7.5 U	**7.3**
DP-29	GD02928	3/23/99	28	0.05 U	**0.48**	62.5 U	62.5 U	**100**	62.5 U	62.5 U	62.5 U	**520**	187.5 U	62.5 U
DP-30	GD03013	3/23/99	13	0.05 U	**0.036**	2.5 U	2.5 U	**170**	2.5 U	2.5 U	2.5 U	**400**	**26**	2.5 U
DP-30	GD03019	3/23/99	19	0.05 U	**0.038**	2.5 U	2.5 U	**42**	2.5 U	2.5 U	2.5 U	**87**	**14**	2.5 U
DP-30	GD03024	3/23/99	24	0.05 U	**0.13**	2.5 U	2.5 U	**380**	2.5 U	2.5 U	**14**	**780**	**21**	2.5 U
DP-30	GD03035	3/23/99	35	0.05 U	**0.38**	2.5 U	2.5 U	**110**	2.5 U	2.5 U	2.5 U	**990**	**21**	2.5 U
DP-31	GD03109	3/24/99	9	0.05 U	0.01 U	2.5 U	2.5 U	**5**	2.5 U	2.5 U	2.5 U	**50**	**18**	2.5 U
DP-31	GD03112	3/24/99	12	**0.15**	**0.024**	2.5 U	2.5 U	**4.3**	2.5 U	2.5 U	2.5 U	**32**	**17**	2.5 U
DP-31	GD03127	3/24/99	27	0.05 U	**0.089**	2.5 U	2.5 U	**22**	2.5 U	2.5 U	2.5 U	**440**	**22**	2.5 U
DP-31	GD53127*	3/24/99	27	0.05 U	**0.098**	2.5 U	2.5 U	**16**	2.5 U	2.5 U	2.5 U	**430**	**19**	2.5 U
DP-31	GD03135	3/24/99	35	**1.8**	**0.8**	2.5 U	2.5 U	**200**	2.5 U	2.5 U	**5.5**	**930**	**12**	2.5 U
DP-32	GD03209	3/25/99	9	0.05 U	**0.087**	2.5 U	2.5 U	**5.3**	2.5 U	2.5 U	2.5 U	**220**	**7.6**	2.5 U

Table 3-19 (Continued)
Analytical Results for Metals and VOCs in Drivepoint Groundwater

				Metals		VOCs								
Location	Sample	Date	Depth (ft bgs)	Iron (mg/L)	Manganese (mg/L)	1,1,1-TCA (µg/L)	Benzene (µg/L)	cis-DCE (µg/L)	Ethyl-benzene (µg/L)	Toluene (µg/L)	Trans-DCE	TCE (µg/L)	Vinyl Chloride (µg/L)	Xylenes (Total) (µg/L)
DP-32	GD03219	3/25/99	19	**0.14**	**0.12**	50 U	50 U	50 U	50 U	50 U	50 U	**680**	150 U	50 U
DP-32	GD53219*	3/25/99	19	**0.11**	**0.083**	50 U	50 U	50 U	50 U	50 U	50 U	**960**	150 U	50 U
DP-32	GD03224	3/25/99	24	**0.66**	**0.49**	50 U	50 U	**86**	50 U	50 U	50 U	**2,200**	150 U	50 U
DP-32	GD03228	3/25/99	28	**0.31**	**0.56**	125 U	125 U	125 U	125 U	125 U	125 U	**840**	375 U	125 U
DP-33	GD03309	3/25/99	9	**0.083**	**0.028**	2.5 U	2.5 U	**37**	2.5 U	2.5 U	2.5 U	**900**	**13**	2.5 U
DP-33	GD03324	3/25/99	24	**0.14**	**0.24**	62.5 U	62.5 U	**1,300**	62.5 U	62.5 U	62.5 U	**75,000**	187.5 U	62.5 U
DP-33	GD03329	3/26/99	29	**0.13**	**0.085**	125 U	125 U	125 U	125 U	125 U	125 U	**7,100**	375 U	125 U
DP-33	GD03335	3/26/99	35	**0.16**	**0.083**	500 U	500 U	500 U	500 U	500 U	500 U	**9,900**	1,500 U	500 U
DP-34	GD03409	3/26/99	9	0.05 U	**0.034**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**4.2**	**12**	2.5 U
DP-34	GD03419	3/26/99	19	**0.084**	**0.099**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**41**	7.5 U	2.5 U
DP-34	GD53419*	3/26/99	19	**0.076**	**0.075**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**36**	7.5 U	2.5 U
DP-34	GD03424	3/26/99	24	0.05 U	**0.069**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**6**	**13**	2.5 U
DP-34	GD03437	3/29/99	37	**0.46**	**0.4**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**23**	**7.7**	2.5 U
DP-35	GD03509	3/29/99	9	**0.06**	0.01 U	2.5 U	2.5 U	**2.9**	2.5 U	2.5 U	2.5 U	**9.2**	**9.2**	2.5 U
DP-35	GD03519	3/29/99	19	**0.056**	**0.013**	2.5 U	2.5 U	**13**	2.5 U	2.5 U	2.5 U	**13**	**14**	2.5 U
DP-35	GD53519*	3/29/99	19	**0.07**	**0.019**	2.5 U	2.5 U	**11**	2.5 U	2.5 U	2.5 U	**10**	**10**	2.5 U
DP-35	GD03524	3/29/99	24	**0.28**	**0.097**	2.5 U	2.5 U	**20**	2.5 U	2.5 U	2.5 U	**21**	**15**	2.5 U
DP-35	GD03534	3/29/99	34	**0.76**	**0.51**	2.5 U	2.5 U	**5.5**	2.5 U	2.5 U	2.5 U	**19**	7.5 U	2.5 U
DP-36	GD03612	3/30/99	12	**0.096**	0.01 U	2.5 U	2.5 U	**8.7**	2.5 U	2.5 U	2.5 U	**14**	7.5 U	2.5 U
DP-36	GD03619	3/30/99	19	**0.086**	**0.012**	2.5 U	2.5 U	**14**	2.5 U	2.5 U	2.5 U	**21**	7.5 U	2.5 U
DP-36	GD03624	3/30/99	24	**0.11**	**0.23**	2.5 U	2.5 U	**27**	2.5 U	2.5 U	**2.1** J	**350**	**12**	2.5 U
DP-36	GD03636	3/30/99	36	**0.17**	**0.46**	25 U	25 U	**75**	25 U	25 U	25 U	**460**	**140**	25 U
DP-37	GD03713	3/30/99	13	**0.1**	0.01 U	2.5 U	2.5 U	**18**	2.5 U	2.5 U	2.5 U	**48**	**9.8**	2.5 U
DP-37	GD03719	3/30/99	19	**0.076**	**0.014**	5 U	5 U	**17**	5 U	5 U	5 U	**12**	15 U	5 U
DP-37	GD53719*	3/30/99	19	**0.11**	**0.018**	5 U	5 U	**17**	5 U	5 U	5 U	**11**	15 U	5 U
DP-37	GD03722	3/31/99	22	**0.42**	**0.52**	5 U	5 U	**7.3**	5 U	5 U	5 U	**19**	15 U	5 U
DP-37	GD03734	3/31/99	34	0.05 U	**0.26**	2.5 U	2.5 U	**4.5**	2.5 U	2.5 U	2.5 U	**17**	7.5 U	2.5 U
DP-38	GD03807.5	3/31/99	7	0.05 U	**0.036**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**4.8**	7.5 U	2.5 U
DP-38	GD03819	3/31/99	19	**0.32**	**0.23**	2.5 U	2.5 U	**4.3**	2.5 U	2.5 U	2.5 U	**6.9**	7.5 U	2.5 U
DP-38	GD03824	3/31/99	24	**0.41**	**0.18**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**4.2**	7.5 U	2.5 U
DP-38	GD53824*	3/31/99	24	**0.4**	**0.22**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**4.5**	7.5 U	2.5 U
DP-38	GD03831	3/31/99	31	**0.067**	**0.37**	2.5 U	2.5 U	**29**	2.5 U	2.5 U	2.5 U	**450**	7.5 U	2.5 U
DP-39	GD03913	4/1/99	13	0.05 U	**0.039**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**7.1**	7.5 U	2.5 U
DP-39	GD03919	4/1/99	19	**0.17**	**0.036**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	7.5 U	2.5 U

Table 3-19 (Continued)
Analytical Results for Metals and VOCs in Drivepoint Groundwater

				Metals		VOCs								
Location	Sample	Date	Depth (ft bgs)	Iron (mg/L)	Manganese (mg/L)	1,1,1-TCA (µg/L)	Benzene (µg/L)	cis-DCE (µg/L)	Ethyl-benzene (µg/L)	Toluene (µg/L)	Trans-DCE	TCE (µg/L)	Vinyl Chloride (µg/L)	Xylenes (Total) (µg/L)
DP-39	GD03924	4/1/99	24	**0.15**	**0.064**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	7.5 U	2.5 U
DP-39	GD03935	4/1/99	35	0.05 U	**0.45**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**4.7**	7.5 U	2.5 U
DP-40	GD04015	4/1/99	15	**0.11**	0.01 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**19**	**8**	2.5 U
DP-40	GD04019	4/1/99	19	**0.12**	**0.018**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**16**	7.5 U	2.5 U
DP-40	GD04023	4/2/99	23	**0.13**	**0.062**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**16**	7.5 U	2.5 U
DP-40	GD04037	4/2/99	37	**0.3**	**0.16**	2.5 U	2.5 U	**8.8**	2.5 U	2.5 U	2.5 U	**88**	7.5 U	2.5 U
DP-41	GD04108	4/2/99	8	0.05 U	**0.12**	2.5 U	2.5 U	**230**	2.5 U	2.5 U	2.5 U	**610**	7.5 U	2.5 U
DP-41	GD04119	4/2/99	19	**0.092**	**0.31**	50 U	50 U	**110**	50 U	50 U	50 U	**1,000**	150 U	50 U
DP-41	GD54119*	4/2/99	19	**0.17**	**0.4**	50 U	50 U	**120**	50 U	50 U	50 U	**1,000**	150 U	50 U
DP-41	GD04130	4/2/99	30	**1.2**	**0.56**	100 U	100 U	**140**	100 U	100 U	100 U	**1,100**	300 U	100 U
DP-41	GD04133	4/5/99	33	**0.66**	**0.21**	100 U	100 U	**120**	100 U	100 U	100 U	**1,200**	300 U	100 U
DP-42	GD04208	4/5/99	8	0.05 U	**0.012**	2.5 U	2.5 U	**7.7**	2.5 U	2.5 U	2.5 U	**63**	7.5 U	2.5 U
DP-42	GD04216	4/5/99	16	**0.12**	**0.25**	5 U	5 U	**96**	5 U	5 U	5 U	**390**	15 U	5 U
DP-42	GD04223	4/5/99	23	**0.068**	**0.1**	50 U	50 U	50 U	50 U	50 U	50 U	**270**	150 U	50 U
DP-42	GD04239	4/6/99	39	**0.19**	**0.39**	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	**96**	37.5 U	12.5 U
DP-43	GD04307	4/6/99	7	0.05 U	0.01 U	2.5 U	2.5 U	**37**	2.5 U	2.5 U	2.5 U	**310**	7.5 U	2.5 U
DP-43	GD04319	4/6/99	19	**0.55**	**0.43**	25 U	25 U	**53**	25 U	25 U	25 U	**120**	75 U	25 U
DP-43	GD54319*	4/6/99	19	**0.63**	**0.56**	25 U	25 U	**54**	25 U	25 U	25 U	**110**	75 U	25 U
DP-43	GD04324	4/6/99	24	**0.65**	**0.4**	10 U	10 U	**39**	10 U	10 U	10 U	**120**	30 U	10 U
DP-43	GD04330	4/6/99	30	**0.83**	**0.2**	10 U	10 U	**110**	10 U	10 U	10 U	**530**	30 U	10 U
DP-44	GD04412	4/6/99	12	0.05 U	0.01 U	2.5 U	2.5 U	**7.5**	2.5 U	2.5 U	2.5 U	**8.3**	7.5 U	2.5 U
DP-44	GD04419	4/7/99	19	0.05 U	**0.087**	2.5 U	2.5 U	**79**	2.5 U	2.5 U	2.5 U	**200**	**8.1**	2.5 U
DP-44	GD04424	4/7/99	24	0.05 U	**0.089**	12.5 U	12.5 U	**50**	12.5 U	12.5 U	12.5 U	**160**	37.5 U	12.5 U
DP-44	GD04433	4/7/99	33	0.05 U	**0.22**	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	**130**	37.5 U	12.5 U
DP-45	GD04506	4/7/99	6	**0.073**	**0.028**	2.5 U	2.5 U	**4.9**	2.5 U	2.5 U	2.5 U	**11**	7.5 U	2.5 U
DP-45	GD04517	4/7/99	17	0.05 U	**0.5**	2.5 U	2.5 U	**110**	2.5 U	2.5 U	**3.2**	**260**	**18**	2.5 U
DP-45	GD54517*	4/7/99	17	0.05 U	**0.45**	2.5 U	2.5 U	**100**	2.5 U	2.5 U	**3.4**	**240**	**19**	2.5 U
DP-45	GD04522	4/7/99	22	0.05 U	**0.24**	25 U	25 U	**210**	25 U	25 U	25 U	**490**	75 U	25 U
DP-45	GD04528	4/8/99	28	**0.074**	**0.23**	25 U	25 U	**180**	25 U	25 U	25 U	**440**	75 U	25 U
DP-46	GD04607	4/8/99	7	0.05 U	**0.011**	2.5 U	2.5 U	**150**	2.5 U	2.5 U	**3.4**	**2,000**	**16**	2.5 U
DP-46	GD04618	4/8/99	18	**0.24**	**0.36**	100 U	100 U	**150**	100 U	100 U	100 U	**1,700**	300 U	100 U
DP-46	GD04624	4/8/99	24	**0.28**	**0.052**	100 U	100 U	**76** J	100 U	100 U	100 U	**1,000**	300 U	100 U
DP-46	GD54624*	4/8/99	24	**0.28**	**0.066**	100 U	100 U	**51** J	100 U	100 U	100 U	**1,100**	300 U	100 U
DP-46	GD04632	4/8/99	32	**0.91**	**0.7**	100 U	100 U	100 U	100 U	100 U	100 U	**360**	300 U	100 U

Table 3-19 (Continued)
Analytical Results for Metals and VOCs in Drivepoint Groundwater

				Metals		VOCs								
Location	Sample	Date	Depth (ft bgs)	Iron (mg/L)	Manganese (mg/L)	1,1,1-TCA (µg/L)	Benzene (µg/L)	cis-DCE (µg/L)	Ethyl-benzene (µg/L)	Toluene (µg/L)	Trans-DCE	TCE (µg/L)	Vinyl Chloride (µg/L)	Xylenes (Total) (µg/L)
DP-47	GD04709	4/8/99	9	0.05 U	0.01 U	2.5 U	2.5 U	**260**	2.5 U	2.5 U	2.5 U	**770**	7.5 U	2.5 U
DP-47	GD04717	4/8/99	17	**0.061**	0.01 U	50 U	50 U	**170**	50 U	50 U	50 U	**550**	150 U	50 U
DP-47	GD04721	4/9/99	21	**0.33**	**0.17**	50 U	50 U	**77**	50 U	50 U	50 U	**610**	150 U	50 U
DP-47	GD04732	4/9/99	32	0.05 U	**0.12**	50 U	50 U	**330**	50 U	50 U	50 U	**21,000**	**170**	50 U
DP-48	GD04806	4/9/99	6	0.05 U	**0.12**	2.5 U	2.5 U	**120**	2.5 U	2.5 U	2.5 U	**35**	**8.4**	2.5 U
DP-48	GD04819	4/9/99	19	**0.13**	**0.038**	10 U	10 U	10 U	10 U	10 U	10 U	**46**	30 U	10 U
DP-48	GD04824	4/9/99	24	0.05 U	**0.022**	10 U	10 U	**31**	10 U	10 U	10 U	**350**	30 U	10 U
DP-48	GD04833	4/9/99	33	0.05 U	**0.12**	25 U	25 U	**41**	25 U	25 U	25 U	**870**	75 U	25 U
DP-49	GD04907	4/12/99	7	0.05 U	0.01 U	2.5 U	2.5 U	**41**	2.5 U	2.5 U	2.5 U	**43**	7.5 U	2.5 U
DP-49	GD04919	4/12/99	19	0.05 U	**0.18**	5 U	5 U	**17**	5 U	5 U	5 U	**91**	**18**	5 U
DP-49	GD04922	4/12/99	22	0.05 U	**0.16**	10 U	10 U	10 U	10 U	10 U	10 U	**27**	30 U	10 U
DP-49	GD04932	4/12/99	32	0.05 U	**0.26**	2.5 U	2.5 U	**59**	2.5 U	2.5 U	2.5 U	**11,000** J	7.5 U	2.5 U
DP-50	GD05009	4/12/99	9	**0.051**	**0.024**	2.5 U	2.5 U	**12**	2.5 U	2.5 U	2.5 U	**23**	7.5 U	2.5 U
DP-50	GD05019	4/13/99	19	0.05 U	**0.039**	2.5 U	2.5 U	**7.1**	2.5 U	2.5 U	2.5 U	**7.6**	7.5 U	2.5 U
DP-50	GD05024	4/13/99	24	0.05 U	**0.15**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**6.6**	7.5 U	2.5 U
DP-50	GD05031	4/13/99	31	0.05 U	**0.14**	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	**6.3**	7.5 U	2.5 U

*field duplicate

Notes:
1,1,1-TCA - 1,1,1-trichloroethane
Boldface indicates analyte detected
cis-DCE - cis-dichloroethene
J - value is an estimated amount
N - result based on presumptive evidence
R - result rejected
TCE - trichloroethene
trans-DCE - trans-1,2-dichloroethene
U - not detected at the associated value

Metals analysis by MultiChem Analytical Services; VOC analysis by Transglobal Environmental Geosciences Northwest

Table 3-20
Elevation of Aquitard in Monitoring Wells and Drivepoint Locations

Monitoring Well Number	Northing	Easting	Surface Elevation (ft msl)	Depth to Contact (ft bgs)	Elevation of Contact (ft msl)
LC-21	652756.0	1496445.0	279.50	32	248
LC-21b	652728.0	1496420.0	279.60	NC	249
LC-21c	652743.0	1496426.0	279.70	NC	248
LC-21-1	652742.0	1496443.0	279.50	40	240
LC-23	652462.0	1496851.0	280.51	38	243
LC-24	652819.0	1497577.0	285.39	43	242
LC-26	651895.0	1497563.0	275.81	NC	
LC-27	651871.0	1496425.0	278.34	40	238
LC-50	652191.0	1495527.0	271.70	29	243
LC-64a	652433.1	1496588.3	276.20	33	243
LC-64b	652424.5	1496580.0	276.50	34	243
LC-106	652717.5	1496403.2	280.25	40	240
LC-107	652729.9	1496388.9	280.98	NC	
LC-108	652634.4	1496486.6	279.07	44	235
LC-133	652243.0	1496450.9	280.09	37	243
LC-134	652374.1	1496669.0	276.12	NC	
LC-135	652622.2	1496727.4	280.30	34	246
LC-136a	652476.2	1496351.9	277.65	NC	
LC-136b	652485.9	1496354.9	277.66	42	236
LC-137a	652684.7	1496167.9	289.32	NC	
LC-137b	652691.5	1496179.7	289.05	NC	
LC-137c	652698.6	1496191.0	289.19	NC	
LC-138	652383.9	1496553.0	277.38	30	247
LC-139	652380.3	1496623.4	276.44	28	248
LC-145	651831.2	1497306.8	279.92	35	245
LC-146	651898.3	1497408.3	277.59	NC	
LC-150	652559.1	1496626.2	279.50	36	244
LC-153	652513.7	1496647.4	278.56	36	243
LC-155	652400.0	1496509.8	277.16	NC	
LC-156	652357.1	1496547.1	276.60	NC	
LC-158	652492.4	1496560.8	276.24	31	245
LC-159	652493.9	1496260.6	276.93	36	241
LC-160	652434.5	1496210.3	276.58	42	235
LC-161	652298.7	1497065.0	280.36	34	246
LC-162	652337.6	1496881.7	277.32	33	244

Table 3-20 (Continued)
Elevation of Aquitard in Monitoring Wells and Drivepoint Locations

Drivepoint Number	Northing	Easting	Surface Elevation (ft msl)	Depth to Aquitard (ft bgs)	Elevation of Aquitard (ft msl)
DP-1	652310.90	1496833.14	276.77	30	247
DP-2	652373.75	1496965.45	279.39	32	247
DP-3	652159.47	1497028.01	278.23	32	246
DP-4	652372.35	1497191.81	281.73	NC	
DP-5	651933.40	1497316.70	277.83	NC	
DP-6	651914.84	1497366.10	276.86	NC	
DP-7	652294.24	1497024.40	279.47	NC	
DP-8	652061.97	1497249.52	278.78	NC	
DP-9	651971.50	1497022.42	277.61	NC	
DP-10	652079.44	1497444.67	280.09	NC	
DP-11	651858.27	1497191.00	281.51	34	248
DP-12	652103.23	1496962.41	278.01	34	244
DP-13	652325.20	1497390.99	280.71	NC	
DP-14	652219.91	1497078.09	279.24	32	247
DP-15	652170.63	1496837.76	277.14	29	248
DP-16	652078.51	1497127.25	278.12	35	243
DP-17	651858.88	1497009.45	282.75	NC	
DP-18	651971.30	1497197.50	277.67	NC	
DP-19	651770.97	1497040.23	283.36	36	247
DP-20	652212.96	1497310.82	279.77	35	245
DP-21	652373.70	1496533.72	276.86	NC	
DP-22	652532.24	1496747.72	280.39	33	247
DP-23	652486.78	1496401.78	276.75	39	238
DP-24	652184.35	1496547.09	279.83	36	244
DP-25	652047.58	1496748.39	278.20	31	247
DP-26	652425.90	1497595.51	281.83	NC	
DP-27	652261.27	1497684.80	282.00	39	243
DP-28	651868.19	1497431.88	278.07	32	246
DP-29	651982.47	1497269.19	277.78	29	249
DP-30	651753.13	1497168.66	284.46	NC	
DP-31	652565.42	1496366.35	277.10	36	241
DP-32	652412.77	1496658.31	275.67	28	248
DP-33	652432.11	1496357.16	277.48	35	242
DP-34	652807.63	1496819.99	278.92	38	241
DP-35	652073.39	1496525.32	280.07	35	245
DP-36	651848.78	1496658.21	282.51	36	247
DP-37	652402.13	1497063.51	285.94	35	251

Table 3-20 (Continued)
Elevation of Aquitard in Monitoring Wells and Drivepoint Locations

Drivepoint Number	Northing	Easting	Surface Elevation (ft msl)	Depth to Aquitard (ft bgs)	Elevation of Aquitard (ft msl)
DP-38	652143.56	1496761.42	278.47	32	246
DP-39	652565.76	1497487.29	286.04	36	250
DP-40	652561.84	1497002.56	288.00	38	250
DP-41	652380.42	1496241.44	276.72	NC	
DP-42	652526.28	1496477.46	276.68	40	237
DP-43	652327.42	1496495.55	277.27	NC	
DP-44	651704.34	1497229.50	282.85	34	249
DP-45	652234.86	1496943.32	277.39	29	248
DP-46	652334.14	1496382.50	276.64	33	244
DP-47	652480.35	1496302.89	278.24	33	245
DP-48	652015.50	1496983.01	277.33	NC	
DP-49	651916.08	1497164.95	277.68	33	245
DP-50	651820.53	1497330.27	280.44	32	248

Notes:
ft bgs - feet below ground surface
msl - mean sea level
NC - No correlation; monitoring well boring log or drivepoint observation did not strongly indicate appropriate presence of silt/sand layer or content. (Layer may be present in subsurface, but is not reflected on log or in field, or boring/drivepoint is too shallow.)

Table 3-21
Field Observations of the Presence of the Aquitard and Discontinuous Lower-Permeability Zones Encountered at Drivepoint Locations

Drivepoint Number	Observed Depth in Field to Surface of Potential Aquitard(s) (ft bgs)	Depth to Top of Aquitard (ft bgs)	Depth to Top of Discontinuous Lower Permeability Zone (ft bgs)	Depths of Elevated Concentrations (>1<10 ppm) of TCE (ft bgs)	Depths of Elevated Concentrations (>10 ppm) of TCE (ft bgs)
DP-1[a]	16; 30		16		
DP-1		30		25, **30**	
DP-2	Possibly at 32 or >36	32	22		
DP-3	~32	32		**33**	
DP-4	No indication of aquitard to 36				
DP-5[b]	24		24	10	**24**, 33
DP-6[b]	24		24	20, **24**	10
DP-7	No indication of aquitard to 35				
DP-8	No indication of aquitard to 36				
DP-9	Possibly at ~32 or >36				11, 20, 25, 36
DP-10	No indication of aquitard to 37				
DP-11	34	34			
DP-12	34	34			
DP-13	No indication of aquitard to 39				
DP-14	32	32			**32**
DP-15	29.5	29			
DP-16	Possibly at ~32 otherwise >36	35			
DP-17[a]	21; 31		21		
DP-17[b]			31		
DP-18	24		24	11, 25	**20**
DP-19	36	36			
DP-20[b]	23; 35		23		
DP-20		35			
DP-21[a]	13; 27; >30		13	**10, 12**	
DP-21			27		
DP-22	33	33		24	
DP-23	39	39			16, 24, **39**
DP-24	36	36			
DP-25	31	31			
DP-26	No indication of aquitard to 38				
DP-27[b]	23; 39		23		
DP-27		39			
DP-28	32	32			
DP-29	29	29		8, 24	
DP-30	No indication of aquitard to 36				
DP-31[a]	13; 28; 36		13		
DP-31[b]			28		
DP-31		36			
DP-32	28	28		24	
DP-33[a]	12; 35		12		
DP-33		35		29, **35**	24
DP-34	38	38			
DP-35	35	35			
DP-36	36	36			
DP-37[b]	23; 35		23		

Table 3-21 (Continued)
Field Observations of the Presence of the Aquitard and Discontinuous Lower-Permeability Zones Encountered at Drivepoint Locations

Drivepoint Number	Observed Depth in Field to Surface of Potential Aquitard(s) (ft bgs)	Depth to Top of Aquitard (ft bgs)	Depth to Top of Discontinuous Lower Permeability Zone (ft bgs)	Depths of Elevated Concentrations (>1<10 ppm) of TCE (ft bgs)	Depths of Elevated Concentrations (>10 ppm) of TCE (ft bgs)
DP-37		35			
DP-38	32	32			
DP-39	36	36			
DP-40	38	38			
DP-41[a]	21; 30		21		
DP-41[b]			30	**19, 30,** 33	
DP-42[a]	17; 24; 40		17		
DP-42[b]			24		
DP-42		40			
DP-43	No indication of aquitard to 31				
DP-44	34	34			
DP-45[a]	18; 29		18		
DP-45		29			
DP-46	33	33		7, 18, 24	
DP-47[b]	22; 33		22		
DP-47		33			**32**
DP-48	No indication of aquitard to 34				
DP-49[b]	22; 33		22		
DP-49		33			**32**
DP-50	32	32			

[a]Second depth
[b]Third depth

Notes:
bgs - below ground surface
Boldface - depth of elevated concentration correlates with depth to aquitard and/or zone of lower permeability
msl - mean sea level
ppm - parts per million
TCE - trichlorethene

Table 3-22
Analytical Data Sets

Sample Group	Laboratory	Collection Date	Analyte Group
Soil-Gas	TEG	October 1998	Volatile organics
Drivepoint Groundwater	TEG	October and November 1998	Volatile organics
Drivepoint Groundwater	TEG	March and April 1999	Volatile organics
Trench Groundwater	TEG	October 1998	Volatile organics
Trench Soil and NAPL	TEG	October 1998	Volatile organics Gasoline-range hydrocarbons Diesel-range hydrocarbons
Drivepoint Groundwater	MultiChem	October and November 1998	Dissolved iron and manganese
Drivepoint Groundwater	MultiChem	March and April 1999	Dissolved iron and manganese
Trench Soil, Groundwater, and NAPL	MultiChem	October 1998	Volatile organics Gasoline-range hydrocarbons Diesel-range hydrocarbons
Barren Area Soil	MultiChem	September 1998	Volatile organics Semivolatile organics Organochlorine pesticides PCBs Chlorinated herbicides
Trench Soil and NAPL	MultiChem	October 1998	Semivolatile organics PCBs
Trench Soil	ARI Soil Tech Core	October 1998	Total organic/inorganic carbon Particle size CBD extraction for iron and manganese
Trench NAPL	PTS	October 1998	Interfacial tension Viscosity

Notes:
ARI - Analytical Resources, Inc.
CBD - citrate-bicarbonate-dithionate
Core - Core Laboratories, Inc.
MultiChem - MultiChem Analytical Services, Inc.
NAPL - nonaqueous-phase liquid
PCB - polychlorinated biphenyl
PTS - PTS Laboratories, Inc.
Soil Tech - Soil Technology, Inc.
TEG - Transglobal Environmental Geosciences Northwest, Inc.

Table 3-23
Water PE Sample Results

Analyte (µg/L)	Certified Value	GD90100	% Recovery	GD90301	% Recovery	GD90713	% Recovery	GT901A	% Recovery	GT904A	% Recovery
Benzene	15	15	100.0	17.3	115.3	17.9	119.3	15.9	106.0	12.7	84.7
cis-1,2-Dichloroethylene	11.1	12.5	112.6	13.3	119.8	11.8	106.3	11.5	103.6	10.6	95.5
trans-1,2-Dichloroethylene	11.9	13.1	110.1	11.7	98.3	13.2	110.9	11	92.4	11.4	95.8
Ethylbenzene	11	11	100.0	12.6	114.5	12.4	112.7	16.3	**148.2**	9.3	84.5
Toluene	14.8	14.7	99.3	16.5	111.5	17.7	119.6	13.4	90.5	12.4	83.8
1,1,1-Trichloroethane	11.2	14.8	**132.1**	12.3	109.8	11.2	100.0	10.7	95.5	12.2	108.9
Trichloroethylene	30.1	29.6	98.3	36.3	120.6	30.2	100.3	25.8	85.7	28.2	93.7
Vinyl chloride	12	12	100.0	10.7	89.2	10.8	90.0	13.3	110.8	11.1	92.5
Total xylenes	11.3	12	106.2	13.4	118.6	13	115.0	15.3	**135.4**	9.5	84.1

Boldface indicates results outside of control limits (70 to 130 percent).

Table 3-24
Soil PE Sample Results

Analyte (mg/kg)	Certified Value	ST901A05	% Recovery
Benzene	1.97	1.78	90.4
cis-1,2-Dichloroethylene	1.98	2.01	101.5
trans-1,2-Dichloroethylene	1.51	1.63	107.9
Ethylbenzene	1.51	1.46	96.7
Toluene	2.95	2.59	87.8
1,1,1-Trichloroethane	1.49	1.81	121.5
Trichloroethene	4.02	3.63	90.3
Vinyl chloride	1.49	1.51	101.3
Total xylenes	0.549	0.54	98.4

Table 3-25
Soil-Gas PE Sample Results

Analyte	Certified Value	SG90105	% Recovery
Benzene	1.98	1.73	87.4
cis-1,2-Dichloroethylene	1.99	1.53	76.9
trans-1,2-Dichloroethylene	1.52	1.36	89.5
Ethylbenzene	1.52	1.48	97.4
Toluene	2.96	2.57	86.8
1,1,1-Trichloroethane	1.5	1.5	100.0
Trichloroethene	4.03	2.96	73.4
Vinyl chloride	1.5	1.5	100.0
Total xylenes	0.551	0.58	105.3

Table 3-26
NAPL Sample Results for VOCs and TPH

Analyte	NT001A09 (mg/kg)		NT006B15 (mg/kg)		NT007C13 (mg/kg)	
TPH–G (TEG)	**150,000**		**450,000**		**640,000**	J
TPH–G (MC)	**43,000**	J	**410,000**		**423,000**	J
TPH–D (TEG)	**190,000**		**150,000**	J	**240,000**	
TPH–D (MC)	**560,000**	J	**550,000**	J	**440,000**	J
Total TPH (TEG)	**340,000**		**600,000**	J	**880,000**	J
Total TPH (MC)	**603,000**	J	**1,010,000**	J	**963,000**	J
Benzene (TEG)	30	U	100	U	30	U
Benzene (MC)	25	UJ	25	UJ	25	UJ
cis-1,2-Dichloroethylene (TEG)	**44**		100	U	30	U
cis-1,2-Dichloroethylene (MC)	**440**	J	12	U	**36**	J
trans-1,2-Dichloroethylene (TEG)	30	U	100	U	30	U
trans-1,2-Dichloroethylene (MC)	12	UJ	12	UJ	12	UJ
Ethylbenzene (TEG)	**78**		**520**		**1,030**	
Ethylbenzene (MC)	12	UJ	12	UJ	12	UJ
Toluene (TEG)	30	U	100	U	**266**	
Toluene (MC)	12	UJ	12	UJ	12	UJ
1,1,1-Trichloroethane (TEG)	30	U	100	U	30	U
1,1,1-Trichloroethane (MC)	12	UJ	12	UJ	12	UJ
Trichloroethylene (TEG)	**180**		100	U	30	U
Trichloroethylene (MC)	12	UJ	12	UJ	**50**	J
Vinyl chloride (TEG)	150	U	500	U	150	U
Vinyl chloride (MC)	12	UJ	12	UJ	12	UJ
Total xylenes (TEG)	**344**		**3,600**		**2,400**	
Total xylenes (MC)	12	UJ	12	UJ	12	UJ

Notes:
Boldface indicates analyte detected
J - value is an estimated amount
MC - MultiChem Analytical Laboratories
TEG - Transglobal Environmental Geosciences
TPH–D - total petroleum hydrocarbons—diesel
TPH–G - total petroleum hydrocarbons—gasoline
U - not detected at the associated value

4.0 DATA INTERPRETATION

The primary objective of this site investigation was to evaluate whether NAPL sources of TCE/DCE contamination to groundwater exist at the EGDY. The focus of the data interpretation is on the existence and extent of NAPL. Also discussed in this section is an evaluation of the effectiveness of the various investigation techniques used to identify the presence of NAPL at this site. A revised conceptual site model is also provided.

4.1 OCCURRENCE OF NAPL

The focus of this section is the occurrence of NAPL, but it should be noted that TCE is also present at drivepoint and other sampling locations on the site regardless of NAPL presence (Figure 4-1 and Tables 4-1 through 4-4). In some cases, TCE was detected in groundwater at areas outside of known NAPL sources. For example, TCE was detected in the shallow sample from DP-26, near the eastern disposal pit (Figures 4-2 and 4-3). This sample is not located near and appears to be detached from identified DNAPL areas. Since this sample was collected from an area near the water table, the source of the TCE may be a vadose zone source or TCE-containing LNAPL not identified in this investigation. As presented on Figures 3-5 and 4-1, and Table 4-4, TCE was detected in groundwater at all 50 drivepoint locations but 1 (DP-20). Also, cis-1,2-DCE was detected in most of the drivepoint samples. NAPL was encountered at 12 drivepoint locations and 5 trenches, based on field observations and analytical results. Unknown sources of TCE (NAPL) may be present elsewhere at the site, as evidenced by the lateral occurrence of TCE in groundwater. The following sections describe the locations of known LNAPL and DNAPL sources in drums, trenches, and drivepoints.

4.1.1 Drums

At the beginning of this investigation it was assumed, based on historical information and aerial photographs, that primarily noncontainerized liquid waste was disposed of at the EGDY. However, during field activities it was discovered that waste disposal was also in the form of containerized liquids in drums. The geophysical surveying, exploratory trenching, and sampling techniques used during this investigation were designed to locate NAPL exclusively in the subsurface media, but not contained in drums. Therefore, a clear understanding of the number of drums in the disposal area was not attained.

Most of the trenches were excavated in areas where the geophysical results indicated the presence of a former disposal area (trench or pit) containing metallic debris. The metallic debris consisted of miscellaneous waste, including drums. The geophysical technique used in this investigation is unable to differentiate between drums and other metallic debris. The exploratory trenches exposed only a small portion of the disposal areas identified. Therefore, the number of

drums encountered in the exploratory trenches may be a small fraction of the actual number of drums present and buried at the site.

As described in Section 2, several crushed and partially or fully intact 55-gallon drums were encountered during trench excavating activities. In many cases, the drums were only partially exposed on a trench wall, so the type and quantity of the contents of each drum could not be determined. The following is a summary of the condition and contents of the drums encountered in the exploratory trenches:

Trench T-1: A drum that was punctured by the backhoe bucket and removed by Fort Lewis personnel was located close to the surface in segment E, and was fully intact and minimally deteriorated. The primary constituent of the liquid was TCE (832,000 mg/kg) (Table 4-5).

Trench T-2: An drum visible on the west wall appeared to be intact, rusted but not leaking.

Trench T-3: Four crushed or partially intact drums were uncovered on the south wall. The drums appeared deteriorated, but liquid was not visibly leaking from any of the drums. However, a strong solvent odor was associated with the drums.

Trench T-5: Four crushed or broken drums and multiple small (5 gallons or less) metal containers were encountered at a shallow depth. The larger drums appeared moderately deteriorated, and the smaller containers were fully rusted. Two of the 55-gallon drums contained a dark, viscous, odorous liquid and were removed by Fort Lewis personnel. Liquid did not appear to be present in the other containers. The liquid from two of the drums was analyzed only for SVOCs and PCBs (Table 4-5) and compounds from these groups were detected. The TPH and TCE concentrations are unknown because the samples were not analyzed for these compounds.

Trench T-6: Three drums were visible at a shallow depth on the south wall and all appeared moderately deteriorated. One of the drums was crushed and contained only rainwater. The second one was partially intact and contained a liquid with mineral spirits odor. The third drum was only partially exposed, but appeared intact. It was not determined whether this drum contained liquids or if it was leaking.

4.1.2 LNAPL

In five of the exploratory trenches (segment A of T-1, T-3, T-6, T-7, and T-8), LNAPL was encountered on the water table. The odor, consistency, and physical characteristics of the

LNAPL varied significantly among trenches. Samples of the LNAPL from three of these trenches (T-1A, T-6, and T-7) were collected and analyzed. Analytical detections in soil and NAPL samples collected from the trenches are presented in Tables 4-2, 4-3, and 4-5. The following is a summary of the NAPL encountered in exploratory trenches:

Trench T-1: The LNAPL encountered in segment A had a strong hydrocarbon odor. The analytical results of an LNAPL sample collected indicate that the LNAPL contained a significant amount of gasoline, mineral spirits, diesel, and oil, and low to moderate concentrations of TCE, cis-1,2-DCE, ethylbenzene, total xylenes, and PCBs. TCE, cis-1,2-DCE, and total TPH were detected at concentrations of 3,400 mg/kg, 370 mg/kg, and 45,240 mg/kg, respectively, in the soil sample collected from segment A. The physical parameter results of this sample indicate that the NAPL is lighter than water because the density and specific gravity are both less than 1. The interfacial tension and viscosity of this sample are within ranges typical of product that predominantly consists of TPH.

Trench T-3: LNAPL was encountered at 6.5 feet bgs, at approximately the same depth that drums were encountered. The LNAPL had a consistency similar to grease, but one of the crushed drums had a solvent odor. No analytical results are available for this LNAPL because a sample was not able to be collected due to a limited volume. TCE, cis-1,2-DCE, and total TPH were detected at maximum concentrations of 2,400 mg/kg, 40.8 mg/kg, and 19,920 mg/kg, respectively, in soil samples collected from this trench.

Trench T-6: One of the drums encountered at 2 to 3 feet bgs contained a liquid with an odor of mineral spirits. The LNAPL encountered at 15 feet bgs had a strong diesel odor. The analytical results for the LNAPL sample collected from this trench indicate that it consisted mainly of gasoline, mineral spirits, diesel, and oil. It also contained significant concentrations of ethylbenzene and total xylenes. TCE was not detected in the LNAPL and was either not detected or was detected at very low concentrations in the soil samples. Cis-1,2-DCE was not detected in the soil samples.

Trench T-7: LNAPL with a strong diesel or kerosene odor was encountered at a depth of 13 feet bgs. The analytical results of LNAPL samples collected from this trench indicate that the LNAPL consisted mainly of gasoline, mineral spirits, diesel, and oil. It also contained significant concentrations of ethylbenzene, toluene, and total xylenes. TCE and cis-1,2-DCE were detected at low concentrations in the LNAPL samples. Neither TCE nor cis-1,2-DCE were detected in the soil samples. Total TPH was detected in the soil samples at a maximum concentration of 10,300 mg/kg. No drums were encountered in this trench. The physical parameter results of this sample indicate that the NAPL is

lighter than water because the density and specific gravity are both less than 1. The interfacial tension and viscosity of this sample are within ranges typical of product that consists predominantly of TPH.

Trench T-8: LNAPL was encountered on the water table in this trench at 10 feet bgs. It was not observed or sampled due to the uncovering of mortar shells in the trench. TCE and cis-1,2-DCE were detected at low concentrations in the soil sample. Total TPH was detected at a concentration of 22,900 mg/kg in this sample.

The LNAPL encountered in trenches T-1 (segment A) and T-3 contained TCE in addition to TPH. A drum with a solvent odor was found in trench T-3 directly above the LNAPL. The LNAPL encountered in trenches T-6 and T-7 consisted predominantly of TPH with little to no TCE. It can be assumed that the LNAPL in trench T-8 consisted predominantly of TPH with little to no TCE because the soil sample reflected this pattern.

Evidence of LNAPL occurrence also was encountered at certain drivepoint locations. Field observations indicate that LNAPL was present in the shallow samples collected from drivepoint locations DP-1 (at 11 feet bgs), DP-2 (at 13 feet bgs), DP-5 (at 10 feet bgs), DP-6 (at 10 feet bgs), DP-9 (at 11 feet bgs), and DP-17 (at 17 feet bgs). TCE was detected at elevated concentrations in shallow samples from DP-6 (77,000 µg/L estimated) and DP-9 (120,000 µg/L). Analytical results of shallow groundwater samples collected at the remaining drivepoint locations indicate that elevated concentrations of TCE were present also at drivepoint locations DP-18 (9,020 µg/L), DP-21 (1,500 µg/L), and DP-46 (2,000 µg/L). The TCE likely was mixed with TPH, but the analytical program did not include TPH analysis of drivepoint groundwater samples.

4.1.3 DNAPL

Evidence of DNAPL was encountered at 9 drivepoint locations. For the purpose of data interpretation in this investigation, it is assumed that DNAPL occurs where dissolved TCE concentrations equal or exceed 10,000 µg/L in groundwater. Table 4-4 summarizes detections of metals and VOCs in drivepoint groundwater samples. Figure 4-2 presents the drivepoint and cross section locations for the following Figures 4-3 through 4-7 discussed in this section. These latter figures present cross section views of concentrations, presented with vertical exaggerations of 5 times.

There are four distinct areas where DNAPL appears to be present: northwest of the treatment system, near the southern fence corner (DP-9), near the infiltration galleries (DP-5/DP-6), and at DP-14. These areas are clearly shown on Figure 4-3. Figure 4-3 presents concentration contours for TCE in samples collected from 30 to 33 feet bgs. Outside of these four areas, DNAPL does not appear to be present elsewhere on the site where sampling has occurred. Conclusions

regarding the extent of DNAPL are limited by the number and locations of sampling points. Note also in Figure 4-3 and those that follow that the TCE concentration appears to drop by orders of magnitude within a short distance of the source. Natural attenuation processes (both physical and biological) are active at this site. Figure 4-4 presents an oblique isosurface view of TCE concentrations of 1,000 µg/L and greater. The isosurface presents another view of the three major areas where DNAPL occurs. In this view, the regions in the vicinity of DP-5/DP-6 and DP-9 merge.

In cross section view (Figures 4-5 and 4-6), these areas of elevated TCE concentrations (DNAPL) are visible with depth. As expected, the TCE DNAPL tends to exist more in the deeper portions of the drivepoint sample areas than in the shallow portions. Figure 4-7 presents a southeast cross-section view of elevated cis-1,2-DCE concentrations in groundwater. The cis-1,2-DCE appears to exist in the shallower portions, not in the deeper portions like the TCE. This is probably in response to the greater degree of TCE biodegradation to form cis-1,2-DCE in the shallow zone.

In four of the nine drivepoint locations where DNAPL was inferred to be present, and in three of the eight locations where TCE concentrations exceeded 1,000 µg/L, a correlation can be made with the potentially continuous aquitard layer. These drivepoint locations where inferred DNAPL was encountered immediately above this aquitard include DP-14 (at 32 feet bgs), DP-23 (at 39 feet bgs), DP-47 (at 32 feet bgs), and DP-49 (at 32 feet bgs). Drivepoints where TCE exceeded 1,000 µg/L directly above this aquitard include DP-1 (at 30 feet bgs), DP-3 (at 33 feet bgs), and DP-33 (at 35 feet bgs). Figure 4-8 presents this potentially continuous aquitard determined by drivepoint information only. Figure 4-9 presents the potentially continuous aquitard layer based on both monitoring well and drivepoint locations, with associated elevated contamination/DNAPL occurrence. Table 3-21 summarizes the depth of the continuous aquitard at drivepoint locations and associated elevated contamination/DNAPL occurrence. The aquitard topography and the locations of the 1,000 µg/L TCE isosurfaces are shown in color on Figure 4-10.

In two of the nine drivepoint locations where DNAPL was inferred to be present (DP-5 at 24 feet bgs and DP-18 at 20 feet bgs), and in three of the eight locations where TCE exceeded 1,000 µg/L (DP-6 at 24 feet bgs, DP-21 at 10 feet and 12 feet bgs, and DP-41 at 19 and 30 feet bgs), a correlation can be made with shallower, discontinuous zones of decreased permeability. These zones, which are shallower than the potentially continuous aquitard surface, were encountered at 17 of the drivepoint locations. Table 3-21 and Figure 4-11 summarize the location of the discontinuous zones of decreased permeability and shallow elevated contamination/DNAPL occurrence.

In the remaining five drivepoint locations (DP-9, DP-22, DP-29, DP-32, and DP-46) where elevated contamination/DNAPL was encountered, no such correlations could be made.

As shown on Figure 4-9, the closest encounter of DNAPL with the four extraction wells associated with the treatment system is 75 feet from DP-47 and LX-19. Therefore, the DNAPL does not appear to be negatively affecting the treatment system.

Measured concentrations of dissolved iron and manganese are presented in Table 4-4 and Figures 4-12 and 4-13. These figures present cross section views with vertical excaggerations equal to 5 times. The maximum concentrations of dissolved iron appear to be located at two of the areas where DNAPL also was encountered: near the treatment system and near the southern fence corner (DP-9). Dissolved iron was either not detected or detected at low concentrations (<0.5 mg/L) throughout the remainder of the site, especially in the eastern half of the study area. The lack of widespread high concentrations of dissolved iron suggests that widespread reducing conditions (low redox potential) do not exist at the site. The dissolved oxygen and Eh field measurements (Table 3-18) also show only localized reducing conditions.

One area near the treatment system appears to have a relatively high concentration of dissolved manganese (Figure 4-13). Generally, the detections of dissolved manganese appear to be more evenly distributed throughout the site than the dissolved iron detections. The maximum detected concentration of dissolved manganese (1.2 mg/L) is located near the eastern disposal pit (DP-26). Detected concentrations of dissolved iron and manganese do not show a direct correlation with occurrences of DNAPL.

4.2 EFFECTIVENESS OF NAPL DETECTION METHODS

The geophysical investigations were effective in locating buried metallic debris in disposal areas. The geophysical information was the basis for designing the subsequent sampling program. The former disposal areas were target sampling areas. Some former disposal areas identified on aerial photographs did not show geophysical anomalies but were considered when sampling strategy was designed.

The soil-gas sampling and analysis was used as a guide, in conjunction with the geophysical results, for the placement of exploratory trenches. The soil-gas program did not directly locate NAPL, but provided useful information for subsequently locating NAPL during trenching and drivepoint sampling. For example, relatively high TCE detections in SG-1, SG-17, and SG-18 near the infiltration galleries led to the excavation of nearby exploratory trenches T-1 and T-3. Both of these trenches contained LNAPL on the water table. However, in general the soil-gas sampling was not reliable for determining whether TCE NAPL was present in the vadose zone.

The exploratory trench excavation and sampling program proved successful in locating LNAPL at specific trench locations (Figure 3-4). LNAPL was encountered on the water table in five (T-1, T-3, T-6, T-7, and T-8) of the eight trenches excavated. Also, in trench T-4, a small amount of NAPL was visible on a cobble; groundwater was not encountered in this trench. Several drums containing NAPL were uncovered in trench T-5, and one drum containing TCE

was uncovered in trench T-1. Various drums and other containers were visible in many of the trenches, but the contents could not be determined.

The exploratory trench program was useful, in conjunction with the geophysics and soil-gas results, in providing guidance for the subsequent drivepoint groundwater sampling program. For example, drivepoint locations DP-5 and DP-6 were selected near the infiltration galleries, based on the results of SG-1, SG-17, and SG-18, and samples from trench T-3. Both LNAPL and DNAPL were visible in samples from these two drivepoint locations.

Generally, the drivepoint groundwater sampling program was a successful method for locating DNAPL throughout the site. Confirmation of the presence of NAPL was based on both visual observations and analytical results. DNAPL was visible during sampling at drivepoint location DP-5, and inferred to be present at four more locations based on analytical results. The drivepoint sampling program was not successful in locating LNAPL based on analytical results, but LNAPL was visible at SA drivepoint locations.

The screening methods used during the field program included vapor monitoring and a NAPL dye test. The vapor monitoring was a useful indicator of potentially elevated concentrations in a sample, but did not specifically determine NAPL presence. It was an unnecessary step in this investigation. Likewise, the NAPL dye test did not prove to be an effective tool in this investigation. The NAPL encountered was usually brown or black in color, so it was clearly visible without performing the dye test.

4.3 CONCEPTUAL SITE MODEL

This section provides a conceptual site model of the EGDY groundwater contamination source area. The conceptual site model is based on the known physical and chemical properties of potential source material (NAPL in the unsaturated and saturated zones) and current site information on subsurface characteristics.

4.3.1 Contamination Source Area

During preparation of the management plan for the EGDY investigation (USACE 1998), historical aerial photographs were reviewed to identify areas within and adjacent to the site that may have been used for disposal of liquid and solid waste. Figure 4-14 provides a summary of features identified during the photo review. Dates associated with the numbered trenches show the time interval during which the trench feature was observable on the photos. Details on observed activities for each disposal feature are provided in the management plan and summarized here.

The aerial photographs show that the EGDY was used from the mid-1940s until about 1971. Early in its history, two large disposal pits were used primarily for solid waste, and trenches may

have been used for disposal of liquid wastes. Trenches were used for disposal of both liquid and solid wastes after about 1957, when major use of the disposal pits ended. The long time that some of the trenches were open and their relatively small capacity suggests that a limited volume of solid waste was being transported to the site for disposal, or that the trench was used primarily for disposal of liquid wastes. Some of the trenches appeared to intersect the groundwater table. The trenches where it appears that liquid waste was disposed of are in the western portion of the EGDY. Areas of dark colored soil in the western portion of the facility, but not in the trenches, may reflect surface dumping of liquid wastes.

Trenching conducted during the Phase I investigation showed that the disposal trenches are now filled with soil and a wide variety of debris. From a groundwater contamination standpoint, the most important material in the trenches is NAPL-containing drums. One or more drums were observed in five of the eight trenches dug at the site. Some of the trenches with drums were outside of the fenced EGDY area. The presence of two mortar shells in one of the trenches is a safety issue to be considered when doing future intrusive work at the site.

4.3.2 Geology

The geology of the EGDY study area reflects many of the processes and events that affected the Puget Sound Lowland. The series of Pleistocene glaciations and interglacial periods have left a distinctive depositional record.

The surficial and subsurface geology of the EGDY study area has been characterized using logs of several borings drilled throughout the past several years. The boring logs have been generated by different geologists for various projects, using many types of drilling methods. Also, the stratigraphy of the Puget Sound Lowland is extremely heterogeneous. Therefore, the soil descriptions on the logs vary tremendously. A cross section A-A' (Figure 4-15) has been developed from the borings located in or near the study area. This cross section will be used to describe the stratigraphy in the study area. The orientation of cross section A-A' is shown on Figure 4-14. It is located in a general east-west transect through the study area.

Vashon Drift

The Vashon Drift represents those units deposited during the Vashon Stage of the Fraser Glaciation. It contains five distinct units. In descending order, these units are Steilacoom Gravel, Recessional Gravel, Vashon Till, Advance Gravel, and Colvos Sand. Since the geologic interpretation of the study area is simplified, the following Vashon Drift descriptions do not represent these five units separately. The recessional and advance outwash gravel and the Colvos Sand unit (outwash sand) are described together under the heading of Vashon Glacial Outwash. On the cross section, the till is not segregated from the outwash, and a distinct silt and sand layer exists.

Recent Deposits and Steilacoom Gravel. Recent deposits were encountered at the ground surface in a thickness of up to 4 feet in some of the boreholes. These deposits consist of brown to black alluvial sand and gravel, with localized silt and clay.

The Steilacoom Gravel is the predominant upper geologic unit. The sands and gravels of this unit were deposited in braided channels that were formed by the rapid discharge of glacial Lake Puyallup. The generally flat glacial outwash plain is broken by swales produced by the intersections of braided stream channels, kettles, and ice-contact depressions of irregular shape.

The Steilacoom Gravel unit was encountered in all boreholes in the study area. Its average thickness is approximately 13 feet throughout the study area. The Steilacoom Gravel encountered is generally a brown, loose to dense, well-graded, sandy, coarse, cobbly gravel.

Vashon Till. The Vashon Till is typically a brown-gray, dense, well-graded gravel in a matrix of sand, silt, and clay. Beneath the Steilacoom Gravel, the Vashon Till and the remaining Vashon Drift units are present at an approximate elevation of 265 to 200 feet above mean sea level (msl).

Vashon Glacial Outwash. The recessional outwash unit of the Vashon Drift deposit typically overlies the Vashon Till. This unit is principally a brown-gray, variegated, poorly-graded sandy gravel and gravelly sand, but locally contains lenses of sand, silty sand, and clay.

Underlying the till typically is the advance gravel outwash of the Vashon Drift. This sandy gravel is denser than the recessional outwash, but has a similar distribution of particle sizes. The advance gravel outwash deposits encountered in the borings generally consist of a brown-gray, medium to coarse sandy gravel with cobbles.

Glacial outwash sand deposits consist of very fine to coarse sand with lenses of gravelly sand and sandy silt.

Silt Aquitard Layer. A silt unit occurs at an elevation of approximately 240 feet msl. It is composed of hard, fine, sandy silt and clayey silt, grading to very dense, silty, clayey, very fine sand toward the west. The color variations of this unit include dark gray, blue-gray, gray-brown, tan, and light gray to light brown.

Pre-Vashon and Post-Kitsap

The non-glacial deposits are characterized by alluvial sand and gravel with some silt and clay (Ebasco 1993). The thickness of this unit beneath the western portion of the study area is approximately 30 to 40 feet thick. The thickness of this unit directly beneath the EGDY is unknown. The elevation of the top of the non-glacial deposits is approximately 200 feet msl.

These deposits encountered in the boreholes consist of a gravelly, medium-grained sand with some silt and organic debris.

Kitsap

The Kitsap formation underlies the Vashon Drift beneath the study area. Encountered in the borings, this unit generally consists of non-glacial brown to black clayey silt, silty sand, and sandy silt with occasional fine gravel. The unit typically contains peat, other organic debris, and ash.

Salmon Springs

This glacial unit encountered beneath the Kitsap formation in the study area consists of brown silty, sandy gravel with organic debris and sand lenses.

4.3.3 Hydrogeology

The interpretation of the study area hydrogeologic conditions is based on cross section A-A' (Figure 4-15). The cross section shows important stratigraphic units, their relative locations, and locations of units with aquitard properties.

The shallow Vashon Drift aquifer is present in several water-bearing units depicted on cross section A-A'. The Vashon Drift and underlying non-glacial and glacial units are composed of several distinct laterally-continuous members. At the study area, the aquifer is present in the following units: the permeable upper gravel member (Steilacoom Gravel), the permeable Vashon glacial outwash, a locally less permeable till (Vashon Till), less permeable to impermeable silt and very fine sand, and non-glacial sand and gravel.

Groundwater elevations depicted on the cross section were measured in March 1997. The groundwater elevation in the study area is generally at 270 feet msl, and approximately 10 feet bgs. Two of the water level measurements used in cross section A-A' were collected from pumping wells (LX-18 and LX-21) associated with the Fort Lewis Logistics Center East Gate pump-and-treat system, and each shows a slight cone of depression. Beneath the study area, groundwater flow is predominantly to the west-northwest.

As shown on the cross section (Figure 4-15), potential laterally extensive aquitard properties are located within the Vashon Drift in a less permeable silt and very fine sand layer (unit V3). The topography of the surface of this aquitard and its relationship to elevated groundwater contaminant concentrations is discussed in Section 4.1.3.

In addition to this aquitard surface, weak, localized aquitard properties also may be found in the overlying Vashon Drift units. The occasional high silt content, density, and horizontal orientation of cobbles in the Vashon Till may restrict downward flow of water or NAPL in this

unit. It is possible that the lower permeability of this till unit and clay, silt, and sand lenses relative to the overlying gravel has enhanced these aquitard conditions.

Localized groundwater flow directions and the migration of DNAPL may be affected by the presence of both this continuous layer of relatively decreased permeability, and localized areas of relative changes in permeability.

4.3.4 Physical Properties of the Source Material

The NAPLs reportedly disposed of at the EGDY were spent chlorinated solvents (primarily TCE with perhaps small amounts of DCE) and POL. The physical and chemical properties of the individual compounds are fairly well known, and were provided in the management plan. However, because the compositions of the mixtures sampled at the EGDY are so variable, there is considerable uncertainty in predicting the fate and transport of these materials and their individual components in the subsurface.

The compositions of product collected from trenches and drums (Tables 3-10 through 3-15) show a very wide spectrum of materials from almost pure TCE (DT001E) to LNAPLs (mineral-spirit and oil-range TPH) with very little TCE (NT006B15 and NT007C13). In addition, soil analytical results show up to tens of thousands of mg/kg TPH with TCE at over 3,000 mg/kg (Table 3-7). These levels suggest a residual NAPL component attached to the soil. The occurrence of TCE at hundreds of thousands of µg/L in groundwater collected from the drivepoint samples (Table 3-19) suggests that DNAPL is present at various depths in the shallow aquifer.

If the mole fraction of the material was known for the product, vapor pressures and water solubilities of contaminants could be calculated using Raoult's Law. However, because the few products that have been analyzed are so variable in composition and probably represent only a small fraction of the variability, it can be concluded only that the site contains LNAPL and DNAPL with TCE present in the NAPL over the entire range of concentrations from nondetectable to close to 100 percent.

4.3.5 NAPL/TCE Site Model

Figure 4-16 is a schematic representation of the presence of NAPL and TCE contamination at the EGDY. Drums in the former trenches and other disposal locations are sources of future contamination. The locations of metallic debris have been identified with the EM-61 surveys; however, the numbers and specific locations of drums are not known.

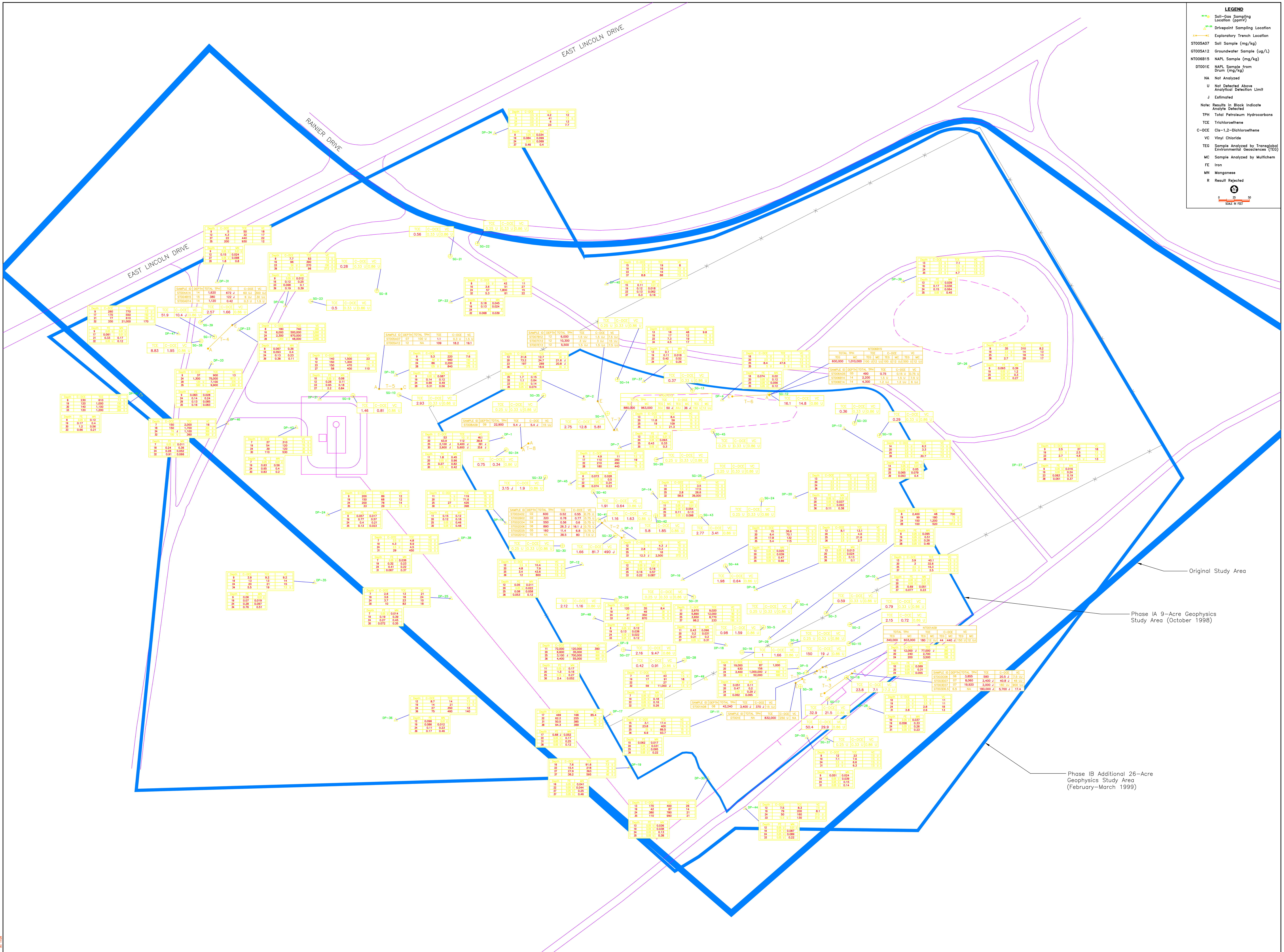
Soil-gas sampling results for VOCs showed TCE present at 36 sampling locations and cis-1,2-DCE present at 26 sampling points. However, all but one (SG-01 at 150 ppmV) of the TCE measurements were much less than 100 ppmV, which was the lower limit on the criterion set for indicating the presence of NAPL in the vadose zone that contains high concentrations of

TCE. That is, soil-gas samples collected over or in LNAPL or soil containing elevated TCE concentrations had concentrations less than 100 ppmV. Therefore, the soil-gas results were not reliable for determining whether TCE NAPL was present in the vadose zone.

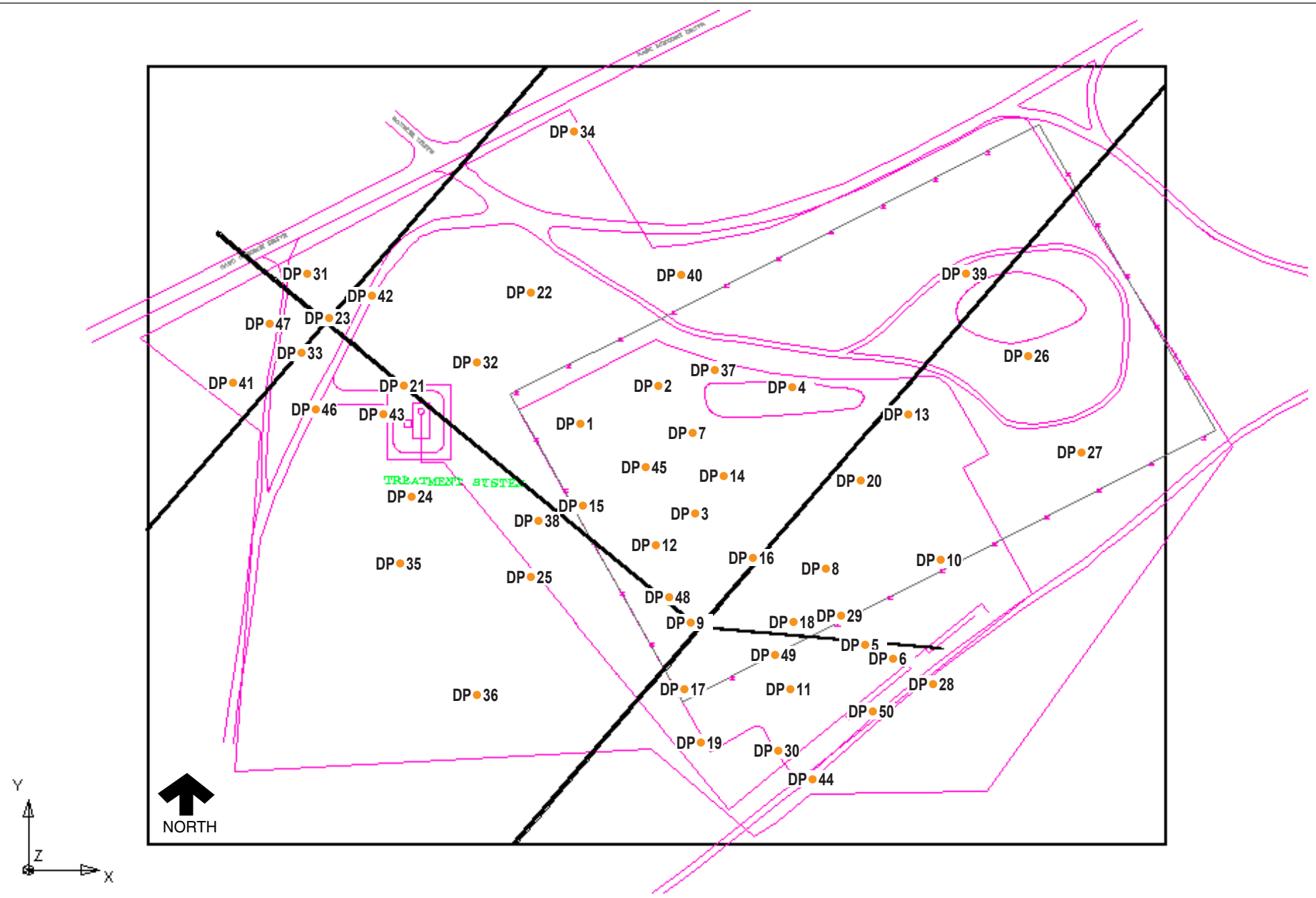
LNAPL containing TCE is present floating on the water table but the extent is unknown. This LNAPL, and soil with residual NAPL, is a source of TCE groundwater contamination, but the level of contamination is orders of magnitude less than that derived from DNAPL deeper in the aquifer. Some of the highest levels of cis-1,2-DCE in groundwater are found near the water table in samples from drivepoints DP-5, DP-6 and DP-9, which also have very high TCE and likely LNAPL. It is possible that the cis-1,2-DCE is produced in these locations as a degradation product of TCE. Under anaerobic conditions, bacteria use TCE as an electron acceptor for oxidation of the organic compounds found in LNAPL. The initial degradation product of TCE in this process is cis-1,2-DCE.

DNAPL containing high levels of TCE has entered the upper aquifer. It has accumulated on localized low-permeability units within the aquifer and on the potentially laterally-extensive aquitard that occurs at about 30 to 40 feet bgs. However, conclusions regarding the extent of DNAPL and the continuity of the aquitard are limited by the number and placement of sampling locations. Because of this lack of information and the possibility that the aquitard is not continuous, it is possible that DNAPL also may be present at greater depths. The presence of DNAPL is inferred from the very high levels of TCE contamination (exceeding 10,000 µg/L) in groundwater at these locations. Currently there are only four locations in the study area that appear to have DNAPL. While these four are associated with geophysical anomalies, many of the other areas of anomalies do not have elevated concentrations of TCE that would suggest the presence of DNAPL.

Current sources of high levels of TCE contamination to groundwater are limited to the four identified DNAPL locations. Future, potential sources of TCE contamination may reside in any of the drums containing liquids in the former disposal areas.



East Gate Disposal Yard Fort Lewis, Washington	Project No. E9518Q	Expanded Site Investigation— Selected Analytical Results	4-1
URS Greiner Woodward Clyde			

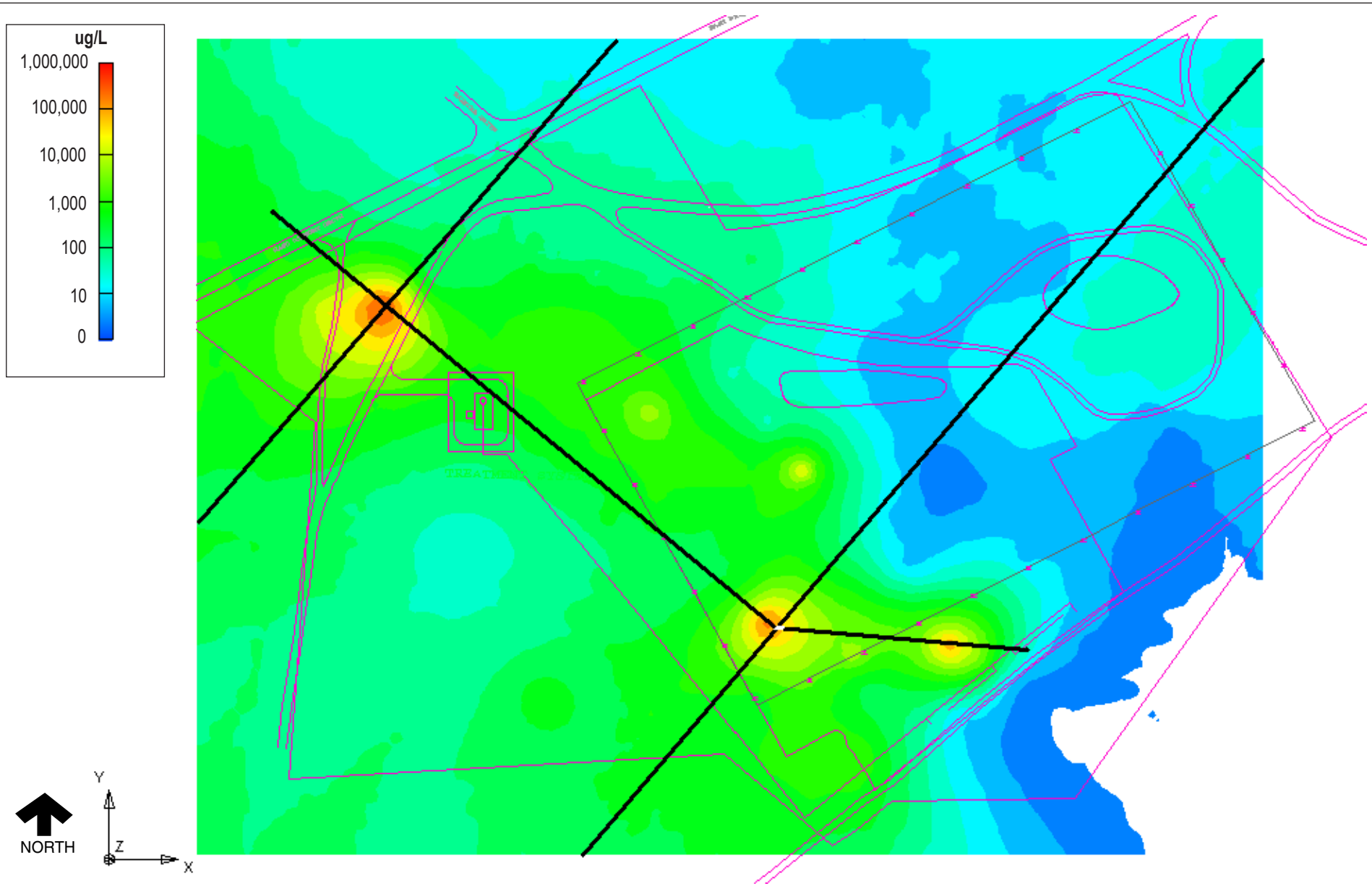


URS Greiner Woodward Clyde

Figure 4-2
Drivepoint and Cross Section Locations

Project No. E9518Q
East Gate Disposal Yard
Fort Lewis, Washington

1,070999

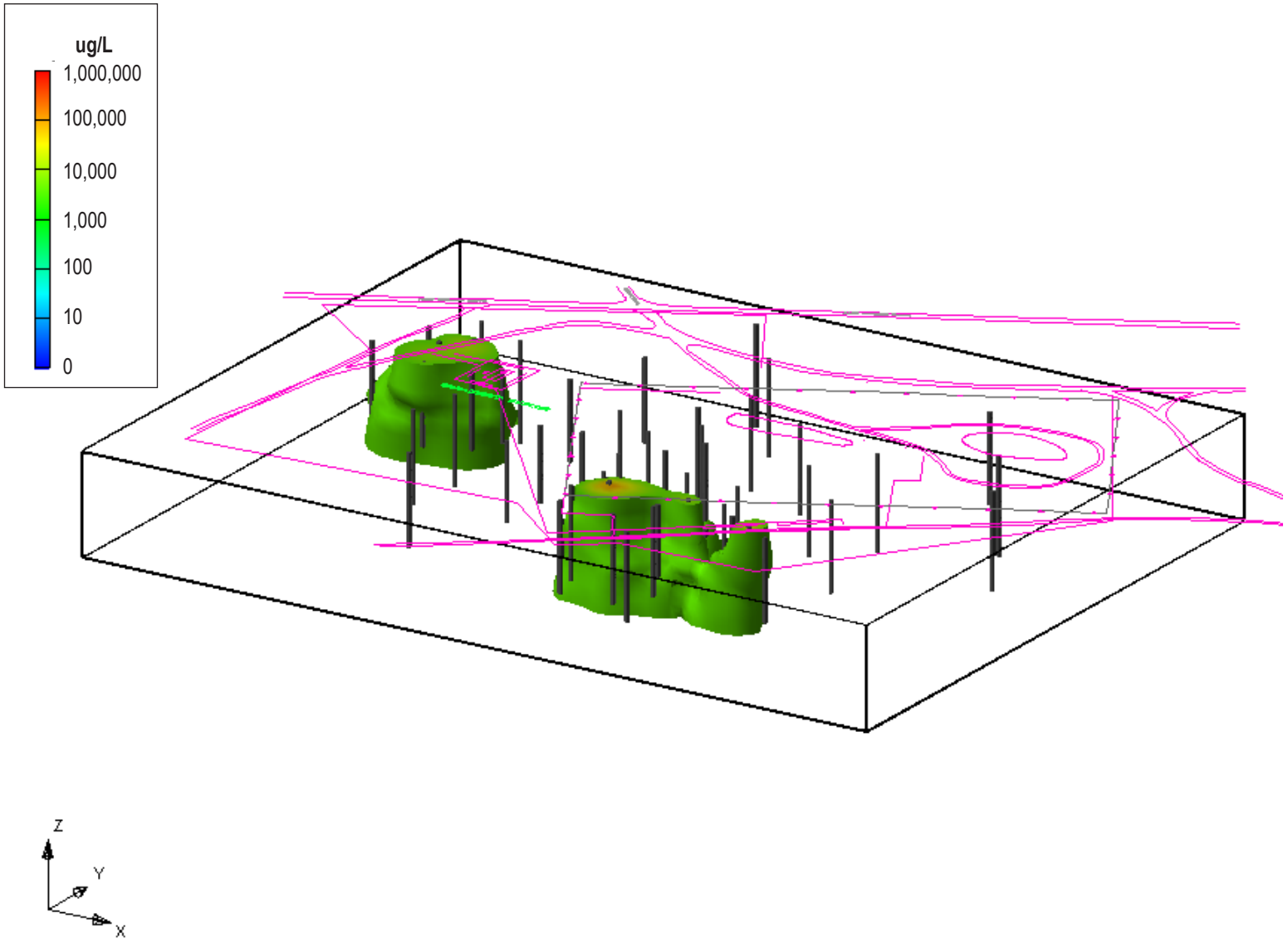


URS Greiner Woodward Clyde

Figure 4-3
TCE Groundwater Concentration Contours (30 to 33 ft bgs) and Cross Section Locations

Project No. E9518Q
East Gate Disposal Yard
Fort Lewis, Washington

2,080399

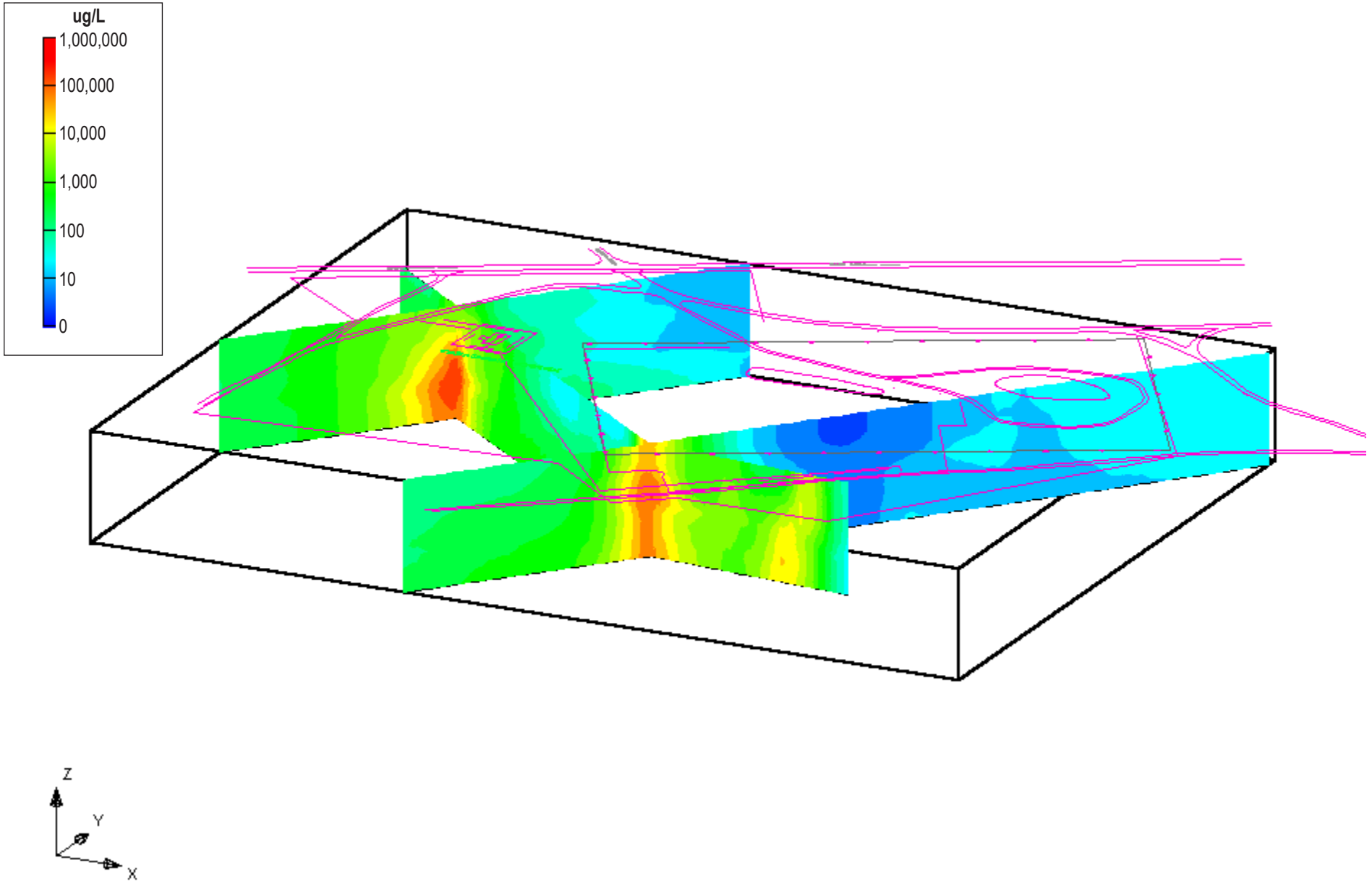


URS Greiner Woodward Clyde

Figure 4-4
Oblique TCE Isosurface (1,000 µg/L)

Project No. E9518Q
East Gate Disposal Yard
Fort Lewis, Washington

11,070299

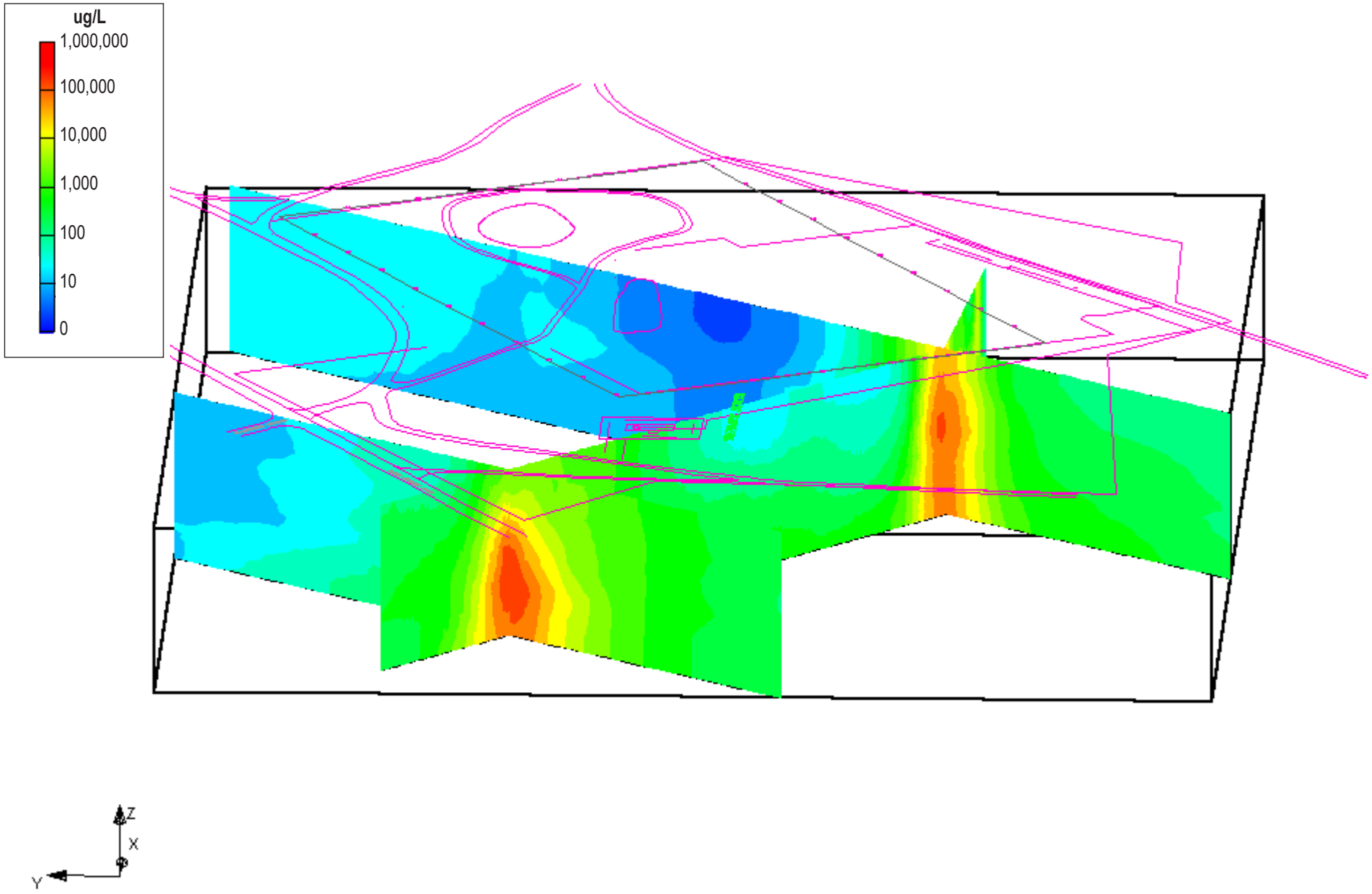


URS Greiner Woodward Clyde

Figure 4-5
TCE Groundwater Concentration Contours Along Select Cross Sections (View From SE)

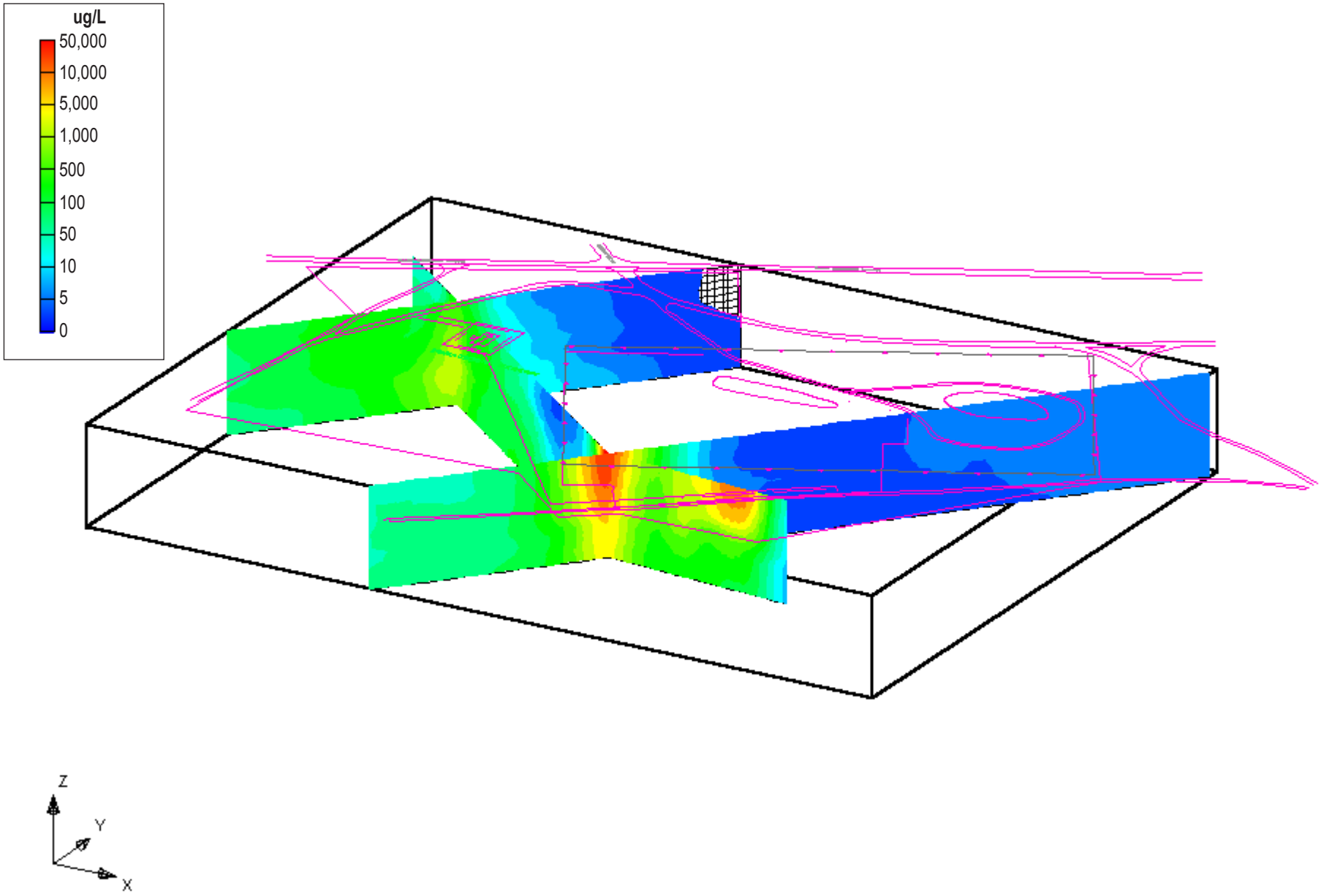
Project No. E9518Q
East Gate Disposal Yard
Fort Lewis, Washington

4,070699



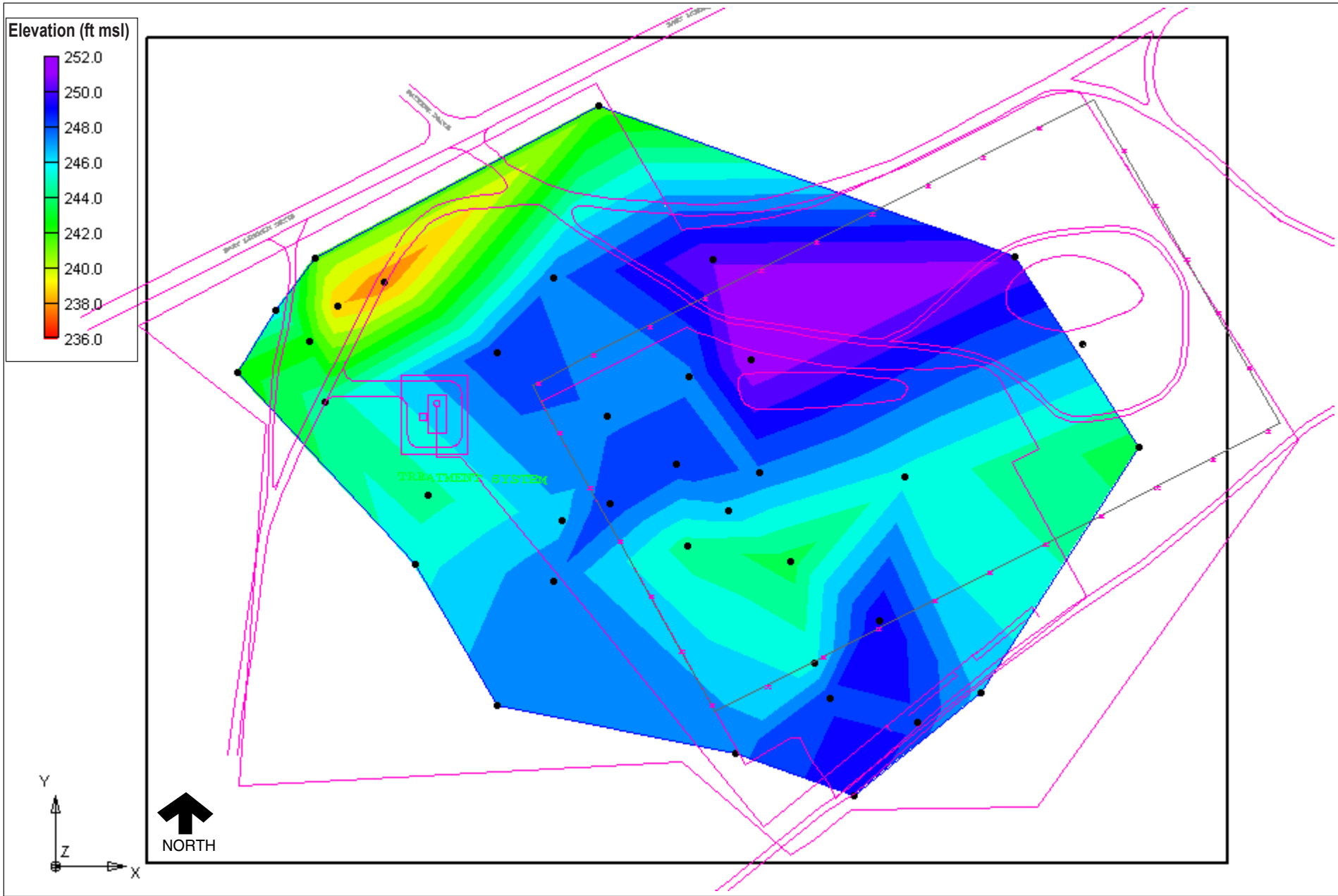
URS Greiner Woodward Clyde	**Figure 4-6** **TCE Groundwater Concentration Contours Along Select Cross Sections (View From NW)**	Project No. E9518Q East Gate Disposal Yard Fort Lewis, Washington

5,070699



URS Greiner Woodward Clyde	**Figure 4-7** **cis-DCE Groundwater Concentration Contours Along Select Cross Sections (View From SE)**	Project No. E9518Q East Gate Disposal Yard Fort Lewis, Washington

6,070999



URS Greiner Woodward Clyde

Figure 4-8
Topography of Potentially Continuous Aquitard (Based on Drivepoint Information)

Project No. E9518Q
East Gate Disposal Yard
Fort Lewis, Washington

9,080499

LEGEND

- Contours of Elevation of Potentialy Continuous Aquitard Surface
- 242 LC-23 — Monitoring Well
- LX-17 — Extraction Well
- 243 DP-27 — Drivepoint Location
- 246 DP-6 — Location of TCE > 1,000 ug/L on Surface of Aquitard
- 246 DP-6 — Location of TCE > 10,000 ug/L on Surface of Aquitard

N

0 75 150

SCALE IN FEET

EAST LINCOLN DRIVE

RAINIER DRIVE

Original Study Area

Phase IA 9–Acre Geophysics Study Area (October 1998)

Phase IB Additional 26–Acre Geophysics Study Area (February–March 1999)

East Gate Disposal Yard Fort Lewis, Washington **URS Greiner Woodward Clyde**	Project No. E9518Q	Expanded Site Investigation–Topography of Potentially Continuous Aquitard and Associated Zones of Elevated Contamination/DNAPL

4–9

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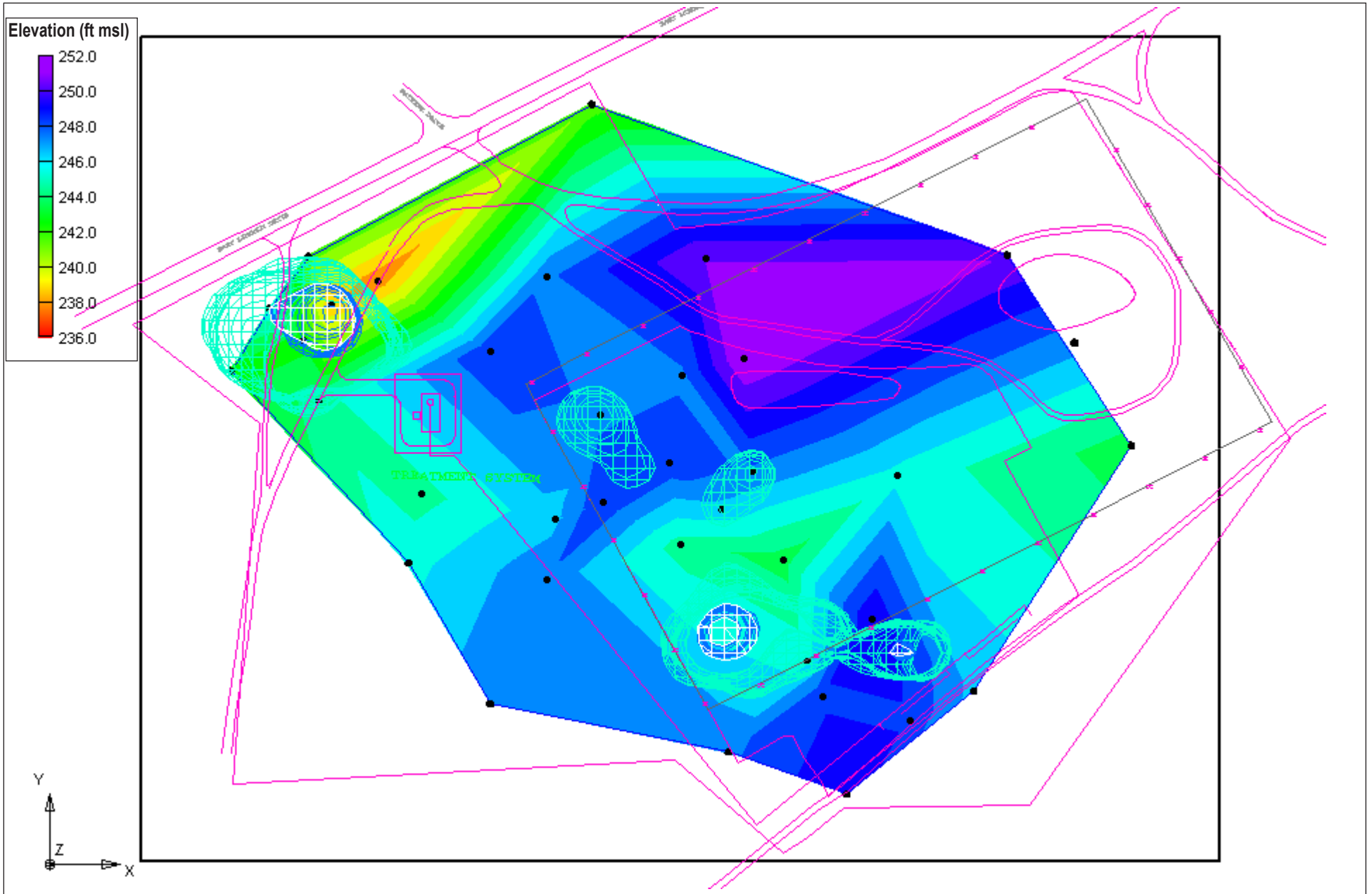

URS Greiner Woodward Clyde	**Figure 4-10** **Topography of Potentially Continuous Aquitard (Based on Drivepoint Information) and 1,000 ug/L TCE Isosurface**	Project No. E9518Q East Gate Disposal Yard Fort Lewis, Washington

10,070699

LEGEND

DP-39 △ Drivepoint Groundwater Sampling Location

NA Not encountered at this location

13 / 10,12 — Depth to Lower-Permeability Zone (feet bgs) / Depth to DNAPL (feet bgs)

N

0 65 130

SCALE IN FEET

RAINIER DRIVE

EAST LINCOLN DRIVE

DP-34

DP-31 13,28 / NA

DP-42 17,24 / NA

DP-47 22 / NA

DP-23 NA / 16,24

DP-33 12 / 24,29

NA / 19,30 DP-41

13 / 10,12 DP-21

DP-46 NA / 7,18,24

DP-43

DP-32 NA / 24

DP-22 NA / 24

DP-40

DP-39

DP-26

DP-2

23 / NA DP-37

DP-4

DP-1 NA / 25

DP-7

DP-13

DP-45 18 / NA

DP-14

DP-20 23 / NA

DP-27 25 / NA

DP-24

DP-15

DP-3

DP-38

DP-12

DP-35

DP-16

DP-10

DP-8

DP-25

DP-48

DP-9 NA / 11,20,25

NA / 11,20,25 DP-18

NA / 8,24 DP-29

22 / NA DP-49

DP-5 24 / 10,24

24 / 10,20,24 DP-6

31 / NA DP-17

DP-36

DP-11

DP-28

DP-50

DP-19

DP-30

DP-44

Original Study Area

Phase IA 9-Acre Geophysics Study Area (October 1998)

Phase IB Additional 26-Acre Geophysics Study Area (February-March 1999)

East Gate Disposal Yard Fort Lewis, Washington	Project No. E9518Q	Expanded Site Investigation-Locations of Discontinuous Lower-Permeability Zones and Shallow Elevated Contamination/DNAPL	4-11
URS Greiner Woodward Clyde			

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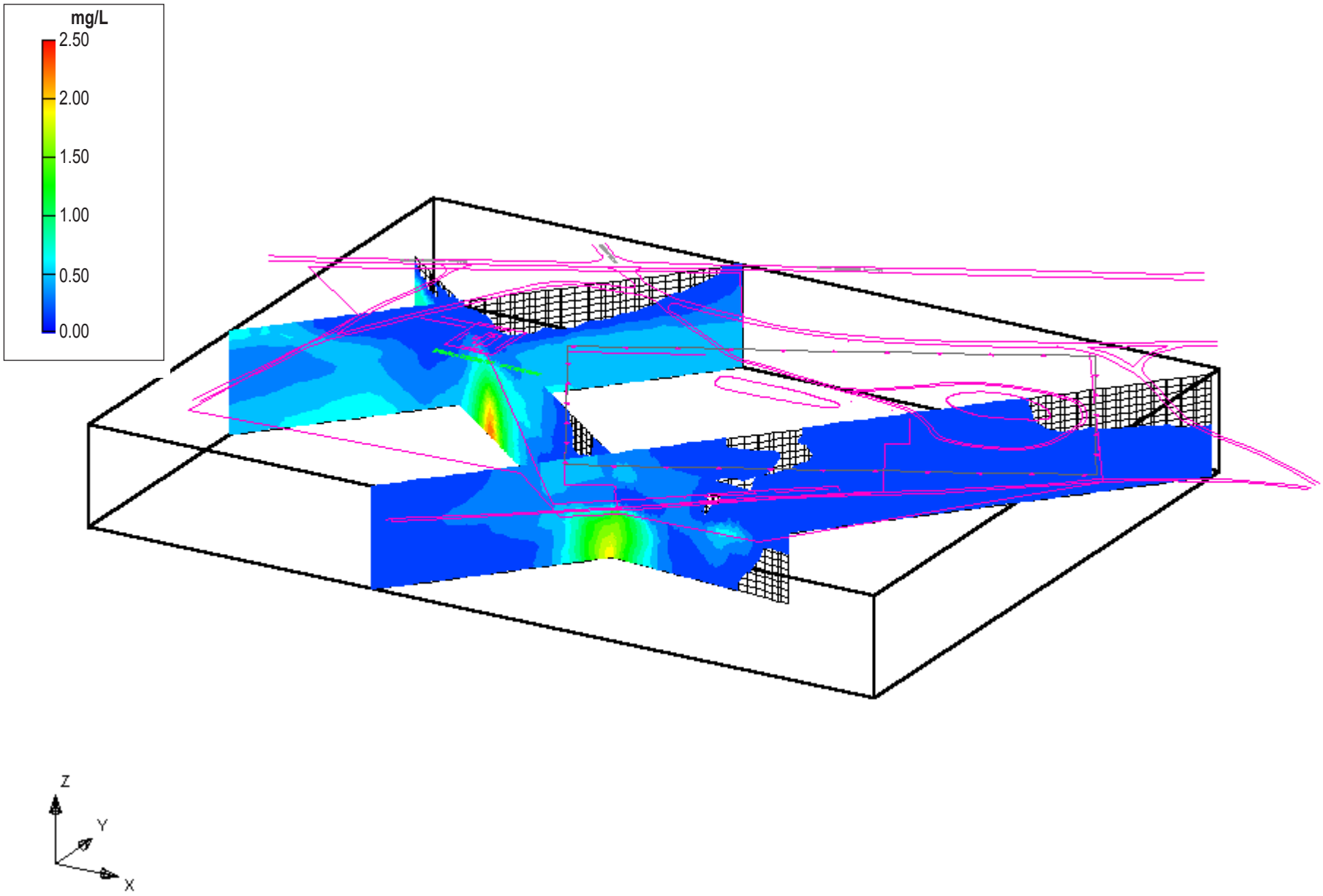
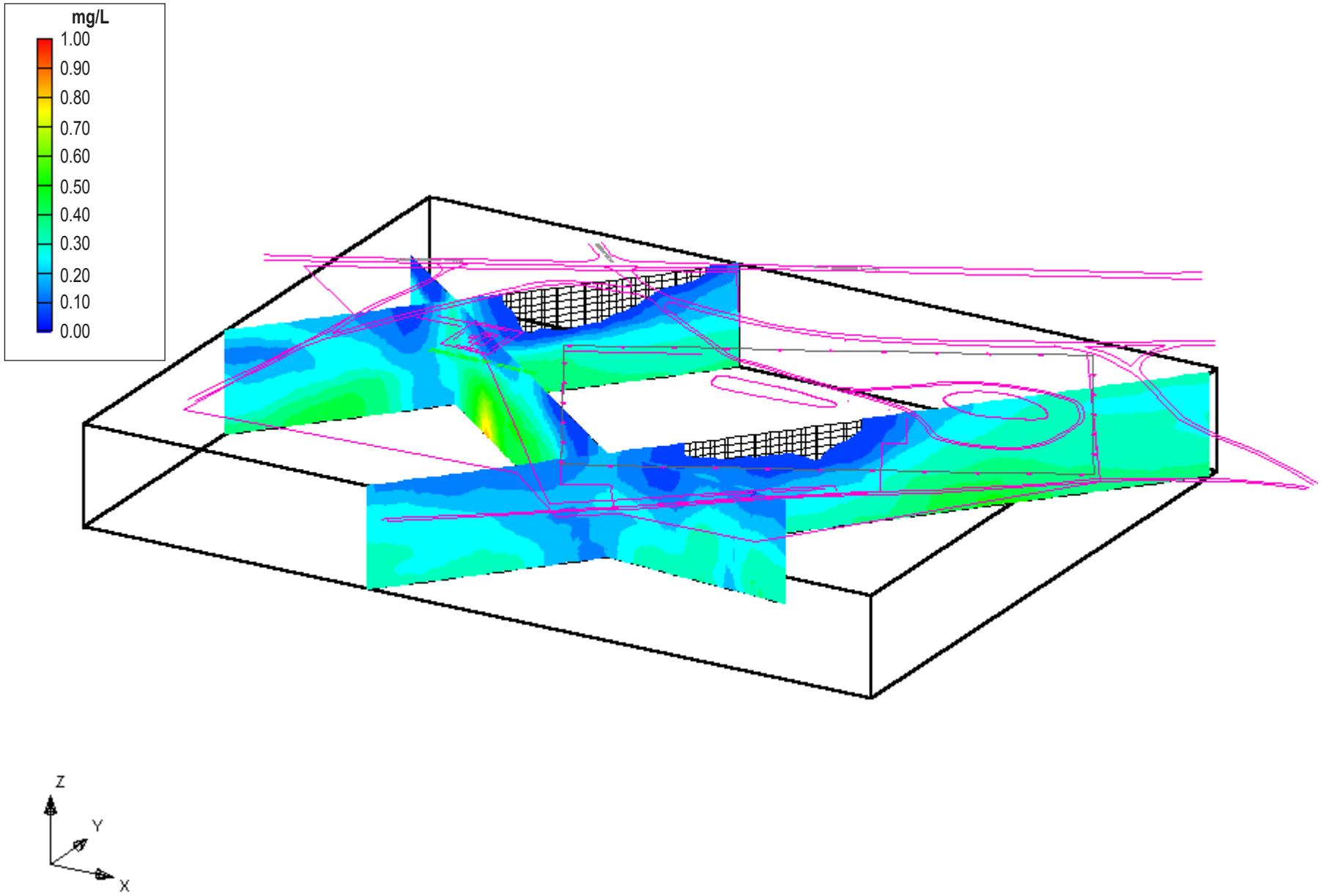


URS Greiner Woodward Clyde	**Figure 4-12** **Total Dissolved Iron Concentration Contours Along Select Cross Sections (View From SE)**	Project No. E9518Q East Gate Disposal Yard Fort Lewis, Washington

7,070999



URS Greiner Woodward Clyde	**Figure 4-13** **Total Dissolved Manganese Concentration Contours Along Select Cross Sections (View From SE)**	Project No. E9518Q East Gate Disposal Yard Fort Lewis, Washington

8,070999

EAST LINCOLN DRIVE

RAINIER DRIVE

EAST LINCOLN DRIVE

A

A'

#11 PRE-1951 TO 1955

#1 1951 TO PRE-1960

#7 1961 TO 1964

#4 1957 TO PRE-1960

#6 1960 TO PRE-1978

#5 1960 TO 1961

#3 1955 TO PRE-1957

#2 1955 TO PRESENT

#8 1964 TO 1965

Western Disposal Pit

Eastern Disposal Pit

#9 1965 TO 1971

#10 PRE-1955 TO 1961

Injection Gallery

Original Study Area

Phase IA 9-Acre Geophysics Study Area (October 1998)

Phase IB Additional 26-Acre Geophysics Study Area (February-March 1999)

N

0 75 150

SCALE IN FEET

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East Gate Disposal Yard
Fort Lewis, Washington

Project No.
E9518Q

URS Greiner Woodward Clyde

Summary of Study Area Disposal Features Identified From Aerial Photographs

4-14

A
West

A'
East

EAST GATE DISPOSAL YARD

LC-107
LC-106
LC-21,LC-21-1,LC-21B,&LC-21C
LX-21
rd
LC-136B (Located 240' South)
LC-136A (Located 245' South)
LC-108
LX-18
LC-150
LC-153
LC-64A (Located 130' South)
LC-64B (Located 140' South)
LC-134 (Located 120' South)
LC-23
rd
LC-162 (MW-2)
AQUITARD SURFACE CONTOURED ON FIGURE 4-10
E-5
LC-146

APPROX. DEPTH FT BGS
ELEVATION (FEET MSL)
VASHON DRIFT

300 (0) 280
260 (20)
240 (40)
220 (60)
200 (80)
180 (100)
160 (120)
140 (140)
120 (160)

Gravelly Sandy Silt Lens
V1
Sand Lens
V2
Clay Lens
Silty Sand Lens
Sand Lens
V4
ng
Clay to Sand Lens
Qk
Qssr
V1
V2
Sand Lens
V3

Section A–A'

Vertical Scale: 1" = 20'
Horizontal Scale: 1" = 100'

Legend

Groundwater Table, March 1997

LC-23 — Boring Name

Screened Interval

Soil Type Descriptions

Vashon Drift

Recent Deposits (rd):
Predominantly brown alluvial sand and gravel, with localized silt and clay.

Steilacoom Gravels (V1):
Brown, well-graded, sandy, coarse (cobbly) gravel.

Till and Outwash (V2 and V4):
Till: Brown-gray dense, well-graded gravel in a matrix of sand, silt, and clay.
Advance and recessional outwash: Brown-gray sandy gravel and gravelly sand; lenses of sand, silty sand, and clay.

Silt Aquitard Layer (V3):
Dark gray, blue-gray, gray-brown to light brown hard fine sandy silt and clayey silt, grading westward to a very dense, silty, clayey, very fine sand.

Nonglacial Deposits (ng):
Nonglacial alluvial sand and gravel with some silt and clay.

Kitsap Formation (Qk):
Nonglacial deposits of silt, sand, and clay; with ash, wood, and peat; (aquitard or aquiclude).

Salmon Springs Recessional Outwash (Qssr);
Stratified sand and gravel with silt and clay lenses.

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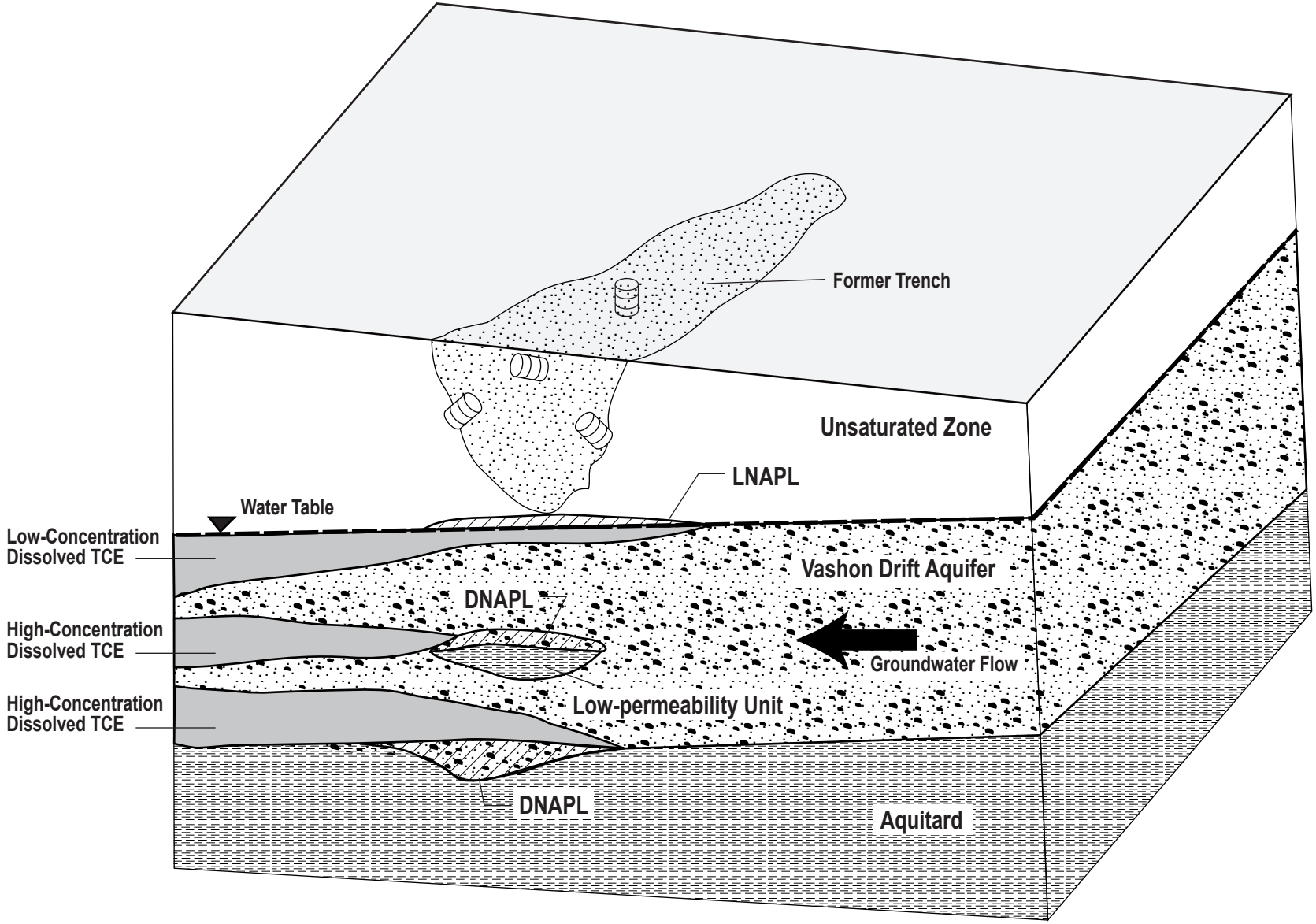
East Gate Disposal Yard Fort Lewis, Washington	Project No. E9518Q	Expanded Site Investigation Geologic Cross Section A–A'	4–15
URS Greiner Woodward Clyde			



URS Greiner Woodward Clyde	Figure 4-16 Conceptual Site Model	Project No. E9518Q East Gate Disposal Yard Fort Lewis, Washington

53F00E95182-1-070999

Table 4-1
Detections of VOCs in Soil-Gas Samples

Location	Sample	Date	Depth (ft bgs)	1,1,1-TCA (ppmV)	cis-DCE (ppmV)	trans-DCE (ppmV)	TCE (ppmV)	Vinyl Chloride (ppmV)	Xylenes (Total) (ppmV)
SG-01	SG00105	10/12/98	5		19 J	1.54	150		
SG-02	SG00205	10/12/98	5				0.79		
SG-03	SG00305	10/12/98	5				0.59		
SG-05	SG00505	10/12/98	5		1.59		0.98		
SG-07	SG00705	10/12/98	5		10.4 J		51.9		
SG-07	SG50705*	10/12/98	5		9.47 J		44.4		
SG-08	SG00805	10/12/98	5				0.28		
SG-09	SG00905	10/12/98	5		0.81		1.46		
SG-10	SG01005	10/12/98	5				2.93		
SG-11	SG01105	10/12/98	5		12.8		2.75	5.81	
SG-12	SG01205	10/12/98	5		14.8	0.34	16.1		
SG-13	SG01305	10/12/98	5				0.37		
SG-15	SG01505	10/13/98	5		0.72		2.15		
SG-16	SG01605	10/13/98	5		1.66	0.53	1.0		
SG-17	SG01705	10/13/98	5		21.5	1.06	32.9		
SG-18	SG01805	10/13/98	5		7.1		23.8		
SG-19	SG01905	10/13/98	5				0.29		
SG-20	SG02005	10/13/98	5				0.36		
SG-21	SG02105	10/13/98	5				0.56		
SG-21	SG52105*	10/13/98	5				0.4		
SG-23	SG02305	10/13/98	5				0.5		
SG-27	SG02705	10/13/98	5		9.47		2.16		
SG-28	SG02805	10/13/98	5		0.91		0.42		
SG-29	SG02905	10/13/98	5		1.16		2.12		
SG-32	SG03205	10/13/98	5		81.7	1.77	1.66	490 J	0.37
SG-33	SG03305	10/13/98	5		1.9		3.15 J		
SG-34	SG03405	10/13/98	5	0.46	0.34		0.75		
SG-36	SG03605	10/14/98	5		29.9	1.54	50.4		

Table 4-1 (Continued)
Detections of VOCs in Soil-Gas Samples

Location	Sample	Date	Depth (ft bgs)	1,1,1-TCA (ppmV)	cis-DCE (ppmV)	trans-DCE (ppmV)	TCE (ppmV)	Vinyl Chloride (ppmV)	Xylenes (Total) (ppmV)
SG-38	SG03805	10/14/98	5		1.95		8.83		
SG-39	SG03905	10/14/98	5		1.66		2.57		
SG-40	SG04005	10/14/98	5		0.64		1.91		
SG-41	SG04105	10/14/98	5		1.48		0.92		
SG-41	SG54105*	10/14/98	5		1.63		1.16		
SG-42	SG04205	10/14/98	5		1.85		5.8		
SG-43	SG04305	10/14/98	5		3.41		2.77		
SG-44	SG04405	10/14/98	5		0.64		1.98		

*field duplicate

Notes:
cis-DCE - cis-1,2-dichloroethene
ft bgs - feet below ground surface
J - value is an estimated amount
ppmV - parts per million volume
1,1,1-TCA - 1,1,1-trichloroethane
TCE - trichloroethene
trans-DCE - trans-1,2-dichloroethene

Table 4-2
Detections of VOCs and SVOCs in Soil Samples

Location	RS-1		RS-1		T-2A		T-4A	
Sample	RS001		RS501*		ST002A10		ST004A14	
Date	9/28/98		9/28/98		10/16/98		10/19/98	
Depth (ft bgs)					10		14	
VOC (mg/kg)								
Trichloroethene	0.079		0.067					
SVOCs (mg/kg)								
2-Methylnaphthalene					0.032	J	0.12	J
Acenaphthene					0.038	J	0.043	J
Anthracene							0.066	J
Benzo(a)anthracene	0.013	J	0.011	J			0.056	J
Benzo(a)pyrene	0.013	J	0.014	J			0.042	J
Benzo(b)fluoranthene	0.017	J	0.019	J				
Benzo(g,h,i)perylene	0.019	J	0.018	J			0.027	J
Benzo(k)fluoranthene	0.014	J	0.013	J				
Chrysene	0.027	J	0.022	J	0.018	J	0.093	J
Di-n-butyl phthalate					0.13	J	0.17	J
Fluoranthene	0.028	J	0.024	J			0.051	J
Fluorene					0.017	J	0.037	J
Indeno(1,2,3-cd)pyrene	0.014	J	0.014	J				
N-Nitrosodiphenylamine					0.016	J	0.03	J
Naphthalene							0.3	J
Phenanthrene	0.019	J	0.015	J	0.067	J	0.56	J
Pyrene	0.023	J	0.019	J	0.026	J	0.41	J

*field duplicate

Notes:
ft bgs - feet below ground surface
J - value is an estimated amount

Analyses by MultiChem Analytical Services

Table 4-3
Detections of PCBs, Metals, and Conventionals in Soil Samples

Location	T-2A	T-4A	T-4A	T-4B	T-4B	T-6B	T-6E	T-7C
Sample	ST002A10	ST004A02	ST004A14	ST004B09	ST504B09	ST006B14	ST006E14	ST007C06
Date	10/16/98	10/19/98	10/19/98	10/19/98	10/19/98	10/20/98	10/20/98	10/21/98
Depth (ft bgs)	10	2	14	9	9	14	14	6
PCBs (µg/kg)								
Aroclor 1254[a]	58 J							
Total Aroclors[a]	58 J							
Metals (mg/kg)								
Extractable Iron[b]	13,000	36,500	10,900	10,900	26,300		5,500	39,500
Extractable Manganese[b]	490	800	700	510	1,500		100	100
Iron[a]	12,000	14,000	12,000	13,000	16,000	400	12,000	16,000
Manganese[a]	200	210	340	270	300	100	130	160
Conventionals (mg/kg)								
Total Inorganic Carbon	3,302	6,378	9,977		494			
Total Organic Carbon[c]	12,000	39,000	22,000	3,700	3,300		16,000	6,700

[a]Analyzed by MultiChem Analytical Services
[b]Analyzed by Core Laboratories, extracted by citrate-bicarbonate-dithionite (CBD), Method A.S. Agronomy
[c]Analyzed by Analytical Resources, Inc.
*field duplicate

Notes:
ft bgs - feet below ground surface
J - value is an estimated amount

Table 4-4
Detections of Metals and VOCs in Groundwater Samples

				Metals		VOCs								
Location	Sample	Date	Depth (ft bgs)	Iron (mg/L)	Manganese (mg/L)	1,1,1-TCA (µg/L)	Benzene (µg/L)	cis-DCE (µg/L)	Ethyl-benzene (µg/L)	Toluene (µg/L)	Trans-DCE (µg/L)	TCE (µg/L)	Vinyl Chloride (µg/L)	Xylenes (Total) (µg/L)
DP-1	GD00111	10/29/98	11	1.8	0.45			53	25.1				46.1	112
DP-1	GD00120	10/29/98	20		0.96			63.9	10.4			112	38.8	47.9
DP-1	GD00125	10/29/98	25	0.27	0.82	140 J	4.9 J	2,100 J	7.6 J	7.2 J	18.8 J	3,400 J	291 J	32.4 J
DP-1	GD00130	10/29/98	30		0.42	49.2 J		2,600 J			73.5 J	5,600 J	33.6 J	27.7 J
DP-2	GD00213	10/29/98	25	1.7	0.15			31.8	19.6			12.7		83.6
DP-2	GD00220	10/30/98	20	1.1	0.64	10		73.2				34.7	21.6 J	27.1
DP-2	GD00223	10/30/98	23		0.14			197				269	20.8 J	
DP-2	GD00236	10/30/98	36		0.074							18.6		
DP-3	GD00312	11/2/98	12									4.3 J		
DP-3	GD00320	11/2/98	20		0.15			2.8				13.3		
DP-3	GD50320*	11/2/98	20		0.16			1.8 J				11.5		
DP-3	GD00325	11/2/98	25	0.16	0.57							18		
DP-3	GD00333	11/3/98	33	0.22	0.087			12.3 J				2,500		
DP-4	GD00416	11/3/98	16	0.074	0.02									
DP-4	GD00420	11/3/98	20		0.12				2.2 J					11
DP-4	GD00425	11/3/98	25		0.056			8.4				47.6		
DP-4	GD00435	11/3/98	35		0.12				3 J					9.7
DP-5	GD00510	11/3/98	10	0.051	0.11			19,000	740		270	87 J	1,000	3,000
DP-5	GD00520	11/4/98	20	0.47	0.2			630			15.3	156		12.4
DP-5	GD00524	11/4/98	24		0.29 J			1,410	1,110	290		470,000		460
DP-5	GD50524*	11/4/98	24		0.1 J			3,400				1,000,000 J		
DP-5	GD00533	11/4/98	33	0.062	0.065							52,000		
DP-6	GD00610	11/4/98	10		0.069			12,000 J				77,000 J		
DP-6	GD00620	11/4/98	20		0.31			240				2,700		
DP-6	GD00624	11/4/98	24		0.055			200				3,500		
DP-7	GD00713	11/5/98	13									8.4		
DP-7	GD00720	11/5/98	20		0.093			11.8				59		
DP-7	GD00725	11/5/98	25	0.43	0.33			19				109		
DP-7	GD00735	11/5/98	35		0.3							21.3		
DP-8	GD00813	11/9/98	13		0.013			8.1				13.1		
DP-8	GD00820	11/9/98	20		0.024							4.6		
DP-8	GD00825	11/9/98	25		0.13							21.6		
DP-8	GD50825*	11/9/98	25		0.11							21.6		
DP-8	GD00836	11/9/98	36		0.1							2.7		

Table 4-4 (Continued)
Detections of Metals and VOCs in Groundwater Samples

				Metals		VOCs								
Location	Sample	Date	Depth (ft bgs)	Iron (mg/L)	Manganese (mg/L)	1,1,1-TCA (µg/L)	Benzene (µg/L)	cis-DCE (µg/L)	Ethyl-benzene (µg/L)	Toluene (µg/L)	Trans-DCE (µg/L)	TCE (µg/L)	Vinyl Chloride (µg/L)	Xylenes (Total) (µg/L)
DP-9	GD00911	11/9/98	11		0.17	960	290	72,000	270	1,500		120,000	390	1,500
DP-9	GD00920	11/10/98	20	1.3	0.16	140	62 J	6,600	110	640		35,000		640
DP-9	GD00925	11/10/98	25		0.27	1,800 J	98 J	3,100 J	790 J	1,100 J		700,000		4,700 J
DP-9	GD00936	11/10/98	36	2.4	0.052	310		4,400	240	1,000		55,000		1,300
DP-10	GD01013	11/10/98	13					3.9				40.1		
DP-10	GD01020	11/10/98	20					3				32.6		
DP-10	GD01025	11/10/98	25	0.69	0.051							16.3		
DP-10	GD01037	11/11/98	37	0.077	0.23							2.5		
DP-11	GD01115	11/11/98	15	0.05	0.01			2.6				17.4		
DP-11	GD51115*	11/11/98	15	0.062	0.017			3.1				16.7		
DP-11	GD01120	11/11/98	20		0.031			23.8				400		
DP-11	GD01125	11/11/98	25		0.095							89.5		
DP-11	GD01136	11/11/98	36		0.22			6.9				93.7		
DP-12	GD01212	11/11/98	12	0.05	0.011							10.4		
DP-12	GD01220	11/11/98	20		0.022			4.8				7.9		
DP-12	GD01225	11/11/98	25	0.08	0.058			3.4				43.6		
DP-12	GD01236	11/11/98	36	0.053	0.12			12				800		
DP-13	GD01314	11/11/98	14									6.2		
DP-13	GD01320	11/11/98	20		0.05							3.3		
DP-13	GD01325	11/13/98	25	0.065	0.079									
DP-13	GD01339	11/13/98	39	0.065	0.4							27		
DP-13	GD51339*	11/13/98	39	0.093	0.36							30.7		
DP-14	GD01411	11/13/98	11									3.5		
DP-14	GD01420	11/13/98	20		0.054							17.5		
DP-14	GD01425	11/13/98	25	0.11	0.13			2.8				26.6		
DP-14	GD01432	11/16/98	32		0.098			58.5			13.6	39,000		
DP-15	GD01511	11/16/98	11	0.12	0.11							119		
DP-15	GD51511*	11/16/98	11	0.15	0.12							109		
DP-15	GD01520	11/16/98	20	0.12	0.18							71.6		
DP-15	GD01525	11/16/98	25		0.46			27				426		
DP-15	GD01530	11/16/98	30		0.48							398		
DP-16	GD01613	11/17/98	13		0.025			15				36.6		
DP-16	GD01620	11/17/98	20		0.039			6.4				70.1		
DP-16	GD01625	11/17/98	25		0.47			17.8				132		

Table 4-4 (Continued)
Detections of Metals and VOCs in Groundwater Samples

				Metals		VOCs								
Location	Sample	Date	Depth (ft bgs)	Iron (mg/L)	Manganese (mg/L)	1,1,1-TCA (µg/L)	Benzene (µg/L)	cis-DCE (µg/L)	Ethyl-benzene (µg/L)	Toluene (µg/L)	Trans-DCE (µg/L)	TCE (µg/L)	Vinyl Chloride (µg/L)	Xylenes (Total) (µg/L)
DP-16	GD01635	11/17/98	35		0.66			5.4				115		
DP-17	GD01717	11/17/98	17	0.45 J	0.052			354			4.4 J	128	64.7	7.7
DP-17	GD51717*	11/17/98	17	0.68 J	0.052			469				168	85.4	
DP-17	GD01722	11/17/98	22		0.17			62.2				255		
DP-17	GD01731	11/18/98	31		0.25			50.5				385		
DP-17	GD01738	11/18/98	38		0.12			94.3				369		
DP-18	GD01811	11/18/98	11	0.43	0.096			2,670			24.4	9,020		
DP-18	GD01820	11/18/98	20	0.2	0.031			5,890			73.8	12,000		
DP-18	GD01825	11/18/98	25	0.21	0.2			3,650			57	8,770		
DP-18	GD01837	11/18/98	37		0.31			98.2				233		
DP-19	GD01916	11/19/98	16		0.041			7.6				91.6		
DP-19	GD01922	11/19/98	22		0.044			15.4				218		
DP-19	GD01927	11/19/98	27		0.25			27.9				363		
DP-19	GD01937	11/19/98	37		0.46			38.2				595		
DP-20	GD02020	11/20/98	20		0.037									
DP-20	GD02024	11/20/98	24		0.092									
DP-20	GD52024*	11/20/98	24		0.085									
DP-20	GD02036	11/20/98	36	0.11	0.38									
DP-21	GD02110	3/15/99	10		0.06			140				1,500	23	
DP-21	GD02112	3/15/99	12	0.26	0.11			150				1,300		
DP-21	GD02123	3/15/99	23	0.95	0.18			150				470		
DP-21	GD02127	3/15/99	27	2.2	0.84			58				400	110	
DP-22	GD02208	3/16/99	8	0.18	0.045							42	11	
DP-22	GD02216	3/16/99	16	0.13	0.024			3.6				51	27	
DP-22	GD02224	3/16/99	24					57				1,800	15	
DP-22	GD02232	3/16/99	32	0.068	0.039			5.3				61	22	
DP-23	GD02308	3/16/99	8	0.067	0.36			180				740		
DP-23	GD02316	3/16/99	16	0.093	0.4			5,100				470,000		
DP-23	GD52316*	3/16/99	16		0.075			6,000				500,000		
DP-23	GD02324	3/17/99	24	0.13	0.23		2,200	2,300		4,200		970,000		
DP-23	GD02339	3/17/99	39	0.38	0.11							48,000		
DP-24	GD02409	3/17/99	9	0.057	0.017	4		200			2.6	89	12	
DP-24	GD02419	3/17/99	19	0.77	0.57	5.4		150			2.6	68	12	
DP-24	GD02424	3/17/99	24	0.4	0.21	8.4		200				78	14	

Table 4-4 (Continued)
Detections of Metals and VOCs in Groundwater Samples

				Metals		VOCs								
Location	Sample	Date	Depth (ft bgs)	Iron (mg/L)	Manganese (mg/L)	1,1,1-TCA (µg/L)	Benzene (µg/L)	cis-DCE (µg/L)	Ethyl-benzene (µg/L)	Toluene (µg/L)	Trans-DCE (µg/L)	TCE (µg/L)	Vinyl Chloride (µg/L)	Xylenes (Total) (µg/L)
DP-24	GD02435	3/17/99	35	0.13	0.023			33				29		
DP-25	GD02507	3/18/99	7		0.014			2.6				13	21	
DP-25	GD02519	3/18/99	19	0.19	0.39			3.6				18	24	
DP-25	GD02524	3/18/99	24	0.27	0.45			3.7				23	10	
DP-25	GD02530	3/18/99	30	0.072	0.35			10				83	18	
DP-26	GD02609	3/18/99	9	0.093	0.39			35				310	8.2	
DP-26	GD02619	3/18/99	19		1.2							14	13	
DP-26	GD02625	3/19/99	25		0.3							18	13	
DP-26	GD02638.5	3/19/99	38		0.27			2.7				28	17	
DP-27	GD02709	3/19/99	9		0.016			2.5				37	18	
DP-27	GD02719	3/19/99	19		0.24							2.5		
DP-27	GD02723	3/19/99	23	0.083	0.19			2.7				4.8		
DP-27	GD02738	3/19/99	38	0.061	0.37								11	
DP-27	GD52738*	3/19/99	38		0.35								13	
DP-28	GD02810	3/22/99	10		0.037								11	
DP-28	GD02819	3/22/99	19	0.058	0.33								11	
DP-28	GD02824	3/22/99	24		0.26							2.8	18	
DP-28	GD02831	3/22/99	31		0.23			2.8				2.6	13	
DP-29	GD02908.5	3/22/99	8		0.095			2,400			20	48	700	
DP-29	GD02919	3/22/99	19		0.51			99				180		
DP-29	GD02924	3/23/99	24		0.26			150				930		7.3
DP-29	GD52924*	3/23/99	24		0.24			130				1,200		7.3
DP-29	GD02928	3/23/99	28		0.48			100				520		
DP-30	GD03013	3/23/99	13		0.036			170				400	26	
DP-30	GD03019	3/23/99	19		0.038			42				87	14	
DP-30	GD03024	3/23/99	24		0.13			380			14	780	21	
DP-30	GD03035	3/23/99	35		0.38			110				990	21	
DP-31	GD03109	3/24/99	9					5				50	18	
DP-31	GD03112	3/24/99	12	0.15	0.024			4.3				32	17	
DP-31	GD03127	3/24/99	27		0.089			22				440	22	
DP-31	GD53127*	3/24/99	27		0.098			16				430	19	
DP-31	GD03135	3/24/99	35	1.8	0.8			200			5.5	930	12	
DP-32	GD03209	3/25/99	9		0.087			5.3				220	7.6	
DP-32	GD03219	3/25/99	19	0.14	0.12							680		

Table 4-4 (Continued)
Detections of Metals and VOCs in Groundwater Samples

				Metals		VOCs								
Location	Sample	Date	Depth (ft bgs)	Iron (mg/L)	Manganese (mg/L)	1,1,1-TCA (µg/L)	Benzene (µg/L)	cis-DCE (µg/L)	Ethyl-benzene (µg/L)	Toluene (µg/L)	Trans-DCE (µg/L)	TCE (µg/L)	Vinyl Chloride (µg/L)	Xylenes (Total) (µg/L)
DP-32	GD53219*	3/25/99	19	0.11	0.083							960		
DP-32	GD03224	3/25/99	24	0.66	0.49			86				2,200		
DP-32	GD03228	3/25/99	28	0.31	0.56							840		
DP-33	GD03309	3/25/99	9	0.083	0.028			37				900	13	
DP-33	GD03324	3/25/99	24	0.14	0.24			1,300				75,000		
DP-33	GD03329	3/26/99	29	0.13	0.085							7,100		
DP-33	GD03335	3/26/99	35	0.16	0.083							9,900		
DP-34	GD03409	3/26/99	9		0.034							4.2	12	
DP-34	GD03419	3/26/99	19	0.084	0.099							41		
DP-34	GD53419*	3/26/99	19	0.076	0.075							36		
DP-34	GD03424	3/26/99	24		0.069							6	13	
DP-34	GD03437	3/29/99	37	0.46	0.4							23	7.7	
DP-35	GD03509	3/29/99	9	0.06				2.9				9.2	9.2	
DP-35	GD03519	3/29/99	19	0.056	0.013			13				13	14	
DP-35	GD53519*	3/29/99	19	0.07	0.019			11				10	10	
DP-35	GD03524	3/29/99	24	0.28	0.097			20				21	15	
DP-35	GD03534	3/29/99	34	0.76	0.51			5.5				19		
DP-36	GD03612	3/30/99	12	0.096				8.7				14		
DP-36	GD03619	3/30/99	19	0.086	0.012			14				21		
DP-36	GD03624	3/30/99	24	0.11	0.23			27			2.1 J	350	12	
DP-36	GD03636	3/30/99	36	0.17	0.46			75				460	140	
DP-37	GD03713	3/30/99	13	0.1				18				48	9.8	
DP-37	GD03719	3/30/99	19	0.076	0.014			17				12		
DP-37	GD53719*	3/30/99	19	0.11	0.018			17				11		
DP-37	GD03722	3/31/99	22	0.42	0.52			7.3				19		
DP-37	GD03734	3/31/99	34		0.26			4.5				17		
DP-38	GD03807.5	3/31/99	7		0.036							4.8		
DP-38	GD03819	3/31/99	19	0.32	0.23			4.3				6.9		
DP-38	GD03824	3/31/99	24	0.41	0.18							4.2		
DP-38	GD53824*	3/31/99	24	0.4	0.22							4.5		
DP-38	GD03831	3/31/99	31	0.067	0.37			29				450		
DP-39	GD03913	4/1/99	13		0.039							7.1		
DP-39	GD03919	4/1/99	19	0.17	0.036									
DP-39	GD03924	4/1/99	24	0.15	0.064									

Table 4-4 (Continued)
Detections of Metals and VOCs in Groundwater Samples

				Metals		VOCs								
Location	Sample	Date	Depth (ft bgs)	Iron (mg/L)	Manganese (mg/L)	1,1,1-TCA (µg/L)	Benzene (µg/L)	cis-DCE (µg/L)	Ethyl-benzene (µg/L)	Toluene (µg/L)	Trans-DCE (µg/L)	TCE (µg/L)	Vinyl Chloride (µg/L)	Xylenes (Total) (µg/L)
DP-39	GD03935	4/1/99	35		0.45							4.7		
DP-40	GD04015	4/1/99	15	0.11								19	8	
DP-40	GD04019	4/1/99	19	0.12	0.018							16		
DP-40	GD04023	4/2/99	23	0.13	0.062							16		
DP-40	GD04037	4/2/99	37	0.3	0.16			8.8				88		
DP-41	GD04108	4/2/99	8		0.12			230				610		
DP-41	GD04119	4/2/99	19	0.092	0.31			110				1,000		
DP-41	GD54119*	4/2/99	19	0.17	0.4			120				1,000		
DP-41	GD04130	4/2/99	30	1.2	0.56			140				1,100		
DP-41	GD04133	4/5/99	33	0.66	0.21			120				1,200		
DP-42	GD04208	4/5/99	8		0.012			7.7				63		
DP-42	GD04216	4/5/99	16	0.12	0.25			96				390		
DP-42	GD04223	4/5/99	23	0.068	0.1							270		
DP-42	GD04239	4/6/99	39	0.19	0.39							96		
DP-43	GD04307	4/6/99	7					37				310		
DP-43	GD04319	4/6/99	19	0.55	0.43			53				120		
DP-43	GD54319*	4/6/99	19	0.63	0.56			54				110		
DP-43	GD04324	4/6/99	24	0.65	0.4			39				120		
DP-43	GD04330	4/6/99	30	0.83	0.2			110				530		
DP-44	GD04412	4/6/99	12					7.5				8.3		
DP-44	GD04419	4/7/99	19		0.087			79				200	8.1	
DP-44	GD04424	4/7/99	24		0.089			50				160		
DP-44	GD04433	4/7/99	33		0.22							130		
DP-45	GD04506	4/7/99	6	0.073	0.028			4.9				11		
DP-45	GD04517	4/7/99	17		0.5			110			3.2	260	18	
DP-45	GD54517*	4/7/99	17		0.45			100			3.4	240	19	
DP-45	GD04522	4/7/99	22		0.24			210				490		
DP-45	GD04528	4/8/99	28	0.074	0.23			180				440		
DP-46	GD04607	4/8/99	7		0.011			150			3.4	2,000	16	
DP-46	GD04618	4/8/99	18	0.24	0.36			150				1,700		
DP-46	GD04624	4/8/99	24	0.28	0.052			76 J				1,000		
DP-46	GD54624*	4/8/99	24	0.28	0.066			51 J				1,100		
DP-46	GD04632	4/8/99	32	0.91	0.7							360		
DP-47	GD04709	4/8/99	9					260				770		

Table 4-4 (Continued)
Detections of Metals and VOCs in Groundwater Samples

				Metals		VOCs								
Location	Sample	Date	Depth (ft bgs)	Iron (mg/L)	Manganese (mg/L)	1,1,1-TCA (µg/L)	Benzene (µg/L)	cis-DCE (µg/L)	Ethyl-benzene (µg/L)	Toluene (µg/L)	Trans-DCE (µg/L)	TCE (µg/L)	Vinyl Chloride (µg/L)	Xylenes (Total) (µg/L)
DP-47	GD04717	4/8/99	17	0.061				170				550		
DP-47	GD04721	4/9/99	21	0.33	0.17			77				610		
DP-47	GD04732	4/9/99	32		0.12			330				21,000	170	
DP-48	GD04806	4/9/99	6		0.12			120				35	8.4	
DP-48	GD04819	4/9/99	19	0.13	0.038							46		
DP-48	GD04824	4/9/99	24		0.022			31				350		
DP-48	GD04833	4/9/99	33		0.12			41				870		
DP-49	GD04907	4/12/99	7					41				43		
DP-49	GD04919	4/12/99	19		0.18			17				91	18	
DP-49	GD04922	4/12/99	22		0.16							27		
DP-49	GD04932	4/12/99	32		0.26			59				11,000 J		
DP-50	GD05009	4/12/99	9	0.051	0.024			12				23		
DP-50	GD05019	4/13/99	19		0.039			7.1				7.6		
DP-50	GD05024	4/13/99	24		0.15							6.6		
DP-50	GD05031	4/13/99	31		0.14							6.3		
T-2D	GT002D10	10/16/98	10					69			2.6	38.5		
T-2D	GT502D10*	10/16/98	10	0.11				80			3.2	36.4		
T-3D	GT003D6.5	10/19/98	6	3.2	0.7			5,700 J	5.7 J	9.4	36.4	180,000 J	17.4	47.9 J
T-5A	GT005A12	10/20/98	12		0.3			18.2				109	19.1	

Notes:
1,1,1-TCA - 1,1,1-trichloroethane
cis-DCE - cis-1,2-dichloroethene
J - value is an estimated amount
TCE - trichloroethene
trans-DCE - trans-1,2-dichloroethene

Metals analysis by MultiChem Analytical Services; VOC analysis by Transglobal Environmental Geosciences Northwest

Table 4-5
Detections in NAPL Samples

Location	T-1A	T-1E[b]	T-5B	T-5C	T-6B	T-7B	T-7C
Sample	NT001A09	DT001E	DT005B03	DT005C03	NT006B15	NT007B13	NT007C13
Date	10/15/98	10/16/98	10/20/98	10/20/98	10/20/98	10/21/98	10/21/98
Depth (ft bgs)	9		3	3	15	13	13
VOCs (mg/kg)							
Benzene							
cis-1,2-Dichloroethene[a]	44						
cis-1,2-Dichloroethene	440 J						36 J
Ethylbenzene	78				520		1,030
N-Butylbenzene	210 J				320 J		350 J
Tetrachloroethene		648					
Toluene							266
trans-1,2-Dichloroethene							
Trichloroethene[a]	180	832,000					
Trichloroethene							50 J
1,2,4-Trimethylbenzene	220 J						
1,3,5-Trimethylbenzene	38 J						
Xylenes (Total)	344				3,600		2,400
SVOCs (mg/kg)							
1,2-Dichlorobenzene			230				
1,4-Dichlorobenzene			42 J				
2-Methylnaphthalene	9.2 J		27 J	44 J	7.6 J		
2-Methylphenol			24 J				
4-Methylphenol			49 J				
Acenaphthene	11 J						
bis(2-Ethylhexyl)phthalate	47 J			36 J	31 J	23 J	
Di-n-butylphthalate	9.4 J		90 J	81 J			
Fluoranthene	6.6 J						
Fluorene	12 J				7.6 J		
N-Nitrosodiphenylamine	9.5 J						
Naphthalene			12 J	190 J			
Phenanthrene	26 J		16 J	12 J	10 J		
Pyrene	23 J				7.5 J		
PCBs (µg/kg)							
Aroclor 1254	1,800		720 J	1,200 J			
Aroclor 1260	1,600						
Total Aroclors	3,400		720 J	1,200 J			

Table 4-5 (Continued)
Detections in NAPL Samples

Location	T-1A	T-1E[b]	T-5B	T-5C	T-6B	T-7B	T-7C
Sample	NT001A09	DT001E	DT005B03	DT005C03	NT006B15	NT007B13	NT007C13
Date	10/15/98	10/16/98	10/20/98	10/20/98	10/20/98	10/21/98	10/21/98
Depth (ft bgs)	9		3	3	15	13	13
TPH (mg/kg)							
Oil-Range[a]	190,000				150,000 J		240,000
Mineral-Spirits-Range[a]	150,000				450,000		640,000 J
Total TPH[a]	340,000				600,000		880,000
TPH (mg/kg)							
Diesel-Range	160,000 J				150,000 J		140,000 J
Motor-Oil-Range	400,000 J				450,000 J		400,000 J
Gasoline-Range	43,000 J				410,000 J		423,000 J
Total TPH	603,000				1,010,000		963,000

[a]Analyzed by Transglobal Environmental Geosciences Northwest, except for sample DT001E
[b]Analyzed by Anatek Labs, Inc. for Fort Lewis

Notes:
J - value is an estimated amount

Analyzed by MultiChem except where noted

5.0 CONCLUSIONS AND RECOMMENDATIONS

The primary objective of this site investigation was to locate NAPL sources of TCE contamination to groundwater at the EGDY. Figure 5-1 provides a summary of areas where NAPL sources were detected or inferred. The following conclusions can be drawn from the results of this investigation. Recommendations for future investigation and remediation activities are also provided.

Sources of TCE exist as NAPL in drums, in NAPL sorbed onto soil in the vadose zone, in LNAPL floating on the water table, and as DNAPL in the shallow aquifer. Drums containing a variety of product materials were found in five of the eight exploratory trenches. It is not known how many drums exist in the disposal areas; however, the geophysical surveys detected metallic debris in many locations that may or may not represent drums. The field exploration also did not provide sufficient data to estimate the extent of LNAPL at the site. LNAPL was encountered in five of the trenches and at six of the drivepoint locations, but may be laterally extensive. The results of the drivepoint groundwater analyses appear to have identified the approximate locations of DNAPL in the subsurface.

LNAPL containing TCE and/or POL occurs floating on the water table. As a result of the abbreviated trenching activities, the extent of this LNAPL could not be fully assessed.

Based on the drivepoint sampling grid, it appears that dissolved TCE concentrations in groundwater decrease by orders of magnitude from hundreds of thousands of µg/L to hundreds of µg/L within a few hundred feet of a NAPL source. This apparent degree of attenuation may be an artifact of limited information on groundwater flow direction and the complexity of the hydrogeology.

Physical and biological natural attenuation processes lower dissolved contaminant concentrations, but are not sufficient to achieve the MCL of 5 µg/L. Given the current levels of TCE groundwater contamination near the source areas, natural attenuation alone can not be considered a remedy. The solubility of TCE in groundwater in contact with DNAPL exceeds the attenuation ability of the system. Source removal will also be necessary to lower contaminant concentrations to a level at which the natural system can be effective in achieving the MCL.

Buried drums with product provide current and potential future sources of high levels of contamination at this site. Priority should be given to removing these sources. The results of the geophysical surveys can be used to locate possible drum locations.

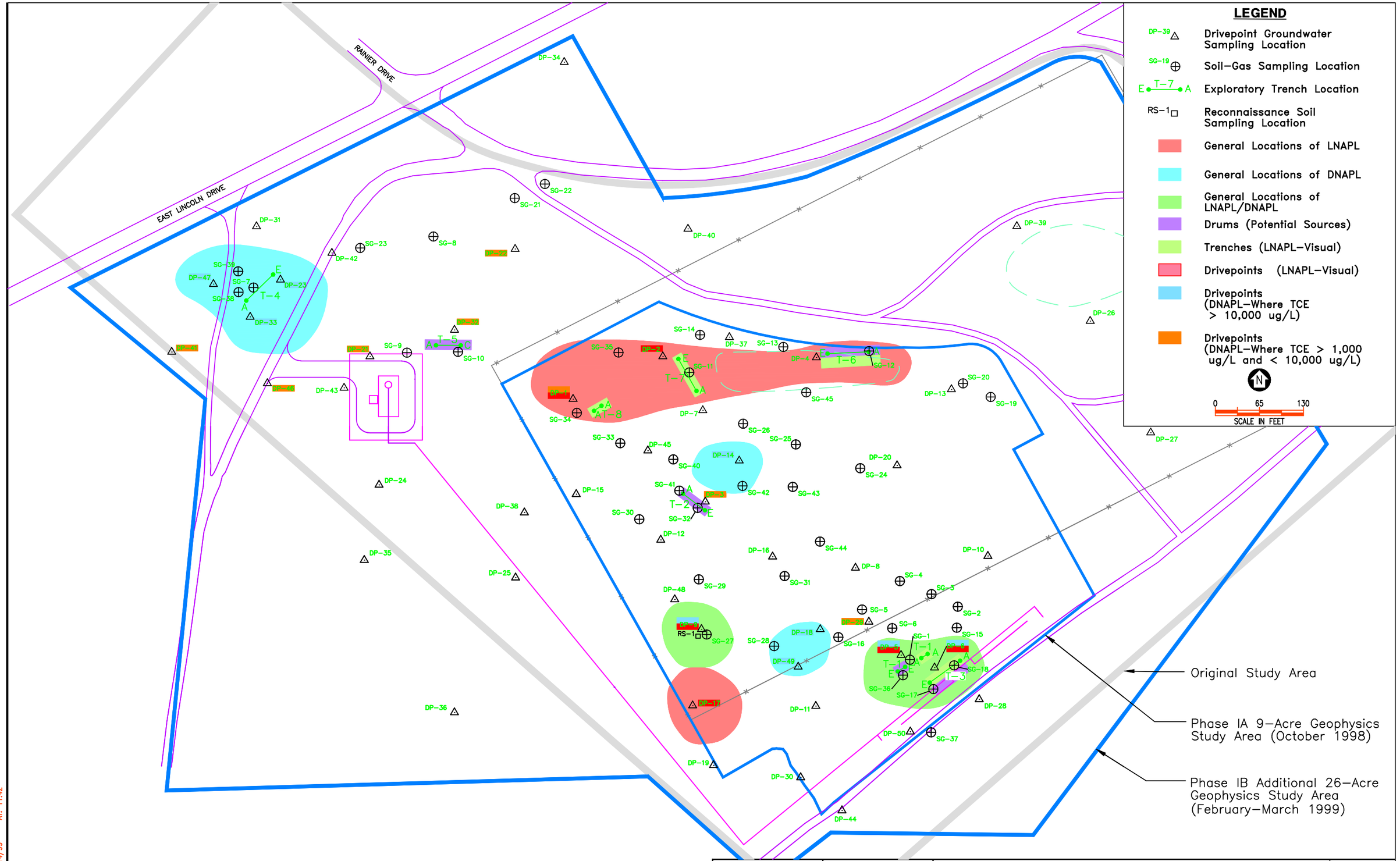
Because of the occurrence of mortar rounds in one of the trenches, future intrusive work in the former disposal trenches and pits should be conducted with the support of personnel trained in avoiding and removing unexploded ordnance.

The current scope of the Phase II investigation calls for the installation of monitoring wells and sampling and analysis of soil and groundwater to better characterize contamination. It is recommended that these wells be located in the four areas where DNAPL was identified from the drivepoint sampling. The DQOs for future investigation activities should be redefined to focus on potential remedial action data needs. It would be advantageous to tailor further investigation activities around potential technologies for DNAPL remediation.

Because of the presence of DNAPL on the aquitard and the lack of information regarding the aquitard, it is recommended that Phase II wells be designed to provide detailed stratigraphic information to at least the base of the aquitard.

Because of the presence of DNAPL on the aquitard and the limited amount of information on the aquifer below the aquitard, it is recommended that some of the Phase II wells be completed below the aquitard to detect potential DNAPL or dissolved contaminants in this zone of the aquifer.

Emerging geophysical techniques may be useful in better characterizing aquitards and other low-permeability zones in an aquifer. These techniques should be evaluated and considered for application in Phase II of this investigation.



East Gate Disposal Yard Fort Lewis, Washington	Project No. E9518Q	Expanded Site Investigation NAPL Encountered	5-1
URS Greiner Woodward Clyde			

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EDIT DATE: 10/14/99 AT: 11:42

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APPENDIX A

Field Notes

Field Logbook 1

September through November 1998 – Phase IA

Hardcopies of Field Logbook 1 are not available in electronic form.

They are in the Draft Phase I Technical Memorandum and also in the Final Phase I Technical Memorandum camera-ready copy.

Field Logbook 2

Field Screening Notes, October 1998 – Phase IA

Hardcopies of Field Logbook 2 are not available in electronic form.

They are in the Draft Phase I Technical Memorandum and also in the Final Phase I Technical Memorandum camera-ready copy.

Field Logbook 3

January through April 1999 – Phase IB

Hardcopies of Field Logbook 3 are not available in electronic form.

They are in the Draft Phase I Technical Memorandum and also in the Final Phase I Technical Memorandum camera-ready copy.

Trench Log and Data Sheet Forms

Hardcopies of Trench Log and Data Sheet Forms are not available in electronic form.

They are in the Draft Phase I Technical Memorandum and also in the Final Phase I Technical Memorandum camera-ready copy.

Groundwater Sampling Data Sheets

Hardcopies of Groundwater Sampling Data Sheets are not available in electronic form.

They are in the Draft Phase I Technical Memorandum and also in the Final Phase I Technical Memorandum camera-ready copy.

Drivepoint Field Observation Sheets

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-1

Depth 0 (ft bgs)	Samples	10/30/98 Observations
5		
		* Thin layer of NAPL on water table (insufficient quantity to sample)
10		
	GD00111	
15		No changes in drilling penetration rate
		No infiltration from 16 to 20' bgs (potential aquitard)
20	GD00120	Very hard penetration; purge water gray, turbid;
		no infiltration from 16 to 20' bgs (potential aquitard)
25	GD00125	Hard penetration; purge water turbid
30	GD00130	Harder penetration; no infiltration from 29 to 33' bgs (potential aquitard)
35		
40		

Total Depth (feet bgs): 33
* Approximate Depth to Groundwater (feet bgs): 9.5
Approximate Depth to Aquitard(s) (feet bgs): 16, 30

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-2

Depth 0 (ft bgs)	Samples	10/30/98 Observations
		Hard to very hard penetration
5		
10		
	GD00213	* Water infiltrated quickly; NAPL on sample tubing when withdrawn
15		
		Hard penetration
20	GD00220	
	GD00223	Harder penetration; no water infiltration from 22 to 25 feet bgs (potential aquitard)
25		Extremely hard penetration
30		
		Softer penetration (potential aquitard?)
35		
	GD00236	
40		

Total Depth (feet bgs): 36
* Approximate Depth to Groundwater (feet bgs): 13
Approximate Depth to Aquitard(s) (feet bgs): 22?, 32

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-3

Depth 0 (ft bgs)	Samples	11/2/98 Observations
		Moderate penetration rate
5		Hard penetration
10		
	GD00312	* Purge water clear
		Very hard penetration
15		
20	GD00320	Purge water turbid
		Moderate penetration rate
25	GD00325	Hard penetration; water infiltrated slowly
		Very hard penetration
30		
		Softer penetration
	GD0333	Purge water gray-brown and very turbid; no infiltration 32 to 36' bgs (potential aquitard)
35		
40		

Total Depth (feet bgs): 36
* Approximate Depth to Groundwater (feet bgs): 12
Approximate Depth to Aquitard(s) (feet bgs): 32

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-4

Depth 0 (ft bgs)	Samples	11/3/98 Observations
5		Moderate penetration rate
10		
15		* Hard penetration
	GD00416	Water infiltrated quickly; brown, moderately turbid
20	GD00420	Water infiltrated quickly; brown, moderately turbid
		Very hard penetration
25	GD00425	Water infiltrated slowly; brownish-gray, turbid
30		
		Hard penetration
35	GD00435	Purge water brown, extremely turbid; diesel-like odor
40		

Total Depth (feet bgs): 36
* Approximate Depth to Groundwater (feet bgs): 14
Approximate Depth to Aquitard(s) (feet bgs): No indication of aquitard to 36' bgs

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-5

Depth 0 (ft bgs)	Samples	11/4/98 Observations
5		
10	GD00510	* NAPL globules in purge water
15		
20	GD00520	Purge water gray, turbid, odor; hard penetration
25	GD00524	No infiltration 23 to 25' bgs; purge water gray, turbid (potential aquitard); LNAPL & DNAPL present
30		Very hard penetration
35	GD00532	Refusal; purge water gray, very turbid
40		

Total Depth (feet bgs): 32
* Approximate Depth to Groundwater (feet bgs): 10
Approximate Depth to Aquitard(s) (feet bgs): 24

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-6

Depth 0 (ft bgs)	Samples	11/4/98 Observations
		Soft penetration
5		
		* Hard penetration
10	GD00610	Purge water brown, turbid
15		Hard penetration
20	GD00620	Purge water brown, turbid, sheen
		Hard penetration
	GD00624	No infiltration 21 to 25' bgs (potential aquitard)
25		
		Refusal (no sample collected from 4th depth)
30		
35		
40		

Total Depth (feet bgs): 28
* Approximate Depth to Groundwater (feet bgs): 8
Approximate Depth to Aquitard(s) (feet bgs): 24

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-7

Depth 0 (ft bgs)	Samples	11/5/98 Observations
5		Moderate penetraiton rate
10		
		*
	GD00713	Purge water infiltrated quickly, clear
15		
20	GD00720	Purge water turbid
25	GD00725	Purge water highly turbid
30		
35	GD00735	Purge water highly turbid
40		

Total Depth (feet bgs): 35
* Approximate Depth to Groundwater (feet bgs): 11
Approximate Depth to Aquitard(s) (feet bgs): No indication of aquitard to 35' bgs

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-8

Depth 0 (ft bgs)	Samples	11/9/98 Observations
5		Moderate penetration rate
10		
		*
	GD00813	Purge water tan-brown, moderately turbid
15		
20	GD00820	Purge water brown and very turbid; moderate penetration rate
25	GD00825	Purge water brown and very turbid; slow infiltration
30		Hard penetration
35		Softer penetration per driller
	GD00836	Purge water gray-brown, turbid; slow infiltration
40		

Total Depth (feet bgs): 36
* Approximate Depth to Groundwater (feet bgs): 12
Approximate Depth to Aquitard(s) (feet bgs): No indication of aquitard to 36' bgs

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-9

Depth 0 (ft bgs)	Samples	11/10/98 Observations
		Hard penetration to 8' bgs
5		
		Moderate penetration rate to 23' bgs
10		
	GD00911	* Purge water dark gray, turbid; NAPL present
15		
20	GD00920	Purge water dark gray, very turbid; NAPL present
		Hard penetration
25	GD00925	Purge water dark gray, very turbid; NAPL present
30		Hard penetration
35		Softer penetration per driller
	GD00936	Purge water dark gray and very turbid; hydrocarbon sheen and odor
40		

Total Depth (feet bgs): 36
* Approximate Depth to Groundwater (feet bgs): 11
Approximate Depth to Aquitard(s) (feet bgs): Possibly at 32' bgs, or deeper than 36' bgs

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-10

11/10/98

Depth 0 (ft bgs)	Samples	Observations
		Very hard penetration to 6' bgs
5		
		Hard penetration to 13' bgs
10		
		*
	GD01013	Purge water initially brown and turbid
15		
		Hard penetration
20	GD01020	Purge water initially brown and turbid
		Very hard penetration (refusal 3 times)
25	GD01025	Purge water initially brown and turbid
30		Moderate penetration
		Hard penetration
35		
	GD01037	Very hard penetration
40		

Total Depth (feet bgs): 37
* Approximate Depth to Groundwater (feet bgs): 12
Approximate Depth to Aquitard(s) (feet bgs): No indication of aquitard to 37' bgs

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-11

Depth 0 (ft bgs)	Samples	11/11/98 Observations
		Very hard penetration
5		
10		Hard penetration to 20' bgs
15	GD01115	* Purge water slightly turbid
20	GD01120	Purge water slightly turbid
25	GD01125	Very hard penetration 21 to 25' bgs Purge water very turbid
30		
35		Soft penetration 33 to 35' bgs
40	GD01136	Very slow infiltration 33 to 36' bgs (potential aquitard)

Total Depth (feet bgs): 36
* Approximate Depth to Groundwater (feet bgs): 13
Approximate Depth to Aquitard(s) (feet bgs): 34

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-12

Depth 0 (ft bgs)	Samples	11/12/98 Observations
5		
10		*
	GD01212	
15		
20	GD01220	Hard penetration to 25' bgs
25	GD01225	Moderate penetration to 31' bgs; purge water very turbid
30		
35		Hard penetration to 35' bgs Softer penetration to 38' bgs
	GD01237	Purge water gray and turbid; no infiltration 33 to 37' bgs (potential aquitard)
40		

Total Depth (feet bgs): 37
* Approximate Depth to Groundwater (feet bgs): 10
Approximate Depth to Aquitard(s) (feet bgs): 34

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-13

Depth 0 (ft bgs)	Samples	11/12/98 Observations
		Hard penetration to 14' bgs
5		
10		
		*
	GD01314	Soft penetration to 17' bgs; purge water turbid, sheen visible
15		
		Hard penetration to 20' bgs
20	GD01320	Moderate penetration rate to 39' bgs, except softer 26 to 28' bgs and 37 to 39' bgs; purge water very turbid
25	GD01325	
30		
35		
	GD01339	Purge water brown-gray and turbid
40		

Total Depth (feet bgs): 39
* Approximate Depth to Groundwater (feet bgs): 13
Approximate Depth to Aquitard(s) (feet bgs): No indication of aquitard to 39' bgs

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-14

Depth 0 (ft bgs)	Samples	11/13/98 Observations
		Hard penetration
5		
		Softer penetration 6 to 8' bgs
10		
	GD01411	* Purge water very clear, H_2S odor
15		Hard penetration
20	GD01420	Purge water brown and initially very turbid
25	GD01425	
30		Hard penetration
		Softer penetration
35		
	GD01437	Purge water gray and very turbid; poor infiltration 32 to 37' bgs (potential aquitard)
40		

Total Depth (feet bgs): 37
* Approximate Depth to Groundwater (feet bgs): 11
Approximate Depth to Aquitard(s) (feet bgs): 32

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-15

Depth 0 (ft bgs)	Samples	11/16/98 Observations
		Very hard to 8' bgs
5		
		Softer penetration 8 to 15' bgs
10		
	GD01511	* Purge water brown and initially very turbid
15		Hard penetration to 30' bgs
20	GD01520	Purge water brown and initially very turbid
25	GD01525	Purge water brown and initially very turbid
		Poor water infiltration 29 to 35' bgs (potential aquitard)
30	GD01530	Softer penetration to 33' bgs
		Harder penetration to 35' bgs
35		
40		

Total Depth (feet bgs): 35
* Approximate Depth to Groundwater (feet bgs): 11
Approximate Depth to Aquitard(s) (feet bgs): 29

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-16

Depth 0 (ft bgs)	Samples	11/17/98 Observations
		Hard penetration
5		
		Moderate penetration to 23' bgs
10		*
	GD01611	Purge water reddish-brown and turbid
15		
20	GD01620	Purge water brown and initially very turbid
		Hard penetration to 33' bgs
25	GD01625	Purge water brown and initially very turbid
30		
		Very hard penetration to 36' bgs
35	GD01635	Purge water brown-gray and very turbid; poor infiltration 34 to 36' bgs (potential aquitard)
		Refusal
40		

Total Depth (feet bgs): 36
* Approximate Depth to Groundwater (feet bgs): 10
Approximate Depth to Aquitard(s) (feet bgs): 35

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-17

Depth 0 (ft bgs)	Samples	11/17/98 Observations
		Hard penetration to 10' bgs
5		
10		Moderate penetration rate to 29' bgs
15		
		*
	GD01717	Purge water gray, low turbidity, sheen, odor
20		
	GD01722	Purge water brown and turbid; no infiltration 20 to 22' bgs (potential aquitard)
25		
		Hard penetration to 33' bgs
30		
	GD01731	Purge water gray, low turbidity, odor; no water infiltration 30 to 32' bgs (potential aquitard)
		Very hard penetration to 38' bgs
35		
	GD01738	Refusal; purge water gray and turbid
40		

Total Depth (feet bgs): 38
* Approximate Depth to Groundwater (feet bgs): 16
Approximate Depth to Aquitard(s) (feet bgs): 21, 31

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-18

Depth 0 (ft bgs)	Samples	11/18/98 Observations
		Very hard penetration to 13' bgs
5		
10		*
	GD01811	Purge water reddish-brown and turbid
		Moderate penetration to 23' bgs
15		
20	GD01820	Purge water initially brown and turbid
		Hard penetration to 33' bgs
25	GD01825	Purge water initially brown and turbid; poor infiltration 23 to 25' bgs (potential aquitard)
30		
		Moderate penetration to 35' bgs
35		Harder penetration to 37' bgs
	GD01837	
40		

Total Depth (feet bgs): 37
* Approximate Depth to Groundwater (feet bgs): 10
Approximate Depth to Aquitard(s) (feet bgs): 24

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-19

Depth 0 (ft bgs)	Samples	11/19/98 Observations
		Moderate penetration to 20' bgs
5		
10		
15		*
	GD01916	Purge water brown and initially very turbid
20		Hard penetration
	GD01922	Purge water brown and initially very turbid
25		
	GD01927	Purge water brown and initially very turbid
30		
35		
	GD01937	Refusal at 37' bgs; poor infiltration 35 to 37' bgs (potential aquitard)
40		

Total Depth (feet bgs): 37
* Approximate Depth to Groundwater (feet bgs): 15
Approximate Depth to Aquitard(s) (feet bgs): 36

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-20

Depth 0 (ft bgs)	Samples	11/20/98 Observations
		Hard penetration to 12' bgs
5		
10		
		* Moderate penetration to 23' bgs
	GD02013	
15		
20	GD02020	
		Very hard penetration to 37' bgs; poor infiltration 23 to 26' bgs (potential aquitard)
25	GD02025	
30		
35		No water infiltration 35 to 39' bgs (potential aquitard)
	GD02036	Hard penetration to 39' bgs
40		

Total Depth (feet bgs): 39
* Approximate Depth to Groundwater (feet bgs): 12
Approximate Depth to Aquitard(s) (feet bgs): 23, 35

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-21

3/15/99

Depth 0 (ft bgs)	Samples	Observations
		Soft penetration to 8' bgs
5		*
		Hard penetration to 10' bgs
10	GD02110	Soft penetration to 17' bgs
	GD02112	Purge water gray and turbid; no infiltration 12 to 20' bgs (potential aquitard)
15		
		Hard penetration to 20' bgs
20		Moderate penetration to 25' bgs
	GD02123	Purge water gray and initially turbid
25		Very hard penetration to 30' bgs
	GD02127	Poor infiltration 27 to 30' bgs (potential aquitard)
30		Refusal
35		
40		

Total Depth (feet bgs): 30
* Approximate Depth to Groundwater (feet bgs): 5
Approximate Depth to Aquitard(s) (feet bgs): 13, 27

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-22

Depth 0 (ft bgs)	Samples	3/16/99 Observations
		Very soft penetration to 8' bgs
5		
	*	
	GD02208	Hard penetration to 12' bgs
10		
		Moderate penetration to 20' bgs
15		
	GD02216	
20		Hard penetration to 25' bgs
	GD02224	
25		Very hard penetration to 35' bgs
30		
	GD02232	No infiltration 32 to 35' bgs (potential aquitard)
35		
40		

Total Depth (feet bgs): 35
* Approximate Depth to Groundwater (feet bgs): 7
Approximate Depth to Aquitard(s) (feet bgs): 33

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-23

Depth 0 (ft bgs)	Samples	3/16/99 Observations
		Soft penetration to 4' bgs
		Hard penetration to 25' bgs
5		
		*
	GD02308	Purge water brown and initially turbid
10		
15		
	GD02316	Purge water gray, oily sheen
20		
	GD02324	Purge water gray and turbid
25		Very hard penetration to 27' bgs
		Moderate penetration rate to 39' bgs
30		
35		
	GD02339	Very hard penetration to 42' bgs; purge water gray and turbid;
40		no water infiltration 39 to 42' bgs (potential aquitard)
42		Refusal

Total Depth (feet bgs): 42
* Approximate Depth to Groundwater (feet bgs): 7
Approximate Depth to Aquitard(s) (feet bgs): 39

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-24

Depth 0 (ft bgs)	Samples	3/17/99 Observations
		Soft penetration to 10' bgs
5		
		*
	GD02409	Purge water clear
10		Moderate penetration rate to 35' bgs
15		
	GD02419	Purge water tan-brown and turbid
20		
	GD02424	Purge water gray and turbid
25		
30		
35	GD02435	Hard penetration to 37' bgs; no water infiltration 36 to 37' bgs; purge water gray-brown and very turbid (potential aquitard)
40		

Total Depth (feet bgs): 37
* Approximate Depth to Groundwater (feet bgs): 8
Approximate Depth to Aquitard(s) (feet bgs): 36

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-25

Depth 0 (ft bgs)	Samples	3/18/99 Observations
		Soft penetration to 10' bgs
5		
		*
	GD02507	Purge water brown and initially turbid
10		Moderate penetration rate to 25' bgs
15		
	GD02519	Purge water brown and initially turbid
20		
	GD02524	Purge water brown and initially turbid
25		Hard penetration to 30' bgs
30	GD02530	Very hard penetration; little to no infiltration 30 to 33' bgs; purge water dark gray and very turbid (potential aquitard)
		Refusal
35		
40		

Total Depth (feet bgs): 33
* Approximate Depth to Groundwater (feet bgs): 6
Approximate Depth to Aquitard(s) (feet bgs): 31

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-26

Depth 0 (ft bgs)	Samples	3/18/99 Observations
		Soft penetration to 30' bgs
5		
		*
	GD02609	Purge water dark brown-black and initially turbid
10		
15		
	GD02619	Purge water brown-tan and initially turbid
20		
25	GD02625	Purge water dark gray-brown and initially turbid
30		Very hard penetration to 38' bgs
35		
	GD02638	Purge water dark gray-brown and initially turbid
40		

Total Depth (feet bgs): 38
* Approximate Depth to Groundwater (feet bgs): 8
Approximate Depth to Aquitard(s) (feet bgs): No indication of aquitard to 38' bgs

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-27

Depth 0 (ft bgs)	Samples	3/19/99 Observations
		Soft penetration to 10' bgs
5		
		*
	GD02709	Purge water tan
10		Moderate penetration to 25' bgs
15		
	GD02719	Purge water tan
20		
	GD02723	Purge water brown and turbid; no infiltration 23 to 25' bgs (potential aquitard)
25		Hard penetration to 30' bgs
30		Moderate penetration to 38' bgs
35		
	GD02738	Very hard penetration to 40' bgs; purge water gray and turbid;
40		no infiltration 38 to 40' bgs (potential aquitard)

Total Depth (feet bgs): 40
* Approximate Depth to Groundwater (feet bgs): 8
Approximate Depth to Aquitard(s) (feet bgs): 23, 39

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-28

Depth 0 (ft bgs)	Samples	3/22/99 Observations
		Moderate penetration to 18' bgs
5		
10	GD02810	* Purge water tan
15		
		Hard penetration to 23' bgs
	GD02819	Purge water dark gray and turbid
20		
		Moderate penetration to 25' bgs
	GD02824	Purge water gray and turbid
25		Hard penetration to 30' bgs
30		Very hard penetration to 34' bgs
	GD02831	Purge water dark gray and turbid; poor infiltration 31 to 34' bgs (potential aquitard)
		Refusal
35		
40		

Total Depth (feet bgs): 34
* Approximate Depth to Groundwater (feet bgs): 10
Approximate Depth to Aquitard(s) (feet bgs): 32

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-29

Depth 0 (ft bgs)	Samples	3/22/99 Observations
		Soft penetration to 24' bgs
5		
	*	
	GD02908	Purge water clear
10		
15		
	GD02919	Purge water gray and initially turbid
20		
	GD02924	Moderate penetration 28' bgs; purge water dark gray and turbid
25		
	GD02928	Hard penetration to 30' bgs; purge water dark gray and turbid; slight sheen;
		poor infiltration 28 to 31' bgs (potential aquitard)
30		Very hard penetration to 31' bgs
		Refusal
35		
40		

Total Depth (feet bgs): 31
* Approximate Depth to Groundwater (feet bgs): 7
Approximate Depth to Aquitard(s) (feet bgs): 29

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-30

Depth 0 (ft bgs)	Samples	3/23/99 Observations
		Moderate penetration to 12' bgs
5		
10		
		* Hard penetration to 20' bgs
	GD03013	Purge water tan
15		
	GD03019	Purge water tan and turbid
20		Moderate penetration to 30' bgs
	GD03024	Purge water gray-brown and turbid
25		
30		Very hard penetration to 36' bgs
35	GD03035	Purge water gray and turbid
		Refusal
40		

Total Depth (feet bgs): 36
* Approximate Depth to Groundwater (feet bgs): 12
Approximate Depth to Aquitard(s) (feet bgs): No indication of aquitard to 36' bgs

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-31

Depth 0 (ft bgs)	Samples	3/24/99 Observations
		Soft penetration to 15' bgs
5		
		*
	GD03109	Purge water light brown
10		
	GD03112	Purge water light gray and turbid; no infiltration 12 to 20' bgs (potential aquitard)
15		Hard penetration to 20' bgs
20		Very hard penetration to 41' bgs
25		
	GD03127	Purge water gray and turbid; no infiltration 20 to 25' bgs and 28 to 30' bgs (potential aquitard)
30		
35	GD03135	Purge water dark gray and turbid; no infiltration 36 to 41' bgs
40		
41		Refusal

Total Depth (feet bgs): 41
* Approximate Depth to Groundwater (feet bgs): 8
Approximate Depth to Aquitard(s) (feet bgs): 13, 28, 36

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-32

Depth 0 (ft bgs)	Samples	3/25/99 Observations
		Moderate penetration rate to 23' bgs
5		
	GD03209	* Purge water gray-brown and turbid
10		
15		
	GD03219	Purge water infiltrated quickly, gray-brown and turbid
20		
		Hard penetration to 30' bgs
	GD03224	Purge water gray-brown and very turbid
25		
	GD03228	Purge water gray and turbid; no infiltration 28 to 33' bgs (potential aquitard)
30		Very hard penetration to 33' bgs
35		
40		

Total Depth (feet bgs): 33
* Approximate Depth to Groundwater (feet bgs): 9
Approximate Depth to Aquitard(s) (feet bgs): 28

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-33

Depth 0 (ft bgs)	Samples	3/25/99 Observations
		Soft penetration to 8' bgs
5		
		* Moderate penetration rate to 25' bgs
	GD03309	Purge water light gray and initially turbid
10		
15		
20		
	GD03324	Purge water gray-brown and turbid; no infiltration 12 to 27' bgs (potential aquitard)
25		Hard penetration to 35' bgs
	GD03329	Purge water gray and turbid
30		
35	GD03335	Very hard penetration to 39' bgs; purge water gray and turbid;
		no infiltration 35 to 39' bgs (potential aquitard)
		Refusal
40		

Total Depth (feet bgs): 39
* Approximate Depth to Groundwater (feet bgs): 8
Approximate Depth to Aquitard(s) (feet bgs): 12, 35

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-34

Depth 0 (ft bgs)	Samples	3/26/99 Observations
		Soft penetration to 19' bgs
5		
		*
	GD03409	Purge water brown and initially turbid
10		
15		
	GD03419	Moderate penetration rate to 35' bgs; purge water gray-brown and turbid
20		
	GD03424	Purge water tan and initially turbid
25		
30		
35		Hard penetration to 44' bgs
	GD03437	Purge water gray and turbid; no infiltration 38 to 41' bgs (potential aquitard)
40		
44		Refusal

Total Depth (feet bgs): 44 (41 second attempt)
* Approximate Depth to Groundwater (feet bgs): 7
Approximate Depth to Aquitard(s) (feet bgs): 38

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-35

Depth 0 (ft bgs)	Samples	3/29/99 Observations
		Soft penetration to 15' bgs
5		
		*
	GD03509	Purge water clear
10		
15		Moderate penetration rate to 34' bgs
	GD03519	Purge water light brown and turbid
20		
	GD03524	Purge water light brown and turbid
25		
30		
	GD03534	Hard penetration to 38' bgs; purge water dark gray and turbid; no infiltration 35 to 38' bgs
35		
40		

Total Depth (feet bgs): 38
* Approximate Depth to Groundwater (feet bgs): 8.5
Approximate Depth to Aquitard(s) (feet bgs): 35

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-36

Depth 0 (ft bgs)	Samples	3/29/99 Observations
		Soft penetration to 21' bgs
5		
10		
		*
	GD03612	Purge water clear
15		
	GD03619	Purge water brown and initially turbid
20		
		Hard penetration to 35' bgs
	GD03624	Purge water brown and turbid
25		
30		
35		Very hard penetration to 38' bgs
	GD03636	Purge water dark gray-brown and turbid; no infiltration 36 to 38' bgs (potential aquitard)
		Refusal
40		

Total Depth (feet bgs): 38
* Approximate Depth to Groundwater (feet bgs): 11
Approximate Depth to Aquitard(s) (feet bgs): 36

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-37

Depth 0 (ft bgs)	Samples	3/30/99 Observations
		Soft penetration to 20' bgs
5		
10		
	GD03713	* Purge water clear
15		
	GD03719	Purge water clear
20		Hard penetration to 25' bgs
	GD03722	Purge water brown and turbid; no water infiltration 22 to 25' bgs (potential aquitard)
25		Moderate penetration rate to 33' bgs
30		
		Very hard penetration to 38' bgs
	GD03734	Purge water gray and turbid; no infiltration 34 to 38' bgs (potential aquitard)
35		
		Refusal
40		

Total Depth (feet bgs): 38
* Approximate Depth to Groundwater (feet bgs): 13
Approximate Depth to Aquitard(s) (feet bgs): 23, 35

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-38

Depth 0 (ft bgs)	Samples	3/31/99 Observations
		Soft penetration to 10' bgs
5		
		*
	GD0387.5	Purge water clear
10		Moderate penetration rate to 33' bgs
15		
	GD03819	Purge water brown and turbid
20		
	GD03824	Purge water gray-brown and turbid
25		
30		
	GD03831	Purge water dark gray and very turbid (potential aquitard)
		Hard penetration to 38' bgs
35		
40		

Total Depth (feet bgs): 38
* Approximate Depth to Groundwater (feet bgs): 6
Approximate Depth to Aquitard(s) (feet bgs): 32

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-39

Depth 0 (ft bgs)	Samples	3/31/99 Observations
		Soft penetration to 14' bgs
5		
10		
		*
	GD03913	Purge water clear
		Moderate penetration rate to 24' bgs
15		
	GD03919	Purge water light tan and turbid
20		
	GD03924	Hard penetration to 37' bgs; purge water brown and turbid
25		
30		
35	GD03935	Purge water gray and very turbid; no infiltration 35 to 37' bgs (potential aquitard)
		Refusal
40		

Total Depth (feet bgs): 37
* Approximate Depth to Groundwater (feet bgs): 12.5
Approximate Depth to Aquitard(s) (feet bgs): 36

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-40

4/1/99

Depth 0 (ft bgs)	Samples	Observations
		Soft penetration to 15' bgs
5		
10		
15	GD04015	* Moderate penetration rate to 38' bgs; purge water clear
20	GD04019	Purge water clear
25	GD04023	Purge water gray and initially turbid
30		
35		
40	GD04037	Purge water gray and very turbid (potential aquitard) Hard penetration to 39' bgs Refusal

Total Depth (feet bgs): 39
* Approximate Depth to Groundwater (feet bgs): 15
Approximate Depth to Aquitard(s) (feet bgs): 38

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-41

Depth 0 (ft bgs)	Samples	4/2/99 Observations
		Soft penetration to 4' bgs
		Hard penetration to 20' bgs
5		
		*
	GD04108	Purge water tan and turbid
10		
15		
	GD04119	Purge water gray and very turbid
20		Very hard penetration to 35' bgs
		No water infiltration 21 (or shallower) to 27' bgs (potential aquitard?)
25		
30	GD04130	Purge water gray-brown and turbid; no infiltration 30 to 35' bgs (potential aquitard)
	GD04133	Purge water dark gray and turbid; poor infiltration 33 to 34' bgs (potential aquitard)
35		Refusal
40		

Total Depth (feet bgs): 35
* Approximate Depth to Groundwater (feet bgs): 7
Approximate Depth to Aquitard(s) (feet bgs): 21, 30

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-42

Depth 0 (ft bgs)	Samples	4/5/99 Observations
		Moderate penetration rate to 41' bgs
5		
		*
	GD04208	Purge water brown and initially turbid
10		
15		
	GD04216	Purge water gray and turbid; no water infiltration 17 to 20' bgs (potential aquitard)
20		
	GD04223	Purge water dark gray and turbid; no infiltration 23 to 25' bgs (potential aquitard)
25		
30		
35		
	GD04239	Purge water gray and turbid; no infiltration 39 to 41' bgs (potential aquitard)
40		
41		Refusal

Total Depth (feet bgs): 41
* Approximate Depth to Groundwater (feet bgs): 6
Approximate Depth to Aquitard(s) (feet bgs): 17, 24, 40

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-43

Depth 0 (ft bgs)	Samples	4/6/99 Observations
		Moderate penetration rate to 25' bgs
5		
		*
	GD04307	
10		
15		
	GD04319	
20		
	GD04324	
25		Hard penetration to 30' bgs
30	GD04330	Very hard penetration to 31' bgs
		Refusal
35		
40		

Total Depth (feet bgs): 31
* Approximate Depth to Groundwater (feet bgs): 6
Approximate Depth to Aquitard(s) (feet bgs): No indication of aquitard to 31' bgs

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-44

Depth 0 (ft bgs)	Samples	4/6/99 Observations
		Soft penetration to 8' bgs
5		
		Moderate penetration rate to 30' bgs
10		
		*
	GD04412	Purge water clear
15		
	GD04419	Purge water tan and turbid
20		
	GD04424	Purge water brown and turbid
25		
30		Hard penetration to 36' bgs
	GD04433	Purge water gray and very turbid; no infiltration 33 to 36' bgs (potential aquitard)
35		
		Refusal
40		

Total Depth (feet bgs): 36
* Approximate Depth to Groundwater (feet bgs): 11
Approximate Depth to Aquitard(s) (feet bgs): 34

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-45

Depth 0 (ft bgs)	Samples	4/7/99 Observations
		Soft penetration to 15' bgs
5		*
	GD04506	Purge water clear
10		
15		Moderate penetration rate to 30' bgs
	GD04517	Purge water gray and very turbid, sheen; no infiltration 17 to 20' bgs (potential aquitard)
20		
	GD04522	Purge water gray-brown and turbid; poor infiltration 22 to 25' bgs (potential aquitard)
25		
	GD04528	Purge water light gray and turbid; no infiltration 28 to 35' bgs (potential aquitard)
30		Hard penetration to 32' bgs
		Refusal
35		
40		

Total Depth (feet bgs): 32
* Approximate Depth to Groundwater (feet bgs): 5
Approximate Depth to Aquitard(s) (feet bgs): 18, 29

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-46

Depth 0 (ft bgs)	Samples	4/8/99 Observations
		Moderate penetration rate to 30' bgs
5		
		*
	GD04607	Purge water clear
10		
15		
	GD04618	Purge water light brown and turbid
20		
	GD04624	Purge water brown and turbid
25		
30		Hard penetration to 35' bgs
	GD04632	Purge water light gray and turbid; no infiltration 32 to 35' bgs (potential aquitard)
35		Refusal
40		

Total Depth (feet bgs): 35
* Approximate Depth to Groundwater (feet bgs): 6
Approximate Depth to Aquitard(s) (feet bgs): 33

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-47

Depth 0 (ft bgs)	Samples	4/8/99 Observations
		Soft penetration to 4' bgs
		Moderate penetration rate to 20' bgs
5		
		*
	GD04709	Purge water clear
10		
15		
	GD04717	Purge water clear
20		Very hard penetration to 25' bgs
	GD04721	Purge water gray and turbid; no infiltration 21 to 25' bgs (potential aquitard)
25		Hard penetration to 30' bgs
30		Very hard penetration to 36' bgs
	GD04732	Purge water gray and turbid; no infiltration 32 to 36' bgs (potential aquitard)
35		
		Refusal
40		

Total Depth (feet bgs): 36
* Approximate Depth to Groundwater (feet bgs): 7
Approximate Depth to Aquitard(s) (feet bgs): 22, 33

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-48

Depth 0 (ft bgs)	Samples	4/9/99 Observations
		Soft penetration to 20' bgs
5		*
	GD04806	Purge water brown and initially trubid
10		
15		
	GD04819	Purge water brown and initially turbid
20		Moderate penetration rate to 28' bgs
	GD04824	Purge water slightly turbid
25		
		Hard penetration to 34' bgs
30		
	GD04833	Purge water gray-brown and turbid
35		
40		

Total Depth (feet bgs): 34
* Approximate Depth to Groundwater (feet bgs): 5
Approximate Depth to Aquitard(s) (feet bgs): No indication of aquitard to 34' bgs

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-49

Depth 0 (ft bgs)	Samples	4/12/99 Observations
		Soft penetration to 23' bgs
5		
		*
	GD04907	Purge water clear
10		
15		
	GD04919	Purge water brown and turbid
20		
	GD04922	Purge water brown and turbid; no infiltration 22 to 25' bgs (potential aquitard)
		Moderate penetration rate to 28' bgs
25		
		Hard penetration to 36' bgs
30		
	GD04932	Purge water brown and turbid; no infiltration 32 to 36' bgs (potential aquitard)
35		
		Refusal
40		

Total Depth (feet bgs): 36
* Approximate Depth to Groundwater (feet bgs): 6
Approximate Depth to Aquitard(s) (feet bgs): 22, 33

Fort Lewis East Gate Disposal Yard
Drivepoint Field Observations

Drivepoint DP-50

4/12/99

Depth 0 (ft bgs)	Samples	Observations
		Soft penetration to 15' bgs
5		
		*
	GD05009	Purge water brown and initially turbid
10		
15		Moderate penetration rate to 29' bgs
	GD05019	Purge water gray and turbid
20		
	GD05024	Purge water gray-tan and turbid
25		
		Hard penetration to 33' bgs
30		
	GD05031	Purge water light brown and turbid; no infiltration 31 to 33' bgs (potential aquitard)
		Refusal
35		
40		

Total Depth (feet bgs): 33
* Approximate Depth to Groundwater (feet bgs): 8
Approximate Depth to Aquitard(s) (feet bgs): 32

APPENDIX B

Data Quality Summary Reports

TRANSGLOBAL ENVIRONMENTAL GEOSCIENCES NORTHWEST— SOIL-GAS SAMPLES

The analytical results for soil-gas samples collected during October 1998 at the East Gate Disposal Yard, were subject to a quality assurance/quality control (QA/QC) review. This QA/QC review includes evaluation of analytical precision, accuracy, representativeness, comparability, and completeness. Precision is evaluated by comparison of results for primary and sample duplicate analyses and laboratory duplicate analyses; accuracy is evaluated using the analytical results for blanks, surrogates, matrix spikes and blank spikes; representativeness is evaluated by examining chain of custody paperwork and verifying analysis was performed within allowable holding times; comparability is evaluated by examining laboratory reporting limits; and completeness is evaluated by calculating the percentage of acceptable data.

All samples were collected using a StrataProbe and were analyzed on site by Transglobal Environmental Geosciences Northwest of Lacey, Washington. Samples were collected and analyzed according to the *Management Plan for East Gate Disposal Yard Expanded Site Investigation* (USACE 1998). Samples were analyzed for target volatile organic compounds (VOCs) by United States Environmental Protection Agency (EPA) SW-846 Method 8021B.

All analytical data are acceptable. No samples were analyzed outside of holding times. One field blank had a detection of benzene. Consequently the benzene result for one sample was qualified as nondetected (U). Results of the performance evaluation sample (PE) were within acceptance criteria. No data were qualified. Field and laboratory duplicate precision was acceptable. The reporting limits met the project goals.

1.0 REPRESENTATIVENESS

1.1 Chain of Custody

The chain of custody (COC) forms indicate that samples were maintained under chain of custody.

1.2 Holding Times

The soil-gas samples were analyzed the day of collection or 1 day after collection; but still within 24 hours. All samples were analyzed within the holding time.

2.0 ACCURACY

2.1 Review of Initial and Continuing Calibration

The laboratory performed an initial 5-point calibration at the beginning of the project. Each day samples were analyzed, the laboratory ran opening, midday, and closing continuing calibration standards at a concentration equivalent to the mid-range initial calibration standard. The continuing calibration standard acceptance criteria was established at +/– 20 percent of the average response factor (percent difference) from the calibration curve (except for vinyl chloride, which was set at +/– 25 percent). The percent difference results were within acceptance criteria for all continuing calibration standards analyzed.

2.2 Review of Blanks

The laboratory analyzed four ambient air blanks, one method blank and three field blanks. Frequency requirements for blanks were met. Target analytes in blanks were below detection with the exception of benzene detected in one field blank. Benzene was not detected in the associated sample (SG02105); therefore, no data were qualified based on these results.

Field Blank Sample ID	Batch	Analyte	Result (ppmV)
SG70105	10/12/98	None	
SG72105	10/13/98	Benzene	1.18
SG74205	10/14/98	None	

2.3 Surrogate Recovery Review

Analysis of surrogate compounds was not required as per the management plan (USACE 1998).

2.4 Matrix Spike/Matrix Spike Duplicate Review

Analysis of matrix spike/matrix spike duplicate compounds was not required as per the management plan (USACE 1998).

2.5 Performance Evaluation Sample Review

One performance evaluation sample was analyzed (SG90105-soil matrix). The performance evaluation sample results were within acceptance limits. Results are summarized below.

Analyte	PE Result (mg/kg)	Certified Value (mg/kg)	Acceptance Limits
cis-1,2-Dichloroethene	1.53	1.99	0.695 – 2.72
trans-1,2-Dichloroethene	1.36	1.52	0.912 – 1.96
1,1,1-Trichloroethane	1.50	1.50	0.542 – 2.08
Trichloroethene	2.96	4.03	1.09 – 5.45
Vinyl chloride	1.50	1.50	0.899 – 2.10
Benzene	1.73	1.98	1.24 – 2.77
Ethylbenzene	1.48	1.52	0.566 – 2.16
Toluene	2.57	2.96	1.41 – 3.96
Total xylenes	0.58	0.551	0.341 – 0.798

2.6 Laboratory Control Sample Review

An initial LCS was analyzed at the beginning of the project. Percent differences ranged from 4.5 to 15.4 percent and were within the acceptance criteria of +/ 20 percent. The frequency of LCS analysis met the project requirement of one per sampling event.

3.0 PRECISION

3.1 Laboratory Duplicate Review

Five laboratory duplicates were analyzed. Duplicate precision ranged from 0 to 30 percent and was within the acceptance criteria of +/ a factor of 2. The frequency of laboratory duplicate analysis (11 percent) met the project duplicate frequency requirement of at least 5 percent.

Sample ID	Analyte	Primary Result (ppmV)	Duplicate Result (ppmV)	RPD %
SG00205	Trichloroethene	0.79	0.79	0
SG01905	Trichloroethene	0.29	0.26	11
SG03805	Trichloroethene	8.83	9.52	7
SG03805	cis-1,2-Dichloroethene	2.81	3.07	9
SG04005	Trichloroethene	1.91	2.55	20
SG04005	cis-1,2-Dichloroethene	0.64	0.87	30
SG04505	None			

3.2 Field Duplicate Review

Four field duplicates and 45 primary samples were collected during the sampling events covered by this review. The field duplicate results showed good agreement and were acceptable as reported.

Sample ID	Analyte	Primary Result (ppmV)	Duplicate Result (ppmV)	RPD %
SG00705 / SG50705	Trichloroethene	51.9	44.4	16
SG00705 / SG50705	cis-1,2-Dichloroethene	10.4 J	9.47 J	9.4
SG02105 / SG52105	Trichloroethene	0.56	0.40	33
SG03005 / SG53005	None			
SG04105 / SG54105	Trichloroethene	0.92	1.16	23
SG04105 / SG54105	cis-1,2-Dichloroethene	1.48	1.63	9.6

The frequency of field duplicate collection (8.9 percent) did not meet the project duplicate frequency requirement of at least 10 percent.

4.0 COMPARABILITY

The requested reporting limits (RLs) for compounds of concern are shown below in comparison with actual reporting limits. The actual reporting limits were slightly above the requested reporting limits but still meet the project needs. Compounds detected below the reporting limit but above the instrument detection limit are considered estimates by the laboratory, and were qualified with a J.

Analyte	Requested Reporting Limit (ppmV)	Actual Reporting Limit (ppmV)
Trichloroethene	0.1	0.25
1,2-DCE	0.1	0.33
Vinyl chloride	0.1	0.86
1,1,1-TCA	0.1	0.24
Benzene	0.1	0.41
Ethylbenzene	0.1	0.31
Toluene	0.1	0.35
Total xylenes	0.1	0.31

Dilution factors are listed in the following table. These samples did not meet the requested reporting limit. All data are acceptable based on high analyte concentrations in these samples.

Sample ID	Dilution Factor
SG50705	40
SG01105	5
SG01805	20

5.0 COMPLETENESS

The laboratory reported all requested analyses and the laboratory report is complete. The project completeness goal is 98 percent. For all samples collected and analyzed, no data were found to be invalid. No data were rejected, so completeness for this sampling event is 100 percent.

Based on the QA/QC review, data can be qualified as estimated (J), rejected (R), or nondetected (U). No data were rejected. The following table summarizes the sample IDs and qualified results for all samples covered by this review. No data were qualified as a result of this review; however, field duplicate frequency was slightly less (8.9 percent) than the required frequency of at least 10 percent.

Sample ID	Sample Type	Analyte	Qualifier
SG70105	Field blank	None	
SG00105	Primary	None	
SG00205	Primary	None	
SG00305	Primary	None	
SG00405	Primary	None	
SG00505	Primary	None	
SG00605	Primary	None	
SG00705	Primary	None	
SG50705	Dup of 00705	None	
SG00805	Primary	None	
SG00905	Primary	None	
SG01005	Primary	None	
SG01105	Primary	None	
SG01205	Primary	None	
SG01305	Primary	None	
SG01405	Primary	None	
SG01505	Primary	None	
SG01605	Primary	None	
SG01705	Primary	None	
SG01805	Primary	None	
SG01905	Primary	None	
SG02005	Primary	None	
SG72105	Field blank	None	
SG52105	Dup of 02105	None	
SG02105	Primary	None	
SG02205	Primary	None	
SG02305	Primary	None	
SG02405	Primary	None	
SG02505	Primary	None	
SG02605	Primary	None	
SG02705	Primary	None	
SG02805	Primary	None	
SG02905	Primary	None	

Sample ID	Sample Type	Analyte	Qualifier
SG03005	Primary	None	
SG53005	Dup of 03005	None	
SG03105	Primary	None	
SG03205	Primary	None	
SG03305	Primary	None	
SG03405	Primary	None	
SG03505	Primary	None	
SG03605	Primary	None	
SG03705	Primary	None	
SG03805	Primary	None	
SG03905	Primary	None	
SG04005	Primary	None	
SG04105	Primary	None	
SG04205	Primary	None	
SG74205	Field blank	None	
SG04305	Primary	None	
SG04405	Primary	None	
SG04505	Primary	None	
S90105	PE	None	

TRANSGLOBAL ENVIRONMENTAL GEOSCIENCES NORTHWEST— TRENCH GROUNDWATER SAMPLES

The analytical results for groundwater samples collected during trenching activities in October 1998 at the East Gate Disposal Yard, were subject to a quality assurance/quality control (QA/QC) review. This QA/QC review includes evaluation of analytical precision, accuracy, representativeness, comparability, and completeness. Precision is evaluated by comparison of results for primary and sample duplicate analyses and laboratory duplicate analyses; accuracy is evaluated using the analytical results for blanks, surrogates, matrix spikes and blank spikes; representativeness is evaluated by examining chain of custody paperwork and verifying analysis was performed within allowable holding times; comparability is evaluated by examining laboratory reporting limits; and completeness is evaluated by calculating the percentage of acceptable data.

All samples were analyzed on site by Transglobal Environmental Geosciences Northwest of Lacey, Washington. Samples were collected and analyzed according to the *Management Plan for East Gate Disposal Yard Expanded Site Investigation* (USACE 1998). Samples were analyzed for target volatile organic compounds (VOCs) by United States Environmental Protection Agency (EPA) SW-846 Method 8021B.

All analytical data are acceptable. No samples were analyzed outside of holding times. Target analytes were below detection for method blanks. One sample had analytes qualified as estimated (J) due to out of control surrogate percent recoveries. The matrix spike (MS) sample results were within the control limits. Two samples analyzed were qualified as estimated (J) due to the performance evaluation (PE) sample results. Field and laboratory duplicate precision were acceptable. The reporting limits met the project goals.

1.0 REPRESENTATIVENESS

1.1 Chain of Custody

The chain of custody (COC) forms indicate that samples were maintained under chain of custody.

1.2 Holding Times

The samples were analyzed within 7 days of collection. All samples were analyzed within the holding time.

2.0 ACCURACY

2.1 Review of Initial and Continuing Calibration

The laboratory performed an initial 5-point calibration at the beginning of the project. Each day samples were analyzed, the laboratory ran opening and closing continuing calibration standards at a concentration equivalent to the mid-range initial calibration standard. The continuing calibration standard acceptance criteria was established at +/– 20 percent of the average response factor (percent difference) from the calibration curve (except for vinyl chloride, which was set at +/– 25 percent). The percent difference results were within acceptance criteria for all continuing calibration standards analyzed.

2.2 Review of Blanks

Field blanks were not collected for the water sampling event because only dedicated sampling equipment was used. Method blanks were analyzed at the requested frequency. Target analytes in method blanks were below detection. No data were qualified due to these results.

2.3 Surrogate Recovery Review

Samples were spiked with surrogates (system monitoring compounds). Samples with all surrogates not reported due to matrix interference or dilution were qualified as estimated (J). Samples with only one of two surrogates not reported due to matrix interference or dilution were not qualified. The sample GT003D6.5 VOC analytes cis-1,2-dichloroethene and trichloroethene were quantified from a diluted analysis where both surrogates were not reported; therefore, only the two affected analytes were qualified as estimated (J).

2.4 Matrix Spike/Matrix Spike Duplicate Review

One VOC matrix spike/matrix spike duplicate pair (MS/MSD) was analyzed for the water sampling event, which meets the frequency requirement of 5 percent. The matrix spike sample results were within the control limits. No data were qualified due to these results.

2.5 Performance Evaluation Sample Review

Two water performance evaluation samples were analyzed. The performance evaluation sample results were within acceptance limits with two exceptions. The ethylbenzene and total xylene results were above the acceptance limits. The ethylbenzene and total xylene results for samples with concentrations greater than the reporting limit were qualified as estimated (J). Results are summarized below.

Analyte	GT901A PE Result (µg/L)	GT904A PE Result (µg/L)	Certified Value (µg/L)	Acceptance Limits
cis-1,2-Dichloroethene	11.5	10.6	11.1	6.83 – 15.2
trans-1,2-Dichloroethene	11.0	11.4	11.9	8.24 – 15.2
1,1,1-Trichloroethane	10.7	12.2	11.2	8.12 – 13.4
Trichloroethene	25.8	28.2	30.1	22.3 – 36.4
Vinyl chloride	13.3	11.1	12.0	7.20 – 16.8
Benzene	15.9	12.7	15.0	11.6 – 18.7
Ethylbenzene	**16.3**	9.3	11.0	8.22 – 12.8
Toluene	13.4	12.4	14.8	11.4 – 17.8
Total xylenes	**15.3**	9.5	11.3	7.29 – 14.2

2.6 Laboratory Control Sample Review

An initial LCS was analyzed at the beginning of the project. Percent recoveries ranged from 78 percent to 115 percent and were within the control limits of 65 to 135 percent. The frequency of LCS analysis met the project requirement of one per batch.

3.0 PRECISION

3.1 Laboratory Duplicate Review

One laboratory duplicate was analyzed. Duplicate precision ranged from 1 to 11 percent and were within the acceptance criteria of +/ 35 percent. The frequency of laboratory duplicate analysis (17 percent) met the project duplicate frequency requirement of at least 10 percent.

Sample ID	Analyte	Primary Result (µg/L)	Duplicate Result (µg/L)	RPD %
GT005A12	cis-1,2-DCE	19.1	17.1	11
	Trichloroethene	109	110	1

3.2 Field Duplicate Review

One water field duplicate and three primary samples were collected during this sampling event. The frequency of field duplicate collection met the project duplicate frequency requirement of at least 10 percent. The field duplicate results showed good agreement and were acceptable; therefore, no data were qualified.

Sample ID	Analyte	Primary Result (µg/L)	Duplicate Result (µg/L)	RPD %
GT002D10 / 502D10	cis-1,2-DCE	69	80	15
	Trichloroethene	38.5	36.4	6

4.0 COMPARABILITY

The standard reporting limits (RLs) for compounds of concern are shown below in comparison with laboratory reporting limits. The vinyl chloride reporting limit was slightly above the requested reporting limits but still met the project needs. Compounds detected below the reporting limit but above the instrument detection limit were considered estimates by the laboratory, and were J-qualified.

Analyte	Requested Reporting Limit (µg/L)	Actual Reporting Limit (µg/L)
Trichloroethene	2.5	2.5
1,2-DCE	2.5	2.5
Vinyl chloride	5.0	7.5
1,1,1-TCA	2.5	2.5
Benzene	2.5	2.5
Ethylbenzene	2.5	2.5
Toluene	2.5	2.5
Total xylenes	2.5	2.5

5.0 COMPLETENESS

The laboratory reported all requested analyses and the laboratory report is complete. The project completeness goal is 98 percent. For all samples collected and analyzed, no data were judged to be invalid. No data were rejected, so completeness for this sampling event is 100 percent.

Based on the QA/QC review, data can be qualified as estimated (J), rejected (R), or nondetected (U). No data were rejected. The following table summarizes the sample IDs and qualified results for all samples covered by this review:

Sample ID	Sample Type	Analyte	Qualifier
GT901A	PE	None	
GT002D10	Primary	None	
GT502D10	Dup of GT002D10	None	
GT003D6.5	Primary	cis-1,2-Dichloroethene	J
		Trichloroethene	J
		Ethylbenzene	J
		Total xylene	J
GT904A	PE	None	
GT005A12	Primary	None	

TRANSGLOBAL ENVIRONMENTAL GEOSCIENCES NORTHWEST— TRENCH SOIL AND NAPL SAMPLES

The analytical results for soil and NAPL samples collected during trenching activities in October 1998 at the East Gate Disposal Yard were subject to a quality assurance/quality control (QA/QC) review. This QA/QC review includes evaluation of analytical precision, accuracy, representativeness, comparability, and completeness. Precision is evaluated by comparison of results for primary and sample duplicate analyses and laboratory duplicate analyses; accuracy is evaluated using the analytical results for blanks, surrogates, matrix spikes and blank spikes; representativeness is evaluated by examining chain of custody paperwork and verifying analysis was performed within allowable holding times; comparability is evaluated by examining laboratory reporting limits; and completeness is evaluated by calculating the percentage of acceptable data.

All samples were analyzed on site by Transglobal Environmental Geosciences Northwest of Lacey, Washington. Samples were collected and analyzed according to the *Management Plan for East Gate Disposal Yard Expanded Site Investigation* (USACE 1998). Samples were analyzed for target volatile organic compounds (VOCs) by United States Environmental Protection Agency (EPA) SW-846 Method 8021B, gasoline-range hydrocarbons by NWTPH-Gx, and diesel range hydrocarbons by NWTPH-Dx.

All analytical data are acceptable. No samples were analyzed outside of holding times. Target analytes were not detected in method or field blanks. Samples qualified as estimated due to out of control surrogates are summarized in the completeness section. The matrix spike (MS) and performance evaluation (PE) sample results were within the control limits. No data were qualified due to laboratory duplicate precision. Sample results for mineral spirits in one soil sample were qualified as estimated due to field duplicate precision. The reporting limits met the project goals.

1.0 REPRESENTATIVENESS

1.1 Chain of Custody

The chain of custody (COC) forms indicate that samples were maintained under chain of custody.

1.2 Holding Times

The samples were analyzed within 7 days of collection. All samples were analyzed within the holding time.

2.0 ACCURACY

2.1 Review of Initial and Continuing Calibration

The laboratory performed an initial 5-point calibration at the beginning of the project. Each day samples were analyzed, the laboratory ran opening, midday, and closing continuing calibration standards at a concentration equivalent to the mid-range initial calibration standard. The continuing calibration standard acceptance criteria was established at +/– 20 percent of the average response factor (percent difference) from the calibration curve (except for vinyl chloride, which was set at +/– 25 percent). The percent difference results were within acceptance criteria for all continuing calibration standards analyzed.

2.2 Review of Blanks

One field blank, ST704B15, was collected. Frequency requirements for field blanks were met. Method blanks were analyzed at the requested frequency. Target analytes in method blank and field blanks were below detection. No data were qualified due to these results.

2.3 Surrogate Recovery Review

Samples were spiked with surrogates (system monitoring compounds). The VOC surrogates for samples ST001A08, ST501A08, ST003C06, ST003D07, ST003E07, ST004A14, ST004B15, ST504B15, ST006E14, ST007B12, ST007C12, ST007E12 and ST008A09 were diluted out. The NWTPH-Gx surrogates for samples ST001A08, ST501A08, ST007B12 and ST007C12 were diluted out. The NWTPH-Gx surrogates for NT007C13, ST003D07, ST003E07, ST004B15 and ST504B15 were not recovered due to matrix interference. The NWTPH-Dx surrogates for ST001A08, ST501A08 were diluted out. The NWTPH-Dx surrogates for NT006B15, ST003E07 and ST008A09 were not reported due to matrix interference. Samples with all surrogates not reported due to matrix interference or dilution were qualified as estimated (J). Samples with only one of two surrogates not reported due to matrix interference or dilution were not qualified.

2.4 Matrix Spike/Matrix Spike Duplicate Review

One VOC matrix spike/matrix spike duplicate (MS/MSD) was analyzed for the soil and NAPL batches, which meets the frequency requirement of 5 percent. The matrix spike sample results were within the control limits. No data were qualified due to these results.

2.5 Performance Evaluation Sample Review

One soil performance evaluation sample, ST901A05, was analyzed. The performance evaluation sample results were within acceptance limits. Results are summarized below.

Analyte	PE Result (mg/kg)	Certified Value (mg/kg)	Acceptance Limits
cis-1,2-Dichloroethene	2.01	1.99	0.695 – 2.72
trans-1,2-Dichloroethene	1.63	1.52	0.912 – 1.96
1,1,1-Trichloroethane	1.83	1.50	0.542 – 2.08
Trichloroethene	3.63	4.03	1.09 – 5.45
Vinyl chloride	1.51	1.50	0.899 – 2.10
Benzene	1.78	1.98	1.24 – 2.77
Ethylbenzene	1.46	1.52	0.566 – 2.16
Toluene	2.59	2.96	1.41 – 3.96
Total xylenes	0.54	0.551	0.341 – 0.798

2.6 Laboratory Control Sample Review

An initial LCS was analyzed at the beginning of the project. Percent recoveries ranged from 82 percent to 89 percent and were within the control limits of 65 to 135 percent. The frequency of LCS analysis met the project requirement of one per sampling event.

3.0 PRECISION

3.1 Laboratory Duplicate Review

Five laboratory duplicates were analyzed. Duplicate precision ranged from 0 to 46 percent and was within the acceptance criteria of +/ 35 percent with the exception of the total xylene result in the batch analyzed on October 26, 1998. No data were qualified due to these results. The frequency of laboratory duplicate analysis (17 percent) met the project duplicate frequency requirement of at least 10 percent.

Sample ID	Analyte	Primary Result (mg/kg)	Duplicate Result (mg/kg)	RPD %
NT006B15	Ethylbenzene	520	710	31
	Total xylenes	3,600	4,020	11
	Mineral spirits	450,000	590,000	27
	TPH-Oil	150,000	150,000	0
ST002E05	cis-1,2-DCE	6.80	6.40	6
	trans-1,2-DCE	4.10	3.50	16
	Trichloroethene	11.4	8.8	26
	TPH-Oil	160	160	0
ST006A05	Trichloroethene	0.75	0.73	3
	TPH-Oil	490	420	15
ST008A09	cis-1,2-DCE	5.4	5.2	4
	Trichloroethene	5.4	5.8	7
	Ethylbenzene	19.6	17.6	11
	Toluene	10.8	9.6	12
	Total xylenes	98.8	61.6	46

Sample ID	Analyte	Primary Result (mg/kg)	Duplicate Result (mg/kg)	RPD %
ST008A09 (Continued)	Mineral spirits	7,700	6,900	11
	TPH-Diesel	2,200	2,400	8.7
	TPH-Oil	13,000	17,000	27

3.2 Field Duplicate Review

Two soil field duplicates and 18 primary samples were collected during this sampling event. Field duplicates were not submitted for product samples. Acceptance criteria were established at <50 percent RPD. The field duplicate results show good agreement except for mineral spirits in ST001A08 / 501A08. These results were qualified as estimated (J).

Sample ID	Analyte	Primary Result (mg/kg)	Duplicate Result (mg/kg)	RPD %
ST001A08 / 501A08	cis-1,2-DCE	370	210	55
	Trichloroethene	3,400	2,000	52
	TPH-Oil	37,000	31,000	18
	Mineral spirits	8,240	2,650	103
ST004B15 / 504B15	Trichloroethene	109	122	11
	Gasoline-range HC	330	380	14

The frequency of field duplicate collection met the project duplicate frequency requirement of at least 10 percent.

4.0 COMPARABILITY

The standard reporting limits (RLs) for compounds of concern are shown below in comparison with laboratory reporting limits. The reporting limits met the project needs. Compounds detected below the reporting limit but above the instrument detection limit were considered estimates by the laboratory, and qualified as estimated (J).

Analyte	Requested Reporting Limit – Soil (µg/kg)	Reporting Limit – Soil (µg/kg)
TPH-G	30,000	30,000
TPH-Dx	50,000	50,000
Trichloroethene	150	150
1,2-DCE	150	150
Vinyl chloride	750	750
1,1,1-TCA	150	150
Benzene	150	150
Ethylbenzene	150	150

Analyte	Requested Reporting Limit – Soil (µg/kg)	Reporting Limit – Soil (µg/kg)
Toluene	150	150
Total xylenes	150	150

Dilution factors are listed on the following table. These samples did not meet the requested reporting limit. All data were acceptable based on high analyte concentrations in these samples.

Sample ID	Method	Dilution Factor
NT001A1	VOC	200
NT006B15	VOC	666
NT007C13	VOC	200
ST001A08	VOC	20
ST501A08	VOC	400
ST002E05	VOC	10
ST003C06	VOC	10
ST003D07	VOC	60
ST003E07	VOC	1,200
ST004A14	VOC	400
ST004B15	VOC	40
ST504B15	VOC	120
ST004D14	VOC	2
ST005A07	VOC	2
ST006B14	VOC	10
ST006E14	VOC	8
ST007B12	VOC	10
ST007C12	VOC	20
ST007E12	VOC	10
ST008A09	VOC	20
ST501A08	TPH-G	10
ST004A14	TPH-G	4
ST004B15	TPH-G	4
ST504B15	TPH-G	4
ST004D14	TPH-G	4
ST007B12	TPH-G	10
ST007C12	TPH-G	10
ST008A09	TPH-G	4
ST001A08	TPH-D	40
ST501A08	TPH-D	20
ST003D07	TPH-D	10
ST003E07	TPH-D	10
ST004A14	TPH-D	8
ST004B15	TPH-D	8
ST504B15	TPH-D	8
ST004D14	TPH-D	8
ST006E14	TPH-D	8

5.0 COMPLETENESS

The laboratory reported all requested analyses and the laboratory report is complete. The project completeness goal is 98 percent. For all samples collected and analyzed, no data were judged to be invalid. No data were rejected, so completeness for these sampling events is 100 percent.

Based on the QA/QC review, data can be qualified as estimated (J), rejected (R), or nondetected (U). No data were rejected. The following table summarizes the sample IDs and qualified results for all samples covered by this review:

Sample ID	Sample Type	Analyte	Qualifier
NT001A1	Primary	None	
NT006B15	Primary	All NWTPH-Dx	J
NT007C13	Primary	All NWTPH-Gx	J
ST0901A05	PE	None	
ST001A08	Primary	All VOCs	J
		All NWTPH-Gx	J
		All NWTPH-Dx	J
ST501A08	Dup of ST001A08	All VOCs	J
		All NWTPH-Gx	J
		All NWTPH-Dx	J
ST002A02	Primary	None	
ST002B02	Primary	None	
ST002C04	Primary	None	
ST002D06	Primary	All VOCs	J
ST002E05	Primary	None	
ST003C06	Primary	All VOCs	J
ST003D07	Primary	All VOCs	J
		All NWTPH-Gx	J
ST003E07	Primary	All VOCs	J
		All NWTPH-Gx	J
		All NWTPH-Dx	J
ST004A14	Primary	All VOCs	J
ST004B15	Primary	All VOCs	J
		All NWTPH-Gx	J
ST504B15	Dup of ST004B15	All VOCs	J
		All NWTPH-Gx	J
ST004D14	Primary	None	
ST005A07	Primary	None	
ST006A05	Primary	None	
ST006B14	Primary	None	
ST006E14	Primary	All VOCs	J
ST007B12	Primary	All VOCs	J
		Mineral spirits	J
ST007C12	Primary	All VOCs	J
		Mineral spirits	J

Sample ID	Sample Type	Analyte	Qualifier
ST007E12	Primary	All VOCs	J
		Mineral spirits	J
ST008A09	Primary	All VOCs	J
		All NWTPH-Dx	J
ST704D15	Blank	None	

TRANSGLOBAL ENVIRONMENTAL GEOSCIENCES NORTHWEST— DRIVEPOINT GROUNDWATER SAMPLES

The analytical results for drivepoint groundwater samples collected during October and November 1998 at the East Gate Disposal Yard were subject to a quality assurance/quality control (QA/QC) review. This QA/QC review includes evaluation of analytical precision, accuracy, representativeness, comparability, and completeness. Precision is evaluated by comparison of results for primary and sample duplicate analyses and laboratory duplicate analyses; accuracy is evaluated using the analytical results for blanks, surrogates, matrix spikes and blank spikes; representativeness is evaluated by examining chain of custody paperwork and verifying analysis was performed within allowable holding times; comparability is evaluated by examining laboratory reporting limits; and completeness is evaluated by calculating the percentage of acceptable data.

All samples were analyzed on site by Transglobal Environmental Geosciences Northwest of Lacey, Washington. Samples were collected and analyzed according to the *Management Plan for East Gate Disposal Yard Expanded Site Investigation* (USACE 1998). Samples were analyzed for target volatile organic compounds (VOCs) by United States Environmental Protection Agency (EPA) SW-846 Method 8021B.

All analytical data are acceptable. No samples were analyzed outside of holding times. Target analytes were below detection for method blanks. Four samples had results qualified as estimated (J) due to out of control surrogate percent recoveries. The matrix spike (MS) sample results were within the control limits. No data were qualified due to the performance evaluation (PE) sample results. Field and laboratory duplicate precision was acceptable. The reporting limits met the project goals.

1.0 REPRESENTATIVENESS

1.1 Chain of Custody

The chain of custody (COC) forms indicate that samples were maintained under chain of custody.

1.2 Holding Times

The samples were analyzed within 3 days of collection. All samples were analyzed within the holding time.

2.0 ACCURACY

2.1 Review of Initial and Continuing Calibration

The laboratory performed an initial 5-point calibration at the beginning of the project. Each day samples were analyzed, the laboratory ran opening and closing continuing calibration standards at a concentration equivalent to the mid-range initial calibration standard. The continuing calibration standard acceptance criteria was established at +/– 20 percent of the average response factor (percent difference) from the calibration curve (except for vinyl chloride, which was set at +/– 25 percent). The percent difference results were within acceptance criteria for all continuing calibration standards analyzed.

2.2 Review of Blanks

Four field blanks were collected for this water sampling event. Frequency requirements for field blanks were met. Method blanks were analyzed at the requested frequency. Target analytes in method and field blanks were below detection. No data were qualified due to these results.

2.3 Surrogate Recovery Review

Samples were spiked with surrogates (system monitoring compounds). Samples with only one of two surrogates not reported due to matrix interference or dilution were not qualified. The following samples with all surrogates not reported or with recoveries out of the control limits due to matrix interference or dilution were qualified as estimated (J):

> The sample GD00125 (1:4) VOC surrogate was not reported due to matrix interference; the results were qualified as estimated (J). The sample GD00125 (1:160) VOC surrogate was diluted out; the results were qualified as estimated (J).
>
> The sample GD00130 (1:8) VOC surrogate was not reported due to matrix interference; the results were qualified as estimated (J). The sample GD00130 (1:160) VOC surrogate was diluted out; the results were qualified as estimated (J).
>
> The sample GD00610 (1:800) VOC surrogate was diluted out; the results were qualified as estimated (J).
>
> The sample GD00925 (1:80) VOC surrogate was not reported due to matrix interference; the results were qualified as estimated (J).

2.4 Matrix Spike/Matrix Spike Duplicate Review

Five VOC matrix spike/matrix spike duplicates (MS/MSD) were analyzed for this water sampling event, which meets the frequency requirement of 5 percent. The matrix spike sample results were within the control limits. No data were qualified due to these results.

2.5 Performance Evaluation Sample Review

Three water performance evaluation samples were analyzed. The performance evaluation sample results were within acceptance limits with one exception. The PE sample GD90100 1,1,1-trichloroethane result was above the acceptance limits. No data were qualified due to these results. The PE sample results are summarized below.

Analyte	GD90100 PE Result (µg/L)	GD90301 PE Result (µg/L)	GD90713 PE Result (µg/L)	Certified Value (µg/L)	Acceptance Limits
cis-1,2-Dichloroethene	12.5	13.3	11.8	11.1	6.83 – 15.2
trans-1,2-Dichloroethene	13.1	11.7	13.2	11.9	8.24 – 15.2
1,1,1-Trichloroethane	14.8	12.3	11.2	11.2	8.12 – 13.4
Trichloroethene	29.6	36.3	30.2	30.1	22.3 – 36.4
Vinyl chloride	12.0	10.7	10.8	12.0	7.20 – 16.8
Benzene	15.0	17.3	17.9	15.0	11.6 – 18.7
Ethylbenzene	11.0	12.6	12.4	11.0	8.22 – 12.8
Toluene	14.7	16.5	17.7	14.8	11.4 – 17.8
Total xylenes	12.0	13.4	13.0	11.3	7.29 – 14.2

2.6 Laboratory Control Sample Review

An initial LCS was analyzed at the beginning of the project. Percent recoveries ranged from 71 percent to 131 percent and were within the control limits of 65 to 135 percent. The frequency of LCS analysis met the project requirement of one per batch.

3.0 PRECISION

3.1 Laboratory Duplicate Review

Nine laboratory duplicates were analyzed. Duplicate precision ranged from 1 to 25 percent and was within the acceptance criteria of +/ 35 percent. The frequency of laboratory duplicate analysis (11 percent) met the project duplicate frequency requirement of at least 5 percent.

Sample ID	Analyte	Primary Result (µg/L)	Duplicate Result (µg/L)	RPD %
GD00425	cis-1,2-DCE	8.4	8.6	2
	Trichloroethene	47.6	41.5	14

Sample ID	Analyte	Primary Result (µg/L)	Duplicate Result (µg/L)	RPD %
GD00725	cis-1,2-DCE	19.0	16.1	17
	Trichloroethene	109	84.4	25
GD00836	Trichloroethene	2.7	2.5	8
GD01013	cis-1,2-DCE	3.9	4.7	19
	Trichloroethene	40.1	43.0	7
GD01136	cis-1,2-DCE	6.9	7.8	12
	Trichloroethene	93.7	115	20
GD01432	cis-1,2-DCE	58.5	60.4	3
	trans-1,2-DCE	13.6	13.7	1
	Trichloroethene	39,000	35,000	11
GD01738	cis-1,2-DCE	89.6	75.3	17
	Trichloroethene	369	362	2
GD01927	cis-1,2-DCE	26.5	25.8	3
	Trichloroethene	363	324	11
GD02020	None detected			

3.2 Field Duplicate Review

Eight water field duplicates and 79 primary samples were collected during this sampling event. The frequency of field duplicate collection met the project duplicate frequency requirement of at least 10 percent. The field duplicate results show good agreement, with one exception. The sample GD00524/50524 RPDs showed some variability. No data were qualified due to these results.

Sample ID	Analyte	Primary Result (µg/L)	Duplicate Result (µg/L)	RPD %
GD00320 / 50320	Trichloroethene	13.3	11.5	15
GD00524 / 50524	cis-1,2-DCE	1,410	3,400	83
	Trichloroethene	470,000	1,000,000	72
GD00825 / 50825	Trichloroethene	21.6	19.9	8.2
GD01115 / 51115	cis-1,2-DCE	2.6	3.1	18
	Trichloroethene	16.7	17.4	4.1
GD01339 / 51339	Trichloroethene	27.0	30.7	13
GD01511 / 51511	Trichloroethene	119	109	8.8
GD01717 / 51717	cis-1,2-DCE	354	469	28
	Trichloroethene	128	168	27
	Vinyl chloride	64.7	85.4	28
GD02024 / 52024	None detected			

4.0 COMPARABILITY

The standard reporting limits (RLs) for compounds of concern are shown below in comparison with laboratory reporting limits. The vinyl chloride reporting limit was slightly above the

requested reporting limits but still met the project needs. Compounds detected below the reporting limit but above the instrument detection limit were considered estimates by the laboratory, and were J-qualified.

Analyte	Requested Reporting Limit – Water (µg/L)	Reporting Limit – Water (µg/L)
Trichloroethene	2.5	2.5
1,2-DCE	2.5	2.5
Vinyl chloride	5.0	7.5
1,1,1-TCA	2.5	2.5
Benzene	2.5	2.5
Ethylbenzene	2.5	2.5
Toluene	2.5	2.5
Total xylenes	2.5	2.5

Three sample results are qualified as estimated (J) for trichloroethene, because the result was outside of the instrument calibration range: GD50524 (1:6400), GD00610 (1:800) and GD00920.

5.0 COMPLETENESS

The laboratory reported all requested analyses and the laboratory report is complete. The project completeness goal is 98 percent. For all samples collected and analyzed, no data were judged to be invalid. No data were rejected, so completeness for this sampling event is 100 percent.

Based on the QA/QC review, data can be qualified as estimated (J), or nondetected (U). No data were rejected. The following table summarizes qualified results:

Sample ID	Sample Type	Analyte	Qualifier
GD00125	Primary	All VOCs	J
GD00130	Primary	All VOCs	J
GD50524	Field duplicate	Trichloroethene	J
GD00610	Primary	All VOCs	J
GD00920	Primary	Trichloroethene	J
GD00925	Primary	All VOCs	J

TRANSGLOBAL ENVIRONMENTAL GEOSCIENCES— DRIVEPOINT GROUNDWATER SAMPLES

The volatile organic analytical results for drivepoint groundwater samples collected during March and April 1999 at the East Gate Disposal Yard were subject to a quality assurance/quality control (QA/QC) review. This QA/QC review includes evaluation of analytical precision, accuracy, representativeness, comparability, and completeness. Precision is evaluated by comparison of results for primary and sample duplicate analyses and laboratory duplicate analyses; accuracy is evaluated using the analytical results for blanks, surrogates, matrix spikes and blank spikes; representativeness is evaluated by examining chain of custody paperwork and verifying analysis was performed within allowable holding times; comparability is evaluated by examining laboratory reporting limits; and completeness is evaluated by calculating the percentage of acceptable data.

All samples were analyzed on site by Transglobal Environmental Geosciences, Inc. of Lacey, Washington. Samples were collected and analyzed according to the *Management Plan for East Gate Disposal Yard Expanded Site Investigation* (USACE 1998). Samples were analyzed for target volatile organic compounds (VOCs) by United States Environmental Protection Agency (EPA) SW-846 Method 8021B.

All analytical data are acceptable. No samples were analyzed outside of holding times. Target analytes were below detection for method blanks. One sample had trichloroethene qualified as estimated (J) due to out of control surrogate percent recoveries. The matrix spike (MS) sample results were within the control limits. Field and laboratory duplicate precision was acceptable. The reporting limits met the project goals.

1.0 REPRESENTATIVENESS

1.1 Chain of Custody

The chain of custody (COC) forms indicate that samples were maintained under chain of custody.

1.2 Holding Times

The samples were analyzed within 3 days of collection. All samples were analyzed within the holding time.

2.0 ACCURACY

2.1 Review of Initial and Continuing Calibration

The laboratory performed an initial 5-point calibration at the beginning of the project. Each day samples were analyzed, the laboratory ran opening and closing continuing calibration standards at a concentration equivalent to the mid-range initial calibration standard. The continuing calibration standard acceptance criteria was established at +/– 15 percent of the average response factor (percent difference) from the calibration curve (except for vinyl chloride, which was set at +/– 20 percent). The percent difference results were within acceptance criteria for all continuing calibration standards analyzed.

2.2 Review of Blanks

Five field blanks were collected for this sampling event, which is slightly below the frequency requirement of 5 percent. Method blanks were analyzed at the requested frequency. Target analytes in method and field blanks were below detection. No data were qualified due to these results.

2.3 Surrogate Recovery Review

Samples were spiked with surrogates (system monitoring compounds). Samples with all surrogates not reported or out of the control limits due to matrix interference or dilution were qualified as estimated (J). Samples with only one of two surrogates not reported due to matrix interference or dilution were not qualified.

The sample GD04932 (1:500) VOC surrogates were diluted out; only trichloroethene, which is reported from the dilution, was qualified as estimated (J).

2.4 Matrix Spike/Matrix Spike Duplicate Review

Eleven VOC matrix spike/matrix spike duplicates (MS/MSD) were analyzed for this sampling event, which met the frequency requirement of 5 percent. The matrix spike sample results were within the control limits. No data were qualified due to these results.

2.5 Laboratory Control Sample Review

An initial LCS was analyzed at the beginning of the project, and again after a 5-point re-calibration. Percent recoveries range from 65 percent to 134 percent and were within the control limits of 65 to 135 percent. The frequency of LCS analysis met the project requirement of one per batch.

3.0 PRECISION

3.1 Laboratory Duplicate Review

Nineteen laboratory duplicates were analyzed. Duplicate precision ranged from 1 to 32 percent and was within the acceptance criteria of +/ 35 percent. The frequency of laboratory duplicate analysis met the project duplicate frequency requirement of at least 5 percent.

Sample ID	Analyte	Primary Result (µg/L)	Duplicate Result (µg/L)	RPD %
GD02110	cis-1,2-DCE	140	130	7
	Trichloroethene	1,500	1,100	31
GD02232	cis-1,2-DCE	5.3	5.8	9
	Trichloroethene	61	60	2
	Vinyl chloride	22	16	32
GD02409	cis-1,2-DCE	200	210	5
	Trichloroethene	89	98	10
GD02507	cis-1,2-DCE	2.6	2.7	4
	Trichloroethene	13	11	17
	Vinyl chloride	21	21	0
GD02625	Trichloroethene	18	22	20
	Vinyl chloride	13	10	26
GD02824	Trichloroethene	2.8	2.6	7
	Vinyl chloride	18	16	12
GD02908.5	cis-1,2-DCE	2,400	2,300	4
	Vinyl chloride	700	740	6
GD03135	cis-1,2-DCE	200	200	0
	Trichloroethene	930	870	7
GD03324	Trichloroethene	75,000	66,000	13
GD03329	Trichloroethene	7,100	6,600	7
GD03534	cis-1,2-DCE	5.5	5.6	2
	Trichloroethene	19	16	17
GD03819	cis-1,2-DCE	4.3	3.9	10
	Trichloroethene	6.9	6.6	4
GD03831	Trichloroethene	450	530	16
GD04208	cis-1,2-DCE	7.9	7.5	5
	Trichloroethene	63	54	15
GD04223	Trichloroethene	270	310	14
GD04330	cis-1,2-DCE	120	120	0
	Trichloroethene	530	470	12
GD04528	cis-1,2-DCE	180	150	18
	Trichloroethene	440	360	20
GD04806	cis-1,2-DCE	120	130	8
	Trichloroethene	41	38	8
GD04922	Vinyl chloride	27	27	0

3.2 Field Duplicate Review

Thirteen field duplicates and 123 primary samples were collected during this sampling event. The frequency of field duplicate collection met the project duplicate frequency requirement of at least 10 percent. The field duplicate results showed good agreement; however, TCE results for two duplicate pairs and vinyl chloride and cis-1,2-DCE in one duplicate pair each had RPDs greater than the acceptance criterion of less than 30 percent. These results were J-qualified. Qualified data are listed in the completeness section.

Sample ID	Analyte	Primary Result (µg/L)	Duplicate Result (µg/L)	RPD %
GD02316 / 52316	Trichloroethene	470,000	500,000	6
GD02738/52738	Vinyl chloride	11	13	17
GD02924/52924	cis-1,2-DCE	150	130	14
	Trichloroethene	930	1,200	25
GD03127/53127	Trichloroethene	50	430	158
GD03219/53219	Trichloroethene	680	960	34
GD03419/53419	Trichloroethene	41	36	13
GD03519/53519	cis-1,2-DCE	13	11	17
	Vinyl chloride	14	10	33
GD03719/53719	cis-1,2-DCE	17	17	0
	Trichloroethene	12	11	9
GD03824/53824	Trichloroethene	4.2	4.5	7
GD04119/54119	cis-1,2-DCE	110	120	15
	Trichloroethene	1,000	1,000	0
GD04319/54319	cis-1,2-DCE	53	54	2
	Trichloroethene	120	110	9
GD04517/54517	cis-1,2-DCE	110	100	10
	Trichloroethene	260	240	8
GD04624/54624	cis-1,2-DCE	76J	51J	39
	Trichloroethene	1,000	1,100	10

4.0 COMPARABILITY

The standard reporting limits (RLs) for compounds of concern are shown below in comparison with laboratory reporting limits. The vinyl chloride reporting limit was slightly above the requested reporting limits but still met the project needs. Compounds detected below the reporting limit but above the instrument detection limit were considered estimates by the laboratory, and were J-qualified.

Analyte	Requested Reporting Limit – Water (µg/L)	Reporting Limit – Water (µg/L)
Trichloroethene	2.5	2.5
1,2-DCE	2.5	2.5

Analyte	Requested Reporting Limit – Water (µg/L)	Reporting Limit – Water (µg/L)
Vinyl chloride	5.0	7.5
1,1,1-TCA	2.5	2.5
Benzene	2.5	2.5
Ethylbenzene	2.5	2.5
Toluene	2.5	2.5
Total xylenes	2.5	2.5

5.0 COMPLETENESS

The laboratory reported all requested analyses and the laboratory report is complete. The project completeness goal is 98 percent. For all samples collected and analyzed, there have been no data judged to be invalid. No data were rejected, so completeness for this sampling event is 100 percent.

Based on the QA/QC review, data can be qualified as estimated (J), or nondetected (U). No data were rejected. The following table summarizes qualified results:

Sample ID	Sample Type	Analyte	Qualifier
GD03219	Primary	Trichlorethene	J
GD03219	Primary	Vinyl chloride	J
GD53219	Duplicate	Trichlorethene	J
GD53219	Duplicate	Vinyl chloride	J
GD04624	Primary	cis-1,2-Dichloroethene	J
GD54624	Primary	cis-1,2-Dichloroethene	J
GD04932 (1:500)	Primary	Trichloroethene	J
GD03127	Primary	Trichloroethene	J
GD53127	Duplicate	Trichloroethene	J
GD03519	Primary	Vinyl Chloride	J
GD53519	Duplicate	Vinyl Chloride	J

MULTICHEM ANALYTICAL SERVICES— BARREN AREA SOIL SAMPLES

The analytical results for soil samples collected from the barren area during September 1998 at the East Gate Disposal Yard were subject to a quality assurance/quality control (QA/QC) review. This QA/QC review includes evaluation of analytical precision, accuracy, representativeness, comparability, and completeness. Precision is evaluated by comparison of results for primary and sample duplicate analyses and laboratory duplicate analyses; accuracy is evaluated using the analytical results for blanks, surrogates, matrix spikes and blank spikes; representativeness is evaluated by examining chain of custody paperwork and verifying analysis was performed within allowable holding times; comparability is evaluated by examining laboratory reporting limits; and completeness is evaluated by calculating the percentage of acceptable data.

MultiChem Analytical Services of Renton, Washington, analyzed the samples. Samples were collected and analyzed according to the *Management Plan for the East Gate Disposal Yard Expanded Site Investigation* (USACE 1998). Samples were analyzed for the following: volatile organic compounds (VOCs) by United States Environmental Protection Agency (EPA) Method 8260B, semivolatile organic compounds (SVOCs) by EPA Method 8270C, organochlorine pesticides by EPA Method 8081A, PCBs by EPA Method 8082, and chlorinated herbicides by EPA Method 8151.

All analytical data are acceptable. The soil samples were analyzed outside of holding times for chlorinated herbicides; results are qualified as estimated (J). The two soil samples were qualified as nondetected (U) for one or more of the following due to method blank contamination: di-n-butylphthalate and bis(2-ethylhexyl)phthalate. The soil sample results were qualified as estimated (J) for chlorinated herbicides, due to out of control surrogate percent recoveries and spike percent recoveries. Field and laboratory duplicate precision was acceptable. The reporting limits met the project goals.

1.0 REPRESENTATIVENESS

1.1 Chain of Custody

The chain of custody (COC) forms indicate that samples were maintained under chain of custody.

1.2 Holding Times

All samples were analyzed within the holding time with the following exception: Samples RS001 and RS501 were extracted for chlorinated herbicides 22 days after collection, which is past the 14-day holding time. Results are qualified as estimated (J).

2.0 ACCURACY

2.1 Review of Initial and Continuing Calibration

The laboratory performed an initial calibration for each method which was acceptable. Each day samples were analyzed, the laboratory ran opening and continuing calibration standards at a concentration equivalent to the mid-range initial calibration standard. The percent difference results were within acceptance criteria for all continuing calibration standards with the following exception. Nine VOC analytes exceeded the +/– 20 percent criteria. As the other quality control data were acceptable, no data were qualified due to these results. One SVOC analyte exceeded the +/– 20 percent criteria; no data were qualified. The pesticide/PCB initial calibration was within limits; however, the average of the response factor was greater than 115 percent. This indicates a high bias and the value was nondetected; therefore, no data were qualified. Many of the chlorinated herbicide continuing calibration verification (CCV) recoveries exceeded the upper limit of 115 percent. Since a high recovery indicates a high bias only results greater than the reporting limit were qualified as estimated (J).

2.2 Review of Blanks

The laboratory analyzed one method blank for each batch. Target analytes in blanks were below detection with two exceptions. The SVOC method blank had detections of di-n-butylphthalate at 0.053 J mg/kg and bis(2-ethylhexyl)phthalate at 0.030 J mg/kg. Qualified data are summarized in the Section 5.

One field blank, one travel blank, and one methanol blank were collected and analyzed. Frequency requirements for field blanks were met. Target analytes in blanks were below detection. No data were qualified based on these results.

2.3 Surrogate Recovery Review

Samples were spiked with surrogates (system monitoring compounds). Samples with only one of two surrogates not reported due to matrix interference or dilution were not qualified. The following sample with all surrogates not reported or out of the control limits due to matrix interference or dilution are qualified as estimated (J):

The sample RS501 chlorinated herbicide surrogate percent recovery was low; the results were J-qualified.

2.4 Matrix Spike/Matrix Spike Duplicate Review

A matrix spike/matrix spike duplicate (MS/MSD) was analyzed with each method. The frequency of MS analysis met the project requirement of at least 5 percent. The results of the MS/MSD review are as follows:

As requested, the calibration second source was used as the VOC spike. Six of the MS/MSD VOC analytes were outside of the advisory percent recovery limits and one result was outside of the advisory RPD limit; no data were qualified.

The organochlorine pesticide MS/MSD RPDs for heptachlor and aldrin were above the control limits. Other batch quality control data were within the control limits; therefore, no data were qualified.

Many of the chlorinated herbicide MS/MSD percent recoveries were below the control limits due to matrix interference. The laboratory reported that the sample extract formed multiple phases and emulsions, which interfered with the extraction process. The laboratory control sample results were acceptable; therefore, the data were qualified only as estimated (J).

2.5 Laboratory Control Sample Review

One LCS was analyzed for each method. Statistical limits are available for only 1,1-dichloroethene, benzene, trichloroethene, toluene, and chlorobenzene. Statistical limits for the remaining spike analytes are not established so the advisory limits of 70 to 130 percent were used. The frequency of LCS analysis meets the project requirement of one per sampling event. The results of the LCS review are as follows:

As requested, the calibration second source was used as the VOC spike. Four of the spiked VOC analytes were outside of the advisory limits; no data were qualified.

The SVOC spike percent recovery for pyrene was slightly below the control limits. Other batch quality control data were within the control limits; therefore, no data were qualified.

The chlorinated herbicide spike percent recoveries for 2,4-DB and 2,4,5-T were above the control limits. Associated results were qualified as estimated (J).

3.0 PRECISION

3.1 Laboratory Duplicate Review

The laboratory analyzed MS/MSDs to determine analytical precision. Duplicate results are discussed in the matrix spike section. No data were qualified due to these results.

3.2 Field Duplicate Review

One soil field duplicate was collected for the one primary sample during this sampling event. The primary and field duplicate results were nondetected or less than five times the reporting limit. The results show good agreement and are acceptable as reported. The frequency of field duplicate collection meets the project duplicate frequency requirement of at least 10 percent.

4.0 COMPARABILITY

The requested reporting limits (RLs) for compounds of concern are shown below in comparison with actual reporting limits. The actual reporting limits were slightly above the requested reporting limits but still meet the project needs. Compounds detected below the reporting limit but above the instrument detection limit were considered estimates by the laboratory, and were J-qualified.

Method	Matrix	Requested Reporting Limit (µg/kg)	Actual Reporting Limit (µg/kg)
VOC	Soil	0.05 to 0.5 mg/kg	0.053 to 0.56
SVOC	Soil	0.17 to 1.7 mg/kg	0.18 to 1.8 mg/kg
Pesticides	Soil	1.7 to 33	1.8 to 33
PCB	Soil	33	33
Herbicides	Soil	Not established	2.2 to 1,100

5.0 COMPLETENESS

The laboratory reported all requested analyses and the laboratory report is complete. The project completeness goal is 98 percent. For all samples collected and analyzed, no data were found to be invalid. No data were rejected, so completeness for this sampling event is 100 percent.

Based on the QA/QC review, data can be qualified as estimated (J) or nondetected (U). No data were rejected. The following table summarizes the sample IDs and qualified results for all samples covered by this review.

Sample ID	Sample Type	Analyte	Qualifier
RS001	Primary	bis(2-Ethylhexyl)phthalate	0.18 U
		All chlorinated herbicides	J
RS501	Primary	di-n-Butylphthalate	0.18 U
		bis(2-Ethylhexyl)phthalate	0.18 U
		All chlorinated herbicides	J
Travel Blank	Trip blank	None	
Field Blank	Field blank	None	
MeOH Blank	Field blank	None	

MULTICHEM ANALYTICAL SERVICES—TRENCH SOIL, GROUNDWATER, AND NAPL SAMPLES

The analytical results for trench soil, groundwater, and NAPL samples collected during October 1998 at the East Gate Disposal Yard were subject to a quality assurance/quality control (QA/QC) review. This QA/QC review includes evaluation of analytical precision, accuracy, representativeness, comparability, and completeness. Precision is evaluated by comparison of results for primary samples with field and laboratory duplicate results; accuracy is evaluated using the analytical results for blanks, surrogates, matrix spikes and blank spikes; representativeness is evaluated by examining chain of custody paperwork and verifying analysis was performed within allowable holding times; comparability is evaluated by examining laboratory reporting limits; and completeness is evaluated by calculating the percentage of acceptable data.

MultiChem Analytical Services of Renton, Washington, analyzed the samples. Samples were collected and analyzed according to the *Management Plan for East Gate Disposal Yard Expanded Site Investigation* (USACE 1998). Samples were analyzed for one or more of the following: gasoline by NWTPH-G, diesel by NWTPH-Dx, volatile organic compounds (VOCs) by United States Environmental Protection Agency (EPA) Method 8260, and metals by EPA SW-846 Method 6010.

All analytical data are acceptable. The product (nonaqueous-phase liquid – NAPL) samples were analyzed outside of holding times for some organics analysis; results are qualified as estimated (J). No contamination was detected in any blank sample. The NAPL sample results were qualified as estimated (J) for VOCs, NWTPH-G, and NWTPH-Dx due to out of control surrogate recoveries. No data were qualified due to spike percent recoveries. Field and laboratory duplicate precision was acceptable. The reporting limits met the project goals.

1.0 REPRESENTATIVENESS

1.1 Chain of Custody

The chain of custody (COC) forms indicate that samples were maintained under chain of custody.

1.2 Holding Times

All samples were analyzed within the holding time with the following exceptions:

Sample NT007C13 was analyzed for gasoline 1 day past the 14 day holding time; results are qualified as estimated (J).

Sample NT007C13 was analyzed for VOCs 27 days after collection (13 days past the holding time). Results were qualified as estimated (J).

Sample NT001A was analyzed for VOCs 32 days after collection (18 days past the holding time). Results were qualified as estimated (J).

Sample NT001A was analyzed for gasoline 21 days after collection (7 days past the holding time). Results were qualified as estimated (J).

Sample NT006B1 was analyzed for VOCs 28 days after collection (14 days past the holding time). Results were qualified as estimated (J).

Sample NT006B15 was analyzed for gasoline 16 days after collection (2 days past the holding time).

Results were qualified as estimated (J).

2.0 ACCURACY

2.1 Review of Initial and Continuing Calibration

The laboratory performed an initial calibration for each method. Each day samples were analyzed, the laboratory ran opening and continuing calibration standards at a concentration equivalent to the mid-range initial calibration standard. The percent difference results were within acceptance criteria for all continuing calibration standards with the following exception. The analyte 1,2-dichloropropane exceeded the +/– 20 percent criteria on November 17, 1998. As the exceedence indicated a high bias and the sample results were nondetected; no data were qualified.

2.2 Review of Blanks

The laboratory analyzed one method blank for each batch. One field blank was collected and analyzed; however, no trip blanks were submitted or analyzed. Frequency requirements for field blanks were met. Target analytes in blanks were below detection. No data were qualified based on these results.

2.3 Surrogate Recovery Review

Samples were spiked with surrogates (system monitoring compounds). Samples with only one of two surrogates not reported due to matrix interference or dilution were not qualified. The following samples with all surrogates not reported or out of the control limits due to matrix interference or dilution are qualified as estimated (J):

> The sample NT007C13 NWTPH-G surrogate was diluted out; the results were qualified as estimated (J). Sample NT007C13 had one of three VOC surrogates out of the control limits (high) due to matrix interference; no data were qualified. The sample NT007C13 NWTPH-Dx surrogate was high due to matrix interference; the results were qualified as estimated (J).
>
> The sample NT001A NWTPH-G surrogate was diluted out; the results were qualified as estimated (J). Sample NT001A had one of three VOC surrogates out of the control limits (high) due to matrix interference; no data were qualified. The sample NT001A NWTPH-Dx surrogate was high due to matrix interference; the results were qualified as estimated (J).
>
> The sample NT006B15 NWTPH-G surrogate was diluted out; the results were qualified as estimated (J). Sample NT006B15 had one of three VOC surrogates out of the control limits (high) due to matrix interference; no data were qualified. The sample NT006B15 NWTPH-Dx surrogate was high due to matrix interference; the results were qualified as estimated (J).

2.4 Matrix Spike/Matrix Spike Duplicate Review

A matrix spike/matrix spike duplicate (MS/MSD) was analyzed with each batch. The frequency of MS analysis met the project requirement of one per sampling event for metals. No NAPL matrix spikes were analyzed for VOCs, NWTPH-G, or NWTPH-Dx, due to the high analyte concentration present in the samples. However, laboratory control samples were analyzed; therefore, no data were qualified due to these results.

The iron MS percent recovery for soil SDGs 810043, 810050, and 810064 was out of control due to a high concentration of iron in the sample; no data were qualified.

2.5 Laboratory Control Sample Review

The calibration second source was used as the VOC spike. Statistical limits are available for 1,1-dichloroethene, benzene, trichloroethene, toluene and chlorobenzene only. Control limits for the remaining spike analytes were established as 70 to 130 percent. The frequency of LCS analysis met the project requirement of one per sampling event.

Six of the blank spike (BS) and six of the blank spike duplicate (BSD) VOC analytes for the soil batch, were outside of the advisory limits; no data were qualified. Three of the analytes with statistical limits available, (1,1-dichloroethene, trichloroethene and benzene) had percent recoveries above the control limits. Since associated results were nondetected, no data were qualified.

3.0 PRECISION

3.1 Laboratory Duplicate Review

Five laboratory duplicates were analyzed. Duplicate precision ranged from 0 to 3.2 percent and was within the acceptance criteria of <20 percent for water and <35 percent for soil for metals analyses. The frequency of laboratory duplicate analysis, 12.5 percent for soil and 25 percent for water, meets the project duplicate frequency requirement of at least 5 percent for metals.

Sample ID	Analyte	Primary Result (mg/kg)	Duplicate Result (mg/kg)	RPD %
ST007C06	Iron	15,700	15,600	0.6
	Manganese	160	155	3.2
ST704B15	None			

3.2 Field Duplicate Review

One water and one soil field duplicate were collected during this sampling event for the six soil, three NAPL, and three groundwater primary samples covered by this review. Control limits for field duplicates are <30 percent for aqueous samples and <50 percent for soil or NAPL samples. The field duplicate results show good agreement and are acceptable as reported.

Sample ID	Analyte	Primary Result (mg/kg)	Duplicate Result (mg/kg)	RPD %
GT002D10 / 502D10	None			
ST004B09 / 504B09	Iron	13,000	16,000	21
	Manganese	270	300	11

The frequency of field duplicate collection, 11 percent for soil and 33 percent for water, met the project duplicate frequency requirement of at least 10 percent. Field duplicates were not collected for product samples due to the limited volume of sample available.

4.0 COMPARABILITY

The requested reporting limits (RLs) for compounds of concern are shown below in comparison with actual reporting limits. The actual reporting limits were slightly above the requested

reporting limits but still meet the project needs. Compounds detected below the reporting limit but above the instrument detection limit were considered estimates by the laboratory, and were J-qualified.

Method	Matrix	Requested Reporting Limit (mg/kg)	Actual Reporting Limit (mg/kg)
VOCs	NAPL	0.5	12 – 120
WTPH-G	NAPL	5	All detections
WTPH-Dx	NAPL	10	All detections
Iron	Water	0.05 mg/L	0.05 mg/L
Manganese	Water	0.01 mg/L	0.01 mg/L
Iron	Soil	2.5	All detections
Manganese	Soil	0.5	All detections

Dilution factors are listed in the following table. These samples did not meet the requested reporting limit. All data are acceptable based on high analyte concentrations in these samples.

Sample ID	Dilution Factor
NT001A	5
NT007C13	5
NT006B15	5

5.0 COMPLETENESS

The laboratory reported all requested analyses and the laboratory report is complete. The project completeness goal is 98 percent. For all samples collected and analyzed, no data were found to be invalid. No data were rejected, so completeness for this sampling event is 100 percent.

Based on the QA/QC review, data can be qualified as estimated (J), rejected (R), or nondetected (U). No data were rejected. The following table summarizes the sample IDs and qualified results for all samples covered by this review.

Sample ID	Sample Type	Analyte	Qualifier
NT007C13	Primary	All VOCs	J
		WTPH-G	J
		WTPH-Dx	J
ST007C06	Primary	None	
GT003D6.5	Primary	None	
ST004A02	Primary	None	
ST004A14	Primary	None	
ST004B09	Primary	None	
ST504B09	Duplicate	None	
ST704B15	Rinse blank	None	

Sample ID	Sample Type	Analyte	Qualifier
NT001A	Primary	All VOCs	J
		WTPH-G	J
		WTPH-Dx	J
GT002D10	Primary	None	
GT502D10	Duplicate	None	
ST002S10	Primary	None	
GT005A12	Primary	None	
NT006B15	Primary	All VOCs	J
		WTPH-G	J
		WTPH-Dx	J
ST006E14	Primary	None	

MULTICHEM ANALYTICAL SERVICES—DRIVEPOINT GROUNDWATER SAMPLES

The dissolved iron and manganese analytical results for drivepoint groundwater samples collected during October and November 1998 at the East Gate Disposal Yard were subject to a quality assurance/quality control (QA/QC) review. This QA/QC review includes evaluation of analytical precision, accuracy, representativeness, comparability, and completeness. Precision is evaluated by comparison of results for primary and sample duplicate analyses and laboratory duplicate analyses; accuracy is evaluated using the analytical results for blanks, matrix spikes and blank spikes; representativeness is evaluated by examining chain of custody paperwork and verifying analysis was performed within allowable holding times; comparability is evaluated by examining laboratory reporting limits; and completeness is evaluated by calculating the percentage of acceptable data.

MultiChem Analytical Services of Renton, Washington, analyzed the samples. Samples were collected and analyzed according to the *Management Plan for East Gate Disposal Yard Expanded Site Investigation* (USACE 1998). Samples were analyzed for dissolved iron and manganese by United States Environmental Protection Agency (EPA) SW-846 Method 6010.

All analytical data are acceptable. The samples were analyzed within the holding times. No contamination was detected in any blank samples. No data were qualified due to spike percent recoveries. Field and laboratory duplicate precision was acceptable. The reporting limits met the project goals.

1.0 REPRESENTATIVENESS

1.1 Chain of Custody

The chain of custody (COC) forms indicate that samples were maintained under chain of custody. Samples were filtered and preserved upon receipt.

1.2 Holding Times

The water holding time for metals is 6 months. All samples were analyzed within the holding time. No data were qualified due to these results.

2.0 ACCURACY

2.1 Review of Initial and Continuing Calibration

The laboratory performed an initial calibration for each method, each day samples were analyzed. A continuing calibration standard was analyzed every 10 samples. The percent difference results were within acceptance criteria for all continuing calibration standards.

2.2 Review of Blanks

The laboratory analyzed one method blank for each batch. Four field blanks were collected and analyzed (GD70320, GD71115, GD71511, GD72024). No trip blanks are required for metals analysis. Frequency requirements for field blanks were met. Target analytes in blanks were below detection with one exception. The method blank for batch 07Dec98 had a detection of iron at 0.14 mg/L. Associated results were nondetected; therefore, no data were qualified based on these results.

2.3 Matrix Spike Review

A matrix spike was analyzed with each batch. The frequency of matrix spike analysis met the project requirement of one per batch. Spike recovery results were within the control limits. No data were qualified due to these results.

2.4 Laboratory Control Sample Review

A blank spike was analyzed with each batch. The frequency of blank spike analysis met the project requirement of one per batch. Spike recovery results were within the control limits with one exception. The iron blank spike recovery for batch 811071 was slightly below the control limits. Other associated quality control data were within the control limits; therefore, no data were qualified due to these results.

3.0 PRECISION

3.1 Laboratory Duplicate Review

Seven laboratory duplicates were analyzed. Duplicate precision ranged from 0 to 10 percent and was within the acceptance criteria of +/– 20 percent. The frequency of laboratory duplicate analysis (8.9 percent) met the project duplicate frequency requirement of at least 5 percent for metals.

Sample ID	Analyte	Primary Result (mg/L)	Duplicate Result (mg/L)	RPD %
GD00111	Iron	1.77	1.76	1
	Manganese	0.453	0.455	0
GD00312	None			
GD00624	Manganese	0.0547	0.0547	0
GD01037	Iron	0.0766	0.0747	3
	Manganese	0.234	0.233	0
GD01220	Manganese	0.0216	0.0238	10
GD01613	Manganese	0.0251	0.0257	2
GD72024	None			

3.2 Field Duplicate Review

Eight field duplicates were collected for the 79 groundwater primary samples covered by this review. Acceptance criteria for aqueous field duplicates is $\leq$30 percent. The field duplicate results showed good agreement except in the duplicate pairs GD00524 / 50524 and GD01717 / 51717. For the former, the RPD for manganese was 97 percent; for the latter, the RPD for iron was 41 percent. Results for these samples were J-qualified.

Sample ID	Analyte	Primary Result (mg/L)	Duplicate Result (mg/L)	RPD %
GD00320 / 50320	Manganese	0.15	0.16	6.5
GD00524 / 50524	Manganese	0.29	0.10	97
GD00825 / 50825	Manganese	0.13	0.11	17
GD01115 / 51115	None			
GD01339 / 51339	Manganese	0.40	0.36	11
GD01511 / 51511	Iron	0.12	0.15	22
	Manganese	0.11	0.12	8.9
GD01717 / 51717	Iron	0.45	0.68	41
	Manganese	0.052	0.052	0
GD02024 / 52024	Manganese	0.092	0.085	7.9

The frequency of field duplicate collection (10 percent) met the project duplicate frequency requirement of at least 10 percent.

4.0 COMPARABILITY

The requested reporting limits (RLs) for compounds of concern are shown below in comparison with actual reporting limits. Reporting limits were acceptable.

Method	Matrix	Requested Reporting Limit (mg/L)	Actual Reporting Limit (mg/L)
Iron	Water	0.05	0.05
Manganese	Water	0.01	0.01

5.0 COMPLETENESS

The laboratory reported all requested analyses and the laboratory report is complete. The project completeness goal is 98 percent. For all samples collected and analyzed, no data were found to be invalid. No data were rejected, so completeness for this sampling event is 100 percent.

Based on the QA/QC review, data can be qualified as estimated (J) or nondetected (U). No data were rejected. The following are the MultiChem sample data groups covered by this review: 810102, 811004, 811017, 811022, 811027, 811032, 811038, 811044, 811048, 811059 and 811071. Qualified results are summarized below:

Sample ID	Analyte	Value (mg/L)	Qualifier
GD01717	Iron	0.45	J
GD51717	Iron	0.68	J
GD00524	Manganese	0.29	J
GD50524	Manganese	0.10	J

MULTICHEM ANALYTICAL SERVICES—DRIVEPOINT GROUNDWATER SAMPLES

The dissolved iron and manganese analytical results for drivepoint groundwater samples collected during March and April 1999 at the East Gate Disposal Yard were subject to a quality assurance/quality control (QA/QC) review. This QA/QC review includes evaluation of analytical precision, accuracy, representativeness, comparability, and completeness. Precision is evaluated by comparison of results for primary and sample duplicate analyses and laboratory duplicate analyses; accuracy is evaluated using the analytical results for blanks, matrix spikes and blank spikes; representativeness is evaluated by examining chain of custody paperwork and verifying analysis was performed within allowable holding times; comparability is evaluated by examining laboratory reporting limits; and completeness is evaluated by calculating the percentage of acceptable data.

All samples were analyzed by MultiChem Analytical Services of Renton, Washington. Samples were collected and analyzed according to the *Management Plan for East Gate Disposal Yard Expanded Site Investigation* (USACE 1998). Samples were analyzed for dissolved iron and manganese by United States Environmental Protection Agency (EPA) SW-846 Method 6010.

All analytical data are acceptable. No samples were analyzed outside of holding times. Target analytes were below detection for method blanks. The matrix spike (MS) sample results were within the control limits. Field and laboratory duplicate precision was acceptable. The reporting limits met the project goals.

1.0 REPRESENTATIVENESS

1.1 Chain of Custody

The chain of custody (COC) forms indicate that samples were maintained under chain of custody, the forms were signed during release and receipt, and the samples were appropriately preserved.

1.2 Holding Times

The laboratory reported all required analyses and the laboratory report is complete.

2.0 ACCURACY

2.1 Review of Initial and Continuing Calibration

The laboratory performed an initial 2-point calibration at the beginning of each day samples were analyzed. The laboratory ran opening, closing, and continuing calibration standards at a concentration equivalent to the mid-range initial calibration standard. The continuing calibration standard acceptance criterion was established at +/– 10 percent of the average response factor (percent difference) from the calibration curve. The percent difference results were within acceptance criteria for all continuing calibration standards analyzed.

2.2 Review of Blanks

Five field blanks were collected for this sampling event, which is slightly below the frequency requirement of 5 percent. Method blanks were analyzed at the requested frequency. Target analytes in method and field blanks were below detection, with one exception. Field blank GD72224 had detections of iron and manganese; however, it also had detections of calcium, magnesium and sodium, which were the same analytes detected in the samples. Due to the fact that this particular field blank appeared to be a sample, and the associated sample appeared to be a field blank, and since it was not obvious where the samples might have been switched, the results for samples GD02224 and GD72224 were qualified as rejected (R).

2.3 Matrix Spike Review

Twelve matrix spikes were analyzed for this water sampling event, which meets the frequency requirement of 5 percent. The matrix spike sample results were within the control limits. No data were qualified due to these results.

2.4 Blank Spike Review

An initial blank spike or laboratory control sample (LCS) was analyzed for each batch of analytical samples (not to exceed 20 samples). Percent recoveries ranged from 88 percent to 106 percent and were within the control limits of 85 to 115 percent. The frequency of LCS analysis met the project requirement of one per batch.

3.0 PRECISION

3.1 Laboratory Duplicate Review

Nine laboratory duplicates were analyzed. Duplicate precision ranged from 1 to 16 percent and was within the acceptance criterion of +/ 35 percent. The frequency of laboratory duplicate analysis met the project duplicate frequency requirement of at least 5 percent.

Sample ID	Analyte	Primary Result (mg/L)	Duplicate Result (mg/L)	RPD %
GD02110	Manganese	0.0601	0.0708	16
GD02324	Iron	0.127	0.129	2
	Manganese	0.228	0.231	1
GD02625	Manganese	0.302	0.300	1
GD02810	Manganese	0.0367	0.0364	1
GD02924	Manganese	0.259	0.271	5
GD03209	Manganese	0.087	0.0864	1
GD03534	Iron	0.757	0.827	9
	Manganese	0.505	0.551	9
GD03612	Iron	0.0958	0.0969	1
GD03913	Manganese	0.0392	0.0396	1
GD04133	Iron	0.664	0.659	1
	Manganese	0.212	0.211	0
GD04419	Manganese	0.0869	0.0878	1
GD04907	None			

3.2 Field Duplicate Review

Thirteen field duplicates and 120 primary samples were collected during this sampling event. The frequency of field duplicate collection met the project duplicate frequency requirement of at least 10 percent. Duplicate and primary sample detections that were five times greater than the reporting limit are show below. The field duplicate results showed good agreement; however, dissolved manganese results for one duplicate pair had an RPD greater than the acceptance criterion of <30 percent. These results were qualified as estimated (J). Qualified data are listed in the completeness section.

Sample ID	Analyte	Primary Result (mg/L)	Duplicate Result (mg/L)	RPD %
GD02738/52738	Manganese	0.37	0.35	6
GD02924/52924	Manganese	0.26	0.24	8
GD03127/53127	Manganese	0.089	0.098	10
GD03219/53219	Iron	0.14	0.11	24
	Manganese	0.12	0.083	36
GD03419/53419	Manganese	0.099	0.075	28
GD03824/53824	Iron	0.41	0.40	2
	Manganese	0.18	0.22	20
GD04119/54119	Manganese	0.31	0.40	25
GD04319/54319	Iron	0.55	0.63	14
	Manganese	0.43	0.56	26
GD04517/54517	Manganese	0.50	0.45	11
GD04624/54624	Iron	0.28	0.28	0
	Manganese	0.052	0.066	24

4.0 COMPARABILITY

4.1 Reporting Limits

The standard reporting limits (RLs) for compounds of interest are shown below in comparison with laboratory reporting limits.

Analyte	Requested Reporting Limit – Water (mg/L)	Reporting Limit – Water (mg/L)
Iron	0.05	0.05
Manganese	0.01	0.01

5.0 COMPLETENESS

The laboratory reported all requested analyses and the laboratory report is complete. The project completeness goal is 98 percent.

Based on the QA/QC review, data can be qualified as rejected (R) and estimated (J). The following table summarizes qualified results:

Sample ID	Sample Type	Analyte	Qualifier (mg/L)
GD02224	Primary	All dissolved metals	R
GD72224	Field blank	All dissolved metals	R
GD03219	Primary	Manganese	0.12 J
GD53219	Duplicate	Manganese	0.083 J

MULTICHEM ANALYTICAL SERVICES—SOIL AND NAPL SAMPLES

The analytical results for soil and NAPL samples collected during October 1998 at the East Gate Disposal Yard were subject to a quality assurance/quality control (QA/QC) review. This QA/QC review includes evaluation of analytical precision, accuracy, representativeness, comparability, and completeness. Precision is evaluated by comparison of results for primary and sample duplicate analyses and laboratory duplicate analyses; accuracy is evaluated using the analytical results for blanks, surrogates, matrix spikes and blank spikes; representativeness is evaluated by examining chain of custody paperwork and verifying analysis was performed within allowable holding times; comparability is evaluated by examining laboratory reporting limits; and completeness is evaluated by calculating the percentage of acceptable data.

All samples were analyzed by MultiChem Analytical Services of Renton, Washington. Samples were collected and analyzed according to the *Management Plan for East Gate Disposal Yard Expanded Site Investigation* (USACE 1998). Samples were analyzed for target semivolatile organic compounds (SVOCs) by United States Environmental Protection Agency (EPA) Method 8270 and polychlorinated biphenyls (PCB) by EPA Method 8082.

All analytical data are acceptable. The data were qualified as estimated (J) for all analyses due to missed holding times. The PCB method blanks were free of contamination. Four samples were qualified as nondetected (U) for bis(2-ethylhexyl)phthalate due to method blank contamination. Three samples were qualified due to out of control SVOC surrogate percent recoveries. No data were qualified due to out of control matrix spike or blank spike percent recoveries. No data were qualified due to field or laboratory duplicate precision. The reporting limits met the project goals.

1.0 REPRESENTATIVENESS

1.1 Chain of Custody

The chain of custody (COC) forms indicate that samples were maintained under chain of custody with the following exception. Samples from data group 901015 were submitted at 7.5 °C. This temperature is outside the suggested range of 4 ± 2 °C. No data were qualified.

1.2 Holding Times

The holding times were not met. The samples were submitted between October 1 and 20, 1998. The samples were put on hold until the analyses were requested in January 1999. The samples were extracted 3 months after collection, which is outside of the holding time of 14 days to extraction for SVOCs and PCBs. All SVOC and PCB data were qualified as estimated (J).

2.0 ACCURACY

2.1 Review of Initial and Continuing Calibration

The laboratory performed an initial 8-point calibration for SVOCs and a 5-point calibration for PCBs at the beginning of the project. Each day samples were analyzed, the laboratory ran calibration standards at a concentration equivalent to the mid-range initial calibration standard. The continuing calibration standard acceptance criteria were established at +/– 20 percent (SVOCs) and +/– 15 percent (PCBs) of the average response factor (percent difference) from the calibration curve. The percent difference results were within acceptance criteria for all continuing calibration standards analyzed, with the following exceptions:

> The relative response factors for acenapthene and pentachlorophenol in the SVOC continuing calibration verification (CCV) analyzed on January 27, 1999, differed from the initial calibration by more than 20 percent. The average percent difference for all calibrated compounds was less than 15 percent; therefore, no data were qualified.
>
> The relative response factors for acenapthene in the SVOC CCV analyzed on January 28, and February 3, 1999, differed from the initial calibration by more than 20 percent. The average percent difference for all calibrated compounds was less than 15 percent; therefore, no data were qualified.
>
> The percent differences for Aroclor 1016 and Aroclor 1254 in the PCB closing CCV were greater than the upper control limit of 15 percent. The second-column percent differences were within control limits; therefore, no data were qualified.

2.2 Review of Blanks

Field blanks were not collected with these samples. Frequency requirements for field blanks were not met. Method blanks were analyzed at the requested frequency. Target analytes in method blanks were below detection with the following exception. The analyte bis(2-ethylhexyl)phthalate was above the reporting limit in the SVOC method blank for data groups 901015 and 901016. Samples less than 10 times the blank contamination were qualified as nondetected. Qualified data are listed in Section 5.

2.3 Surrogate Recovery Review

Samples were spiked with surrogates (system monitoring compounds). Surrogate percent recoveries were within the control limits with the following exceptions:

Three of the six SVOC surrogate percent recoveries were above the control limits for sample NT007B13. Associated data above the reporting limit were qualified as estimated (J).

Two of the six SVOC surrogate percent recoveries were above the control limits and one of the six surrogates was not recovered for sample NT006B15. Associated data above the reporting limit were qualified as estimated (J).

One of the six SVOC surrogate percent recoveries was below the control limits for samples ST004A14 and ST504B09. Associated quality control data were within the control limits; therefore, no data were qualified.

Two of the six SVOC surrogate percent recoveries were above the control limits for sample NT001A. Associated data above the control limit were qualified as estimated (J).

2.4 Spike/Spike Duplicate Review

One SVOC and PCB matrix spike/matrix spike duplicate (MS/MSD) or blank spike/blank spike duplicate (BS/BSD) was analyzed for the soil and NAPL batches, which met the frequency requirement of 5 percent. The matrix spike results were within the control limits. No data were qualified due to these results.

The soil SVOC BS percent recovery was below the control limit for 2-chlorophenol at 36 percent. The blank spike duplicate and associated matrix spike percent recoveries were within the control limits; therefore, no data were qualified.

3.0 PRECISION

The laboratory analyzed spike duplicates; results were within control limits as discussed above. The project duplicate frequency requirement of 10 percent was met. No data were qualified.

One field duplicate was collected for the eight primary samples covered by this review. The primary and duplicate samples are ST004B09 and ST504B09. The RPDs were not calculated since the results were not greater than five times the reporting limit. The project duplicate frequency requirement of 10 percent was met. No data were qualified.

4.0 COMPARABILITY

The laboratory reporting limits (RLs) for soil and product samples are shown below. The reporting limits met the project needs. Compounds detected below the reporting limit but above the instrument detection limit were considered estimates by the laboratory, and were J-qualified.

Analyte	Reporting Limit – NAPL (mg/kg)	Reporting Limit – Soil (µg/kg)
SVOC	50 to 1,000	0.2 to 1.0
PCBs	500 to 1,200	40 to 42

Dilution factors are listed on the following table. All data were acceptable based on high analyte concentrations in these samples.

Sample ID	Method	Dilution Factor
DT005C03	SVOC	20
DT005B	SVOC	20
NT006B15	SVOC	20
NT007B13	SVOC	20
NT001A	SVOC	10

5.0 COMPLETENESS

The laboratory reported all requested analyses and the laboratory report is complete. The project completeness goal is 98 percent. For all samples collected and analyzed, there have been no data judged to be invalid. No data were rejected, so completeness for this sampling event is 100 percent.

Based on the QA/QC review, data can be qualified as estimated (J), or nondetected (U). No data were rejected. The following table summarizes the sample IDs and qualified results for all samples covered by this review:

Sample ID	Sample Type	Laboratory Sample ID	Analyte	Qualifier (µg/kg)
DT005C03	Primary NAPL	810073-1	All SVOCs and PCBs	J
DT005B	Primary NAPL	810073-2	All SVOCs and PCBs	J
NT006B15	Primary NAPL	810073-3	All SVOCs and PCBs	J
NT007B13	Primary NAPL	810073-4	All SVOCs and PCBs	J
ST002A10	Primary soil	901015-1	All SVOCs and PCBs bis(2-Ethylhexyl)phthalate	J 1.4UJ
ST004A14	Primary soil	901016-1	All SVOCs and PCBs bis(2-Ethylhexyl)phthalate	J 0.27UJ
ST004B09	Primary soil	901016-2	All SVOCs and PCBs bis(2-Ethylhexyl)phthalate	J 0.20UJ

Sample ID	Sample Type	Laboratory Sample ID	Analyte	Qualifier (µg/kg)
ST504B09	Duplicate soil	901016-3	All SVOCs and PCBs bis(2-Ethylhexyl)phthalate	J 0.20UJ
NT001A	Primary NAPL	901017-1	All SVOCs and PCBs	J

SOIL TECHNOLOGY, CORE LABORATORIES, AND ANALYTICAL RESOURCES—TRENCH SOIL SAMPLES

The analytical and physical testing results for trench soil samples collected during September 1998 at the East Gate Disposal Yard were subject to quality assurance/quality control (QA/QC) review. This QA/QC review includes evaluation of analytical precision, accuracy, representativeness, comparability, and completeness. Precision is evaluated by comparison of results for primary and sample duplicate analyses and laboratory duplicate analyses; accuracy is evaluated using the analytical results for blanks, surrogates, matrix spikes and blank spikes; representativeness is evaluated by examining chain of custody paperwork and verifying analysis was performed within allowable holding times; comparability is evaluated by examining laboratory reporting limits; and completeness is evaluated by calculating the percentage of acceptable data.

Samples were analyzed by Soil Technology, Inc. of Bainbridge Island, Washington, for particle size distribution; Core Laboratories of Aurora, Colorado, for citrate-bicarbonate-dithionite (CBD) extractable iron and manganese; and Analytical Resources, Inc. of Seattle, Washington, for total organic and inorganic carbon. Samples were collected and analyzed according to the *Management Plan for the East Gate Disposal Yard Expanded Site Investigation* (USACE 1998). Samples were analyzed for particle size distribution by American Society for Testing and Materials (ASTM) D-422; CBD extractable iron and manganese by Core Lab standard operating procedure; and total organic carbon (TOC) and total inorganic carbon (TIC) by U.S. Environmental Protection Agency (EPA) SW-846 Method 9060.

All analytical data are acceptable. The soil samples were analyzed within holding times. Percent recovery of the TOC matrix spike was outside control limits at 131 percent. All TOC and TIC results (calculated from the TOC results) were qualified as estimated (J). Laboratory duplicate precision was acceptable. The field duplicate precision results for CBD extractable iron and manganese were outside of control limits at 83 percent and 98 percent relative percent difference, respectively. All CBD extractable iron and manganese results were qualified as estimated. Method blanks were free of contamination. LCS percent recoveries were acceptable. The reporting limits met the project goals.

1.0 REPRESENTATIVENESS

1.1 Chain of Custody

The chain of custody (COC) forms indicate that samples were maintained under chain of custody.

1.2 Holding Times

All samples were analyzed within established holding times.

2.0 ACCURACY

2.1 Review of Initial and Continuing Calibration

Not evaluated.

2.2 Review of Blanks

The laboratory analyzed one method blank for each batch as required by the methods. Target analytes in blanks were below detection. No data were qualified based on these results.

2.3 Surrogate Recovery Review

Not applicable.

2.4 Matrix Spike/Matrix Spike Duplicate Review

A matrix spike/matrix spike duplicate (MS/MSD) was analyzed with each method as required. The frequency of MS analysis met the project requirement of at least 5 percent.

Percent recovery of the TOC matrix spike was outside control limits at 131 percent. The laboratory control sample results were acceptable. All TOC and TIC results (calculated from the TOC results) were qualified as estimated (J).

2.5 Laboratory Control Sample Review

On LCS was analyzed for each method as required. LCS percent recoveries were acceptable. The frequency of LCS analysis met the project requirement of one per sampling event.

3.0 PRECISION

3.1 Laboratory Duplicate Review

The laboratory analyzed duplicate samples to determine analytical precision. Relative percent differences (RPDs) were within control limits.

3.2 Field Duplicate Review

One soil field duplicate was collected for the one primary sample during this sampling event. The field duplicate precision results for CBD extractable iron and manganese outside of control limits at 83 percent and 98 percent RPD, respectively. All CBD extractable iron and manganese results were qualified as estimated (J). The field duplicate precision for total inorganic carbon was outside of control limits at 163 percent RPD. All TIC results were qualified as estimated. The frequency of field duplicate collection met the project duplicate frequency requirement of at least 10 percent.

4.0 COMPARABILITY

The requested reporting limits (RLs) for compounds of concern are shown below in comparison with actual reporting limits. The actual reporting limits varied from the requested reporting limits but still meet the project needs because results were all detected.

Method	Matrix	Requested Reporting Limit	Actual Reporting Limit
TOC/TIC	soil	200/200 mg/kg	50/50 mg/kg
Particle size	soil	0.1%	0.1%
CBD extractable iron	soil	3	200-800 mg/kg
CBD extractable manganese	soil	1	80-300 mg/kg

5.0 COMPLETENESS

The laboratory reported all requested analyses and the laboratory report is complete. The project completeness goal is 98 percent. For all samples collected and analyzed, no data were found to be invalid. No data were rejected, so completeness for this sampling event is 100 percent.

Based on the QA/QC review, data can be qualified as estimated (J). No data were rejected. The following table summarizes the sample IDs and qualified results for all samples covered by this review.

Sample ID	Sample Type	Analyte	Qualifier
ST002A10	Primary	TOC/TIC	J
		CBD extractable Fe/Mn	J
ST004A02	Primary	TOC/TIC	J
		CBD extractable Fe/Mn	J
ST004A14	Primary	TOC/TIC	J
		CBD extractable Fe/Mn	J
ST004B09	Primary	TOC/TIC	J
		CBD extractable Fe/Mn	J
ST504B09	Field duplicate	TOC/TIC	J
		CBD extractable Fe/Mn	J
ST006E14	Primary	TOC/TIC	J
		CBD extractable Fe/Mn	J
ST007C06	Primary	TOC/TIC	J
		CBD extractable Fe/Mn	J

PTS LABORATORIES—TRENCH NAPL SAMPLES

The physical testing results for trench NAPL samples collected during September 1998 at the East Gate Disposal Yard were subject to a quality assurance/quality control (QA/QC) review. This QA/QC review includes evaluation of analytical precision, accuracy, representativeness, comparability, and completeness. Precision is evaluated by comparison of results for primary and sample duplicate analyses and laboratory duplicate analyses; accuracy is evaluated using the analytical results for blanks, surrogates, matrix spikes and blank spikes; representativeness is evaluated by examining chain of custody paperwork and verifying analysis was performed within allowable holding times; comparability is evaluated by examining laboratory reporting limits; and completeness is evaluated by calculating the percentage of acceptable data.

Samples were analyzed by PTS Laboratories of Santa Fe Springs, California. Samples were collected and analyzed according to the *Management Plan for the East Gate Disposal Yard Expanded Site Investigation* (USACE 1998). Samples were analyzed for interfacial tension by American Society for Testing and Materials (ASTM) D971 and viscosity by ASTM D455-71.

1.0 REPRESENTATIVENESS

1.1 Chain of Custody

The chain of custody (COC) forms indicate that samples were maintained under chain of custody.

1.2 Holding Times

Holding times have not been established for NAPL samples.

2.0 ACCURACY

2.1 Review of Initial and Continuing Calibration

Not applicable.

2.2 Review of Blanks

Not applicable.

2.3 Surrogate Recovery Review

Not applicable.

2.4 Matrix Spike/Matrix Spike Duplicate Review

Not applicable.

2.5 Laboratory Control Sample Review

One LCS was analyzed for each method as required. LCS percent recoveries were acceptable. The frequency of LCS analysis met the project requirement of one per sampling event.

3.0 PRECISION

3.1 Laboratory Duplicate Review

The laboratory analyzed duplicate samples to determine analytical precision. Relative percent differences (RPDs) were within control limits.

3.2 Field Duplicate Review

Field duplicates were not submitted with NAPL samples due to limited sample volume availability.

4.0 COMPARABILITY

The requested reporting limits (RLs) for compounds of concern are shown below in comparison with actual reporting limits. The reporting limits are acceptable for project uses.

Method	Matrix	Requested Reporting Limit	Actual Reporting Limit
Interfacial tension	NAPL	0.01 dynes/cm	0.01 dynes/cm
Viscosity	NAPL	0.1 centistokes	0.1 centistokes

5.0 COMPLETENESS

The laboratory reported all requested analyses and the laboratory report is complete. The project completeness goal is 98 percent. For all samples and analyzed, no data were found to be invalid.

No data were rejected, so completeness for this sampling event is 100 percent.

Based on the QA/QC review, data are acceptable as reported. No qualifiers were assigned.