FINAL REMEDIAL INVESTIGATION REPORT

PSC Washougal Facility

Washougal, Washington

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PSC Washougal Facility
Seattle, Washington
Washougal, Washington

September 12, 2013
Project 9625

This report was prepared by the staff of AMEC Environment & Infrastructure, Inc., under the supervision of the Geologist whose seal and signature appears hereon.

The findings, recommendations, specifications, or professional opinions are presented within the limits described by the client, in accordance with generally accepted professional geologic practice. No warranty is expressed or implied.

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9/12/2013

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Licensed Hydrogeologist #2261
Expiration Date: September 30, 2013

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APPENDICES

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ACRONYMS & ABBREVIATIONS

3-D	three-dimensional
µg/L	micrograms per liter
µS/cm	microsiemens per centimeter
AMEC	AMEC Environment & Infrastructure, Inc.; previously AMEC Geomatrix, Inc.
ARARs	applicable or relevant and appropriate requirements
ASTM	American Society for Testing Materials
AWW	All Weather Wood
BEI	Burlington Environmental, Inc.
bgs	below the ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CAP	cleanup action plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
Chempro	Chemical Processors, Inc.
CLARC	Cleanup Levels and Risk Calculation
cm/s	centimeters per second
CMS	Corrective Measures Study
CO_2	carbon dioxide
COCs	constituents of concern
Columbia	Columbia Analytical Services, Inc.
COPC	chemicals of potential concern
CPOC	conditional point of compliance
1,1-DCA	1,1-dichloroethane
DCE	dichloroethene
1,1-DCE	1,1-dichloroethene
1,2-DCE	*cis*- and trans-1,2-dichloroethene
cis-1,2-DCE	*cis*-1,2-dichloroethene
DNAPL	dense nonaqueous phase liquids
DQO	data quality objective
DSM	deep soil mixing
DTW	depth to water
DUS	dynamic underground stripping
Ecology	Washington State Department of Ecology
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
ERH	electrical resistive heating
EZVI	emulsified zero-valent iron
Facility	PSC Washougal Facility
FS	Feasibility Study
ft/day	feet per day
ft^3/day	cubic feet per day
GAC	granular activated carbon

ACRONYMS & ABBREVIATIONS
(Continued)

Geomatrix	Geomatrix Consultants, Inc.
gpm	gallons per minute
HI	hazard index
HRC	hydrogen-releasing compound
HQ	hazard quotient
HSWA	Hazardous and Solid Waste Amendments
IPIM	inhalation pathway interim measure
ISCO	in situ chemical oxidation
iSOC™	in situ oxygen curtain
MA	monitored attenuation
McClary	McClary Columbia Corporation
MCL	maximum contaminant level
MDL	method detection limit
mg/kg	milligram per kilogram
mg/L	milligrams per liter
mph	miles per hour
MS/MSD	matrix spike/matrix spike duplicate
MSL	mean sea level
MTCA	model Toxics control Act
mV	millivolts
NAD83	North American Datum of 1983
NGVD	National Geodetic Vertical Datum
NAPL	Nonaqueous phase liquid
NGVD29	National Geodetic Vertical Datum of 1929
NPDES	National Pollutant Discharge Elimination System
NPV	net present value
NRWQC	National Recommended Water Quality Criteria (for Priority and Non Priority Toxic Pollutants)
O&M	Operation and maintenance
ORC	oxygen release compound
ORP	Oxidation reduction potential
PAH	Polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyls
PCE	tetrachloroethene
PCL	preliminary cleanup level
POC	point of compliance
POTW	Publicly owned treatment works
PPE	Personal protective equipment
PQL	Practical Quantitation Limit
PRB	permeable reactive barriers
PSC	PSC Environmental Services, LLC
PVC	Polyvinyl chloride
QC	quality control
RCRA	Resource Conservation and Recovery Act
redox	Reduction/oxidation

ACRONYMS & ABBREVIATIONS
(Continued)

RFI	RCRA Facility Investigation
RFA	RCRA Facility Assessment
RI	Remedial Investigation
RI/FS	Remedial Investigation and Feasibility Study Report
S/S	solidification/stabilization
SEAR	solvent-enhanced aquifer remediation
SEE	Sweet-Edwards/EMCON
SIM	selective ion monitoring
SLNWR	Steigerwald Lake National Wildlife Refuge
SOP	standard operating procedure
SPOC	standard point of compliance
S/S	solidification/stabilization
SVE	soil vapor extraction
SVOC	semivolatile organic compounds
SWMU	Solid Waste Management Unit
SWPPP	Stormwater Pollution Prevention Plan
TCE	trichloroethene
TDS	total dissolved solids
TPH-D	total petroleum hydrocarbons, diesel range
TPH-G	total petroleum hydrocarbons, gasoline range
TPH-Oil	total petroleum hydrocarbons, lube oil range
TrueGuard	TrueGuard, LLC
TPH	total petroleum hydrocarbon
TSDF	treatment, storage, or disposal facility
UCL	upper confidence limit
USC	United States Code
USGS	U.S. Geological Survey
VC	vinyl chloride
VOC	volatile organic compound
WAC	Washington Administrative Code
WDOH	Washington State Department of Health
Work Plan	RI/FS Work Plan for the PSC Washougal Facility
ZVI	zero-valent iron

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FINAL REMEDIAL INVESTIGATON
PSC Washougal Facility
Washougal, Washington

1.0 INTRODUCTION

Burlington Environmental, LLC, a wholly owned subsidiary of PSC Environmental Services, LLC (hereafter referred to as PSC), has prepared this Remedial Investigation (RI) Report (RI Report) pursuant to the Resource Conservation and Recovery Act (RCRA) and the Model Toxics Control Act (MTCA) for its Washougal Facility (facility) located at 632 South 32nd Street, Washougal, Washington. The facility is a RCRA (Code of Federal Regulations [CFR] Title 40 Parts 260-299) permitted dangerous waste management facility (RCRA Part B Permit WADO92300250). One of the major provisions of the Hazardous and Solid Waste Amendments (HSWA) to RCRA [Section 3004(u)] requires corrective action for releases of hazardous waste or hazardous constituents from Solid Waste Management Units (SWMUs) at hazardous waste treatment, storage, or disposal facilities (TSDFs). Under Section 3004(u), a facility applying for a RCRA hazardous waste management facility permit is subject to the Corrective Action (CA) process. PSC received a RCRA Part B permit for the Washougal facility in October 1992. However, activities related to corrective action have been ongoing since the facility was an "Interim Status" RCRA facility starting in 1980.

The specific requirements relating to corrective action at the facility are outlined in Part VII of the facility's RCRA Part B permit, revised in September 1999. The Washington State Department of Ecology (Ecology) has been authorized by the U.S. Environmental Protection Agency (EPA) to implement corrective action under the MTCA regulations.

PSC has conducted RCRA facility investigation (RFI) and RI activities at the facility under the RCRA permit since 1992. The scope of the RI work was refined and updated according to the approved permit modification WAMOD 28-1 (1998) and in an RI/FS Work Plan (Work Plan) approved in 1999 (PSC, 1998a).

PSC completed and submitted a draft RI Report to Ecology for the Washougal site in September 2000 (PSC, 2000). In response to Ecology's comments on the RI document, PSC conducted numerous field and analytical activities to address data gaps identified since the 2000 Draft RI Report. A Remedial Investigation/Feasibility Study (RI/FS) Report submitted to Ecology in 2010 summarized the data collected since the 2000 Draft RI, updated the original RI, and included a Feasibility Study (FS) to determine an appropriate cleanup alternative for the site. Based on comments from Ecology received in May 2011, PSC has split the RI/FS into separate RI and FS reports. This document presents the final RI report for the Washougal site.

1.1 PURPOSE

PSC has conducted RI activities at the site under a RCRA Part B permit since 1992. Preliminary investigations were conducted prior to issuance of the permit in the late 1980s and even earlier under the interim status. The purpose of this RI is to summarize the results of historical investigations and cleanup efforts conducted at the site.

1.2 OBJECTIVES

The objectives of this report are to:

- Summarize and interpret data collected during site characterization studies and remedial investigations conducted at the site;
- Define the nature and extent of surface and subsurface contamination that resulted from releases on the facility; and
- Describe the risks associated with that contamination.

1.3 ORGANIZATION AND SCOPE

This RI report is organized into the following sections:

- Section 1 — Introduction
- Section 2 – Facility Description
- Section 3 – Facility History
- Section 4 – Data Collection Summary
- Section 5 – Physiography and Climate
- Section 6 – Geology
- Section 7 – Hydrogeology
- Section 8 – Conceptual Site Model
- Section 9 – Selection of Cleanup Levels
- Section 10 – Selection of Constituents of Concern
- Section 11 – Nature and Extent of Contamination
- Section 12 – Fate and Transport

1.4 TERMINOLOGY

The PSC Washougal property is located in Washougal, Washington (Figure 1-1). The RCRA facility's dangerous waste permit, issued by Ecology in 1992 under the Washington Dangerous Waste Regulations (Chapter 173-303 of the Washington Administrative Code [WAC]), requires PSC to perform corrective action (cleanup) within and beyond the property boundaries of the permitted RCRA facility to address releases of hazardous substances. Chapter 173-303 WAC requires that cleanup actions be implemented consistent with the Washington State MTCA regulations (Chapter 173-340 WAC). MTCA requires PSC to perform cleanup actions to address releases "where a hazardous substance has been deposited, stored, disposed of, placed, or otherwise come to be located." Under Washington State MTCA regulations, this area of contamination is called the "site" or "facility;" under the MTCA regulations, these terms are essentially synonymous. In this RI, the terms *facility* and *site* are used to refer to the area affected by releases from operations of the dangerous waste facility, which includes both the PSC former RCRA operational facility and other areas that have been affected by releases that occurred at, or through, RCRA operations.

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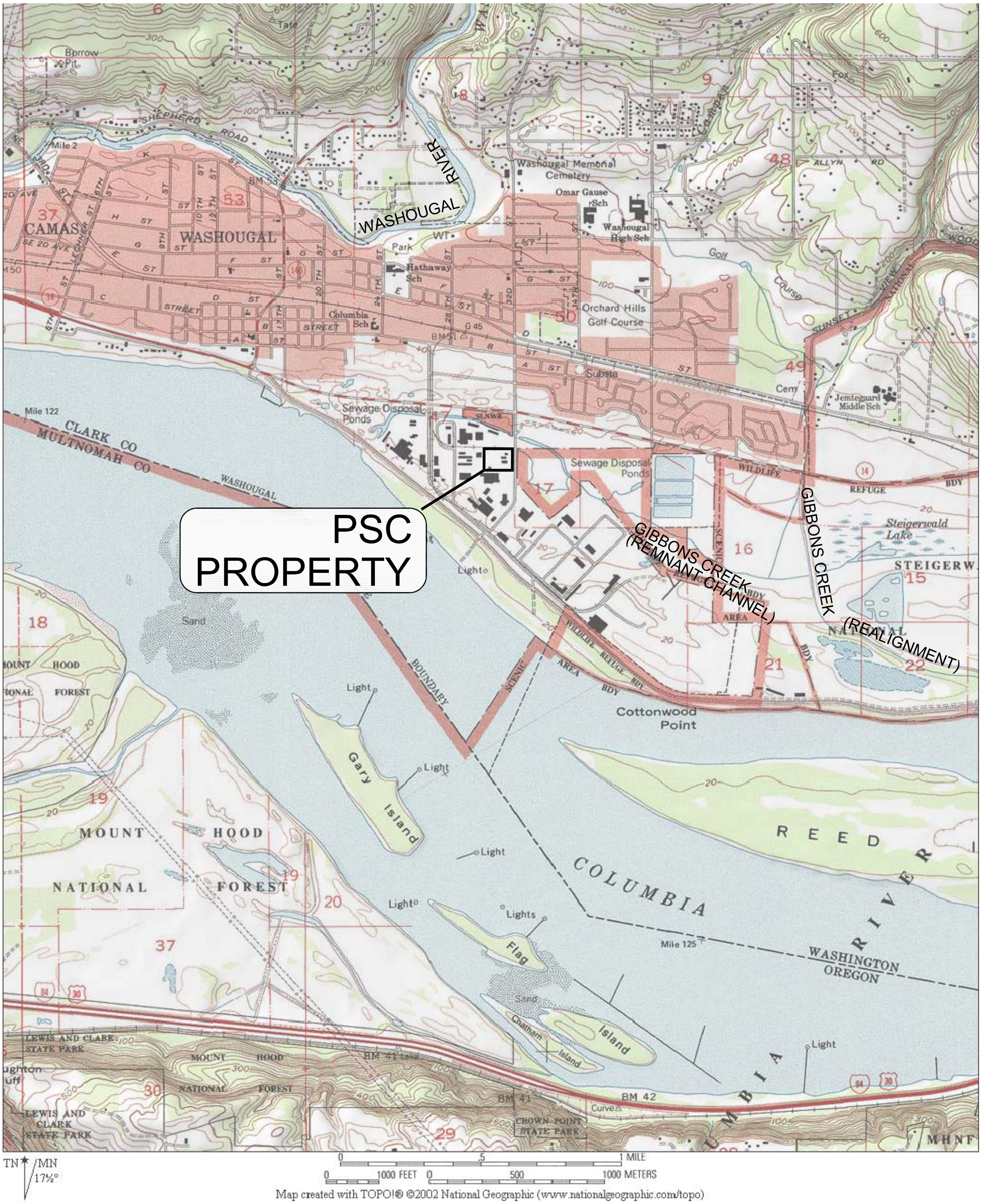
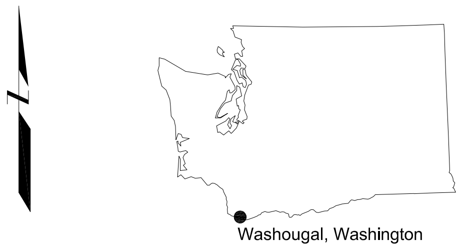
FIGURES



Map created with TOPO!® ©2002 National Geographic (www.nationalgeographic.com/topo)



PROPERTY LOCATION
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 11/06/09	Project No. 9625
AMEC Geomatrix		Figure 1-1

Plot Date: 11/06/09 - 12:16pm, Plotted by: adam.stenberg
Drawing Path: S:\9625\008_RIFS-2009\CAD\, Drawing Name: PSC Washougal_vicinity.DWG

2.0 FACILITY DESCRIPTION

This section describes the location and layout of the PSC operations and neighboring properties.

2.1 LOCATION

The PSC property is located at 632 South 32nd Street, Washougal, Clark County, Washington, near the Columbia River, as shown in Figure 1-1. In the Public Land Survey System, the facility is located in Section 17, Township 1N, Range 4E. The 5.2-acre property is situated within a diked portion of the Columbia River floodplain in the Camas/Washougal Industrial Park. Prior to development of the industrial park, the area was part of low marshlands in the Columbia River floodplain.

2.2 PROPERTY LAYOUT

The PSC property currently operates as a hazardous waste transfer facility. Figure 2-1 shows the current layout of the PSC operations. A small portion of the south end of the property is leased to the neighbor, TrueGuard, LLC, for vehicle parking (Figure 2-2). Approximately half of the PSC property is an unpaved open field and not used for facility operations. There are four existing buildings at the property, one of which is a temporary office trailer (not slab on grade) constructed in 2006. The PSC property was formerly used for other operations, including as a hazardous waste TSDF, as described in Section 3.0.

2.3 LAND USE AND ZONING

Land use in the vicinity of the facility is industrial, with the exception of the Steigerwald Marsh, which is part of the Steigerwald Lake National Wildlife Refuge (SLNWR) to the east of the PSC property. The PSC property is one of 33 properties located within the Camas/Washougal Industrial park, which was developed in the 1960s (PSC, 2000). The PSC property is bordered to the north by Hambleton Lumber Company a lumber mill; to the south by TrueGuard, LLC, a wood treating facility; to the west by Corrosion Controllers, a fiberglass manufacturer; and to the east by South 32nd Street and the Steigerwald Marsh portion of the SLNWR. These properties are shown in Figure 2-2. Gibbons Creek remnant channel is located north of the PSC property, on the north side of Hambleton Lumber Company, and runs east to west from SLNWR to the Columbia River, where it discharges via a pump station. Both SLNWR and the Gibbons Creek remnant channel collect storm water discharge from within the industrial park.

2.4 NEARBY PROPERTIES

This section describes relevant information regarding properties neighboring the PSC property. An in-depth description of the SLNWR is provided later in Section 5.2.1. Copies of relevant records received from Ecology file review are provided in Appendix A.

2.4.1 TrueGuard, LLC

The property to the south is owned by TrueGuard, LLC (TrueGuard), which operates a wood-treating facility. TrueGuard is currently part of Ecology's Voluntary Cleanup Program and has been conducting investigation and cleanup activities for soil and groundwater related to arsenic and copper contamination. Prior to October 2007, the property was owned by Allweather Wood (AWW), which also conducted wood-treating operations. Chemicals used by AWW for wood treatment included chromated copper arsenic (CCA).

High arsenic concentrations in groundwater at the former AWW property were documented in June and August 2007 and reported to Ecology (Maul Foster & Alongi, Inc., 2008). Arsenic concentrations from 600 to 6,400 micrograms per liter (µg/L) were documented in groundwater from shallow wells located in the central portion of the former AWW property (Figure 2-3). Arsenic concentrations in groundwater samples from four groundwater monitoring wells on the AWW property (MW-3, MW-8, MW-9, and MW-10) ranged from 600 to 4,800 µg/L in June 2007, and from 690 to 6,400 µg/L in August 2007. At the northwest corner of the former AWW property, arsenic in groundwater from well MW-2 was documented at 33 µg/L, and on the western border, arsenic in groundwater from well MW-5 was documented at 61 µg/L. More recent analytical results for samples collected in 2009 are presented in Figure 2-4. Iron, manganese, copper, and chromium have all also been detected at the former AWW property concentrations above the preliminary cleanup levels (PCLs) developed for the PSC site (Section 9.0).

In April 2008, approximately 5,250 pounds of Adventus EHC-MTM was injected into the uppermost aquifer at 10 locations in two separate areas of the former AWW property. Ecology had approved this pilot test, which was intended to assess the applicability of in situ stabilization (via chemical reduction) of dissolved arsenic concentrations in the uppermost aquifer. Post-injection groundwater sampling was completed in July and October 2008 and in January and March 2009. The data show marginal improvement in arsenic groundwater quality—concentrations of arsenic decreased only slightly. Quarterly groundwater monitoring was performed on May 4 and 5, 2009, and the results were consistent with prior monitoring events. The average concentration of dissolved arsenic in samples obtained from monitoring wells MW-3 and MW-11 on May 5, 2009, is 1,700 µg/L. TrueGuard plans to conduct an additional pilot test to evaluate a different remedial approach based on successful bench-scale testing designed to create an oxidizing environment in which arsenic removal via chemisorption can occur (Maul Foster and Alongi, Inc., 2009).

All documents related to the TrueGuard facility obtained through multiple public records requests are provided in Appendix A. Boring logs for monitoring wells MW-8, MW-9, and MW-10 as well as a table detailing well depths and screen intervals are included in Appendix A. A boring log for MW-5 was not available; however, information regarding some construction details was provided and is included in Table A-1.

Arsenic releases from the former AWW property have likely impacted surface waters as well as groundwater in the area, including the marsh to the east. A January 2009 letter to Ecology regarding stormwater management at the TrueGuard facility reports that over 500,000 gallons of untreated stormwater was discharged (presumably to Steigerwald Marsh). The untreated stormwater contained concentrations of arsenic at 27.2 μg/L, chromium at 35.5 μg/L, and copper at 1,500 μg/L (TrueGuard, 2009). Copper was detected at concentrations of 204 μg/L in stormwater discharged in January 2009 (Ecology, 2009a) and 1,540 μg/L during a sampling event in December 2007 (Ecology, 2008). Historical stormwater testing from AWW in February 1996 found arsenic concentrations as high as 1,030 μg/L and chromium concentrations of 1,500 μg/L. Stormwater runoff from the former AWW property has been historically discharged to the marsh and to the Gibbons Creek remnant channel along South 32nd Street.

2.4.2 Hambleton Lumber Company

Hambleton Lumber Company is located to the north of the PSC property and operates a lumber mill on the property. In 2008 Ecology fined Hambleton for failure to submit stormwater discharge monitoring reports for all quarters of 2004, 2005, 2006, and 2007, as required by its Industrial Stormwater permit. No known environmental releases have occurred on the property; however, the property does discharge to the Gibbons Creek remnant channel (see Section 5.2.2). Ecology also lists the property as a hazardous waste generator.

2.4.3 Corrosion Controllers

Corrosion Controllers is located to the west of the PSC property and operates as a fiberglass manufacturer. The Corrosion Controllers property has had several previous environmental compliance violations found by Ecology, including mismanagement of dangerous waste and chemical products (Acetone and resins) and reports of uncontrolled acid spraying of iron outside. Stormwater from this facility reportedly discharges to Gibbons Creek remnant channel (see Section 5.2.2).

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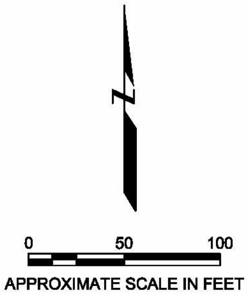
FIGURES

2007 AERIAL PHOTOGRAPHY
COURTESY OF CLARK COUNTY.

— — — FENCE LINE



CURRENT PSC PROPERTY LAYOUT
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 11/06/09	Project No. 9625
AMEC Geomatrix		Figure 2-1

Plot Date: 11/06/09 - 12:24pm, Plotted by: adam.stenberg
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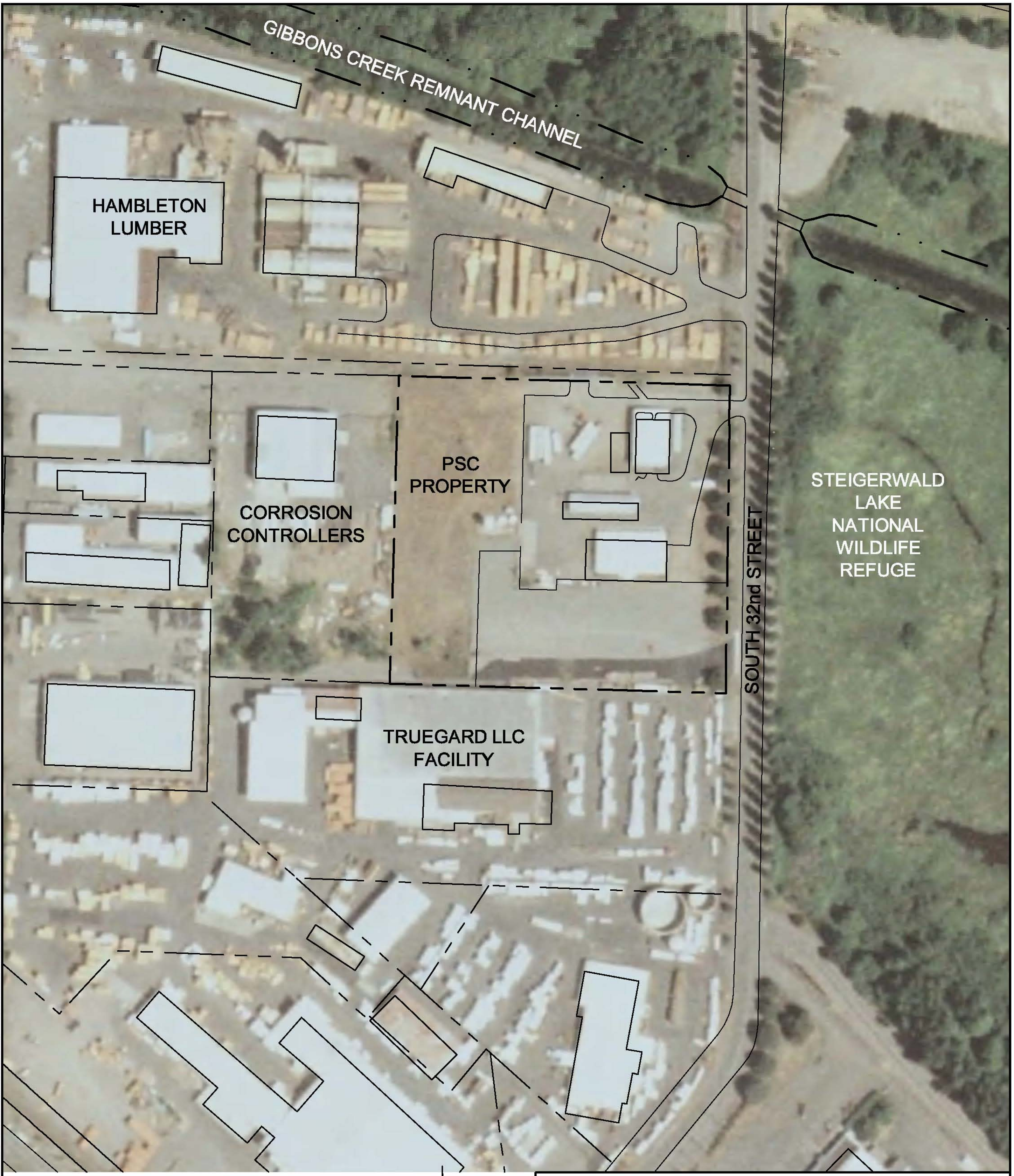

2006 AERIAL PHOTOGRAPHY
COURTESY OF USDA/FSA
AERIAL PHOTOGRAPHY FIELD OFFICE.

SURROUNDING PROPERTIES
PSC Washougal Facility
Washougal, Washington

By: APS
Date: 11/06/09
Project No. 9625

AMEC Geomatrix

Figure 2-2

Plot Date: 11/06/09 - 12:27pm, Plotted by: adam.stenberg
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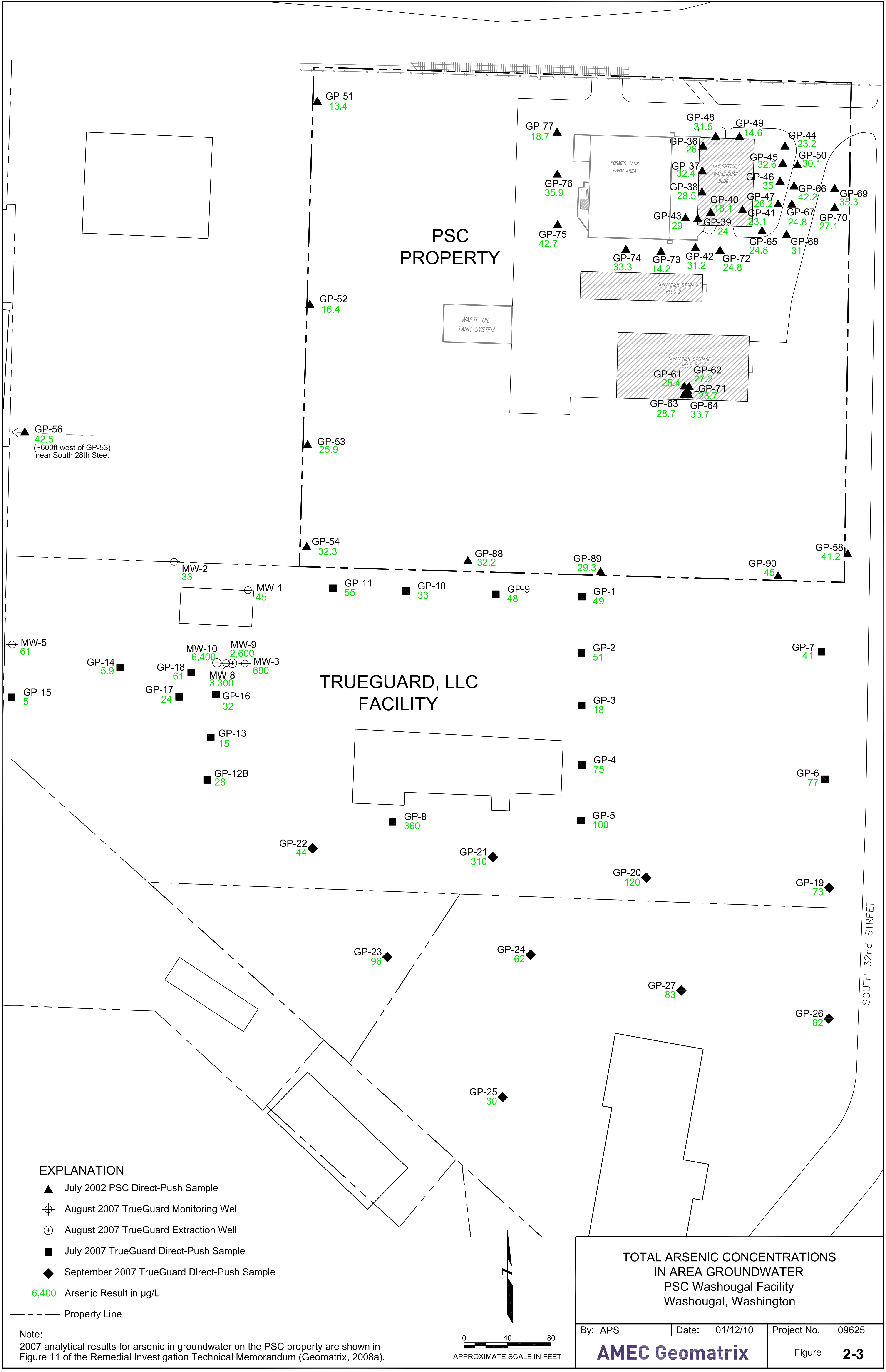


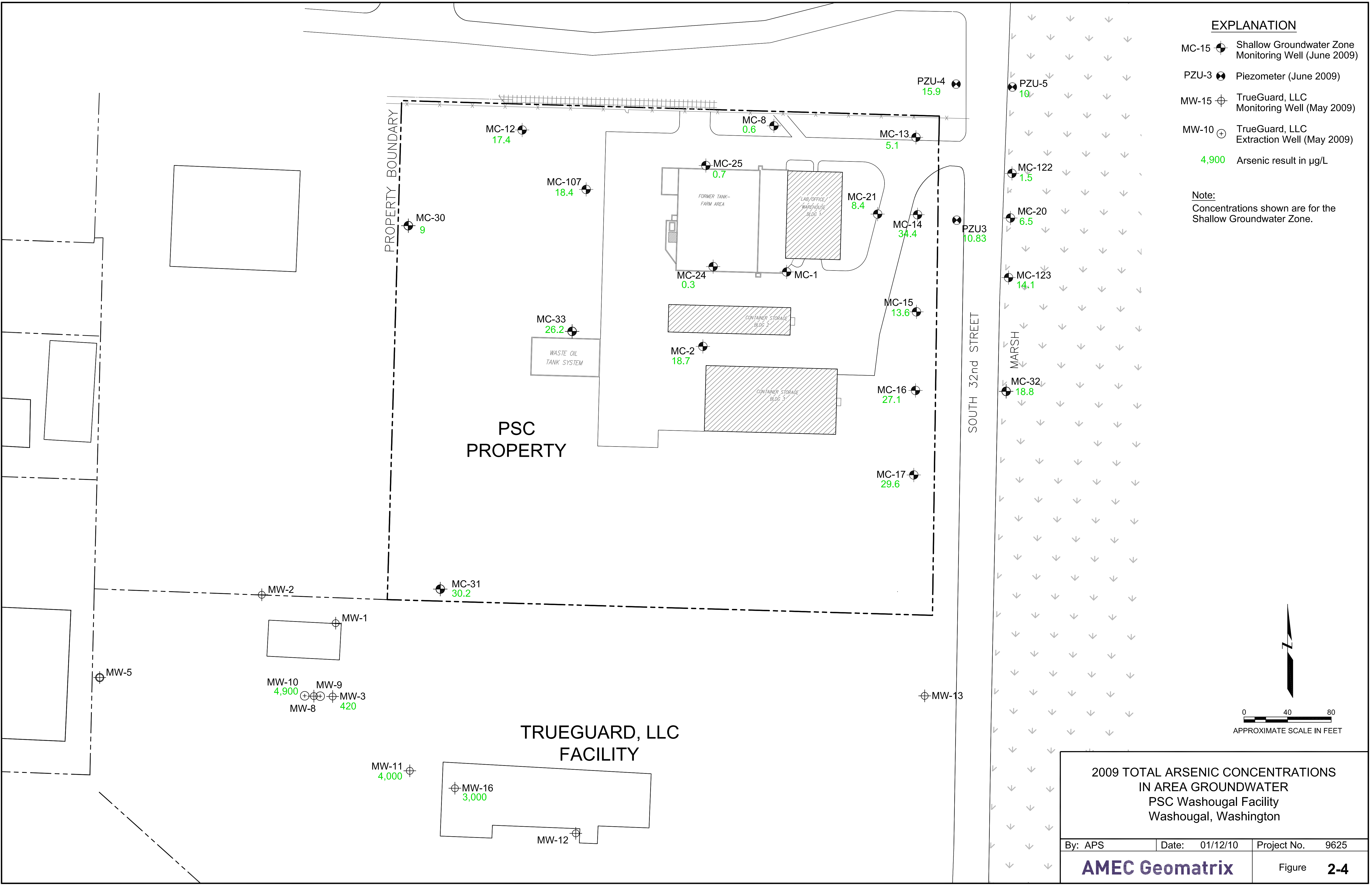
EXPLANATION

▲ July 2002 PSC Direct-Push Sample
⊕ August 2007 TrueGuard Monitoring Well
⊙ August 2007 TrueGuard Extraction Well
■ July 2007 TrueGuard Direct-Push Sample
◆ September 2007 TrueGuard Direct-Push Sample
6,400 Arsenic Result in µg/L
– – – – Property Line

Note:
2007 analytical results for arsenic in groundwater on the PSC property are shown in Figure 11 of the Remedial Investigation Technical Memorandum (Geomatrix, 2008a).

TOTAL ARSENIC CONCENTRATIONS
IN AREA GROUNDWATER
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 01/12/10	Project No. 09625
AMEC Geomatrix		Figure 2-3



2009 TOTAL ARSENIC CONCENTRATIONS
IN AREA GROUNDWATER
PSC Washougal Facility
Washougal, Washington

By: APS
Date: 01/12/10
Project No. 9625

AMEC Geomatrix

Figure 2-4

Plot Date: 01/12/10 - 4:34pm, Plotted by: adam.stenberg
Drawing Path: S:\9625\008_RIFS-2009\CAD\, Drawing Name: PSC Washougal_OFFSITE-Arsenic_110509.DWG

3.0 FACILITY HISTORY

McClary Columbia Corporation (McClary) constructed the original 4-acre phenolic resin production facility on the current PSC property in 1978. Activities related to the paper industry, including production of defoamer and water treatment chemicals, began in 1979. Waste oil and solvent recovery began in 1979 and 1980, respectively. By 1981, the facility was converted to a waste solvent recovery plant and drum storage operation that included oil storage and blending. Chemical Processors, Inc. (Chempro), bought ownership of part of the property and the adjoining additional 1.2 acres in 1986, and took full ownership in 1987. In 1992, Chempro was bought by Burlington Environmental, Inc. (BEI), which was bought by Philip Environmental, Inc. (the predecessor to PSC), in 1993 (PSC, 2000). Figure 3-1 shows the layout of the former operations, and Figure 3-2 shows the location of solid waste management units (SWMUs). The PSC property currently operates as a 10-day transfer facility for dangerous waste.

3.1 OPERATIONAL HISTORY

The 2000 Draft RI Report (PSC, 2000) provided information on the operational history of the site. Mr. Jack McClary operated the McClary Columbia Corporation at the site beginning in 1978. McClary began operations as a maker of phenolic resins for the wood products industry. In 1979, McClary added manufacturing of defoamers and water treatment chemicals for the paper industry to the operations. Commercial recovery of waste oil for use as boiler fuel began in late 1979, and in 1980 the facility began recycling waste solvents. In 1981, the former resin plant was converted to a waste solvent recovery plant, and Building 2 was built for drum storage (Figure 3-1).

During ownership of the site by Chempro, drum storage Building 3 was built in 1985. In 1986, tanks were installed at the facility for petroleum oil storage and blending. The waste solvent recycling plant and tank farm included tanks for product storage, waste oil storage, and waste solvent storage and processing. The contents stored in the tanks included industrial defoamers, detergents, and a variety of recycled solvents, including mineral spirits, acetone, toluene, isopropyl alcohol, methanol, Freon, methylene chloride, tetrachloroethene (PCE), trichloroethene (TCE), and 1,1,1-trichloroethane (1,1,1-TCA). The tank farm was dismantled in 1995.

The additional 1.2 acres purchased by Chempro in 1986 formerly belonged to Corrosion Controllers. Corrosion Controllers had used the land for equipment storage before and after fiberglass coating. Their operations involved the use of acetone.

In August 1999, PSC conducted the fieldwork necessary to close the RCRA Part B operating permit and polychlorinated biphenyls (PCB) permit. The Closure Reports (PSC, 1999a; PSC, 1999b) were submitted to Ecology in 1999 and approved in 2000. Since then the PSC property has operated as a transfer facility for hazardous waste only. As a transfer facility, a manifested shipment can be held at the facility for no more than 10 days. The facility also hosts monthly household hazardous waste collection events on behalf of Clark County.

3.2 REGULATORY HISTORY

The PSC property initially operated under federally regulated programs. Ecology gained corrective action authority under the MTCA Alternative Authorities Initiative and thereby assumed authority for regulation of the facility from EPA in 1998. PSC is obligated under the current RCRA Part B permit to conduct an RFI and Corrective Measures to address contamination at the site. The regulatory history of the facility can be summarized as follows.

- In 1980, McClary submitted a RCRA Part A permit application. The Part A permit was required, under RCRA, for existing facilities and provided the facility with "interim status" to operate while McClary applied for a Part B permit. As an interim status facility, McClary was allowed to continue operations without a Part B permit.
- On February 13, 1985, a Consent Agreement and Final Order (DE 85-165, Jack McClary/Ecology) were issued as a result of a letter from Ecology dated June 18, 1984. The letter followed an Ecology compliance inspection on May 16, 1984, and accusations by former employees of spills and improper disposal of wastes at the former McClary facility. The primary requirement of the order was a soil and groundwater investigation to begin within 10 days of the signing of the order.
- In 1985, Chempro purchased majority ownership of the facility and therefore took over interim status RCRA responsibilities.
- In September 1988, Chempro signed a RCRA 3008(h) order with the EPA. The 3008(h) order was issued because the groundwater and soil study conducted at the facility in 1985 after the Consent Agreement and the Final Order indicated the presence of hazardous constituents in the soil and groundwater underlying the facility. The 3008(h) order required the facility to complete interim measures to mitigate the release of hazardous waste and/or constituents, a RCRA Facility Investigation, and a Corrective Measures Study.
- In August 1992, EPA and Ecology jointly issued BEI a RCRA Part B permit (WAD 092300250) for the facility. The permit contained HSWA 3004(u) corrective action sections. The content of the 3008(h) order was incorporated into the RCRA Part B Permit effective October 23, 1992. The permit included provisions for the study and implementation of corrective action, so the 3008(h) order that had been issued in 1988 was rescinded.
- In November 1992, BEI submitted a National Pollutant Discharge Elimination System (NPDES) permit application. This permit was necessary due to a new

effluent discharge into the City of Washougal effluent pipeline and upgrading of the facility's wastewater treatment system in association with the RCRA Part B permit. The permit required aquifer testing and sampling for characterization of chemical constituents and flow.

- In 1995, the tank farm was dismantled under the permit's Interim Status Dangerous Waste Tank System Closure Plan (dated July 28, 1995). This plan described the procedures that BEI was to follow to undergo closure of the tank system at the facility. The plan also provided procedures to be used in closing the tanks on the interim-status tank system's secondary containment pad, and a procedure for decontamination of the tank containment area and the north loading/unloading pad.
- On October 13, 1997, PSC submitted Permit Modification WAMOD 31-2, Revised RCRA Permit Language Regarding Corrective Action, which went through a public comment period and was approved on September 1, 1999. This modification incorporated MTCA provisions into Section VII of the permit and clearly defined the remaining corrective actions work for the facility.
- In March 1998, PSC submitted Permit Modification WAMOD 28-1, Closure Plan and Closure Cost Estimates, to Ecology. This permit modification was approved on April 21, 1999. This modification updated the RCRA Closure Plan, Closure Cost Estimates, and the Sampling and Analysis Plan.
- In August 1999, the RCRA Dangerous Waste Management Facility was closed. Ecology granted the PSC-owned facility Final RCRA Closure on July 31, 2000.
- PSC conducted the fieldwork for the PCB Unit Closure in September 1999. Approval for the closure of the PCB Permit was received by PSC from EPA on January 4, 2000.

3.2.1 Potential Sources of Contamination

Spills and releases have historically occurred at the facility. Release and spill documentation prior to 1990 is not likely to be as reliable as post-1990 documentation due to stricter reporting requirements under environmental legislation passed in the late 1980s. This section describes the documented spills and releases and the undocumented releases that are suspected to have occurred.

The following potential historical spill/release areas were noted during review of historical records conducted as part of the 2000 draft RI (PSC, 2000). Figure 3-3 shows the approximate location of these areas, as well as the footprint of the original (McClary) operations, which was smaller than the current footprint of the PSC operations. The fence line during the McClary operations was identified based on drawings provided in a June 1983 Ecology Site Inspection Report, in a July 1983 Ecology Site Inspection Report, and in September 1984 court reports for a deposition of former McClary employee Gary Campbell. The former fence line is pertinent to the RI because it is suspected that most releases at the PSC Washougal facility occurred within or along the original fence line during the early 1980s while it was operated by Jack

McClary. While it is possible that releases occurred outside the footprint of the former operations, the areas where contamination was most likely to have occurred are within the former fence line. In early 1983, former employees of McClary made allegations of illegal discharges of product and waste to the environment. The allegations included pumping of the rainwater/runoff collection sumps and trenches to the ground surface prior to testing for contaminants, dumping of phenolic and solvent resins, and burying formaldehyde resins. These allegations led to the 1985 Consent Agreement and Final Order that required environmental investigation at the facility, as discussed in Section 3.2.

Listed below are the suspected and documented historical spills; a summary of these known events is presented in Table 3-1, and locations, if known, of each event are shown on Figure 3-3. All of these events occurred within or along the perimeter of the original McClary fence line. These suspected and known releases were documented in the 2000 draft RI as a result of a detailed record search of Ecology files and PSC records (PSC, 2000).

- Settling Pond (1980) – A settling pond was shown northwest of the former tank farm on plans sent to Ecology from the former McClary facility. The referenced pond had a capacity of 13,500 gallons and measured 20 feet by 30 feet by 3 feet deep. No evidence has been found that the pond was actually constructed (Figure 3-3, location A).

- Buried Paraformaldehyde Tank (1980) – A complaint made to Ecology indicates that Crosby and Overton cleaned out an approximately 16,000-gallon paraformaldehyde tank buried in the tank farm. The area was reported as paved by the time of the report in 1983. The tank is shown in a drawing made by Ecology (Figure 3-3, location B).

- Sewer Discharge (1980) – According to the 1988 RCRA Facility Assessment (RFA), in March 1980, 200 gallons of solvent and distillate were discharged to the municipal sewer system and entered Gibbons Creek due to a broken sewer main. The water-solvent mixture dissolved the polyvinyl chloride (PVC) pipe at the former operations and leaked into surrounding soils and groundwater. Historical documents identified this area as SWMU 15 (Past Spill Area) (Figure 3-3, location C).

- Defoamer Spill (1982) – This area is shown apparently northwest of Building 2 (drum storage building) in a photo taken by Ecology (Figure 3-3, location D). This spill was identified as an oil-based defoamer of less than 300 gallons in the 2000 Draft RI Report (PSC, 2000). Material was reportedly cleaned up, and the ground surface was returned to grade.

- Formaldehyde Release (1982) – A complaint made to Ecology in 1983 indicates that a “load” of approximately 1,000 pounds of formaldehyde waste was received in 1982 and placed between the drum storage building (Building 2) and the tank farm, as shown in a drawing made by Ecology (Figure 3-3, location E).

- Distillation Bottoms Release (1982) – A complaint made to Ecology in 1983 indicates that Crosby and Overton cleaned out a tank of still bottoms in 1982. The material was mixed with water and sprayed on the ground west of the tank farm, as shown in a drawing made by Ecology (Figure 3-3, location F).

- Solvent Sump (1983) – Ecology found a sump located on the northeast corner of the tank farm during an inspection. According to statements made by Jack McClary during the inspection, solvents were dumped in the sump prior to being pumped into tanks. Rainwater also flowed into the sump, and if the sump overflowed it discharged away from the sump to the north. Spillage was observed near the sump; the facility indicated it was probably waste oil. The approximate location is shown in a drawing made by Ecology (Figure 3-3, location G).

- Buried Fatty Alcohol Solids (1982) – During the same inspection described above, Ecology noted white, gooey solids west of the southwest corner of the tank farm. Jack McClary stated that staff had buried fatty alcohol solids in this area. The approximate location is shown in a drawing made by Ecology. A 1983 complaint to Ecology also describes this release. The complaint indicates it occurred in the fall of 1982, consisted of 3,000 gallons, was rototilled into the soil, and covered with gravel (Figure 3-3, location H).

- Dry Well (1984) – During a 1984 site inspection by Ecology, Jack McClary admitted that some of the water in the storm drains within the tank farm was discharged to a dry well at the west end of the tank farm. The dry well was described as a drum filled with stone. The precise location of the dry well was not indicated in the report (Figure 3-3, location I).

- Motor Oil (1985) – During a 1985 site inspection by Ecology, soil staining was noted on the adjoining property to the north. Jack McClary told Ecology that it was the result of a motor oil drum that the neighbor spilled there (Figure 3-3, location J).

- Area 4 (1985) – This area was identified as an area for sampling during the 1985 Sweet Edwards/EMCON investigation due to suspected defoamer or other product spills (Figure 3-3, location K).

- Low Chloride A-Fuel Flammable Liquid (1991) – Ecology and facility records noted a 20-gallon spill to asphalt that was contained.

- Sulfide Gas (1992) –Ecology and facility records noted an unquantifiable release to air, which was subsequently controlled.

- Plating Bath Treatment Sludge (1992) – Ecology and facility records noted a 30-gallon release from a leaking drum, which was contained within secondary containment.

- Household Hazardous Waste (1993) – Ecology and facility records noted one leaking drum of household hazardous waste that was contained.

- Methylamine, Acetone, and Benzaldehyde (1993) – Ecology and facility records noted an unquantifiable release to air.
- Waste Flammable Liquid (1993) – Ecology and facility records noted a 30 gallon release in the southern containment area which was contained.
- Motor Oil (1996) – Ecology and facility records noted a 1-pint release of motor oil to pavement at the facility. Cleanup measures are not known.
- Dry Well (1997) – During the December 1997 tank farm area excavation interim measure, PSC discovered a potential dry well at an unspecified location within the excavation area. The dry well was constructed of a series of plastic five-gallon buckets connected together. The bottom-most bucket was perforated along the side with the bottom intact. The buckets above all had their bottoms removed. The buckets extended from just below the surface concrete to 6 feet below ground surface. The buckets were removed as part of the removal action.

3.2.2 RCRA Closure

In August 1999, the PSC's RCRA Dangerous Waste Management Facility was closed in accordance with WAC 173-303-806, -610, -630, and –640 and CFR 264 Subparts G and H. PSC collected 32 samples of soil beneath the surface pavement and sumps as part of the closure. Surface pavement was cored after decontamination, and samples were collected using a hand auger to extract soil (PSC, 1999a). PSC submitted the Final RCRA Closure Report to Ecology in November 1999. Ecology granted the PSC-owned facility Final RCRA Closure on July 31, 2000.

3.2.3 TSCA Closure

PSC conducted the fieldwork for the PCB Unit Closure in September 1999. This entailed decontaminating areas used for PCB storage, or adjacent to or underlying areas where PCBs were stored or transported. PSC collected samples of surface material (concrete, asphalt, and sometimes underlying soil) as part of the closure. PSC submitted the PCB Closure Report in December 1999, including certification by an independent engineer (PSC, 1999b). Approval for the closure of the PCB Permit was received by PSC from EPA on January 4, 2000.

3.3 ENVIRONMENTAL INVESTIGATIONS

Initial environmental investigations at the facility were conducted under a 1985 Consent Agreement and Final Order (DE 85-165 Jack McClary/Ecology) and subsequently under a 1988 RCRA 3008(h) Order. PSC has conducted RI activities at the facility under a RCRA Part B permit (WAD092300250) since 1992. Ecology was authorized to implement corrective action requirements at the facility beginning in 1994. PSC completed RCRA closure at the facility in 1999 (with Ecology approval in July 2000). The PSC property currently operates as a transfer facility under WAC 173-303-240(6); however, Section VII of the facility's RCRA Part B Permit still applies to corrective actions requirements regarding environmental releases.

Multiple investigations and interim remedial actions have been conducted at the facility. These previous investigations are summarized in this section. Known locations of historical soil sampling points from investigations conducted since 1996 are shown on Figure 3-4 and Figure 3-5. Locations of existing and historical groundwater sampling locations are shown on Figure 3-6. Previous interim actions conducted at the site are summarized in Section 3.4.

- In 1984 and 1985, a groundwater investigation was completed by Sweet Edwards/EMCON (SEE), as a result of the February 1985 Consent Agreement between McClary and Ecology. The 1984/1985 investigation targeted areas of potential releases based on site use and employee complaints made regarding deliberate releases made or directed by former facility owner Jack McClary. The investigation included installation and sampling of 14 shallow groundwater monitoring wells and surface water sampling in the Gibbons Creek remnant channel and Steigerwald Marsh. This investigation also assessed the potential soil contamination beneath the tank farm. Results were reported in a December 17, 1985, SEE report (SEE, 1991).

- In December 1985 and January 1986 soil sampling was conducted at seven locations in the Sand Fill and the Silt Layer, north of the former product tank farm area near an abandoned sump. Particular emphasis was placed on obtaining samples of the silt aquitard to check for the presence of dense nonaqueous phase liquids (DNAPLs). Results were reported in a February 26, 1986, letter from SEE (SEE, 1991). Concentrations of light organic contaminants were highest in boreholes adjacent to the abandoned sump, indicating that pure product was likely spilled or otherwise discharged in this area. Organic contaminants with specific gravities greater than one (DNAPLs) generally were not detected.

- In October 1986, 12 soil and groundwater borings were completed in the solvent distillation area of the tank farm. DNAPL was present in four samples at two locations, at approximately 4.5 to 5.5 feet below ground surface (bgs) near former tanks N and O. The DNAPL was described as a two-phase liquid that was dark brown to black. The primary contaminants identified in the DNAPL samples were 1,1,1-trichloroethane, trichlorotrifluoroethane, TCE, PCE, toluene; and xylene. Results were reported in an October 24, 1986, letter from SEE (SEE, 1991).

- In December 1986, a recovery well (MC-R) was installed in the former product tank farm area to recover solvent and contaminated groundwater. This well pumped approximately 60 gallons of dark-colored solvent mixture and 18,000 gallons of contaminated groundwater from a screened interval of 1.5 to 8 feet bgs. The installation methods were summarized in a letter from SEE dated December 29, 1986 (SEE, 1991).

- On October 28 and 29, 1987, 12 test borings (T-1 through T-12) were drilled and sampled at the facility for one-time groundwater sampling along the north and east sides of the facility. No soil samples were collected. The purpose of this work was to examine the on-site contaminant plume. Results indicated that contaminants from the tank farm area were migrating eastward. Results were reported in a January 18, 1988, letter from SEE (SEE, 1991).

- In November 1987, an aquifer test was conducted for the Shallow Groundwater Zone at groundwater monitoring well MC-1. Time-variant groundwater samples were also collected and analyzed during the pumping test. The purpose of the pumping test was to collect additional information necessary to evaluate potential remedial alternatives for the Shallow Groundwater Zone, including hydraulic conductivities, radius of influence, and concentrations of volatile organic compounds (VOCs). Three piezometers (P-1, P-2, and P-3) were installed northeast of monitoring well MC-1 to monitor water levels during pumping. Two pumping tests were run on MC-1, one pumping test was run for 7 hours and the other for 26.5 hours. Both tests used a pumping rate of 1 gallon per minute (gpm). Results were reported in a letter from SEE dated January 29, 1988 (SEE, 1991).

- In 1988, an Interim Corrective Measures Study (CMS) was completed for shallow groundwater at the facility. The Interim CMS recommended installation of shallow groundwater recovery wells to pump contaminated groundwater (SEE, 1991).

- Also in 1988, at the request of the EPA, a SWMU evaluation for the facility was completed and presented in a July 5, 1988, Chempro report (SEE, 1991). The following four SWMUs (Figure 3-2) were identified that were closed prior to 1988:
    - Tank containment area sumps and trenches (SWMU-1);
    - Drum storage areas southwest and southeast of Building 2 (non-RCRA regulated) (SWMU-2);
    - Tote-container storage area (non-RCRA regulated) (SWMU-5); and
    - Sludge removal unloading sump (SWMU-6).

- Additionally PSC identified eight potential source units (Figure 3-2) that were active after 1988:
    - Maxon mixer area/stabilization unit (SWMU-3);
    - Central loading/unloading pad (SWMU-4);
    - Tank farm (resin plant/solvent recycling plant) (SWMU-7);
    - Building 2 container storage (SWMU-8);
    - Building 3 container storage (SWMU-9);
    - Waste oil tank system (non-RCRA regulated) (SWMU-10);

  - PCB modular unit (SWMU-11); and

  - Catch basins (SWMU-12).

- SWMUs 1 through 12 (Figure 3-2) underwent RCRA closure in 1999, except for the units identified above as non-RCRA regulated (waste oil tank system, drum storage areas southwest and southeast of Building 2, and the tote-container storage area).

- In October 1988, eight shallow groundwater recovery wells were installed along the north and east property boundaries. No report was prepared to summarize this work, but subsequent related documents were submitted, including applications for an NPDES permit, an engineering report, and an operations and maintenance manual (SEE, 1991). The recovery system was never made operational, and the wells were abandoned in 1998 (PSC, 2000).

- Between April 1990 and April 1991, the Phase I RFI was completed. The Phase 1 RFI included installation of groundwater monitoring wells in the Lower Aquifer; groundwater, surface water, and sediment sampling; soil sampling; test borings outside the boundaries of the PSC property; ground-penetrating radar survey inside and outside the property boundary; and piezometer installation. A Draft RFI Report was submitted in June 1991 (SEE, 1991). This RFI was never finalized, and subsequent investigative and remediation work continued.

- In 1996, PSC conducted a silt investigation at the facility to determine the depth and continuity of the Silt Layer below the facility and to collect soil samples for chemical analysis. A total of 26 direct-push soil borings were completed. No evidence of DNAPL was observed. VOCs were detected at their highest concentrations beneath the former tank farm pad. Based on the results of this investigation, there did not appear to be significant contamination at the top of the Silt Layer; rather, the contaminants appeared to be highly concentrated at about 4 feet bgs. These data led to the decision to remove the soil beneath the former tank farm. The data were reported in a November 1996 PSC Technical Memorandum (PSC, 1996).

- In 1997, PSC conducted an interim action to excavate soils from beneath the former product tank farm. Soils were excavated to a depth of approximately 6 feet. An apparent dry well was discovered and removed during the excavation. Soil sampling was also conducted during this investigation in the vicinity of well MC-7 and well MC-18 to investigate the source of contamination near these wells (PSC, 1998b).

- In 1998, PSC submitted a Final RI/FS Work Plan (PSC, 1998a) that revised the scope of remaining investigative activities, consistent with the approved RCRA Part B permit modification WAMOD 31-2.

- During 1998, PSC researched the location and depth of the storm sewer line that runs north to south along South 32nd Street and drains into the Gibbons Creek remnant channel. Washougal city officials did not have accurate engineering drawings of the pipeline. It was determined that it is likely that the pipeline is located only about 4 feet bgs and just a few feet east of PSC's fence line along South 32nd Street, but not under the road. The information was presented in the Quarterly Corrective Actions Progress Report (PSC, 1999c).

- In July 1999, PSC installed three additional Lower Aquifer monitoring wells, replaced monitoring well MC-18 with MC-118D, and replaced shallow well MC-7 with MC-107. As part of this work phase, PSC conducted nine direct-push soil borings for soil and groundwater sampling and analysis. Surface water/sediment sampling planned for the Gibbons Creek remnant channel was not completed, as PSC personnel were unable to find the storm water outlet at that time. The information was presented in the Quarterly Corrective Actions Progress Report (PSC, 1999c).

- In 2000, PSC submitted a Draft RI Report (PSC, 2000).

- Based on negotiations with Ecology, a Supplemental RI Investigation (PSC, 2001a; 2002) was completed to address data gaps identified in the draft RI Report (PSC, 2000). This work included 60 direct-push borings for soil and/or groundwater sampling, installation and sampling of 10 soil gas monitoring ports, hand locating (via hand digging) of the storm sewer utility line on South 32nd Street, installation of four piezometers, and a continuous water level monitoring event to evaluate water levels in relation to underground utilities.

- In October 2005, PSC installed a subslab depressurization system to address immediate concerns regarding soil gas concentrations measured under Building 1 that may have been adversely impacting indoor air quality in Building 1 (PSC, 2005a).

- In December 2006, Geomatrix Consultants, Inc. (Geomatrix), (on behalf of PSC) abandoned two wells (MC-22 and MC-23) and replaced them with nearby wells MC-122 and MC-123, screened slightly deeper and into the Silt Layer near SLNWR (Geomatrix, 2006).

- In September and October 2007, Geomatrix (on behalf of PSC) conducted additional soil, groundwater, and marsh investigations including 13 direct-push borings for soil and groundwater sampling, installation of two shallow groundwater monitoring wells, installation of two shallow groundwater piezometers, installation of four Lower Aquifer groundwater monitoring wells, sampling of material in eight catch basins, pore water sampling at three locations in SLNWR, and slug testing of 14 monitoring wells and piezometers. The results of this investigation were reported in a Technical Memorandum (Geomatrix, 2008a).

- In September 2008, AMEC Geomatrix, Inc. (AMEC) (on behalf of PSC), conducted additional soil, groundwater, surface water and sediment sampling including eight direct-push borings for soil and groundwater sampling, installation of two shallow groundwater monitoring wells and four Lower Aquifer monitoring wells, collection of sediment samples in SLNWR and the Gibbons Creek remnant channel, and collection of pore water samples in SLNWR (AMEC, 2009).

- In spring 2009, AMEC (on behalf of PSC) conducted additional soil and groundwater sampling, including: four direct-push borings for soil and groundwater sampling and installation of two shallow groundwater monitoring wells and three Lower Aquifer monitoring wells (AMEC, 2009).

- In the summer of 2011, AMEC (on behalf of PSC) performed an investigation within the Former Tank-Farm Area to characterize soil and groundwater contamination in the Silt Layer and to evaluate the potential impact of contamination in the Silt Layer on the Lower Aquifer. The investigation included collection and analysis of soil samples from 10 direct-push soil borings advanced into the Silt Layer. In addition, groundwater samples were collected from temporary wells constructed in four of the direct-push boreholes (AMEC, 2011a).

- As required by the RCRA Part B Permit, quarterly groundwater sampling and analysis have occurred from the second quarter of 1993 to the present. These data are summarized in quarterly and annual letter reports from PSC to Ecology.

3.4 INTERIM MEASURES

This section describes interim measures that have been conducted at the facility.

3.4.1 DNAPL Recovery

In October 1986, soils saturated with solvent product were encountered in 4 of 18 samples collected in the area of the former solvent distillation processing area of the tank farm (PSC, 1998b). At the time of the investigation, these product-saturated soils were interpreted to represent DNAPL. These soil samples were collected at depths of approximately 4.5 to 5.5 feet bgs, presumably near the water table. The primary constituents detected in the DNAPL included 1,1,1-TCA, trichlorotrifluoroethane, TCE, PCE, toluene, and xylene. As a result, a DNAPL recovery well (MC-R) was installed in December 1986. The location of MC-R is shown on Figure 3-7. MC-R was screened from approximately 1.5 to 8 feet bgs, which placed the bottom of the well approximately 2 feet into the Silt Layer, as observed during subsequent excavation of the area. Approximately 60 gallons of a dark-colored solvent mixture and 18,000 gallons of contaminated groundwater were pumped from MC-R beginning in 1987. The well was abandoned during a 1997 interim measure soil excavation (Section 3.4.2).

3.4.2 Former Tank Farm Area Excavation Interim Measure

The tank farm and tank containment area sumps and trenches were identified as SWMUs in the 1988 SWMU report (SEE, 1991). The tank farm was dismantled in 1995. Eight soil borings

(GP-07, GP-09, GP-10, GP-11, GP-12, GP-14, GP-15, and GP-16) were completed in the area of the former tank farm in 1996 as part of the Silt Layer Investigation (PSC, 1996). These locations are shown on Figure 3-7. Soil samples were collected at multiple depths above the Silt Layer during this investigation. DNAPL was not observed at any of these borings. Results indicated that the highest constituent concentrations were present at approximately 4 feet bgs, several feet above the top of the Silt Layer. These findings prompted an interim action soil excavation, which was conducted in September and October 1997.

The 1997 interim action involved excavation of soils down to the Silt Layer (approximately 6 feet bgs) in the area of the former tank farm and north loading dock (Figure 3-7) (PSC, 1998b). A potential “dry well” was discovered within a few feet of the recovery well MC-R during the excavation, as described in Section 3.2.1.

A total of 22 confirmation soil samples were collected from 14 sampling locations at the base of the excavation (Figure 3-7). Results indicated residual contamination in many of the samples, particularly those collected near the office building on the east side of the excavation (PSC, 1998b). The excavation was limited to the east by the office building, and it is assumed that contamination remains under the building. Additional sampling points were shown in the interim action report (PSC, 1998b), but a search for analytical results failed to identify data from these sampling locations. It is likely either (1) that these locations were not sampled or (2) that results were returned as nondetectable.

3.4.3 HRC Pilot Test

Over time, monitoring well MC-14 has consistently shown the highest concentrations of various constituents in the Shallow Groundwater Zone. MC-14 is located east and downgradient of the former tank farm and Building 1. However, another well, MC-21, is located closer to the source area, yet shows chemical concentrations generally lower than those observed at MC-14 (Figure 3-8). PSC previously investigated the Silt Layer near MC-14 to determine if a depression in the Silt Layer was present there, causing contaminants to pool in this area. No obvious depression was found (Geomatrix, 2008b). MC-14’s one distinction from other Shallow Groundwater Zone wells at the facility is its construction. The MC-14 well construction diagram (Figure 3-9) shows that its screen was set directly above the Silt Layer, but it has 8 feet of sand pack used to backfill the boring below the bottom of the well. In essence, this well is completed into the Silt Layer. Fairly coarse (>2 millimeter [mm]), #6 sand was used for the backfill. All other Shallow Groundwater Zone wells have filter packs that extend less than 2.5 feet into the underlying Silt Layer.

In 2000, PSC conducted a pilot test to evaluate treatment of groundwater in the area of MC-14 (Geomatrix, 2008b).

3.4.3.1 Background

In January 2000, PSC requested a variance from the approved RI/FS Work Plan (PSC, 1998a) in order to more immediately address potential off-site migration of Shallow Groundwater Zone contamination. As part of the approved RI/FS Work Plan, PSC planned to conduct surface water and sediment sampling in the marsh. PSC requested that this surface water/sediment sampling be dropped. In its place, PSC proposed conducting a pilot-scale groundwater remediation system near MC-14. The purpose of the pilot study was to act as an interim measure to reduce the amount of Shallow Groundwater Zone contamination migrating across 32nd Street toward Steigerwald Marsh and to pilot test a technology that could be considered for a final remediation system in the FS. The pilot test included 12 direct-push borings to be injected with hydrogen-releasing compound (HRC) and installation of two Shallow Groundwater Zone monitoring wells, MC-20 and MC-21 (Figure 3-10).

On March 13, 2000, PSC installed monitoring well MC-20 downgradient of MC-14, across South 32nd Street to the east of the PSC property. PSC also installed monitoring well MC-21 upgradient of MC-14 near the east side of Building 1 (Figure 3-10). Both wells are screened in the Shallow Groundwater Zone Sand Fill, above the Silt Layer (Appendix F).

On March 16, 2000, PSC installed 12 direct-push borings upgradient of MC-14 (Figure 3-10) then backfilled each boring with Regenesis® HRC to assist in reductive dechlorination of chlorinated solvent contaminants in the Shallow Groundwater Zone. The 2-inch-diameter borings were drilled to the top of the Silt Layer (approximately 7.5 feet bgs). The HRC was heated to approximately 270 degrees Fahrenheit (°F), then approximately 50 to 55 pounds of HRC was pumped into each boring, filling them to the ground surface. Dirt and gravel were spread over the top of each boring.

3.4.3.2 Monitoring

The pilot test was monitored after installation to evaluate its effectiveness. The HRC monitoring system (MC-13, MC-14, and MC-21) was sampled in April, June, September, and December 2000 and reported in the applicable quarterly reports. MC-14 is located directly downgradient of the injection area, MC-21 is slightly upgradient, and MC-13 is cross-gradient to the north. During each sampling event, samples were collected and analyzed for VOCs, ferrous iron, total and dissolved manganese, nitrate, sulfate, total organic carbon (TOC), methane, ethane, and ethene (Geomatrix, 2008b).

3.4.3.3 Effectiveness

The results of the four sampling events in combination with prior and subsequent sampling events were used to evaluate the effectiveness of the HRC pilot test. Figures 3-11 through 3-13 show the historical trend in concentrations of PCE, TCE, *cis*-1,2-dichloroethene (*cis*-1,2-DCE), and vinyl chloride (VC) for monitoring wells MC-13, MC-14, and MC-21, respectively. As shown, the most obvious decreases in concentrations occurred after the 1997 tank farm area soil removal interim measure and before the HRC Pilot Test. Natural degradation is also documented based on the presence of degradation products, including VC, in groundwater samples collected prior to the HRC pilot test.

Figures 3-14 through 3-17 show the trends in chlorinated solvent concentrations during the period after the HRC pilot test for MC-13, MC-14, MC-20, and MC-21, respectively. The trend from downgradient well MC-20 is shown for comparison. Concentrations have fluctuated but are consistently lower since the pilot test, suggesting that contamination migrating away from the former tank farm source area has decreased over time. The overall pattern in the monitoring trends for MC-14 are not significantly different from those at up-gradient (MC-21) and cross-gradient (MC-13) wells. Thus, it is unclear whether the decreases in chlorinated solvent concentrations are partially due to the HRC injection or solely the result of the source removal and subsequent natural degradation.

Figure 3-18 shows the trends in concentration of methane, ethane, and ethene for samples collected just before and in the years following the HRC pilot test. Ethene was not detected in samples from the cross-gradient well MC-13, and ethane concentrations were higher in samples from MC-14 than from upgradient well MC-21. Ethane was detected primarily in samples from MC-14, and only after the HRC pilot test. These data suggest that the pilot test has aided in stimulating the natural degradation processes that were already underway at the facility. Similarly, TOC concentrations initially increased after the pilot test, and oxidation/reduction (redox) potential (ORP) initially decreased, as shown in Figure 3-19.

This analysis of the results of the HRC pilot test does not conclusively show that the HRC pilot test stopped the off-site migration of low-level VOCs; however, it is clear from the trends that concentrations have continued to decrease over time, including concentrations in wells downgradient of the former tank farm source area and at downgradient well MC-20. This finding is important because it suggests that the source removal interim action has removed the majority of the contaminant source at the facility and that natural attenuation is continuing to remove contaminant mass resulting in continuous improvements to water quality. The use of HRC to enhance the natural attenuation had some benefit but not a significant one.

3.4.3.4 Natural Attenuation

Data collected as part of quarterly groundwater monitoring also indicate that natural attenuation processes are occurring at the facility. As described in Section 2.0, prior to development of the industrial park, the area surrounding the PSC property was marshland. The imported fill used to build the industrial park overlies the native Silt Layer. Data collected at the facility have shown that the Silt Layer is composed of marsh-type soils, rich in organic matter and peaty in places. These marsh-type soils create reducing conditions that are conducive to natural degradation of chlorinated solvents.

Methane concentrations have been consistently high in samples from upgradient wells MC-12 and MC-107 (Figure 3-20) and even higher in samples from wells MC-13, MC-14, and MC-21 near the HRC pilot test. Elevated methane and TOC levels (Figures 3-18 and 3-20) suggest that site conditions are conducive to natural degradation processes, and that these processes are actively occurring downgradient of the former source area.

Additionally, the presence of vinyl chloride, a daughter product of PCE and TCE, in samples from wells near the HRC pilot test and farther upgradient (MC-1) shows that natural degradation of chlorinated solvents is occurring at the facility with and without the additional stimulation produced by the HRC pilot test.

3.4.4 Indoor Air Inhalation Pathway Interim Measure

PSC conducted soil gas sampling beneath Building 1 in October 2001 and February 2002 to evaluate the groundwater to indoor air contaminant migration pathway (PSC, 2001). Results indicated that soil gas concentrations beneath the building might be adversely impacting indoor air in Building 1. Subsequently in June 2005, PSC collected indoor air, soil gas, and ambient air samples at or adjacent to Building 1 to evaluate whether indoor air concentrations, associated with potential vapor intrusion from soil gas, exceeded levels of concern to human health. Results were not conclusive enough to rule out risk from soil gas, so PSC proposed to install a mitigation system in Building 1 in lieu of resampling and conducting routine air monitoring. The mitigation system is designed to prevent exposures of workers to VOCs in indoor air resulting from vapor intrusion from soil gas (PSC, 2005b).

The mitigation system was installed in October 2005. The system is a sub-slab depressurization system installed in the warehouse, directly outside of the office area, and consists of one sub-slab sump with associated ventilation pipe. The pipe extends from the sump pit, up the outside wall of the office area, to the ceiling, where it penetrates the roof and is attached to an exhaust fan. The subsurface ventilation system depressurizes the ground immediately below the concrete slab of the building by generating sufficient negative pressure to prevent airflow from the soil, through the slab, and into the building. The system decreases the pressure below the building slab so that pressure inside the building is higher. Thus, any airflow between the building and the slab occurs downward, out of the building and into the slab. A fan pulls gases from the subsurface and vents them to the ambient air. The system location (including sump and pressure monitoring points) and construction within Building 1 are shown in Figure 3-21.

3.5 INVESTIGATIONS OF POTENTIAL MIGRATION PATHWAYS

Underground utility lines and their surrounding fill materials may act as preferential pathways for migration of groundwater in the subsurface. Several buried utility lines exist to the east of the PSC property boundary and on the north end of the PSC property, as shown in Figure 3-22. During previous phases of the RI, PSC researched and performed field investigations to determine if the utility lines located near the facility may be acting as preferential pathways for contaminant transport. This section summarizes the construction information collected about these utility lines. An evaluation of the lines in relationship to the site hydrogeology and potential groundwater diversion to utility corridors occurring east and north of the PSC property is presented in Section 7.2.4.

3.5.1 Utility Lines along the Northern Property Line

Figure 3-22 shows the approximate location of buried utility lines near the northern property boundary. A 2-inch-diameter gas line is buried at approximately 2.25 feet bgs; a 10-inch-diameter water line is buried at approximately 11 feet bgs; and a 10-inch sanitary sewer line is buried at approximately 14 feet bgs at 32nd Street. The sanitary sewer line has a slight slope (0.003) from west to east, so it would be slightly higher to the west near MC-118D.

According to Mike Conway and Lee Fitzpatrick from the City of Washougal, the water line was installed above the native silt material and covered with dredge sand materials when the industrial park was built (PSC, 2002). The sanitary sewer line was installed approximately 2 feet below the top of the native silt and was backfilled with the native silt material. Mr. Fitzpatrick observed excavation of the water line in 2001 on South 32nd Street and of the sanitary sewer line on South 28th Street (one block west of 32nd) and saw no sign of porous sand or gravel fill material around either utility line.

The depth of utility lines derived from the as-built drawings seem to be slightly greater than the generally observed depth to the top of the Silt Layer observed in borings near MC-118D. The Silt Layer was observed in nearby borings MC-18, MC-118D, GP-4, and GP-9 at depths ranging from 7 to 11.5 feet bgs.

These methods of underground utility installation are unlikely to have produced preferential flow pathways for groundwater along the lines. Moreover, the lines were installed at depths above the depth of the Lower Aquifer. Thus, utility lines are not expected to be the source of contamination observed in the Lower Aquifer at MC-18 and MC-118D. Therefore, no further evaluation of the utility lines was completed or recommended for this area.

3.5.2 Utility Lines Along South 32nd Street

AMEC personnel visited Larry Connolly at the Port of Camas/Washougal and Travis Giesler at the City of Washougal (Utility Maintenance) in 2007 to gather additional information regarding construction of the underground utility lines along South 32nd Street. Cleaner copies of the previously acquired drawings were provided to AMEC (Appendix B, Figures B-1 through B-6). Personnel from the City and the Port confirmed previous reports that many of the utility lines were installed prior to placement of fill at the industrial park, and that native fill was typically used. The City representatives also believed that the entire industrial park stormwater system drains to the Gibbons Creek remnant channel.

3.5.3 Utility Line Investigation

There are four separate underground utility corridors in the vicinity of the facility: gas, water, sanitary sewer, and storm sewer (Figure 3-22). The gas, water, and sanitary sewer lines run east-west along the northern property boundary and also link to north-south branches running along South 32nd Street. The storm sewer line runs north-south along South 32nd Street only.

3.5.3.1 Storm Sewer Line Location and Construction

The storm sewer line runs north-south along the west side of South 32nd Street. The line was installed in November 1977,[1] at the same time the road was built.[2] A cross-section of the storm sewer prepared based on partial field reconnaissance indicates a 6-inch subsurface drain located in the same trench as the storm drain (SEE, 1991, Figure 4.8). SEE's (1991) cross section is included as Figure B-7 in Appendix B. However, no as-built construction drawings have been identified for this line. The drain line is believed to be located approximately 2 to 3 feet bgs in the sand fill material.[3]

In 2001, PSC attempted to uncover the storm sewer line in several places to determine if the subsurface drain shown beneath the utility line in the engineer and planners cross section (Appendix B, Figure B-2) actually exists (PSC, 2002). These locations were designated UT-ST-1, UT-ST-2, and UT-ST-3 prior to conducting the field work. Ultimately only UT-ST-1 was actually dug. PSC also hoped to determine the flow direction and slope of the storm sewer line in order to estimate more accurately where the outfall at Gibbons Creek may be located. Ecology personnel were also on site to observe the investigation.

PSC began by attempting to hand dig down to the line at a location east of MC-14 next to South 32nd Street, approximately 10 feet south of the driveway entrance to the PSC property.

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[1] Steve Lee, Washougal Public Utilities.

[2] City of Washougal officials Mike Conway and Lee Fitzpatrick.

[3] Steve Roberts, City of Washougal Public Works, and City of Washougal officials Mike Conway and Lee Fitzpatrick.

PSC dug to approximately 5 feet bgs and determined that the line was apparently deeper than the expected 2 to 3 feet bgs and too deep to locate using hand methods at that location. The field team proceeded to locate a sewer junction box (sewer grate) south of the original location and checked the depth of pipe there. The line was observed to be located at approximately 2 feet bgs. A location approximately 20 feet north of the sewer junction and south of the original location was selected to attempt manual digging down to the line again. The line was located at 2.5 feet bgs at this location. No imported fill material was observed around the line. The pipe was observed to be 18-inch corrugated metal. Hand augering diagonally beneath the line revealed 0.75- to 1-inch sized subangular gravel, which is assumed to be a gravel bedding material for the pipe since it is not similar to native material in the area.

A private utility locator then locked onto the uncovered metal utility line to locate the line farther north. The line was located at approximately 6 feet bgs in front of the PSC property and appears to level out at that depth. It also was located at approximately 6 feet bgs north of the PSC property. A cross-sectional drawing shows the slope as south to north at 0.1 percent (Appendix B, Figure B-2). The private locator determined the location of the line north of the PSC property where PSC could install a piezometer, UT-ST-1, in the backfill material beneath the line (Figure 3-22). The locator located the line approximately 4 feet west of the street curb at UT-ST-1, which suggests the line flows toward the culvert that cuts underneath South 32nd Street at Gibbons Creek remnant channel.

In 2001, PSC installed UT-ST-1, a 1-inch piezometer, in the gravel bedding material underlying the storm sewer line north of the PSC property (Figure 3-22). Sampling of groundwater from UT-ST-1 for VOCs, arsenic, and beryllium was conducted in December 2001 and again during each quarterly sampling event between October 2007 and June 2009 for a wider suite of analytes to determine if the gravel bedding material was acting as a preferential pathway for contaminated groundwater that may have migrated from the facility. Most constituents of concern (COCs) were not detected or were detected at very low levels, suggesting that though the utility line bedding material may serve as a conduit for groundwater, water chemistry suggests that contaminants are not moving within this conduit. Summary results are provided in Table 3-2. Additional evaluation of the storm sewer line’s potential to act as a preferential pathway is discussed in Section 7.2.4.

The line’s location on historical maps (Appendix B, Figures B-1 and B-2) indicate that it discharges to Gibbons Creek remnant channel, north of the facility; however, multiple attempts to locate the outfall in Gibbons Creek remnant channel in the late 1990s were unsuccessful. In September 2007 the level of Gibbons Creek remnant channel was particularly low, and the outfall was finally located and observed, low on the channel sidewall at South 32nd Street. In September 2008 the outfall was again located, and sediment samples were collected from

Gibbons Creek remnant channel beneath and downgradient from the outfall in the channel wall. Results are provided in Table 3-3 and discussed further in Section 11.3.

3.5.3.2 Facility Storm Water Catch Basin Use and Maintenance

AMEC personnel met with the PSC Washougal plant manager in September 2007 to gather information about the stormwater management practices at the facility. The facility manager explained that since the facility was formerly operated as a TSD facility, the catch basins are “blind” (i.e., do not drain off site); TSD regulations required the facility to have full containment. The plant manager was not aware if the catch basins existed at some other point in history as basins draining directly to a storm sewer line. The Washougal facility operates under conditions of its Stormwater Pollution Prevention Plan (SWPPP), included as Appendix C. When the catch basins fill, the water is transferred, using electric sump pumps, to the former waste oil tank system containment area (Figure 3-22). There, the stormwater is visually inspected, and if it appears potentially contaminated then prior to discharge it is treated by a carbon treatment system and sampled for analysis to determine if carbon filtration will be sufficient. The stormwater is discharged to piping that runs below ground from the former waste oil tank system area north to the northern property boundary, then east along the fence line, before being diverted into the storm sewer system on South 32nd Street. A professional utility locator was hired to try to locate this piping in 2008, but it was not traceable and is assumed to be plastic pipe. The stormwater discharges to the Gibbons Creek remnant channel via an outfall. The piping of this system is visible in CB-2, which is in line with the discharge line.

Stormwater sample results are reported by PSC to the Washington State Department of Health. Catch basins are inspected annually and cleaned out as needed as specified in the SWPPP. Sediment and water were sampled, if present, in each catch basin at the site in September 2007. During sampling in September 2007, CB-1, CB-2, CB-3, CB-6, and CB-7 all contained varying levels of sediment, while CB-4, CB-5, and CB-8 contained no sediment. All of the catch basins except CB-2 contained water at the time of sampling. Sediment samples were analyzed for VOCs, semivolatile organic compounds (SVOCs), PCBs, pesticides, total petroleum hydrocarbons (TPH), and metals. Water samples were analyzed for VOCs, SVOCs, and metals. Analytical results are summarized in Tables 3-4 through 3-8. In October 2008, all catch basins were cleaned out by PSC.

3.5.3.3 Water Line Location and Construction

The water line runs east-west along the north property boundary and links to a north-south line running down South 32nd Street, east of the storm sewer line (Figure 3-22). A map provided by the City of Washougal Water Department (Appendix B, Figure B-3) shows the line buried at 11 feet bgs along both South 32nd Street and the PSC northern property boundary. The line was reportedly installed prior to the placement of dredge fill in the industrial park, laid on the native silt material, and then covered with dredge material.[4] However, this contradicts local knowledge of the depth to silt in this area, which indicates that at 11 feet bgs the line would be buried below the top of the Silt Layer.

City of Washougal official Lee Fitzpatrick told PSC he witnessed excavation of the water line on South 32nd street in summer 2001 and saw no porous sand or gravel backfill nor wood trench for the line. Based on this information, the water line would be presumed to have been backfilled with native material that would not have created a preferential pathway. It is possible that a gravel bedding material was used beneath the pipe, but there is no evidence of such material at this time.

3.5.3.4 Sanitary Sewer Line Location and Construction

The sanitary sewer line runs east-west along the northern property boundary (approximately 10 feet south of the water line[5]) and links to a north-south line running down South 32nd Street, east of the storm sewer and water line (Figure 3-22). The line connects with a lift station on the east side of South 32nd Street. The lift station lifts the line to approximately 10 feet higher than the elevation of the line where it enters the station. A City of Washougal Water Department map shows the line to be buried at 14 feet bgs along the northern property boundary, 14 feet bgs on South 32nd Street south of the lift station, and rising to 4 feet bgs north of the lift station (Appendix B, Figure B-3). The Engineers and Planners sketches[6] confirm the location and show that the line is 10-inches in diameter (Appendix B, Figures B-1 and B-2).

The line was reportedly installed prior to the placement of dredge fill in the industrial park, laid approximately 2 feet below the top of the native silt material, and then covered with dredge material. However, this contradicts local knowledge of the depth to silt in this area, which indicates that at 14 feet bgs the line would be buried more than 2 feet below the top of the Silt Layer. City of Washougal official Lee Fitzpatrick witnessed excavation of the sanitary sewer line in approximately 1996 on South 28th Street, one block west of South 32nd Street (a street which was installed during the same period as South 32nd Street). He noted that no porous sand or gravel was used for backfill nor was there any evidence of wood trenching for the line. Mr. Fitzpatrick's professional opinion is that the line was likely to have been backfilled with native material. A historical ground-penetrating radar survey appears to confirm that the excavation for the line was backfilled with silt (PSC, 2001).

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[4] City of Washougal Water Department and City of Washougal officials Mike Conway and Lee Fitzpatrick.

[5] City of Washougal official Lee Fitzpatrick.

[6] City of Washougal.

A Washougal Sanitary Sewer System Industrial Park as-built drawing (Appendix B, Figures B-4 and B-5) shows the 10-inch line set at a 0.30 percent grade west to east toward the lift station. The slope is shown as 0.78 percent south to north toward the lift station.

Based on this information, the sanitary sewer line can be presumed to have been backfilled with native material that would not have created a preferential pathway. It is possible a gravel bedding material was used beneath the pipe, but there is no evidence of such material at this time.

3.5.3.5 Gas Line Location and Construction

The Northwest Natural Gas line runs along the northern PSC property boundary and along the eastern side of South 32nd Street (Appendix B, Figure B-6). A small segment also runs south from the northern branch of the line connecting the office building on the PSC property. The gas line was installed in 1990 using horizontal push methods, meaning no backfill was required.[7] The line is buried at 1.5 to 3.0 feet bgs along the northern property boundary and on South 32nd Street and at approximately 18 inches bgs where the line connects to the building. The line is 4-inch-diameter PVC on South 32nd Street, 2-inch-diameter PVC along the northern property boundary, and 1-inch-diameter PVC where the line connects to the building.[8] Based on this information the line is buried in the shallow sands above the Silt Layer and does not have any nonnative backfill material that would create a preferential pathway.

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[7] Linda Christy, Northwest Natural Gas, 2001.

[8] Steve Roberts, City of Washougal Public Works, and City of Washougal officials Mike Conway and Lee Fitzpatrick.

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TABLES

TABLE 3-1

HISTORICAL AREAS OF CONCERN AND SOLID WASTE MANAGEMENT UNITS

PSC Washougal Facility
Washougal, Washington

SWMU Number	Reference	Unit(s)	Description
1	2000 Draft RI	Tank Containment Area Sumps and Trenches	
2	2000 Draft RI	Drum Storage Areas	Two small areas southwest and southeast of Building 2.
3	2000 Draft RI	Maxon Mixer Area/ Stabilization Unit	
4	2000 Draft RI	Central Load/ Unload Pad	
5	2000 Draft RI	Tote Container Storage Area	
6	2000 Draft RI	Sludge Removal Unload Sump/ Former North Load Pad	
7	2000 Draft RI	Tank Farm	
8	2000 Draft RI	Building 2 Container Storage	
9	2000 Draft RI	Building 3 Container Storage	
10	2000 Draft RI/1988 RFA	Waste Oil Tank System	Formerly housed four 20,000-gallon tanks used for waste oil. Area is 2,000 sq. ft. with a 6-inch-thick concrete foundation and 1-foot concrete berm.
11	2000 Draft RI	PCB Modular Unit	
12	2000 Draft RI	Catch Basins	
B	Ecology Notes	Buried Paraformaldehyde Tank	1980 - A complaint to Ecology indicates that Crosby and Overton cleaned out an approximately 16,000-gallon paraformaldehyde tank buried in the tank farm. The area was reported as paved by the time of the report in 1983. The tank is shown in a drawing made by Ecology.

TABLE 3-1

HISTORICAL AREAS OF CONCERN AND SOLID WASTE MANAGEMENT UNITS

PSC Washougal Facility
Washougal, Washington

SWMU Number	Reference	Unit(s)	Description
C	1988 RFA	Sewer Discharge	1980 - According to the 1988 RCRA RFA, in March 1980, 200 gallons of solvent and distillate were discharged to the municipal sewer system and entered Gibbons Creek due to a broken sewer main. The water-solvent mixture dissolved the PVC pipe at the former facility and leaked into surrounding soils and groundwater. The RFA identified this area as SWMU 15 (Past Spill Area).
D	Ecology Inspection Report 9/3/82	Defoamer Spill	1982 - Shown apparently northwest of drum storage building (Building 2) in a photo taken by Ecology.
E	Ecology Notes	Formaldehyde Release	1982 - A complaint to Ecology in 1983 indicates that a “load” of approximately 1,000 pounds of formaldehyde waste was received in 1982 and placed between the drum storage building (Building 2) and the tank farm, as shown in a drawing made by Ecology.
F	Ecology Notes	Distillation Bottoms Release	1982 - A complaint to Ecology in 1983 indicates that Crosby and Overton cleaned out a tank of still bottoms in 1982. The material was mixed with water and sprayed on the ground west of the tank farm, as shown in a drawing made by Ecology.
G	Ecology Notes	Solvent Sump	1983 - Ecology found a sump located on the northeast corner of the tank farm during an inspection. According to Jack McClary, solvents were dumped in the sump prior to being pumped into tanks. Rainwater also flowed into the sump, and if the sump overflowed, it discharged away from the sump to the north. Spillage was observed near the sump; the facility indicated it was probably waste oil. The approximate location is shown in a drawing made by Ecology
H	Ecology Notes	Buried Fatty Alcohol Solids	1982 - During the same inspection described above, Ecology noted white, gooey solids west of the southwest corner of the tank farm. Jack McClary stated that staff had buried fatty alcohol solids in this area. The approximate location is shown in a drawing made by Ecology. A 1983 complaint to Ecology also describes this release. The complaint indicates it occurred in fall 1982, consisted of 3,000 gallons, and was rototilled into the soil and covered with gravel.

TABLE 3-1

HISTORICAL AREAS OF CONCERN AND SOLID WASTE MANAGEMENT UNITS

PSC Washougal Facility
Washougal, Washington

SWMU Number	Reference	Unit(s)	Description
I	Ecology Notes	Dry Well	1984 - During a 1984 site inspection by Ecology, Jack McClary admitted that some of the water in the storm drains within the tank farm was discharged to a dry well at the west end of the tank farm. The dry well was described as a drum filled with stone. The precise location of the dry well was not indicated in the report.
J	Ecology Field Notes 4/11/85	Motor Oil	1985 - During a 1985 site inspection by Ecology, soil staining was noted on the adjoining property to the north. Jack McClary told Ecology that it was the result of a motor oil drum that the neighbor spilled there.
K	Ecology Notes	Area 4	1985 - Identified as an area for sampling during the 1985 investigation due to suspected defoamer or other product spills.
13	1988 RFA	Buffing Treatment Area	Former location of several tanks that held buffing compound wastes from electronic industries. Area was 370 square feet with a 6-inch-thick concrete foundation and 2.5-foot concrete walls.

Abbreviation(s)
PCB = polychlorinated biphenyl
PVC = polyvinyl chloride
RCRA = Resource Conservation and Recovery Act
RFA = RCRA Facility Assessment
RI = Remedial Investigation
SWMU = Solid Waste Management Unit

TABLE 3-2

ANALYTICAL RESULTS FOR GROUNDWATER SAMPLES FROM UT-ST-1 [1]

PSC Washougal Facility
Washougal, Washington

Analyte	12/11/2001	10/23/2007	10/24/2007	12/17/2007	3/10/2008	6/9/2008	9/24/2008	12/1/2008	3/23/2009	6/22/2009
VOCs (µg/L)										
1,1,1,2-Tetrachloroethane	0.5 U	--	--	--	--	--	--	--	--	--
1,1,1-Trichloroethane	0.5 U	0.12 U	--	0.12 U	0.12 U	0.05 U	0.05 U	0.05 U	0.5 U	0.075 U
1,1,2,2-Tetrachloroethane	1 U	--	--	--	--	--	--	--	--	--
1,1,2-Trichloroethane	1 U	--	--	--	--	--	--	--	--	--
1,1,2-Trichlorotrifluoroethane	2 U	0.14 U	--	0.14 U	0.14 U	0.079 U	0.079 U	0.079 U	0.5 U	0.13 U
1,1-Dichloro-1,2,2-trifluoroethane	--	--	--	0.49 U	--	--	--	--	--	--
1,1-Dichloroethane	0.5 U	0.11 U	--	0.11 U	0.11 U	0.042 U	0.042 U	0.042 U	0.5 U	0.077 U
1,1-Dichloroethene	0.5 U	0.0061 U	0.0061 U	0.0061 U	0.0061 U	0.0061 U	--	0.0095 U	0.02 U	0.0095 U
1,2-Dibromo-3-chloropropane	--	--	0.0014 U	0.0014 U	0.0014 U	0.0028 U	--	--	--	--
1,2-Dichloroethane	0.5 U	0.12 U	--	0.12 U	0.12 U	0.073 U	0.073 U	0.073 U	0.5 U	0.08 U
1,2-Dichloropropane	0.5 U	--	--	--	--	--	--	--	--	--
2,2-Dichloro-1,1,1-trifluoroethane	--	0.49 U	--	--	0.49 U	0.38 U	0.38 U	0.38 U	1 U	0.21 U
2-Butanone	10 U	2.3 U	--	2.3 U	2.3 U	3.8 U	3.8 U	3.8 U	20 U	1.9 U
2-Hexanone	10 U	--	--	--	--	--	--	--	--	--
2-Methylpentane	--	0.49 U	--	0.49 U	0.49 U	0.4 U	0.4 U	0.4 U	1 U	0.21 U
3-Methylpentane	--	0.41 U	--	0.41 U	0.41 U	0.36 U	0.36 U	0.36 U	1 U	0.18 U
4-Methyl-2-pentanone	5 U	--	--	--	--	--	--	--	--	--
Acetone	25 U	4.1 U	--	4.1 U	4.1 U	2.5 U	2.5 U	2.5 U	20 U	3.3 U
Benzene	0.5 U	0.14 U	--	0.14 U	0.14 U	0.045 U	0.045 U	0.045 U	0.5 U	0.038 U
Bromodichloromethane	0.5 U	--	--	--	--	--	--	--	--	--
Bromoform	1 U	--	--	--	--	--	--	--	--	--
Bromomethane	5 U	--	--	--	--	--	--	--	--	--
Carbon disulfide	10 U	0.16 U	--	0.16 U	0.16 U	0.045 U	0.045 U	0.045 U	0.5 U	0.1 U
Carbon tetrachloride	0.5 U	0.14 U	--	0.14 U	0.14 U	0.068 U	0.068 U	0.068 U	0.5 U	0.096 U
Chlorobenzene	0.5 U	0.14 U	--	0.14 U	0.14 U	0.045 U	0.045 U	0.045 U	0.5 U	0.11 U
Chloroethane	1 U	0.23 U	--	0.23 U	0.23 U	0.13 U	0.13 U	0.13 U	0.5 U	0.16 U
Chloroform	0.5 U	0.14 U	--	0.14 U	0.14 U	0.042 U	0.042 U	0.042 U	0.5 U	0.064 U
Chloromethane	5 U	0.14 U	--	0.14 U	0.14 U	0.12 UJ	0.053 U	0.053 U	0.5 U	0.1 UJ
cis-1,2-Dichloroethene	0.5 U	0.12 U	--	0.12 U	0.12 U	0.045 U	0.045 U	0.045 U	0.5 U	0.067 U
cis-1,3-Dichloropropene	0.5 U	--	--	--	--	--	--	--	--	--
Dibromochloromethane	1 U	--	--	--	--	--	--	--	--	--
Dichlorodifluoromethane	5 U	0.17 U	--	0.17 U	0.17 U	0.083 U	0.083 U	0.083 U	0.5 U	0.13 U
Ethylbenzene	0.5 U	0.13 U	--	0.13 U	0.13 U	0.042 U	0.042 U	0.042 U	0.5 U	0.05 U

TABLE 3-2

ANALYTICAL RESULTS FOR GROUNDWATER SAMPLES FROM UT-ST-1 [1]

PSC Washougal Facility
Washougal, Washington

Analyte	12/11/2001	10/23/2007	10/24/2007	12/17/2007	3/10/2008	6/9/2008	9/24/2008	12/1/2008	3/23/2009	6/22/2009
VOCs (Continued) (µg/L)										
m,p-Xylenes	1 U	0.22 U	--	0.22 U	0.22 U	0.078 U	0.078 U	0.08 J	0.5 U	0.091 U
Methylcyclopentane	--	0.42 U	--	0.42 U	0.42 U	0.4 U	0.4 U	0.4 U	1 U	0.21 U
Methylene bromide	0.5 U	--	--	--	--	--	--	--	--	--
Methylene chloride	5 U	0.2 U	--	0.2 U	0.2 U	0.23 U	0.23 U	0.23 U	2 U	0.17 U
o-Xylene	--	0.11 U	--	0.11 U	0.11 U	0.037 U	0.037 U	0.037 U	0.5 U	0.074 U
Styrene	0.5 U	--	--	--	--	--	--	--	--	--
Tetrachloroethene	0.5 U	0.13 U	--	0.13 U	0.13 U	0.077 U	0.077 U	0.077 U	0.5 U	0.066 U
Toluene	0.5 U	1.8 U	--	0.11 U	0.11 U	0.54 UJ	0.048 U	0.12 UJ	0.5 UJ	0.2 JJ
trans-1,2-Dichloroethene	0.5 U	0.15 U	--	0.15 U	0.15 U	0.048 U	0.048 U	0.048 U	0.5 U	0.091 U
trans-1,3-Dichloropropene	0.5 U	--	--	--	--	--	--	--	--	--
Trichloroethene	0.5 U	0.14 U	--	0.14 U	0.14 U	0.061 U	0.061 U	0.061 U	0.5 U	0.1 U
Trichlorofluoromethane	2 U	0.14 U	--	0.14 U	0.14 U	0.086 U	0.086 U	0.086 U	0.5 U	0.12 U
Vinyl acetate	5 U	--	--	--	--	--	--	--	--	--
Vinyl chloride	0.5 U	0.0035 U	0.0035 U	0.0035 U	0.0035 U	0.0035 U	--	0.0035 U	0.02 U	0.0084 U
Metals (mg/L)										
Arsenic	0.00772	--	--	0.00353	0.003	0.00308	--	0.0036	0.003	0.0028
Barium	--	--	--	0.0205	0.0122	0.01591	--	--	--	--
Beryllium	0.001 U	--	--	--	--	--	--	--	--	--
Cadmium	--	--	--	0.000039	0.000024	0.000023	--	--	--	--
Chromium	--	--	--	0.00023 U	0.00023 U	0.00029 U	--	--	--	--
Cobalt	--	--	--	0.000247	0.000058	0.000058	--	--	--	--
Copper	--	--	--	0.00059	0.00033	0.000333	--	--	--	--
Iron	--	--	--	0.231	0.137 J	0.064 J	--	--	--	--
Magnesium	--	--	--	3.49	2.42	3.22	--	--	--	--
Manganese	--	--	--	0.116	0.0853	0.0502	--	--	--	--
Mercury	--	--	--	--	--	0.00003 U	--	--	--	--
Nickel	--	--	--	0.00061	0.00069 U	0.00043	--	--	--	--
Potassium	--	--	--	1.5	1.08	1.2	--	--	--	--
Silver	--	--	--	0.000004 U	0.000006 U	0.000009 U	--	--	--	--
Sodium	--	--	--	2.72	2.26	2.81	--	--	--	--
Vanadium	--	--	--	0.00065	0.000508	0.000594	--	--	--	--
Zinc	--	--	--	0.0014 U	0.0029 U	0.0007 U	--	--	--	--

TABLE 3-2

ANALYTICAL RESULTS FOR GROUNDWATER SAMPLES FROM UT-ST-1 [1]

PSC Washougal Facility
Washougal, Washington

Analyte	12/11/2001	10/23/2007	10/24/2007	12/17/2007	3/10/2008	6/9/2008	9/24/2008	12/1/2008	3/23/2009	6/22/2009
TPH (µg/L)										
TPH (as gasoline)	--	--	13 U	13 U	50 U	50 U	--	50 U	50 U	50 U
Lube oil	--	--	--	19 U	500 U	500 U	--	--	--	--
Diesel	--	--	--	11 U	250 U	250 U	--	--	--	--
SVOCs (µg/L)										
1,4-Dioxane	--	--	--	0.26 U	0.26 U	0.26 U	--	0.24 U	1 U	0.16 U
1,2,4-Trichlorobenzene	--	--	--	0.016 U	0.016 U	0.016 U	--	--	--	--
1,2-Dichlorobenzene	--	--	--	0.022 U	0.022 U	0.022 U	--	--	--	--
1,3-Dichlorobenzene	--	--	--	0.49	0.36	0.11 J	--	--	--	--
1,4-Dichlorobenzene	--	--	--	0.029 U	0.029 U	0.029 U	--	--	--	--
1-Methylnaphthalene	--	--	--	--	--	0.0035 U	--	--	--	--
2,4,5-Trichlorophenol	--	--	--	--	0.031 U	0.031 U	--	--	--	--
2,4,6-Trichlorophenol	--	--	--	--	0.058 U	0.058 U	--	--	--	--
2,4-Dichlorophenol	--	--	--	--	0.047 U	0.047 U	--	--	--	--
2,4-Dimethylphenol	--	--	--	--	2.2 U	2.2 U	--	--	--	--
2,4-Dinitrophenol	--	--	--	--	0.17 U	0.17 U	--	--	--	--
2,4-Dinitrotoluene	--	--	--	0.018 U	0.018 U	0.018 U	--	--	--	--
2,6-Dinitrotoluene	--	--	--	0.033 U	0.033 U	0.033 U	--	--	--	--
2-Chloronaphthalene	--	--	--	0.041 U	0.041 U	0.041 U	--	--	--	--
2-Chlorophenol	--	--	--	--	0.054 U	0.054 U	--	--	--	--
2-Methyl-4,6-dinitrophenol	--	--	--	--	0.025 U	0.025 U	--	--	--	--
2-Methylnaphthalene	--	--	--	0.0025 U	0.0027 UJ	0.0023 U	--	--	--	--
2-Methylphenol	--	--	--	--	0.11 U	0.11 U	--	--	--	--
2-Nitroaniline	--	--	--	0.024 U	0.024 U	0.024 U	--	--	--	--
2-Nitrophenol	--	--	--	--	0.063 U	0.063 U	--	--	--	--
3,3'-Dichlorobenzidine	--	--	--	0.43 U	--	0.43 U	--	--	--	--
3-Nitroaniline	--	--	--	0.029 U	0.029 U	0.029 U	--	--	--	--
4,6-Dinitro-2-methylphenol	--	--	--	--	--	--	--	--	--	--
4-Bromophenyl phenyl ether	--	--	--	0.026 U	0.026 U	0.026 U	--	--	--	--
4-Chloro-3-methylphenol	--	--	--	0.037 UR	0.037 U	0.037 U	--	--	--	--
4-Chloroaniline	--	--	--	0.025 U	0.025 U	0.025 U	--	--	--	--
4-Chlorophenyl phenyl ether	--	--	--	0.027 U	0.027 U	0.027 U	--	--	--	--
4-Methylphenol	--	--	--	--	0.12 U	0.12 U	--	--	--	--

TABLE 3-2

ANALYTICAL RESULTS FOR GROUNDWATER SAMPLES FROM UT-ST-1 [1]

PSC Washougal Facility
Washougal, Washington

Analyte	12/11/2001	10/23/2007	10/24/2007	12/17/2007	3/10/2008	6/9/2008	9/24/2008	12/1/2008	3/23/2009	6/22/2009
SVOCs (Continued) (µg/L)										
4-Nitroaniline	--	--	--	0.019 U	0.019 U	0.019 U	--	--	--	--
4-Nitrophenol	--	--	--	--	0.28 U	0.28 U	--	--	--	--
Acenaphthene	--	--	--	0.0044 U	0.0044 U	0.0044 U	--	--	--	--
Acenaphthylene	--	--	--	0.0034 U	0.0034 U	0.0034 U	--	--	--	--
Anthracene	--	--	--	0.0036 UJ	0.0036 U	0.0036 U	--	--	--	--
Benzo(a)anthracene	--	--	--	0.0026 U	0.0039 J	0.0026 U	--	--	--	--
Benzo(a)pyrene	--	--	--	0.0043 UJ	0.0043 U	0.0043 U	--	--	--	--
Benzo(b)fluoranthene	--	--	--	0.0023 U	0.0023 U	0.0023 U	--	--	--	--
Benzo(g,h,i)perylene	--	--	--	--	0.0029 U	0.0029 U	--	--	--	--
Benzo(ghi)perylene	--	--	--	0.0029 U	--	--	--	--	--	--
Benzo(k)fluoranthene	--	--	--	0.0025 U	0.0025 U	0.0025 U	--	--	--	--
Benzoic acid	--	--	--	--	1.1 U	1.1 U	--	--	--	--
Benzyl alcohol	--	--	--	0.073 U	0.073 U	0.073 U	--	--	--	--
bis(2-Chloroethoxy)methane	--	--	--	0.024 U	0.024 U	0.024 U	--	--	--	--
bis(2-Chloroethyl) ether	--	--	--	0.035 U	0.035 U	0.035 U	--	--	--	--
bis(2-Chloroisopropyl) ether	--	--	--	0.026 U	0.026 U	0.026 U	--	--	--	--
bis(2-Ethylhexyl) phthalate	--	--	--	0.13 U	0.42 UJ	0.13 U	--	--	--	--
Butyl benzyl phthalate	--	--	--	0.047 U	0.15 UJ	0.041 J	--	--	--	--
Carbazole	--	--	--	--	--	0.0045 U	--	--	--	--
Chrysene	--	--	--	0.0034 U	0.0034 U	0.0034 U	--	--	--	--
Dibenz(a,h)anthracene	--	--	--	0.0025 U	0.0025 U	0.0025 U	--	--	--	--
Dibenzofuran	--	--	--	0.0046 U	0.0046 U	0.0046 U	--	--	--	--
Diethyl phthalate	--	--	--	0.062 U	0.13 UJ	0.024 UJ	--	--	--	--
Dimethyl phthalate	--	--	--	0.021 U	0.021 U	0.021 U	--	--	--	--
Di-n-butyl phthalate	--	--	--	0.25 U	1.3 U	0.14 UJ	--	--	--	--
Di-n-octyl phthalate	--	--	--	0.018 U	0.018 U	0.018 U	--	--	--	--
Fluoranthene	--	--	--	0.0044 U	0.0044 U	0.0044 U	--	--	--	--
Fluorene	--	--	--	0.0038 U	0.0038 U	0.0038 U	--	--	--	--
Hexachlorobenzene	--	--	--	0.022 U	0.022 U	0.022 U	--	--	--	--
Hexachlorobutadiene	--	--	--	0.027 U	0.027 U	0.027 U	--	--	--	--
Hexachlorocyclopentadiene	--	--	--	0.19 U	--	0.19 U	--	--	--	--
Hexachloroethane	--	--	--	0.024 U	0.024 U	0.024 U	--	--	--	--
Indeno(1,2,3-cd)pyrene	--	--	--	0.0026 U	0.0026 U	0.0026 U	--	--	--	--

TABLE 3-2

ANALYTICAL RESULTS FOR GROUNDWATER SAMPLES FROM UT-ST-1 [1]

PSC Washougal Facility
Washougal, Washington

Analyte	12/11/2001	10/23/2007	10/24/2007	12/17/2007	3/10/2008	6/9/2008	9/24/2008	12/1/2008	3/23/2009	6/22/2009
SVOCs (Continued) (µg/L)										
Isophorone	--	--	--	0.016 U	0.016 U	0.016 U	--	--	--	--
Naphthalene	--	--	--	0.022 U	0.018 UJ	0.003 U	--	--	--	--
Nitrobenzene	--	--	--	0.028 U	0.028 U	0.028 U	--	--	--	--
N-Nitrosodi-n-propylamine	--	--	--	--	0.037 U	0.037 U	--	--	--	--
N-Nitrosodiphenylamine	--	--	--	0.048 U	0.048 U	0.048 U	--	--	--	--
N-Nitrosodipropylamine	--	--	--	0.037 U	--	--	--	--	--	--
Pentachlorophenol	--	--	--	--	0.34 U	0.34 U	--	--	--	--
Phenanthrene	--	--	--	0.005 U	0.005 U	0.005 U	--	--	--	--
Phenol	--	--	--	0.21 UR	0.063 U	0.063 U	--	--	--	
Pyrene	--	--	--	0.0035 U	0.0035 U	0.0035 U	--	--	--	--

Note

1. Laboratory data flags are as follows:
   J = analyte was positively identified; result is an estimated concentration.
   U = analyte was not detected at the reporting limit indicated.
   UJ = analyte was not detected at the concentration indicated, which is the estimated reporting limit.

Abbreviations

-- = not analyzed
µg/L = micrograms per liter
mg/L = milligrams per liter
SVOCs = semivolatile organic compounds
TPH = total petroleum hydrocarbons
VOCs = volatile organic compounds

TABLE 3-3

ANALYTICAL RESULTS FOR SEDIMENT SAMPLES FROM GIBBONS CREEK REMNANT CHANNEL[1]

PSC Washougal Facility
Washougal, Washington

Analyte	GC-1	GC-2
	9/11/2008	9/11/2008
Metals (mg/kg)		
Arsenic	207	11.1
Barium	746	150
Cadmium	0.28	0.459
Chromium	9.05	16.3
Copper	12.6	50.3
Iron	119,000	40,700
Manganese	882	516
Nickel	8.71	9.97
Potassium	779	965
Silver	0.04 U	0.05
Vanadium	40.6	73.9
Zinc	50.4	88.3
SVOCs (µg/kg)		
1,4-Dioxane	2.8 UJ	2 UJ
TPH (mg/kg)		
TPH (as gasoline)	15 U	19 U
VOCs (µg/kg)		
1,1,1-Trichloroethane	0.47 U	0.41 U
1,1,2-Trichlorotrifluoroethane	0.3 U	0.27 U
1,1-Dichloroethane	0.15 U	0.14 U
1,1-Dichloroethene	0.22 U	0.19 U
1,2-Dichlorobenzene	0.2 U	0.18 U
1,2-Dichloroethane	0.17 U	0.15 U
2,2-Dichloro-1,1,1-trifluoroethane	15 U	14 U
2-Butanone	25 J	40 J
2-Methylpentane	15 U	14 U
3-Methylpentane	15 U	14 U
Acetone	210	400
Benzene	0.44 U	0.38 U
Carbon disulfide	31	10 J
Carbon tetrachloride	0.24 U	0.22 U
Chlorobenzene	0.17 U	0.15 U
Chloroethane	0.93 U	0.82 U
Chloroform	0.15 U	0.14 U
Chloromethane	0.18 U	0.16 U
cis-1,2-Dichloroethene	0.25 U	0.22 U
Dichlorodifluoromethane	0.23 U	0.2 U
Ethylbenzene	0.13 U	0.12 U
m,p-Xylenes	0.68 J	0.76 J
Methylcyclopentane	15 U	14 U

TABLE 3-3

ANALYTICAL RESULTS FOR SEDIMENT SAMPLES FROM GIBBONS CREEK REMNANT CHANNEL[1]

PSC Washougal Facility
Washougal, Washington

Analyte	GC-1 9/11/2008	GC-2 9/11/2008
VOCs (µg/kg) (Continued)		
Methylene chloride	1.6 UJ	1.1 UJ
o-Xylene	0.19 U	0.16 U
Tetrachloroethene	0.37 U	0.33 U
Toluene	1.7 J	2.5 J
trans-1,2-Dichloroethene	0.15 U	0.14 U
Trichloroethene	0.4 U	0.36 U
Trichlorofluoromethane	0.17 U	0.15 U
Vinyl chloride	0.18 U	0.16 U

Notes

1. Laboratory data flags are as follows:
   J = analyte was positively identified; result is an estimated concentration.
   U = analyte was not detected at the reporting limit indicated.
   UJ = analyte was not detected at the concentration indicated, which is the estimated reporting limit.

Abbreviations

µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
SVOCs = semivolatile organic compounds
TPH = total petroleum hydrocarbons
VOCs = volatile organic compounds

TABLE 3-4

ANALYTICAL RESULTS FOR VOLATILE ORGANIC COMPOUNDS IN SEDIMENT AND WATER SAMPLES FROM CATCH BASINS[1,2]

PSC Washougal Facility
Washougal, Washington

Analyte	CB-1	CB-2	CB-3	CB-4	CB-5	CB-6	CB-6 Duplicate	CB-7	CB-8	CB-8 Duplicate
	9/20/2007	9/25/2007	9/25/2007	9/20/2007	9/25/2007	9/25/2007	9/25/2007	9/20/2007	9/25/2007	9/25/2007
VOCs in Sediment (mg/kg)										
1,1,1-Trichloroethane	0.27 U	0.14 U	0.12 U	NA	NA	34	27	0.13 U	NA	NA
1,1,2-Trichlorotrifluoroethane	0.57 U	0.30 U	0.24 U	NA	NA	2.1 J	0.38 U	0.27 U	NA	NA
1,1-Dichloroethane	0.28 U	0.15 U	0.12 U	NA	NA	16	15	0.13 U	NA	NA
1,1-Dichloroethene	0.24 U	0.12 U	0.096 U	NA	NA	0.12 U	0.16 U	0.11 U	NA	NA
2-Butanone	59 J	6.5 J	44	NA	NA	24 J	27 J	22 J	NA	NA
2-Methylpentane	20 UNJ	10 UNJ	8.4 UNJ	NA	NA	14.1 NJ	13 J	9.3 J	NA	NA
3-Methylpentane	20 UNJ	10 UNJ	8.4 UNJ	NA	NA	12.8 NJ	13 J	9.3 J	NA	NA
Acetone	300	43	200	NA	NA	180	180	140	NA	NA
Benzene	8.8 J	0.17 U	4.8 J	NA	NA	0.16 U	0.22 U	0.16 U	NA	NA
Carbon disulfide	15 J	0.12 U	4.0 J	NA	NA	9.6 J	15	0.80 J	NA	NA
Chloroethane	0.98 U	0.50 U	0.41 U	NA	NA	6,700	3,100	0.46 U	NA	NA
Chloromethane	0.45 U	0.23 U	0.19 U	NA	NA	0.22 U	0.62 J	0.21 U	NA	NA
cis-1,2-Dichloroethene	1.5 J	0.21 U	0.17 U	NA	NA	0.74 J	0.75 J	0.20 U	NA	NA
Ethylbenzene	50	0.14 U	4.1 J	NA	NA	15	36	0.13 U	NA	NA
m,p-Xylenes	34	0.32 U	4.7 J	NA	NA	19	42	0.29 U	NA	NA
o-Xylene	18 J	0.12 U	1.7 J	NA	NA	6.5 J	15	0.11 U	NA	NA
Tetrachloroethene	0.31 U	0.16 U	0.13 U	NA	NA	3.9 J	2.3 J	0.15 U	NA	NA
Toluene	35	1.3 J	93	NA	NA	83	100	2.1 J	NA	NA
Trichloroethene	1.6 J	0.15 U	1.1 J	NA	NA	0.90 J	0.19 U	0.14 U	NA	NA
Vinyl chloride	0.39 U	0.20 U	0.16 U	NA	NA	18	23	0.18 U	NA	NA

TABLE 3-4

ANALYTICAL RESULTS FOR VOLATILE ORGANIC COMPOUNDS IN SEDIMENT AND WATER SAMPLES FROM CATCH BASINS[1,2]

PSC Washougal Facility
Washougal, Washington

Analyte	CB-1	CB-2	CB-3	CB-4	CB-5	CB-6	CB-6 Duplicate	CB-7	CB-8	CB-8 Duplicate
	9/20/2007	9/25/2007	9/25/2007	9/20/2007	9/25/2007	9/25/2007	9/25/2007	9/20/2007	9/25/2007	9/25/2007
VOCs in Water (mg/L)										
Chloroethane	0.23 U	NA	NA	0.23 U	3.4	NA	NA	NA	2.1	2.2
Vinyl chloride	0.23 U	NA	NA	0.23 U	3.4 J	NA	NA	NA	2.1 J	2.2 J

Notes
1. Only constituents detected in at least one sample are shown.
2. Laboratory data flags are as follows:
   J = analyte was positively identified; result is an estimated concentration.
   NJ = analyte is tentatively identified; concentration shown is estimated.
   U = analyte was not detected at the reporting limit indicated.
   UNJ = result was reported by laboratory as not detected but result is qualified as tentatively identified at the estimated concentration shown because a method detection limit and method reporting limit have not been established for these compounds in the solid matrix.

Abbreviations
mg/kg = milligrams per kilogram
mg/L = milligrams per liter
NA = not applicable

TABLE 3-5

ANALYTICAL RESULTS FOR SEMIVOLATILE ORGANIC COMPOUNDS IN SEDIMENT AND WATER SAMPLES FROM CATCH BASINS [1,2]

PSC Washougal Facility
Washougal, Washington

Analyte	CB-1	CB-2	CB-3	CB-4	CB-5	CB-6	CB-6 Duplicate	CB-7	CB-8	CB-8 Duplicate
	9/20/2007	9/25/2007	9/25/2007	9/20/2007	9/25/2007	9/25/2007	9/25/2007	9/20/2007	9/25/2007	9/25/2007
SVOCs in Sediment (µg/kg)										
4-Methylphenol	30 U	1.7 U	30 U	NA	NA	15 U	88 J	1,600	NA	NA
Acenaphthene	39 J	1.6 U	28 U	NA	NA	14 U	15 U	35 U	NA	NA
Acenaphthylene	110 J	1.4 J	68 J	NA	NA	19 J	13 U	61 J	NA	NA
Anthracene	41 J	1.8 U	32 U	NA	NA	19 J	29 J	40 U	NA	NA
Benzo(a)anthracene	81 J	4.0 J	97 J	NA	NA	81 J	69 J	70 J	NA	NA
Benzo(a)pyrene	120 J	4.6 J	170 J	NA	NA	110	18 U	130 J	NA	NA
Benzo(b)fluoranthene	170 J	10	270	NA	NA	200	160	220 J	NA	NA
Benzo(g,h,i)perylene	190 J	9.1 J	350	NA	NA	160	170	290	NA	NA
Benzo(k)fluoranthene	35 J	2.9 J	71 J	NA	NA	36 J	15 U	56 J	NA	NA
Benzoic acid	NA	NA	NA	NA	NA	NA	1,000 J	NA	NA	NA
Benzyl alcohol	41 U	4.5 J	42 U	NA	NA	180 J	66 J	52 U	NA	NA
bis(2-Ethylhexyl) phthalate	4,000	300	13,000	NA	NA	7,400	8,000	12,000	NA	NA
Butyl benzyl phthalate	930	450	670	NA	NA	130	150	310	NA	NA
Chrysene	160 J	7.7 J	510	NA	NA	120	200	140 J	NA	NA
Diethyl phthalate	26 U	4.0 J	26 U	NA	NA	28 J	17 J	32 U	NA	NA
Dimethyl phthalate	700	74	2,200	NA	NA	1,300	1,300	1,500	NA	NA
Di-n-butyl phthalate	560	23	300 J	NA	NA	1,400	820	200 U	NA	NA
Di-n-octyl phthalate	34 U	1.9 U	34 U	NA	NA	17 U	640	42 U	NA	NA
Fluoranthene	230	7.1 J	210	NA	NA	150	170	190 J	NA	NA
Fluorene	22 U	1.2 U	22 U	NA	NA	17 J	20 J	27 U	NA	NA
Indeno(1,2,3-cd)pyrene	120 J	9.6 J	160 J	NA	NA	100	99 J	120 J	NA	NA
Naphthalene	45 U	2.5 U	82 J	NA	NA	23 U	24 U	57 U	NA	NA
Pentachlorophenol	400 U	22 U	400 U	NA	NA	220 J	220 J	500 U	NA	NA
Phenanthrene	200 J	4.2 J	180 J	NA	NA	120	150	130 J	NA	NA
Phenol	40 U	18 UJ	40 U	NA	NA	20 U	21 U	210 J	NA	NA
Pyrene	290	7.7 J	290	NA	NA	170	190	360	NA	NA

TABLE 3-5

ANALYTICAL RESULTS FOR SEMIVOLATILE ORGANIC COMPOUNDS IN SEDIMENT AND WATER SAMPLES FROM CATCH BASINS [1,2]

PSC Washougal Facility
Washougal, Washington

Analyte	CB-1	CB-2	CB-3	CB-4	CB-5	CB-6	CB-6 Duplicate	CB-7	CB-8	CB-8 Duplicate
	9/20/2007	9/25/2007	9/25/2007	9/20/2007	9/25/2007	9/25/2007	9/25/2007	9/20/2007	9/25/2007	9/25/2007
SVOCs in Water (µg/L)										
2-Methylnaphthalene	0.026 U	NA	NA	0.034 J	0.026 U	NA	NA	NA	0.026 U	0.026 U
2-Methylphenol	0.46 J	NA	NA	0.34 J	0.11 U	NA	NA	NA	0.11 U	0.11 U
4-Methylphenol	0.42 J	NA	NA	0.35 J	0.18 J	NA	NA	NA	0.13 J	0.13 J
Acenaphthylene	0.015 U	NA	NA	0.045 J	0.015 U	NA	NA	NA	0.015 U	0.015 U
Benzoic acid	1.8 J	NA	NA	1.1 U	1.1 U	NA	NA	NA	1.1 U	1.1 U
Isophorone	0.016 U	NA	NA	0.016 U	0.12 J	NA	NA	NA	0.016 U	0.016 U
Phenol	0.24 J	NA	NA	0.063 U	0.063 U	NA	NA	NA	0.082 J	0.086 J

Notes
1. Only constituents detected in at least one sample are shown.
2. Laboratory data flags are as follows:
   J = analyte was positively identified; result is an estimated concentration.
   U = analyte was not detected at the reporting limit indicated.
   UJ = analyte was not detected at the concentration indicated, which is the estimated reporting limit.

Abbreviations
NA = not analyzed

TABLE 3-6

ANALYTICAL RESULTS FOR POLYCHLORINATED BIPHENYLS AND PESTICIDES IN SEDIMENT SAMPLES FROM CATCH BASINS[1,2]

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per kilogram (µg/kg)

Analyte	CB-1 9/20/2007	CB-2 9/25/2007	CB-3 9/25/2007	CB-6 9/25/2007	CB-6 Duplicate 9/25/2007	CB-7 9/20/2007
4,4'-DDD	17 J	2.4	30	7.8	8.4	31
4,4'-DDE	12	1.4	32	6.5	6.9	10
4,4'-DDT	38 U	56 J	14 U	12 U	6.6 U	9.1 U
Aldrin	3.3 U	0.17 U	8.9 U	1.0 U	0.79 J	0.83 J
alpha-Chlordane	10	1.0 U	7.5 J	6.2 J	5.0 J	6.3
Aroclor 1254	86	9.9 U	26 U	110 J	83 J	90 J
Aroclor 1260	200	2.7 U	98	140	90	77
beta-BHC	5.3 U	4.7 U	4.9 U	3.7	1.9 J	3.5 J
delta-BHC	3.6 U	0.9 U	1.5 U	1.3 U	1.1 U	2.6 J
Dieldrin	5.1 U	0.3 U	4.8 U	1.0 U	2.4 J	1.0 U
Endosulfan I	3.0 U	0.9 J	2.8 U	1.0 U	1.1 U	5.8 J
Endosulfan II	3.4 U	0.2 U	10 U	2.1 J	2.5 J	2.3 U
Endosulfan sulfate	1.4 U	0.4 J	2.0 U	1.0 U	2.2 U	3.9 J
Endrin aldehyde	6.5 U	0.9 U	10 U	8.0	2.0 U	2.1 U
gamma-BHC	2.7 U	1.0 U	2.5 U	1.0 U	1.1 U	1.0 J
gamma-Chlordane	12 U	0.40 J	17 J	4.5 J	3.6 U	13 J
Heptachlor	1.5 U	0.23 U	2.0 U	1.0 U	2.6	3.7 U
Heptachlor epoxide	2.3 U	1.0 U	5.4 U	2.4 J	1.1 U	1.0 U

<u>Notes</u>

1. Only constituents detected in at least one sample are shown.
2. Laboratory data flags are as follows:
   J = analyte was positively identified; result is an estimated concentration.
   U = analyte was not detected at the reporting limit indicated.

TABLE 3-7

ANALYTICAL RESULTS FOR TOTAL PETROLEUM HYDROCARBONS IN SEDIMENT SAMPLES FROM CATCH BASINS[1]

PSC Washougal Facility
Washougal, Washington

Concentrations in milligrams per kilogram (mg/kg)

Analyte	CB-1 9/20/2007	CB-2 9/25/2007	CB-3 9/25/2007	CB-6 9/25/2007	CB-6 Duplicate 9/25/2007	CB-7 9/20/2007
Diesel range hydrocarbons	260 J	57 J	390 J	270 J	390 J	380 J
Lube oil range hydrocarbons	2,300 J	130 J	3,200 J	1,400 J	1,700 J	2,900 J
Gasoline range hydrocarbons	11 J	5.3 U	8.7 J	10 U	11 U	9 U

Notes

1. Laboratory data flags are as follows:
   J = analyte was positively identified; result is an estimated concentration.
   U = analyte was not detected at the reporting limit indicated.

TABLE 3-8

ANALYTICAL RESULTS FOR INORGANIC CONSTITUENTS IN SEDIMENT AND WATER SAMPLES FROM CATCH BASINS[1,2]

PSC Washougal Facility
Washougal, Washington

Concentrations in milligrams per kilogram (mg/kg) or milligrams per liter (mg/L)

	CB-1	CB-2	CB-3	CB-4	CB-5	CB-6	CB-6 Duplicate	CB-7	CB-8	CB-8 Duplicate
Analyte	**9/20/2007**	**9/25/2007**	**9/25/2007**	**9/20/2007**	**9/25/2007**	**9/25/2007**	**9/25/2007**	**9/20/2007**	**9/25/2007**	**9/25/2007**
Metals in Sediment (mg/kg)										
Antimony	0.96	0.22	2.08	NA	NA	1.66	4.83	1.06	NA	NA
Arsenic	3.8	2.4	13.4	NA	NA	7.2	8.9	4.6	NA	NA
Barium	165	101	145	NA	NA	80	91	191	NA	NA
Beryllium	0.362	0.242	0.344	NA	NA	0.323	0.307	0.405	NA	NA
Cadmium	2.96	0.25	4.12	NA	NA	2.83	2.97	2.97	NA	NA
Chromium	23.2	9.6	62.3	NA	NA	39.8	33.4	27.0	NA	NA
Cobalt	10.9 J	5.8 J	9.7 J	NA	NA	7.7 J	8.1 J	10.1 J	NA	NA
Copper	68.4 J	9.8 J	166.0 J	NA	NA	108.0 J	106.0 J	78.2 J	NA	NA
Lead	114	11	148	NA	NA	59	84	69	NA	NA
Manganese	378	199	305	NA	NA	257	246	402	NA	NA
Mercury	0.704	0.039	1.550	NA	NA	0.238	0.279	0.332	NA	NA
Nickel	24	11	27	NA	NA	29	25	19	NA	NA
Silver	0.708	0.063	1.080	NA	NA	0.312	0.368	0.450	NA	NA
Vanadium	70.1	22.7	77.6	NA	NA	39.7	40.0	70.3	NA	NA
Zinc	450	81	1,050	NA	NA	1,580	1,820	1,470	NA	NA
Total Metals in Water (mg/L)										
Arsenic	NA	NA	NA	0.0006	0.0021	NA	NA	NA	0.0012	0.0012
Barium	NA	NA	NA	0.0113	0.0206	NA	NA	NA	0.0335	0.0337
Cadmium	NA	NA	NA	0.000157	0.000524	NA	NA	NA	0.000683	0.000634
Chromium	NA	NA	NA	0.00215	0.00115 U	NA	NA	NA	0.00071 U	0.00082 U
Cobalt	NA	NA	NA	0.000589	0.000435	NA	NA	NA	0.000399	0.000408
Copper	NA	NA	NA	0.0166	0.0157	NA	NA	NA	0.00741 J	0.00742 J
Iron	NA	NA	NA	0.937	2.98	NA	NA	NA	3.31	3.05
Magnesium	NA	NA	NA	1.12	0.814	NA	NA	NA	0.889	0.86
Manganese	NA	NA	NA	0.0299	0.0298	NA	NA	NA	0.0283	0.0293
Nickel	NA	NA	NA	0.00263 J	0.00389 J	NA	NA	NA	0.00253 J	0.0025 J
Potassium	NA	NA	NA	1.62	3.1	NA	NA	NA	3.54	4.14
Silver	NA	NA	NA	0.000036	0.000036	NA	NA	NA	0.000049	0.00006
Sodium	NA	NA	NA	1.72 U	11.2	NA	NA	NA	9.27	9.52
Vanadium	NA	NA	NA	0.00198	0.00176	NA	NA	NA	0.00074	0.00075
Zinc	NA	NA	NA	0.0296	0.0712	NA	NA	NA	0.183	0.176
Dissolved Metals in Water (mg/L)										
Arsenic	NA	NA	NA	0.0004	0.0019	NA	NA	NA	0.0009	0.0008
Barium	NA	NA	NA	0.00726	0.019	NA	NA	NA	0.0316	0.0316
Cadmium	NA	NA	NA	0.000097 J	0.000344 J	NA	NA	NA	0.0001 J	0.000106 J
Chromium	NA	NA	NA	0.0016	0.00088 U	NA	NA	NA	0.00046 U	0.00051 U
Cobalt	NA	NA	NA	0.000317	0.00038	NA	NA	NA	0.000335	0.000309
Copper	NA	NA	NA	0.0142	0.0141	NA	NA	NA	0.0048	0.00505 J
Iron	NA	NA	NA	0.16 U	2.05	NA	NA	NA	0.827	0.873
Magnesium	NA	NA	NA	0.981	0.792	NA	NA	NA	0.894	0.835
Manganese	NA	NA	NA	0.0181	0.022	NA	NA	NA	0.0249	0.0252
Nickel	NA	NA	NA	0.0021 J	0.00355 J	NA	NA	NA	0.00216 J	0.00216 J
Potassium	NA	NA	NA	1.81	2.8	NA	NA	NA	3.63	3.66

TABLE 3-8

ANALYTICAL RESULTS FOR INORGANIC CONSTITUENTS IN SEDIMENT AND WATER SAMPLES FROM CATCH BASINS[1,2]

PSC Washougal Facility
Washougal, Washington

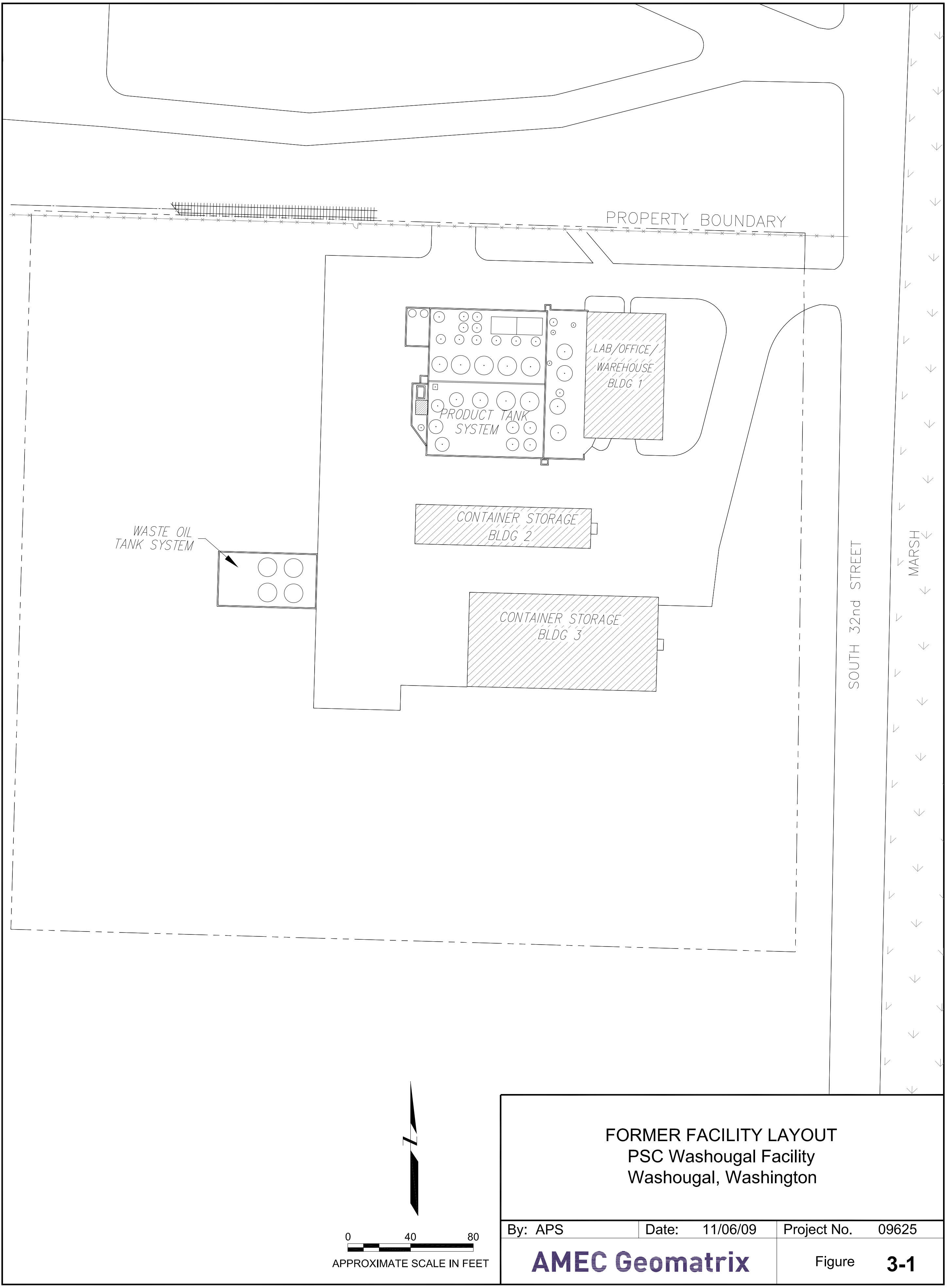
Concentrations in milligrams per kilogram (mg/kg) or milligrams per liter (mg/L)

Analyte	CB-1 9/20/2007	CB-2 9/25/2007	CB-3 9/25/2007	CB-4 9/20/2007	CB-5 9/25/2007	CB-6 9/25/2007	CB-6 Duplicate 9/25/2007	CB-7 9/20/2007	CB-8 9/25/2007	CB-8 Duplicate 9/25/2007
Dissolved Metals in Water (mg/L)										
Silver	NA	NA	NA	0.000011	0.00002	NA	NA	NA	0.000004	0.000005
Sodium	NA	NA	NA	1.62 U	11	NA	NA	NA	9.06	9.16
Vanadium	NA	NA	NA	0.00099	0.00142	NA	NA	NA	0.00033	0.00038
Zinc	NA	NA	NA	0.0203	0.0621	NA	NA	NA	0.0621	0.0702

Notes
1. Only constituents detected in at least one sample are shown.
2. Laboratory data flags are as follows:
   J = analyte
   U = analyte

Abbreviations
mg/kg = milligrams per kilogram
mg/L = milligrams per liter
NA = not analyzed

FIGURES



FORMER FACILITY LAYOUT
PSC Washougal Facility
Washougal, Washington

By: APS
Date: 11/06/09
Project No. 09625

AMEC Geomatrix

Figure 3-1

Plot Date: 11/06/09 - 1:03pm, Plotted by: adam.stenberg
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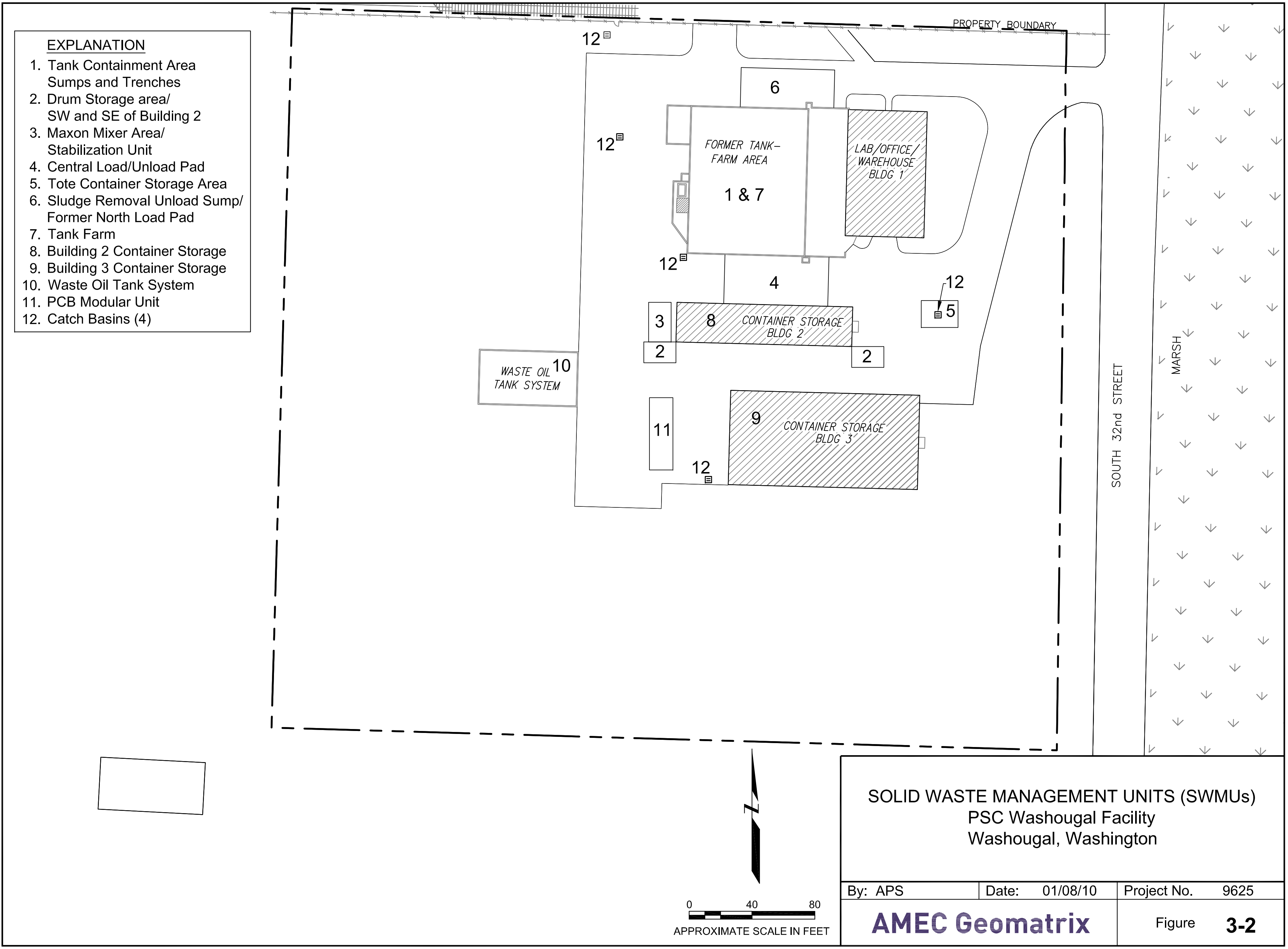

EXPLANATION

1. Tank Containment Area Sumps and Trenches
2. Drum Storage area/ SW and SE of Building 2
3. Maxon Mixer Area/ Stabilization Unit
4. Central Load/Unload Pad
5. Tote Container Storage Area
6. Sludge Removal Unload Sump/ Former North Load Pad
7. Tank Farm
8. Building 2 Container Storage
9. Building 3 Container Storage
10. Waste Oil Tank System
11. PCB Modular Unit
12. Catch Basins (4)

SOLID WASTE MANAGEMENT UNITS (SWMUs)
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 01/08/10	Project No. 9625
AMEC Geomatrix		Figure 3-2

Plot Date: 01/08/10 - 3:05pm, Plotted by: adam.stenberg
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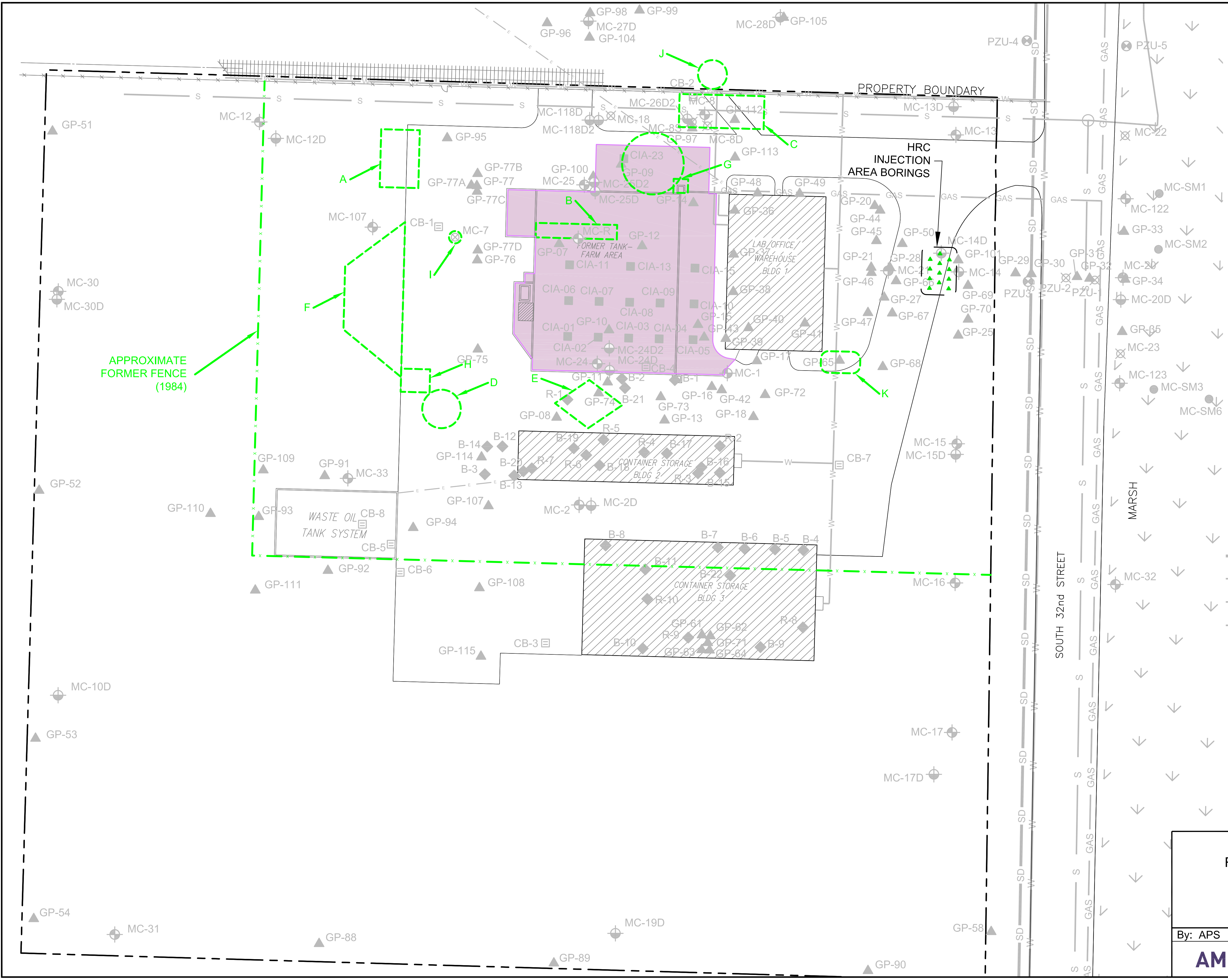

KEY TO HISTORIC RELEASES

A. Settling pond, no evidence ever constructed (1980)
B. Buried paraformaldehyde tank (1980)
C. 1980 solvent distillate sewer release
D. Defoamer spill (1982)
E. Formaldehyde release (1982)
F. Distillation bottoms release (1982)
G. Solvent sump and approximate overflow/discharge area (1983)
H. Buried fatty alcohol solids (1982)
I. Potential dry well
J. Motor oil staining; Mr. McClary reported that neighbor spilled drum of motor oil (1985)
K. Area 4 suspected defoamer or product spills

EXPLANATION

R-8 ◆	Historic Surface Soil/Concrete Sample
CIA-01 ■	Historic Tank Farm Excavation Soil Confirmation Sample
GP-33 ▲	Direct-Push Sample Location
MC-17 ⊕	Existing Shallow Groundwater Zone Monitoring Well
MC-17D ⊕	Existing Lower Aquifer Monitoring Well
PZU3 ⊗	Piezometer
MC-7 ⊠	Abandoned Monitoring Well / Piezometer
CB-7 ⊟	Catch Basin Sampling Point
MC-SM3 ●	Pore Water Sample Location
—SD—	Storm Sewer (18-Inch)
—S—	Sanitary Sewer (10-Inch)
—W—	Water line (14-Inch)
—GAS—	Gas line
▨	Area of 1997 Excavation

NOTE:
Locations of historical releases are approximated based on historical records, including hand-drawn maps in ecology records, reports, and court records.

0 25 50
APPROXIMATE SCALE IN FEET

REPORTED HISTORICAL RELEASES
PSC Washougal Facility
Washougal, Washington

By: APS
Date: 01/12/10
Project No. 9625
AMEC Geomatrix
Figure 3-3

Plot Date: 01/12/10 - 5:08pm, Plotted by: adam.stenberg
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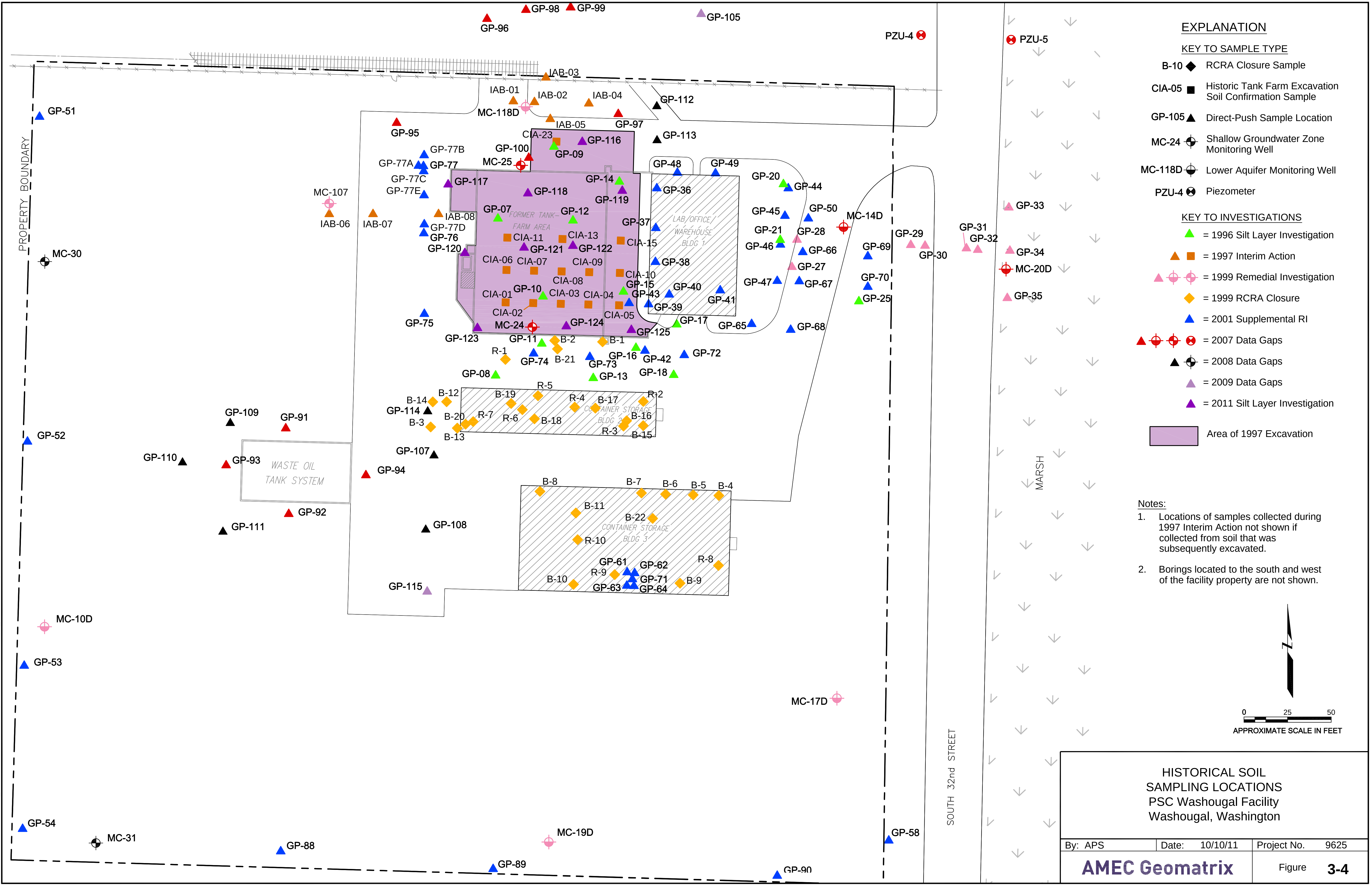

EXPLANATION

KEY TO SAMPLE TYPE

B-10 ◆ RCRA Closure Sample

CIA-05 ■ Historic Tank Farm Excavation Soil Confirmation Sample

GP-105 ▲ Direct-Push Sample Location

MC-24 ⊕ Shallow Groundwater Zone Monitoring Well

MC-118D ⊕ Lower Aquifer Monitoring Well

PZU-4 ⊗ Piezometer

KEY TO INVESTIGATIONS

▲ = 1996 Silt Layer Investigation

▲ ■ = 1997 Interim Action

▲ ⊕ ⊕ = 1999 Remedial Investigation

◆ = 1999 RCRA Closure

▲ = 2001 Supplemental RI

▲ ⊕ ⊕ ⊗ = 2007 Data Gaps

▲ ⊕ = 2008 Data Gaps

▲ = 2009 Data Gaps

▲ = 2011 Silt Layer Investigation

▨ Area of 1997 Excavation

Notes:

1. Locations of samples collected during 1997 Interim Action not shown if collected from soil that was subsequently excavated.
2. Borings located to the south and west of the facility property are not shown.

HISTORICAL SOIL
SAMPLING LOCATIONS
PSC Washougal Facility
Washougal, Washington

By: APS | Date: 10/10/11 | Project No. 9625

AMEC Geomatrix | Figure 3-4

Plot Date: 10/10/11 - 3:44pm, Plotted by: adam.stenberg
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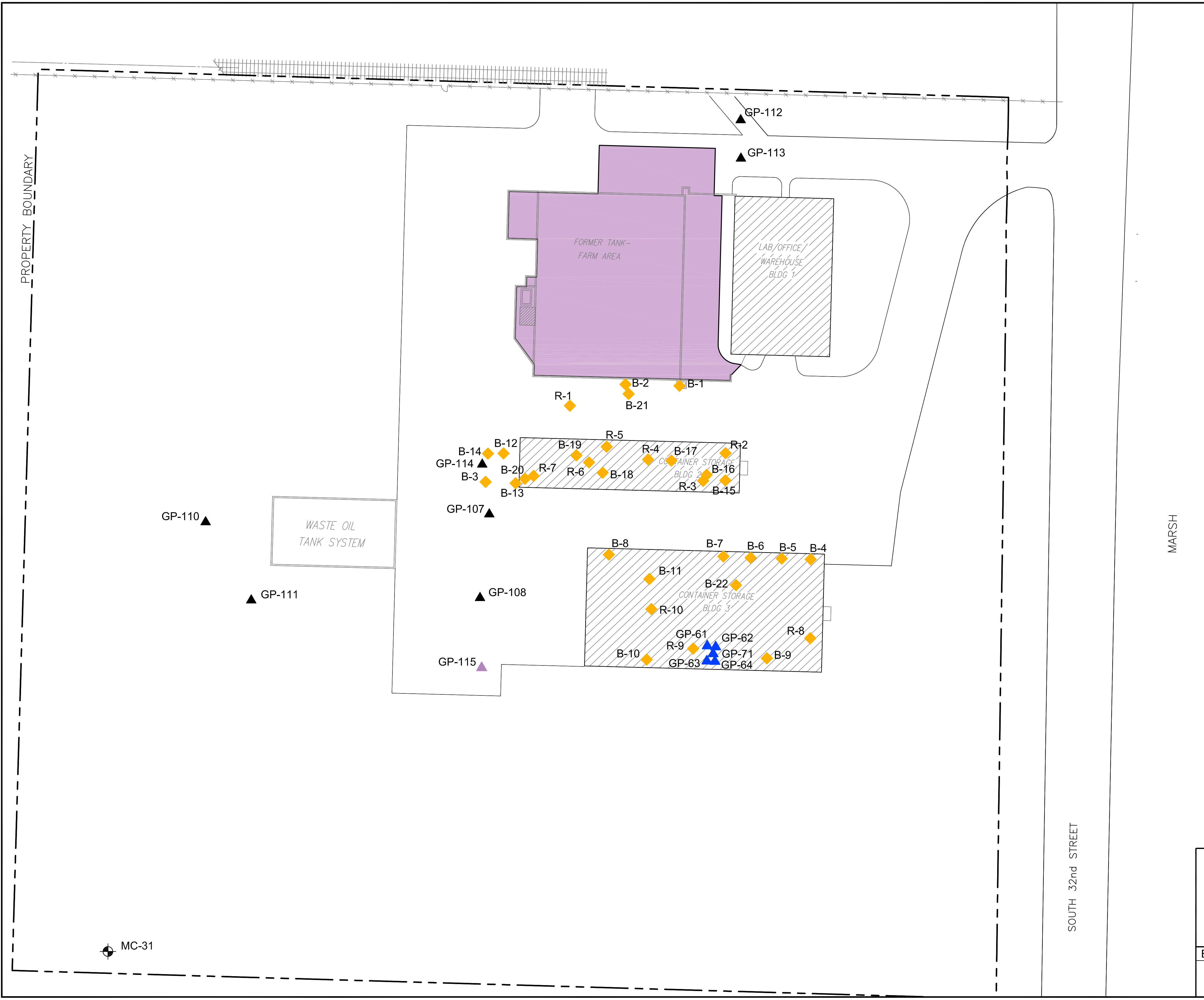

EXPLANATION

KEY TO SAMPLE TYPE

B-10 ◆ RCRA Closure Sample

GP-107 ▲ Direct-Push Sample Location

MC-31 ⌖ Shallow Groundwater Zone Monitoring Well

KEY TO INVESTIGATIONS

◆ = 1999 RCRA Closure

▲ = 2001 Supplemental RI

▲ ⌖ = 2008 Data Gaps

▲ = 2009 Data Gaps

▨ Area of 1997 Excavation

Notes:

1. Locations of samples collected during 1997 Interim Action not shown if collected from soil that was subsequently excavated.
2. Shallow soil samples collected between ground surface and 1 foot below ground surface are shown.

0 25 50

APPROXIMATE SCALE IN FEET

HISTORICAL SHALLOW SOIL SAMPLING LOCATIONS
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 08/04/11	Project No. 9625
AMEC Geomatrix		Figure 3-5

Plot Date: 08/04/11 - 2:18pm, Plotted by: adam.stenberg
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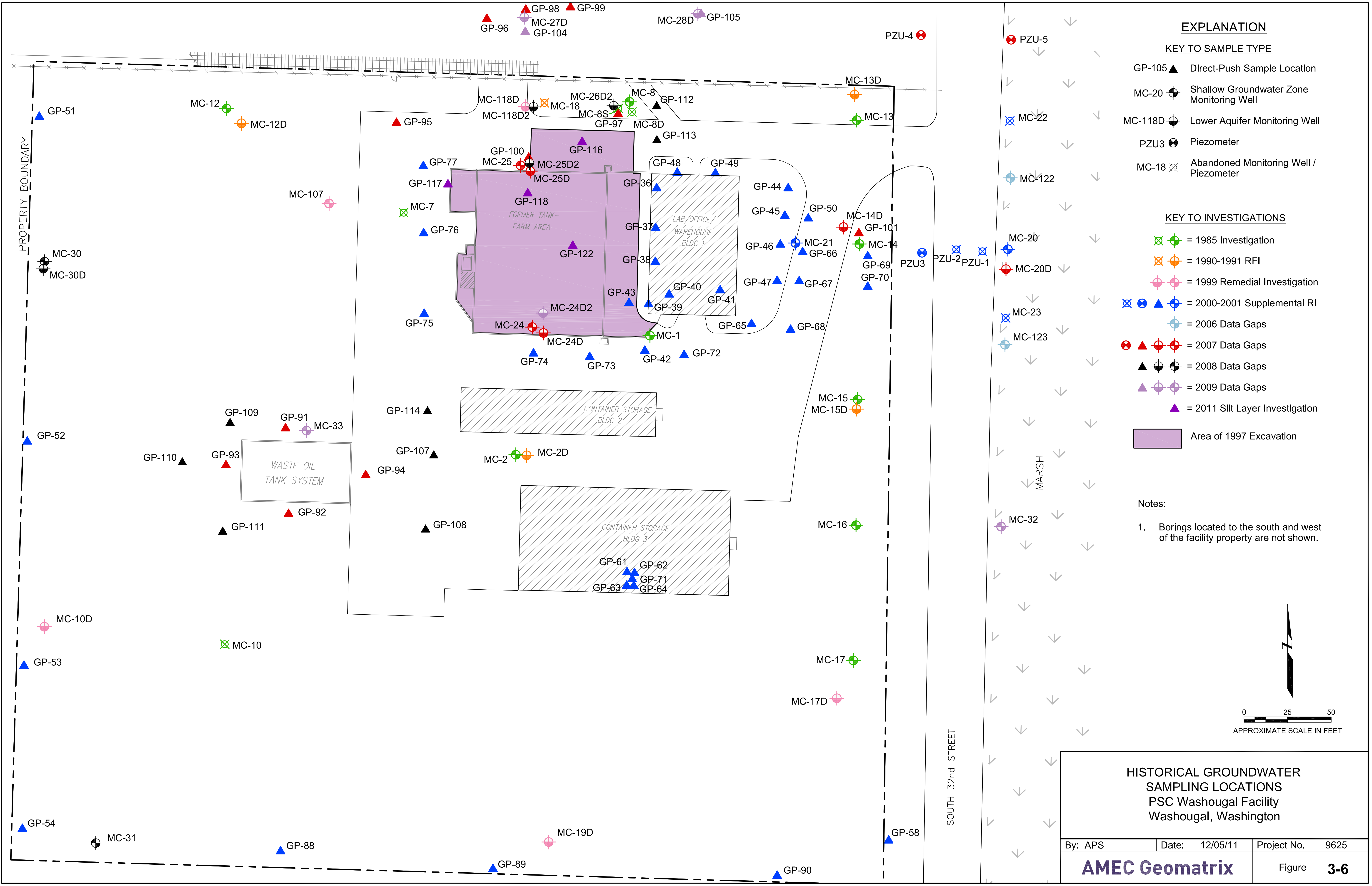

HISTORICAL GROUNDWATER
SAMPLING LOCATIONS
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/05/11	Project No. 9625
AMEC Geomatrix		Figure 3-6

Plot Date: 12/05/11 - 10:05am, Plotted by: adam.stenberg
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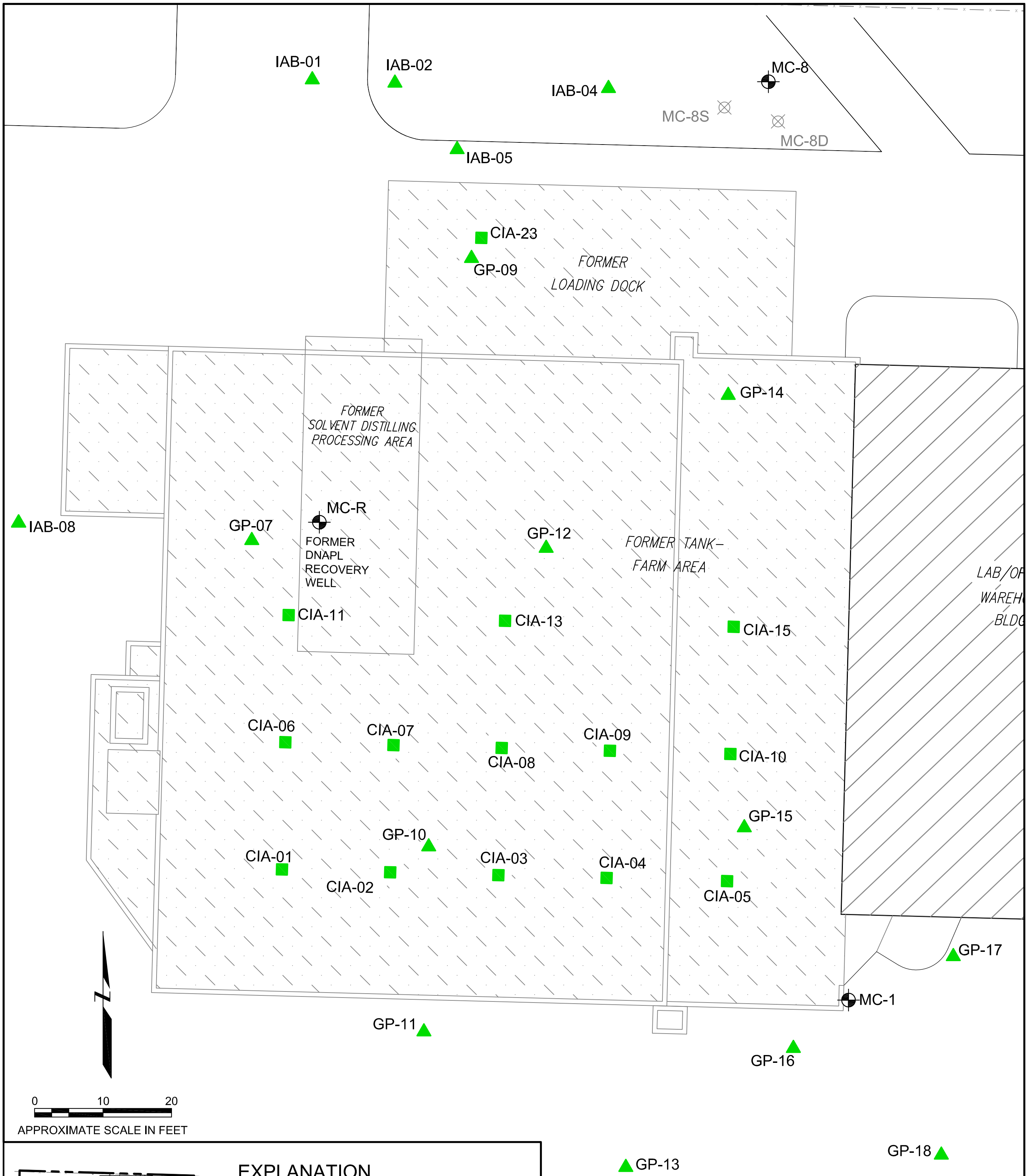

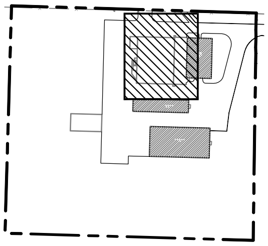

SITE MAP

EXPLANATION

- ⊕ Shallow Groundwater Zone Monitoring Well / Piezometer
- ⊗ Abandoned Monitoring Well
- ▲ Soil Borings
- 🟩 Confirmation Soil Sample
- ▨ 1997 Excavation

SAMPLING LOCATIONS RELATED TO
1997 EXCAVATION IN FORMER TANK FARM AREA
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 08/04/11	Project No. 9625
AMEC Geomatrix		Figure 3-7

Plot Date: 08/04/11 - 11:52am, Plotted by: adam.stenberg
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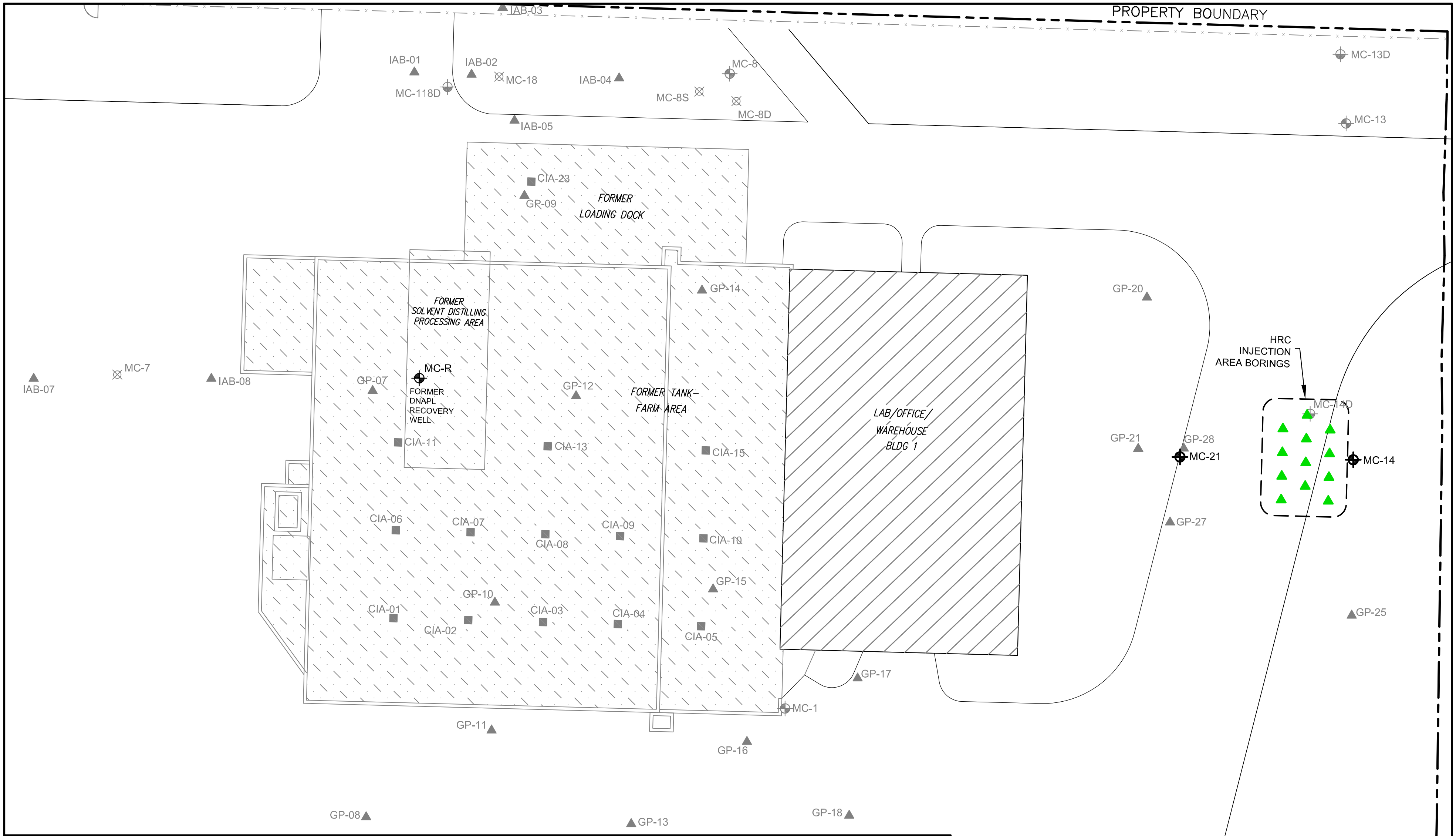
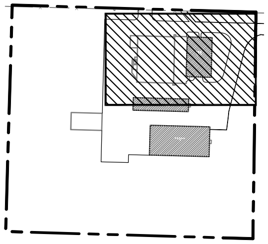




SITE MAP

EXPLANATION

⊕ Shallow Groundwater Zone Monitoring Well / Piezometer

⊗ Abandoned Monitoring Well

▲ HRC Area Borings

▲ Historical Soil Borings

■ Confirmation Soil Sample, 1997 Interim Action

▨ 1997 Excavation

N

0 15 30

APPROXIMATE SCALE IN FEET

FORMER TANK FARM AREA RELATED TO HRC PILOT TEST DIRECT-PUSH BORINGS
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 08/04/11	Project No. 9625
AMEC Geomatrix		Figure 3-8

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT McCLARY - COLUMBIA **Page** 1 **of** 1

Location East side of fence in McClary yard

Boring No. MC-14

Surface Elevation Top of PVC 18.38 ft.

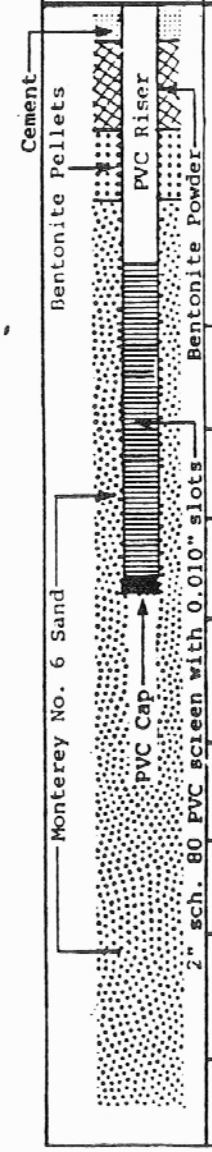
Drilling Method 6" I.D. Hollow Stem Auger

Total Depth 16.5 ft.

Drilled By Geo-Tech Exploration, Inc.

Date Completed 6/7/85

Logged By S. Henshaw



WELL DETAILS	PENETRATION TIME/RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
		0						
	6/5/5	5 ▽	1	SS		SP	5.0-6.5' SAND, gray, medium grained, clean, poorly graded, some organics, "Dredge Spoils", saturated.	
	2/4/2		2	SS		SP	6.5-8.0' SAND, gray, same as above.	
	1/1/2		3	SS		SP ML	8.0-9.5' SAND, same as above.8.0-9.0' SILT, gray-black to green, abundant vegetal matter, SAND/SILT contact at 9.0'.	
		10	4	Shelby Tube		ML	9.5-11.5' SILT, same as above, slightly mottled.	
	4/4/5		5	SS		ML	11.5-13.0' SILT, same as above, mottled orange.	
	2/3/4		6	SS		ML	13.0-14.5' SILT, same as above.	
		15	7	Shelby Tube		ML	14.5-16.5' SILT, same as above.	

SEA-300-02a

MC-14 WELL CONSTRUCTION LOG
PSC Washougal Facility
Washougal, Washington

By: APS | Date: 08/04/11 | Project No. 9625

AMEC Geomatrix

Figure **3-9**

Plot Date: 08/04/11 - 11:59am, Plotted by: adam.stenberg
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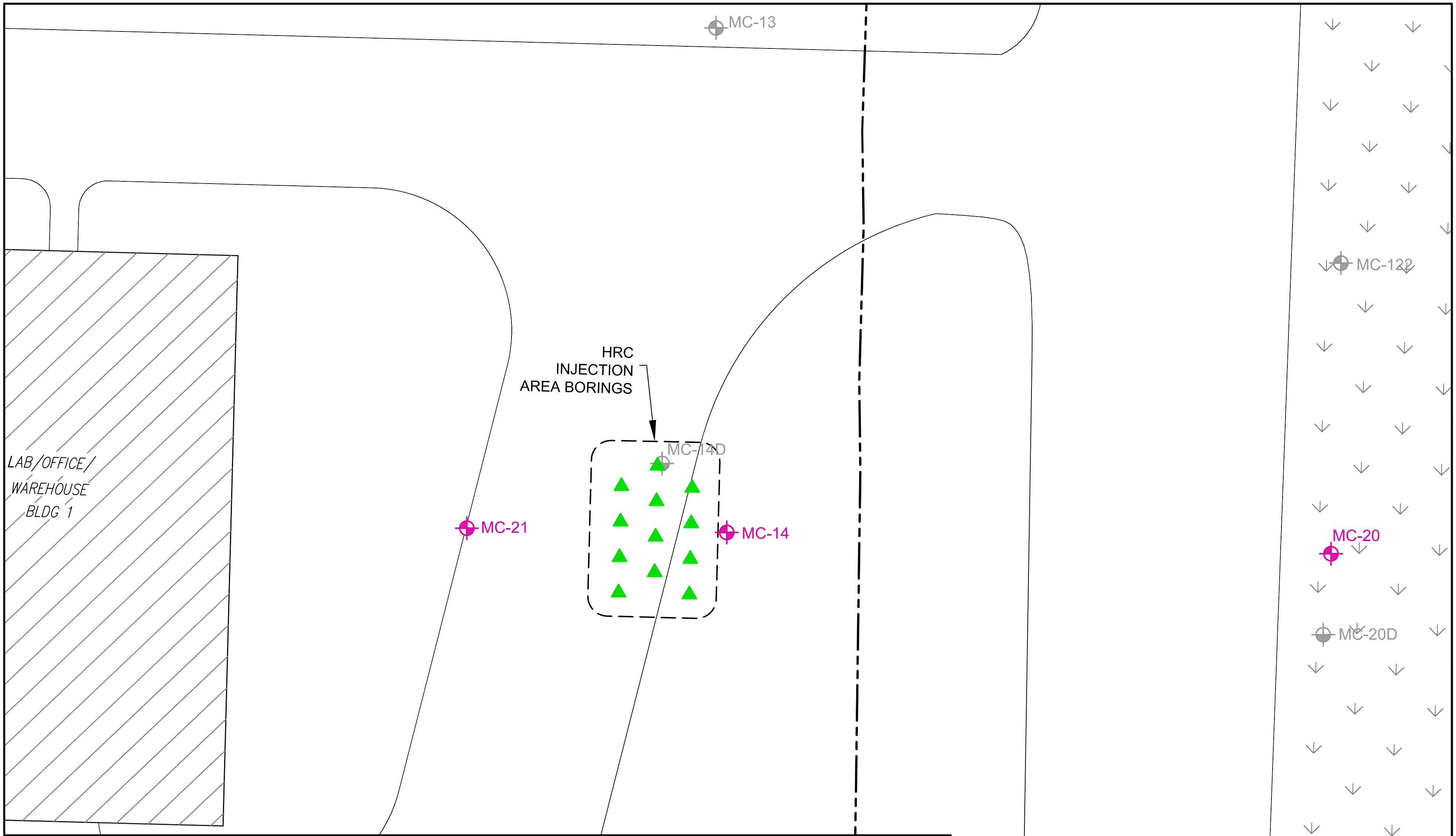
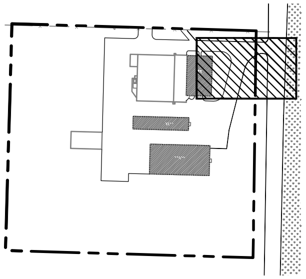
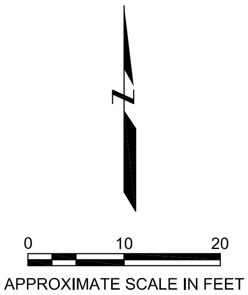




SITE MAP

EXPLANATION

⌖	Shallow Groundwater Zone Monitoring Well / Piezometer
⌖	Lower Aquifer Monitoring Well
⊗	Abandoned Monitoring Well
▲	HRC Area Borings



MC-14 HYDROGEN-RELEASING COMPOUND INJECTION PILOT TEST AREA
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 08/04/11	Project No. 9625
AMEC Geomatrix		Figure 3-10

Plot Date: 08/04/11 - 11:56am, Plotted by: adam.stenberg
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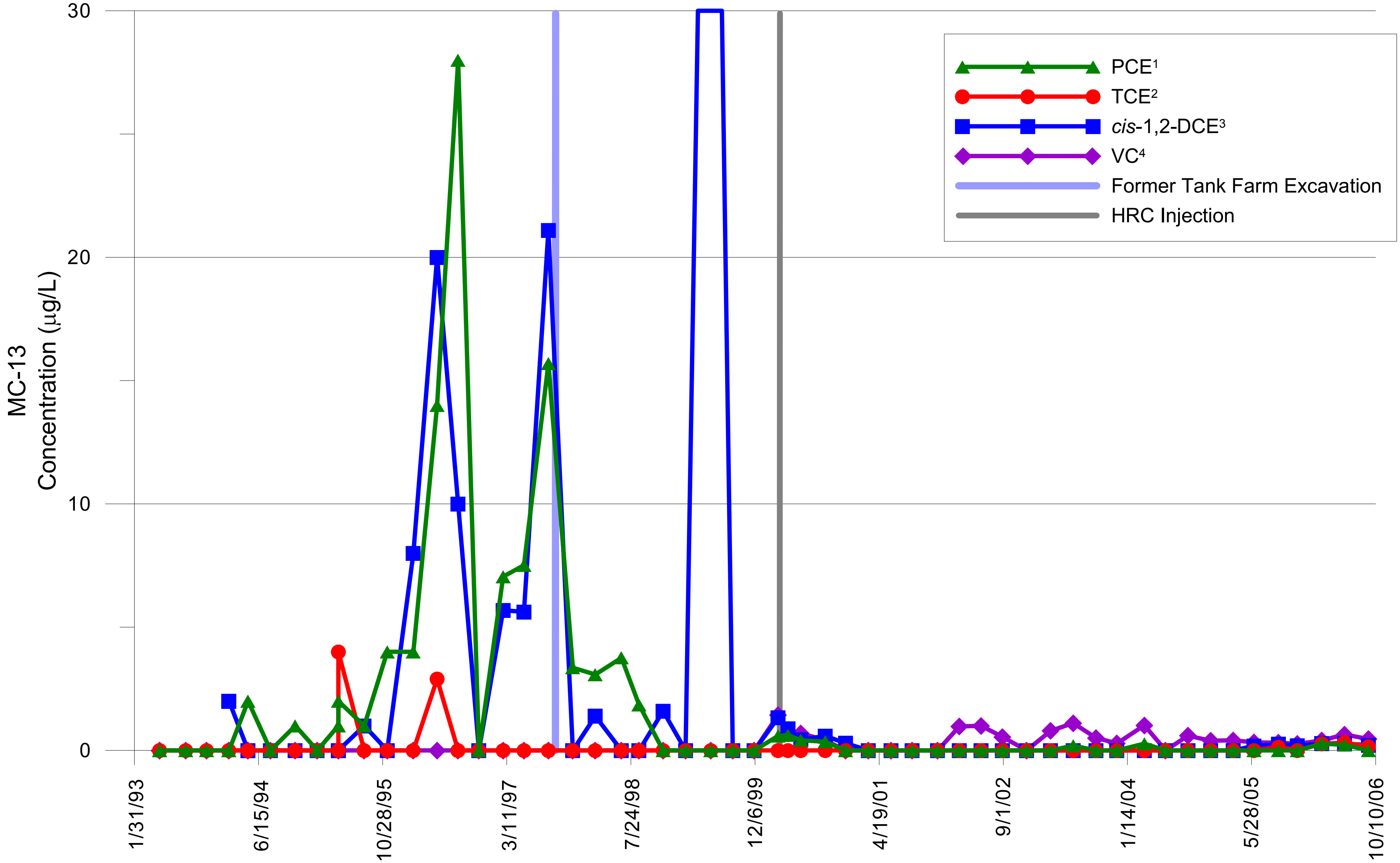

Abbreviations: *cis*-1,2-DCE = *cis*-1,2-Dichloroethene
HRC = hydrogen-release compounds
µg/L = micrograms per liter

PCE = tetrachloroethene
TCE = trichloroethene
VC = vinyl chloride

Notes:
1. Proposed cleanup level for PCE = 0.081 µg/L.
2. Proposed cleanup level for TCE = 0.11 µg/L.
3. Proposed cleanup level for *cis*-1,2-DCE = 16 µg/L.
4. Proposed cleanip level for VC = 0.025 µg/L.

AMEC Geomatrix

2000 HRC PILOT TEST - HISTORICAL TRENDS IN SELECTED VOCs - MC-13
PSC Washougal Facility
Washougal, Washington

Project No.
9625

Figure 3-11

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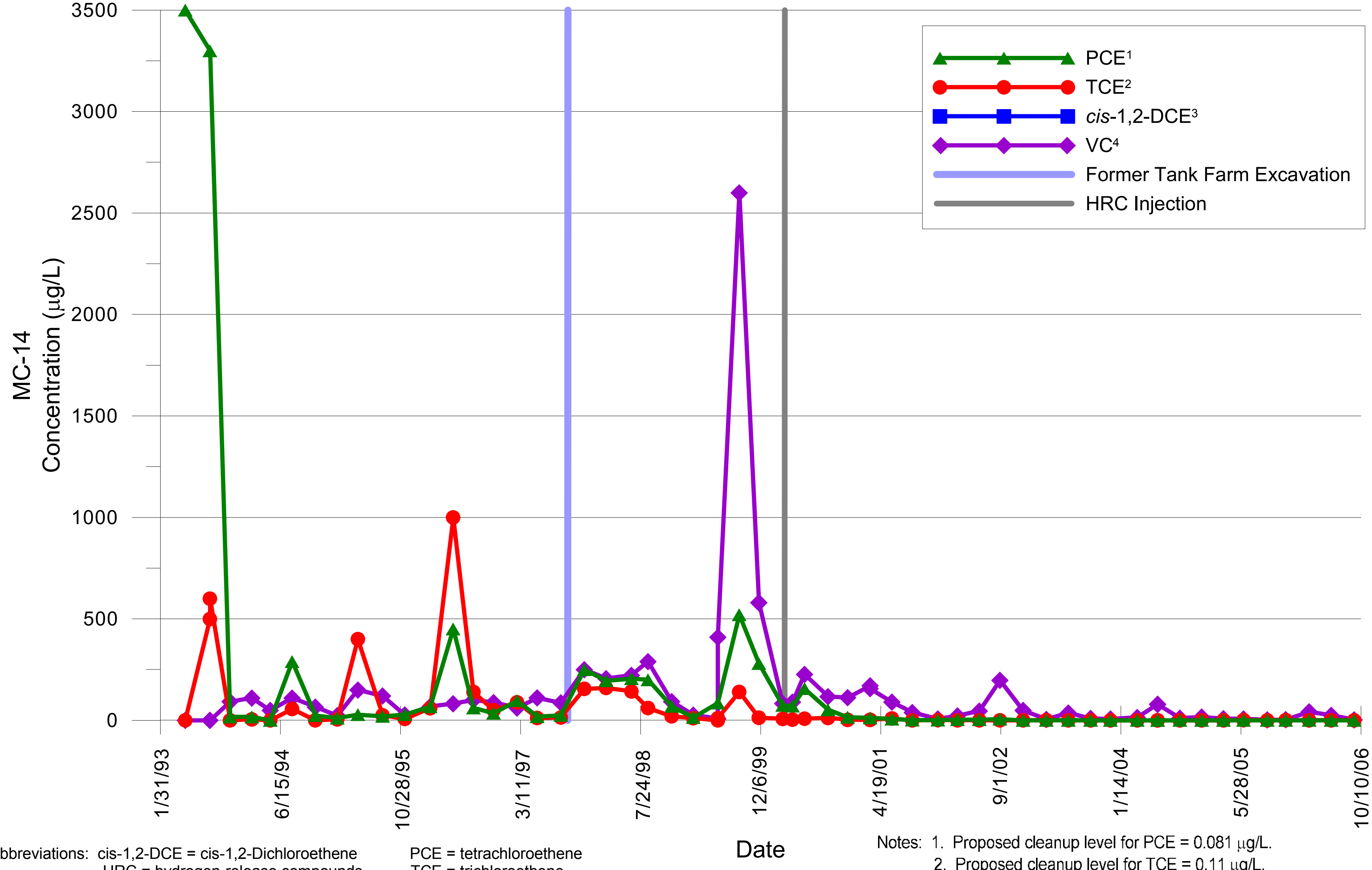

Abbreviations: cis-1,2-DCE = cis-1,2-Dichloroethene
HRC = hydrogen-release compounds
mg/L = micrograms per liter

PCE = tetrachloroethene
TCE = trichloroethene
VC = vinyl chloride

Notes:
1. Proposed cleanup level for PCE = 0.081 µg/L.
2. Proposed cleanup level for TCE = 0.11 µg/L.
3. Proposed cleanup level for *cis*-1,2-DCE = 16 µg/L.
4. Proposed cleanip level for VC = 0.025 µg/L.

AMEC Geomatrix

2000 HRC PILOT TEST - HISTORICAL TRENDS IN SELECTED VOCs - MC-14
PSC Washougal Facility
Washougal, Washington

Project No.
9625

Figure 3-12

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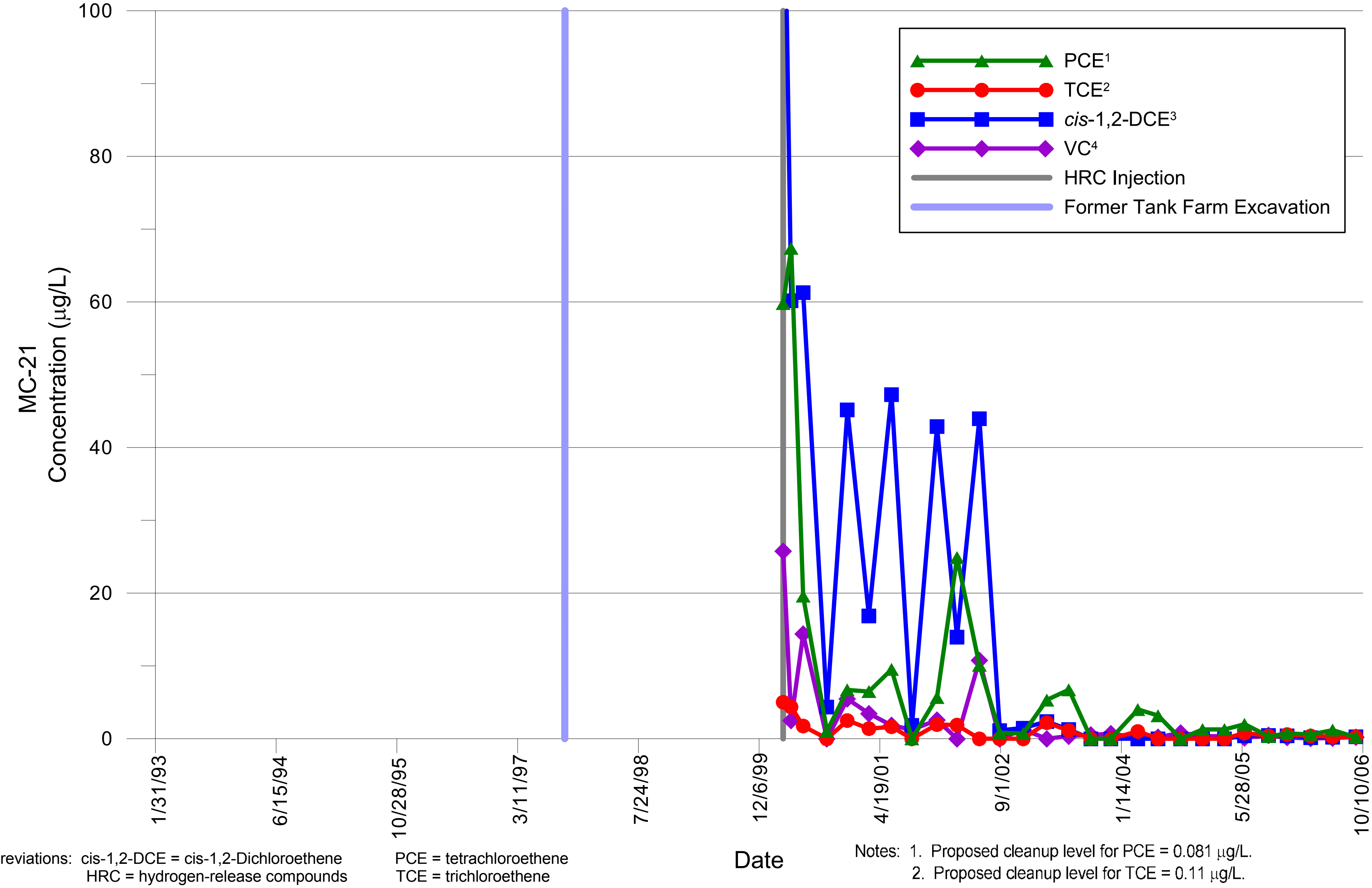

Abbreviations: cis-1,2-DCE = cis-1,2-Dichloroethene
HRC = hydrogen-release compounds
µg/L = micrograms per liter

PCE = tetrachloroethene
TCE = trichloroethene
VC = vinyl chloride

Notes:
1. Proposed cleanup level for PCE = 0.081 µg/L.
2. Proposed cleanup level for TCE = 0.11 µg/L.
3. Proposed cleanup level for *cis*-1,2-DCE = 16 µg/L.
4. Proposed cleanip level for VC = 0.025 µg/L.

AMEC Geomatrix

2000 HRC PILOT TEST - HISTORICAL TRENDS IN SELECTED VOCs - MC-21
PSC Washougal Facility
Washougal, Washington

Project No.
9625

Figure 3-13

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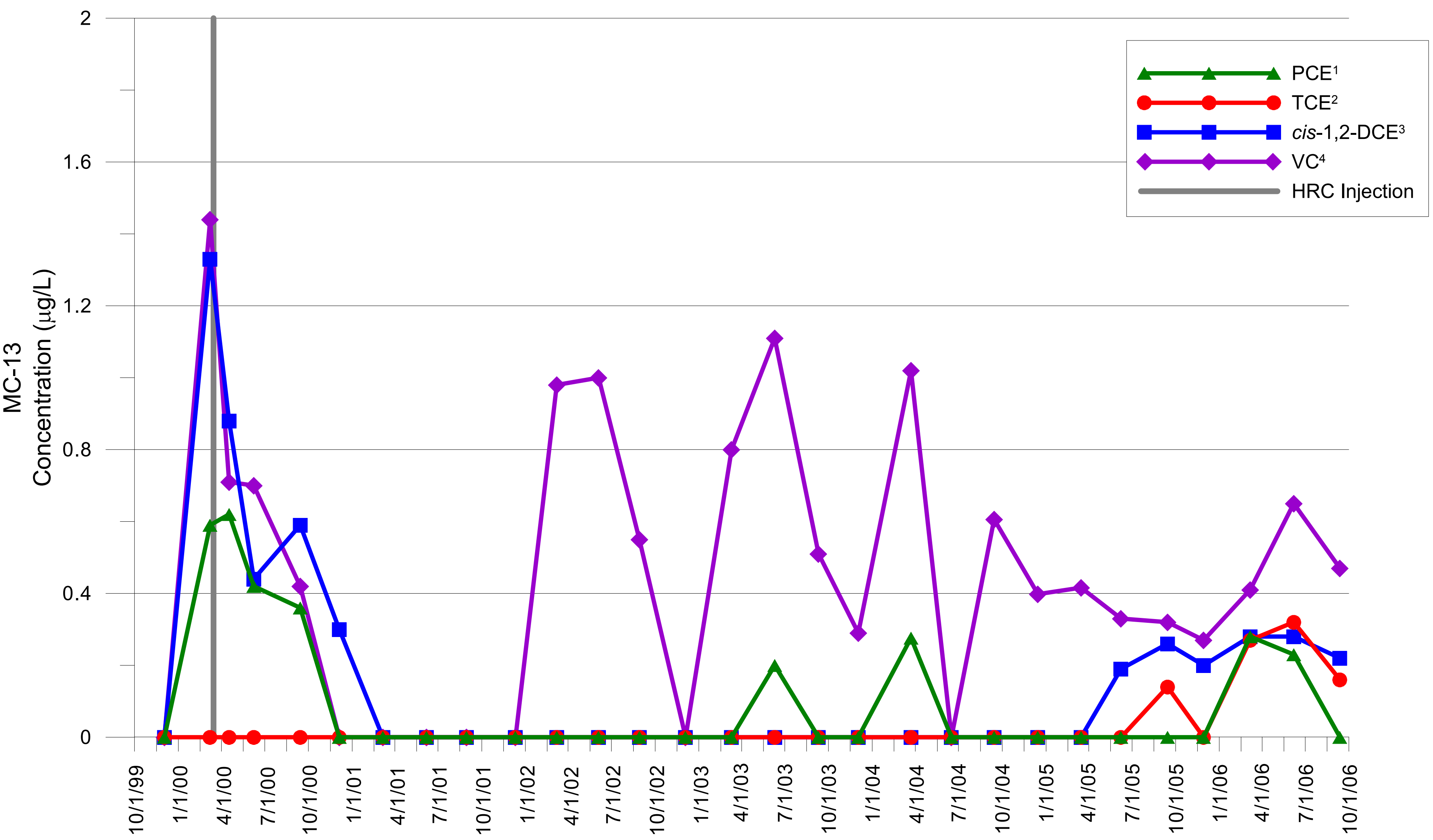

Abbreviations: cis-1,2-DCE = cis-1,2-Dichloroethene
HRC = hydrogen-release compounds
µg/L = micrograms per liter

PCE = tetrachloroethene
TCE = trichloroethene
VC = vinyl chloride

Notes:
1. Proposed cleanup level for PCE = 0.081 µg/L.
2. Proposed cleanup level for TCE = 0.11 µg/L.
3. Proposed cleanup level for *cis*-1,2-DCE = 16 µg/L.
4. Proposed cleanip level for VC = 0.025 µg/L.

AMEC Geomatrix

2000 HRC PILOT TEST - RECENT TRENDS IN SELECTED VOCs - MC-13
PSC Washougal Facility
Washougal, Washington

Project No.
9625

Figure 3-14

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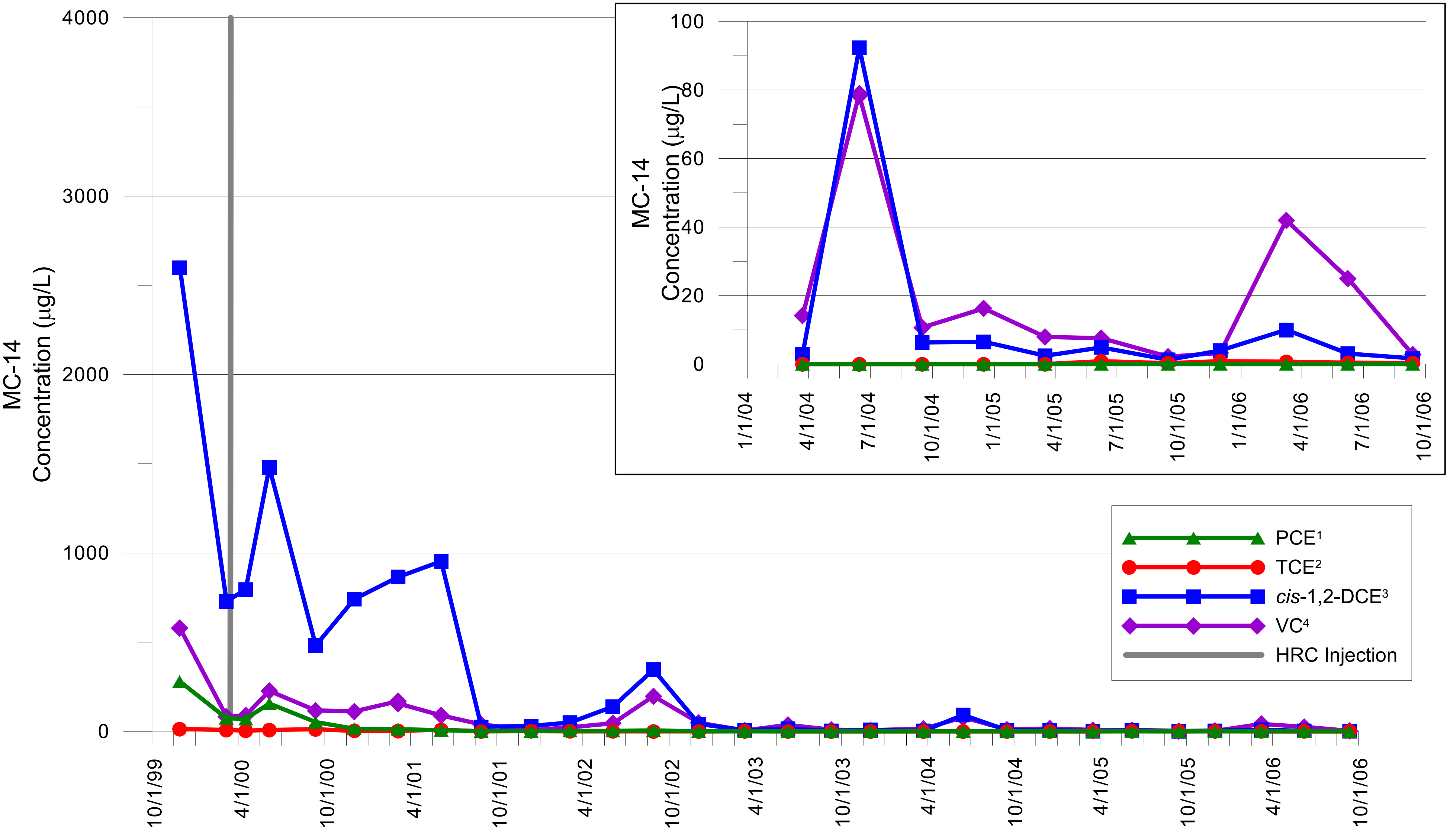


Notes: 1. Proposed cleanup level for PCE = 0.081 µg/L.
2. Proposed cleanup level for TCE = 0.11 µg/L.
3. Proposed cleanup level for *cis*-1,2-DCE = 16 µg/L.
4. Proposed cleanip level for VC = 0.025 µg/L.

Abbreviations:
cis-1,2-DCE = cis-1,2-Dichloroethene
HRC = hydrogen-release compounds
µg/L = micrograms per liter
PCE = tetrachloroethene
TCE = trichloroethene
VC = vinyl chloride

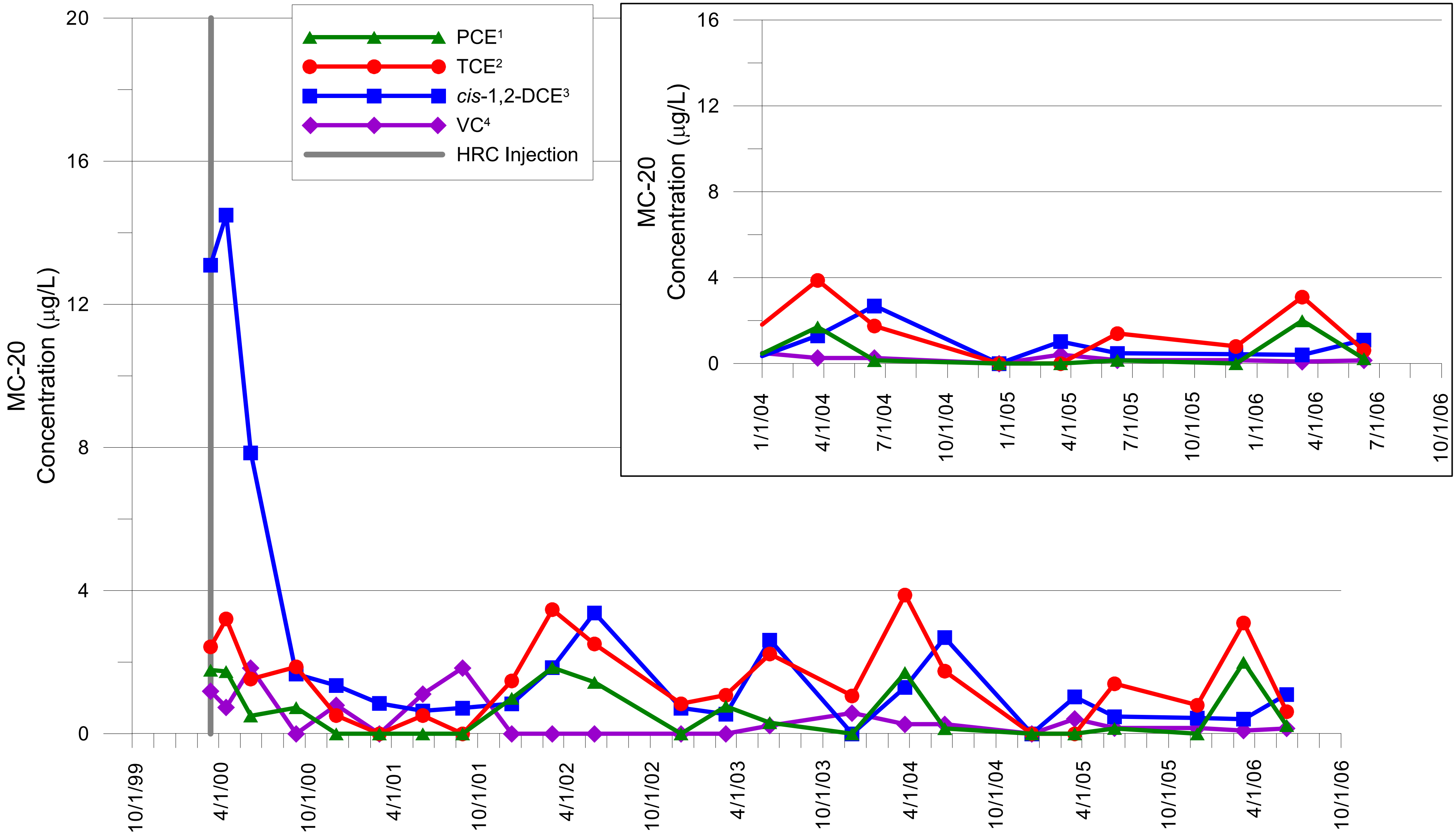
AMEC Geomatrix

2000 HRC PILOT TEST - RECENT TRENDS IN SELECTED VOCs - MC-14
PSC Washougal Facility
Washougal, Washington

Project No.
9625

Figure 3-15

P:\9625 - PSC Washougal\3000 REPORT\2009 RI FS Report\Figures\HRC Pilot Figures Revisions\Figure 7-8b.grf



Abbreviations: *cis*-1,2-DCE = *cis*-1,2-Dichloroethene
HRC = hydrogen-release compounds
µg/L = micrograms per liter

PCE = tetrachloroethene
TCE = trichloroethene
VC = vinyl chloride

Notes:
1. Proposed cleanup level for PCE = 0.081 µg/L.
2. Proposed cleanup level for TCE = 0.11 µg/L.
3. Proposed cleanup level for *cis*-1,2-DCE = 16 µg/L.
4. Proposed cleanip level for VC = 0.025 µg/L.

AMEC Geomatrix

2000 HRC PILOT TEST - RECENT TRENDS IN SELECTED VOCs - MC-20
PSC Washougal Facility
Washougal, Washington

Project No.
9625

Figure 3-16

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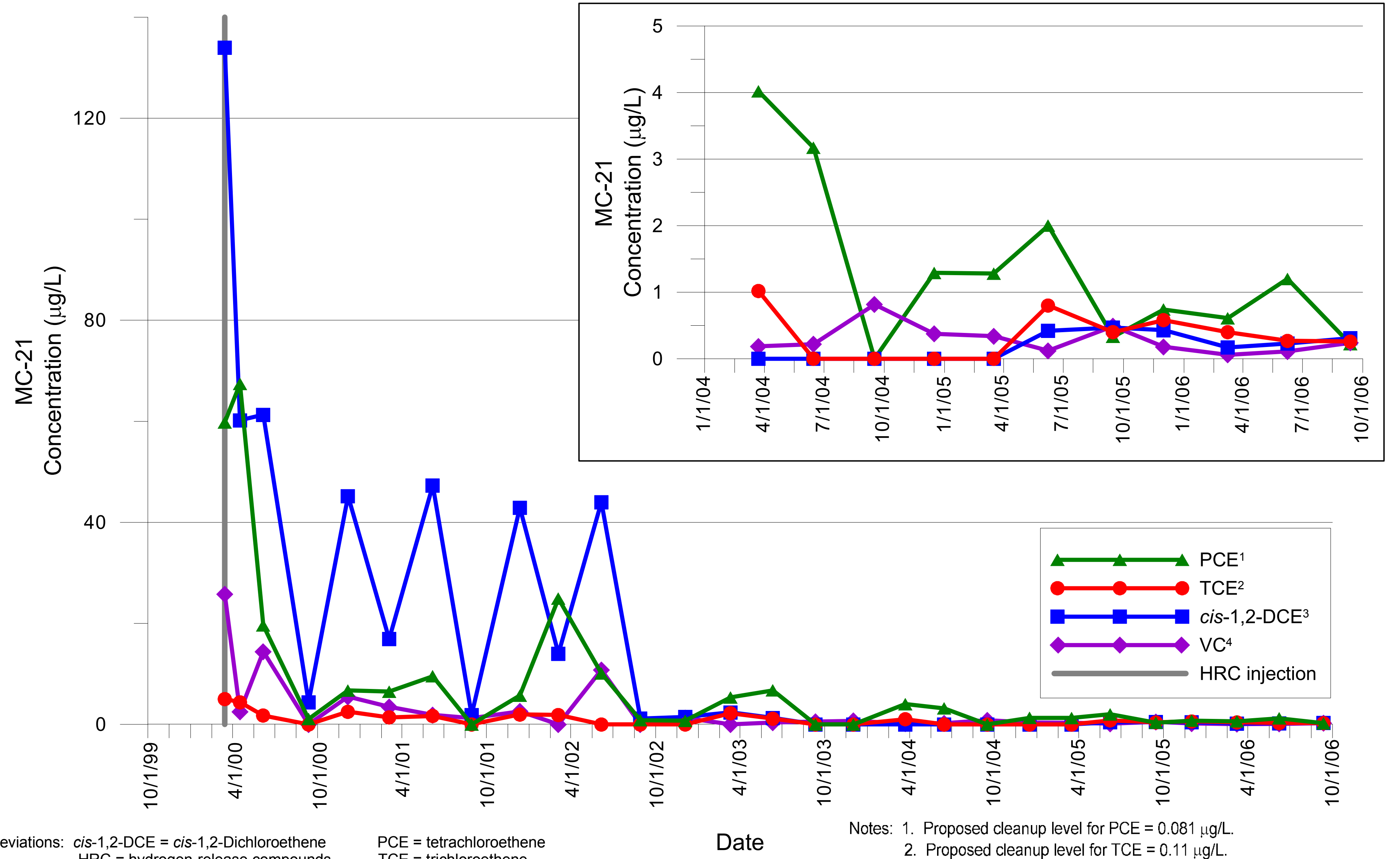

Abbreviations: *cis*-1,2-DCE = *cis*-1,2-Dichloroethene
HRC = hydrogen-release compounds
µg/L = micrograms per liter

PCE = tetrachloroethene
TCE = trichloroethene
VC = vinyl chloride

Notes:
1. Proposed cleanup level for PCE = 0.081 µg/L.
2. Proposed cleanup level for TCE = 0.11 µg/L.
3. Proposed cleanup level for *cis*-1,2-DCE = 16 µg/L.
4. Proposed cleanip level for VC = 0.025 µg/L.

AMEC Geomatrix

2000 HRC PILOT TEST - RECENT TRENDS IN SELECTED VOCs - MC-21
PSC Washougal Facility
Washougal, Washington

Project No.
9625

Figure 3-17

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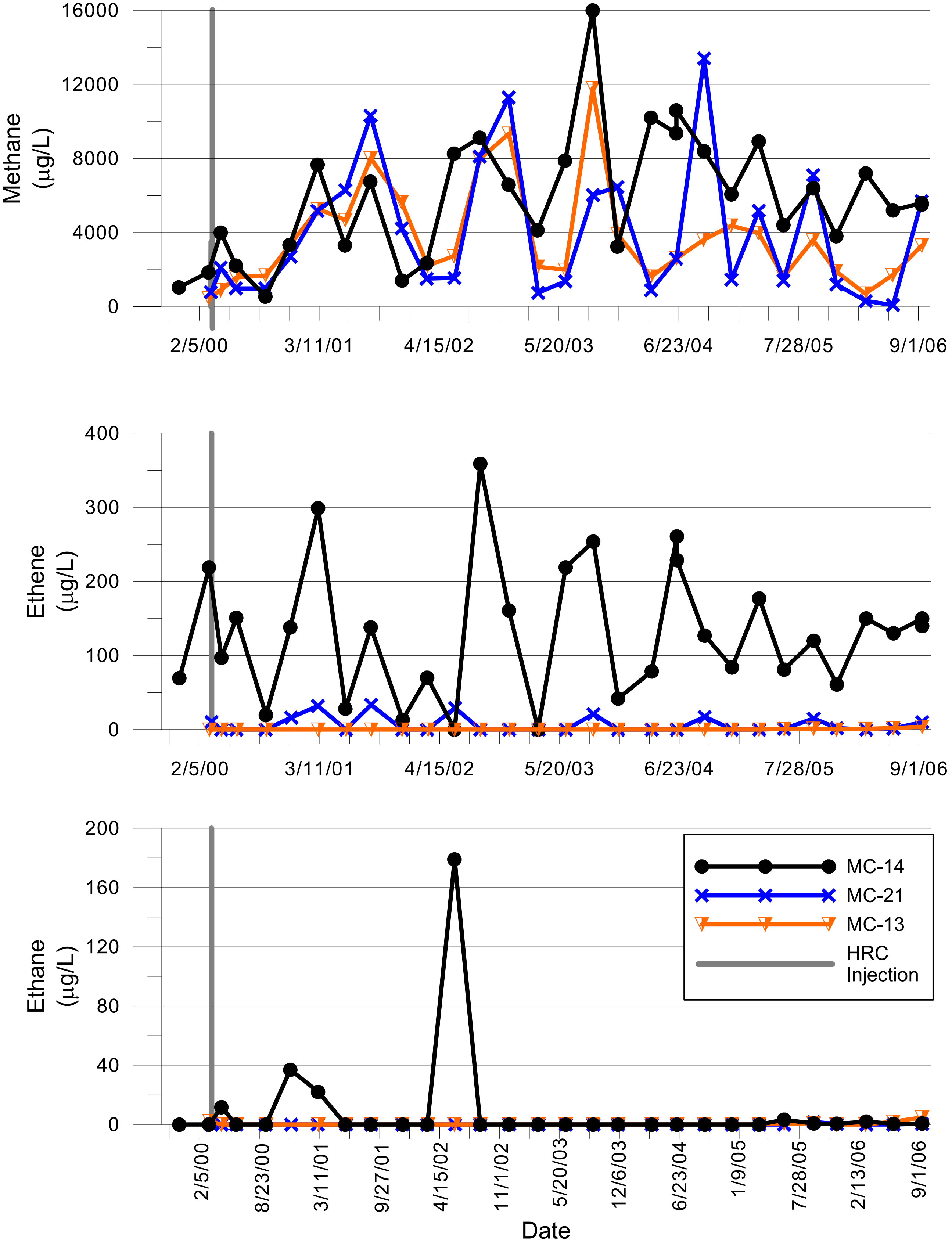
P:\9625 - PSC Washougal\3000 REPORT\2009 RI FS Report\Figures\HRC Pilot Figures Revisions\Figure 7-9.grf



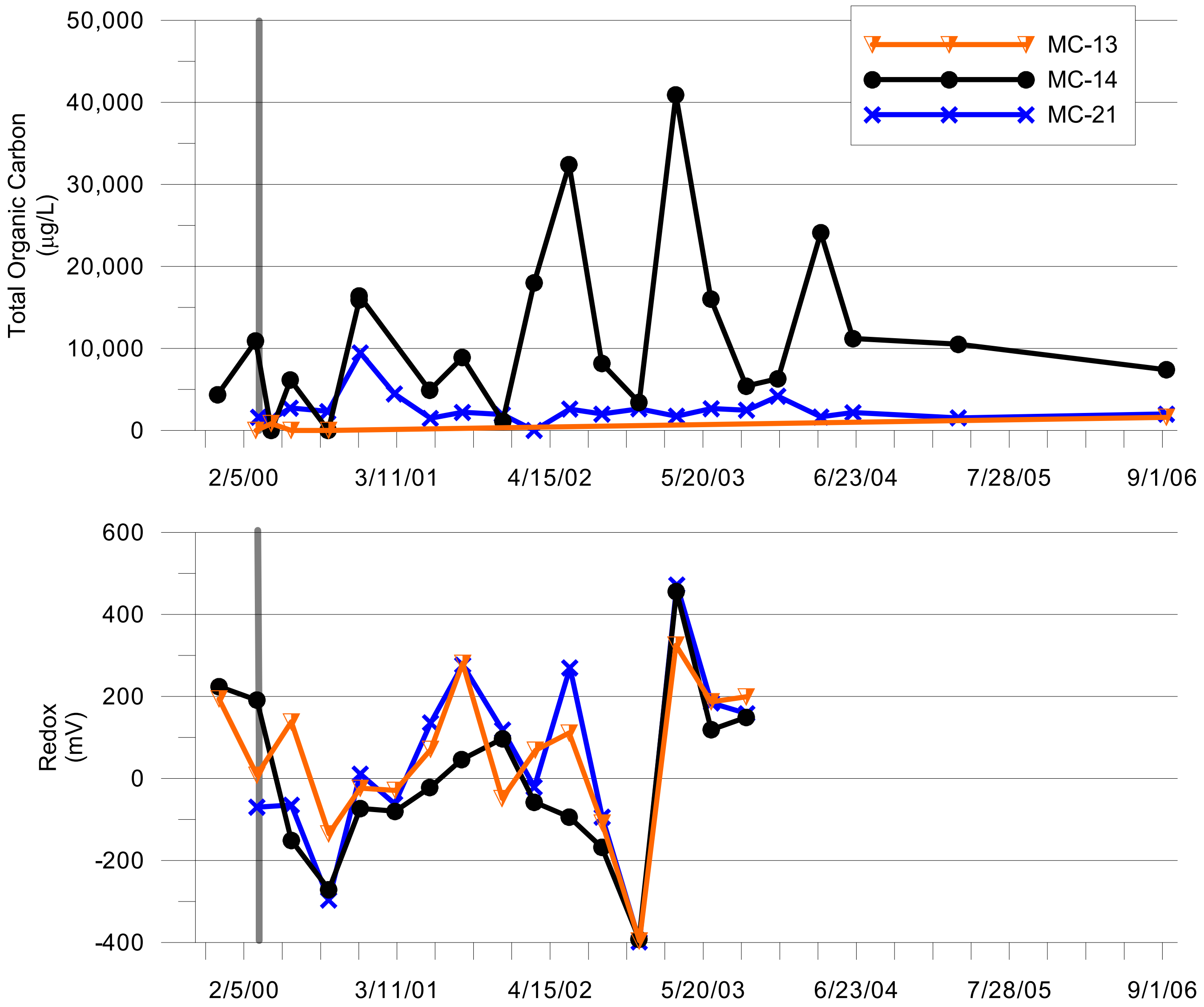
Abbreviations: HRC = hydrogen-release compounds
µg/L = micrograms per liter

AMEC Geomatrix

2000 HRC PILOT TEST
METHANE, ETHENE, AND ETHANE
PSC Washougal Facility
Washougal, Washington

Project No.
9625

Figure
3-18



Abbreviations: HRC = hydrogen-release compounds
µg/L = micrograms per liter
mV = millivolts
TOC = total organic carbon

AMEC Geomatrix

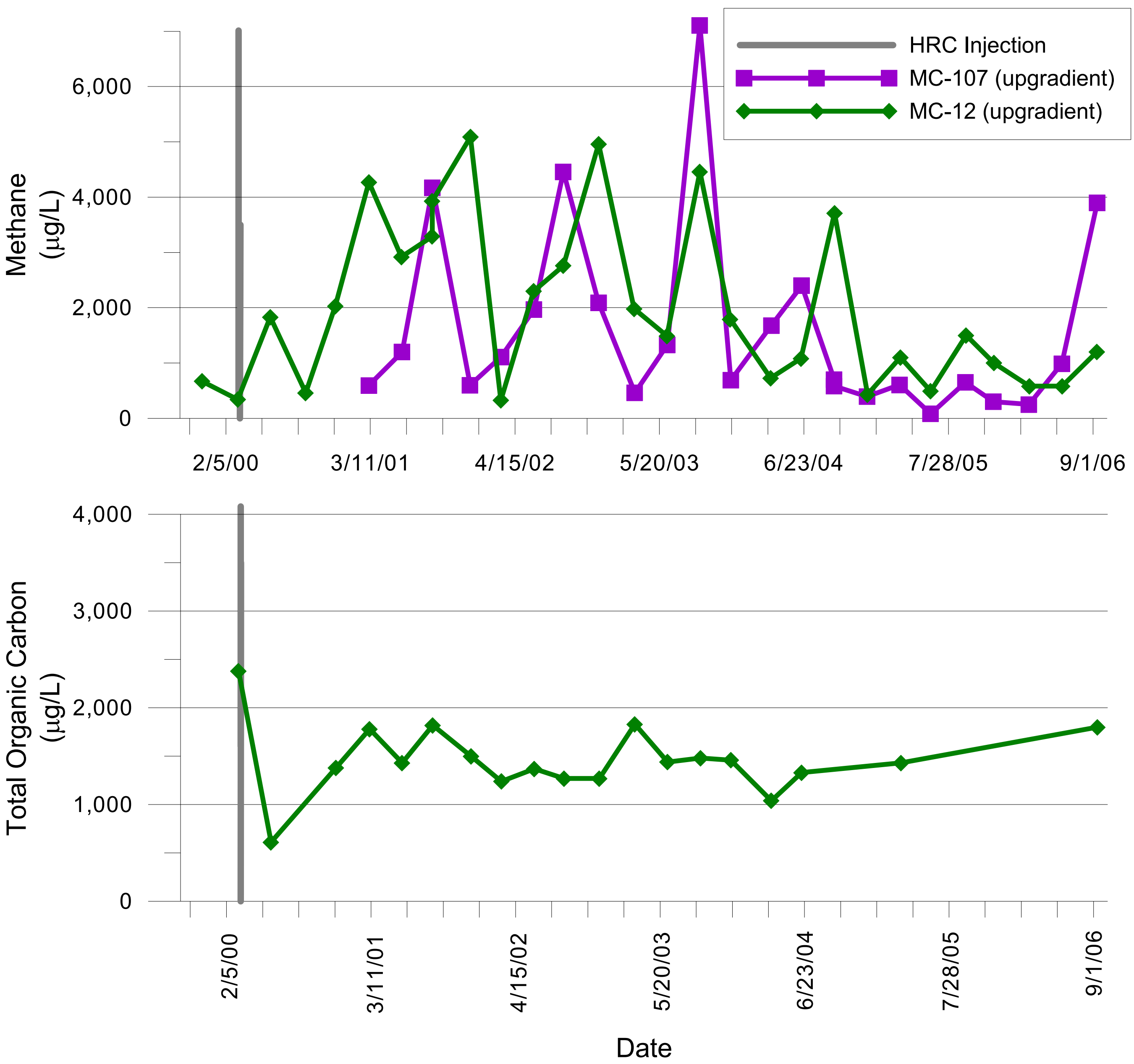
2000 HRC PILOT TEST
TOC AND REDOX POTENTIAL

PSC Washougal Facility
Washougal, Washington

Project No.
9625

Figure
3-19

P:\9625 - PSC Washougal\3000 REPORT\2009 RI FS Report\Figures\HRC Pilot Figures Revisions\Figure 7-10.grf



Abbreviations: HRC = hydrogen-release compounds TOC = total organic carbon
µg/L = micrograms per liter

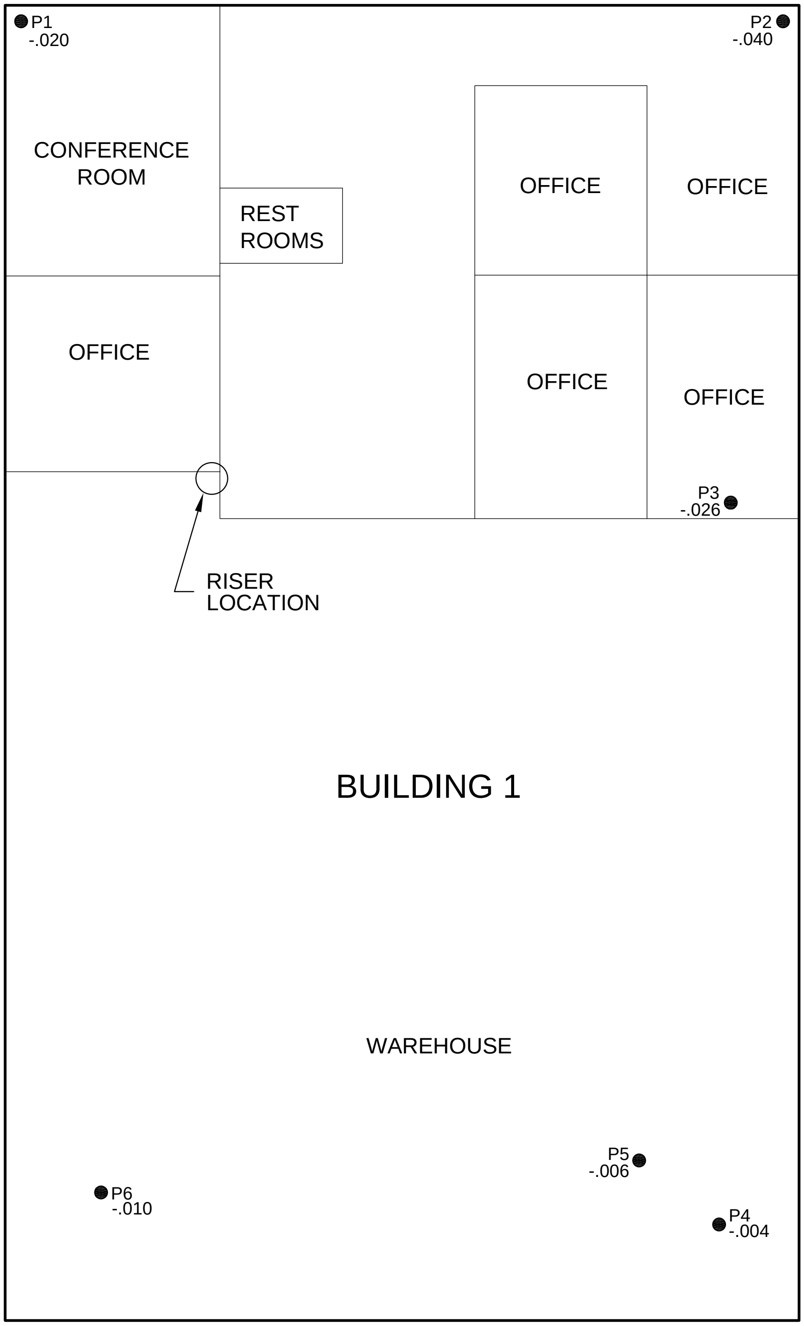
AMEC Geomatrix

2000 HRC PILOT TEST
UPGRADIENT METHANE AND TOC RESULTS
PSC Washougal Facility
Washougal, Washington

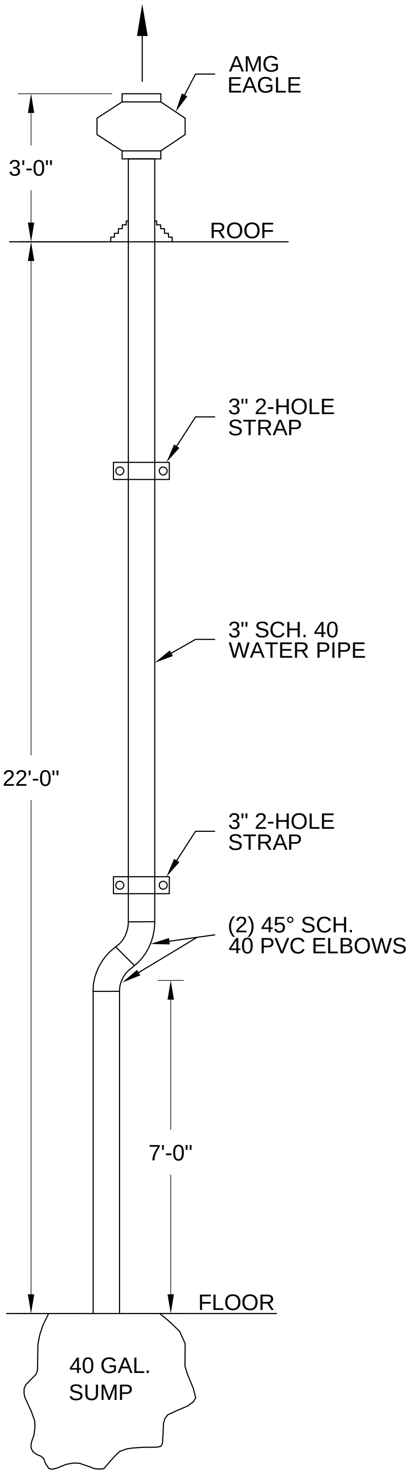
Project No.
9625

Figure
3-20

P:\9625 - PSC Washougal\3000 REPORT\2009 RI FS Report\Figures\HRC Pilot Figures Revisions\Figure 7-11.grf



PLAN



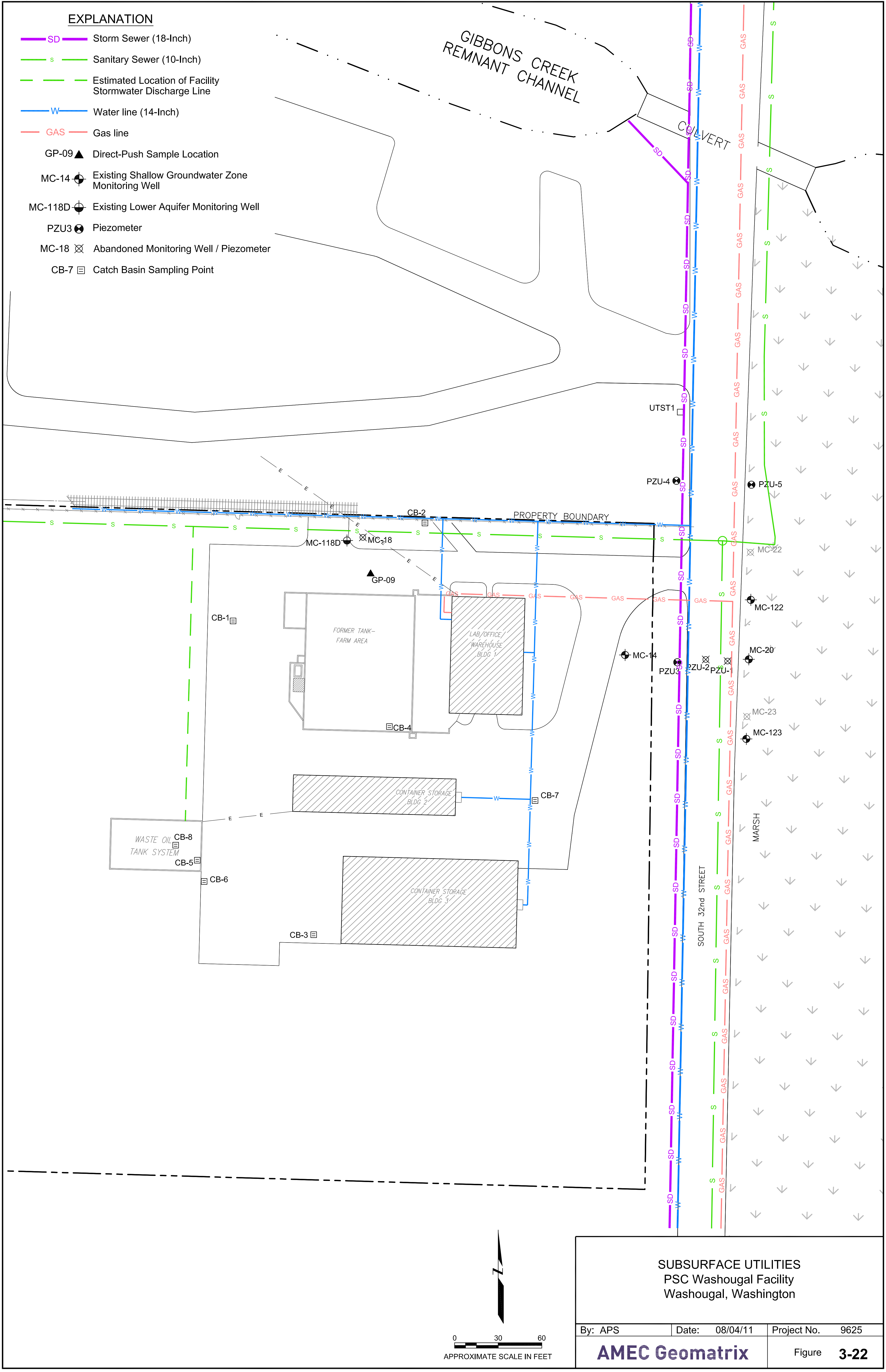
ELEVATION

BUILDING ONE
DEPRESSURIZATION SYSTEM
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 10/10/11	Project No. 9625
AMEC Geomatrix		Figure **3-21**

Plot Date: 10/10/11 - 3:50pm, Plotted by: adam.stenberg
Drawing Path: S:\9625\009_RIFS-2011\CAD\, Drawing Name: PSC Washougal_Building1-DepressSystem_101011.DWG

Plot Date: 08/04/11 - 2:14pm, Plotted by: adam.stenberg
Drawing Path: S:\9625\009_RIFS-2011\CAD\, Drawing Name: PSC Washougal_SubsurfUtil_080411.DWG



SUBSURFACE UTILITIES
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 08/04/11	Project No. 9625
AMEC Geomatrix		Figure **3-22**

4.0 DATA COLLECTION SUMMARY

This section provides a summary of the data collection activities conducted at the site since the mid-1980s and provides tables that summarize the samples collected and analyses performed. Sampling activities are outlined separately for each medium. The methodologies for the various sampling activities conducted at the site are summarized in PSC's standard operating procedures (SOPs), presented in Appendix D or described below for the individual event. All wells and piezometers were surveyed by a professional surveyor following installation, and the survey data are presented in Appendix E. Boring logs and well construction diagrams are presented in Appendix F.

4.1 SOIL

Soil samples have been collected at the facility during a number of investigations since the mid-1980s, as discussed in Section 3.3. A number of samples have been collected from material that was subsequently excavated, so these data are no longer representative of site conditions.

Only samples collected from areas that have not been excavated are considered further in this RI report. Figure 3-4 shows the soil sample locations. Table 4-1 provides an overview of the soil samples collected during each investigation and the various analyses performed for each soil sample. The procedures for collecting soil samples are presented in Appendix D. Soil samples were submitted to laboratories for physical property testing or for chemical analyses. Soil analytical results are summarized in Appendix G.

4.2 GROUNDWATER

Groundwater samples have been collected at the facility from both permanent and temporary monitoring wells since the mid-1980s. This section briefly describes the monitoring wells that have been installed on the PSC Washougal facility and outlines the current monitoring well network, as well as groundwater sampling events and groundwater sample analyses. This discussion will focus on groundwater samples collected since 2000 because these data are most useful for the purposes of this RI, as described further in the data quality assessment presented in Section 10.0.

4.2.1 Groundwater Monitoring Wells and Piezometers

Overall, 67 permanent monitoring wells and piezometers have been installed at the site since 1985. Figure 3-6 shows their locations. Well construction details for all permanent wells installed at the site are presented in Table 4-2. As indicated in the table, several wells have been decommissioned. The current monitoring well network is shown in Figure 4-1. The procedures for well installation are presented in Appendix D.

All wells and piezometers were surveyed by a professional surveyor following installation. The vertical survey datum was based on the National Geodetic Vertical Datum (NGVD) of 1929 (NGVD29). Horizontal information was based on the Washington State Plane Coordinate System, South Zone (North American Datum, 1983 [NAD83]). The horizontal accuracy was ± 0.1 foot. The vertical accuracy was ± 0.01 foot. Table 4-3 lists the results of the most recent survey for each well and piezometer.

4.2.1.1 Well Development

All permanent monitoring wells were developed following installation and are periodically sounded to determine if redevelopment is necessary. The procedures for well development are presented in Appendix D.

4.2.1.2 Groundwater Monitoring

Water levels have been measured at each permanent monitoring well at least once per quarter. Quarterly monitoring began at the facility in 1993 although wells were monitored periodically prior to that period. New wells have been added to the monitoring network including recently and a few wells have been dropped from the network. The procedures for measuring water levels are presented in Appendix D. These measurements are discussed in more detail in Section 7.2.

Groundwater samples have been collected routinely from permanent monitoring wells since 1985. The groundwater monitoring program has varied over the years. Dedicated pumps were installed in several wells and low-flow sampling techniques were implemented in 1994. In January 1998, dedicated pumps were installed in most of the remaining wells. In June 1999, Ecology approved the use of EPA’s low-flow (“micropurge”) groundwater sampling technique at the PSC Washougal facility; this sampling methodology was implemented in June 1999. The current groundwater sampling SOP, presented in Appendix D, was modified, approved, and implemented during the first quarter of 2002.

Under the current groundwater-monitoring program, groundwater samples are collected after several water quality parameters, including dissolved oxygen, temperature, turbidity, specific conductivity, pH, and redox potential, have stabilized. Water quality readings collected before sample collection at each well for recent sampling events are presented in Appendix H. Groundwater samples are submitted to an Ecology-accredited laboratory for chemical analyses. Table 4-4 summarizes the groundwater sampling events, the analyses performed, and the sampling method for samples that will be considered in this RI. Groundwater analytical results are summarized in Appendix I.

4.2.2 Temporary Groundwater Wells

Several groundwater investigations have involved the installation and one-time sampling of temporary monitoring wells. The procedure for installing and sampling temporary monitoring wells is presented in Appendix D. The locations of temporary monitoring wells that have been installed at the site are shown in Figure 3-6. Groundwater samples were collected from temporary monitoring wells in July 1999, September 2001, October 2007, and September 2008. Table 4-5 summarizes the temporary well (direct-push) groundwater samples collected during each investigation. Groundwater samples were submitted to laboratories for physical property testing or for chemical analyses. Table 4-5 summarizes the various analyses performed for each direct-push groundwater sample. Groundwater analytical results are summarized in Appendix I.

4.3 SEDIMENT AND SURFACE WATER

Sediment sampling was conducted in 1990, including four samples collected in the Gibbons Creek remnant channel and 12 samples in the SLNWR (SEE, 1991). These samples were collected at depths ranging from 0 to 2.5 feet bgs. The methodology used to collect these samples is not known.

Additional sediment and pore-water sampling was conducted in 2007 and 2008 (Geomatrix, 2008; AMEC, 2009). Three porewater samples were collected in the SLNWR in 2007 using the techniques described in Appendix D. In 2008, an additional six porewater samples were collected following the same techniques. Also in 2008, six sediment samples were collected in the SLNWR, and two sediment samples were collected in the Gibbons Creek remnant channel. Table 4-6 provides a summary of the sediment and surface water samples that have been collected and the analyses performed. The locations of sediment and surface water (or porewater) samples are shown on Figure 4-2. Sediment and surface water analytical results are summarized in Appendix J.

4.4 DNAPL

In October 1986, 12 borings were completed to sample groundwater in the solvent distillation process area (Area 9) within the tank farm (SEE, 1991). No soil samples were collected from these borings, but groundwater samples were collected from 10 of the borings and analyzed. Using a hand auger, samples were collected at the water table, approximately 5 feet below the top of the concrete slab, and just above the Silt Layer. Of the 18 groundwater samples collected in this sampling event, DNAPL was present in four samples at two locations, at approximately 4.5 to 5.5 feet bgs near former tanks N and O. The DNAPL was described as a two-phase liquid that was dark brown to black. A sample of the DNAPL was collected and analyzed, and the results are presented in Table 4-7. The primary contaminants identified in the DNAPL samples were 1,1,1-trichloroethane, trichlorotrifluoroethane, TCE, PCE, toluene, and xylene (PSC, 2000). DNAPL has not been encountered during any subsequent investigations at the facility.

4.5 SOIL GAS AND INDOOR AIR

In September 2001, PSC installed 10 permanent soil-gas ports beneath Building 1 to determine whether soil gas migrating to indoor air is a significant exposure pathway at the facility (PSC, 2002) (see also Section 3.4.4). The ports were sampled for a 24-hour period in October 2001 and again in February 2002 to assess periods of high and low water table conditions.

In June 2005, additional sampling was conducted to evaluate indoor air quality (PSC, 2005b). PSC collected two 8-hour indoor air samples in Building 1 in the office space and one ambient air sample outside and upwind of the building. During the same period one soil gas sample was collected from the soil gas port GP-37, located closest to the office area of Building 1. After this sampling, PSC installed the depressurization system interim measure described in Section 3.4.4, instead of pursuing additional sampling to confirm whether or not soil gas is affecting indoor air. Following system installation, PSC replicated the June sampling during November 2005, collecting two indoor air, one ambient outdoor air, and one soil gas sample. Results indicated that the system was functioning as designed. Additional samples were collected in June 2010 to determine whether or not the system is continuing to operate as designed. PSC collected one indoor air and one ambient outdoor air sample and concluded that the system is functioning as designed.

TABLES

TABLE 4-1

SUMMARY OF SOIL AND SOIL GAS SAMPLES COLLECTED

PSC Washougal Facility
Washougal, Washington

Investigation	Date	Sample Location	Depth (feet bgs)	Analyses
1985 Soil & Groundwater Investigation	12/17/1985	Area 1	unknown	VOCs, SVOCs, metals
1985 Soil & Groundwater Investigation	12/17/1985	Area 2	unknown	VOCs, SVOCs, metals
1985 Soil & Groundwater Investigation	12/17/1985	Area 3	unknown	VOCs, SVOCs, metals
1985 Soil & Groundwater Investigation	12/17/1985	Area 4	unknown	VOCs, SVOCs, metals
1985 Soil & Groundwater Investigation	12/17/1985	Area 5	unknown	VOCs, SVOCs, metals
1985 Soil & Groundwater Investigation	12/17/1985	Area 6	unknown	VOCs, SVOCs, metals
1985 Soil & Groundwater Investigation	12/17/1985	Area 7	unknown	VOCs, SVOCs, metals
1985 Soil & Groundwater Investigation	12/17/1985	Area 8	unknown	VOCs, SVOCs, metals
1985 Soil & Groundwater Investigation	12/17/1985	Area 9	unknown	VOCs, SVOCs, metals
October 1986 Soil Investigation	10/17/1986	1 - SS Blender	unknown	VOCs
October 1986 Soil Investigation	10/17/1986	2 - Hot Melt Mixer	unknown	VOCs
October 1986 Soil Investigation	10/17/1986	3 - Control Room	unknown	VOCs
October 1986 Soil Investigation	10/17/1986	4 - Solvent Drier	unknown	VOCs
October 1986 Soil Investigation	10/17/1986	5 - Defoamer Blender	unknown	VOCs
October 1986 Soil Investigation	10/17/1986	6 - Solvent Drier	unknown	VOCs
RFI	6/1/1990	MC-15D	13, 13.5	VOCs, metals
RFI	6/1/1990	MC-18	10, 11, 15, 16	VOCs, phenols, metals
RFI	6/1/1990	MC-2D	18.5, 20, 28.5	VOCs, metals
RFI	2/1/1991	MC-12D	9, 14	metals
RFI	2/1/1991	MC-13D	11.5, 14	VOCs, metals
Silt Layer Investigation	7/10/1996	GP-17	8	VOCs, SVOCs
Silt Layer Investigation	7/10/1996	GP-18	7.7	VOCs
Silt Layer Investigation	7/10/1996	GP-20	9	VOCs
Silt Layer Investigation	7/10/1996	GP-21	10	VOCs
Silt Layer Investigation	7/10/1996	GP-25	9	VOCs
Silt Layer Investigation	7/11/1996	GP-07	2, 4, 6, 7	VOCs, SVOCs
Silt Layer Investigation	7/11/1996	GP-08	8	VOCs
Silt Layer Investigation	7/11/1996	GP-09	2, 4, 6, 7	VOCs, SVOCs
Silt Layer Investigation	7/11/1996	GP-10	2, 4, 6, 7	VOCs
Silt Layer Investigation	7/11/1996	GP-11	7.5	VOCs

TABLE 4-1

SUMMARY OF SOIL AND SOIL GAS SAMPLES COLLECTED

PSC Washougal Facility
Washougal, Washington

Investigation	Date	Sample Location	Depth (feet bgs)	Analyses
Silt Layer Investigation	7/11/1996	GP-12	2, 4, 6, 7	VOCs, SVOCs
Silt Layer Investigation	7/11/1996	GP-13	7.5	VOCs
Silt Layer Investigation	7/11/1996	GP-14	2, 4, 6, 7	VOCs
Silt Layer Investigation	7/11/1996	GP-15	2, 4, 6, 7	VOCs
Silt Layer Investigation	7/11/1996	GP-16	8	VOCs, SVOCs
Interim Action	9/15/1997	IAB-01	2, 4, 6	VOCs, SVOCs
Interim Action	9/15/1997	IAB-02	2, 4, 6, 8	VOCs, SVOCs
Interim Action	9/15/1997	IAB-03	2, 4, 6	VOCs, SVOCs
Interim Action	9/15/1997	IAB-04	2, 4, 6	VOCs, SVOCs
Interim Action	9/15/1997	IAB-05	2, 4, 6	VOCs, SVOCs
Interim Action	9/15/1997	IAB-06	2, 4, 6	VOCs, SVOCs
Interim Action	9/15/1997	IAB-07	2, 4, 6	VOCs, SVOCs
Interim Action	9/15/1997	IAB-08	2, 4, 6	VOCs, SVOCs
Interim Action	9/19/1997	CIA-01	4	VOCs
Interim Action	9/19/1997	CIA-02	4	VOCs
Interim Action	9/19/1997	CIA-03	4	VOCs
Interim Action	9/19/1997	CIA-04	4	VOCs
Interim Action	9/19/1997	CIA-05	6	VOCs
Interim Action	9/19/1997	CIA-06	4	VOCs
Interim Action	9/19/1997	CIA-07	4	VOCs
Interim Action	9/19/1997	CIA-08	4	VOCs
Interim Action	9/19/1997	CIA-09	4	VOCs
Interim Action	9/19/1997	CIA-10	6	VOCs, SVOCs
Interim Action	9/24/1997	CIA-01	6	VOCs, SVOCs
Interim Action	9/24/1997	CIA-03	6	VOCs, SVOCs
Interim Action	9/24/1997	CIA-06	6	VOCs, SVOCs
Interim Action	9/24/1997	CIA-08	6	VOCs, SVOCs
Interim Action	9/24/1997	CIA-11	6	VOCs, SVOCs
Interim Action	9/24/1997	CIA-13	6	VOCs, SVOCs
Interim Action	9/24/1997	CIA-15	6	VOCs, SVOCs

TABLE 4-1

SUMMARY OF SOIL AND SOIL GAS SAMPLES COLLECTED

PSC Washougal Facility
Washougal, Washington

Investigation	Date	Sample Location	Depth (feet bgs)	Analyses
Interim Action	9/30/1997	CIA-23	6	VOCs, SVOCs
Summer 1999 RI	7/26/1999	MC-10D	1.5	VOCs, SVOCs, metals
Summer 1999 RI	7/26/1999	MC-19D	1.5	VOCs, SVOCs, metals
Summer 1999 RI	7/27/1999	MC-107	??	VOCs, SVOCs, metals
Summer 1999 RI	7/27/1999	MC-17D	1.5	VOCs, SVOCs, metals
Summer 1999 RI	7/28/1999	MC-118D	1.5	VOCs, SVOCs, metals
Summer 1999 RI	7/29/1999	GP-29	5.9	VOCs, SVOCs, metals
Summer 1999 RI	7/29/1999	GP-30	8.5	VOCs, metals
Summer 1999 RI	7/29/1999	GP-31	9.5	VOCs, SVOCs, metals
Summer 1999 RI	7/29/1999	GP-32	10	VOCs, SVOCs, metals
Summer 1999 RI	7/29/1999	GP-33	8	VOCs, SVOCs, metals
Summer 1999 RI	7/29/1999	GP-34	10	VOCs, SVOCs, metals
Summer 1999 RI	7/29/1999	GP-35	10	VOCs, SVOCs, metals
Summer 1999 RI	7/30/1999	GP-27	6	VOCs, SVOCs, metals
Summer 1999 RI	7/30/1999	GP-28	8	VOCs, SVOCs, metals
RCRA Closure	8/19/1999	B1	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/19/1999	B14	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/19/1999	B17	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/19/1999	B18	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/19/1999	B19	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/19/1999	B2	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/19/1999	B20	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/19/1999	B21	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/19/1999	B3	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/19/1999	R-1	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/19/1999	R-4	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/19/1999	R-5	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/19/1999	R-6	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/19/1999	R-7	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/20/1999	B10	0	VOCs, SVOCs, metals, PCBs, pesticides

TABLE 4-1

SUMMARY OF SOIL AND SOIL GAS SAMPLES COLLECTED

PSC Washougal Facility
Washougal, Washington

Investigation	Date	Sample Location	Depth (feet bgs)	Analyses
RCRA Closure	8/20/1999	B11	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/20/1999	B12	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/20/1999	B13	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/20/1999	B15	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/20/1999	B16	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/20/1999	B22	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/20/1999	B4	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/20/1999	B5	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/20/1999	B6	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/20/1999	B7	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/20/1999	B8	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/20/1999	B9	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/20/1999	R-10	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/20/1999	R-2	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/20/1999	R-3	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/20/1999	R-8	0	VOCs, SVOCs, metals, PCBs, pesticides
RCRA Closure	8/20/1999	R-9	0	VOCs, SVOCs, metals, PCBs, pesticides
Supplemental RI	9/17/2001	GP-58	2, 7	metals
Supplemental RI	9/17/2001	GP-59	2, 6	metals
Supplemental RI	9/17/2001	GP-60	4, 8	metals
Supplemental RI	9/18/2001	GP-55	3, 5	metals
Supplemental RI	9/18/2001	GP-56	5, 9	metals
Supplemental RI	9/18/2001	GP-57	3	metals
Supplemental RI	9/18/2001	GP-78	3, 5	metals
Supplemental RI	9/18/2001	GP-79	3, 7	metals
Supplemental RI	9/18/2001	GP-80	3	metals
Supplemental RI	9/18/2001	GP-81	3	metals
Supplemental RI	9/18/2001	GP-82	3	metals
Supplemental RI	9/19/2001	GP-61	1, 2	arsenic
Supplemental RI	9/19/2001	GP-62	1, 2	arsenic

TABLE 4-1

SUMMARY OF SOIL AND SOIL GAS SAMPLES COLLECTED

PSC Washougal Facility
Washougal, Washington

Investigation	Date	Sample Location	Depth (feet bgs)	Analyses
Supplemental RI	9/19/2001	GP-63	1, 2	arsenic
Supplemental RI	9/19/2001	GP-64	1, 2	arsenic
Supplemental RI	9/19/2001	GP-71	1, 2	arsenic
Supplemental RI	9/19/2001	GP-83	3	metals
Supplemental RI	9/19/2001	GP-86	2	metals
Supplemental RI	9/19/2001	GP-90	3, 5	arsenic
Supplemental RI	9/20/2001	GP-51	2, 4	arsenic
Supplemental RI	9/20/2001	GP-52	4, 6	arsenic
Supplemental RI	9/20/2001	GP-53	4, 6	arsenic
Supplemental RI	9/20/2001	GP-54	4, 6	arsenic
Supplemental RI	9/20/2001	GP-72	4, 6, 8	VOCs, metals
Supplemental RI	9/20/2001	GP-88	2, 6	arsenic
Supplemental RI	9/20/2001	GP-89	3, 5	arsenic
Supplemental RI	9/21/2001	GP-73	4, 6, 8	VOCs, metals
Supplemental RI	9/21/2001	GP-74	2, 6, 7, 8	VOCs, metals
Supplemental RI	9/21/2001	GP-75	2, 6, 8	VOCs, metals
Supplemental RI	9/21/2001	GP-76	2, 6, 8	VOCs, metals
Supplemental RI	9/21/2001	GP-77	4, 5, 6, 8	VOCs, gasoline
Supplemental RI	9/21/2001	GP-77A	5	VOCs, metals
Supplemental RI	9/21/2001	GP-77B	5	VOCs, metals
Supplemental RI	9/21/2001	GP-77C	5	VOCs, metals
Supplemental RI	9/21/2001	GP-77D	5	VOCs, metals
Supplemental RI	9/21/2001	GP-77E	5	VOCs, metals
Supplemental RI	9/22/2001	GP-36	4, 6, 8	VOCs
Supplemental RI	9/22/2001	GP-37	4, 6, 7, 8	VOCs, metals
Supplemental RI	9/22/2001	GP-38	2, 6, 7, 8	VOCs
Supplemental RI	9/22/2001	GP-39	4, 6, 8	VOCs
Supplemental RI	9/22/2001	GP-42	2, 6, 8	VOCs
Supplemental RI	9/24/2001	GP-40	4, 6, 8	VOCs
Supplemental RI	9/24/2001	GP-41	2, 4, 6, 7, 8	VOCs

TABLE 4-1

SUMMARY OF SOIL AND SOIL GAS SAMPLES COLLECTED

PSC Washougal Facility
Washougal, Washington

Investigation	Date	Sample Location	Depth (feet bgs)	Analyses
Supplemental RI	9/24/2001	GP-43	4, 6, 8	VOCs, metals
Supplemental RI	9/24/2001	GP-48	6, 8, 9	VOCs
Supplemental RI	9/24/2001	GP-49	4, 6, 8	VOCs
Supplemental RI	9/25/2001	GP-50	4, 6, 7, 8	VOCs
Supplemental RI	9/25/2001	GP-66	4, 6, 7, 8	VOCs
Supplemental RI	9/26/2001	GP-44	6, 8	VOCs
Supplemental RI	9/26/2001	GP-45	6, 8	VOCs
Supplemental RI	9/26/2001	GP-46	6, 8	VOCs
Supplemental RI	9/26/2001	GP-47	6, 8	VOCs
Supplemental RI	9/26/2001	GP-65	2, 4, 6, 7, 8	VOCs
Supplemental RI	9/26/2001	GP-69	6, 7, 8	VOCs
Supplemental RI	9/27/2001	GP-67	5, 6, 8	VOCs
Supplemental RI	9/27/2001	GP-68	5, 6	VOCs
Supplemental RI	9/27/2001	GP-70	5, 6, 7, 8	VOCs
Supplemental RI	10/2/2001	GP-36	soil gas	VOCs
Supplemental RI	10/2/2001	GP-37	soil gas	VOCs
Supplemental RI	10/2/2001	GP-38	soil gas	VOCs
Supplemental RI	10/2/2001	GP-39	soil gas	VOCs
Supplemental RI	10/2/2001	GP-40	soil gas	VOCs
Supplemental RI	10/2/2001	GP-41	soil gas	VOCs
Supplemental RI	10/2/2001	GP-42	soil gas	VOCs
Supplemental RI	10/2/2001	GP-43	soil gas	VOCs
Supplemental RI	10/2/2001	GP-48	soil gas	VOCs
Supplemental RI	10/2/2001	GP-49	soil gas	VOCs
Indoor Air Evaluation	2/24/2002	GP-36	soil gas	VOCs
Indoor Air Evaluation	2/24/2002	GP-37	soil gas	VOCs
Indoor Air Evaluation	2/24/2002	GP-38	soil gas	VOCs
Indoor Air Evaluation	2/24/2002	GP-40	soil gas	VOCs
Indoor Air Evaluation	2/24/2002	GP-41	soil gas	VOCs
Indoor Air Evaluation	2/24/2002	GP-42	soil gas	VOCs

TABLE 4-1

SUMMARY OF SOIL AND SOIL GAS SAMPLES COLLECTED

PSC Washougal Facility
Washougal, Washington

Investigation	Date	Sample Location	Depth (feet bgs)	Analyses
Indoor Air Evaluation	2/24/2002	GP-43	soil gas	VOCs
Indoor Air Evaluation	2/24/2002	GP-48	soil gas	VOCs
Indoor Air Evaluation	2/24/2002	GP-49	soil gas	VOCs
Indoor Air Evaluation	2/25/2002	GP-39	soil gas	VOCs
Indoor Air Evaluation	6/8/2005	SG37	soil gas	VOCs
Fall 2007 Data Gaps	9/24/2007	MC-24	1.5, 3, 4.5	VOCs, SVOCs, metals, PCBs, pesticides, gasoline, diesel
Fall 2007 Data Gaps	9/24/2007	MC-25	1.5, 3, 4.5	VOCs, SVOCs, metals, PCBs, pesticides, gasoline, diesel
Fall 2007 Data Gaps	9/27/2007	MC-20D	2.5, 4.5	VOCs, SVOCs, metals, PCBs, pesticides, gasoline, diesel
Fall 2007 Data Gaps	9/28/2007	MC-14D	2, 4	VOCs, SVOCs, metals, PCBs, pesticides, gasoline, diesel
Fall 2007 Data Gaps	10/1/2007	GP-95	2.5, 4	VOCs, SVOCs, metals, PCBs, pesticides, gasoline, diesel
Fall 2007 Data Gaps	10/2/2007	PZU-4	3, 6	VOCs, SVOCs, metals, PCBs, pesticides, gasoline, diesel
Fall 2007 Data Gaps	10/2/2007	PZU-5	3.5, 8	VOCs, SVOCs, metals, PCBs, pesticides, gasoline, diesel
Fall 2007 Data Gaps	10/3/2007	GP-92	2, 3	VOCs, SVOCs, metals, PCBs, pesticides, gasoline, diesel
Fall 2007 Data Gaps	10/3/2007	GP-93	1.5, 5.5	VOCs, SVOCs, metals, PCBs, pesticides, gasoline, diesel
Fall 2007 Data Gaps	10/3/2007	GP-96	2, 3.5	VOCs, SVOCs, metals, PCBs, pesticides, gasoline, diesel
Fall 2007 Data Gaps	10/4/2007	GP-94	3, 5.5	VOCs, SVOCs, metals, PCBs, pesticides, gasoline, diesel
Fall 2007 Data Gaps	10/4/2007	GP-98	1.5, 2.5	VOCs, SVOCs, metals, PCBs, pesticides, gasoline, diesel
Fall 2007 Data Gaps	10/4/2007	GP-99	1.5, 2.5	VOCs, SVOCs, metals, PCBs, pesticides, gasoline, diesel
Fall 2007 Data Gaps	10/5/2007	GP-91	2, 3	VOCs, SVOCs, metals, PCBs, pesticides, gasoline, diesel
Fall 2007 Data Gaps	10/5/2007	GP-97	2.5, 5.5, 8	VOCs, SVOCs, metals, PCBs, pesticides, gasoline, diesel
Fall 2008 Data Gaps	9/2/2008	GP-109	3, 4	VOCs
Fall 2008 Data Gaps	9/2/2008	GP-110	1, 3	VOCs
Fall 2008 Data Gaps	9/2/2008	GP-111	1, 4	VOCs
Fall 2008 Data Gaps	9/3/2008	GP-107	1, 3	VOCs, SVOCs, metals, gasoline, diesel
Fall 2008 Data Gaps	9/3/2008	GP-108	1, 4	VOCs, SVOCs, metals, gasoline, diesel
Fall 2008 Data Gaps	9/3/2008	GP-113	1, 4	VOCs, SVOCs, metals, gasoline, diesel
Fall 2008 Data Gaps	9/3/2008	GP-114	1, 3	VOCs, SVOCs, metals, gasoline, diesel
Fall 2008 Data Gaps	9/4/2008	GP-112	1, 4	VOCs, SVOCs, metals, gasoline, diesel
Fall 2008 Data Gaps	9/4/2008	MC-30	2	VOCs, SVOCs, metals, gasoline, diesel
Fall 2008 Data Gaps	9/4/2008	MC-31	1	VOCs, SVOCs, metals, gasoline, diesel

TABLE 4-1

SUMMARY OF SOIL AND SOIL GAS SAMPLES COLLECTED

PSC Washougal Facility
Washougal, Washington

Investigation	Date	Sample Location	Depth (feet bgs)	Analyses
Spring 2009 Data Gaps	5/5/2009	GP-105	4	VOCs, metals, gas, diesel
Spring 2009 Data Gaps	5/5/2009	GP-108	1	metals (mercury)
Spring 2009 Data Gaps	5/5/2009	GP-115	1	metals (mercury)
2011 Data Gaps Investigation	8/10/2011	GP-116	16	VOCs, 1,4-dioxane, metals
2011 Data Gaps Investigation	8/10/2011	GP-117	11.5	VOCs, 1,4-dioxane, metals
2011 Data Gaps Investigation	8/10/2011	GP-118	17	VOCs, 1,4-dioxane, metals
2011 Data Gaps Investigation	8/11/2011	GP-119	16	VOCs, 1,4-dioxane, metals
2011 Data Gaps Investigation	8/11/2011	GP-119 Duplicate	16	VOCs, 1,4-dioxane, metals
2011 Data Gaps Investigation	8/11/2011	GP-120	17.5	VOCs, 1,4-dioxane, metals
2011 Data Gaps Investigation	8/11/2011	GP-121	16	VOCs, 1,4-dioxane, metals
2011 Data Gaps Investigation	8/10/2011	GP-122	8.5	VOCs, 1,4-dioxane, metals
2011 Data Gaps Investigation	8/11/2011	GP-123	9	VOCs, 1,4-dioxane, metals
2011 Data Gaps Investigation	8/11/2011	GP-124	18	VOCs, 1,4-dioxane, metals
2011 Data Gaps Investigation	8/11/2011	GP-125	18	VOCs, 1,4-dioxane, metals

Abbreviations
bgs = below ground surface
PCBs = polychlorinated biphenyls
RCRA = Resource Conservation and Recovery Act
RFI = RCRA Facility Investigation
RI = Remedial Investigation
SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds

TABLE 4-2

CONSTRUCTION DETAILS FOR GROUNDWATER MONITORING WELL AND PIEZOMETER

PSC Washougal Facility
Washougal, Washington

Well Identification	Drilling Method	Installation Date	Abandonment Date	Total Borehole Depth (feet bgs)	Total Well Depth (feet bgs)	Diameter (inches)	Material	Screen Slot Size	Screen Interval (feet bgs)	Filter Pack Sand Type	Filter Pack Interval (feet bgs)	Seal Interval (feet bgs)	Surface Seal
MC-1	HSA	3/22/1985	NA	11.5	11.5	2	Sch. 80 PVC	0.01	2.5-11.5	No.1 Monterey	2.5-11.5	0.5-2	Flush Mount
MC-10	HSA	6/6/1985	3/10/1992	11	11	2	Sch. 80 PVC	0.01	3-10	No.1 Monterey	2.5-10	0.5-2.5	unknown
MC-107	HSA	7/27/1999	NA	10	10	2	Sch. 40 PVC	0.01	4-10	10/20 Silica	3-10	1-3	Stand Pipe
MC-10D	HSA	7/26/1999	NA	36	35	2	Sch. 40 PVC	0.01	25-35	10/20 Silica	23-36	2-23	Stand Pipe
MC-11	HSA	6/7/1985	5/1/1992	24	9.75	2	Sch. 80 PVC	0.01	4-9.5	No.1 Monterey	3.5-12.5	0.5-3.5	unknown
MC-118D	HSA	7/28/1999	NA	22.5	22.5	2	Sch. 40 PVC	0.01	15.5-22.5	10/20 Silica	13-22.5	3-13.5	Flush Mount
MC-118D2	sonic	9/10-11/08	NA	37	35.1	2	Sch. 40 PVC	0.01	24.9-34.7	10/20 Silica	23.0-37.0	0.0-23.0	Flush Mount
MC-12	HSA	6/7/1985	NA	9.5	7.75	2	Sch. 80 PVC	0.01	2.5-7.5	No.1 Monterey	2-9.5	0-2	Stand Pipe
MC-122	HSA	12/1/2006	NA	16	15.5	2	Sch. 40 PVC	0.01	5.2-15.2	20/40 Silica	3.25-16	1-3.25	Stand Pipe
MC-123	HSA	12/1/2006	NA	16	15.5	2	Sch. 40 PVC	0.01	5.2-15.2	20/40 Silica	3.25-16	1-3.25	Stand Pipe
MC-12D	Cable Tool	2/8/1991	NA	22.5	22.5	2	Sch. 40 PVC	0.01	17.7-22.5	10/20 Silica	15.7-22.5	2-15.7	Stand Pipe
MC-13	HSA	6/7/1985	NA	12	9.2	2	Sch. 80 PVC	0.01	2.5-9	No.1 Monterey	2-12	0.5-2	Stand Pipe
MC-13D	Cable Tool	2/12/1991	NA	23.5	23.5	2	Sch. 40 PVC	0.01	18.7-23.5	10/20 Silica	16.5-23.5	2-15.7	Stand Pipe
MC-14	HSA	6/7/1985	NA	16.5	9.3	2	Sch. 80 PVC	0.01	4-9	No.1 Monterey	3-16.5	0.5-3	Stand Pipe
MC-14D	sonic	9/28/2007	NA	34	32	2	Sch. 40 PVC	0.01	22-31.4	10/20 Silica	20-33	1-20	Stand Pipe
MC-15	HSA	9/19/1985	NA	8.5	8.5	2	Sch. 80 PVC	0.01	2.5-8.5	No.1 Monterey	1.5-8.5	0.25-1.5	Stand Pipe
MC-15D	Cable Tool	6/8/1990	NA	26.2	26	2	Sch. 40 PVC	0.01	21-26	10/20 Silica	18-26.2	2-18	Stand Pipe
MC-16	HSA	9/19/1985	NA	7.5	7.5	2	Sch. 80 PVC	0.01	2.5-7.5	No.1 Monterey	2-7.5	0.5-2	Stand Pipe
MC-17	HSA	9/19/1985	NA	7.5	7.5	2	Sch. 80 PVC	0.01	2.5-7.5	No.1 Monterey	2-7.5	0.5-2	Stand Pipe
MC-17D	HSA	7/27/1999	NA	33	32	2	Sch. 40 PVC	0.01	22-32	10/20 Silica	20-33	2-20	Stand Pipe
MC-18	Cable Tool	6/13/1990	8/24/1998	24.5	25	2	Sch. 40 PVC	0.01	19-24	10/20 Silica	17-25	2-17	Flush Mount
MC-19D	HSA	7/26/1999	NA	39	38	2	Sch. 40 PVC	0.01	28-38	10/20 Silica	26-39	2-26	Stand Pipe
MC-2	HSA	3/21/1985	NA	13.5	13.5	2	Sch. 80 PVC	0.01	2.5-12.5	No.1 Monterey	2-12.5	0.5-2	Flush Mount
MC-20	HSA	3/13/2000	NA	11.4	11.4	2	Sch. 40 PVC	0.01	4.4-11.4	10/20 Silica	2.5-11.4	1-2.5	Stand Pipe
MC-20D	sonic	9/27/2007	NA	37	35.5	2	Sch. 40 PVC	0.01	25.5-35	10/20 Silica	24-37	1-24	Stand Pipe
MC-21	HSA	3/13/2000	NA	8.5	7.5	2	Sch. 80 PVC	0.02	2.5-7.5	10/20 Silica	1-8	0.5-1	Flush Mount
MC-22	HSA	9/27/2001	12/1/2006	7.5	7.1	2	Sch. 40 PVC	0.01	4.5-7	2/12 Monterey	4-7.5	1-4	Stand Pipe
MC-23	HSA	10/3/2001	12/1/2006	6.1	5.9	2	Sch. 40 PVC	0.01	4.6-5.7	2/12 Monterey	4-6.1	1-4	Stand Pipe
MC-24	HSA	9/24/2007	NA	9.3	9.2	2	Sch. 40 PVC	0.01	4.1-8.9	10/20 Silica	3-9.3	1-3	Stand Pipe
MC-24D	sonic	10/1/2007	NA	33	32.2	2	Sch. 40 PVC	0.01	22-32	10/20 Silica	20-33	1-20	Stand Pipe
MC-24D2	sonic	5/8/2009	NA	46	44.8	2	Sch. 40 PVC	0.01	34.8-44.6	10/20 Silica	33.1-46.0	0.0-33.1	Stand Pipe
MC-25	HSA	9/24/2007	NA	9.8	9.1	2	Sch. 40 PVC	0.01	4-8.8	10/20 Silica	3-9.8	1-3	Flush Mount
MC-25D	sonic	10/2/2007	NA	34	33	2	Sch. 40 PVC	0.01	23-32.5	10/20 Silica	21-34	1-21	Flush Mount
MC-25D2	sonic	9/8/2008	NA	46.5	45.8	2	Sch. 40 PVC	0.01	35.6-45.3	10/20 Silica	32.0-46.5	0.0-32.0	Flush Mount
MC-26D2	sonic	9/9-10/08	NA	41	40.6	2	Sch. 40 PVC	0.01	30.5-40.2	10/20 Silica	27.0-41.0	0.0-27.0	Stand Pipe

TABLE 4-2

CONSTRUCTION DETAILS FOR GROUNDWATER MONITORING WELL AND PIEZOMETER

PSC Washougal Facility
Washougal, Washington

Well Identification	Drilling Method	Installation Date	Abandonment Date	Total Borehole Depth (feet bgs)	Total Well Depth (feet bgs)	Diameter (inches)	Material	Screen Slot Size	Screen Interval (feet bgs)	Filter Pack Sand Type	Filter Pack Interval (feet bgs)	Seal Interval (feet bgs)	Surface Seal
MC-27D	sonic	5/6/2009	NA	36	35.5	2	Sch. 40 PVC	0.01	25.2-35.1	10/20 Silica	22.6-36.0	0.0-22.6	Flush Mount
MC-28D	sonic	5/7/2009	NA	36	35.9	2	Sch. 40 PVC	0.01	25.9-35.6	10/20 Silica	23.8-36.0	0.0-23.8	Flush Mount
MC-2D	Cable Tool	6/15/1990	NA	33	32.8	2	Sch. 40 PVC	0.01	28-33	10/20 Silica	25-33	2-2.5	Flush Mount
MC-30	direct push	9/4/2008	NA	9.6	9.6	2	Sch. 40 PVC (with SS wrapped prepacked screen)	0.01	4.5-9.2	10/20 Silica	3.7-9.2	0.0-3.7	Stand Pipe
MC-30D	sonic	9/9/2008	NA	37	35.7	2	Sch. 40 PVC	0.01	25.5-35.2	10/20 Silica	22.5-37.0	0.0-22.5	Stand Pipe
MC-31	direct push	9/4/2008	NA	9.6	9.6	2	Sch. 40 PVC (with SS wrapped prepacked screen)	0.01	4.4-9.2	10/20 Silica	3.0-9.2	0.0-3.0	Stand Pipe
MC-32	direct push	5/11/2009	NA	14	13.9	2	Sch. 40 PVC (with SS wrapped prepacked screen)	0.01	3.9-13.4	10/20 Silica	3.9-13.9	0.0-3.9	Stand Pipe
MC-33	direct push	5/11/2009	NA	13	10.0	2	Sch. 40 PVC (with SS wrapped prepacked screen)	0.01	5.0-9.4	10/20 Silica	4.0-10.0	0.0-4.0	Stand Pipe
MC-7	HSA	3/22/1985	8/24/1998	10.5	10.5	2	Sch. 80 PVC	0.01	2.5-10	No.1 Monterey	2-10	1-2	Flush Mount
MC-8	HSA	3/20/1985	NA	11.5	11.5	2	Sch. 80 PVC	0.01	2.5-11.5	No.1 Monterey	2-11.5	0.5-2	Stand Pipe
MC-8D	HSA	3/25/1985	8/24/1998	8.5	8.5	2	Sch. 80 PVC	0.01	6.5-8.5	No.1 Monterey	6-8.5	0.5-6	Stand Pipe
MC-8S	HSA	3/25/1985	8/24/1998	7.5	7.5	2	Sch. 80 PVC	0.01	2.5-7.5	No.1 Monterey	2-7.5	0.25-2	Stand Pipe
MC-R	driven	12/23/1986	unknown	9.7	9.7	4	stainless steel	0.01	1.75-8	unknown	unknown	unknown	Stand Pipe
P-10	unknown	unknown	8/25/1998	unknown	10.5	1	unknown	unknown	unknown	unknown	unknown	unknown	Stand Pipe
P-11	unknown	unknown	8/25/1998	unknown	10	1	unknown	unknown	unknown	unknown	unknown	unknown	Stand Pipe
P-12	unknown	unknown	8/25/1998	unknown	8.75	1	unknown	unknown	unknown	unknown	unknown	unknown	Stand Pipe
P-13	unknown	unknown	8/25/1998	unknown	8.75	1	unknown	unknown	unknown	unknown	unknown	unknown	Stand Pipe
P-4	unknown	unknown	8/25/1998	unknown	7.5	1	unknown	unknown	unknown	unknown	unknown	unknown	Flush Mount
P-5	unknown	unknown	8/25/1998	unknown	7.5	1	unknown	unknown	unknown	unknown	unknown	unknown	Flush Mount
P-6	unknown	unknown	8/25/1998	unknown	7.5	1	unknown	unknown	unknown	unknown	unknown	unknown	Flush Mount
P-7	unknown	unknown	8/24/1998	unknown	10.5	1	unknown	unknown	unknown	unknown	unknown	unknown	Stand Pipe
P-8	unknown	unknown	8/24/1998	unknown	10.5	1	unknown	unknown	unknown	unknown	unknown	unknown	Stand Pipe
P-9	unknown	unknown	8/24/1998	unknown	10.5	1	unknown	unknown	unknown	unknown	unknown	unknown	Stand Pipe

TABLE 4-2

CONSTRUCTION DETAILS FOR GROUNDWATER MONITORING WELL AND PIEZOMETER

PSC Washougal Facility
Washougal, Washington

Well Identification	Drilling Method	Installation Date	Abandonment Date	Total Borehole Depth (feet bgs)	Total Well Depth (feet bgs)	Diameter (inches)	Material	Screen Slot Size	Screen Interval (feet bgs)	Filter Pack Sand Type	Filter Pack Interval (feet bgs)	Seal Interval (feet bgs)	Surface Seal
PZU-1	HSA	9/27/2001		10.5	10.1	2	Sch. 40 PVC	0.01	4.5-10	2/12 Monterey	4-10.5	1-4	Flush Mount
PZU-2	HSA	9/27/2001		10	9.5	2	Sch. 40 PVC	0.01	4.5-9.3	2/12 Monterey	4-10	1-4	Flush Mount
PZU-3	HSA	10/25/2001		9	8.9	2	Sch. 40 PVC	0.01	4.5-8.5	2/12 Monterey	4-9	1-4	Flush Mount
PZU-4	direct push	10/2/2007	NA	13.6	10	2	Sch. 40 PVC (with SS wrapped prepacked screen)	0.01	4.9-9.5	20/40 Silica	4-9.5	1-4	Flush Mount
PZU-5	direct push	10/2/2007	NA	15	14.8	2	Sch. 40 PVC (with SS wrapped prepacked screen)	0.01	4.7-14.4	20/40 Silica	4-15	1-4	Flush Mount
RC-1	unknown	unknown	8/24/1998	unknown	11.5	4	unknown	unknown	unknown	unknown	unknown	unknown	Stand Pipe
RC-2	unknown	unknown	8/24/1998	unknown	12	4	unknown	unknown	unknown	unknown	unknown	unknown	Stand Pipe
RC-3	unknown	unknown	8/24/1998	unknown	12.5	4	unknown	unknown	unknown	unknown	unknown	unknown	Stand Pipe
RC-4	unknown	unknown	8/24/1998	unknown	13	4	unknown	unknown	unknown	unknown	unknown	unknown	Stand Pipe
RC-5	unknown	unknown	8/25/1998	unknown	13	4	unknown	unknown	unknown	unknown	unknown	unknown	Stand Pipe
RC-6	unknown	unknown	8/25/1998	unknown	13	4	unknown	unknown	unknown	unknown	unknown	unknown	Stand Pipe
RC-7	unknown	unknown	8/25/1998	unknown	12.5	4	unknown	unknown	unknown	unknown	unknown	unknown	Stand Pipe
RC-8	unknown	unknown	8/25/1998	unknown	12.5	4	unknown	unknown	unknown	unknown	unknown	unknown	Stand Pipe
UT-ST-1	direct push	10/25/2001	NA	10.7	10.25	0.75	Sch. 80 PVC	0.01	6.75-10.25	2/12 Monterey	5.5-10.7	1-5.5	Flush Mount

Abbreviations
bgs = below ground surface
HSA = hollow-stem auger
NA = not applicable
PVC = polyvinyl chloride
SS = stainless steel

TABLE 4-3

SURVEY DATA SUMMARY

PSC Washougal Facility
Washougal, Washington

Sampling Point	Survey Date	Ground Surface Elevation[1] (feet)	Measuring Point Elevation[1] (feet)	Ground Surface Elevation[2] (feet)	Measuring Point Elevation[2] (feet)	Northing[3] (feet)	Easting[3] (feet)
MC-1	1/4/2007	17.70	17.14	21.08	20.52	92590.60	1169832.40
MC-2	1/4/2007	17.60	17.00	20.97	20.37	92522.30	1169755.60
MC-2D	1/4/2007	17.60	17.10	20.97	20.47	92522.00	1169761.80
MC-7	5/3/1994	17.40	17.04	20.78	20.42	92661.08	1169691.33
MC-8	1/4/2007	17.70	19.05	21.08	22.43	92724.60	1169820.70
MC-8S	5/3/1994	17.60	18.98	20.98	22.36	92720.84	1169814.28
MC-8D	5/3/1994	17.70	19.21	21.08	22.59	92718.81	1169822.11
MC-10	unknown	unknown	unknown	unknown	unknown	92413.68	1169588.81
MC-10D	1/4/2007	18.50	21.04	21.87	24.41	92423.70	1169485.50
MC-11	unknown	unknown	unknown	unknown	unknown	unknown	unknown
MC-12	1/4/2007	17.70	18.91	21.08	22.29	92720.80	1169589.90
MC-12D	1/4/2007	17.70	19.25	21.08	22.63	92712.30	1169598.40
MC-13	1/4/2007	18.00	19.14	21.38	22.52	92714.10	1169950.90
MC-13D	1/4/2007	18.30	20.13	21.68	23.51	92728.70	1169949.70
MC-14	1/4/2007	17.00	18.41	20.38	21.79	92643.10	1169952.40
MC-15	1/4/2007	16.40	17.46	19.78	20.84	92554.00	1169951.40
MC-15D	1/4/2007	16.20	17.37	19.58	20.75	92548.50	1169950.80
MC-16	1/4/2007	16.40	17.67	19.77	21.04	92481.90	1169950.50
MC-17	1/4/2007	16.40	17.57	19.77	20.94	92404.40	1169948.90
MC-17D	1/4/2007	17.10	19.92	20.47	23.29	92382.70	1169939.50
MC-18	5/3/1994	17.60	17.41	20.98	20.79	92723.98	1169772.01
MC-19D	1/4/2007	18.20	18.05	21.57	21.42	92300.30	1169774.40
MC-20	1/4/2007	17.80	17.80	21.18	21.18	92640.10	1170037.50
MC-21	1/4/2007	17.10	17.10	20.48	20.48	92643.70	1169915.80
MC-107	1/4/2007	17.30	20.13	20.68	23.51	92666.30	1169648.60
MC-118D	1/4/2007	17.70	17.28	21.08	20.66	92721.80	1169761.10
MC-22	1/4/2007	18.00	20.87	21.38	24.25	92713.70	1170038.60
MC-23	1/4/2007	17.50	19.99	20.88	23.37	92600.70	1170036.20
MC-122	10/24/2007	17.50	19.95	20.88	23.33	92681.00	1170038.90
MC-123	10/24/2007	17.40	19.91	20.78	23.29	92585.40	1170035.80
UT-ST-1	1/4/2007	19.40	19.25	22.78	22.63	92810.10	1169990.30
PZU-1	1/4/2007	17.80	17.44	21.18	20.82	92638.90	1170022.90
PZU-2	1/4/2007	18.10	17.74	21.48	21.12	92640.00	1170007.90
PZU-3	1/4/2007	17.70	17.03	21.08	20.41	92638.10	1169988.30
PZU-4	10/24/2007	18.80	18.58	22.18	21.96	92762.90	1169987.70
PZU-5	10/24/2007	18.70	18.34	22.08	21.72	92760.20	1170039.30
MC-14D	10/24/2007	17.20	19.33	20.58	22.71	92652.80	1169943.30
MC-20D	10/24/2007	17.80	20.18	21.18	23.56	92628.70	1170036.40
MC-24	10/24/2007	16.80	19.49	20.18	22.87	92595.50	1169765.00

TABLE 4-3

SURVEY DATA SUMMARY

PSC Washougal Facility
Washougal, Washington

Sampling Point	Survey Date	Ground Surface Elevation^1 (feet)	Measuring Point Elevation^1 (feet)	Ground Surface Elevation^2 (feet)	Measuring Point Elevation^2 (feet)	Northing^3 (feet)	Easting^3 (feet)
MC-24D	10/24/2007	16.90	19.03	20.28	22.41	92592.10	1169771.40
MC-25	10/24/2007	17.40	16.97	20.78	20.35	92688.20	1169758.30
MC-25D	10/24/2007	17.00	16.71	20.38	20.09	92684.90	1169763.90
MC-30	12/9/2008	18.20	20.32	21.58	23.70	92633.00	1169485.60
MC-30D	12/9/2008	18.20	20.77	21.58	24.15	92628.90	1169484.90
MC-31	12/9/2008	17.90	21.03	21.27	24.40	92299.70	1169514.90
MC-25D2	12/9/2008	17.20	16.68	20.58	20.06	92689.50	1169763.40
MC-26D2	12/9/2008	17.60	20.07	20.98	23.45	92722.40	1169811.70
MC-118D2	12/9/2008	17.60	17.26	20.98	20.64	92721.70	1169765.70
MC-27D	5/13/2009	17.80	17.52	21.18	20.90	92773.10	1169771.20
MC-28D	5/13/2009	18.10	17.79	21.48	21.17	92775.10	1169859.90
MC-24D2	5/13/2009	16.40	18.21	19.78	21.59	92603.50	1169771.20
MC-32	5/13/2009	17.40	20.30	20.77	23.67	92481.10	1170033.60
MC-33	5/13/2009	17.90	20.87	21.27	24.24	92536.10	1169635.70

Notes
1. Elevation datum: National Geodetic Vertical Datum 29(47).
2. Elevation datum: North American Vertical Datum of 1988 (NAVD88).
3. Washington State Plane Coordinate System, South Zone, North American Datum 83/91.

TABLE 4-4

GROUNDWATER MONITORING HISTORY

PSC Washougal Facility
Washougal, Washington

Year	Month	Analyte Group	Wells Sampled																																																				
			MC-1	MC-2	MC-2D	MC-7	MC-8	MC-8S	MC-8D	MC-10	MC-10D	MC-11	MC-12	MC-12D	MC-13	MC-13D	MC-14	MC-15	MC-15D	MC-16	MC-17	MC-17D	MC-18	MC-19D	MC-20	MC-21	MC-107	MC-118D	MC-22	MC-23	MC-122	MC-123	UT-ST-1	PZU-1	PZU-2	PZU-3	PZU-4	PZU-5	MC-14D	MC-20D	MC-24	MC-24D	MC-25	MC-25D	MC-27D	MC-28D	MC-30	MC-30D	MC-31	MC-32	MC-33	MC-24D2	MC-25D2	MC-26D2	MC-118D2
1990	Jan	VOCs	X	X		X	X	X	X				X		X			X																																					
	Mar	VOCs																																																					
	Apr	VOCs	X			X	X		X			X	X		X			X		X	X																																		
	Jun	VOCs	X	X		X	X					X			X					X	X																																		
	Jul	VOCs	X	X	X	X	X	X	X			X	X		X			X	X	X	X	X																																	
		TOC	X	X		X	X	X	X				X		X			X																																					
		Phenols	X	X		X	X	X	X				X		X			X																																					
		Organic Halides	X	X		X	X	X	X				X		X			X																																					
	Aug	VOCs	X	X	X	X	X					X			X				X	X	X	X																																	
		SVOCs	X	X	X	X	X					X			X		X	X	X	X	X																																		
		Metals	X	X	X	X	X					X			X		X	X	X	X	X																																		
	Oct	VOCs	X	X	X	X	X					X			X				X	X	X	X																																	
		SVOCs	X	X	X	X	X					X			X		X	X	X	X	X																																		
		Metals	X	X	X	X	X					X			X		X	X	X	X	X																																		
	Nov	VOCs	X	X	X	X	X					X			X				X	X	X	X																																	
		Metals	X	X	X	X	X					X			X		X	X	X	X	X																																		
		SVOCs	X	X	X	X	X					X			X		X	X	X	X	X																																		
1991^2	Jan	VOCs	X	X	X	X	X					X			X				X	X	X	X																																	
		Metals	X	X	X	X	X					X			X		X	X	X	X	X																																		
		SVOCs	X	X	X	X	X					X			X		X	X	X	X	X																																		
	Feb	Metals												X		X																																							
		SVOCs												X		X																																							
1992^2																																																							
1993	May	Metals	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
		SVOCs	X		X	X	X		X				X	X	X	X	X	X	X	X	X		X																																
		VOCs	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
	Aug	Metals	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
		SVOCs	X	X	X	X	X	X	X				X	X	X	X	X	X	X		X		X																																
		VOCs	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
	Nov	Metals	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
		SVOCs	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
		VOCs	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
1994	Feb	Metals	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
		SVOCs	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
		VOCs	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
	May	Metals	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
		SVOCs	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
		VOCs	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
	Aug	Metals	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
		SVOCs	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
		VOCs	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																

TABLE 4-4

GROUNDWATER MONITORING HISTORY

PSC Washougal Facility
Washougal, Washington

Year	Month	Analyte Group	Wells Sampled																																																			
			MC-1	MC-2	MC-2D	MC-7	MC-8	MC-8S	MC-8D	MC-10	MC-10D	MC-11	MC-12	MC-12D	MC-13	MC-13D	MC-14	MC-15	MC-15D	MC-16	MC-17	MC-17D	MC-18	MC-19D	MC-20	MC-21	MC-107	MC-118D	MC-22	MC-23	MC-122	MC-123	UT-ST-1	PZU-1	PZU-2	PZU-3	PZU-4	PZU-5	MC-14D	MC-20D	MC-24	MC-24D	MC-25	MC-25D	MC-27D	MC-28D	MC-30	MC-30D	MC-31	MC-32	MC-33	MC-24D2	MC-25D2	MC-26D2	MC-118D2
1994 cont.	Nov	Metals	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
		SVOCs	X	X	X	X	X	X	X				X	X		X	X	X	X	X	X		X																																
		VOCs	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
1995	Feb	Metals	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
		SVOCs	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
		VOCs	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
	May	Metals	X	X	X	X	X	X	X				X	X	X		X	X	X	X	X		X																																
		SVOCs	X	X	X	X	X	X	X				X	X	X		X	X	X	X	X		X																																
		VOCs	X	X	X	X	X	X	X				X	X	X		X	X	X	X	X		X																																
	Aug	Metals	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
		SVOCs	X		X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
		VOCs	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
	Nov	Metals	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
		SVOCs	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
		VOCs	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
1996	Feb	Metals	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
		SVOCs	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
		VOCs	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X		X																																
	Jun	Metals	X	X	X	X	X						X	X	X	X	X	X	X	X	X		X																																
		SVOCs	X	X	X	X	X						X	X	X	X	X	X	X	X	X		X																																
		VOCs	X	X	X	X	X						X	X	X	X	X	X	X	X	X		X																																
	Aug	Metals	X	X	X	X	X						X	X	X	X	X	X	X	X	X		X																																
		SVOCs	X	X	X	X	X						X	X	X	X	X	X	X	X	X		X																																
		VOCs	X	X	X	X	X						X	X	X	X	X	X	X	X	X		X																																
	Nov	Metals	X	X	X	X	X						X	X	X	X	X	X	X	X	X		X																																
		SVOCs	X	X	X	X	X						X	X	X	X	X	X	X	X	X		X																																
		VOCs	X	X	X	X	X						X	X	X	X	X	X	X	X	X		X																																
1997	Feb	Metals	X	X	X	X	X						X	X	X	X	X	X	X	X	X		X																																
		SVOCs	X	X	X	X	X						X	X	X	X	X	X	X	X	X		X																																
		VOCs	X	X	X	X	X						X	X	X	X	X	X	X	X	X		X																																
	May	Metals	X	X	X	X	X						X	X	X	X	X	X	X	X	X		X																																
		SVOCs	X	X	X	X	X						X	X	X	X	X	X	X	X	X		X																																
		VOCs	X	X	X	X	X						X	X	X	X	X	X	X	X	X		X																																
	Aug	Metals	X	X	X	X	X						X	X	X	X	X	X	X	X	X		X																																
		SVOCs	X	X	X	X	X						X	X	X	X	X	X	X	X	X		X																																
		VOCs	X	X	X	X	X						X	X	X	X	X	X	X	X	X		X																																
	Dec	Metals	X	X	X	X	X						X	X	X	X	X	X	X	X	X		X																																
		SVOCs	X	X	X	X	X						X	X	X	X	X	X	X	X	X		X																																
		VOCs	X	X	X	X	X						X	X	X	X	X	X	X	X	X		X																																

TABLE 4-4

GROUNDWATER MONITORING HISTORY

PSC Washougal Facility
Washougal, Washington

Year	Month	Analyte Group	Wells Sampled																																																	
			MC-1	MC-2	MC-2D	MC-7	MC-8	MC-8S	MC-8D	MC-10	MC-10D	MC-11	MC-12	MC-12D	MC-13	MC-13D	MC-14	MC-15	MC-15D	MC-16	MC-17	MC-17D	MC-18	MC-19D	MC-20	MC-21	MC-107	MC-118D	MC-22	MC-23	MC-122	MC-123	UT-ST-1	PZU-1	PZU-2	PZU-3	PZU-4	PZU-5	MC-14D	MC-20D	MC-24	MC-24D	MC-25	MC-25D	MC-27D	MC-28D	MC-30	MC-30D	MC-31	MC-32	MC-33	MC-24D2	MC-25D2	MC-26D2	MC-118D2
1998	Mar	VOCs	X	X	X	X	X						X	X	X	X	X	X	X	X	X		X																																
		SVOCs	X	X	X	X	X						X	X	X	X	X	X		X	X		X																																
		Metals	X	X	X	X	X						X	X	X	X	X	X	X	X	X		X																																
		PCBs	X																																																				
	Jun	VOCs	X	X	X	X	X						X	X	X	X	X	X	X	X	X		X																																
		SVOCs	X	X	X	X	X						X	X	X	X	X	X	X	X	X		X																																
		Metals	X	X	X	X	X						X	X	X	X	X	X	X	X	X		X																																
	Aug	VOCs	X	X	X		X						X	X	X	X	X	X	X	X	X																																		
		SVOCs	X	X	X		X						X	X	X	X	X	X	X	X	X																																		
		Metals	X	X	X		X						X	X	X	X	X	X	X	X	X																																		
		PCBs															X																																						
		Pesticides															X																																						
	Nov/Dec	VOCs	X	X	X		X						X	X	X	X	X	X	X	X	X																																		
		SVOCs	X	X	X		X						X	X	X	X	X	X	X	X	X																																		
		Metals	X	X	X		X						X	X	X	X	X	X	X	X	X																																		
1999	Dec	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X			X	X																											
		SVOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X			X	X																											
		Metals	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X			X	X																											
		General Chemistry	X				X						X	X			X	X	X									X																											
2000	Mar	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		NA Parameters	X	X									X		X		X	X		X	X				X	X																													
		Appendix IX [1]	X																																																				
	Apr	VOCs													X		X								X	X																													
		NA Parameters													X		X								X	X																													
	Jun	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		As and Mn	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		NA Parameters	X	X									X		X		X	X		X	X				X	X																													
	Sep	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		Appendix IX [1]															X																																						
		NA Parameters	X	X									X		X		X	X		X	X				X	X																													
	Dec	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X																												
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X																												
		NA Parameters	X											X			X								X	X																													
		Appendix IX [1]																										X																											
2001	Mar	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		As and Be	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		Appendix IX [1]	X														X																																						

TABLE 4-4

GROUNDWATER MONITORING HISTORY

PSC Washougal Facility
Washougal, Washington

Year	Month	Analyte Group	Wells Sampled																																																		
			MC-1	MC-2	MC-2D	MC-7	MC-8	MC-8S	MC-8D	MC-10	MC-10D	MC-11	MC-12	MC-12D	MC-13	MC-13D	MC-14	MC-15	MC-15D	MC-16	MC-17	MC-17D	MC-18	MC-19D	MC-20	MC-21	MC-107	MC-118D	MC-22	MC-23	MC-122	MC-123	UT-ST-1	PZU-1	PZU-2	PZU-3	PZU-4	PZU-5	MC-14D	MC-20D	MC-24	MC-24D	MC-25	MC-25D	MC-27D	MC-28D	MC-30	MC-30D	MC-31	MC-32	MC-33	MC-24D2	MC-25D2	MC-26D2	MC-118D2
2001 cont'd	Jun	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		As and Be	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		Appendix IX[1]																										X																											
	Sep	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		As and Be	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
	Dec	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X					X																						
		As and Be	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X					X																						
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
2002	Mar	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		As and Be	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
	Jun	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
	Aug	1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X		X	X	X																											
		SVOCs																								X																													
		VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X		X	X	X																											
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X		X	X	X																											
		Pesticides / PCBs																								X																													
		Herbicides																								X																													
		Dioxins/Furans																								X																													
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X		X	X	X																											
	Dec	1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
2003	Mar	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
	Jun	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
	Sep	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											

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GROUNDWATER MONITORING HISTORY
PSC Washougal Facility
Washougal, Washington

			Wells Sampled																																																	
Year	Month	Analyte Group	MC-1	MC-2	MC-2D	MC-7	MC-8	MC-8S	MC-8D	MC-10	MC-10D	MC-11	MC-12	MC-12D	MC-13	MC-13D	MC-14	MC-15	MC-15D	MC-16	MC-17	MC-17D	MC-18	MC-19D	MC-20	MC-21	MC-107	MC-118D	MC-22	MC-23	MC-122	MC-123	UT-ST-1	PZU-1	PZU-2	PZU-3	PZU-4	PZU-5	MC-14D	MC-20D	MC-24	MC-24D	MC-25	MC-25D	MC-27D	MC-28D	MC-30	MC-30D	MC-31	MC-32	MC-33	MC-24D2	MC-25D2	MC-26D2	MC-118D2
2003 cont.	Dec	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
2004	Mar	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
	Jun	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
	Sep	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X		X	X	X																											
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X		X	X	X																											
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X		X	X	X																											
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X		X	X	X																											
	Dec	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
2005	Mar	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
	Jun	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
	Sep	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X		X	X	X																											
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X		X	X	X																											
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X		X	X	X																											
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X		X	X	X																											
	Nov/Dec	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
2006	Mar	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											

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GROUNDWATER MONITORING HISTORY

PSC Washougal Facility
Washougal, Washington

			Wells Sampled																																																
Year	Month	Analyte Group	MC-1	MC-2	MC-2D	MC-7	MC-8	MC-8S	MC-8D	MC-10	MC-10D	MC-11	MC-12	MC-12D	MC-13	MC-13D	MC-14	MC-15	MC-15D	MC-16	MC-17	MC-17D	MC-18	MC-19D	MC-20	MC-21	MC-107	MC-118D	MC-22	MC-23	MC-122	MC-123	UT-ST-1	PZU-1	PZU-2	PZU-3	PZU-4	PZU-5	MC-14D	MC-20D	MC-24	MC-24D	MC-25	MC-25D	MC-27D	MC-28D	MC-30	MC-30D	MC-31	MC-32	MC-33	MC-24D2	MC-25D2	MC-26D2	MC-118D2
2006 cont'd	Jun	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X																											
	Sep	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X		X	X	X																											
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X		X	X	X																											
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X		X	X	X																											
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X		X	X	X																											
	Dec	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X																							
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X																							
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X																							
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X																							
2007	Mar	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X																							
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X																							
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X																							
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X																							
	Jun	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X																							
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X																							
		Metals	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X																							
		DBCP	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X																							
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X																							
	Sep/Oct	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X		X	X	X			X	X	X				X	X	X	X	X	X	X	X											
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X		X	X	X																											
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X		X	X	X																											
		DBCP	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X		X	X	X			X	X	X				X	X	X	X	X	X	X	X											
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X		X	X	X			X	X					X	X	X	X	X	X	X	X											
		TPH-D																													X	X					X	X	X	X	X	X	X	X											
		TPH-G																													X	X	X				X	X	X	X	X	X	X	X											
		SVOCs																													X	X						X	X	X	X	X	X	X											
		Metals																													X	X					X	X	X	X	X	X	X	X											
	Dec	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X											
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X											
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X											
		DBCP	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X		X	X	X	X	X											
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X		X	X	X	X	X											
		TPH-D																													X	X	X				X	X	X	X	X	X	X	X											
		TPH-G																													X	X	X				X	X	X	X	X	X	X	X											
		SVOCs																													X	X	X				X	X	X	X	X	X	X	X											
		Metals																													X	X	X				X	X	X	X	X	X	X	X											

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GROUNDWATER MONITORING HISTORY

PSC Washougal Facility
Washougal, Washington

Year	Month	Analyte Group	Wells Sampled																																																		
			MC-1	MC-2	MC-2D	MC-7	MC-8	MC-8S	MC-8D	MC-10	MC-10D	MC-11	MC-12	MC-12D	MC-13	MC-13D	MC-14	MC-15	MC-15D	MC-16	MC-17	MC-17D	MC-18	MC-19D	MC-20	MC-21	MC-107	MC-118D	MC-22	MC-23	MC-122	MC-123	UT-ST-1	PZU-1	PZU-2	PZU-3	PZU-4	PZU-5	MC-14D	MC-20D	MC-24	MC-24D	MC-25	MC-25D	MC-27D	MC-28D	MC-30	MC-30D	MC-31	MC-32	MC-33	MC-24D2	MC-25D2	MC-26D2	MC-118D2
2008	Mar	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X											
		NA Parameters	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X											
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X											
		DBCP	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X		X	X	X	X	X											
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X		X	X	X	X	X											
		TPH-D																													X	X	X				X	X	X	X	X	X	X	X											
		TPH-G																													X	X	X				X	X	X	X	X	X	X	X											
		SVOCs																													X	X	X				X	X	X	X	X	X	X	X											
		Metals																													X	X	X				X	X	X	X	X	X	X	X											
	Jun	VOCs					X								X	X		X									X				X	X	X				X	X	X	X	X	X	X	X											
		NA Parameters					X								X	X		X									X				X	X	X				X	X	X	X	X	X	X	X											
		As					X								X	X		X							X		X				X	X	X				X	X	X	X	X	X	X	X											
		DBCP					X								X	X		X									X				X	X	X				X	X	X	X	X	X	X	X											
		1,4-Dioxane					X								X	X		X									X				X	X	X				X	X	X	X	X	X	X	X											
		TPH-D																													X	X	X				X	X	X	X	X	X	X	X											
		TPH-G																													X	X	X				X	X	X	X	X	X	X	X											
		SVOCs																													X	X	X				X	X	X	X	X	X	X	X											
		Metals																													X	X	X				X	X	X	X	X	X	X	X											
	Sept	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X			X	X	X				X	X	X
		NA Parameters	X								X						X								X	X		X														X		X			X	X	X						
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X		X	X			X	X					X	X	X	X	X	X	X	X			X	X	X				X	X	X
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X						X	X	X	X	X	X	X			X	X	X				X	X	X
		TPH-G	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X					X	X	X	X	X	X	X	X			X	X	X				X	X	X
	Dec	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X			X	X	X				X	X	X
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X		X	X			X	X	X				X	X	X	X	X	X	X	X			X	X	X				X	X	X
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X			X	X	X				X	X	X
		TPH-G	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X			X	X	X				X	X	X
2009	Mar	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X			X	X	X				X	X	X
		NA Parameters	X								X						X								X	X		X														X		X			X	X	X						
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X		X	X	X	X	X			X	X	X				X	X	X
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X			X	X	X				X	X	X
		TPH-G	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X			X	X	X				X	X	X
	Jun	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		Appendix IX [1]															X																																						
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		TPH-D																																																					
		TPH-G	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

TABLE 4-4

GROUNDWATER MONITORING HISTORY

PSC Washougal Facility
Washougal, Washington

Year	Month	Analyte Group	Wells Sampled																																																		
			MC-1	MC-2	MC-2D	MC-7	MC-8	MC-8S	MC-8D	MC-10	MC-10D	MC-11	MC-12	MC-12D	MC-13	MC-13D	MC-14	MC-15	MC-15D	MC-16	MC-17	MC-17D	MC-18	MC-19D	MC-20	MC-21	MC-107	MC-118D	MC-22	MC-23	MC-122	MC-123	UT-ST-1	PZU-1	PZU-2	PZU-3	PZU-4	PZU-5	MC-14D	MC-20D	MC-24	MC-24D	MC-25	MC-25D	MC-27D	MC-28D	MC-30	MC-30D	MC-31	MC-32	MC-33	MC-24D2	MC-25D2	MC-26D2	MC-118D2
2009 cont'd	Sep	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X		X	X	X			X	X					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		NA Parameters	X								X						X									X		X														X		X			X	X	X						
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X		X	X	X			X	X					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		TPH-G	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X		X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Dec	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X		X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X		X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X		X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		TPH-G	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X		X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2010	Mar	VOCs	X	X			X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		NA Parameters	X								X						X								X	X		X														X		X			X	X	X						
		As	X	X			X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		1,4-Dioxane	X	X			X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		TPH-G	X	X			X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Jun	VOCs	X	X			X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		As	X	X			X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		1,4-Dioxane	X	X			X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		TPH-G	X	X			X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Sep	VOCs	X	X			X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		As	X	X			X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		NA Parameters	X								X						X								X	X		X														X		X			X	X	X						
		1,4-Dioxane	X	X			X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		TPH-G	X	X			X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Dec	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		As	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		TPH-G	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

TABLE 4-4

GROUNDWATER MONITORING HISTORY

PSC Washougal Facility
Washougal, Washington

Year	Month	Analyte Group	Wells Sampled																																																		
			MC-1	MC-2	MC-2D	MC-7	MC-8	MC-8S	MC-8D	MC-10	MC-10D	MC-11	MC-12	MC-12D	MC-13	MC-13D	MC-14	MC-15	MC-15D	MC-16	MC-17	MC-17D	MC-18	MC-19D	MC-20	MC-21	MC-107	MC-118D	MC-22	MC-23	MC-122	MC-123	UT-ST-1	PZU-1	PZU-2	PZU-3	PZU-4	PZU-5	MC-14D	MC-20D	MC-24	MC-24D	MC-25	MC-25D	MC-27D	MC-28D	MC-30	MC-30D	MC-31	MC-32	MC-33	MC-24D2	MC-25D2	MC-26D2	MC-118D2
2011	Mar	VOCs	X	X	X		X				X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
		NA Parameters	X								X						X								X	X		X														X		X			X	X							
		As	X	X	X						X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
		1,4-Dioxane	X	X	X						X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
		TPH-G	X	X	X						X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
	Jun	VOCs	X	X	X		X				X		X	X	X	X	X	X	X						X	X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		As	X	X	X		X				X		X	X	X	X	X	X	X						X	X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		1,4-Dioxane	X	X	X		X				X		X	X	X	X	X	X	X						X	X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		TPH-G	X	X	X		X				X		X	X	X	X	X	X	X						X	X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Notes
1. Appendix IX includes analyses for chlorinated herbicides, conventionals, cyanide, dioxin/furans, metals, organophosphorus pesticides, PCBs, pesticides, SVOCs, and VOCs.
2. Data from years 1991 and 1992 are unavailable

Abbreviations
As = arsenic
Be = beryllium
DBCP = 1,2-dibromo-3-chloropropane
NA Parameters = natural attenuation parameters
PCBs = polychlorinated biphenyls
SVOCs = semivolatile organic compounds
TOC = total organic carbon
TPH-G = total petroleum hydrocarbons-gasoline range
TPH-D = total petroleum hydrocarbon-diesel range
VOCs = volatile organic compounds

TABLE 4-5

SUMMARY OF DIRECT PUSH GROUNDWATER SAMPLES

PSC Washougal Facility
Washougal, Washington

Investigation	Date	Sample Location	Depth (feet bgs)	Analyses
Solvent Distillation Area Investigation	10/20/1986	MC-A	5.5, 11.5	VOCs
Solvent Distillation Area Investigation	10/20/1986	MC-B	5.5, 11.5	VOCs
Solvent Distillation Area Investigation	10/20/1986	MC-C	5.5	VOCs
Solvent Distillation Area Investigation	10/20/1986	MC-D	6	VOCs
Solvent Distillation Area Investigation	10/20/1986	MC-E	6	VOCs
Solvent Distillation Area Investigation	10/21/1986	MC-F	6, 11.5	VOCs
Solvent Distillation Area Investigation	10/21/1986	MC-G	5.5, 11.5	VOCs
Solvent Distillation Area Investigation	10/21/1986	MC-H	5.5, 11.5	VOCs
Solvent Distillation Area Investigation	10/22/1986	MC-I	6, 11.5	VOCs
Solvent Distillation Area Investigation	10/22/1986	MC-J	5.5, 11.5	VOCs
Off-Site Test Boring Program	12/7/1990	OT-3	6.2	VOCs, PAHs, metals
Off-Site Test Boring Program	12/7/1990	OT-6	6.1	VOCs, PAHs, metals
Off-Site Test Boring Program	12/7/1990	OT-7	7.2	VOCs, PAHs, metals
Off-Site Test Boring Program	12/7/1990	OT-8	7.5	VOCs, PAHs, metals
Off-Site Test Boring Program	12/7/1990	OT-9	7.5	VOCs, PAHs, metals
Off-Site Test Boring Program	12/7/1990	OT-10	7.5	VOCs, PAHs, metals
Off-Site Test Boring Program	12/7/1990	OT-11	7.5	VOCs, PAHs, metals
Off-Site Test Boring Program	12/7/1990	OT-12	5.5	VOCs, PAHs, metals
Off-Site Test Boring Program	12/7/1990	OT-13	5.5	VOCs, PAHs, metals
Off-Site Test Boring Program	12/7/1990	OT-14	5.5	VOCs, PAHs, metals
Summer 1999 RI	7/30/1999	GP-27	shallow	VOCs, SVOCs, metals
Summer 1999 RI	7/30/1999	GP-28	shallow	VOCs, SVOCs, metals
Summer 1999 RI	7/29/1999	GP-29	shallow	VOCs, SVOCs, metals
Summer 1999 RI	7/29/1999	GP-30	shallow	VOCs, SVOCs, metals
Summer 1999 RI	7/29/1999	GP-31	shallow	VOCs, SVOCs, metals
Summer 1999 RI	7/29/1999	GP-32	shallow	VOCs, SVOCs, metals
Summer 1999 RI	7/29/1999	GP-33	shallow	VOCs, SVOCs, metals
Summer 1999 RI	7/29/1999	GP-34	shallow	VOCs, SVOCs, metals
Summer 1999 RI	7/29/1999	GP-35	shallow	VOCs, SVOCs, metals

TABLE 4-5

SUMMARY OF DIRECT PUSH GROUNDWATER SAMPLES

PSC Washougal Facility
Washougal, Washington

Investigation	Date	Sample Location	Depth (feet bgs)	Analyses
Supplemental RI	9/22/2001	GP-36	8	VOCs, metals
Supplemental RI	9/22/2001	GP-37	8	VOCs, metals
Supplemental RI	9/22/2001	GP-38	8	VOCs, metals, conventionals
Supplemental RI	9/22/2001	GP-39	8	VOCs, metals
Supplemental RI	9/24/2001	GP-40	8	VOCs, metals
Supplemental RI	9/24/2001	GP-41	8	VOCs, metals
Supplemental RI	9/22/2001	GP-42	8	VOCs, metals
Supplemental RI	9/24/2001	GP-43	8	VOCs, metals, conventionals
Supplemental RI	9/26/2001	GP-44	8	VOCs, metals
Supplemental RI	9/26/2001	GP-45	8	VOCs, metals
Supplemental RI	9/26/2001	GP-46	8	VOCs, metals
Supplemental RI	9/26/2001	GP-47	8	VOCs, metals
Supplemental RI	9/24/2001	GP-48	8	VOCs, metals
Supplemental RI	9/24/2001	GP-49	8	VOCs, metals
Supplemental RI	9/24/2001	GP-50	8	VOCs, metals
Supplemental RI	9/20/2001	GP-51	8	arsenic
Supplemental RI	9/20/2001	GP-52	8	arsenic
Supplemental RI	9/20/2001	GP-53	8	arsenic
Supplemental RI	9/20/2001	GP-54	8	arsenic
Supplemental RI	9/18/2001	GP-56	8	metals
Supplemental RI	9/17/2001	GP-58	10	metals
Supplemental RI	9/17/2001	GP-59	9	metals
Supplemental RI	9/17/2001	GP-60	10	metals
Supplemental RI	9/19/2001	GP-61	9	arsenic
Supplemental RI	9/19/2001	GP-62	9	arsenic
Supplemental RI	9/19/2001	GP-63	9	arsenic
Supplemental RI	9/19/2001	GP-64	9	arsenic
Supplemental RI	9/26/2001	GP-65	8	VOCs, arsenic
Supplemental RI	9/25/2001	GP-66	8	VOCs, metals, conventionals

TABLE 4-5

SUMMARY OF DIRECT PUSH GROUNDWATER SAMPLES

PSC Washougal Facility
Washougal, Washington

Investigation	Date	Sample Location	Depth (feet bgs)	Analyses
Supplemental RI	9/27/2001	GP-67	8	VOCs, metals
Supplemental RI	9/27/2001	GP-68	8	VOCs, metals
Supplemental RI	9/26/2001	GP-69	8	VOCs, metals
Supplemental RI	9/27/2001	GP-70	8	VOCs, metals
Supplemental RI	9/19/2001	GP-71	9	arsenic
Supplemental RI	9/20/2001	GP-72	7.5	VOCs, arsenic
Supplemental RI	9/21/2001	GP-73	8	VOCs, arsenic
Supplemental RI	9/21/2001	GP-74	8	VOCs, metals
Supplemental RI	9/21/2001	GP-75	8	VOCs, metals
Supplemental RI	9/21/2001	GP-76	8	VOCs, metals
Supplemental RI	9/21/2001	GP-77	8	VOCs, metals
Supplemental RI	9/18/2001	GP-78	7	metals
Supplemental RI	9/20/2001	GP-88	8	arsenic
Supplemental RI	9/20/2001	GP-89	7	arsenic
Supplemental RI	9/19/2001	GP-90	7	arsenic
Fall 2007 Data Gaps	10/5/2007	GP-91	8	VOCs, SVOCs, metals, gasoline, diesel
Fall 2007 Data Gaps	10/3/2007	GP-92	8	VOCs, SVOCs, metals, gasoline, diesel
Fall 2007 Data Gaps	10/3/2007	GP-93	8	VOCs, SVOCs, metals, gasoline, diesel
Fall 2007 Data Gaps	10/4/2007	GP-94	8, 11.5	VOCs, SVOCs, metals, gasoline, diesel
Fall 2007 Data Gaps	10/1/2007	GP-95	20, 25	VOCs, SVOCs, metals, gasoline, diesel
Fall 2007 Data Gaps	10/3/2007	GP-96	18	VOCs, SVOCs, metals, gasoline, diesel
Fall 2007 Data Gaps	10/5/2007	GP-97	12	VOCs, SVOCs, metals, gasoline, diesel
Fall 2007 Data Gaps	10/5/2007	GP-97	19.8	VOCs, gasoline, diesel
Fall 2007 Data Gaps	10/4/2007	GP-98	16.5	VOCs, SVOCs, metals, gasoline, diesel
Fall 2007 Data Gaps	10/4/2007	GP-99	15.5	VOCs, SVOCs, metals, gasoline, diesel
Fall 2007 Data Gaps	10/3/2007	GP-100	12	VOCs, SVOCs, metals, gasoline, diesel
Fall 2007 Data Gaps	10/2/2007	GP-101	11	VOCs, SVOCs, metals, gasoline, diesel
Fall 2008 Data Gaps	9/3/2008	GP-107	7.5	VOCs, 1,4-dioxane, gasoline, diesel, metals
Fall 2008 Data Gaps	9/3/2008	GP-108	7.5	VOCs, 1,4-dioxane, gasoline, diesel, metals

TABLE 4-5

SUMMARY OF DIRECT PUSH GROUNDWATER SAMPLES

PSC Washougal Facility
Washougal, Washington

Investigation	Date	Sample Location	Depth (feet bgs)	Analyses
Fall 2008 Data Gaps	9/2/2008	GP-110	7	VOCs, SVOCs, gasoline, diesel, metals
Fall 2008 Data Gaps	9/4/2008	GP-112	8	VOCs, SVOCs, gasoline, diesel, metals
Fall 2008 Data Gaps	9/3/2008	GP-113	7.5	VOCs, SVOCs, gasoline, diesel, metals
Fall 2008 Data Gaps	9/3/2008	GP-114	7	VOCs, 1,4-dioxane, gasoline, diesel, metals
2009 Data Gaps	5/5/2009	GP-104	5	VOCs, SVOCs, metals, gasoline, diesel
2009 Data Gaps	5/5/2009	GP-105	6	VOCs, SVOCs, metals, gasoline, diesel
2011 Data Gaps Investigation	8/10/2011	GP-116	16	VOCs, 1,4-dioxane, metals
2011 Data Gaps Investigation	8/10/2011	GP-117	11.5	VOCs, 1,4-dioxane, metals
2011 Data Gaps Investigation	8/10/2011	GP-118	17	VOCs, 1,4-dioxane, metals
2011 Data Gaps Investigation	8/10/2011	GP-118 Duplicate	17	VOCs, 1,4-dioxane, metals
2011 Data Gaps Investigation	8/10/2011	GP-122	8.5	VOCs, 1,4-dioxane

Abbreviations
bgs = below ground surface
PAHs = polycyclic aromatic hydrocarbons
RI = Remedial Investigation
SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds

TABLE 4-6

SUMMARY OF SURFACE WATER, SEDIMENT, AND POREWATER SAMPLES

PSC Washougal Facility
Washougal, Washington

Investigation	Date	Sample Location	Depth (feet bgs)	Analyses
Gibbons Creek Sediment Investigation	8/27/1990	East-0	0	VOCs, SVOCs, metals
Gibbons Creek Sediment Investigation	8/27/1990	East-175	0	VOCs, SVOCs, metals
Gibbons Creek Sediment Investigation	8/27/1990	West-75	0	VOCs, SVOCs, metals
Gibbons Creek Sediment Investigation	8/27/1990	West-300	0	VOCs, SVOCs, metals
Steigerwald Marsh Sediment Investigation	8/27/1990	B-1	0.5, 2.5	VOCs, SVOCs, metals
Steigerwald Marsh Sediment Investigation	8/27/1990	B2	0.5, 2.5	VOCs, SVOCs, metals
Steigerwald Marsh Sediment Investigation	8/27/1990	B-3	0.5, 2.5	VOCs, SVOCs, metals
Steigerwald Marsh Sediment Investigation	8/27/1990	B-4	0.5, 2.5	VOCs, SVOCs, metals
Steigerwald Marsh Sediment Investigation	8/27/1990	B-5	0.5	VOCs, SVOCs, metals
Steigerwald Marsh Sediment Investigation	8/27/1990	B-6	0.5, 2.5	VOCs, SVOCs, metals
Steigerwald Marsh Surface Water Sampling	4/23/1990	SW-1	0	VOCs, Phenols
Steigerwald Marsh Surface Water Sampling	6/5/1990	SW-1	0	VOCs, Phenols
Steigerwald Marsh Surface Water Sampling	7/16/1990	SW-1	0	VOCs, Phenols
Steigerwald Marsh Surface Water Sampling	8/27/1990	SW-1	0	VOCs, metals, PAHs
Steigerwald Marsh Surface Water Sampling	10/9/1990	SW-1	0	VOCs, metals, PAHs
Steigerwald Marsh Surface Water Sampling	11/20/1990	SW-1	0	VOCs, metals, PAHs
Steigerwald Marsh Surface Water Sampling	1/17/1991	SW-1	0	VOCs, metals, PAHs
Gibbons Creek (Upgradient) Surface Water	4/23/1990	SW-2	0	VOCs, Phenols
Gibbons Creek (Upgradient) Surface Water	6/5/1990	SW-2	0	VOCs, Phenols
Gibbons Creek (Upgradient) Surface Water	7/16/1990	SW-2	0	VOCs, Phenols
Gibbons Creek (Upgradient) Surface Water	8/27/1990	SW-2	0	VOCs, metals, PAHs
Gibbons Creek (Upgradient) Surface Water	10/9/1990	SW-2	0	VOCs, metals, PAHs
Gibbons Creek (Upgradient) Surface Water	11/20/1990	SW-2	0	VOCs, metals, PAHs
Gibbons Creek (Upgradient) Surface Water	1/17/1991	SW-2	0	VOCs, metals, PAHs
Gibbons Creek (Downgradient) Surface Water	4/23/1990	SW-3	0	VOCs, Phenols
Gibbons Creek (Downgradient) Surface Water	6/5/1990	SW-3	0	VOCs, Phenols
Gibbons Creek (Downgradient) Surface Water	7/16/1990	SW-3	0	VOCs, Phenols
Gibbons Creek (Downgradient) Surface Water	8/27/1990	SW-3	0	VOCs, metals, PAHs
Gibbons Creek (Downgradient) Surface Water	10/9/1990	SW-3	0	VOCs, metals, PAHs
Gibbons Creek (Downgradient) Surface Water	11/20/1990	SW-3	0	VOCs, metals, PAHs
Gibbons Creek (Downgradient) Surface Water	1/17/1991	SW-3	0	VOCs, metals, PAHs

TABLE 4-6

SUMMARY OF SURFACE WATER, SEDIMENT, AND POREWATER SAMPLES

PSC Washougal Facility
Washougal, Washington

Investigation	Date	Sample Location	Depth (feet bgs)	Analyses
Steigerwald Marsh Surface Water Sampling	4/23/1990	SW-4	0	VOCs, Phenols
Steigerwald Marsh Surface Water Sampling	6/5/1990	SW-4	0	VOCs, Phenols
Steigerwald Marsh Surface Water Sampling	7/16/1990	SW-4	0	VOCs, Phenols
Steigerwald Marsh Surface Water Sampling	10/9/1990	SW-4	0	VOCs, metals, PAHs
Steigerwald Marsh Surface Water Sampling	11/20/1990	SW-4	0	VOCs, metals, PAHs
Steigerwald Marsh Surface Water Sampling	1/17/1991	SW-4	0	VOCs, metals, PAHs
Steigerwald Marsh Pore Water Sampling	10/25/2007	MC-SM-1	3	VOCs, gasoline, diesel, metals
Steigerwald Marsh Pore Water Sampling	9/21/2007	MC-SM-2	2.5	VOCs, gasoline, diesel, metals, 1,4-dioxane
Steigerwald Marsh Pore Water Sampling	9/21/2007	MC-SM-3	3	VOCs, gasoline, diesel, metals, 1,4-dioxane
Steigerwald Marsh Sediment Sampling	9/9/2008	MC-SM-1	0	VOCs, 1,4-dioxane, metals
Steigerwald Marsh Sediment Sampling	9/9/2008	MC-SM-2	0	VOCs, 1,4-dioxane, metals
Steigerwald Marsh Sediment Sampling	9/9/2008	MC-SM-3	0	VOCs, 1,4-dioxane, metals
Steigerwald Marsh Sediment Sampling	9/9/2008	MC-SM-4	0	VOCs, 1,4-dioxane, metals
Steigerwald Marsh Sediment Sampling	9/9/2008	MC-SM-5	0	VOCs, 1,4-dioxane, metals
Steigerwald Marsh Sediment Sampling	9/9/2008	MC-SM-6	0	VOCs, 1,4-dioxane, metals
Gibbons Creek Remnant Channel Sediment Sampling	9/11/2008	MC-GCRC1	0	VOCs, gasoline, 1,4-dioxane, metals
Gibbons Creek Remnant Channel Sediment Sampling	9/11/2008	MC-GCRC2	0	VOCs, gasoline, 1,4-dioxane, metals

Abbreviations
bgs = below ground surface
PAHs = polycyclic aromatic hydrocarbons
SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds

TABLE 4-7

ANALYTICAL RESULTS FOR DENSE NONAQUEOUS-PHASE LIQUIDS[1]

PSC Washougal Facility
Washougal, Washington

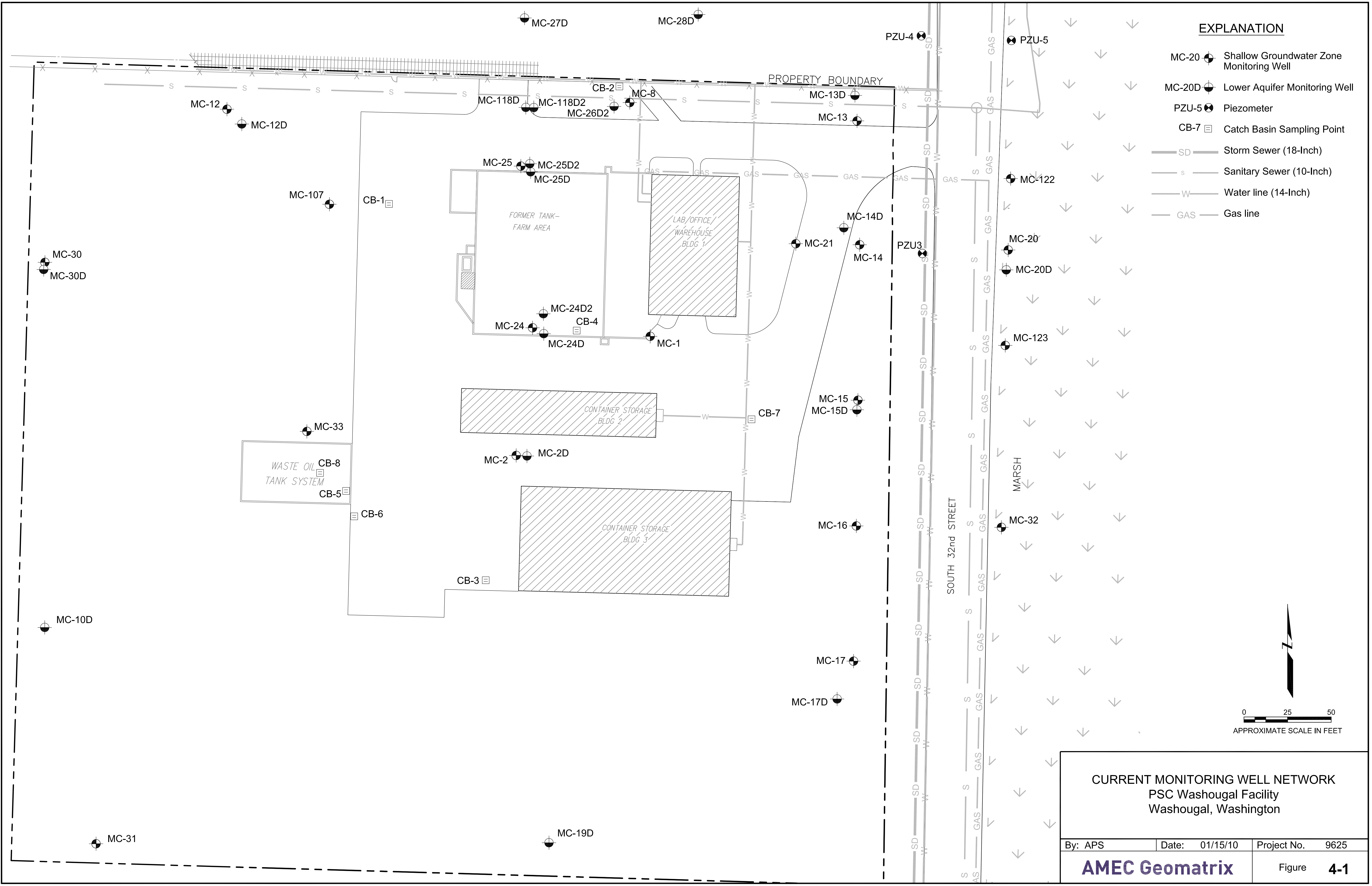
Sample ID	Date	1,1,1-TCA	Methylene Chloride	Trichlorotrifluoroethane	TCE	PCE	Toluene	Xylene
20-A	10/20/1986	29.50%	0.70%	18.40%	5.80%	38%	1%	0.80%

Note

1. Source: SEE, June 1991.

Abbreviations:
PCE = tetrachloroethene
TCA = trichloroethane
TCE = trichloroethene

FIGURES

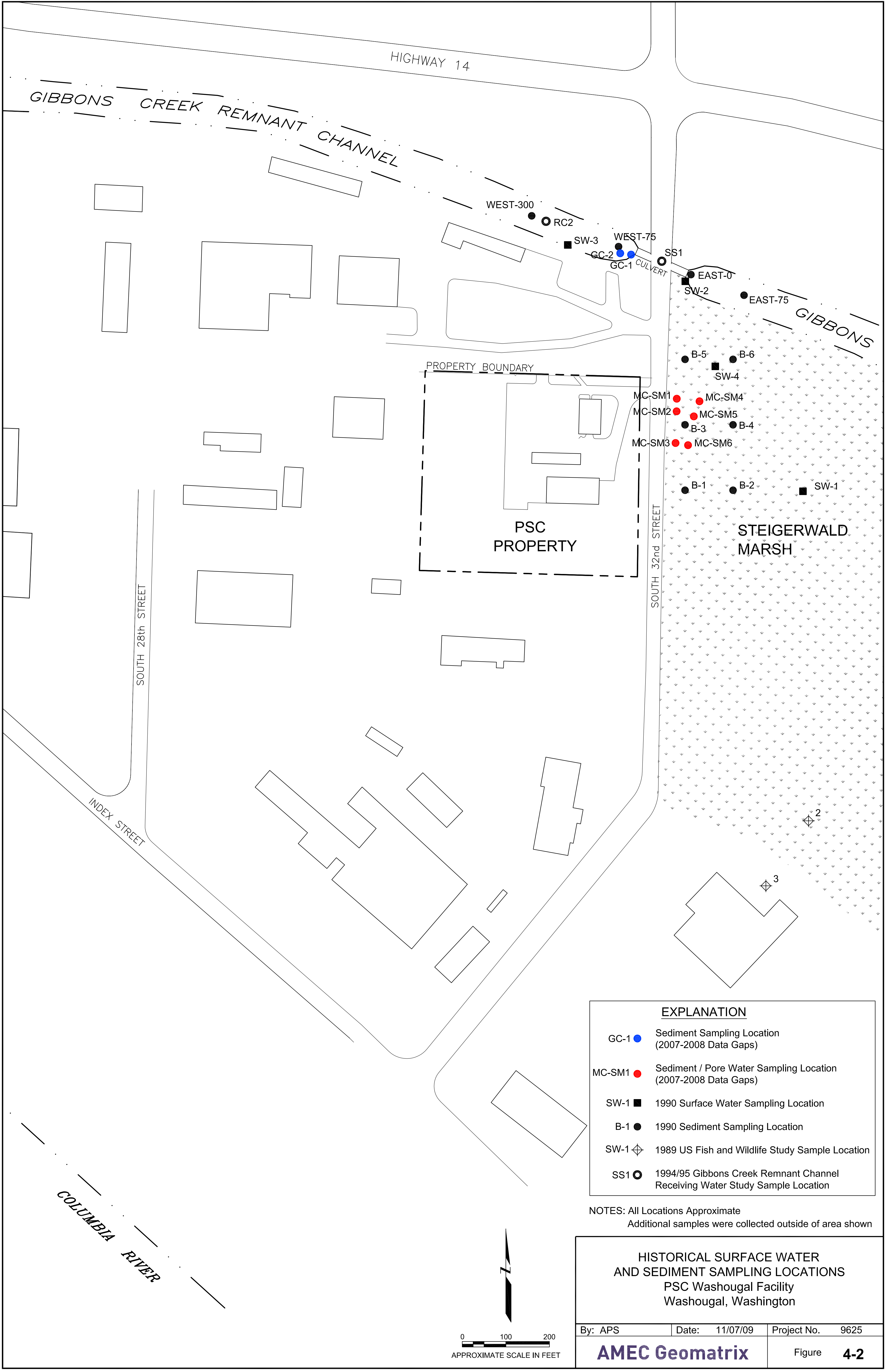


CURRENT MONITORING WELL NETWORK
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 01/15/10	Project No. 9625
AMEC Geomatrix		Figure 4-1

Plot Date: 01/15/10 - 12:25pm, Plotted by: adam.stenberg
Drawing Path: S:\9625\008_RIFS-2009\CAD\, Drawing Name: PSC Washougal_MW-Network_011410.DWG

Plot Date: 11/07/09 - 10:08pm, Plotted by: adam.stenberg
Drawing Path: S:\9625\008_RIFS-2009\CAD\, Drawing Name: PSC Washougal_HistoricalSW-SEDLoc_102809.DWG



EXPLANATION

GC-1 ●	Sediment Sampling Location (2007-2008 Data Gaps)
MC-SM1 ●	Sediment / Pore Water Sampling Location (2007-2008 Data Gaps)
SW-1 ■	1990 Surface Water Sampling Location
B-1 ●	1990 Sediment Sampling Location
SW-1 ⌖	1989 US Fish and Wildlife Study Sample Location
SS1 ○	1994/95 Gibbons Creek Remnant Channel Receiving Water Study Sample Location

NOTES: All Locations Approximate
Additional samples were collected outside of area shown

HISTORICAL SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS

PSC Washougal Facility
Washougal, Washington

By: APS
Date: 11/07/09
Project No. 9625

AMEC Geomatrix

Figure 4-2

5.0 PHYSIOGRAPHY AND CLIMATE

5.1 PHYSIOGRAPHY

Washougal lies in the floodplain of the Columbia River Valley, approximately 25 miles west of the Cascade mountain range and 60 miles east of the Coast mountain range. The PSC facility is located in the Camas/Washougal Industrial Park, which was constructed by the U.S. Army Corps of Engineers by building up dredge sands on top of the marshy silts to elevate the land for development.

5.2 DISCHARGE AREAS AND SURFACE WATER BODIES

Surface water bodies identified in the area surrounding the facility include:

- The Columbia River;
- the Washougal River;
- Steigerwald Lake National Wildlife Refuge;
- Gibbons Creek;
- the Gibbons Creek remnant channel; and
- wastewater treatment plant lagoons.

Locations of these features are shown on Figure 5-1. Of these six bodies, Steigerwald Lake and the Gibbons Creek remnant channel are closest to the site. They are discussed below.

5.2.1 Steigerwald Lake National Wildlife Refuge

Steigerwald Lake is included within the Steigerwald Lake National Wildlife Refuge. Located east of Washougal, Washington, the SLNWR is bounded on the north by State Route 14, on the west by the Camas/Washougal Industrial Park, on the east by Lawton Creek, and on the south by the Columbia River. The SLNWR has an area of approximately 974 acres, and is located between Columbia River miles 124 and 128. Since 1992, Steigerwald Lake has consisted of seasonally intermittent wetlands. Steigerwald Marsh, which is part of the SLNWR, is located immediately east of the PSC property, across South 32nd Street. The marsh is connected to Steigerwald Lake by a narrow corridor of the wildlife refuge (Figure 5-1).

A 1984 federal law authorized the U.S. Army Corps of Engineers to acquire the area now known as the SLNWR, as mitigation for the loss of wildlife habitat associated with the construction of the Bonneville Lock and Dam Second Powerhouse Project at North Bonneville, Washington. In 1988, the SLNWR came under the authority of the U.S. Fish and Wildlife

Service (Materna et al., 1992). Prior to 1992, Steigerwald Lake was a shallow lake. In 1992 it was drained and diked, and now consists of seasonally intermittent wetlands (PSC, 2000).

Based on hydrogeologic data, including aquifer stratigraphy and hydraulic gradients, it appears that groundwater from the site discharges to the SLNWR. Hydrogeology of the site is discussed further in Section 7.0. Groundwater in the Shallow Groundwater Zone flows eastward toward the SLNWR. The Shallow Groundwater Zone sand pinches out toward the SLNWR, and groundwater in this zone likely discharges to the marsh through the lower permeability Silt Layer underlying the Sand Fill. The gradient of groundwater in the Lower Aquifer is highly variable on a daily and seasonal basis, but net groundwater flow is generally east-southeast to southward, toward the SLNWR and the Columbia River. Vertical hydraulic gradients between the Lower Aquifer and the Shallow Groundwater Zone are upward along the east side of the PSC property, indicating that a portion of Lower Aquifer groundwater also discharges to the SLNWR.

Five major habitat types occur within the SLNWR: (1) upland/agricultural fields and cattle pastures; (2) riparian habitat along the Columbia River at Cottonwood Beach and riverward of the levee; (3) wooded areas of cottonwood, alder, oak, and willow; (4) wetlands (five different types); and (5) open water. These habitats support a variety of wildlife. The SLNWR is used as resting and wintering grounds by raptors, waterfowl, marsh and water birds, and riparian woodland songbirds. The SLNWR also supports mammals, including beaver, river otter, mink, nutria, and muskrat. Gibbons Creek and its tributaries, which drain part of the SLNWR, support steelhead, cutthroat, and rainbow trout. With the exception of spawning coho salmon, anadromous fish have been eradicated from the SLNWR (Materna et al., 1992).

5.2.2 Gibbons Creek and the Gibbons Creek Remnant Channel

Gibbons Creek drains the low-lying hills northeast of the facility north of Highway 14. The headwater of Gibbons Creek is a spring on the border of Clark and Skamania Counties. The creek flows south approximately 7 miles, and across the SLNWR before joining the Columbia River. In recent history, the channel of Gibbons Creek has been rerouted several times. Historically, Gibbons Creek flowed into Steigerwald Lake and then into the Columbia River (Materna et al., 1992). In 1961, Gibbons Creek flowed southwest, discharging directly into the Columbia River. In 1966, the U.S. Army Corps of Engineers realigned Gibbons Creek to flow due west as part of an attempt to drain Steigerwald Lake. In 1992, as part of a project to restore and control wetlands within the SLNWR, the U.S. Army Corps of Engineers abandoned the realigned channel and constructed an elevated bypass to convey the waters of Gibbons Creek southeasterly through the Steigerwald wetlands, to discharge into the Columbia River (Erickson and Tooley, 1996) (Figure 5-1).

The original 1.5-mile-long Gibbons Creek channel continues to drain Steigerwald Lake and the immediate area surrounding the PSC facility. The channel is now referred to as the Gibbons Creek remnant channel. The Gibbons Creek remnant channel now drains an area of about 4.5 square miles instead of its prediversion drainage area of approximately 12 square miles. The channel serves as the receiving water body for the wastewater from five industrial facilities, and stormwater runoff from many more facilities. A summary table of facilities discharging to the Gibbons Creek remnant channel is provided in Table 5-1. Since rerouting of Gibbons Creek, the amount of water available for dilution for these discharges have been substantially reduced, prompting concerns that discharges may be adversely impacting water quality and wildlife from the adjacent SLNWR (Erickson and Tolley, 1996).

Because the rerouted part of the channel is elevated (built into a dike), the surrounding land does not drain into Gibbons Creek, but instead drains to the Gibbons Creek remnant channel. Therefore, no land south of Highway 14, including the SLNWR and the industrial park, contributes runoff to Gibbons Creek.

Flow from the remnant channel to the Columbia River is controlled using a passive 72-inch tide gate with three 200-horsepower pumps, each pumping 20,000 gpm. When the Columbia River stage is greater than 8.5 feet above mean sea level (MSL), the gate is open and water in the remnant channel is pumped through the dike. When the Columbia River stage is less than 8.5 feet MSL, the gate is closed, the pumps are off, and there is no flow in the remnant channel (Erickson and Tooley, 1996). The pumps are used primarily during periods when the Columbia River stage is high (PSC, 2000).

It is likely that some groundwater from the site also reaches the remnant channel via the French drain underlying the storm sewer line on South 32nd Street. A more detailed discussion of to the potential for this discharge is found in Section 7.2.4.

The Remnant Channel is classified as a Class A Water by Ecology (Erickson and Tooley, 1996). Potential receptors in the marsh and other nearby surface water bodies are discussed in Section 8.4.

5.2.3 Washougal River

The Washougal River is a tributary of the Columbia River. The confluence of the Washougal River with the Columbia River is approximately 3 miles west of the facility. The Washougal River is 32.9 miles long, draining 108 square miles. The total volumetric discharge of the Washougal River varies from approximately 105 to 1,750 cfs (SEE, 1991). High discharge rates occur from November through April; low flows occur from August through October

(Fuste, 2000). The high flow rates typically correlate with increased precipitation rates (Mundorff, 1964).

5.2.4 Wastewater Treatment Plant Lagoons

The City of Washougal wastewater treatment plant borders the SLNWR on the northwest (Figure 5-1). The treatment plant includes concrete-lined oxidation ditches and open (uncovered) surface ponds ("lagoons") (Bachelder, 2000). The lagoons, which are unlined, were constructed in 1967 and 1968. The total surface area of the lagoons is approximately 15.4 acres. The lagoons were used historically to treat raw sewage. Treated effluent was discharged from the lagoons to Gibbons Creek, which then flowed into the wetlands of the SLNWR. Currently, sewage is treated in the oxidation ditches. Following treatment, the effluent discharges directly to the Columbia River (Erickson and Tooley, 1996). The lagoons currently serve as emergency overflow basins that can provide additional storage capacity.

5.3 CLIMATE

Rockey (2000) provided a description of the climate for the region surrounding Portland, Oregon, which applies to the Washougal area as well.

> The Coast Range provides the Washougal area limited shielding from Pacific Ocean storms. The Cascades offer a steep slope for orographic lifting of moisture-laden westerly winds, resulting in moderate rainfall for the region. The Cascades also act as a barrier, preventing colder continental air masses originating in the Canadian Arctic from invading western Oregon. Occasionally, however, cold air works its way into western Oregon through the Columbia River Gorge.
>
> Rain is common during the winter months in the Washougal area. Nearly 90 percent of the annual rainfall occurs from October through May. Less than 20 percent of the annual rainfall occurs during the period from June to September, with less than 5 percent in July and August combined. Precipitation falls predominantly as rain, with an average of only five days per year recording measurable snow. Snowfall accumulations are rarely more than 2 inches, and often melt within one or two days.
>
> The winter season is characterized by mild temperatures, cloudy skies, and rain. Winds are predominantly either southerly during mild rainy spells, or easterly during colder dry spells. Cold arctic air from east of the Cascades occasionally spills into the area, bringing cold, blustery east winds. If the easterly winds occur when rain is falling, a shallow layer of cold air forms along the Columbia River. In and near this sub-freezing air, freezing rain and even snow will occur over the Washougal area.

> The cold easterly winds also bring the coldest air to the Washougal area. Temperatures below 0°F are rare. Most temperatures during the winter reach the 40s during the day and fall back into the low to middle 30s at night.
>
> Spring is a transitional time as the weather patterns shift from winter to summer. As a result, March and April are wet and cool, while May and June turn drier. Temperatures during May and June often fluctuate, ranging mostly in the 60s and 70s, occasionally reaching the 90s for a day or two. Even though the number of days with rain decreases in May and June, there are still many cloudy days.
>
> Summer typically arrives in middle to late June, when the temperatures finally reach the 80s on a daily basis. Northwesterly winds bring cool air from the Pacific Ocean down along the Columbia River. Summer temperatures frequently reach the middle 90s, but these warm days do not last long before the cool marine air arrives with temperatures in the 70s. Temperatures above 100°F are rare.
>
> Autumn is the reverse of spring, with many warm days in September. The rains begin to arrive by the middle of October. In addition, cooler temperatures arrive, with afternoon highs in the 50s and 60s. Fog begins to occur nightly during late October and November, with visibility commonly less than 1 mile. Fog can persist for several consecutive days.
>
> Destructive storms are infrequent in the Washougal area. Surface winds seldom exceed gale force (wind speed sustained at 50 miles per hour (mph) or greater) and only rarely exceed 75 mph. Thunderstorms can occur during any month, but are uncommon. During the winter and spring, thunderstorms are weak, producing gusty winds and small hail. During the summer, thunderstorms tend to be more vigorous, frequently accompanied by lightning, strong winds, and hail. Thunderstorms occasionally produce funnel clouds, but tornadoes are exceedingly rare. The most famous tornado on record in the area occurred in June 1972, damaging property and injuring many people as it moved from near Jantzen Beach (northwest of Portland) across the Columbia River into south Vancouver, Washington.
>
> On average, the last occurrence of freezing temperatures in the spring is March 30, while the first occurrence in the fall occurs on November 8. This provides for a long growing season.

The nearest known weather station to the facility is the Troutdale, Oregon, station. Troutdale is located approximately 2.5 miles due south of the confluence of the Washougal and Columbia

Rivers, and less than 5 miles from the facility. The Western Regional Climate Center provides long-term climatic data for the Troutdale station (WRCC, 2009). Average annual precipitation at this station is approximately 47 inches, with historical annual highs as high as 66 inches and lows down to 36 inches over the last 15 years. Figure 5-2 illustrates the average total monthly precipitation for the Troutdale station for the period 1994 to 2008. Table 5-2 lists the monthly total precipitation measured at the Troutdale station during the period January 1994 to August 2008.

TABLES

TABLE 5-1

PRESENT AND HISTORICAL SOURCES OF DISCHARGE TO GIBBONS CREEK REMNANT CHANNEL[1]

PSC Washougal Facility
Washougal, Washington

Facility	Address	Type of Industry	Permits	Permit Number	Permit Expiration	Type of Discharge
PSC (formerly Burlington Environmental)	625 S 32nd St	Former TSD, solvent recycling	NPDES for discharge to GCRC	SO3003079C	5/31/2008	Historical - treated wastewater and stormwater; Current - stormwater only
TrueGuard (formerly Allweather Wood Treaters)	725 S 32nd St	Wood preserving	NPDES for discharge to GCRC	WA0040029E	6/30/2013	Stormwater runoff from treated and untreated product storage areas
Exterior Wood	2685 S Index St	Wood preserving	NPDES for discharge to GCRC	WA0040711D	6/30/2013	Stormwater runoff from treated and untreated product storage areas, and treated vehicle washwater
Fiberweb	3720 Grant St	Production of nonwoven polypropylene fabric	NPDES for discharge to GCRC	SO3000503D	5/31/2008	Stormwater, cooling water, wastewater from cooling tower, and compressor condensate
Union Carbide	750 S 32nd St	Silicon purification, electronic crystals manufacturing	NPDES for discharge to GCRC	not found	not found	Stormwater, cooling water
Pendleton Woolen Mills	north of Hwy 14, not in industrial park	Wool finishing	NPDES for discharge to GCRC	ST0006002C	6/30/2013	Stormwater, cooling tower blowdown
Hambleton Lumber (formerly High Cascade)	520 S 28th St	Lumber remanufacturing - planer mill	general stormwater	SO3000618D	5/31/2008	Stormwater runoff
Advanced Drainage Systems	627 S 37th St	Manufacturing and distribution of plastic corrugated tubing and fittings	general stormwater	SO3000137D	5/31/2008	Stormwater runoff
Allen Brown Woodwaste	3495 S Truman St	Trucking of wood/wood residuals	general stormwater	SO3001811D	5/31/2008	Stormwater runoff
Hildebrand Concrete Construction, Inc. (formerly Betz Laboratories)	818 S 32nd St	Industrial water treatment	general stormwater	not found	not found	Stormwater runoff
Trojan Manufacturing Inc. (formerly Burkes Paint Company)	727 S 27th St	Paint manufacturing and retailing	general stormwater	not found	not found	Stormwater runoff
Kemira Chemicals (formerly Container Management Services)	3556 S Truman St	Refurbishment of storage drums	general stormwater	not found	not found	Stormwater runoff
Corrosion Controllers	3725 Grant St	Reinforced fiberglass products	general stormwater	SO3011162A	4/30/2009	Stormwater runoff
Ferguson Enterprises (formerly Industrial Plastics)	740 S 28th St	Machine plastics for industries	general stormwater	SO3004479B	5/31/2008	Stormwater runoff
Intech	3825 Grant St	Refurbishment of palletizing equipment	general stormwater	SO3011345A	4/30/2009	Stormwater runoff
Orbit Industries/DuraWound Inc.	778 S 27th St	Manufacturing of filament winding machines	general stormwater	SO3001814D	5/31/2008	Stormwater runoff
Pillar Plastics	3925 S Grant St	Plastic wedges - logging tools	general stormwater	SO3011660A	4/30/2009	Stormwater runoff
Calvert (formerly Sharp)	3559 S Truman St	Electronic components warehouse	general stormwater	SO3011365A	4/30/2009	Stormwater runoff
Textured Forest Products	721 S 28th St	Plywood siding	general stormwater	not found	not found	Stormwater runoff
TrueGuard (formerly Vancouver Manufacturing)	725 S 32nd St	Pallet manufacturing plant	general stormwater	not found	not found	Stormwater runoff
Kemira Chemicals (Vinings West, Inc.)	1150 S 35th St	Chemical blending	general stormwater	SO3001125D ST0006164C	5/31/2008 6/30/2013	Stormwater runoff

Notes
1. Source: Ecology, 1996.

Abbreviations
GCRC = Gibbons Creek Remnant Channel
NPDES = National Pollutant Discharge Eliminiation System
TSD = treatment, storage, and dispsal

TABLE 5-2

MONTHLY TOTAL PRECIPITATION, TROUTDALE WEATHER STATION[1]

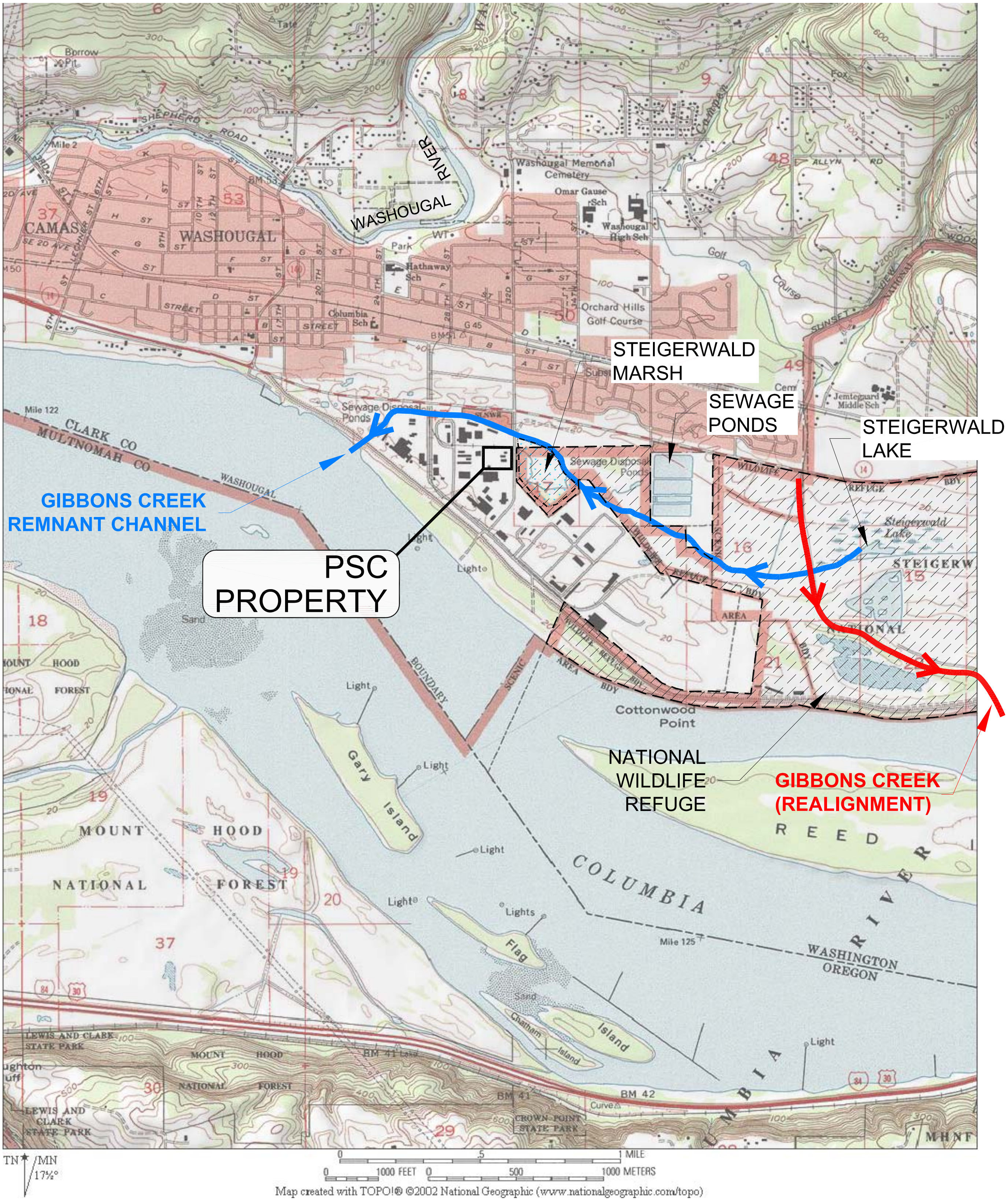
PSC Washougal Facility
Washougal, Washington

Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)	Date	Precipitation (inches)
Jan-1994	5.63	Aug-1997	1.63 [2]	Mar-2001	5.25	Oct-2004	5.44	May-2008	1.88 [2]
Feb-1994	6.47	Sep-1997	2.22 [2]	Apr-2001	3.29	Nov-2004	3.57	Jun-2008	1.48 [2]
Mar-1994	2.4	Oct-1997	5.97 [2]	May-2001	2.1	Dec-2004	0 [2]	Jul-2008	0.18 [2]
Apr-1994	3.12	Nov-1997	3.33 [2]	Jun-2001	2.48	Jan-2005	2.96	Aug-2008	0.94 [2]
May-1994	0.93	Dec-1997	4.30 [2]	Jul-2001	0.6	Feb-2005	1.41	Sep-2008	0.89 [2]
Jun-1994	1.62	Jan-1998	8.38 [2]	Aug-2001	1	Mar-2005	4.82	Oct-2008	0.98
Jul-1994	0.08	Feb-1998	4.49 [2]	Sep-2001	1	Apr-2005	5.63 [2]	Nov-2008	7.24 [2]
Aug-1994	0.14	Mar-1998	5.90 [2]	Oct-2001	4.04	May-2005	5.02	Dec-2008	3.36 [2]
Sep-1994	1.49	Apr-1998	2.07 [2]	Nov-2001	7.98	Jun-2005	4.08	Jan-2009	6.21 [2]
Oct-1994	7.21	May-1998	5.28- [2]	Dec-2001	9.03	Jul-2005	0.78	Feb-2009	2.66 [2]
Nov-1994	8.95	Jun-1998	3.27 [2]	Jan-2002	7.15 [2]	Aug-2005	1.53	Mar-2009	6.01 [2]
Dec-1994	7.2	Jul-1998	0.35 [2]	Feb-2002	4.32	Sep-2005	0.09	Apr-2009	4.38 [2]
Jan-1995	7.72 [2]	Aug-1998	0	Mar-2002	5.36	Oct-2005	6.8	May-2009	3.31
Feb-1995	4.70 [2]	Sep-1998	1.05 [2]	Apr-2002	3.61	Nov-2005	7.04	Jun-2009	0.77 [2]
Mar-1995	4.51	Oct-1998	2.51 [2]	May-2002	1.55	Dec-2005	9.26	Jul-2009	0.05
Apr-1995	4.78 [2]	Nov-1998	9.34 [2]	Jun-2002	2.31	Jan-2006	10.43	Aug-2009	1
May-1995	2.21 [2]	Dec-1998	7.81 [2]	Jul-2002	0.42	Feb-2006	3.69	Sep-2009	1.97
Jun-1995	3.28 [2]	Jan-1999	6.84 [2]	Aug-2002	0.12	Mar-2006	3.27	Oct-2009	4.65 [2]
Jul-1995	1.31	Feb-1999	6.10 [2]	Sep-2002	0.9	Apr-2006	4.41	Nov-2009	6.24 [2]
Aug-1995	1.72 [2]	Mar-1999	6.52 [2]	Oct-2002	1.81	May-2006	0 [2]	Dec-2009	3.84
Sep-1995	0 [2]	Apr-1999	1.91 [2]	Nov-2002	2.51 [2]	Jun-2006	1.78	Jan-2010	7.96
Oct-1995	5.24 [2]	May-1999	2.52 [2]	Dec-2002	9.6	Jul-2006	0.38	Feb-2010	2.82
Nov-1995	12.01 [2]	Jun-1999	3.13 [2]	Jan-2003	8.67	Aug-2006	0.15	Mar-2010	5.31 [2]
Dec-1995	4.82 [2]	Jul-1999	0.88 [2]	Feb-2003	4.57 [2]	Sep-2006	2.12	Apr-2010	3.98 [2]
Jan-1996	6.89 [2]	Aug-1999	0.59 [2]	Mar-2003	7.75 [2]	Oct-2006	2.21	May-2010	3.31 [2]
Feb-1996	9.89 [2]	Sep-1999	0.46 [2]	Apr-2003	4.42	Nov-2006	14.42 [2]	Jun-2010	5.9 [2]
Mar-1996	3.35 [2]	Oct-1999	2.98	May-2003	1.83	Dec-2006	8.86 [2]	Jul-2010	0.26 [2]
Apr-1996	5.63 [2]	Nov-1999	8.24	Jun-2003	0.48	Jan-2007	4.15	Aug-2010	0.03 [2]
May-1996	5.23 [2]	Dec-1999	5.6	Jul-2003	0	Feb-2007	5.1	Sep-2010	3.61 [2]
Jun-1996	1.16 [2]	Jan-2000	6.90 [2]	Aug-2003	0.05	Mar-2007	6.03	Oct-2010	5.23 [2]
Jul-1996	0.47 [2]	Feb-2000	6.84	Sep-2003	1.94	Apr-2007	3.58	Nov-2010	9.23 [2]
Aug-1996	0	Mar-2000	4.15	Oct-2003	3.13	May-2007	1.79	Dec-2010	10.12 [2]
Sep-1996	3.01 [2]	Apr-2000	2.92	Nov-2003	5.98	Jun-2007	1.77	Jan-2011	5.33 [2]
Oct-1996	5.61 [2]	May-2000	3.41	Dec-2003	9.18 [2]	Jul-2007	0.58	Feb-2011	4.01 [2]
Nov-1996	11.64 [2]	Jun-2000	1.45	Jan-2004	6.67 [2]	Aug-2007	0.7	Mar-2011	--
Dec-1996	13.55 [2]	Jul-2000	0.25	Feb-2004	5.47	Sep-2007	2.06	Apr-2011	--
Jan-1997	9.10 [2]	Aug-2000	0.12	Mar-2004	2.58	Oct-2007	5.88	May-2011	--
Feb-1997	2.00 [2]	Sep-2000	1.88	Apr-2004	1.41	Nov-2007	6.3	Jun-2011	--
Mar-1997	6.19 [2]	Oct-2000	5.03	May-2004	3.49	Dec-2007	8.47 [2]		
Apr-1997	5.44 [2]	Nov-2000	3.92	Jun-2004	1.75	Jan-2008	7.35 [2]		
May-1997	2.01 [2]	Dec-2000	3.97	Jul-2004	0.2	Feb-2008	4.05 [2]		
Jun-1997	3.07 [2]	Jan-2001	2.68	Aug-2004	3.91	Mar-2008	5.39 [2]		
Jul-1997	1.55 [2]	Feb-2001	2.38	Sep-2004	2.34	Apr-2008	3.28 [2]		

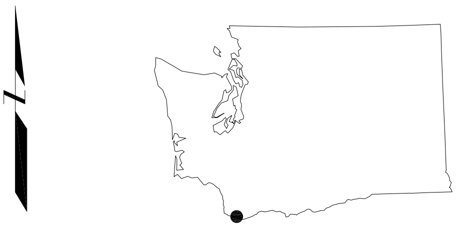
Notes
1. Source: WRCC, 2009.
2. One or more days of data missing from dataset.

Abbreviations
-- = not reported

FIGURES



Map created with TOPO!® ©2002 National Geographic (www.nationalgeographic.com/topo)

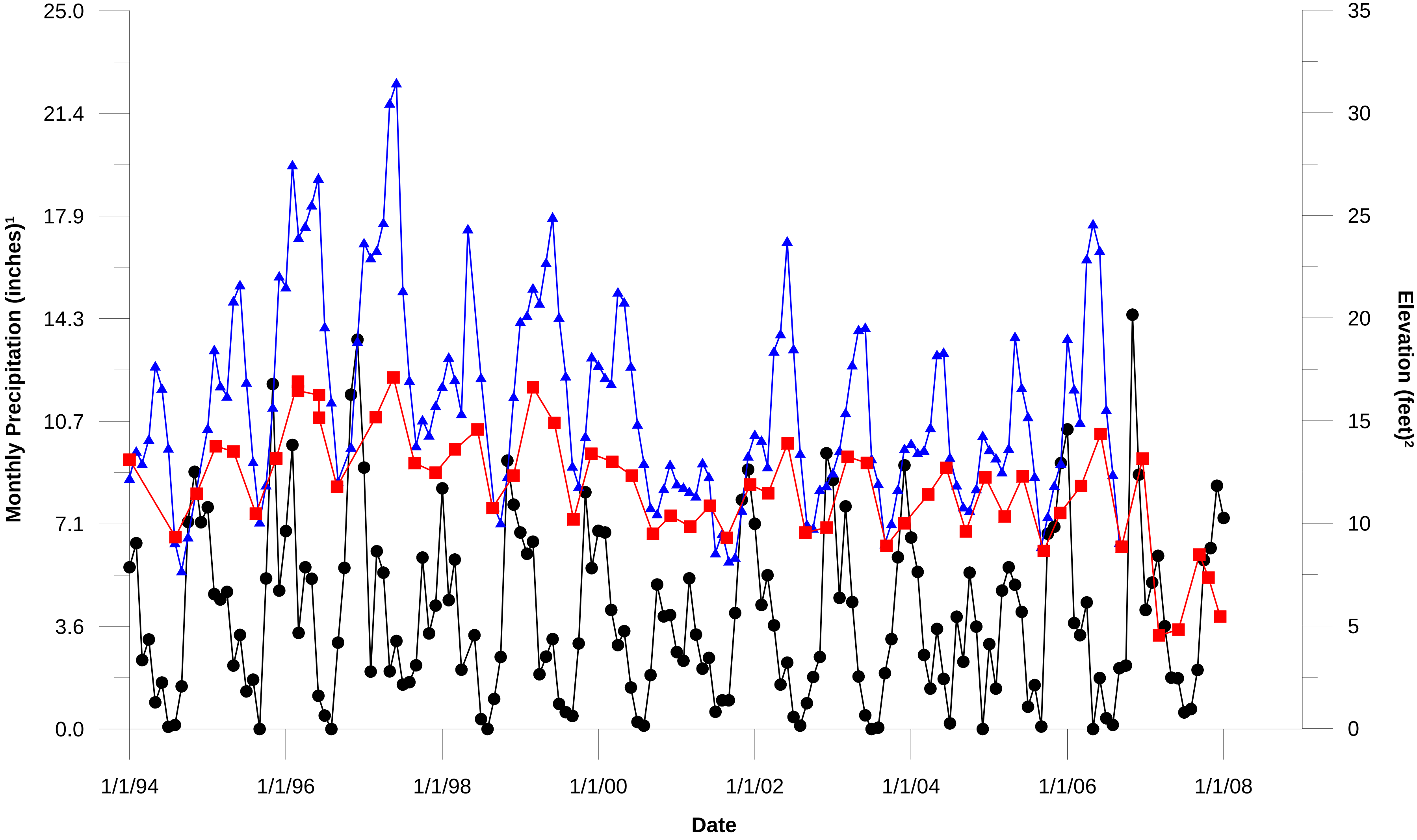


GIBBONS CREEK AND GIBBONS CREEK REMNANT CHANNEL RELATIONSHIP

PSC Washougal Facility
Washougal, Washington

By: APS	Date: 11/07/09	Project No. 09625
AMEC Geomatrix		Figure 5-1

Plot Date: 11/07/09 - 10:14pm, Plotted by: adam.stenberg
Drawing Path: S:\9625\008_RIFS-2009\CAD\, Drawing Name: PSC Washougal_GibbonsCreek_102609.DWG



Notes: 1. Troutdale, Oregon Station (NCDC COOP ID 358634);
Data from Western Regional Climate Center
(available Oct 2009 *http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ortrou*)
2. Elevation (feet) applies to both river stage and groundwater elevation.
3. USGS Stream Gage 14128870 Columbia River Below Bonneville Dam, OR.
Data through 2006 available from *http://waterdata.usgs.gov/nwis* as of October 2009

LEGEND
● Precipitation¹
▲ River Stage³
■ MC-2D Groundwater Elevation

AMEC Geomatrix

TOTAL MONTHLY PRECIPITATION, RIVER STAGE, AND LOWER AQUIFER GROUNDWATER ELEVATION (1994-2008)
PSC Washougal Facility
Washougal, Washington

Prepared By: RLW	Project No. 9625
10/14/2009	Figure No. 5-2

6.0 GEOLOGY

6.1 REGIONAL GEOLOGY

The site is located in a northwest-trending enclosed structural basin called the Portland Basin. The basin, which consists of Eocene to Miocene volcanic and marine sedimentary rocks, lies approximately 25 miles west of the Cascade Mountain Range and approximately 60 miles east of the Coast Mountain Range (McFarland and Morgan, 1996).

The basin was formed by downwarping and faulting of Eocene to Miocene volcanic and marine sedimentary rock during the late Miocene and early Pliocene epochs. Clay, silt, and sand of the Lower Troutdale formation formed the basin in the Portland/Vancouver area. During the Miocene epoch, Columbia River Basalts flowed through the area, spreading out and around the older Eocene Skamania volcanics. During the later Pliocene epoch and into the Pleistocene epoch, the basin subsided, and repeated periods of erosion and deposition occurred, building up to 1,800 feet of sediment in some areas. The following sediments formed:

- the Sandy River Mudstone, the oldest sediment;
- the Upper Troutdale Formation, deposited during the Pliocene as a large fluvial piedmont fan along the Western Cascade Mountains;
- the Boring Lava, usually overlaying the Upper Troutdale Formation; and
- Alluvium deposited along stream channels.

During the Pleistocene and Holocene epochs, the center of the basin was filled with flood deposits from the Columbia River. Fill is thickest along rivers and forms a great deltaic fan downstream of the Columbia River Gorge. The fill left broad plains and terraces up to 370 feet above sea level. More recent alluvial deposits are confined to the area's floodplains and are made up of fine-grained sand and silt (Mundorff, 1964; McFarland and Morgan, 1996). Figures 6-1 and 6-2 show these regional units.

Geologic units in the Washougal area are as follows in order of increasing depth (McFarland and Morgan, 1996):

- Unconsolidated Sediments: a series of alluvial deposits from the Columbia River and other surface waters, mostly late Pleistocene catastrophic flood deposits and Holocene Columbia River alluvium that fills the late Pleistocene Columbia River channel;
- Troutdale Gravel: poorly to moderately cemented conglomerate and sandy conglomerate with some lava accumulations;

- Confining Unit 1: medium- to fine-grained arkosic sand, silt, and clay, with some vitric sand beds;
- Troutdale Sandstone: coarse vitric sandstone and conglomerate with lenses and beds of fine to medium sand and silt;
- Confining Unit 2: composition similar to Confining Unit 1; and
- Sand and Gravel: sandy gravel, silty sand, sand, and clay overlying the Older Rock Subsystem.
- Older Rock Subsystem: volcanic and marine sedimentary rocks of Miocene age and older.

6.2 LOCAL GEOLOGY

The PSC Washougal property is situated within a diked portion of the Columbia River floodplain. Development has changed the landscape in this area. Since the site is on the floodplain of the river, the depth to groundwater is minimal and investigations on the site have been limited to depths less than approximately 35 feet, which corresponds to the uppermost portion of the unconsolidated alluvial sediments described in Section 6.1. Within this investigation depth at the site, four lithologic units have been identified. These units include the following, in order of increasing depth:

- Sand Fill;
- Silt Layer;
- Gravel; and
- Deeper Silty Sand.

The locations of cross sections developed for the PSC property and surrounding areas are shown on Figure 6-3. Figures 6-4 through 6-8 show two-dimensional geologic cross sections using all available lithologic borings that have been conducted at the site. Figure 6-4 shows a north/south-trending cross section (A-A') for locations adjacent to South 32nd Street and Steigerwald Marsh. Figure 6-5 shows a cross section (B-B') across the northern half of the PSC property. Figure 6-6 shows an expansion of this cross section to include borings GP-55, GP-85, and GP-86, which are located west of the property boundary. Figures 6-9 though 6-11 show three-dimensional model cross-sections based on lithologic data collected through 2007 illustrating the geologic stratigraphy at the site. The three-dimensional cross section shown on Figure 6-11 corresponds to transect location E-E´ shown on Figure 6-3.

6.2.1 Sand Fill

The uppermost soils at the site are the Sand Fill Unit. The Sand Fill consists primarily of brown to dark grey, poorly graded, fine- to coarse-grained sands, with occasional fine gravel. Soil sample grain size analysis from nine locations estimates the grain size distribution for the unit to be approximately 1 to 25 percent clay, 4 to 50 percent silt, 24 to 93 percent sand, and 1 to 15 percent gravel (Table 6-1). The Sand Fill consists of sands that were dredged from the Columbia River and emplaced hydraulically over Columbia River floodplain silts in the Camas/Washougal Industrial Park. The fill was needed to raise the ground surface above the level of the seasonal water table/wetlands interface for development of the Camas/Washougal Industrial Park. As a result, the extent of the Sand Fill is roughly equivalent to the area of the industrial park. The Sand Fill extends vertically from the ground surface to as much as 12 feet bgs and is present across the entire area of the PSC property. The Sand Fill is as thin as about 3 feet at the southeast portion of the property, near MC-123 (Figure 6-4), and was not found to the west of the PSC property. In general, this unit is thickest at the north end of the site in areas west of South 32nd Street, but its thickness varies. Groundwater occurring within the Sand Fill represents the Shallow Groundwater Zone (see Section 7.2.1).

In the vicinity of the former tank farm area, the surface Sand Fill Unit is slightly thicker than the 6 foot layer of sand that was excavated during the 1997 former tank farm area excavation interim action (Section 3.4.2). This discrepancy may be due to the placement of backfill following excavation to bring the area up to grade or to some error in measurement and depth estimates during drilling investigations.

6.2.2 Silt Layer

The Silt Layer represents the former floodplain and marsh that were present at the location of the PSC property and the rest of the Industrial Park prior to filling. The Silt Layer consists of dark greenish-grey to black, well-sorted silt and clay, with some sand. Grain-size analysis of samples from eight locations estimate the grain size distribution for the Silt Layer to be approximately 18 to 28 percent clay, 55 to 77 percent silt, 3 to 26 percent sand, and 2 to 6 percent gravel (Table 6-2). As would be expected for marsh-type soils, the silt is rich in organic matter and peaty in places. Soil samples collected from the borings for MC-20, GP-102, and GP-103 in the Silt Layer had 1.5 percent, 1.3 percent, and 1.3 percent TOC content, respectively. Woody debris was reported in the Silt Layer at borings GP-29, GP-34, GP-95, MC-2D, MC-14D, MC-18, MC-19D, and MC-24, at depths primarily between 7 and 9 feet bgs. The woody debris is likely the fibrous remains of vegetation from the marsh that existed in this area prior to development. Orange streaking reported in samples from this unit at borings GP-33, GP-96, GP-98, GP-99, MC-1, MC-2D, MC-10D, MC-11, MC-14, MC-18, MC-20D, and MC-24D is likely related to seasonally variable levels of groundwater and/or surface water within the former marsh. The Silt Layer represents a lower permeability unit that separates the Shallow Groundwater Zone and the Lower Aquifer (Section 7.2.2).

At the PSC property, the top of the Silt Layer ranges from approximately 3.5 to 12.0 feet bgs (6.1 to 14.0 feet above MSL, relative to NGVD29/47). As shown on Figures 6-12 and 6-13, the Silt Layer appears to be continuous in the industrial park. The Silt Layer is encountered at shallower depths to the east, northeast, and west of the PSC property, where it was found just below surface soils at off-property borings GP-81 through GP-87, and across South 32nd Street toward Steigerwald Marsh beyond the PSC property boundary (Figure 6-12 and Figure 6-13). To northeast and east, the Silt Layer is encountered at a shallower depth because of decreasing ground surface elevations in the direction of the marsh (Figure 6-5 and Figure 6-9). No fill material was placed on the marsh, making the marshland surface elevation lower than the PSC property. To the west of the PSC property, the Silt Layer slopes gradually upward toward the ground surface (Figure 6-6).

The Silt Layer has been fully penetrated in 25 borings (Lower Aquifer wells and GP-95 through GP-99). It is thickest toward the southwest portion of the property and thinnest (<6.5 feet thick) at the north side of the property near GP-96, GP-99, MC-13D, MC-27D, MC-28D, and PZU-4 (Figure 6-14). The thickness of the Silt Layer at the site ranges from approximately 5 feet to 20 feet (Table 6-3).

The elevation of the Silt Layer's upper surface varies slightly in the area surrounding the PSC property (approximately 6.5 to 12.0 feet bgs, or elevation of approximately 7.4 to 25.3 feet above MSL) (Figures 6-10, 6-12, and 6-13). Previous investigations thoroughly investigated the elevation of the silt to evaluate if there is a correlation between the depth to silt and higher constituent concentration. There does not appear to be a depression in the upper surface of the Silt Layer near borings MC-14, MC-14D, and MC-21 or beneath Building 1 (Figure 6-12). On the east side of South 32nd Street, in the areas north and south of boring MC-20, the top of the Silt Layer is at depths of approximately 3.5 to 10 feet bgs (8 to 14 feet above MSL).

The most notable features of the Silt Layer are apparent “depressions” in the top of the Silt Layer. An apparent east/west-trending “depression” occurs in the top of the Silt Layer between GP-35 and GP-33, east of South 32nd Street (Figure 6-4). The top of the Silt Layer drops approximately 5 feet between MC-123 and MC-20, then rises again 3 feet to GP-33. This localized low point between MC-123 and MC-20 is part of a larger depression formed between two peaks in the silt layer elevation present at PZU-4 to the north and MC-123 to the south (Figure 6-12). Underneath the former tank farm, the top of the Silt Layer is relatively flat. The silt slopes downward towards the northeast of Building 1, so that the top elevation near MC-13D is approximately 2 feet lower than the silt elevation beneath the former tank farm area. To the south of the tank farm, the top of the Silt Layer drops slightly to the south, making a depression in the top of the Silt Layer near MC-33 and another smaller depression near MC-2 (Figure 6-8).

6.2.3 Gravel Unit

Underlying the Silt Layer is a silty to sandy gravel referred to as the Gravel Unit. The Gravel Unit and deeper layers correspond to the Lower Aquifer (Section 7.2.3). The Gravel Unit is generally composed of dark grey to dark brown, poorly graded, fine to coarse gravel intermixed with silt and sand (silt decreasing with depth). Large gravel and boulders are present within this unit. Grain size analyses were not performed on soil samples from this unit due to the difficulty in collecting representative samples in the bouldery material. Boring logs from several Lower Aquifer wells indicate that the depth to the top of the unit increases in the southwest portion of the facility. At 16 borings (GP-95 through GP-99, MC-13D, MC-24D, MC-24D2, MC-25D, MC-25D2, MC-26D2, MC-27D, MC-28D, MC-30D, MC-118D, and MC-118D2) the upper surface of the Gravel Unit lies approximately between 14 and 22 feet bgs. At borings MC-10D, MC-19D, and MC-20D the upper surface of the unit lies at approximately 26 and 28 feet bgs, respectively.

Seven borings (MC-2D, MC-17D, MC-19D, MC24-D, MC-24D2, MC-25D2, and MC-30D) fully penetrate the Gravel Unit. The unit thickness ranges from approximately 0.5 feet at boring MC-2D to greater than 24 feet at boring MC-26D2. In some locations the unit may “pinch out.” At these locations, the Silt Layer directly overlies the Deeper Silty Sand (Section 6.2.4).

6.2.4 Deeper Silty Sand

The Deeper Silty Sand is composed of yellowish-brown, moderately sorted, fine to coarse sand and silt. A grain-size analysis performed on a sample collected from the Deeper Silty Sand unit in boring MC-19D showed a grain size distribution of 90 percent sand and 10 percent silt or clay (Table 6-4). At borings that intersect the Deeper Silty Sand (MC-17D, MC-19D, MC-24D, MC-24D2, MC-25D2, and MC-30D), the top of the unit was encountered between 24 and 36 feet bgs. Borings in the northeast portion of the facility did not encounter the Deeper Silty Sand. Evidently these borings, whose total depths ranged from 22.5 to 39 feet bgs, were not deep enough to intersect the unit. No borings fully penetrated the Deeper Silty Sand Unit.

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TABLES

TABLE 6-1

GEOTECHNICAL AND HYDRAULIC PROPERTIES OF SAND FILL

PSC Washougal Facility
Washougal, Washington

Parameter	Location	Depth (feet bgs)	Value	Units	Test Type
Grain Size					
	GP-28 [1]	7-8	24% Sand, 50% Silt, 25% Clay	percent	Sieve Test - ASTM D421/D422
	GP-28 [1]	7-8	74% Sand, 6% Silt or Clay	percent	Sieve Test - ASTM D421/D422
	GP-45	0-2	15% Gravel, 79% Sand, 6% Silt or Clay	percent	Sieve Test - ASTM D421/D422
	GP-47	0-2	9% Gravel, 86% Sand, 5% Silt or Clay	percent	Sieve Test - ASTM D421/D422
	GP-102	9	1% Gravel, 88% Sand, 11% Silt or Clay	percent	Sieve Test - ASTM D422
	GP-103	7.5	1 % Gravel, 93% Sand, 4% Silt, 1% Clay	percent	Sieve Test - ASTM D422
	MC-118D	9-11	36% Sand, 43% Silt, 15% Clay	percent	Sieve Test - ASTM D421/D422
	MC-21	5-7	89% Sand, 9% Silt, 2% Clay	percent	Sieve Test - ASTM D421/D422
	MC-21	5-7	94% #20 or finer	percent	Sieve Test - ASTM D421/D422
	PZU-1	0-1	48% Gravel, 43% Sand, 9% Silt or Clay	percent	Sieve Test - ASTM D421/D422
	PZU-2	1-2	3% Gravel, 88% Sand, 9% Silt or Clay	percent	Sieve Test - ASTM D421/D422
	PZU-2	0-1	44% Gravel, 49% Sand, 7% Silt or Clay	percent	Sieve Test - ASTM D421/D422
Horizontal Hydraulic Conductivity					
	MC-1	11.5	1.00E-02	cm/s	pumping (drawdown)
	MC-1	2.5-11.5	6.10E-03	cm/s	pumping (drawdown)
	MC-1	2.5-11.5	9.80E-03	cm/s	pumping (recovery)
	MC-10	~3-10	1.40E-02	cm/s	pumping (drawdown)
	MC-10	~3-10	3.80E-02	cm/s	pumping (recovery)
	MC-12	2.5-7.5	4.70E-02	cm/s	pumping (recovery)
	MC-12	2.5-7.5	5.00E-02	cm/s	pumping (drawdown)
	MC-13	2.5-9	2.40E-02	cm/s	pumping (recovery)
	MC-14	4-9	1.70E-03	cm/s	pumping (drawdown)
	MC-14	4-9	3.30E-03	cm/s	pumping (recovery)
	MC-2	2.5-12.5	5.70E-04	cm/s	pumping (recovery)
	MC-7	2.5-10	3.70E-03	cm/s	pumping (recovery)
	MC-8D	6.5-8.5	3.10E-03	cm/s	pumping (recovery)
	MC-8D	6.5-8.5	0.022-0.032	cm/s	pumping (drawdown)
	MC-8S	2.5-7.5	4.00E-03	cm/s	pumping (drawdown)
	MC-8S	2.5-7.5	6.00E-03	cm/s	pumping (recovery)
	P-11	3-10	0.0022-0.0042	cm/s	pumping (drawdown)
	P-13	3-8.75	5.90E-03	cm/s	pumping (recovery)
	P-13	3-8.75	2.40E-02	cm/s	pumping (drawdown)
	R-1	3-8	3.60E-03	cm/s	pumping (recovery)
	R-6	4.5-9.5	5.90E-04	cm/s	pumping (recovery)
	R-8	4-9	5.00E-03	cm/s	pumping (recovery)
	PZU-3	4.9-8.9	3.10E-02	cm/s	slug test (rising head)
	MC-20 (Test 1)	4.4-11.4	2.20E-03	cm/s	slug test (rising head)
	MC-20 (Test 2)	4.4-11.4	2.60E-03	cm/s	slug test (rising head)
	MC-24 (Test 1)	4.1-8.9	3.20E-03	cm/s	slug test (rising head)
	MC-24 (Test 2)	4.1-8.9	3.70E-03	cm/s	slug test (rising head)
	MC-25 (Test 1)	4.0-8.8	2.00E-03	cm/s	slug test (rising head)
	MC-25 (Test 2)	4.0-8.8	2.30E-03	cm/s	slug test (rising head)

TABLE 6-1

GEOTECHNICAL AND HYDRAULIC PROPERTIES OF SAND FILL

PSC Washougal Facility
Washougal, Washington

Parameter	Location	Depth (feet bgs)	Value	Units	Test Type
Vertical Hydraulic Conductivity					
	GP-45	0-2	3.70E-02	cm/s	rigid wall
	GP-47	0-2	6.40E-04	cm/s	rigid wall
	PZU-1	0-1	8.30E-02	cm/s	rigid wall
	PZU-2	1-2	3.30E-03	cm/s	rigid wall
	PZU-2	0-1	7.50E-03	cm/s	rigid wall
	GP-28 [1]	7-8	2.50E-07	cm/s	triaxial
	GP-28 [1]	7-8	3.20E-04	cm/s	rigid-wall
	MC-118D	9-11	8.10E-06	cm/s	triaxial
	MC-21	5-7	1.60E-05	cm/s	rigid-wall
Porosity					
	GP-28	7-8	0.525	unitless	triaxial
	GP-28	7-8	0.43	unitless	rigid-wall
	GP-45	0-2	0.34	unitless	ASTM-D-5084
	GP-47	0-2	0.44	unitless	ASTM-D-5084
	MC-118D	9-11	0.419	unitless	triaxial
	MC-15D-2A	2-3.5	0.43	unitless	ASTM-D-5084
	MC-18-2A	2-3.5	0.41	unitless	ASTM-D-5084
	MC-21	5-7	0.47	unitless	rigid-wall
	MC-2D-2A	5.5-7	0.4	unitless	ASTM-D-5084
	PZU-1	0-1	0.39	unitless	ASTM-D-5084
	PZU-2	1-2	0.45	unitless	ASTM-D-5084
	PZU-2	0-1	0.41	unitless	ASTM-D-5084
Specific Yield					
	MC-14	4-9	4.80E-01	unitless	pumping (drawdown)
	MC-8D	6.5-8.5	5.30E-03	unitless	pumping (drawdown)
	MC-8D	6.5-8.5	3.10E-02	unitless	pumping (recovery)
	MC-8D	6.5-8.5	0.015-0.021	unitless	pumping (drawdown)
	MC-8S	2.5-7.5	2.40E-03	unitless	pumping (drawdown)
	MC-8S	2.5-7.5	1.50E-02	unitless	pumping (recovery)
	P-11	7-10	0.000022-0.0011	unitless	pumping (drawdown)
	P-13	5.75-8.75	2.60E-02	unitless	pumping
Total Organic Carbon					
	GP-45	0-2	0.32	percent	Plumb, 1981
	GP-47	0-2	0.3	percent	Plumb, 1981
	GP-102	10	0.08	percent	EPA Method 9060
	GP-103	10	0.07	percent	EPA Method 9060
	MC-21	5-7	0.12	percent	Plumb, 1981
	PZU-1	0-1	3.4	percent	Plumb, 1981
	PZU-2	1-2	1.8	percent	Plumb, 1981
	PZU-2	0-1	0.2	percent	Plumb, 1981

TABLE 6-1

GEOTECHNICAL AND HYDRAULIC PROPERTIES OF SAND FILL

PSC Washougal Facility
Washougal, Washington

Parameter	Location	Depth (feet bgs)	Value	Units	Test Type
Volumetric Moisture Content					
	GP-28 [1]	7-8	39.6	percent	triaxial
	GP-28 [1]	7-8	27	percent	rigid wall
	MC-118D	9-11	27.4	percent	rigid wall
	MC-15D-2A	2-3.5	7.9	percent	rigid wall
	MC-18-2A	2-3.5	12.1	percent	rigid wall
	MC-21	5-7	31.7	percent	rigid wall
	MC-2D-2A	5.5-7	22.8	percent	rigid wall
Wet Density					
	GP-28 [1]	7-8	112	lb/ft^3	triaxial
	GP-28 [1]	7-8	122.2	lb/ft^3	rigid wall
	GP-45	0-2	97.6	lb/ft^3	rigid wall
	GP-47	0-2	96.8	lb/ft^3	rigid wall
	MC-118D	9-11	122	lb/ft^3	triaxial
	MC-21	5-7	119.2	lb/ft^3	unknown
	PZU-1	0-1	94	lb/ft^3	rigid wall
	PZU-2	1-2	92.5	lb/ft^3	rigid wall
	PZU-2	0-1	99.2	lb/ft^3	rigid wall
Dry Bulk Density					
	MC-15D-2A	2-3.5	96.9	lb/ft^3	estimated from wet bulk density
	MC-18-2A	2-3.5	100.2	lb/ft^3	estimated from wet bulk density
	MC-2D-2A	5.5-7	101.9	lb/ft^3	estimated from wet bulk density

Notes

1. GP-28-7-8 was split by the laboratory into two units for analysis due to observed visual differences.

Abbreviations

ASTM = American Society for Testing and Materials
bgs = below ground surface
cm/s = centimeters per second
EPA = US Environmental Protection Agency
lb/ft^3 = pounds per cubic foot

TABLE 6-2

GEOTECHNICAL AND HYDRAULIC PROPERTIES OF SILT LAYER
PSC Washougal Facility
Washougal, Washington

<table>
<tr><th>Parameter</th><th>Location</th><th>Depth (feet bgs)</th><th colspan="3">Value</th><th>Units</th><th>Test Type</th></tr>
<tr><td colspan="8">Grain Size</td></tr>
<tr><td></td><td>GP-30</td><td>12-14</td><td colspan="3">3% Sand, 69% Silt, 28% Clay</td><td>percent</td><td>Sieve Test - ASTM[1] D421/D422</td></tr>
<tr><td></td><td>GP-31</td><td>14-16</td><td colspan="3">26% Sand, 55% Silt, 20% Clay</td><td>percent</td><td>Sieve Test - ASTM D421/D422</td></tr>
<tr><td></td><td>GP-34</td><td>14-16</td><td colspan="3">5% Sand, 70% Silt, 25% Clay</td><td>percent</td><td>Sieve Test - ASTM D421/D422</td></tr>
<tr><td></td><td>GP-102</td><td>10</td><td colspan="3">2% Gravel, 10% Sand, 69% Silt, 21% Clay</td><td>percent</td><td>Hydrometer Test - ASTM D422</td></tr>
<tr><td></td><td>GP-103</td><td>10</td><td colspan="3">6% Gravel, 6% Sand, 65% Silt, 20% Clay</td><td>percent</td><td>Hydrometer Test - ASTM D422</td></tr>
<tr><td></td><td>MC-107</td><td>8-10</td><td colspan="3">4% Sand, 77% Silt, 19% Clay</td><td>percent</td><td>Sieve Test - ASTM D421/D422</td></tr>
<tr><td></td><td>MC-17D[1]</td><td>7.5-9.5</td><td colspan="3">8% Sand, 74% Silt,18% Clay</td><td>percent</td><td>Sieve Test - ASTM D421/D422</td></tr>
<tr><td></td><td>MC-20[2]</td><td>7-9</td><td colspan="3">3% Sand, 75% Silt, 22% Clay</td><td>percent</td><td>Sieve Test - ASTM D421/D422</td></tr>
<tr><td></td><td>GP-119</td><td>16</td><td colspan="3">10% Sand, 70% Silt, 19% Clay</td><td>percent</td><td>Sieve Test - ASTM D422</td></tr>
<tr><td></td><td>GP-123</td><td>9</td><td colspan="3">4% Sand, 74% Silt, 17% Clay</td><td>percent</td><td>Sieve Test - ASTM D422</td></tr>
<tr><td colspan="8">Plasticity</td></tr>
<tr><td></td><td></td><td></td><td><i>Index</i></td><td><i>Liquid Limit</i></td><td><i>Plastic Limit</i></td><td></td><td></td></tr>
<tr><td></td><td>GP-102</td><td>10</td><td>8.2</td><td>32.4</td><td>24.2</td><td>percent</td><td>ASTM Method D4318</td></tr>
<tr><td></td><td>GP-103</td><td>10</td><td>9.7</td><td>34.8</td><td>25.1</td><td>percent</td><td>ASTM Method D4318</td></tr>
<tr><td colspan="8">Vertical Hydraulic Conductivity</td></tr>
<tr><td></td><td>GP-31</td><td>14-16</td><td colspan="3">0.00000072</td><td>cm/s</td><td>triaxial</td></tr>
<tr><td></td><td>GP-34</td><td>14-16</td><td colspan="3">9.80E-08</td><td>cm/s</td><td>triaxial</td></tr>
<tr><td></td><td>MC-107</td><td>8-10</td><td colspan="3">0.000002</td><td>cm/s</td><td>triaxial</td></tr>
<tr><td></td><td>MC-11</td><td>12.5-14.5</td><td colspan="3">0.000023</td><td>cm/s</td><td>triaxial</td></tr>
<tr><td></td><td>MC-11</td><td>17.5-19.5</td><td colspan="3">0.000008</td><td>cm/s</td><td>triaxial</td></tr>
<tr><td></td><td>MC-14</td><td>14.5-16.5</td><td colspan="3">0.0000012</td><td>cm/s</td><td>triaxial</td></tr>
<tr><td></td><td>MC-14</td><td>9.5-11.5</td><td colspan="3">0.00025</td><td>cm/s</td><td>triaxial</td></tr>
<tr><td></td><td>MC-15D-5A</td><td>12.5-14</td><td colspan="3">1.80E-07</td><td>cm/s</td><td>triaxial</td></tr>
<tr><td></td><td>MC-17D[1]</td><td>7.5-9.5</td><td colspan="3">4.30E-07</td><td>cm/s</td><td>triaxial</td></tr>
<tr><td></td><td>MC-18-6A</td><td>10-11.5</td><td colspan="3">0.00000082</td><td>cm/s</td><td>triaxial</td></tr>
<tr><td></td><td>MC-18-8A</td><td>15-16.5</td><td colspan="3">6.40E-07</td><td>cm/s</td><td>triaxial</td></tr>
<tr><td></td><td>MC-20[2]</td><td>7-9</td><td colspan="3">0.0000015</td><td>cm/s</td><td>triaxial</td></tr>
<tr><td></td><td>MC-2D-6A</td><td>19-20.5</td><td colspan="3">4.40E-07</td><td>cm/s</td><td>triaxial</td></tr>
<tr><td colspan="8">Horizontal Hydraulic Conductivity</td></tr>
<tr><td></td><td>MC-122 (Test 1)</td><td>5.2-15.2</td><td colspan="3">5.00E-04</td><td>cm/s</td><td>slug test (rising head)</td></tr>
<tr><td></td><td>MC-122 (Test 2)</td><td>5.2-15.2</td><td colspan="3">4.70E-04</td><td>cm/s</td><td>slug test (rising head)</td></tr>
<tr><td></td><td>MC-123 (Test 1)</td><td>5.2-15.2</td><td colspan="3">4.80E-04</td><td>cm/s</td><td>slug test (rising head)</td></tr>
<tr><td></td><td>MC-123 (Test 2)</td><td>5.2-15.2</td><td colspan="3">6.60E-04</td><td>cm/s</td><td>slug test (rising head)</td></tr>
<tr><td colspan="8">Porosity</td></tr>
<tr><td></td><td>GP-30</td><td>12-14</td><td colspan="3">0.519</td><td>unitless</td><td>triaxial</td></tr>
<tr><td></td><td>GP-31</td><td>14-16</td><td colspan="3">0.477</td><td>unitless</td><td>triaxial</td></tr>
<tr><td></td><td>GP-34</td><td>14-16</td><td colspan="3">0.48</td><td>unitless</td><td>triaxial</td></tr>
<tr><td></td><td>MC-107</td><td>8-10</td><td colspan="3">0.535</td><td>unitless</td><td>triaxial</td></tr>
<tr><td></td><td>MC-11</td><td>12.5-14.5</td><td colspan="3">0.56</td><td>unitless</td><td>gravimetric and ASTM D-854</td></tr>
<tr><td></td><td>MC-11</td><td>17.5-19.5</td><td colspan="3">0.59</td><td>unitless</td><td>gravimetric and ASTM D-854</td></tr>
<tr><td></td><td>MC-14</td><td>14.5-16.5</td><td colspan="3">0.61</td><td>unitless</td><td>gravimetric and ASTM D-854</td></tr>
<tr><td></td><td>MC-14</td><td>9.5-11.5</td><td colspan="3">0.6</td><td>unitless</td><td>gravimetric and ASTM D-854</td></tr>
<tr><td></td><td>MC-15D-5A</td><td>12.5-14</td><td colspan="3">0.65</td><td>unitless</td><td>gravimetric and ASTM D-854</td></tr>
<tr><td></td><td>MC-17D[1]</td><td>7.5-9.5</td><td colspan="3">0.476</td><td>unitless</td><td>triaxial</td></tr>
<tr><td></td><td>MC-18-6A</td><td>10-11.5</td><td colspan="3">0.56</td><td>unitless</td><td>gravimetric and ASTM D-854</td></tr>
<tr><td></td><td>MC-18-8A</td><td>15-16.5</td><td colspan="3">0.47</td><td>unitless</td><td>gravimetric and ASTM D-854</td></tr>
<tr><td></td><td>MC-20[2]</td><td>7-9</td><td colspan="3">0.61</td><td>unitless</td><td>triaxial</td></tr>
<tr><td></td><td>MC-2D-6A</td><td>19-20.5</td><td colspan="3">0.41</td><td>unitless</td><td>gravimetric and ASTM D-854</td></tr>
</table>

TABLE 6-2

GEOTECHNICAL AND HYDRAULIC PROPERTIES OF SILT LAYER

PSC Washougal Facility
Washougal, Washington

Parameter	Location	Depth (feet bgs)	Value	Units	Test Type
Total Organic Carbon					
	MC-20[2]	7-9	1.5	percent	Plumb, 1981
	GP-102	10	1.3	percent	
	GP-103	10	1.3	percent	
Volumetric Moisture Content					
	GP-30	12-14	0	percent	triaxial
	GP-31	14-16	33.1	percent	triaxial
	GP-34	14-16	34.6	percent	triaxial
	MC-107	8-10	41.4	percent	triaxial
	MC-15D-5A	12.5-14	65.4	percent	triaxial
	MC-17D[1]	7.5-9.5	33	percent	rigid wall
	MC-18-6A	10-11.5	46.7	percent	triaxial
	MC-18-8A	15-16.5	32.4	percent	triaxial
	MC-20[2]	7-9	60.4	percent	triaxial
	MC-2D-6A	19-20.5	25.3	percent	triaxial
Wet Density					
	GP-30	12-14	114	lb/ft^3	triaxial
	GP-31	14-16	117	lb/ft^3	triaxial
	GP-34	14-16	118	lb/ft^3	triaxial
	MC-107	8-10	111	lb/ft^3	triaxial
	MC-11	12.5-14.5	104.5	lb/ft^3	gravimetric
	MC-11	17.5-19.5	93.1	lb/ft^3	gravimetric
	MC-14	14.5-16.5	97	lb/ft^3	gravimetric
	MC-14	9.5-11.5	95.2	lb/ft^3	gravimetric
	MC-17D[1]	7.5-9.5	117	lb/ft^3	triaxial
	MC-20[2]	7-9	103	lb/ft^3	triaxial
Dry Bulk Density					
	MC-11	12.5-14.5	69	lb/ft^3	estimated from wet bulk density
	MC-11	17.5-19.5	65.9	lb/ft^3	estimated from wet bulk density
	MC-14	14.5-16.5	65.4	lb/ft^3	estimated from wet bulk density
	MC-14	9.5-11.5	65.9	lb/ft^3	estimated from wet bulk density
	MC-15D-5A	12.5-14	58.8	lb/ft^3	estimated from wet bulk density
	MC-18-6A	10-11.5	74.3	lb/ft^3	estimated from wet bulk density
	MC-18-8A	15-16.5	89	lb/ft^3	estimated from wet bulk density
	MC-2D-6A	19-20.5	99.4	lb/ft^3	estimated from wet bulk density

Notes

1. MC-17D reported in 2000 RI as Shallow Groundwater Zone sample, but grain size analysis shows it to be silt-upper confining unit.
2. MC-20 reported in 2000 RI as Shallow Groundwater Zone sample, but grain size analysis shows it to be silt-upper confining unit.

Abbreviations

ASTM = American Society for Testing and Materials
bgs = below ground surface
cm/s = centimeters per second
lb/ft^3 = pounds per cubic foot
RI = remedial investigation

TABLE 6-3

THICKNESS OF SILT LAYER

PSC Washougal Facility
Washougal, Washington

Exploration ID	Ground Surface Elevation[1] (feet)	Depth to Top of Silt (feet)	Depth to Bottom of Silt (feet)	Top of Silt Elevation[1] (feet)	Bottom of Silt Elevation[1] (feet)	Silt Thickness (feet)
GP-95	17.3	8.0	16.5	9.3	0.8	8.5
GP-96	17.5	8.0	14.0	9.5	3.5	6.0
GP-97	17.6	8.0	17.0	9.6	0.6	9.0
GP-98	17.7	7.5	14.0	10.2	3.7	6.5
GP-99	17.8	8.0	15.0	9.8	2.8	7.0
MC-2D	17.6	9.5	25.0	8.1	-7.4	15.5
MC-10D	18.5	10.0	26.5	8.5	-8.0	16.5
MC-12D	17.7	8.5	15.0	9.2	2.7	6.5
MC-13D	18.3	10.0	16.0	8.3	2.3	6.0
MC-14D	19.3	7.5	18.5	11.8	0.8	11.0
MC-15D	16.2	7.0	15.9	9.2	0.3	8.9
MC-17D	17.1	11.0	21.8	6.1	-4.7	10.8
MC-18	17.6	8.5	16.0	9.1	1.6	7.5
MC-19D	18.2	8.3	28.0	9.9	-9.8	19.7
MC-20D	20.2	7.5	21.0	12.7	-0.8	13.5
MC-24D	19.0	7.5	20.0	11.5	-1.0	12.5
MC-24D2	16.4	7.0	20.0	9.4	-3.6	13.0
MC-25D	16.7	8.5	18.0	8.2	-1.3	9.5
MC-27D	17.8	10.0	16.5	7.8	1.3	6.5
MC-28D	18.1	10.5	17.0	7.6	1.1	6.5
MC-30D	18.0	7.0	19.0	11.0	-1.0	12.0
MC-118D	17.7	11.6	16.5	6.1	1.2	4.9
MC-118D2	17.7	7.0	16.7	10.7	1.0	9.7

Notes

1. Elevations are relative to National Geodetic Vertical Datum 29/47.

TABLE 6-4

GEOTECHNICAL AND HYDRAULIC PROPERTIES OF LOWER AQUIFER

PSC Washougal Facility
Washougal, Washington

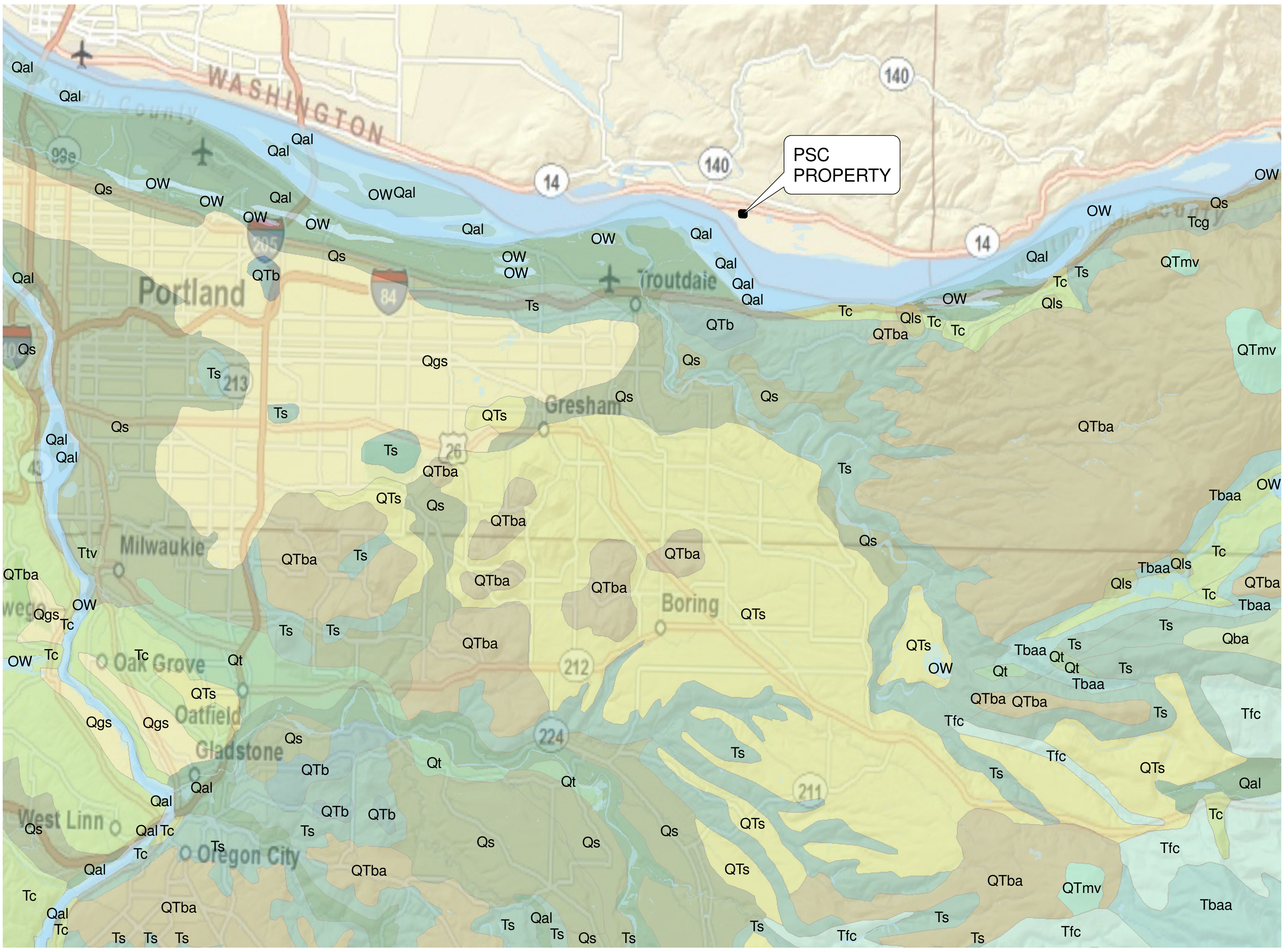
Parameter	Location	Depth (feet bgs)	Value	Units	Test Type
Grain Size					
	MC-19D	38.5-39	90% Sand,10% Silt or Clay	percent	Sieve Test - ASTM D421/D422
Vertical Hydraulic Conductivity					
	MC-19D	38.5-39	2.20E-06	cm/s	triaxial
	MC-2D-9A	27.5-29	6.60E-04	cm/s	triaxial
Porosity					
	MC-2D-9A	27.5-29	0.4	unitless	triaxial
	MC-19D	38.5-39	0.466	unitless	triaxial
Volumetric Moisture Content					
	MC-2D-9A	27.5-29	24.1	percent	triaxial
	MC-19D	38.5-39	31.3	percent	triaxial
Wet Density					
	MC-19D	38.5-39	118	lb/ft^3	triaxial
Dry Bulk Density					
	MC-2D-9A	27.5-29	100.8	lb/ft^3	estimated from wet bulk density

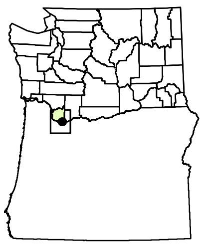
Abbreviations
ASTM = American Society for Testing and Materials
bgs = below ground surface
cm/s = centimeters per second
lb/ft^3 = pounds per cubic foot

FIGURES

S:\9625\008_RIFS-2009\GIS\GeologyMap_110409.mxd

OW	**Water**
QTb	**Basalt (Pleistocene and Pliocene)** - Thin flows and minor flow breccia of open--textured (diktytaxitic) olivine basalt in southeastern part of map area. Locally contains thin interbeds of sedimentary rocks. Grades laterally through palagonite tuff and breccia into sedimentary rocks (unit QTs)
QTba	**Basalt and basaltic andesite (Pleistocene and Pliocene**) - Flows, flow breccia, and pyroclastic deposits. Flows are aphanitic to finely crystalline, commonly diktytaxitic, and aphyric to porphyritic. Textures are mostly intergranular grading to intersertal; some andesite flows are finely trachytic and a few basalt flows are subophitic. Phenocrysts, mostly unaltered, include bytownite and labradorite, olivine, calcic augite, and hypersthene. Flows and breccia form shields, lava cones, and valley fill; in places greatly dissected and modified by fluvial erosion. Includes Boring Lava of Trimble (1963) and Hampton (1972) and Battle Ax Basalts of Thayer (1936). Potassium-argon ages from this unit range from about 1.2 to 3.9 Ma; in places difficult to distinguish from youngest flows of unit Trb
QTmv	**Mafic vent complexes (Pleistocene, Pliocene, and Miocene?)** - Plugs, dikes, and related near-vent flows, breccia, cinders, and agglutinate of basalt, basaltic andesite, and andesite; commonly in the form of either little-modified lava cones or partly eroded piles of reddish, iron-stained thin flows and fragmental ejecta cut by mafic intrusions. May also include rocks of late Miocene(?) age
QTs	**Sedimentary rocks (Pleistocene and Pliocene)** - Semiconsolidated lacustrine and fluvial ashy and palagonitic sedimentary rocks, mostly tuffaceous sandstone and siltstone; locally contains abundant palagonitized basaltic debris and some pebble conglomerate. Includes alluvial gravel and mudflow deposits of Walters Hill and Springwater Formations (Trimble, 1963). In places, grades laterally through palagonite tuff and breccia into basalt flows
Qal	**Alluvial deposits (Holocene)** - Sand, gravel, and silt forming flood plains and filling channels of present streams. In places includes talus and slope wash. Locally includes soils containing abundant organic material, and thin peat beds
Qba	**Basaltic andesite and basalt (Holocene? and Pleistocene)** - Flows and flow breccia dominantly of basaltic andesite containing plagioclase, olivine, and pyroxene phenocrysts and olivine-bearing basalt representing part of the volcanic sequence of the High Cascade Range (Thayer, 1937). Unit mostly forms small shield volcanoes, gentle-sided lava cones, and, in places, intracanyon flows
Qg	**Glacial deposits (Pleistocene)** - Unsorted bouldery gravel, sand, and rock flour in ground, terminal, and lateral moraines. Locally partly sorted
Qgs	**Glaciofluvial, lacustrine, and pediment sedimentary deposits (Holocene and Pleistocene)** - Unconsolidated, poorly sorted silt, sand, and gravel. Includes lacustrine deposits west of Columbia River Gorge (Trimble, 1963). Mostly in northern Morrow and Umatilla Counties where unit represents deposits of swollen late Pleistocene Columbia River (Hogenson, 1964)
Qls	**Landslide and debris-flow deposits (Holocene and Pleistocene)** - Unstratified mixtures of fragments of adjacent bedrock. Locally includes slope wash and colluvium. Largest slides and debris flows occur where thick sections of basalt and andesite flows overlie clayey tuffaceous rocks. May include some deposits of late Pliocene age
Qs	**Lacustrine and fluvial sedimentary rocks (Pleistocene)** - Unconsolidated to semiconsolidated lacustrine clay, silt, sand, and gravel; in places includes mudflow and fluvial deposits and discontinuous layers of peat. Includes older alluvium and related deposits of Piper (1942), Willamette Silt (Allison, 1953; Wells and Peck, 1961), alluvial silt, sand, and gravel that form terrace deposits of Wells and others (1983), and Gresham and Estacada Formations of Trimble (1963). Includes deltaic gravel and sand and gravel bars, in pluvial lake basins in southeastern part of map area. In Rome Basin, includes discontinuous layers of poorly consolidated conglomerate characterized by well-rounded, commonly polished pebbles of chert and pebbles and cobbles of quartzite. In places contains mollusks or vertebrate fossils indicating Pleistocene age; mostly deposits of late Pleistocene age, but locally includes some deposits of early Holocene age. Includes Touchet Beds of Flint (1938), deposits of valley terraces of Newcomb (1965), and, in southeast Oregon, basin-filling deposits that incorporate Mazama ash deposits (Qma, Qmp) in the youngest layers
Qt	**Terrace, pediment, and lag gravels (Holocene and Pleistocene)** - Unconsolidated deposits of gravel, cobbles, and boulders intermixed and locally interlayered with clay, silt, and sand. Mostly on terraces and pediments above present flood plains. Includes older alluvium of Smith and others (1982) in the Klamath Mountains and both high- and low-level terraces along Oregon coast. Includes dissected alluvial fan deposits northeast of Lebanon, and Linn and Leffler Gravels of Allison and Felts (1956)
Ttv	**Tillamook Volcanics (upper and middle Eocene)** - Subaerial basaltic flows and breccia and submarine basaltic breccia, pillow lavas, lapilli and augite-rich tuff with interbeds of basaltic sandstone, siltstone, and conglomerate. Includes some basaltic andesite and, near the top of the sequence, some dacite. Potassium-argon ages on middle and lower parts of sequence range from about 43 to 46 Ma (Magill and others, 1981): one potassium-argon age from dacite near top of sequence is about 40 Ma (see Wells and others, 1983)
Tbaa	**Basaltic and andesitic rocks (upper and middle Miocene)** - Lava flows and flow breccia of hypersthene and olivine andesite, basaltic andesite containing plagioclase and pyroxene phenocrysts, and basalt; many flows contain phenocrysts of both hypersthene and augite. Includes interbedded volcaniclastic and epiclastic rocks mostly of andesitic composition, but partly of dacitic or rhyodacitic composition. Includes really restricted flows of silicic andesite or dacite. Upper part of unit mostly unaltered, although olivine crystals are locally altered to clay minerals. Lower parts commonly altered; secondary minerals include nontronite and saponite, chalcedony, calcite, and zeolites. Older parts of this unit locally are propylitically altered adjacent to larger intrusions. Erupted mostly from widespread, northwest- and north-trending dikes and dike swarms and related plugs and lava cones. Potassium-argon ages range from about 10 Ma to about 17 Ma. Much of this unit was previously assigned to the Sardine Formation (Peck and others, 1964), although the type locality of the Sardine Formation ("Sardine Series" as mapped by Thayer, 1939) may be older. Includes Elk Lake Formation (White, 1980a, 1980b), part of the Rhododendron Formation (Trimble, 1963; Wise, 1969), and andesite of Nohorn Creek of Hammond and others (1982)
Tc	**Columbia River Basalt Group and related flows (Miocene)** - Subaerial basalt and minor andesite lava flows and flow breccia; submarine palagonitic tuff and pillow complexes of the Columbia River Basalt Group (Swanson and others, 1979); locally includes invasive basalt flows. Flows locally grade laterally into subaqueous pillow-palagonite complexes and bedded palagonitic tuff and breccia. In places includes tuffaceous sedimentary interbeds. Joints commonly coated with nontronite and other clayey alteration products. Occurs principally in the Willamette Valley from Salem north to the Columbia River, and in the northern Coast Range. Unit includes correlative Cape Foulweather and Depoe Bay Basalts in the Coast Range (Snavely and others, 1973, 1976a, 1976b; Swanson and others, 1979; Wells and others, 1983). In Eastern Oregon, occurs principally in Deschutes-Umatilla Plateau and in the Blue Mountains. K-Ar ages range from about 6 to about 16.5 Ma (McKee and others, 1977; Swanson and others, 1979; Sutter, 1978; Lux, 1982). Locally separated into Tcs, Tcw, Tcg, Tcp, and Tci
Tcg	**Grande Ronde Basalt (middle and lower Miocene)** - Flows of dark-gray to black, aphyric tholeiitic basalt, including both high- and low-Mg chemical types (Swanson and others, 1979). Potassium-argon ages mostly in the range of 15 to 17 Ma (Lux, 1982; Watkins and Baksi, 1974; Fiebelkorn and others, 1983)
Tcw	**Wanapum Basalt (middle Miocene)** - Flows of gray to dark-gray, medium-grained, commonly plagioclase porphyritic basalt of Frenchman Springs petrochemical type (Wright and others, 1973). Generally exhibits blocky to platy jointing. Potassium-argon ages mostly about 15 Ma (Lux, 1982; Fiebelkorn and others, 1983)
Tfc	**Flows and clastic rocks, undifferentiated (Miocene)** - Chiefly basaltic andesite and andesite lava flows and flow breccia containing plagioclase and pyroxene (hypersthene and augite) phenocrysts, mudflows (lahars), and volcanic conglomerates; locally includes some dacite flows. Includes lesser, coarse- to fine-grained epiclastic volcanic sedimentary rocks and ash-flow and air-fall tuffs. Partly equivalent in age to unit Tba and may be partly coeval with younger parts of unit Tstb. Locally altered adjacent to larger intrusions. The oldest radiometrically dated rocks assigned to this unit are about 17 Ma (Sutter, 1978); in part lapped by flows questionably assigned to unit Tba, radiometrically dated at about 10 Ma, and unconformably overlain by flows of unit Trb. Includes some of rocks formerly mapped as Sardine Formation and some mapped as Rhododendron Formation
Thi	**Hypabyssal intrusive rocks (Miocene and Miocene?)** - Hypabyssal, medium-grained, hornblende diorite and quartz diorite in small stocks and large dikes; includes intrusions of medium- to fine-grained gabbro and plugs and small stocks of medium-grained, holocrystalline, olivine andesite. Also includes medium-grained, commonly porphyritic biotite quartz monzonite and leucocratic granodiorite. Many of these intrusive bodies are moderately to intensely propylitized, as are wallrocks they intrude; locally, along shears, the rocks also are sericitized. Potassium-argon ages on several of these shallow intrusions range from about 8 Ma to about 22 Ma (Wise, 1969; Bikerman, 1970; Sutter, 1978; Power and others, 1981a, b; Fiebelkorn and others, 1983)
Tmst	**Marine sedimentary and tuffaceous rocks (middle Miocene to upper Eocene)** - Tuffaceous and arkosic sandstone, locally fossiliferous, tuffaceous siltstone, tuff, glauconitic sandstone, minor conglomerate layers and lenses, and a few thin coal beds. Includes Scappoose Formation (Trimble, 1963; Wells and others, 1983), mudstone of Oswald West (Niem and Van Atta, 1973; Wells and others, 1983), Pittsburg Bluff Formation (see Wells and others, 1983), and Smuggler Cove and Northrup Creek formations (informal names) of Niem and Niem (1985)
Ts	**Tuffaceous sedimentary rocks and tuff (Pliocene and Miocene)** - Semiconsolidated to well-consolidated mostly lacustrine tuffaceous sandstone, siltstone, mudstone, concretionary claystone, conglomerate, pumicite, diatomite, air-fall and water-deposited vitric ash, palagonitic tuff and tuff breccia, and fluvial sandstone and conglomerate. Palagonitic tuff and breccia grade laterally into altered and unaltered basalt flows of unit Tob. In places includes layers of fluvial conglomerate and, in parts of the Deschutes-Umatilla Plateau, extensive deposits of fanglomerate composed mostly of Miocene basalt debris and silt. Also includes thin, welded and nonwelded ash-flow tuffs. Vertebrate and plant fossils indicate rocks of unit are mostly of Clarendonian and Hemphillian (late Miocene and Pliocene) age. Potassium-argon ages on interbedded basalt flows and ash-flow tuffs range from about 4 to 10 Ma. Includes the Drewsey Formation of Shotwell and others (1963); sedimentary parts of the Rattlesnake Formation of Brown and Thayer (1966); an interstratified ash-flow tuff has been radiometrically dated by potassium-argon methods at about 6.6 Ma (see Fiebelkorn and others, 1983); Bully Creek Formation of Kittleman and others (1967); Dalles Formation of Newcomb (1966, 1969); Shutler Formation of Hodge (1932), McKay beds of Hogenson (1964) and Newcomb (1966) (see also Shotwell, 1956); Kern Basin Formation of Corcoran and others (1962); Rome beds of Baldwin (1976); parts of the (now obsolete) Danforth Formation of Piper and others (1939), Idaho Group of Malde and Powers (1962), Thousand Creek Beds of Merriam (1910); the Madras (or Deschutes) Formation, the "Simtustus formation" of Smith (1984), and the Yonna Formation (Newcomb, 1958). In areas west of Cascade crest, includes the Sandy River Mudstone and the Troutdale Formation of Trimble (1963) and the lower Pliocene Helvetia Formation of Schlicker and Deacon (1967)





Source: United States Geological Survey (Ludington et al., 2007)

0 1 2
Miles

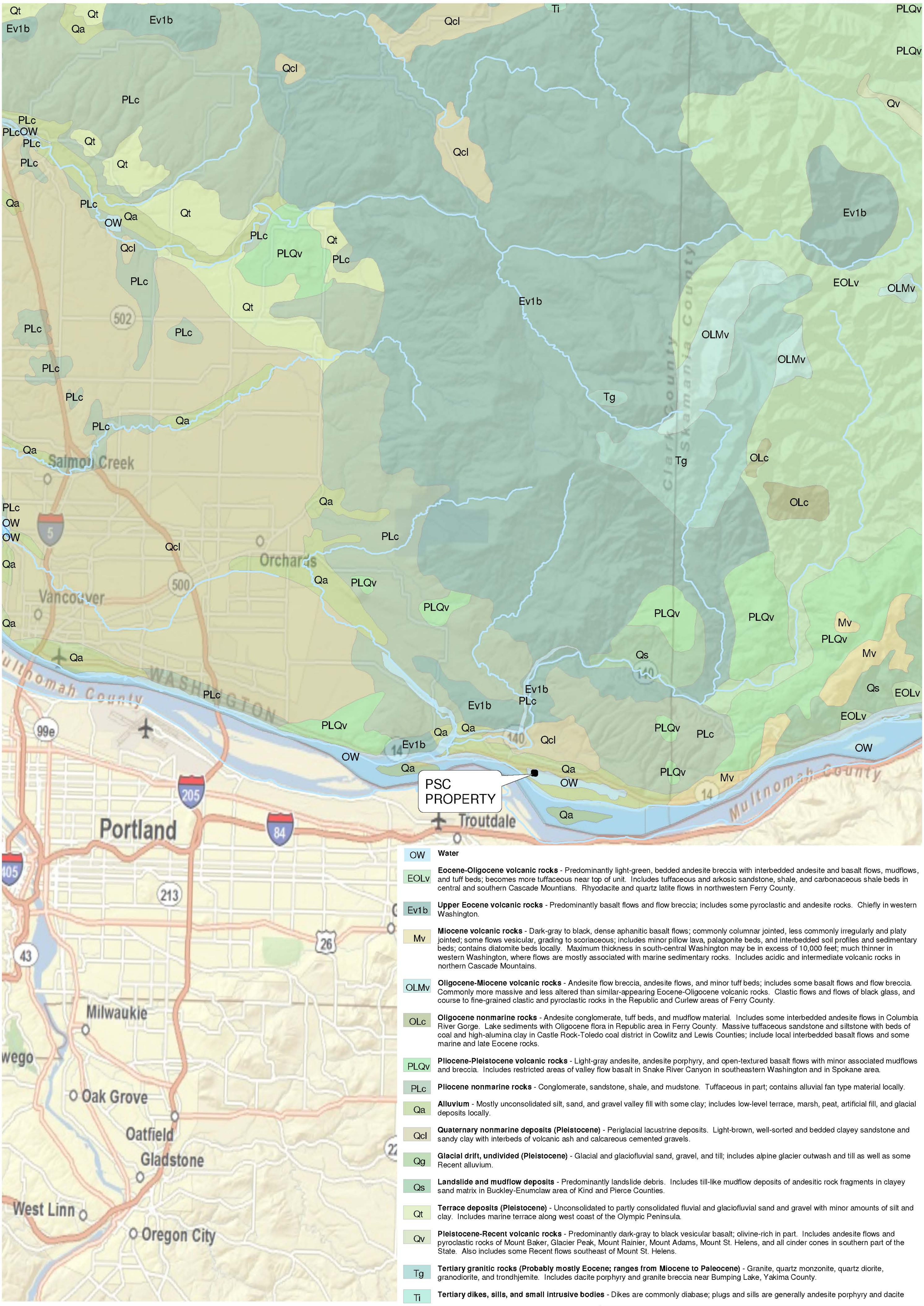
N

REGIONAL GEOLOGIC UNITS IN OREGON
PSC Washougal Facility
Washougal, Washington

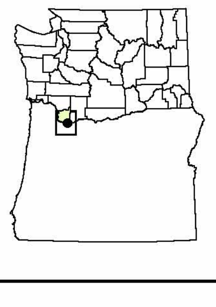
By: APS
Date: 11/09/09
Project No. 9625

AMEC Geomatrix

Figure 6-1



OW	**Water**
EOLv	**Eocene-Oligocene volcanic rocks** - Predominantly light-green, bedded andesite breccia with interbedded andesite and basalt flows, mudflows, and tuff beds; becomes more tuffaceous near top of unit. Includes tuffaceous and arkosic sandstone, shale, and carbonaceous shale beds in central and southern Cascade Mountians. Rhyodacite and quartz latite flows in northwestern Ferry County.
Ev1b	**Upper Eocene volcanic rocks** - Predominantly basalt flows and flow breccia; includes some pyroclastic and andesite rocks. Chiefly in western Washington.
Mv	**Miocene volcanic rocks** - Dark-gray to black, dense aphanitic basalt flows; commonly columnar jointed, less commonly irregularly and platy jointed; some flows vesicular, grading to scoriaceous; includes minor pillow lava, palagonite beds, and interbedded soil profiles and sedimentary beds; contains diatomite beds locally. Maximum thickness in south-central Washington may be in excess of 10,000 feet; much thinner in western Washington, where flows are mostly associated with marine sedimentary rocks. Includes acidic and intermediate volcanic rocks in northern Cascade Mountains.
OLMv	**Oligocene-Miocene volcanic rocks** - Andesite flow breccia, andesite flows, and minor tuff beds; includes some basalt flows and flow breccia. Commonly more massive and less altered than similar-appearing Eocene-Oligocene volcanic rocks. Clastic flows and flows of black glass, and course to fine-grained clastic and pyroclastic rocks in the Republic and Curlew areas of Ferry County.
OLc	**Oligocene nonmarine rocks** - Andesite conglomerate, tuff beds, and mudflow material. Includes some interbedded andesite flows in Columbia River Gorge. Lake sediments with Oligocene flora in Republic area in Ferry County. Massive tuffaceous sandstone and siltstone with beds of coal and high-alumina clay in Castle Rock-Toledo coal district in Cowlitz and Lewis Counties; include local interbedded basalt flows and some marine and late Eocene rocks.
PLQv	**Pliocene-Pleistocene volcanic rocks** - Light-gray andesite, andesite porphyry, and open-textured basalt flows with minor associated mudflows and breccia. Includes restricted areas of valley flow basalt in Snake River Canyon in southeastern Washington and in Spokane area.
PLc	**Pliocene nonmarine rocks** - Conglomerate, sandstone, shale, and mudstone. Tuffaceous in part; contains alluvial fan type material locally.
Qa	**Alluvium** - Mostly unconsolidated silt, sand, and gravel valley fill with some clay; includes low-level terrace, marsh, peat, artificial fill, and glacial deposits locally.
Qcl	**Quaternary nonmarine deposits (Pleistocene)** - Periglacial lacustrine deposits. Light-brown, well-sorted and bedded clayey sandstone and sandy clay with interbeds of volcanic ash and calcareous cemented gravels.
Qg	**Glacial drift, undivided (Pleistocene)** - Glacial and glaciofluvial sand, gravel, and till; includes alpine glacier outwash and till as well as some Recent alluvium.
Qs	**Landslide and mudflow deposits** - Predominantly landslide debris. Includes till-like mudflow deposits of andesitic rock fragments in clayey sand matrix in Buckley-Enumclaw area of Kind and Pierce Counties.
Qt	**Terrace deposits (Pleistocene)** - Unconsolidated to partly consolidated fluvial and glaciofluvial sand and gravel with minor amounts of silt and clay. Includes marine terrace along west coast of the Olympic Peninsula.
Qv	**Pleistocene-Recent volcanic rocks** - Predominantly dark-gray to black vesicular basalt; olivine-rich in part. Includes andesite flows and pyroclastic rocks of Mount Baker, Glacier Peak, Mount Rainier, Mount Adams, Mount St. Helens, and all cinder cones in southern part of the State. Also includes some Recent flows southeast of Mount St. Helens.
Tg	**Tertiary granitic rocks (Probably mostly Eocene; ranges from Miocene to Paleocene)** - Granite, quartz monzonite, quartz diorite, granodiorite, and trondhjemite. Includes dacite porphyry and granite breccia near Bumping Lake, Yakima County.
Ti	**Tertiary dikes, sills, and small intrusive bodies** - Dikes are commonly diabase; plugs and sills are generally andesite porphyry and dacite



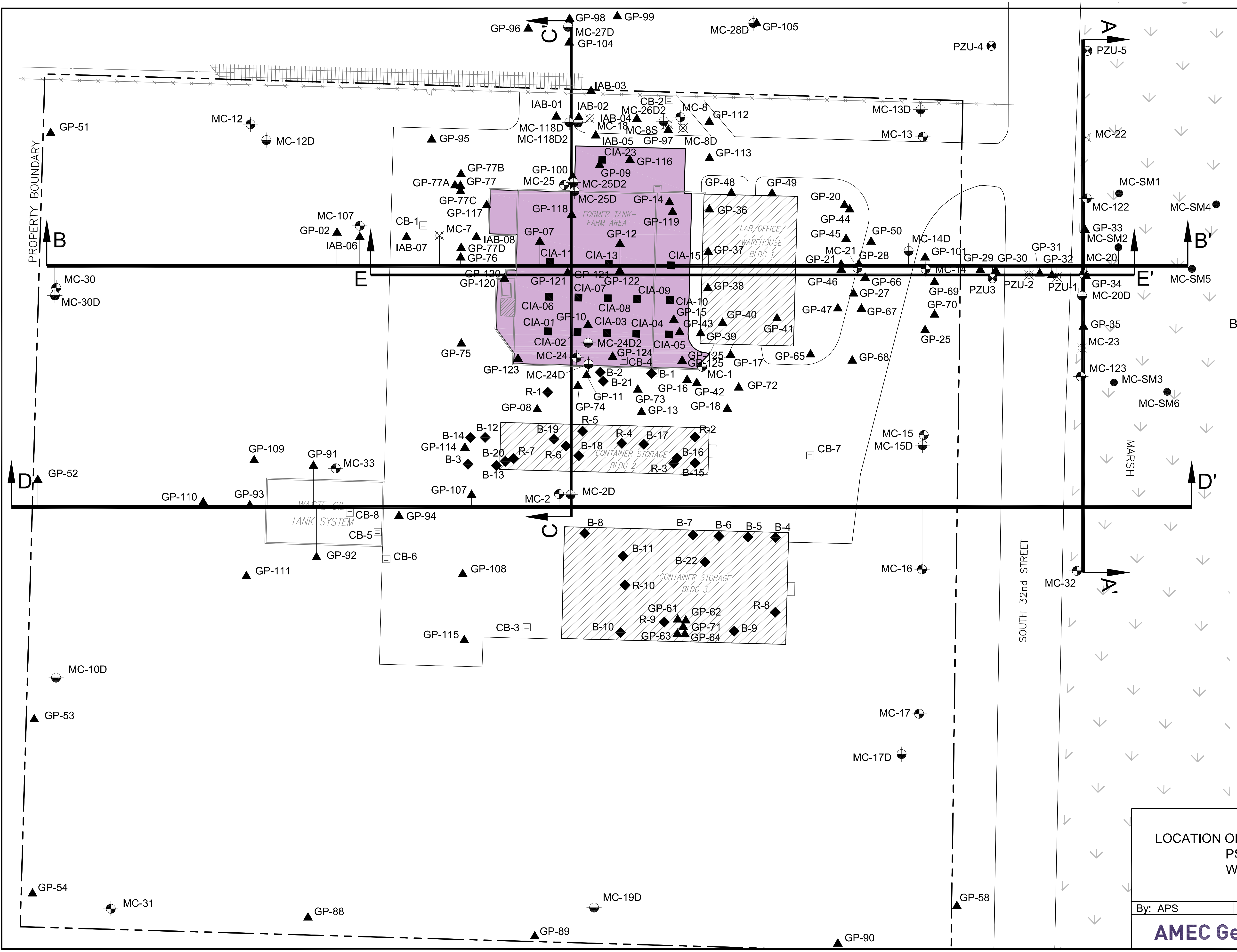
Source: United States Geological Survey (Ludington et al., 2007)

0 1 2
Miles

N

REGIONAL GEOLOGIC UNITS IN WASHINGTON
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 11/09/09	Project No. 9625
AMEC Geomatrix		Figure 6-2



EXPLANATION

B-5 ◆	Historic Surface Soil / Concrete Sample
CIA-09 ■	Historic Tank Farm Excavation Soil Confirmation Sample
GP-12 ▲	Direct-Push Sample Location
MC-122 ◐	Shallow Groundwater Zone Monitoring Well
MC-14D ⊖	Lower Aquifer Monitoring Well
PZU-5 ⊗	Piezometer
PZU-1 ☒	Abandoned Monitoring Well / Piezometer
CB-7 ⊟	Catch Basin Sampling Point
MC-SM4 ●	Sediment / Pore Water Sample Location
🟪	Area of 1997 Excavation
B ⟶ B'	Cross Section Location

NOTES:

1. Borings located to the south and west of the facility property are not shown and were not used to produce silt layer elevation contours.

N

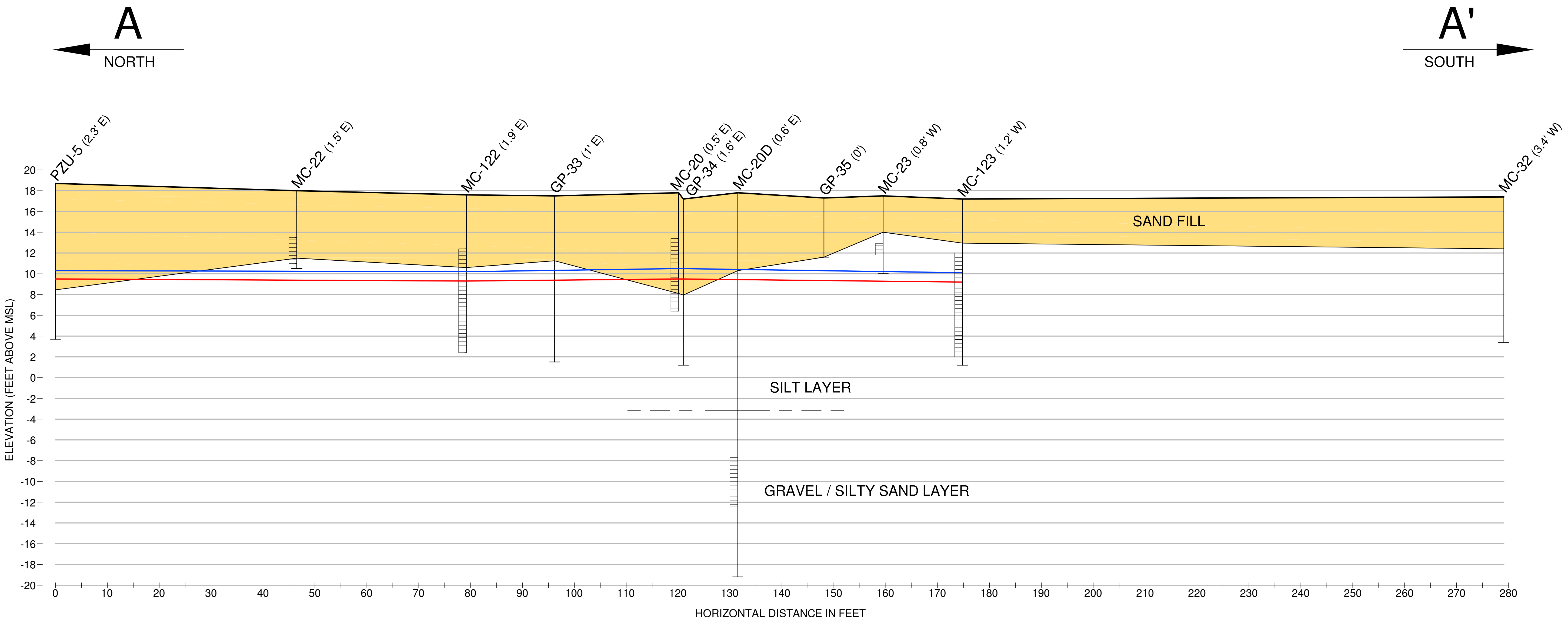
0 25 50

APPROXIMATE SCALE IN FEET

LOCATION OF GEOLOGIC CROSS SECTIONS
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 11/21/11	Project No. 9625
AMEC Geomatrix		Figure 6-3

Plot Date: 11/21/11 - 11:11am, Plotted by: mike.stenberg
Drawing Path: S:\9625\009_RIFS-2011\CAD\, Drawing Name: PSC Washougal_Cross-Sections_111811.DWG



EXPLANATION

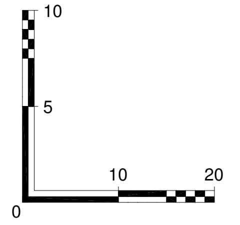
MC-122 (1.5' E)	Well / Boring Identification (distance in feet and cardinal direction from cross section plane)
🟨	Poorly Graded Sand
▤	Screened Interval
—	2006-2009 average high water level elevation
—	2006-2009 average low water level elevation

NOTES:

Contacts dashed where estimated.

Water levels were calculated using the average of the water level elevations from 2006-2009.

Location of cross section A-A' is shown on Figure 6-3.



APPROXIMATE SCALE IN FEET
VERTICAL EXAGGERATION = 2X

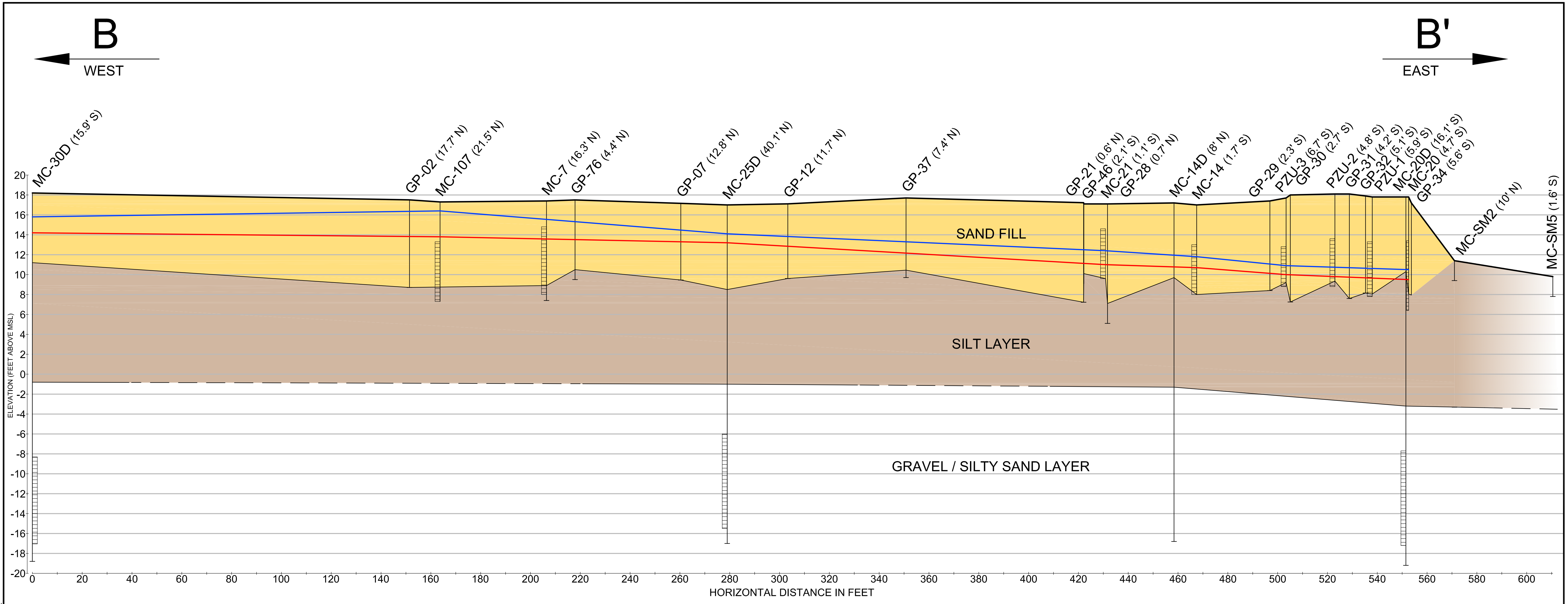
CROSS SECTION A-A'
PSC Washougal Facility
Washougal, Washington

By: APS
Date: 11/18/11
Project No. 9625

AMEC Geomatrix

Figure 6-4

Plot Date: 11/18/11 - 10:56am, Plotted by: mike.stenberg
Drawing Path: S:\9625\009_RIFS-2011\CAD\, Drawing Name: PSC Washougal_Cross-Sections_102811.DWG



EXPLANATION

MC-107 (21.5' N)	Well / Boring Identification (distance in feet and cardinal direction from cross section plane)
🟨	Poorly Graded Sand
🟫	Organic Soil or Silty Clay
▤	Screened Interval
—	2006-2009 average high water level elevation
—	2006-2009 average low water level elevation

NOTES:

1. Contacts are dashed where estimated.
2. Water levels were calculated using the average of the water level elevations from 2006-2009.
3. Location of cross section B-B' is shown on Figure 6-3.

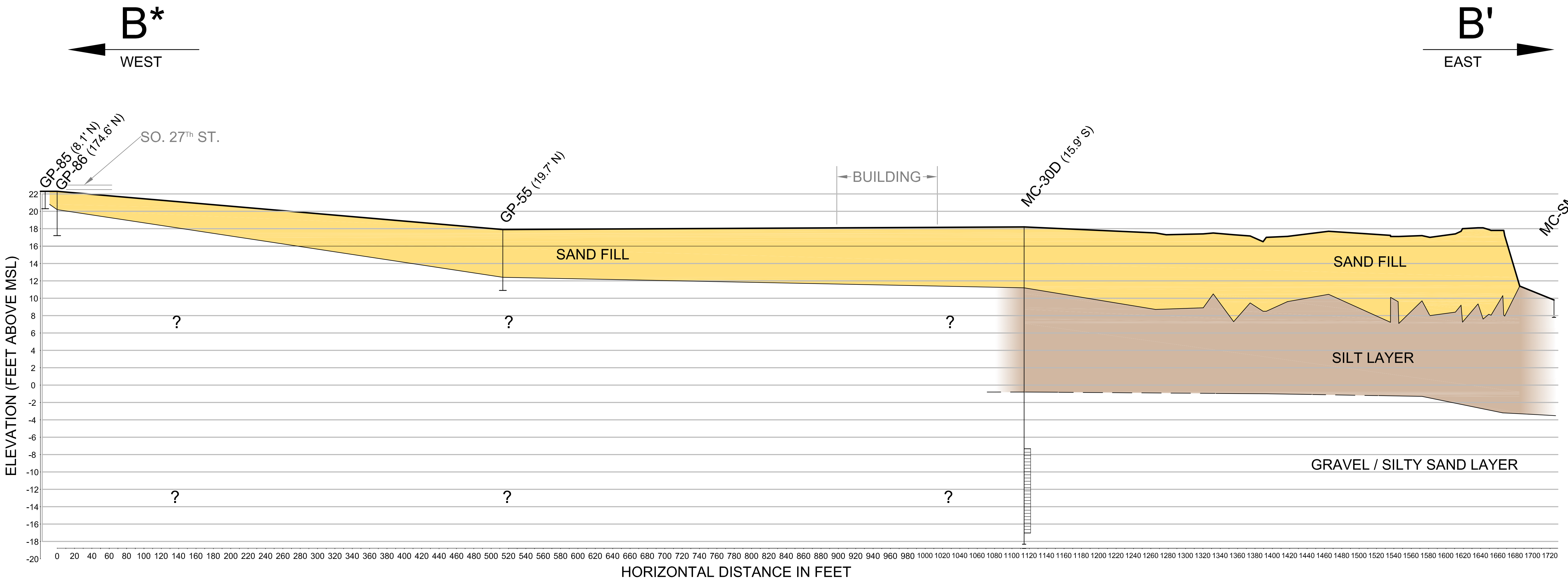
10
5
0
20
40

APPROXIMATE SCALE IN FEET
VERTICAL EXAGGERATION = 4X

CROSS SECTION B-B'
Enlarged Central Area
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 09/10/13	Project No. 9625
amec		Figure 6-5

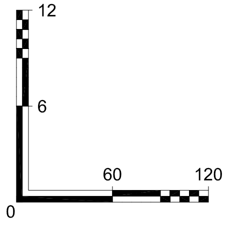
Plot Date: 09/10/13 - 2:04pm, Plotted by: adam.stenberg
Drawing Path: S:\9625\010_RI-2012\CAD\, Drawing Name: Figures 6-3 thru 6-8_PSC-Wash_Cross-Sections_091013.DWG



EXPLANATION

GP-85 (8.1' N)	Well / Boring Identification (distance in feet and cardinal direction from cross section plane)
🟨	Poorly Graded Sand
🟫	Organic Soil or Silty Clay
▤	Screened Interval

NOTE:
Contacts are dashed where estimated.

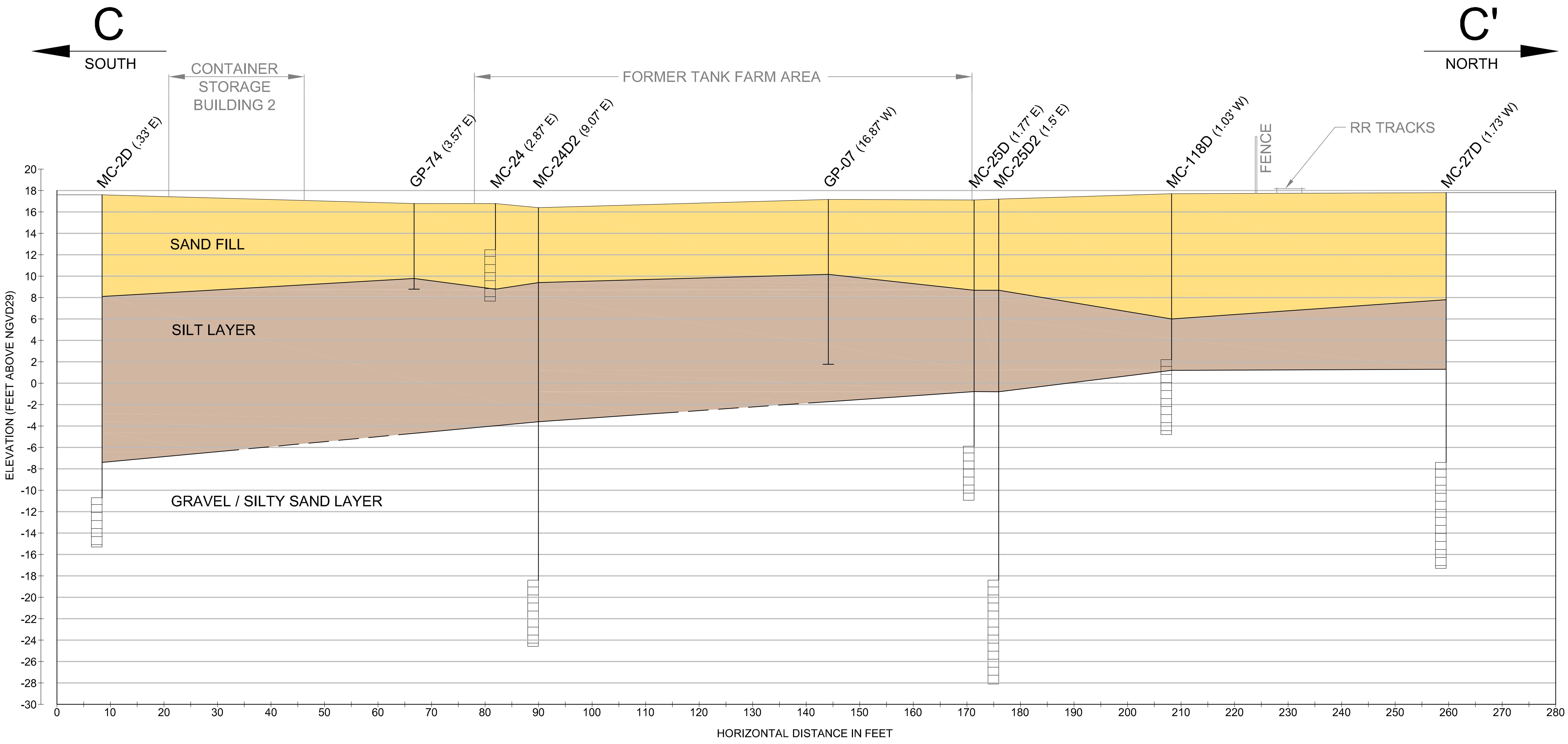


APPROXIMATE SCALE IN FEET
VERTICAL EXAGGERATION = 10X

CROSS SECTION B-B'
PSC Washougal Facility
Washougal, Washington

By: APS | Date: 09/10/13 | Project No. 9625
amec
Figure **6-6**

Plot Date: 09/10/13 - 2:13pm, Plotted by: adam.stenberg
Drawing Path: S:\9625\010_RI-2012\CAD\, Drawing Name: Figures 6-6_PSC-Wash_Cross-SectionOffsite_091013.DWG



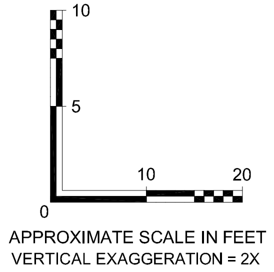
EXPLANATION

MC-2D (.33' E)	Well / Boring Identification (distance in feet and cardinal direction from cross section plane)
🟨	Poorly Graded Sand
🟫	Organic Soil or Silty Clay
▤	Screened Interval

NOTES:

Contacts are dashed where estimated.

Location of cross section C-C' is shown on Figure 6-3.



APPROXIMATE SCALE IN FEET
VERTICAL EXAGGERATION = 2X

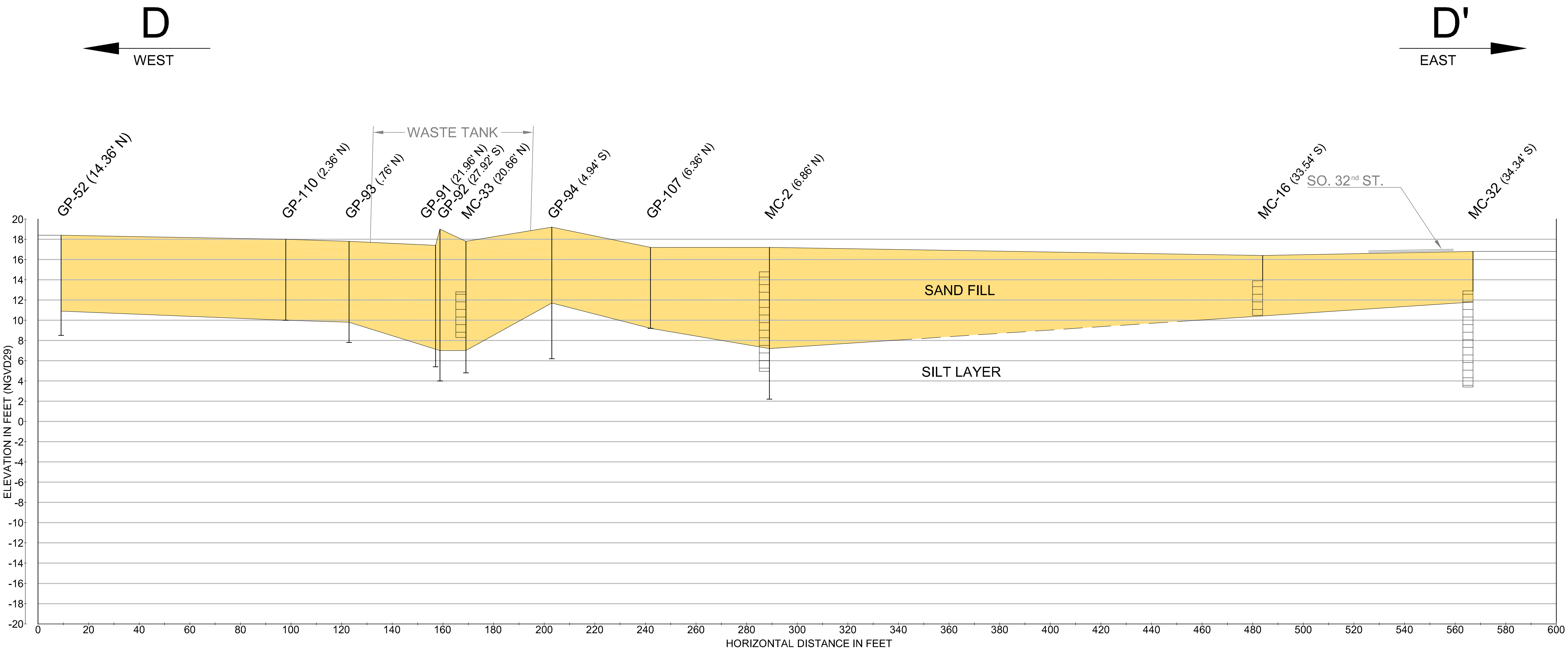
CROSS SECTION C-C'
PSC Washougal Facility
Washougal, Washington

By: APS | Date: 11/18/11 | Project No. 9625

AMEC Geomatrix

Figure 6-7

Plot Date: 11/18/11 - 12:21pm, Plotted by: mike.stenberg
Drawing Path: S:\9625\009_RIFS-2011\CAD\, Drawing Name: PSC Washougal_Cross-Sections_111811.DWG



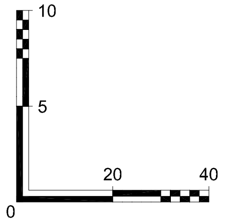
EXPLANATION

GP-52 (14.36'N)	Well / Boring Identification (distance in feet and cardinal direction from cross section plane)
🟨	Poorly Graded Sand
▤	Screened Interval

NOTES:

Contacts are dashed where estimated.

Location of cross section D-D' is shown on Figure 6-3.

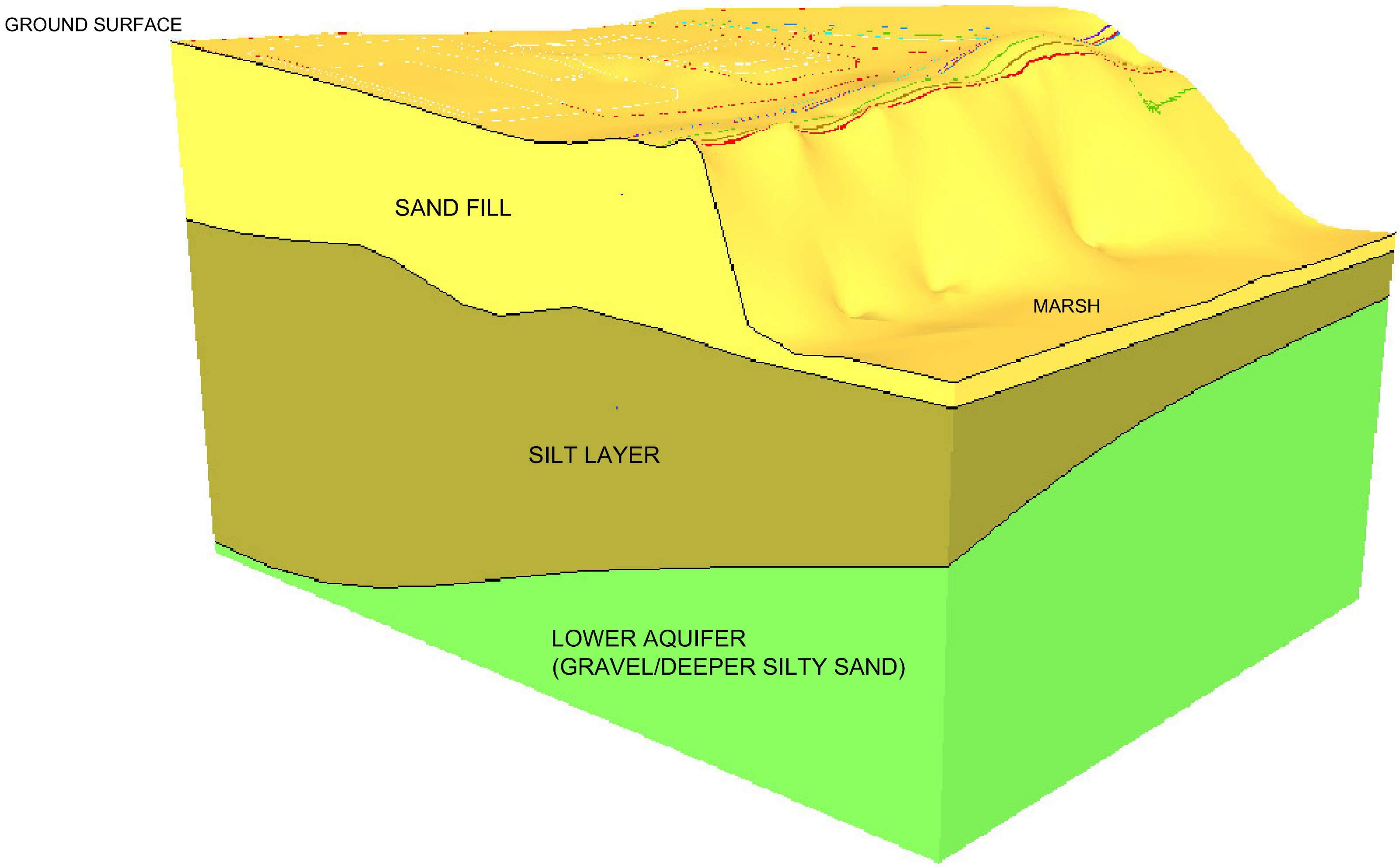


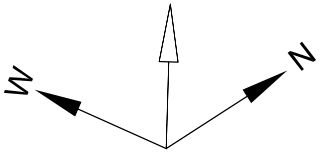
APPROXIMATE SCALE IN FEET
VERTICAL EXAGGERATION = 4X

CROSS SECTION D-D'
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 11/18/11	Project No. 9625
AMEC Geomatrix		Figure 6-8

Plot Date: 11/18/11 - 12:33pm, Plotted by: mike.stenberg
Drawing Path: S:\9625\009_RIFS-2011\CAD\, Drawing Name: PSC Washougal_Cross-Sections_111811.DWG



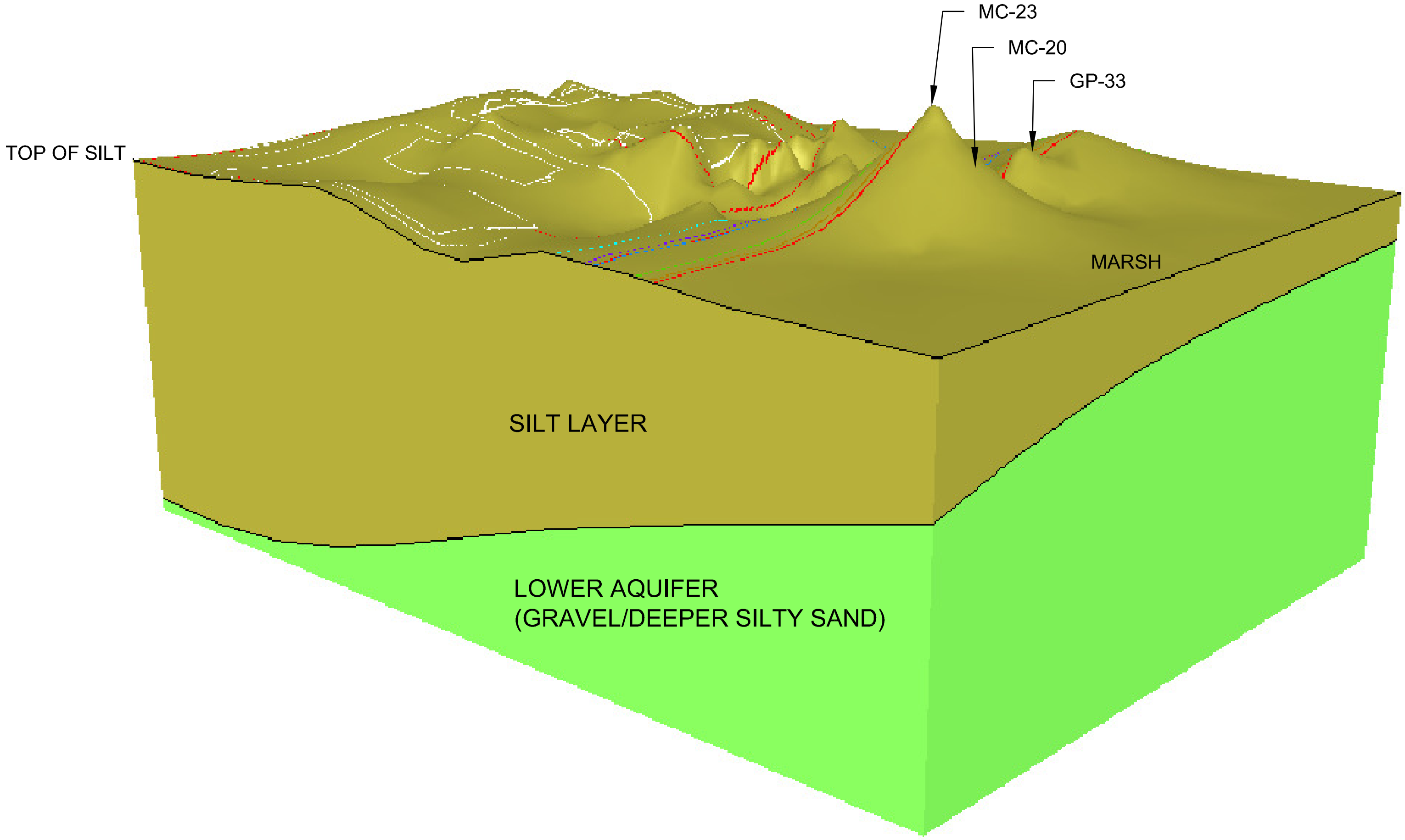


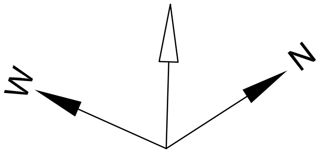
Note: Cross section is based on field data collected through 2007.

THREE-DIMENSIONAL SITE MODEL
VIEW OF SITE, LOOKING NORTHWEST
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 11/18/11	Project No. 9625
AMEC Geomatrix		Figure **6-9**

Plot Date: 11/18/11 - 11:48am, Plotted by: mike.stenberg
Drawing Path: S:\9625\009_RIFS-2011\CAD\, Drawing Name: PSC Washougal_3D-CrossSects_080511.dwg



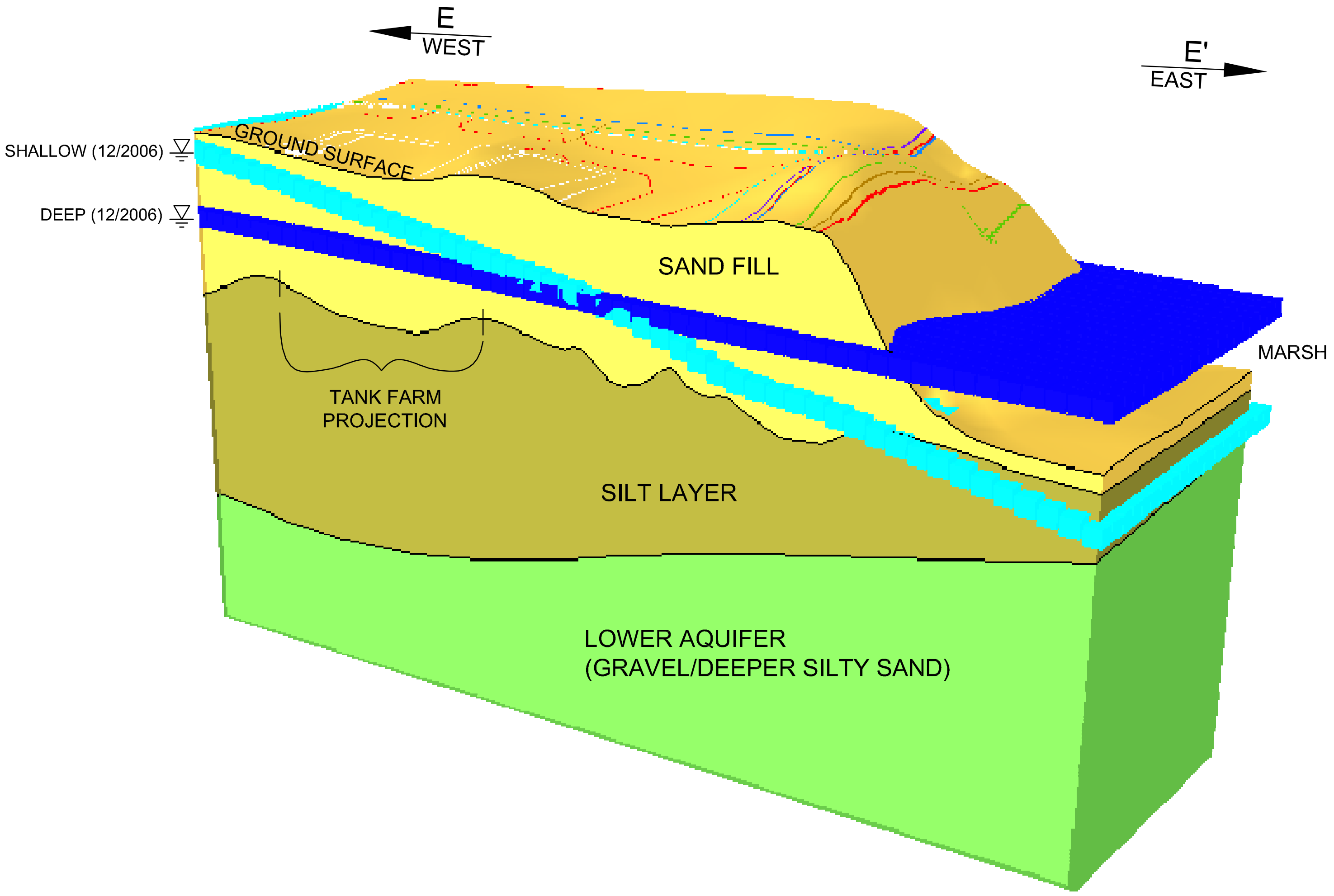


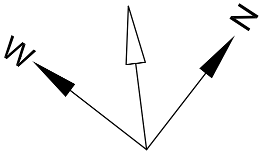
Note: Cross section is based on field data collected through 2007.

THREE-DIMENSIONAL SITE MODEL
TOP OF SILT LAYER, LOOKING NORTHWEST
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 11/18/11	Project No. 9625
AMEC Geomatrix		Figure **6-10**

Plot Date: 11/18/11 - 11:55am, Plotted by: mike.stenberg
Drawing Path: S:\9625\009_RIFS-2011\CAD\, Drawing Name: PSC Washougal_3D-CrossSects_080511.dwg



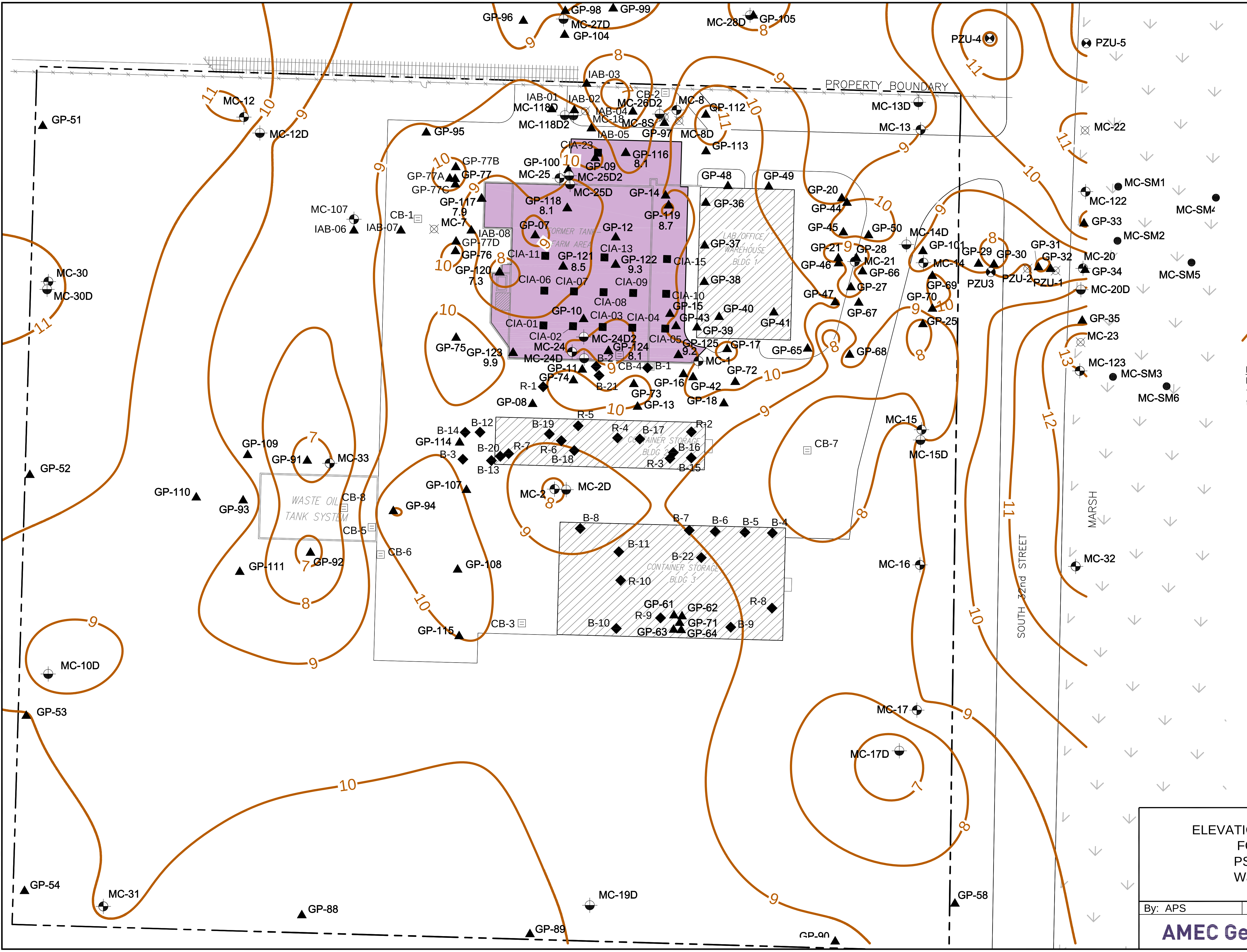


Notes:
Cross section is based on field data collected through 2007.
Location of cross section E-E' is shown on Figure 6-3

THREE-DIMENSIONAL
TANK FARM CROSS SECTION E-E'
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 11/18/11	Project No. 9625
AMEC Geomatrix		Figure **6-11**

Plot Date: 11/18/11 - 11:54am, Plotted by: mike.stenberg
Drawing Path: S:\9625\009_RIFS-2011\CAD\, Drawing Name: PSC Washougal_3D-CrossSects_080511.dwg



EXPLANATION

B-5 ◆	Historic Surface Soil / Concrete Sample
CIA-09 ■	Historic Tank Farm Excavation Soil Confirmation Sample
GP-12 ▲	Direct-Push Sample Location
MC-122 ⊕	Shallow Groundwater Zone Monitoring Well
MC-14D ⊕	Lower Aquifer Monitoring Well
PZU-5 ⊗	Piezometer
PZU-1 ☒	Abandoned Monitoring Well / Piezometer
CB-7 ⊟	Catch Basin Sampling Point
MC-SM4 ●	Sediment / Pore Water Sample Location
🟪	Area of 1997 Excavation
9	Silt Elevation Contour (Feet above MSL)

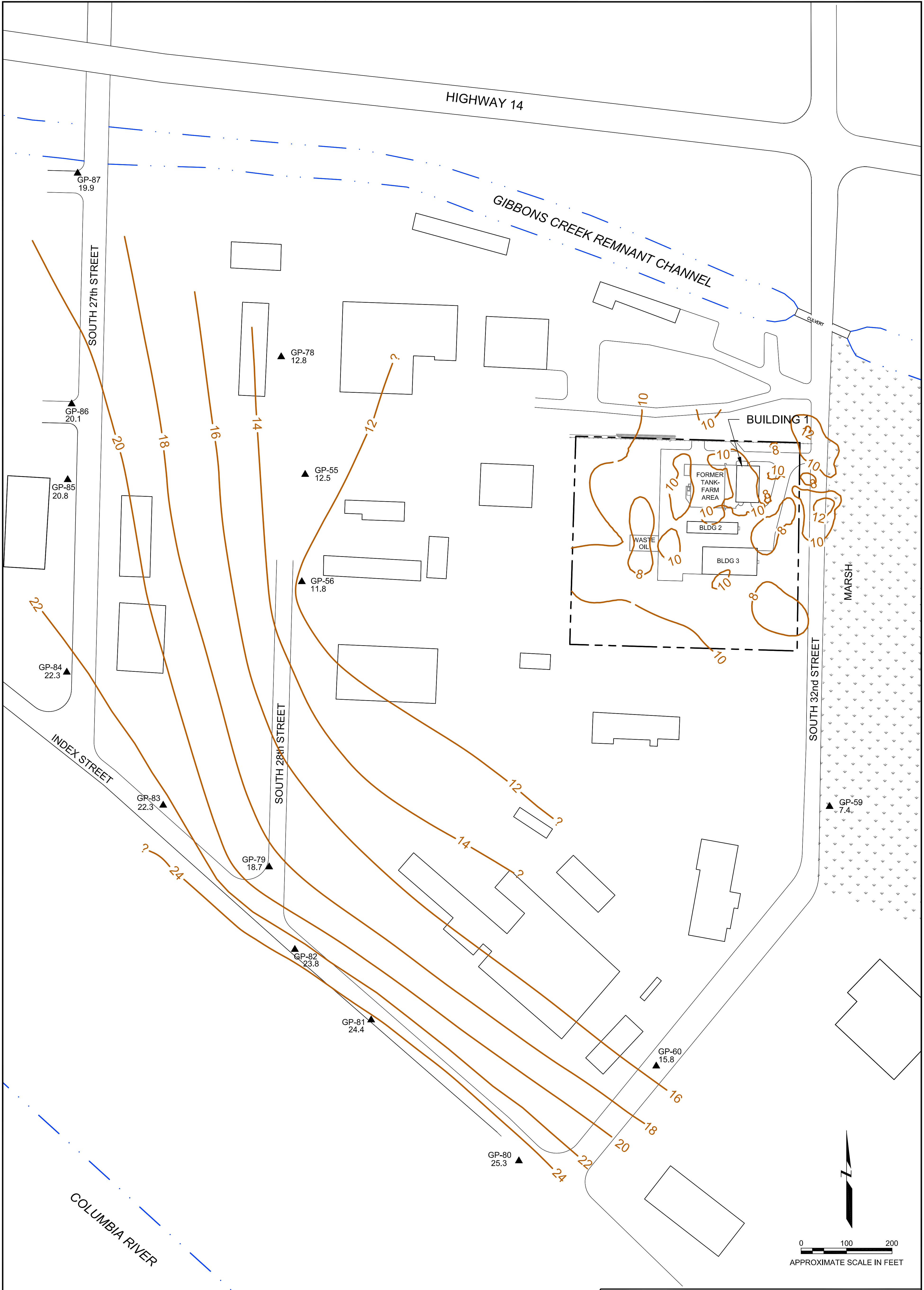
NOTES:
Borings located to the south and west of the facility property are not shown and were not used to produce silt layer elevation contours.

ELEVATION AT TOP OF SILT LAYER
FOR PSC PROPERTY
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 11/07/11	Project No. 9625
AMEC Geomatrix		Figure 6-12

Plot Date: 11/07/11 - 4:41pm, Plotted by: adam.stenberg
Drawing Path: S:\9625\009_RIFS-2011\CAD\, Drawing Name: PSC Washougal_SiltLayer_110711.DWG

Plot Date: 08/05/11 - 2:52pm, Plotted by: adam.stenberg
Drawing Path: S:\9625\009_RIFS-2011\CAD\, Drawing Name: PSC Washougal_SiltLayerVicinity_080511.dwg



EXPLANATION

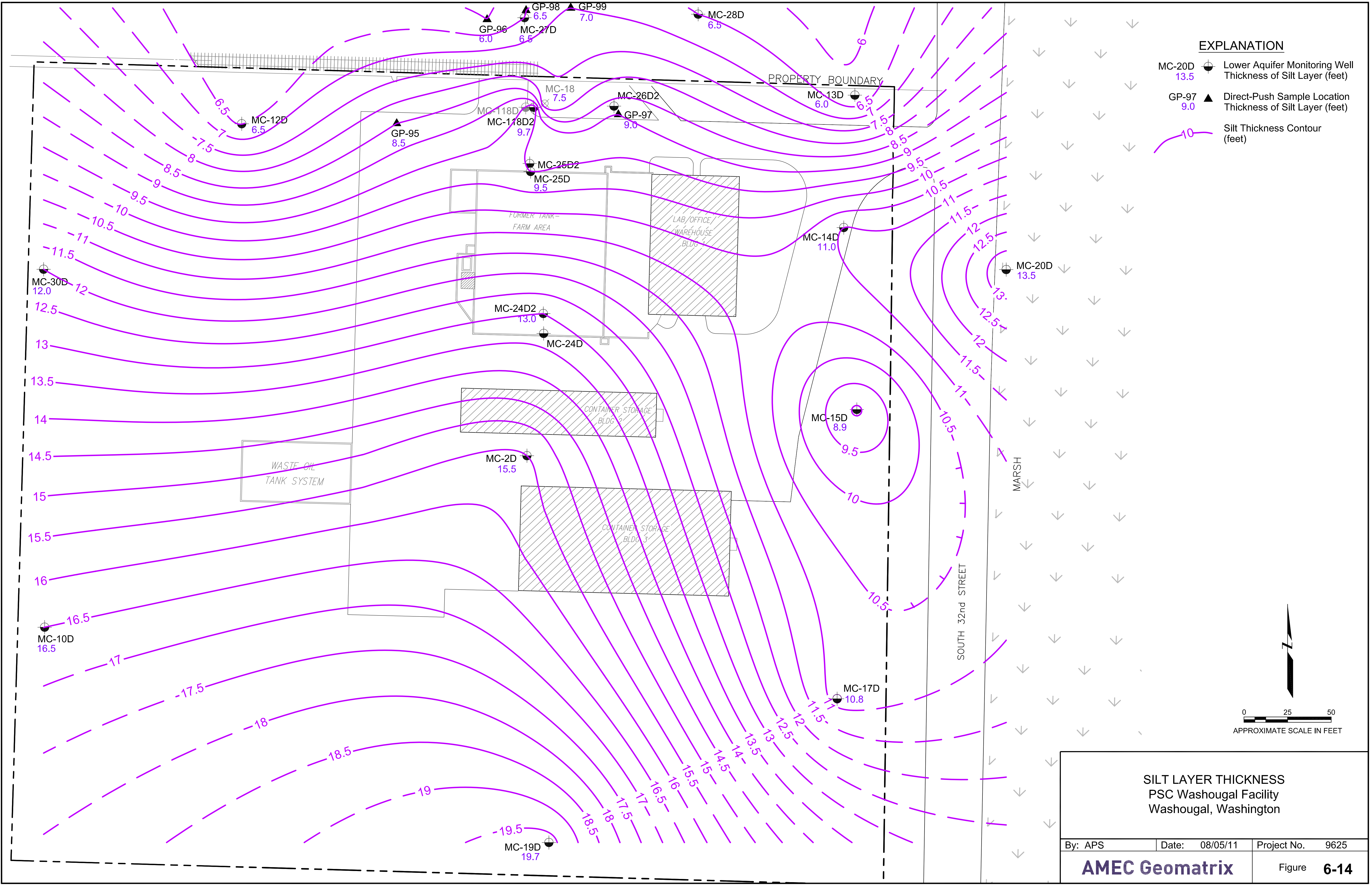
▲ GP-60 15.8 EXPLORATION LOCATION AND TOP OF SILT ELEVATION (FEET MSL)

—12— SILT ELEVATION CONTOUR (FEET ABOVE MSL)

NOTE:
EXPLORATIONS LOCATED ON PSC PROPERTY NOT SHOWN

ELEVATION AT TOP OF SILT LAYER
FOR PROJECT VICINITY
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 08/05/11	Project No. 9625
AMEC Geomatrix		Figure 6-13



SILT LAYER THICKNESS
PSC Washougal Facility
Washougal, Washington

By: APS Date: 08/05/11 Project No. 9625

AMEC Geomatrix Figure **6-14**

Plot Date: 08/05/11 - 2:54pm, Plotted by: adam.stenberg
Drawing Path: S:\9625\009_RIFS-2011\CAD\, Drawing Name: PSC Washougal_SiltThickness_080511.DWG

7.0 HYDROGEOLOGY

This section describes the regional and local hydrogeology for the site, including the site conceptual model for how groundwater flows at the site.

7.1. REGIONAL HYDROGEOLOGY

As described in Section 6.0, the PSC Washougal site is located within an area known as the Portland Basin within the Columbia River floodplain. This section describes the principal regional hydrogeologic features. Local hydrogeology in the immediate vicinity of the PSC Washougal site is described in Section 7.2.

7.1.1 Regional Hydrogeologic Subsystems

Six primary hydrogeologic units within two major subsystems have been described for the Portland Basin of the Willamette Lowland Aquifer System, as indicated by analysis of geologic and hydrogeologic data (McFarland and Morgan, 1996). These include:

- The Upper Sedimentary Subsystem, consisting of the Unconsolidated Sedimentary Aquifer and the Troutdale Gravel Aquifer; and
- The Lower Sedimentary Subsystem, consisting of Confining Units 1 and 2, the Troutdale Sandstone Aquifer, and the Sand and Gravel Aquifer.

Beneath these subsystems lies the Older Rock Subsystem. These subsystems and their geologic units are described in further detail below.

7.1.1.1 Upper Sedimentary Subsystem

The Upper Sedimentary Subsystem overlies the Lower Sedimentary Subsystem and is the uppermost regional hydrogeologic unit within the Portland Basin. The Upper Sedimentary Subsystem consists of the Unconsolidated Sedimentary Aquifer and the Troutdale Gravel Aquifer. The Unconsolidated Sedimentary Aquifer correlates with the Unconsolidated Sediments regional geologic unit. Within the Portland Basin, the ground surface forms this aquifer's upper boundary. The aquifer is composed of catastrophic flood, alluvial, and floodplain deposits. The aquifer, which is unconfined, is thickest under the Columbia River floodplain. The deeper wells in this aquifer are completed at depths from 250 to 300 feet bgs; most wells are completed at depths between 50 and 100 feet bgs. Public-supply and industrial wells generally yield approximately 1,000 to 6,000 gpm, with less than 10 feet of drawdown (McFarland and Morgan, 1996).

The Troutdale Gravel Aquifer correlates with the Troutdale Gravel geologic unit. The aquifer is composed of formations with poorly to moderately cemented conglomerate, sandy conglomerate, lavas, and a mantling soil horizon. The aquifer is typically 100 to 400 feet thick, and is widely utilized in the Portland Basin. Public-supply, industrial, and domestic wells completed in this aquifer yield approximately 50 to 2,000 gpm.

7.1.1.2 Lower Sedimentary Subsystem

The Lower Sedimentary Subsystem lies between the Upper Sedimentary Subsystem and the underlying Older Rock Subsystem. It is the lowermost hydrogeologic unit within the Portland Basin, consisting of Confining Units 1 and 2, the Troutdale Sandstone Aquifer, and the Sand and Gravel Aquifer.

Confining Units 1 and 2 are composed of medium to fine-grained arkosic sand, silt, and clay. The Troutdale Sandstone Aquifer is intermittent, located between the two confining units. Consequently, Confining Units 1 and 2 vary in thickness, depending on the presence of the Troutdale Sandstone Aquifer. Where the Troutdale Sandstone Aquifer is not present, Confining Units 1 and 2 are not distinguishable and the unit is identified as Confining Unit 1. These confining units do not readily supply water.

The Troutdale Sandstone Aquifer correlates with the Troutdale Sandstone Unit. The aquifer consists of coarse vitric sandstone and conglomerate with beds of fine to medium sand and silt. The aquifer, whose thickness typically varies from about 100 to 200 feet, is widely utilized in the Portland Basin. High-capacity public-supply wells in the Portland well field yield up to 2,500 gpm. Lower capacity municipal, irrigation, and industrial wells completed in this aquifer can yield 500 gpm.

The Sand and Gravel Aquifer correlates with the Sand and Gravel geologic unit. The Sand and Gravel Aquifer is the lowermost hydrogeologic unit of the Lower Sedimentary Subsystem. It lies beneath Confining Unit 1 in the absence of the Troutdale Sandstone Aquifer, and beneath Confining Unit 2 in the presence of the Troutdale Sandstone Aquifer, and directly overlies the Older Rock Subsystem. The aquifer consists primarily of sandy gravel, silty sand, sand, and clay. In the Portland well field, the Sand and Gravel Aquifer has a relatively coarse-grained upper subunit and a predominantly fine-grained lower subunit (McFarland and Morgan, 1996). Public-supply wells completed in this aquifer yield approximately 2,000 to 3,000 gpm.

7.1.1.3 Older Rock Subsystem

The Older Rock Subsystem is composed of older volcanic and marine sedimentary rocks. It has limited water-bearing capacity and is only adequate for supplying water used for domestic purposes (McFarland and Morgan, 1996).

7.1.2 Columbia River

The Columbia River serves as the ultimate surface water and shallow groundwater drainage in the area of the facility. Figure 1-1 illustrates the general topography and surface water features of the area. The facility is located approximately 0.3 mile from the Columbia River, near river mile 123.

The total discharge of the Columbia River averages 193,500 cfs. Although numerous dams influence surface flow in the Columbia River, discharge also fluctuates seasonally with precipitation and daily due to tidal cycles. Both discharge and stage typically peak during the spring as snowmelt and precipitation increase (Mundorff, 1964). The nearest dam is Bonneville Dam. Table 7-1 lists monthly average values of the Columbia River stage as measured just downstream of Bonneville Dam, during the period from January 1994 to September 2006 (USGS National Water Information System, 2009). These data are illustrated together with the corresponding monthly precipitation in Figure 5-2.

7.1.3 Regional Hydrogeologic Units

The estimated hydraulic properties of the regional hydrogeologic units within the Willamette Lowland Aquifer System are summarized in Table 7-2. Within each of the regional hydrogeologic units, the hydraulic conductivity estimates vary over at least two orders of magnitude. Possible causes of this variation are measurement error and natural spatial variation. Spatial variations in hydraulic conductivity are likely caused by spatial variations in lithology, including grain size, sorting, consolidation, and cementation of the deposits.

Aquifer productivity on the regional scale is evaluated through specific capacity rather than well yield, because specific capacity takes into consideration the loss in head associated with pumping of groundwater. Specific capacity values are a function of well depth, casing diameter, duration of well discharge during testing, saturated length of the open interval, well losses, and partial penetration of the well throughout the saturated thickness of the aquifer.

The specific capacity values vary depending upon the depositional environment. Floodplain deposits compose the most productive parts of the Upper Sedimentary Subsystem; buried alluvial fans are the next most productive; and the least productive deposits of the aquifer are those that do not contain the floodplain or alluvial-fan deposits. The specific capacities for floodplain and alluvial-fan deposits of the aquifer range from 7 to greater than 300 gpm per foot. The specific capacities of deposits that do not contain the floodplain or alluvial-fan deposits typically range from 0 to 7 gpm per foot (Woodward et al., 1998).

7.2. LOCAL HYDROGEOLOGY

Three primary hydrogeologic units have been delineated beneath the site based on analysis of the geologic and hydrogeologic data collected during previous investigations:

- the Sand Fill Shallow Groundwater Zone;
- the Silt Layer or Upper Confining Unit (Silt Aquitard); and
- the Lower Aquifer.

These units correspond roughly to the stratigraphic units described in Section 6.2.1 through Section 6.2.4. The three primary hydrogeologic units identified at the site are located within the Unconsolidated Sedimentary aquifer and are much shallower than (and not associated with) either the Troutdale Gravel Aquifer (Upper Sedimentary Subsystem) or the Troutdale Sandstone Aquifer (Lower Sedimentary Subsystem) (Swanson, et al., 1993; McFarland and Morgan, 1996). Two-dimensional (Figures 6-4 through 6-8) and three-dimensional (Figures 6-9 through 6-11) cross sections were developed to illustrate the hydrogeologic stratigraphy along both the east and north sides of the facility. The following sections describe the three primary hydrogeologic units at the site in descending order below ground surface.

7.2.1 Sand Fill Shallow Groundwater Zone

The uppermost groundwater at the site, which occurs primarily within the Sand Fill, is referred to as the Shallow Groundwater Zone. The following subsections describe the hydrostratigraphy and hydraulic properties of this zone.

7.2.1.1 Hydrostratigraphy

The uppermost groundwater on the site is found predominantly within the Shallow Groundwater Zone, which includes portions of both the Sand Fill and the underlying Silt Layer near Steigerwald Marsh. A contour map of groundwater elevations within the Shallow Groundwater Zone at the PSC property and neighboring properties is shown in Figure 7-1.

Prior to development of the industrial park, the site was a marsh area and part of the Columbia River floodplain. By definition, groundwater in the marsh was at or near the ground surface. When the area was developed, fill was placed to raise the ground surface above the existing marsh. Groundwater within the Shallow Groundwater Zone results from a combination of (1) groundwater recharge; (2) impedance of vertical groundwater redistribution across the lower permeability Silt Layer; and (3) lateral subsurface groundwater flow across the site from west to east toward Steigerwald Marsh. The active portion of the PSC operations is paved, and therefore infiltration to the subsurface is minimal on the active portions of the property.

However, the remainder of the property is unpaved, and infiltration into the Shallow Groundwater Zone is assumed to occur on unpaved portions of the property.

Past reports on this site have assumed that the lower extent of the Sand Fill is saturated throughout the PSC property and off-property to the east and that the Silt Layer serves as a confining unit for the underlying Lower Aquifer. However, more recently collected data show that this assumption is not entirely accurate. Wells MC-122 and MC-123 were installed along South 32nd Street (Figure 3-6) in December 2006 to replace permanently dry wells MC-22 and MC-23. Wells MC-22 and MC-23 were screened in the Sand Fill above the Silt Layer. In 2009, well MC-32 was installed immediately east of South 32nd Street also at the edge of Steigerwald Marsh. The new wells are screened within the Silt Layer. Data collected from these wells demonstrate that the Silt Layer near Steigerwald Marsh is saturated and produces groundwater. Furthermore, groundwater data indicate that the upper surface of the saturated zone slopes gradually downward from the Sand Fill into the Silt Layer near Steigerwald Marsh. Because groundwater elevations are located within the Silt Layer, evidence suggests that the silt unit likely behaves as a leaky aquitard allowing some hydraulic communication between all three hydrogeologic units.

Groundwater level monitoring data were reviewed to further evaluate this hypothesis. Groundwater elevation data collected from 1994 to 2009 are shown in Appendix K, and average seasonal elevations are shown on cross sections A-A', B-B' on Figures 6-4 through 6-6, respectively. Groundwater levels in wells completed within the Sand Fill differ significantly from water levels measured in wells completed in the underlying gravel (Lower Aquifer). In addition, the water levels in the Shallow Groundwater Zone are not affected by fluctuations in the Columbia River, whereas the Lower Aquifer water levels are strongly influenced by the river, as shown in Figure 5-2. These data suggest that the Silt Layer serves at least partially as an effective aquitard. The term "leaky aquitard" is appropriate when describing the Silt Layer since the layer is mostly saturated and capable of transmitting groundwater.

As expected, groundwater within the Sand Fill coincides with the lateral extent of the Fill, which is roughly equivalent to the footprint of the Camas/Washougal Industrial Park. Groundwater is found within the Sand Fill across the entire PSC property. The saturated thickness of the Shallow Groundwater Zone varies seasonally. During the dry season when water levels are lowest (ranging from approximately 4 to 6 feet bgs on the PSC property), the saturated thickness ranges from about 1.0 to 4.5 feet across the site. During the wet season when water levels are highest (ranging from approximately 1 to 4 feet bgs on the PSC property), the saturated thickness ranges from about 1.5 feet to 6.5 feet across the site. The greatest saturated thicknesses and the greatest variability between seasonal high and low water levels occur at MC-2, near the center of the PSC property. The smallest saturated thicknesses and the smallest variability between seasonal high and low water levels occur at PZU-3 and MC-20, off-property to the east where the thickness of the Sand Fill Unit decreases.

7.2.1.2 Groundwater Flow Direction

Water level monitoring since 1994 in wells completed within the Shallow Groundwater Zone has shown that groundwater consistently flows to the east toward Steigerwald Marsh. Groundwater contour maps for the second quarter 2008 through the second quarter 2009 are presented in Figures 7-2 through 7-6 for the Shallow Groundwater Zone. The average magnitude of the hydraulic gradient estimated from the groundwater contour maps is 0.011.

Vertical gradients at the facility were evaluated using paired wells screened in the shallow groundwater zone (MC-2, MC-12 through MC-15, MC-17, MC-20, MC-24, and MC-25) and the lower aquifer (MC-2D, MC-12D through MC-15D, MC-17D, MC-20D, MC-24D, and MC-25D). Historically, vertical hydraulic gradients are typically downward in well clusters in the center and northern portions of the PSC property (MC-2/MC-2D, MC-12/MC-12D, MC-24/MC-24D, and MC-25/MC-25D), where the saturated thickness in the Sand Fill is generally greatest; however, groundwater data from June 2008 show an upward vertical gradient in the central portion of the facility (MC-2/MC-2D, MC-24/MC-24D, and MC-25/MC-25D). Also during the June 2008 monitoring event, hydraulic gradients near the northwest property boundary (MC-12/MC-12D) were slightly downward. From September 2008 through June 2009, downward gradients were observed in the northwestern (MC-12/MC-12D) and central portions of the PSC property (MC-2/MC-2D, MC-24/MC-24D, and MC-25/MC-25D).

In June 2008 and again in June 2009, vertical hydraulic gradients along the eastern property boundary were directed upward (MC-13/MC-13D, MC-14/MC-14D, MC-15/MC-15D, and MC-17/MC-17D). From September 2008 through March 2009 vertical gradients in this area were downward.

Only one well pair (MC-20/MC-20D), which is located along the western edge of Steigerwald Marsh, shows a consistent upward gradient. The upward gradient is consistent with a groundwater conceptual model of groundwater discharge to the marsh.

In general, vertical hydraulic gradients at the facility show seasonal variability. Since the water table within the shallow Sand Fill is recharged during the wet winter months, groundwater vertical gradients are primarily downward for most of the site during the winter and early spring. During the drier months, when the water table in the Sand Fill drops, recharge decreases and the downward vertical gradients tend to weaken or reverse to upward in portions of the site and/or in especially dry years.

In December 1990, a study was conducted to determine potential influences of the Columbia River on groundwater at the site. A pressure transducer was used to record water levels in one Shallow Groundwater Zone well (MC-15S) every 10 minutes for 13 days. Groundwater elevation, Columbia River Stage elevation, and precipitation are plotted in Figure 7-7. Results show no apparent causal correlation between groundwater elevation in the Shallow Groundwater Zone and river stage. The abrupt rise in stage in the Columbia River on December 18, 1990, does not coincide with a similar response in the groundwater levels recorded in the Shallow Groundwater Zone. The rise in river stage beginning around December 27 does correspond to a rise in groundwater elevation. This relationship between river stage and groundwater elevation is likely the result of a precipitation event (Figure 7-7). Moderate precipitation in the area would have resulted in both increased river stage downstream of Bonneville Dam and a rise in groundwater levels at the site due to recharge to the Shallow Groundwater Zone. Given the lack of correlation with groundwater observed during and after the December 18 river flood event, the rise in groundwater elevations beginning on December 27 is likely due to recharge from precipitation and not hydraulic influences from the Columbia River.

7.2.1.3 Hydraulic Properties

In previous investigations, the following parameters were measured in the Shallow Groundwater Zone: moisture content, dry and wet soil density, grain size, hydraulic conductivity (horizontal and vertical), porosity, and specific yield (Table 6-1). Field tests, including constant-discharge aquifer tests and slug tests, were also performed, and horizontal seepage velocities were calculated for the Shallow Groundwater Zone.

Aquifer test results indicate horizontal hydraulic conductivity for the Shallow Groundwater Zone ranges between 5.7 x 10^{-4} and 5.0 x 10^{-2} centimeters per second (cm/s), with an average (geometric mean) value of 7.2 x 10^{-3} cm/s. These values are consistent with literature values for a silty sand (Domenico and Schwartz, 1990). The range of estimated vertical hydraulic conductivity varies from 2.5 x 10^{-7} to 8.3 x 10^{-2} cm/s. The hydraulic conductivity ratios (horizontal/vertical, or H:V) for the Shallow Groundwater are greater than 1.0, indicating that the aquifer is anisotropic. The fill material was hydraulically emplaced but is still likely somewhat horizontally stratified, resulting in lower vertical hydraulic conductivities. The specific yield of the Sand Fill ranges from 2.2 x 10^{-5} to 0.48, with all but one value greater than 0.0024. Porosity estimates range from 0.34 to 0.53. Typical porosity and specific yield estimates for sands range from about 0.25 to 0.55 and from about 0.2 to 0.3, respectively (Domenico and Schwartz, 1990). Measured values that fall outside these ranges may not be representative of the Sand Fill.

To provide additional horizontal conductivity characterization, rising head slug tests were performed during fall 2007 in three Shallow Groundwater Zone monitoring wells and one piezometer. Falling head tests would be inappropriate for the Shallow Groundwater Zone wells/piezometers, because the well screen intervals are not completely submerged below the water table at these locations. Therefore, for the Shallow Groundwater Zone wells/piezometers, rising head tests were performed in which the slug in the well is withdrawn in order to lower the water level or hydraulic head in the well. Methods outlined by Bouwer (1989) and Bouwer and Rice (1976) are generally used to analyze slug test results in wells with screens that straddle the water table. Calculations done using these methods depend on the rate at which the water returns to static levels after removal of the slug.

Results show that horizontal hydraulic conductivity for the Sand Fill Unit (PZU-3, MC-20, MC-24, and MC-25) ranges between 2.0 x 10^{-3} and 3.1 x 10^{-2} cm/s (Table 7-3), with a geometric mean value of 3.7 x 10^{-3} cm/s. Results also show that PZU-3 had an order of magnitude higher hydraulic conductivity value than MC-20, MC-24, and MC-25. This result is likely due to the proximity of PZU-3 to the storm sewer utility line. Nonetheless, these results are consistent with previous estimates calculated from aquifer test data. The hydraulic conductivity values calculated from both slug test and aquifer test data are typical for a clean to silty sand (Freeze and Cherry, 1979). The range in conductivity can be attributed to natural variation in hydraulic properties of the Sand Fill including silt and gravel content, grain sorting, and sediment compaction. Full slug test results are provided in Appendix L.

Based on these data, the hydraulic properties of most of the Sand Fill are well characterized and are sufficient for completing the FS.

7.2.1.4 Groundwater Flow Rates and Velocity

The groundwater Darcy flow velocity (q with units of feet per day [ft/day]) in an unconfined (water table) aquifer with a horizontal, impermeable bottom can be estimated using the Dupuit Approximation as:

$$q = K\frac{(h_0^2 - h_L^2)}{2Lh}$$

where K is the hydraulic conductivity (ft/day), h_0 is the head at the origin, h_L is the head at *L*, *h* is the hydraulic head as a function of the x position, and L is the distance in feet between the locations of h_0 and h_L (Fetter, 2001; Schwartz and Zhang, 2003). Hydraulic head (*h*) as a function of *x* is determined by:

$$h = \sqrt{h_0^2 + (h_L^2 - h_0^2)\frac{x}{L}}$$

where x is the distance from the origin (Fetter, 2001; Schwartz and Zhang, 2003). The total groundwater discharge Q (in units of cubic feet per day [ft^3/day]) can then be calculated as:

$$Q = qbw$$

where b is the aquifer saturated thickness (feet) and w is aquifer width (feet).

The groundwater flow direction in the Sand Fill is generally to the east; therefore groundwater discharge across the eastern property boundary was estimated using the above equations. Wells MC-20 and MC-21 are located 116 feet apart along a west-to-east flow path and have average saturated thicknesses above the silt of about 1.83 feet to 2.43 feet, respectively (Table 7-4). Using an average (geometric) hydraulic conductivity calculated from the MC-14 aquifer test and the MC-20 slug test (2.3×10^{-3} cm/s; 6.7 ft/day) as well as a length of 500 feet along the eastern property boundary, the average groundwater discharge from the site in the Shallow Groundwater Zone is approximately 124 ft^3/day (Table 7-4).

The linear groundwater velocity (v with units of ft/day) can be estimated as:

$$v = q/n_e$$

where n_e is the effective porosity (unitless), and q is defined above. Using the average of the two saturated thicknesses (b), the width w, and Q calculated above, and assuming an effective porosity equal to 0.30, the average linear groundwater velocity at the eastern side of the site in the Shallow Groundwater Zone is approximately 0.4 ft/day.

Calculations of Q and v are summarized in Table 7-4. Based on boring log and water level data, the saturated portion of the Sand Fill gradually becomes thinner along South 32nd Street, and groundwater discharges to the marsh through the silt. The horizontal hydraulic conductivity of the Silt Layer is expected to be lower than the hydraulic conductivity of the Sand Fill, and the above estimate of v may overestimate the actual groundwater velocity in the Silt Layer.

7.2.1.5 Fill Geochemistry

In previous investigations, the following water quality parameters have been measured in the Shallow Groundwater Zone: chloride; alkalinity; nitrate, nitrite, and ammonia; sulfate and sulfide; ethane and ethene; methane; ferrous and ferric iron; total dissolved solids (TDS); and TOC. Table 4-4 summarizes the Shallow Groundwater Zone and Lower Aquifer groundwater samples that have been analyzed for these parameters. In addition to laboratory analysis of the above parameters, field measurements of dissolved oxygen, pH, temperature, and redox potential are collected during groundwater sampling. These data are included in Appendix H.

The available data are sufficient to characterize aquifer geochemistry and evaluate fate and transport of contaminants at the site, particularly with respect to biodegradation of organic constituents. A full summary and interpretation of these data, including spatial distribution and temporal trend plots, is included in Section 12.0.

7.2.2 Silt Layer (Aquitard)

The Silt Layer serves as an aquitard (Silt Aquitard) that partially confines the Lower Aquifer. The following subsections describe the hydrostratigraphy and hydraulic properties of the Silt Aquitard.

7.2.2.1 Hydrostratigraphy

The Silt Aquitard, or Upper Confining Unit, corresponds to the Silt Layer geologic unit. The Upper Confining Unit consists of a low-permeability Silt Layer that underlies the Shallow Groundwater Zone. This layer directly overlies and hydraulically confines the Lower Aquifer, as shown by the different potentiometric surfaces observed in the Lower Aquifer versus the Shallow Groundwater Zone (compare Figures 7-2 through 7-6 versus Figures 7-8 through 7-12). The Upper Confining Unit is laterally continuous, as determined by a ground-penetrating radar survey of the facility and surrounding area (SEE, 1991) and the more than 80 borings that have tagged the Silt Layer within the site. Contour maps showing the elevation of the top of the Silt Layer are presented in Figures 6-12 and 6-13, and a contour map of the thickness of the Silt Layer is given in Figure 6-14. Figure 7-13 shows the Shallow Groundwater Zone wells and the unit from which groundwater samples were collected. The thickness of the unit varies across the site. Beneath the western portion of the site, the Silt Layer is between approximately 8.1 to 17.6 feet thick (Figure 6-14). Beneath the central portion, the Silt Layer is from 5.5 to 19.7 feet thick. Beneath the eastern portion, the Silt Layer is from 2.5 to 13.0 feet thick.

7.2.2.2 Hydraulic Properties

As described in Section 7.2.1.2, in June 2008 an upward hydraulic gradient was observed in the central portion of the PSC property (wells MC-2/MC-2D, MC-24/MC-24D, and MC-25/MC-25D). Additionally, during the June 2008 quarterly monitoring event, a downward gradient was observed in the northwest portion of the PSC property at MC-12/MC-12D. From September 2008 through June 2009, vertical hydraulic gradients were downward in well clusters in the central and northern portions of the facility (MC-2/MC-2D, MC-12/MC-12D, MC-24/MC-24D, and MC-25/MC-25D). Along the eastern boundary of the PSC property (MC-13/MC-13D, MC-14/MC-14D, MC-15/MC-15D, MC-17/MC-17D), wells exhibited seasonal variability in the direction of the hydraulic gradient. In June 2008 and June 2009, vertical gradients near the eastern property boundary (MC-13/MC-13D, MC-14/MC-14D, MC-15/MC-15D, and MC-17/MC-17D) were upward. From September 2008 through

March 2009, vertical gradients at these wells were downward. Hydraulic gradients observed at the western edge of Steigerwald Marsh (MC-20/MC-20D) are consistently upward throughout different seasons.

In previous investigations, the following parameters were measured in the laboratory for samples from the Silt Layer: moisture content, dry and wet soil density, grain size, hydraulic conductivity (vertical), and porosity (Table 6-2). Vertical hydraulic conductivity measured in the laboratory using disturbed samples varied from 9.8×10^{-8} to 2.5×10^{-4} cm/s. Porosity values have varied from 0.41 to 0.65, which is in the range of literature values for silt (Domenico and Schwartz, 1990). In order to gain additional data regarding the Silt Layer hydraulic conductivity, slug tests were conducted at wells MC-122 and MC-123 (wells screened partially in the Silt Layer) near the marsh in 2007. Results show horizontal hydraulic conductivity of the Shallow Groundwater Zone Silt Unit (MC-122 and MC-123) to range between 4.7×10^{-4} and 6.6×10^{-4} cm/s (Table 7-3), with an average (geometric mean) value of 5.2×10^{-4} cm/s. This value for horizontal hydraulic conductivity is higher than typical literature values for silt (Fetter, 2001), which range from 10^{-6} to 10^{-4} cm/s. The high slug test conductivity values may indicate the presence of slightly sandy silt. Furthermore, MC-122 is partially screened across the Sand Fill, and MC-123, while screened fully within the silt, has a sand filter pack that extends into the Shallow Groundwater Zone Sand Fill Unit above the Silt Layer. Full slug test results are included in Appendix L.

7.2.2.3 Geochemistry

Until recently there were no wells that were completed within the Silt Layer and as a result, there are no data on general geochemistry of this unit. However, there are a number of wells screened in the lower portion of the Sand Fill and the upper portion of the Silt Layer which provide an indication of the geochemistry of this unit. The Silt Layer is an important unit from a geochemical perspective to characterization of the fate and transport of COCs. As described in Section 6.2.2, the Silt Layer represents the former ground surface of the marsh before filling of the area to build the industrial park on which the site is located. The silt is high in organic content and contains peat layers and woody debris. The fine-grained nature of the silt will adsorb organic COCs and the organic content increases the adsorptive effect. In addition, the slow degradation of organics within the Silt Layer results in a reducing groundwater geochemical environmental which mobilizes some metals, such as iron and arsenic, as discussed in Section 12.0. This condition is expected throughout the industrial park.

7.2.3 Lower Aquifer

The Lower Aquifer corresponds to the Gravel and Deeper Silty Sand geologic units. The following subsections describe hydrostratigraphy, groundwater flow, hydraulic properties, and geochemistry of the Lower Aquifer.

7.2.3.1 Hydrostratigraphy

The Lower Aquifer acts as a confined aquifer, and is directly overlain by the Silt Aquitard. As noted above, the Lower Aquifer is located within the regional Unconsolidated Sedimentary Aquifer. No borings completed at the site have completely penetrated the Lower Aquifer, and the total thickness of this aquifer is not known. Seasonal groundwater elevations in the Lower Aquifer vary by approximately 6 feet. Short-term groundwater elevations vary by approximately 1 foot in response to changes in river stage.

7.2.3.2 Groundwater Flow Direction

Interpretations of groundwater flow directions in the Lower Aquifer are based on quarterly groundwater elevation measurements collected since 1994 and the results of a tidal monitoring study performed in 1990.

Based on quarterly groundwater elevation measurements from 1994 to 2000, groundwater in the Lower Aquifer appears to flow to the north or northeast during the wet season (January, February, and March), and to the south during the dry season (August and September). A review of data collected between March 2000 and December 2006 (Appendix K) indicates this pattern may not always be representative of current conditions in the Lower Aquifer. Of the 28 quarterly sets of groundwater elevation data from this time period, only 3 show a northerly or northeastward flow direction, while the rest show a predominantly southerly or southeastward flow. Additional deep wells installed in 2008 and 2009 allowed further characterization of groundwater flow directions in the Lower Aquifer. Groundwater contour maps from the second quarter 2008 through the second quarter 2009 are presented in Figures 7-8 through 7-12. Data collected in June 2008 and June 2009 demonstrate a northeasterly flow path, whereas groundwater flow paths observed during September 2008, November 2008, and March 2009 all trend generally toward the south. The reason for the observed inconsistency in seasonal flow paths since 1994 is unclear; however, as discussed below, the results of a tidal water level monitoring study at the facility indicate that although short-term northward flows do occur, they are limited in magnitude and duration, and the predominant flow direction is to the south or southeast.

Vertical hydraulic gradients are consistently downward in well clusters in the central and northern portions of the PSC property (MC-2/MC-2D, MC-24/MC-24D, and MC-25/MC-25D), where the saturated thickness of the Shallow Groundwater Zone is greatest; this occurs during the winter and spring months. Along the eastern boundary of the property (MC-13/MC-13D, MC-14/MC-14D, MC-15/MC-15D, MC-17/MC-17D), wells exhibited seasonal variability in the hydraulic gradient direction. From the second quarter 2008 through the second quarter 2009, observed gradients during June were upward, whereas gradients during the remainder of the year were downward. The nearby Steigerwald Marsh is a groundwater discharge area and that, in combination with the downward sloping water table from the Sand Fill into the Silt Layer, is the presumed reason the vertical gradient appears to reverse just to the west of South 32nd Street.

Groundwater elevations in the Lower Aquifer are influenced by changes in surface water stage in the Columbia River. The Columbia River stage near Washougal is affected by daily and seasonal changes in river discharge and daily ocean tidal changes. The nearest Columbia River gaging station operated by the U.S. Geologic Survey (USGS) is located approximately 15 miles downstream at Vancouver. River stage data from this gage (14144700) are not directly applicable to the site; however the variability in river stage at the gage is likely similar to the variability at Washougal. For example, the difference between high and low mean monthly river stages at Vancouver is approximately 6 feet, and a similar average monthly variability is observed between June 2008 and September 2008 for Washougal groundwater elevations. Due to the variability in river stage, quarterly groundwater measurements may not reflect the true variability in groundwater elevations and the magnitude and direction of the hydraulic gradient in the Lower Aquifer.

In December 1990, a 2-week continuous water level monitoring study was conducted at the site (SEE, 1991) to evaluate the effect of river stage on groundwater elevations and flow directions. Pressure transducers with data recorders were installed in three Lower Aquifer Wells (MC-2D, MC-15D, and MC-18D), a shallow well (MC-15), and the Columbia River. Water level data were recorded every 10 minutes. The Columbia River hydrograph is plotted with hydrographs for each of the three Lower Aquifer wells on Figures 7-14 through 7-16. The hydrograph for the Columbia River shows both the daily tidal variability of approximately 1 to 2 feet, and larger stage changes of up to 4 to 5 feet due to changes in river discharge. The water level hydrographs show a strong correlation between diurnal fluctuations in the river and the Lower Aquifer, indicating a hydraulic connection between the river and aquifer. During the 2-week study, the magnitude of fluctuations in groundwater elevation in the Lower Aquifer was approximately one-third of those recorded in the river, and there was an approximate 4-hour lag between the changes in the river and changes in the Lower Aquifer.

Water levels in the river were almost always lower than water levels in the Lower Aquifer. Over the 2-week tidal water level monitoring study, there were only two periods lasting approximately 16 hours when river stage was higher than groundwater elevations in the Lower Aquifer (December 21 and 22). Both of these periods correspond to high-discharge, high-tide conditions, and the river stage dropped below groundwater elevations in the Lower Aquifer during low tide. During lower discharge conditions, river stage remained continuously below groundwater elevations. These data indicate that even during high river elevations, overall flow from the river northward or northeastward toward the site is expected to be of short duration.

Data from the tidal water level monitoring study were used to evaluate the short-term variability of hydraulic gradients in the Lower Aquifer. An initial attempt was made to evaluate the data using 25-hour and 72-hour tidal averaging techniques (Serfes, 1991). These techniques require cyclical variability in tidal water levels in the surface water body (e.g., river or ocean) around a stable average water level (e.g., mean sea level). River stage changed frequently during the tidal water level monitoring study, and was relatively stable for only one period of approximately 25 hours around December 21, 1990. This short stable period immediately followed an abrupt 3-foot change in river stage on December 20, and groundwater elevations showed a rising trend following this stage change. These water level data do not meet the requirements for applying the 25-hour or 72-hour tidal averaging techniques, and an alternative approach was developed to evaluate the data.

A spreadsheet was developed to calculate the instantaneous magnitude and direction of the horizontal hydraulic gradient in the Lower Aquifer for each hourly set of contemporaneous groundwater elevations measured in the three Lower Aquifer wells. The spreadsheet applies a standard “three-point problem” solution for calculating the slope (gradient) and direction of the slope on a plane. Figure 7-17 shows the calculated hourly magnitude and direction of the hydraulic gradient over the period of the tidal monitoring study. The direction of the hydraulic gradient is shown in degrees east of north, such that a direction of 90 degrees would be due east and a direction of 180 degrees would be due south.

The magnitude of the calculated gradient varied between 0.0001 and about 0.0032, although most values were between 0.0004 and 0.0016. The average gradient over the period of the tidal study, calculated as the arithmetic mean of the individual hourly gradient values, was 0.001. The direction of the gradient varied between about 20 degrees east of north to 180 degrees due south, which corresponds to the two different flow directions inferred from second quarter 2008 through second quarter 2009 groundwater contour maps. For the tidal study, the largest gradients corresponded with low river stage and a predominantly southward flow direction, whereas the smallest gradients occurred during higher river stage and an east-northeastward flow direction. In contrast, the largest gradient observed between the second quarter 2008 and second quarter 2009 corresponds to a northeasterly flow direction observed in June 2008. This discrepancy between the tidal study and the recent groundwater elevation data is likely a function of the limited duration (2 weeks) of the tidal study. Using the tidal study dataset, the average direction of the hydraulic gradient was calculated as a weighted-average of the individual hourly gradient direction values, weighted by the individual magnitudes of the hydraulic gradient. The weighted-average direction of the hydraulic gradient was 118 degrees east of north (i.e., east-southeast).

In summary, the magnitude and direction of hydraulic gradients in the Lower Aquifer are highly variable on a daily and seasonal basis. Groundwater levels and flow are affected by tides in the Columbia River and also by the seasonal river levels. Since the Columbia River levels are controlled by a series of upstream dams for power generation and irrigation needs, high and low seasonal levels are not predictable and cannot always be directly correlated to precipitation events or spring runoff. The tidal effects on the groundwater levels in the Lower Aquifer are dampened by the aquifer, and there appears to be a delay of approximately 4 hours from the river tidal cycle. Average flows under normal to low river levels are primarily to the south toward the river. During high river flow levels, the river becomes a discharging stream. This results in groundwater flows on the site to be reversed from normal with flow direction to the north-northeast. Groundwater gradients during these reversed flow periods are generally small. Based on the quarterly water level data and the tidal monitoring study, it appears that net groundwater flow in the Lower Aquifer is generally east-southeast to southward, toward Steigerwald Marsh and the Columbia River.

7.2.3.3 Hydraulic Properties

In previous investigations, the following parameters were measured in the Lower Aquifer: moisture content, dry and wet soil bulk density, grain size, laboratory hydraulic conductivity (vertical), and total porosity (Table 6-4). Laboratory measurements of vertical hydraulic conductivity using two disturbed samples collected from the Lower Aquifer varied from 2.2×10^{-6} to 6.6×10^{-4} cm/s. These conductivities are low for an aquifer consisting primarily of gravel (Dominico and Schwartz, 1990) and are similar to those measured in the overlying Silt Layer, which is considered an aquitard. Laboratory measurements of porosity varied from 0.40 to 0.47.

For the Lower Aquifer, the Hvorslev method was used (Hvorslev, 1951) to calculate conductivities. This method is applied to slug tests in wells that do not fully penetrate an aquifer, and can be applied only to wells with screens set fully below the water table. Calculations done using this method are dependent on the rate at which the water level returns to static levels after the insertion or removal of the slug.

The hydraulic conductivity of the Lower Aquifer is considered well characterized. Results show the hydraulic conductivity of the Lower Aquifer ranges from 1.7×10^{-4} to 2.9×10^{-3} centimeters per second (cm/s), with an average (geometric mean) value of 6.3×10^{-4} cm/s (Table 7-5). This average value for conductivity is slightly lower than literature values for well-sorted sands and glacial outwash (Fetter, 2001), which range from 10^{-3} to 10^{-1} cm/s. The lower observed hydraulic conductivity is likely due to the presence of fine-grained fractions (i.e., clays and silts) within the well screen interval at most of the Lower Aquifer wells where slug tests were performed. The standard deviation of the hydraulic conductivity for all Lower Aquifer wells is 7.8 x 10^{-4} cm/s, which is rather low.

7.2.3.4 Groundwater Flow Rates and Velocity

Assuming one-dimensional uniform flow, the groundwater Darcy flow velocity (q with units of ft/day) in a confined aquifer can be estimated as:

$$q = K\frac{dh}{dl}$$

where K is the hydraulic conductivity (ft/day) and dh/dl is the hydraulic gradient.

The total groundwater discharge (Q; ft^3/day) can then be calculated as:

$$Q = qbw$$

where b is the aquifer saturated thickness (feet) and w is aquifer width (feet).

Using Darcy's Law, the groundwater discharge within the Lower Aquifer was calculated for different well pairs depending on the direction of the hydraulic gradient. Wells MC-14D and MC-19D were used for flow paths trending toward the northeast, while groundwater elevations from wells MC-19D and MC-118D2 were used to calculate discharge for hydraulic gradients directed toward the south. These well pairs were selected because their position allows the quantification of discharge along the two general groundwater flow directions observed at the site. In addition, data from these wells captures nearly the total change in head across the site. Certain assumptions were made in calculating groundwater discharge regardless of flow path direction. These assumptions include the following.

- Because the total depth of the Lower Aquifer is unknown, the saturated thickness corresponds to the 10-foot screen interval used at each well.
- Hydraulic conductivity is determined using a geometric average of slug test results from all Lower Aquifer wells.
- The length (dl) over which the change in head (dh) occurs is the estimated flow path distance rather than straight line distance.
- Aquifer width is defined as the 500 feet separating the eastern and western boundaries of the PSC property.

After calculating Darcy flow velocity, the linear groundwater velocity (v with units of ft/day) can be estimated as:

$$v = q/n_e$$

where n_e is the effective porosity (unitless), and q is defined above. The linear groundwater velocity for the Lower Aquifer was calculated using the saturated thickness (b), the width w, and Q calculated above, and assuming an effective porosity equal to 0.30.

Table 7-6 shows Lower Aquifer discharge and linear groundwater velocity calculations for the defined aquifer volume from June 2008 through June 2009. When groundwater flow is to the northeast, average discharge and linear groundwater velocity are 51 ft^3/day and 0.03 ft/day, respectively. When the gradient reverses to the south, the average groundwater discharge and linear groundwater velocity are 38 ft^3/day and 0.03 ft/day, respectively. For the time period evaluated, both the maximum and minimum discharge occurred when the hydraulic gradient was directed toward the northeast. Average linear groundwater velocity for the Lower Aquifer remained the same, regardless of flow directions.

7.2.3.5 Aquifer Geochemistry

In previous investigations, the following water quality parameters have been measured in the Lower Aquifer: chloride; alkalinity; nitrate, nitrite, and ammonia; sulfate and sulfide; ethane and ethene; methane; ferrous and ferric iron; TDS; and TOC. Table 4-4 summarizes the Shallow Groundwater Zone and Lower Aquifer Wells groundwater samples that have been analyzed for these parameters. In addition to laboratory analysis of the above parameters, field measurements of dissolved oxygen, pH, temperature, and redox potential are collected during groundwater sampling. The available data are sufficient to characterize aquifer geochemistry and evaluate fate and transport of contaminants at the site, particularly with respect to biodegradation of organic constituents. A full summary and interpretation of these data, including spatial distribution and temporal trend plots, is provided in the Section 12.0.

7.2.4 Potential Preferred Groundwater Flow Pathways

As discussed initially in Section 3.5, underground utility lines have been a concern as a preferential pathway for groundwater, and utility lines were investigated further as part of the RI work. In order for utility lines or other underground features to act as a preferential pathway for groundwater flow, there must be both a conduit of higher hydraulic conductivity material (e.g., sand or gravel backfill) and a hydraulic gradient to drive groundwater along the conduit. Little evidence of higher conductivity material was identified during a review of utility construction and investigation data, with the exception of the gravel bedding beneath the storm sewer line that runs along South 32nd Street (Appendix B, Figures B-1 and B-2).

To further investigate the potential for underground utilities to act as preferential pathways for contaminated groundwater, PSC measured groundwater elevations in three piezometers (PZU-1 through PZU-3) installed between the utility lines immediately downgradient of the PSC property. The piezometers were installed along an east-to-west transect oriented parallel to the general direction of groundwater flow in the Shallow Groundwater Zone and perpendicular to the trend of the utility lines (Figure 3-22). Piezometer PZU-1 was installed between the gas line and the sanitary sewer line, PZU-2 was installed between the sanitary sewer line and the water line, and PZU-3 was installed between the storm sewer line and the PSC property (Figure 3-22). There was insufficient space between the water and the storm sewer lines to install a fourth piezometer at this location.

Between December 14, 2001, and February 25, 2002, continuous groundwater elevations were measured in the three piezometers and wells MC-14 and MC-20 using pressure transducers and data loggers. Quarterly groundwater elevations have also been collected at the existent piezometers and wells as part of routine monitoring at the facility. The continuous and quarterly groundwater elevation data show a strong, consistently eastward gradient between PZU-3 and PZU-2 (average gradient of 0.018), and a flat gradient between PZU-2 and PZU-1 and between PZU-1 and MC-20 (0.001 westward to 0.002 eastward). Because all these wells and piezometers are located along an east-west line, it is not possible to evaluate whether there is a northward or southward component to the gradient.

In March 2006, piezometers PZU-1 and PZU-2 were decommissioned. Monitoring wells MC-122 and MC-123 were installed north and south of MC-20 in December 2006 (Figure 3-22). These new wells were included in the subsequent quarterly groundwater elevation measurements. Data from groundwater elevation measurements indicate divergent flow at MC-20, with both a northward and southward component of the gradient toward MC-122 and MC-123, respectively. It was still unclear if a higher hydraulic conductivity conduit exists along the utility lines. However, these water level data indicated that groundwater could be migrating along the path of the utilities. More recent groundwater contour maps using wells installed since 2007 (Figures 7-2 through 7-6) indicate a southward hydraulic gradient from the general area of PZU-4 and PZU-5 toward MC-122 and MC-20 during the summer, fall, and spring months. At these times, a northerly flow path is observed in the general vicinity of MC-20 and MC-123, resulting in convergent groundwater flow paths near either MC-122 or MC-20 (Figures 7-2, 7-3, 7-5, and 7-6). Divergent flow is also observed away from MC-20 during summer and spring months (Figures 7-2, 7-5, and 7-6). In early winter (Figure 7-4), convergent flow appears to occur farther north along the edge of Steigerwald Marsh near PZU-5.

Additional water level and hydraulic conductivity data collected in 2007, along with the construction information, were used to assess migration of shallow groundwater as it encounters the storm sewer utility line on South 32nd Street, west of Steigerwald Marsh. Groundwater flow conditions in the Shallow Groundwater Zone were simulated using an enhanced version of the USGS groundwater flow model, MODFLOW. MODFLOW-2000 is an enhanced version of the original MODFLOW computer program that simulates three-dimensional groundwater flow through a porous medium using a finite-difference method (Harbaugh et al., 2000). The numerical model is intended to serve as a decision-making tool that contributes additional understanding of the physical flow system at a location, including quantification of volumetric flow rates along the storm sewer utility line. Numerical modeling results suggest that approximately 155 ft^3/day of groundwater flows along the storm sewer utility line towards the Gibbons Creek remnant channel, while total discharge from the site is estimated to be approximately 124 ft^3/day (Section 7.2.1.4). Although the calibrated model adequately simulates groundwater elevations, flow paths, and discharge across the eastern boundary, there are certain limitations associated with the numerical model.

7.3 HYDROGEOLOGIC CONCEPTUAL MODEL

The Hydrogeologic Conceptual Model for the site is that the uppermost groundwater is located primarily within the Sand Fill but slopes downward into the Silt Layer near Steigerwald Marsh Groundwater flow within this Shallow Groundwater Zone is primarily horizontal toward Steigerwald Marsh to the east, but there are also downward and upward vertical flow components that vary both spatially and temporally. Near Steigerwald Marsh the Sand Fill becomes thinner, and the phreatic water table is located within the Silt Layer. This observation suggests that the shallow groundwater within the Sand Fill drains into the Silt Layer at the eastern boundary of the PSC property and ultimately discharges into the Marsh. Observed horizontal flow gradients suggest that the Lower Aquifer typically discharges to the Columbia River. Vertical gradients on the eastern boundary of the PSC property between the Shallow Groundwater Zone and the Lower Aquifer are consistently upwards, as can be expected for discharge to a marsh area.

In order to visually represent subsurface conditions at the site, two-dimensional cross sections were updated using data collected from the additional borings performed at the site since fall 2007 (Figures 6-4 through 6-6). The additional field work did not yield any dramatic changes in the conceptual model of the site geology, although the data allowed further refinement of the top and bottom elevation of the Silt Layer. The new data confirmed that the Silt Layer bed becomes thinner north and northeast of the PSC property near PZU-4 and PZU-5, as shown in cross sections A-A' and B-B'. The other notable feature of the Silt Layer ascertained from data collected since 2007 is the apparent east/west-trending depression that occurs in the top of the Silt Layer between GP-35 and GP-33, east of South 32nd Street. The boring for well MC-20D confirmed the top of the Silt Layer is approximately 3 to 6 feet higher on both sides of MC-20, MC-20D, and GP-34. Beneath most of the PSC Washougal property, the top of the Silt Layer is relatively flat, as shown in Figure 6-12, which illustrates the revised silt elevation contours beneath the property. Lithologic data collected through fall 2007 were also used in a three-dimensional (3-D) modeling program that incorporated stratigraphic, topographic, and water level information from previous site investigations, as well as utility corridor information and other subsurface characteristics. Three-dimensional cross sections are presented in Figures 6-9 through 6-11. The location of cross section E-E´ is shown in Figure 6-3.

Piezometers and wells installed since 2007 added 8 new Shallow Groundwater Zone and 11 new Lower Aquifer points to gather additional water level data during quarterly monitoring. The Shallow Groundwater Zone contour maps from June 2008 through June 2009 are shown in Figures 7-2 through 7-6. The data show trends similar to those observed previously; the direction of groundwater flow is generally west to east in the Shallow Groundwater Zone. The new Lower Aquifer wells allowed detailed characterization of the spatial variability in groundwater elevations and hydraulic gradients at depth beneath the site. Groundwater contour maps from June 2008 through June 2009 (Figures 7-8 through 7-12) demonstrate that hydraulic gradients in the Lower Aquifer tend to oscillate between northeasterly and southerly directions at various times of the year. Observed groundwater flow directions are consistent with previously documented trends and a tidal study performed in 1990. Collectively, data for the Lower Aquifer suggest the magnitude and direction of hydraulic gradients in the Lower Aquifer are temporally variable due to influences imparted by tides and seasonal flows in the Columbia River.

Slug tests performed in Fall 2007 allowed additional characterization of horizontal hydraulic conductivity in the Sand Fill, Silt Layer, and Lower Aquifer. Results for tests conducted in the Sand Fill showed conductivity values between 2.0×10^{-3} cm/s and 3.1×10^{-2} cm/s, which were consistent with previous estimates derived from aquifer test data. Test performed in wells screened within the Silt Layer indicate that conductivity varies from approximately 4.7×10^{-4} cm/s and 6.6×10^{-4} cm/s. Slug test results for the Lower Aquifer indicate hydraulic conductivity values range from approximately 1.7×10^{-4} cm/s to 2.9×10^{-3} cm/s. These data suggest that although the Lower Aquifer contains sand and gravels, the presence of fine-grained materials within the aquifer matrix limits the hydraulic conductivity of this hydrogeologic unit. This hypothesis is consistent with lithology observed in boring logs.

The storm sewer utility line located along the west side of South 32nd Street is recognized as a possible preferential groundwater flow pathway that could result in northward contaminant transport.

TABLES

TABLE 7-1

AVERAGE MONTHLY STAGE - COLUMBIA RIVER BELOW BONNEVILLE DAM, OREGON[1,2,3]

PSC Washougal Facility
Washougal, Washington

Year	Month											
	January	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
1994	12.201	13.524	12.922	14.105	17.678	16.588	13.671	9.065	7.692	9.34	--[3]	--
1995	14.632	18.466	16.706	16.203	20.846	21.626	16.889	13.008	10.071	11.881	15.664	22.059
1996	21.525	27.477	23.931	24.483	25.518	26.818	19.583	15.914	12.056	--	13.717	18.875
1997	23.675	22.945	23.295	24.664	30.473	31.465	21.342	16.979	13.789	15.043	14.302	15.743
1998	16.681	18.098	17.011	15.346	24.349	--	17.106	--	10.813	10.026	12.288	16.175
1999	19.84	20.131	21.47	20.732	22.72	24.931	20.041	17.181	12.799	11.808	14.243	18.117
2000	17.716	17.107	16.818	21.274	20.783	17.662	14.842	12.935	10.77	10.471	11.704	12.874
2001	11.931	11.757	11.554	11.34	12.952	12.274	8.568	9.506	8.173	8.354	10.65	13.288
2002	14.334	14.048	12.765	18.393	19.239	23.758	18.508	13.416	9.957	9.767	11.654	11.831
2003	12.458	13.548	15.402	17.721	19.446	19.555	13.15	11.944	9.015	9.994	11.663	13.648
2004	13.891	13.448	13.562	14.673	18.222	18.34	13.212	11.877	10.81	10.641	11.696	14.286
2005	13.596	13.19	12.522	13.661	19.109	16.615	15.201	12.293	8.872	10.335	11.855	12.931
2006	19.012	16.548	14.931	22.896	24.595	23.296	15.545	12.395	9.071	--	--	--
Mean	16.27	16.95	16.38	18.11	21.23	21.08	15.97	13.04	10.3	10.7	12.68	15.44

Notes

1. US Geological Survey stream gauge 14128870 on Columbia River below Bonneville Dam, OR.
2. Data available from *http://waterdata.usgs.gov/nwis.*
3. -- indicates missing or unreported data; data were not used for statistical calculations.

TABLE 7-2

ESTIMATED HYDRAULIC PROPERTIES OF REGIONAL HYDROGEOLOGIC UNITS

PSC Washougal Facility
Washougal, Washington

Hydraulic Property	Regional Hydrogeologic Unit	Median	Range	Units	Type of Test	Data Source
Horizontal Hydraulic Conductivity	Unconsolidated Sedimentary Aquifer	3.9×10^{-2}	1×10^{-3} - 2×10^{-1}	cm/s	Calculated from Transmissivity	Woodward et al. (1998)
	Troutdale Gravel Aquifer	5.3×10^{-3}	1×10^{-3} - 7.1×10^{-2}			
	Confining Unit 1	4×10^{-5}	3.5×10^{-5} - 2.8×10^{-3}			
	Troutdale Sandstone Aquifer	--	--			
	Confining Unit 2	7×10^{-4}	3.5×10^{-5} - 3.2×10^{-2}			
	Sand and Gravel Aquifer	4×10^{-4}	3.5×10^{-7} - 2.6×10^{-1}			
Storage Coefficient	Troutdale Gravel Aquifer	8×10^{-4}	--	--	Aquifer Tests	McFarland and Morgan (1996)
	Confining Unit 1	5×10^{-5}				
	Troutdale Sandstone Aquifer	8×10^{-4}				
	Confining Unit 2	5×10^{-5}				
	Sand and Gravel Aquifer	4×10^{-4}				

Abbreviations
cm/s = centimeters per second
-- = not available

TABLE 7-3

SLUG TEST RESULTS FOR SAND FILL AND SILT LAYER

PSC Washougal Facility
Washougal, Washington

Slug Test Parameter	PZU-3 Rising Head Test 1	MC-20 Rising Head Test 1	MC-20 Rising Head Test 2	MC-24 Rising Head Test 1	MC-24 Rising Head Test 2	MC-25 Rising Head Test 1	MC-25 Rising Head Test 2	MC-122 Rising Head Test 1	MC-122 Rising Head Test 2	MC-123 Rising Head Test 1	MC-123 Rising Head Test 2
Well Depth	9 ft	11.4 ft	11.4 ft	9 ft	9 ft	9.8 ft	9.8 ft	15.5 ft	15.5 ft	15.5 ft	15.5 ft
Screen Length	5 ft	7 ft	7 ft	5 ft	5 ft	5 ft	5 ft	10 ft	10 ft	10 ft	10 ft
Depth to Screen	4 ft	4.5 ft	4.5 ft	4 ft	4 ft	4 ft	4 ft	5.2 ft	5.2 ft	5.2 ft	5.2 ft
Depth to Aquitard	12 ft	12 ft	12 ft	8 ft	8 ft	7.3 ft	7.3 ft	9 ft	9 ft	4.4 ft	4.4 ft
Depth to Water	7.25 ft	10.81 ft	10.81 ft	6.36 ft	6.36 ft	3.75 ft	3.75 ft	11.05 ft	11.05 ft	10.93 ft	10.93 ft
Depth to Sandpack	4 ft	2.5 ft	2.5 ft	3 ft	3 ft	3 ft	3 ft	3.2 ft	3.2 ft	3.7 ft	3.7 ft
D	4.75 ft	1.19 ft	1.19 ft	1.64 ft	1.64 ft	3.55 ft	3.55 ft	-2.05 ft	-2.05 ft	-6.53 ft	-6.53 ft
n	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
r_c	0.083 ft	0.083 ft	0.083 ft	0.083 ft	0.083 ft	0.083 ft	0.083 ft	0.083 ft	0.083 ft	0.083 ft	0.083 ft
r_w	0.333 ft	0.333 ft	0.333 ft	0.333 ft	0.333 ft	0.333 ft	0.333 ft	0.333 ft	0.333 ft	0.333 ft	0.333 ft
r_eq	0.182 ft	0.182 ft	0.182 ft	0.182 ft	0.182 ft	0.182 ft	0.182 ft	0.182 ft	0.182 ft	0.182 ft	0.182 ft
L_e	1.75 ft	0.69 ft	0.69 ft	2.64 ft	2.64 ft	5 ft	5 ft	4.15 ft	4.15 ft	4.27 ft	4.27 ft
L_w	1.75 ft	0.69 ft	0.69 ft	2.64 ft	2.64 ft	5.25 ft	5.25 ft	4.15 ft	4.15 ft	4.27 ft	4.27 ft
y1	0.01 ft	0.01 ft	0.01 ft	0.1 ft	0.1 ft	0.1 ft	0.1 ft	0.211 ft	0.39 ft	0.1 ft	0.1 ft
t1	14 sec	155 sec	150 sec	105 sec	95 sec	70 sec	65 sec	500 sec	350 sec	300 sec	275 sec
y2	0.001 ft	0.001 ft	0.001 ft	0.01 ft	0.01 ft	0.01 ft	0.01 ft	0.1 ft	0.1 ft	0.01 ft	0.01 ft
t2	39 sec	555 sec	485 sec	310 sec	270 sec	310 sec	273 sec	838 sec	1000 sec	1360 sec	1045 sec
L_e/r_w	5.25	2.07	2.07	7.92	7.92	15	15	12.45	12.45	12.81	12.81
A	1.7	1.5	1.5	1.7	1.7	2.0	2.0	1.9	1.9	1.9	1.9
B	0.3	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
C	1.0	0.9	0.9	1.1	1.1	1.4	1.4	1.3	1.3	1.3	1.3
Fully Penetrating Well											
ln(R_e/r_w)	1.171	0.517	0.517	1.490	1.490	2.037	2.037	1.855	1.855	1.878	1.878
K in cm/s	3.1E-02 cm/s	2.2E-03 cm/s	2.6E-03 cm/s	3.2E-03 cm/s	3.7E-03 cm/s	2.0E-03 cm/s	2.3E-03 cm/s	5.0E-04 cm/s	4.7E-04 cm/s	4.8E-04 cm/s	6.6E-04 cm/s
Soil Description	Poorly Graded Sand	Poorly Graded Sand	Poorly Graded Sand	Silty, Gravelly Sand	Silty, Gravelly Sand	Silty, Gravelly Sand	Silty, Gravelly Sand	Silt	Silt	Silt	Silt

Abbreviations

A, B, C = dimensionless parameters
cm/s = centimeters per second
D = saturated thickness of shallow aquifer (feet)
ft = feet
K = hydraulic conductivity in centimeters per second (cm/s)
L_e = length of the screen (feet)
L_w = length of the well in the aquifer (feet)
n = porosity (unitless)
r_c = radius of well casing (feet)
R_e = effective radial distance over which head is dissipated (feet)
r_eq = equivalent radius (feet)
r_w = radius of well boring (feet)
t1 = time at which y1 was measured (seconds)
t2 = time at which y2 was measured (seconds)
y1 = water level change between t = 0 and the first measurement recorded at t1 (feet)
y2 = water level change (drawdown) at t2 (feet)

TABLE 7-4

CALCULATED GROUNDWATER DISCHARGE VOLUME AND VELOCITY IN SAND FILL

PSC Washougal Facility
Washougal, Washington

	MC-21		**MC-20**		**Groundwater Flow (Q)** $Q = Kbw \frac{(h_0^2 - h_L^2)}{2Lh(x)}$ **(cubic feet/day)**	**Groundwater Velocity** $\frac{Q}{bw} * \frac{1}{n_e}$ **(feet/day)**
Date	**Groundwater Elevation**[1] **[h_o] (feet)**	**Saturated Thickness [b] (feet)**	**Groundwater Elevation**[1] **[h_L] (feet)**	**Saturated Thickness [b] (feet)**		
12/10/01	12.22	2.93	10.06	2.01	170.6	0.46
03/04/02	12.00	2.71	10.16	2.11	139.7	0.39
06/03/02	11.50	2.21	10.23	2.18	85.5	0.26
12/02/02	10.47	1.18	8.87	0.82	50.4	0.34
03/10/03	12.80	3.51	10.67	2.62	207.4	0.45
06/09/03	11.42	2.13	9.62	1.57	105.2	0.38
12/01/03	11.50	2.21	9.72	1.67	108.9	0.37
03/22/04	11.94	2.65	10.26	2.21	127.5	0.35
06/14/04	11.46	2.17	9.90	1.85	97.7	0.32
09/13/04	10.69	1.40	7.65	-0.40	94.7	1.26
12/13/04	11.94	2.65	10.02	1.97	140.4	0.41
03/14/05	10.96	1.67	9.32	1.27	75.7	0.34
06/06/05	11.79	2.50	10.17	2.12	116.7	0.34
11/28/05	11.69	2.40	9.71	1.66	127.9	0.42
03/06/06	12.38	3.09	10.38	2.33	171.6	0.42
06/05/06	11.91	2.62	10.09	2.04	133.5	0.38
12/18/06	13.05	3.76	10.32	2.27	269.1	0.60
03/05/07	13.11	3.82	10.83	2.78	240.2	0.49
06/04/07	11.83	2.54	10.49	2.44	102.5	0.27
10/22/07	11.20	1.91	9.59	1.54	86.9	0.34
12/16/2007	10.88	1.59	10.03	1.98	45.7	0.17
3/9/2008	12.14	2.85	10.61	2.56	128.1	0.32
6/8/2008	11.87	2.58	10.52	2.47	104.8	0.28
9/21/2008	10.48	1.19	8.01	-0.04	50.6	0.59
11/30/2008	11.33	2.04	9.72	1.67	93.4	0.34
3/22/2009	12.07	2.78	10.00	1.95	156.0	0.44
Min	10.47	1.18	7.65	-0.40	45.7	0.26
Max	13.11	3.82	10.83	2.78	269.1	1.26
Average	11.72	2.43	9.88	1.83	124.3	0.43

Silt Elevation [1] (feet)	9.29	8.05

K	6.7	feet/day
w	500	feet
L	116	feet
n_e	0.30	--

Notes

1. Elevations are relative to National Geodetic Vertical Datum 29/47.

Abbreviations

h (x) = hydraulic head as a function of x,
where x is the distance from the origin (feet).

h_L = head at L (feet)

h_o = head at origin (feet)

K = hydraulic conductivity

L = distance between locations of h_o and h_L

n_e = effective porosity

w = aquifer width

TABLE 7-5

SLUG TEST RESULTS FOR LOWER AQUIFER

PSC Washougal Facility
Washougal, Washington

Slug Test Parameter	Well ID									
	MC-2D Falling Head	**MC-2D Rising Head**	**MC-10D Falling Head**	**MC-10D Rising Head**	**MC-14D Falling Head**	**MC-14D Rising Head**	**MC-15D Falling Head**	**MC-15D Rising Head**	**MC-17D Falling Head**	**MC-17D Rising Head**
Well Depth	32.75 ft	32.75 ft	38.18 ft	38.18 ft	32 ft	32 ft	26 ft	26 ft	32 ft	32 ft
Screen Length	5 ft	5 ft	10 ft	10 ft	10 ft	10 ft	4.5 ft	4.5 ft	10 ft	10 ft
Depth to Screen	28 ft	28 ft	25 ft	25 ft	22 ft	22 ft	21.5 ft	21.5 ft	22 ft	22 ft
Depth to Water	7.21 ft	7.21 ft	12.24 ft	12.24 ft	9.26 ft	9.26 ft	8.67 ft	8.67 ft	8.67 ft	8.67 ft
Radius of Casing	0.083 ft	0.083 ft	0.083 ft	0.083 ft	0.083 ft	0.083 ft	0.083 ft	0.083 ft	0.083 ft	0.083 ft
Radius of Boring	0.417 ft	0.417 ft	0.417 ft	0.417 ft	0.417 ft	0.417 ft	0.417 ft	0.417 ft	0.417 ft	0.417 ft
y1	1 ft	1 ft	1 ft	1 ft	1 ft	0.98 ft	230 ft	230 ft	50 ft	55 ft
t1	90 sec	100 sec	20 sec	50 sec	0 sec	0 sec	0.1 sec	0.1 sec	0.1 sec	0.1 sec
y2	0.1 ft	0.1 ft	0.1 ft	0.1 ft	0.1 ft	0.1 ft	505 ft	500 ft	90 ft	105 ft
t2	300 sec	320 sec	400 sec	300 sec	645 sec	700 sec	0.01 sec	0.01 sec	0.01 sec	0.01 sec
K in ft/s	3.1E-05 ft/s	3.0E-05 ft/s	1.0E-05 ft/s	1.5E-05 ft/s	5.9E-06 ft/s	5.4E-06 ft/s	2.6E-05 ft/s	2.6E-05 ft/s	9.6E-05 ft/s	7.7E-05 ft/s
K in cm/s	9.5E-04 cm/s	9.1E-04 cm/s	3.1E-04 cm/s	4.7E-04 cm/s	1.8E-04 cm/s	1.7E-04 cm/s	7.9E-04 cm/s	8.0E-04 cm/s	2.9E-03 cm/s	2.3E-03 cm/s
Soil Description	Silty Sand	Silty Sand	Silty Gravel	Silty Gravel	Well Graded Sand with Silt and Gravel	Well Graded Sand with Silt and Gravel	Sandy Gravel	Sandy Gravel	Clay / Clayey Sand	Clay / Clayey Sand

Slug Test Parameter	Well ID							
	MC-20D Falling Head	**MC-20D Rising Head**	**MC-24D Falling Head**	**MC-24D Rising Head**	**MC-25D Falling Head**	**MC-25D Rising Head**	**MC-118D Falling Head**	**MC-118D Falling Head**
Well Depth	35.5 ft	35.5 ft	32 ft	32 ft	32.5 ft	32.5 ft	22.5 ft	22.5 ft
Screen Length	10 ft	10 ft	10 ft	10 ft	10 ft	10 ft	7 ft	7 ft
Depth to Screen	25.5 ft	25.5 ft	22 ft	22 ft	22.5 ft	22.5 ft	15.5 ft	15.5 ft
Depth to Water	10.14 ft	10.14 ft	8.93 ft	8.93 ft	6.38 ft	6.38 ft	6.89 ft	6.89 ft
Radius of Casing	0.083 ft	0.083 ft	0.083 ft	0.083 ft	0.083 ft	0.083 ft	0.083 ft	0.083 ft
Radius of Boring	0.417 ft	0.417 ft	0.417 ft	0.417 ft	0.417 ft	0.417 ft	0.417 ft	0.417 ft
y1	1 ft	1 ft	2.068 ft	2.875 ft	1 ft	1 ft	1 ft	1 ft
t1	25 sec	30 sec	0 sec	0 sec	10 sec	15 sec	175 sec	170 sec
y2	0.1 ft	0.1 ft	0.1 ft	0.1 ft	0.1 ft	0.1 ft	0.1 ft	0.1 ft
t2	425 sec	358 sec	100 sec	92 sec	210 sec	165 sec	625 sec	625 sec
K in ft/s	9.6E-06 ft/s	1.2E-05 ft/s	5.0E-05 ft/s	6.1E-05 ft/s	1.9E-05 ft/s	2.6E-05 ft/s	1.1E-05 ft/s	1.1E-05 ft/s
K in cm/s	2.9E-04 cm/s	3.6E-04 cm/s	1.5E-03 cm/s	1.8E-03 cm/s	5.8E-04 cm/s	7.8E-04 cm/s	3.4E-04 cm/s	3.4E-04 cm/s
Soil Description	Silty Sand with Gravel	Silty Sand with Gravel	Silty Gravel with Sand	Silty Gravel with Sand	Poorly Graded Gravel with Silt and Sand	Poorly Graded Gravel with Silt and Sand	Clayey Gravel	Clayey Gravel

Abbreviations

cm/s = centimeters per second
ft = feet
ft/s = feet per second
K = hydraulic conductivity in feet per second (ft/s) or centimeters per second (cm/s)

t1 = time at which y1 was measured (seconds)
t2 = time at which y2 was measured (seconds)
y1 = water level change between t = 0 and the first measurement recorded at t1 (feet)
y2 = water level change (drawdown) at t2 (feet)

TABLE 7-6

CALCULATED GROUNDWATER DISCHARGE VOLUME AND VELOCITY IN LOWER AQUIFER[1]

PSC Washougal Facility
Washougal, Washington

Hydraulic Gradient Direction - North

Date	MC-19D	MC-14D	Groundwater Flow (Q) $Q = Kbw\frac{dh}{dl}$ (cubic feet/day)	Groundwater Velocity $\frac{Q}{bw} * \frac{1}{n_e}$ (feet/day)
	Groundwater Elevation^2 [h_1] (feet)	Groundwater Elevation^2 [h_2] (feet)		
6/8/2008	17.36	13.99	77	0.05
9/21/2008	--	--	--	--
11/30/2008	--	--	--	--
3/22/2009	--	--	--	--
6/22/2009	13.10	12.00	25.1	0.02
Min			25.1	0.02
Max			77	0.05
Average			51	0.03

Hydraulic Gradient Direction - South

Date	MC-118D2	MC-19D	Groundwater Flow (Q) $Q = Kbw\frac{dh}{dl}$ (cubic feet/day)	Groundwater Velocity $\frac{Q}{bw} * \frac{1}{n_e}$ (feet/day)
	Groundwater Elevation^2 [h_1] (feet)	Groundwater Elevation^2 [h_2] (feet)		
6/8/2008	--	--	--	--
9/21/2008	9.33	7.35	43	0.03
11/30/2008	11.04	9.36	37	0.02
3/22/2009	11.60	9.98	35	0.02
6/22/2009	--	--	--	--
Min			35	0.02
Max			43	0.03
Average			38	0.03

Parameters

K	1.8	feet/day
w	500.00	feet
b	10.00	feet
dl - North	394.00	feet
dl - South	413.00	feet
n_e	0.30	--

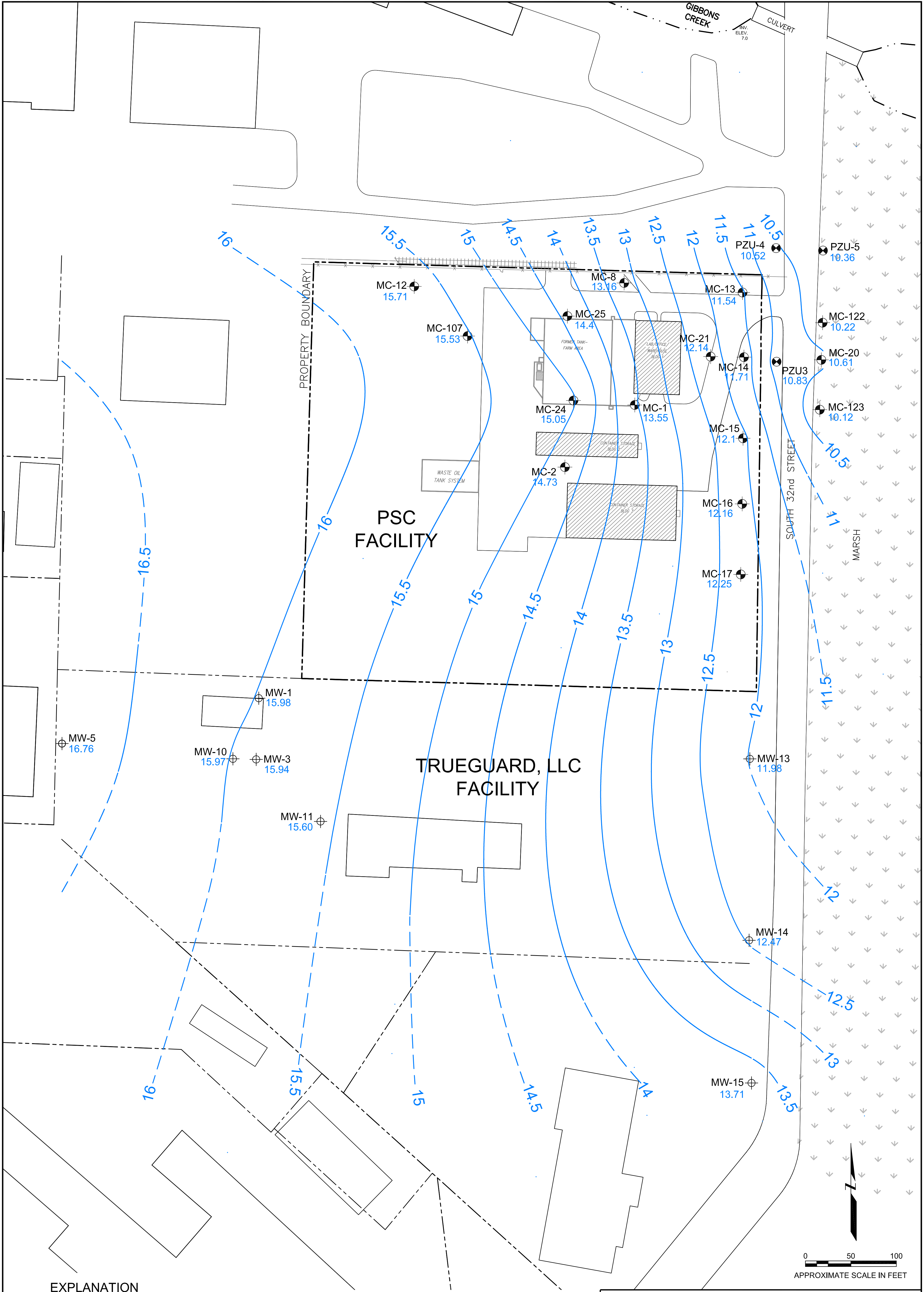
<u>Notes</u>

1. -- indicates flow was not in the specified direction for the given quarter.
2. Elevations are relative to National Geodetic Vertical Datum 29/47.

<u>Abbreviations</u>

b = aquifer saturated thickness
dh = head diferential (feet)
dl = distance between well points (feet)
K = hydraulic conductivity
n_e = effective porosity
w = aquifer width

FIGURES



EXPLANATION

MC-15 ⊕	Shallow Groundwater Zone Monitoring Well
PZU-3 ⊗	Piezometer
MW-15 ⊕	TrueGuard, LLC Monitoring Well
15 ~	Groundwater Elevation Contour (feet above MSL)

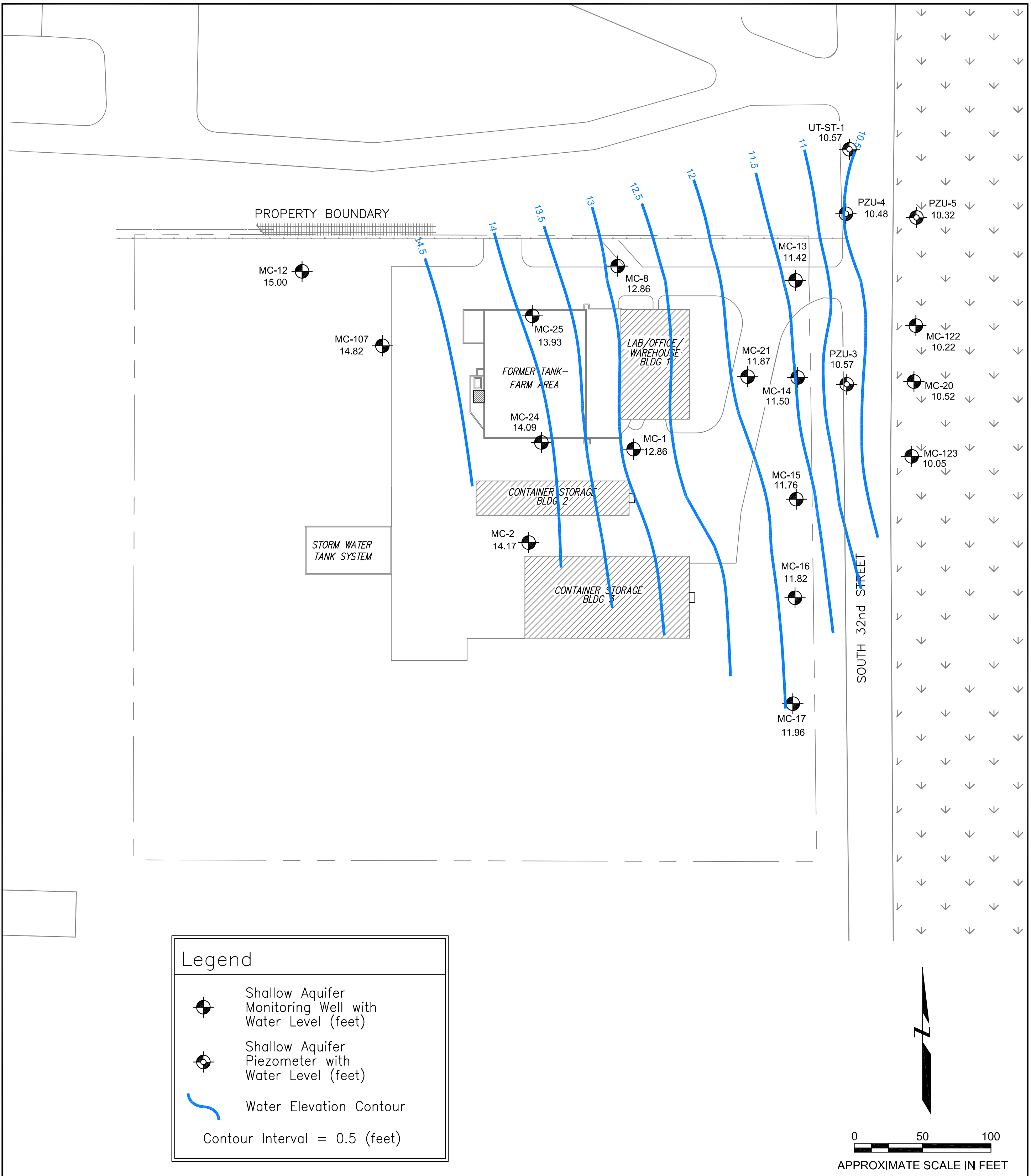
NOTE:

Groundwater elevations for PSC Washougal Facility collected on March 9, 2008.

Groundwater elevations for TrueGuard, LLC Facility collected on February 28, 2008. (Maul, Foster, Alongi, 2009)

AREA-WIDE GROUNDWATER ELEVATION
SHALLOW GROUNDWATER ZONE
PSC Washougal Facility
Washougal, Washington

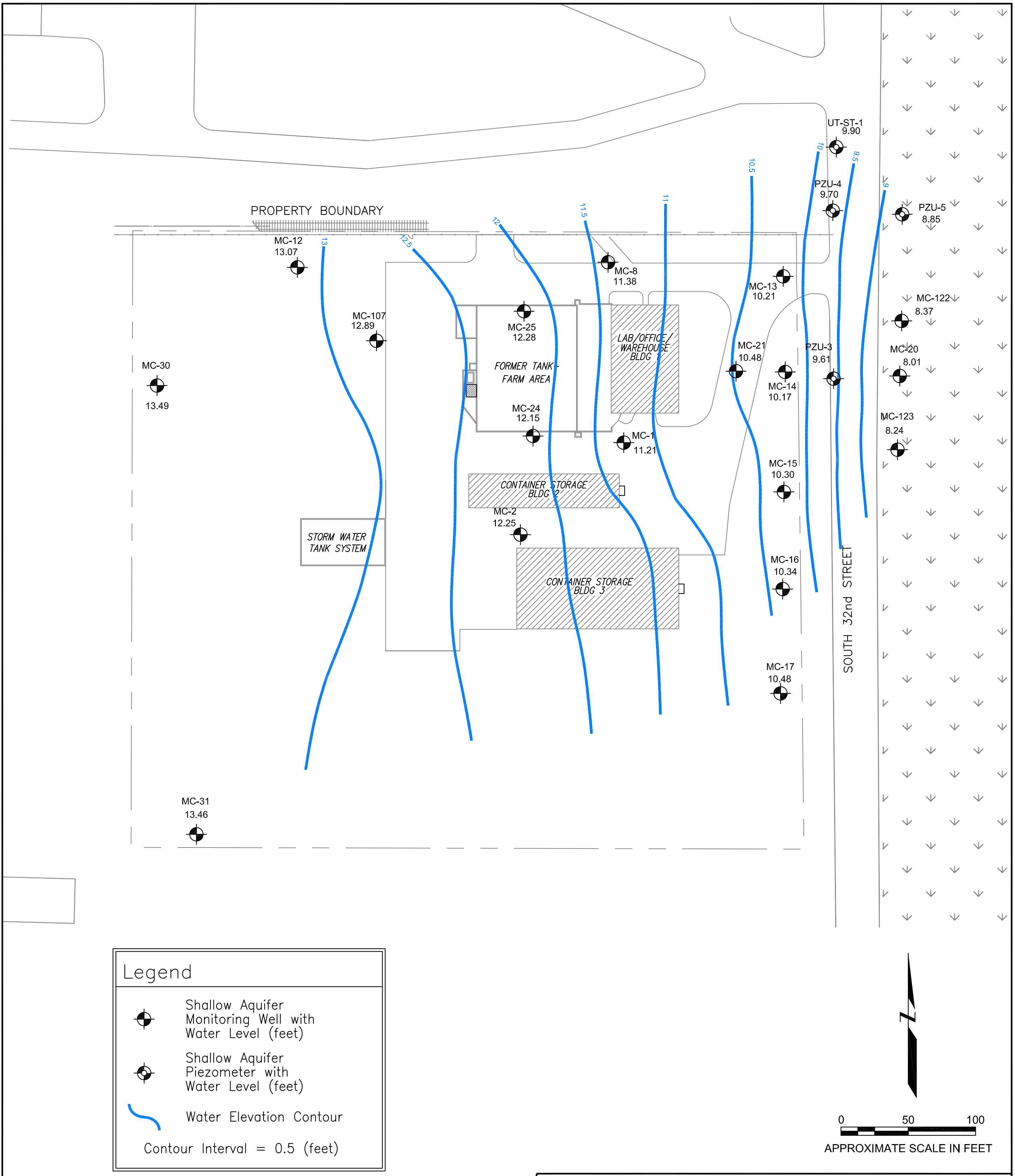
By: APS	Date: 01/15/10	Project No. 09625
AMEC Geomatrix		Figure 7-1



GROUNDWATER ELEVATIONS
SHALLOW GROUNDWATER ZONE
JUNE 8, 2008
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/23/09	Project No. 9625
AMEC Geomatrix		Figure **7-2**

Plot Date: 12/23/09 - 1:15pm, Plotted by: adam.stenberg
Drawing Path: S:\9625\008_RIFS-2009\CAD\PSC-GW\, Drawing Name: 2Q08sh.dwg



GROUNDWATER ELEVATIONS
SHALLOW GROUNDWATER ZONE
SEPTEMBER 21, 2008
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/23/09	Project No. 9625
AMEC Geomatrix		Figure 7-3

Plot Date: 12/23/09 - 1:16pm, Plotted by: adam.stenberg
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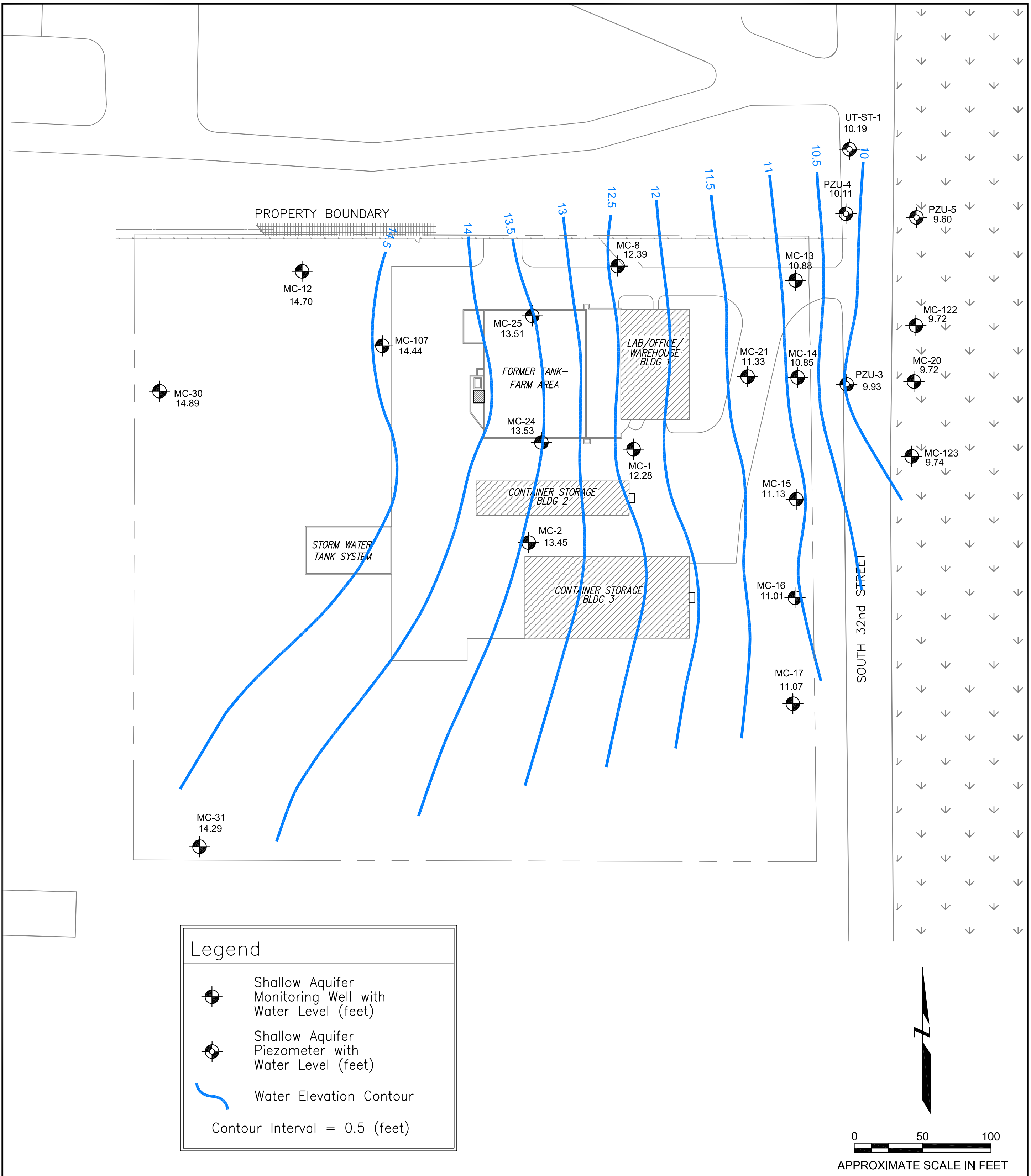

GROUNDWATER ELEVATIONS
SHALLOW GROUNDWATER ZONE
NOVEMBER 30, 2008
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/23/09	Project No. 9625
AMEC Geomatrix		Figure **7-4**

Plot Date: 12/23/09 - 1:17pm, Plotted by: adam.stenberg
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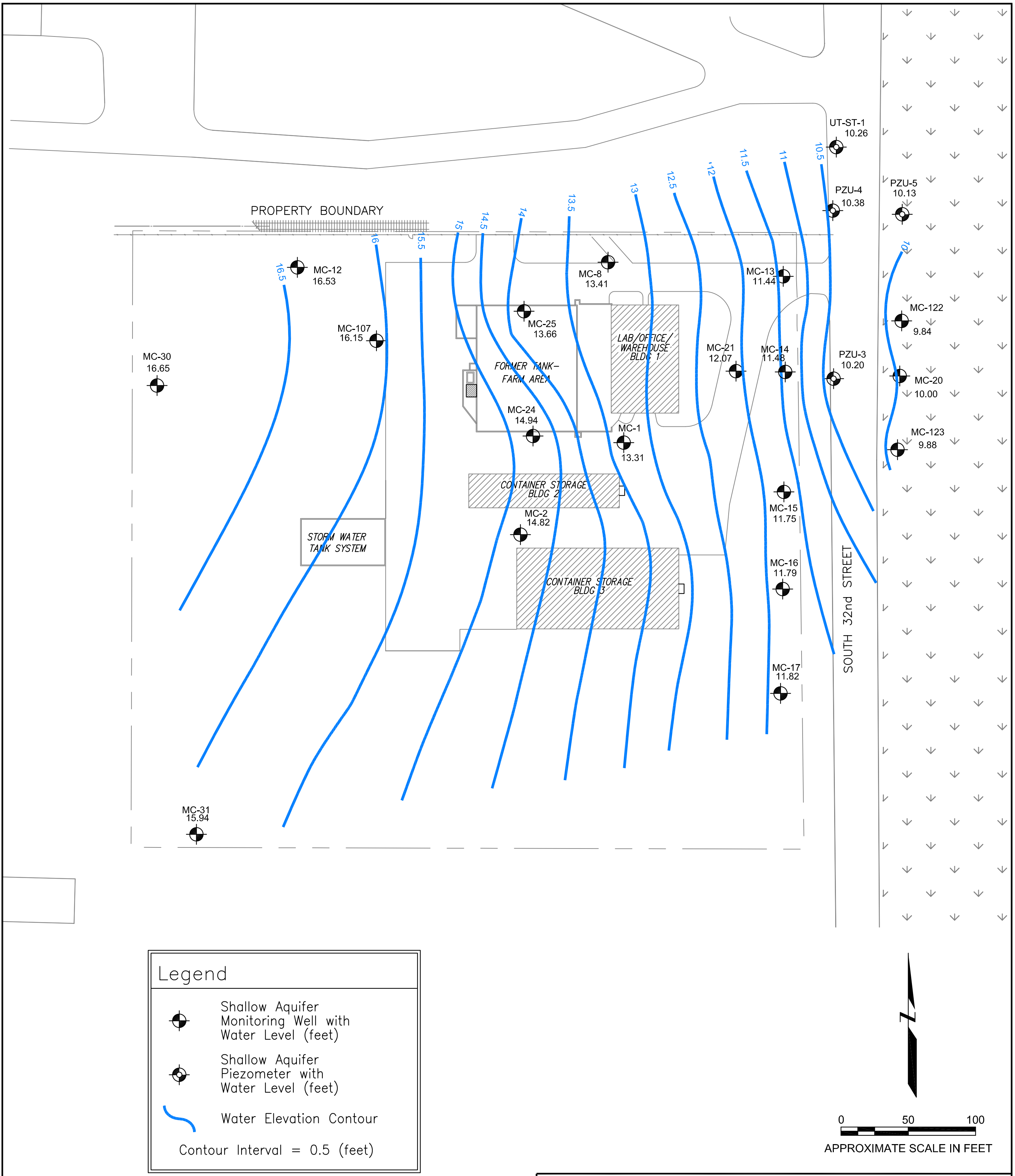

GROUNDWATER ELEVATIONS
SHALLOW GROUNDWATER ZONE
MARCH 22, 2009
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/23/09	Project No. 9625
AMEC Geomatrix		Figure 7-5

Plot Date: 12/23/09 - 1:18pm, Plotted by: adam.stenberg
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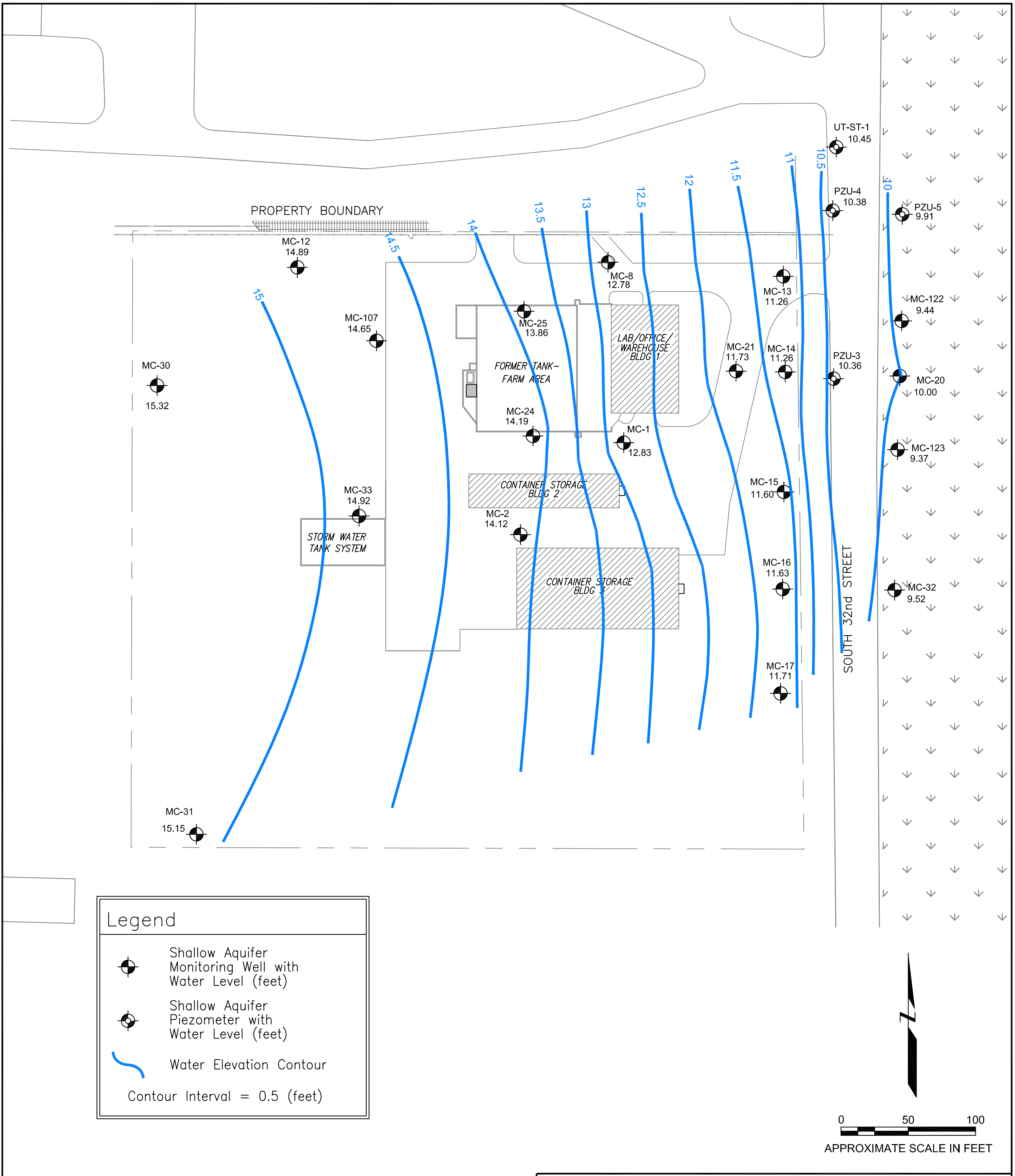

GROUNDWATER ELEVATIONS
SHALLOW GROUNDWATER ZONE
JUNE 22, 2009
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 01/15/10	Project No. 9625
AMEC Geomatrix		Figure 7-6

Plot Date: 01/15/10 - 10:42am, Plotted by: adam.stenberg
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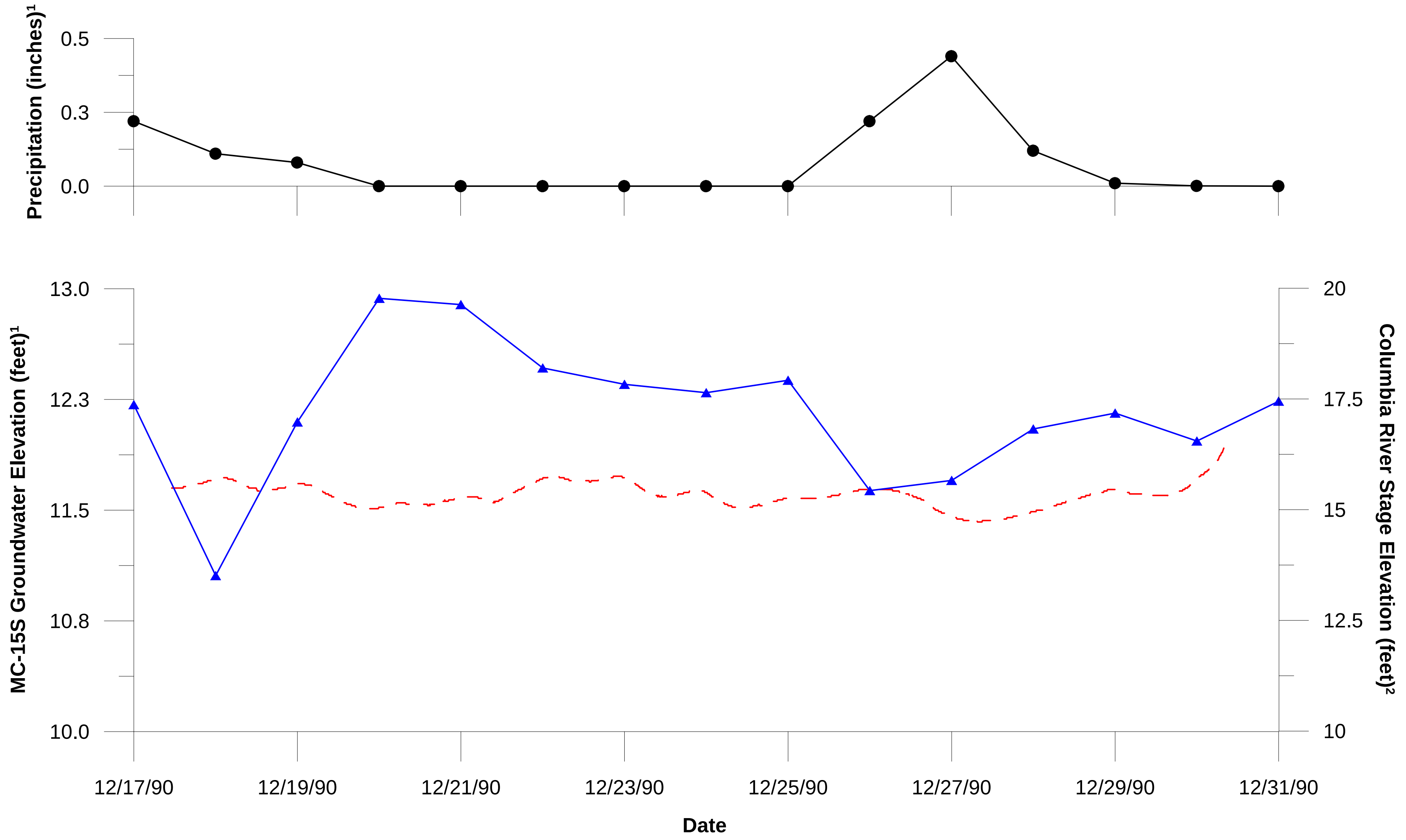
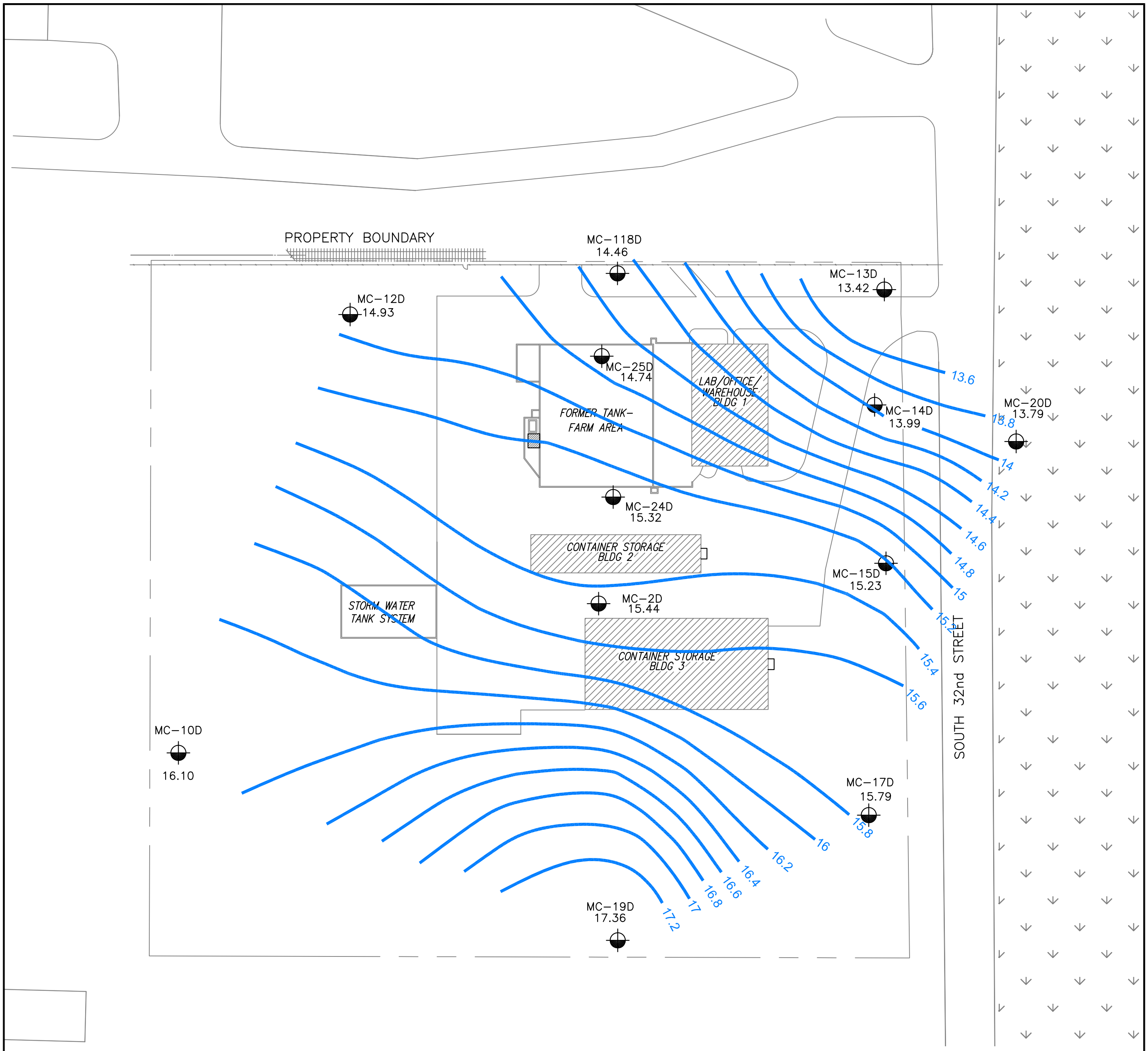


Notes: 1. Troutdale, Oregon Station (NCDC COOP ID 358634);
Data from Western Regional Climate Center
(available Nov. 2009
http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwDI~StnSrch~StnID~20016537)
2. USGS Stream Gage 14128870 Columbia River Below Bonneville Dam, OR.
Daily mean Columbia River stage elevation available from
http://waterdata.usgs.gov/nwis as of November 2009

AMEC Geomatrix	**SHALLOW GROUNDWATER ELEVATION AND RIVER STAGE (DECEMBER 1990)** PSC Washougal Facility Washougal, Washington	Prepared By: RLW	Project No. 9625
		11/4/2009	Figure No. 7-7

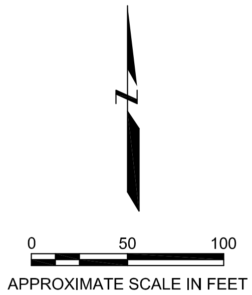


Legend

⊕ Deep Aquifer Monitoring Well with Water Level (feet)

Water Elevation Contour

Contour Interval = 0.2 (feet)



GROUNDWATER ELEVATIONS
LOWER AQUIFER, JUNE 8, 2008
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/23/09	Project No. 9625
AMEC Geomatrix		Figure 7-8

Plot Date: 12/23/09 - 1:22pm, Plotted by: adam.stenberg
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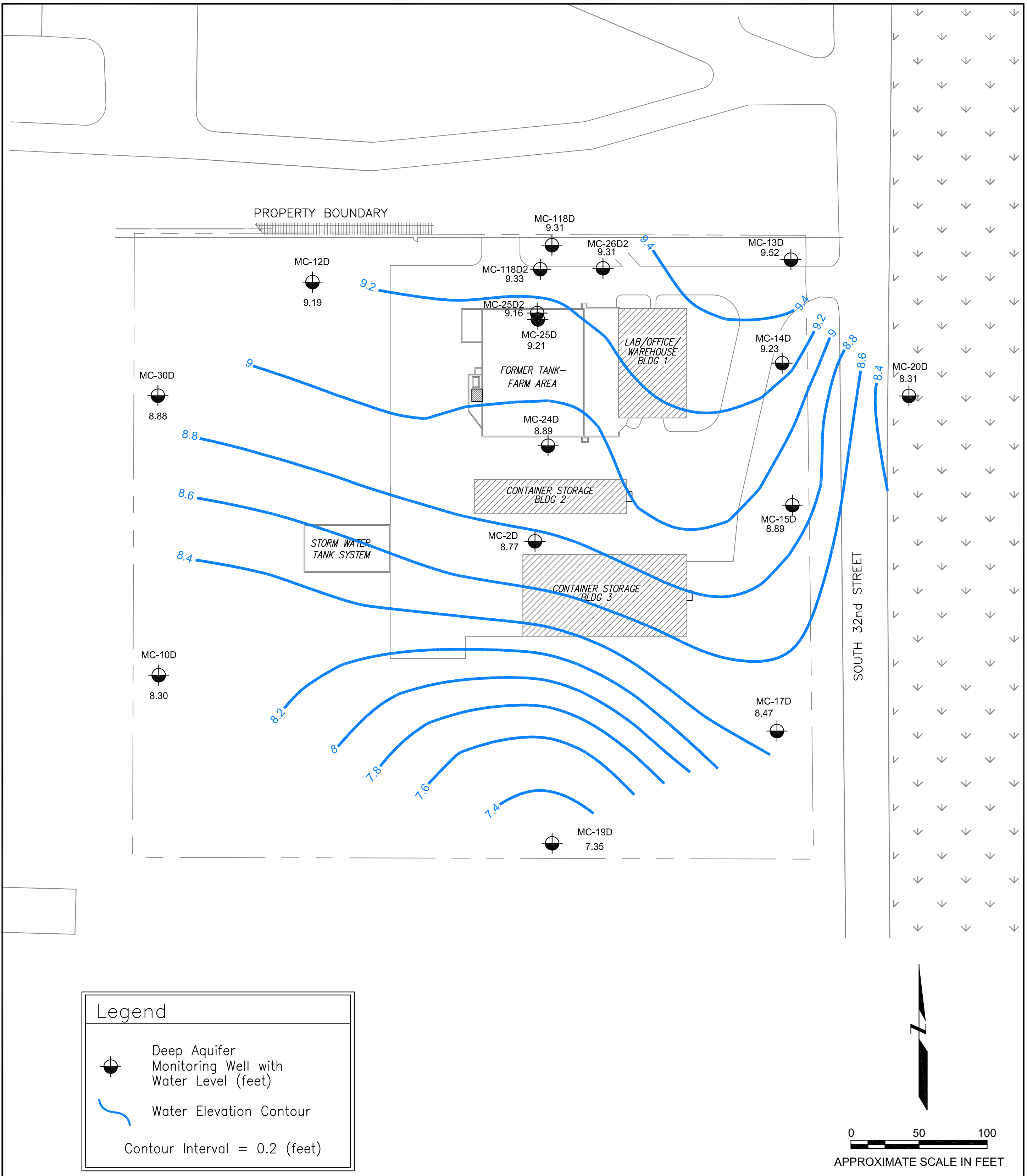

GROUNDWATER ELEVATIONS
LOWER AQUIFER, SEPTEMBER 21, 2008
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/23/09	Project No. 9625
AMEC Geomatrix		Figure **7-9**

Plot Date: 12/23/09 - 1:28pm, Plotted by: adam.stenberg
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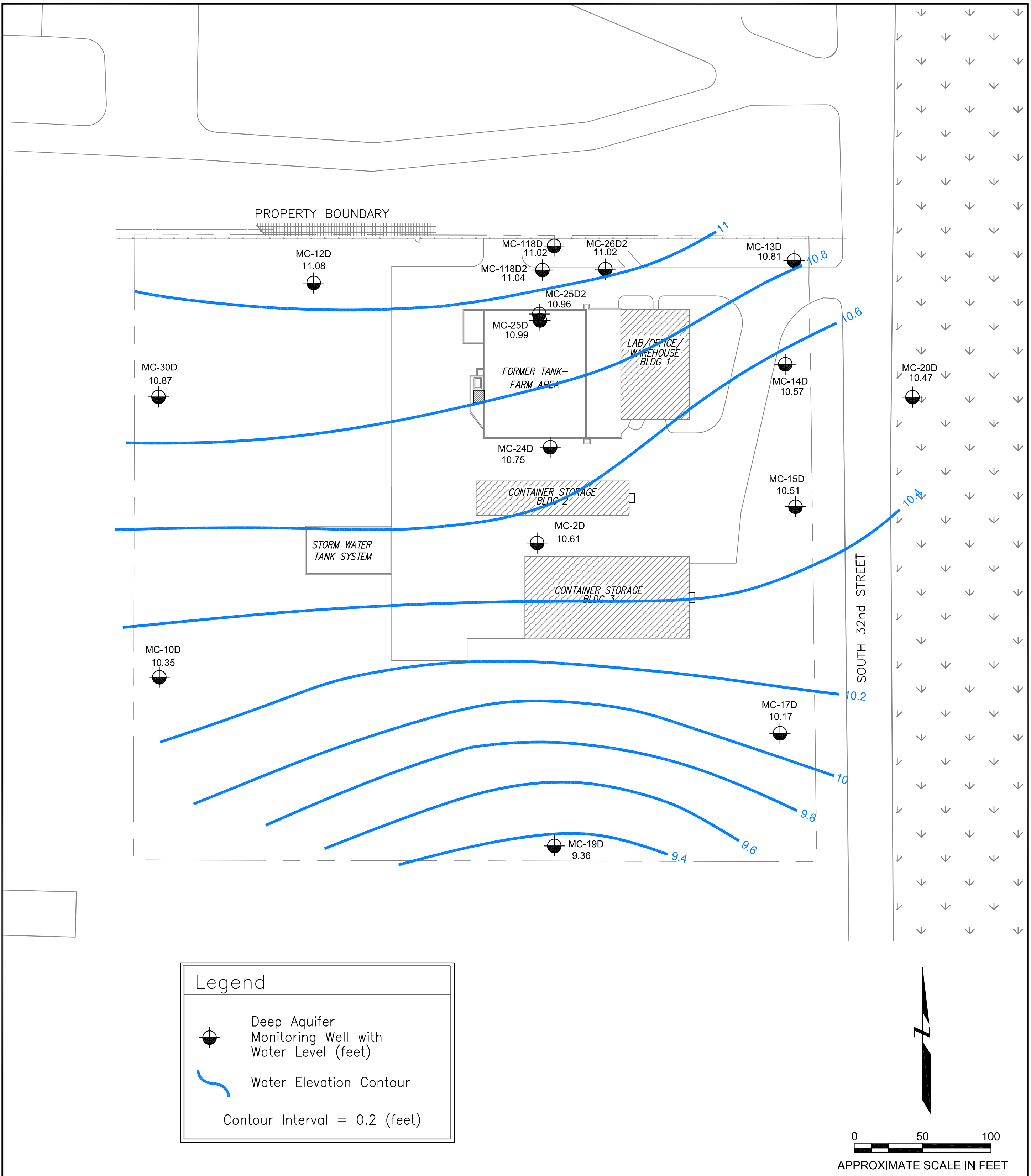

Legend

⊕	Deep Aquifer Monitoring Well with Water Level (feet)
~	Water Elevation Contour

Contour Interval = 0.2 (feet)

GROUNDWATER ELEVATIONS
LOWER AQUIFER, NOVEMBER 30, 2008
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/23/09	Project No. 9625
AMEC Geomatrix		Figure 7-10

Plot Date: 12/23/09 - 1:29pm, Plotted by: adam.stenberg
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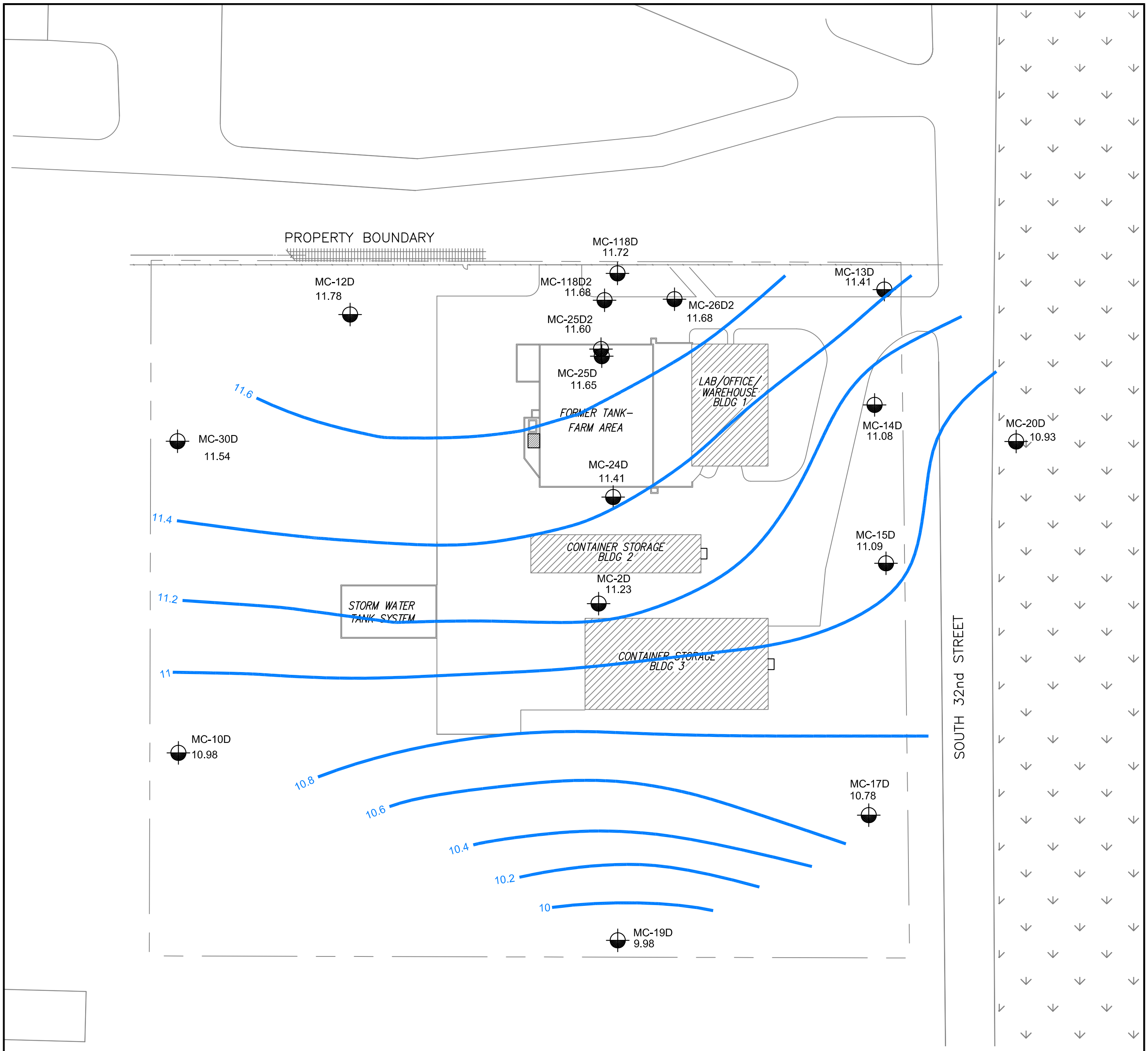
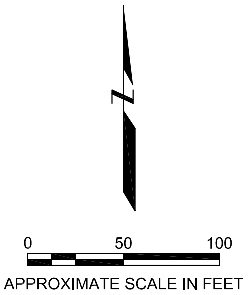


Legend

⌖ Deep Aquifer Monitoring Well with Water Level (feet)

Water Elevation Contour

Contour Interval = 0.2 (feet)



GROUNDWATER ELEVATIONS
LOWER AQUIFER, MARCH 22, 2009
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/23/09	Project No. 9625
AMEC Geomatrix		Figure 7-11

Plot Date: 12/23/09 - 1:29pm, Plotted by: adam.stenberg
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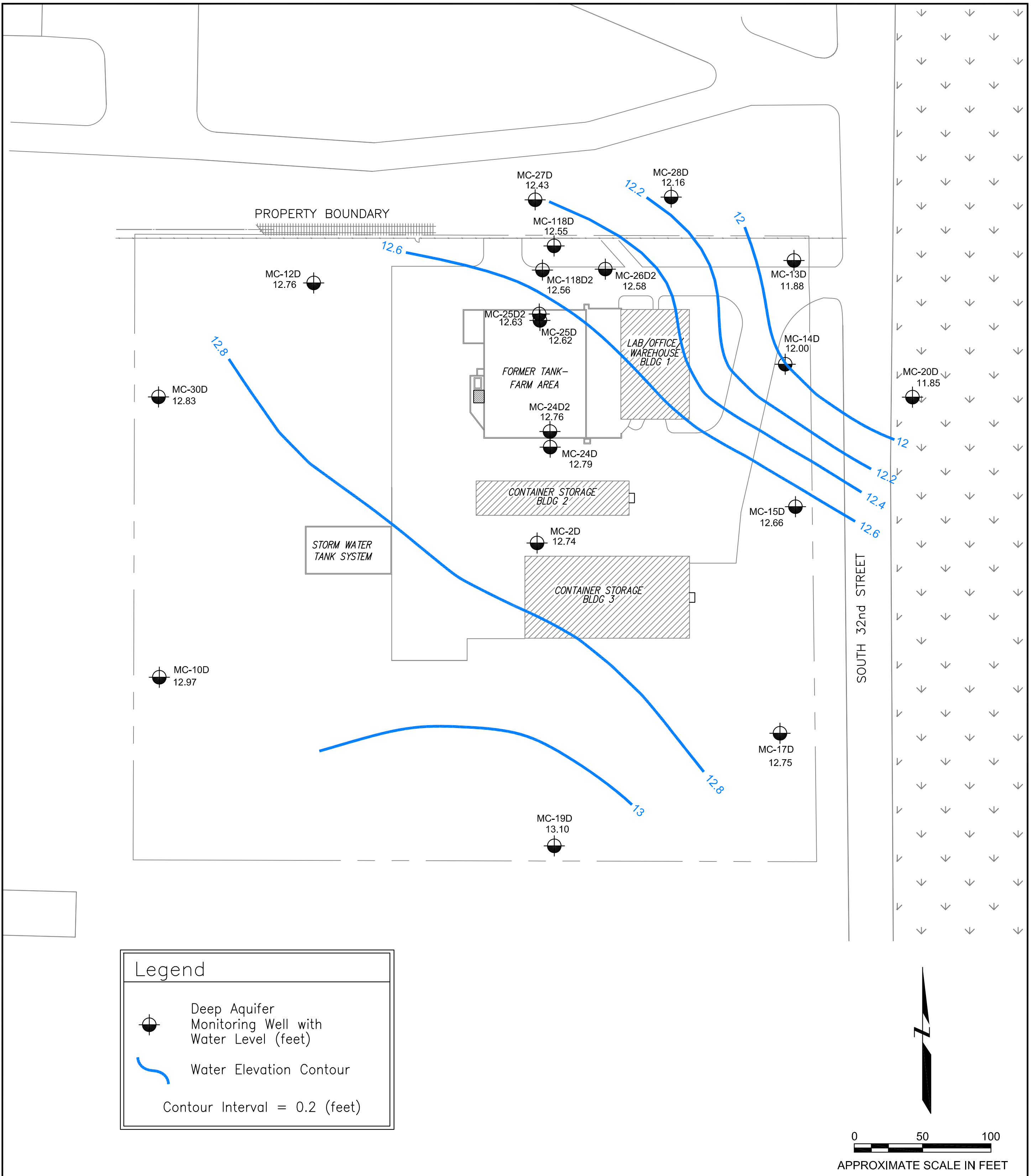

GROUNDWATER ELEVATIONS
LOWER AQUIFER, JUNE 22, 2009
PSC Washougal Facility
Washougal, Washington

By: APS

Date: 01/15/10

Project No. 9625

AMEC Geomatrix

Figure **7-12**

Plot Date: 01/15/10 - 10:48am, Plotted by: adam.stenberg
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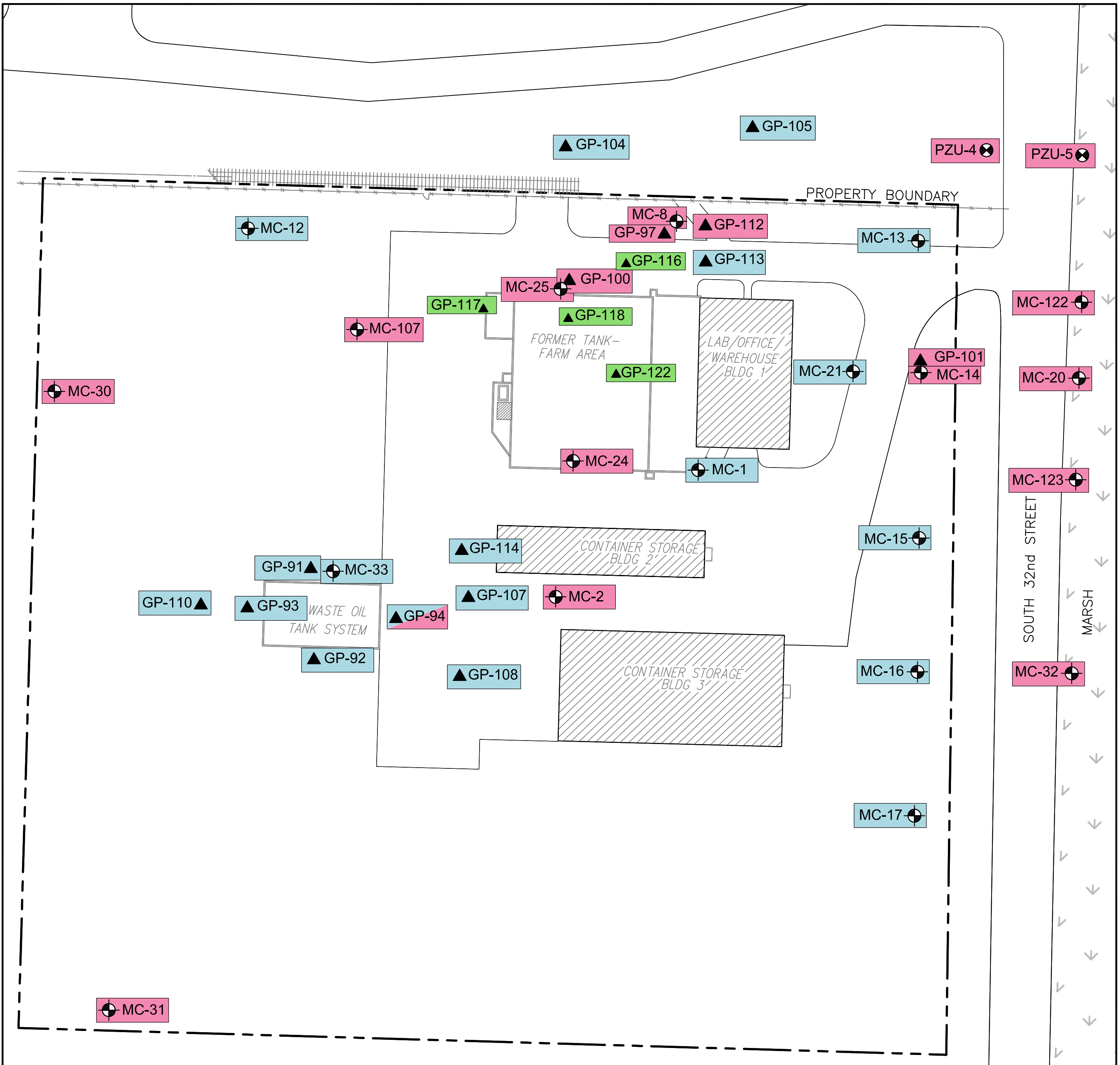


EXPLANATION

▲ Direct-Push Sample Location

⊕ Shallow Groundwater Zone Monitoring Well

⊗ Piezometer

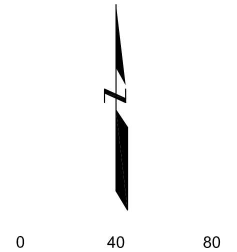
Key

🟩 Screened fully in Silt Layer

🟥 Screened partially in Silt Layer

🟦 Screened fully in Shallow Sand Fill

◪ Samples collected from both depth zones



APPROXIMATE SCALE IN FEET

SAMPLE INTERVAL DEPTH
SHALLOW GROUNDWATER SAMPLE LOCATIONS
(2004 - 2011)
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/07/12	Project No. 9625
amec		Figure 7-13

Plot Date: 12/07/12 - 2:56pm, Plotted by: adam.stenberg
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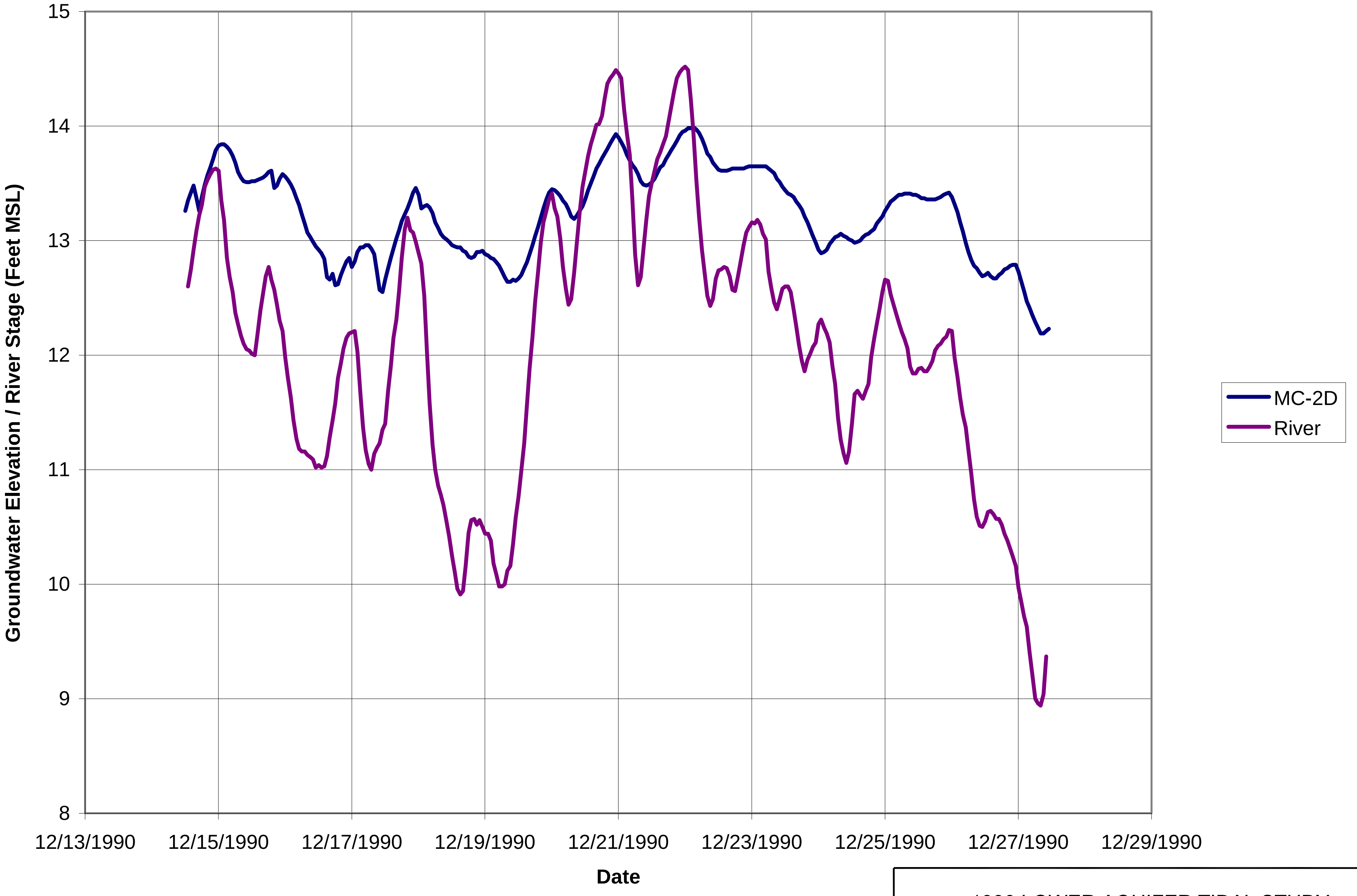

1990 LOWER AQUIFER TIDAL STUDY
AT WELL MC-2D
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 01/15/10	Project No. 9625
AMEC Geomatrix		Figure **7-14**

Plot Date: 01/15/10 - 9:36am, Plotted by: adam.stenberg
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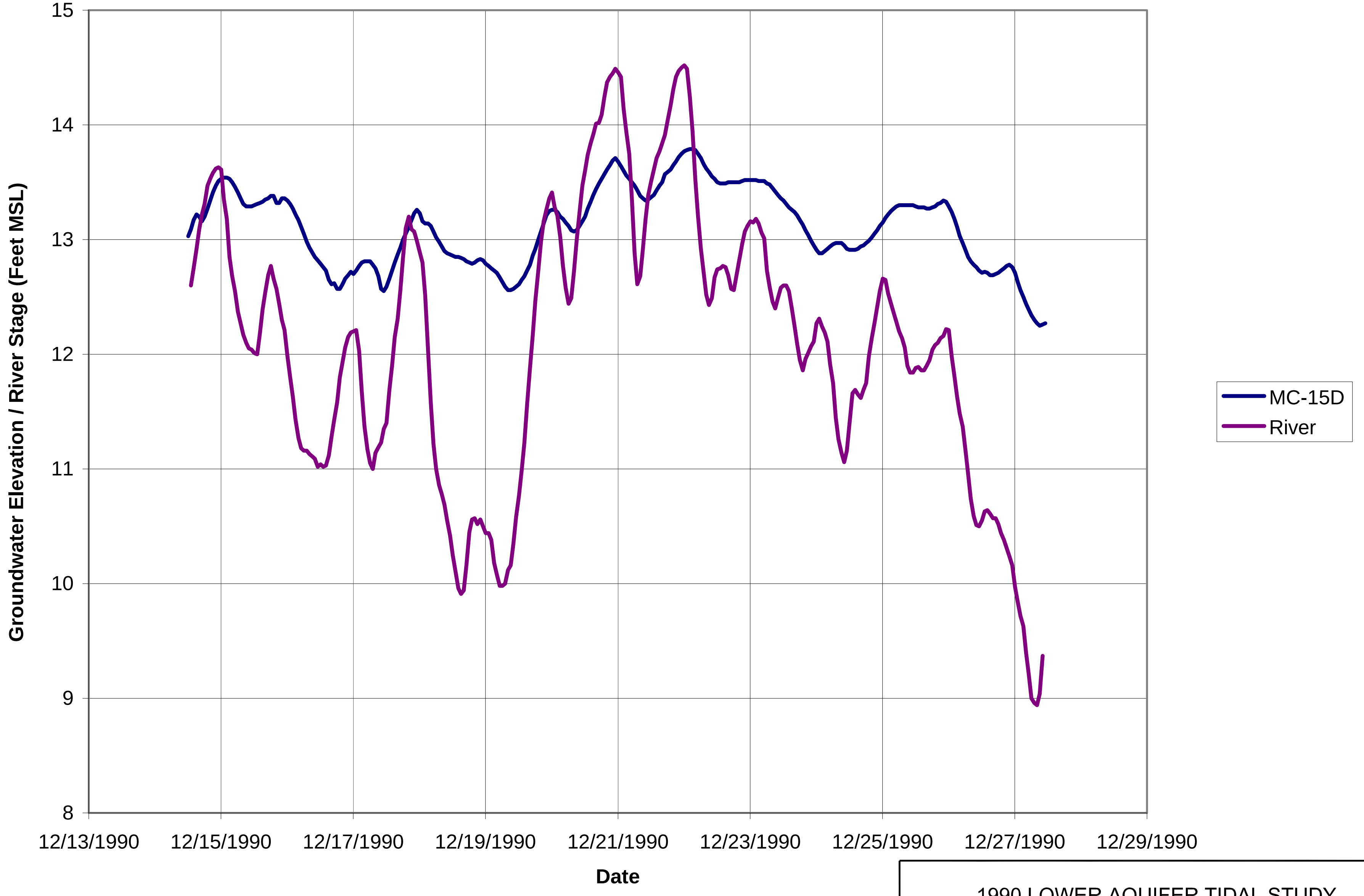
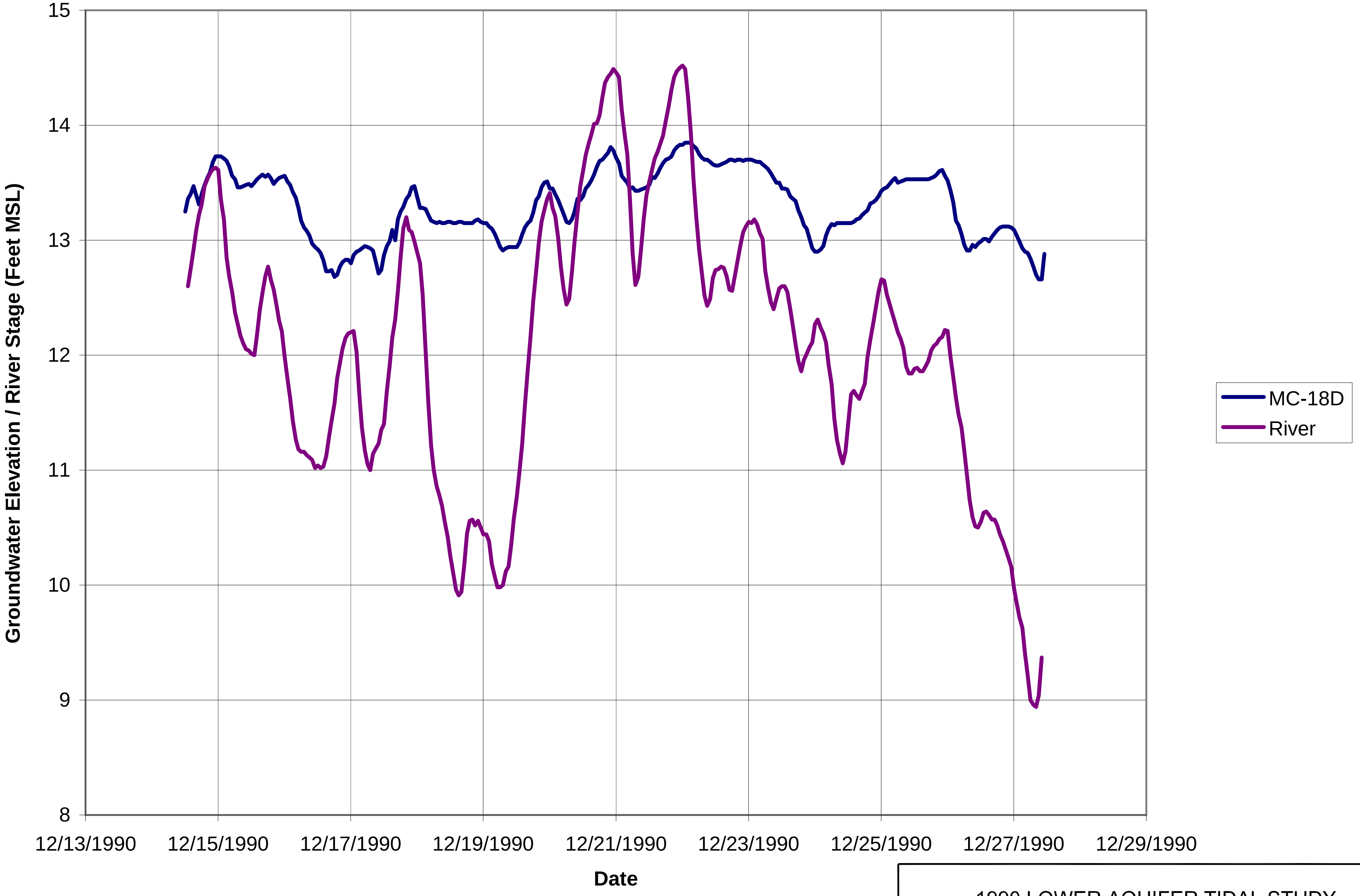


1990 LOWER AQUIFER TIDAL STUDY
AT WELL MC-15D
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 01/15/10	Project No. 9625
AMEC Geomatrix		Figure 7-15



1990 LOWER AQUIFER TIDAL STUDY
AT WELL MC-18D
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 01/15/10	Project No. 9625
AMEC Geomatrix		Figure 7-16

Plot Date: 01/15/10 - 9:37am, Plotted by: adam.stenberg
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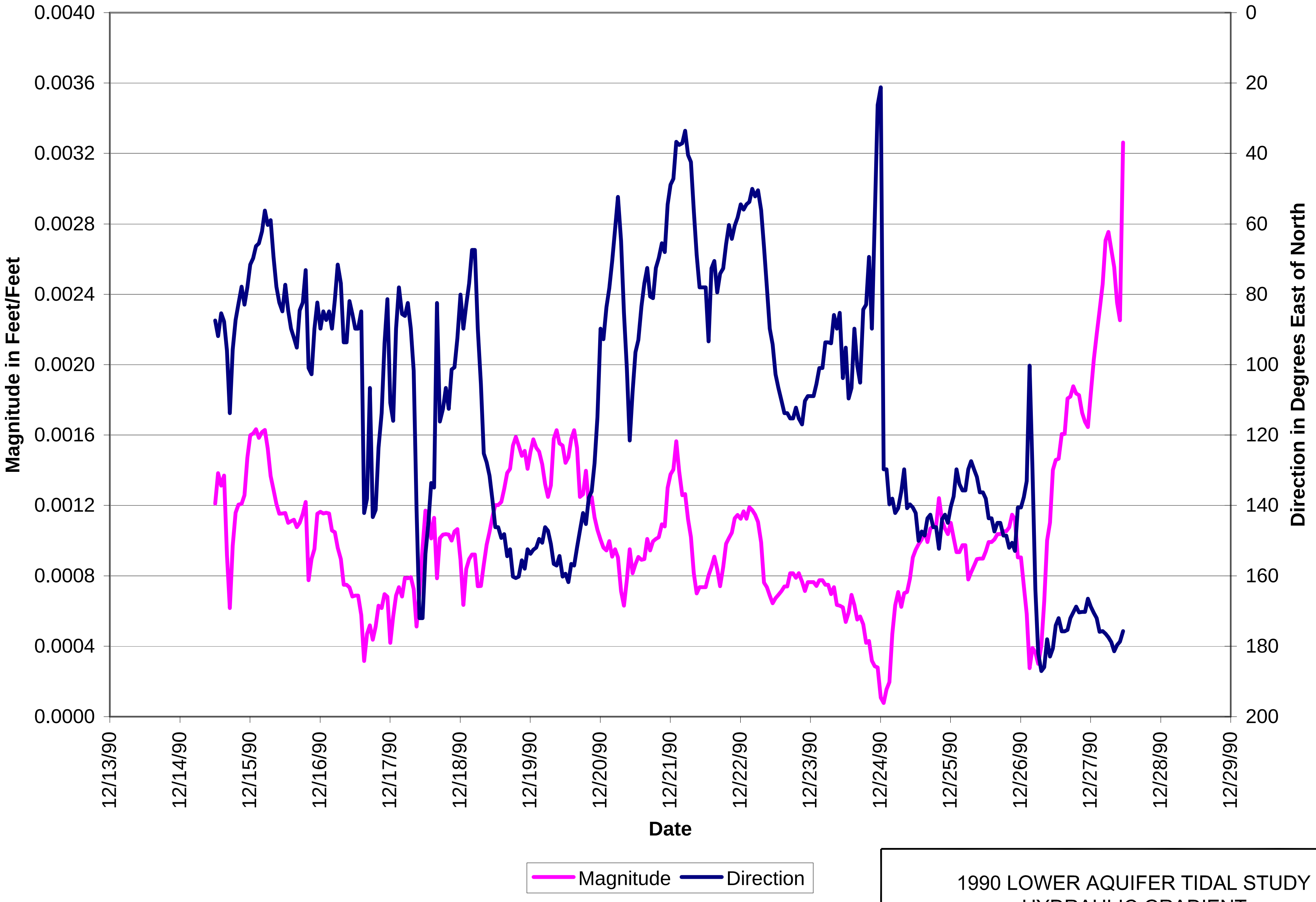

1990 LOWER AQUIFER TIDAL STUDY
HYDRAULIC GRADIENT
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/23/09	Project No. 9625
AMEC Geomatrix		Figure **7-17**

Plot Date: 12/23/09 - 1:40pm, Plotted by: adam.stenberg
Drawing Path: S:\9625\008_RIFS-2009\CAD\, Drawing Name: PSC Washougal-Chart-Figures_103009.dwg

8.0 CONCEPTUAL SITE MODEL

The conceptual site model (CSM) combines the hydrogeologic conceptual model with contaminant pathways and analysis of potential receptors. The CSM identifies human and environmental receptors based on land use and activities at and near the facility, and determines if a receptor has the potential to be exposed to contamination caused by site releases. If this potential exposure to contamination is present, either a potentially complete exposure pathway or a complete exposure pathway is considered to exist. A potentially complete pathway exists when exposure to contamination is considered possible but unlikely. A complete exposure pathway exists when an individual or population is exposed or has the potential to be exposed to hazardous substances at or originating from a site. Separate pathways are evaluated in the CSM for human health and ecological receptors that may have pathways linked to these releases. A block diagram visually depicting the CSM is presented in Figure 8-1. The block diagram illustrates the current understanding of the potential sources and releases of constituents, generalized hydrogeologic information, and constituent distribution and transport at the facility.

The CSM is based on assumed current and future industrial land use at the PSC property and its location within an industrial park. The PSC property is considered an industrial property in this RI based on definitions and criteria provided in WAC 173-340-200 and WAC-340-745(1); however, portions of the site that are east of the property, outside the industrial park, do not meet this definition since a national wildlife refuge exists in this area. Areas of the site outside the industrial park will be considered as part of the CSM and in development of cleanup levels that would apply in these areas.

Separately, based on WAC 173-340-200, the PSC property and areas within the industrial park portion of the site are defined as “industrial property,” meaning a property that has been characterized by, or is to be committed to, traditional industrial uses, and that is zoned for industrial use under land use planning under the Revised Code of Washington (RCW), Chapter 36.70A (Growth Management Act) or zoned for industrial use and adjacent to properties currently used or designated for industrial purposes. In addition, the following criteria established under WAC 173-340-745(1) for identification of an industrial property and to establish that industrial soil cleanup levels apply to the property and are expected to continue to apply to the property under the following future use conditions:

- The primary potential exposure is to adult employees of businesses located on the industrial property.
- Access to the industrial property by the general public is not allowed or is highly limited and controlled.
- Food is not grown on the property.

- Operations are characterized by use and storage of chemicals, noise, odors, and truck traffic.
- The land surface is primarily covered by buildings, structures, and paving, minimizing potential exposure to the soil. Part of the PSC property is paved with asphalt or concrete and part of the property is unimproved. The entire PSC property is fenced.
- Support facilities on the PSC property, such as offices, restaurants, and other facilities, are primarily intended to serve the industrial operations and not the general public.
- Institutional controls will be established at the site as part of the cleanup action in accordance with WAC 173-340-440 to limit potential exposure to residual hazardous substances. These institutional controls shall include, at a minimum, placement of a covenant on the property restricting use of the area to industrial property uses. Institutional controls will forbid both “commercial” (i.e., all but non-industrial) and residential property uses. No residential areas are present adjacent to or near the site, so hazardous substances remaining at the site after remedial action are not anticipated to pose a threat to human health in adjacent non-industrial areas.

8.1 SOURCES

Releases of COCs due to facility operations are known to have affected soils and groundwater. The former tank farm area is the main source area for these constituents. Historical spills at the facility that are discussed in Section 3.2.1 and shown on Figure 3-3 have been contained and are unlikely to represent continuing sources of COCs. Historic facility operations included storage and handling of materials containing COCs in aboveground tanks, piping, and drums. Releases from these operations migrated into the soil through uncovered soils, cracked or missing pavement, and/or potentially via the possible dry well identified during the 1997 interim measure. From the soil, constituents could then migrate into the unsaturated zone soils and the underlying groundwater. The releases migrated down through the unsaturated Sand Fill soils to the shallow groundwater within the Fill. COCs such as chlorinated solvents, which could have existed as DNAPL, could eventually reach the lower permeability Silt Layer under the former tank farm area. The possible existence of a dry well could have resulted in direct release of COCs to the depth of the Silt Layer. Historical releases of hazardous substances, resulting in high concentrations of COCs in groundwater, have been partly recovered by pumping the extraction well MC-R in the late 1980s and by the 1997 soil excavation interim measure.

Dissolution of COCs into groundwater has occurred, as is evidenced by analytical results from ongoing groundwater sampling, particularly in the Lower Aquifer. The source removal interim action conducted in 1997 to remove all the soil from the former tank farm area down to the top of the Silt Layer reduced COCs that were contributing to groundwater contamination; but

COCs remain under Building 1 and adsorbed into the underlying Silt Layer. The Silt Layer likely behaves as a source area to groundwater. COC trends in groundwater indicate that the Silt Layer is retaining contamination that continues to leach to groundwater in the Lower Aquifer.

8.2 TRANSPORT AND EXPOSURE MECHANISMS

Described below are the potential transport and exposure mechanisms at the facility and the likelihood that each pathway has occurred at the site:

- Leaching of COCs from soils into groundwater can occur due to infiltration of precipitation into COC-impacted soil or when seasonal rises in water table elevation flush residual contamination from the soil into groundwater. Data indicate the leaching of COCs from soils into groundwater has occurred at the facility and exists as a complete migration pathway.
- COCs can be mobilized in fugitive dust in areas of the PSC property that are not paved. Inhalation of contaminated fugitive dust exists as a potentially complete migration pathway, but is not considered a significant pathway because the majority of contamination is at depth and the majority of active areas of the facility are paved.
- COCs in groundwater have the potential to migrate to surface water, because groundwater in the Shallow Groundwater Zone and Lower Aquifer discharges to surface water bodies (Section 7.0). The migration of COCs from groundwater to surface water exists as a complete migration pathway at the site.
- The more volatile COCs could potentially volatilize from soil or groundwater into soil gas, which could migrate to indoor air of buildings at the current PSC property. PSC installed a depressurization system in 2006 within the only building at the property built on slab to mitigate this potential exposure. Although exposure to COCs volatilized from soil outdoors is a potentially complete pathway, concentrations of volatile constituents migrating from soil gas to outdoor air are negligible due to rapid mixing and dilution in ambient air.

Groundwater in the Shallow Groundwater Zone of the site is not a current use of drinking water, and has a very low yield; however, the Shallow Groundwater Zone is partially connected to the Lower Aquifer groundwater, which could potentially be used as a drinking water source, and therefore drinking water is a potential exposure mechanism for both the Shallow Groundwater Zone and the Lower Aquifer. Since groundwater discharges to Steigerwald Marsh and the Gibbons Creek Remnant Channel, surface water and ecological receptors will be considered.

8.3 HUMAN HEALTH ASSESSMENT

Figure 8-1 summarizes potential human receptors, potentially complete exposure pathways, and complete exposure pathways. Based on the information above, the following exposure pathways and receptors are considered either complete or potentially complete exposure pathways.[9]

- Office workers, working primarily indoors, may potentially be exposed to COCs through the inhalation of fugitive dust, although this exposure pathway is considered unlikely. In addition, office workers could be exposed to COCs in indoor air via inhalation of volatile compounds if new buildings are constructed without building controls similar to those currently in place in Building 1 to prevent this pathway from being complete. Office worker exposure to COCs through the ingestion of aquatic biota from Steigerwald Marsh is considered a potentially complete pathway but very unlikely.

- Industrial workers, working primarily outdoors, may be exposed to COCs through fugitive dust via inhalation or the inhalation of volatile compounds. Industrial workers may also have direct contact with chemicals in uncovered surface soil, resulting in exposure via dermal contact or incidental ingestion; however, it is assumed that industrial workers will adhere to appropriate protective measures to minimize exposure (e.g., personal protective equipment) so this mechanism is considered a potentially complete but unlikely pathway. Industrial workers exposure to COCs through the ingestion of aquatic biota from Steigerwald Marsh is also considered a potentially complete pathway with a low potential of occurring. Potential exposure to COCs from the Gibbons Creek Remnant Channel is considered a potentially complete pathway though accessibility to the creek is limited by thick vegetation (Himalayan blackberry).

- Temporary workers, working primarily outdoors, may be exposed to COCs through fugitive dust via inhalation or by direct inhalation of volatile compounds. Temporary workers involved in trenching or other excavation activities may also have direct contact with chemicals in uncovered surface soil, resulting in exposure via dermal contact or incidental ingestion. In this specific case, the exposure pathway is considered complete. For all other temporary workers who are not involved in trenching or excavating activities, the pathway is incomplete as they will not be interacting with uncovered surface soil. Exposure of temporary workers to COCs through the ingestion of aquatic biota from Steigerwald Marsh is also considered a potentially complete but very unlikely pathway.

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[9] Receptors could become exposed to contaminated groundwater, other media, or organisms impacted currently or potentially impacted in the future due to contamination already in groundwater or from future migration of soil contaminants into groundwater.

- Site visitors, present at the PSC property for short durations, may be exposed to COCs in fugitive dust and in indoor air via inhalation of volatile compounds if new buildings are constructed without building controls similar to those currently in place in Building 1 to prevent this pathway from being complete. Visitors to the Steigerwald Marsh may also be exposed to COCs via dermal contact and incidental ingestion of surface water and/or ingestion of aquatic organisms. Because visits to the site are expected to be of short duration and visitor activities are unlikely to result in COC exposures, these mechanisms are considered potentially complete exposure pathways. Although no residential properties in the industrial park and the PSC property and surrounding properties are zoned industrial, residents in the area may be exposed to COCs through the ingestion of aquatic organisms from neighboring Steigerwald Marsh. This mechanism is considered a potentially complete pathway.

For site visitors and office, industrial, and temporary workers, potential exposure to COCs from the Gibbons Creek Remnant Channel is considered a potentially complete pathway, though accessibility to the creek is limited by thick vegetation (Figures 8-2 and 8-3). Due to the creek's geomorphology, inaccessibility, and presence on an industrial property, the Gibbons Creek Remnant Channel is not currently used and is unlikely to be used in the future as a recreational water body (Figures 8-2 and 8-3). James R. Clapp, refuge manager for Steigerwald Lake National Wildlife Refuge, stated in an email dated October 19, 2011, that other than the Gibbons Creek Wildlife Art Trail and the Columbia River Dike Trail and Road, the refuge is closed to the public. Mr. Clapp stated that he has never observed anyone using the Gibbons Creek Remnant Channel for recreational activities, including fishing (AMEC, 2011b).

Future receptors pathways, including well installation for drinking water use and site development for residential use, are considered unlikely since institutional controls will forbid commercial and residential use of the property and forbid the use of groundwater at the site for drinking water.

8.4 ECOLOGICAL ASSESSMENT

Figure 8-1 summarizes the potential ecological receptors and complete exposure pathways. The ecological assessment was developed using MTCA ecological evaluation guidance (WAC 173-340-7490).

A site-specific terrestrial ecological evaluation was performed for the facility, as specified in WAC 173-340-7493 (Appendix M). Protection of surface water was assessed as specified in WAC 173-340-730. PSC considered conducting a simplified evaluation (WAC 173-340-7492) due to the low potential for exposure to ecological receptors, but agreed with Ecology to conduct the additional evaluation of the potential impact to ecological receptors based on the facility's close proximity to Steigerwald Marsh National Wildlife Refuge (SLNWR) and the

Gibbons Creek remnant channel (GCRC). The evaluation for SLNWR is provided in Appendix M.1.

Since GCRC is a surface water body, evaluation of the GCRC was completed following procedures for surface water evaluations in WAC 173-340-730 (Surface water cleanup standards) and the procedures for sediment evaluations described in WAC 173-340-760 (which addresses Chapter 13-204 WAC, Sediment Management Standards). The evaluation for GCRC is provided in Appendix M.2.

PSC’s property also was evaluated in accordance with WAC 173-340-7493. Because PSC’s property meets the definition of an industrial property, only the potential for exposure of terrestrial wildlife to soil contamination on PSC’s property was evaluated. Soil concentrations were compared to ecological indicator concentrations described in MTCA Table 749-3 (Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals). Barium was the only compound found in soil samples collected from PSCs property with concentrations exceeding the criteria in MTCA Table 749-3, as summarized in Table 8-1. Therefore, the ecological exposure pathway for small birds, rodents, and rabbits is potentially complete at the PSC property. Soil COCs include constituents listed in MTCA Table 749-3; however, as described above and based on historical sampling results, only barium concentrations in the upper 6 feet of soil exceed levels listed in MTCA Table 749-3. Therefore, while soil is a complete pathway for terrestrial rodents, concentrations do not cause an unacceptable risk, except as described further in Section 11.

Additionally, there were only four barium exceedances, all on the PSC property (not neighboring areas) all relatively low, with values ranging from a low of 104 milligrams per kilogram (mg/kg) to a maximum value of 160 mg/kg. The wildlife screening level for barium from Table 749-3 is 102 mg/kg in soil. Unlike other metals, barium was not evaluated as part of Ecology’s often-cited October 1994 Natural Background Soil Metals Concentrations in Washington State. However, as reported in a U.S. Geological Survey study of statewide metals concentrations performed in cooperation with Ecology (Ames and Prych, 1995), average barium concentrations in soil in the region, collected from Columbia River Alluvium, are approximately the same as the state average of approximately 600 mg/kg for barium. The barium exceedances summarized in Table 8-1 are far below reported background levels for barium in the region and statewide.

As defined in Washington Administrative Code (WAC) 173-340-7493(1)(b): “the site-specific terrestrial ecological evaluation is intended to facilitate selection of a cleanup action by developing information necessary to conduct evaluations of cleanup action alternatives in the feasibility study.” Therefore, the barium exceedances will be revisited in the FS to assure compliance with this section of MTCA.

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TABLES

TABLE 8-1

SOIL RESULTS THAT EXCEED MTCA WILDLIFE ECOLOGICAL INDICATOR CRITERIA

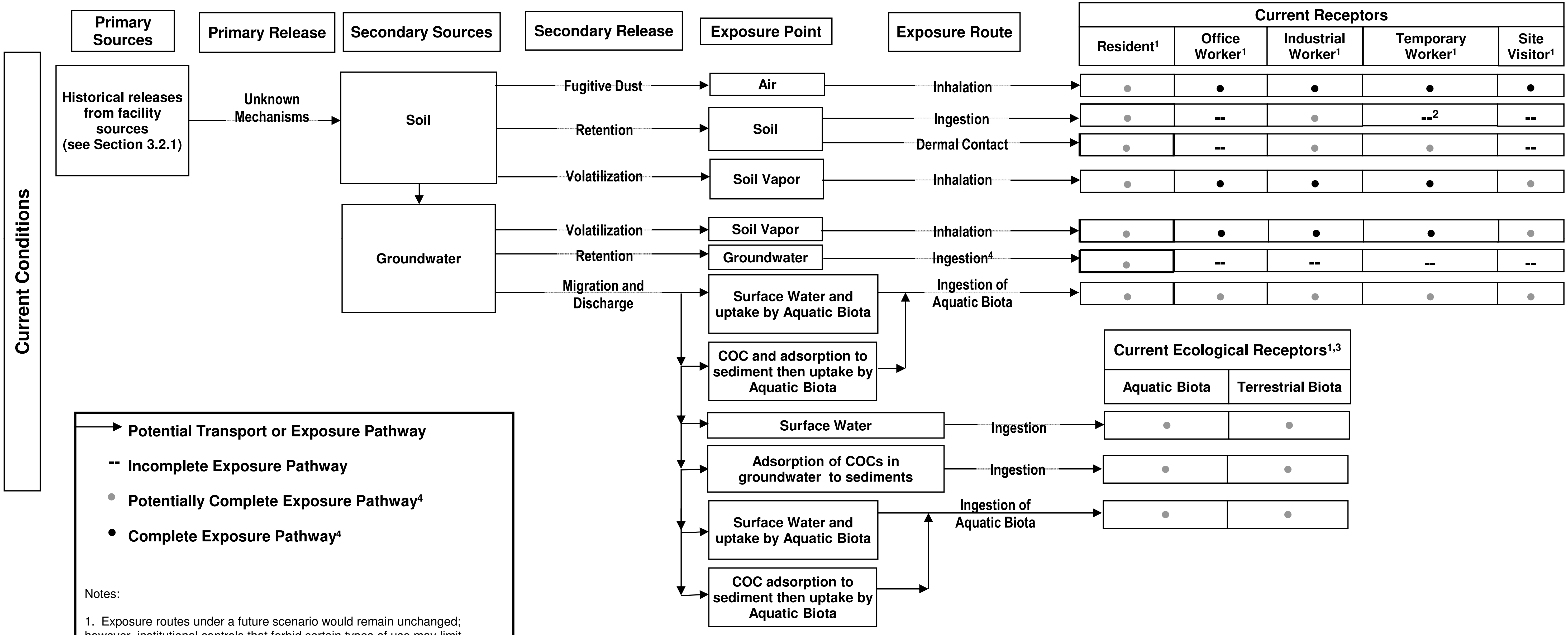
PSC Washougal Facility
Washougal, Washington

Sample ID	**Wildlife Screening Level[2]**	**B-12**	**MC-14D**	**MC-24**	**MC-25**
Depth (ft bgs)		**0**	**2**	**3**	**4.5**
Location		**West side of Building 2**	**East of Building 1 (well location)**	**South Side of Former Tank Farm Area**	**North Side of Former Tank Farm Area**
Sample Date		**8/20/1999**	**9/28/2007**	**9/24/2007**	**9/24/2007**
Metals (mg/kg)					
Barium	102	160	106	121	104

Notes
1. Data flags are as follows:
2. Ecological Inidcator Soil Concentraion for Protection of Terrestrial Plants and Animals - Wildlife (Table 749-3 MTCA)

Abbreviations
ft bgs = feet below ground surface
mg/kg = milligrams per kilogram

FIGURES



Exposure Point	Exposure Route	Current Receptors				
		Resident[1]	Office Worker[1]	Industrial Worker[1]	Temporary Worker[1]	Site Visitor[1]
Air	Inhalation	○	●	●	●	●
Soil	Ingestion	○	--	○	--[2]	--
Soil	Dermal Contact	○	--	○	○	--
Soil Vapor	Inhalation	○	●	●	●	○
Soil Vapor	Inhalation	○	●	●	●	○
Groundwater	Ingestion[4]	○	--	--	--	--
Surface Water and uptake by Aquatic Biota	Ingestion of Aquatic Biota	○	○	○	○	○

Exposure Point	Exposure Route	Current Ecological Receptors[1,3]	
		Aquatic Biota	Terrestrial Biota
Surface Water	Ingestion	○	○
Adsorption of COCs in groundwater to sediments	Ingestion	○	○
Surface Water and uptake by Aquatic Biota; COC adsorption to sediment then uptake by Aquatic Biota	Ingestion of Aquatic Biota	○	○

→ **Potential Transport or Exposure Pathway**

-- **Incomplete Exposure Pathway**

○ **Potentially Complete Exposure Pathway[4]**

● **Complete Exposure Pathway[4]**

Notes:

1. Exposure routes under a future scenario would remain unchanged; however, institutional controls that forbid certain types of use may limit exposure route scenarios on the PSC property.

2. Soil ingestion by temporary workers is considered an incomplete pathway except for workers engaged in trenching activities, where the pathway is considered complete. If a temporary worker is not performing excavation activities, then the pathway is considered incomplete.

3. Dermal contact is not considered a complete pathway for ecological receptors. Note barium concentrations in excess of Ecological Indicator Soil Concentrations for the Protection of Terrestrial Plants and Animals (MTCA Table 749-3) are present on the property, but less than reported background. See Section 8.4 for further detail.

4. A potentially complete exposure pathway exists when potential contamination exposure to an individual or population is considered possible but unlikely.

5. A complete exposure pathway exists when an individual or population is exposed or has the potential to be exposed to hazardous substances at or originating from the site.

CONCEPTUAL SITE MODEL- RECEPTORS
PSC Washougal Facility
Washougal, Washington

By: RLW | Date: 06/28/2013 | Project No. 9625

amec

Figure 8-1

Note

Photographs were taken near where the Gibbons Creek Remnant Channel flows beneath South 32nd Street.

GIBBONS CREEK REMNANT CHANNEL –
EASTWARD VIEW
AUGUST 2011
PSC Washougal Facility
Washougal, Washington

By:	RW	Date:	11/01/201	Project No.	9625
amec				Figure	**8-2**

Note

Photographs were taken near where the Gibbons Creek Remnant Channel flows beneath South 32nd Street.

GIBBONS CREEK REMNANT CHANNEL –
WESTWARD VIEW
AUGUST 2011
PSC Washougal Facility
Washougal, Washington

By: RW Date: 11/01/2011 Project No. 9625

amec

Figure **8-3**

9.0 SELECTION OF CLEANUP LEVELS

This section outlines the approach used to develop PCLs for the facility. The PCLs must be established for affected media and must be appropriate for the land use and relevant exposure pathways identified in the CSM. Affected media identified through previous investigations include soil in the area of the former tank farm, including areas outside the tank farm footprint, and groundwater beneath the PSC property that is migrating beyond the PSC property boundary.

MTCA regulations require that remedial action alternatives achieve cleanup standards. MTCA regulations establish three primary components for cleanup standards:

- Cleanup levels for COCs;
- The point of compliance (POC) where these cleanup levels must be met; and
- Other regulatory requirements that apply.

MTCA regulations define three basic methods of determining cleanup levels for soil and groundwater.

- Method A – applies to “routine” sites or where few hazardous substances are involved. Method A cleanup levels have been established for unrestricted and industrial land uses.
- Method B – the “universal” method that can be applied to all media at all sites (unrestricted and industrial use). Two types of Method B cleanup levels can be used: standard (or default) cleanup levels based on standard assumptions, and modified cleanup levels that incorporate chemical-specific or site-specific information.
- Method C – a conditional cleanup level that can be used where more rigorous cleanup levels cannot be achieved. Similar to Method B, Method C comprises two types: standard and modified. Use of Method C cleanup levels requires institutional controls to ensure future protection of human health and the environment and is generally applicable only to industrial sites.

For carcinogenic COCs, MTCA Method B and Method C cleanup levels are generally defined by the upper bound of the estimated lifetime cancer risk, which cannot exceed 1×10^{-6} and 1×10^{-5}, respectively, for each method, for individual carcinogens. Hazard indices for both Methods B and C cannot exceed 1.0, and the total risk for COCs under each method cannot exceed 1×10^{-5}.

Cleanup standards in MTCA Methods A, B, and C are required by RCW 70.105D.030 (2)(d) to be “at least as stringent as all applicable state and federal laws.” These requirements are similar to the applicable, relevant and appropriate requirements (ARAR) approach of the federal superfund law, and are described in entirety in WAC 173-340-710. In addition, the PSC property meets criteria established in WAC 173-340-200 and 173-340-745 for a site to be defined as an industrial property, as described in Section 8.0. Although there is a potential for the property to be used sometime in the future for residential use (and therefore residential exposure was considered in the CSM as a potentially complete exposure pathway), the property and surrounding industrial park are industrial and are expected to remain industrial for the foreseeable future, and institutional controls will be established at the site as part of the cleanup action restricting use of the property to industrial uses. As noted in the CSM, groundwater from the PSC property discharges to the SLNWR, and since Steigerwald Marsh is not zoned as industrial, the entire “facility” or “site” cannot be viewed as industrial and PCLs must reflect this distinction for areas outside the industrial park.

Preliminary site-specific cleanup levels must be protective of the pathways established in the CSM, including the following media exposure pathways:

- Groundwater – the groundwater-to-surface water pathway (the Shallow Groundwater Zone groundwater discharges to the Steigerwald Marsh and Gibbons Creek Remnant Channel, and the Lower Aquifer groundwater discharges to the Columbia River);
- Groundwater – indoor vapor inhalation pathway;
- Soil – industrial direct human exposure pathways (ingestion, inhalation, dermal absorption);
- Soil – indoor vapor inhalation pathway; and
- Soil – groundwater pathway (protective of a groundwater level that accounts for all groundwater-related pathways including drinking water, surface water, and vapor pathways).

Since groundwater in the Lower Aquifer is also considered a potential drinking water source, and the Shallow Aquifer appears to have some connectivity to the Lower Aquifer, these aquifers must also be considered for direct ingestion of groundwater (levels protective of drinking water). PCLs were determined for all constituents that were analyzed in the RI data set.

9.1 POINT OF COMPLIANCE

To develop and evaluate a reasonable range of cleanup alternatives in the FS, a POC must be defined for contaminated sites. As defined in the MTCA regulations, the POC is the point or points at which cleanup levels must be attained. As stated previously, the POC, cleanup levels, and other applicable standards taken together define the cleanup standard. Sites that achieve the cleanup standards at the point of compliance and comply with applicable state and federal laws are presumed to be protective of human health and the environment, as approved by Ecology. The POC or multiple POCs will be used in the FS for design and evaluation of potential remedial alternatives. After approval of the FS, the proposed final POC(s) will be incorporated into a cleanup action plan (CAP) and final design for the cleanup alternative selected in the FS. The basis for selecting the POC(s) for the FS is defined in the following subsections. The final POC(s) to be used for implementing the cleanup action will be determined after Ecology approval of the CAP and after completing the requirements specified in the MTCA regulations for approval by other agencies, other property owners, and the public.

9.1.1 Regulatory Requirements

The MTCA regulations specify POCs for various media that may become contaminated. MTCA defines both the standard POC (SPOC) and the less stringent conditional POC (CPOC). The SPOC applies to all soil, groundwater, air, or surface water at or adjacent to any location where releases of hazardous substances have occurred or that has been impacted by releases from the location. A CPOC is usually defined only for groundwater, air, or surface water; however, a CPOC may be defined for soil under some circumstances. A CPOC typically applies to a specific location as near as possible to the source of the release. Site-specific conditions determine whether the SPOC or CPOC would be appropriate for a site. Several requirements are specified in the MTCA regulations for establishing a CPOC, as discussed in more detail below. The most important criterion for approval of a CPOC is the practicality of attaining cleanup levels within a reasonable time frame throughout the plume. A common situation for use of a CPOC is migration of contaminated groundwater beyond the property boundary. In this case, a CPOC is most frequently established at the property boundary beyond which contaminated groundwater has migrated. However, in certain instances a CPOC may be established beyond the property boundary if Ecology and any landowners located between the source area and the CPOC approve the CPOC before it can be incorporated into a final cleanup action.

As described in this RI Report, affected media at the facility include soil and groundwater. The inhalation pathway also is significant for the RI; however, cleanup levels (and therefore POCs) have only been established for soil and groundwater. POCs for soil and groundwater are established separately and may be different due to different regulatory requirements and potential exposure pathways associated with the two media. The regulatory requirements for POCs in soil and groundwater are summarized in Sections 9.1.1.1 and 9.1.1.2 below.

9.1.1.1 Soil Point of Compliance

The regulatory requirements for the soil POC are presented in the MTCA regulations, WAC 173-340-740(6). The requirements for the soil POC depend on the relevant exposure pathway. Therefore, MTCA may require different soil POCs for different COCs. The requirements specified by MTCA are as follows.

- For soil COCs whose cleanup level is based on protection of groundwater, the SPOC (e.g., in the soils throughout the site) must be used;
- For soil COCs whose cleanup level is based on the vapor/inhalation pathway, the POC must be the soils throughout the site (from the ground surface to the uppermost water table).
- For soil COCs whose cleanup level is based on human exposure (i.e., the Commercial Cleanup Level defined in the RI Report), the POC must include the soils throughout the site from the ground surface to a depth of 15 feet bgs.
- For soil COCs whose cleanup level is based on ecological exposure, additional specific requirements that must be addressed are presented in WAC 173-370-7490(4).

The soil POCs defined above by MTCA would apply to soil at the surface and beneath the surface affected by releases from the PSC operations. For the purposes of the RI, the soil POC extends from the ground surface to the water table. The cleanup action will comply with the requirements of WAC 173-340-740(6)(f) for a CPOC.

Soil cleanup levels for the site were established either for protection of groundwater or for human exposure; no soil cleanup levels were established based on ecological exposure following the results of the simplified terrestrial ecological evaluation performed for the site. Therefore, the soil POC will be either the shallower of (a) the SPOC (extending from the land surface to the water table) or (b) the upper 15 feet of soil, depending on the specific COC. The dry season water table on the PSC property ranges from 4 feet bgs on the western portion of the property to 6 feet on the eastern edge of the property.

9.1.1.2 Groundwater Point of Compliance

The MTCA regulations favor a permanent solution for groundwater cleanup at the SPOC. The SPOC is essentially a volume of groundwater extending from the water table to an appropriate depth, as determined by Ecology. If a permanent cleanup action (e.g., a cleanup action capable of attaining cleanup levels of all COCs in groundwater at the SPOC) is not selected for a site, the MTCA imposes additional requirements as described in WAC 173-340-360(2)(c)(ii). It is expected that the range of groundwater remediation alternatives considered in the FS will include nonpermanent cleanup actions that would not attain cleanup levels at the SPOC.

The groundwater SPOC, as described in WAC 173-340-720(8)(b), would include all groundwater within the saturated zone beneath the PSC property and in any area affected by releases from the PSC operations. Under WAC 173-340-720(8)(c), Ecology may approve use of a CPOC if the responsible person demonstrates that it is not practicable to attain the SPOC within a reasonable restoration time frame and that all practicable methods of treatment have been used. A CPOC is essentially a vertical surface extending downward from the water table and laterally so that it spans the vertical area affected by the release (e.g., the contaminated groundwater extending beyond the boundary of the PSC property). Groundwater cleanup levels would apply everywhere downgradient from the CPOC; groundwater cleanup levels could be exceeded upgradient from the CPOC. Under WAC 173-340-720(8)(c), a CPOC must be as close as practicable to the source of hazardous substances and not exceed the property boundary.

Under the MTCA, the groundwater CPOC may be located either within the boundary of the property or beyond the property boundary. The requirements for establishing a groundwater CPOC beyond the property boundary for facilities such as the PSC Washougal facility that is near, but not abutting, surface water are set forth in WAC 173-340-720(8)(d)(ii).

- The CPOC must be located as close as practicable to the source of the release.
- The CPOC must not be located beyond the point or points where groundwater flows into surface water.
- The conditions specified in WAC 173-340-720(8)(d)(i) must be met.
- All affected property owners between the source of contamination and the CPOC agree in writing to the CPOC location.
- The CPOC cannot be located beyond the extent of groundwater contamination exceeding cleanup levels when Ecology approves the CPOC.

It is anticipated that a CPOC at the property boundary will be selected for groundwater. The specific regulatory requirements that will apply for establishing a groundwater CPOC for the facility include the following.

- It is not practicable to attain the SPOC within a reasonable restoration time frame [WAC 173-340-720(8)(c)].
- The CPOC shall be as close as practicable to the source of the release [WAC 173-340-720(8)(c)].
- All practicable methods of treatment are used in the site cleanup [WAC 173-340-720(8)(c)].

The regulatory requirements in the bullet list above must be met in order to specify a groundwater CPOC for the facility.

9.1.2 Proposed Points of Compliance

To develop and evaluate a reasonable range of cleanup alternatives in the FS, it is necessary to establish POCs for both soil and groundwater. Given the nature and extent of contamination in the source area within the site and in the groundwater downgradient from the source area, it is expected that some cleanup alternatives will incorporate a CPOC for groundwater. The POCs proposed for consideration in completing the FS are described in Sections 9.1.2.1 and 9.1.2.2.

9.1.2.1 Proposed Soil Point of Compliance

The proposed soil POC includes all soil from the land surface to the water table. Remedial alternatives to be considered in the FS will incorporate the above soil POC as appropriate for each of the soil COCs. For remedial alternatives to be considered in the FS that rely on containment and will not meet the soil POC, the requirements specified in the MTCA rules to demonstrate compliance with the soil POC will be presented in the description of the alternative.

9.1.2.2 Proposed Groundwater Conditional Points of Compliance

In order to proceed with the FS, it is necessary to define POCs for the Shallow Groundwater Zone and the Lower Aquifer. As noted above, it is expected that at least some remedial alternatives considered for groundwater will include a CPOC at the property boundary. This approach will provide a common basis for development and evaluation of the remedial alternatives in the FS.

As noted above, the CPOC must be located as close to the source area as practicable. Site characterization data confirm that COC concentrations exceeding PCLs in the Shallow Groundwater Zone and Lower Aquifer extend downgradient from the source area in the former tank farm. Some remedial alternatives to be considered in the FS may not attain cleanup levels throughout the site for an extended period of time, but are expected to improve groundwater quality sufficiently to decrease concentrations below cleanup levels near the PSC property line much faster. Since the property use is not expected to change, institutional controls could be readily implemented to support a CPOC placed at the boundary of the PSC property.

If a CPOC is selected in the CAP, groundwater compliance monitoring will be conducted along or immediately downgradient of the CPOC. This location is consistent with the location-specific CPOC requirements cited in the MTCA regulations. For a CPOC located at the property boundary, WAC 170-340-720(8)(c) specifies the following requirements:

- The location is as close as practicable to the source area;

- The location shall not exceed the property boundary except as provided under WAC 173-340-720(8)(d).
- Where a CPOC is proposed, the person undertaking the cleanup action shall demonstrate that all possible methods of treatment are to be used in the site cleanup.

The practicability of attaining an SPOC or a CPOC will be discussed in relation to the remedial alternatives to be considered in the FS.

9.2 GROUNDWATER PRELIMINARY CLEANUP LEVELS

Preliminary groundwater cleanup levels are based on a general analysis of groundwater use and the MTCA methodology for establishing cleanup levels. These levels will be used in the RI to establish COPCs and evaluate the nature and extent of contamination. Final cleanup levels are established for use in designing the final remedy for the facility, as described in Section 9.4. For groundwater in the Shallow Groundwater Zone (above or in the Silt Layer) as well as for groundwater in the Lower Aquifer (in or below the Silt Layer), the PCL for each constituent is a MTCA Method B Cleanup level selected by choosing the minimum of the following (presented graphically in Figure 9-1):

- **MTCA Groundwater Table Values (from CLARC) (Table 9-1)**
    - MTCA Method A levels for constituents that do not have a Method B level available;
    - MTCA standard Method B levels based on drinking water beneficial use, which include Federal Maximum Contaminant Levels (MCLs) (Ecology, 2007a) (Note: EPA Region 6 medium-specific screening levels [EPA, 2009a] were used, as recommended by Ecology, for several constituents that did not have a MTCA Method B value);
- **Surface Water ARARs (Table 9-2)**
    - Water Quality Standards for Surface Waters of the State of Washington (WAC 173-201A) – Acute and Chronic effects, Aquatic Life, Freshwater;
    - National Recommended Water Quality Criteria (NRWQC) (Clean Water Act §304) – Freshwater, Acute and Chronic effects, Aquatic Life and for the Protection of Human Health, Consumption of Water and Organisms and Consumption of Organisms Only ;
    - National Toxics Rule (40 CFR 131) – Freshwater, Acute and Chronic effects, Aquatic Life, and Human Health, Consumption of Water and Organisms;
- **MTCA Surface Water Table Values (from CLARC) (Table 9-2)**

- MTCA Method B Surface Water levels calculated using Ecology's Cleanup Levels and Risk Calculation (CLARC) tables if a federal or local surface water value is not found in the above references (Ecology, 2007a); and

- **Values Protective of Indoor Air (Table 9-3)**
  - For the Shallow Groundwater Zone only, MTCA Method B groundwater to vapor cleanup levels, obtained from Table B-1 in Ecology's Draft Guidance for Evaluating Soil Vapor Intrusion in Washington State (Ecology, 2009b) as described in Appendix N. An evaluation of the EPA IRIS database in 2013 identified five compounds with updated Reference Concentrations for Chronic Inhalation Exposure and Inhalation Unit Risks. These updated values were used to recalculate values protective of indoor air. The affected compounds and the equations used to calculate the updated values are described in Appendix N.

After selecting the minimum value from the MTCA Method B levels and the ARARs, PCLs are established below for use in the RI. For some constituents, the preliminary Method B cleanup levels were revised upward in accordance with the MTCA regulations [WAC 173-340-705(6)] so that the screening levels were not lower than the practical quantitation limits (PQLs) obtained by the project laboratory. The PCLs established by this process are modified MTCA Method B cleanup levels. In reviewing the modified Method B cleanup levels based on analytical considerations, Ecology may consider the availability of improved analytical techniques and require their use. In accordance with WAC 173-340-707, if the PQL for a constituent was higher than the preliminary groundwater cleanup level, the cleanup level was raised to the PQL level if:

- The PQL is no greater than 10 times the method detection limit (MDL); and
- The laboratory PQL is not higher than the PQL established by the EPA.

The PQLs were obtained from the current project laboratory, Columbia Analytical Services, Inc. (Columbia) of Kelso, Washington, which is certified by the state of Washington. Columbia performs low-level and selective ion monitoring (SIM) for VOCs and SVOCs, and analyses for PCBs, to attain PQLs below typical reporting limits. For some constituents, the Columbia PQL was slightly higher than 10 times the MDL. In these cases, the value of 10 times the MDL was used as the PQL. Applicable analytical methods, MDLs, and PQLs (Columbia and federal) used for adjusting the Method B groundwater cleanup levels are provided in Table 9-4.

The preliminary groundwater cleanup levels for the Shallow Groundwater Zone are summarized on Table 9-5 and the preliminary groundwater cleanup levels for the Lower Aquifer are summarized on Table 9-6. The final PCLs chosen for both shallow and deep groundwater are presented separately on Table 9-7. Additional adjustments for background were considered for arsenic in accordance with WAC 173-340-705 and -706, which establish the applicability of Method B and C to determine cleanup levels for this constituent (further discussed in Appendix O).

Both area and natural background were considered in developing PCLs for arsenic. Background values were calculated using upgradient site data outside of contaminated source areas as described in Appendix O. These calculated values are 22.84 µg/L for the Shallow Groundwater Zone and 1.42 µg/L for the Lower Aquifer. It is difficult to ascertain if these background values should be categorized strictly as natural background values or area background values given that the site has both natural and anthropogenic (area) influences:

- Natural - The site and surrounding industrial park are built over a large marsh, resulting in naturally reducing conditions. These naturally reducing conditions are directly impacting concentrations of arsenic on the site. The arsenic concentrations show a clear and consistent trend of higher concentrations in the Shallow Groundwater Zone during the summer months (when the groundwater elevation is lowest and we observe the strongest reducing conditions) and lower concentrations in the winter months when recharge of oxygenated rainwater occurs. The natural conditions (high organic content and peat layers that promote reducing conditions) would encourage mobility of arsenic.
- Area - The site is located within a man-made industrial park, constructed on imported fill. The shallow aquifer is actually within this fill zone, but the geochemistry of this unit is strongly influenced by the methanogenic conditions produced by the underlying marsh deposits.

In 2010, the MTCA Science Advisory Board reviewed a statewide dataset of groundwater data for arsenic (Ecology 2010a; San Juan, 2010). For this background study, arsenic study data were obtained from the Washington Department of Health Drinking Water Program. A total of 18,238 groundwater sample results, collected over a 10-year period (2000-2010) from 6,776 drinking water wells (depths of 10 to 2,200 feet.), were evaluated. Ecology used the “MTCAStat” statistical software to estimate background arsenic concentrations using the procedures specified in WAC 173-340-709. The review produced the following key results:

- On a statewide basis, Ecology estimated that arsenic concentrations of 10.7 µg/L represent the 90th percentile of the sampling distribution for groundwater in the State.
- High arsenic concentrations (> 25 µg/L) were detected in 12 western Washington counties (Clark, Cowlitz, Island, Jefferson, King, Lewis, Mason, Skagit, Skamania, Snohomish, Thurston, and Whatcom). The PSC Washougal facility is located in Clark County.

PSC’s site-specific background calculation yielded results consistent with Ecology’s study that indicates high arsenic concentrations are present in Clark County. PSC has set the PCL for arsenic in Tables 9-5 and 9-6 for the Shallow Groundwater Zone and 1.42 μg/L for the Lower Aquifer.

The arsenic assessment and background calculation are described in Appendix O.

9.2.1 Beneficial Use of Groundwater

The designation of the highest beneficial use of groundwater in an area governs potential exposure to groundwater in that area. The designation of the highest beneficial use of groundwater in a particular area is regulated by several different agencies, including Ecology, the Washington State Department of Health (WDOH), and county and city governments. The requirements, rules, and guidance of each of these agencies are considered in the determination of the highest beneficial use of groundwater under MTCA (WAC 173-340-720). According to WAC 173-340-720, groundwater cleanup levels must be based on the highest beneficial use of groundwater, which is human ingestion, unless the criteria outlined in WAC 173-340-720(2) subsections (a) through (c) are met. Unless all of the criteria can be demonstrated, WAC 173-340-720(2) defines all groundwater as potable.

Since groundwater in the Lower Aquifer is considered a potential drinking water source, cleanup levels must be developed based on an exposure pathway that includes direct ingestion of groundwater (levels protective of drinking water). Groundwater in the Shallow Groundwater Zone of the site is not a current source of drinking water, and has a very low yield; however, the Shallow Groundwater Zone is partially connected to the Lower Aquifer groundwater, which could potentially be used as a drinking water source, and therefore drinking water is a potential exposure mechanism for both the Shallow Groundwater Zone and the Lower Aquifer.

9.3 SOIL PRELIMINARY CLEANUP LEVELS

The PSC property is located in an area zoned for heavy industrial use; therefore, MTCA Method C soil cleanup levels are appropriate for use at the PSC property. In addition, the PSC property meets criteria established in WAC 173-340-200 and 173-340-745 for a site to be defined as an industrial property, as described in Section 8.0. However, portions of the site that are east of the property, outside the industrial park, do not meet this definition since a national wildlife refuge exists in this area. Areas of the site outside the industrial park require development of more stringent cleanup levels, which would apply in these areas. MTCA Method C industrial soil cleanup levels are based on adult occupational exposures and assume that current and future land use will be restricted to industrial purposes.

PCLs for soil are selected by choosing the minimum of the following MTCA cleanup levels (presented graphically in Figure 9-1):

- MTCA Method C - Industrial Cleanup Level based on direct contact/ingestion obtained from the CLARC website (Ecology, 2007a);
- For those constituents with no available Method C cleanup levels, MTCA Method A Soil Cleanup Levels for Industrial Land Use (MTCA Table 745-1);
- Soil cleanup levels protective of the preliminary groundwater cleanup levels described in Section 9.2 [WAC 173-340-747(4)]; soil cleanup calculations and input parameters are provided in Appendix P; and
- EPA Regional Screening Levels (Formerly EPA Region 9 Preliminary Remediation Goals), based on the dust ingestion pathway.

Additionally, areas of the site outside the Industrial Park will be considered with regard to MTCA Method B – Unrestricted Cleanup Levels, based on direct contact/ingestion obtained from the CLARC website. After selecting the minimum value from the levels described above, the PCLs are established below for use in the RI. For some constituents, the preliminary Method C cleanup levels were revised upward when compared to natural background levels and PQLs in accordance with the MTCA regulations [WAC 173-340-709 and WAC 173-340-705(6)]. The modified Method C PCLs were established as follows.

- The risk-based soil cleanup level selected for each constituent was compared to the natural background concentration. If the risk-based cleanup level was less than the natural background concentration, the natural background concentration was selected for comparison to the PQL.
- If natural background concentrations were lower than the risk-based soil cleanup level, the risk-based soil cleanup level was selected for comparison to the PQL.
- If the selected natural background concentration or risk-based soil cleanup level was less than the PQL, the PQL was selected as the PCL.

Natural background levels for metals were defined by Ecology (1994) for the Clark County area. The Clark County natural background values were calculated as the 90th percentile value using Ecology's MTCA STAT program on a sample set of n = 45. Screening levels that were below the defined Clark County natural background levels were adjusted up to the applicable natural background level in accordance with the limitations set forth in WAC 173-340-706(6).

Applicable PQLs were established for soil in the same manner described in Section 9.2 for groundwater. Applicable analytical methods, MDLs, and PQLs (Columbia and federal) used for establishing the Method C soil screening levels are provided in Table 9-8. The PCLs for on-property soils are listed in Table 9-9, and for off-property soils in Table 9-10. Finally, the final PCLs selected for both on- and off-property soils are listed in Table 9-11.

9.4 FINAL CLEANUP LEVELS

In accordance with WAC 173-340-705(4) (multiple hazardous substances or pathways), cleanup levels for individual hazardous substances are required to be adjusted downward if the total combined excess cancer risk potential (calculated in accordance with MTCA methods) for the carcinogenic substances would exceed one in 100,000 (1×10^{-5}), or if the hazard index (HI) calculated in accordance with MTCA methods exceeds 1. The HI is calculated by summing hazard quotients (HQs) for individual COPCs. The cleanup levels applicable at the POC must be adjusted to meet these two total risk criteria.

This risk-based adjustment will be made to the PCLs for soil and groundwater to develop final cleanup levels in the Revised FS. The final cleanup levels will be used for cleanup action planning.

TABLES

TABLE 9-1

GROUNDWATER PRELIMINARY CLEANUP LEVELS – MTCA GROUNDWATER TABLE VALUES[1]
PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Groundwater, MTCA Method A Cleanup Level	Groundwater, MTCA Method B Cleanup Level, Carcinogenic	Groundwater, MTCA Method B Cleanup Level, Non-carcinogenic	Groundwater ARAR-Federal MCL[2]	Groundwater ARAR - State MCL[3]
Inorganics						
Ammonia (as nitrogen)	7664-41-7	--	--	--	--	--
Antimony	7440-36-0	--	--	6.4	6	6
Arsenic, inorganic	7440-38-2	5	0.058	4.8	10	10
Barium	7440-39-3	--	--	3,200	2,000	2,000
Beryllium	7440-41-7	--	--	32	4	4
Cadmium	7440-43-9	5	--	16	5	5
Chloride	16887-00-6	--	--	--	--	--
Chromium	7440-47-3	50	--	--	100	100
Cobalt	7440-48-4	--	--	--	--	--
Copper	7440-50-8	--	--	640	1,300	1,300
Cyanide	57-12-5	--	--	--	200	200
Iron	7439-89-6	--	--	11,200	--	--
Lead	7439-92-1	15	--	--	15	15
Manganese	7439-96-5	--	--	2,240	--	--
Mercury	7439-97-6	2	--	--	2	2
Nickel	7440-02-0	--	--	320	--	100
Nitrate (as nitrogen)	14797-55-8	--	--	--	10,000	10,000
Nitrite	14797-65-0	--	--	--	1,000	1,000
Selenium and compounds	7782-49-2	--	--	80	50	50
Silver	7440-22-4	--	--	80	--	--
Sulfate	14808-79-8	--	--	--	--	--
Thallium, soluble salts	7440-28-0	--	--	--	2	2
Tin	7440-31-5	--	--	9,600	--	--
Vanadium	7440-62-2	--	--	1.12	--	--
Zinc	7440-66-6	--	--	4,800	--	--
VOCs						
Acetic acid	64-19-7	--	--	--	--	--
Acetone	67-64-1	--	--	7,200	--	--
Acrolein	107-02-8	--	--	4	--	--
Acrylonitrile	107-13-1	--	0.081	--	--	--
Allyl chloride	107-05-1	--	--	--	--	--
Benzene	71-43-2	5	0.8	32	5	5
Bromobenzene	108-86-1	--	--	--	--	--
Bromochloromethane	74-97-5	--	--	--	--	--
Bromodichloromethane	75-27-4	--	0.71	160	80	80
Bromoform	75-25-2	--	5.54	160	80	80
Bromomethane	74-83-9	--	--	11.2	--	--
n-Butanoic acid	107-92-6	--	--	--	--	--
2-Butanone (MEK)	78-93-3	--	--	4,800	--	--
sec-Butylbenzene	135-98-8	--	--	61	--	--
tert-Butylbenzene	98-06-6	--	--	61	--	--
n-Butylbenzene	104-51-8	--	--	61	--	--
iso-Butyric acid	79-31-2	--	--	--	--	--
Carbon disulfide	75-15-0	--	--	800	--	--
Carbon tetrachloride	56-23-5	--	0.625	32	5	5
2-Chloro-1,3-butadiene	126-99-8	--	--	160	--	--
Chlorobenzene	108-90-7	--	--	160	100	100
Chloroform	67-66-3	--	--	80	80	80
Chloromethane	74-87-3	--	--	--	--	--

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PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Groundwater, MTCA Method A Cleanup Level	Groundwater, MTCA Method B Cleanup Level, Carcinogenic	Groundwater, MTCA Method B Cleanup Level, Non-carcinogenic	Groundwater ARAR- Federal MCL[2]	Groundwater ARAR - State MCL[3]
VOCs (Continued)						
o-Chlorotoluene	95-49-8	--	--	160	--	--
4-Chlorotoluene	106-43-4	--	--	--	--	--
Cumene (Isopropylbenzene)	98-82-8	--	--	800	--	--
1,2-Dibromo-3-chloropropane	96-12-8	--	0.055	1.6	0.2	0.2
1,4-Dibromobenzene	106-37-6	--	--	80	--	--
Dibromochloromethane	124-48-1	--	0.52	160	80	80
1,1-Dichloro-1,2,2-trifluoroethane	812-04-4	--	--	--	--	--
2,2-Dichloro-1,1,1-trifluoroethane	306-83-2	--	--	--	--	--
1,2-Dichlorobenzene	95-50-1	--	--	720	600	600
1,3-Dichlorobenzene	541-73-1	--	--	--	--	--
1,4-Dichlorobenzene	106-46-7	--	--	--	75	75
1,1-Dichloroethane	75-34-3	--	--	1,600	--	--
1,2-Dichloroethane	107-06-2	5	0.48	160	5	5
1,1-Dichloroethene	75-35-4	--	--	400	7	7
1,2-Dichloroethene (total)	540-59-0	--	--	72	--	--
cis-1,2-Dichloroethene	156-59-2	--	--	16	70	70
trans-1,2-Dichloroethene	156-60-5	--	--	160	100	100
Dichlorodifluoromethane	75-71-8	--	--	1,600	--	--
1,2-Dichloropropane	78-87-5	--	--	--	5	5
1,3-Dichloropropane	142-28-9	--	--	--	--	--
2,2-Dichloropropane	594-20-7	--	--	--	--	--
1,1-Dichloropropene	563-58-6	--	--	--	--	--
cis-1,3-Dichloropropene	10061-01-5	--	--	--	--	--
trans-1,3-Dichloropropene	10061-02-6	--	--	--	--	--
Ethyl chloride (chloroethane)	75-00-3	--	--	--	--	--
Ethylbenzene	100-41-4	700	--	800	700	700
Ethylene dibromide (EDB)	106-93-4	0.01	0.0219	72	0.05	0.05
2-Hexanone	591-78-6	--	--	--	--	--
Isobutyl alcohol	78-83-1	--	--	2,400	--	--
p-Isopropyltoluene	99-87-6	--	--	--	--	--
Methacrylonitrile	126-98-7	--	--	0.8	--	--
Methyl iodide	74-88-4	--	--	--	--	--
4-Methyl-2-pentanone (MIBK)	108-10-1	--	--	640	--	--
Methylcyclopentane	96-37-7	--	--	--	--	--
Methylene bromide	74-95-3	--	--	80	--	--
Methylene chloride	75-09-2	5	5.83	480	5	5
2-Methylpentane	107-83-5	--	--	--	--	--
3-Methylpentane	96-14-0	--	--	--	--	--
Propanoic acid	79-09-4	--	--	--	--	--
n-Propylbenzene	103-65-1	--	--	800	--	--
Styrene	100-42-5	--	--	1,600	100	100
1,1,1,2-Tetrachloroethane	630-20-6	--	1.68	240	--	--
1,1,2,2-Tetrachloroethane	79-34-5	--	0.22	160	--	--
Tetrachloroethene	127-18-4	5	20.8	48	5	5
Toluene	108-88-3	1,000	--	640	1,000	1,000
1,2,3-Trichlorobenzene	87-61-6	--	--	--	--	--
1,2,4-Trichlorobenzene	120-82-1	--	1.51	80	70	70
1,1,1-Trichloroethane	71-55-6	200	--	16,000	200	200
1,1,2-Trichloroethane	79-00-5	--	0.77	32	5	5

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PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Groundwater, MTCA Method A Cleanup Level	Groundwater, MTCA Method B Cleanup Level, Carcinogenic	Groundwater, MTCA Method B Cleanup Level, Non-carcinogenic	Groundwater ARAR- Federal MCL[2]	Groundwater ARAR - State MCL[3]
VOCs (Continued)						
Trichloroethene	79-01-6	5	0.54	4	5	5
Trichlorofluoromethane	75-69-4	--	--	2,400	--	--
1,1,2-Trichlorotrifluoroethane	76-13-1	--	--	240,000	--	--
1,2,3-Trichloropropane	96-18-4	--	0.0015	32	--	--
1,2,4-Trimethylbenzene	95-63-6	--	--	--	--	--
1,3,5-Trimethylbenzene	108-67-8	--	--	80	--	--
Vinyl acetate	108-05-4	--	--	8,000	--	--
Vinyl chloride	75-01-4	0.2	0.029	24	2	2
m,p-Xylene	106-42-3	--	--	1,600	--	--
o-Xylene	95-47-6	--	--	1,600	--	--
Xylenes	1330-20-7	1,000	--	1,600	10,000	10,000
SVOCs						
2,4,5-Trichlorophenol	95-95-4	--	--	800	--	--
2,4,6-Trichlorophenol	88-06-2	--	4	8	--	--
2-Chloronaphthalene	91-58-7	--	--	640	--	--
2-Chlorophenol	95-57-8	--	--	40	--	--
4-Methylphenol	106-44-5	--	--	40	--	--
1-Methylnaphthalene	90-12-0	--	--	1.51	--	--
2-Methyl-4,6-dinitrophenol	534-52-1	--	--	--	--	--
2-Methylaniline	95-53-4	--	--	--	--	--
2-Methylnaphthalene	91-57-6	--	--	32	--	--
2-Nitroaniline	88-74-4	--	--	160	--	--
2-Nitrophenol	88-75-5	--	--	--	--	--
3-Nitroaniline	99-09-2	--	--	--	--	--
4-Bromophenyl phenyl ether	101-55-3	--	--	--	--	--
4-Chloro-3-methylphenol	59-50-7	--	--	--	--	--
4-Chlorophenyl phenyl ether	7005-72-3	--	--	--	--	--
4-Nitroaniline	100-01-6	--	--	--	--	--
4-Nitrophenol	100-02-7	--	--	--	--	--
Acenaphthene	83-32-9	--	--	960	--	--
Acenaphthylene	208-96-8	--	--	--	--	--
Acetophenone	98-86-2	--	--	800	--	--
Aldrin	309-00-2	--	0.0026	0.24	--	--
alpha-Hexachlorocyclohexane	319-84-6	--	0.014	--	--	--
Aniline	62-53-3	--	7.7	56	--	--
Anthracene	120-12-7	--	--	4,800	--	--
Benzo(a)anthracene	56-55-3	--	0.12	--	--	--
Benzo(a)pyrene	50-32-8	0.1	0.012	--	0.2	0.2
Benzo(b)fluoranthene	205-99-2	--	0.12	--	--	--
Benzo(g,h,i)perylene	191-24-2	--	--	--	--	--
Benzo(k)fluoranthene	207-08-9	--	1.2	--	--	--
Benzoic acid	65-85-0	--	--	64,000	--	--
Benzyl alcohol	100-51-6	--	--	800	--	--
beta-Hexachlorocyclohexane	319-85-7	--	0.049	--	--	--
bis(2-Chloro-1-methylethyl) ether	108-60-1	--	0.625	320	--	--
bis(2-Chloroethoxy) methane	111-91-1	--	--	--	--	--
bis(2-Chloroethyl) ether	111-44-4	--	0.04	--	--	--
bis(2-Ethylhexyl) phthalate	117-81-7	--	6.25	320	6	6
Butylbenzyl phthalate	85-68-7	--	46.1	3,200	--	--

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PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Groundwater, MTCA Method A Cleanup Level	Groundwater, MTCA Method B Cleanup Level, Carcinogenic	Groundwater, MTCA Method B Cleanup Level, Non-carcinogenic	Groundwater ARAR- Federal MCL[2]	Groundwater ARAR - State MCL[3]
SVOCs (Continued)						
Chlordane	57-74-9	--	0.25	8	2	2
Chrysene	218-01-9	--	0.012	--	--	--
3,3'-Dichlorobenzidine	91-94-1	--	0.19	--	--	--
1,4-Dioxane	123-91-1	--	0.438	240	--	--
2,4-Dichlorophenol	120-83-2	--	--	24	--	--
2,4-Dimethylphenol	105-67-9	--	--	160	--	--
2,4-Dinitrophenol	51-28-5	--	--	32	--	--
2,4-Dinitrotoluene	121-14-2	--	--	32	--	--
2,6-Dichlorophenol	87-65-0	--	--	--	--	--
2,6-Dinitrotoluene	606-20-2	--	--	16	--	--
Decachlorobiphenyl	2051-24-3	--	--	--	--	--
Dibenzo[a,h]anthracene	53-70-3	--	0.012	--	--	--
Dibenzofuran	132-64-9	--	--	16	--	--
Diethyl phthalate	84-66-2	--	--	12,800	--	--
Dimethyl phthalate	131-11-3	--	--	--	--	--
di-n-Butyl phthalate	84-74-2	--	--	1,600	--	--
di-n-Octyl phthalate	117-84-0	--	--	--	--	--
Dinoseb	88-85-7	--	--	--	7	7
Diphenylamine	122-39-4	--	--	400	--	--
Fluoranthene	206-44-0	--	--	640	--	--
Fluorene	86-73-7	--	--	640	--	--
Heptachlor	76-44-8	--	0.019	8	0.4	0.4
Heptachlor epoxide	1024-57-3	--	0.0048	0.104	0.2	0.2
Hexachlorobenzene	118-74-1	--	0.055	12.8	1	1
Hexachlorobutadiene	87-68-3	--	0.56	8	--	--
Hexachlorocyclopentadiene	77-47-4	--	--	48	50	50
Hexachloroethane	67-72-1	--	3.125	8	--	--
Hexachloropropene	1888-71-7	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	193-39-5	--	0.12	--	--	--
Isophorone	78-59-1	--	46.05	1,600	--	--
Kepone	143-50-0	--	--	--	--	--
m-Cresol	108-39-4	--	--	400	--	--
m-Dinitrobenzene	99-65-0	--	--	1.6	--	--
N-Nitroso-di-n-propylamine	621-64-7	--	--	--	--	--
N-Nitrosodiphenylamine	86-30-6	--	--	--	--	--
Naphthalene	91-20-3	160	--	160	--	--
Nitrobenzene	98-95-3	--	--	16	--	--
p-Chloroaniline	106-47-8	--	0.219	32	--	--
o-Cresol	95-48-7	--	--	400	--	--
Pentachlorophenol	87-86-5	--	0.219	80	1	1
Phenanthrene	85-01-8	--	--	--	--	--
Phenol	108-95-2	--	--	2,400	--	--
Pyrene	129-00-0	--	--	480	--	--
PCBs/Pesticides						
delta-BHC	319-86-8	--	--	--	--	--
alpha-Chlordane	103-71-9	--	--	--	--	--
4,4'-DDD	72-54-8	--	0.37	--	--	--
4,4'-DDE	72-55-9	--	0.26	--	--	--
4,4'-DDT	50-29-3	0.3	0.26	8	--	--
Dicamba	1918-00-9	--	--	480	--	--

TABLE 9-1

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PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Groundwater, MTCA Method A Cleanup Level	Groundwater, MTCA Method B Cleanup Level, Carcinogenic	Groundwater, MTCA Method B Cleanup Level, Non-carcinogenic	Groundwater ARAR-Federal MCL[2]	Groundwater ARAR - State MCL[3]
PCBs/Pesticides (Continued)						
Dieldrin	60-57-1	--	0.0055	0.8	--	--
Dimethoate	60-51-5	--	--	3.2	--	--
Endosulfan I[4]	959-98-8	--	--	96	--	--
Endosulfan II[4]	33213-65-9	--	--	96	--	--
Endosulfan sulfate	1031-07-8	--	--	--	--	--
Endrin	72-20-8	--	--	4.8	2	2
Endrin aldehyde	7421-93-4	--	--	--	--	--
Endrin ketone	53494-70-5	--	--	--	--	--
Isodrin	465-73-6	--	--	--	--	--
Lindane	58-89-9	0.2	--	4.8	0.2	0.2
Methoxychlor	72-43-5	--	--	80	40	40
Methyl parathion	298-00-0	--	--	4	--	--
Parathion	56-38-2	--	--	96	--	--
Tetrachloro-m-xylene	877-09-8	--	--	--	--	--
Thionazin	297-97-2	--	--	--	--	--
Aroclor 1016	12674-11-2	--	1.25	1.12	--	--
Aroclor 1254	11097-69-1	--	0.0437	0.32	--	--
Aroclor 1260	11096-82-5	--	0.0437	--	--	--
Toxaphene	8001-35-2	--	0.08	--	3	3
Total PCBs	1336-36-3	0.1	0.044	--	0.5	0.5
TPH						
Diesel		500	--	--	--	--
Gasoline	86290-81-5	800	--	--	--	--
Heavy oils	NA	500	--	--	--	--
Lube oil	NA	500	--	--	--	--

Notes
1. All levels downloaded from Washington State Department of Ecology Cleanup Levels and Risk Calculations (CLARC) Web site, https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx.
2. Federal MCL established under the Safe Drinking Water Act.
3. State MCL established under Washington Administrative Code Chapter 246-290.
4. Values for endosulfan (CAS 115-29-7) listed.

Abbreviations
-- = not available
CAS = Chemical Abstracts Service
MCL = maximum contaminant level
MTCA = Model Toxics Control Act
NA = not applicable
PCBs = polychlorinated biphenyls
SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds

TABLE 9-2

GROUNDWATER PRELIMINARY CLEANUP LEVELS – SURFACE WATER ARARS [1]

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Surface Water, MTCA Method B Cleanup Level, Carcinogenic	Surface Water, MTCA Method B Cleanup Level, Non-carcinogenic	Surface Water ARAR - Aquatic Life - Fresh/Acute (WAC 173-201A)	Surface Water ARAR - Aquatic Life - Fresh/Acute (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Acute - NTR (40 CFR 131)	Surface Water ARAR - Aquatic Life - Fresh/Chronic (WAC 173-201A)	Surface Water ARAR- Aquatic Life - Fresh/Chronic (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Chronic - NTR (40 CFR 131)	Surface Water ARAR - Human Health Consumption of Water and Organisms - Fresh Water (CWA §304)	Surface Water ARAR - Human Health Consumption of Organisms- Fresh Water (CWA §304)	Surface Water ARAR - Human Health Consumption of Water and Organisms - Fresh Water - NTR (40 CFR 131)
Inorganics												
Ammonia (as nitrogen)	7664-41-7	--	--	--	--	--	--	--	--	--	--	--
Antimony	7440-36-0	--	1,000	--	--	--	--	--	--	5.6	640	14
Arsenic, inorganic	7440-38-2	0.098	18	360	340	360	190	150	190	0.018	0.14	0.018
Barium	7440-39-3	--	--	--	--	--	--	--	--	1,000	--	--
Beryllium	7440-41-7	--	270	--	--	--	--	--	--	--	--	--
Cadmium	7440-43-9	--	41	0.82	2	3.9	0.37	0.25	1	--	--	--
Chloride	16887-00-6	--	--	860,000	860,000	--	230,000	230,000	--	--	--	--
Chromium	7440-47-3	--	--	--	--	--	--	--	--	--	--	--
Cobalt	7440-48-4	--	--	--	--	--	--	--	--	--	--	--
Copper	7440-50-8	--	2,900	4.61	13	17	3.47	9	11	1,300	--	--
Cyanide	57-12-5	--	52,000	22	22	22	5.2	5.2	5.2	140	140	700
Iron	7439-89-6	--	--	--	--	--	--	1,000	--	--	--	--
Lead	7439-92-1	--	--	13.88	65	65	0.54	2.5	2.5	--	--	--
Manganese	7439-96-5	--	--	--	--	--	--	--	--	50	100	--
Mercury	7439-97-6	--	--	2.1	1.4	2.1	0.012	0.77	0.012	--	0.3	0.14
Nickel	7440-02-0	--	1,103	438	470	1,400	48.65	52	160	610	4,600	610
Nitrate (as nitrogen)	14797-55-8	--	--	--	--	--	--	--	--	10,000	--	--
Nitrite	14797-65-0	--	--	--	--	--	--	--	--	--	--	--
Selenium and compounds	7782-49-2	--	2,701	20	--	20	5	5	5	170	4,200	--
Silver	7440-22-4	--	25,926	0.32	3.2	3.4	--	--	--	--	--	--
Sulfate	14808-79-8	--	--	--	--	--	--	--	--	--	--	--
Thallium, soluble salts	7440-28-0	--	--	--	--	--	--	--	--	0.24	0.47	1.70
Tin	7440-31-5	--	--	--	--	--	--	--	--	--	--	--
Vanadium	7440-62-2	--	--	--	--	--	--	--	--	--	--	--
Zinc	7440-66-6	--	16,548	35.36	120	110	32.29	120	100	7,400	26,000	--
VOCs												
Acetic acid	64-19-7	--	--	--	--	--	--	--	--	--	--	--
Acetone	67-64-1	--	--	--	--	--	--	--	--	--	--	--
Acrolein	107-02-8	--	--	--	--	--	--	--	--	6	9	320
Acrylonitrile	107-13-1	0.40	--	--	--	--	--	--	--	0.051	0.25	0.059
Allyl chloride	107-05-1	--	--	--	--	--	--	--	--	--	--	--
Benzene	71-43-2	23	2,000	--	--	--	--	--	--	2.2	51	1.2
Bromobenzene	108-86-1	--	--	--	--	--	--	--	--	--	--	--
Bromochloromethane	74-97-5	--	--	--	--	--	--	--	--	--	--	--
Bromodichloromethane	75-27-4	28	14,000	--	--	--	--	--	--	0.55	17	0.27
Bromoform	75-25-2	220	14,000	--	--	--	--	--	--	4.3	140	4.3
Bromomethane	74-83-9	--	970	--	--	--	--	--	--	47	1,500	48
n-Butanoic acid	107-92-6	--	--	--	--	--	--	--	--	--	--	--
2-Butanone (MEK)	78-93-3	--	--	--	--	--	--	--	--	--	--	--
sec-Butylbenzene	135-98-8	--	--	--	--	--	--	--	--	--	--	--
tert-Butylbenzene	98-06-6	--	--	--	--	--	--	--	--	--	--	--
n-Butylbenzene	104-51-8	--	--	--	--	--	--	--	--	--	--	--
iso-Butyric acid	79-31-2	--	--	--	--	--	--	--	--	--	--	--
Carbon disulfide	75-15-0	--	--	--	--	--	--	--	--	--	--	
Carbon tetrachloride	56-23-5	4.9	550	--	--	--	--	--	--	0.23	1.6	0.25
2-Chloro-1,3-butadiene	126-99-8	--	--	--	--	--	--	--	--	--	--	--
Chlorobenzene	108-90-7	--	5,000	--	--	--	--	--	--	130	1,600	680
Chloroform	67-66-3	--	6,900	--	--	--	--	--	--	5.7	470	5.7
Chloromethane	74-87-3	--	--	--	--	--	--	--	--	--	--	

TABLE 9-2

GROUNDWATER PRELIMINARY CLEANUP LEVELS – SURFACE WATER ARARS [1]

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Surface Water, MTCA Method B Cleanup Level, Carcinogenic	Surface Water, MTCA Method B Cleanup Level, Non-carcinogenic	Surface Water ARAR - Aquatic Life - Fresh/Acute (WAC 173-201A)	Surface Water ARAR - Aquatic Life - Fresh/Acute (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Acute - NTR (40 CFR 131)	Surface Water ARAR - Aquatic Life - Fresh/Chronic (WAC 173-201A)	Surface Water ARAR- Aquatic Life - Fresh/Chronic (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Chronic - NTR (40 CFR 131)	Surface Water ARAR - Human Health Consumption of Water and Organisms - Fresh Water (CWA §304)	Surface Water ARAR - Human Health Consumption of Organisms- Fresh Water (CWA §304)	Surface Water ARAR - Human Health Consumption of Water and Organisms - Fresh Water - NTR (40 CFR 131)
VOCs (Continued)												
o-Chlorotoluene	95-49-8	--	--	--	--	--	--	--	--	--	--	--
4-Chlorotoluene	106-43-4	--	--	--	--	--	--	--	--	--	--	--
Cumene (Isopropylbenzene)	98-82-8	--	--	--	--	--	--	--	--	--	--	1,600
1,2-Dibromo-3-chloropropane	96-12-8	--	--	--	--	--	--	--	--	--	--	--
1,4-Dibromobenzene	106-37-6	--	--	--	--	--	--	--	--	--	--	--
Dibromochloromethane	124-48-1	21	14,000	--	--	--	--	--	--	0.4	13	0.41
1,1-Dichloro-1,2,2-trifluoroethane	812-04-4	--	--	--	--	--	--	--	--	--	--	--
2,2-Dichloro-1,1,1-trifluoroethane	306-83-2	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichlorobenzene	95-50-1	--	4,200	--	--	--	--	--	--	420	1,300	2,700
1,3-Dichlorobenzene	541-73-1	--	--	--	--	--	--	--	--	320	960	400
1,4-Dichlorobenzene	106-46-7	--	--	--	--	--	--	--	--	63	190	400
1,1-Dichloroethane	75-34-3	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichloroethane	107-06-2	59	43,200	--	--	--	--	--	--	0.38	37	0.38
1,1-Dichloroethene	75-35-4	--	23,100	--	--	--	--	--	--	330	7,100	0.057
1,2-Dichloroethene (total)	540-59-0	--	--	--	--	--	--	--	--	--	--	--
cis-1,2-Dichloroethene	156-59-2	--	--	--	--	--	--	--	--	--	--	--
trans-1,2-Dichloroethene	156-60-5	--	32,818	--	--	--	--	--	--	140	10,000	--
Dichlorodifluoromethane	75-71-8	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichloropropane	78-87-5	--	--	--	--	--	--	--	--	0.50	15	--
1,3-Dichloropropane	142-28-9	--	--	--	--	--	--	--	--	--	--	--
2,2-Dichloropropane	594-20-7	--	--	--	--	--	--	--	--	--	--	--
1,1-Dichloropropene	563-58-6	--	--	--	--	--	--	--	--	--	--	--
cis-1,3-Dichloropropene	10061-01-5	--	--	--	--	--	--	--	--	--	--	--
trans-1,3-Dichloropropene	10061-02-6	--	--	--	--	--	--	--	--	--	--	--
Ethyl chloride (chloroethane)	75-00-3	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	100-41-4	--	6,914	--	--	--	--	--	--	530	2,100	3,100
Ethylene dibromide (EDB)	106-93-4	--	--	--	--	--	--	--	--	--	--	--
2-Hexanone	591-78-6	--	--	--	--	--	--	--	--	--	--	--
Isobutyl alcohol	78-83-1	--	--	--	--	--	--	--	--	--	--	--
p-Isopropyltoluene	99-87-6	--	--	--	--	--	--	--	--	--	--	--
Methacrylonitrile	126-98-7	--	--	--	--	--	--	--	--	--	--	--
Methyl iodide	74-88-4	--	--	--	--	--	--	--	--	--	--	--
4-Methyl-2-pentanone (MIBK)	108-10-1	--	--	--	--	--	--	--	--	--	--	--
Methylcyclopentane	96-37-7	--	--	--	--	--	--	--	--	--	--	--
Methylene bromide	74-95-3	--	--	--	--	--	--	--	--	--	--	48
Methylene chloride	75-09-2	960	172,840	--	--	--	--	--	--	4.6	590	4.7
2-Methylpentane	107-83-5	--	--	--	--	--	--	--	--	--	--	--
3-Methylpentane	96-14-0	--	--	--	--	--	--	--	--	--	--	--
Propanoic acid	79-09-4	--	--	--	--	--	--	--	--	--	--	--
n-Propylbenzene	103-65-1	--	--	--	--	--	--	--	--	--	--	--
Styrene	100-42-5	--	--	--	--	--	--	--	--	--	--	--
1,1,1,2-Tetrachloroethane	630-20-6	--	--	--	--	--	--	--	--	--	--	--
1,1,2,2-Tetrachloroethane	79-34-5	6.48	10,400	--	--	--	--	--	--	0.17	4.0	0.17
Tetrachloroethene	127-18-4	99.6	502	--	--	--	--	--	--	0.69	3.3	0.80
Toluene	108-88-3	--	19,400	--	--	--	--	--	--	1,300	15,000	6,800
1,2,3-Trichlorobenzene	87-61-6	--	--	--	--	--	--	--	--	--	--	--
1,2,4-Trichlorobenzene	120-82-1	1.96	227	--	--	--	--	--	--	35	70	--
1,1,1-Trichloroethane	71-55-6	--	926,000	--	--	--	--	--	--	--	--	--
1,1,2-Trichloroethane	79-00-5	25.3	2,305	--	--	--	--	--	--	0.59	16	0.60

TABLE 9-2

GROUNDWATER PRELIMINARY CLEANUP LEVELS – SURFACE WATER ARARS[1]

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Surface Water, MTCA Method B Cleanup Level, Carcinogenic	Surface Water, MTCA Method B Cleanup Level, Non-carcinogenic	Surface Water ARAR - Aquatic Life - Fresh/Acute (WAC 173-201A)	Surface Water ARAR - Aquatic Life - Fresh/Acute (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Acute - NTR (40 CFR 131)	Surface Water ARAR - Aquatic Life - Fresh/Chronic (WAC 173-201A)	Surface Water ARAR- Aquatic Life - Fresh/Chronic (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Chronic - NTR (40 CFR 131)	Surface Water ARAR - Human Health Consumption of Water and Organisms - Fresh Water (CWA §304)	Surface Water ARAR - Human Health Consumption of Organisms- Fresh Water (CWA §304)	Surface Water ARAR - Human Health Consumption of Water and Organisms - Fresh Water - NTR (40 CFR 131)
VOCs (Continued)												
Trichloroethene	79-01-6	12.7	118	--	--	--	--	--	--	2.5	30	2.7
Trichlorofluoromethane	75-69-4	--	--	--	--	--	--	--	--	--	--	--
1,1,2-Trichlorotrifluoroethane	76-13-1	--	--	--	--	--	--	--	--	--	--	--
1,2,3-Trichloropropane	96-18-4	--	--	--	--	--	--	--	--	--	--	--
1,2,4-Trimethylbenzene	95-63-6	--	--	--	--	--	--	--	--	--	--	--
1,3,5-Trimethylbenzene	108-67-8	--	--	--	--	--	--	--	--	--	--	--
Vinyl acetate	108-05-4	--	--	--	--	--	--	--	--	--	--	--
Vinyl chloride	75-01-4	--	6,648	--	--	--	--	--	--	0.025	2.4	2.0
m,p-Xylene	106-42-3	--	--	--	--	--	--	--	--	--	--	--
o-Xylene	95-47-6	--	--	--	--	--	--	--	--	--	--	--
Xylenes	1330-20-7	--	--	--	--	--	--	--	--	--	--	--
SVOCs												
2,4,5-Trichlorophenol	95-95-4	--	--	--	--	--	--	--	--	1,800	3,600	--
2,4,6-Trichlorophenol	88-06-2	3.93	17.3	--	--	--	--	--	--	1.4	2.4	2.1
2-Chloronaphthalene	91-58-7	--	1,000	--	--	--	--	--	--	1,000	1,600	--
2-Chlorophenol	95-57-8	--	97	--	--	--	--	--	--	81	150	--
4-Methylphenol	106-44-5	--	--	--	--	--	--	--	--	--	--	--
1-Methylnaphthalene	90-12-0	--	--	--	--	--	--	--	--	--	--	--
2-Methyl-4,6-dinitrophenol	534-52-1	--	--	--	--	--	--	--	--	13	280	--
2-Methylaniline	95-53-4	--	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	91-57-6	--	--	--	--	--	--	--	--	--	--	--
2-Nitroaniline	88-74-4	--	--	--	--	--	--	--	--	--	--	--
2-Nitrophenol	88-75-5	--	--	--	--	--	--	--	--	--	--	--
3-Nitroaniline	99-09-2	--	--	--	--	--	--	--	--	--	--	--
4-Bromophenyl phenyl ether	101-55-3	--	--	--	--	--	--	--	--	--	--	--
4-Chloro-3-methylphenol	59-50-7	--	--	--	--	--	--	--	--	--	--	--
4-Chlorophenyl phenyl ether	7005-72-3	--	--	--	--	--	--	--	--	--	--	--
4-Nitroaniline	100-01-6	--	--	--	--	--	--	--	--	--	--	--
4-Nitrophenol	100-02-7	--	--	--	--	--	--	--	--	--	--	--
Acenaphthene	83-32-9	--	640	--	--	--	--	--	--	670	990	--
Acenaphthylene	208-96-8	--	--	--	--	--	--	--	--	--	--	--
Acetophenone	98-86-2	--	--	--	--	--	--	--	--	--	--	--
Aldrin	309-00-2	0.000082	0.017	2.5	3	3	0.0019	--	--	0.000049	0.00005	0.00013
alpha-Hexachlorocyclohexane	319-84-6	0.0079	--	--	--	--	--	--	--	0.0026	0.0049	0.0039
Aniline	62-53-3	--	--	--	--	--	--	--	--	--	--	--
Anthracene	120-12-7	--	26,000	--	--	--	--	--	--	8,300	40,000	9,600
Benzo(a)anthracene	56-55-3	0.3	--	--	--	--	--	--	--	0.0038	0.018	0.0028
Benzo(a)pyrene	50-32-8	0.03	--	--	--	--	--	--	--	0.0038	0.018	0.0028
Benzo(b)fluoranthene	205-99-2	0.3	--	--	--	--	--	--	--	0.0038	0.018	0.0028
Benzo(g,h,i)perylene	191-24-2	--	--	--	--	--	--	--	--	--	--	--
Benzo(k)fluoranthene	207-08-9	3	--	--	--	--	--	--	--	0.0038	0.018	0.0028
Benzoic acid	65-85-0	--	--	--	--	--	--	--	--	--	--	--
Benzyl alcohol	100-51-6	--	--	--	--	--	--	--	--	--	--	--
beta-Hexachlorocyclohexane	319-85-7	0.03	--	--	--	--	--	--	--	0.0091	0.017	0.014
bis(2-Chloro-1-methylethyl) ether	108-60-1	37	42,000	--	--	--	--	--	--	--	--	--
bis(2-Chloroethoxy) methane	111-91-1	--	--	--	--	--	--	--	--	--	--	--
bis(2-Chloroethyl) ether	111-44-4	0.85	--	--	--	--	--	--	--	0.030	0.53	0.031
bis(2-Ethylhexyl) phthalate	117-81-7	3.6	400	--	--	--	--	--	--	1.2	2.2	1.8
Butylbenzyl phthalate	85-68-7	8.2	1,300	--	--	--	--	--	--	1,500	1,900	--

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GROUNDWATER PRELIMINARY CLEANUP LEVELS – SURFACE WATER ARARS [1]

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Surface Water, MTCA Method B Cleanup Level, Carcinogenic	Surface Water, MTCA Method B Cleanup Level, Non-carcinogenic	Surface Water ARAR - Aquatic Life - Fresh/Acute (WAC 173-201A)	Surface Water ARAR - Aquatic Life - Fresh/Acute (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Acute - NTR (40 CFR 131)	Surface Water ARAR - Aquatic Life - Fresh/Chronic (WAC 173-201A)	Surface Water ARAR- Aquatic Life - Fresh/Chronic (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Chronic - NTR (40 CFR 131)	Surface Water ARAR - Human Health Consumption of Water and Organisms - Fresh Water (CWA §304)	Surface Water ARAR - Human Health Consumption of Organisms- Fresh Water (CWA §304)	Surface Water ARAR - Human Health Consumption of Water and Organisms - Fresh Water - NTR (40 CFR 131)
SVOCs (Continued)												
Chlordane	57-74-9	0.0013	0.092	2.4	2.4	2.4	0.0043	0.0043	0.0043	0.0008	0.00081	0.00057
Chrysene	218-01-9	30	--	--	--	--	--	--	--	0.0038	0.018	0.0028
3,3'-Dichlorobenzidine	91-94-1	0.046	--	--	--	--	--	--	--	0.021	0.028	0.04
1,4-Dioxane	123-91-1	--	--	--	--	--	--	--	--	--	--	--
2,4-Dichlorophenol	120-83-2	--	191	--	--	--	--	--	--	77	290	93
2,4-Dimethylphenol	105-67-9	--	553	--	--	--	--	--	--	380	850	--
2,4-Dinitrophenol	51-28-5	--	3,457	--	--	--	--	--	--	69	5,300	70
2,4-Dinitrotoluene	121-14-2	--	1,365	--	--	--	--	--	--	0.11	3.4	0.11
2,6-Dichlorophenol	87-65-0	--	--	--	--	--	--	--	--	--	--	--
2,6-Dinitrotoluene	606-20-2	--	--	--	--	--	--	--	--	--	--	--
Decachlorobiphenyl	2051-24-3	--	--	--	--	--	--	--	--	--	--	--
Dibenzo[a,h]anthracene	53-70-3	0.030	--	--	--	--	--	--	--	0.0038	0.018	0.0028
Dibenzofuran	132-64-9	--	--	--	--	--	--	--	--	--	--	--
Diethyl phthalate	84-66-2	--	--	--	--	--	--	--	--	17,000	44,000	23,000
Dimethyl phthalate	131-11-3	--	--	--	--	--	--	--	--	270,000	1,100,000	313,000
di-n-Butyl phthalate	84-74-2	--	2,900	--	--	--	--	--	--	2,000	4,500	2,700
di-n-Octyl phthalate	117-84-0	--	--	--	--	--	--	--	--	--	--	--
Dinoseb	88-85-7	--	--	--	--	--	--	--	--	--	--	--
Diphenylamine	122-39-4	--	2,160	--	--	--	--	--	--	--	--	--
Fluoranthene	206-44-0	--	90.2	--	--	--	--	--	--	130	140	300
Fluorene	86-73-7	--	3,457	--	--	--	--	--	--	1,100	5,300	1,300
Heptachlor	76-44-8	0.0001	0.12	0.52	0.52	0.52	0.0038	0.0038	0.0038	0.000079	0.000079	0.00021
Heptachlor epoxide	1024-57-3	0.0001	0.003	--	0.52	0.52	--	0.0038	0.0038	0.000039	0.000039	0.0001
Hexachlorobenzene	118-74-1	0.0005	0.24	--	--	--	--	--	--	0.00028	0.00029	0.00075
Hexachlorobutadiene	87-68-3	30	933	--	--	--	--	--	--	0.44	18	0.44
Hexachlorocyclopentadiene	77-47-4	--	3,584	--	--	--	--	--	--	40	1,100	240
Hexachloroethane	67-72-1	5.3	30	--	--	--	--	--	--	1.4	3.3	1.9
Hexachloropropene	1888-71-7	--	--	--	--	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	193-39-5	0.296	--	--	--	--	--	--	--	0.0038	0.018	0.0028
Isophorone	78-59-1	1,558	118,383	--	--	--	--	--	--	35	960	8.4
Kepone	143-50-0	--	--	--	--	--	--	--	--	--	--	--
m-Cresol	108-39-4	--	--	--	--	--	--	--	--	--	--	--
m-Dinitrobenzene	99-65-0	--	--	--	--	--	--	--	--	--	--	--
N-Nitroso-di-n-propylamine	621-64-7	0.819	--	--	--	--	--	--	--	0.005	0.51	--
N-Nitrosodiphenylamine	86-30-6	10	--	--	--	--	--	--	--	3.3	6	5
Naphthalene	91-20-3	--	4,938	--	--	--	--	--	--	--	--	--
Nitrobenzene	98-95-3	--	1,790	--	--	--	--	--	--	17	690	17
p-Chloroaniline	106-47-8	--	--	--	--	--	--	--	--	--	--	--
o-Cresol	95-48-7	--	--	--	--	--	--	--	--	--	--	--
Pentachlorophenol	87-86-5	1.47	1,180	20.27	19	20	12.79	15	13	0.27	3.0	0.28
Phenanthrene	85-01-8	--	--	--	--	--	--	--	--	--	--	--
Phenol	108-95-2	--	556,000	--	--	--	--	--	--	10,000	860,000	21,000
Pyrene	129-00-0	--	2,593	--	--	--	--	--	--	830	4,000	960
PCBs/Pesticides												
delta-BHC	319-86-8	--	--	--	--	--	--	--	--	--	--	--
alpha-Chlordane	103-71-9	--	--	--	--	--	--	--	--	--	--	--
4,4'-DDD	72-54-8	0.0005	--	1.1	--	--	0.001	--	--	0.00031	0.00031	0.00083
4,4'-DDE	72-55-9	0.00036	--	1.1	--	--	0.001	--	--	0.00022	0.00022	0.00059
4,4'-DDT	50-29-3	0.00036	--	1.1	1.1	1.1	0.001	0.001	0.001	0.00022	0.00022	0.00059
Dicamba	1918-00-9	--	--	--	--	--	--	--	--	--	--	--

TABLE 9-2

GROUNDWATER PRELIMINARY CLEANUP LEVELS – SURFACE WATER ARARS [1]

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Surface Water, MTCA Method B Cleanup Level, Carcinogenic	Surface Water, MTCA Method B Cleanup Level, Non-carcinogenic	Surface Water ARAR - Aquatic Life - Fresh/Acute (WAC 173-201A)	Surface Water ARAR - Aquatic Life - Fresh/Acute (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Acute - NTR (40 CFR 131)	Surface Water ARAR - Aquatic Life - Fresh/Chronic (WAC 173-201A)	Surface Water ARAR- Aquatic Life - Fresh/Chronic (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Chronic - NTR (40 CFR 131)	Surface Water ARAR - Human Health Consumption of Water and Organisms - Fresh Water (CWA §304)	Surface Water ARAR - Human Health Consumption of Organisms- Fresh Water (CWA §304)	Surface Water ARAR - Human Health Consumption of Water and Organisms - Fresh Water - NTR (40 CFR 131)
PCBs/Pesticides (Continued)												
Dieldrin	60-57-1	0.00009	0.028	2.5	0.24	2.5	0.0019	0.056	0.0019	0.000052	0.000054	0.00014
Dimethoate	60-51-5	--	--	--	--	--	--	--	--	--	--	--
Endosulfan I[2]	959-98-8	--	--	0.22	--	0.22	0.056	--	0.056	62	89	--
Endosulfan II[2]	33213-65-9	--	--	0.22	--	0.22	0.056	--	0.056	62	89	--
Endosulfan sulfate	1031-07-8	--	--	--	--	--	--	--	--	62	89	--
Endrin	72-20-8	--	0.20	0.18	0.086	0.18	0.0023	0.036	0.0023	0.059	0.060	0.76
Endrin aldehyde	7421-93-4	--	--	--	--	--	--	--	--	0.29	0.30	--
Endrin ketone	53494-70-5	--	--	--	--	--	--	--	--	--	--	--
Isodrin	465-73-6	--	--	--	--	--	--	--	--	--	--	--
Lindane	58-89-9	--	5.98	2	0.95	2	0.08	--	0.08	0.98	1.8	0.019
Methoxychlor	72-43-5	--	8.36	--	--	--	--	0.03	--	100	--	--
Methyl parathion	298-00-0	--	--	--	--	--	--	--	--	--	--	--
Parathion	56-38-2	--	--	0.065	0.065	--	0.013	0.013	--	--	--	--
Tetrachloro-m-xylene	877-09-8	--	--	--	--	--	--	--	--	--	--	--
Thionazin	297-97-2	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1016	12674-11-2	0.0030	0.0058	--	--	--	--	--	0.014	--	--	--
Aroclor 1254	11097-69-1	0.0001	0.0017	--	--	--	--	--	0.014	--	--	--
Aroclor 1260	11096-82-5	--	--	--	--	--	--	--	0.014	--	--	--
Toxaphene	8001-35-2	0.00045	--	0.73	0.73	0.73	0.0002	0.0002	0.0002	0.00028	0.00028	0.00073
Total PCBs	1336-36-3	0.00010	--	2	--	--	0.014	0.014	0.14	0.000064	0.000064	0.00017
TPH												
Diesel		--	--	--	--	--	--	--	--	--	--	--
Gasoline	86290-81-5	--	--	--	--	--	--	--	--	--	--	--
Heavy oils	NA	--	--	--	--	--	--	--	--	--	--	--
Lube oil	NA	--	--	--	--	--	--	--	--	--	--	--

Notes

1. All levels downloaded from Washington State Department of Ecology, Cleanup Levels and Risk Calculations (CLARC) Web site, https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx.
2. Values for endosulfan (CAS 115-29-7) listed.

Abbreviations

-- = not available
ARAR = applicable or relevant and appropriate requirement
CAS = Chemical Abstracts Service
CFR = Code of Federal Regulations
CWA = Clean Water Act
MTCA = Model Toxics Control Act
NA = not applicable
NTR = National Toxics Rule
PCBs = polychlorinated biphenyls
PQL = practical quantitation limit
SVOCs = semivolatile organic compounds
TPH = total petroleum hydrocarbons
VOCs = volatile organic compounds
WAC = Washington Adminstrative Code

TABLE 9-3

GROUNDWATER PRELIMINARY CLEANUP LEVELS – GROUNDWATER VALUES PROTECTIVE OF INDOOR AIR [1]

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Groundwater Screening Level Protective of Indoor Air
Inorganics		
Ammonia (as nitrogen)	7664-41-7	--
Antimony	7440-36-0	--
Arsenic, inorganic	7440-38-2	--
Barium	7440-39-3	--
Beryllium	7440-41-7	--
Cadmium	7440-43-9	--
Chloride	16887-00-6	--
Chromium	7440-47-3	--
Cobalt	7440-48-4	--
Copper	7440-50-8	--
Cyanide	57-12-5	--
Iron	7439-89-6	--
Lead	7439-92-1	--
Manganese	7439-96-5	--
Mercury	7439-97-6	0.89
Nickel	7440-02-0	--
Nitrate (as nitrogen)	14797-55-8	--
Nitrite	14797-65-0	--
Selenium and compounds	7782-49-2	--
Silver	7440-22-4	--
Sulfate	14808-79-8	--
Thallium, soluble salts	7440-28-0	--
Tin	7440-31-5	--
Vanadium	7440-62-2	--
Zinc	7440-66-6	--
VOCs		
Acetic acid	64-19-7	--
Acetone	67-64-1	--
Acrolein	107-02-8	2.9
Acrylonitrile	107-13-1	16
Allyl chloride	107-05-1	--
Benzene	71-43-2	2.4
Bromobenzene	108-86-1	--
Bromochloromethane	74-97-5	--
Bromodichloromethane	75-27-4	0.09
Bromoform	75-25-2	200
Bromomethane	74-83-9	13
n-Butanoic acid	107-92-6	--
2-Butanone (MEK)	78-93-3	350,000
sec-Butylbenzene	135-98-8	--
tert-Butylbenzene	98-06-6	--
n-Butylbenzene	104-51-8	--
iso-Butyric acid	79-31-2	--
Carbon disulfide	75-15-0	400
Carbon tetrachloride	56-23-5	0.54 [2]
2-Chloro-1,3-butadiene	126-99-8	12
Chlorobenzene	108-90-7	100
Chloroform	67-66-3	1.2
Chloromethane	74-87-3	5.2

GROUNDWATER PRELIMINARY CLEANUP LEVELS – GROUNDWATER VALUES PROTECTIVE OF INDOOR AIR [1]

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Groundwater Screening Level Protective of Indoor Air
VOCs (Continued)		
o-Chlorotoluene	95-49-8	--
4-Chlorotoluene	106-43-4	--
Cumene (Isopropylbenzene)	98-82-8	720
1,2-Dibromo-3-chloropropane	96-12-8	--
1,4-Dibromobenzene	106-37-6	--
Dibromochloromethane	124-48-1	0.22
1,1-Dichloro-1,2,2-trifluoroethane	812-04-4	--
2,2-Dichloro-1,1,1-trifluoroethane	306-83-2	--
1,2-Dichlorobenzene	95-50-1	1,800
1,3-Dichlorobenzene	541-73-1	--
1,4-Dichlorobenzene	106-46-7	790
1,1-Dichloroethane	75-34-3	2,300
1,2-Dichloroethane	107-06-2	4.2
1,1-Dichloroethene	75-35-4	130
1,2-Dichloroethene (total)	540-59-0	--
cis-1,2-Dichloroethene	156-59-2	160
trans-1,2-Dichloroethene	156-60-5	130
Dichlorodifluoromethane	75-71-8	9.9
1,2-Dichloropropane	78-87-5	28
1,3-Dichloropropane	142-28-9	--
2,2-Dichloropropane	594-20-7	--
1,1-Dichloropropene	563-58-6	--
cis-1,3-Dichloropropene	10061-01-5	--
trans-1,3-Dichloropropene	10061-02-6	--
Ethyl chloride (chloroethane)	75-00-3	12
Ethylbenzene	100-41-4	2,800
Ethylene dibromide (EDB)	106-93-4	0.74
2-Hexanone	591-78-6	--
Isobutyl alcohol	78-83-1	--
p-Isopropyltoluene	99-87-6	--
Methacrylonitrile	126-98-7	56
Methyl iodide	74-88-4	--
4-Methyl-2-pentanone (MIBK)	108-10-1	11,000
Methylcyclopentane	96-37-7	--
Methylene bromide	74-95-3	--
Methylene chloride	75-09-2	4434 [2]
2-Methylpentane	107-83-5	--
3-Methylpentane	96-14-0	--
Propanoic acid	79-09-4	--
n-Propylbenzene	103-65-1	--
Styrene	100-42-5	78
1,1,1,2-Tetrachloroethane	630-20-6	7.4
1,1,2,2-Tetrachloroethane	79-34-5	6.2
Tetrachloroethene	127-18-4	4.4 [2]
Toluene	108-88-3	15,000
1,2,3-Trichlorobenzene	87-61-6	--
1,2,4-Trichlorobenzene	120-82-1	3,900
1,1,1-Trichloroethane	71-55-6	11,000
1,1,2-Trichloroethane	79-00-5	7.9

TABLE 9-3

GROUNDWATER PRELIMINARY CLEANUP LEVELS – GROUNDWATER VALUES PROTECTIVE OF INDOOR AIR [1]

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Groundwater Screening Level Protective of Indoor Air
VOCs (Continued)		
Trichloroethene	79-01-6	2.6 [2]
Trichlorofluoromethane	75-69-4	120
1,1,2-Trichlorotrifluoroethane	76-13-1	1,100
1,2,3-Trichloropropane	96-18-4	--
1,2,4-Trimethylbenzene	95-63-6	24
1,3,5-Trimethylbenzene	108-67-8	25
Vinyl acetate	108-05-4	7,800
Vinyl chloride	75-01-4	0.35
m,p-Xylene	106-42-3	670
o-Xylene	95-47-6	440
Xylenes	1330-20-7	--
SVOCs		
2,4,5-Trichlorophenol	95-95-4	--
2,4,6-Trichlorophenol	88-06-2	--
2-Chloronaphthalene	91-58-7	--
2-Chlorophenol	95-57-8	--
4-Methylphenol	106-44-5	--
1-Methylnaphthalene	90-12-0	--
2-Methyl-4,6-dinitrophenol	534-52-1	--
2-Methylaniline	95-53-4	--
2-Methylnaphthalene	91-57-6	--
2-Nitroaniline	88-74-4	--
2-Nitrophenol	88-75-5	--
3-Nitroaniline	99-09-2	--
4-Bromophenyl phenyl ether	101-55-3	--
4-Chloro-3-methylphenol	59-50-7	--
4-Chlorophenyl phenyl ether	7005-72-3	--
4-Nitroaniline	100-01-6	--
4-Nitrophenol	100-02-7	--
Acenaphthene	83-32-9	--
Acenaphthylene	208-96-8	--
Acetophenone	98-86-2	50
Aldrin	309-00-2	0.32
alpha-Hexachlorocyclohexane	319-84-6	--
Aniline	62-53-3	--
Anthracene	120-12-7	--
Benzo(a)anthracene	56-55-3	--
Benzo(a)pyrene	50-32-8	--
Benzo(b)fluoranthene	205-99-2	--
Benzo(g,h,i)perylene	191-24-2	--
Benzo(k)fluoranthene	207-08-9	--
Benzoic acid	65-85-0	--
Benzyl alcohol	100-51-6	--
beta-Hexachlorocyclohexane	319-85-7	--
bis(2-Chloro-1-methylethyl) ether	108-60-1	--
bis(2-Chloroethoxy) methane	111-91-1	--
bis(2-Chloroethyl) ether	111-44-4	26
bis(2-Ethylhexyl) phthalate	117-81-7	--
Butylbenzyl phthalate	85-68-7	--

TABLE 9-3

GROUNDWATER PRELIMINARY CLEANUP LEVELS – GROUNDWATER VALUES PROTECTIVE OF INDOOR AIR [1]

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Groundwater Screening Level Protective of Indoor Air
SVOCs (Continued)		
Chlordane	57-74-9	--
Chrysene	218-01-9	--
3,3'-Dichlorobenzidine	91-94-1	--
1,4-Dioxane	123-91-1	--
2,4-Dichlorophenol	120-83-2	--
2,4-Dimethylphenol	105-67-9	--
2,4-Dinitrophenol	51-28-5	--
2,4-Dinitrotoluene	121-14-2	--
2,6-Dichlorophenol	87-65-0	--
2,6-Dinitrotoluene	606-20-2	--
Decachlorobiphenyl	2051-24-3	--
Dibenzo[a,h]anthracene	53-70-3	--
Dibenzofuran	132-64-9	--
Diethyl phthalate	84-66-2	--
Dimethyl phthalate	131-11-3	--
di-n-Butyl phthalate	84-74-2	--
di-n-Octyl phthalate	117-84-0	--
Dinoseb	88-85-7	--
Diphenylamine	122-39-4	--
Fluoranthene	206-44-0	--
Fluorene	86-73-7	--
Heptachlor	76-44-8	--
Heptachlor epoxide	1024-57-3	--
Hexachlorobenzene	118-74-1	--
Hexachlorobutadiene	87-68-3	0.81
Hexachlorocyclopentadiene	77-47-4	--
Hexachloroethane	67-72-1	8.6
Hexachloropropene	1888-71-7	--
Indeno(1,2,3-cd)pyrene	193-39-5	--
Isophorone	78-59-1	--
Kepone	143-50-0	--
m-Cresol	108-39-4	--
m-Dinitrobenzene	99-65-0	--
N-Nitroso-di-n-propylamine	621-64-7	--
N-Nitrosodiphenylamine	86-30-6	--
Naphthalene	91-20-3	170
Nitrobenzene	98-95-3	10514 [2]
p-Chloroaniline	106-47-8	--
o-Cresol	95-48-7	--
Pentachlorophenol	87-86-5	--
Phenanthrene	85-01-8	--
Phenol	108-95-2	--
Pyrene	129-00-0	--
PCBs/Pesticides		
delta-BHC	319-86-8	--
alpha-Chlordane	103-71-9	--
4,4'-DDD	72-54-8	--
4,4'-DDE	72-55-9	--
4,4'-DDT	50-29-3	--
Dicamba	1918-00-9	--

TABLE 9-3

GROUNDWATER PRELIMINARY CLEANUP LEVELS – GROUNDWATER VALUES PROTECTIVE OF INDOOR AIR [1]

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Groundwater Screening Level Protective of Indoor Air
PCBs/Pesticides (Continued)		
Dieldrin	60-57-1	--
Dimethoate	60-51-5	--
Endosulfan I[5]	959-98-8	--
Endosulfan II[5]	33213-65-9	--
Endosulfan sulfate	1031-07-8	--
Endrin	72-20-8	--
Endrin aldehyde	7421-93-4	--
Endrin ketone	53494-70-5	--
Isodrin	465-73-6	--
Lindane	58-89-9	--
Methoxychlor	72-43-5	--
Methyl parathion	298-00-0	--
Parathion	56-38-2	--
Tetrachloro-m-xylene	877-09-8	--
Thionazin	297-97-2	--
Aroclor 1016	12674-11-2	--
Aroclor 1254	11097-69-1	--
Aroclor 1260	11096-82-5	--
Toxaphene	8001-35-2	--
Total PCBs	1336-36-3	--
TPH		
Diesel		--
Gasoline	86290-81-5	--
Heavy oils	NA	--
Lube oil	NA	--

Notes

1. All levels obtained from Table B-1 in the Washington State Department of Ecology 2009 Draft Guidance for Evaluating Soil Vapor Intrusion in Washington State.
2. These values recalculated as described in Appendix N.

Abbreviations

-- = not available
CAS = Chemical Abstracts Service
NA = not applicable
PCBs = polychlorinated biphenyls
SVOCs = semivolatile organic compounds
TPH = total petroleum hydrocarbons
VOCs = volatile organic compounds

TABLE 9-4

GROUNDWATER PRACTICAL QUANTITATION LIMITS

PSC Washougal Facility
Washougal, Washington

Concentrations are in micrograms per liter (µg/L)

Constituent	Analytical Method[1]	Columbia PQL	Columbia Method Detection Limit	Federal Reporting Limit[2]	Applicable PQL[3]
Acenaphthene	8270 SIM	0.0044	0.02	0.02	0.0044
Acetone	8260	20	4.08	1	1
Acetophenone	8270 low level	0.5	0.16	10	0.5
Acrolein	8260	20	1.42	1	1
Acrylonitrile	8260	5	0.531	1	1
Aldrin	8081	0.0005	0.000054	--	0.0005
Allyl chloride	8260	5	0.154	1	1
Ammonia (as nitrogen)	350.1	50	6	--	50
Aniline	8270 low level	1	0.25	10	1
Anthracene	8270 SIM	0.0036	0.02	0.02	0.0036
Antimony	200.8	0.05	0.02	--	0.05
Arsenic	6020	0.5	0.2	--	0.5
Barium	6020	0.05	0.03	--	0.05
Benzene	8021B	0.5	0.11	1	0.5
Benzo(a)anthracene	8270 SIM PAH	0.02	0.0021	10	0.02
Benzo(a)pyrene	8270C SIM PAH	0.02	0.00158	10	0.0158
Benzo(b)fluoranthene	8270 SIM PAH	0.02	0.00194	10	0.0194
Benzo(g,h,i)perylene	8270C SIM PAH	0.02	0.00368	10	0.02
Benzo(k)fluoranthene	8270 SIM PAH	0.02	0.00134	10	0.0134
Benzoic acid	8270C low level	5	1.1	50	5
Benzyl alcohol	8270 low level	5	0.073	20	0.73
Beryllium	6020	0.02	0.007	--	0.02
Bromobenzene	8260	2	0.172	1	1
Bromochloromethane	8260	0.5	0.164	1	0.5
Bromodichloromethane	8260	0.5	0.109	1	0.5
Bromoform	8260	0.5	0.279	1	0.5
Bromomethane	8260	0.5	0.217	1	0.5
4-Bromophenyl phenyl ether	8270 low level	0.2	0.026	10	0.2
2-Butanone (MEK)	8260	20	1.94	1	1
Butyl benzyl phthalate	8270 low level	0.2	0.018	10	0.18
n-Butylbenzene	8260	2	0.221	1	1
Cadmium	200.8	0.02	0.01	--	0.02
Carbon disulfide	8260	0.5	0.159	--	0.5
Carbon tetrachloride	8260 SIM	0.2	0.0043	--	0.043
Carbon tetrachloride	8260	0.5	0.139	1	0.5
Chlordane	8270 low level	0.005	0.005	10	0.005
Chloride	300	200	30	--	200
2-Chloro-1,3-butadiene	8260	10	0.348	1	1
bis(2-Chloro-1-methylethyl) ether	8270 low level	0.2	0.0167	10	0.167
4-Chloro-3-methylphenol	8270 low level	0.5	0.0289	20	0.289
p-Chloroaniline	8270 low level	0.2	0.0174	10	0.174
Chlorobenzene	8260	0.5	0.134	1	0.5
alpha-Chlordane	8081	0.0005	0.000072	0.0005	0.0005
Chloroethane	8260	0.5	0.226	1	0.5
bis(2-Chloroethoxy)methane	8270 low level	0.2	0.0113	10	0.113
bis(2-Chloroethyl) ether	8270	0.2	0.035	10	0.2
2-Chloroethyl vinyl ether	8260	5	0.333	--	3.33
bis(2-Chloroisopropyl) ether	8270 low level	0.2	0.0167	10	0.167

TABLE 9-4

GROUNDWATER PRACTICAL QUANTITATION LIMITS

PSC Washougal Facility
Washougal, Washington

Concentrations are in micrograms per liter (µg/L)

Constituent	Analytical Method[1]	Columbia PQL	Columbia Method Detection Limit	Federal Reporting Limit[2]	Applicable PQL[3]
Chloroform	8260	0.5	0.136	1	0.5
Chloromethane	8260	0.5	0.136	1	0.5
2-Chloronaphthalene	8270 low level	0.2	0.0151	10	0.151
2-Chlorophenol	8270 low level	0.5	0.0145	10	0.145
4-Chlorophenyl phenyl ether	8270 low level	0.2	0.00842	10	0.0842
4-Chlorotoluene	8260	2	0.118	1	1
Chromium	6020	0.2	0.06	--	0.2
Chrysene	8270 SIM PAH	0.02	0.00124	10	0.0124
o-Chlorotoluene	8260	2	0.111	1	1
o-Cresol	8270 low level	0.5	0.0594	10	0.5
Cobalt	200.8	0.02	0.01	--	0.02
Copper	6020	0.1	0.03	--	0.1
Cumene	8260	2	0.105	--	1.05
Cyanide	335.2/335.4	10	2	20	10
4,4'-DDD	8081 low level	0.0005	0.000047	--	0.00047
4,4'-DDE	8081 low level	0.0005	0.00012	--	0.0005
4,4'-DDT	8081 low level	0.0005	0.000047	--	0.00047
Decachlorobiphenyl	8270 low level	0.005	0.00034	10	0.0034
delta-BHC	8081 low level	0.0005	0.000062	--	0.0005
Dibenzo(a,h)anthracene	8270 SIM PAH	0.02	0.00162	10	0.0162
Dibenzofuran	8270C SIM PAH	0.02	0.00705	10	0.02
1,2-Dibromo-3-chloropropane	8260B	2	0.991	1	1
Dibromochloromethane	8260	0.5	0.104	1	0.5
Dicamba	8151	0.4	0.059	0.081	0.081
2,2-Dichloro-1,1,1-trifluoroethane	8260	0.5	0.4	1	0.5
1,2-Dichlorobenzene	8260	0.5	0.111	1	0.5
1,3-Dichlorobenzene	8260	0.5	0.102	1	0.5
1,4-Dichlorobenzene	8270 low level	0.2	0.029	10	0.2
1,4-Dichlorobenzene	8260B	0.5	0.114	1	0.5
3,3'-Dichlorobenzidine	8270	2	0.428	2	2
Dichlorodifluoromethane	8260	0.5	0.166	--	0.5
1,1-Dichloroethane	8260	0.5	0.101	1	0.5
1,1-Dichloroethene	8260 SIM	0.02	0.0061	1	0.02
1,2-Dichloroethane	8260 SIM	0.02	0.0027	1	0.02
1,2-Dichloroethene (total)	8260B	0.5	0.116	1	0.5
cis -1,2-Dichloroethene	8260	0.5	0.116	1	0.5
trans -1,2-Dichloroethene	8260	0.5	0.143	1	0.5
2,4-Dichlorophenol	8270 low level	0.5	0.047	11	0.47
2,6-Dichlorophenol	8270	10	0.48	10	4.8
1,2-Dichloropropane	8260	0.5	0.139	1	0.5
1,3-Dichloropropane	8260	0.5	0.174	1	0.5
2,2-Dichloropropane	8260	0.5	0.174	1	0.5
1,1-Dichloropropene	8260	0.5	0.15	1	0.5
trans - 1,3-Dichloropropene	8260	0.5	0.0894	1	0.5
Dieldrin	8081 low level	0.0005	0.000056	--	0.0005
Diesel	NWTPH-Dx	100	7.6	--	76
Diethyl phthalate	8270 low level	0.2	0.012	10	0.12
Dimethoate	8141A	0.5	0.11	--	0.5

TABLE 9-4

GROUNDWATER PRACTICAL QUANTITATION LIMITS
PSC Washougal Facility
Washougal, Washington

Concentrations are in micrograms per liter (µg/L)

Constituent	Analytical Method[1]	Columbia PQL	Columbia Method Detection Limit	Federal Reporting Limit[2]	Applicable PQL[3]
Dimethyl phthalate	8270 low level	0.2	0.021	10	0.2
2,4-Dimethylphenol	8270 low level	4	2.2	10	4
Di-n-butyl phthalate	8270 low level	0.2	0.023	10	0.2
Di-n-Octyl phthalate	8270 low level	0.2	0.018	10	0.18
m-Dinitrobenzene	8270	10	0.52	10	5.2
2,4-Dinitrophenol	8270 low level	4	0.529	10	4
2,4-Dinitrotoluene	8270	0.2	0.018	0.18	0.18
2,6-Dinitrotoluene	8270	0.033	0.2	0.2	0.033
Dinoseb	8270	10	0.42	20	4.2
1,4-Dioxane	modified 8270	1	0.26	--	1
Diphenylamine	8270	10	0.42	10	4.2
Endosulfan I	8081	0.000067	0.0005	0.0005	0.000067
Endosulfan II	8081	0.000087	0.0005	0.0005	0.000087
Endosulfan sulfate	8081 low level	0.0005	0.00013	--	0.0005
Endrin	8081 low level	0.0005	0.000054	17	0.0005
Endrin aldehyde	8081 low level	0.0005	0.000038	--	0.00038
Endrin ketone	8081 low level	0.0005	0.00003	--	0.0003
Ethane	RSK 175	0.5	0.38	--	0.5
Ethene	RSK 175	1.5	0.55	--	1.5
Ethyl chloride	8260	0.5	0.226	1	0.5
Ethylbenzene	8260	0.5	0.13	1	0.5
Ethylene dibromide (EDB)	8260	2	0.0981	1	0.981
bis(2-Ethylhexyl) phthalate	8270 low level	1	0.13	10	1
Fluoranthene	8270C SIM PAH	0.02	0.00238	10	0.02
Fluorene	8270C SIM PAH	0.02	0.00258	10	0.02
Gasoline	NWTPH-Gx	250	13	--	130
Heptachlor	8081 low level	0.0005	0.000073	--	0.0005
Heptachlor epoxide	8081 low level	0.0005	0.000065	--	0.0005
Hexachlorobenzene	8270 low level	0.2	0.0141	10	0.141
Hexachlorobutadiene	8270	0.027	0.2	0.2	0.027
alpha-Hexachlorocyclohexane	8270 low level	0.0005	0.00025	10	0.0005
beta-Hexachlorocyclohexane	8081	0.01	0.00091	--	0.0091
Hexachlorocyclopentadiene	8270	0.19	1	1	0.19
Hexachloroethane	8260	0.2	0.024	1	0.2
n-Hexane	8260	1	0.18	1	1
2-Hexanone	8260	20	3.96	--	20
Hexavalent chromium	SM3500-CR	10	0.02	--	0.2
Indeno(1,2,3-cd)pyrene	8270 SIM PAH	0.02	0.00208	10	0.02
Iron	6010B	20	20	--	20
Isobutyl alcohol	8260	100	5.01	1	1
Isodrin	8081 low level	0.05	0.015	--	0.05
Isophorone	8270 low level	0.2	0.016	10	0.16
Kepone	8270	10	4.1	10	10
Lead	6020	0.02	0.009	--	0.02
Lindane	8081 low level	0.0005	0.0002	--	0.0005
Lube oil	NWTPH-Dx	500	19	--	190
Magnesium	6010B	20	9	--	20
Manganese	6020	0.05	0.02	--	0.05

TABLE 9-4

GROUNDWATER PRACTICAL QUANTITATION LIMITS

PSC Washougal Facility
Washougal, Washington

Concentrations are in micrograms per liter (µg/L)

Constituent	**Analytical Method[1]**	**Columbia PQL**	**Columbia Method Detection Limit**	**Federal Reporting Limit[2]**	**Applicable PQL[3]**
Mercury	7470A	0.2	0.02	--	0.2
Methacrylonitrile	8260	5	0.444	1	1
Methane	RSK 175	0.5	0.3	--	0.5
Methoxychlor	8081 low level	0.0005	0.00017	--	0.0005
Methyl iodide	8260	5	0.375	1	1
Methyl parathion	8141	0.5	0.1	--	0.5
4-Methyl-2-pentanone (MIBK)	8260	20	2.7	--	20
2-Methyl-4,6-dinitrophenol	8270 low level	2	0.013	10	0.13
2-Methylaniline	8270	10	1.4	10	10
Methylcyclopentane	8270	1	0.42	--	1
Methylene bromide	8260	0.5	0.119	1	0.5
Methylene chloride	8260	2	0.193	1	1
1-Methylnaphthalene	8270 SIM PAH	0.02	0.0025	1	0.02
2-Methylnaphthalene	8270 SIM PAH	0.02	0.00268	--	0.02
2-Methylpentane	8260	1	0.49	1	1
3-Methylpentane	8260	1	0.41	1	1
Methylphenol	8270 low level	0.5	0.0594	10	0.5
2-Methylphenol	8270 low level	0.5	0.11	10	0.5
4-Methylphenol	8270 low level	0.5	0.12	--	0.5
N-Nitroso-di-n-propylamine	8270	0.2	0.037	0.2	0.2
N-Nitrosodiphenylamine	8270 low level	0.2	0.0278	10	0.2
Naphthalene	8270C SIM PAH	0.02	0.00316	10	0.02
Naphthalene	8260	2	0.285	1	1
Nickel	6020	0.2	0.06	--	0.2
Nitrate (as nitrogen)	300	100	4	--	40
3-Nitroaniline	8270 low level	1	0.227	50	1
4-Nitroaniline	8270 low level	1	0.163	20	1
Nitrobenzene	8270 low level	0.2	0.028	10	0.2
2-Nitrophenol	8270 low level	0.5	0.0134	10	0.134
4-Nitrophenol	8270 low level	2	0.534	50	2
Parathion	8270	10	0.51	10	5.1
Aroclor 1016	8082 low level	0.005	0.0024	0.005	0.005
Aroclor 1232	8082 low level	0.005	0.0024	0.005	0.005
Aroclor 1260	8082 low level	0.005	0.0024	0.005	0.005
Pentachlorophenol	8270 SIM PAH	1	0.095	50	0.95
Phenanthrene	8270C SIM PAH	0.02	0.0032	10	0.02
Phenol	8270 low level	0.5	0.063	--	0.5
p-Isopropyltoluene (4-isopropyltoluene)	8260	2	0.128	1	1
Propylbenzene	8260	2	0.098	1	0.98
n-Propylbenzene	8260B	2	0.098	1	0.98
Pyrene	8270C SIM PAH	0.02	0.00222	10	0.02
sec-Butylbenzene	8260	2	0.127	1	1
Selenium	6020	1	0.2	--	1
Silver	6020	0.02	0.009	--	0.02
Styrene	8260	0.5	0.0943	1	0.5
Sulfate	300	200	30	--	200
tert-Butylbenzene	8260	2	0.122	1	1
Tetrachloroethene	8260 SIM	0.02	0.0035	1	0.02

TABLE 9-4

GROUNDWATER PRACTICAL QUANTITATION LIMITS

PSC Washougal Facility
Washougal, Washington

Concentrations are in micrograms per liter (µg/L)

Constituent	Analytical Method[1]	Columbia PQL	Columbia Method Detection Limit	Federal Reporting Limit[2]	Applicable PQL[3]
1,1,1,2-Tetrachloroethane	8260	0.5	0.138	1	0.5
1,1,2,2-Tetrachloroethane	8260 SIM	0.02	0.0093	1	0.02
Thallium, soluble salts	6020 / 200.8	0.003	0.02	0.02	0.003
Thionazin	8270	25	0.71	20	7.1
Tin	6020 / 200.8	0.1	0.02	0.1	0.1
Toluene	8260	0.5	0.108	1	0.5
Toxaphene	8081 low level	0.025	0.013	--	0.025
TPH, heavy oils	NWTPH-Dx	19	500	190	19
Trichloroethene	8260 SIM	0.02	0.0067	1	0.02
1,1,1-Trichloroethane	8260	0.5	0.116	1	0.5
1,1,2-Trichloroethane	8260	0.5	0.138	1	0.5
Trichlorofluoromethane	8260	0.5	0.131	1	0.5
1,1,2-Trichlorotrifluoroethane	8260	0.5	0.13	1	0.5
2,4,5-Trichlorophenol	8270 low level	0.5	0.0251	10	0.251
2,4,6-Trichlorophenol	8270 low level	0.5	0.0367	10	0.367
1,2,3-Trichlorobenzene	8260B	2	0.326	1	1
1,2,4-Trichlorobenzene	8260B	2	0.218	1	1
1,2,4-Trimethylbenzene	8260	2	0.141	1	1
1,2,3-Trichloropropane	8260B	0.5	0.213	1	0.5
1,3,5-Trimethylbenzene	8260	0.5	0.121	1	0.5
Vanadium	6020	0.2	0.03	--	0.2
Vinyl acetate	8260	5	0.663	1	1
Vinyl chloride	8260 SIM	0.02	0.0035	1	0.02
m,p-Xylene	8260B	0.5	0.219	1	0.5
o-Xylene	8260B	0.5	0.102	1	0.5
Zinc	6020	0.5	0.3	--	0.5

Notes

1. Analytical methods are U.S. Environmental Protection Agency method numbers, unless otherwise noted.
2. Federal reporting limits from U.S. Environmental Protection Agency Publication SW-846 (www.epa.gov/epaoswer/hazwaste/test/6_series.htm).
3. The Columbia Analytical Services, Inc. PQL was selected as the applicable PQL unless it was less than 10 times the Columbia method detection limit, in which case 10 times the method detection limit was considered the applicable PQL (per Washington Administrative Code 173-340-707[a]). If the Columbia PQL was greater than the federal reporting limit, then the federal reporting limit was selected as the applicable PQL (per Washington Administrative Code 173-340-707[b]). Columbia PQLs were provided January 2008.

Abbreviations

-- = not available
NWTPH-Dx = Northwest Total Petroleum Hydrocarbons-Diesel Range
NWTPH-Gx = Northwest Total Petroleum Hydrocarbons-Gasoline Range
PAH = polycyclic aromatic hydrocarbon
PQL = practical quantitation limit
SIM = selective ion monitoring
TPH = total petroleum hydrocarbons

TABLE 9-5

SHALLOW GROUNDWATER ZONE
GROUNDWATER PRELIMINARY CLEANUP LEVELS[1]
PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Groundwater, MTCA Method A Cleanup Level	Groundwater, MTCA Method B Cleanup Level, Carcinogenic	Groundwater, MTCA Method B Cleanup Level, Non-carcinogenic	Groundwater ARAR- Federal MCL[2]	Groundwater ARAR - State MCL[3]	Groundwater Screening Level Protective of Indoor Air	Surface Water, MTCA Method B Cleanup Level, Carcinogenic	Surface Water, MTCA Method B Cleanup Level, Non-carcinogenic	Surface Water ARAR - Aquatic Life - Fresh/Acute (WAC 173-201A)	Surface Water ARAR - Aquatic Life - Fresh/Acute (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Acute - NTR (40 CFR 131)	Surface Water ARAR - Aquatic Life - Fresh/Chronic (WAC 173-201A)	Surface Water ARAR- Aquatic Life - Fresh/Chronic (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Chronic - NTR (40 CFR 131)	ARAR - Human Health Consumption of Water and Organisms - Fresh Water (CWA §304)	Surface Water ARAR - Human Health Consumption of Organisms- Fresh Water (CWA §304)	ARAR - Human Health Consumption of Water and Organisms - Fresh Water - NTR (40 CFR 131)	Applicable PQL[4]	Preliminary Cleanup Level[5]
Inorganics																				
Ammonia (as nitrogen)	7664-41-7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	50	--
Antimony	7440-36-0	--	--	6.4	6	6	--	--	1,000	--	--	--	--	--	--	5.6	640	14	0.05	5.6
Arsenic, inorganic	7440-38-2	5	0.058	4.8	10	10	--	0.098	18	360	340	360	190	150	190	0.018	0.14	0.018	0.5	22.84 [7]
Barium	7440-39-3	--	--	3,200	2,000	2,000	--	--	--	--	--	--	--	--	--	1,000	--	--	0.05	1,000
Beryllium	7440-41-7	--	--	32	4	4	--	--	270	--	--	--	--	--	--	--	--	--	0.02	4
Cadmium	7440-43-9	5	--	16	5	5	--	--	41	0.82	2	3.9	0.37	0.25	1	--	--	--	0.02	0.25
Chloride	16887-00-6	--	--	--	--	--	--	--	--	860,000	860,000	--	230,000	230,000	--	--	--	--	200	230,000
Chromium	7440-47-3	50	--	--	100	100	--	--	--	--	--	--	--	--	--	--	--	--	0.2	50
Cobalt	7440-48-4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.02	--
Copper	7440-50-8	--	--	640	1,300	1,300	--	--	2,900	4.61	13	17	3.47	9	11	1,300	--	--	0.1	3.47
Cyanide	57-12-5	--	--	--	200	200	--	--	52,000	22	22	22	5.2	5.2	5.2	140	140	700	10	10
Iron	7439-89-6	--	--	11,200	--	--	--	--	--	--	--	--	--	1,000	--	--	--	--	20	1,000
Lead	7439-92-1	15	--	--	15	15	--	--	--	13.88	65	65	0.54	2.5	2.5	--	--	--	0.02	0.54
Manganese	7439-96-5	--	--	2,240	--	--	--	--	--	--	--	--	--	--	--	50	100	--	0.05	50
Mercury	7439-97-6	2	--	--	2	2	0.89	--	--	2.1	1.4	2.1	0.012	0.77	0.012	--	0.3	0.14	0.2	0.2
Nickel	7440-02-0	--	--	320	--	100	--	--	1,103	438	470	1,400	48.65	52	160	610	4,600	610	0.2	48.7
Nitrate (as nitrogen)	14797-55-8	--	--	--	10,000	10,000	--	--	--	--	--	--	--	--	--	10,000	--	--	40	10,000
Nitrite	14797-65-0	--	--	--	1,000	1,000	--	--	--	--	--	--	--	--	--	--	--	--	0.1	1,000
Selenium and compounds	7782-49-2	--	--	80	50	50	--	--	2,701	20	--	20	5	5	5	170	4,200	--	1	5
Silver	7440-22-4	--	--	80	--	--	--	--	25,926	0.32	3.2	3.4	--	--	--	--	--	--	0.02	0.32
Sulfate	14808-79-8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Thallium, soluble salts	7440-28-0	--	--	--	2	2	--	--	--	--	--	--	--	--	--	0.24	0.47	1.70	0.003	0.24
Tin	7440-31-5	--	--	9,600	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.1	9,600
Vanadium	7440-62-2	--	--	1.12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.2	1.12
Zinc	7440-66-6	--	--	4,800	--	--	--	--	16,548	35.36	120	110	32.29	120	100	7,400	26,000	--	0.5	32.3
VOCs																				
Acetic acid	64-19-7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.25	--
Acetone	67-64-1	--	--	7,200	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	7,200
Acrolein	107-02-8	--	--	4	--	--	2.9	--	--	--	--	--	--	--	--	6	9	320	1	2.9
Acrylonitrile	107-13-1	--	0.081	--	--	--	16	0.40	--	--	--	--	--	--	--	0.051	0.25	0.059	1	1
Allyl chloride	107-05-1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
Benzene	71-43-2	5	0.8	32	5	5	2.4	23	2,000	--	--	--	--	--	--	2.2	51	1.2	0.5	0.8
Bromobenzene	108-86-1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
Bromochloromethane	74-97-5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	--
Bromodichloromethane	75-27-4	--	0.71	160	80	80	0.09	28	14,000	--	--	--	--	--	--	0.55	17	0.27	0.5	0.5
Bromoform	75-25-2	--	5.54	160	80	80	200	220	14,000	--	--	--	--	--	--	4.3	140	4.3	0.5	4.3
Bromomethane	74-83-9	--	--	11.2	--	--	13	--	970	--	--	--	--	--	--	47	1,500	48	0.5	11.2
n-Butanoic acid	107-92-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.25	--
2-Butanone (MEK)	78-93-3	--	--	4,800	--	--	350,000	--	--	--	--	--	--	--	--	--	--	--	1	4,800
sec-Butylbenzene	135-98-8	--	--	61	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	61
tert-Butylbenzene	98-06-6	--	--	61	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	61
n-Butylbenzene	104-51-8	--	--	61	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	61
iso-Butyric acid	79-31-2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.25	--
Carbon disulfide	75-15-0	--	--	800	--	--	400	--	--	--	--	--	--	--	--	--	--		0.5	400
Carbon tetrachloride	56-23-5	--	0.625	32	5	5	0.54	4.9	550	--	--	--	--	--	--	0.23	1.6	0.25	0.043	0.23
2-Chloro-1,3-butadiene	126-99-8	--	--	160	--	--	12	--	--	--	--	--	--	--	--	--	--	--	1	12
Chlorobenzene	108-90-7	--	--	160	100	100	100	--	5,000	--	--	--	--	--	--	130	1,600	680	0.5	100
Chloroform	67-66-3	--	--	80	80	80	1.2	--	6,900	--	--	--	--	--	--	5.7	470	5.7	0.5	1.2
Chloromethane	74-87-3	--	--	--	--	--	5.2	--	--	--	--	--	--	--	--	--	--		0.5	5.2

TABLE 9-5

SHALLOW GROUNDWATER ZONE
GROUNDWATER PRELIMINARY CLEANUP LEVELS[1]

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Groundwater, MTCA Method A Cleanup Level	Groundwater, MTCA Method B Cleanup Level, Carcinogenic	Groundwater, MTCA Method B Cleanup Level, Non-carcinogenic	Groundwater ARAR- Federal MCL[2]	Groundwater ARAR - State MCL[3]	Groundwater Screening Level Protective of Indoor Air	Surface Water, MTCA Method B Cleanup Level, Carcinogenic	Surface Water, MTCA Method B Cleanup Level, Non-carcinogenic	Surface Water ARAR - Aquatic Life - Fresh/Acute (WAC 173-201A)	Surface Water ARAR - Aquatic Life - Fresh/Acute (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Acute - NTR (40 CFR 131)	Surface Water ARAR - Aquatic Life - Fresh/Chronic (WAC 173-201A)	Surface Water ARAR- Aquatic Life - Fresh/Chronic (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Chronic - NTR (40 CFR 131)	ARAR - Human Health Consumption of Water and Organisms - Fresh Water (CWA §304)	Surface Water ARAR - Human Health Consumption of Organisms- Fresh Water (CWA §304)	ARAR - Human Health Consumption of Water and Organisms - Fresh Water - NTR (40 CFR 131)	Applicable PQL[4]	Preliminary Cleanup Level[5]
VOCs (Continued)																				
o-Chlorotoluene	95-49-8	--	--	160	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	160
4-Chlorotoluene	106-43-4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
Cumene (Isopropylbenzene)	98-82-8	--	--	800	--	--	720	--	--	--	--	--	--	--	--	--	--	1,600	1.05	720
1,2-Dibromo-3-chloropropane	96-12-8	--	0.055	1.6	0.2	0.2	--	--	--	--	--	--	--	--	--	--	--	--	1	1
1,4-Dibromobenzene	106-37-6	--	--	80	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	80
Dibromochloromethane	124-48-1	--	0.52	160	80	80	0.22	21	14,000	--	--	--	--	--	--	0.4	13	0.41	0.5	0.5
1,1-Dichloro-1,2,2-trifluoroethane	812-04-4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2,2-Dichloro-1,1,1-trifluoroethane	306-83-2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	--
1,2-Dichlorobenzene	95-50-1	--	--	720	600	600	1,800	--	4,200	--	--	--	--	--	--	420	1,300	2,700	0.5	420
1,3-Dichlorobenzene	541-73-1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	320	960	400	0.5	320
1,4-Dichlorobenzene	106-46-7	--	--	--	75	75	7,900	--	--	--	--	--	--	--	--	63	190	400	0.2	63
1,1-Dichloroethane	75-34-3	--	--	1,600	--	--	2,300	--	--	--	--	--	--	--	--	--	--	--	0.5	1,600
1,2-Dichloroethane	107-06-2	5	0.48	160	5	5	4.2	59	43,200	--	--	--	--	--	--	0.38	37	0.38	0.02	0.38
1,1-Dichloroethene	75-35-4	--	--	400	7	7	130	--	23,100	--	--	--	--	--	--	330	7,100	0.057	0.02	0.057
1,2-Dichloroethene (total)	540-59-0	--	--	72	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	72
cis-1,2-Dichloroethene	156-59-2	--	--	16	70	70	160	--	--	--	--	--	--	--	--	--	--	--	0.5	16
trans-1,2-Dichloroethene	156-60-5	--	--	160	100	100	130	--	32,818	--	--	--	--	--	--	140	10,000	--	0.5	100
Dichlorodifluoromethane	75-71-8	--	--	1,600	--	--	9.9	--	--	--	--	--	--	--	--	--	--	--	0.5	9.9
1,2-Dichloropropane	78-87-5	--	--	--	5	5	28	--	--	--	--	--	--	--	--	0.50	15	--	0.5	0.5
1,3-Dichloropropane	142-28-9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	--
2,2-Dichloropropane	594-20-7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	--
1,1-Dichloropropene	563-58-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	--
cis-1,3-Dichloropropene	10061-01-5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
trans-1,3-Dichloropropene	10061-02-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	--
Ethyl chloride (chloroethane)	75-00-3	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	--	0.5	12
Ethylbenzene	100-41-4	700	--	800	700	700	2,800	--	6,914	--	--	--	--	--	--	530	2,100	3,100	0.5	530
Ethylene dibromide (EDB)	106-93-4	0.01	0.0219	72	0.05	0.05	0.74	--	--	--	--	--	--	--	--	--	--	--	0.981	0.981
2-Hexanone	591-78-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20	--
Isobutyl alcohol	78-83-1	--	--	2,400	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	2,400
p-Isopropyltoluene	99-87-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
Methacrylonitrile	126-98-7	--	--	0.8	--	--	56	--	--	--	--	--	--	--	--	--	--	--	1	1
Methyl iodide	74-88-4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
4-Methyl-2-pentanone (MIBK)	108-10-1	--	--	640	--	--	11,000	--	--	--	--	--	--	--	--	--	--	--	20	640
Methylcyclopentane	96-37-7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
Methylene bromide	74-95-3	--	--	80	--	--	--	--	--	--	--	--	--	--	--	--	--	48	0.5	48
Methylene chloride	75-09-2	5	5.83	480	5	5	4434	960	172,840	--	--	--	--	--	--	4.6	590	4.7	1	4.6
2-Methylpentane	107-83-5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
3-Methylpentane	96-14-0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
Propanoic acid	79-09-4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.25	--
n-Propylbenzene	103-65-1	--	--	800	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.98	800
Styrene	100-42-5	--	--	1,600	100	100	78	--	--	--	--	--	--	--	--	--	--	--	0.5	78
1,1,1,2-Tetrachloroethane	630-20-6	--	1.68	240	--	--	7.4	--	--	--	--	--	--	--	--	--	--	--	0.5	1.7
1,1,2,2-Tetrachloroethane	79-34-5	--	0.22	160	--	--	6.2	6.48	10,400	--	--	--	--	--	--	0.17	4.0	0.17	0.02	0.17
Tetrachloroethene	127-18-4	5	20.8	48	5	5	4.4	99.6	502	--	--	--	--	--	--	0.69	3.3	0.80	0.02	0.69
Toluene	108-88-3	1,000	--	640	1,000	1,000	15,000	--	19,400	--	--	--	--	--	--	1,300	15,000	6,800	0.5	640
1,2,3-Trichlorobenzene	87-61-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
1,2,4-Trichlorobenzene	120-82-1	--	1.51	80	70	70	3,900	1.96	227	--	--	--	--	--	--	35	70	--	1	1.51
1,1,1-Trichloroethane	71-55-6	200	--	16,000	200	200	11,000	--	926,000	--	--	--	--	--	--	--	--	--	0.5	200
1,1,2-Trichloroethane	79-00-5	--	0.77	32	5	5	7.9	25.3	2,305	--	--	--	--	--	--	0.59	16	0.60	0.5	0.59

TABLE 9-5

SHALLOW GROUNDWATER ZONE
GROUNDWATER PRELIMINARY CLEANUP LEVELS[1]
PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Groundwater, MTCA Method A Cleanup Level	Groundwater, MTCA Method B Cleanup Level, Carcinogenic	Groundwater, MTCA Method B Cleanup Level, Non-carcinogenic	Groundwater ARAR- Federal MCL[2]	Groundwater ARAR - State MCL[3]	Groundwater Screening Level Protective of Indoor Air	Surface Water, MTCA Method B Cleanup Level, Carcinogenic	Surface Water, MTCA Method B Cleanup Level, Non-carcinogenic	Surface Water ARAR - Aquatic Life - Fresh/Acute (WAC 173-201A)	Surface Water ARAR - Aquatic Life - Fresh/Acute (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Acute - NTR (40 CFR 131)	Surface Water ARAR - Aquatic Life - Fresh/Chronic (WAC 173-201A)	Surface Water ARAR- Aquatic Life - Fresh/Chronic (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Chronic - NTR (40 CFR 131)	ARAR - Human Health Consumption of Water and Organisms - Fresh Water (CWA §304)	Surface Water ARAR - Human Health Consumption of Organisms- Fresh Water (CWA §304)	ARAR - Human Health Consumption of Water and Organisms - Fresh Water - NTR (40 CFR 131)	Applicable PQL[4]	Preliminary Cleanup Level[5]
VOCs (Continued)																				
Trichloroethene	79-01-6	5	0.54	4	5	5	2.6	12.7	118	--	--	--	--	--	--	2.5	30	2.7	0.02	0.54
Trichlorofluoromethane	75-69-4	--	--	2,400	--	--	120	--	--	--	--	--	--	--	--	--	--	--	0.5	120
1,1,2-Trichlorotrifluoroethane	76-13-1	--	--	240,000	--	--	1,100	--	--	--	--	--	--	--	--	--	--	--	0.5	1,100
1,2,3-Trichloropropane	96-18-4	--	0.0015	32	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	0.5
1,2,4-Trimethylbenzene	95-63-6	--	--	--	--	--	24	--	--	--	--	--	--	--	--	--	--	--	1	24
1,3,5-Trimethylbenzene	108-67-8	--	--	80	--	--	25	--	--	--	--	--	--	--	--	--	--	--	0.5	25
Vinyl acetate	108-05-4	--	--	8,000	--	--	7,800	--	--	--	--	--	--	--	--	--	--	--	1	7,800
Vinyl chloride	75-01-4	0.2	0.029	24	2	2	0.35	--	6,648	--	--	--	--	--	--	0.025	2.4	2.0	0.02	0.025
m,p-Xylene	106-42-3	--	--	1,600	--	--	670	--	--	--	--	--	--	--	--	--	--	--	0.5	670
o-Xylene	95-47-6	--	--	1,600	--	--	440	--	--	--	--	--	--	--	--	--	--	--	0.5	440
Xylenes	1330-20-7	1,000	--	1,600	10,000	10,000	--	--	--	--	--	--	--	--	--	--	--	--	0.5	1,000
SVOCs																				
2,4,5-Trichlorophenol	95-95-4	--	--	800	--	--	--	--	--	--	--	--	--	--	--	1,800	3,600	--	0.251	800
2,4,6-Trichlorophenol	88-06-2	--	4	8	--	--	--	3.93	17.3	--	--	--	--	--	--	1.4	2.4	2.1	0.367	1.4
2-Chloronaphthalene	91-58-7	--	--	640	--	--	--	--	1,000	--	--	--	--	--	--	1,000	1,600	--	0.151	640
2-Chlorophenol	95-57-8	--	--	40	--	--	--	--	97	--	--	--	--	--	--	81	150	--	0.145	40
4-Methylphenol	106-44-5	--	--	40	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	40
1-Methylnaphthalene	90-12-0	--	--	1.51	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.02	1.51
2-Methyl-4,6-dinitrophenol	534-52-1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13	280	--	0.13	13
2-Methylaniline	95-53-4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10	--
2-Methylnaphthalene	91-57-6	--	--	32	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.02	32
2-Nitroaniline	88-74-4	--	--	160	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.024	160
2-Nitrophenol	88-75-5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.134	--
3-Nitroaniline	99-09-2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
4-Bromophenyl phenyl ether	101-55-3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.2	--
4-Chloro-3-methylphenol	59-50-7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.289	--
4-Chlorophenyl phenyl ether	7005-72-3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0842	--
4-Nitroaniline	100-01-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
4-Nitrophenol	100-02-7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--
Acenaphthene	83-32-9	--	--	960	--	--	--	--	640	--	--	--	--	--	--	670	990	--	0.0044	640
Acenaphthylene	208-96-8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0044	--
Acetophenone	98-86-2	--	--	800	--	--	50	--	--	--	--	--	--	--	--	--	--	--	0.5	50
Aldrin	309-00-2	--	0.0026	0.24	--	--	0.32	0.000082	0.017	2.5	3	3	0.0019	--	--	0.000049	0.00005	0.00013	0.0005	0.0005
alpha-Hexachlorocyclohexane	319-84-6	--	0.014	--	--	--	--	0.0079	--	--	--	--	--	--	--	0.0026	0.0049	0.0039	0.0005	0.0026
Aniline	62-53-3	--	7.7	56	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	7.7
Anthracene	120-12-7	--	--	4,800	--	--	--	--	26,000	--	--	--	--	--	--	8,300	40,000	9600	0.036	4,800
Benzo(a)anthracene	56-55-3	--	0.12	--	--	--	--	0.3	--	--	--	--	--	--	--	0.0038	0.018	0.0028	0.02	0.02
Benzo(a)pyrene	50-32-8	0.1	0.012	--	0.2	0.2	--	0.03	--	--	--	--	--	--	--	0.0038	0.018	0.0028	0.0158	0.0158
Benzo(b)fluoranthene	205-99-2	--	0.12	--	--	--	--	0.3	--	--	--	--	--	--	--	0.0038	0.018	0.0028	0.0194	0.0194
Benzo(g,h,i)perylene	191-24-2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.02	--
Benzo(k)fluoranthene	207-08-9	--	1.2	--	--	--	--	3	--	--	--	--	--	--	--	0.0038	0.018	0.0028	0.0134	0.0134
Benzoic acid	65-85-0	--	--	64,000	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5	64,000
Benzyl alcohol	100-51-6	--	--	800	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.73	800
beta-Hexachlorocyclohexane	319-85-7	--	0.049	--	--	--	--	0.03	--	--	--	--	--	--	--	0.0091	0.017	0.014	0.0091	0.0091
bis(2-Chloro-1-methylethyl) ether	108-60-1	--	0.625	320	--	--	--	37	42,000	--	--	--	--	--	--	--	--	--	0.167	0.625
bis(2-Chloroethoxy) methane	111-91-1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.113	--
bis(2-Chloroethyl) ether	111-44-4	--	0.04	--	--	--	26	0.85	--	--	--	--	--	--	--	0.030	0.53	0.031	0.2	0.2
bis(2-Ethylhexyl) phthalate	117-81-7	--	6.25	320	6	6	--	3.6	400	--	--	--	--	--	--	1.2	2.2	1.8	1	1.2
Butylbenzyl phthalate	85-68-7	--	46.1	3,200	--	--	--	8.2	1,300	--	--	--	--	--	--	1,500	1,900	--	0.18	8.2

TABLE 9-5

SHALLOW GROUNDWATER ZONE
GROUNDWATER PRELIMINARY CLEANUP LEVELS[1]

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Groundwater, MTCA Method A Cleanup Level	Groundwater, MTCA Method B Cleanup Level, Carcinogenic	Groundwater, MTCA Method B Cleanup Level, Non-carcinogenic	Groundwater ARAR- Federal MCL[2]	Groundwater ARAR - State MCL[3]	Groundwater Screening Level Protective of Indoor Air	Surface Water, MTCA Method B Cleanup Level, Carcinogenic	Surface Water, MTCA Method B Cleanup Level, Non-carcinogenic	Surface Water ARAR - Aquatic Life - Fresh/Acute (WAC 173-201A)	Surface Water ARAR - Aquatic Life - Fresh/Acute (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Acute - NTR (40 CFR 131)	Surface Water ARAR - Aquatic Life - Fresh/Chronic (WAC 173-201A)	Surface Water ARAR- Aquatic Life - Fresh/Chronic (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Chronic - NTR (40 CFR 131)	ARAR - Human Health Consumption of Water and Organisms - Fresh Water (CWA §304)	Surface Water ARAR - Human Health Consumption of Organisms- Fresh Water (CWA §304)	ARAR - Human Health Consumption of Water and Organisms - Fresh Water - NTR (40 CFR 131)	Applicable PQL[4]	Preliminary Cleanup Level[5]
SVOCs (Continued)																				
Chlordane	57-74-9	--	0.25	8	2	2	--	0.0013	0.092	2.4	2.4	2.4	0.0043	0.0043	0.0043	0.0008	0.00081	0.00057	0.005	0.005
Chrysene	218-01-9	--	0.012	--	--	--	--	30	--	--	--	--	--	--	--	0.0038	0.018	0.0028	0.0124	0.0124
3,3'-Dichlorobenzidine	91-94-1	--	0.19	--	--	--	--	0.046	--	--	--	--	--	--	--	0.021	0.028	0.04	2	2
1,4-Dioxane	123-91-1	--	0.438	240	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1
2,4-Dichlorophenol	120-83-2	--	--	24	--	--	--	--	191	--	--	--	--	--	--	77	290	93	0.47	24
2,4-Dimethylphenol	105-67-9	--	--	160	--	--	--	--	553	--	--	--	--	--	--	380	850	--	4	160
2,4-Dinitrophenol	51-28-5	--	--	32	--	--	--	--	3,457	--	--	--	--	--	--	69	5,300	70	4	32
2,4-Dinitrotoluene	121-14-2	--	--	32	--	--	--	--	1,365	--	--	--	--	--	--	0.11	3.4	0.11	0.18	0.18
2,6-Dichlorophenol	87-65-0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.8	--
2,6-Dinitrotoluene	606-20-2	--	--	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.033	16
Decachlorobiphenyl	2051-24-3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0034	--
Dibenzo[a,h]anthracene	53-70-3	--	0.012	--	--	--	--	0.030	--	--	--	--	--	--	--	0.0038	0.018	0.0028	0.0162	0.0162
Dibenzofuran	132-64-9	--	--	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.02	16
Diethyl phthalate	84-66-2	--	--	12,800	--	--	--	--	--	--	--	--	--	--	--	17,000	44,000	23,000	0.12	12,800
Dimethyl phthalate	131-11-3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	270,000	1,100,000	313,000	0.2	270,000
di-n-Butyl phthalate	84-74-2	--	--	1,600	--	--	--	--	2,900	--	--	--	--	--	--	2,000	4,500	2,700	0.2	1,600
di-n-Octyl phthalate	117-84-0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.18	--
Dinoseb	88-85-7	--	--	--	7	7	--	--	--	--	--	--	--	--	--	--	--	--	4.2	7
Diphenylamine	122-39-4	--	--	400	--	--	--	--	2,160	--	--	--	--	--	--	--	--	--	4.2	400
Fluoranthene	206-44-0	--	--	640	--	--	--	--	90.2	--	--	--	--	--	--	130	140	300	0.02	90
Fluorene	86-73-7	--	--	640	--	--	--	--	3,457	--	--	--	--	--	--	1,100	5,300	1,300	0.02	640
Heptachlor	76-44-8	--	0.019	8	0.4	0.4	--	0.0001	0.12	0.52	0.52	0.52	0.0038	0.0038	0.0038	0.000079	0.000079	0.00021	0.0005	0.0005
Heptachlor epoxide	1024-57-3	--	0.0048	0.104	0.2	0.2	--	0.0001	0.003	--	0.52	0.52	--	0.0038	0.0038	0.000039	0.000039	0.0001	0.0005	0.0005
Hexachlorobenzene	118-74-1	--	0.055	12.8	1	1	--	0.0005	0.24	--	--	--	--	--	--	0.00028	0.00029	0.00075	0.141	0.141
Hexachlorobutadiene	87-68-3	--	0.56	8	--	--	0.81	30	933	--	--	--	--	--	--	0.44	18	0.44	0.027	0.44
Hexachlorocyclopentadiene	77-47-4	--	--	48	50	50	--	--	3,584	--	--	--	--	--	--	40	1,100	240	0.19	40
Hexachloroethane	67-72-1	--	3.125	8	--	--	8.6	5.3	30	--	--	--	--	--	--	1.4	3.3	1.9	0.2	1.4
Hexachloropropene	1888-71-7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10	--
Indeno(1,2,3-cd)pyrene	193-39-5	--	0.12	--	--	--	--	0.296	--	--	--	--	--	--	--	0.0038	0.018	0.0028	0.02	0.02
Isophorone	78-59-1	--	46.05	1,600	--	--	--	1,558	118,383	--	--	--	--	--	--	35	960	8.4	0.16	8.4
Kepone	143-50-0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10	--
m-Cresol	108-39-4	--	--	400	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.78	400
m-Dinitrobenzene	99-65-0	--	--	1.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.2	5.2
N-Nitroso-di-n-propylamine	621-64-7	--	--	--	--	--	--	0.819	--	--	--	--	--	--	--	0.005	0.51	--	0.2	0.2
N-Nitrosodiphenylamine	86-30-6	--	--	--	--	--	--	10	--	--	--	--	--	--	--	3.3	6	5	0.2	3.3
Naphthalene	91-20-3	160	--	160	--	--	170	--	4,938	--	--	--	--	--	--	--	--	--	1	160
Nitrobenzene	98-95-3	--	--	16	--	--	10514	--	1,790	--	--	--	--	--	--	17	690	17	0.2	16
p-Chloroaniline	106-47-8	--	0.219	32	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.174	0.219
o-Cresol	95-48-7	--	--	400	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	400
Pentachlorophenol	87-86-5	--	0.219	80	1	1	--	1.47	1,180	20.27	19	20	12.79	15	13	0.27	3.0	0.28	0.95	0.95
Phenanthrene	85-01-8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.02	--
Phenol	108-95-2	--	--	2,400	--	--	--	--	556,000	--	--	--	--	--	--	10,000	860,000	21,000	0.5	2,400
Pyrene	129-00-0	--	--	480	--	--	--	--	2,593	--	--	--	--	--	--	830	4,000	960	0.02	480
PCBs/Pesticides																				
delta-BHC	319-86-8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0005	--
alpha-Chlordane	103-71-9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0005	--
4,4'-DDD	72-54-8	--	0.37	--	--	--	--	0.0005	--	1.1	--	--	0.001	--	--	0.00031	0.00031	0.00083	0.00047	0.00047
4,4'-DDE	72-55-9	--	0.26	--	--	--	--	0.00036	--	1.1	--	--	0.001	--	--	0.00022	0.00022	0.00059	0.0005	0.0005
4,4'-DDT	50-29-3	0.3	0.26	8	--	--	--	0.00036	--	1.1	1.1	1.1	0.001	0.001	0.001	0.00022	0.00022	0.00059	0.00047	0.00047
Dicamba	1918-00-9	--	--	480	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.081	480

TABLE 9-5

SHALLOW GROUNDWATER ZONE
GROUNDWATER PRELIMINARY CLEANUP LEVELS[1]

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Groundwater, MTCA Method A Cleanup Level	Groundwater, MTCA Method B Cleanup Level, Carcinogenic	Groundwater, MTCA Method B Cleanup Level, Non-carcinogenic	Groundwater ARAR- Federal MCL[2]	Groundwater ARAR - State MCL[3]	Groundwater Screening Level Protective of Indoor Air	Surface Water, MTCA Method B Cleanup Level, Carcinogenic	Surface Water, MTCA Method B Cleanup Level, Non-carcinogenic	Surface Water ARAR - Aquatic Life - Fresh/Acute (WAC 173-201A)	Surface Water ARAR - Aquatic Life - Fresh/Acute (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Acute - NTR (40 CFR 131)	Surface Water ARAR - Aquatic Life - Fresh/Chronic (WAC 173-201A)	Surface Water ARAR- Aquatic Life - Fresh/Chronic (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Chronic - NTR (40 CFR 131)	ARAR - Human Health Consumption of Water and Organisms - Fresh Water (CWA §304)	Surface Water ARAR - Human Health Consumption of Organisms- Fresh Water (CWA §304)	ARAR - Human Health Consumption of Water and Organisms - Fresh Water - NTR (40 CFR 131)	Applicable PQL[4]	Preliminary Cleanup Level[5]
PCBs/Pesticides (Continued)																				
Dieldrin	60-57-1	--	0.0055	0.8	--	--	--	0.00009	0.028	2.5	0.24	2.5	0.0019	0.056	0.0019	0.000052	0.000054	0.00014	0.0005	0.0005
Dimethoate	60-51-5	--	--	3.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	3.2
Endosulfan I[6]	959-98-8	--	--	96	--	--	--	--	--	0.22	--	0.22	0.056	--	0.056	62	89	--	0.04	0.056
Endosulfan II[6]	33213-65-9	--	--	96	--	--	--	--	--	0.22	--	0.22	0.056	--	0.056	62	89	--	0.000087	0.056
Endosulfan sulfate	1031-07-8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	62	89	--	0.0005	62
Endrin	72-20-8	--	--	4.8	2	2	--	--	0.20	0.18	0.086	0.18	0.0023	0.036	0.0023	0.059	0.060	0.76	0.0005	0.0023
Endrin aldehyde	7421-93-4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.29	0.30	--	0.00038	0.29
Endrin ketone	53494-70-5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0003	--
Isodrin	465-73-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.05	--
Lindane	58-89-9	0.2	--	4.8	0.2	0.2	--	--	5.98	2	0.95	2	0.08	--	0.08	0.98	1.8	0.019	0.0005	0.019
Methoxychlor	72-43-5	--	--	80	40	40	--	--	8.36	--	--	--	--	0.03	--	100	--	--	0.0005	0.03
Methyl parathion	298-00-0	--	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	4
Parathion	56-38-2	--	--	96	--	--	--	--	--	0.065	0.065	--	0.013	0.013	--	--	--	--	5.1	5.1
Tetrachloro-m-xylene	877-09-8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Thionazin	297-97-2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.1	--
Aroclor 1016	12674-11-2	--	1.25	1.12	--	--	--	0.0030	0.0058	--	--	--	--	--	0.014	--	--	--	0.005	0.005
Aroclor 1254	11097-69-1	--	0.0437	0.32	--	--	--	0.0001	0.0017	--	--	--	--	--	0.014	--	--	--	0.005	0.005
Aroclor 1260	11096-82-5	--	0.0437	--	--	--	--	--	--	--	--	--	--	--	0.014	--	--	--	0.005	0.014
Toxaphene	8001-35-2	--	0.08	--	3	3	--	0.00045	--	0.73	0.73	0.73	0.0002	0.0002	0.0002	0.00028	0.00028	0.00073	0.025	0.025
Total PCBs	1336-36-3	0.1	0.044	--	0.5	0.5	--	0.00010	--	2	--	--	0.014	0.014	0.14	0.000064	0.000064	0.00017	0.005	0.005
TPH																				
Diesel		500	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	76	500
Gasoline	86290-81-5	800	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	130	800
Heavy oils	NA	500	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19	500
Lube oil	NA	500	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	190	500

Notes

1. All levels downloaded from Washington State Department of Ecology Cleanup Levels and Risk Calculations (CLARC) Web site, https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx.
2. Federal MCL established under the Safe Drinking Water Act.
3. State MCL established under WAC 246-290.
4. Applicable PQL taken from Table 9-4.
5. Preliminary cleanup level was selected based on criteria described in text. In some cases, the screening level was adjusted up to the PQL (WAC 173-340-707).
6. Values for endosulfan (CAS 115-29-7) listed.
7. Value calculated as the site specific area background (Appendix O).

Abbreviations

-- = not available
ARAR = applicable or relevant and appropriate requirement
CAS = Chemical Abstracts Service
CFR = Code of Federal Regulations
CWA = Clean Water Act
MCL = maximum contaminant level
MTCA = Model Toxics Control Act
NA = not applicable
NTR = National Toxics Rule
PCBs = polychlorinated biphenyls
PQL = practical quantitation limit
SVOCs = semivolatile organic compounds
TPH = total petroleum hydrocarbons
VOCs = volatile organic compounds
WAC = Washington Adminstrative Code

TABLE 9-6

LOWER AQUIFER GROUNDWATER ZONE
GROUNDWATER PRELIMINARY CLEANUP LEVELS[1]

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Groundwater, MTCA Method A Cleanup Level	Groundwater, MTCA Method B Cleanup Level, Carcinogenic	Groundwater, MTCA Method B Cleanup Level, Non-carcinogenic	Groundwater ARAR-Federal MCL[2]	Groundwater ARAR - State MCL[3]	Surface Water, MTCA Method B Cleanup Level, Carcinogenic	Surface Water, MTCA Method B Cleanup Level, Non-carcinogenic	Surface Water ARAR - Aquatic Life - Fresh/Acute (WAC 173-201A)	Surface Water ARAR - Aquatic Life - Fresh/Acute (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Acute - NTR (40 CFR 131)	Surface Water ARAR - Aquatic Life - Fresh/Chronic (WAC 173-201A)	Surface Water ARAR- Aquatic Life - Fresh/Chronic (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Chronic - NTR (40 CFR 131)	Surface Water ARAR - Human Health Consumption of Water and Organisms - Fresh Water (CWA §304)	Surface Water ARAR - Human Health Consumption of Organisms- Fresh Water (CWA §304)	ARAR - Human Health Consumption of Water and Organisms - Fresh Water - NTR (40 CFR 131)	Applicable PQL[4]	Preliminary Cleanup Level[5]
Inorganics																			
Ammonia (as nitrogen)	7664-41-7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	50	--
Antimony	7440-36-0	--	--	6.4	6	6	--	1,000	--	--	--	--	--	--	5.6	640	14	0.05	5.6
Arsenic, inorganic	7440-38-2	5	0.058	4.8	10	10	0.098	18	360	340	360	190	150	190	0.018	0.14	0.018	0.5	1.42 [7]
Barium	7440-39-3	--	--	3,200	2,000	2,000	--	--	--	--	--	--	--	--	1,000	--	--	0.05	1,000
Beryllium	7440-41-7	--	--	32	4	4	--	270	--	--	--	--	--	--	--	--	--	0.02	4
Cadmium	7440-43-9	5	--	16	5	5	--	41	0.82	2	3.9	0.37	0.25	1	--	--	--	0.02	0.25
Chloride	16887-00-6	--	--	--	--	--	--	--	860,000	860,000	--	230,000	230,000	--	--	--	--	200	230,000
Chromium	7440-47-3	50	--	--	100	100	--	--	--	--	--	--	--	--	--	--	--	0.2	50
Cobalt	7440-48-4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.02	--
Copper	7440-50-8	--	--	640	1,300	1,300	--	2,900	4.61	13	17	3.47	9	11	1,300	--	--	0.1	3.47
Cyanide	57-12-5	--	--	--	200	200	--	52,000	22	22	22	5.2	5.2	5.2	140	140	700	10	10
Iron	7439-89-6	--	--	11,200	--	--	--	--	--	--	--	--	1,000	--	--	--	--	20	1,000
Lead	7439-92-1	15	--	--	15	15	--	--	13.88	65	65	0.54	2.5	2.5	--	--	--	0.02	0.54
Manganese	7439-96-5	--	--	2,240	--	--	--	--	--	--	--	--	--	--	50	100	--	0.05	50
Mercury	7439-97-6	2	--	--	2	2	--	--	2.1	1.4	2.1	0.012	0.77	0.012	--	0.3	0.14	0.2	0.2
Nickel	7440-02-0	--	--	320	--	100	--	1,103	438	470	1,400	48.65	52	160	610	4,600	610	0.2	48.7
Nitrate (as nitrogen)	14797-55-8	--	--	--	10,000	10,000	--	--	--	--	--	--	--	--	10,000	--	--	40	10,000
Nitrite	14797-65-0	--	--	--	1,000	1,000	--	--	--	--	--	--	--	--	--	--	--	0.1	1,000
Selenium and compounds	7782-49-2	--	--	80	50	50	--	2,701	20	--	20	5	5	5	170	4,200	--	1	5
Silver	7440-22-4	--	--	80	--	--	--	25,926	0.32	3.2	3.4	--	--	--	--	--	--	0.02	0.32
Sulfate	14808-79-8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Thallium, soluble salts	7440-28-0	--	--	--	2	2	--	--	--	--	--	--	--	--	0.24	0.47	1.70	0.003	0.24
Tin	7440-31-5	--	--	9,600	--	--	--	--	--	--	--	--	--	--	--	--	--	0.1	9,600
Vanadium	7440-62-2	--	--	1.12	--	--	--	--	--	--	--	--	--	--	--	--	--	0.2	1.12
Zinc	7440-66-6	--	--	4,800	--	--	--	16,548	35.36	120	110	32.29	120	100	7,400	26,000	--	0.5	32.3
VOCs																			
Acetic acid	64-19-7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.25	--
Acetone	67-64-1	--	--	7200	--	--	--	--	--	--	--	--	--	--	--	--	--	1	7,200
Acrolein	107-02-8	--	--	4	--	--	--	--	--	--	--	--	--	--	6	9	320	1	4
Acrylonitrile	107-13-1	--	0.081	--	--	--	0.40	--	--	--	--	--	--	--	0.051	0.25	0.059	1	1
Allyl chloride	107-05-1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
Benzene	71-43-2	5	0.8	32	5	5	23	2,000	--	--	--	--	--	--	2.2	51	1.2	0.5	0.8
Bromobenzene	108-86-1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
Bromochloromethane	74-97-5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	--
Bromodichloromethane	75-27-4	--	0.71	160	80	80	28	14,000	--	--	--	--	--	--	0.55	17	0.27	0.5	0.5
Bromoform	75-25-2	--	5.54	160	80	80	220	14,000	--	--	--	--	--	--	4.3	140	4.3	0.5	4.3
Bromomethane	74-83-9	--	--	11.2	--	--	--	970	--	--	--	--	--	--	47	1,500	48	0.5	11.2
n-Butanoic acid	107-92-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.25	--
2-Butanone (MEK)	78-93-3	--	--	4,800	--	--	--	--	--	--	--	--	--	--	--	--	--	1	4,800
sec-Butylbenzene	135-98-8	--	--	61	--	--	--	--	--	--	--	--	--	--	--	--	--	1	61
tert-Butylbenzene	98-06-6	--	--	61	--	--	--	--	--	--	--	--	--	--	--	--	--	1	61
n-Butylbenzene	104-51-8	--	--	61	--	--	--	--	--	--	--	--	--	--	--	--	--	1	61
iso-Butyric acid	79-31-2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.25	--
Carbon disulfide	75-15-0	--	--	800	--	--	--	--	--	--	--	--	--	--	--	--		0.5	800
Carbon tetrachloride	56-23-5	--	0.625	32	5	5	4.9	550	--	--	--	--	--	--	0.23	1.6	0.25	0.043	0.23
2-Chloro-1,3-butadiene	126-99-8	--	--	160	--	--	--	--	--	--	--	--	--	--	--	--	--	1	160
Chlorobenzene	108-90-7	--	--	160	100	100	--	5,000	--	--	--	--	--	--	130	1,600	680	0.5	100
Chloroform	67-66-3	--	--	80	80	80	--	6,900	--	--	--	--	--	--	5.7	470	5.7	0.5	5.7
Chloromethane	74-87-3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		0.5	--

TABLE 9-6

LOWER AQUIFER GROUNDWATER ZONE
GROUNDWATER PRELIMINARY CLEANUP LEVELS^1
PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Groundwater, MTCA Method A Cleanup Level	Groundwater, MTCA Method B Cleanup Level, Carcinogenic	Groundwater, MTCA Method B Cleanup Level, Non-carcinogenic	Groundwater ARAR- Federal MCL^2	Groundwater ARAR - State MCL^3	Surface Water, MTCA Method B Cleanup Level, Carcinogenic	Surface Water, MTCA Method B Cleanup Level, Non-carcinogenic	Surface Water ARAR - Aquatic Life - Fresh/Acute (WAC 173-201A)	Surface Water ARAR - Aquatic Life - Fresh/Acute (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Acute - NTR (40 CFR 131)	Surface Water ARAR - Aquatic Life - Fresh/Chronic (WAC 173-201A)	Surface Water ARAR- Aquatic Life - Fresh/Chronic (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Chronic - NTR (40 CFR 131)	Surface Water ARAR - Human Health Consumption of Water and Organisms - Fresh Water (CWA §304)	Surface Water ARAR - Human Health Consumption of Organisms- Fresh Water (CWA §304)	ARAR - Human Health Consumption of Water and Organisms - Fresh Water - NTR (40 CFR 131)	Applicable PQL^4	Preliminary Cleanup Level^5
VOCs (Continued)																			
o-Chlorotoluene	95-49-8	--	--	160	--	--	--	--	--	--	--	--	--	--	--	--	--	1	160
4-Chlorotoluene	106-43-4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
Cumene (Isopropylbenzene)	98-82-8	--	--	800	--	--	--	--	--	--	--	--	--	--	--	--	1,600	1.05	800
1,2-Dibromo-3-chloropropane	96-12-8	--	0.055	1.6	0.2	0.2	--	--	--	--	--	--	--	--	--	--	--	1	1
1,4-Dibromobenzene	106-37-6	--	--	80	--	--	--	--	--	--	--	--	--	--	--	--	--	--	80
Dibromochloromethane	124-48-1	--	0.52	160	80	80	21	14,000	--	--	--	--	--	--	0.4	13	0.41	0.5	0.4
1,1-Dichloro-1,2,2-trifluoroethane	812-04-4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2,2-Dichloro-1,1,1-trifluoroethane	306-83-2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	--
1,2-Dichlorobenzene	95-50-1	--	--	720	600	600	--	4,200	--	--	--	--	--	--	420	1,300	2,700	0.5	420
1,3-Dichlorobenzene	541-73-1	--	--	--	--	--	--	--	--	--	--	--	--	--	320	960	400	0.5	320
1,4-Dichlorobenzene	106-46-7	--	--	--	75	75	--	--	--	--	--	--	--	--	63	190	400	0.2	63
1,1-Dichloroethane	75-34-3	--	--	1,600	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	1,600
1,2-Dichloroethane	107-06-2	5	0.48	160	5	5	59	43,200	--	--	--	--	--	--	0.38	37	0.38	0.02	0.38
1,1-Dichloroethene	75-35-4	--	--	400	7	7	--	23,100	--	--	--	--	--	--	330	7,100	0.057	0.02	0.057
1,2-Dichloroethene (total)	540-59-0	--	--	72	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	72
cis-1,2-Dichloroethene	156-59-2	--	--	16	70	70	--	--	--	--	--	--	--	--	--	--	--	0.5	16
trans-1,2-Dichloroethene	156-60-5	--	--	160	100	100	--	32,818	--	--	--	--	--	--	140	10,000	--	0.5	100
Dichlorodifluoromethane	75-71-8	--	--	1,600	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	1600
1,2-Dichloropropane	78-87-5	--	--	--	5	5	--	--	--	--	--	--	--	--	0.50	15	--	0.5	0.5
1,3-Dichloropropane	142-28-9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	--
2,2-Dichloropropane	594-20-7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	--
1,1-Dichloropropene	563-58-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	--
cis-1,3-Dichloropropene	10061-01-5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
trans-1,3-Dichloropropene	10061-02-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	--
Ethyl chloride (chloroethane)	75-00-3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	--
Ethylbenzene	100-41-4	700	--	800	700	700	--	6,914	--	--	--	--	--	--	530	2,100	3,100	0.5	530
Ethylene dibromide (EDB)	106-93-4	0.01	0.0219	72	0.05	0.05	--	--	--	--	--	--	--	--	--	--	--	0.981	0.981
2-Hexanone	591-78-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20	--
Isobutyl alcohol	78-83-1	--	--	2,400	--	--	--	--	--	--	--	--	--	--	--	--	--	1	2,400
p-Isopropyltoluene	99-87-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
Methacrylonitrile	126-98-7	--	--	0.8	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1
Methyl iodide	74-88-4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
4-Methyl-2-pentanone (MIBK)	108-10-1	--	--	640	--	--	--	--	--	--	--	--	--	--	--	--	--	20	640
Methylcyclopentane	96-37-7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
Methylene bromide	74-95-3	--	--	80	--	--	--	--	--	--	--	--	--	--	--	--	48	0.5	48
Methylene chloride	75-09-2	5	5.83	480	5	5	960	172,840	--	--	--	--	--	--	4.6	590	4.7	1	4.6
2-Methylpentane	107-83-5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
3-Methylpentane	96-14-0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
Propanoic acid	79-09-4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.25	--
n-Propylbenzene	103-65-1	--	--	800	--	--	--	--	--	--	--	--	--	--	--	--	--	0.98	800
Styrene	100-42-5	--	--	1,600	100	100	--	--	--	--	--	--	--	--	--	--	--	0.5	100
1,1,1,2-Tetrachloroethane	630-20-6	--	1.68	240	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	1.68
1,1,2,2-Tetrachloroethane	79-34-5	--	0.22	160	--	--	6.48	10,400	--	--	--	--	--	--	0.17	4.0	0.17	0.02	0.17
Tetrachloroethene	127-18-4	5	20.8	48	5	5	99.6	502	--	--	--	--	--	--	0.69	3.3	0.80	0.02	0.69
Toluene	108-88-3	1,000	--	640	1,000	1,000	--	19,400	--	--	--	--	--	--	1,300	15,000	6,800	0.5	640
1,2,3-Trichlorobenzene	87-61-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
1,2,4-Trichlorobenzene	120-82-1	--	1.51	80	70	70	1.96	227	--	--	--	--	--	--	35	70	--	1	1.51
1,1,1-Trichloroethane	71-55-6	200	--	16,000	200	200	--	926,000	--	--	--	--	--	--	--	--	--	0.5	200
1,1,2-Trichloroethane	79-00-5	--	0.77	32	5	5	25.3	2,305	--	--	--	--	--	--	0.59	16	0.60	0.5	0.59

TABLE 9-6

LOWER AQUIFER GROUNDWATER ZONE
GROUNDWATER PRELIMINARY CLEANUP LEVELS[1]

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Groundwater, MTCA Method A Cleanup Level	Groundwater, MTCA Method B Cleanup Level, Carcinogenic	Groundwater, MTCA Method B Cleanup Level, Non-carcinogenic	Groundwater ARAR-Federal MCL[2]	Groundwater ARAR - State MCL[3]	Surface Water, MTCA Method B Cleanup Level, Carcinogenic	Surface Water, MTCA Method B Cleanup Level, Non-carcinogenic	Surface Water ARAR - Aquatic Life - Fresh/Acute (WAC 173-201A)	Surface Water ARAR - Aquatic Life - Fresh/Acute (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Acute - NTR (40 CFR 131)	Surface Water ARAR - Aquatic Life - Fresh/Chronic (WAC 173-201A)	Surface Water ARAR- Aquatic Life - Fresh/Chronic (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Chronic - NTR (40 CFR 131)	Surface Water ARAR - Human Health Consumption of Water and Organisms - Fresh Water (CWA §304)	Surface Water ARAR - Human Health Consumption of Organisms- Fresh Water (CWA §304)	ARAR - Human Health Consumption of Water and Organisms - Fresh Water - NTR (40 CFR 131)	Applicable PQL[4]	Preliminary Cleanup Level[5]
VOCs (Continued)																			
Trichloroethene	79-01-6	5	0.54	4	5	5	12.7	118	--	--	--	--	--	--	2.5	30	2.7	0.02	0.54
Trichlorofluoromethane	75-69-4	--	--	2,400	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	2,400
1,1,2-Trichlorotrifluoroethane	76-13-1	--	--	240,000	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	240,000
1,2,3-Trichloropropane	96-18-4	--	0.0015	32	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	0.5
1,2,4-Trimethylbenzene	95-63-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
1,3,5-Trimethylbenzene	108-67-8	--	--	80	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	80
Vinyl acetate	108-05-4	--	--	8,000	--	--	--	--	--	--	--	--	--	--	--	--	--	1	8,000
Vinyl chloride	75-01-4	0.2	0.029	24	2	2	--	6,648	--	--	--	--	--	--	0.025	2.4	2.0	0.02	0.025
m,p-Xylene	106-42-3	--	--	1,600	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	1600
o-Xylene	95-47-6	--	--	1,600	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	1,600
Xylenes	1330-20-7	1,000	--	1,600	10,000	10,000	--	--	--	--	--	--	--	--	--	--	--	0.5	1,000
SVOCs																			
2,4,5-Trichlorophenol	95-95-4	--	--	800	--	--	--	--	--	--	--	--	--	--	1,800	3,600	--	0.251	800
2,4,6-Trichlorophenol	88-06-2	--	4	8	--	--	3.93	17.3	--	--	--	--	--	--	1.4	2.4	2.1	0.367	1.4
2-Chloronaphthalene	91-58-7	--	--	640	--	--	--	1,000	--	--	--	--	--	--	1,000	1,600	--	0.151	640
2-Chlorophenol	95-57-8	--	--	40	--	--	--	97	--	--	--	--	--	--	81	150	--	0.145	40
4-Methylphenol	106-44-5	--	--	40	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	40
1-Methylnaphthalene	90-12-0	--	--	1.51	--	--	--	--	--	--	--	--	--	--	--	--	--	0.02	1.51
2-Methyl-4,6-dinitrophenol	534-52-1	--	--	--	--	--	--	--	--	--	--	--	--	--	13	280	--	0.13	13
2-Methylaniline	95-53-4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10	--
2-Methylnaphthalene	91-57-6	--	--	32	--	--	--	--	--	--	--	--	--	--	--	--	--	0.02	32
2-Nitroaniline	88-74-4	--	--	160	--	--	--	--	--	--	--	--	--	--	--	--	--	0.024	160
2-Nitrophenol	88-75-5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.134	--
3-Nitroaniline	99-09-2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
4-Bromophenyl phenyl ether	101-55-3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.2	--
4-Chloro-3-methylphenol	59-50-7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.289	--
4-Chlorophenyl phenyl ether	7005-72-3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0842	--
4-Nitroaniline	100-01-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
4-Nitrophenol	100-02-7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--
Acenaphthene	83-32-9	--	--	960	--	--	--	640	--	--	--	--	--	--	670	990	--	0.0044	640
Acenaphthylene	208-96-8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0044	--
Acetophenone	98-86-2	--	--	800	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	800
Aldrin	309-00-2	--	0.0026	0.24	--	--	0.000082	0.017	2.5	3	3	0.0019	--	--	0.000049	0.00005	0.00013	0.0005	0.0005
alpha-Hexachlorocyclohexane	319-84-6	--	0.014	--	--	--	0.0079	--	--	--	--	--	--	--	0.0026	0.0049	0.0039	0.0005	0.0026
Aniline	62-53-3	--	7.7	56	--	--	--	--	--	--	--	--	--	--	--	--	--	1	7.7
Anthracene	120-12-7	--	--	4,800	--	--	--	26,000	--	--	--	--	--	--	8,300	40,000	9600	0.036	4,800
Benzo(a)anthracene	56-55-3	--	0.12	--	--	--	0.3	--	--	--	--	--	--	--	0.0038	0.018	0.0028	0.02	0.02
Benzo(a)pyrene	50-32-8	0.1	0.012	--	0.2	0.2	0.03	--	--	--	--	--	--	--	0.0038	0.018	0.0028	0.0158	0.0158
Benzo(b)fluoranthene	205-99-2	--	0.12	--	--	--	0.3	--	--	--	--	--	--	--	0.0038	0.018	0.0028	0.0194	0.0194
Benzo(g,h,i)perylene	191-24-2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.02	--
Benzo(k)fluoranthene	207-08-9	--	1.2	--	--	--	3	--	--	--	--	--	--	--	0.0038	0.018	0.0028	0.0134	0.0134
Benzoic acid	65-85-0	--	--	64,000	--	--	--	--	--	--	--	--	--	--	--	--	--	5	64,000
Benzyl alcohol	100-51-6	--	--	800	--	--	--	--	--	--	--	--	--	--	--	--	--	0.73	800
beta-Hexachlorocyclohexane	319-85-7	--	0.049	--	--	--	0.03	--	--	--	--	--	--	--	0.0091	0.017	0.014	0.0091	0.0091
bis(2-Chloro-1-methylethyl) ether	108-60-1	--	0.625	320	--	--	37	42,000	--	--	--	--	--	--	--	--	--	0.167	0.625
bis(2-Chloroethoxy) methane	111-91-1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.113	--
bis(2-Chloroethyl) ether	111-44-4	--	0.04	--	--	--	0.85	--	--	--	--	--	--	--	0.030	0.53	0.031	0.2	0.2
bis(2-Ethylhexyl) phthalate	117-81-7	--	6.25	320	6	6	3.6	400	--	--	--	--	--	--	1.2	2.2	1.8	1	1.2
Butylbenzyl phthalate	85-68-7	--	48.1	3,200	--	--	8.2	1,300	--	--	--	--	--	--	1,500	1,900	--	0.18	8.2

TABLE 9-6

LOWER AQUIFER GROUNDWATER ZONE
GROUNDWATER PRELIMINARY CLEANUP LEVELS[1]
PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Groundwater, MTCA Method A Cleanup Level	Groundwater, MTCA Method B Cleanup Level, Carcinogenic	Groundwater, MTCA Method B Cleanup Level, Non-carcinogenic	Groundwater ARAR- Federal MCL[2]	Groundwater ARAR - State MCL[3]	Surface Water, MTCA Method B Cleanup Level, Carcinogenic	Surface Water, MTCA Method B Cleanup Level, Non-carcinogenic	Surface Water ARAR - Aquatic Life - Fresh/Acute (WAC 173-201A)	Surface Water ARAR - Aquatic Life - Fresh/Acute (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Acute - NTR (40 CFR 131)	Surface Water ARAR - Aquatic Life - Fresh/Chronic (WAC 173-201A)	Surface Water ARAR- Aquatic Life - Fresh/Chronic (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Chronic - NTR (40 CFR 131)	Surface Water ARAR - Human Health Consumption of Water and Organisms - Fresh Water (CWA §304)	Surface Water ARAR - Human Health Consumption of Organisms- Fresh Water (CWA §304)	ARAR - Human Health Consumption of Water and Organisms - Fresh Water - NTR (40 CFR 131)	Applicable PQL[4]	Preliminary Cleanup Level[5]
SVOCs (Continued)																			
Chlordane	57-74-9	--	0.25	8	2	2	0.0013	0.092	2.4	2.4	2.4	0.0043	0.0043	0.0043	0.0008	0.00081	0.00057	0.005	0.005
Chrysene	218-01-9	--	0.012	--	--	--	30	--	--	--	--	--	--	--	0.0038	0.018	0.0028	0.0124	0.0124
3,3'-Dichlorobenzidine	91-94-1	--	0.19	--	--	--	0.046	--	--	--	--	--	--	--	0.021	0.028	0.04	2	2
1,4-Dioxane	123-91-1	--	0.438	240	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1
2,4-Dichlorophenol	120-83-2	--	--	24	--	--	--	191	--	--	--	--	--	--	77	290	93	0.47	24
2,4-Dimethylphenol	105-67-9	--	--	160	--	--	--	553	--	--	--	--	--	--	380	850	--	4	160
2,4-Dinitrophenol	51-28-5	--	--	32	--	--	--	3,457	--	--	--	--	--	--	69	5,300	70	4	32
2,4-Dinitrotoluene	121-14-2	--	--	32	--	--	--	1,365	--	--	--	--	--	--	0.11	3.4	0.11	0.18	0.18
2,6-Dichlorophenol	87-65-0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.8	--
2,6-Dinitrotoluene	606-20-2	--	--	16	--	--	--	--	--	--	--	--	--	--	--	--	--	0.033	16
Decachlorobiphenyl	2051-24-3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0034	--
Dibenzo[a,h]anthracene	53-70-3	--	0.012	--	--	--	0.030	--	--	--	--	--	--	--	0.0038	0.018	0.0028	0.0162	0.0162
Dibenzofuran	132-64-9	--	--	16	--	--	--	--	--	--	--	--	--	--	--	--	--	0.02	16
Diethyl phthalate	84-66-2	--	--	12,800	--	--	--	--	--	--	--	--	--	--	17,000	44,000	23,000	0.12	12,800
Dimethyl phthalate	131-11-3	--	--	--	--	--	--	--	--	--	--	--	--	--	270,000	1,100,000	313,000	0.2	270,000
di-n-Butyl phthalate	84-74-2	--	--	1,600	--	--	--	2,900	--	--	--	--	--	--	2,000	4,500	2,700	0.2	1,600
di-n-Octyl phthalate	117-84-0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.18	--
Dinoseb	88-85-7	--	--	--	7	7	--	--	--	--	--	--	--	--	--	--	--	4.2	7
Diphenylamine	122-39-4	--	--	400	--	--	--	2,160	--	--	--	--	--	--	--	--	--	4.2	400
Fluoranthene	206-44-0	--	--	640	--	--	--	90.2	--	--	--	--	--	--	130	140	300	0.02	90.2
Fluorene	86-73-7	--	--	640	--	--	--	3,457	--	--	--	--	--	--	1,100	5,300	1,300	0.02	640
Heptachlor	76-44-8	--	0.019	8	0.4	0.4	0.0001	0.12	0.52	0.52	0.52	0.0038	0.0038	0.0038	0.000079	0.000079	0.00021	0.0005	0.0005
Heptachlor epoxide	1024-57-3	--	0.0048	0.104	0.2	0.2	0.0001	0.003	--	0.52	0.52	--	0.0038	0.0038	0.000039	0.000039	0.0001	0.0005	0.0005
Hexachlorobenzene	118-74-1	--	0.055	12.8	1	1	0.0005	0.24	--	--	--	--	--	--	0.00028	0.00029	0.00075	0.141	0.141
Hexachlorobutadiene	87-68-3	--	0.56	8	--	--	30	933	--	--	--	--	--	--	0.44	18	0.44	0.027	0.44
Hexachlorocyclopentadiene	77-47-4	--	--	48	50	50	--	3,584	--	--	--	--	--	--	40	1,100	240	0.19	40
Hexachloroethane	67-72-1	--	3.125	8	--	--	5.3	30	--	--	--	--	--	--	1.4	3.3	1.9	0.2	1.4
Hexachloropropene	1888-71-7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10	--
Indeno(1,2,3-cd)pyrene	193-39-5	--	0.12	--	--	--	0.296	--	--	--	--	--	--	--	0.0038	0.018	0.0028	0.02	0.02
Isophorone	78-59-1	--	46.05	1,600	--	--	1,558	118,383	--	--	--	--	--	--	35	960	8.4	0.16	8.4
Kepone	143-50-0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10	--
m-Cresol	108-39-4	--	--	400	--	--	--	--	--	--	--	--	--	--	--	--	--	4.78	400
m-Dinitrobenzene	99-65-0	--	--	1.6	--	--	--	--	--	--	--	--	--	--	--	--	--	5.2	5.2
N-Nitroso-di-n-propylamine	621-64-7	--	--	--	--	--	0.819	--	--	--	--	--	--	--	0.005	0.51	--	0.2	0.2
N-Nitrosodiphenylamine	86-30-6	--	--	--	--	--	10	--	--	--	--	--	--	--	3.3	6	5	0.2	3.3
Naphthalene	91-20-3	160	--	160	--	--	--	4,938	--	--	--	--	--	--	--	--	--	1	160
Nitrobenzene	98-95-3	--	--	16	--	--	--	1,790	--	--	--	--	--	--	17	690	17	0.2	16
p-Chloroaniline	106-47-8	--	0.219	32	--	--	--	--	--	--	--	--	--	--	--	--	--	0.174	0.219
o-Cresol	95-48-7	--	--	400	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	400
Pentachlorophenol	87-86-5	--	0.219	80	1	1	1.47	1,180	20.27	19	20	12.79	15	13	0.27	3.0	0.28	0.95	0.95
Phenanthrene	85-01-8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.02	--
Phenol	108-95-2	--	--	2,400	--	--	--	556,000	--	--	--	--	--	--	10,000	860,000	21,000	0.5	2,400
Pyrene	129-00-0	--	--	480	--	--	--	2,593	--	--	--	--	--	--	830	4000	960	0.02	480
PCBs/Pesticides																			
delta-BHC	319-86-8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0005	--
alpha-Chlordane	103-71-9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0005	--
4,4'-DDD	72-54-8	--	0.37	--	--	--	0.0005	--	1.1	--	--	0.001	--	--	0.00031	0.00031	0.00083	0.00047	0.00047
4,4'-DDE	72-55-9	--	0.26	--	--	--	0.00036	--	1.1	--	--	0.001	--	--	0.00022	0.00022	0.00059	0.0005	0.0005
4,4'-DDT	50-29-3	0.3	0.26	8	--	--	0.00036	--	1.1	1.1	1.1	0.001	0.001	0.001	0.00022	0.00022	0.00059	0.00047	0.00047
Dicamba	1918-00-9	--	--	480	--	--	--	--	--	--	--	--	--	--	--	--	--	0.081	480

TABLE 9-6

LOWER AQUIFER GROUNDWATER ZONE
GROUNDWATER PRELIMINARY CLEANUP LEVELS[1]
PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Groundwater, MTCA Method A Cleanup Level	Groundwater, MTCA Method B Cleanup Level, Carcinogenic	Groundwater, MTCA Method B Cleanup Level, Non-carcinogenic	Groundwater ARAR-Federal MCL[2]	Groundwater ARAR - State MCL[3]	Surface Water, MTCA Method B Cleanup Level, Carcinogenic	Surface Water, MTCA Method B Cleanup Level, Non-carcinogenic	Surface Water ARAR - Aquatic Life - Fresh/Acute (WAC 173-201A)	Surface Water ARAR - Aquatic Life - Fresh/Acute (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Acute - NTR (40 CFR 131)	Surface Water ARAR - Aquatic Life - Fresh/Chronic (WAC 173-201A)	Surface Water ARAR- Aquatic Life - Fresh/Chronic (CWA §304)	Surface Water ARAR - Aquatic Life - Fresh/Chronic - NTR (40 CFR 131)	Surface Water ARAR - Human Health Consumption of Water and Organisms - Fresh Water (CWA §304)	Surface Water ARAR - Human Health Consumption of Organisms- Fresh Water (CWA §304)	ARAR - Human Health Consumption of Water and Organisms - Fresh Water - NTR (40 CFR 131)	Applicable PQL[4]	Preliminary Cleanup Level[5]
PCBs/Pesticides (Continued)																			
Dieldrin	60-57-1	--	0.0055	0.8	--	--	0.00009	0.028	2.5	0.24	2.5	0.0019	0.056	0.0019	0.000052	0.000054	0.00014	0.0005	0.0005
Dimethoate	60-51-5	--	--	3.2	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	3.2
Endosulfan I[6]	959-98-8	--	--	96	--	--	--	--	0.22	--	0.22	0.056	--	0.056	62	89	--	0.04	0.056
Endosulfan II[6]	33213-65-9	--	--	96	--	--	--	--	0.22	--	0.22	0.056	--	0.056	62	89	--	0.000087	0.056
Endosulfan sulfate	1031-07-8	--	--	--	--	--	--	--	--	--	--	--	--	--	62	89	--	0.0005	62
Endrin	72-20-8	--	--	4.8	2	2	--	0.20	0.18	0.086	0.18	0.0023	0.036	0.0023	0.059	0.060	0.76	0.0005	0.0023
Endrin aldehyde	7421-93-4	--	--	--	--	--	--	--	--	--	--	--	--	--	0.29	0.30	--	0.00038	0.29
Endrin ketone	53494-70-5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0003	--
Isodrin	465-73-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.05	--
Lindane	58-89-9	0.2	--	4.8	0.2	0.2	--	5.98	2	0.95	2	0.08	--	0.08	0.98	1.8	0.019	0.0005	0.019
Methoxychlor	72-43-5	--	--	80	40	40	--	8.36	--	--	--	--	0.03	--	100	--	--	0.0005	0.03
Methyl parathion	298-00-0	--	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	4
Parathion	56-38-2	--	--	96	--	--	--	--	0.065	0.065	--	0.013	0.013	--	--	--	--	5.1	5.1
Tetrachloro-m-xylene	877-09-8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Thionazin	297-97-2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.1	--
Toxaphene	8001-35-2	--	0.08	--	3	3	0.00045	--	0.73	0.73	0.73	0.0002	0.0002	0.0002	0.00028	0.00028	0.00073	0.025	0.025
Aroclor 1016	12674-11-2	--	1.25	1.12	--	--	0.00297	0.005816714	--	--	--	--	--	0.014	--	--	--	0.005	0.005
Aroclor 1254	11097-69-1	--	0.0437	0.32	--	--	0.00010	0.001661918	--	--	--	--	--	0.014	--	--	--	0.005	0.005
Aroclor 1260	11096-82-5	--	0.0437	--	--	--	--	--	--	--	--	--	--	0.014	--	--	--	0.005	0.014
Total PCBs	1336-36-3	0.1	0.044	--	0.5	0.5	0.00010	--	2	--	--	0.014	0.014	0.14	0.000064	0.000064	0.00017	0.005	0.005
TPH																			
Diesel		500	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	76	500
Gasoline	86290-81-5	800	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	130	800
Heavy oils	NA	500	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19	500
Lube oil	NA	500	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	190	500

Notes
1. All levels downloaded from Washington State Department of Ecology Cleanup Levels and Risk Calculations (CLARC) Web site, https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx.
2. Federal MCL established under the Safe Drinking Water Act.
3. State MCL established under WAC 246-290.
4. Applicable PQL taken from Table 9-4.
5. Preliminary cleanup level was selected based on criteria described in text. In some cases, the screening level was adjusted up to the PQL (WAC 173-340-707).
6. Values for endosulfan (CAS 115-29-7) listed.
7. Value calculated as the site specific area background (Appendix O).

Abbreviations
-- = not available
ARAR = applicable or relevant and appropriate requirement
CAS = Chemical Abstracts Service
CFR = Code of Federal Regulations
CWA = Clean Water Act
MCL = maximum contaminant level
MTCA = Model Toxics Control Act
NA = not applicable
NTR = National Toxics Rule
PCBs = polychlorinated biphenyls
PQL = practical quantitation limit
SVOCs = semivolatile organic compounds
TPH = total petroleum hydrocarbons
VOCs = volatile organic compounds
WAC = Washington Adminstrative Code

TABLE 9-7

GROUNDWATER PRELIMINARY CLEANUP LEVELS
SHALLOW AND DEEP GROUNDWATER ZONES [1]

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Shallow Groundwater Zone Preliminary Cleanup Level	Lower Aquifer Groundwater Zone Preliminary Cleanup Level
Inorganics			
Ammonia (as nitrogen)	7664-41-7	--	--
Antimony	7440-36-0	5.6	5.6
Arsenic, inorganic	7440-38-2	22.84 [3]	1.42 [3]
Barium	7440-39-3	1,000	1,000
Beryllium	7440-41-7	4	4
Cadmium	7440-43-9	0.25	0.25
Chloride	16887-00-6	230,000	230,000
Chromium	7440-47-3	50	50
Cobalt	7440-48-4	--	--
Copper	7440-50-8	3.47	3.47
Cyanide	57-12-5	10	10
Iron	7439-89-6	1,000	1,000
Lead	7439-92-1	0.54	0.54
Manganese	7439-96-5	50	50
Mercury	7439-97-6	0.2	0.2
Nickel	7440-02-0	48.7	48.7
Nitrate (as nitrogen)	14797-55-8	10,000	10,000
Nitrite	14797-65-0	1,000	1,000
Selenium and compounds	7782-49-2	5	5
Silver	7440-22-4	0.32	0.32
Sulfate	14808-79-8	--	--
Thallium, soluble salts	7440-28-0	0.24	0.24
Tin	7440-31-5	9,600	9,600
Vanadium	7440-62-2	1.12	1.12
Zinc	7440-66-6	32.3	32.3
VOCs			
Acetic acid	64-19-7	--	--
Acetone	67-64-1	7,200	7,200
Acrolein	107-02-8	2.9	4
Acrylonitrile	107-13-1	1	1
Allyl chloride	107-05-1	--	--
Benzene	71-43-2	0.8	0.8
Bromobenzene	108-86-1	--	--
Bromochloromethane	74-97-5	--	--
Bromodichloromethane	75-27-4	0.5	0.5
Bromoform	75-25-2	4.3	4.3
Bromomethane	74-83-9	11.2	11.2
n-Butanoic acid	107-92-6	--	--
2-Butanone (MEK)	78-93-3	4,800	4,800

TABLE 9-7

GROUNDWATER PRELIMINARY CLEANUP LEVELS
SHALLOW AND DEEP GROUNDWATER ZONES [1]

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Shallow Groundwater Zone Preliminary Cleanup Level	Lower Aquifer Groundwater Zone Preliminary Cleanup Level
VOCs (Continued)			
sec-Butylbenzene	135-98-8	61	61
tert-Butylbenzene	98-06-6	61	61
n-Butylbenzene	104-51-8	61	61
iso-Butyric acid	79-31-2	--	--
Carbon disulfide	75-15-0	400	800
Carbon tetrachloride	56-23-5	0.23	0.23
2-Chloro-1,3-butadiene	126-99-8	12	160
Chlorobenzene	108-90-7	100	100
Chloroform	67-66-3	1.2	5.7
Chloromethane	74-87-3	5.2	--
o-Chlorotoluene	95-49-8	160	160
4-Chlorotoluene	106-43-4	--	--
Cumene (Isopropylbenzene)	98-82-8	720	800
1,2-Dibromo-3-chloropropane	96-12-8	1	1
1,4-Dibromobenzene	106-37-6	80	80
Dibromochloromethane	124-48-1	0.5	0.4
1,1-Dichloro-1,2,2-trifluoroethane	812-04-4	--	--
2,2-Dichloro-1,1,1-trifluoroethane	306-83-2	--	--
1,2-Dichlorobenzene	95-50-1	420	420
1,3-Dichlorobenzene	541-73-1	320	320
1,4-Dichlorobenzene	106-46-7	63	63
1,1-Dichloroethane	75-34-3	1,600	1,600
1,2-Dichloroethane	107-06-2	0.38	0.38
1,1-Dichloroethene	75-35-4	0.057	0.057
1,2-Dichloroethene (total)	540-59-0	72	72
cis-1,2-Dichloroethene	156-59-2	16	16
trans-1,2-Dichloroethene	156-60-5	100	100
Dichlorodifluoromethane	75-71-8	9.9	1600
1,2-Dichloropropane	78-87-5	0.5	0.5
1,3-Dichloropropane	142-28-9	--	--
2,2-Dichloropropane	594-20-7	--	--
1,1-Dichloropropene	563-58-6	--	--
cis-1,3-Dichloropropene	10061-01-5	--	--
trans-1,3-Dichloropropene	10061-02-6	--	--
Ethyl chloride (chloroethane)	75-00-3	12	--
Ethylbenzene	100-41-4	530	530
Ethylene dibromide (EDB)	106-93-4	0.981	0.981
2-Hexanone	591-78-6	--	--
Isobutyl alcohol	78-83-1	2,400	2,400

TABLE 9-7

GROUNDWATER PRELIMINARY CLEANUP LEVELS
SHALLOW AND DEEP GROUNDWATER ZONES [1]

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Shallow Groundwater Zone Preliminary Cleanup Level	Lower Aquifer Groundwater Zone Preliminary Cleanup Level
VOCs (Continued)			
p-Isopropyltoluene	99-87-6	--	--
Methacrylonitrile	126-98-7	1	1
Methyl iodide	74-88-4	--	--
4-Methyl-2-pentanone (MIBK)	108-10-1	640	640
Methylcyclopentane	96-37-7	--	--
Methylene bromide	74-95-3	48	48
Methylene chloride	75-09-2	4.6	4.6
2-Methylpentane	107-83-5	--	--
3-Methylpentane	96-14-0	--	--
Propanoic acid	79-09-4	--	--
n-Propylbenzene	103-65-1	800	800
Styrene	100-42-5	78	100
1,1,1,2-Tetrachloroethane	630-20-6	1.7	1.68
1,1,2,2-Tetrachloroethane	79-34-5	0.17	0.17
Tetrachloroethene	127-18-4	0.69	0.69
Toluene	108-88-3	640	640
1,2,3-Trichlorobenzene	87-61-6	--	--
1,2,4-Trichlorobenzene	120-82-1	1.51	1.51
1,1,1-Trichloroethane	71-55-6	200	200
1,1,2-Trichloroethane	79-00-5	0.59	0.59
Trichloroethene	79-01-6	0.54	0.54
Trichlorofluoromethane	75-69-4	120	2,400
1,1,2-Trichlorotrifluoroethane	76-13-1	1,100	240,000
1,2,3-Trichloropropane	96-18-4	0.5	0.5
1,2,4-Trimethylbenzene	95-63-6	24	--
1,3,5-Trimethylbenzene	108-67-8	25	80
Vinyl acetate	108-05-4	7,800	8,000
Vinyl chloride	75-01-4	0.025	0.025
m,p-Xylene	106-42-3	670	1600
o-Xylene	95-47-6	440	1,600
Xylenes	1330-20-7	1,000	1,000
SVOCs			
2,4,5-Trichlorophenol	95-95-4	800	800
2,4,6-Trichlorophenol	88-06-2	1.4	1.4
2-Chloronaphthalene	91-58-7	640	640
2-Chlorophenol	95-57-8	40	40
4-Methylphenol	106-44-5	40	40
1-Methylnaphthalene	90-12-0	1.51	1.51
2-Methyl-4,6-dinitrophenol	534-52-1	13	13

TABLE 9-7

GROUNDWATER PRELIMINARY CLEANUP LEVELS
SHALLOW AND DEEP GROUNDWATER ZONES [1]

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Shallow Groundwater Zone Preliminary Cleanup Level	Lower Aquifer Groundwater Zone Preliminary Cleanup Level
SVOCs (Continued)			
2-Methylaniline	95-53-4	--	--
2-Methylnaphthalene	91-57-6	32	32
2-Nitroaniline	88-74-4	160	160
2-Nitrophenol	88-75-5	--	--
3-Nitroaniline	99-09-2	--	--
4-Bromophenyl phenyl ether	101-55-3	--	--
4-Chloro-3-methylphenol	59-50-7	--	--
4-Chlorophenyl phenyl ether	7005-72-3	--	--
4-Nitroaniline	100-01-6	--	--
4-Nitrophenol	100-02-7	--	--
Acenaphthene	83-32-9	640	640
Acenaphthylene	208-96-8	--	--
Acetophenone	98-86-2	50	800
Aldrin	309-00-2	0.0005	0.0005
alpha-Hexachlorocyclohexane	319-84-6	0.0026	0.0026
Aniline	62-53-3	7.7	7.7
Anthracene	120-12-7	4,800	4,800
Benzo(a)anthracene	56-55-3	0.02	0.02
Benzo(a)pyrene	50-32-8	0.0158	0.0158
Benzo(b)fluoranthene	205-99-2	0.0194	0.0194
Benzo(g,h,i)perylene	191-24-2	--	--
Benzo(k)fluoranthene	207-08-9	0.0134	0.0134
Benzoic acid	65-85-0	64,000	64,000
Benzyl alcohol	100-51-6	800	800
beta-Hexachlorocyclohexane	319-85-7	0.0091	0.0091
bis(2-Chloro-1-methylethyl) ether	108-60-1	0.625	0.625
bis(2-Chloroethoxy) methane	111-91-1	--	--
bis(2-Chloroethyl) ether	111-44-4	0.2	0.2
bis(2-Ethylhexyl) phthalate	117-81-7	1.2	1.2
Butylbenzyl phthalate	85-68-7	8.2	8.2
Chlordane	57-74-9	0.005	0.005
Chrysene	218-01-9	0.0124	0.0124
3,3'-Dichlorobenzidine	91-94-1	2	2
1,4-Dioxane	123-91-1	1	1
2,4-Dichlorophenol	120-83-2	24	24
2,4-Dimethylphenol	105-67-9	160	160
2,4-Dinitrophenol	51-28-5	32	32
2,4-Dinitrotoluene	121-14-2	0.18	0.18
2,6-Dichlorophenol	87-65-0	--	--

TABLE 9-7

GROUNDWATER PRELIMINARY CLEANUP LEVELS
SHALLOW AND DEEP GROUNDWATER ZONES [1]

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Shallow Groundwater Zone Preliminary Cleanup Level	Lower Aquifer Groundwater Zone Preliminary Cleanup Level
SVOCs (Continued)			
2,6-Dinitrotoluene	606-20-2	16	16
Decachlorobiphenyl	2051-24-3	--	--
Dibenzo[a,h]anthracene	53-70-3	0.0162	0.0162
Dibenzofuran	132-64-9	16	16
Diethyl phthalate	84-66-2	12,800	12,800
Dimethyl phthalate	131-11-3	270,000	270,000
di-n-Butyl phthalate	84-74-2	1,600	1,600
di-n-Octyl phthalate	117-84-0	--	--
Dinoseb	88-85-7	7	7
Diphenylamine	122-39-4	400	400
Fluoranthene	206-44-0	90	90.2
Fluorene	86-73-7	640	640
Heptachlor	76-44-8	0.0005	0.0005
Heptachlor epoxide	1024-57-3	0.0005	0.0005
Hexachlorobenzene	118-74-1	0.141	0.141
Hexachlorobutadiene	87-68-3	0.44	0.44
Hexachlorocyclopentadiene	77-47-4	40	40
Hexachloroethane	67-72-1	1.4	1.4
Hexachloropropene	1888-71-7	--	--
Indeno(1,2,3-cd)pyrene	193-39-5	0.02	0.02
Isophorone	78-59-1	8.4	8.4
Kepone	143-50-0	--	--
m-Cresol	108-39-4	400	400
m-Dinitrobenzene	99-65-0	5.2	5.2
N-Nitroso-di-n-propylamine	621-64-7	0.2	0.2
N-Nitrosodiphenylamine	86-30-6	3.3	3.3
Naphthalene	91-20-3	160	160
Nitrobenzene	98-95-3	16	16
p-Chloroaniline	106-47-8	0.219	0.219
o-Cresol	95-48-7	400	400
Pentachlorophenol	87-86-5	0.95	0.95
Phenanthrene	85-01-8	--	--
Phenol	108-95-2	2,400	2,400
Pyrene	129-00-0	480	480
PCBs/Pesticides			
delta-BHC	319-86-8	--	--
alpha-Chlordane	103-71-9	--	--
4,4'-DDD	72-54-8	0.00047	0.00047
4,4'-DDE	72-55-9	0.0005	0.0005

TABLE 9-7

GROUNDWATER PRELIMINARY CLEANUP LEVELS
SHALLOW AND DEEP GROUNDWATER ZONES [1]

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Shallow Groundwater Zone Preliminary Cleanup Level	Lower Aquifer Groundwater Zone Preliminary Cleanup Level
PCBs/Pesticides (Continued)			
4,4'-DDT	50-29-3	0.00047	0.00047
Dicamba	1918-00-9	480	480
Dieldrin	60-57-1	0.0005	0.0005
Dimethoate	60-51-5	3.2	3.2
Endosulfan I[2]	959-98-8	0.056	0.056
Endosulfan II[2]	33213-65-9	0.056	0.056
Endosulfan sulfate	1031-07-8	--	62
Endrin	72-20-8	0.0023	0.0023
Endrin aldehyde	7421-93-4	--	0.29
Endrin ketone	53494-70-5	--	--
Isodrin	465-73-6	--	--
Lindane	58-89-9	0.019	0.019
Methoxychlor	72-43-5	0.03	0.03
Methyl parathion	298-00-0	4	4
Parathion	56-38-2	5.1	5.1
Tetrachloro-m-xylene	877-09-8	--	--
Thionazin	297-97-2	--	--
Toxaphene	8001-35-2	0.025	0.025
Aroclor 1016	12674-11-2	0.005	0.005
Aroclor 1254	11097-69-1	0.005	0.005
Aroclor 1260	11096-82-5	0.014	0.014
Total PCBs	1336-36-3	0.005	0.005
TPH			
Diesel		500	500
Gasoline	86290-81-5	800	800
Heavy oils	NA	500	500
Lube oil	NA	500	500

Notes

1. All levels downloaded from Washington State Department of Ecology, Cleanup Levels and Risk Calculations (CLARC) Web site, https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx.
2. Values for endosulfan (CAS 115-29-7) listed.
3. Value calculated as the site specific area background (Appendix O).

Abbreviations

-- = not available
CAS = Chemical Abstracts Service
NA = not applicable
PCBs = polychlorinated biphenyls
SVOCs = semivolatile organic compounds
TPH = total petroleum hydrocarbons
VOCs = volatile organic compounds

TABLE 9-8

SOIL PRACTICAL QUANTITATION LIMITS

PSC Washougal Facility
Washougal, Washington

Concentrations in milligrams per kilogram (mg/kg)

Constituent	Analytical Method[1]	Columbia PQL	Columbia Method Detection Limit	Federal Reporting Limit[2]	Applicable PQL[3]
Acenaphthene	8270 SIM	0.005	0.00023	0.66	0.0023
Acenaphthylene	8270 SIM	0.005	0.00024	0.66	0.0024
Acetone	8260	0.02	0.01	0.005	0.005
Acetophenone	8270 low level	0.05	0.012	--	0.05
Acrolein	8260	0.1	0.014	0.005	0.005
Acrylonitrile	8260	0.02	0.0032	0.005	0.005
Aldrin	8081	0.001	0.00015	--	0.001
alpha-BHC	8081 low level	0.001	0.00026	--	0.001
alpha-Chlordane	8081	0.001	0.00023	--	0.001
Aniline	8270 low level	0.02	0.0015	--	0.015
Anthracene	8270 SIM	0.005	0.00047	0.66	0.0047
Antimony	6020	0.05	0.02	--	0.05
Aroclor 1016	8270 low level	0.01	0.0016	3.8	0.01
Aroclor 1242	8270 low level	0.01	0.0016	3.8	0.01
Aroclor 1254	8270 low level	0.01	0.0016	3.8	0.01
Aroclor 1260	8270 low level	0.01	0.0016	3.8	0.01
Arsenic	200.8	0.5	0.07	--	0.5
Azobenzene	8270 low level	0.01	0.0024	--	0.01
Barium	6020	0.05	0.03	--	0.05
Benzene	8260	0.005	0.00079	0.005	0.005
Benzidine	8270 low level	0.2	0.2	--	0.2
Benzo(a)anthracene	8270 SIM PAH	0.005	0.00016	0.66	0.0016
Benzo(a)pyrene	8270 SIM PAH	0.005	0.00022	0.66	0.0022
Benzo(b)fluoranthene	8270 SIM PAH	0.005	0.00048	0.66	0.0048
Benzo(ghi)perylene	8270 SIM PAH	0.005	0.00023	0.66	0.0023
Benzo(k)fluoranthene	8270 SIM PAH	0.005	0.00033	0.66	0.0033
Benzoic acid	8270 low level	0.2	0.096	3.3	0.2
Benzyl alcohol	8270 low level	0.01	0.0037	1.3	0.01
Beryllium	6020	0.02	0.006	--	0.02
beta-BHC	8081 low level	0.001	0.0003	--	0.001
delta-BHC	8081	0.001	0.00014	--	0.001
Bromobenzene	8260	0.005	0.00081	0.005	0.005
Bromochloromethane	8260	0.005	0.00052	0.005	0.005
Bromodichloromethane	8260	0.005	0.00053	0.005	0.005
Bromoform	8260	0.005	0.00065	0.005	0.005
Bromomethane	8260	0.005	0.0008	0.005	0.005
4-Bromophenyl phenyl ether	8270	0.00033	0.0000122	0.66	0.000122
2-Butanone (MEK)	8260	0.02	0.0084	0.005	0.005
Butyl benzyl phthalate	8270	0.00033	0.0000163	0.66	0.000163
n -Butylbenzene	8260	0.02	0.00075	0.005	0.005
tert -Butylbenzene	8260	0.02	0.00074	0.005	0.005
Cadmium	6020	0.05	0.007	--	0.05
Carbon disulfide	8260	0.005	0.0015	0.005	0.005

TABLE 9-8

SOIL PRACTICAL QUANTITATION LIMITS

PSC Washougal Facility
Washougal, Washington

Concentrations in milligrams per kilogram (mg/kg)

Constituent	Analytical Method[1]	Columbia PQL	Columbia Method Detection Limit	Federal Reporting Limit[2]	Applicable PQL[3]
Carbon tetrachloride	8260	0.005	0.0006	0.005	0.005
bis(2-Chloro-1-methylethyl) ether	8270 low level	0.01	0.0012	--	0.01
4-Chloro-3-methylphenol	8270 low level	0.01	0.0021	1.3	0.01
p -Chloroaniline (4-chloroaniline)	8270 low level	0.01	0.0021	1.3	0.01
Chlorobenzene	8260	0.005	0.0007	0.005	0.005
Chloroethane (ethyl chloride)	8260	0.005	0.00078	0.005	0.005
bis(2-Chloroethoxy)methane	8270 low level	0.01	0.0013	0.66	0.01
bis(2-Chloroethyl) ether	8270	0.01	0.0019	0.66	0.01
2-Chloroethyl vinyl ether	8260	0.01	0.001	0.005	0.005
Chloroform	8260	0.005	0.00057	0.005	0.005
Chloromethane	8260	0.005	0.00099	0.005	0.005
2-Chloronaphthalene	8270	0.01	0.0036	0.66	0.01
2-Chlorophenol	8270 low level	0.01	0.0017	0.66	0.01
4-Chlorophenyl phenyl ether	8270 low level	0.01	0.002	0.66	0.01
o -Chlorotoluene	8260	0.02	0.00073	0.005	0.005
2-Chlorotoluene	8260	0.02	0.00073	0.005	0.005
4-Chlorotoluene	8260	0.02	0.00074	0.005	0.005
Chromium	6020	0.2	0.04	--	0.2
Chromium VI	7196	0.5	0.08	--	0.5
Chrysene	8270 SIM PAH	0.005	0.00041	--	0.0041
cis -1,2-Dichloroethene	8260	0.005	0.00083	0.005	0.005
cis -1,3-Dichloropropene	8260	0.005	0.00076	0.005	0.005
Cobalt	6020	0.02	0.01	**--**	0.02
Copper	6020	0.1	0.02	--	0.1
Cyanide	335.2/9012A	0.1	0.03	--	0.1
4,4'-DDD	8081	0.001	0.00012	--	0.001
4,4'-DDE	8081	0.001	0.000076	--	0.00076
4,4'-DDT	8081	0.000064	0.001	--	0.000064
di-*n* -Butyl phthalate	8270 low level	0.01	0.0026	--	0.01
di-*n* -Octyl phthalate	8270 low level	0.01	0.0012	0.66	0.01
Dibenzo(a,h)anthracene	8270 SIM PAH	0.005	0.00026	0.66	0.0026
Dibenzofuran	8270 SIM PAH	0.005	0.00017	0.66	0.0017
1,2-Dibromo-3-chloropropane	8260	0.02	0.00085	0.005	0.005
Dibromochloromethane	8260	0.005	0.0006	0.005	0.005
Dichlorodifluoromethane	8260	0.005	0.0007	0.005	0.005
1,2-Dichlorobenzene	8260	0.005	0.00065	0.005	0.005
1,3-Dichlorobenzene	8260	0.005	0.00071	0.005	0.005
1,4-Dichlorobenzene	8260	0.005	0.00082	0.005	0.005
3,3'-Dichlorobenzidine	8270	0.1	0.0037	1.3	0.037
1,1-Dichloroethane	8260	0.005	0.00078	0.005	0.005
1,2-Dichloroethane	8260	0.005	0.00067	0.005	0.005
1,2-Dichloroethane	8260	0.005	0.00067	0.005	0.005
1,1-Dichloroethene	8260	0.005	0.00069	0.005	0.005

TABLE 9-8

SOIL PRACTICAL QUANTITATION LIMITS

PSC Washougal Facility
Washougal, Washington

Concentrations in milligrams per kilogram (mg/kg)

Constituent	Analytical Method[1]	Columbia PQL	Columbia Method Detection Limit	Federal Reporting Limit[2]	Applicable PQL[3]
trans -1,2-Dichloroethene	8260	0.005	0.00073	0.005	0.005
1,2-Dichloropropane	8260	0.005	0.00072	0.005	0.005
1,3-Dichloropropane	8260	0.005	0.00052	0.005	0.005
2,2-Dichloropropane	8260	0.005	0.00081	0.005	0.005
1,1-Dichloropropene	8260	0.005	0.00073	0.005	0.005
trans -1,3-Dichloropropene	8260	0.005	0.0006	0.005	0.005
2,4-Dichlorophenol	8270	0.01	0.0018	0.66	0.01
Dieldrin	8081	0.005	0.00048	--	0.0048
Diesel	NWTPH-Dx9	25	2.7	--	25
Diethyl phthalate	8270 low level	0.01	0.0035	0.66	0.01
Dimethyl phthalate	8270	0.00033	0.0000141	0.66	0.000141
2,4-Dimethylphenol	8270 low level	0.05	0.0055	0.66	0.05
2,4-Dinitrophenol	8270 low level	0.2	0.036	3.3	0.2
2,4-Dinitrotoluene	8270	0.01	0.0015	0.66	0.01
2,6-Dinitrotoluene	8270	0.01	0.002	0.66	0.01
1,4-Dioxane	8270C SIM6	0.0015	0.00045	--	0.0015
Endosulfan I	8081	0.001	0.00017	--	0.001
Endosulfan II	8081	0.001	0.00019	--	0.001
Endosulfan sulfate	8081	0.001	0.000079	--	0.00079
Endrin	8081	0.001	0.0002	--	0.001
Endrin aldehyde	8081	0.001	0.000053	--	0.00053
Endrin ketone	8270	0.001	0.000059	--	0.00059
Endrin ketone	8081 low level	0.001	0.00082	--	0.001
Ethyl ether	8260			0.005	0
Ethylbenzene	8260	0.005	0.00057	0.005	0.005
Ethylene dibromide (EDB)	8260	0.02	0.00079	0.005	0.005
bis(2-Ethylhexyl) phthalate	8270 low level	0.2	0.0017	--	0.017
Fluoranthene	8270 SIM PAH	0.005	0.00034	0.66	0.0034
Fluorene	8270 SIM PAH	0.005	0.00019	0.66	0.0019
gamma-Chlordane	8081	0.001	0.000064	--	0.00064
Gasoline	NWTPH-Gx 10	5	0.3	--	3
Heptachlor	8081 low level	0.001	0.00008	--	0.0008
Heptachlor epoxide	8081	0.001	0.00013	--	0.001
Hexachlorobenzene	8081 low level	0.001	0.000079	--	0.00079
Hexachlorobutadiene	8270	0.01	0.0025	0.66	0.01
Hexachlorocyclopentadiene	8270	0.05	0.029	0.66	0.05
Hexachloroethane	8260	0.01	0.003	0.015	0.01
2-Hexanone	8260	0.02	0.0061	--	0.02
Indeno(1,2,3-cd)pyrene	8270 SIM PAH	0.005	0.00024	0.66	0.0024
Isophorone	8270 low level	0.01	0.0016	0.66	0.01
Isopropylbenzene (Cumene)	8260	0.02	0.00068	0.005	0.005
p -Isopropyltoluene	8260	0.02	0.00072	0.005	0.005
Lead	6020	0.05	0.02	--	0.05

TABLE 9-8

SOIL PRACTICAL QUANTITATION LIMITS
PSC Washougal Facility
Washougal, Washington

Concentrations in milligrams per kilogram (mg/kg)

Constituent	Analytical Method[1]	Columbia PQL	Columbia Method Detection Limit	Federal Reporting Limit[2]	Applicable PQL[3]
Lindane	8081	0.001	0.000099	--	0.00099
Lube oil	NWTPH-Dx	100	2.9	--	29
Manganese	6010B	1	0.3	--	1
Mercury	7471A	0.02	0.008	--	0.02
Methoxychlor	8081	0.001	0.00004	--	0.0004
4-Methyl-2-pentanone (MIBK)	8260	0.02	0.0055	0.005	0.005
2-Methyl-4,6-Dinitrophenol	8270 low level	0.1	0.0017	3.3	0.017
Methylcyclopentane	8270	0.005	0.005	--	0.005
Methylene bromide	8260	0.005	0.00072	0.005	0.005
Methylene chloride	8260	0.01	0.00096	0.005	0.005
1-Methylnaphthalene	8270 SIM PAH	0.005	0.00025	--	0.0025
2-Methylnaphthalene	8270 SIM PAH	0.005	0.00034	0.66	0.0034
2-Methylpentane	8260	0.005	0.005	0.005	0.005
2-Methylphenol	8270 low level	0.01	0.0034	0.66	0.01
4-Methylphenol	8270 low level	0.01	0.0029	0.66	0.01
3-Methylpentane	8260	0.005	0.005	0.005	0.005
N-Nitroso-di-*n*-propylamine	8270	0.01	0.0024	0.66	0.01
N-Nitrosodiphenylamine	8270 low level	0.01	0.0022	0.66	0.01
Naphthalene	8260	0.02	0.00089	0.005	0.005
Naphthalene	8270 SIM	0.00037	0.005	0.66	0.00037
Nickel	6020	0.2	0.04	--	0.2
2-Nitroaniline	8270 low level	0.02	0.0027	3.3	0.02
3-Nitroaniline	8270 low level	0.02	0.0026	3.3	0.02
4-Nitroaniline	8270 low level	0.02	0.0034	--	0.02
Nitrobenzene	8270	0.00033	0.0000261	0.66	0.000261
2-Nitrophenol	8270 low level	0.01	0.0026	0.66	0.01
4-Nitrophenol	8270 low level	0.1	0.03	3.3	0.1
Pentachlorophenol	8270 SIM PAH	0.2	0.015	3.3	0.15
Phenanthrene	8270 SIM PAH	0.005	0.00033	0.66	0.0033
Phenol	8270 low level	0.03	0.0019	0.66	0.019
Propylbenzene	8260	0.02	0.00072	0.005	0.005
Pyrene	8270 SIM PAH	0.005	0.00036	0.005	0.0036
sec-Butylbenzene	8260	0.02	0.00074	0.005	0.005
Selenium	6020	0.1	0.02	--	0.1
Silver	6020	0.02	0.003	--	0.02
Styrene	8260	0.005	0.00073	0.005	0.005
Tetrachloroethene	8260	0.005	0.00031	0.005	0.0031
1,1,1,2-Tetrachloroethane	8260	0.005	0.00051	0.005	0.005
1,1,2,2-Tetrachloroethane	8260	0.005	0.00073	0.005	0.005
Thallium	6020	0.02	0.003	--	0.02
Toluene	8260	0.005	0.00084	0.005	0.005
Toxaphene	8081 low level	0.05	0.0049	--	0.049
1,2,3-Trichlorobenzene	8260	0.02	0.0009	0.005	0.009

TABLE 9-8

SOIL PRACTICAL QUANTITATION LIMITS

PSC Washougal Facility
Washougal, Washington

Concentrations in milligrams per kilogram (mg/kg)

Constituent	Analytical Method[1]	Columbia PQL	Columbia Method Detection Limit	Federal Reporting Limit[2]	Applicable PQL[3]
1,2,4-Trichlorobenzene	8260	0.02	0.00077	0.005	0.005
Trichloroethene	8260	0.005	0.00028	0.005	0.0028
1,1,1-Trichloroethane	8260	0.005	0.00057	0.005	0.005
1,1,2-Trichloroethane	8260	0.005	0.00069	0.005	0.005
2,4,5-Trichlorophenol	8270 low level	0.01	0.003	0.66	0.01
2,4,6-Trichlorophenol	8270 low level	0.01	0.0018	0.66	0.01
1,2,3-Trichloropropane	8260	0.005	0.00061	0.005	0.005
Trichlorofluoromethane	8260	0.005	0.00073	0.005	0.005
1,1,2-Trichlorotrifluoroethane	8260	0.005	0.00074	0.005	0.005
1,2,4-Trimethylbenzene	8260	0.02	0.00082	0.005	0.005
1,3,5-Trimethylbenzene	8260	0.02	0.00082	0.005	0.005
Vanadium	6010B	2	0.9	--	2
Vinyl acetate	8260	0.02	0.0036	0.005	0.005
Vinyl chloride	8260	0.005	0.00062	0.005	0.005
m ,*p* -Xylenes	8260	0.005	0.00015	0.005	0.0015
o -Xylene	8260	0.005	0.00069	0.005	0.005
Xylenes (total)	8260	0.005	0.0015	0.005	0.005
Zinc	6020	0.5	0.2	--	0.5

Notes

1. Analytical methods are U.S. Environmental Protection Agency method numbers unless otherwise noted.
2. Federal reporting limits from U.S. Environmental Protection Agency Publication SW-846 (www.epa.gov/epaoswer/hazwaste/test/6_series.htm).
3. The Columbia Analytical Services, Inc. PQL was selected as the applicable PQL unless it was less than 10 times the Columbia method detection limit, in which case 10 times the method detection limit was considered the applicable PQL (per Washington Administrative Code 173-340-707[a]). If the Columbia PQL was greater than the federal reporting limit, then the federal reporting limit was selected as the applicable PQL (per Washington Administrative Code 173-340-707[b]). Columbia PQLs were provided January 2008.

Abbreviations

-- = not available
NWTPH-Dx = Northwest Total Petroleum Hydrocarbons-Diesel Range
NWTPH-Gx - Northwest Total Petroleum Hydrocarbons-Gasoline Range
PAH = polycyclic aromatic hydrocarbon
PQL = practical quantitation limit
SIM = selective ion monitoring

TABLE 9-9

SOIL PRELIMINARY CLEANUP LEVELS
FOR PSC PROPERTY SOILS [1]

PSC Washougal Facility
Washougal, Washington

Concentrations are in milligrams per kilogram (mg/kg)

Constituent	CAS Number	Soil, MTCA Method A Cleanup Level, Industrial Land Use	Soil, MTCA Method C Cleanup Level, Carcinogenic[2]	Soil, MTCA Method C Cleanup Level, Non-carcinogenic[2]	EPA Regional Screening Levels[3]	Soil Cleanup Level Protective of Groundwater[4]	Clark County Natural Background Level[5]	Applicable PQL[6]	Preliminary Cleanup Level[7]
Inorganics									
Antimony	7440-36-0	--	--	1,400	410	5.1	--	0.05	5.1
Arsenic	7440-38-2	20	87.5	1,100	1.6	13.3	6	0.5	6.0
Barium	7440-39-3	--	--	700,000	190,000	824	--	0.05	824
Beryllium	7440-41-7	--	--	7,000	2,000	63.2	2	0.02	63
Cadmium	7440-43-9a	2	--	3,500	800	0.035	1.1	0.05	1.1
Chromium (total)	7440-47-3	--	--	--	--	1,000	27	0.2	--
Chromium (VI)	18540-29-9	19	--	11,000	5.6	--	--	0.50	5.6
Cobalt	7440-48-4	--	--	--	300	--	--	0.02	300
Copper	7440-50-8	--	--	130,000	41,000	1.5	34	0.1	34
Cyanide	57-12-5	--	--	70,000	20,000	1.1	--	0.1	1.1
Lead	7439-92-1	1,000	--	--	800	108	24	0.05	108
Manganese	7439-96-5	--	--	490,000	--	--	1,511	1	490,000
Mercury	7439-97-6	2	--	1,100	43	0.2	0.04	0.02	0.21
Nickel	7440-02-0	--	--	70,000	20,000	63.5	21	0.2	64
Selenium and compounds	7782-49-2	--	--	18,000	5,100	5.2	--	0.1	5.2
Silver	7440-22-4	--	--	18,000	5,100	0.054	--	0.02	0.054
Sulfide	18496-25-8	--	--	--	--	--	--	--	--
Thallium, soluble salts	7440-28-0	--	--	250	10	0.34	--	0.02	0.34
Vanadium	7440-62-2	--	--	25,000	5,200	22.4	--	2	22
Zinc	7440-66-6	--	--	1,100,000	310,000	40.2	96	0.5	96
PCBs/Pesticides									
Aldrin	309-00-2	--	7.72	105	0.1	0.00049	--	0.001	0.0010
beta-BHC	319-85-7	--	72.92	--	0.96	0.00042	--	0.001	0.0010
delta-BHC	319-86-8	--	--	--	--	--	--	0.001	--
alpha-Chlordane	103-71-9	--	--	--	--	--	--	0.001	--
gamma-Chlordane	12789-03-6	--	--	--	6.5	--	--	0.00064	6.5
4,4'-DDD	72-54-8	--	546.88	--	7.2	0.00043	--	0.001	0.0010
4,4'-DDE	72-55-9	--	386.03	--	5.1	0.00086	--	0.00076	0.00086
4,4'-DDT	50-29-3	4	386.03	1,750	7	0.0064	--	0.000064	0.0064
Dieldrin	60-57-1	--	8.2	175	0.11	0.00026	--	0.0048	0.0048
Endosulfan I[8]	959-98-8	--	--	21,000	3,700	0.0025	--	0.001	0.0025
Endosulfan II[8]	33213-65-9	--	--	21,000	3,700	0.0025	--	0.001	0.0025
Endosulfan sulfate	1031-07-8	--	--	--	--	--	--	0.00079	--
Endrin	72-20-8	--	--	1,050	180	0.00052	--	0.001	0.0010
Endrin aldehyde	7421-93-4	--	--	--	--	--	--	0.00053	--
Endrin ketone	53494-70-5	--	--	--	--	--	--	0.001	--
Heptachlor	76-44-8	--	29.17	1,750	0.38	0.00010	--	0.0008	0.00080
Heptachlor epoxide	1024-57-3	--	14.42	45.5	0.19	0.00083	--	0.001	0.0010
Lindane	58-89-9	0.01	--	1,050	2.1	0.00061	--	0.00099	0.00099
Methoxychlor	72-43-5	--	--	17,500	3,100	0.048	--	0.0004	0.048
Toxaphene	8001-35-2	--	119.32	--	1.6	0.048	--	0.049	0.049
Aroclor 1016	12674-11-2	--	1880	245	--	--	--	0.01	245
Aroclor 1254	11097-69-1	--	65.6	70	--	--	--	0.01	65.6
Aroclor 1260	11096-82-5	--	65.6	--	--	--	--	0.01	65.6
Polychlorinated biphenyls, total[9]	1336-36-3	10	65.6	--	0.74	--	--	0.02	0.74

TABLE 9-9

SOIL PRELIMINARY CLEANUP LEVELS
FOR PSC PROPERTY SOILS [1]

PSC Washougal Facility
Washougal, Washington

Concentrations are in milligrams per kilogram (mg/kg)

Constituent	CAS Number	Soil, MTCA Method A Cleanup Level, Industrial Land Use	Soil, MTCA Method C Cleanup Level, Carcinogenic[2]	Soil, MTCA Method C Cleanup Level, Non-carcinogenic[2]	EPA Regional Screening Levels[3]	Soil Cleanup Level Protective of Groundwater[4]	Clark County Natural Background Level[5]	Applicable PQL[6]	Preliminary Cleanup Level[7]
SVOCs									
Acenaphthene	83-32-9	--	--	210,000	33,000	65	--	0.0023	65
Acenaphthylene	208-96-8	--	--	--	--	--	--	0.0024	--
Acetophenone	98-86-2	--	--	350,000	100,000	--	--	0.05	100,000
Aniline	62-53-3	--	23,026.32	24,500	300	--	--	0.015	300
Anthracene	120-12-7	--	--	1,050,000	170,000	2,275	--	0.0047	2,275
Azobenzene	103-33-3	--	1,193.18	--	23	--	--	0.01	23
alpha-BHC	319-84-6	--	20.83	--	0.27	0.00010	--	0.001	0.0010
Benzidine	92-87-5	--	0.57	10,500	0.0075	--	--	0.2	0.20
Benzo(a)anthracene	56-55-3	--	180	--	2.1	0.14	--	0.0016	0.14
Benzo(a)pyrene	50-32-8	2	17.98	--	0.21	0.31	--	0.0022	0.14
Benzo(b)fluoranthene	205-99-2	--	180	--	2.1	0.47	--	0.0048	0.47
Benzo(g,h,i)perylene	191-24-2	--	--	--	--	--	--	0.0023	--
Benzo(k)fluoranthene	207-08-9	--	1,800	--	21	0.34	--	0.0033	0.34
Benzoic acid	65-85-0	--	--	14,000,000	2,500,000	257	--	0.2	257
Benzyl alcohol	100-51-6	--	--	350,000	62,000	--	--	0.01	62,000
4-Bromophenyl phenyl ether	101-55-3	--	--	--	--	--	--	0.000122	--
Butyl benzyl phthalate	85-68-7	--	69,100	700,000	910	2.3	--	0.000163	2.3
bis(2-Chloro-1-methylethyl) ether	108-60-1	--	1,875	140,000	22	--	--	0.01	22
4-Chloro-3-methylphenol	59-50-7	--	--	--	62,000	--	--	0.01	62,000
p-Chloroaniline (4-chloroaniline)	106-47-8	--	656	14,000	8.6	0.0012	--	0.01	0.010
bis(2-Chloroethoxy)methane	111-91-1	--	--	--	1,800	--	--	0.01	--
bis(2-Chloroethyl) ether	111-44-4	--	119.32	--	1.0	0.0011	--	0.01	0.010
2-Chloronaphthalene	91-58-7	--	--	280,000	82,000	--	--	0.01	82,000
2-Chlorophenol	95-57-8	--	--	17,500	5,100	0.47	--	0.01	0.47
4-Chlorophenyl phenyl ether	7005-72-3	--	--	--	--	--	--	0.01	--
Chrysene	218-01-9	--	18,000	--	210	0.099	--	0.0041	0.099
o-Cresol (2-methylphenol)	95-48-7	--	--	175,000	31,000	2.3	--	0.01	2.3
Cumene (Isopropylbenzene)	98-82-8	--	--	350,000	11,000	--	--	0.005	11,000
3,3'-Dichlorobenzidine	91-94-1	--	291.67	--	3.8	0.037	--	0.037	0.037
2,4-Dichlorophenol	120-83-2	--	--	10,500	1,800	0.17	--	0.01	0.17
Dibenzo[a,h]anthracene	53-70-3	--	18	--	0.21	0.58	--	0.0026	0.58
Dibenzofuran	132-64-9	--	--	3,500	1,000	0.086	--	0.0017	0.086
Di-n-butyl phthalate	84-74-2	--	--	350,000	62,000	58	--	0.01	57.6
Di-n-octyl phthalate	117-84-0	--	--	--	--	--	--	0.01	--
Diethyl phthalate	84-66-2	--	--	2,800,000	490,000	72	--	0.01	72.2
Dimethyl phthalate	131-11-3	--	--	--	--	1,088.4	--	0.000141	1,088.4
2,4-Dimethylphenol	105-67-9	--	--	70,000	12,000	1.3	--	0.05	1.3
2,4-Dinitrophenol	51-28-5	--	--	7,000	1,200	0.13	--	0.2	0.20
2,4-Dinitrotoluene	121-14-2	--	--	7,000	5.5	0.0011	--	0.01	0.010
2,6-Dinitrotoluene	606-20-2	--	--	3,500	620	0.086	--	0.01	0.086
1,4-Dioxane	123-91-1	--	1,310	105,000	17	0.0043	--	0.0015	0.0043
bis(2-Ethylhexyl) phthalate	117-81-7	--	9,375	70,000	120	2.6	--	0.017	2.6
Fluoranthene	206-44-0	--	--	140,000	22,000	128	--	0.0034	128
Fluorene	86-73-7	--	--	140,000	22,000	101	--	0.0019	101

TABLE 9-9

SOIL PRELIMINARY CLEANUP LEVELS
FOR PSC PROPERTY SOILS [1]

PSC Washougal Facility
Washougal, Washington

Concentrations are in milligrams per kilogram (mg/kg)

Constituent	CAS Number	Soil, MTCA Method A Cleanup Level, Industrial Land Use	Soil, MTCA Method C Cleanup Level, Carcinogenic[2]	Soil, MTCA Method C Cleanup Level, Non-carcinogenic[2]	EPA Regional Screening Levels[3]	Soil Cleanup Level Protective of Groundwater[4]	Clark County Natural Background Level[5]	Applicable PQL[6]	Preliminary Cleanup Level[7]
SVOCs (Continued)									
Hexachlorobenzene	118-74-1	--	82.03	2,800	1.1	0.23	--	0.00079	0.23
Hexachlorobutadiene	87-68-3	--	1,683	3,500	22	0.47	--	0.01	0.47
Hexachlorocyclopentadiene	77-47-4	--	--	21,000	3,700	160	--	0.05	160
Hexachloroethane	67-72-1	--	9,375	3,500	120	0.056	--	0.01	0.056
Indeno(1,2,3-cd)pyrene	193-39-5	--	180	--	2.1	1.4	--	0.0024	1.40
Isophorone	78-59-1	--	138,157.9	700,000	1,800	0.041	--	0.01	0.041
2-Methyl-4,6-dinitrophenol	534-52-1	--	--	--	49	--	--	0.017	49
1-Methylnaphthalene	90-12-0	--	4,530	--	99	--	--	0.0025	99.0
2-Methylnaphthalene	91-57-6	--	--	14,000	4,100	--	--	0.0034	4,100
4-Methylphenol	106-44-5	--	--	17,500	3,100	--	--	0.01	3,100
N-Nitroso-di-n-propylamine	621-64-7	--	18.75	--	0.25	0.00090	--	0.01	0.010
N-Nitrosodiphenylamine	86-30-6	--	26,785.71	--	350	0.099	--	0.01	0.099
Naphthalene	91-20-3	5	--	70,000	18	4.5	--	0.005	4.5
Nitrobenzene	98-95-3	--	--	7,000	24	0.10	--	0.000261	0.10
2-Nitroaniline	88-74-4	--	--	35,000	6,000	--	--	0.02	6,000
3-Nitroaniline	99-09-2	--	--	--	--	--	--	0.02	--
4-Nitroaniline	100-01-6	--	--	--	86	--	--	0.02	86
2-Nitrophenol	88-75-5	--	--	--	--	--	--	0.01	--
4-Nitrophenol	100-02-7	--	--	--	--	--	--	0.1	--
Pentachlorophenol	87-86-5	--	328	17,500	2.7	0.012	--	0.15	0.15
Phenanthrene	85-01-8	--	--	--	--	--	--	0.0033	--
Phenol	108-95-2	--	--	1,050,000	180,000	11	--	0.019	11
Pyrene	129-00-0	--	--	105,000	17,000	655	--	0.0036	655
2,4,5-Trichlorophenol	95-95-4	--	--	350,000	62,000	29	--	0.01	29
2,4,6-Trichlorophenol	88-06-2	--	11,932	3,500	160	0.016	--	0.01	0.016
TPH									
Diesel		2,000	--	--	--	--	--	25	2,000
Gasoline	86290-81-5	30	--	--	--	--	--	3	30
Lube Oil		2,000	--	--	--	--	--	29	2,000
VOCs									
Acetone	67-64-1	--	--	3,150,000	630,000	29	--	0.005	29
Acrolein	107-02-8	--	--	1,750	0.65	--	--	0.005	0.65
Acrylonitrile	107-13-1	--	243.06	--	1.2	--	--	0.005	1.2
Benzene	71-43-2	0.03	2,386.36	14,000	5.4	0.0045	--	0.005	0.0050
Bromobenzene	108-86-1	--	--	--	1,800	--	--	0.005	1,800
Bromochloromethane	74-97-5	--	--	--	680	--	--	0.005	--
Bromodichloromethane	75-27-4	--	2,116.94	70,000	1.4	0.0037	--	0.005	0.0050
Bromoform	75-25-2	--	16,613.92	70,000	220	0.028	--	0.005	0.028
Bromomethane	74-83-9	--	--	4,900	32	0.052	--	0.005	0.052
2-Butanone (MEK)	78-93-3	--	--	2,100,000	200,000	--	--	0.005	200,000
n-Butylbenzene	104-51-8	--	--	--	51,000	--	--	0.005	51,000
sec-Butylbenzene	135-98-8	--	--	--	--	--	--	0.005	--
tert-Butylbenzene	98-06-6	--	--	--	--	--	--	0.005	--

TABLE 9-9

SOIL PRELIMINARY CLEANUP LEVELS
FOR PSC PROPERTY SOILS [1]

PSC Washougal Facility
Washougal, Washington

Concentrations are in milligrams per kilogram (mg/kg)

Constituent	CAS Number	Soil, MTCA Method A Cleanup Level, Industrial Land Use	Soil, MTCA Method C Cleanup Level, Carcinogenic[2]	Soil, MTCA Method C Cleanup Level, Non-carcinogenic[2]	EPA Regional Screening Levels[3]	Soil Cleanup Level Protective of Groundwater[4]	Clark County Natural Background Level[5]	Applicable PQL[6]	Preliminary Cleanup Level[7]
VOCs (Continued)									
Carbon disulfide	75-15-0	--	--	350,000	3,700	2.83	--	0.005	2.83
Carbon tetrachloride	56-23-5	--	1,880	14,000	3.0	0.0021	--	0.005	0.0050
Chlorobenzene	108-90-7	--	--	70,000	1,400	0.874	--	0.005	0.874
2-Chloroethyl vinyl ether	110-75-8	--	--	--	--	--	--	0.005	--
Chloroform	67-66-3	--	--	35,000	1.5	0.0064	--	0.005	0.0064
Chloromethane	74-87-3	--	--	--	500	0.050	--	0.005	0.050
2-Chlorotoluene	95-49-8	--	--	70,000	20,000	--	--	0.005	20,000
4-Chlorotoluene	106-43-4	--	--	70,000	20,000	--	--	0.005	--
1,2-Dibromo-3-chloropropane	96-12-8	--	164	700	0.069	--	--	0.005	0.069
1,4-Dibromobenzene	106-37-6	--	--	35,000	6,200	--	--	--	6,200
Dibromochloromethane	124-48-1	--	1,562.5	70,000	3.3	0.0027	--	0.005	0.0050
1,1-Dichloro-1,2,2-trifluoroethane	812-04-4	--	--	--	--	--	--	--	--
2,2-Dichloro-1,1,1-trifluoroethane	306-83-2	--	--	--	--	--	--	--	--
1,2-Dichlorobenzene	95-50-1	--	--	315,000	9,800	4.92	--	0.005	4.92
1,3-Dichlorobenzene	541-73-1	--	--	--	--	--	--	0.005	--
1,4-Dichlorobenzene	106-46-7	--	--	--	12	1.0	--	0.005	1.0
Dichlorodifluoromethane	75-71-8	--	--	700,000	400	--	--	0.005	400
1,1-Dichloroethane	75-34-3	--	--	700,000	17	8.73	--	0.005	8.73
1,2-Dichloroethane	107-06-2	--	1,442.31	70,000	2.2	0.00184	--	0.005	0.0050
1,1-Dichloroethene	75-35-4	--	--	175,000	1,100	0.00041	--	0.005	0.0050
cis-1,2-Dichloroethene	156-59-2	--	--	7,000	2,000	0.080	--	0.005	0.080
trans-1,2-Dichloroethene	156-60-5	--	--	70,000	690	0.544	--	0.005	0.544
1,2-Dichloropropane	78-87-5	--	--	--	4.7	0.0026	--	0.005	0.0050
2,2-Dichloropropane	594-20-7	--	--	--	--	--	--	0.005	--
1,3-Dichloropropane	142-28-9	--	--	--	20,000	--	--	0.005	20,000
1,1-Dichloropropene	563-58-6	--	--	--	--	--	--	0.005	--
cis-1,3-Dichloropropene	10061-01-5	--	--	--	--	--	--	0.005	--
trans-1,3-Dichloropropene	10061-02-6	--	--	--	--	--	--	0.005	--
Ethyl chloride (chloroethane)	75-00-3	--	--	--	61,000	--	--	0.005	61,000
Ethyl ether	60-29-7	--	--	700,000	200,000	--	--	0	200,000
Ethylbenzene	100-41-4	6	--	350,000	27	4.58	--	0.005	4.58
Ethylene dibromide (EDB)	106-93-4	0.005	65.6	31,500	0.17	--	--	0.005	0.17
2-Hexanone	591-78-6	--	--	--	1,400	--	--	0.02	--
p-Isopropyltoluene (p-cymene)	99-87-6	--	--	--	--	--	--	0.005	--
4-Methyl-2-butanone	108-10-1	--	--	280,000	53,000	--	--	0.005	53,000
Methylcyclopentane	96-37-7	--	--	--	--	--	--	0.005	--
Methylene bromide	74-95-3	--	--	35,000	110	--	--	0.005	110
Methylene chloride	75-09-2	0.02	17,500	210,000	53	0.020	--	0.005	0.020
2-Methylpentane	107-83-5	--	--	--	--	--	--	0.005	--
3-Methylpentane	96-14-0	--	--	--	--	--	--	0.005	--
Naphthalene	91-20-3	5	--	70,000	18	4.5	--	0.005	4.5
Propylbenzene	103-65-1	--	--	350,000	21,000	3.3	--	0.005	3.3
Styrene	100-42-5	--	--	700,000	36,000	1.7	--	0.005	1.7

TABLE 9-9

SOIL PRELIMINARY CLEANUP LEVELS
FOR PSC PROPERTY SOILS[1]

PSC Washougal Facility
Washougal, Washington

Concentrations are in milligrams per kilogram (mg/kg)

Constituent	CAS Number	Soil, MTCA Method A Cleanup Level, Industrial Land Use	Soil, MTCA Method C Cleanup Level, Carcinogenic[2]	Soil, MTCA Method C Cleanup Level, Non-carcinogenic[2]	EPA Regional Screening Levels[3]	Soil Cleanup Level Protective of Groundwater[4]	Clark County Natural Background Level[5]	Applicable PQL[6]	Preliminary Cleanup Level[7]
VOCs (Continued)									
1,1,1,2-Tetrachloroethane	630-20-6	--	5,048.08	105,000	9.3	--	--	0.005	9.3
1,1,2,2-Tetrachloroethane	79-34-5	--	656.25	70,000	2.8	0.0010	--	0.005	0.0050
Tetrachloroethene	127-18-4	0.05	62,500	21,000	2.6	0.00738	--	0.0031	0.0074
1,2,3-Trichlorobenzene	87-61-6	--	--	--	490	--	--	0.005	--
1,2,4-Trichlorobenzene	120-82-1	--	4,530	35,000	99	0.056	--	0.005	0.056
1,1,1-Trichloroethane	71-55-6	2	--	7,000,000	38,000	1.6	--	0.005	1.6
1,1,2-Trichloroethane	79-00-5	--	2,302.63	14,000	5.3	0.0033	--	0.005	0.0050
Trichloroethene	79-01-6	0.03	2,800	1,750	14	0.00357	--	0.0028	0.0036
1,2,3-Trichloropropane	96-18-4	--	4.38	14,000	0.095	--	--	0.005	0.033
1,1,2-Trichlorotrifluoroethane	76-13-1	--	--	105,000,000	180,000	--	--	0.005	180,000
1,2,4-Trimethylbenzene	95-63-6	--	--	--	260	--	--	0.005	260
1,3,5-Trimethylbenzene	108-67-8	--	--	35,000	10,000	--	--	0.005	10,000
Toluene	108-88-3	7	--	280,000	45,000	4.7	--	0.005	4.7
Trichlorofluoromethane	75-69-4	--	--	1,050,000	3,400	--	--	0.005	3,400
Vinyl acetate	108-05-4	--	--	3,500,000	4,100	32	--	0.005	32
Vinyl chloride	75-01-4	--	87.5	10,500	1.7	0.00016	--	0.005	0.0050
m,p-Xylene[10]	106-42-3	9	--	700,000	2,600	7.19	--	0.0015	7.19
o-Xylene	95-47-6	--	--	700,000	3,000	4.04	--	0.005	4.04

Notes

1. All levels downloaded from Washington State Department of Ecology Cleanup Levels and Risk Calculations (CLARC) web site, https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx.
2. Direct contact (ingestion only), industrial land use.
3. EPA Regional Screening Levels are based on ingestion of dust.
4. The calculations for soil cleanup levels protective of groundwater are presented in Appendix R, Table R-1, Since drinking water screening levels are being applied to the site as one of the criteria used in developing PCLs for soil, no additional soil screening levels need to be formulated to be protective of indoor air. The soil PCLs in the RI meet MTCA's criteria for being stringent enough to be protective of the vapor intrusion pathway (WAC 173-340-745(5)(c)(iv)(A)(v)).
5. 90th percentile natural background levels from the 1994 Washington State Department of Ecology *Natural Background Soil Metals Concentrations in Washington State.*
6. Applicable PQL taken from Table 9-8.
7. Preliminary cleanup level was selected based on criteria described in text. In some cases, the screening level was adjusted up to the PQL (WAC 173-340-707).
8. No data were available for Endosulfan I or Endosulfan II, so data for Endosulfan were used.
9. Screening levels have not been developed for many individual Aroclors; therefore, the screening level for total PCBs was used. The preliminary remediation goal for "high-risk" PCBs was used as a conservative estimate for total PCBs.
10. Information on xylenes was used to calculate a cleanup level for m,p-xylenes.

Abbreviations

-- = not available
CAS = Chemical Abstracts Service
EPA = US Environmental Protection Agency
MTCA = Model Toxics Control Act
PCBs = polychlorinated biphenyls
PQL = practical qnantitation limit
SVOCs = semivolatile organic compounds
TPH = total petroleum hydrocarbons
VOCs = volatile organic compounds

TABLE 9-10

SOIL PRELIMINARY CLEANUP LEVELS
FOR OFF-PROPERTY SOILS [1]

PSC Washougal Facility
Washougal, Washington

Concentrations are in milligrams per kilogram (mg/kg)

Constituent	CAS Number	Soil, MTCA Method A Cleanup Level, Industrial Land Use	Soil, MTCA Method B Cleanup Level Carcinogenic	Soil, MTCA Method B Cleanup Level Non-Carcinogenic	Soil, MTCA Method C Cleanup Level, Carcinogenic[2]	Soil, MTCA Method C Cleanup Level, Non-carcinogenic[2]	EPA Regional Screening Levels[3]	Soil Cleanup Level Protective of Groundwater[4]	Clark County Natural Background Level[5]	Applicable PQL[6]	Preliminary Cleanup Level[7]
Inorganics											
Antimony	7440-36-0	--	--	32	--	1,400	410	5.1	--	0.05	5.1
Arsenic	7440-38-2	20	0.67	24	87.5	1,100	1.6	13.8	6	0.5	6.0
Barium	7440-39-3	--	--	16,000	--	700,000	190,000	824	--	0.05	824
Beryllium	7440-41-7	--	--	160	--	7,000	2,000	63.2	2	0.02	63
Cadmium	7440-43-9a	2	--	--	--	3,500	800	0.0	1.1	0.05	1.1
Chromium (total)	7440-47-3	--	--	--	--	--	--	--	27	0.2	--
Chromium (VI)	18540-29-9	19	--	--	--	11,000	5.6	--	--	0.50	5.6
Cobalt	7440-48-4	--	--	--	--	--	300	--	--	0.02	300
Copper	7440-50-8	--	--	3,200	--	130,000	41,000	1.5	34	0.1	34
Cyanide	57-12-5	--	--	1,600	--	70,000	20,000	1.1	--	0.1	1.1
Lead	7439-92-1	1,000	--	--	--	--	800	108	24	0.05	108
Manganese	7439-96-5	--	--	11,200	--	490,000	--	--	1,511	1	490,000
Mercury	7439-97-6	2	--	--	--	1,100	43	0.2	0.04	0.02	0.21
Nickel	7440-02-0	--	--	1,600	--	70,000	20,000	63.5	21	0.2	64
Selenium and compounds	7782-49-2	--	--	400	--	18,000	5,100	5.2	--	0.1	5.2
Silver	7440-22-4	--	--	400	--	18,000	5,100	0.054	--	0.02	0.054
Sulfide	18496-25-8	--	--	--	--	--	--	--	--	--	--
Thallium, soluble salts	7440-28-0	--	--	--	--	250	10	0.34	--	0.02	0.34
Vanadium	7440-62-2	--	--	5.6	--	25,000	5,200	22.4	--	2	22
Zinc	7440-66-6	--	--	24,000	--	1,100,000	310,000	40.2	96	0.5	96
PCBs/Pesticides											
Aldrin	309-00-2	--	0.059	2.4	7.72	105	0.1	0.00049	--	0.001	0.0010
beta-BHC	319-85-7	--	0.556	--	72.92	--	0.96	0.00042	--	0.001	0.0010
delta-BHC	319-86-8	--	--	--	--	--	--	--	--	0.001	--
alpha-Chlordane	103-71-9	--	--	--	--	--	--	--	--	0.001	--
gamma-Chlordane	12789-03-6	--	--	--	--	--	6.5	--	--	0.00064	6.5
4,4'-DDD	72-54-8	--	4.17	--	546.88	--	7.2	0.00043	--	0.001	0.0010
4,4'-DDE	72-55-9	--	2.94	--	386.03	--	5.1	0.00086	--	0.00076	0.00086
4,4'-DDT	50-29-3	4	2.94	40	386.03	1,750	7	0.0064	--	0.000064	0.0064
Dieldrin	60-57-1	--	0.063	4	8.2	175	0.11	0.00026	--	0.0048	0.0048
Endosulfan I[8]	959-98-8	--	--	--	--	21,000	3,700	0.0025	--	0.001	0.0025
Endosulfan II[8]	33213-65-9	--	--	--	--	21,000	3,700	0.0025	--	0.001	0.0025
Endosulfan sulfate	1031-07-8	--	--	--	--	--	--	--	--	0.00079	--
Endrin	72-20-8	--	--	24	--	1,050	180	0.00052	--	0.001	0.0010
Endrin aldehyde	7421-93-4	--	--	--	--	--	--	--	--	0.00053	--
Endrin ketone	53494-70-5	--	--	--	--	--	--	--	--	0.001	--
Heptachlor	76-44-8	--	0.222	40	29.17	1,750	0.38	0.00010	--	0.0008	0.00080
Heptachlor epoxide	1024-57-3	--	0.110	1.04	14.42	45.5	0.19	0.00083	--	0.001	0.0010
Lindane	58-89-9	0.01	--	24	--	1,050	2.1	0.00061	--	0.00099	0.00099
Methoxychlor	72-43-5	--	--	400	--	17,500	3,100	0.048	--	0.0004	0.048
Toxaphene	8001-35-2	--	0.909	--	119.32	--	1.6	0.048	--	0.049	0.049
Aroclor 1016	12674-11-2	--	14.300	5.6	1880	245	--	--	--	0.01	5.6
Aroclor 1254	11097-69-1	--	0.500	1.6	65.6	70	--	--	--	0.01	0.5
Aroclor 1260	11096-82-5	--	0.500	--	65.6	--	--	--	--	0.01	0.5
Polychlorinated biphenyls, total[9]	1336-36-3	10	0.5	--	65.6	--	0.74	--	--	0.02	0.5

TABLE 9-10

SOIL PRELIMINARY CLEANUP LEVELS
FOR OFF-PROPERTY SOILS [1]

PSC Washougal Facility
Washougal, Washington

Concentrations are in milligrams per kilogram (mg/kg)

Constituent	CAS Number	Soil, MTCA Method A Cleanup Level, Industrial Land Use	Soil, MTCA Method B Cleanup Level Carcinogenic	Soil, MTCA Method B Cleanup Level Non-Carcinogenic	Soil, MTCA Method C Cleanup Level, Carcinogenic[2]	Soil, MTCA Method C Cleanup Level, Non-carcinogenic[2]	EPA Regional Screening Levels[3]	Soil Cleanup Level Protective of Groundwater[4]	Clark County Natural Background Level[5]	Applicable PQL[6]	Preliminary Cleanup Level[7]
SVOCs											
Acenaphthene	83-32-9	--	--	4,800	--	210,000	33,000	65	--	0.0023	65
Acenaphthylene	208-96-8	--	--	--	--	--	--	--	--	0.0024	--
Acetophenone	98-86-2	--	--	8,000	--	350,000	100,000	--	--	0.05	8,000
Aniline	62-53-3	--	175	560	23,026.32	24,500	300	--	--	0.015	175
Anthracene	120-12-7	--	--	24,000	--	1,050,000	170,000	2,275	--	0.0047	2,275
Azobenzene	103-33-3	--	9.1	--	1,193.18	--	23	--	--	0.01	9.1
alpha-BHC	319-84-6	--	0.159	--	20.83	--	0.27	0.00010	--	0.001	0.0010
Benzidine	92-87-5	--	0.004	240	0.57	10,500	0.0075	--	--	0.2	0.20
Benzo(a)anthracene	56-55-3	--	1.37	--	180	--	2.1	0.14	--	0.0016	0.14
Benzo(a)pyrene	50-32-8	2	0.137	--	17.98	--	0.21	0.31	--	0.0022	0.14
Benzo(b)fluoranthene	205-99-2	--	1.37	--	180	--	2.1	0.47	--	0.0048	0.47
Benzo(g,h,i)perylene	191-24-2	--	--	--	--	--	--	--	--	0.0023	--
Benzo(k)fluoranthene	207-08-9	--	13.7	--	1,800	--	21	0.34	--	0.0033	0.34
Benzoic acid	65-85-0	--	--	320,000	--	14,000,000	2,500,000	257	--	0.2	257
Benzyl alcohol	100-51-6	--	--	8,000	--	350,000	62,000	--	--	0.01	8,000
4-Bromophenyl phenyl ether	101-55-3	--	--	--	--	--	--	--	--	0.000122	--
Butyl benzyl phthalate	85-68-7	--	526	16,000	69,100	700,000	910	2.3	--	0.000163	2.3
bis(2-Chloro-1-methylethyl) ether	108-60-1	--	14.3	3,200	1,875	140,000	22	--	--	0.01	14.3
4-Chloro-3-methylphenol	59-50-7	--	--	--	--	--	62,000	--	--	0.01	62,000
p-Chloroaniline (4-chloroaniline)	106-47-8	--	5	320	656	14,000	8.6	0.0012	--	0.01	0.010
bis(2-Chloroethoxy)methane	111-91-1	--	--	--	--	--	1,800	--	--	0.01	--
bis(2-Chloroethyl) ether	111-44-4	--	0.909	--	119.32	--	1.0	0.0011	--	0.01	0.010
2-Chloronaphthalene	91-58-7	--	--	6,400	--	280,000	82,000	--	--	0.01	6,400
2-Chlorophenol	95-57-8	--	--	400	--	17,500	5,100	0.47	--	0.01	0.47
4-Chlorophenyl phenyl ether	7005-72-3	--	--	--	--	--	--	--	--	0.01	--
Chrysene	218-01-9	--	137	--	18,000	--	210	0.099	--	0.0041	0.099
o-Cresol (2-methylphenol)	95-48-7	--	--	4,000	--	175,000	31,000	2.3	--	0.01	2.3
Cumene (Isopropylbenzene)	98-82-8	--	--	8,000	--	350,000	11,000	--	--	0.005	8,000
3,3'-Dichlorobenzidine	91-94-1	--	2.2	--	291.67	--	3.8	0.037	--	0.037	0.037
2,4-Dichlorophenol	120-83-2	--	--	240	--	10,500	1,800	0.17	--	0.01	0.17
Dibenzo[a,h]anthracene	53-70-3	--	0.137	--	18	--	0.21	0.58	--	0.0026	0.137
Dibenzofuran	132-64-9	--	--	80	--	3,500	1,000	0.086	--	0.0017	0.086
Di-n-butyl phthalate	84-74-2	--	--	8,000	--	350,000	62,000	58	--	0.01	57.6
Di-n-octyl phthalate	117-84-0	--	--	--	--	--	--	--	--	0.01	--
Diethyl phthalate	84-66-2	--	--	64,000	--	2,800,000	490,000	72	--	0.01	72.2
Dimethyl phthalate	131-11-3	--	--	--	--	--	--	1088.4	--	0.000141	1,088.4
2,4-Dimethylphenol	105-67-9	--	--	1,600	--	70,000	12,000	1.3	--	0.05	1.3
2,4-Dinitrophenol	51-28-5	--	--	160	--	7,000	1,200	0.13	--	0.2	0.20
2,4-Dinitrotoluene	121-14-2	--	--	160	--	7,000	5.5	0.0011	--	0.01	0.010
2,6-Dinitrotoluene	606-20-2	--	--	80	--	3,500	620	0.086	--	0.01	0.086
1,4-Dioxane	123-91-1	--	10	2,400	1,310	105,000	17	0.0043	--	0.0015	0.0043
bis(2-Ethylhexyl) phthalate	117-81-7	--	71.4	1,600	9,375	70,000	120	2.6	--	0.017	2.6
Fluoranthene	206-44-0	--	--	3,200	--	140,000	22,000	128	--	0.0034	128
Fluorene	86-73-7	--	--	3,200	--	140,000	22,000	101	--	0.0019	101

TABLE 9-10

SOIL PRELIMINARY CLEANUP LEVELS
FOR OFF-PROPERTY SOILS [1]
PSC Washougal Facility
Washougal, Washington

Concentrations are in milligrams per kilogram (mg/kg)

Constituent	CAS Number	Soil, MTCA Method A Cleanup Level, Industrial Land Use	Soil, MTCA Method B Cleanup Level Carcinogenic	Soil, MTCA Method B Cleanup Level Non-Carcinogenic	Soil, MTCA Method C Cleanup Level, Carcinogenic[2]	Soil, MTCA Method C Cleanup Level, Non-carcinogenic[2]	EPA Regional Screening Levels[3]	Soil Cleanup Level Protective of Groundwater[4]	Clark County Natural Background Level[5]	Applicable PQL[6]	Preliminary Cleanup Level[7]
SVOCs (Continued)											
Hexachlorobenzene	118-74-1	--	0.625	64	82.03	2,800	1.1	0.23	--	0.00079	0.23
Hexachlorobutadiene	87-68-3	--	12.8	80	1,683	3,500	22	0.47	--	0.01	0.47
Hexachlorocyclopentadiene	77-47-4	--	--	480	--	21,000	3,700	160	--	0.05	160
Hexachloroethane	67-72-1	--	71.4	80	9,375	3,500	120	0.056	--	0.01	0.056
Indeno(1,2,3-cd)pyrene	193-39-5	--	1.37	--	180	--	2.1	1.4	--	0.0024	1.37
Isophorone	78-59-1	--	1,053	16,000	138,157.9	700,000	1,800	0.041	--	0.01	0.041
2-Methyl-4,6-dinitrophenol	534-52-1	--	--	--	--	--	49	--	--	0.017	49
1-Methylnaphthalene	90-12-0	--	34.5	--	4,530	--	99	--	--	0.0025	34.5
2-Methylnaphthalene	91-57-6	--	--	320	--	14,000	4,100	--	--	0.0034	320
4-Methylphenol	106-44-5	--	--	400	--	17,500	3,100	--	--	0.01	400
N-Nitroso-di-n-propylamine	621-64-7	--	0.143	--	18.75	--	0.25	0.00090	--	0.01	0.010
N-Nitrosodiphenylamine	86-30-6	--	204	--	26,785.71	--	350	0.099	--	0.01	0.099
Naphthalene	91-20-3	5	--	1,600	--	70,000	18	4.5	--	0.005	4.5
Nitrobenzene	98-95-3	--	--	160	--	7,000	24	0.10	--	0.000261	0.10
2-Nitroaniline	88-74-4	--	--	800	--	35,000	6,000	--	--	0.02	800
3-Nitroaniline	99-09-2	--	--	--	--	--	--	--	--	0.02	--
4-Nitroaniline	100-01-6	--	--	--	--	--	86	--	--	0.02	86
2-Nitrophenol	88-75-5	--	--	--	--	--	--	--	--	0.01	--
4-Nitrophenol	100-02-7	--	--	--	--	--	--	--	--	0.1	--
Pentachlorophenol	87-86-5	--	2.5	400	328	17,500	2.7	0.012	--	0.15	0.15
Phenanthrene	85-01-8	--	--	--	--	--	--	--	--	0.0033	--
Phenol	108-95-2	--	--	24,000	--	1,050,000	180,000	11	--	0.019	11
Pyrene	129-00-0	--	--	2,400	--	105,000	17,000	655	--	0.0036	655
2,4,5-Trichlorophenol	95-95-4	--	--	8,000	--	350,000	62,000	29	--	0.01	29
2,4,6-Trichlorophenol	88-06-2	--	90.9	80	11,932	3,500	160	0.016	--	0.01	0.016
TPH											
Diesel		2,000	--	--	--	--	--	--	--	25	2,000
Gasoline	86290-81-5	30	--	--	--	--	--	--	--	3	30
Lube Oil		2,000	--	--	--	--	--	--	--	29	2,000
VOCs											
Acetone	67-64-1	--	--	72,000	--	3,150,000	630,000	29	--	0.005	29
Acrolein	107-02-8	--	--	40	--	1,750	0.65	--	--	0.005	0.65
Acrylonitrile	107-13-1	--	1.85	--	243.06	--	1.2	--	--	0.005	1.2
Benzene	71-43-2	0.03	18.2	320	2,386.36	14,000	5.4	0.0045	--	0.005	0.0050
Bromobenzene	108-86-1	--	--	--	--	--	1,800	--	--	0.005	1,800
Bromochloromethane	74-97-5	--	--	--	--	--	680	--	--	0.005	--
Bromodichloromethane	75-27-4	--	16.1	1,600	2,116.94	70,000	1.4	0.0037	--	0.005	0.0050
Bromoform	75-25-2	--	127	1,600	16,613.92	70,000	220	0.028	--	0.005	0.028
Bromomethane	74-83-9	--	--	112	--	4,900	32	0.052	--	0.005	0.052
2-Butanone (MEK)	78-93-3	--	--	48,000	--	2,100,000	200,000	--	--	0.005	48,000
n-Butylbenzene	104-51-8	--	--	--	--	--	51,000	--	--	0.005	51,000
sec-Butylbenzene	135-98-8	--	--	--	--	--	--	--	--	0.005	--
tert-Butylbenzene	98-06-6	--	--	--	--	--	--	--	--	0.005	--

TABLE 9-10

SOIL PRELIMINARY CLEANUP LEVELS
FOR OFF-PROPERTY SOILS [1]

PSC Washougal Facility
Washougal, Washington

Concentrations are in milligrams per kilogram (mg/kg)

Constituent	CAS Number	Soil, MTCA Method A Cleanup Level, Industrial Land Use	Soil, MTCA Method B Cleanup Level Carcinogenic	Soil, MTCA Method B Cleanup Level Non-Carcinogenic	Soil, MTCA Method C Cleanup Level, Carcinogenic[2]	Soil, MTCA Method C Cleanup Level, Non-carcinogenic[2]	EPA Regional Screening Levels[3]	Soil Cleanup Level Protective of Groundwater[4]	Clark County Natural Background Level[5]	Applicable PQL[6]	Preliminary Cleanup Level[7]
VOCs (Continued)											
Carbon disulfide	75-15-0	--	--	8,000	--	350,000	3,700	2.83	--	0.005	2.83
Carbon tetrachloride	56-23-5	--	14.3	320	1,880	14,000	3.0	0.0021	--	0.005	0.0050
Chlorobenzene	108-90-7	--	--	1,600	--	70,000	1,400	0.874	--	0.005	0.874
2-Chloroethyl vinyl ether	110-75-8	--	--	--	--	--	--	--	--	0.005	--
Chloroform	67-66-3	--	--	800	--	35,000	1.5	0.0064	--	0.005	0.0064
Chloromethane	74-87-3	--	--	--	--	--	500	0.050	--	0.005	0.050
2-Chlorotoluene	95-49-8	--	--	1,600	--	70,000	20,000	--	--	0.005	1,600
4-Chlorotoluene	106-43-4	--	--	--	--	70,000	20,000	--	--	0.005	--
1,2-Dibromo-3-chloropropane	96-12-8	--	1.25	16	164	700	0.069	--	--	0.005	0.069
1,4-Dibromobenzene	106-37-6	--	--	800	--	35,000	6,200	--	--	--	800
Dibromochloromethane	124-48-1	--	11.9	1,600	1,562.5	70,000	3.3	0.0027	--	0.005	0.0050
1,1-Dichloro-1,2,2-trifluoroethane	812-04-4	--	--	--	--	--	--	--	--	--	--
2,2-Dichloro-1,1,1-trifluoroethane	306-83-2	--	--	--	--	--	--	--	--	--	--
1,2-Dichlorobenzene	95-50-1	--	--	7,200	--	315,000	9,800	4.92	--	0.005	4.92
1,3-Dichlorobenzene	541-73-1	--	--	--	--	--	--	--	--	0.005	--
1,4-Dichlorobenzene	106-46-7	--	--	--	--	--	12	1.0	--	0.005	1.0
Dichlorodifluoromethane	75-71-8	--	--	16,000	--	700,000	400	--	--	0.005	400
1,1-Dichloroethane	75-34-3	--	--	16,000	--	700,000	17	8.73	--	0.005	8.73
1,2-Dichloroethane	107-06-2	--	11.0	1,600	1,442.31	70,000	2.2	0.00184	--	0.005	0.0050
1,1-Dichloroethene	75-35-4	--	--	4,000	--	175,000	1,100	0.00041	--	0.005	0.0050
cis-1,2-Dichloroethene	156-59-2	--	--	160	--	7,000	2,000	0.080	--	0.005	0.080
trans-1,2-Dichloroethene	156-60-5	--	--	1,600	--	70,000	690	0.544	--	0.005	0.544
1,2-Dichloropropane	78-87-5	--	--	--	--	--	4.7	0.0026	--	0.005	0.0050
2,2-Dichloropropane	594-20-7	--	--	--	--	--	--	--	--	0.005	--
1,3-Dichloropropane	142-28-9	--	--	--	--	--	20,000	--	--	0.005	20,000
1,1-Dichloropropene	563-58-6	--	--	--	--	--	--	--	--	0.005	--
cis-1,3-Dichloropropene	10061-01-5	--	--	--	--	--	--	--	--	0.005	--
trans-1,3-Dichloropropene	10061-02-6	--	--	--	--	--	--	--	--	0.005	--
Ethyl chloride (chloroethane)	75-00-3	--	--	--	--	--	61,000	--	--	0.005	61,000
Ethyl ether	60-29-7	--	--	16,000	--	700,000	200,000	--	--	0	16,000
Ethylbenzene	100-41-4	6	--	8,000	--	350,000	27	4.58	--	0.005	4.58
Ethylene dibromide (EDB)	106-93-4	0.005	0.5	720	65.6	31,500	0.17	--	--	0.005	0.17
2-Hexanone	591-78-6	--	--	--	--	--	1,400	--	--	0.02	--
p-Isopropyltoluene (p-cymene)	99-87-6	--	--	--	--	--	--	--	--	0.005	--
4-Methyl-2-butanone	108-10-1	--	--	6,400	--	280,000	53,000	--	--	0.005	6,400
Methylcyclopentane	96-37-7	--	--	--	--	--	--	--	--	0.005	--
Methylene bromide	74-95-3	--	--	800	--	35,000	110	--	--	0.005	110
Methylene chloride	75-09-2	0.02	133	4,800	17,500	210,000	53	0.020	--	0.005	0.020
2-Methylpentane	107-83-5	--	--	--	--	--	--	--	--	0.005	--
3-Methylpentane	96-14-0	--	--	--	--	--	--	--	--	0.005	--
Naphthalene	91-20-3	5	--	1,600	--	70,000	18	4.5	--	0.005	4.5
Propylbenzene	103-65-1	--	--	8,000	--	350,000	21,000	3.3	--	0.005	3.3
Styrene	100-42-5	--	--	16,000	--	700,000	36,000	1.7	--	0.005	1.7

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SOIL PRELIMINARY CLEANUP LEVELS
FOR OFF-PROPERTY SOILS [1]

PSC Washougal Facility
Washougal, Washington

Concentrations are in milligrams per kilogram (mg/kg)

Constituent	CAS Number	Soil, MTCA Method A Cleanup Level, Industrial Land Use	Soil, MTCA Method B Cleanup Level Carcinogenic	Soil, MTCA Method B Cleanup Level Non-Carcinogenic	Soil, MTCA Method C Cleanup Level, Carcinogenic[2]	Soil, MTCA Method C Cleanup Level, Non-carcinogenic[2]	EPA Regional Screening Levels[3]	Soil Cleanup Level Protective of Groundwater[4]	Clark County Natural Background Level[5]	Applicable PQL[6]	Preliminary Cleanup Level[7]
VOCs (Continued)											
1,1,1,2-Tetrachloroethane	630-20-6	--	38.5	2,400	5,048.08	105,000	9.3	--	--	0.005	9.3
1,1,2,2-Tetrachloroethane	79-34-5	--	5	1,600	656.25	70,000	2.8	0.0010	--	0.005	0.0050
Tetrachloroethene	127-18-4	0.05	476	480	62,500	21,000	2.6	0.00738	--	0.0031	0.0074
1,2,3-Trichlorobenzene	87-61-6	--	--	--	--	--	490	--	--	0.005	--
1,2,4-Trichlorobenzene	120-82-1	--	34.5	800	4,530	35,000	99	0.056	--	0.005	0.056
1,1,1-Trichloroethane	71-55-6	2	--	160,000	--	7,000,000	38,000	1.6	--	0.005	1.6
1,1,2-Trichloroethane	79-00-5	--	17.5	320	2,302.63	14,000	5.3	0.0033	--	0.005	0.0050
Trichloroethene	79-01-6	0.03	11.5	40	2,800	1,750	14	0.00357	--	0.0028	0.0036
1,2,3-Trichloropropane	96-18-4	--	0.033	320	4.38	14,000	0.095	--	--	0.005	0.033
1,1,2-Trichlorotrifluoroethane	76-13-1	--	--	2,400,000	--	105,000,000	180,000	--	--	0.005	180,000
1,2,4-Trimethylbenzene	95-63-6	--	--	--	--	--	260	--	--	0.005	260
1,3,5-Trimethylbenzene	108-67-8	--	--	800	--	35,000	10,000	--	--	0.005	800
Toluene	108-88-3	7	--	6,400	--	280,000	45,000	4.7	--	0.005	4.7
Trichlorofluoromethane	75-69-4	--	--	24,000	--	1,050,000	3,400	--	--	0.005	3,400
Vinyl acetate	108-05-4	--	--	80,000	--	3,500,000	4,100	32	--	0.005	32
Vinyl chloride	75-01-4	--	--	240	87.5	10,500	1.7	0.00016	--	0.005	0.0050
m,p-Xylene[10]	106-42-3	9	--	16,000	--	700,000	2,600	7.19	--	0.0015	7.19
o-Xylene	95-47-6	--	--	16,000	--	700,000	3,000	4.04	--	0.005	4.04

Notes

1. All levels downloaded from Washington State Department of Ecology Cleanup Levels and Risk Calculations (CLARC) web site, https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx.
2. Direct contact (ingestion only), industrial land use.
3. EPA Regional Screening Levels are based on ingestion of dust.
4. The calculations for soil cleanup levels proective of groundwater are presented in Appendix Q, Table Q-1.
5. 90th percentile natural background levels from the 1994 Washington State Department of Ecology *Natural Background Soil Metals Concentrations in Washington State.*
6. Applicable PQL taken from Table 9-8.
7. Preliminary cleanup level was selected based on criteria described in text. In some cases, the screening level was adjusted up to the PQL (WAC 173-340-707).
8. No data were available for Endosulfan I or Endosulfan II, so data for Endosulfan were used.
9. Screening levels have not been developed for many individual Aroclors; therefore, the screening level for total PCBs was used. The preliminary remediation goal for "high-risk" PCBs was used as a conservative estimate for total PCBs.
10. Information on xylenes was used to calculate a cleanup level for m,p-xylenes.

Abbreviations

= not available
CAS = Chemical Abstracts Service
EPA = US Environmental Protection Agency
MTCA = Model Toxics Control Act
PCBs = polychlorinated biphenyls
PQL = practical qnantitation limit
SVOCs = semivolatile organic compounds
TPH = total petroleum hydrocarbons
VOCs = volatile organic compounds

TABLE 9-11

SOIL PRELIMINARY CLEANUP LEVELS [1]

PSC Washougal Facility
Washougal, Washington

Concentrations are in milligrams per kilogram (mg/kg)

Constituent	CAS Number	Soils on PSC Property Preliminary Cleanup Level[2]	Soils Off PSC Property Preliminary Cleanup Level[2]
Inorganics			
Antimony	7440-36-0	5.1	5.1
Arsenic	7440-38-2	6.0	6.0
Barium	7440-39-3	824	824
Beryllium	7440-41-7	63	63
Cadmium	7440-43-9a	1.1	1.1
Chromium (total)	7440-47-3	--	--
Chromium (VI)	18540-29-9	5.6	5.6
Cobalt	7440-48-4	300	300
Copper	7440-50-8	34	34
Cyanide	57-12-5	1.1	1.1
Lead	7439-92-1	108	108
Manganese	7439-96-5	490,000	490,000
Mercury	7439-97-6	0.21	0.21
Nickel	7440-02-0	64	64
Selenium and compounds	7782-49-2	5.2	5.2
Silver	7440-22-4	0.054	0.054
Sulfide	18496-25-8	--	--
Thallium, soluble salts	7440-28-0	0.34	0.34
Vanadium	7440-62-2	22	22
Zinc	7440-66-6	96	96
PCBs/Pesticides			
Aldrin	309-00-2	0.0010	0.0010
beta-BHC	319-85-7	0.0010	0.0010
delta-BHC	319-86-8	--	--
alpha-Chlordane	103-71-9	--	--
gamma-Chlordane	12789-03-6	6.5	6.5
4,4'-DDD	72-54-8	0.0010	0.0010
4,4'-DDE	72-55-9	0.00086	0.00086
4,4'-DDT	50-29-3	0.0064	0.0064
Dieldrin	60-57-1	0.0048	0.0048
Endosulfan I[3]	959-98-8	0.0025	0.0025
Endosulfan II[3]	33213-65-9	0.0025	0.0025
Endosulfan sulfate	1031-07-8	--	--
Endrin	72-20-8	0.0010	0.0010
Endrin aldehyde	7421-93-4	--	--
Endrin ketone	53494-70-5	--	--
Heptachlor	76-44-8	0.00080	0.00080
Heptachlor epoxide	1024-57-3	0.0010	0.0010
Lindane	58-89-9	0.00099	0.00099
Methoxychlor	72-43-5	0.048	0.048
Toxaphene	8001-35-2	0.049	0.049
Aroclor 1016	12674-11-2	245	5.6
Aroclor 1254	11097-69-1	65.6	0.5
Aroclor 1260	11096-82-5	65.6	0.5
Polychlorinated biphenyls, total[4]	1336-36-3	0.74	0.5

TABLE 9-11

SOIL PRELIMINARY CLEANUP LEVELS [1]

PSC Washougal Facility
Washougal, Washington

Concentrations are in milligrams per kilogram (mg/kg)

Constituent	CAS Number	Soils on PSC Property Preliminary Cleanup Level[2]	Soils Off PSC Property Preliminary Cleanup Level[2]
SVOCs			
Acenaphthene	83-32-9	65	65
Acenaphthylene	208-96-8	--	--
Acetophenone	98-86-2	100,000	8,000
Aniline	62-53-3	300	175
Anthracene	120-12-7	2,275	2,275
Azobenzene	103-33-3	23	9.1
alpha-BHC	319-84-6	0.0010	0.0010
Benzidine	92-87-5	0.20	0.20
Benzo(a)anthracene	56-55-3	0.14	0.14
Benzo(a)pyrene	50-32-8	0.14	0.14
Benzo(b)fluoranthene	205-99-2	0.47	0.47
Benzo(g,h,i)perylene	191-24-2	--	--
Benzo(k)fluoranthene	207-08-9	0.34	0.34
Benzoic acid	65-85-0	257	257
Benzyl alcohol	100-51-6	62,000	8,000
4-Bromophenyl phenyl ether	101-55-3	--	--
Butyl benzyl phthalate	85-68-7	2.3	2.3
bis(2-Chloro-1-methylethyl) ether	108-60-1	22	14.3
4-Chloro-3-methylphenol	59-50-7	62,000	62,000
p-Chloroaniline (4-chloroaniline)	106-47-8	0.010	0.010
bis(2-Chloroethoxy)methane	111-91-1	--	--
bis(2-Chloroethyl) ether	111-44-4	0.010	0.010
2-Chloronaphthalene	91-58-7	82,000	6,400
2-Chlorophenol	95-57-8	0.47	0.47
4-Chlorophenyl phenyl ether	7005-72-3	--	--
Chrysene	218-01-9	0.099	0.099
o-Cresol (2-methylphenol)	95-48-7	2.3	2.3
Cumene (Isopropylbenzene)	98-82-8	11,000	8,000
3,3'-Dichlorobenzidine	91-94-1	0.037	0.037
2,4-Dichlorophenol	120-83-2	0.17	0.17
Dibenzo[a,h]anthracene	53-70-3	0.58	0.137
Dibenzofuran	132-64-9	0.086	0.086
Di-n-butyl phthalate	84-74-2	57.6	57.6
Di-n-octyl phthalate	117-84-0	--	--
Diethyl phthalate	84-66-2	72.2	72.2
Dimethyl phthalate	131-11-3	1,088.4	1,088.4
2,4-Dimethylphenol	105-67-9	1.3	1.3
2,4-Dinitrophenol	51-28-5	0.20	0.20
2,4-Dinitrotoluene	121-14-2	0.010	0.010
2,6-Dinitrotoluene	606-20-2	0.086	0.086
1,4-Dioxane	123-91-1	0.0043	0.0043
bis(2-Ethylhexyl) phthalate	117-81-7	2.6	2.6
Fluoranthene	206-44-0	128	128
Fluorene	86-73-7	101	101

TABLE 9-11

SOIL PRELIMINARY CLEANUP LEVELS [1]

PSC Washougal Facility
Washougal, Washington

Concentrations are in milligrams per kilogram (mg/kg)

Constituent	CAS Number	Soils on PSC Property Preliminary Cleanup Level[2]	Soils Off PSC Property Preliminary Cleanup Level[2]
SVOCs (Continued)			
Hexachlorobenzene	118-74-1	0.23	0.23
Hexachlorobutadiene	87-68-3	0.47	0.47
Hexachlorocyclopentadiene	77-47-4	160	160
Hexachloroethane	67-72-1	0.056	0.056
Indeno(1,2,3-cd)pyrene	193-39-5	1.40	1.37
Isophorone	78-59-1	0.041	0.041
2-Methyl-4,6-dinitrophenol	534-52-1	49	49
1-Methylnaphthalene	90-12-0	99.0	34.5
2-Methylnaphthalene	91-57-6	4,100	320
4-Methylphenol	106-44-5	3,100	400
N-Nitroso-di-n-propylamine	621-64-7	0.010	0.010
N-Nitrosodiphenylamine	86-30-6	0.099	0.099
Naphthalene	91-20-3	4.5	4.5
Nitrobenzene	98-95-3	0.10	0.10
2-Nitroaniline	88-74-4	6,000	800
3-Nitroaniline	99-09-2	--	--
4-Nitroaniline	100-01-6	86	86
2-Nitrophenol	88-75-5	--	--
4-Nitrophenol	100-02-7	--	--
Pentachlorophenol	87-86-5	0.15	0.15
Phenanthrene	85-01-8	--	--
Phenol	108-95-2	11	11
Pyrene	129-00-0	655	655
2,4,5-Trichlorophenol	95-95-4	29	29
2,4,6-Trichlorophenol	88-06-2	0.016	0.016
TPH			
Diesel		2,000	2,000
Gasoline	86290-81-5	30	30
Lube Oil		2,000	2,000
VOCs			
Acetone	67-64-1	29	29
Acrolein	107-02-8	0.65	0.65
Acrylonitrile	107-13-1	1.2	1.2
Benzene	71-43-2	0.0050	0.0050
Bromobenzene	108-86-1	1,800	1,800
Bromochloromethane	74-97-5	--	--
Bromodichloromethane	75-27-4	0.0050	0.0050
Bromoform	75-25-2	0.028	0.028
Bromomethane	74-83-9	0.052	0.052
2-Butanone (MEK)	78-93-3	200,000	48,000
n-Butylbenzene	104-51-8	51,000	51,000
sec-Butylbenzene	135-98-8	--	--
tert-Butylbenzene	98-06-6	--	--

TABLE 9-11

SOIL PRELIMINARY CLEANUP LEVELS [1]
PSC Washougal Facility
Washougal, Washington

Concentrations are in milligrams per kilogram (mg/kg)

Constituent	CAS Number	Soils on PSC Property Preliminary Cleanup Level[2]	Soils Off PSC Property Preliminary Cleanup Level[2]
VOCs (Continued)			
Carbon disulfide	75-15-0	2.83	2.83
Carbon tetrachloride	56-23-5	0.0050	0.0050
Chlorobenzene	108-90-7	0.874	0.874
2-Chloroethyl vinyl ether	110-75-8	--	--
Chloroform	67-66-3	0.0064	0.0064
Chloromethane	74-87-3	0.050	0.050
2-Chlorotoluene	95-49-8	20,000	1,600
4-Chlorotoluene	106-43-4	--	--
1,2-Dibromo-3-chloropropane	96-12-8	0.069	0.069
1,4-Dibromobenzene	106-37-6	6,200	800
Dibromochloromethane	124-48-1	0.0050	0.0050
1,1-Dichloro-1,2,2-trifluoroethane	812-04-4	--	--
2,2-Dichloro-1,1,1-trifluoroethane	306-83-2	--	--
1,2-Dichlorobenzene	95-50-1	4.92	4.92
1,3-Dichlorobenzene	541-73-1	--	--
1,4-Dichlorobenzene	106-46-7	1.0	1.0
Dichlorodifluoromethane	75-71-8	400	400
1,1-Dichloroethane	75-34-3	8.73	8.73
1,2-Dichloroethane	107-06-2	0.0050	0.0050
1,1-Dichloroethene	75-35-4	0.0050	0.0050
cis-1,2-Dichloroethene	156-59-2	0.080	0.080
trans-1,2-Dichloroethene	156-60-5	0.544	0.544
1,2-Dichloropropane	78-87-5	0.0050	0.0050
2,2-Dichloropropane	594-20-7	--	--
1,3-Dichloropropane	142-28-9	20,000	20,000
1,1-Dichloropropene	563-58-6	--	--
cis-1,3-Dichloropropene	10061-01-5	--	--
trans-1,3-Dichloropropene	10061-02-6	--	--
Ethyl chloride (chloroethane)	75-00-3	61,000	61,000
Ethyl ether	60-29-7	200,000	16,000
Ethylbenzene	100-41-4	4.58	4.58
Ethylene dibromide (EDB)	106-93-4	0.17	0.17
2-Hexanone	591-78-6	--	--
p-Isopropyltoluene (p-cymene)	99-87-6	--	--
4-Methyl-2-butanone	108-10-1	53,000	6,400
Methylcyclopentane	96-37-7	--	--
Methylene bromide	74-95-3	110	110
Methylene chloride	75-09-2	0.020	0.020
2-Methylpentane	107-83-5	--	--
3-Methylpentane	96-14-0	--	--
Naphthalene	91-20-3	4.5	4.5
Propylbenzene	103-65-1	3.3	3.3
Styrene	100-42-5	1.7	1.7

TABLE 9-11

SOIL PRELIMINARY CLEANUP LEVELS [1]

PSC Washougal Facility
Washougal, Washington

Concentrations are in milligrams per kilogram (mg/kg)

Constituent	CAS Number	Soils on PSC Property Preliminary Cleanup Level[2]	Soils Off PSC Property Preliminary Cleanup Level[2]
VOCs (Continued)			
1,1,1,2-Tetrachloroethane	630-20-6	9.3	9.3
1,1,2,2-Tetrachloroethane	79-34-5	0.0050	0.0050
Tetrachloroethene	127-18-4	0.0074	0.0074
1,2,3-Trichlorobenzene	87-61-6	--	--
1,2,4-Trichlorobenzene	120-82-1	0.056	0.056
1,1,1-Trichloroethane	71-55-6	1.6	1.6
1,1,2-Trichloroethane	79-00-5	0.0050	0.0050
Trichloroethene	79-01-6	0.0036	0.0036
1,2,3-Trichloropropane	96-18-4	0.033	0.033
1,1,2-Trichlorotrifluoroethane	76-13-1	180,000	180,000
1,2,4-Trimethylbenzene	95-63-6	260	260
1,3,5-Trimethylbenzene	108-67-8	10,000	800
Toluene	108-88-3	4.7	4.7
Trichlorofluoromethane	75-69-4	3,400	3,400
Vinyl acetate	108-05-4	32	32
Vinyl chloride	75-01-4	0.0050	0.0050
m,p-Xylene[5]	106-42-3	7.19	7.19
o-Xylene	95-47-6	4.04	4.04

Notes

1. All MTCA direct contact levels downloaded from Washington State Department of Ecology Cleanup Levels and Risk Calculations (CLARC) web site, https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx.
2. Preliminary cleanup level was selected based on criteria described in text. In some cases, the screening level was adjusted up to the PQL (Washington Administrative Code 173-340-707).
3. No data were available for Endosulfan I or Endosulfan II, so data for Endosulfan were used.
4. Screening levels have not been developed for many individual Aroclors; therefore, the screening level for total PCBs was used. The preliminary remediation goal for "high-risk" PCBs was used as a conservative estimate for total PCBs.
5. Information on xylenes was used to calculate a cleanup level for m,p-xylenes.

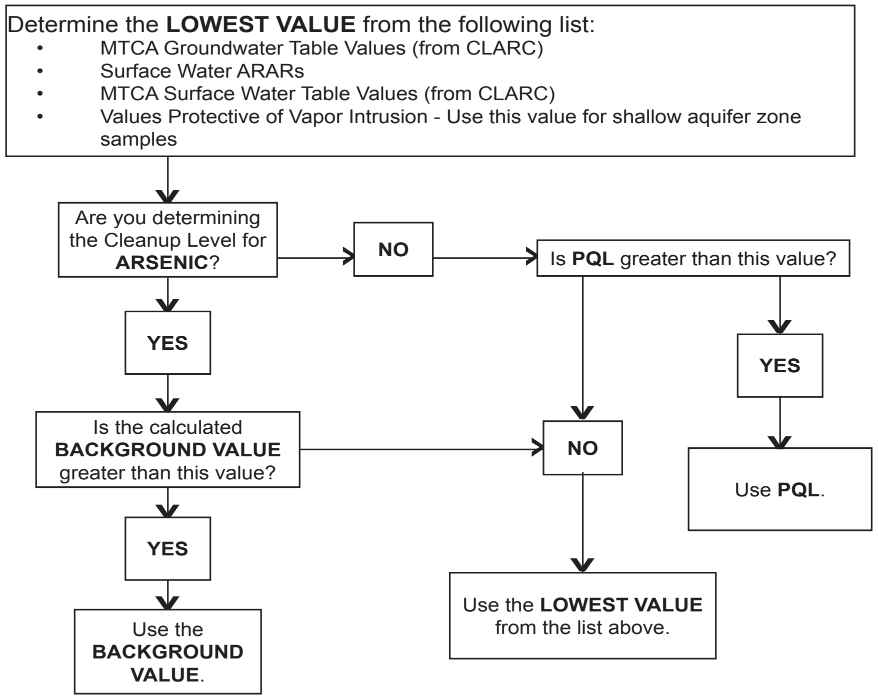
Abbreviations

 = not available
CAS = Chemical Abstracts Service
PCBs = polychlorinated biphenyls
PSC = PSC Environmental Services, LLC
SVOCs = semivolatile organic compounds
TPH = total petroleum hydrocarbons
VOCs = volatile organic compounds

FIGURES

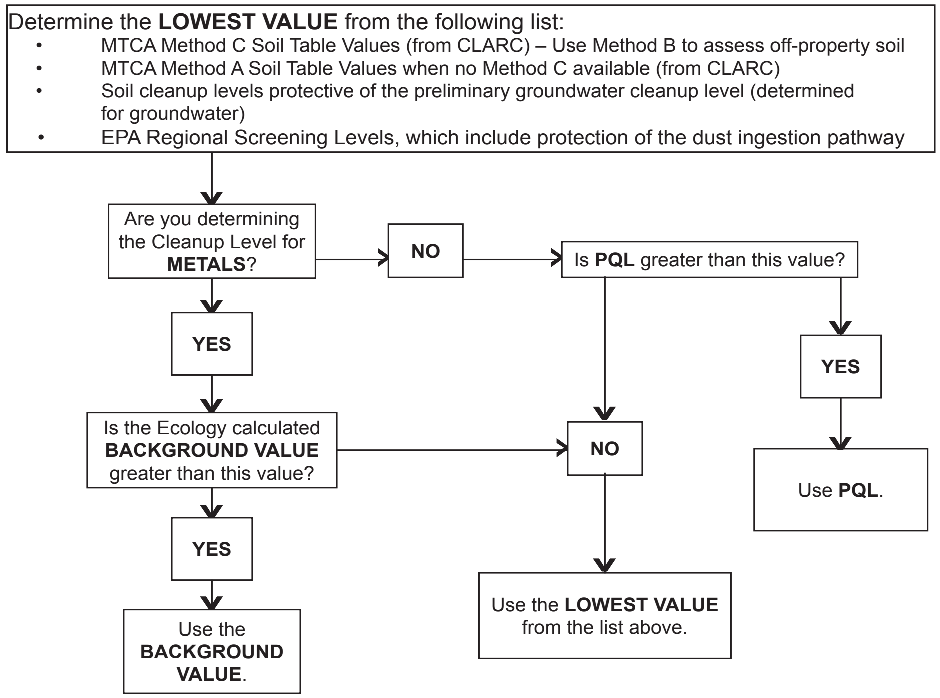
R:\9625.001 PSC Washougal\024\Figures\Figure 9-1_Flow Chart.pdf

How to determine the Cleanup Level for Groundwater


Determine the **LOWEST VALUE** from the following list:

- MTCA Groundwater Table Values (from CLARC)
- Surface Water ARARs
- MTCA Surface Water Table Values (from CLARC)
- Values Protective of Vapor Intrusion - Use this value for shallow aquifer zone samples

How to determine the Cleanup Level for Soil


Determine the **LOWEST VALUE** from the following list:

- MTCA Method C Soil Table Values (from CLARC) – Use Method B to assess off-property soil
- MTCA Method A Soil Table Values when no Method C available (from CLARC)
- Soil cleanup levels protective of the preliminary groundwater cleanup level (determined for groundwater)
- EPA Regional Screening Levels, which include protection of the dust ingestion pathway

Abbreviations

ARARs = applicable or relevant and appropriate requirements
CLARC = Cleanup Levels and Risk Calculation
EPA = US Environmental Protection Agency
MTCA = Model Toxics Control Act
PQL = practical quantitation limit

amec

FLOW CHART FOR SELECTION OF CLEANUP LEVELS
PSC Washougal Facility
Washougal, Washington

Project No. 9625
Figure **9-1**

10.0 SELECTION OF CONSTITUENTS OF CONCERN

This section presents the methods used to determine the list of COCs to be addressed in this RI. The site has been investigated extensively since 1985 (Section 3.3), but many of the older data may not be representative of current conditions or meet the data quality objectives (DQOs) for the project. Thus, the process to identify COCs involves two main steps:

1. Assess existing data to identify those analytical data that meet project-specific DQOs (Section 10.1); and
2. Evaluate the relevant and appropriate data in relation to site-specific cleanup levels (Section 10.2).

10.1 DATA QUALITY ASSESSMENT

The 2000 RI Report included a data quality assessment for data used in the RI. Additional soil and groundwater sampling events have been conducted at the facility since that report was completed, and these additional data are included in the data set considered for use in the RI/FS. The data set selected for use in the RI includes soil data collected since 1996 and groundwater data collected since 2000. These data were selected based on the data's age, distribution, quality, and appropriateness for meeting the project DQOs. The assessment that led to selection of this data set is described in this section.

10.1.1 Data Evaluation Steps

The RI and final remedy planning for the site are based on the results of data collection activities conducted over the past 10 to 20 years. The DQOs have varied for the different phases of investigation and cleanup historically conducted at the site. In order to complete the RI/FS, all available data were compiled into a single data set. The data set was assessed to identify portions of that data set that are relevant and appropriate to final characterization and cleanup. The resulting data were selected for use in the RI. To be selected for the RI data set, data were evaluated relative to the following DQOs:

DQO #1. Use the highest quality available data to quantitatively assess the identity, distribution, and fate of site COPCs. Highest quality data will meet the following requirements:

- Be relatively recent data, in particular collected subsequent to any remedial actions for a given medium (soil, groundwater);
- Be validated by an independent data validator;
- Qualify as usable by the data validator;
- Be collected via approved, high-quality methods; and
- Meet detection limits consistent with the requirements of cleanup levels.

DQO #2. Use good-quality available data to quantitatively assess the identity and distribution of site COPCs, recognizing that these data may not rule out the presence of COPCs at concentrations above cleanup levels but below the reporting limit. Good-quality data will meet the requirements listed above for highest quality data, except that the detection limit for a constituent may be higher than the cleanup level. These data therefore cannot be used to rule out the presence of a COPC, or to determine whether cleanup levels have been met. However, when used alongside the highest quality data, these data provide an improved distribution of data. In addition, non-detects with elevated reporting limits can be used to show that concentrations at a given location are at least no higher than the reporting limit.

DQO #3. Use lower quality data to qualitatively assess the distribution of site COPCs and identify source areas. Lower quality data do not meet some or most of the requirements listed for highest quality and good-quality data. However, detections of COPCs in this dataset do indicate the presence or former presence of a COPC at a sample location, as well as an approximate magnitude, and help guide additional stages of investigation. For example, data that were not collected or analyzed using the current industry standard and/or Ecology-approved field and/or analytical protocols would be considered lower quality.

DQO #4. Use poor-quality data only as a very qualitative data source to help identify historical source areas. These data do not meet any of the requirements for highest quality or good-quality data and were collected prior to remedial activities conducted at the site, which may have produced significant changes in constituent concentrations. These data may help identify historical source areas but do not provide adequate data to characterize those areas.

PCLs were developed in Section 9.0 and used to help in statistical screening of existing data to determine their usability.

10.1.2 Available Current and Historical Data – DQO #1

This section describes the current and historical data reviewed for potential use in the RI.

10.1.2.1 Soil Data

Soil samples were collected as part of the RI between 1987 and the present. A summary of the data collected and the age of those data is provided in Table 10-1. Some initial soil sampling was conducted prior to the 1991 RFI Draft Report (SEE, 1991); however, the 1991 report discounted most of these data due to compositing errors, holding time exceedances, and surrogate recovery difficulties. Data collected prior to 1996 were never validated by a third-party data validator. Most soil samples at the site were collected between 1996 and 2007, well after the 1991 RFI report, and third-party data validation was employed beginning in 2000. The early investigations (pre-1996) are valuable in a qualitative sense in that they aided in determining areas of concern on the site and documented historical uses of the various areas and activities that might have led to releases to soil or groundwater. They helped initially identify the most highly contaminated areas of the PSC property where further investigation and remediation have been conducted. While the historical field collection and analytical methods did not meet the standard to use the data for quantitative purpose, these data do provide an indication of the severity of releases that occurred at different areas of the PSC property.

Soil data were collected between 1996 and 2000 during four primary investigations:

1. Direct-push sampling to characterize the Silt Layer and prepare for source area excavation;
2. confirmation soil sampling during implementation of the soil interim measure (tank farm area excavation),
3. shallow soil sampling during RCRA closure activities, and
4. ongoing RI and data gaps investigations, primarily well installations.

Formal third-party data validation was not started until 2000, but these earlier samples were evaluated for use in the 2000 RI. Due to their age, the lack of full quality control data from the laboratory, and lack of full documentation of sampling procedures, the data are not viewed to be as reliable as data collected subsequent to 2000; however, they are still partially useable for the RI, as is discussed further below.

Soil data collected in 2000 and forward were collected during multiple phases of RI investigation. Most soils data are fully usable for the RI, based on the following factors.

1. The data were collected during investigation based on detailed work plans employing approved field and laboratory methods.
2. Data validation was conducted to screen out data rejected due to quality control issues.
3. Data were collected at the site using logic-based distribution of data based on knowledge derived from the historical research and investigation into the site.

Although VOC soil results from samples collected prior to 2004 were not analyzed using EPA Method 5035, data are still characterized as good-quality data and are acceptable for establishing the areal distribution and magnitude of VOC detections at the site. The data are quantitatively usable for certain purposes but may be biased low. Therefore, at values near the cleanup level, these data are not used to establish compliance with cleanup levels; however, at values above the cleanup level, these data provide a quantitative indication of the magnitude of VOC concentrations in a given area of the site.

Sampling locations for soil data collected since 1996, keyed to the applicable investigation, are shown on Figure 3-4.

10.1.2.2 Groundwater Data

Periodic groundwater sampling has been conducted at the site since 1985; however, low-flow groundwater sampling methods were not routinely used until 1994. The DQOs for the RI involve data that can identify both the historical source areas (DQO #2) and also the conceptual model of current conditions to aid in planning for cleanup (DQO #3).

In order to meet DQO #2, a groundwater data set consisting of data collected since 2000 provides over 10 years of quarterly groundwater data, plus several direct-push temporary well groundwater data collection events. Use of this data set in the RI to evaluate the historical sources and identify constituents of potential concern (COPCs) at the site is logical for several reasons.

- The year 2000 is when PSC switched from using an in-house PSC laboratory to an independent laboratory, North Creek Analytical.
- The year 2000 is when PSC began having quarterly groundwater data routinely validated by an independent data validator, outside of the laboratory and PSC.
- The year 2000 is several years after the 1997 soil excavation interim measure, which had a large effect on concentrations of COPCs in groundwater.

In order to meet DQO #3, a more recent subset of data was selected to evaluate the current nature and extent of groundwater contamination in the RI. This subset of data consists of data collected since 2004, as agreed to with Ecology.

The sampling locations for groundwater data collected since 2000, keyed to the applicable investigation and date, are shown on Figure 3-6.

10.1.3 Characterization of Historical Source Areas – DQO #2

As described above, the initial investigations into the site in the 1980s and 1990s provided the basis for subsequent investigation and remediation at the site. While the age and data quality issues make the data less usable from a quantitative perspective, they aid in completion of the RI because they provide a rational basis for the later investigations that resulted in higher quality data. Historical records and investigations led to identification of historically likely areas of contaminant release, as shown in Figure 3-3. More recent investigations (1996 and forward) have provided sufficient data to delineate the extent of these historical source areas for the purposes of the RI.

10.1.4 Conceptual Model of Current Soil and Groundwater Conditions – DQO #3

This section describes how DQO #3 is met using the available data for the RI.

10.1.4.1 Soil

Unlike groundwater data, soil data are typically not routinely collected from the same locations over time. Thus, it can be more difficult to pinpoint current concentrations of COCs based on a dataset that dates back over 10 years, as is the case for this project. Data collected prior to 1996 were eliminated from use for the purposes of trying to assess current soil conditions at the site. Sufficient data of higher quality have been collected since 1996 to characterize soil conditions.

Data collected between 1996 and 2000 are still predominantly over 10 years old, and as described in Section 10.1.2 and further in Section 10.1.5, are not of as high data quality as more recent data. Nevertheless, the investigations conducted after 2000 were based largely on the information garnered from these earlier data. A data set consisting of only the most recent data from 2000 forward would not adequately characterize the soil conditions at the site for the purposes of the RI and meet the DQO. Therefore, data collected between 1996 and 2000 were included in the RI data set, with the caveat that the data are partially, and not fully, usable. For the purposes of the RI, partially usable soil data are suitable for determining COCs and evaluating the nature and extent of soil contamination used to evaluate remedies for the site. These data are not suitable for designing a final remedy for the site, nor determining compliance with final cleanup levels.

Since these data are only partially usable, the FS will consider the reliability of these data and acknowledge that additional contemporary data may need to be collected as part of engineering design depending on the selected remedy. Even if the data quality of these older data were high (based on methods, quality control criteria, etc.) their age may still dictate the necessity for more current data during engineering design to properly design the final remedy for the site depending on the remedy selected.

10.1.4.2 Groundwater

As described in Section 10.1.2.2, groundwater data collected since 2004 are used in the RI to evaluate the current nature and extent of groundwater contamination at the site. This data set covers a sufficiently long time period to incorporate seasonal variability, but originates long enough after the source area excavation (interim measure) to be representative of current conditions.

10.1.5 Assumptions, Limitations, and Data Gaps – DQO #4

In order to evaluate limitations on the data used in the RI, historical field collection, analytical, data management, and data validation methods used during investigation of the site were considered.

10.1.5.1 Sampling Methods

Several general uncertainties are difficult to avoid during the sample collection part of site characterization, but are acknowledged. These include:

- Samples were not collected in some areas of the property because of the presence of buildings or other constraints (utilities, etc.) during investigation of the site.
- Many of the samples were collected from discrete depths, with gaps in sampling intervals. These samples may not be representative of the matrix at all depths.

Matrix specific details are described below.

Soil

Prior to 1998, PSC did not have a SOP for soil or sediment sampling procedures; sampling was conducted in accordance with individual sampling plans. Soil data collected between 1996 and 1998 included the 1996 Silt Layer investigation (PSC, 1996) which used direct-push methods, and the 1997 interim measure (PSC, 1998b) during which confirmation samples were collected from the base of the excavation, with no drilling required.

After 1998, the same SOP, including decontamination methods, was used for collection of soil and sediment samples. The drilling/extraction method varied depending on the other purposes of the phase of investigation. Soil samples were collected via sonic, hollow-stem auger (split-spoon), direct-push, and hand-auger methods. All of these methods are acceptable for sample collection and were approved by Ecology.

The soil sampling protocol for VOCs changed in Washington in 2004. Prior to 2004, soil samples were generally collected as grab samples using spoons and jars. After 2004, EPA Method 5035A sample collection and preparation methods were used. The introduction of this method is thought to more conservatively preserve VOCs in a sample during collection. Hence, VOC soil results prior to 2004 are acceptable for use as described in Section 10.1.2.1, but may be biased low in comparison to those resulting from investigations conducted after 2004.

Groundwater

All groundwater data used in the RI (2000 forward), have been collected under the PSC SOP for low-flow groundwater monitoring. All samples were collected via dedicated sampling pumps or dedicated tubing via peristaltic pump, as described in more detail in Section 4.2, after groundwater parameters monitored during purging have stabilized.

At some groundwater sampling locations, groundwater production has not been sufficient at all times to allow monitoring of groundwater parameters until stability prior to sample collection. Both permanent and temporary wells occasionally run dry during purging prior to or during sampling. Due to the fine grained composition of the Silt Layer and the relatively thin upper groundwater zone, this is not unexpected at the site. As a result, the groundwater samples that are collected may not be representative of the full length of the screened interval. Still, these samples offer the most usable data available regarding the concentrations of COCs in groundwater at a particular location. Conditions of low flow have been reported to Ecology as part of data reporting when they have occurred.

10.1.5.2 Quality Control

Quality control procedures were applied to field procedures to ensure validity of the data. The following quality control (QC) measures have been included as part of sample collection methods for all data collected after 2000. These QC procedures have been evaluated as part of the data validation process for each sampling event since 2000.

> Trip Blanks: Trip blanks were prepared in the laboratory, by filling a VOC vial with deionized water. This blank was sent to the field in a cooler along with the VOC sample bottles. The trip blank remained in the VOC cooler throughout the sampling event and was returned to the laboratory for VOC analysis. Trip blanks were collected and analyzed to evaluate if VOCs had cross-contaminated the samples while they were being transported from the field to the laboratory.
>
> Field Blanks: Field blanks were collected in the field by pouring deionized water directly into sample bottles. Field blanks were collected and analyzed to evaluate if any airborne contaminants had cross-contaminated samples in the field at the time of collection.
>
> Equipment Blanks: Equipment blanks were collected in the field by pouring deionized water over decontaminated, nondedicated sampling equipment, and then allowing the water to drain directly into sample bottles. Equipment blanks were collected and analyzed to evaluate if the sampling equipment had cross-contaminated the samples at the time of collection, due to inadequate equipment decontamination.

Duplicates: Field duplicates were collected in the field by collecting twice as much sample volume at a corresponding location and submitting the sample volume to the laboratory for analysis as two distinct samples. Duplicate samples were collected and analyzed to evaluate the consistency of the sampling procedure and analytical methods.

Matrix Spike/Matrix Spike Duplicates (MS/MSD): MS/MSDs are laboratory quality control samples. Approximately three times the typical sample volume is submitted to the laboratory for a sample, so that the laboratory can analyze the sample three times, once normally, and twice separately with a given spike volume. The results of the MS/MSD analyses were used to evaluate the recovery rate of the sample concentrations in comparison to the recovery rate of a sample spiked with a constituent at a known volume.

Quality control procedures for the soil sampling investigations conducted prior to 2000 that are included in the RI data set were less stringent, as described in the 2000 RI Report data quality evaluation. These earlier studies included limited field quality control sampling and reporting of associated laboratory quality control measures such as MS/MSDs. The lack of supporting quality control data means the pre-2000 soil data cannot be considered fully usable and must be treated as estimated. These data are suitable for evaluating the conceptual model of contamination at the site but not for purposes of compliance monitoring against final cleanup levels or design of the selected final remedy.

10.1.5.3 Analytical Methods

Analytical methods developed by EPA or ASTM have been used historically for all project data analyses. Table 10-2 indicates the methods used for soils analyses as stored in the project database based on the analyte and the year in which the samples were analyzed. Methods used are included in the database, and newer, more reliable, methods are used as they are developed (i.e., SIM for VOCs). Generally a change in analytical method affects mainly the reporting limit and makes it possible to reach lower reporting limits.

Reporting limits that meet PCLs are not feasible in some cases due to elevated concentrations of another compound in a particular sample. Non-detect results for analyses with elevated reporting limits may still be useful in evaluating site conditions, but cannot be used to rule out contamination that may be present above the cleanup level and below the detection limit. As with older results that cannot be used to determine if current conditions are meeting cleanup levels, non-detect results from analyses with elevated reporting limits cannot be used to determine if cleanup criteria are met. However, these results can be used to determine the nature and extent of contamination at the site for the purposes of evaluating cleanup remedies in the FS.

Tables 10-3 through 10-5 present a statistical summary of analytical results from the project database, including information on reporting limits for non-detected analytes. Inspection of the tables shows that reporting limits did not exceed PCLs for most COCs, even for analyses conducted prior to 2000, except for analyses of selected metals, VOCs, and SVOCs, for which analytical methods have improved over time.

It is difficult to determine whether a constituent has not been detected at a location because (1) it is probably not present; (2) it was released at low levels, and concentrations are below reporting limits; or (3) the analysis was unable to quantify it at a meaningful level (i.e., the reporting limit was too high). This question is essentially impossible to answer without resampling the majority of historical sampling points conducted earlier in the RI process. Such resampling would often still not yield the desired results in areas where the presence of other contaminants may result in elevated detection limits for undetected compounds. To address this problem, a conservative approach is used to determine which constituents should be retained as COCs for cases when the analyte has not been detected during analytical testing, but analyses were conducted with elevated reporting limits (see Section 10.3). Under this approach, the highest detected concentration or the highest detection limit is used as the value to compare to the PCLs when a constituent was not detected in more than 50 percent of samples analyzed. Using this method, nondetected constituents that may fall into category “3” described above are retained as COCs, so that they can be further evaluated in the discussion of the nature and extent of contamination (Section 11.0). Specifically, nondetected constituents with elevated reporting limits are used in the RI to demonstrate that concentrations are at least no higher than the reporting limit.

10.1.5.4 Data Management and Validation Methods

PSC maintains a database for the PSC Washougal project that includes historical soil and groundwater data. The current data management process involves the following procedures.

- Electronic data deliverables (EDDs) are generated by the laboratory, along with a hard-copy report and case narrative.
- The EDD and hard copy-report are reviewed by a third-party data validator. Additional data qualifiers may be added to the EDD and notated on the hard copy during validation.
- The revised EDD is uploaded to the project database by PSC. Data tables and data export files are generated from the database for analysis and reporting.

This process has been in place since 2000. Data collected prior to 2000 were uploaded to the database from historical tables and laboratory reports both electronically and manually.

Soil data collected between 1996 and 2000 were reviewed by a third-party validator for the 2000 Draft RI Report (PSC, 2000). The project database was updated at that time to include qualifiers assigned during the data validation, including designation of rejected results.

As described previously, some initial soil sampling was conducted prior to the 1991 RFI (SEE, 1991); however, the 1991 report discounted most of those data due to compositing errors, holding time exceedances, and surrogate recovery difficulties. Most soil samples were collected between 1996 and 2009, well after the 1991 RFI report, and the third-party data validation process described above was employed.

Validation has followed EPA Contract Laboratory Program protocols for data evaluation, including assessment of precision, bias, accuracy, completeness, and other quality control factors (EPA, 2004; EPA, 2008). Data that were rejected during validation were not used for any purpose. Data that were qualified as estimated during validation were assigned a “J” qualifier that is attached to the value in the project database and any reported data tables or figures. These data are still considered usable, with the understanding that an estimated value may be biased slightly low or slightly high. The individual data validation reports have not been included or resummarized with this RI but were included in the individual reports in which investigative data were originally reported to Ecology.

10.1.6 Summary of Data Usability

The dataset that is used in the RI and its inherent usability, based on this data assessment, are summarized in this section. Statistical evaluations of the historical data used in this data assessment are provided in Tables 10-3 through 10-5. The inherent nature of site characterization results in making assumptions about the expected concentrations of a COC between data points. For the purposes of this report, characterization is considered complete when sufficient information has been collected to (1) evaluate potential remedial technologies and alternatives for soil and groundwater with concentrations of COCs that exceed the final cleanup levels, and (2) estimate the costs to clean up areas of the site. It is expected that monitoring or confirmation samples would be performed during remediation phases to confirm success of any remedial action.

A significant data set has been developed for this site. The data set includes substantial recent high-quality data. However, due to the long-term course of investigation at the site, the data set also includes some older data as well. These older data were derived from samples collected and analyzed by standard EPA methods and guidance and accepted by Ecology at the time (via approved work plans). PSC acknowledges that not all data are suitable for all things. The selected datasets are sufficient to meet the DQOs for the RI.

10.1.6.1 Soil

Data collected prior to 1996 – These data are of limited usability. They are usable only as a qualitative data source to help identify historical source areas and assist in meeting the RI DQO #4 to qualitatively identify historical source areas.

Data collected between 1996 and 2000 – These data are partially usable. Due to incomplete data quality monitoring, elevated reporting limits in some cases, and the age of the data, these data may be used to determine COCs and evaluate the nature and extent of contamination at the site. Results from these data are treated as estimated and cannot be used for final design of the selected remedy nor compliance monitoring. Detections in these data confirm the presence and approximate magnitude of detected constituents in a given sample. Although these data may not rule out the presence of constituents that were not analyzed or that have elevated detection limits, this does not negate the usefulness of these data in establishing the nature and extent of constituents that were in fact analyzed and detected. Non-detect data with elevated reporting limits are still useful to show that concentrations are at least no higher than the reporting limit.

Data collected after 2000 – These data are usable as described in Section 10.1.2.1. These data were collected under strict quality control and validation procedures, and rejected data have been eliminated from the dataset. Limitations on data from this time period are those with reporting limits that are elevated due to analytical methods and/or matrix interferences, as well as data that are “J” flagged as estimated. Additionally, VOC soil samples collected prior to 2004 did not include use of the current EPA Method 5035 for sample collection, potentially biasing results. These factors of estimation are acknowledged and considered in the use of these data. Although these data may not rule out the presence of constituents that were not analyzed or that have elevated detection limits, this does not negate the usefulness of these data in establishing the nature and extent of constituents that were in fact analyzed and detected. Non-detect data with elevated reporting limits are still useful to show that concentrations are at least no higher than the reporting limit.

10.1.6.2 Groundwater

Data collected prior to 2000 – These data are not used in the RI.

Data collected between 2000 and 2009 – These data are fully usable. These data were collected under strict quality control and validation procedures, and rejected data have been eliminated from the dataset. The only limitations on data from this time period are those with reporting limits that are elevated due to analytical methods and/or matrix interferences and data that are “J” flagged as estimated. These factors of estimation are acknowledged and considered in the use of these data. These data are used for selection of COCs at the site.

Data collected since 2004 – These data are fully usable. These data were collected under strict quality control and validation procedures, and rejected data have been eliminated from the dataset. The only limitations on data from this time period are those with reporting limits that are elevated due to analytical methods and/or matrix interferences and data that are “J” flagged as estimated. These factors of estimation are acknowledged and considered in the use of these data. These data constitute the “current” dataset used to evaluate the nature and extent of groundwater contamination at the site.

10.2 CONSTITUENTS OF POTENTIAL CONCERN

Qualitative and quantitative methods were used to further assess the soil and groundwater data sets selected for use in the RI and to determine constituents of potential concern (COPCs) for the RI. These methods included statistical analysis of the data sets, consistent with Ecology’s Statistical Guidance for Ecology Site Managers (Ecology, 1992), WAC 173-340-740(7)(f), and WAC 173-340-720(9)(f).

The data analysis procedures described in WAC 173-740(7)(d) for soil and WAC 173-720(9)(d) for water were used to identify COPCs by comparing data from the selected data set to the site-specific PCLs. The following process was followed in 2008 (Geomatrix, 2008a) for each soil and groundwater constituent that has been analyzed for in the data set.

1. Determine the percentage of non-detect values for the constituent and follow the procedures for handling those values described in Section 10.3.
2. Determine the statistical distribution (normal or lognormal) of the results for the constituent using Ecology’s MTCA STAT program (Ecology, 1997b). MTCA STAT specifically directs users with censored data sets (those including non-detect values), and with multiple detection limits in the data set, to use the BACKGROUND version of MTCA STAT for establishing data distribution. The BACKGROUND model is capable of accepting multiple non-detect values with different detection limits.
3. Calculate the 95 percent upper confidence limit (UCL) on the true mean concentration for the constituent using Ecology’s SITE version of the MTCA STAT program based on the data distribution determined in Step 2. For constituents with greater than 50 percent non-detects, the highest detected concentration or the highest detection limit for non-detects was used as the UCL on the true mean, as described in Section 10.3.

4. Compare the UCL on the true mean established in Step 3 to the PCL established in Section 9.0. If the PCL is higher, the constituent is not considered a COPC; if the PCL is lower, the constituent is considered a COPC.
5. Identify constituents identified as COPCs during Step 4 based solely on non-detect results with elevated detection limits that are above the PCL. These constituents will be further reviewed in Section 10.3 to evaluate if they should be retained as COCs.

Chemical concentrations in sediment and surface water were assessed separately, as part of the ecological assessments described in Appendices N1 and N2. Revised Sediment Management Standards, which now include cleanup levels for freshwater sediments, were released by Ecology in September 2013. The sediment will COPCs will be evaluated as part of the FS using the updated cleanup levels in the Sediment Management Standards.

As described in Section 8.4, PSC's property also was evaluated in accordance with WAC 173-340-7493. Because PSC's property meets the definition of an industrial property, only the potential for exposure of terrestrial wildlife to soil contamination on PSC's property was evaluated. Soil concentrations were compared to ecological indicator concentrations described in MTCA Table 749-3 (Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals). Barium was the only compound found in soil samples collected from PSCs property with concentrations exceeding the criteria in MTCA Table 749-3. Therefore, barium has been added as a CPOC for soil on PSC's property.

The results of this screening are shown in Table 10-6 for soil and Table 10-7 for groundwater. The statistical methods used to develop the list of COPCs in the RI were selected to be extremely conservative. In practical terms, if a constituent was ever detected at a concentration greater than the screening level, it was included as a COPC. Therefore, the list of COPCs is considered comprehensive regardless of whether the site is considered one large exposure area or several smaller ones. Alternative approaches that break the site into smaller areas for individual assessment might make it possible to limit COPCs for certain areas. This can and is done in later sections of the RI as the nature and extent of contamination are evaluated, but PSC used an approach that created one broad suite of constituents in this section that will be carried through for assessment in the RI. Due to elevated reporting limits, many constituents that have been largely undetected have been identified as COPCs using this method.

10.3 ASSESSMENT OF NON-DETECT DATA

Non-detect results may be of good data quality, but introduce uncertainty depending on the reporting limits. To assess this potential uncertainty, non-detect values were evaluated to determine how detection limits compared to PCL. Older analytical methods may not have been capable of detecting constituents at the low reporting limits that are currently achievable by the project laboratory. Detection limits are also often higher than expected due to interference caused by detections of other constituents present in the sample or due to general laboratory dilution.

To assess non-detect data in the Washougal data set we used an approach based on WAC 173-340-740(7)(f) and WAC 173-720(9)(f), which describe how non-detect values should be handled under MTCA when performing a statistical analysis of data for comparison to cleanup levels. The following three scenarios were encountered in the data set and handled as follows.

- Case 1 – When no more than 15 percent of reported values are below the PQL, a value of one-half the MDL (or PQL if MDL was not available) was assigned as the PQL for use in calculating the UCL.
- Case 2 – When 15 to 50 percent of values are below the PQL (and the data are determined to be lognormally or normally distributed), a corrected mean and standard deviation (using Cohen's method) was calculated for use in calculating an UCL on the true mean (one-half of the PQL or the highest PQL was used to calculate the UCL).
- Case 3 – When more than 50 percent of values are below the PQL, the largest value in the data set was assigned in place of an UCL on the true mean. The largest value was selected as the greater of (1) the highest detected concentration; and (2) the highest PQL among the non-detected results.

This process was used to evaluate the data set for individual constituents in both soil and groundwater. As described in Section 10.2, these approaches were selected in Section 10 to keep from eliminating any compound simply because it was not detected at multiple locations or were generally non-detect. Specifically, for constituents in Case 3 where a constituent was not detected in more than 50 percent of samples, the highest concentration or the highest non-detect reporting limit was used to compare against screening levels and determine if the constituent should become a COPC. This conservative approach includes most of the compounds that could be considered COCs at the site, even if biased low in the older data sets. Inevitably, at a contaminated site some data will have skewed reporting limits that are higher due to matrix interference caused by higher concentrations of detected constituents in some areas. Generally, these interferences are not of great concern because these areas have been identified as contaminated based on the elevated concentrations of other analytes that lead to the interference and a lack of clarity on concentrations of other specific compounds.

10.4 CONSTITUENTS OF CONCERN

The initial screening for COPCs was performed in 2008 as part of a technical memorandum (Geomatrix, 2008a). This list of COPCs was re-evaluated as part of the RI in light of additional data collected since the 2008 Technical Memorandum. No new constituents were detected in this more recent dataset at concentrations above PCLs; therefore, the COPCs presented in Tables 10-8 and 10-9 are considered final COCs for the RI.

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TABLES

TABLE 10-1

ASSESSMENT OF AGE OF DATA[1,2]

PSC Washougal Facility
Washougal, Washington

Analysis	1990s	2000s	Total	Percentage from 1990s	Percentage from 2000s
Shallow Groundwater					
Conventionals	60	1,195	1,255	5	95
Chlorinated Herbicides	0	33	33	0	100
Dioxins/Furans	0	14	14	0	100
Gases	15	1,242	1,257	1	99
Metals	2,522	2,919	5,441	46	54
Pesticides/PCBs	112	179	291	38	62
SVOCs	5,746	3,799	9,545	60	40
TPH	0	244	244	0	100
VOCs	10,808	20,290	31,098	35	65
Deep Groundwater					
Conventionals	32	329	361	9	91
Chlorinated Herbicides	0	21	21	0	100
Cyanide	0	1	1	0	100
Dioxins/Furans	0	32	32	0	100
Gases	9	759	768	1	99
Metals	1,044	1,295	2,339	45	55
Pesticides/PCBs	0	126	126	0	100
SVOCs	2,452	2,223	4,675	52	48
TPH	0	153	153	0	100
VOCs	4,517	13,010	17,527	26	74
Soil					
Conventionals	32	0	32	100	0
Metals	497	533	1,030	48	52
Pesticides/PCBs	896	525	1,421	63	37
SVOCs	5,610	2,143	7,753	72	28
TPH	0	111	111	0	100
VOCs	7,856	5,244	13,100	60	40

Notes
1. Numbers presented are total number of results for each analysis.
2. Field- and laboratory-calculated results for groundwater are not presented.

Abbreviations
PCBs = polychlorinated biphenyls
SVOCs = semivolatile organic compounds
TPH = total petroleum hydrocarbons
VOC = volatile organic compounds

TABLE 10-2

ANALYTICAL METHODS FOR SOIL SAMPLES

PSC Washougal Facility
Washougal, Washington

Analysis	Years Sampled	Method Used[1]
Metals	1999, 2001	6010
Metals	2007, 2008,2011	6010B
Metals	2007, 2008	6020
Metals	2007, 2008	7471A
Pesticides/PCBs	1999	8081
Pesticides/PCBs	1999, 2007	8082
Pesticides/PCBs	2007	8081A
SVOCs	1996, 1997, 1999	8270
SVOCs	2007, 2008, 2011	8270C
SVOCs	2007, 2008	8270C SIM
TPH	2001	WTPH
TPH	2007, 2008	NWTPH-Dx
TPH	2007, 2008	NWTPH-Gx
VOCs	1996, 1997, 1999, 2001	8260
VOCs	2007, 2008, 2011	8260B

Notes

1. Analytical methods are EPA method numbers unless otherwise noted.

Abbreviations

EPA = U.S. Environmental Protection Agency
NWTPH-Dx = Northwest Total Petroleum Hydrocarbons–Diesel Range
NWTPH-Gx = Northwest Total Petroleum Hydrocarbons–Gasoline Range
PCBs = polychlorinated biphenyls
SIM = selective ion monitoring
SVOCs = semivolatile organic compounds
TPH = total petroleum hydrocarbons
VOCs = volatile organic compounds
WTPH = Washington Total Petroleum Hydrocarbons

TABLE 10-3

STATISTICAL EVALUATIONS OF HISTORICAL ANALYTICAL DATA FOR SOIL[1]

PSC Washougal Facility
Washougal, Washington

Concentrations in milligrams per kilogram (mg/kg)

Analyte	Preliminary Cleanup Level	1996 through 2000											
		No. of Samples Analyzed	Percentage of Samples with Detections	Percentage of Samples with Detected Concentration > PCL[2]	Percentage of Samples with Nondetections > PCL[2,3]	Maximum Detected Concentration	Minimum Detected Concentration	Average Detected Concentration	Maximum Reporting Limit for Nondetections[4]	Minimum Reporting Limit for Nondetections[5]	Average Reporting Limit for Nondetections[6]	Sample ID of Maximum Detected Concentration	Date of Maximum Detected Concentration
Metals													
Antimony	5.0624	32	6	0	0	1.73	1.55	1.64	1.56	1.29	1.452333333	R-2	8/20/1999
Arsenic	6	39	100	0	0	4.28	1.503	2.219846154	--	--	--	GP-28	7/30/1999
Barium	824	39	100	0	0	160	49.8	74.10769231	--	--	--	B-12	8/20/1999
Beryllium	63.22	7	57	0	0	0.238	0.111	0.20425	0.01	0.01	0.01	MC-17D/MC107	7/27/1999
Cadmium	2.208	32	100	0	0	2.12	0.261	0.4121875	--	--	--	B-12	8/20/1999
Chromium	27	32	100	0	0	15.8	5.9	8.123125	--	--	--	B-12	8/20/1999
Cobalt	1900	7	100	0	0	7.73	5.25	6.708571429	--	--	--	GP-28	7/30/1999
Copper	34	39	100	0	0	22.3	6.26	9.187179487	--	--	--	B-12	8/20/1999
Cyanide	1.0504	32	88	88	0	194.41	1.41	24.63214286	0.571	0.048	0.17875	B-4	8/20/1999
Iron	--	--	--	--	--	--	--	--	--	--	--	--	--
Lead	108.00216	32	100	0	0	46.8	2	4.9490625	--	--	--	B-12	8/20/1999
Manganese	1511	--	--	--	--	--	--	--	--	--	--	--	--
Mercury	0.04	32	25	9	0	0.0998	0.0213	0.050525	0.0232	0.02	0.021191667	B-12	8/20/1999
Nickel	63.896	39	100	3	0	102	7.22	11.76512821	--	--	--	B-16	8/20/1999
Selenium	0.52	32	0	0	0	--	--	--	0.131	0.112	0.12175	--	--
Potassium	--	--	--	--	--	--	--	--	--	--	--	--	--
Silver	0.0544	32	0	0	100	--	--	--	0.261	0.215	0.2424375	--	--
Thallium	0.342	32	0	0	100	--	--	--	5.21	4.29	4.8465625	--	--
Vanadium	1000	--	--	--	--	--	--	--	--	--	--	--	--
Zinc	96	39	100	3	0	108	8.56	39.38871795	--	--	--	B-12	8/20/1999
Pesticides/PCBs													
4,4'-DDD	0.001	32	6	6	0	0.02926	0.00222	0.01574	0.0000297	0.0000266	0.00002815	B-3	8/19/1999
4,4'-DDE	0.033175729	32	9	0	0	0.00477	0.000371	0.0019198	0.0000297	0.0000266	2.81448E-05	B-3	8/19/1999
4,4'-DDT	0.00298379	32	3	3	0	0.01109	0.01109	0.01109	0.0000297	0.0000266	2.81548E-05	B-3	8/19/1999
Aldrin	0.001	32	0	0	0	--	--	--	0.0001436	0.0000137	0.00001815	--	--
alpha-BHC	0.36	32	0	0	0	--	--	--	0.0001436	0.0000137	0.00001815	--	--
alpha-Chlordane	--	32	3	0	0	0.0059	0.0059	0.0059	0.0001436	0.0000137	1.82774E-05	B-12	8/20/1999
Aroclor 1016	--	32	0	0	0	--	--	--	1.072	0.127	0.52996875	--	--
Aroclor 1221	--	32	0	0	0	--	--	--	1.072	0.127	0.52996875	--	--
Aroclor 1232	--	32	0	0	0	--	--	--	1.072	0.127	0.52996875	--	--
Aroclor 1242	--	32	0	0	0	--	--	--	1.072	0.127	0.52996875	--	--
Aroclor 1248	--	32	0	0	0	--	--	--	1.072	0.127	0.52996875	--	--
Aroclor 1254	--	32	0	0	0	--	--	--	1.072	0.127	0.52996875	--	--
Aroclor 1260	--	32	0	0	0	--	--	--	1.072	0.127	0.52996875	--	--
beta-BHC	1.3	32	0	0	0	--	--	--	0.0001436	0.0000137	0.00001815	--	--
delta-BHC	0.0010704	32	6	0	0	0.000766	0.000291	0.0005285	0.0001436	0.0000132	1.83933E-05	B-12	8/20/1999
Dieldrin	0.0048	32	13	3	0	0.01353	0.00112	0.0047	0.0000297	0.0000266	2.81143E-05	B-12	8/20/1999
Endosulfan I	3700	32	3	0	0	0.002009	0.002009	0.002009	0.0001436	0.0000137	1.82548E-05	B-2	8/19/1999
Endosulfan II	3700	32	3	0	0	0.00287	0.00287	0.00287	0.0000297	0.0000266	2.81097E-05	B-12	8/20/1999
Endosulfan sulfate	--	32	3	0	0	0.009389	0.009389	0.009389	0.0000297	0.0000266	2.81129E-05	B-13	8/20/1999
Endrin	0.001	32	3	3	0	0.0017	0.0017	0.0017	0.0000289	0.0000266	2.80677E-05	B-2	8/19/1999
Endrin aldehyde	--	32	0	0	0	--	--	--	0.0001436	0.0000137	0.00001905	--	--
Endrin ketone	--	32	6	0	0	0.00158	0.000614	0.001097	0.0000289	0.000027	0.00002816	B-2	8/19/1999
gamma-BHC	--	--	--	--	--	--	--	--	--	--	--	--	--
gamma-BHC	--	--	--	--	--	--	--	--	--	--	--	--	--
gamma-Chlordane	6.5	32	0	0	0	--	--	--	0.0001436	0.0000137	0.00001815	--	--
Heptachlor	0.0008	32	0	0	0	--	--	--	0.0001436	0.0000132	1.81094E-05	--	--
Heptachlor epoxide	0.001	32	0	0	0	--	--	--	0.0001436	0.000013	1.81188E-05	--	--
Lindane	0.00099	32	6	0	0	0.000364	0.000343	0.0003535	0.0001436	0.0000137	1.84133E-05	B-17	8/19/1999
Methoxychlor	0.048120034	32	3	0	0	0.00481	0.00481	0.00481	0.000157	0.0000153	0.000137	B-17	8/19/1999
Toxaphene	0.049	32	0	0	0	--	--	--	0.000033	0.0000308	3.16969E-05	--	--

TABLE 10-3

STATISTICAL EVALUATIONS OF HISTORICAL ANALYTICAL DATA FOR SOIL[1]

PSC Washougal Facility
Washougal, Washington

Concentrations in milligrams per kilogram (mg/kg)

Analyte	Preliminary Cleanup Level	1996 through 2000											
		No. of Samples Analyzed	Percentage of Samples with Detections	Percentage of Samples with Detected Concentration > PCL[2]	Percentage of Samples with Nondetections > PCL[2,3]	Maximum Detected Concentration	Minimum Detected Concentration	Average Detected Concentration	Maximum Reporting Limit for Nondetections[4]	Minimum Reporting Limit for Nondetections[5]	Average Reporting Limit for Nondetections[6]	Sample ID of Maximum Detected Concentration	Date of Maximum Detected Concentration
SVOCs													
1,2,4-Trichlorobenzene	1.304818667	33	0	0	0	--	--	--	0.029	0.0026	0.004309091	--	--
1,2-Dichlorobenzene	3.069	33	0	0	0	--	--	--	0.032	0.0029	0.004812121	CIA-8	9/24/1997
1,3-Dichlorobenzene	4.416042667	33	0	0	0	--	--	--	0.033	0.003	0.004972727	--	--
1,4-Dichlorobenzene	0.0297	33	0	0	3	--	--	--	0.032	0.0029	0.004812121	--	--
1-Methylnaphthalene	0.0447	2	100	0	0	0.018	0.0026	0.0103	--	--	--	CIA-8	9/24/1997
1,4-Dioxane	0.016	--	--	--	--	--	--	--	--	--	--	--	--
2,4,5-Trichlorophenol	28.8	81	0	0	0	--	--	--	1.1	0.032	0.079209877	--	--
2,4,6-Trichlorophenol	0.0162	81	0	0	100	--	--	--	1.1	0.032	0.074271605	--	--
2,4-Dichlorophenol	0.166565408	81	1	1	10	0.42	0.42	0.42	1.1	0.016	0.0743875	B-3	8/19/1999
2,4-Dimethylphenol	1.31	88	0	0	1	--	--	--	1.7	0.016	0.092943182	--	--
2,4-Dinitrophenol	0.2	81	0	0	15	--	--	--	5.6	0.167	0.382740741	--	--
2,4-Dinitrotoluene	0.01	81	0	0	100	--	--	--	1.1	0.033	0.075432099	--	--
2,6-Dinitrotoluene	0.0861	81	0	0	12	--	--	--	1.1	0.032	0.074271605	--	--
2-Chloronaphthalene	23000	81	0	0	0	--	--	--	1.1	0.016	0.073876543	--	--
2-Chlorophenol	0.473	81	0	0	1	--	--	--	1.1	0.016	0.073876543	--	--
2-Methyl-4,6-dinitrophenol	62	--	--	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	5.57	87	3	0	0	0.36	0.0059	0.132633333	1.7	0.033	0.089130952	CIA-13	9/24/1997
2-Methylphenol	2.33	88	0	0	0	--	--	--	1.7	0.016	0.092943182	--	--
2-Nitroaniline	1800	81	0	0	0	--	--	--	2.2	0.032	0.153234568	--	--
2-Nitrophenol	--	81	0	0	--	--	--	--	1.1	0.016	0.073876543	--	--
3,3'-Dichlorobenzidine	0.037	81	0	0	12	--	--	--	5	0.032	0.134765432	--	--
3-Nitroaniline	82	81	0	0	0	--	--	--	5.6	0.032	0.375728395	--	--
4,6-Dinitro-2-methylphenol	62	81	0	0	0	--	--	--	5.6	0.158	0.378839506	--	--
4-Bromophenyl phenyl ether	--	81	1	--	0	0.073	0.073	0.073	1.1	0.016	0.0743875	IAB-07	9/15/1997
4-Chloro-3-methylphenol	--	81	0	0	0	--	--	--	2.2	0.016	0.147901235	--	--
4-Chloroaniline	0.17	81	0	0	11	--	--	--	2.2	0.016	0.147901235	--	--
4-Chlorophenyl phenyl ether	--	81	0	0	0	--	--	--	1.1	0.016	0.073876543	--	--
4-Methylphenol	0.199	81	2	0	10	0.0046	0.0022	0.0034	1.1	0.033	0.075341772	CIA-8	9/24/1997
4-Nitroaniline	82	81	0	0	0	--	--	--	5.6	0.032	0.375728395	--	--
4-Nitrophenol	--	81	0	0	0	--	--	--	1.1	0.032	0.079209877	--	--
Acenaphthene	68.3	81	0	0	0	--	--	--	1.1	0.016	0.073876543	--	--
Acenaphthylene	--	81	0	0	0	--	--	--	1.1	0.016	0.073876543	--	--
Acetone	3.211498667	1	100	0	0	0.012	0.012	0.012	--	--	--	IAB-08	9/15/1997
Anthracene	2230	--	--	--	--	--	--	--	--	--	--	--	--
Acetophenone	3.921	86	0	0	2	--	--	--	8.3	0.165	0.479011628	--	--
Aniline	300	81	0	0	0	--	--	--	5.6	0.016	0.370395062	--	--
Anthracene	2230	81	0	0	0	--	--	--	1.1	0.016	0.073876543	--	--
Azobenzene	16	79	0	0	0	--	--	--	1.1	0.033	0.075341772	--	--
Benzidine	0.2	81	0	0	10	--	--	--	1.1	0.033	0.075037037	--	--
Benzo(a)anthracene	0.02017	81	0	0	98	--	--	--	2.2	0.016	0.147901235	--	--
Benzo(a)pyrene	0.05433	81	0	0	12	--	--	--	1.1	0.016	0.073876543	--	--
Benzo(b)fluoranthene	0.06721	81	0	0	12	--	--	--	1.1	0.016	0.073876543	--	--
Benzo(g,h,i)perylene	--	81	0	0	0	--	--	--	1.1	0.016	0.073876543	--	--
Benzo(k)fluoranthene	0.06721	81	0	0	12	--	--	--	1.1	0.016	0.073876543	--	--
Benzoic acid	256.8	81	0	0	0	--	--	--	5.6	0.167	0.381234568	--	--
Benzyl alcohol	10.8960624	81	1	0	0	0.07151	0.07151	0.07151	2.2	0.016	0.1489125	B-5	8/20/1999
bis(2-Chloroethoxy)methane	--	81	0	0	0	--	--	--	1.1	0.016	0.073876543	--	--
bis(2-Chloroethyl) ether	0.01	81	0	0	100	--	--	--	1.1	0.016	0.073876543	--	--
bis(2-Chloroisopropyl)ether	--	79	0	0	0	--	--	--	1.1	0.033	0.075341772	--	--
bis(2-Ethylhexyl) phthalate	2.671752009	81	1	0	1	1.4	1.4	1.4	5.6	0.052	0.3788375	GP-07	7/11/1996
Butyl benzyl phthalate	426	81	1	0	0	0.0054	0.0054	0.0054	1.1	0.016	0.0746	CIA-8	9/24/1997
Carbon disulfide	0.2969	1	100	0	0	0.00432	0.00432	0.00432	--	--	--	IAB-08	9/15/1997
Chrysene	0.02241	81	0	0	98	--	--	--	1.1	0.016	0.073876543	--	--
Dibenz(a,h)anthracene	0.21	67	0	0	12	--	--	--	1.1	0.016	0.080447761	--	--
Dibenzofuran	5.33	81	1	0	1	0.0018	0.0018	0.0018	5.6	0.016	0.374825	CIA-8	9/24/1997
Diethyl phthalate	73.32	81	0	0	0	--	--	--	1.1	0.016	0.073876543	--	--

TABLE 10-3

STATISTICAL EVALUATIONS OF HISTORICAL ANALYTICAL DATA FOR SOIL[1]

PSC Washougal Facility
Washougal, Washington

Concentrations in milligrams per kilogram (mg/kg)

Analyte	Preliminary Cleanup Level	1996 through 2000											
		No. of Samples Analyzed	Percentage of Samples with Detections	Percentage of Samples with Detected Concentration > PCL[2]	Percentage of Samples with Nondetections > PCL[2,3]	Maximum Detected Concentration	Minimum Detected Concentration	Average Detected Concentration	Maximum Reporting Limit for Nondetections[4]	Minimum Reporting Limit for Nondetections[5]	Average Reporting Limit for Nondetections[6]	Sample ID of Maximum Detected Concentration	Date of Maximum Detected Concentration
SVOCs (Continued)													
Dimethyl phthalate	76.80011898	81	11	0	0	0.19383	0.03766	0.067848889	1.1	0.016	0.078986111	R-1	8/19/1999
Di-n-butyl phthalate	57.60000011	80	9	0	0	1.523	0.039	0.266571429	1.1	0.033	0.084739726	B-3	8/19/1999
Di-n-octyl phthalate	25000	81	2	0	0	0.19643	0.03679	0.11661	1.1	0.016	0.079974684	B-9	8/20/1999
Fluoranthene	127.9	81	0	0	0	--	--	--	1.1	0.016	0.073876543	--	--
Fluorene	101	81	2	0	0	0.0027	0.00052	0.00161	1.1	0.033	0.075341772	CIA-8	9/24/1997
Hexachlorobenzene	0.2262	81	0	0	10	--	--	--	1.1	0.016	0.073876543	--	--
Hexachlorobutadiene	0.477	81	0	0	1	--	--	--	1.1	0.016	0.073876543	--	--
Hexachlorocyclopentadiene	160	81	0	0	0	--	--	--	1.1	0.016	0.073876543	--	--
Hexachloroethane	0.0564	81	0	0	12	--	--	--	1.1	0.016	0.073876543	--	--
Indeno(1,2,3-cd)pyrene	0.196	81	0	0	10	--	--	--	1.1	0.016	0.073876543	--	--
Isophorone	0.0415	81	0	0	12	--	--	--	1.1	0.016	0.078814815	--	--
Naphthalene	4.486	85	1	0	0	0.1	0.1	0.1	1.7	0.033	0.092666667	CIA-10	9/19/1997
Nitrobenzene	0.025526795	81	1	1	96	0.044	0.044	0.044	1.1	0.016	0.0743875	GP-07	7/11/1996
N-Nitroso-di-n-propylamine	0.01	81	0	0	100	--	--	--	1.1	0.016	0.073876543	--	--
N-Nitrosodiphenylamine	0.099	81	0	0	12	--	--	--	1.1	0.016	0.075111111	--	--
Pentachlorophenol	0.15	81	0	0	98	--	--	--	5.6	0.032	0.375728395	--	--
Phenanthrene	--	81	2	0	0	0.0041	0.0013	0.0027	1.1	0.033	0.075341772	CIA-8	9/24/1997
Phenol	21.98	88	0	0	0	--	--	--	1.7	0.016	0.092943182	--	--
Pyrene	654.7	81	0	0	0	--	--	--	1.1	0.016	0.073876543	--	--
TPH													
Diesel range hydrocarbons	2000	--	--	--	--	--	--	--	--	--	--	--	--
Lube oil range hydrocarbons	2000	--	--	--	--	--	--	--	--	--	--	--	--
TPH (as gasoline)	30	--	--	--	--	--	--	--	--	--	--	--	--
VOCs													
1,1,1,2-Tetrachloroethane	7.3	34	0	0	0	--	--	--	0.993	0.003	0.081676471	--	--
1,1,1-Trichloroethane	1.606	117	28	4	0	13	0.003	0.915534242	0.238	0.001	0.006532262	GP-15	7/11/1996
1,1,2,2-Tetrachloroethane	0.005	108	4	4	65	1.7	0.094	1.121	0.03	0.003	0.011855096	GP-15	7/11/1996
1,1,2,2-Tetrachloroethane	0.005	108	4	4	65	1.7	0.094	1.121	0.03	0.003	0.011855096	GP-10	7/11/1996
1,1,2-Trichloroethane	0.005	108	4	3	24	1.8	0.0026	0.7079	0.238	0.001	0.006220288	GP-15	35257
1,1,2-Trichlorotrifluoroethane	10940.8	7	0	0	0	--	--	--	0.018	0.005	0.011285714	--	--
1,1-Dichloroethane	1.713	115	21	0	0	0.291	0.0015	0.029427083	0.331	0.001	0.013601209	CIA-03	35692
1,1-Dichloroethene	0.005	115	0	0	24	--	--	--	0.331	0.001	0.011467043	--	--
1,1-Dichloropropene	--	108	0	--	--	--	--	--	0.331	0.001	0.012063981	--	--
1,2,3-Trichlorobenzene	--	108	2	--	--	0.018	0.00241	0.010205	0.331	0.001	0.012253868	GP-15	7/11/1996
1,2,3-Trichloropropane	0.005	108	1	1	25	0.048	0.048	0.048	0.331	0.001	0.012099159	B-6	8/20/1999
1,2,4-Trichlorobenzene	1.304818667	108	2	0	0	0.0102	0.0093	0.00975	0.331	0.001	0.012178396	CIA-04	9/19/1997
1,2,4-Trimethylbenzene	23.47072	108	40	6	0	63	0.0016	6.909872791	0.0083	0.001	0.003964769	GP-15	7/11/1996
1,2-Dibromo-3-chloropropane	0.00605	115	1	1	72	0.012	0.012	0.012	1.655	0.004	0.057434211	IAB-02	9/15/1997
1,2-Dibromoethane	0.073	108	0	0	3	--	--	--	0.331	0.001	0.012063981	--	--
1,2-Dichlorobenzene	3.069	115	25	0	0	2.88	0.0012	0.447053448	0.01	0.001	0.003612907	CIA-03	9/19/1997
1,2-Dichloroethane	0.005	115	0	0	24	--	--	--	0.331	0.001	0.011467043	--	--
1,2-Dichloropropane	0.005	108	1	0	26	0.00487	0.00487	0.00487	0.331	0.001	0.012158037	CIA-11	9/24/1997
1,3,5-Trimethylbenzene	7.159093333	108	32	6	0	23	0.0019	3.070156857	0.0083	0.001	0.003763151	GP-15	7/11/1996
1,3-Dichlorobenzene	4.416042667	108	9	0	0	0.16	0.0027	0.051472	0.331	0.001	0.012529694	CIA-04	9/19/1997
1,3-Dichloropropane	360	108	0	0	0	--	--	--	0.331	0.001	0.012063981	--	--
1,4-Dichlorobenzene	0.0297	108	11	7	2	0.35	0.00277	0.092733333	0.321	0.001	0.009321979	GP-15	7/11/1996
2,2-Dichloro-1,1,1-trifluoroethane	--	77	0	--	--	--	--	--	1.655	0.004	0.071798701	--	--
2,2-Dichloropropane	--	108	0	--	--	--	--	--	0.331	0.001	0.012063981	--	--
2-Butanone	19.7182528	115	5	0	0	9.47	0.01	1.598	1.655	0.004	0.059344037	CIA-04	9/19/1997
2-Chloroethyl vinyl ether	--	108	0	--	--	--	--	--	0.331	0.001	0.012063981	--	--
2-Chlorotoluene	2.417361067	108	4	2	0	4.4	0.16	2.465	0.01	0.001	0.003951058	GP-15	7/11/1996
2-Hexanone	--	108	4	--	--	8.4	0.0548	3.5562	1.19	0.004	0.031225962	GP-15	7/11/1996
2-methylpentane	--	115	8	--	--	1.6	0.0136	0.343877778	1.655	0.004	0.058834906	CIA-04	9/19/1997
3-Methylpentane	--	115	8	--	--	1.22	0.00968	0.276631111	1.655	0.004	0.058834906	CIA-04	9/19/1997
4-Chlorotoluene	--	108	2	--	--	0.0714	0.006	0.0387	0.331	0.001	0.012178396	CIA-06	9/19/1997

TABLE 10-3

STATISTICAL EVALUATIONS OF HISTORICAL ANALYTICAL DATA FOR SOIL[1]

PSC Washougal Facility
Washougal, Washington

Concentrations in milligrams per kilogram (mg/kg)

		1996 through 2000											
Analyte	**Preliminary Cleanup Level**	**No. of Samples Analyzed**	**Percentage of Samples with Detections**	**Percentage of Samples with Detected Concentration > PCL[2]**	**Percentage of Samples with Nondetections > PCL[2,3]**	**Maximum Detected Concentration**	**Minimum Detected Concentration**	**Average Detected Concentration**	**Maximum Reporting Limit for Nondetections[4]**	**Minimum Reporting Limit for Nondetections[5]**	**Average Reporting Limit for Nondetections[6]**	**Sample ID of Maximum Detected Concentration**	**Date of Maximum Detected Concentration**
VOCs (Continued)													
4-Methyl-2-pentanone	2.80945664	108	2	1	0	87	0.018	43.509	1.655	0.004	0.050268868	GP-07	7/11/1996
Acetone	3.211498667	108	42	2	0	890	0.01	19.98300444	1.605	0.004	0.049619048	GP-07	7/11/1996
Acrolein	0.34	108	0	0	3	--	--	--	6.62	0.01	0.240288889	--	--
Acrylonitrile	0.49	108	0	0	3	--	--	--	1.655	0.004	0.060078704	--	--
Benzene	0.005	115	5	3	23	0.546	0.0014	0.094886667	0.331	0.001	0.011951468	CIA-03	9/19/1997
Bromobenzene	92	108	1	0	0	0.0023	0.0023	0.0023	0.331	0.001	0.012158037	GP-15	7/11/1996
Bromochloromethane	--	108	0	--	--	--	--	--	0.331	0.001	0.012063981	--	--
Bromodichloromethane	0.005	108	0	0	26	--	--	--	0.331	0.001	0.012063981	--	--
Bromoform	0.0285	108	0	0	3	--	--	--	0.331	0.001	0.012063981	--	--
Bromomethane	0.0509	108	0	0	3	--	--	--	0.331	0.001	0.012063981	--	--
Carbon disulfide	0.2969	114	16	0	2	0.106	0.0011	0.014672222	0.331	0.001	0.013085521	CIA-01	9/19/1997
Carbon tetrachloride	0.005	115	0	0	24	--	--	--	0.331	0.001	0.011467043	--	--
Chlorobenzene	0.005	115	0	0	24	--	--	--	0.331	0.001	0.011467043	--	--
Chloroethane	0.0169	108	6	0	3	0.014	0.002	0.00665	0.331	0.001	0.012714804	GP-15	7/11/1996
Chloroform	0.005	113	1	0	25	0.0021	0.0021	0.0021	0.331	0.001	0.011719732	GP-15	7/11/1996
Chloromethane	0.0104	108	2	2	3	0.025	0.017	0.021	0.331	0.001	0.012263302	GP-18	7/10/1996
cis-1,2-Dichloroethene	0.1113	114	27	5	3	0.593	0.0011	0.092779677	0.331	0.001	0.014243373	CIA-04	9/19/1997
cis-1,3-Dichloropropene	1.8	108	0	0	0	--	--	--	0.331	0.001	0.012063981	--	--
Dibromochloromethane	0.005	108	0	0	26	--	--	--	0.331	0.001	0.012063981	--	--
Dibromomethane	230	108	0	0	0	--	--	--	0.331	0.001	0.012063981	--	--
Dichlorodifluoromethane	0.0499	108	3	0	3	0.0202	0.0013	0.0103	0.331	0.001	0.012370571	CIA-8	9/24/1997
Dichlorotrifluoroethane	--	7	0	--	--	--	--	--	0.0036	0.001	0.002257143	--	--
Diethyl ether	1800	75	0	0	0	--	--	--	0.05	0.001	0.018345333	--	--
Ethylbenzene	3.287	114	39	5	0	18	0.0012	1.397356222	0.01	0.001	0.003678261	GP-15	7/11/1996
Hexachlorobutadiene	0.477	108	0	0	0	--	--	--	0.331	0.001	0.012063981	--	--
Isopropylbenzene	76.192	108	24	0	0	3.9	0.0015	0.534891538	0.01	0.001	0.003755	GP-15	7/11/1996
m,p-Xylene	0.3331	112	54	15	0	78	0.0011	4.029335082	0.01	0.001	0.004043137	GP-15	7/11/1996
methylcyclopentane	--	115	15	--	--	2.02	0.0023	0.379432941	0.331	0.001	0.012517449	CIA-04	9/19/1997
Methylene chloride	0.0200376	113	2	2	37	2.1	0.13	1.115	1.655	0.004	0.048130631	GP-07	35257
Naphthalene	4.486	108	24	15	0	19.8	0.0094	3.923153846	0.05	0.004	0.018237805	CIA-03	9/19/1997
Naphthalene	4.486	108	24	15	0	19.8	0.0094	3.923153846	0.05	0.004	0.018237805	CIA-03	9/19/1997
n-Butylbenzene	240	108	19	0	0	5.8	0.00864	1.276909048	0.01	0.001	0.003481724	GP-15	7/11/1996
n-Propylbenzene	240	108	31	0	0	12	0.0014	2.057318788	0.0083	0.001	0.003745467	CIA-03	9/19/1997
o-Xylene	146.944	114	40	0	0	42	0.001	2.63757913	0.01	0.001	0.003869118	GP-15	7/11/1996
p-isopropyltoluene	--	108	26	--	--	3.3	0.0011	0.726307143	0.01	0.001	0.003686375	GP-15	7/11/1996
p-isopropyltoluene	--	108	26	--	--	3.3	0.0011	0.726307143	0.01	0.001	0.003686375	GP-10	7/11/1996
sec-Butylbenzene	220	108	15	0	0	3.6	0.00515	1.281203125	0.01	0.001	0.003488152	GP-15	7/11/1996
Styrene	0.033646	108	3	2	1	1.4	0.0096	0.7532	0.238	0.001	0.006180095	GP-15	7/11/1996
tert-Butylbenzene	390	108	4	0	0	8.1	0.24	5.01	0.01	0.001	0.003951058	GP-15	7/11/1996
Tetrachloroethene	0.0031	113	43	34	27	74	0.001	2.326776531	0.01	0.001	0.004164219	GP-15	7/11/1996
Toluene	4.65152	111	37	2	0	21	0.002	0.955156098	0.02	0.002	0.007548857	GP-15	7/11/1996
trans-1,2-Dichloroethene	0.104	115	3	0	3	0.0391	0.016	0.025533333	0.331	0.001	0.011506339	CIA-04	9/19/1997
trans-1,3-Dichloropropene	1.8	108	0	0	0	--	--	--	0.331	0.001	0.012063981	--	--
Trichloroethene	0.0028	116	20	20	59	8.4	0.0034	0.490643478	0.642	0.002	0.018704516	GP-15	7/11/1996
Trichlorofluoromethane	2000	115	0	0	0	--	--	--	0.331	0.001	0.011467043	--	--
Vinyl acetate	33.1	108	0	0	0	--	--	--	0.331	0.001	0.012063981	--	--
Vinyl chloride	0.005	115	5	2	24	0.0081	0.0012	0.003441667	0.331	0.001	0.012015688	GP-07	7/11/1996

TABLE 10-3

STATISTICAL EVALUATIONS OF HISTORICAL ANALYTICAL DATA FOR SOIL[1]

PSC Washougal Facility
Washougal, Washington

Concentrations in milligrams per kilogram (mg/kg)

Analyte	Preliminary Cleanup Level	2001 through 2009										
		No. of Samples Analyzed	Percentage of Samples with Detections	Percentage of Samples with Detected Concentration > PCL[2]	Percentage of Samples with Nondetections > PCL[2,3]	Maximum Detected Concentration	Minimum Detected Concentration	Average Detected Concentration	Maximum Reporting Limit for Nondetections[4]	Minimum Reporting Limit for Nondetections[5]	Average Reporting Limit for Nondetections[6]	Sample ID of Maximum Detected Concentration	Date of Maximum Detected Concentration
Metals													
Antimony	5.0624	20	85	0	0	0.19	0.03	0.058235294	0.04	0.03	0.033333333	GP-97	10/5/2007
Arsenic	6	77	100	0	0	3.72	0.7	1.968311688	--	--	--	GP-77D	9/21/2001
Barium	824	33	100	0	0	138	69.2	89.94545455	--	--	--	MC-14D	9/28/2007
Beryllium	63.22	40	50	0	0	0.403	0.17	0.22475	0.5	0.455	0.49775	MC-24	9/24/2007
Cadmium	2.208	33	100	0	0	0.203	0.059	0.115969697	--	--	--	GP-97	10/5/2007
Chromium	27	33	100	0	0	15	5.63	9.324545455	--	--	--	GP-95	10/1/2007
Cobalt	1900	20	100	0	0	9.37	4.41	5.7195	--	--	--	MC-24	9/24/2007
Copper	34	33	100	0	0	25.6	5.02	8.223939394	--	--	--	MC-24	9/24/2007
Cyanide	1.0504	--	--	--	--	--	--	--	--	--	--	--	--
Iron	--	13	100	0	0	16900	11500	14623.07692	--	--	--	MC-30	9/4/2008
Lead	108.00216	20	100	0	0	14	2.41	4.041	--	--	--	GP-97	10/5/2007
Manganese	1511	33	100	0	0	477	136	225.0909091	--	--	--	MC-24	9/24/2007
Mercury	0.04	33	100	3	0	1.52	0.007	0.062515152	--	--	--	GP-108	9/3/2008
Nickel	63.896	33	100	0	0	11.6	7.21	9.529090909	--	--	--	GP-114/GP-113	9/3/2008
Selenium	0.52	--	--	--	--	--	--	--	--	--	--	--	--
Potassium	--	13	100	0	0	793	547	632.7692308	--	--	--	GP-113	9/3/2008
Silver	0.0544	33	76	6	0	0.127	0.019	0.034	0.02	0.02	0.02	GP-97	10/5/2007
Thallium	0.342	--	--	--	--	--	--	--	--	--	--	--	--
Vanadium	1000	33	100	0	0	60.4	22.5	34.99090909	--	--	--	MC-14D	9/28/2007
Zinc	96	33	100	3	0	123	30.4	46.53939394	--	--	--	GP-97	10/5/2007
Pesticides/PCBs													
4,4'-DDD	0.001	20	5	0	5	0.00028	0.00028	0.00028	0.0011	0.00011	0.000217368	GP-97	10/5/2007
4,4'-DDE	0.033175729	20	0	0	0	--	--	--	0.00029	0.000091	0.0001181	--	--
4,4'-DDT	0.00298379	20	10	0	0	0.00066	0.00037	0.000515	0.0022	0.000059	0.000313056	MC-24	9/24/2007
Aldrin	0.001	20	0	0	0	--	--	--	0.0002	0.00014	0.0001605	--	--
alpha-BHC	0.36	20	0	0	0	--	--	--	0.00034	0.00024	0.000275	--	--
alpha-Chlordane	--	20	0	0	0	--	--	--	0.00098	0.00021	0.0002845	--	--
Aroclor 1016	--	15	0	0	0	--	--	--	0.011	0.0018	0.0027	--	--
Aroclor 1221	--	15	0	0	0	--	--	--	0.03	0.0018	0.004113333	--	--
Aroclor 1232	--	15	0	0	0	--	--	--	0.023	0.0018	0.003733333	--	--
Aroclor 1242	--	15	0	0	0	--	--	--	0.011	0.0018	0.002693333	--	--
Aroclor 1248	--	15	0	0	0	--	--	--	0.0049	0.0018	0.00212	--	--
Aroclor 1254	--	15	0	0	0	--	--	--	0.0073	0.0018	0.00228	--	--
Aroclor 1260	--	15	7	0	0	0.0033	0.0033	0.0033	0.0045	0.0018	0.002107143	GP-97	10/5/2007
beta-BHC	1.3	20	10	0	0	0.0018	0.00055	0.001175	0.0014	0.00028	0.000413889	GP-92	10/3/2007
delta-BHC	0.0010704	20	5	0	0	0.00031	0.00031	0.00031	0.00075	0.00005	0.000100474	MC-25	9/24/2007
Dieldrin	0.0048	20	0	0	0	--	--	--	0.00038	0.00027	0.0003065	--	--
Endosulfan I	3700	20	5	0	0	0.00027	0.00027	0.00027	0.00022	0.00016	0.000178947	GP-97	10/5/2007
Endosulfan II	3700	20	0	0	0	--	--	--	0.00025	0.00018	0.0002025	--	--
Endosulfan sulfate	--	20	10	0	0	0.00046	0.00026	0.00036	0.00077	0.000072	0.000123	GP-97	10/5/2007
Endrin	0.001	20	0	0	0	--	--	--	0.00048	0.00019	0.000228	--	--
Endrin aldehyde	--	20	5	0	0	0.00044	0.00044	0.00044	0.0003	0.000049	8.05789E-05	GP-97	10/5/2007
Endrin ketone	--	20	0	0	0	--	--	--	0.0013	0.000075	0.00027485	--	--
gamma-BHC	--	20	5	0	0	0.00018	0.00018	0.00018	0.0003	0.00014	0.000168421	GP-94	10/4/2007
gamma-BHC	--	20	5	0	0	0.00018	0.00018	0.00018	0.0003	0.00014	0.000168421	GP-91	10/5/2007
gamma-Chlordane	6.5	20	5	0	0	0.00011	0.00011	0.00011	0.00095	0.000059	0.000286316	GP-95	10/1/2007
Heptachlor	0.0008	20	0	0	5	--	--	--	0.0011	0.000073	0.0001492	--	--
Heptachlor epoxide	0.001	20	15	5	0	0.0028	0.00031	0.001243333	0.00048	0.00012	0.000174118	GP-92	10/3/2007
Lindane	0.00099	--	--	--	--	--	--	--	--	--	--	--	--
Methoxychlor	0.048120034	20	0	0	0	--	--	--	0.00087	0.000091	0.00020525	--	--
Toxaphene	0.049	20	0	0	10	--	--	--	0.082	0.0082	0.01702	--	--

TABLE 10-3

STATISTICAL EVALUATIONS OF HISTORICAL ANALYTICAL DATA FOR SOIL[1]

PSC Washougal Facility
Washougal, Washington

Concentrations in milligrams per kilogram (mg/kg)

		2001 through 2009										
Analyte	Preliminary Cleanup Level	No. of Samples Analyzed	Percentage of Samples with Detections	Percentage of Samples with Detected Concentration > PCL[2]	Percentage of Samples with Nondetections > PCL[2,3]	Maximum Detected Concentration	Minimum Detected Concentration	Average Detected Concentration	Maximum Reporting Limit for Nondetections[4]	Minimum Reporting Limit for Nondetections[5]	Average Reporting Limit for Nondetections[6]	Sample ID of Maximum Detected Concentration	Date of Maximum Detected Concentration
SVOCs													
1,2,4-Trichlorobenzene	1.304818667	33	0	0	0	--	--	--	0.029	0.0026	0.004309091	--	--
1,2-Dichlorobenzene	3.069	33	0	0	0	--	--	--	0.032	0.0029	0.004812121	--	--
1,3-Dichlorobenzene	4.416042667	33	0	0	0	--	--	--	0.033	0.003	0.004972727	--	--
1,4-Dichlorobenzene	0.0297	33	0	0	3	--	--	--	0.032	0.0029	0.004812121	--	--
1-Methylnaphthalene	0.0447	--	--	--	--	--	--	--	--	--	--	--	--
1,4-Dioxane	0.016	21	5	0	0	0.00085	0.00085	0.00085	0.0025	0.00045	0.0005935	GP-97	10/5/2007
2,4,5-Trichlorophenol	28.8	32	0	0	0	--	--	--	0.0096	0.0015	0.002046875	--	--
2,4,6-Trichlorophenol	0.0162	32	0	0	0	--	--	--	0.009	0.0014	0.0019125	--	--
2,4-Dichlorophenol	0.166565408	32	0	0	0	--	--	--	0.0064	0.001	0.001375	--	--
2,4-Dimethylphenol	1.31	17	0	0	0	--	--	--	0.028	0.0055	0.006982353	--	--
2,4-Dinitrophenol	0.2	32	0	0	0	--	--	--	0.11	0.017	0.02315625	--	--
2,4-Dinitrotoluene	0.01	33	0	0	3	--	--	--	0.017	0.0015	0.0025	--	--
2,6-Dinitrotoluene	0.0861	33	0	0	0	--	--	--	0.022	0.002	0.003306061	--	--
2-Chloronaphthalene	23000	33	0	0	0	--	--	--	0.018	0.0016	0.002678788	--	--
2-Chlorophenol	0.473	32	0	0	0	--	--	--	0.013	0.002	0.002721875	--	--
2-Methyl-4,6-dinitrophenol	62					--	--	--	--	--	--	--	--
2-Methylnaphthalene	5.57	33	12	0	0	0.19	0.033	0.078	0.015	0.0022	0.002775862	GP-93	10/3/2007
2-Methylphenol	2.33	32	0	0	0	--	--	--	0.0096	0.0015	0.002046875	--	--
2-Nitroaniline	1800	33	0	0	0	--	--	--	0.035	0.0032	0.005278788	--	--
2-Nitrophenol	--	32	0	--	--	--	--	--	0.0096	0.0015	0.002046875	--	--
3,3'-Dichlorobenzidine	0.037	26	0	0	0	--	--	--	0.019	0.0037	0.004473077	--	--
3-Nitroaniline	82	33	0	0	0	--	--	--	0.028	0.0025	0.004151515	--	--
4,6-Dinitro-2-methylphenol	--	32	0	0	0	--	--	--	0.009	0.0014	0.0019125	--	--
4-Bromophenyl phenyl ether	--	33	0	--	--	--	--	--	0.018	0.0016	0.002678788	--	--
4-Chloro-3-methylphenol	--	32	0	--	--	--	--	--	0.009	0.0014	0.0019125	--	--
4-Chloroaniline	0.17	26	0	0	0	--	--	--	0.0095	0.0019	0.0023	--	--
4-Chlorophenyl phenyl ether	--	33	0	--	--	--	--	--	0.016	0.0014	0.002339394	--	--
4-Methylphenol	0.199	32	0	0	0	--	--	--	0.0096	0.0015	0.002046875	--	--
4-Nitroaniline	82	33	0	0	0	--	--	--	0.02	0.0018	0.002987879	--	--
4-Nitrophenol	--	32	0	--	--	--	--	--	0.12	0.018	0.0245625	--	--
Acenaphthene	68.3	33	0	0	0	--	--	--	0.016	0.0014	0.002339394	--	--
Acenaphthylene	--	33	0	--	--	--	--	--	0.014	0.0012	0.002012121	--	--
Acetone	3.211498667	--	--	--	--	--	--	--	--	--	--	--	--
Anthracene	2230	33	0	0	0	--	--	--	0.018	0.0016	0.002678788	--	--
Acetophenone	3.921	--	--	--	--	--	--	--	--	--	--	--	--
Aniline	300	--	--	--	--	--	--	--	--	--	--	--	--
Anthracene	2230	--	--	--	--	--	--	--	--	--	--	--	--
Azobenzene	16	--	--	--	--	--	--	--	--	--	--	--	--
Benzidine	0.2	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(a)anthracene	0.02017	33	0	0	0	--	--	--	0.019	0.0017	0.002857576	--	--
Benzo(a)pyrene	0.05433	33	0	0	0	--	--	--	0.019	0.0017	0.002821212	--	--
Benzo(b)fluoranthene	0.06721	33	0	0	0	--	--	--	0.014	0.0012	0.002012121	--	--
Benzo(g,h,i)perylene	--	33	6	--	--	0.031	0.0042	0.0176	0.0096	0.0015	0.002064516	GP-97	10/5/2007
Benzo(k)fluoranthene	0.06721	33	0	0	0	--	--	--	0.016	0.0014	0.002339394	--	--
Benzoic acid	256.8	28	11	0	0	0.19	0.1	0.136666667	0.62	0.096	0.13864	GP-93	10/3/2007
Benzyl alcohol	10.8960624	33	12	0	0	0.0033	0.0024	0.002975	0.023	0.0021	0.003641379	GP-95	10/1/2007
bis(2-Chloroethoxy)methane	--	33	0	--	--	--	--	--	0.017	0.0015	0.0025	--	--
bis(2-Chloroethyl) ether	0.01	33	0	0	6	--	--	--	0.021	0.0019	0.003163636	--	--
bis(2-Chloroisopropyl)ether	--	33	0	--	--	--	--	--	0.029	0.0026	0.004309091	--	--
bis(2-Ethylhexyl) phthalate	2.671752009	33	52	0	0	0.75	0.0073	0.180547059	0.082	0.007	0.0133125	MC-25	9/24/2007
Butyl benzyl phthalate	426	33	18	0	0	0.98	0.0047	0.195783333	0.021	0.0032	0.004507407	GP-93	10/3/2007
Carbon disulfide	0.2969	--	--	--	--	--	--	--	--	--	--	--	--
Chrysene	0.02241	33	3	3	0	0.032	0.032	0.032	0.017	0.0015	0.00240625	GP-114	9/3/2008
Dibenz(a,h)anthracene	0.21	33	0	0	0	--	--	--	0.017	0.0015	0.0025	--	--
Dibenzofuran	5.33	33	3	0	0	0.005	0.005	0.005	0.014	0.0012	0.00203125	GP-93	10/3/2007
Diethyl phthalate	73.32	33	21	0	0	0.0075	0.0013	0.003328571	0.015	0.0013	0.003492308	GP-113	9/3/2008

TABLE 10-3

STATISTICAL EVALUATIONS OF HISTORICAL ANALYTICAL DATA FOR SOIL[1]

PSC Washougal Facility
Washougal, Washington

Concentrations in milligrams per kilogram (mg/kg)

		2001 through 2009											
Analyte	Preliminary Cleanup Level	No. of Samples Analyzed	Percentage of Samples with Detections	Percentage of Samples with Detected Concentration > PCL[2]	Percentage of Samples with Nondetections > PCL[2,3]	Maximum Detected Concentration	Minimum Detected Concentration	Average Detected Concentration	Maximum Reporting Limit for Nondetections[4]	Minimum Reporting Limit for Nondetections[5]	Average Reporting Limit for Nondetections[6]	Sample ID of Maximum Detected Concentration	Date of Maximum Detected Concentration
SVOCs (Continued)													
Dimethyl phthalate	76.80011898	33	24	0	0	0.013	0.0027	0.007325	0.011	0.001	0.001852	MC-31	9/4/2008
Di-n-butyl phthalate	57.60000011	33	52	0	0	0.14	0.0086	0.0221	0.087	0.0079	0.01806875	GP-112	9/4/2008
Di-n-octyl phthalate	25000	33	0	0	0	--	--	--	0.019	0.0017	0.002821212	--	--
Fluoranthene	127.9	33	9	0	0	0.0096	0.0027	0.005233333	0.018	0.0016	0.002726667	GP-114	9/3/2008
Fluorene	101	33	0	0	0	--	--	--	0.012	0.0011	0.001824242	--	--
Hexachlorobenzene	0.2262	33	0	0	0	--	--	--	0.014	0.0012	0.002012121	--	--
Hexachlorobutadiene	0.477	33	0	0	0	--	--	--	0.028	0.0025	0.004151515	--	--
Hexachlorocyclopentadiene	160	33	0	0	0	--	--	--	0.32	0.029	0.048121212	--	--
Hexachloroethane	0.0564	33	0	0	0	--	--	--	0.034	0.0031	0.005124242	--	--
Indeno(1,2,3-cd)pyrene	0.196	33	0	0	0	--	--	--	0.017	0.0015	0.0025	--	--
Isophorone	0.0415	33	3	0	0	0.0015	0.0015	0.0015	0.011	0.001	0.001684375	MC-25	9/24/2007
Naphthalene	4.486	33	15	0	0	0.044	0.0024	0.01724	0.015	0.0023	0.003235714	GP-93	10/3/2007
Nitrobenzene	0.025526795	33	0	0	0	--	--	--	0.024	0.0022	0.003648485	--	--
N-Nitroso-di-n-propylamine	0.01	33	0	0	9	--	--	--	0.027	0.0024	0.003987879	--	--
N-Nitrosodiphenylamine	0.099	33	0	0	0	--	--	--	0.018	0.0016	0.002678788	--	--
Pentachlorophenol	0.15	32	0	0	0	--	--	--	0.13	0.02	0.02721875	--	--
Phenanthrene	--	33	15	--	--	0.017	0.0032	0.01032	0.009	0.0014	0.002003571	GP-97	10/5/2007
Phenol	21.98	33	18	0	0	0.051	0.0049	0.019483333	0.096	0.002	0.02812963	GP-97	10/5/2007
Pyrene	654.7	33	15	0	0	0.018	0.0017	0.00836	0.0096	0.0015	0.002021429	GP-97	10/5/2007
TPH													
Diesel range hydrocarbons	--	34	18	0	0	860	32	193	31	1.3	6.010714286	GP-97	10/5/2007
Lube oil range hydrocarbons	--	34	12	0	0	500	120	287.5	130	3	21.96333333	GP-114	9/3/2008
TPH (as gasoline)	--	37	14	3	0	120	6.9	30.598	6.2	0.62	2.3225	GP-97	10/5/2007
VOCs													
1,1,1,2-Tetrachloroethane	7.3	91	0	0	0	--	--	--	0.5	0.05	0.055494505	--	--
1,1,1-Trichloroethane	1.606	131	7	0	0	0.141	0.00021	0.016467778	0.5	0.000069	0.040605779	GP-40	9/24/2001
1,1,2,2-Tetrachloroethane	0.005	91	0	0	100	--	--	--	1	0.1	0.110989011	--	--
1,1,2-Trichloroethane	0.005	91	0	0	100	--	--	--	1	0.1	0.110989011	--	--
1,1,2-Trichlorotrifluoroethane	10940.8	131	2	0	0	0.0017	0.00036	0.00102	2	0.00011	0.157854141	GP-93	10/3/2007
1,1-Dichloroethane	1.713	131	2	0	0	0.0541	0.00022	0.02716	0.5	0.000052	0.038780473	GP-37	9/22/2001
1,1-Dichloroethene	0.005	131	0	0	69	--	--	--	0.5	0.00006	0.038572427	--	--
1,1-Dichloropropene	--	--	--	--	--	--	--	--	--	--	--	--	--
1,1-Dichlorotrifluoroethane	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3-Trichloropropane	0.005	--	--	--	--	--	--	--	--	--	--	--	--
1,2,4-Trichlorobenzene	1.304818667	--	--	--	--	--	--	--	--	--	--	--	--
1,2,4-Trimethylbenzene	23.47072	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Dibromo-3-chloropropane	0.00605	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Dibromoethane	0.073	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichlorobenzene	3.069	131	5	0	0	0.301	0.0037	0.112366667	0.5	0.000068	0.038023584	GP-40	9/24/2001
1,2-Dichloroethane	0.005	131	0	0	69	--	--	--	0.5	0.000058	0.038569672	--	--
1,2-Dichloropropane	0.005	91	0	0	100	--	--	--	0.5	0.05	0.055494505	--	--
1,3,5-Trimethylbenzene	7.159093333	--	--	--	--	--	--	--	--	--	--	--	--
1,3-Dichlorobenzene	4.416042667	91	0	0	0	--	--	--	0.5	0.05	0.055494505	--	--
1,3-Dichloropropane	360	--	--	--	--	--	--	--	--	--	--	--	--
1,4-Dichlorobenzene	0.0297	91	1	1	99	0.11	0.11	0.11	0.5	0.05	0.055	GP-40	9/24/2001
2,2-Dichloro-1,1,1-trifluoroethane	--	40	0	0	0	--	--	--	0.009	0.0041	0.005765	--	--
2,2-Dichloropropane	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Butanone	19.7182528	131	2	0	0	0.021	0.0027	0.01185	10	0.0012	0.783424806	GP-93	10/3/2007
2-Chloroethyl vinyl ether	0	--	--	--	--	--	--	--	--	--	--	--	--
2-Chlorotoluene	2.417361067	--	--	--	--	--	--	--	--	--	--	--	--
2-Hexanone	--	91	0	0	0	--	--	--	10	1	1.10989011	--	--
2-methylpentane	--	40	0	0	0	--	--	--	0.009	0.0041	0.005765	--	--
3-Methylpentane	--	40	0	0	0	--	--	--	0.009	0.0041	0.005765	--	--
4-Chlorotoluene	--	--	--	--	--	--	--	--	--	--	--	--	--

TABLE 10-3

STATISTICAL EVALUATIONS OF HISTORICAL ANALYTICAL DATA FOR SOIL[1]

PSC Washougal Facility
Washougal, Washington

Concentrations in milligrams per kilogram (mg/kg)

		2001 through 2009											
Analyte	Preliminary Cleanup Level	No. of Samples Analyzed	Percentage of Samples with Detections	Percentage of Samples with Detected Concentration > PCL[2]	Percentage of Samples with Nondetections > PCL[2,3]	Maximum Detected Concentration	Minimum Detected Concentration	Average Detected Concentration	Maximum Reporting Limit for Nondetections[4]	Minimum Reporting Limit for Nondetections[5]	Average Reporting Limit for Nondetections[6]	Sample ID of Maximum Detected Concentration	Date of Maximum Detected Concentration
VOCs (Continued)													
4-Methyl-2-pentanone	2.80945664	91	0	0	1	--	--	--	5	0.5	0.554945055	--	--
Acetone	3.211498667	131	3	0	2	0.085	0.0075	0.029125	25	0.0029	1.991104724	GP-93	10/3/2007
Acrolein	0.34	--	--	--	--	--	--	--	--	--	--	--	--
Acrylonitrile	0.49	--	--	--	--	--	--	--	--	--	--	--	--
Benzene	0.005	131	1	0	69	0.0024	0.0024	0.0024	0.5	0.000083	0.038885454	GP-95	10/1/2007
Bromobenzene	92	--	--	--	--	--	--	--	--	--	--	--	--
Bromochloromethane	--	--	--	--	--	--	--	--	--	--	--	--	--
Bromodichloromethane	0.005	91	0	0	100	--	--	--	0.5	0.05	0.055494505	--	--
Bromoform	0.0285	91	0	0	100	--	--	--	1	0.1	0.110989011	--	--
Bromomethane	0.0509	91	0	0	100	--	--	--	5	0.5	0.554945055	--	--
Carbon disulfide	0.2969	131	15	0	69	0.0017	0.000097	0.000383526	10	0.000057	0.901810679	GP-113	9/3/2008
Carbon tetrachloride	0.005	131	0	0	69	--	--	--	0.5	0.000076	0.038576519	--	--
Chlorobenzene	0.005	131	0	0	69	--	--	--	0.5	0.000054	0.038568519	--	--
Chloroethane	0.0169	131	0	0	69	--	--	--	1	0.00026	0.077196947	--	--
Chloroform	0.005	131	0	0	69	--	--	--	0.5	0.000052	0.038569733	--	--
Chloromethane	0.0104	131	3	0	69	0.00024	0.00017	0.0002	5	0.000061	0.397667717	MC-30	9/4/2008
cis-1,2-Dichloroethene	0.1113	131	2	0	1	0.00048	0.00027	0.000375	0.5	0.000087	0.039179256	GP-97	10/5/2007
cis-1,3-Dichloropropene	1.8	91	0	0	0	--	--	--	0.5	0.05	0.055494505	--	--
Dibromochloromethane	0.005	91	0	0	100	--	--	--	1	0.1	0.110989011	--	--
Dibromomethane	--	--	--	--	--	--	--	--	--	--	--	--	--
Dichlorodifluoromethane	0.0499	131	2	0	69	0.0016	0.00032	0.00096	5	0.000069	0.391496698	GP-110	9/2/2008
Dichlorotrifluoroethane	--	--	--	--	--	--	--	--	--	--	--	--	--
Diethyl ether	1800	--	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	3.287	131	18	1	0	12.2	0.00025	0.75677875	0.5	0.000044	0.040672374	GP-77E	9/21/2001
Hexachlorobutadiene	0.477	--	--	--	--	--	--	--	--	--	--	--	--
Isopropylbenzene	76.192	--	--	--	--	--	--	--	--	--	--	--	--
m,p-Xylene	0.3331	131	23	8	1	24	0.00034	2.048213333	1	0.0001	0.087163069	GP-77E	9/21/2001
methylcyclopentane	--	40	0	0	0	--	--	--	0.009	0.0041	0.005765	--	--
Methylene bromide	230	91	0	0	0	--	--	--	0.5	0.05	0.055494505	--	--
Methylene chloride	0.0200376	131	5	0	69	0.0019	0.00021	0.000733333	5	0.00015	0.40431728	GP-107	9/3/2008
Naphthalene	4.486	91	4	0	0	2.66	0.464	1.20575	2	0.2	0.220689655	GP-40	9/24/2001
n-Butylbenzene	240	--	--	--	--	--	--	--	--	--	--	--	--
n-Propylbenzene	240	--	--	--	--	--	--	--	--	--	--	--	--
o-Xylene	146.944	40	30	0	0	0.036	0.00026	0.003981667	0.00011	0.00006	6.86786E-05	GP-93	10/3/2007
p-Cymene	--	--	--	--	--	--	--	--	--	--	--	--	--
p-isopropyltoluene	--	--	--	--	--	--	--	--	--	--	--	--	--
sec-Butylbenzene	220	--	--	--	--	--	--	--	--	--	--	--	--
Styrene	0.033646	91	0	0	100	--	--	--	0.5	0.05	0.055494505	--	--
tert-Butylbenzene	390	--	--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene	0.0031	131	12	5	67	0.629	0.00049	0.047951875	0.5	0.00008	0.042200548	GP-40	9/24/2001
Toluene	4.65152	131	28	0	0	2.56	0.00031	0.141425405	0.5	0.00032	0.049527021	GP-37	9/22/2001
trans-1,2-Dichloroethene	0.104	131	0	0	1	--	--	--	0.5	0.000052	0.038573901	--	--
trans-1,3-Dichloropropene	1.8	91	0	0	0	--	--	--	0.5	0.05	0.055494505	--	--
Trichloroethene	0.0028	131	6	0	69	0.0019	0.0003	0.0006775	0.5	0.000074	0.041086569	GP-93	10/3/2007
Trichlorofluoromethane	2000	131	0	0	0	--	--	--	2	0.000058	0.154228962	--	--
Vinyl acetate	33.1	91	0	0	0	--	--	--	5	0.5	0.554945055	--	--
Vinyl chloride	0.005	131	0	0	69	--	--	--	0.5	0.000061	0.038577718	--	--

Notes
1. Statistics were calculated using results from soil samples collected within the property boundary. Off-site soil samples were not included.
2. PCL values used to perform statistical evaluations are from the 2008 Draft Remedial Investigation Technical Memorandum (Geomatrix, 2008a).
3. Percentage of samples in which constituent was not detected, but the reporting limit exceeded the PCL.
4. Maximum reporting limit for samples in which constituent was not detected.
5. Minimum reporting limit for samples in which constituent was not detected.
6. Average reporting limit for samples in which constituent was not detected.

Abbreviations
-- = not established/not analyzed/not applicable
PCBs = polychlorinated biphenyls
PCL = preliminary cleanup level
SVOCs = semivolatile organic compounds
TPH = total petroleum hydrocarbons
VOCs = volatile organic compounds

TABLE 10-4

STATISTICAL EVALUATION OF HISTORICAL ANALYTICAL DATA FOR SHALLOW GROUNDWATER

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Analyte	Preliminary Cleanup Level	pre-2000											
		No. of Samples Analyzed	Percentage of Samples with Detections	Percentage of Samples with Detected Concentration > PCL^1	Percentage of Samples with Nondetections > PCL^{1,2}	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration	Minimum Reporting Limit for Nondetections^3	Maximum Reporting Limit for Nondetections^4	Average Reporting Limit for Nondetections^5	Sample ID of Maximum Detected Concentration	Date of Maximum Detected Concentration
Gases													
Ethane	--	5	0	--	--	--	--	--	2	2	2	--	--
Ethene	--	5	20	--	--	69.5	69.5	69.5	2	2	2	MC-14	11/29/1999
Methane	--	5	80	--	--	244	1680	906.25	2	2	2	MC-15	11/30/1999
Metals													
Antimony	5.6	12	0	0	100				60	60	60		
Arsenic	0.5	430	64.41860465	64.41860465	35.11627907	0.82	27800	337.291769	0.02	10	9.869542484	MC-16	6/4/1996
Arsenic III	--	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic V	--	--	--	--	--	--	--	--	--	--	--	--	--
Barium	1000	426	2.34741784	0	0	200	650	307.7	200	200	200	GP-34	7/29/1999
Beryllium	4	24	0	0	62.5	--	--	--	0.01	10	5.630416667	--	--
Cadmium	0.25	12	0	0	100	--	--	--	5	5	5	--	--
Calcium	--	--	--	--	--	--	--	--	--	--	--	--	--
Chromium	50	13	15.38461538	0	0	33.5	40	36.75	10	10	10	MC-14	6/16/1998
Chromium (hexavalent)	--	105	0.952380952	--	--	40	40	40	10	500	55.96153846	MC-14	8/24/1998
Cobalt	730	426	0.234741784	0	0	53	53	53	50	50	50	GP-34	7/29/1999
Copper	3.5	131	2.290076336	2.290076336	97.70992366	32	86.5	53.7	25	25	25	GP-34	7/29/1999
Cyanide	10	11	63.63636364	63.63636364	36.36363636	10.3	1900	689.3	24	60	33	MC-12	9/9/1999
Ferric iron	--	--	--	--	--	--	--	--	--	--	--	--	--
Ferrous iron	--	--	--	--	--	--	--	--	--	--	--	--	--
Iron	300	9	100	100	0	1000	36000	9688.888889	--	--	--	MC-14	11/29/1999
Lead	0.54	7	0	0	100	--	--	--	3	3	3	--	--
Magnesium	--	--	--	--	--	--	--	--	--	--	--	--	--
Manganese	50	9	100	100	0	54	12000	2781.555556	--	--	--	MC-14	11/29/1999
Mercury	0.2	6	0	0	0	--	--	--	0.2	0.2	0.2	--	--
Nickel	49	428	6.542056075	3.738317757	0	41	420	130.5035714	40	40	40	GP-31	7/29/1999
Potassium	--	--	--	--	--	--	--	--	--	--	--	--	--
Selenium	5	12	0	0	0	--	--	--	5	5	5	--	--
Silver	0.32	12	0	0	100	--	--	--	10	10	10	--	--
Sodium	--	9	55.55555556	--	--	5300	27800	12580	3400	5000	4600	MC-14	11/29/1999
Sulfide	--	--	--	--	--	--	--	--	--	--	--	--	--
Thallium	0.24	12	0	0	100	--	--	--	10	300	192.5	--	--
Tin	--	--	--	--	--	--	--	--	--	--	--	--	--
Total inorganic arsenic	--	--	--	--	--	--	--	--	--	--	--	--	--
Vanadium	110	--	--	--	--	--	--	--	--	--	--	--	--
Zinc	32	428	17.75700935	10.74766355	0	20	380	62.54078947	20	20	20	MC-1	6/9/1999
Pesticides/PCBs													
4,4'-DDD	0.00047	4	0	0	100	--	--	--	0.08	0.08	0.08	--	--
4,4'-DDE	0.0005	4	0	0	100	--	--	--	0.08	0.08	0.08	--	--
4,4'-DDT	0.00047	4	0	0	100	--	--	--	0.08	0.08	0.08	--	--
Aldrin	0.0005	4	0	0	100	--	--	--	0.04	0.04	0.04	--	--
alpha-BHC	0.0026	4	0	0	100	--	--	--	0.04	0.04	0.04	--	--
alpha-Chlordane	--	4	0	--	--	--	--	--	0.04	0.04	0.04	--	--
Aroclor 1016	--	4	0	--	--	--	--	--	0.1	0.3	0.225	--	--
Aroclor 1221	--	4	0	--	--	--	--	--	0.1	0.3	0.225	--	--
Aroclor 1232	--	4	0	--	--	--	--	--	0.1	0.3	0.225	--	--
Aroclor 1242	--	4	0	--	--	--	--	--	0.1	0.3	0.225	--	--
Aroclor 1248	--	4	0	--	--	--	--	--	0.1	0.3	0.225	--	--
Aroclor 1254	--	4	0	--	--	--	--	--	0.1	0.3	0.225	--	--
Aroclor 1260	--	4	0	--	--	--	--	--	0.1	0.3	0.225	--	--

TABLE 10-4

STATISTICAL EVALUATION OF HISTORICAL ANALYTICAL DATA FOR SHALLOW GROUNDWATER

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

		pre-2000											
Analyte	**Preliminary Cleanup Level**	**No. of Samples Analyzed**	**Percentage of Samples with Detections**	**Percentage of Samples with Detected Concentration > PCL[1]**	**Percentage of Samples with Nondetections > PCL[1,2]**	**Minimum Detected Concentration**	**Maximum Detected Concentration**	**Average Detected Concentration**	**Minimum Reporting Limit for Nondetections[3]**	**Maximum Reporting Limit for Nondetections[4]**	**Average Reporting Limit for Nondetections[5]**	**Sample ID of Maximum Detected Concentration**	**Date of Maximum Detected Concentration**
Pesticides/PCBs (Continued)													
beta-BHC	0.0091	4	0	0	100	--	--	--	0.04	0.04	0.04	--	--
Chlordane	0.005	--	--	--	--	--	--	--	--	--	--	--	--
delta-BHC	0.012	4	0	0	100	--	--	--	0.04	0.04	0.04	--	--
Dieldrin	0.0005	4	0	0	100	--	--	--	0.08	0.08	0.08	--	--
Endosulfan I	--	4	0	--	--	--	--	--	0.04	0.04	0.04	--	--
Endosulfan II	--	4	0	--	--	--	--	--	0.08	0.08	0.08	--	--
Endosulfan sulfate	--	4	0	--	--	--	--	--	0.08	0.08	0.08	--	--
Endrin	0.0023	4	0	0	100	--	--	--	0.08	0.08	0.08	--	--
Endrin aldehyde	--	4	0	--	--	--	--	--	0.08	0.08	0.08	--	--
Endrin ketone	--	4	0	--	--	--	--	--	0.08	0.08	0.08	--	--
gamma-Chlordane	--	4	0	--	--	--	--	--	0.04	0.04	0.04	--	--
Heptachlor	0.0005	4	0	0	100	--	--	--	0.04	0.04	0.04	--	--
Heptachlor epoxide	0.0005	4	0	0	100	--	--	--	0.04	0.04	0.04	--	--
Isodrin	--	--	--	--	--	--	--	--	--	--	--	--	--
Kepone	--	--	--	--	--	--	--	--	--	--	--	--	--
Lindane	0.019	4	0	0	100	--	--	--	0.04	0.04	0.04	--	--
Methoxychlor	0.03	4	0	0	100	--	--	--	0.4	0.4	0.4	--	--
Toxaphene	0.025	4	0	0	100	--	--	--	0.09	0.09	0.09	--	--
SVOCs													
1,2,4,5-Tetrachlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,4-Trichlorobenzene	35	65	0	0	3.076923077	--	--	--	1	100	8.615384615	--	--
1,2-Dichlorobenzene	261.5061728	65	6.153846154	0	0	1	51	25.5	1	100	8.967213115	MC-1	11/8/1994
1,3-Dichlorobenzene	320	65	1.538461538	0	0	1	1	1	1	100	8.734375	MC-1	5/3/1995
1,4-Dichlorobenzene	1.8	65	1.538461538	1.538461538	53.84615385	4	4	4	1	100	8.734375	MC-1	2/7/1995
1,4-Dioxane	4	--	--	--	--	--	--	--	--	--	--	--	--
1,4-Naphthoquinone	--	--	--	--	--	--	--	--	--	--	--	--	--
1-Methylnaphthalene	--	--	--	--	--	--	--	--	--	--	--	--	--
1-Naphthylamine	--	--	--	--	--	--	--	--	--	--	--	--	--
2,3,4,6-Tetrachlorophenol	--	--	--	--	--	--	--	--	--	--	--	--	--
2,4,5-Trichlorophenol	800	65	0	0	0	--	--	--	1	100	8.8	--	--
2,4,6-Trichlorophenol	1.4	65	0	0	72.30769231	--	--	--	1	100	8.8	--	--
2,4-Dichlorophenol	24	65	0	0	3.076923077	--	--	--	1	100	8.8	--	--
2,4-Dimethylphenol	160	303	2.97029703	0	0	1	31	11.36666667	1	100	3.95085034	MC-14	5/4/1994
2,4-Dinitrophenol	32	65	0	0	53.84615385	--	--	--	5	500	44	--	--
2,4-Dinitrotoluene	0.18	65	0	0	100	--	--	--	1	100	8.8	--	--
2,6-Dichlorophenol	--	--	--	--	--	--	--	--	--	--	--	--	--
2,6-Dinitrotoluene	16	65	0	0	3.076923077	--	--	--	1	100	8.8	--	--
2-Chloronaphthalene	640	65	0	0	0	--	--	--	1	100	8.615384615	--	--
2-Chlorophenol	40	65	0	0	3.076923077	--	--	--	1	100	8.615384615	--	--
2-Methyl-4,6-dinitrophenol	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Methylaniline	10	--	--	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	32	303	7.920792079	0	0.660066007	1	30.67	8.8025	1	100	4.062365591	GP-29	7/29/1999
2-Methylphenol	400	303	3.96039604	0	0	1	43	10.525	1	100	3.968728522	MC-14	11/8/1994
2-Naphthylamine	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Nitroaniline	--	65	0	--	--	--	--	--	2	500	41.69230769	--	--
2-Nitrophenol	--	65	0	--	--	--	--	--	1	100	8.8	--	--
2-Picoline	--	--	--	--	--	--	--	--	--	--	--	--	--
3,3'-Dichlorobenzidine	2	65	0	0	72.30769231	--	--	--	1	200	18.43076923	--	--
3,3'-Dimethylbenzidine	--	--	--	--	--	--	--	--	--	--	--	--	--

TABLE 10-4

STATISTICAL EVALUATION OF HISTORICAL ANALYTICAL DATA FOR SHALLOW GROUNDWATER

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

		pre-2000											
Analyte	Preliminary Cleanup Level	No. of Samples Analyzed	Percentage of Samples with Detections	Percentage of Samples with Detected Concentration > PCL[1]	Percentage of Samples with Nondetections > PCL[1,2]	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration	Minimum Reporting Limit for Nondetections[3]	Maximum Reporting Limit for Nondetections[4]	Average Reporting Limit for Nondetections[5]	Sample ID of Maximum Detected Concentration	Date of Maximum Detected Concentration
SVOCs (Continued)													
3-Methylcholanthrene	--	--	--	--	--	--	--	--	--	--	--	--	--
3-Methylphenol	400	--	--	--	--	--	--	--	--	--	--	--	--
3-Nitroaniline	--	65	0	--	--	--	--	--	5	500	43.07692308	--	--
4,6-Dinitro2-methylphenol	--	65	0	--	--	--	--	--	5	500	44	--	--
4-Aminobiphenyl	--	--	--	--	--	--	--	--	--	--	--	--	--
4-Bromophenyl phenyl ether	--	65	0	--	--	--	--	--	1	100	8.8	--	--
4-Chloro-3-methylphenol	--	65	0	--	--	--	--	--	2	200	17.23076923	--	--
4-Chloroaniline	32	65	0	0	3.076923077	--	--	--	1	200	17.04615385	--	--
4-Chlorophenyl phenyl ether	--	65	0	--	--	--	--	--	1	100	8.615384615	--	--
4-Methylphenol	40	65	1.538461538	1.538461538	3.076923077	42	42	42	1	100	8.734375	MC-1	2/7/1995
4-Nitroaniline	--	65	0	--	--	--	--	--	2	500	42.52307692	--	--
4-Nitrophenol	--	65	1.538461538	1.538461538	--	2.6	2.6	2.6	1	500	43.546875	MC-8	12/2/1998
4-Nitroquinoline-1-oxide	--	--	--	--	--	--	--	--	--	--	--	--	--
5-Nitro-o-toluidine	--	--	--	--	--	--	--	--	--	--	--	--	--
7,12-Dimethybenz(a)anthracene	--	--	--	--	--	--	--	--	--	--	--	--	--
Acenaphthene	670	65	0	0	0	--	--	--	1	100	8.615384615	--	--
Acenaphthylene	--	65	0	--	--	--	--	--	1	100	8.615384615	--	--
Acetamidofluorene	--	--	--	--	--	--	--	--	--	--	--	--	--
Acetophenone	800	238	0.420168067	0	0	18	18	18	1	10	5.716455696	MC-8	12/5/1997
alpha, alpha-Dimethylphenethylamine	--	--	--	--	--	--	--	--	--	--	--	--	--
Aniline	7.7	30	0	0	0	--	--	--	5	5	5	--	--
Anthracene	4800	65	0	0	0	--	--	--	1	100	8.615384615	--	--
Aramite	--	--	--	--	--	--	--	--	--	--	--	--	--
Azobenzene	--	18	0	--	--	--	--	--	1	1	1	--	--
Benzidine	--	30	0	--	--	--	--	--	1	25	10.6	--	--
Benzo(a)anthracene	0.02	65	0	0	100	--	--	--	1	100	8.892307692	--	--
Benzo(a)pyrene	0.0158	65	0	0	100	--	--	--	1	100	8.615384615	--	--
Benzo(b)fluoranthene	0.0194	65	0	0	100	--	--	--	1	100	8.615384615	--	--
Benzo(g,h,i)perylene	--	65	0	--	--	--	--	--	1	100	8.615384615	--	--
Benzo(k)fluoranthene	0.0134	64	0	0	100	--	--	--	1	100	8.59375	--	--
Benzoic acid	64000	53	0	0	0	--	--	--	5	500	56.22641509	--	--
Benzyl alcohol	2400	65	0	0	0	--	--	--	1	200	17.04615385	--	--
Bis(2-chloro-1-methylethyl) ether	0.63	16	0	0	100	--	--	--	1	1	1	--	--
Bis(2-chloroethoxy)methane	--	65	0	--	--	--	--	--	1	100	8.615384615	--	--
Bis(2-chloroethyl) ether	0.2	65	0	--	--	--	--	--	1	100	8.615384615	--	--
Bis(2-chloroisopropyl) ether	320	53	0	--	--	--	--	--	1	100	10.33962264	--	--
Bis(2-ethylhexyl) phthalate	1.2	65	15.38461538	--	--	1	16	3.5	1	100	9.945454545	MC-1	8/3/1994
Butyl benzyl phthalate	1500	65	1.538461538	0	0	1	1	1	1	100	8.734375	MC-16	5/4/1995
Carbazole	--	12	0	--	--	--	--	--	1	1	1	--	--
Chlorobenzilate	--	--	--	--	--	--	--	--	--	--	--	--	--
Chrysene	0.0124	65	0	0	100	--	--	--	1	100	8.615384615	--	--
Diallate	--	--	--	--	--	--	--	--	--	--	--	--	--
Dibenzo(a,h)anthracene	0.0162	65	0	0	100	--	--	--	1	100	8.615384615	--	--
Dibenzofuran	32	65	0	0	3.076923077	--	--	--	1	100	9.723076923	--	--
Diethyl phthalate	13000	65	0	0	0	--	--	--	1	100	8.615384615	--	--
Dimethyl phthalate	16000	65	0	0	0	--	--	--	1	100	8.615384615	--	--
Di-n-butyl phthalate	1600	65	1.538461538	0	0	1	1	1	1	100	8.734375	MC-2	2/7/1995
Di-n-octyl phthalate	320	65	0	0	0	--	--	--	1	100	8.615384615	--	--
Dinoseb	7	--	--	--	--	--	--	--	--	--	--	--	--

TABLE 10-4

STATISTICAL EVALUATION OF HISTORICAL ANALYTICAL DATA FOR SHALLOW GROUNDWATER
PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Analyte	Preliminary Cleanup Level	pre-2000											
		No. of Samples Analyzed	Percentage of Samples with Detections	Percentage of Samples with Detected Concentration > PCL[1]	Percentage of Samples with Nondetections > PCL[1,2]	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration	Minimum Reporting Limit for Nondetections[3]	Maximum Reporting Limit for Nondetections[4]	Average Reporting Limit for Nondetections[5]	Sample ID of Maximum Detected Concentration	Date of Maximum Detected Concentration
SVOCs (Continued)													
Diphenylamine	400	--	--	--	--	--	--	--	--	--	--	--	--
Ethyl methacrylate	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethyl methanesulfonate	--	--	--	--	--	--	--	--	--	--	--	--	--
Fluoranthene	130	65	0	0	0	--	--	--	1	100	8.615384615	--	--
Fluorene	640	65	1.538461538	0	0	1.3	1.3	1.3	1	100	8.734375	MC-1	11/30/1998
Hexachlorobenzene	0.141	65	0	0	100	--	--	--	1	100	8.8	--	--
Hexachlorobutadiene	0.44	65	0	0	100	--	--	--	1	100	8.615384615	--	--
Hexachlorocyclopentadiene	40	65	0	0	3.076923077	--	--	--	1	100	8.8	--	--
Hexachloroethane	1.4	65	0	0	72.30769231	--	--	--	1	100	8.8	--	--
Hydrazine-1,2-diphenyl	--	12	0	0	0	--	--	--	2	2	2	--	--
Hexachlorophene	--	--	--	--	--	--	--	--	--	--	--	--	--
Hexachloropropene	--	--	--	--	--	--	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	0.02	65	0	0	100	--	--	--	1	100	8.615384615	--	--
Isophorone	8.4	65	1.538461538	0	53.84615385	1	1	1	1	100	8.734375	MC-17	2/7/1995
Isosafrole	--	--	--	--	--	--	--	--	--	--	--	--	--
m-Dinitrobenzene	5.2	--	--	--	--	--	--	--	--	--	--	--	--
Methapyrilene	--	--	--	--	--	--	--	--	--	--	--	--	--
Methyl methacrylate	--	--	--	--	--	--	--	--	--	--	--	--	--
Methyl methanesulfonate	--	--	--	--	--	--	--	--	--	--	--	--	--
Naphthalene	160	303	16.83168317	0	0	1	130	19.57431373	1	100	4.318253968	MC-1	2/15/1994
Nitrobenzene	4	65	0	0	53.84615385	--	--	--	1	100	8.615384615	--	--
N-Nitrosodiethylamine	--	--	--	--	--	--	--	--	--	--	--	--	--
N-Nitrosodimethylamine	--	--	--	--	--	--	--	--	--	--	--	--	--
N-Nitroso-di-n-butylamine	--	--	--	--	--	--	--	--	--	--	--	--	--
N-Nitrosodi-n-propylamine	--	--	--	--	--	--	--	--	--	--	--	--	--
N-Nitrosodiphenylamine	3.3	65	0	0	53.84615385	--	--	--	1	100	8.615384615	--	--
N-Nitrosodipropylamine	0.2	65	1.538461538	1.538461538	98.46153846	14	14	14	1	100	8.734375	MC-12	12/2/1998
N-Nitrosomethylethylamine	--	--	--	--	--	--	--	--	--	--	--	--	--
N-Nitrosomorpholine	--	--	--	--	--	--	--	--	--	--	--	--	--
N-Nitrosopiperidine	--	--	--	--	--	--	--	--	--	--	--	--	--
N-Nitrosopyrrolidine	--	--	--	--	--	--	--	--	--	--	--	--	--
PCNB	--	--	--	--	--	--	--	--	--	--	--	--	--
p-Dimethylaminoazobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--
Pentachlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--
Pentachloroethane	--	--	--	--	--	--	--	--	--	--	--	--	--
Pentachlorophenol	0.95	65	0	0	100	--	--	--	5	500	44	--	--
Phenacetin	--	--	--	--	--	--	--	--	--	--	--	--	--
Phenanthrene	--	65	0	--	--	--	--	--	1	100	8.615384615	--	--
Phenol	4800	303	0.660066007	0	0	3	11	7	1	100	3.979069767	MC-14	5/15/1993
p-Phenylenediamine	--	--	--	--	--	--	--	--	--	--	--	--	--
Pronamide	--	--	--	--	--	--	--	--	--	--	--	--	--
Pyrene	480	65	0	0	0	--	--	--	1	100	8.615384615	--	--
Pyridine	--	--	--	--	--	--	--	--	--	--	--	--	--
Safrole	--	--	--	--	--	--	--	--	--	--	--	--	--
sym-Trinitrobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--

TABLE 10-4

STATISTICAL EVALUATION OF HISTORICAL ANALYTICAL DATA FOR SHALLOW GROUNDWATER

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

		pre-2000											
Analyte	Preliminary Cleanup Level	No. of Samples Analyzed	Percentage of Samples with Detections	Percentage of Samples with Detected Concentration > PCL[1]	Percentage of Samples with Nondetections > PCL[1,2]	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration	Minimum Reporting Limit for Nondetections[3]	Maximum Reporting Limit for Nondetections[4]	Average Reporting Limit for Nondetections[5]	Sample ID of Maximum Detected Concentration	Date of Maximum Detected Concentration
VOCs													
1,1,1,2-Tetrachloroethane	--	--	--	--	--	--	--	--	--	--	--	--	--
1,1,1-Trichloroethane	200	308	37.66233766	10.06493506	0.649350649	1	13000	749.3508621	1	500	9.625	MC-14	5/4/1995
1,1,2,2-Tetrachloroethane	0.17	94	0	0	100	--	--	--	2	40	5.095744681	--	--
1,1,2-Trichloroethane	0.59	94	6.382978723	6.382978723	84.04255319	1	130	26.83333333	0.2	40	2.134090909	MC-16	9/8/1999
1,1,2-Trichlorotrifluoroethane	240000	298	52.01342282	0	0	3	24000	1512.722194	0.98	50	6.258601399	MC-14	12/2/1997
1,1-Dichloro-1,2,2-trifluoroethane	--	279	3.584229391	3.584229391	--	6.94	40.4	133.014	1	1000	18.46096654	MC-14	11/15/1995
1,1-Dichloroethane	313.8074074	308	43.18181818	8.441558442	0.649350649	1	8300	301.7558647	1	500	10.76571429	MC-14	9/8/1999
1,1-Dichloroethene	0.057	308	10.71428571	10.71428571	89.28571429	1.1	130	16.24484848	0.2	500	7.727272727	MC-2	11/10/1994
1,1-Dichloropropene	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3-Trichloropropane	0.5	--	--	--	--	--	--	--	--	--	--	--	--
1,2,4-Trichlorobenzene	35	--	--	--	--	--	--	--	--	--	--	--	--
1,2,4-Trimethylbenzene	400	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Dibromo-3-chloropropane	1	298	0	0	96.6442953	--	--	--	1	1000	20.06711409	--	--
1,2-Dibromoethane	0.981	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichlorobenzene	261.5061728	308	11.03896104	0	0.649350649	1	68	18.18058824	1	500	8.711678832	MC-15	11/15/1995
1,2-Dichloroethane	0.38	308	1.298701299	1.298701299	95.45454545	1	3.87	2.2175	0.2	500	7.657894737	MC-16	6/16/1998
1,2-Dichloropropane	0.5	94	0	0	89.36170213	--	--	--	0.2	40	2.053191489	--	--
1,3,5-Trimethylbenzene	400	--	--	--	--	--	--	--	--	--	--	--	--
1,3-Dichlorobenzene	320	94	3.191489362	0	0	1	2	1.333333333	1	100	3.197802198	MC-2	11/10/1994
1,3-Dichloropropane	--	--	--	--	--	--	--	--	--	--	--	--	--
1,4-Dichlorobenzene	1.8	94	2.127659574	1.063829787	21.27659574	1	4	2.5	1	40	2.163043478	MC-2	11/10/1994
1,4-Dioxane	4												
2,2-Dichloro-1,1,1-trifluoroethane	--	--	--	--	--	--	--	--	--	--	--	--	--
2,2-Dichloropropane	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Butanone	4800	308	4.220779221	0.324675325	0	7.13	7700	619.8030769	5	2500	36.05084746	MC-14	8/26/1993
2-Chloro-1,3-butadiene	160												
2-Chloroethyl vinyl ether	--	84	0	--	--	--	--	--	1	40	2.273809524	--	--
2-Chlorotoluene	160	--	--	--	--	--	--	--	--	--	--	--	--
2-Hexanone	--	94	2.127659574	2.127659574	--	8	18	13	2	50	8.119565217	MC-17	5/4/1995
2-Methylpentane	--	298	2.348993289	2.348993289	--	5.9	17	10.51428571	5	500	12.40549828	MC-2	11/10/1994
3-Methylpentane	--	298	2.013422819	2.013422819	--	5.3	11	7.533333333	5	500	12.38013699	MC-2	11/10/1994
4-Chlorotoluene	--	--	--	--	--	--	--	--	--	--	--	--	--
4-Isopropyltoluene													
4-Methyl-2-pentanone	640	94	3.191489362	0	0	3	62	23.33333333	2	50	7.692307692	MC-14	8/3/1994
Acetone	800	302	10.59602649	0	0.993377483	5.32	550	57.6990625	1.3	2500	30.89740741	MC-2	5/13/1993
Acetonitrile	--	--	--	--	--	--	--	--	--	--	--	--	--
Acrolein	160	--	--	--	--	--	--	--	--	--	--	--	--
Acrylonitrile	1	--	--	--	--	--	--	--	--	--	--	--	--
Allyl chloride	400	--	--	--	--	--	--	--	--	--	--	--	--
Benzene	0.8	308	13.63636364	13.63636364	86.36363636	1	120	10.96666667	1	500	8.584962406	MC-14	9/8/1999
Bromobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--
Bromodichloromethane	0.5	94	0	0	89.36170213	--	--	--	0.2	40	2.053191489	--	--
Bromoform	4.3	94	0	0	9.574468085	--	--	--	1	40	2.138297872	--	--
Bromomethane	11	94	0	0	1.063829787	--	--	--	1	40	2.138297872	--	--
Carbon disulfide	42.40640641	308	2.597402597	0	2.597402597	1.4	22.2	7.5	0.62	500	7.758733333	MC-14	5/20/1997
Carbon tetrachloride	0.140092593	308	1.298701299	1.298701299	98.7012987	9	190	68.75	0.2	500	7.657894737	MC-2	11/10/1994
Chlorobenzene	0.5	308	0.324675325	0.324675325	99.67532468	1	1	1	1	500	7.618892508	MC-16	8/27/1996

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PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

		pre-2000											
Analyte	Preliminary Cleanup Level	No. of Samples Analyzed	Percentage of Samples with Detections	Percentage of Samples with Detected Concentration > PCL^{1}	Percentage of Samples with Nondetections > PCL^{1,2}	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration	Minimum Reporting Limit for Nondetections^{3}	Maximum Reporting Limit for Nondetections^{4}	Average Reporting Limit for Nondetections^{5}	Sample ID of Maximum Detected Concentration	Date of Maximum Detected Concentration
VOCs (Continued)													
Chlorobromomethane	--	11	0	--	--	--	--	--	1	5	1.363636364	--	--
Chloroethane	3.137376879	94	14.89361702	13.82978723	6.382978723	2	2100	245.2857143	1	40	1.9875	MC-14	9/8/1999
Chloroform	0.582432196	308	2.922077922	2.922077922	97.07792208	1	10	3.631111111	1	500	7.799331104	MC-2	11/18/1996
Chloromethane	2.204735883	94	1.063829787	0	9.574468085	1	1	1	1	40	2.150537634	MC-16	5/4/1995
Chloroprene	--	--	--	--	--	--	--	--	--	--	--	--	--
cis-1,2-Dichloroethene	22.2033543	272	43.01470588	22.79411765	0	1	14000	460.4087179	1	10	1.225806452	MC-14	9/8/1999
cis-1,3-Dichloropropene	--	94	0	--	--	--	--	--	1	40	2.138297872	--	--
Dibromochloromethane	0.5	94	0	0	89.36170213	--	--	--	0.2	40	2.053191489	--	--
Dichlorodifluoromethane	1.551794872	94	32.9787234	31.91489362	25.53191489	1	1900	486.1290323	1	40	2.666666667	MC-14	11/8/1994
Dichlorotrifluoroethane	--	9	0	--	--	--	--	--	1	1	1	--	--
Ethyl cyanide	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	384.2539683	308	30.19480519	4.545454545	0.324675325	1.06	1100	137.1150538	1	500	6.729767442	MC-14	5/4/1994
Hexachlorobutadiene	0.44	--	--	--	--	--	--	--	--	--	--	--	--
Isobutyl alcohol	2400	--	--	--	--	--	--	--	--	--	--	--	--
Isopropylbenzene	800	--	--	--	--	--	--	--	--	--	--	--	--
m,p-Xylene	39.09560724	200	32.5	19.5	3	1.1	5400	447.6276923	1	500	9.752592593	MC-14	5/15/1993
m,p-Xylenes	1600												
Methacrylonitrile	1	--	--	--	--	--	--	--	--	--	--	--	--
Methyl iodide	--	--	--	--	--	--	--	--	--	--	--	--	--
Methylcyclopentane	--	298	12.75167785	12.75167785	0	1	50	7.275	1	500	10.03884615	MC-2	11/10/1994
Methylene bromide	48	--	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	4.6	308	16.88311688	16.88311688	75	5	750	55.40961538	0.55	500	11.42140625	MC-2	8/25/1997
Naphthalene	160	94	8.510638298	1.063829787	1.063829787	17	170	64.875	5	240	11.86046512	MC-2	11/10/1994
m-Xylene	--	108	33.33333333	--	--	1	2500	377.3611111	1	10	1.527777778	MC-14	5/4/1994
n-Butylbenzene	61	--	--	--	--	--	--	--	--	--	--	--	--
n-Propylbenzene	--	--	--	--	--	--	--	--	--	--	--	--	--
o-Xylene	16000	272	32.35294118	0	0	1	2500	221.3285227	1	10	1.282608696	MC-14	5/4/1994
p-Xylene	--	108	34.25925926	--	--	1	2300	366.2432432	1	10	1.478873239	MC-14	5/4/1994
p-Cymene	--	--	--	--	--	--	--	--	--	--	--	--	--
sec-Butylbenzene	61	--	--	--	--	--	--	--	--	--	--	--	--
Styrene	1.5	94	1.063829787	1.063829787	21.27659574	6	6	6	1	40	2.150537634	MC-8	8/14/1995
tert-Butylbenzene	61	--	--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene	0.081	308	46.42857143	46.42857143	53.57142857	1	3500	103.4772028	0.2	200	5.811878788	MC-14	5/15/1993
Toluene	640	308	35.71428571	3.896103896	0	2	11000	451.6513636	2	500	8.199494949	MC-14	5/4/1994
trans-1,2-Dichloroethene	19.13459801	308	8.441558442	0.649350649	3.246753247	1	15000	582.2446154	0.58	500	8.183617021	MC-14	9/8/1999
trans-1,3-Dichloropropene	--	94	0	0	0	--	--	--	1	40	2.150537634	--	--
trans-1,4-Dichloro-2-butene	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichloroethene	0.055407407	308	25.64935065	25.64935065	74.35064935	2.2	4400	212.4337975	0.68	500	9.147947598	MC-1	2/7/1995
Trichlorofluoromethane	2400	308	0.974025974	0	0	1	19	7.666666667	1	1000	13.96065574	MC-7	11/16/1993
Vinyl acetate	8000	129	0	0	0	--	--	--	1	50	4.992248062	--	--
Vinyl chloride	0.025	308	12.33766234	12.33766234	87.66233766	1	2600	161.3376316	1	1000	15.47407407	MC-14	9/8/1999

TABLE 10-4

STATISTICAL EVALUATION OF HISTORICAL ANALYTICAL DATA FOR SHALLOW GROUNDWATER

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

		post-2000											
Analyte	Preliminary Cleanup Level	No. of Samples Analyzed	Percentage of Samples with Detections	Percentage of Samples with Detected Concentration > PCL[1]	Percentage of Samples with Nondetections > PCL[1,2]	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration	Minimum Reporting Limit for Nondetections[3]	Maximum Reporting Limit for Nondetections[4]	Average Reporting Limit for Nondetections[5]	Sample ID of Maximum Detected Concentration	Date of Maximum Detected Concentration
Gases													
Ethane	--	414	26	--	--	0.11	179	4.147476636	0.1	10000	60.92065147	MC-14	6/4/2002
Ethene	--	414	31	--	--	0.11	359	38.16813953	0.1	10000	57.25533333	MC-14	8/29/2002
Methane	--	414	97	--	--	0.42	20900	4455.438682	0.3	2	0.8825	MC-15	9/10/2003
Metals													
Antimony	5.6	8	25	0	0	0.1	0.11	0.105	1.7	3.5	2.366666667	MC-14	6/24/2009
Arsenic	0.5	718	97	93	3	0.15	76.8	18.01965136	0.2	1	0.9	MC-14	9/16/2004
Arsenic III	--	53	100	--	--	0.019	64.8	10.63318868	--	--	--	MC-2	9/13/2006
Arsenic V	--	53	89	--	--	0.372	31.6	5.254617021	0.1	4	1.216666667	MC-16	9/13/2006
Barium	1000	105	100	1	0	4.7	1010	80.85247619	--	--	--	MC-SM3	9/21/2007
Beryllium	4	95	3	0	0	0.009	0.31	0.11	0.1	1	0.95326087	MC-14	3/6/2001
Cadmium	0.25	105	83	17	5	0.005	2.76	0.19062069	0.005	0.4	0.101666667	MC-SM2	9/21/2007
Calcium	--	54	100	--	--	4030	164000	26832.03704	--	--	--	MC-14	12/19/2006
Chromium	50	112	40	1	0	0.13	57.9	4.430222222	0.05	2.96	0.646567164	MC-SM3	9/21/2007
Chromium (hexavalent)	--	--	--	--	--	--	--	--	--	--	--	--	--
Cobalt	730	75	97	0	0	0.058	43.7	4.350082192	1.1	1.4	1.25	MC-SM3	9/21/2007
Copper	3.5	112	73	28	7	0.12	117	7.695243902	0.1	11.8	3.120333333	MC-SM3	9/21/2007
Cyanide	10	6	0	0	0	--	--	--	5	10	7.5	--	--
Ferric iron	--	9	89	--	--	1170	55500	18375	1000	1000	1000	MC-20	3/7/2001
Ferrous iron	--	80	65	--	--	1000	34700	5239.615385	1000	1900	1032.142857	GP-43	9/24/2001
Iron	300	247	94	89	1	7	101000	11502.27468	100	486	153.2857143	MC-SM3	9/21/2007
Lead	0.54	12	50	33	33	0.041	13.6	6.087833333	0.02	3.1	1.723333333	MC-14	3/6/2001
Magnesium	--	121	100	--	--	614	100000	14144.12397	--	--	--	MC-SM3	9/21/2007
Manganese	50	187	94	86	5	1.8	15400	1991.940511	10	100	91.81818182	MC-14	6/6/2000
Mercury	0.2	21	5	0	0	0.04	0.04	0.04	0.02	0.2	0.084	MC-SM1	10/25/2007
Nickel	49	105	86	17	0	0.35	190	31.70066667	0.2	2.3	0.636	MC-14	3/6/2001
Potassium	--	151	97	--	--	600	12400	2478.231293	800	900	825	MC-SM3	9/21/2007
Selenium	5	8	13	0	0	0.3	0.3	0.3	0.3	4.3	3.042857143	MC-14	6/24/2009
Silver	0.32	105	33	3	5	0.006	0.68	0.087028571	0.004	1.1	0.061614286	MC-14	3/6/2001
Sodium	--	121	100	--	--	990	47600	8362.231405	--	--	--	MC-SM3	9/21/2007
Sulfide	--	9	0	--	--	--	--	--	4	4	4	--	--
Thallium	0.24	8	0	0	75	--	--	--	0.005	6.9	3.28875	--	--
Tin	--	8	25	--	--	0.022	0.024	0.023	2.3	4.7	3.466666667	MC-14	6/24/2009
Total inorganic arsenic	--	28	100	--	--	1.05	39	8.267142857	--	--	--	MC-14	12/19/2006
Vanadium	110	105	99	1	0	0.15	125	5.456875	1.1	1.1	1.1	MC-SM3	9/21/2007
Zinc	32	105	61	13	0	1.7	260	29.1921875	0.5	9.9	2.490487805	MC-SM2	9/21/2007
Pesticides/PCBs													
4,4'-DDD	0.00047	6	0	0	83	--	--	--	0.00021	0.5	0.150035	--	--
4,4'-DDE	0.0005	6	0	0	83	--	--	--	0.0005	0.5	0.150083333	--	--
4,4'-DDT	0.00047	6	0	0	83	--	--	--	0.00017	0.5	0.150028333	--	--
Aldrin	0.0005	6	0	0	83	--	--	--	0.00011	0.5	0.125018333	--	--
alpha-BHC	0.0026	6	0	0	83	--	--	--	0.00021	0.5	0.125035	--	--
alpha-Chlordane	--	6	0	--	--	--	--	--	0.00027	0.5	0.125045	--	--
Aroclor 1016	--	6	0	--	--	--	--	--	0.0041	1	0.750683333	--	--
Aroclor 1221	--	6	0	--	--	--	--	--	0.0041	2	1.334016667	--	--
Aroclor 1232	--	6	0	--	--	--	--	--	0.0041	1	0.750683333	--	--
Aroclor 1242	--	6	0	--	--	--	--	--	0.0041	1	0.750683333	--	--
Aroclor 1248	--	6	0	--	--	--	--	--	0.0041	1	0.750683333	--	--
Aroclor 1254	--	6	0	--	--	--	--	--	0.0041	1	0.750683333	--	--
Aroclor 1260	--	6	0	--	--	--	--	--	0.0041	1	0.750683333	--	--

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PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Analyte	Preliminary Cleanup Level	post-2000											
		No. of Samples Analyzed	Percentage of Samples with Detections	Percentage of Samples with Detected Concentration > PCL[1]	Percentage of Samples with Nondetections > PCL[1,2]	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration	Minimum Reporting Limit for Nondetections[3]	Maximum Reporting Limit for Nondetections[4]	Average Reporting Limit for Nondetections[5]	Sample ID of Maximum Detected Concentration	Date of Maximum Detected Concentration
Pesticides/PCBs (Continued)													
beta-BHC	0.0091	6	0	0	83	--	--	--	0.00041	0.5	0.125068333	--	--
Chlordane	0.005	1	0	--	100	--	--	--	1	1	1	--	--
delta-BHC	0.012	6	0	0	83	--	--	--	0.00014	0.5	0.125023333	--	--
Dieldrin	0.0005	6	0	0	83	--	--	--	0.00037	0.5	0.150061667	--	--
Endosulfan I	--	6	0	--	--	--	--	--	0.00025	0.5	0.125041667	--	--
Endosulfan II	--	6	0	--	--	--	--	--	0.00061	0.5	0.150101667	--	--
Endosulfan sulfate	--	6	0	--	--	--	--	--	0.00028	0.5	0.150046667	--	--
Endrin	0.0023	6	0	0	83	--	--	--	0.00049	0.5	0.150081667	--	--
Endrin aldehyde	--	6	0	--	--	--	--	--	0.0005	0.5	0.150083333	--	--
Endrin ketone	--	2	0	--	--	--	--	--	0.00032	0.1	0.05016	--	--
gamma-Chlordane	--	6	0	--	--	--	--	--	0.00031	0.5	0.125051667	--	--
Heptachlor	0.0005	6	0	0	83	--	--	--	0.00018	0.5	0.12503	--	--
Heptachlor epoxide	0.0005	6	0	0	83	--	--	--	0.00021	0.5	0.125035	--	--
Isodrin	--	4	0	--	--	--	--	--	0.1	0.5	0.2	--	--
Kepone	--	4	0	--	--	--	--	--	0.5	0.5	0.5	--	--
Lindane	0.019	6	0	0	100	--	--	--	0.05	0.5	0.15	--	--
Methoxychlor	0.03	6	0	0	83	--	--	--	0.00028	0.5	0.350046667	--	--
Toxaphene	0.025	6	0	0	83	--	--	--	0.025	5	3.420833333	--	--
SVOCs													
1,2,4,5-Tetrachlorobenzene	--	6	0	--	--	--	--	--	0	41	14	--	--
1,2,4-Trichlorobenzene	35	50	0	0	2	--	--	--	0.016	41	1.67442	--	--
1,2-Dichlorobenzene	261.5061728	50	12	0	0	0.043	1	0.3155	0.022	41	1.681045455	MC-21	8/29/2002
1,3-Dichlorobenzene	320	50	18	0	0	0.078	0.87	0.363444444	0.021	41	2.032756098	PZU-4	10/24/2007
1,4-Dichlorobenzene	1.8	50	2	0	10	0.11	0.11	0.11	0.029	41	1.716244898	GP-101	10/2/2007
1,4-Dioxane	4	429	24	15	0.47	0.18	546	60.07038095	0.16	10	0.666141975	MC-14	6/10/2003
1,4-Naphthoquinone	--	6	0	--	--	--	--	--	0.41	41	13.56833333	--	--
1-Methylnaphthalene	2.4	7	14	0	0	0.0061	0.0061	0.0061	0.0035	0.0035	0.0035	PZU-5	6/10/2008
1-Naphthylamine	--	6	0	--	--	--	--	--	0	41	13.5	--	--
2,3,4,6-Tetrachlorophenol	--	6	0	--	--	--	--	--	1.1	41	13.68333333	--	--
2,4,5-Trichlorophenol	800	50	0	0	0	--	--	--	0.031	100	3.52684	--	--
2,4,6-Trichlorophenol	1.4	50	0	0	10	--	--	--	0.058	41	2.36086	--	--
2,4-Dichlorophenol	24	50	6	0	2	0.051	0.1	0.068666667	0.047	41	1.843744681	GP-112	9/4/2008
2,4-Dimethylphenol	160	33	0	0	0	--	--	--	0.52	41	4.649090909	--	--
2,4-Dinitrophenol	32	50	0	0	2	--	--	--	0.17	100	4.8052	--	--
2,4-Dinitrotoluene	0.18	50	0	0	26	--	--	--	0.018	41	1.67228	--	--
2,6-Dichlorophenol	--	6	0	--	--	--	--	--	0.93	41	13.655	--	--
2,6-Dinitrotoluene	16	50	0	0	2	--	--	--	0.033	41	1.68684	--	--
2-Chloronaphthalene	640	50	0	0	0	--	--	--	0.041	41	1.69076	--	--
2-Chlorophenol	40	50	0	0	2	--	--	--	0.054	41	1.74196	--	--
2-Methyl-4,6-dinitrophenol	--	38	0	--	--	--	--	--	0.025	4.1	0.494394737	--	--
2-Methylaniline	10	2	0	0	0	--	--	--	10	10	10	--	--
2-Methylnaphthalene	32	43	12	0	2	0.0072	5	1.04104	0.0023	41	1.895405263	MC-21	8/29/2002
2-Methylphenol	400	50	0	0	0	--	--	--	0.11	41	1.7862	--	--
2-Naphthylamine	--	6	0	--	--	--	--	--	2	41	13.83333333	--	--
2-Nitroaniline	--	50	0	--	--	--	--	--	0.024	100	4.09928	--	--
2-Nitrophenol	--	50	0	--	--	--	--	--	0.063	41	1.75132	--	--
2-Picoline	--	6	0	--	--	--	--	--	8.7	41	14.95	--	--
3,3'-Dichlorobenzidine	2	34	0	0	15	--	--	--	0.43	41	3.074705882	--	--
3,3'-Dimethylbenzidine	--	6	0	--	--	--	--	--	10	41	15.33333333	--	--

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Concentrations in micrograms per liter (µg/L)

		post-2000											
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SVOCs (Continued)													
3-Methylcholanthrene	--	6	0	--	--	--	--	--	0.6	41	13.6	--	--
3-Methylphenol	400	3	0	0	0	--	--	--	10	41	20.33333333	--	--
3-Nitroaniline	--	50	0	--	--	--	--	--	0.029	100	4.3239	--	--
4,6-Dinitro2-methylphenol	--	12	0	--	--	--	--	--	0.025	100	16.84791667	--	--
4-Aminobiphenyl	--	6	0	--	--	--	--	--	2.8	41	13.96666667	--	--
4-Bromophenyl phenyl ether	--	50	0	--	--	--	--	--	0.026	41	1.6784	--	--
4-Chloro-3-methylphenol	--	50	0	--	--	--	--	--	0.037	41	1.7357	--	--
4-Chloroaniline	32	34	0	0	3	--	--	--	0.025	41	2.460294118	--	--
4-Chlorophenyl phenyl ether	--	50	0	--	--	--	--	--	0.027	41	1.67936	--	--
4-Methylphenol	40	44	7	0	0	0.18	4	2.46	0.12	10	1.17097561	MC-14	3/6/2001
4-Nitroaniline	--	50	0	--	--	--	--	--	0.019	100	4.34626	--	--
4-Nitrophenol	--	50	0	--	--	--	--	--	0.28	100	4.6094	--	--
4-Nitroquinoline-1-oxide	--	5	0	--	--	--	--	--	20	82	32.4	--	--
5-Nitro-o-toluidine	--	5	0	--	--	--	--	--	10	41	16.2	--	--
7,12-Dimethybenz(a)anthracene	--	5	0	--	--	--	--	--	10	41	16.2	--	--
Acenaphthene	670	43	2	0	0	0.05	0.05	0.05	0.0044	41	1.956852381	GP-101	10/2/2007
Acenaphthylene	--	43	0	--	--	--	--	--	0.0034	41	1.904902326	--	--
Acetamidofluorene	--	5	0	--	--	--	--	--	10	41	16.2	--	--
Acetophenone	800	6	17	0	0	3	3	3	1.2	10	8.24	MC-14	3/6/2001
alpha, alpha-Dimethylphenethylamine	--	2	0	--	--	--	--	--	10	10	10	--	--
Aniline	7.7	6	0	0	83	--	--	--	0.95	41	13.65833333	--	--
Anthracene	4800	43	0	0	0	--	--	--	0.0036	41	1.925874419	--	--
Aramite	--	5	0	--	--	--	--	--	20	82	32.4	--	--
Azobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzidine	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(a)anthracene	0.02	43	9	2	16	0.0036	0.035	0.012	0.0026	41	2.119246154	GP-113	9/3/2008
Benzo(a)pyrene	0.0158	43	0	0	67	--	--	--	0.0043	41	1.931195349	--	--
Benzo(b)fluoranthene	0.0194	43	5	0	33	0.0025	0.0046	0.00355	0.0023	41	2.016229268	MC-123	12/18/2007
Benzo(g,h,i)perylene	--	43	14	--	--	0.0035	0.032	0.009516667	0.0029	41	2.245127027	PZU-5	3/10/2008
Benzo(k)fluoranthene	0.0134	43	2	0	67	0.0035	0.0035	0.0035	0.0025	41	1.98077619	MC-123	12/18/2007
Benzoic acid	64000	50	6	0	0	1.8	14	7.933333333	1.1	26	4.063829787	MC-123	10/23/2007
Benzyl alcohol	2400	50	10	0	0	0.076	0.11	0.093	0.073	41	2.665911111	GP-101	10/2/2007
Bis(2-chloro-1-methylethyl) ether	0.63	--	--	--	--	--	--	--	--	--	--	--	--
Bis(2-chloroethoxy)methane	--	50	0	--	--	--	--	--	0.024	41	1.67708	--	--
Bis(2-chloroethyl) ether	0.2	50	0	0	14	--	--	--	0.035	41	1.930186047	--	--
Bis(2-chloroisopropyl) ether	320	50	0	0	0	--	--	--	0.026	41	1.921162791	--	--
Bis(2-ethylhexyl) phthalate	1.2	50	44	9	7	0.16	6	0.88	0.13	41	2.46875	GP-94	10/4/2007
Butyl benzyl phthalate	1500	50	14	0	0	0.031	0.058	0.044	0.018	41	1.972511628	GP-92	10/3/2007
Carbazole	--	7	0	--	--	--	--	--	0.0045	0.0047	0.004528571	--	--
Chlorobenzilate	--	6	0	--	--	--	--	--	0.87	41	13.645	--	--
Chrysene	0.0124	43	7	2	65	0.0036	0.033	0.0136	0.0034	41	2.08105	GP-113	9/3/2008
Diallate	--	5	0	--	--	--	--	--	10	41	16.2	--	--
Dibenzo(a,h)anthracene	0.0162	43	2	0	67	0.0035	0.0035	0.0035	0.0025	41	1.975609524	MC-123	12/18/2007
Dibenzofuran	32	43	2	0	2	0.025	0.025	0.025	0.0046	41	1.955538095	GP-101	10/2/2007
Diethyl phthalate	13000	49	2	0	0	0.49	0.49	0.49	0.012	41	2.004020833	PZU-5	10/23/2007
Dimethyl phthalate	16000	50	2	0	0	0.042	0.042	0.042	0.021	41	1.707979592	GP-94	10/4/2007
Di-n-butyl phthalate	1600	49	2	0	0	0.47	0.47	0.47	0.064	41	1.799666667	PZU-5	10/23/2007
Di-n-octyl phthalate	320	50	0	0	0	--	--	--	0.018	41	1.6886	--	--
Dinoseb	7	5	0	0	100	--	--	--	50	200	80.2	--	--

TABLE 10-4

STATISTICAL EVALUATION OF HISTORICAL ANALYTICAL DATA FOR SHALLOW GROUNDWATER
PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

		post-2000											
Analyte	Preliminary Cleanup Level	No. of Samples Analyzed	Percentage of Samples with Detections	Percentage of Samples with Detected Concentration > PCL[1]	Percentage of Samples with Nondetections > PCL[1,2]	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration	Minimum Reporting Limit for Nondetections[3]	Maximum Reporting Limit for Nondetections[4]	Average Reporting Limit for Nondetections[5]	Sample ID of Maximum Detected Concentration	Date of Maximum Detected Concentration
SVOCs (Continued)													
Diphenylamine	400	6	0	0	0	--	--	--	0.82	41	13.63666667	--	--
Ethyl methacrylate	--	5	0	--	--	--	--	--	10	41	16.2	--	--
Ethyl methanesulfonate	--	6	0	--	--	--	--	--	0.55	41	13.59166667	--	--
Fluoranthene	130	43	14	0	0	0.0046	0.11	0.028783333	0.0044	41	2.241243243	GP-110	9/2/2008
	640	43	7	0	0	0.0046	0.043	0.017466667	0.0038	41	2.05649	GP-101	10/2/2007
Hexachlorobenzene	0.141	50	0	0	26	--	--	--	0.022	41	1.69076	--	--
Hexachlorobutadiene	0.44	50	0	0	12	--	--	--	0.027	41	1.67996	--	--
Hexachlorocyclopentadiene	40	41	0	0	2	--	--	--	0.19	41	2.330487805	--	--
Hexachloroethane	1.4	50	0	0	10	--	--	--	0.024	41	1.67748	--	--
Hydrazine-1,2-diphenyl	--	--	--	--	--	--	--	--	--	--	--	--	--
Hexachlorophene	--	5	0	--	--	--	--	--	250	1000	402	--	--
Hexachloropropene	--	6	0	--	--	--	--	--	0	41	13.5	--	--
Indeno(1,2,3-cd)pyrene	0.02	43	2	0	51	0.0038	0.0038	0.0038	0.0026	41	1.974621429	MC-123	12/18/2007
Isophorone	8.4	50	2	0	10	0.069	0.069	0.069	0.016	41	1.703510204	MC-SM3	9/21/2007
Isosafrole	--	6	0	--	--	--	--	--	0.93	41	13.655	--	--
m-Dinitrobenzene	5.2	5	0	0	100	--	--	--	10	41	16.2	--	--
Methapyrilene	--	6	0	--	--	--	--	--	10	41	16.5	--	--
Methyl methacrylate	--	5	0	--	--	--	--	--	10	41	16.2	--	--
Methyl methanesulfonate	--	6	0	--	--	--	--	--	0.6	41	13.6	--	--
Naphthalene	160	43	5	0	0	5	6	5.5	0.003	10	0.773639024	MC-14	3/6/2001
Nitrobenzene	4	50	0	0	10	--	--	--	0.028	41	1.69134	--	--
N-Nitrosodiethylamine	--	6	0	--	--	--	--	--	0.8	41	13.63333333	--	--
N-Nitrosodimethylamine	--	6	0	--	--	--	--	--	0.93	41	13.655	--	--
N-Nitroso-di-n-butylamine	--	6	0	--	--	--	--	--	1.2	41	13.7	--	--
N-Nitrosodi-n-propylamine	--	38	0	--	--	--	--	--	0.037	0.96	0.092526316	--	--
N-Nitrosodiphenylamine	3.3	43	0	0	12	--	--	--	0.048	41	1.972813953	--	--
N-Nitrosodipropylamine	0.2	12	0	0	42	--	--	--	0.037	41	6.771583333	--	--
N-Nitrosomethylethylamine	--	6	0	--	--	--	--	--	8.9	41	14.98333333	--	--
N-Nitrosomorpholine	--	6	0	--	--	--	--	--	0.49	41	13.58166667	--	--
N-Nitrosopiperidine	--	6	0	--	--	--	--	--	0.62	200	66.93666667	--	--
N-Nitrosopyrrolidine	--	6	0	--	--	--	--	--	0.76	41	13.62666667	--	--
PCNB	--	5	0	--	--	--	--	--	50	200	80.2	--	--
p-Dimethylaminoazobenzene	--	6	0	--	--	--	--	--	0.6	41	13.6	--	--
Pentachlorobenzene	--	6	0	--	--	--	--	--	0.6	41	13.6	--	--
Pentachloroethane	--	5	0	--	--	--	--	--	10	41	16.2	--	--
Pentachlorophenol	0.95	50	0	0	24	--	--	--	0.34	100	4.5336	--	--
Phenacetin	--	6	0	--	--	--	--	--	0.82	41	13.63666667	--	--
Phenanthrene	--	43	7	--	--	0.007	0.012	0.009566667	0.005	41	2.06356	PZU-5	12/17/2007
Phenol	4800	50	2	0	0	1.6	1.6	1.6	0.063	41	1.945734694	MC-123	10/23/2007
p-Phenylenediamine	--	5	0	--	--	--	--	--	10	41	16.2	--	--
Pronamide	--	5	0	--	--	--	--	--	10	41	16.2	--	--
Pyrene	480	43	19	0	0	0.0041	0.14	0.034075	0.0035	41	2.374614286	GP-110	9/2/2008
Pyridine	--	6	0	--	--	--	--	--	10	41	16	--	--
Safrole	--	6	0	--	--	--	--	--	0.7	41	13.61666667	--	--
sym-Trinitrobenzene	--	5	0	--	--	--	--	--	10	41	16.2	--	--

TABLE 10-4

STATISTICAL EVALUATION OF HISTORICAL ANALYTICAL DATA FOR SHALLOW GROUNDWATER

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

		post-2000											
Analyte	Preliminary Cleanup Level	No. of Samples Analyzed	Percentage of Samples with Detections	Percentage of Samples with Detected Concentration > PCL[1]	Percentage of Samples with Nondetections > PCL[1,2]	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration	Minimum Reporting Limit for Nondetections[3]	Maximum Reporting Limit for Nondetections[4]	Average Reporting Limit for Nondetections[5]	Sample ID of Maximum Detected Concentration	Date of Maximum Detected Concentration
VOCs													
1,1,1,2-Tetrachloroethane	--	133	0	0	7	--	--	--	0.11	5	0.775263158	--	--
1,1,1-Trichloroethane	200	584	25	0	0	0.07	250	13.02075342	0.05	7.4	0.431244292	MC-21	3/15/2000
1,1,2,2-Tetrachloroethane	0.17	124	0	0	99	--	--	--	0.16	10	1.364193548	--	--
1,1,2-Trichloroethane	0.59	133	1	0	98	0.27	0.27	0.27	0.14	10	1.372272727	MC-14	6/6/2000
1,1,2-Trichlorotrifluoroethane	240000	577	21	0	0	0.08	2800	62.93308943	0.079	4	1.041944934	MC-14	6/6/2000
1,1-Dichloro-1,2,2-trifluoroethane	--	284	0	--	--	--	--	--	0.14	5	0.684049296	--	--
1,1-Dichloroethane	313.8074074	584	42	1	0	0.05	1100	24.78349593	0.042	1	0.421195266	MC-14	6/6/2000
1,1-Dichloroethene	0.057	583	19	9	31	0.0056	22	0.625768807	0.0047	5	0.243346624	MC-21	4/17/2000
1,1-Dichloropropene	--	5	0	--	--	--	--	--	0.089	1	0.8178	--	--
1,2,3-Trichlorobenzene	--	5	0	--	--	--	--	--	0.11	1	0.822	--	--
1,2,3-Trichloropropane	0.5	9	0	0	89	--	--	--	0.2	5	2.688888889	--	--
1,2,4-Trichlorobenzene	35	5	0	0	0	--	--	--	0.096	1	0.8192	--	--
1,2,4-Trimethylbenzene	400	5	80	0	0	0.16	70	30.165	1	1	1	MC-21	4/17/2000
1,2-Dibromo-3-chloropropane	1	394	0	0	14	--	--	--	0.0014	25	0.723930964	--	--
1,2-Dibromoethane	0.981	33	0	0	24	--	--	--	0.0017	5	0.734557576	--	--
1,2-Dichlorobenzene	261.5061728	581	17	0	0	0.05	10.7	1.795816327	0.044	5	0.467354037	MC-21	6/6/2002
1,2-Dichloroethane	0.38	588	1	1	40	0.1	700	96.4025	0.073	5	0.331418966	MC-14	3/6/2001
1,2-Dichloropropane	0.5	133	0	0	13	--	--	--	0.095	5	0.775150376	--	--
1,3,5-Trimethylbenzene	400	5	60	0	0	0.69	10.3	5.43	1	1	1	MC-21	4/17/2000
1,3-Dichlorobenzene	320	129	6	0	0	0.11	0.85	0.38	0.5	5	0.628099174	MC-14	12/3/2000
1,3-Dichloropropane	--	5	0	--	--	--	--	--	0.14	1	0.828	--	--
1,4-Dichlorobenzene	1.8	129	7	0	3	0.17	1.1	0.504444444	0.5	5	0.629166667	MC-14	12/3/2000
1,4-Dioxane	4	1	100	100	0	310	310	310	--	--	--	MC-14	6/24/2009
2,2-Dichloro-1,1,1-trifluoroethane	--	169	0	--	--	--	--	--	0.21	1	0.534792899	--	--
2,2-Dichloropropane	--	5	0	--	--	--	--	--	0.06	1	0.812	--	--
2-Butanone	4800	584	2	0	0	1.67	56.1	12.72636364	1.9	100	7.988307155	MC-14	9/12/2000
2-Chloro-1,3-butadiene	160	1	0	0	0	--	--	--	3.6	3.6	3.6	--	--
2-Chloroethyl vinyl ether	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Chlorotoluene	160	5	80	0	0	0.23	3.59	2.015	1	1	1	MC-21	4/17/2000
2-Hexanone	--	133	0	--	--	--	--	--	2.7	100	12.50150376	--	--
2-Methylpentane	--	453	6	--	--	0.27	20	3.23	0.15	5	0.633764706	GP-113	9/3/2008
3-Methylpentane	--	453	7	--	--	0.12	55	6.222333333	0.12	5	0.611323877	GP-113	9/3/2008
4-Chlorotoluene	--	5	0	--	--	--	--	--	0.13	1	0.826	--	--
4-Isopropyltoluene	--	1	100	--	--	3.3	3.3	3.3	--	--	--	MC-14	6/24/2009
4-Methyl-2-pentanone	640	133	0	0	0	--	--	--	2.6	50	6.410526316	--	--
Acetone	800	584	4	0	0	2.9	62.9	17.0512	2.5	250	14.7039356	MC-14	9/12/2000
Acetonitrile	--	5	0	--	--	--	--	--	6.4	20	17.28	--	--
Acrolein	160	5	0	0	0	--	--	--	0.96	20	16.192	--	--
Acrylonitrile	1	5	0	0	80	--	--	--	0.26	5	4.052	--	--
Allyl chloride	400	4	0	0	0	--	--	--	10	10	10	--	--
Benzene	0.8	584	14	9	1	0.04	13.9	3.104125	0.038	5	0.350125	MC-14	6/6/2000
Bromobenzene	--	5	0	--	--	--	--	--	0.12	1	0.824	--	--
Bromodichloromethane	0.5	133	0	0	13	--	--	--	0.091	5	0.775120301	--	--
Bromoform	4.3	133	0	0	6	--	--	--	0.16	10	1.264360902	--	--
Bromomethane	11	133	1	0	5	3	3	3	0.09	50	6.667348485	MC-1	3/6/2001
Carbon disulfide	42.40640641	584	1	0	1	0.22	0.33	0.273333333	0.045	100	3.362900172	MC-122	10/23/2007
Carbon tetrachloride	0.140092593	584	1	0	40	0.061	0.062	0.0618	0.05	5	0.32570639	MC-17	3/25/2004
Chlorobenzene	0.5	584	1	0	19	0.06	0.21	0.136	0.045	5	0.470233161	GP-101	10/2/2007

TABLE 10-4

STATISTICAL EVALUATION OF HISTORICAL ANALYTICAL DATA FOR SHALLOW GROUNDWATER

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

		post-2000										
Analyte	**Preliminary Cleanup Level**	**No. of Samples Analyzed**	**Percentage of Samples with Detections**	**Percentage of Samples with Detected Concentration > PCL[1]**	**Percentage of Samples with Nondetections > PCL[1,2]**	**Minimum Detected Concentration**	**Maximum Detected Concentration**	**Average Detected Concentration**	**Minimum Reporting Limit for Nondetections[3]**	**Maximum Reporting Limit for Nondetections[4]**	**Average Reporting Limit for Nondetections[5]**	**Sample ID of Maximum Detected Concentration**	**Date of Maximum Detected Concentration**
VOCs (Continued)													
Chlorobromomethane	--	4	0	--	--	--	--	--	1	1	1	--	--
Chloroethane	3.137376879	572	19	13	0	0.14	460	34.78388889	0.13	10	0.619396552	MC-14	6/15/2004
Chloroform	0.582432196	584	1	0	19	0.05	0.24	0.135	0.042	5	0.468713793	MC-123	12/19/2006
Chloromethane	2.204735883	572	2	0	40	0.06	0.47	0.155384615	0.053	50	2.612057245	MC-24	9/24/2008
Chloroprene	--	4	0	--	--	--	--	--	5	5	5	--	--
cis-1,2-Dichloroethene	22.2033543	581	39	4	0	0.05	1480	33.93208889	0.045	1	0.444258427	MC-14	6/6/2000
cis-1,3-Dichloropropene	--	133	0	--	--	--	--	--	0.18	5	0.775789474	--	--
Dibromochloromethane	0.5	133	0	0	99	--	--	--	0.14	10	1.369473684	--	--
Dichlorodifluoromethane	1.551794872	572	2	2	22	0.65	135	22.00916667	0.083	50	1.784832143	MC-14	12/3/2000
Dichlorotrifluoroethane	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethyl cyanide	--	4	0	--	--	--	--	--	50	50	50	--	--
Ethylbenzene	384.2539683	584	23	0	0	0.06	118	8.468106061	0.042	5	0.418411504	MC-21	6/6/2002
Hexachlorobutadiene	0.44	5	0	0	80	--	--	--	0.11	2	1.622	--	--
Isobutyl alcohol	2400	5	0	0	0	--	--	--	0	100	80	--	--
Isopropylbenzene	800	5	80	0	0	0.19	7.12	3.3125	1	1	1	MC-21	4/17/2000
m,p-Xylene	39.09560724	584	23	6	0	0.08	618	36.69084615	0.078	5	0.887156322	MC-21	6/6/2002
m,p-Xylenes	1600	19	11	0	0	1.4	7.9	4.65	0.5	0.5	0.5	MC-14	3/13/2008
Methacrylonitrile	1	5	0	0	80	--	--	--	0.32	10	8.064	--	--
Methyl iodide	--	4	0	--	--	--	--	--	5	5	5	--	--
Methylcyclopentane	--	453	11	--	--	0.13	120	8.448979592	0.13	5	0.627821782	GP-113	9/3/2008
Methylene bromide	48	132	0	0	0	--	--	--	0.5	5	0.78030303	--	--
Methylene chloride	4.6	584	2	0	48	0.24	11	2.116428571	0.17	50	3.049894737	MC-14	3/6/2001
Naphthalene	160	129	22	0	0	0.11	18.4	8.357586207	1	20	1.99	MC-14	9/12/2000
m-Xylene	--					--	--	--	--	--	--	--	--
n-Butylbenzene	61	5	40	0	0	1.42	3.86	2.64	0.42	1	0.806666667	MC-21	4/17/2000
n-Propylbenzene	--	5	40	--	--	7.49	15.4	11.445	0.53	1	0.843333333	MC-21	4/17/2000
o-Xylene	16000	457	21	0	0	0.04	359	19.3609375	0.037	1	0.445905817	MC-21	6/6/2002
p-Xylene	--	--	--	--	--	--	--	--	--	--	--	--	--
p-Cymene	--	4	75	--	--	2.55	14.6	9.583333333	1	1	1	MC-14	4/17/2000
sec-Butylbenzene	61	5	60	0	0	0.38	3.92	2.023333333	1	1	1	MC-21	4/17/2000
Styrene	1.5	133	0	0	7	--	--	--	0.12	5	0.775338346	--	--
tert-Butylbenzene	61	5	60	0	0	0.06	0.48	0.276666667	1	1	1	MC-21	4/17/2000
Tetrachloroethene	0.081	584	37	36	51	0.07	156	4.099378505	0.05	5	0.385391892	MC-14	6/6/2000
Toluene	640	584	32	0	0	0.05	84.2	7.122887701	0.048	12.8	0.57143073	MC-14	6/6/2000
trans-1,2-Dichloroethene	19.13459801	581	6	0	0	0.19	3.04	0.909090909	0.048	5	0.436538321	MC-14	6/6/2000
trans-1,3-Dichloropropene	--	133	0	--	--	--	--	--	0.068	5	0.774947368	--	--
trans-1,4-Dichloro-2-butene	--	5	0	--	--	--	--	--	0.35	200	52.07	--	--
Trichloroethene	0.055407407	584	26	26	74	0.07	11.9	1.228344371	0.061	5	0.465311778	MC-14	9/12/2000
Trichlorofluoromethane	2400	584	1	0	0	1.06	8.7	3.743333333	0.086	20	1.029487091	MC-14	12/3/2000
Vinyl acetate	8000	129	0	0	0	--	--	--	0.43	50	6.43744186	--	--
Vinyl chloride	0.025	583	48	41	24	0.0037	227	7.196838351	0.0023	10	0.299042434	MC-14	6/6/2000

Notes
1. PCL values used to perform statistical evaluations are from the 2008 Draft Remedial Investigation Technical Memorandum (Geomatrix, 2008a).
2. Percentage of samples in which constituent was not detected, but the reporting limit exceeded the PCL.
3. Minimum reporting limit for samples in which constituent was not detected.
4. Maximum reporting limit for samples in which constituent was not detected.
5. Average reporting limit for samples in which constituent was not detected.

Abbreviations
-- = not established/not analyzed/not applicable
PCBs = polychlorinated biphenyls
PCL = preliminary cleanup level
SVOCs = semivolatile organic compounds
TPH = total petroleum hydrocarbons
VOCs = volatile organic compounds

TABLE 10-5

STATISTICAL EVALUATION OF HISTORICAL ANALYTICAL DATA FOR THE LOWER AQUIFER

PSC Washougal
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

		pre-2000											
	Preliminary Cleanup Level	**No. of Samples Analyzed**	**Percentage of Samples with Detections**	**Percentage of Samples with Detected Concentration > PCL^{1}**	**Percentage of Samples with Nondetections > PCL^{1,2}**	**Minimum Detected Concentration**	**Maximum Detected Concentration**	**Average Detected Concentration**	**Minimum Reporting Limit for Nondetections^{3}**	**Maximum Reporting Limit for Nondetections^{4}**	**Average Reporting Limit for Nondetections^{5}**	**Sample ID of Maximum Detected Concentration**	**Date of Maximum Detected Concentration**
Gases													
Ethane	--	3	67	0	0	2.44	2.62	2.53	2	2	2	MC-15D	11/30/1999
Ethene	--	3	0	0	0	--	--	--	2	20	8	--	--
Methane	--	3	100	0	0	89.1	1230	477.3666667	--	--	--	MC-118D	12/1/1999
Metals													
Antimony	5.6	5	0	0	100	--	--	--	60	60	60	--	--
Arsenic	0.5	176	10	10	90	0.51	12	1.68	10	10	10	MC-8D	11/15/1995
Arsenic III	--	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic V	--	--	--	--	--	--	--	--	--	--	--	--	--
Barium	1000	176	0	0	0	--	--	--	200	200	200	--	--
Beryllium	4	5	0	0	0	--	--	--	0.01	0.02	0.014	--	--
Cadmium	0.25	5	0	0	100	--	--	--	5	5	5	--	--
Calcium	--	--	--	--	--	--	--	--	--	--	--	--	--
Chromium	50	5	0	0	0	--	--	--	10	10	10	--	--
Chromium (hexavalent)	--	48	0	0	0	--	--	--	10	500	58.33333333	--	--
Cobalt	730	176	0	0	0	--	--	--	50	50	50	--	--
Copper	3.5	56	0	0	100	--	--	--	25	25	25	--	--
Cyanide	10	5	60	60	40	121	1370	833.6666667	24	24	24	MC-12D	9/9/1999
Iron	300	5	80	80	0	1500	7300	3550	100	100	100	MC-118D	12/1/1999
Lead	0.54	3	0	0	100	--	--	--	3	3	3	--	--
Magnesium	--	--	--	--	--	--	--	--	--	--	--	--	--
Manganese	50	5	100	60	0	16	1800	543.8	--	--	--	MC-118D	12/1/1999
Mercury	0.2	2	0	0	0	--	--	--	0.2	0.2	0.2	--	--
Nickel	49	176	1	1	0	55	55	55	40	40	40	MC-13D	8/3/1994
Potassium	--	--	--	--	--	--	--	--	--	--	--	--	--
Selenium	5	5	0	0	0	--	--	--	5	5	5	--	--
Silver	0.32	5	0	0	100	--	--	--	10	10	10	--	--
Sodium	--	5	100	0	0	6400	53700	21820	--	--	--	MC-118D	12/1/1999
Thallium	0.24	5	0	0	100	--	--	--	200	200	200	--	--
Tin	--	--	--	--	--	--	--	--	--	--	--	--	--
Total inorganic arsenic	--	--	--	--	--	--	--	--	--	--	--	--	--
Vanadium	110	--	--	--	--	--	--	--	--	--	--	--	--
Zinc	32	176	7	5	0	29	96	48.75	20	20	20	MC-13D	8/26/1997
SVOCs													
1,2,4,5-Tetrachlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,4-Trichlorobenzene	35	28	0	0	0	--	--	--	1	10	5.821428571	--	--
1,2-Dichlorobenzene	261.5061728	28	0	0	0	--	--	--	1	10	5.821428571	--	--
1,3-Dichlorobenzene	320	28	0	0	0	--	--	--	1	10	5.821428571	--	--
1,4-Dichlorobenzene	1.8	28	0	0	54	--	--	--	1	10	5.821428571	--	--
1,4-Dioxane	4	--	--	--	--	--	--	--	--	--	--	--	--
1,4-Naphthoquinone	--	--	--	--	--	--	--	--	--	--	--	--	--
1-Methylnaphthalene	2.4	--	--	--	--	--	--	--	--	--	--	--	--
1-Naphthylamine	--	--	--	--	--	--	--	--	--	--	--	--	--
2,3,4,6-Tetrachlorophenol	--	--	--	--	--	--	--	--	--	--	--	--	--
2,4,5-Trichlorophenol	800	28	0	0	0	--	--	--	1	10	6	--	--
2,4,6-Trichlorophenol	1.4	28	0	0	71	--	--	--	1	10	6	--	--
2,4-Dimethylphenol	160	126	0	0	0	--	--	--	1	10	3.4976	--	--
2,4-Dichlorophenol	24	28	0	0	0	--	--	--	1	10	6	--	--

TABLE 10-5

STATISTICAL EVALUATION OF HISTORICAL ANALYTICAL DATA FOR THE LOWER AQUIFER
PSC Washougal
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

		pre-2000											
	Preliminary Cleanup Level	No. of Samples Analyzed	Percentage of Samples with Detections	Percentage of Samples with Detected Concentration > PCL[1]	Percentage of Samples with Nondetections > PCL[1,2]	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration	Minimum Reporting Limit for Nondetections[3]	Maximum Reporting Limit for Nondetections[4]	Average Reporting Limit for Nondetections[5]	Sample ID of Maximum Detected Concentration	Date of Maximum Detected Concentration
SVOCs (Continued)													
2,4-Dinitrophenol	32	28	0	0	54	--	--	--	5	50	30	--	--
2,4-Dinitrotoluene	0.18	28	0	0	100	--	--	--	1	10	6	--	--
2,6-Dichlorophenol	--	--	--	--	--	--	--	--	--	--	--	--	--
2,6-Dinitrotoluene	16	28	0	0	0	--	--	--	1	10	6	--	--
2-Chloronaphthalene	640	28	0	0	0	--	--	--	1	10	5.821428571	--	--
2-Chlorophenol	40	28	0	0	0	--	--	--	1	10	5.821428571	--	--
2-Methyl-4,6-dinitrophenol	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	32	126	0	0	0	--	--	--	1	10	3.517741935	--	--
2-Methylphenol	400	126	0	0	0	--	--	--	1	10	3.4976	--	--
2-Naphthylamine	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Nitroaniline	--	28	0	--	--	--	--	--	2	50	27.71428571	--	--
2-Nitrophenol	--	28	0	--	--	--	--	--	1	10	6	--	--
2-Picoline	--	--	--	--	--	--	--	--	--	--	--	--	--
3,3'-Dichlorobenzidine	2	28	0	0	71	--	--	--	1	20	12.78571429	--	--
3,3'-Dimethylbenzidine	--	--	--	--	--	--	--	--	--	--	--	--	--
3-Methylcholanthrene	--	--	--	--	--	--	--	--	--	--	--	--	--
3-Methylphenol	--	--	--	--	--	--	--	--	--	--	--	--	--
3-Nitroaniline	--	28	0	--	--	--	--	--	5	50	29.10714286	--	--
4,6-Dinitro2-methylphenol	--	28	0	0	0	--	--	--	5	50	30	--	--
4-Aminobiphenyl	--	--	--	--	--	--	--	--	--	--	--	--	--
4-Bromophenyl phenyl ether	--	28	0	0	0	--	--	--	1	10	6	--	--
4-Chloro-3-methylphenol	--	28	0	0	0	--	--	--	2	20	11.64285714	--	--
4-Chloroaniline	32	28	0	0	0	--	--	--	1	20	11.46428571	--	--
4-Chlorophenyl phenyl ether	--	28	0	0	0	--	--	--	1	10	5.821428571	--	--
4-Methylphenol	40	28	0	0	0	--	--	--	1	10	5.821428571	--	--
4-Nitroaniline	--	28	0	0	0	--	--	--	2	50	28.57142857	--	--
4-Nitrophenol	--	28	0	0	0	--	--	--	1	50	28.85714286	--	--
4-Nitroquinoline 1-oxide	--	--	--	--	--	--	--	--	--	--	--	--	--
5-Nitro-o-toluidine	--	--	--	--	--	--	--	--	--	--	--	--	--
7,12-Dimethybenz(a)anthracene	--	--	--	--	--	--	--	--	--	--	--	--	--
Acenaphthene	670	28	0	0	0	--	--	--	1	10	5.821428571	--	--
Acenaphthylene	--	28	0	--	--	--	--	--	1	10	5.821428571	--	--
Acetamidofluorene	--	--	--	--	--	--	--	--	--	--	--	--	--
Acetophenone	800	98	0	0	0	--	--	--	1	10	5.709278351	--	--
Aniline	7.7	13	0	0	0	--	--	--	5	5	5	--	--
Anthracene	4800	28	0	0	0	--	--	--	1	10	5.821428571	--	--
Aramite	--	--	--	--	--	--	--	--	--	--	--	--	--
Azobenzene	--	8	0	0	0	--	--	--	1	1	1	--	--
Benzidine	--	13	0	0	0	--	--	--	1	25	10.23076923	--	--
Benzo(a)anthracene	0.02	28	0	0	100	--	--	--	1	10	6.107142857	--	--
Benzo(a)pyrene	0.0158	28	0	0	100	--	--	--	1	10	5.821428571	--	--
Benzo(b)fluoranthene	0.0194	28	0	0	100	--	--	--	1	10	5.821428571	--	--
Benzo(g,h,i)perylene	--	28	0	--	--	--	--	--	1	10	5.821428571	--	--
Benzo(k)fluoranthene	0.0134	28	0	0	100	--	--	--	1	10	5.821428571	--	--
Benzoic acid	64000	24	0	0	0	--	--	--	5	50	37.29166667	--	--
Benzyl alcohol	2400	28	0	0	0	--	--	--	1	20	11.46428571	--	--
bis(2-Chloro-1-methylethyl) ether	0.63	8	0	0	100	--	--	--	1	1	1	--	--

TABLE 10-5

STATISTICAL EVALUATION OF HISTORICAL ANALYTICAL DATA FOR THE LOWER AQUIFER
PSC Washougal
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

		pre-2000											
	Preliminary Cleanup Level	No. of Samples Analyzed	Percentage of Samples with Detections	Percentage of Samples with Detected Concentration > PCL[1]	Percentage of Samples with Nondetections > PCL[1,2]	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration	Minimum Reporting Limit for Nondetections[3]	Maximum Reporting Limit for Nondetections[4]	Average Reporting Limit for Nondetections[5]	Sample ID of Maximum Detected Concentration	Date of Maximum Detected Concentration
SVOCs (Continued)													
bis(2-Chloroethoxy)methane	--	28	0	--	--	--	--	--	1	10	5.821428571	--	--
bis(2-Chloroethyl) ether	0.2	28	0	0	0	--	--	--	1	10	5.821428571	--	--
bis(2-Chloroisopropyl) ether	320	24	0	0	0	--	--	--	1	10	6.625	--	--
bis(2-Ethylhexyl) phthalate	1.2	28	18	0	0	1	44	17.4	1	10	6.608695652	MC-15D	12/1/1998
Butyl benzyl phthalate	1500	28	0	0	0	--	--	--	1	10	5.821428571	--	--
Carbazole	--	5	0	0	0	--	--	--	1	1	1	--	--
Chlorobenzilate	--	--	--	--	--	--	--	--	--	--	--	--	--
Chrysene	0.0124	28	0	0	100	--	--	--	1	10	5.821428571	--	--
Diallate	--	--	--	--	--	--	--	--	--	--	--	--	--
Dibenzo(a,h)anthracene	0.0162	28	0	0	100	--	--	--	1	10	5.821428571	--	--
Dibenzofuran	32	28	0	0	0	--	--	--	1	10	6.964285714	--	--
Diethyl phthalate	13000	28	0	0	0	--	--	--	1	10	5.821428571	--	--
Dimethyl phthalate	16000	28	4	0	0	5.5	5.5	5.5	1	10	6	MC-12D	12/2/1998
Di-n-butyl phthalate	1600	28	4	0	0	1	1	1	1	10	6	MC-13D	2/7/1995
Di-n-octyl phthalate	320	28	0	0	0	--	--	--	1	10	5.821428571	--	--
Dinoseb	7	--	--	--	--	--	--	--	--	--	--	--	--
Diphenylamine	400	--	--	--	--	--	--	--	--	--	--	--	--
Ethyl methacrylate	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethyl methanesulfonate	--	--	--	--	--	--	--	--	--	--	--	--	--
Fluoranthene	130	28	0	0	0	--	--	--	1	10	5.821428571	--	--
Fluorene	640	28	0	0	0	--	--	--	1	10	5.821428571	--	--
Hexachlorobenzene	0.141	28	0	0	100	--	--	--	1	10	6	--	--
Hexachlorobutadiene	0.44	28	0	0	100	--	--	--	1	10	5.821428571	--	--
Hexachlorocyclopentadiene	40	28	0	0	0	--	--	--	1	10	6	--	--
Hexachloroethane	1.4	28	0	0	71	--	--	--	1	10	6	--	--
Hexachlorophene	--	--	--	--	--	--	--	--	--	--	--	--	--
Hexachloropropene	--	--	--	--	--	--	--	--	--	--	--	--	--
Hydrazine-1,2-diphenyl	--	5	0	0	0	--	--	--	2	2	2	--	--
Indeno(1,2,3-cd)pyrene	0.02	28	0	0	100	--	--	--	1	10	5.821428571	--	--
Isophorone	8.4	28	0	0	54	--	--	--	1	10	5.821428571	--	--
Isosafrole	--	--	--	--	--	--	--	--	--	--	--	--	--
m-Dinitrobenzene	5.2	--	--	--	--	--	--	--	--	--	--	--	--
Methapyrilene	--	--	--	--	--	--	--	--	--	--	--	--	--
Methyl methacrylate	--	--	--	--	--	--	--	--	--	--	--	--	--
Methyl methanesulfonate	--	--	--	--	--	--	--	--	--	--	--	--	--
Naphthalene	160	126	3	0	0	2	2	2	1	10	3.559016393	MC-13D	11/16/1995
Nitrobenzene	4	28	0	0	54	--	--	--	1	10	5.821428571	--	--
N-Nitrosodiethylamine	--	--	--	--	--	--	--	--	--	--	--	--	--
N-Nitrosodimethylamine	--	--	--	--	--	--	--	--	--	--	--	--	--
N-Nitroso-di-n-butylamine	--	--	--	--	--	--	--	--	--	--	--	--	--
N-Nitrosodi-n-propylamine	--	--	--	--	--	--	--	--	--	--	--	--	--
N-Nitrosodiphenylamine	3.3	28	0	0	54	--	--	--	1	10	5.821428571	--	--
N-Nitrosodipropylamine	0.2	28	0	0	100	--	--	--	1	10	5.821428571	--	--
N-Nitrosomethylethylamine	--	--	--	--	--	--	--	--	--	--	--	--	--
N-Nitrosomorpholine	--	--	--	--	--	--	--	--	--	--	--	--	--
N-Nitrosopiperidine	--	--	--	--	--	--	--	--	--	--	--	--	--
N-Nitrosopyrrolidine	--	--	--	--	--	--	--	--	--	--	--	--	--

TABLE 10-5

STATISTICAL EVALUATION OF HISTORICAL ANALYTICAL DATA FOR THE LOWER AQUIFER
PSC Washougal
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

		pre-2000												
	Preliminary Cleanup Level	No. of Samples Analyzed	Percentage of Samples with Detections	Percentage of Samples with Detected Concentration > PCL[1]	Percentage of Samples with Nondetections > PCL[1,2]	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration	Minimum Reporting Limit for Nondetections[3]	Maximum Reporting Limit for Nondetections[4]	Average Reporting Limit for Nondetections[5]	Sample ID of Maximum Detected Concentration	Date of Maximum Detected Concentration
SVOCs (Continued)													
PCNB	--	--	--	--	--	--	--	--	--	--	--	--	--
p-Dimethylaminoazobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--
Pentachlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--
Pentachloroethane	--	--	--	--	--	--	--	--	--	--	--	--	--
Pentachlorophenol	0.95	28	0	0	100	--	--	--	5	50	30	--	--
Phenacetin	--	--	--	--	--	--	--	--	--	--	--	--	--
Phenanthrene	--	28	--	--	--	--	--	--	1	10	5.821428571	--	--
Phenol	4800	126	0	0	0	--	--	--	1	10	3.357936508	--	--
p-Phenylenediamine	--	--	--	--	--	--	--	--	--	--	--	--	--
Pronamide	--	--	--	--	--	--	--	--	--	--	--	--	--
Pyrene	480	28	0	0	0	--	--	--	1	10	5.821428571	--	--
Pyridine	--	--	--	--	--	--	--	--	--	--	--	--	--
Safrole	--	--	--	--	--	--	--	--	--	--	--	--	--
sym-Trinitrobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--
VOCs													
1,1,1,2-Tetrachloroethane	--	--	--	--	--	--	--	--	--	--	--	--	--
1,1,1-Trichloroethane	200	127	6	0	0	1	75	18.55875	1	10	1.789915966	MC-12D	5/2/1995
1,1,2,2-Tetrachloroethane	0.17	43	0	0	100	--	--	--	2	30	3.511627907	--	--
1,1,2-Trichloroethane	0.59	43	0	0	81	--	--	--	0.2	10	1.176744186	--	--
1,1,2-Trichlorotrifluoroethane	240000	120	61	0	0	8.9	2500	129.290411	1	50	5.927659574	MC-118D	12/1/1999
1,1-Dichloro-1,2,2-trifluoroethane	--	116	2	--	--	6	11	8.5	1	50	6.166666667	MC-2D	2/29/1996
1,1-Dichloroethane	313.8074074	127	29	0	0	1	290	16.69567568	1	10	2.044444444	MC-118D	9/9/1999
1,1-Dichloroethene	0.057	127	4	4	96	1	74	17	0.2	10	1.718032787	MC-15D	8/15/1995
1,2,3-Trichloropropane	0.5	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Dibromo-3-chloropropane	1	120	0	0	96	--	--	--	1	50	6.916666667	--	--
1,2-Dibromoethane	0.981	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichlorobenzene	261.5061728	127	2	0	0	1	5	3	1	10	1.879032258	MC-15D	2/16/1994
1,2-Dichloroethane	0.38	127	0	0	94	--	--	--	0.2	10	1.68976378	--	--
1,2-Dichloropropane	0.5	43	0	0	81	--	--	--	0.2	10	1.176744186	--	--
1,3-Dichlorobenzene	320	43	0	0	0	--	--	--	1	10	1.674418605	--	--
1,4-Dichlorobenzene	1.8	43	0	0	14	--	--	--	1	10	1.325581395	--	--
2,2-Dichloro-1,1,1-trifluoroethane	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Butanone	4800	127	3	0	0	6.94	20.7	11.915	5	50	8.780487805	MC-15D	2/25/1997
2-Chloroethyl vinyl ether	--	35	0	0	0	--	--	--	1	10	1.4	--	--
2-Hexanone	--	43	0	0	0	--	--	--	2	50	5.714285714	--	--
2-Methylpentane	--	120	0	0	0	--	--	--	1	50	5.662184874	--	--
3-Methylpentane	--	120	0	--	--	--	--	--	1	50	5.623333333	--	--
4-Methyl-2-pentanone	640	43	0	0	0	--	--	--	2	50	5.697674419	--	--
Acetone	800	124	10	0	0	5.04	75.2	23.04153846	1	50	7.663963964	MC-2D	12/3/1997
Acetonitrile	--	--	--	--	--	--	--	--	--	--	--	--	--
Acrolein	160	--	--	--	--	--	--	--	--	--	--	--	--
Acrylonitrile	1	--	--	--	--	--	--	--	--	--	--	--	--
Allyl chloride	400	--	--	--	--	--	--	--	--	--	--	--	--
Benzene	0.8	127	1	1	99	1.1	1.1	1.1	1	10	1.746031746	MC-13D	12/1/1998
Bromodichloromethane	0.5	43	0	0	81	--	--	--	0.2	10	1.176744186	--	--
Bromoform	4.3	43	0	0	2	--	--	--	1	10	1.325581395	--	--

TABLE 10-5

STATISTICAL EVALUATION OF HISTORICAL ANALYTICAL DATA FOR THE LOWER AQUIFER

PSC Washougal
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

		pre-2000										
	Preliminary Cleanup Level	No. of Samples Analyzed	Percentage of Samples with Detections	Percentage of Samples with Detected Concentration > PCL[1]	Percentage of Samples with Nondetections > PCL[1,2]	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration	Minimum Reporting Limit for Nondetections[3]	Maximum Reporting Limit for Nondetections[4]	Average Reporting Limit for Nondetections[5]	Sample ID of Maximum Detected Concentration	Date of Maximum Detected Concentration
VOCs (Continued)													
Bromomethane	11	43	0	0	0	--	--	--	1	10	1.325581395	--	--
Carbon disulfide	42.40640641	127	3	0	0	1.8	29	8.95	1	10	1.764227642	MC-118D	9/9/1999
Carbon tetrachloride	0.140092593	127	2	2	98	2.8	13	7.9	0.2	10	1.7008	MC-12D	5/2/1995
Chlorobenzene	0.5	127	0	0	100	--	--	--	1	10	1.730708661	--	--
Chlorobromomethane	--	4	0	0	0	--	--	--	1	1	1	--	--
Chloroethane	3.137376879	43	2	2	2	4	4	4	1	10	1.333333333	MC-15D	11/8/1994
Chloroform	0.582432196	127	0	0	100	--	--	--	1	10	1.74015748	--	--
Chloromethane	2.204735883	43	0	0	2	--	--	--	1	10	1.325581395	--	--
Chloroprene	--	--	--	--	--	--	--	--	--	--	--	--	--
cis-1,2-Dichloroethene	22.2033543	112	14	4	0	1	280	40.53	1	10	1.197916667	MC-118D	12/1/1999
cis-1,3-Dichloropropene	--	43	0	--	--	--	--	--	1	10	1.325581395	--	--
Dibromochloromethane	0.5	43	0	0	81	--	--	--	0.2	10	1.176744186	--	--
Dichlorodifluoromethane	1.551794872	43	42	40	21	1	930	56.44444444	1	10	2.04	MC-118D	9/9/1999
Ethyl cyanide	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	384.2539683	127	16	0	0	1	6	5.067	1	10	1.788785047	MC-12D	5/2/1995
Isobutyl alcohol	--	--	--	--	--	--	--	--	--	--	--	--	--
m,p-Xylene	39.09560724	83	23	0	0	1	17	5.478947368	1	10	2.075	MC-118D	9/9/1999
Methacrylonitrile	1	--	--	--	--	--	--	--	--	--	--	--	--
Methyl iodide	--	--	--	--	--	--	--	--	--	--	--	--	--
Methylcyclopentane	--	119	5	--	--	1.1	6.6	3.533333333	1	50	2.853982301	MC-2D	5/13/1993
Methylene bromide	--	--	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	4.6	127	17	17	73	5.3	57	19.44761905	0.73	50	5.369150943	MC-2D	8/15/1995
m-Xylene	--	44	25	0	0	1	26	23.63636364	1	10	1.424242424	MC-15D	11/8/1994
Naphthalene	160	43	0	0	0	--	--	--	5	50	6.860465116	--	--
o-Xylene	16000	112	21	0	0	1	49	16.07478261	1	10	1.213483146	MC-15D	11/8/1994
p-Xylene	--	44	25	0	0	1	26	19.81818182	1	10	1.424242424	MC-15D	11/8/1994
Styrene	1.5	43	0	0	14	--	--	--	1	10	1.325581395	--	--
Tetrachloroethene	0.081	127	11	11	89	1	170	18.20714286	0.2	10	1.777876106	MC-118D	12/1/1999
Toluene	640	127	24	0	0	2	24	6.533225806	0.84	20	2.755625	MC-19D	12/2/1999
trans-1,2-Dichloroethene	19.13459801	127	0	0	0	--	--	--	1	10	1.74015748	--	--
trans-1,3-Dichloropropene	--	43	0	0	0	--	--	--	1	10	1.325581395	--	--
trans-1,4-Dichloro-2-butene	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichloroethene	0.055407407	127	9	9	91	2	12	6.713636364	2	20	2.600862069	MC-10D	12/2/1999
Trichlorofluoromethane	2400	127	0	0	0	--	--	--	1	20	2.448818898	--	--
Vinyl acetate	8000	57	0	0	0	--	--	--	1	50	3.280701754	--	--
Vinyl chloride	0.025	127	1	1	99	3	3	3	1	20	2.46031746	MC-15D	11/8/1994

TABLE 10-5

STATISTICAL EVALUATION OF HISTORICAL ANALYTICAL DATA FOR THE LOWER AQUIFER

PSC Washougal
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Analyte	Preliminary Cleanup Level	2000-2009											
		No. of Samples Analyzed	Percentage of Samples with Detections	Percentage of Samples with Detected Concentration > PCL[1]	Percentage of Samples with Nondetections > PCL[1,2]	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration	Minimum Reporting Limit for Nondetections[3]	Maximum Reporting Limit for Nondetections[4]	Average Reporting Limit for Nondetections[5]	Sample ID of Maximum Detected Concentration	Date of Maximum Detected Concentration
Gases													
Ethane	--	253	18	--	--	0.17	190	42.25266667	0.1	10	5.919326923	MC-25D	3/26/2009
Ethene	--	253	13	--	--	0.11	74	3.148125	0.1	10	6.285791855	MC-118D	6/11/2003
Methane	--	253	82	--	--	0.36	9360	1569.532788	0.3	23.9	1.89	MC-118D	3/15/2005
Metals													
Antimony	5.6	2	0	0	0	--	--	--	1.9	2.3	2.1	--	--
Arsenic	0.5	428	92	83	8	0.201	5.82	1.423852792	1	2.3	1.038235294	MC-10D	8/29/2001
Arsenic III	--	30	77	--	--	0.013	4.43	1.156347826	0.009	0.2	0.042285714	MC-118D	3/7/2007
Arsenic V	--	32	94	--	--	0.31	3.77	0.781766667	0.001	0.4	0.2005	MC-118D	9/12/2006
Barium	1000	32	100	0	0	21.4	910	115.5634375	--	--	--	GP-95	10/1/2007
Beryllium	4	42	2	0	0	0.26	0.26	0.26	0.2	1	0.980487805	MC-118D	12/4/2000
Cadmium	0.25	32	72	3	6	0.008	1.34	0.089565217	0.005	0.3	0.080555556	GP-95	10/1/2007
Calcium	--	32	100	--	--	12900	144000	53056.25	--	--	--	MC-12D	9/12/2006
Chromium	50	32	22	3	0	0.88	73.8	13.58142857	0.2	2.26	0.5632	GP-95	10/1/2007
Chromium (hexavalent)	--	--	--	--	--	--	--	--	--	--	--	--	--
Cobalt	730	32	100	0	0	0.089	75.6	8.64671875	--	--	--	GP-95	10/1/2007
Copper	3.5	32	88	34	3	0.157	144	9.722285714	0.1	3.68	1.78	GP-95	10/1/2007
Cyanide	10	2	0	0	0	--	--	--	5	5	5	--	--
Iron	300	45	89	89	0	437	148000	9161.5	100	100	100	GP-95	10/1/2007
Lead	0.54	2	0	0	100	--	--	--	2.1	2.6	2.35	--	--
Magnesium	--	62	100	--	--	6330	106000	33932.90323	--	--	--	GP-95	10/1/2007
Manganese	50	50	98	82	0	1.67	12500	1127.485918	10	10	10	GP-95	10/1/2007
Mercury	0.2	7	0	0	0	--	--	--	0.03	0.1	0.05	--	--
Nickel	49	32	88	3	0	0.19	66.6	12.50071429	0.2	0.2	0.2	GP-95	10/1/2007
Potassium	--	62	100	--	--	2800	15700	6398.870968	--	--	--	GP-95	10/1/2007
Selenium	5	2	0	0	0	--	--	--	2.6	3.3	2.95	--	--
Silver	0.32	32	22	3	6	0.011	0.339	0.069	0.004	1.1	0.09548	GP-95	10/1/2007
Sodium	--	62	100	--	--	7040	28200	15445.32258	--	--	--	MC-118D	9/12/2006
Thallium	0.24	2	0	0	100	--	--	--	3.9	4	3.95	--	--
Tin	--	2	0	--	--	--	--	--	2.6	3.5	3.05	--	--
Total inorganic arsenic	--	16	100	--	--	0.49	5.57	1.5216875	--	--	--	MC-118D	3/7/2007
Vanadium	110	32	97	3	0	0.052	287	14.11003226	0.7	0.7	0.7	GP-95	10/1/2007
Zinc	32	32	41	9	0	2.1	363	46.98461538	0.5	4.8	1.384210526	GP-95	10/1/2007
SVOCs													
1,2,4,5-Tetrachlorobenzene	--	2	0	--	--	--	--	--	10	10	10	--	--
1,2,4-Trichlorobenzene	35	23	0	0	0	--	--	--	0.016	10	0.923	--	--
1,2-Dichlorobenzene	261.5061728	23	0	0	0	--	--	--	0.022	10	0.927173913	--	--
1,3-Dichlorobenzene	320	23	0	0	0	--	--	--	0.021	10	0.926478261	--	--
1,4-Dichlorobenzene	1.8	23	0	0	9	--	--	--	0.029	10	0.932043478	--	--
1,4-Dioxane	4	294	36	25	0	0.19	9.9	5.192990654	0.16	1.22	0.621925134	MC-24D	12/18/2007
1,4-Naphthoquinone	--	2	0	--	--	--	--	--	10	10	10	--	--
1-Methylnaphthalene	2.4	5	0	0	0	--	--	--	0.0035	0.0035	0.0035	--	--
1-Naphthylamine	--	2	0	--	--	--	--	--	10	10	10	--	--
2,3,4,6-Tetrachlorophenol	--	2	0	--	--	--	--	--	10	10	10	--	--
2,4,5-Trichlorophenol	800	23	0	0	0	--	--	--	0.031	26	2.343434783	--	--
2,4,6-Trichlorophenol	1.4	23	0	0	9	--	--	--	0.058	10	1.014478261	--	--
2,4-Dimethylphenol	160	18	0	0	0	--	--	--	2.2	10	3.538888889	--	--
2,4-Dichlorophenol	24	23	0	0	0	--	--	--	0.047	10	1.006782609	--	--

TABLE 10-5

STATISTICAL EVALUATION OF HISTORICAL ANALYTICAL DATA FOR THE LOWER AQUIFER
PSC Washougal
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

		2000-2009											
Analyte	**Preliminary Cleanup Level**	**No. of Samples Analyzed**	**Percentage of Samples with Detections**	**Percentage of Samples with Detected Concentration > PCL[1]**	**Percentage of Samples with Nondetections > PCL[1,2]**	**Minimum Detected Concentration**	**Maximum Detected Concentration**	**Average Detected Concentration**	**Minimum Reporting Limit for Nondetections[3]**	**Maximum Reporting Limit for Nondetections[4]**	**Average Reporting Limit for Nondetections[5]**	**Sample ID of Maximum Detected Concentration**	**Date of Maximum Detected Concentration**
SVOCs (Continued)													
2,4-Dinitrophenol	32	23	0	0	0	--	--	--	0.17	26	3.17173913	--	--
2,4-Dinitrotoluene	0.18	23	0	0	30	--	--	--	0.018	10	0.924391304	--	--
2,6-Dichlorophenol	--	2	0	--	--	--	--	--	10	10	10	--	--
2,6-Dinitrotoluene	16	23	0	0	0	--	--	--	0.033	10	0.934826087	--	--
2-Chloronaphthalene	640	23	0	0	0	--	--	--	0.041	10	0.940434783	--	--
2-Chlorophenol	40	23	0	0	0	--	--	--	0.054	10	1.011695652	--	--
2-Methyl-4,6-dinitrophenol	--	17	0	--	--	--	--	--	0.025	2	0.588411765	--	--
2-Methylnaphthalene	32	18	6	0	0	0.0029	0.0029	0.0029	0.0023	10	1.186805882	MC-24D	6/10/2008
2-Methylphenol	400	23	0	0	0	--	--	--	0.11	10	1.05173913	--	--
2-Naphthylamine	--	2	0	--	--	--	--	--	10	10	10	--	--
2-Nitroaniline	--	23	0	--	--	--	--	--	0.024	26	2.276391304	--	--
2-Nitrophenol	--	23	0	--	--	--	--	--	0.063	10	1.017956522	--	--
2-Picoline	--	2	0	--	--	--	--	--	10	10	10	--	--
3,3'-Dichlorobenzidine	2	18	0	0	11	--	--	--	0.43	10	1.914444444	--	--
3,3'-Dimethylbenzidine	--	2	0	--	--	--	--	--	10	10	10	--	--
3-Methylcholanthrene	--	2	0	--	--	--	--	--	10	10	10	--	--
3-Methylphenol	400	2	0	0	0	--	--	--	10	10	10	--	--
3-Nitroaniline	--	23	0	--	--	--	--	--	0.029	26	2.445086957	--	--
4,6-Dinitro2-methylphenol	--	6	0	--	--	--	--	--	0.025	26	8.516666667	--	--
4-Aminobiphenyl	--	2	0	--	--	--	--	--	10	10	10	--	--
4-Bromophenyl phenyl ether	--	23	0	--	--	--	--	--	0.026	10	0.929956522	--	--
4-Chloro-3-methylphenol	--	23	0	--	--	--	--	--	0.037	10	0.999782609	--	--
4-Chloroaniline	32	18	0	0	0	--	--	--	0.025	10	1.180444444	--	--
4-Chlorophenyl phenyl ether	--	23	0	--	--	--	--	--	0.027	10	0.930652174	--	--
4-Methylphenol	40	18	0	0	0	--	--	--	0.12	10	1.319444444	--	--
4-Nitroaniline	--	23	0	--	--	--	--	--	0.019	26	2.438130435	--	--
4-Nitrophenol	--	23	0	--	--	--	--	--	0.28	26	2.835217391	--	--
4-Nitroquinoline 1-oxide	--	2	0	--	--	--	--	--	20	21	20.5	--	--
5-Nitro-o-toluidine	--	2	0	--	--	--	--	--	10	10	10	--	--
7,12-Dimethybenz(a)anthracene	--	2	0	--	--	--	--	--	10	10	10	--	--
Acenaphthene	670	18	0	0	0	--	--	--	0.0044	10	1.121755556	--	--
Acenaphthylene	--	18	0	--	--	--	--	--	0.0034	10	1.120033333	--	--
Acetamidofluorene	--	2	0	--	--	--	--	--	10	10	10	--	--
Acetophenone	800	2	50	0	0	3	3	3	10	10	10	MC-118D	6/5/2001
Aniline	7.7	2	0	0	100	--	--	--	10	10	10	--	--
Anthracene	4800	18	0	0	0	--	--	--	0.0036	10	1.121133333	--	--
Aramite	--	2	0	--	--	--	--	--	20	21	20.5	--	--
Azobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzidine	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(a)anthracene	0.02	18	0	0	11	--	--	--	0.0026	10	1.119966667	--	--
Benzo(a)pyrene	0.0158	18	0	0	50	--	--	--	0.0043	10	1.122261111	--	--
Benzo(b)fluoranthene	0.0194	18	0	0	33	--	--	--	0.0023	10	1.119705556	--	--
Benzo(g,h,i)perylene	--	18	0	--	--	--	--	--	0.0029	10	1.120227778	--	--
Benzo(k)fluoranthene	0.0134	18	0	0	50	--	--	--	0.0025	10	1.120583333	--	--
Benzoic acid	64000	23	4	0	0	1.3	1.3	1.3	1.1	26	4.263636364	MC-24D	6/10/2008
Benzyl alcohol	2400	23	4	0	0	0.077	0.077	0.077	0.073	10	2.05	MC-14D	10/24/2007
bis(2-Chloro-1-methylethyl) ether	0.63	--	--	--	--	--	--	--	--	--	--	--	--

TABLE 10-5

STATISTICAL EVALUATION OF HISTORICAL ANALYTICAL DATA FOR THE LOWER AQUIFER
PSC Washougal
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

		2000-2009											
Analyte	**Preliminary Cleanup Level**	**No. of Samples Analyzed**	**Percentage of Samples with Detections**	**Percentage of Samples with Detected Concentration > PCL[1]**	**Percentage of Samples with Nondetections > PCL[1,2]**	**Minimum Detected Concentration**	**Maximum Detected Concentration**	**Average Detected Concentration**	**Minimum Reporting Limit for Nondetections[3]**	**Maximum Reporting Limit for Nondetections[4]**	**Average Reporting Limit for Nondetections[5]**	**Sample ID of Maximum Detected Concentration**	**Date of Maximum Detected Concentration**
SVOCs (Continued)													
bis(2-Chloroethoxy)methane	--	23	0	--	--	--	--	--	0.024	10	0.928565217	--	--
bis(2-Chloroethyl) ether	0.2	23	0	0	11	--	--	--	0.035	10	1.142388889	--	--
bis(2-Chloroisopropyl) ether	320	23	0	0	0	--	--	--	0.026	10	1.134388889	--	--
bis(2-Ethylhexyl) phthalate	1.2	23	67	6	6	0.15	13	1.374166667	0.13	10	1.776666667	MC-118D	12/4/2000
Butyl benzyl phthalate	1500	23	4	0	0	0.048	0.048	0.048	0.018	10	0.969272727	MC-14D	6/10/2008
Carbazole	--	5	0	--	--	--	--	--	0.0045	0.0045	0.0045	--	--
Chlorobenzilate	--	2	0	--	--	--	--	--	10	10	10	--	--
Chrysene	0.0124	18	0	0	50	--	--	--	0.0034	10	1.121477778	--	--
Diallate	--	2	0	--	--	--	--	--	10	10	10	--	--
Dibenzo(a,h)anthracene	0.0162	18	6	0	50	0.0031	0.0031	0.0031	0.0025	10	1.185529412	MC-14D	6/10/2008
Dibenzofuran	32	18	0	0	0	--	--	--	0.0046	10	1.120966667	--	--
Diethyl phthalate	13000	23	0	0	0	--	--	--	0.012	10	1.061521739	--	--
Dimethyl phthalate	16000	23	0	0	0	--	--	--	0.021	10	0.926478261	--	--
Di-n-butyl phthalate	1600	23	4	0	0	1	1	1	0.12	10	0.762727273	MC-118D	12/4/2000
Di-n-octyl phthalate	320	23	0	0	0	--	--	--	0.018	10	0.924391304	--	--
Dinoseb	7	2	0	--	100	--	--	--	50	52	51	--	--
Diphenylamine	400	2	0	0	0	--	--	--	10	10	10	--	--
Ethyl methacrylate	--	2	0	--	--	--	--	--	10	10	10	--	--
Ethyl methanesulfonate	--	2	0	--	--	--	--	--	10	10	10	--	--
Fluoranthene	130	18	0	0	0	--	--	--	0.0044	10	1.121088889	--	--
Fluorene	640	18	0	0	0	--	--	--	0.0038	10	1.121566667	--	--
Hexachlorobenzene	0.141	23	0	0	30	--	--	--	0.022	10	0.927173913	--	--
Hexachlorobutadiene	0.44	23	0	0	9	--	--	--	0.027	10	0.930652174	--	--
Hexachlorocyclopentadiene	40	23	0	0	0	--	--	--	0.19	10	1.210434783	--	--
Hexachloroethane	1.4	23	0	0	9	--	--	--	0.024	10	0.928565217	--	--
Hexachlorophene	--	2	0	--	--	--	--	--	250	260	255	--	--
Hexachloropropene	--	2	0	--	--	--	--	--	10	10	10	--	--
Hydrazine-1,2-diphenyl	--	--	--	--	--	--	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	0.02	18	0	0	22	--	--	--	0.0026	10	1.120338889	--	--
Isophorone	8.4	23	0	0	9	--	--	--	0.016	10	0.923	--	--
Isosafrole	--	2	0	--	--	--	--	--	10	10	10	--	--
m-Dinitrobenzene	5.2	2	0	0	100	--	--	--	10	10	10	--	--
Methapyrilene	--	2	0	--	--	--	--	--	10	10	10	--	--
Methyl methacrylate	--	2	0	--	--	--	--	--	10	10	10	--	--
Methyl methanesulfonate	--	2	0	--	--	--	--	--	10	10	10	--	--
Naphthalene	160	18	0	0	0	--	--	--	0.003	10	1.130111111	--	--
Nitrobenzene	4	23	0	0	9	--	--	--	0.028	10	0.931347826	--	--
N-Nitrosodiethylamine	--	2	0	--	--	--	--	--	10	10	10	--	--
N-Nitrosodimethylamine	--	2	0	--	--	--	--	--	10	10	10	--	--
N-Nitroso-di-n-butylamine	--	2	0	--	--	--	--	--	10	10	10	--	--
N-Nitrosodi-n-propylamine	--	17	0	--	--	--	--	--	0.037	0.2	0.083352941	--	--
N-Nitrosodiphenylamine	3.3	18	0	0	11	--	--	--	0.048	10	1.194555556	--	--
N-Nitrosodipropylamine	0.2	6	0	0	33	--	--	--	0.037	10	3.358	--	--
N-Nitrosomethylethylamine	--	2	0	--	--	--	--	--	10	10	10	--	--
N-Nitrosomorpholine	--	2	0	--	--	--	--	--	10	10	10	--	--
N-Nitrosopiperidine	--	2	0	--	--	--	--	--	50	52	51	--	--
N-Nitrosopyrrolidine	--	2	0	--	--	--	--	--	10	10	10	--	--

TABLE 10-5

STATISTICAL EVALUATION OF HISTORICAL ANALYTICAL DATA FOR THE LOWER AQUIFER
PSC Washougal
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Analyte	Preliminary Cleanup Level	2000-2009											
		No. of Samples Analyzed	Percentage of Samples with Detections	Percentage of Samples with Detected Concentration > PCL[1]	Percentage of Samples with Nondetections > PCL[1,2]	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration	Minimum Reporting Limit for Nondetections[3]	Maximum Reporting Limit for Nondetections[4]	Average Reporting Limit for Nondetections[5]	Sample ID of Maximum Detected Concentration	Date of Maximum Detected Concentration
SVOCs (Continued)													
PCNB	--	2	0	--	--	--	--	--	50	52	51	--	--
p-Dimethylaminoazobenzene	--	2	0	--	--	--	--	--	10	10	10	--	--
Pentachlorobenzene	--	2	0	--	--	--	--	--	10	10	10	--	--
Pentachloroethane	--	2	0	--	--	--	--	--	10	10	10	--	--
Pentachlorophenol	0.95	23	0	0	17	--	--	--	0.34	26	2.662608696	--	--
Phenacetin	--	2	0	--	--	--	--	--	10	10	10	--	--
Phenanthrene	--	18	6	--	--	0.005	0.005	0.005	0.005	10	1.187294118	MC-20D	6/10/2008
Phenol	4800	23	0	0	0	--	--	--	0.063	10	1.049173913	--	--
p-Phenylenediamine	--	2	0	--	--	--	--	--	10	10	10	--	--
Pronamide	--	2	0	--	--	--	--	--	10	10	10	--	--
Pyrene	480	18	0	0	0	--	--	--	0.0035	10	1.120527778	--	--
Pyridine	--	2	0	--	--	--	--	--	10	10	10	--	--
Safrole	--	2	0	--	--	--	--	--	10	10	10	--	--
sym-Trinitrobenzene	--	2	0	--	--	--	--	--	10	10	10	--	--
VOCs													
1,1,1,2-Tetrachloroethane	--	66	0	0	15				0.5	25	1.560606061		
1,1,1-Trichloroethane	200	374	2	0	0	0.05	0.75	0.368333333	0.05	25	0.683849315	MC-24D	3/27/2009
1,1,2,2-Tetrachloroethane	0.17	59	0	0	100				1	25	2.711864407		
1,1,2-Trichloroethane	0.59	66	0	0	100				1	25	2.666666667		
1,1,2-Trichlorotrifluoroethane	240000	372	58	0	0	0.1	2240	200.8825806	0.079	20	1.319967742	MC-118D	3/8/2000
1,1-Dichloro-1,2,2-trifluoroethane	--	188	2	0	0	0.58	234	65.0825	0.14	20	0.983804348	MC-118D	3/24/2004
1,1-Dichloroethane	313.8074074	374	37	5	0	0.11	960	102.8027143	0.042	1	0.438162393	MC-25D	9/25/2008
1,1-Dichloroethene	0.057	373	9	6	37	0.01	8	0.62878125	0.0047	25	0.548385337	MC-118D	6/5/2001
1,2,3-Trichloropropane	0.5	2	0	0	100				5	25	15		
1,2-Dibromo-3-chloropropane	1	264	0	0	13				0.0014	100	1.40694697		
1,2-Dibromoethane	0.981	18	0	0	11				0.0017	25	1.671866667		
1,2-Dichlorobenzene	261.5061728	372	0	0	0				0.044	20	0.732854839		
1,2-Dichloroethane	0.38	376	1	1	38	0.25	80	38.3825	0.073	25	0.538322581	MC-118D	12/4/2000
1,2-Dichloropropane	0.5	66	0	0	15				0.5	25	1.560606061		
1,3-Dichlorobenzene	320	64	0	0	0				0.5	10	1.140625		
1,4-Dichlorobenzene	1.8	64	0	0	13				0.5	10	1.140625		
2,2-Dichloro-1,1,1-trifluoroethane	--	120	0	0	0				0.21	5	0.713166667		
2-Butanone	4800	374	0	0	0				1.9	200	12.07245989		
2-Chloroethyl vinyl ether	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Hexanone	--	66	0	0	0				10	200	23.03030303		
2-Methylpentane	--	308	0	0	0	0.26	0.26	0.26	0.15	20	0.883257329	MC-118D2	6/30/2009
3-Methylpentane	--	308	3	0	0	0.15	0.51	0.2675	0.12	20	0.868566667	MC-118D2	12/4/2008
4-Methyl-2-pentanone	640	66	0	0	0				5	100	11.96969697		
Acetone	800	374	1	0	0	3.7	17	10.35	2.5	500	21.36182796	MC-25D	6/26/2009
Acetonitrile	--	2	0	0	0				20	100	60		
Acrolein	160	2	0	0	0				20	100	60		
Acrylonitrile	1	2	0	0	100				5	25	15		
Allyl chloride	400	2	0	0	0				10	50	30		
Benzene	0.8	374	12	4	4	0.04	1.5	0.590869565	0.038	25	0.635091463	MC-24D	3/27/2009
Bromodichloromethane	0.5	66	0	0	15	--	--	--	0.5	25	1.560606061	--	--
Bromoform	4.3	66	0	0	15	--	--	--	0.5	25	2.409090909	--	--

TABLE 10-5

STATISTICAL EVALUATION OF HISTORICAL ANALYTICAL DATA FOR THE LOWER AQUIFER
PSC Washougal
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

		2000-2009											
Analyte	**Preliminary Cleanup Level**	**No. of Samples Analyzed**	**Percentage of Samples with Detections**	**Percentage of Samples with Detected Concentration > PCL[1]**	**Percentage of Samples with Nondetections > PCL[1,2]**	**Minimum Detected Concentration**	**Maximum Detected Concentration**	**Average Detected Concentration**	**Minimum Reporting Limit for Nondetections[3]**	**Maximum Reporting Limit for Nondetections[4]**	**Average Reporting Limit for Nondetections[5]**	**Sample ID of Maximum Detected Concentration**	**Date of Maximum Detected Concentration**
VOCs (Continued)													
Bromomethane	11	66	0	0	14	--	--	--	5	100	11.96969697	--	--
Carbon disulfide	42.40640641	374	2	0	2	0.1	0.82	0.455	0.045	200	5.261763587	MC-26D2	12/3/2008
Carbon tetrachloride	0.140092593	374	1	0	41	0.061	0.064	0.06175	0.05	25	0.541581081	MC-13D	3/23/2004
Chlorobenzene	0.5	374	0	0	23	0.05	0.05	0.05	0.045	25	0.688201072	MC-118D	3/26/2009
Chlorobromomethane	--	--	--	--	--	--	--	--	--	--	--	--	--
Chloroethane	3.137376879	366	2	1	4	0.47	6.4	2.845	0.13	50	1.119777778	MC-25D	12/4/2008
Chloroform	0.582432196	374	0	0	22	--	--	--	0.042	25	0.683735294	--	--
Chloromethane	2.204735883	366	1	0	37	0.06	0.36	0.168	0.053	100	3.380193906	MC-118D	3/26/2009
Chloroprene	--	2	0	--	--	--	--	--	5	25	15	--	--
cis-1,2-Dichloroethene	22.2033543	372	31	15	0	0.08	1300	121.1121053	0.045	1	0.424891473	MC-25D	3/26/2009
cis-1,3-Dichloropropene	--	66	0	--	--	--	--	--	0.5	25	1.560606061	--	--
Dibromochloromethane	0.5	66	0	0	100	--	--	--	1	25	2.666666667	--	--
Dichlorodifluoromethane	1.551794872	366	3	2	19	0.28	510	105.616	0.083	270	3.039474719	MC-118D	6/13/2008
Ethyl cyanide	--	2	0	--	--	--	--	--	50	250	150	--	--
Ethylbenzene	384.2539683	374	4	0	0	0.09	0.65	0.259285714	0.042	25	0.701891667	MC-24D	12/18/2007
Isobutyl alcohol	2400	2	0	0	0	--	--	--	100	500	300	--	--
m,p-Xylene	39.09560724	374	6	0	1	0.16	3.1	0.697727273	0.078	40	1.58283432	MC-118D	3/26/2009
Methacrylonitrile	1	2	0	0	100	--	--	--	10	50	30	--	--
Methyl iodide	--	2	0	--	--	--	--	--	5	25	15	--	--
Methylcyclopentane	--	308	6	--	--	0.21	1.5	0.608823529	0.13	20	0.892989691	MC-118D	6/30/2009
Methylene bromide	48	66	0	0	--	--	--	--	0.5	25	1.560606061	--	--
Methylene chloride	4.6	374	2	0	46	0.55	48	5.967777778	0.17	100	4.511369863	MC-118D	12/4/2000
m-Xylene	--	--	--	--	--	--	--	--	--	--	--	--	--
Naphthalene	160	64	0	0	0	--	--	--	1	40	4.03125	--	--
o-Xylene	16000	308	16	0	0	0.04	26	4.280204082	0.037	20	0.684671815	MC-118D	6/30/2009
p-Xylene	--	--	--	--	--	--	--	--	--	--	--	--	--
Styrene	1.5	66	0	0	15	--	--	--	0.5	25	1.560606061	--	--
Tetrachloroethene	0.081	374	23	22	59	0.059	47.8	11.69535294	0.05	1	0.364747405	MC-118D	3/8/2000
Toluene	640	374	10	0	0	0.05	49	6.52025641	0.048	25	0.746519403	MC-118D	12/4/2008
trans-1,2-Dichloroethene	19.13459801	372	3	0	0	0.06	2	0.685	0.048	10	0.615002762	MC-24D	6/26/2009
trans-1,3-Dichloropropene	--	66	0	--	--	--	--	--	0.5	25	1.560606061	--	--
trans-1,4-Dichloro-2-butene	--	2	0	--	--	--	--	--	20	100	60	--	--
Trichloroethene	0.055407407	374	20	20	80	0.12	6.4	2.194931507	0.061	25	0.684106312	MC-118D	3/8/2000
Trichlorofluoromethane	2400	374	1	0	0	0.35	36.6	12.152	0.086	40	1.614883469	MC-15D	12/4/2003
Vinyl acetate	8000	66	0	0	0	--	--	--	5	100	11.96969697	--	--
Vinyl chloride	0.025	373	29	22	29	0.0026	22	3.227177064	0.0023	50	0.697193561	MC-25D	6/26/2009

Notes
1. PCL values used to perform statistical evaluations are from the 2008 Draft Remedial Investigation Technical Memorandum (Geomatrix, 2008a).
2. Percentage of samples in which constituent was not detected, but the reporting limit exceeded the PCL.
3. Minimum reporting limit for samples in which constituent was not detected.
4. Maximum reporting limit for samples in which constituent was not detected.
5. Average reporting limit for samples in which constituent was not detected.

Abbreviations
-- = not established/not analyzed/not applicable
PCL = preliminary cleanup level
SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds

TABLE 10-6

SOIL SCREENING FOR CONSTITUENTS OF POTENTIAL CONCERN

PSC Washougal Facility
Washougal, Washington

Concentrations in milligrams per kilogram (mg/kg)

Constituent	Frequency of Detection	95% UCL	Screening Level[1]	COPC?[2]
Metals				
Antimony[3]	50%	1.279	5.06	NO
Arsenic	100%	2.13	6	NO
Barium	100%	191	824	NO
Beryllium	58%	0.5207	63	NO
Cadmium	100%	4.12	2.208	YES
Chromium	100%	62.3	27.0	YES
Chromium (total hexavalent)	0%	2	64	NO
Cobalt	100%	12.3	1,900	NO
Copper	100%	166	34	YES
Cyanide	88%	268.665	1.05	YES
Lead	100%	148	108	YES
Manganese	100%	477	1,511	NO
Mercury	66%	1.55	0.04	YES
Nickel	100%	102	64	YES
Selenium	0%	131	0.52	YES
Silver	54%	1.08	0.0544	YES
Thallium	0%	5.21	0.342	YES
Vanadium	100%	77.6	1,000	NO
Zinc	100%	1,820	96	YES
PCBs/Pesticides				
Aroclor 1016	0%	1.072	--	--
Aroclor 1221	0%	1.072	--	--
Aroclor 1232	0%	1.072	--	--
Aroclor 1242	0%	1.072	--	--
Aroclor 1248	0%	1.072	--	--
Aroclor 1254	7%	1.072	--	--
Aroclor 1260	10%	1.072	--	--
Total PCBs	2%	7.504	0.74	YES
4,4'-DDD	13%	0.031	0.001	YES
4,4'-DDE	13%	0.032	0.033	NO
4,4'-DDT	9%	0.056	0.003	YES
Aldrin	3%	0.0089	0.001	YES
alpha-BHC	0%	0.0046	0.36	NO
alpha-Chlordane	9%	0.01	--	--
beta-BHC	7%	0.0053	1.3	NO
delta-BHC	7%	0.0036	0.001	YES
Dieldrin	7%	0.01353	0.005	YES
Endosulfan I	6%	0.0058	3,700	NO
Endosulfan II	4%	0.01	3,700	NO
Endosulfan sulfate	7%	0.009389	--	--
Endrin	1%	0.0067	0.001	YES
Endrin aldehyde	3%	0.01	--	--

TABLE 10-6

SOIL SCREENING FOR CONSTITUENTS OF POTENTIAL CONCERN

PSC Washougal Facility
Washougal, Washington

Concentrations in milligrams per kilogram (mg/kg)

Constituent	Frequency of Detection	95% UCL	Screening Level[1]	COPC?[2]
PCBs/Pesticides (Continued)				
Endrin ketone	3%	0.015	--	--
gamma-Chlordane	7%	0.017	6.5	NO
Heptachlor	1%	0.0037	0.0008	YES
Heptachlor epoxide	7%	0.0054	0.001	YES
Lindane	6%	0.0027	0.001	YES
Methoxychlor	1%	0.0059	0.048	NO
Toxaphene	0%	0.78	0.049	YES
SVOCs				
1,4-Dioxane	3%	0.035	0.016	YES
1-Methylnaphthalene	100%	0.018	0.045	NO
2,4,5-Trichlorophenol	0%	1.1	28.8	NO
2,4,6-Trichlorophenol	0%	1.1	0.016	YES
2,4-Dichlorophenol	1%	1.1	0.167	YES
2,4-Dimethylphenol	0%	1.7	1.31	YES
2,4-Dinitrophenol	0%	5.6	0.2	YES
2,4-Dinitrotoluene	0%	1.1	0.01	YES
2,6-Dinitrotoluene	0%	1.1	0.086	NO
2-Chloronaphthalene	0%	1.1	23,000	TES
2-Chlorophenol	0%	1.1	0.473	NO
2-Methyl-4,6-dinitrophenol	0%	5.6	62	NO
2-Methylnaphthalene	5%	1.7	5.6	NO
2-Methylphenol (o-cresol)	0%	1.7	31,000	NO
2-Nitroaniline	0%	2.2	1,800	NO
2-Nitrophenol	0%	1.1	--	--
3,3'-Dichlorobenzidine	0%	5	0.037	YES
3-Nitroaniline	0%	5.6	82	NO
4-Bromophenyl phenyl ether	1%	1.1	--	--
4-Chloro-3-methylphenol	0%	2.2	--	--
4-Chloroaniline (p-chloroaniline)	0%	2.2	0.17	YES
4-Chlorophenyl phenyl ether	0%	1.1	--	--
4-Methylphenol	3%	1.6	0.199	YES
4-Nitroaniline	0%	5.6	82	NO
4-Nitrophenol	0%	1.1	--	--
Acenaphthene	1%	1.1	68	NO
Acenaphthylene	4%	1.1	--	--
Acetophenone	0%	8.3	3.921	YES
Aniline	0%	5.6	300	NO
Anthracene	3%	1.1	2,230	NO
Azobenzene	0%	1.1	16	NO
Benzidine	0%	1.1	0.2	YES
Benzo(a)anthracene	6%	2.2	0.02	YES
Benzo(a)pyrene	5%	1.1	0.054	YES

TABLE 10-6

SOIL SCREENING FOR CONSTITUENTS OF POTENTIAL CONCERN

PSC Washougal Facility
Washougal, Washington

Concentrations in milligrams per kilogram (mg/kg)

Constituent	Frequency of Detection	95% UCL	Screening Level[1]	COPC?[2]
SVOCs (Continued)				
Benzo(b)fluoranthene	6%	1.1	0.067	YES
Benzo(g,h,i)perylene	7%	1.1	--	--
Benzo(k)fluoranthene	5%	1.1	0.067	YES
Benzoic acid	5%	5.6	256.8	NO
Benzyl alcohol	8%	2.2	10.9	NO
bis(2-Chloroethoxy)methane	0%	1.1	--	--
bis(2-Chloroethyl) ether	0%	1.1	0.001	YES
bis(2-Chloro-1-methylethyl) ether	0%	1.1	7.4	NO
bis(2-Ethylhexyl) phthalate	15%	13	2.7	YES
Butyl benzyl phthalate	11%	1.1	426	NO
Chrysene	6%	1.1	0.022	YES
Dibenzo(a,h)anthracene	0%	1.1	0.21	YES
Dibenzofuran	2%	5.6	5.3	YES
Diethyl phthalate	4%	1.1	73.3	NO
Dimethyl phthalate	18%	2.2	76.8	NO
Di-n-butyl phthalate	15%	1.523	57.6	NO
Di-n-octyl phthalate	3%	1.1	25,000	NO
Fluoranthene	8%	1.1	127.9	NO
Fluorene	3%	1.1	101.0	NO
Hexachlorobenzene	0%	1.1	0.226	YES
Hexachlorobutadiene	0%	1.1	0.477	YES
Hexachlorocyclopentadiene	0%	1.1	160	NO
Hexachloroethane	0%	1.1	0.056	YES
Indeno(1,2,3-cd)pyrene	6%	1.1	0.196	YES
Isophorone	1%	1.1	0.042	YES
Naphthalene	7%	1.7	4.5	NO
Nitrobenzene	1%	1.1	0.026	YES
N-Nitroso-di-n-propylamine	0%	1.1	0.01	YES
N-Nitrosodiphenylamine	0%	1.1	0.099	YES
Pentachlorophenol	2%	5.6	0.15	YES
Phenanthrene	11%	1.1	--	--
Phenol	8%	1.7	22	NO
Pyrene	9%	1.1	654.7	NO
TPH				
Diesel range hydrocarbons	26%	860	2000	NO
Gasoline	17%	120	30	YES
Lube oil range hydrocarbons	21%	3200	2000	YES
VOCs				
1,1,1,2-Tetrachloroethane	0%	0.993	7.3	NO
1,1,1-Trichloroethane	15%	13	1.606	YES
1,1,2,2-Tetrachloroethane	2%	1.7	0.005	YES

TABLE 10-6

SOIL SCREENING FOR CONSTITUENTS OF POTENTIAL CONCERN

PSC Washougal Facility
Washougal, Washington

Concentrations in milligrams per kilogram (mg/kg)

Constituent	Frequency of Detection	95% UCL	Screening Level[1]	COPC?[2]
VOCs (Continued)				
1,1,2-Trichloroethane	2%	1.8	0.005	YES
1,1,2-Trichlorotrifluoroethane	3%	2	10,941	NO
1,1-Dichloro-1,2,2-trifluoroethane	0%	1.655	--	--
1,1-Dichloroethane	11%	0.5	1.7	NO
1,1-Dichloroethene	0%	0.5	0.005	YES
1,1-Dichloropropene	0%	0.331	--	--
1,1-Dichlorotrifluoroethane	0%	0.05	--	--
1,2,3-Trichlorobenzene	2%	0.331	--	--
1,2,3-Trichloropropane	1%	0.331	0.006	YES
1,2,4-Trichlorobenzene	1%	1.1	1.305	NO
1,2,4-Trimethylbenzene	40%	63	23.5	YES
1,2-Dibromo-3-chloropropane	1%	1.655	0.005	YES
1,2-Dibromoethane	0%	0.331	0.073	YES
1,2-Dichlorobenzene	10%	2.88	3.1	NO
1,2-Dichloroethane	0%	0.5	0.005	YES
1,2-Dichloropropane	1%	0.5	0.005	YES
1,3,5-Trimethylbenzene	32%	23	7.2	YES
1,3-Dichlorobenzene	3%	1.1	4.4	NO
1,3-Dichloropropane	0%	0.331	360	NO
1,4-Dichlorobenzene	4%	1.1	0.03	YES
2,2-Dichloro-1,1,1-trifluoroethane	0%	0.02	--	--
2,2-Dichloropropane	0%	0.331	--	--
2-Butanone (methyl ethyl ketone)	5%	10	19.7	NO
2-Chloroethyl vinyl ether	0%	0.331	--	--
2-Chlorotoluene (o-chlorotoluene)	4%	4.4	2.4	YES
2-Hexanone	2%	10	--	--
2-Methylpentane	6%	1.655	--	--
3-Methylpentane	6%	1.655	--	--
4-Chlorotoluene	2%	0.331	--	--
4-Methyl-2-pentanone	1%	87	2.8	YES
Acetone	24%	890	3.2	YES
Acrolein	0%	6.62	0.34	YES
Acrylonitrile	0%	1.655	0.49	YES
Benzene	4%	0.546	0.005	YES
Bromobenzene	1%	0.331	92	NO
Bromochloromethane	0%	0.331	--	--
Bromodichloromethane	0%	0.5	0.005	YES
Bromoform	0%	1	0.029	YES
Bromomethane	0%	5	0.051	YES
Carbon disulfide	18%	10	0.297	YES
Carbon tetrachloride	0%	0.5	0.005	YES
Chlorobenzene	0%	0.5	0.005	YES

TABLE 10-6

SOIL SCREENING FOR CONSTITUENTS OF POTENTIAL CONCERN

PSC Washougal Facility
Washougal, Washington

Concentrations in milligrams per kilogram (mg/kg)

Constituent	Frequency of Detection	95% UCL	Screening Level[1]	COPC?[2]
VOCs (Continued)				
Chloroethane	3%	6.7	0.02	YES
Chloroform	0%	0.5	0.005	YES
Chloromethane	1%	5	0.01	YES
cis-1,2-Dichloroethene	15%	0.593	0.1	YES
cis-1,3-Dichloropropene	0%	0.5	1.8	NO
Dibromochloromethane	0%	1	0.005	YES
Dichlorodifluoromethane	1%	5	0.05	YES
Dichlorotrifluoroethane	0%	0.0036	--	--
Ethyl ether	0%	0.05	1,800	NO
Ethylbenzene	26%	18	3.3	YES
Cumene	24%	3.9	76.2	NO
m,p-Xylenes	35%	78	0.333	YES
Methylcyclopentane	11%	2.02	--	--
Methylene bromide	0%	0.5	230	NO
Methylene chloride	1%	5	0.02	YES
Naphthalene	15%	19.8	4.5	YES
n-Butylbenzene	19%	5.8	240	NO
n-Propylbenzene	31%	12	240	NO
o-Xylene	35%	42	146.9	NO
p-Cymene	26%	3.3	--	--
sec-Butylbenzene	15%	3.6	220	NO
Styrene	2%	1.4	0.034	YES
tert-Butylbenzene	4%	8.1	390	NO
Tetrachloroethene	24%	74	0.003	YES
Toluene	35%	21	4.65	YES
trans-1,2-Dichloroethene	1%	0.5	0.104	YES
trans-1,3-Dichloropropene	0%	0.5	1.8	NO
Trichloroethene	12%	8.4	0.003	YES
Trichlorofluoromethane	0%	2	2,000	NO
Vinyl acetate	0%	5	33	NO
Vinyl chloride	3%	0.5	0.005	YES

Notes

1. Screening levels are from the 2008 Draft Remedial Investigation Technical Memorandum (Geomatrix, 2008a).
2. Constituents were evaluated as COPCs based on criteria described in text.
3. The 95% UCL calculated for antimony using MTCASTAT was greater than the highest detected value in the data set, so the greatest detected value was used.

Abbreviations

-- = not established/not applicable
COPC = chemical of potential concern
PCBs = polychorlinated biphenyls
SVOCs = semivolatile organic compounds
TPH = total petroleum hydrocarbons
UCL = upper confidence limit
VOCs = volatile organic compounds

TABLE 10-7

GROUNDWATER SCREENING FOR CONSTITUENTS OF POTENTIAL CONCERN[1]

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	Frequency of Detection	Minimum Concentration	Maximun Concentration	95% UCL[2]	Screening Level[3]	COPC?[4]
Inorganics						
Ammonia (as nitrogen)	74%	16	2,070	2,070	210	YES
Antimony	0%	1.7	3.5	3.5	5.6	NO
Arsenic	93%	0.09	76.8	11	0.5	YES
Barium	100%	0.08	1,010	178	1,000	NO
Beryllium	1%	0.1	1	1	4	NO
Cadmium	84%	0.005	2.76	0.69557	0.25	YES
Chloride	100%	400	400,000	8,133	230,000	NO
Chromium	40%	0.24	89.5	89.5	50	YES
Cobalt	96%	0.008	75.6	20.7	730	NO
Copper	61%	0.16	144	51.2	3.5	YES
Cyanide	0%	5	10	10	10	YES
Iron	91%	63	148,000	40,616	300	YES
Lead	25%	2.1	13.6	13.6	0.54	YES
Magnesium	100%	2.5	106,000	29,340	--	--
Manganese	93%	1.1	15,400	6,061	50	YES
Mercury	10%	0.03	0.1	0.1	0.2	NO
Nickel	96%	0.07	190	70.7	49	YES
Nitrate (as nitrogen)	45%	0.9	9,800	9,800	10,000	NO
Nitrite (as nitrogen)	4%	3	200	200	1,000	NO
Silver	44%	0.004	1.1	1.1	0.32	YES
Vanadium	93%	0.08	287	56.2	110	NO
Zinc	85%	0.5	363	215	32	YES
Pesticides						
Dimethoate	17%	0.42	0.52	0.52	3.2	NO
SVOCs						
1,4-Dioxane	29%	0.26	546	546	4	YES
2,4,5-Trichlorophenol	0%	0.031	100	100	800	NO
2,4,6-Trichlorophenol	0%	0.058	41	41	1.4	YES
2,4-Dichlorophenol	4%	0.047	41	41	24	YES
2,4-Dimethylphenol	0%	2.2	41	41	160	NO
2,4-Dinitrophenol	0%	0.17	100	100	32	YES
2,4-Dinitrotoluene	0%	0.018	41	41	0.018	YES
2,6-Dinitrotoluene	0%	0.033	41	41	16	YES
2-Chlorophenol	0%	0.054	41	41	40	YES
2-Methyl-4,6-dinitrophenol	0%	0.025	0.05	0.05	--	--
2-Methylphenol (o-cresol)	4%	0.11	41	41	400	NO
2-Nitroaniline	0%	0.024	100	100	--	--
2-Nitrophenol	2%	0.063	41	41	--	--
3,3'-Dichlorobenzidine	0%	0.43	41	41	2	YES
3-Nitroaniline	0%	0.029	100	100	--	--

TABLE 10-7

GROUNDWATER SCREENING FOR CONSTITUENTS OF POTENTIAL CONCERN[1]

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	Frequency of Detection	Minimum Concentration	Maximun Concentration	95% UCL[2]	Screening Level[3]	COPC?[4]
SVOCs (Continued)						
4-Bromophenyl phenyl ether	0%	0.026	41	41	--	--
4-Chloro-3-methylphenol	0%	0.037	41	41	--	--
4-Chloroaniline (p-chloroaniline)	0%	0.025	41	41	32	YES
4-Chlorophenyl phenyl ether	0%	0.027	41	41	--	--
4-Nitroaniline	0%	0.019	100	100	--	--
4-Nitrophenol	0%	0.28	100	100	--	--
Acenaphthene	4%	0.0044	41	41	670	NO
Acenaphthylene	2%	0.0034	41	41	--	--
Acetophenone	29%	3	10	10	800	NO
Aniline	0%	10	41	41	7.7	YES
Anthracene	9%	0.0036	41	41	4,800	NO
Benzo(a)anthracene	2%	0.0026	41	41	0.02	YES
Benzo(a)pyrene	0%	0.0043	41	41	0.0158	YES
Benzo(b)fluoranthene	9%	0.0023	41	41	0.0194	YES
Benzo(g,h,i)perylene	2%	0.0029	41	41	--	--
Benzo(k)fluoranthene	0%	0.0025	41	41	0.0134	YES
Benzoic acid	11%	1.1	26	26	64,000	NO
Benzyl alcohol	16%	0.073	41	41	2,400	NO
bis(2-Chloroethoxy)methane	0%	0.024	41	41	--	--
bis(2-Chloroethyl) ether	0%	0.035	41	41	0.2	YES
bis(2-Chloroisopropyl) ether	0%	0.026	41	41	320	NO
bis(2-Ethylhexyl) phthalate	56%	0.13	41	2.212	1.2	YES
Butyl benzyl phthalate	16%	0.018	41	41	1,500	NO
Chrysene	7%	0.0034	41	41	0.0124	YES
Dibenzo(a,h)anthracene	2%	0.0025	41	41	0.0162	YES
Dibenzofuran	7%	0.0046	41	41	32	YES
Diethyl phthalate	9%	0.012	41	41	13,000	NO
Dimethyl phthalate	9%	0.021	41	41	16,000	NO
Di-n-butyl phthalate	11%	0.23	41	41	1,600	NO
Di-n-octyl phthalate	0%	0.018	41	41	320	NO
Dinoseb	0%	0.5	200	200	7	YES
Fluoranthene	9%	0.0044	41	41	130	NO
Fluorene	9%	0.0038	41	41	640	NO
Hexachlorobenzene	0%	0.022	41	41	0.141	YES
Hexachlorobutadiene	0%	0.027	41	41	0.44	YES
Hexachlorocyclopentadiene	0%	0.19	41	41	40	YES
Indeno(1,2,3-cd)pyrene	9%	0.0026	41	41	0.02	YES
Isophorone	9%	0.016	41	41	8.4	YES
Methylcyclopentane	8%	0.13	20	20	--	--
Nitrobenzene	0%	0.028	41	41	4	YES

TABLE 10-7

GROUNDWATER SCREENING FOR CONSTITUENTS OF POTENTIAL CONCERN[1]

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	Frequency of Detection	Minimum Concentration	Maximun Concentration	95% UCL[2]	Screening Level[3]	COPC?[4]
SVOCs (Continued)						
N-Nitrosodi-n-propylamine	0%	0.037	41	41	0.2	YES
N-Nitrosodiphenylamine	0%	0.048	41	41	3.3	YES
Pentachlorophenol	0%	0.34	100	100	0.95	YES
Phenanthrene	2%	0.005	41	41	--	--
Phenol	11%	0.063	41	41	4,800	NO
Pyrene	9%	0.0035	41	41	480	NO
TPH						
Diesel range hydrocarbons	3%	11	360	360	500	NO
Gasoline	8%	13	5,700	80	800	NO
Lube oil range hydrocarbons	0%	19	720	720	500	YES
VOCs						
1,1,1,2-Tetrachloroethane	0%	0.5	25	25	1.7	YES
1,1,1-Trichloroethane	17%	0.12	250	250	200	YES
1,1,2,2-Tetrachloroethane	0%	1	25	25	0.17	YES
1,1,2-Trichloroethane	1%	0.27	25	25	0.59	YES
1,1,2-Trichlorotrifluoroethane	34%	0.14	3,400	3,400	240,000	NO
1,1-Dichloro-1,2,2-trifluoroethane	1%	0.14	234	234	--	--
1,1-Dichloroethane	41%	0.11	1,100	1,100	314	YES
1,1-Dichloroethene	14%	0.0047	25	25	0.057	YES
1,1-Dichloropropene	0%	1	1	1	--	--
1,2,3-Trichlorobenzene	0%	1	1	1	--	--
1,2,3-Trichloropropane	0%	1	25	25	0.5	YES
1,2,4-Trichlorobenzene	0%	0.016	41	41	35	YES
1,2,4-Trimethylbenzene	75%	0.16	70	70	400	NO
1,2-Dibromo-3-chloropropane	0%	0.0014	100	100	1	YES
1,2-Dibromoethane	0%	0.0017	25	25	0.981	YES
1,2-Dichlorobenzene	11%	0.022	41	41	262	NO
1,2-Dichloroethane	1%	0.1	25	25	0.38	YES
1,2-Dichloroethene (total)	83%	1	700	700	72	YES
1,2-Dichloropropane	0%	0.5	25	25	0.5	YES
1,3,5-Trimethylbenzene	50%	1	10.3	10.3	400	NO
1,3-Dichlorobenzene	4%	0.021	41	41	320	NO
1,3-Dichloropropane	0%	1	1	1	--	--
1,4-Dichlorobenzene	4%	0.029	41	41	1.8	YES
2,2-Dichloro-1,1,1-trifluoroethane	0%	0.49	4.9	4.9	--	--
2,2-Dichloropropane	0%	1	1	1	--	--
2-Butanone	2%	1.67	200	200	4,800	NO
2-Chloronaphthalene	0%	0.041	41	41	640	NO
2-Chlorotoluene	75%	0.23	3.59	3.59	160	NO
2-Hexanone	0%	10	200	200	--	--

TABLE 10-7

GROUNDWATER SCREENING FOR CONSTITUENTS OF POTENTIAL CONCERN[1]

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	Frequency of Detection	Minimum Concentration	Maximun Concentration	95% UCL[2]	Screening Level[3]	COPC?[4]
VOCs (Continued)						
2-Methylnaphthalene	9%	0.0023	41	41	32	YES
2-Methylpentane	4%	0.15	20	20	--	--
3-Methylpentane	5%	0.12	20	20	--	--
4-Chlorotoluene	0%	1	1	1	--	--
4-Methyl-2-pentanone	0%	5	100	100	640	NO
4-Methylphenol	24%	0.12	10	10	40	NO
Acetic acid	20%	250	13,000	13,000	--	--
Acetone	4%	4	500	500	800	NO
Benzene	11%	0.14	25	25	0.8	YES
Bromobenzene	0%	1	1	1	--	--
Bromodichloromethane	0%	0.5	25	25	0.5	YES
Bromoform	0%	0.5	25	25	4.3	YES
Bromomethane	1%	3	100	100	11	YES
Carbon disulfide	1%	0.16	200	200	42.4	NO
Carbon tetrachloride	1%	0.05	25	25	0.14	YES
Chlorobenzene	0%	0.14	25	25	0.5	YES
Chlorobromomethane	0%	1	1	1	--	--
Chloroethane	14%	0.23	460	460	3.14	YES
Chloroform	0%	0.14	25	25	0.582	YES
Chloromethane	1%	0.14	100	100	2.2	YES
cis-1,2-Dichloroethene	34%	0.12	1,480	1,480	22	YES
cis-1,3-Dichloropropene	0%	0.5	25	25	--	--
Dibromochloromethane	0%	1	25	25	0.5	YES
Dichlorodifluoromethane	3%	0.17	270	270	2	YES
Ethylbenzene	17%	0.13	118	118	384	NO
Hexachloroethane	0%	0.024	41	41	1.4	YES
Isopropylbenzene (cumene)	75%	0.19	7.12	7.12	800	NO
m,p-Xylenes	17%	0.22	618	618	39	YES
Methylene bromide	0%	0.5	25	25	48	NO
Methylene chloride	2%	0.2	100	100	4.6	YES
Naphthalene	14%	0.019	40	40	160	NO
n-Butylbenzene	50%	1	3.86	3.86	61	NO
n-Propylbenzene	50%	1	15.4	15.4	--	--
o-Xylene	18%	0.11	359	359	16,000	NO
p-Isopropyltolune (p-cymene)	75%	1	14.6	14.6	--	--
sec-Butylbenzene	50%	1	3.92	3.92	61	NO
Styrene	0%	0.5	25	25	1.5	YES
tert-Butylbenzene	50%	0.29	1	1	61	NO
Tetrachloroethene	31%	0.05	156	156	0.081	YES
Toluene	24%	0.11	2,000	2,000	640	YES

TABLE 10-7

GROUNDWATER SCREENING FOR CONSTITUENTS OF POTENTIAL CONCERN[1]

PSC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	Frequency of Detection	Minimum Concentration	Maximun Concentration	95% UCL[2]	Screening Level[3]	COPC?[4]
VOCs (Continued)						
trans-1,2-Dichloroethene	4%	0.15	10	10	19	NO
trans-1,3-Dichloropropene	0%	0.5	25	25	--	--
Trichloroethene	22%	0.14	25	25	0.055	YES
Trichlorofluoromethane	1%	0.14	40	40	2,400	NO
Vinyl acetate	0%	5	100	100	8,000	NO
Vinyl chloride	37%	0.0023	227	227	0.025	YES

Notes

1. Constituents analyzed only for Appendix IX sampling that were never detected were not included in this screening.
2. If the number of samples was <20, the highest detected value in the data set was used as the UCL.
3. Screening levels are from the 2008 Draft Remedial Investigation Technical Memorandum (Geomatrix, 2008a).
4. Constituents were evaluated as COPCs based on criteria described in text.

Abbreviations

-- = not established/not applicable
COPC = constituent of potential concern
SVOCs = semivolatile organic compounds
TPH = total petroleum hydrocarbons
UCL = upper confidence limit
VOCs = volatile organic compounds

TABLE 10-8

CONSTITUENTS OF CONCERN IN SOIL[1]

PSC Washougal Facility
Washougal, Washington

Metals		PCBs/Pesticides		TPH
Barium	Nickel	Total PCBs	Endrin	Gasoline
Cadmium	Selenium	4,4'-DDD	Heptachlor	Lube oil range hydrocarbons
Chromium	Silver	4,4'-DDT	Heptachlor epoxide	
Copper	Thallium	Aldrin	Lindane	
Cyanide	Vanadium	delta-BHC	Toxaphene	
Lead	Zinc			
Mercury		Dieldrin		
SVOCs				
1,4-Dioxane	2-Chloronaphthalene	Benzo(a)anthracene	Dibenzo(a,h)anthracene	Nitrobenzene
2,4,6-Trichlorophenol	2-Chlorophenol	Benzo(a)pyrene	Dibenzofuran	N-Nitroso-di-n-propylamine
2,4-Dichlorophenol	3,3'-Dichlorobenzidine	Benzo(b)fluoranthene	Hexachlorobenzene	N-Nitrosodiphenylamine
2,4-Dimethylphenol	4-Chloroaniline (p-chloroaniline)	Benzo(k)fluoranthene	Isophorone	Pentachlorophenol
2,4-Dinitrophenol	4-Methylphenol	bis(2-Chloroethyl) ether	Indeno(1,2,3-cd)pyrene	
2,4-Dinitrotoluene	Acetophenone	bis(2-Ethylhexyl) phthalate	Hexachlorobutadiene	
2,6-Dinitrotoluene	Benzidine	Chrysene	Hexachloroethane	
VOCs				
1,1,1-Trichloroethane	1,2-Dichloroethane	Acrylonitrile	Chloroethane	Methylene chloride
1,1,2,2-Tetrachloroethane	1,2-Dichloropropane	Benzene	Chloroform	Styrene
1,1,2-Trichloroethane	1,3,5-Trimethylbenzene	Bromodichloromethane	Chloromethane	Tetrachloroethene
1,1-Dichloroethene	1,4-Dichlorobenzene	Bromoform	cis-1,2-Dichloroethene	Toluene
1,2,3-Trichloropropane	2-Chlorotoluene (o-chlorotoluene)	Bromomethane	Dibromochloromethane	trans-1,2-Dichloroethene
1,2,4-Trimethylbenzene	4-Methyl-2-pentanone	Carbon disulfide	Dichlorodifluoromethane	Trichloroethene
1,2-Dibromo-3-chloropropane	Acetone	Carbon tetrachloride	Ethylbenzene	Vinyl chloride
1,2-Dibromoethane	Acrolein	Chlorobenzene	m,p-Xylenes	

Notes

1. Constituents were evaluated as constituents of concern based on criteria described in text.

Abbreviations

PCBs = polychorlinated biphenyls
SVOCs = semivolatile organic compounds
TPH = total petroleum hydrocarbons
VOCs = volatile organic compounds

TABLE 10-9

CONSTITUENTS OF CONCERN IN GROUNDWATER [1]

PSC Washougal Facility
Washougal, Washington

Inorganics	SVOCs	
Ammonia (as nitrogen)	1,4-Dioxane	bis(2-Chloroethyl) ether
Arsenic	1,4-Dichlorobenzene	bis(2-Ethylhexyl) phthalate
Barium	2,4,6-Trichlorophenol	Chrysene
Cadmium	2,4-Dichlorophenol	Dibenzo(a,h)anthracene
Chromium	2,4-Dinitrophenol	Dibenzofuran
Copper	2,4-Dinitrotoluene	Dinoseb
Cyanide	2,6-Dinitrotoluene	Hexachlorobenzene
Iron	2-Chlorophenol	Hexachlorobutadiene
Lead	3,3'-Dichlorobenzidine	Hexachlorocyclopentadiene
Manganese	4-Chloroaniline (p-chloroaniline)	Indeno(1,2,3-cd)pyrene
Nickel	Aniline	Isophorone
Silver	Benzo(a)anthracene	Nitrobenzene
Vanadium	Benzo(a)pyrene	N-Nitrosodi-n-propylamine
Zinc	Benzo(b)fluoranthene	N-Nitrosodiphenylamine
TPH	Benzo(k)fluoranthene	Pentachlorophenol
Gasoline range hydrocarbons		
Lube oil range hydrocarbons		
	VOCs	
1,1,1,2-Tetrachloroethane	1,4-Dichlorobenzene	Dibromochloromethane
1,1,1-Trichloroethane	2-Methylnaphthalene	Dichlorodifluoromethane
1,1,2,2-Tetrachloroethane	Benzene	Hexachloroethane
1,1,2-Trichloroethane	Bromodichloromethane	m,p-Xylenes
1,1-Dichloroethane	Bromoform	Methylene chloride
1,1-Dichloroethene	Bromomethane	Styrene
1,2,3-Trichloropropane	Carbon disulfide	Tetrachloroethene
1,2,4-Trichlorobenzene	Carbon tetrachloride	Toluene
1,2-Dibromo-3-chloropropane	Chlorobenzene	Trans-1,2,-Dichloroethene
1,2-Dibromoethane	Chloroethane	Trichloroethene
1,2-Dichloroethane	Chloroform	Vinyl chloride
1,2-Dichloroethene (total)	Chloromethane	
1,2-Dichloropropane	cis-1,2-Dichloroethene	

Notes
1. Constituents were evaluated as constituents of concern based on criteria described in text.

Abbreviations
SVOCs = semivolatile organic compounds
TPH = total petroleum hydrocarbons
VOCs = volatile organic compounds

11.0 NATURE AND EXTENT OF CONTAMINATION

The current understanding of the distribution of COCs is evaluated in this section. The nature and extent of soil and groundwater contamination at the site have been investigated extensively from 1986 through the present. Soil data collected since 1996 and groundwater data collected since 2000 were selected for use in the RI (Section 10.0). A more recent data set for groundwater (2004-present) was used to evaluate current nature and extent of groundwater contamination in this section. An even smaller sub-set of data was used for contouring purposes to look at current conditions. Groundwater data from the most recent year of sampling events (the third quarter 2011 through the second quarter 2012) were used to update the analyte concentrations for the contour figures in this section.

The sampling locations for analyses included in the RI/FS data set are shown in Figure 3-4 for soil and Figure 3-6 for groundwater. For clarity the data points shown on Figures 3-4 and 3-6 are keyed to the individual investigation and year during which the samples were collected.

As discussed in Section 10.1, controls on data collection, laboratory analysis, and data quality review were not as stringent for data collected prior to 2000 as for investigations conducted after 2000. Therefore data collected prior to 2000 are viewed as partially usable. The pre-2000 data used in this section are useful in determining the nature and extent but are not of the same quality as data collected later, and are therefore not *fully* usable. A summary of the investigations included as part of the data set is provided below together with an assessment of issues that may limit the full usability of data from that investigation.

- **1996 Silt Layer Investigation:** In 1996, PSC conducted an investigation to determine the depth and continuity of the Silt Layer below the PSC property. A total of 26 direct-push soil borings were completed, and soil samples were collected for chemical analysis from 15 of those direct-push borings (Figure 3-4). The intent of this investigation was primarily to confirm the presence and evaluate the characteristics of the Silt Layer. Boring logs were not completed, so PSC does not have a record of any field observations confirming the absence or presence of potential contamination at these sample locations. Since the Silt Layer is generally saturated, soil samples collected as part of this investigation were collected below the water table and results are likely to reflect constituents present in the groundwater.

- **1997 Interim Action:** In 1997, PSC conducted an interim action to excavate soils from beneath the former tank farm. Soils were excavated to a depth of approximately 6 feet, and confirmation samples were collected to document remaining soil conditions after the excavation was complete. Logging of soils was not completed during the excavation so PSC does not have a record of field observations confirming the absence or presence of potential contamination in different areas of the excavated area. Soil samples collected as part of this excavation are likely to have been at or below the water table based on the depth excavated (6 feet). Soil samples were also collected from several borings near MC-7 and MC-118 at that time. These borings also do not appear to have been logged during completion to record visual observations.

- **1999 Remedial Investigation:** In July 1999, PSC installed five groundwater monitoring wells (three new monitoring wells and two replacements) and advanced nine direct-push soil borings for soil sampling and analysis.

- **1999 RCRA Closure Investigation:** In 1999, PSC collected 32 soil samples beneath the surface pavement and sumps as part of the RCRA Dangerous Waste Management Facility Closure. Surface pavement was cored and samples were collected beneath the pavement before being sent for analysis. Soil was not logged as part of sampling to provide visual or field screening information. All samples were collected at shallow depth, immediately beneath surface pavement.

- **2001 Supplemental Remedial Investigation:** In 2001, PSC collected soil and groundwater samples to further characterize the former tank farm source area. Samples were collected at 32 locations (GP-36 through GP-50, GP-65 through GP-70, and GP-72 through GP-77[A-E]) surrounding the former tank farm and Building 1 (Figure 3-4). Soil samples were collected from the vadose zone, the water table, directly above the Silt Layer, and the top of the Silt Layer. Analysis was focused on the constituents of primary concern that had been identified at the site up to that date. Therefore only VOCs and/or arsenic were analyzed at many locations. PSC did have formal SOPs in place for sample collection, as well as data quality assessment procedures in place for this investigation. The only change in methods used after 2001 was implementation of more stringent soil collection methods for VOCs (utilizing EPA Method 5035). Therefore, these data are viewed as fully usable with the acknowledgement that current sample collection procedures under Method 5035A are a more conservative approach to retaining VOCs in a sample; therefore, the results possibly have a low bias. In addition, these data points are now over 10 years old and constituents prone to natural degradation may have decreased in concentration over the last decade.

- **2007 Data Gaps Investigation:** Geomatrix conducted additional investigative activities during 2007 to address existing data gaps and to evaluate additional issues requested by Ecology that needed to be evaluated prior to completing the RI. Field work included advancing 13 direct push borings to sample soil (GP-91 through GP-103), installation of two Shallow Groundwater Zone monitoring wells (near the former tank farm), installation of two Shallow Groundwater Zone piezometers (northeast of the PSC property across South 32nd Street), installation of four Lower Aquifer groundwater monitoring wells (two near the former tank farm, one east of the warehouse, and one east of South 32nd Street), collection of water and sediment samples from eight catch basins, collection of porewater samples at three locations next to Steigerwald Marsh, and slug tests on 14 groundwater monitoring wells/piezometers. These data included rigorous data quality assessment from collection planning to data validation, and included modern techniques to collect samples that are consistent with current best practices. These data are viewed as fully usable for the analysis completed and aid in putting in perspective earlier results.

- **2008 Data Gaps Investigation:** Based on the results of the 2007 data gaps investigation (Geomatrix, 2008a), additional investigation work was carried out in 2008 (AMEC, 2009). This work included additional soil and/or groundwater samples collected from 10 new locations (GP-107 through GP-114, MC-30, and MC-31). Three new wells near the western property boundary were also installed, MC-30, MC-30D, and MC-31, to aid in evaluating area background concentrations of arsenic in groundwater. Three new Lower Aquifer wells were installed near the tank farm to further evaluate Lower Aquifer conditions (MC-118D2, MC-25D2, and MC-26D2). Sediment and porewater samples were collected from three previous Steigerwald Marsh sampling locations (MC-SM1, MC-SM2, and MC-SM3) and three additional locations farther east (MC SM4, MC-SM5, and MC-SM6). Two sediment samples were collected from immediately below and downstream of the Gibbons Creek stormwater outfall (GC-1 and GC-2). The sediment was cleaned out from five catch basins (CB-1, CB-2, CB-3, CB-6, and CB-7) sampled in 2007. These data included rigorous data quality assessment from collection planning to data validation, and included modern techniques to collect samples that are consistent with current best practices. These data are viewed as fully usable for the analysis completed and aid in putting in perspective earlier results.

- **2009 Data Gaps Investigation:** Based on the evaluation of data collected during the 2008 data gaps investigation, further investigations were carried out in 2009 to address existing data gaps (AMEC, 2009). This work included collection of soil and groundwater samples from three direct-push borings (GP-104 through GP-106), collection of shallow soil samples from GP-108 (repeat sampling to verify a mercury detection in soil) and GP-115 (south of GP-108 to bound a mercury detection in soil), and the installation of five new monitoring wells (MC-24D2, MC-27D, and MC-28D in the Lower Aquifer, and MC-32 and MC-33 in the Shallow Groundwater Zone). These data included rigorous data quality assessment from collection planning to data validation, and included modern techniques to collect samples that are consistent with current best practices. These data are viewed as fully usable for the analysis completed and aid in putting in perspective earlier results.

- **2011 Data Gaps Investigation:** An additional soil and groundwater investigation was performed to address Ecology's concerns that the extent of contamination in the Silt Layer had not been adequately characterized (AMEC, 2011). The objective of the 2011 Data Gaps Investigation was to obtain data for a baseline characterization of the contamination remaining within the Silt Layer and the potential impact of cleanup alternatives to address groundwater in the Shallow Groundwater Zone and/or Lower Aquifer. The work included collection of soil (GP-116 through GP-125) and groundwater (GP-116 through GP-118 and GP-122) samples that were analyzed for arsenic, 1,4-dioxane, and VOCs. These data included rigorous data quality assessment from collection planning to data validation, and included modern techniques to collect samples that are consistent with current best practices. These data are viewed as fully usable for the analysis completed and aid in putting in perspective earlier results.

Information from these investigations is synthesized in the following sections to describe the nature and extent of contamination in soil (Section 11.1), groundwater (Section 11.2), and surface water and sediments (Section 11.3).

11.1 NATURE AND EXTENT OF SOIL CONTAMINATION

The current understanding of the distribution of COCs in soil is evaluated in this section.
The nature and extent of soil contamination at the site have been investigated extensively from 1986 through the present. Soil data collected from 1996 to the present were selected for use in the RI since most soil samples were collected between 1996 and 2011, well after the 1991 RFI report (SEE, 1991), and these data were validated by a third party. The soil sampling locations included in the RI data set are shown in Figure 3-4, keyed to the individual investigation and date during which the samples were collected. The analytical results available for various constituent groups are shown on Figure 11-1 for specific sampling locations.

Investigations conducted prior to 1996 are valuable in a qualitative sense in that they aid in identifying areas of concern at the facility and help document historical uses of the property and activities that might have led to releases to soil or groundwater. While the field and analytical methods employed for data collected before 1996 do not meet the standard required to use these data for quantitative purpose, these data do provide an indication of the severity of releases that may have occurred at different areas of the site.

Data collected between 1996 and 2000 are now over 10 years old and do not meet the same quality standards that have been maintained since 2000, as discussed in Section 10.0. Data collected between 1996 and 2000 remain usable based on the data review described in Section 10.1 and the earlier review done as part of the 2000 RI (PSC, 2000). Data collected between 1996 and 2000 have been used to determine COCs and to evaluate the nature and extent of soil contamination at the site. These data also will be used to determine minimum concentrations of volatile organic compounds at each sampled location. Since analyses conducted prior to 2000 often had higher detection limits, additional sampling may be required during the engineering design phase or following cleanup in order to properly quantify the concentrations of COCs that may be present. Data quality for the RI is discussed in more detail in Section 10.0.

Investigation of the site began initially during the 1980s in areas of potential releases, identified based on land use in those areas and on employee complaints regarding deliberate releases made or directed by former property owner Jack McClary. Areas were also investigated after identification of SWMUs by EPA and PSC (SEE, 1991). These investigations are described further in Section 3.3. These early investigations culminated in the 1991 Draft RFI Report. Although these early data are not fully usable, they do qualitatively help to identify areas of concern for soil contamination. These potential areas of concern include the following locations (see Sections 3.3 and 3.4 for additional background information on historical releases and historical investigations).

- **Former tank farm area (and areas north and east)** – Early sampling was completed in several areas around the tank farm, confirming that releases had occurred in this area. Several interim remedial efforts have already been performed in this area, including the removal of DNAPL via pumping in 1986 and a large soil excavation in 1997 (Section 3.4). More recent data collected since the 1997 soil excavation are useful in evaluating what contamination remains in the area of the former tank farm.

- **Former waste storage areas in Building 2 and 3** – RCRA-regulated use of these areas led to sampling during closure of the aboveground facility in 1999 and additional sampling in 2008 and 2009.

- **Potential dry well west of the former tank farm** – Early sampling did not confirm or rule out that a dry well was present at this location and led to additional investigation of the area in both 1996 and 2001.

- **Former waste oil tank system** – This area was not identified during early investigations as an area of concern, but was later investigated in 2008 and 2009 based on the historical operations that are believed to have taken place in this area.

Other sampling with lower density of sampling points has occurred in other areas of the PSC property and at neighboring properties (South 32nd Street right-of-way and Hambleton Lumber property to the north). The description of the current nature and extent of contamination at the site in this section focuses on the areas of concern noted above, which have been identified base on the lengthy course of investigations that have been conducted at the site. Since the water table ranges from 4 to 6 feet in depth below ground surface across the property during the driest periods of the year (Figure 6-5), data related to soil samples collected below this depth are considered to be influenced by groundwater.

Figures 11-2 and 11-3 show the analytical results for detected concentrations that exceed PCLs for VOCs and inorganic constituents, the two most frequently detected COC analyte groups. Other analyte groups, including TPH, pesticides, and SVOCs, have also occasionally been detected in soil at concentrations above the respective PCL (Figure 11-4). However, as is evident in Figure 11-4, these occasional detections above the PCL have occurred in samples collected in areas where VOCs and metals have also been found at elevated concentrations. Because VOCs and metals are more widespread around the property and tend to occur in the same locations where elevated levels of other COC groups are found, these groups have been designated as indicators of areas of contamination for a broad range of constituents at the facility and to highlight the spatial distribution of COCs.

Concentrations of COCs in soil must be evaluated in light of the shallow depth to groundwater and considered in combination with the comprehensive analytical data available for groundwater. In addition, for the purposes of developing remedial alternatives, it should be noted that the soil concentrations present at the site are below the direct contact/ingestion MTCA Method C cleanup levels and only exceed cleanup levels for inhalation or groundwater protection (including surface water protection). Table 11-1 summarizes this comparison. As a result these exceedances represent a much lower real risk than the elevated concentrations present prior to the 1997 interim measure, and remediation should consider this fact.

11.1.1 Volatile Organic Compounds

As shown in Figure 11-4, VOCs have been detected at elevated concentrations underneath and in the vicinity of several areas of the PSC property, specifically:

- The former tank farm (including the potential dry well area) and immediately surrounding areas;
- A localized area just west of Building 2;
- A small isolated area beneath Building 3, and
- An isolated area in the vicinity of the waste oil tank area.

11.1.1.1 Tank Farm Area

The most extensive area impacted with VOCs is the area of the former tank farm. This area was addressed with an interim action in 1997; however, VOCs remain, with PCE, TCE, and m,p-xylenes detected at concentrations exceeding their individual PCL. Many of the results for samples collected at direct-push locations GP-36 through GP-77 surrounding the former tank farm were non-detect but had elevated detection limits. These results probably arise from detections of other constituents, such as ethylbenzene and toluene, at levels below PCLs but high enough to drive up laboratory detection limits for other constituents above their respective PCLs.

The highest concentrations (PCE, TCE, and *cis*-1,2-DCE greater than 100 micrograms per kilogram [µg/kg]) were detected in samples collected at depths of approximately 4 feet bgs underneath the former tank farm area (1996 and 1997) and samples collected from the underlying Silt Layer (2011).

The shallow samples were collected in 1996 and 1997 as part of the tank farm investigation and remediation (soil excavation), and represent soil that was removed as part of the remediation. Soil confirmation samples collected at the maximum excavation depth of approximately 6 feet bgs underneath the former tank farm area had PCE concentrations ranging from 9.19 to 438 µg/kg and TCE concentrations ranging from 8.7 to 20.1 µg/kg. Based on the site conceptual model, COCs are present in the silt layer and are evident in the concentrations observed in groundwater. It is reasonable to conclude that this remnant contamination does not pose a future risk to shallow soil; the risk it creates for the site is a groundwater concern. However, any risk associated with residual contamination under under Building 1 will be addressed in the FS, including anticipation of any potential changes to the building, building maintenance issues, or changes in site use. While a potential migration pathway to indoor air from contaminated soil in this area does exist, this pathway is currently managed by the 2005 installation of a depressurization system under Building 1, which has shown to be effective.

Soil samples collected from the saturated Silt Layer during the 2011 Data Gaps Investigation (AMEC, 2011) showed PCE concentrations ranging from 29 to 4,100 µg/kg; TCE concentrations ranged from 4.6 to 150 µg/kg; *cis*-1,2-DCE concentrations ranged from 1,400 to 6,200 µg/kg; and VC concentrations ranged from 37 to 45 µg/kg. The results support the hypothesis that the Silt Layer continues to represent a source of COCs to groundwater, particularly in the Lower Aquifer. Although concentrations detected in the Silt Layer are not extremely high, the data do verify the presence of COCs within the silt acting as a residual source.

The area of elevated VOC concentrations is not fully bounded by other soil samples in all cases, though concentrations drop by orders of magnitude in samples collected in areas surrounding Building 1 and the former tank farm area. VOC concentrations are also lower immediately south of B-21, which is located just south of the old tank farm. A soil sample from 1 foot bgs at B-21 contained PCE concentration equal to 14 µg/kg. Monitoring well MW-1 is located immediately downgradient of B-21. Any PCE impacts to groundwater resulting from PCE in soil near B-21 would be captured by analytical data associated with MW-1. As discussed previously, recent PCE concentrations at MW-1 have been relatively low. This data gap associated with B-21 will not impact conclusions of the RI or prevent the selection of remedies during the feasibility study.

Elevated levels of PCE (50.7 µg/kg) were also observed in a soil sample collected from 4 feet bgs at GP-37, which is located on the west side of Building 1. Elevated levels of PCE in soil have not been bounded to the northeast, east, or southeast of this location, as access to those areas is prevented by the presence of Building 1. However, monitoring well MC-21 is located immediately downgradient of GP-37. Any PCE impacts to groundwater resulting from affected soil near GP-37 would be evident in analytical data associated with MW-21. As discussed below in Section 11.5.2, TCE concentrations in MC-21 from the third quarter 2010 through the second quarter 2011 have been below the detection limit of 0.5 µg/L. Ultimately, the data gaps associated with elevated levels of PCE in soil at GP-37 will not impact the conclusions of the RI or prevent the selection of an appropriate remedy in the feasibility study. Based on the investigation to date, affected soil is presumed to remain below Building 1, as this area was not accessible for soil removal during in the 1997 interim action and the shallow water table at the site would have made horizontal transport of shallow contaminants readily possible at the time of release.

Several soil sampling locations east of the former tank farm area also showed detections of VOCs, including PCE, TCE, and m,p-xylenes. PCE was detected at concentrations above the PCL in the sample collected at GP-20 at 9 feet bgs; PCE and TCE were found at concentrations exceeding their PCL at GP-25, also at a sampling depth of 9 feet bgs. Based on the depth of these samples, the PCE, TCE, and m,p-xylenes detected in this area represent a groundwater condition, as the depth to groundwater is generally several feet shallower than the depth at which these samples were collected. The annual variation in depth to groundwater in the vicinity of GP-20, at nearby well MC-21, varies from approximately 4 feet bgs to 7 feet bgs. Farther east, the annual variation in depth to groundwater at MW-14 ranges from 2 feet bgs to 7 feet bgs. Both of these observations support the hypothesis that the VOCs seen in the eastern part of the site can be attributed to VOCs retained in the silt layer and groundwater. The impact of these VOCs in the silt layer and groundwater on indoor air, specifically at Building 1, will be further investigated in the FS.

11.1.1.2 Buildings 2 and 3

Elevated TCE and PCE concentrations exceeding PCLs are also present just west of Building 2 and in localized areas beneath Building 3 at a depth of 0.5 feet in the vicinity of RCRA closure sample locations B-6, B-11, and R-8. As shown in Figure 11-2, samples collected outside the perimeter of these buildings (GP-08, GP-13, GP-107, GP-108, GP-114, and MC-17D) have not shown elevated concentrations of these COCs, indicating the source is localized. While soil samples from deeper intervals have not been analyzed, groundwater analytical results from downgradient of this area indicate that a source area of the same magnitude or greater is not present at depth beneath Building 2 or Building 3. VOC concentrations in groundwater downgradient of Buildings 2 and 3 demonstrate that COC impacts beneath Buildings 2 and 3 are limited to shallow depths and are not impacting groundwater flowing off the PSC property. Therefore, while elevated concentrations of VOCs have been identified in shallow soils in this area, the specific VOC concentrations at depth beneath Buildings 2 and 3 are an acceptable unknown since they do not appear to be affecting downgradient areas and will not prevent the assessment of remedial alternatives in this area of the facility. Unlike areas near the former tank farm, the dataset has not shown historically widespread migration with groundwater downgradient, and indicates a limited extent of impact.

11.1.1.3 Waste Oil Tank Area

PCE was detected in the sample collected at GP-93 at 5.5 feet bgs during the 2007 data gaps investigation (Geomatrix, 2008a) at a concentration of 6.1 µg/kg, which is above the PCE PCL of 3 μg/kg. Additional samples collected during the 2008 data gaps investigation to the west (GP-110) and south (GP-111) were non-detect for PCE. The sample collected to the north (GP-109) at 4 feet bgs had an estimated PCE concentration of 4.5 μg/kg, which is above the PCL for PCE. The relatively low concentrations detected in this area and the decreasing concentrations toward the north and east indicate that the PCE-affected soil is localized to the area surrounding GP-93. PCE and TCE have not been detected in groundwater in this area; however, vinyl chloride has been detected in groundwater collected from nearby monitoring well MC-33.

11.1.2 Semivolatile Organic Compounds

As shown in Figure 11-1, abundant soil sampling has been conducted for SVOCs; however, not all SVOCs were analyzed at all locations. Samples collected prior to and during the 1999 RI were analyzed for a narrowed list of phenols and naphthalenes in many of the samples. The locations of these samples are shown in Figure 3-4, and were primarily in the area east of Building 1 and extending to the western edge of Steigerwald marsh. These analyses for an abbreviated suite of SVOCs occurred prior to the selection of an outside laboratory and implementation of validation procedures. Since these changes were instituted, SVOC results have been heavily supplemented with more recent analytical data. The older data still provide a good synopsis of general SVOC concentrations in this area of the facility.

Samples collected during the 2007 and 2008 data gaps investigation, which included samples in various areas of the facility as shown in Figure 3-4, were analyzed for the full SVOC list in accordance with EPA Method 8270. Two SVOCs were detected above the PCL in samples collected at two locations prior to 2007. Nitrobenzene was detected only at GP-07 at a depth of 4 feet bgs in the former tank farm area. The area around GP-07 was subsequently excavated as part of the 1997 soil excavation.

2,4-Dichlorophenol was detected at B-3 at a depth of 1 foot at a concentration of 420 μg/kg, which exceeds the PCL. Samples collected to the west (GP-94), north (GP-114), east (B-13), and south (GP-107 and GP-108) had no SVOCs exceeding the PCL. These results demonstrate that the SVOCs exceedances are localized to the area around location B-3 (Figure 11-5).

No other SVOCs were found exceeding PCLs during the 2007-2009 investigations.

During the 2011 Data Gaps Investigation (AMEC, 2011), soil samples were collected from direct-push borings beneath the Former Tank Farm Area. The borings were advanced to depths of 11.5 to 18 feet below ground surface and extended into the Silt Layer. The samples were analyzed for the SVOC 1,4-dioxane. Low levels of 1,4-dioxane were detected in only two samples at concentrations that do not exceed the PCL (1.9 µg/kg at GP-121) and 1 µg/kg at GP-124).

Ultimately, the narrow range of SVOC analyses conducted prior to and during the 1999 RI has not prevented adequate characterization of the nature and extent of SVOC-affected soil at the facility. The unknowns created by the shorter list of SVOC analytes in older sampling sets are not significant and will not change the results of the RI or prevent the assessment of remedial alternatives for the facility.

11.1.3 Inorganics

The majority of samples collected for inorganic analysis were collected during the RI investigations (1999-2001), and most were located around the perimeter of the PSC property (Figure 11-1). Shallow samples were collected at additional areas of the facility with historical operations as part of the RCRA Facility Closure (PSC, 1999a). Additional samples were collected for inorganic analysis during the 2007-2009 investigations to assess data gaps in the spatial coverage of inorganic analytical data. Soil samples collected during the 2011 Data Gaps Investigation from the Silt Layer beneath the former tank farm area were also analyzed for arsenic.

Seven inorganic soil COCs (arsenic, cadmium, cyanide, mercury, silver, nickel, vanadium, and zinc) were detected above the respective PCL in soil (Figure 11-3). Cyanide was detected in most samples analyzed at concentrations ranging from 1.41 mg/kg to 194.4 mg/kg. All of these samples containing elevated levels of cyanide were collected north of container storage Building 2 and underneath both container Building 2 and Building 3. These samples were collected in the upper 0.5 feet of soil beneath the concrete foundation of these buildings. The highest concentrations were found in samples collected in the northeast corner of Building 3. All of the cyanide detections are well below alternative cleanup levels considered in developing PCLs for all pathways except groundwater protection, which drives the selected PCL. Cyanide has not been analyzed in groundwater collected from monitoring wells since 2004. Cyanide was not detected in the groundwater in 2004 or during any of the previous sampling events that occurred in 2000 and 2001 (from monitoring wells MC-1, MC-14, and MC-118D) and 2002 (MC-21). Groundwater cyanide results are described further in Section 11.2.4. All cyanide groundwater sampling was conducted at the wells on site with the highest historical impacts, which were not downgradient of Buildings 2 and 3. Cyanide will be analyzed at wells MC-15, MC-16, and MC-17 as part of quarterly sampling for a period of two quarters, in third and fourth quarters, 2013. These additional data will be considered during development of the FS and Cleanup Action Plan.

Mercury exceeded the PCL at one location; the concentration above the PCL was found in a sample from location GP-108 (1.52 mg/kg at 1 foot bgs in 2008) (Figure 11-6). Mercury was detected at much lower concentrations in samples surrounding GP-108. As a result, this location was resampled in 2009 in an attempt to verify the concentration of 1.52 mg/kg. The 2008 result appears to be an anomaly because the 2009 result from resampling the location at 1 foot bgs was 0.011 mg/kg, which is much more consistent with the result from the 2008 sample collected at 4 feet bgs (0.013 mg/kg) and the results from surrounding locations. Samples to the west (GP-92), to the north (GP-107), and to the south (GP-115) had no detected mercury concentrations above the PCL (Figure 11-6). Mercury concentrations were also below the PCL at three other locations (B-12, B-16, and B-17). All three of these locations are co-located with the large area impacted by cyanide, discussed above. Mercury was also detected at concentrations below the PCL at location PZU-5 northeast of the PSC property across South 32nd Street near the Steigerwald Marsh; the low concentration of mercury at PZU-5 and the lack of contamination upgradient of PZU-5 suggests that the detection is unrelated to former facility activities.

The concentration of cadmium exceeded the PCL at one sample location, the surface sample collected from B-12 (0 feet bgs) in 1999. The cadmium concentration of 2.1 mg/kg is only slightly greater than the natural background level for Clark County and the PCL (1.1 mg/kg). All other soil samples that were collected and analyzed for cadmium did not exceed the PCL.

Silver and zinc were found at concentrations of 0.127 mg/kg and 123 mg/kg, respectively, at location GP-97, both exceeding their respective PCL, but only in the shallowest sample (Figure 11-3). Samples collected around location GP-97 at GP-112 and GP-113 (both approximately 20 feet east of GP-97) had no detected concentration of silver and zinc exceeding their individual PCL (Figure 11-6). Concentrations of silver and zinc in samples from GP-97 decreased dramatically with depth and were below PCLs in each of the two deeper samples collected at GP-97. The nearest sample west of GP-97 where zinc was analyzed is MC-118D, approximately 45 feet to the west. Zinc was detected in the sample collected at MC-118D, but the concentration did not exceed the PCL. Silver was analyzed and detected at GP-95, approximately 100 feet west of GP-97, but the detected concentration did not exceed the PCL. Based on these data, silver and zinc exceedances of soil PCLs are localized in shallow soils around location GP-97 (Figure 11-6).

During the 2011 Data Gaps Investigation (AMEC, 2011), saturated soil samples (below the water table) were collected from the Silt Layer beneath the Former Tank Farm Area at depths ranging from 11.5 to 18 feet bgs. Arsenic was detected in all samples at concentrations ranging from 2.18 to 12.6 mg/kg. Arsenic concentrations were above the PCL at GP-117, GP-120, GP-122, and GP-123.

The cleanup levels in Section 9 were updated as part of this Final RI report to reflect recent revisions to CLARC. The MTCA Method B cleanup levels from the CLARC tables for vanadium in groundwater have dropped substantially, from 110 to 1.12 µg/L. This decrease in the MTCA Method B cleanup level for vanadium led to a recalculation of the soil cleanup level (protective of groundwater), which dropped the final PCL for soil to 22 mg/kg. While vanadium was not identified previously as a COC, this adjustment in the PCL results in vanadium being present in soil everywhere it has been sampled at concentrations above the PCL. Concentrations are fairly consistent across the site, ranging from 22.5 to 53 mg/kg, with no indication of a contaminant source that led to the presence of vanadium. Unfortunately vanadium was not assessed as part of Ecology's 1994 Natural Background Soil Metals study in Washington State, so a statewide or regional natural background concentration for vanadium has not been established at this point; therefore, the site-wide vanadium concentrations in soil are compared to the standard PCL and vanadium has been included as a COC. However, the spatial distribution of vanadium concentrations at the site suggest a natural background issue and not a vanadium source at the facility.

11.1.4 Total Petroleum Hydrocarbons

Petroleum hydrocarbons were analyzed historically in only one sample, collected in 2001 at GP-77 west of the former tank farm, where field observations indicated potential TPH contamination. The sample was analyzed for TPH in the gasoline range with a result of 9.09 mg/kg, which is below the PCL.

Additional TPH samples were subsequently collected during the 2007, 2008, and 2009 data gaps investigations. TPH samples were collected from 15 sampling locations during the 2007 investigation, from seven sampling locations during the 2008 investigation, and from one sampling location during the 2009 investigation (Figure 11-1). Several samples were collected from each sampling location at various depths ranging from 1 to 8 feet bgs and were analyzed for TPH in the gasoline (TPH-G), diesel (TPH-D), and lube oil ranges (TPH-Oil). One sample (GP-97 at 8 feet bgs) just north of the former tank farm area (Figure 3-4) had an estimated detected concentration of 120 mg/kg, which exceeds the PCL for TPH-G. No other hydrocarbons were detected above PCLs during the 2007, 2008, and 2009 sampling events.

11.1.5 Polychlorinated Biphenyls

Surface soil samples were collected for PCB analysis from 32 locations as part of the RCRA PCB Closure in 1999 (Figure 3-4). Results for all of these samples were below detection limits.

Subsurface samples were collected from 15 locations during the 2007 data gaps investigation and analyzed for PCBs. Several samples were collected from each sampling location at various depths ranging from 1.5 to 8 feet bgs and analyzed for PCBs. One sample (GP-97 at

5.5 feet bgs) immediately north of the former tank farm area had an estimated detected Aroclor 1260 concentration of 3.3 µg/kg, well below the total PCBs PCL of 740 µg/kg. This is the same location where hydrocarbons were detected.

11.1.6 Pesticides

Several pesticides were identified as COCs based on results from the RCRA closure soil samples. These constituents were detected in samples from only a few locations out of the 32 analyzed during the RCRA closure, all located just south of the former tank farm and in Building 2.

Samples collected for PCB analysis during the 2007 data gaps investigation discussed above were also sampled for pesticides at depths ranging from 0.5 to 8 feet bgs. Samples from MC-24, MC-25, MC-20D, GP-95, and GP-97 had few detected concentrations for a small group of pesticides. The detected concentrations ranged from 0.11 to 0.66 µg/kg, all below the PCL of 4,4'-DDD (1 µg/kg) which was one of the earlier detected pesticide species and the pesticide species with the lowest PCL. No other pesticides have been detected in other parts of the site above the respective PCL.

11.2 GROUNDWATER

Groundwater samples were collected from 2004 through 2011 at direct-push locations (2007 through 2011 data gaps investigations) and monitoring wells/piezometers for analysis of a variety of constituents, including VOCs, SVOCs, TPH, and inorganic constituents. The new sampling locations (2007-2011 data gaps investigations) were selected in areas where PSC had not historically collected samples or in areas that required additional characterization. Samples were collected from the Shallow Groundwater Zone above the Silt Layer, from the Lower Aquifer beneath the Silt Layer, and from within the Silt Layer. The following subsections summarize results for each constituent group.

11.2.1 Volatile Organic Compounds

Figures 11-7 through 11-14 show the distribution of the highest concentrations of selected VOCs detected during the 2004 through the second quarter of 2012 sampling events. Temporal trends in concentration at individual locations are further evaluated in Section 12. Chlorinated ethenes are the primary VOCs that were detected above PCLs in samples collected during the 2004 through mid-2012 sampling time frame. PCE, *cis*-1,2-DCE, TCE, and/or VC were detected above PCLs at multiple locations near and east of the former tank farm (Figures 11-7 through 11-14).

11.2.1.1 Historical Results

Samples collected from the Shallow Groundwater Zone showed the highest VOC concentrations east of the former tank farm area at MC-14, MC-20, and MC-21, similar to results for samples collected prior to 2004. Lower concentrations, still above PCLs for PCE, TCE, and VC, were detected at the Shallow Groundwater Zone monitoring well MC-25, located on the north end of the former tank farm, and monitoring well MC-15, located east of container storage Building 2. Northeast of the PSC property, low concentrations were also detected in the two piezometers PZU-4 and PZU-5, which are screened partially in the Silt Layer and located on South 32nd Street. VOCs were not detected above PCLs in the Shallow Groundwater Zone well MC-24, located on the south side of the former tank farm. While VOCs have not been detected above PCLs at any of the Shallow Groundwater Zone direct-push sample locations surrounding the former waste oil tank farm (GP-91 through GP-94), VC has been detected above the PCL in groundwater collected from monitoring well MC-33, which is just north of the former waste oil tank farm. TCE and VC were detected above PCLs in the sample collected at GP-108, located between the waste oil tank and the container storage Building 3. VC was also detected above the PCL at samples collected at MC-30 (along the western perimeter of the PSC property) and MC-16 (south of MC-14 and MC-15 along the eastern property perimeter).

Samples collected from within, or mostly within, the Silt Layer (Figure 7-13) showed elevated VOC concentrations beneath or near the former tank farm area (Figures 11-7, 11-9, 11-11, and 11-13). Samples collected from GP-118, located immediately south of well cluster MC-25, had elevated concentrations of *cis*-1,2-DCE (16,000 μg/L), PCE (24 μg/L), and VC (21 μg/L) in comparison to other samples collected from the Shallow Groundwater Zone and the Silt Layer since 2004. Groundwater samples from GP-116, GP-117, and GP-122 were above the PCLs for *cis*-1,2-DCE, PCE, TCE, and VC (except for *cis*-1,2-DCE at GP-117).

Lower VOC concentrations were generally observed in samples collected from GP-94, GP-97, GP-100, and GP-101. Of these boring locations, TCE in GP-101 and VC in GP-101, GP-97, and GP-100 were the only chlorinated ethenes detected within the Silt Layer that exceeded their individual PCLs. Wells MC-122, MC-123, and MC-20, which are all screened partially in the Silt Layer, show results similar to those for GP-101, for TCE, *cis*-1,2-DCE, and VC. GP-97, the direct-push boring where an odor was noted during drilling, contained VC at 1.5 μg/L and *cis*-1,2-DCE at 40 μg/L, but no other VOCs above PCLs were found in the sample collected at GP-97 from the Silt Layer zone.

Samples collected from the Lower Aquifer showed a different spatial distribution of VOCs than observed in the Shallow Groundwater Zone (i.e., excluding concentrations observed in the Silt Layer). Concentrations of COCs collected from the Lower Aquifer beneath the former tank farm and in areas just north of this area are higher than concentrations observed near MC-14D and across South 32nd Street. Samples collected from GP-97, MC-118D, MC-24D, and MC-25D showed the highest concentrations in the Lower Aquifer, with lower concentrations observed to the north, south, east, and west of this area (Figures 11-8, 11-10, 11-12, and 11-14). Deeper samples collected at MC-118D2, MC-25D2, and MC-24D2 contained detected concentrations of VOCs on the order of one magnitude lower than the samples collected from shallower intervals within the Lower Aquifer. Concentrations of PCE, TCE, and VC still exceeded the PCL in samples collected from MC-118D2 and MC-25D2, but not from MC-24D2 or MC-26D2.

11.2.1.2 Recent Results

More recent groundwater concentrations were assessed by creating groundwater geochemical contour maps for the Shallow Groundwater Zone, the Silt Layer, and the Lower Groundwater zone for two key VOCs: TCE (Figures 11-15 through 11-17) and VC (Figures 11-18 through 11-20). Each contour map was produced using the highest detected value at each respective sampling location during the period from September 2011 through June 2012. For wells where the COC was not detected during this time period, the figures were constructed using the highest reporting limit value, which is above the PCL in some cases. Groundwater samples collected from locations considered partially screened within the Shallow Groundwater Zone were included in the dataset used to generate the Silt Layer contour map in order to increase the spatial coverage of the data. The geochemical contour maps were constructed using a logarithmic kriging methodology to interpolate between observation points. The PCL was selected as the lowest value contour, and then a few other contours for higher concentrations were selected for display for ease of readability.

Recent TCE concentrations in the Shallow Groundwater Zone are much lower, and areas with the greatest concentrations are located farther east, than concentrations observed in the Silt Layer and in the Lower Aquifer (Figures 11-15 through 11-17). The highest detected concentration of TCE in the Shallow Groundwater Zone is 1.4 µg/L at MC-20, next to Steigerwald Marsh, while the concentrations from the 2011 Silt Layer investigation (former tank farm area) showed a concentration as high as 12.5 µg/L, and Lower Aquifer concentrations have been as high as 31 µg/L in the area of the former tank farm.

Figures 11-18 through 11-20 show a similar pattern for recent VC concentrations, with higher concentrations observed in the Silt Layer and Lower Aquifer than in the Shallow Groundwater Zone. Concentrations of VC in Shallow Groundwater Zone samples are highest at MC-14 (6.2 µg/L), east of Building 1. VC concentrations in the Silt Layer were highest at GP-118 (21 µg/L), next to well MC-25D, which shows the highest recent concentration in the Lower Aquifer (69 µg/L).

While not contoured, recent data for other chlorinated VOCs show a similar pattern. For example, *cis*-1,2-DCE was detected in 2010-2011 at concentrations over 1,000 µg/L in Lower Aquifer wells MC-24D and MC-25D located in the former tank farm area, while concentrations of *cis*-1,2-DCE in the Shallow Groundwater Zone were less than 10 µg/L at their highest (MC-14). Concentrations of *cis*-1,2-DCE detected in the Silt Layer were as high as 16,000 µg/L (GP-118). PCE also shows a similar pattern, though concentrations are much lower in all groundwater zones (highs of 24 µg/L in the Silt Layer and 29 µg/L in the Lower Aquifer).

In summary, VOCs in groundwater are primarily associated with the former tank farm area. The excavation of soils in this area resulted in a dramatic improvement of groundwater quality; however, VOCs, primarily PCE, TCE, and their degradation products, are present in the Shallow Groundwater Zone, Silt Layer, and Lower Aquifer below and downgradient of the old excavation. VOC concentrations in groundwater are continuing to decline, and concentrations of TCE and PCE (<5 µg/L) near the property boundary to the east are relatively low, as discussed further in Section 12. It is clear that the Silt Layer, which is high in organic content, has adsorbed VOC mass and represents a remaining secondary source of VOCs to groundwater in the lower aquifer

11.2.2 Semivolatile Organic Compounds

The primary SVOC detected above PCLs during the 2004 through mid-2012 time frame is 1,4-dioxane. The only other SVOCs detected above PCLs in the Shallow Groundwater Zone or in the Silt Layer zone are bis(2-ethylhexyl) phthalate and chrysene. Bis(2-ethylhexyl) phthalate was detected at concentrations of 1.7 µg/L at GP-97 and 6 µg/L at GP-94 in the Silt Layer zone (PCL is 1.2 µg/L). It was not detected above the PCL at any other location. One sample collected from GP-113 had an estimated chrysene concentration of 0.033 µg/L, slightly exceeding the PCL of 0.0124 µg/L. Sampling location GP-113 is located north of the office building, and chrysene was not detected in samples from surrounding locations.

11.2.2.1 Historical Results

The highest level of 1,4-dioxane (400 µg/L) was detected in a Shallow Groundwater Zone sample collected from MC-14, as shown in Figure 11-21. Since 2004, 1,4-dioxane has been detected above the PCL (1 µg/L) at eight other Shallow Groundwater Zone sample locations. Of these other detections, GP-122 (78 µg/L), MC-123 (64 µg/L), and MC-20 (48 µg/L) also exhibited 1,4-dioxane concentrations above the PCL. GP-101 located adjacent to MC-14 and MC-122 located northeast of MC-14, both of which are screened in the Silt Layer, had a 1,4-dioxane concentration of 15 µg/L, exceeding the PCL, but lower by an order of magnitude than the highest concentration observed at MC-14. Groundwater samples collected from the Silt Layer at direct-push borings GP-116, GP-118, and GP-122 exhibited 1,4-dioxane concentrations ranging from 11 µg/L to 78 µg/L. No other sampling location screened in the

Silt Layer had detected concentrations of 1,4-dioxane. Samples with detectable concentrations of 1,4-dioxane in the Shallow Groundwater Zone were spread sporadically around the northern half of the PSC property and east of South 32nd Street.

All sampling locations in the Lower Aquifer have been sampled for full SVOC analysis since 2004. 1,4-Dioxane has been detected at all Lower Aquifer monitoring locations except MC-10D, MC-13D, MC-17D, MC-24D2, and MC-26D2 (Figure 11-22). Twelve locations (GP-95, GP-96, GP-98, GP-99, MC-12D, MC-15D, MC-24D, MC-25D, MC-27D, MC-30D, MC-118D, MC-118D2) had at least one detection since 2004 with a concentration of 1,4-dioxane equal to or exceeding the PCL (1 µg/L), with highest values ranging from 1 µg/L to 15 µg/L. 1,4-Dioxane has not been detected in deeper samples collected at MC-24D2 and MC-26D2, indicating that the vertical extent of impacted groundwater is bounded at the elevation of these two sample locations. Location MC-24D is located along the southernmost extent of the former tank farm area, and 1,4-dioxane was not detected in samples above the PCL collected farther south at MC-2D. The locations north and northwest of the former tank farm where slightly elevated concentrations of 1,4-dioxane have been observed are typically upgradient of Lower Aquifer groundwater beneath the former tank farm; however, as discussed in Section 7.2.3.2, groundwater flow directions in the Lower Aquifer exhibit short-duration reversals in gradient depending on stage levels in the Columbia River. During periods when groundwater flow directions in the Lower Aquifer reverse from a southward to northward or northeast direction, areas north of the former tank farm area are positioned either crossgradient or downgradient of Lower Aquifer groundwater beneath the former tank farm. Groundwater flow directions and the spatial distribution of 1,4-dioxane concentrations in the Lower and Shallow Aquifers suggest that a source area for 1,4-dioxane is likely present beneath the former tank farm area. Although no releases of 1,4-dioxane have been documented at the facility, it is also possible that releases outside the former tank farm area have also contributed to the observed 1,4-dioxane distribution in groundwater. No other SVOC compounds have been detected above the respective PCL.

11.2.2.1 Recent Concentrations

Groundwater geochemical contours were constructed to evaluate current conditions for 1,4-dioxane for the Shallow Groundwater Zone, the Silt Layer, and the Lower Groundwater zone (Figures 11-23 through 11-25, respectively). These figures also contain the locations with detected concentrations of bis(2-ethylhexyl)phthalate (BEHP) and chrysene.

Each contour map was produced using the highest detected value at each respective sampling location during the period of the September 2011 through June 2012. Groundwater samples that were collected from locations considered partially screened within the Shallow

Groundwater Zone were included in the dataset used to generate the Silt Layer contour map to increase the spatial coverage of the data.

The contour maps show that unlike VOCs, the highest recent concentrations of 1,4-dioxane are found in the Shallow Groundwater Zone (Figure 11-23), with lower concentrations in the Silt Layer (Figure 11-24) and Lower Aquifer (Figure 11-25). Shallow well MC-14, east of Building 1, shows the highest 1,4-dioxane concentration at the site of 400 µg/L. The highest concentration in the Silt Layer is much lower, at 78 µg/L (GP-122). The highest 1,4-dioxane concentration is even lower in the Lower Aquifer, where the high was 15 µg/L detected at MC-24D. The maximum 1,4-dioxane concentrations in the Silt Layer and the Lower Aquifer are both located within the area of the former tank farm.

The highest concentrations of BEHP in the Shallow Groundwater Zone are near the former tank farm with concentrations ranging from 0.30 µg/L at GP-92 to 6.0 µg/L at GP-94. Low level concentrations of BEHP were also detected in samples MC-122 and MC-123 at concentrations of 0.87 and 0.24 µg/L, respectively. There were only two locations in the Shallow Groundwater Zone with detectable concentrations of chrysene; GP-113 and MC-123 at 0.033 and 0.0036 µg/L, respectively.

11.2.3 Total Petroleum Hydrocarbons

Shallow Groundwater Zone samples were analyzed for gasoline range, diesel range, and oil range petroleum hydrocarbons during quarterly monitoring events from September 2007 through September 2008. Analysis for gasoline range hydrocarbons in groundwater samples has continued since September 2008 and is included in the quarterly suite of groundwater analytes. Diesel was detected at one location (GP-97) at an estimated concentration of 260 µg/L, below the PCL of 500 µg/L. Gasoline has been detected at several locations since 2004, including GP-97, GP-101, GP-112, MC-8, MC-13, MC-14, and MC-21, with maximum concentrations ranging from 19 µg/L to 550 µg/L. None of these concentrations was above the PCL for gasoline (800 µg/L). Sampling locations MC-8, GP-97, and GP-112 are located near each other north of the former tank farm area, and sampling locations MC-13, MC-14, MC-21, and GP-101 are located east of Building 1 and the former tank farm area. Benzene, a component of gasoline, was also present at concentrations above the PCL in Shallow Groundwater Zone samples from GP-101, GP-116, GP-118, and MC-14 (Figure 11-26). Oil range hydrocarbons were not detected in any Shallow Groundwater Zone samples collected during the 2007 to 2009 time frame.

TPH constituents have been analyzed in Lower Aquifer groundwater samples since 2007. All three TPH constituents (gasoline, diesel, lube oil) have not been detected or have been detected below the PCL in all samples, except for one sample collected at GP-97.

The sample collected in the Lower Aquifer at GP-97 had a gasoline concentration of 5,700 µg/L, exceeding the PCL of 800 µg/L. This Lower Aquifer sample also contained related gasoline constituents benzene (13 µg/L) and toluene (2,000 µg/L) at concentrations above PCLs, and benzene was also present above its PCL in samples from MC-118D, MC-24D, MC-25D, and MC-26D2, in addition to GP-97 (Figure 11-27). Gasoline was not detected above the PCL at any other location. GP-97 is located just north of the former tank farm area, and samples collected from the Shallow Groundwater Zone at this same location had detectable concentrations of gasoline (below the PCL), indicating that the gasoline found in this area is possibility associated with an old spill that has migrated into the Lower Aquifer.

11.2.4 Inorganic Constituents

The highest groundwater concentrations of arsenic, zinc, copper, cadmium, chromium, manganese, nickel, and vanadium since 2004 are summarized in Figures 11-28 through 11-43. A figure was not created for lead since lead has only been analyzed in samples collected from GP-104 and MC-14 since 2004. In general, the highest concentrations of inorganic constituents in the Shallow Groundwater Zone have been found in samples collected at points located in identified source areas, including the waste oil tank area (GP-91, GP-94, GP-110, and MC-33), north of the former tank farm area (GP-100, GP-112, and GP-113), and east of Building 1 (GP-101 and MC-14) (Figures 11-28, 11-30, 11-32, 11-34, 11-36, 11-38, 11-40, and 11-42). The inorganic constituents manganese and iron have been detected in samples from all Shallow Groundwater Zone and Lower Aquifer monitoring wells at concentrations above the PCLs, except at MC-24 in the Shallow Groundwater Zone, and MC-2D, MC-17D, and MC-19D in the Lower Aquifer (Figures 11-38 and 11-39).

11.2.4.1 Historical Results

The PCL for arsenic in groundwater in the Shallow Groundwater Zone is 22.84 µg/L, and in the Lower Aquifer is 1.42 µg/L based on area background. As described in Section 9 and Appendix O, the Shallow Groundwater Zone and Lower Aquifer background was determined by using groundwater data from 2004 forward to calculate a 90 percent upper confidence limit. This 90 percent upper confidence limit was then evaluated in combination with a recent Ecology state-wide background study of natural arsenic conditions, which included county-specific information that is consistent with the calculated site-specific background (San Juan, 2010). .

Evaluation of the temporal trends in arsenic concentrations at the site, described further in Section 12 and Appendix O, show that arsenic concentrations vary. Therefore, direct comparison of discrete concentrations for arsenic (seasonal highs and lows) at the site against a level based on a 90 percent UCL that is inclusive of the seasonal variation in concentrations is not appropriate. Instead, the annual average concentration at each monitoring well (shown in Figures 11-28 and 11-29) was used for comparison with the PCL and area background concentration. Figures 11-28 and 11-29 also include discrete sample results from direct-push borings; discrete sample results are shown for these borings since averaging is not possible for these one-time sampling events. The areas with elevated arsenic concentrations in the Shallow Groundwater Zone occur along the eastern property perimeter, around the waste oil tank system, and at scattered locations north and northwest of the former tank farm area (Figures 11-28 and 11-29).

Zinc exceeded the PCL (32 µg/L) in Shallow Groundwater Zone samples from GP-94, GP-100, and GP-112 at concentrations of 117 µg/L, 126 µg/L, and 37.6 µg/L, respectively (Figure 11-30). Copper was detected in the Shallow Groundwater Zone at concentrations exceeding the PCL (3.5 µg/L) at several direct-push groundwater sample locations (GP-94, GP-100, GP-104, GP-108, GP-110, GP-112, GP-113), as well as in one permanent well location (MC-24), at concentrations ranging from 3.59 µg/L (GP-113) to 43.1 µg/L (GP-100) (Figure 11-32). Copper also was detected in groundwater samples collected from two monitoring wells (MC-20D and MC-25D) and three direct push locations (GP-95, GP-98, and GP-99) screened in the Lower Aquifer at concentrations ranging from 3.61 µg/L at MC-20D to 144 µg/L at GP-95 (Figure 11-33). Samples from two locations were analyzed for lead (GP-104 and MC-14), and the resulting concentrations of 4.66 µg/L and 3.1 µg/L both exceeded the PCL (0.54 µg/L). In addition, elevated concentrations were also found above the PCL at a few other locations for cadmium (GP-91, GP-92, GP-94, GP-100, and PZU-5) and nickel (MC-123, MC-14, and PZU-5) (Figures 11-34 and 11-40). Chromium has not been detected at concentrations above the PCL in the groundwater from the monitoring wells in the Shallow Groundwater Zone, but chromium was detected above the PCL in the groundwater from two locations (GP-95 and GP-99) screened in the Lower Aquifer (Figures 11-36 and 11-37).

Arsenic concentrations exceeding the PCL in the lower aquifer are present MC-10D, and MC-118D. Cadmium, chromium, copper, nickel, and zinc were also found at concentrations exceeding their individual PCLs at GP-95, GP-99, and GP-98 (copper and zinc only). These exceedances are found at the north end of the facility, near arsenic exceedances in MC-118D. Silver is found exceeding its PCL in this area as well in a sample collected from GP-95.

In general, most of the inorganic constituents found exceeding their individual PCL were collected from temporary, direct-push sample locations sampled during 2008 and 2011 to evaluate differences between groundwater concentrations in the Shallow Groundwater Zone and Lower Aquifer and concentrations within the Silt Layer. Some of these locations (GP-94, GP-95, GP-96, GP-97, GP-100, GP-101, GP-116, GP-117, GP-118, and GP-122) were sampled without prior stabilization of water quality parameters due to very low groundwater recharge rates at these sampling locations. Collecting groundwater samples from within silty units is challenging. Few of these constituents, except arsenic in the Shallow Groundwater Zone, have been detected above their PCL in the permanently installed groundwater monitoring wells at the site; however, even for arsenic, concentrations in samples collected from direct-push probes are generally higher than samples from permanent groundwater monitoring wells. This observation indicates that the presence of these inorganic constituents in the samples collected at the direct-push sample locations is most likely related to colloidal particles, present at higher concentrations in the Silt Layer. This hypothesis is further strengthened by comparing the concentrations of total versus dissolved constituents to assess what truly is dissolved in the groundwater sample (dissolved concentrations) and what is both dissolved and transported on colloidal particles (total concentrations). For example, the total concentration of copper at GP-95 is 144 µg/L, whereas the dissolved concentration is non-detectable at a reporting limit of 2.4 µg/L, which is below the PCL for copper. Also, the highest concentration of copper detected in a permanent well in the Shallow Groundwater Zone above the Silt Layer was 6.82 µg/L at MC-24.

As noted in Section 11.1.3, vanadium's PCL has dropped substantially due to Ecology's revision to the MTCA Method B cleanup value to 1.12 µg/L. Vanadium has been detected in groundwater throughout the site. Similar to other inorganic constituents, the highest concentrations are found in samples from direct-push borings. The majority of concentrations falling between 1 and 10 µg/L, although a few samples from direct push borings contained concentrations at higher values ranging from 20 to 200 µg/L.

Groundwater samples have not been analyzed for cyanide since June 2004, when it was analyzed in groundwater collected from monitoring well MC-14. Cyanide was not detected in the groundwater in 2004 or during any of the previous sampling events that occurred in 2000 and 2001 (from monitoring wells MC-1, MC-14, and MC-118D) and 2002 (MC-21). All cyanide groundwater sampling was conducted at the wells on site with the highest historical impacts, which were not downgradient of Buildings 2 and 3. As mentioned above, Cyanide will be analyzed at wells MC-15, MC-16, and MC-17 as part of quarterly sampling for a period of two quarters, in third and fourth quarters, 2013. These additional data will be considered during development of the FS and Cleanup Action Plan.

11.2.4.2 Recent Concentrations

Groundwater geochemical contours were produced to evaluate recent concentrations of total arsenic for the Shallow Groundwater Zone and the Silt Layer (Figures 11-44 and 11-45). Each contour map was produced using the average concentration at each respective sampling location calculated using data from the third quarter 2011 through the second quarter 2012.

Figure 11-46 is a contour map for the Lower Groundwater Zone, also produced using the average concentration from the third quarter 2011 through the second quarter 2012.

The arsenic contour map for the Shallow Groundwater Zone shows that areas above the PCL (0.02284 mg/L) in the Shallow Groundwater Zone are generally restricted to locations south and east of the former tank farm area and Building 1 (Figure 11-44). Most data from the Silt Layer were collected in the northern half of the property, making it harder to distinguish trends about the southern portion of the property. Concentrations detected within the Silt Layer were generally of a similar magnitude to those detected in the Shallow Groundwater Zone and much higher than those observed in the Lower Aquifer (Figure 11-45). The highest concentrations detected in the Silt Layer were 0.047 mg/L at GP-94, immediately east of the former waste oil tank system and MC-123 on the edge of the marsh at 0.096 mg/L. The highest concentrations detected in the Lower Groundwater Zone were from MC-10D at a concentration of 0.0038 mg/L and MC-118D at a concentration of 0.004 mg/L, both above the PCL of 0.00142 mg/L. No other locations in the Lower Groundwater Zone exceed the PCL with concentrations ranging from 0.0005 mg/L to 0.0011 mg/L.

11.2.5 PCBs and Pesticides

PCBs and pesticides were analyzed in June 2004 and in June 2009 in Shallow Groundwater Zone samples collected from well MC-14, which have historically shown the highest concentrations of COCs. PCBs and pesticides were not detected during either sampling event.

No Lower Aquifer sample has been analyzed for PCBs and pesticides since 2004. Prior to 2004, PCBs have been analyzed only at Lower Aquifer zone well MC-118D, the well that historically showed the highest concentrations of other constituents in the Lower Aquifer. PCBs and pesticides were not detected in samples from MC-118D.

11.3 SURFACE WATER AND SEDIMENT

This section describes historical investigations into contamination levels in nearby surface water and sediment and the current understanding of potential impacts from the activities at the PSC facility on these surface water and sediment areas. The locations of all sediment and surface water (or porewater) samples discussed in this section are shown on Figure 4-2.

11.3.1 History

As described in Section 4.3, sediment sampling was conducted in 1990, including four samples collected in the Gibbons Creek remnant channel and 12 samples in the Steigerwald Lake National Wildlife Refuge (SEE, 1991). Additional sediment and porewater sampling was conducted in 2007 and 2008 to fill data gaps identified in the RI process (AMEC, 2009). These sampling events were designed to provide data representative of locations that would likely be impacted as a result of contaminant transport through groundwater pathways or storm water discharge originating within the PSC property. This approach to investigation was based upon the extensive hydrogeologic data collected at the site, including characterization of suspected preferential flow paths (i.e., underground utility lines) and groundwater flow paths delineated from groundwater elevation data. No known direct releases have occurred from the site to the Gibbons Creek remnant channel or Steigerwald Marsh; however, as stated above, investigations have focused on potential discharges that could have impacted these areas. Data have not been collected to investigate all areas of the nearby surface water bodies. They have been investigated to evaluate concentrations generally located at the nearest edges of the PSC property to evaluate the potential relationship between concentrations in soil and groundwater on the PSC property and those in the neighboring surface water areas.

11.3.1.1 Steigerwald Marsh

In 1990, SEE sampled surface water adjacent to the PSC property four times in conjunction with quarterly groundwater sampling. Two sampling locations were selected in Steigerwald Marsh and the other two in the Gibbons Creek remnant channel. The marsh sampling points were located in shallow channels that could act to drain water discharging from the upper aquifer. This drainage could follow two courses: directly to the remnant channel (station SW-4) or into the marsh (station SW-1). A total of 13 samples were collected in the marsh during the four sampling events and analyzed for VOCs. Only one target VOC (total xylenes) was detected, in one sample collected on October 19, 1990, at a concentration of 1.1 µg/L (SEE, 1991). No target PAHs or phenols were detected in the eight samples analyzed. Arsenic, barium, cobalt, and zinc were detected at least once at both marsh sampling locations. Concentrations of these metals, except zinc, tended to be lower than those detected in the upper aquifer (SEE, 1991). Zinc was generally not detected in upper aquifer waters. Concentrations of other metals were highest in summer and declined in the winter.

In addition, SEE collected 11 sediment samples from six locations in Steigerwald marsh in 1990. Low concentrations of VOCs were detected in 8 out of the 11 Steigerwald marsh sediment samples. Acetone and total xylenes were detected in two and six samples, respectively, of the 11 samples collected. The highest concentration of xylenes was 0.011 mg/kg, and most detections were at or near the detection limit. Acetone was detected at 0.023 mg/kg and 0.056 mg/kg. Acetone was the only compound detected in both the remnant channel and marsh. No target PAHs/phenols were detected in any sediment samples. All five target metals were detected in all samples. Arsenic was detected at concentrations up to 27 mg/kg. Barium, cobalt, nickel, and zinc concentrations upgradient of South 32nd Street were 3 to 4 times greater than concentrations in downgradient samples, suggesting an upgradient source for the metals (SEE, 1991).

Water, sediment, and biological tissue samples were collected by the U.S. Fish and Wildlife Service following a major storm event in 1989 (Materna et al., 1992). Three sites were selected to represent possible routes of non-point-source pollution into the Steigerwald Marsh. Station 1 was at the confluence of the Gibbons Creek remnant channel and the Columbia River. Station 2 was located on the western part of the Steigerwald Marsh. Station 3 was located at a drainage ditch leading from the industrial park to the southwestern edge of the Steigerwald Marsh. A fourth sampling location was selected as a reference point in the central part of Steigerwald Marsh. Chemical analysis included metals, pesticides, PAHs, aliphatic hydrocarbons, PCBs, and dioxins (2,3,7,8-tetrachlorodibenzo-p-dioxin [2,3,7,8-TCCD] and 2,3,7,8-tetrachlorodibenzofuran [2,3,7,8-TCDF]).

Elevated concentrations of metals were observed in water samples collected in the drainage ditch and in sediment samples collected from the Gibbons Creek Remnant Channel compared to reference point samples. Boron, iron, magnesium, manganese, nickel, strontium, and zinc concentrations in water samples from the drainage ditch had greater than twice the reference point concentrations. Concentrations of arsenic, chromium, copper, magnesium, manganese, mercury, nickel, strontium, and zinc were at least 1.5 times greater in Gibbons Creek remnant channel sediments compared with reference point sediments. In general, contaminant concentrations in water samples are more indicative of recent exposure, whereas sediment samples are representative of long-term accumulation. Thus, the study concluded that the differences between the reference point and the drainage channels in contaminant concentrations suggest deposition of trace contaminants in the drainage channels below the industrial park (Materna et al., 1992).

Concentrations of chromium (up to 12 µg/L), copper (up to 11 µg/L), and iron (420 to 3,100 µg/L) detected in water samples approached or exceeded state and federal criteria for protection of freshwater biota. Concentrations of chromium (up to 12 µg/L), copper (up to 11 µg/L), and zinc (less than 5 to 43 µg/L) in water exceeded levels reported to cause sublethal effects to aquatic organisms. Additionally, concentrations of arsenic (3 to 17 µg/L), chromium (19 to 79 µg/L), copper (less than 5 to 28 µg/L), and nickel (12 to 27 µg/L) in sediment samples collected downstream of the industrial park approached or exceeded levels considered polluted and levels which have the potential to affect sensitive benthic organisms (Materna et al., 1992).

A total maximum daily load assessment for fecal coliform bacteria in Gibbons Creek was conducted by the Department of Ecology in 1996 (Erickson and Tooley, 1996). Because the portion of Gibbons Creek south of State Route 14 is elevated (built on a dike), the surrounding land does not drain into Gibbons Creek, but instead drains to the Gibbons Creek remnant channel. Therefore, no land south of State Route 14, including the wildlife refuge, Steigerwald

Marsh, and the industrial park, contributes runoff into Gibbons Creek. Water quality in the remnant channel was the subject of a separate, concurrent investigation by the Department of Ecology (Erickson and Tooley, 1996), which is discussed in more detail in Section 11.3.1.2.

11.3.1.2 Gibbons Creek Remnant Channel

In 1990, SEE sampled surface water adjacent to the site four times at four locations in conjunction with quarterly groundwater sampling (Figure 4-2). Two sampling locations were located in Steigerwald Marsh and the other two in the Gibbons Creek remnant channel. The Gibbons Creek remnant channel sampling points were located upstream (station SW-2) and downstream (SW-3) of South 32nd Street. A total of 14 samples were collected and analyzed. Seven target VOC compounds were detected 14 times at SW-2. Five target VOC compounds were detected 18 times at SW-3. Of the compounds detected, 1,1,1-trichloroethane, dichloromethane, toluene, total xylenes, and *cis*-1,2-DCE were detected at both sampling locations. PCE and ethylbenzene were detected at SW-2 only. In all cases, the detected concentrations of VOCs in the creek samples were less than 0.007 mg/L. With the exception of the June 4, 1990, event, detected concentrations were generally greater at station SW-2. The highest concentrations were detected at SW-2 in samples collected on August 27, 1990. However, compounds were detected more consistently through time at SW-3 (SEE, 1991). No target PAHs/phenols were detected in the creek samples. Arsenic, barium, and zinc were detected in the eight creek samples analyzed. Barium was the only metal detected in all samples. The concentration of barium was generally lower than detected in the marsh water samples. Arsenic was detected twice at or near the detection limit in SW-2, but was not detected in SW-3 samples (SEE, 1991).

In addition, SEE collected four sediment samples in Gibbons Creek remnant channel in 1990. Low concentrations of VOCs, including acetone, methylene chloride, and toluene, were detected in three out of the four Gibbons Creek remnant channel sediment samples. Acetone and methylene chloride were detected in two out of the four samples and toluene in one sample. Four of the five compound detections were in samples collected east, or upstream, of South 32nd Street. Methylene chloride concentrations in samples decreased in the downstream direction indicating that there may be an upstream source. Acetone was detected at the highest concentration (0.106 mg/kg) of the compounds detected. No target PAHs/phenols were detected in any sediment samples. All five target metals were detected in all samples (SEE, 1991).

A Gibbons Creek remnant channel receiving water study was completed in 1996 by the Department of Ecology (Erickson and Tooley, 1996). The study was conducted to assess whether rerouting Gibbons Creek had adversely affected water and sediment quality in the remnant channel due to decreased water flow available to dilute treated processing and cooling water from the industrial park, which runs into the remnant channel. Historical data available for the area, some of which is discussed above, was reviewed for this study, and additional water and sediment samples were subsequently collected. Three water and sediment quality surveys were conducted from September 1994 through January 1995 at four receiving water sites and one storm sewer site (Figure 4-2). The results show that the storm sewer water violates state water quality criteria (WAC 173-201A) for pH, hexavalent chromium (124 to 396 µg/L), total chromium (97 to 511 µg/L), copper (32 to 114 µg/L), zinc (36 to 120 µg/L), and arsenic (74 to 270 µg/L). Sediment samples in the lower channel also contained elevated concentrations of metals, including arsenic, chromium, copper, zinc, cadmium, and lead. Volatile organic compounds (PCE, *cis*-1,2-DCE, TCE, m- and p-xylene, ethylbenzene, toluene, total xylenes, 1,1-dichloroethane [1,1-DCA], 1,1-dichloroethene [1,1-DCE], TCE, o-xylene, and 1,1,2-trichlorotrifluoroethane) were detected at low levels in surface water samples downstream from the South 32nd Street culvert. In addition, six SVOCs [phenol, benzyl alcohol, fluoranthene, pyrene, chrysene, and benzo(k)fluoranthene] were detected in storm sewer samples.

11.3.2 Recent Surface Water and Sediment Assessment

In order to evaluate current conditions, PSC conducted the following work to further evaluate potential impacts to surface water and sediments during the 2007-2009 data gaps investigations:

- Sampling of water at UT-ST-1 (as described in Section 3.5.3.1), a piezometer screened in the “French drain” underlying the storm sewer line that discharges to Gibbons Creek remnant channel;
- Groundwater modeling (as described in Section 7.2.4) to evaluate groundwater discharge from the site to Steigerwald Marsh and the Gibbons Creek Remnant Channel;
- Porewater sampling at six locations in Steigerwald Marsh;
- Sediment sampling at six locations in Steigerwald Marsh and two locations in Gibbons Creek Remnant Channel. An assessment of ecological risk based on recent concentrations of COCs detected in surface water and sediment (Appendix M).

Results of the recent surface water and sediment sampling are shown on Figure 11-47, and an evaluation of these data is presented in Appendix M. Steigerwald Marsh is a wetlands, and so an ecological evaluation was conducted and is presented in Appendix M.1. Since GCRC is a surface water body, evaluation of the GCRC was completed following procedures for surface water evaluations in WAC 173-340-730 (Surface water cleanup standards) and the procedures for sediment evaluations described in WAC 173-340-760 (which addresses Chapter 13-204 WAC, Sediment Management Standards). The evaluation for GCRC is provided in

Appendix M.2. The results of the screening assessment and ecological risk assessment demonstrate that there is no significant potential for adverse ecological impacts to ecological receptors that may utilize the SLNWR and Gibbons Creek remnant channel adjacent to the PSC Washougal facility. Concentrations of metals and organic compounds in groundwater and sediment are substantially below any level of potential concern.

11.3.3 Summary

Early studies conducted in 1990 and 1996 confirmed the presence of several COCs in the adjoining surface water bodies. The PSC site COCs confirmed present in Steigerwald Marsh at that time were VOCs (xylenes) and inorganics (arsenic and zinc) in surface water, and VOCs (xylenes) and inorganics (arsenic, nickel, and zinc) in sediments. COCs confirmed present in Gibbons Creek Remnant Channel were VOCs (ethylbenzene, 1,1,1-trichloroethane, toluene, PCE, and *cis*-1,2-DCE) and inorganics (arsenic, chromium, copper, iron, manganese, nickel, and zinc) in surface water, and VOCs (PCE, *cis*-1,2-DCE, TCE, xylenes, 1,1-DCA, 1,1-DCE, methylene chloride, and toluene), inorganics (arsenic, cadmium, chromium, copper, manganese, lead, nickel, and zinc), and SVOCs (chrysene) in sediments. The historical studies are most useful in confirming that surface water bodies near the Industrial Park are impacted by COCs but have multiple sources of contribution affecting them. It is not possible to distinguish sources of contamination based on these data, because the Gibbons Creek remnant channel receives surface water discharge from multiple properties in the Industrial Park and the remnant channel is interconnected to Steigerwald Marsh. Both surface water bodies also are interconnected to shallow groundwater flowing from multiple properties within the Industrial Park via direct groundwater flow as well as underground utility lines acting as preferential pathways as confirmed in the vicinity of the PSC property.

The recent data collected closer to the PSC property provide a more quantitative assessment of conditions that represent areas expected to be most heavily impacted by releases from the PSC operations. These data show Several COCs (1,4-dioxane and metals in particular) are present at concentrations higher than many of the concentrations observed on the PSC property, indicating that there may be other sources contributing to contaminants present in Steigerwald Marsh and the Gibbons Creek remnant channel even in close proximity to the PSC property. These potential sources include the industrial land use in the area and the variety of industrial facilities discharging to both surface water bodies. However, since these unidentified sources have not been confirmed, it is assumed for the purposes of the RI that the 1,4-dioxane and metals observed in the marsh and remnant channel are the result of groundwater contaminant transport from historical releases that occurred on the PSC property.

Ultimately, it is unknown whether a historical release emanating from the PSC property directly entered either Steigerwald Marsh or the Gibbons Creek Remnant Channel. However, based on investigations performed as part of the RI, it is believed that the underground sewer line has behaved as a groundwater flow preferential pathway. This pathway likely resulted in contaminant transport from the PSC property as groundwater traveled along the utility line and eventually discharged directly to the Gibbons Creek Remnant Channel. Contaminant transport along this preferential pathway has likely contributed to the elevated metals and COCs observed in surface water and sediments observed in the 1990 samples.

The COC detections on the western edge of Steigerwald Marsh are from samples collected immediately downgradient from known source areas. Although no known preferential pathway is present that would rapidly convey COCs to the marsh, it is assumed that source areas present on the PSC property contributed to the metals and/or VOCs observed in marsh porewater and sediment samples. COCs were likely transported along with groundwater flow eastward across the PSC property and ultimately discharged into Steigerwald Marsh. As groundwater discharges from the Shallow Zone to the marsh sediments COCs would be likely to accumulate in the lower permeability silts present there. These marsh soils are not easily flushed and would allow the buildup of COC concentrations over time, potentially leading to the conditions observed in this RI.

The full extent of all COCs in the surface water bodies has not been bounded, and it is anticipated this would be difficult to do given the industrial nature of the area and surface water contributions from multiple sites. Since COCs have been confirmed present in multiple locations, it is anticipated that any additional sampling at greater distances from the PSC property could still yield detections of COCs and likely make distinguishing sources even more difficult. Although COCs have been detected in surface water, sediments, and porewater near the PSC property, the Terrestrial Ecological Evaluation provided in Appendix M demonstrates that the observed concentrations in Steigerwald Marsh and the Gibbons Creek Remnant Channel do not pose an unreasonable risk to human or ecological receptors. Furthermore, any impact to these surface water features caused by contaminants released from the PSC operations will be addressed through the remedial action selected to address COCs in source areas.

11.4 SOIL GAS AND INDOOR AIR RESULTS

As described in Section 4.5, PSC installed 10 permanent soil-gas ports beneath Building 1 in 2001 to determine whether soil gas migrating to indoor air is a significant exposure pathway at the facility (PSC, 2002). Construction diagrams for the gas port wells are provided in Appendix Q. The ports were sampled in October 2001 and again in February 2002 to assess periods of high and low water table conditions. In June 2005, additional sampling was conducted to evaluate indoor air quality (PSC, 2005b). During the same period one soil gas sample was collected from the soil gas port GP-37, located closest to the office area of

Building 1. After this sampling, PSC installed the depressurization system interim measure described in Section 3.4.4, instead of pursuing additional sampling to confirm whether or not soil gas is affecting indoor air. Following system installation, PSC replicated the June sampling during November 2005, collecting two indoor air, one ambient outdoor air, and one soil gas sample. Additionally, one indoor air sample and one ambient air sample were collected in June 2010 to evaluate results of five years of system operations. Results from both the 2005 and 2010 sampling indicated that the system was functioning as designed. Results of air sampling are summarized in Appendix R.

11.5 SUMMARY OF NATURE AND EXTENT

The nature and extent of the various COCs at the site have been described in detail in this section. This subsection provides a summary of the section. Specific data gaps are recognized for each area, and distinguished from data needs required to complete the RI.

The approximate areas of most highly impacted soil and groundwater are shown on Figure 11-48 for the Shallow Groundwater Zone and Figure 11-49 for the Lower Aquifer.

The areas that highlight impacted groundwater are based on the more recent data from the third quarter 2010 through the second quarter 2011. The areas of Buildings 2 and 3 were not highlighted in these figures because concentrations in those areas are much lower than the areas highlighted on Figures 11-48 and 11-49. The intent of the figures was not to show all areas above cleanup levels, but to visually show the site areas that appear to be contributing most significantly to groundwater contamination and driving risk. To illustrate up-to-date conditions at the site, Figures 11-48 and 11-49 also show the highest concentrations of analytes detected in groundwater samples collected from the third quarter 2010 through the second quarter 2011. Data used to establish the nature and extent of contamination are considered to be highest quality or good-quality data based on DQOs established in this RI. While historical data are used that were of lower quality, abundant recent high quality data exists to supplement and confirm findings. A wide range of COCs have been identified at the site in soil and/or groundwater at concentrations above PCLs; these COCs include VOCs, SVOCs, hydrocarbons, and a number of inorganics. Despite the range of COCs, the majority of the site is not impacted above PCLs, or impacts are isolated. The following general areas of the PSC property are discussed in summary in this section: former tank farm area and areas east and north, Gibbons Creek Remnant Channel and Steigerwald Marsh, Buildings 2 and 3, and the former waste oil tank area.

As described in Section 7.2.1.2, vertical gradients at the site can be both upward and downward and depend on the season and other influences such as the Columbia River stage. Therefore, while residual COCs in the Silt Layer appear to be affecting the Lower Aquifer to a greater extent, this is a factor for the Shallow Groundwater Zone as well. As illustrated in Figures 11-48 and 11-49, the Lower Aquifer is most heavily affected in the area of the Former

Tank Farm, and this is likely the result of residual contamination in the Silt Layer migrating downward. The Shallow Groundwater Zone still shows some effect, but the magnitude is much lower. The higher concentrations observed in the Shallow Groundwater Zone are farther east of the Former Tank Farm and likely more affected by the residual shallow soil contamination present underneath Building 1, leaching COCs that migrate east in the Shallow Groundwater Zone.

11.5.1 Former Tank Farm Area

Historically, the former tank farm area is the primary area of soil and groundwater impacts on the site (Figures 11-48 and 11-49). A source removal interim action was conducted in 1997 to remove all the soil from the former tank farm area down to the top of the Silt Layer; but COCs remain under Building 1 and adsorbed into the underlying Silt Layer.

11.5.1.1 Soil

Historically, VOCs and inorganics have been the primary COCs detected in soil. Some soil samples collected from areas in the vicinity of the former tank farm area have exhibited elevated concentrations of PCE and TCE. Concentrations are particularly high in the Silt Layer, confirming that residual concentrations of COCs are a likely source of groundwater impact at the site. Areas of elevated concentrations are not bounded by other soil samples, though concentrations drop by orders of magnitude in samples collected in areas surrounding Building 1 and the former tank farm. This includes areas immediately south of B-21, which is located just south of the old tank farm. A soil sample from B-21 at 1 foot bgs contained PCE at a concentration of 14 µg/kg. However, monitoring well MW-1 is located immediately downgradient of the B-21 sample. Any PCE impacts to groundwater resulting from PCE in soil near B-21 would be captured by analytical data associated with MW-1. As discussed previously, recent PCE concentrations at MW-1 have been relatively low. This data gap associated with B-21 will not impact conclusions of the RI or prevent the selection of remedies during the feasibility study.

Elevated PCE (50.7 µg/kg) was also observed in a soil sample collected from 4 feet bgs at GP-37, which is located on the west side of Building 1. Elevated levels of PCE in soil have not been bounded to the northeast, east, or southeast of this location, which would fall beneath Building 1. However, monitoring well MC-21 is located immediately downgradient of GP-37. Any PCE impacts to groundwater resulting from affected soil near GP-37 would be evident in analytical data associated with MC-21. As discussed below in Section 11.5.2, TCE concentrations in MC-21 from the third quarter 2010 through the second quarter 2011 have been below detection limits. Ultimately, the data gaps associated with elevated PCE in soil at GP-37 will not impact the conclusions of the RI or prevent the selection of an appropriate remedy in the feasibility study.

Many of the soil samples that were historically collected in the immediate vicinity of the former tank farm area and beneath Building 1 were not analyzed for metals. However, as discussed above for chlorinated ethenes, the distribution of wells in the Shallow Groundwater Zone allows the collection of samples that would identify groundwater impacted by elevated metals concentrations that originate beneath the former tank farm area and Building 1. Therefore, while there may be a data gap associated with metals concentrations in soils within these areas, continued groundwater monitoring would identify elevated levels of metals in groundwater that originates beneath central portions of the former tank farm area and Building 1. The absence of metals data for soil in these areas does not present a data gap that would impact conclusions of the RI or selection of an appropriate remedy in the feasibility study.

11.5.1.2 Shallow Groundwater

Recent groundwater analytical data collected between the third quarter 2011 and second quarter 2012 indicate that the maximum VOC concentrations observed in Shallow Groundwater Zone samples from locations within the former tank farm area (i.e., MC-24, MC-25, and MC-1) are relatively low (Figure 11-48). Sample concentrations from these wells are generally within a comparable range as concentrations observed north of the source area (GP-104, GP-105, GP-113, and MC-8), but lower than the range of concentrations observed east of the former tank farm area (Figure 11-48). COC concentrations in the source area have declined considerably from historic levels as a result of the source removal interim action, natural attenuation, and possibly aided by an enhanced bioremediation pilot test conducted in 2001. The data indicate that impacted soil remains present beneath Building 1, at least along the western edge where releases in the former tank farm would have migrated into the Shallow Groundwater Zone. The elevated COC concentrations described in this section are east of Building 1 in this downgradient area, whereas wells in and near the former tank farm are upgradient of Building 1 in areas that have had source removal.

Close to the former tank farm area, 1,4-dioxane concentrations are less than or not detected at the reporting limit of 1 µg/L within the Shallow Aquifer (MC-1, MC-21, MC-25). 1,4-Dioxane was not observed at detectable concentrations within the former tank farm area (i.e., MC-24, MC-25, and MC-1) or in locations to the north (GP-112, GP-113, GP-108, and MC-8). In general, the highest concentrations are to the east near South 32nd Street (i.e., MC-14, MC-20, and MC-123). 1,4-Dioxane concentrations in groundwater samples collected from the Silt Layer as part of the 2011 Data Gaps investigation varied from non-detect (GP-117) to 78 µg/L at GP-122 in the middle of the former tank farm area.

Recent data collected during 2011 and into 2012 show that arsenic concentrations remain below the PCL (22.84 µg/L) in the Sand Fill but exceed the PCL within the Silt Layer in areas west of Building 2. Specifically, arsenic exceeded the PCL at GP-114 (43.8 µg/L). Arsenic concentrations farther north are comparable to those observed in the former tank farm area, but arsenic concentrations are higher to the east and southeast.

Zinc and copper concentrations above their respective PCLs have been observed at some direct-push borings advanced near the former tank farm area in 2007. Zinc exceeded the PCL (32 µg/L) in the Shallow Groundwater Zone groundwater sample from GP-100 (126 µg/L). This sample was collected just north of the former tank farm area. Copper concentrations greater than the PCL (3.5 µg/L) were observed in the vicinity of the former tank farm area at GP-100 (43.1 µg/L) and MW-24 (6.82 µg/L). Inorganics in groundwater that exceed PCLs appear to be related to reducing conditions associated with former marsh sediments underlying the entire site and with reducing conditions associated with natural degradation of organic COCs. As a result, these COCs do not likely represent a release from facility operations but instead are a secondary result of impacts of organic COCs to groundwater and naturally occurring reducing conditions related to the organic-rich Silt Aquitard.

Although no monitoring wells are centrally located within the former tank farm area, this source area is suitably bounded by groundwater monitoring wells screened in the Shallow Groundwater Zone. These wells include MC-24 and MC-25, which are located immediately south and north of the tank farm area, respectively. In addition, monitoring well MC-1 is located immediately southeast of the source area and MC-21 is positioned approximately 100 feet east of Building 1. In addition, the tank farm area has been excavated and completely replaced by clean fill, which was part of the rationale for placement of wells at the perimeter rather than directly in the backfilled area. The placement of monitoring wells around the perimeter of the former tank farm allows characterization of affected shallow groundwater underlying the tank farm area. In addition, recent Silt Layer groundwater samples collected from direct-push borings have also provided additional quantification of affected groundwater beneath the former tank farm area and newer fill.

Certain data gaps are present related to the distribution of monitoring wells in the Shallow Groundwater Zone. Specifically, no shallow wells are located between MC-107 and the western side of Building 1 where groundwater samples could be collected directly from the Sand Fill. Nonetheless, the 2011 Data Gaps Investigation provided soil and groundwater COC concentrations from the Silt Layer, which is connected to the Shallow Groundwater Zone (Chapters 6 and 7). The results of this data gaps investigation demonstrated the Silt Layer likely behaves as a source area to the Shallow Groundwater Zone and the Lower Aquifer. Furthermore, as discussed above, the current shallow well distribution still allows adequate characterization and bounds constituent concentrations in this area. Ultimately the absence of a Shallow Groundwater Zone monitoring well between MC-107 and the west side of Building 1 does not impact the conclusions of the RI or prevent selection of an appropriate remedy in the feasibility study because the full historical data record for the site provides sufficient information for the nature of releases and how COCs have migrated in the subsurface over time. We know:

- Information about where the majority of releases occurred (Former Tank Farm),
- The concentrations in groundwater surrounding this area are,
- How concentrations have changed over time in areas around the Former Tank Farm, and
- Concentrations in shallow groundwater within the Silt Layer in the Former Tank Farm area based on the 2011 discrete sampling event.

The cumulative conceptual model these data paint is sufficient for the purposes of the RI.

11.5.1.3 Lower Aquifer Groundwater

Groundwater analytical data collected between the third quarter 2011 and second quarter 2012 from the Lower Aquifer exhibit much higher concentrations of select VOCs than observed in shallow groundwater. Groundwater samples collected from within the Lower Aquifer show PCE and TCE concentrations comparable to those observed in the Shallow Groundwater Zone. However, the maximum VC and *cis*-1,2-DCE concentrations were as high as 84 µg/Land 1,600 µg/L (both at MC-25D), respectively, during the same period. Historically, 1,1,1-TCA, 1,1-DCA, 1,1-DCE, have also been detected at MC-25D in addition to the current detections of PCE, TCE, *cis*-1,2-DCE, and VC. Similarly, 1,1,1-TCA and 1,1-DCA have historically been detected at MC-24D in addition to the current detections of PCE, TCE, *cis*-1,2-DCE, and VC.

Within the Lower Aquifer, 1,4-dioxane concentrations in the area of impacted groundwater beneath the former tank farm area range from non-detect (MC-24D2 and MC-26D2) to 11 µg/L (MC-24D), with higher concentrations in the upper wells within the Lower Aquifer (MC-24D and MC-25D).

Zinc and copper concentrations above their respective PCLs have been observed at some direct-push borings advanced near the former tank farm area in 2007. A sample collected from GP-95 (363 µg/L) exceeded the PCL (32 µg/L) for Zinc. GP-95 was located northwest of the former tank farm area. Copper concentrations above the PCL (3.5 µg/L) were observed at MC-25D (14 µg/L) and GP-95 (144 µg/L).

Certain data gaps exist in the Lower Aquifer due to the distribution of monitoring wells. Currently no Lower Aquifer wells are centrally located in the former tank farm area or immediately east of Building 1 (i.e., near MC-1); however, MC-15D, MC-17D, and MC-19D provide water quality data for groundwater to the south and southeast of the source area (Figure 4-1). These wells bound the zone where groundwater from beneath Building 1 is likely to migrate, thereby providing sufficient information to complete the RI and select an appropriate remedy in the feasibility study.

The data gap associated with the absence of Lower Aquifer wells in the central portion of the former tank farm area was addressed by the 2011 Data Gaps Investigation. The presence of elevated concentrations of COCs in the soil and groundwater samples collected in the tank farm area as part of that investigation supports the hypothesis that the Silt Layer is retaining contamination that continues to diffuse from the Silt Layer, and that contaminated shallow soils remain beneath the former tank farm area and Building 1. Concentrations are low enough that visual evidence of contamination was not observed during the 2011 investigation, and historical logs show little evidence to document significant signs of contamination. Nevertheless, moderate concentrations of COCs contained within the Silt Layer continue to gradually migrate into the Lower Aquifer. These COCs in the Silt Layer are the likely source for the higher VOC concentrations observed in the Lower Aquifer compared to the Shallow Groundwater Zone beneath the former tank farm area.

Other data gaps also exist due to the placement of Lower Aquifer monitoring wells. A significant distance where no monitoring wells are present separates the southwest side of the former tank farm area and Lower Aquifer Well MC-10D. However, no additional major source areas have been identified within this area from historical direct-push boring data. Therefore, the distance between the former tank farm area and MC-10D is not a substantive data gap. Any contaminant migration to the southwest of the source area would be indentified from analytical data collected at MC-10D. Furthermore, additional groundwater data from this area is unlikely to change the conclusions of the RI or selection of remedies in the feasibility study. The current network of Lower Aquifer data points have determined an area where cleanup is needed both vertically and horizontally at the site.

11.5.2 East of the Former Tank Farm Area

The area east of the former tank farm area lies immediately downgradient of the former tank farm area and has historically shown some of the highest COC concentrations in the Shallow Groundwater Zone. Historical sampling indicates that residual contamination is present in soil and groundwater beneath Building 1 in this area. While the depressurization system appears to have been effective, residual contamination under Building 1 will be a concern addressed in the FS, including anticipation of any potential changes to the building, building maintenance issues, or changes in site use.

11.5.2.1 Shallow Groundwater

VOC concentrations above PCLs but relatively low are present in the area east of the former tank farm from MC-14 toward MC-20 and MC-123 (Figure 11-48). Monitoring wells MC-20 and MC-123 are located east of South 32nd Street on the edge of Steigerwald Marsh. During the period from the third quarter 2011 through the second quarter 2012, maximum PCE concentrations at MC-14, MC-20, and MC-123 were 0.10 μg/L, 0.37 μg/L, and 0.14 μg/L, respectively, and maximum TCE concentrations in the same wells were 0.39 μg/L 0.95 μg/L, below detection, respectively (Figure 11-48). Groundwater samples at MC-14 exhibited higher maximum concentrations, though still relatively low levels, of *cis*-1,2-DCE (1.6 μg/L) and VC (1.4 μg/L); lower concentrations of *cis*-1,2-DCE and VC were observed at MC-20 and MC-123 (Figure 11-48).

Similarly, the maximum concentration of 1,4-dioxane (270 μg/L) during this period was observed at MC-14, with lower concentrations observed at MC-20 (13 μg/L), MC-123 (12 μg/L), and other areas of the property.

Immediately upgradient of MC-14 at MC-21, concentrations of chlorinated ethenes and 1,4-dioxane in the Shallow Aquifer were below 0.5 μg/L between the third quarter 2011 and second quarter 2012. PCE, TCE, *cis*-1,2-DCE, and VC concentrations were also low in wells to the north and south (MC-13, MC-15, MC-32, and MC-122) of the area of highly impacted shallow groundwater shown in Figure 11-48. In the Shallow Groundwater Zone, the area of affected groundwater located east of the former tank farm area is well bounded by data from existing monitoring wells.

Historically, benzene concentrations exceeded the PCL in the Shallow Groundwater Zone at MC-14 (8.9 μg/L) and GP-101 (2.5 μg/L) (Figure 11-26). Groundwater samples collected from monitoring wells MC-13, MC-15, MC-20, MC-21, and MC-123 were below the PCL for benzene (Figure 11-26). More recently, during the period from the third quarter 2011 through the second quarter 2012, benzene concentrations at MC-14 have been lower, ranging from 1.4 μg/L to 2.3 μg/L. In addition, benzene has not exceeded the PCL at nearby wells MC-13, MC-15, MC-20, MC-21, MC-122, or MC-123 during this time period.

Arsenic concentrations in shallow groundwater east of the former tank farm area exceeded the PCL (22.84 μg/L) only at MC-14 for samples collected between the third quarter 2011 and the second quarter 2012. Arsenic concentrations were all below the PCL for arsenic at MC-13, MC-122, MC-20, and MC-123. To the southeast of the area identified in Figure 11-48 as the area of highly impacted shallow groundwater, a sample from well MC-32 had an arsenic concentration of 49.3 μg/L. Inorganic constituents in groundwater that exceed PCLs are likely related to reducing conditions associated with the former marsh sediments beneath the site and with reducing conditions associated with natural degradation of organic COCs.

11.5.2.2 Lower Aquifer

The concentrations of *cis*-1,2-DCE, PCE, TCE, VC, and 1,4-dioxane observed between the third quarter 2011 and second quarter 2012 were below detection limits at MC-14D, which is located east of the former tank farm area and screened in the Lower Aquifer (Figure 11-49). The concentrations observed at MC-14 suggest that the COCs present at MC-14 are generally confined to the Shallow Groundwater Zone. To the north and east of MC-14D, maximum concentrations of PCE, TCE, *cis*-1,2-DCE, VC, and 1,4-dioxane at MC-13D and MC-20D were below detection limits, with the exception of a detection of TCE at the reporting limit of 0.5 µg/L at MC-13D (Figure 11-49).

Groundwater samples collected east of the former tank farm area in the Lower Aquifer have not exceeded the PCL for benzene, total arsenic, or total zinc. Cooper concentrations exceeded the PCL for total copper (3.5 µg/L) in only one sample collected from MC-20D in 2007 with a concentration of 3.61 µg/L. As discussed above, inorganics in groundwater that exceed PCLs are likely related to reducing conditions associated with the former marsh sediments beneath the site and with reducing conditions associated with natural degradation of organic COCs.

11.5.3 North of the Former Tank Farm Area

Historically, north of the former tank farm has been an area of impacted soil and groundwater associated with facility releases (Figures 11-48 and 11-49). It has been assumed that these impacts are the result of contaminant migration from the source area beneath the former tank farm area. However, it has not been ruled out that a separate release may have contributed to the elevated levels of COCs north of the former tank farm area. Ultimately, the direct cause of the elevated levels of COCs observed in this area has not been definitively established. This area represents conditions on the northern edge of the PSC property.

11.5.3.1 Soil

Elevated levels of PCE were detected in soils at boring IAB-03, at the north property line. This contamination is not bounded to the northeast or east. Nor have elevated levels of TCE at IAB-01, near well MC-118D, been bounded to the north or northwest. This impact is bounded to the west of IAB-01, but at a point 75 feet away. While these soil data are over 10 years old, groundwater data in this area similarly show chlorinated VOC impacts, as described below.

11.5.3.2 Shallow Groundwater

In the shallow groundwater zone, elevated concentrations of PCE greater than the PCL have historically been detected in groundwater samples collected from MC-8 (2.36 µg/L) **and** GP-116 (4.5 µg/L) (Figure 11-7). At GP-97 and GP-116, *cis*-1,2-DCE concentrations have been as high as 1.7 µg/L and 450 µg/L, respectively (Figure 11-9). *cis*-1,2-DCE has also been detected at MC-8, GP-112, and GP-113, although concentrations were less than the PCL. TCE concentrations above the PCL have been detected at GP-97, GP-116, GP-117, GP-122, MC-1, MC-14, MC-15, MC-20, MC-21, and MC-122 at levels ranging from 0.62 µg/L to 24 µg/L (Figure 11-11). VC concentrations above the PCL have been detected at MC-8, GP-97, GP-112, GP-113, and GP-116 at levels ranging from 0.5 µg/L to 7.2 µg/L (Figure 11-13).

More recent VOC data collected between the third quarter 2011 and the second quarter 2012 show that concentrations north of the tank farm area have remained relatively low. Groundwater data during this period collected at MC-8 have shown chlorinated ethene concentrations below 1 µg/L (Figure 11-48).

The VOC data north of the former tank farm area is bounded north of the property by samples collected from GP-104 and GP-105, where VOC concentrations did not exceed their respective PCLs (Figure 11-7, Figure 11-9, Figure 11-11, and Figure 11-13). In addition, VOC concentrations in groundwater are well characterized to the east by quarterly groundwater samples collected from MC-13, PZU-4, and PZU-5. Recent VOC concentrations at these three locations are all less than 0.5 µg/L (Figure 11-48). VOC concentrations in groundwater are also well characterized west of the area north of the former tank farm using data collected from GP-104 and MC-25. In both these locations, recent VOC concentrations have been less than 1 µg/L (Figure 11-48).

Historically, concentrations of 1,4-dioxane exceed the PCL only at GP-116 (11 µg/L). Concentrations above the detection limit but below the PCL have historically been observed at MC-8 (Figure 11-21). More recent 1,4-dioxane data collected from the third quarter 2011 through the second quarter 2012 show 1,4-dioxane concentrations are below the detection limit at MC-8 (Figure 11-48). North of the former tank farm, concentrations of 1,4-dioxane in groundwater are well bounded by samples collected from GP-100, GP-104, GP-105, GP-112, and GP-113, where 1,4-dioxane was not detected.

Total arsenic was not detected above the PCL in this area. A total zinc concentration above the PCL was detected at GP-112 (37.6 µg/L). Although below the PCL, total zinc concentrations above the detection limit were observed at GP-97, GP-104, GP-105, and GP-113 (Figure 11-30). Total copper concentrations above the PCL were detected in the shallow groundwater zone at GP-104 (8.55 µg/L), GP-112 (6.26 µg/L), and GP-113 (3.59 µg/L).

As mentioned previously, concentrations of inorganic constituents in groundwater greater than the PCLs are likely related to reducing conditions associated with former marsh sediments that underlie the entire site as well as the reducing conditions associated with natural degradation of organic COCs. As a result, these COCs do not likely represent a release from facility operations but instead are a secondary result of impacts of organic COCs to groundwater and naturally occurring reducing conditions related to the organic-rich Silt Layer.

Ultimately, the COCs north of the tank farm area and within the Shallow Groundwater Zone are similar in type and concentration to those observed in the former fuel farm area.

11.5.3.3 Lower Aquifer

Chlorinated ethene concentrations in the Lower Aquifer are generally higher than those observed in the Shallow Groundwater Zone in areas north of the former tank farm area. In the Lower Groundwater Zone, PCE concentrations have been above the PCL (0.69 µg/L) at MC-118D (29.4 µg/L), MC-118D2 (3.1 µg/L), and GP-97 (20 µg/L) (Figure 11-8). In addition, *cis*-1,2-DCE concentrations in the area north of the former tank farm have exceeded the PCL (16 µg/L) at MC-118D (160 µg/L), MC-118D2 (62 µg/L), and GP-97 (40 µg/L) (Figure 11-10). *Cis*-1,2-DCE has also been detected at MC-27D, but concentrations are below the PCL. Concentrations of TCE have been detected above the PCL (0.54 µg/L) at many of the same locations as PCE. Wells MC-15D (0.67 µg/L), MC-24D (31 µg/L), MC-25D (5.3 µg/L), MC-118D (3.07 µg/L), MC-118D2 (0.95 µg/L), and direct-push boring GP-97 (5.6 µg/L) all had groundwater samples exceeding the PCL for TCE (Figure 11-12). Vinyl chloride concentrations in the Lower Aquifer exceeded the PCL (0.025 µg/L) in groundwater samples collected from MC-118D (18 µg/L), MC-118D2 (6.9 µg/L), and GP-97 (0.3 µg/L) (Figure 11-14). VC was also detected at GP-96, although below the PCL. 1,1,1-TCA and 1,1-DCA have also been detected at MC-118D and MC-118D2.

Recent groundwater data collected from the third quarter 2011 through the second quarter 2012 show that most chlorinated ethene concentrations have remained consistent with historic values (Figure 11-49). Well MC-118D continues to exhibit the highest chlorinated ethene concentrations, with elevated concentrations of PCE (4.4 µg/L), TCE (1.3 µg/L), *cis*-1,2-DCE (140 µg/L), and VC (16 µg/L) relative to MC-27D, MC-28D, and MC-118D2. The lower concentrations observed at MC-118D2 suggest that contamination is restricted to the upper regions of the Lower Groundwater Zone in the vicinity of MC-118D.

Elevated concentrations of chlorinated ethenes immediately north of the former tank farm area are bounded to the east by concentrations below the reporting limit at MC-28D and MC-13D (Figure 11-49). To the north, elevated concentrations closer to the tank farm area are bounded by groundwater concentrations that were below the detection limit or below the PCL in samples collected from GP-96, GP-98, and GP-99 (Figure 11-8, Figure 11-10, Figure 11-12, and Figure 11-14). To the west, chlorinated ethene concentrations are bounded by groundwater samples collected from GP-95, where concentrations were below detection limits for PCE, *cis*-1,2-DCE, TCE, and VC.

Concentrations of benzene in groundwater samples from the Lower Aquifer have historically been above the PCL (0.8 µg/L) in areas north of the former tank farm area in samples collected at wells MC-26D2 (0.96 µg/L), MC-118D (0.86 µg/L), and direct-push boring GP-97 (13 µg/L) (Figure 11-27). A single detection for benzene above the PCL did occur at MC-118D from the third quarter 2011 through the second quarter 2012. No benzene concentrations above the PCL have been observed in samples from MC-26D2 during this period. Historically, benzene has also been detected at monitoring wells MC-27D (0.17 µg/L), MC-28D (0.1 µg/L), and MC-118D2 (0.43 µg/L), but concentrations have been below the PCL (Figure 11-27).

In areas north of the former tank farm within the Lower Aquifer, 1,4-dioxane concentrations above or equal to the PCL (1 µg/L) range from 1 µg/L at GP-93 to 9.6 µg/L at MC-118D. Concentrations of 1,4-dioxane above the PCL extend off the PSC property boundary to the north, but these concentrations are only slightly higher than the PCL (Figure 11-22). To the east, the elevated concentrations of 1,4-dioxane are bounded by either non-detects or concentrations below the PCL at MC-28D and GP-97. To the west, concentrations have also historically been elevated at GP-95 and as far west as MC-12D (Figure 11-22 and Figure 11-49). These areas of known elevated 1,4-dioxane concentrations north of the property boundary and extending westward do not present significant data gaps.

In areas north of the former tank farm area, total arsenic concentrations in the Lower Aquifer have exceeded the PCL (1.42 µg/L) at GP-96, GP-98, and GP-99. Monitoring well MC-118D is the only well with arsenic concentrations in groundwater consistently exceeding the PCL. Arsenic concentrations in recent groundwater samples collected from the third quarter 2011 through the second quarter 2012 from monitoring wells, MC-118D2, MC-26D2, MC-27D, and MC-28D did not exceed the arsenic PCL.

Total zinc concentrations in groundwater exceeded the PCL (32 µg/L) at GP-98 (91.8 µg/L) and GP-99 (322 µg/L) (Figure 11-31). Total zinc concentration was also greater than the PCL in a sample collected from GP-95 (363 µg/L). Zinc was detected in GP-96, although the concentration was below the PCL. Total zinc concentrations were below detection limits in a groundwater sample collected from direct-push boring GP-97.

Similar to total zinc concentrations, total copper concentrations exceeded the PCL (3.5 μg/L) in groundwater samples collected from GP-95 (144 μg/L), GP-98 (18.3 μg/L), and GP-99 (100 μg/L) (Figure 11-33). The total copper concentrations in samples collected from GP-96 and GP-97 were below detection limits.

As discussed above, inorganic concentrations in groundwater greater than the PCLs are likely related to reducing conditions associated with former marsh sediments that are beneath the entire site in addition to the reducing conditions associated with natural degradation of organic COCs. As a result, these COCs do not likely represent a release from facility operations but instead are a secondary result of impacts of organic COCs to groundwater and naturally occurring reducing conditions related to the organic-rich Silt Layer.

Although elevated concentrations of COCs near MC-118D and GP-97 are well bounded, small data gaps still remain related to the spatial resolution of sampling data. Specifically, 100 foot gaps to the northwest and southwest of MC-118D. In addition, no wells are present within more than 200 feet to the south-southeast of GP-97. These data gaps do not affect the conclusions of the RI and will not prevent the selection of an appropriate remedy in the feasibility study because other wells at greater distance and in other zones provide sufficient information to characterize conditions for the RI.

11.5.4. Steigerwald Marsh

Elevated levels of metals, chlorinated VOCs, and 1,4-dioxane have been detected in shallow groundwater beyond the PSC property boundary to the east and within the Steigerwald Marsh. However, the concentrations of COCs present are not expected to pose a risk to ecological receptors in this surface water body, as described further in Appendix M.1. Specific findings of the RI for Steigerwald Marsh are summarized in this section.

Chlorinated VOCs were detected in sediments and porewater in the marsh, including very low levels of VC at MC-SM2 and MC-SM3 (<0.4 μg/L). VC was not detected farther north or east, but was detected in upgradient groundwater at wells MC-123 and MC-122. PCE was detected in marsh sediments at MC-SM4 (4 μg/kg), but not in porewater, nor was it detected in groundwater at upgradient monitoring wells or any other marsh sampling location. Additionally, ethylbenzene was detected in porewater at MC-SM-5 and acetone was detected in sediment above the applicable PCL at all locations.

1,4-Dioxane was detected in the marsh in porewater (31 µg/L) and sediments (47 µg/kg) at MC-SM2. It was also detected in porewater at MC-SM3 at similar concentrations and in groundwater from monitoring wells upgradient of these marsh sampling locations (MC-123 and MC-20). 1,4-Dioxane was not detected farther north or east in sediments or porewater.

Several inorganics were also detected in the sediments and porewater. Arsenic was detected in porewater at MC-SM6 at 6 µg/L and at a similar level at MC-SM2. Concentrations at all porewater locations ranged from 1 to 6 µg/L. Barium, cadmium, cobalt, iron, magnesium, managanese, nickel, and vanadium were all detected in porewater samples at concentrations above groundwater PCLs. Iron and vanadium were also detected in marsh sediments at concentrations above the soil PCL. Copper was detected in upgradient groundwater at concentrations above the PCL.

11.5.5 Gibbons Creek Remnant Channel

An underground utility line on East 32nd Street appears to act as a preferential pathway for groundwater, which would cause groundwater to flow not only east toward the marsh, but also north toward the Gibbons Creek Remnant Channel once it is off site. Metals and VOCs were detected in the sediment samples and arsenic and zinc were detected in the porewater samples collected from the GCRC. Specific findings of the RI for the Gibbon Creek Remnant Channel are summarized in this section.

Surface water samples were collected at locations SW-2 and SW-3 between April 1990 and January 1991 and analyzed selectively for metals, VOCs, and SVOCs. Results showed arsenic and zinc elevated slightly above the screening level in a sample collected from location SW-2, collected immediately east of the culvert that runs beneath 32nd Street. Arsenic was detected in the surface water sample during August and January, and the concentrations were very close to the reporting limit achieved by the lab at that time. Zinc was only detected in the sample from SW-2 during the January event. None of the detected concentrations from SW-3 exceeded the screening levels.

The sediment results were compared to the 2012 draft Washington fresh water sediment standards. Both the cleanup screening level (CSL) and the sediment cleanup objective (SCO) are presented. Arsenic was detected at a concentration greater than both the CSL and SCO in one of the two samples collected in 2008. Arsenic was also detected in one of the four samples collected in 1990; however, the concentration detected only slightly exceeded the SCO. There are currently no draft screening levels for total petroleum hydrocarbons as gasoline or VOCs.

11.5.6 Buildings 2 and 3

Analysis of soil samples collected between, around, and underneath Building 2 and Building 3 identified chlorinated VOCs and inorganics above PCLs in isolated locations. Chlorinated VOCs were also found in groundwater in this area, but groundwater is not impacted outside the source area. As with the area of the Waste Oil Tank, the contamination associated with this area appears to be minimal and is not migrating. Although this area has not been bounded immediately to the northwest, conditions surrounding the boring in other directions suggest the impacted area is small and limited to soils directly surrounding Building 2.

An area of uncertainty regarding the extent of TCE impact is present to the northeast, east, and southeast of B-6 and R-8. While elevated concentrations of VOCs have been identified in shallow soils in this area, the specific VOC concentrations at depth beneath Buildings 2 and 3 and in the vicinity are an acceptable unknown since they do not appear to be affecting downgradient areas and will not prevent the assessment of remedial alternatives in this area of the facility.

Cyanide was detected in most samples analyzed at concentrations ranging from 1.41 mg/kg to 194.4 mg/kg in the areas north of Building 2 and underneath both Building 2 and Building 3. These samples were collected in the upper 0.5 feet of soil beneath the concrete foundation of these buildings. The highest concentrations were found in samples collected in the northeast corner of Building 3. The full extent of cyanide is not well bounded since most of this sampling was done as part of the RCRA closure and did not extend beyond the buildings. All of the cyanide detections are well below alternative cleanup levels considered in developing PCLs for all pathways except groundwater protection, which drives the PCL selected. While cyanide has not been detected in groundwater above the PCL, cyanide has not been analyzed extensively in groundwater. Cyanide will be analyzed at wells MC-15, MC-16, and MC-17 as part of quarterly sampling for a period of two quarters, in third and fourth quarters, 2013. These additional data will be considered during development of the FS and Cleanup Action Plan. The data gaps present in the Building 2 and 3 area are acceptable: the absence of data is unlikely to change the type of remedy selected since the data have sufficiently characterized the problem as primarily a soil issue in this area. If the additional groundwater data does not fill in all data gaps, and specific uncertainties require additional data for design of a cleanup action, they will be addressed as part of engineering design, since conditions are expected to continue to gradually change over time between completion of this RI and implementation of cleanup.

11.5.7 Waste Oil Tank Area

PCE is present in soil in a small isolated area immediately west of the Waste Oil Tank area at concentrations above its soil PCL. No groundwater impacts are associated with this area, and no other COCs have been identified in this area. Although this area has not been bounded immediately to the north, conditions to the east (GP-94), west (GP-110), and south (GP-111), as well as the lack of impact observed in groundwater, indicate that the impacted area is small and limited to soils directly surrounding the waste oil tank area.

Relatively new monitoring well MC-33 in this area has shown very low level concentrations of VC and *cis*-1,2-DCE (<0.1 µg/L) and higher concentrations of arsenic, as high as 32.8 µg/L, above the PCL of 22.84 µg/L.

11.6 CONCLUSIONS

The review of site data shows that the primary COCs detected above PCLs are a subset of the extensive COC list established in Section 10. In soil, primary soil COCs include:

- TCE and PCE, and their breakdown component, VC
- Limited areas of BTEX
- Inorganics including cyanide, arsenic, copper, silver, zinc, and barium

There are very few areas of soil concentrations exceeding PCLs for TPH, pesticides, or SVOCs, and no instances of PCBs being detected above PCLs. In groundwater, the primary COCs are similar to soil with the same VOCs consistently present, along with 1,4-dioxane, arsenic, and a few other inorganic COCs. The review of nature and extent of COCs in this section confirmed that the extensive lists of COCs presented in Section 10 resulted from a conservative screening process appropriate for the site.

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TABLES

TABLE 11-1

SOIL VOC RESULTS MTCA METHOD C CLEANUP LEVEL COMPARISON SUMMARY

PSC Washougal Facility
Washougal, Washington

Analyte	Maximum Concentration (mg/Kg)	Calculated Maximum Concentration (mg/Kg)	MTCA Method C Carcinogenic Screening Level (mg/Kg)	MTCA Method C Non Carcinogenic Screening Level (mg/Kg)
1,1,1-Trichloroethane	13	130	NE	7,000,000
1,1,2,2-Tetrachloroethane	1.7	17	656	NE
1,1,2-Trichloroethane	1.8	18	2,303	NE
1,1,2-Trichlorotrifluoroethane	0.027	0.27	NE	105,000,000
1,1-dichloroethane	0.291	2.91	NE	700,000
1,1-Dichloroethene	0.0027	0.027	NE	175,000
1,2,3-Trichlorobenzene	0.018	0.18	NE	NE
1,2,3-Trichloropropane	0.048	0.48	4	NE
1,2,4-Trichlorobenzene	0.0102	0.102	4,530	NE
1,2,4-Trimethylbenzene	63	630	NE	NE
1,2-Dibromo-3-chloropropane	0.012	0.12	164	NE
1,2-dichlorobenzene	2.88	28.8	NE	315,000
1,2-Dichloropropane	0.00487	0.0487	NE	NE
1,3,5-Trimethylbenzene	23	230	NE	35,000
1,3-dichlorobenzene	0.16	1.6	NE	NE
1,4-Dichlorobenzene	0.35	3.5	NE	NE
2-Butanone	0.04	0.4	NE	2,100,000
2-Butanone (MEK)	9.47	94.7	NE	2,100,000
2-Chlorotoluene	4.4	44	NE	70,000
2-Hexanone	8.4	84	NE	NE
2-methylpentane	1.6	16	NE	NE
3-methylpentane	1.22	12.2	NE	NE
4-Chlorotoluene	0.0714	0.714	NE	NE
4-Methyl-2-Pentanone (MIBK)	87	870	NE	280,000
Acetone	890	8900	NE	3,150,000
benzene	0.546	5.46	2,386	NE
Bromobenzene	0.0023	0.023	NE	NE
Carbon disulfide	0.106	1.06	NE	350,000
Chloroethane	6.7	67	NE	NE
Chloroform	0.0021	0.021	NE	35,000
Chloromethane	0.025	0.25	NE	NE
cis-1,2-dichloroethene	0.593	5.93	NE	7,000
Dichlorodifluoromethane	0.0202	0.202	NE	700,000
Ethylbenzene	18	180	NE	350,000
Isopropylbenzene	3.9	39	NE	350,000
m,p-Xylene	78	780	NE	700,000
methylcyclopentane	2.02	20.2	NE	NE
Methylene chloride	2.1	21	17,500	NE
naphthalene	19.8	198	NE	70,000
n-Butylbenzene	5.8	58	NE	NE
n-propylbenzene	12	120	NE	350,000

TABLE 11-1

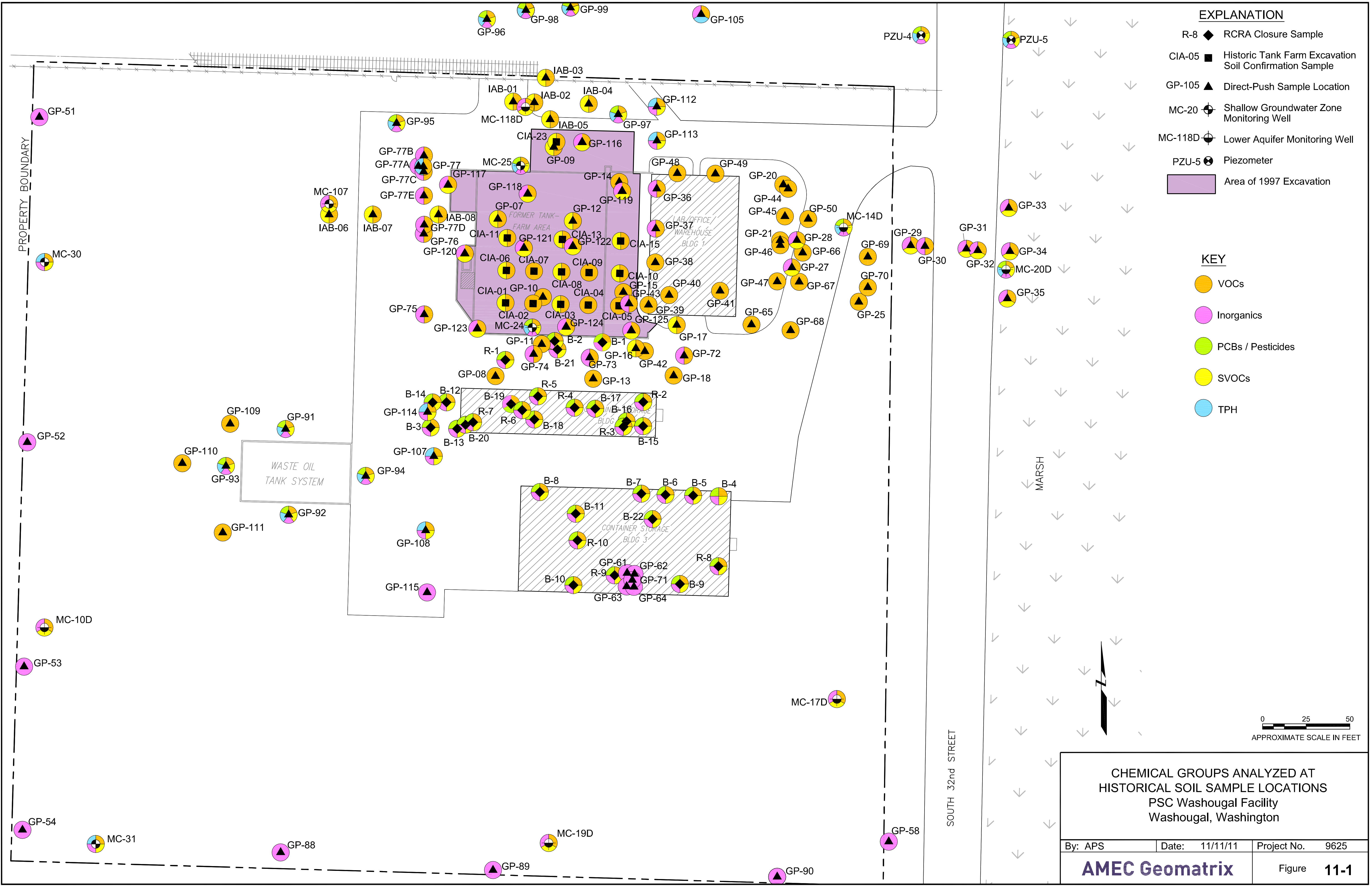
SOIL VOC RESULTS MTCA METHOD C CLEANUP LEVEL COMPARISON SUMMARY

PSC Washougal Facility
Washougal, Washington

Analyte	**Maximum Concentration (mg/Kg)**	**Calculated Maximum Concentration (mg/Kg)**	**MTCA Method C Carcinogenic Screening Level (mg/Kg)**	**MTCA Method C Non Carcinogenic Screening Level (mg/Kg)**
o-Xylene	42	420	NE	700,000
p-Cymene	3.3	33	NE	NE
p-isopropyltoluene	2.46	24.6	NE	NE
sec-Butylbenzene	3.6	36	NE	NE
Styrene	1.4	14	NE	700,000
tert-Butylbenzene	8.1	81	NE	NE
Tetrachloroethene	74	740	NE	21,000
Toluene	21	210	NE	280,000
trans-1,2-Dichloroethene	0.0391	0.391	NE	70,000
Trichloroethene	8.4	84	NE	1,750
Vinyl Chloride	0.037	0.37	NE	10,500

Abbreviations
NE = Not Established
mg/Kg = milligrams per kilogram

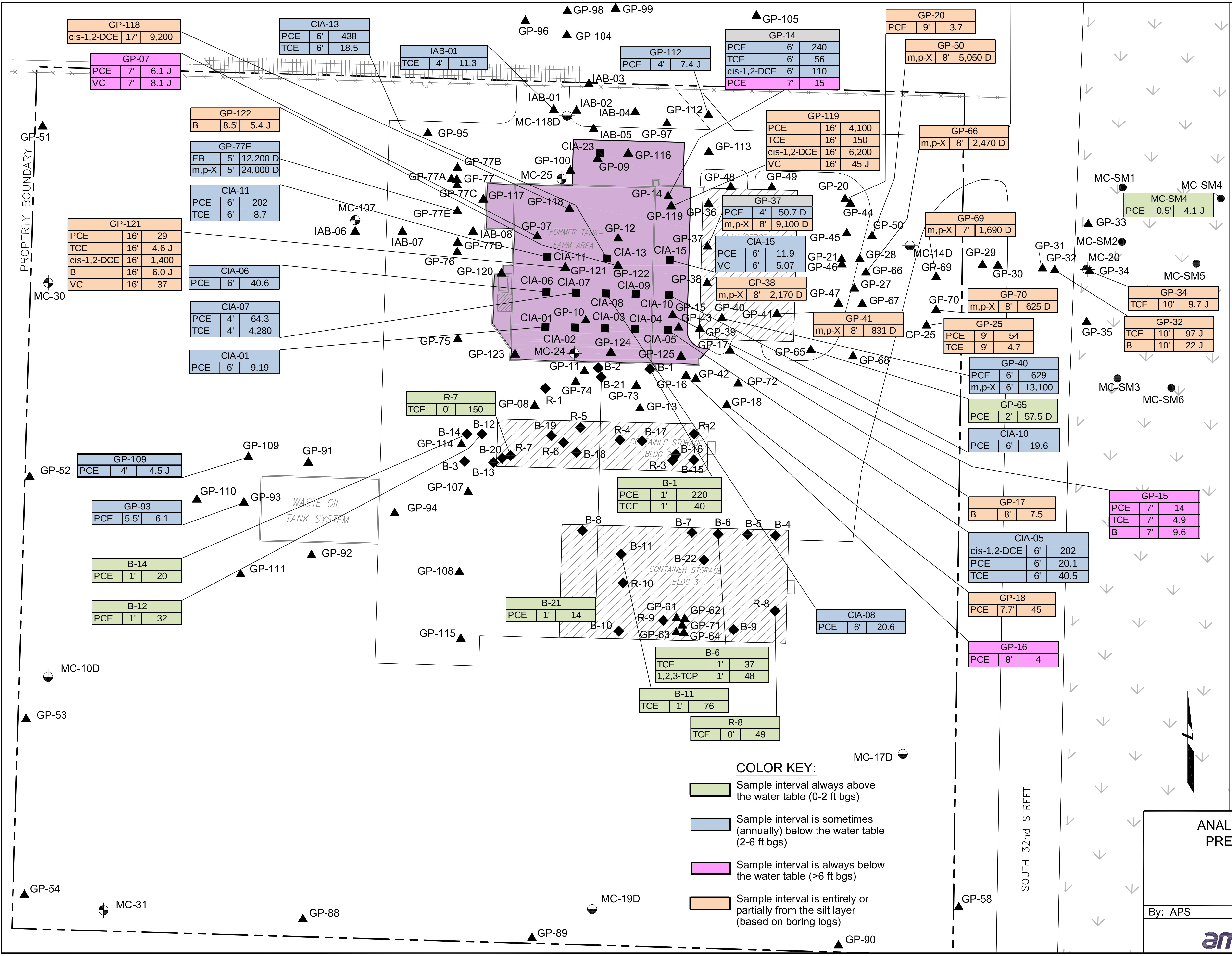
FIGURES



CHEMICAL GROUPS ANALYZED AT
HISTORICAL SOIL SAMPLE LOCATIONS
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 11/11/11	Project No. 9625
AMEC Geomatrix		Figure 11-1

Plot Date: 11/11/11 - 10:58am, Plotted by: mike.stenberg
Drawing Path: S:\9625\009_RIFS-2011\CAD\, Drawing Name: PSC Washougal_SoilSampChemGroups_111111.DWG



COLOR KEY:

🟩	Sample interval always above the water table (0-2 ft bgs)
🟦	Sample interval is sometimes (annually) below the water table (2-6 ft bgs)
🟪	Sample interval is always below the water table (>6 ft bgs)
🟧	Sample interval is entirely or partially from the silt layer (based on boring logs)

EXPLANATION

R-8	◆	RCRA Closure Sample
CIA-05	■	Historic Tank Farm Excavation Soil Confirmation Sample
GP-32	▲	Direct-Push Sample Location
MC-20	⊕	Shallow Groundwater Zone Monitoring Well
MC-118D	⊕	Lower Aquifer Monitoring Well
MC-SM4	●	Sediment/Pore Water Sample Location
	🟪	Area of 1997 Excavation

DATABOX KEY

B	Benzene
cis-1,2-DCE	cis-1,2-Dichloroethene
EB	Ethylbenzene
m,p-X	m,p-Xylenes
PCE	Tetrachloroethene
TCE	Trichloroethene
TCP	Trichloropropane
VC	Vinyl Chloride

GP-65		
PCE	2'	57.5 D

← Location I.D.

Detected Concentration above preliminary cleanup level (µg/kg)

depth (feet bgs)

Data Qualifiers

D = Value shown is result from dilution of field sample.

J = Value shown is estimated concentration.

Results shown only for analytes that were detected at concentration above the respective preliminary cleanup level.

Note:

Analytical results for soil samples collected at all depths are shown, including those samples collected below the water table that are representative of groundwater conditions.

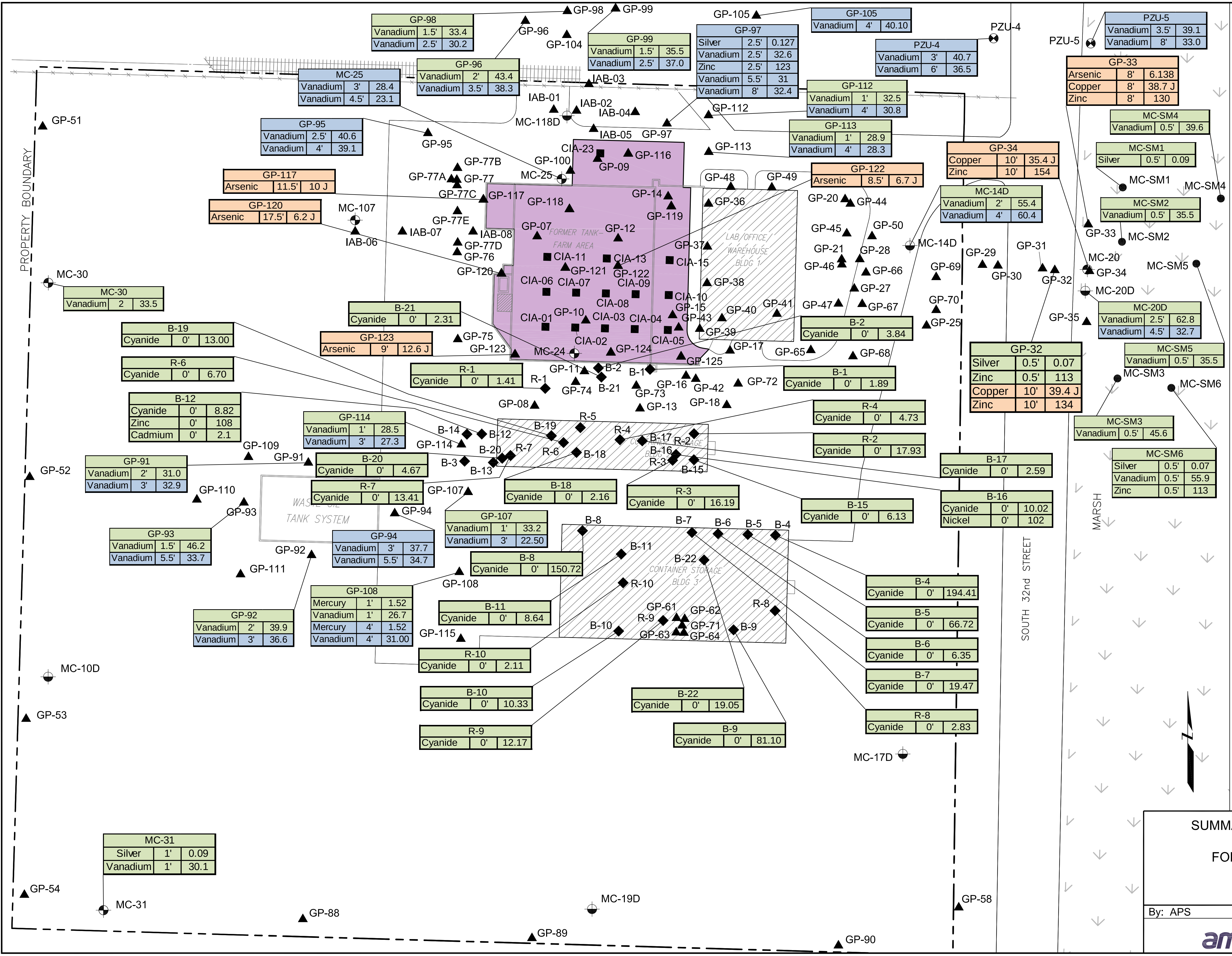
0 25 50

APPROXIMATE SCALE IN FEET

ANALYTICAL RESULTS EXCEEDING
PRELIMINARY CLEANUP LEVELS
FOR VOCs IN SOIL
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 08/15/13	Project No. 9625
amec		Figure 11-2

Plot Date: 08/15/13 - 9:07pm, Plotted by: adam.stenberg
Drawing Path: S:\9625\010_RI-2012\CAD\, Drawing Name: Figure 11-2_PSC-Wash_SoilSampResults-VOCs_081513.dwg



EXPLANATION

R-8 ◆	RCRA Closure Sample
CIA-05 ■	Historic Tank Farm Excavation Soil Confirmation Sample
GP-101 ▲	Direct-Push Sample Location
MC-20 ⊕	Shallow Groundwater Zone Monitoring Well
MC-118D ⊕	Lower Aquifer Monitoring Well
PZU-5 ⊗	Piezometer
MC-SM1 ●	Sediment/Pore Water Sample Location
🟪	Area of 1997 Excavation

DATABOX KEY

B-1		
Cyanide	0'	1.89

Location I.D.

Detected Concentration above preliminary cleanup level (mg/kg)

depth (feet bgs)

Data Qualifiers

D= Value shown is result from dilution of field sample.

J = Value shown is estimated concentration.

Results shown only for analytes that were detected at concentration above the respective preliminary cleanup level.

Note:

Analytical results for soil samples collected at all depths are shown, including those samples collected below the water table that are representative of groundwater conditions.

COLOR KEY:

🟩	Sample interval always above the water table (0-2 ft bgs)
🟦	Sample interval is sometimes (annually) below the water table (2-6 ft bgs)
🟧	Sample interval is entirely or partially from the silt layer (based on boring logs)

0 25 50
APPROXIMATE SCALE IN FEET

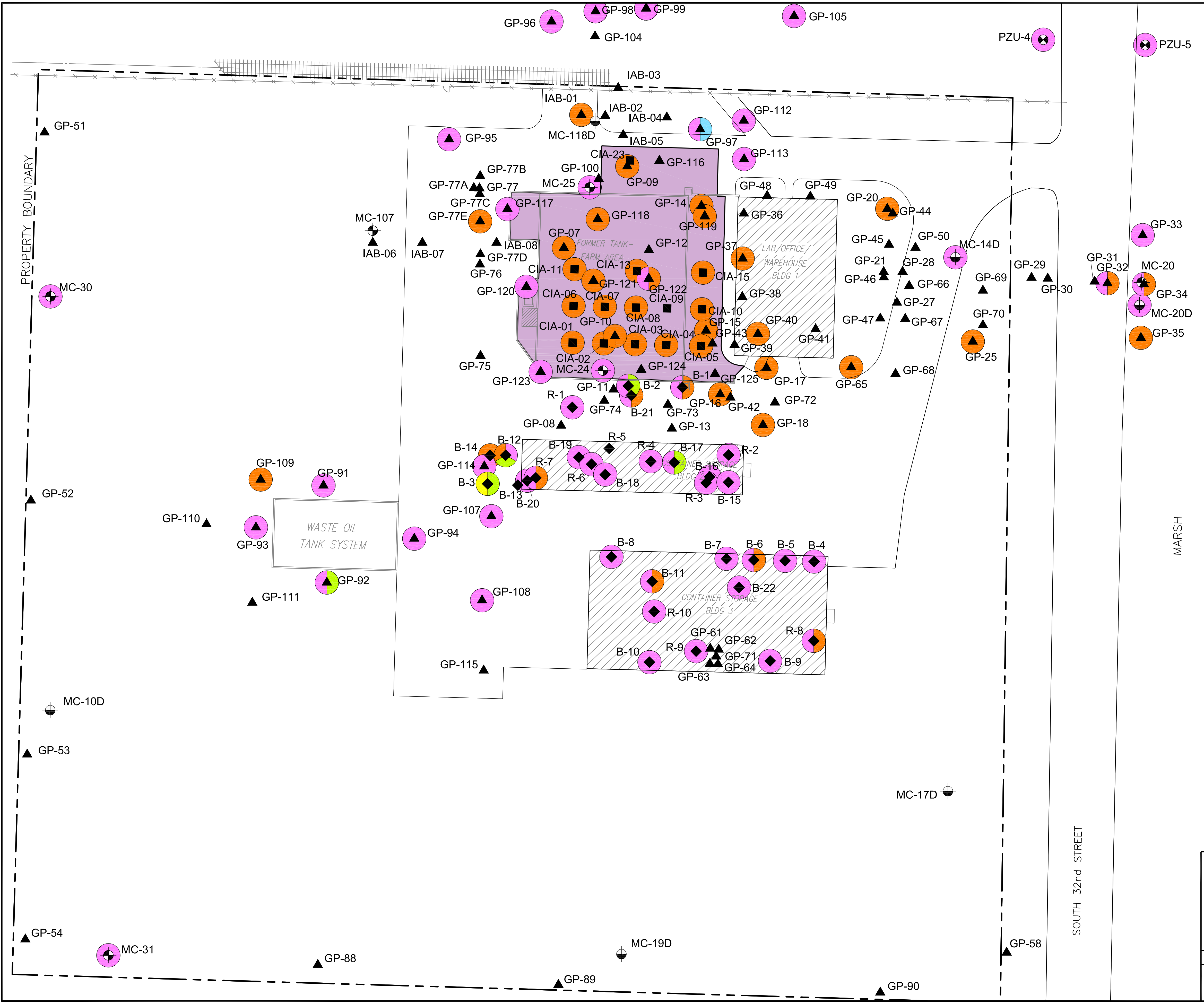
SUMMARY OF ANALYTICAL RESULTS
EXCEEDING PCLs
FOR INORGANIC COCs IN SOIL
PSC Washougal Facility
Washougal, Washington

By: APS | Date: 12/10/12 | Project No. 9625

amec

Figure 11-3

Plot Date: 12/10/12 - 9:30am, Plotted by: adam.stenberg
Drawing Path: S:\9625\010_RI-2012\CAD\, Drawing Name: Figure 11-3_PSC-Wash_SoilSampResults-Metals_112612.dwg



EXPLANATION

R-8 ◆	RCRA Closure Sample
CIA-05 ■	Historic Tank Farm Excavation Soil Confirmation Sample
GP-105 ▲	Direct-Push Sample Location
MC-20 ⊕	Shallow Groundwater Zone Monitoring Well
MC-118D ⊕	Lower Aquifer Monitoring Well
PZU-4 ⊗	Piezometer
▨	Area of 1997 Excavation

KEY

Locations where soil samples exceed preliminary cleanup levels for:

●	VOCs
●	Inorganics
●	Pesticides
●	SVOCs
●	TPH

Unshaded samples did not exceed preliminary cleanup level for any analyte tested for that sample.

Note:

Results shown include results for samples collected below the water table, which are representative of groundwater conditions.

N

0 25 50

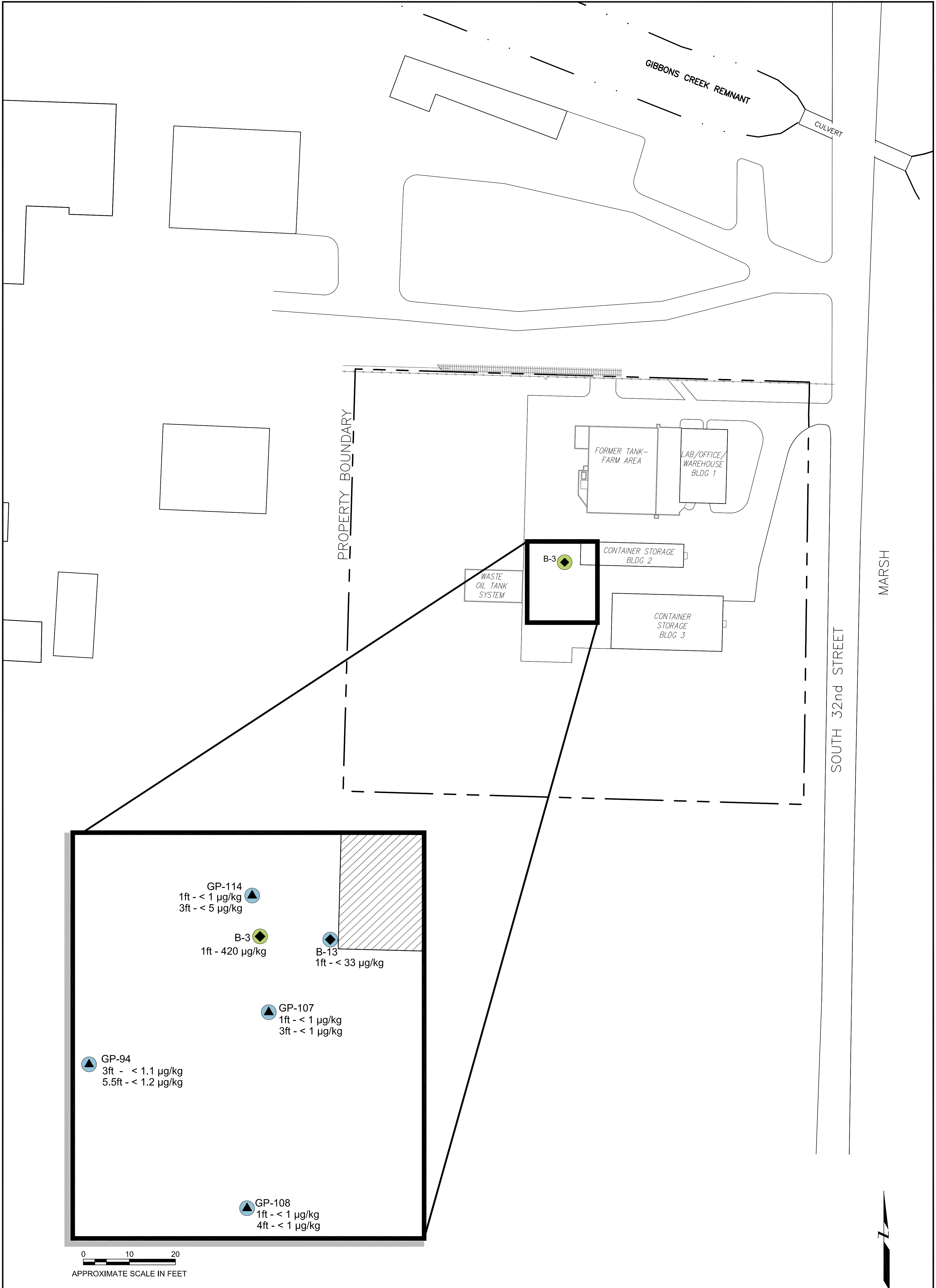
APPROXIMATE SCALE IN FEET

SUMMARY OF ANALYTICAL RESULTS
ABOVE PCLs FOR SOIL
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 08/15/13	Project No. 9625
amec		Figure **11-4**

Plot Date: 08/15/13 - 9:09pm, Plotted by: adam.stenberg
Drawing Path: S:\9625\010_RI-2012\CAD\, Drawing Name: Figure 11-4_PSC-Wash_SoilSampExceedances_081513.dwg

Plot Date: 12/05/11 - 5:17pm, Plotted by: adam.stenberg
Drawing Path: S:\9625\009_RIFS-2011\CAD\, Drawing Name: PSC Washougal_SoilSampExceedZooms_120511.DWG



EXPLANATION

B-13 ◆ RCRA Closure Sample
GP-107 ▲ Direct-Push Sample Location

Detected Analyte Key

🟢 SVOCs detected above preliminary cleanup levels.
🔵 SVOCs not detected, or detected but below preliminary cleanup levels.

Notes
Results shown are concentrations of 2,4-dichlorophenol in micrograms per kilogram (µg/kg).
No other SVOC was present above the respective preliminary cleanup levels.
< = analyte not detected at reporting limit shown.

SVOCs (2,4-dichlorophenol) ABOVE PCLs IN SOIL
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/05/11	Project No. 9625
AMEC Geomatrix		Figure 11-5

Plot Date: 09/10/13 - 1:54pm, Plotted by: adam.stenberg
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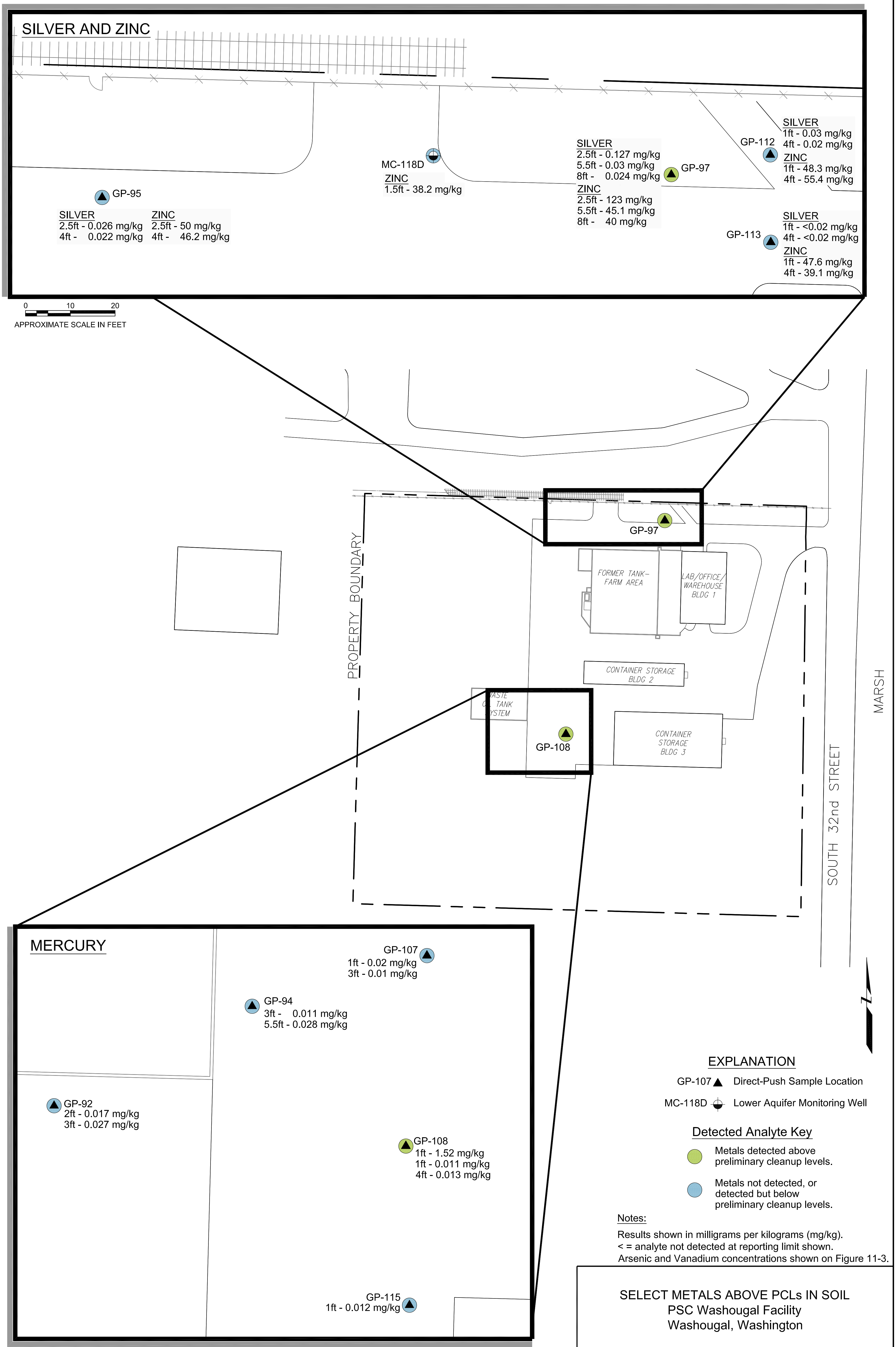


Notes:

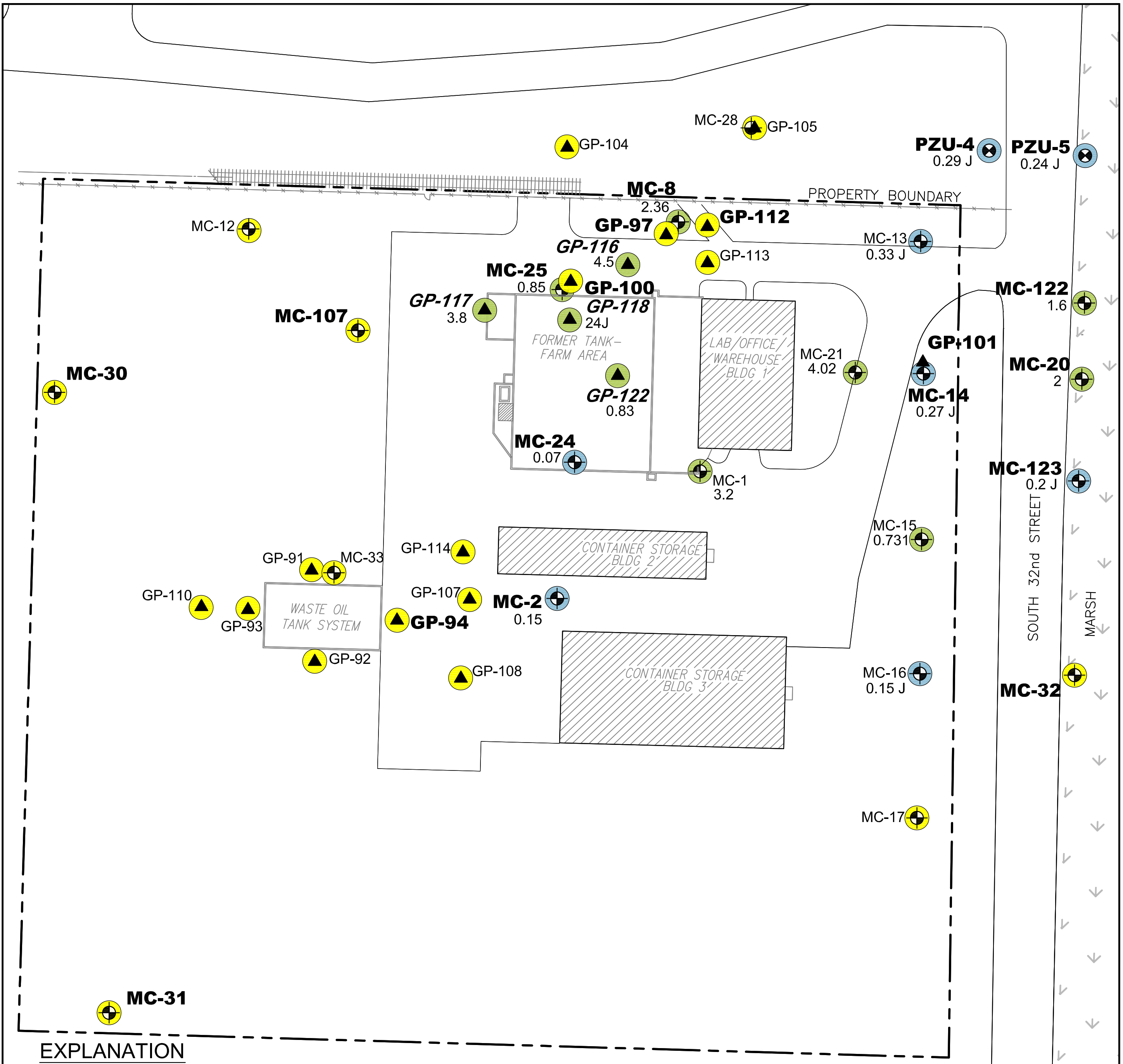
Results shown in milligrams per kilograms (mg/kg).
< = analyte not detected at reporting limit shown.
Arsenic and Vanadium concentrations shown on Figure 11-3.

0 10 20
APPROXIMATE SCALE IN FEET

Note: Mercury was found exceeding the proposed cleanup level at GP-108 in September 2008. An additional confirmation sample was collected at the same location in May 2009, and the resulting concentration was below the preliminary cleanup level.

SELECT METALS ABOVE PCLs IN SOIL
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 09/10/13	Project No. 9625
amec		Figure 11-6



EXPLANATION

▲ Direct-Push Sample Location

⊕ Shallow Groundwater Zone Monitoring Well

⊗ Piezometer

Detected Analyte Key

Preliminary Cleanup Level is 0.69 µg/L

🟢 Concentration above preliminary cleanup level (highest detected concentration shown for each location)

🔵 Concentration below preliminary cleanup level (highest detected concentration shown for each location)

🟡 Analyte never detected

Concentrations in micrograms per liter (µg/L).

Data Qualifiers

J = Value shown is estimated concentration.

Notes

bold Screened partially in silt layer

italics Screened fully in silt layer

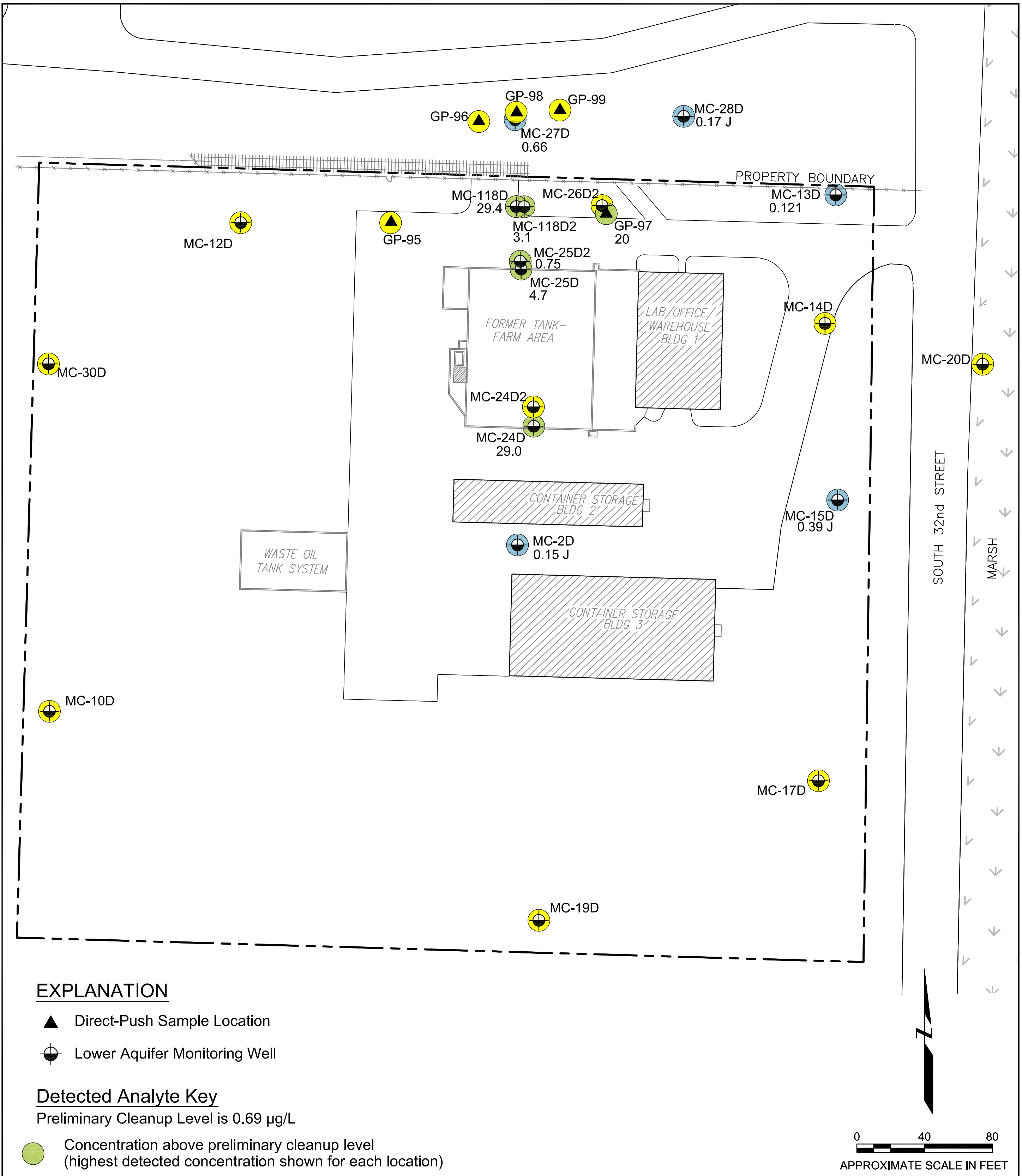
0 40 80

APPROXIMATE SCALE IN FEET

HIGHEST TETRACHLOROETHENE RESULTS
SHALLOW GROUNDWATER ZONE
2004 THROUGH SECOND QUARTER 2012
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/07/12	Project No. 9625
amec		Figure **11-7**

Plot Date: 12/07/12 - 12:59pm, Plotted by: jeffrey.sanders
Drawing Path: G:\0096250050 - PSC-Washougal\, Drawing Name: Figure_11-7_PSC-Wash_GW-PCE-Sh_120712.dwg



EXPLANATION

▲ Direct-Push Sample Location

⊕ Lower Aquifer Monitoring Well

Detected Analyte Key

Preliminary Cleanup Level is 0.69 µg/L

🟩 Concentration above preliminary cleanup level
(highest detected concentration shown for each location)

🟦 Concentration below preliminary cleanup level
(highest detected concentration shown for each location)

🟨 Analyte never detected

Concentrations in micrograms per liter (µg/L).

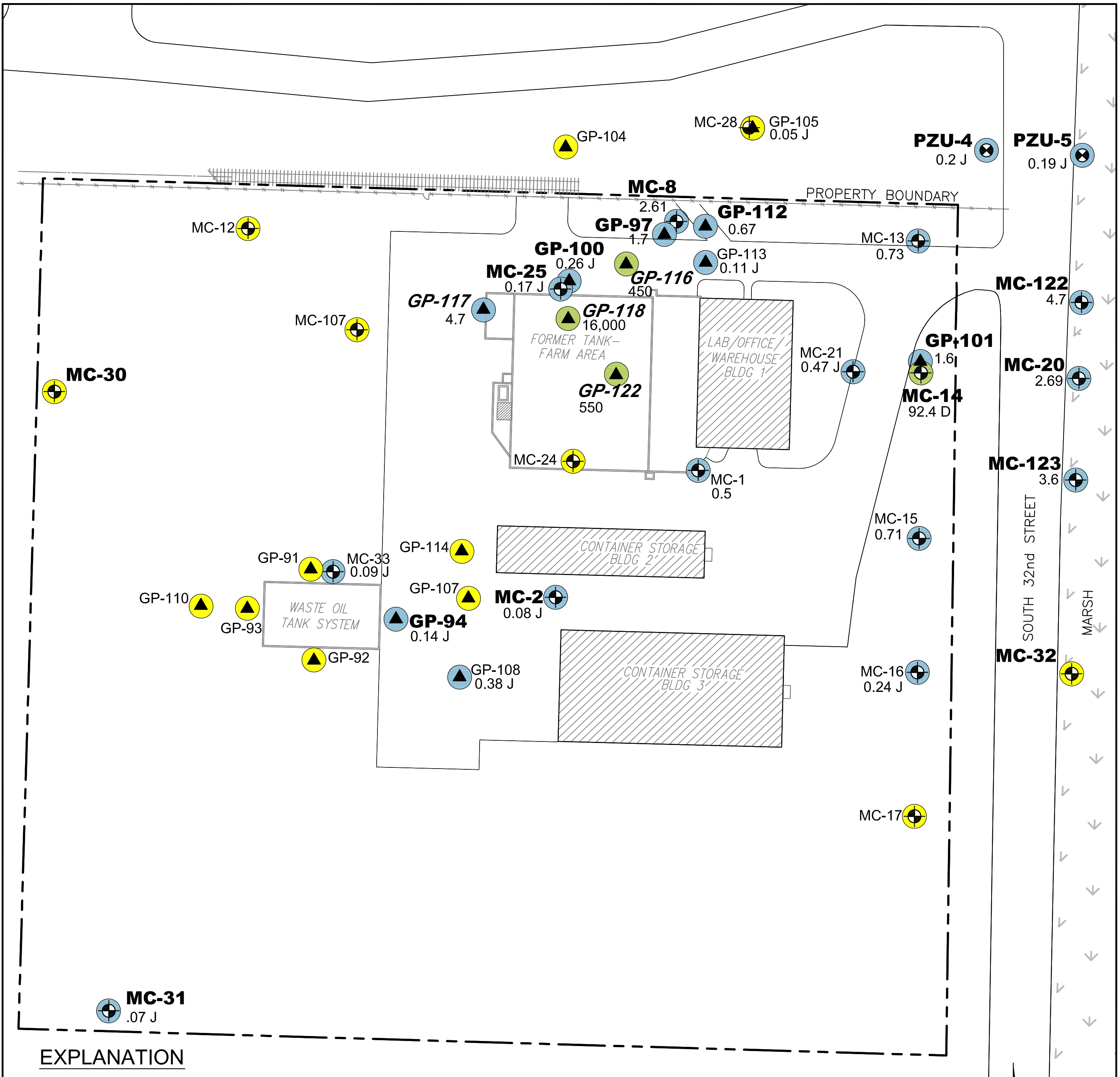
Data Qualifiers

J = Value shown is estimated concentration.

HIGHEST TETRACHLOROETHENE RESULTS
LOWER AQUIFER
GROUNDWATER ZONE
2004 THROUGH SECOND QUARTER 2012
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/07/12	Project No. 9625
		Figure 11-8

Plot Date: 12/07/12 - 9:12am, Plotted by: jeffrey.sanders
Drawing Path: G:\0096250050 - PSC-Washougal\, Drawing Name: Figure_11-8_PSC-Wash_GW-PCE-Low_120712.dwg



EXPLANATION

▲ Direct-Push Sample Location

⊕ Shallow Groundwater Zone Monitoring Well

⊗ Piezometer

Detected Analyte Key

Preliminary Cleanup Level is 16 µg/L

● Concentration above preliminary cleanup level (highest detected concentration shown for each location)

● Concentration below preliminary cleanup level (highest detected concentration shown for each location)

● Analyte never detected

Concentrations in micrograms per liter (µg/L).

Data Qualifiers

D = Value shown is result from dilution of field sample.

J = Value shown is estimated concentration.

Notes

bold	Screened partially in silt layer
italics	Screened fully in silt layer

N

0 40 80

APPROXIMATE SCALE IN FEET

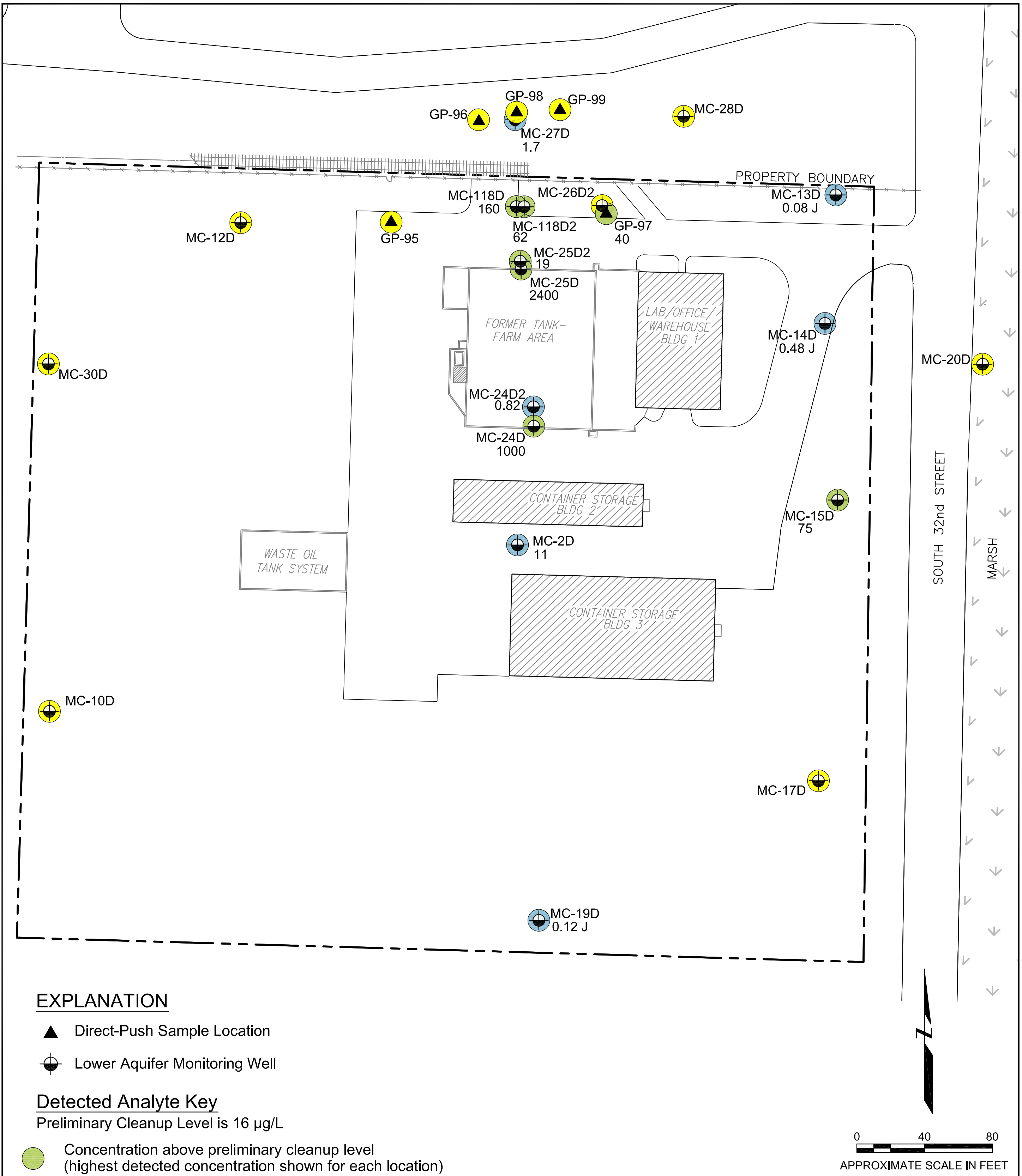
HIGHEST cis-1,2-DICHLOROETHENE RESULTS
SHALLOW GROUNDWATER ZONE
2004 THROUGH SECOND QUARTER 2012
PSC Washougal Facility
Washougal, Washington

By: APS | Date: 12/07/12 | Project No. 9625

amec

Figure **11-9**

Plot Date: 12/07/12 - 4:33pm, Plotted by: jeffrey.sanders
Drawing Path: G:\0096250050 - PSC-Washougal\, Drawing Name: Figure_11-9_PSC-Wash_GW-cis12-Sh_120712.dwg



EXPLANATION

▲ Direct-Push Sample Location

⊕ Lower Aquifer Monitoring Well

Detected Analyte Key

Preliminary Cleanup Level is 16 µg/L

🟢 Concentration above preliminary cleanup level
(highest detected concentration shown for each location)

🔵 Concentration below preliminary cleanup level
(highest detected concentration shown for each location)

🟡 Analyte never detected

Concentrations in micrograms per liter (µg/L).

Data Qualifiers

J = Value shown is estimated concentration.

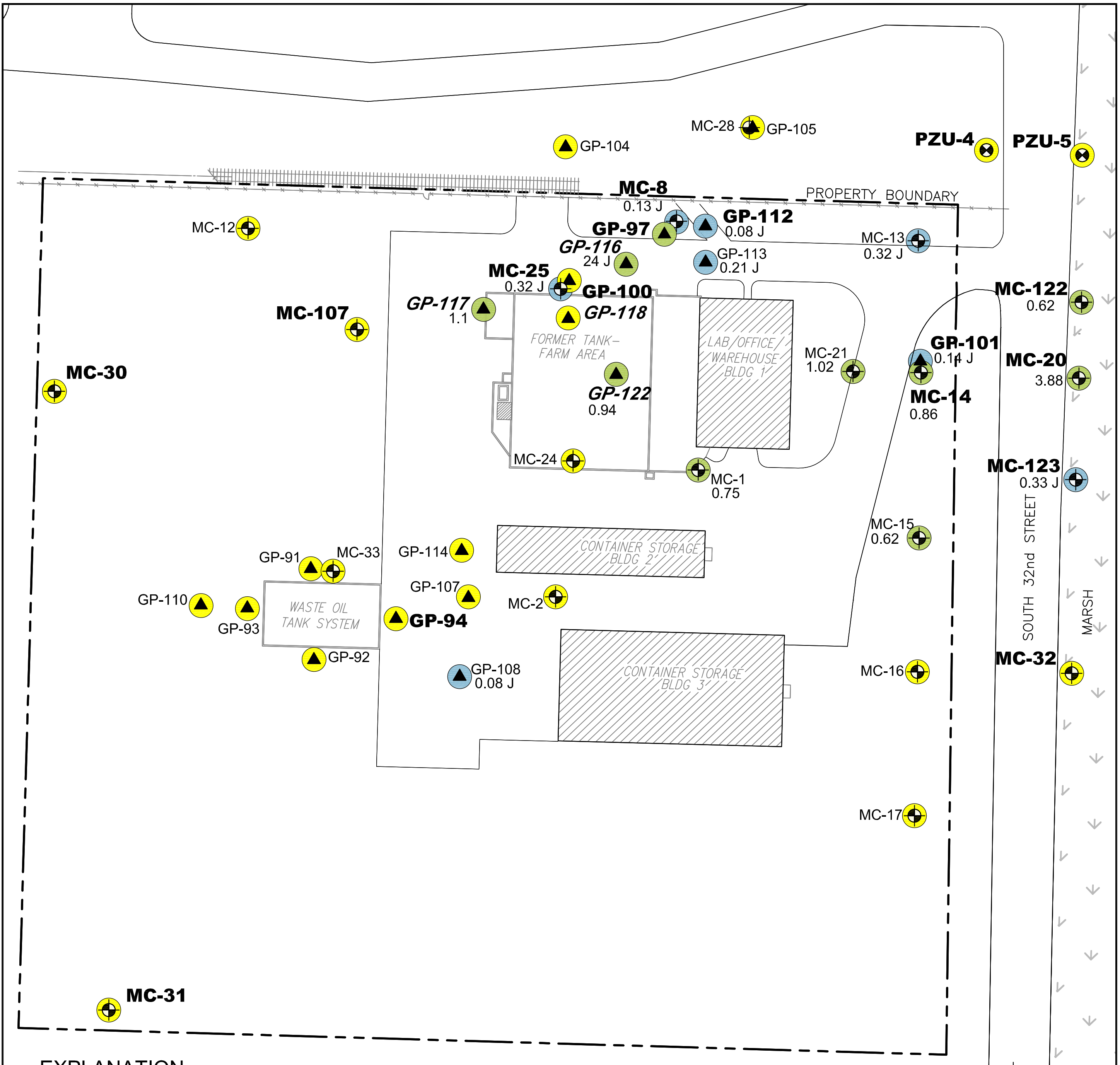
HIGHEST cis-1,2-DICHLOROETHENE RESULTS
LOWER AQUIFER
GROUNDWATER ZONE
2004 THROUGH SECOND QUARTER 2012
PSC Washougal Facility
Washougal, Washington

By: APS
Date: 12/07/12
Project No. 9625

amec

Figure 11-10

Plot Date: 12/07/12 - 9:19am, Plotted by: jeffrey.sanders
Drawing Path: G:\0096250050 - PSC-Washougal\, Drawing Name: Figure_11-10_PSC-Wash_GW-cis12-Low_120712.dwg



EXPLANATION

▲ Direct-Push Sample Location

⊕ Shallow Groundwater Zone Monitoring Well

⊗ Piezometer

Detected Analyte Key

Preliminary Cleanup Level is 0.54 µg/L

🟢 Concentration above preliminary cleanup level (highest detected concentration shown for each location)

🔵 Concentration below preliminary cleanup level (highest detected concentration shown for each location)

🟡 Analyte never detected

Concentrations in micrograms per liter (µg/L).

Data Qualifiers

J = Value shown is estimated concentration.

Notes

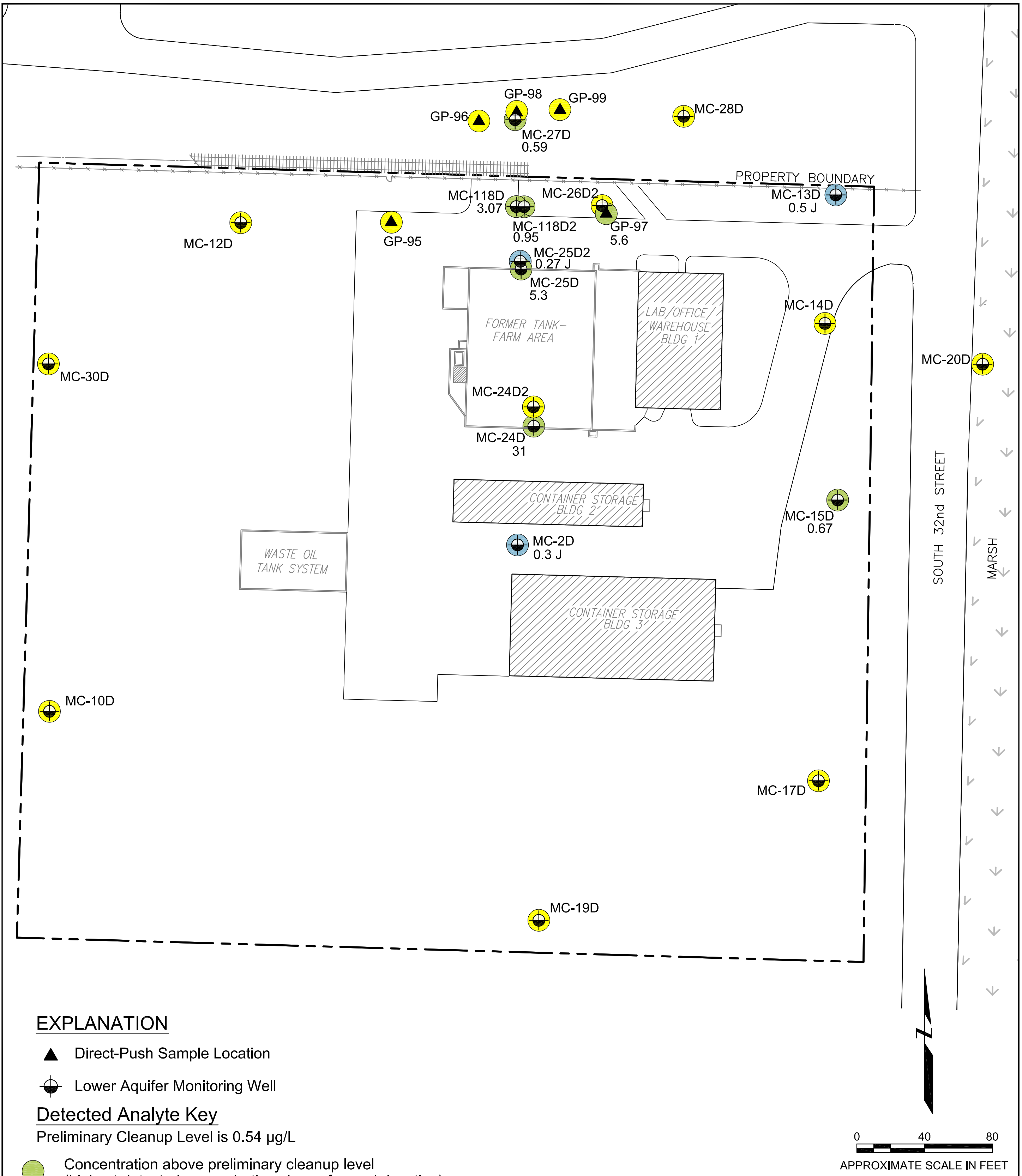
bold	Screened partially in silt layer
italics	Screened fully in silt layer

0 40 80
APPROXIMATE SCALE IN FEET

HIGHEST TRICHLOROETHENE RESULTS
SHALLOW GROUNDWATER ZONE
2004 THROUGH SECOND QUARTER 2012
PSC Washougal Facility
Washougal, Washington

By: APS
Date: 08/15/13
Project No. 9625
amec
Figure 11-11

Plot Date: 08/15/13 - 2:17pm, Plotted by: adam.stenberg
Drawing Path: S:\9625\010_RI-2012\CAD\, Drawing Name: Figure_11-11_PSC-Wash_GW-TCE-Sh_081513.dwg



EXPLANATION

▲ Direct-Push Sample Location

⊕ Lower Aquifer Monitoring Well

Detected Analyte Key

Preliminary Cleanup Level is 0.54 µg/L

● Concentration above preliminary cleanup level
(highest detected concentration shown for each location)

● Concentration below preliminary cleanup level
(highest detected concentration shown for each location)

● Analyte never detected

Concentrations in micrograms per liter (µg/L).

Data Qualifiers

J = Value shown is estimated concentration.

HIGHEST TRICHLOROETHENE RESULTS
LOWER AQUIFER
GROUNDWATER ZONE
2004 THROUGH SECOND QUARTER 2012
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/07/12	Project No. 9625
amec		Figure **11-12**

Plot Date: 12/07/12 - 9:39am, Plotted by: jeffrey.sanders
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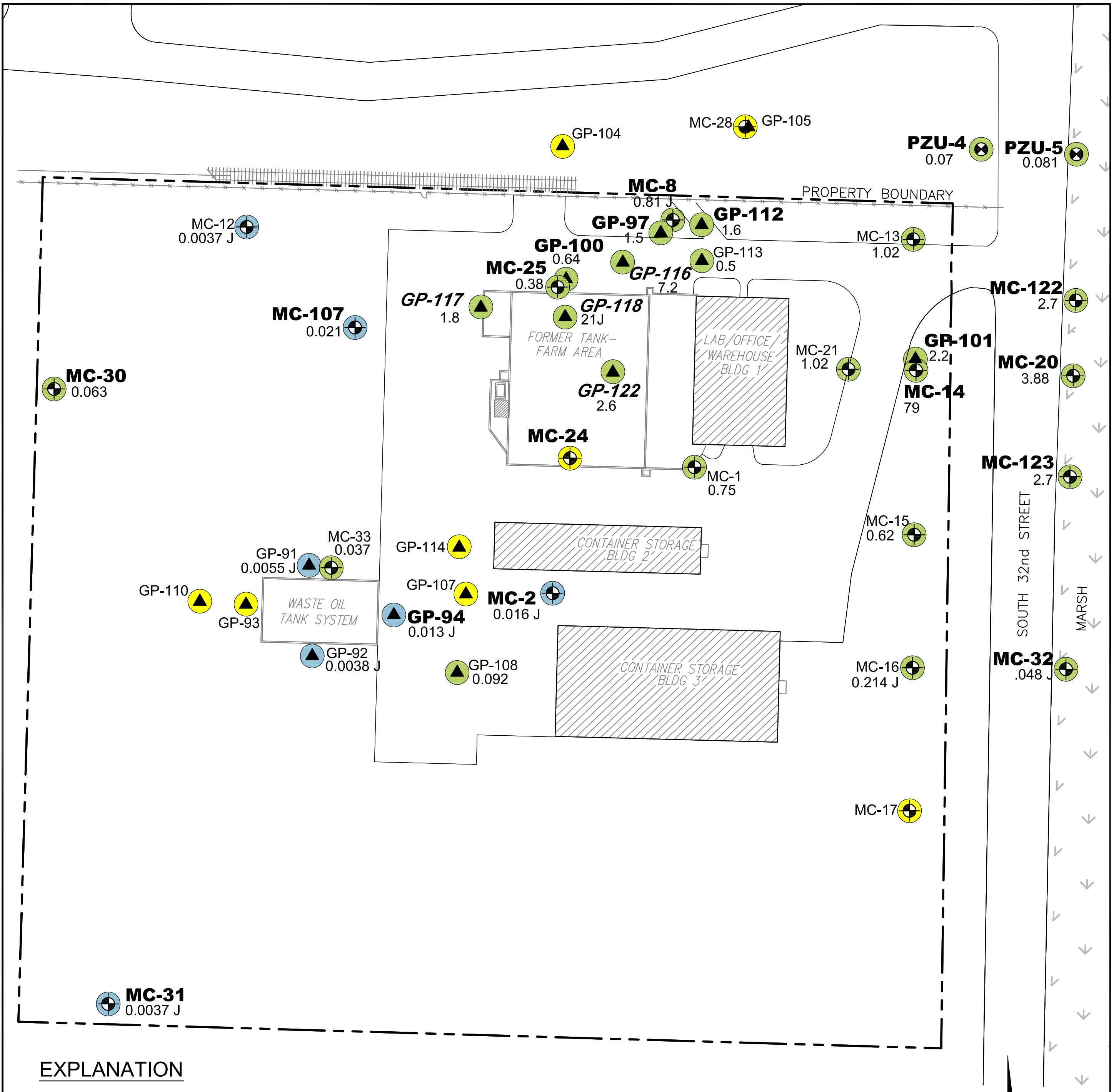


EXPLANATION

▲ Direct-Push Sample Location

⌖ Shallow Groundwater Zone Monitoring Well

⊗ Piezometer

Detected Analyte Key

Preliminary Cleanup Level is 0.025 µg/L

🟢 Concentration above preliminary cleanup level
(highest detected concentration shown for each location)

🔵 Concentration below preliminary cleanup level
(highest detected concentration shown for each location)

🟡 Analyte never detected

Concentrations in micrograms per liter (µg/L).

Data Qualifiers

J = Value shown is estimated concentration.

Notes

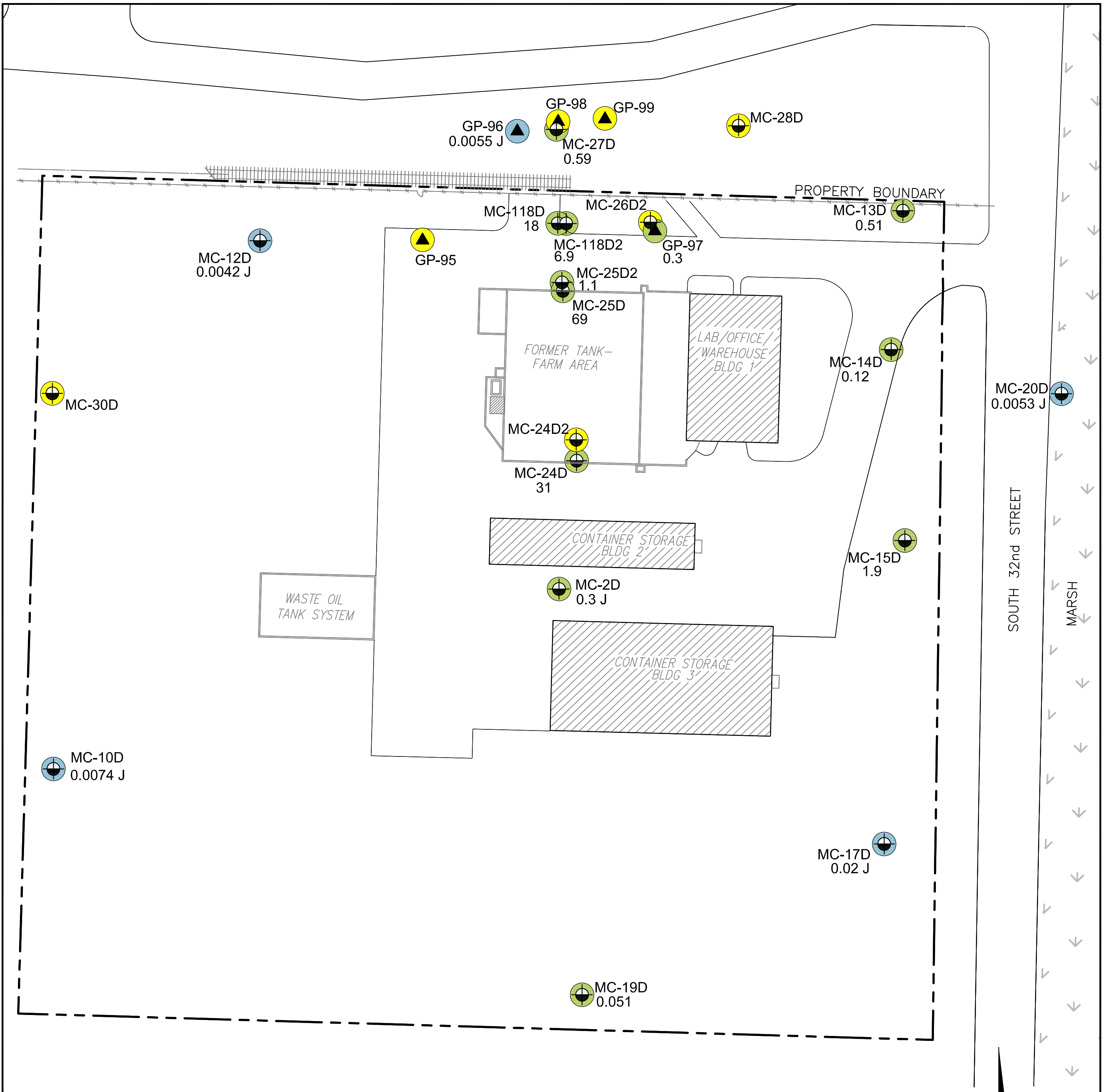
bold Screened partially in silt layer
italics Screened fully in silt layer

0 40 80
APPROXIMATE SCALE IN FEET

HIGHEST VINYL CHLORIDE RESULTS
SHALLOW GROUNDWATER ZONE
2004 THROUGH SECOND QUARTER 2012
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/07/12	Project No. 9625
	amec	Figure **11-13**

Plot Date: 12/07/12 - 1:02pm, Plotted by: jeffrey.sanders
Drawing Path: G:\0096250050 - PSC-Washougal\, Drawing Name: Figure_11-13_PSC-Wash_GW-VC-Sh_120712.dwg



N

0 40 80

APPROXIMATE SCALE IN FEET

EXPLANATION

▲ Direct-Push Sample Location

⊕ Lower Aquifer Monitoring Well

Detected Analyte Key

Preliminary Cleanup Level is 0.025 µg/L

🟢 Concentration above preliminary cleanup level (highest detected concentration shown for each location)

🔵 Concentration below preliminary cleanup level (highest detected concentration shown for each location)

🟡 Analyte never detected

Concentrations in micrograms per liter (µg/L).

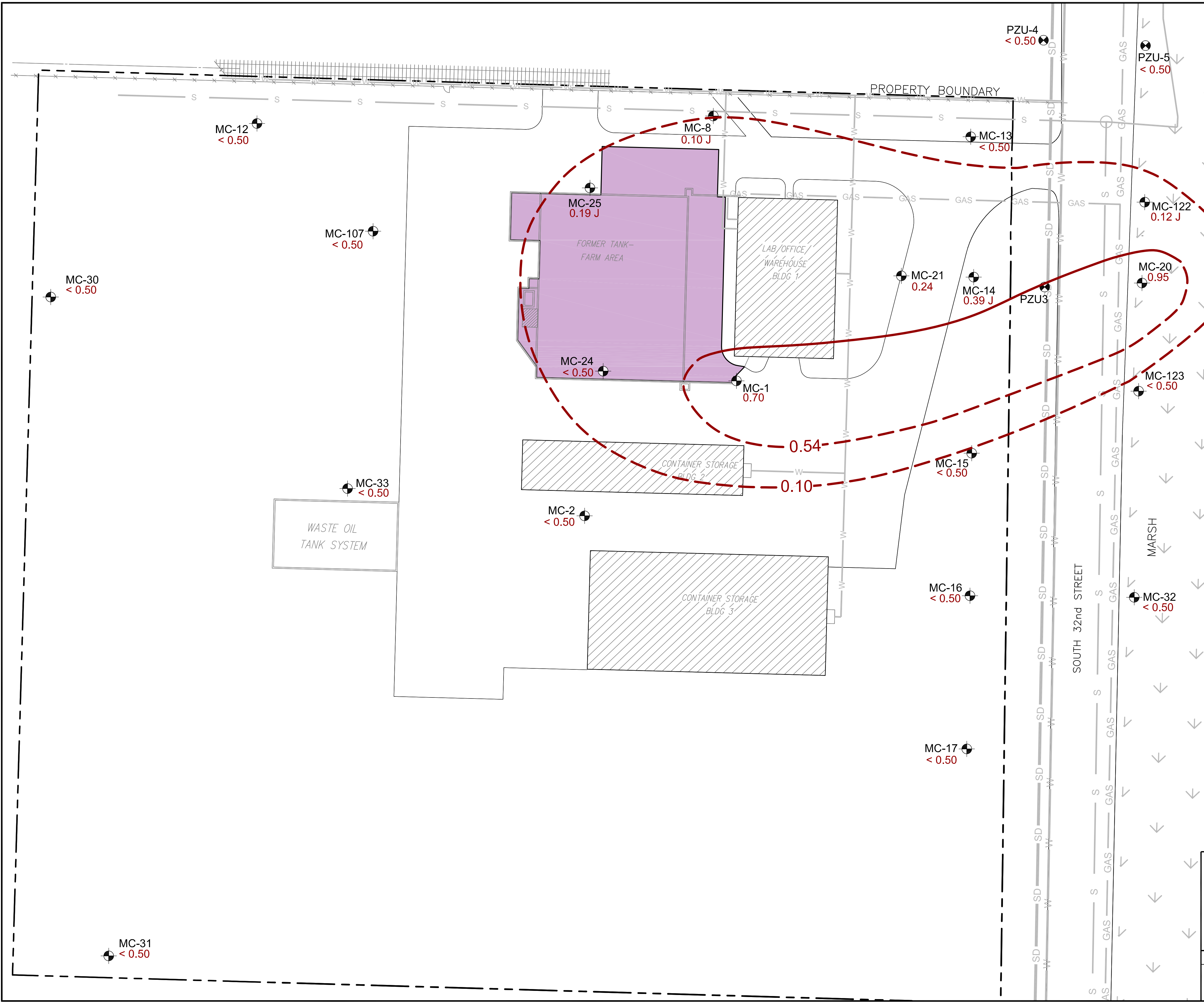
Data Qualifiers

J = Value shown is estimated concentration.

HIGHEST VINYL CHLORIDE RESULTS
LOWER AQUIFER
GROUNDWATER ZONE
2004 THROUGH SECOND QUARTER 2012
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/07/12	Project No. 9625
amec		Figure 11-14

Plot Date: 12/07/12 - 9:55am, Plotted by: jeffrey.sanders
Drawing Path: G:\0096250050 - PSC-Washougal\, Drawing Name: Figure_11-14_PSC-Wash_GW-VC-Low_120712.dwg



EXPLANATION

MC-122 ⊕	Shallow Groundwater Zone Monitoring Well
PZU-5 ⊗	Piezometer
🟪	Area of 1997 Excavation
—0.54—	Trichloroethene Concentration Contour (µg/L)
- - - -	Dashed where inferred
—SD—	Storm Sewer (18-Inch)
— s —	Sanitary Sewer (10-Inch)
—W—	Water line (14-Inch)
—GAS—	Gas line

NOTES:

1. Concentrations shown in µg/L.
2. Concentrations for monitoring wells are the maximum values observed between 3rd Quarter 2011 and 2nd Quarter 2012. Only data from monitoring wells used for contouring.
3. Proposed groundwater cleanup level for Trichloroethene is 0.54 µg/L.
4. Numbers in red are the highest detected concentration for that well. When preceded by the < symbol, result is "not detected" and number is the reporting limit for these wells.

ABBREVIATIONS:

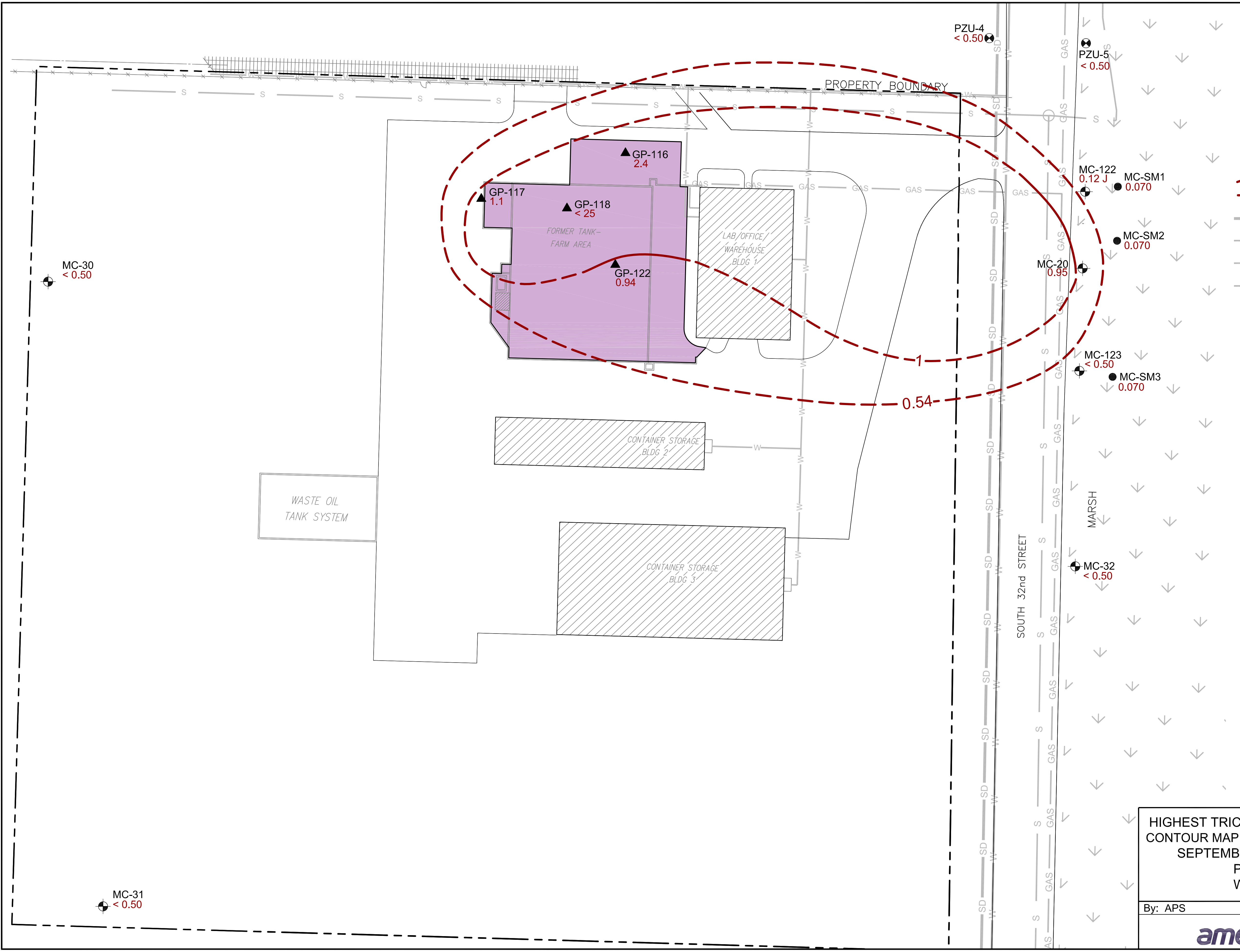
J = Result is an estimate
L = Liter
µg = micrograms

HIGHEST TRICHLOROETHENE CONCENTRATION CONTOUR MAP - SHALLOW GROUNDWATER ZONE SEPTEMBER 2011 THROUGH JUNE 2012

PSC Washougal Facility
Washougal, Washington

By: APS	Date: 09/10/13	Project No. 9625
amec		Figure 11-15

Plot Date: 09/10/13 - 1:30pm, Plotted by: adam.stenberg
Drawing Path: S:\9625\010_RI-2012\CAD\, Drawing Name: Figure_11-15_PSC-Wash_TCE_Shallow_091013.dwg



EXPLANATION

GP-116 ▲	Direct-Push Sample Location
MC-122 ⊕	Shallow Groundwater Zone Monitoring Well
PZU-5 ⊗	Piezometer
MC-SM4 ●	Sediment/Porewater Sample Location
▨	Area of 1997 Excavation
—1—	Trichloroethene Concentration Contour (µg/L) Dashed where inferred
— SD —	Storm Sewer (18-Inch)
— s —	Sanitary Sewer (10-Inch)
— W —	Water line (14-Inch)
— GAS —	Gas line

NOTES:

1. Concentrations shown in µg/L.
2. Concentrations for monitoring wells are the maximum values observed between 3rd Quarter 2011 and 2nd Quarter 2012.
3. Groundwater concentrations from direct push investigations performed in 2011 were also used to generate contours.
4. Proposed groundwater cleanup level for Trichloroethene is 0.54 µg/L.
5. Numbers in red are the highest detected concentration for that well. When preceded by the < symbol, result is "not detected" and number is the reporting limit for these wells.

ABBREVIATIONS:

J = Result is an estimate
L = Liter
µg = micrograms

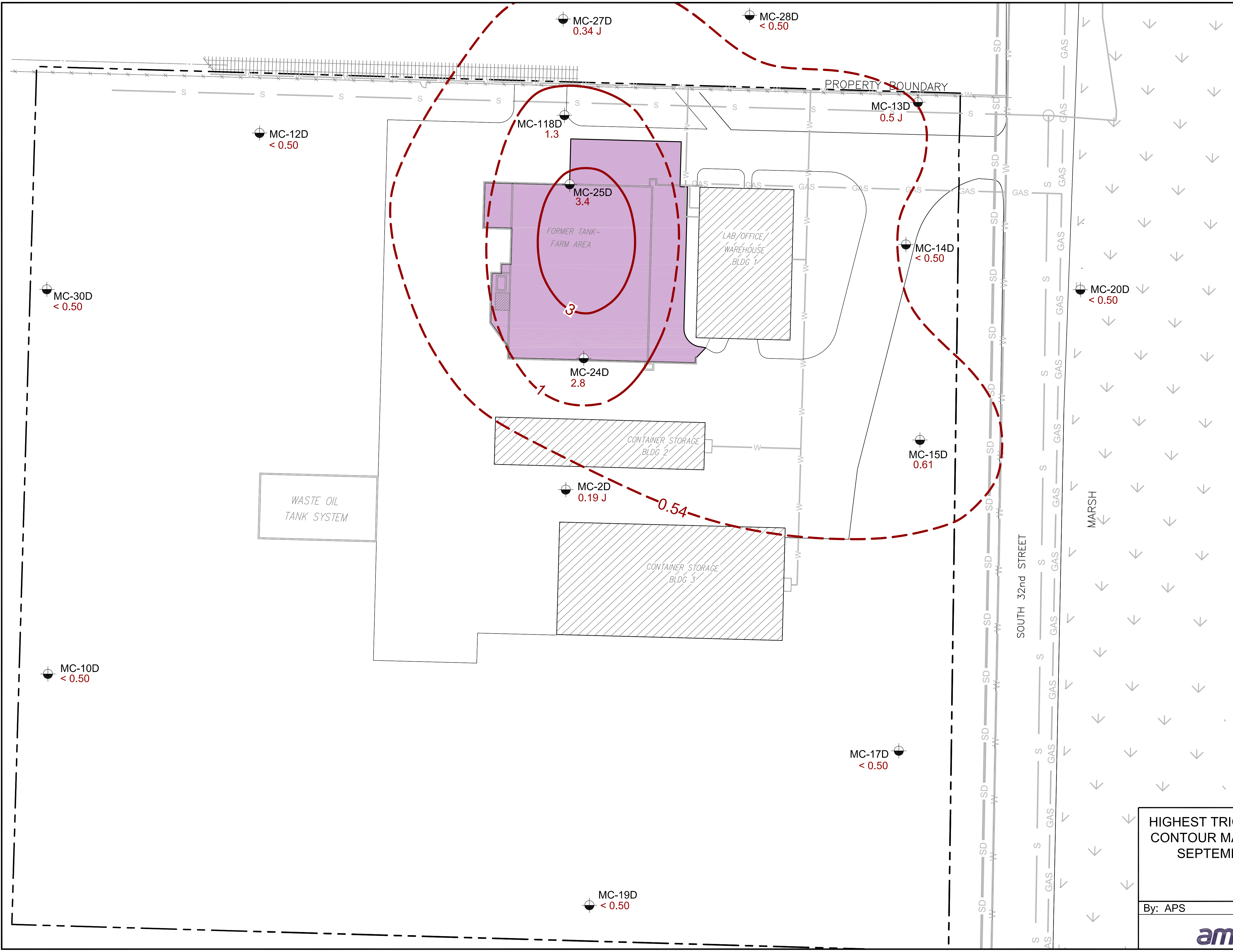
HIGHEST TRICHLOROETHENE CONCENTRATION
CONTOUR MAP - SILT LAYER GROUNDWATER ZONE
SEPTEMBER 2011 THROUGH JUNE 2012
PSC Washougal Facility
Washougal, Washington

By: APS
Date: 09/10/13
Project No. 9625

amec

Figure **11-16**

Plot Date: 09/10/13 - 1:40pm, Plotted by: adam.stenberg
Drawing Path: S:\9625\010_RI-2012\CAD\, Drawing Name: Figure_11-16_PSC-Wash_TCE_Silt_091013.dwg



EXPLANATION

MC-14D ⊕ Lower Aquifer Monitoring Well

▨ Area of 1997 Excavation

— 1 — Trichloroethene Concentration Contour (µg/L)
Dashed where inferred

— SD — Storm Sewer (18-Inch)

— s — Sanitary Sewer (10-Inch)

— W — Water line (14-Inch)

— GAS — Gas line

NOTES:

1. Concentrations shown in µg/L.
2. Concentrations for monitoring wells are the maximum values observed between 3rd Quarter 2011 and 2nd Quarter 2012. Only data from monitoring wells used for contouring.
3. Proposed groundwater cleanup level for Trichloroethene is 0.54 µg/L.
4. Numbers in red are the highest detected concentration for that well. When preceded by the < symbol, result is "not detected" and number is the reporting limit for these wells.

ABBREVIATIONS:

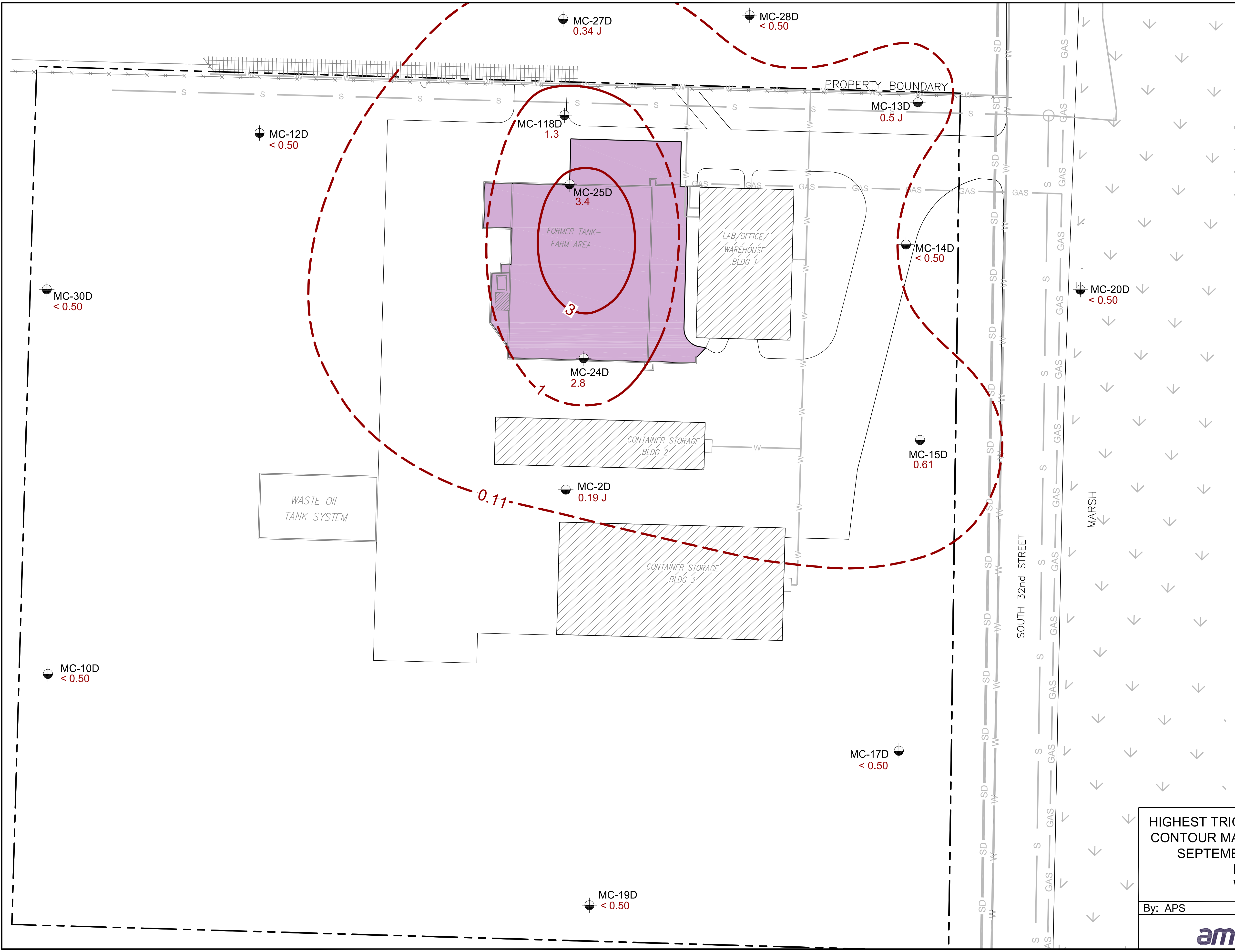
J = Result is an estimate
L = Liter
µg = micrograms

0 25 50
APPROXIMATE SCALE IN FEET

HIGHEST TRICHLOROETHENE CONCENTRATION
CONTOUR MAP - LOWER GROUNDWATER ZONE
SEPTEMBER 2011 THROUGH JUNE 2012
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 09/10/13	Project No. 9625
amec		Figure 11-17

Plot Date: 09/10/13 - 3:14pm, Plotted by: adam.stenberg
Drawing Path: S:\9625\010_RI-2012\CAD\, Drawing Name: Figure_11-17_PSC-Wash_TCE_Lower_091013.dwg



EXPLANATION

MC-14D ⊕	Lower Aquifer Monitoring Well
▨	Area of 1997 Excavation
— 1 —	Trichloroethene Concentration Contour (µg/L) Dashed where inferred
— SD —	Storm Sewer (18-Inch)
— s —	Sanitary Sewer (10-Inch)
— W —	Water line (14-Inch)
— GAS —	Gas line

NOTES:

1. Concentrations shown in µg/L.
2. Concentrations for monitoring wells are the maximum values observed between 3rd Quarter 2011 and 2nd Quarter 2012. Only data from monitoring wells used for contouring.
3. Proposed groundwater cleanup level for Trichloroethene is 0.54 µg/L.
4. Numbers in red are the highest detected concentration for that well. When preceded by the < symbol, result is "not detected" and number is the reporting limit for these wells.

ABBREVIATIONS:

J = Result is an estimate
L = Liter
µg = micrograms

N

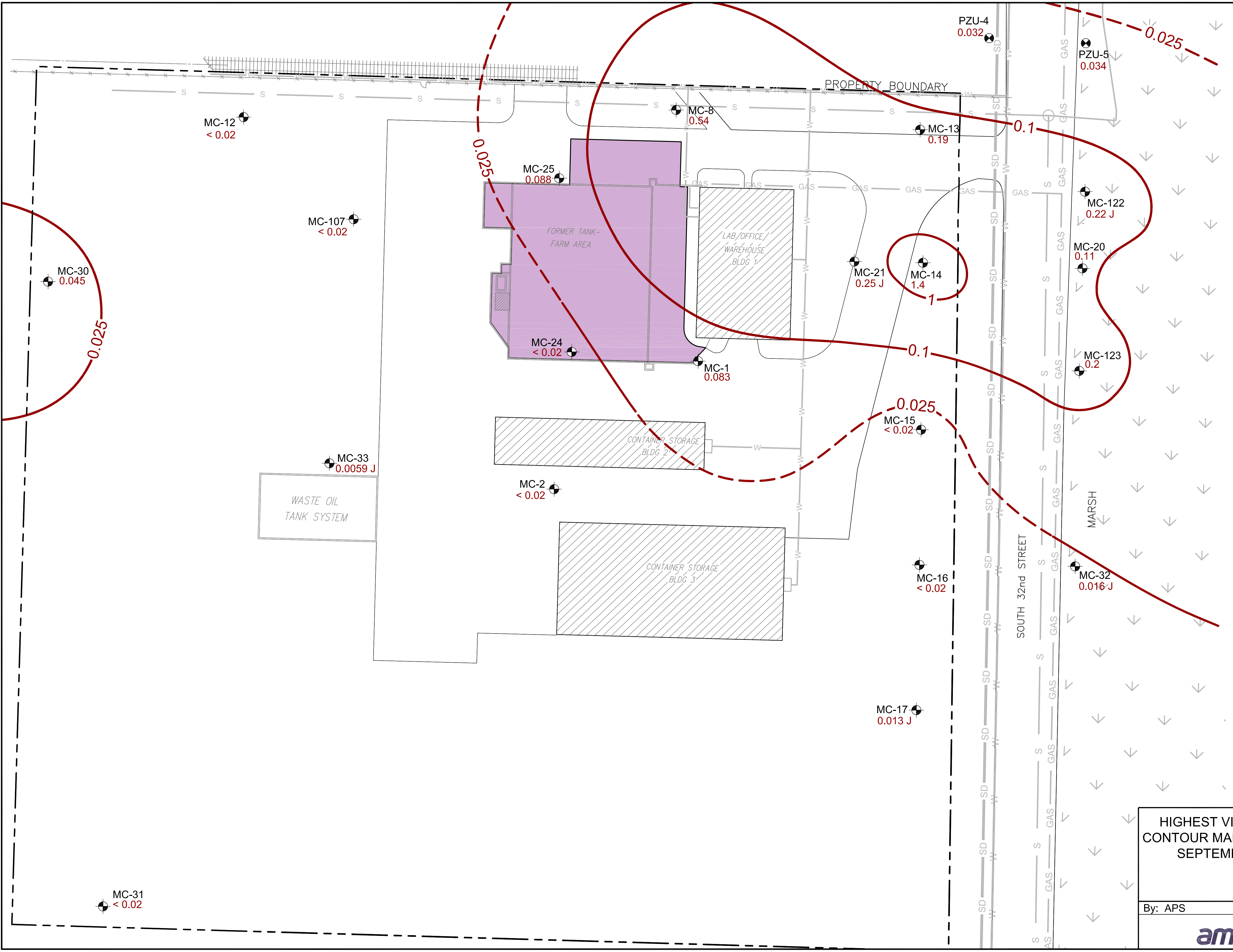
0 25 50

APPROXIMATE SCALE IN FEET

HIGHEST TRICHLOROETHENE CONCENTRATION
CONTOUR MAP - LOWER GROUNDWATER ZONE
SEPTEMBER 2011 THROUGH JUNE 2012
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/07/12	Project No. 9625
amec		Figure 11-17

Plot Date: 12/07/12 - 3:15pm, Plotted by: adam.stenberg
Drawing Path: S:\9625\010_RI-2012\CAD\, Drawing Name: Figure_11-17_PSC-Wash_TCE_Lower_120712.dwg



EXPLANATION

MC-122 ⊕	Shallow Groundwater Zone Monitoring Well
PZU-5 ⊗	Piezometer
🟪	Area of 1997 Excavation
0.1	Vinyl Chloride Concentration Contour (µg/L) Dashed where inferred
SD	Storm Sewer (18-Inch)
S	Sanitary Sewer (10-Inch)
W	Water line (14-Inch)
GAS	Gas line

NOTES:

1. Concentrations shown in µg/L.
2. Concentrations for monitoring wells are the maximum values observed between 3rd Quarter 2011 and 2nd Quarter 2012. Only data from monitoring wells used for contours.
3. Proposed groundwater cleanup level for Vinyl Chloride is 0.025 µg/L.
4. Numbers in red are the highest detected concentration for that well. When preceded by the < symbol, result is "not detected" and number is the reporting limit for these wells.

ABBREVIATIONS:

J = Result is an estimate
L = Liter
µg = micrograms

N

0 25 50
APPROXIMATE SCALE IN FEET

HIGHEST VINYL CHLORIDE CONCENTRATION
CONTOUR MAP - SHALLOW GROUNDWATER ZONE
SEPTEMBER 2011 THROUGH JUNE 2012
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/07/12	Project No. 9625
amec		Figure 11-18

Plot Date: 12/07/12 - 3:31pm, Plotted by: adam.stenberg
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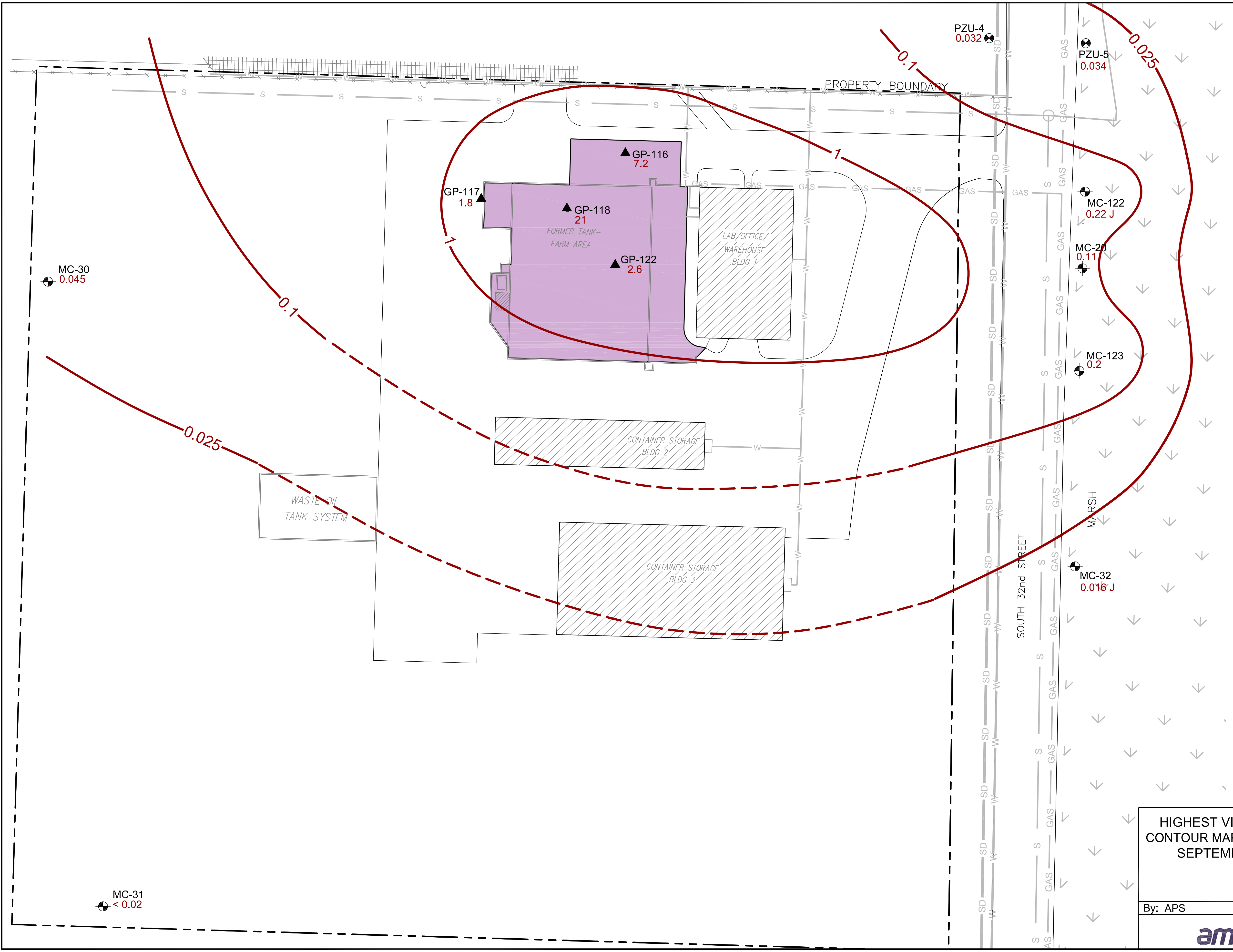


EXPLANATION

GP-116 ▲	Direct-Push Sample Location
MC-122 ⊕	Shallow Groundwater Zone Monitoring Well
PZU-5 ⊗	Piezometer
▨	Area of 1997 Excavation
0.025	Vinyl Chloride Concentration Contour (µg/L) Dashed where inferred
SD	Storm Sewer (18-Inch)
S	Sanitary Sewer (10-Inch)
W	Water line (14-Inch)
GAS	Gas line

NOTES:

1. Concentrations shown in µg/L.
2. Concentrations for monitoring wells are the maximum values observed between 3rd Quarter 2011 and 2nd Quarter 2012.
3. Groundwater concentrations from direct push investigation performed in 2011 were also used to generate contours.
4. Proposed groundwater cleanup level for Vinyl Chloride is 0.025 µg/L.
5. Numbers in red are the highest detected concentration for that well. When preceded by the < symbol, result is "not detected" and number is the reporting limit for these wells.

ABBREVIATIONS:

J = Result is an estimate
L = Liter
µg = micrograms

0 25 50
APPROXIMATE SCALE IN FEET

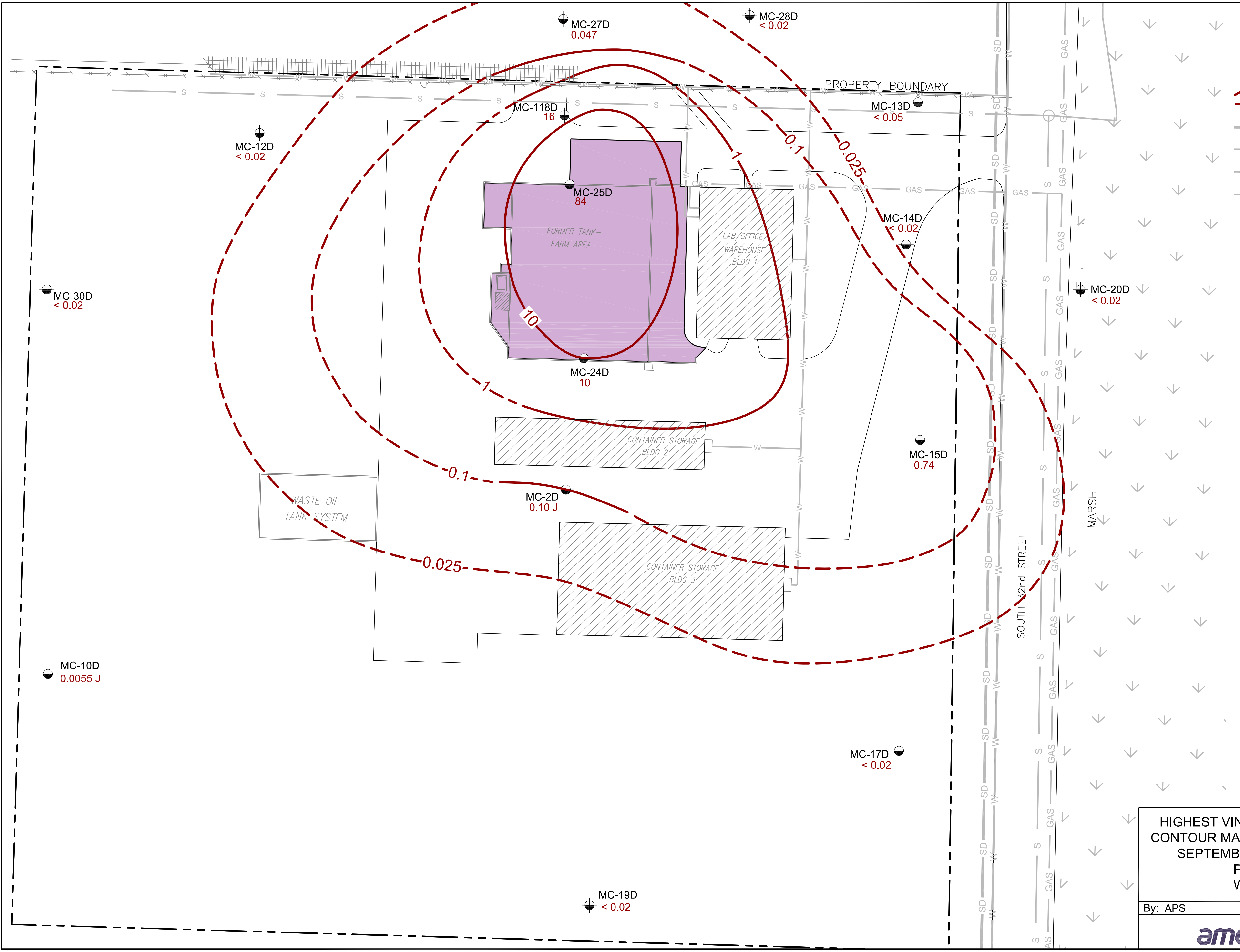
HIGHEST VINYL CHLORIDE CONCENTRATION
CONTOUR MAP - SILT LAYER GROUNDWATER ZONE
SEPTEMBER 2011 THROUGH JUNE 2012
PSC Washougal Facility
Washougal, Washington

By: APS
Date: 12/07/12
Project No. 9625

amec

Figure **11-19**

Plot Date: 12/07/12 - 3:34pm, Plotted by: adam.stenberg
Drawing Path: S:\9625\010_RI-2012\CAD\, Drawing Name: Figure_11-19_PSC-Wash_VC_Silt_120712.dwg



EXPLANATION

MC-14D ⊕ Lower Aquifer Monitoring Well

🟪 Area of 1997 Excavation

0.1 Vinyl Chloride Concentration Contour (µg/L)
Dashed where inferred

SD Storm Sewer (18-Inch)

S Sanitary Sewer (10-Inch)

W Water line (14-Inch)

GAS Gas line

NOTES:
1. Concentrations shown in µg/L.
2. Concentrations for monitoring wells are the maximum values observed between 3rd Quarter 2011 and 2nd Quarter 2012. Only data from monitoring wells used for contouring.
3. Proposed groundwater cleanup level for Vinyl Chloride is 0.025 µg/L.
4. Numbers in red are the highest detected concentration for that well. When preceded by the < symbol, result is "not detected" and number is the reporting limit for these wells.

ABBREVIATIONS:
J = Result is an estimate
L = Liter
µg = micrograms

N

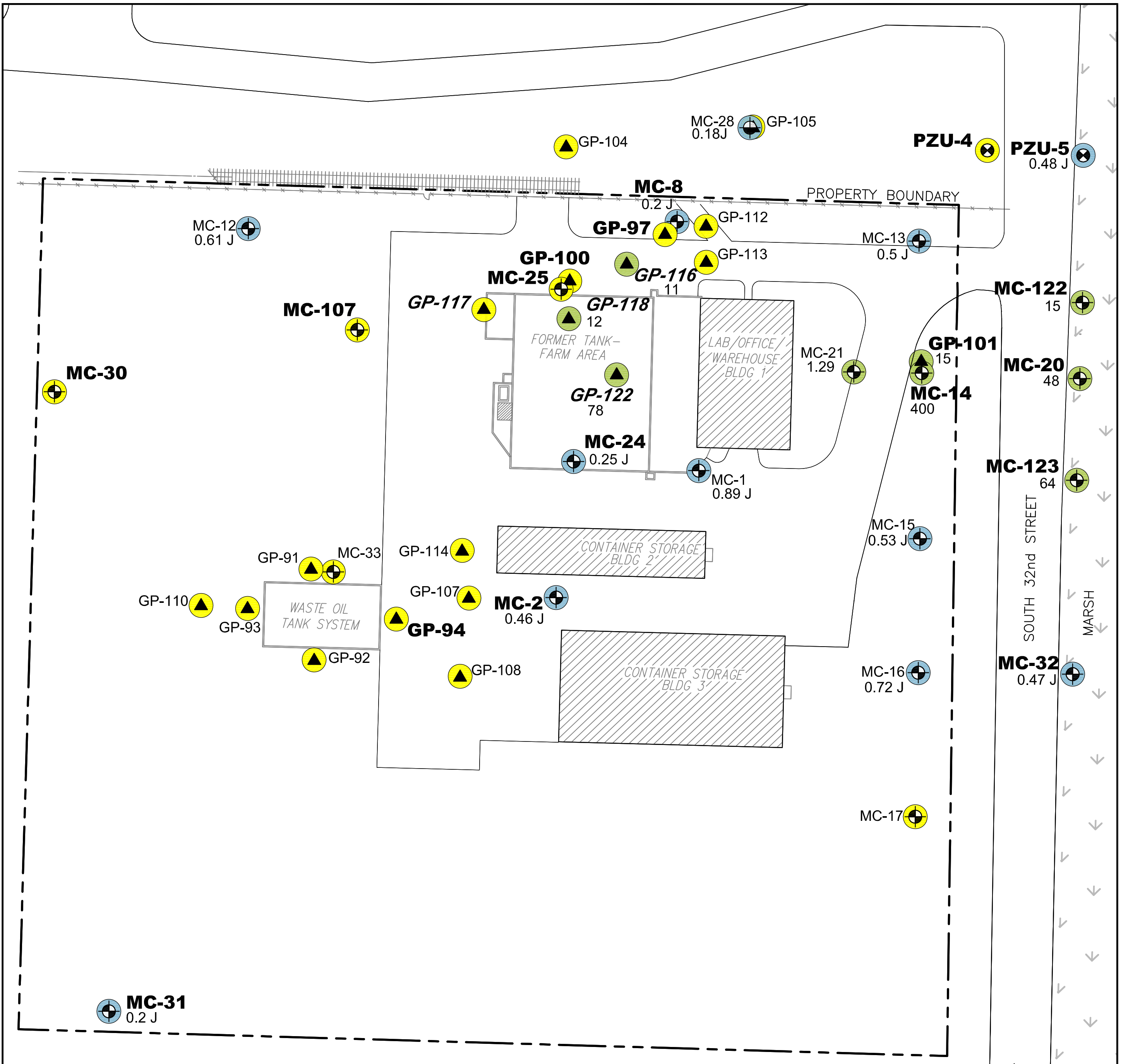
0 25 50
APPROXIMATE SCALE IN FEET

HIGHEST VINYL CHLORIDE CONCENTRATION CONTOUR MAP - LOWER GROUNDWATER ZONE SEPTEMBER 2011 THROUGH JUNE 2012

PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/10/12	Project No. 9625
amec		Figure 11-20

Plot Date: 12/10/12 - 8:22am, Plotted by: adam.stenberg
Drawing Path: S:\9625\010_RI-2012\CAD\, Drawing Name: Figure_11-20_PSC-Wash_VC_Lower_121012.dwg



EXPLANATION

▲ Direct-Push Sample Location

⊕ Shallow Groundwater Zone Monitoring Well

⊗ Piezometer

Detected Analyte Key

Preliminary Cleanup Level is 1 µg/L

🟢 Concentration above preliminary cleanup level (highest detected concentration shown for each location)

🔵 Concentration below preliminary cleanup level (highest detected concentration shown for each location)

🟡 Analyte never detected

Concentrations in micrograms per liter (µg/L).

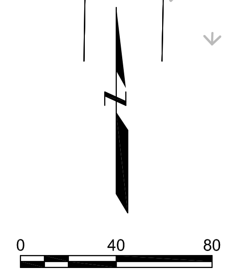
Data Qualifiers

J = Value shown is estimated concentration.

Notes

bold Screened partially in silt layer

italics Screened fully in silt layer

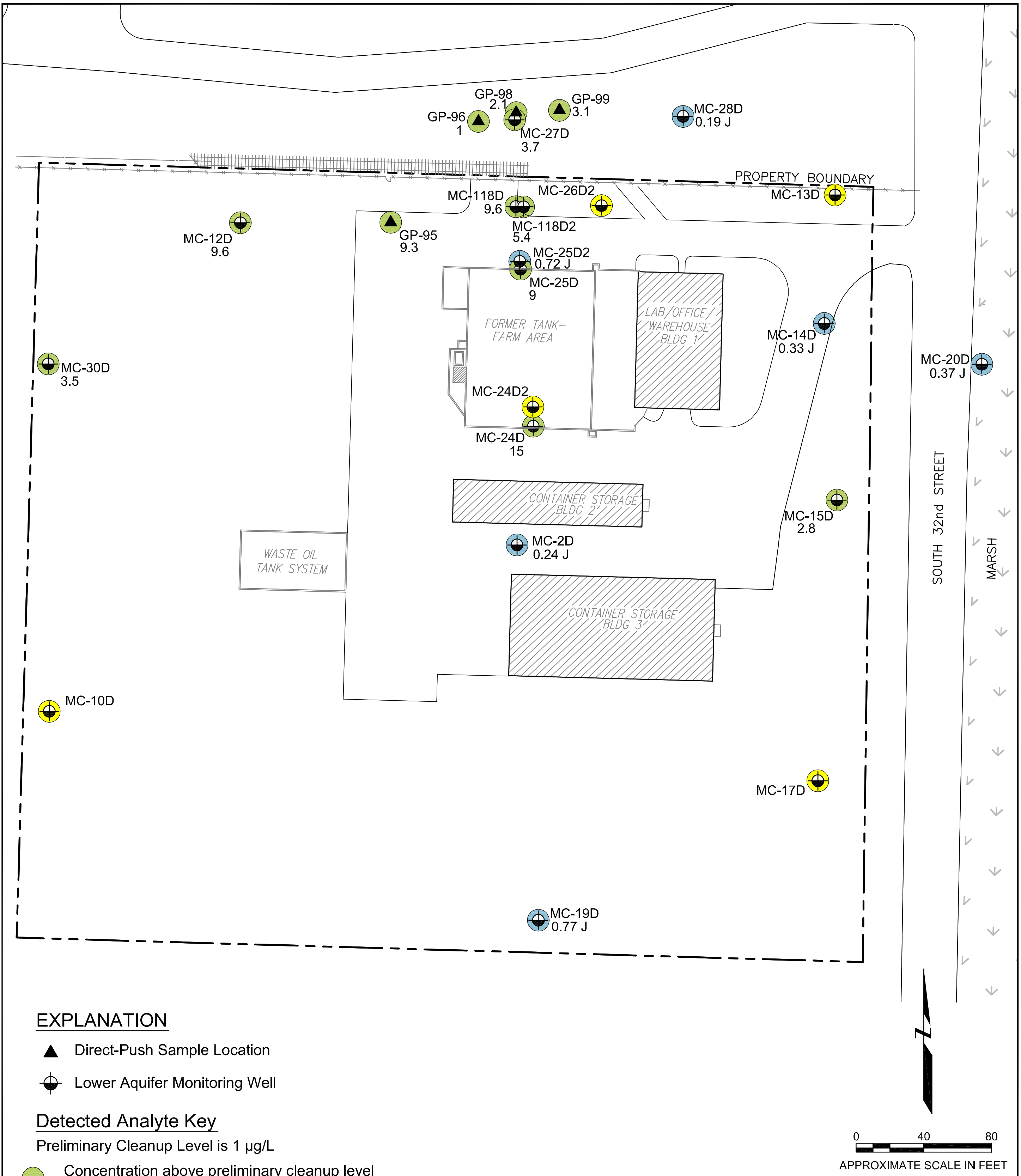


APPROXIMATE SCALE IN FEET

HIGHEST 1,4-DIOXANE RESULTS
SHALLOW GROUNDWATER ZONE
2004 THROUGH SECOND QUARTER 2012
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/07/12	Project No. 9625
	amec	Figure 11-21

Plot Date: 12/07/12 - 1:02pm, Plotted by: jeffrey.sanders
Drawing Path: G:\0096250050 - PSC-Washougal\, Drawing Name: Figure_11-21_PSC-Wash_GW-14Diox-Sh_120712.dwg



EXPLANATION

▲ Direct-Push Sample Location

⊕ Lower Aquifer Monitoring Well

Detected Analyte Key

Preliminary Cleanup Level is 1 µg/L

🟢 Concentration above preliminary cleanup level (highest detected concentration shown for each location)

🔵 Concentration below preliminary cleanup level (highest detected concentration shown for each location)

🟡 Analyte never detected

Concentrations in micrograms per liter (µg/L).

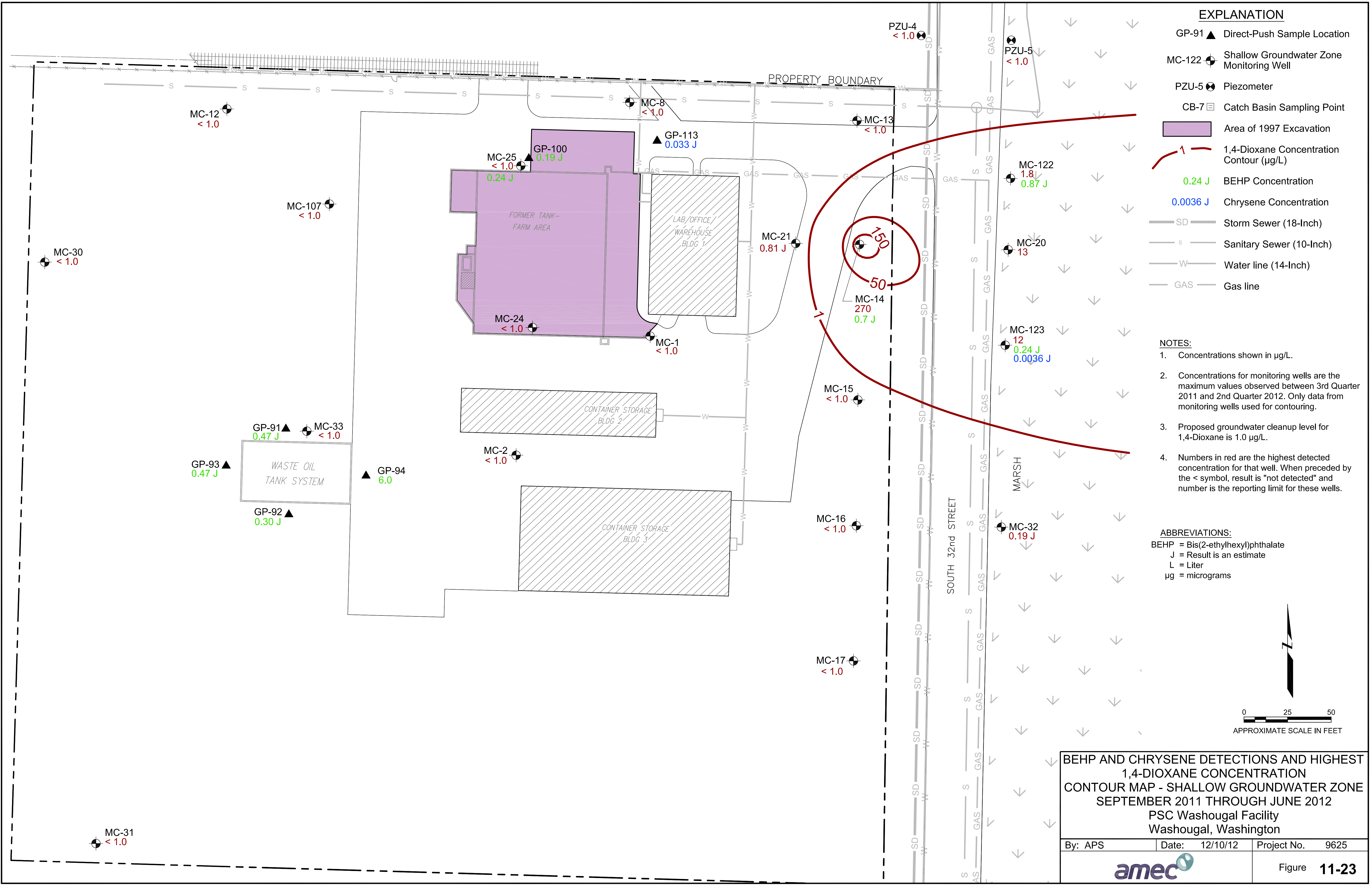
Data Qualifiers

J = Value shown is estimated concentration.

HIGHEST 1,4-DIOXANE RESULTS
LOWER AQUIFER
GROUNDWATER ZONE
2004 THROUGH SECOND QUARTER 2012
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/01/12	Project No. 9625
amec		Figure **11-22**

Plot Date: 12/01/12 - 11:23am, Plotted by: mike.stenberg
Drawing Path: Z:\PSC WASHOUGAL\113012\, Drawing Name: Figure_11-22_PSC-Wash_GW-14Diox-Low_113012.dwg



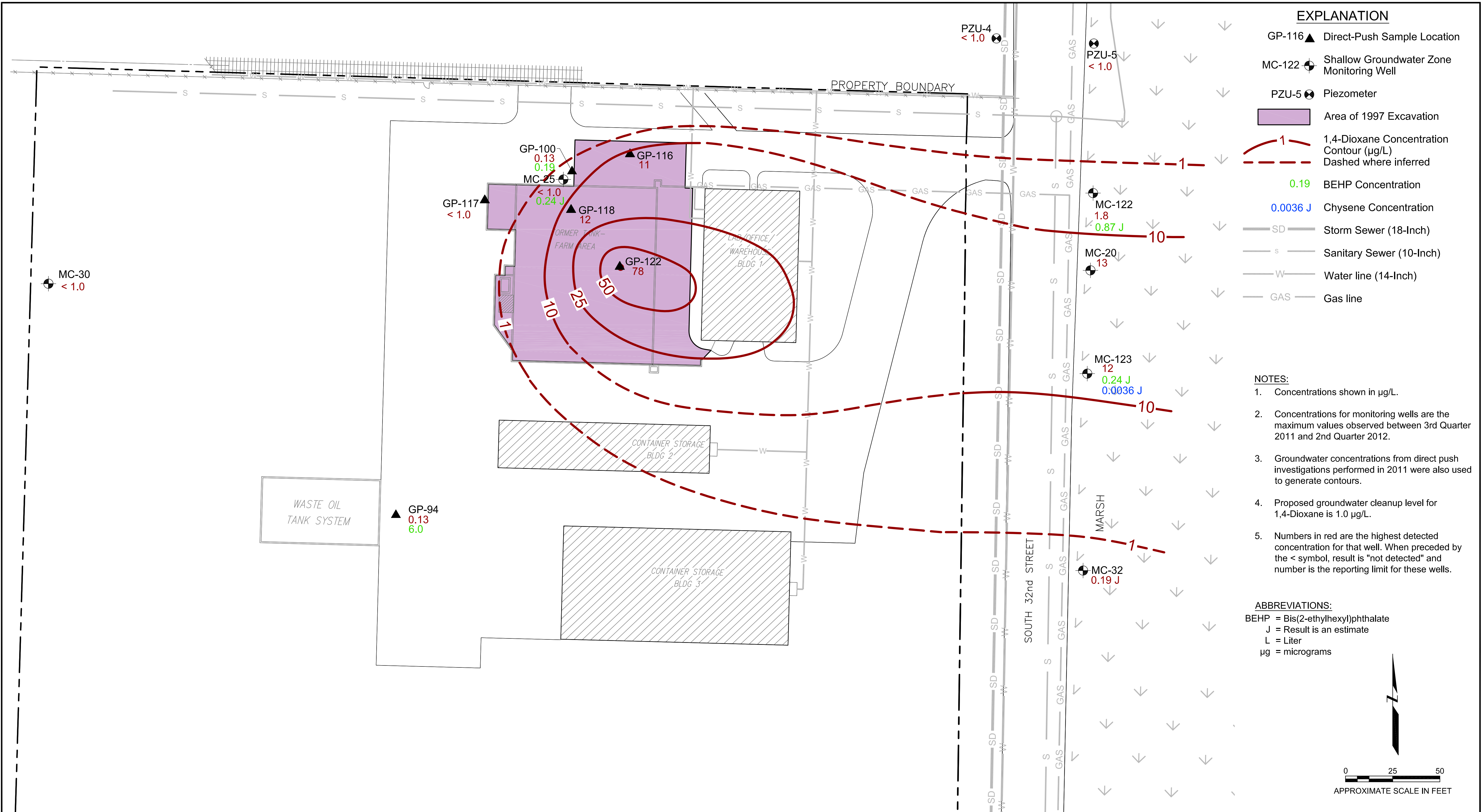
NOTES:
1. Concentrations shown in µg/L.
2. Concentrations for monitoring wells are the maximum values observed between 3rd Quarter 2011 and 2nd Quarter 2012. Only data from monitoring wells used for contouring.
3. Proposed groundwater cleanup level for 1,4-Dioxane is 1.0 µg/L.
4. Numbers in red are the highest detected concentration for that well. When preceded by the < symbol, result is "not detected" and number is the reporting limit for these wells.

ABBREVIATIONS:
BEHP = Bis(2-ethylhexyl)phthalate
J = Result is an estimate
L = Liter
µg = micrograms

BEHP AND CHRYSENE DETECTIONS AND HIGHEST
1,4-DIOXANE CONCENTRATION
CONTOUR MAP - SHALLOW GROUNDWATER ZONE
SEPTEMBER 2011 THROUGH JUNE 2012
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/10/12	Project No. 9625
amec		Figure 11-23

Plot Date: 12/10/12 - 8:23am, Plotted by: adam.stenberg
Drawing Path: S:\9625\010_RI-2012\CAD\, Drawing Name: Figure_11-23_PSC-Wash_14Diox_Shallow_121012.dwg



NOTES:

1. Concentrations shown in µg/L.
2. Concentrations for monitoring wells are the maximum values observed between 3rd Quarter 2011 and 2nd Quarter 2012.
3. Groundwater concentrations from direct push investigations performed in 2011 were also used to generate contours.
4. Proposed groundwater cleanup level for 1,4-Dioxane is 1.0 µg/L.
5. Numbers in red are the highest detected concentration for that well. When preceded by the < symbol, result is "not detected" and number is the reporting limit for these wells.

ABBREVIATIONS:

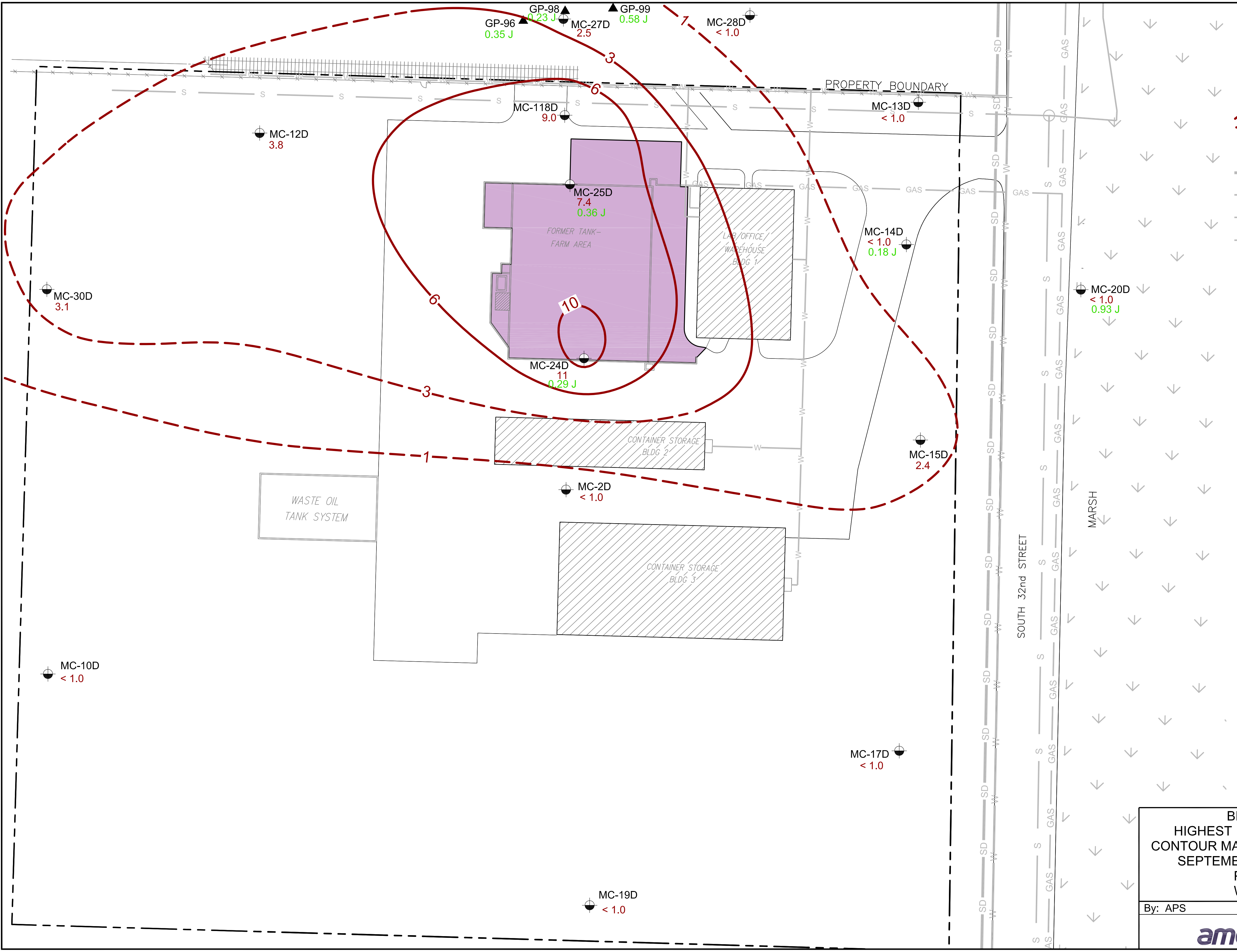
BEHP = Bis(2-ethylhexyl)phthalate
J = Result is an estimate
L = Liter
µg = micrograms

BEHP AND CHRYSENE DETECTIONS AND HIGHEST
1,4-DIOXANE CONCENTRATION
CONTOUR MAP - SILT LAYER GROUNDWATER ZONE
SEPTEMBER 2011 THROUGH JUNE 2012
PSC Washougal Facility
Washougal, Washington

By: APS | Date: 12/10/12 | Project No. 9625

amec | Figure **11-24**

Plot Date: 12/10/12 - 9:51am, Plotted by: adam.stenberg
Drawing Path: S:\9625\010_RI-2012\CAD\, Drawing Name: Figure_11-24_PSC-Wash_14Diox_Silt_121012.dwg



EXPLANATION

GP-97 ▲	Direct-Push Sample Location
MC-14D ⊕	Lower Aquifer Monitoring Well
▨	Area of 1997 Excavation
3	1,4-Dioxane Concentration Contour (µg/L) Dashed where inferred
0.93 J	BEHP Concentration
SD	Storm Sewer (18-Inch)
S	Sanitary Sewer (10-Inch)
W	Water line (14-Inch)
GAS	Gas line

NOTES:

1. Concentrations shown in µg/L.
2. Concentrations for monitoring wells are the maximum values observed between 3rd Quarter 2011 and 2nd Quarter 2012. Only data from monitoring wells used for contouring.
3. Proposed groundwater cleanup level for 1,4-Dioxane is 1.0 µg/L.
4. Numbers in red are the highest detected concentration for that well. When preceded by the < symbol, result is "not detected" and number is the reporting limit for these wells.

ABBREVIATIONS:

BEHP = Bis(2-ethylhexyl)phthalate
J = Result is an estimate
L = Liter
µg = micrograms

0 25 50
APPROXIMATE SCALE IN FEET

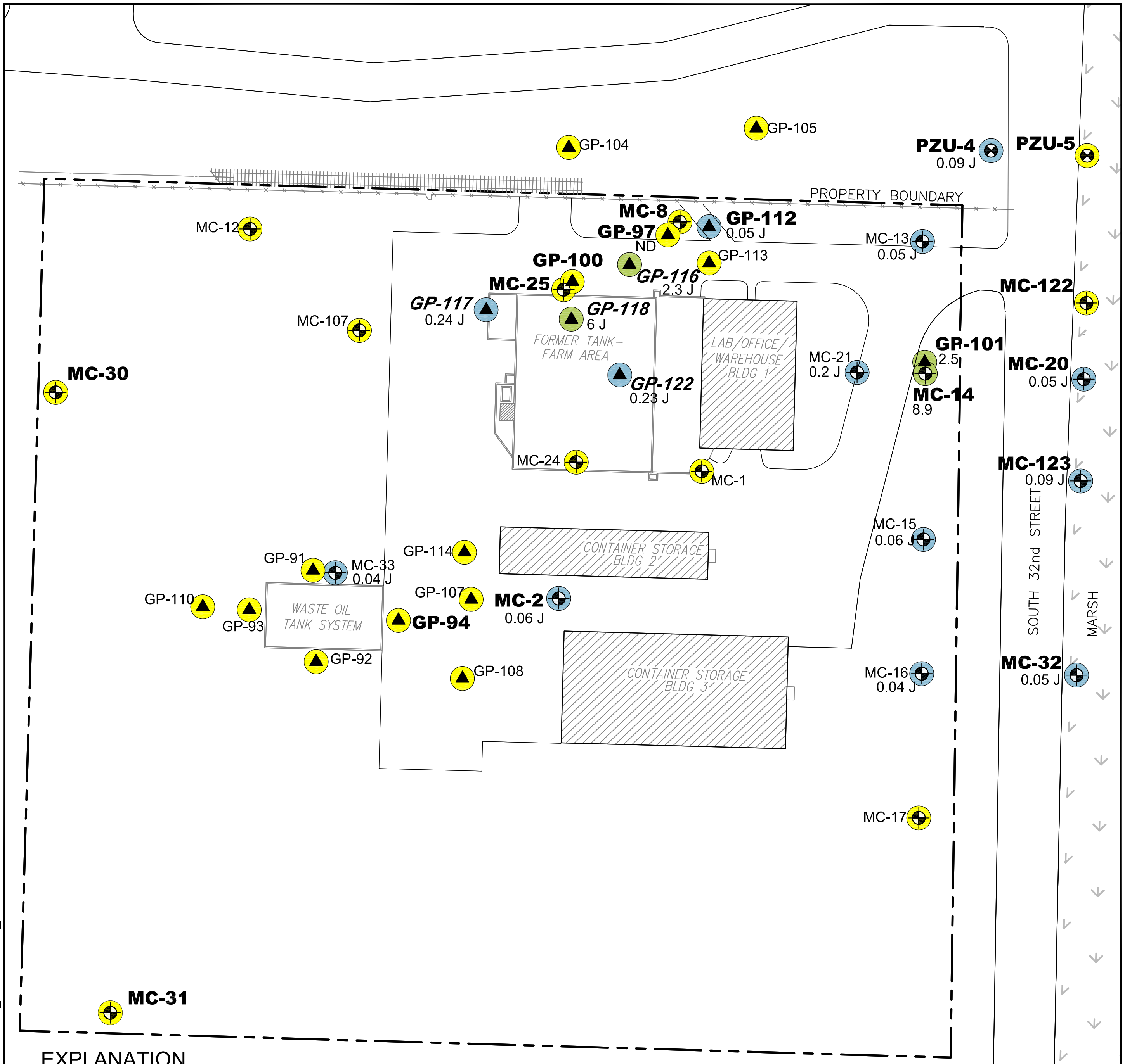
BEHP DETECTIONS AND
HIGHEST 1,4-DIOXANE CONCENTRATION
CONTOUR MAP - LOWER GROUNDWATER ZONE
SEPTEMBER 2011 THROUGH JUNE 2012
PSC Washougal Facility
Washougal, Washington

By: APS | Date: 12/10/12 | Project No. 9625

amec

Figure 11-25

Plot Date: 12/10/12 - 9:52am, Plotted by: adam.stenberg
Drawing Path: S:\9625\010_RI-2012\CAD\, Drawing Name: Figure_11-25_PSC-Wash_14Diox_Lower_121012.dwg



EXPLANATION

▲ Direct-Push Sample Location

⊕ Shallow Groundwater Zone Monitoring Well

⊗ Piezometer

Detected Analyte Key

Preliminary Cleanup Level is 0.8 μg/L

🟢 Concentration above preliminary cleanup level (highest detected concentration shown for each location)

🔵 Concentration below preliminary cleanup level (highest detected concentration shown for each location)

🟡 Analyte never detected

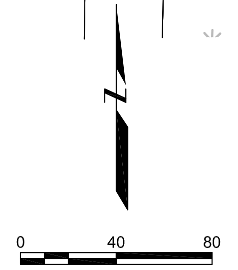
Concentrations in micrograms per liter (μg/L).

Data Qualifiers

J = Value shown is estimated concentration.

Notes

bold Screened partially in silt layer
italics Screened fully in silt layer

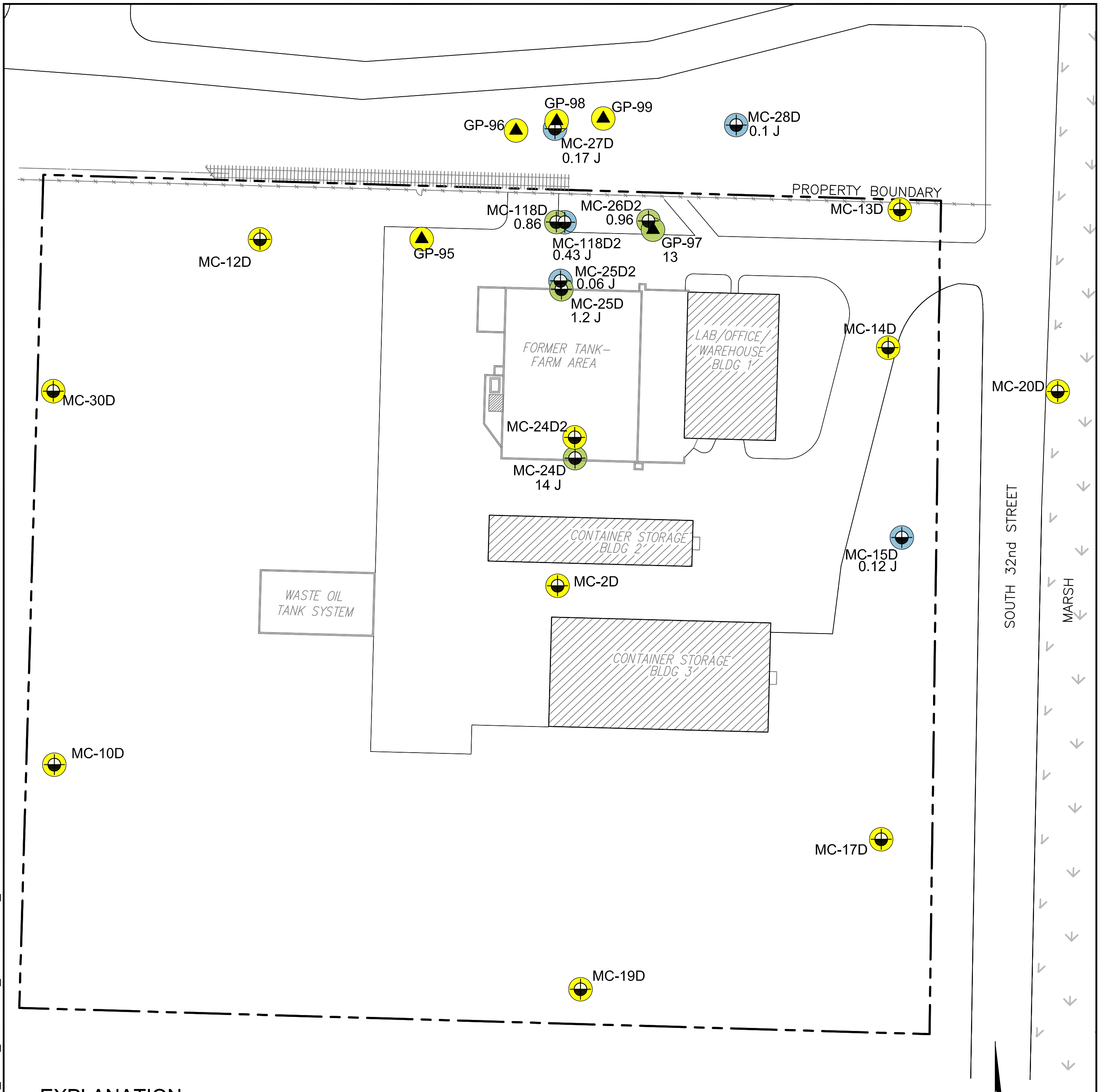


APPROXIMATE SCALE IN FEET

HIGHEST BENZENE RESULTS
SHALLOW GROUNDWATER ZONE
2004 THROUGH SECOND QUARTER 2012
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/07/12	Project No. 9625
AMEC Geomatrix		Figure 11-26

Plot Date: 12/07/12 - 4:29pm, Plotted by: jeffrey.sanders
Drawing Path: G:\0096250050 - PSC-Washougal\, Drawing Name: Figure_11-26_PSC-Wash_GW-Benz-Sh_120711.DWG



N

0 40 80

APPROXIMATE SCALE IN FEET

EXPLANATION

▲ Direct-Push Sample Location

⌖ Lower Aquifer Monitoring Well

Detected Analyte Key

Preliminary Cleanup Level is 0.8 µg/L

🟩 Concentration above preliminary cleanup level
(highest detected concentration shown for each location)

🟦 Concentration below preliminary cleanup level
(highest detected concentration shown for each location)

🟨 Analyte never detected

Concentrations in micrograms per liter (µg/L).

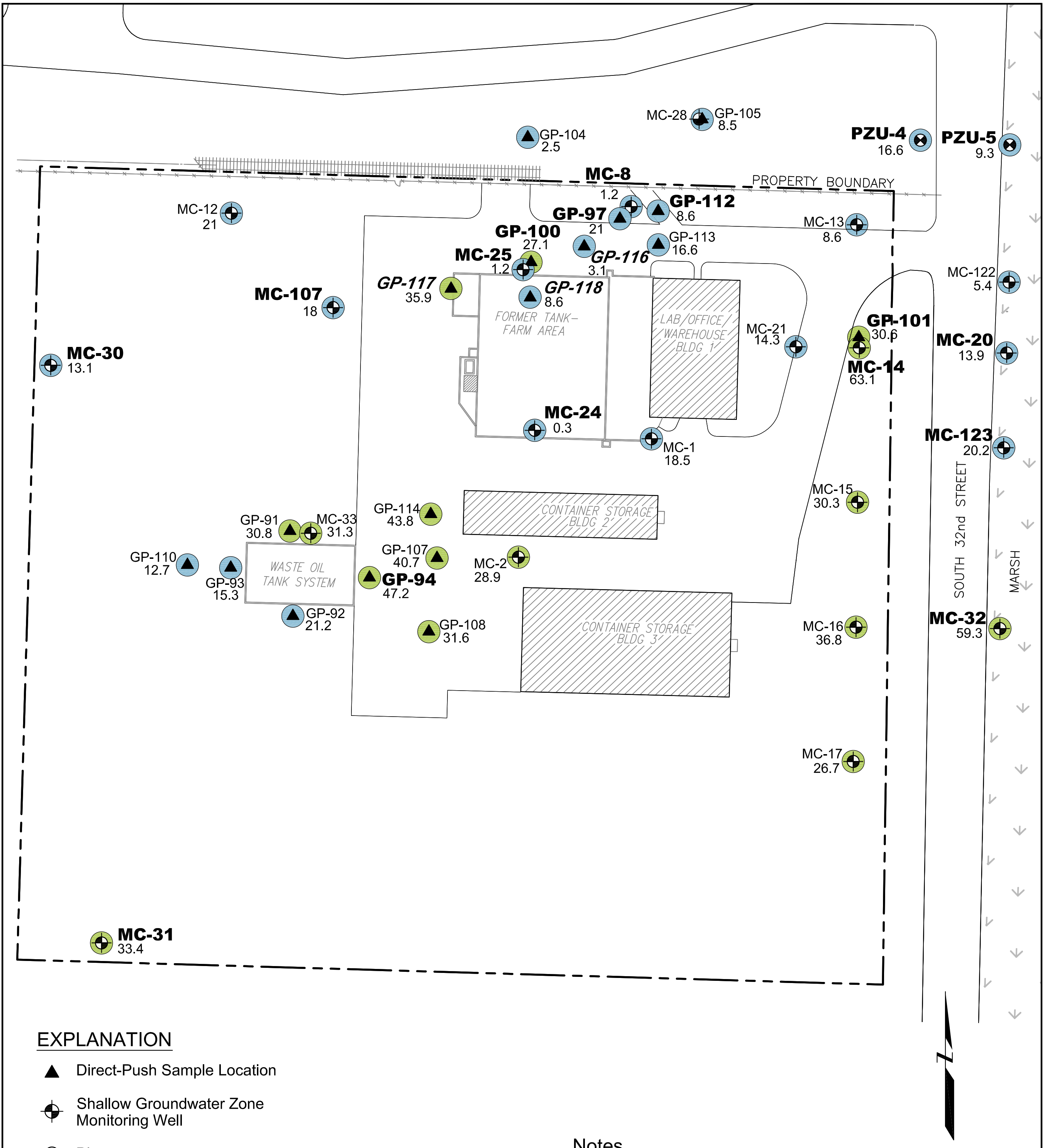
Data Qualifiers

J = Value shown is estimated concentration.

HIGHEST BENZENE RESULTS
LOWER AQUIFER/GROUNDWATER ZONE
2004 THROUGH SECOND QUARTER 2012
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/07/12	Project No. 9625
AMEC Geomatrix		Figure 11-27

Plot Date: 12/07/12 - 4:31pm, Plotted by: jeffrey.sanders
Drawing Path: G:\0096250050 - PSC-Washougal\, Drawing Name: Figure_11-27_PSC Wash_GW-Benz-Low_120711.DWG



EXPLANATION

▲ Direct-Push Sample Location

⌖ Shallow Groundwater Zone Monitoring Well

⊗ Piezometer

Detected Analyte Key

Preliminary Cleanup Level is 22.84 µg/L

● Concentration above preliminary cleanup level (highest annual average concentration shown for each location)

● Concentration below preliminary cleanup level (highest annual average concentration shown for each location)

Concentrations in micrograms per liter (µg/L).

Notes

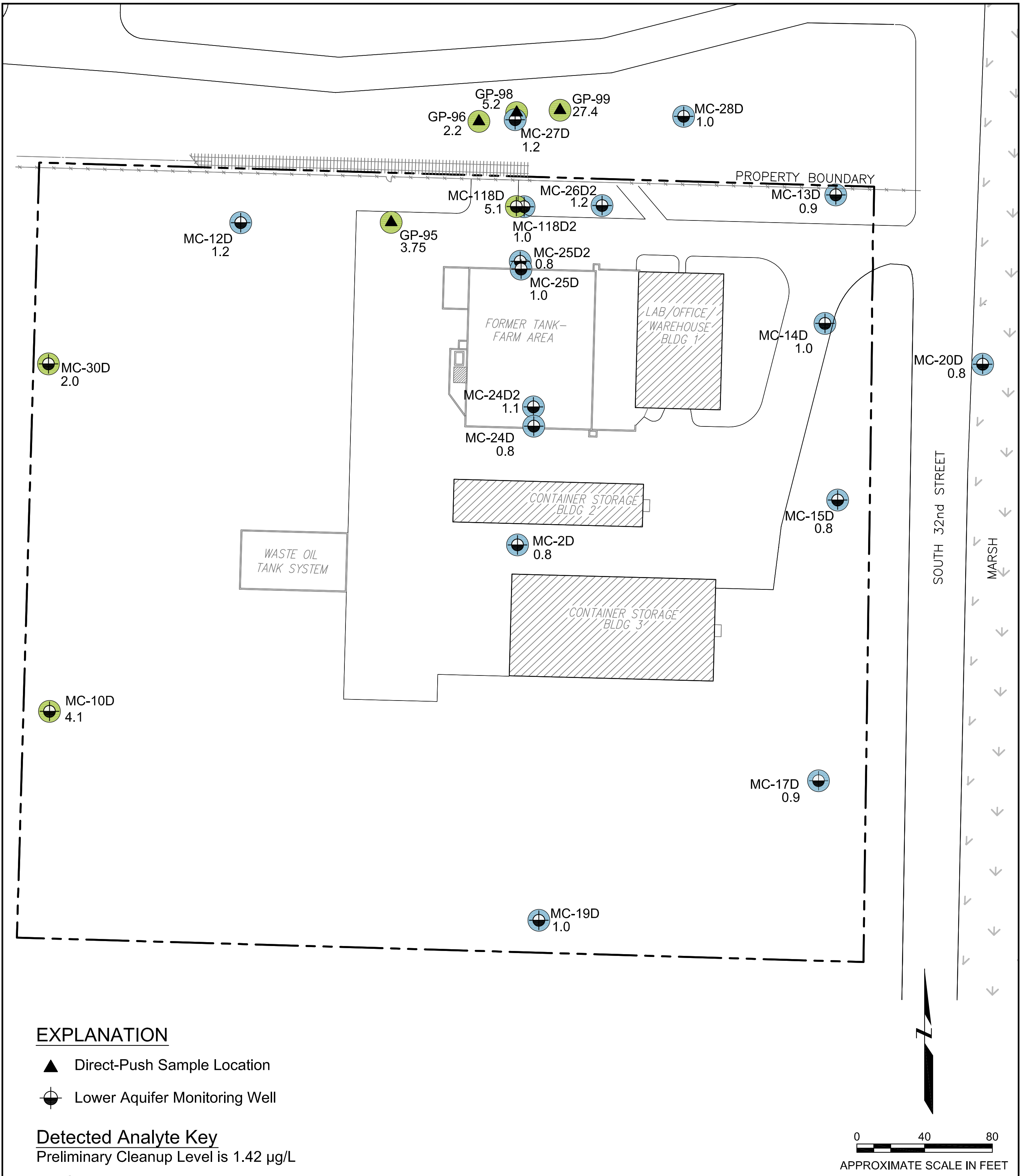
bold	Screened partially in silt layer
italics	Screened fully in silt layer

0 40 80
APPROXIMATE SCALE IN FEET

HIGHEST AVERAGE TOTAL ARSENIC RESULTS
SHALLOW GROUNDWATER ZONE
2004 THROUGH SECOND QUARTER 2012
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/07/12	Project No. 9625
amec		Figure **11-28**

Plot Date: 12/07/12 - 1:04pm, Plotted by: jeffrey.sanders
Drawing Path: G:\0096250050 - PSC-Washougal\, Drawing Name: Figure_11-28_PSC-Wash_GW-Arsenic-Sh_120712.dwg



EXPLANATION

▲ Direct-Push Sample Location

⊕ Lower Aquifer Monitoring Well

Detected Analyte Key

Preliminary Cleanup Level is 1.42 µg/L

🟢 Concentration above preliminary cleanup level
(highest annual average concentration shown for each location)

🔵 Concentration below preliminary cleanup level
(highest annual average concentration shown for each location)

Concentrations in micrograms per liter (µg/L).

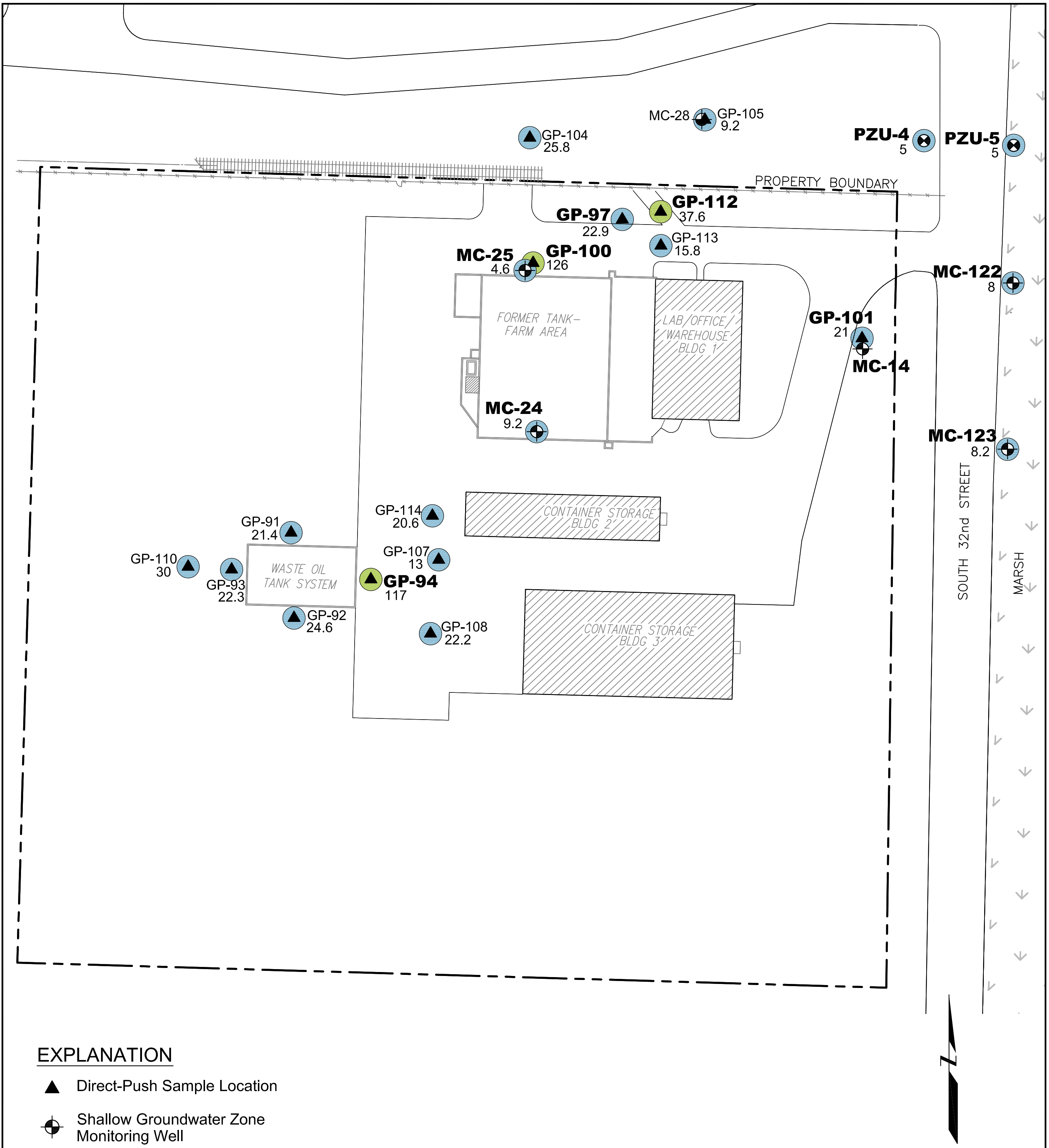
HIGHEST AVERAGE TOTAL ARSENIC RESULTS
LOWER AQUIFER
GROUNDWATER ZONE
2004 THROUGH SECOND QUARTER 2012
PSC Washougal Facility
Washougal, Washington

By: APS
Date: 12/07/12
Project No. 9625

amec

Figure **11-29**

Plot Date: 12/07/12 - 1:29pm, Plotted by: adam.stenberg
Drawing Path: S:\9625\010_RI-2012\CAD\, Drawing Name: Figure_11-29_PSC-Wash_GW-Arsenic-Low_113012.dwg



EXPLANATION

▲ Direct-Push Sample Location

⊕ Shallow Groundwater Zone Monitoring Well

⊗ Piezometer

Detected Analyte Key

Preliminary Cleanup Level is 32.3 µg/L

🟢 Concentration above preliminary cleanup level (highest detected concentration shown for each location)

🔵 Concentration below preliminary cleanup level (highest detected concentration shown for each location)

Concentrations in micrograms per liter (µg/L).

Notes

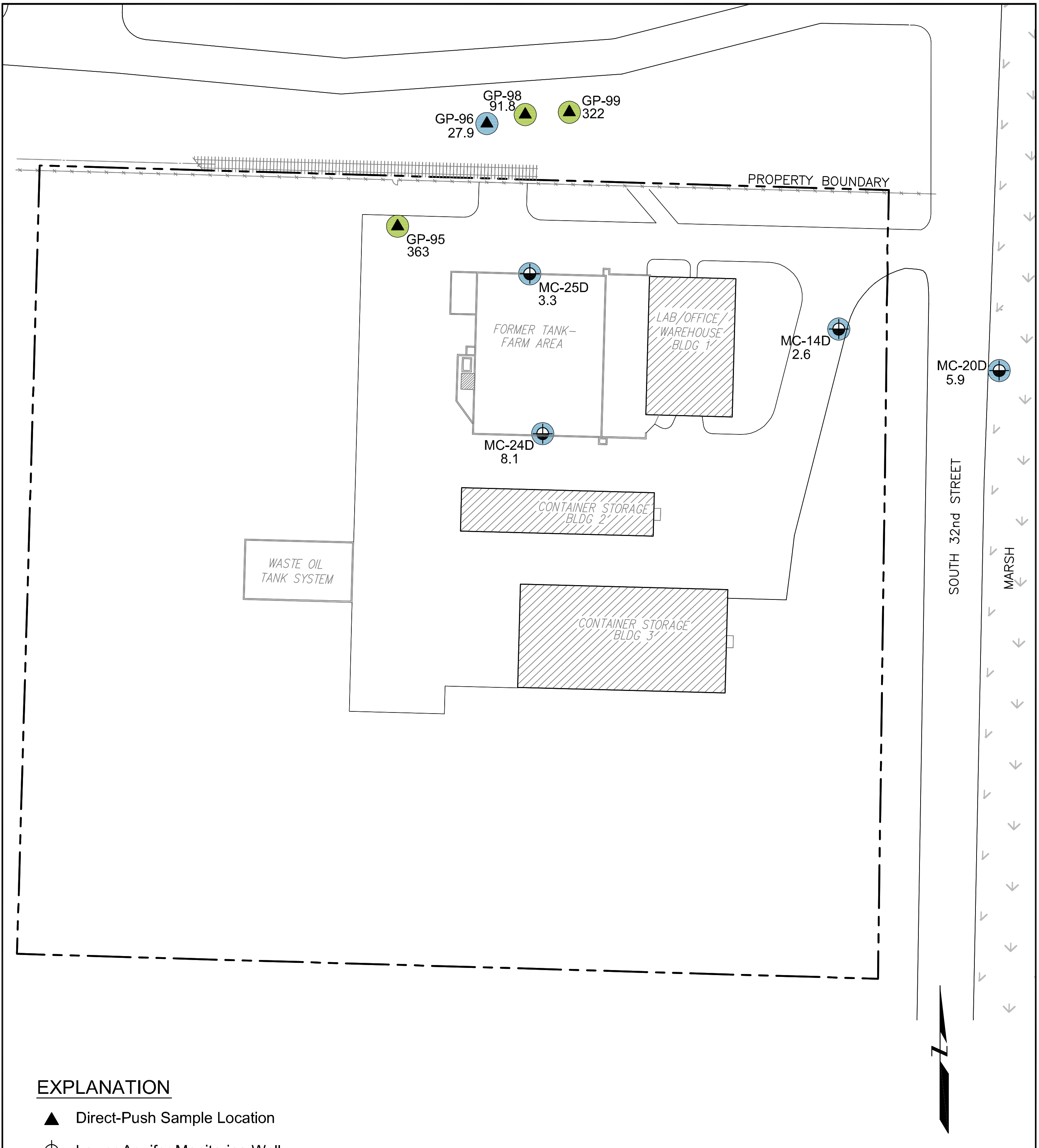
bold Screened partially in silt

0 40 80
APPROXIMATE SCALE IN FEET

HIGHEST TOTAL ZINC RESULTS
SHALLOW GROUNDWATER ZONE
2004 THROUGH 2009
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/07/12	Project No. 9625
amec		Figure **11-30**

Plot Date: 12/07/12 - 10:54am, Plotted by: jeffrey.sanders
Drawing Path: G:\0096250050 - PSC-Washougal\, Drawing Name: Figure_11-30_PSC-Wash_GW-Zinc-Sh_120712.dwg



EXPLANATION

▲ Direct-Push Sample Location

⊕ Lower Aquifer Monitoring Well

Detected Analyte Key

Preliminary Cleanup Level is 32.3 µg/L

🟢 Concentration above preliminary cleanup level
(highest detected concentration shown for each location)

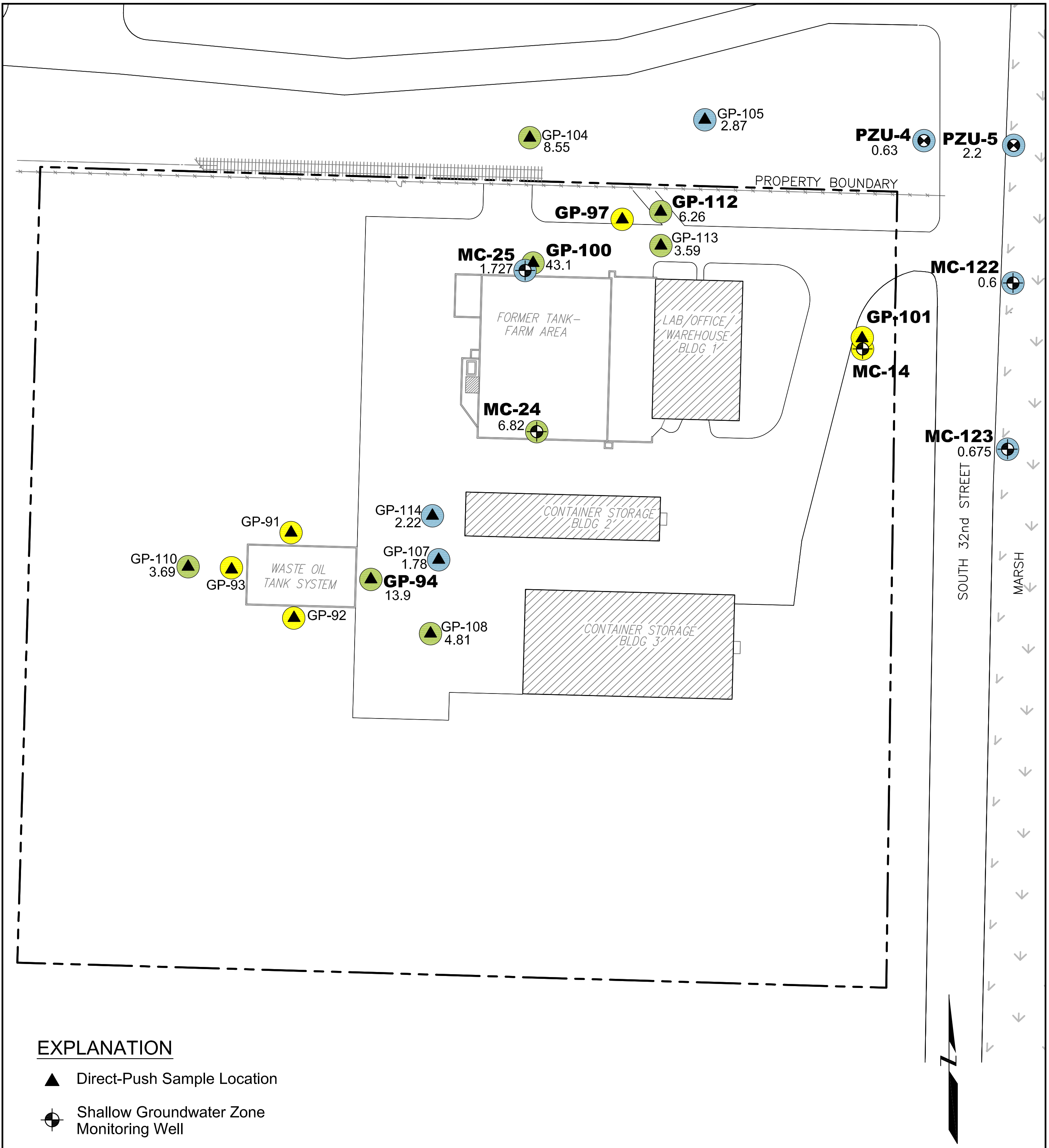
🔵 Concentration below preliminary cleanup level
(highest detected concentration shown for each location)

Concentrations in micrograms per liter (µg/L).

HIGHEST TOTAL ZINC RESULTS
LOWER AQUIFER
GROUNDWATER ZONE
2004 THROUGH 2009
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/01/12	Project No. 9625
amec		Figure **11-31**

Plot Date: 12/01/12 - 11:48am, Plotted by: mike.stenberg
Drawing Path: Z:\PSC WASHOUGAL\113012\, Drawing Name: Figure_11-31_PSC-Wash_GW-Zinc-Low_113012.dwg



EXPLANATION

▲ Direct-Push Sample Location

⌖ Shallow Groundwater Zone Monitoring Well

⊗ Piezometer

Detected Analyte Key

Preliminary Cleanup Level is 3.47 µg/L

🟢 Concentration above preliminary cleanup level (highest detected concentration shown for each location)

🔵 Concentration below preliminary cleanup level (highest detected concentration shown for each location)

🟡 Analyte never detected

Concentrations in micrograms per liter (µg/L).

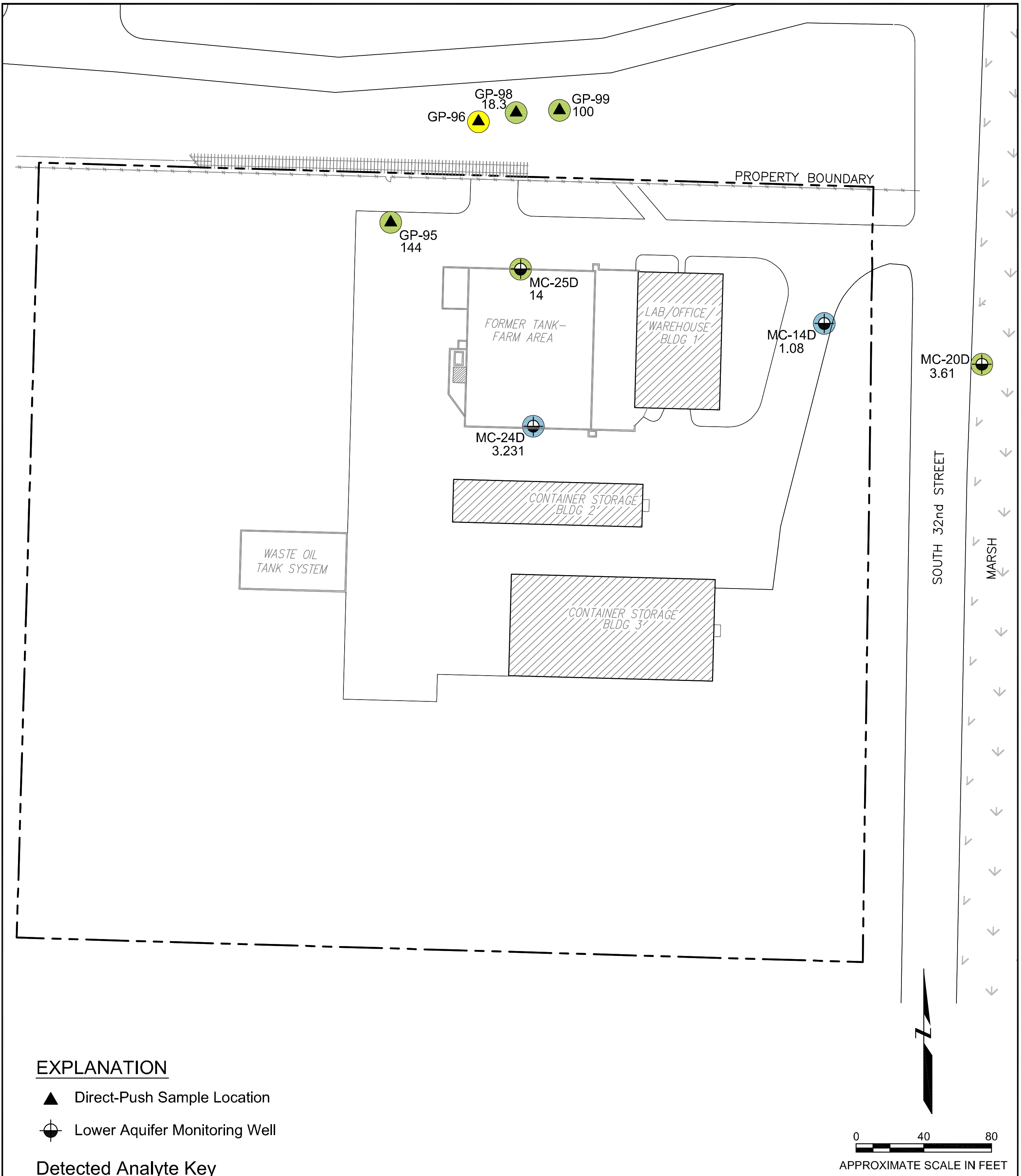
Notes

bold Screened partially in silt

HIGHEST TOTAL COPPER RESULTS
SHALLOW GROUNDWATER ZONE
2004 THROUGH 2009
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/07/12	Project No. 9625
amec		Figure 11-32

Plot Date: 12/07/12 - 4:18pm, Plotted by: jeffrey.sanders
Drawing Path: G:\0096250050 - PSC-Washougal\, Drawing Name: Figure_11-32_PSC-Wash_GW-Copper-Sh_120712.dwg



EXPLANATION

▲ Direct-Push Sample Location

⊕ Lower Aquifer Monitoring Well

Detected Analyte Key

Preliminary Cleanup Level is 3.47 µg/L

● Concentration above preliminary cleanup level
(highest detected concentration shown for each location)

● Concentration below preliminary cleanup level
(highest detected concentration shown for each location)

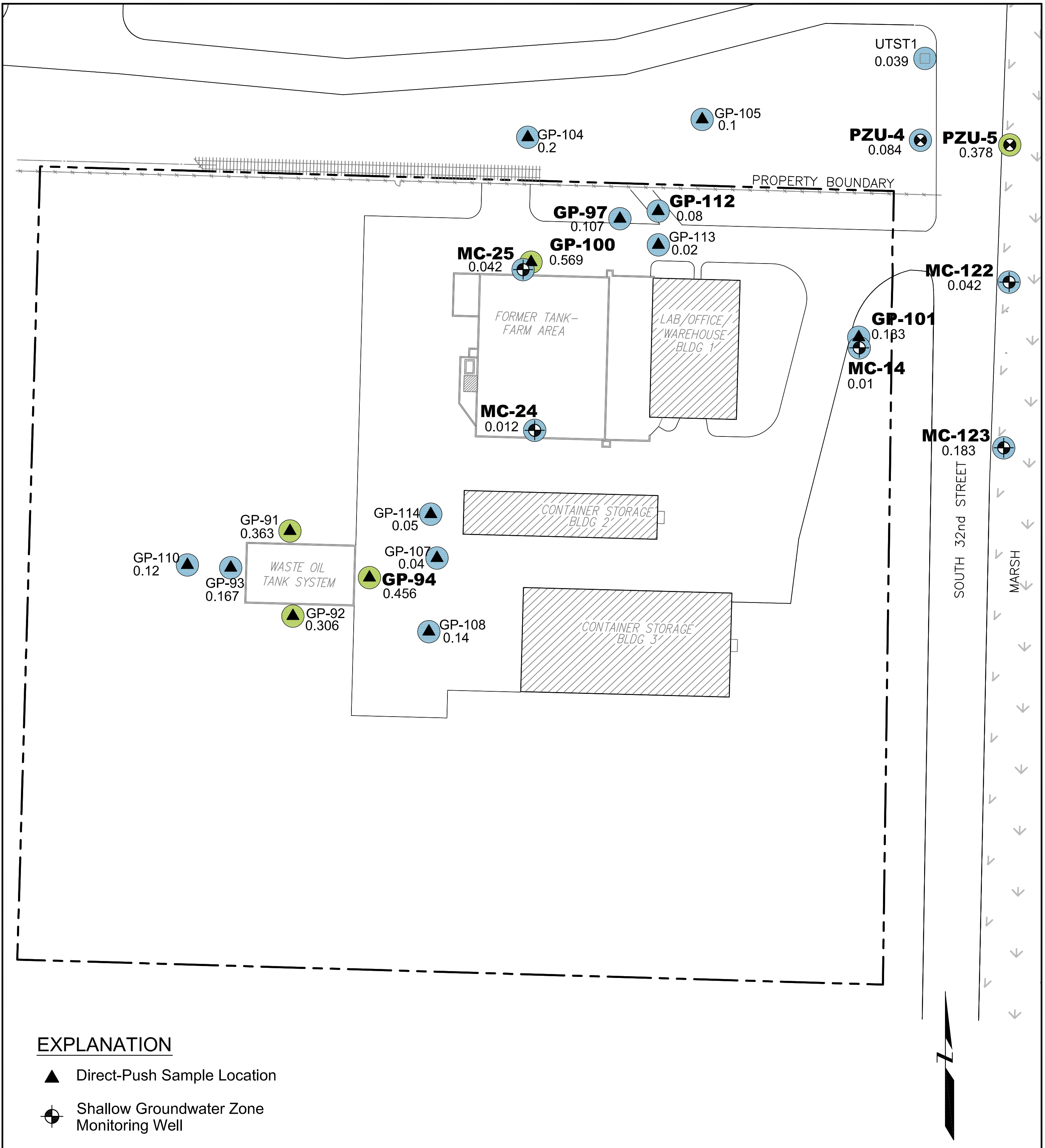
● Analyte never detected

Concentrations in micrograms per liter (µg/L).

HIGHEST TOTAL COPPER RESULTS
LOWER AQUIFER
GROUNDWATER ZONE
2004 THROUGH 2009
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/01/12	Project No. 9625
amec		Figure **11-33**

Plot Date: 12/01/12 - 11:56am, Plotted by: mike.stenberg
Drawing Path: Z:\PSC WASHOUGAL\113012\, Drawing Name: Figure_11-33_PSC-Wash_GW-Copper-Low_113012.dwg



EXPLANATION

- ▲ Direct-Push Sample Location
- ⊕ Shallow Groundwater Zone Monitoring Well
- ⊗ Piezometer
- ☐ Underground Storage Tank

Detected Analyte Key

Preliminary Cleanup Level is 0.25 µg/L

- 🟢 Concentration above preliminary cleanup level (highest detected concentration shown for each location)
- 🔵 Concentration below preliminary cleanup level (highest detected concentration shown for each location)

Concentrations in micrograms per liter (µg/L).

Notes

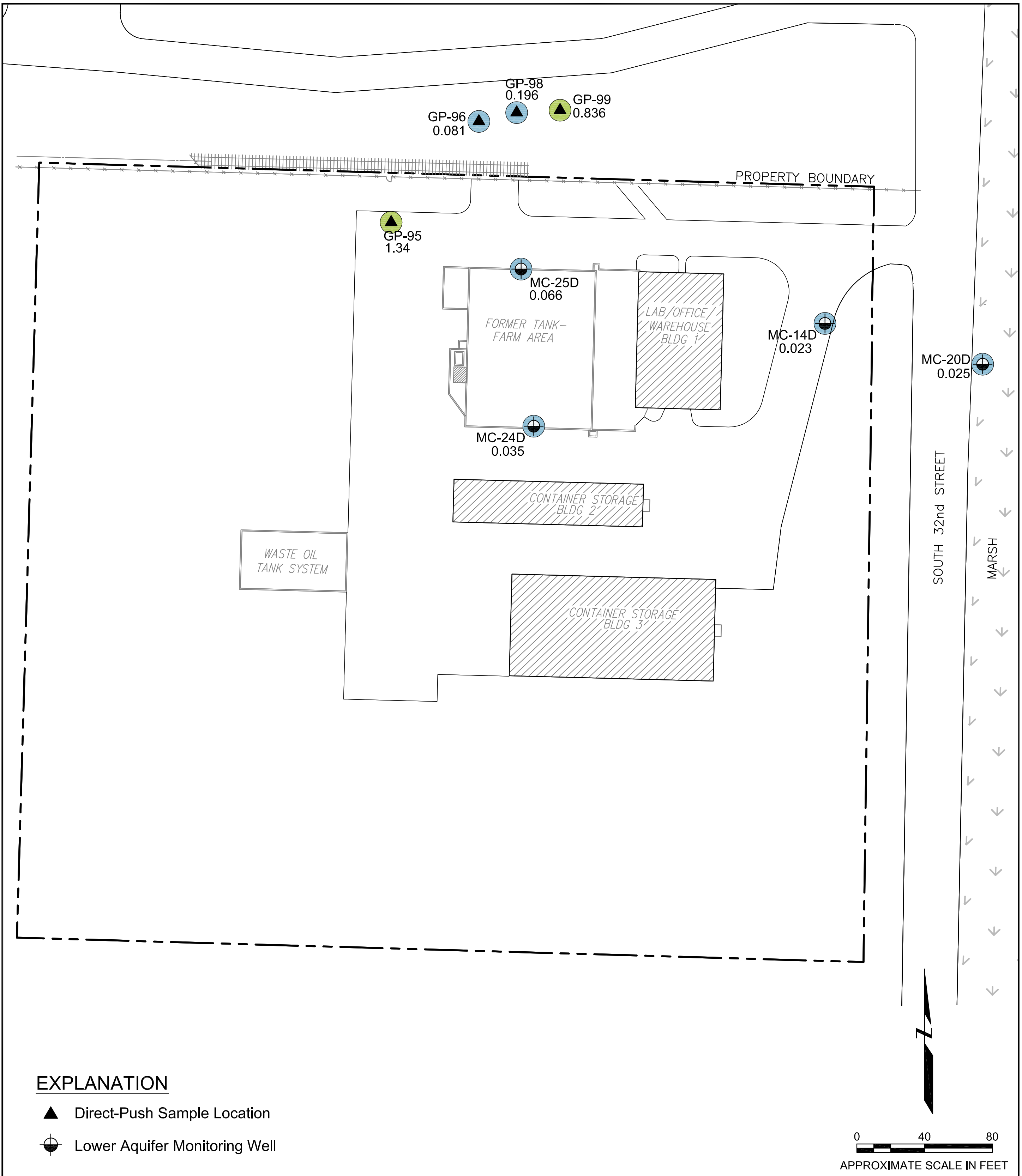
bold Screened partially in silt

0 40 80
APPROXIMATE SCALE IN FEET

HIGHEST TOTAL CADMIUM RESULTS
SHALLOW GROUNDWATER ZONE
2004 THROUGH 2009
PSC Washougal Facility
Washougal, Washington

By: APS
Date: 12/07/12
Project No. 9625
amec
Figure 11-34

Plot Date: 12/07/12 - 11:05am, Plotted by: jeffrey.sanders
Drawing Path: G:\0096250050 - PSC-Washougal\, Drawing Name: Figure_11-34_PSC-Wash_GW-Cd-Sh_120712.dwg



EXPLANATION

▲ Direct-Push Sample Location

⊕ Lower Aquifer Monitoring Well

Detected Analyte Key

Preliminary Cleanup Level is 0.25 µg/L

🟢 Concentration above preliminary cleanup level
(highest detected concentration shown for each location)

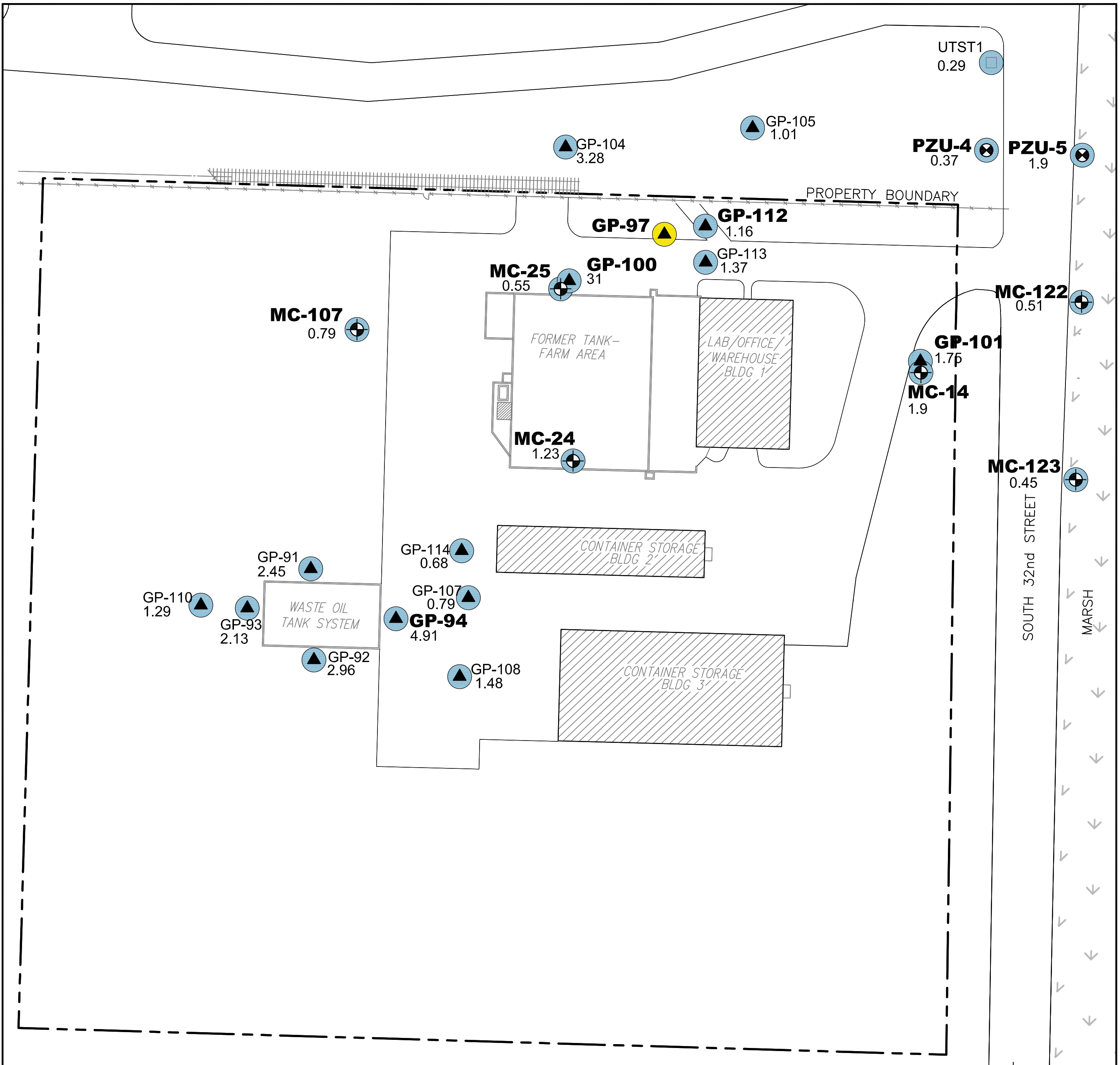
🔵 Concentration below preliminary cleanup level
(highest detected concentration shown for each location)

Concentrations in micrograms per liter (µg/L).

HIGHEST TOTAL CADMIUM RESULTS
LOWER AQUIFER/GROUNDWATER ZONE
2004 THROUGH 2009
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 11/30/12	Project No. 9625
	amec	Figure **11-35**

Plot Date: 11/30/12 - 12:54pm, Plotted by: jeffrey.sanders
Drawing Path: G:\0096250050 - PSC-Washougal\, Drawing Name: Figure_11-35_PSC-Wash_GW-Cd-Low_113012.dwg



N

0 40 80
APPROXIMATE SCALE IN FEET

EXPLANATION

▲ Direct-Push Sample Location

⊕ Shallow Groundwater Zone Monitoring Well

⊗ Piezometer

☐ Underground Storage Tank

Detected Analyte Key

Preliminary Cleanup Level is 50 µg/L

🟢 Concentration above preliminary cleanup level (highest detected concentration shown for each location)

🔵 Concentration below preliminary cleanup level (highest detected concentration shown for each location)

🟡 Analyte never detected

Concentrations in micrograms per liter (µg/L).

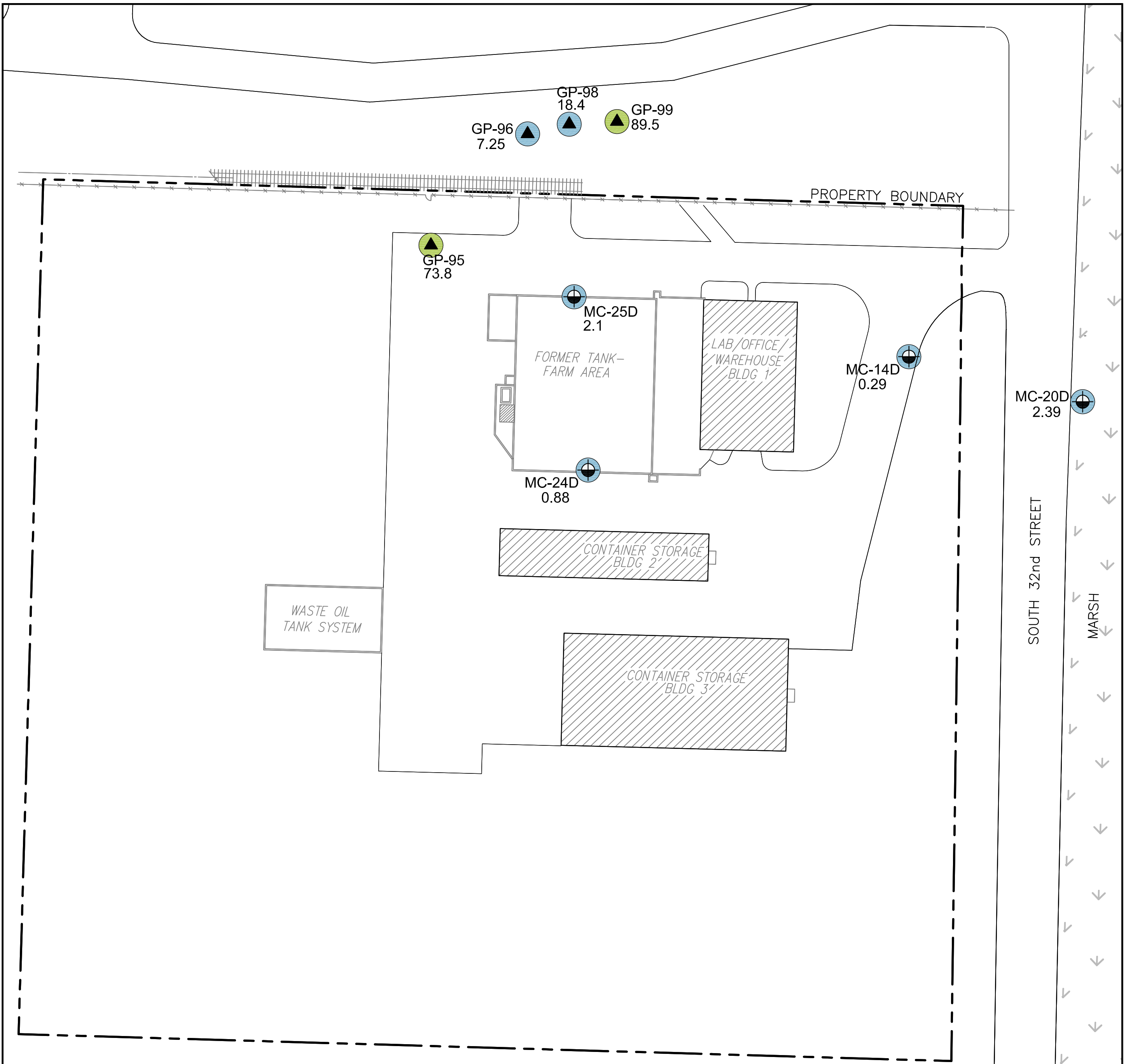
Notes

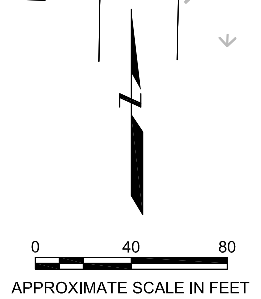
bold Screened partially in silt

HIGHEST TOTAL CHROMIUM RESULTS
SHALLOW GROUNDWATER ZONE
2004 THROUGH 2009
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/07/12	Project No. 9625
amec		Figure **11-36**

Plot Date: 12/07/12 - 11:11am, Plotted by: jeffrey.sanders
Drawing Path: G:\0096250050 - PSC-Washougal\, Drawing Name: Figure_11-36_PSC-Wash_GW-Cr-Sh_120712.dwg





EXPLANATION

▲ Direct-Push Sample Location

⊕ Lower Aquifer Monitoring Well

Detected Analyte Key

Preliminary Cleanup Level is 50 µg/L

● Concentration above preliminary cleanup level (highest detected concentration shown for each location)

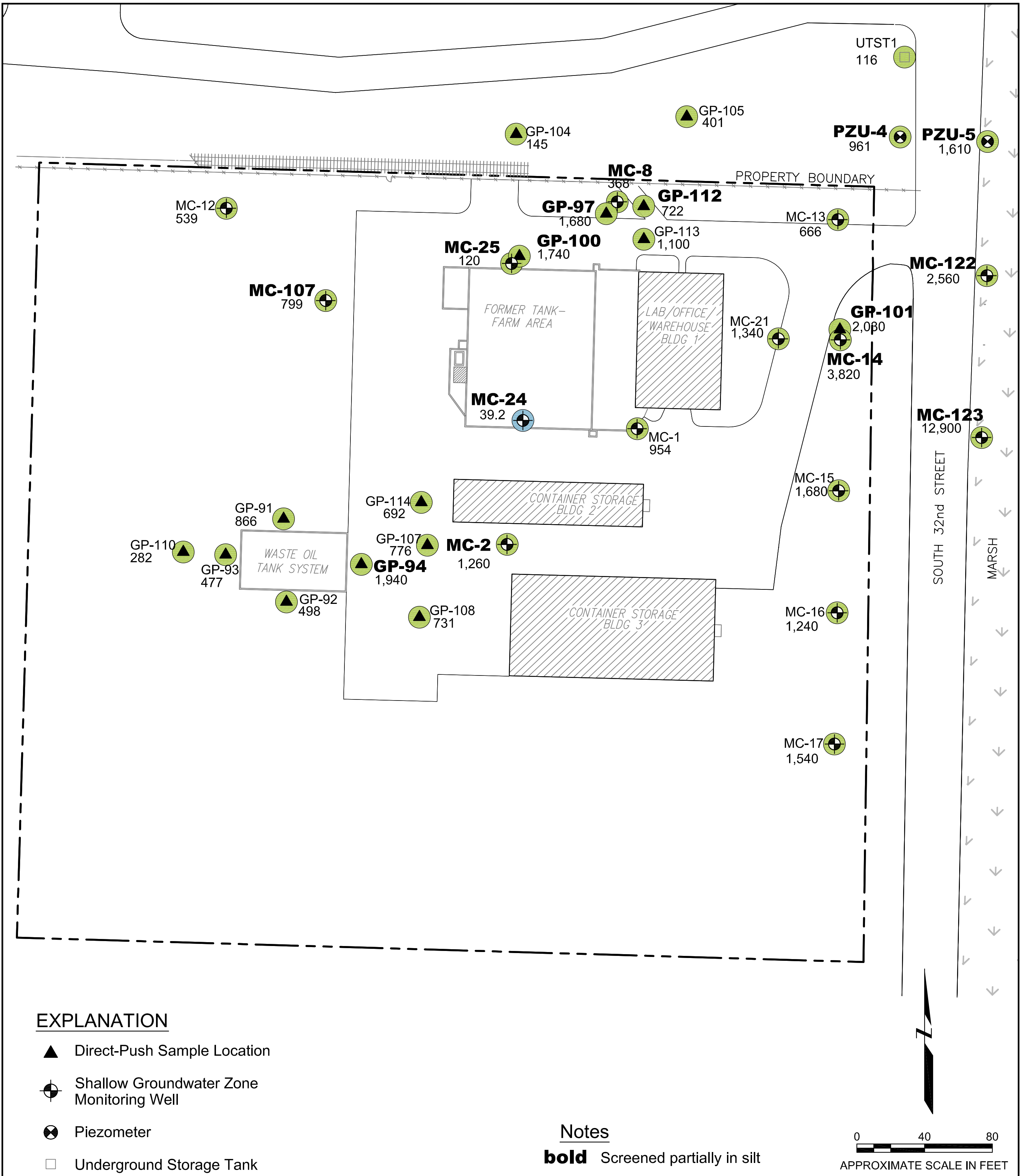
● Concentration below preliminary cleanup level (highest detected concentration shown for each location)

Concentrations in micrograms per liter (µg/L).

HIGHEST TOTAL CHROMIUM RESULTS
LOWER AQUIFER/GROUNDWATER ZONE
2004 THROUGH 2009
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/07/12	Project No. 9625
		Figure **11-37**

Plot Date: 12/07/12 - 11:12am, Plotted by: jeffrey.sanders
Drawing Path: G:\0096250050 - PSC-Washougal\, Drawing Name: Figure_11-37_PSC-Wash_GW-Cr-Low_120712.dwg



EXPLANATION

▲ Direct-Push Sample Location

⊕ Shallow Groundwater Zone Monitoring Well

⊗ Piezometer

□ Underground Storage Tank

Detected Analyte Key

Preliminary Cleanup Level is 50 µg/L

🟢 Concentration above preliminary cleanup level (highest detected concentration shown for each location)

🔵 Concentration below preliminary cleanup level (highest detected concentration shown for each location)

Concentrations in micrograms per liter (µg/L).

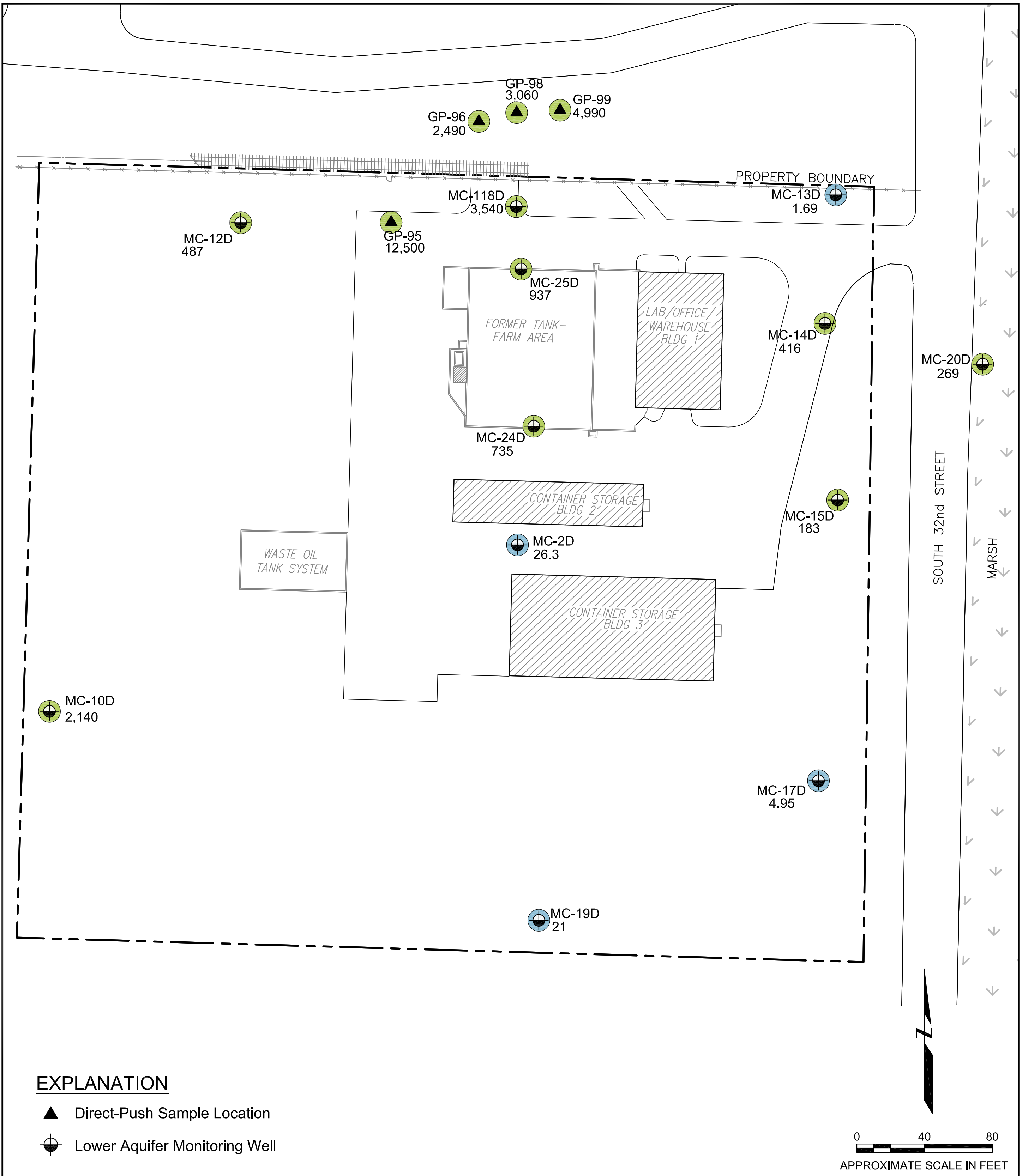
Notes

bold Screened partially in silt

HIGHEST TOTAL MANGANESE RESULTS
SHALLOW GROUNDWATER ZONE
2004 THROUGH 2009
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/07/12	Project No. 9625
amec		Figure 11-38

Plot Date: 12/07/12 - 1:04pm, Plotted by: jeffrey.sanders
Drawing Path: G:\0096250050 - PSC-Washougal\, Drawing Name: Figure_11-38_PSC-Wash_GW-Mn-Sh_120712.dwg



EXPLANATION

▲ Direct-Push Sample Location

⊕ Lower Aquifer Monitoring Well

Detected Analyte Key

Preliminary Cleanup Level is 50 µg/L

🟢 Concentration above preliminary cleanup level
(highest detected concentration shown for each location)

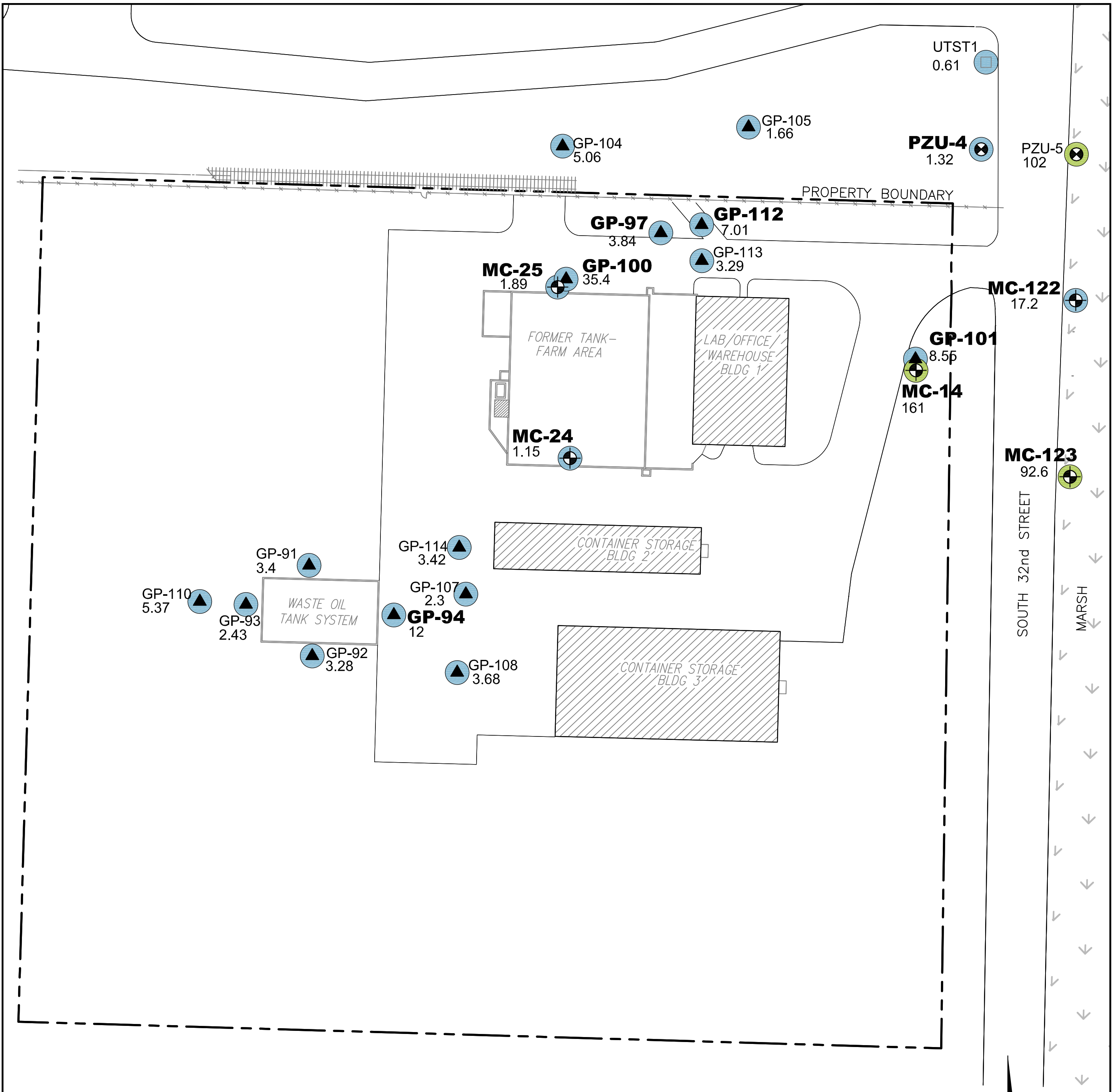
🔵 Concentration below preliminary cleanup level
(highest detected concentration shown for each location)

Concentrations in micrograms per liter (µg/L).

HIGHEST TOTAL MANGANESE RESULTS
LOWER AQUIFER/GROUNDWATER ZONE
2004 THROUGH 2009
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/07/12	Project No. 9625
amec		Figure **11-39**

Plot Date: 12/07/12 - 11:19am, Plotted by: jeffrey.sanders
Drawing Path: G:\0096250050 - PSC-Washougal\, Drawing Name: Figure_11-39_PSC-Wash_GW-Mn-Low_120712.dwg



EXPLANATION

▲ Direct-Push Sample Location

⊕ Shallow Groundwater Zone Monitoring Well

⊗ Piezometer

☐ Underground Storage Tank

Detected Analyte Key

Preliminary Cleanup Level is 48.7 µg/L

🟢 Concentration above preliminary cleanup level
(highest detected concentration shown for each location)

🔵 Concentration below preliminary cleanup level
(highest detected concentration shown for each location)

Concentrations in micrograms per liter (µg/L).

Notes

bold Screened partially in silt

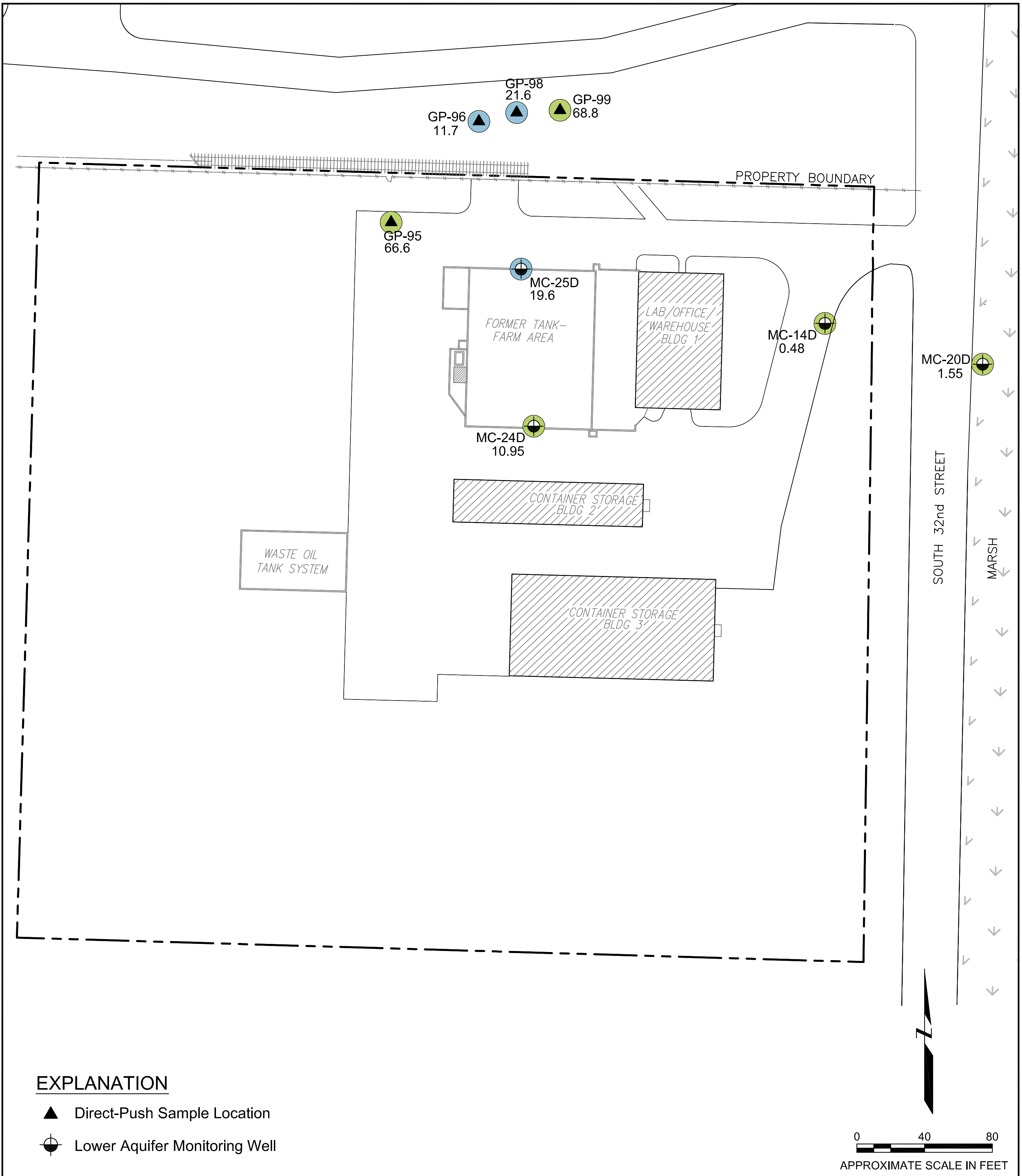
0 40 80
APPROXIMATE SCALE IN FEET

HIGHEST TOTAL NICKEL RESULTS
SHALLOW GROUNDWATER ZONE
2004 THROUGH 2009

PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/07/12	Project No. 9625
amec		Figure **11-40**

Plot Date: 12/07/12 - 11:57am, Plotted by: jeffrey.sanders
Drawing Path: G:\0096250050 - PSC-Washougal\, Drawing Name: Figure_11-40_PSC-Wash_GW-Ni-Sh_120712.dwg



EXPLANATION

▲ Direct-Push Sample Location

⊕ Lower Aquifer Monitoring Well

Detected Analyte Key

Preliminary Cleanup Level is 48.7 μg/L

🟢 Concentration above preliminary cleanup level
(highest detected concentration shown for each location)

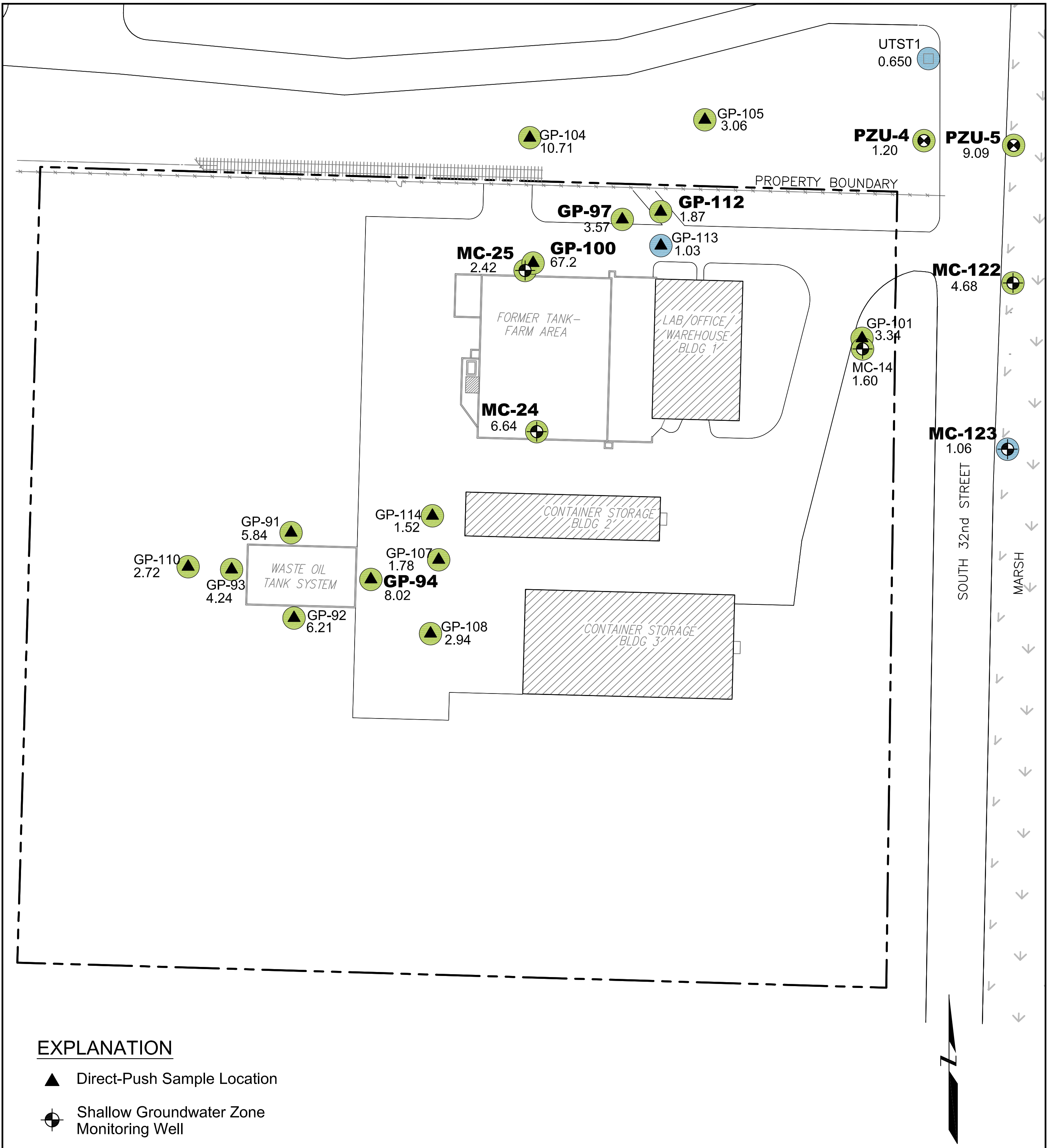
🔵 Concentration below preliminary cleanup level
(highest detected concentration shown for each location)

Concentrations in micrograms per liter (μg/L).

HIGHEST TOTAL NICKEL RESULTS
LOWER AQUIFER/GROUNDWATER ZONE
2004 THROUGH 2009
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 11/30/12	Project No. 9625
amec		Figure **11-41**

Plot Date: 11/30/12 - 1:47pm, Plotted by: jeffrey.sanders
Drawing Path: G:\0096250050 - PSC-Washougal\, Drawing Name: Figure_11-41_PSC-Wash_GW-Ni-Low_113012.dwg



EXPLANATION

▲ Direct-Push Sample Location

⊕ Shallow Groundwater Zone Monitoring Well

⊗ Piezometer

☐ Underground Storage Tank

Detected Analyte Key

Preliminary Cleanup Level is 1.12 µg/L

🟢 Concentration above preliminary cleanup level (highest detected concentration shown for each location)

🔵 Concentration below preliminary cleanup level (highest detected concentration shown for each location)

Concentrations in micrograms per liter (µg/L).

Notes

bold Screened partially in silt

0 40 80
APPROXIMATE SCALE IN FEET

HIGHEST TOTAL VANADIUM RESULTS
SHALLOW GROUNDWATER ZONE
2004 THROUGH 2009
PSC Washougal Facility
Washougal, Washington

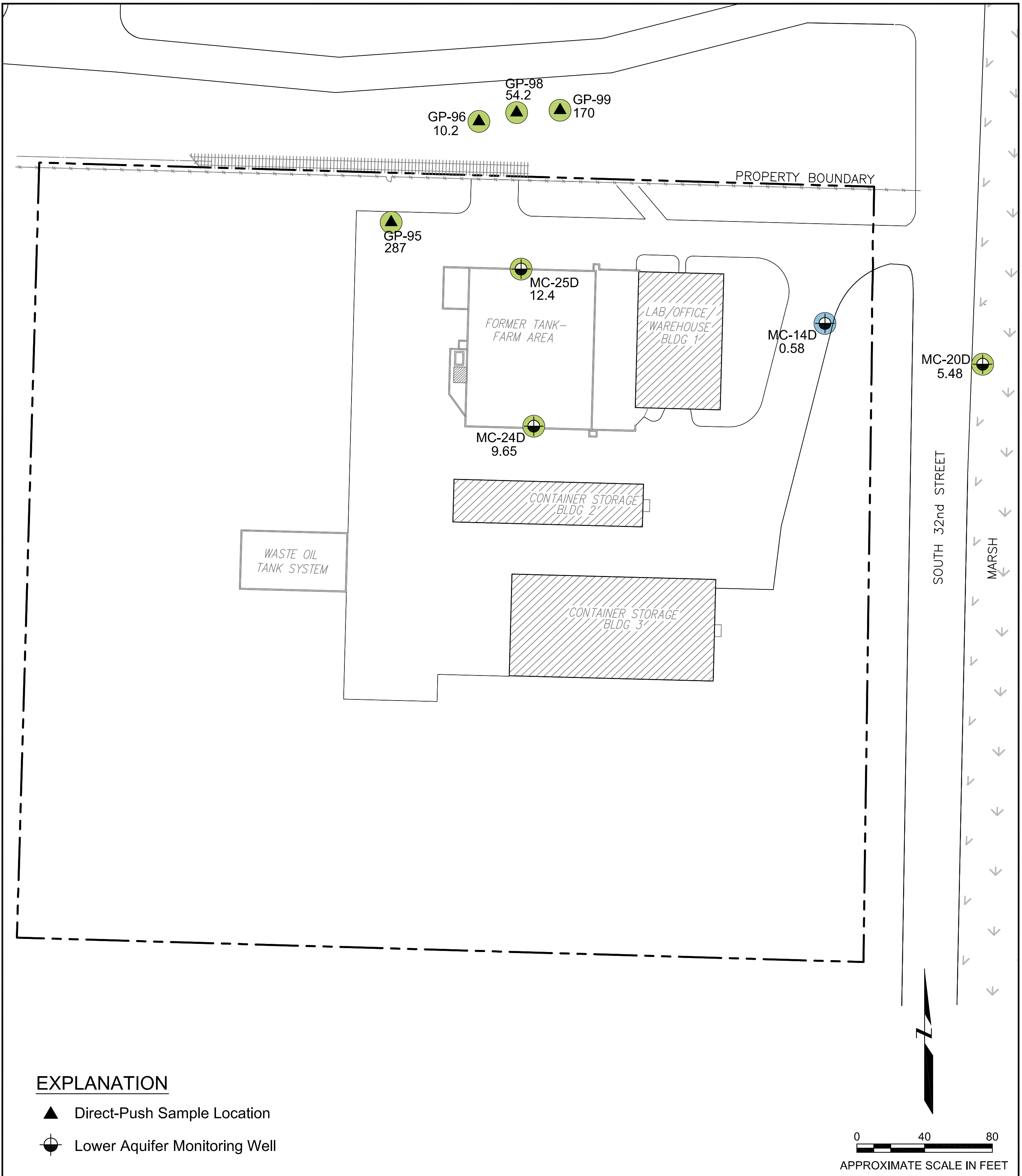
By: APS
Date: 12/07/12
Project No. 9625

amec

Figure **11-42**

Plot Date: 12/07/12 - 12:06pm, Plotted by: jeffrey.sanders
Drawing Path: G:\0096250050 - PSC-Washougal\, Drawing Name: Figure_11-42_PSC-Wash_GW-V-Sh_120712.dwg

Plot Date: 11/30/12 - 1:52pm, Plotted by: jeffrey.sanders
Drawing Path: G:\0096250050 - PSC-Washougal\, Drawing Name: Figure_11-43_PSC-Wash_GW-V-Low_113012.dwg



EXPLANATION

▲ Direct-Push Sample Location

⊕ Lower Aquifer Monitoring Well

Detected Analyte Key

Preliminary Cleanup Level is 1.12 µg/L

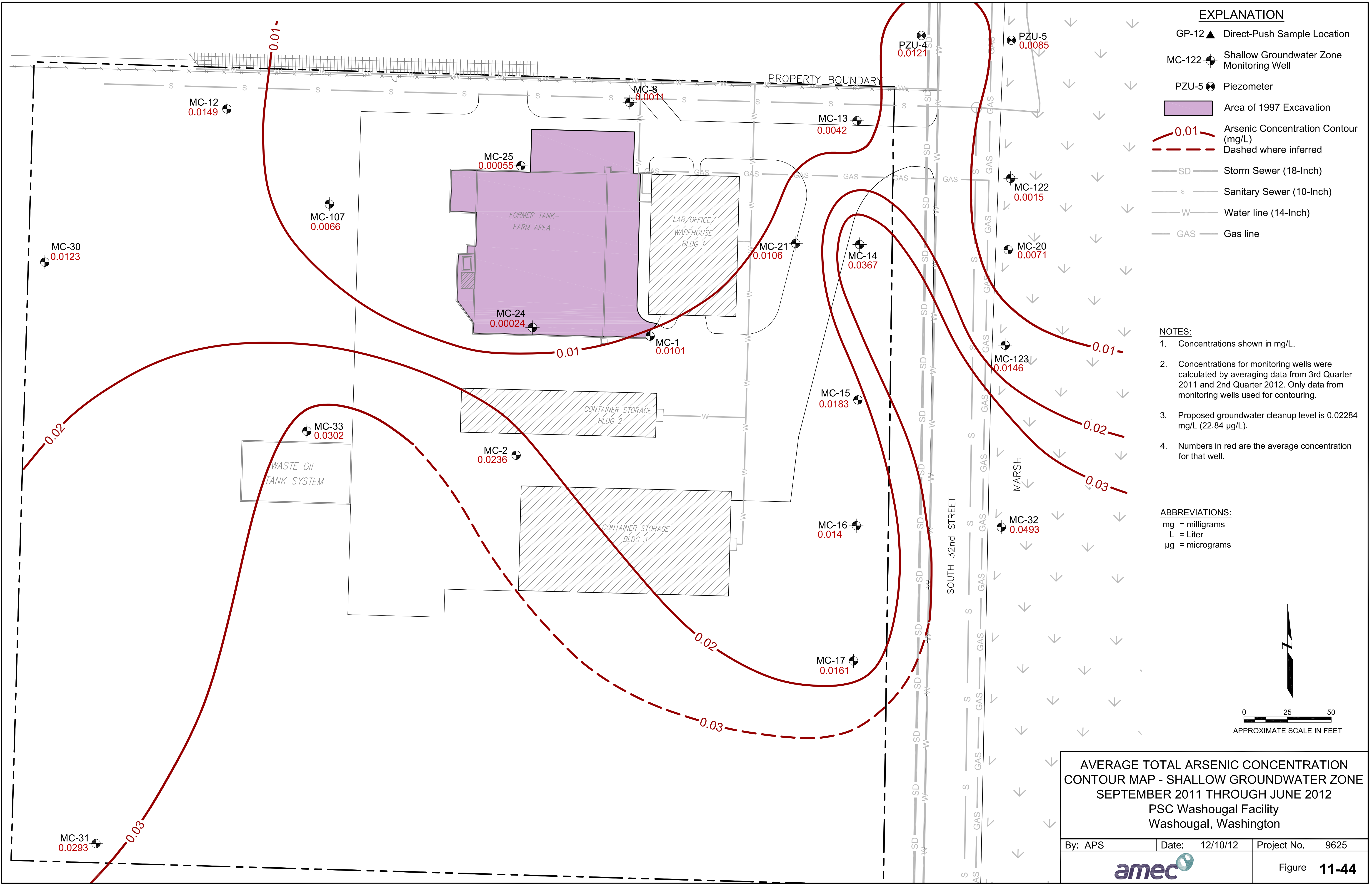
🟢 Concentration above preliminary cleanup level (highest detected concentration shown for each location)

🔵 Concentration below preliminary cleanup level (highest detected concentration shown for each location)

Concentrations in micrograms per liter (µg/L).

HIGHEST TOTAL VANADIUM RESULTS
LOWER AQUIFER/GROUNDWATER ZONE
2004 THROUGH 2009
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 11/30/12	Project No. 9625
amec		Figure **11-43**



EXPLANATION

GP-12 ▲	Direct-Push Sample Location
MC-122 ⊕	Shallow Groundwater Zone Monitoring Well
PZU-5 ⊗	Piezometer
▨	Area of 1997 Excavation
0.01	Arsenic Concentration Contour (mg/L) Dashed where inferred
SD	Storm Sewer (18-Inch)
S	Sanitary Sewer (10-Inch)
W	Water line (14-Inch)
GAS	Gas line

NOTES:

1. Concentrations shown in mg/L.
2. Concentrations for monitoring wells were calculated by averaging data from 3rd Quarter 2011 and 2nd Quarter 2012. Only data from monitoring wells used for contouring.
3. Proposed groundwater cleanup level is 0.02284 mg/L (22.84 µg/L).
4. Numbers in red are the average concentration for that well.

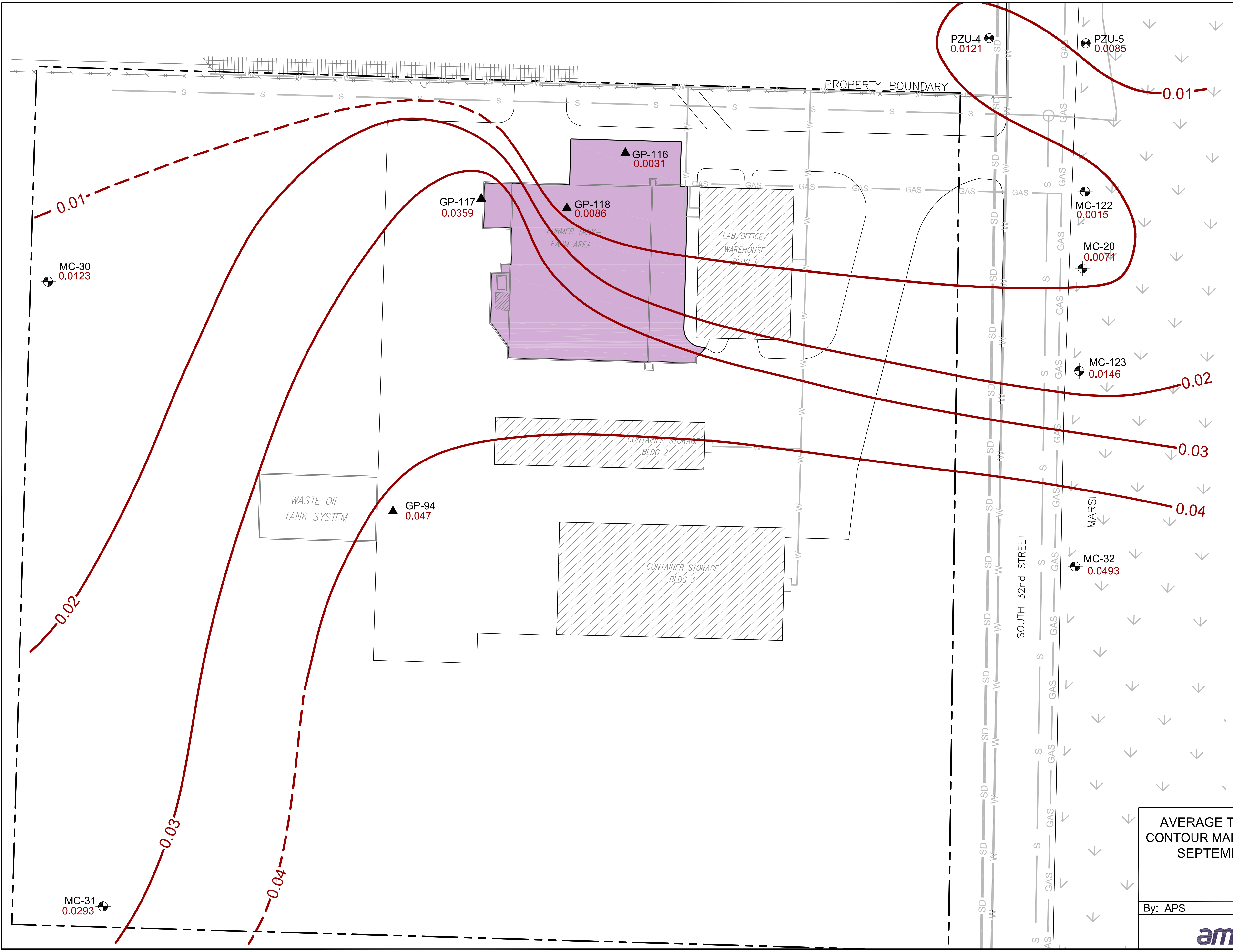
ABBREVIATIONS:

mg = milligrams
L = Liter
µg = micrograms

AVERAGE TOTAL ARSENIC CONCENTRATION
CONTOUR MAP - SHALLOW GROUNDWATER ZONE
SEPTEMBER 2011 THROUGH JUNE 2012
PSC Washougal Facility
Washougal, Washington

By: APS
Date: 12/10/12
Project No. 9625
amec
Figure 11-44

Plot Date: 12/10/12 - 9:48am, Plotted by: adam.stenberg
Drawing Path: S:\9625\010_RI-2012\CAD\, Drawing Name: Figure_11-44_PSC-Wash_Arsenic_Shallow_113012.dwg



EXPLANATION

GP-116 ▲ Direct-Push Sample Location

MC-122 ⊕ Shallow Groundwater Zone Monitoring Well

PZU-5 ⊗ Piezometer

▨ Area of 1997 Excavation

0.01 Arsenic Concentration Contour (mg/L)
Dashed where inferred

SD Storm Sewer (18-Inch)

S Sanitary Sewer (10-Inch)

W Water line (14-Inch)

GAS Gas line

NOTES:

1. Concentrations shown in mg/L.
2. Concentrations for monitoring wells were calculated by averaging data from 3rd Quarter 2011 and 2nd Quarter 2012.
3. Groundwater concentrations from direct push investigations performed in 2011 were also used to generate contours.
4. Proposed groundwater cleanup level is 0.02284 mg/L (22.84 μg/L).
5. Numbers in red are the average concentration for that well.

ABBREVIATIONS:

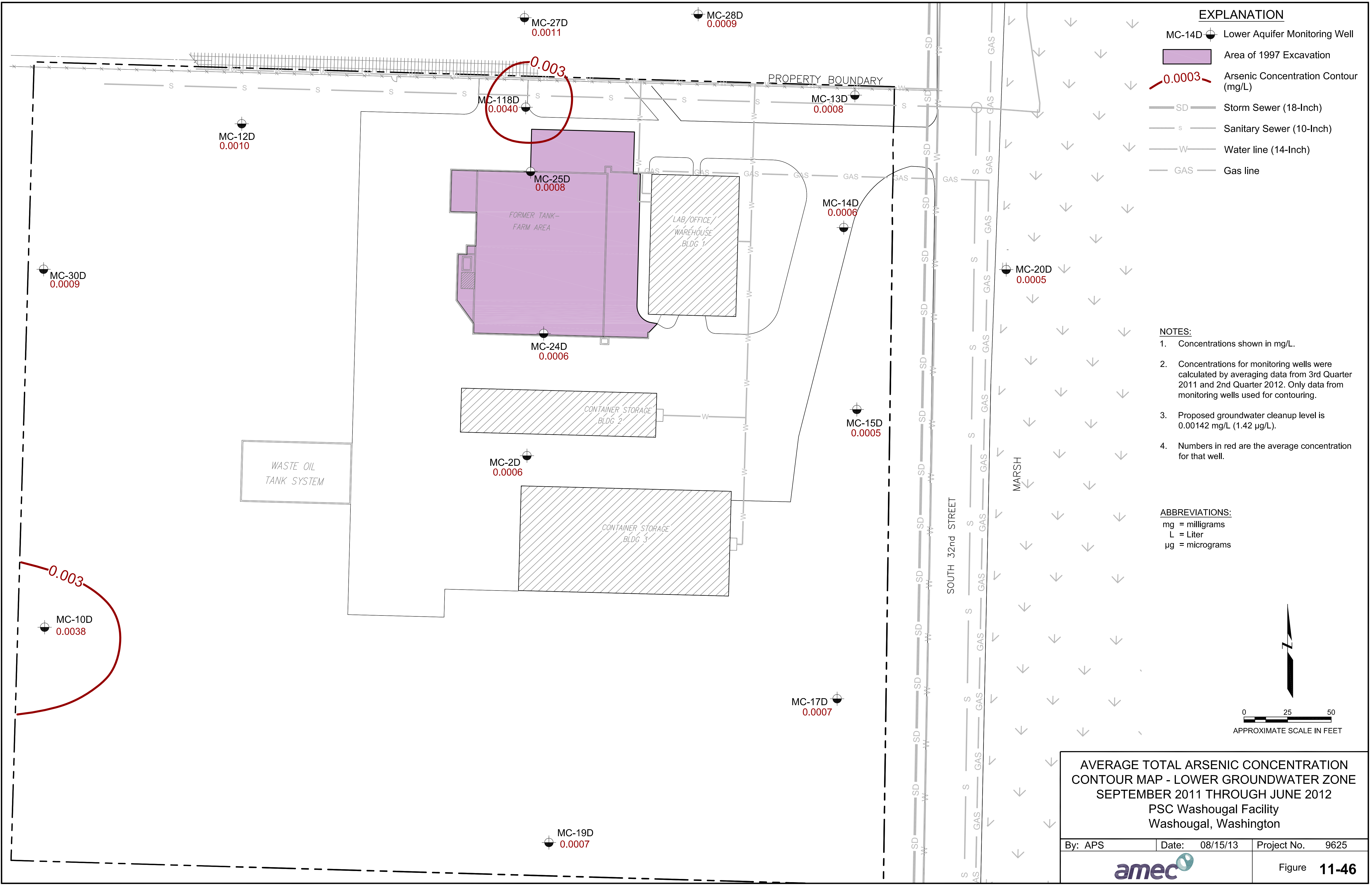
mg = milligrams
L = Liter
μg = micrograms

0 25 50
APPROXIMATE SCALE IN FEET

AVERAGE TOTAL ARSENIC CONCENTRATION
CONTOUR MAP - SILT LAYER GROUNDWATER ZONE
SEPTEMBER 2011 THROUGH JUNE 2012
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/10/12	Project No. 9625
amec		Figure 11-45

Plot Date: 12/10/12 - 9:47am, Plotted by: adam.stenberg
Drawing Path: S:\9625\010_RI-2012\CAD\, Drawing Name: Figure_11-45_PSC-Wash_Arsenic_Silt_113012.dwg



NOTES:

1. Concentrations shown in mg/L.
2. Concentrations for monitoring wells were calculated by averaging data from 3rd Quarter 2011 and 2nd Quarter 2012. Only data from monitoring wells used for contouring.
3. Proposed groundwater cleanup level is 0.00142 mg/L (1.42 µg/L).
4. Numbers in red are the average concentration for that well.

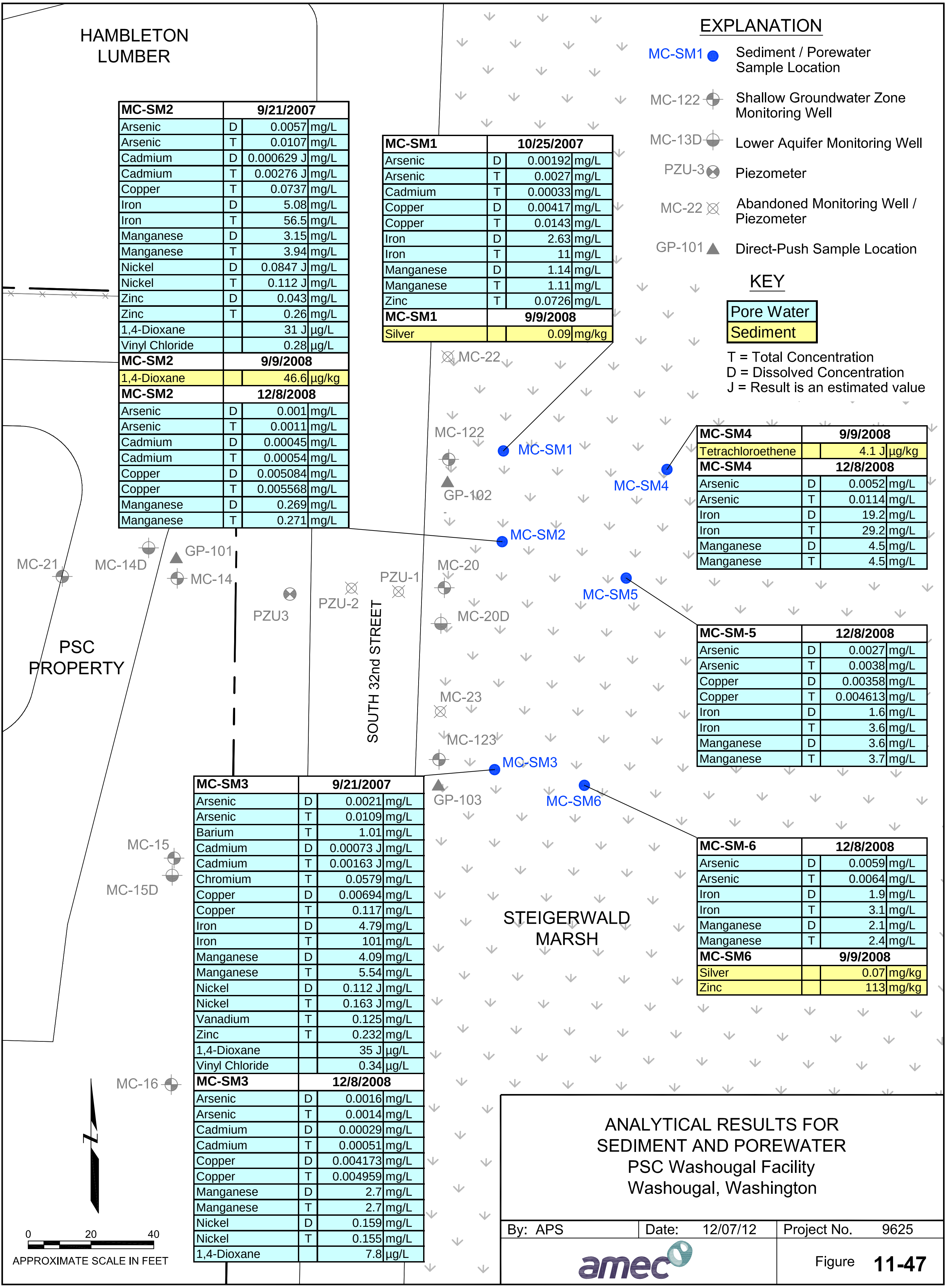
ABBREVIATIONS:

mg = milligrams
L = Liter
µg = micrograms

AVERAGE TOTAL ARSENIC CONCENTRATION
CONTOUR MAP - LOWER GROUNDWATER ZONE
SEPTEMBER 2011 THROUGH JUNE 2012
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 08/15/13	Project No. 9625
amec		Figure 11-46

Plot Date: 08/15/13 - 9:14pm, Plotted by: adam.stenberg
Drawing Path: S:\9625\010_RI-2012\CAD\, Drawing Name: Figure_11-46_PSC-Wash_Arsenic_Lower_081513.dwg



T = Total Concentration
D = Dissolved Concentration
J = Result is an estimated value

MC-SM2		**9/21/2007**	
Arsenic	D	0.0057	mg/L
Arsenic	T	0.0107	mg/L
Cadmium	D	0.000629 J	mg/L
Cadmium	T	0.00276 J	mg/L
Copper	T	0.0737	mg/L
Iron	D	5.08	mg/L
Iron	T	56.5	mg/L
Manganese	D	3.15	mg/L
Manganese	T	3.94	mg/L
Nickel	D	0.0847 J	mg/L
Nickel	T	0.112 J	mg/L
Zinc	D	0.043	mg/L
Zinc	T	0.26	mg/L
1,4-Dioxane		31 J	µg/L
Vinyl Chloride		0.28	µg/L
MC-SM2		**9/9/2008**	
1,4-Dioxane		46.6	µg/kg
MC-SM2		**12/8/2008**	
Arsenic	D	0.001	mg/L
Arsenic	T	0.0011	mg/L
Cadmium	D	0.00045	mg/L
Cadmium	T	0.00054	mg/L
Copper	D	0.005084	mg/L
Copper	T	0.005568	mg/L
Manganese	D	0.269	mg/L
Manganese	T	0.271	mg/L

MC-SM1		**10/25/2007**	
Arsenic	D	0.00192	mg/L
Arsenic	T	0.0027	mg/L
Cadmium	T	0.00033	mg/L
Copper	D	0.00417	mg/L
Copper	T	0.0143	mg/L
Iron	D	2.63	mg/L
Iron	T	11	mg/L
Manganese	D	1.14	mg/L
Manganese	T	1.11	mg/L
Zinc	T	0.0726	mg/L
MC-SM1		**9/9/2008**	
Silver		0.09	mg/kg

MC-SM4		**9/9/2008**	
Tetrachloroethene		4.1 J	µg/kg
MC-SM4		**12/8/2008**	
Arsenic	D	0.0052	mg/L
Arsenic	T	0.0114	mg/L
Iron	D	19.2	mg/L
Iron	T	29.2	mg/L
Manganese	D	4.5	mg/L
Manganese	T	4.5	mg/L

MC-SM-5		**12/8/2008**	
Arsenic	D	0.0027	mg/L
Arsenic	T	0.0038	mg/L
Copper	D	0.00358	mg/L
Copper	T	0.004613	mg/L
Iron	D	1.6	mg/L
Iron	T	3.6	mg/L
Manganese	D	3.6	mg/L
Manganese	T	3.7	mg/L

MC-SM3		**9/21/2007**	
Arsenic	D	0.0021	mg/L
Arsenic	T	0.0109	mg/L
Barium	T	1.01	mg/L
Cadmium	D	0.00073 J	mg/L
Cadmium	T	0.00163 J	mg/L
Chromium	T	0.0579	mg/L
Copper	D	0.00694	mg/L
Copper	T	0.117	mg/L
Iron	D	4.79	mg/L
Iron	T	101	mg/L
Manganese	D	4.09	mg/L
Manganese	T	5.54	mg/L
Nickel	D	0.112 J	mg/L
Nickel	T	0.163 J	mg/L
Vanadium	T	0.125	mg/L
Zinc	T	0.232	mg/L
1,4-Dioxane		35 J	µg/L
Vinyl Chloride		0.34	µg/L
MC-SM3		**12/8/2008**	
Arsenic	D	0.0016	mg/L
Arsenic	T	0.0014	mg/L
Cadmium	D	0.00029	mg/L
Cadmium	T	0.00051	mg/L
Copper	D	0.004173	mg/L
Copper	T	0.004959	mg/L
Manganese	D	2.7	mg/L
Manganese	T	2.7	mg/L
Nickel	D	0.159	mg/L
Nickel	T	0.155	mg/L
1,4-Dioxane		7.8	µg/L

MC-SM-6		**12/8/2008**	
Arsenic	D	0.0059	mg/L
Arsenic	T	0.0064	mg/L
Iron	D	1.9	mg/L
Iron	T	3.1	mg/L
Manganese	D	2.1	mg/L
Manganese	T	2.4	mg/L
MC-SM6		**9/9/2008**	
Silver		0.07	mg/kg
Zinc		113	mg/kg

ANALYTICAL RESULTS FOR SEDIMENT AND POREWATER
PSC Washougal Facility
Washougal, Washington

By: APS
Date: 12/07/12
Project No. 9625

amec

Figure **11-47**

Plot Date: 12/07/12 - 8:52am, Plotted by: adam.stenberg
Drawing Path: S:\9625\010_RI-2012\CAD\, Drawing Name: Figure_11-47_PSC-Wash_PoreWater-Sediment-Data_112812.dwg

EXPLANATION

GP-101 ▲	Direct-Push Sample Location
MC-20 ⊕	Shallow Groundwater Zone Monitoring Well
PZU-5 ⊗	Piezometer
🟥	Highly Impacted Shallow Groundwater
▨	Highly Impacted Soil

DATABOX KEY

As	Arsenic
cis	cis-1,2-Dichloroethene
D	1,4-Dioxane
PCE	Tetrachloroethene
TCE	Trichloroethene
VC	Vinyl Chloride

MC-123		← Location I.D.
PCE	0.14 J	Highest detected concentration (µg/L)
TCE	0.5 U	
cis	1.0	
VC	0.2	
1,4-D	12	
As	14.6	Average concentration (µg/L)

Data Qualifiers

U = analyte was not detected at the quantitation limit indicated.

J = analyte was positively identified. Result is an estimated value.

Notes:

Values shown for VOCs are highest detected concentration (or highest detection limit for non-detected analytes) from the most recent four quarters of sampling (3Q11 through 2Q12). Values shown for Arsenic are average total Arsenic concentrations over the last four quarters of sampling.

Concentrations shown in µg/L

Groundwater samples from direct push borings GP-104, GP-105, GP-107, GP-108, GP-110, GP-112, and GP-113 were collected in 2008.

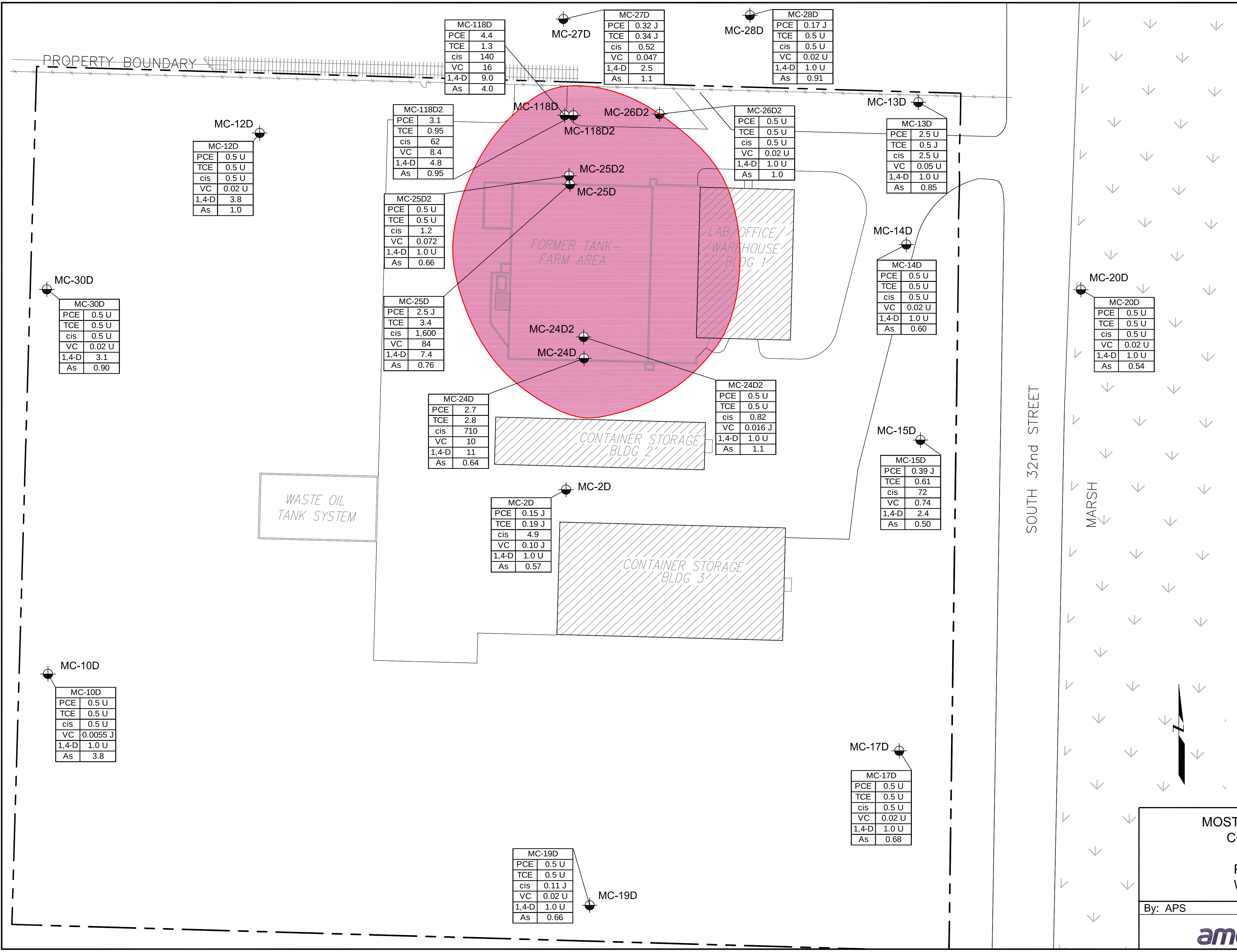
Groundwater samples from direct push borings GP-116, GP-117, GP-118, and GP-122 were collected in 2011.

Other non-highlighted impacted soil areas not included are under buildings 2 and 3 and around the waste oil system.

MOST RECENT GROUNDWATER
COC CONCENTRATIONS
SHALLOW GROUNDWATER ZONE
PSC Washougal Facility
Washougal, Washington

By: APS	Date: 12/10/12	Project No. 9625
amec		Figure 11-48

Plot Date: 12/10/12 - 12:00pm, Plotted by: adam.stenberg
Drawing Path: S:\9625\010_RI-2012\CAD\, Drawing Name: Figure_11-48_PSC-Wash_HighImpacted-Sh_112812.dwg



MC-118D	
PCE	4.4
TCE	1.3
cis	140
VC	16
1,4-D	9.0
As	4.0

MC-27D	
PCE	0.32 J
TCE	0.34 J
cis	0.52
VC	0.047
1,4-D	2.5
As	1.1

MC-28D	
PCE	0.17 J
TCE	0.5 U
cis	0.5 U
VC	0.02 U
1,4-D	1.0 U
As	0.91

MC-12D	
PCE	0.5 U
TCE	0.5 U
cis	0.5 U
VC	0.02 U
1,4-D	3.8
As	1.0

MC-118D2	
PCE	3.1
TCE	0.95
cis	62
VC	8.4
1,4-D	4.8
As	0.95

MC-26D2	
PCE	0.5 U
TCE	0.5 U
cis	0.5 U
VC	0.02 U
1,4-D	1.0 U
As	1.0

MC-13D	
PCE	2.5 U
TCE	0.5 J
cis	2.5 U
VC	0.05 U
1,4-D	1.0 U
As	0.85

MC-25D2	
PCE	0.5 U
TCE	0.5 U
cis	1.2
VC	0.072
1,4-D	1.0 U
As	0.66

MC-14D	
PCE	0.5 U
TCE	0.5 U
cis	0.5 U
VC	0.02 U
1,4-D	1.0 U
As	0.60

MC-30D	
PCE	0.5 U
TCE	0.5 U
cis	0.5 U
VC	0.02 U
1,4-D	3.1
As	0.90

MC-25D	
PCE	2.5 J
TCE	3.4
cis	1,600
VC	84
1,4-D	7.4
As	0.76

MC-20D	
PCE	0.5 U
TCE	0.5 U
cis	0.5 U
VC	0.02 U
1,4-D	1.0 U
As	0.54

MC-24D2	
PCE	0.5 U
TCE	0.5 U
cis	0.82
VC	0.016 J
1,4-D	1.0 U
As	1.1

MC-24D	
PCE	2.7
TCE	2.8
cis	710
VC	10
1,4-D	11
As	0.64

MC-15D	
PCE	0.39 J
TCE	0.61
cis	72
VC	0.74
1,4-D	2.4
As	0.50

MC-2D	
PCE	0.15 J
TCE	0.19 J
cis	4.9
VC	0.10 J
1,4-D	1.0 U
As	0.57

MC-10D	
PCE	0.5 U
TCE	0.5 U
cis	0.5 U
VC	0.0055 J
1,4-D	1.0 U
As	3.8

MC-17D	
PCE	0.5 U
TCE	0.5 U
cis	0.5 U
VC	0.02 U
1,4-D	1.0 U
As	0.68

MC-19D	
PCE	0.5 U
TCE	0.5 U
cis	0.11 J
VC	0.02 U
1,4-D	1.0 U
As	0.66

EXPLANATION

MC-118D ⊕ Lower Aquifer Monitoring Well

🟥 Highly Impacted Lower Aquifer Groundwater

DATABOX KEY

PCE	Tetrachloroethene
TCE	Trichloroethene
cis	cis-1,2-Dichloroethene
VC	Vinyl Chloride
1,4-D	1,4-Dioxane
As	Arsenic

MC-20D	
PCE	0.5 U
TCE	0.5 U
cis	0.5 U
VC	0.02 U
1,4-D	1.0 U
As	0.54

Location I.D.

Highest detected concentration (µg/L)

Average concentration (µg/L)

Data Qualifiers

U = analyte was not detected at the quantitation limit indicated.

J = analyte was positively identified. Result is an estimated value.

Notes:

Values shown for VOCs are highest detected concentration (or highest detection limit for non-detected analytes) from the most recent four quarters of sampling (3Q11 through 2Q12). Values shown for Arsenic are average total Arsenic concentrations over the last four quarters of sampling.

Concentrations shown in µg/L

0 25 50
APPROXIMATE SCALE IN FEET

MOST RECENT GROUNDWATER COC CONCENTRATIONS LOWER AQUIFER

PSC Washougal Facility
Washougal, Washington

By: APS | Date: 12/10/12 | Project No. 9625

amec

Figure 11-49

Plot Date: 12/10/12 - 2:24pm, Plotted by: adam.stenberg
Drawing Path: S:\9625\010_RI-2012\CAD\, Drawing Name: Figure_11-49_PSC-Wash_HighImpacted-Low_113012.dwg

12.0 FATE AND TRANSPORT

This section discusses the fate and transport of the COCs in soil and groundwater at the site. This section includes a brief overview of fate-and-transport processes, presents evidence for the occurrence of natural attenuation at the site, and discusses the potential for migration of COCs beyond the PSC property boundary.

The distribution of COCs on the site is generally attributable to three specific source areas: (1) the area of the former tank farm; (2) a small isolated area near the waste oil tank, and (3) an isolated area near Buildings 2 and 3. Of these areas, only the former tank farm area is associated with a groundwater plume that is resulting in migration of COCs outside the PSC property at concentrations exceeding PCLs. Concentrations of COCs within the former tank farm area have declined greatly since a 1997 interim action removed most of the contaminated soil down to the Silt Layer. The discussion of fate and transport in this section addresses the entire site and all the COCs; however, due to the nature and extent of contamination within the site, the discussion focuses largely on the former tank farm area and corresponding groundwater plume.

12.1 FATE AND TRANSPORT PROCESSES

The processes that determine the fate and transport of contaminants at the site can be grouped into two categories: nondestructive and destructive. Both categories are described below.

12.1.1 Nondestructive Processes

Nondestructive processes are those that do not change the chemical composition of the contaminant, and therefore do not reduce its mass. Nondestructive processes include those that spatially redistribute contaminants within a given phase (e.g., advection, dispersion, and diffusion) and those that repartition contaminants among two or more coexisting phases (e.g., dissolution/precipitation, sorption/desorption and volatilization/condensation).

12.1.2 Destructive Processes

Destructive processes are those that change the chemical composition of a contaminant and therefore reduce its mass. These include abiotic transformations and biodegradation. Abiotic degradation processes are those chemical reactions that are not mediated by microbes. These reactions include processes such as photolysis and hydrolysis. Biodegradation is the process by which organic compounds are broken down into similar compounds by naturally occurring microorganisms.

The ability of microorganisms to break down contaminants depends on the chemical condition of their environment as well as on the availability of electron acceptors (dissolved oxygen, nitrate [NO_3^-], ferric iron [Fe^{3+}], sulfate [SO_4^{3-}], and carbon dioxide [CO_2]) and electron donors (organic matter, petroleum hydrocarbons, chlorinated organics, and dissolved hydrogen) (Wiedemeier et al., 1999). As an electron acceptor oxygen has among the highest energy potential, followed by nitrate, manganese (Mn^{4+}), Fe^{3+}, sulfate, and carbon dioxide. The redox potential of groundwater dictates the dominant biodegradation mechanisms occurring. The redox potential is a measure of the electron activity and indicates the relative tendency of a solution to accept or transfer electrons. Because oxygen is an electron acceptor with among the highest energy potentials, it is consumed first; therefore, the redox potential can also be indicative of whether the environment is aerobic or anaerobic.

The dominant biodegradation mechanisms (discussed below) for chlorinated organic compounds include direct aerobic and anaerobic oxidation and reductive chlorination.

12.1.2.1 Aerobic and Anaerobic Oxidation

Under aerobic conditions, microbes can degrade contaminants through direct aerobic oxidation when an organic compound is used as an electron donor and oxygen is used as an electron acceptor. Similarly, these compounds also can be oxidized directly under anaerobic conditions when an alternate electron acceptor, such as Fe^{3+}, is used. This mechanism has been shown to be particularly effective for the biodegradation of petroleum hydrocarbons and vinyl chloride and may be a significant degradation mechanism for DCE. Direct oxidation requires the presence of external electron acceptors, such as oxygen, ferric iron, carbon dioxide, manganese, and sulfate (Wiedemeier et al., 1999).

12.1.2.2 Reductive Dechlorination/Halorespiration

Direct reduction is a significant biodegradation mechanism for a number of compounds, including highly chlorinated organic compounds such as PCE and TCE (Wiedemeier et al., 1999). In reduction of chlorinated solvents, the solvent acts as an electron acceptor, and the chlorine atom is replaced by a hydrogen atom in a process called reductive dechlorination. As a result, PCE is reductively dechlorinated to TCE, which in turn is reductively dechlorinated to dichloroethene (DCE) and vinyl chloride, and finally to ethane and ethene. Reductive dechlorination is thought to be the primary degradation mechanisms for PCE, TCE, and other highly chlorinated compounds. The rate of the reductive dechlorination reaction slows with the decreasing chlorination of the compound. However, the less chlorinated compounds such as vinyl chloride and ethane also may degrade via oxidation. Reductive dechlorination requires a reducing environment in which oxygen and nitrate have been depleted and in which fermentation may occur in order to provide an adequate source of dissolved hydrogen (Wiedemeier et al., 1999).

12.1.2.3 Fermentation

A number of organic compounds, including petroleum hydrocarbons and naturally occurring organic matter, can be degraded through a process called fermentation. Fermentation is a balanced redox reaction in which different portions of a single substrate are oxidized and reduced, yielding energy. Dissolved hydrogen is a by-product of the fermentation reaction. The energy released during fermentation is significantly less than that derived from oxidation reactions, so fermentation typically does not occur until all external electron acceptors have been used. Field observations indicate that fermentation occurs at nearly all sites where benzene, toluene, ethylbenzene, and xylenes (BTEX) are found in groundwater. Fermentation reactions require the presence of microbes that will utilize hydrogen and thereby keep hydrogen concentration sufficiently low such that production of hydrogen is still an energetically favorable reaction.

12.2 DEMONSTRATION OF NATURAL ATTENUATION

Biodegradation appears to be a very important process affecting the fate and transport of chlorinated organic compounds in groundwater at the site. Levels of dissolved oxygen in groundwater at the site are likely suppressed by the biological oxygen demand resulting from the naturally occurring organic matter in aquifer materials associated with the current and former wetland environment. Consequently, anaerobic degradation processes, such as fermentation and reductive dechlorination, are likely to be the most important biodegradation processes occurring at the site. Patterns observed in both contaminant and geochemical data for groundwater at the site indicate that microbial degradation of contaminants is likely occurring. Evidence for the degradation of chlorinated organic compounds will be discussed in the following sections.

Several lines of evidence can be used to demonstrate that natural attenuation is occurring at a site (EPA, 1999). These lines of evidence include:

- Historical groundwater and/or soil chemistry data that demonstrate a clear and meaningful trend of decreasing contaminant mass and/or concentration over time at appropriate monitoring or sampling points;

- Hydrogeologic and geochemical data that can be used to demonstrate indirectly the type(s) of natural attenuation processes active at the site, and the rate at which processes will reduce contaminant concentrations to required levels; and

- Data from field or microcosm studies (conducted in or with actual contaminated site media) that directly demonstrate the occurrence of a particular natural attenuation process at the site and its ability to degrade the contaminants of concern.

The first line of evidence shows that groundwater contamination is being attenuated. The second line of evidence shows that contaminant mass is being destroyed rather than only diluted or sorbed to aquifer materials. The third line of evidence is used to show that indigenous microbes are capable of degrading contaminants at the site. Because a great deal of research on microbial degradation has been conducted and has shown that contaminant-degrading bacteria are nearly ubiquitous, site-specific microstudies typically are deemed unnecessary (Wiedemeier et al., 1999).

12.3 TEMPORAL TRENDS IN GROUNDWATER CONCENTRATIONS

A number of different factors control the chemical concentrations measured in groundwater samples collected from the Shallow Groundwater Zone and Lower Aquifer at the site. While natural attenuation processes such as biodegradation may be occurring and reducing concentrations, the strongest influence on the chemical concentrations is the hydrologic system at the site. As discussed in Section 7.0, the groundwater in the Shallow Groundwater Zone (primarily within the Sand Fill) generally flows eastward toward Steigerwald Marsh. In the Lower Aquifer, groundwater flow patterns are complicated by the tidal influence and stage of the Columbia River.

Figures 12-1 through 12-30 present the concentrations over time of selected COCs detected in groundwater samples from select monitoring wells at the site. MC-14 has historically shown the highest concentrations of COCs at the site. Concentrations of chlorinated organics at MC-14 dropped dramatically after the 1997 soil removal interim measure, but concentrations remain slightly elevated for chlorinated organics and well above the PCL for 1,4-dioxane. Figure 12-1 shows TCE, *cis*-1,2-DCE, and vinyl chloride concentrations from 2004 through 2011 at MC-14. All three of these compounds show a decreasing trend toward PCLs. Seasonal fluctuations in concentrations occur, but these appear strongly linked to groundwater elevation at the site and the effect of groundwater levels on naturally occurring reducing conditions. Figure 12-1 shows that the highest TCE concentrations occur at times of high groundwater elevations. This finding suggests that contamination present in shallow soils in the vicinity of Building 1, as described in Section 11.1, may be still serving as a source of contamination for shallow groundwater at the site.

Figure 12-2 compares trends in oxidation/reduction potential (ORP) to TCE, *cis*-1,2-DCE, and vinyl chloride concentrations over time. Shallow groundwater ORP values have gradually decreased since 2004, indicating that conditions at MC-14 have become more reducing. Within this overall downward trend in ORP, ORP values have fluctuated. Higher ORP values are correlated slightly with groundwater elevation, as indicated by short-term highs in both groundwater and ORP that occurred in early 2006 and around June 2009. Higher water levels in the Shallow Groundwater Zone appear to result in more aerobic conditions in this zone during the high-water months. Enhanced aerobic conditions would slow the rate of anaerobic degradation of parent chlorinated solvents. This hypothesis is supported by other redox data (Section 12.4), including trends in DO concentration and indicators of anaerobic metabolism, such as nitrate, iron, and methane levels. These parameters exhibit regular seasonal variability, and tend toward more strongly reducing conditions during the summer, when oxygenated recharge from precipitation is limited. Ultimately, multiple lines of evidence suggest that conditions are less reducing during winter months and strongly reducing during periods of reduced recharge. It may be that this trend is not readily evident in the ORP data due to difficulties associated with the maintenance, use, and calibration of field instrumentation. Furthermore, parameters such as methane levels that are measured in the laboratory under more reliably controlled conditions should be viewed as higher quality in comparison to data collected with field instrumentation. Collectively, the available redox data suggest that during high groundwater elevations, the anaerobic degradation of parent chlorinated solvents is reduced in comparison to degradation rates during low-groundwater conditions.

While less pronounced, Figure 12-3 shows the same type of correlation between PCE concentrations at MC-14 and groundwater elevation, further supporting the theory of higher rates of oxidation in winter. PCE and arsenic concentrations at MC-14 are also decreasing over time, as shown in Figure 12-3. Concentrations of 1,4-Dioxane are generally decreasing, but at a much lower rate than the other COCs. Concentrations of 1,4-dioxane also tend to fluctuate seasonally, peaking toward the beginning of each year, which is likely due to higher groundwater elevations.

Historical trends were also evaluated for Shallow Groundwater Zone wells MC-1 (Figures 12-4 through 12-6), MC-8 (Figures 12-7 and 12-8), MC-13 (Figures 12-9 through 12-11), MC-15 (Figures 12-12 and 12-13), MC-16 (Figures 12-14 and 12-15), MC-20 (Figures 12-16 through 12-18), and MC-21 (Figures 12-19 through 12-21). None of these wells has shown concentrations of COCs as high as MC-14, but they are useful in evaluating trends in concentrations in groundwater from wells in different parts of the site. All of them show steady or decreasing trends in concentrations of chlorinated organics, generally steady or decreasing trends in arsenic (with the exception of MC-1), and steady or decreasing trends in 1,4-dioxane.

Concentration trends for Lower Aquifer wells are presented for the most heavily impacted wells MC-24D (Figures 12-22 through12-24), MC-25D (Figures 12-25 through 12-27), and MC-118D (Figures 12-28 through 12-30). The Lower Aquifer wells show much less seasonal variation, as would be expected. Concentrations of chlorinated organics are generally steady or increasing at MC-24D and MC-25D in the area of the former tank farm, but decreasing (except for vinyl chloride) at MC-118D to the north of the former tank farm. Figure 12-28 shows that during the second quarter 2011, a historically high water table elevation in the lower aquifer is associated with an increase in *cis*-1,2-DCE concentrations at MC-118D. It is likely that the high water table elevation, which was the result of a very high flow condition in the Columbia River, resulted in the transport of *cis*-1,2-DCE from areas near MC-25D, where concentrations are historically higher, toward MC-118D.

In lower aquifer wells MC-24D, MC-25D, and MC-118D, arsenic and 1,4-dioxane concentrations are generally steady or increasing. These trends indicate that the Silt Layer is retaining contamination that continues to leach to groundwater in the Lower Aquifer; however, these concentrations remain at relatively low levels (<5 µg/L for PCE and TCE). Deeper wells in the Lower Aquifer (MC-118D2, MC-24D2, MC-25D2, and MC-26D2) show dramatically lower concentrations and do not exceed PCLs. The site data do not indicate that contamination in the Silt Layer is having much effect on the Lower Aquifer arsenic concentrations. Conditions in the Lower Aquifer are more steady-state, because water level fluctuations are not the factor they are for the Shallow Groundwater Zone. The reducing conditions present in the Lower Aquifer would encourage mobilization of arsenic. However, the VOC migration we see occurring between the Silt Layer and the Lower Aquifer is still fairly low in concentration and does not appear to be increasing mobilization of arsenic. Concentrations of COCs in wells completed in the Lower Aquifer off the PSC property to the north and east are below or only marginally above the PCL. Since the concentrations of VOCs in the wells in the tank farm area are relatively low, the risk of increases in concentration at the property line are low.

12.4 SUBSURFACE GEOCHEMISTRY

Subsurface geochemistry strongly influences the fate and transport of organic and inorganic COCs. Evaluation of geochemical parameters along with contaminant concentrations can help to explain the nature and extent of contamination at the site. Water quality parameters, including temperature, dissolved oxygen, turbidity, redox potential, and specific conductivity, are recorded during groundwater sampling during each sampling event. A summary of these parameters is presented in Table 12-1 for groundwater sampling events from 2004 through mid-2011. In addition, selected groundwater samples have been analyzed for sulfide/sulfate, nitrate, ferrous iron, dissolved organic carbon, dissolved manganese, carbon dioxide, and alkalinity. These parameters can provide evidence of natural attenuation and can aid in the interpretation of other chemical data by providing potential explanations of fate and transport mechanisms.

12.4.1 Dissolved Oxygen

The concentration of dissolved oxygen in groundwater varies greatly but can be an important factor controlling the mobility of many inorganic constituents and the biodegradation of xenobiotic organic constituents. Oxygen in groundwater typically reacts with any oxidizable material in its flow path; thus, unless the groundwater is located near the point of recharge, dissolved oxygen levels are typically very low (Hem, 1985). Obtaining accurate dissolved oxygen (DO) field measurements is often highly problematic due to sensitive field equipment (Wiedemeier et al., 1999). However, at the site, DO concentrations have consistently been below 1 mg/L in readings taken since 2004. Although most of the groundwater DO measurements have shown low oxygen levels, elevated dissolved oxygen concentrations have been observed during winter months at wells MC-1, MC-8, MC-24, and MC-25. These wells likely show higher dissolved oxygen concentrations due to increased precipitation and groundwater recharge during the wet season. This increase in DO is also likely resulting in a decline in natural reductive dechlorination in winter, which is consistent with the seasonal variation in VOC levels.

12.4.2 Specific Conductance

Specific conductance is often used as an approximation of the dissolved solids content and can help to verify that samples are obtained from the same groundwater system. In natural waters, dissolved solids vary from 55 percent to 75 percent of the specific conductance (Hem, 1985). Specific conductivity typically ranges from between 0.0220 microsiemens per centimeter (µS/cm) and 0.5095 µS/cm in the Shallow Groundwater Zone and between 0.0647 µS/cm and 0.7885 µS/cm in the Lower Aquifer. Values in the Shallow Groundwater Zone show more seasonal variability than in the Lower Aquifer.

12.4.3 pH

The pH is a measure of the hydrogen ion concentration in solution and is an indication of the balance between acids and bases in water. The pH of the groundwater in the Shallow Groundwater Zone and Lower Aquifer appears to fall consistently between 5.9 and 7.9, indicating relatively neutral groundwater.

12.4.4 Redox Potential

Redox potential is a measure of electron activity and indicates the relative tendency of a solution to accept or transfer electrons. As the reserve of electron acceptors is depleted by microbial activity, redox potential decreases, indicating a reducing environment. Conversely, a high concentration of electron acceptors results in a high redox potential, indicative of an oxidizing environment. Because oxygen has among the highest energy potentials among electron acceptors, it is consumed first, and thus redox potential can also be indicative of whether the environment is aerobic or anaerobic. Redox potentials in groundwater typically range between -400 millivolts (mV) and 800 mV. Redox potentials greater than approximately 750 mV correspond to oxidizing or aerobic environments. While reductive dechlorination can occur in anaerobic conditions, the optimum range for this process is a redox potential of below approximately -150 mV, where sulfate reduction and methanogenesis occur (Wiedemeier et al., 1999). The measured redox potential is the best representation of electron activity and the relative tendency of a solution to accept or transfer electrons within the sample area; however, more oxidizing or reducing conditions may be occurring within microsites in the same area.

Field instrumentation is not always sufficiently sensitive to accurately measure redox potential in groundwater; thus, field measurements of redox potential should be supported by data on the concentrations of oxidized and reduced constituents. The average redox potentials measured in all of the water-bearing units at the site indicate moderately reducing conditions in which nitrate, manganese, and iron reduction can occur. The ORP of all wells in the Shallow Groundwater Zone ranged from -45 mV to 388 mV in 2008-2009, suggesting at least slightly reducing conditions. ORP of wells in the Lower Aquifer range from -81 to 365 in the shallower Lower Aquifer wells and -242 to 264 mV in the deeper (D2) Lower Aquifer wells, suggesting reducing conditions exist in the Lower Aquifer and are stronger with depth.

12.4.5 Methane

The presence of methane is indicative of strongly reducing conditions. Furthermore, the presence of methane in groundwater contaminated with chlorinated solvents suggests that the geochemistry of water is favorable for reductive chlorination. Methane has been detected in Shallow Groundwater Zone and Lower Aquifer groundwater samples, indicating strong reducing conditions exist in groundwater across the site. Trends in methane concentrations for several Shallow Groundwater Zone and Lower Aquifer wells are presented in Figures 12-31 through 12-34. The highest concentrations of methane are present in the wells near the former tank farm area (MC-14, MC-21, MC-118D) and near Steigerwald Marsh (MC-20), while lower concentrations (<2,000 µg/L) are observed in wells located farther away from the marsh and the former tank farm area (MC-8, MC-15D, MC-17D, and MC-19D). Although lower concentrations were observed away from the tank farm area and the marsh, methane was still measured in shallow groundwater throughout the site. These data support the hypothesis that natural attenuation of chlorinated organics is occurring at the site and that the former marsh environment and organic silt provide conditions conducive to natural attenuation.

12.4.6 Redox Pairs: Nitrite/Nitrate, Ferric/Ferrous Iron, Sulfide/Sulfate

The presence of reduced forms of many naturally occurring elements is another indicator of redox conditions within an aquifer. Analytical data collected from a subset of monitoring wells in both the Shallow Groundwater Zone and Lower Aquifer (MC-12, MC-14, MC-20, MC-25; MC-14D, MC-19D, MC-25D, and MC-118D) were used to further evaluate groundwater geochemistry at the facility through analysis of redox pairs.

Nitrite (reduced form) is a very short-lived form of nitrogen and thus is very difficult to measure. However, nitrate (oxidized form) is quickly reduced in the absence of an electron acceptor with a higher energy potential, and thus the presence of nitrate should indicate that reducing conditions are not strong. For the nitrate/nitrite redox pair, nitrate was detected at low concentrations in samples from the Shallow Groundwater Zone (Figure 12-35) and Lower Aquifer (Figure 12-36), suggesting a reducing environment.

The oxidized form of iron, ferric iron [Fe(III)], is insoluble, and thus the presence of dissolved iron in groundwater indicates that reduced iron, ferrous iron [Fe(II)], is present. Ferrous iron was detected in selected Shallow Groundwater Zone and Lower Aquifer wells indicating reducing conditions (Figures 12-37 through 12-39). The highest concentrations of ferrous iron occur in wells that have shown the greatest impact from the releases in the area of the former tank farm (MC-14, MC-118D, and MC-25D) and near the Steigerwald Marsh (MC-20), whereas lower concentrations are observed at wells that have not historically shown such high COC concentrations (MC-12, MC-25, and MC-14D).

Similar to iron, the oxidized form of manganese [Mn(IV)] is insoluble in water; therefore, the presence of dissolved manganese in groundwater indicates that reduced manganese [Mn(II)] is present. Figures 12-40 and 12-41 demonstrate the presence of manganese at various locations throughout the Shallow Groundwater Zone and Lower Aquifer, indicating reducing conditions at the site.

Sulfide (reduced form) and sulfate (oxidized form) concentrations were available for monitoring wells screened in the Shallow Groundwater Zone and Lower Aquifer (Figure 12-42 and Figure 12-43). Overall, sulfide concentrations were lower than sulfate concentrations, suggesting that the reducing conditions in groundwater are not so strong that sulfate reduction is occurring.

12.4.7 Dissolved Organic Carbon

The concentration of dissolved organic carbon is a measure of the naturally occurring organic carbon in the aquifer. Its presence can indicate reducing conditions are likely, regardless of the presence of anthropogenic carbon. From March 2004 through March 2009, concentrations of dissolved organic carbon in Shallow Groundwater Zone Wells ranged between 0.6 mg/L and 35.4 mg/L. From September 2006 through March 2009, concentrations of dissolved organic carbon in the Lower Aquifer ranged between 0.06 mg/L and 8.1 mg/L. Historically, dissolved organic carbon concentrations tend to be highest near MC-14, which has typically been the well with the highest concentrations of organic COCs.

12.4.8 Alkalinity

Alkalinity is important in the maintenance of groundwater pH because it buffers the groundwater system against acids generated during both aerobic and anaerobic biodegradation. Changes in alkalinity are most pronounced during aerobic respiration, denitrification, iron reduction, and sulfate reduction and less pronounced during methanogenesis. In the Shallow Groundwater Zone, highest alkalinity concentrations are observed at MC-14 and MC-123. Well MC-14 is in the center of the chlorinated solvent plume; however, MC-123 is on the edge of the chlorinated solvent plume but within the marsh, which is expected to be a naturally reductive environment. 1,4-Dioxane is present at relatively high concentrations in MC-123, but typically this compound is not easily biodegraded. In the Lower Aquifer, higher alkalinity readings occur across the western half of the site at wells MC-10D, MC-12D, MC-25D, MC-30D, and MC-118D, which is a broad distribution across the site, including areas upgradient of any known source areas.

12.5 EVALUATION OF FATE AND TRANSPORT OF COCS AT THE FACILITY

The mobility and persistence of the COCs identified in soil and groundwater at the site are discussed in this section. These characteristics can be inferred from the physical properties of each compound. The potential for migration of COCs beyond the PSC property boundary is evaluated based on the persistence and mobility of the individual compound along with its distribution at the site.

12.5.1 Petroleum Hydrocarbons and Associated Compounds

Petroleum products consist of varying mixtures of petroleum hydrocarbons. When such a mixture is released into the environment, its composition changes with time due to natural attenuation processes often referred to as weathering. The type and degree of weathering depend on the initial composition of the petroleum mixture and on site-specific environmental conditions, because different types of hydrocarbons weather differently. Aromatics, such as benzene, tend to be more water-soluble than aliphatics, such as hexane, which tend to be more volatile. Therefore, when a petroleum mixture is released into the environment, the principal contaminants in water are likely to be aromatics, while aliphatics will be the principal contaminants in air (Potter and Simmons, 1998). The solubility and volatility of all compounds generally decrease with increased molecular weight, and thus the more volatile and water-soluble compounds are lost most rapidly from the source.

Petroleum compounds are degraded readily by naturally occurring microbes in the subsurface under a wide variety of conditions. While these compounds are typically degraded more quickly under aerobic conditions, anaerobic degradation is equally effective at reducing concentrations of petroleum compounds. Oxidation and fermentation are the primary mechanisms by which petroleum hydrocarbons are degraded. Because petroleum contains a complex and variable mixture of hydrocarbons, all of which eventually break down to carbon dioxide, water, or methane (depending on the degradation environment), there are no telltale daughter products that can be used as evidence that petroleum biodegradation is occurring. Lines of evidence that are typically used to demonstrate the occurrence of petroleum biodegradation include the presence of reducing conditions and increases in carbon dioxide or methane concentrations, however, both of these can also indicate biodegradation of naturally occurring organic matter.

Gasoline-range organics have been detected in a single soil and a single groundwater sample at concentrations exceeding PCLs in the area north of the former tank farm area (see Sections 11.1.4 and 11.2.3). Both samples were collected from GP-97, which suggests that gasoline detected in this area is from a historical spill that likely migrated to the Lower Aquifer with the downward hydraulic gradient in this area. Because gasoline-range organics have not been detected in either soil samples or groundwater samples collected from other locations at the site, the zone of contamination appears localized only within the area immediately near GP-97. Reducing conditions and methane concentrations observed at the site suggest that concentrations of gasoline-range hydrocarbons should decrease as a result of biodegradation. In addition to the likelihood of biodegradation, based on the extent of contamination in soil and groundwater, gasoline-range organics are not expected to migrate at elevated concentrations beyond the PSC property boundary.

12.5.2 Benzene

Benzene is a primary component of gasoline that is expected to be fairly mobile in the subsurface and is not expected to adsorb strongly to soils. Benzene readily degrades to water, carbon dioxide, and methane under a variety of geochemical conditions (Wiedemeier et al., 1999), although biodegradation in soils has been reported to occur more quickly under aerobic conditions. Volatilization and/or biodegradation from moist soil surfaces are expected to be important fate processes (HSDB, 2002).

Areas with elevated concentrations of benzene appear to be centered near MC-14 in the Shallow Groundwater Zone and in the area of the former tank farm area (GP-97) in the Lower Aquifer. The majority of detected concentrations in groundwater, however, are either below or within an order of magnitude of the PCL in both the Shallow Groundwater Zone and the Lower Aquifer. Figure 12-44 shows benzene concentrations as a function of time for selected wells within the groundwater monitoring network. For the majority of wells, benzene concentrations have decreased over time. The concentrations of benzene in samples collected at MC-118D, however, have increased since June 2008 but are still at very low levels (mostly below the PCLs).

Based on the extent of benzene contamination in soil and groundwater and the fact that it is likely to volatilize and biodegrade, benzene is not expected to migrate beyond the PSC property boundary at elevated concentrations.

12.5.3 1,4-Dioxane

1,4-Dioxane does not bind readily to soils, does not adsorb to organic carbon (such as is found in the Silt Layer), and is resistant to naturally occurring biodegradation processes. As a result, 1,4-dioxane is expected to be fairly mobile in the subsurface. In the Shallow Groundwater Zone, the highest concentration of 1,4-dioxane above PCLs in groundwater was detected in a sample collected from MC-14. Other groundwater samples exhibiting elevated concentrations of 1,4-dioxane were collected from downgradient wells bordering Steigerwald Marsh (e.g., MC-20, MC-122, and MC-123). Although analytical data together with groundwater contours for the Shallow Groundwater Zone indicate the 1,4-dioxane plume has migrated downgradient toward Steigerwald Marsh, levels of 1,4-dioxane detected at these downgradient wells are much lower than acceptable levels for a surface water environment such as the Steigerwald Marsh (see a review of freshwater sediment toxicity levels in Appendix M).

In the Lower Aquifer, concentrations of 1,4-dioxane in groundwater do not exhibit a distinct spatial pattern. In areas north and northwest of the former tank farm, slightly elevated concentrations of 1,4-dioxane have been observed in locations typically upgradient of Lower Aquifer groundwater beneath the former tank farm; however, as groundwater flow directions in the Lower Aquifer reverse from a southward to northward or northeastward direction in response to high stage elevation in the Columbia River, areas north of the former tank farm area are positioned either cross-gradient or downgradient of Lower Aquifer groundwater beneath the former tank farm at certain times during the year.

Concentrations of 1,4-dioxane in the Lower Aquifer are much lower than those in the Shallow Groundwater Zone.

12.5.4 Chlorinated Organics

Chlorinated solvent compounds identified as COCs include PCE, TCE, *cis*-1,2-DCE, and vinyl chloride. Data discussed in Section 12.3 indicate a steadily decreasing trend in concentrations of PCE, TCE, and *cis*-1,2-DCE at the site in the time since the former tank farm excavation was completed. Vinyl chloride concentrations have also decreased at Shallow Groundwater Zone monitoring wells MC-2, MC-14, MC-16, and MC-21.

In the Lower Aquifer, the highest concentrations of *cis*-1,2-DCE occur at MC-24D, MC-25D, and MC-118D. The concentrations of this compound relative to other chlorinated organics at these wells suggests that reductive dechlorination of *cis*-1,2-DCE is likely the most favored pathway microbial metabolic degradation of chlorinated organic species. The relative speed of reductive dechlorination relative to other dechlorination reactions at these wells is likely resulting in an increase of VC over time. As concentrations of *cis*-1,2-DCE decrease over time, dechlorination of 1,2-DCE is likely to slow, vinyl chloride degradation will continue, and concentrations of VC should begin to decline.

The increase in the concentration of vinyl chloride observed at these Lower Aquifer wells is probably due to progression of reductive dechlorination. Reductive dechlorination is likely decreasing the concentrations of chlorinated solvent compounds in both soil and groundwater at the site based upon the following evidence:

- Decreases in concentrations of a parent COC over time;
- Geochemical conditions indicating reducing conditions and depletion of electron acceptors; and
- Production of breakdown products in the areas where COCs are present.

As described in Section 11.0, the Silt Layer appears to act as a continuous source of COCs in the Lower Aquifer as well, contributing to the elevated concentrations observed in Lower Aquifer groundwater.

The concentrations of chlorinated organics have decreased to the point that with a few exceptions, the concentrations are only slightly above the PCLs at the PSC property line. Highest concentrations near the property line are in the center of the solvent plume at MC-14, but these concentrations have dropped substantially (by 50 percent or more for PCE) since the 1997 excavation interim measure in the tank farm area.

12.5.5 Metals

A number of physical, chemical, and biological processes influence the concentrations of metals in an aqueous system. These processes include chemical speciation, hydrolysis, volatilization, sorption, bioaccumulation, and biodegradation. Each metal behaves differently in a particular environment due to its unique chemical nature. Evaluation of the mobility of metals is especially difficult given their ability to form ions and interact with water, minerals, biota, and organic materials. Site-specific conditions that may affect the mobility of the metals identified as COCs at the site are pH, the presence of organic matter, and anaerobic conditions. However, even though these environmental factors are important, their relative importance is uncertain for determining the final fate of metals in the environment.

It is expected that the presence of metals at the site at elevated concentrations (above area background) is due primarily to the presence of chlorinated organic compounds in groundwater, leading to reducing conditions that thereby mobilize metals from the soil to groundwater. As concentrations of chlorinated organic compounds decrease, metals are expected to similarly decrease to concentrations reflective of area background. This hypothesis is supported by the trend observed for the concentration of arsenic at MC-14 (Figure 12-3). Groundwater quality in this well has improved dramatically since the 1997 interim action, and the concentration of arsenic now shows a steady downward trend.

The highest concentrations of arsenic at the site occur when the groundwater elevation is lowest. This observation could be attributed to: (1) more reducing conditions when groundwater elevations are low (less recharge from surface water with higher dissolved oxygen levels); and/or (2) the presence of more colloidal particles in samples collected during periods of low groundwater levels. Table 12-3 shows total and dissolved arsenic concentrations in groundwater from all sampling events. There are a limited number of analyses of total and dissolved arsenic analyses (collected concurrently) during periods of low groundwater levels. The results in Table 12-3 are inconclusive; therefore, the possibility that higher amounts of colloidal particles during periods of low groundwater levels could contribute to higher arsenic concentrations cannot be ruled out. Naturally reducing conditions are also directly impacting concentrations of arsenic and chlorinated VOCs on the site. The arsenic concentrations show a clear and consistent trend of higher concentrations in the Shallow Groundwater Zone during the summer months and lower concentrations in the winter months. Conversely, concentrations of chlorinated VOCs are frequently highest in the winter months and lowest in the summer. Since arsenic is more mobile and chlorinated VOCs biologically degrade predominantly under reducing conditions, it is clear that water level changes in the Shallow Groundwater Zone are resulting in seasonal changes in the oxidizing/reducing conditions of the groundwater. Since reducing conditions seem to predominate in the summer, it appears that the infiltration of fresh rain water in the wet winter months results in increasing levels of dissolved oxygen in the winter. During the summer, the oxygen within the shallow groundwater is consumed as a result of degradation of natural organics within the Silt Aquitard, resulting in reducing conditions. The reducing conditions mobilize more arsenic but biodegrade the chlorinated VOCs.

To expand on the evaluation of inorganic trends at the site, PSC completed additional assessment of the groundwater data for inorganics at the site as part of this RI. Table 12-2 lists all inorganic constituents detected at a concentration greater than their respective PCLs in one or more groundwater samples collected since 2004. Given the site history presented in Chapter 3, no known releases of strictly inorganic constituents are identifiable as contributing to observed metals concentrations, though these inorganic constituents may have been handled in wastes managed at the site historically. Even if undocumented, a release could be inferred to have occurred if elevated metals concentrations in groundwater were particularly localized within the site. However, concentrations of inorganic constituents listed in Table 12-2 above the respective PCLs have been observed in groundwater samples collected from across the site within both the Shallow Groundwater Zone and the Lower Aquifer, including:

- The Shallow Groundwater Zone near the former waste oil tank system;
- The Shallow Groundwater Zone, the Silt Layer, and the Lower Aquifer near the former tank farm area;
- The Shallow Groundwater Zone upgradient (west) of the former tank farm area (i.e., MC-12);
- The Shallow Groundwater Zone and Lower Aquifer north of the former tank farm area (GP-96, GP-98, GP-99, GP-104, GP-105);
- The Shallow Groundwater Zone and Lower Aquifer downgradient of the former tank farm area (i.e., MC-14, MC-14D, MC-20D, GP-101, MC-122); and
- Northeast of the PSC property at PZU-4 and PZU-5, which are screened across both the Shallow Groundwater Zone and the Silt Layer.

Table 12-2 also provides the highest metal concentrations observed at the site covering the period from 2004 to the second quarter 2011 and separately for a more recent period from 2008 to the second quarter 2011. With respect to the PCLs, the highest metals concentrations occurred for iron and manganese. Under increasingly reducing conditions, iron and manganese become more soluble in water (Wiedemeier et al., 1999). As observed at the site, groundwater conditions have become more reducing with time resulting in elevated concentrations of manganese and iron. Arsenic also becomes more mobile in a more reducing environment (Corwin et al,. 1999). It is anticipated that iron, manganese, and arsenic concentrations will decrease once reductive chlorination slows and groundwater conditions become more oxidizing. This trend is already beginning to occur, as most of the chlorinated organic species are being depleted from the Shallow Groundwater Zone and concentrations of arsenic are similarly decreasing.

Recent samples analyzed for zinc, silver, chromium, and cadmium have exhibited concentrations only slightly above or below the PCLs. These constituents have shown very little variability in recent sampling events. Elevated concentrations of arsenic, manganese, copper, iron, and vanadium above the PCL are more widespread throughout the site. One groundwater sample from GP-104 exceeded the PCL for lead. No other samples from direct-push borings or groundwater monitoring wells have exceeded the PCL for lead. Lead has not been frequently sampled in groundwater recently at the site because it was not detected in the majority of historical sampling conducted earlier at the site.

12.6 CONCLUSIONS

The RI completed for the PSC Washougal site has determined that while interim actions have significantly improved site conditions, COCs do remain present in soil and groundwater at concentrations that present a potential risk to human health and the environment. The information presented in the RI meets the requirements of WAC 173-340-350(7), which outlines the RI process and contents. Cleanup levels will be finalized as part of the FS, and the site conceptual model of COCs that require cleanup will need to be refined as part of that process. Restoration time frames for groundwater will be assessed as part of the FS, since cleanup levels will be finalized in that document, and additional data are being collected in the interim between the RI and the FS.

Specific exposure pathways identified as part of the site conceptual model (Section 8) are reiterated in this section to summarize those exposure pathways that remain complete based on the RI findings.

- Office workers, working primarily indoors, may potentially be exposed to COCs through the inhalation of fugitive dust, although this exposure pathway is considered unlikely. In addition, office workers could be exposed to COCs in indoor air via inhalation of volatile compounds if new buildings are constructed without building controls similar to those currently in place in Building 1 to prevent this pathway from being complete.
- Industrial workers, working primarily outdoors, may be exposed to COCs through inhalation of fugitive dust or inhalation of volatile compounds. Industrial workers may also have direct contact with chemicals in uncovered surface soil, resulting in exposure via dermal contact or incidental ingestion; however, it is assumed that industrial workers will adhere to appropriate protective measures to minimize exposure (e.g., personal protective equipment), so this mechanism is considered a potentially complete but unlikely pathway.
- Temporary workers, working primarily outdoors, may be exposed to COCs through fugitive dust via inhalation or by direct inhalation of volatile compounds. Temporary workers involved in trenching or other excavation activities may also have direct contact with chemicals in uncovered surface soil or contact with groundwater, resulting in exposure via dermal contact or incidental ingestion. In this specific case, the exposure pathway is considered complete. For all other temporary workers who are not involved in trenching or excavating activities, the pathway is incomplete as they will not be interacting with uncovered surface soil.
- Site visitors, present at the PSC property for short durations, may be exposed to COCs in fugitive dust and in indoor air via inhalation of volatile compounds if new buildings are constructed without building controls similar to those currently in place in Building 1 to prevent this pathway from being complete. Because visits to the site

are expected to be of short duration and visitor activities are unlikely to result in COC exposures, these mechanisms are considered potentially complete exposure pathways.

- Based on the ecological assessment and TEE, risks to ecological receptors on the property and in the neighboring surface water bodies are considered acceptable under MTCA and use of the nearby surface water bodies by people in the area for fishing or recreation is not expected to occur.

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TABLES

TABLE 12-1

SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING QUARTERLY GROUNDWATER SAMPLING EVENTS

PSC Washougal Facility
Washougal, Washington

Well ID	Date	pH (pH units)	Dissolved Oxygen (ppm)	Temperature (°C)	Redox Potential (millivolts)	Specific Conductivity (mS/cm)	Turbidity (NTU)
2004							
Shallow Groundwater Zone Wells							
MC-1	3/24/2004	5.64	2.93	14.10	422	0.0473	6.21
	6/15/2004	6.56	0.67	20.03	371	0.0964	1.98
	9/16/2004	6.56	0.14	25.29	398	0.0576	2.49
	12/16/2004	6.39	4.69	16.64	515	0.0220	13.30
MC-2	3/24/2004	6.63	0.38	17.31	434	0.1421	1.20
	6/16/2004	6.50	0.31	21.62	435	0.1949	0.79
	9/14/2004	6.52	0.17	26.98	428	0.0896	1.92
	12/14/2004	6.46	0.23	20.41	507	0.1454	2.83
MC-8	3/24/2004	5.79	4.95	10.00	529	0.0653	21.80
	6/17/2007	6.48	0.34	16.31	407	0.0612	7.11
	9/14/2004	6.35	0.22	19.74	436	0.0672	2.13
	12/14/2004	6.31	6.02	13.48	533	0.0480	13.10
MC-12	3/23/2004	6.65	1.72	11.08	448	0.1087	0.06
	6/15/2004	6.86	0.63	16.66	375	0.0851	1.14
	9/16/2004	7.17	0.29	19.93	393	0.0637	0.49
	12/16/2004	7.01	1.11	12.77	503	0.0709	0.69
MC-13	3/23/2004	6.10	0.57	12.96	455	0.1610	1.30
	6/16/2004	6.61	0.22	16.54	429	0.0776	1.10
	9/14/2004	6.68	0.15	19.69	425	0.0604	1.48
	12/15/2004	6.57	0.46	14.13	510	0.0796	0.70
MC-14	3/23/2004	6.63	0.78	12.06	434	0.3776	1.61
	6/15/2004	6.86	0.55	15.50	370	0.4095	3.26
	9/16/2004	6.67	0.57	18.41	433	0.0875	2.82
	12/16/2004	6.49	0.71	11.48	545	0.0992	5.53
MC-15	3/25/2004	6.54	0.51	10.47	445	0.1259	0.62
	6/17/2004	6.50	0.36	16.94	424	0.1596	1.27
	6/15/2004	6.71	0.32	19.56	373	0.0764	1.93
	12/15/2004	6.68	0.61	11.33	498	0.0494	0.01
MC-16	3/25/2004	6.82	0.58	10.02	451	0.1949	1.51
	6/17/2004	6.50	0.66	16.77	439	0.1579	1.44
	6/15/2004	6.63	0.47	18.85	330	0.0743	1.56
	12/15/2004	6.71	0.35	11.69	505	0.0878	0.44
MC-17	3/25/2004	6.84	0.71	10.42	460	0.2051	0.36
	6/17/2004	6.57	0.48	16.05	444	0.1640	0.37
	9/15/2004	6.82	0.27	20.20	398	0.0779	2.61
	12/15/2004	6.77	0.59	12.10	502	0.0880	1.20

TABLE 12-1

SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING QUARTERLY GROUNDWATER SAMPLING EVENTS

PSC Washougal Facility
Washougal, Washington

Well ID	Date	pH (pH units)	Dissolved Oxygen (ppm)	Temperature (°C)	Redox Potential (millivolts)	Specific Conductivity (mS/cm)	Turbidity (NTU)
2004							
Shallow Groundwater Zone Wells (Continued)							
MC-20	3/23/2004	6.17	1.80	14.51	459	0.2263	2.06
	6/15/2004	6.12	0.48	18.11	400	0.1688	3.85
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MC-21	3/23/2004	6.67	1.80	13.35	450	0.0857	2.06
	6/15/2004	6.69	0.78	16.57	357	0.0950	1.77
	9/16/2004	6.88	0.32	18.33	412	0.0762	0.47
	12/16/2004	6.53	1.15	12.97	520	0.0871	0.97
MC-107	3/25/2004	6.91	1.49	10.59	441	0.0710	1.24
	6/17/2004	6.57	0.74	17.98	426	0.0756	1.08
	9/15/2004	7.09	0.40	19.49	381	0.0449	3.30
	12/15/2004	6.96	0.79	12.91	490	0.0608	1.09
Lower Aquifer Wells							
MC-2D	3/24/2004	6.96	1.18	17.97	430	0.2529	0.04
	6/16/2004	6.93	0.64	18.33	431	0.2084	0.13
	9/14/2004	6.82	0.30	19.36	444	0.1103	0.51
	12/14/2004	6.65	0.28	18.51	552	0.2140	1.41
MC-10D	3/24/2004	6.86	0.70	17.51	426	0.3353	2.64
	6/16/2004	6.75	0.57	16.67	432	0.1966	0.44
	9/14/2004	6.99	0.30	17.70	416	0.0981	2.11
	12/14/2004	6.72	0.45	17.26	492	0.1781	1.36
MC-12D	3/24/2004	6.66	0.24	18.00	440	0.4092	3.82
	6/16/2004	6.63	0.42	18.99	423	0.2378	0.83
	9/14/2004	6.73	0.29	19.05	435	0.1179	1.35
	12/14/2004	6.54	0.45	18.02	509	0.2062	1.36
MC-13D	3/23/2004	6.67	0.93	14.35	451	0.1612	0.06
	6/16/2004	7.04	0.63	16.14	420	0.1243	0.42
	9/14/2004	6.85	0.40	15.43	416	0.0701	1.30
	12/15/2004	6.90	1.07	14.02	506	0.0975	0.38
MC-15D	3/25/2004	6.81	0.42	17.08	439	0.2877	0.07
	6/13/2004	7.06	0.49	18.10	412	0.1847	0.06
	9/14/2004	6.95	0.38	22.24	413	0.1038	0.93
	12/14/2004	6.81	0.82	18.65	483	0.1677	0.88
MC-17D	3/25/2004	6.86	1.15	16.19	450	0.1496	0.96
	6/17/2004	6.78	0.84	18.21	431	0.1266	0.22
	9/15/2004	7.13	0.37	19.69	372	0.0708	1.53
	12/15/2004	6.95	0.75	17.76	491	0.1049	0.59

TABLE 12-1

SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING QUARTERLY GROUNDWATER SAMPLING EVENTS

PSC Washougal Facility
Washougal, Washington

Well ID	Date	pH (pH units)	Dissolved Oxygen (ppm)	Temperature (°C)	Redox Potential (millivolts)	Specific Conductivity (mS/cm)	Turbidity (NTU)
2004							
Lower Aquifer Wells (Continued)							
MC-19D	3/24/2004	7.06	0.38	16.63	409	0.1443	3.13
	6/16/2004	7.02	0.36	15.42	408	0.1263	0.36
	9/15/2004	7.48	0.26	18.55	371	0.0647	2.54
	12/14/2004	7.12	0.29	17.32	465	0.1087	1.08
MC-118D	3/24/2004	6.62	0.38	18.16	477	0.4743	3.41
	6/17/2004	6.55	0.47	21.61	415	0.2820	1.72
	9/15/2004	6.83	0.26	21.30	399	0.1168	2.92
	12/14/2004	6.55	0.89	19.94	526	0.2310	4.87
2005							
Shallow Groundwater Zone Wells							
MC-1	3/17/2005	7.01	0.32	16.68	428	0.0665	2.65
	6/8/2005	6.35	0.80	21.19	457	0.0669	4.18
	9/15/2005	6.51	0.47	24.24	438	0.1490	2.65
	12/1/2005	6.75	5.21	16.20	474	0.0369	1.41
MC-2	3/15/2005	6.82	0.20	19.94	417	0.2341	1.32
	6/9/2005	6.70	0.06	23.74	202	0.2028	1.27
	6/13/2005	6.48	0.45	26.83	522	0.2113	1.47
	11/29/2005	6.81	0.29	19.47	482	0.1532	0.22
MC-8	3/15/2005	6.24	0.49	11.41	449	0.0970	5.93
	6/8/2005	6.21	1.08	16.88	520	0.0876	3.74
	9/13/2005	6.42	0.94	20.58	446	0.1913	0.92
	11/30/2005	6.69	6.30	13.37	504	0.0936	2.25
MC-12	3/17/2005	7.48	0.66	11.09	435	0.1016	0.59
	6/9/2005	7.37	0.43	16.37	122	0.1135	3.41
	9/15/2005	7.09	0.64	19.57	448	0.1218	0.35
	12/1/2005	7.33	1.21	11.83	458	0.1215	0.41
MC-13	3/16/2005	6.82	0.27	11.73	433	0.1245	0.78
	6/8/2005	6.86	0.27	15.22	167	0.1160	1.35
	9/14/2005	6.57	0.76	19.33	366	0.1263	0.48
	11/29/2005	6.94	0.34	14.53	438	0.1289	0.29
MC-14	3/17/2005	6.66	0.65	10.48	482	0.2169	3.47
	6/8/2005	6.70	0.52	15.01	169	0.3411	4.37
	9/15/2005	6.45	0.97	17.90	527	0.2814	0.68
	12/1/2005	6.66	0.63	10.03	502	0.6331	1.29
MC-15	3/16/2005	6.91	0.22	11.49	443	0.1589	0.92
	6/7/2005	6.82	0.29	18.36	479	0.4402	0.32
	9/14/2005	6.80	0.66	19.05	355	0.2421	0.71
	11/30/2005	6.69	0.42	11.42	462	0.0956	1.11

TABLE 12-1

SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING QUARTERLY GROUNDWATER SAMPLING EVENTS

PSC Washougal Facility
Washougal, Washington

Well ID	Date	pH (pH units)	Dissolved Oxygen (ppm)	Temperature (°C)	Redox Potential (millivolts)	Specific Conductivity (mS/cm)	Turbidity (NTU)
2005							
Shallow Groundwater Zone Wells (Continued)							
MC-16	3/16/2005	6.91	0.23	10.98	442	0.2020	1.02
	6/7/2005	6.86	0.30	14.75	166	0.3210	2.55
	9/14/2005	6.78	0.54	18.89	407	0.1882	0.31
	11/30/2005	6.98	0.51	13.66	465	0.1518	1.39
MC-17	3/16/2005	6.94	0.27	11.34	444	0.1929	0.50
	6/7/2005	6.91	0.26	14.57	168	0.2906	0.33
	6/14/2005	6.81	0.59	18.62	471	0.2195	0.39
	11/30/2005	7.08	0.48	14.08	431	0.1895	0.83
MC-20	3/17/2005	6.57	0.50	11.74	471	0.2403	6.22
	6/9/2005	6.38	0.30	18.08	200	0.1912	1.33
	--	--	--	--	--	--	--
	12/1/2005	6.41	0.86	11.00	503	0.6962	2.88
MC-21	3/17/2005	7.23	0.41	13.41	444	0.1327	1.82
	6/8/2005	6.77	0.80	16.30	396	0.1299	1.74
	9/15/2005	6.68	0.84	18.39	500	0.1942	0.59
	120105	6.96	1.20	12.60	474	0.1256	1.20
MC-107	3/15/2005	7.03	0.53	11.54	432	0.1219	1.88
	6/9/2005	6.83	0.74	17.08	348	0.0682	1.52
	9/13/2005	6.66	0.86	19.89	481	0.1138	0.96
	11/30/2005	7.19	1.06	12.80	452	0.0798	0.96
2005							
Lower Aquifer Wells							
MC-2D	3/15/2005	6.97	0.32	18.75	429	0.3347	0.63
	6/9/2005	6.86	0.35	20.78	358	0.2721	0.63
	9/13/2005	6.72	0.77	19.01	543	0.3812	0.29
	11/29/2005	7.04	0.27	17.33	493	0.2829	0.27
MC-10D	3/15/2005	6.86	0.28	17.96	442	0.6475	0.49
	6/7/2005	6.87	0.32	17.04	160	0.4199	0.25
	9/13/2005	6.64	0.57	17.93	517	0.5727	0.97
	11/29/2005	6.98	0.30	15.89	484	0.8019	0.33
MC-12D	3/15/2005	6.68	0.32	18.21	455	0.7705	1.09
	6/9/2005	6.69	0.26	18.69	305	0.3604	1.61
	9/13/2005	6.51	0.79	20.18	494	0.5958	0.19
	11/29/2005	6.80	0.34	16.84	505	1.1180	0.41
MC-13D	3/16/2005	7.07	0.52	13.17	435	0.1696	0.52
	6/9/2005	7.18	0.68	13.97	494	0.1807	1.17
	9/14/2005	6.89	1.57	14.81	341	0.1902	0.59
	11/29/2005	7.15	1.45	11.99	447	0.1724	0.18

TABLE 12-1

SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING QUARTERLY GROUNDWATER SAMPLING EVENTS

PSC Washougal Facility
Washougal, Washington

Well ID	Date	pH (pH units)	Dissolved Oxygen (ppm)	Temperature (°C)	Redox Potential (millivolts)	Specific Conductivity (mS/cm)	Turbidity (NTU)
2005							
Lower Aquifer Wells (Continued)							
MC-15D	3/16/2005	6.93	0.22	17.73	442	0.3138	0.61
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	9/14/2005	6.84	0.59	18.78	365	0.3490	0.19
	11/30/2005	7.11	0.40	17.82	463	0.2791	0.48
MC-17D	3/16/2005	7.22	0.57	17.63	456	0.1961	0.51
	6/10/2005	7.11	0.35	17.85	475	0.1710	0.42
	6/15/2005	6.86	0.85	19.18	472	0.1698	0.45
	121/05	7.13	0.66	16.37	471	0.1677	0.18
MC-19D	3/15/2005	7.45	0.38	17.85	420	0.1895	0.45
	6/7/2005	7.25	0.25	16.68	184	0.1884	0.41
	9/13/2005	7.07	0.55	18.28	414	0.1915	0.74
	11/29/2005	7.41	0.33	15.53	410	0.1472	0.47
MC-118D	3/15/2005	6.61	0.32	18.99	474	1.0490	0.57
	6/8/2005	6.70	0.28	21.38	154	0.4453	0.89
	9/14/2005	6.71	0.42	21.98	220	0.5382	1.25
	11/30/2005	6.81	0.38	19.39	506	1.0270	0.93
2006							
Shallow Groundwater Zone Wells							
MC-1	3/9/2006	7.23	8.01	12.33	453	0.0336	9.76
	6/8/2006	6.49	0.81	20.39	344	0.0641	2.75
	9/14/2006	6.89	0.17	24.42	252	0.1355	2.86
	12/21/2006	6.66	6.86	12.28	194	0.0633	13.30
MC-2	3/7/2006	6.87	0.43	14.47	448	0.1200	0.17
	6/6/2006	6.63	0.03	22.45	79	0.4982	1.30
	9/13/2006	6.77	0.38	25.92	317	0.1507	1.00
	12/20/2006	7.11	0.14	16.23	162	0.2428	0.40
MC-8	3/7/2006	6.79	6.52	9.75	468	0.0607	11.80
	6/7/2006	6.32	1.49	16.24	300	0.0769	4.00
	9/12/2006	6.26	0.48	22.10	323	0.1459	1.38
	12/21/2006	7.21	7.10	9.46	141	0.0895	2.02
MC-12	3/9/2006	7.04	1.05	8.75	463	0.1241	1.16
	6/8/2006	6.98	0.62	15.77	293	0.1158	0.73
	9/12/2006	6.82	0.30	21.62	257	0.1008	0.25
	12/20/2006	7.57	0.91	9.93	153	0.1502	0.44
MC-13	3/7/2006	6.74	0.28	10.38	464	0.0773	1.20
	6/7/2006	6.57	0.29	15.23	222	0.1142	1.47
	9/12/2006	6.28	0.30	18.67	314	0.1361	0.58
	12/19/2006	7.04	0.26	11.69	125	0.1500	2.24

TABLE 12-1

SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING QUARTERLY GROUNDWATER SAMPLING EVENTS

PSC Washougal Facility
Washougal, Washington

Well ID	Date	pH (pH units)	Dissolved Oxygen (ppm)	Temperature (°C)	Redox Potential (millivolts)	Specific Conductivity (mS/cm)	Turbidity (NTU)
2006							
Shallow Groundwater Zone Wells (Continued)							
MC-14	3/9/2006	6.81	0.57	8.48	479	1.0930	2.26
	6/8/2006	6.84	0.53	15.26	92	0.6174	8.44
	9/12/2006	6.36	0.79	18.34	362	0.3388	0.96
	12/19/2006	6.94	0.86	9.50	175	0.2975	2.36
MC-15	3/8/2006	6.68	0.68	8.51	478	0.1380	0.43
	6/6/2006	6.77	0.31	17.29	133	0.2391	1.21
	9/13/2006	6.84	0.51	18.97	307	0.2369	0.52
	12/21/2006	6.67	3.99	5.64	185	0.0814	0.60
MC-16	3/8/2006	6.89	0.45	8.36	486	0.2241	3.43
	6/7/2006	6.83	0.61	15.81	93	0.2757	3.52
	9/13/2006	6.87	0.43	19.08	247	0.1986	0.98
	12/21/2006	7.10	0.84	8.65	179	0.1181	2.47
MC-17	3/7/2006	6.82	0.61	8.88	464	0.2075	4.24
	6/7/2006	6.79	0.47	16.35	133	0.2160	1.19
	9/14/2006	6.85	0.49	18.26	315	0.2118	0.27
	12/20/2006	7.09	3.16	9.44	135	0.1581	0.72
MC-20	3/9/2006	6.92	1.34	10.29	461	0.1529	2.76
	6/8/2006	6.47	0.62	15.54	260	0.2763	14.10
	--	--	--	--	--	--	--
	12/19/2006	6.53	1.29	10.16	171	0.2493	2.42
MC-21	3/9/2006	7.31	2.23	10.57	445	0.0649	3.55
	6/8/2006	6.89	0.49	14.95	200	0.0943	0.98
	9/12/2006	6.84	0.33	18.37	317	0.1623	0.72
	12/19/2006	7.43	1.97	11.50	113	0.1132	1.71
Shallow Groundwater Zone Wells (Continued)							
MC-107	3/8/2006	7.20	1.62	8.81	462	0.0806	0.39
	6/7/2006	6.93	0.37	14.87	218	0.1047	0.25
	9/13/2006	6.89	0.30	20.31	227	0.1432	0.51
	12/20/2006	7.15	1.08	9.59	158	0.1150	1.28
MC-122	--	--	--	--	--	--	--
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	12/19/2006	7.11	0.66	11.54	163	0.2043	4.02
MC-123	--	--	--	--	--	--	--
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	12/19/2006	6.74	1.02	10.85	177	0.4565	4.21

TABLE 12-1

SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING QUARTERLY GROUNDWATER SAMPLING EVENTS

PSC Washougal Facility
Washougal, Washington

Well ID	Date	pH (pH units)	Dissolved Oxygen (ppm)	Temperature (°C)	Redox Potential (millivolts)	Specific Conductivity (mS/cm)	Turbidity (NTU)
2006							
Lower Aquifer Wells							
MC-2D	3/7/2006	7.02	1.07	16.79	467	0.2921	0.11
	6/6/2006	6.91	0.23	18.20	218	0.2551	0.63
	9/13/2006	6.73	0.18	18.45	335	0.2657	0.23
	12/20/2006	7.28	0.28	16.47	147	0.3506	0.58
MC-10D	3/7/2006	6.96	0.41	16.49	470	0.7783	1.00
	6/6/2006	6.86	0.12	17.95	87	0.8175	2.64
	9/13/2006	6.64	0.23	18.70	285	0.4790	1.24
	12/20/2006	7.15	0.29	15.12	136	0.3387	0.54
MC-12D	3/7/2006	6.81	0.16	16.83	488	1.1210	3.24
	6/6/2006	6.56	0.28	17.58	255	1.0380	3.72
	9/12/2006	6.29	0.25	21.41	301	0.8104	0.69
	12/20/2006	6.97	0.35	15.58	178	0.3736	0.80
MC-13D	3/7/2006	7.18	1.08	11.47	469	0.1612	0.13
	6/7/2006	6.85	0.30	15.75	301	0.1507	0.30
	9/12/2006	6.55	0.64	15.34	323	0.1533	0.27
	12/19/2006	7.39	1.01	11.09	133	0.2210	0.55
MC-15D	3/8/2006	7.03	0.33	15.85	480	0.3744	0.08
	6/6/2006	6.80	0.18	18.42	293	0.3159	0.67
	9/13/2006	6.89	0.19	19.09	247	0.3116	0.26
	12/21/2006	7.14	0.27	15.08	188	0.2988	0.45
MC-17D	3/7/2006	7.21	0.74	17.28	454	0.1714	0.11
	6/7/2006	7.08	0.79	18.24	131	0.1551	0.46
	9/14/2006	6.94	0.41	17.28	257	0.1557	0.39
	12/20/2006	7.49	0.91	14.97	100	0.2273	0.30
MC-19D	3/8/2006	7.36	0.36	15.22	459	0.1445	0.38
	6/6/2006	6.90	0.23	17.17	315	0.1974	0.76
	9/13/2006	6.99	0.21	19.10	233	0.1675	1.34
	12/21/2006	7.46	0.19	15.48	139	0.2036	1.08
MC-118D	3/8/2006	6.85	0.24	16.65	494	1.0130	1.03
	6/7/2006	6.84	0.11	19.24	97	0.8139	2.13
	9/12/2006	6.42	0.26	22.66	350	0.9497	1.59
	12/21/2006	7.01	0.26	17.22	187	0.3930	0.43
MC-1	3/8/2007	6.38	6.24	13.30	148	0.0916	2.21
	9/7/2007	6.58	0.36	21.80	177	0.2228	0.71
	9/13/2007	6.64	0.17	25.63	134	0.2317	4.01
	12/19/2007	6.29	4.63	15.86	254	0.0595	11.61

TABLE 12-1

SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING QUARTERLY GROUNDWATER SAMPLING EVENTS

PSC Washougal Facility
Washougal, Washington

Well ID	Date	pH (pH units)	Dissolved Oxygen (ppm)	Temperature (°C)	Redox Potential (millivolts)	Specific Conductivity (mS/cm)	Turbidity (NTU)
2007							
Shallow Groundwater Zone Wells							
MC-2	3/8/2007	6.89	0.18	15.36	118	0.1458	3.67
	6/7/2007	6.57	0.11	23.36	170	0.2632	0.58
	9/12/2007	6.49	0.20	26.89	137	0.2502	1.65
	12/21/2007	6.70	0.28	17.70	263	0.1290	0.94
MC-8	3/8/2007	6.88	7.01	9.11	122	0.0475	24.10
	6/6/2007	6.28	2.38	15.41	180	0.1708	2.08
	9/13/2007	6.55	0.70	17.89	147	0.1872	0.98
	12/20/2007	6.79	5.56	10.10	259	0.0479	7.25
MC-12	3/7/2007	6.82	1.58	9.31	129	0.1091	1.99
	6/6/2007	6.79	1.19	14.62	210	0.1069	1.09
	9/12/2007	6.54	0.30	19.57	155	0.2158	0.63
	12/21/2007	7.29	1.60	9.70	252	0.0965	0.36
MC-13	3/6/2007	6.76	0.50	11.16	156	0.1058	1.82
	6/6/2007	6.40	0.29	14.49	199	0.1201	2.27
	9/11/2007	6.25	0.29	18.40	188	0.1505	2.21
	12/19/2007	6.87	0.31	11.08	242	0.0693	1.09
MC-14	3/6/2007	6.92	0.54	10.64	160	0.4989	6.25
	6/5/2007	6.45	0.58	14.75	198	0.4525	4.22
	9/11/2007	6.48	0.68	18.41	146	0.9802	1.76
	12/19/2007	6.68	1.62	11.11	264	0.1154	6.11
MC-15	3/6/2007	5.92	3.10	11.47	184	0.0492	1.67
	6/5/2007	6.33	0.58	13.43	187	0.2002	0.53
	9/11/2007	6.64	0.47	20.56	180	0.3323	2.04
	12/20/2007	7.81	7.20	6.52	239	0.0278	7.97
MC-16	3/7/2007	6.46	0.51	8.12	133	0.1289	2.29
	6/5/2007	6.58	0.34	14.65	173	0.1398	1.08
	9/11/2007	6.52	0.56	22.48	171	0.2869	0.83
	12/20/2007	6.92	1.90	8.55	256	0.0869	2.60
MC-17	3/8/2007	6.24	3.46	9.46	147	0.1889	1.55
	9/7/2007	6.50	0.51	14.57	153	0.1672	0.47
	9/13/2007	6.59	1.16	18.16	149	0.3002	1.08
	12/20/2007	6.82	2.16	10.26	261	0.0943	0.63
MC-20	3/5/2007	6.45	1.16	12.88	152	0.2841	2.49
	6/4/2007	6.33	0.82	18.40	186	0.1736	1.04
	--	--	--	--	--	--	--
	12/19/2007	6.55	1.31	10.39	272	0.1147	3.68

TABLE 12-1

SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING QUARTERLY GROUNDWATER SAMPLING EVENTS

PSC Washougal Facility
Washougal, Washington

Well ID	Date	pH (pH units)	Dissolved Oxygen (ppm)	Temperature (°C)	Redox Potential (millivolts)	Specific Conductivity (mS/cm)	Turbidity (NTU)
2007							
Shallow Groundwater Zone Wells (Continued)							
MC-21	3/6/2007	6.81	0.97	11.49	159	0.1805	1.24
	6/5/2007	6.45	0.25	15.54	171	0.1885	0.28
	9/11/2007	6.86	0.29	19.72	159	0.2676	0.85
	12/19/2007	6.98	1.84	10.34	245	0.1002	0.97
MC-24	--	--	--	--	--	--	--
	--	--	--	--	--	--	--
	10/24/2007	8.31	6.33	13.50	169	0.0714	23.60
	12/18/2007	7.46	7.62	7.57	214	0.0431	26.30
MC-25	--	--	--	--	--	--	--
	--	--	--	--	--	--	--
	10/24/2007	8.36	3.22	17.27	183	0.1384	7.48
	12/19/2007	7.01	6.36	9.81	258	0.1200	8.23
MC-107	3/7/2007	6.77	2.02	9.55	125	0.0779	3.12
	6/6/2007	7.01	0.68	14.88	164	0.1300	2.00
	9/12/2007	6.98	0.24	20.31	140	0.1907	0.70
	12/20/2007	6.96	2.84	10.86	253	0.0746	0.66
MC-122	3/6/2007	6.63	2.13	10.54	170	0.1450	28.10
	6/5/2007	6.47	0.61	14.11	218	0.1483	3.01
	10/23/2007	7.63	0.47	18.44	76	0.1586	8.83
	12/18/2007	7.16	0.72	10.36	221	0.1567	2.99
MC-123	3/5/2007	6.68	0.60	14.06	132	0.4522	7.08
	6/4/2007	6.16	0.47	16.54	194	0.3363	0.98
	10/23/2007	7.32	0.76	14.64	253	0.1535	20.10
	12/18/2007	6.52	0.91	10.89	258	0.1782	9.87
PZU-4	--	--	--	--	--	--	--
	--	--	--	--	--	--	
	--	--	--	--	--	--	--
	12/17/2007	7.34	1.42	9.10	236	0.1094	0.86
PZU-5	--	--	--	--	--	--	--
	--	--	--	--	--	--	--
	10/22/2007	7.24	1.47	19.76	223	0.2456	1.65
	12/17/2007	6.74	1.81	10.04	254	0.2322	12.20
UT-ST-1	--	--	--	--	--	--	--
	--	--	--	--	--	--	--
	--	--	--	--	--	--	--
	12/17/2007	7.96	3.97	11.58	228	0.1268	1.77

TABLE 12-1

SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING QUARTERLY GROUNDWATER SAMPLING EVENTS

PSC Washougal Facility
Washougal, Washington

Well ID	Date	pH (pH units)	Dissolved Oxygen (ppm)	Temperature (°C)	Redox Potential (millivolts)	Specific Conductivity (mS/cm)	Turbidity (NTU)
2007							
Lower Aquifer Wells							
MC-2D	3/8/2007	7.07	1.06	17.25	133	0.2837	2.88
	6/7/2007	6.77	0.27	17.78	215	0.2758	0.50
	9/12/2007	6.77	0.20	18.52	147	0.4587	0.48
	12/21/2007	6.82	0.37	17.05	266	0.1440	0.88
MC-10D	3/7/2007	6.92	0.21	16.31	141	0.5357	11.40
	6/6/2007	6.63	0.28	16.95	199	0.3673	0.22
	9/12/2007	6.66	0.38	18.23	165	0.4171	1.21
	12/21/2007	6.70	0.34	15.91	262	0.1438	0.81
MC-12D	3/7/2007	6.73	0.18	16.75	147	0.5463	18.90
	6/5/2007	6.51	0.31	16.57	203	0.4243	1.03
	9/12/2007	6.57	0.40	19.84	168	0.4929	0.83
	12/21/2007	6.58	0.39	16.75	270	0.1531	0.74
MC-13D	3/6/2007	7.11	1.48	15.38	153	0.1602	0.68
	6/6/2007	6.63	0.54	14.43	192	0.1453	0.89
	9/11/2007	6.36	0.80	16.10	200	0.2525	1.24
	122/19/7	7.03	1.31	11.50	244	0.1032	1.44
MC-14D	--	--	--	--	--	--	--
	--	--	--	--	--	--	--
	10/24/2007	8.64	0.74	14.28	137	0.1829	4.16
	12/18/2007	7.84	0.41	13.08	211	0.1767	0.53
MC-15D	3/6/2007	6.66	0.25	18.06	151	0.3973	0.58
	6/5/2007	6.66	0.09	17.69	199	0.3817	1.09
	9/11/2007	6.68	0.22	20.71	189	0.5575	0.69
	12/20/2007	6.91	0.49	16.52	259	0.1579	0.40
MC-17D	3/8/2007	7.00	1.07	16.53	127	0.1627	1.18
	6/7/2007	6.90	0.84	16.42	148	0.1449	1.02
	9/13/2007	7.00	0.44	17.93	131	0.2576	1.10
	12/20/2007	6.91	0.61	15.32	257	0.1274	0.76
MC-19D	3/7/2007	7.08	0.21	15.75	127	0.1466	2.88
	6/7/2007	6.87	0.16	17.44	185	0.1822	0.98
	9/12/2007	6.91	0.28	18.34	128	0.2243	1.83
	12/21/2007	7.21	0.29	16.34	257	0.1398	0.74
MC-20D	--	--	--	--	--	--	--
	--	--	--	--	--	--	--
	10/23/2007	8.74	0.50	15.06	-26	0.2247	54.20
	12/18/2007	7.66	0.44	12.92	213	0.1915	3.24

TABLE 12-1

SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING QUARTERLY GROUNDWATER SAMPLING EVENTS

PSC Washougal Facility
Washougal, Washington

Well ID	Date	pH (pH units)	Dissolved Oxygen (ppm)	Temperature (°C)	Redox Potential (millivolts)	Specific Conductivity (mS/cm)	Turbidity (NTU)
2007							
Lower Aquifer Wells (Continued)							
MC-24D	--	--	--	--	--	--	--
	--	--	--	--	--	--	--
	10/24/2007	7.62	0.70	14.45	177	0.1530	13.60
	12/18/2007	6.68	0.57	13.29	237	0.1687	2.63
MC-25D	--	--	--	--	--	--	--
	--	--	--	--	--	--	--
	10/24/2007	7.66	0.39	14.84	188	0.1468	27.70
	12/18/2007	6.78	0.52	13.92	247	0.1584	8.82
MC-118D	3/7/2007	6.71	0.17	17.72	140	0.5200	1.99
	6/6/2007	6.60	0.30	19.28	183	0.4098	0.62
	9/13/2007	6.64	0.44	20.76	154	0.5014	1.13
	12/21/2007	6.58	0.61	18.21	275	0.1813	0.70
2008							
Shallow Groundwater Zone Wells							
MC-1	3/14/2008	6.95	3.33	15.10	241	0.0339	4.00
	6/13/2008	7.68	0.24	18.66	-32	0.1263	0.51
	9/26/2008	5.81	0.21	26.02	-8	0.1101	14.20
	12/3/2008	6.22	0.32	19.26	260	0.0880	1.63
MC-2	3/14/2008	7.30	0.25	15.17	137	0.0675	1.13
	6/12/2008	7.27	0.29	21.63	97	0.5536	0.48
	9/23/2008	5.70	0.19	28.40	17	0.0969	1.06
	12/3/2008	6.41	0.31	20.55	223	0.1119	1.07
MC-8	3/14/2008	6.97	5.18	8.60	326	0.0632	0.72
	6/11/2008	7.43	3.79	13.02	296	0.0922	0.76
	9/26/2008	6.22	0.55	16.36	203	0.0689	3.37
	12/4/2008	6.99	4.39	11.23	329	0.0866	9.78
MC-12	3/13/2008	7.85	0.98	9.41	156	0.0643	0.19
	6/13/2008	8.23	1.61	17.75	-3	0.0706	0.48
	9/26/2008	6.38	0.36	18.99	-38	0.0870	1.87
	12/5/2008	6.88	1.06	11.06	388	0.0796	2.13
MC-13	3/12/2008	7.49	0.28	10.79	17	0.0466	2.03
	6/11/2008	7.37	0.24	12.84	291	0.0964	0.41
	9/24/2008	5.95	0.28	17.19	71	0.0629	1.11
	12/1/2008	6.53	0.36	14.94	39	0.0741	1.76
MC-14	3/13/2008	7.19	0.93	9.54	4	0.6263	1.08
	6/13/2008	7.41	0.70	17.28	163	0.5100	2.63
	9/24/2008	5.69	1.12	18.04	19	0.1776	3.65
	12/1/2008	6.47	1.16	14.45	-9	0.4164	3.37

TABLE 12-1

SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING QUARTERLY GROUNDWATER SAMPLING EVENTS

PSC Washougal Facility
Washougal, Washington

Well ID	Date	pH (pH units)	Dissolved Oxygen (ppm)	Temperature (°C)	Redox Potential (millivolts)	Specific Conductivity (mS/cm)	Turbidity (NTU)
2008							
Shallow Groundwater Zone Wells (Continued)							
MC-15	3/12/2008	7.03	0.91	9.91	101	0.1175	1.37
	6/11/2008	7.27	0.32	13.97	276	0.3456	0.51
	9/23/2008	5.93	0.32	17.09	-28	0.1626	1.19
	12/2/2008	6.43	2.13	12.73	223	0.0457	1.59
MC-16	3/12/2008	7.39	0.65	10.21	-18	0.0979	1.08
	6/12/2008	7.59	0.51	12.94	278	0.1350	0.50
	9/23/2008	5.84	0.56	16.51	-35	0.0858	0.63
	12/3/2008	6.35	0.51	12.28	264	0.0798	1.27
MC-17	3/12/2008	7.24	0.62	10.88	46	0.0718	0.71
	6/12/2008	7.65	0.64	13.86	198	0.1341	0.75
	9/25/2008	5.98	0.46	17.54	-35	0.1416	2.25
	12/3/2008	6.45	0.69	13.21	309	0.1191	0.91
MC-20	3/13/2008	7.04	1.09	9.71	168	0.2112	24.20
	6/13/2008	7.37	0.52	13.74	279	0.1399	38.70
	9/22/2008	5.63	0.85	16.64	-24	0.1897	7.90
	12/2/2008	6.21	1.11	13.67	277	0.5739	12.10
MC-21	3/13/2008	7.28	1.13	11.03	90	0.1084	0.10
	6/13/2008	8.10	0.45	16.09	2	0.0977	0.60
	9/23/2008	5.74	0.24	19.28	-14	0.1124	0.68
	12/1/2008	6.65	0.54	14.65	21	0.1123	0.56
MC-24	3/12/2008	8.00	5.91	8.81	347	0.0313	13.50
	6/11/2008	7.75	5.41	14.97	294	0.0496	8.05
	9/24/2008	6.17	1.46	20.53	114	0.0571	14.40
	12/3/2008	6.79	7.77	12.10	255	0.0344	13.00
MC-25	3/12/2008	7.27	5.63	10.03	360	0.0658	7.91
	6/11/2008	7.42	3.73	15.11	299	0.0892	3.65
	9/25/2008	5.84	2.51	21.24	55	0.0833	29.10
	12/4/2008	6.71	5.30	12.69	305	0.0518	21.30
MC-30	--	--	--	--	--	--	--
	--	--	--	--	--	--	--
	9/29/2008	8.32	0.33	17.70	-45	0.1400	2.38
	12/5/2008	7.25	0.47	12.70	261	0.1286	4.78
MC-31	--	--	--	--	--	--	--
	--	--	--	--	--	--	--
	9/29/2008	8.04	0.36	17.26	-30	0.1616	0.58
	12/5/2008	6.90	0.45	12.16	241	0.0965	0.47

TABLE 12-1

SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING QUARTERLY GROUNDWATER SAMPLING EVENTS

PSC Washougal Facility
Washougal, Washington

Well ID	Date	pH (pH units)	Dissolved Oxygen (ppm)	Temperature (°C)	Redox Potential (millivolts)	Specific Conductivity (mS/cm)	Turbidity (NTU)
2008							
Shallow Groundwater Zone Wells (Continued)							
MC-107	3/14/2008	7.39	2.14	8.69	318	0.0363	0.61
	6/11/2008	7.60	0.82	13.91	289	0.0962	0.68
	9/25/2008	6.10	0.32	18.74	24	0.1012	1.82
	12/4/2008	6.69	2.09	13.66	324	0.0427	4.39
MC-122	3/11/2008	7.45	0.76	11.19	322	0.0869	33.70
	6/10/2008	7.55	0.45	11.59	127	0.1069	3.75
	9/22/2008	6.20	0.48	16.76	19	0.0984	8.53
	12/2/2008	6.49	0.56	14.12	292	0.1569	14.10
MC-123	3/11/2008	7.00	0.72	11.07	340	0.2978	9.90
	6/10/2008	6.69	0.72	10.91	310	0.5914	1.43
	9/22/2008	5.62	0.51	16.89	-38	0.2873	3.70
	12/2/2008	6.52	0.68	13.81	-83	1.3960	21.70
PZU-4	3/10/2008	7.17	1.22	13.11	297	0.0492	4.34
	6/9/2008	6.93	1.32	13.66	287	0.1142	2.80
	--	--	--	--	--	--	--
	12/1/2008	6.62	1.18	13.62	61	0.0711	4.39
PZU-5	3/10/2008	7.08	1.06	14.83	319	0.2588	16.80
	6/10/2008	6.89	1.39	10.70	320	0.4376	3.00
	9/23/2008	6.06	1.20	13.16	66	0.1749	8.34
	12/2/2008	6.37	1.56	14.16	321	0.2251	8.23
UT-ST-1	3/10/2008	7.64	3.94	11.10	308	0.0445	2.26
	6/9/2008	7.24	4.27	12.61	243	0.0605	0.32
	--	--	--	--	--	--	--
	12/1/2008	6.38	5.00	9.84	155	0.0675	4.74
Lower Aquifer Wells							
MC-2D	3/14/2008	7.33	0.95	16.69	316	0.1980	0.24
	6/12/2008	7.81	0.36	18.01	156	0.2163	0.51
	9/23/2008	5.91	0.24	20.50	9	0.2275	0.47
	12/3/2008	6.59	0.28	18.34	208	0.2335	0.20
MC-10D	3/13/2008	7.29	0.32	15.64	20	0.5822	16.30
	6/12/2008	7.46	0.38	16.72	-11	0.4878	0.60
	9/26/2008	5.83	0.21	18.28	-17	0.1839	1.37
	12/5/2008	6.56	0.29	17.28	225	0.6513	0.00
MC-12D	3/13/2008	7.15	0.49	16.53	97	0.7005	16.20
	6/12/2008	7.38	0.43	17.70	-18	0.5255	0.51
	9/26/2008	5.77	0.26	18.94	-5	0.1842	2.71
	12/5/2008	6.45	0.29	17.10	365	0.7642	0.11

TABLE 12-1

SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING QUARTERLY GROUNDWATER SAMPLING EVENTS

PSC Washougal Facility
Washougal, Washington

Well ID	Date	pH (pH units)	Dissolved Oxygen (ppm)	Temperature (°C)	Redox Potential (millivolts)	Specific Conductivity (mS/cm)	Turbidity (NTU)
2008							
Lower Aquifer Wells (Continued)							
MC-13D	3/12/2008	7.70	1.50	11.28	353	0.1007	0.43
	6/11/2008	7.66	0.34	13.38	276	0.1165	0.53
	9/24/2008	6.77	0.65	13.79	216	0.1131	0.51
	12/1/2008	6.81	1.43	14.22	21	0.1192	0.63
MC-14D	3/11/2008	7.94	0.50	13.87	320	0.0933	2.90
	6/10/2008	7.95	0.27	13.42	165	0.1209	0.27
	9/24/2008	6.66	0.16	15.21	-39	0.1097	1.28
	12/1/2008	7.25	1.09	14.42	-51	0.1078	0.47
MC-15D	3/12/2008	7.30	0.38	16.20	213	0.2463	0.30
	6/12/2008	7.57	0.22	16.09	295	0.2948	0.42
	9/23/2008	6.05	0.22	18.32	48	0.2124	0.01
	12/2/2008	6.68	0.31	17.89	197	0.2394	0.39
MC-17D	3/12/2008	7.44	0.48	15.10	161	0.1088	0.52
	6/12/2008	7.83	0.68	15.60	127	0.1238	0.79
	9/25/2008	6.04	0.27	17.92	-14	0.1280	1.65
	12/2/2008	6.82	0.40	16.12	207	0.1279	0.83
MC-19D	3/14/2008	7.56	0.31	15.86	307	0.0905	2.03
	6/13/2008	7.96	0.13	16.85	-20	0.1665	0.64
	9/26/2008	6.26	0.16	19.42	95	0.1272	4.40
	12/5/2008	6.96	0.32	17.43	235	0.1048	14.60
MC-20D	3/11/2008	7.85	0.44	13.00	316	0.0989	32.90
	6/10/2008	7.79	0.47	13.07	160	0.1284	1.75
	9/22/2008	6.88	0.20	14.26	-76	0.1140	3.30
	12/2/2008	7.32	1.22	13.55	-81	0.1148	3.01
MC-24D	3/11/2008	7.03	0.67	13.96	358	0.6916	12.90
	6/10/2008	7.16	0.19	13.59	153	0.5987	2.91
	9/24/2008	5.70	0.24	15.76	68	0.2137	2.29
	12/3/2008	6.29	1.18	14.06	260	0.7410	1.88
MC-25D	3/12/2008	7.25	0.39	13.59	365	0.5842	38.20
	6/11/2008	7.25	0.13	13.72	316	0.5566	2.10
	9/25/2008	5.76	0.22	14.93	90	0.2058	6.79
	12/4/2008	6.51	1.54	13.81	269	0.7321	3.85
MC-25D2	--	--	--	--	--	--	--
	--	--	--	--	--	--	--
	9/29/2008	8.36	0.35	15.76	-139	0.1880	30.30
	12/4/2008	7.25	0.97	13.39	264	0.1909	7.61

TABLE 12-1

SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING QUARTERLY GROUNDWATER SAMPLING EVENTS

PSC Washougal Facility
Washougal, Washington

Well ID	Date	pH (pH units)	Dissolved Oxygen (ppm)	Temperature (°C)	Redox Potential (millivolts)	Specific Conductivity (mS/cm)	Turbidity (NTU)
2008							
Lower Aquifer Wells (Continued)							
MC-26D2	--	--	--	--	--	--	--
	--	--	--	--	--	--	--
	9/29/2008	8.18	1.02	16.57	-188	0.1957	48.60
	12/3/2008	7.44	0.99	13.63	221	0.1173	11.90
MC-30D	--	--	--	--	--	--	--
	--	--	--	--	--	--	--
	9/29/2008	7.28	0.54	14.74	-26	0.2601	13.60
	12/5/2008	6.19	0.71	12.51	318	1.0200	2.28
MC-118D	3/14/2008	7.12	0.33	18.34	-30	0.6786	7.97
	6/13/2008	7.43	0.34	20.10	36	0.5022	0.71
	9/25/2008	5.68	0.18	19.99	-9	0.2097	1.40
	12/4/2008	5.57	0.39	18.84	241	0.6832	1.57
MC-118D2	--	--	--	--	--	--	--
	--	--	--	--	--	--	--
	9/28/2008	8.31	0.21	16.76	-242	0.2143	4.48
	12/4/2008	6.81	0.51	13.62	143	0.3875	9.74
2009							
Shallow Groundwater Zone Wells							
MC-1	3/27/2009	6.90	3.42	14.24	142	0.0348	6.18
	6/30/2009	7.07	0.21	21.07	138	0.1548	2.01
	9/29/2009	6.57	0.24	23.15	65	0.1309	1.96
	12/21/2009	6.86	0.00	18.20	-47	0.013	1.66
MC-2	3/27/2009	7.43	0.07	15.64	127	0.0821	1.14
	6/29/2009	6.84	0.14	24.39	123	0.4161	0.86
	9/23/2009	6.92	0.27	29.01	85	0.1249	3.08
	12/21/2009	6.96	0.00	18.40	-60	0.016	2.27
MC-8	3/26/2009	8.35	7.03	7.98	141	0.0556	4.21
	6/30/2009	7.47	2.92	18.65	134	0.1023	3.32
	9/28/2009	6.28	0.90	17.72	94	0.0891	1.12
	12/17/2009	7.09	8.40	11.10	218	0.0082	19.7
MC-12	3/25/2009	7.58	1.23	9.15	59	0.0788	2.98
	6/29/2009	7.56	0.71	18.93	95	0.0888	1.01
	9/24/2009	7.65	0.35	18.68	84	0.1031	0.31
	12/17/2009	7.36	0.00	10.70	-64	0.012	0.94
MC-13	3/27/2009	7.25	0.29	9.99	112	0.0479	9.85
	6/23/2009	6.97	0.30	15.92	130	0.0834	2.48
	9/22/2009	7.31	0.37	18.44	92	0.0742	1.45
	12/16/2009	7.14	0.00	13.20	-57	0.010	2.04

TABLE 12-1

SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING QUARTERLY GROUNDWATER SAMPLING EVENTS

PSC Washougal Facility
Washougal, Washington

Well ID	Date	pH (pH units)	Dissolved Oxygen (ppm)	Temperature (°C)	Redox Potential (millivolts)	Specific Conductivity (mS/cm)	Turbidity (NTU)
2009							
Shallow Groundwater Zone Wells (Continued)							
MC-14	3/24/2009	6.92	0.87	9.43	119	0.1883	4.27
	6/24/2009	6.99	1.21	17.00	126	0.9490	14.80
	9/22/2009	7.29	1.84	18.62	101	0.2406	2.15
	12/16/2009	6.98	0.00	9.70	-52	0.042	3.69
MC-15	3/24/2009	6.65	0.92	8.82	112	0.0791	2.40
	6/24/2009	6.98	0.64	18.39	127	0.1843	0.76
	9/23/2009	7.24	0.45	18.16	85	0.1797	1.15
	12/16/2009	7.01	0.00	9.10	-13	0.012	1.53
MC-16	3/24/2009	7.15	0.44	9.26	79	0.0836	4.23
	6/24/2009	7.16	0.41	18.71	113	0.1213	0.75
	9/23/2009	7.12	0.49	18.69	88	0.0998	0.93
	12/16/2009	7.02	0.00	10.20	-24	0.012	0.91
MC-17	3/24/2009	7.06	0.69	9.88	88	0.1119	3.85
	6/25/2009	7.10	0.45	16.54	83	0.3027	0.96
	9/25/2009	7.35	0.50	17.90	88	0.1724	0.06
	12/21/2009	7.12	0.00	10.40	-77	0.023	1.02
MC-20	3/23/2009	6.57	1.45	8.53	92	0.1085	10.38
	6/23/2009	6.76	0.89	17.74	139	0.2425	9.10
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MC-21	3/24/2009	6.85	1.19	10.75	107	0.1525	2.94
	6/25/2009	7.10	0.65	17.76	86	0.0977	4.07
	9/23/2009	7.18	0.69	17.87	108	0.1386	1.71
	12/16/2009	7.28	0.00	11.70	-84	0.015	0.98
MC-24	3/27/2009	7.42	8.28	9.30	131	0.0388	8.04
	6/26/2009	7.36	3.13	19.12	142	0.0454	27.80
	9/28/2009	6.76	0.74	19.80	68	0.0623	10.00
	12/21/2009	6.42	9.79	8.40	402	0.005	20.3
MC-25	3/26/2009	7.50	6.37	10.13	90	0.0535	10.08
	6/26/2009	7.27	3.45	20.20	164	0.1001	4.35
	9/28/2009	6.52	3.05	18.87	90	0.0867	12.2
	12/18/2009	6.36	8.78	10.00	223	0.007	24.9
MC-30	3/25/2009	7.92	1.70	9.02	51	0.0973	12.70
	6/29/2009	7.99	0.39	15.72	95	0.0862	2.38
	9/24/2009	8.05	0.42	17.30	83	0.0998	0.92
	12/17/2009	7.58	0.00	11.80	-23	0.013	4.21

TABLE 12-1

SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING QUARTERLY GROUNDWATER SAMPLING EVENTS

PSC Washougal Facility
Washougal, Washington

Well ID	Date	pH (pH units)	Dissolved Oxygen (ppm)	Temperature (°C)	Redox Potential (millivolts)	Specific Conductivity (mS/cm)	Turbidity (NTU)
2009							
Shallow Groundwater Zone Wells (Continued)							
MC-31	3/25/2009	7.59	0.28	8.36	88	0.0657	4.06
	6/29/2009	7.63	0.28	14.79	98	0.1009	0.57
	9/24/2009	7.46	0.42	16.47	95	0.1027	0.59
	12/17/2009	7.30	0.00	11.70	-112	0.013	1.74
MC-32	--	--	--	--	--	--	--
	6/25/2009	7.24	2.75	15.20	141	0.9506	18.60
	9/22/2009	7.10	1.08	26.14	89	0.9327	9.24
	12/15/2009	6.97	0.00	6.60	-110	0.1530	20.3
MC-33	--	--	--	--	--	--	--
	6/25/2009	7.37	0.28	14.60	104	0.1004	4.49
	9/23/2009	7.20	0.36	18.98	68	0.1121	1.40
	12/18/2009	7.19	0.00	12.20	-115	0.013	2.08
MC-107	3/25/2009	8.18	1.29	9.18	43	0.0400	2.73
	6/25/2009	7.40	0.52	16.31	97	0.0836	1.57
	9/24/2009	7.60	0.57	19.62	78	0.1189	0.60
	12/17/2009	7.29	1.26	10.90	11	0.010	2.74
MC-122	3/23/2009	6.60	0.49	10.02	83	0.1420	21.40
	6/23/2009	7.36	0.65	17.15	119	0.1162	11.50
	9/23/2009	7.25	1.05	20.88	62	0.1238	10.15
	12/15/2009	6.69	0.00	10.80	-46	0.034	9.16
MC-123	3/23/2009	6.65	0.87	11.41	114	0.2665	8.75
	6/23/2009	6.91	0.61	15.09	153	1.0550	4.03
	9/22/2009	7.07	0.38	22.21	78	1.173	4.54
	12/15/2009	6.90	0.00	11.30	-131	0.2310	3.64
PZU-4	3/23/2009	6.97	2.71	8.92	145	0.0567	4.27
	6/22/2009	6.70	1.15	17.18	118	0.0966	2.02
	9/21/2009	6.53	4.34	23.04	114	0.0998	3.89
	12/15/2009	6.91	0.00	8.90	-10	0.012	12.0
PZU-5	3/23/2009	6.71	1.91	11.50	131	0.2903	11.20
	6/22/2009	6.86	1.51	20.68	107	0.3988	21.00
	9/21/2009	6.83	1.60	25.54	85	0.2970	3.14
	12/15/2009	6.86	0.00	10.00	-13	0.033	23.4
UT-ST-1	3/23/2009	7.20	3.81	6.30	163	0.0586	3.97
	6/22/2009	6.82	2.73	16.12	129	0.0699	0.49
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	12/15/2009	6.28	4.52	8.70	126	0.010	11.4

TABLE 12-1

SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING QUARTERLY GROUNDWATER SAMPLING EVENTS

PSC Washougal Facility
Washougal, Washington

Well ID	Date	pH (pH units)	Dissolved Oxygen (ppm)	Temperature (°C)	Redox Potential (millivolts)	Specific Conductivity (mS/cm)	Turbidity (NTU)
2009							
Lower Aquifer Wells							
MC-2D	3/27/2009	7.26	0.65	17.29	130	0.2001	0.10
	6/29/2009	7.23	0.23	19.12	108	0.2651	0.00
	9/23/2009	7.27	0.24	20.60	80	0.2983	0.91
	12/21/2009	7.09	0.00	17.90	130	0.034	0.82
MC-10D	3/25/2009	6.99	0.21	15.88	100	0.2283	2.23
	6/29/2009	7.09	0.36	18.58	120	0.6451	0.00
	9/24/2009	7.24	0.32	18.36	97	0.6583	0.30
	12/17/2009	7.06	0.00	16.00	-105	0.088	0.67
MC-12D	3/25/2009	6.91	0.22	16.50	73	0.2429	23.00
	6/29/2009	7.07	0.33	18.89	111	0.7223	0.88
	9/24/2009	7.19	0.24	19.27	100	0.8203	0.06
	12/17/2009	6.88	0.00	17.30	-59	0.1160	1.25
MC-13D	3/27/2009	7.41	1.16	11.57	102	0.1174	1.25
	6/23/2009	7.48	0.57	16.05	117	0.1222	0.49
	9/22/2009	7.58	0.61	15.42	89	0.1399	0.16
	12/16/2009	7.45	0.00	11.40	123	0.016	0.56
MC-14D	3/24/2009	7.83	0.44	13.14	75	0.1092	2.66
	6/23/2009	7.74	0.39	16.68	94	0.1223	0.10
	9/22/2009	7.93	0.44	15.27	75	0.1330	0.19
	12/16/2009	7.81	0.00	13.10	-120	0.014	0.36
MC-15D	3/24/2009	7.06	0.21	16.43	84	0.2389	0.37
	6/24/2009	7.16	0.23	19.16	116	0.3298	0.23
	9/23/2009	7.28	0.26	18.58	83	0.3352	0.64
	12/16/2009	7.17	0.00	17.10	69	0.032	0.71
MC-17D	3/24/2009	7.20	0.71	15.74	75	0.1377	2.42
	6/26/2009	8.22	0.77	16.62	123	0.1274	0.00
	9/24/2009	7.61	0.32	18.91	73	0.1684	0.29
	12/21/2009	7.20	0.00	15.80	13	0.018	1.12
MC-19D	3/25/2009	7.52	0.05	15.43	108	0.1089	13.10
	6/30/2009	7.87	0.14	17.66	103	0.1762	3.12
	9/29/2009	6.81	0.26	18.30	47	0.1251	3.16
	12/21/2009	7.38	0.00	17.20	14	0.015	1.69
MC-20D	3/23/2009	7.88	1.17	13.07	59	0.1198	7.85
	6/23/2009	7.77	0.60	14.20	101	0.1332	4.67
	9/22/2009	8.16	0.31	16.11	14	0.1356	4.35
	12/15/2009	7.75	0.00	12.30	-123	0.015	3.74

TABLE 12-1

SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING QUARTERLY GROUNDWATER SAMPLING EVENTS

PSC Washougal Facility
Washougal, Washington

Well ID	Date	pH (pH units)	Dissolved Oxygen (ppm)	Temperature (°C)	Redox Potential (millivolts)	Specific Conductivity (mS/cm)	Turbidity (NTU)
2009							
Lower Aquifer Wells (Continued)							
MC-24D	3/27/2009	6.93	0.43	13.20	130	0.2178	4.65
	6/26/2009	7.03	0.27	14.42	146	0.8874	35.90
	9/28/2009	6.48	0.30	14.93	72	0.5305	7.40
	12/21/2009	6.83	0.00	14.20	158	0.1240	3.26
MC-24D2	6/26/2009	7.47	0.41	15.54	126	0.1236	12.20
	9/28/2009	6.84	0.90	15.12	57	0.1254	3.73
	12/21/2009	7.31	0.00	13.80	359	0.015	2.51
MC-25D	3/26/2009	7.00	0.45	14.20	76	0.2314	14.70
	6/26/2009	7.16	0.32	16.44	145	0.7863	4.79
	9/28/2009	6.61	0.30	15.19	68	0.5377	3.28
	12/18/2009	7.04	0.00	14.70	49	0.1120	3.40
MC-25D2	3/26/2009	7.71	0.28	14.04	52	0.2042	6.06
	6/26/2009	7.67	0.50	15.79	119	0.1326	8.24
	9/28/2009	6.87	0.43	15.12	54	0.2210	3.34
	12/18/2009	7.65	0.00	14.00	-104	0.024	1.86
MC-26D2	3/26/2009	7.75	0.83	12.55	124	0.1114	10.91
	6/30/2009	8.09	0.98	14.97	105	0.1253	1.10
	9/28/2009	6.58	0.56	14.08	80	0.1392	1.40
	12/17/2009	7.41	0.00	13.20	96	0.017	3.06
MC-27D	6/25/2009	7.57	0.21	13.81	-6	0.3581	37.90
	9/25/2009	8.01	0.26	13.10	98	0.5351	19.9
	12/16/2009	7.22	0.00	12.40	-49	0.056	8.27
MC-28D	6/25/2009	8.03	0.96	14.08	14	0.1563	10.12
	9/25/2009	7.98	0.39	13.34	89	0.2870	2.31
	12/16/2009	8.00	0.00	12.70	-81	0.019	1.93
MC-30D	3/25/2009	6.76	0.65	12.44	103	0.2236	4.19
	6/29/2009	7.13	0.55	15.11	123	0.9110	1.87
	9/24/2009	7.15	0.16	14.09	110	1.044	0.90
	12/17/2009	6.82	0.00	13.10	0	0.1430	2.20
MC-118D	3/26/2009	6.89	0.21	18.65	115	0.2555	2.49
	6/30/2009	7.09	0.33	19.14	141	0.6360	4.02
	9/25/2009	7.10	0.28	20.63	88	0.5860	1.34
	12/18/2009	6.90	0.00	19.10	-95	0.095	2.34
MC-118D2	3/26/2009	7.16	0.46	13.13	126	0.2124	3.48
	6/30/2009	7.45	0.79	16.23	122	0.4535	1.27
	9/25/2009	7.47	0.34	14.76	73	0.4406	0.93
	12/18/2009	7.10	0.00	13.80	-65	0.065	1.07

TABLE 12-1

SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING QUARTERLY GROUNDWATER SAMPLING EVENTS

PSC Washougal Facility
Washougal, Washington

Well ID	Date	pH (pH units)	Dissolved Oxygen (ppm)	Temperature (°C)	Redox Potential (millivolts)	Specific Conductivity (mS/cm)	Turbidity (NTU)
2010							
Shallow Groundwater Zone Wells							
UT-ST-1	3/23/2010	6.82	5.93	8.91	192	0.0742	1.03
	6/21/2010	6.70	4.06	15.87	39	0.0879	0.00
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	12/13/2010	6.79	1.95	13.23	55	0.0843	0.25
PZU-4	3/23/2010	6.82	3.80	10.52	129	0.0779	3.70
	6/21/2010	6.71	4.90	16.46	10	0.0731	0.28
	9/14/2010	6.51	1.42	16.96	47	0.1312	4.20
	12/13/2010	6.73	4.29	12.61	105	0.0543	4.46
PZU-5	3/24/2010	6.58	1.93	13.71	-10	0.3038	11.2
	6/21/2010	6.67	2.64	16.32	-56	0.4336	8.83
	9/14/2010	6.45	1.28	16.82	21	0.3605	4.91
	12/16/2010	6.63	1.52	10.31	171	0.3076	15.1
MC-1	3/26/2010	6.59	0.31	16.80	221	0.0775	1.99
	6/25/2010	6.44	1.28	21.83	9	0.1098	0.94
	9/17/2010	6.80	0.34	20.02	-9	0.2255	9.37
	12/16/2010	7.46	6.34	13.32	35	0.0368	20.2
MC-2	3/25/2010	6.73	0.21	18.10	-23	0.1127	1.22
	6/25/2010	6.66	0.20	22.69	-86	0.4040	1.41
	9/20/2010	6.47	0.28	24.15	12	0.1632	3.39
	12/16/2010	7.04	0.11	16.76	-53	0.1729	0.74
MC-8	3/29/2010	7.12	7.12	9.75	245	0.0900	4.45
	6/23/2010	6.36	3.10	17.91	163	0.0615	6.95
	9/21/2010	6.75	1.24	20.85	44	0.1023	2.22
	12/14/2010	7.15	5.97	10.01	154	0.0557	9.06
MC-12	3/29/2010	7.60	0.97	10.25	22	0.0985	0.25
	6/24/2010	7.09	0.74	17.45	-105	0.1248	0.00
	9/20/2010	6.79	0.31	18.01	3	0.1243	0.57
	12/20/2010	7.17	1.13	10.20	-44	0.0824	3.62
MC-13	3/24/2010	6.72	0.29	13.34	41	0.0688	1.76
	6/22/2010	6.79	0.35	13.79	-15	0.0586	4.46
	9/16/2010	6.86	0.28	17.58	23	0.1052	0.79
	12/17/2010	7.10	2.08	9.56	64	0.0406	10.54
MC-14	3/25/2010	6.68	1.70	12.03	5	0.2330	2.60
	6/22/2010	6.72	1.59	16.88	-62	0.5240	2.06
	9/15/2010	6.75	1.30	21.85	11	0.2680	0.88
	12/20/2010	6.63	0.47	8.88	-18	0.3989	1.71

TABLE 12-1

SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING QUARTERLY GROUNDWATER SAMPLING EVENTS

PSC Washougal Facility
Washougal, Washington

Well ID	Date	pH (pH units)	Dissolved Oxygen (ppm)	Temperature (°C)	Redox Potential (millivolts)	Specific Conductivity (mS/cm)	Turbidity (NTU)
2010							
Shallow Groundwater Zone Wells (Continued)							
MC-15	3/25/2010	6.79	0.57	9.92	78	0.1135	0.46
	6/28/2010	6.54	0.59	18.24	63	0.2814	0.00
	9/15/2010	6.80	0.70	19.24	-3	0.2492	2.24
	12/21/2010	6.90	2.71	7.03	65	0.0415	2.80
MC-16	3/25/2010	6.99	0.74	10.70	-50	0.1133	2.72
	6/28/2010	6.72	0.50	17.97	-48	0.2270	0.10
	9/16/2010	6.77	0.84	17.71	9	0.1734	0.61
	12/21/2010	6.88	1.73	7.92	65	0.0752	15.4
MC-17	3/30/2010	7.26	5.49	10.11	336	0.0463	9.43
	6/29/2010	6.68	0.55	16.03	-22	0.3994	0.00
	9/16/2010	6.82	0.48	19.17	-24	0.3338	0.30
	12/21/2010	6.81	2.90	9.14	89	0.0629	3.13
MC-20	3/23/2010	6.07	0.88	14.88	43	0.1322	4.71
	6/22/2010	6.37	1.61	18.80	33	0.2194	3.27
	9/14/2010	6.52	0.88	17.58	15	0.3031	7.04
	12/15/2010	6.48	0.73	11.32	7	0.3235	2.81
MC-21	3/26/2010	6.79	1.59	11.47	214	0.1158	2.24
	6/28/2010	6.41	1.63	16.40	160	0.1715	0.00
	9/16/2010	6.67	0.39	19.26	14	0.2297	1.60
	12/17/2010	6.85	3.05	10.67	12	0.0835	3.20
MC-24	3/30/2010	7.15	7.98	10.71	262	0.0498	25.4
	6/28/2010	6.53	2.71	17.55	133	0.1523	1.79
	9/17/2010	6.60	6.03	19.64	278	0.0876	19.8
	12/16/2010	7.35	7.05	9.50	56	0.0269	16.9
MC-25	3/30/2010	6.91	1.98	10.97	239	0.1103	2.10
	6/23/2010	6.38	7.62	18.37	195	0.1012	0.93
	9/21/2010	6.25	2.97	20.41	265	0.0944	13.2
	12/14/2010	6.83	7.78	10.35	203	0.1152	3.24
MC-30	3/29/2010	7.73	1.33	10.34	280	0.0836	4.45
	6/24/2010	7.35	0.82	14.80	35	0.0873	0.95
	9/13/2010	7.19	0.40	17.73	94	0.1588	1.67
	12/20/2010	7.46	1.86	10.61	8	0.0917	4.00
MC-31	3/26/2010	7.16	0.24	9.78	-72	0.0980	0.93
	6/24/2010	7.05	0.53	13.99	-79	0.1068	0.62
	9/13/2010	6.63	0.39	16.32	-23	0.1939	2.17
	12/21/2010	7.05	0.21	10.20	-64	0.0822	9.53

TABLE 12-1

SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING QUARTERLY GROUNDWATER SAMPLING EVENTS

PSC Washougal Facility
Washougal, Washington

Well ID	Date	pH (pH units)	Dissolved Oxygen (ppm)	Temperature (°C)	Redox Potential (millivolts)	Specific Conductivity (mS/cm)	Turbidity (NTU)
2010							
Shallow Groundwater Zone Wells (Continued)							
MC-32	3/23/2010	6.65	2.08	12.62	-62	1.162	78.9
	6/22/2010	6.62	2.19	18.64	-74	0.5587	10.23
	9/14/2010	6.63	1.74	17.27	13	0.4010	12.8
	12/15/2010	6.66	0.22	10.38	-79	1.428	14.5
MC-33	3/25/2010	6.86	0.26	10.85	-96	0.1466	1.68
	6/24/2010	6.81	0.34	15.04	-83	0.1297	0.00
	9/20/2010	6.33	0.21	17.86	-20	0.1286	3.01
	12/21/2010	6.90	0.21	11.31	-66	0.1319	12.9
MC-107	3/29/2010	7.28	2.40	10.27	175	0.0878	1.81
	6/24/2010	6.85	1.06	18.52	38	0.1134	0.00
	9/20/2010	6.59	0.49	18.35	40	0.1057	0.24
	12/21/2010	7.25	3.79	9.20	19	0.0500	3.04
MC-122	3/24/2010	6.26	1.24	11.37	117	0.2547	13.4
	6/22/2010	6.94	1.03	17.50	-2	0.1238	7.98
	9/15/2010	6.90	0.75	14.96	55	0.1984	9.41
	12/15/2010	6.30	3.57	10.40	111	0.1039	14.8
MC-123	3/23/2010	6.46	0.96	12.96	-75	1.169	9.39
	6/22/2010	6.46	1.13	15.80	-25	0.4205	2.37
	9/14/2010	6.59	0.66	16.51	3	0.3489	12.0
	12/15/2010	6.40	0.69	11.62	47	0.3840	3.81
Lower Aquifer Wells							
MC-2D	3/25/2010	6.82	0.77	18.53	83	0.3001	0.49
	6/25/2010	6.97	0.28	18.11	-1	0.2505	0.00
	9/20/2010	6.57	0.20	19.57	162	0.3324	0.00
	12/16/2010	6.92	0.13	17.13	-1	0.3140	0.08
MC-10D	3/26/2010	6.68	0.15	16.45	-39	0.8537	1.40
	6/24/2010	6.77	0.20	17.74	-74	0.4534	1.17
	9/20/2010	6.55	0.00	18.16	-43	0.5075	0.97
	12/20/2010	6.81	0.06	15.99	-71	0.8379	10.82
MC-12D	3/29/2010	6.93	0.23	16.23	46	0.8730	2.96
	6/24/2010	6.73	0.27	18.97	-12	0.4551	0.00
	9/20/2010	6.44	0.07	19.55	12	0.7001	0.41
	12/20/2010	6.74	0.06	16.60	-29	0.7737	4.28
MC-13D	3/24/2010	7.09	1.61	15.74	224	0.1404	0.86
	6/22/2010	7.02	0.82	13.59	186	0.1328	0.36
	9/16/2010	6.92	1.06	15.73	60	0.2280	0.00
	12/17/2010	7.03	1.16	10.78	36	0.1357	0.35

TABLE 12-1

SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING QUARTERLY GROUNDWATER SAMPLING EVENTS

PSC Washougal Facility
Washougal, Washington

Well ID	Date	pH (pH units)	Dissolved Oxygen (ppm)	Temperature (°C)	Redox Potential (millivolts)	Specific Conductivity (mS/cm)	Turbidity (NTU)
2010							
Lower Aquifer Wells (Continued)							
MC-14D	3/24/2010	7.40	0.38	15.34	-36	0.1314	2.26
	6/22/2010	7.50	0.36	14.51	-101	0.1269	4.65
	9/16/2010	7.15	0.41	15.08	-1	0.2096	1.70
	12/17/2010	7.41	0.45	12.87	-50	0.1200	0.27
MC-15D	3/25/2010	6.87	0.27	16.90	187	0.2935	0.32
	6/28/2010	6.70	0.32	17.98	114	0.6160	0.00
	9/15/2010	6.79	0.20	19.10	64	0.3771	0.00
	12/21/2010	6.88	0.30	14.62	-9	0.3669	0.06
MC-17D	3/30/2010	7.11	0.30	15.17	334	0.1592	0.12
	6/29/2010	6.90	0.75	16.24	4	0.2466	0.78
	9/16/2010	6.89	0.35	18.20	60	0.2786	1.07
	12/21/2010	6.99	0.29	13.92	75	0.1642	0.56
MC-19D	3/30/2010	7.26	0.17	16.49	332	0.1243	3.00
	6/29/2010	6.68	0.55	16.03	-22	0.3994	0.00
	9/15/2010	7.14	0.34	18.48	116	0.2056	0.77
	12/21/2010	7.20	0.23	15.48	76	0.1220	0.74
MC-20D	3/23/2010	7.40	1.51	14.34	-66	0.1355	24.3
	6/22/2010	7.45	0.55	14.29	-90	0.1371	7.13
	9/14/2010	7.45	0.37	14.23	-33	0.2184	4.45
	12/15/2010	7.38	0.42	12.84	-81	0.1322	4.44
MC-24D	3/30/2010	6.84	0.25	12.82	310	0.9557	31.4
	6/28/2010	6.58	0.34	16.03	171	0.8744	11.8
	9/17/2010	6.58	0.20	15.01	288	0.3768	2.00
	12/16/2010	6.67	0.09	13.29	79	0.9661	2.96
MC-24D2	3/30/2010	7.53	1.51	12.46	192	0.1248	18.8
	6/28/2010	7.01	1.51	15.24	98	0.2240	1.22
	9/17/2010	6.84	1.55	14.54	281	0.2063	0.74
	12/16/2010	7.36	1.50	13.12	8	0.1260	1.33
MC-25D	3/30/2010	6.95	0.26	12.87	275	0.9195	10.61
	6/23/2010	6.71	0.37	15.91	199	0.5173	3.33
	9/21/2010	6.46	0.66	14.94	272	0.6091	3.20
	12/14/2010	6.79	0.24	13.28	56	0.9373	1.53
MC-25D2	3/30/2010	7.46	0.90	12.44	212	0.2265	23.1
	6/23/2010	7.25	0.93	15.67	117	0.1348	4.69
	9/21/2010	6.97	0.65	14.68	36	0.1797	2.52
	12/14/2010	7.15	0.89	12.92	14	0.2174	8.34

TABLE 12-1

SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING QUARTERLY GROUNDWATER SAMPLING EVENTS

PSC Washougal Facility
Washougal, Washington

Well ID	Date	pH (pH units)	Dissolved Oxygen (ppm)	Temperature (°C)	Redox Potential (millivolts)	Specific Conductivity (mS/cm)	Turbidity (NTU)
2010							
Lower Aquifer Wells (Continued)							
MC-26D2	3/29/2010	7.51	2.13	12.38	266	0.1357	6.94
	6/23/2010	7.19	2.13	15.32	122	0.1355	1.27
	9/21/2010	6.81	0.74	15.32	63	0.1396	1.47
	12/14/2010	7.43	1.74	12.99	65	0.1390	0.98
MC-27D	3/24/2010	6.90	0.65	13.68	96	0.4946	15.8
	6/23/2010	6.97	0.32	13.89	43	0.4188	13.8
	9/15/2010	6.85	0.25	13.72	47	0.3404	4.15
	12/14/2010	6.96	0.21	12.38	-3	0.4924	4.34
MC-28D	3/24/2010	7.46	1.31	14.05	96	0.1707	2.89
	6/23/2010	7.18	2.64	14.37	72	0.1523	2.00
	9/15/2010	7.29	1.62	14.29	94	0.2516	0.20
	12/14/2010	6.99	1.32	12.51	190	0.1532	0.53
MC-30D	3/29/2010	6.78	0.34	12.44	290	1.166	4.37
	6/24/2010	6.59	0.40	14.66	42	0.3844	1.40
	9/13/2010	6.50	0.29	14.86	106	0.4115	1.37
	12/20/2010	6.55	0.17	12.16	17	1.032	0.88
MC-118D	3/30/2010	6.83	0.20	17.42	49	0.8301	3.51
	6/25/2010	6.75	0.23	18.68	-50	0.4607	1.86
	9/21/2010	6.48	0.33	20.58	-24	0.4997	3.17
	12/16/2010	6.74	0.00	18.06	-46	0.7828	3.16
MC-118D2	3/30/2010	7.05	0.25	12.74	266	0.4977	3.73
	6/25/2010	6.89	0.22	14.29	12	0.4228	0.45
	9/21/2010	6.54	0.39	15.60	16	0.4015	1.77
	12/16/2010	6.81	0.00	13.53	-20	0.5611	0.33
2011							
Shallow Groundwater Zone Wells							
UT-ST-1	3/21/2011	7.13	2.50	9.24	113	0.0633	1.88
	6/21/2011	8.01	2.21	15.05	44	0.0601	1.32
PZU-4	3/21/2011	7.02	6.90	9.07	108	0.0464	7.91
	6/21/2011	7.77	0.94	19.70	-67	0.1236	2.98
PZU-5	3/22/2011	6.70	1.45	12.36	23	0.2969	18.3
	6/30/2011	7.08	2.72	15.30	-13	0.2807	0.22
MC-1	3/24/2011	7.41	8.50	11.26	160	0.0586	3.15
	6/21/2011	7.60	0.51	21.72	-56	0.2733	0.51
MC-2	3/28/2011	7.18	0.14	13.10	57	0.1589	0.52
	6/21/2011	7.61	0.16	23.68	-115	0.7070	1.51
MC-8	3/23/2011	7.46	8.65	9.57	151	0.0367	17.3
	6/22/2011	7.25	4.00	16.86	136	0.1155	2.12

TABLE 12-1

SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING QUARTERLY GROUNDWATER SAMPLING EVENTS

PSC Washougal Facility
Washougal, Washington

Well ID	Date	pH (pH units)	Dissolved Oxygen (ppm)	Temperature (°C)	Redox Potential (millivolts)	Specific Conductivity (mS/cm)	Turbidity (NTU)
2011							
Shallow Groundwater Zone Wells (Continued)							
MC-12	3/29/2011	7.66	0.60	9.53	104	0.1114	0.07
	6/27/2011	7.82	0.21	15.32	-123	0.1281	0.00
MC-13	3/25/2011	7.32	1.14	8.99	148	0.0476	4.38
	6/28/2011	7.36	0.25	14.09	-51	0.1091	1.97
MC-14	3/25/2011	7.08	0.37	9.75	-22	0.8509	1.10
	6/28/2011	7.44	0.73	15.79	-102	0.8397	17.2
MC-15	3/28/2011	6.29	8.26	8.15	178	0.0459	2.22
	6/21/2011	7.82	0.53	15.42	-88	0.5972	0.82
MC-16	3/29/2011	7.18	0.55	8.96	42	0.0957	0.80
	7/1/2011	7.69	0.51	13.88	-104	0.1915	0.76
MC-17	3/29/2011	6.97	7.54	8.95	96	0.0453	1.53
	7/1/2011	7.46	0.41	15.70	-77	0.2499	0.35
MC-20	3/22/2011	7.08	1.59	11.09	-24	0.1155	3.63
	6/30/2011	7.09	1.31	15.06	-21	0.1435	1.95
MC-21	3/25/2011	7.17	2.17	10.39	-42	0.0778	0.73
	6/28/2011	7.58	0.30	15.75	-67	0.0866	0.46
MC-24	3/24/2011	7.23	7.60	9.14	139	0.0628	2.30
	6/22/2011	7.12	1.12	16.18	101	0.1089	0.94
MC-25	3/23/2011	7.21	8.28	9.97	-3	0.1077	1.28
	6/22/2011	7.01	3.90	18.52	118	0.1042	7.24
MC-30	3/28/2011	7.74	2.35	9.85	5	0.0706	2.28
	6/29/2011	7.72	0.48	13.90	-42	0.1377	0.37
MC-31	--	--	--	--	--	--	--
	6/29/2011	8.09	0.27	13.11	-133	0.1112	1.19
MC-32	3/22/2011	7.14	1.10	9.07	-66	1.168	6.44
	6/30/2011	7.43	1.39	14.59	-115	1.215	12.5
MC-33	3/29/2011	7.08	0.21	10.01	60	0.1334	4.16
	6/29/2011	7.64	0.24	13.93	-111	0.1476	0.96
MC-107	3/29/2011	7.53	1.64	9.15	57	0.0432	1.29
	6/27/2011	7.50	0.31	15.52	-39	0.1100	0.00
MC-122	3/22/2011	6.71	5.18	11.94	36	0.1294	7.26
	6/30/2011	7.72	0.93	14.69	-68	0.1316	1.72
MC-123	3/22/2011	6.74	1.11	10.49	-18	0.1330	6.74
	6/30/2011	7.31	1.08	14.58	-71	1.012	0.85

TABLE 12-1

SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING QUARTERLY GROUNDWATER SAMPLING EVENTS

PSC Washougal Facility
Washougal, Washington

Well ID	Date	pH (pH units)	Dissolved Oxygen (ppm)	Temperature (°C)	Redox Potential (millivolts)	Specific Conductivity (mS/cm)	Turbidity (NTU)
2011							
Lower Aquifer Wells							
MC-2D	3/28/2011	7.13	0.55	16.29	54	0.3142	0.07
	6/22/2011	7.47	0.20	17.58	93	0.3633	1.15
MC-10D	3/28/2011	6.94	0.00	16.11	24	0.9402	1.73
	6/29/2011	7.34	0.27	16.24	-90	0.9686	0.29
MC-12D	3/29/2011	6.96	0.00	15.06	213	0.8313	0.78
	6/27/2011	7.00	0.13	17.57	-25	0.9815	0.58
MC-13D	3/25/2011	7.40	0.65	10.05	141	0.1372	0.63
	6/28/2011	7.53	0.44	14.36	5	0.1338	0.89
MC-14D	3/25/2011	7.90	0.37	13.14	-86	0.1290	1.78
	6/28/2011	8.20	0.30	14.58	-108	0.1392	8.37
MC-15D	3/28/2011	6.94	0.14	15.13	157	0.4546	0.07
	6/29/2011	6.93	0.16	15.98	97	0.3372	0.09
MC-17D	3/29/2011	7.23	1.22	14.79	76	0.1406	0.62
	7/1/2011	7.29	0.72	16.01	7	0.1609	0.08
MC-19D	3/29/2011	7.27	0.14	15.82	191	0.1435	2.49
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MC-20D	3/22/2011	7.76	0.95	12.59	-86	0.1398	3.82
	6/30/2011	8.28	0.27	13.75	-114	0.1553	4.48
MC-24D	3/24/2011	7.00	0.00	13.00	135	1.055	36.2
	6/22/2011	7.44	0.29	14.58	73	0.4948	32.6
MC-24D2	3/24/2011	7.73	1.66	12.53	99	0.1316	3.99
	6/22/2011	7.80	1.13	14.98	63	0.1413	1.76
MC-25D	3/23/2011	7.08	0.00	13.45	8	0.9412	4.65
	6/22/2011	7.49	0.25	15.70	39	0.7229	9.39
MC-25D2	3/23/2011	7.50	0.66	13.34	-20	0.1323	10.8
	6/22/2011	8.10	0.72	15.17	-20	0.1412	2.45
MC-26D2	3/23/2011	7.45	1.82	12.59	103	0.1374	4.17
	6/22/2011	7.84	1.84	14.34	93	0.1511	2.65
MC-27D	3/24/2011	7.39	0.10	11.91	90	0.4559	16.5
	6/28/2011	7.51	0.22	13.43	-26	0.4175	4.94
MC-28D	3/24/2011	7.53	2.50	11.97	62	0.1591	3.08
	6/28/2011	7.13	2.47	13.85	116	0.1625	0.49
MC-30D	3/28/2011	6.65	0.00	12.91	36	1.040	2.96
	6/29/2011	6.89	0.40	14.17	49	1.043	4.05
MC-118D	3/23/2011	6.89	0.03	17.46	-53	0.8909	2.32
	6/27/2011	7.24	0.17	19.19	-76	0.7018	0.87
MC-118D2	3/23/2011	7.02	0.54	13.74	143	0.6113	3.11
	6/27/2011	7.23	0.21	15.52	-50	0.4245	3.56

Abbreviations
-- = Data not collected

TABLE 12-2

HISTORICAL CONCENTRATIONS OF INORGANIC CONSTITUENTS IN GROUNDWATER

PSC Washougal Facility
Washougal, Washington

Inorganic	Historically Handled at Facility	Evidence of Release to Soil	Evidence of Release to Groundwater[1]	Proposed Groundwater Cleanup Level (µg/L)	Three Highest Concentrations 2004 - 2nd Quarter 2011			Three Highest Concentrations 2008 - 2nd Quarter 2011			Three Lowest Concentrations 2004 - 2nd Quarter 2011		
					Location	Date	Concentration (µg/L)	Location	Date	Concentration (µg/L)	Location	Date	Concentration (µg/L)
Arsenic	Unknown But Likely	No	No	23.4/10.7	MC-32	12/15/2009	134	MC-32	12/15/2009	134	MC-24	3/30/2010	0.1
					MC-14	9/16/2004	76.8	MC-32	6/22/2010	75.7	MC-24	6/22/2011	0.1
					MC-14	6/15/2004	76.0	MC-32	3/23/2010	70.8	MC-24	12/3/2008	0.2 U
Cadmium	Unknown But Likely	Yes	No	0.25	GP-95	10/1/2007	1.34	GP-104	5/5/2009	0.20	MC-14D	3/11/2008	0.008
					GP-99	10/4/2007	0.84	MC-123	6/10/2008	0.20	MC-14	6/24/2009	0.01
					GP-100	10/3/2007	0.57	GP-108	9/3/2008	0.18	MC-24	10/24/2007	0.01
Chromium	Unknown But Likely	No	No	50	GP-99	10/4/2007	89.5	GP-104	5/5/2009	3.3	MC-14	6/24/2009	0.3
					GP-95	10/1/2007	73.8	MC-25D	3/12/2008	2.1	GP-107	9/3/2008	0.64
					GP-100	10/3/2007	31.0	PZU-5	3/10/2008	1.9	GP-114	9/3/2008	0.68
Copper	Unknown But Likely	No	No	3.5	GP-95	10/1/2007	144	MC-25D	3/12/2008	14	MC-122	3/11/2008	0.1 U
					GP-99	10/4/2007	100	GP-104	5/5/2009	8.6	MC-14D	6/10/2008	0.157
					GP-100	10/3/2007	43.1	MC-25D	6/11/2008	6.7	MC-122	6/10/2008	0.167
Iron	Unknown But Likely	No	No	300	GP-95	10/1/2007	148,000	MC-14	6/13/2008	56,400	UT-ST-1	6/9/2008	64 J
					GP-99	10/4/2007	148,000	MC-14	3/13/2008	53,300	MC-30	9/13/2010	108
					MC-14	6/8/2006	58,100	MC-123	6/10/2008	31,300	MC-30	3/28/2011	134
Lead	Unknown But Likely	No	No	0.54	GP-104	5/5/2009	4.7	GP-104	5/5/2009	4.7	GP-104	5/5/2009	4.7
					MC-14	6/15/2004	3.1 U	MC-14	6/24/2009	0.1	MC-14	6/15/2004	3.1 U
					MC-14	6/24/2009	0.1	--	--	--	MC-14	6/24/2009	0.1
Manganese	Unknown But Likely	No	No	50	MC-123	10/23/2007	12,900	MC-123	6/10/2008	10,400	MC-17D	9/14/2006	4.95
					GP-95	10/1/2007	12,500	MC-123	3/11/2008	3,910	MC-13D	9/12/2006	1.69
					MC-123	6/10/2008	10,400	PZU-5	3/10/2008	1,610	MC-25	3/12/2008	14.6
Nickel	Unknown But Likely	Yes	No	48.7	MC-14	6/24/2009	161	MC-14	6/24/2009	161	MC-122	3/11/2008	0.2 U
					MC-14	6/15/2004	150	MC-123	6/10/2008	30.4	MC-14D	3/11/2008	0.2 U
					PZU-5	10/22/2007	102	MC-123	3/11/2008	20.9	MC-20D	3/11/2008	0.2 U
Silver	Unknown But Likely	No	No	0.32	MC-14	5/15/2004	0.80	GP-108	9/3/2008	0.10	MC-24D	12/18/2007	0.006
					GP-95	10/1/2007	0.34	GP-114	9/3/2008	0.07	MC-20D	10/23/2007	0.011
					GP-99	10/4/2007	0.24	GP-112	9/4/2008	0.07	MC-24	10/24/2007	0.011
Vanadium	Unknown But Likely	No	No	1.1	GP-95	10/1/2007	287	MC-25D	3/12/2008	12.4	MC-14D	6/10/2008	0.118
					GP-99	10/4/2007	170	GP-104	5/5/2009	10.7	MC-14D	12/18/2007	0.18
					GP-100	10/3/2007	67.2	MC-24D	3/11/2008	9.1	MC-20D	12/18/2007	0.19
Zinc	Unknown But Likely	No	No	32.3	GP-95	10/1/2007	363	GP-112	9/4/2008	37.6	MC-14	6/15/2004	0.5 U
					GP-99	10/4/2007	322	GP-110	9/2/2008	30	MC-20D	3/11/2008	0.5 U
					GP-100	10/3/2007	126	GP-104	5/5/2009	25.8	MC-14D	3/11/2008	0.5 U

Notes:

1. A historical release to groundwater is assumed if observed concentrations are substantially higher than the PCL and/or the concentrations cannot be attributed to increased mobilization due to reducing

Abbreviations:

-- = That no other samples were analyzed for given constituent.

TABLE 12-3

COMPARISON OF DISSOLVED AND TOTAL ARSENIC CONCENTRATIONS

PSC Washougal Facility
Washougal, Washington

(all results reported in milligrams per liter)

Sample ID	Date Sampled	Dissolved Arsenic	Total Arsenic	Dissolved Value Greater than Total?
GP-91-8	10/5/2007	0.0303	0.0308	false
GP-92-8	10/3/2007	0.0209	0.0212	false
GP-92-9-8	10/3/2007	0.0204	0.0211	false
GP-93-8	10/3/2007	0.0149	0.0153	false
GP-94-11.5	10/4/2007	0.0465	0.0472	false
GP-94-8	10/4/2007	0.0357	0.0338	true
GP-95-20	10/1/2007	0.00169	0.00375	false
GP-95-25	10/1/2007	0.00153	0.003	false
GP-96-18	10/3/2007	0.00157	0.00224	false
GP-97-12	10/5/2007	0.0208	0.021	false
GP-98-16.5	10/4/2007	0.00352	0.00515	false
GP-99-15.5	10/4/2007	0.0231	0.0274	false
GP-100-12	10/3/2007	0.0263	0.0271	false
GP-101-11	10/2/2007	0.0308	0.0306	true
GP-104	5/5/2009	0.0004	0.0024	false
GP-9-104-0509	5/5/2009	0.0004	0.0025	false
GP-105	5/5/2009	0.0052	0.0085	false
GP-107-7.5	9/3/2008	0.0404	0.0407	false
GP-9-107-7.5	9/3/2008	0.0399	0.0387	true
GP-108-7.5	9/3/2008	0.0328	0.0316	true
GP-110-7	9/2/2008	0.0125	0.0127	false
GP-112-8	9/4/2008	0.0084	0.0086	false
GP-113-7.5	9/3/2008	0.0166	0.0162	true
GP-114-7	9/3/2008	0.0432	0.0438	false
MC-1	3/23/2004	0.000448	0.00145	false
	12/16/2004	0.00106	0.00113	false
	3/9/2006	0.0007	0.0009	false
	12/21/2006	0.0005	0.00062	false
	12/19/2007	0.00092	0.00103	false
	9/26/2008	0.0185	0.0179	true
	3/27/2009	0.001	0.0011	false
	9/17/2010	0.0229	0.0233	false
	12/16/2010	0.0008	0.0009	false
	3/27/2012	0.00097	0.00109	false
MC-10D	3/7/2007	0.00253	0.00329	false
	3/13/2008	0.0026	0.0027	false
	12/20/2010	0.0034	0.0043	false
MC-118D	3/14/2008	0.0046	0.0046	false
MC-118D2	12/4/2008	0.0007	0.0007	false

TABLE 12-3

COMPARISON OF DISSOLVED AND TOTAL ARSENIC CONCENTRATIONS

PSC Washougal Facility
Washougal, Washington

(all results reported in milligrams per liter)

Sample ID	Date Sampled	Dissolved Arsenic	Total Arsenic	Dissolved Value Greater than Total?
MC-122	3/6/2007	0.00147	0.0018	false
	10/23/2007	0.0079	0.00825	false
	3/11/2008	0.0021	0.0023	false
	9/22/2008	0.0016	0.002	false
	12/2/2008	0.0064	0.0063	true
	3/23/2009	0.0021	0.0024	false
	6/23/2009	0.0012	0.0015	false
	9/23/2009	0.0018	0.0019	false
	12/15/2009	0.0035	0.0037	false
	3/24/2010	0.0022	0.0028	false
	6/22/2010	0.0018	0.0021	false
	9/15/2010	0.0017	0.0016	true
	12/15/2010	0.0004 J	0.0007	true
	3/22/2011	0.0004 J	0.0008	true
	3/21/2012	0.00072	0.00116	false
	6/20/2012	0.0009	0.0014	false
MC-123	3/5/2007	0.0102	0.0108	false
	10/23/2007	0.0179	0.0186	false
	12/18/2007	0.0162	0.0154	true
	3/11/2008	0.0133	0.0136	false
	12/2/2008	0.0312	0.0335	false
	3/23/2009	0.0122	0.0146	false
	3/23/2010	0.0144	0.0157	false
	9/14/2010	0.0203	0.0209	false
	3/22/2011	0.0011	0.0012	false
	12/21/2011	0.0218	0.0238	false
	3/21/2012	0.0013	0.0015	false
	6/20/2012	0.0161	0.016	true
MC-12D	3/7/2007	0.00086	0.00093	false
	3/13/2008	0.00079	0.00087	false
	3/25/2009	0.0011	0.0012	false
MC-13	3/27/2009	0.0038	0.0041	false
	12/17/2010	0.0029	0.0028	true
MC-14	12/16/2004	0.0489	0.0503	false
	6/8/2006	0.0536	0.0479	true
	3/6/2007	0.0335	0.0293	true
	12/19/2007	0.0413	0.0433	false
	6/24/2009	0.0321	0.0344	false
	6/24/2009	0.0339	0.034	false
	6/28/2011	0.0415	0.0399	true
	9/21/2011	0.06083	0.0601	true
	3/27/2012	0.02383	0.02367	true
	6/19/2012	0.0408	0.04	true

TABLE 12-3

COMPARISON OF DISSOLVED AND TOTAL ARSENIC CONCENTRATIONS

PSC Washougal Facility
Washougal, Washington

(all results reported in milligrams per liter)

Sample ID	**Date Sampled**	**Dissolved Arsenic**	**Total Arsenic**	**Dissolved Value Greater than Total?**
MC-14D	6/28/2011	0.0008	0.001	false
MC-15	12/20/2007	0.00042	0.00107	false
MC-16	12/21/2010	0.0043	0.0053	false
MC-17	3/30/2010	0.0031	0.0034	false
MC-19D	12/5/2008	0.0008	0.0009	false
	3/25/2009	0.0008	0.0013	false
MC-20	3/17/2005	0.0151	0.0151	false
	6/8/2006	0.0133	0.0127	true
	3/13/2008	0.0048	0.0049	false
	6/9/2008	0.00301		true
	9/25/2008	0.0055	0.0103	false
	12/2/2008	0.0134	0.0136	false
	3/23/2009	0.0149	0.016	false
	6/23/2009	0.0066	0.0065	true
	9/14/2010	0.0281	0.026	true
	9/20/2011	0.00921	0.00777	true
	3/21/2012	0.00105	0.00118	false
MC-20D	10/23/2007	0.00078	0.00105	false
	3/11/2008	0.00044	0.00043	true
	3/23/2009	0.0005	0.0005	false
	3/23/2010	0.0005 U	0.0006	true
	6/22/2010	0.0005 J	0.0006	true
	9/20/2011	0.00042 J	0.00053	true
	3/21/2012	0.00046 JJ	0.00062	true
	6/20/2012	0.0004 JJ	0.0005	true
MC-24	10/24/2007	0.00019	0.00022	false
	12/18/2007	0.0002	0.00029	false
	3/12/2008	0.00015	0.00024	false
	6/11/2008	0.00022		true
	9/24/2008	0.0003	0.0004	false
	12/3/2008	0.0002 U	0.0002 U	false
	3/27/2009	0.0005 U	0.0002	true
	6/26/2009	0.0003	0.0003	false
	9/28/2009	0.0005 U	0.0005 U	false
	12/21/2009	0.0003 UJ	0.0003 UJ	false
	3/30/2010	0.0001 J	0.0001 J	false
	9/17/2010	0.0002 J	0.0002 J	false
	12/16/2010	0.0002 J	0.0002 J	false
	9/27/2011	0.0003 J	0.0004 J	false

TABLE 12-3

COMPARISON OF DISSOLVED AND TOTAL ARSENIC CONCENTRATIONS

PSC Washougal Facility
Washougal, Washington

(all results reported in milligrams per liter)

Sample ID	Date Sampled	Dissolved Arsenic	Total Arsenic	Dissolved Value Greater than Total?
MC-24D	10/24/2007	0.00061	0.0006	true
	3/11/2008	0.00059	0.0008	false
	6/26/2009	0.0006	0.0008	false
	9/28/2009	0.0005 U	0.0005 U	false
	3/30/2010	0.0006	0.0008	false
	6/28/2010	0.0006	0.0009	false
	3/24/2011	0.0006	0.0009	false
	6/22/2011	0.0004 J	0.0013	true
	3/23/2012	0.00064	0.00087	false
	6/22/2012	0.0004 JJ	0.0006	true
MC-24D2	6/26/2009	0.0014	0.0014	false
	3/30/2010	0.001	0.0012	false
MC-25	10/24/2007	0.00133	0.00128	true
	12/19/2007	0.00078	0.00103	false
	3/12/2008	0.0004	0.00073	false
	9/25/2008	0.0014	0.0022	false
	12/4/2008	0.0006	0.0012	false
	3/26/2009	0.0006	0.0009	false
	9/28/2009	0.0005 U	0.0005 U	false
	12/18/2009	0.0005 U	0.0005 U	false
	9/21/2010	0.0007	0.0008	false
	6/22/2011	0.0005	0.0006	false
	12/16/2011	0.0005	0.0006	false
MC-25D	10/24/2007	0.00084	0.00096	false
	12/18/2007	0.0009	0.00101	false
	3/12/2008	0.00064	0.0008	false
	9/25/2008	0.0007	0.0008	false
	3/26/2009	0.0008	0.0009	false
	3/30/2010	0.0006	0.0007	false
	6/22/2011	0.0004 J	0.0008	true
	6/25/2012	0.0004 JJ	0.0011	true
MC-25D2	9/29/2008	0.0007	0.0009	false
	12/4/2008	0.0006	0.0007	false
	3/26/2009	0.0006	0.0007	false
	6/26/2009	0.0005	0.0006	false
	3/30/2010	0.0006	0.0007	false
	12/14/2010	0.0006	0.0007	false
	3/23/2011	0.0005	0.0007	false

TABLE 12-3

COMPARISON OF DISSOLVED AND TOTAL ARSENIC CONCENTRATIONS

PSC Washougal Facility
Washougal, Washington

(all results reported in milligrams per liter)

Sample ID	Date Sampled	Dissolved Arsenic	Total Arsenic	Dissolved Value Greater than Total?
MC-26D2	9/29/2008	0.0006	0.0007	false
	9/29/2008	0.0005	0.0005	false
	12/3/2008	0.0005	0.0005	false
	12/3/2008	0.0005	0.0005	false
	3/26/2009	0.0006	0.0006	false
	3/29/2010	0.0008	0.0007	true
	3/29/2010	0.0006	0.0008	false
	3/26/2012	0.00087	0.00109	false
	3/26/2012	0.00092	0.00105	false
MC-27D	6/25/2009	0.0009	0.001	false
	9/25/2009	0.0005 U	0.0005 U	false
	12/16/2009	0.0005 U	0.0005 U	false
	3/24/2010	0.0009	0.0011	false
	6/23/2010	0.0008	0.0011	false
	3/24/2011	0.0008	0.0014	false
	12/20/2011	0.0009	0.0012	false
	3/22/2012	0.0009	0.00109	false
	6/19/2012	0.0008	0.0012	false
MC-28D	6/25/2009	0.0009	0.001	false
MC-30	3/25/2009	0.0053	0.0061	false
MC-30D	9/29/2008	0.0014	0.0014	false
MC-31	12/21/2010	0.0289	0.0298	false
MC-32	6/29/2009	0.0279	0.0188	true
	9/22/2009	0.0286	0.025	true
	12/15/2009	0.1131	0.1338	false
	3/23/2010	0.0113	0.0708	false
	6/22/2010	0.0736	0.0757	false
	9/14/2010	0.083	0.02	true
	12/15/2010	0.0784	0.0706	true
	3/22/2011	0.0264	0.0227	true
	6/30/2011	0.0488	0.0458	true
	9/20/2011	0.06485	0.05596	true
	12/21/2011	0.0751	0.0773	false
	6/20/2012	0.0693	0.0638	true
MC-33	12/21/2010	0.0314	0.0337	false

TABLE 12-3

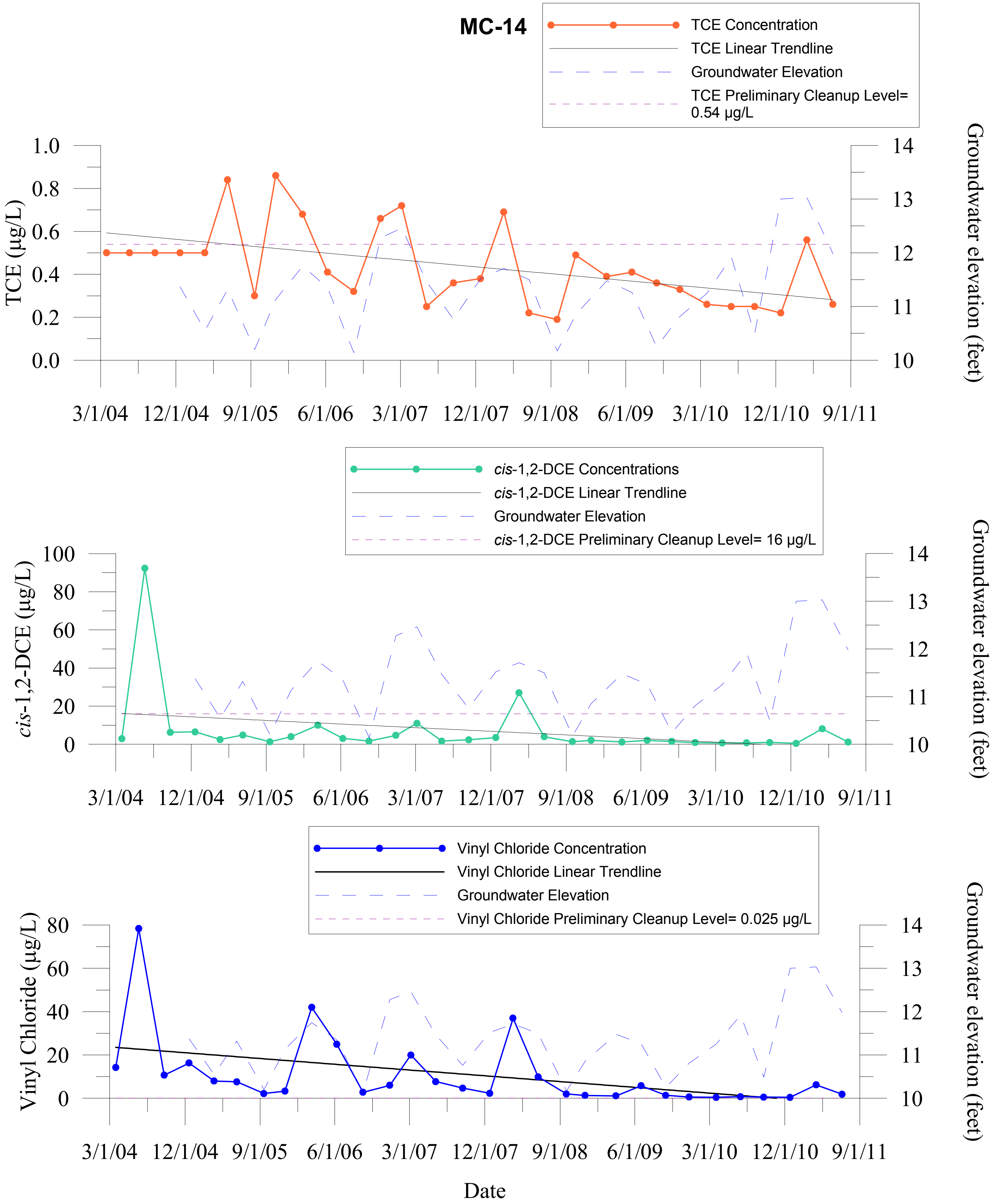
COMPARISON OF DISSOLVED AND TOTAL ARSENIC CONCENTRATIONS

PSC Washougal Facility
Washougal, Washington

(all results reported in milligrams per liter)

Sample ID	Date Sampled	Dissolved Arsenic	Total Arsenic	Dissolved Value Greater than Total?
MC-8	3/24/2004	0.00018	0.000203	false
	6/17/2004	0.00118	0.00107	true
	12/14/2004	0.000382	0.000501	false
	3/15/2005	0.001 U	0.001 U	false
	3/7/2006	0.0007	0.0011	false
	3/8/2007	0.0018	0.00215	false
	12/20/2007	0.00092	0.00113	false
	12/4/2008	0.0006	0.0008	false
	12/17/2009	0.0005 U	0.0013	true
	6/23/2010	0.0007	0.0008	false
	12/14/2010	0.0008	0.001	false
	3/23/2011	0.0008	0.0011	false
	12/16/2011	0.0013	0.0013	false
	3/26/2012	0.00106	0.00109	false
MC-SM-2-3.0	12/8/2008	0.001	0.0011	false
MC-SM-3-3.0	12/8/2008	0.0016	0.0014	true
MC-SM-4-1.5	12/8/2008	0.0052	0.0114	false
MC-SM-5-0.5	12/8/2008	0.0027	0.0038	false
MC-SM-6-0.5	12/8/2008	0.0059	0.0064	false
PZU-4	12/15/2009	0.0145	0.015	false
	3/21/2011	0.0028	0.0028	false
PZU-5	12/17/2007	0.00258	0.00277	false
	3/10/2008	0.0048	0.0065	false
	9/23/2008	0.0124	0.0129	false
	12/2/2008	0.0105	0.0083	true
	3/23/2009	0.0045	0.0047	false
	6/22/2009	0.0092	0.01	false
	12/15/2009	0.0105	0.0112	false
	3/24/2010	0.0112	0.013	false
	6/21/2010	0.0019	0.0036	false
	12/16/2010	0.0015	0.0021	false
	3/22/2011	0.0012	0.0021	false
	9/20/2011	0.01368	0.01524	false
	12/20/2011	0.0139	0.0136	true
	3/21/2012	0.00172	0.00226	false
	6/20/2012	0.002	0.003	false
SM-1-2.0	10/25/2007	0.00192	0.0027	false
SM2-3	9/21/2007	0.0057	0.0107	false
SM3-3	9/21/2007	0.0035	0.0109	false
SM3-9-3	9/21/2007	0.0021	0.0023	false
UT-ST-1	12/15/2009	0.0005 U	0.0022	true

FIGURES



Abbreviations: *cis*-1,2-DCE = *cis*-1,2-dichloroethene
µg/L = micrograms per liter
TCE = trichloroethene

Notes: 1. Value plotted is one-half reporting limit when analyte was not detected.
2. Groundwater elevations in feet above mean sea level.

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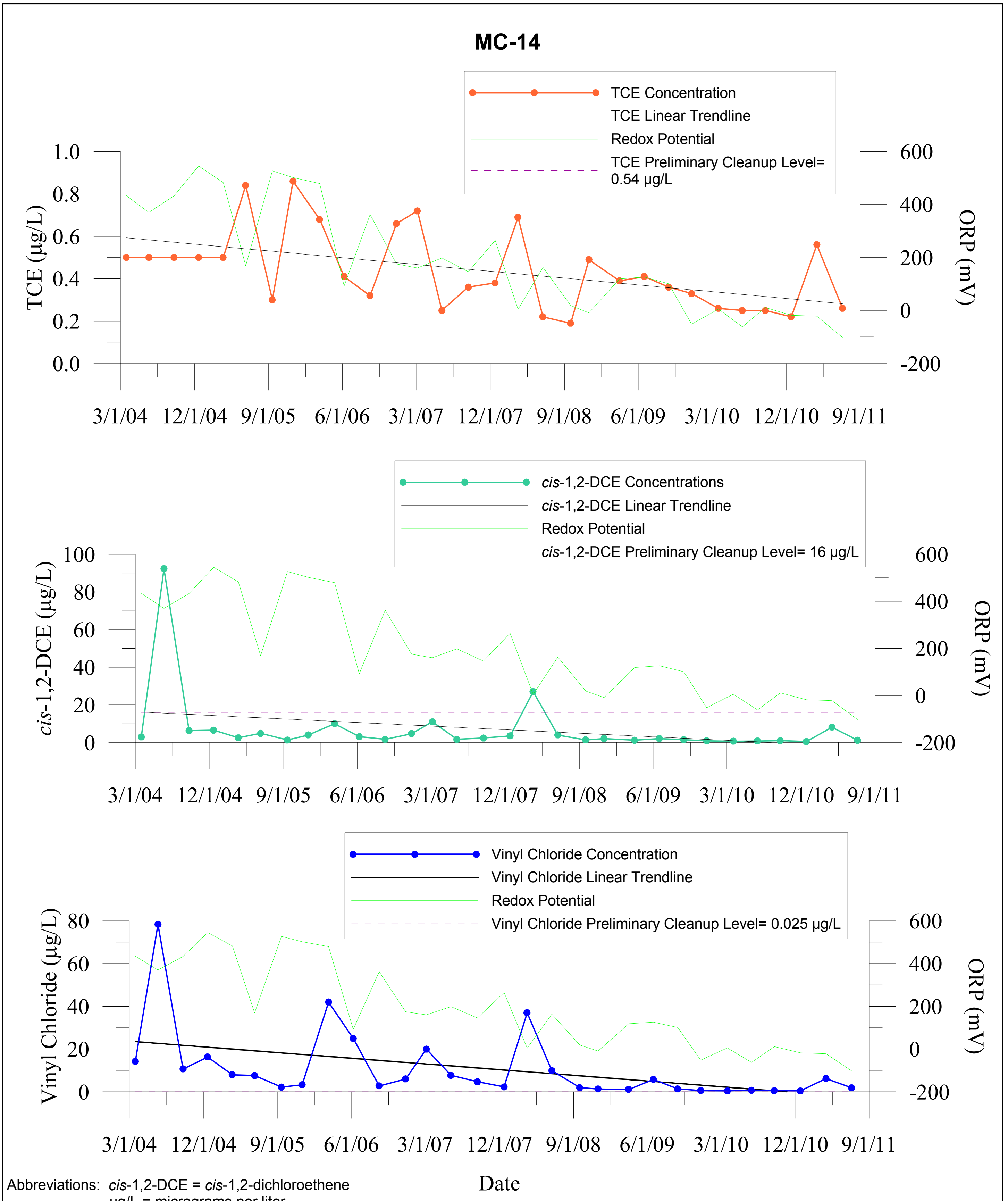
amec

TCE, *CIS*-1,2-DCE, AND VINYL CHLORIDE CONCENTRATIONS
WITH GROUNDWATER ELEVATIONS VERSUS TIME^{1,2}
Shallow Groundwater Zone Well MC-14
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-1



Abbreviations: *cis*-1,2-DCE = *cis*-1,2-dichloroethene
µg/L = micrograms per liter
TCE = trichloroethene
ORP = oxidation reduction potential

Notes: 1. Value plotted is one-half reporting limit when analyte was not detected.

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TCE, *CIS*-1,2-DCE, AND VINYL CHLORIDE CONCENTRATIONS
WITH OXIDATION REDUCTION POTENTIAL VERSUS TIME[1]
Shallow Groundwater Zone Well MC-14
PSC Washougal Facility, Washougal, Washington

Project No.	9625
Figure No.	12-2

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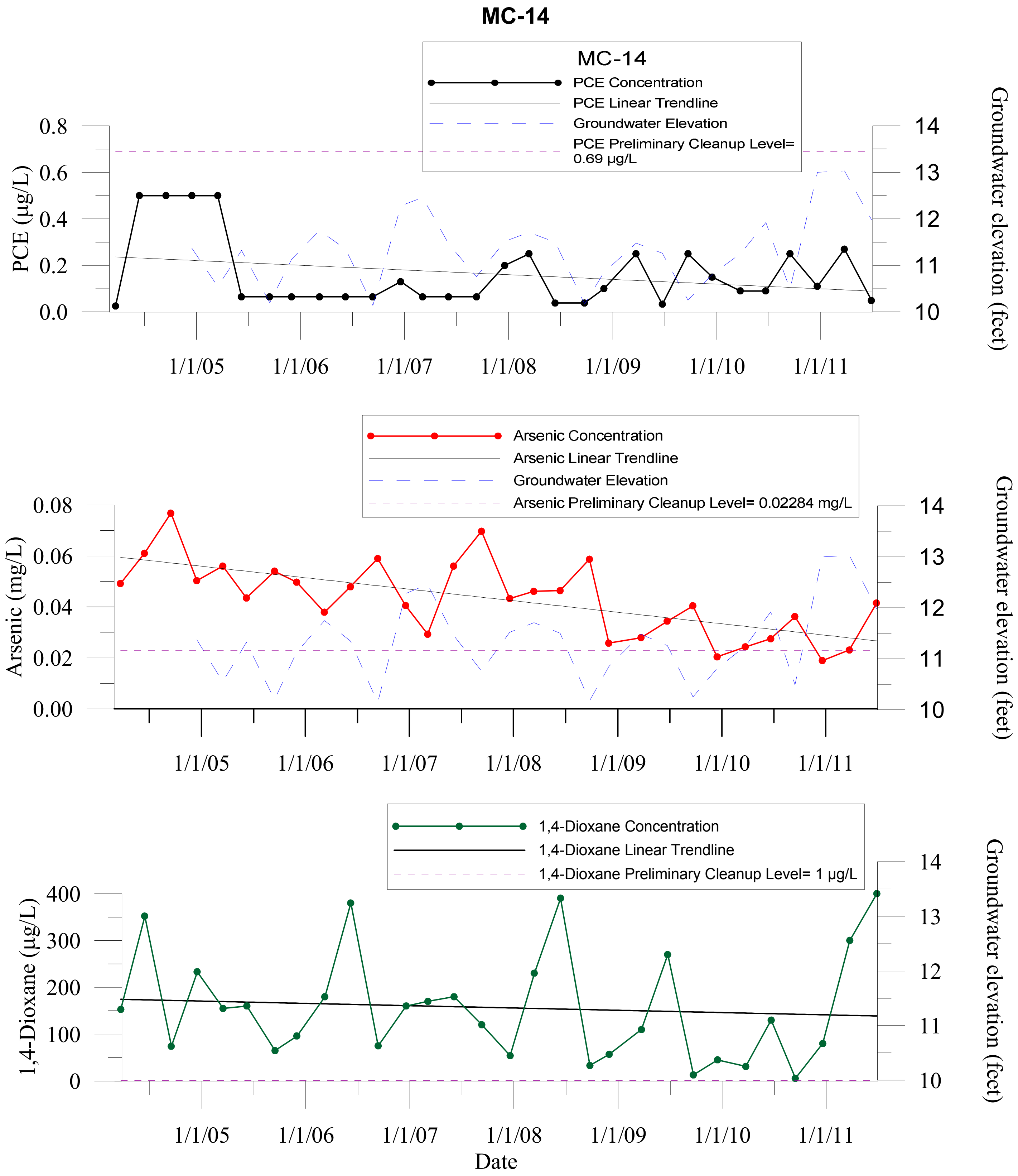

Abbreviations: µg/L = micrograms per liter
mg/L = milligrams per liter
PCE = tetrachloroethene

Notes: 1. Value plotted is one-half reporting limit when analyte was not detected.
2. Groundwater elevations in feet above mean sea level.

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PCE, ARSENIC, AND 1,4-DIOXANE CONCENTRATIONS VERSUS TIME^{1,2}
Shallow Groundwater Zone Well MC-14
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-3

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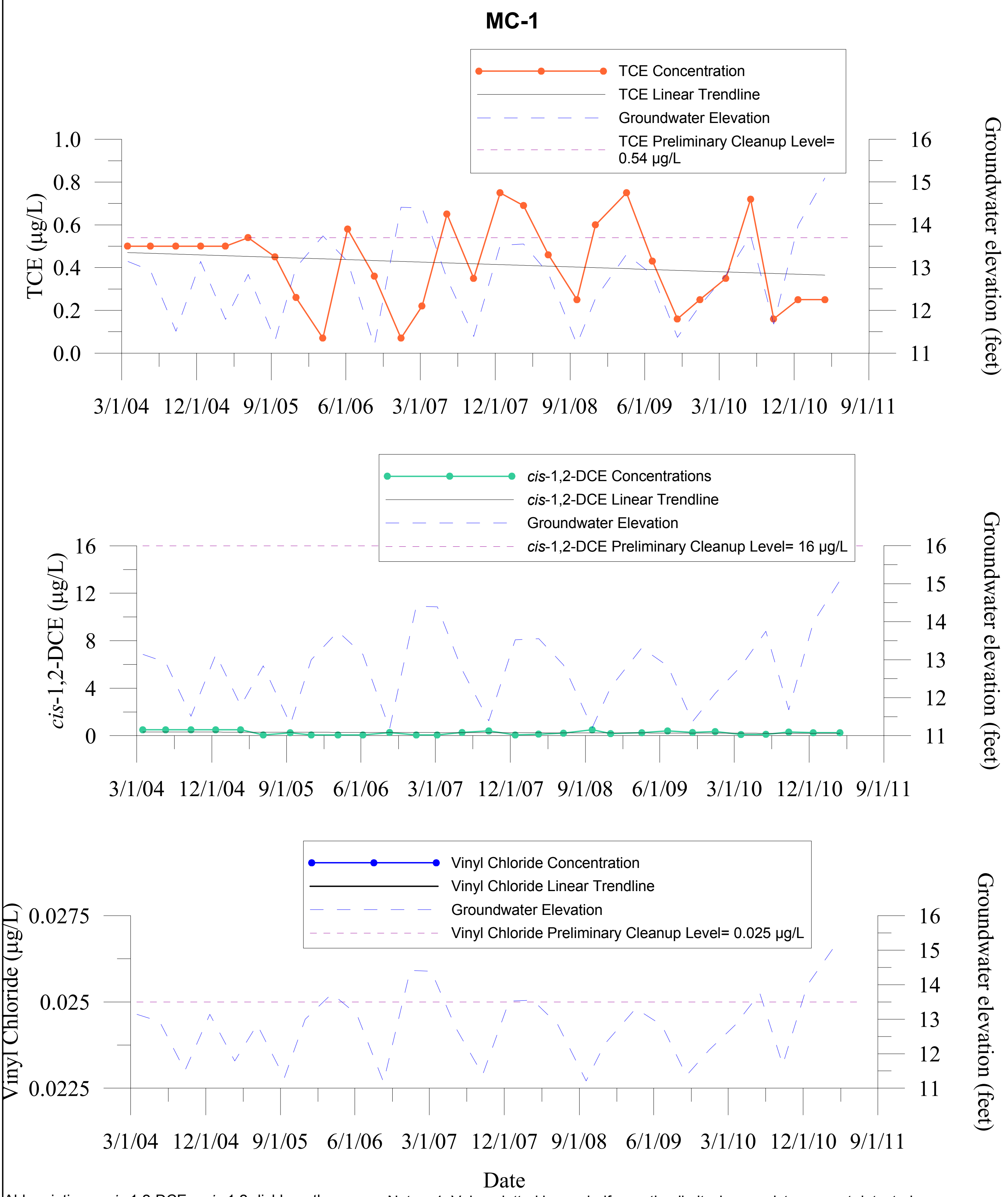

Abbreviations: *cis*-1,2-DCE = *cis*-1,2-dichloroethene
µg/L = micrograms per liter
TCE = trichloroethene

Notes: 1. Value plotted is one-half reporting limit when analyte was not detected.
2. Groundwater elevations in feet above mean sea level.

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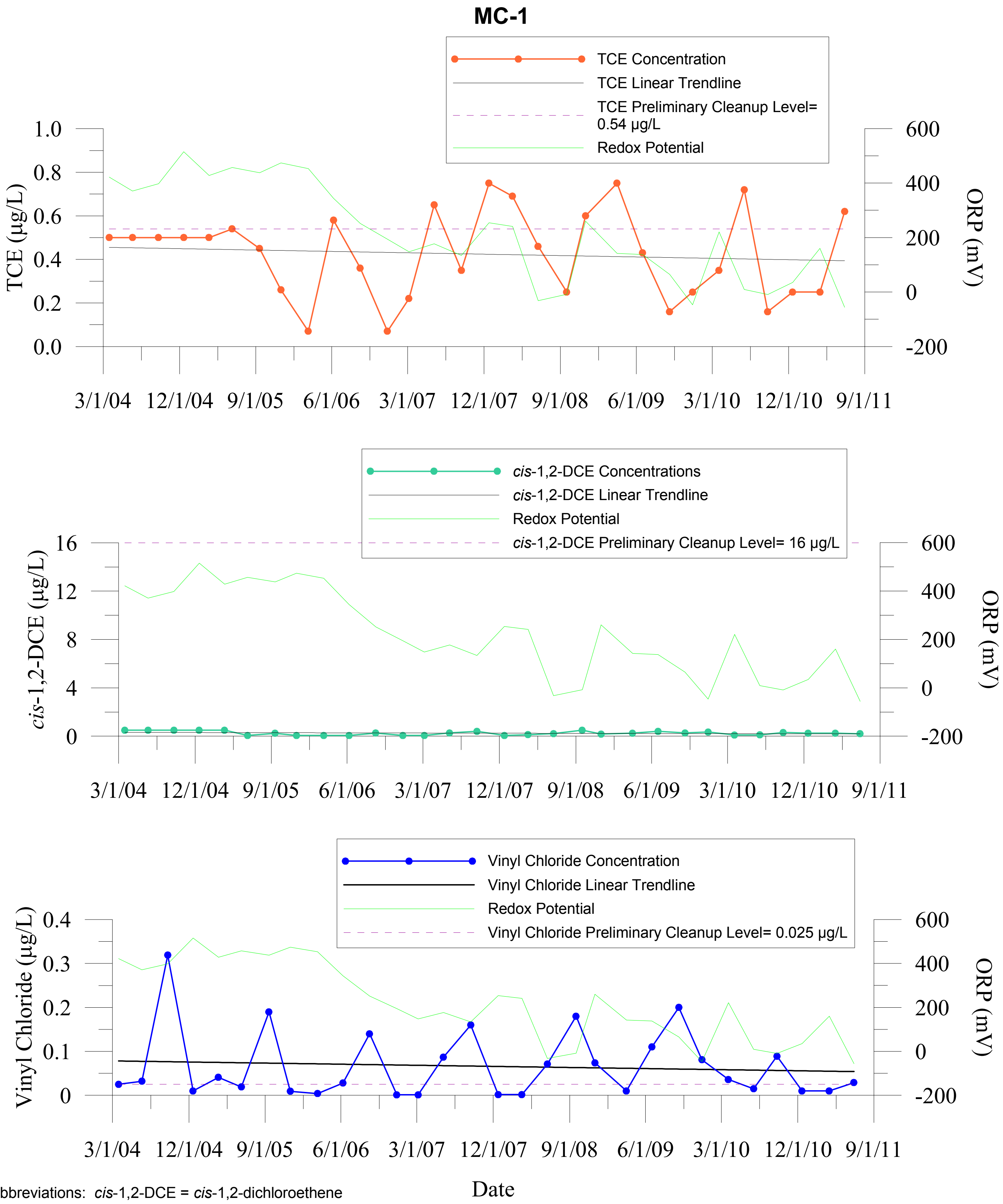
TCE, *CIS*-1,2-DCE, AND VINYL CHLORIDE CONCENTRATIONS
WITH GROUNDWATER ELEVATIONS VERSUS TIME[1,2]
Shallow Groundwater Zone Well MC-1
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-4

P:\9625 - PSC Washougal\3000 REPORT\2009 RI FS Report\Figures\Grapher\MC-14_TCEcisVC.grf



Abbreviations: *cis*-1,2-DCE = *cis*-1,2-dichloroethene
µg/L = micrograms per liter
TCE = trichloroethene
ORP = oxidation reduction potential

Notes: 1. Value plotted is one-half reporting limit when analyte was not detected.

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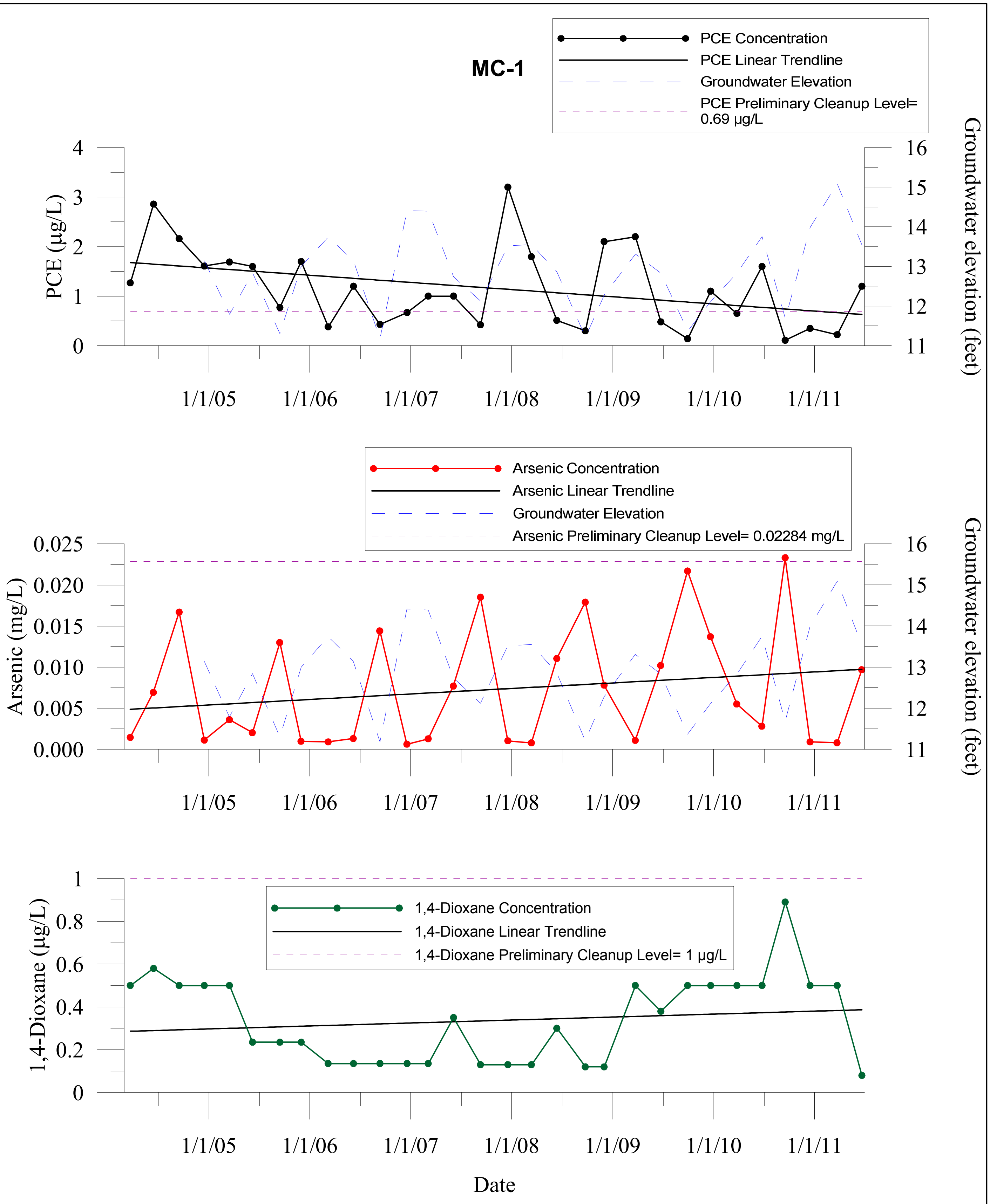
TCE, *CIS*-1,2-DCE, AND VINYL CHLORIDE CONCENTRATIONS
WITH OXIDATION REDUCTION POTENTIALS VERSUS TIME[1]
Shallow Groundwater Zone Well MC-1
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-5

P:\9625 - PSC Washougal\3000 REPORT\2009 RI FS Report\Figures\Grapher\MC-14_TCEcisVC.grf



Abbreviations: µg/L = micrograms per liter
mg/L = milligrams per liter
PCE = tetrachloroethene

Notes: 1. Value plotted is one-half reporting limit when analyte was not detected.
2. Groundwater elevations in feet above mean sea level.

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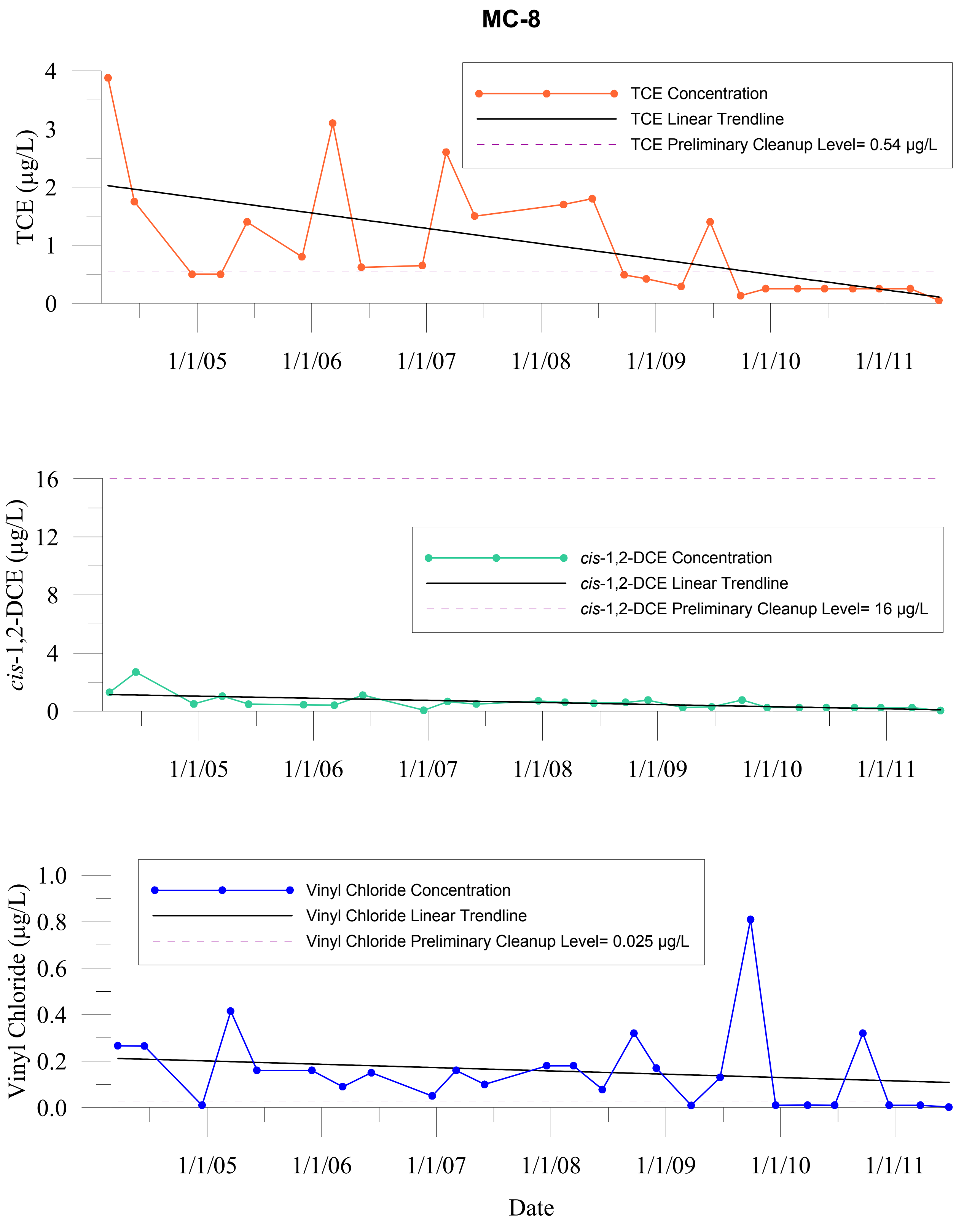
amec

PCE, ARSENIC, AND 1,4-DIOXANE CONCENTRATIONS VERSUS TIME^{1,2}
Shallow Groundwater Zone Well MC-1
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-6



Abbreviations: *cis*-1,2-DCE = *cis*-1,2-dichloroethene
µg/L = micrograms per liter
TCE = trichloroethene

Note: 1. Value plotted is one-half reporting limit when analyte was not detected.

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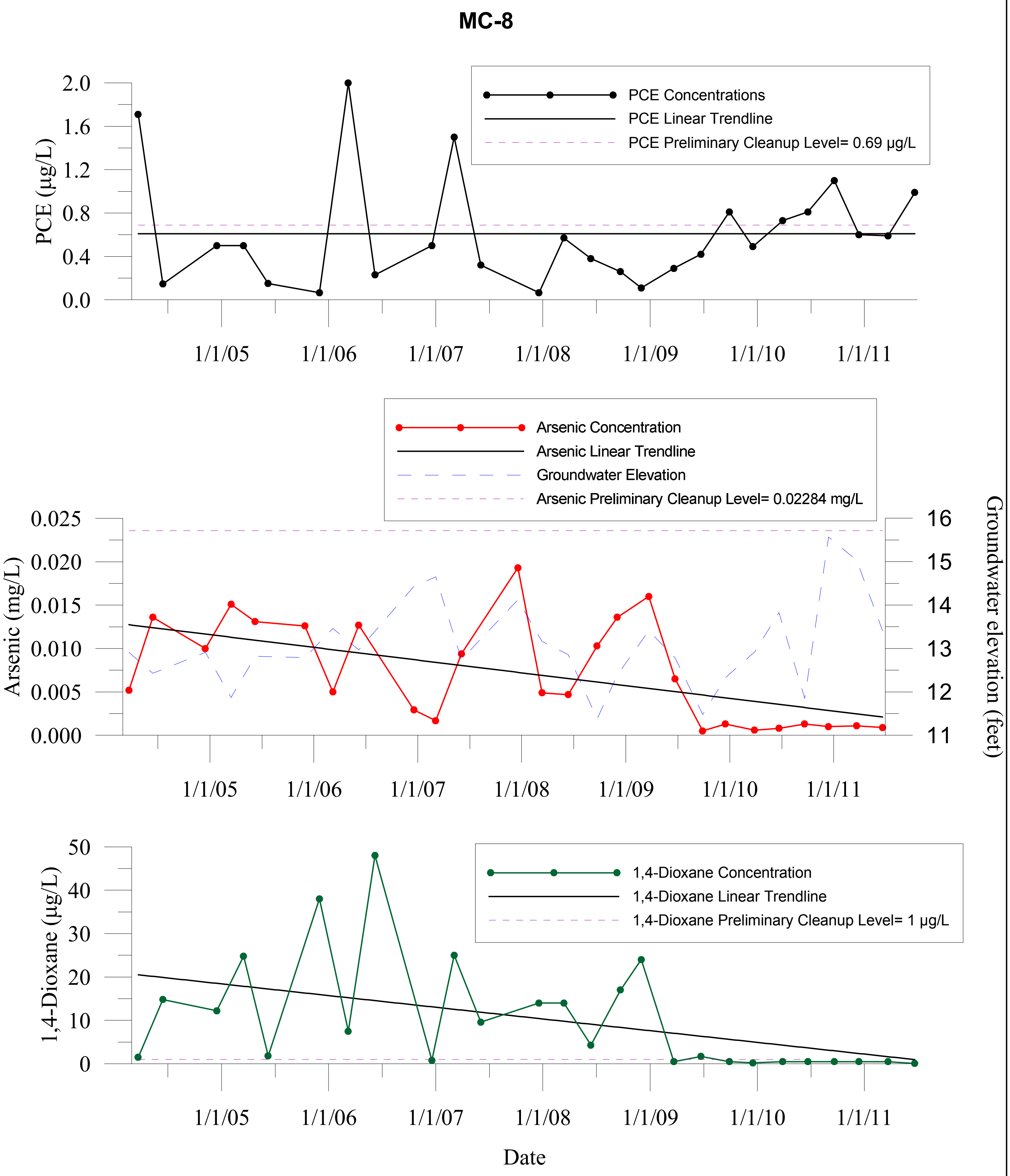
TCE, C*IS*-1,2-DCE, AND VINYL CHLORIDE CONCENTRATIONS
VERSUS TIME[1]
Shallow Groundwater Zone Well MC-8
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-7

P:\9625 - PSC Washougal\3000 REPORT\2009 RI FS Report\Figures\Grapher\MC-8_TCEcisVC.grf



Abbreviations: µg/L = micrograms per liter
mg/L = milligrams per liter
PCE = tetrachloroethene

Note: 1. Value plotted is one-half reporting limit when analyte was not detected.
2. Groundwater elevations in feet above mean sea level.

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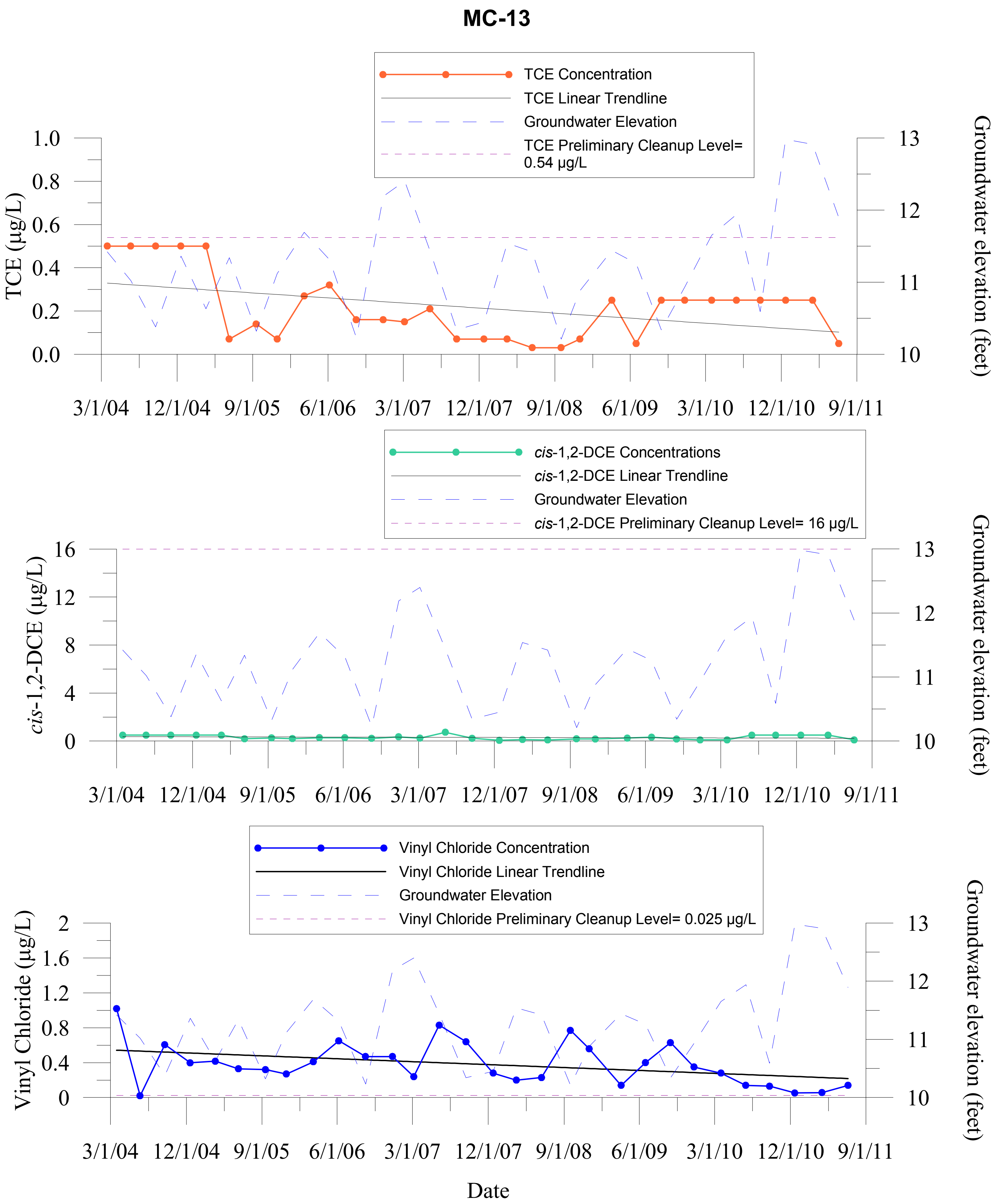
PCE, ARSENIC, AND 1,4-DIOXANE CONCENTRATIONS
VERSUS TIME^{1,2}
Shallow Groundwater Zone Well MC-8
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-8

P:\9625 - PSC Washougal\3000 REPORT\2009 RI FS Report\Figures\Grapher\MC-8_PCEAs14dio.grf



Abbreviations: *cis*-1,2-DCE = *cis*-1,2-dichloroethene
µg/L = micrograms per liter
TCE = trichloroethene

Notes: 1. Value plotted is one-half reporting limit when analyte was not detected.
2. Groundwater elevations in feet above mean sea level.

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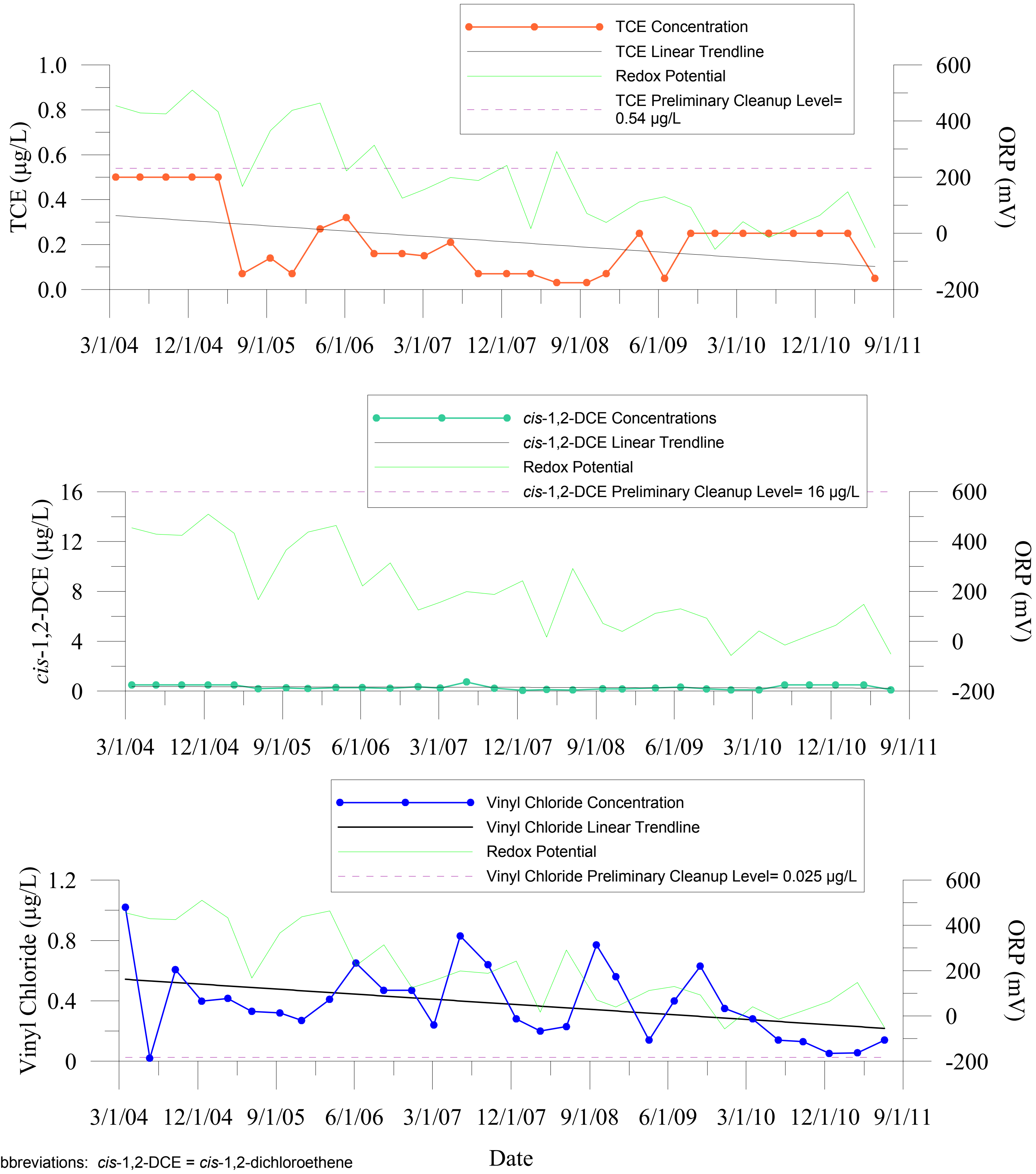
TCE, *CIS*-1,2-DCE, AND VINYL CHLORIDE CONCENTRATIONS
WITH GROUNDWATER ELEVATIONS VERSUS TIME^{1,2}
Shallow Groundwater Zone Well MC-13
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-9

MC-13



Abbreviations: *cis*-1,2-DCE = *cis*-1,2-dichloroethene
µg/L = micrograms per liter
TCE = trichloroethene
ORP = oxidation reduction potential

Notes: 1. Value plotted is one-half reporting limit when analyte was not detected.

TCE, *CIS*-1,2-DCE, AND VINYL CHLORIDE CONCENTRATIONS
WITH OXIDATION REDUCTION POTENTIALS VERSUS TIME[1]
Shallow Groundwater Zone Well MC-13
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-10

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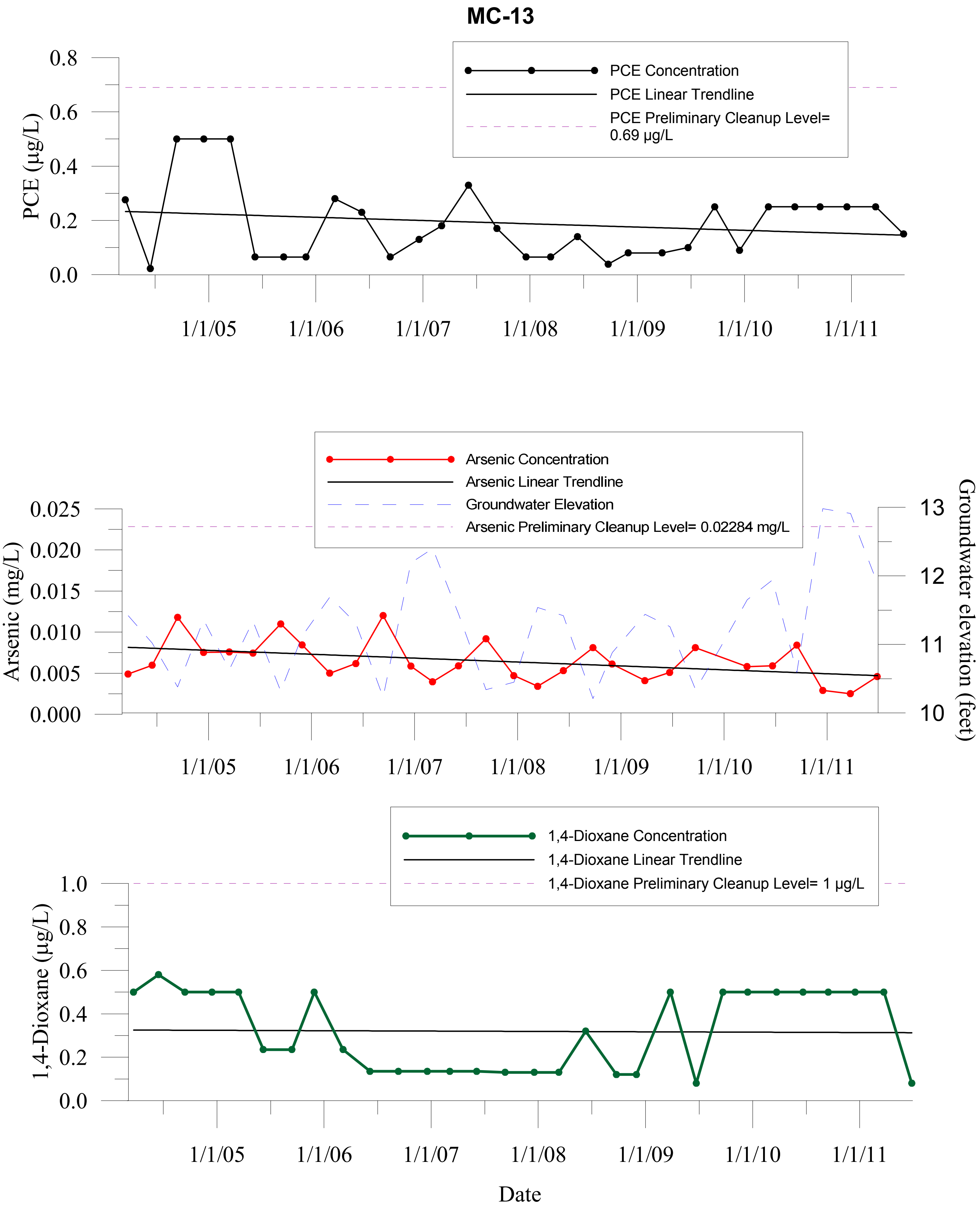

Abbreviations: µg/L = micrograms per liter
mg/L = milligrams per liter
PCE = tetrachloroethene

Note: 1. Value plotted is one-half reporting limit when analyte was not detected.
2. Groundwater elevations in feet above mean sea level.

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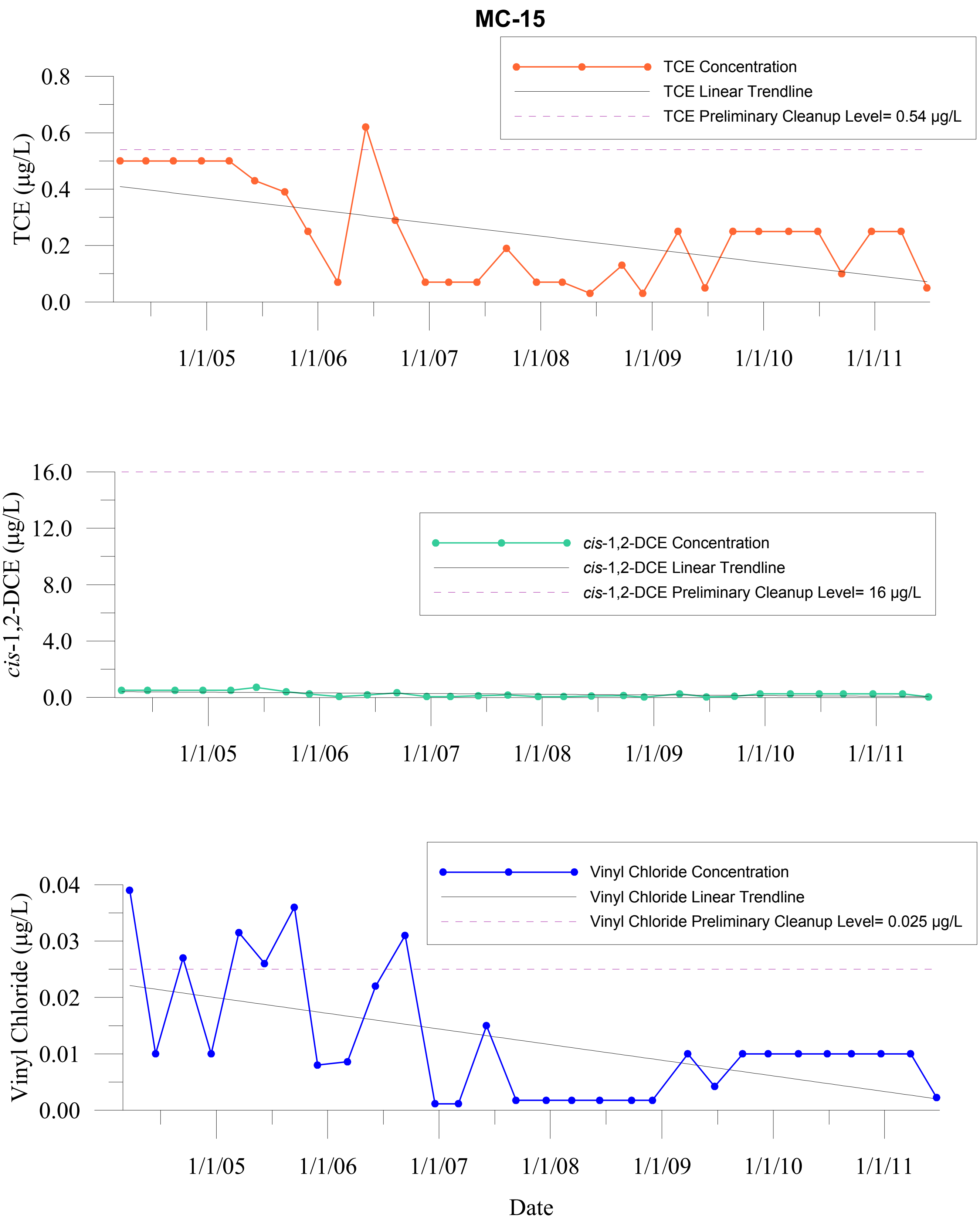
PCE, ARSENIC, AND 1,4-DIOXANE CONCENTRATIONS VERSUS TIME^{1,2}
Shallow Groundwater Zone Well MC-13
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-11

P:\9625 - PSC Washougal\3000 REPORT\2009 RI FS Report\Figures\Grapher\MC-13_PCEAs14dio.grf



Abbreviations: *cis*-1,2-DCE = *cis*-1,2-dichloroethene
µg/L = micrograms per liter
TCE = trichloroethene

Note: 1. Value plotted is one-half reporting limit when analyte was not detected.

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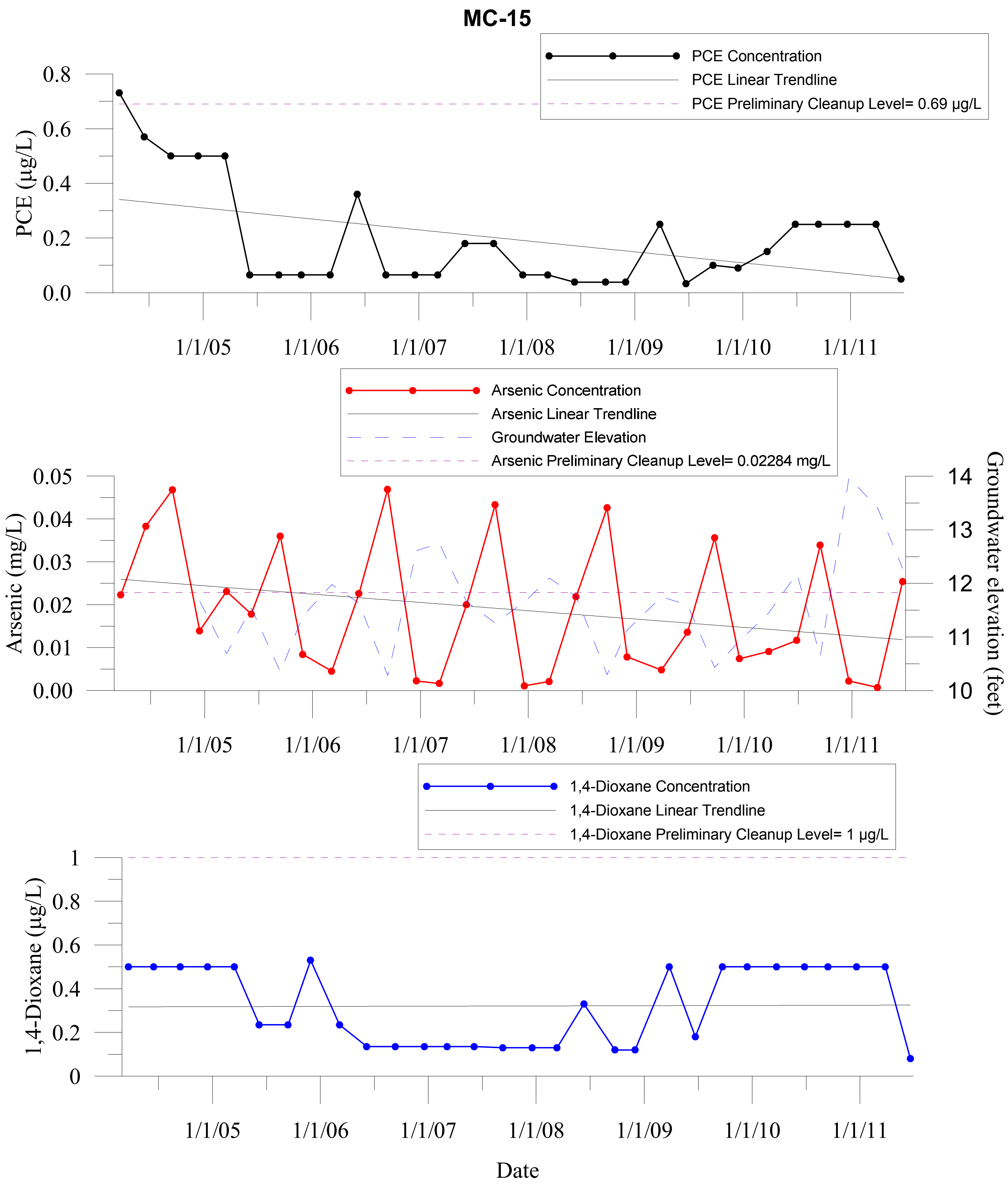
TCE, *CIS*-1,2-DCE, AND VINYL CHLORIDE
CONCENTRATIONS VERSUS TIME[1]
Shallow Groundwater Zone Well MC-15
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-12



Abbreviations: g/L = micrograms per liter
mg/L = milligrams per liter
PCE = tetrachloroethene

Note: 1. Value plotted one-half reporting limit when analyte was not detected.
2. Groundwater elevations in feet above mean sea level.

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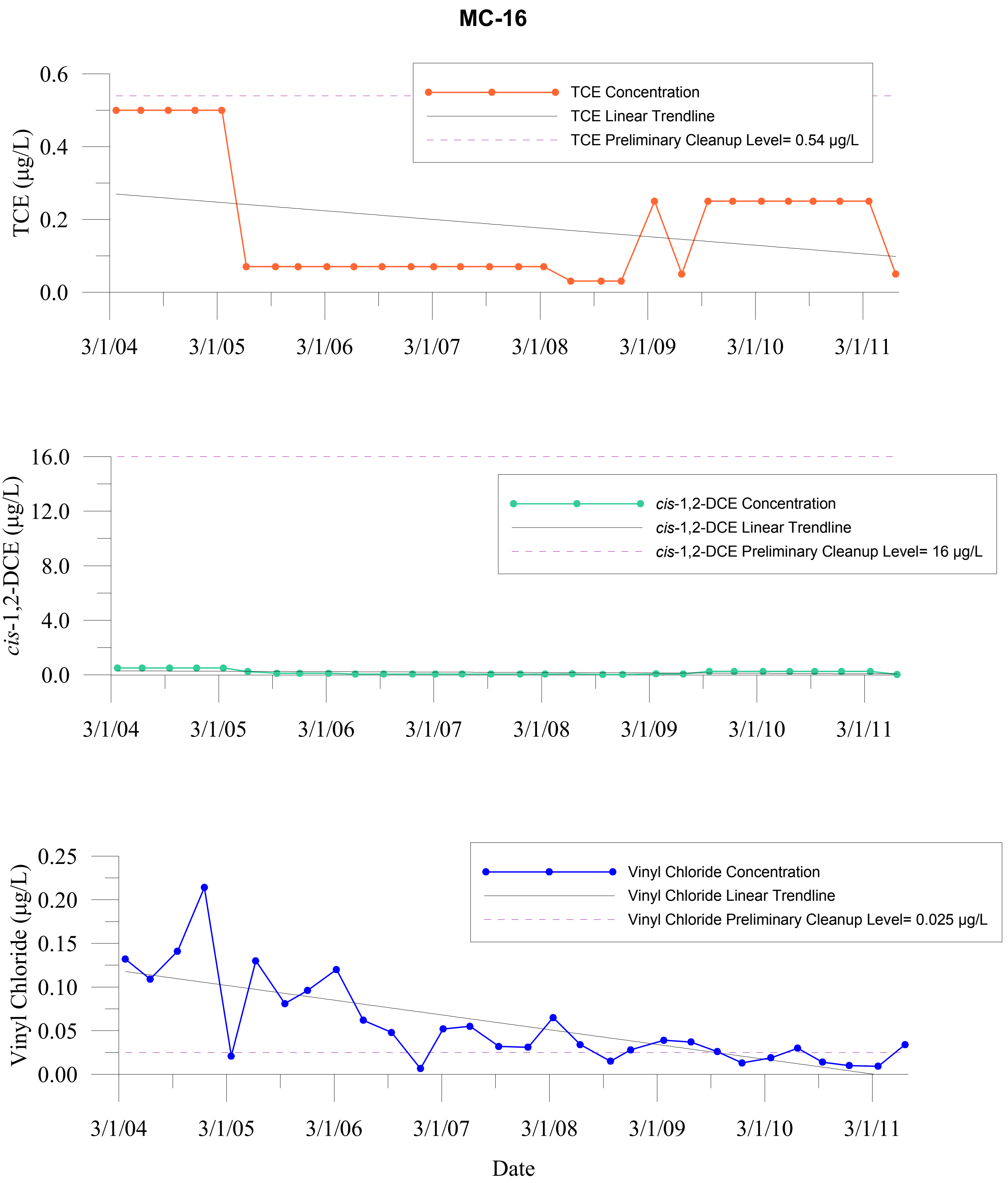
PCE, ARSENIC AND 1,4-DIOXANE
CONCENTRATIONS VERSUS TIME^{1,2}
Shallow Groundwater Zone Well MC-15
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-13

P:\9625 - PSC Washougal\3000 REPORT\2009 RI FS Report\Figures\Grapher\MC-15_PCEAs14dio.grf



Abbreviations: *cis*-1,2-DCE = *cis*-1,2-dichloroethene
µg/L = micrograms per liter
TCE = trichloroethene

Note: 1. Value plotted is one-half reporting limit when analyte was not detected

TCE, *CIS*-1,2-DCE, AND VINYL CHLORIDE
CONCENTRATIONS VERSUS TIME[1]
Shallow Groundwater Zone Well MC-16
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-14

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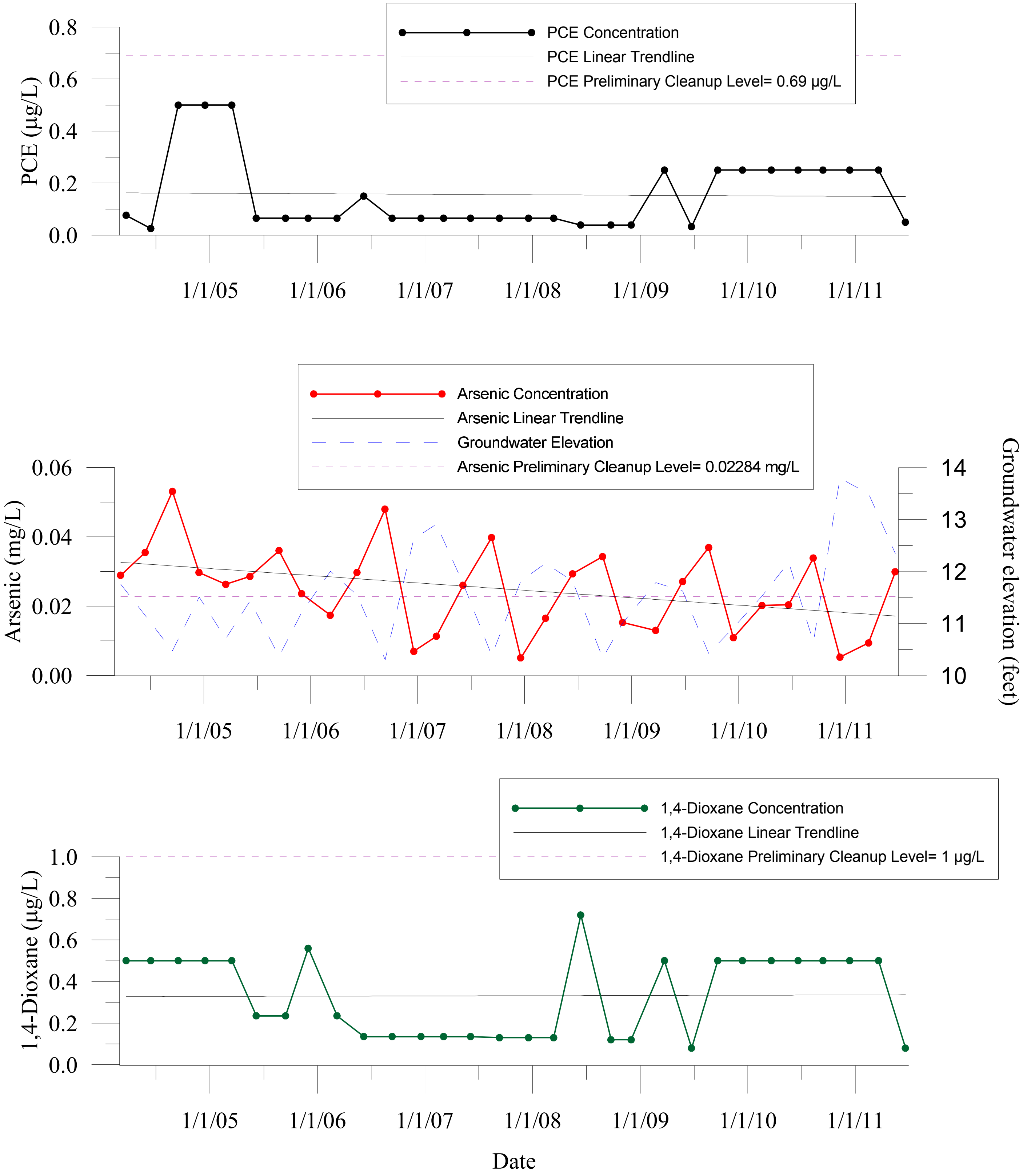
MC-16



Abbreviations: µg/L = micrograms per liter
mg/L = milligrams per liter
PCE = tetrachloroethene

Note: 1. Value plotted is one-half the reporting limit when analyte was not detected.
2. Groundwater elevations in feet above mean sea level.

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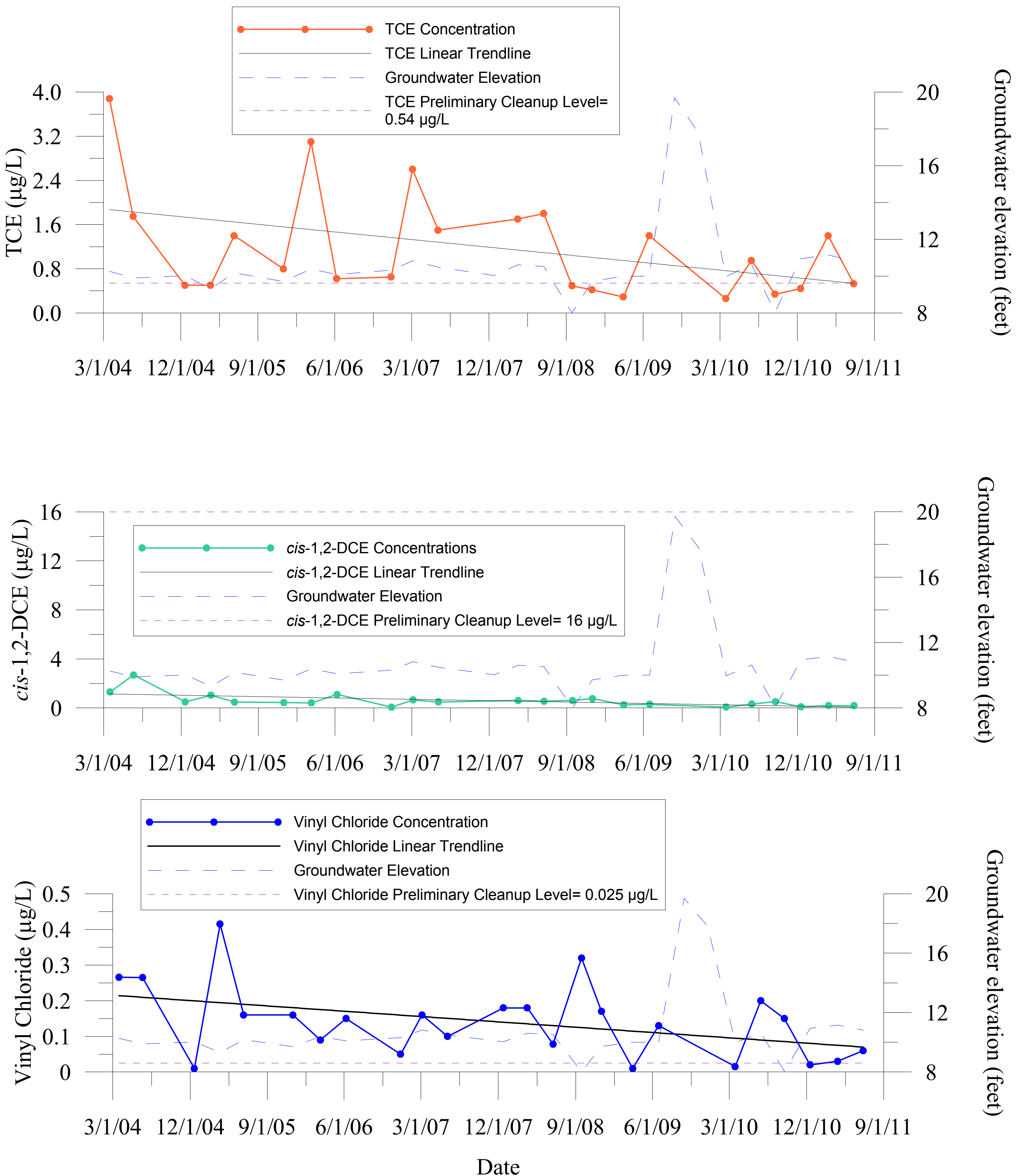
PCE, ARSENIC, AND 1,4-DIOXANE
CONCENTRATIONS VERSUS TIME^{1,2}
Shallow Groundwater Zone Well MC-16
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-15

MC-20



Abbreviations: *cis*-1,2-DCE = *cis*-1,2-dichloroethene
µg/L = micrograms per liter
TCE = trichloroethene

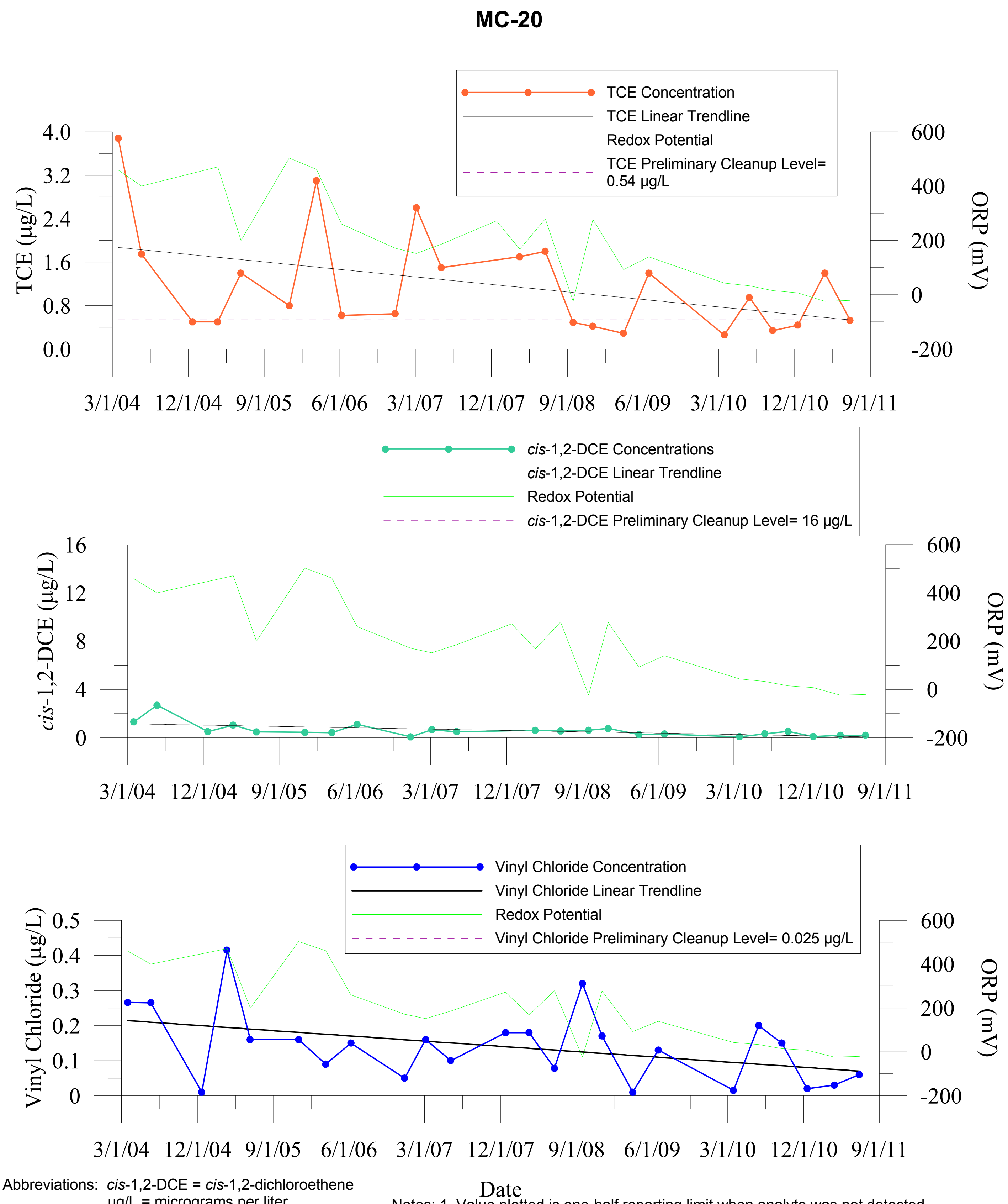
Notes: 1. Value plotted is one-half reporting limit when analyte was not detected.
2. Groundwater elevations in feet above mean sea level.

TCE, *CIS*-1,2-DCE, AND VINYL CHLORIDE CONCENTRATIONS
WITH GROUNDWATER ELEVATIONS VERSUS TIME^{1,2}
Shallow Groundwater Zone Well MC-20
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-16

P:\9625 - PSC Washougal\3000 REPORT\2009 RI FS Report\Figures\Grapher\MC-14_TCEcisVC.grf



Abbreviations: *cis*-1,2-DCE = *cis*-1,2-dichloroethene
µg/L = micrograms per liter
TCE = trichloroethene
ORP = oxidation reduction potential

Notes: 1. Value plotted is one-half reporting limit when analyte was not detected.

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TCE, *CIS*-1,2-DCE, AND VINYL CHLORIDE CONCENTRATIONS
WITH OXIDATION REDUCTION POTENTIAL VERSUS TIME[1]
Shallow Groundwater Zone Well MC-20
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-17

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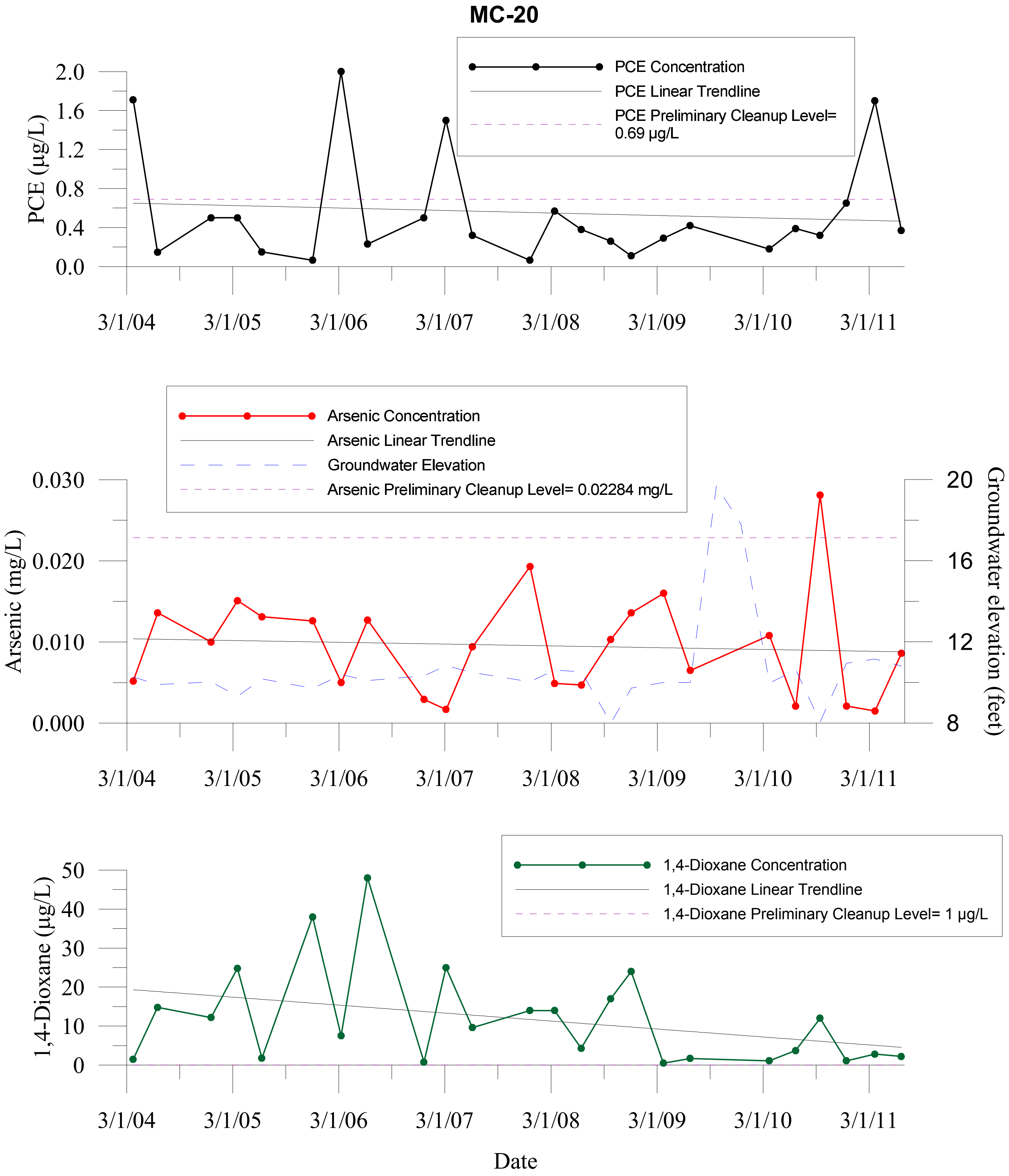

Abbreviations:
µg/L = micrograms per liter
mg/L = milligrams per liter
PCE = tetrachloroethene

Note:
1. Value plotted is one-half reporting limit when analyte was not detected.
2. Groundwater elevations in feet above mean sea level.

PCE, ARSENIC, AND 1,4-DIOXANE
CONCENTRATIONS VERSUS TIME[1,2]
Shallow Groundwater Zone Well MC-20
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-18

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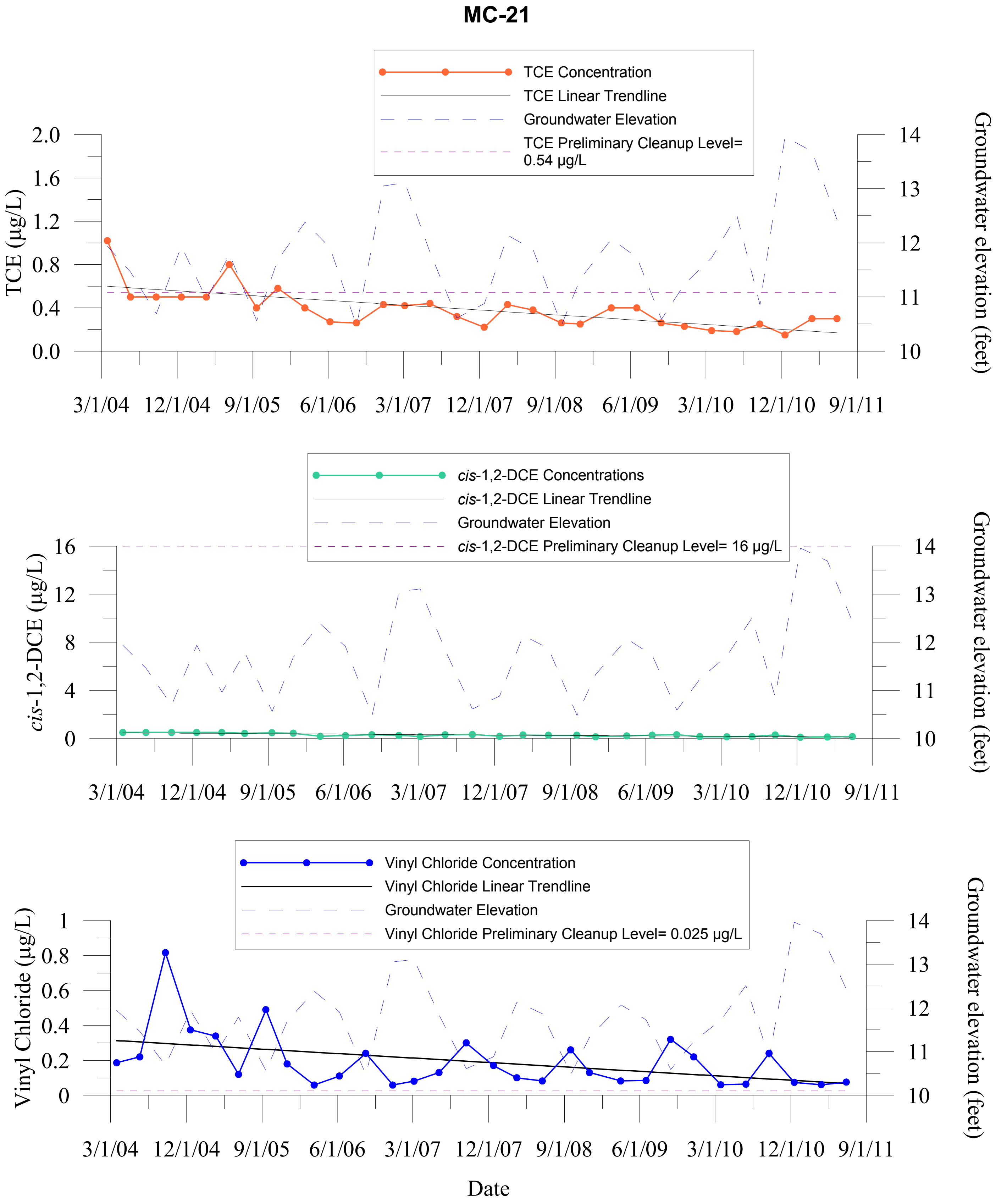

Abbreviations: *cis*-1,2-DCE = *cis*-1,2-dichloroethene
µg/L = micrograms per liter
TCE = trichloroethene

Notes: 1. Value plotted is one-half reporting limit when analyte was not detected.
2. Groundwater elevations in feet above mean sea level.

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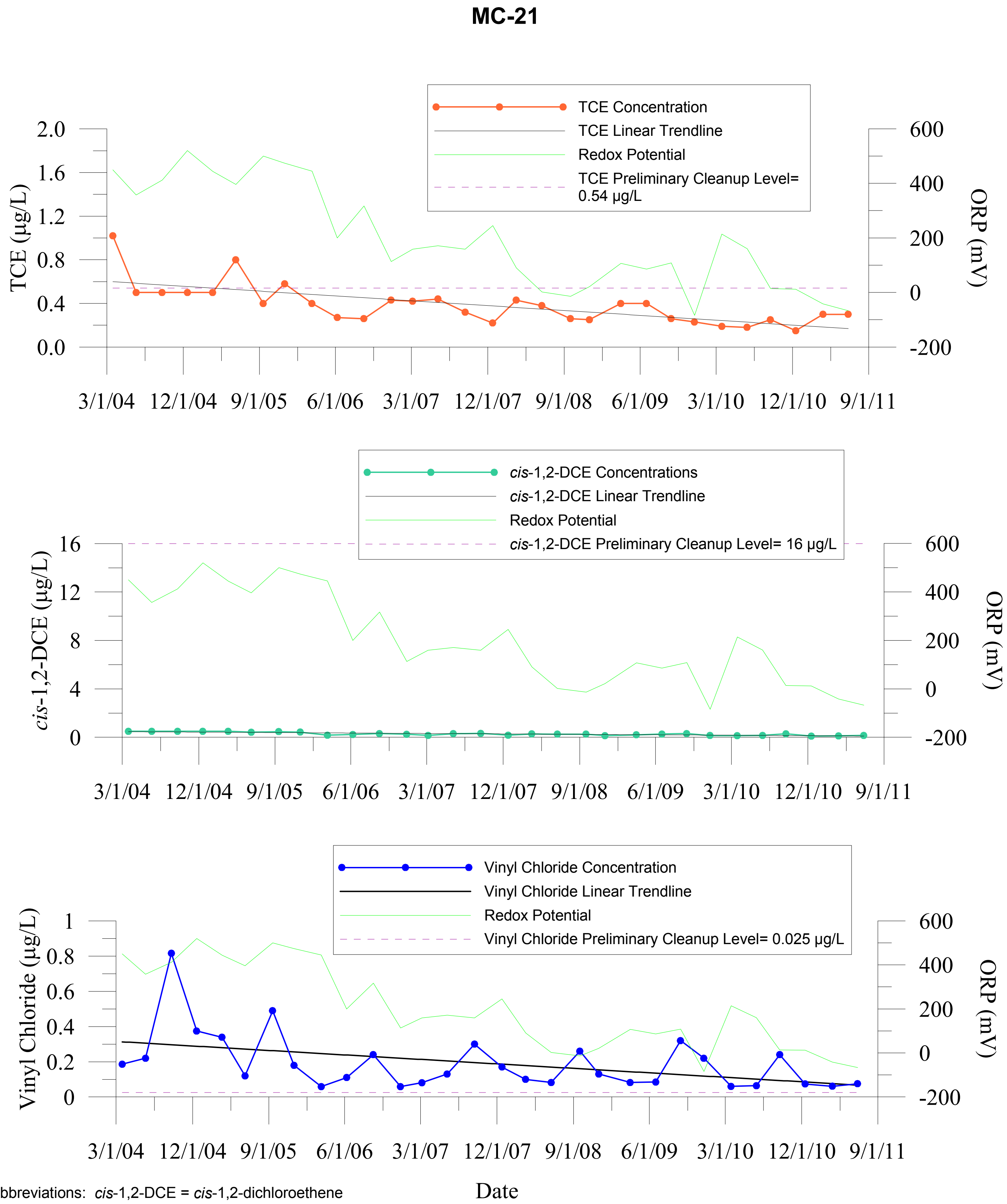
TCE, *CIS*-1,2-DCE, AND VINYL CHLORIDE CONCENTRATIONS
WITH GROUNDWATER ELEVATIONS VERSUS TIME^{1,2}
Shallow Groundwater Zone Well MC-21
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-19



Abbreviations: *cis*-1,2-DCE = *cis*-1,2-dichloroethene
µg/L = micrograms per liter
TCE = trichloroethene
ORP = oxidation reduction potential

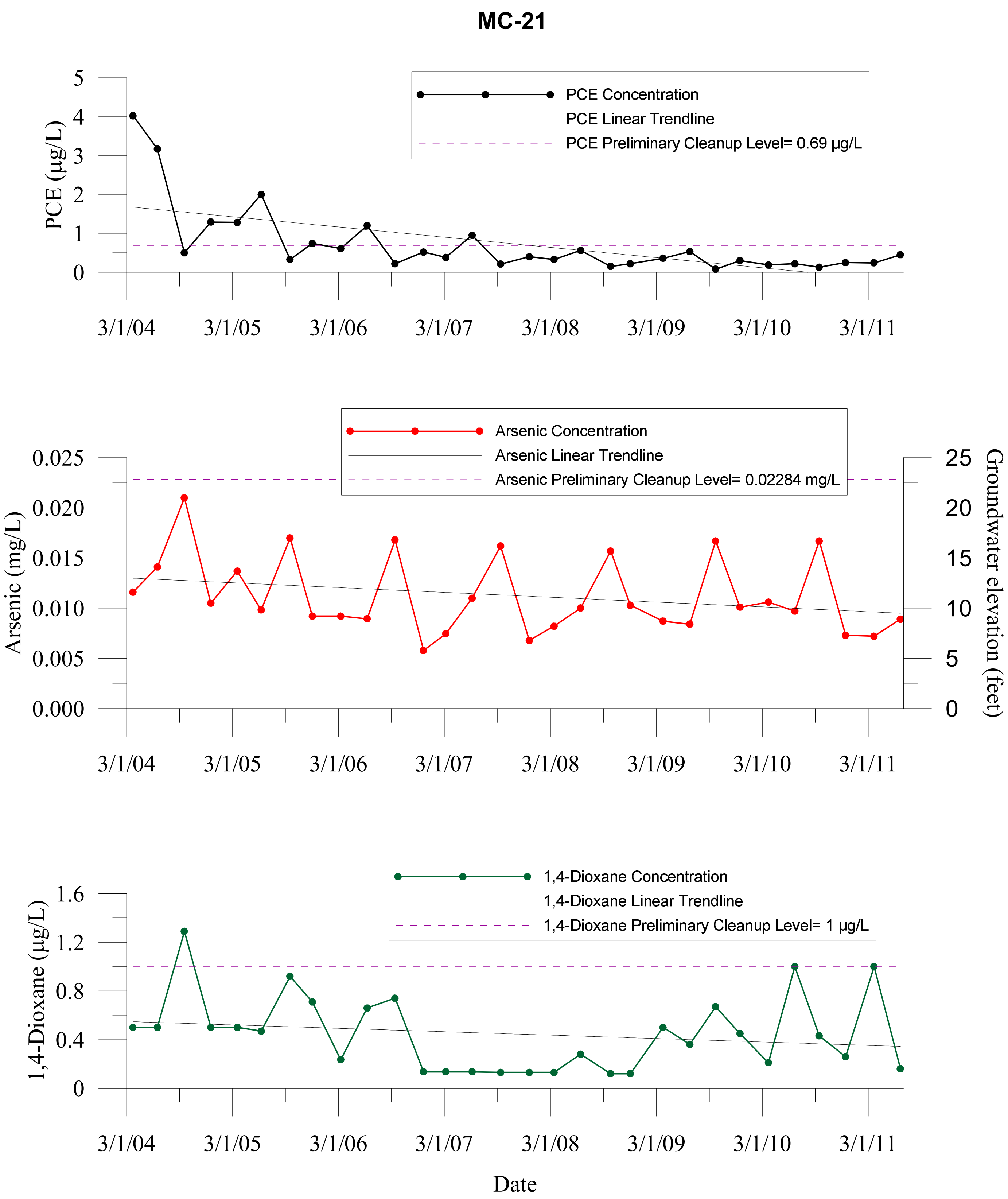
Notes: 1. Value plotted is one-half reporting limit when analyte was not detected.

TCE, *CIS*-1,2-DCE, AND VINYL CHLORIDE CONCENTRATIONS
WITH OXIDATION REDUCTION POTENTIAL VERSUS TIME[1]
Shallow Groundwater Zone Well MC-21
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-20

P:\9625 - PSC Washougal\3000 REPORT\2009 RI FS Report\Figures\Grapher\MC-14_TCEcisVC.grf



Abbreviations: µg/L = micrograms per liter
mg/L = milligrams per liter
PCE = tetrachloroethene

Note: 1. Value plotted is one-half reporting limit when analyte was not detected.
2. Groundwater elevations in feet above mean sea level.

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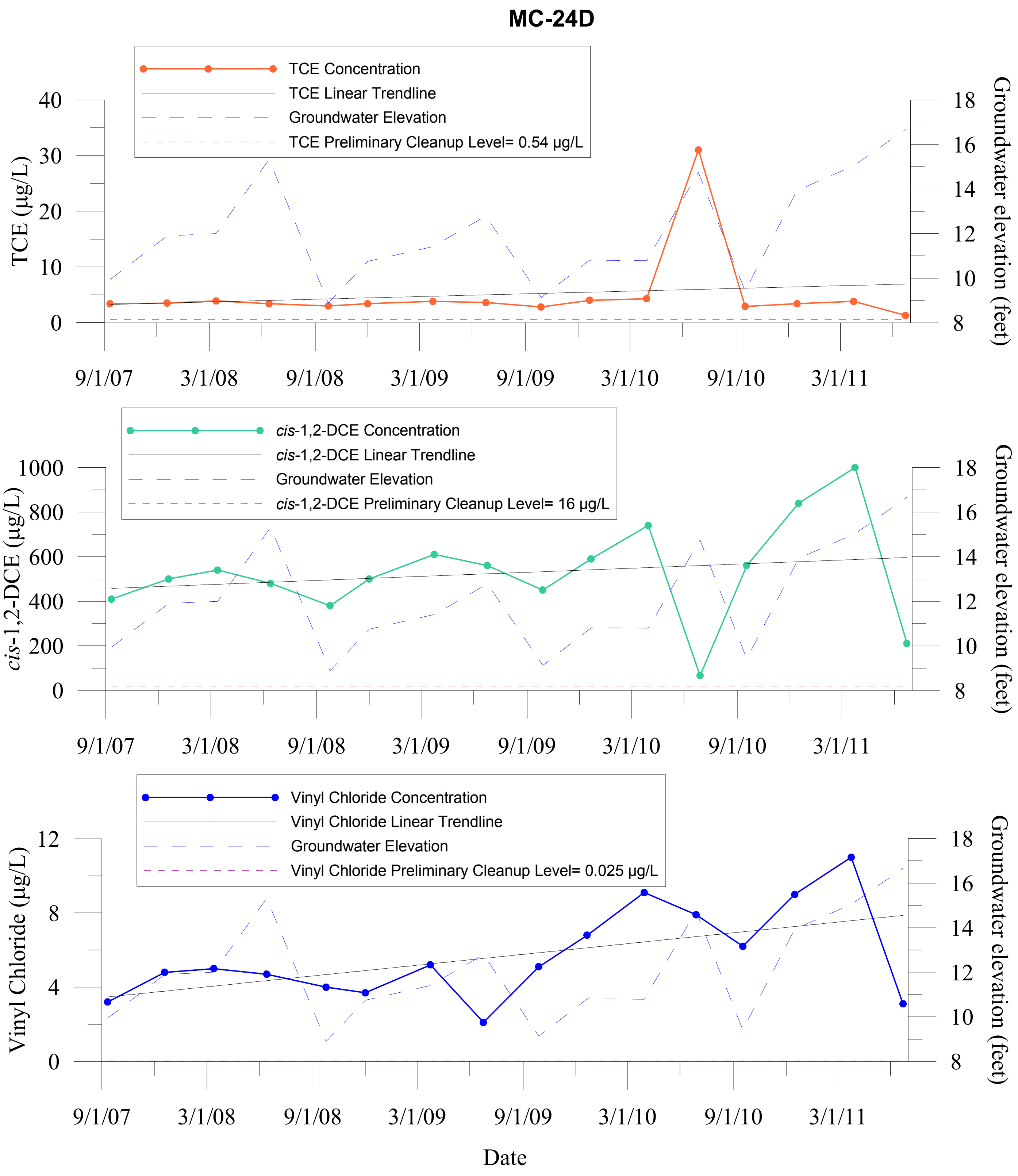
PCE, ARSENIC, AND 1,4-DIOXANE
CONCENTRATIONS VERSUS TIME^{1,2}
Shallow Groundwater Zone Well MC-21
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-21

P:\9625 - PSC Washougal\3000 REPORT\2009 RI FS Report\Figures\Grapher\MC-21_PCEAs14dio.grf



Abbreviations: *cis*-1,2-DCE = *cis*-1,2-dichloroethene
µg/L = micrograms per liter
TCE = trichloroethene

Note: 1. Value plotted is one-half reporting limit when analyte was not detected.
2. Groundwater elevations in feet above mean sea level.

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TCE, *CIS*-1,2-DCE, AND VINYL CHLORIDE
WITH GROUNDWATER ELEVATIONS VERSUS TIME[1,2]
Lower Aquifer Well MC-24D
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-22

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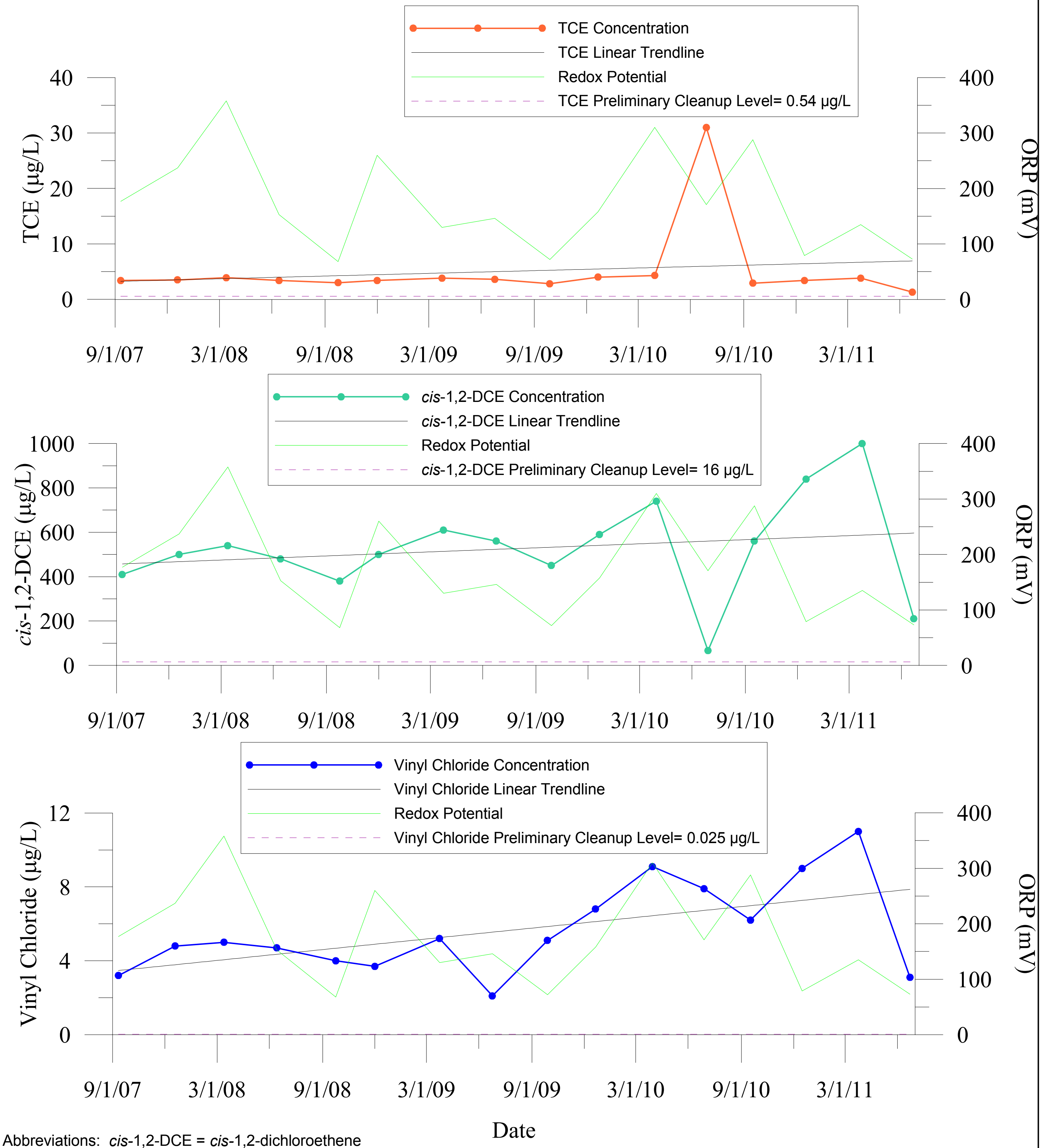
MC-24D



Abbreviations: *cis*-1,2-DCE = *cis*-1,2-dichloroethene
µg/L = micrograms per liter
TCE = trichloroethene
ORP = oxidation reduction potential

Note: 1. Value plotted is one-half reporting limit when analyte was not detected.

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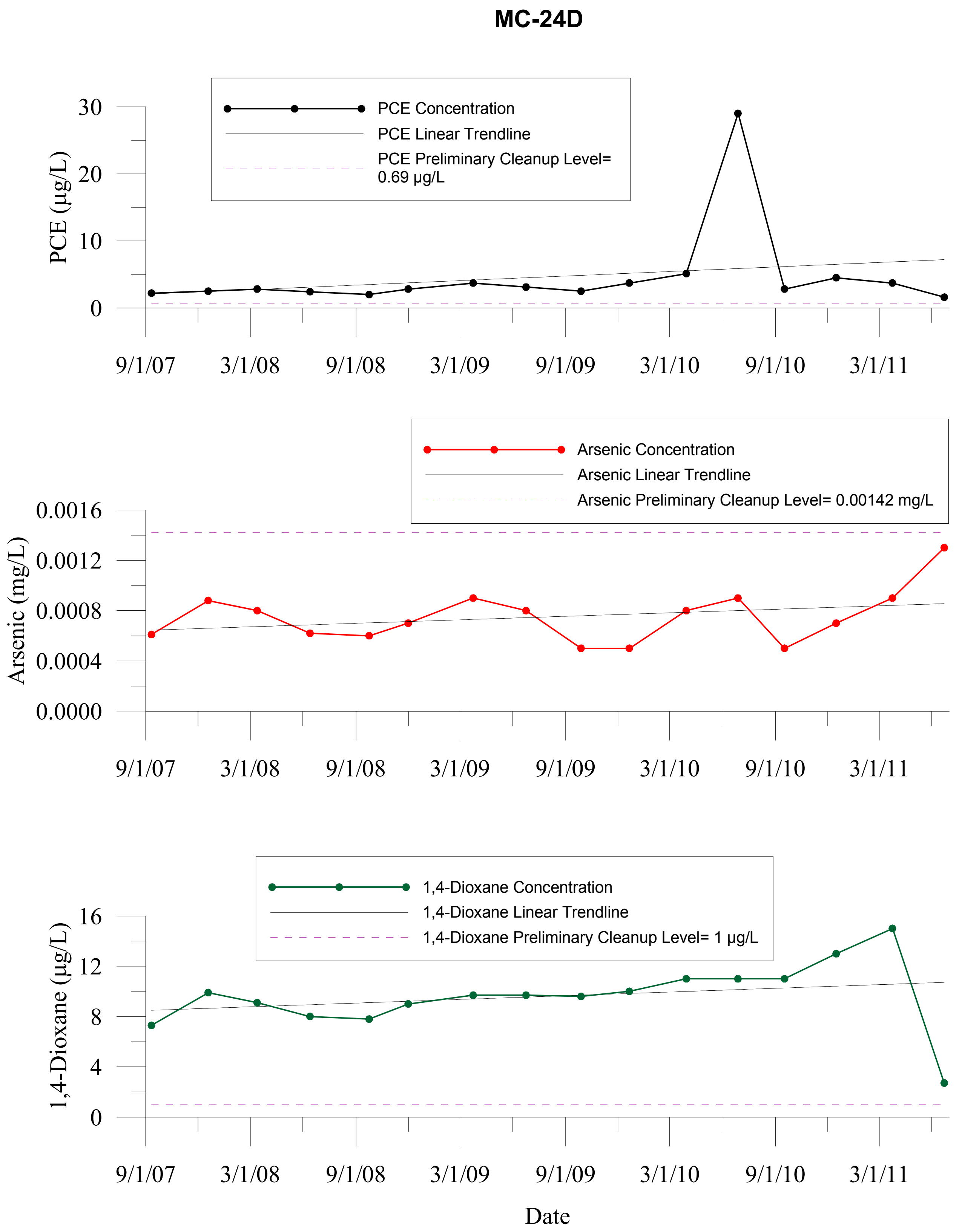
TCE, *CIS*-1,2-DCE, AND VINYL CHLORIDE
CONCENTRATIONS WITH ORP VERSUS TIME[1]
Lower Aquifer Well MC-24D
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-23



Abbreviations: µg/L = micrograms per liter
mg/L = milligrams per liter
PCE = tetrachloroethene

Note: 1. Value plotted is one-half reporting limit when analyte was not detected.

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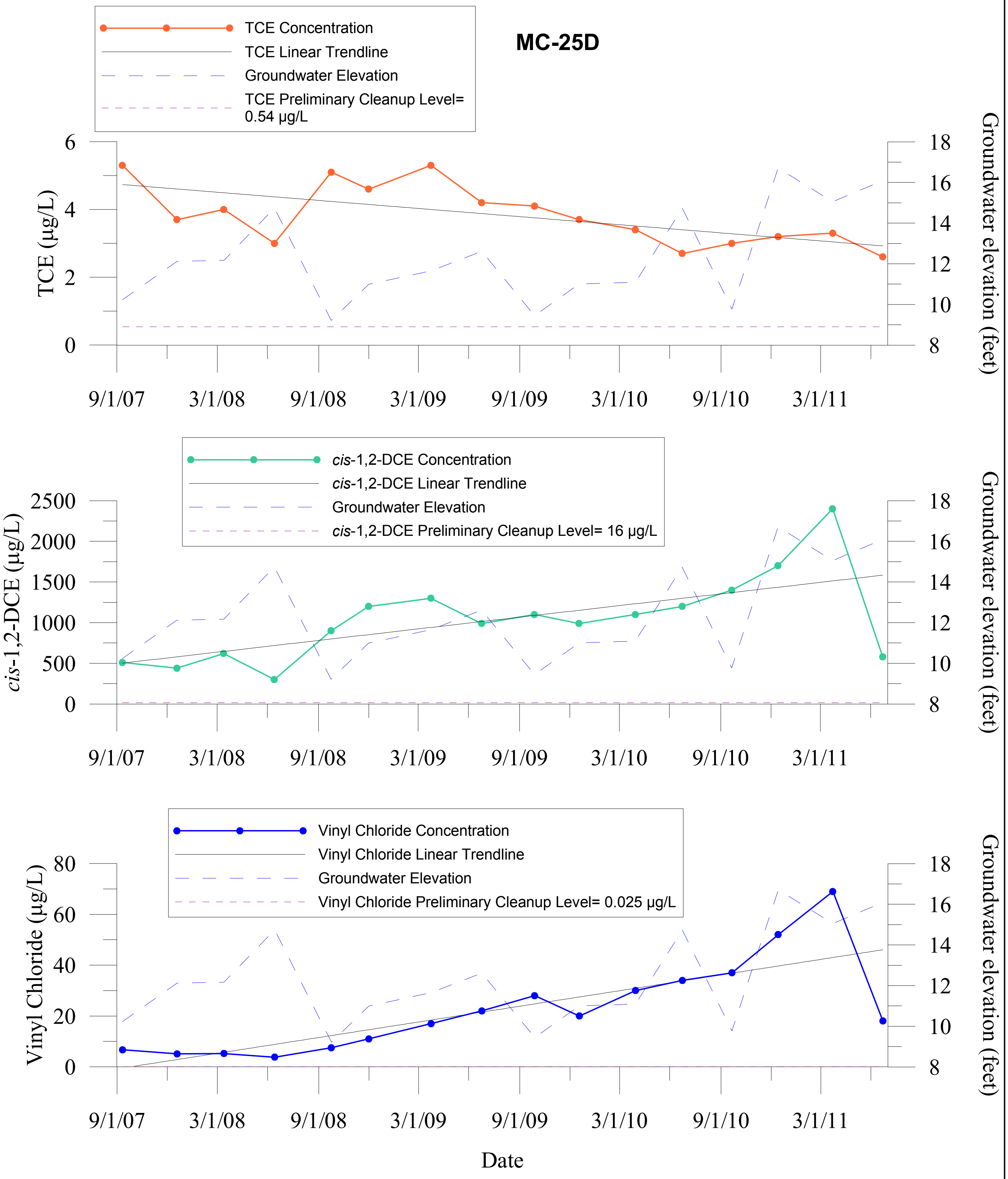
PCE, ARSENIC, AND 1,4-DIOXANE
CONCENTRATIONS VERSUS TIME[1]
Lower Aquifer Well MC-24D
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-24



Abbreviations: *cis*-1,2-DCE = *cis*-1,2-dichloroethene
µg/L = micrograms per liter
TCE = trichloroethene

Note: 1. Value plotted is one-half reporting limit when analyte was not detected.
2. Groundwater elevations in feet above mean sea level.

TCE, *CIS*-1,2-DCE, AND VINYL CHLORIDE
WITH GROUNDWATER ELEVATIONS VERSUS TIME[1,2]
Lower Aquifer Well MC-25D
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-25

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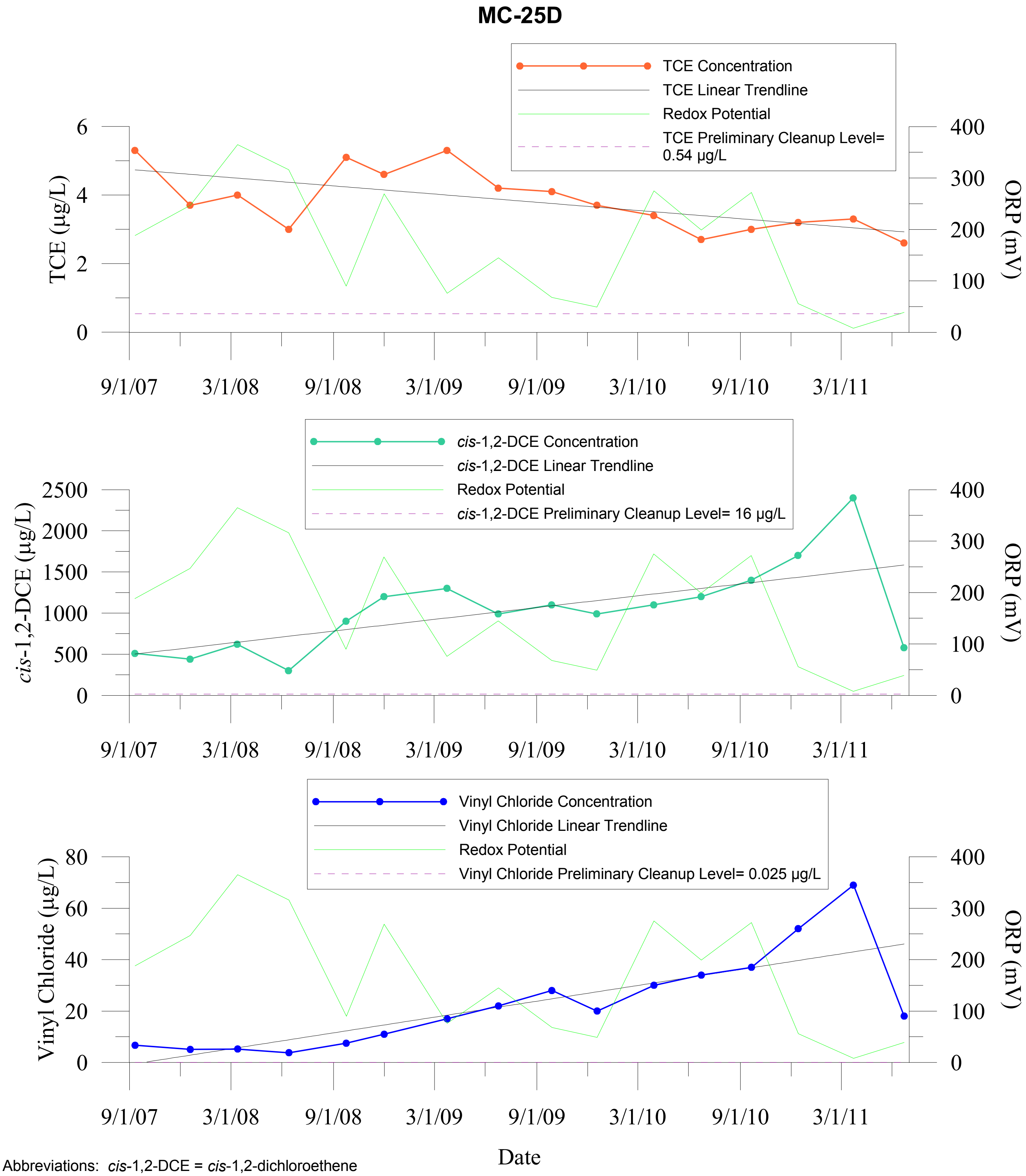

Abbreviations: *cis*-1,2-DCE = *cis*-1,2-dichloroethene
µg/L = micrograms per liter
TCE = trichloroethene
ORP = oxidation reduction potential

Note: 1. Value plotted is one-half reporting limit when analyte was not detected.

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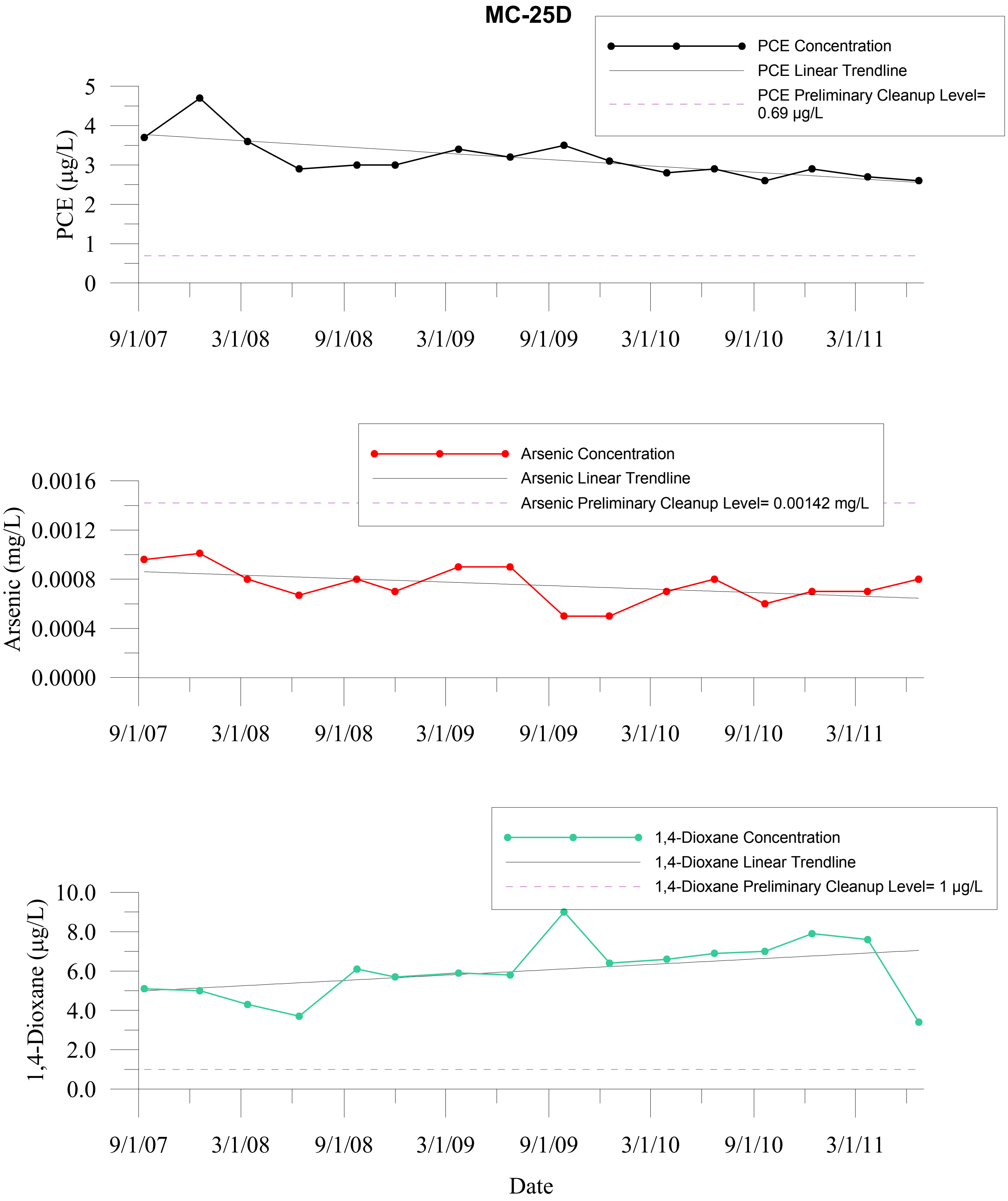
TCE, *CIS*-1,2-DCE, AND VINYL CHLORIDE
CONCENTRATIONS WITH ORP VERSUS TIME[1]
Lower Aquifer Well MC-25D
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-26

P:\9625 - PSC Washougal\3000 REPORT\2009 RI FS Report\Figures\Grapher\MC-25D_TCEcisVC.grf



Abbreviations: µg/L = micrograms per liter
mg/L = milligrams per liter
PCE = tetrachloroethene

Note: 1. Value plotted is one-half reporting limit when analyte was not detected.

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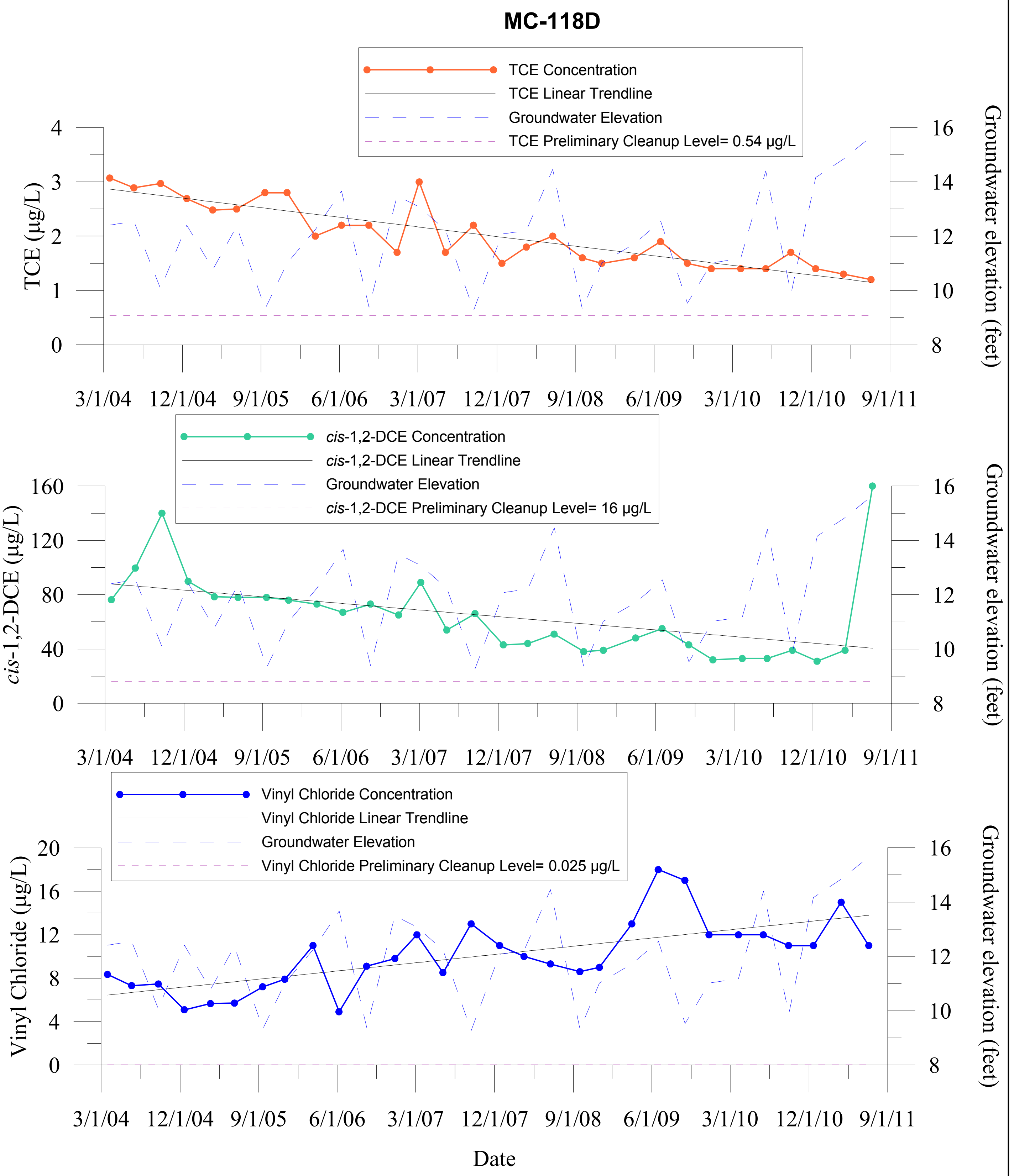
PCE, ARSENIC, AND 1,4-DIOXANE
CONCENTRATIONS VERSUS TIME[1]
Lower Aquifer Well MC-25D
PSC Washougal Facility, Washougal, Washington

Project No.	9625
Figure No.	12-27



Abbreviations: *cis*-1,2-DCE = *cis*-1,2-dichloroethene
µg/L = micrograms per liter
TCE = trichloroethene

Note: 1. Value plotted is one-half reporting limit when analyte was not detected.
2. Groundwater elevations in feet above mean sea level.

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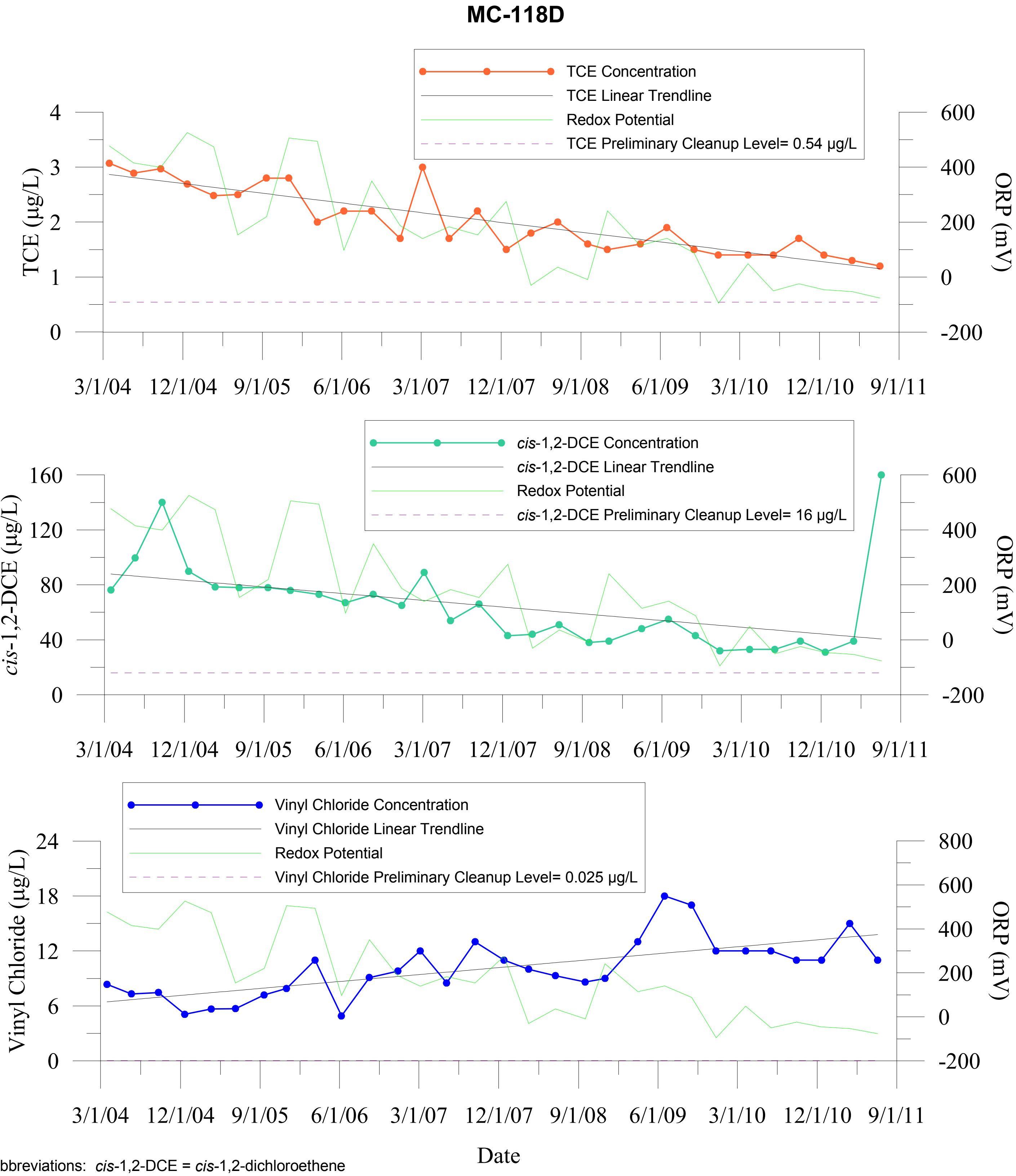
TCE, *CIS*-1,2-DCE, AND VINYL CHLORIDE
WITH GROUNDWATER ELEVATIONS VERSUS TIME^{1,2}
Lower Aquifer Well MC-118D
PSC Washougal Facility, Washougal, Washington

Project No.	9625
Figure No.	12-28



Abbreviations: *cis*-1,2-DCE = *cis*-1,2-dichloroethene
µg/L = micrograms per liter
TCE = trichloroethene
ORP = oxidation reduction potential

Note: 1. Value plotted is one-half reporting limit when analyte was not detected.

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TCE, *CIS*-1,2-DCE, AND VINYL CHLORIDE CONCENTRATIONS WITH ORP VERSUS TIME[1]
Lower Aquifer Well MC-118D
PSC Washougal Facility, Washougal, Washington

Project No.	9625
Figure No.	12-29

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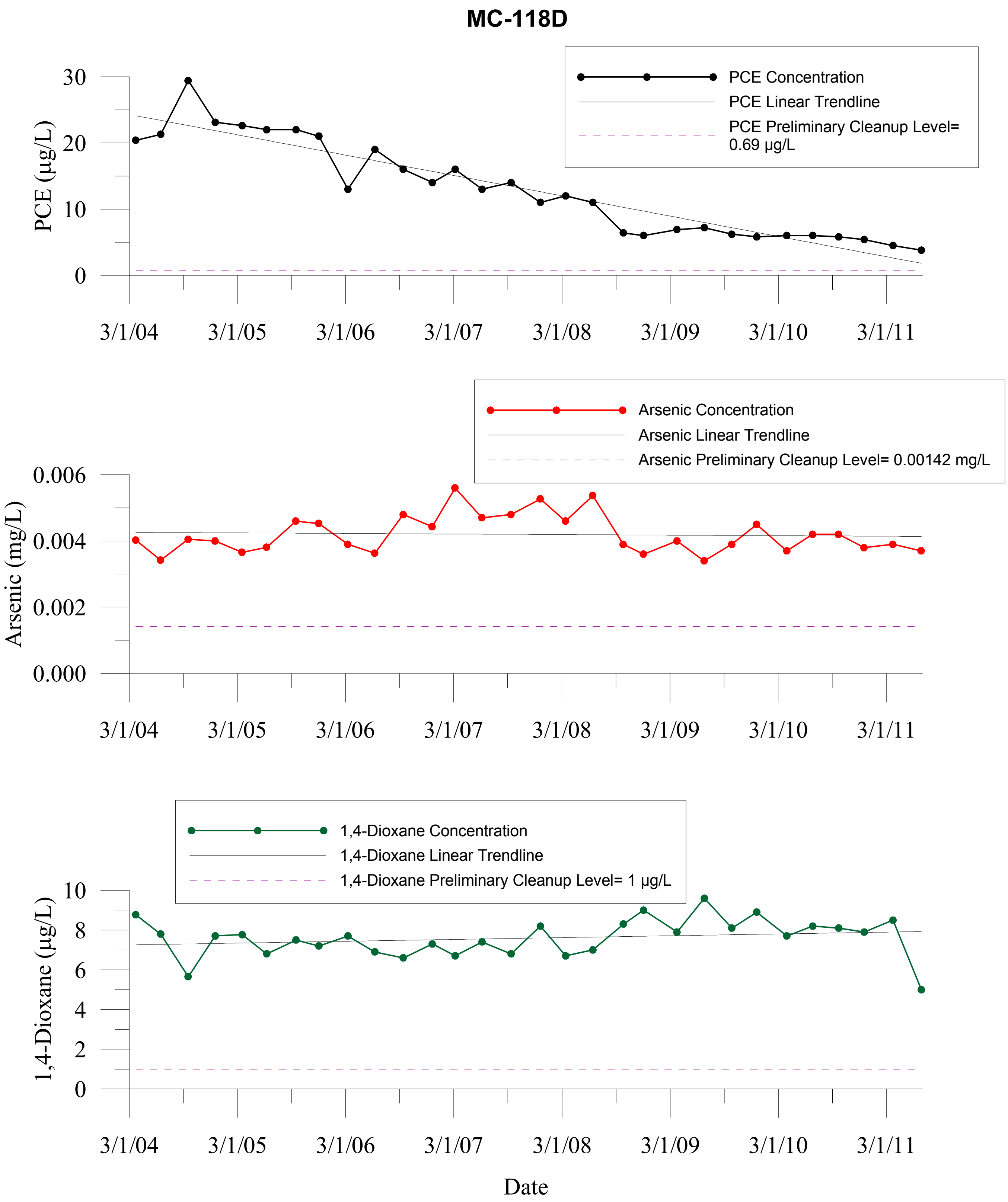

Abbreviations: µg/L = micrograms per liter
mg/L = milligrams per liter
PCE = tetrachlotorethene

Note: 1. Value plotted is one-half reporting limit when analyte was not detected.

PCE, ARSENIC, AND 1,4-DIOXANE
CONCENTRATIONS VERSUS TIME¹
Lower Aquifer Well MC-118D
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-30

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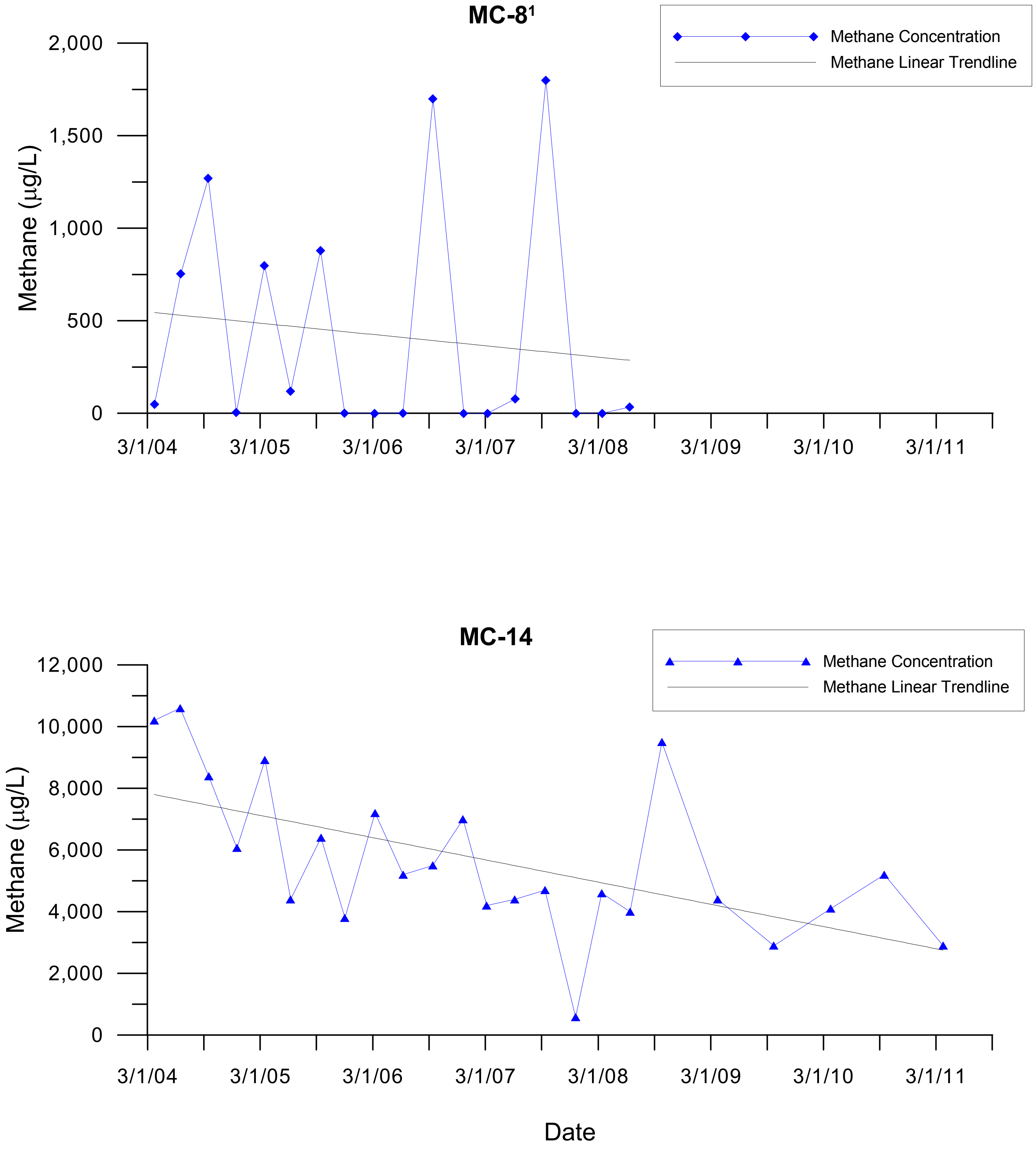

MC-8[1]

MC-14

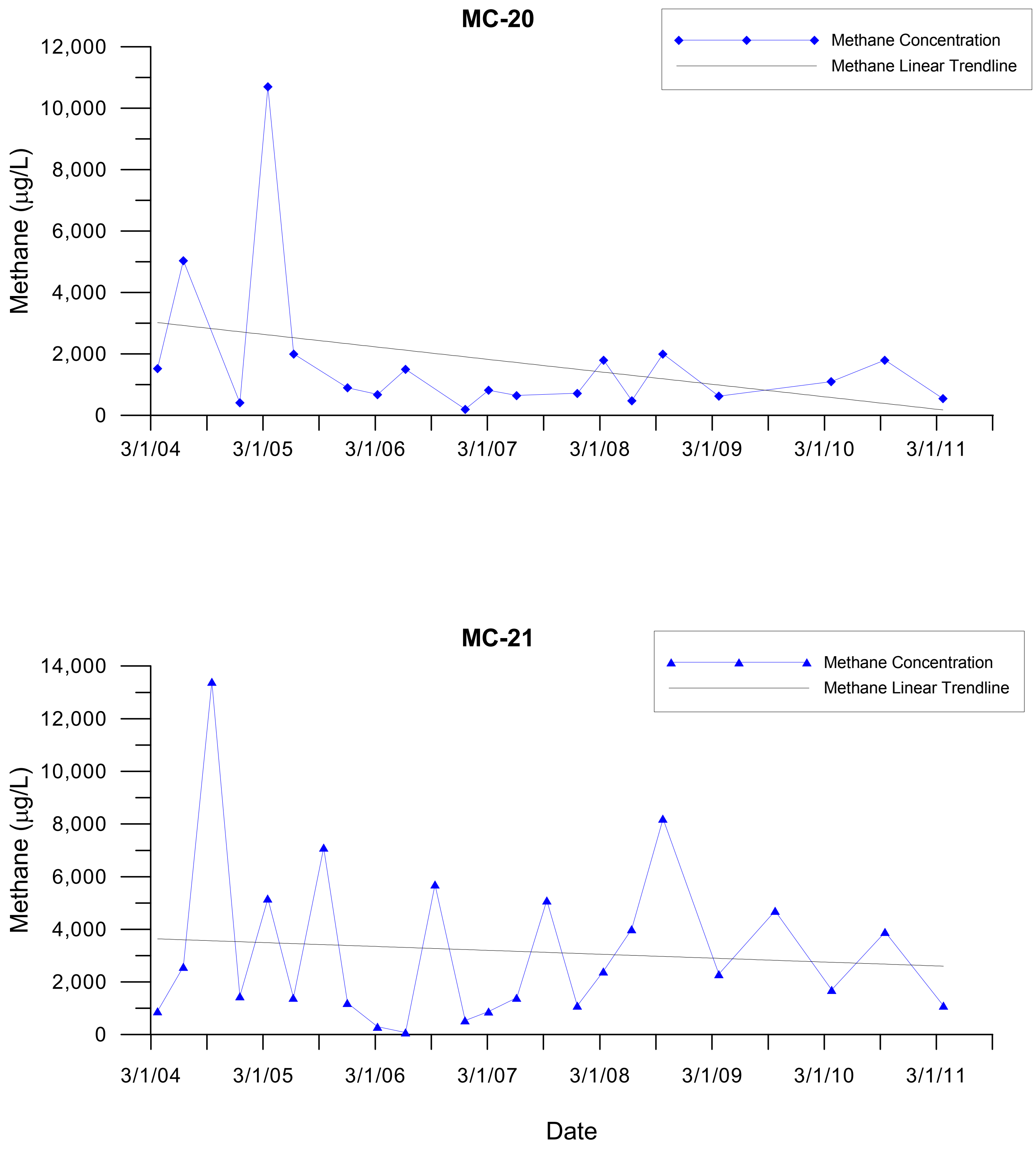
Abbreviations: µg/L = micrograms per liter

Note: 1. No methane data collected from MC-8 after 6/11/08.

METHANE CONCENTRATION VERSUS TIME
IN WELLS MC-8 AND MC-14
Shallow Groundwater Zone
PSC Washougal Facility, Washougal, Washington

Project No.	9625
Figure No.	12-31

P:\9625 - PSC Washougal\3000 REPORT\2009 RI FS Report\Chapter 12 - Fate and Transport\Figures\Figure 12-25 Methane Shallow Aquifer_A.grf



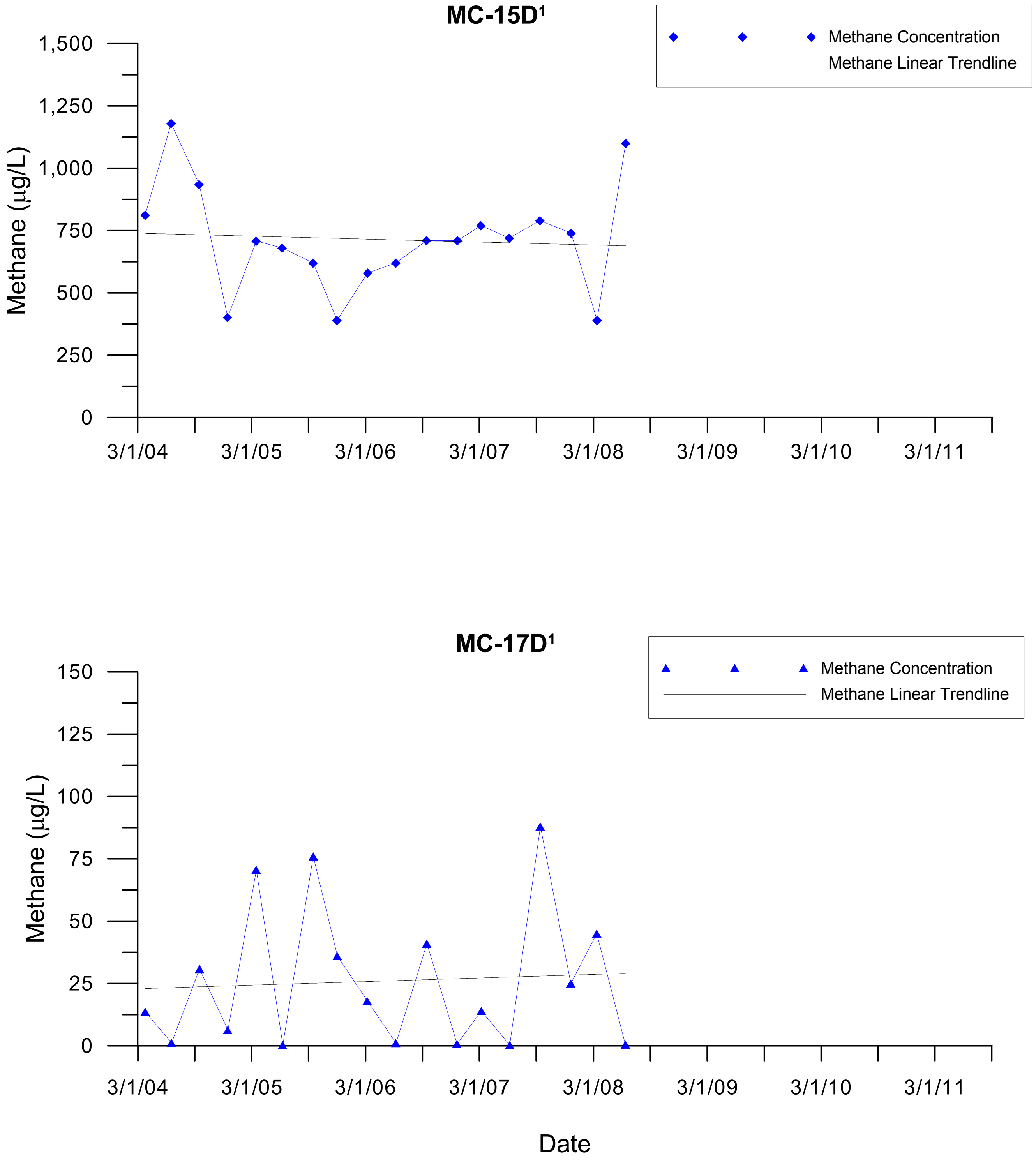
Abbreviations: µg/L = micrograms per liter

METHANE CONCENTRATION VERSUS TIME
IN WELLS MC-20 AND MC-21
Shallow Groundwater Zone
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-32

P:\9625 - PSC Washougal\3000 REPORT\2009 RI FS Report\Chapter 12 - Fate and Transport\Figures\Figure 12-26 Methane Shallow Aquifer_B.grf



Abbreviations: µg/L = micrograms per liter

Note: 1. No methane data collected from MC-15D or MC-17D after 6/12/08.

METHANE CONCENTRATION VERSUS TIME
IN WELLS MC-15D AND MC-17D
Lower Aquifer
PSC Washougal Facility, Washougal, Washington

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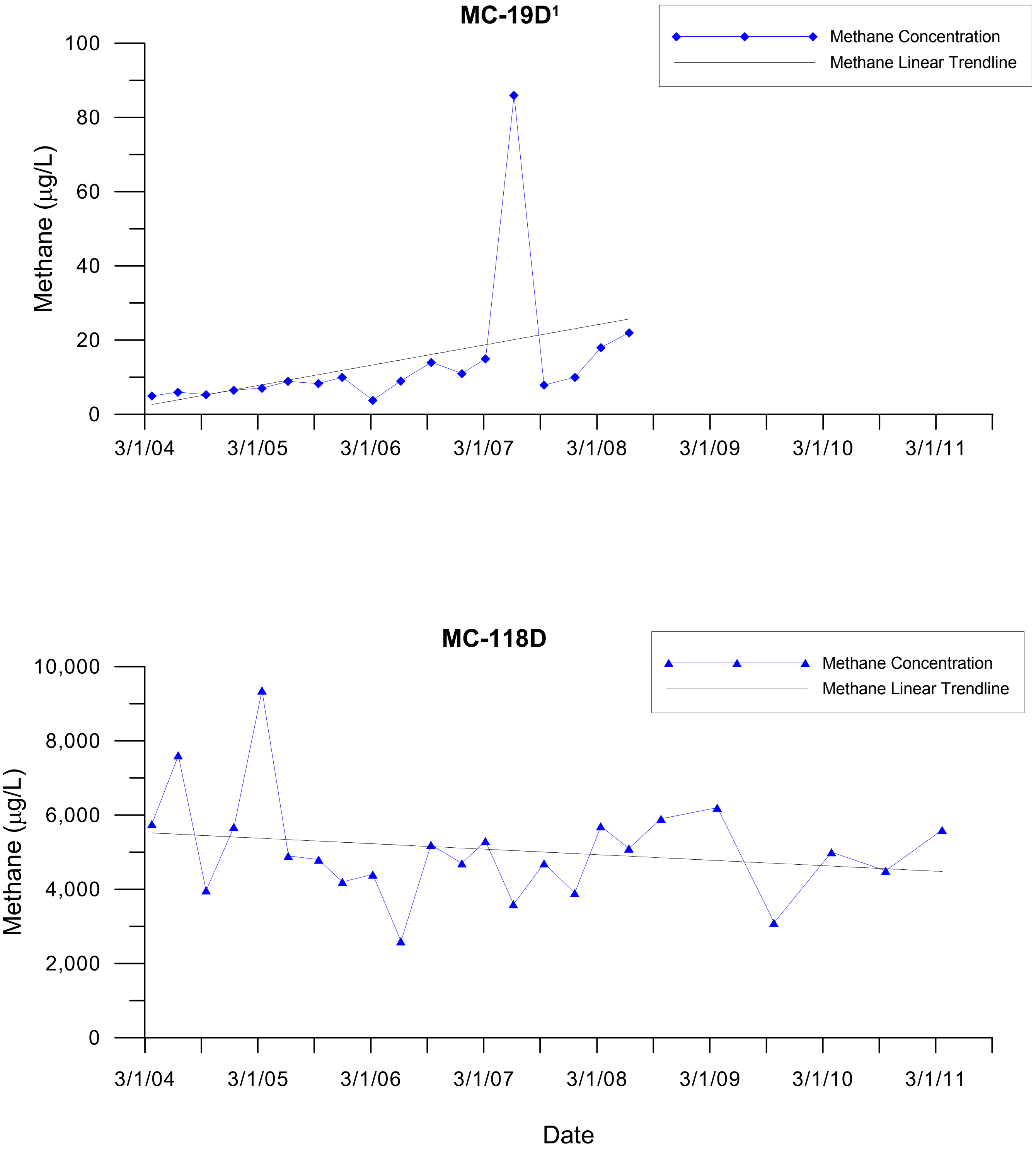
Project No.	9625
Figure No.	12-33



Abbreviations: µg/L = micrograms per liter

Note: 1. No methane data collected from MC-19D after 6/13/08.

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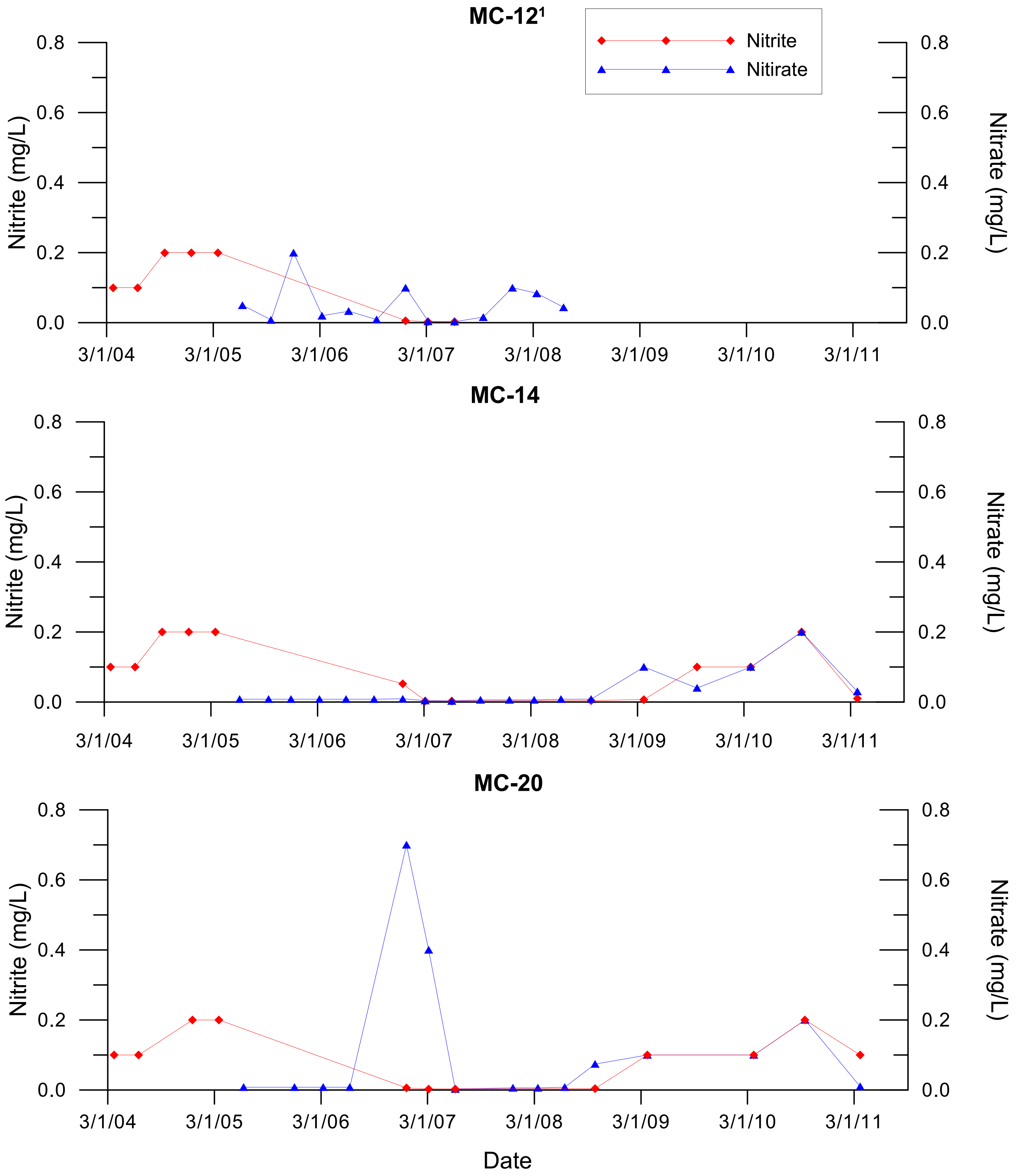
METHANE CONCENTRATION VERSUS TIME
IN WELLS MC-19D AND MC-118D
Lower Aquifer
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-34

P:\9625 - PSC Washougal\3000 REPORT\2009 RI FS Report\Chapter 12 - Fate and Transport\Figures\Figure 12-28 Methane Lower Aquifer_B.grf



Abbreviations: mg/L = milligrams per liter

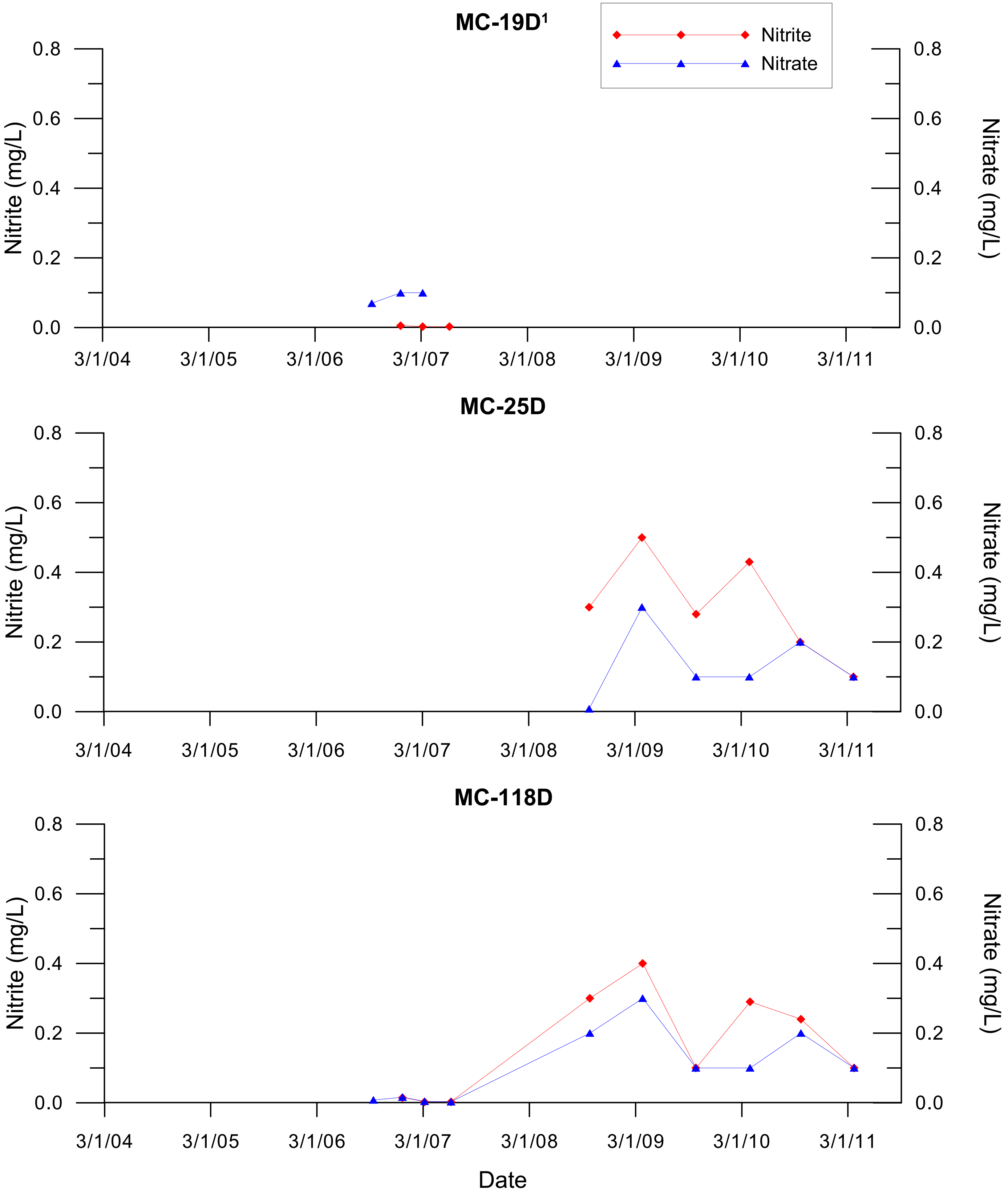
Notes: 1. No nitrite/nitrate data collected from MC-12 after 6/13/08.
2. Nitrate/nitrite data unavailable for Well MC-25.

NITRATE AND NITRITE CONCENTRATIONS VERSUS TIME
SHALLOW GROUNDWATER ZONE²
WELLS MC-12, MC-14, AND MC-20
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-35

P:\9625 - PSC Washougal\3000 REPORT\2009 RI FS Report\Chapter 12 - Fate and Transport\Figure 12-29 NitrateNitrite Shallow Zone.grf



Abbreviations: mg/L = milligrams per liter

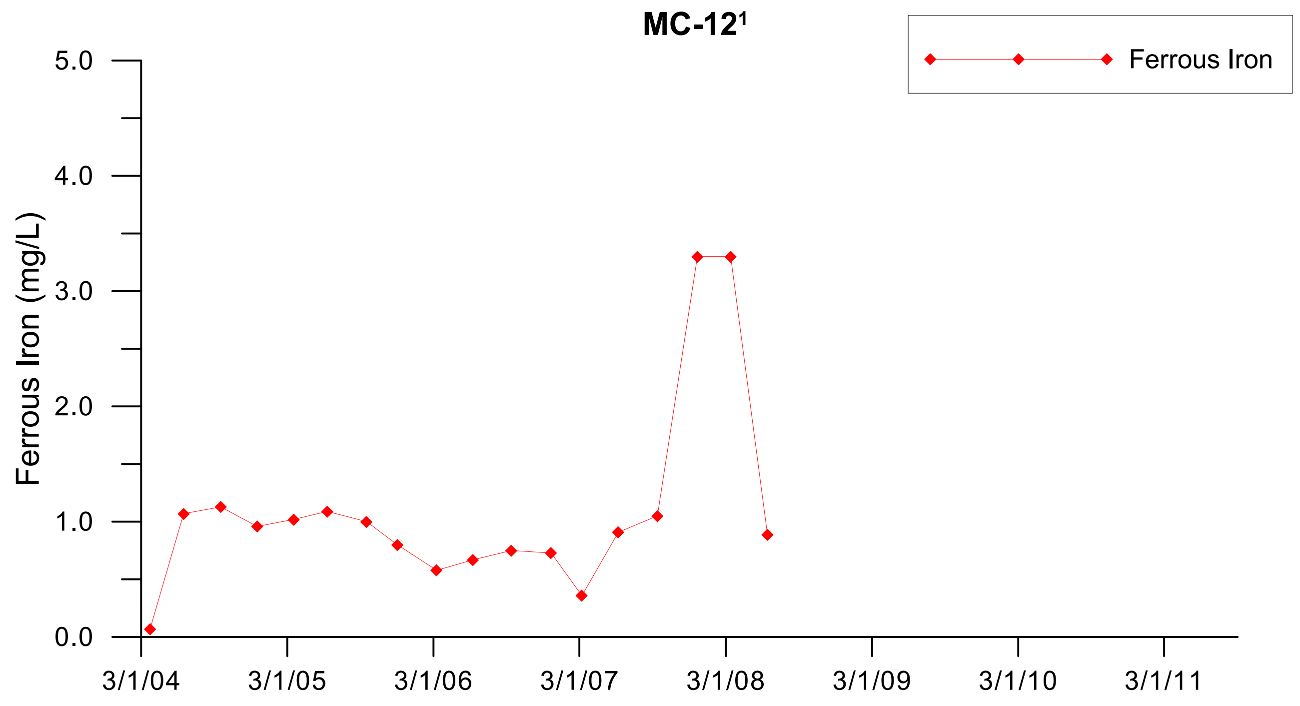
Notes: 1. No nitrite/nitrate data collected from MC-19D after 6/07/07.
2. Nitrate/Nitrite data unavailable for Well MC-14D.

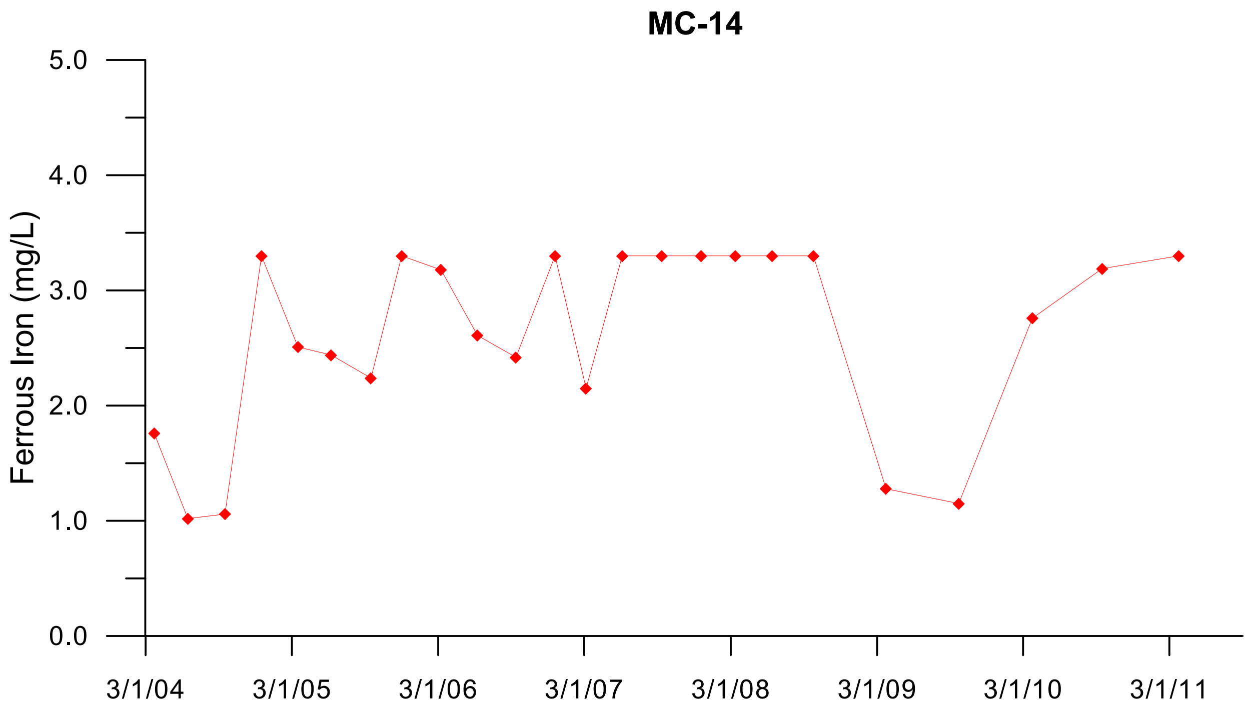
NITRATE AND NITRITE CONCENTRATIONS VERSUS TIME
LOWER AQUIFER WELLS MC-19D, MC-25D, AND MC-118D²
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-36

P:\9625 - PSC Washougal\3000 REPORT\2009 RI FS Report\Chapter 12 - Fate and Transport\Figures\Figure 12-30 NitrateNitrite Lower Aquifer 1.grf





Abbreviations: mg/L = milligrams per liter

Note: 1. No ferrous iron data collected from MC-12 after 6/13/08.

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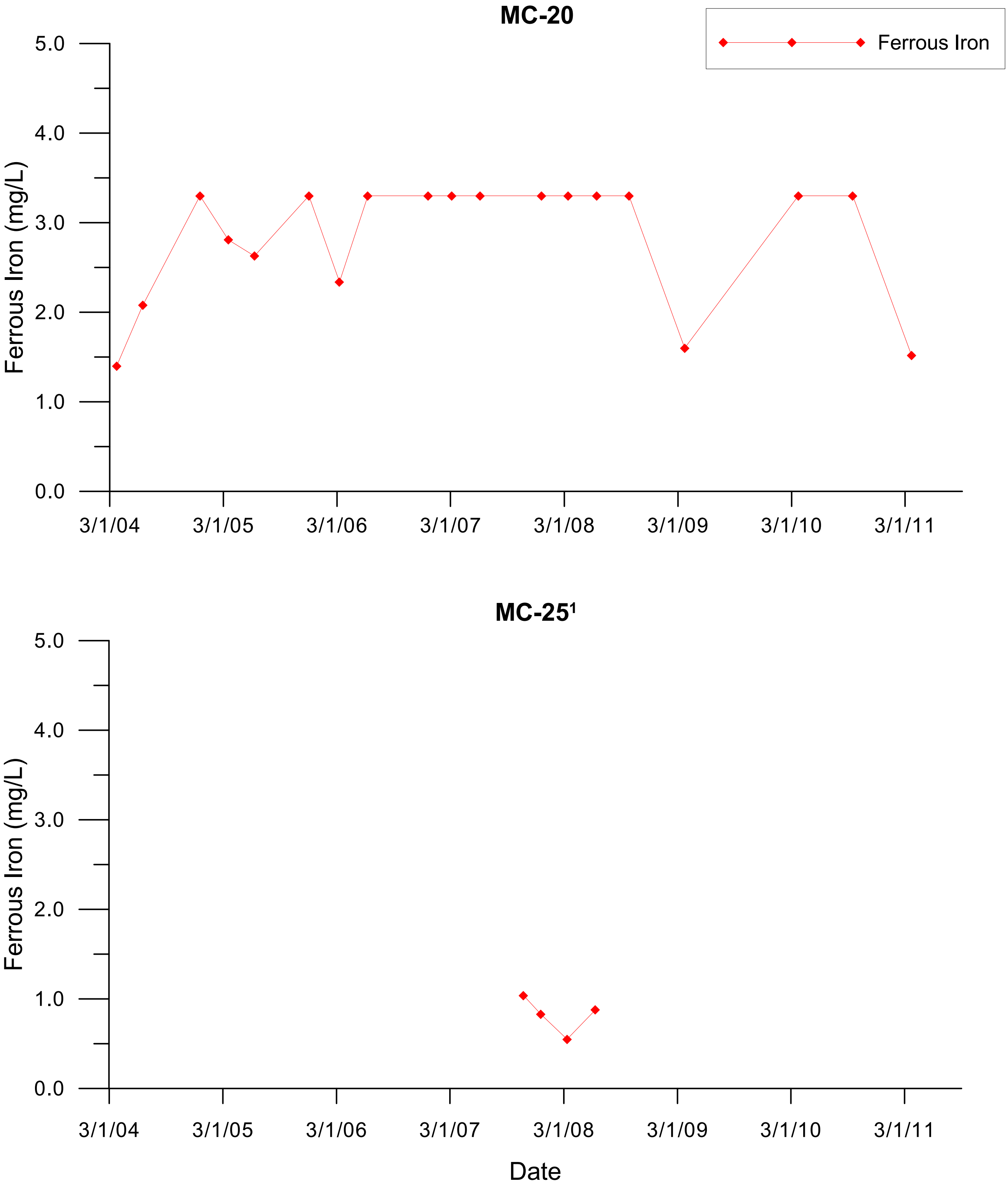
FERROUS IRON CONCENTRATION VERSUS TIME
SHALLOW GROUNDWATER ZONE
WELLS MC-12 AND MC-14
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-37

P:\9625 - PSC Washougal\3000 REPORT\2009 RI FS Report\Chapter 12 - Fate and Transport\Figures\Figure 12-31 Ferrous Shallow Zone 1.grf



Abbreviations: mg/L = milligrams per liter

Note: 1. No ferrous iron data collected from MC-25 after 6/11/08.

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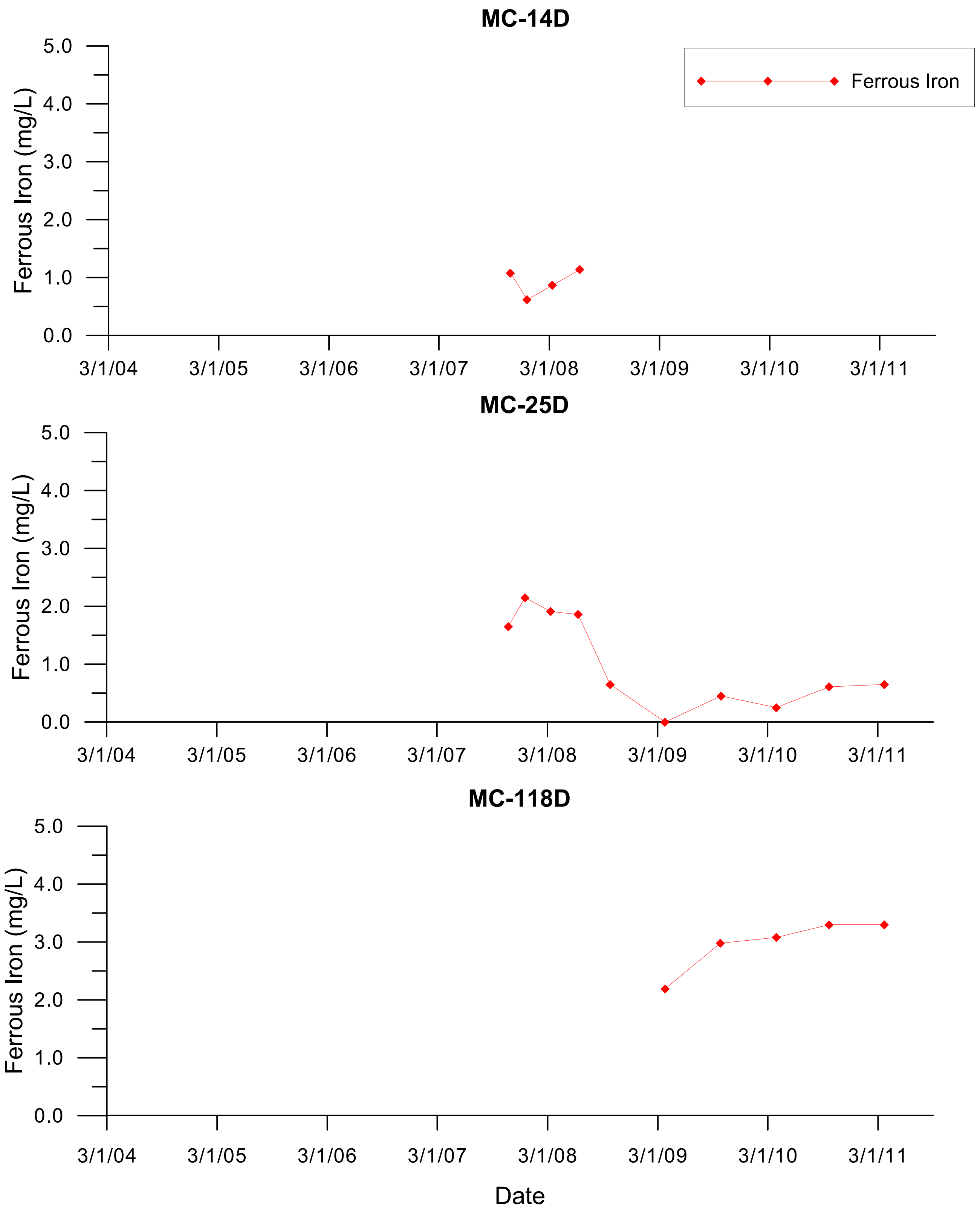
FERROUS IRON CONCENTRATION VERSUS TIME
SHALLOW GROUNDWATER ZONE
WELLS MC-20 and MC-25
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-38

P:\9625 - PSC Washougal\3000 REPORT\2009 RI FS Report\Chapter 12 - Fate and Transport\Figures\Figure 12-32 Ferrous Shallow Zone 2.grf



Abbreviations: mg/L = milligrams per liter

Notes: 1. No ferrous iron data collected from MC-14D after 6/10/08.
2. Ferrous iron data unavailable for Well MC-19D.

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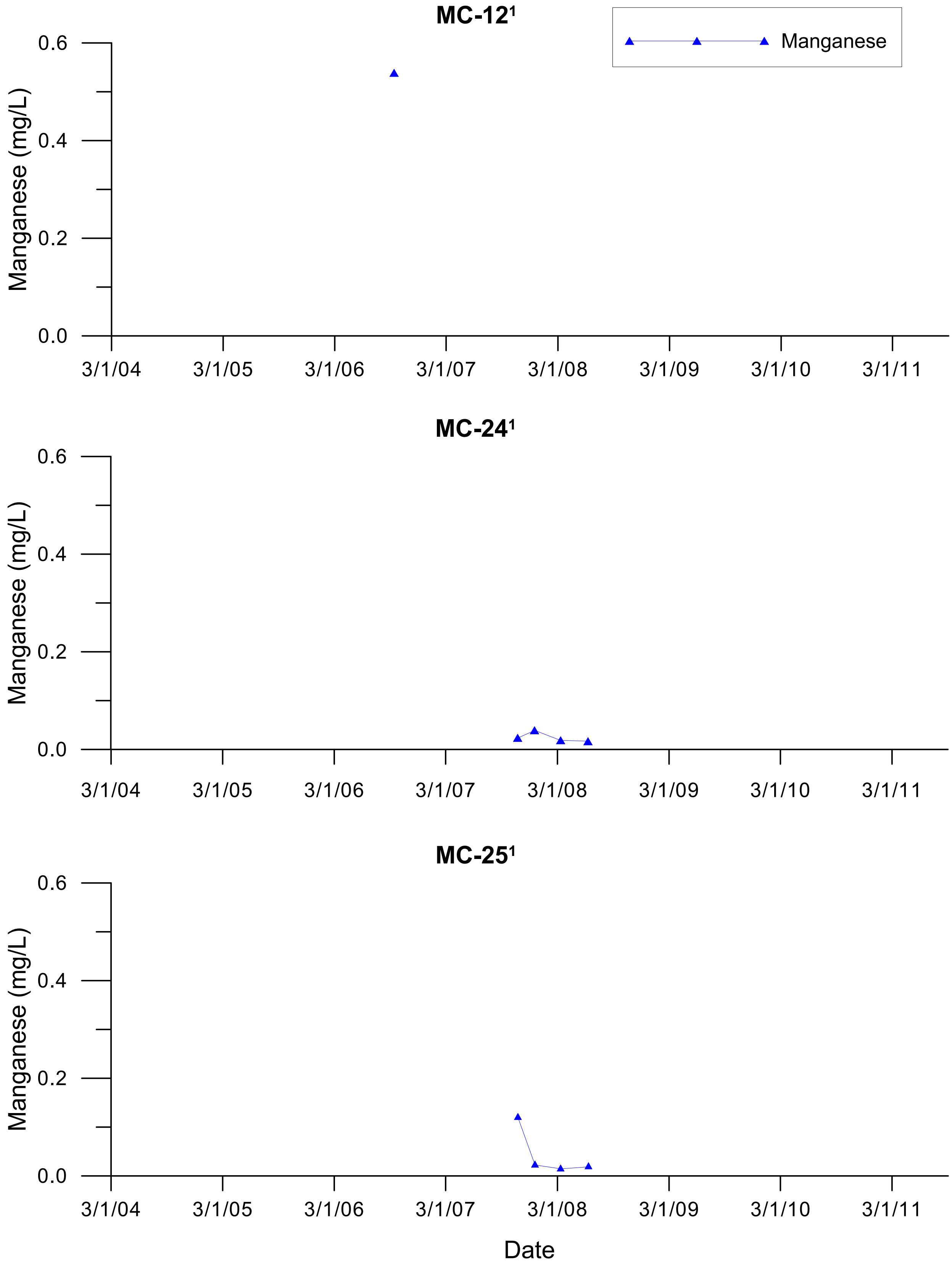
FERROUS IRON CONCENTRATION VERSUS TIME
LOWER AQUIFER WELLS^2
MC-14D, MC-25D, AND MC-118D
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-39

P:\9625 - PSC Washougal\3000 REPORT\2009 RI FS Report\Chapter 12 - Fate and Transport\Figures\Figure 12-33 Ferrous Lower Aquifer 1.grf



Abbreviations: mg/L = milligrams per liter

Note: 1. No manganese data collected from MC-12, MC-24 or MC-25 after 6/10/08.

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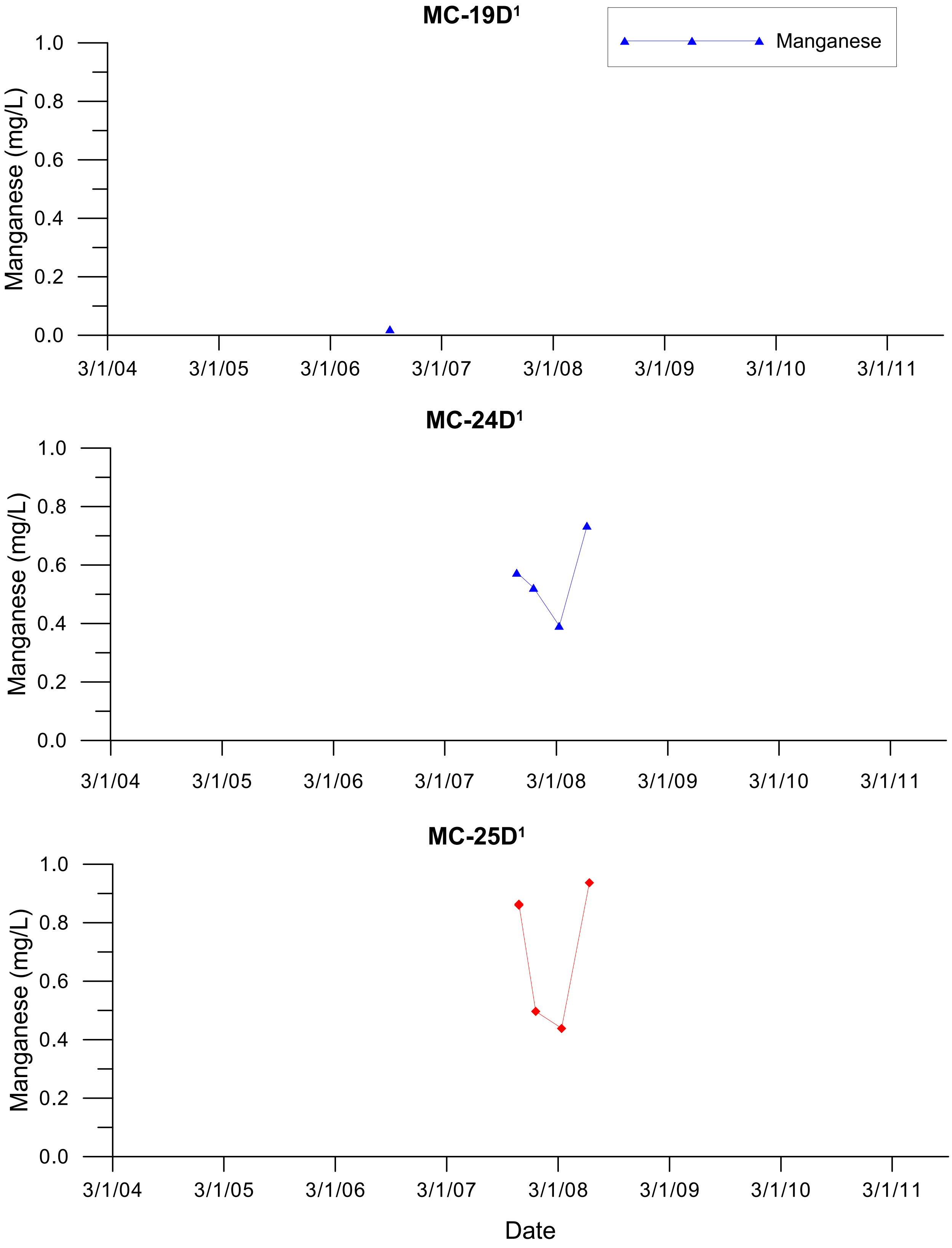
MANGANESE CONCENTRATIONS VERSUS TIME
SHALLOW GROUNDWATER ZONE WELLS
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-40

P:\9625 - PSC Washougal\3000 REPORT\2009 RI FS Report\Chapter 12 - Fate and Transport\Figure 12-34 Manganese Shallow Zone.grf


MC-19D[1]

MC-24D[1]

MC-25D[1]

Abbreviations: mg/L = milligrams per liter

Note: 1. No manganese data collected from MC-19D, MC-24D or MC-25D after 6/11/08.

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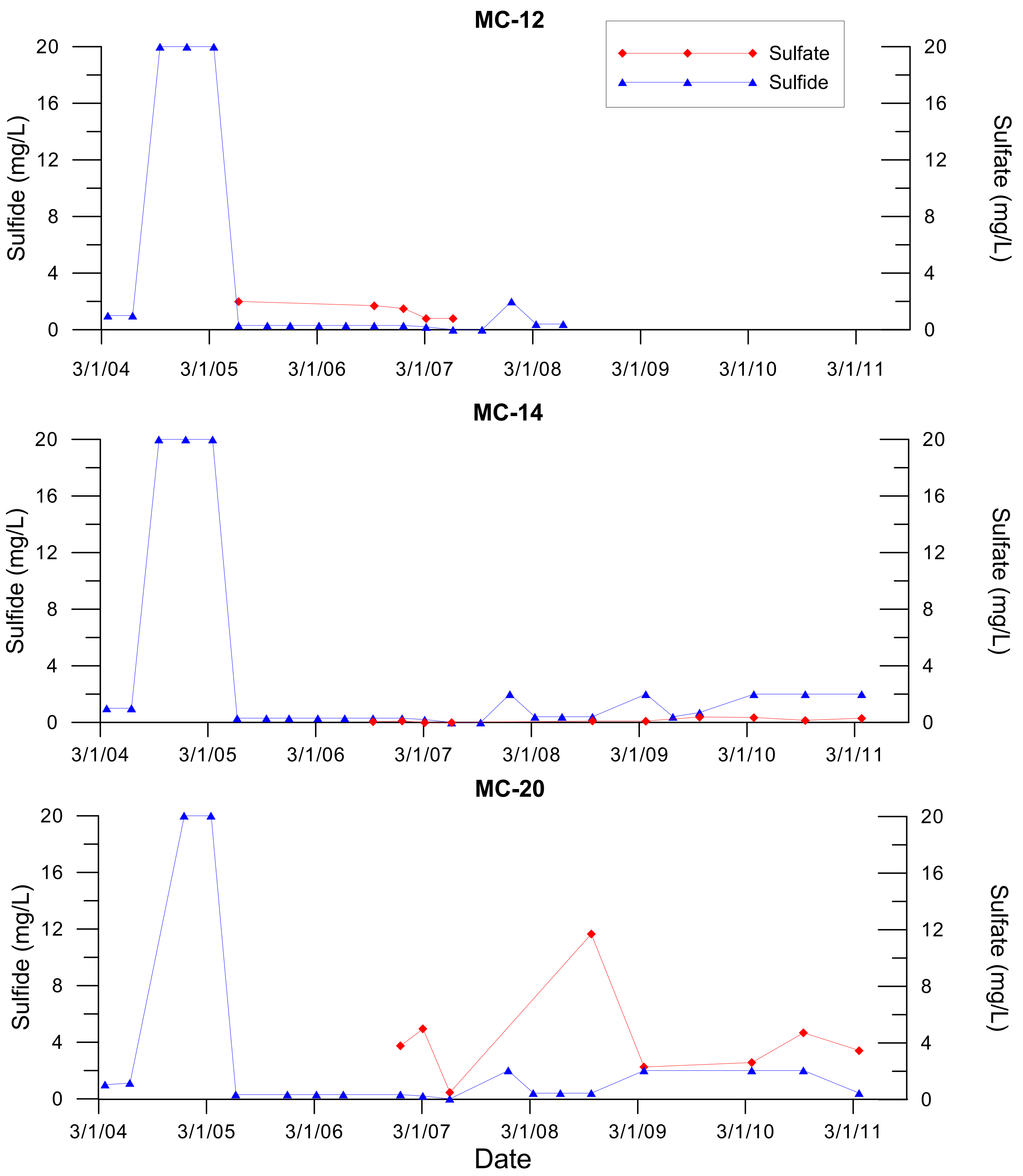
MANGANESE CONCENTRATIONS VERSUS TIME
LOWER AQUIFER WELLS
PSC Washougal Facility, Washougal, Washington

Project No.	9625
Figure No.	12-41

P:\9625 - PSC Washougal\3000 REPORT\2009 RI FS Report\Chapter 12 - Fate and Transport\Figure 12-35 Manganese Lower Aquifer.grf



Abbreviations: mg/L = milligrams per liter

Notes: 1. No sulfide/ sulfate data collected from MC-12 after 6/13/08.
2. Sulfate/sulfide data unavailable for Well MC-25.

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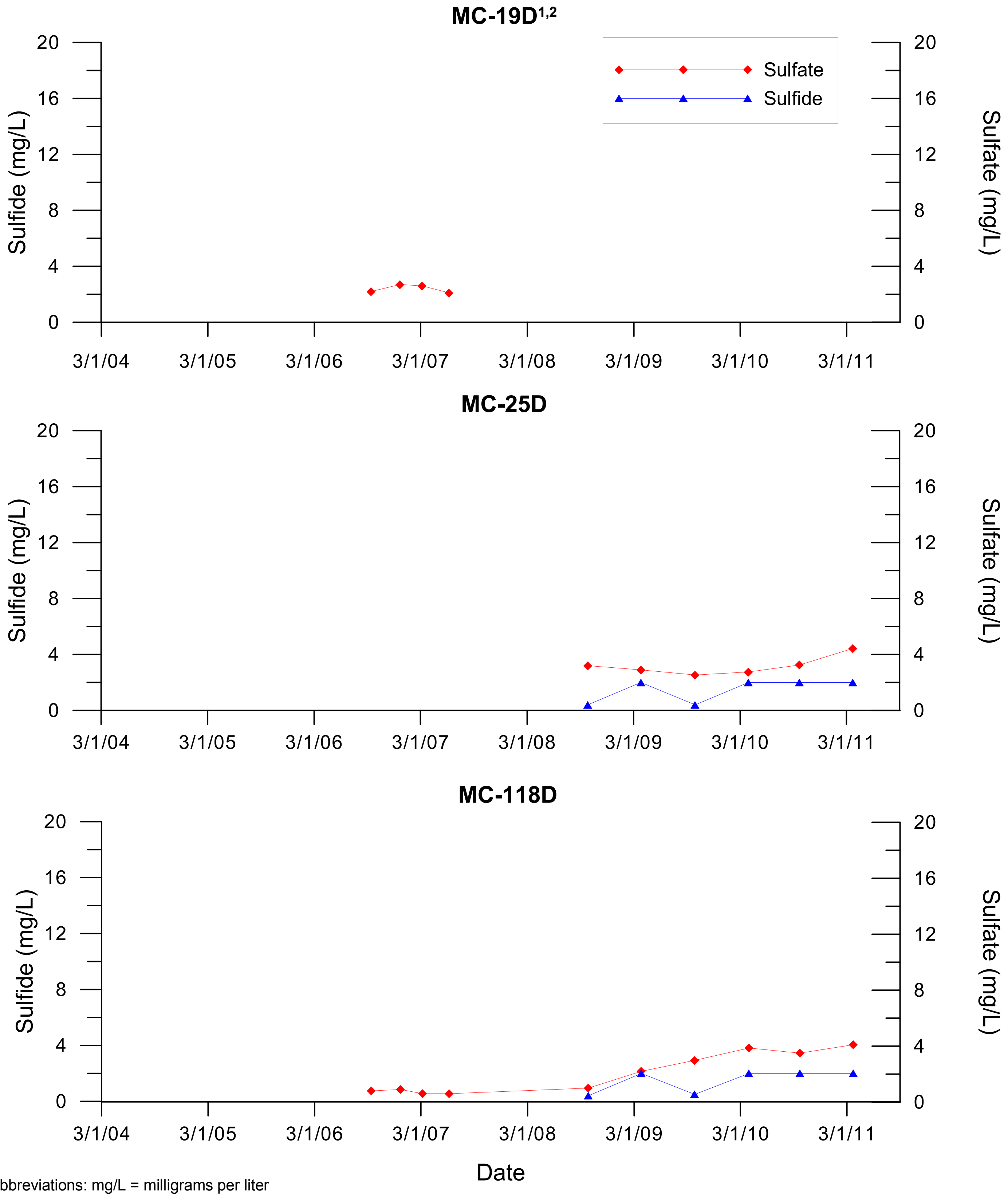
SULFATE AND SULFIDE CONCENTRATIONS VERSUS TIME
SHALLOW GROUNDWATER ZONE^2
WELLS MC-12, MC-14, AND MC-20
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-42

P:\9625 - PSC Washougal\3000 REPORT\2009 RI FS Report\Chapter 12 - Fate and Transport\Figures\Figure 12-6 SulfideSulfate Shallow Zone.grf



MC-19D[1,2]

MC-25D

MC-118D

Abbreviations: mg/L = milligrams per liter

Notes: 1. No sulfate data collected from MC-19D after 6/07/07.
2. Sulfide data unavailable for Well MC-19D.
3. Sulfate/sulfide data unavailable for Well MC-14D.

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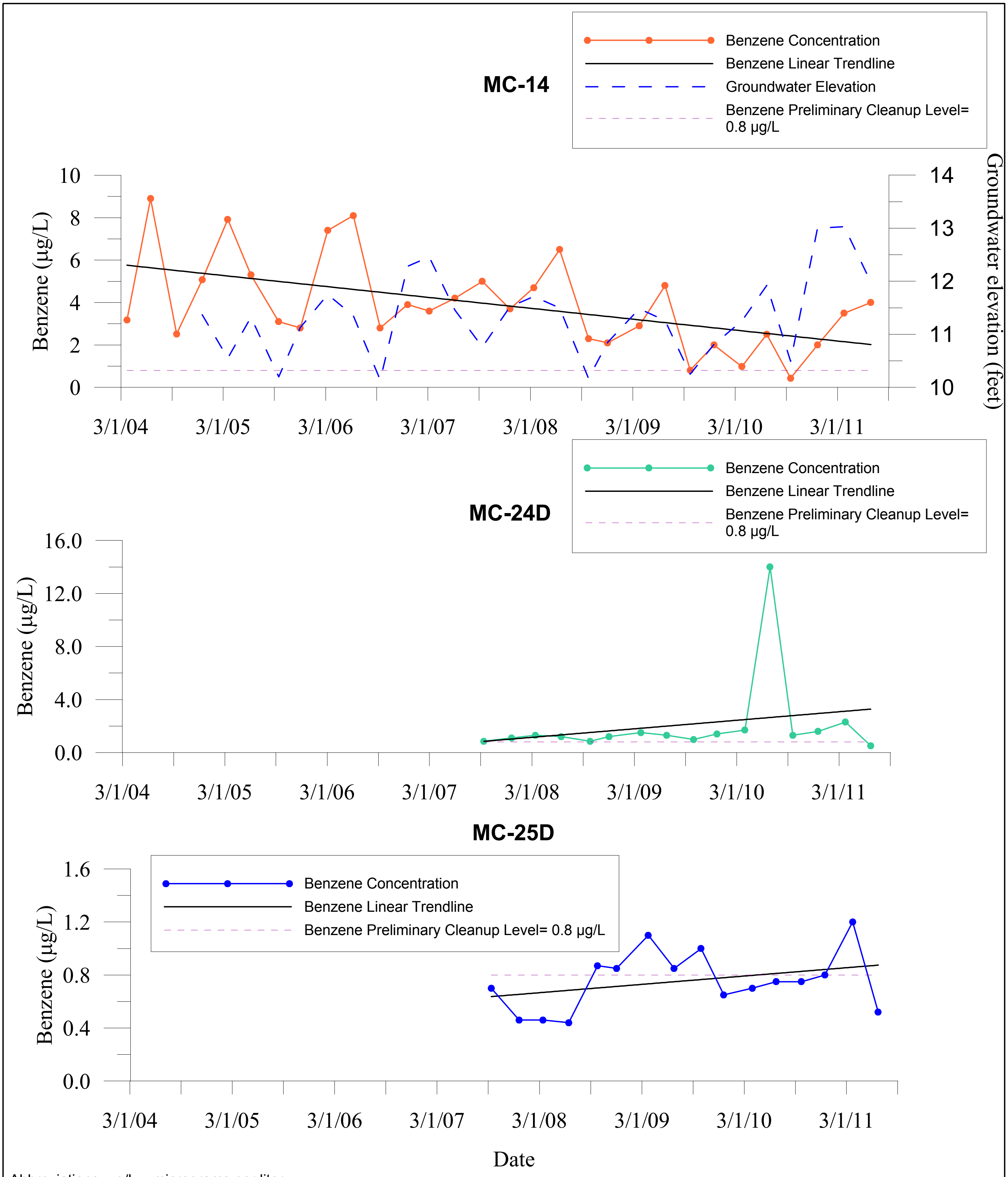
SULFATE AND SULFIDE
CONCENTRATIONS VERSUS TIME[3]
LOWER AQUIFER WELLS
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-43

P:\9625 - PSC Washougal\3000 REPORT\2009 RI FS Report\Chapter 12 - Fate and Transport\Figures\Figure 12-37 SulfideSulfate Lower Aquifer.grf



Abbreviations: µg/L = micrograms per liter

Notes: 1. Value plotted is one-half reporting limit when analyte was not detected.
2. Groundwater elevations in feet above mean sea level.

BENZENE CONCENTRATIONS AND GROUNDWATER ELEVATION VERSUS TIME^{1,2}
Wells MC-14, MC-24D, and MC-25D
PSC Washougal Facility, Washougal, Washington

Project No.
9625

Figure No.
12-44

P:\9625 - PSC Washougal\3000 REPORT\2009 RI FS Report\Figures\Grapher\Figure 12-38 Benzene and GW Elevation.grf

13.0 REPORT LIMITATIONS

Within the limitations of the agreed-upon scope of work, this assessment has been undertaken and performed in a professional manner in accordance with generally accepted practices, using the degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. Due to physical limitations inherent to this or any environmental assessment, AMEC expressly does not warrant that the site is free of pollutants or that all pollutants have been identified. No other warranties, express or implied, are made.

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