

FINAL
Remedial Investigation Summary Report
Terminal 91 Tank Farm Site
Seattle, Washington

August 2007

Prepared for:
Port of Seattle



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Roth Consulting

LICENSED GEOLOGIST SIGNATURE PAGE

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LIST OF ABBREVIATIONS AND ACRONYMS

Agreed Order	Agreed Order No. 98HW-N108
AOC	Area of Concern
APH	Air-Phase Petroleum Hydrocarbons
Aspect	Aspect Consulting
Baseline Report	<i>Terminal 91 Baseline Report</i>
BD Work Plan	<i>Bridge Document Work Plan</i>
BDR1	<i>Bridge Document Report 1</i>
BDR2	<i>Bridge Document Report 2</i>
BDR3	<i>Bridge Document Report 3</i>
BEI	Burlington Environmental Inc.
bgs	Below ground surface
Chempro	Chemical Processors, Inc.
COPC	Chemical of potential concern
CSM	Conceptual site model
CUL	Cleanup level
DCA	Deep Confined Aquifer
DO	Dissolved oxygen
Ecology	Washington Department of Ecology
EIS	Environmental Impact Statement
EPA	U. S. Environmental Protection Agency
ESE	Environmental Science and Engineering, Inc.
FAMM	Fuel and Marine Marketing
ft	feet
FS	Feasibility Study
GWSAP	<i>Groundwater Sampling and Analysis Plan</i>
IHS	Indicator hazardous substance
JE Model	Johnson and Ettinger Model for Subsurface Vapor Intrusion into Buildings
Lease Parcel	Tank Farm Lease Parcel
LNAPL	Light non-aqueous-phase liquid
MADEP	Massachusetts Department of Environmental Protection
MNA Work Plan	<i>Monitored Natural Attenuation Evaluation Work Plan</i>
MTCA	Model Toxics Control Act (WAC 173-340)
NAPL	Non-aqueous-phase liquid
NCA	North Creek Analytical
PAHs	Polycyclic (or Polynuclear) aromatic hydrocarbons
PCBs	Polychlorinated biphenyls
PES	PES Environmental, Inc.
PIONEER	PIONEER Technologies Corporation
PLPs	Potentially liable persons
PLRD	Passive LNAPL recovery device
PNO	Pacific Northern Oil Corporation
POC	Point of compliance

LIST OF ABBREVIATIONS AND ACRONYMS

POS	Port of Seattle
PSC	Philip Services Corporation
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RI	Remedial investigation
RI Summary Report	<i>Remedial Investigation Summary Report</i>
RI/DE Report	<i>Draft Remedial Investigation/Data Evaluation Report</i>
SA	Shallow Aquifer
SDS	Sayler Data Solutions
Seepage Report	<i>Groundwater Seepage Evaluation Report</i>
SVOCs	Semivolatile organic compounds
SVSAP	<i>Soil Vapor Sampling and Analysis Plan</i>
SVSAP Addendum	<i>Soil Vapor Sampling and Analysis Plan Addendum</i>
SVTM1	<i>Soil Vapor Technical Memorandum No. 1</i>
SVTM2	<i>Soil Vapor Technical Memorandum No. 2</i>
SWMU	Solid waste management unit
Site	Terminal 91 Tank Farm Site
T91	Terminal 91
TOC	Total organic carbon
TPH	Total petroleum hydrocarbons
TSD Facility	Treatment, storage, and disposal facility
USGS	United States Geological Survey
UST	Underground storage tank
VOCs	Volatile organic compounds
VSI	Visual site inspection
WAC	Washington Administrative Code
WPADC	<i>Work Plan for Additional Data Collection</i>
WPGSE	<i>Work Plan for Groundwater Seepage Evaluation</i>

1.0 INTRODUCTION

This document is the *Remedial Investigation Summary Report* (“RI Summary Report”) for the Terminal 91 Tank Farm Site (“Site”) in Seattle, Washington. Remedial investigation activities were performed in accordance with the Model Toxics Control Act (“MTCA”) [Washington Administrative Code (“WAC”) 173-340] and Agreed Order No. DE 98HW-N108 (“Agreed Order”). This RI Summary Report provides a summary of relevant sections from the *Draft Remedial Investigation and Data Evaluation Report* (“RI/DE Report”) and subsequent reports and plans, including the “Bridge Documents” that were prepared in accordance with the *Proposed Bridge Document Work Plan* (“BD Work Plan”) that was submitted to the Washington Department of Ecology (“Ecology”) on October 15, 2000 (Roth Consulting 2000g). This RI Summary Report is being submitted to Ecology on behalf of the Port of Seattle (“POS”).

The BD Work Plan anticipated that documents produced as part of the Bridge Document work would be incorporated into the RI/DE Report as an addendum to that report. Based on subsequent discussions between the potentially liable persons (“PLPs”) and Ecology, that plan was modified to require production of a separate RI Summary Report summarizing the work performed under the Agreed Order and incorporating by reference specific sections of the Draft RI/DE Report, and subsequent documents in their entirety, according to MTCA [WAC 173-340-350(6)]. This RI Summary Report, along with the Bridge Document reports it summarizes and the RI/DE Report, is submitted to satisfy the Agreed Order’s requirement for submittal of “the final remedial investigation/data evaluation and any data gap report(s)” . . . Agreed Order, §V.6.

The Site location is shown on Figure 1, and the Site plan and surrounding locations prior to 2005 tank farm demolition activities are shown on Figures 2 and 3.

1.1 PHYSICAL SETTING

The physical setting of the Site was provided in Section 1.1 of the Draft RI/DE Report. Note that the feature referred to as “Lake Jacobs” in the RI/DE Report has been referred to in subsequent reports as the “Short Fill Impoundment”.

1.2 SITE DESCRIPTION

The Site is defined in the Agreed Order as “the Tank Farm Lease Parcel and areas where releases of dangerous constituents originating from the Tank Farm Lease Parcel operations have come to be located”. The Tank Farm Lease Parcel (“Lease Parcel”) is a contiguous parcel approximately four acres in size located within the confines of the POS T91 Complex. The T91 Complex is located at 2001 West Garfield Street, Seattle, Washington and encompasses approximately 216 acres including adjacent water areas and upland areas. A description of the Lease Parcel prior to tank farm demolition activities was provided in Section 1.2 of the RI/DE Report.

The Site is within the "facility" as defined under the Resource Conservation and Recovery Act (“RCRA”) for the purpose of corrective action for solid waste management units (“SWMUs”). POS was notified of this determination in a letter from the U.S. Environmental Protection Agency (“EPA”) to Port of Seattle dated May 1, 1992. Ecology and POS currently are negotiating a revised Agreed Order to include corrective action requirements for the entire "facility", which includes all property owned by POS contiguous to the Lease Parcel.

1.3 OBJECTIVES

The objective of the RI was to collect and evaluate sufficient information to perform a feasibility study (“FS”) under MTCA, as required by the Agreed Order for the Site.

1.4 REPORT ORGANIZATION

This report is organized as follows:

- Section 1.0 provides an introduction, which includes the Site description and physical setting as well as the objectives of the RI and a description of how the report is organized.
- Section 2.0 provides a Site background, including the Site history, potential contaminant sources, and a summary of previous investigations.
- Section 3.0 provides descriptions of the investigative activities that were performed as part of the RI, and methods used to perform these activities.
- Section 4.0 provides descriptions of the physical characteristics of the Site, including physiography, geology, hydrogeology, and groundwater use. A terrestrial ecological exclusion under MTCA is documented, and a conceptual site model (“CSM”) consisting of an exposure pathway analysis is summarized.
- Section 5.0 provides descriptions of the nature and extent of contamination, including potential sources, non-aqueous-phase liquids (“NAPLs”), and the nature and extent of soil, groundwater, and air contamination. A land use summary also is provided in this section.

- Section 6.0 provides an interpretation of the contaminant fate and transport from sources into media at the Site.
- Section 7.0 provides the summary of RI findings and conclusions made based on the RI work.
- Section 8.0 includes a list of references that were used in developing this RI Summary Report.

2.0 SITE BACKGROUND

This section includes a summary of the Site background, including the Site history and descriptions of investigative work performed to date.

2.1 HISTORY OF THE TANK FARM LEASE PARCEL AND SURROUNDING VICINITY

2.1.1 History of the Tank Farm Lease Parcel and Related Operations

From the late 1800s through 1920, owners of the T91 Complex included various railroads, land development companies, and private individuals. The Great Northern Railroad began to develop the area in the early 1900s by filling the area between Magnolia Bluff and Queen Anne Hill. Fill material was added to the area through 1920.

The tank farm at the Lease Parcel was constructed in the 1920s. The Lease Parcel initially may have been used as a gasoline refinery by California Petroleum Company around 1925 (Converse Consultants NW 1993). The Texas Company appears to have operated the tank farm as a fuel storage facility in the late 1920s and 1930s. The U.S. Navy acquired the entire T91 Complex in 1942 through condemnation and operated the tank farm until 1972.

During the Navy's possession of the T91 Complex, the Lease Parcel was used primarily as a fuel and lubricating oil transfer station. The Navy began leasing T91 back to POS in 1972 and deeded it to POS in 1976.

At about the time the POS leased T91 back from the Navy, Chemical Processors, Inc. ("Chempro"), a predecessor of Burlington Environmental Inc. ("BEI") and Philip Services Corporation ("PSC") subleased the Lease Parcel from POS. The main activities conducted by Chempro and its successors were waste oil recovery and wastewater treatment. Typical waste streams included oil and coolant emulsions, industrial wastewater, and industrial waste sludge. Bilge and ballast waters were primarily received from ships and transferred to the

Lease Parcel via pipeline. Other wastes and wastewater were received via tankers or in drums.

Chempro notified EPA of its dangerous waste activities at the Lease Parcel on November 14, 1980, and was granted interim status under the RCRA regulations for its dangerous waste management operations. Federal permitting requirements became effective November 19, 1980 under 40 CFR 264. BEI and POS (as operator and owner, respectively) were issued a Part B RCRA permit effective August 22, 1992 for the continued operation of a permitted dangerous waste management facility at the Lease Parcel. In September 1995, BEI ceased operations at the Lease Parcel and terminated its lease with POS. BEI subsequently performed aboveground closure activities at all permit-related facility equipment, secondary containment, and treatment units pursuant to a closure plan approved by Ecology. No dangerous waste operations requiring a permit (other than corrective action) have been conducted at the Lease Parcel since September 1995, and all regulated waste units at the Lease Parcel have undergone closure. This aboveground closure was approved by Ecology in October 2003 (Ecology 2003b). A Part B permit remains in effect for corrective action at the Site.

From approximately 1974 through 1995, Chempro and its successors also sublet a portion of the Lease Parcel to Pacific Northern Oil Corporation (“PNO”) for storage of non-regulated bunker oil and other fuels product. PNO used aboveground and underground piping systems at the Site to transfer bunker oil and fuels in the Lease Parcel and other areas of the Terminal 91 Complex. PNO operations at the Site included blending and storage of marine boiler fuel, diesel, and other petroleum products. PNO conducted these activities under a throughput agreement with Chempro from 1974 through 1981 and under sublease with PSC and its predecessors from 1981 until PSC ended its occupancy in 1995.

Following PSC’s surface closure action, PNO entered a new lease for the entire Lease Parcel. PNO continued operation of a bunker oil, lube oil, and fuels product storage and blending facility until 1999. In 1999, PNO terminated its lease with POS and discontinued its fuels product and blending operations at the Site. Subsequently, POS entered into an agreement

with Fuel and Marine Marketing (“FAMM”), and that entity conducted bunker oil and fuel product storage, blending and marketing operations at the Site until early 2003, when FAMM terminated its lease of the facility. FAMM also subleased the lube-oil portion of the operation to Rainier Petroleum during that period. Rainier Petroleum continued to operate tankage at the tank farm until August 2003. Delta Western was hired to provide terminaling operations during this period, and, after August 2003, monitored the facility during its caretaker status until the tank farm demolition activities were initiated in the spring of 2005.

Because the facility would no longer be used as a tank farm, POS decided to remove the remaining aboveground equipment to reduce risks of hazardous substance releases. In the spring of 2005, POS initiated product removal and demolition activities, including final paving of the Lease Parcel, as part of an independent interim remedial action. That interim action was completed in Summer 2005. An independent cleanup report documenting the interim action was submitted to Ecology on October 20, 2005 (Roth Consulting 2005e).

2.1.2 History of the Vicinity Surrounding the Tank Farm Lease Parcel

Another tank farm historically was located in the area southwest of the Lease Parcel. This former tank farm was identified as the Old Tank Farm and was called out as Area of Concern (“AOC”) 11 in the Terminal 91 RCRA Facility Assessment (“RFA”) (EPA 1994). Converse Consultants (1993) reported that historical documents for T91 showed this tank farm consisted of nine tanks containing gasoline and oil, and was in existence from approximately 1927 to 1942. Figure 3 shows the approximate footprint of the Old Tank Farm (AOC 11).

Other uses of the area in the vicinity of the Lease Parcel, particularly those that could have been potential contaminant sources, were described in Converse (1993), Kennedy/Jenks Consultants (1997), and in the Bridge Document Report 2 (“BDR2”) (Roth Consulting 2003a).

2.2 OPERATIONAL HISTORY

The operational history of the Site through 1998 was provided in Section 2.3 of the RI/DE Report (PSC 1999). The subsequent history (1999 through present) is described in Section 2.1.1 of this RI Summary Report.

2.3 POTENTIAL SOURCES

Potential sources of chemicals of potential concern ("COPCs") that have been identified in environmental media at the Site, including documented and undocumented releases, were described in Section 2.4 of the RI/DE Report (PSC 1999) and in Section 2.5 of the BDR2 (Roth Consulting 2003a).

2.4 SUMMARY OF PREVIOUS INVESTIGATIONS

A summary of investigations performed prior to the preparation of the RI/DE Report (PSC 1999) was provided in the Section 2.5 of that report.

2.5 SUMMARY OF AGREED ORDER INVESTIGATIONS

The Agreed Order required the Potentially Liable Person group (PLP group) (POS, Phillip and PNO) to prepare the RI/DE Report (PSC 1999). After completing the Draft RI/DE Report, the PLP group concluded that additional work would be necessary prior to evaluating cleanup options for the Site in an FS under MTCA. In June 1999, the PLP group submitted a letter (Roth Consulting 1999c) to Ecology summarizing the proposed additional work and suggesting a meeting to discuss the proposed approach. The PLP group recommended that a piezometer be installed in the area between the Lease Parcel and the Pier 89/90 Slip, and that a Bridge Document be prepared to evaluate existing Site data with respect to potential cleanup alternatives in order to focus future data collection efforts. The PLP group also recognized that significant ground water data had been collected at the Site

during past ground water monitoring events. The PLP group therefore also proposed that ground water monitoring be performed semiannually instead of quarterly.

After meeting with Ecology on August 10, 1999, the PLP group and Ecology agreed on the terms of the modified ground water monitoring program, on the installation of the piezometer, and on the concept of the Bridge Document work. The terms of the revised ground water monitoring program are described in letter to Ecology dated September 17, 1999 (Roth Consulting 1999e). A *Proposed Piezometer Work Plan* (Roth Consulting 2000f) was submitted to Ecology on August 21, 2000, and a piezometer was installed at the Site in February 2001. A second piezometer was installed between the first piezometer and the Site in May 2001 at the suggestion of Ecology at a meeting with the PLP Group on March 8, 2001. Subsequent to the piezometer installation, after determining that the piezometers were downgradient from the Lease Parcel, the wells were incorporated into the ground water sampling program and are now considered “monitoring wells”. The well construction information for these monitoring wells was provided to Ecology in the *Piezometer Installation Report* dated March 2002 (Roth Consulting 2000c). The PLP Group also incorporated five downgradient wells, which were installed by the POS as part of its T91 Upland independent cleanup, into the ground water monitoring program for the Site. The well construction information for those wells was provided to Ecology in the *Downgradient Well Installation Report* dated September 2002 (Roth Consulting 2002f).

The Bridge Document work was described in the BD Work Plan (Roth Consulting 2000g) and approved by Ecology in a letter dated November 17, 2000 (Ecology 2000). The Bridge Document work included preparation of the Bridge Document Reports 1, 2, and 3 (“BDR1”, “BDR2”, and “BDR3”), soil vapor investigation reports, related work plans, and a ground water sampling and analysis plan. Investigative activities and methods covered by these documents are further described in Section 3.0.

3.0 INVESTIGATIVE ACTIVITIES AND METHODS

This section summarizes the investigative activities that have been performed at the Site and the methods used to perform these activities.

3.1 ACTIVITIES PERFORMED AND METHODS USED DURING RI/DE REPORT AND PREVIOUS INVESTIGATIONS

Activities performed and methods used during previous investigations (i.e., those performed prior to preparation of the RI/DE Report) were described in Section 3 of the RI/DE Report (PSC 1999) and in the specific relevant reports and work plans.

3.2 ACTIVITIES PERFORMED AND METHODS USED DURING BRIDGE DOCUMENT INVESTIGATIONS

This section summarizes the scope of work of environmental investigations performed after preparation of the RI/DE Report, including those performed as part of the Bridge Document work.

3.2.1 Piezometer (Ground Water Monitoring Well) Installation

Two ground water monitoring wells (CP_GP01 and CP_GP02) were installed at the Site in February and May 2001. These wells initially were to be used only for water-level measurements, but were found to be downgradient from the Lease Parcel and were subsequently incorporated into the ground water sampling program. Activities and methods for this work were described in the *Proposed Piezometer Work Plan* (Roth Consulting 2000f) and the *Piezometer Installation Report* (Roth Consulting 2002c).

3.2.2 Downgradient Well Installation (T91 Upland)

Five ground water monitoring wells (CP_GP03 through CP_GP07) were installed at the Site in February and May 2001 as part of the T91 Upland work. These wells were found to be downgradient from the Lease Parcel and were subsequently incorporated into the Tank Farm Site ground water sampling program. Activities and methods for this work were described in the *Terminal 91 Upland Independent Cleanup Proposed Work Plan No. 1* (Roth Consulting 2000c) and the *Downgradient Well Installation Report* (Roth Consulting 2002f).

3.2.3 Bridge Document Report 1

The *Proposed Final Bridge Document Report 1* (“BDR1”) (Roth Consulting 2001f) included the findings of the following tasks:

- Identify potential exposure pathways at the Site
- Perform analysis of highest beneficial use of ground water at the Site
- Determine terrestrial ecological exclusion
- Develop screening levels for ground water based on site-specific potential exposure pathways and highest beneficial use of ground water
- Assess potential points of compliance for ground water at the Site
- Review existing data as relevant to site-specific potential exposure pathways and potential cleanup alternatives
- Identify data gaps that exist with respect to site-specific potential exposure pathways and potential cleanup alternatives.

The activities and methods for this work were described in the BDR1 and in the BD Work Plan (Roth Consulting 2000g).

3.2.4 Soil Vapor Technical Memorandum No. 1

Based on the findings of the BDR1, a soil vapor investigation was initiated in 2001 in the vicinity of Building M-28, located immediately to the southwest of the Lease Parcel. The initial investigation consisted of the following tasks:

- Installation of three soil vapor ports through the concrete slab inside Building M-28
- Collection of soil vapor samples from the three ports in August 2001 and analysis for volatile organic compounds (“VOCs”)
- Collection of two geotechnical soil samples for porosity, soil moisture content, particle-size distribution, organic carbon fraction, and bulk density
- Modeling concentrations of VOCs in soil vapor to concentrations in indoor air using the Johnson and Ettinger (“JE”) Model for Subsurface Vapor Intrusion into Buildings
- Comparison of modeled indoor air concentrations with MTCA Method C air cleanup levels.

The activities and methods for this work were described in the *Soil Vapor Investigation Technical Memorandum No. 1* (“SVTM1”) (PSC 2001b) and the *Soil Vapor Sampling and Analysis Plan* (“SVSAP”) (PSC 2001a).

3.2.5 Tidal Study (Tank Farm Site and T91 Upland)

A tidal study was performed in the summer of 2001 as part of the work required under the Tank Farm Site Agreed Order and as part of the T91 Upland independent cleanup work. The tidal study consisted of the following tasks:

- Automatic measurement of water levels in 13 selected ground water monitoring wells and in a stilling well installed in Elliott Bay at 15-minute intervals over a 72-hour period during the June 22-25, 2001 minus tides
- Automatic measurement of pH, dissolved oxygen (“DO”), and specific conductivity in 10 of the 13 ground water monitoring wells
- Manual measurement of water levels in the 13 selected wells, the stilling well, and 10 additional ground water monitoring wells on two occasions during the automatic monitoring period
- Collection of ground water samples from the seven furthest downgradient wells (GP-01 through GP-07) at times representing the low low tide in each well (six wells were sampled on July 20, 2001 and one of the wells was sampled on August 1, 2001)
- Assessment for the presence of LNAPL in 23 monitoring wells and one piezometer on June 13, 2001
- Calculation of lag times and stage ratios for the monitored wells
- Preparing contour maps and graphs of the tidal study results
- Assessment of the findings.

The activities and methods for this work were described in the *Tidal Study Report* (POS and Fitzgerald 2002), the *Terminal 91 Upland Independent Cleanup Proposed Work Plan No. 1* (Roth Consulting 2000c), and the *Proposal for Shallow Aquifer Tidal Study and Ground Water Sampling* (Roth Consulting 2001c).

3.2.6 Soil Vapor Technical Memorandum No. 2

Subsequent to the SVTM1, additional investigation of the soil vapor pathway was performed in 2002 in the vicinity of Building M-28. The additional investigation consisted of the following tasks:

- Collection of soil vapor samples from the three soil vapor ports in May 2002 and analysis for VOCs
- Modeling concentrations of VOCs in soil vapor to concentrations in indoor air using the JE Model
- Modeling concentrations of VOCs in ground water to concentrations in indoor air using the JE Model
- Modeling concentrations of VOCs in soil to concentrations in indoor air using the JE Model
- Using an attenuation factor to estimate concentrations of VOCs in indoor air that could result from intrusion from soil vapor into indoor air
- Comparison of modeled indoor air concentrations with MTCA Method C cleanup levels
- Investigation of sumps inside Building M-28 that could act as preferential pathways for soil vapor migration into the building

- Provision of a recommendation to abandon a deep sump at the south end of Building M-28 to minimize the potential for preferential pathway migration.

The activities and methods for this work were described in the *Soil Vapor Technical Memorandum No. 2* (“SVTM2”) (PSC 2003a) (which also incorporates the work done as part of the SVTM1) and the SVSAP (PSC 2001a).

3.2.7 Bridge Document Report 2

The BDR2 (Roth Consulting 2003a) included the findings of the following tasks:

- Addition of chemicals to the list of COPCs
- Review and revision of ground water screening levels
- Removal of COPCs from the prior list (i.e., the list developed during the BDR1 work)
- Evaluation of existing ground water data based on ground water screening levels, including identification of monitoring wells with screening level exceedances
- Plotting concentrations of selected COPCs on Site maps
- Assessment of the distribution and possible sources of COPCs
- Expanded review of data from property outside the Lease Parcel
- Review of monitoring well locations and the then-current sampling program

- Review of passive LNAPL recovery program results
- Preparation of the *Groundwater Sampling and Analysis Plan* (“GWSAP”) (PSC 2003b)
- Recommendations for additional work to be performed and reported in the BDR3.

The activities and methods for this work were described in the BDR2 (Roth Consulting 2003a) and in the BD Work Plan (Roth Consulting 2000g).

3.2.8 Bridge Document Report 3

The BDR3 [Aspect Consulting (“Aspect”) 2004a] included the findings of the following tasks:

- Abandonment of monitoring wells CP-103B and W-10 and replacement with new monitoring wells CP-203B and W-210 in June 2003
- Installation of three new deep confined aquifer (“DCA”) monitoring wells (GP-01B, GP-03B, and MW-06B) in August 2003
- Hydraulic testing (slug tests) of the three new DCA wells in August/September 2003
- Collection of ten soil samples from the new DCA well borings for physical and hydraulic property testing [moisture content, wet density, dry density, total organic carbon (“TOC”), specific gravity, total porosity, vertical hydraulic conductivity, and saturated sample drainage rate]
- Installation, development, short-term tidal monitoring, and decommissioning of 11 Shallow Aquifer (“SA”) temporary piezometers in June 2003

- Month-long tidal and water-level monitoring in five SA/DCA well pairs (GP-01A/B, GP-03A/B, MW-06A/B, CP-203B, and CP-108A/B) in September and October 2003
- Analysis of tidal study data, including filtering tidal effects, calculating ground water gradients, and construction of ground water elevation contour maps
- Compilation of bulkhead construction data
- Assessment of potential stratification of contaminants in ground water (including depth-specific ground water sampling at three discrete intervals in wells GP-01A and GP-07)
- Review of underground utilities information to assess the potential for contaminant migration along preferred pathways
- Collection of LNAPL samples from four wells (CP-109, CP-117, CP-118, and MW-39-3) and analysis for density and viscosity
- Baildown testing of LNAPL in wells MW-39-3 and CP-117
- Calculation of hydraulic conductivities for the SA and DCA based on the slug test results
- Evaluation of tidal efficiency, tidal lag, salinity, vertical gradients, and tidally adjusted ground water flow
- Assessment of the potential effect of bulkhead construction on ground water flow in the SA and DCA

- Assessment of the LNAPL physical characteristics and baildown testing results
- Description of the revised hydrogeologic CSM for the Site.

The activities and methods for this work were described in the BDR3 (Aspect Consulting 2004a), a memorandum re *Preliminary Results—Limited Tidal Monitoring Study, Piers 90 and 91* (Aspect 2003), the *Final Work Plan for Additional Data Collection* (“WPADC”) (PSC and Geomatrix 2003), and the BD Work Plan (Roth Consulting 2000g).

3.2.9 Soil Vapor Evaluation, Building M-28

A supplemental soil vapor evaluation was performed in and near Building M-28 in July 2004 to evaluate petroleum-hydrocarbon-related soil vapor constituents and their potential to impact indoor air quality. The following tasks were performed as part of this evaluation:

- Collection of one sub-slab soil vapor sample from permanent soil vapor port W39-3
- Collection of one ambient air sample from outside Building M-28
- Laboratory analysis of vapor and air samples for air-phase petroleum hydrocarbons using the Massachusetts Department of Environmental Protection (“MADEP”) Method of the Determination of Air-Phase Petroleum Hydrocarbons (“APH”)
- Development of MTCA Method C air cleanup levels for the sampled constituents
- Comparison of concentrations of constituents in vapor and air with Method C air cleanup levels.

The activities and methods for this work were described in the *Soil Vapor Evaluation, Building M-28* [PIONEER Technologies Corporation (“PIONEER”) 2004], the *Soil Vapor Sampling*

and Analysis Plan (PSC 2001a), and the *Soil Vapor Sampling and Analysis Plan Addendum* (“SVSAP Addendum”) (PSC 2003c).

3.2.10 Sealing of Floor Structures in Building M-28

As part of the soil vapor investigative work, several floor structures were identified that had the potential for acting as preferential pathways for migration of vapors from soil to indoor air in Building M-28. Those floor structures were filled in early October 2003 and March 2005. The activities and methods for this work were described in a letter from Roth Consulting to Ecology (Roth Consulting 2003g), in the *Status Report for Fourth Quarter 2003* (Roth Consulting 2004a), and in the *Status Report for First Quarter 2005* (Roth Consulting 2005c).

3.2.11 Ground Water Seepage Evaluation

Aspect performed a ground water seepage evaluation in 2004 to further refine the hydrogeologic CSM for the Site. The work performed included the following tasks:

- Installation, development, and decommissioning of 16 SA temporary piezometers on Piers 90 and 91 in August 2004
- Performance of a 22-day tidal study in August/September 2004
- Modeling the SA along the piers using the United States Geological Survey (“USGS”) ground water flow model MODFLOW with the RIVER package
- Modeling the DCA from upland areas to the downgradient offshore limit of the DCA using a 2-dimensional MODFLOW model with the RIVER package
- Calculation of tidal efficiency and tidal lag

- Evaluation of field-measured ground water parameters over time (temperature, pH, conductivity, pH, and DO)
- Evaluation of relative discharge and discharge locations of ground water to Elliott Bay from the SA and DCA
- Description of the revised hydrogeologic CSM for the Site
- Provision of recommended locations for SA and DCA compliance monitoring wells
- Presentation of a proposed approach for evaluating ground water compliance.

The activities and methods were described in the *Groundwater Seepage Evaluation Report* (“Seepage Report”) (Aspect 2004c) and the *Work Plan for Groundwater Seepage Evaluation* (“WPGSE”) (Aspect 2004b)

3.2.12 December 2004 Shallow Aquifer Well Installation and Development

Aspect conducted the installation and development of three new SA monitoring wells (CP_GP08, CP_GP09, and CP_GP10) in December 2004. POS staff performed conductivity profiling of each new SA monitoring well. The methods used were described in the *Letter Report re Shallow Aquifer Well Installation and Development* (Aspect 2005) and in a letter from Roth Consulting to Ecology dated December 13, 2004 (Roth Consulting 2004f). Ground water samples were collected from these wells beginning in December 2004 and subsequently on a quarterly basis. Methods used for ground water sample collection were provided in the GWSAP (PSC 2003b).

3.2.13 March 2004 Shallow Aquifer Well Installation and Development (T91 Upland)

On March 17 and 18, 2005, four new ground water monitoring wells (CP_GP11 through CP_GP14) were installed and developed as part of the T91 Upland independent cleanup activities (POS 2005). Based on an assessment of the results of the March 2005 water level measurement event for the Tank Farm Site, together with the water level measurements from the four new wells, the wells were determined to be in the ground water flowpath downgradient from the Lease Parcel and were incorporated into the Tank Farm Site monitoring program beginning in March 2005.

3.2.14 Monitored Natural Attenuation (MNA) Evaluation

As described in the MNA Evaluation Work Plan (PES 2005b), an MNA evaluation was performed as part of the data gaps investigations under the FS Work Plan (PES 2005a). Results were reported in the MNA Evaluation Final Technical Memorandum (PES 2006b). PES concluded that, based on the very low-level or non-detect results for VOCs, PAHs, SVOCs, and oil-range organics, the stable GRO/DRO plumes, and the favorable geochemical results, MNA at the Site could be a viable component of cleanup alternatives. PES therefore recommended that MNA be included as a technology considered in the FS.

3.2.15 Ongoing Ground Water Monitoring Program

Ground water monitoring is currently being performed at the Site on a semiannual basis for most wells and on a quarterly basis for selected wells. The current ground water monitoring program is as follows:

- Measurement, on a semiannual basis, of ground water levels and light non-aqueous-phase liquid (“LNAPL”) thickness (where present) in 45 SA monitoring wells, 10 DCA monitoring wells; and in 1 deep short fill monitoring well (SHFLL_W9) and 1

shallow piezometer (B1-93) that are installed deeper than the SA monitoring wells. The two semiannual events are performed during the wet season (February/March) and the dry season (September/October) of each year.

- Collection of ground water samples from 22 SA monitoring wells and 7 DCA monitoring wells on a semiannual basis (in conjunction with ground water and LNAPL level measurement events) and laboratory analysis for the constituents listed in the following bullet.

- Laboratory analysis of the ground water samples listed above for the following constituents:
 - VOCs by EPA Method 8260B
 - Semivolatile organic compounds (“SVOCs”) by EPA Method 8270C
 - Polynuclear aromatic hydrocarbons (“PAHs”) by GC/MIS with Selective-Ion Monitoring
 - Total metals (arsenic, chromium, lead and zinc) by EPA 6000/7000 Series methods
 - Total mercury by EPA Method 1631
 - Polychlorinated biphenyls (“PCBs”) by EPA 8082 Modified with Micro-Extraction
 - Total petroleum hydrocarbons (“TPH”) as gasoline by Washington State Method NWTPH-Gx
 - TPH as diesel and heavier oil fractions by Washington State Method NWTPH-Dx, using the acid and silica gel cleanup method.

These wells are sampled and the laboratory analyses performed as required under the terms of the Agreed Order as modified by the following documents:

- Letters from Roth Consulting to Ecology dated September 17, 1999 and October 1, 2002

- Ecology's approval letters dated October 1, 1999, October 15, 1999, and November 7, 2002
- A letter from Roth Consulting to Ecology dated September 10, 2003 with respect to sampling some additional potential background wells
- Ecology's approval of sampling some additional potential background wells, emailed from Galen Tritt to Susan Roth on September 25, 2003
- Final GWSAP (PSC 2003b)
- A letter from Roth Consulting to Ecology dated December 13, 2004 requesting approval to add three new monitoring wells (CP_GP08 through CP_GP10)
- Ecology's letter of approval dated December 15, 2004 to add three new monitoring wells
- A letter from Roth Consulting dated March 4, 2005 with an attached memo from PIONEER (2005), proposing to discontinue ground water sampling at selected monitoring wells beginning with the March 2005 event
- Ecology's April 26, 2005 letter of approval for discontinuing sampling at selected wells
- MNA Work Plan (PES 2005b)
- A letter from Roth Consulting dated May 17, 2007 requesting approval to move seven monitoring wells to the semiannual ground water monitoring program and Ecology's approval letter dated May 24, 2007.

4.0 PHYSICAL CHARACTERISTICS

The physical characteristics of the Lease Parcel were described in Section 4.0 of the RI/DE Report. Subsequent investigations performed as part of the Bridge Document process, including the BDR3 (Aspect 2004a) and the Seepage Report (Aspect 2004c) provided additional information on the physical characteristics of the Site and refined the hydrogeologic CSM in the area downgradient of the Lease Parcel, including Piers 90 and 91. References to these documents are provided in the following sections.

4.1 SITE PHYSIOGRAPHY

The Site physiography was described in Section 4.1 of the BDR3 (Aspect 2004a).

4.1.1 Regional Geology

The regional geologic history was described in the Section 4.2.1 of the BDR3 (Aspect 2004a).

4.1.2 Local Geology

The geology of the Lease Parcel was described in Section 4.1 of the RI/DE Report. Information on the Lease Parcel geology was expanded to downgradient areas of the Site during subsequent Bridge Document investigations. The revised description of Site geology was provided in Section 4.2.2 of the BDR3 (Aspect 2004a).

4.2 HYDROGEOLOGY

4.2.1 Regional Hydrogeology

The regional Hydrogeologic setting was described in the Section 4.3.1 of the BDR3 (Aspect 2004a).

4.2.2 Local Hydrogeology

The hydrogeology of the Lease Parcel was described in Section 4.2 of the RI/DE Report. Subsequent investigations performed as part of the Bridge Document process (Aspect 2004a and 2004c) provided additional information on hydrogeology in the area downgradient of the Lease Parcel, including Piers 90 and 91. A revised hydrogeologic CSM was provided in the BDR3, Section 4.3 (Aspect 2004a), and the model was further refined in the Seepage Report, Section 4 (Aspect 2004c).

4.3 GROUNDWATER USE

Ground water use at the Site and surrounding area was described in Section 4.3 of the RI/DE Report (PSC 1999) and in Section 2.1 of the BDR1 (Roth Consulting 2001f). The findings are summarized as follows.

No drinking water supply wells are present on or downgradient from the Site. Two deep water-supply wells, neither of which is currently in use, have been identified within approximately a one-half-mile radius of the Lease Parcel. Both wells are within the Terminal 91 Complex owned by the POS. Both wells are screened or perforated at depths of greater than about 250 feet (“ft”) bgs in artesian aquifers, and one of the two wells is upgradient from the Site. The BDR1 concluded that ground water at the Site is nonpotable based on the criteria provided in MTCA [WAC 173-340-720(2)].

4.4 TERRESTRIAL ECOLOGICAL EXCLUSION

An assessment of Site conditions was performed in order to determine the need for a terrestrial ecological evaluation under WAC 173-340-7490. The Site qualifies for an exclusion from the terrestrial ecological evaluation process as documented in Section 2.2.2.1 of the BDR1 (Roth Consulting 2001f) that was approved by Ecology in a letter dated May 30, 2002 (Ecology 2002b).

4.5 EXPOSURE PATHWAY ANALYSIS/CONCEPTUAL SITE MODEL

A preliminary screening of exposure pathways at the Site was performed as part of the BDR1 work (Roth Consulting 2001f). The results showed the primary potentially complete exposure pathways at the Site were the ground water to surface water pathway and the soil to vapor pathway. A discussion of these pathways was provided in the BDR1, and a graphical presentation of the exposure pathway analysis was provided as Figure 3 in the BDR1.

That exposure pathway analysis/CSM was further refined during preparation of the FS Work Plan (PES 2005a) to account for current known and planned future Site conditions. The potentially complete exposure pathways described in the FS Work Plan are as follows:

- Direct contact with soil (construction workers)
- Soil to indoor air (for potential future Site uses)
- Soil to ground water
- Ground water to indoor air (for potential future Site uses)

- Ground water to surface water/sediment.

A summary of how each of these pathways will be addressed in the FS, as provided in Section 5.2 of the FS Work Plan (PES 2005a), is provided in the following sections. Figure 3 in the FS Work Plan shows the current CSM for the Site. Also note that, as summarized in the FS Work Plan, although the ponding in the short-fill impoundment may offer some limited habitat value (primarily loafing for overwintering or migratory waterfowl) in the short term, quantification of risks will not be conducted in the FS because the impoundment will be filled or covered. Mitigation for the filling of the pond was addressed as part of the overall mitigation performed for construction of the short fill.

4.5.1 Direct Contact with Soil Pathway

Workers have the potential to be exposed to soil if any future excavation or underground utility work takes place. However, institutional controls and standard worker health and safety procedures should provide adequate protections. The FS will provide a detailed description of how these measures would be implemented to provide protection of Site workers.

4.5.2 Soil to Indoor Air Pathway

Previous soil vapor investigative reports [SVTM1 (PSC 2001b), SVTM2 (PSC 2003a), and *Soil Vapor Evaluation, Building M-28* (PIONEER 2004)] have documented that there are no unacceptable current Site risks. The only potential future exposures via this pathway would result from site development activities. The approach to addressing these potential future exposures will be to use institutional controls, such as notices on parcel deeds of the potentially impacted properties, which would require one of the following responses:

- Include engineering controls (e.g., vapor barriers, subslab venting systems) in site development plans to mitigate the potential exposure, or

- Conduct a development-specific evaluation of the soil to indoor air pathway [i.e., develop risk-based cleanup levels (“CULs”) for the specific potential exposures related to the proposed development.] If concentrations of indicator hazardous substances (“IHSs”) exceed the CULs developed under the second option, appropriate supplemental remedial actions will be evaluated and implemented as part of site development activities. Calculating CULs at the time of development, if that is the response that is chosen, would allow for the specific location (e.g., northeast corner of the tank farm), nature of the development (e.g., industrial or commercial), and building-specific factors (e.g., slab-on-grade warehouse, ground-level parking) to be accounted for in the CUL calculations

4.5.3 Soil to Ground Water Pathway

The FS will address the LNAPL and residual ground water contamination through evaluation of LNAPL recovery approaches and development of ground water CULs. The soil to ground water pathway will be evaluated empirically consistent with the requirements of WAC 173-340-747, and based on these ground water CULs. That is, if ground water concentrations are below CULs at the point of compliance (“POC”) or conditional POC, then by definition the concentrations of IHSs in soil are not causing exceedances of ground water CULs. Conversely, if ground water concentrations at the POC exceed CULs, then soil to ground water CULs can be developed for those constituents at that time.

4.5.4 Ground Water to Indoor Air Pathway

CULs for ground water will be developed in the FS that will be protective of indoor air quality, as described in the FS Work Plan Section 5.2.3 (PES 2005a).

4.5.5 Ground Water to Surface Water/Sediment Pathway

CULs for ground water will be developed in the FS that will be protective of the ground water to surface water and sediment pathways, as described in the FS Work Plan Section 5.2.3 (PES 2005a).

5.0 NATURE AND EXTENT OF CONTAMINATION

This section describes the potential contaminant sources at the Site and the nature and extent of COPCs in contaminated media.

5.1 POTENTIAL SOURCES

Potential sources of COPCs in environmental media in and surrounding the Lease Parcel were provided in Section 2.4 of the RI/DE Report. The sources include documented and undocumented releases of product and waste resulting from incidents involving operator errors or mishandling during transfer operations and other handling activities, pipeline ruptures for various reasons, leaking tanks, a leaking oil/water separator that was a primary wastewater treatment unit, and equipment failures of various types.

In addition to the potential sources described in the RI/DE Report, other potential sources within the area of influence of the tank farm have been described in the following documents:

- RFA (EPA 1994)
- Letter from Kennedy/Jenks Consultants to Port of Seattle re Update on SWMUs and AOCs at Terminal 91 (Kennedy/Jenks Consultants 1996)
- Baseline Report (Kennedy/Jenks Consultants 1997)
- BDR2 (Roth Consulting 2003a).

The RFA (EPA 1994) included the findings of the visual site inspection (“VSI”) that was performed by EPA at the T91 property in October 1992. In the RFA, EPA lists a number

of solid waste management units (“SWMUs”) and AOCs at T91 and discusses their history and potential for releases.

In 1996, POS provided Ecology with an update on the SWMU and AOC situation at T91 (Kennedy/Jenks Consultants 1996b). The update described the status of SWMUs and AOCs that were identified during the 1992 VSI, excluding those considered to be associated with Lease Parcel activities.

The Baseline Report (Kennedy/Jenks Consultants 1997) summarized SWMUs and AOCs that were listed in the RFA but were outside the immediate vicinity of the Lease Parcel. The Baseline Report also discussed additional areas of potential contamination that had been discovered or investigated after the 1992 VSI through April 1997.

The BDR2 identified several additional potential sources in the area of influence of the Tank Farm. Section 2.5 of the BDR2 references Figure 16 in that report, which shows several potential sources (or areas of reported contamination) in the area surrounding and downgradient from the Lease Parcel.

5.2 NON-AQUEOUS-PHASE LIQUIDS

The nature and extent of NAPL at the Site was initially described in Section 5.1 of the RI/DE Report (PSC 1999). NAPL has been further investigated since that report was prepared, as described in the Tidal Study Report (POS and Fitzgerald 2002), BDR2 (Roth Consulting 2003a), BDR3 (Aspect 2004a), and quarterly reports of passive LNAPL recovery activities that were initiated in October 1999 (included in quarterly status reports for the Site beginning with Roth Consulting 2000b). A brief summary of the nature and extent of NAPL at the Site is as follows.

LNAPL accumulations (including a sheen to measurable LNAPL) have been detected in the following wells since the Agreed Order became effective in April 1998:

- Eight wells (CP-107, CP-109, CP-110, CP-116, CP-117, CP-118, CP-119, and MW-39-3) monitored as part of the monthly LNAPL recovery program that was initiated in October 1999
- MW-104, PNO-MW-3, EW-1, MW-102, MW-103, and MW-152-1—six wells that are not currently monitored but are included in the T91 Upland independent cleanup (SWMU 30—PNO Pipeline Release)
- Two wells (PR-1 and PR-2), which have been incorporated into the monthly LNAPL recovery program, that were installed for the LNAPL pilot study as part of the FS work.

The five wells inside the tank farm secondary containment walls (CP-109, CP-116, CP-117, CP-118, and CP-119) were abandoned prior to demolition of aboveground structures at the tank farm, which was performed in the spring and summer of 2005. These wells were abandoned on August 10, 2004, as described in a letter to Ecology dated June 28, 2004 (Roth Consulting 2004c) as approved by Ecology on July 9, 2004 (Ecology 2004b). A summary of the decommissioning activities was provided in the *Status Report for Third Quarter 2004* (Roth Consulting 2004e).

The Tank Farm LNAPL recovery program was initiated in October 1999 with the installation of passive LNAPL recovery devices (“PLRDs”) in the eight wells that formerly contained or currently contain LNAPL (CP-107, CP-109, CP-110, CP-116, CP-117, CP-118, CP-119, and MW-39-3). The remaining three wells (CP-107, CP-110, and MW-39-3) are checked monthly for LNAPL accumulations, and recoverable LNAPL is removed from the PLRDs or by bailing or pumping if significant accumulations are present.

As part of the FS work described in the FS Work Plan (PES 2005a), two new monitoring wells (PR-1 and PR-2) were installed in August 2005 to use in a pilot study. The purpose of the pilot study is to evaluate the recoverability of LNAPL at the Lease Parcel. The wells were installed at locations where former wells showed the highest LNAPL recovery rate. From the time of installation until the early November 2005 monthly LNAPL monitoring

event, only sheens were detected in the two pilot study wells. Therefore, the two pilot study wells were incorporated into the monthly LNAPL monitoring program until sufficient LNAPL has accumulated to perform the pilot study. The first measurable LNAPL was observed during the November 2005 monthly LNAPL monitoring event, when 4.5 inches of LNAPL were measured in well PR-1 (near former CP-117), and about 0.5 gallons of LNAPL were recovered.

5.3 SOIL

As part of previous investigations at the Lease Parcel and surrounding vicinity, soil samples were collected and analyzed for one or more of the following compounds: VOCs, SVOCs, PAHs, PCBs, TPH, and metals. The results of those soil sampling events are summarized in the following sections.

5.3.1 Previous RCRA Investigations at Former TSD Facility

As discussed in Section 2.4, soil samples have been collected during several investigations that were conducted by Chempro/BEI at and near the Lease Parcel under past RCRA 3013 and 3008(h) Orders. Those investigations were:

- Phase I Hydrogeological Investigation (Sweet-Edwards/EMCON 1988)
- Hydrogeologic Investigation (Sweet-Edwards/EMCON 1989)
- RCRA Facility Investigation (Burlington Environmental Inc. 1995).

The results of the soil sampling performed during those investigations are summarized in this section.

Laboratory analytical results from soil samples that were collected from the Lease Parcel and surrounding vicinity during the 1988 Hydrogeologic Investigation and the 1992-1993 RCRA Facility Investigation (“RFI”) (BEI 1995) were summarized in Section 5.3 of the

RI/DE Report (PSC 1999). Laboratory analytical reports for those soil samples were provided in Appendix E of the *Hydrogeologic Investigation Report* (Sweet-Edwards/EMCON 1989) and in Appendix I.3 of the RI/DE Report.

Chemical distribution maps of selected COPCs or chemical groups were provided in the RI/DE Report as Figures 5-21 through 5-53. RI/DE Report Tables 5.5 through 5.9 summarize the COPCs that were in Site soil samples. RI/DE Report Table 5.10 compares the concentrations of metals in Site soil samples with Puget Sound background concentrations.

5.3.2 Previous Non-RCRA Investigations at or near Tank Farm Lease Parcel

As discussed in Section 2.4, soil samples have been collected during several investigations that have been conducted at and near the Lease Parcel, and that were not associated with the RCRA operations at the former TSD facility. Those investigations included:

- Triangular Area Investigation, 1992-1995
- Lube Warehouse Soil Sampling, 1995
- Soil Sampling Beneath Warehouse M-19, 1995

The results of the soil sampling performed during those investigations are described in the following sections.

5.3.2.1 Triangular Area Investigation, 1992-1995.

The purpose of the work performed in the “Triangular Area” was to assess subsurface soil and ground water conditions in the area prior to installation of an underground storage tank (“UST”). The original reports of this work were summarized in the Baseline Report (Kennedy/Jenks Consultants 1997). The soil sample locations are shown on Figure 2, and the laboratory analytical results are summarized in Table 1.

In October 1992, four soil borings (B1 through B4) were installed by Environmental Science and Engineering, Inc. (“ESE”) in the area known as the “Triangular Area” (Figure 2). The results of the investigation were provided in ESE (1992). Soil samples and a grab ground water sample were collected from the borings. TPH as gasoline, diesel, and oil was detected in soil samples (Table 1) and TPH as oil was detected in the grab ground water sample.

5.3.2.2 Lube Oil Warehouse Soil Sampling, 1995.

In April 1995, PNO demolished the two-story foam tank building and the adjacent single-story machine shop at the north end of the Lease Parcel. In May 1995, five soil samples (SS-1, SS-2, and HA-1 through HA-3) were collected from beneath the demolished buildings. Two of the samples (SS-1 and SS-2) were collected from 0.5 ft bgs, and three samples (HA-1 through HA-3) were collected from 2.5 ft bgs (Pacific Northern Geoscience 1995a). The soil sample locations are shown on Figure 2, and the laboratory analytical results are summarized in Table 1.

TPH as diesel and oil was detected at concentrations as high as 772 mg/kg in the soil samples collected from 0.5 ft bgs. TPH was not detected in the soil samples collected from 2.5 ft bgs.

5.3.2.3 Soil Sampling Beneath Warehouse M-19, 1995.

In August 1995, four composite shallow soil samples (C-1 through C-4) were collected from beneath the main warehouse in the north part of the Lease Parcel (Kennedy/Jenks Consultants 1996a). Each of the four soil samples was a composite of two to four individual grab samples. The soil sample locations are shown on Figure 2, and the laboratory analytical results are summarized in Tables 1 through 5.

5.4 GROUNDWATER

Ground water samples have been collected from Site wells on a quarterly to semiannual basis since RFI activities were initiated in 1992. The current ground water monitoring program under the Agreed Order was described in Section 3.2.13 above.

The RI/DE Report (PSC 1999) included the ground water sampling results for the period April 1996 through January 1998, which were analyzed by PSC's laboratory. Subsequent quarterly status reports and annual ground water monitoring reports that were prepared under the Agreed Order included the ground water sampling results for the period April 1998 through June 2005.

Due to concerns about the quality of the data being produced by PSC's laboratory, the PLPs contracted Sayler Data Solutions ("SDS") to perform a summary data validation on Site ground water data collected under the Agreed Order during the period April 1998 through October 1999. Results of the data validation (SDS 2000a) showed that there were significant data quality issues, and the report concluded that at least some of the data should not be used for decision-making purposes. The PLPs discontinued their use of PSC's laboratory for the Site, and North Creek Analytical ("NCA") was contracted to analyze Site ground water samples beginning with the February 2000 event.

Because the ground water data provided in the RI/DE Report appears to be suspect based on the data validation results, Section 5.4 in that report and related tables and appendices of laboratory analytical results cannot be considered reliable for use in evaluating ground water chemistry at the Site. Ground water results from February 2000 through June 2005 are generally considered to be of good quality. These results have been validated, and the results have been provided in quarterly status reports. The distribution and occurrence of selected COPCs have been reported in annual ground water monitoring reports that have been prepared under the Agreed Order.

Three ground water monitoring wells (CP_GP08 through CP_GP10) have been installed on Piers 90 and 91 along the flowpath downgradient from the Lease Parcel. Another well (CP_GP14) was installed along the western edge of the east-west bulkhead at the head of the slip between Pier 91 and the West Yard, just west of the head of Pier 91. These four wells are potential compliance wells for the ground water to surface water/sediments pathway based on their locations downgradient from the Lease Parcel. Wells CP_GP08 through CP_GP10 have been sampled on a quarterly basis since December 2004, and well CP_GP14 has been sampled quarterly since March 2005. The locations of these wells are shown on Figure 3, and the laboratory analytical results from these four wells are provided in Table 6.

5.5 AIR

Several soil vapor investigations were performed at the Site in order to evaluate the potential for vapor intrusion from underlying contaminated soil, ground water, and LNAPL into Building M-28. These investigations were described in Section 3.2 above. Several belowground concrete sumps in the building were sealed as part of this work.

The results of the investigations showed that based on current land use, there is no unacceptable risk to workers in the building from vapor intrusion. In its June 16, 2005 approval letter (Ecology 2005), Ecology acknowledged that no additional vapor intrusion investigations would be needed based on the current use of the Site.

5.6 SURFACE WATER AND SEDIMENTS

Based on data gathered during the RI, sediment samples have not been collected at the Site. Data gathered to date do not demonstrate that chemicals from the Site have been released to the surface water or sediments.

The marine sediments near T91 likely have been impacted by a host of direct discharges and incidental releases from a wide variety of sources that are not related to the T91 Tank Farm Site. For example, direct discharge sources include the City of Seattle's ("City's) 92-inch

storm drain/CSO discharge and the City's 44-inch storm drain that historically received and then discharged contaminants from numerous sources, including the City's truck disposal station just north of T91. Contaminants from such discharges might be expected to include metals, petroleum hydrocarbons, polychlorinated biphenyls ("PCBs"), polynuclear aromatic hydrocarbons ("PAHs"), and other priority pollutant compounds.

POS and Ecology are currently negotiating a revised Agreed Order for the Site that is expected to address timing of any remedial action for submerged lands that contain sediments. Cleanup decisions relating to sediment issues will be made according to the terms of that Order or subsequent documents.

5.7 LAND USE

This section provides a description of current and potential future land use for the Lease Parcel and nearby surrounding areas.

5.7.1 Current Land Use

The T91 property is currently zoned for industrial land use. Current land use at the Lease Parcel consists primarily of unused paved parking space, since the Tank Farm demolition was completed in July 2005. The Main Warehouse and yard located north of the tank farm in the Lease Parcel was not demolished, and is currently being leased by Snider Petroleum and used for repackaging of lubricating oils.

The nearest building to the Lease Parcel is Building M-28, which is currently leased by City Ice and used for prepared food manufacturing such as salad dressings. To the west of the Lease Parcel are two cold storage warehouses, Buildings W-390 and W-39, which are currently leased by City Ice and used for cold storage of seafood products. To the west of Building W-39 is Building W-40, which is currently leased by City Ice and is being used for seafood processing. Open areas under the Magnolia Bridge/West Garfield Street Viaduct to the south of the Lease Parcel are used by tenants for boat parking and miscellaneous storage.

An UST is located in the Triangular Area to the east of the south end of the Lease Parcel and is used by POS to fuel POS vehicles used on the Terminal.

To the south of the Lease Parcel is the Short Fill Impoundment, locally known as “Lake Jacobs.” As described in the BDR1 (Roth Consulting 2001f), this impoundment is a remnant body of water that was created in the 1980s when a small part of the Pier 90/91 slip was filled with dredge material under a permit issued by the U.S. Army Corps of Engineers. A range of alternatives for filling the slip was considered in the original environmental impact statement (“EIS”) for the project. The alternatives ranged from a “full fill” through the small “short fill”, which is the alternative that was ultimately selected. The term “short fill” was retained during and after project construction

The body of water making up the short fill impoundment was isolated from the rest of the slip by construction of the North Short Fill Berm in the 1980s. The reason for isolating the water was to avoid potential geotechnical effects that the short fill might have on the existing bridge/viaduct structure. POS completed mitigation for the loss of the entire slip north of the South Short Fill Berm, including the short fill impoundment, at that time.

Other land uses in the nearby vicinity include berthing of ships along Piers 90 and 91.

5.7.2 Future Land Use

POS is currently planning for future land uses at T91 as part of the North Bay redevelopment project. As part of that process, several different alternatives are being considered for future land uses for the Site and surrounding areas. All considered alternatives assume that the Lease Parcel will remain zoned for industrial uses. Most of the nearby areas also are planned to remain in industrial use. The nearest area planned for potentially different land uses is in the vicinity of Building W-40 to the southwest of the Lease Parcel, where some of the possible future land use alternatives include rezoning for commercial use.

POS has identified the short fill impoundment area as a location where additional space for tenant operations could be obtained. POS has completed a geotechnical assessment of the short fill impoundment area, taking into consideration new engineering technology available since the original short fill construction. POS plans to fill the short fill impoundment within the next few years as part of its ongoing pier redevelopment work. The exact schedule will be dependent on the City of Seattle's decision regarding where to locate the Magnolia Bridge, which will need to be factored into the decision-making process. If filling the impoundment is not completed, POS plans to cover the impoundment to minimize exposure to potential receptors.

6.0 CONTAMINANT FATE AND TRANSPORT

6.1 POTENTIAL TRANSPORT MECHANISMS

Potential transport mechanisms were discussed in Section 5.5 of the RI/DE Report (PSC 1999). Updates based on subsequent investigations are described in this section.

Section 5.5.1 of the RI/DE Report discussed storm drain sediments that were present at the Lease Parcel over 10 years ago. The RI/DE Report noted that those storm drains were connected to a closed system routed through the City of Seattle Metro sanitary sewer system; hence it would have been unlikely that COPCs would have migrated from storm drain sediments to the environment. In addition, the tank farm has now been demolished, and the Lease Parcel is paved, so this transport mechanism is no longer relevant.

Section 5.5.3 of the RI/DE Report discusses the potential for off-gassing of VOCs from impacted Site media. As described in Section 5.5 above, a soil vapor investigation subsequently was performed at the Site, and the related reports concluded no unacceptable risks from this mechanism based on current Site use.

Section 5.5.5 of the RI/DE Report stated that the then-current ground water monitoring network did not extend to Lake Jacobs (Short Fill Impoundment) or Puget Sound. The monitoring network subsequently has been extended downgradient along several flowpaths, and potential compliance wells have been installed to evaluate the potential for migration of constituents to Puget Sound. Results of the compliance well sampling to date were provided above in Section 5.4.

Based on the investigative work described in this report, all transport mechanisms have been adequately characterized to support preparation of the FS.

7.0 SUMMARY AND CONCLUSIONS

Numerous environmental investigations have been performed at the Site beginning in the 1980s. This RI Summary Report summarizes primarily investigations performed at the Lease Parcel in association with its past use as a RCRA TSD facility, and investigations performed under the Agreed Order for the Site.

VOCs, SVOCs, PAHs, PCBs, TPH, and/or metals have been detected in soil, ground water, and soil vapor at the Site. The likely sources of these constituents include leaks of fuel and wastes from tanks and other equipment used during Lease Parcel operations, and releases caused by equipment failure and operator errors during fuel and waste handling and transfer operations. Migration of contaminants was primarily downward through the soil column to the shallow water table. An LNAPL plume is present beneath and in the immediate vicinity of the Lease Parcel, but it does not appear to be expanding.

A ground water seepage evaluation was performed downgradient from the Lease Parcel. The seepage evaluation included areas outward along Piers 90 and 91. Potential compliance wells were installed upgradient of the areas of significant seepage along Piers 90 and 91. Very low concentrations of a few chemicals have been detected in these wells, and the FS will evaluate these results with respect to potential risk to receptors. .

Soil vapor investigations were performed at the Site, and the results showed no unacceptable risk to workers based on current Site conditions. This exposure pathway will be further evaluated for potential future Site use as part of the FS.

Several data gaps relative to the potential for LNAPL accumulation and recovery have been identified, and those data gaps currently are being addressed under the FS Work Plan (PES 2005a) and the Data Gaps Investigation Work Plan (PES 2007).

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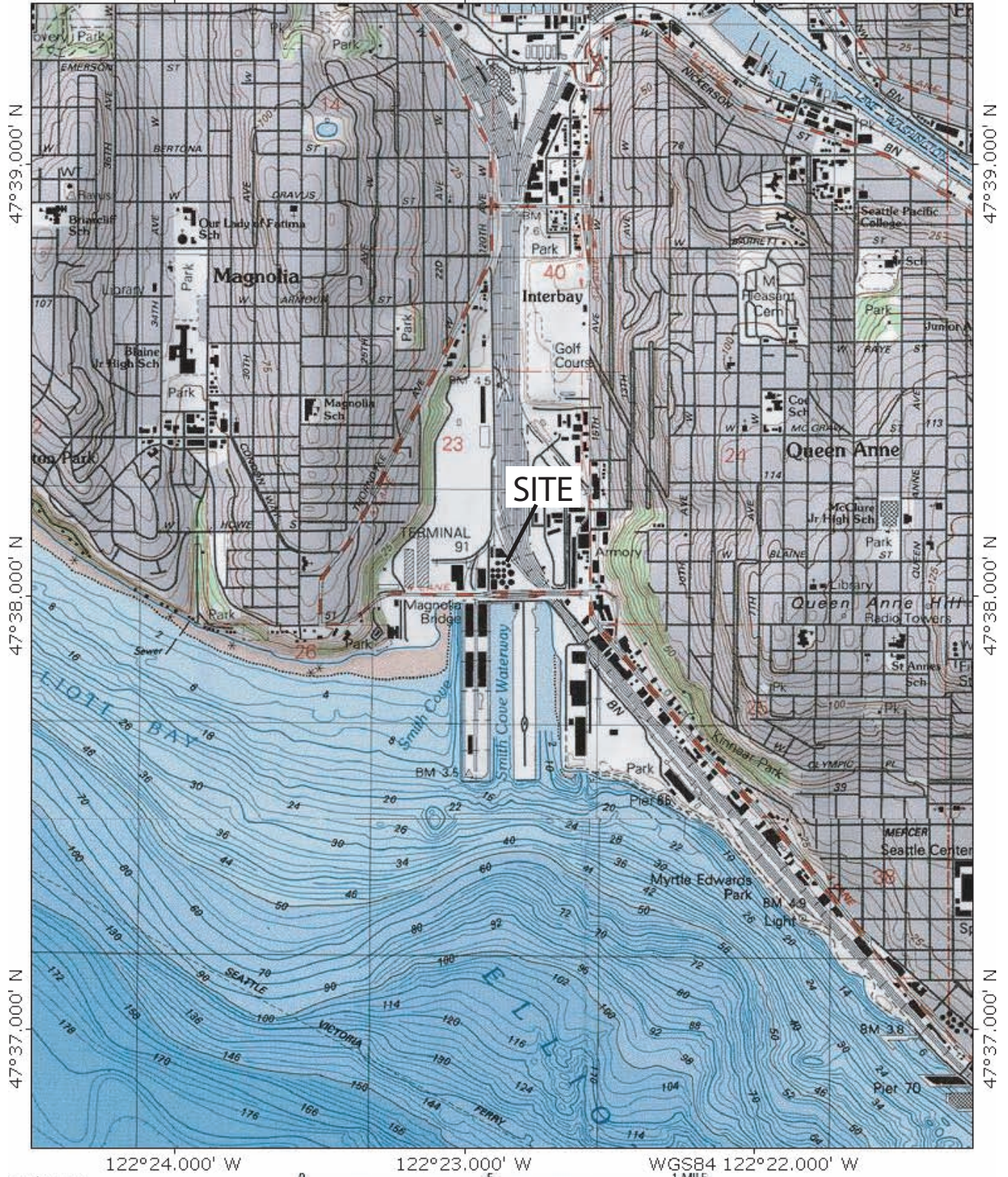
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Figures

TOPO! map printed on 11/26/05 from "Washington.tpo" and "Untitled.tpg"
122°24.000' W 122°23.000' W WGS84 122°22.000' W



TN
MN
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0 1000 FEET 0 500 1000 METERS
1 MILE
WGS84 122°22.000' W

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Figure 1
Site Location Map
Terminal 91 Tank Farm Site

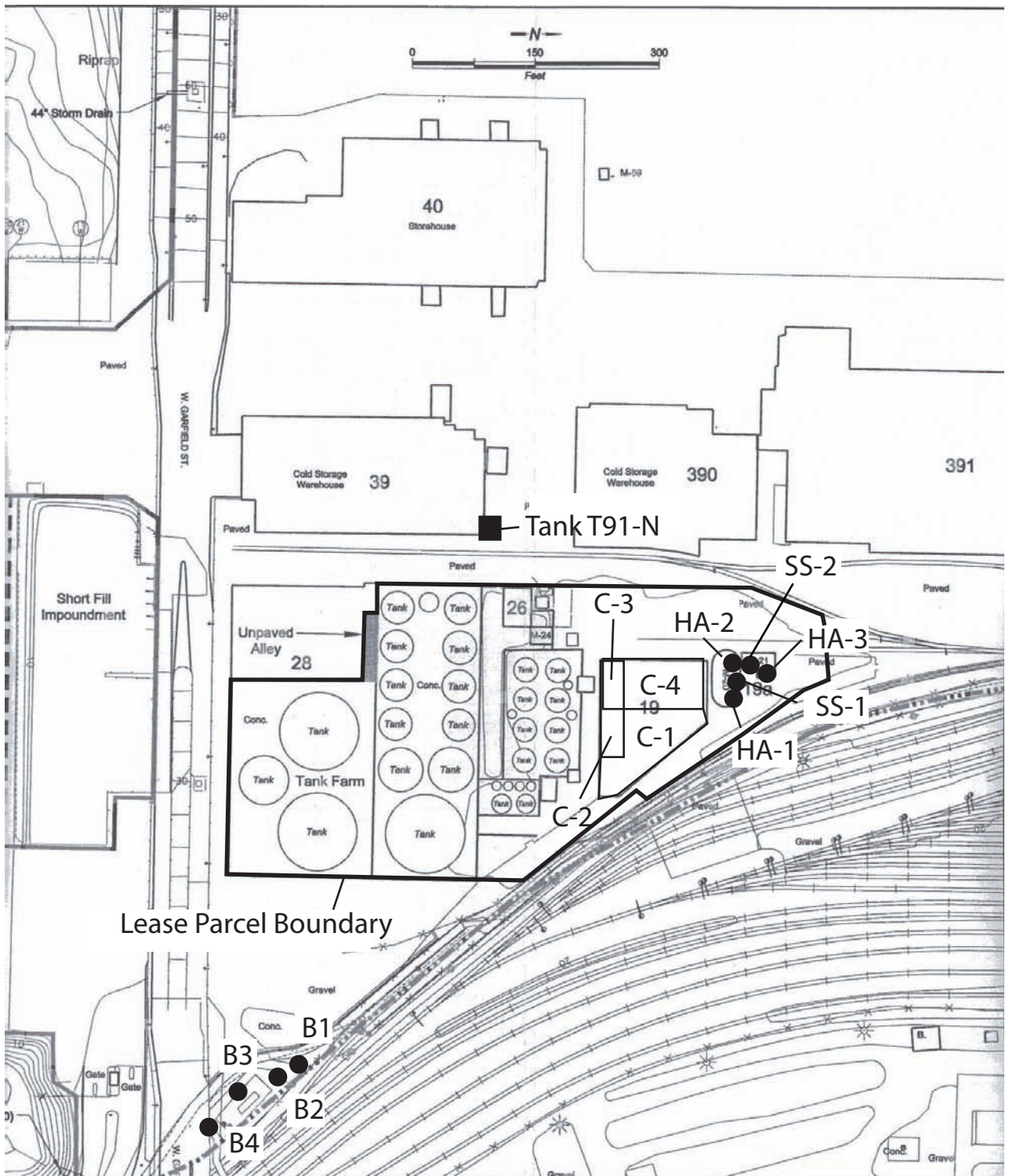
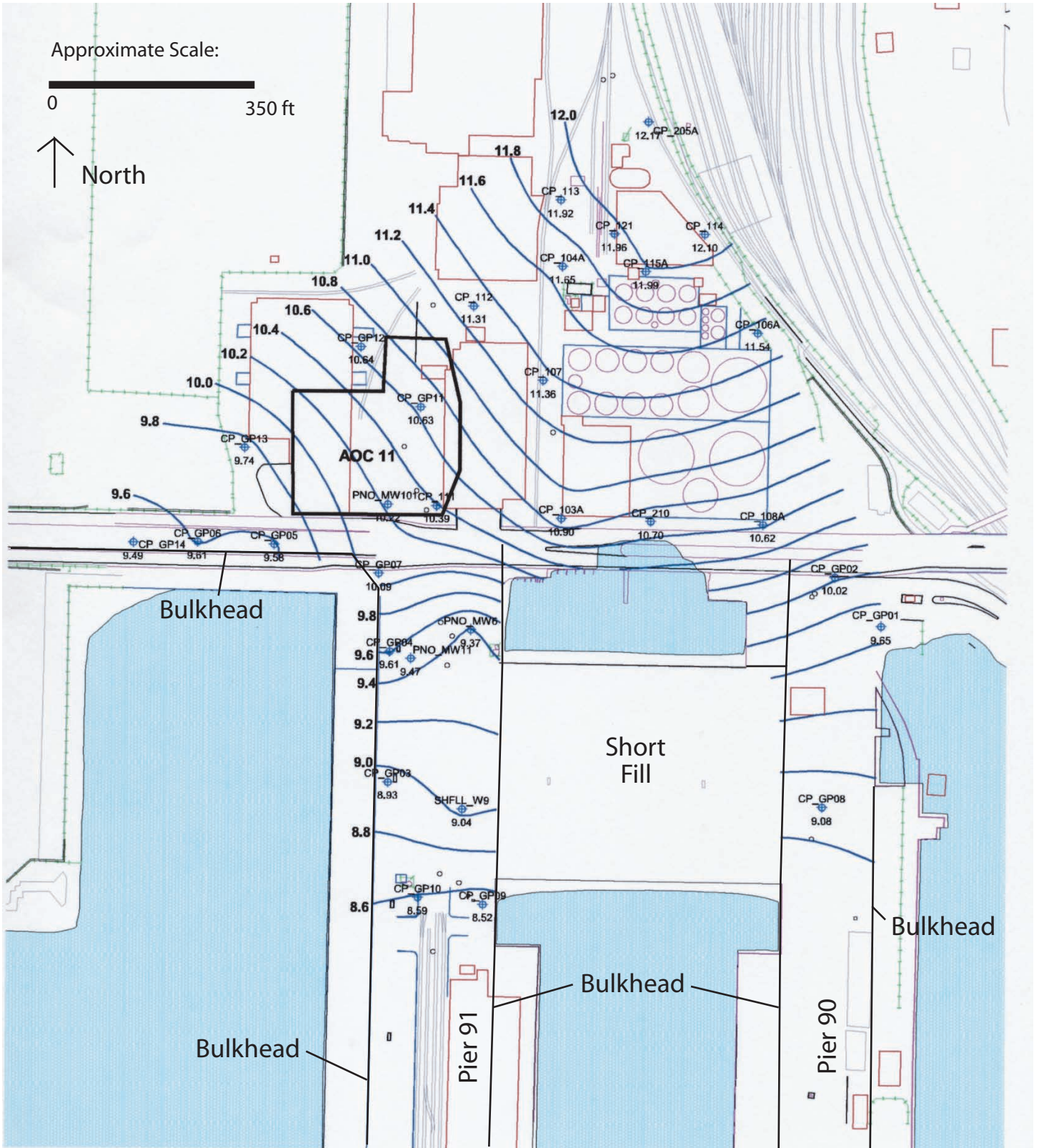


Figure 2
 Pre-Demolition Site Plan and
 Locations of Soil Samples from
 Previous Non-RCRA
 Investigations
 Terminal 91 Tank Farm Site



Notes:
 Contour elevations are in ft above MSL (MLLW)

Figure 3
 Pre-Demolition Site Plan and
 Ground Water Contour Map from
 March 2005 Monitoring Event
 Terminal 91 Tank Farm Site

Tables

Table 1
TPH in Soil Samples from Previous Non-RCRA Investigations

Location	Sample ID	Date	TPH-HCID	418.1	TPH-G	TPH-D	TPH-O
Triangular Area	B-1@2'	10/06/92	NA	150	NA	NA	NA
	B-1@4'	10/06/92	D	65	36	79	NA
	B-1@6'	10/06/92	NA	15,000	NA	NA	NA
	B-2@2.5'	10/06/92	NA	370	NA	NA	NA
	B-2@4'	10/06/92	G, D, O	15,000	840	9,000	NA
	B-3@2'	10/06/92	NA	12	NA	NA	NA
	B-3@4'	10/06/92	D	60	NA	57	NA
	B-4@2'	10/06/92	NA	60	NA	NA	NA
	B-4@4'	10/06/92	D	450	NA	170	NA
Lube Warehouse	SS-1	05/03/95	D, O	771	NA	NA	NA
	SS-2	05/03/95	D, O	772	NA	NA	NA
	HA-1	05/24/95	ND	NA	NA	NA	NA
	HA-2	05/24/95	ND	NA	NA	NA	NA
	HA-3	05/24/95	ND	NA	NA	NA	NA
Warehouse M-19	C-1	08/11/95	G, D, O	NA	<5.6	7,400	12,000
	C-2	08/11/95	G, D, O	NA	<5.4	1,200	5,400
	C-3	08/11/95	D, O	NA	NA	2,800	2,600
	C-4	08/11/95	D, O	NA	NA	4,700	7,400

Notes:

All sample results in mg/kg.

NA = Not analyzed.

ND = not detected

G= gasoline, D = diesel, O = heavy oil (range of hydrocarbons detected).

Table 2
VOCs in Soil Samples from Previous Non-RCRA Investigations

Location	Sample ID	Date	Benzene	Toluene	Ethylbenzene	Xylenes
Triangular Area	B-1@4'	10/06/92	<0.02	<0.02	<0.02	0.07
	B-2@4'	10/06/92	<0.02	0.83	0.50	2.19
Warehouse M-19	C-1	08/11/95	<0.0012	<0.0015	<0.0012	<0.0013
	C-2	08/11/95	<0.0011	<0.0012	<0.0011	<0.0012
	C-3	08/11/95	<0.0011	<0.0011	<0.0011	<0.0011
	C-4	08/11/95	<0.0010	<0.0010	<0.0010	<0.0010
Location	Sample ID	Date	Acetone	Methylene Chloride	n-Butylbenzene	1,2,4-Trichlorobenzene
Triangular Area	B-1@4'		NA	NA	NA	NA
	B-2@4'		NA	NA	NA	NA
Warehouse M-19	C-1	08/11/95	0.024 B	0.014 B	0.0014 M	0.012 M
	C-2	08/11/95	<0.0055	0.011 B	<0.0011	<0.0054
	C-3	08/11/95	0.018 B	0.0071 B	<0.0011	<0.0057
	C-4	08/11/95	0.011 B	0.0055 B	<0.0010	<0.0050

Notes:

All results in mg/kg.

NA = Not analyzed.

B = Compound was also detected in the method blank.

M = An estimated value of analyte found and confirmed by analyst but with low spectral match.

Table 3
SVOCs in Soil Samples from Previous Non-RCRA Investigations

Location	Sample ID	Date	Naphthalene	2-Methylnaphthalene	Acenaphthylene	Acenaphthene	Dibenzofuran	Fluorene	Pentachlorophenol
Warehouse M-19	C-1	08/11/95	0.47	0.82	0.44	1.1	1.9	1.2	2.4 M
	C-2	08/11/95	0.18	<0.074	0.29	<0.074	<0.074	<0.074	<0.37
	C-3	08/11/95	0.58	1.0	<0.45	<0.45	<0.45	<0.45	<2.2
	C-4	08/11/95	<0.40	0.40	0.46	<0.40	<0.40	<0.40	<2.0
Location	Sample ID	Date	Phenanthrene	Carbazole	Anthracene	Fluoranthene	Pyrene	Benzo (a) anthracene	bis (2-Ethylhexyl) phthalate
Warehouse M-19	C-1	08/11/95	37	7.5	7.1	18	13	3.5	1.6
	C-2	08/11/95	1.3	<0.074	0.16	1.4	2.4	0.90	0.11
	C-3	08/11/95	<0.45	<0.45	<0.45	<0.45	5.8	1.2 M	1.5
	C-4	08/11/95	0.86	<0.40	<0.40	0.77	1.8	0.85	1.0
Location	Sample ID	Date	Chrysene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Benzo (a) pyrene	Indeno (1,2,3-cd) pyrene	Dibenz(a,h) anthracene	Benz (g,h,i) perylene
Warehouse M-19	C-1	08/11/95	3.5	1.5	1.3	1.2	1.1	0.36 M	1.2
	C-2	08/11/95	1.2	0.94	0.51	0.58	0.47	0.22 M	0.54
	C-3	08/11/95	5.1	2.0	1.0	3.8	1.4	0.94 M	2.7
	C-4	08/11/95	1.5	0.71	0.56	0.73	<0.40	<0.40	0.50

Notes:

All results in mg/kg.

M = An estimated value of analyte found and confirmed by analyst but with low spectral match.

Table 4
PCBs in Soil Samples from Previous Non-RCRA Investigations

Location	Sample ID	Date	Aroclor 1260	Aroclor 1254
Warehouse M-19	C-1	08/11/95	4.8	< 0.036
	C-2	08/11/95	<0.037	0.026 J
	C-3	08/11/95	0.014	<0.10
	C-4	08/11/95	<0.034	<0.034

Notes:

All results in mg/kg.

J = An estimated value.

Table 5
Metals in Soil Samples from Previous Non-RCRA Investigations

Location	Sample ID	Date	Arsenic	Barium	Beryllium	Cadmium	Chromium
Warehouse M-19	C-1	08/11/95	<5	239	0.30	2.3	40.9
	C-2	08/11/95	<5	356	0.20	0.6	19.1
	C-3	08/11/95	<5	572	0.20	1.5	23.1
	C-4	08/11/95	<5	72.1	0.21	0.4	20.8
Location	Sample ID	Date	Copper	Lead	Mercury	Nickel	Zinc
Warehouse M-19	C-1	08/11/95	120	201	0.17	30	444
	C-2	08/11/95	43.5	129	0.25	24	135
	C-3	08/11/95	21.4	396	0.07	30	255
	C-4	08/11/95	18.9	43	0.07	40.1	109

Notes:

All sample results in mg/kg.

Table 6

COPCs Detected in Ground Water Samples Collected from Four Potential Compliance Wells

COPCs	Screening Levels from BDR2	GP-08			GP-09		
		Dec-04	Mar-05	Jun-05	Dec-04	Mar-05	Jun-05
Arsenic	0.14	1.00	0.569	1.06	4.38 (3.70)	4.25	2.09
Chromium	50	1.00 U	1.00 U	1.00 U	1.00 U (1.00 U)	1.14	1.00 U
Zinc	81	10.0 U	10.0 U	10.0 UJ	14.7 (15.8)	11.1	10.0 UJ
2-Methylnaphthalene	N/A	0.0472 U	0.0476 U	0.0472 U	0.0472 U (0.0500 U)	0.0495 U	0.0472 U
Anthracene	110,000 (40,000)	0.0472 U	0.0476 J	0.0490 UJ	0.0481 U (0.0500 U)	0.0495 U	0.0472 U
Fluoranthene	370 (140)	0.0472 U	0.0476 U	0.0490 UJ	0.0558 (0.0560)	0.0495 U	0.0472 U
Naphthalene	4,940	0.0472 U	0.0476 U	0.0472 U	0.0510 (0.0500 U)	0.0495 U	0.0472 U
Pyrene	11,000 (4,000)	0.0472 U	.0476U	0.0490 UJ	0.176 (0.187)	0.0495 U	0.0472 U
Chloroform	470	1.00 U	1.00 U	1.00 U	1.00 U (1.00 U)	1.00 U	1.00 U
COPCs	Screening Levels from BDR2	GP-10			GP-14		
		Dec-04	Mar-05	Jun-05	Dec-04	Mar-05	Jun-05
Arsenic	0.14	1.75	1.85	3.43	NA	4.23	3.17
Chromium	50	2.41	1.56	1.17	NA	1.16	1.00 U
Zinc	81	26.5	19.9	17.7 J	NA	10.0 U	10.7 J
2-Methylnaphthalene	N/A	0.0472 U	0.0495 U	0.0472 U	NA	0.0485 U	0.0541
Anthracene	110,000 (40,000)	0.0472 U	0.0495 U	0.0472 U	NA	0.0485 U	0.0510 U
Fluoranthene	370 (140)	0.0472 U	0.0495 U	0.0472 U	NA	0.0485 U	0.0510 U
Naphthalene	4,940	0.0472 U	0.0495 U	0.0472 U	NA	0.0971 J	0.0949
Pyrene	11,000 (4,000)	0.0745	0.0495 U	0.0472 U	NA	0.0485 U	0.0510 U
Chloroform	470	1.00 U	1.00 U	2.99	NA	1.00 U	1.00 U

Table 6

COPCs Detected in Ground Water Samples Collected from Four Potential Compliance Wells

Notes:

All samples were analyzed for TPH-Gx, TPH-Dx, VOCs, SVOCs, PAH-SIM, and PCBs; except that SVOCs were not analyzed in December 2004. Only detections are listed.

NA = Not analyzed (because well had not been installed at the time of the sampling event.)

N/A = Not available.

All sample results in ug/L.

Detections are indicated in bold font. Screening level exceedances are indicated in bold and italic font.

J qualifier indicates value is estimated.

U qualifier indicates chemical was not detected in sample at reporting limit listed.

Data in parentheses for GP-09, Dec-04 are the field duplicate results.