Remedial Investigation Report

Parcel 15 (Portac) Investigation

Ecology Facility Site No. 1215 / Cleanup Site No. 3642

February 2018

Prepared for

Port of Tacoma and

Portac, Inc.

Prepared by

GSI Water Solutions, Inc.

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Public Review Draft
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Will sign when finalized

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Date

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Abbreviations and Acronyms

µg/kg	micrograms per kilogram
µg/L	micrograms per liter
µS/cm	micro Siemens per centimeter
ARAR	applicable or relevant and appropriate requirement
BAT	batch adsorption tests
bgs	below ground surface
bml	below mudline
CFR	*Code of Federal Regulations*
cm	centimeter
COC	chain of custody
CSM	conceptual site model
CUL	MTCA's Cleanup Levels
DO	dissolved oxygen
DV	data validation
Ecology	Department of Ecology, Washington State
EDD	electronic data deliverables
EIM	Environmental Information Management, Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FS	Feasibility Study
FSP	Field Sampling Plan
GIS	geographic information system
GSI	GSI Water Solutions, Inc.
LEL	lower explosive limit
Log Yard	former log yard area at the Site
MDL	method detection limit
MLLW	mean lower low water
MTCA	Model Toxics Control Act, Washington State
NCDS	National Climatic Data Station
NOAA	National Ocean and Atmospheric Administration
Order	Agreed Order
ORP	oxidation-reduction potential
PAH	polycyclic aromatic hydrocarbon
PCP	pentachlorophenol
pH	negative log of the hydrogen ion concentration in solution
Port	Port of Tacoma
Portac	Portac, Inc.
PQL	practical quantitation limit
PSL	preliminary screening levels
QAPP	Quality Assurance Project Plan
QA	quality assurance
QC	quality control
RCC	roller-compacted concrete
RCRA	Resource Conservation and Recovery Act
RCW	Revised Code of Washington
RI	remedial investigation
RI/FS	remedial investigation/feasibility study

Abbreviations and Acronyms (continued)

RI Report	*Remedial Investigation Report*
RIWP	Remedial Investigation Work Plan
RPD	relative percent difference
RZA	Rittenhouse-Zeman & Associates
SAP	Sampling Analysis Plan
Sawmill	former sawmill area at the Site
SCO	Sediment Cleanup Objective
Site	Parcel 15 – Former Portac Sawmill and Log Yard
SL	screening level
SMS	Sediment Management Standards, Washington State
SR	State Route
SSPA	S.S. Papadopulos & Associates
SWAC	surface weighted average concentration
TEAP	terminal electron accepting process
TEE	Terrestrial Ecological Evaluation
TEQ	toxicity equivalency quotient
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TSS	total suspended solids
VCP	Ecology's Voluntary Cleanup Program
VOC	volatile organic compound
WAC	Washington Administrative Code
WCT	Wapato Creek transects
WES	Whitman Environmental Services

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1 Introduction

This Remedial Investigation Report (RI Report) was prepared by GSI Water Solutions, Inc. (GSI), and S.S. Papadopulos & Associates, Inc. (SSPA), on behalf of the Port of Tacoma (Port) and Portac, Inc. (Portac), in accordance with the requirements of the 2016 Agreed Order (Order) No. DE11237 between the State of Washington Department of Ecology (Ecology), the Port, and Portac, pursuant to the Washington State Model Toxics Control Act (MTCA; Revised Code of Washington [RCW] 70.105D), MTCA regulations (Washington Administrative Code [WAC] Chapter 173-340), and Washington's Sediment Management Standards (SMS; WAC 173-204).

1.1 Site Location

Parcel 15 (the Site[1]) consists of an approximately triangular parcel of about 52 acres of land owned by the Port. The Site is located at 4215 State Route (SR) 509 – North Frontage Road in an industrial area between Interstate 5 and Commencement Bay, in Tacoma, Washington, as shown in Figure 1-1. The Site is bounded by East 4th Street (northern boundary), Alexander Avenue East (western boundary), and North Frontage Road (SR 509) (southeastern boundary). Wapato Creek is situated between Alexander Avenue East and the western edge of the property and empties into the Blair Waterway through a culvert under East 4th Street. The Blair Waterway is in the southern portion of Commencement Bay, one of multiple industrial waterways developed in the 1900s to support international commerce.

1.2 Background

Portac and its predecessors leased the Site from the Port beginning in 1974 and vacated the Site in 2009. The Site consists of two functionally distinct historical use areas: the former sawmill area (Sawmill) in the southwestern part of the property, and the former log yard area (Log Yard) occupying the remainder of the Site.

Historical industrial activities conducted on the Site adversely impacted upland soil, groundwater, and surface water in the adjacent Wapato Creek. Environmental investigations and cleanup under Ecology oversight have been ongoing since the late 1980s and are described in Section 2 of this RI Report and are summarized below.

Similar to other milling and log storage operations in the region, slag from the former ASARCO smelter was used as ballast (e.g., road base) to stabilize surface soils in the Log Yard. An investigation conducted by Ecology, under authority of RCW 90.48 in the 1980s, showed that metals (e.g., arsenic, copper, lead, and zinc) were leaching from the slag and being discharged into surface water. Historical analysis of upland soil and fill containing slag indicate that metals (e.g., arsenic) were present at concentrations that would exceed current MTCA soil cleanup levels. In addition, historical groundwater monitoring did not confirm that current MTCA cleanup levels were met at a conditional point of compliance, as would be required under current MTCA rules. Current MTCA rules require confirmational monitoring and institutional controls.

[1] For the purpose of this RI Report, the Site encompasses the Log Yard and Sawmill and is based on the Site Boundary shown in Exhibit A of the Order. The final site definition will be developed after completion of the remedial investigation/feasibility study (RI/FS).

Pursuant to a 1988 Order on Consent (under RCW 90.48), Portac and the Port agreed to cap the Log Yard to abate metals contamination of surface water runoff discharging to adjacent Wapato Creek. Although the primary purpose for capping the Log Yard was to mitigate surface water metals contamination, the action also was expected to mitigate groundwater contamination by preventing surface water infiltration through the slag and associated leaching of metals. Site groundwater is hydraulically connected with, and flows into, Wapato Creek, which in turn flows into the Blair Waterway of Commencement Bay in Puget Sound.

In addition to capping the Log Yard, Portac and the Port conducted groundwater monitoring for 3 years (1990 to 1992) after capping was completed. Historical analysis of groundwater, collected in the Log Yard, indicate that metals (e.g., arsenic) were present at concentrations that would exceed current MTCA groundwater cleanup levels. Inspection and maintenance of the cap is required under the 1988 Order on Consent (Section VI (4)).

In 2009, Portac entered into Ecology's Voluntary Cleanup Program (VCP) to address the presence of contaminants (e.g., pentachlorophenol [PCP]) in soil and groundwater in the Sawmill. As described in Section 2.2.3, Portac implemented soil removals to address areas of identified contaminants. At the conclusion of those actions and after multiple rounds of groundwater sampling, PCP remained at concentrations above current MTCA groundwater cleanup standards in a single groundwater monitoring well.

1.3 Purpose and Objectives

The RI Report was developed to comply with a requirement of the Order between Ecology, and the Port and Portac. The primary objective of the Order is to develop a remedial investigation/feasibility study (RI/FS) that will determine what remedial actions are required to comply with current MTCA regulations. Specifically, Ecology is requiring a groundwater evaluation to determine whether capping of the fill containing slag is a sufficiently protective remedy to satisfy current MTCA cleanup standards. The Order requires Portac and the Port to complete an RI and prepare an FS. The RI/FS is to include both the capped Log Yard and the Sawmill (a portion of which also is known as the "VCP area").

Existing data were reviewed and summarized in the Draft Data Gaps Memorandum (GSI, 2015). Data and figures from previous Site investigations were extracted from earlier reports and are provided by media in Appendix A. Sections 2 and 3.1 of this RI Report summarize the Site history and the data needs that were identified for completion of an RI/FS. The Remedial Investigation Work Plan (RIWP; GSI, 2016) was approved by Ecology and describes RI activities to collect, develop, and evaluate sufficient information regarding the Site to allow completion of the RI/FS and to support the selection of a cleanup action under WAC 173-340-360 through 173-340-390.

The purpose of this RI Report is to describe the RI activities that were completed to address the data needs presented in the Data Gaps Memorandum and the RIWP. The RI sampling approach was designed with the intent of collecting sufficient information to support technically sound risk-based management decisions.

1.4 Document Organization

This RI report is organized into the following sections:

- Section 1 – Provides an introduction to the project and objectives.

- Section 2 – Summarizes the pre-industrial development and the operational and regulatory history of the Log Yard and Sawmill.
- Section 3 – Summarizes the RI approach and sampling activities.
- Section 4 – Summarizes the geologic and hydrogeologic Site setting and physical features.
- Section 5 – Provides a summary of the data validation process and the RI analytical results.
- Section 6 – Discusses development of screening levels.
- Section 7 – Describes the nature and extent of Site-associated contaminants relative to the screening levels (SLs) identified in Section 6.
- Section 8 – Describes the conceptual site model (CSM), including Site-associated contaminant sources and fate and transport mechanisms. An updated exposure assessment also is provided.
- Section 9 – References are highlighted in Table 9-1.

Supporting information is provided in the following appendices:

- Appendix A Extracted Tables and Figures from Previous Investigations
- Appendix B Sampling and Analysis Plan (SAP)
- Appendix C Laboratory Reports and Chain of Custody Form
- Appendix D Soil Boring and Test Pit Logs and Well Construction Forms
- Appendix E Representative Photographs
- Appendix F Data Validation Report
- Appendix G Terrestrial Ecological Evaluation (TEE) Waiver Form
- Appendix H Specialized Geochemical Testing Results and Fate and Transport Evaluation
- Appendix I Induced Precipitation Tests Report (Anchor QEA)

2 Site History

This section describes the pre-industrial development of the Site and vicinity (Section 2.1) and the operational and regulatory history of the Sawmill and Log Yard (Section 2.2). Additional information about the hydrogeologic Site setting and physical features is provided in Section 4.

2.1 Pre-Industrial Development and Land Use

The Site is situated within the Puyallup River Estuary and lowlands, which were largely undeveloped until construction of the U.S. Naval Station and the Port began in the early 1900s. Growth in the Tacoma tide flats was further stimulated in response to World War I and World War II. Additional information regarding development of the Puyallup River Estuary can be found in the Draft Puyallup River Watershed Assessment (Puyallup River Watershed Council, 2014).

Aerial photographs were compiled and reviewed to gain a better understanding of historical land use at the Site. Copies of these photographs are provided in Appendix A.1 for 1936, 1940, 1944, 1950, 1969, 1973, 1985, 1990, 2002, 2006, 2009, 2011, 2012, and 2015. A summary of historical events and observations from aerial photographs is provided in Table 2-1.

Review of historical aerial photographs indicates that the Site was used for agricultural purposes from at least the 1930s through about 1950. At that time, Wapato Creek ran in a northwesterly direction through the Site. The orientation of this former channel is shown on a 1940 aerial photograph in Figure 2-1. Between 1959 and 1965, the Site and surrounding area received extensive fill. The fill likely originated from the Blair Waterway, which was extended in 1965. As part of filling and regrading, Wapato Creek was rerouted parallel to Alexander Avenue, along the western boundary of the Site. Review of the 1969 aerial photo shows the disturbed surface of the Site following filling of the Site and rerouting of the creek.

The Site remained undeveloped until 1974, when Portac's predecessor, West Coast Orient Lumber Mill, leased the property from the Port to begin milling operations. The history of these operations is described in the following section.

2.2 Operational and Regulatory History

Portac and its predecessors leased the Site beginning in 1974 and vacated the premises in 2009. The Port owned the Site during the operation of the Site as a log yard and sawmill and maintains current ownership. Figure 2-2 shows the general layout of the former Site features on an aerial photograph from 1985. The Sawmill was situated in the southwestern portion of the property while the Log Yard occupied the remainder of the Site. The operational and regulatory history for each of these areas since development began in the 1970s is described separately in Sections 2.2.1 and 2.2.3. The former central drainage ditch, which separated the Log Yard and the Sawmill, is discussed in Section 2.2.2. A summary of previous environmental investigations and sampling events is provided in Table 2-2 and supporting tables and figures are provided by sampling media in Appendix A.4 through A.7 of this RI Report. A summary of identified source areas, Site-associated contaminants, and associated remedial activities (if applicable) is provided in Table 2-3 and the locations of the source areas are shown in Figure 2-2.

2.2.1 Log Yard

The Log Yard was constructed in 1974 on the northern and eastern portion of the Site (Figure 2-2). The portion of the Log Yard north of the former central drainage ditch was unpaved and used for log storage while the southeastern portion was paved and used for lumber storage (HC, 1988b).

While conducting investigations in the Commencement Bay Area in the 1980s, the U.S. Environmental Protection Agency (EPA) and Ecology discovered metals concentrations in Wapato Creek above chronic aquatic toxicity standards. The source of metals was identified as slag from the ASARCO copper smelter, which was placed to stabilize the Log Yard surface during development of the Site in 1974 through the early 1980s. Subsequent environmental investigations conducted by Hart Crowser, Inc. (HC, 1988b and 1992), on behalf of the Port, indicated that the predominant contamination migration pathway for metals to Wapato Creek was stormwater runoff via overland flow, the onsite former central drainage ditch, and subsurface drainage pipes. The configuration of the historical stormwater conveyance system is shown in Figure 2-2. Groundwater discharge was not considered to be a significant source of metals to surface water because the water table was reported to be deeper than the fill containing slag.

An environmental cap was placed over this area, subject to a 1988 Order on Consent (DE 88-S326) executed between Ecology, the Port and Portac under RCW 90.48 (this Order on Consent pre-dated the MTCA regulations). The cap consisted of gravel ballast and two layers of roller-compacted concrete (RCC) and was graded to direct surface water runoff to catch basins that carried water to Wapato Creek via underground piping of lined ditches (HC, 1988b.) The cap was selected as a remedy that would provide containment of the ASARCO slag and wood debris and prevent them from coming into contact with stormwater and subsequently impacting adjacent surface waters. The current area of the cap is approximately 29.4 acres (Figure 2-2).

The Log Yard area cap was installed by Portac and the Port as a jointly funded action under the 1988 Order on Consent. Subsequent stormwater and groundwater monitoring activities required by the 1988 Order on Consent have been completed. Since installation, Portac (until 2009) and the Port have performed periodic inspections and maintenance, primarily in the form of filling cracks. A summary of past cap inspections and cap maintenance was provided by the Port and is provided in Appendix A.8.

2.2.2 Former Central Drainage Ditch

The Portac Log Sort Yard Remediation Plan (1988 Remediation Plan; HC, 1988b) discusses historical Site drainage features as described below. During operations, stormwater from about two thirds of the Log Yard area drained to Wapato Creek via an open drainage ditch (i.e., former central drainage ditch), that flowed through the middle of the Site (Figure 2-2). Drainage in the southern portion of the Log Yard (where logs were stored) was conveyed through shallow perforated pipes. Stormwater in the northern portion of the Sawmill was collected in subsurface piping and also routed to the former central drainage ditch, just east of the machine shop (Figure 2-2). The northern portion of the Log Yard drained to four catch basins along the northern property line and discharged to Wapato Creek via subsurface piping (Figure 2-2).

Section 7.2 of the 1988 Remediation Plan indicates that a PCP cleanup was occurring along the former central drainage ditch, but that those cleanup efforts likely would not be completed at the same time as the capping of the Log Yard in the late 1980s. To provide space for the PCP cleanup to occur, the cap was set back about 50 feet from the former central drainage ditch. The 1988 Remediation Plan indicates that a new trench was to be dug parallel to the former central drainage ditch and either lined or equipped with a drainage pipe. Stormwater discharging to the former central drainage ditch was to be rerouted into the new trench and paved following completion of the PCP cleanup.

In late 1988, Portac removed approximately 471 tons of soil from the former central drainage ditch. The work was performed by Crowley Environmental Services and was overseen by Rittenhouse-Zeman & Associates (RZA, 1988a, 1988b). Sampling was performed on the remaining ditch soils to document the adequacy of soil removal. The soils were managed by offsite disposal at Waste Management's Arlington, Oregon, permitted landfill. In parallel with this work, RZA also conducted testing for PCP in surface sediments along Wapato Creek (RZA, 1988c) adjacent to and upstream of the Site. The maximum concentration of PCP detected in that study was 10 micrograms per kilogram (µg/kg) dry weight. Other samples adjacent to the Site were non-detect for PCP. Test reports that documented the ditch cleanout were provided to Ecology, and Ecology summarized its review of the work in a letter dated February 6, 1989 (Ecology, 1989). Following the Ecology-approved ditch cleanup, the ditch was backfilled and the cap was extended over 0.51 acre at the Site, to its current location (Port, 1989).

2.2.3 Sawmill

Portac began operating the 22-acre Sawmill in 1974. Sawmill operations involved the use of a commercial wood-treating preservative containing PCP that was used as a water-based solution and applied to lumber as it passed through spray booths at the facility between approximately 1976 and 1980 (WES, 2009e). The locations of the spray booth areas in the Mill Building and Planer Building are shown in Figure 2-2 and the history of usage is further described in the Lumber Mill Demolition and Environmental Cleanup and Testing Report (WES, 2009e). In 1980, Portac installed a dip tank to replace the spray booths. The rectangular steel tank (about 30 feet long, 6 feet wide, and about 6 feet deep) was located at the north end of the storage building where lumber was bundled before shipping. In 1986, Portac switched from using a PCP product to a different sap stain control solution, Kop-Coat NP-1.

A large centralized hydraulic system operated much of the equipment in the Sawmill building. There were two hydraulic pump rooms located in the northeastern part of the mill (see hydraulics area in Figure 2-2). Reportedly, there were several spills related to the pumps and hydraulic lines during the life of the mill. The spills were on concrete floors and were thought to be well contained. However, petroleum-contaminated soil was encountered during demolition beneath the former concrete floor slabs.

In 2008, Portac demolished the Sawmill portion of the Site in anticipation of vacating the premises. During demolition activities, Portac conducted an environmental site assessment and discovered detectable concentrations of PCP and petroleum in soil and groundwater beneath the Sawmill, and elevated levels of arsenic in groundwater in the area of the former dip tank. Between 2008 and 2009, Portac undertook cleanup actions in areas identified by the environmental site assessment and other conditions identified during the demolition of the structures. Closure actions taken by Portac during demolition included removal of the dip tank, excavation of PCP and/or petroleum-impacted soils, confirmation sampling of the sidewalls and bases of the excavated areas, waste characterization of soils for disposal, installation of monitoring wells at locations where PCP spray equipment was used in the past, remediation of arsenic in slag and soil in the former ramp area adjacent to the Log Yard, and investigation of other potential sources of environmental contaminants. Additional details regarding the environmental site characterization and cleanup are provided in the Lumber Mill Demolition and Environmental Cleanup and Testing Report (WES, 2009e). A summary of environmental investigations and sampling events is provided in Table 2-2 and a brief description of the remedial action taken in each source area is provided in Table 2-3.

A paved earthen ramp that was used as a pathway to transport logs from the adjacent storage yard into the Sawmill was removed as part of the closure and demolition of the Sawmill. The log ramp was located near the central portion of the property adjacent to the capped Log Yard (Figure 2-2) and had a layered construction of asphalt (22 to 27 inches thick), crushed gravel (12 to 18 inches thick), fill containing slag material (1 to 5 feet thick), and a 6-inch-thick layer of sand and gravel (WES, 2009b). A cross section of the log ramp area prepared by Whitman Environmental Services (WES) is provided in Appendix A.2. During removal of the log ramp, 2,473 tons of wood waste, slag, and soil containing elevated concentrations of arsenic were removed and disposed of offsite at the permitted LRI Landfill in Graham, Washington (WES, 2009b). Despite excavation beyond the planned final grade at the ramp area, the base of the excavation still contained visible slag. Based on Site conditions and a meeting among Portac, Ecology, and the Port on September 24, 2008, it was agreed that no further excavation would be conducted. The area was backfilled and regraded using stockpiled soils, crushed concrete, and asphalt, and then paved with an approximately 4-inch-thick layer of asphalt in November 2008 (WES, 2009b).

All of the Sawmill buildings have been removed and Portac has terminated its lease agreement with the Port. Between 2009 and 2014, Portac worked with the Port and Ecology under MTCA's VCP to resolve MTCA liabilities for soil and groundwater contamination issues associated with the Sawmill operations. While remediation of the Sawmill under the VCP was mostly completed, Ecology requested that additional confirmational monitoring and other activities be conducted to complete the remediation of the Sawmill contamination. In 2014, Ecology terminated Portac's VCP and integrated the remaining Sawmill cleanup work under the Order.

2.3 Current and Future Site Use

2.3.1 Log Yard

The Log Yard is currently used by Port customers for parking and storage of new automobiles before transfer to dealerships. The 2015 aerial photos in Appendix A.1 show the current usage on this portion of the Site.

2.3.2 Sawmill

During the RI, the Sawmill was redeveloped to change its use from a heavy equipment storage yard to a paved area that is used for truck queuing to alleviate some of the traffic on North Frontage Road (SR 509). The 2015 aerial photos in Appendix A.1 shows the Site before completion of the truck queing project. As-built drawings of the truck queuing project are provided for reference in Appendix A.9.

2.3.3 Future Site Use

Specific future development plans are not specifically known at this time, but the Site is expected to remain in Port ownership and continue to be used for industrial and Port-related uses.

3 Summary of RI Methods and Activities

3.1 RI Data Needs and Proposed RI Approach

The purpose of the RI is to investigate the nature and extent of contamination caused by the release of hazardous substances at the Site (i.e., Site-associated contaminants) and collect data to support the selection of an appropriate cleanup action for the Site. Many of the RI data needs have been satisfied during previous investigations completed on the Site, as discussed in the Data Gaps Memorandum and the RIWP. However, the Data Gaps Memorandum also identified potential Site-associated contaminants and migration pathways where additional data are needed to assess the presence and significance of these contaminants. Specifically, the Data Gaps Memorandum and RIWP identified additional data needed within the following categories to provide sufficient information to enable Ecology to select a cleanup action for the Site in accordance with RCW 70.105D.050(1), SMS (WAC 173-204-562), and MTCA (WAC Chapter 173-340-350):

- Environmental setting
- Geology and hydrogeology
- Nature and extent of contamination
- Contaminant fate and transport

Section 5 of the RIWP presents the proposed approach for completing the RI to address the identified data gaps and complete the RI/FS. Table 3-1 provides a summary of RI/FS data needs, existing information, previously identified data gaps, and the work that was conducted as part of the RI to address the identified data gaps. Figures 3-1 and 3-2 show the actual RI sample locations.

The RI approach focuses on gathering enough information to support an informed risk management decision regarding which remedy appears to be most appropriate for the Site. As such, four Site-wide sampling events (Events 1 through 4) were conducted to evaluate concentrations of Site-associated contaminants in multiple media (groundwater, surface water, porewater). Concurrent with the first sampling event, additional soil chemistry data and Wapato Creek sediment chemistry data were collected to supplement existing Site data. Samples collected during Event 1 provide comprehensive groundwater, porewater, surface water, outfall discharge, sediment, and soil chemistry data across the Site and within Wapato Creek. These data are used to supplement existing Site information and evaluate arsenic fate and transport mechanisms. The first event (designated Event 1) was conducted in May 2016 with the subsequent three events (Events 2 through 4) targeting different times of the year (August, November, and February) to evaluate potential seasonal effects on water quality and groundwater/surface water interactions.

A summary of specific sampling locations by media and sub-area (Log Yard, Sawmill, and Wapato Creek) is provided in Section 3.2.

3.2 RI Sampling Activities

This section describes the field activities that were conducted as part of the RI. This includes information on the actual sampling locations and the analytical program. Specific details on the sampling techniques, analytical methods, and quality assurance/quality control (QA/QC) measures are provided in the SAP (Appendix B), which includes the Field Sampling Plan (FSP) and the Quality Assurance Project Plan (QAPP). Unless otherwise noted in this section of the report or the Ecology-approved modifications, provided in Appendix C, all work was conducted in general accordance with the SAP.

Actual sampling locations are shown in Figures 3-1 and 3-2 and sample coordinates and elevations are provided in Table 3-2. Event 1 was conducted in May 2016 and entailed drilling, construction, and sampling of groundwater monitoring wells; collection of soil and groundwater samples from temporary borings; test pit explorations; porewater sampling; and surface water sampling, outfall discharge sampling, sediment sampling, and a tidal study in adjacent Wapato Creek. Event 2, Event 3, and Event 4 were conducted in August 2016, November 2016, and February 2017, respectively, and were limited to groundwater, porewater, surface water, and outfall discharge sampling.

Samples from each media collected during Events 1 through 4 were submitted for laboratory analysis of Site-associated contaminants. Laboratory analyses for the soil and sediment samples collected during Event 1 are summarized in Table 3-3. The analytical program for groundwater, porewater, surface water, and outfall discharge for Events 1 through 4 is provided in Table 3-4. Given that the field measurments and/or analytical tests varied somewhat by location and event, Table 3-4 includes the event number(s) so that the similarities and differences between the analytical program for each of the four sampling events is apparent. The analytical approach for the RI entails analysis of a "Standard Analytical Suite" to assess arsenic concentrations and redox chemistry across the Site. In addition, a more comprehensive suite of analyses was conducted on samples from locations within the nearshore transition zone (the "Nearshore Study Areas" outlined in Figure 3-1) to evaluate general chemistry and geochemical conditions that affect arsenic fate and transport. Additional constituents, such as PCP, were analyzed in historical source areas in the Sawmill. Samples were brought to TestAmerica Laboratory, Tacoma, Washington (TestAmerica), for standard analysis of total organic carbon (TOC), sulfide, PCP, major cations and anions, alkalinity, nitrate and nitrite, and dioxins/furans. Sample volumes were sent to Brooks Analytical Laboratory, Bothell, Washington (Brooks), for metals analysis and specialized testing.

The RI sampling activities conducted within the Log Yard, Wapato Creek, and Sawmill are summarized separately below. Details of the sampling techniques and laboratory analytical procedures are provided in the SAP (see Appendix B).

3.2.1 Event 1

3.2.1.1 Log Yard

Sampling in the Log Yard was focused along three transects, for purposes of assessing the groundwater migration pathway. These transects are aligned along existing car storage aisle ways and extend into the adjacent Wapato Creek, as shown in Figure 3-1. Event 1 sampling activities in the Log Yard are summarized below and were conducted in general accordance with the procedures set forth in the SAP. In addition to these activities, surface water, porewater, and sediment samples collected in Wapato Creek, immediately adjacent to the three Log Yard transects, are summarized in Section 3.2.1.3.

Monitoring Wells

Seven new monitoring wells (MW-7 through MW-13; see Figure 3-1) were installed as part of the Event 1 sampling activities, along the three transects to augment the existing monitoring well network. The wells were installed by Steadfast Services Northwest, LLC, a Washington licensed driller.

Continuous soil cores were collected, logged by a Washington licensed geologist, and the depth to water was identified during the well drilling. Transcribed copies of the monitoring well boring logs and construction forms are provided in Appendix D. Soil samples were collected on approximately 2- to 3-foot centers and include collection of archival samples from the unsaturated zone, the capillary fringe, and the saturated zone. See Figure 3-3 for a conceptual illustration of this sampling program with actual sample intervals noted on the boring logs (Appendix D) and included in Table 3-3. One soil sample was collected from approximately 1 to 2 feet below the water table in each of the seven new monitoring well borings and submitted for the Standard Analytical Suite, which includes arsenic, iron, TOC, and total solids. Soil samples collected from the five new wells located within the nearshore study area (Figure 3-1 and Table 3-3) also were analyzed for the expanded Geochemical Suite, which includes sulfide, grain-size, sequential extraction, batch adsorption, and arsenic speciation tests. Additional information on the analytical methods is provided in the SAP. Table 3-3 lists the laboratory analyses for the soil samples from the well borings. The analytical program for soil was consistent with that proposed in the RIWP.

All new and existing monitoring wells were developed before groundwater sampling. Manual water levels were collected in all new and existing wells, and in piezometers (NLR-Portac-16, -17, and -18) to assess the current depth to groundwater and groundwater flow direction. Field measurements were taken at each sampling location for temperature, pH, specific conductance, oxidation-reduction potential [ORP], dissolved oxygen (DO), and turbidity. The headspace of each well also was monitored for methane gas upon initial opening. Field measurements, including groundwater elevations, methane headspace readings, and water quality field parameters, are included in Tables 3-5 through 3-9 and discussed (as applicable) in Sections 5 and 6 of this RI Report.

Groundwater samples were collected from each of the seven new wells and four existing wells (B-1R, B-6R, B-3R, and HC-2) during Event 1. The existing shallow wells, HC-1 and HC-2, were installed to monitor perched water in the fill containing slag and anticipated to go dry over time were evaluated to assess whether these wells contain perched water or stagnant water trapped in the bottom of the wells. Recoverable quantities of water were encountered in HC-2, but HC-1 was consistently dry, except when minor amounts of surficial runoff entered the well during a rain event. HC-2 was redeveloped and sampled, but HC-1 was dry during Event 1 and, therefore, not sampled.

The groundwater samples were submitted to the laboratory for analysis of the Standard Analytical Suite, which for groundwater includes total and dissolved arsenic, TOC, dissolved organic carbon, dissolved sulfide, dissolved iron, and dissolved manganese. Additionally, the five new monitoring wells within the nearshore area (Figure 3-1 and Table 3-4) were analyzed for the expanded Geochemical Suite, which includes major cations/anions, alkalinity, dissolved nitrate and nitrite, and iron speciation. Arsenic speciation was also performed on groundwater samples with dissolved arsenic concentrations greater than or equal to 36 µg/L (Table 3-4). The analytical program for groundwater was consistent with that proposed in the RIWP.

Temporary Borings

Eight targeted temporary (direct-push method) borings (TB-1 through TB-8; see Figure 3-1) were advanced along the three sampling transects and along the northern property boundary to supplement arsenic concentration data in soil and groundwater.

The soil sampling procedures and analytical program for the temporary borings are identical to those described above for the new monitoring wells. The boring was logged and archival samples were collected from the unsaturated zone, capillary fringe, and unsaturated zone. Transcribed copies of the monitoring well boring logs and construction forms are provided in Appendix C. One soil sample from each boring (collected from the uppermost saturated zone) was submitted for laboratory analysis of the Standard Analytical Suite. Soil from the three borings within the nearshore study area also were analyzed for the expanded Geochemical Suite (see Table 3-3 and Figure 3-1).

A groundwater grab sample was collected from each temporary boring and submitted for laboratory analysis, as listed in Table 3-4. Field measurements were taken for temperature, pH, specific conductance, ORP, and DO. Water quality field parameters are included in Table 3-6 and discussed (as applicable) in Sections 5 and 6 of this RI Report. The analytical program for soil and groundwater from the temporary borings was consistent with that proposed in the RIWP.

Outfall Discharge

Flow was observed from outfalls OF-2 and OF-3 (Figure 3-1) during Event 1 sampling activities. These outfalls are the end point of the stormwater system that conveys runoff from the capped Log Yard. Subsequently, stormwater samples were collected for analysis at both outfalls from the respective end of pipe on the eastern bank of Wapato Creek.The samples collected during Event 1 were proceeded by approximately a 17-day dry period, indicating that the samples are representative of dry-weather flow conditions. The field measurements, approximate flow rates, and antecedent dry period information for the outfall discharge sampling for Events 1 through 4 are provided in Table 3-10.

3.2.1.2 Sawmill

RI activities in the Sawmill are targeted to supplement existing data collected during previous investigations completed under the VCP and address the identified data gaps discussed in Section 3.1 and Table 3-1. The Event 1 RI activities in the Sawmill consisted of groundwater sampling from the existing (including replacement) monitoring wells, collecting soil samples from test pits near the former dip tank (see Figure 3-2), and collecting soil and groundwater samples from a temporary boring placed in the former drainage ditch (TB-9; see Figure 3-1). These activities are summarized below and were conducted in general accordance with the procedures set forth in the SAP. In addition to these activities, surface water, porewater, and sediment samples collected in Wapato Creek, immediately adjacent to the former dip tank area, are described in Section 3.2.1.3.

Monitoring Wells

Existing monitoring well MW-5, which had a damaged vault and casing, was abandoned and replaced (as MW-5R) as part of the Event 1 sampling activities by Steadfast Services Northwest, LCC, a Washington licensed driller. A copy of the new monitoring well log and construction form are provided in Appendix C. Because of damage of the surface monument and upper portion of the casing for MW-6R, the upper casing also was repaired and the monument was replaced with one rated for heavy traffic (e.g., trucks and heavy machinery). The monitoring well network that was used to evaluate groundwater levels, groundwater gradients, and water quality in the Sawmill is shown in Figure 3-1.

During drilling of the replacement well MW-5R, soil was sampled at intervals consistent with those shown for the non-capped borings in the conceptual sampling diagram (Figure 3-3). Samples from the unsaturated zone, the capillary fringe, and the saturated zone were archived and one soil sample that was collected from approximately 1 to 2 feet below the water table was submitted for the Standard Analytical Suite, which includes arsenic, iron, TOC, and total solids (Table 3-3).

All replacement (MW-5R) and existing (MW-1; MW-2R; MW-3, MW-4; MW-6R; and B-5R) wells were developed before sampling. Manual water levels were collected in the new and existing wells to assess the current depth to groundwater and groundwater flow direction. Field measurements were taken for temperature, pH, specific conductance, ORP, and DO. The headspace of each well was monitored for methane gas upon opening. Field measurements, including groundwater elevations, methane headspace readings, and water quality field parameters, are included in Tables 3-5 and 3-6 and discussed (as applicable) in Sections 5 and 6 of this RI Report.

Groundwater samples were collected from the seven groundwater monitoring wells and submitted to the laboratory for analysis of the Standard Analytical Suite plus PCP (Table 3-4.) The five monitoring wells in the nearshore area close to the former dip tank (Figure 3-1) also were be analyzed for the expanded Geochemical Suite, which includes major cations/anions, alkalinity, dissolved nitrate and nitrite, and iron speciation. Although bottles were filled for potential analysis, arsenic speciation was not performed because all dissolved arsenic concentrations were less than 36 µg/L.

Temporary Borings

Soil and groundwater samples were collected from one temporary (direct-push method) boring (TB-9) within the former drainage ditch (see Figure 3-1). The soil core was logged to identify the presence of the former drainage ditch and/or Wapato Creek channel. A copy of that soil boring log and supporting photographs are provided in Appendix C and Appendix E, respectively.

Field measurements were taken in groundwater at TB-9 for temperature, pH, specific conductance, ORP, and DO (Table 3-6). A groundwater grab sample was collected from this temporary boring and submitted to be analyzed for the Standard Analytical Suite plus PCP (see Table 3-4). The field samplers noted that this boring was much more productive than any of the other monitoring well or temporary borings sampled on the Site.

Former Dip Tank Area Test Pits

Two test pits/trenches (TP-1 and TP-2) were excavated near the location of the former dip tank to identify the edge of former remedial excavation and to collect soil samples approximately 3 feet beyond edge of the former cleanup area. The locations of TP-1 and TP-2 relative to the approximate extent of the former excavation are shown in Figure 3-2. The westerly test pit (TP-2) was excavated to be approximately 3 feet wide by 10 feet long and 10 feet deep. The contact between the former exacavation fill material (sands) and native material (silt) was observed 27.5 feet west of MW-2R, so slightly farther west than initially anticipated. A shallow sample of the native material (TPS002-0.5-

1.5) was collected approximately 3 feet west of that contact from 0.5 to 1.5 feet below ground surface (bgs) and submitted for analysis of the Standard Analytical Suite plus PCP and dioxins/furans. An additional shallow sample was collected from approximately 3 feet east of that contact from within the former excavation fill for archival. After the shallow samples were collected, the test pit was excavated to a depth of approximately 10 feet bgs and a hand auger was used to collect a saturated soil sample from 10.5 to 12.5 feet bgs (TPS002-10.5-12.5). The saturated soil sample was submitted for analysis of the Standard Analytical Suite plus PCP. Following completion of sampling, the test pit was backfilled with the excavated material and the gravel was spread back around to restore the existing surface.

The northerly test pit (TP-1) was excavated to be approximately 3 feet wide by 20 feet long and 2.5 feet deep. The contact between the former exacavation fill material (sands) and native material (silt) was identified close to the anticipated location (Figure 3-2). A shallow sample was collected approximately 3 feet north of the fill contact (TPS001-0.5-1.5). An additional shallow sample was collected from approximately 3 feet east of that contact, from 1.5 to 2.5 feet bgs within the former excavation fill (TPS001F-1.5-2.5). Both of the shallow soil samples were submitted for analysis of the Standard Analytical Suite plus PCP, and dioxins/furans. Hydrocarbons (gasoline range organics, gasoline, and motor oil) and Resource Conservation and Recovery Act (RCRA) metals were accidentally run and reported by the laboratory and these results are included in Section 5. Rather than excavate deeper, the test pit was backfilled with the excavated material and the gravel were spread back around to restore the existing surface. The saturated sample of native material outside of the excavation was attained by advancing a temporary boring (via direct push) to attain sample (TPS001-12_13). The location of that temporary boring is shown in Figure 3-2 as TPS001TB. The saturated soil sample was submitted for analysis of the Standard Analytical Suite plus PCP.

Test pit description logs are included in Appendix C and a summary of the requested analyses are provided in Table 3-3. With the exception of the added sample within the excavation fill at Test Pit 1 (TP-1) and added hydrocarbon and RCRA metal analysis on the two shallow TP-1 soil samples, the analytical program for soil was consistent with that proposed in the RIWP.

3.2.1.3 Wapato Creek Sediment and Porewater Sampling and Short-Term Tidal Study

As discussed above, the RI sampling in the Log Yard included locations along three sampling transects, delineated for purposes of assessing the groundwater migration pathway from the upland portion of the Site underlying the cap toward Wapato Creek. A similar transect is delineated across the former dip tank remedial excavation in the Sawmill, as shown in Figure 3-1. These four transects each include two sampling stations in adjacent Wapato Creek, one on the east bank of the creek (Location A), and one within the channel (Location B). Collocated porewater, sediment, and surface water data from the Wapato Creek transects (WCT-1 through WCT-4) were evaluated in conjunction with soil and groundwater data collected in upland monitoring wells and temporary borings that fall along the same transects (Figure 3-1). Figure 3-4 shows the schematic positioning of the collocated porewater, sediment, and surface water samples relative to the tidal fluctuation zone in Wapato Creek. These sampling activities, and a short-term study of tidal influence at the Site, are discussed below and were conducted in accordance with the SAP (Appendix B). Laboratory analyses conducted on the Wapato Creek sediment samples (Event 1 only) are listed in Table 3-3 and analyses to be conducted on porewater and surface water samples are listed in Table 3-4. The analytical program for sediment, porewater, and surface water during Event 1 was consistent with that proposed in the RIWP.

Porewater Sampling

Passive porewater samplers on each transect were placed in two locations in the creek bed of Watpato Creek to collect porewater from the bioactive zone (i.e., approximately 10 centimeters below mudline [cm bml]) and from a depth of approximately 40 to 50 cm bml representing the groundwater discharge zone to porewater (see Figures 3-1 and 3-4). Four porewater samples per transect were collected during Event 1 and submitted to the laboratory for analysis of the Standard Analytical Suite and expanded Geochemical Suite (Table 3-4). Samples from Transect 4, adjacent to the former dip tank, also were analyzed for PCP. Field measurements were taken for temperature, pH, specific conductance, ORP, DO, and turbidity (Table 3-6). Elevated turbidity was observed in the porewater samplers during Event 1 because the grain size of the sediment where the samplers were buried and the size of the mesh used to construct the passive porewater samplers (120 microns). The mesh size was reduced during Event 2 through 4 (to 22 microns) as discussed in Section 3.2.2.

Sediment Sampling

Wapato Creek sediment samples were collected during Event 1 in the immediate proximity and from the same depths as the porewater samples (see Figures 3-1 and 3-4). The sediment samples were analyzed for the Standard Analytical Suite plus sulfide and grain size (Table 3-3). Sediment samples from Transect 4 (WCT-4), adjacent to the Sawmill were analyzed for PCP. Four sediment samples from Transect 1 (WCT-1) also were selected for geochemical sequential extraction, batch adsorption tests, and arsenic speciation testing based on preliminary analytical results.

Surface Water Sampling

Surface water samples from Wapato Creek were collected near Location B in each transect, as shown schematically in Figure 3-4. Two additional surface water samples were collected for reference, including a sample in Wapato Creek upstream of the Site, and a sample in the Blair Waterway (Figure 3-1). The surface water samples in Wapato Creek were collected approximately 10 cm above the mudline during low-tide conditions, when groundwater discharge would be expected to be most prevalent. Surface water samples were analyzed for same constituents as groundwater and porewater, including the Standard Analytical Suite plus the expanded Geochemical Suite (Table 3-4). Field measurements were taken for temperature, pH, specific conductance, ORP, and DO (Table 3-6).

Short-Term Tidal Study

The tidal study was designed to assess and document tidal fluctuations in Site groundwater and Wapato Creek and consisted of the following elements:

- **Synchronized Water Level Monitoring.** Synchronized monitoring of water levels in Wapato Creek and selected groundwater monitoring wells (Figure 3-1, Table 3-4). Continuous water levels were obtained using pressure transducers installed in a stilling well in Wapato Creek, and in nearshore monitoring wells (Table 3-4). Transducers were programed to measure water level on 5-minute intervals for a period of at least 73 hours, between May 16 and May 20, 2016. Manual water levels were obtained in all monitoring wells and piezometers during each RI sampling event.
- **Review of Published Tide Table Data.** Reviewed published tide tables for Commencement Bay (Sitcum Waterway, National Ocean and Atmospheric Administration [NOAA] Station ID

9446484). Published data were used to compare water levels observed in Wapato Creek to those in Commencement Bay to determine if there is a lag time between the observed water levels.

- **Collection of General Water Quality Data.** As described in Sections 3.2.1 and 3.2.2. Groundwater monitoring wells and surface water in the Wapato Creek and the Blair Waterway were sampled and analyzed for general water quality parameters including: major cations (calcium, magnesium, potassium, and sodium), major anions (carbonate, bicarbonate, sulfate, chloride, bromide, fluoride, and ortho-phosphate), pH, temperature, ORP, specific conductivity, and TOC.
- **Fresh Water and Saline Water Mixing Analysis**. The effects of tidal fluctuations on groundwater quality were evaluated using general water quality data (e.g., specific conductivity, and major cations and anions).

Data collected from this study were used to assess:

- Variations in groundwater flow directions and gradient resulting from the tidal fluctuations in Wapato Creek
- Whether tidal fluctuations in surface water levels influence the discharge of groundwater to Wapato Creek
- Surface water hydrology and tidal flow dynamics
- Variations in conductivity in Wapato Creek resulting from tidal fluctuations
- The effect of tidal fluctuations on groundwater quality (e.g., conductivity)
- The interface between fresh water and brackish water within the shallow water-bearing zone (i.e., mixing analyses of major anions and cations)
- Tidal fluctuation amplitudes and phase lags of tidal groundwater harmonic motions

The results of these evaluations have been incorporated into Sections 4 and 5 (as applicable) of this RI Report.

3.2.2 Events 2 through 4

The Event 1 sampling and analytical program was generally consistent with the RIWP, but several modifications were made to subsequent sampling events that aimed to repeat the groundwater monitoring and sampling, porewater sampling, and surface water sampling (including from reference locations) conducted for Event 1. These changes were discussed with and approved by Ecology before implementing the modifications in Events 2 through 4. Email correspondence about the modifications is provided in Appendix C.

Events 2 through 4:

- Reduce the nylon mesh size used in the porewater samplers (see Appendix B) from 120 microns to 22 microns because of the high total suspended solids (TSS)/turbidity observed in the porewater samplers.
- Conduct TSS analysis on all groundwater, porewater, and surface water samples in-lieu of collecting field turbidity measurements. Note that TSS was added to several samples from Event 1.
- Collect dry-weather flow samples from the two outfalls coming from under the capped Log Yard and analyze them for the standard analytical suite, minus sulfide.

- Reduce the locations where specialized geochemical testing will occur to focus on the nearshore locations on or adjacent to the Log Yard. Nearshore wells were pre-selected for arsenic speciation testing whereas porewater retained the caveat that speciation would be conducted only if the disssolved arsenic result were greater than or equal to 36 µg/L.
- Drop the Geochemical Suite and sulfide for the Sawmill wells, and porewater and surface water from Wapato Creek Transect (WCT) #4.
- Drop iron speciation (ferrous and ferric iron) everywhere.
- Discontinue headspace methane readings in the Log Yard, but continue them in the Sawmill.

Events 3 and 4:

- Eliminate the “B” porewater station on WCT-4.
- Eliminate the deep (40 cm) porewater samples from all four transects (WCT-1 through WCT-4).
- Allow work to be conducted during non-daylight hours to accommodate the timing of the daily low tides that allow access to sampling in Wapato Creek.

With the modifications noted above, Events 2 through 4 included a repeat of the groundwater monitoring and sampling, porewater sampling, and surface water sampling conducted for Event 1 (May 2016). The sampling locations were the same between each event, as shown in Figure 3-1. Table 3-4 illustrates the differences in the analytical program between each of the sampling events. Table 3-5 contains the water level elevations and methane readings (where applicable) for all sampling events and the Event 2 through Event 4 water quality field parameter measurements are provided in Tables 3-6 through 3-9. Outfall discharge was sampled during each event and information on the antecedent dry-period, flow rate, and field parameter measurements are provided in Table 3-10.

Information such as geologic observations, grain-size data, water level elevations, and general chemistry data from the RI sampling activities was used to update the descriptions of the physical site setting in Section 4 and the CSM in Section 6. The analytical results of the RI sampling activities and an updated description of the nature and extent of contamination are provided in Section 5.

Other Add-on Activities:

In addition, the following activities were conducted beyond the scope of work described in the RIWP:

- Conducted a video survey of the stormwater lines where dry weather flow was observed to find the source of the suspected leak and gather information to inform line repairs. (One time only) Observations from the stormwater video are discussed in Section 4.5
- Visually inspected and surveyed the invert elevations in the spill containment vessels located adjacent to Manholes #1 and #6 (Figure 3-1). The results of the spill containment vessel inspection are provided in Section 4.5
- The procedures for the sequential extraction and batch adsorptions tests were updated in December 2016 and those updated procedures are provided in Attachment 2 of the SAP (Appendix B).

- Given the spontaneous precipitation of arsenic and iron that was observed during preparation of the method blank sample (using groundwater from the Site) for the Batch adsorption tests, additional testing was conducted to better understand the cause and nature of the arsenic-bearing precipitates formed from groundwater. The additional testing involved anaerobic collection of groundwater from MW-7 that was subsequently spiked with arsenate and arsenite under controllect conditions to induce precipitation and identify the types of precipitates formed from groundwater under both aerobic and anaerobic conditions. The results of this study are discussed further in Section 7.
- To evaluate if seepage through the cap may be occurring, transducers were installed in three perched (HC-2, MW-10, MW-11) and one upgradient (MW-13) well in the Log Yard and the well located in the former dip tank excavation (MW-2R) in the Sawmill on January 14, 2017. The transducers were left to collect water level measurements on a 5-minute interval for a period of 1 month to evaluate if water level fluctuations in response to precipitation were occurring. The results of this study are discussed in Section 4.2.2.
- The dry monitoring well HC-1 was abandoned to prevent it from acting as potential conduit of rainwater to the fill containing slag. It is always dry unless there is a rain event and small amounts of surficial runoff gets into the well (as was observed in Event 3.) The well was initially completed in a perched water zone that was expected to go dry after completion of the cap. Given that it has gone dry and it serves no purpose in the RI/FS, it was abandoned in February 2017 by a Washington licensed driller from Steadfast Services Northwest, LLC. Well abandonment included a high early strength concrete seal to the full depth of the boring to preserve the integrity of the cap.

4 Physical Site Setting

4.1 Geology

The Site is located within the Puget Sound Lowland, which is a complex basin formed in response to tectonic, glacial, and volcanic activity. The soils of the Puget Sound Lowlands reflect a highly complex sequence of glacial and interglacial deposits that occurred during the Pleistocene Ice Age. The last advance of glacial ice (about 14,000 years ago) scoured out some of the older deposits, resulting in troughs that became exposed and/or filled with water as the glaciers retreated north of the Straights of San Juan de Fuca. At that time, sea level was about 200 feet lower than today and the Puyallup Trough began to collect sediment from the Puyallup River. The Puyallup River Delta has grown irregularly in response to changes in sea level, river discharge, and sediment availability. The interbedded layers of silts and sand are reflective of the highly variable nature of the propagation of this delta into shallow water. A more detailed description of the geologic history is provided in the following documents:

- Geology Study of the Port of Tacoma (HC, 1976)
- Puyallup River Watershed Assessment (Puyallup River Watershed Council, 2014)

The subsurface lithology and geology at the Site have been investigated and described in previous Site reports. Copies of available soil boring and monitoring well logs from previous reports are provided in Appendix A.2, and soil boring and monitoring well logs attained as part of this RI Report, are provided in Appendix D. Figure 4-1 shows the location of all monitoring well and soil boring locations relative to three geologic cross section lines labeled A through C. Site-specific cross sections depicting the subsurface lithology were created and/or updated using all available boring logs and are provided as Figure 4-2 for the Log Yard, and 4-3 for the Sawmill. For the purposes of this RI Report, the subsurface lithology at the Site is divided into the following units:

- **Fill Containing Slag** – Near-surface material placed since industrial development of the Site began in 1974 (e.g., includes a mixture of sand, silt, slag, and bark fill material). This unit is overlain by the capping materials.
- **Dredged Sediment Fill** – This represents the silty sand material that is situated above the fine-grained native alluvial deposits and likely originated from sediment that was dredged during construction of the adjacent Blair Waterway and deposited onto the Site and surrounding area between 1959 and 1965.
- **Native Alluvium** – The natural deposits from the Puyallup River wetlands consists of a mixture of interbedded silt, sand, and clay and may be hard to distinguish from the overlying dredged sediment fill.

The surficial and subsurface conditions for the Log Yard and Sawmill are discussed separately below.

4.1.1 Log Yard

During construction and/or use of the Log Yard, ballast material was used to fill and grade it for stability. The ballast material was produced as a by-product of smelting operations at a nearby ASARCO facility. Section 4.1.2 of the 1988 Remediation Plan notes three types of fill units (fines, rock, and bark) that contain combinations of sand, silt, bark, rock, and slag. The finer-grained surficial layer was approximately 1 to 2 feet thick and was underlain by a second predominantly slag and fill soils/wood debris layer. The 1988 Remediation Plan states that there may be more than 40,000 tons of slag below the surface (HC, 1988b). The reported thickness of the fill containing slag was 1 to 6 feet.

As discussed in Section 2, the Log Yard was capped to eliminate infiltration of surface water runoff into the fill containing slag, which is now overlain by a gravel base course, the RCC cap and an asphalt overlay. The thickness of the cap and underlying fill materials was investigated and refined as part of the 2014 Log Yard Soil Testing Report (AEQA, 2014). While thicknesses vary across the Log Yard, the average thickness of each unit in the capped area is reported as follows:

- RCC cap and asphalt overlay: 15 inches (combined average thickness)
- Gravel base course: 26 inches
- Fill containing slag: 38 inches

These average thicknesses fall within the range of thicknesses observed during the RI (Appendix D). To illustrate the cap configuration and subsurface lithology, two geologic cross sections were generated using available soil boring and monitoring well logs across the Log Yard at the locations shown in Figure 4-1 (A and B cross section lines). As shown in Figure 4-2, the surface of the cap contains a few gently sloping ridges and valleys with approximately 2 feet of elevation difference between them to promote drainage (see Section 4.5). The RCC and gravel base thickness are fairly consistent across both cross section lines. The thickness of the fill containing slag averaged 42 inches across this A-A’ cross section line 40 inches across this B-B’ cross section line, with more variation in thickness observed on the B-B’ cross section line (Figure 4-2). The thickest fill containing slag layers along this cross section line (B-B’) were reported in borings AQ-24 (57 inches), AQ-26 (65 inches), PORTAC-09 (66 inches), and new monitoring well MW-13 (56 inches). In borings AQ-24, AQ-26, MW-13, and TB-7, the lower approximately 12 inches of the fill unit were noted to contain predominantly slag. T-3 also had an approximately 6-inch-thick layer of clean slag at the bottom of the boring. The boring log for PORTAC-09 noted that gravel with slag was observed above and below the wood/slag layer.

Representative photos of the cap materials, fill containing slag, and lithologic units are provided in Appendix E. Based on observations made by the Washington licensed hydrogeologist during the RI (Appendix D), generalized descriptions of the units observed at the Site and shown in Figure 4-2 are as follows:

- **RCC Cap and Asphalt Overlay:** A concrete coring tool was used to get through the double layer of RCC and asphalt overlay (Photo E-1). The concrete cores that were removed during the RI ranged in thickness from 1 to 1.6 feet.
- **Gravel Base Coarse:** The gravel base course consisted of a well-graded gravel (GW) that was light gray to gray green in color with ¼-inch to 3-inch angular to sub-rounded gravel in a silty sand matrix (Photo E-2).
- **Fill Containing Slag:** The proportion of wood and slag varies between borings and is usually observed in a dark brown organic soil or silty sand matrix, although clean layers of slag gravel were observed at the base of the fill in several borings. The slag was black in color and ¼ inch to 3 inches in size. The texture of the slag varied from angular, to glassy with concoidal fractures, to vesicular, to slag with an undulating texture on the surface. The wood waste ranged in color from reddish, to dark brown, to peaty black. The fill containing slag was unsaturated in most locations, but was saturated in the perched water zone

located in the western portion of the Log Yard (Figure 4-2, Section 4.2, and Photos E-2 and E-3).

- **Silty Sand:** The silty sand immediately below the fill containing slag likely was the dredged sediment fill material that originated from the Blair Waterway. The unit ranged from relatively clean fine-grained poorly graded sand (SP) to silty sand with occasional minor gravel. The lithology of this layer was similar to other native silty sand layers observed at depth. Most of the unit was dark grey in color with red and black lithics.
- **Fine-Grained Deposits (Silt and Clay):** Beneath the upper silty sand dredge fill, the natural deposits from the Puyallup River wetlands consisted of interbedded silt, clay, and sand units. Fine-grained deposits dominated by the silt or clay fraction were grouped together for the sake of this discussion (Figure 4-2; Photo E-4). The clay content was greater in the northern portion of the Log Yard (Cross Section A) than it was in the southern portion (Cross Section B), where more inter-bedding with silty sands were observed. At least a thin layer of fine-grained deposits underlies most of the upper silty sands (i.e., dredge fill), but appears to have been absent in one of the RI borings (MW-11) and the borings advanced off the cap, to the north of the Site (TB-1 and TB-2).

4.1.2 Sawmill

The geology in the Sawmill is similar to that in the Log Yard with the exception that (1) ASARCO slag was not reported to be used as ballast in this portion of the Site (except for the log ramp area), and (2) the surface is not capped with RCC and asphalt overlay. As noted in Section 2.3.2, the ground surface across a portion of the Sawmill was re-paved in 2016 for a new truck queuing project (Appendix A.9). Conceptual geologic cross sections that were presented in other reports are provided in Appendix A.2. Figure 4-3 was generated using available boring logs to illustrate the subsurface geology through the location shown in Figure 4-1, which includes a view through the former Wapato Creek channel and the former dip tank excavation area. As shown in those cross sections, the subsurface geology in the Sawmill also consists of interbedded silt and sand units that resulted from the native deltaic setting and the addition of dredged fill materials. Based on observations from the test pits (Figure 3-1 and Appendix D), the former dip tank excavation is filled with a coarse sand and the shallow silts observed nearby, were removed as part of that excavation.

Based on cross sections that were developed for Parcel 14, south of the Site (GeoEngineers, 2010), and observations from TB-9 (see also photos E-5 through E-9 and associated descriptions in Appendix E), the former Wapato Creek channel base is denoted by a contact between the hydraulic fill (fine-grained poorly graded sand or silty sand) above and a dark brown to black colored silt below that sits at an elevation of approximately 12 feet mean lower low water (MLLW). In TB-9 that black silt layer was observed from 12 to 14 feet bgs, but there was an approximately 4.6-foot-thick transition zone of fine-grained deposits (clays and silts) interbedded with sandy units above that silt and below the hydraulic fill. This transition zone likely reflects variability in Wapato Creek flow conditions before filling of the creek in the 1960s. In both the Parcel 14 cross sections and TB-9, the black silt unit is underlain by a sandy unit that is cleaner and coarser than the surrounding native deltaic/flood deposits, potentially representing an older, larger, version of the Wapato Creek drainage (see Figure 4-3 and Parcel 14 cross sections in Appendix A.2).

4.2 Hydrogeology

While the RIWP relied on hydrogeologic descriptions from previous investigations, the updated hydrogeologic descriptions provided in this section of the RI Report are based largely on new data collected as part of the RI, which provides a more comprehensive look at groundwater conditions and the factors that influence them. These factors, including surface water hydrology and tidal influence, precipitation and potential seepage/infiltration, and the positioning and condition of existing infrastructure relative to groundwater, are discussed in Sections 4.2.1 through 4.2.3. Section 4.2.4 provides groundwater contour maps for Events 1 through 4 and discusses groundwater flow directions and gradients.

4.2.1 Hydrology and Tidal Influence

The Site is bounded to the west by Wapato Creek, which drains 3.5 square miles of land from north of the City of Puyallup, City of Fife, and Port to the Blair Waterway and Commencement Bay in the City of Tacoma (WDOT, 2006). Wapato Creek receives a substantial amount of runoff directly from adjacent agricultural, residential, commercial, and industrial lands in the Cities of Puyallup and Fife. Wapato Creek has been greatly altered from its natural condition, and riparian cover along most of the system is sparse to nonexistent.

While the freshwater base flow in Wapato Creek varies seasonally in response to local precipitation, the creek is inundated twice daily in response to the mixed semidiurnal tides in Commencement Bay. The invert elevation of Wapato Creek adjacent to the Blair Waterway is approximately 5 feet MLLW, so when tides rise above that level, a flow reversal in the creek occurs as salt water from the Blair Waterway ascends into the creek raising the water level until high tide is reached. The highest tidal influence in the creek raises water levels to approximately 13 feet MLLW.

To evaluate the influence of the tides on groundwater at the Site, a tidal study was conducted as part of the RI that consisted of synchronized monitoring of water levels in Wapato Creek and selected groundwater monitoring wells (Figure 3-1, Table 3-4). Transducer data that were collected on 5-minute intervals for a period of at least 73 hours, between May 16 and May 20, 2016, were used to create the hydrograph shown in Figure 4-4. Tidal data from Commencement Bay (Sitcum Waterway, NOAA Station ID 9446484) also were included in Figure 4-4. It is clear that once the tides rise above the invert elevation of Wapato Creek, water levels in the creek increase in response to the regional tides with little to no lag time between the observed water levels.

As illustrated in Figure 4-4, only minor water levels changes (typically less than 0.5 foot) are observed in response to tides in the wells located along the top of the bank in the Log Yard (MW-7, MW-9, and MW-12) with no response observed in wells located approximately 200 feet (or greater) upgradient (HC-2, B-1R, MW-10, MW-11, and MW-13). Similarly, in the Sawmill, a minimal response was observed in the two top-of-bank wells (MW-1 and MW-4) near the former dip tank area and no response observed only 50 feet upgradient in wells MW-2R and MW-3. The minimal influence of the tides on groundwater flow directions and gradients is likely attributable to the low permeability of the hydraulic fill and native deltaic deposits, consisting of a mixture of fine-grained sands, silts, and clays. One location where tidal influences are more pronounced is in the coarser-grained sand deposits underlying the former Wapato Creek channel. This is illustrated by the larger fluctuation in water levels (up to 2 feet) observed in response to the tides at B-5R, which is situated right along the banks of the former Wapato Creek channel.

In addition to water levels, the transducers installed as part of tidal study also were equipped to collect temperature and conductivity measurements at most locations. Figure 4-5 shows the conductivity measurements in groundwater and Wapato Creek for the same time period in May 2016. Surface water conductivity, which is plotted on the secondary y-axis, ranges from less than 1,000 micro Siemens per centimeter (µS/cm) (fresh to brackish water) at low tide up to 40,000 µS/cm (saline) when the tide was in. No direct tidal-related oscillation of conductivity in groundwater was observed, indicating that the water level response to the tides was a hydrostatic response to reduced groundwater flow at high tide rather than a true flow reversal and/or hydraulic mixing in response to diurnal tidal events. Because the top-of-bank wells in the Log Yard (MW-7, MW-9, and MW-12) have higher conductivity than the other wells, some sustained tidal influence is present in the immediate vicinity of the creek; however, the conductivity values are much lower than the Blair Waterway.

To evaluate potential mixing between groundwater and surface water, monitoring wells and surface water in Wapato Creek and the Blair Waterway were sampled and analyzed for general water quality parameters including: major cations (calcium, magnesium, potassium, sodium), major anions (carbonate, bicarbonate, sulfate, chloride, bromide, fluoride, and ortho-phosphate), pH, temperature, ORP, specific conductivity, and TOC. A trilinear (Piper) plot was generated using Event 1 water data to assess the differences in major ion chemistry and potential mixing of fresh groundwater and saline surface water (Figure 4-6).

As shown in Figure 4-6, the predominant groundwater geochemistry is sodium bicarbonate with more variability in the cation geochemistry than the predominant anion bicarbonate signature (>70 percent for most samples). The monitoring wells containing perched water (HC-2, MW-10, and MW-13) are even more enriched in bicarbonate (>95 percent) and contain more calcium than most groundwater samples. With a couple exceptions, surface water and porewater at the Site are sodium chloride enriched, indicating that tidal mixing is driving geochemistry in these locations. Also note the difference between the Blair Waterway surface water sample (which is consistent with Site porewater) and the upstream Wapato Creek surface water sample, which is calcium bicarbonate enriched. The geochemistry in the Sawmill is similar to that observed in the Log Yard with the exception of well MW-2R, in the former dip tank area. This is the well that has had consistently high pH (i.e., alkaline conditions). As shown in Figure 4-6, MW-2R has a unique geochemical signature and is highly enriched in calcium and sulfate.

Figure 4-7 contains the Event 1 and Event 2 results for samples that fall on sampling transect #1 (see Figure 3-1). The Event 1 results are shown in green and Event 2 results in red. Note the clear increase in sodium and chloride concentrations when moving from the source area (HC-2 and B-1R) to the nearshore area (TB-3 and MW-7), to the nearshore deep porewater (WCT-1A-40), to the shallow nearshore and offshore porewater (WCT-1A-10, WCT-1B-40, WCT-1B-10), to surface water. While a direct response to diurnal tides is not evident in the nearshore wells, the prolonged influence of seawater has some sustained influence on geochemistry at the edge of the transition zone.

4.2.2 Precipitation and Potential Groundwater Recharge

Annual precipitation in the area ranges from 30 to 40 inches near Tacoma with most of the precipitation falling during the fall and winter months (October to March) (Ecology, 2011c).

Groundwater recharge throughout the Log Yard is limited by the cap and the associated stormwater conveyance system, but observations and data collected during the RI indicate that the cap is not impermeable. Evidence of emergent cracks on previously repaired surfaces and in new locations was noted in the most recent Environmental Cap Inspection Report (Windward, 2017). Ponded water was observed in various locations on the cap during the November 2016 (Event 3) and February 2017 (Event 4) RI sampling events, including the area with documented cracking, around MW-11 (see Photo E-8). To further evaluate if leakage through the cap may be occurring, transducers were installed in three perched (HC-2, MW-10, MW-11) and one upgradient (MW-13) well in the Log Yard and the well located in the former dip tank excavation (MW-2R) in the Sawmill on January 14, 2017. The transducers were left to collect water level measurements on a 5-minute interval for a period of 1 month. A hydrograph showing the water levels and hourly precipitation data is provided as Figure 4-13. Note that the closest source of hourly precipitation to the Site is the NOAA station located at the Tacoma Narrows Airport (National Climatic Data Station [NCDS] ID 93274), which is located approximately 9.6 miles west of the Site. Actual rainfall quantities and timing at the Site likely vary from what was reported at the airport.

As shown in Figure 4-8, the first sustained rainfall of the monitoring period occurred on January 17, 2017, and January 18, 2017, with a total of 2.1 inches of rain. The most intense period of rainfall (1.86 inches) occurred during a 23-hour period between 12:00 on January 17, 2017, and 10:00 on January 18, 2017. The well with the quickest and most direct response to precipitation was the non-capped monitoring well (MW-2R), but a muted response to precipitation also was observed in wells in the capped Log Yard. A summary of the maximum water level response and lag time compared to the start of those heavy rains is provided below, in order of decreasing responsiveness:

- MW-2R: Water levels in this uncapped well began to increase sharply 3 hours after the heavy rains began, increasing to a maximum height of 4.1 feet 1.75 days after the heavy precipitation event began.
- MW-11: The water level in this capped well already demonstrated an increased trend when the heavy precipitation event began and continued to increase by 0.3 foot after 1.25 days, with a second peek observed after 3.1 days.
- MW-13 and MW-10: Similar responses were observed in these capped perched wells, with gradual water level increases that result in an approximately 0.3-foot increase approximately 3.5 to 4 days after heavy precipitation events.
- HC-2: A readily distinguishable response in HC-2 was not observed.

Of the Log Yard wells equipped with transducers, MW-11 appears to have the most immediate response to precipitation. Seepage through the cap in the vicinity of MW-11 was accelerated by the ponding that was observed on the surface during heavy rainfall events (see Figure E-8). Note that the water levels in MW-11 decline at a faster rate after the rain stopped, suggesting better subsurface drainage in this area than in the perched zone. The geologic observations from this boring support this concept because no silt layer was observed in MW-11 as it was in MW-10 and MW-13. The increased lag time observed in the perched wells suggests that rainwater seepage through the cap in the immediate vicinity of these wells is less than that observed near MW-11. The source of perched water in this area could be slower seepage of non-ponded water through the cap in the vicinity of those wells, and/or lateral migration of perched water along the top of the fine-grained unit/base of the fill containing slag (see Section 4.2.4) from areas with greater seepage velocities (such as MW-11). Water level declines in the perched zone are much slower, reflecting the low hydraulic conductivity of the underlying fine-grained unit.

Infiltration and vertical migration of precipitation in the Sawmill is limited by (1) paving that occurred over a portion of the Site as part of the truck queuing project, and (2) a shallow subsurface layer of silt (Figure 4-3). While monitoring well MW-3 was paved over as part of this project, the other three wells in the former dip tank area (MW-1, MW-2R, and MW-4) were not paved, suggesting that more recharge may occur in this area. Additionally, the shallow silt layer was locally removed as part of the excavation of contaminated soil surrounding the former dip tank. To evaluate potential recharge in this area, a transducer was installed in MW-2R. As shown in Figure 4-8, the response of groundwater to precipitation is much more immediate and dramatic (an approximately 5-foot increase in water levels after each prolonged precipitation event) vs. that observed in the capped Log Yard (less than 1-foot response). This observation is consistent with the mounded groundwater elevation observed in MW-2R during Event 4 (see Section 4.2.4) and suggests that the mounding is restricted to the area of the excavation, where the shallow silt layer was removed.

4.2.3 Existing Infrastructure

As discussed in Section 2, the 29.4-acre cap that was constructed over the Log Yard was graded to direct stormwater runoff to catch basins that carried water to Wapato Creek via underground piping. This grading is evident in the ridges and valleys observed in the ground surface elevation data shown in Figure 4-9. The configuration of the current stormwater conveyance system is also shown in Figure 4-9. The conveyance system consists of concrete pipes, ranging in diameter from 18 to 36 inches. The video survey of the pipes indicates that they are segmented, likely with bell-and-spigot connections.

Following the observation of dry-weather flow during Event 1, the stormwater lines were added to cross sections A and B (Figure 4-10) using the invert elevations in the Port's geographic information system (GIS) file and the few invert elevations that were collected during the May 2016 survey. As shown in Figure 4-10, the stormwater system is in contact with groundwater across much of the Site. To evaluate potential leakage of groundwater into the system a stormwater video of the main northern and southern stormwater lines was conducted in August 2016. Sedimentation along the bottom of the pipes and the presence of water minimized visibility along the bottom of the pipe (see Photos E-9 and E-10). There were a few locations where evidence of seepage was observed along the joints between pipes (see Photo E-10), but no obvious leakage was observed at the time of the video.

Further inspection of the spill containment vessels, located at the downstream end of the northern and southern stormwater lines (Figure 4-9), was performed in conjunction with the Event 3 sampling event to confirm the configuration of those features. As illustrated in Figure 4-11, two baffles exist inside each spill containment vessel, but water is hydraulically connected throughout the unit. During the time of the inspection, water was visibly flowing into the vessel from the contact between the bottom two concrete ring joints in each of the access holes (see photos in Figure 4-11). The elevation of the leakage corresponded with the approximate perched groundwater levels in that area and thus perched groundwater is the likely source of leakage into the pipes during the rainy portions of the year (October to March).

Other existing infrastructure includes sewage and electrical lines, which are shown in Figure 4-9.

4.2.4 Groundwater Flow Directions and Gradients

New and existing well locations are shown in Figure 3-1 with surveyed coordinates and elevations provided in Table 3-2. Table 4-1 provides a summary of the well installation dates and well construction details (e.g., casing diameter and material, screened interval, and description of surface completion) for both existing and new wells. Appendix A.2 provides copies of monitoring well logs from previous investigations, where available. Monitoring well logs and construction forms for the seven new monitoring wells (MW-7 through MW-13) and the replacement well MW-5R are provided in Appendix D.

The descriptions of groundwater flow directions and gradients provided in this section of the RI Report are based largely on new data collected as part of the RI, which provides an updated snapshot of groundwater conditions during four discrete, yet comprehensive, sampling events.

Appendix A.3 provides tables with historical water level measurements in Site monitoring wells and figures from previous Site reports that interpreted groundwater flow direction. As part of the RI, groundwater levels were measured in all new and existing monitoring wells and piezometers during each of the four RI monitoring events (see Table 3-5). Groundwater contour maps for Events 1 through 4 are provided in Figures 4-12 through 4-15.

As shown in Figure 4-4, during Event 1, groundwater flow was west toward Wapato Creek. The hydraulic gradient across the Site ranged from approximately 0.002 to 0.006 foot/foot, with a gradient of 0.004 between wells MW-11 and MW-9 in the central western portion of the Log Yard. Groundwater was encountered from approximately 8 to 18 feet bgs, with perched water observed as shallow as 6.5 feet bgs. The lowest groundwater elevations of the four RI sampling events were observed in August 2016 (during the dry summer) and the highest elevations were observed in February 2017 (after an exceptionally rainy winter).

Two perched groundwater zones shown in Figure 4-2 and Figures 4-12 through 4-15 indicate areas where groundwater was encountered closer to the ground surface than in nearby adjacent wells. The perched zone in the western portion of the Log Yard (centered on HC-2, MW-10, and MW-13) corresponds with a slight natural depression in the base of the fill containing slag (Figure 4-2 and Figure 4-16). While there may be some connectivity between the perched groundwater and the deeper groundwater, vertical infiltration in this perched zone is limited by the silty sand and fine-grained units below. The Log Yard Soil Testing Report (AQEA, 2014) concluded that the fill containing slag is not saturated and that continued leaching of metals from the fill containing slag is unlikely; however, information collected as part of the RI confirmed that saturated conditions were observed in the base of the fill containing slag in new monitoring well borings MW-10 and MW-13, both of which had clean slag in the lower approximately 12 inches of the fill unit. The historically perched well HC-2 also contained recoverable quantities of perched groundwater. The source of this perched water is thought to be seepage through the cap, as further discussed in Section 4.2.2. In addition, seepage of water out of the stormwater conveyance system may be occurring at high tide and adding groundwater to the system in the vicinity of well B-1R, as evidenced by the higher conductivities in that well (Figure 4-5).

It is unclear whether the perched zone shown in the eastern portion of the Log Yard (Figure 4-2 and Figures 4-12 through 4-14) is truly perched or just seasonally mounded and influenced by precipitation events and associated stormwater infiltration east of the Site, along SR-509. The fine-grained water-bearing units (i.e., silty sands, sandy silts, and silt) have a low hydraulic conductivity and thus groundwater in these fine-grained units moves slowly relative to the overlying silty sands that thicken between well MW-8 and the eastern edge of the Site. While seasonal fluctuations are evident in the northeastern corner of the Site (e.g., PORTAC-18), the effects on water levels under the remainder of the Site are minimal and muted because of the fine-grained nature of the deltaic deposits.

The groundwater flow directions and gradients in the Sawmill are less certain given the lack of monitoring wells within and on both sides of the former Wapato Creek channel, which contains coarser sands at depth than the nearby alluvial deposits (see Figures 4-3 and 4-4). The deeper Wapato Creek paleochannel appears to serve as a preferential groundwater flow path transporting groundwater toward Wapato Creek faster than it moves in the surrounding silty sands and fine-grained deposits. The groundwater gradient between the former and current Wapato Creek is typically flat, but a mound around well MW-2R was observed during Event 4. The mound is consistent with historical groundwater monitoring data that indicated varied groundwater flow directions (e.g., west, southwest, east, and northwest) in that area. As discussed in Section 4.4, the source of the mounded groundwater in MW-2R is infiltration of rain water through the former dip tank excavation fill.

5 Data Validation and Results

5.1 Data Validation, Management, and Usability

Field and laboratory data were subjected to a formal verification and validation process in accordance with EPA guidance documents as described in the QAPP (Appendix B). A document summarizing the Level II data validation (DV) procedures and findings was prepared and is provided in Appendix F of this RI Report.

GSI performed the data validation to determine the usability of the data for meeting project objectives. The DV consisted of reviewing the following elements from provided laboratory reports (Appendix C) and electronic data deliverables (EDDs):

- Chain-of-custody (COC) form – for completeness and continuous custody; Condition of samples upon receipt
- Analytical methods
- Analysis conducted within holding times
- Laboratory blanks
- Surrogate recoveries
- Matrix spike and matrix spike duplicate (MS/MSD) percent recoveries (%R) and relative percent difference (%RPD)
- Field duplicate analysis frequency and %RPD
- Metals split sample frequency and %RPD
- Laboratory control and laboratory control duplicate sample (LC/LCDS) %R and %RPD
- Method detection limits (MDL) and reporting limits (RL/PQL), which in this case are identical to the practical quantitation limit (PQL)
- Laboratory narratives
- Porewater equipment blanks

Data qualifiers were assigned during data validation when applicable QA/QC limits were not met and the qualification was warranted following EPA guidance, QC requirements specified in the SAP (Appendix B), and method-specific QC requirements, as applicable. Final, qualified (as necessary) laboratory results were combined into a project-specific database using the Ecology EIM data format. Data will be uploaded to the Ecology EIM database, upon finalization of the RI/FS Report.

After verification and validation of the field and laboratory data, data completeness was calculated by comparing the total number of acceptable data (non-rejected data) to the total number of data points generated. Overall, completeness for the RI dataset is 99.95 percent since two of the total 3,722 results were rejected (R) because of an MS/MSD zero percent recovery. With the exception of the rejected fluoride and nitrite as N results, all data are considered complete and usable for the intended purposes. Detailed discussion regarding the qualification and usability of the data can be found in the DV report in Appendix F.

5.2 RI Sample Results

Analytical results have been tabulated for samples collected as part of the RI as follows:

- Table 5-1: Soil Results – Event 1
- Table 5-2: Sediment Results – Event 1
- Table 5-3: Groundwater, Porewater, Surface Water, and Outfall Discharge Results – Event 1 through Event 4

The tables listed above present all analytical results for all normal (i.e., non-field QC) RI samples. These results have been incorporated in Section 4.3, Section 7, and Section 8, which provide an updated description of the potential influence of tidal mixing, the nature and extent of contamination, and the geochemical CSM, respectively. Screening levels and results for site-associated contaminants are discussed further in Section 6.

6 Development of Screening Levels

Screening levels (SLs) were developed for the Site to screen for indicator hazardous substances. In accordance with MTCA, SLs for Site-associated contaminants are selected by media and Site uses. MTCA's Cleanup Levels (CULs) are risk-based concentrations that are protective of generic exposure scenarios for a given site use. Tables 6-1 through 6-4 summarize all potentially relevant screening criteria by media, and show the lowest human health and ecological screening values, where applicable.

The selection of SLs presented in this section builds upon the preliminary screening levels (PSLs) presented in Section 4.5 of the RIWP. An explanation of SL selection is provided below for each media that may be impacted by Site-associated contaminants. The RI screening results, comparing the RI data to the lowest and other relevant screening criteria, are provided in Section 7.

6.1 Soil

Natural Background. MTCA states that CULs should not be lower than natural background concentrations. Therefore, natural background concentrations, where available, for soil are provided for comparison in Table 6-1.

Ecological. The Site consists of an industrial plot of land adjacent to Wapato Creek. SLs for potential ecological exposures to contaminants that may be in the creek are discussed in Sections 6.4 and 6.6. Terrestrial habitat in the upland portion of the Site is extremely limited.

Upland site conditions meet the criteria in WAC 173-340-7491(1)(b) for an exclusion from a TEE. A TEE waiver form is included in Appendix G. Site conditions in the Log Yard and Sawmill areas specifically qualify for the exclusion as the site is within an area of Port-owned property that is zoned for industrial uses characterized by surface paving, buildings, and hard-scape that provide physical barriers preventing plant and wildlife exposure to soils containing elevated concentrations of hazardous substances. These types of Port industrial land uses are expected to continue for the foreseeable future. In the case of the Log Yard, the areas of contaminated soil are currently contained by an environmental cap. The Feasibility Study will consider MTCA requirements for formal institutional controls complying with WAC 173-340-440 for remedial alternatives that do not remove soils containing hazardous substances.

Human Health. Currently, the Site is zoned industrial and is expected to be used only for industrial purposes in the future. The Site meets MTCA characteristics for an industrial site, and public access is restricted by fences, signs, and security patrols around the property. The only people who may come into contact with contaminants in soil at the Site are industrial workers. Therefore, MTCA Method A and MTCA Method C (WAC 173-340) levels for industrial use are appropriate SLs to screen soil for direct contact exposure scenarios (Table 6-1). The MTCA Method A criterion of 20 milligrams per kilogram (mg/kg) was developed to be protective of groundwater at a concentration of 5 µg/L, which is the most stringent surface water or groundwater SL evaluated.

6.2 Bioactive Zone Sediment

Natural Background. MTCA states that CULs should not be lower than natural background concentrations. Therefore, the natural background concentrations for arsenic in marine sediment is provided for comparison in Table 6-2.

Practical Quantitation Limit (PQL). Although there is not an established natural background concentration for PCP in sediment, the average sediment PQL is intended to be used as a guide for sediment natural background values for Puget Sound, from Table D-1 of the Sediment Cleanup Users Manual II, Department of Ecology, March 2015 (SCUM II). Under MTCA rules, if CULs fall below the PQL of a substance that is analyzed using appropriate sampling and analytical procedures and has a PQL that is no greater than 10 times the MDL, then the CUL will be considered to have been attained. This condition is met at the Site and the PQL for PCP of 0.355 mg/kg will be used in lieu of potentially lower risk-based human health criteria. Coincidentally, the PQL of 0.36 mg/kg (when rounded up from 0.355 mg/kg) is identical to the Sediment Cleanup Objective (SCO) of 0.36 mg/kg, the lowest ecological SL value applied to the data.

Ecological. Ecological receptors may come in contact with contaminants in the sediment/porewater of Wapato Creek. Washington State Marine Sediment Quality Standards (WAC 173-204-562) SCOs are selected as SLs for sediment (Table 6-2).

Human Health. There is no existing shellfish harvesting area in Wapato Creek. While there is no documented fishery in Wapato Creek, it is possible that people may consume fish that use Wapato Creek during some life stages. As discussed above, the natural sediment background number and the PCP PQL will be used as the relevant human health SL (Table 6-2).

6.3 Groundwater

Natural Background. MTCA states that CULs should not be lower than natural background concentrations. Therefore, the natural background concentrations for arsenic in marine water is provided for comparison in Table 6-3[2]. As stated in Section 6.1, the MTCA Method A criterion of 20 milligrams per kilogram (mg/kg) was developed to be protective of groundwater at a concentration of 5 µg/L, which is the most stringent surface water or groundwater SL evaluated.

Practical Quantitation Limit (PQL). In lieu of an established background concentration for PCP in marine water, the PQL can be used as the SL. Under MTCA rules, if the CUL falls below the PQL of a substance that is analyzed using appropriate sampling and analytical procedures and has a PQL that is no greater than 10 times the MDL, then the CUL will be considered to have been attained. A recently completed MDL/PQL study performed by TestAmerica concluded that the reliably attainable PQL for PCP is 1 µg/L (as further discussed in Appendix F). This is consistent with the PQL used in Ecology's National Pollutant Discharge Elimination System (NPDES) permit program and is used as the lowest SL value applied to the data.

Ecological. Contaminants in groundwater at the Site may migrate to surface water in the adjacent Wapato Creek, impacting ecological receptors in the creek. The chronic Washington State Water

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[2] Although arsenic occurs naturally in the environment, a background number has not been established by Ecology. Therefore, the MTCA Method A value for groundwater is used as surrogate for the natural background concentration of arsenic in marine surface water, and is the lowest screening level value applied to the data. This number may underestimate the natural regional groundwater concentrations and may be refined as groundwater background studies advance. Based on a 1989 Ecology study, *Background Concentrations of Selected Chemicals in Water, Soil, Sediments, and Air of Washington State* (PTI Environmental Services, 1989), a regional background concentration of 8 ug/L represents the 90th percentile of groundwater data collected as part of the study. Systematic background studies quantifying natural background arsenic concentrations in sediment porewater along marine shorelines have not been performed, though geochemical processes are known to cause elevated arsenic levels in the shoreline transition zone as described in Section 8.3.

Quality Criteria (for the protection of marine aquatic life; WAC 173-201A) were used as SLs for the screening of groundwater. Surface water SLs are discussed in Section 6.6.

Human Health. Groundwater at the Site currently is not used as a potable supply and likely will not be used in the future for the following reasons:

- The Site is located within City of Tacoma municipal water service area.
- Drinking water wells are not located in the vicinity of the Site.
- Proximity of the Site to marine waters. Site groundwater across the majority of the Site contains specific conductivity above state and local secondary MCLs of 700 uS/cm (WAC 246-290-310(3)(a) and a Tacoma-Pierce County Health Department Environmental Health Code Chapter 3 Drinking Water; (Figure 4-10).
- Low yield of the water-bearing zone.

Because groundwater at the Site is not potable, MTCA CULs related to drinking water do not apply to the Site. However, because contaminants in groundwater may migrate to the adjacent Wapato Creek, impacting biota, such as fish that may be consumed by humans, the groundwater-to-surface-water pathway must be considered. The National Toxics Rule (40 CFR 131) chronic criteria and the new Clean Water Act (CWA) Effective Criteria for human consumption of fish and marine organisms, are surface water criteria and are not directly applicable to groundwater and shallow porewater. However, given the potential bioaccumulation of arsenic and PCP, these SLs remain indirectly relevant. In lieu of calculating Site-specific SLs that are protective of the groundwater-to-surface-water pathway, the natural background for arsenic and the PQL for PCP are proposed for use as SLs at the Site.

6.4 Bioactive Zone Porewater

Contaminants may migrate from groundwater and be present in porewater.

Natural Background and PQL. As with groundwater, the available natural background concentrations for arsenic in marine water and the PCP PQL are provided for comparison in Table 6-3, and were the lowest SLs applied to the porewater data. The same limitations applicable to groundwater apply to porewater (i.e., the lack of good regional data defining natural background concentrations of arsenic).

Ecological. Aquatic ecological receptors may be impacted by contaminants in porewater that have migrated from groundwater at the Site. SLs for ecological receptors in porewater are applicable or relevant and appropriate requirements (ARARs) for the protection of marine aquatic life, including acute and chronic Water Quality Standards for Surface Waters in the State of Washington (WAC 173-201A).

Human Health. The highest beneficial use of groundwater is recharge to marine waters. While there is no documented fishery in Wapato Creek, it is possible that people may consume fish that use Wapato Creek during some life stages. Given the potential bioaccumulation of arsenic and PCP, the groundwater-to-surface-water pathway must be considered. As with groundwater (Section 6.3), the natural background for arsenic and the PQL for PCP are proposed for use as SLs in lieu of calculating Site-specific SLs that are protective of the groundwater-to-surface-water pathway (Table 6-3).

6.5 Outfall Discharge

Contaminants may migrate from groundwater into the stormwater conveyance system and be present in dry-weather flow and/or stormwater discharge from outfalls adjacent to the Log Yard.

Ecological. Aquatic ecological receptors may be impacted by contaminants in outfall discharge. SLs for ecological receptors in outfall discharge are acute and chronic Water Quality Standards for Surface Waters in the State of Washington (WAC 173-201A).

Human Health. The highest beneficial use of outfall discharge is recharge to marine waters. While there is no documented fishery in Wapato Creek, it is possible that people may consume fish that use Wapato Creek during some life stages. Given that fish swim throughout Wapato Creek and Commencement Bay and are not directly exposed to outfall discharge water, the human health criteria in Table 6-3 are applicable only to surface water, as discussed in Section 6.6.

6.6 Surface Water

Contaminants may migrate from groundwater and be present in porewater or surface water.

Natural Background and PQL. As with groundwater, the available natural background concentrations for arsenic in marine water and the PCP PQL are provided for comparison in Table 6-3 and were the lowest SLs applied to the surface water data.

Ecological. Aquatic ecological receptors may be impacted by contaminants in surface water that have migrated from groundwater at the Site. SLs for ecological receptors in surface water are acute and chronic Water Quality Standards for Surface Waters in the State of Washington (WAC 173-201A).

Human Health. A beneficial use of groundwater is recharge to marine waters, while there is no documented fishery in Wapato Creek, it is possible that people may consume fish that use Wapato Creek during some life stages. Relevant human health comparison criteria are presented in Table 6-3 and include MTCA Method B Values for Surface Water (cancer and non-cancer endpoints) (WAC 173-340), the new Clean Water Act (CWA) Effective Water Quality Criteria for Surface Waters in the State of Washington (WAC 173-201A), and the National Toxics Rule (40 CFR 131) criteria for protection of human health from marine water fish consumption. Given that the lowest applicable human health criteria fall below background and/or PQL concentrations, the SLs will default up to those values.

6.7 Air

As shown in Table 6-4, MTCA Air Quality Guidance (WAC 173-340) suggests that the methane standard should be set at 0.5 percent by volume, which is 10 percent of methane's lower explosive limit (LEL) of 5 percent.

7 Nature and Extent of Contamination

7.1 Log Yard

This section describes the extent of contamination in the Log Yard as defined by the occurrences of constituents exceeding the SLs identified in Section 6. The discussions of the nature of contamination in this section focus primarily on data collected during the 2016 to 2017 RI, but unsaturated soils data presented in the Log Yard Soil Testing Report (AQEA, 2014) also are brought forward. Data from previous investigations are included in Appendix A. Previous source areas and the fate and transport of Site-associated contaminants are described in Section 8.

7.1.1 Soil and Sediment

Table 7-1 shows the results for Site-associated contaminant concentrations in saturated soil samples, collected as part of the RI, in comparison to the lowest of the MTCA Method C and MTCA Method A screening criteria. Comparison of arsenic concentrations to the MTCA Method C soil cancer CUL is provided to inform the FS. As shown in Table 7-1, four samples exceeded the MTCA Method A criteria of 20 mg/kg for arsenic, with two of those saturated soil samples having concentrations that also are elevated above the MTCA Method C soil cancer CUL. No exceedances of iron were observed in soil.

Tables 7-2 and 7-3 have been updated from the Log Yard Soil Testing Report (AQEA, 2014) and include comparison of the unsaturated soil arsenic results relative to the MTCA Method A and MTCA Method C CULs. Tables 7-2 and 7-3 also include the estimated depth to the top of soil that has arsenic concentrations below the MTCA Method C CUL. The maximum reported arsenic concentrations in the unsaturated zone are shown as square symbols, color coded relative to SLs in Figure 7-1. The anticipated depth of impact above the MTCA Method C CUL (in feet bgs) and a parenthetical note on whether the depth of impact was confirmed through collection of clean samples also are provided in the labels adjacent to each sample location. With the exception of the eastern portion of the capped area, the unsaturated arsenic concentrations in the fill containing slag exceed MTCA Method C CUL to an average depth of 7.5 feet bgs. The saturated soil samples that were collected as part of the RI, were collected from approximately 1 to 2 feet below the water table and with two exceptions (MW-10 and TB-8), those soil concentrations are below the MTCA Method C criteria, and of the remaining, all but MW-8 were below the MTCA Method A CUL (Figure 7-1).

Table 7-4 and Figure 7-2 show the results for Site-associated contaminant concentrations (i.e., arsenic) in bioactive zone sediment, collected as part of the RI from depths of zero to 10 cm bml, in comparison to the natural sediment background SL of 11 mg/kg and the SCOs. Because of the tidal fluctuations in Wapato Creek and the associated flow reversals that occur in the creek at high tide, the sample locations shown in Figure 7-2 are believed to be representative of sediment conditions between the two culverts. Although one individual sediment result (from WCT-1B) exceeds that SL, the natural background SL is meant to be compared to data collected in Wapato Creek based on a surface weighted average concentration (SWAC). A SWAC of 7.0 was calculated in ArcGIS using the six surface sediment samples collected as part of the RI. The SWAC in surface sediment is less than the background based SL and thus no further comparison to human health criteria is warranted. The surface sediment data all had arsenic concentrations less than the SCO SL of 57 mg/kg.

7.1.2 Groundwater

Tables 7-5 shows the total and dissolved arsenic results in Event 1 through Event 4 groundwater samples, in comparison to the MTCA Method A value, adjusted for background (5 µg/L) and the chronic aquatic toxicity SL (36 µg/L). Figure 7-3 shows the distribution of dissolved arsenic in groundwater, with the highest concentrations (up to 79,800 µg/L) centered in the central western portion of the Log Yard, surrounding wells HC-2, B-1R, MW-10, and MW-13. This is the area where perched water was observed in contact with the fill containing slag (see Section 4). Arsenic concentrations in groundwater decrease between that source area, and the wells located at the top of the bank (MW-7, MW-9, MW-12), which have an average concentration of 235 µg/L between the four sampling events. Further reduction in arsenic concentrations occurs between those nearshore wells and the transition zone porewater collected from approximately 40 to 50 cm bml, which had an average concentration of 24 µg/L. As shown in Table 7-5, all samples from WCT-1B and one sample from WCT-3B, exceeded the chronic aquatic toxicity SL of 36 µg/L. Most other samples from transects 1 and 3 (WCT-1 and WCT-3) exceeded the MTCA Method A value, adjusted for background value of 5 µg/L but samples from transect 2 (WCT-2) were more similar to background. Arsenic fate and transport at the Site is discussed further in Section 8 and Appendix H.

7.1.3 Bioactive Zone Porewater

Given the presence of a turbidity artifact in the porewater samples, only dissolved arsenic concentrations were used in the screening evaluation. Shallow porewater results from Event 1 through Event 4 are shown in Table 7-6 relative to the MTCA Method A value, adjusted for background (5 µg/L) and the chronic aquatic toxicity SL (36 µg/L). Shallow porewater concentrations were variable between event and between the nearshore "A" and offshore "B" stations on each transect. With one exception (WCTPW001B-10-E2), all results were less than the chronic aquatic toxicity SL, but most samples exceeded the background concentration of 5 µg/L. The bioactive zone porewater results are included in Figure 7-3 and the fate and transport of arsenic in the transition zone are discussed further in Section 7.3.1 and Appendix H.

7.1.4 Outfall Discharge

Total and dissolved arsenic in both of the samples stormwater outfalls had concentrations exceeding the chronic aquatic toxicity SL (36 µg/L), with dissolved arsenic concentrations up to 850 µg/L and 444 µg/L for outfalls #2 and #3, respectively (Table 7-7; and Figure 7-3). As discussed in Section 4.2.3, the source of the arsenic potentially could be leakage of perched groundwater in the source area into the stormwater conveyance system, along seams in the stormwater pipes and the ring joints in the spill containment vessels. Arsenic in the stormwater system will be addressed in the FS.

7.1.5 Surface Water

Table 7-8 shows the total and dissolved arsenic results in Event 1 through Event 4 surface water samples, in comparison to the MTCA Method A value, adjusted for background (5 µg/L) and the chronic aquatic toxicity value (36 µg/L). All dissolved arsenic concentrations were below the marine water background concentration; three of total arsenic results from transect WCT-1 and one of the results from WCT-3 were greater than background, but less than the chronic aquatic toxicity SL. Available data suggests that outfall discharge contributes a significant fraction of total arsenic loading in Wapato Creek during dry weather conditions (i.e. Events 1 and 2). During wet weather and greater freshwater discharge (i.e. Events 3 and 4), additional loading may be attributed to entrained arsenic present in suspended solids.

7.1.6 Air

Headspace readings of methane gas (percent by volume) were collected from within the monitoring well borings before groundwater sampling during Event 1 (May 2016) and are shown in Figure 6-3. All methane readings in the capped area exceed the 0.5 percent by volume MTCA Air Quality Guidance (WAC 173-340) standard, with observed methane concentrations up to 72.1 percent by volume. Two of the three monitoring wells installed just off the cap, along the top of the bank, had no methane gas detected.

7.2 Sawmill

This section describes the extent of contamination in the Sawmill as defined by the occurrences of constituents exceeding the SLs identified in Section 6. The discussions in this section focus on data collected during the 2016 to 2017 RI. Data from previous investigations are included in Appendix A. Previous source areas and the fate and transport of Site-associated contaminants are described in Section 8.

7.2.1 Soil and Sediment

Table 7-1 compares Event 1 soil results for arsenic, iron, dioxin/furan toxicity equivalency quotient (TEQ), and PCP against the lowest associated SL and the MTCA Method C value for arsenic (see Table 6-1). Soil results from the replacement monitoring well MW-5R, TB-9 in the former Wapato Creek channel, and the shallow (unsaturated) and deep (saturated) test pit samples from outside of the former dip tank excavation were all below Site-associated contaminant SLs. The one extra shallow sample collected from within the former dip tank excavation fill material (TPS001F-1.5_2.5) had a total arsenic concentration of 27.5 mg/kg, which is greater than the MTCA Method A level. All other soil results are below the associated SLs. Arsenic and PCP results in soil are shown in Figures 7-1 and 7-5, respectively.

Table 7-4 shows the results for Site-associated contaminant concentrations in bioactive zone sediment in comparison to the lowest SL (i.e., natural sediment background for arsenic and the PCP PQL) and the SCO. No exceedances of SLs were observed in sediment as shown in Table 7-4 and Figures 7-2 and 7-5.

7.2.2 Groundwater

Tables 7-5 shows the total and dissolved arsenic results in Event 1 through Event 4 groundwater and transition zone porewater samples, in comparison to the MTCA Method A value, adjusted for background (5 µg/L) and the chronic aquatic toxicity SL (36 µg/L). Figure 7-3 shows the dissolved arsenic results relative to these SLs. With the exception of the Event 3 (November 2016) sample from MW-1, all other groundwater and transition zone porewater samples in the Sawmill had arsenic concentrations below the chronic aquatic toxicity screening criteria of 36 µg/L. The other arsenic results from MW-1 and MW-3 also exceeded background values. During Event 2, the total arsenic result in MW-2R was similar to the marine background value, but the dissolved arsenic result was below it.

Two of the four transition zone porewater results collected from WCT-4 had dissolved arsenic results that are less than the MTCA Method A value, adjusted for background SL. The remaining two dissolved arsenic results and all of the total arsenic results collected from transition zone porewater are less than the chronic aquatic toxicity value but exceed the background SL.

The other Site-associated contaminant in groundwater in the Sawmill is PCP (see Table7-5 and Figure 7-6). The highest PCP concentrations were observed in MW-2R, within the former dip tank excavation, and exceeded the chronic aquatic toxicity SL of 7.9 µg/L. MW-2R also had elevated pH values ranging from 11.21 to 12.01 (Tables 3-6 through 3-9), which are much greater than the neutral pH values (of approximately 5.5 to 7.0) observed throughout the rest of the Site.

As shown in Table 7-5 and Figure 7-6, PCP also was detected at concentrations greater than the PQL in MW-5R and MW-6R. All results from MW-1R, MW-3, MW-4, B-5R, TB-9, and porewater collected from the transition zone at WCT-4 were below the associated SLs.

7.2.3 Porewater

Table 7-6 and Figure 7-3 show shallow dissolved arsenic porewater results from Event 1 through Event 4 relative to the MTCA Method A value, adjusted for background (5 µg/L) and the chronic aquatic toxicity value (36 µg/L). For dissolved arsenic, three of the six shallow porewater sample results at transect WCT-4 were greater than the groundwater background SL and five of the six were greater than the marine water background SL.

For PCP, four of the six shallow porewater results were not detected at concentrations above 0.091 µg/L. The two detections (0.073 and 0.12 µg/L) are similar in magnitude to the reporting limits used during the RI and lower than the PQL of 1 µg/L that TestAmerica is using going forward. Thus, these low-level results may be below accurately quantifiable limits (see Attachment 1 of Appendix E). PCP results in bioactive zone porewater are shown in Figure 7-6.

7.2.4 Surface Water

Table 7-8 shows Event 1 through Event 4 total and dissolved arsenic and PCP surface water results relative to the lowest SL (background or PQL) and the chronic aquatic toxicity values. Surface water results adjacent to the Sawmill were all below applicable SLs, indicating no adverse impacts from Site-associated contaminants.

7.2.5 Air

Headspace readings of methane gas (percent by volume) were collected from within the monitoring well casings before groundwater sampling during all four events in the Sawmill; however, the methane meter was not functioning properly during Event 2, so those readings were discarded. Methane readings from Event 1, Event 3, and Event 4 are shown in Figure 7-4. Methane readings in one or more event were greater than the 0.5 percent (by volume) in all wells except the top-of-bank well MW-4. The highest repeatable methane detections (of approximately 20 percent by volume) were observed in MW-1 and MW-3.

8 Conceptual Site Model

This section describes the CSM. EPA's Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (EPA, 1988), states that the purpose of a CSM is to describe what is known about potential contaminant sources, migration pathways, exposure routes, and receptors at a site.

The CSM is an iterative, 'living representation' of a site that summarizes and helps project teams visualize and understand available information (EPA, 2011). The primary components of a CSM describe the potential sources, release mechanisms, and transport pathways of contaminants present at the site, and identify how potential human or ecological receptors may be exposed to site contaminants via exposure media (e.g., soil, groundwater, sediment) and exposure routes (e.g., direct contact, ingestion). The CSM for the Site was refined throughout the RI/FS process as additional information and data were collected and evaluated to fill previously identified data gaps.

Figures 8-1 and 8-2 are updated from the RIWP and represent the CSM, reflecting historical (pre-cap) and current (post-cap) conditions, respectively. Figures 8-1 and 8-2 relay the relationship among potential sources, release mechanisms, and transport media and mechanisms. Each of these categories is discussed in the following sections, and updates to the preliminary CSM—based on data collected as part of the RI—are discussed in each section.

8.1 Site-Associated Contaminants

Site-associated contaminants were identified during previous investigations, based on analytical testing and screening against various screening levels (e.g., MTCA) and include: PCP, total petroleum hydrocarbons (TPHs), polycyclic aromatic hydrocarbons (PAHs), and metals. Dioxins are commonly present in PCP formulations and potentially could be present.[3] Cleanup activities conducted in the Sawmill between 2008 and 2009 addressed areas with known TPH and PAH contamination in soil. As part of the RI, dioxin/furan analysis was conducted on saturated soil from the replacement well MW-5R and on the shallow soil samples collected within the two test pits advanced across the former dip tank excavation area. Those dioxin/furan TEQ results were well below the associated dioxin/furan MTCA Method C CULs (see Section 6.2). Therefore, the Site-associated contaminants driving the RI and the need for added cleanup at the Site are arsenic and PCP, with arsenic being the primary driver in the Log Yard (Section 8.3.1), and PCP being the driver in the Sawmill, although arsenic and pH also are elevated in some locations in the Sawmill (Section 8.3.2). In addition, methane gas is identified as a Site-associated contaminant. Methane, a naturally occurring gas, may be present below the Log Yard cap as a result of decomposition of the wood waste associated with the fill containing slag or decomposition of naturally occurring organics (e.g., tide flat deposits).

8.2 Sources

The potential source areas were identified and discussed in previous Site investigations and documents, and are summarized in Section 2 and Table 2-3. The locations of potential source areas are shown in Figure 2-2. These source areas include (1) areas where hazardous substances were

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[3] PCP was used in a water-based solution as an anti-sap stain reagent. Dioxins are identified as a potential Site-associated contaminant because of the historical PCP use onsite. Dioxins may have been an impurity by-product/contaminant in the PCP used onsite.

placed (e.g., the slag ballast in the Log Yard) or stored (e.g., the above ground fuel tank), or (2) areas where historical activities may have resulted in the release of contaminants to the environment (e.g., the spray booths, dip tank, etc.).

Several historical source areas have undergone remediation and are no longer considered an ongoing source. The following is a summary of former potential source areas and their associated contaminant usage:

- Machine Shop – Petroleum products, metals. Soil was tested in 2009 for volatile organic compounds (VOCs), metals, and TPHs. VOCs and TPH were not detected; metal concentrations did not exceed MTCA Method A CULs (WES, 2009e). Therefore, no cleanup was performed and this area is not considered an ongoing source.
- Fuel Storage Area – Petroleum products. Soil was tested in 2009 for VOCs and TPH. Results did not exceed MTCA Method A CULs (WES, 2009e). Therefore, no cleanup was performed and this area is not considered an ongoing source.
- Mill Hydraulic Equipment Area – Petroleum products. Soil from this area was excavated and disposed of offsite. This area is no longer considered an ongoing source (WES, 2009e).
- Former Central Drainage Ditch – Secondary source of PCP and TPH. Impacted ditch soil was excavated, the ditch was backfilled, and the cap was extended to cover the remediated area (RZA, 1988a, 1988b, 1988c; Port, 1989). This area is no longer considered an ongoing source.
- Former Log Ramp – Metals from slag were used to construct the ramp. The log ramp has been demolished, soil removal has occurred, and a cap is in place in this area (WES, 2009b). This area is no longer considered an ongoing source.
- Planer Spray Booth – PCP. Soil excavation has occurred in this area and it is no longer considered an ongoing source (WES, 2009e).
- Spray Booth and Mill Spray Area – PCP. Soil excavation has occurred in this area and it is no longer considered an ongoing source (WES, 2009e).

The RI targeted further evaluation of the two remaining Site-associated contaminants in the following source areas:

- Log Yard (northern portion of the Site) – Metals from use of slag across this portion of the Site. A concrete cap currently covers this area (HC, 1988b, 1988d). This area remains a source although it has been capped to control surface water and groundwater impacts.
- Former Dip Tanks (western portion of the Sawmill) – PCP. Soil excavation has occurred in this area (WES, 2009e). Additional information is required to determine the current status of this area.

8.3 Contaminant Fate and Transport

The RI confirmed that concentrations of arsenic in groundwater under the Log Yard cap are still elevated above current SLs. The RI also confirmed that perched water remains in contact with the fill containing slag, thus serving as an ongoing source to groundwater. Fortunately, arsenic concentrations attenuate strongly before reaching Wapato Creek. The results of (1) the specialized arsenic geochemical tests conducted as part of the RI and (2) an in-depth evaluation of arsenic fate and transport mechanisms via the groundwater migration pathway and in the tidal transition zone are presented in Appendix H and summarized in Section 8.3.1.

PCP and elevated pH also was observed in groundwater from MW-2R, which is located within the former dip tank area. This contamination is confined to the uplands because PCP concentrations in the downgradient wells closer to the creek (i.e., MW-1, MW-4, and B-5R) are below groundwater SLs and with neutral pH. The fate and transport processes associated with PCP in the Sawmill are summarized in Section 8.3.2.

8.3.1 Arsenic in the Log Yard

Table 8-1 and Figure 8-1 summarize the key fate and transport processes that have been evaluated for arsenic within and adjacent to the Log Yard. Each is described further below.

- Arsenic leaching in perched groundwater: Arsenic at the Site is associated with the historical use of slag as ballast in the Log Yard. Past and current leaching of slag has resulted in groundwater, stormwater, and (historical) surface water impacts in Wapato Creek. The primary source of arsenic to groundwater currently is an upland area of the Site where fill containing slag is interacting with perched water. As shown in Figure 8-1, groundwater arsenic concentrations in this area are high (average of 41,238 µg/L). Though perched water arsenic concentrations are lower than measured in the early 1990s, they are much higher than those measured elsewhere within the Log Yard. Temporal trends in perched zone water levels and the results of the transducer study performed during the RI demonstrate that the cap performance has deteriorated since initial installation, and significant groundwater recharge occurs following precipitation events.
- Geochemical interactions within groundwater: The fate and transport of arsenic during groundwater flow toward Wapato Creek is moderated by precipitation, co-precipitation, and adsorption processes as described in Appendix H. Each of these processes is summarized in more detail below:
    - Precipitation and co-precipitation reactions: In the Log Yard, arsenic fate and transport is additionally controlled by interactions between arsenic and dissolved iron, the latter of which is significantly elevated because of the presence of relatively reducing redox conditions, which stabilize dissolved ferrous iron in groundwater. High dissolved iron concentrations promote the precipitation of iron arsenate minerals at high arsenic concentrations, and the co-precipitation of arsenic with mixed Fe(II)/Fe(III) green rusts at lower arsenic concentrations. These are known geochemical processes that can effectively immobile arsenic. Both were documented as part of laboratory precipitation studies.
    - Adsorption processes: At the relatively low arsenic concentrations found in most groundwater, arsenic fate and transport is predominantly controlled by adsorption-desorption reactions, which involve the binding of arsenic to the surfaces of soil minerals, particularly iron oxyhydroxide minerals that are ubiquitous in soils and sediments. These processes occur throughout the site in the aquifer solids and sediments.

Tidally-induced mixing: In addition to the other processes listed above, groundwater and surface water mixing occurs in the nearshore and transition zones. This mixing introduces oxygen and results in other geochemical changes that can enhance precipitation and sorption of arsenic. Evidence that arsenic attenuation is occurring includes elevated soil concentrations beneath the source area, and dramatically lower groundwater concentrations immediately downgradient of it. In addition, laboratory testing and geochemical modeling demonstrate arsenic attenuation via precipitation, co-precipitation, and adsorption processes (Appendix H). The importance of different attenuation processes along the nearshore transect shown in Figure 8-1 includes the following:

- Log Yard Source Area: In source area groundwater, the primary attenuation process for arsenic is iron arsenate mineral precipitation. Evidence for precipitation includes (1) groundwater arsenic and iron concentrations that are poised at concentrations expected for groundwater that is saturated by (or in equilibrium with) various iron arsenate minerals and (2) the direct identification of iron arsenate minerals in induced precipitation tests using Site groundwater (Appendix H).

  Arsenic is also being adsorbed to, and co-precipitated with, iron oxyhydroxides and mixed Fe(II)/Fe(III) layered hydroxides (such as green rust) in the source area. Adsorption was directly demonstrated in batch adsorption tests (BAT) using Site soils. Evidence for co-precipitation includes the removal of arsenic along with green rust-type phases in the anaerobic-arsenite induced precipitation test discussed in Appendix H. Also, the sequential extraction tests found that most arsenic in source area soils is associated with insoluble (co-precipitated) mineral fractions.

- Log Yard Groundwater: In groundwater located downgradient of the source area (and containing lower arsenic concentrations), the primary arsenic attenuation process is likely adsorption; however, co-precipitation and/or mineral precipitation also occur (Figure 8-1). Attenuation was directly demonstrated by sequential extraction tests on Log Yard soils, which found a significant amount of arsenic in the exchangeable (adsorbed) fraction and the oxide and residual (co-precipitated) fractions. Whereas adsorption is likely ubiquitous (as demonstrated by significant arsenic adsorption in the BAT in all Site soils and sediments), co-precipitation is more likely in areas where redox gradients are present. For example, co-precipitation could occur in shallow groundwater where vadose zone infiltration potentially is causing the mixing between more-oxidized vadose zone porewater and groundwater (leading to iron oxyhydroxide and/or green rust precipitation and arsenic co-precipitation).

- Transition Zone and Shallow Porewater: The fate and transport of arsenic near Wapato Creek is affected by terminal electron accepting processes (TEAPs) and groundwater mixing. TEAPs in shallow porewater are microbiologically mediated reactions that can cause reductive dissolution of iron oxyhydroxides and release of adsorbed arsenic in shallow sediments at rates that produce naturally high dissolved concentrations (note: re-precipitation [and sequestration] of arsenic is also possibly higher in the sediment profile, near the sediment-water interface). By contrast, groundwater mixing with surface water can significantly decrease arsenic concentrations in nearshore groundwater and porewater. The effect of mixing is to additionally introduce oxygenated surface water into the subsurface, which promotes the oxidation of ferrous iron and its subsequent precipitation (including as iron arsenate minerals and iron oxyhydroxide minerals containing arsenic).

  Evidence that arsenic attenuation is occurring near Wapato Creek includes the formation of iron arsenate and iron oxyhydroxide in the induced precipitation tests conducted on Site groundwater under aerobic conditions (Appendix H). In addition, arsenic adsorption by iron oxyhydroxides was demonstrated in the BAT and found to be significant in shallow sediments.

In the future, groundwater redox conditions are likely to remain iron-reducing because of ferrous iron mineral buffers and ongoing degradation of organics from wood waste and natural humic matter. Therefore, the same attenuation processes identified in this study are predicted to continue. Even if all wood waste were to be removed from the Site, reducing conditions likely would persist in the groundwater for an extended period (i.e., hundreds of years), and attempting to modify the Site groundwater conditions (i.e., to create oxidizing conditions) may be unsuccessful because reducing conditions will tend to result in “rebound” to current conditions. Factors that might improve observed attenuation performance will be further evaluated in the FS. These may include reducing leaching in the upland source areas, flattening groundwater gradients, or adding iron-containing media along the groundwater flow path.

8.3.2 Pentachlorophenol and Arsenic in the Sawmill

PCP was used at the Sawmill as an anti-sap stain in a water-based solution. PCP is considered relatively immobile in the environment and migration is retarded by organic matter in soil and it naturally degrades. In soil, the major degradation pathway for PCP occurs by microbial degradation. High organic matter and moisture content, median temperatures, and neutral to slightly acidic pH enhance microbial breakdown of PCP in soil.

While PCP contaminated soil was removed from the former dip tank area in 2008, elevated PCP continues to be observed in the groundwater well, MW-2R, which is situated within that former excavation (Figure 4-3). PCP is subject to microbial degradation in groundwater, which can occur during either aerobic or anaerobic conditions. The fate and transport of PCP in groundwater is primarily influenced by the pH of the media. MW-2R also had elevated pH values ranging from 11.21 to 12.01 (Tables 3-6 through 3-9), which are much greater than the more neutral pH values (of approximately 5.5 to 7.0) observed throughout the rest of the Site. Alkaline conditions in this range can inhibit biological activity and reduce PCP’s adsorptive capacity, resulting in a localized increase in PCP mobility.

MW-2R is situated within the extent of historical excavations of the former dip tank. Elevated groundwater pH has been observed at this location following removal actions. The former dip tank area is unpaved, and as discussed in Section 4.2.2, demonstrates a direct response to precipitation (Figure 4-8), with increases in water levels of several feet observed following heavy rainfall, resulting in localized groundwater mounding (Figure 4-15). Increases in dissolved oxygen content were also observed in MW-2R (Table 3-8 and Table 3-9).

Natural attenuation of PCP in the transition zone is affected by processes such as biodegradation, dispersion, diffusion, recharge, tidal mixing, sorption, volatilization, and chemical or biological stabilization, transformation, or destruction of contaminants. Degradation of PCP in surface water occurs primarily through photo-degradation. When exposed to direct sunlight, the degradation process may be rapid. Photo-degradation rates decrease with increasing depth in the water column. The pH of the water also affects the photo-degradation rate. Half-lives in surface waters have been shown to range from less than an hour (20 minutes) to days, in part dependent on the exposure to sunlight. In aerobic aquatic environments, PCP also may be degraded by microbes.
Arsenic concentrations in the Sawmill exceed 5 ug/L in groundwater at MW-1 (38.8 ug/L) and MW-3 (15.5 ug/L), and in porewater at 4A (16.4 ug/L). Groundwater arsenic concentrations in this range are likely caused by arsenic desorption from naturally-occurring iron oxyhydroxides (a process that is promoted under the reducing geochemical conditions [and the nearby alkaline conditions in the former dip tank area]).

8.4 Exposure Assessment

Historical and current contaminant migration pathways are discussed by media in the following sections. Contaminant fate and transport is discussed in Section 8.3 and Appendix H.

8.4.1 Soil

Potential migration pathways for contaminants in Site soil include:

- Stormwater infiltration and subsequent leaching of contaminants in soil to groundwater
- Stormwater or wind erosion of contaminated surface soil and subsequent transport to Wapato Creek
- Migration of methane gas through unsaturated soils beneath the cap

Before installation of the cap (Figure 8-2), infiltration or precipitation through the fill containing slag and subsequent discharge of stormwater to Wapato Creek (via the former central drainage ditch and/or subsurface drains shown in Figure 2-2, or direct overland flow) served as a direct pathway for metals migration to surface water and potentially groundwater. The cap in the Log Yard was installed between late 1988 and early 1989 with the intention of cutting off surficial and shallow subsurface stormwater drainage through the fill containing slag (Figure 8-3). Although perched groundwater was observed in shallow monitoring wells HC-1 and HC-2 soon after the cap was installed, it was anticipated that those wells would run dry as the source of the perched water (i.e., surficial infiltration) was cut off and the perched groundwater zones drained. However, observations of ongoing perched water in HC-2, and some of the new monitoring wells advanced as part of the RI confirmed that there are portions of the Site where fill containing slag is still saturated, and thus leaching of metals from the slag still serves as an ongoing source of arsenic to groundwater (Figures 8-2 and 8-3). As described in Section 4, seepage of ponded stormwater through the cap appears to be the source of the ongoing perched water. Because the Log Yard has been capped, surface soil migration through wind erosion is not a significant release mechanism in the Log Yard portion of the Site.

As part of the VCP activities in the Sawmill, impacted surface soils from the source areas identified in Figure 2-2 and Table 2-3 have been removed. Furthermore, portions of the Sawmill have been regraded and/or paved so wind erosion or stormwater runoff are not anticipated to be substantial transport mechanisms for impacted soils in this area.

Tables and figures presenting the results of previous soil and stormwater investigations are included in Appendix A.5 and A.7, respectively, and RI soil results are presented in Section 5 and Section 7.

8.4.2 Groundwater

Potential migration pathways for contaminants in Site groundwater include:

- Migration of Site-associated contaminants in groundwater to porewater and subsequently to surface water in Wapato Creek or to offsite groundwater
- Migration of contaminants in groundwater via infiltration into portions of the existing storm drain system (Figures 8-2, 4-10, and 4-11) and subsequent transport to Wapato Creek
- Sorption/precipitation of groundwater contaminants onto sediments in Wapato Creek

The release of contaminants in the subsurface to groundwater is controlled by the contaminant chemical properties (e.g., solubility, partitioning coefficients) and by processes such as infiltration, leaching, dissolution, and adsorption. For example, the highest arsenic concentrations in groundwater were observed beneath where perched groundwater is in contact with the fill-containing slag underlying the Log Yard, which indicates that arsenic is leaching out of the slag and provides an ongoing source of contamination to groundwater. Arsenic in groundwater has the potential to be transported to Wapato Creek via either the groundwater to porewater to surface water flow pathway, or through infiltration into the storm drain system. As discussed in Section 4.2.3, groundwater seepage into the stormwater conveyance system was confirmed to be occurring and is likely the source of the elevated arsenic observed in both dry-weather and stormwater discharge in OF#2 and OF#3 (see Sections 5 and 7 for results).

Infiltration of precipitation through contaminated subsurface Site soils (if any remain after completed soil removals) in unpaved portions of the Sawmill have the potential to leach contaminants, such as PCP (which is soluble in water), to groundwater and subsequently to Wapato Creek through advective flow. Any groundwater impacts are anticipated to be shallow given the fine-grained and relatively impermeable nature of the silty substrate underlying much of Site. Tables and figures presenting the results of previous groundwater investigations are included in Appendix A and RI soil results are presented in Sections 5 and 6.

A detailed geochemical evaluation was conducted to evaluate whether discharge of pollutants in groundwater to Wapato Creek is a significant transport mechanism. These results are presented in Appendix H, and demonstrate that significant arsenic attenuation is occurring at the Site and that the long-term fate of arsenic will continue to be shaped by arsenic precipitation, co-precipitation, adsorption and groundwater mixing near Wapato Creek. The implication that arsenic attenuation is ongoing and stable will be further evaluated in the FS.

8.4.3 Sediment/Porewater

After contaminants reach the aquatic environment, they may mix with surface water or sorb to sediment that can be suspended and be redeposited through tidal fluctuations, flood events, and/or anthropogenic activities. Sediment deposition rates and changes in the elevation of the riverbed in Wapato Creek over time have not been quantified for the Site; however, the Site is considered to be depositional in nature given the fine-grained nature of the sediment, the small size of the watershed, the low surface-water flow velocities, and the lack of marine vessel and recreational use adjacent to the Site.

Sediment samples from Wapato Creek were collected in 1984 (before capping), 2009, and in May 2016 as part of RI Event 1. In 1984, total arsenic in sediment adjacent to the Log Yard was 14 mg/kg near the culvert to the Blair Waterway and 45 mg/kg just downstream of the road that crosses Wapato Creek, connecting the Site to Alexander Avenue (so near the former central drainage ditch). Samples collected in 2009, about 20 years after the cap was installed, had arsenic concentrations in surface sediment adjacent to the Log Yard ranging from 8 U (non-detect) mg/kg to 40 mg/kg, with the highest concentration observed near the former central drainage ditch. Tables and figures presenting the results of previous sediment investigations are included in Appendix A.6.

The range of arsenic concentrations in sediment observed during the RI sampling was 1.84 to 13.6 mg/kg adjacent to the Log Yard, with a surface weighted average concentration of 7.0 mg/kg, which is less than natural background (11 mg/kg) for sediments. Although samples were not collected from the immediate vicinity of outfalls OF-2 and OF-3, the sediment collected during the RI is believed to be representative of this portion of the creek because of the flow reversals and associated mixing redistributes fine grained sediments based on the tidal cycles within the creek. In general, sediment concentrations in the bioactive zone appear to have improved over time, likely because of source control actions in the late 1980s and natural recovery through deposition of incoming suspended solids in Wapato Creek.

The interstitial water contained within surface sediment is referred to as porewater, and is a potentially relevant exposure media within the bioactive zone (upper 10 cm of sediment). Site-associated contaminants, if discharged to Wapato Creek, may partition to sediments, porewater, or surface water. The partitioning process depends on the geochemistry of the sediment matrix and the groundwater, as well as the type of contaminant. Multiple porewater samples were collected along each Wapato Creek transect to evaluate porewater concentrations within this transition zone (see Section 3).

A detailed geochemical evaluation was conducted to evaluate whether discharge of pollutants in groundwater to Wapato Creek is a significant transport mechanism (Appendix H). Dissolved arsenic concentrations in all but one porewater sample were below SLs for protection of aquatic organisms. The measured arsenic concentrations in porewater are within (or near) the natural range expected from microbial activity and TEAPs releasing adsorbed arsenic from iron oxyhydroxides in sediments, and sediment quality remains within the range of natural background concentrations.

8.4.4 Surface Water

If Site-associated contaminants are discharged to surface water in Wapato Creek (e.g., from stormwater, groundwater, air deposition, or resuspension of contaminated bedded sediments), they may be present in surface water as suspended particulates or dissolved contaminants. Suspended particulates are likely to be redeposited in nearby quiescent areas and dissolved contaminants may either remain in the water column, become adsorbed to particulates, or precipitate. Contaminants in the dissolved phase may be bioavailable to aquatic organisms and enter the food chain.

Surface water testing was performed in 1984 (pre-cap), the late 1980s (post-cap), and as part of the four RI sampling events (conducted between May 2016 and February 2017):

- Total arsenic in surface water adjacent to the Log Yard declined from 70 µg/L in 1984 to a range of < 5 to 14 µg/L after the cap was installed (late 1980s). Dissolved arsenic concentrations were consistently less than 5 ug/L after the cap was installed.
- The range of total arsenic concentrations observed during the RI was similar to that observed in the late 1980s, with most (75%) values less than 5 ug/L and a maximum total arsenic value of 11.9 µg/L observed at Station WCT-1B. All dissolved arsenic concentrations measured during the RI were less than 5 ug/L.

The immediate reduction in surface water concentrations following installation of the cap and associated replacement of the stormwater conveyance system, indicates that the remedy implemented in the late 1980s was an effective means of reducing Site-related impacts to surface water. Comparison of surface water samples collected immediately after the cap was installed and samples collected as part of the RI suggests that post-remedial arsenic concentration ranges in surface water have remained relatively consistent over time. Tables and figures presenting the results of previous surface water investigations are included in Appendix A.6 and RI soil results are presented in Sections 5 and 7. As discussed in Section 7.1.3, all dissolved arsenic concentrations were below applicable ecological toxicity SLs and the marine water background concentration; however, three of total arsenic results from Transect WCT-1 and one of the results from Transect

WCT-3 were greater than background, but less than the chronic aquatic toxicity value. These samples had elevated TSS indicating that a turbidity artifact may be contributing to the total results.

9 References

An inventory of project documents is provided in Table 9-1. References that are cited in this RI Report are highlighted in Table 9-1.

Table 2-1. Site History/Chronology

Years	Area	Event Category	Description	Supporting Aerial Photograph Observations [1]
1890-1985	Parcel 15	Site Use	Parcel 15 is located within the air deposition area of the historical Asarco Smelter in Ruston. Arsenic, lead, and other heavy metals have been detected at elevated concentrations within soils in the air deposition plume.	Historical documents; City of Tacoma GovMe website.
pre-1950	Parcel 15	Site Use	Agricultural - Wapato Creek runs northwest across property.	1936, 1940, 1944, 1950 Aerial Photographs
1959-1965	Parcel 15	Site Use	Placement of fill on Parcel 15 (dredge sediment, likely from Blair Waterway). Re-routing of Wapato Creek.	1973. Site appears vacant with limited vegetation
1969	Parcel 15	Site Use	Site surface disturbed. Wapato Creek has been rerouted. Limited vegetation in southwestern portion of property.	1969 Aerial Photograph
1974 (actual date is uncertain)	Former Log Yard	Site Use	ASARCO slag fill used at some point during the construction and/or use of the Log Yard.	N/A
1974-1978	Parcel 15	Site Use	West Coast Orient Lumber Mills, Inc. operates Sawmill.	N/A
1978-1983	Parcel 15	Site Use	West Coast Lumber Operations Co. (WCLOC) operates mill.	N/A
1983-1988	Parcel 15	Site Use	WCLOC changes name to Portac, Inc. (1983) Mill operated by Portac Inc.	1985. Log Yard and Sawmill in full operation. Very dark soil (interpreted to be due to presence of bark) present on Log Yard. Heavy vegetation along both banks of Wapato Creek adjacent to Log Yard (north of access road). Very limited vegetation on southern banks of Creek adjacent to Sawmill - banks appear to have been cleared - creek channel very linear.
1986-1987	Former Log Yard	Investigation	Log Yard soil and groundwater assessment.	N/A
1988-1989	Former Log Yard	Cleanup	Log Yard cap is constructed; central drainage ditch cleanup completed..	N/A
1989-1992	Former Log Yard	Monitoring	Log Yard post-construction monitoring program is active.	1990. Log Yard and Sawmill in full operation. Creek vegetation similar to 1985. Dark soil/bark limited to northeast corner of site (on top of capped surface) . Western bank of Creek being used for parking.
2002 -2006	Parcel 15	Site Use	Sawmill and Log Yard in use.	2002. Sawmill appears in full operation; Log storage less than previous years. Surface of Log Yard (i.e., cap) appears reddish-brown likely due to the presence of bark. Dark circular pattern (road?) in northeastern corner. 2006. Sawmill appears in full operation; Log storage is less than previous years. Surface of Log Yard appears reddish-brown.
2008-2009	Parcel 15	Site Use, Cleanup	Portac Sawmill closes. Sawmill demolition and soil removals. Cap repairs and maintenance conducted.	2009. Former Log Yard vacant. Cap is apparent with several large dark rectangular patches which are assumed to be areas of cap repair or modification. Former Saw Mill has been demolished and area is being used for automobile storage. Cap repairs include asphalt overlay (184,000 sq.ft) and sealing of cracks (38,500 linear feet).
2008	Former Sawmill	Site Use	Log Yard ramp demolition.	N/A
2008-2014	Former Sawmill	Investigation, Cleanup	VCP activities on Sawmill.	N/A
2010	Parcel 15	Site Use	Portac lease with Port of Tacoma ends.	N/A
2011-2014	Former Sawmill	Investigation, Cleanup	Supplemental testing on Sawmill.	2011. Former Log Yard vacant. Cap is apparent and has numerous north-south trending lines (e.g., patches). Northwestern half of cap appears reddish brown and appears logs or lumber may be stored onsite. Former Saw Mill is gone and area is vacant. Former building foundations (e.g., slab on grade?) visible.
2012-2013	Former Log Yard	Site Use	Cap repairs occur based on recommendations in 2012 Cap Inspection Report.	2012. Former Log Yard mostly vacant - some unknown storage. Cap is apparent and has numerous north-south and east-west trending lines (e.g., patches). Surface of cap now gray. Former Saw Mill area being used for automobile storage and former building foundations visible.
2014 - 2017	Former Log Yard	Inspection	Cap inspection observations result in repair recommendations.	2015. Former Log Yard being used for automobile storage. Former Saw Mill is currently being used as a truck queuing area to alleviate some of the traffic on North Frontage Road (SR 509).

Notes:

N/A = Not applicable. Event not represented by an aerial photo observation.

1 See Appendix A of this RI Report for photograph log.

Table 2-2. Previous Investigations And Sampling Events

Area Sampled	Activity Description/ Objective	Years Sampled	Media Sampled						Analytes Tested	Source Document
			Groundwater	Soil	Catch Basin Sediment	Stormwater/ Runoff	Wapato Creek Sediment	Wapato Creek Surface Water		
Former Log Yard, Wapato Creek	Surface water sampling for log sort yard remediation project (1988 consent order).	1983-1990				**X** (drainage discharges)		**X**	Metals	HC 1990a
Former Log Yard, Wapato Creek	3rd and final round of surface water sampling for log sort yard remediation project (1988 consent order).	1983-1990				**X** (drainage discharges)		**X**	Metals	HC 1990c
Former Log Yard	Groundwater assessment to address whether groundwater is contributing to metals in nearby waterways	1986-1987	**X**	**X**					Metals, EP toxicity	HC 1987a
Central Drainage Ditch	Soil cleanup in central drainage ditch between Log Yard and Sawmill. Soils were excavated and disposed of offsite. Area was subsequently filled and capped.	1988		**X**		**X** (drainage ditch)			PCP, TOX, PNAs, TPH	RZA 1988a,c
Wapato Creek	Ten sediment samples collected in Wapato Creek (8 adjacent to the site and 2 upstream).	1988					**X**		PCP, TOX, PCBs, pesticides	RZA 1988b
Former Log Yard	Spring 1990 groundwater monitoring event for log sort yard remediation project (1988 consent order).	1987-1990	**X**						Metals	HC 1990b
Former Log Yard	Spring 1991 groundwater monitoring event for log sort yard remediation project (1988 consent order).	1987-1991	**X**						Metals	HC 1991d
Former Log Yard	Spring 1992, Final groundwater monitoring event for log sort yard remediation project (1988 consent order).	1987-1992	**X**						Metals	HC 1992
Former Log Yard	Characterize surface material on the sort yard.	1988		**X** (test pits, slag, wood waste, soil)					Metals	HC 1988a
Former Sawmill	Closure assessment focused on hog fuel ramp, former wood treatment area, former dip tank and drip pad.	2008	**X**	**X**					Groundwater: Metals, TCLP metals. Soil: TPH, PCP, nitrogen, BTEX	CDM 2008a
Parcel 15	Stormwater monitoring under WA Industrial Stormwater General Permit - Discharge Monitoring Reports for 2003 - 2009	2003-2009				**X**			pH, turbidity, oil and grease, hardness, BOD, copper, lead, zinc,	Portac, 2015
Former Sawmill	Second phase of closure assessment activities	2008	**X**	**X**					Groundwater: PCP, TPH. Soil: PCP, TPH, TCLP metals.	CDM 2008b
Former Sawmill	Sediment and stormwater sampling of catch basins	2009			**X**	**X**			PCP	EMS 2009
Parcel 15	Assess catch basin solids	2009			**X**				Metals, TPH, SVOCs	HC 2009b
Wapato Creek	Evaluate potential impacts to creek sediment quality from site stormwater runoff and historical activities	2009					**X** (surface and subsurface)		TPH, metals, PCP	HC 2009c
Wapato Creek	Confirm low-level PAH concentrations in creek sediment	2009					**X**		PAHs	WES 2009a
Former Log Yard	Log ramp demolition	2008		**X** (demolition, stockpiles)					Arsenic, Lead	WES 2009b

Table 2-2. Previous Investigations And Sampling Events

Area Sampled	Activity Description/ Objective	Years Sampled	Media Sampled						Analytes Tested	Source Document
			Groundwater	Soil	Catch Basin Sediment	Stormwater/ Runoff	Wapato Creek Sediment	Wapato Creek Surface Water		
Former Sawmill	Additional information regarding Sawmill site: storm drain cleaning, TEE, Wapato Creek sample	2009			**X**	**X** (stormwater)	**X**		Storm drain sediment: PCP, TPH, BTEX. Catch basin sediment: PCP. Stormwater: PCP. Wapato Creek sediment: PAHs.	WES 2009c
Former Log yard	Termination of Baseline General Permit to Discharge Stormwater for Industrial Activity	2009								Portac, 2009
Former Sawmill	Lumber mill demolition cleanup and testing	2008-2009	**X**	**X** (soil and waste characterization)					Groundwater: TPH, SVOCs, VOCs, metals. Soil: TPH, SVOCs, metals, dioxins, PCBs, TCLP metals.	WES 2009e
Former Sawmill	4th quarter, 2009 groundwater monitoring report	2008-2009	**X**						SVOCs, PAHs, TPH, metals	WES 2010a
Former Sawmill	1st quarter, 2010 groundwater monitoring report	2008-2010	**X**						SVOCs, PAHs, TPH, metals	WES 2010b
Former Sawmill	2nd quarter, 2010 groundwater monitoring report	2008-2010	**X**						SVOCs, PAHs, TPH, metals	WES 2010c
Former Sawmill	3rd quarter, 2010 groundwater monitoring report	2008-2010	**X**						SVOCs, PAHs, TPH, metals	WES 2010d
Former Sawmill	1st quarter, 2013 groundwater monitoring report	2008-2013	**X**						SVOCs, PAHs, TPH, metals	WES 2013
Former Sawmill	Collection of data to support modified MTCA screening levels	2011		**X**					TOC	WES 2011
Former Log Yard	Subsurface soil investigation in Log Yard area	2014		**X** (slag, wood waste)					Arsenic, TCLP metals	AQEA 2014
Former Log Yard	Groundwater sampling and summary of investigation for north lead rail improvement project	2013-2014	**X**	**X**					Metals	Landau 2014

Abbreviations:

BTEX = benzene, toluene, ethylbenzene, and xylenes
PAHs = polycyclic aromatic hydrocarbons
PCBs = polychlorinated biphenyls
PCP = pentachlorophenol
SVOCs = semi-volatile organic compounds
TCLP metals = toxicity characteristic leaching procedure for metals
TEE = terrestrial ecological evaluation
TPH = total petroleum hydrocarbons (diesel-, motor oil- and/or gasoline-range hydrocarbon analysis)
VOCs = volatile organic compounds

Table 2-3. Potential Sources of Contamination and Associated Remedial Actions

Source Location	Source Activity	Site-Associated Contaminant	Remedial Activity
Regional soils	Natural and urban background conditions and presence of arsenic and/or lead in aerial deposition from the ASARCO smelter plume	Metals	NA
Former Log Yard parcel	Placement of fill containing ASARCO slag and leaching from slag over time	Metals	Log yard capped pursuant to 1988 Order to prevent surface water infiltration through the slag and associated leaching of metals (HC 1988b, HC 1988d).
Log ramp in Former Sawmill area	Use of ASARCO slag as construction material and leaching from slag over time	Metals	During removal of the log ramp in 2008, the fill containing slag was excavated beyond the planned final grade at the ramp area. The area was then backfilled, regraded, and paved in November 2008 (WES, 2009b).
Edger spray booth area of mill building	Sawmill operations/ wood treatment and processing	PCP	Impacted soil was excavated (WES, 2009e).
Mill spray area of mill building	Sawmill operations/ wood treatment and processing	PCP	Impacted soil was excavated (WES, 2009e).
Plant spray booth area of planer building	Sawmill operations/ wood treatment and processing	PCP	Impacted soil was excavated (WES, 2009e).
Former drainage ditch between former Log Yard and Sawmill	Secondary source due to accumulation of stormwater runoff and eroded soil that was impacted by PCP	PCP	Impacted soil was excavated, the ditch was backfilled, and the cap was extended to cover the former drainage ditch.
Fuel Tank Area near former Sawmill	Above ground fuel tank, leaks, spills	TPH	Impacted soil was excavated (WES, 2009e).
Mill hydraulics area in mill building	General operations, spills	TPH	Impacted soil was excavated (WES, 2009e).
Dip tank area near main storage building	General operations, spills	TPH	Impacted soil was excavated (WES, 2009e).

Notes:

PCP = pentachlorophenol

TPH = total petroleum hydrocarbons

Table 3-1. Summary of Existing Information, Data Gaps, and Data Collection

RI/FS Information Needs by Topic	Existing Information	Data Gaps	Data Collection
Environmental Site Setting			
Survey data for the site and vicinity, including topography, bathymetry, utilities, and surface features.	• Extensive survey data are available for the site and vicinity.	• Limited supplemental surveys may be required to fill gaps in existing survey data and to document the locations and elevations of newly-placed groundwater monitoring wells or other investigation features.	• Conducted targeted surveys to confirm topography, depths of existing stormwater outfalls, and locations/elevations of new and existing monitoring wells, piezometers and other RI sampling locations.
Document current and likely future land uses at the site and vicinity.	• The site is zoned for industrial uses and is located within the Port industrial area.	• Specific future development plans are not specifically known at this time, but the site is expected to remain in Port ownership and continue to be used for industrial and Port-related uses.	• Descriptions of current and anticipated land uses to the extent they are known are provided in Section 2.3 of this RI Report.
Document current and likely future groundwater use at the site and vicinity.	• Groundwater is not currently used onsite. • Municipal water is available from the City of Tacoma. • Water-bearing zone is shallow (8-12 ft. bgs) and likely impacted by marine waters in Commencement Bay. • Groundwater discharges towards Wapato Creek and Commencement Bay (e.g., Blair Waterway) - there is an extremely low probability that groundwater will be used for drinking water in the future. • The highest beneficial groundwater use is likely discharge to marine water.	• Sufficient information is available to support the development of the RI.	• Current and likely future groundwater use documented and explained in Section 6 of this RI Report.
Current human and fish/wildlife uses of Wapato Creek.	• Groundwater discharges towards Wapato Creek and Commencement Bay (e.g., Blair Waterway) - there is an extremely low probability that groundwater will be used for drinking water in the future.	• Sufficient information is available to support the development of the RI.	• Description of current human and fish/wildlife uses of Wapato Creek are now available
Geology and Hydrogeology			
Soil stratigraphy including the presence of water-bearing zones and lower-permeability confining layers.	• Regional and site geology and hydrogeology are documented in previous reports. • Silty soils have been documented beneath the sandy fill materials at the site and in the vicinity.	• The depth and type of fill placed in the former Wapato Creek channel and the former drainage ditch and are not documented. It is unknown if this fill may be acting as either a potential preferential groundwater flow pathway or groundwater barrier. Data may be useful to support interpretation of groundwater flow directions, gradients, and potential contaminant transport if pathway is complete.	• One shallow soil boring within the former Wapato Creek channel and ditch alignment (TB-9) has been collected and logged to document depth and type of fill and the depth of former drainage channel and/or Wapato Creek beds. Section 4 of this RI Report provides additional information on the fill material and its permeability compared to native soils. • Additional insight on the soil stratigraphy was attained by logging soil from the temporary soil borings and monitoring wells. The description of the geologic and hydrogeologic setting in Section 4 of this RI Report has been updated to include this new subsurface data.
Groundwater flow directions, gradients, and migration pathways.	• Groundwater flow directions, gradients, and migration pathways were documented during hydrogeologic studies for the Log Yard area (late 1980s) and during the VCP studies in the Sawmill area (2009-2013).	• Current site groundwater flow directions and gradients and migration pathways are generally understood. Additional data may be useful to refine groundwater flow near Wapato Creek and along the northern property boundary.	• Groundwater elevation data collected from new and existing monitoring wells and piezometers during each of the four RI sampling events increased the understanding of groundwater flow directions, gradients and migration pathways within the site and adjacent to Wapato Creek. This new data was used to generate groundwater contour maps and update the descriptions provided in Section 4 of this RI Report.
Nature and extent of tidal influences.	• Tidal influences were documented in and along the shoreline of Wapato Creek during hydrogeologic studies for the Log Yard area (late 1980s) and during the VCP studies in the Sawmill area (2009-2013).	• Tidal influences need to be considered during collection of groundwater elevation and groundwater quality data and mapping of groundwater flow directions and gradients near Wapato Creek.	• A stilling well was installed in Wapato Creek and equipped with a transducer for a period of at least 73 hours so that tidal fluctuations can be better understood. Transducers were also installed in new and existing wells within the nearshore study area (within approximately 300 feet of the creek bank) and set to collect continuous (every 5 minutes) water level, temperature, and conductivity measurements. The groundwater and surface water elevations were evaluated to better understand tidal influences on groundwater flow directions, gradients, and geochemistry. The results of this short-term tidal study are provided in Section 4 of this RI Report.
Hydrogeologic properties of water-bearing zones.	• Hydrogeologic properties of the water bearing zones were documented as part of hydrogeologic studies for the Log Yard area (late 1980s) and during the VCP studies in the Sawmill area (2009-2013).	• Supplemental hydrogeologic testing (e.g., slug tests, grain size measurements) may be warranted to refine estimates of hydraulic conductivity.	• The water level information collected during the tidal study combined with grain-size data and information about flow rates and drawdown obtained during development and sampling of groundwater monitoring wells were used to estimate the hydraulic properties of the shallow water-bearing zone. An updated description of these hydrogeologic properties (e.g., hydraulic conductivity and groundwater flow direction and flux) is provided in Section 4 of this RI Report.

Table 3-1. Summary of Existing Information, Data Gaps, and Data Collection

RI/FS Information Needs by Topic	Existing Information	Data Gaps	Data Collection
Nature & Extent of Contamination			
Documentation of historical uses and potential contaminant sources.	• The history of the site is well documented, including initial filling of the site, operation of the Sawmill and Log Yard, and the uses of slag, PCP and other petroleum and chemical products associated with Portac-Inc. operations.	• Existing historical information is sufficient to identify candidate source areas and evaluate the findings of environmental testing.	• No additional information collected for RI.
Identification of potential off-site sources or regional influences.	• Parcel 15 is located within the regional air-deposition footprint of the historical ASARCO smelter. The ASARCO plume is a large-scale site defined by elevated arsenic levels in soil. • ASARCO fallout patterns are well defined in residential and hillside areas of northeast Tacoma and surrounding areas. The patterns of contamination are more varied in developed urban and industrial areas.	• The contribution of the ASARCO plume site and other regional contaminant sources to groundwater and pore-water arsenic concentrations are less defined.	• The potential contribution of regional arsenic sources to observed groundwater and pore-water arsenic concentrations was considered during development of the RI and but thought to have relatively insignificant contributions at the nature and extent of contamination observed at the Parcel 15 Site.
Document nature and extent of slag-associated contaminants in soils and groundwater within the former Log Yard.	• The extent of slag-containing soils was documented during investigations conducted prior to capping of the Log Yard in the late 1980s, and more recently during soil testing in 2013 (Landau) and 2014 (Anchor QEA). • Groundwater quality testing was performed within the Log Yard during the late 1980s and early 1990s. • Limited groundwater testing was performed within the eastern portion of the capped area during 2013 (Landau).	• The current nature and extent of arsenic contamination in groundwater beneath the Log Yard cap is not known. Available data suggest that the arsenic concentrations may be heterogeneous. • The current groundwater concentrations of arsenic along the migration pathway between upland slag-containing fill and Wapato creek are not known. • Documenting soil properties between the cap and Wapato Creek may be useful to help understand geochemical processes occurring in the Nearshore Transition Zone and how these may affect arsenic mobility.	• The spatial distribution of groundwater sample locations were selected to meet the defined objectives for the RI and are based on historical sample results and identified Site-associated contaminants migration and risk exposure pathways (i.e., the preliminary CSMs). • Temporary soil borings and groundwater monitoring wells were advanced during Event 1 to collect a comprehensive "snapshot" and document the concentrations of arsenic in saturated soil and groundwater beneath the Log Yard Cap. • All new and existing monitoring wells were resampled during Events 2 through 4. • Section 5 of this RI Report presents the results of the RI sampling events and provides an updated description on of the nature and extent of contamination at the Site.
Verify the current concentrations of Sawmill-associated contaminants in groundwater within the Sawmill area.	• Extensive groundwater testing including quarterly monitoring was performed within the Sawmill area as part of investigations conducted under the VCP.	• No groundwater data have been collected since early 2013. It is not known whether residual PCP detected at that time has attenuated, or whether it remains above applicable screening levels.	• Groundwater wells within the Sawmill area were resampled during each of the four RI sampling events to document current groundwater quality. These results are provided in Section 5 of this RI Report.
Assess the nature and extent of Sawmill-associated contaminants in Sawmill-area soils.	• Extensive soil testing was performed throughout potentially contaminated areas of the Sawmill as part of investigations conducted under the VCP.	• Supplemental testing data are required to verify the absence of residual PCP-associated contamination near the former PCP dip tanks.	• Test pits were advanced during Event 1 and soil samples from outside of the former excavations were used to document the quality of residual soils near the former dip tank. Testing for PCP, dioxin/furans and metals was also included as presented in Section 5 of this RI Report.
Evaluate sediment quality within Wapato creek for potential site-associated contamination.	• Surface and subsurface sediments were tested by Hart Crowser in 2009 for potential sediment contamination. No exceedances of SMS criteria for the protection of benthic community were detected. • Surface sediments were tested in 10 locations in 1988 for Site-related contaminants by RZA. PCP was detected at low concentrations, PCBs, and pesticides were not detected.	• No additional data are required to assess potential sediment contamination.	• Although additional testing data was not required to characterize sediments, additional samples were collected along-side newly-collected pore-water data to aid in interpretation of the groundwater to surface water pathway.
Evaluate stormwater quality for potential impacts from site-associated contamination.	• Contaminated soils in the former Log Yard are capped and the cap is maintained. The cap prevents exposure of stormwater to contaminated soils in the former Log Yard. Stormwater from the surface of the cap is captured and discharges to Wapato Creek. • Limited stormwater quality testing was performed for slag-associated metals following construction of the Log Yard Cap. • Former Sawmill area surface consists of asphalt, concrete, and graveled areas. Contaminated soils do not appear to be present at the surface. Stormwater is captured and discharged to Wapato Creek. Catch basins were observed to have stormwater filters installed in them.	• Recent stormwater testing data are not available. • Current stormwater system operations and maintenance activities should be documented.	• Available stormwater system information was evaluated. • Dry-Weather flow and/or stormwater was collected during each of the four RI sampling events and analyzed for arsenic. Elevated arsenic concentrations were detected, as described in Section 5 of this RI Report. • A video of the stormwater system and visual inspection of the spill containment vessels was conducted during the RI to evaluate the source of arsenic observed in outfall samples. • The current system configuration, condition, and operations and maintenance activities are documented in Section 4.5 of this RI Report.
Evaluate whether the stormwater conveyance systems may intersect the shallow water-bearing zone and act as a preferential groundwater migration pathway to Wapato Creek.	• Most of the current storm drainage system is located above the elevation of site groundwater.	• Supplemental surveys may be required to determine which portions of the storm drainage system are located below the water table.	• Used the updated groundwater contour maps (Section 4 of this RI Report) and new and existing information on the storm drainage system to identify potential entry points for contaminated groundwater in areas where system structures are located below the water table. These results are discussed in Sections 4 through 6 of this RI Report. • Given the observance of dry-weather flow, discharge was sampled. • A video of the stormwater system and visual inspection of the spill containment vessels was conducted during the RI to evaluate where groundwater may be entering the storm drainage system.

Table 3-1. Summary of Existing Information, Data Gaps, and Data Collection

RI/FS Information Needs by Topic	Existing Information	Data Gaps	Data Collection
Contaminant Fate and Transport			
Verify the northern boundary of groundwater arsenic contamination associated with the site.	• Existing data from wells and borings documents that arsenic concentrations in groundwater are less than 5 ug/L in groundwater to the northeast of the site.	• No groundwater testing for arsenic has been performed to the northwest of the site.	• Two temporary borings were advanced during Event 1 along the northern site boundary and saturated soil and groundwater was tested for arsenic. The arsenic concentrations in those borings were 102 and 317 ug/L as described in Section 5 of this RI Report.
Quantify the concentrations of arsenic (and if applicable PCP) in groundwater and pore-water of the Nearshore Transition Zone.	• To date, groundwater data collection has been limited to the upland zone. • No testing has been performed for porewater within the sediment bioactive zone or deeper soils/sediments within the Nearshore Wapato Creek Transition Zone.	• Additional data are required to document the concentrations of arsenic in groundwater and porewater within the Nearshore Transition Zone. • Similar data may be required for PCP adjacent to the Sawmill area. The need for those data can be assessed after review of current upland groundwater quality.	• Nearshore groundwater samples were collected during each of the four RI sampling events in order to characterize contaminant levels in groundwater discharges to Wapato Creek. • Passive samplers were used to document the concentrations of arsenic in porewater of the sediment bioactive zone, in the soils about a foot beneath it, and in overlying surface water. Pentachlorophenol was also evaluated in the Wapato Creek Transect adjacent to the Sawmill (WCT-4). • Wet season and dry season sampling at locations along the groundwater migration pathway between the upland zone and Wapato Creek was conducted to evaluate potential seasonal influence on porewater and surface water concentrations. • Section 5 of this RI Report presents the results of the RI sampling events and provides an updated description on of the nature and extent of contamination at the Site.
Document the hydrogeologic and geochemical processes that may affect the attenuation or transport of site-associated groundwater contaminants.	• Existing groundwater studies have documented the presence of tidally-induced groundwater fluctuation and mixing in nearshore areas. • Some data for field screening parameters (pH, dissolved oxygen, redox, conductivity) have been collected during previous site groundwater investigations.	• Additional information is required to document the geochemical properties of soil and groundwater in the upland and transition zones. • Modeling can be used along with additional contaminant data (particularly for arsenic) for groundwater, pore-water and surface water, to assess whether contaminants are reaching or are likely to reach the sediment bioactive zone or Wapato Creek above applicable screening levels.	• Geochemical parameters within soil and groundwater of the upland zone and the transition zone were tested. • Geochemical parameters within the sediment bioactive zone, just below it, and just above it (in Wapato Creek) were documented. • Sequential extraction tests, batch adsorption tests, and induced arsenic precipitation tests were performed to evaluate arsenic attenuation processes and behavior at the Site. The results of these tests and evaluation of all the geochemical data is provided in Appendices E through G and used to support the conceptual site model conclusions presented in Section 6 of this RI Report.
Determine if water quality within Wapato Creek is adversely impacted by discharges of site-associated groundwater contaminants.	• Surface water testing was performed for slag-associated metals following construction of the Log Yard Cap. Though limited, the data showed that water quality within Wapato Creek had recovered to background levels.	• Additional data are required to determine if site-related discharges (particularly for arsenic) are adversely affecting water quality within Wapato creek. • Data are also required to evaluate to characterize off-site water quality within Wapato Creek and the Blair Waterway to ensure that any site-related impacts can be distinguished from regional conditions.	• Surface water testing for arsenic was conducted during each of the four RI sampling events at each of the four Wapato Creek Transects adjacent to the Site, a location within Wapato Creek upstream of the site, and within the Blair Waterway. • Surface water from WCT-4, adjacent to the Sawmill, was also analyzed for PCP. • Surface water results are presented in Section 5 of this RI Report.
Assess whether decomposition of capped wood waste poses potential risks from production of methane.	• No vapor data are currently available for the site.	• Given the age of the site, empirical data can be used to assess the potential for significant methane generation.	• Methane (percent by volume) was measured in the headspace of all wells at the commencement of Event 1. Elevated methane vapors were observed in most monitoring wells within the Log Yard area and a couple wells within the Sawmill. The presence of methane within the soil vapor within the Log Yard was confirmed during Event 1 and provided sufficient information for development of the FS, such that further methane readings were discontinued in this area. However, testing continued within the Sawmill area to assess the nature and extent of soil vapor in that area during subsequent RI sampling events.

Notes:

PCP = Pentachlorophenol
RI = Remedial Investigation
SMS = Washington Sediment Management Standards regulations (WAC-173-204)
VCP = Voluntary cleanup program

Table 3-2. Remedial Investigation Sampling Locations

Sample Location	Location Type	RI Sample Locations [1] Coordinates [2] Northing	Easting	Top of Pipe Elevation [3]	Ground Surface Elevation [3]
Log Yard *(includes samples located on or adjacent to)*					
HC-1 [6]	Abandoned Monitoring Well	705154.38	1176788.22	22.92	23.18
B-1R	Monitoring Well	705708.88	1175728.54	22.88	23.56
B-3R	Monitoring Well	705141.75	1176791.25	22.44	23.10
B-6R	Monitoring Well	705157.37	1175958.91	23.74	24.11
MW-11	Monitoring Well	705423.16	1176262.87	24.39	24.77
MW-12	Monitoring Well	705245.84	1175499.21	25.32	22.49
MW-7	Monitoring Well	705662.36	1175514.59	25.03	22.58
MW-9	Monitoring Well	705447.44	1175502.49	25.02	22.27
HC-2	Perched Monitoring Well	705707.34	1175720.05	23.37	23.65
MW-10	Perched Monitoring Well	705440.82	1175721.83	25.23	25.54
MW-13	Perched Monitoring Well	705239.20	1175722.55	23.69	24.04
MW-8	Perched Monitoring Well	705611.58	1176763.25	23.62	23.91
PORTAC-16	Piezometer	704648.65	1176499.33	24.06	24.27
PORTAC-17	Piezometer	705096.18	1176873.11	23.10	23.50
PORTAC-18	Piezometer	705562.14	1177257.36	23.46	23.81
Stilling Well	Stilling Well	705130.30	1175450.98	--	5.40
OF-1	Stormwater Outfall	705794.52	1175456.22	--	7.70
OF-2	Stormwater Outfall	705749.02	1175483.34	--	10.14
OF-3	Stormwater Outfall	705120.44	1175473.43	--	10.54
TB-1	Temporary Soil and Groundwater Boring	705799.17	1175724.52	--	20.47
TB-2	Temporary Soil and Groundwater Boring	705783.11	1176255.59	--	20.48
TB-3	Temporary Soil and Groundwater Boring	705647.08	1175574.11	--	25.29
TB-4	Temporary Soil and Groundwater Boring	705624.45	1176267.70	--	23.61
TB-5	Temporary Soil and Groundwater Boring	705444.23	1175571.90	--	26.79
TB-6	Temporary Soil and Groundwater Boring	705411.21	1176761.22	--	25.29
TB-7	Temporary Soil and Groundwater Boring	705242.60	1175572.96	--	25.38
TB-8	Temporary Soil and Groundwater Boring	705222.12	1176255.61	--	23.83
WCT-1A	Wapato Creek Porewater and Sediment	705654.16	1175474.99	--	7.95
WCT-2A	Wapato Creek Porewater and Sediment	705436.23	1175467.90	--	8.36
WCT-3A	Wapato Creek Porewater and Sediment	705234.39	1175459.83	--	6.92
WCT-1B	Wapato Creek Porewater, Surface Water, Sediment	705655.69	1175467.14	--	5.07
WCT-2B	Wapato Creek Porewater, Surface Water, Sediment	705436.72	1175460.03	--	5.63
WCT-3B	Wapato Creek Porewater, Surface Water, Sediment	705234.64	1175455.54	--	5.66
Sawmill *(includes samples located on or adjacent to)*					
B-5R	Monitoring Well	705055.90	1175499.80	20.46	20.62
MW-1	Monitoring Well	704590.59	1175483.12	20.25	20.88
MW-2R [4]	Monitoring Well	704505.89	1175526.32	20.69	21.50
MW-3 [4]	Monitoring Well	704532.01	1175594.01	20.33	21.11
MW-4	Monitoring Well	704498.33	1175466.62	20.66	20.94
MW-5R [4]	Monitoring Well	704208.05	1175987.88	19.63	20.15
MW-6R [4]	Monitoring Well	704768.91	1175980.36	20.96	21.36
OF-5	Stormwater Outfall	704367.07	1175448.54	--	16.27
TB-9	Temporary Soil and Groundwater Boring	705074.60	1175566.08	--	20.72
TP-1 [5]	Test Pit 1	704517.25	1175499.51	--	--
TP-1TB [5]	Test Pit 1 - Temporary Boring	704522.41	1175498.45	--	--
TP-2 [5]	Test Pit 2	704508.23	1175498.57	--	--

Table 3-2. Remedial Investigation Sampling Locations

Sample Location	Location Type	RI Sample Locations [1]			
		Coordinates [2]		Top of Pipe Elevation [3]	Ground Surface Elevation [3]
		Northing	Easting		
WCT-4A	Wapato Creek Porewater and Sediment	704506.40	1175439.01	--	7.69
WCT-4B	Wapato Creek Porewater, Surface Water, Sediment	704506.87	1175434.27	--	6.96
Off-Site *(reference sample locations)*					
BWB-1 [5]	Blair Waterway Background Surface Water	707975.06	1173748.99	--	--
USB-1 [5]	Upstream Background Surface Water	703136.21	1176065.94	--	--

Notes:

-- = Not applicable or not available

[1] Remedial Investigation (RI) sampling locations were located by professional surveyors from Sitts and Hill Engineers, Inc. in June 2016. The survey was conducted to provide horizontal (+/- 0.10’ accuracy) and vertical (+/- 0.01’ accuracy) on key sampling locations.

[2] Horizontal Datum - Washington State Plan Coordinate System South Zone, North American Datum of 1983 (NAD83) based on 2007 Port of Tacoma Control.

[3] Vertical Datum = Mean Low Low Water (MLLW) per Port of Tacoma Survey Control #2352 (Elevation 28.54)

[4] Sample Location was paved over following professional survey. A manual correction was made to reflect the corrected ground surface and RIM elevations but the vertical accuracy is not as refined as other surveyed

[5] Sample Location not surveyed, so locations are approximate, as recorded by either a handheld global positioning system (GPS) or by reference off of geo-referenced aerial photos.

[6] Monitoring Well HC-1 was consistently dry and was abandoned in February 2017.

Table 3-3. Analytical Schedule for Soil and Sediment

Site	Station Type	Station ID	Sample Depth[2] (ft bgs)		Located Within Nearshore Study Area	Standard Analytical Suite					Add-Ons			Nearshore Study Area Geochemical				
						Arsenic	Iron	Total Organic Carbon (TOC)	Total Solids	Frozen Archival	Pentachlorophenol (PCP) and pH	Dioxins/Furans	Hydrocarbons and RCRA Metals	Sulfide	Grain-Size	Sequential Extraction Testing	Batch Adsorption Testing	Arsenic Speciation - As(III)/As(V)
Soil Testing																		
Log Yard	New Monitoring Wells	MW-7	Saturated Zone	9-10 ft bgs	X	X	X	X	X	X	--	--	--	X	X	X	X	X
		MW-9	Saturated Zone	11-12 ft bgs	X	X	X	X	X	X	--	--	--	X	X	X	X	X
		MW-10	Saturated Zone	12-13 ft bgs	X	X	X	X	X	X	--	--	--	X	X	X	X	X
		MW-12	Saturated Zone	11.5-12.5 ft bgs	X	X	X	X	X	X	--	--	--	X	X	X	X	X
		MW-13	Saturated Zone	12.5-13.5 ft bgs	X	X	X	X	X	X	--	--	--	X	X	X	X	X
		MW-8	Saturated Zone	11.5-12.5 ft bgs		X	X	X	X	X	--	--	--	--	--	--	--	--
		MW-11	Saturated Zone	13-14 ft bgs		X	X	X	X	X	--	--	--	--	--	--	--	--
	Temporary Borings	TB-3	Saturated Zone	14-15 ft bgs	X	X	X	X	X	X	--	--	--	X	X	X	X	X
		TB-5	Saturated Zone	17-18 ft bgs	X	X	X	X	X	X	--	--	--	X	X	X	X	X
		TB-7	Saturated Zone	16.5-17.5 ft bgs	X	X	X	X	X	X	--	--	--	X	X	X	X	X
		TB-1	Saturated Zone	11-12 ft bgs		X	X	X	X	X	--	--	--	--	--	--	--	--
		TB-2	Saturated Zone	12.5-13.5 ft bgs		X	X	X	X	X	--	--	--	--	--	--	--	--
		TB-4	Saturated Zone	12-13 ft bgs		X	X	X	X	X	--	--	--	--	--	--	--	--
		TB-6	Saturated Zone	13-14 ft bgs		X	X	X	X	X	--	--	--	--	--	--	--	--
		TB-8	Saturated Zone	13-14 ft bgs		X	X	X	X	X	--	--	--	--	--	--	--	--
Sawmill	New Monitoring Well	MW-5R[1]	Saturated Zone	10.5-11.5 ft bgs		X	X	X	X	X	X	X	--	--	--	--	--	--
	Temporary Borings	TB-9	Artificial Fill	7.4-8.4 ft bgs	X	X	X	X	X	X	X	--	--	--	X	--	--	--
		TB-9	Channel Bottom	8.8-9.8 ft bgs	X	X	X	X	X	X	X	--	--	--	X	--	--	--
		TB-9	Native Sediments	12-13 ft bgs	X	X	X	X	X	X	X	--	--	--	X	--	--	--
	Test Pit	TP-1	Unsaturated Zone	0.5-1.5 ft bgs	X	X	X	X	X	X	X	X	X	--	--	--	--	--
		TP-1	Excavation Fill[3]	1.5-2.5 ft bgs	X	X	X	X	X	X	X	X	X	--	--	--	--	--
		TP-1	Saturated Zone	12-13 ft bgs	X	X	X	X	X	X	X	--	--	--	--	--	--	--
		TP-2	Unsaturated Zone	0.5-1.5 ft bgs	X	X	X	X	X	X	X	X	--	--	--	--	--	--
		TP-2	Saturated Zone	10.5-12.5 ft bgs	X	X	X	X	X	X	X	--	--	--	--	--	--	--
Sediment Testing																		
Log Yard	Wapato Creek Transect	WCT-1A	Bioactive Zone	0-10 cm bml	X	X	X	X	X	X	--	--	--	X	X	X	X	X
			Transition Zone	40-50 cm bml	X	X	X	X	X	X	--	--	--	X	X	X	X	X
		WCT-1B	Bioactive Zone	0-10 cm bml	X	X	X	X	X	X	--	--	--	X	X	X	X	X
			Transition Zone	40-50 cm bml	X	X	X	X	X	X	--	--	--	X	X	X	X	X
		WCT-2A	Bioactive Zone	0-10 cm bml	X	X	X	X	X	X	--	--	--	X	X	--	--	--
			Transition Zone	40-50 cm bml[4]	X	X	X	X	X	X	--	--	--	X	X	--	--	--
		WCT-2B	Bioactive Zone	0-10 cm bml	X	X	X	X	X	X	--	--	--	X	X	--	--	--
			Transition Zone	40-50 cm bml	X	X	X	X	X	X	--	--	--	X	X	--	--	--
		WCT-3A	Bioactive Zone	0-10 cm bml	X	X	X	X	X	X	--	--	--	X	X	--	--	--
			Transition Zone	40-50 cm bml	X	X	X	X	X	X	--	--	--	X	X	--	--	--
		WCT-3B	Bioactive Zone	0-10 cm bml	X	X	X	X	X	X	--	--	--	X	X	--	--	--
			Transition Zone	40-50 cm bml	X	X	X	X	X	X	--	--	--	X	X	--	--	--
Sawmill	Wapato Creek Transect	WCT-4A	Bioactive Zone	0-10 cm bml	X	X	X	X	X	X	X	--	--	X	X	--	--	--
			Transition Zone	40-50 cm bml	X	X	X	X	X	X	X	--	--	X	X	--	--	--
		WCT-4B	Bioactive Zone	0-10 cm bml	X	X	X	X	X	X	X	--	--	X	X	--	--	--
			Transition Zone	40-50 cm bml	X	X	X	X	X	X	X	--	--	X	X	--	--	--

Notes:

cm bml = centimeters below mudline

ft bgs = feet below ground surface

-- = Not analyzed

* = Four sediment samples will be selected for analysis based on initial sediment results.

[1]New monitoring well MW-5R is a replacement well for MW-5, which was abandoned in May 2016.

[2]Selection of sampling depth intervals are discussed in the SAP (Appendix B). Additional soil samples from the capillary fringe and saturated zone were collected from the temporary borings and monitoring well borings for archival at the lab.

[3]Extra sample collected, not specified in RIWP.

[4]Grain size sample (WCTSD002A-40_50) was collected separately from chemistry sample (WCTSD002A-36-46), which was collected a from 36 to 46 dm bml due to the difficulty in manually advancing the sampling tube deeper.

Table 3-4. Analytical Schedule for Surface Water, Porewater, Outfall Discharge, and Groundwater

					Field Measurements				Standard Analytical Suite							Nearshore Study Area Geochemical					
Site	Station Type	Station ID (and Sample Depth for Porewater)		Located Within Nearshore Study Area	Water Field Parameters[1]	Headspace Monitoring (Methane)[2]	Manual Water Level	Transducer Water Levels	Arsenic (total)	Arsenic, Iron, Manganese (dissolved)	Total Organic Carbon (TOC)	Dissolved Organic Carbon (DOC)	Sulfide (dissolved)	Total Suspended Solids	Pentachlorophenol (PCP)	Major Cations (dissolved)[3]	Major Anions (dissolved)[4]	Alkalinity (dissolved)	Nitrate /Nitrite (dissolved)	Iron Speciation (dissolved)	Arsenic Speciation - As(III)/As(V) (dissolved)[5]
Groundwater																					
Log Yard	New Monitoring Well	MW-7		X	1 2 3 4	1	1 2 3 4	1	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1	2 3 4
		MW-9		X	1 2 3 4	1	1 2 3 4	1	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1	1 2 3 4
		MW-10		X	1 2 3 4	1	1 2 3 4	1 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1	1 2 3 4
		MW-11		X	1 2 3 4	1	1 2 3 4	1 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	2 3 4	--						
		MW-12		X	1 2 3 4	1	1 2 3 4	1	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1	2 3 4
		MW-8			1 2 3 4	1	1 2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	2 3 4	--						
		MW-13			1 2 3 4	1	1 2 3 4	1 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1	1 2 3 4
	Existing Monitoring Well	B-1R		X	1 2 3 4	1	1 2 3 4	1	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1	1 2 3 4
		HC-2[6]		X	1 2 3 4	1	1 2 3 4	4	1 2 3 4	1 2 3 4	1 2 4	1 2 3 4	1 2 3 4	2 4	--	1 2 4	1 2 4	1 2 4	1 2 4	1	1 2 3 4
		B-3R			1 2 3 4	1	1 2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	2 3 4	--	--	--	--	--	--	--
		B-6R			1 2 3 4	1	1 2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	2 3 4	--	--	--	--	--	--	--
		HC-1 (Dry)[6]			--	1	1 2 3 4	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Temporary Boring	TB-3		X	1	--	1	--	1	1	1	1	1	--	--	1	1	--	1	1	1
		TB-5		X	1	--	1	--	1	1	1	1	1	--	--	1	1	--	1	1	1
		TB-7		X	1	--	1	--	1	1	1	1	1	--	--	1	1	--	1	1	1
		TB-1			1	--	1	--	1	1	1	1	1	--	--	--	--	--	--	--	--
		TB-2			1	--	1	--	1	1	1	1	1	--	--	--	--	--	--	--	--
		TB-4			--	--	1	--	1	1	1	1	1	--	--	--	--	--	--	--	--
		TB-6			1	--	1	--	1	1	1	1	1	--	--	--	--	--	--	--	--
		TB-8			1	--	1	--	1	1	1	1	1	--	--	--	--	--	--	--	--
Sawmill	New Monitoring Well	MW-5R[7]			1 2 3 4	1 2 3 4	1 2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1	2 3 4	1 2 3 4	--	--	--	--	--	--
	Existing Monitoring Well	MW-1		X	1 2 3 4	1 2 3 4	1 2 3 4	1	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1	2 3 4	1 2 3 4	1	1	1	1	1	--
		MW-2R		X	1 2 3 4	1 2 3 4	1 2 3 4	1 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1	2 3 4	1 2 3 4	1	1	1	1	1	--
		MW-3		X	1 2 3 4	1 2 3 4	1 2 3 4	1	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1	2 3 4	1 2 3 4	1	1	1	1	1	--
		MW-4		X	1 2 3 4	1 2 3 4	1 2 3 4	1	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1	2 3 4	1 2 3 4	1	1	1	1	1	--
		B-5R		X	1 2 3 4	1 2 3 4	1 2 3 4	1	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	2 3 4	1 2 3 4	1	1	1	1	1	--
		MW-6R			1 2 3 4	1 2 3 4	1 2 3 4	1	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1	2 3 4	1 2 3 4	--	--	--	--	--	--
	Temporary Boring	TB-9		X	1 2 3 4	1 2 3 4	1 2 3 4	--	1	1	1	1	1	--	1	--	--	--	--	--	--
Bioactive Zone Porewater																					
Log Yard	Wapato Creek Transect	WCT-1A	10 cm bml	X	1 2 3 4	--	1 2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1	--
		WCT-1B		X	1 2 3 4	--	1 2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1	2
		WCT-2A		X	2 3 4	--	1 2 3 4	--	2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1	--
		WCT-2B		X	1 2 3 4	--	1 2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1	--
		WCT-3A		X	1 2 3 4	--	1 2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1	4
		WCT-3B		X	1 2 3 4	--	1 2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1	--
Sawmill		WCT-4A		X	1 2 3 4	--	1 2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2	1 2 3 4	1 2 3 4	1 2	1 2	1 2	1 2	1	--
		WCT-4B		X	1 2 3 4	--	1 2 3 4	--	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1	--

Table 3-4. Analytical Schedule for Surface Water, Porewater, Outfall Discharge, and Groundwater

Site	Station Type	Station ID (and Sample Depth for Porewater)		Located Within Nearshore Study Area	Field Measurements: Water Field Parameters[1]	Field Measurements: Headspace Monitoring (Methane)[2]	Field Measurements: Manual Water Level	Field Measurements: Transducer Water Levels	Standard Analytical Suite: Arsenic (total)	Standard Analytical Suite: Arsenic, Iron, Manganese (dissolved)	Standard Analytical Suite: Total Organic Carbon (TOC)	Standard Analytical Suite: Dissolved Organic Carbon (DOC)	Standard Analytical Suite: Sulfide (dissolved)	Standard Analytical Suite: Total Suspended Solids	Pentachlorophenol (PCP)	Nearshore Study Area Geochemical: Major Cations (dissolved)[3]	Nearshore Study Area Geochemical: Major Anions (dissolved)[4]	Nearshore Study Area Geochemical: Alkalinity (dissolved)	Nearshore Study Area Geochemical: Nitrate /Nitrite (dissolved)	Nearshore Study Area Geochemical: Iron Speciation (dissolved)	Nearshore Study Area Geochemical: Arsenic Speciation - As(III)/As(V) (dissolved)[5]
Transition Zone Porewater																					
Log Yard	Wapato Creek Transect	WCT-1A	40 cm bml	X	1 2 3 4	--	1 2 3 4	--	1 2	1 2	1 2	1 2	1 2	2	--	1 2	1 2	1 2	1 2	1	--
Log Yard	Wapato Creek Transect	WCT-1B	40 cm bml	X	1 2 3 4	--	1 2 3 4	--	1 2	1 2	1 2	1 2	1 2	2	--	1 2	1 2	1 2	1 2	1	1 2
Log Yard	Wapato Creek Transect	WCT-2A	40 cm bml	X	1 2 3 4	--	1 2 3 4	--	1 2	1 2	1 2	1 2	1 2	2	--	1 2	1 2	1 2	1 2	1	--
Log Yard	Wapato Creek Transect	WCT-2B	40 cm bml	X	1 2 3 4	--	1 2 3 4	--	1 2	1 2	1 2	1 2	1 2	2	--	1 2	1 2	1 2	1 2	1	--
Log Yard	Wapato Creek Transect	WCT-3A	40 cm bml	X	1 3 4	--	1 2 3 4	--	1 2	1 2	1 2	1 2	1 2	1 2	--	1 2	1 2	1 2	1 2	1	--
Log Yard	Wapato Creek Transect	WCT-3B	40 cm bml	X	1 2 3 4	--	1 2 3 4	--	1 2	1 2	1 2	1 2	1 2	1 2	--	1 2	1 2	1 2	1 2	1	2
Sawmill	Wapato Creek Transect	WCT-4A	40 cm bml	X	1 2 3 4	--	1 2 3 4	--	1 2	1 2	1 2	1 2	1	1 2	1 2	1	1	1	1	1	--
Sawmill	Wapato Creek Transect	WCT-4B	40 cm bml	X	1 2 3 4	--	1 2 3 4	--	1 2	1 2	1 2	1 2	1	1 2	1 2	1	1	1	1	1	--
Surface Water																					
Log Yard	Wapato Creek Transect	WCT-1B		X	1 2 3 4	--	1 2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1	--
Log Yard	Wapato Creek Transect	WCT-2B		X	1 2 3 4	--	1 2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1	--
Log Yard	Wapato Creek Transect	WCT-3B		X	1 2 3 4	--	1 2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1	--
Sawmill	Wapato Creek Transect	WCT-4B		X	1 2 3 4	--	1 2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1	2 3 4	1 2 3 4	1	1	1	1	1	--
Blair Waterway	Blair Waterway Background	BWB-1		X	1 2 3 4	--	1 2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1	--
Upstream	Wapato Creek Background	USB-1		X	1 2 3 4	--	1 2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1	--
Outfall Discharge[8]																					
Log Yard	Outfall	OF#2-E1		X	1 2 3 4	1 2 3 4	1 2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1	2 3 4	--	--	--	--	--	--	--
Log Yard	Outfall	OF#3-E1		X	2 3 4	1 2 3 4	1 2 3 4	--	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1	2 3 4	--	--	--	--	--	--	--

Notes:

The Event number(s) are shown in the table to indicate when the field measurements were collected or analytical tests conducted.

cm bml = centimeters below mudline

-- = Not measured or not analyzed

[1] Field parameters are temperature, pH, specific conductance (SC), oxidation reduction potential (ORP), and dissolved oxygen (DO).

[2] Headspace readings were collected during Event 2 but the methane meter malfunctioned and gave erroneous 0% by volume readings everywhere which are not being reported.

[3] Major cations include calcium, magnesium, potassium, and sodium.

[4] Major anions include carbonate, bicarbonate, sulfate, chloride, bromide, fluoride, and ortho-phosphate.

[5] Arsenic and iron speciation testing was only performed on water samples with arsenic concentrations greater than (>) 36 µg/L.

[6] Wells HC-1 and HC-2 historically contained perched groundwater but were anticipated to be dry with the presence of the cap. The wells were checked for the presence of perched water during each event. Recoverable quantities of groundwater were encountered in HC-2, so it was sampled but HC-1 was consistently dry and therefore not sampled.

[7] New monitoring well MW-5R is a replacement well for MW-5, which will be abandoned.

[8] See Table 3-10 for additional information on outfall sampling conditions.

Table 3-5. Groundwater Elevations and Methane Headspace Readings - Event 1 through Event 4

Well Identification	Location	Event 1														Event 2		
		Monday, May 9, 2016				Well Development				Wednesday, May 18, 2016			Monday, May 9, 2016			Wednesday, August 31, 2016		
		Time	Methane (%)	Water Level (ft btoc)	Water Elevation (MLLW)	Date/Time	Methane (%)	Water Level (ft btoc)	Water Elevation (MLLW)	Time	Water Level (ft btoc)	Water Elevation (MLLW) [1]	Time	Water Level (ft btoc)	Water Elevation (MLLW)	Date/Time	Water Level (ft btoc)	Water Elevation (MLLW)
Monitoring Wells																		
B-1R	Log Yard	12:01	6.1	11.54	11.34	5/11/2016 11:05	4.5	11.30	11.58	14:12	11.77	11.11	13:55	11.72	11.16	8/31/2016 10:46	12.07	10.81
B-3R	Log Yard	11:22	72.1	8.62	13.82	5/11/2016 13:40	75.6	7.31	15.13	16:40	8.68	13.76	--	--	--	8/31/2016 11:30	8.90	13.54
B-5R	Sawmill	10:26	0.0	11.42	9.04	5/10/2016 15:00	0.0	12.15	8.31	16:54	11.26	9.20	13:15	12.37	8.09	8/31/2016 11:32	12.09	8.37
B-6R	Log Yard	11:05	49.0	11.68	12.06	5/11/2016 8:10	49.6	11.69	12.05	16:46	11.77	11.97	--	--	--	8/31/2016 11:24	12.48	11.26
HC-1	Log Yard	11:20	37.5	DRY	--	5/11/2016 13:45	32.3	DRY	--	16:36	DRY	--	--	--	--	8/31/2016 11:31	DRY	--
HC-2	Log Yard	12:03	15.8	6.60	16.77	5/11/2016 11:10	56.3	6.57	16.80	14:10	6.61	16.76	14:05	6.59	16.78	8/31/2016 10:50	7.14	16.23
MW-1	Sawmill	9:50	25.4	9.84	10.41	5/10/2016 9:30	19.8	9.87	10.38	15:46	10.29	9.96	12:40	10.32	9.93	8/31/2016 11:15	10.49	9.76
MW-2R	Sawmill	10:00	0.2	9.96	10.73	5/9/2016 15:30	--	9.98	10.71	15:52	10.06	10.63	12:50	10.08	10.61	8/31/2015 11:10	10.69	10.00
MW-3	Sawmill	10:07	17.6	9.53	10.80	5/9/2016 17:00	--	9.50	10.83	16:01	9.59	10.74	13:00	9.64	10.69	8/31/2016 11:21	10.29	10.04
MW-4	Sawmill	10:04	0.0	10.12	10.54	5/10/2016 12:06	0.0	10.31	10.35	15:57	10.80	9.86	12:45	10.81	9.85	8/31/2016 11:06	10.88	9.78
MW-5R	Log Yard	*not constructed*				5/11/2016 17:45	0.0	8.78	10.85	16:25	8.57	11.06	--	--	--	8/31/2016 11:41	9.31	10.32
MW-6R	Sawmill	9:27	1.4	10.38	10.58	5/11/2016 16:35	1.4	10.06	10.90	16:12	10.31	10.65	13:05	10.31	10.65	8/31/2016 11:52	10.81	10.15
MW-7	Log Yard	*not constructed*				5/12/2016 11:26	0.0	12.57	14.96	16:05	17.90	9.63	13:35	17.88	9.65	8/31/2016 10:43	15.31	9.72
MW-8	Log Yard	*not constructed*				5/16/2016 11:45	50.1	8.60	15.02	16:20	8.51	15.11	--	--	--	8/31/2016 12:06	9.16	14.46
MW-9	Log Yard	*not constructed*				5/13/2016 8:45	12.8	16.61	10.13	15:56	16.95	9.79	12:26	16.92	9.82	8/31/2016 10:40	15.08	9.94
MW-10	Log Yard	*not constructed*				5/12/2016 10:00	55.4	12.28	12.95	16:00	9.88	15.35	--	--	--	8/31/2016 11:12	9.33	15.90
MW-11	Log Yard	*not constructed*				5/16/2016 11:00	65.8	11.66	12.73	16:27	11.53	12.86	13:45	11.37	13.02	8/31/2016 11:02	11.99	12.40
MW-12	Log Yard	*not constructed*				5/13/2016 12:35	0.0 [2]	17.62	9.72	15:45	17.93	9.41	12:16	17.89	9.45	8/31/2016 10:35	15.71	9.61
MW-13	Log Yard	*not constructed*				5/12/2016 8:30	1.6	7.00	16.69	15:50	7.11	16.58	13:30	7.10	16.59	8/31/2016 11:16	7.64	16.05
Piezometers																		
NLR-PORTAC-16	Log Yard	12:30	33.6	9.92	14.14	--	--	--	--	--	--	--	--	--	--	8/31/2016 11:55	8.95	15.11
NLR-PORTAC-17	Log Yard	11:40	5.2	8.26	14.84	--	--	--	--	--	--	--	--	--	--	8/31/2016 11:48	8.78	14.32
NLR-PORTAC-18	Log Yard	12:20	67.5	9.04	14.42	--	--	--	--	--	--	--	--	--	--	8/31/2016 12:00	11.19	12.27

Notes:
bgs = below ground surface
btoc = below top of well casing
ft = feet
MLLW = mean low low water datum
-- = Not measured
[1] MW-7, MW-9, and MW-12 had an extended stick-up temporarily during construction.
Highlighted value used for Event 1 Methane reading in RI Figure 5-5.
[2] The cap was not on the well at the time the methane reading was collected, so the reading is not representative of enclosed headspace within the well boring.

Table 3-5. Groundwater Elevations and Methane Headspace Readings - Event 1 through Event 4

Well Identification	Location	Event 3 Wednesday, November 15, 2016				Event 4 Tuesday, February 7, 2017			
		Date/Time	Methane (%)	Water Level (ft btoc)	Water Elevation (MLLW)	Date/Time	Methane (%)	Water Level (ft btoc)	Water Elevation (MLLW)
Monitoring Wells									
B-1R	Log Yard	11/15/2016 12:50	--	10.82	12.06	2/7/2017 11:36	--	10.83	12.05
B-3R	Log Yard	11/15/2016 12:30	--	8.05	14.39	2/7/2017 11:05	--	7.84	14.60
B-5R	Sawmill	11/15/2016 12:08	0.0	11.29	9.17	2/7/2017 9:15	0.0	9.77	10.69
B-6R	Log Yard	11/15/2016 13:18	--	11.01	12.73	2/7/2017 10:00	--	9.83	13.91
HC-1	Log Yard	11/15/2016 12:36	--	4.82	--	2/7/2017 9:32	--	--	--
HC-2	Log Yard	11/15/2016 12:48	--	7.40	15.97	2/7/2017 11:07	--	7.07	16.30
MW-1	Sawmill	11/15/2016 12:10	14.5	8.29	11.96	2/7/2017 8:45	17.2	8.40	11.85
MW-2R	Sawmill	11/17/2016 11:07	2.2	7.19	13.50	2/7/2017 8:52	--[2]	5.18	15.51
MW-3	Sawmill	11/15/2016 12:35	20.8	8.97	11.36	2/7/2017 9:30	14.7	7.77	12.56
MW-4	Sawmill	11/15/2016 12:15	0.1	7.38	13.28	2/7/2017 8:32	0.0	8.09	12.57
MW-5R	Log Yard	11/17/2016 11:43	0.7	7.50	12.13	2/7/2017 9:47	0.1	8.11	11.52
MW-6R	Sawmill	11/15/2016 13:20	0.2	9.85	11.11	2/7/2017 10:00	0.0	9.83	11.13
MW-7	Log Yard	11/15/2016 12:22	--	14.21	10.82	2/7/2017 8:59	--	14.22	10.81
MW-8	Log Yard	11/15/2016 12:58	--	8.37	15.25	2/7/2017 9:56	--	8.24	15.38
MW-9	Log Yard	11/15/2016 12:18	--	13.71	11.31	2/7/2017 8:53	--	13.92	11.10
MW-10	Log Yard	11/15/2016 12:35	--	8.79	16.44	2/7/2017 9:25	--	8.02	17.21
MW-11	Log Yard	11/15/2016 12:50	--	11.20	13.19	2/7/2017 9:41	--	11.19	13.20
MW-12	Log Yard	11/15/2016 12:15	--	14.65	10.67	2/7/2017 8:45	--	14.89	10.43
MW-13	Log Yard	11/15/2016 13:12	--	7.16	16.53	2/7/2017 9:12	--	6.39	17.30
Piezometers									
NLR-PORTAC-16	Log Yard	11/15/2016 12:20	--	10.51	13.55	2/7/2017 11:20	--	10.75	13.31
NLR-PORTAC-17	Log Yard	11/15/2016 12:10	--	9.36	13.74	2/7/2017 11:15	--	8.79	14.31
NLR-PORTAC-18	Log Yard	11/15/2016 13:10	--	6.95	16.51	2/7/2017 10:11	--	6.5	16.96

Notes:

bgs = below ground surface

btoc = below top of well casing

ft = feet

MLLW = mean low low water datum

-- = Not measured

[1] MW-7, MW-9, and MW-12 had an extended stick-up temporarily during construction.

Highlighted value used for Event 1 Methane reading in RI Figure 5-5.

[2] The cap was not on the well at the time the methane reading was collected, so the reading is not representative of enclosed headspace within the well boring.

Table 3-6. Event 1 Water Quality Field Parameters

Location ID	Location	Sample Date	Temperature (°C)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Oxidation Reduction Potential (mV)	Turbidity (NTU)	Purge Rate (mL/min)
Groundwater, Monitoring Wells									
B-1R	Log Yard	6/1/16 15:00	16.1	1,572	0.23	6.35	-80.9	26.1	150
B-3R	Log Yard	5/31/16 18:10	17.0	4,260	0.09	6.76	-114.3	8.2	125
B-5R	Sawmill	6/1/16 9:30	15.7	544	0.41	6.43	-39.7	5.0	150
B-6R	Log Yard	6/1/16 11:25	15.9	2,223	0.17	6.83	-138.7	12.9	200
HC-2	Log Yard	6/1/16 16:20	16.0	1,110	0.15	6.11	-76.8	9.8	350
MW-1	Sawmill	5/31/16 18:55	15.1	799	0.71	6.60	-75.7	10.4	380
MW-2R	Sawmill	5/31/16 16:45	12.9	859	0.41	12.01	-77.6	7.1	250
MW-3	Sawmill	5/31/16 16:20	15.6	694	0.64	6.70	-86.2	0.7	550
MW-4	Sawmill	5/31/16 18:45	15.1	135	0.28	5.71	167.7	12.3	200
MW-5R	Log Yard	5/31/16 13:55	15.5	486	0.45	6.44	-40.7	9.9	260
MW-6R	Sawmill	5/31/16 14:30	14.5	718	0.20	6.26	-56.8	3.3	670
MW-7	Log Yard	6/1/16 17:45	15.7	2,342	0.36	6.65	-83.8	28.6	150
MW-8 [1]	Log Yard	6/1/16 15:40	19.3	2,163	0.49	6.60	-55.2	34.9	125
MW-9	Log Yard	6/1/16 17:50	13.9	2,004	0.16	6.43	-102.4	58.3	350
MW-10	Log Yard	6/1/16 14:30	16.3	1,360	0.42	6.26	-58.8	11.5	275
MW-11	Log Yard	5/31/16 15:40	18.7	2,224	0.04	6.72	-109.0	395.0	150
MW-12	Log Yard	6/1/16 16:20	14.8	2,012	0.81	6.63	-86.5	2.1	400
MW-13	Log Yard	6/1/16 12:45	16.6	1,115	0.36	6.34	-61.4	12.3	400
Groundwater, Temporary Borings									
TB-1	Log Yard	5/16/16 12:50	15.7	1,173	0.16	7.08	-137.8	--	100
TB-2	Log Yard	5/16/16 15:20	15.0	545	0.22	6.63	-107.1	--	200
TB-3	Log Yard	5/17/16 10:50	16.7	2,012	0.16	6.58	-136.3	--	110
TB-4 [2]	Log Yard	5/12/16 18:05	--	--	--	--	--	--	75
TB-5	Log Yard	5/17/16 13:05	18.4	2,441	0.17	6.77	-191.8	--	75
TB-6	Log Yard	5/12/16 14:45	21.1	2,762	0.19	6.52	-121.9	--	75
TB-7	Log Yard	5/17/16 16:45	18.0	2,278	0.22	6.63	-166.5	--	125
TB-8	Log Yard	5/13/16 10:45	19.0	7,065	0.19	6.75	-138.0	--	75
TB-9	Sawmill	5/13/16 13:40	14.7	3,447	0.59	6.05	-27.2	--	250
Surface Water									
Blair WW	--	6/1/15 14:30	17.3	28,931	15.42	8.57	263.8	3.8	275
WCT-1B	Log Yard	6/1/16 9:15	14.8	3,773	8.27	7.15	112.5	10.1	320
WCT-2B	Log Yard	6/1/16 10:45	16.7	2,593	8.47	7.23	114.8	25.0	350
WCT-3B	Log Yard	6/1/16 10:30	16.0	2,625	7.39	7.07	5.2	--	500
WCT-4B [3]	Sawmill	6/3/16 12:20	18.2	559	8.08	7.49	63.2	--	500
USS1 [4]	--	6/1/16 12:00	14.3	199	11.11	7.71	239.0	--	--

Table 3-6. Event 1 Water Quality Field Parameters

Location ID	Location	Sample Date	Temperature (°C)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Oxidation Reduction Potential (mV)	Turbidity (NTU)	Purge Rate (mL/min)
Porewater									
WCT-1A-10	Log Yard	6/2/16 10:15	16.9	23,241	1.13	9.67	-74.0	--	--
WCT-1A-40	Log Yard	6/2/16 9:45	16.0	2,987	1.28	9.96	-68.0	--	--
WCT-1B-10	Log Yard	6/2/16 9:15	15.7	22,751	1.08	8.78	-53.7	--	--
WCT-1B-40	Log Yard	6/2/16 8:56	14.4	8,921	2.45	6.44	195.1	--	--
WCT-2A-10	Log Yard	6/2/16 12:20	--	--	--	--	--	--	--[5]
WCT-2A-40	Log Yard	6/2/16 11:45	16.7	23,445	3.90	10.56	64.1	--	--
WCT-2B-10	Log Yard	6/2/16 11:25	15.3	7,185	2.10	9.45	4.9	--	--
WCT-2B-40	Log Yard	6/2/16 11:05	15.1	17,539	1.85	10.45	-20.3	--	--
WCT-3A-10	Log Yard	6/2/16 13:00	19.8	8,421	4.60	11.31	-20.5		--
WCT-3A-40	Log Yard	6/3/16 9:30	15.4	29,184	5.35	6.26	121.9	> 1,000	--
WCT-3B-10	Log Yard	6/2/16 12:45	18.7	7,487	1.99	9.30	-22.1	--	--
WCT-3B-40	Log Yard	6/3/16 9:00	15.9	5,803	3.05	6.50	19.2	> 1,000	--
WCT-4A-10	Sawmill	6/3/16 12:30	22.6	3,204	2.39	6.65	-50.6	34.2	--
WCT-4A-40	Sawmill	6/3/16 11:20	19.0	520	2.31	6.52	-39.0	> 1,000	--
WCT-4B-10	Sawmill	6/3/16 11:50	19.6	12,904	2.44	6.85	-19.8	82.7	--
WCT-4B-40	Sawmill	6/3/16 10:30	19.9	4,039	1.84	6.69	-36.0	--	--
Outfalls									**Est. Flow Rate (gpm)**
OF-2	W.Creek	5/12/16 18:20	12.6	15,221	6.82	--	--	--	0.5
OF-3[5]	W.Creek	5/12/16 18:40	--	--	--	--	--	--	0.7

Notes:

-- = Not measured

> = greater than (exceeds meter range)

°C = degree Celsius

µS/cm = microSiemen per centimeter

mg/L = milligram per liter

mL/min = milliliter per minute

mV = millivolt

NTU = nephelometric turbidity unit

[1] MW-8 purged dry on 5/31/2016 and sampled on 6/1/2016.

[2] Field parameters not collected at TB-4 due to poor recharge in temporary boring.

[3] Sample collection started on 6/1/2016 but was not completed due to lack of charged battery for pump. Collection finished on 6/3/2016.

[4] Field parameters measured by lowering probe module, with weighted protective case, into current.

[5] Field Parameters not measured due to rising tide.

Table 3-7. Event 2 Water Quality Field Parameters

Location ID	Location	Sample Date	Temperature (°C)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Oxidation Reduction Potential (mV)	Purge Rate (mL/min)
Groundwater								
B-1R	Log Yard	8/18/16 9:15	16.1	1,538	0.39	6.41	-64.0	200
B-3R	Log Yard	8/18/16 10:10	18.3	4,286	0.11	6.80	-261.2	100
B-5R	Sawmill	8/18/16 15:20	16.2	581	0.10	6.50	-331.0	600
B-6R	Log Yard	8/18/16 11:35	17.6	2,369	0.05	6.78	-351.2	200
HC-2	Log Yard	8/17/16 15:30	19.1	1,216	0.44	6.23	-101.9	300
MW-1	Sawmill	8/15/16 16:45	16.3	895	0.37	6.63	-163.2	550
MW-2R	Sawmill	8/15/16 16:00	16.8	825	0.61	11.72	29.7	125
MW-3	Sawmill	8/15/16 15:00	18.9	687	0.21	6.59	-246.2	500
MW-4	Sawmill	8/15/16 18:20	17.3	256	0.21	6.12	-347.3	150
MW-5R	Log Yard	8/30/16 15:20	15.1	430	0.68	6.36	-101.1	600
MW-6R	Sawmill	8/30/16 16:40	15.7	756	0.82	6.53	23.0	600
MW-7	Log Yard	8/16/16 14:05	16.0	2,822	0.37	6.88	-144.8	260
MW-8	Log Yard	8/17/16 17:45	20.7	2,254	0.28	6.63	-168.2	150
MW-9	Log Yard	8/16/16 16:55	14.8	2,315	0.40	6.69	-121.6	375
MW-10	Log Yard	8/17/16 15:40	19.1	1,367	0.43	6.17	-73.9	330
MW-11	Log Yard	8/18/16 11:40	17.5	2,118	0.46	6.77	-100.2	350
MW-12	Log Yard	8/18/16 9:55	15.5	2,358	0.50	6.45	-57.7	300
MW-13	Log Yard	8/18/16 10:55	19.5	1,231	0.35	6.30	-73.1	800
Surface Water								
Blair WW	--	8/15/16 13:30	19.7	35,236	11.83	8.33	246.9	350
WCT-1B	Log Yard	8/15/16 10:15	18.0	4,643	7.12	7.06	146.6	--
WCT-2B	Log Yard	8/15/16 10:30	18.3	3,740	5.96	7.28	-106.4	400
WCT-3B	Log Yard	8/15/16 9:45	17.5	3,650	6.50	7.27	-136.0	500
WCT-4B	Sawmill	8/15/16 11:45	19.1	574	6.90	7.66	-49.0	400
USS1 [1]	--	8/15/16 13:30	19.6	231	7.63	7.68	-261.0	--

Table 3-7. Event 2 Water Quality Field Parameters

Location ID	Location	Sample Date	Temperature (°C)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Oxidation Reduction Potential (mV)	Purge Rate (mL/min)
Porewater								
WCT-1A-10	Log Yard	8/30/16 10:30	17.1	22,658	1.58	6.75	-46.7	--
WCT-1A-40	Log Yard	8/30/16 10:00	16.9	10,534	1.72	6.69	-34.8	--
WCT-1B-10	Log Yard	8/30/16 9:17	17.0	21,617	1.91	7.24	-40.8	--
WCT-1B-40	Log Yard	8/30/16 9:00	16.6	13,408	1.32	6.93	141.0	--
WCT-2A-10	Log Yard	8/30/16 12:30	18.3	32,876	2.92	6.95	14.9	--
WCT-2A-40	Log Yard	8/30/16 11:50	19.1	24,469	1.50	6.87	7.7	--
WCT-2B-10	Log Yard	8/30/16 11:30	17.7	28,314	2.16	6.57	33.4	--
WCT-2B-40	Log Yard	8/30/16 11:15	18.2	19,911	2.48	6.59	36.0	--
WCT-3A-10	Log Yard	8/31/16 10:15	17.7	12,618	2.38	6.92	-19.7	--
WCT-3A-40	Log Yard	8/30/16 13:15	--[2]	--[2]	--[2]	--[2]	--[2]	--
WCT-3B-10	Log Yard	8/30/16 13:00	19.2	21,959	2.34	6.89	37.2	--
WCT-3B-40	Log Yard	8/30/16 12:45	19.6	2,811	2.80	6.66	67.4	--
WCT-4A-10	Sawmill	8/31/16 9:50	16.8	22,271	1.60	6.54	30.7	--
WCT-4A-40	Sawmill	8/31/16 9:35	17.0	3,412	2.34	6.98	47.1	--
WCT-4B-10	Sawmill	8/31/16 9:15	16.9	22,425	2.02	6.77	149.7	--
WCT-4B-40	Sawmill	8/31/16 9:00	17.7	2,933	2.31	7.02	171.6	--
Outfalls								**Est. Flow Rate (gpm)**
OF-2	W.Creek	8/15/16 11:11	16.6	20,029	6.03	7.3	211.8	0.2
OF-3	W.Creek	8/15/16 11:39	17.5	8,801	7.15	8.06	210.6	0.6

Notes:

-- = Not measured or not applicable
°C = degree Celsius
µS/cm = microSiemen per centimeter
mg/L = milligram per liter
mL/min = milliliter per minute
mV = millivolt
NTU = nephelometric turbidity unit
[1] Field parameters measured by lowering probe module, with weighted protective case, into current.
[2] Field parameters not collected due to limited sample volume.

Table 3-8. Event 3 Water Quality Field Parameters

Location ID	Location	Sample Date	Temperature (°C)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Oxidation Reduction Potential (mV)	Purge Rate (mL/min)
Groundwater								
B-1R	Log Yard	11/16/16 11:00	14.8	1,364	0.27	6.43	-58.7	100
B-3R	Log Yard	11/16/16 16:45	14.5	4,018	0.18	6.78	-91.0	125
B-5R	Sawmill	11/17/16 11:00	15.5	577	0.15	6.37	-47.4	350
B-6R	Log Yard	11/16/16 13:40	15.2	2,165	0.15	6.79	-108.2	175
HC-2	Log Yard	11/16/16 16:15	13.8	837	1.14	6.23	-40.4	<50
MW-1	Sawmill	11/17/16 12:45	16.2	851	0.19	6.99	-93.1	320
MW-2R	Sawmill	11/17/16 11:45	12.8	1,027	6.16	11.21	119.4	340
MW-3	Sawmill	11/15/16 15:00	16.9	759	0.17	6.62	-105.5	550
MW-4	Sawmill	11/17/16 10:30	14.4	75	1.80	5.60	247.2	150
MW-5R	Log Yard	11/17/16 12:35	14.6	400	0.18	6.30	-30.5	300
MW-6R	Sawmill	11/15/16 15:50	15.6	681	0.21	6.42	-57.7	550
MW-7	Log Yard	11/16/16 12:00	15.2	570	0.25	5.90	8.3	310
MW-7	Log Yard	12/12/16 10:30	14.7	388	0.05	5.82	106.2	175
MW-8	Log Yard	11/17/16 11:00	15.5	2,110	0.28	6.57	-124.9	125
MW-9	Log Yard	11/16/16 15:00	14.6	1,192	0.18	6.43	-85.5	325
MW-10	Log Yard	11/16/16 11:00	16.5	1,302	0.24	6.21	-110.1	250
MW-11	Log Yard	11/17/16 12:45	16.1	2,049	0.14	6.69	-174.9	175
MW-12	Log Yard	11/16/16 16:20	14.7	1,175	0.25	6.54	-71.0	320
MW-13	Log Yard	11/16/16 12:30	16.7	830	0.20	6.08	-34.3	650
Surface Water								
Blair WW	--	11/15/16 16:15	11.8	31,080	7.17	6.79	323.0	600
WCT-1B	Log Yard	11/14/16 20:45	11.3	3,515	8.21	6.85	229.9	670
WCT-2B	Log Yard	11/14/16 21:30	11.3	2,080	8.28	7.09	215.9	670
WCT-3B	Log Yard	11/14/16 22:10	11.4	4,498	8.06	7.03	210.0	670
WCT-4B	Sawmill	11/14/16 23:00	11.2	359	8.17	7.48	213.5	670
USS1	--	11/15/16 14:45	11.4	166	6.17	6.03	346.9	350

Table 3-8. Event 3 Water Quality Field Parameters

Location ID	Location	Sample Date	Temperature (°C)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Oxidation Reduction Potential (mV)	Purge Rate (mL/min)
Porewater								
WCT-1A-10	Log Yard	11/28/16 22:15	10.6	12,574	3.24	6.18	154.7	--
WCT-1A-10	Log Yard	11/28/16 22:15	10.9	7,435	2.50	6.93	51.5	--
WCT-1B-10	Log Yard	11/28/16 22:30	11.1	11,584	2.70	7.22	4.6	--
WCT-2A-10	Log Yard	11/28/16 21:00	11.1	23,638	2.82	6.84	48.1	--
WCT-2A-10	Log Yard	11/28/16 21:00	10.7	21,881	4.71	7.07	65.4	--
WCT-2B-10	Log Yard	11/28/16 21:30	10.6	28,955	2.88	6.44	67.4	--
WCT-2B-10	Log Yard	11/28/16 21:30	10.4	22,744	3.81	6.83	28.9	--
WCT-3A-10	Log Yard	11/28/16 22:00	10.4	25,965	2.80	7.12	21.0	--
WCT-3A-10	Log Yard	11/28/16 22:00	10.3	17,354	3.2	7.1	5.6	--
WCT-3B-10	Log Yard	11/28/16 22:30	10.1	6,638	2.89	7.01	3.2	--
WCT-3B-10	Log Yard	11/28/16 22:30	9.4	8,419	2.83	7.12	-3.7	--
WCT-4A-10	Sawmill	11/28/16 23:00	9.7	1,694	2.60	7.05	-27.9	--
WCT-4A-10	Sawmill	11/28/16 23:00	9.3	1,476	2.43	7.17	-23.5	--
Outfalls								**Est. Flow Rate (gpm)**
OF-2	W.Creek	11/14/16 20:20	11.6	12,550	0.06	6.83	212.0	4.0
OF-3	W.Creek	11/14/16 22:30	11.8	7,178	9.16	6.92	220.1	3.0

Notes:
< = less than (below minimum range of meter)
-- = Not measured or not applicable
°C = degree Celsius
µS/cm = microSiemen per centimeter
mg/L = milligram per liter
mL/min = milliliter per minute
mV = millivolt
NTU = nephelometric turbidity unit

Table 3-9. Event 4 Water Quality Field Parameters

Location ID	Location	Sample Date	Temperature (°C)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Oxidation Reduction Potential (mV)	Purge Rate (mL/min)
Groundwater								
B-1R	Log Yard	2/21/17 10:50	12.0	1,217	0.84	6.26	-90.1	150
B-3R	Log Yard	2/21/17 13:15	10.6	3,484	0.43	6.76	-92.2	100
B-5R	Sawmill	11/17/16 11:55	14.0	483	0.20	6.06	-35.10	500
B-6R	Log Yard	11/16/16 12:45	13.8	2,008	0.51	6.78	-1350.00	250
HC-2	Log Yard	2/21/17 10:55	9.3	511	2.74	5.72	30.50	400
MW-1	Sawmill	2/20/17 17:45	13.0	762	0.44	6.77	-76.2	375
MW-2R	Sawmill	2/20/17 17:40	6.7	807	10.17	11.84	448.0	300
MW-3	Sawmill	2/22/17 14:00	13.4	683	0.10	7.06	-112.1	550
MW-4	Sawmill	2/20/17 15:40	10.8	80	5.56	6.05	336.8	150
MW-5R	Log Yard	2/22/17 15:00	11.0	389	0.16	6.06	-18.9	250
MW-6R	Sawmill	2/22/17 15:05	14.0	617	0.13	6.28	-24.6	750
MW-7	Log Yard	2/22/17 17:00	11.8	187	2.02	5.58	168.1	230
MW-8	Log Yard	2/23/17 11:50	12.7	1,806	0.16	6.63	-97.6	175
MW-9	Log Yard	2/23/17 15:00	12.5	919	0.69	6.31	-107.7	310
MW-10	Log Yard	2/22/17 15:45	12.9	1,126	0.85	6.26	-70.4	200
MW-11	Log Yard	2/21/17 14:05	14.2	1,457	0.59	6.62	-101.2	200
MW-12	Log Yard	2/23/17 11:25	11.9	1,010	0.38	6.38	-103.6	350
MW-13	Log Yard	11/16/16 12:30	9.8	630	1.23	6.06	-143.0	300
Surface Water								
Blair WW	--	2/6/17 14:15	7.4	36,839	7.57	7.62	260.7	--
WCT-1B	Log Yard	2/6/17 17:20	3.8	1,530	10.29	6.75	124.7	--
WCT-2B	Log Yard	2/6/17 18:00	3.7	904	10.62	7.05	112.7	--
WCT-3B	Log Yard	2/6/17 18:30	3.6	1,208	10.25	7.06	120.5	--
WCT-4B	Sawmill	2/6/17 19:15	3.5	170	10.25	6.90	142.4	--
USS1	--	2/7/17 23:40	3.7	155	9.54	6.96	227.2	--

Table 3-9. Event 4 Water Quality Field Parameters

Location ID	Location	Sample Date	Temperature (°C)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Oxidation Reduction Potential (mV)	Purge Rate (mL/min)
Porewater								
WCT-1A-10	Log Yard	2/21/17 16:50	10.5	1,503	4.69	6.62	14.7	--
WCT-1A-10	Log Yard	2/21/17 16:50	9.9	1,970	1.47	6.66	-65.7	--
WCT-1B-10	Log Yard	2/21/17 17:05	9.8	11,200	2.48	7.12	-42.3	--
WCT-1B-10	Log Yard	2/21/17 17:05	9.7	7,252	1.51	7.16	-28.9	--
WCT-2A-10	Log Yard	2/21/17 17:50	9.1	14,976	2.67	6.87	22.8	--
WCT-2A-10	Log Yard	2/21/17 17:50	9.7	23,095	4.74	6.95	61.4	--
WCT-2B-10	Log Yard	2/21/17 18:20	9.4	16,082	2.34	6.44	28.1	--
WCT-2B-10	Log Yard	2/21/17 18:20	9.1	18,408	2.33	6.34	15.9	--
WCT-3A-10	Log Yard	2/21/17 18:50	9.7	7,858	2.67	6.85	-48.9	--
WCT-3A-10	Log Yard	2/21/17 18:50	10.4	12,385	2.7	7.1	-20.1	--
WCT-3B-10	Log Yard	2/21/17 19:40	9.7	3,432	2.57	7.12	-39.7	--
WCT-3B-10	Log Yard	2/21/17 19:40	9.8	11,000	2.17	6.88	7.5	--
WCT-4A-10	Sawmill	2/21/17 20:05	10.2	596	4.11	6.91	-10.0	--
WCT-4A-10	Sawmill	2/21/17 20:05	10.2	459	2.79	6.68	-48.4	--
Outfalls								**Est. Flow Rate (gpm)**
OF-2	W.Creek	2/6/17 17:30	4.1	85	10	5.33	175.6	12
OF-3	W.Creek	2/6/16 18:10	4.1	77	10.1	6.74	126.0	10

Notes:
-- = Not measured or not applicable
°C = degree Celsius
µS/cm = microSiemen per centimeter
mg/L = milligram per liter
mL/min = milliliter per minute
mV = millivolt
NTU = nephelometric turbidity unit

Table 3-10. Outfall Discharge Field Parameters, Flow Estimates, and Antecedent Dry-Period Event 1 through Event 4

Location ID	Sample Date	Elapsed time since previous precipitation event[1]	Magnitude of previous precipitation event (24 hour total)[1]	Dry-Weather Flow or Stormwater?[2]	Temperature (°C)	Specific Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	pH	Oxidation Reduction Potential (mV)	Est. Flow Rate (gpm)
OF-2	5/12/16 18:20	17.6 days	0.51 in	Dry-Weather	12.6	15,221	6.82	--	--	0.5
OF-3	5/12/16 18:40	17.6 days	0.51 in	Dry-Weather	--	--	--	--	--	0.750
OF-2	8/15/16 11:11	6.8 days	0.06 in	Dry-Weather	16.6	20,029	6.03	7.3	211.8	0.2
OF-3	8/15/16 11:39	6.9 days	0.06 in	Dry-Weather	17.5	8,801	7.15	8.1	210.6	0.6
OF-2	11/14/16 20:20	13.6 hours	1.32 in	Stormwater	11.6	12,550	0.06	6.8	212.0	4.0
OF-3	11/14/16 22:30	15.8 hours	1.32 in	Stormwater	11.8	7,178	9.16	6.9	220.1	3.0
OF-2	2/6/17 17:30	2.6 hours	1.22 in	Stormwater	4.1	85	10	5.3	175.6	12.0
OF-3	2/6/17 18:10	3.3 hours	1.22 in	Stormwater	4.1	77	10.1	6.7	126.0	10.0

Notes:

-- = Not measured or not applicable
°C = degree Celsius
µS/cm = microSiemen per centimeter
mg/L = milligram per liter
mV = millivolt
gpm = gallons per minute

[1] Precipitation readings from Tacoma Narrows Airport, NOAA NCDC Station ID 94274 (https://www.ncdc.noaa.gov/qclcd/QCLCD?prior=N).

[2] Dry Weather Flow is defined as flow in a stormwater conveyance system during periods of dry weather in which the conveyance system is under minimum influence of inflow and infiltration. Stormwater Flow is defined as flow in a stormwater conveyance system during periods of wet weather in which the conveyance system is under the influence of inflow and infiltration.

Table 4-1. Monitoring Well Construction Details

			May 2016 Survey Information					Original Well Construction Data [1]										
Well Identification	Location	Well Type	Northing[5] (NAD 83/91)	Easting[5] (NAD 83/91)	Inner Casing Elevation (MLLW)	Current Ground Surface Elevation (MLLW)	Stick-up Height (ft)	Source Document for Well Log	Date Drilled	Water Level ATD (ft bgs)	Casing Diameter (inches)	Casing Material	Total Depth of Boring (ft bgs)	Screen Length (ft)	Top of Screen (ft bgs)	Bottom of Screen/ Casing (ft bgs)	Screen Slot Size (inch)	Filter Pack
B-1R [1]	Log Yard	Monitoring Well	705708.88	1175728.54	22.88	23.56	--	HC, 1987	3/24/1987	6	2	Sch 40 PVC	14	5	5	10	0.02	Silica Sand Backfill
B-3R [1]	Log Yard	Monitoring Well	705141.75	1176791.25	22.44	23.10	--	HC, 1987	3/24/1987	7	2	Sch 40 PVC	14	5	8	13	0.02	Silica Sand Backfill
B-5R	Sawmill	Monitoring Well	705055.90	1175499.80	20.46	20.62	--	HC, 1987	3/24/1987	8.5	2	Sch 40 PVC	19	5	12	17	0.02	Silica Sand Backfill
B-6R [1]	Log Yard	Monitoring Well	705157.37	1175958.91	23.74	24.11	--	HC, 1987	3/24/1987	7.5	2	Sch 40 PVC	14	5	8	13	0.02	Silica Sand Backfill
HC-1[2, 7]	Log Yard	Dry Monitoring Well	705154.38	1176788.22	22.92	23.18	--	Unknown	Unknown	Unknown	2	Sch 40 PVC[3]	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
HC-2[2]	Log Yard	Perched Monitoring Well	705707.34	1175720.05	23.37	23.65	--	Unknown	Unknown	Unknown	2	Sch 40 PVC[3]	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
MW-1	Sawmill	Monitoring Well	704590.59	1175483.12	20.25	20.88	--	CDM, 2008	4/30/2008	10	2	Sch 40 PVC	15	10	5	15	0.01	10-20 Silica Sand
MW-2R	Sawmill	Monitoring Well	704505.89	1175526.32	20.69	21.50	--	WES, 2009	4/22/2009	10	2	Sch 40 PVC	16.5	10	5	15	Unknown	10-20 Silica Sand
MW-3	Sawmill	Monitoring Well	704532.01	1175594.01	20.33	21.11	--	CDM, Nov. 2008	9/8/2008	10	2	Sch 40 PVC	15	10	5	15	0.01	10-20 Silica Sand
MW-4	Sawmill	Monitoring Well	704498.33	1175466.62	20.66	20.94	--	CDM, Nov. 2008	9/8/2008	8.5	2	Sch 40 PVC	15	10	5	15	0.01	10-20 Silica Sand
MW-5R	Log Yard	Monitoring Well	704208.05	1175987.88	19.63	20.15	--	GSI, 2016	5/10/2016	9	2	Sch 40 PVC	15	10	5	15	0.01	10/20 Colorado Silica Sand
MW-6R	Sawmill	Monitoring Well	704768.91	1175980.36	20.96	21.36	--	WES, 2009	4/22/2009	10	2	Sch 40 PVC	16.5	9	5	14	Unknown	10-20 Silica Sand
MW-7	Log Yard	Monitoring Well	705662.36	1175514.59	25.03	22.58	2.45	GSI, 2016	5/11/2016	8.15	2	Sch 40 PVC	15	10	5	15	0.01	10/20 Colorado Silica Sand
MW-8	Log Yard	Perched Monitoring Well	705611.58	1176763.25	23.62	23.91	--	GSI, 2016	5/9/2016	10.5	2	Sch 40 PVC	16	10	6	16	0.01	10/20 Colorado Silica Sand
MW-9	Log Yard	Monitoring Well	705447.44	1175502.49	25.02	22.27	2.75	GSI, 2016	5/11/2016	10	2	Sch 40 PVC	15	10	5	15	0.01	10/20 Colorado Silica Sand
MW-10	Log Yard	Perched Monitoring Well	705440.82	1175721.83	25.23	25.54	--	GSI, 2016	5/11/2016	9	2	Sch 40 PVC	20	10	7	17	0.01	10/20 Colorado Silica Sand
MW-11	Log Yard	Monitoring Well	705423.16	1176262.87	24.39	24.77	--	GSI, 2016	5/11/2016	12	2	Sch 40 PVC	20	10	7	17	0.01	10/20 Colorado Silica Sand

Table 4-1. Monitoring Well Construction Details

Well Identification	Location	Well Type	May 2016 Survey Information					Original Well Construction Data [1]											
			Northing[5] (NAD 83/91)	Easting[5] (NAD 83/91)	Inner Casing Elevation (MLLW)	Current Ground Surface Elevation (MLLW)	Stick-up Height (ft)	Source Document for Well Log	Date Drilled	Water Level ATD (ft bgs)	Casing Diameter (inches)	Casing Material	Total Depth of Boring (ft bgs)	Screen Length (ft)	Top of Screen (ft bgs)	Bottom of Screen/ Casing (ft bgs)	Screen Slot Size (inch)	Filter Pack
MW-12	Log Yard	Monitoring Well	705245.84	1175499.21	25.32	22.49	2.83	GSI, 2016	5/12/2016	10	2	Sch 40 PVC	15	10	5	15	0.01	10/20 Colorado Silica Sand
MW-13	Log Yard	Perched Monitoring Well	705239.20	1175722.55	23.69	24.04	--	GSI, 2016	5/10/2016	11.5	2	Sch 40 PVC	20	10	7	17	0.01	10/20 Colorado Silica Sand
NLR-PORTAC-16	Log Yard	Piezometer	704648.65	1176499.33	24.06	24.27	--	Landau, 2013	1/16/2014	11	0.75	Sch 40 PVC	20	2.5	12	14.5	Pre-Packed	Pre-Packed
NLR-PORTAC-17	Log Yard	Piezometer	705096.18	1176873.11	23.10	23.50	--	Landau, 2013	1/16/2014	13.5	0.75	Sch 40 PVC	20	2.5	15.3	17.8	Pre-Packed	Pre-Packed
NLR-PORTAC-18	Log Yard	Piezometer	705562.14	1177257.36	23.46	23.81	--	Landau, 2013	1/16/2014	10	0.75	Sch 40 PVC	20	2.5	15	17.5	Pre-Packed	Pre-Packed

Notes:
-- = Not measured or not applicable.
ATD = At time of drilling
bgs = below ground surface
ft = feet
MLLW = mean low low water datum
MW = monitoring well
PVC = polychlorinated vinyl
Sch = schedule

[1] Well construction information reflects information from original well logs and construction schematics. The 1988 Portac Paving Plan indicates that existing wells (those drilled in 1987) were likely extended during capping. The amount of extension for each well is unknown but the 2015 well assessment data suggests that the casing in monitoring wells B-6R and B-3R, and B-1R was extended by approximately 3 feet. The paving plan figures also suggest that B-2R was abandoned during construction of the cap.

[2] Well logs have not been located for HC-1 and HC-2 by the production of this document.
[3] Casing diameter and material of HC-1 and HC-2 confirmed during November, 2015 well assessment.
[4] MW-5 was be abandoned due to damaged casing and replaced by MW-5R as part of the remedial investigation.
[5] Well locations surveyed in May, 2016. Datum is Washington State Plane Coordinate System, South Zone, NAD83/91 based on 2007 Port of Tacoma control.
[6] This measurement is suspected to be erroneous because it is deeper than anticipated.
[7] This well (HC-1) was abandoned in May 2017.

Table 5-1. Soil Results – Event 1

		General Parameters			Grain Size								Primary Site-Related Metals and Speciation Data						Other Metals						
Location	Sample ID[1]	TS	Total Organic Carbon	Sulfide	Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay	Pentachlorophenol	pH	Arsenic (Total)	Arsenate	Arsenite	Cacodylic acid	Monomethylarsonic acid	Iron (Total)	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
		%	mg/kg	mg/kg	%	%	%	%	%	%	mg/kg	SU	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Soil																									
Logyard	MWS007-9_10	84.68	550 J	5.9 UJ	0	0	13.6	73.2	10.4	2.7	--	--	2.69	0.98	0.06 U	0.06 U	0.009 J	12,100	--	--	--	--	--	--	--
	MWS008-11.5_12.5	81.99	5,600	--	--	--	--	--	--	--	--	--	72.9	--	--	--	--	17,000	--	--	--	--	--	--	--
	MWS009-11_12	77.88	1,100 J	6.4 UJ	0	0	0.1	49.9	46.3	3.7	--	--	1.23	0.40	0.06 U	0.06 U	0.07 U	14,700	--	--	--	--	--	--	--
	MWS010-12_13	74.1	12,000	3.2 J	0	0	1.2	13.8	61.2	23.7	--	--	237	124	0.65 U	0.16 J	0.58 J	20,200	--	--	--	--	--	--	--
	MWS011-13_14	76.39	6,500	--	--	--	--	--	--	--	--	--	2.98	--	--	--	--	18,000	--	--	--	--	--	--	--
	MWS012-11.5_12.5	79.01	580 J	6.2 UJ	0	0	0.3	81.4	18.4	0	--	--	0.936	0.34	0.06 U	0.07 U	0.08 U	21,700	--	--	--	--	--	--	--
	MWS013-12.5_13.5	73.48	6,400	4.2 J	0	0	0.3	29.9	45	24.8	--	--	7.91 J	1.63	0.02 J	0.01 J	0.02 J	24,100	--	--	--	--	--	--	--
	TBS001-11_12	84.45	1200 J	--	--	--	--	--	--	--	--	--	12.7	--	--	--	--	24,200	--	--	--	--	--	--	--
	TBS002-12.5_13.5	80.48	380 J	--	--	--	--	--	--	--	--	--	7.68	--	--	--	--	26,200	--	--	--	--	--	--	--
	TBS003-14_15	72.82	22,000	38 J	1.1	0.6	1.5	14.7	45.4	36.8	--	--	3.92	0.94	0.009 J	0.06 U	0.02 J	23,100	--	--	--	--	--	--	--
	TBS004-12_13	79.81	4,100	--	--	--	--	--	--	--	--	--	6.46	--	--	--	--	15,300	--	--	--	--	--	--	--
	TBS005-17_18	72.82	1,700 J	6.7 UJ	0	0	0	53.6	42.7	3.6	--	--	1.55	0.72	0.07 U	0.07 U	0.08 U	16,500	--	--	--	--	--	--	--
	TBS006-13_14	79.54	5,700	--	--	--	--	--	--	--	--	--	92.3	--	--	--	--	22,500	--	--	--	--	--	--	--
	TBS007-16.5_17.5	86.9	1100 J	6.3 UJ	0	0	0.2	71.1	26.8	1.9	--	--	1.1	0.44	0.05 U	0.06 U	0.06 U	14,600	--	--	--	--	--	--	--
	TBS008-13_14	71.64	11,000	--	--	--	--	--	--	--	--	--	4.6	--	--	--	--	19,800	--	--	--	--	--	--	--
Sawmill	MWS005R-10.5_11.5	86.88	8,400	--	--	--	--	--	--	--	0.56 J	10.5	5.81	--	--	--	--	16,500	--	--	--	--	--	--	--
	TBS009-12_13	63.82	20,000	--	0.5	2.1	56.7	19.8	15	5.9	0.016 J	7.61	8.84 J	--	--	--	--	17,000	--	--	--	--	--	--	--
	TBS009-7.4_8.4	88.7	2,100	--	0	0	4.9	80.4	11.3	3.2	0.015 J	9.12	1.52	--	--	--	--	11,100	--	--	--	--	--	--	--
	TBS009-8.8_9.8	63.92	42,000	--	4.8	4.4	11.3	38.4	32.4	8.7	0.027 J	7.8	5.77	--	--	--	--	34,600	--	--	--	--	--	--	--
	TPS001-0.5_1.5	91.81	4,900	--	--	--	--	--	--	--	0.018 J	8.75	3.93	--	--	--	--	20,800	30	0.12 J	19	7.5	0.041	0.28 J	0.027 J
	TPS001F-1.5_2.5	90.47	4,300	--	--	--	--	--	--	--	0.018 J	8.5	27.5	--	--	--	--	24,800	42	0.24	16	21	0.02 J	0.41 J	0.096 J
	TPS001TB-12_13	75.86	1,200 J	--	--	--	--	--	--	--	0.015 J	8.25	1.67	--	--	--	--	13,300	--	--	--	--	--	--	--
	TPS002-0.5_1.5	94.02	710 J	--	--	--	--	--	--	--	0.014 J	7.95	2.97	--	--	--	--	20,200	--	--	--	--	--	--	--
	TPS002-10.5_12.5	77.28	3,000	--	--	--	--	--	--	--	0.019 J	8.4	4.8	--	--	--	--	18,400	--	--	--	--	--	--	--

Notes:

-- = Not measured
MWS = Monitoring well soil boring sample
TBS = Temporary boring soil sample
TPS = Test pit soil sample
SU = Standard Unit
mg/kg = milligrams per kilogram
pg/g = pictogram per gram
J = Estimated result.
T = Calculated result.
U = Non-detected result, reported at the Practical Quantitation Limit (PQL).
OCDD = Octachlorodibenzodioxin
OCDF = Octachlorodibenzofuran

[1] Sample ID includes two components separated by a hyphen. The first component contains the sample type abbreviation followed by the station ID or monitoring well number, with leading zeros for ease of management. The second component includes the start and end depth in feet below ground surface with an underscore between them.

[2] When establishing and determining compliance with cleanup levels and remediation levels for mixtures of dioxin congeners (CDDs) and furan congeners (CDFs) under the MTCA Cleanup Regulation (WAC 173-340-708[8][d]), the mixture shall be considered a single hazardous substance. Dioxin and furan toxic equivalents (TEQs) were calculated using the 2005 World Health Organization consensus toxicity equivalency factors (TEF) relative to 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD or TCDD) or 2,3,7,8-tetrachlorodibenzo-p-furan (2,3,7,8-TCDF or TCDF) values for mammals, as described in Washington Department of Ecology guidance document entitled, "Evaluating the Toxicity and Assessing the Carcinogenic Risk of Environmental Mixtures Using TEFs" (Ecology, 2006). TEQs were calculated as the sum of each congener concentration (or PQL for non-detects) multiplied by the corresponding TEF value (In Table 2 of Ecology, 2006). <https://fortress.wa.gov/ecy/clarc/FocusSheets/tef.pdf>.

Table 5-1. Soil Results – Event 1

Location	Sample ID[1]	Hydrocarbons			Dioxins/Furans																			
		Diesel Range Organics	Gasoline	Motor Oil	1,2,3,4,6,7,8-HpCDD	1,2,3,4,6,7,8-HpCDF	1,2,3,4,7,8,9-HpCDF	1,2,3,4,7,8-HxCDD	1,2,3,4,7,8-HxCDF	1,2,3,6,7,8-HxCDD	1,2,3,6,7,8-HxCDF	1,2,3,7,8,9-HxCDD	1,2,3,7,8,9-HxCDF	1,2,3,7,8-PeCDD	1,2,3,7,8-PeCDF	2,3,4,6,7,8-HxCDF	2,3,4,7,8-PeCDF	2,3,7,8-TCDD	2,3,7,8-TCDF	OCDD	OCDF	TCDD TEQ Sum (ND=PQL)[2]	TCDF TEQ Sum (ND=PQL)[2]	TCDD/F Dioxin Furan TEQ Sum (ND=PQL)[2]
		mg/kg	mg/kg	mg/kg	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g
Soil																								
Logyard	MWS007-9_10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	MWS008-11.5_12.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	MWS009-11_12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	MWS010-12_13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	MWS011-13_14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	MWS012-11.5_12.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	MWS013-12.5_13.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	TBS001-11_12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	TBS002-12.5_13.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	TBS003-14_15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	TBS004-12_13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	TBS005-17_18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	TBS006-13_14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	TBS007-16.5_17.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	TBS008-13_14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sawmill	MWS005R-10.5_11.5	--	--	--	6,800	390	7 U	6.8 U	10	980	7.3	250	5.7 U	5.4 J	12	15	33	0.63 J	32	88,000 J	180	200 JT	20 JT	200 JT
	TBS009-12_13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	TBS009-7.4_8.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	TBS009-8.8_9.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	TPS001-0.5_1.5	54 UJ	21 UJ	230 J	130	40 J	5.3 U	1.9 J	5.3 U	7.3	5.3 U	5.3 U	5.3 U	1.3 J	0.64 J	1.9 J	0.89 J	0.099 J	0.94 J	830	65 J	4.1 JT	2.6 JT	6.8 JT
	TPS001F-1.5_2.5	54 UJ	22 UJ	110 UJ	82	16 J	5.2 U	0.63 J	5.2 U	5.9	5.2 U	5.2 U	5.2 U	0.4 J	5.2 U	0.61 J	0.25 J	1 U	0.45 J	530	30 J	3.4 JT	2.1 JT	5.5 JT
	TPS001TB-12_13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	TPS002-0.5_1.5	--	--	--	13 J	5.3 U	0.2 J	0.2 J	5.3 U	0.79 J	0.13 J	0.4 J	5.3 U	0.1 J	5.3 U	0.14 J	5.3 U	1.1 U	0.093 J	97 J	11 U	1.5 JT	3.4 JT	4.9 JT
	TPS002-10.5_12.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:
-- = Not measured
MWS = Monitoring well soil boring sample
TBS = Temporary boring soil sample
TPS = Test pit soil sample
SU = Standard Unit
mg/kg = milligrams per kilogram
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OCDD = Octachlorodibenzodioxin
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[1] Sample ID includes two components separated by a hyphen. The first component contains the sample type abbreviation followed by the station ID or monitoring well number, with leading zeros for ease of management. The second component includes the start and end depth in feet below ground surface with an underscore between them.

[2] When establishing and determining compliance with cleanup levels and remediation levels for mixtures of dioxin congeners (CDDs) and furan congeners (CDFs) under the MTCA Cleanup Regulation (WAC 173-340-708[8][d]), the mixture shall be considered a single hazardous substance. Dioxin and furan toxic equivalents (TEQs) were calculated using the 2005 World Health Organization consensus toxicity equivalency factors (TEF) relative to 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD or TCDD) or 2,3,7,8-tetrachlorodibenzo-p-furan (2,3,7,8-TCDF or TCDF) values for mammals, as described in Washington Department of Ecology guidance document entitled, “Evaluating the Toxicity and Assessing the Carcinogenic Risk of Environmental Mixtures Using TEFs” (Ecology, 2006). TEQs were calculated as the sum of each congener concentration (or PQL for non-detects) multiplied by the corresponding TEF value (In Table 2 of Ecology, 2006). <https://fortress.wa.gov/ecy/clarc/FocusSheets/tef.pdf>.

Table 5-2. Sediment Results – Event 1

		General Parameters			Metals and Speciation Data								Grain Size					
Location	Station ID[1]	TS	Total Organic Carbon	Sulfide	Arsenic (Total)	Arsenate	Arsenite	Cacodylic acid	Monomethylarsonic acid	Iron (Total)	Pentachlorophenol	pH	Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay
		%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	SU	%	%	%	%	%	%
Bioactive Zone Sediment (0 - 10 cm bml)																		
Logyard	WCTSD001A-0_10	71.52	5,700	110 J	2.28	1.11	0.06 U	0.07 U	0.01 J	15,800	--	--	0	1.2	4.1	50	26.7	18
	WCTSD001B-0_10	70.52	10,000	47 J	13.6	9.14	0.07 U	0.009 J	0.09 J	24,100	--	--	0	0	1.2	61	32.6	5.1
	WCTSD002A-0_10	68.7	9,300	14 J	10.3	--	--	--	--	19,800	--	--	0.8	1.7	1.9	56.8	32.3	6.5
	WCTSD002B-0_10	65.74	15,000	250 J	9.08	--	--	--	--	22,500	--	--	0	0.2	2.8	79.5	6.7	10.8
	WCTSD003A-0_10	71.13	4,700	29 J	4.49	--	--	--	--	18,700	--	--	0	0.1	0.5	44.7	44.9	9.8
	WCTSD003B-0_10	76.5	3,600	20 J	5.01	--	--	--	--	20,500	--	--	0	0.1	2	62.1	29.3	6.6
Sawmill	WCTSD004A-0_10	69.99	7,300	64 J	2.53	--	--	--	--	20,000	0.016 J	7.05	0	0.2	1.2	12.1	71.9	14.6
	WCTSD004B-0_10	74.3	6,200	11 J	6.21	--	--	--	--	25,200	0.018 J	6.43	0	1.1	1.7	28.6	60.1	8.6
Transition Zone Sediment (40 - 50 cm bml)																		
Logyard	WCTSD001A-40_50	74.27	4,800	98 J	1.78	0.48	0.06 U	0.07 U	0.07 U	18,100	--	--	0	0	0.4	16.6	73	10.1
	WCTSD001B-40_50	49.02	22,000	13 UJ	12.6	1.10 J	0.10 U	0.11 U	0.03 J	31,600	--	--	0.5	0.7	3.8	38.5	46.2	10.3
	WCTSD002A-36_46	75.31	4,200	6.7 UJ	1.84	--	--	--	--	13,800	--	--	--	--	--	--	--	--
	WCTSD002A-40_50	--	--	--	--	--	--	--	--	--	--	--	0	0.1	0.5	68.8	26.1	4.5
	WCTSD002B-40_50	68.13	9,900	16 J	2.43	--	--	--	--	21,800	--	--	0.1	0.2	6.2	63.7	25.5	4.3
	WCTSD003A-40_50	76.21	3,700	29 J	4.41	--	--	--	--	18,300	--	--	0	0.1	1.1	23.3	63.5	12.1
	WCTSD003B-40_50	66.39	11,000	47 J	3.27	--	--	--	--	25,200	--	--	0	0.1	0.6	14.4	68.2	16.7
Sawmill	WCTSD004A-40_50	69.03	8,400	43 J	2.6	--	--	--	--	22,100	0.018 J	8.06	0	0.1	1.5	15.1	66.2	17.1
	WCTSD004B-40_50	71.83	4,900	41 J	3.72	--	--	--	--	31,300	0.015 J	6.76	0	0	0.5	4.8	74.3	20.3

Notes:
-- = Not measured
SU = Standard unit
bml = Below mudline
TS = Total solids
mg/kg = milligrams per kilogram
J = Estimated result.
U = Non-detected result, reported at the Practical Quantitation Limit (PQL).
[1] Sample ID includes two components separated by a hyphen. The first component contains the sample type abbreviation followed by the station ID or monitoring well number, with leading zeros for ease of management. The second component includes the start and end depth in centimeters (cm) below mudline (bml) with an underscore between them.

Table 5-3. Groundwater, Porewater, Surface Water, and Outfall Discharge Results – Event 1 through Event 4

		General Parameters			Metals and Speciation Data											Cations				Anions											
Location	Station ID (and Sample Depth for Porewater)	Total Organic Carbon	Total Suspended Solids	Dissolved Organic Carbon	Arsenic (Total)	Arsenic (Dissolved)	Arsenate	Arsenite	Cacodylic acid	Monomethylarsonic acid	Iron (Dissolved)	Ferric iron	Ferrous iron	Manganese (Dissolved)	Pentachlorophenol	Calcium	Magnesium	Potassium	Sodium	Bromide	Chloride	Fluoride	Nitrate as N	Nitrite as N	Ortho-Phosphate	Sulfate	Sulfide	Alkalinity as Bicarbonate	Alkalinity as Carbonate	Alkalinity as Hydroxide	Alkalinity, Total
		mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Groundwater																															
Logyard	B001R-E1	110	--	100	75,600	54,400	7,540	45,700	420 U	460 U	92,800	13,300	79,500	2,080	--	120	59	52	100	0.5 U	51	1	0.2 U	0.4 U	1	1.2 U	0.05 U	760	5 U	5 U	760
	B001R-E2	94	25	110	66,300	79,800	1750 J	8,010	2100 U	2300 U	122,000	--	--	1,960	--	110	52	52	100	0.5 U	42	1	0.2 U	0.4 U	2	1.2 U	1 U	750	5 U	5 U	750
	B001R-E3	89	200	88	70,400	72,400	12,900	45,500	1050 U	1150 U	104,000	--	--	1,860	--	100	53	53	120	1	51	1	0.11 J	0.4 U	1	0.53 J	0.05 U	840	5 U	5 U	840
	B001R-E4	96 J	170	90 J	60,000	47,500	10,000	40,200	105 U	115 U	116,000	--	--	1,630	--	100	53	49	110	0	51	1	0.100 UJ	0.100 UJ	1	3	0.05 U	700	5 U	5 U	700
	B003R-E1	50	--	51	346	251	--	--	--	--	2,000	--	--	438	--	--	--	--	--	--	--	--	--	--	--	--	0.022 J	--	--	--	--
	B003R-E2	49	4	59	403	373	--	--	--	--	11,100	--	--	558	--	--	--	--	--	--	--	--	--	--	--	--	1 U	--	--	--	--
	B003R-E3	51	3	55	264	251	--	--	--	--	11,100	--	--	597	--	--	--	--	--	--	--	--	--	--	--	--	0.05 U	--	--	--	--
	B003R-E4	51 J	4	50 J	266	239	--	--	--	--	10,400	--	--	574	--	--	--	--	--	--	--	--	--	--	--	--	0.05 U	--	--	--	--
	B006R-E1	120	--	100	61	62	--	--	--	--	76,500	--	--	1,240	--	--	--	--	--	--	--	--	--	--	--	--	0.05 U	--	--	--	--
	B006R-E2	98	3	110	69	53	--	--	--	--	70,500	--	--	1,250	--	--	--	--	--	--	--	--	--	--	--	--	1 U	--	--	--	--
	B006R-E3	100	42	100 J	123	80	--	--	--	--	81,900	--	--	1,420	--	--	--	--	--	--	--	--	--	--	--	--	0.05 U	--	--	--	--
	B006R-E4	93	18	92	74	66	--	--	--	--	77,700	--	--	1,410	--	--	--	--	--	--	--	--	--	--	--	--	0.05 U	--	--	--	--
	HC002-E1	130	--	140	43,300	37,200	9,250	34,700	420 U	460 U	162,000	27,000	135,000	4,780	--	69	20	28	55	0.5 U	10	1	0.2 U	0.4 U	1	0.55 J	0.05 U	540	5 U	5 U	540
	HC002-E2	110	160	120	48,400	47,100	12,500	39,600	210 U	230 U	166,000	--	--	5,050	--	73	20	32	60	0.5 U	12	1	0.2 U	0.4 U	2	1.2 U	1 U	550	5 U	5 U	550
	HC002-E3	--	--	75	23,800	22,900	3,330	16,200	420 U	460 U	104,000	--	--	3,830	--	--	--	--	--	--	--	--	--	--	--	--	0.05 U	--	--	--	--
	HC002-E4	69 J	72	70 J	14,000	13,600	2,550	9,520	105 U	115 U	116,000	--	--	3,410	--	47	15	19	40	0.100 U	3	1	0.100 UJ	0.100 UJ	0.26 J	4	0.05 U	260	5 U	5 U	260
	MW007-E1	64	--	66	21	22	--	--	--	--	118,000	11,500	107,000	7,180	--	160	110	37	200	0.49 J	240	1	0.14 J	4 UJ	0	0.71 J	0.05 U	940	5 U	5 U	940
	MW007-E2	79	87	80	26	28	31	0.924 J	1.05 U	1.15 U	123,000	--	--	7,980	--	150	100	38	260	2	260	1	0.16 J	0.4 U	0	1	0.5 U	1,100	5 U	5 U	1,100
	MW007-E3	12	55	23	16	13	10	4	1.05 U	1.15 U	59,100	--	--	2,770	--	53	30	24	37	0.5 U	26	1	0.13 J	0.4 U	0.1 U	95 J	0.05 U	310	5 U	5 U	310
	MW007-E4	6	5	5.1 J	0.951 J	1	0.221 J	1	0.077 J	0.575 U	1,880	--	--	781	--	18	9	15	7	0.100 U	4	0	0.100 U	0.100 U	0	44	0.05 U	70	5 U	5 U	70
	MW008-E1	62	--	68	28	24	--	--	--	--	74,100	--	--	2,040	--	--	--	--	--	--	--	--	--	--	--	--	0.05 U	--	--	--	--
	MW008-E2	60	140	69	13	72	--	--	--	--	68,300	--	--	1,810	--	--	--	--	--	--	--	--	--	--	--	--	1 U	--	--	--	--
	MW008-E3	59	160	64	29	28	--	--	--	--	61,800	--	--	1,870	--	--	--	--	--	--	--	--	--	--	--	--	0.05 U	--	--	--	--
	MW008-E4	61	130	55	29	23	--	--	--	--	70,500	--	--	2,120	--	--	--	--	--	--	--	--	--	--	--	--	0.05 U	--	--	--	--
	MW009-E1	89	--	93	73	87	90	5	0.179 J	1.15 U	243,000	26,000	217,000	4,450	--	78	65	30	130	1	130	1	0.2 U	0.4 U	0.1 U	0.58 J	0.05 U	830	5 U	5 U	830
	MW009-E2		160	100	54	55	51	3.11 J	4.2 U	4.6 U	201,000	--	--	4,960	--	92	88	37	190	2	160	1	0	0.4 U	0	1.2 U	0.5 U	880	5 U	5 U	880
	MW009-E3	66	150	60	96	84	46	40	0.249 J	1.15 U	225,000	--	--	3,250	--	50	31	21	61	1	47	1	0.2 U	0.4 U	0.1 U	10	0.05 U	660	5 U	5 U	660
	MW009-E4	45	170	42	83	74	74	2	0.169 J	0.265 J	207,000	--	--	2,990	--	44	25	18	32	0	19	1	2	0.100 U	0	1	0.05 U	430	5 U	5 U	430
	MW010-E1	81	--	75	45,800	37,000	10,800	33,700	420 U	460 U	149,000	18,400	131,000	6,280	--	150	100	35	190	0.5 U	13	1	0.2 U	0.4 U	1	0.59 J	0.05 U	650	5 U	5 U	650
	MW010-E2	54	42	65	33,700	32,000	10,700	23,400	210 U	230 U	143,000	--	--	5,220	--	85	30	29	72	0.5 U	11	0	0.2 U	0.4 U	1	1.2 U	1 U	660	5 U	5 U	660
	MW010-E3	82	160	81	53,500	55,400	13,900	30,600	1050 U	1150 U	170,000	--	--	6,270	--	100	36	32	81	0.5 U	10	0	0.2 U	0.4 U	1	0.54 J	0.05 U	750	5 U	5 U	750
	MW010-E4	61	170	53	34,500	34,300	7,790	22,800	105 U	115 U	123,000	--	--	6,780	--	100	36	32	73	0	10	0	0.100 U	0.100 U	1	1	0.05 U	520	5 U	5 U	520
	MW011-E1	67	--	70	30	28	--	--	--	--	25,900	--	--	1,760	--	--	--	--	--	--	--	--	--	--	--	--	0.05 U	--	--	--	--
	MW011-E2	62	1,200	64	34	24.1 J	--	--	--	--	55,200	--	--	2,540	--	--	--	--	--	--	--	--	--	--	--	--	1 U	--	--	--	--
	MW011-E3	60	290	60	27	30	--	--	--	--	56,600	--	--	2,720	--	--	--	--	--	--	--	--	--	--	--	--	0.05 U	--	--	--	--
	MW011-E4	48	65	48	20	19	--	--	--	--	81,600	--	--	3,300	--	--	--	--	--	--	--	--	--	--	--	--	0.05 U	--	--	--	--
	MW012-E1	68	--	85	19	17	--	--	--	--	107,000	36,500	70,400	6,540	--	62	60	50	310	1	200	2	0.2 U	0.4 U	0.1 U	0.52 J	0.05 U	920	5 U	5 U	920
	MW012-E2	75	37	84	15	10 J	14	0.318 J	1.05 U	0.211 J	105,000	--	--	6,610	--	64	63	55	310	1.7 J	190 J	1	0.2 U	0.4 U	0	1.2 U	1 U	920	5 U	5 U	920
	MW012-E3	64	130	64	39	37	29	3	0.247 J	1.15 U	138,000	--	--	7,130	--	93	41	38	37	0.5 U	14	1	0.2 U	0.4 U	0.1 U	28	0.05 U	650	5 U	5 U	650
	MW012-E4	47	190	52	18	15	14	1	0.180 J	0.575 U	126,000	--	--	5,870	--	84	40	32	72	0	48	1	0	0.100 U	0	7	0.05 U	490	5 U	5 U	490
	MW013-E1	48	--	43	33,700	34,300	6,220	29,700	420 U	460 U	113,000	14,800	98,700	6,340	--	110	37	35	78	0.5 U	8	0.2 U	0.2 U	0.4 U	0	0.48 J	0.05 U	550	5 U	5 U	550
	MW013-E2	42	130	46	36,800	33,100	10,400	26,500	210 U	230 U	118,000	--	--	6,680	--	100	25	22	68	0.5 U	9	0	0.2 U	0.4 U	2	1.2 U	1 U	620	5 U	5 U	620
	MW013-E3	19	81	22	8,630	8,280	1,200	7,130	210 U	230 U	63,200	--	--	5,750	--	86	18	12	63	0.5 U	0.9 U	0.2 U	0.2 U	0.4 U	0	1.2 U	0.05 U	520	5 U	5 U	520
	MW013-E4	23 J	97	22 J	6,540	6,370	798	5,090	105 U	115 U	61,500	--	--	5,000	--	72	17	10	44	0.100 U	2	0	0.100 U	0.100 U	0	3	0.05 U	320	5 U	5 U	320

Table 5-3. Groundwater, Porewater, Surface Water, and Outfall Discharge Results – Event 1 through Event 4

		General Parameters			Metals and Speciation Data											Cations				Anions											
Location	Station ID (and Sample Depth for Porewater)	Total Organic Carbon	Total Suspended Solids	Dissolved Organic Carbon	Arsenic (Total)	Arsenic (Dissolved)	Arsenate	Arsenite	Cacodylic acid	Monomethylarsonic acid	Iron (Dissolved)	Ferric iron	Ferrous iron	Manganese (Dissolved)	Pentachlorophenol	Calcium	Magnesium	Potassium	Sodium	Bromide	Chloride	Fluoride	Nitrate as N	Nitrite as N	Ortho-Phosphate	Sulfate	Sulfide	Alkalinity as Bicarbonate	Alkalinity as Carbonate	Alkalinity as Hydroxide	Alkalinity, Total
		mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Logyard	TBGW001-E1	10	--	11	151	102	--	--	--	--	3,480	--	--	1,060	--	--	--	--	--	--	--	--	--	--	--	--	0.05 U	--	--	--	--
	TBGW002-E1	8	--	8	295	317	--	--	--	--	19,200	--	--	6,290	--	--	--	--	--	--	--	--	--	--	--	--	0.05 U	--	--	--	--
	TBGW003-E1	66	--	83	364	424	317	82	5.25 U	5.75 U	127,000	66,200	60,600	3,690	--	110	75	34	190	1	140	1	0.2 U	0.4 U	0	1.1 J	0.05 U	800	5 U	--	--
	TBGW004-E1	60 J	--	11	22,500	16,100	--	--	--	--	104,000	--	--	3,490	--	--	--	--	--	--	--	--	--	--	--	--	0.05 U	--	--	--	--
	TBGW005-E1	100	--	110	116	80	74	3	1.05 U	1.15 U	215,000	74,500	140,000	5,220	--	83	95	65	220	2	220	1	0.2 U	0.4 U	0	0.47 J	0.05 U	840	5 U	--	--
	TBGW006-E1	98	--	10	228	200	--	--	--	--	147,000	--	--	2,760	--	--	--	--	--	--	--	--	--	--	--	--	0.011 J	--	--	--	--
	TBGW007-E1	71	--	81	373	202	272	74	2.1 U	2.3 U	135,000	61,100	73,700	4,820	--	58	56	75	340	1	130	1	0.2 U	0.4 U	0	0.48 J	0.05 U	920	5 U	--	--
	TBGW008-E1	100	--	100	1,670	1,500	--	--	--	--	61,000	--	--	1,330	--	--	--	--	--	--	--	--	--	--	--	--	0.05 U	--	--	--	--
Sawmill	B005R-E1	18 J	--	17	0.29 J	0.311 J	--	--	--	--	25,300	1,960	23,300	1,000	0	18	22	13	58	0.5 U	28	1	0.2 U	0.4 U	0	1.2 U	0.029 J	230	5 U	5 U	230
	B005R-E2	19	2 U	18	1.06 U	0.521 J	--	--	--	--	32,200	--	--	1,060	0	--	--	--	--	--	--	--	--	--	--	--	1 U	--	--	--	--
	B005R-E3	17	2 U	15	2	0.440 J	--	--	--	--	27,600	--	--	1,010	0.088 U	--	--	--	--	--	--	--	--	--	--	--	0.047 J	--	--	--	--
	B005R-E4	17 J	3	17 J	0.317 J	1.01 U	--	--	--	--	25,700	--	--	951	0	--	--	--	--	--	--	--	--	--	--	--	0.05 U	--	--	--	--
	MW001-E1	52	--	52	11	12	--	--	--	--	52,000	16,600	35,400	2,070	1	70	39	4	44	0.5 U	38	0.2 U	0.2 U	0.4 U	1	0.81 J	0.05 U	360	5 U	5 U	360
	MW001-E2	49	130	51	17	18	--	--	--	--	54,100	--	--	1,960	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	MW001-E3	50	2 U	49	45	39	--	--	--	--	59,800	--	--	2,340	0.1 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	MW001-E4	46	9	43	28	28	--	--	--	--	61,000	--	--	2,030	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	MW002R-E1	9	--	8	4	3	--	--	--	--	35	17.6 J	17	1.2 J	18	87	1.1 U	6	9	0.5 U	3.9 J	0.09 J	0.2 U	0.4 U	0	16	0.05 U	5 U	56	150	210
	MW002R-E2	12	2 U	12	5	4	--	--	--	--	21.5 U	--	--	1.13 J	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	MW002R-E3	6	2 U	6	4	3	--	--	--	--	8.94 J	--	--	1.59 U	21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	MW002R-E4	3	2	3.4 J	3	2	--	--	--	--	21.5 U	--	--	1.59 U	8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	MW003-E1	38	--	40	11	11	--	--	--	--	48,000	12,500	35,500	1,420	1	66	32	2.6 J	37	0.5 U	23	1	0.2 U	0.4 U	1	0.73 J	0.05 U	330	5 U	5 U	330
	MW003-E2	31	100	31	11	11	--	--	--	--	47,700	--	--	1,190	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	MW003-E3	37	110	41	17	17	--	--	--	--	53,800	--	--	2,230	0.074 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	MW003-E4	37 J	110	41	17	16	--	--	--	--	57,100	--	--	2,040	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	MW004-E1	5	--	6	0.87 J	0.802 J	--	--	--	--	218	21.5 U	236	291	0	15	4	2.4 J	14	0.5 U	11	0.12 J	0.2 U	0.4 U	0.1 U	4	0.05 U	77	5 U	5 U	77
	MW004-E2	9	39	11	3	4	--	--	--	--	5,000	--	--	652	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	MW004-E3	3	360	3	2	0.770 J	--	--	--	--	143	--	--	8	0.063 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	MW004-E4	2	100	2.2 J	1.01 J	0.386 J	--	--	--	--	118	--	--	4	0.084 U	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	MW005R-E1	29	--	26	2	2	--	--	--	--	23,800	--	--	340	7	--	--	--	--	--	--	--	--	--	--	--	0	--	--	--	--
	MW005R-E2	25	4	22	2	2	--	--	--	--	18,400	--	--	198	0.11 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	MW005R-E3	19	2 U	17	3	3	--	--	--	--	13,200	--	--	183	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	MW005R-E4	19 J	2 U	18 J	2	2	--	--	--	--	17,800	--	--	182	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	MW006R-E1	23	--	24	1.75 J	2	--	--	--	--	48,000	--	--	6,120	1	--	--	--	--	--	--	--	--	--	--	--	0.0099 J	--	--	--	--
	MW006R-E2	23	100	24	1	1	--	--	--	--	45,900	--	--	5,560	0.1 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	MW006R-E3	21	9	22	3	2	--	--	--	--	39,800	--	--	5,650	1.1 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	MW006R-E4	24 J	5	21 J	2	2	--	--	--	--	39,300	--	--	5,270	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	TBGW009-E1	4	--	4	2	3	--	--	--	--	3,740	--	--	310	0	--	--	--	--	--	--	--	--	--	--	--	0.05 U	--	--	--	--

Table 5-3. Groundwater, Porewater, Surface Water, and Outfall Discharge Results – Event 1 through Event 4

Location	Station ID (and Sample Depth for Porewater)	General Parameters			Metals and Speciation Data										Pentachlorophenol	Cations				Anions											
		Total Organic Carbon	Total Suspended Solids	Dissolved Organic Carbon	Arsenic (Total)	Arsenic (Dissolved)	Arsenate	Arsenite	Cacodylic acid	Monomethylarsonic acid	Iron (Dissolved)	Ferric iron	Ferrous iron	Manganese (Dissolved)		Calcium	Magnesium	Potassium	Sodium	Bromide	Chloride	Fluoride	Nitrate as N	Nitrite as N	Ortho-Phosphate	Sulfate	Sulfide	Alkalinity as Bicarbonate	Alkalinity as Carbonate	Alkalinity as Hydroxide	Alkalinity, Total
		mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Bioactive Zone Porewater (0-10 cm bml)																															
Logyard	WCTPW001A-10-E1	21	--	26	23	2	--	--	--	--	396	237	159	222	--	200 J	550	160	3,800	50 U	11,000	20 U	20 U	40 U	0.1 U	1,800	0.05 U	170	5 U	5 U	170
	WCTPW001A-10-E2	20	290	13	41	2	--	--	--	--	1,170	--	--	102	--	260	750	240	6,300	500 U	23,000	200 U	200 U	400 U	0.1 U	3,900	0.05 U	75	5 U	5 U	75
	WCTPW001A-10-E3	30	170	12	11	9	--	--	--	--	20,000	--	--	2,500	--	190	570	160	4,500	36 J	7000 J	0.2 R	0.2 U	0.4 R	0.1 UJ	1,600	0.05 U	340	5 U	5 U	340
	WCTPW001A-10-E4	39	180	22	8	5	--	--	--	--	10,800	--	--	653	--	100	320	100	2,900	10	2,760	1	0.100 UJ	0.100 UJ	0.1 U	427	0.05 U	420	5 U	5 U	420
	WCTPW001B-10-E1	9	--	14	27	2	--	--	--	--	562	487	75	1,280	--	130 J	360	130	3,100	50 U	8,900	20 U	20 U	40 U	0.1 U	1,600	0.05 U	190	5 U	5 U	190
	WCTPW001B-10-E2	11	110	10	56	71	24	50	1.05 U	1.15 U	20,800	--	--	950	--	170	480	180	4,300	500 U	7,100	200 U	200 U	400 U	0.1 U	1,600	0.05 U	150	5 U	5 U	150
	WCTPW001B-10-E3	4	67	4	21	16	--	--	--	--	7,420	--	--	1,680	--	82	240	94	2,200	50 U	4900 J	20 U	20 U	40 U	0.1 U	530	0.05 U	110	5 U	5 U	110
	WCTPW001B-10-E4	4	39	5 J	17	13	--	--	--	--	13,700	--	--	1,430	--	56	160	64	1,500	12	3,390	0	0.100 UJ	0.100 UJ	0	407	0.05 U	83	5 U	5 U	83
	WCTPW002A-10-E1	--	--	2	--	2	--	--	--	--	321	281	40	1,270	--	150 J	420	130	3,400	50 U	13,000	20 U	20 U	40 U	0.1 U	2,300	0.05 U	100	5 U	5 U	100
	WCTPW002A-10-E2	2	80	2	4	15	--	--	--	--	5,340	--	--	971	--	250	740	260	6,400	500 U	12,000	200 U	200 U	400 U	0.1 U	2,500	0.05 U	110	5 U	5 U	110
	WCTPW002A-10-E3	2	28	2	9	2	--	--	--	--	1,110	--	--	454	--	220	700	250	6,200	73	9,900 J	20 U	20 U	40 U	0.1 U	3,300	0.05 U	88	5 U	5 U	88
	WCTPW002A-10-E4	2	24	4 J	7	6	--	--	--	--	2,100	--	--	163	--	180	570	190	5,300	33	9,360	0.100 U	0.130 J	0.452 J	0	1,520	0.05 U	110	5 U	5 U	110
	WCTPW002B-10-E1	10	--	5	28	8	--	--	--	--	12,300	1,060	11,200	442	--	120 J	350	120	2,800	50 U	4,400	20 U	20 U	40 U	0.1 U	560	0.05 U	88	5 U	5 U	88
	WCTPW002B-10-E2	4	72	2	5	3	--	--	--	--	9,920	--	--	126	--	130	400	140	3,300	500 U	9,900	200 U	200 U	400 U	0.1 U	2,100	0	68	5 U	5 U	68
	WCTPW002B-10-E3	3	31	3	5	3	--	--	--	--	12,400	--	--	525	--	160	500	170	4,400	36 J	7700 J	20 U	20 U	40 U	0.1 U	1,400	0.05 U	91	5 U	5 U	91
	WCTPW002B-10-E4	3	47	4	10	8	--	--	--	--	23,800	--	--	502	--	140	410	110	3,200	21	5,520	0.100 U	0.100 UJ	0.100 UJ	0	800	0.05 U	44	5 U	5 U	44
	WCTPW003A-10-E1	5	--	6.1 J	6	5	--	--	--	--	13,200	2,020	11,200	4,270	--	160 J	330	100	2,300	50 U	6,800	20 U	20 U	40 U	0.1 U	920	0.05 U	140	5 U	5 U	140
	WCTPW003A-10-E2	4	300	5	13	11	--	--	--	--	7,340	--	--	321	--	170	500	170	5,000	500 U	8,800	200 U	200 U	400 U	0	2,000	0.05 U	130	5 U	5 U	130
	WCTPW003A-10-E3	3	39	3	20	19	--	--	--	--	16,000	--	--	1,110	--	210	640	240	6,100	40 J	9300 J	20 U	20 U	40 U	0.1 U	1,600	0.05 U	97	5 U	5 U	97
	WCTPW003A-10-E4	3	55	6	33	34	11	13	0.525 U	0.575 U	40,100	--	--	958	--	110	300	110	2,900	25	6,700	0.100 U	0.100 UJ	0.100 UJ	0.1 U	1,180	0.05 U	250	5 U	5 U	250
	WCTPW003B-10-E1	11	--	13	37	0.871 J	--	--	--	--	313	250	63	1,080	--	31 J	71	34	560	50 U	1,600	20 U	20 U	40 U	0.1 U	190	0.05 U	240	5 U	5 U	240
	WCTPW003B-10-E2	25	190	18	131	14	--	--	--	--	34,900	--	--	3,850	--	120	240	85	1,600	500 U	3,400	200 U	200 U	400 U	0.1 U	1,100 J	0.05 U	240	5 U	5 U	240
	WCTPW003B-10-E3	10	100	7	11	9	--	--	--	--	22,800	--	--	2,980	--	90	210	87	1,800	50 U	3800 J	20 U	20 U	40 U	0.1 U	380	0.05 U	150	5 U	5 U	150
	WCTPW003B-10-E4	4	86	4	14	10	--	--	--	--	11,500	--	--	1,650	--	53	100	48	1,000	6	2,030	0	0.100 UJ	0.100 UJ	0.1 U	161	0.05 U	110	5 U	5 U	110
Sawmill	WCTPW004A-10-E1	18	230	14	25	10	--	--	--	--	76,500	22,000	54,400	3,260	0	220	360	65 J	2,400	50 U	6,400	20 U	20 U	40 U	1	870	0.05 U	120	5 U	--	--
	WCTPW004A-10-E2	4	270	9	18	16	--	--	--	--	32,300	--	--	1,130	0.067 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	WCTPW004A-10-E3	9	53	5	7	6	--	--	--	--	6,970	--	--	112	0.089 U	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	WCTPW004A-10-E4	11	87	12	11	8	--	--	--	--	7,490	--	--	95	0.091 U	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	WCTPW004B-10-E1	10	190	13	2	3	--	--	--	--	13,700	2,590	11,100	1,590	0	110	270	85	2,100	50 U	3,000	20 U	20 U	40 U	0	390	0.05 U	140	5 U	--	--
	WCTPW004B-10-E2	7	230	8	6	6	--	--	--	--	31,000	--	--	1,710	0.067 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Transition Zone Porewater (40-50 cm bml)																															
Logyard	WCTPW001A-40-E1	57	--	59	28	19	--	--	--	--	51,500	16,000	35,500	3,240	--	73 J	65	27 J	270	0.5 U	390	1	0.11 J	0.4 U	0.1 U	13	0.05 U	710	5 U	5 U	710
	WCTPW001A-40-E2	20	310	18	17	20	--	--	--	--	25,700	--	--	1,850	--	59	70	32	320	0.5 U	670	0.2 U	20 U	40 U	0.1 U	95	0	440	5 U	5 U	440
	WCTPW001B-40-E1	24	--	6	74	49	21	29	1.05 U	1.15 U	21,200	3,000 U	20,600	1,810	--	80 J	200	79	1,800	50 U	6,400	20 U	20 U	40 U	0.1 U	1,000	0.05 U	91	5 U	5 U	91
	WCTPW001B-40-E2	10	380	11	80	119	46	73	2.1 U	2.3 U	29,100	--	--	1,220	--	77	190	79	1,700	500 U	3,400	200 U	200 U	400 U	0.1 U	990 J	0	310	5 U	5 U	310
	WCTPW002A-40-E1	4	--	5	3	1	--	--	--	--	3,270	750 U	3,270	133	--	76 J	220	98	1,900	50 U	5,400	20 U	20 U	40 U	0.1 U	690	0.05 U	68	5 U	5 U	68
	WCTPW002A-40-E2	3	330	3	5	7	--	--	--	--	18,300	--	--	248	--	210	600	220	5,400	500 U	11,000	200 U	200 U	400 U	0.1 U	2,200	0	80	5 U	5 U	80
	WCTPW002B-40-E1	6	--	8	6	4	--	--	--	--	22,700	3,090	19,600	446	--	120 J	320	100	2,600	50 U	4,800	20 U	20 U	40 U	0.1 U	610	0.05 U	140	5 U	5 U	140
	WCTPW002B-40-E2	3	270	4	7	10	--	--	--	--	25,600	--	--	382	--	84	240	110	2,300	500 U	8,200	200 U	200 U	400 U	0.1 U	1,900	0.036 J	90	5 U	5 U	90
	WCTPW003A-40-E1	9	3,400	2	7	1	--	--	--	--	7,090	876	6,220	3,800	--	210	500	160	3,800	50 U	4,300	20 U	20 U	40 U	0	540	0.05 U	260	5 U	--	--
	WCTPW003A-40-E2	14	550	11	13	13	--	--	--	--	39,200	--	--	4,780	--	110	230	84	1,500	500 U	5,600	200 U	200 U	400 U	0.1 U	1,500	0.05 U	300	5 U	5 U	300
	WCTPW003B-40-E1	16	3,800	12	10	4	--	--	--	--	15,700	2,830	12,900	2,640	--	51	87	37	650	50 U	2,200	20 U	20 U	40 U	0	230	0	310	5 U	--	--
	WCTPW003B-40-E2	18	540	35	16	43	12	32	1.05 U	1.15 U	17,500	--	--	1,050	--	36	72	46	720	250 U	1,800	100 U	100 U	200 U	0.1 U	510 J	0	430	5 U	5 U	430
Sawmill	WCTPW004A-40-E1	17	440	11	13	2	--	--	--	--	7,620	1,780	5,840	886	0	16	32	13	200	0.5 U	400	0	0	0.4 U	0	32	0.05 U	76	5 U	--	--
	WCTPW004A-40-E2	10	380	11	13	6	--	--	--	--	19,500	--	--	1,320	0.061 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	WCTPW004B-40-E1	15	2,500	10	11	4	--	--	--	--	9,660	1,900	7,760	1,140	0	71	68	21	540	5 U	860	2 U	2 U	4 U	0	72	0.05 U	130	5 U	--	--
	WCTPW004B-40-E2	20	290	18	13	12	--	--	--	--	13,300	--	--	1,100	0.07 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 5-3. Groundwater, Porewater, Surface Water, and Outfall Discharge Results – Event 1 through Event 4

		General Parameters			Metals and Speciation Data											Cations				Anions											
Location	Station ID (and Sample Depth for Porewater)	Total Organic Carbon	Total Suspended Solids	Dissolved Organic Carbon	Arsenic (Total)	Arsenic (Dissolved)	Arsenate	Arsenite	Cacodylic acid	Monomethylarsonic acid	Iron (Dissolved)	Ferric iron	Ferrous iron	Manganese (Dissolved)	Pentachlorophenol	Calcium	Magnesium	Potassium	Sodium	Bromide	Chloride	Fluoride	Nitrate as N	Nitrite as N	Ortho-Phosphate	Sulfate	Sulfide	Alkalinity as Bicarbonate	Alkalinity as Carbonate	Alkalinity as Hydroxide	Alkalinity, Total
		mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Outfall Discharge																															
Logyard	OF2-E1	9	--	2	734	109	--	--	--	--	1,270	--	--	2,060	--	--	--	--	--	--	--	--	--	--	--	--	0.05 U	--	--	--	--
	OF2-E2	12	21	8	93	39	--	--	--	--	9.73 J	--	--	441	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	OF2-E3	5	34	5	974	850	--	--	--	--	4,850	--	--	1,000	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	OF2-E4	2	2 U	1.9 J	305	315	--	--	--	--	2,580	--	--	140	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	OF3-E1	16	--	15	1,300	444	--	--	--	--	446	--	--	2,740	--	--	--	--	--	--	--	--	--	--	--	--	0.05 U	--	--	--	--
	OF3-E2	18	39	19	415	284	--	--	--	--	7.75 J	--	--	334	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	OF3-E3	4	14	4	275	255	--	--	--	--	1,230	--	--	481	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	OF3-E4	2	14	2 J	90	88	--	--	--	--	766	--	--	54	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Surface Water																															
Background	BWSW001-E1	2	--	2	1.79 J	1	--	--	--	--	21.5 U	21.5 U	9.8 J	8	--	280	900	290	9,400	100 U	15,000	40 U	40 UJ	80 UJ	0.1 U	2,000	0.05 U	86	5 U	5 U	86
	BWSW001-E2	5	19	2	2	1	--	--	--	--	21.5 U	--	--	15	--	260	790	250	6,200	45	13,000	1.9 J	8	0.4 U	0.1 U	3,200	0.05 U	86	5 U	5 U	86
	BWSW001-E3	1	5	2	2	3	--	--	--	--	11.1 J	--	--	18	--	270	910	290	8,200	0.5 U	18,000	37	6	0.4 U	0	2,700	0.05 UJ	110	12	5 U	130
	BWSW001-E4	2	7	1.5 J	3	3	--	--	--	--	21.5 U	--	--	8	--	310	1,100	320	9,100	120	16,000	20 UJ	20 UJ	40 U	0	6,300	0.05 U	95	5 U	5 U	95
	USSW001-E1	2	--	2	0.73 J	0.495 J	--	--	--	--	191	129	61	28	--	21	11	2.3 J	10	0.5 U	10	0.2 U	2	0.4 U	0	11	0.05 U	90	5 U	5 U	90
	USSW001-E2	2	2	2	0.702 J	0.533 J	--	--	--	--	125	--	--	18	--	23	13	2.7 J	10	0.5 U	32	0.2 U	2	0.4 U	0.1 U	14	0.05 U	96	5 U	5 U	96
	USSW001-E3	8	7	8	2	0.808 J	--	--	--	--	738	--	--	54	--	16	7	5	8	0.5 U	6	0.2 U	1	0.4 U	0.1 U	7	0.05 U	88	5 U	5 U	88
	USSW001-E4	5	11	4.5 J	0.570 J	0.858 J	--	--	--	--	497	--	--	76	--	17	8	4	10	0.5 U	9.1 J	0.06 J	1.5 J	0.4 U	0.1 U	6.8 J	0.05 U	64	5 U	5 U	64
Logyard	WCTSW001B-E1	4	--	4	3	2	--	--	--	--	917	311	606	217	--	41	83	27	670	50 U	1,300	20 U	1	40 UJ	0.1 U	200	0.05 U	130	5 U	5 U	130
	WCTSW001B-E2	4	110	3	10	2	--	--	--	--	560 J	--	--	128	--	42	91	31	720	5	1,500	0	2	0.4 U	0.1 U	180	0.05 U	140	5 U	5 U	140
	WCTSW001B-E3	6	210	6	12	0.922 J	--	--	--	--	777	--	--	130	--	39	73	25	570	3	900	2	1	0.4 U	0.1 U	140	0.05 U	130	5 U	5 U	130
	WCTSW001B-E4	6	190	4.5 J	11	0.506 J	--	--	--	--	630	--	--	117	--	23	31	12	250	0.5 U	450	0.2 U	0.2 U	0.4 U	0.1 U	61	0.05 U	62	5 U	5 U	62
	WCTSW002B-E1	4	--	3	4	2	--	--	--	--	702	266	437	169	--	33	59	19	420	50 U	950	20 U	1	40 UJ	0	130	0.05 U	120	5 U	5 U	120
	WCTSW002B-E2	4	49	4	4	0.903 J	--	--	--	--	495	--	--	118	--	38	77	26	580	4	1,200	0.19 J	2	0.4 U	0.1 U	150	0.05 U	130	5 U	5 U	130
	WCTSW002B-E3	6	92	6	3	1	--	--	--	--	885	--	--	109	--	30	45	16	330	2	580	0.2 U	1	0.4 U	0.1 U	87	0.05 U	120	5 U	5 U	120
	WCTSW002B-E4	6	51	4.5 J	4	2	--	--	--	--	724	--	--	108	--	20	23	8	150	0.5 U	250	0.2 U	0.2 U	0.4 U	0.1 U	32	0.05 U	62	5 U	5 U	62
	WCTSW003B-E1	4	--	3	8	2	--	--	--	--	781	192	589	179	--	35	59	19	430	50 U	890	20 U	1	40 UJ	0	140	0.05 U	120	5 U	5 U	120
	WCTSW003B-E2	3	37	3	3	1	--	--	--	--	564	--	--	111	--	37	74	25	570	4	1,100	0.17 J	2	0.4 U	0.1 U	140	0.05 U	130	5 U	5 U	130
	WCTSW003B-E3	5	30	6	2	1	--	--	--	--	834	--	--	110	--	43	88	31	720	4	1,200	4	1	0.4 U	0.1 U	170	0.05 U	130	5 U	5 U	130
	WCTSW003B-E4	5	54	4.9 J	2	1	--	--	--	--	669	--	--	106	--	22	30	10	200	1	360	0.2 U	1	0.4 U	0.1 U	54	0.05 U	61	5 U	5 U	61
Sawmill	WCTSW004B-E1	3	--	3	0.92 J	0.432 J	--	--	--	--	201	194	7 J	65	0.021 U	19	16	5	64	0.5 U	120	0.09 J	2	0.4 U	0	23	0.05 U	96	5 U	--	--
	WCTSW004B-E2	2	15	2	2	0.402 J	--	--	--	--	218	--	--	36	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	WCTSW004B-E3	6	41	6	2	0.892 J	--	--	--	--	812	--	--	71	0.059 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	WCTSW004B-E4	5	50	4.7 J	1	1	--	--	--	--	728	--	--	89	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:
-- = Not measured
bml = Below mudline
cm = centimeter
mg/kg = milligrams per kilogram
mg/L = micrograms per liter
ug/L = micrograms per liter
J = Estimated result.
U = Non-detected result, reported at the Practical Quantitation Limit (PQL).
UJ = Combined qualifier.

Table 6-1. Screening Levels in Soil

Analyte	Units	Screening Level Values[1] for Soil: Relevant Comparison Criteria: MTCA A Industrial (WAC 173-340)	MTCA C for Soil (WAC 173-340): Non cancer	MTCA C for Soil (WAC 173-340): Cancer	Natural Soil Background (ECY 94-115)	Ecological Screening Level	Human Health Screening Level
Pentachlorophenol	mg/kg	--	17,500	328	--	N/A - TEE Exemption	328
Dioxins/Furans (TCDD/F TEQ[2])	pg/g	--	4,080	1,683	5.2[4]	N/A - TEE Exemption	1,683
Arsenic	mg/kg	20	1,050	87.5	7.30[5]	N/A - TEE Exemption	20
Iron[3]	mg/kg	--	2,450,000	--	36,128[5]	N/A - TEE Exemption	2,450,000

Notes

[1] Blank cells indicate a screening level value is not published for the given analyte. MTCA values will be applied to upland soil samples. Screening levels for soil leaching to groundwater are not considered because both Site groundwater and surface water are and non-potable.

[2] When establishing and determining compliance with cleanup levels and remediation levels for mixtures of dioxin congeners (CDDs) and furan congeners (CDFs) under the MTCA Cleanup Regulation (WAC 173-340-708[8][d]), the mixture shall be considered a single hazardous substance. Dioxin and furan toxic equivalents (TEQs) were calculated using the 2005 World Health Organization consensus toxicity equivalency factors (TEF) relative to 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD or TCDD) or 2,3,7,8-tetrachlorodibenzo-p-furan (2,3,7,8-TCDF or TCDF) values for mammals, as described in Washington Department of Ecology guidance document entitled, “Evaluating the Toxicity and Assessing the Carcinogenic Risk of Environmental Mixtures Using TEFs” (Ecology, 2006). TEQs were calculated as the sum of each congener concentration (or PQL for non-detects) multiplied by the corresponding TEF value (In Table 2 of Ecology, 2006). <https://fortress.wa.gov/ecy/clarc/FocusSheets/tef.pdf>.

[3] Analysis is being performed to develop the geochemical conceptual site model and understand fate and transport of chemicals at the site. Not considered an indicator hazardous substance for the Site.

[4] Natural Background for Dioxins/Furans in WA Soils. Technical Memorandum #8. Washington Department of Ecology. Publication No. 10-09-053. August 9, 2010. Value listed is 2,3,7,8-TCDD toxic equivalent.

[5] 90th percentile concentration for the Puget Sound. Natural Background Soil Metals Concentrations in Washington State. Toxics Cleanup Program. Washington Department of Ecology. Pub #94-115. October 1994.

Green Highlighting = Preliminary Human Health Screening level

Table 6-2. Screening Levels in Sediment

Analyte	Units	Screening Level Values for Bioactive Zone Sediment (0-10 cm bml)					
		Relevant Comparison Criteria				Ecological Screening Level	Human Health Screening Level
		Washington Marine Sediment Quality Standards[1] (WAC 173-204-562)		Practical Quantitation Limit (PQL)[2]	Natural Sediment Background		
		Sediment Cleanup Objective	Cleanup Screening Level	(SCUM II)	(SCUM II)		
Pentachlorophenol	mg/kg	0.360	0.690	0.355	--	0.360	0.355
Arsenic	mg/kg	57	93	--	11[3]	57	11[3]

Notes

-- = Not available or not applicable

[1] The Washington Sediment Management Standards (2013) define freshwater sediment as surface sediments in which the sediment pore water contains less than or equal to 0.5 parts per thousand (ppt) salinity, and marine sediment pore water contains 25 ppt salinity or greater. Site sediment is expected to be classified as marine.

[2] Average Sediment Practical Quantitation Limit (PQL) intended to be used as a guide for sediment natural background values for Puget Sound, from Table D-1 of the Sediment Cleanup Users Manual II, Department of Ecology, March 2015 (SCUM II). Under MTCA rules, cleanup levels that fall below the PQL of a substance that is analyzed using appropriate sampling and analytical procedures and has a PQL that is no greater than ten times the method detection limit (MDL), then the cleanup level shall considered to have been attained . Therefore, the PQL will be the lowest screening level value applied to the data.

[3] 90/90 Upper Tolerance Limit, intended to be used as a guide for sediment natural background values for Puget Sound, from Table 10-1 of the Sediment SCUM II, Department of Ecology, March 2015.

Yellow Highlighting = Preliminary Ecological Screening Level

Green Highlighting = Preliminary Human Health Screening level

Table 6-3. Screening Levels in Groundwater, Porewater, Outfall Discharge, and Surface Water

		Screening Level Values[1]																
Criteria Applied to Groundwater:									x	x							Groundwater	
Criteria Applied to Bioactive Zone Porewater:		x	x						x	x					Bioactive Zone Porewater (0-10 cm bml)			
Criteria applied to Outfall Discharge:		x	x						x	x			Outfall Discharge					
Criteria Applied to Surface Water:		x	x	x	x	x	x	x	x	x	Surface Water							
		Aquatic Toxicity		Relevant Human Health Comparison Criteria														
		Water Quality Standards For Surface Waters of the State of Washington (WAC 173-201A)		*New CWA Effective Criteria*[2] Water Quality Standards For Surface Waters of the State of Washington (WAC 173-201A)		NTR 40 CFR 131	MTCA B for Surface Water (WAC 173-340)											
Analyte	Units	Marine Water Acute	Marine Water Chronic	Water & Organism	Organisms Only	Marine Water Fish Consumption	Non cancer	Cancer	MTCA Method A, Background Value	Practical Quantitation Limit (PQL)	Ecological Screening Level[4]	Human Health Screening Level[5]	Ecological Screening Level[4]	Human Health Screening Level[5]	Ecological Screening Level[4]	Human Health Screening Level[5]	Ecological Screening Level[4]	Human Health Screening Level[5]
Pentachlorophenol	ug/L	13.0	7.9	0.002	0.002	8.2	1180	1.47	--	1.0	7.9	1.0	7.9	N/A	7.9	N/A	N/A	N/A
Arsenic	ug/L	69	36	0.018	0.14	0.14	17.7	0.0982	5[3]	--	36	5[3]	36	N/A	36	5[3]	N/A	5[3]

Notes

-- = Not available or not applicable

1 Screening levels for drinking water scenarios are not considered because both Site groundwater and surface water are brackish and non-potable

2 Updated Water Quality Standards for Surface Waters Of the State of Washington, WAC 173-201A, are currently undergoing review, including the development of human health criteria. A partial approval/disapproval of Washington's Human Health Water Quality Criteria and Implementation Tools was issued by EPA Region 10 on November 15, 2016.

3 Under MTCA, cleanup levels are not established below natural background levels. Although arsenic occurs naturally in the environment, a background number has not been established by Ecology. Therefore, the MTCA Method A value for groundwater is used as surrogate for the natural background concentration of arsenic in groundwater and marine surface water, and is the lowest screening level value applied to the data. This number may underestimate the natural regional groundwater concentrations and may be refined as groundwater background studies advance. Based on a 1989 Ecology study, *Background Concentrations of Selected Chemicals in Water, Soil, Sediments, and Air of Washington State* (PTI Environmental Services, 1989), a regional background concentration of 8 ug/L represents the 90th percentile of groundwater data collected as part of the study. Systematic background studies quantifying natural background arsenic concentrations in sediment porewater along marine shorelines have not been performed, though geochemical processes are known to cause elevated arsenic levels in the shoreline transition zone as described in Section 8.3 of this RI Report.

4 Aquatic toxicity values are typically applied to dissolved arsenic concentrations however comparison to both total and dissolved arsenic are made in this RI Report, and discussed in Section 6.

5 Human health criteria are typically applied to total arsenic concentrations however comparison to both total and dissolved arsenic are made in this RI Report, and discussed in Section 6.

Yellow Highlighting = Preliminary Ecological Screening Level

Green Highlighting = Preliminary Human Health Screening level

Table 6-4. Screening Levels for Indoor Air

		Screening Level Values for Indoor Air		
		Relevant Comparison Criteria		
Analyte	Units	MTCA Air Quality Guidance (WAC 173-340)	Ecological Screening Level	Human Health Screening Level
Methane	% by Volume	0.5[1]	TEE Exemption	0.5

Notes

[1] MTCA sets a standard of 10 % of the lower explosive limit (LEL) for all VOCs. Methane's LEL is 5% so a screening level of 0.5%.

Green Highlighting = Preliminary Human Health Screening level

Table 7-1. RI Soil Screening Results

Location	Sample ID	Arsenic (Total)	Iron (Total)	Dioxin Furan TCDD/F TEQ[1]	Pentachlorophenol
	Units	*mg/kg*	*mg/kg*	*pg/g*	*mg/kg*
	Lowest Screening Level (see Table 6.1)	*20* [2]	*2,450,000* [3]	*1,683* [4]	*328* [4]
	Secondary Screening Level (see Table 6.1)	*87.5* [4]	--	--	--
Log Yard	***Monitoring Wells***				
	MWS007-9_10	2.69	12,100	--	--
	MWS008-11.5_12.5	72.9	17,000	--	--
	MWS009-11_12	1.23	14,700	--	--
	MWS010-12_13	237	20,200	--	--
	MWS011-13_14	2.98	18,000	--	--
	MWS012-11.5_12.5	0.936	21,700	--	--
	MWS013-12.5_13.5	7.91 J	24,100	--	--
	Temporary Borings				
	TBS001-11_12	12.7	24,200	--	--
	TBS002-12.5_13.5	7.68	26,200	--	--
	TBS003-14_15	3.92	23,100	--	--
	TBS004-12_13	6.46	15,300	--	--
	TBS005-17_18	1.55	16,500	--	--
	TBS006-13_14	92.3	22,500	--	--
	TBS007-16.5_17.5	1.1	14,600	--	--
	TBS008-13_14	4.6	19,800	--	--
Sawmill	***Monitoring Wells***				
	MWS005R-10.5_11.5	5.81	16,500	200 JT	0.56 J
	Temporary Borings				
	TBS009-12_13	8.84 J	17,000	--	0.016 J
	TBS009-7.4_8.4	1.52	11,100	--	0.015 J
	TBS009-8.8_9.8	5.77	34,600	--	0.027 J
	Test Pits				
	TPS001-0.5_1.5	3.93	20,800	6.8 JT	0.018 J
	TPS001F-1.5_2.5	27.5	24,800	5.5 JT	0.018 J
	TPS001TB-12_13	1.67	13,300	--	0.015 J
	TPS002-0.5_1.5	2.97	20,200	4.9 JT	0.014 J
	TPS002-10.5_12.5	4.8	18,400	--	0.019 J
Screening Summary					
	Number of Samples Analyzed	24	24	4	9
	No. of Detected Exceedances of Lowest Screening Level	4	0	0	0
	No. of Detected Exceedances of Secondary Screening Level	2	0	0	0

Notes:

Blue highlighted values indicate exceedance of lowest Screening Level

Orange highlighted values indicate exceedance of Sediment Quality Objective

Table 7-1. RI Soil Screening Results

Notes (Continued):

[1] When establishing and determining compliance with cleanup levels and remediation levels for mixtures of dioxin congeners (CDDs) and furan congeners (CDFs) under the MTCA Cleanup Regulation (WAC 173-340-708[8][d]), the mixture shall be considered a single hazardous substance. Dioxin and furan toxic equivalents (TEQs) were calculated using the 2005 World Health Organization consensus toxicity equivalency factors (TEF) relative to 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD or TCDD) or 2,3,7,8-tetrachlorodibenzo-p-furan (2,3,7,8-TCDF or TCDF) values for mammals, as described in Washington Department of Ecology guidance document entitled, "Evaluating the Toxicity and Assessing the Carcinogenic Risk of Environmental Mixtures Using TEFs" (Ecology, 2006). TEQs were calculated as the sum of each congener concentration (or PQL for non-detects) multiplied by the corresponding TEF value (In Table 2 of Ecology, 2006). <https://fortress.wa.gov/ecy/clarc/FocusSheets/tef.pdf>.

[2] Screening level based on MTCA A Industrial (WAC 173-340)

[3] Screening level based on MTCA C Non-Cancer (WAC 173-340)

[4] Screening level based on MTCA C Cancer (WAC 173-340)

-- = Not analyzed or not applicable

mg/kg = milligrams per kilogram

pg/g = pictogram per gram

J = Estimated result.

T = Calculated Value.

JT = Combined Qualifier.

Table 7-2. 2014 Sediment Cap Investigation Soil Screening Results

Layer/Material Sampled			AQ-B1	AQ-B2	AQ-B3	AQ-B4	AQ-B5	AQ-B6	AQ-B7	AQ-B8	AQ-B9	AQ-B10	AQ-B11	AQ-B12	AQ-B13	AQ-B14	AQ-B15	AQ-B16
			Boring ID and Total Arsenic Concentration															
	Depth to base of slag (inches):		84	92	82	90	nv	84	80	85	87	106	70	113	80	87	80	89
Gravel base course layer	(6-12" above slag)	*mg/kg*	3.2	3.3	4.0	3.4	4.3	3.4	3.9	2.8	4.4	3.2	3.0	3.5	3.1	4.5	3.6	3.6
Wood/slag layer sample	(within slag layer)	*mg/kg*	--	--	236	--	--	414	--	--	--	--	--	--	--	--	--	--
Slag/soil transition layer	(0-6" below slag)	*mg/kg*	272	210	437	398	2.0*	347	328	334	340	390	433	316	386	96.4	244	430
Soil beneath slag layer	(6-12" below slag)	*mg/kg*	192	356	91	124	1.0*	200	180	61	154	346	177	194	322	23.8	4.8	250
Soil beneath slag layer	(12-18" below slag)	*mg/kg*	167	253	333	684		9.4	66.4		59.7	711	4.2	--	68.1		0.9	305
Soil beneath slag layer	(18-24" below slag)	*mg/kg*	94.5	59.2	101	374						--		--				157
Soil beneath slag layer	(24-30" below slag)	*mg/kg*			--	--						--						--
Soil beneath slag layer	(30-36" below slag)	*mg/kg*				--												
Estimated depth to soil below MTCA Method C Cleanup Level (inches below slag)			18	18	24	30	0	12	12	6	12	24	12	18	12	6	6	24
Depth interval meeting MTCA Method C Cleanup Level Confirmed? (yes/no)			yes	yes	no**	no***	yes	yes	yes	yes	yes	no***	yes	no***	yes	yes	yes	no**

Layer/Material Sampled			AQ-B17	AQ-B18	AQ-B19	AQ-B20	AQ-B21	AQ-B22	AQ-B23	AQ-B24	AQ-B25	AQ-B26	AQ-B27	AQ-B28	AQ-B29	AQ-B30	AQ-B32	AQ-B33
			Boring ID and Total Arsenic Concentration															
	Depth to base of slag (inches):		74	72	48	102	85	91	82	100	48	110	58	84	77	62	78	57
Gravel base course layer	(6-12" above slag)	*mg/kg*	8.1	3.9	3.3	4.0	3.8	3.8	3.9	3.4	3.9	3.0	3.1	4.2	8.4	3.8	3.7	3.1
Wood/slag layer sample	(within slag layer)	*mg/kg*	1910	--	--	1360	--	--	334	--	--	--	--	--	--	--	--	165
Slag/soil transition layer	(0-6" below slag)	*mg/kg*	185	282	5.1	236	544	288	298	271	240	600	337	304	22.9	486	97.8	7.7
Soil beneath slag layer	(6-12" below slag)	*mg/kg*	148	91	1.9	215	14.8	240	241	444	149	146	475	104	1.6	27.1	31.3	1.7
Soil beneath slag layer	(12-18" below slag)	*mg/kg*	151	21.1		172		357	130	405	109	--	224	90.1	1.1	6.3	3.3	0.7
Soil beneath slag layer	(18-24" below slag)	*mg/kg*	10.4			--		278	126	1480	125		91.9					
Soil beneath slag layer	(24-30" below slag)	*mg/kg*						--	--	--	--							
Soil beneath slag layer	(30-36" below slag)	*mg/kg*						--		--								
Estimated depth to soil below MTCA Method C Cleanup Level (inches below slag)			18	12	0	18	6	30	24	30	24	12	18	12	0	6	6	0
Depth interval meeting MTCA Method C Cleanup Level Confirmed? (yes/no)			yes	yes	yes	no**	yes	no***	no**	no***	no**	no**	yes	yes	yes	yes	yes	yes
Arsenic Concentration in Soil intervals meeting MTCA Method C Cleanup Level				36.9	average of 21 samples													
Average estimated depth to soil below MTCA Method C Cleanup Level (inches below slag)				14	average of 32 samples													

Notes:

- Gravel base course
- Fill containing slag
- Estimated top of depth interval meeting MTCA Method C Cleanup Level (87.5 mg/kg)
- Estimated top of depth interval meeting MTCA Method A Cleanup Level (20 mg/kg)

Black Result complies with the MTCA Method C Cleanup Level.

Blue Result exceeds the MTCA Method C Cleanup Level on a point by point basis but soils comply with MTCA compliance tests at the Method C Cleanup Level considering existing data along with the previous Landau soil testing data.

Red Result exceeds the MTCA Method C Cleanup Level based on MTCA compliance tests.

mg/kg milligram per kilogram dry weight

MTCA Model Toxics Control Act

* Sample interval was disturbed

no** Deepest sample analyzed exceeded the MTCA Method C cleanup level by less than two times. Contaminated layer assumed to extend to base of sample.

no*** Deepest sample analyzed exceeded the MTCA Method C cleanup level by more than two times. Contaminated layer assumed to extend to base of next sample interval (i.e., additional 6 inches assumed to be contaminated).

This table was modified from Table 2 of the Log Yard Soil Testing Report (AQEA, 2014).

Table 7-3. 2013 Sediment Cap Investigation Soil Screening Results

		Boring ID and Total Arsenic Concentration (mg/kg)														
Layer/Material Sampled		**PORTAC-01**	**PORTAC-02**	**PORTAC-03**	**PORTAC-04**	**PORTAC-05**	**PORTAC-06**	**PORTAC-07**	**PORTAC-08**	**PORTAC-09**	**PORTAC-10**	**PORTAC-11**	**PORTAC-12**	**PORTAC-13**	**PORTAC-14**	**PORTAC-15**
Depth to base of slag (inches)		48	68	52	31	38	65	65	95	83	83	71	36	82	77	78
>12" above slag	*mg/kg*	--	5.4	--	--	--	4.2*			2.6*	3.3*	--	--	--	--	--
>6" above slag	*mg/kg*	3.9	4.6	3.2	4.4*	3.2*	--	6.5*	3.9*	--	--	--	5.0	5.8	3.5	9.0
<6" above slag	*mg/kg*	4.5	--	3.7	4.4*	**103***	3.9*	3.7*	3.2*	3.8*	4.1*	3.2	9.2	3.9	4.5	41.9
Wood/slag layer sample	*mg/kg*	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
0-6" below slag	*mg/kg*	**--**	**--**	**--**	**5.4**	**2.6**	**6.9**	**230**	**615**	**151**	**--**	**62.8**	**86.4**	**24.3**	**172**	**359**
6-12" to 8-14" below slag	*mg/kg*	**--**	**--**	**--**	**--**	**--**	**1.1**	**46.2**	**137**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
10-16" to 12-18" below slag	*mg/kg*	**--**	**7.0**	**--**	**1.0**	**--**	**--**	**--**	**68.6**	**25.7**	**71.3**	**--**	**--**	**--**	**--**	**--**
>15" below slag	*mg/kg*	**--**	**9.1**	**1.6**	**--**	**--**	**7.0**	**--**	**--**	**3.9**	**--**	**--**	**--**	**11**	**--**	**--**
>24" below slag	*mg/kg*	**--**	**2.6**	**2.4**	**--**	**35.8**	**--**	**--**	**18.3**	**--**	**--**	**--**	**6.0**	**--**	**--**	**--**
>30"below slag	*mg/kg*	**2.4**	**4.3**	**2.3**	**0.6**	**1.4**	**--**	**62.4**		**25.0**	**--**	**--**	**4.3**	**--**	**--**	**--**
>40"below slag	*mg/kg*	**--**					**--**				**--**	**--**	**--**	**--**	**86.4**	**1.4**
>50"below slag	*mg/kg*	**--**			**--**	**--**	**--**	**--**			**--**	**--**	**1.1**	**--**	**--**	**--**
>60"below slag	*mg/kg*	**--**			**4.9**	**2.3**	**--**	**3.7**			**1.9**	**--**		**--**	**--**	**--**
>70"below slag	*mg/kg*	**1.4**									**--**	**2.2**		**1.2**	**--**	**--**
>90"below slag	*mg/kg*	**--**									**--**	**3.0**		**--**	**2.9**	**2.8**
>100"below slag	*mg/kg*	**--**									**3.8**	**--**		**4.1**	**24.6**	**6.2**
>120"below slag	*mg/kg*	**--**									**4.9**	**--**				
>140"below slag	*mg/kg*	**1.2**										**41.4**				
>150"below slag	*mg/kg*	**2.1**														
Estimated depth to soil below MTCA Method C Cleanup Level (inches below slag)		< 30 *	< 12	< 15	0	0	0	8	12	10	< 11	0	0	0	< 40*	< 40*
Depth interval meeting MTCA Method C Cleanup Level Confirmed? (yes/no)		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Average Arsenic Concentration in Soil intervals meeting MTCA Method C Cleanup Level		33.3	average of 15 samples													
Average estimated depth to soil below MTCA Method C Cleanup Level (inches below slag)		6	average of 12 samples													

Notes:
- (blue shading) - Gravel base course
- (green shading) - Fill containing slag
- (orange shading) - Estimated top of depth interval meeting MTCA Method C Cleanup Level (87.5 mg/kg)
- (pink shading) - Estimated top of depth interval meeting MTCA Method A Cleanup Level (20 mg/kg)

Black Result complies with the MTCA Method C Cleanup Level.
Blue Result exceeds the MTCA Method C Cleanup Level on a point by point basis but soils comply with MTCA compliance tests at the Method C Cleanup Level.
Red Result exceeds the MTCA Method C Cleanup Level based on MTCA compliance tests.
mg/kg milligram per kilogram dry weight
MTCA Model Toxics Control Act
* sample not used in estimate of average thickness due to lack of sampling data in first 1-2 feet below slag layer.
This table was modified from Table 3 of the Log Yard Soil Testing Report (AQEA, 2014).

Table 7-4. Bioactive Zone Sediment Screening Results

Location	Sample ID	Arsenic (Total)	Pentachlorophenol
	Units	*mg/kg*	*mg/kg*
	Lowest Screening Level (Background or PQL; Table 6-2)	*11* [1]	*0.355* [2]
	Secondary Screening Level (SCO; Table 6-2)	*57* [3]	*0.360* [3]
Logyard	***Wapato Creek Transect 1 (WCT-1)***		
	WCTSD001A-0_10	2.28	--
	WCTSD001B-0_10	13.6 [1]	--
	Wapato Creek Transect 2 (WCT-2)		
	WCTSD002A-0_10	10.3	--
	WCTSD002B-0_10	9.08	--
	Wapato Creek Transect 3 (WCT-3)		
	WCTSD003A-0_10	4.49	--
	WCTSD003B-0_10	5.01	--
	Surface Weighted Average Concentration [1]	7.0	
Sawmill	***Wapato Creek Transect 4 (WCT-4)***		
	WCTSD004A-0_10	2.53	0.016 J
	WCTSD004B-0_10	6.21	0.018 J
Screening Summary			
	Number of Samples Analyzed	9	2
	No. of Detected Exceedances of Lowest Screening Level	0[1]	0
	No. of Detected Exceedances of Secondary Screening Level	0	0

Notes:

Blue highlighted values indicate exceedance of lowest Screening Level

Orange highlighted values indicate exceedance of Sediment Quality Objective

[1] Screening level represents natural sediment background. 90/90 Upper Tolerance Limit, intended to be used as a guide for sediment natural background values for Puget Sound, from Table 10-1 of the Sediment SCUM II, Department of Ecology, March 2015. This Human Health Screening Level in sediment is to be compared to the surface weighted average concentration (SWAC) in Wapato Creek, rather than to point-by-point results.

[2] Average Sediment Practical Quantitation Limit (PQL) intended to be used as a guide for sediment natural background values for Puget Sound, from Table D-1 of the Sediment Cleanup Users Manual II, Department of Ecology, March 2015 (SCUM II). Under MTCA rules, cleanup levels that fall below the PQL of a substance that is analyzed using appropriate sampling and analytical procedures and has a PQL that is no greater than ten times the method detection limit (MDL), then the cleanup level shall considered to have been attained . Therefore, the PQL will be the lowest screening level value applied to the data.

[3] Screening level represents the Sediment Cleanup Objective (SCO) from the Washington Marine Sediment Quality Standards (WAC 173-204-562).

-- = Not analyzed or not applicable

mg/kg = milligram per kilogram

PQL = Practical Quantitation Limit

WAC = Washington Administrative Code

J = Estimated result.

Table 7-5. Groundwater Screening Results

Location	Sample ID	Arsenic (Total)	Arsenic (Dissolved)	Pentachlorophenol
	Units	*ug/L*	*ug/L*	*ug/L*
	Lowest Screening Level (Background or PQL; Table 6-3)	*5* [1]	*5* [1]	*1* [2]
	Secondary Screening Level (Chronic Aquatic Toxicity Values; Table 6-3)	*36* [3]	*36* [3]	*7.9* [3]
	Monitoring Wells			
Logyard	B001R-E1	75,600	54,400	--
	B001R-E2	66,300	79,800	--
	B001R-E3	70,400	72,400	--
	B001R-E4	60,000	47,500	--
	B003R-E1	346	251	--
	B003R-E2	403	373	--
	B003R-E3	264	251	--
	B003R-E4	266	239	--
	B006R-E1	61	62	--
	B006R-E2	69	53	--
	B006R-E3	123	80	--
	B006R-E4	74	66	--
	HC002-E1	43,300	37,200	--
	HC002-E2	48,400	47,100	--
	HC002-E3	23,800	22,900	--
	HC002-E4	14,000	13,600	--
	MW007-E1	21	22	--
	MW007-E2	26	28	--
	MW007-E3	16	13	--
	MW007-E4	1 J	1	--
	MW008-E1	28	24	--
	MW008-E2	13	72	--
	MW008-E3	29	28	--
	MW008-E4	29	23	--
	MW009-E1	73	87	--
	MW009-E2	54	55	--
	MW009-E3	96	84	--
	MW009-E4	83	74	--
	MW010-E1	45,800	37,000	--
	MW010-E2	33,700	32,000	--
	MW010-E3	53,500	55,400	--
	MW010-E4	34,500	34,300	--
	MW011-E1	30	28	--
	MW011-E2	34	24 J	--
	MW011-E3	27	30	--
	MW011-E4	20	19	--
	MW012-E1	19	17	--
	MW012-E2	15	10 J	--
	MW012-E3	39	37	--
	MW012-E4	18	15	--
	MW013-E1	33,700	34,300	--
	MW013-E2	36,800	33,100	--
	MW013-E3	8,630	8,280	--
	MW013-E4	6,540	6,370	--

Table 7-5. Groundwater Screening Results

Location	Sample ID	Arsenic (Total)	Arsenic (Dissolved)	Pentachlorophenol
	Units	*ug/L*	*ug/L*	*ug/L*
	Lowest Screening Level (Background or PQL; Table 6-3)	*5* [1]	*5* [1]	*1* [2]
	Secondary Screening Level (Chronic Aquatic Toxicity Values; Table 6-3)	*36* [3]	*36* [3]	*7.9* [3]
Logyard (Continued)	***Temporary Borings (Event 1 Only)***			
	TBGW001-E1	151	102	--
	TBGW002-E1	295	317	--
	TBGW003-E1	364	424	--
	TBGW004-E1	22,500	16,100	--
	TBGW005-E1	116	80	--
	TBGW006-E1	228	200	--
	TBGW007-E1	373	202	--
	TBGW008-E1	1,670	1,500	--
	Transition Zone Porewater			
	WCTPW001A-40-E1	28	19	--
	WCTPW001A-40-E2	17	20	--
	WCTPW001B-40-E1	74	49	--
	WCTPW001B-40-E2	80	119	--
	WCTPW002A-40-E1	3	1	--
	WCTPW002A-40-E2	5	7	--
	WCTPW002B-40-E1	6	4	--
	WCTPW002B-40-E2	7	10	--
	WCTPW003A-40-E1	7	1	--
	WCTPW003A-40-E2	13	13	--
	WCTPW003B-40-E1	10	4	--
	WCTPW003B-40-E2	16	43	--
Sawmill	***Monitoring Wells***			
	B005R-E1	0 J	0 J	0.089
	B005R-E2	1 U	1 J	0.049
	B005R-E3	2	0 J	0.088 U
	B005R-E4	0 J	1 U	0.43
	MW001-E1	11	12	0.78
	MW001-E2	17	18	0.084
	MW001-E3	45	39	0.1 J
	MW001-E4	28	28	0.099
	MW002R-E1	4	3	18
	MW002R-E2	5	4	22
	MW002R-E3	4	3	21
	MW002R-E4	3	2	7.8
	MW003-E1	11	11	0.89
	MW003-E2	11	11	0.067
	MW003-E3	17	17	0.088 U
	MW003-E4	17	16	0.084

Table 7-5. Groundwater Screening Results

Location	Sample ID	Arsenic (Total)	Arsenic (Dissolved)	Pentachlorophenol
	Units	*ug/L*	*ug/L*	*ug/L*
	Lowest Screening Level (Background or PQL; Table 6-3)	*5* [1]	*5* [1]	*1* [2]
	Secondary Screening Level (Chronic Aquatic Toxicity Values; Table 6-3)	*36* [3]	*36* [3]	*7.9* [3]
Sawmill (Continued)	MW004-E1	1 J	1 J	0.41
	MW004-E2	3	4	0.057
	MW004-E3	2	1 J	0.087 U
	MW004-E4	1 J	0 J	0.084 U
	MW005R-E1	2	2	7.1
	MW005R-E2	2	2	0.11 J
	MW005R-E3	3	3	2.5
	MW005R-E4	2	2	0.91
	MW006R-E1	2 J	2	1
	MW006R-E2	1	1	0.1 J
	MW006R-E3	3	2	1.1 J
	MW006R-E4	2	2	0.73
	Temporary Borings (Event 1 Only)			
	TBGW009-E1	2	3	0.12
	Transition Zone Porewater			
	WCTPW004A-40-E1	13	2	0.071
	WCTPW004A-40-E2	13	6	0.031 J
	WCTPW004B-40-E1	11	4	0.08
	WCTPW004B-40-E2	13	12	0.07 J
Screening Summary				
	Number of Samples Analyzed	97	97	33
	No. of Detected Exceedances of Lowest Screening Level	75	69	7
	No. of Detected Exceedances of Secondary Screening Level	40	40	3

Notes:

Blue highlighted values indicate exceedance of lowest Screening Level

Orange highlighted values indicate exceedance of Aquatic Toxicity Value

[1] Under MTCA, cleanup levels are not established below natural background levels. Although arsenic occurs naturally in the environment, a background number has not been established by Ecology. Therefore, the MTCA Method A value for groundwater is used as surrogate for the natural background concentration of arsenic, and is the lowest screening level value applied to the data. This number may underestimate the natural regional groundwater concentrations and may be refined as groundwater background studies advance. Based on a 1989 Ecology study, *Background Concentrations of Selected Chemicals in Water, Soil, Sediments, and Air of Washington State* (PTI Environmental Services, 1989), a regional background concentration of 8 ug/L represents the 90th percentile of groundwater data collected as part of the study. Systematic background studies quantifying natural background arsenic concentrations in sediment porewater along marine shorelines have not been performed, though geochemical processes are known to cause elevated arsenic levels in the shoreline transition zone as described in Section 8.3 of this RI Report.

[2] Screening level represents the practical quantitation limit (PQL).

[3] Screening level represents the Marine Water Chronic Aquatic Toxicity Water Quality Standard for Surface Waters of the State of Washington (WAC 173-201A).

-- = Not analyzed or not applicable

ug/L = micrograms per liter

WAC = Washington Administrative Code

J = Estimated result.

U = Non-detected result, reported at the Practical Quantitation Limit (PQL).

Table 7-6. Bioactive Zone Porewater Screening Results

Location	Sample ID	Arsenic (Dissolved)	Pentachlorophenol
	Units	*ug/L*	*ug/L*
	Lowest Screening Level (Background or PQL; Table 6-3)	*5* [1]	*1* [2]
	Secondary Screening Level (Chronic Aquatic Toxicity Values; Table 6-3)	*36* [3]	*7.9* [3]
Logyard	***Wapato Creek Transect 1 (WCT-1)***		
	WCTPW001A-10-E1	2.14	--
	WCTPW001A-10-E2	1.97	--
	WCTPW001A-10-E3	8.95	--
	WCTPW001A-10-E4	5.43	--
	WCTPW001B-10-E1	2.27	--
	WCTPW001B-10-E2	71.4	--
	WCTPW001B-10-E3	15.8	--
	WCTPW001B-10-E4	13.4	--
	Wapato Creek Transect 2 (WCT-2)		
	WCTPW002A-10-E1	1.92	--
	WCTPW002A-10-E2	15.2	--
	WCTPW002A-10-E3	2.3	--
	WCTPW002A-10-E4	5.92	--
	WCTPW002B-10-E1	8.37	--
	WCTPW002B-10-E2	2.77	--
	WCTPW002B-10-E3	3.28	--
	WCTPW002B-10-E4	8.45	--
	Wapato Creek Transect 3 (WCT-3)		
	WCTPW003A-10-E1	4.54	--
	WCTPW003A-10-E2	10.9	--
	WCTPW003A-10-E3	18.7	--
	WCTPW003A-10-E4	34.3	--
	WCTPW003B-10-E1	0.871 J	--
	WCTPW003B-10-E2	14.4	--
	WCTPW003B-10-E3	8.98	--
	WCTPW003B-10-E4	9.96	--
Sawmill	***Wapato Creek Transect 4 (WCT-4)***		
	WCTPW004A-10-E1	10.4	0.073
	WCTPW004A-10-E2	16.4	0.079 U
	WCTPW004A-10-E3	5.72	0.089 U
	WCTPW004A-10-E4	8.03	0.091 U
	WCTPW004B-10-E1	3.26	0.12
	WCTPW004B-10-E2	5.84	0.08 U
Screening Summary			
	Number of Samples Analyzed	30	6
	No. of Detected Exceedances of Lowest Screening Level	20	0
	No. of Detected Exceedances of Secondary Screening Level	1	0

Notes:

Blue highlighted values indicate exceedance of lowest Screening Level

Orange highlighted values indicate exceedance of Aquatic Toxicity Value

Table 7-6. Bioactive Zone Porewater Screening Results

Notes (Continued):

[1] Under MTCA, cleanup levels are not established below natural background levels. Although arsenic occurs naturally in the environment, a background number has not been established by Ecology. Therefore, the MTCA Method A value for groundwater is used as surrogate for the natural background concentration of arsenic in groundwater and marine surface water, and is the lowest screening level value applied to the data. This number may underestimate the natural regional groundwater concentrations and may be refined as groundwater background studies advance. Based on a 1989 Ecology study, *Background Concentrations of Selected Chemicals in Water, Soil, Sediments, and Air of Washington State* (PTI Environmental Services, 1989), a regional background concentration of 8 ug/L represents the 90th percentile of groundwater data collected as part of the study. Systematic background studies quantifying natural background arsenic concentrations in sediment porewater along marine shorelines have not been performed, though geochemical processes are known to cause elevated arsenic levels in the shoreline transition zone as described in Section 8.3 of this RI Report.

[2] Screening level represents the practical quantitation limit (PQL).

[3] Screening level represents the Marine Water Chronic Aquatic Toxicity Water Quality Standard for Surface Waters of the State of Washington (WAC 173-201A).

-- = Not analyzed or not applicable

ug/L = micrograms per liter

WAC = Washington Administrative Code

J = Estimated result.

U = Non-detected result, reported at the Practical Quantitation Limit (PQL).

Table 7-7. Outfall Discharge Screening Results

Location	Sample ID	Arsenic (Total)	Arsenic (Dissolved)
	Units	*ug/L*	*ug/L*
	Lowest Screening Level (Chronic Aquatic Toxicity Values; Table 6-3)	*36* [1]	*36* [1]
Logyard	OF2-E1	734	109
	OF2-E2	92.5	38.9
	OF2-E3	974	850
	OF2-E4	305	315
	OF3-E1	1,300	444
	OF3-E2	415	284
	OF3-E3	275	255
	OF3-E4	90.4	87.9
Screening Summary			
	Number of Samples Analyzed	8	8
	No. of Detected Exceedances of Lowest Screening Level	8	8

Notes:

Blue highlighted values indicate exceedance of lowest Screening Level

[1] Screening level represents the Marine Water Chronic Aquatic Toxicity Water Quality Standard for Surface Waters of the State of Washington (WAC 173-201A)

WAC = Washington Administrative Code

ug/L = micrograms per liter

PQL = Practical Quantitation Limit

Table 7-8. Surface Water Screening Results

Location	Sample ID	Arsenic (Total)	Arsenic (Dissolved)	Pentachlorophenol
	Units	*ug/L*	*ug/L*	*ug/L*
	Lowest Screening Level (Background or PQL; Table 6-3)	*5* [1]	*5* [1]	*1* [2]
	Secondary Screening Level (Chronic Aquatic Toxicity Values; Table 6-3)	*36* [3]	*36* [3]	*7.9* [3]
Downstream Background	***Blair Waterway***			
	BWSW001-E1	1.79 J	1.47	--
	BWSW001-E2	1.69	1.46	--
	BWSW001-E3	2.25	2.53	--
	BWSW001-E4	2.7	2.68	--
Logyard	***Wapato Creek Transect 1 (WCT-1)***			
	WCTSW001B-E1	2.8	1.67	--
	WCTSW001B-E2	9.88	1.97	--
	WCTSW001B-E3	11.9	0.922 J	--
	WCTSW001B-E4	11.2	0.506 J	--
	Wapato Creek Transect 2 (WCT-2)			
	WCTSW002B-E1	4.49	1.53	--
	WCTSW002B-E2	3.95	0.903 J	--
	WCTSW002B-E3	3.35	1.28	--
	WCTSW002B-E4	4.23	1.71	--
	Wapato Creek Transect 3 (WCT-3)			
	WCTSW003B-E1	8.45	2.11	--
	WCTSW003B-E2	3.01	1.42	--
	WCTSW003B-E3	1.64	1.06	--
	WCTSW003B-E4	1.66	1.22	--
Sawmill	***Wapato Creek Transect 4 (WCT-4)***			
	WCTSW004B-E1	0.92 J	0.432 J	0.021 U
	WCTSW004B-E2	1.53	0.402 J	0.063
	WCTSW004B-E3	1.63	0.892 J	0.085 U
	WCTSW004B-E4	1.13	1.3	0.11
Upstream Background	***Wapato Creek Upstream***			
	USSW001-E1	0.73 J	0.495 J	--
	USSW001-E2	0.702 J	0.533 J	--
	USSW001-E3	1.72	0.808 J	--
	USSW001-E4	0.57 J	0.858 J	--
Screening Summary				
	Number of Samples Analyzed	24	24	4
	No. of Detected Exceedances of Lowest Screening Level	4	0	0
	No. of Detected Exceedances of Secondary Screening Level	0	0	0

Notes:

Blue highlighted values indicate exceedance of lowest Screening Level

Orange highlighted values indicate exceedance of Aquatic Toxicity Value

Table 7-8. Surface Water Screening Results

Notes (Continued):

[1] Under MTCA, cleanup levels are not established below natural background levels. Although arsenic occurs naturally in the environment, a background number has not been established by Ecology. Therefore, the MTCA Method A value for groundwater is used as surrogate for the natural background concentration of arsenic in groundwater and marine surface water, and is the lowest screening level value applied to the data. This number may underestimate the natural regional groundwater concentrations and may be refined as groundwater background studies advance. Based on a 1989 Ecology study, *Background Concentrations of Selected Chemicals in Water, Soil, Sediments, and Air of Washington State* (PTI Environmental Services, 1989), a regional background concentration of 8 ug/L represents the 90th percentile of groundwater data collected as part of the study. Systematic background studies quantifying natural background arsenic concentrations in sediment porewater along marine shorelines have not been performed, though geochemical processes are known to cause elevated arsenic levels in the shoreline transition zone as described in Section 8.3 of this RI Report.

[2] Screening level represents the practical quantitation limit (PQL).

[3] Screening level represents the Marine Water Chronic Aquatic Toxicity Water Quality Standard for Surface Waters of the State of Washington (WAC 173-201A).

-- = Not analyzed or not applicable

ug/L = micrograms per liter

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J = Estimated result.

U = Non-detected result, reported at the Practical Quantitation Limit (PQL).

Table 8-1. Summary of Arsenic Fate and Transport Processes

Log Yard Location	Average RI Dissolved Arsenic Concentrations (ug/L)	Identified Fate and Transport Processes	Supporting RI Data
Log Yard Cap	--	Seepage through existing cap (i.e., via cracks and infiltration of ponded water)	Temporal trends in perched zone wells (i.e., water level increases in well HC-2) show decreases in cap performance since the early 1990s. Wet season transducer study data performed during the RI documented significant groundwater recharge following precipitation events.
Perched Groundwater Zone (Source Area Groundwater)	41,238	Arsenic leaching to groundwater from fill containing slag layer in areas of perched water	Four quarters of groundwater data show arsenic concentrations lower than historic (early 1990s) concentrations in the perched zone. However, concentrations are much higher than arsenic concentrations in other areas.
Intermediate Groundwater Zone	235	Precipitation and co-precipitation of arsenic with iron	Groundwater arsenic concentrations decrease dramatically downgradient of perched groundwater zone. Four quarters of RI groundwater data confirm the presence of excess iron in groundwater. Induced arsenic precipitation study documented the presence of both iron/arsenic precipitation and co-precipitation processes under anoxic as well as aerobic conditions.
Nearshore Groundwater Zone	37		
Transition Zone Porewater	24	Tidally-induced groundwater mixing	RI tidal study confirmed that tidal influences extend from Wapto Creek into the nearshore groundwater zone. Changes in conductivity between the bioactive zone and transition zone porewater were noted during the RI porewater sampling events. Mixing processes resulted in measured changes in redox conditions, and differences in geochemical parameters between these two porewater zones.
Bioactive Zone Porewater	11		
Log Yard Soils and Sediments	Varies by location	Adsorption of arsenic to aquifer solids and sediments	Sequention batch leaching documented the forms of arsenic within and adsorbed to the aquifer solids and sediments. Batch adsorption testing documented the capacity of site soils and sediment to sorb additional arsenic.
Surface Water (Wapato Creek)	1	N/A	Four quarters of RI surface water sampling documented that arsenic concentrations within Wapato Creek remain consistent with natural background levels.

Table 9-1. Inventory of Project Documents

Author Abbreviation	Year	Author	Document Title
AMEC	2009	AMEC	Technical Memorandum: Pavement Survey and Evaluation.
AQEA	2014	Anchor QEA (AQEA)	Log Yard Soil Testing Report. Former Portac Inc. Site. Tacoma, WA. Prepared for Portac and Port of Tacoma.
AQEA	2015a	Anchor QEA (AQEA)	Email from Mark Larsen (Anchor QEA) to Andrew Smith (Washington Department of Ecology). Subject: Thursday Port-Portac Meeting at Ecology (1:30 PM). Email presents the agenda for February 5, 2015 Meeting. Email included an attachment (Portac Site: Existing Information)
AQEA	2015b	Anchor QEA (AQEA)	Email from Mark Larsen (Anchor QEA) to Andrew Smith (Washington Department of Ecology). Subject: Confirming Friday's Meeting - Port of Tacoma and Portac Meeting. Email presents the agenda for February 5, 2015 Meeting. Email included attachments (Draft Exhibit B - 3-2-2015.docx; Exhibit C - Schedule - 3-2-2015.docx)
AQEA	2015c	Anchor QEA (AQEA)	Wapato Creek - Low Tide Conditions. Copy of presentation given to Washington Department of Ecology. Prepared for Portac and the Port of Tacoma.
Bessinger, B., and F. Mohsen,	2008	Bessinger, B., and F. Mohsen,	Simulation of Tidal Effects on Contaminant Fate and Transport near the Sediment-Water Interface. Presentation at Pacific Northwest Society of Environmental Toxicology and Chemistry (PNW-SETAC) Annual Meeting, Corvallis, OR, March 27-29, 2008.
Bessinger, et. al.,	2012	Bessinger, B.A., D. Vlassopoulos, S. Serrano, and P.A. O'Day	Reactive Transport Modeling of Subaqueous Sediment Caps and Implications for the Long-Term Fate of Arsenic, Mercury, and Methylmercury. Aquatic Geochemistry, v. 18, pp. 297-326.
CDM	2008a	CDM	Facility Closure Assessment Former Portac Lumber Facility
CDM	2008b	CDM	Facility Closure Assessment Second Phase Former Portac Lumber Facility
COT	2015a	City of Tacoma	Tacoma Public Works - Vertical Datums. Downloaded from the City of Tacoma's GovMe website: http://www.govme.org. Files downloaded on September 23, 2015.
COT	2015b	City of Tacoma	Historical Aerial Photographs downloaded from the City of Tacoma's GovMe website: http://www.govme.org. Files downloaded on October 2, 2015.
CRC	2009	Cultural Resources Consultants, Inc. (CRC)	Cultural Resources Overview for the Blair-Hylebos Terminal Redevelopment Project. Prepared by Cultural Resources Consultants, Inc. (CRC). Dated February 18, 2009.
D&M	1974	Dames & Moore	Report of Soils Investigation Proposed Sawmill (West Coast Orient Lumber Mills Site)
Ecology	1989	Washington Department of Ecology (Ecology)	Letter, dated February 6, 1989, from Scott Morrison, Ecology to Curtis Ratcliffe, Port of Tacoma. Draft. Letter provides approve for filling the central ditch area of the Portac Site.
Ecology	1994	Washington Department of Ecology (Ecology)	Natural Background Soil Metals Concentrations in Washington State

Table 9-1. Inventory of Project Documents

Author Abbreviation	Year	Author	Document Title
Ecology	2005	Washington Department of Ecology (Ecology)	Focus on Developing Ground Water Cleanup Standards Under the Model Toxics Control Act from Department of Ecology's Toxic Cleanup Program. Washington Department of Ecology. Publication No. 01-09-049. Revised April 2005.
Ecology	2006	Washington Department of Ecology (Ecology)	Evaluating the Toxicity and Assessing the Carcinogenic Risk of Environmental Mixtures Using Toxicity Equivalency Factors. Washington Department of Ecology (Ecology).
Ecology	2008	Washington Department of Ecology (Ecology)	The Industrial Stormwater General Permit - National Pollutant Discharge Elimination System and State Waste Discharge General Permit for Stormwater Discharges Associated with Industrial Activities. Permit issued by the Washington Department of Ecology (Ecology). Issuance Date: October 15, 2008. Effective Date: November 15, 2008. Expiration Date: April 30, 2009.
Ecology	2009a	Washington Department of Ecology (Ecology)	Letter from Ecology to Whitman Environmental Services, dated March 12, 2009, Re: Ecology Review of Portac Draft Log yard Ramp Removal Report.
Ecology	2009b	Washington Department of Ecology (Ecology)	Letter to Portac from Ecology, dated October 18, 2009, RE: Further Action at the Portac Sawmill Site, Tacoma, WA - Facility/Site No. 1215; VCP Project No. SW1016.
Ecology	2010	Washington Department of Ecology (Ecology)	Natural Background for Dioxins/Furans in WA Soils. Technical Memorandum #8. Washington Department of Ecology. Publication No. 10-09-053. August 9, 2010.
Ecology	2011a	Washington Department of Ecology (Ecology)	Background Characterization for Metals and Organic Compounds in Northeast Washington Lakes - Part 1: Bottom Sediments. Washington Department of Ecology. Publication No. 11-03-035. September 2011.
Ecology	2011b	Washington Department of Ecology (Ecology)	Guidance for Remediation of Petroleum Contaminated Sites. Washington Department of Ecology. Toxics Cleanup Program. Publication No. 10-09-057. September, 2011.
Ecology	2011c	Washington Department of Ecology (Ecology)	Puyallup-White Watershed, WRIA 10 – Focus on Water Availability. Water Resources Program. Publication Number: 11-11-015.
Ecology	2013a	Washington Department of Ecology (Ecology)	Letter from Ecology to Portac. Re: Notice of Potential Liability under the Model Toxics Control Act for the Release of Hazardous Substances at the following Hazardous Waste Site: Portac, Inc., 4215 SR 509 E. Frontage Road Tacoma. Facility/Site No. 1215.
Ecology	2013b	Washington Department of Ecology (Ecology)	Letter from Ecology to Port of Tacoma. Re: Notice of Potential Liability under the Model Toxics Control Act for the Release of Hazardous Substances at the following Hazardous Waste Site: Portac, Inc., 4215 SR 509 E. Frontage Road Tacoma. Facility/Site No. 1215.
Ecology	2015a	Washington Department of Ecology (Ecology)	Ecology EIM files down for Parcel 15. Files downloaded September 23, 2015.
Ecology	2015b	Washington Department of Ecology (Ecology)	Cleanup Site Details. Downloaded from Ecology's Toxic Cleanup Programs website.
Ecology	2015c	Washington Department of Ecology (Ecology)	Ecology Establishing Regional Background for Sediment. Washington Department of Ecology. Toxics Cleanup Program. January 2015.
Ecology	2016	Washington Department of Ecology (Ecology)	In the Matter of Remedial Action by: Portac, Inc. and Port of Tacoma, Agreed Order No. DE 11237
EMS	2009	Environmental Management Services, LLC. (EMS)	Field Report: Catchbasin Sampling. Prepared for Portac.

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Author Abbreviation	Year	Author	Document Title
EPA	1988	U.S. Environmental Protection Agency (EPA)	Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final. U.S. Environmental Protection Agency (EPA), Office of Emergency and Remedial Response, Washington, DC, EPA/540/G-89/004. Dated October 1988.
EPA	1993	U.S. Environmental Protection Agency (EPA)	Data Quality Objectives Process for Superfund: Interim Final Guidance. Office of Research and Development. EPA 540-R-93-071. September.
EPA	2000a	U.S. Environmental Protection Agency (EPA)	Guidance for the Data Quality Objectives Process. EPA QA/G-4. EPA/600/R-96/055. U.S. Environmental Protection Agency (EPA), Office of Environmental Information, Washington, DC. 100 pp.
EPA	2000b	U.S. Environmental Protection Agency (EPA)	Transmittal of Policy Statement: “Role of Background in the CERCLA Cleanup Program.” OSWER 9285.6-07P. U.S. Environmental Protection Agency (EPA), Office of Emergency and Remedial Response, Washington, DC.
EPA	2002a	U.S. Environmental Protection Agency (EPA)	Guidance for Comparing Background and Chemical Concentrations in Soil at CERCLA Sites. U.S. Environmental Protection Agency (EPA), Office of Emergency and Remedial Response, Washington, DC. EPA/540-R-01-003. OSWER 9285.7-41. Dated September 2002.
EPA	2002b	U.S. Environmental Protection Agency (EPA)	Transmittal of Policy Statement: “Role of Background in the CERCLA Cleanup Program.” OSWER 9285.6-07P. U.S. Environmental Protection Agency (EPA), Office of Emergency and Remedial Response, Washington, DC.
EPA	2004	U.S. Environmental Protection Agency (EPA)	PCP. Environmental Fate. Washington DC: EPA-HQ-OPP-2004-0402-0015.
EPA	2005	U.S. Environmental Protection Agency (EPA)	Environmental Research Brief - The Impact of Ground-Water/Surface-Water Interactions on Contaminant Transport with Application to an Arsenic Contaminated Site EPA-600-S-05-002. Dated January 2005
EPA	2005	U.S. Environmental Protection Agency (EPA)	Field Study of the Fate of Arsenic, Lead, and Zinc at the Ground-Water/Surface-Water Interface. EPA 600-R-05-161. Dated December 2005.
EPA	2007	U.S. Environmental Protection Agency (EPA)	Monitored Natural Attenuation of Inorganic Contaminants in Ground Water, Vol. I: Technical Basis for Assessment. EPA/600/R-07/139.
EPA	2008	U.S. Environmental Protection Agency (EPA)	Environmental Fate and Transport Assessment of Pentachlorophenol (PCP) for Reregistration Eligibility Decision Process. Washington DC: February 16, 2008. EPA-HQ-OPP-2004-0402-0066.
EPA	2011	U.S. Environmental Protection Agency (EPA)	Environmental Cleanup Best Management Practices: Effective Use of the Project Life Cycle Conceptual Site Model. U.S. Environmental Protection Agency (EPA), Office of Solid Waste and Emergency Response. EPA 542-F-11-011. Dated July 2011.
GeoEngineers	2003a	GeoEngineers	Supplemental Report - Geotechnical Engineering Services - Administration Building and Truck Scale Canopies - East Gate Yard - Pierce County Terminal Expansion Project - Phase 1. Tacoma, WA. Prepared for the Port of Tacoma.
GeoEngineers	2003b	GeoEngineers	Report - Geotechnical Engineering Services - Pavement Support Evaluation - Container Storage Yard and East Gate Yard - Pierce County Terminal Expansion Project - Phase 1. Tacoma, WA. Prepared for the Port of Tacoma.
GeoEngineers	2010	GeoEngineers	Site Investigation, Port of Tacoma Parcel 14. Tacoma, WA. Prepared for Grertte Associates LLC and Port of Tacoma. Dated December 6, 2010.
Google	2015	Google Earth	Historical Aerial Photographs downloaded from Google Earth
GSI	2015	GSI Water Solutions, Inc. (GSI)	Draft Data Gaps Memorandum. Parcel 15 (Portac) Investigation. Ecology Facility Site No. 1215/Cleanup Site No. 3642. Prepared for the Port of Tacoma and Portac, Inc. Prepared by GSI Water Solutions, Inc. and S.S. Papadopulos & Associates, Inc. November 2015.

Table 9-1. Inventory of Project Documents

Author Abbreviation	Year	Author	Document Title
GSI	2016	GSI Water Solutions, Inc. (GSI)	Final Remedial Investigation Work Plan. Parcel 15 (Portac) Investigation. Ecology Facility Site No. 1215/Cleanup Site No. 3642. Prepared for the Port of Tacoma and Portac, Inc. Prepared by GSI Water Solutions, Inc. and S.S. Papadopulos & Associates, Inc. April 2016
HC	1976	Hart Crowser, Inc. (HC)	Geology Study of the Port of Tacoma
HC	1986a	Hart Crowser, Inc. (HC)	Results of Test Pit Explorations and Chemical Testing Results - Portac Log Sort Yard. Letter to C. Ratcliffe, Port of Tacoma from Lori Herman, Hart Crower.
HC	1986b	Hart Crowser, Inc. (HC)	Portac Groundwater Quality Assessment
HC	1987a	Hart Crowser, Inc. (HC)	Portac Log Yard, Groundwater Assessment (See #117 & 125)
HC	1987b	Hart Crowser, Inc. (HC)	Letter from Julie Wukelic, Hart Crowser, dated September 25, 1987, to Lesie Sacha, Port of Tacoma. Re: Portac Log Sort Yard. This letter describes bulk sampling and laboratory testing of surficial soil from the log yard.
HC	1988a	Hart Crowser, Inc. (HC)	Portac Log Sort Yard, Phase I Material Characterization
HC	1988b	Hart Crowser, Inc. (HC)	Portac Log Sort Yard Remediation Plan, Volume I and II Appendices
HC	1988c	Hart Crowser, Inc. (HC)	Portac Log Sort Yard Spill Contingency Plan
HC	1988d	Hart Crowser, Inc. (HC)	Portac Log Sort Yard Log Deck Maintenance Plan
HC	1988e	Hart Crowser, Inc. (HC)	Addendum 1 to Exhibit B - Volume 1 - Portac Log Sort Yard Remediation Plan. Portac Log Sort Yard - Port of Tacoma, WA.
HC	1990a	Hart Crowser, Inc. (HC)	Portac Log Sort Yard Water Quality Monitoring Program, Second Round of Surface Water Samples
HC	1990b	Hart Crowser, Inc. (HC)	Portac Log Sort Yard, Water Quality Monitoring Program, Spring Groundwater Sampling and Analysis Results
HC	1990c	Hart Crowser, Inc. (HC)	Portac Log Yard Remediation, Water Quality Monitoring Program, 3rd & Final Round of Surface Water Sampling

Table 9-1. Inventory of Project Documents

Author Abbreviation	Year	Author	Document Title
HC	1991d	Hart Crowser, Inc. (HC)	Portac Log Sort Yard, Spring 1991 Groundwater Sampling/Analysis Water Quality Monitoring Program
HC	1992	Hart Crowser, Inc. (HC)	Final Report Groundwater Quality Monitoring Program Portac Log Sort Yard Remediation
HC	2009a	Hart Crowser, Inc. (HC)	Roller Compacted Concrete Cap Condition Assessment
HC	2009b	Hart Crowser, Inc. (HC)	Technical Memorandum: Portac Catch Basin Sampling and Analysis Portac Sawmill and Log Yard Site
HC	2009c	Hart Crowser, Inc. (HC)	Wapato Creek Sediment Sampling and Analysis Results
HC	2009d	Hart Crowser, Inc. (HC)	Technical Memorandum, dated September 28, 2009. To Bill Evans, Port of Tacoma from Rick Moore, HC. RE: Review of Whitman Environmental Service (WES) July 6, 2009 Report - Lumber Mill Demolition, Environmental Cleanup and Testing -Former Portac, Inc. Site.
HC	2012	Hart Crowser, Inc. (HC)	Technical Memorandum, dated October 24, 2012. To Bill Evans, Port of Tacoma from Will Abercrombie and Roger McGinnis, HC. RE: Evaluation of 2011 Summary Groundwater Monitoring Reports by Whitman Environmental Services - Former Portac, Inc. Site.
HC	2014	Hart Crowser, Inc. (HC)	Cap Inspection Report - Former Portac Facility - Port of Tacoma, Tacoma, Washington
Port	2017	KPFF	Port of Tacoma - PCT Truck Staging Project No. 091606, Contract No. 070287. As-Built Drawings Prepared by KPFF for the Port of Tacoma.
Landau	2007	Landau Associates Inc.	Geotechnical Report Blair Navigational Aid Realignment - Tacoma, WA. Prepared for the Port of Tacoma.
Landau	2014	Landau Associates Inc.	North Lead Rail Improvements - Portac Cap Subsurface Investigation - Port of Tacoma, Washington
Langmuir, et.al.,	2005	Langmuir, D., P. Chrostowski, B. Vigneault, and R. Chaney.	Issue paper on the environmental chemistry of metals. Available at: http://www.epa.gov/raf/publications/pdfs/ ENVCHEMFINAL81904CORR01-25-05.PDF.
Lovley, D.R. and S. Goodwin	1988	Lovley, D.R. and S. Goodwin	Hydrogen concentrations as an indicator of the predominant terminal electron-accepting reactions in aquatic sediments. Geochim. Cosmochim. Acta 52: 2993–3003.
Olympic	2009	Olympic Associates Company	Letter from Olympic to Ecology, dated August 26, 2009. RE: Post-Construction Report - Portac Tacoma Mill Closure/Repairs to Environmental Cap - 4215 SR 509 N. Frontage Road, Tacoma, WA
Port	1989	Port of Tacoma	Port of Tacoma Chief Engineer’s Recommendation to the Port Commission for Final Acceptance of Contract No. 646 with M. A. Segale, Portac Yard Improvements, Work Order No. E1068. Prepared by R.L. MacLeod, Chief Engineer. July 19, 1989.
Port	2009	Port of Tacoma	Letter from the Port of Tacoma to Ecology, dated September 21, 2009, RE: Former Portac Site - Log Yard Environmental Cap.
Port	2015	Port of Tacoma	Port of Tacoma - Summary of past cap inspections and cap maintenance @ Portac Site. Prepared by the Port of Tacoma. Draft received October 5, 2015

Table 9-1. Inventory of Project Documents

Author Abbreviation	Year	Author	Document Title
Portac	2009	Portac	Letter from Portac to Ecology, dated July 1, 2009, RE: Portac Tacoma Mill Closure/Repairs to Cap. Letter transmits AMEC's Report on recommended cap repairs.
Portac	2009	Portac, Inc.	Notice of Termination - Baseline General Permit to Discharge Stormwater for Industrial Activity. Permit No. 0326. Form dated February 28, 2008. Submitted to Ecology by Portac, Inc.
Portac	2015	Portac, Inc.	Portac Industrial Stormwater General Permit - Discharge Monitoring Reports for 2003 - 2009 and reports documenting Portac activities in response to stormwater detections above benchmark values. Forms present stormwater sampling results at discharge point for "SW outflow log yard".
PTI	1989	PTI Environmental Services	Background Concentrations of Selected Chemicals in Water, Soil, Sediments, and Air of Washington State
Puyallup River Watershed Council	2014	Puyallup River Watershed Council	Puyallup River Watershed Assessment (Draft). Prepared by Puyallup River Watershed Council. Watershed Assessment Committee. February 2014.
Root, et.al.,	2009	Root, R.A., D. Vlassopoulos, N.A. Rivera, M.T. Rafferty, C. Andrews, and P.A. O'Day.	Speciation and Natural Attenuation of Arsenic and Iron in a Tidally Influenced Shallow Aquifer. Geochim. Cosmochim. Acta 73: 5528-5553.
RZA	1988a	Rittenhourse, Zeman & Associates (RZA)	Memorandum to C.C. Pittman. Regarding Results of Soil Sampling and Analytical Results Following Partial Soil Removal in the Central Ditch Area of the Portac Site. Prepared by Rittenhouse-Zeman & Associates Inc. (RZA) for Portac, Inc.. August 23, 1988.
RZA	1988b	Rittenhourse, Zeman & Associates (RZA)	Letter from Daniel Whitman, RZA to C. Pittman, Portac, Inc., dated September 8, 1988. Subject: Wapato Creek Sediment Sampling and Analytical Results.
RZA	1988c	Rittenhourse, Zeman & Associates (RSA)	Memorandum to C.C. Pittman. Regarding Results of Soil Sampling and Analytical Results following Soil Removal in the Central Ditch Area of the Portac Site. Prepared by Rittenhouse-Zeman & Associates Inc. for Portac, Inc.. September 23, 1988.
RZA	1988d	Rittenhourse, Zeman & Associates (RSA)	Remedial Action Observations, Sampling and Analyses. Portac Site. Port of Tacoma, Washington. Prepared by Rittenhouse-Zeman & Associates Inc. for Portac, Inc.. August 1988.
USGS	1987	US Geological Survey (USGS)	Water Quality in the Lower Puyallup River Valley and Adjacent Uplands, Pierce County, Washington. Prepared in Cooperation with the Puyallup Tribe of Indians.
Welch, et.al.,	2000	Welch, A.H., D.B. Westjohn, D.R. Helsel, and R.B. Wanty	Arsenic in the groundwater of the United States: Occurrence and geochemistry. Ground Water 38: 589-604.
WES	2009a	Whitman Environmental Services (WES)	Letter to Washington Department of Ecology. Subject: Additional Wapato Creek Sediment Sample Analyses. Portac, Inc. 4215 N. Frontage Road. Tacoma, WA.
WES	2009b	Whitman Environmental Services (WES)	Log yard Ramp Demolition - Portac, Inc. - 4215 N. Frontage Road, Tacoma, WA. (Draft)

Table 9-1. Inventory of Project Documents

Author Abbreviation	Year	Author	Document Title
WES	2009c	Whitman Environmental Services (WES)	Letter from WES to Ecology, dated November 17, 2009. RE: Additional Site Information, Portac, Inc. Tacoma, WA. Including documentation of storm drain sampling and cleaning; terrestrial ecological evaluation; Wapato Creek sediment analysis.
WES	2009d	Whitman Environmental Services (WES)	Letter from WES to Ecology, dated February 23, 2009. RE: Voluntary Cleanup Program Application, Lumber Mill Demolition, Environmental Cleanup and Testing Report, Portac, Inc. Tacoma, WA
WES	2009e	Whitman Environmental Services (WES)	Lumber Mill Demolition - Environmental Cleanup and Testing Report - Former Portac Inc. Site - Tacoma, WA. Prepared by WES for Portac, Inc. July 6, 2009.
WES	2010a	Whitman Environmental Services (WES)	Letter from WES to Ecology, dated May 7, 2010, First Quarter 2010 Groundwater Monitoring - Former Portac Inc. Site - Tacoma, WA
WES	2010b	Whitman Environmental Services (WES)	Letter from WES to Ecology, dated August 25, 2010, Second Quarter 2010 Groundwater Monitoring - Former Portac Inc. Site - Tacoma, WA
WES	2010a	Whitman Environmental Services (WES)	Letter from WES to Ecology, dated January 21, 2010, Fourth Quarter 2009 Groundwater Monitoring - Former Portac Inc. Site - Tacoma, WA
WES	2010b	Whitman Environmental Services (WES)	Email from Daniel Whitman/WES to Thomas Middleton, Dom Reale/Ecology and others, dated January 29, 2010, Portac December 2009 Groundwater Monitoring Report. Transmittal.
WES	2010c	Whitman Environmental Services (WES)	Letter from WES to Ecology, dated November 29, 2010, Third Quarter 2010 Groundwater Monitoring - Former Portac Inc. Site - Tacoma, WA
WES	2011	Whitman Environmental Services (WES)	Letter from WES to Thomas Middleton/Ecology, dated September 28, 2011, Addendum to Summary of Groundwater Monitoring Report - Former Portac Inc. Site - Tacoma, WA. Presents recalculated Method B soil and groundwater cleanup levels for PCP.
WES	2012a	Whitman Environmental Services	Letter to Washington Department of Ecology, dated April 4,2012. Subject: Compliance Monitoring Plan for the Former Portac, Inc. Site -4215 N. Frontage Road. Tacoma, WA.
WES	2012b	Whitman Environmental Services (WES)	Letter from WES to Portac, dated September 5, 2012, Feasibility of Additional Cleanup and Disproportionate Cost Analyses - Former Portac Inc. Site - Tacoma, WA

Table 9-1. Inventory of Project Documents

Author Abbreviation	Year	Author	Document Title
WES	2013	Whitman Environmental Services (WES)	Letter from WES to Portac, dated March 25, 2013, First Quarter 2013 Groundwater Monitoring - Former Portac Inc. Site - Tacoma, WA
WDOT	2006	Washington Department of Transportation (WDOT)	SR 167, Puyallup to SR 509 -- Tier II Final Environmental Impact Statement
Windward	2017	Windward Environmental LLC (Winward) and Landau Associates	Environmental Cap Inspection Report Former Portac Facility

Notes:
Highlighted references are cited in the RI Report.

FIGURE 1-1

Vicinity Map

Remedial Investigation Report
Parcel 15
Tacoma, WA

LEGEND

- Site Boundary
- Watercourse
- Waterbody

N

0 1,000 2,000 3,000
Feet

Date: May 11, 2017
Data Sources: PORTAC, Aerial photo taken in July of 2013 by the USDA

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Document Path: P:\Portland\603-Port of Tacoma\GIS\Project_mxds\RI\Figure1-1_Vicinity_Map.mxd

FIGURE 2-1

1940 Aerial Photograph Showing Former Location of Wapato Creek

Remedial Investigation Report
Parcel 15
Tacoma, WA

LEGEND

Site Boundary[1]
Former Wapato Creek Channel[2]

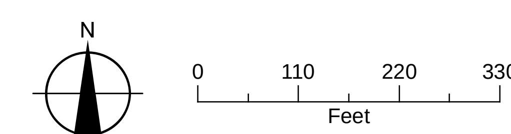
NOTES:

Location of all site features is approximate.

SOURCE INFORMATION:

1. Site Boundary defined in Exhibit A of the Agreed Order No. DE 11237 (Ecology, 2016).
2. Former Wapato Creek Channel alignment based on figure provided in the Review Comments on the 2011 Groundwater Monitoring Reports (HC, 2012) and historical aerial photographs from 1931, 1936, and 1940.

Historical 1940 Aerial Photograph downloaded from the City of Tacoma's GovMe website: http://www.govme.org. File downloaded on October 2, 2015.



Date: May 11, 2017
Data Sources: Aerial photo taken on July 18, 1940 by the US Army Corps of Engineers

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Document Path: P:\Portland\603-Port of Tacoma\GIS\Project_mxds\RI\Figure2-1_Site_Photo_from_1940.mxd

FIGURE 2-2

Historical Site Features and Source Areas

Remedial Investigation Report
Parcel 15
Tacoma, WA

LEGEND

- Site Boundary[1]
- Former Site Structure[2]

Contaminants of Potential Concern[3]

- Metals
- Pentachlorophenol
- Petroleum

Former Drainage

- Catch Basin[4]
- Surface Drainage[4]
- Subsurface Drainage[4]
- Former Wapato Creek Channel[5]

All Other Features

- Railroad

NOTES:

Location of all site features is approximate.

SOURCE INFORMATION:

1. Site Boundary defined in Exhibit A of the Agreed Order No. DE 11237 (Ecology, 2016).
2. Footprints of former site structures are based on the Site Plan (Figure 2) from the Catch Basin Sampling and Analysis Memo (HC, 2009).
3. Source area boundaries in the sawmill area are based on the "approximate soil clean-up area boundaries" shown on Figure 12 of the Lumber Mill Cleanup Report (WES, 2009). PCP source area in the central drainage ditch reflects the lower 200 feet of the ditch which is noted to be the extent of impact in Section 7.3 of the Portac Log Yard Remediation Plan (HC, 1988). The approximate extent of the slag fill matches the lower boundary of the phased Portac Log Sort Yard Paving Project which is shown in Sheet 2 of the associated drawing set (HC, 1988).
4. Former catch basin and surface and subsurface drainage features based on Figure 2 of the Portac Log Sort Yard Remediation Plan (HC, 1988).
5. Former Wapato Creek Channel alignment based on figure provided in the Review Comments on the 2011 Groundwater Monitoring Reports (HC, 2012) and 1931, 1936, 1940 historical aerial photographs.

N

0 110 220 330
Feet

Date: June 29, 2017
Data Sources: Aerial photo taken in 1985

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Document Path: P:\Portland\603-Port of Tacoma\GIS\Project_mxds\RI\Figure2-2_Historical_Site_Map.mxd

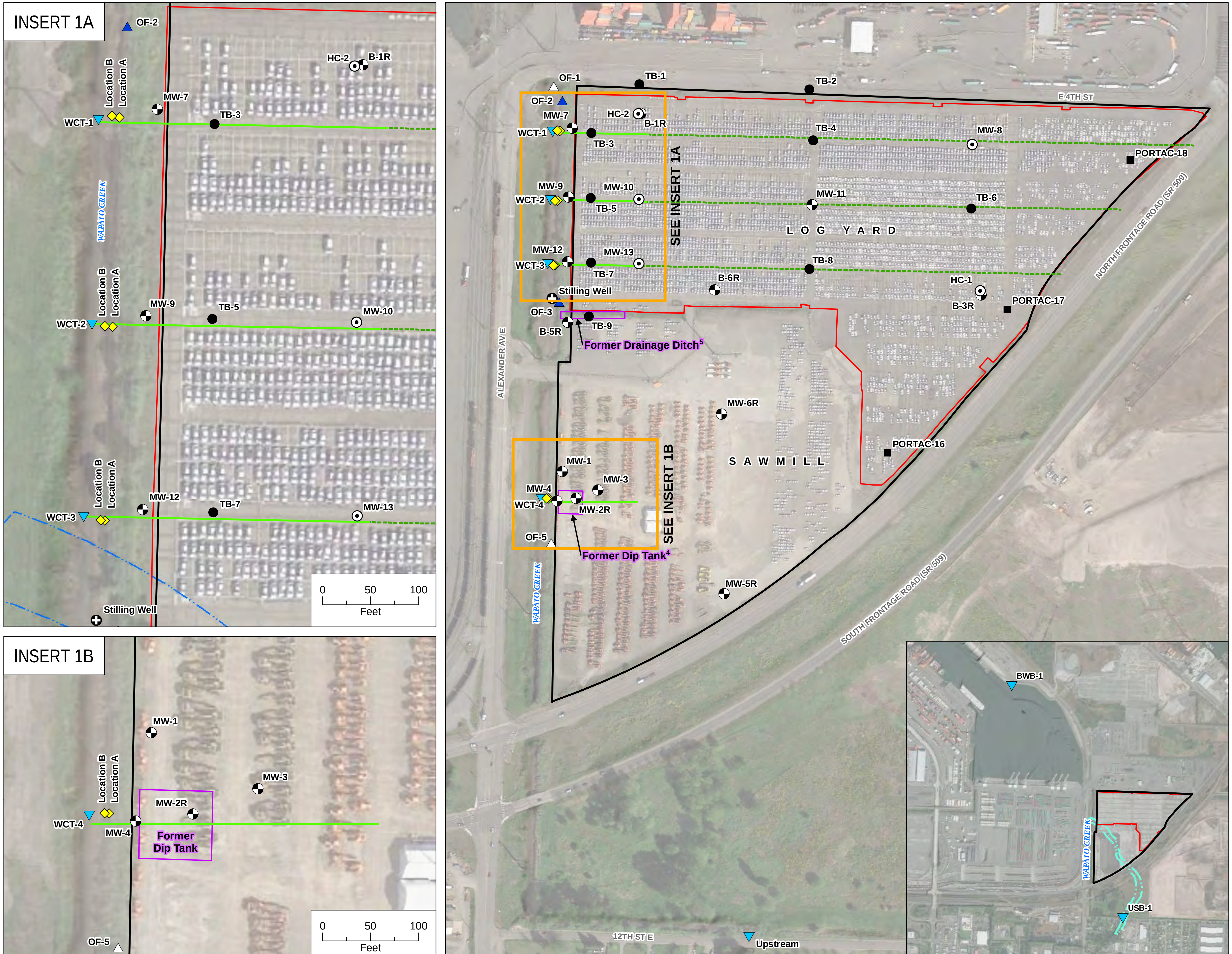


FIGURE 3-1

RI Sampling Locations

Remedial Investigation Report
Parcel 15
Tacoma, WA

LEGEND

Sampling Locations[1]

- Monitoring Well
- Perched Monitoring Well
- Stilling Well
- Piezometer
- Temporary Soil and Groundwater Boring
- Surface Water
- Wapato Creek Porewater and Sediment
- Stormwater Outfall
- Sampling Transect
- Nearshore Study Area Transect

All Other Features

- Site Boundary[2]
- Stormwater Outfall
- Cap[3]
- Former Drainage Ditch and Dip Tank Boundaries[4,5]
- Nearshore Study Area

NOTES:

1. Sampling locations were surveyed in May 2016. All other site location features are approximate.
2. Site Boundary defined in Exhibit A of the Agreed Order No. DE 11237 (Ecology, 2016).
3. Cap extent defined on Figure 2 of the Former Portac Inc. Site (AQEA, 2014).
4. Former dip tank boundary based on the "approximate soil clean-up area boundaries" shown on Figure 12 of the Lumber Mill Cleanup Report (WES, 2009).
5. Former drainage ditch boundary reflects the lower 200 feet of the ditch which is noted to be the extent of impact in Section 7.3 of the Portac Log Yard Remediation Plan (HC, 1988).

N

0 150 300 450
Feet

Date: June 29, 2017
Data Sources: PORTAC, Aerial photo taken on April 19, 2015 by the Google Earth

GSI Water Solutions, Inc.

Document Path: P:\Portland\603-Port of Tacoma\GIS\Project_mxds\RI\Figure3-1_Sampling_Locations.mxd

FIGURE 3-2

Test Pit Locations

Remedial Investigation Report
Parcel 15
Tacoma, WA

LEGEND

Sampling Locations[2]

- Test Pit
- Approximate Test Pit Soil Sample
- Monitoring Well
- Surface Water
- Wapato Creek Porewater and Sediment

All Other Features

- Site Boundary[2]
- Former Dip Tank Excavation/Fill Extent (Approximate)[3]
- Former Dip Tank Boundary[4]
- Buried 10-inch Cast Iron Fire Line and 2.25-inch Domestic Water Line (Approximate Location)[3]

SOURCE INFORMATION:

1.Sampling locations were surveyed in May 2016. All other site location features are approximate.
2. Site Boundary defined in Exhibit A of the Draft Agreed Order No. DE 11237 (Ecology, 2015).
3. Former Dip Tank Excavation and Buried Fire Line Locations approximated from Figure 8, (WES, 2009).
4. Former dip tank boundary based on the "approximate soil clean-up area boundaries" shown on Figure 12 of the Lumber Mill Cleanup Report (WES, 2009).

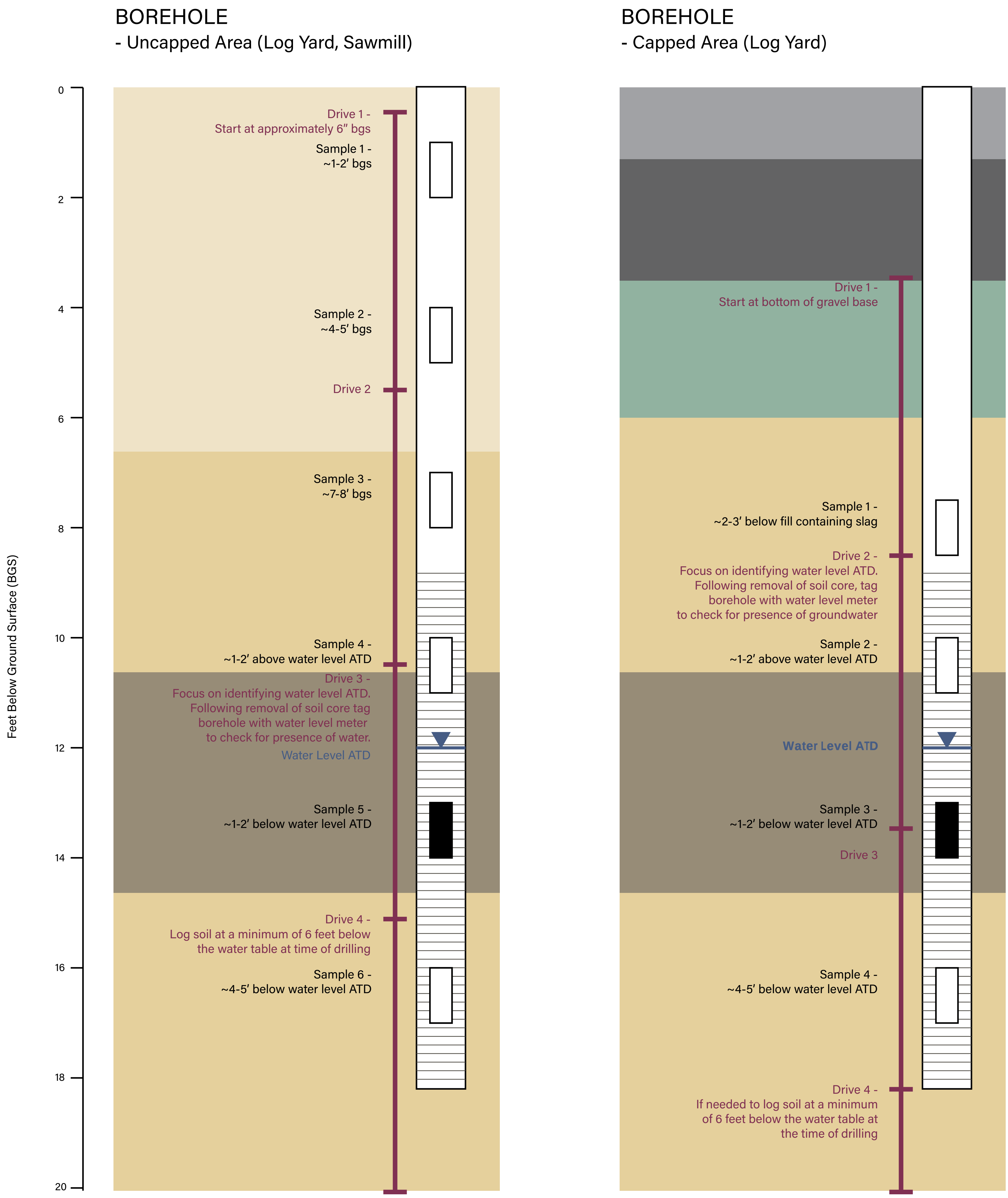
N

0 11 22 33
Feet

Date: June 29, 2017
Data Sources: PORTAC, Aerial photo taken 2016 by Metro

GSI Water Solutions, Inc.

Document Path: P:\Portland\603-Port of Tacoma\GIS\Project_mxds\RI\Figure3-2_Test_Pit_Locs.mxd



LEGEND

- Sample for Analytical Testing (~1' Core)
- Sample for Archival (~1' Core)
- Approximate Location of Well Screen

Geology

- Roller Compacted Concrete
- Gravel Base, Coarse
- Fill
- Fill Containing Slag
- Silty Sand
- Silt

NOTES:

ATD = At time of drilling
Actual sample locations will be based on consideration of soil type, stratigraphy, sample recovery, depth of water at time of drilling (ATD), observations, etc.
Well screen placement will be determined by field conditions.
Screen depths will be placed approximately 4 feet above and 6 feet below water level ATD.

FIGURE 3-3

Conceptual Soil Sampling Intervals

Remedial Investigation Report
Parcel 15
Tacoma, WA

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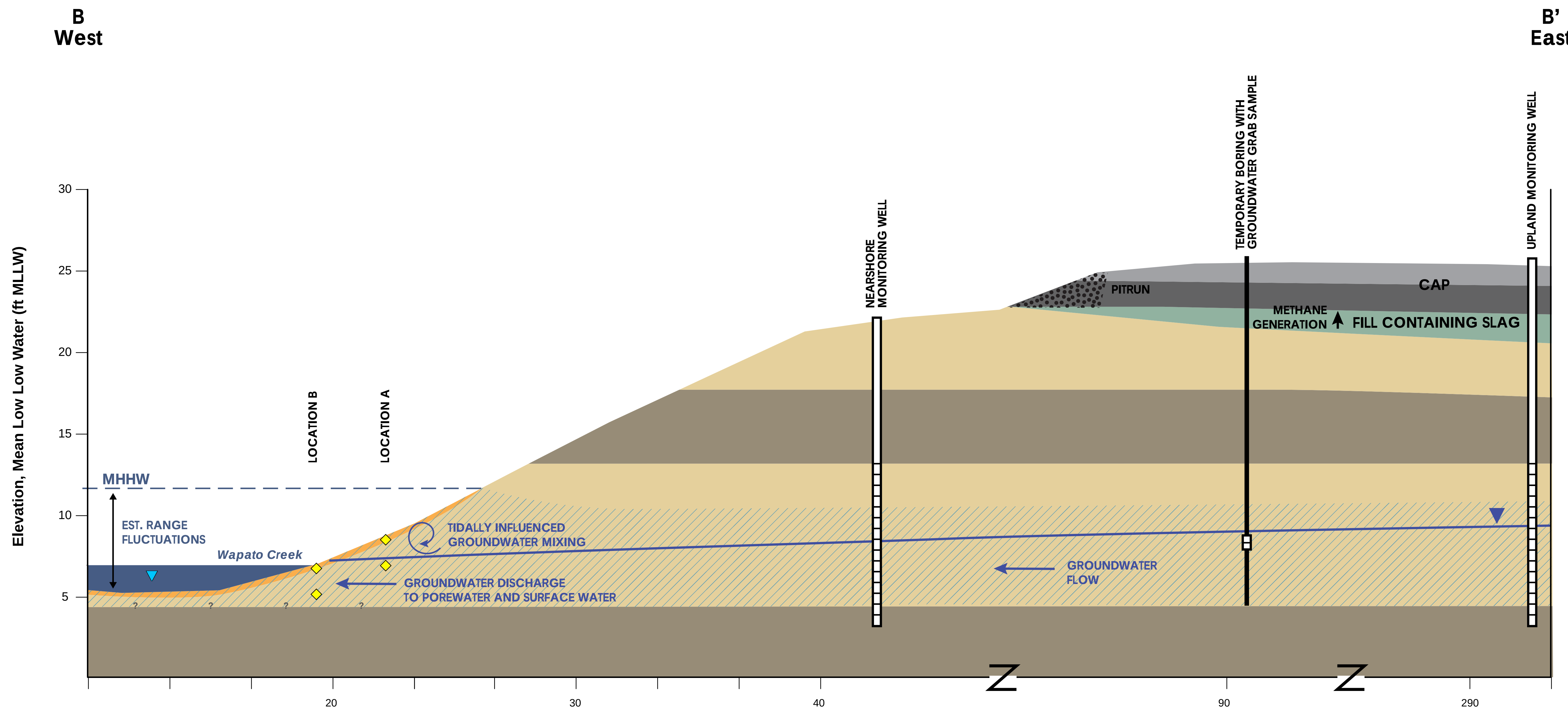

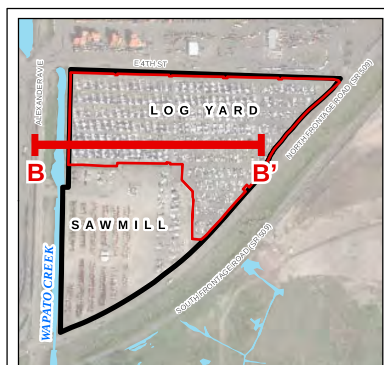

LEGEND

- Porewater/Sediment Grab Sample (0-10 cm, 40-50 cm)
- Surface Water Sample (1' above mud line)
- New Monitoring Well
- Approximate Range in Groundwater Levels
- Approximate Static Water Level (April 1988)

Geology

- Roller Compacted Concrete
- Gravel Base Course
- Fill Containing Slag
- Silty Sand
- Silt
- Biozone

NOTE

Vertical Exaggeration = 1X

FIGURE 3-4

Nearshore Study Area Sampling Schematic

Remedial Investigation Report
Parcel 15
Tacoma, WA

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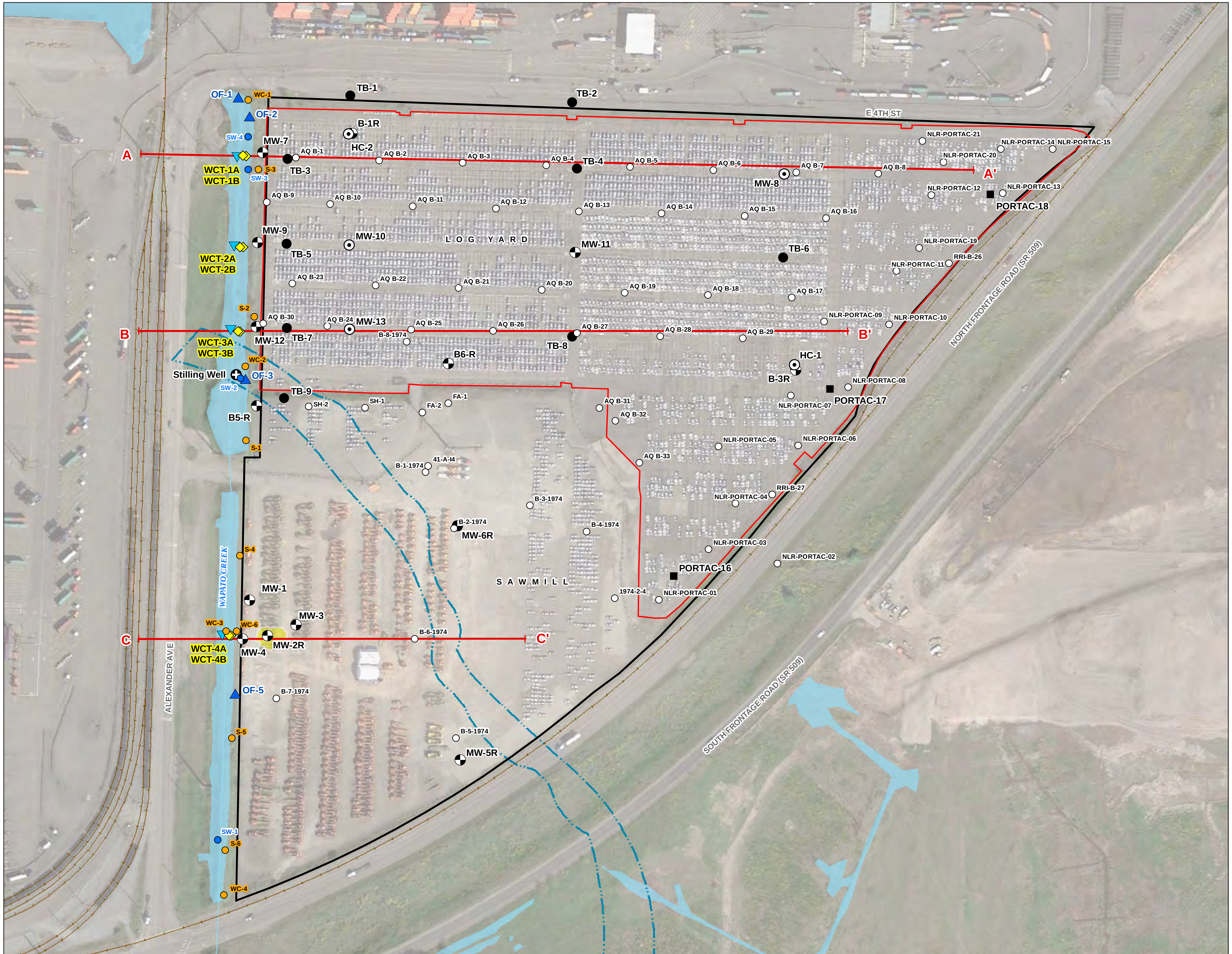

FIGURE 4-1

Geologic Cross-Section Overview Map

Remedial Investigation Report
Parcel 15
Tacoma, WA

LEGEND

Pre-RI Samples

- Soil Boring
- Sediment Sample
- Surface Water Sample

Sampling Locations[1]

- Monitoring Well
- Perched Monitoring Well
- Stilling Well
- Stormwater Outfall
- Surface Water
- Temporary Soil and Groundwater Boring
- Wapato Creek Porewater and Sediment
- Piezometer

All Other Features

- Cross Section Line
- Site Boundary[2]
- Cap[3]
- Former Dip Tank Excavation/Fill Extent (Approximate)[3]
- Railroad
- Former Wapato Creek Channel[5]
- Watercourse
- Waterbody

NOTES:

1. RI sampling locations were surveyed in May 2016. All other site location features are approximate.
2. Site Boundary defined in Exhibit A of the Agreed Order No. DE 11237 (Ecology, 2016).
3. Cap extent defined on Figure 2 of the Former Portac Inc. Site (AQEA, 2014).
4. Former dip tank boundary based on the "approximate soil clean-up area boundaries" shown on Figure 12 of the Lumber Mill Cleanup Report (WES, 2009).
5. Former Wapato Creek Channel alignment based on figure provided in the Review Comments on the 2011 Groundwater Monitoring Reports (HC, 2012) and historical aerial photographs from 1931, 1936 and 1940.

N

0 115 230 345
Feet

Date: June 29, 2017
Data Sources: PORTAC, Aerial photo taken on April 19, 2015 by the Google Earth

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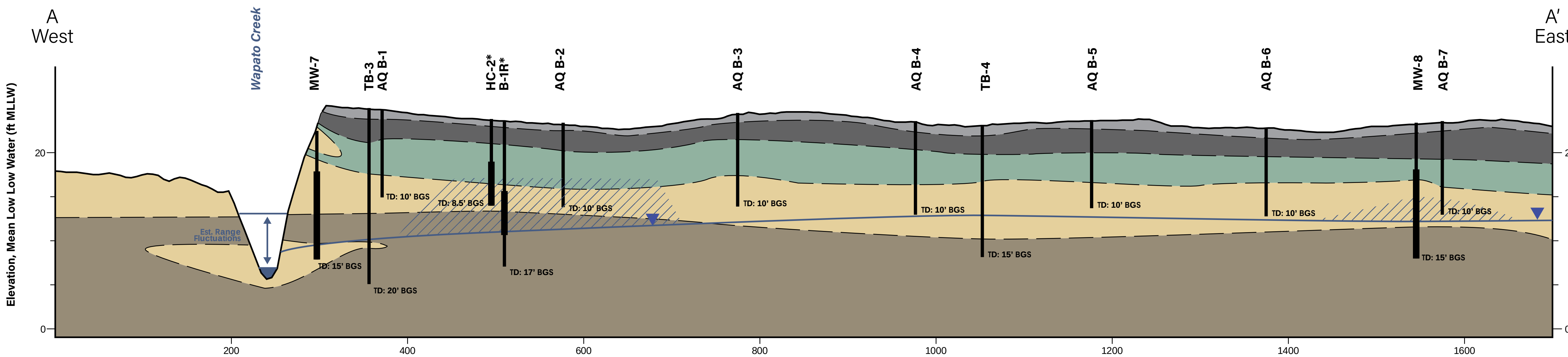
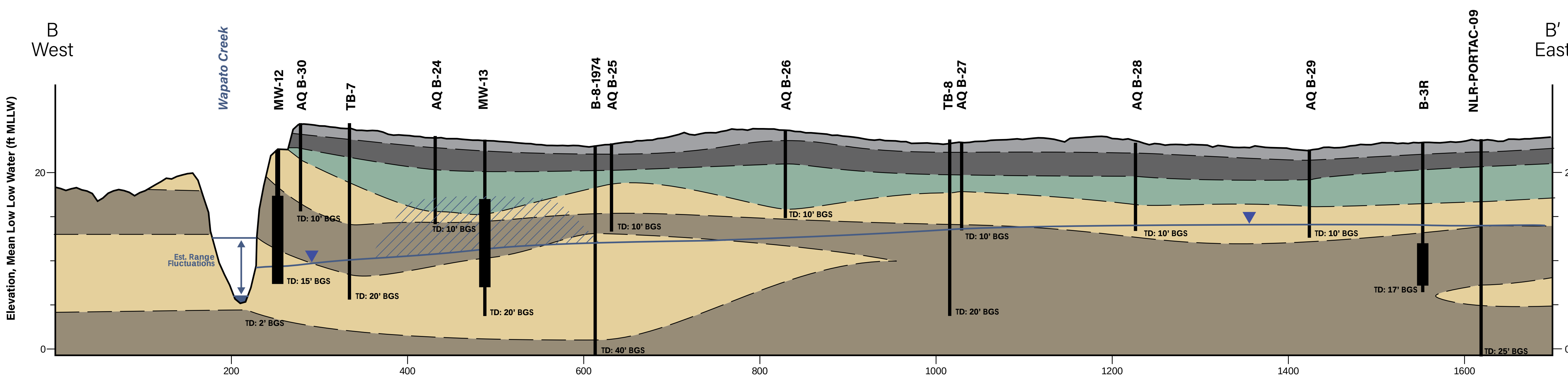
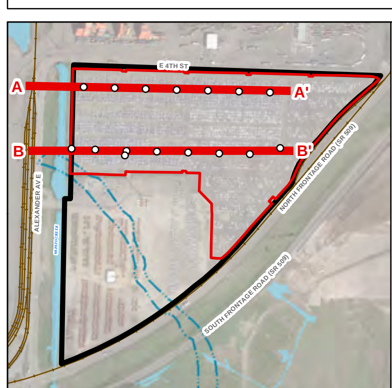
Document Path: P:\Portland\603-Port of Tacoma\GIS\Project_mxds\RI\Figure4-1_Cross_Section_Overview.mxd







LEGEND

- Soil Boring/Well
- Screened Interval
- May 2016 Water Level
- Observed Perched Water

Geology

- Roller Compacted Concrete
- Gravel Base Course
- Fill Containing Slag
- Silty Sand
- Fine Grained Deposits (Silt and Clay)

NOTES:

Vertical Exaggeration = 10X
Extent of all geologic features shown is approximate and conceptual in nature.
* Borehole log not available

FIGURE 4-2

Geologic Cross-Section A-A' and B-B' through Log Yard

Remedial Investigation Report
Parcel 15
Tacoma, WA

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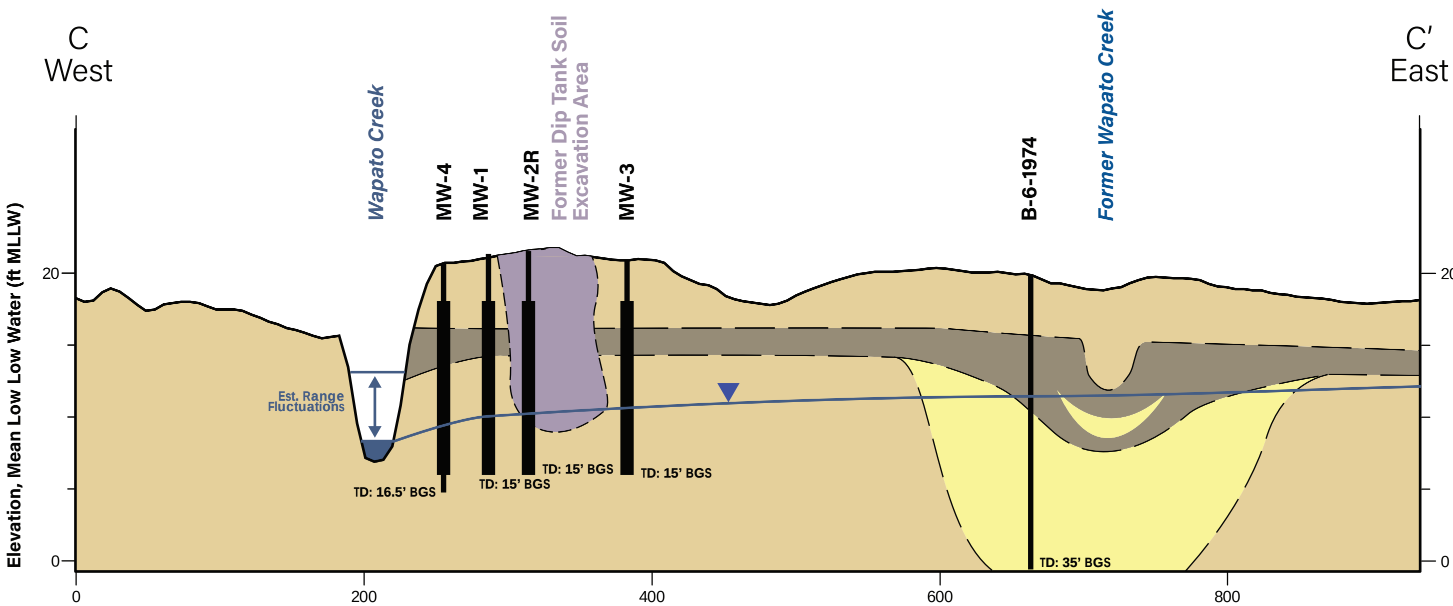
FIGURE 4-3

Geologic Cross-Section C-C′ through Sawmill

Remedial Investigation Report
Parcel 15
Tacoma, WA



LEGEND

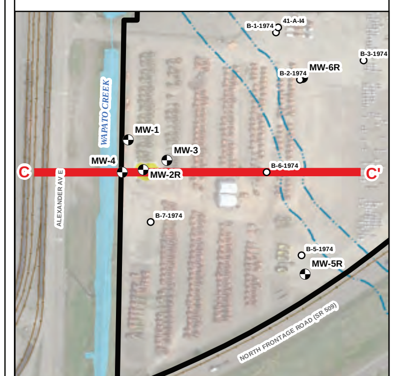
- Soil Boring/Well
- Screened Interval
- May 2016 Water Level

Geology

- Sand FIll (Soil Excavation Area)
- Silty Sand
- Fine Grained Deposits (Silt and Clay)
- Sand

NOTES:

Vertical Exaggeration = 10X
Extent of all geologic features shown is approximate and conceptual in nature.



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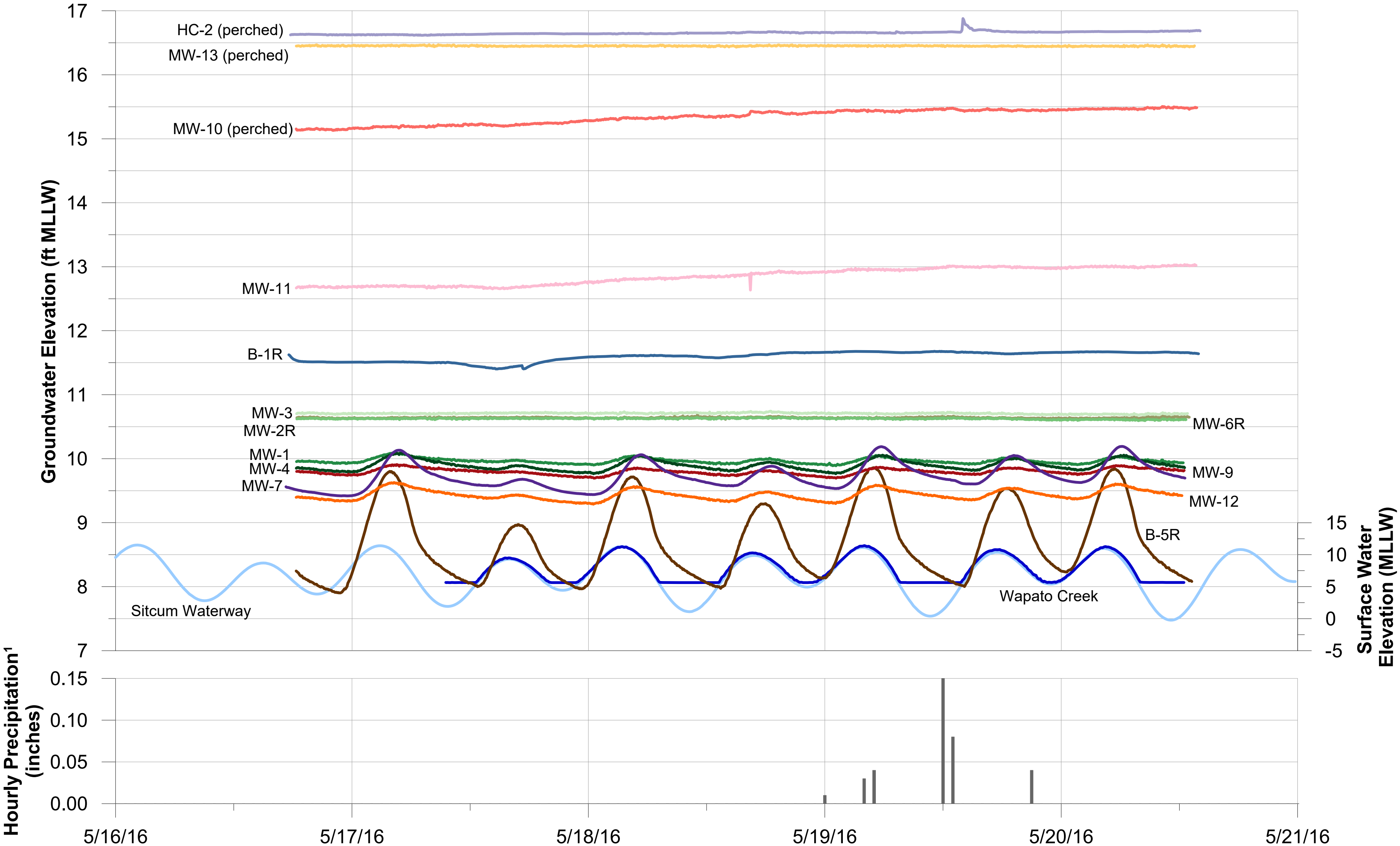


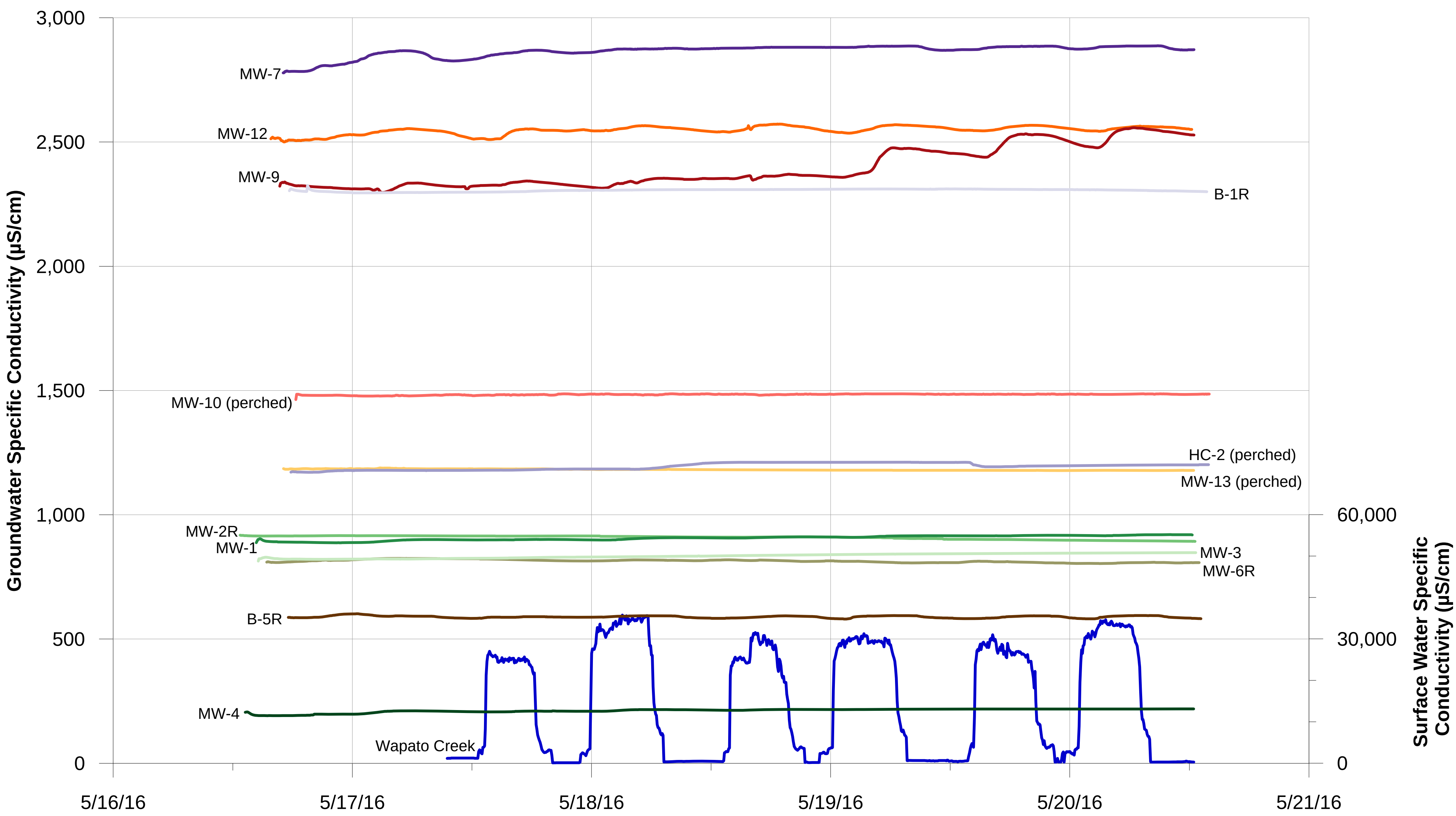
Legend[3]

WCT-1	WCT-2	WCT-3	WCT-4		Other Wells	Surface Water
MW-7	MW-9	MW-12	MW-4	MW-2R	B-5R	Wapato Creek (Stilling Well)
HC-2	MW-10	MW-13	MW-1	MW-3	MW-6R	Sitcum Waterway[2]
B-1R	MW-11					

Note:
MLLW = mean low low water
[1] Precipitation readings from Tacoma Narrows Airport, NOAA NCDC Station ID 94274
[2] Tidal readings from Commencement Bay, Sitcum Waterway, NOAA Station ID 9446484
[3] Monitoring wells are grouped by Wapato Creek Transect (WCT) number, where applicable.

Figure 4-4
Tidal Study Hydrograph
Event 1 - May 2016
Remedial Investigation Report
Parcel 15
Tacoma, Washington

GSI Water Solutions, Inc.



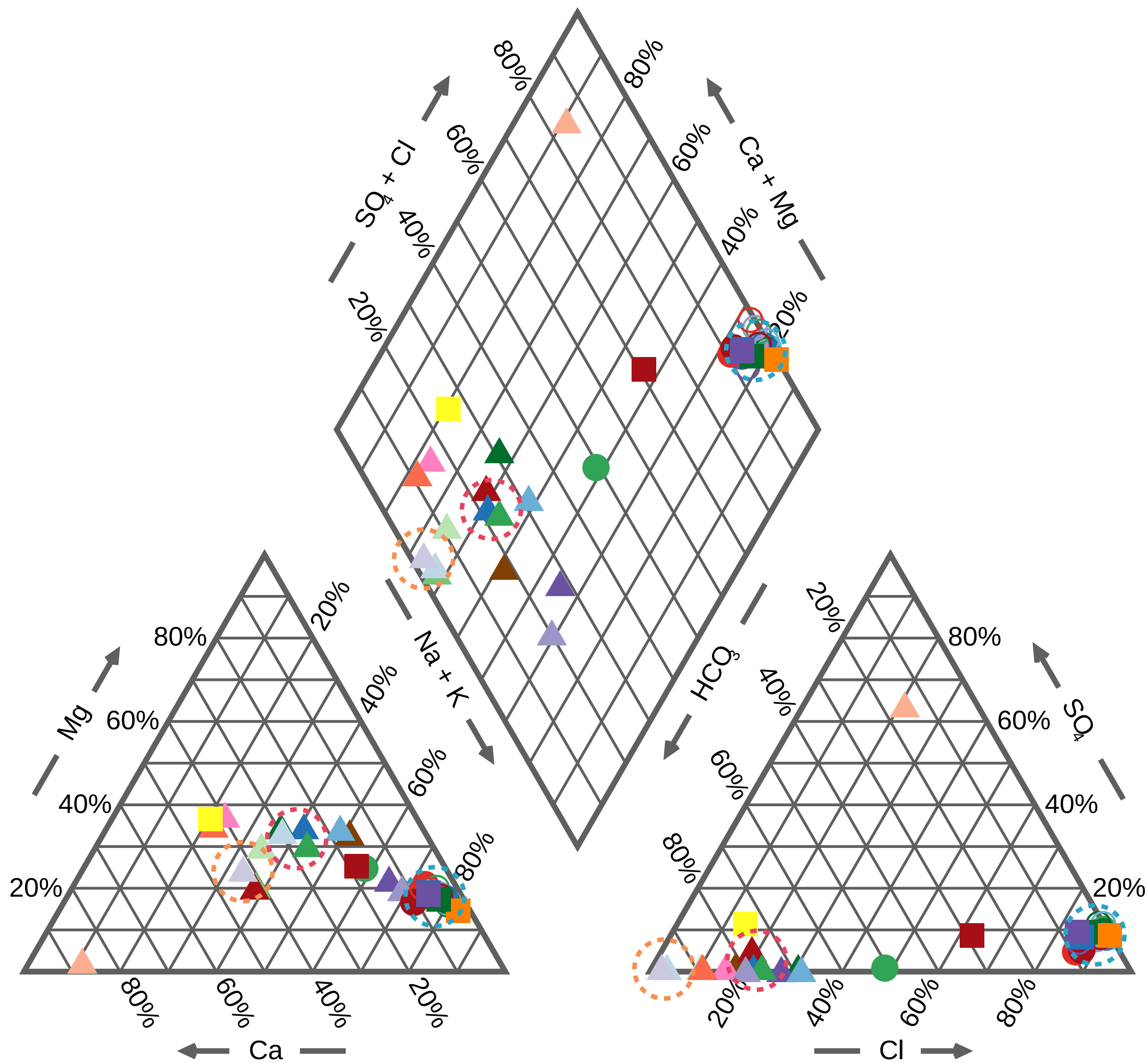
Legend:

WCT-1	WCT-2	WCT-3	WCT-4	Other Wells	Surface Water
MW-7	MW-9	MW-12	MW-4	B-5R	Wapato Creek
HC-2	MW-10	MW-13	MW-1	MW-6R	
B-1R			MW-2R		
			MW-3		

Note:
µS/cm = microSiemens per centimeter

Figure 4-5
Tidal Study Conductivity Plot
Event 1 - May 2016
Remedial Investigation Report
Parcel 15
Tacoma, Washington

GSI Water Solutions, Inc.



LEGEND

Groundwater: B001R-E1, B005R-E1, HC002-E1, MW001-E1, MW002R-E1, MW003-E1, MW004-E1, MW007-E1, MW009-E1, MW010-E1, MW012-E1, MW013-E1, TBGW003-E1, TBGW005-E1, TBGW007-E1

Deep Porewater: WCTPW001A-10-E1, WCTPW001B-10-E1, WCTPW002A-10-E1, WCTPW002A-10-E1, WCTPW003A-10-E1, WCTPW003B-10-E1, WCTPW004A-10-E1, WCTPW004B10-E1

Shallow Porewater: WCTPW001A-40-E1, WCTPW001B-40-E1, WCTPW002A-40-E1, WCTPW002B-40-E1, WCTPW003A-40-E1, WCTPW003B-40-E1, WCTPW004A-40-E1, WCTPW004B-40-E1

Surface Water: BWSW001-E1, USSW001-E1, WCTSW001B-40-E1, WCTSW002B-40-E1, WCTSW003B-40-E1, WCTSW004B-40-E1

Predominant Chemistry: Perched Water, Nearshore Groundwater, Surface Water/Porewater

FIGURE 4-6

Piper Plot for Event 1 Groundwater, Porewater, and Surface Water

Remedial Investigation Report
Parcel 15
Tacoma, WA

GSI Water Solutions, Inc.

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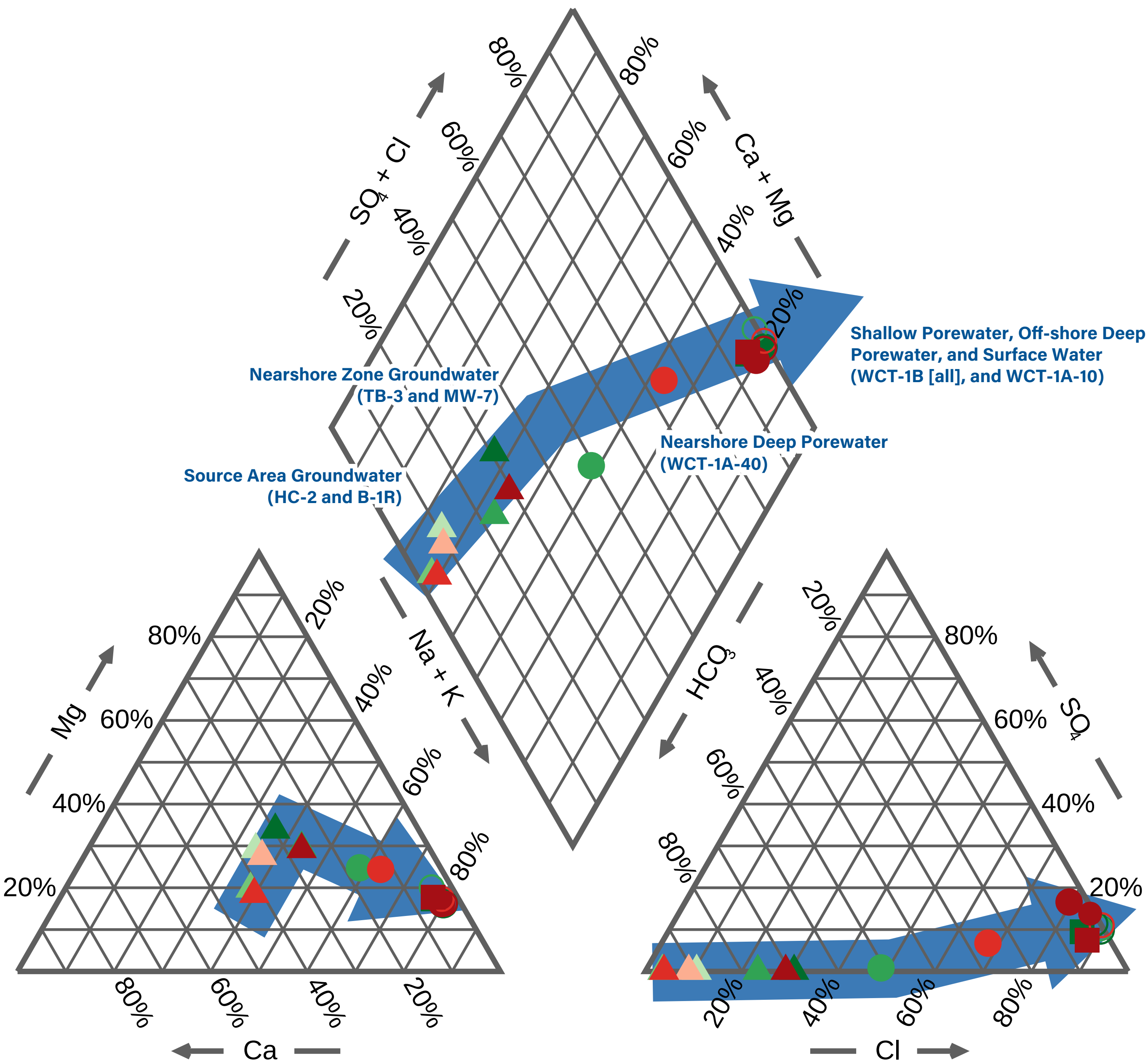


LEGEND

Groundwater
- B001R-E1
- HC002-E1
- MW007-E1
- TBGW003-E1
- B001R-E2
- HC002-E2
- MW007-E2

Deep Porewater
- WCTPW001A-40-E1
- WCTPW001B-40-E1
- WCTPW001A-40-E2
- WCTPW001B-40-E2

Shallow Porewater
- WCTPW001A-10-E1
- WCTPW001B-10-E1
- WCTPW001A-10-E2
- WCTPW001B-10-E2

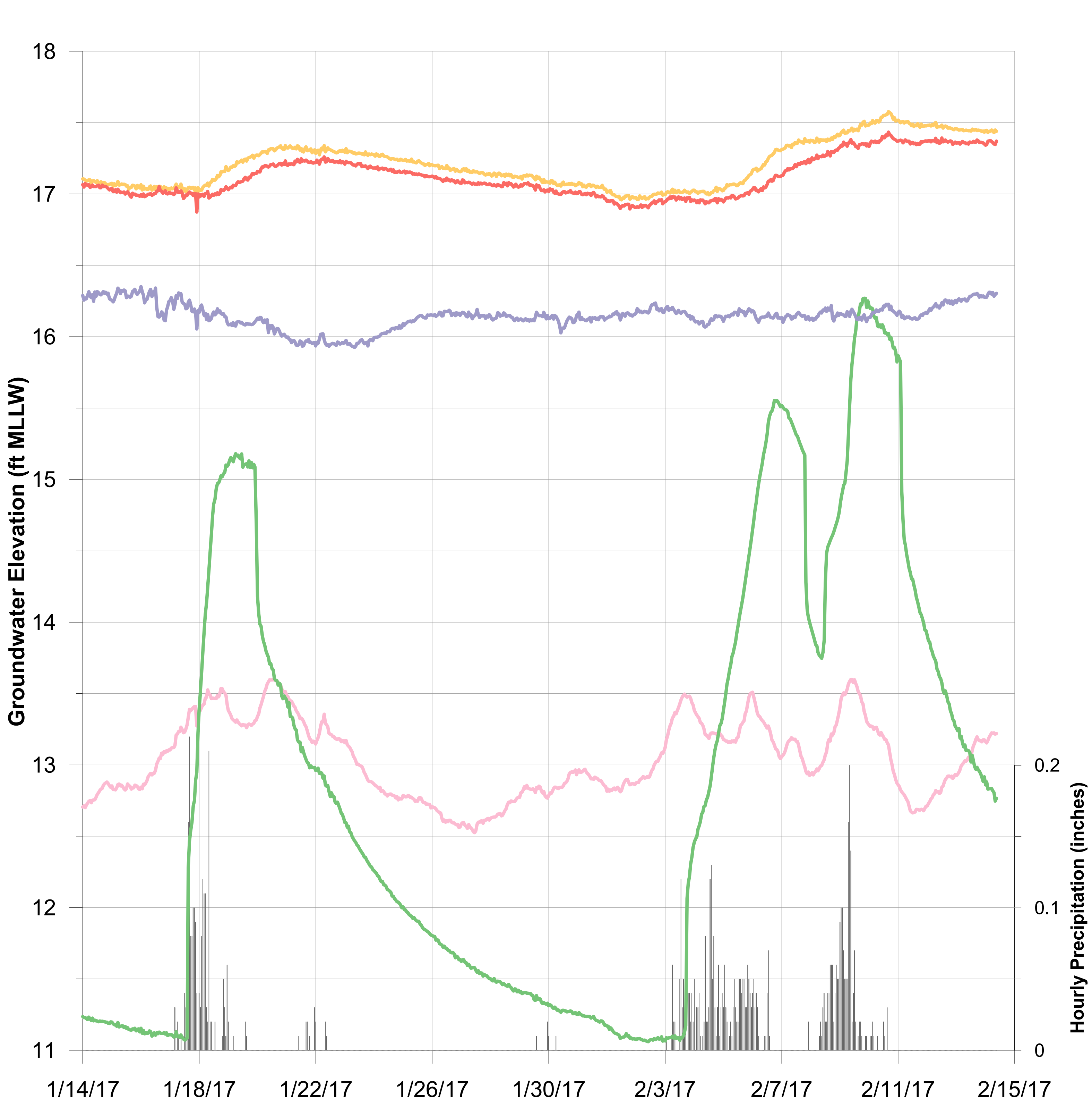
Surface Water
- WCTSW001B-E1
- WCTSW001B-E2

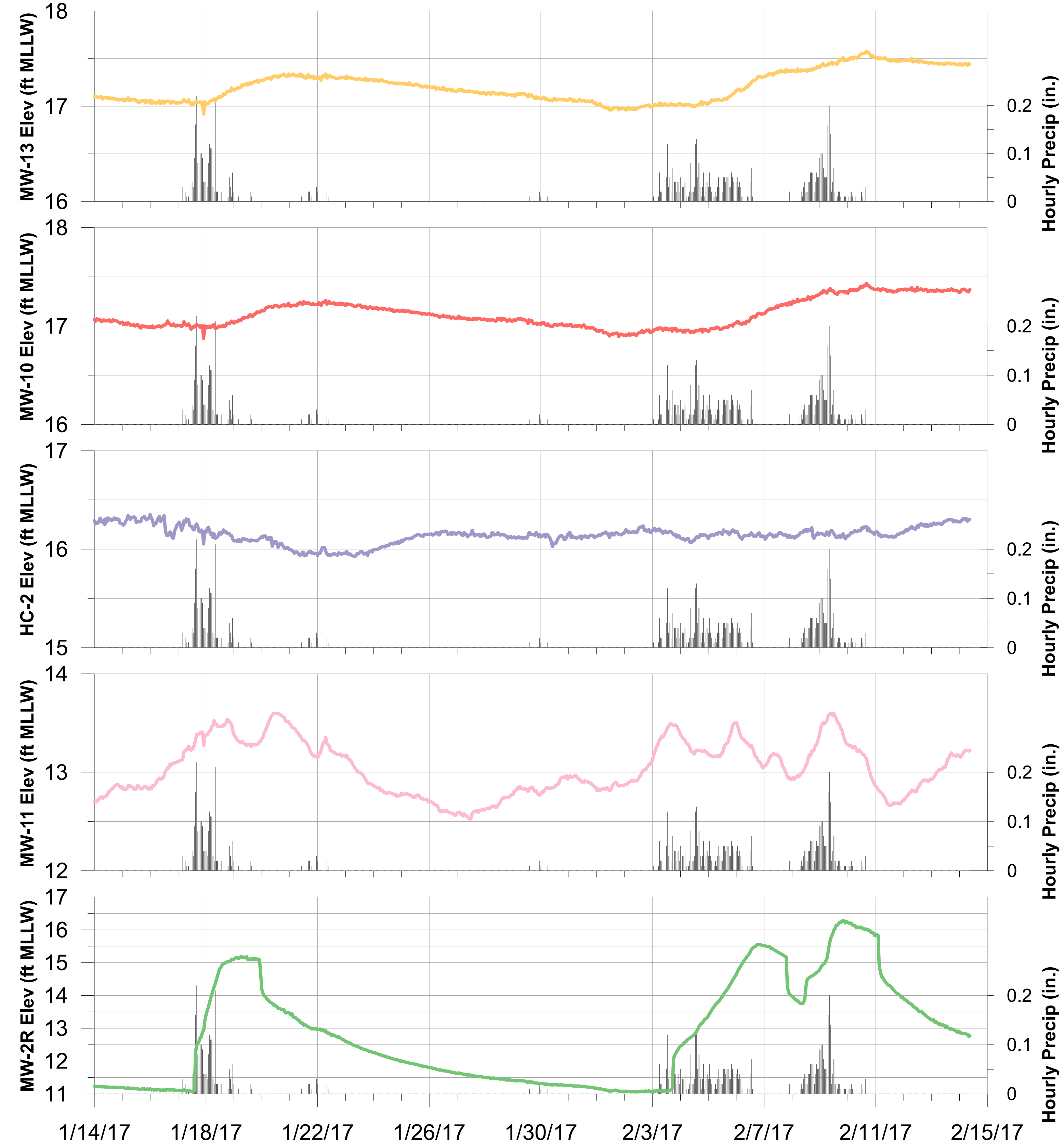
Other
- Groundwater to Porewater to Surface Water Flow Path

FIGURE 4-7

Piper Plot for Event 1 and Event 2 Groundwater, Porewater, and Surface Water from Transect 1
Remedial Investigation Report
Parcel 15
Tacoma, WA

GSI Water Solutions, Inc.





Legend:

- HC-2 (perched)
- MW-10 (perched)
- MW-13 (perched)
- MW-11
- MW-2R (sawmill)
- Hourly Precipitation[1]

Note:
MLLW = mean low low water
[1] Precipitation readings from Tacoma Narrows Airport, NOAA NCDC Station ID 94274

Figure 4-8
Event 4 Hydrograph
January 14 to February 14, 2017
Remedial Investigation Report
Parcel 15
Tacoma, Washington

GSI Water Solutions, Inc.

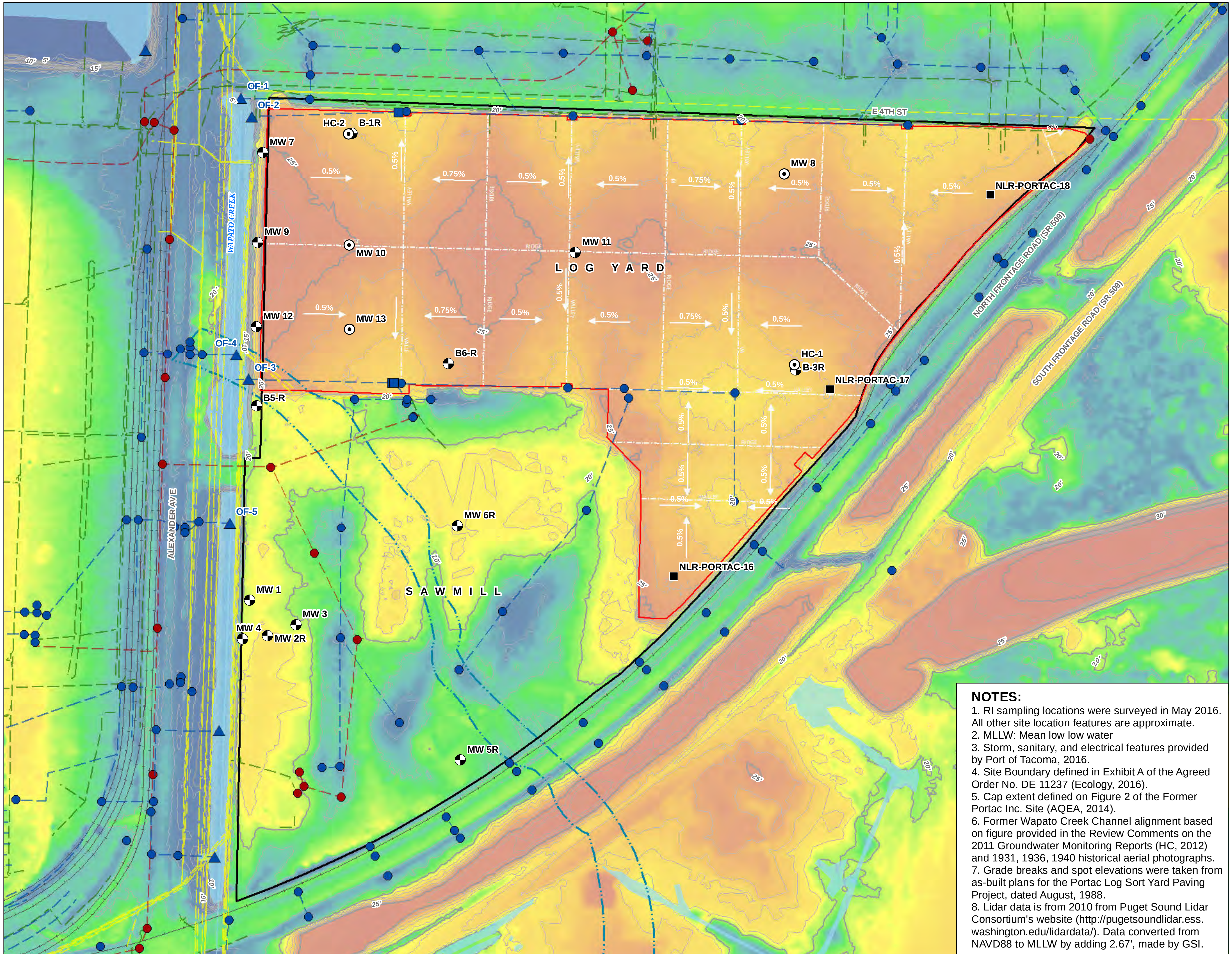


FIGURE 4-9

Existing Infrastructure and Ground Surface Elevations

Remedial Investigation Report
Parcel 15
Tacoma, WA

LEGEND

Monitoring Wells and Piezometers[1]
- Monitoring Well
- Perched Monitoring Well
- Piezometer

Storm Features[3]
- Outfall
- Vault
- Spill Containment Vessel
- Storm Line

Sanitary Features[3]
- Sanitary Point
- Sanitary Line

Electrical Features[3]
- Above Ground Electric Line
- Below Ground Electric Line

All Other Features
- Site Boundary[4]
- Cap[5]
- Railroad
- Former Wapato Creek Channel[6]
- Watercourse
- Waterbody

Ground Surface Elevation (ft MLLW)
- High : 32.71'
- Mid : 24.09'
- Low : 15.47'

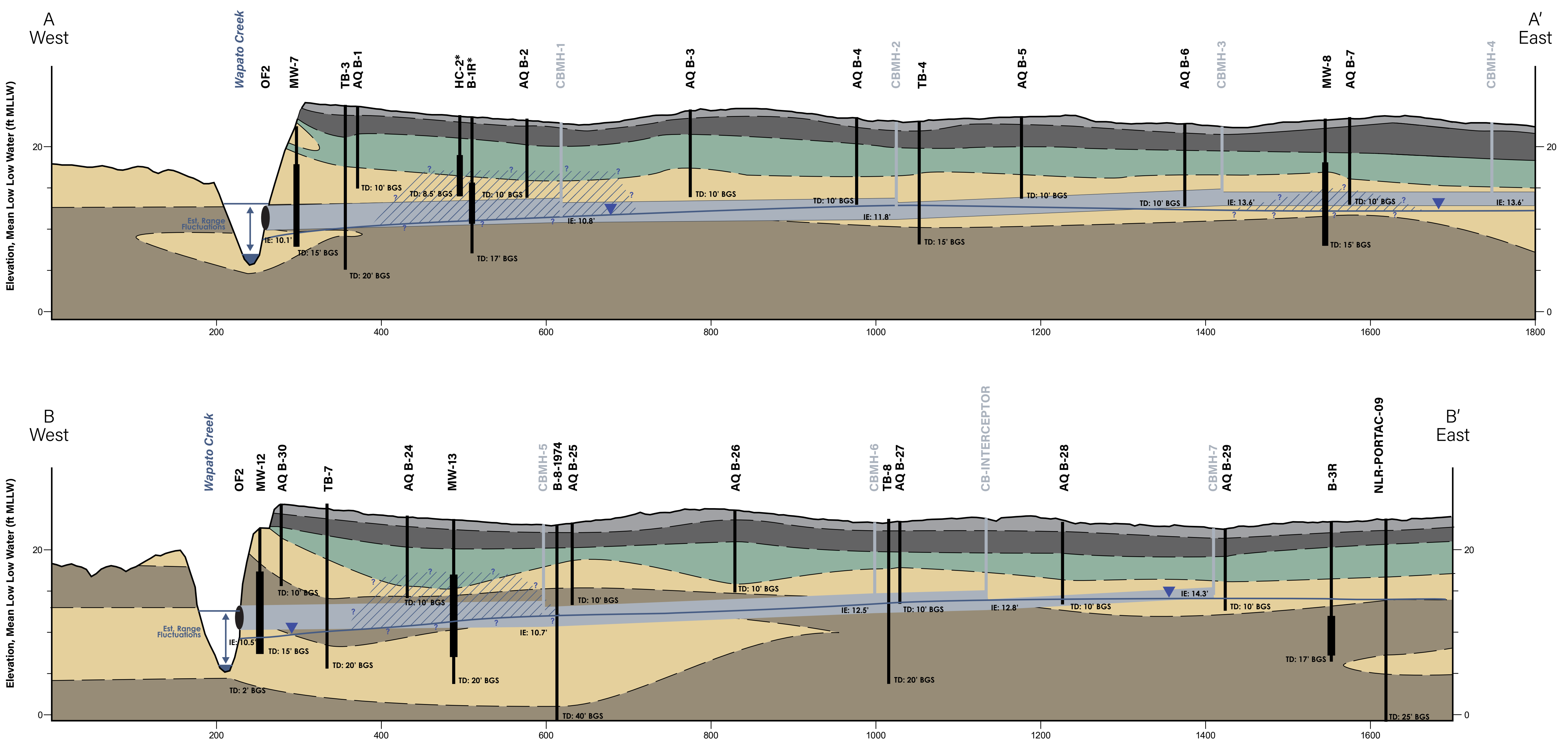
N

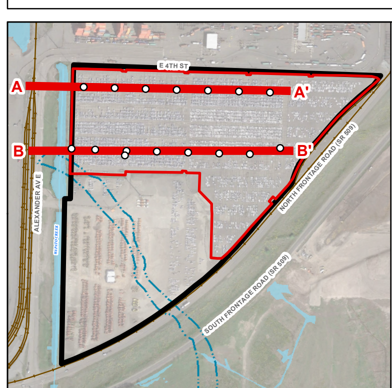
0 100 200 300
Feet

Date: June 29, 2017
Data Sources: PORTAC, Aerial photo taken on April 19, 2015 by the Google Earth

GSI Water Solutions, Inc.

NOTES:
1. RI sampling locations were surveyed in May 2016. All other site location features are approximate.
2. MLLW: Mean low low water
3. Storm, sanitary, and electrical features provided by Port of Tacoma, 2016.
4. Site Boundary defined in Exhibit A of the Agreed Order No. DE 11237 (Ecology, 2016).
5. Cap extent defined on Figure 2 of the Former Portac Inc. Site (AQEA, 2014).
6. Former Wapato Creek Channel alignment based on figure provided in the Review Comments on the 2011 Groundwater Monitoring Reports (HC, 2012) and 1931, 1936, 1940 historical aerial photographs.
7. Grade breaks and spot elevations were taken from as-built plans for the Portac Log Sort Yard Paving Project, dated August, 1988.
8. Lidar data is from 2010 from Puget Sound Lidar Consortium's website (http://pugetsoundlidar.ess.washington.edu/lidardata/). Data converted from NAVD88 to MLLW by adding 2.67', made by GSI.





LEGEND

- Soil Boring/Well
- Screened Interval
- May 2016 Water Level
- Observed Perched Water
- Catch Basin
- Stormwater Conveyance System

Geology

- Roller Compacted Concrete
- Gravel Base Course
- Fill Containing Slag
- Silty Sand
- Fine Grained Deposits (Silt and Clay)

NOTES:

Vertical Exaggeration = 10X

Extent of all geologic features shown is approximate and conceptual in nature.

* Borehole log not available

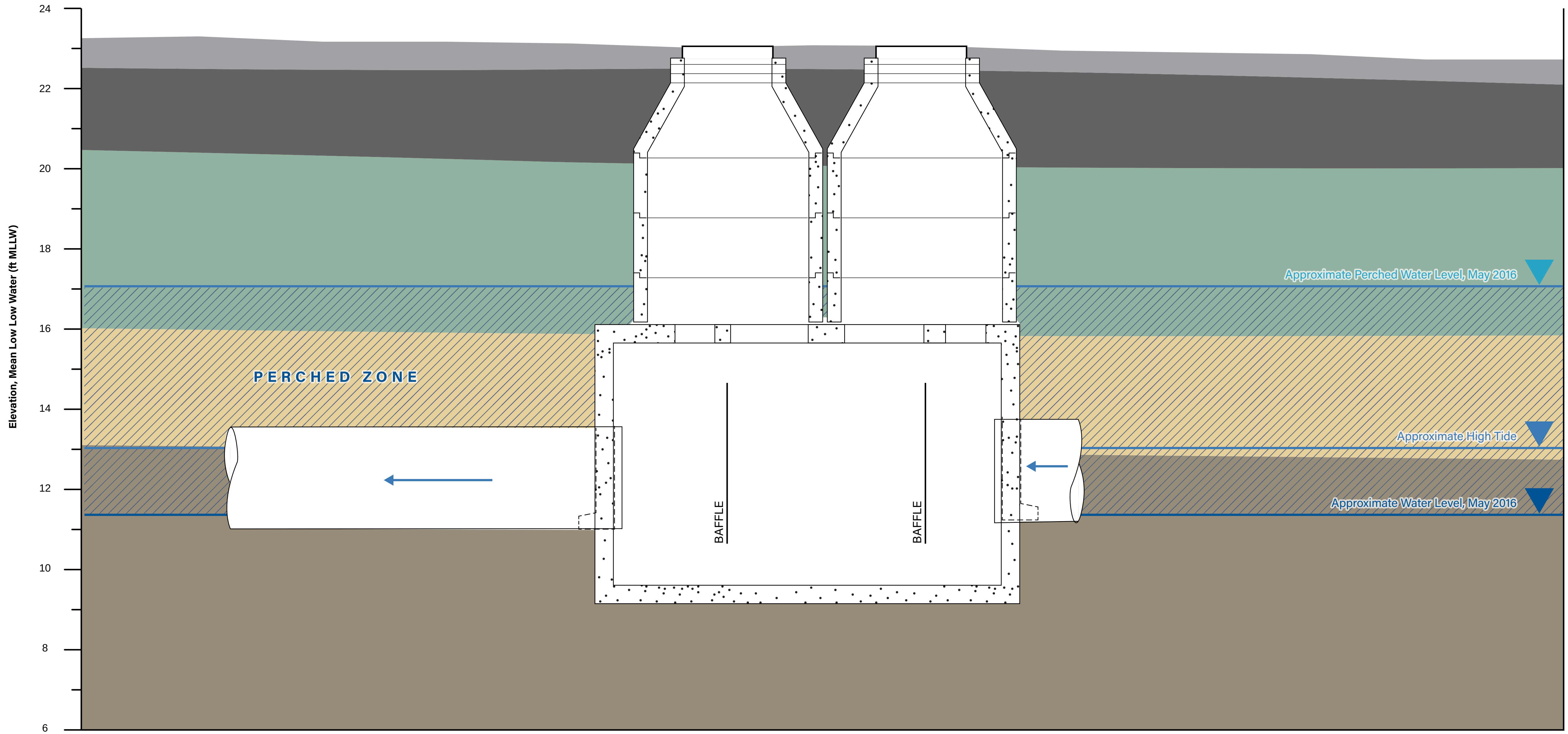
P:\Portland\603-Port of Tacoma\Figures\RI

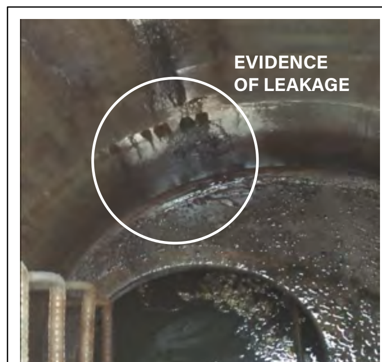
FIGURE 4-10

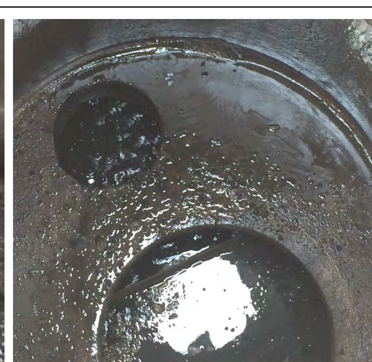
Geologic Cross-Section A-A′ and B-B′ through Log Yard (with Stormwater Conveyance System)

Remedial Investigation Report
Parcel 15
Tacoma, WA

GSI Water Solutions, Inc.







LEGEND

Geology

- Roller Compacted Concrete
- Gravel Base Course
- Fill Containing Slag
- Silty Sand
- Fine Grained Deposits (Silt and Clay)
- Sand

FIGURE 4-11

Spill Containment Vessel Schematic and Photos

Remedial Investigation Report
Parcel 15
Tacoma, WA

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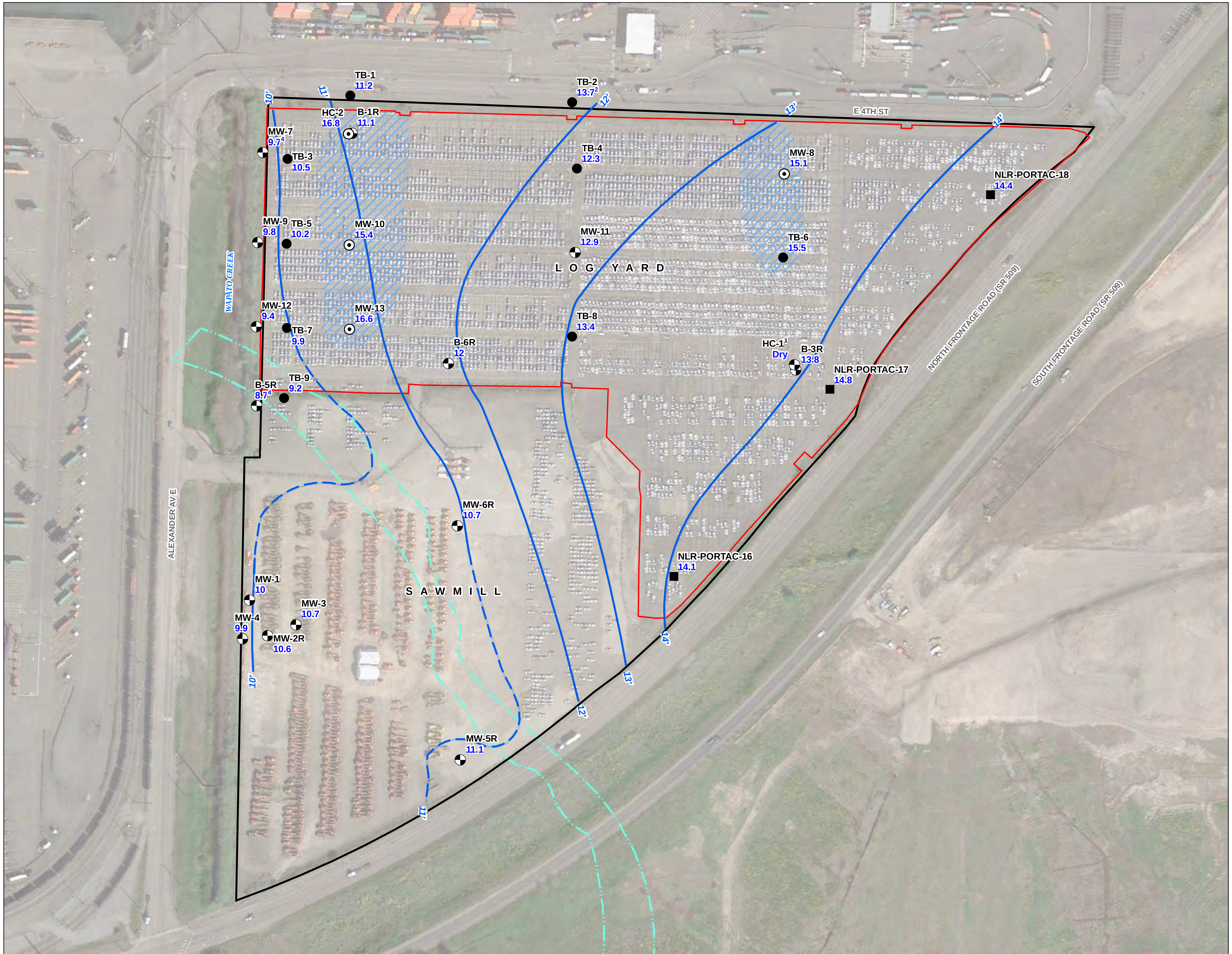


FIGURE 4-12

Event 1: May 2016 Groundwater Contour Map

Remedial Investigation Report
Parcel 15
Tacoma, WA

LEGEND

- Monitoring Well[3]
- Perched Monitoring Well[3]
- Piezometer[3]
- Temporary Boring[3]
- Groundwater Elevation Contour (ft MLLW), Dashed Where Inferred
- Observed Perched Zone

All Other Features

- Site Boundary[5]
- Cap[6]
- Former Wapato Creek Channel[7]

NOTES:

1. HC-1 was dry.
2. TB-2 reading not included in contours.
3. Monitoring well, piezometer, and temporary boring locations surveyed in May 2016.
4. With the exception of monitoring wells MW-7 and B-5R, the 24-hour average that was calculated from 72-hours of transducer data equalled the manual water level measurement collected during the central portion of that time period. The tidally corrected 24-hour average is shown for wells MW-7 and B-5R.
5. Site Boundary defined in Exhibit A of the Draft Agreed Order No. DE 11237 (Ecology, 2015).
6. Cap extent defined on Figure 2 of the Former Portac Inc. Site (AQEA, 2014).
7. Former Wapato Creek Channel alignment based on figure provided in the Review Comments on the 2011 Groundwater Monitoring Reports (HC, 2012) and 1931, 1936, 1940 historical aerial photographs.
8. MLLW: Mean low low water

N

0 115 230 345
Feet

Date: January 27, 2017
Data Sources: PORTAC, Aerial photo taken on April 19, 2015 by Google Earth

GSI Water Solutions, Inc.

Document Path: P:\Portland\603-Port of Tacoma\GIS\Project_mxds\RI\Figure4-12_GW_Contour_Event1.mxd

FIGURE 4-13

Event 2: August 2016 Groundwater Contour Map

Remedial Investigation Report
Parcel 15
Tacoma, WA

LEGEND

- Monitoring Well
- Perched Monitoring Well
- Piezometer
- Groundwater Elevation Contour (ft MLLW), Dashed Where Inferred
- Observed Perched Zone

All Other Features

- Site Boundary[3]
- Cap[4]
- Former Wapato Creek Channel[5]

NOTES:
1. HC-1 was dry.
2. Monitoring well and piezometer locations surveyed in May 2016.
3. Site Boundary defined in Exhibit A of the Draft Agreed Order No. DE 11237 (Ecology, 2015).
4. Cap extent defined on Figure 2 of the Former Portac Inc. Site (AQEA, 2014).
5. Former Wapato Creek Channel alignment based on figure provided in the Review Comments on the 2011 Groundwater Monitoring Reports (HC, 2012) and 1931, 1936, 1940 historical aerial photographs.
6. MLLW: Mean low low water

N

0 115 230 345
Feet

Date: January 27, 2017
Data Sources: PORTAC, Aerial photo taken on April 19, 2015 by Google Earth

GSI Water Solutions, Inc.

Document Path: P:\Portland\603-Port of Tacoma\GIS\Project_mxds\RI\Figure4-13_GW_Contour_Event2.mxd

FIGURE 4-14

Event 3: November 2016 Groundwater Contour Map

Remedial Investigation Report
Parcel 15
Tacoma, WA

LEGEND

- Monitoring Well
- Perched Monitoring Well
- Piezometer
- Groundwater Elevation Contour (ft MLLW), Dashed Where Inferred
- Observed Perched Zone

All Other Features

- Site Boundary[3]
- Cap[4]
- Former Wapato Creek Channel[5]

NOTES:

1. HC-1 had standing water in the well due to a leaking well cap. Insufficient water to sample.
2. Monitoring well and piezometer locations surveyed in May 2016.
3. Site Boundary defined in Exhibit A of the Draft Agreed Order No. DE 11237 (Ecology, 2015).
4. Cap extent defined on Figure 2 of the Former Portac Inc. Site (AQEA, 2014).
5. Former Wapato Creek Channel alignment based on figure provided in the Review Comments on the 2011 Groundwater Monitoring Reports (HC, 2012) and 1931, 1936, 1940 historical aerial photographs.
6. MLLW: Mean low low water

N

0 115 230 345
Feet

GSI Water Solutions, Inc.

Date: June 29, 2017
Data Sources: PORTAC, Aerial photo taken on April 19, 2015 by Google Earth

Document Path: P:\Portland\603-Port of Tacoma\GIS\Project_mxds\RI\Figure4-14_GW_Contour_Event3.mxd

FIGURE 4-15

Event 4: February 2017 Groundwater Contour Map

Remedial Investigation Report
Parcel 15
Tacoma, WA

LEGEND

- Monitoring Well
- Perched Monitoring Well
- Piezometer
- Groundwater Elevation Contour (ft MLLW), Dashed Where Inferred
- Observed Perched Zone

All Other Features

- Site Boundary[2]
- Cap[3]
- Former Wapato Creek Channel[4]

NOTES:

1. Monitoring well and piezometer locations surveyed in February 2017.
2. Site Boundary defined in Exhibit A of the Draft Agreed Order No. DE 11237 (Ecology, 2015).
3. Cap extent defined on Figure 2 of the Former Portac Inc. Site (AQEA, 2014).
4. Former Wapato Creek Channel alignment based on figure provided in the Review Comments on the 2011 Groundwater Monitoring Reports (HC, 2012) and 1931, 1936, 1940 historical aerial photographs.
5. MLLW: Mean low low water

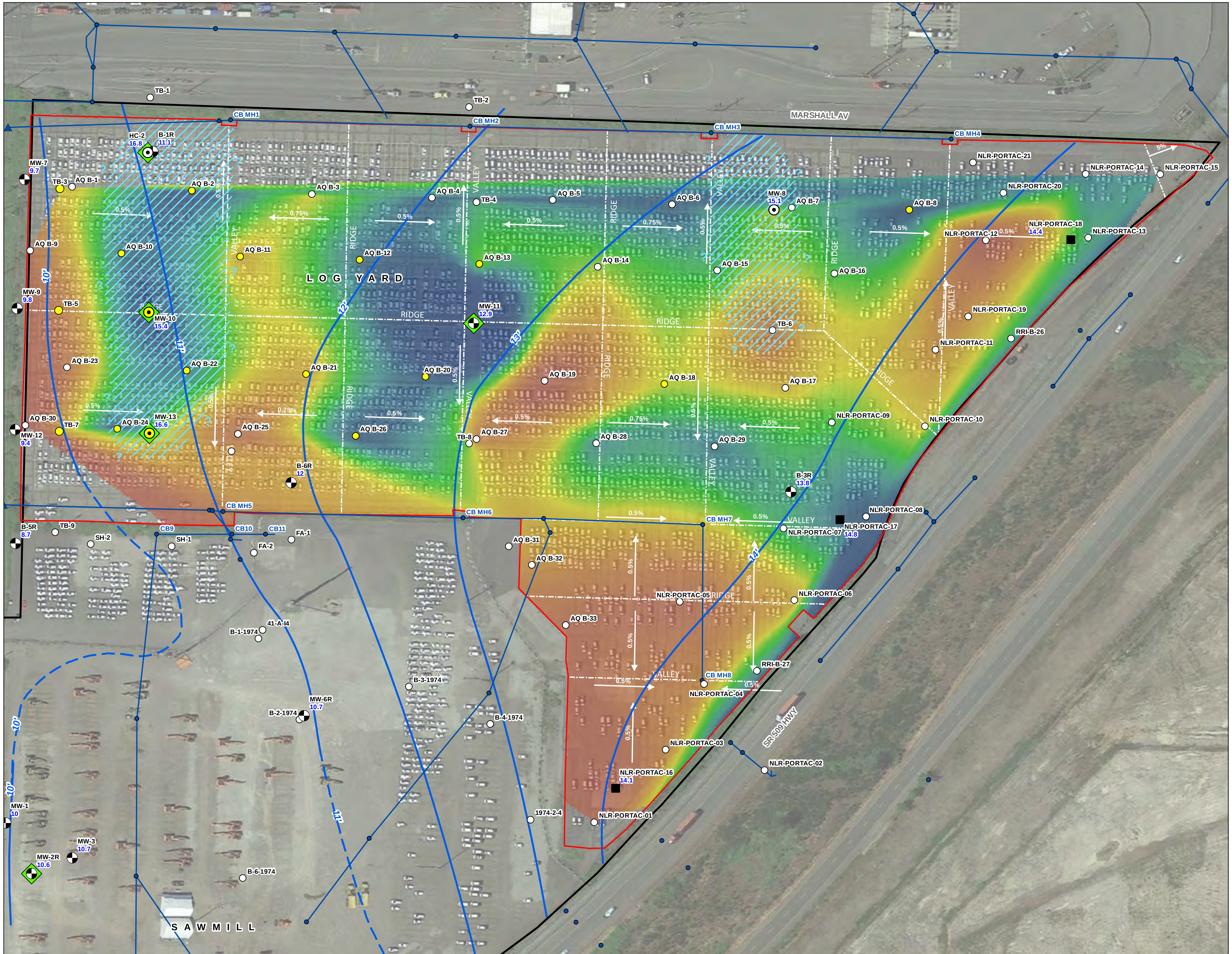
N

0 115 230 345
Feet

Date: June 29, 2017
Data Sources: PORTAC, Aerial photo taken on April 19, 2015 by Google Earth

GSI Water Solutions, Inc.

Document Path: P:\Portland\603-Port of Tacoma\GIS\Project_mxds\RI\Figure4-15_GW_Contour_Event4.mxd



Document Path: P:\Portland\603-Port of Tacoma\GIS\Project_mxds\RI\Figure4-16_BaseFill_Containing_Slag_Elevation.mxd

FIGURE 4-16

Base of Fill Containing Slag Elevation

Remedial Investigation Report
Parcel 15
Tacoma, WA

LEGEND

- Monitoring Well
- Perched Monitoring Well
- Piezometer
- Temporary Soil and/or Groundwater Boring
- Contained Transducer during the February 2017 Seepage Study
- Borings with Slag Gravel at Base or > 100 inches of Fill Containing Slag
- Groundwater Elevation Contour (ft MLLW), Dashed Where Inferred
- Observed Perched Water (Approximate)

Current Storm Features

- Outfall
- Vault
- Stormwater Line

All Other Features

- Site Boundary[1]
- Cap[3]

Base of Fill Containing Slag, Elevation (ft MLLW)

20.0'
19.0'
17.0'
15.0'
13.0'
11.5'

NOTES:

RI sampling locations were surveyed in May 2016. All other site location features are approximate.
MLLW: Mean low low water
1. Site Boundary defined in Exhibit A of the Agreed Order No. DE 11237 (Ecology, 2016).
2. Grade breaks and spot elevations were taken from as-built plans for the Portac Log Sort Yard Paving Project, dated August, 1988.
3. Cap extent defined on Figure 2 of the Former Portac Inc. Site (AQEA, 2014).
4. Air Photo from Google Earth June 2016

N

0 80 160 240
Feet

MAP NOTES:
Date: June 29, 2017
Data Sources: Aerial photo taken in 2006 by NAIP

GSI Water Solutions, Inc.

Document Path: P:\Portland\603-Port of Tacoma\GIS\Project_mxds\RI\Figure7-1_Soil_As_Results.mxd

FIGURE 7-1

Arsenic Concentrations in Soil

Remedial Investigation Report
Parcel 15
Tacoma, WA

LEGEND

Saturated Soil Sampling Locations[1]

- Monitoring Well
- Perched Monitoring Well
- Temporary Soil and Groundwater Boring

Unsaturated Soil Sampling Locations[8]

- Temporary Soil Boring[8]

Total Arsenic Results (mg/kg)

- 0 - 20[5]
- >20 - 57[6]
- >57 - 87.5[7]
- >87.5

All Other Features

- Site Boundary[2]
- Cap[3]
- Former Wapato Creek Channel[4]

NOTES:

1. Locations have been surveyed, May 2016.
2. Site Boundary defined in Exhibit A of the Draft Agreed Order No. DE 11237 (Ecology, 2015).
3. Cap extent defined on Figure 2 of the Former Portac Inc. Site (AQEA, 2014).
4. Former Wapato Creek Channel alignment based on figure provided in the Review Comments on the 2011 Groundwater Monitoring Reports (HC, 2012) and 1931, 1936, 1940 historical aerial photographs.
5. MTCA A Industrial (WAC 173-340) = 20 mg/kg
6. Washington Marine Sediment Cleanup Objecting (WAC 173-204-562) = 57 mg/kg
7. MTCA C for Soil, Cancer (WAC 173-340) = 87.5 mg/kg
8. Log Yard Soil Testing Report (AQEA, 2014). Label indicates maximum arsenic value, followed by estimated depth below ground surface to depths where MTCA Method C Cleanup Levels are met. If the estimated depth to the clean surface was confirmed through sampling, a (Y) = Yes is included in the label. Otherwise a (N) = No is used.

N

0 115 230 345
Feet

Date: June 29, 2017
Data Sources: PORTAC, Aerial photo taken on April 19, 2015 by Google Earth

GSI Water Solutions, Inc.

Document Path: P:\Portland\603-Port of Tacoma\GIS\Project_mxds\RI\Figure7-2_Soil_As_Results.mxd

FIGURE 7-2

Arsenic Concentrations in Sediment

Remedial Investigation Report
Parcel 15
Tacoma, WA

LEGEND

△ Stormwater Outfall

Sediment Sampling Locations[1]

◇ Wapato Creek Sediment

Total Arsenic Results (mg/kg)

- 0 - 11[5]
- >11 - 20[6]
- >20 - 57[7]
- >57 - 87.5[8]
- >87.5

All Other Features

- Site Boundary[2]
- Cap[3]
- Former Wapato Creek Channel[4]

NOTES:

1. Locations have been surveyed, May 2016.
2. Site Boundary defined in Exhibit A of the Draft Agreed Order No. DE 11237 (Ecology, 2015).
3. Cap extent defined on Figure 2 of the Former Portac Inc. Site (AQEA, 2014).
4. Former Wapato Creek Channel alignment based on figure provided in the Review Comments on the 2011 Groundwater Monitoring Reports (HC, 2012) and 1931, 1936, 1940 historical aerial photographs.
5. Natural Sediment Background = 11 mg/kg, based on comparison to the surface weighted average concentration (SWAC) in surface sediment, which is 7.0 mg/kg in Wapato Creek adjacent to the Log Yard.
6. MTCA A Industrial (WAC 173-340) = 20 mg/kg
7. Washington Marine Sediment Cleanup Objecting (WAC 173-204-562) = 57 mg/kg
8. MTCA C for Soil, Cancer (WAC 173-340) = 87.5 mg/kg

N

0 60 120 180
Feet

Date: June 29, 2017
Data Sources: PORTAC, Aerial photo taken on April 19, 2015 by Google Earth

GSI Water Solutions, Inc.

FIGURE 7-3

Arsenic Concentrations in Groundwater, Porewater, Surface Water, and Outfall Discharge - Event 1 through Event 4

Remedial Investigation Report
Parcel 15
Tacoma, WA

LEGEND

Sampling Locations[1]

- Monitoring Well
- Perched Monitoring Well
- Temporary Soil and Groundwater Boring
- Surface Water
- Wapato Creek Porewater
- Stormwater Outfall

Dissolved Arsenic Results (ug/L)

- 0 - 5[4]
- >5 - 36[5]
- >36 - 69[6]
- >69 - 690
- >690

All Other Features

- Site Boundary[2]
- Cap[3]
- Stormwater Outfall

NOTES:

1. Locations have been surveyed, May 2016.
2. Site Boundary defined in Exhibit A of the Draft Agreed Order No. DE 11237 (Ecology, 2015).
3. Cap extent defined on Figure 2 of the Former Portac Inc. Site (AQEA, 2014).
4. MTCA Method A, Adjusted for Background
5. Marine Water Chronic Toxicity Water Quality Standards For Surface Waters of the State of Washington (WAC 173-201A) = 36 ug/L
6. Marine Water Acute Toxicity Water Quality Standards For Surface Waters of the State of Washington (WAC 173-201A) = 69 ug/L
7. Not sampled
8. Color coding represents the highest concentration for stations with multiple data results.

N

0 115 230 345
Feet

Date: February 14, 2018
Data Sources: PORTAC, Aerial photo taken on April 19, 2015 by Google Earth

GSI Water Solutions, Inc.

FIGURE 7-4

Methane Headspace Readings - Event 1 through Event 4

Remedial Investigation Report
Parcel 15
Tacoma, WA

LEGEND

Groundwater Sampling Locations[1]

- Monitoring Well
- Perched Monitoring Well
- Dry Monitoring Well
- Piezometer

Percent Methane Readings (by volume)

- 0% - 0.5%[2]
- 0.5% - 20%
- 20% - 40%
- 40% - 60%
- >60%

All Other Features

- Site Boundary[3]
- Cap[4]
- Former Dip Tank Excavation/Fill Extent (Approximate)[5]

NOTES:

1. Locations have been surveyed, May 2016.
2. Methane Screening Level is for Indoor Air based on a MTCA standard of 10% of the lower explosive limit (LEL) of 5% (WAC 173-340).
3. Site Boundary defined in Exhibit A of the Draft Agreed Order No. DE 11237 (Ecology, 2015).
4. Cap extent defined on Figure 2 of the Former Portac Inc. Site (AQEA, 2014).
5. Former Dip Tank Excavation location approximated from Figure 8, (WES, 2009).
6. NM: Not measured due to cap being off the well.
7. Event 3 and Event 4 methane readings were not conducted on Log Yard wells.
8. The methane meter malfunctioned during Event 2 and accurate methane headspace readings were not collected.
9. Color coding represents the highest concentration for stations with multiple data results.

N

0 115 230 345
Feet

GSI Water Solutions, Inc.

Date: June 29, 2017
Data Sources: PORTAC, Aerial photo taken on April 19, 2015 by Google Earth

Document Path: P:\Portland\603-Port of Tacoma\GIS\Project_mxds\RI\Figure7-4_Methane_Headspace_Readings.mxd

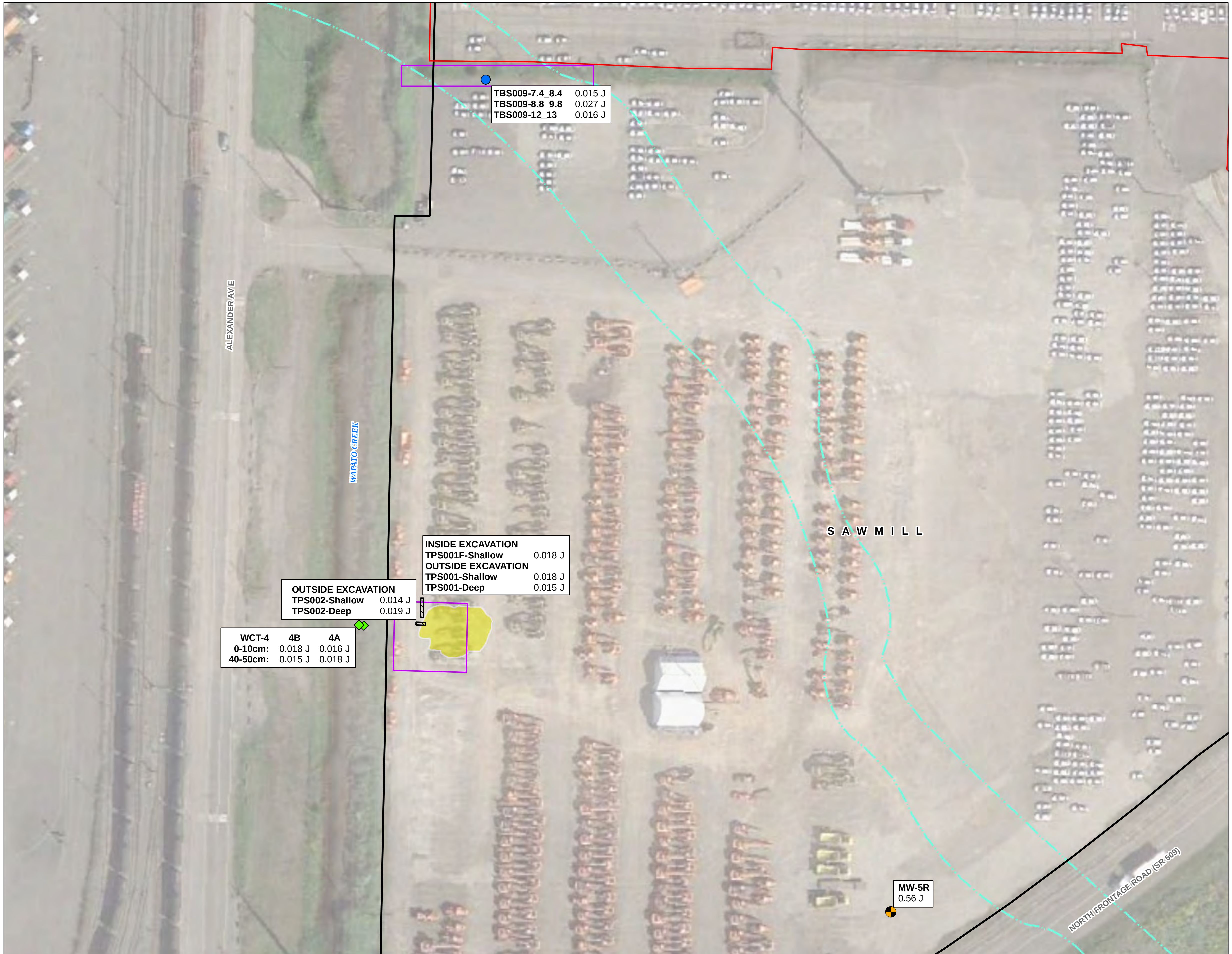


FIGURE 7-5

Pentachlorophenol Concentrations in Soil and Sediment - Event 1

Remedial Investigation Report
Parcel 15
Tacoma, WA

LEGEND

Groundwater Sampling Locations[1]
- Monitoring Well
- Temporary Soil and Groundwater Boring

Porewater Sampling Locations[1]
- Wapato Creek Sediment
- Test Pit Area

Total Pentachlorophenol Results (mg/kg)
- 0 - 0.02
- >0.02 - 0.36[8]
- >0.36 - 328[9]
- >328

All Other Features
- Site Boundary[2]
- Cap[3]
- Former Dip Tank Excavation/Fill Extent (Approximate)[4]
- Former Drainage Ditch and Dip Tank Boundaries[5,6]
- Former Wapato Creek Channel[7]

NOTES:
1. Locations have been surveyed, May 2016.
2. Site Boundary defined in Exhibit A of the Draft Agreed Order No. DE 11237 (Ecology, 2015).
3. Cap extent defined on Figure 2 of the Former Portac Inc. Site (AQEA, 2014).
4. Former Dip Tank Excavationl ocation approximated from Figure 8, (WES, 2009).
5. Former dip tank boundary based on the "approximate soil clean-up area boundaries" shown on Figure 12 of the Lumber Mill Cleanup Report (WES, 2009).
6. Former drainage ditch boundary reflects the lower 200 feet of the ditch which is noted to be the extent of impact in Section 7.3 of the Portac Log Yard Remediation Plan (HC, 1988).
7. Former Wapato Creek Channel alignment based on figure provided in the Review Comments on the 2011 Groundwater Monitoring Reports (HC, 2012) and 1931, 1936, 1940 historical aerial photographs.
8. Washington Marine Sediment Cleanup Objective (WAC 173-204-562) = 0.36 mg/kg
9. MTCA C for Soil, Cancer (WAC 173-340)

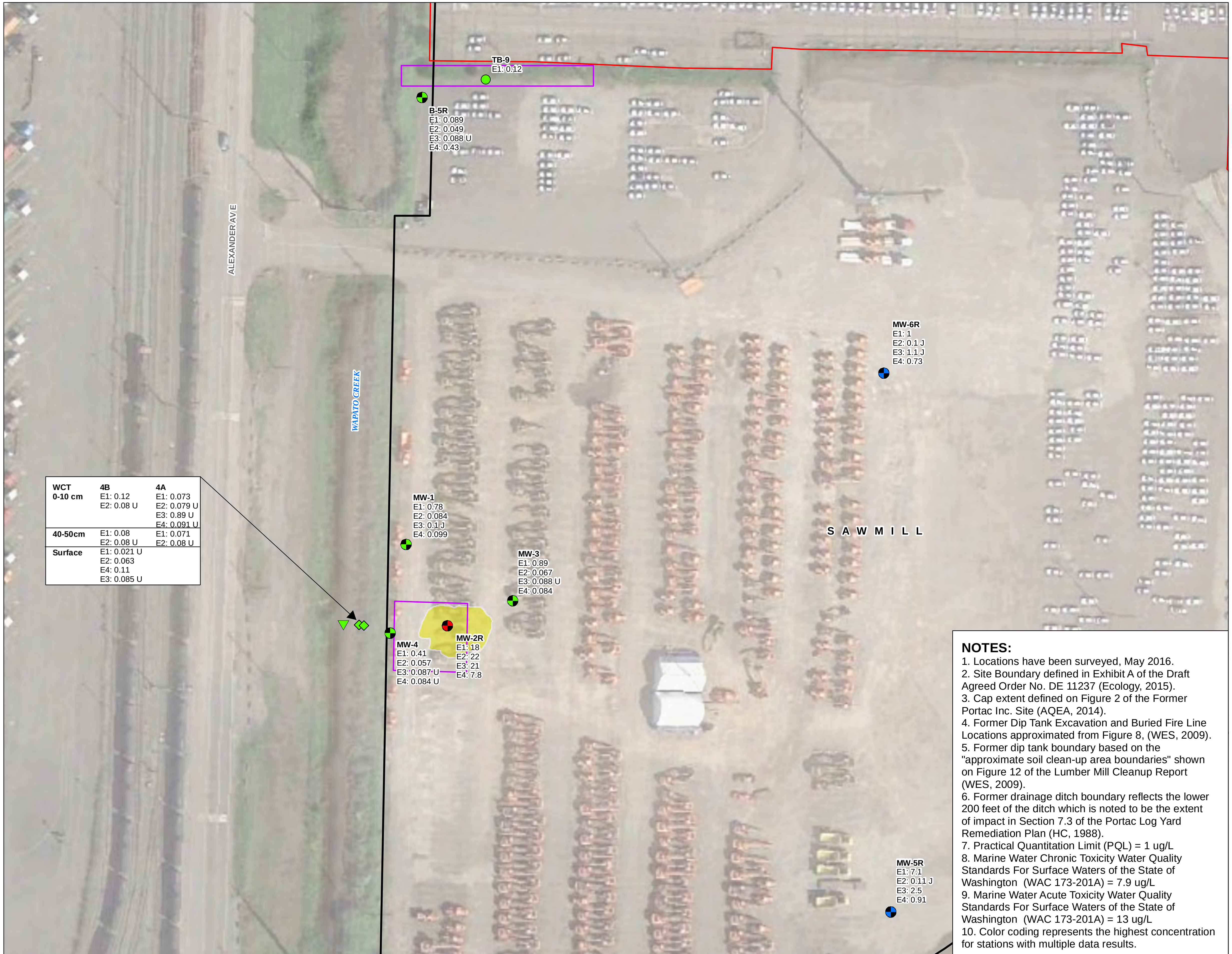
N

0 50 100 150
Feet

Date: June 29, 2017
Data Sources: PORTAC, Aerial photo taken on April 19, 2015 by Google Earth

GSI Water Solutions, Inc.

Document Path: P:\Portland\603-Port of Tacoma\GIS\Project_mxds\RI\Figure7-5_Soil_PCP_Results.mxd



NOTES:

1. Locations have been surveyed, May 2016.
2. Site Boundary defined in Exhibit A of the Draft Agreed Order No. DE 11237 (Ecology, 2015).
3. Cap extent defined on Figure 2 of the Former Portac Inc. Site (AQEA, 2014).
4. Former Dip Tank Excavation and Buried Fire Line Locations approximated from Figure 8, (WES, 2009).
5. Former dip tank boundary based on the "approximate soil clean-up area boundaries" shown on Figure 12 of the Lumber Mill Cleanup Report (WES, 2009).
6. Former drainage ditch boundary reflects the lower 200 feet of the ditch which is noted to be the extent of impact in Section 7.3 of the Portac Log Yard Remediation Plan (HC, 1988).
7. Practical Quantitation Limit (PQL) = 1 ug/L
8. Marine Water Chronic Toxicity Water Quality Standards For Surface Waters of the State of Washington (WAC 173-201A) = 7.9 ug/L
9. Marine Water Acute Toxicity Water Quality Standards For Surface Waters of the State of Washington (WAC 173-201A) = 13 ug/L
10. Color coding represents the highest concentration for stations with multiple data results.

FIGURE 7-6

Pentachlorophenol Concentrations in Groundwater, Porewater, and Surface Water - Event 1 through Event 4

Remedial Investigation Report
Parcel 15
Tacoma, WA

LEGEND

Sampling Locations[1]

- Monitoring Well
- Temporary Soil and Groundwater Boring
- Wapato Creek Porewater and Surface Water
- Surface Water

Pentachlorophenol Results (ug/L)

- 0 - 1[7]
- >1 - 7.9[8]
- >7.9 - 13[9]
- >13

All Other Features

- Site Boundary[2]
- Cap[3]
- Former Dip Tank Excavation/Fill Extent (Approximate)[4]
- Former Drainage Ditch and Dip Tank Boundaries[5,6]

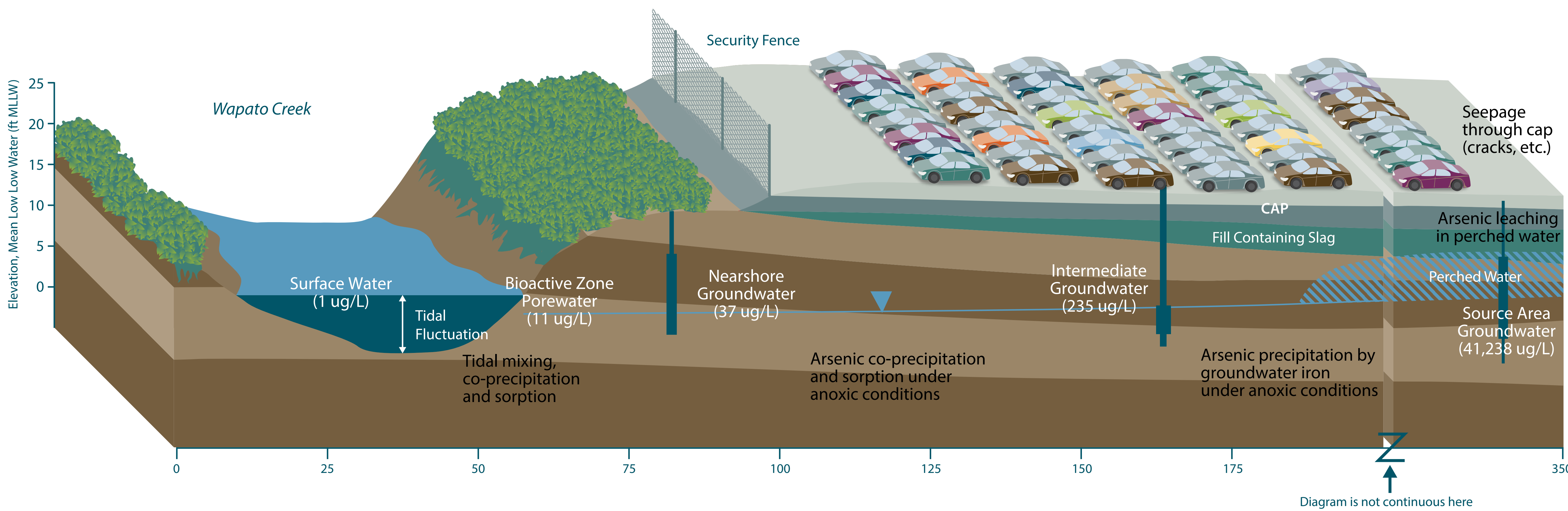
N

0 50 100 150
Feet

Date: August 18, 2017
Data Sources: PORTAC, Aerial photo taken on April 19, 2015 by Google Earth

GSI Water Solutions, Inc.

Document Path: P:\Portland\603-Port of Tacoma\GIS\Project_mxds\RI\Figure7-6_Water_PCP_Results.mxd



LEGEND

- Soil Boring/Well
- Screened Interval May 2016
- May 2016 Water Level
- Perched Groundwater

Geology

- Roller Compacted Concrete
- Gravel Base Course
- Fill Containing Slag
- Silty Sand
- Fine Grained Deposits (Silt and Clay)

FIGURE 8-1

Summary of Geochemical Data and Processes

Remedial Investigation Report
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Tacoma, WA

GSI Water Solutions, Inc.

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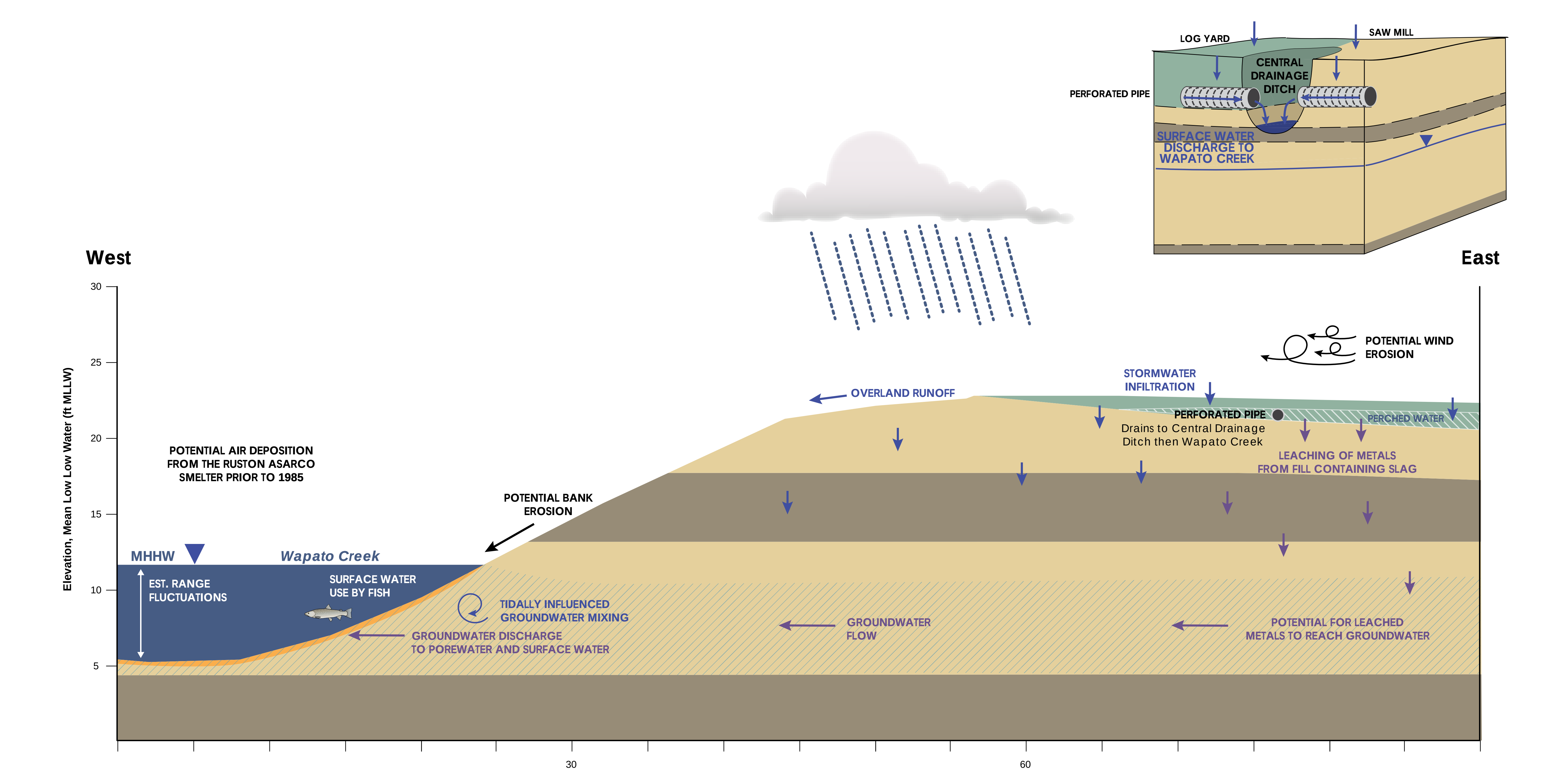

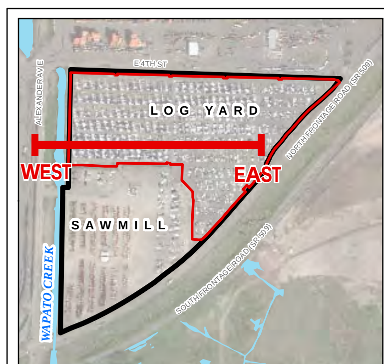

LEGEND

- Approximate Groundwater Fluctuations
- Approximate Extent of Perched Water

Geology

- Fill Containing Slag
- Slag
- Silty Sand
- Silt
- Bioactive Zone Sediments

NOTE

Vertical Exaggeration = 1X

FIGURE 8-2

Conceptual Site Model - Historical (Pre-Cap) Conditions

Remedial Investigation Report
Parcel 15
Tacoma, WA

GSI Water Solutions, Inc.

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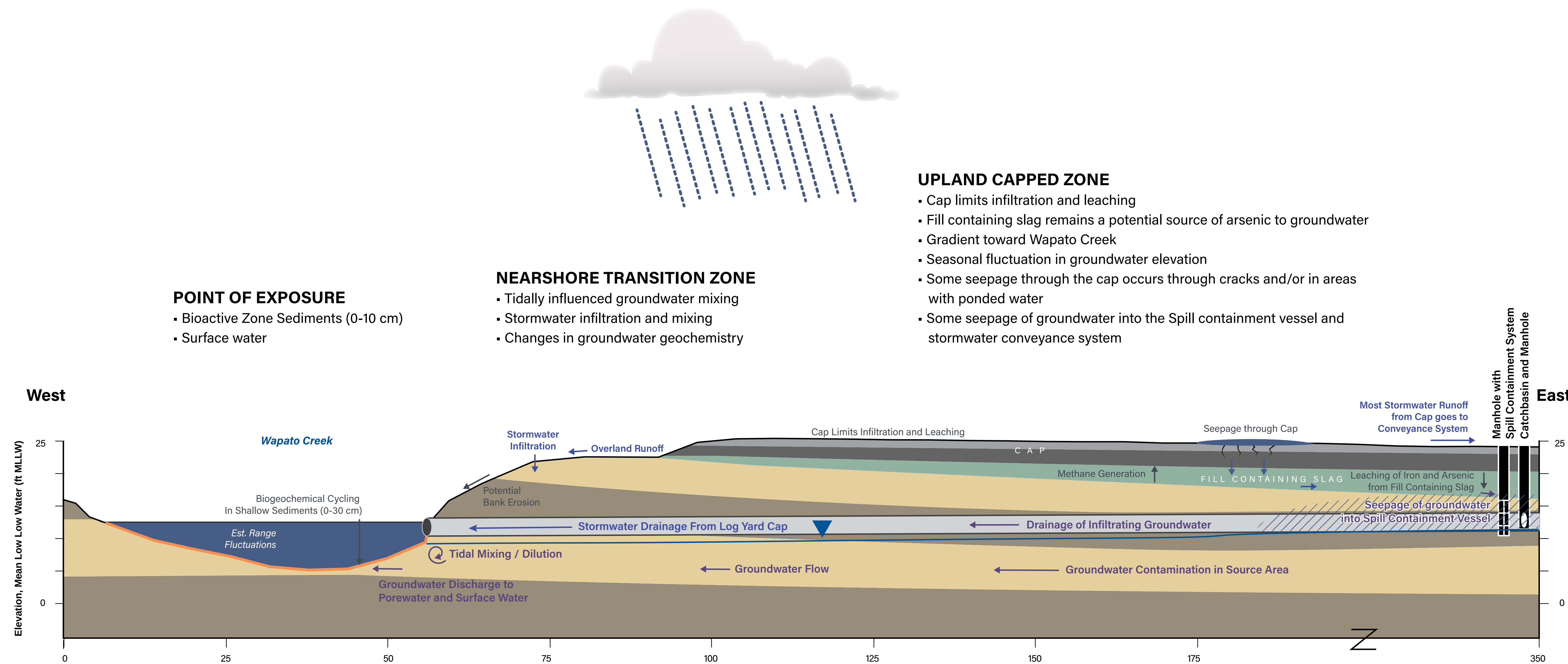

LEGEND

- Stormwater Pipe
- Catch Basin/Manhole
- Spill Containment System
- May 2016 Water Level
- Perched Groundwater

Geology

- Roller Compacted Concrete
- Gravel Base Course
- Fill Containing Slag
- Silty Sand
- Fine Grained Deposits (Silt and Clay)
- Bioactive Zone Sediments

NOTE:
Vertical Exaggeration = 1X

FIGURE 8-3

Conceptual Site Model - Current (Post-Cap) Conditions

Remedial Investigation Report
Parcel 15
Tacoma, WA

GSI Water Solutions, Inc.

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